

Air Quality Monitoring:

In the Grande Cache Area

Sept 2008

Final Report

Overview

Alberta Environment, in conjunction with Energy Resources Conservation Board undertook a mobile air monitoring project in the Grande Cache area in September of 2008. The survey focused on measurement of particulate matter in the area of the operations of Grande Cache Coal and Milner Power. Elevated concentrations of particulate matter were observed near mine haul roads. Particulate matter at these sites were characterized to be larger in size (greater than 2.5 µm) and likely due to road dust and haul vehicle emissions. In addition to particulate matter, sulphur dioxide and oxides of nitrogen concentrations were also noteworthy. Although ambient air quality objectives were not exceeded, elevated sulphur dioxide and oxides of nitrogen were noted concurrently at a number of sites. These observations occurred when the sites were downwind from the coal fired power plant. The results indicate that:

- Road dust and mine haul vehicles are a source of particulate matter especially near haul roads; and
- With the correct meteorological conditions, emissions from nearby power plant may impact ambient concentrations in the area. The measured concentrations during this study were well below the ambient air quality objectives.

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1 Introduction

Alberta Environment regularly conducts short term air quality surveys as part of its air quality monitoring program. These surveys are typically conducted in areas with no permanent monitoring stations or may be done to supplement existing monitoring. For the current survey the department's Mobile Air Monitoring Laboratory (MAML) was used. The MAML is equipped to measure a suite of pollutants commonly associated with industrial and urban emissions.

The study in the Grande Cache area was conducted with the assistance of the Energy Resources Conservation Board staff. Measurements were made at seven different sites on September 15, 16, and 17, 2008. Monitoring sites were located within the town of Grande Cache and near the operations of Grande Cache Coal and Milner Power Station. The power station and coal mine are located approximately 15 km northeast of the town of Grande Cache. This is the first mobile air monitoring survey conducted by Alberta Environment in this area.

Sources that could impact air samples include: the Milner Power Station, coal mine fleet operation, and local emission from the town of Grand Cache. Thus, the parameters of interest for this study were: particulate matter, sulphur dioxide and oxides of nitrogen. Throughout the sample period a total of 28 hours of data were collected.

2 Monitoring method and location

The MAML is equipped to measure ammonia, carbon monoxide, hydrocarbons, oxides of nitrogen, ozone, particulate matter, reduced sulphur compounds and sulphur dioxide. These parameters are measured and reported simultaneously to provide a "snapshot" of the air quality in time and space. A description of the MAML and the detection limit of the various instruments onboard are given in Appendix B.

Air quality surveys are designed to provide information on pollutant levels downwind of existing facilities as well as concentrations in the area of communities. The overall sample area for the current study is shown in Figure 1. The sample sites are listed in Table 1 and their approximate locations are indicated in Figure 2 and Figure 3. Monitoring at each of the sites consisted of stops for at least one hour. The amount of

data collected at each site ranged from one sample hour at **Site 2** to twelve one-hour samples collected over night at **Site 7**. Two of the sample sites (**Site 4 and 7**) were in the town of Grande Cache. Two of the sites were in the Winniandy Flats area northeast of the Milner Power Station (**Site 1 and 2**) while the remaining three (**Sites 3, 5 and 6**) were along Highway 40. Highway 40 runs northeast to southwest following the valley as indicated in Figure 1 and 3 as a red line.

The MAML was plugged into land power while parked in Grande Cache overnight on September 16 and 17. At this location only particulate matter and meteorological conditions were monitored. The full complement of equipment could not be run while plugged into land power due to the power limitations.

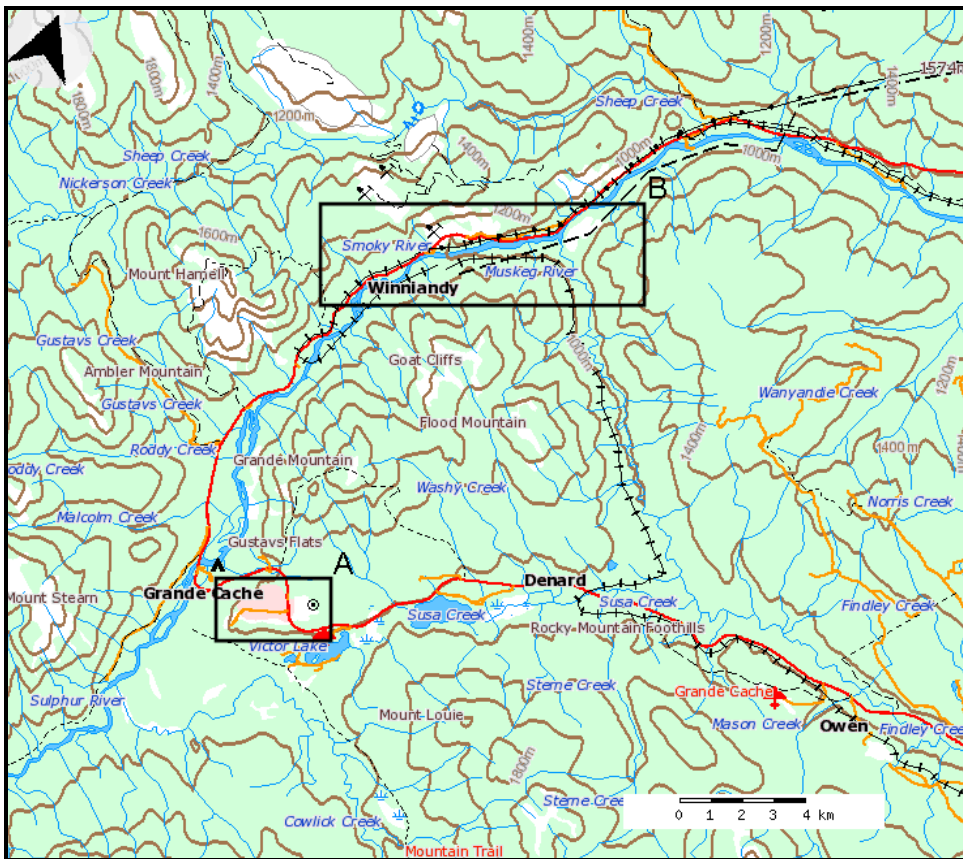


Figure 1: Overview map showing the two monitoring areas. A detailed map of area A is shown in Figure 2 and a detailed map of area B is shown in Figure 3. Map obtained from: <http://atlas.nrcan.gc.ca/site/english/maps/topo/map>

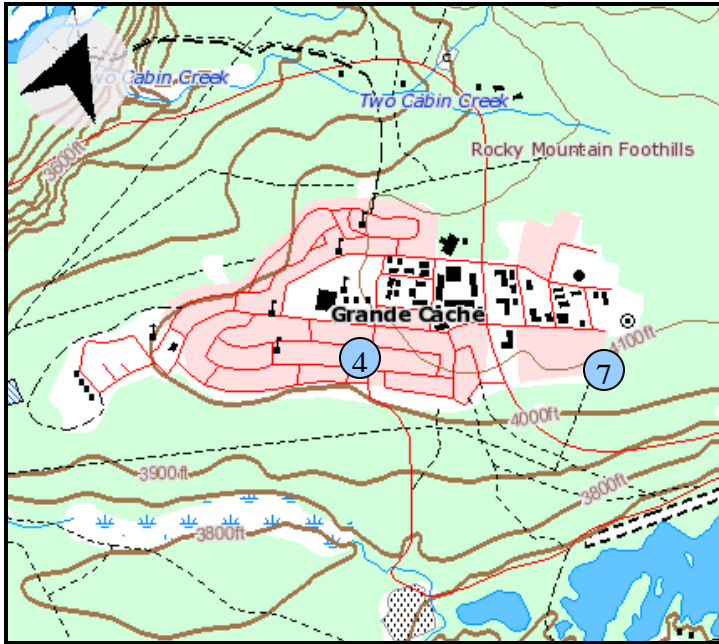


Figure 2: Monitoring locations in Grande Cache, area A shown in Figure 1. Map obtained from: <http://atlas.nrcan.gc.ca/site/english/maps/topo/map>

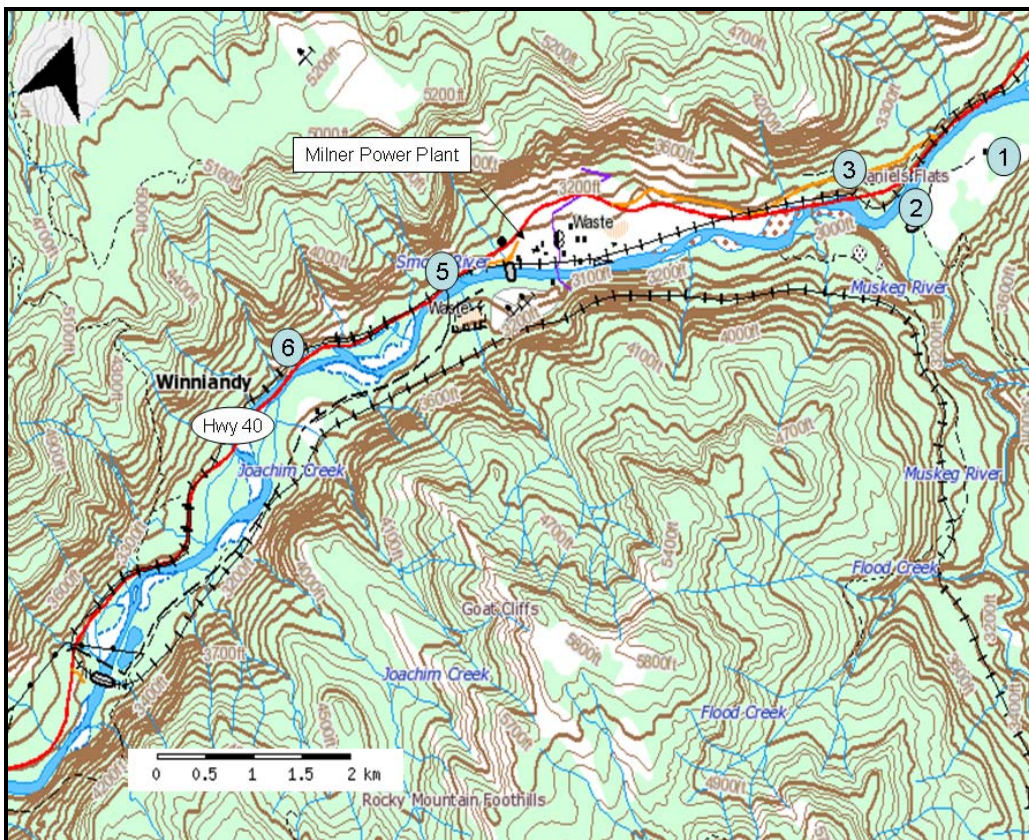


Figure 3: Monitoring locations along Highway 40, area B shown in Figure 1. Map obtained from: <http://atlas.nrcan.gc.ca/site/english/maps/topo/map>

Table 1: List of monitoring locations

Site	Site name	Description
1	Winniandy Flats	Near residences
2	Winniandy Bridge	Bridge over the creek at entrance to Winniandy Flats
3	Haul Road	200m from Haul Road bridge over Hwy 40
4	Grande Cache Rec. Center	Recreation Center near Hoppe Ave. in Grande Cache
5	Lookout Point	Lookout point on Hwy 40 overlooking plant
6	Hwy 40 west	Hwy 40 2km west of plant
7	Grande Cache	100 Street near Hwy 40

3 Results and Discussion

Multiple one-hour samples were collected at a number of the sites. In discussing these results, the median and the maximum one-hour average concentrations are compared to established **Alberta Ambient Air Quality Objectives/Guidelines** (AAAQO/G). The median concentration is a common way of representing the central value for environmental data. Further justification for using the median concentration and information on AAAQO are presented in Appendix B. When there is only a single sample hour, the indicated concentration is the average for the hour. *The key in Figure 4 illustrates how the median and maximum one-hour average concentrations are represented in the following section.* In some cases, time series of measured concentrations are presented to further illustrate measurement results.

The result and discussion section focuses on particulate matter, sulphur dioxide and oxides of nitrogen. Concentrations of all the parameters monitored are presented in the Appendix (Tables A1-3). Comparison to concentrations at other monitoring stations and recent MAML surveys is presented in Table A4.

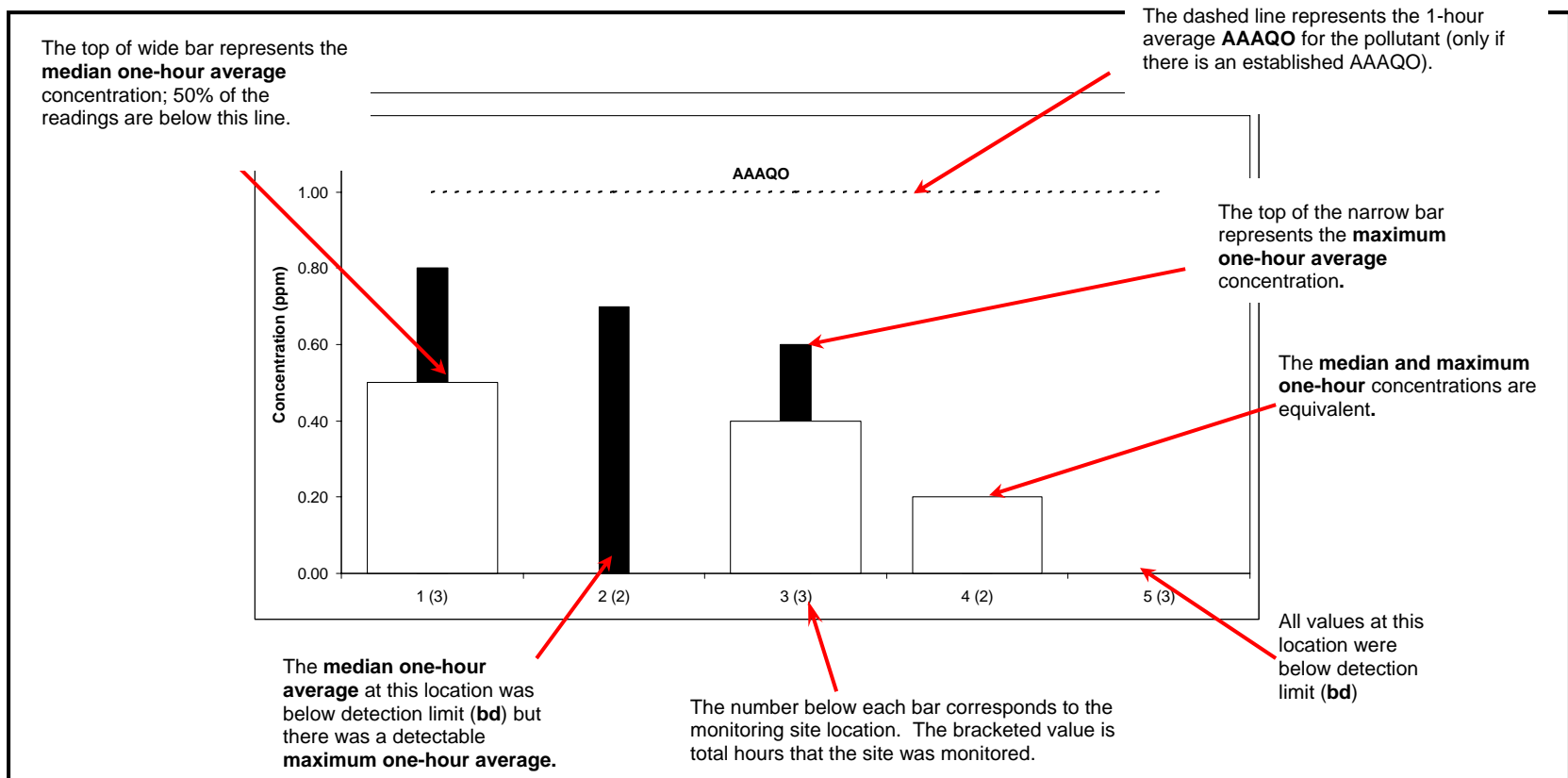


Figure 4: A key for interpreting the figures in the following section.

3.1 Particulate Matter (PM_{10} , $PM_{2.5}$, PM_1)

Particulate matter are often categorized by their size. Inhalable particulates are particulate matter less than 10 micrometers (μm) in aerodynamic diameter (PM_{10}). These particles can be inhaled into the nose and throat. Sources of PM_{10} include soil dust, road dust, agricultural dust (e.g., harvest), smoke from forest fires and wood burning, vehicle exhaust and industrial emissions. Respirable particulates are those particulate matter less than 2.5 μm ($PM_{2.5}$) in aerodynamic diameter. These particles are small enough to penetrate into the lungs. In addition to PM_{10} and $PM_{2.5}$, PM_1 (particles less than 1 μm in aerodynamic diameter) were also measured. $PM_{2.5}$ and PM_1 may form in the atmosphere and/or arise from combustion sources such as vehicle exhaust emissions, industrial emissions and wood burning.

As illustrated in Figure 5, maximum PM_{10} concentrations were notably higher than median values. Implying variability in the PM_{10} concentration measured at these sites. The maximum one-hour average PM_{10} concentrations ranged from 33 $\mu\text{g}/\text{m}^3$ at **Site 2**¹ (entrance to Winniandy Bridge) to 222 $\mu\text{g}/\text{m}^3$ at **Site 3** near the mine haul road bridge over Highway 40. Samples collected at **Site 3** tended to exhibit higher concentrations than samples at other sites. This is likely due to impact from haul road dust and emissions from haul vehicles. PM_{10} concentrations near residences, **Sites 7** and **4** in Grand Cache and **Site 2** at Winniandy Flats, were relatively low with median one-hour average concentrations ranging from 23 to 34 $\mu\text{g}/\text{m}^3$. There was a single exception at **Site 7** where a one-hour average of 218 $\mu\text{g}/\text{m}^3$ was measured. At the time of this elevated PM_{10} concentration, wide spread haze was noted.

To facilitate comparison, the y-axis of Figures 5 and 6 are equivalent. $PM_{2.5}$ formed on average 27 percent of the PM_{10} mass concentration. Alberta has a one-hour ambient guideline² for $PM_{2.5}$ of 80 $\mu\text{g}/\text{m}^3$. One-hour average $PM_{2.5}$ concentrations during this study did not exceed this level. The maximum one-hour average concentrations ranged from 7 $\mu\text{g}/\text{m}^3$ at **Site 2** at Winniandy Flats to 40 $\mu\text{g}/\text{m}^3$ at **Site 3** near the mine

¹ There is only one sample hour at this station

² This guideline is for the purpose air quality evaluation only and should not be used for compliance purposes.

haul road bridge over Highway 40. The median one-hour average concentration near residences (**Site 2, 7 and 4**) did not vary significantly ranging from 7 to 11 $\mu\text{g}/\text{m}^3$.

On average PM_{10} formed 16 percent of the PM_{10} mass concentration. The maximum one hour average concentrations ranged from 9 $\mu\text{g}/\text{m}^3$ at **Sites 3 and 7** to 2 $\mu\text{g}/\text{m}^3$ at **Site 2**. The median one-hour average PM_{10} concentrations near residences (**Site 2, 7 and 4**) ranged from 2 to 7 $\mu\text{g}/\text{m}^3$. The results imply that elevated particulate concentration can occur in the study area especially near haul roads. When concentrations were elevated, the particles were largely composed of matter with aerodynamic diameters greater than 2.5 μm .

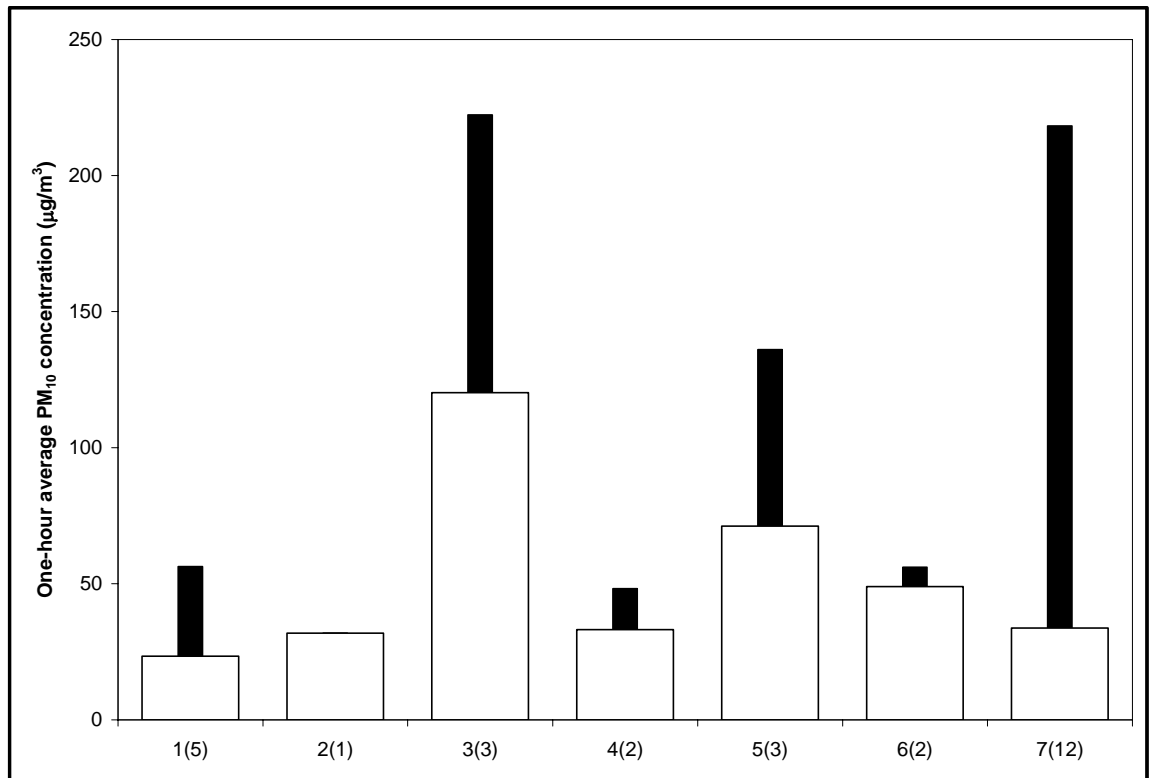


Figure 5: Median and maximum one-hour average concentrations for PM_{10} .

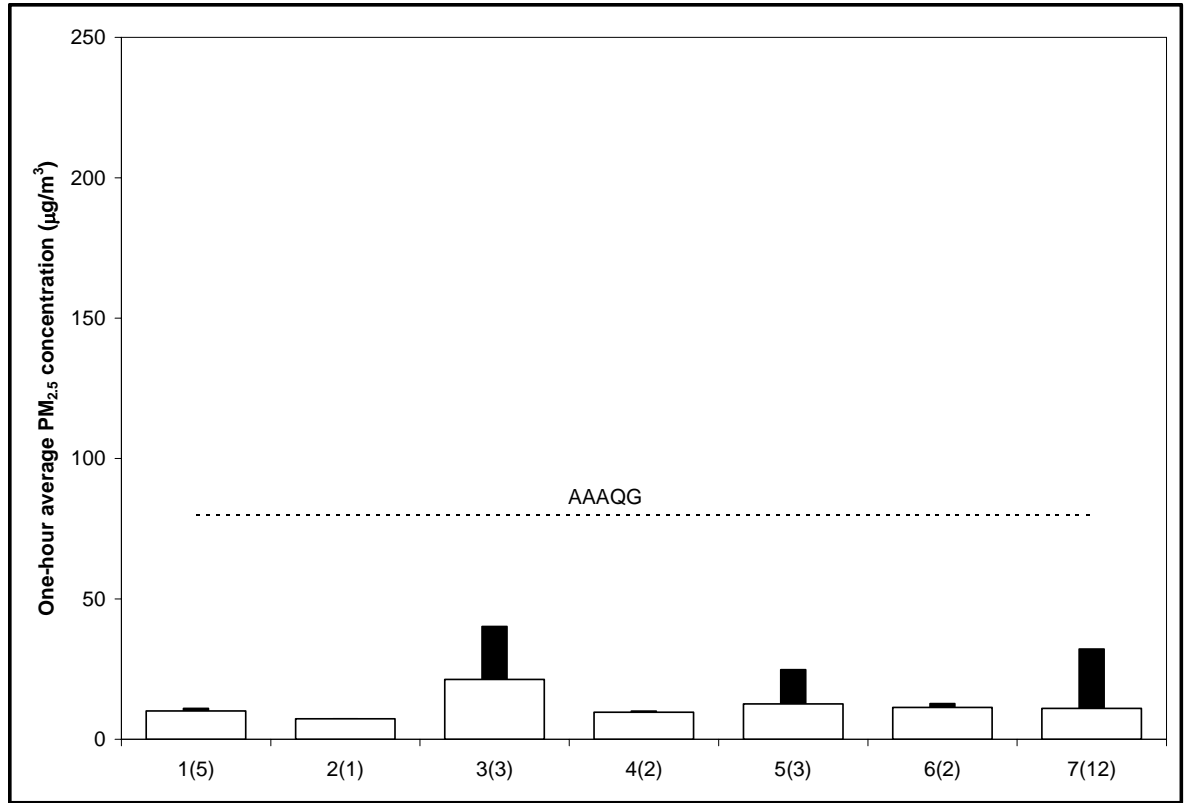


Figure 4: Median and maximum one-hour average concentrations for PM_{2.5}.

3.2 Sulphur Dioxide and Oxides of Nitrogen

In Alberta, upstream oil and gas processes are responsible for close to half of the Sulphur dioxide (SO₂) emissions in the province. Oil sands facilities and power plants are also major SO₂ sources. Other sources include gas plant flares, oil refineries, pulp and paper mills and fertilizer plants. For the area currently under study, the most likely major source of SO₂ is the coal fired power station. Along with SO₂, oxides of nitrogen (NO_x) are also emitted from coal fired power plants. Nitrogen dioxide (NO₂) and nitric oxide (NO) are known as NO_x. Both NO and NO₂ may be emitted by high temperature combustion processes. Typically NO forms the significant fraction³. Often the ratio of NO and NO₂ is used to determine the relative age of air mass. This is because NO is readily converted in the atmosphere into NO₂ through reaction with ozone (O₃). Alberta

³ Slotiv P., and Weilenmann M.(2003). NO₂/NO emission of gasoline passenger cars and light-duty trucks with Euro-2 emission standard. Atmospheric Environment 37, pp5207-5216.

has a one-hour ambient air quality objective for SO₂ of 0.172 ppm and for NO₂ of 0.212 ppm.

Figure 7 illustrates the median and maximum one-hour average SO₂ concentrations at the various sites. The maximum one-hour average concentrations ranged from 0.020 ppm at **Site 1** to 0.001 ppm at **Site 4**. Relatively high one-hour average concentrations for SO₂ were also measured at **Sites 5** and **6**, 0.010 ppm and 0.015 ppm, respectively. Elevated SO₂ concentrations were observed concurrent to elevated NO_x concentrations. Maximum one-hour average NO_x concentrations ranged from 0.035 ppm at **Site 1** to 0.001 ppm at **Site 2**. Figure 8 illustrates the median and maximum one-hour average NO_x concentrations. During periods of elevated concentrations the NO/NO₂ ratio was 1.57 on average, the more abundant NO implies nearby source(s). These events were typically noted when a site was downwind from Minlar Power Plant, for example at **Site 1** when the wind direction was south westerly and at **Site 6** when the wind direction was easterly. An example time series for NO_x and SO₂ are shown in Figure 9, it illustrates the co-varying nature of these two pollutants. Although concentrations measured did not exceed ambient air quality objectives, the results indicate that samples may have been impacted by nearby emissions which most likely came from the power plant.

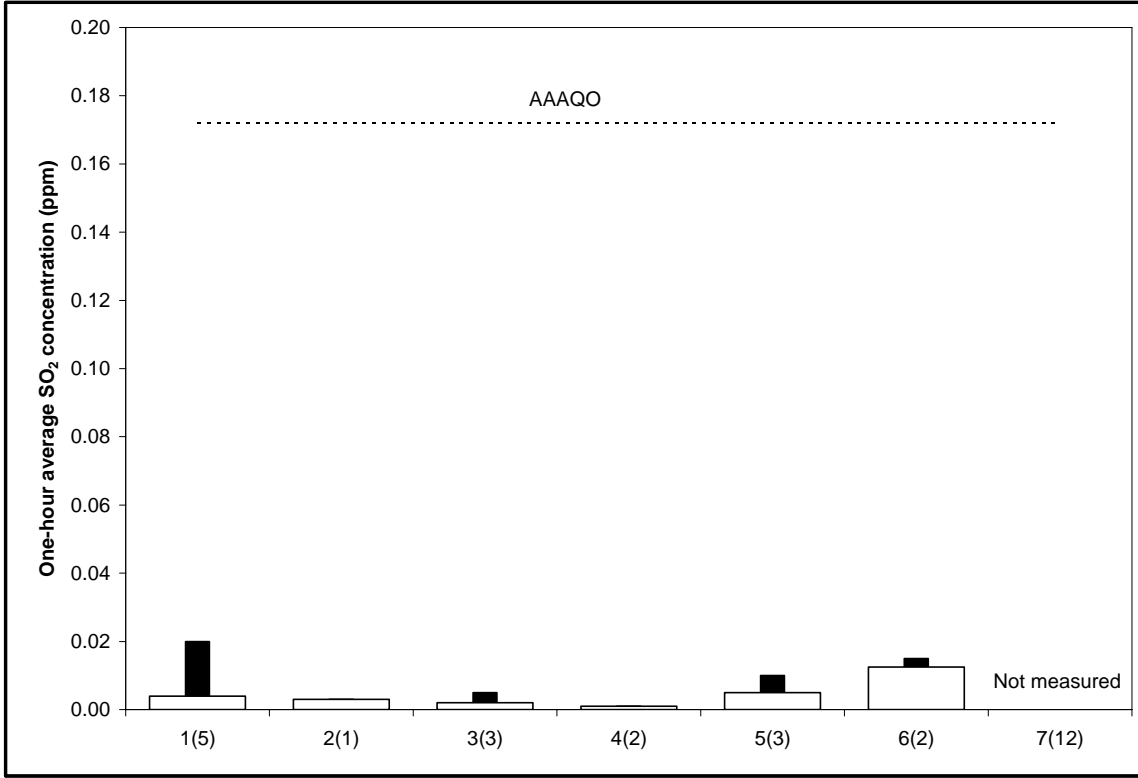


Figure 5: Median and maximum one-hour average concentrations for SO₂

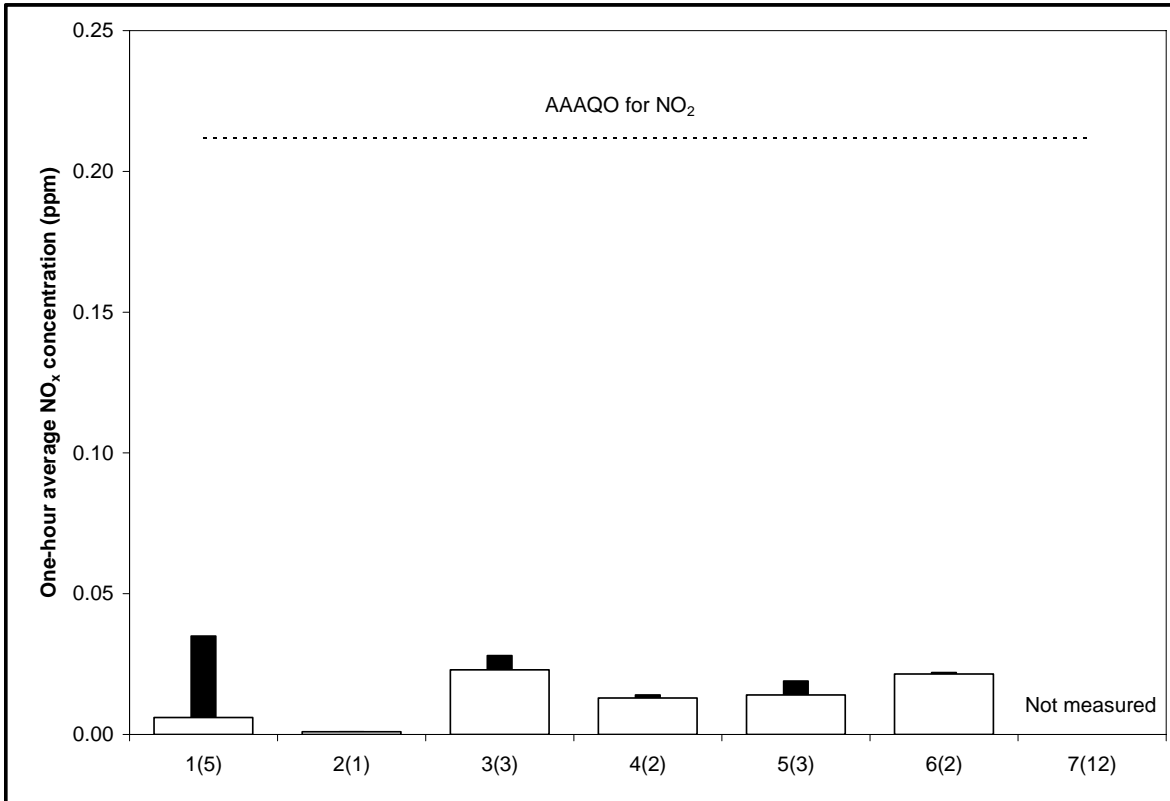


Figure 6: Median and maximum one-hour average concentrations for NO_x

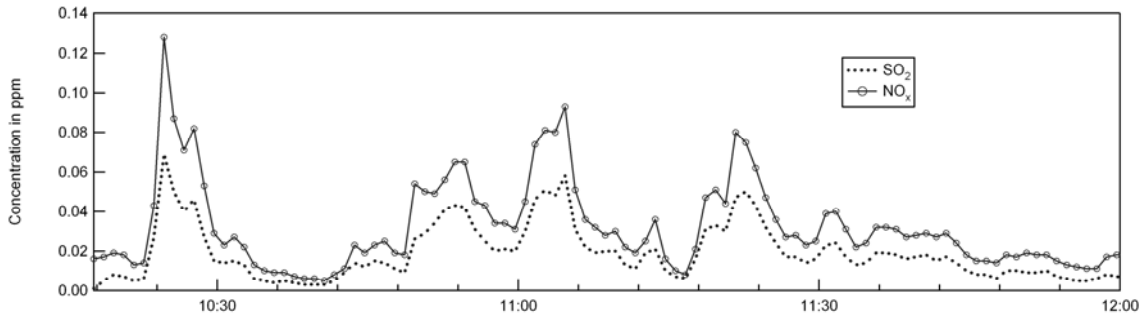


Figure 7: SO₂ and NO_x concentration as measured at Site 1 on September 17, 2008. The figure illustrates the co-varying nature of these two pollutants

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Appendix A

Table A 1: One-hour average concentrations for gaseous pollutants measured at the various sites.

Site	Date	Sample Times	CO PPM	O ₃ PPM	THC PPM	CH ₄ PPM	RHC PPM	SO ₂ PPM	NO PPM	NO ₂ PPM	NO _x PPM	NH ₃ PPM	TRS PPM	H ₂ S PPM
1 Wanyandie Flats	9/15/2008	14:20 to 15:20	0.0	0.032	1.6	1.7	bd	0.002	0.003	0.002	0.001	0.005	bd	bd
	9/15/2008	15:20 to 16:20	0.1	0.031	1.6	1.7	bd	0.002	0.002	0.002	0.002	0.004	bd	bd
	9/16/2008	12:11 to 13:12	0.2	ND	1.9	1.8	0.1	0.004	0.004	0.003	0.006	0.003	0.001	bd
	9/17/2008	10:16 to 11:16	0.2	0.013	1.9	1.8	bd	0.020	0.023	0.013	0.035	0.001	bd	bd
	9/17/2008	11:16 to 12:16	0.2	0.015	1.9	1.9	bd	0.015	0.015	0.012	0.026	0.001	bd	bd
2 Flats Bridge	9/15/2008	16:24 to 17:25	0.1	0.031	1.7	1.7	bd	0.003	0.002	0.002	0.001	0.003	bd	bd
	9/15/2008	17:47 to 18:48	0.1	0.027	1.6	1.7	bd	0.002	0.002	0.004	0.003	0.002	bd	bd
3 Haul Bridge	9/16/2008	10:47 to 11:50	0.2	ND	2.0	1.9	0.1	0.005	0.017	0.009	0.023	0.003	0.001	bd
	9/17/2008	09:00 to 10:01	0.1	0.009	2.2	2.2	bd	0.002	0.019	0.010	0.028	0.002	0.001	bd
	9/16/2008	07:57 to 08:58	0.2	ND	1.9	1.8	0.1	0.001	0.010	0.004	0.014	0.002	bd	bd
4 GC Rec. Center	9/17/2008	07:27 to 08:28	0.2	0.017	1.8	1.8	0.1	0.001	0.006	0.007	0.012	0.001	0.001	bd
	9/16/2008	09:41 to 10:42	0.2	ND	1.9	1.8	0.1	0.002	0.010	0.005	0.014	0.001	0.001	bd
5 Lookout	9/16/2008	13:26 to 14:26	0.2	ND	2.0	1.9	0.1	0.010	0.013	0.008	0.019	0.005	0.001	bd
	9/16/2008	14:26 to 15:26	0.2	ND	2.0	1.9	0.1	0.005	0.005	0.004	0.007	0.005	0.001	bd
	9/16/2008	15:32 to 16:32	0.1	ND	1.9	1.9	0.1	0.015	0.016	0.011	0.022	0.002	0.001	bd
6 2 km SW of power station	9/16/2008	16:32 to 17:32	0.1	ND	1.9	1.8	0.1	0.010	0.012	0.011	0.021	0.002	0.001	bd

Notes:

bd – below detection limit **ND** - no data

ppm - parts per million

Table A 2: One-hour average concentrations for particulate matter measured at the various sites.

Site	Date	Sample Times	PM ₁₀ µg/m ³	PM _{2.5} µg/m ³	PM ₁ µg/m ³	PAH ng/m ³	
1	Wanyandie Flats	9/15/2008	14:20 to 15:20	56	10	3	bd
		9/15/2008	15:20 to 16:20	27	6	2	bd
		9/16/2008	12:11 to 13:12	21	7	4	bd
		9/17/2008	10:16 to 11:16	22	11	8	bd
		9/17/2008	11:16 to 12:16	23	11	8	bd
2	Flats Bridge	9/15/2008	16:24 to 17:25	32	7	2	bd
		9/15/2008	17:47 to 18:48	222	40	7	bd
3	Haul Bridge	9/16/2008	10:47 to 11:50	120	21	8	bd
		9/17/2008	09:00 to 10:01	28	13	9	4
		9/16/2008	07:57 to 08:58	48	10	6	bd
4	GC Rec Center	9/17/2008	07:27 to 08:28	18	9	7	6
		9/16/2008	09:41 to 10:42	31	11	8	9
5	Lookout	9/16/2008	13:26 to 14:26	71	13	4	bd
		9/16/2008	14:26 to 15:26	136	25	7	bd
		9/16/2008	15:32 to 16:32	42	10	4	bd
6	2km SW of Plant	9/16/2008	16:32 to 17:32	56	13	5	bd
		9/16/2008	18:00 to 19:00	218	32	9	ND
7	Grande Cache overnight	9/16/2008	19:00 to 20:00	47	14	8	ND
		9/16/2008	20:00 to 21:00	69	14	7	ND
		9/16/2008	21:00 to 22:00	31	10	7	ND
		9/16/2008	22:00 to 23:00	46	12	7	ND
		9/16/2008	22:59 to 23:59	18	10	8	ND
		9/17/2008	00:00 to 01:00	14	8	6	ND
		9/17/2008	01:00 to 02:00	29	10	6	ND
		9/17/2008	02:00 to 03:00	13	8	6	ND
		9/17/2008	03:00 to 04:00	11	8	6	ND
		9/17/2008	04:00 to 05:00	42	14	7	ND
		9/17/2008	05:00 to 06:00	36	13	7	ND

Notes:

PAHs measured by instrumentation on board the MAML are particle bound PAHs

bd – below detection limit **ND** - no data

ppm - parts per million **ng/m³** = nanograms per cubic meter **µg/m³** = micrograms per cubic meter

Table A 3: Operator remarks and weather conditions based on measurements at monitoring location.

Site	Date	Sample Times	Comments	Temp °C	RH %RH	WSP KPH	WDR DEGREES
1 Wanyandie Flats	9/15/2008	14:20 to 15:20	near homes	29.2	22.4	10.9	227
	9/15/2008	15:20 to 16:20	near homes	28.7	23.0	10.7	232
	9/16/2008	12:11 to 13:12	dust from passing vehicles at 1:42 & 12:51	25.6	34.7	7.9	81
	9/17/2008	10:16 to 11:16	no apparent dust	17.7	46.8	11.0	200
	9/17/2008	11:16 to 12:16	no apparent dust	18.8	43.6	10.1	196
2 Flats Bridge	9/15/2008	16:24 to 17:25	near creek, dust from passing vehicle @ 16:38	26.4	25.4	7.1	216
3 Haul Bridge	9/15/2008	17:47 to 18:48	dust from passing trucks	24.3	28.7	7.4	294
	9/16/2008	10:47 to 11:50	dust from haul trucks passing nearby approx 70 m away	21.6	38.3	5.5	154
	9/17/2008	09:00 to 10:01	dust from passing trucks	13.6	59.4	6.3	245
4 GC Rec Center	9/16/2008	07:57 to 08:58	dust from vehicles on gravel laneway	13.2	56.8	4.6	103
	9/17/2008	07:27 to 08:28	haze in the area	8.8	68.5	6.4	119
5 Lookout	9/16/2008	09:41 to 10:42		15.5	54.5	6.3	201
	9/16/2008	13:26 to 14:26	dust is from passing vehicles on haul road, part of mine ops	26.9	31.7	6.9	111
	9/16/2008	14:26 to 15:26		27.8	29.4	7.6	62
6 2km SW of Plant	9/16/2008	15:32 to 16:32	downwind of plant ops	25.9	34.5	14.6	44
	9/16/2008	16:32 to 17:32		24.6	38.8	14.5	37
7 Grande Cache overnight	9/16/2008	18:00 to 19:00	Gravel laneway alongside and gravel road upwind	20.5	45.2	8.0	296
	9/16/2008	19:00 to 20:00	hazy in the whole area, town included	18.5	51.3	10.0	308
	9/16/2008	20:00 to 21:00		17.2	55.0	10.8	317
	9/16/2008	21:00 to 22:00		15.8	61.0	8.0	278
	9/16/2008	22:00 to 23:00		14.3	69.2	4.2	219
	9/16/2008	22:59 to 23:59		11.5	79.7	3.9	133
	9/17/2008	00:00 to 01:00		10.4	79.9	3.8	133
	9/17/2008	01:00 to 02:00		9.2	82.6	2.6	151
	9/17/2008	02:00 to 03:00		8.5	82.3	4.0	135
	9/17/2008	03:00 to 04:00		7.7	82.1	3.6	130
9/17/2008	04:00 to 05:00		6.8	83.0	3.9	133	
9/17/2008	05:00 to 06:00		5.9	84.6	4.6	137	

Notes:

Temp - Temperature in degrees centigrade RH – Relative humidity in percentage WSP KPH – Wind speed in Km/hr
WDR DEGREES – Wind direction in degrees 0 or 360=north, 90=east, 180=south, 270=west

Table A 4: Operator observed weather conditions during monitoring period

Date	Observation	Cloud cover
September 15/08	Clear sky moderate southwest wind, high 28 degrees	no cloud cover
September 16/08	Clear sky, moderate east wind, high 26 degrees	no cloud cover
September 16 to 17 overnight	Clear sky, calm, low overnight temperature 5 degrees	no cloud cover
September 17/08	Clear sky, light southwest wind, warm - high of 25 degrees	no cloud cover

Table A 5: Median one-hour average concentration for the current study, selected MAML surveys and permanent monitoring stations.

Station or Survey Type	Air Quality Station or Survey Name	Monitoring Period	CO ppm	O ₃ ppm	THC ppm	CH ₄ ppm	RHC ppm	SO ₂ ppm	NO ₂ ppm	NH ₃ ppm	TRS ppm	H ₂ S ppm	PM ₁₀ µg/m ³	PM _{2.5} µg/m ³	PM ₁ µg/m ³	PAH ng/m ³
Grande Cache Area	Site #1	Sept 15-17 2008	0.2	0.023	1.9	1.8	0.1	0.004	0.003	0.003	0.001	bd	23	10	4	bd
	Site #2	Sept 15-17 2008	0.1	0.031	1.7	1.7	bd	0.003	0.002	0.003	bd	bd	32	7	2	bd
	Site #3	Sept 15-17 2008	0.1	0.018	2.0	1.9	0.1	0.002	0.009	0.002	0.001	bd	120	21	8	bd
	Site #4	Sept 15-17 2008	0.2	0.017	1.9	1.8	0.1	0.001	0.006	0.002	0.001	bd	33	10	7	3
	Site #5	Sept 15-17 2008	0.2	ND	2.0	1.9	0.1	0.005	0.005	0.005	0.001	bd	71	13	7	bd
	Site #6	Sept 15-17 2008	0.1	ND	1.9	1.9	0.1	0.013	0.011	0.002	0.001	bd	49	11	4	bd
	Site #7	Sept 15-17 2008	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	34	11	7	ND
Other Mobile Surveys	Fort Saskatchewan and Redwater Area	2006 - 2007	0.2	0.030	1.9	1.9	bd	0.003	0.004	0.003	bd	bd	10	3	7*	bd
	Slave Lake	2005 - 2006	0.2	0.003	2.4	2.4	bd	0.001	0.012	bd	0.001	bd	13	5	n/a	8
	Tolko High Prairie	2005 - 2006	0.2	0.018	2.0	1.9	bd	0.001	0.005	bd	0.001	bd	12	3	n/a	bd
	Caroline	2005 -2006	0.2	0.038	1.8	1.8	bd	0.002	0.004	0.003	0.001	0.001	49	6	n/a	bd
	Girouxville	2004, '05, 2006	0.3	0.028	2.1	2.1	bd	0.001	0.001	0.013	0.002	0.001	15	2	n/a	bd
	Whitecourt	2005	0.2	0.027	2.1	2.1	bd	0.001	0.002	0.084	0.001	0.001	16	2	n/a	bd
Permanent Continuous Monitoring Stations																
urban	Calgary Central	Sept 15-17 2008	0.5	0.014	1.9	1.9	0.0	n/a	0.023	n/a	n/a	n/a	37	14	n/a	n/a
	Edmonton South	Sept 15-17 2008	0.2	0.021	1.9	n/a	n/a	0.001	0.009	n/a	n/a	n/a	33	5	n/a	n/a
	Lethbridge	Sept 15-17 2008	0.1	0.028	ND	ND	ND	bd	0.011	0.008	n/a	bd	n/a	8	n/a	n/a
rural	Beaverlodge	Sept 15-17 2008	n/a	0.024	n/a	n/a	n/a	bd	0.002	n/a	n/a	bd	n/a	3	n/a	n/a

Notes:

bd – below detection limit **ND** - no data * monitored for part of the study

ppm - parts per million **ng/m³** = nanograms per cubic meter **µg/m³** = micrograms per cubic meter

Appendix B

The median concentration

The median concentration is a common way of representing the central value for environmental data. Most environmental data usually consist of a distribution that is skewed to the right; that is most data values are low and only a few are high. For such data sets, the arithmetic mean will be biased by the high concentrations; the resulting value may not be representative of the central value for the data set. For example, a data distribution consisting of five numbers: 1, 2, 2, 3 and 10. The arithmetic mean of these data is 3.6 and the median is 2. In this case, the arithmetic mean is biased high by the extreme value of 10. The median is the middlemost value in the data set; thus more representative of the central value of the data distribution. Fifty percent of the values in the dataset are below the median and fifty percent are above.

Alberta's Ambient Air Quality Objectives

Alberta's Ambient Air Quality Objectives¹ are established under Section 14 of the Environmental Protection and Enhancement Act (EPEA R.S.A. 2000, c.E-12, as amended). EPEA provides for the development of environmental objectives for Alberta.

The Ambient Air Quality Objectives are used for:

- Reporting on the state of the atmospheric environment in Alberta.
- Reporting to Albertans on the quality of the air through Alberta's Air Quality Index (AQI).
- Establishing approval conditions for regulated industrial facilities.
- Evaluating proposals to construct facilities that will have air emissions.
- Guiding special ambient air quality surveys.
- Assessing compliance near major industrial air emission sources.

Some of Alberta's Ambient Air Quality Objectives are based on odour perception. This is the case for ammonia, nitrogen dioxide and hydrogen sulphide. For these chemicals, people are likely to detect an odour at concentrations well below levels that may affect human health. Alberta's Ambient Air Quality Objectives for one-hour average concentration of pollutants monitored by the MAML are listed in Table B1. Additional objectives can be found on the Alberta Environment's web site or through the department's information centre ((780) 427-2700).

Table B1: Alberta's Ambient Air Quality Objective measured by the MAML

Pollutant	One-hour AAAO (ppm*)	Basis for Objective
Ammonia	2	odour perception
Carbon monoxide	13	oxygen carrying capacity of blood
Nitrogen dioxide	0.212	odour perception
Ozone	0.082	reduction of lung function and effects on vegetation
Hydrogen sulphide	0.01	odour perception
Sulphur dioxide	0.172	pulmonary function

ppm - parts per million

¹ *Alberta Ambient Air Quality Objectives*. Alberta Environment. April 2005.

The Mobile Air Monitoring Laboratory (MAML)

The MAML is a 27-foot (8.2 m) vehicle that has been specially designed and equipped to measure air quality. It houses a variety of instruments that continuously sample the air at specified time or distance intervals. The MAML is equipped with:

- a dual computer system custom-programmed to accept and record the measurement of air samples from each analyser,
- a GPS (Global Positioning System) that identifies the MAML's location as it moves around Alberta,
- an exhaust purifying system that minimizes emissions from the vehicle and
- two on-board generators that are also equipped with exhaust scrubbers

Table B2 lists the pollutants and meteorological data monitored by the MAML. Also indicated are the lower and upper detection limits for each monitored species.



Figure B1: Alberta Environment's Mobile Air Monitoring Laboratory

Table B2: Pollutants and meteorological data monitoring by the MAML.

Pollutant	Operating Range	
	Lower Detection Limit *	Upper Detection Limit **
Ammonia (NH ₃)	0.001 ppm	5 ppm
Ozone (O ₃)	0.001 ppm	0.5 ppm
Carbon Monoxide (CO)	0.1 ppm	50 ppm
Hydrocarbons		
Methane (CH ₄)	0.1 ppm	20 ppm
Reactive Hydrocarbons (RHC)	0.1 ppm	20 ppm
Total Hydrocarbons (THC)	0.1 ppm	20 ppm
Polycyclic Aromatic Hydrocarbons (PAH)	3 ng/m ³	1000 ng/m ³
Oxides of nitrogen		
Nitrogen dioxide (NO ₂)	0.0006 ppm	1 ppm
Nitric Oxide (NO)	0.0006 ppm	1 ppm
Oxides of nitrogen (NO _x)	0.0006 ppm	1 ppm
Particulate Matter		
Particulate Matter <10µm (PM ₁₀)	1 µg/m ³	1.0 g/m ³
Particulate Matter <2.5µm (PM _{2.5})	1 µg/m ³	1.0 g/m ³
Particulate Matter <1µm (PM ₁)	1 µg/m ³	1.0 g/m ³
Sulphur Compounds		
Hydrogen Sulphide (H ₂ S)	0.001 ppm	1 ppm
Total Reduced Sulphur (TRS)	0.001 ppm	1 ppm
Sulphur Dioxide (SO ₂)	0.001 ppm	2 ppm
Meteorological data		
Wind Speed	0 km/hr	200 km/hr
Wind Direction	0 degrees	360 degrees
Temperature	-40 °C	50 °C
Relative humidity	0%	100%

ppm - parts per million

ng/m³ = nanograms per cubic meter

µg/m³ = micrograms per cubic meter

g/m³ = grams per cubic meter

* The **lower detection limit** indicates the *minimum* amount of pollutant and the lower limit of meteorological data can be measured by the instrument.

** The **upper detection limit** indicates the *maximum* amount of pollutant the instrument can detect and the upper limit for meteorological data measured. This limit is set to provide the optimum precision over that range. The upper limit can be raised, however, precision at the lower levels (where most levels are monitored) is then compromised.