Alberta Government

Alberta: Air Zones Report 2011-2013

September 2015

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1.0 Summary

Alberta Environment and Parks has completed the 2011-2013 Canadian Ambient Air Quality Standards (CAAQS) $PM_{2.5}$ and ozone assessment. This report is the first such annual assessment applying the new CAAQS standards and approach.

Alberta's six air zones have been assessed for achievement against the CAAQS using thirty three ambient air monitoring stations distributed throughout the province. A summary of the CAAQS achievement status and the air management level for each air zone is presented in Table 1.

Management actions have already been initiated within some air zones as part of Alberta's implementation of the former Canada-wide standards for $PM_{2.5}$ and ozone.

Table 1 Summary of CAAQS Achievement Status and Air Zone Management Level

Air Zone	Results						Management Actions
	$PM_{2.5}$ 24-hour ($\mu g\ m^{-3}$)		$PM_{2.5}$ Annual ($\mu g\ m^{-3}$)		Ozone 8-hour (ppb)		
Peace	19		7.0		59		Actions for preventing air quality deterioration due to $PM_{2.5}$
Lower Athabasca	41*		9.3		60		Actions for preventing $PM_{2.5}$ CAAQS exceedance and air quality deterioration due to ozone
Upper Athabasca	19		8.1		62		Actions for preventing $PM_{2.5}$ CAAQS exceedance and air quality deterioration due to ozone
North Saskatchewan	30*		10.1*		62		Actions for preventing $PM_{2.5}$ and ozone CAAQS exceedance
Red Deer	30		11.4		57		Actions for achieving $PM_{2.5}$ CAAQS and preventing air quality deterioration due to ozone
South Saskatchewan	23		8.5		60		Actions for preventing $PM_{2.5}$ CAAQS exceedance and air quality deterioration due ozone

* Air zone achieves the CAAQS after removing influence of transboundary flows or exceptional events.

2.0 Canadian Ambient Air Quality Standards

In October 2012, the Canadian Council of Ministers of the Environment endorsed the Air Quality Management System (AQMS), a comprehensive approach to protect and improve ambient air quality. The Canadian Ambient Air Quality Standards (CAAQS) are air standards to protect human health and the environment and form the driver for AQMS. In October 2012, the Canadian Council of Ministers of the Environment agreed to new CAAQS for fine particulate matter ($PM_{2.5}$) and ozone. The CAAQS management levels for $PM_{2.5}$ and ozone are presented in Table 2. These CAAQS replace the former Canada-wide Standards for $PM_{2.5}$ and ozone.

This report summarizes the Canadian Ambient Air Quality Standards (CAAQS) achievement status and management levels for Alberta's air zones for fine particulate matter and ground-level ozone ambient concentrations measured in the years 2011, 2012 and 2013.

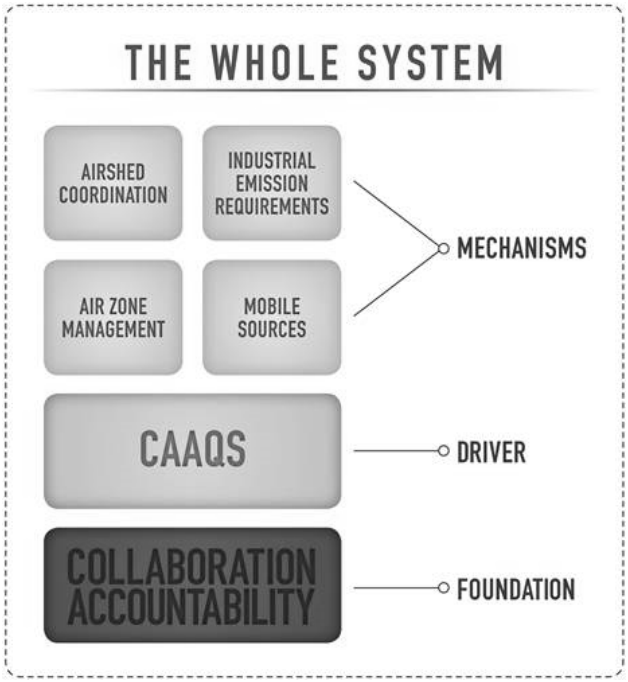


Figure 1 The Air Quality Management System
(from http://www.ccme.ca/en/resources/air/aqms.html)

Table 2 Canadian Ambient Air Quality Standards Management Levels

Management Level	Ozone 8 Hour (ppb)	$PM_{2.5}$ 24 hour (µg m^{-3})	$PM_{2.5}$ Annual (µg m^{-3})
Red	**Actions for Achieving CAAQS**		
Standard (2015)	63	28	10.0
Orange	**Actions for Preventing CAAQS Exceedances**		
Threshold	56	19	6.4
Yellow	**Actions for Preventing Air Quality Deterioration**		
Threshold	50	10	4.0
Green	**Actions for Keeping Clean Areas Clean**		

3.0 $PM_{2.5}$ and Ozone

Significant health and environmental effects have been associated with both ozone and $PM_{2.5}$ (US Environmental Protection Agency, 2007 and 2009).

Ground level ozone is a pollutant and a component of summer time smog. Ozone is produced by a series of chemical reactions in the atmosphere. During hot weather conditions, emissions of volatile organic compounds (VOCs) and oxides of nitrogen (NO_x) from automobiles, industry and other sources can react to produce elevated concentrations of ground level ozone. At times, ozone can also be transported down to the surface from the ozone rich upper atmosphere.

$PM_{2.5}$ refers to particles in the air with diameter less than 2.5 micrometres. These fine particles are small enough to penetrate the lungs. $PM_{2.5}$ may form in the atmosphere through reactions of precursor gases, or be emitted by any combustion source including automobiles, industry, and wood burning. Precursor gases that can react to form $PM_{2.5}$ include VOCs, NO_x, ammonia and sulphur dioxide. At time, smoke from forest fires and other types of biomass burning can be a major source of $PM_{2.5}$. Emissions of precursor gases by sector are discussed in Section 8.

4.0 Alberta Air Zones and Ambient Monitoring

Six air zones have been delineated in Alberta (Figure 2). The Alberta air zone delineation has been based on the Land Use Framework regional boundaries. Land Use Framework regions are the areas by which Alberta manages environmental cumulative effects. To assess achievement under the CAAQS, jurisdictions at a minimum are required to use one station for each centre with a population equal to or greater than 100,000. Alberta has a network of air quality monitoring stations across the province and has used thirty three ambient monitoring stations (Figure 2) located in varying monitoring environments including large urban centres to conduct this assessment. These monitoring stations are operated in accordance with a prescribed provincial standard by local multi-stakeholder airsheds and the Alberta Environmental Monitoring Evaluating and Reporting Agency. The data go through a set of quality assurance and quality control process and are available from a publicly-accessible database.

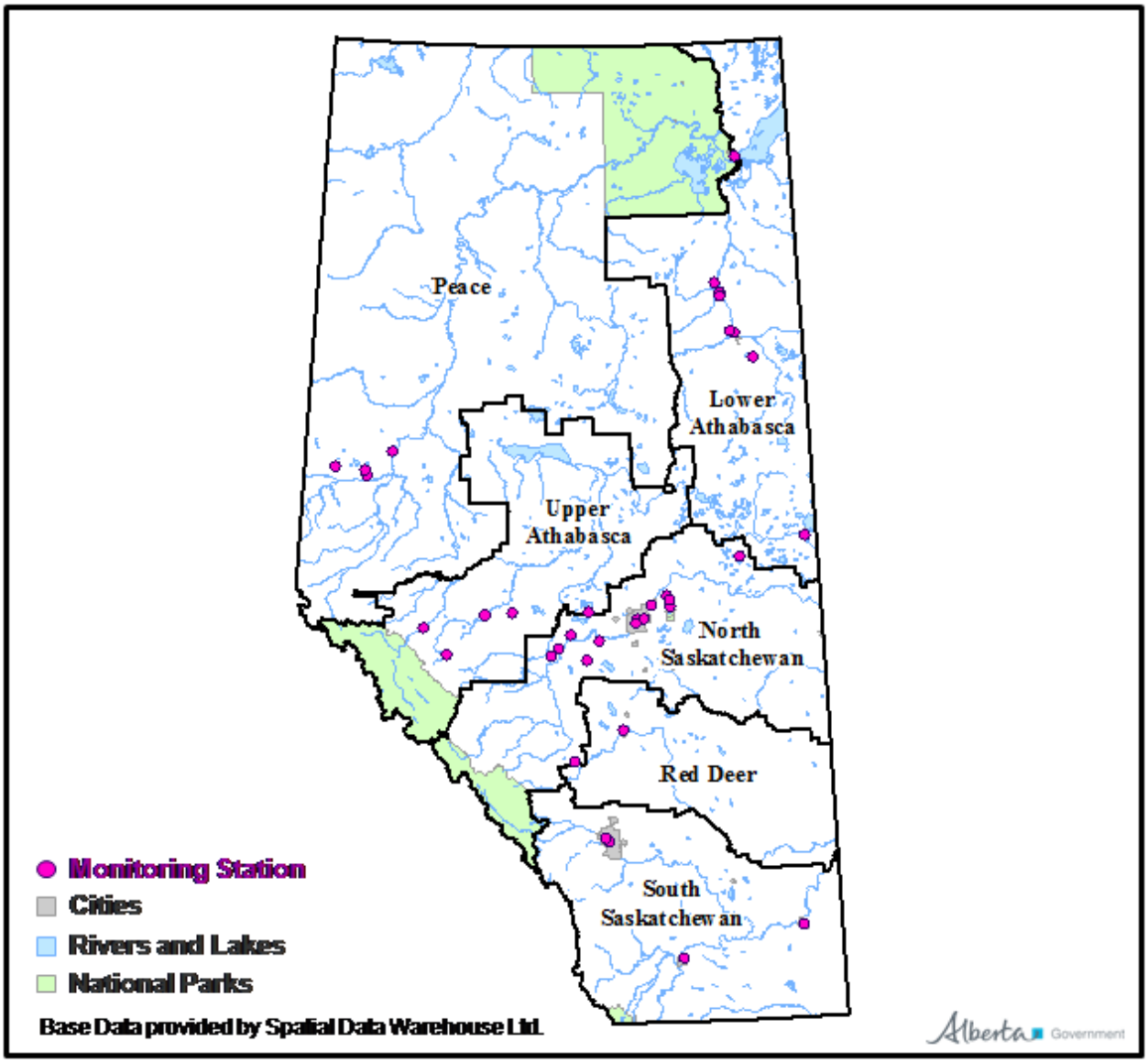


Figure 2 Air Zones and Location of Ambient Stations Used for CAAQS Reporting

5.0 Achievement Status

The achievement status of Alberta air zones for the $PM_{2.5}$ 24-hour standard, the $PM_{2.5}$ annual standard and the ozone standard is based on concentrations measured at CAAQS reporting stations (hereafter referred to as stations) in 2011, 2012 and 2013.

Briefly, achievement status is determined by:

- averaging the concentrations measured at each station and converting to the metric values required by the respective standards;
- comparing the highest metric value from all the stations in an air zone to the standard; and

- if a metric value for a station exceeds the standard,
    - the data are examined for transboundary flows (TF) and exceptional events (EE) and removed from the data if identified; and
    - metric values are recalculated after TF/EE influenced events are removed and compared again against the standard.

Metric values are stated without removal of TF/EE influences. If a station achieved the standard after removal of TF/EE influences, this is described in the comments and footnotes. See Appendix 1 for information demonstrating the influence of TF/EE on achievement status.

The complete requirements and procedures for determining the CAAQS achievement status of an air zone are presented in the Guidance Document on Achievement Determination Canadian Ambient Air Quality Standards for Fine Particulate Matter and Ozone (Canadian Council of Ministers of the Environment, 2012).

5.1 $PM_{2.5}$ 24-hour Standard

The 2015 $PM_{2.5}$ 24-hour standard is 28 µg m^{-3}. The form of the standard is the 3-year average of the annual 98^{th} percentile of the daily 24-hour average concentrations for each of three consecutive years. Table 3 presents the $PM_{2.5}$ concentrations in the form of the standard. There are data completeness criteria at each stage of the calculation. For a complete description of these criteria, and exceptions to them, see the Guidance Document on Achievement Determination.

Before analysis of transboundary flows and exceptional events:

- all stations in the Peace, Upper Athabasca and South Saskatchewan air zones achieved the 24-hour $PM_{2.5}$ standard; and
- five stations in the Lower Athabasca air zone, one in the North Saskatchewan air zone, and the only station in the Red Deer air zone exceeded the standard.

In the Lower Athabasca air zone, a number of forest fire events were identified:

- in 2011 at 5 stations: Bertha Ganter – Fort McKay; CNRL Horizon; Fort McKay South (Syncrude UE1); Fort McMurray – Athabasca Valley; and Fort McMurray – Patricia McInnes; and
- in 2012 at two stations: Bertha Ganter – Fort McKay; and CNRL Horizon.

In 2011, the fires occurred between May 15 and June 1, between June 6 and June 15, and on June 26 and 27. In 2012, the fires occurred between June 1 and June 8, between July 12 and July 14, and on August 20 and 22. In 2013, all stations in the Lower Athabasca air zone were below the standard. After removing these forest fire influences of 2011 and 2012, the recalculated metric values achieved the standard at all stations within the air zone. Therefore, the standard was achieved in the Lower Athabasca air zone after removal of exceptional events.

In the North Saskatchewan air zone, one station (Edmonton East) had a metric value above the standard in 2013. Two dates in 2013 (May 21 and 22) were influenced by an exceptional windblown dust event. Removing these two dates resulted in a metric value which achieved the

standard. Therefore, the standard was achieved at Edmonton East and in the North Saskatchewan air zone after removal of exceptional events.

There is only one station in the Red Deer air zone, the Red Deer – Riverside station. This station had metric values above the standard in 2011 and 2013. There were no TF/EE events above the 98^{th} percentile values identified in these years at this station. As a result, the Red Deer air zone did not achieve the standard.

The Calgary Central station in the South Saskatchewan air zone had insufficient data in 2011 and 2012, and the Beaverlodge station in the Peace air zone had insufficient data in 2013. This is a result of specific periods of $PM_{2.5}$ concentration data at these stations having been determined to be of unknown quality and therefore not suitable for use in assessment of the CAAQS. These periods of data were not used in the calculation of the 24-hour or annual average metrics.

5.2 $PM_{2.5}$ Annual Standard

The 2015 $PM_{2.5}$ annual standard is 10.0 µg m^{-3}. The form of the standard is the 3-year-average of the annual 1-year average of the daily 24-hour average concentrations for each of three consecutive years. Table 4 presents the $PM_{2.5}$ concentrations in the form of the standard. There are data completeness criteria at each stage of the calculation. For a complete description of these criteria, and exceptions to them, see the Guidance Document on Achievement Determination.

All stations in the Peace, Lower Athabasca, Upper Athabasca and South Saskatchewan air zones achieved the annual $PM_{2.5}$ standard before analysis of TF/EE. Therefore, these air zones achieved the standard.

One station in each of the North Saskatchewan and Red Deer air zones exceeded the standard before analysis of TF/EE influences.

In the North Saskatchewan air zone, the Edmonton East station had an annual average above the standard in 2013. As noted in Section 5.1, there were two dates in May which were affected by a high wind speed dust event. Additionally, there were influences from forest fire smoke in May and June 2011 and in July 2012. Removing these influences resulted in a metric value which was below the standard. Therefore, this station achieved the standard after the removal of these exceptional events.

The only station in the Red Deer air zone is the Red Deer – Riverside station. This station had annual averages above the standard in all three years. There were a number of dates in each year which were affected by forest fire smoke, resulting in 24-hour averages above the standard. However, after removing the affected dates, this station still exceeded the annual $PM_{2.5}$ standard.

Table 3 $PM_{2.5}$ 24-hour Metric Values

Air Zone	Station	Station Number	Annual 98th Percentile ($\mu g\ m^{-3}$)			3-Year Average
			2011	2012	2013	2011-2013
Peace	Beaverlodge	91501	20.2	26.5	n/a[a]	23[b]
	Evergreen Park	93001	15.6	17.2	13.2	15
	Grande Prairie (Henry Pirker)	92001	20.2	19.5	17.6	19
	Smoky Heights	94001	16.2	18.2	12.9	16
	Peace Air Zone					**19**
Lower Athabasca	Anzac		29.2[c]	16.3	14.0	20[d]
	Bertha Ganter - Fort McKay	90801	59.6	32.5	19.3	37*
	CNRL Horizon		61.0	36.9	20.9	40*
	Cold Lake South	94301	15.6	n/a[a]	16.8	16[b]
	Fort Chipewyan	91801	12.8	27.5	13.8	18
	Fort McKay South (Syncrude UE1)	90806	49.2	25.0	13.1	29*
	Fort McMurray-Athabasca Valley	90701	79.9	22.2	19.6	41*
	Fort McMurray-Patricia McInnes	90702	64.8	19.4	14.4	33*
	Lower Athabasca Air Zone					**41***
Upper Atha-basca	Edson	92901	11.5	13.3	12.5	12
	Hinton	93202	14.5	23.4	20.1	19
	Power	93901	11.3	14.7	9.3	12
	Steeper	91701	7.8	10.6	9.1	9
	Upper Athabasca Air Zone					**19**
North Saskatchewan	Bruderheim	90606	28.1	24.8	23.8	26
	Caroline	91901	12.9	16.9	16.2	15
	Drayton Valley	92801	14.3	17.4	13.5	15
	Edmonton Central	90130	26.5	21.1	26.5	25
	Edmonton East	90121	26.8	23.5	38.2	30*
	Edmonton South	90120	27.4	n/a[a]	23.9	26[b]
	Elk Island	91101	12.4	13.3	15.2	14
	Fort Saskatchewan	90601	23.8	18.8	24.1	22
	Genesee	93101	11.2	11.3	8.6	10
	Lamont County	92201	n/a[a]	16.9	17.7	17[b]
	St. Lina	94401	16.0	19.5	n/a[a]	18[b]
	Tomahawk	91301	10.3	11.1	8.2	10
	North Saskatchewan Air Zone					**30***
Red Deer	Red Deer - Riverside	90302	34.2	22.2	34.5	30†
	Red Deer Air Zone					**30†**
South Saskatch-ewan	Calgary Central	90228	n/a[a]	n/a[a]	18.7	n/a[e]
	Calgary Northwest	90222	24.4	20.7	22.9	23
	Crescent Heights	90402	18.3	23.4	n/a[a]	21[b]
	Lethbridge	90502	18.7	n/a[a]	17.1	18[b]
	South Saskatchewan Air Zone					**23**

a: The year is not available as it did not meet the data completeness criteria.
b: One of 2011, 2012 or 2013 years did not meet completeness criteria. The 3-year average is based on 2 years.
c: The year did not meet the data completeness criteria, but is included because it exceeded the standard.
d: One or two of 2011, 2012 or 2013 years did not meet completeness criteria, but was included because it exceeded the standard.
e: The 3-year average cannot be calculated because only one year is available.
* Station or air zone achieves the CAAQS after removing influence of transboundary flows or exceptional events.
† Station or air zone does not achieve the CAAQS.

Table 4 $PM_{2.5}$ Annual Metric Values

Air Zone	Station	Station Number	Annual Average ($\mu g\ m^{-3}$)			3-Year Average
			2011	2012	2013	2011-2013
Peace	Beaverlodge	91501	6.7	8.3	n/a[a]	7.5[b]
	Evergreen Park	93001	5.1	5.2	3.8	4.7
	Grande Prairie (Henry Pirker)	92001	8.3	6.4	6.3	7.0
	Smoky Heights	94001	4.0	5.0	4.1	4.4
	Peace Air Zone					**7.0**
Lower Athabasca	Anzac		n/a[a]	4.9	4.3	4.6[b]
	Bertha Ganter - Fort McKay	90801	8.2	8.0	7.4	7.9
	CNRL Horizon		10.2	9.3	8.4	9.3
	Cold Lake South	94301	5.7	n/a[a]	7.4	6.6[b]
	Fort Chipewyan	91801	3.2	5.5	3.6	4.1
	Fort McKay South (Syncrude UE1)	90806	7.3	6.8	5.4	6.5
	Fort McMurray-Athabasca Valley	90701	10.3	6.7	7.1	8.0
	Fort McMurray-Patricia McInnes	90702	6.0	5.1	5.7	5.6
	Lower Athabasca Air Zone					**9.3**
Upper Athabasca	Edson	92901	3.8	4.8	4.0	4.2
	Hinton	93202	7.9	8.5	8.0	8.1
	Power	93901	3.6	4.5	3.5	3.9
	Steeper	91701	2.0	2.5	2.3	2.3
	Upper Athabasca Air Zone					**8.1**
North Saskatchewan	Bruderheim	90606	8.2	8.7	8.5	8.5
	Caroline	91901	4.2	4.9	4.4	4.5
	Drayton Valley	92801	7.2	7.9	7.3	7.5
	Edmonton Central	90130	10.1	8.0	8.6	8.9
	Edmonton East	90121	9.9	9.4	11.0	10.1*
	Edmonton South	90120	9.1	n/a[a]	6.5	7.8[b]
	Elk Island	91101	3.8	5.3	5.5	4.9
	Fort Saskatchewan	90601	6.5	6.8	6.8	6.7
	Genesee	93101	3.5	4.0	3.1	3.5
	Lamont County	92201	n/a[a]	7.0	6.9	7.0[b]
	St. Lina	94401	6.0	6.3	n/a[a]	6.2[b]
	Tomahawk	91301	3.2	3.8	3.1	3.4
	North Saskatchewan Air Zone					**10.1***
Red Deer	Red Deer – Riverside	90302	13.7	10.2	10.4	11.4†
	Red Deer Air Zone					**11.4†**
South Saskatchewan	Calgary Central	90228	n/a[a]	n/a[a]	7.5	n/a[c]
	Calgary Northwest	90222	8.4	8.4	8.7	8.5
	Crescent Heights	90402	7.9	9.4	n/a[a]	8.7[b]
	Lethbridge	90502	6.7	n/a[a]	7.0	6.9[b]
	South Saskatchewan Air Zone					**8.5**

a: The year is not available as it did not meet the data completeness criteria.
b: One of 2011, 2012 or 2013 years did not meet completeness criteria. The 3-year average is based on 2 years.
c: The 3-year average cannot be calculated because only one year is available.
* Station or air zone achieved the CAAQS after removing influence of transboundary flows or exceptional events.
† Station or air zone does not achieve the CAAQS.

5.3 Ozone Standard

The 2015 8-hour ozone standard is 63 ppb. The form of the standard is the 3-year-average of the annual 4th highest of the daily maximum 8-hour average concentration for each of three consecutive years. Table 5 presents the ozone concentrations in the form of the standard. There are data completeness criteria at each stage of the calculation. For a complete description of these criteria, and exceptions to them, see the Guidance Document on Achievement Determination.

Over the 2011-2013 period, all stations achieved the ozone standard, before removal of any influences from transboundary flows or exceptional events. In some cases, individual years within the three year period exceeded the standard, but the three-year averages all achieved the standard. Most stations were influenced by exceptional events, including forest fire influences and transport of ozone-rich air from the upper troposphere to ground level. This is discussed further in Section 6.0.

Table 5 Ozone Metric Values

Air Zone	Station	Station Number	Annual 4th Highest (ppb)			3-Year Average
			2011	2012	2013	2011-2013
Peace	Beaverlodge	91501	60.8	56.2	59.0	59
	Grande Prairie (Henry Pirker)	92001	58.1	53.4	53.9	55
	Peace Air Zone					**59**
Lower Athabasca	Anzac		63.1	56.1	58.3	59
	Bertha Ganter - Fort McKay	90801	74.0	51.1	55.6	60
	Cold Lake South	94301	59.4	56.9	65.1	60
	Fort Chipewyan	91801	58.0	51.3	50.4	53
	Fort McKay South (Syncrude UE1)	90806	67.4	56.1	53.0	59
	Fort McMurray-Athabasca Valley	90701	62.8	51.4	53.3	56
	Fort McMurray-Patricia McInnes	90702	62.4	59.5	52.8	58
	Lower Athabasca Air Zone					**60**
Upper Atha-basca	Carrot Creek	91601	58.3	60.1	59.9	59
	Edson	92901	n/a[a]	62.4	59.4	61[b]
	Steeper	91701	62.6	66.3	57.9	62
	Upper Athabasca Air Zone					**62**
North Saskatchewan	Breton	92601	64.4	59.8	60.3	62
	Bruderheim	90606	65.6[c]	48.1	68.3	61[d]
	Caroline	91901	59.0	59.3	65.8	61
	Edmonton Central	90130	55.6	50.8	52.4	53
	Edmonton East	90121	58.9	53.9	56.9	57
	Edmonton South	90120	64.5	57.3	60.9	61
	Elk Island	91101	67.5	50.6	60.4	60
	Fort Saskatchewan	90601	63.6	54.8	55.1	58
	Genesee	93101	58.8	58.9	65.4	61
	Lamont County	92201	64.5	56.9	59.6	60
	St. Lina	94401	57.3	55.0	63.4	59
	Tomahawk	91301	61.8	61.0	62.0	62
	Violet Grove	91401	62.5	58.9	59.1	60
	North Saskatchewan Air Zone					**62**
Red Deer	Red Deer – Riverside	90302	54.1	58.6	56.8	57
	Red Deer Air Zone					**57**
South Saskatch-ewan	Calgary Central	90228	54.3	48.6	52.5	52
	Calgary Northwest	90222	55.9	58.1	65.8	60
	Crescent Heights	90402	59.4	61.6	56.1	59
	Lethbridge	90502	60.5	63.3	56.4	60
	South Saskatchewan Air Zone					**60**

a: The year is not available as it did not meet the data completeness criteria.
b: One of 2011, 2012 or 2013 years did not meet completeness criteria. The 3-year average is based on 2 years.
c: 2nd and 3rd quarters less than 75% complete, but the year is included because it exceeded the standard.
d: One or two of 2011, 2012 or 2013 years did not meet completeness criteria, but was included because it exceeded the standard. The 3-year average includes such a value.

6.0 Air Zone Management Levels

The four colour-coded management levels for $PM_{2.5}$ and ozone are presented in Table 2.

A brief description of the steps taken to determine the management level for each air zone is as follows:

- Metric values are calculated for each station within an air zone for each pollutant.
- Transboundary flows (TF) and exceptional events (EE) are determined and removed from the data.
- Metric values are recalculated after TF/EE influenced events are removed.
- If an air zone has more than one station, the highest metric value is used for comparison against the threshold values and the CAAQS to determine the management level for the air zone.
- As there are two CAAQS averaging times for $PM_{2.5}$, a management level is first determined for each of $PM_{2.5}$ 24-hour and $PM_{2.5}$ annual for a given air zone. The final management level for the air zone is the most stringent of the two (e.g., if the 24-hour is orange and the annual is yellow, the management level for the air zone is orange).

Detailed information on the management levels is in the Guidance Document on Achievement Determination Canadian Ambient Air Quality Standards for Fine Particulate Matter and Ozone (Canadian Council of Ministers of the Environment, 2012).

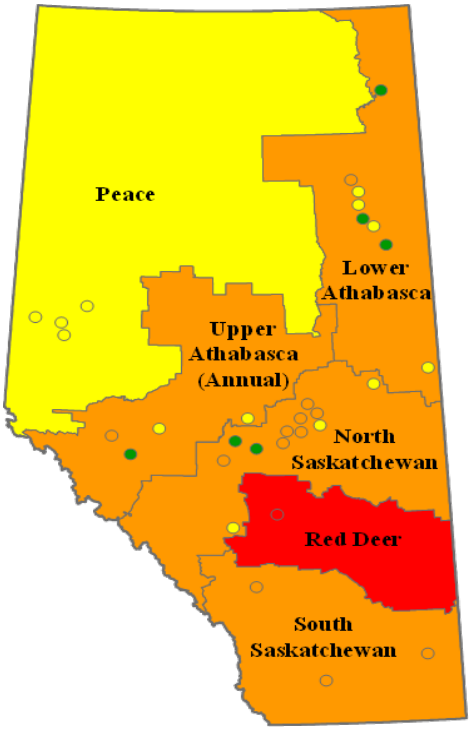
6.1 Determination of Management Levels for $PM_{2.5}$ and Ozone

Alberta Environment and Parks has performed weight of evidence analysis for the influence of exceptional events for all stations in Alberta for the 2011 to 2013 period. This followed the procedures set out in the Guidance Document on Air Zone Management. After removing influences from transboundary flows and exceptional events, the $PM_{2.5}$ and ozone metric values were recalculated, and the recalculated metric values were used to determine the management levels for the air zones. See Appendix 2 for a table detailing management level assignments for each station for both $PM_{2.5}$ metrics and ozone. See Section 7.0 for information on management actions taken to date.

Figure 3 presents the management levels for the $PM_{2.5}$ 24-hour and $PM_{2.5}$ annual metrics. In the case of air zones where each metric provided a different management level, the higher management level was used, and is stated in parentheses. In all other cases, both metrics provided the same management level.

The Red Deer air zone did not achieve the $PM_{2.5}$ CAAQS, and it has been determined to be in the red, Actions for Achieving CAAQS management level, based on the Red Deer – Riverside station.

Figure 3 Management Levels for $PM_{2.5}$



The Lower Athabasca and North Saskatchewan air zones achieve the CAAQS after removing forest fire influences and high-wind dust events, and have been determined to be in the orange, Actions for Preventing CAAQS Exceedances, management level. In Lower Athabasca, this is based on the CNRL Horizon station, in North Saskatchewan this is based on the Edmonton East station.

The South Saskatchewan and Upper Athabasca air zones achieve the CAAQS. After removing forest fire influences, these air zones are still determined to be in the orange level. In South Saskatchewan, this is based on the Calgary Northwest station. In the case of the Upper Athabasca air zone, this is based on the annual average metric at the Hinton station.

The Peace air zone achieves the CAAQS. After removing forest fire influences, it has been determined to be in the yellow, Actions for Preventing Air Quality Deterioration, management level. This is based on the Grande Prairie - Henry Pirker station.

Figure 4 Management Levels for Ozone

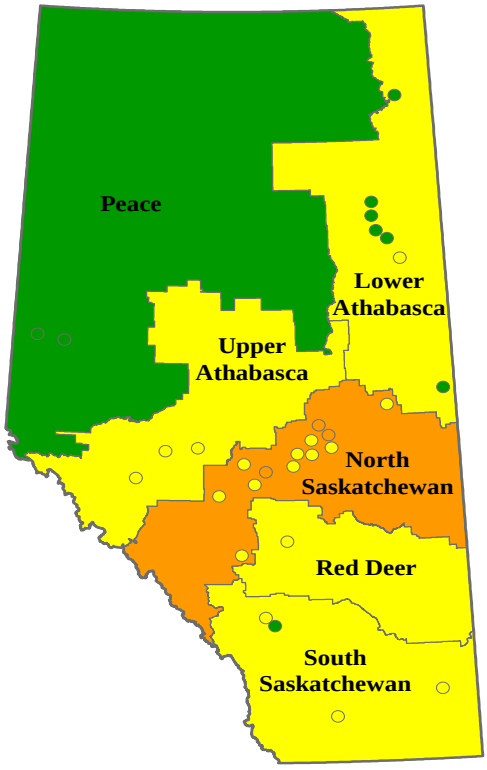


Figure 4 presents the management levels for ozone. All air zones in the province achieved the CAAQS for ozone. All areas of the province were affected by exceptional events, including forest fire influences, transport of upper-tropospheric ozone to ground level, and ozone arriving from outside North America.

After removing these influences, the North Saskatchewan air zone was determined to be in the orange, Actions for Preventing CAAQS Exceedances, management level. This is based on the Lamont County station.

The Lower Athabasca air zone was determined to be in the yellow, Actions for Preventing Air Quality Deterioration, management level, based on the Anzac station. The Upper Athabasca, Red Deer and South Saskatchewan air zones were also assigned to the yellow level, based on the Carrot Creek, Red Deer – Riverside and Calgary Northwest stations, respectively.

The Peace air zone was determined to be in the green, Actions for Keeping Clean Areas Clean, management level.

7.0 Management Actions

Air zones assigned to the red and orange management levels, as outlined in Section 6.0 require the development of management plans to reduce levels of $PM_{2.5}$ and ozone. In the cases of the North Saskatchewan, Red Deer and South Saskatchewan air zones, some management actions have already been initiated, as described below. These plans will require review to ensure that they meet the requirements outlined in the Guidance Document on Air Zone Management. In the cases of the Lower Athabasca and Upper Athabasca air zones, plans for preventing exceedances of the $PM_{2.5}$ CAAQS will need to be developed within two years. These plans may be developed through regional plans, or through local stakeholder groups.

In 2003, the Clean Air Strategic Alliance developed a management framework for $PM_{2.5}$ and ozone, which was adopted by the Government of Alberta as Alberta's implementation of the Canada-wide Standards (CWS) for $PM_{2.5}$ and ozone. Under this framework, action levels were developed which were comparable to the management levels now in place under the CAAQS. As a result of this framework some areas of the province have or are in the process of developing air quality management plans for one or both of $PM_{2.5}$ and ozone.

Following the 2001 to 2003 CWS assessment, stations in and around Edmonton, Red Deer, Calgary, Fort Saskatchewan and West Central Alberta were assigned to a management plan action level, equivalent to the orange CAAQS management level. Stakeholder groups in these areas developed ozone management plans, which were finalized and submitted to Alberta Environment and Parks in 2008. The plan for the Calgary area also included management of $PM_{2.5}$.

More recently, following the 2008 to 2010 CWS assessment, stations in Edmonton exceeded the numerical CWS for $PM_{2.5}$. In the 2009 to 2011 CWS assessment, the Red Deer station exceeded the CWS for $PM_{2.5}$. In response, Alberta Environment and Parks led the development of mandatory plans to reduce particulate matter in both of these areas.

The plan for the Capital Region has been developed, and was finalized in December 2014. The Capital Region Fine Particulate Matter Response, as well as a science report and other documents are available on the department website.

The plan for the Red Deer area is presently in development. More information on the Red Deer Fine Particulate Matter Response is available on the department website.

The Calgary Region Airshed Zone Particulate Matter and Ozone Management Plan from 2008 covers particulate matter. This plan has been reviewed and was updated and submitted by the Calgary Region Airshed Zone to Alberta Environment and Parks to ensure that the standards are not exceeded in future.

Further information about the history of $PM_{2.5}$ and ozone management in Alberta, including links to the ozone management plans previously developed, can be found on the department website.

8.0 Emissions

The following tables provide emissions of selected parameters, by sector and air zone. This is based on the 2008 Alberta Air Emissions Inventory. While these data are a few years old, they represent the best known data, including non-point sources, and small sources.

Table 6 Primary $PM_{2.5}$ Emissions by Sector and Air Zone

Primary $PM_{2.5}$ (tonnes)	Lower Athabasca	North Saskatchewan	Red Deer	South Saskatchewan	Peace	Upper Athabasca	Total
Agriculture	214	5,243	4,353	6,292	1,275	1,268	18,645
Cement and Concrete	26	303	53	642	33	22	1,079
Chemical	0	51	481	59	4	0	594
Construction	4,853	50,342	9,894	54,336	6,326	4,198	129,949
Conventional Oil and Gas*	329	1,241	550	649	1,122	655	4,546
Electrical Power Generation	56	1,821	483	190	102	22	2,674
Fertilizer	0	146	0	73	0	0	219
Oil Sands	3,848	12	0	0	15	0	3,874
Pulp and Paper	0	0	0	0	183	431	614
Road Dust	13,282	56,687	23,406	61,836	25,159	22,964	203,335
Transportation	267	2,934	1,377	3,408	782	496	9,265
Wood Products	0	53	20	19	97	212	401
Other Sources	1,012	1,591	413	1,187	696	581	5,480
Non-Industrial Sources	113	1,552	313	1,753	171	154	4,057
Natural Sources	1,592	7	1	6	469	50	2,125

*Conventional oil and gas includes both upstream and downstream oil and gas.

Table 7 SO_2 Emissions by Sector and Air Zone

SO_2 (tonnes)	Lower Athabasca	North Saskatchewan	Red Deer	South Saskatchewan	Peace	Upper Athabasca	Total
Agriculture	0	0	0	0	0	0	0
Cement and Concrete	0	54	4	1,615	0	0	1,674
Chemical	0	724	8	60	0	0	792
Construction	0	0	0	0	0	0	0
Conventional Oil and Gas*	324	32,416	10,106	30,287	18,146	25,135	116,413
Electrical Power Generation	5	59,367	62,464	14	2,001	1	123,851
Fertilizer	0	1,960	0	0	0	0	1,961
Oil Sands	106,893	7,218	0	0	3,439	0	117,550
Pulp and Paper	0	0	0	0	4,148	2,730	6,879
Road Dust	0	0	0	0	0	0	0
Transportation	101	730	279	913	196	117	2,335
Wood Products	0	56	15	23	23	40	157
Other Sources	162	5,296	61	550	193	198	6,460
Non-Industrial Sources	45	599	122	693	72	57	1,589
Natural Sources	1	0	0	0	0	0	2

SO_2 is sulphur dioxide.
*Conventional oil and gas includes both upstream and downstream oil and gas.

Table 8 NO_X Emissions by Sector and Air Zone

NO_X (tonnes)	Lower Athabasca	North Saskatchewan	Red Deer	South Saskatchewan	Peace	Upper Athabasca	Total
Agriculture	0	0	0	0	0	0	0
Cement and Concrete	0	1,768	4	3,967	0	0	5,740
Chemical	0	2,870	2,660	751	0	0	6,281
Construction	11	115	23	124	14	10	297
Conventional Oil and Gas*	18,601	63,301	62,409	58,846	76,607	48,354	328,117
Electrical Power Generation	1,355	59,069	21,893	5,569	3,996	1,589	93,471
Fertilizer	0	2,166	44	3,535	0	0	5,745
Oil Sands	62,203	680	0	0	172	0	63,055
Pulp and Paper	0	0	0	0	1,981	2,004	3,985
Road Dust	0	0	0	0	0	0	0
Transportation	6,402	69,760	26,916	81,095	15,650	10,331	210,153
Wood Products	0	336	71	98	489	839	1,833
Other Sources	1,651	2,530	110	857	121	282	5,552
Non-Industrial Sources	222	3,032	613	3,431	336	301	7,935
Natural Sources	4,551	2,650	1,322	2,333	10,697	3,218	24,770

NO_X is oxides of nitrogen.
*Conventional oil and gas includes both upstream and downstream oil and gas.

Table 9 VOC Emissions by Sector and Air Zone

VOCs (tonnes)	Lower Athabasca	North Saskatchewan	Red Deer	South Saskatchewan	Peace	Upper Athabasca	Total
Agriculture	831	32,535	27,053	39,113	3,536	7,771	110,839
Cement and Concrete	0	16	4	16	0	0	37
Chemical	0	808	782	20	0	0	1,611
Construction	0	0	0	0	0	0	0
Conventional Oil and Gas*	7,103	65,701	25,423	26,817	39,550	19,078	183,672
Electrical Power Generation	41	560	31	146	53	67	899
Fertilizer	0	278	2	476	0	0	756
Oil Sands	45,900	263	0	0	991	0	47,154
Pulp and Paper	0	0	0	0	401	397	798
Road Dust	0	0	0	0	0	0	0
Transportation	2,079	25,873	6,361	30,280	3,841	2,764	71,199
Wood Products	0	3,224	852	1,313	2,785	3,251	11,425
Other Sources	2,829	17,563	3,357	22,870	2,117	1,660	50,396
Non-Industrial Sources	127	1,732	350	1,957	191	172	4,529
Natural Sources	568,480	378,829	189,090	333,596	1,506,529	457,927	3,434,451

VOCs are volatile organic compounds.
*Conventional oil and gas includes both upstream and downstream oil and gas.

Table 10 NH_3 Emissions by Sector and Air Zone

NH_3 (tonnes)	Lower Athabasca	North Saskatchewan	Red Deer	South Saskatchewan	Peace	Upper Athabasca	Total
Agriculture	757	31,769	25,983	36,550	4,525	6,872	106,456
Cement and Concrete	0	0	0	0	0	0	0
Chemical	0	1	3	2	0	0	6
Construction	0	2	0	2	0	0	5
Conventional Oil and Gas*	221	437	383	404	518	323	2,286
Electrical Power Generation	2	93	6	35	76	3	215
Fertilizer	0	2,831	54	3,439	0	0	6,324
Oil Sands	997	0	0	0	0	0	997
Pulp and Paper	0	0	0	0	165	131	296
Road Dust	0	0	0	0	0	0	0
Transportation	82	1,072	254	1,245	150	111	2,914
Wood Products	0	82	20	34	34	48	219
Other Sources	18	653	49	510	12	7	1,250
Non-Industrial Sources	2	32	6	36	4	3	83
Natural Sources	40	0	0	0	12	1	54

NH_3 is ammonia.
*Conventional oil and gas includes both upstream and downstream oil and gas.

9.0 References

Canadian Council of Ministers of the Environment. (2012). *Guidance Document on Achievement Determination Canadain Ambient Air Quality Standards for Fine Particulate Matter and Ozone.*

US Environmental Protection Agency. (2007). *Review of the National Ambient Air Quality Standards for Ozone: Policy Assessment of Scienctific and Technical Information.*

US Environmental Protection Agency. (2009). *Integrated Science Assessment for Particulate Matter*.

Appendix 1 Demonstrating the Influence of Exceptional Events on $PM_{2.5}$

This appendix provides a brief description and tables outlining the analysis of transboundary flows and exceptional events and the recalculated metrics after removing these influences, demonstrating achievement of the CAAQS. In order to determine the management levels for each station, further analysis was performed in those cases where these stations exceeded thresholds below the CAAQS. This was performed until a 98^{th} percentile value not influenced by TF/EE had been found for the 24-hour metric, and on dates between the annual average and the next lower threshold for the annual average metric. As such, the maps in Section 4.0 should be referred to for the management levels designated for each air zone.

24-Hour CAAQS Analysis

The following tables provide the top 20 dates which contributed to the metric values at those stations which exceeded the 24-hour CAAQS for $PM_{2.5}$. The tables contain two sections with listings of dates and the 24-hour average PM2.5 concentrations recorded on those dates. In the left columns are dates before analysis of TF/EE influences, with the removed dates indicated with a double asterisk (**), while in the right columns are the list of dates which remain after removal of those affected by TF/EE. In both sections, the annual metric values are identified in bold.

For the forest fire smoke events removed at stations in the Lower Athabasca air zone, the weight of evidence analysis considered back-trajectory analysis of air parcel movement and satellite-detected forest fire activity to indicate whether known forest fires were a potential source of $PM_{2.5}$ in the events in question, as well as satellite imagery showing visible smoke plumes, and other indications.

In the case of the windblown dust events removed at the Edmonton East station, eye-witness reporting by station technicians, wind speed and direction data, satellite imagery showing relative positions of the station and the indicated source of dust, the correlation with other measured air quality parameters, and the low likelihood of the activities which generated the dust recurring were factors considered in the decision to remove the two dates.

After removing the forest-fire influenced dates at the stations in the Lower Athabasca air zone and the windblown dust events removed at the Edmonton East station, these stations do not exceed the CAAQS. Therefore, it is demonstrated that if not for the exceptional events, the standard would have been achieved.

Table A-1 Demonstration of TF/EE Analysis at Bertha Ganter Fort McKay

Station:	**Bertha Ganter - Fort McKay (Formerly Fort McKay (WBEA))**											
Air Zone:	**Lower Athabasca**											
	Daily 24hr-$PM_{2.5}$ ($\mu g\ m^{-3}$) Before Removing TF/EE (Identified with **)						Daily 24hr-$PM_{2.5}$ ($\mu g\ m^{-3}$) After removing TF/EE					
Rank	2011		2012		2013		2011		2012		2013	
Highest	May 27	164.4 **	Jul 13	138.3 **	Jul 4	62.1	Nov 7	32.1	Jan 23	42.6	Jul 4	62.1
2nd Highest	May 29	144.5 **	Jul 14	63.3 **	Jul 5	53.0	Nov 8	31.7	Jul 10	28.1	Jul 5	53.0
3rd Highest	May 28	132.1 **	Jul 12	54.7 **	May 27	25.3	Jun 16	26.0	Jul 11	27.7	May 27	25.3
4th Highest	Jun 7	122.1 **	Jun 2	43.0 **	Nov 21	24.8	Sep 13	25.8	Jun 8	27.3	Nov 21	24.8
5th Highest	May 23	86.7 **	Jan 23	42.6	Aug 5	21.8	Jun 28	25.6	Jul 15	26.7	Aug 5	21.8
6th Highest	Jun 8	69.8 **	Jun 1	35.7 **	Nov 12	21.6	Jun 9	22.9	Jul 17	25.3	Nov 12	21.6
7th Highest	**Jun 12**	**59.6 ****	Jun 3	32.5 **	Jan 26	21.4	**Jun 6**	**22.8**	Jul 9	24.2	Jan 26	21.4
8th Highest	Jun 13	48.9 **	**Aug 22**	**32.5 ****	**Jan 27**	**19.3**	Dec 21	20.8	**Jul 16**	**23.1**	**Jan 27**	**19.3**
9th Highest	Jun 26	39.9 **	Jul 10	28.1	Aug 6	18.9	Oct 16	20.2	Dec 16	22.3	Aug 6	18.9
10th Highest	Nov 7	32.1	Jul 11	27.7	Dec 16	18.5	May 15	18.3	Jul 21	20.1	Dec 16	18.5
11th Highest	Nov 8	31.7	Jun 8	27.3	Feb 27	16.5	Nov 15	17.8	Aug 21	20.1	Feb 27	16.5
12th Highest	Jun 1	30.9 **	Jul 15	26.7	Aug 9	16.0	Jul 18	17.7	Jan 31	18.5	Aug 9	16.0
13th Highest	Jun 16	26.0	Jul 17	25.3	Feb 26	15.5	Dec 18	16.3	Nov 29	18.3	Feb 26	15.5
14th Highest	Sep 13	25.8	Jul 9	24.2	Dec 17	15.3	Jun 27	16.0	Sep 26	18.0	Dec 17	15.3
15th Highest	Jun 28	25.6	Jul 16	23.1	Jun 5	15.1	Oct 17	15.1	Nov 28	18.0	Jun 5	15.1
16th Highest	Jun 9	22.9	Dec 16	22.3	Aug 8	14.6	Sep 15	14.6	Dec 3	17.5	Aug 8	14.6
17th Highest	Jun 6	22.8	Jul 21	20.1	Jun 24	14.4	Dec 28	14.6	Jul 18	17.1	Jun 24	14.4
18th Highest	Dec 21	20.8	Aug 21	20.1	Jul 6	14.0	Jun 23	14.3	Aug 20	17.0	Jul 6	14.0
19th Highest	Oct 16	20.2	Jan 31	18.5	Jun 4	13.5	Sep 16	14.0	Aug 19	16.8	Jun 4	13.5
20th Highest	May 15	18.3	Nov 29	18.3	Jul 3	13.5	Jul 7	13.6	Jul 8	16.1	Jul 3	13.5
# of Valid Days:	345		358		360		335		351		360	
98P Rank:	7		8		8		7		8		8	
3-Year average:	(59.6+32.5+19.3)/3=37.1						(22.8+23.1+19.3)/3=21.7					
After rounding:	37 - Exceeds CAAQS						22 - Achieves CAAQS					
Note: All TF/EE events for this site in 2011 and 2012 were due to forest fire smoke.												

Table A-2 Demonstration of TF/EE Analysis at CNRL Horizon

Station:	**CNRL Horizon**											
Air Zone:	**Lower Athabasca**											
	Daily 24hr-$PM_{2.5}$ ($\mu g\ m^{-3}$) Before Removing TF/EE (Identified with **)						Daily 24hr-$PM_{2.5}$ ($\mu g\ m^{-3}$) After removing TF/EE					
Rank	2011		2012		2013		2011		2012		2013	
Highest	May 23	190.6 **	Jul 13	117.3 **	Jul 4	115.0	Sep 27	37.3	Jan 22	83.1	Jul 4	115.0
2nd Highest	May 24	175.8 **	Jan 22	83.1	Jul 5	85.5	Jun 2	24.5	Jan 23	70.5	Jul 5	85.5
3rd Highest	Jun 7	132.4 **	Jul 12	71.8 **	Jan 19	26.8	Oct 16	19.1	Jan 21	42.8	Jan 19	26.8
4th Highest	May 19	121.0 **	Jan 23	70.5	Jan 7	26.6	Aug 12	18.5	Jan 24	34.7	Jan 7	26.6
5th Highest	May 16	82.9 **	Jul 14	67.5 **	Aug 24	25.6	Jun 28	18.0	Feb 7	29.1	Aug 24	25.6
6th Highest	Jun 12	72.6 **	Jun 2	47.9 **	Jun 22	21.8	Nov 7	17.9	Jan 15	27.2	Jun 22	21.8
7th Highest	**Jun 8**	**61.0 ****	Jan 21	42.8	Nov 22	21.4	**Oct 17**	**17.6**	**May 28**	**27.2**	Nov 22	21.4
8th Highest	Jun 15	55.8 **	**Jun 8**	**36.9 ****	**Aug 6**	**20.9**	Jul 11	17.3	Nov 29	26.7	**Aug 6**	**20.9**
9th Highest	Jun 13	54.6 **	Jun 4	35.1 **	Aug 9	20.2	Sep 8	16.5	Jul 10	26.5	Aug 9	20.2
10th Highest	Jun 1	42.5 **	Jan 24	34.7	Jan 11	19.9	Sep 15	16.4	Jul 11	26.2	Jan 11	19.9
11th Highest	Sep 27	37.3	Jun 3	33.4 **	Jan 21	19.9	Jul 17	15.8	Dec 20	26.0	Jan 21	19.9
12th Highest	Jun 6	31.7 **	Aug 20	31.7 **	Dec 27	19.9	Jun 5	15.6	Jul 15	25.6	Dec 27	19.9
13th Highest	May 15	30.6 **	Feb 7	29.1	Jul 6	19.8	Jul 14	15.2	Aug 21	25.2	Jul 6	19.8
14th Highest	Jun 9	28.5 **	Jan 15	27.2	Jan 23	19.7	Sep 30	15.1	Jan 20	24.3	Jan 23	19.7
15th Highest	Jun 2	24.5	May 28	27.2	Jul 7	19.6	Jun 20	14.8	Feb 10	23.0	Jul 7	19.6
16th Highest	Oct 16	19.1	Nov 29	26.7	Nov 4	19.6	Jul 3	14.8	Jul 9	22.5	Nov 4	19.6
17th Highest	Aug 12	18.5	Jul 10	26.5	Nov 5	19.6	Jun 10	14.7	Jul 16	22.4	Nov 5	19.6
18th Highest	Jun 28	18.0	Jul 11	26.2	Nov 6	19.5	Jun 16	14.6	Jul 17	20.8	Nov 6	19.5
19th Highest	Nov 7	17.9	Dec 20	26.0	Jun 16	18.9	Jun 18	14.4	Jul 25	20.3	Jun 16	18.9
20th Highest	Oct 17	17.6	Jul 15	25.6	Sep 15	18.4	Sep 5	14.3	Jun 1	20.1	Sep 15	18.4
# of Valid Days:	343		353		361		330		345		361	
98P Rank:	7		8		8		7		7		8	
3-Year average:	(61.0+36.9+20.9)/3=39.6						(17.6+27.2+20.9)/3=21.9					
After rounding:	40 - Exceeds CAAQS						22 - Achieves CAAQS					
Note: All TF/EE events for this site in 2011 and 2012 were due to forest fire smoke.												

Table A-3 Demonstration of TF/EE Analysis at Fort McKay South - Syncrude UE1

Station:	**Fort McKay South (Syncrude UE1) (Formerly Syncrude UE1)**											
Air Zone:	**Lower Athabasca**											
	Daily 24hr-$PM_{2.5}$ ($\mu g\ m^{-3}$) Before Removing TF/EE (Identified with **)						Daily 24hr-$PM_{2.5}$ ($\mu g\ m^{-3}$) After removing TF/EE					
Rank	2011		2012		2013		2011		2012		2013	
Highest	May 19	221.4 **	Jul 13	123.3	Jul 4	59.3	Jun 13	27.9	Jul 13	123.3	Jul 4	59.3
2nd Highest	May 20	193.6 **	Jul 12	55.0	Jul 5	53.8	Jun 1	26.7	Jul 12	55.0	Jul 5	53.8
3rd Highest	May 29	138.8 **	Jul 14	51.4	Jan 26	21.0	Jun 2	23.6	Jul 14	51.4	Jan 26	21.0
4th Highest	Jun 14	127.9 **	Jun 2	40.9	Jan 27	18.9	May 15	22.1	Jun 2	40.9	Jan 27	18.9
5th Highest	May 28	123.5 **	Jun 1	30.4	Aug 5	16.9	May 17	21.1	Jun 1	30.4	Aug 5	16.9
6th Highest	Jun 7	83.4 **	Jun 3	29.5	Aug 14	13.4	Jun 6	20.9	Jun 3	29.5	Aug 14	13.4
7th Highest	**Jun 8**	**49.2 ****	Jul 15	27.6	Aug 6	13.2	**May 18**	**20.0**	Jul 15	27.6	Aug 6	13.2
8th Highest	Jun 12	38.2 **	**Jul 11**	**25.0**	**Aug 9**	**13.1**	Jun 16	17.7	**Jul 11**	**25.0**	**Aug 9**	**13.1**
9th Highest	Jun 15	37.7 **	Jun 4	24.0	Feb 26	13.0	Jun 28	17.0	Jun 4	24.0	Feb 26	13.0
10th Highest	Jun 13	27.9	Jul 10	23.6	Aug 8	12.9	Jul 12	16.5	Jul 10	23.6	Aug 8	12.9
11th Highest	Jun 1	26.7	Jul 17	23.2	Nov 6	12.9	Jun 9	14.3	Jul 17	23.2	Nov 6	12.9
12th Highest	Jun 2	23.6	Jan 23	22.7	Jun 16	12.5	Oct 16	13.8	Jan 23	22.7	Jun 16	12.5
13th Highest	May 15	22.1	Jul 9	22.4	Nov 12	12.5	Jun 27	13.0	Jul 9	22.4	Nov 12	12.5
14th Highest	May 17	21.1	Jul 16	22.0	Sep 21	12.2	Jun 23	12.3	Jul 16	22.0	Sep 21	12.2
15th Highest	Jun 6	20.9	Jun 8	20.5	Jul 9	12.0	Sep 15	12.0	Jun 8	20.5	Jul 9	12.0
16th Highest	May 18	20.0	Aug 22	19.0	Aug 24	11.9	May 16	11.8	Aug 22	19.0	Aug 24	11.9
17th Highest	Jun 16	17.7	Dec 3	18.6	May 29	11.8	Jul 11	11.5	Dec 3	18.6	May 29	11.8
18th Highest	Jun 28	17.0	Nov 29	18.5	Jul 8	11.8	Mar 8	10.4	Nov 29	18.5	Jul 8	11.8
19th Highest	Jul 12	16.5	Aug 21	18.2	Feb 27	11.7	Jul 7	10.4	Aug 21	18.2	Feb 27	11.7
20th Highest	Jun 9	14.3	Jan 31	16.2	Mar 27	11.5	Feb 21	10.2	Jan 31	16.2	Mar 27	11.5
# of Valid Days:	341		358		358		332		358		358	
98P Rank:	7		8		8		7		8		8	
3-Year average:	(49.2+25.0+13.1)/3=29.1						(22.8+23.1+19.3)/3=19.4					
After rounding:	29 - Exceeds CAAQS						19 - Achieves CAAQS					
Note: All TF/EE events for this site in 2011 were due to forest fire smoke.												

Table A-4 Demonstration of TF/EE Analysis at Fort McMurray - Athabasca Valley

Station:	**Fort McMurray - Athabasca Valley**											
Air Zone:	**Lower Athabasca**											
	Daily 24hr-$PM_{2.5}$ ($\mu g\ m^{-3}$) Before Removing TF/EE (Identified with **)						Daily 24hr-$PM_{2.5}$ ($\mu g\ m^{-3}$) After removing TF/EE					
Rank	2011		2012		2013		2011		2012		2013	
Highest	May 21	137.1 **	Jul 13	73.3	Jul 5	68.8	Jun 2	28.1	Jul 13	73.3	Jul 5	68.8
2nd Highest	May 19	95.0 **	Jul 12	39.0	Jul 4	33.4	Jun 26	24.0	Jul 12	39.0	Jul 4	33.4
3rd Highest	May 27	94.6 **	Jul 15	36.3	Aug 5	27.9	Jun 12	23.7	Jul 15	36.3	Aug 5	27.9
4th Highest	May 24	91.8 **	Jun 2	33.0	Jan 27	27.8	Jun 9	20.7	Jun 2	33.0	Jan 27	27.8
5th Highest	May 31	86.0 **	Jul 17	23.0	Jan 26	21.7	May 15	19.4	Jul 17	23.0	Jan 26	21.7
6th Highest	May 29	83.0 **	Jun 3	22.9	Nov 12	20.8	Jun 28	18.5	Jun 3	22.9	Nov 12	20.8
7th Highest	**May 30**	**79.9 ****	**Jul 11**	**22.2**	Aug 26	20.0	**Aug 13**	**16.3**	**Jul 11**	**22.2**	Aug 26	20.0
8th Highest	Jun 7	76.0 **	Jun 4	21.8	**Aug 6**	**19.6**	May 22	15.7	Jun 4	21.8	**Aug 6**	**19.6**
9th Highest	Jun 15	65.7 **	Sep 23	20.0	Jun 5	16.4	Dec 3	15.5	Sep 23	20.0	Jun 5	16.4
10th Highest	May 28	57.6 **	Jul 16	19.7	Jan 22	16.0	Jul 18	14.9	Jul 16	19.7	Jan 22	16.0
11th Highest	May 25	56.6 **	Aug 22	18.3	Jun 16	15.0	Nov 7	14.8	Aug 22	18.3	Jun 16	15.0
12th Highest	Jun 14	50.5 **	Feb 4	17.7	Jul 8	15.0	Jun 13	14.5	Feb 4	17.7	Jul 8	15.0
13th Highest	May 26	48.8 **	Jul 9	17.0	Jul 17	14.3	Aug 9	14.4	Jul 9	17.0	Jul 17	14.3
14th Highest	Jun 8	47.2 **	Sep 28	16.6	Jul 18	14.0	Sep 23	13.8	Sep 28	16.6	Jul 18	14.0
15th Highest	May 23	33.3 **	Aug 7	16.4	Jun 24	13.8	Jun 10	13.4	Aug 7	16.4	Jun 24	13.8
16th Highest	Jun 6	33.1 **	Aug 21	16.2	Jul 21	13.8	Nov 6	13.0	Aug 21	16.2	Jul 21	13.8
17th Highest	Jun 1	31.7 **	Aug 20	16.0	Dec 8	13.5	Nov 23	12.9	Aug 20	16.0	Dec 8	13.5
18th Highest	Jun 27	29.5 **	Jul 26	15.2	Jul 9	13.3	Oct 19	12.6	Jul 26	15.2	Jul 9	13.3
19th Highest	Jun 2	28.1	Jul 25	14.4	Jul 7	13.0	Feb 13	12.3	Jul 25	14.4	Jul 7	13.0
20th Highest	Jun 26	24.0	Aug 6	14.3	Oct 14	13.0	May 17	12.3	Aug 6	14.3	Oct 14	13.0
# of Valid Days:	343		348		354		325		348		354	
98P Rank:	7		7		8		7		7		8	
3-Year average:	(79.9+22.2+19.6)/3=40.6						(16.3+22.2+19.6)/3=19.4					
After rounding:	41 - Exceeds CAAQS						19 - Achieves CAAQS					
Note: All TF/EE events for this site in 2011 were due to forest fire smoke.												

Table A-5 Demonstration of TF/EE Analysis at Fort McMurray - Patricia McInnes

Station:	**Fort McMurray - Patricia McInnes**											
Air Zone:	**Lower Athabasca**											
	Daily 24hr-$PM_{2.5}$ ($\mu g\ m^{-3}$) Before Removing TF/EE (Identified with **)						Daily 24hr-$PM_{2.5}$ ($\mu g\ m^{-3}$) After removing TF/EE					
Rank	2011		2012		2013		2011		2012		2013	
Highest	May 31	118.9 **	Jul 13	67.4	Jul 5	62.4	Jun 26	26.7	Jul 13	67.4	Jul 5	62.4
2nd Highest	May 19	115.5 **	Jul 12	50.1	Jul 4	37.0	Jun 12	25.6	Jul 12	50.1	Jul 4	37.0
3rd Highest	May 25	87.5 **	Jul 14	38.3	Aug 5	28.9	Jun 1	21.3	Jul 14	38.3	Aug 5	28.9
4th Highest	May 26	82.2 **	Jun 2	37.6	Jan 26	22.6	Jun 2	17.6	Jun 2	37.6	Jan 26	22.6
5th Highest	May 27	78.7 **	Jul 15	36.9	Aug 6	18.2	Jun 27	17.3	Jul 15	36.9	Aug 6	18.2
6th Highest	May 24	74.2 **	Jul 11	33.8	Aug 26	16.2	Jun 9	14.1	Jul 11	33.8	Aug 26	16.2
7th Highest	**Jun 7**	**64.8 ****	Jul 26	21.0	Jan 27	15.0	**Jun 28**	**14.0**	Jul 26	21.0	Jan 27	15.0
8th Highest	May 28	63.3 **	**Jul 25**	**19.4**	**Nov 12**	**14.4**	May 15	12.9	**Jul 25**	**19.4**	**Nov 12**	**14.4**
9th Highest	Jun 14	55.6 **	Aug 22	18.8	Jun 16	14.0	Jun 13	12.4	Aug 22	18.8	Jun 16	14.0
10th Highest	Jun 8	40.7 **	Jul 16	18.4	Jul 7	13.8	May 17	12.2	Jul 16	18.4	Jul 7	13.8
11th Highest	May 23	31.5 **	Jul 17	17.2	Jul 8	13.1	Jul 18	10.1	Jul 17	17.2	Jul 8	13.1
12th Highest	Jun 6	30.4 **	Jun 3	16.0	May 29	12.5	Nov 6	10.1	Jun 3	16.0	May 29	12.5
13th Highest	Jun 26	26.7	Jun 4	15.5	May 28	12.4	Jun 5	9.9	Jun 4	15.5	May 28	12.4
14th Highest	Jun 12	25.6	Aug 20	15.3	Jul 21	12.3	Aug 13	9.9	Aug 20	15.3	Jul 21	12.3
15th Highest	Jun 1	21.3	Sep 26	14.7	Jun 20	11.9	Dec 9	9.7	Sep 26	14.7	Jun 20	11.9
16th Highest	Jun 2	17.6	Aug 21	14.3	May 30	10.9	Dec 10	9.4	Aug 21	14.3	May 30	10.9
17th Highest	Jun 27	17.3	Jul 10	13.9	Mar 27	10.7	Jul 21	9.0	Jul 10	13.9	Mar 27	10.7
18th Highest	Jun 9	14.1	Jun 1	13.4	Feb 1	10.6	Jun 11	8.9	Jun 1	13.4	Feb 1	10.6
19th Highest	Jun 28	14.0	Sep 28	12.5	May 31	10.2	Jun 23	8.5	Sep 28	12.5	May 31	10.2
20th Highest	May 15	12.9	Jul 9	12.3	Jun 15	10.2	Nov 23	8.5	Jul 9	12.3	Jun 15	10.2
# of Valid Days:	347		356		360		335		356		360	
98P Rank:	7		8		8		7		8		8	
3-Year average:	(64.8+19.4+14.4)/3=32.9						(14.0+19.4+14.4)/3=15.9					
After rounding:	33 - Exceeds CAAQS						16 - Achieves CAAQS					
Note: All TF/EE events for this site in 2011 were due to forest fire smoke.												

Table A-6 Demonstration of TF/EE Analysis at Edmonton East

Station:	**Edmonton East**											
Air Zone:	**North Saskatchewan**											
	Daily 24hr-$PM_{2.5}$ ($\mu g\ m^{-3}$) Before Removing TF/EE (Identified with **)						Daily 24hr-$PM_{2.5}$ ($\mu g\ m^{-3}$) After removing TF/EE					
Rank	2011		2012		2013		2011		2012		2013	
Highest	Jun 27	66.7	Jul 13	63.7	May 21	76.3 **	Jun 27	66.7	Jul 13	63.7	Feb 7	59.8
2nd Highest	Mar 15	41.2	Jul 14	41.4	Feb 7	59.8	Mar 15	41.2	Jul 14	41.4	May 20	56.6
3rd Highest	May 28	32.1	Feb 29	33.6	May 20	56.6	May 28	32.1	Feb 29	33.6	Mar 29	45.9
4th Highest	Mar 13	29.8	Jul 15	30.9	Mar 29	45.9	Mar 13	29.8	Jul 15	30.9	Mar 28	44.8
5th Highest	Jun 26	28.8	Sep 24	25.7	Mar 28	44.8	Jun 26	28.8	Sep 24	25.7	Mar 27	40.9
6th Highest	Mar 14	27.6	Nov 17	25.3	Mar 27	40.9	Mar 14	27.6	Nov 17	25.3	Oct 25	38.2
7th Highest	**Nov 21**	**26.8**	**Sep 23**	**23.5**	May 22	38.5 **	**Nov 21**	**26.8**	**Sep 23**	**23.5**	Mar 26	37.1
8th Highest	Mar 17	25.8	Nov 16	23.5	**Oct 25**	**38.2**	Mar 17	25.8	Nov 16	23.5	**Mar 8**	**32.7**
9th Highest	May 20	23.1	Jun 2	22.4	Mar 26	37.1	May 20	23.1	Jun 2	22.4	Mar 25	32.5
10th Highest	Oct 10	23.1	Nov 27	22.3	Mar 8	32.7	Oct 10	23.1	Nov 27	22.3	Jan 4	32.2
11th Highest	Jun 13	22.2	Dec 6	22.3	Mar 25	32.5	Jun 13	22.2	Dec 6	22.3	Feb 6	29.4
12th Highest	Jun 9	22.1	Aug 20	22.2	Jan 4	32.2	Jun 9	22.1	Aug 20	22.2	Nov 29	27.3
13th Highest	Jan 31	20.8	Aug 28	21.9	Feb 6	29.4	Jan 31	20.8	Aug 28	21.9	Feb 1	23.9
14th Highest	Jun 8	20.8	Nov 19	21.6	Nov 29	27.3	Jun 8	20.8	Nov 19	21.6	Jul 2	23.4
15th Highest	Jun 12	20.7	Sep 25	21.5	Feb 1	23.9	Jun 12	20.7	Sep 25	21.5	Nov 21	23.0
16th Highest	Jan 12	20.5	Feb 28	21.4	Jul 2	23.4	Jan 12	20.5	Feb 28	21.4	May 30	22.8
17th Highest	Mar 28	19.9	Jul 26	20.7	Nov 21	23.0	Mar 28	19.9	Jul 26	20.7	Nov 26	22.3
18th Highest	Apr 2	19.9	Aug 21	20.0	May 30	22.8	Apr 2	19.9	Aug 21	20.0	Jan 27	22.0
19th Highest	Mar 16	19.8	Sep 9	20.0	Nov 26	22.3	Mar 16	19.8	Sep 9	20.0	Aug 16	21.3
20th Highest	Jan 11	19.7	Jul 27	19.9	Jan 27	22.0	Jan 11	19.7	Jul 27	19.9	Feb 28	20.7
# of Valid Days:	336		328		360		335		350		358	
98P Rank:	7		7		8		7		7		8	
3-Year average:	(26.8+23.5+38.2)/3=29.5						(26.8+23.5+38.2)/3=27.7					
After rounding:	30 - Exceeds CAAQS						28 - Achieves CAAQS					
Note: Both TF/EE events for this site in 2013 were due to windblown dust.												

Table A-7 Demonstration of TF/EE Analysis at Red Deer – Riverside

Station:	**Red Deer - Riverside**											
Air Zone:	**Red Deer**											
	Daily 24hr-$PM_{2.5}$ ($\mu g\ m^{-3}$) Before Removing TF/EE (Identified with **)						Daily 24hr-$PM_{2.5}$ ($\mu g\ m^{-3}$) After removing TF/EE					
Rank	2011		2012		2013		2011		2012		2013	
Highest	Mar 8	46.6	Feb 29	33.0	Mar 8	50.1	Mar 8	46.6	Feb 29	33.0	Mar 8	50.1
2nd Highest	Mar 9	44.5	Dec 5	25.2	Feb 6	43.5	Mar 9	44.5	Dec 5	25.2	Feb 6	43.5
3rd Highest	Mar 16	42.8	Nov 25	24.6	Mar 27	41.2	Mar 16	42.8	Nov 25	24.6	Mar 27	41.2
4th Highest	Mar 18	42.4	Jul 13	24.4	Mar 25	41.0	Mar 18	42.4	Jul 13	24.4	Mar 25	41.0
5th Highest	Mar 17	41.8	Dec 20	24.1	Mar 28	37.0	Mar 17	41.8	Dec 20	24.1	Mar 28	37.0
6th Highest	Mar 10	39.6	Dec 6	23.3	Mar 9	36.4	Mar 10	39.6	Dec 6	23.3	Mar 9	36.4
7th Highest	Mar 19	36.8	Dec 27	22.7	**Feb 7**	**34.5**	Mar 19	36.8	Dec 27	22.7	**Feb 7**	**34.5**
8th Highest	**Mar 12**	**34.2**	**Mar 26**	**22.2**	Feb 28	29.8	**Mar 12**	**34.2**	**Mar 26**	**22.2**	Feb 28	29.8
9th Highest	Jan 31	32.6	Feb 28	22.1	Mar 5	29.0	Jan 31	32.6	Feb 28	22.1	Mar 5	29.0
10th Highest	Jun 27	32.1	Dec 13	22.0	Mar 13	27.3	Jun 27	32.1	Dec 13	22.0	Mar 13	27.3
11th Highest	Feb 19	31.6	Dec 7	21.6	Mar 7	26.6	Feb 19	31.6	Dec 7	21.6	Mar 7	26.6
12th Highest	May 28	31.6	Dec 12	21.2	Feb 27	26.5	May 28	31.6	Dec 12	21.2	Feb 27	26.5
13th Highest	Mar 4	31.5	Dec 18	21.2	Jan 4	25.8	Mar 4	31.5	Dec 18	21.2	Jan 4	25.8
14th Highest	Mar 20	31.1	Mar 1	20.7	Feb 20	25.8	Mar 20	31.1	Mar 1	20.7	Feb 20	25.8
15th Highest	Mar 7	29.6	Dec 9	20.4	Mar 10	25.8	Mar 7	29.6	Dec 9	20.4	Mar 10	25.8
16th Highest	Feb 18	27.0	Dec 19	20.4	Mar 29	25.7	Feb 18	27.0	Dec 19	20.4	Mar 29	25.7
17th Highest	Feb 23	26.4	Dec 28	20.4	Jan 22	25.5	Feb 23	26.4	Dec 28	20.4	Jan 22	25.5
18th Highest	Mar 11	26.4	Dec 1	20.0	Jan 24	24.9	Mar 11	26.4	Dec 1	20.0	Jan 24	24.9
19th Highest	Dec 28	26.4	May 16	19.2	Jan 25	24.8	Dec 28	26.4	May 16	19.2	Jan 25	24.8
20th Highest	Feb 20	26.2	Sep 23	19.0	Mar 4	24.3	Feb 20	26.2	Sep 23	19.0	Mar 4	24.3
# of Valid Days:	357		355		343		357		354		343	
98P Rank:	8		8		7		8		8		7	
3-Year average:	(34.2+22.2+34.5)/3=30.3						(34.2+22.2+34.5)/3=30.3					
After rounding:	30 - Exceeds CAAQS						30 - Exceeds CAAQS					
Note: There were no TF/EE Events above the 98th percentile identified in 2011 or 2013												

Annual Average CAAQS Analysis

Table A-8 illustrates the dates removed from the calculation of the annual average $PM_{2.5}$ metric at Edmonton East. As described previously, two windblown dust events were removed in 2013. In each of 2011 and 2012, there were three dates identified as being influenced by forest fire smoke and have been removed from the calculation of the annual average for those years. After removing them, the annual average standard is not exceeded. Therefore, it is demonstrated that if not for the influence of these events, the standard would have been achieved.

Table A-8 Demonstration of TF/EE Analysis at Edmonton for Annual Average Metric

Station:	**Edmonton East**					
Air Zone:	**North Saskatchewan**					
Year	2011		2012		2013	
Number of Valid Days	336		328		360	
Sum of $PM_{2.5}$ Concentrations ($\mu g\ m^{-3}$)	3325.4		3072.8		3969.9	
Average	9.9		9.4		11.0	
3-Year average:	(9.9+9.4+11.0)/3=10.1 - Exceeds CAAQS					
Dates removed after TF/EE Analysis	Jun 27	66.7	Jul 13	63.7	May 21	76.3
	May 28	32.1	Jul 14	41.4	May 22	38.5
	Jun 26	28.8	Jul 15	30.9		
Adjusted Number of days	333		325		358	
Sum of $PM_{2.5}$ Concentrations ($\mu g\ m^{-3}$)	3197.8		2936.8		3855.1	
Average	9.6		9.0		10.8	
3-Year average:	(9.6+9.0+10.8)/3=9.8 - Achieves CAAQS					

Appendix 2 Management Level Assignments at All Stations

Table A-9 $PM_{2.5}$ and Ozone Management Level Assignments at All Stations, 2011-2013 Assessment Period

Air Zone	Station	Station Number	$PM_{2.5}$ 24-hour	$PM_{2.5}$ Annual	Ozone 8-Hour
Peace	Beaverlodge	91501			
	Evergreen Park	93001			-[a]
	Grande Prairie (Henry Pirker)	92001			
	Smoky Heights	94001			-[a]
Lower Athabasca	Anzac				
	Bertha Ganter - Fort McKay	90801			
	CNRL Horizon				-[a]
	Cold Lake South	94301			
	Fort Chipewyan	91801			
	Fort McKay South (Syncrude UE1)	90806			
	Fort McMurray-Athabasca Valley	90701			
	Fort McMurray-Patricia McInnes	90702			
Upper Athabasca	Carrot Creek	91601	-[a]	-[a]	
	Edson	92901			
	Hinton	93202			-[a]
	Power	93901			-[a]
	Steeper	91701			
North Saskatchewan	Breton	92601	-[a]	-[a]	
	Bruderheim	90606			
	Caroline	91901			
	Drayton Valley	92801			-[a]
	Edmonton Central	90130			
	Edmonton East	90121			
	Edmonton South	90120			
	Elk Island	91101			
	Fort Saskatchewan	90601			
	Genesee	93101			
	Lamont County	92201			
	St. Lina	94401			
	Tomahawk	91301			
	Violet Grove	91401	-[a]	-[a]	
Red Deer	Red Deer - Riverside	90302			
South Saskatchewan	Calgary Central	90228	n/a[b]	n/a[b]	
	Calgary Northwest	90222			
	Crescent Heights	90402			
	Lethbridge	90502			

a: No assessment is possible as this substance is not monitored at this station.
b: No assessment is possible because only one year is available.
Green, yellow, orange and red correspond to the CAAQS management levels.