Chipman PORTABLE MONITORING STATION Project

Air Quality Monitoring Report | October 2020

Fort Air Partnership

We Monitor the Air You Breathe

Executive Summary

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. FAP operates a portable air quality monitoring station (also referred to as 'the portable') that can be sited throughout the FAP region, as well as outside FAP boundaries (if necessary as per FAP's site selection matrix criteria), to monitor ambient air quality. The portable station was located in the Village of Chipman where it collected air quality measurements from June 1, 2019 to May 31, 2020.

Factors that led to the selection of Chipman as a location for the station included the village being a populated area that had no continuous monitoring done in its immediate vicinity previous to this project, and an interest in the possible impacts of Alberta's Industrial Heartland on local air quality that was brought to the attention of FAP by the village. This location was also selected because Chipman is on the eastern border of FAP and would provide a good representation of the air quality leaving the FAP Airshed when winds are from the western quadrant.

Since the Air Quality Health Index (AQHI) is a measurement of air quality as it pertains to human health, substances monitored for during this project were included as a standard suite of parameters for a community AQHI station:

- **Particulate Matter** - Chipman had the lowest monthly $PM_{2.5}$ averages for the majority of the project term.
- **Nitrogen Dioxide** - NO_2 levels at Chipman were generally lower than levels recorded at other communities within FAP during the wintertime period but were otherwise very similar to other stations in the region.
- **Ozone** – O_3 levels at Chipman did not differ substantially from levels recorded at other communities within FAP, with all monthly averages being within 3 parts per billion (ppb) of those recorded at Chipman.
- **Sulphur Dioxide** - SO_2 levels at Chipman did not differ substantially from levels recorded at other communities within FAP, with all monthly averages being within 0.8 ppb of the averages recorded at Chipman. There was some variability from month to month as can be expected with such low concentrations.
- **Hydrogen Sulphide** – H_2S levels at Chipman did not differ substantially from other communities where H_2S is monitored within FAP's Airshed.

Data collected during the 12-month Chipman project was used to calculate an AQHI, as is done at other community stations within FAP. Chipman was in the low risk category 98.6% of the time, a slightly better percentage than the four other FAP community stations used for comparison in this report. Less than two per cent of time the AQHI was in the moderate risk category. These occurred predominately during wintertime inversion conditions experienced across the region in January and February of 2020. There were no high or very high-risk hours recorded at Chipman during the project term.

These results indicate that air quality Chipman residents experience is of low risk to health the vast majority of the time, and even more so than other communities located near Alberta's Industrial Heartland.

In order to assess the difference between air quality measurements on the west side of the Airshed with the east side, wind direction plots for $PM_{2.5}$, NO_2 and SO_2 were created for Gibbons (west side of FAP) and Chipman (east side of FAP). Slightly more measurements of fine particulate matter were recorded at levels above 30 micrograms per cubic metre (µgr/m^3) at Gibbons than at Chipman. Gibbons also recorded somewhat higher concentrations of NO_2 than at Chipman when winds had a westerly component, suggesting influence from outside of FAP's Airshed.

Higher concentrations of SO_2 were recorded more frequently at Chipman than Gibbons while winds had a northwest component suggesting influence from sources within FAP's boundaries. However, these measurements did not exceed 10 ppb, which is less than 6% of the one-hour Alberta Ambient Air Quality Objective (AAAQO).

Regional events such as wildfires and wintertime temperature inversions affected air quality in Chipman similarly to other communities throughout the FAP region, albeit at a slightly lower level. The particulate matter exceedances recorded on June 1, 2019 and January 25, 2020 both occurred during events that affected the entire FAP region (in the case of the June 1 exceedance most of the province was affected). The small number of air quality events monitored during the Chipman project were not enough to definitively conclude the influence of regional events on Chipman relative to other communities in FAP.

Table of Contents

List of Figures and Tables

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, 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 approximately equal one ppb. FAP has developed a documented process to select sites for the portable station.

Project Description

Project Objectives

The objectives of the Chipman portable station ambient air monitoring project are to monitor and record air quality data to:

- Characterize the air quality Chipman residents experience.
- Determine the possible influence from sources in Alberta's Industrial Heartland on ambient air quality in and around Chipman.
- Determine the possible effects of regional air quality events such as inversions and summertime smog on ambient air quality in and around Chipman.
- Compare air quality in Chipman with that of other communities of similar size in the FAP Airshed, such as Bruderheim, Gibbons and Redwater. Although not a similar size community, data from the Fort Saskatchewan station is shown in the plots in this report for comparison purposes.

Figure 1: Exterior photo of the Portable Air Monitoring Station

Figure 2: Interior photo of the Portable Air Monitoring Station.

Station Location

In September 2018, a sub-committee of FAP's Technical Working Group (TWG) followed the site selection process to identify Chipman among several candidate locations as the next site for the portable station. This recommendation was subject to finding a suitable location to place the shelter. The Village of Chipman had the highest ranking in the assessment for a number of reasons:

- There has been no continuous monitoring done in the immediate vicinity of Chipman prior to this project. The nearest continuous air monitoring station is in Lamont County, located approximately 17 kilometres from the Chipman site.
- Chipman is on the eastern border of the FAP Airshed and would provide a good representation of the air quality leaving the Airshed when winds are from the western quadrant.
- A specific question regarding the impact of industrial development on air quality in the Village of Chipman was brought forward to FAP, which resulted in a request for air quality monitoring.

Village of Chipman Information

- The Village of Chipman is located in the southeast corner of the FAP Airshed. The village touches the Airshed border, but the developed portion of the village lies predominately outside of it.
- There was interest expressed by the Village of Chipman to assess whether there was any impact on local ambient air quality from Alberta's Industrial Heartland.
- The nearest continuous monitoring stations are FAP's Elk Island and Lamont County stations, which are located approximately 15 and 17 kilometres away respectively.
- The village population recorded during the last census was 274.

Site Chosen

Figure 3 shows the site for the portable monitoring station at the Batiuk Water Commission pump booster station located at 5241-48 street on the east edge of Chipman along Range Road 185.

Project 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 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. FAP's **Exceedance Fact Sheet** provides more information about AAAQOs.

Table 1 provides details of the AAAQO exceedances measured and reported at the Chipman site including the dates, the number of exceedances of each type and the attribution assigned by FAP and submitted to AEP.

Table 1: Detail of Exceedances Measured at Chipman

Date	Substance	One hour	24 hours	Attribution
June 1, 2019	$PM_{2.5}$	-	1	Wildfire smoke
July 16, 2019	H_2S	1	-	Wetlands/natural Source
Jan 25, 2020	$PM^{2.5}$	-	1	Wintertime inversion

May 30, 2019 saw the highest $PM_{2.5}$ levels ever recorded, both across the FAP Airshed and in Alberta. This was due to the long-range transport of wildfire smoke from other parts of Alberta and British Columbia. This event caused the 24-hour $PM_{2.5}$ exceedance on June 1, 2019.

The July 16 H_2S exceedance was attributed to natural causes from wetlands in the area, specifically Redwater Creek. The creek is located just over 200 metres east of the portable and by midsummer had only a slow-moving flow. 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.

Rotting materials in wetlands 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 sulfide, 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 sulphur or rotten egg odour. Slow moving creeks and streams, as well as stagnant pools of water, are known to be H_2S sources through this natural process.

The January 25, 2020 $PM_{2.5}$ exceedance was attributed to a meteorological condition known as a wintertime inversion. This weather condition occurs in very low wind where a stable layer of cold air near the earth's surface is trapped by a layer of warmer air aloft, effectively trapping pollutants at ground level. This will often result in increased levels of $PM_{2.5}$.

Table 2 below shows all the instances where an exceedance of an AAAQO occurred in communities across FAP while the portable was in Chipman.

Table 2: Exceedances in FAP communities (June 2019 to May 2020)

AIR QUALITY EVENT DATES	SUB-STANCE	Bruderheim 1 Hour	Bruderheim 24 Hour	Chipman 1 Hour	Chipman 24 Hour	Fort Saskatchewan 1 Hour	Fort Saskatchewan 24 Hour	Gibbons 1 Hour	Gibbons 24 Hour	Redwater 1 Hour	Redwater 24 Hour	AIR QUALITY EVENT CAUSE
June 1, 2019	$PM_{2.5}$		1		1		1	1	1	4	1	Wildfire Smoke
June 7, 2019	$PM_{2.5}$								1			Wildfire Smoke
June 8, 2019	$PM_{2.5}$					3		2		3		Wildfire Smoke
July 16, 2019	H_2S			1								Wetlands / natural source
July 16, 2019	H_2S									3	1	Local Industry
Sept. 18, 2019	H_2S									1		Undetermined
Nov. 3, 2019	$PM_{2.5}$							1				Undetermined
Dec. 9, 2019	H_2S									1		Undetermined
Jan. 25, 2020	$PM_{2.5}$		1		1		1		1		1	Wintertime Inversion
Jan. 26, 2020	$PM_{2.5}$						1				1	Wintertime Inversion
Jan. 27, 2020	$PM_{2.5}$								1			Multiple sources east of station
Jan. 28, 2020	$PM_{2.5}$						1		1			Wintertime Inversion
Jan. 29, 2020	$PM_{2.5}$						1					Wintertime Inversion
Apr. 24, 2020	$PM_{2.5}$					1						Undetermined
TOTAL HOURS	H_2S			1						5	1	7
	$PM_{2.5}$		2		2	4	5	4	5	7	3	32

At the FAP community stations, there were a total of 21 exceedances of a one-hour AAAQO and 18 instances where a 24-hour AAAQO was exceeded. All FAP stations measured $PM_{2.5}$ exceedances during the June 2019 wildfire event. In addition to the one exceedance caused by wildfire smoke at Chipman, the station only measured two additional exceedances out of a total of 39 among all community stations in FAP during the 12-month project; a one-hour H_2S due to nearby wetlands and a 24-hour $PM_{2.5}$ exceedance, experienced across FAP due to wintertime inversion conditions.

Results Compared Against the Project Objectives

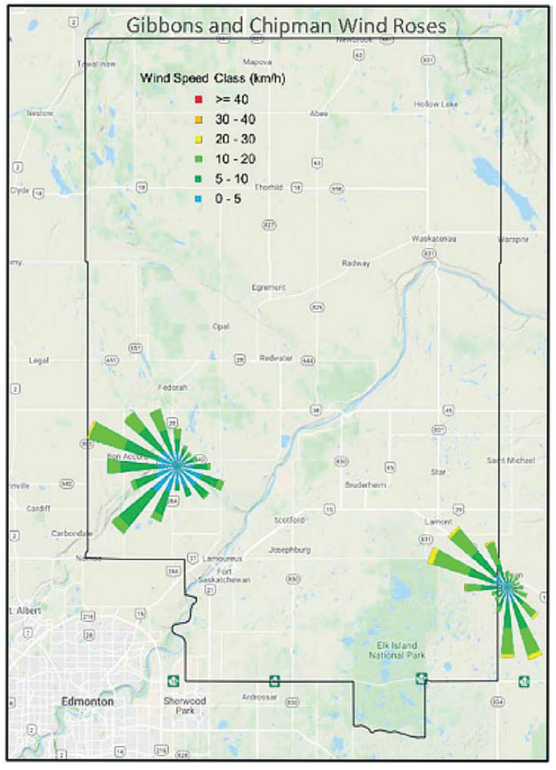
Possible influence of Alberta's Industrial Heartland on Chipman Air Quality

Figures 4 to 7 show plots superimposed on a map of the FAP Airshed. The plots, known as roses, are shown for two of FAP's continuous monitoring stations; Gibbons near FAP's western boundary and the portable station just off FAP's eastern boundary. All plots summarize the measurements taken from June 1, 2019 to May 13, 2020 at the two stations.

Figure 4 shows a wind rose which depicts the directions the wind was blowing from. Figures 5 through 7 show the results for $PM_{2.5}$, NO_2, and SO_2 respectively.

A note on reading rose plots: The colours break down the concentration into six categories, with blue representing the lowest concentration and red the highest concentration, or in the case of the wind rose, wind speeds. The concentrations shown in red are those that would exceed the applicable AAAQO. The length of each 'arm' represents the number of one-hour averages in that category. The longer the arm, the greater number of measurements logged in that category.

Figure 4: Wind Roses for Chipman and Gibbons



The plots show the greatest number of one-hour average measurements tended to be with a northwest component in the wind direction for the stations in both Chipman and Gibbons. Measurements at Chipman were dominated by the west-northwest and northwest wind directions. The largest portion of measurements at Gibbons was also from those two directions.

Figure 5: Particulate Matter ($PM_{2.5}$) Pollutant Rose

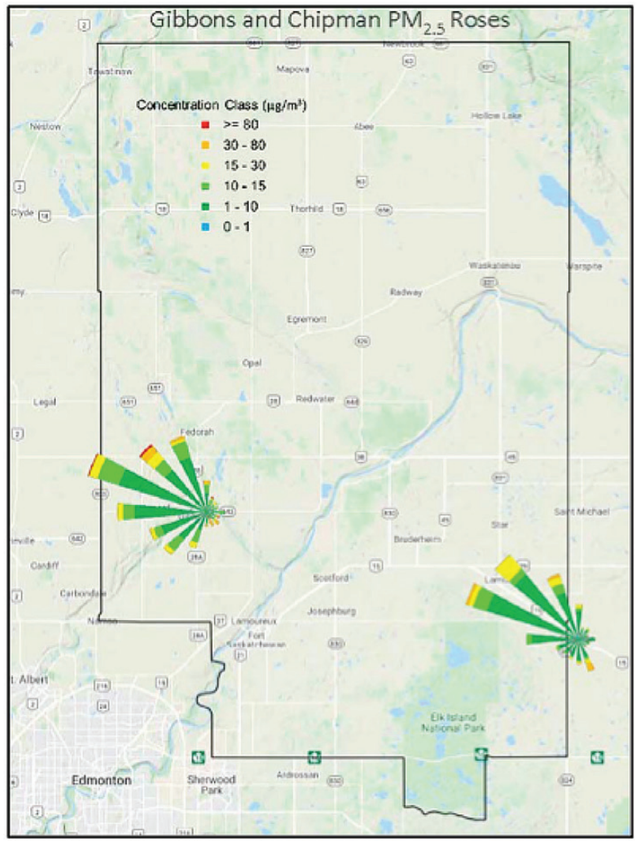


Figure 5 shows slightly more measurements of $PM_{2.5}$ were recorded at levels above 30 µg/m³ at Gibbons than at Chipman.

Figure 6: Nitrogen Dioxide (NO_2) Pollutant Rose

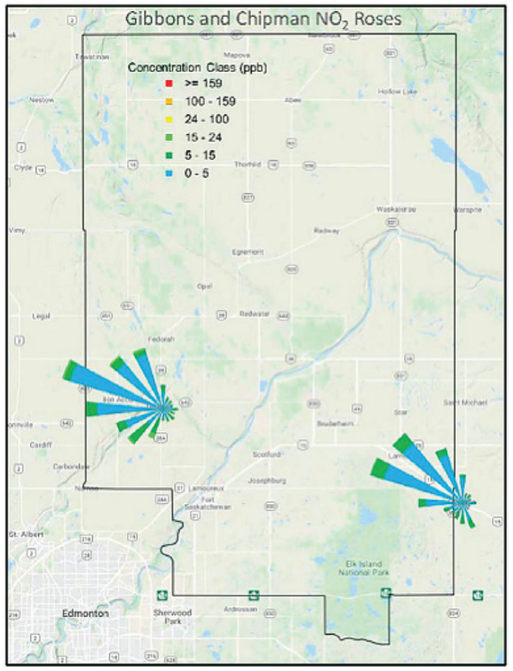
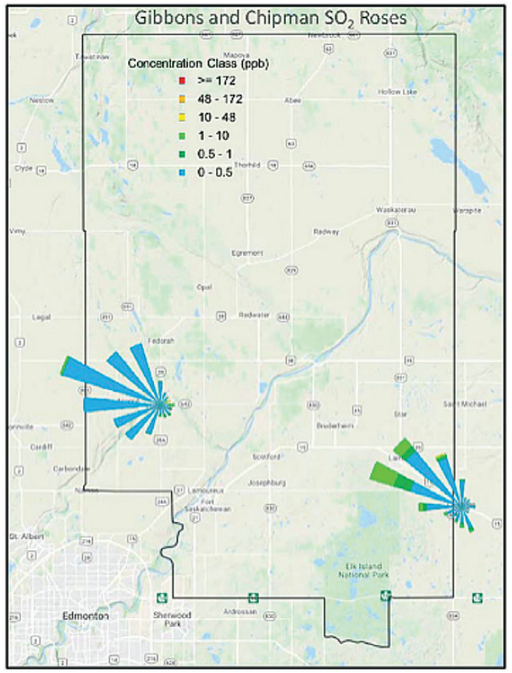


Figure 7: Sulphur Dioxide (SO_2) Pollutant Rose



Gibbons also recorded somewhat higher concentrations of NO_2 than at Chipman when winds had a westerly component, as shown in **Figure 6**, suggesting influence from outside of FAP's Airshed.

Figure 7 shows higher concentrations of SO_2 were recorded more frequently at Chipman than Gibbons while winds had a northwest component, suggesting influence from sources within FAP's boundaries. However, these measurements did not exceed 10 ppb, which is less than 6% of the one-hour AAAQO.

Results by Substance

The following section describes the results examining each compound measured by the portable station while at Chipman. Plots are provided showing measurements recorded at continuous stations located within communities in the FAP Airshed. Not all continuous stations measure the same set of compounds. For instance, other than at the portable, fine particulates are measured at four community stations, while hydrocarbons are only measured at two. The data shown in each plot covers the period June 1, 2019 to May 31, 2020, the time the portable was active at Chipman.

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, wildfire smoke, 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 29 $\mu g/ m^3$.
- 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 Chipman station was 65 $\mu g/m^3$ and occurred on June 1, 2019 as the wildfire event at the end of May 2019 was ending and station reporting began. There were no exceedances of the one-hour guideline for $PM_{2.5}$ at the Chipman station.

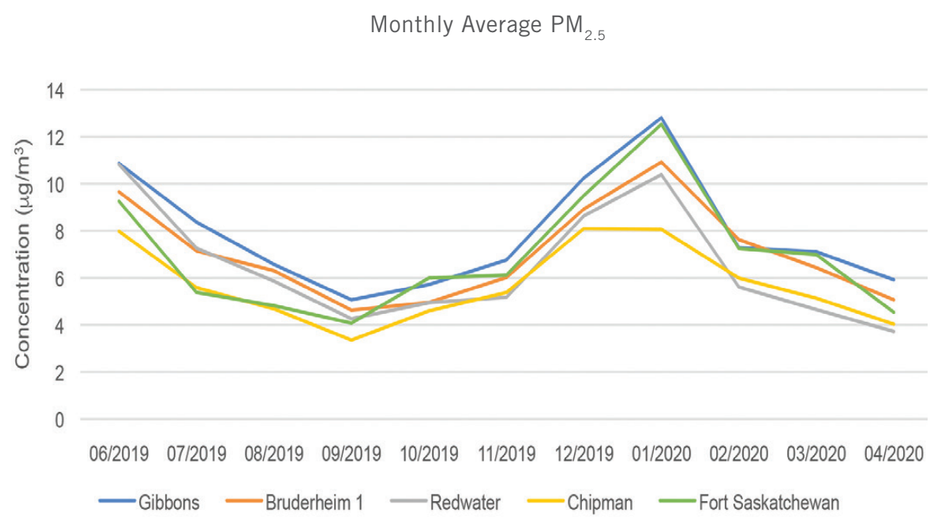
The highest one-hour average measured outside the period of wildfire smoke impact was 60 $\mu g/m^3$ (less than the one-hour guideline of 80 $\mu g/m^3$). This occurred the morning of January 25, 2019. This event was attributed to multiple sources throughout the region, coupled with a wintertime temperature inversion. Other stations in FAP and the Edmonton Metropolitan Region also recorded elevated $PM_{2.5}$ measurements that same afternoon.

There were two 24-hour $PM_{2.5}$ exceedances during the time the portable station was operated at the Chipman site:

- June 1, 2019 – attributed to long-range transport of wildfire smoke from other parts of Alberta and British Columbia. During that time, similar air quality effects were experienced at all FAP air monitoring stations as well as most stations operated by others throughout Alberta.
- January 25, 2020 - attributed to a wintertime inversion.

Figure 8 shows the monthly average concentrations of $PM_{2.5}$ at Chipman and other air monitoring stations located in communities in the FAP network. Chipman had the lowest monthly $PM_{2.5}$ averages for the majority of the project term.

Figure 8: Particulate Matter ($PM_{2.5}$) Monthly Averages from June 2019 to May 2020



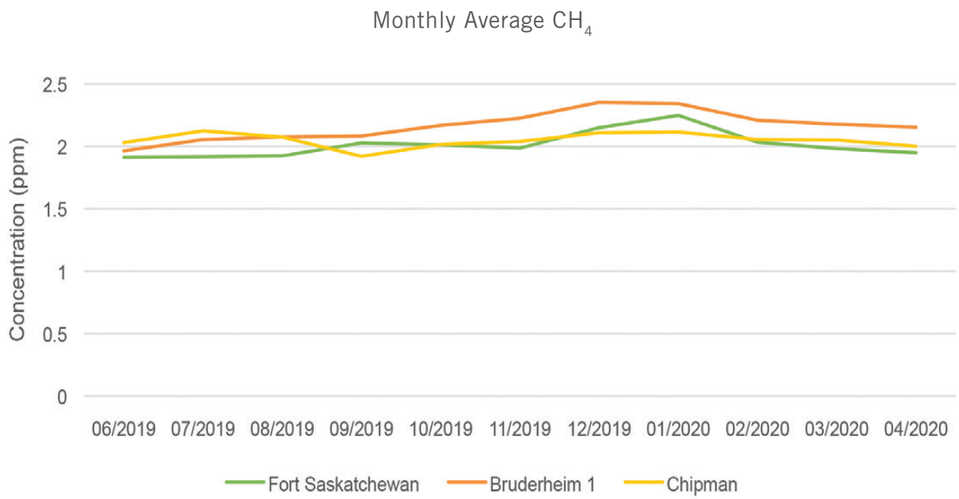
There is evidence in the $PM_{2.5}$ monitoring data that road dust from Range Road 185, located approximately 60 metres west of the monitoring station, had an effect on the $PM_{2.5}$ levels monitored during the project timeframe, particularly during dry weather and dusty road conditions. However, despite this local influence during the summer months, the Chipman station recorded lower monthly $PM_{2.5}$ averages than other community stations in the FAP Airshed.

Hydrocarbon Results

Total hydrocarbons (THC) refer to a broad family of chemicals that contain carbon and hydrogen atoms. Total hydrocarbons are the sum of non-reactive and reactive hydrocarbons.

The major non-reactive hydrocarbon in the atmosphere is methane. Major worldwide sources of atmospheric methane include wetlands, ruminants such as cows, energy use, landfills and burning biomass such as wood. Methane is the primary component of natural gas. Monthly average methane levels for Chipman and other communities throughout the network are illustrated in **Figure 9**.

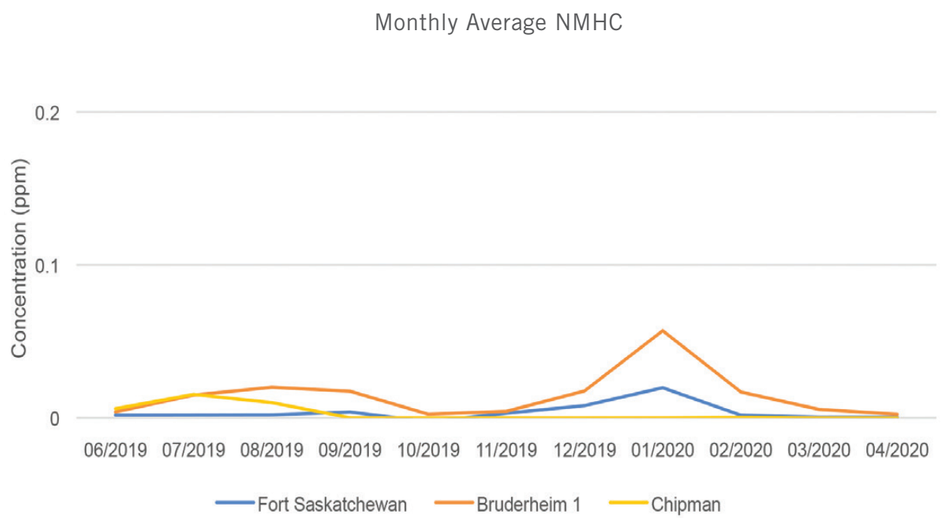
Figure 9: Methane (CH_4) Monthly Averages from June 2019 to May 2020



The reactive (or non-methane) hydrocarbons consist of many volatile organic compounds (VOCs), some of which react with oxides of nitrogen in the atmosphere to form ozone. FAP measures a group of these non-methane or VOC hydrocarbons at one station. These are detailed later in this section under Volatile Organic Compounds. While Alberta does not have ambient air quality objectives (AAAQO) for total hydrocarbons, methane or non-methane hydrocarbons, the oxidation of hydrocarbons in the atmosphere contributes to an increased amount of nitrogen oxides and ozone, which do have objectives. Additionally, there are objectives for specific reactive hydrocarbons such as benzene, toluene, ethylbenzene, xylenes, styrene and ethylene.

Figure 10 shows the monthly average concentrations of non-methane hydrocarbons (NMHC) at Chipman and other community air monitoring stations in the FAP network. Chipman had among the lowest levels of non-methane hydrocarbons in the network.

Figure 10: Non-Methane (NHMC) Monthly Averages from June 2019 to May 2020



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:

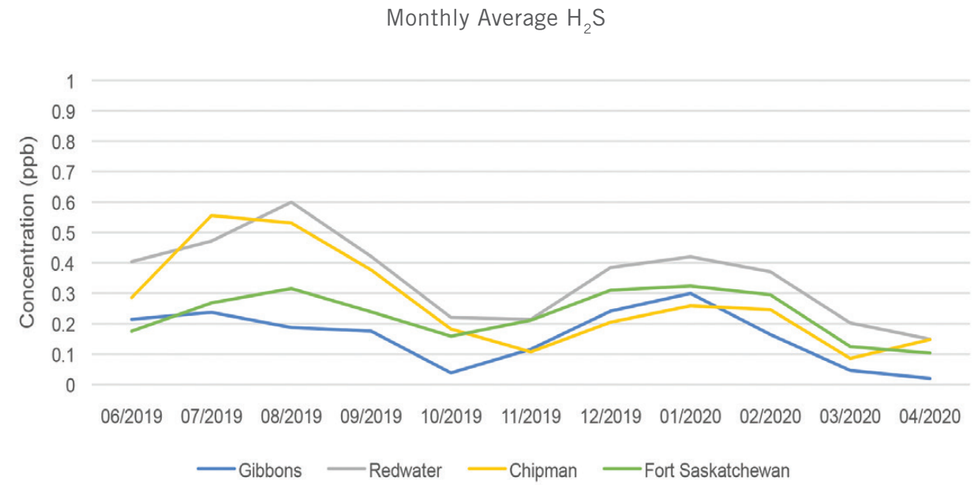
- The one-hour average concentration at 10 ppb.
- The 24-hour average concentration at 3 ppb.

The highest one-hour average H_2S recorded at the Chipman station was at 3:00 a.m. on July 16, 2019 at 14.2 ppb, which represents 1.4 times the one-hour AAAQO. This exceedance was attributed to a natural source from wetlands in the area, namely Redwater Creek. Located just over 200 metres due east of the monitoring station, the creek by midsummer had only a slow-moving flow.

There were no exceedances of the 24-hour AAAQO. The highest 24-hour average H_2S recorded at the Chipman station was 2.32 ppb on July 16, 2019. This represents 76% of the 24-hour AAAQO.

Figure 11 shows the monthly average concentrations of H_2S at Chipman and other air monitoring stations located in communities in the FAP network. The H_2S levels at Chipman do not differ substantially from other communities where H_2S is monitored within FAP's Airshed. All the monthly averages recorded at other stations varied less than one ppb from those recorded at Chipman.

Figure 11: Hydrogen Sulphide (H_2S) Monthly Averages from June 2019 to May 2020



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.

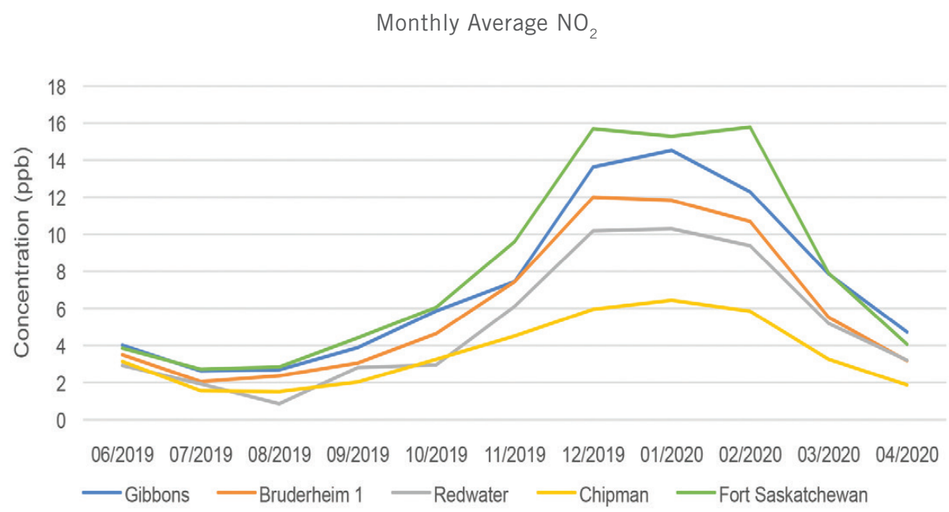
NO_2 is reported as parts per billion (ppb). Alberta has established the following AAAQOs for NO_2:

- One-hour average concentration at 159 ppb.
- Annual average concentration at 24 ppb.

The highest one-hour average NO_2 recorded at the Chipman station was 32.0 ppb, approximately 20% of the one-hour AAAQO. This occurred on January 15, 2019. The station operated for less than nine months in each of 2019 and 2020 so there was insufficient data to calculate a calendar annual average. However, a 12-month average calculated for the duration of the project is 3.58 ppb at 14.9% of the annual AAAQO.

Figure 12 shows the monthly average concentrations of NO_2 at Chipman and other air monitoring stations located in communities in the FAP network. The NO_2 levels at Chipman were generally lower than levels recorded at other communities within FAP during the wintertime period but were otherwise similar to other stations in the region.

Figure 12: Nitrogen Dioxide (NO_2) Monthly Averages from June 2019 to May 2020



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 (upwards of 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. This is known as ozone scavenging. O_3 levels are generally 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.

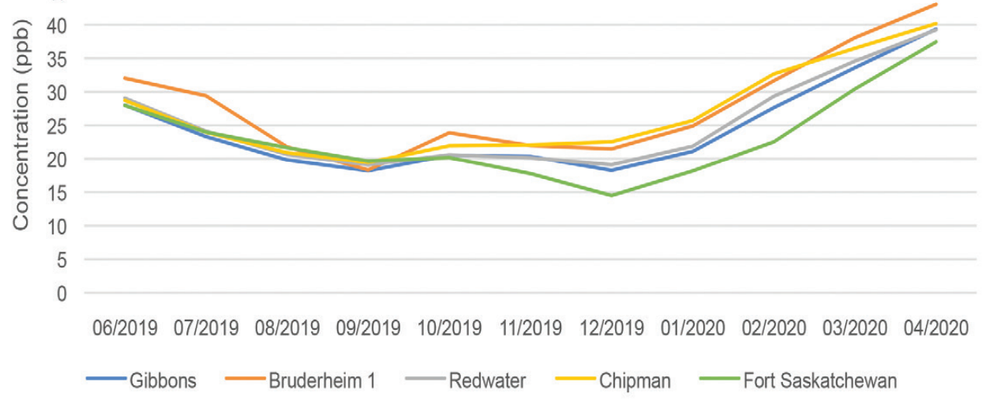
Clear skies provide ample sunlight, which combined with warm temperatures and a stable air mass, result in summertime smog. These weather conditions are conducive to the formation of secondary pollutants from ozone precursors emitted by multiple sources both small and large in the Edmonton Metropolitan 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 extremely high concentrations, such as that experienced immediately after lightning storms. O_3 is reported as parts per billion (ppb). Alberta has established the one-hour average concentration AAAQO for ozone at 76 ppb.

The highest one-hour average ozone recorded at the Chipman station was 68 ppb, approximately 88% of the one-hour AAAQO. This occurred on June 1, 2019. Higher results were also observed at several FAP stations and are associated with atmospheric reactions of wildfire smoke products creating O_3.

Figure 13 shows the monthly average concentrations of O_3 at Chipman and air monitoring stations located in other communities in the FAP network. The O_3 levels at Chipman do not differ substantially from levels recorded at other communities within FAP, with all monthly averages being within 3 ppb of Chipman.

Figure 13: Ozone (O_3) Monthly Averages from June 2019 to May 2020



Sulphur Dioxide Results

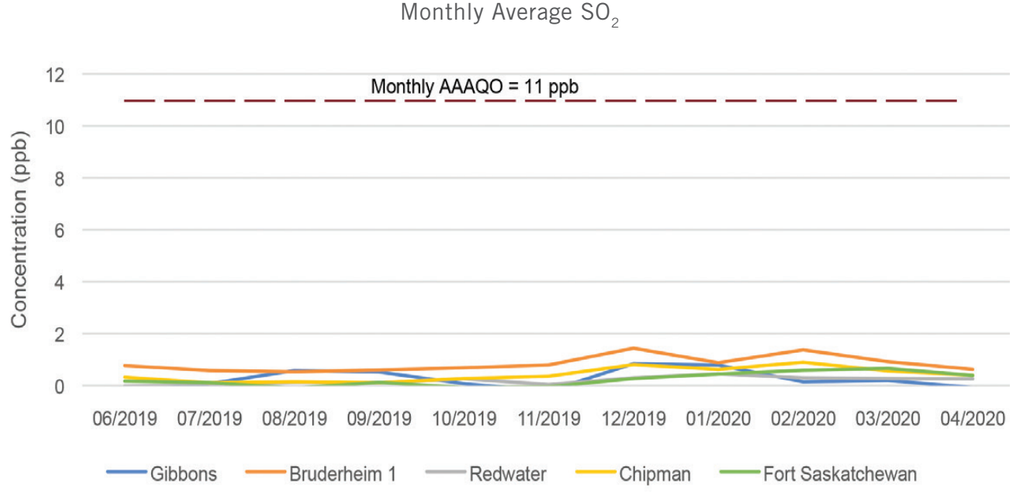
Sulphur dioxide (SO_2) is a colourless gas with a pungent odour. In Alberta, natural gas processing plants are responsible for close to half of the SO_2 emissions in the province. Sources of SO_2 in the Airshed are primarily industrial, from both within and outside FAP's boundaries. SO_2 is reported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

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

The highest one-hour average SO_2 recorded at the Chipman station was 25.7 ppb on June 26, 2019. This represents 14.9% of the one-hour AAAQO. The highest 24-hour average SO_2 recorded at the Chipman station was 3.6 ppb on March 22, 2020. This represents 8% of the 24-hour AAAQO. The highest monthly (30 day) average SO_2 recorded at the Chipman station was 0.9 ppb in February 2020. This represents 8% of the 30-day AAAQO. The station operated for less than nine months in each of 2019 and 2020 so there was insufficient data to calculate a calendar annual average. However, a 12-month average calculated for the duration of the project is 0.42 ppb at 5% of the annual AAAQO.

Figure 14 shows the monthly average concentrations of SO_2 at Chipman and air monitoring stations located in other communities in the FAP network. The SO_2 levels at Chipman do not differ substantially from levels recorded at other communities within FAP, with all monthly averages being within 0.8 ppb of Chipman.

Figure 14: Sulphur Dioxide (SO_2) Monthly Averages from June 2019 to May 2020

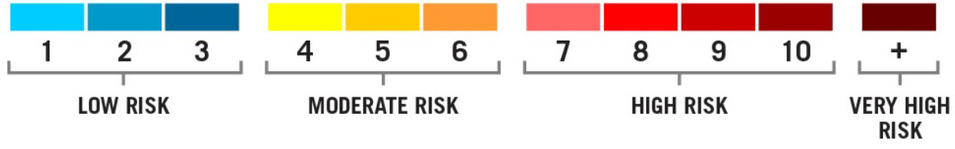


Note: Of the substances compared in this report, only SO_2 has a monthly AAAQO.

Results vs. Air Quality Health Index

AQHI Risk Distribution

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 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, although only the community stations are shown in the following tables. 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 12-month period that FAP operated the portable in Chipman, an AQHI was calculated in the same manner as is done for the rest of the FAP region. The results compared to other community stations operated by FAP are summarized in Figure 15. The extreme wildfire smoke event of 2019 occurred on May 30 just prior to June 1 when the portable began reporting data.

Figure 15: Percentage of Time in Each AQHI Risk Category at FAP Community Stations

Chipman, like all the community stations in FAP, recorded low risk to health AQHI ratings for the vast majority of the project. Chipman was in the low risk category 98.57% of the time, a slightly higher percentage than the three FAP community stations used for comparison in this report. The remaining 1.43% of time (123 hours) were in the moderate range.

AQHI High and Very High Risk events

Table 3 breaks down all the monitoring hours in the FAP network that resulted in an AQHI calculation of high or very-high risk to health. There were also two high risk hours, not shown in this table, that occurred at Gibbons due to an unidentified but localized cause.

Table 3: High and Very High Risk Air Quality Health Events

	FAP Continuous Air Quality Monitoring Station											
	Bruderheim		Chipman		Fort Saskatchewan		Gibbons		Redwater			
AIR QUALITY EVENT DATES	High Risk	Very High Risk	High Risk	Very High Risk	High Risk	Very High Risk	High Risk	Very High Risk	High Risk	Very High Risk	TOTAL HOURS	AIR QUALITY EVENT CAUSE
June 1, 2019	2				3		3		6		14	Wildfire Smoke
June 8, 2019					3		3		3		9	Wildfire Smoke
Jan. 25, 2020	2				3						5	Wintertime Inversion
Jan. 26, 2020					2						2	Wintertime Inversion
Jan. 27, 2020							1				1	Wintertime Inversion
Jan. 29, 2020					3						3	Wintertime Inversion
TOTAL HOURS	4				14		7		9		34	

Where causes could be identified, there were two prolonged regional events while the portable was in Chipman. A total of 24 hours of high or very high-risk hours occurred during the June 2019 wildfire event. Of these, none were registered at the Chipman station. The wildfire event that led to measurements of $PM_{2.5}$ exceeding the AAAQO in the network began on May 30, 2019 and carried over to June 1. However, the portable at Chipman only began reporting data on June 1.

A period of weather in late January 2020 resulted in wintertime inversion conditions. Twelve hours of high or very high-risk ratings occurred during this episode. Again, none were recorded at the Chipman station. These results suggest regional events have less influence on Chipman when compared to the rest of the FAP network, particularly during wintertime inversions. However, the relatively small number of air quality events monitored during the Chipman project was not enough to definitively conclude the influence of regional events on Chipman relative to other communities in FAP.

Figure 16: Chipman Mayor Tori Nygren (centre) and Lamont County Councillor Daniel Warawa (left) join FAP Board Director Paul Smith in a tour of the portable station.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