Bon Accord PORTABLE MONITORING STATION Project

FORT AIR PARTNERSHIP

We Monitor the Air You Breathe

Air Quality Monitoring Report | August 2019

Executive Summary

Fort Air Partnership (FAP) operates a portable air quality monitoring station that can be sited inside and occasionally outside FAP's Airshed to monitor ambient air quality. The first location chosen for the portable station was the Town of Bon Accord, where it collected air quality measurements from April 12, 2018 to February 28, 2019.

Factors that led to the selection of Bon Accord as the first location for the portable station included the town having a large population base in the Airshed, no continuous air monitoring had been done in the immediate vicinity of the Town previous to this project, and specific air quality concerns had been brought to the attention of FAP.

One of the major air quality concerns brought forward was the impact of coal burning as a source of residential home heating. The substance measured to investigate this concern was fine particulate matter ($PM_{2.5}$). Although there were exceedances of the Alberta Ambient Air Quality Objective (AAAQO) for $PM_{2.5}$ recorded during the 10 month project, these were all attributed to wildfire smoke or regional temperature inversion events that covered the entire Edmonton Metropolitan Region. $PM_{2.5}$ measurements at Bon Accord for the duration of this project did not differ significantly from other community stations in the FAP network. If coal burning did influence air quality within Bon Accord it did not lead to $PM_{2.5}$ measurements in exceedance of the AAAQO.

Another concern brought forward involved odours believed to be generated by a municipal sewage lagoon located south of Bon Accord. Hydrogen sulphide (H_2S) was measured to investigate this concern. Although there were exceedances of the AAAQO for H_2S recorded during the 10 month project, all of these were attributed to wetlands located in the southeast corner of town. The H_2S levels at Bon Accord do not differ substantially from other communities within FAP's Airshed except for levels measured in May, 2018. May levels were elevated above those recorded at other FAP stations. This was also attributed largely to the nearby wetlands. All the monthly averages, other than in May, recorded at other FAP stations were within 0.2 parts per billion (ppb) of those measured at Bon Accord.

Other substances monitored for during this project, as listed below, were included as a standard suite of parameters for a community station. Note that data for April, 2018 was included in this report although the station only operated for part of that month.

- **Nitrogen Dioxide** – NO_2 levels at Bon Accord did not differ substantially from levels recorded at other communities within FAP's Airshed during the same time period.
- **Ozone** – O3 levels at Bon Accord did not differ substantially from levels recorded at other communities within FAP's Airshed during the same time period.
- **Sulphur Dioxide** – SO2 levels generally trended with those of other community stations in FAP's Airshed.

Data collected during the Bon Accord project was also used to calculate an Air Quality Health Index (AQHI), as is done at other community stations within FAP. Bon Accord was in the low risk category 90.1% of the time, a slightly higher percentage than the three FAP community stations used for comparison in this report. The 79 hours of high risk and 12 hours of very high risk accounted for less than 2% of the total time that the portable was in operation.

The majority of these high and very high risk hours occurred in August, 2018. They were caused by the long-range transport of smoke into the region from wildfires in British Columbia. The number of high and very high risk hours during this period was consistent with what occurred at other FAP stations. The remainder of high and very high risk hours at Bon Accord occurred in mid-February, 2019. This was a result of the cumulative impact from multiple sources predominately east of the station, coupled with temperature inversion conditions.

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Background

About Fort Air Partnership

Fort Air Partnership (FAP) is a not-for-profit organization formed in 1997 to monitor the air people breathe within a 4,500 square kilometre Airshed located immediately north and east of Edmonton, Alberta, Canada. The FAP area (referred to as the "Airshed" in this report) includes Fort Saskatchewan, Gibbons, Bon Accord, Bruderheim, Lamont, Redwater, Waskatenau, Thorhild, portions of the counties of Sturgeon, Westlock, Thorhild, Lamont, Strathcona, and Elk Island National Park. Alberta's Industrial Heartland is located within FAP's borders. FAP collects and reports on air quality data in a region encompassing one of the most concentrated industrial development areas in Alberta.

FAP's work is open and transparent, governed by a multi-stakeholder Board of Directors, guided by a scientific Technical Working Group and driven by national and provincial standards. Continuous data is collected 24 hours a day, seven days a week and made available to anyone.

Portable Station Program Description

FAP operates a portable air quality monitoring station that can be sited throughout the region to monitor ambient air quality. The portable station is equipped with the parameters required to calculate the AQHI including oxides of nitrogen ($NO/NO_x/NO_2$), ozone (O_3), fine particulate matter ($PM_{2.5}$), sulphur dioxide (SO_2) and hydrogen sulphide (H_2S), along with meteorological parameters including wind speed, wind direction, ambient temperature and relative humidity.

Equipment to measure other substances can also be added to the monitoring suite depending on the project objectives. All parameters report in ppb with the exception of fine particulate matter which is measured in micrograms per cubic metre ($\mu g/m^3$), are measured in parts per billion (ppb). A pinch of salt in a 10 ton bag of potato chips or one drop of ink in a large gasoline tanker truck would equal approximately one ppb.

FAP has developed a documented process to select sites for the portable station.

Bon Accord Project Description

Several factors led to the selection of Bon Accord as the first location for FAP's portable air monitoring station.

i. There had been no continuous monitoring done in the immediate vicinity of Bon Accord previous to this project. The nearest station is located in Gibbons which is six kilometres away. While this station may be representative of regional air quality it is not representative of local air quality that may be affected by local sources.

ii. Bon Accord has a large population base for the region. The 2016 census recorded 1,529 residents.

iii. Specific air quality concerns were brought to the attention of FAP, which resulted in a request for air quality monitoring. These included:

- Odours believed to be generated by the town's sewage lagoon located south of Bon Accord.
- The potential impact on local air quality of residents burning coal to heat their homes in the wintertime.

The site for the monitoring station in Bon Accord was donated by the Town. It was selected due to its ease of access, proximity to power and because it met Alberta Environment and Parks' (AEP) site requirements for ambient air monitoring as per the Air Monitoring Directive.

The portable began monitoring and reporting air quality data on April 12, 2018 and was shut down February 28, 2019. April 2018 data is included in this report even though the station was not operational for the entire month. The station was operated according to AEP Air Monitoring Directive requirements and was subject to a performance audit by AEP conducted on site in May, 2018. The audit results are posted on FAP's website.

The portable station was located at approximately 49 Avenue and 49 Street in the southeast corner of Bon Accord.

Figure 1: Location of the Portable Air Monitoring Station at Bon Accord.

Figure 1 shows the relative location of the town sewage lagoon. The monitoring station was located 750 metres north of the lagoon, 120 metres north of a small wetland and 30 metres north of one of the Town's sewage lift stations where power was obtained. Highway 28, with an average daily traffic count of approximately 6,800 vehicles, runs about 300 metres south of the station site.

Figure 2: Exterior photo of the Portable Air Monitoring Station in Bon Accord.

Figure 3: Interior photo of the Portable Air Monitoring Station.

FAP community monitoring stations used in the data comparisons are located at Bruderheim (32 kilometres to the east) Gibbons (5.5 kilometres to the east) and Redwater (25 kilometres to the northwest), as shown in **Figure 4**.

Figure 4: Location of the Portable Station at Bon Accord Relative to Nearby FAP Continuous Stations.

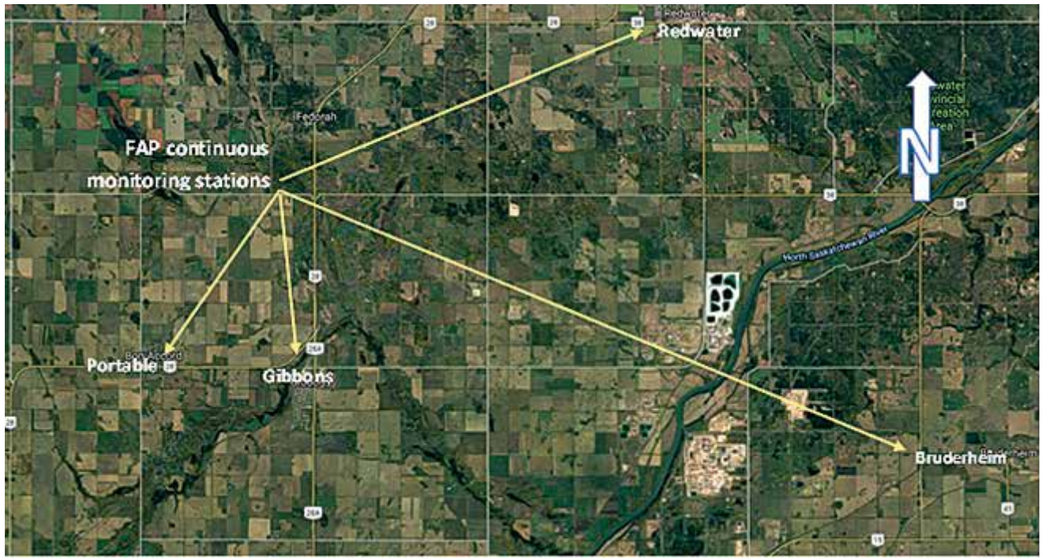


Figure 5: FAP Stations and Stations Reporting to NPRI

Figure 5 shows the position of the FAP continuous stations, including the portable at Bon Accord, and the relative position of all the facilities that report to the **National Pollutant Release Inventory** (NPRI).

Note: red markers denote FAP operated ambient air monitoring stations. Purple markers denote NPRI emission sources both within and outside of the FAP region.

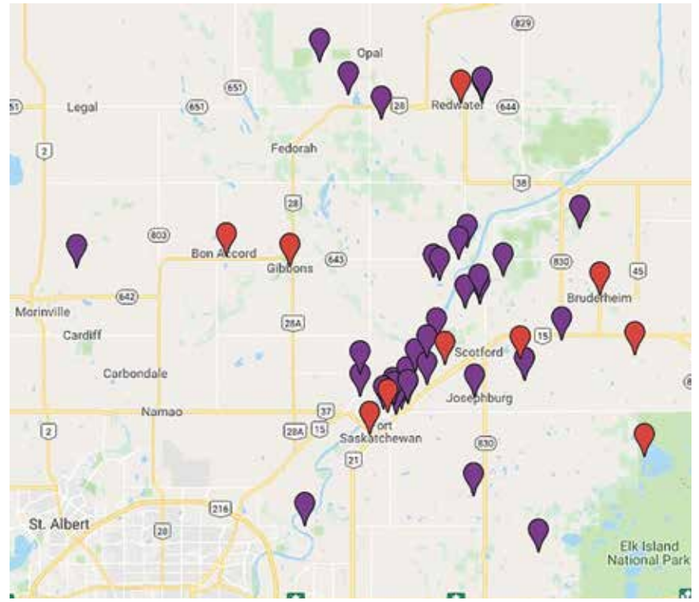


Figure 6: Looking north from the air monitoring station.

Figure 7: Looking east from the air monitoring station.

Figure 8: Looking south from the air monitoring station.

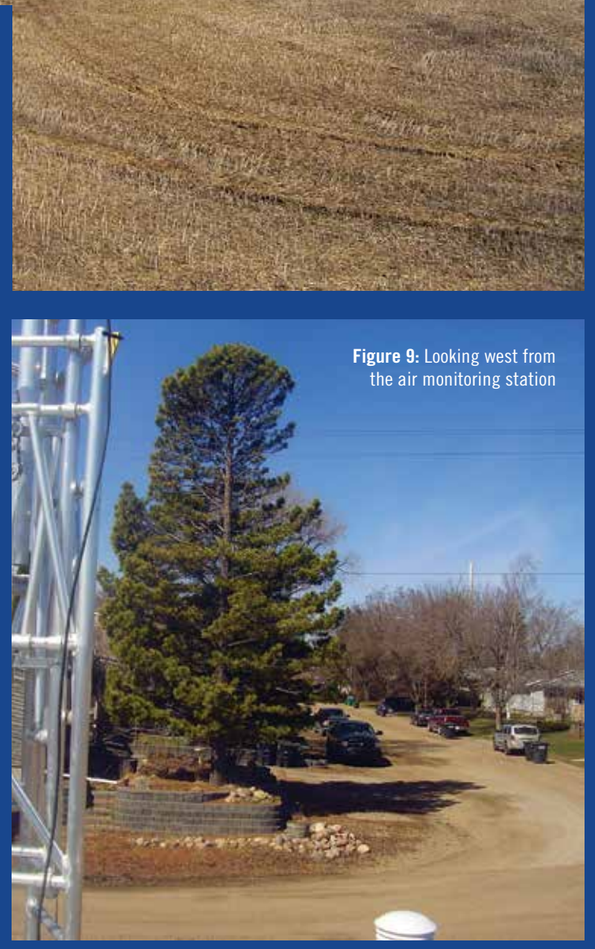


Figure 9: Looking west from the air monitoring station

Bon Accord Station Monitoring Results

Results compared to Alberta Ambient Air Quality Objectives

Alberta Ambient Air Quality Objectives (AAAQOs) are regulatory tools established by the Government of Alberta, under the Alberta Environmental Protection and Enhancement Act. Alberta Environment and Parks (AEP) works with a variety of stakeholders, including other government departments, the scientific community, environmental organizations, industry and the general public to develop and review objectives. AAAQOs provide environmental and human health protection to an extent technically and economically feasible, as well as consider what is socially and politically acceptable. AAAQOs are set well below what are considered emergency levels. Read FAP's **Exceedance Fact Sheet** for more information about AAAQOs.

Table 1 provides details of the exceedances measured and reported at the Bon Accord station including the dates, the number of exceedances of each type and the attribution assigned by FAP.

Table 1: Detail of Exceedances Measured at Bon Accord

Date	Substance	One hour	24 hours	Attribution
May 5, 2018	H_2S	1	-	Nearby wetlands
May 11	H_2S	3	1	Nearby wetlands
May 14	H_2S	2	1	Nearby wetlands
May 16	H_2S	2	-	Nearbywetlands
May 19	H_2S	2	-	Nearby wetlands
May 23	H_2S	2	1	Nearby wetlands
May 27	H_2S	2	1	Nearby wetlands
August 7	$PM_{2.5}$	6	1	Wildfire smoke
August 8	$PM_{2.5}$	7	1	Wildfire smoke
August 9	$PM_{2.5}$	-	1	Wildfire smoke
August 10	$PM_{2.5}$	10	1	Wildfire smoke
August15	$PM_{2.5}$	17	1	Wildfire smoke
August 16	$PM_{2.5}$	6	1	Wildfire smoke
August 17	$PM_{2.5}$	15	1	Wildfire smoke
August 18	$PM_{2.5}$	8	1	Wildfire smoke
August 20	$PM_{2.5}$	-	1	Wildfire smoke
August 21	$PM_{2.5}$	-	1	Wildfire smoke
August 22	$PM_{2.5}$	4	1	Wildfire smoke
August 23	$PM_{2.5}$	-	1	Wildfire smoke
August 25	$PM_{2.5}$	4	1	Wildfire smoke
January 13, 2019	$PM_{2.5}$	-	1	Wintertime inversion
February 13	$PM_{2.5}$	1	1	Multiple sources east of station
February 14	$PM_{2.5}$	5	1	Multiple sources east of station
Total H_2S		**14**	**4**	
Total $PM_{2.5}$		**83**	**16**	

Fine Particulate Matter Results

Fine particulate matter ($PM_{2.5}$) consists of tiny particles that are smaller than 2.5 microns. In comparison, a strand of human hair is about 100 microns in width, meaning that a $PM_{2.5}$ particle is approximately 1/40 the diameter of a human hair. Sources of $PM_{2.5}$ include soil, roads, agricultural dust, vehicles, industrial emissions, smoke from forest fires, cigarettes, household heating, fireplaces and barbecues. Secondary particulate matter may also be produced in the atmosphere through several complex chemical processes involving other substances. Particulates can come from both solid matter and liquid aerosols.

In high concentrations, suspended particulates may lead to human health problems. Inhaling particulate matter can make breathing more difficult or may aggravate existing lung and heart problems. Smaller particles have the ability to travel deep into the lungs where they may cause permanent lung damage.

Higher levels of $PM_{2.5}$ typically occur during winter temperature inversions when air movement is limited, or in the summer months during periods of very warm weather with little or no wind. This is particularly problematic when coupled with smoke from wildfires.

$PM_{2.5}$ is measured and reported in micrograms per cubic meter ($\mu g/m^3$) throughout this report.

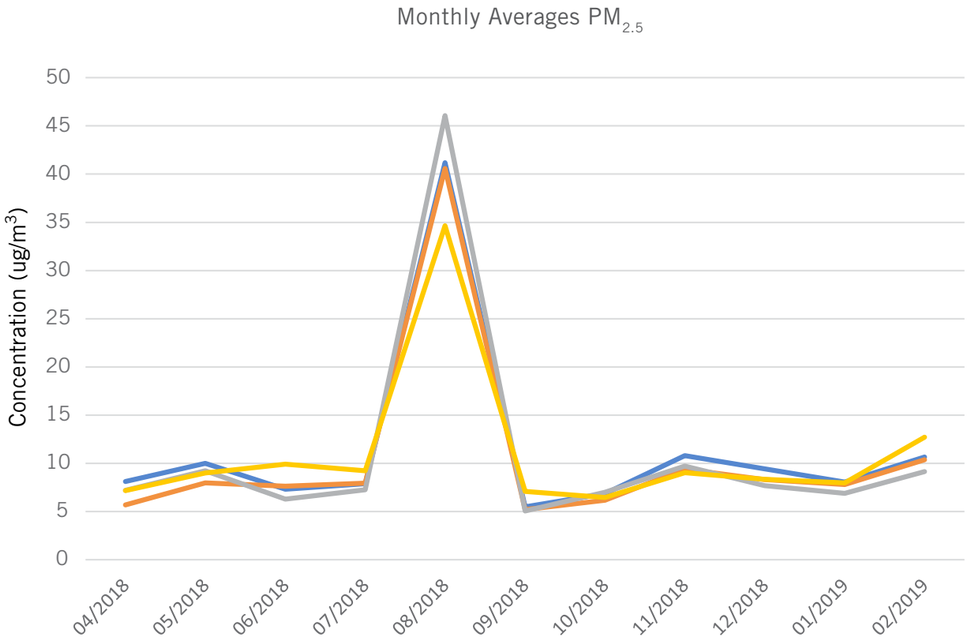
- Alberta has established a 24 hour AAAQO for $PM_{2.5}$ at 30 $\mu g/m^3$.
- Alberta also has a one hour average guideline in place for fine particulate at 80 $\mu g/m^3$.

The highest one hour average $PM_{2.5}$ recorded at the Bon Accord station was 339 $\mu g/m^3$ (approximately four times the one hour guideline). This occurred on August 18, 2018 during wildfire smoke events. Although smoke began to affect $PM_{2.5}$ levels on July 26, the first AAAQO exceedances were recorded on August 7 as heavy smoke from wildfires in British Columbia affected the entire Edmonton Metropolitan Region. This smoke caused elevated $PM_{2.5}$ in the region for much of August and until September 3. There were 77 exceedances of the one hour guideline for $PM_{2.5}$ at the Bon Accord station from August 7-26. On 13 of those 20 days, the 24 hour AAAQO was also exceeded. During that time, similar air quality effects were experienced at all FAP air monitoring stations as well as all stations operated by others in the Edmonton Metropolitan Region.

The highest one hour average measured outside the period of wildfire smoke impact was 198 $\mu g/ m^3$ (almost two and a half times the one hour guideline). This occurred on February 14, 2019 in the afternoon. This event was attributed to multiple regional sources coupled with a meteorological condition called a temperature inversion. This type of inversion occurs when a layer of warm air traps a layer of cold air near the ground. This traps substances such as $PM_{2.5}$, leading to increased levels and, at times, exceedances of AAAQOs. Other stations in FAP and the Edmonton Metropolitan Region also recorded elevated $PM_{2.5}$ measurements that same afternoon. Nighttime levels during the winter months were at times higher than daytime, with the highest one hour measurement (aside from the regional events) occurring during nighttime in December, 2018. However, this measurement only reached 60% of the one hour Alberta Ambient Air Quality guideline of 80 $\mu g/m^3$.

Monthly averages of $PM_{2.5}$ are summarized in **Figure 10**.

Figure 10: $PM_{2.5}$ Monthly Averages from April 2018 to February 2019



Findings Against the Project Objectives

One of the objectives of this project was to address the Town of Bon Accord's concern regarding the potential impact on local air quality from residents burning coal to heat their homes. $PM_{2.5}$ was measured for the 10 month period that the portable was operating in the town.

Figure 11 provides a summary of daily $PM_{2.5}$ averages recorded from April, 2018 to February, 2019. As is indicated on the chart, the impact of the summertime wildfires can clearly be observed during the month of August. The increased $PM_{2.5}$ levels during the month of February correlate with regional temperature inversion events which affected the entire Edmonton Metropolitan Region.

Figure 11: $PM_{2.5}$ Daily Average Seasonal Chart Summer (April to September) vs. Winter (October to February)

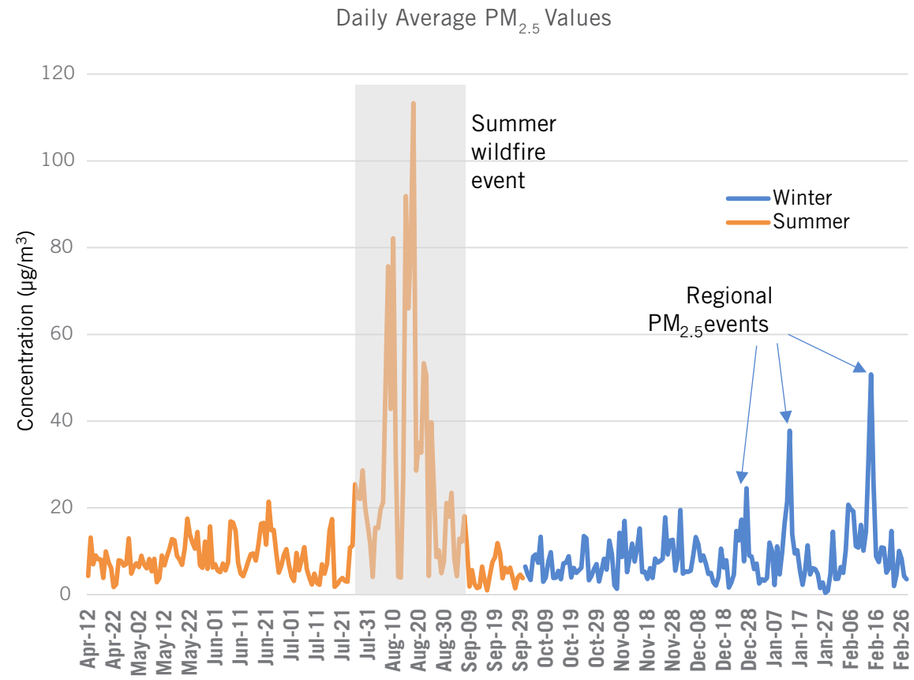


Figure 12 summarizes $PM_{2.5}$ 12 hour averages recorded during the winter months (October, 2018 to February, 2019). The 12 hour averages are separated into daytime (6 am to 6 pm) and nighttime (6 pm to 6 am). If residential coal burning were to have a significant influence on local $PM_{2.5}$ levels during wintertime months, it would be expected that higher 12 hour average $PM_{2.5}$ levels would be recorded overnight. While there is a slightly higher average observed for nighttime measurements (between five and eight µg/m³), substantially higher measurements occurred on event days where regional temperature inversions affected the entire Edmonton Metropolitan region.

Figure 12: $PM_{2.5}$ 12 Hour Averages During the Wintertime Months (October 2018 to February 2019): Daytime (6 AM to 6 PM) and Nighttime (6 PM to 6 AM)

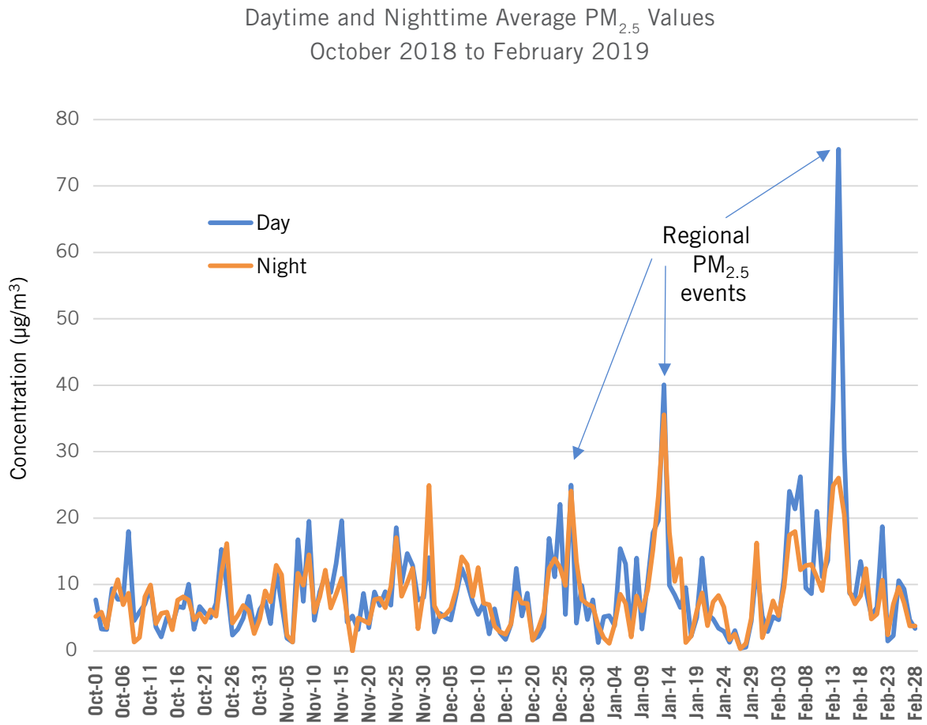


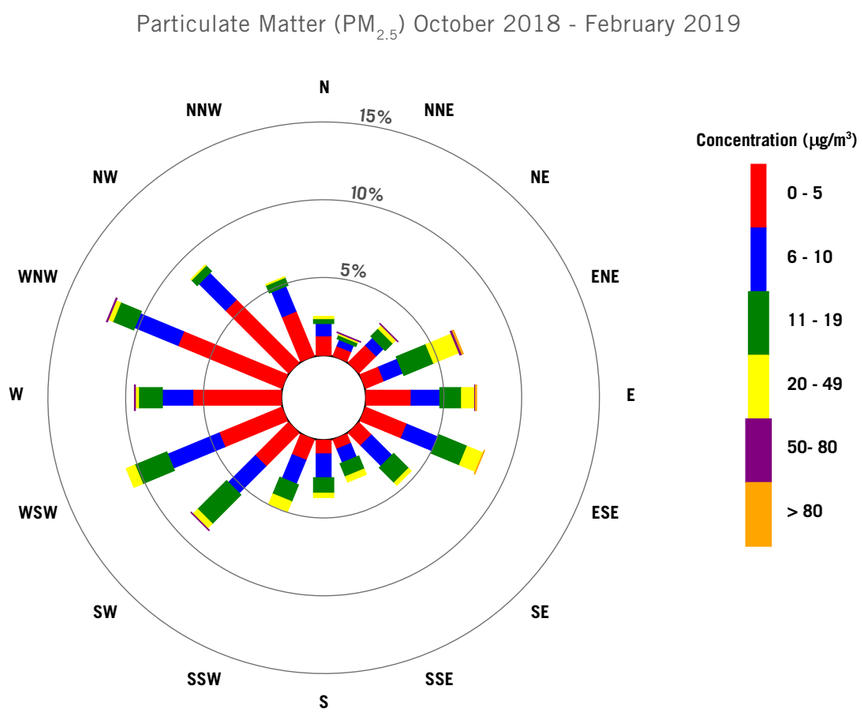
Figure 13 shows daily minimum nighttime temperatures with $PM_{2.5}$ concentrations. The blue dots represent the lowest one hour average temperature overnight while the orange bars show all 12 one hour averages measured during an overnight period. For select days, as the maximum temperatures decrease overnight, $PM_{2.5}$ concentrations increase. This is especially evident in early to mid-February, 2019. Although $PM_{2.5}$ levels increase with decreased temperatures it is not possible to correlate the increased $PM_{2.5}$ with the use of coal burning in homes. The increased levels of $PM_{2.5}$ may be related to an overall increase in all sources of home heating in Bon Accord due to the colder temperatures. Note that the significant peaks in $PM_{2.5}$ recorded on January 14 and February 14 were due to regional temperature inversion events.

Figure 13: $PM_{2.5}$ Nighttime (6PM to 6AM) Minimum Temperatures during the Wintertime Months (October 2018 to February 2019)

Figure 14 plots $PM_{2.5}$ hourly averages against wind direction for the wintertime months (October, 2018 to February, 2019). This chart illustrates the majority of $PM_{2.5}$ measurements (indicated by the longer bars) were recorded when the wind was coming from the west-northwest and west-southwest towards the monitoring station. The highest $PM_{2.5}$ levels (as indicated by the colored scale) were recorded on February 14, 2019 during a temperature inversion event when the wind was from the east-northeast and was observed at other monitoring stations over a larger region. This indicates an influence from sources farther away from the town. Refer to **Figures 4 and 6** which shows the relative location of the station to Bon Accord and NPRI sources within FAP.

There was no definite cause attributed to the slightly higher nighttime $PM_{2.5}$ averages in the winter months. However, if coal burning did influence air quality within Bon Accord it did not lead to $PM_{2.5}$ measurements to exceed the AAAQO. The only AAAQO exceedances occurred during regional air quality events when widespread impact from multiple sources occurred.

Figure 14: $PM_{2.5}$ Pollution Rose for the Wintertime Months



Hydrogen Sulphide Results

Hydrogen sulphide (H_2S) is a colourless gas with a rotten egg odour. Industrial sources of H_2S include fugitive emissions (leaks) from petroleum refineries, tank farms for unrefined petroleum products, natural gas plants, petrochemical plants, sewage treatment facilities and animal feedlots. Natural sources of H_2S include wetlands, swamps and lakes.

H_2S is reported as parts per billion (ppb) throughout this report. Alberta has established the following AAAQOs for H_2S:

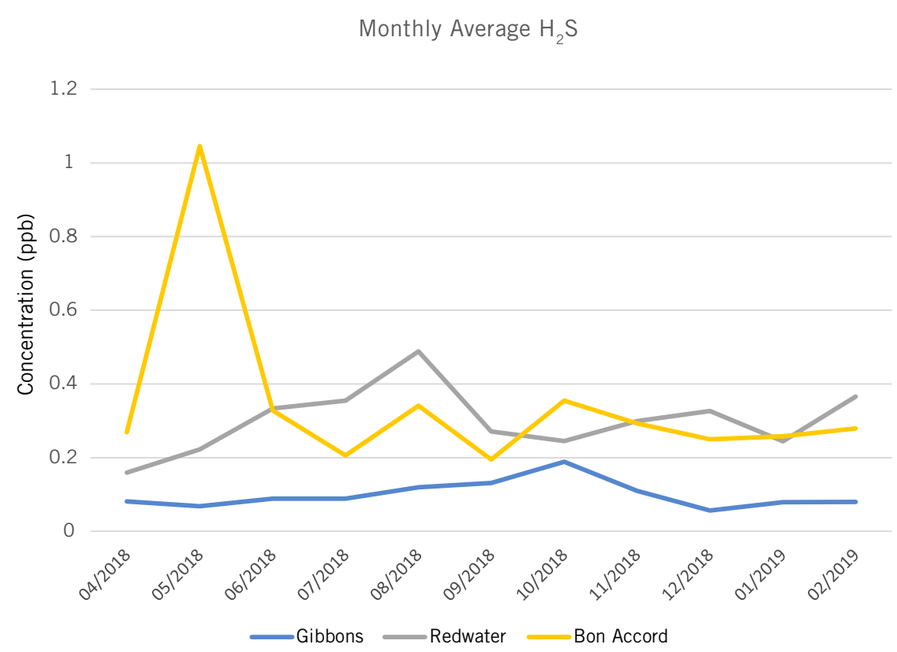
- One hour average concentration = 10 ppb
- 24 hour average concentration = 3 ppb

The highest one hour average H_2S recorded at the Bon Accord station was 50.0 ppb on May 23, 2018 at 6 am. This represents five times the one hour AAAQO. The highest 24 hour average H_2S recorded at the Bon Accord station was 5.27 ppb on May 23. This represents 1.75 times the 24 hour AAAQO.

Both of these exceedances, as well as an additional 12 exceedances of the one hour AAAQO and four exceedances of the 24 hour AAAQO, occurred in May and were attributed to the wetlands near the station.

Figure 15 shows the monthly average concentrations of H_2S at air monitoring stations located in other communities in the FAP network. The data shown is for the time the portable station was active at Bon Accord. The H_2S levels at Bon Accord do not differ substantially from other communities where H_2S is monitored within FAP's airshed except for levels measured in May. There is no H_2S monitoring done at Bruderheim. The measurements in May were elevated above the other stations due to the nearby wetlands. All the monthly averages, with the exception of May, recorded at other stations were within 0.2 ppb of Bon Accord.

Figure 15: H_2S Monthly Averages from April, 2018 to February 2019



**Note: The April average, although shown here, represented less than three weeks of data.*

Hydrogen Sulphide Findings Against Project Objectives

One of the objectives for the project was to assess the odours thought to be released from Bon Accord's sewage lagoon located south of town.

See **Figure 1** for the relative location of the town sewage lagoon. The monitoring station was located 750 metres north of the lagoon, 120 metres north of a small wetland and 30 metres north of one of the Town's sewage lift stations where power was obtained. The lift station is the final pumping station prior to sewage effluent going to the lagoon across Highway 28. The lift station is normally a closed system except during maintenance or on rare occasions when abnormal operation or events require transfer of sewage directly to trucks for disposal elsewhere. There were no such incidents during the 10 month air monitoring project.

The H_2S results and timing characteristics of the elevated H_2S measurements suggests the odours are naturally occurring and a result of the processes from a 13,000 square metre wetland located on the edge of town. The nearest residents are within 50 metres of this pond.

One of the sources of hydrogen sulphide is a natural process that occurs in wetlands. Wetlands serve the important function of collecting organic material and reducing it to usable nutrients. Through this process, bacteria and fungi break down the structural elements of leaves and other materials, creating by-products that either enrich the soil with nutrients or escape in the form of gases. Different types of wetlands house different bacteria and fungi, resulting in different gaseous byproducts.

Rotting materials in the wetland are digested by aerobic bacteria (those that require oxygen). If there is sufficient oxygen, the bacteria will decompose all organic material without producing any odour. However, most wetlands develop stagnant water with a warm layer on top and a cooler layer below. The bottom layer will then run out of oxygen, leading to anaerobic decomposition which produces odours as a by-product (hydrogen sulphide, methane and ammonia).

The top water layer cools when the weather changes seasonally or at nighttime and the ambient air temperature drops. The warmer bottom water layer then rises to the top of the wetland, causing a sulfur or rotten egg odour.

Figure 16: H_2S Day and Nighttime Averages from April to September, 2018

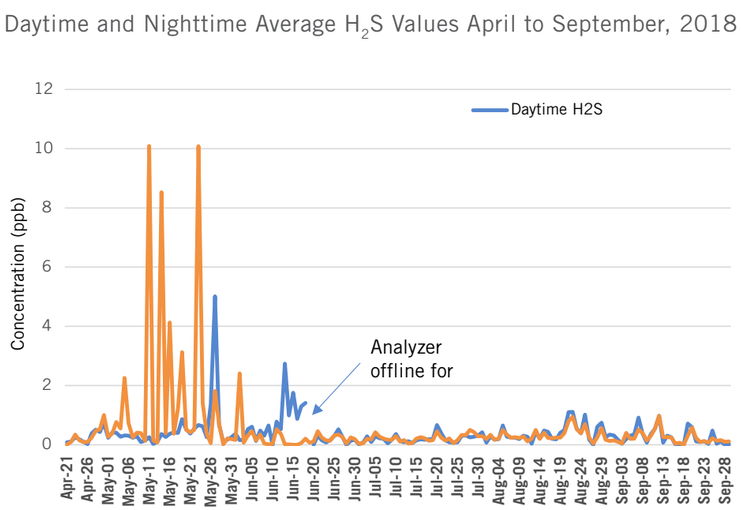


Figure 16 summarizes the data collected for hydrogen sulphide during summer (April to the end of September). Daytime (6 am to 6 pm) levels are highlighted in blue and nighttime (6 pm to 6 am) levels are highlighted in orange. The pattern of increased hydrogen sulphide levels during the nighttime or early morning hours is indicative of anaerobic wetland hydrogen sulphide gas production.

Figure 17 illustrates the pattern of H_2S levels relative to ambient temperature from April to the end of August, 2018. This data shows that hydrogen sulphide levels increased when ambient temperatures began to increase in May until mid to late June. Note the blue bars in both figures 17 and 18 represent the hourly temperatures recorded for each day, with the lowest point on the bar being the minimum temperature and the highest point on the bar being the maximum temperature for that day. Levels again increased in August when daytime temperatures increased. This is again indicative of wetland anaerobic hydrogen sulphide production since warm days coupled with cooler nights (as is the case in early and late summer) increases the chances of the thermal layer turnover in wetland areas.

Figure 17: H_2S Daytime Averages Relative to Ambient Temperature

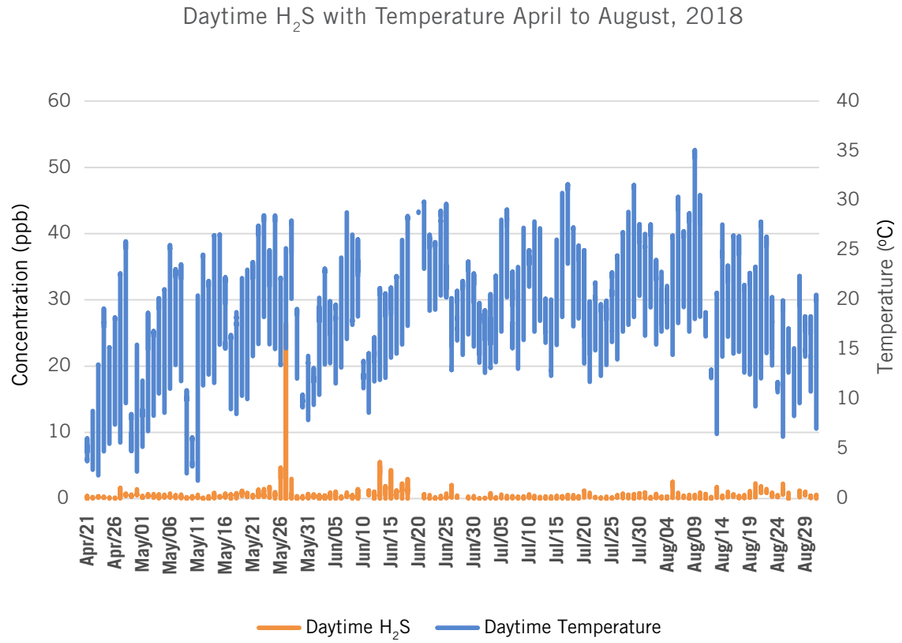


Figure 18 shows the same pattern of H_2S production relative to temperature for nighttime measurements during the summer months. However, the increases in H_2S are more significant and frequent likely due to the thermal layer turnover that generates the release of hydrogen sulphide into the air. This generally occurs in the early morning hours (prior to 6 am).

Figure 18: H_2S Nighttime Averages Relative to Ambient Temperature

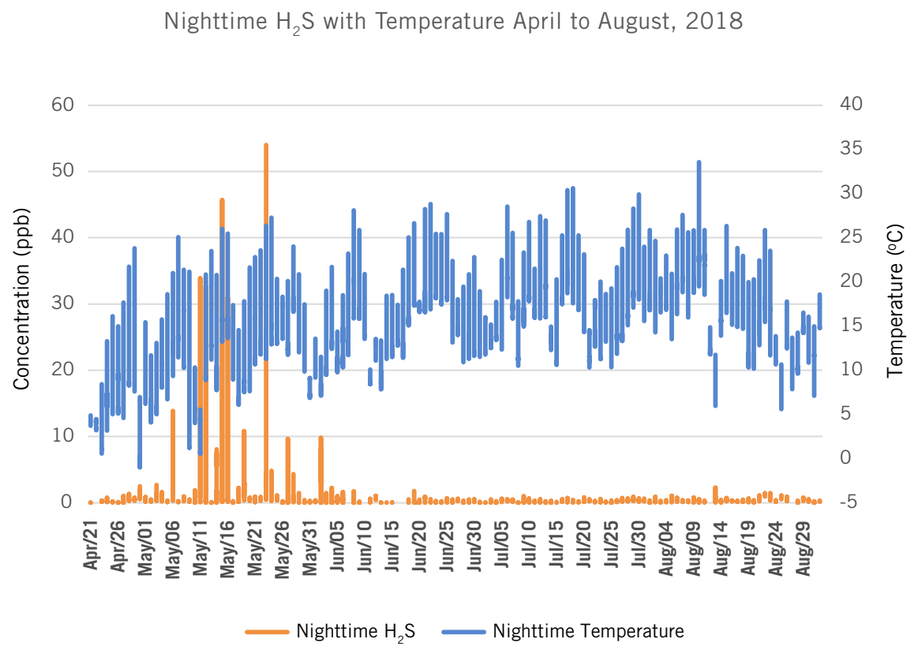
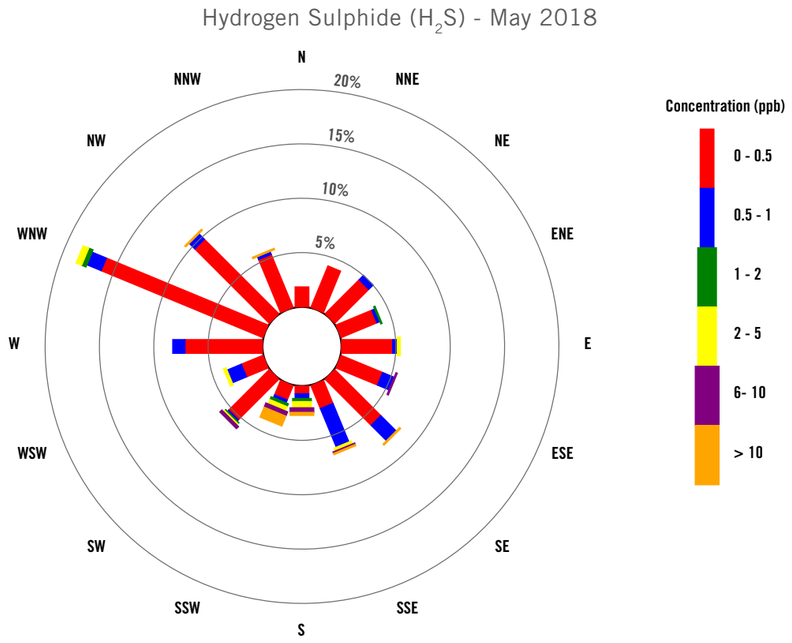


Figure 19 illustrates H_2S concentration levels relative to wind direction for May, 2018. May data was used for this chart since that is the only month when AAAQO exceedances occurred. This comparison of H_2S levels to wind direction shows that while the majority of the H_2S measurements (indicated by the longer bars) occurred when the wind was coming from the west-northwest, the highest concentrations (as indicated by the colored scale) of H_2S were recorded when the wind was coming from a southerly direction.

It should be noted that no correlation could be found between activity at the lift station located near the monitoring station and H_2S levels. This was determined after a review of pump run-time records and maintenance during the times when there were AAAQO exceedances of the H_2S.

Figure 19: H_2S distribution Rose for May 2018



Nitrogen Dioxide Results

Nitrogen Dioxide (NO_2) is a component of nitrogen oxides (NO_x), along with nitric oxide (NO), dinitrogen monoxide (N_2O) and nitrogen pentoxide (NO_5). Most NO in the ambient air will react readily with ozone to form nitrogen dioxide. NO_2 is a reddish-brown gas with a pungent odour and is partially responsible for the brown haze often observed near large cities.

Sources of NO_x in Alberta include transportation, oil and gas industry, natural gas combustion, heating fuel combustion (including home heating) and forest fires.

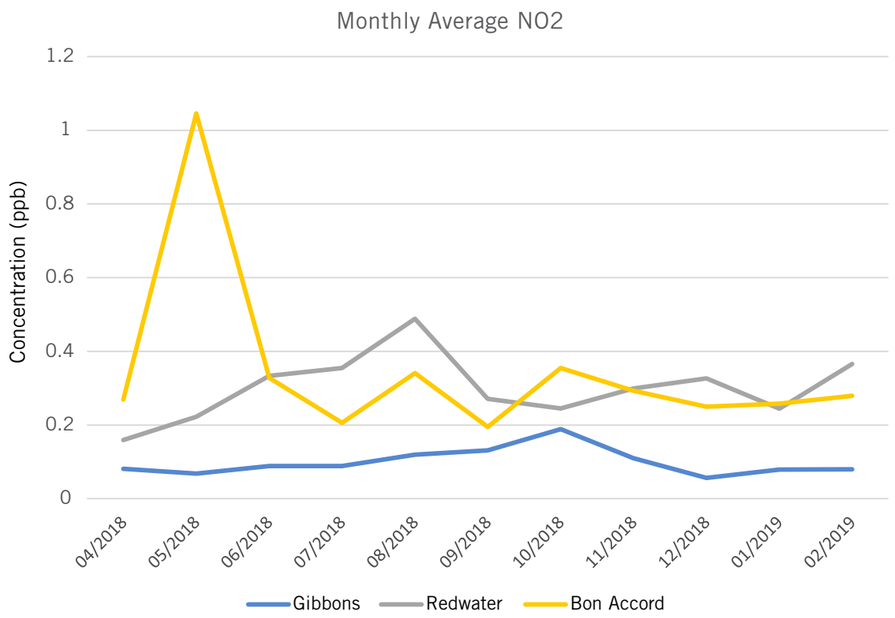
NO_2 is reported as parts per billion (ppb). Alberta has established the following AAAQOs for NO_2:

- One hour average concentration = 159 ppb
- Annual average concentration = 24 ppb

The highest one hour average NO_2 recorded at the Bon Accord station was 49.8 ppb, approximately 31% of the one hour AAAQO. This occurred on February 25, 2019. The station operated for less than nine months in 2018 so there was insufficient data to calculate an annual average.

Figure 20 shows the monthly average concentrations of NO_2 at air monitoring stations located in other communities in the FAP network. The data shown is for the time the portable station was active at Bon Accord. The NO_2 levels at Bon Accord do not differ substantially from levels recorded at other communities within FAP, with all monthly averages being within 10% of Bon Accord.

Figure 20: NO_2 Monthly Averages from April 2018 to February 2019



**Note: The April average, although shown here, represented less than three weeks of data.*

Ozone Results

Unlike other pollutants ozone (O_3) is not emitted directly by anthropogenic (human made) activities. O_3 in the lower atmosphere is produced by a complicated set of chemical reactions involving oxides of nitrogen (NO_x) and volatile organic compounds (VOCs) in the presence of sunlight. Significant natural sources of VOCs in remote and rural areas of Alberta are emissions from trees and vegetation.

O_3 is also transported to the ground from the ozone rich upper atmosphere by natural weather processes. O_3 and substances that form ozone, such as NO_x and VOCs (referred to as ozone precursors), may also be carried from upwind sources such as urban centers and industrial complexes. This phenomenon can be observed in Alberta particularly in summer when warm temperatures (30°C or more), coupled with light winds and abundant sunshine, result in an air quality condition referred to as summertime smog.

O_3 concentrations are generally lower at urban locations than at rural locations due to the destruction of O_3 by nitric oxide (NO) generated by the combustion of fossil fuels, known as ozone scavenging. O_3 levels are usually higher during the spring and summer months because of increased concentrations coming from the upper atmosphere and more sunlight, which leads to more rapid chemical reactions that form O_3.

Clear skies provide ample sunlight, which combined with warm temperatures and a stable air mass, result in summertime smog. These weather conditions are conducive to the formation of secondary pollutants from ozone precursors emitted by multiple sources both small and large in the Edmonton Metropolitan Region. This smog takes some time to form and is often experienced dozens of kilometres downwind of the urban core.

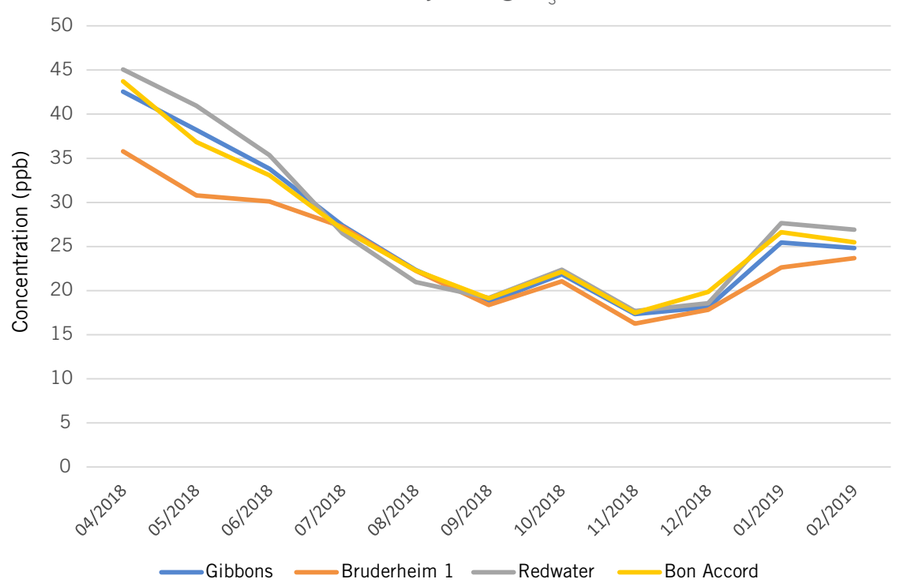
At normal outdoor concentrations, O_3 is a colourless, odourless gas. However, O_3 does have a characteristically sharp 'very fresh air' odour at very high concentrations, such as that experienced immediately after lightning storms. O_3 is reported as parts per billion (ppb).

At the time this project was completed, Alberta had an established one hour daily AAAQO for ozone at 82 ppb. However, in April, 2019 this AAAQO was reduced to 76 ppb. The comparisons in this report are made to the 82 ppb AAAQO in effect at the time the ozone measurements were recorded.

The highest one hour average ozone recorded at the Bon Accord station was 95 ppb, approximately 115% of the one hour AAAQO. This occurred on August 9, 2018. Higher results were also observed at several FAP stations.

Figure 21 shows the monthly average concentrations of O_3 at air monitoring stations located in other communities in the FAP network. The data shown is for the time the portable was active at Bon Accord. As mentioned above O_3 tends to be higher in springtime than at other times of the year. This is reflected in the results. Bon Accord exhibits similar levels and trends in O_3 measurements to other FAP community stations. Monthly averages at three other community FAP stations were within 10% of Bon Accord except for three months at Bruderheim and one month at Redwater. The largest difference to another station was the May, 2018 average where Bruderheim reported a 16% lower O_3 measurement compared to Bon Accord.

Figure 21: O_3 Monthly Averages from April 2018 to February 2019



**Note: The April average, although shown here, represented less than three weeks of data.*

Sulphur Dioxide Results

Sulphur dioxide (SO_2) is a colourless gas with a pungent odour. In Alberta, natural gas processing plants are responsible for close to half of the SO_2 emissions in the province. Sources of SO_2 in the Airshed are primarily industrial, from both within and outside FAP's boundaries. SO_2 is reported as parts per billion (ppb).

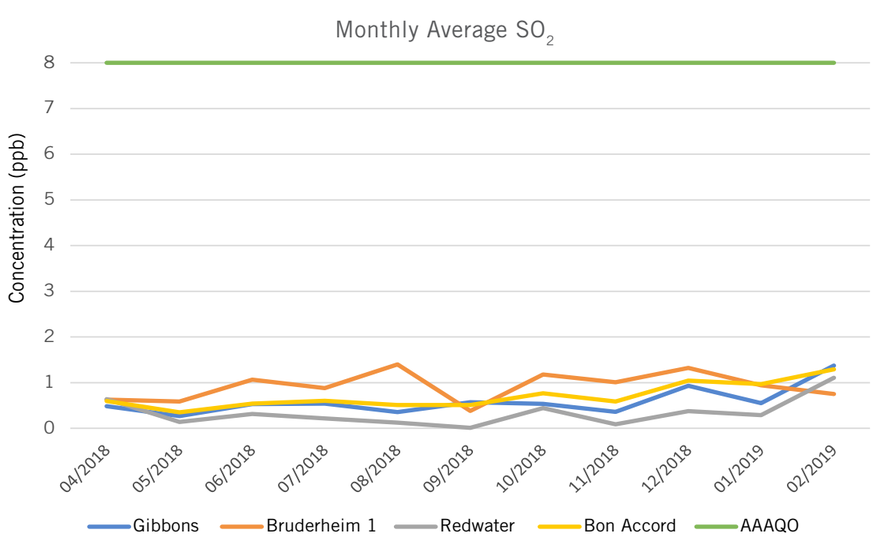
Alberta has established the following AAAQOs for SO_2:

- One hour average concentration = 172 ppb
- 24 hour average concentration = 48 ppb
- 30 day average concentration = 11 ppb
- Annual average concentration = 8 ppb

The highest one hour average SO_2 recorded at the Bon Accord station was 35.6 ppb on July 3, 2018. This represents 20.6% of the one hour AAAQO. The highest 24 hour average SO_2 recorded at the Bon Accord station was 4.4 ppb on February 15, 2019. This represents 9% of the 24 hour AAAQO. The highest monthly (30 day) average SO_2 recorded at the Bon Accord station was 1.3 ppb in February, 2019. This represents 12% of the 30 day AAAQO. The station operated for less than nine months in 2018 so there was insufficient data to calculate an annual average.

Figure 22 shows the monthly average concentrations of SO_2 at air monitoring stations located in other communities in the FAP network. The data shown is for the time the portable station was active at Bon Accord. Bon Accord SO_2 concentrations generally trend with that of other community stations in FAP. However, concentrations in Bon Accord were higher than Gibbons and Redwater during the fall and winter months. It is expected there will be some variability from month to month since the recorded concentrations were low. While the February, 2019 monthly average was 12% of the monthly AAAQO, all other months were less than 10% of the monthly objective.

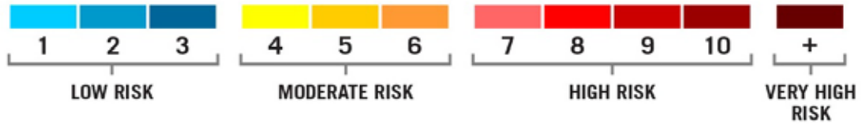
Figure 22: SO_2 Monthly Averages from April 2018 to February 2019



**Note: The April average, although shown here, represented less than three weeks of data.*

Results vs. Air Quality Health Index

The Alberta Government calculates an Air Quality Health Index (AQHI) using hourly measurements of fine particulate matter, ozone and nitrogen dioxide in the air. Alberta has augmented the national AQHI formulation to better account for rapidly changing air quality and to include additional pollutants (namely hydrogen sulphide, sulphur dioxide and carbon monoxide). The AQHI is a tool that helps people understand what the local outside air quality means to their health using a scale from one to 10. The lower the number, the lower the health risk. An **outdoor activity recommendation** corresponds to each risk category.



Seven of FAP's continuous air monitoring stations provide data on substances required by the provincial and federal governments to calculate and forecast an AQHI for the region. Daily and forecast ratings are updated every three hours. While the daily rating is based on what is occurring at individual stations, the forecast is a regional prediction of the average concentration of monitored substances at FAP stations.

The AQHI is designed as a communications tool. It is not used by environmental managers to monitor and measure long-term trends in air quality or to assign management actions.

During the 10 month period that FAP operated the portable station in Bon Accord, an AQHI was calculated in the same manner as is done for the rest of the FAP Airshed. The results compared to other community stations operated by FAP are summarized in **Figure 23**.

Figure 23: Percentage of Time in Each AQHI Risk Category at FAP Community Stations

Bon Accord, like all the community stations in FAP, recorded low risk to health AQHI ratings for the vast majority of the project. Bon Accord was in the low risk category 90.1% of the time, a slightly higher percentage than the three FAP community stations used for comparison in this report. The 79 hours of high risk and 12 hours of very high risk accounted for less than 2% of the total time that the portable was in operation. All but seven of these hours were due to the long-range transport of smoke into the region from wildfires in British Columbia. All other community stations in FAP were similarly affected.

The seven hours of high risk AQHI not due to wildfire smoke in August occurred in mid-February, 2019. This was the result of the cumulative impact from multiple sources predominately east of the station, coupled with temperature inversion conditions. See **Figure 5** for the relative position of the possible influencing sources.

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