Fort Air Partnership

2019

Ambient Air Quality Monitoring Annual Network Report And Data Summary

FORT AIR PARTNERSHIP

We Monitor the Air You Breathe

FAP Technical Working Group April 24, 2019

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Abbreviations

24-hours	A calendar day, beginning at midnight
AAAQG	Alberta Ambient Air Quality Guideline
AAAQO	Alberta Ambient Air Quality Objective
AER	Alberta Energy Regulator
AMD	Air Monitoring Directive
AQM	Air Quality Monitoring
BTEX/S	Benzene, toluene, ethylbenzene, xylenes and styrene
CAAQS	Canadian Ambient Air Quality Standards
Calm	1-hour average wind speed is lower than 5 km/hour
CASA	Clean Air Strategic Alliance
CH_4	Methane
EPEA	Alberta's Environmental Protection and Enhancement Act
FAP	Fort Air Partnership
H_2S	Hydrogen sulphide
MST	Mountain Standard Time
NAPS	National Air Pollution Surveillance
NMHC	Non-methane hydrocarbons
NH_3	Ammonia
NO_2	Nitrogen dioxide
NO	Nitric oxide
NO_X	Oxides of nitrogen
O_3	Ozone (present at ground level)
$PM_{2.5}$	Particulate matter with aerodynamic diameter less than 2.5 µm in diameter, referred to as fine particles
QA/QC	Quality assurance / quality control
SO_2	Sulphur dioxide
THC	Total hydrocarbons
TWG	Technical Working Group
VOC	Volatile organic compound
WD or WDR	Wind direction
WS or WSP	Wind speed

Units of Measurement

µg/m^3	micrograms per cubic meter
km/hr	kilometers per hour
ppb	parts per billion by volume
ppm	parts per million by volume

Note: Where the Alberta Government is mentioned in this report, the reference is to the Department that has authority over and regulates the industrial approvals of air monitoring and reporting. As of December 31, 2019, this department was Alberta Environment and Parks.

2019 Network Summary

Network Overview

During 2019 Fort Air Partnership (FAP) operated ten continuous ambient air quality monitoring stations. One of the stations, a portable monitoring station, operated in two locations during 2019. Table 1 describes the parameters measured at continuous stations as of the end of 2019.

In addition to the continuous network, FAP operated a regional passive monitoring network in 2019, monitoring for sulphur dioxide (SO_2) and hydrogen sulphide (H_2S) at 47 sites throughout the network.

Table 1: FAP continuous monitoring stations and parameters 2019

	Bruderheim 1	Elk Island	Fort Sask.	Gibbons	Lamont County	Range Road 220	Redwater	Ross Creek	Scotford Temporary	Portable*
Alberta Health Quality Index	✓	✓	✓	✓	✓		✓			✓
Ammonia (NH_3)			✓				✓	✓		
Carbon Monoxide (CO)			✓							
Ethylene (C_2H_4)						✓		✓		
Ozone (O_3)	✓	✓	✓	✓	✓		✓			✓
Total Hydrocarbons (THC)	✓		✓		✓	✓				✓*
Non-methane Hydrocarbons (NMHC)	✓		✓		✓	✓				✓*
Methane (CH_4)	✓		✓		✓	✓				✓*
Hydrogen Sulphide (H_2S)			✓	✓	✓		✓		✓	✓
Oxides of Nitrogen (NO_X)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Nitric Oxide (NO)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Nitrogen Dioxide (NO_2)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Fine Particulates ($PM_{2.5}$)	✓	✓	✓	✓	✓		✓			✓

Table 1: FAP continuous monitoring stations and parameters 2019 (continued)

	Bruderheim 1	Elk Island	Fort Sask.	Gibbons	Lamont County	Range Road 220	Redwater	Ross Creek	Scotford Temporary	Portable
Sulphur Dioxide (SO_2)	✓	✓	✓	✓	✓		✓	✓	✓	✓
Benzene (C_6H_6)									✓	
Ethylbenzene (C_8H_{10})									✓	
Styrene (C_8H_8)									✓	
Toluene (C_7H_8)									✓	
Xylene ($C_{24}H_{30}$)									✓	
Air Temperature @ 2 meters	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Air Temperature @ 10 meters								✓		
Delta Temperature								✓		
Barometric Pressure							✓	✓		
Relative Humidity	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Solar Radiation								✓		
Vertical Wind Speed								✓		
Wind Speed and Wind Direction	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

*The Portable station operated at Bon Accord in January and February then moved to Chipman for June through December of 2019. The hydrocarbon analyzer (marked with *) was only installed on the Portable for the Chipman project.

Continuous Monitoring Performance Measures

In 2019 the average monthly uptime of all continuous monitoring equipment in the network was **99.38%.** FAP's uptime target is 98.5% while the Alberta Government requires that monitoring equipment be fully operational a minimum of 90% of the time each month.

There was only one instance in 2019 where operational uptime of an ambient air monitor fell below the minimum 90% in a month as required by the Alberta Government. This was reported to the Alberta Government and the problem promptly resolved.

Table 2: Data completeness 2019 (percent)

	Bruderheim 1	Elk Island	Fort Sask.	Gibbons	Lamont County	Portable	Range Road 220	Redwater	Ross Creek	Scotford Temporary
Wind Speed & Direction	*99.4*	*98.3*	*99.4*	*98.5*	*99.8*	*99.1*	*99.8*	*99.4*	*98.5*	*98.5*
Sulphur Dioxide SO_2	*99.7*	*99.7*	*99.7*	*99.9*	*99.6*	*99.8*		*99.7*	*99.9*	*99.4*
Nitric Oxide NO	*99.4*	*99.5*	*99.9*	*99.7*	*99.2*	*99.4*	*99.9*	*99.4*	*99.5*	*99.4*
Nitrogen Dioxide NO_2	*99.4*	*99.5*	*99.1*	*99.9*	*99.9*	*99.5*	*99.9*	*99.3*	*99.5*	*99.4*
Oxides of Nitrogen NOx	*99.4*	*99.5*	*99.1*	*99.9*	*99.9*	*99.5*	*99.9*	*99.3*	*99.5*	*99.4*
Ammonia NH_3			*99.2*					*99.4*	*99.5*	
Ozone O_3	*99.1*	*99.7*	*99.9*	*99.9*	*99.9*	*99.8*				
Hydrogen Sulphide H_2S			*99.9*	*99.7*	*99.2*	*99.4*				*99.4*
Ethylene C_2H_4							*99.1*		*98.7*	
Particulate Matter $PM_{2.5}$	*97.0*		*99.0*		*98.8*	97.7	*99.7*			
Total Hydrocarbon THC	*96.8*		*99.0*		*98.8*	*97.7*	*99.7*			
Methane CH_4	*96.8*		*99.0*		*98.8*	*97.7*	*99.7*			
Non-Methane Hydrocarbon NMHC	*99.5*	*99.1*	*98.3*	*99.7*	*99.9*	*99.9*		*99.1*		
Carbon Monoxide CO			*99.8*							
Benzene C_6H_6										*97.3*
Toluene C_7H_8										*97.3*
Ethylbenzene C_8H_{10}										*97.3*
Styrene C_8H_8										*97.3*
o-Xylene $C_{24}H_{30}$										*97.3*
m,p-Xylene $C_{24}H_{30}$										*97.2*
Site Average	**98.62**	**99.30**	**99.33**	**99.64**	**99.44**	**99.03**	**99.69**	**99.38**	**99.28**	**98.28**

*The Portable station uptime does not include the March to May period when not in service.

Monitoring Network Changes in 2019

FAP made the following changes to the continuous monitoring network in 2019, including improvements to infrastructure and equipment.

- The Portable continuous monitoring station operated at Bon Accord to the end of February 2019. It was then moved to a new project near the village of Chipman to begin operation as of June 1st, where it remained for the rest of 2019.

- Barometric pressure measurement was added to Redwater and removed from the Range Road 220 site.

Air Quality Events and Exceedances Summary

Air quality measurements are compared hourly to Alberta Ambient Air Quality Objectives (AAAQO). Any exceedance of an AAAQO is reported to the Alberta Government and the cause of the exceedance investigated. One-hour and 24-hour average exceedances in 2019 are listed in Table 3 and 4 respectively

A complete listing of the AAAQO compounds and values can be found at:

https://www.alberta.ca/ambient-air-quality-objectives.aspx.

Table 3: 2019 1-hour average exceedances of the AAAQO

One Hour Exceedances			
Parameter	**Exceedances**	**Dates**	**Attributed Cause**
Fine Particulate ($PM_{2.5}$)	2	February 9	Wintertime inversion
	2	February 10 & 13	Multiple sources east of station combined with inversion conditions
	12	February 14	
	2	March 21	Wintertime inversion
	1	March 23	
Hydrogen Sulphide (H_2S)	1	May 22	Local industry
	1	May 26	
Ozone (O_3)	23	May 28	Summertime smog
Fine Particulate ($PM_{2.5}$)	55	May 30	Wildfire smoke
	30	May 31	
	5	June 1	
Hydrogen Sulphide (H_2S)	1	June 1	Local industry
Fine Particulate ($PM_{2.5}$)	9	June 7, 8	Wildfire smoke
Hydrogen Sulphide (H2S)	3	July 16	Local industry
	1	July 16	Local wetlands
	1	September 18	Undetermined
Fine Particulate (PM2.5)	1	November 3	Undetermined
Hydrogen Sulphide (H2S)	1	December 9	Undetermined
Total	**151**		

Table 4: 2019 24-hour average exceedances of the AAAQO

24 Hour Exceedances			
Parameter	**Exceedances**	**Dates**	**Attributed Cause**
Fine Particulates ($PM_{2.5}$)	7	January 13	Wintertime inversion
	1	February 13	Multiple sources east of station combined with inversion conditions
	3	February 14	
	4	March 21	Wintertime inversion
	4	March 22	
	1	March 23	
	7	May 30	Wildfire smoke
	3	May 31	
	7	June 1	
Hydrogen Sulphide (H_2S)	1	July 16	Local industry
Total	**38**		

Air Quality Health Index Summary

The Air Quality Health Index (AQHI) was reported from seven FAP stations in 2019. The FAP portable station operated at Bon Accord in January and February and Chipman June through December 2019. AQHI results for the two sites are listed separately. The AQHI is calculated by the Government of Alberta using FAP collected data. In Alberta the AQHI is calculated using fine particulate matter ($PM_{2.5}$), ozone (O_3), nitrogen dioxide (NO_2), sulphur dioxide (SO_2) and hydrogen sulphide (H_2S) data.

Table 5: Air Quality Health Index in FAP region by percent - 2019

		Risk Level (% of time)			
Station Name	Hours Monitored	Low Risk	Moderate Risk	High Risk	Very High Risk
Bruderheim 1	8,472	94.17%	5.44%	0.34%	0.05%
Elk Island	8,332	94.86%	4.72%	0.36%	0.06%
Fort Saskatchewan	8,198	90.77%	8.94%	0.24%	0.05%
Gibbons	8,403	92.41%	7.19%	0.33%	0.07%
Lamont County	8,558	95.54%	4.31%	0.11%	0.05%
Redwater	8,309	93.33%	6.29%	0.30%	0.07%
Bon Accord*	1,379	85.93%	13.56%	0.51%	-
Chipman*	4,434	100.00%	-	-	-
Total hours	**56,085**	**52,638**	**3,270**	**148**	**29**

*****FAP portable station*

Table 6: Air Quality Health Index in FAP region number of hours - 2019

		Risk Level (# of hours)			
Station Name	Hours Monitored	Low Risk	Moderate Risk	High Risk	Very High Risk
Bruderheim 1	8,472	7,978	461	29	4
Elk Island	8,332	7,904	393	30	5
Fort Saskatchewan	8,198	7,441	733	20	4
Gibbons	8,403	7,765	604	28	6
Lamont County	8,558	8,176	369	9	4
Redwater	8,309	7,755	523	25	6
Bon Accord*	1,379	1,185	187	7	-
Chipman*	4,434	4,434	-	-	-
Total hours	**56,085**	**52,638**	**3,270**	**148**	**29**

*****FAP portable station*

The higher the AQHI number, the greater the health risk. The index describes the level of health risk associated with the AQHI number as 'low', 'moderate', 'high' or 'very high', and suggests steps people can take to reduce exposure. Table 7 details the occurrence of air quality events in 2019 and the number of hours with a high or very high risk AQHI rating at each station.

Table 7: Distribution of hours with an AQHI High or Very High Risk rating

	FAP Continuous Air Quality Monitoring Station															
	Bruder-heim 1		Elk Island		Fort Sask.		Gibbons		Lamont County		Redwater		Portable *			
Air Quality Event Dates	High Risk	Very High Risk	High Risk	Very High Risk	High Risk	Very High Risk	Very High Risk	High Risk	High Risk	Very High Risk	High Risk	Very High Risk	High Risk	Very High Risk	Total Hrs.	Attributed Cause
Jan. 13, 14	10	-	16	-	-	-	-	-	-	-	-	-	-	-	**26**	Winter inversion
Feb. 9, 10	-	-	1	-	-	-	2	-	2	-	-	-	-	-	**5**	Multiple sources east of station during inversion
Feb. 14	-	-	-	-	-	-	8	-	-	-	-	-	7	-	**15**	
Feb. 27	-	-	3	-	-	-	-	-	-	-	-	-	-	-	**3**	Local influence near station
March 20	5	-	4	-	-	-	-	-	-	-	-	-	-	-	**9**	Winter inversion
March 21	-	-	-	-	6	-	-	-	-	-	-	-	-	-	**6**	Winter inversion
March 22	-	-	-	-	1	-	-	-	-	-	-	-	-	-	**1**	Winter inversion
March 23	-	-	-	-	1	-	-	-	-	-	-	-	-	-	**1**	Winter inversion
May 28	-	-	4	-	2	-	-	-	-	-	-	-	-	-	**6**	Summer smog
May 30, 31	12	4	2	5	4	4	11	6	6	4	16	6	-	-	**80**	Smoke from wildfires
June 1	2	-	-	-	3	-	3	-	1	-	6	-	-	-	**15**	
June 8	-	-	-	-	3	-	3	-	-	-	3	-	-	-	**9**	
Nov. 3	-	-	-	-	-	-	1	-	-	-	-	-	-	-	**1**	Unknown
Total Hours	**29**	**4**	**30**	**5**	**20**	**6**	**28**	**4**	**9**	**4**	**25**	**6**	**7**	**-**	**177**	

2019 Summary of Exceedances

The data Fort Air Partnership collects is compared to Alberta Ambient Air Quality Objectives (AAAQO) set by the Government of Alberta. Exceedances are reported to the Government of Alberta and follow up information provided within seven days. Table 8 provides the total exceedances for each compound FAP measures with an AAAQO in 2019 and the previous 6 years.

Table 8: Summary of 2019 Exceedances and 6 years previous

Parameter Measured		2019	2018	2017	2016	2015	2014	2013
Ammonia (NH_3)	*1-hr*	-	-	1	-	4	-	-
Benzene (C_6H_6)	*1-hr*	-	-	-	-	2	5	-
Carbon Monoxide (CO)	*1-hr*	-	-	-	-	-	-	-
	8-hr	-	-	-	-	-	-	-
Ethyl Benzene ($C_6H_5CH_2CH_3$)	*1-hr*	-	-	-	-	-	-	-
Ethylene (C_2H_4)	*1-hr*	-	-	-	-	-	-	-
	3-day	-	-	-	-	-	-	-
	Annual	-	-	-	-	-	-	-
Fine Particulate Matter ($PM_{2.5}$)	*1-hr*	119	810	69	35	144	13	15
	24-hr	37	117	29	11	27	12	11
Hydrogen Sulphide (H_2S)	*1-hr*	9	20	-	-	3	-	147
	24-hr	1	4	-	-	1	-	29
Nitrogen Dioxide (NO_2)	*1-hr*	-	-	-	-	-	-	-
	24-hr	-	-	-	-	-	-	-
	Annual	-	-	-	-	-	-	-
Ozone (O_3)	*1-hr*	23	6	-	-	3	-	-
Styrene ($C_6H_5CH=CH_3$)	*1-hr*	-	-	-	-	-	-	-
Sulphur Dioxide (SO_2)	*1-hr*	-	-	38	51	34	26	6
	24-hr	-	-	9	9	6	3	2
	30-day	-	-	1	2	-	-	-
	Annual	-	-	-	-	-	-	-
Toluene ($C_6H_5CH_3$)	*1-hr*	-	-	-	-	-	-	-
Xylenes (o-, m- and p- isomers)	*1-hr*	-	-	-	-	-	-	-
Total Exceedances		**189**	**957**	**147**	**108**	**224**	**59**	**210**

Note: The Scotford 2 station was moved in April of 2014 because of pipeline construction beginning in May. The new location for the station, named Scotford Temporary had no nearby wetlands, hence the decrease in H_2S exceedances from 2014 to 2015.

May 30th recorded the highest $PM_{2.5}$ levels in FAP and indeed across Alberta since the technology for real time continuous measurement of fine particulate became available in Alberta in the mid 1990's. As noted in Table 7 the cause was the long range transport of forest fire smoke from outside the region.

Introduction

The FAP Organization (2019)

The Fort Air Partnership (FAP) is a registered not-for-profit society established in 1997 to operate an air quality monitoring network in a 4,500-square kilometer area northeast of Edmonton, Alberta that includes the city of Fort Saskatchewan, the communities of Gibbons, Bon Accord, Bruderheim, Lamont, Redwater, Waskatenau, Thorhild, and Elk National Island Park. In November 2000, FAP became the fourth Airshed in Alberta recognized by the Clean Air Strategic Alliance (CASA).

FAP is a multi-stakeholder group with members from industry, provincial and municipal government, and the public. FAP members see the benefit of working collaboratively to meet the organization's vision and mission.

The FAP Board holds regular meetings that are open to the public. Decisions of the Board and its committees are made by consensus.

The FAP Vision:

"*Public, industry and government have a clear shared understanding of ambient air quality in the region".*

The FAP Mission:

"To operate a regional network to monitor and report credible and comprehensive ambient air quality information".

FAP uses a governance organizational structure, such that the Board of Directors establishes policy and strategic direction for the organization, and contracted staff and committees manage the operational details in accordance with the set direction. In 2019 FAP continued to operate with several committees including: An Executive Committee, a Technical Working Group (TWG) and related subcommittees, an External Relations Committee, a Finance Committee and a Governance Committee, which all make recommendations to the FAP Board of Directors. FAP operations were managed by an Executive Director, with contracted staff consisting of a Network Manager, a Communications Director, and an Administrative Assistant. FAP contracts air

monitoring service providers who perform monitoring equipment operation, maintenance, calibration, and data validation and reporting.

Fort Air Partnership's monitoring and communications programs are funded by:

- Northeast Capital Industrial Association,
- Alberta Government
- Alberta's Industrial Heartland Association
- Environment and Climate Change Canada provides monitoring equipment for two continuous monitoring stations.

FAP works with other Airsheds provincially as part of the Alberta Airsheds Council. Airsheds in Alberta collaborate with both the provincial and federal government to implement successful air monitoring, reporting, and education within Alberta. Multi-stakeholder oversight of monitoring, data and analysis through Alberta's Airshed organizations is critical to ensuring a neutral, science-based approach to understanding air quality in Alberta. Timely execution of environmental monitoring, and the provision of scientifically credible monitoring data to the public and policy makers for informed decision making are critical functions provided by Airsheds. An important aspect to this collaborative work is sharing of technical expertise and information through the Alberta Airsheds Council Technical Committee.

Fort Air Partnership Technical Working Group

FAP's TWG is primarily responsible for oversight of the implementation and operation of the monitoring network and provides technical guidance to FAP. The TWG meets monthly to review the data and network operations. The TWG works under the leadership of the Network Manager to ensure that appropriate protocols are in place to assure data quality and guide air monitoring projects.

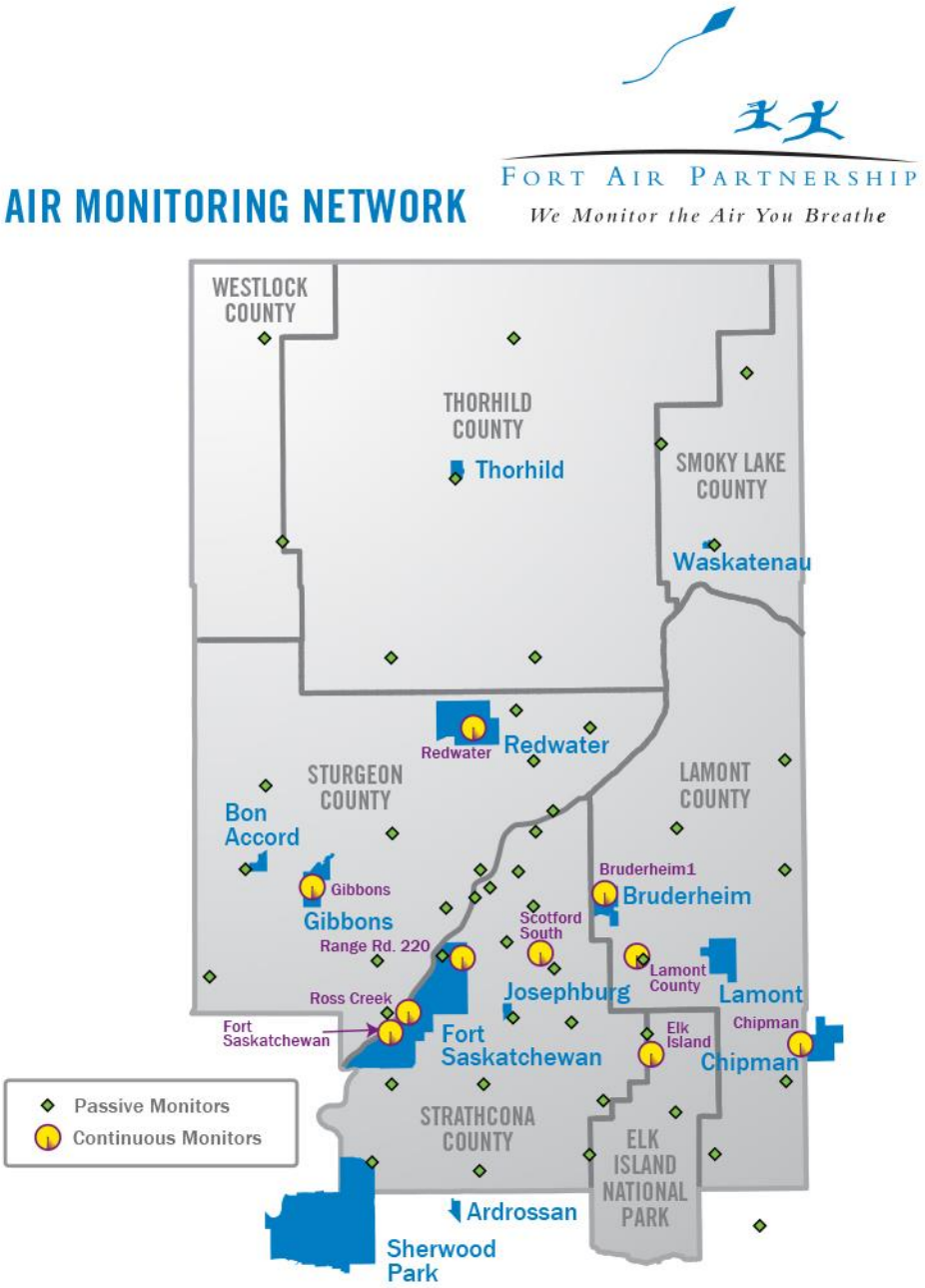
TWG members represent a wide range of technical air quality roles from industry, the Alberta Government (Health and Environment Ministries), and the Government of Canada (Environment Ministry), FAP's primary monitoring and data validation contractors, and members of the public. Committee members have substantial combined experience including monitoring technology, data analysis, laboratory analysis, quality systems, engineering, air quality modeling, environmental health and safety and regulatory reporting. Additionally, the TWG membership draws upon outside expertise from industry, air quality consultants, academia and government. Members of the TWG collaborate with other air monitoring agencies in Alberta and Canada. he FAP TWG chair also plays a leading role as a member of the Alberta Airsheds Council Technical Committee, consisting of technical leads from all Airsheds in Alberta. A list of TWG committee members on December 31, 2019 can be found in Appendix A. Lists of industry approval holders participating in FAP, as required in many cases by Environmental and Protection Enhancement Act (EPEA) operating approval clauses can be found in Appendix C.

2019 Air Quality Monitoring Program

FAP Monitoring Sites

The FAP Airshed map in Figure 1 shows the locations of the continuous and passive air monitoring sites in the network as of the end of December 2019.

Figure 1: FAP Monitoring sites at December 31, 2019



2019 Continuous Monitoring Network

Continuous Monitoring Description

A continuous air monitoring station is a temperature-controlled shelter typically housing several different continuous ambient air analyzers. Continuous analyzers, as the name implies, run continuously, and store data in one-minute averages. Continuous analyzers are designed to measure ambient air for specific compounds. FAP uses different combinations of these analyzers at the various stations depending on the monitoring objectives of each station.

Every FAP station has a wind sensor atop a tower that is at least 10 meters tall. Stations also measure several meteorological conditions including wind speed and direction and ambient temperature.

Data acquisition and data quality control at these stations is discussed elsewhere in this report.

Figure 2: Continuous air monitoring station interior

Network Overview

Continuous Monitoring and Reporting Requirements

The FAP continuous monitoring network is composed of nine continuous monitoring stations with the tenth, a portable station that measure 20 air quality parameters along with meteorological conditions. The nine permanent continuous monitoring stations are all in the southern portion of the Airshed around population centres, industrial facilities, and downwind of these source areas. These stations each have individual objectives to focus on monitoring where people live (population exposure), characterizing regional sources, characterizing local industrial emissions, or characterizing air quality in a protected national park. The portable station moves around the Airshed to deal with short term projects or emerging issues. Monitoring and reporting protocols are structured to meet the requirements of the Alberta Government Air Monitoring Directive.

Several industrial facilities hold Environmental Protection and Enhancement Act (EPEA) operating approvals, or authorizations, and are required to either conduct, or fund ambient air quality monitoring through participating in FAP. The FAP continuous monitoring stations, with the corresponding approval holders as of December 31, 2019, are listed in Appendix C.

Alberta Ambient Air Quality Objectives

Alberta Ambient Air Quality Objectives are intended to provide protection of the environment and human health to an extent technically and economically feasible, as well as socially and politically acceptable. Fort Air Partnership continuously compares the data it collects data to these provincial Ambient Air Quality Objectives. This information is used to inform policy and management decisions by government and other organizations.

When air quality standards are exceeded, FAP alerts Alberta Environment and Parks. This information is also accessed by Alberta Health Services to determine if a health advisory should be issued. Whenever possible, the cause of an exceedance is determined. Often, natural causes lead to exceedances, including weather events such as temperature inversions, or smoke from forest fires.

Canadian Ambient Air Quality Standards

FAPs data is also compared to national standards known as Canadian Ambient Air Quality Standards (CAAQS). These standards are in place for fine particulate matter ($PM_{2.5}$), ozone (O_3), nitrogen dioxide (NO_2) and Sulphur dioxide (SO_2).

Table 9 summarizes the CAAQS threshold and management levels for these four substances. Alberta is divided into six separate air zones. Each is assessed separately for achievement against these values. Fort Air Partnership falls within the North Saskatchewan Air Zone.

Table 9: Air Quality Management System Thresholds

Pollutant	Averaging Time	Numerical Value			Statistical Form
		2015	2020	2025	
Fine Particulate Matter ($PM_{2.5}$)	24-hour	28 $\mu g/m^3$	27 $\mu g/m^3$		The 3-year average of the annual 98th percentile of the daily 24-hour average concentrations
	Annual	10.0 $\mu g/m^3$	8.8 $\mu g/m^3$		The 3-year average of the annual average of all 1-hour concentrations
Ozone (O_3)	8-hour	63 ppb	62 ppb	60 ppb	The 3-year average of the annual 4th highest of the daily maximum 8-hour average ozone concentrations
Sulphur Dioxide (SO_2)	1-hour	-	70 ppb	65 ppb	The 3-year average of the annual 99th percentile of the SO_2 daily maximum 1-hour average concentrations
	Annual	-	5.0 ppb	4.0 ppb	The average over a single calendar year of all 1-hour average SO_2 concentrations
Nitrogen Dioxide (NO_2)	1-hour	-	60 ppb	42 ppb	The 3-year average of the annual 98th percentile of the daily maximum 1-hour average concentrations
	Annual	-	17.0 ppb	12.0 ppb	The average over a single calendar year of all 1-hour average concentrations

All provinces and territories including Alberta must annually report the status of air quality as compared to these national standards. The 2015-2017 Alberta Air Zones Report was released in November of 2019.

There are two levels of planning areas under CAAQS, larger airsheds that consist of six broad geographic regions for the entire country, and below that, air zones, which enable a place-based approach to manage local air quality. Provinces and territories delineate and manage air zones within their boundaries with the goal to drive continuous improvements in air quality and prevent the CAAQS from being exceeded, Alberta has 6 air zones.

These federal “airsheds” are not to be confused with Alberta Airsheds, which are regional air monitoring and reporting organizations throughout Alberta. Alberta’s 10 Airsheds who operate an extensive, integrated ambient air monitoring network. Air quality data collected by the Airsheds is also used by the province of Alberta to report against the federal CAAQS on an air zone basis.

The FAP Network Monitoring Objectives

FAP has established several monitoring objectives to ensure that it meets the needs of all its stakeholders. These objectives guided a Network Assessment completed by an independent third party in 2012. FAP developed a comprehensive monitoring plan using the findings of that network assessment in 2015. This monitoring plan was revised as needed according to the AMD requirements in place at the time, including continuous updates of progress made on monitoring projects from 2015 through to 2019. These updates were provided to AEP every six months or as the need arose. However, the AMD requirement for Airsheds to have a monitoring plan in place ended in December of 2019. FAP has decided to continue to have a monitoring plan in place for internal purposes, the design of this ongoing plan will be decided in 2020. While the design and operation of the monitoring network strives to meet FAP monitoring objectives, the overarching objective is that the monitoring must, at a minimum, meet regulatory requirements as set out by the Alberta Government including both Alberta Environment and Parks and the Alberta Energy Regulator.

The monitoring objectives for the FAP network are as follows:

- Understand spatial distribution of pollutants in the region
- Identify regional air quality trends
- Provide flexibility to characterize emerging issues, sources, and locations
- Provide appropriate information for evaluating population exposure to ambient air quality
- Provide information required to understand air quality impacts on the health of the environment
- Improve the ability to identify and apportion pollutant sources for purposes of air quality management
- Provide suitable input and validation information for air quality models

FAP Continuous Monitoring Site Descriptions

Bruderheim 1 Station

Primary Monitoring Objective: To monitor ambient air quality where people live. For a complete list of monitoring objectives, see table in Appendix B.

Continuous Parameters Monitored:
Methane and non-methane hydrocarbons, NO/NO_X/NO_2, ozone, $PM_{2.5}$, SO_2, ambient temperature, wind speed and direction. This station collects the data required to calculate the Air Quality Health Index.

Figure 3: Bruderheim 1 Station

Site Description: FAP has been operating a station in Bruderheim and reporting data to the Provincial Air Monitoring data warehouse since 2010. This station, formerly named Bruderheim was moved to the northwest corner of the Bruderheim school sports fields in 2016 and renamed Bruderheim 1. Bruderheim population is listed as 1,395 in the most recent census (2018).

Elk Island Station

Primary monitoring objective:
Understand the air quality impacts of a large Canadian city and concentrated heavy industry on a protected area. For a complete list of monitoring objectives, see table in Appendix B.

Continuous parameters monitored:
$NO/NO_X/NO_2$, ozone, $PM_{2.5}$, SO_2, outdoor temperature and relative humidity, wind speed and wind direction. A wet deposition (precipitation quality) sampler is also at the site part of a program run by the Alberta Government. This station collects the data required to calculate the Air Quality Health Index.

Figure 4: Elk Island Station

Site Description: This station is located within the boundaries of Elk Island National Park, between the administration building and Astotin Lake, near the west entrance to the park at Township Road 544 near Range Road 203. FAP has been operating this station and reporting data to the Provincial Air Monitoring data warehouse since January 2003. This station was designated a National Air Pollution Surveillance (NAPS) station in 2008.

Fort Saskatchewan Station

Primary monitoring objective:
Monitor air quality where people live and to establish air quality compliance to the AAAQOs. With the longest operational history and data record in the FAP network, it is an important station for understanding historical trends. It is a designated NAPS station. For a complete list of monitoring objectives, see table in Appendix B.

Continuous parameters monitored:
Ammonia, carbon monoxide, H_2S, methane and non-methane hydrocarbons, $NO/NO_X/NO_2$, ozone, $PM_{2.5}$, SO_2, outdoor temperature and relative humidity, wind speed and direction. This station collects the data required to calculate the Air Quality Health Index.

Figure 5: Fort Saskatchewan Station

Site description: This station is in the Airshed's largest population center (26,942 in 2019 census). It is located adjacent to a residential area of the City of Fort Saskatchewan near 92nd Street and 96th Avenue, 80 meters west of Highway 15, a major traffic artery, with an annual average daily traffic count of over 18,000 vehicles per day in 2018. FAP has been operating this station and reporting data to the Provincial Air Monitoring data warehouse since January 2003. Data from this site goes back to 1993 in the Provincial Air Monitoring data warehouse.

Gibbons Station

Primary monitoring objective: To monitor ambient air quality where people live. For a complete list of monitoring objectives, see table in Appendix B.

Continuous Parameters Monitored:
H_2S, $NO/NO_X/NO_2$, ozone, $PM_{2.5}$, SO_2, outdoor temperature and relative humidity, wind speed and direction. This station collects the data required to calculate the Air Quality Health Index.

Figure 6: Gibbons Station

Site Description: This station began operating and reporting data to the Provincial Air Monitoring data warehouse in February 2016. Alberta Environment and Parks has loaned FAP a $PM_{2.5}$ analyzer to enable the collection of data required to calculate the AQHI for this station. This station is at the rear of the Gibbons Town office located on 50th Avenue at 48th Street. Gibbons population is listed as 3,159 in the most recent census (2016).

Lamont County Station

Primary monitoring objective: Understand impacts of multiple pollutant sources in the region, which may include sources from Alberta's Industrial Heartland and from Strathcona industrial area, as well as from other sources in the City of Edmonton. This site was selected because modeling indicated that this elevated area of the region may experience higher concentrations of SO_2. The Lamont County Station is an EPEA compliance station. For a complete list of monitoring objectives, see table in Appendix B.

Figure 7: Lamont County Station

Continuous parameters monitored:
H_2S, methane and non-methane hydrocarbons, $NO/NO_X/NO_2$, ozone, $PM_{2.5}$, SO_2, outdoor temperature and relative humidity, wind speed and direction. This station collects the data required to calculate the Air Quality Health Index. FAP has been operating this station and reporting data to the Provincial Air Monitoring data warehouse since January 2003.

Site description: This station is in a rural area located in a hay field, several kilometers away from industrial facilities and other large pollutant sources, approximately 6 km west of the town of Lamont. The station is on a hill, 1.5 kilometers south of Highway 15, about 250 meters west of Range Road 202.

Portable Station

Primary monitoring objective: The portable is used to meet various objectives depending on the specific location and/or project. Along with FAPs stated monitoring objectives the portable can also respond to local air quality concerns as is being done in the Town of Bon Accord. For a complete list of monitoring objectives, see table in Appendix B.

Figure 8: Portable Station at Bon Accord

Continuous parameters monitored: H_2S, $NO/NO_X/NO_2$, SO2, methane and non-methane hydrocarbons, outdoor temperature and relative humidity, wind speed and direction. Other parameters can be added as required to meet project monitoring objectives.

Site description: In January and February 2019 the station was located on the southeast section of the town of Bon Accord at 48 avenue and 49 street. The Chipman site is a fenced compound approximately 60 meters to the east of Range Road 185 (a gravel surface road) and 500 meters north of Highway 15. The compound encloses a water pump booster station for the John S. Batiuk Regional Water Commission and is surrounded on four sides predominately by agricultural land. The station has been operating and reporting data to the Provincial data warehouse beginning in April 2018.

Portable changes (2019): The portable monitoring in the Town of Bon Accord ended at the end of February. The portable station was situated at Bon Accord to address some local air quality questions and compare air quality in the community with others in FAP. A report on the findings of this project is available on the FAP website or by contacting FAP at info@fortairmail.org.

The portable was moved to Chipman and began operation in June of 2019. A methane non methane analyzer was added to the station for the Chipman project.

Range Road 220 Station

Primary monitoring objective: Monitor the impacts of local industrial emissions on air quality. For a complete list of monitoring objectives, see table in Appendix B.

Continuous parameters monitored: Ethylene, methane and non-methane hydrocarbons, $NO/NO_X/NO_2$, barometric pressure, outdoor temperature and relative humidity, wind speed and direction.

Site description: The station is located off Range Road 220 in an open area along the facility fence line east of the Dow Chemical ethylene production facilities. FAP has been operating this station and reporting data to the Provincial Air Monitoring data warehouse since January 2003.

Range Road 220 changes (2019): Barometric pressure measurement ended at the station in May.

Figure 8: Range Road 220 Station

Redwater Station

Primary monitoring objective: To monitor ambient air quality where people live. For a complete list of monitoring objectives, see table in Appendix B.

Continuous parameters monitored: **A**mmonia, $NO/NO_X/NO_2$, ozone, $PM_{2.5}$, SO_2, outdoor temperature and relative humidity, wind speed and direction.

Figure 9: Redwater Station

Site description: The Redwater air quality monitoring station was established in October 2017, replacing the Redwater Industrial station. A suitability assessment commissioned by FAP in 2017 identified this location as appropriate to enable FAP to meet the established monitoring objectives. The station is located near the center of the town of Redwater at 47th street

and 49th avenue, just south of the town administration offices. The town of Redwater population is 2053 as of the most recent census (2016).

Redwater changes (2019): Barometric pressure measurement began at the station in May.

Ross Creek Station

Primary monitoring objective: To monitor the impacts of local industrial emissions on air quality. For a complete list of monitoring objectives, see table in Appendix B.

Continuous parameters monitored: Ammonia, ethylene, $NO/NO_X/NO_2$, SO_2, barometric pressure, solar radiation, relative humidity, temperature at 2 meters and 10 meters, vertical wind speed, wind speed and direction.

Site description: The station is located west of the Sherritt Fort Saskatchewan site, between the industrial facility and the City of Fort Saskatchewan. FAP has been operating this station and reporting data to the Provincial Air Monitoring data warehouse since January 2003.

Figure 10: Ross Creek Station

Scotford Temporary Station

The Scotford Temporary Station began operation at the current location in 2014. It is a relocation of the former Scotford 2 station.

Primary objective: The station is intended to monitor the impacts of local industrial emissions on air quality. The Scotford Temporary station is intended to meet EPEA operating approval conditions of two Approval holders. For a complete list of monitoring objectives, see table in Appendix B.

Continuous parameters monitored: H_2S, $NO/NO_X/NO_2$, SO_2, benzene, toluene, ethylbenzene, xylenes (o-, m- and p- isomers), styrene, outdoor temperature and relative humidity, wind speed and direction.

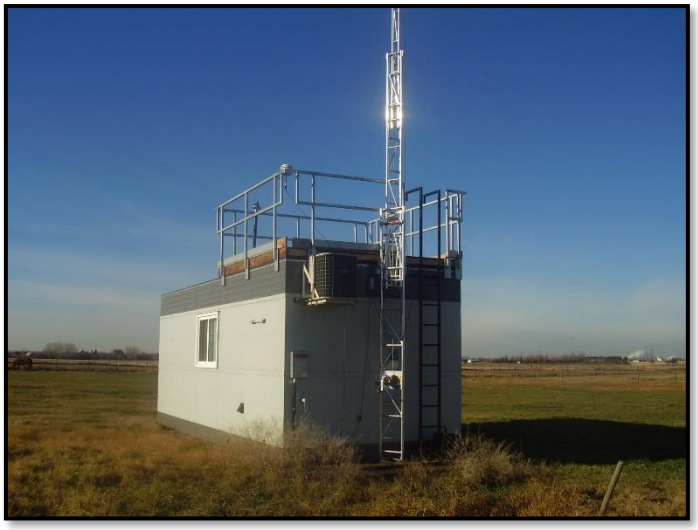


Figure 11: Scotford Temporary Station

Site description: The monitoring site is located to the south east of industrial facilities on Range Road 212, approximately 2 kilometers south of Highway 15. The station is in an open area located within a farmyard. The monitoring station was moved from the Scotford 2 location and began operation at this site in April 2014.

Capital Purchases for the Network – 2019

Capital Expansion:

- A new methane non-methane hydrocarbon analyzer and hydrogen generator were purchased for addition to the portable station.
- A new ozone analyzer was purchased to replace an analyzer at Redwater on loan from AEP.

Life cycle replacement across the network:

In 2019 FAP owned approximately $1.8M in equipment and shelters at the 8 stations it owned. Spare and backup equipment was valued at approximately an additional $0.9M. The capital replacement plan target is for purchases equaling approximately 10% of the total value of the active monitoring and support equipment within FAP each year.

- Equipment purchased as part of the capital equipment replacement plan in 2019 for deployment throughout the network included one analyzer each for ozone, H_2S, and SO_2. Also purchased were three uninterruptable power supplies, two computers for data loggers, and one zero air generator.
- A new BTEX analyzer was purchased for the Scotford Temporary station.
- A new fine particulate ($PM_{2.5}$) analyzer was purchased for the Redwater station.

- A new vertical wind speed sensor was purchased for Ross Creek Station.

Monitoring Station Coordinates

Table 10 gives the longitude and latitude coordinates for the FAP monitoring stations in 2019.

Table 10: Continuous monitoring station locations

Station	Latitude	Longitude	Elevation	Year Established	Land Use
Bruderheim 1	53.805629 N	-112.925851 W	630 m	Mar 2016	Residential
Elk Island	53.68236 N	-112.86806 W	711 m	2003	Parkland
Fort Saskatchewan	53.69883 N	-113.22319 W	629 m	Jan 2003	Residential
Gibbons	53.827241 N	-113.327174W	673 m	Feb 2016	Residential
Lamont County	53.76036 N	-112.88017 W	727 m	Jan 2003	Agricultural
Portable at Bon Accord	53.835190 N	-113.409146 W	693 m	April 2018	Residential
Portable at Chipman	53.70123 N	-112.63081 W	693 m	June 2019	Residential /Agricultural
Range Road 220	53.75245 N	-113.12582 W	625 m	Jan 2003	Industrial
Redwater	53.951834 N	-113.105857 W	627 m	Oct 2017	Residential
Ross Creek	53.71622 N	-113.19994 W	624 m	Jan 2003	Industrial
Scotford Temporary	53.756786 N	-113.028947 W	626 m	May 2014	Agricultural

Note: the year established reflects the date when data from that station was first reported to the Alberta Government Air Monitoring data warehouse

Continuous Monitoring Methods

Continuous monitoring methods are generally prescribed by the Alberta Government's Air Monitoring Directive. Details of the monitoring methods used by FAP are summarized in Appendix E.

Data Reporting

FAPs air monitoring data is reported and available in several ways:

- FAP maintains a near-real-time data portal for raw un-validated data for use by its members and the public at http://data.fortair.org/fortair.php

- Live, un-validated data is also reported hourly to the Alberta Government and retained for 1 year on the real-time website at: http://airquality.alberta.ca/map

- If the Air Quality Health Index approaches the *High Risk* to health category, medical officers from the local health authority are notified by Alberta Environment and Parks. Medical officers then decide whether to issue a public health or air quality advisory.

- Validated historical data, suitable for use in analysis and reports, is available from the Alberta Government data warehouse. As of the date of this report the new Alberta Government data warehouse was still under construction with data not yet available to download.

- Passive monitoring data tables are available upon request at info@fortairmail.org

2019 Passive Monitoring Network

Passive Monitoring Description

Passive monitoring is a cost-effective solution for monitoring air quality at locations where continuous monitoring is not practical. Passive sampling devices can monitor air pollutants without the need for electricity, data loggers or pumps. Passive sampling devices are lightweight, portable and relatively simple to operate. No active movement of air through the sampler is necessary.

Passive sampling involves the exposure of a reactive surface to the air. Transfer of the pollutant occurs by diffusion from the air to the surface via naturally occurring air movement. The surface consists of a membrane that is impregnated with a reactive solution. The sampling devices are mounted under a hood to protect it from rain or snow. Samplers are exposed for one month and analysis is completed in a laboratory.

A major advantage of using a passive sampling system is that a network of multiple samplers can be used over a large area to determine the spatial variation of pollutant levels. Passive samplers are also useful for looking at long-term trends of air pollutants at specific locations. However, since a sample is exposed for a month, events that last for a short time may be "averaged out".

Figure 12: Passive monitoring site

Figure 13: Changing passive monitoring devices

FAP Passive Monitoring Network

The passive samplers used by FAP monitor for monthly average concentrations of pollutants. As of December 31, 2019, FAP operated passive monitors at 47 different locations. Thirty-two (32) of these sites measure both sulphur dioxide (SO_2) and hydrogen sulphide (H_2S). Ten sites measure just SO_2 while five measure only H_2S. Three of the sites are co-located with monitors for the same substance in operation at FAP continuous stations as a comparison. Samples are exchanged within three days of the end of each month and sent to a laboratory for analysis. Results from the passive monitors are submitted each month to the Alberta Government.

Alberta Environment and Parks conducted an evaluation of the FAP passive network for both H_2S and SO_2 in 2018. The purpose of this evaluation was to determine what sites if any produced redundant data to sites near it and if so, identify which sites produce less-valuable data. Using this analysis, FAP then sought approval from AEP for removal of passive monitors at selected sites for each of SO_2 and H_2S. After receiving the approval from AEP, FAP reduced the size of the passive sampling network beginning January 2019.

Selected H_2S and SO_2 sites ceased operation as of December 31, 2018.

- H_2S (14 sites in all): 17, 27, 30, 32, 35, 40, 43, 48, 49, 54, 57*, 67, 69 and 70
- SO_2 (19 sites in all): 8, 10, 15, 21, 22, 28, 30, 32, 35, 40, 48, 49, 50, 52, 54, 57*, 67, 69 and 70.

  *Site 57 was removed in March of 2018 by road crews during construction.

Passive Monitoring Network Site Descriptions

Passive samplers are intended to gather information over a broad spatial area and to measure trends over time. The majority of FAP passive monitoring sites are not selected based on a high likelihood of impingement, but rather on a spatial grid to establish a picture of comparative air quality throughout the Airshed. A few passive monitoring sites are located near local emission sources instead of on the spatial grid, which should be considered when interpreting the data.

The site coordinates and parameters measured at each passive monitoring site are listed in Table 11. Some sites are named if there is a recognizable nearby landmark or reference. To locate the sites, see the map in Figure 2.

Table 11: FAP passive monitoring sites in 2019

Site	Location	Longitude	Latitude	SO_2	H_2S	Date Started
1	Stocks Greenhouses	-113.246659	53.596325	1		Jul 1, 2005
2	Ardrossan northeast	-113.098671	53.587175	1		Jul 1, 2005
3	NE of Bruderheim	-112.82701	53.866674	1		Jul 1, 2005
4	Waskatenau	-112.77622	54.09875	1	1	Jul 1, 2005
5	Thorhild	-113.1331	54.15233	1		Jul 1, 2005
7	Bon Accord	-113.42423	53.83382	1		Jul 1, 2005
11	North of BA	-113.04892	53.83195	1		Jan 1, 2006
12	TwpRd 564A RgeRd 212	-113.02542	53.86578	1	1	Jan 1, 2006
14	Astotin Creek	-113.02553	53.80367		1	Jan 1, 2006
18	Rge Rd 211 TwpRd 552	-113.00044	53.74747	1	1	Jan 1, 2006
20	Rge Rd 202	-112.880153	53.76029	1	1	Jan 1, 2006
21	Josephburg east	-112.97535	53.709517		1	Jan 1, 2006
22	Elk Island Park west gate	-112.87693	53.68760		1	Jan 1, 2006
23	Goodhope	-112.95082	53.65668	1	1	Jan 1, 2006
24	North of Scotford	-113.08703	53.82035	1	1	Jan 1, 2006
26	Twp Rd 560 Rge Rd 221	-113.15109	53.80340	1	1	Jan 1, 2006
27	N Sask. boat launch	-113.00035	53.88125	1		Jan 1, 2006
29	Redwater Natural Area N	-112.95213	53.94892	1	1	Jan 1, 2006
31	Northwest of Scotford	-113.10838	53.81068	1	1	Aug 1, 2006
33	Twp Rd 552 Rge Rd 225	-113.24816	53.74508	1	1	Aug 1, 2006
34	C&C Tree Farm	-113.48362	53.74538	1		Aug 1, 2006
36	Galloway Seed	-113.22421	53.65760		1	Aug 1, 2006
37	Twp Rd 564 Rge Rd 224	-113.22356	53.86307	1	1	Aug 1, 2006
38	Peno	-112.67866	53.92182	1	1	Aug 1, 2006
39	Saint Michael	-112.67831	53.83245	1	1	Aug 1, 2006
41	Lily Lake	-113.38755	53.91996		1	Nov 1, 2007
42	Radway - Val Soucy	-113.02451	54.00701	1	1	Nov 1, 2007
43	Keyera Site	-113.16707	53.74515	1		Nov 1, 2007
45	Scotford east	-113.06388	53.77449	1		Nov 1, 2007
46	Josephburg	-113.0693	53.71279	1	1	Nov 1, 2007
47	Southeast of FAP	-112.71777	53.54142	1		Nov 1, 2007
50	Sprucefield	-112.84794	54.18045		1	Aug 1, 2008
51	Hollow Lake	-112.72578	54.238822	1	1	Aug 1, 2008
52	Abee	-113.05062	54.268211		1	Aug 1, 2008
53	Tawatinaw - Clearbrook	-113.40057	54.268146	1	1	Aug 1, 2008
55	Taylor Lake	-113.37483	54.10185	1	1	Aug 1, 2008
56	Opal	-113.22475	54.00706	1	1	Aug 1, 2008
58	Ft Saskatchewan	-113.22319	53.69883	1	1	Jul 1, 2015

Table 11: FAP passive monitoring sites in 2019 - continued

Site	Location	Longitude	Latitude	SO_2	H_2S	Date Started
59	Partridge Hill	-113.09843	53.65791	1	1	Jun 1, 2010
60	Oxbow Lake	-112.95166	53.59954	1	1	Jun 1, 2010
61	Drygrass Lake	-112.77896	53.59954		1	Jun 1, 2010
62	FAP East boundary	-112.68102	53.65779	1	1	Jun 1, 2010
63	Elk Island Park	-112.85717	53.63338		1	Jun 1, 2010
64	Agrium Redwater	-113.09922	53.843689	1		Jul 1, 2015
66	Plains Midstream # 1	-113.14935	53.752583	1	1	Jan 1, 2018
68	ARC Resources Site 1	-113.07487	53.954450	1	1	Jan 1, 2018
71	ARC Resources Site 4	-113.02543	53.92183	1	1	Jan 1, 2018

Passive Monitoring for Compliance to EPEA Approvals

FAP performs passive monitoring on behalf of approval holders listed in Table 12. Air quality monitoring reports are submitted monthly to the Alberta Government. Data is archived in the Provincial government data warehouse.

Table 12: Passive monitoring requirements (December 31, 2019)

Passive Monitoring Network	Facility	EPEA Approval Number
FAP operates a total of **38 SO_2 locations** **35 H_2S locations on behalf of partners**	ACCEL Energy (4 sites H_2S, 4 sites SO_2)	150-03-02

2019 Monitoring Results

2019 Ambient Air Monitoring Data and Discussion

Continuous Monitoring Results by Compound

Ammonia

Ammonia (NH_3) is a colourless gas with the well-known pungent odour often found in household cleaners. NH_3 can be produced by both natural and anthropogenic sources. Some natural sources of NH_3 include the decay of plant material and animal waste. A small portion is also released during respiration. In Alberta, the fertilizer industry is the main industrial source of NH_3. This industry produces synthetic NH_3 for either direct application to soil as a fertilizer, or as a raw material for use in the production of other high nitrogen fertilizer products. The other significant source of NH_3 in Alberta is commercial livestock feedlots, specifically from their large amounts of animal waste.

Sources of ammonia in the Airshed are primarily from industrial sources in the production of fertilizer but can also be formed from natural sources such as the decay of plant material and animal waste.

The AAAQO for ammonia is:

- 1-hour average concentration 2000 ppb

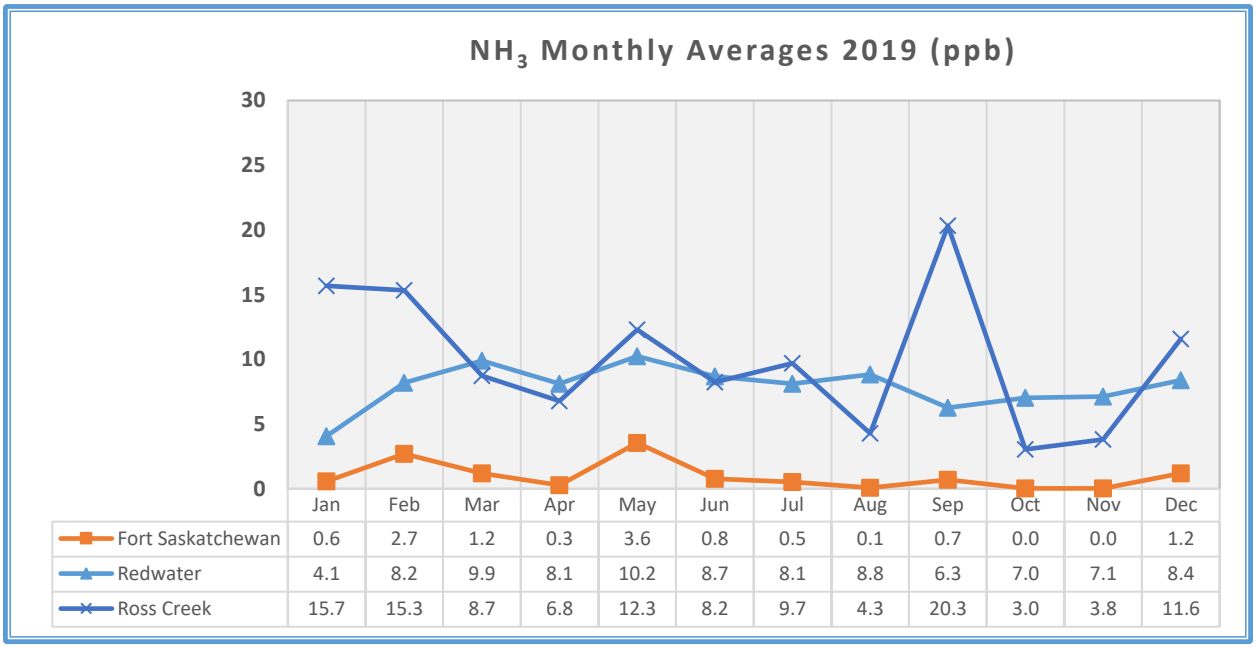
There were no exceedances of the NH_3 AAAQO recorded at any FAP stations in 2019.

Comparing air quality monitoring data at the three FAP stations that measure NH_3 in the FAP region for 2019 against the ammonia AAAQO, it was observed that the maximum 1-hour average concentration of NH_3 was 656 ppb measured at the Ross Creek station on February 14th. This measurement is approximately 33% of the 1-hr AAAQO.

Figure 14 below presents a summary of NH_3 concentrations recorded in 2019 at individual stations. Figure 15 shows annual NH_3 averages back to 2012. Figure 16 provides maximum 1-hour average NH_3 concentrations each month at the three continuous stations that measure it.

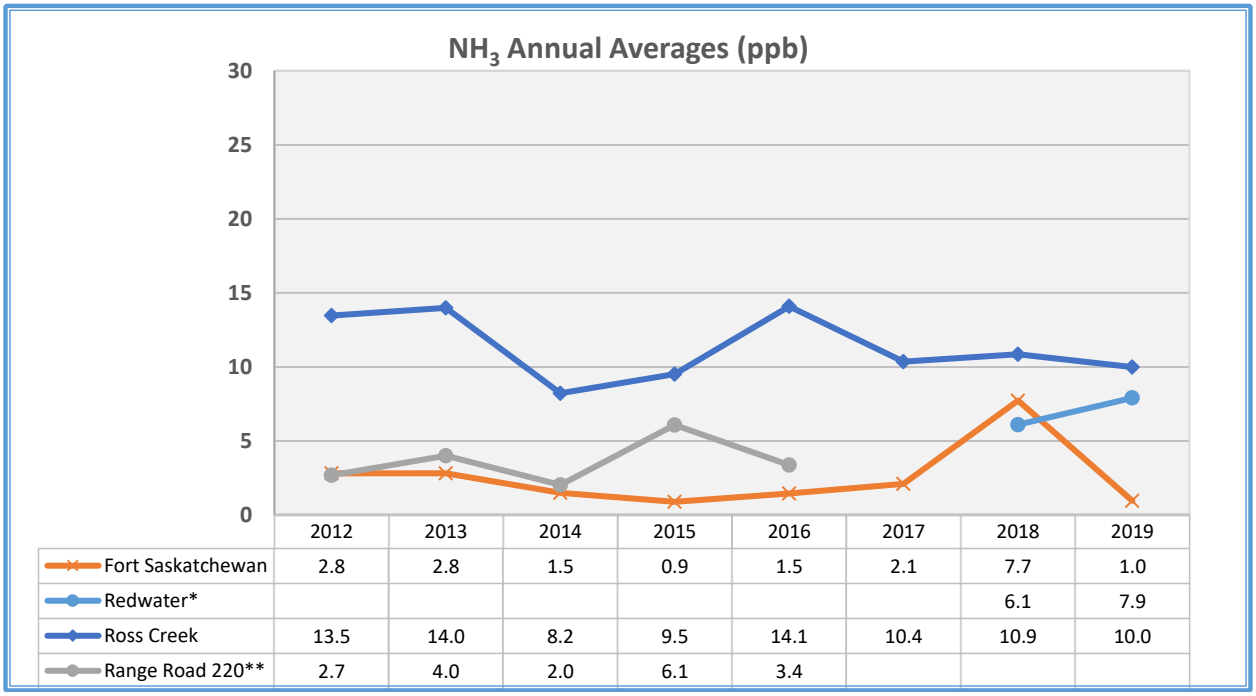
Ammonia (continued)

Figure 14: Monthly average NH_3 concentrations in 2019



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Fort Saskatchewan	0.6	2.7	1.2	0.3	3.6	0.8	0.5	0.1	0.7	0.0	0.0	1.2
Redwater	4.1	8.2	9.9	8.1	10.2	8.7	8.1	8.8	6.3	7.0	7.1	8.4
Ross Creek	15.7	15.3	8.7	6.8	12.3	8.2	9.7	4.3	20.3	3.0	3.8	11.6

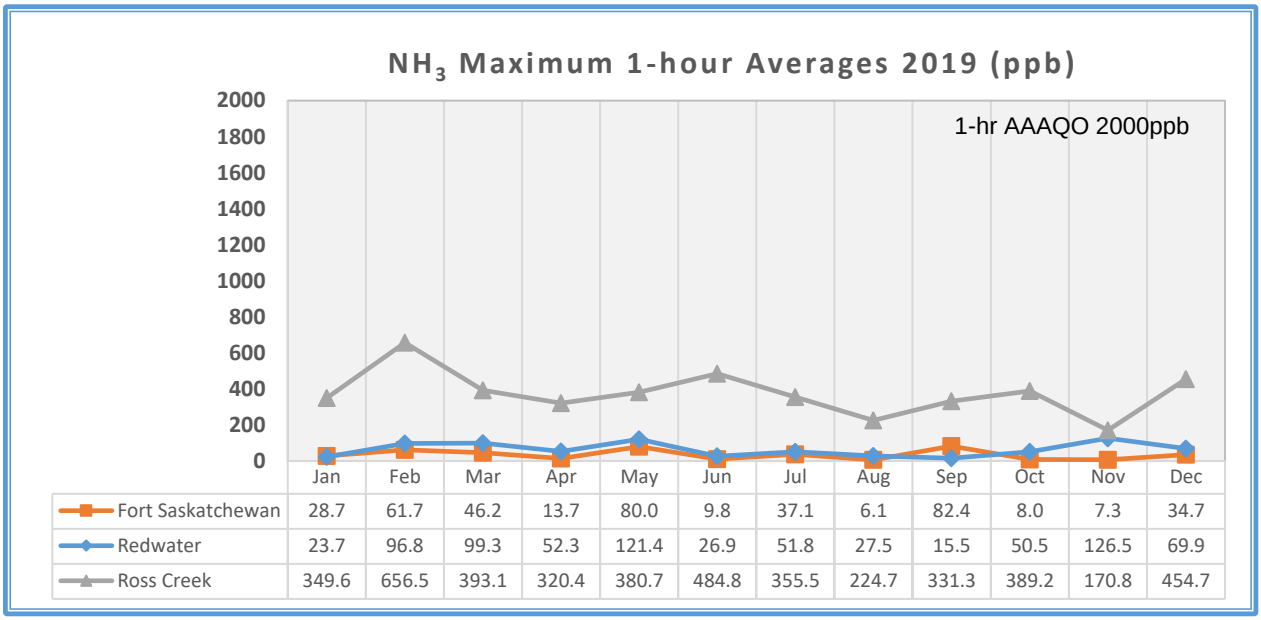
Figure 15: Annual average NH_3 concentrations



	2012	2013	2014	2015	2016	2017	2018	2019
Fort Saskatchewan	2.8	2.8	1.5	0.9	1.5	2.1	7.7	1.0
Redwater*							6.1	7.9
Ross Creek	13.5	14.0	8.2	9.5	14.1	10.4	10.9	10.0
Range Road 220**	2.7	4.0	2.0	6.1	3.4			

***** The Redwater station began operation October 2017
** Ammonia monitoring was stopped at Range Road 220 in January 2017

Figure 16: Maximum 1-hour average NH_3 concentrations



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Fort Saskatchewan	28.7	61.7	46.2	13.7	80.0	9.8	37.1	6.1	82.4	8.0	7.3	34.7
Redwater	23.7	96.8	99.3	52.3	121.4	26.9	51.8	27.5	15.5	50.5	126.5	69.9
Ross Creek	349.6	656.5	393.1	320.4	380.7	484.8	355.5	224.7	331.3	389.2	170.8	454.7

Carbon Monoxide

Carbon monoxide (CO) is a colourless, odourless gas present in small amounts in the atmosphere primarily from incomplete combustion of carbon-based fuels such as gasoline, oil and wood. The major source of CO in urban locations is motor vehicle exhaust emissions. Minor sources include fireplaces, industry, aircraft and natural gas combustion. Wildfires are also a significant natural source of CO.

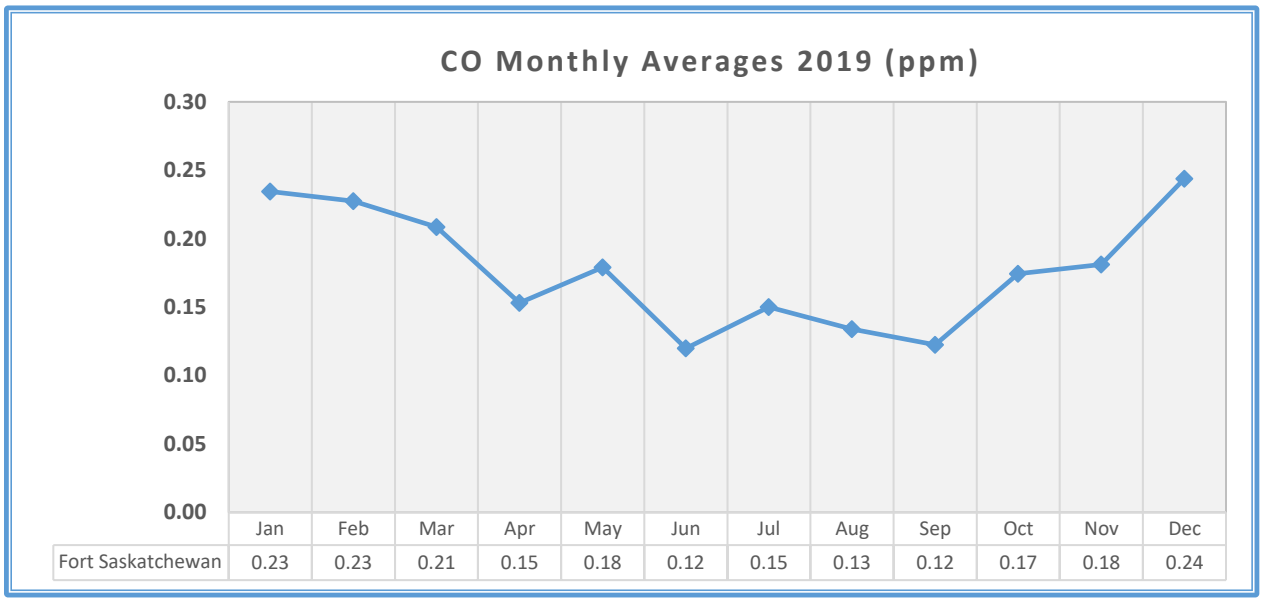
The AAAQOs for carbon monoxide are:

- 1-hour average concentration 13 ppm
- 8-hour average concentration 5 ppm

In FAP only the Fort Saskatchewan station measures CO. Comparing air quality monitoring data for 2019 against the AAAQOs for carbon monoxide, it was observed that the maximum 1-hour average concentration of CO was 4.66 ppm in May. This was due to the impact of heavy wildfire smoke in the entire region and was approximately 36% of the 1-hr AAAQO.

The CO monthly average concentrations recorded at Fort Saskatchewan station is given Figure 17. A comparison of annual averages going back to 2011 is presented in Figure 18 below.

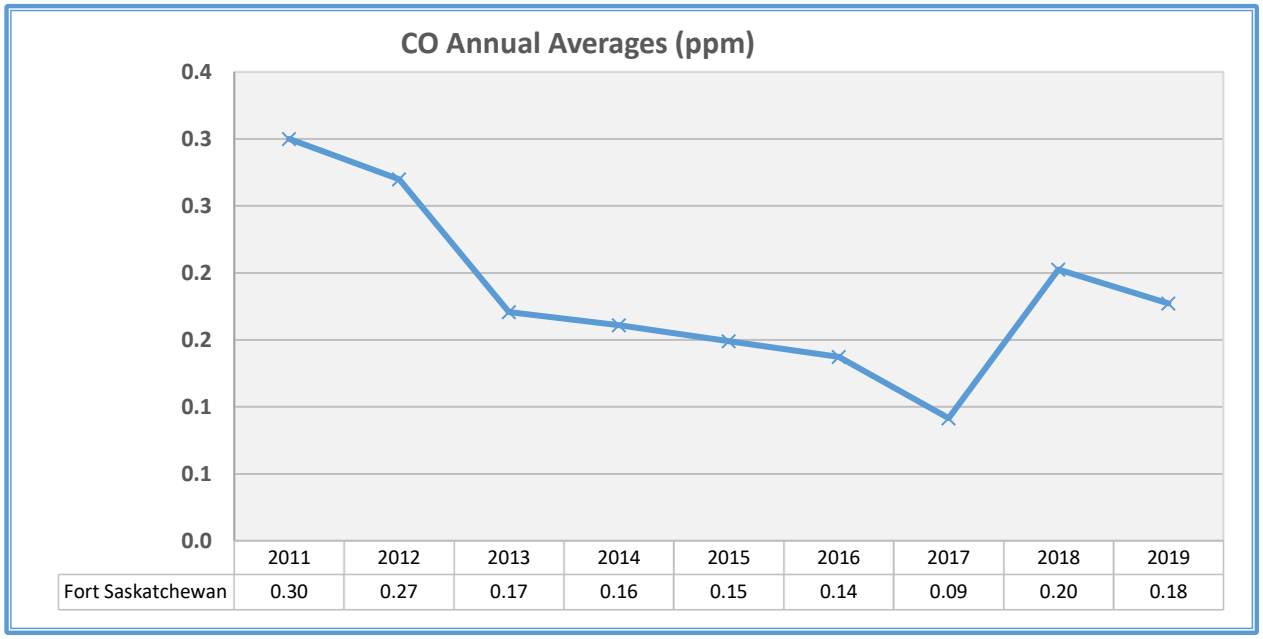
Figure 17: Monthly average CO concentrations in 2019



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Fort Saskatchewan	0.23	0.23	0.21	0.15	0.18	0.12	0.15	0.13	0.12	0.17	0.18	0.24

A slight rise in the monthly average in May 2019 over normal summer month averages was due to heavy wildfire smoke in the entire region the latter part of the month.

Figure 18: Annual average CO concentrations



	2011	2012	2013	2014	2015	2016	2017	2018	2019
Fort Saskatchewan	0.30	0.27	0.17	0.16	0.15	0.14	0.09	0.20	0.18

Ethylene

Ethylene is a naturally occurring compound in ambient air. It is produced at low levels by soil microorganisms, algae, lichens and plants. Other natural sources of ethylene include volcanic activity and combustion in forest and grass fires. In Alberta, the concentration in ambient air resulting from these natural sources is typically low.

Anthropogenic sources of ethylene include combustion of fossil fuels, and processing of natural gas in petrochemical facilities (e.g. production of plastics).

The AAAQOs for ethylene are:

- 1-hour average concentration 1044ppb
- 3-day average 40 ppb
- Annual mean 26 ppb

Ethylene is measured at two stations in FAP. Comparing air quality monitoring data for 2019 in the FAP region against the AAAQOs for ethylene, it was observed that:

- There were no exceedances of any of the three average periods AAAQO for ethylene.
- The maximum one-hour average concentration measured in 2019 was 282.4 ppb at Ross Creek station on April 15th (27% of the AAAQO).
- The maximum 3-day average concentration measured in 2019 was 33.8 ppb at the Ross Creek station for the 3-day period ending August 14th. This represents 85% of the AAAQO.
- The 2019 annual average at Range Road 220 was 1.3 ppb (5% of the annual objective) and Ross Creek 2.1 ppb (8% of the annual objective).

Figure 19 gives a summary of ethylene concentrations recorded in 2019 at individual stations. Table 13 lists the maximum hourly concentrations recorded each month at both stations that measure ethylene. Figure 20 shows theFigure 20Figure 20 annual ethylene averages at the two stations going back to 2012.

Ethylene (continued)

Figure 19: Monthly average Ethylene concentrations in 2019

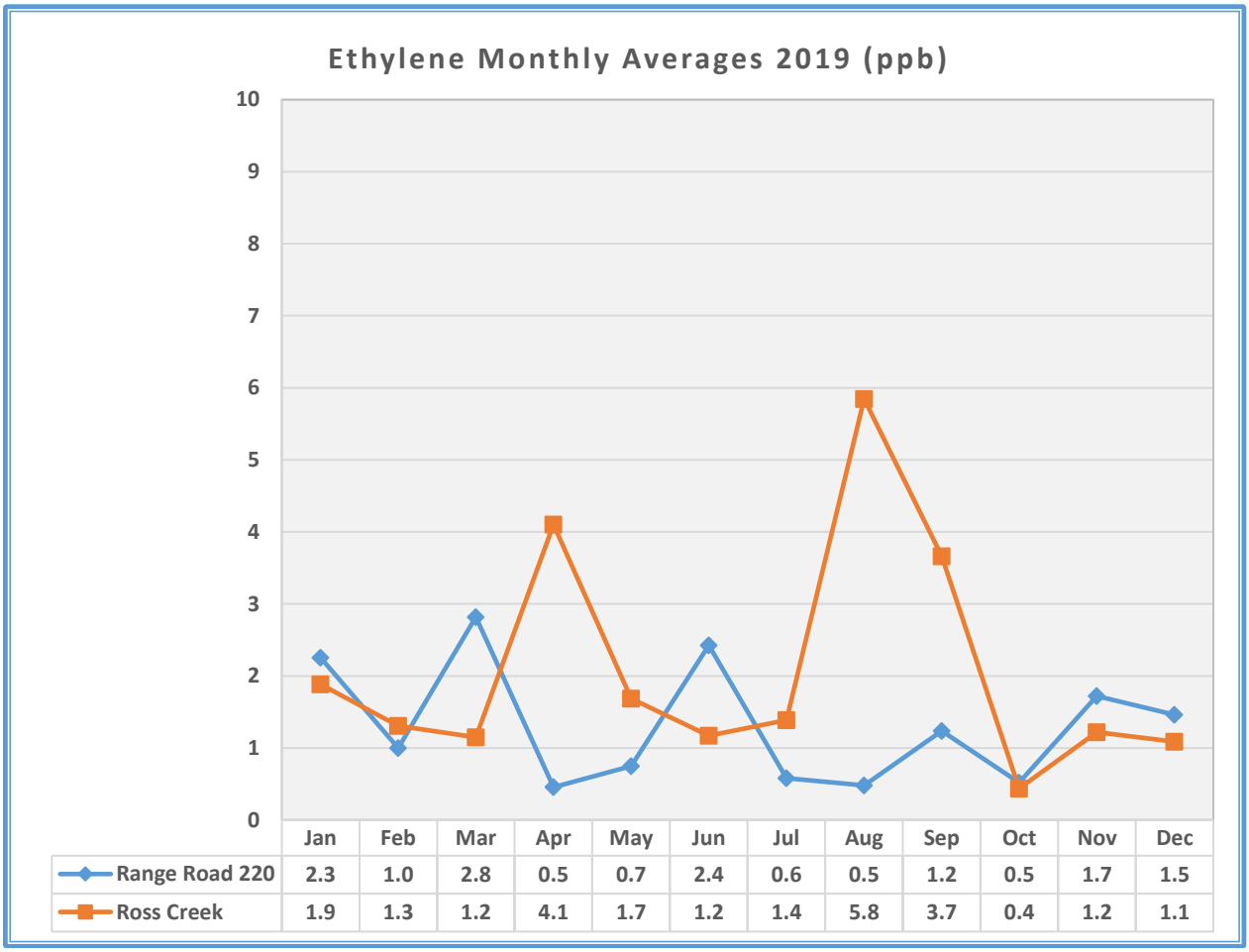
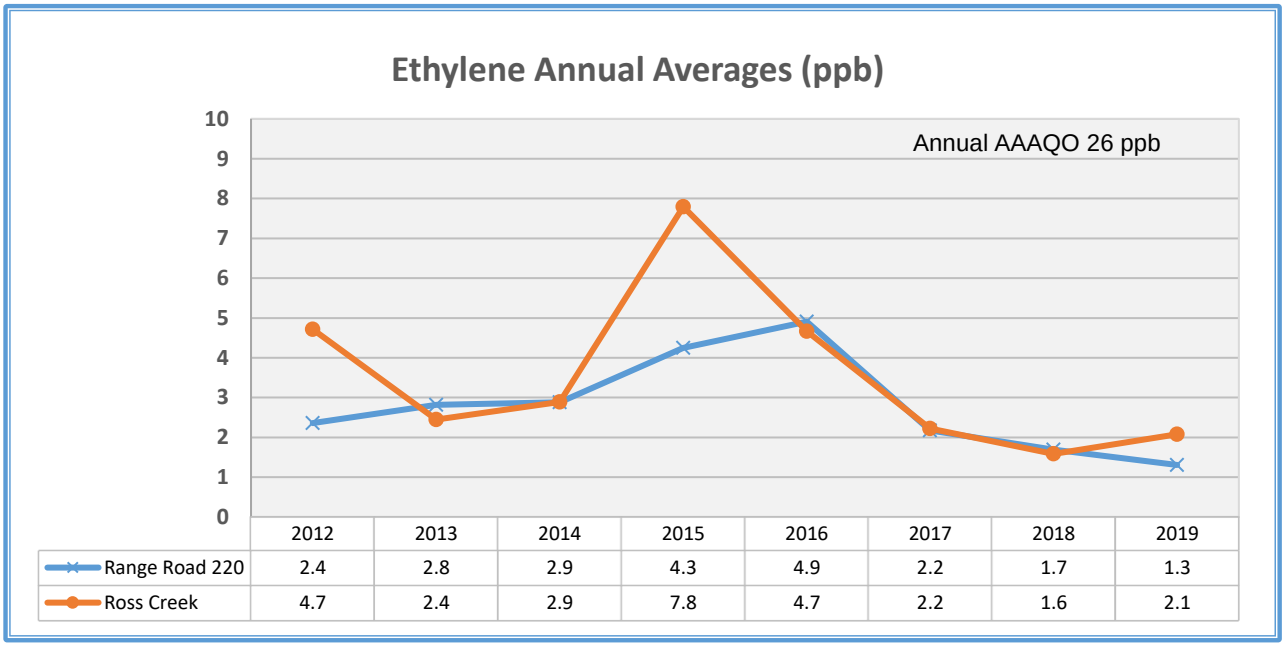


Table 13: Maximum 1-hour average Ethylene concentrations (ppb) in 2019

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Range Road 220	128.1	61.0	184.1	46.2	44.8	25.4	22.3	21.5	64.2	32.0	68.1	30.1
Ross Creek	96.7	77.2	27.4	282.4	34.0	11.3	14.5	273.4	71.9	11.1	98.5	20.3

Ethylene (continued)

Figure 20: Annual average Ethylene concentrations



	2012	2013	2014	2015	2016	2017	2018	2019
Range Road 220	2.4	2.8	2.9	4.3	4.9	2.2	1.7	1.3
Ross Creek	4.7	2.4	2.9	7.8	4.7	2.2	1.6	2.1

Fine Particulates ($PM_{2.5}$)

Fine particulate matter ($PM_{2.5}$) consists of tiny particles, 2.5 microns in size and smaller. In comparison, a strand of human hair is about 70 microns in width. 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 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 can travel deep into the lungs where they may cause permanent lung damage.

Higher values of $PM_{2.5}$ typically occur during winter temperature inversions when air movement is limited, or in summer with impact from long range transport of forest fire smoke often coupled with warm weather and little or no wind.

The AAAQO for $PM_{2.5}$ is:

- 24-hour average concentration 29 $\mu g/m^3$

There is also an Air Quality Guideline for $PM_{2.5}$:

- 1-hour average concentration 80 $\mu g/m^3$

A one-hour average concentration of 80$\mu g/m^3$ will trigger an AQHI in the “High Risk' category.

Fine Particulates (continued)

Comparing air quality monitoring data in the Fort Air Partnership region for 2019 against the Alberta ambient guideline and objective (AAAQG / AAAQO), it was observed that there were 119 1-hour Guideline exceedances and 37 24-hour AAAQO exceedances of fine particulates ($PM_{2.5}$) throughout the network. In 2019 there were only 5 days (May 30, 31 and June 1, 7 and 8th) with exceedances due to wildfires but these accounted for 83% of the 1-hour exceedances. May 30th saw the highest $PM_{2.5}$ levels ever recorded since measurement of it began in FAP.

The highest 1-hour average recorded was 1410 µg/m^3 occurring on May 30th at Gibbons, 1760% of the Guideline. There were five 1-hour averages recorded that day over 800 µg/m^3 or 10 times the Guideline, and 37 1-hour averages recorded greater than 300% of the Guideline.

The following two photos are street scenes in Sherwood Park during the highest $PM_{2.5}$ measurements due to wildfire smoke ever recorded in the capital region at noon on May 30 and for comparison, noon July 15th.

Figure 21: Noon May 30, 2019

Figure 22: Noon July 15, 2019

Table 14 and Table 14Table 15 group the exceedances by date and station with the attributed causes.

Table 14: 2019 1-hour average exceedances of the AAAQG for $PM_{2.5}$

Station	Highest 1 hour average ($\mu g/m^3$)	Exceedances	Date(s)	Attributed Cause
Elk Island, Portable at Bon Accord, Gibbons	197.1	16	February 9-14	Wintertime inversion
Ft. Saskatchewan	84.8	3	March 21,23	Wintertime inversion
All with $PM_{2.5}$ measurement	1165	85	May 30,31	Wildfire smoke
Ft. Saskatchewan Gibbons Redwater	137.4	14	June 1, 7, 8	Wildfire smoke
Gibbons	89.3	1	November 3	Undetermined

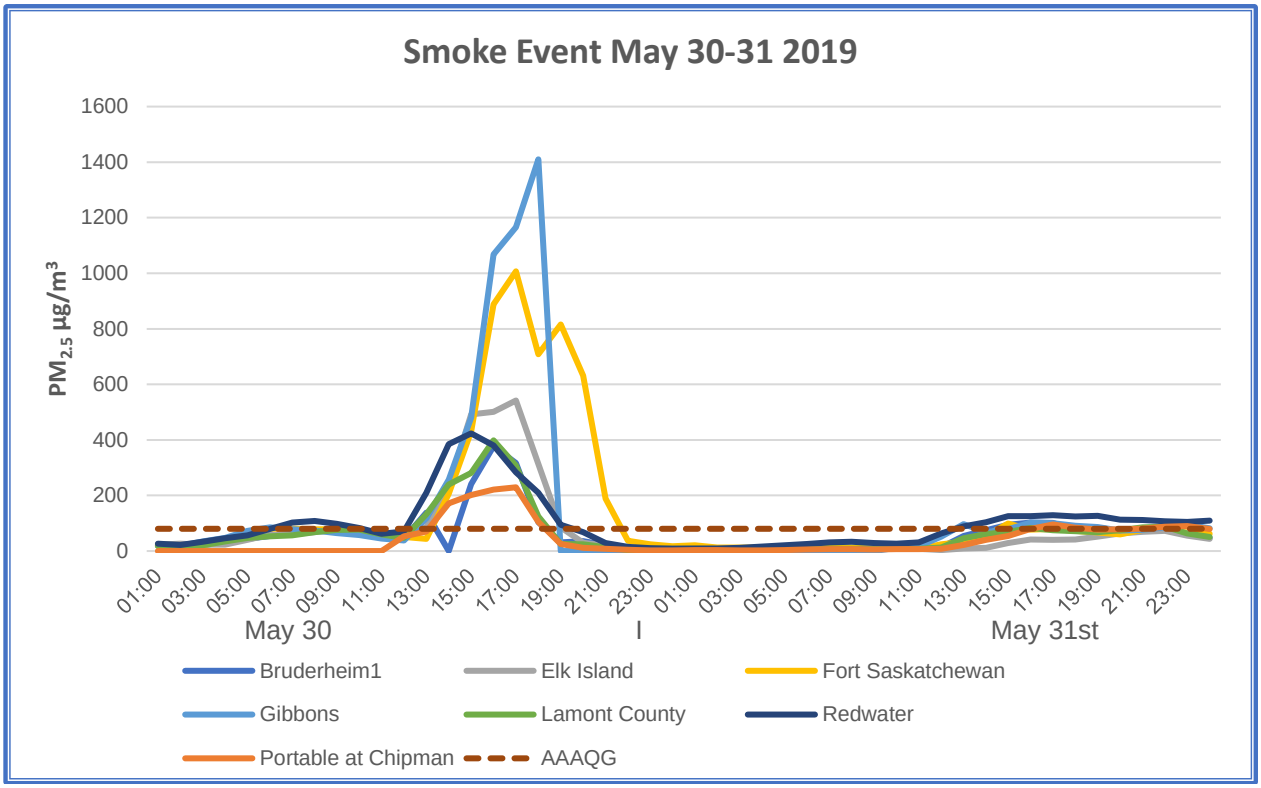
Table 15: 24-hour average exceedances of the AAAQO for $PM_{2.5}$ in 2019

Station	Highest 24 hour average ($\mu g/m^3$)	Exceedances	Date(s)	Attributed Cause
All with $PM_{2.5}$ measurement	43.5	7	January 13	Wintertime inversion
Fort Saskatchewan, Gibbons, Portable at Bon Accord	52.4	4	February 13 & 14	Wintertime inversion
Bruderheim1, Fort Sask, Gibbons, Lamont Cnty, Redwater, Portable at Bon Accord	41.5	9	March 21, 22, 23	Regional meteorological conditions
All with $PM_{2.5}$ measurement	285.1	17	May 30, 31 June 1	Wildfire smoke

Fine Particulates (continued)

Figure 23 below shows the 1-hour average concentrations at FAP continuous stations on May 30 and 31st 2019.

Figure 23: 1-hr $PM_{2.5}$ averages in the FAP network during May smoke event



Fine Particulates (continued)

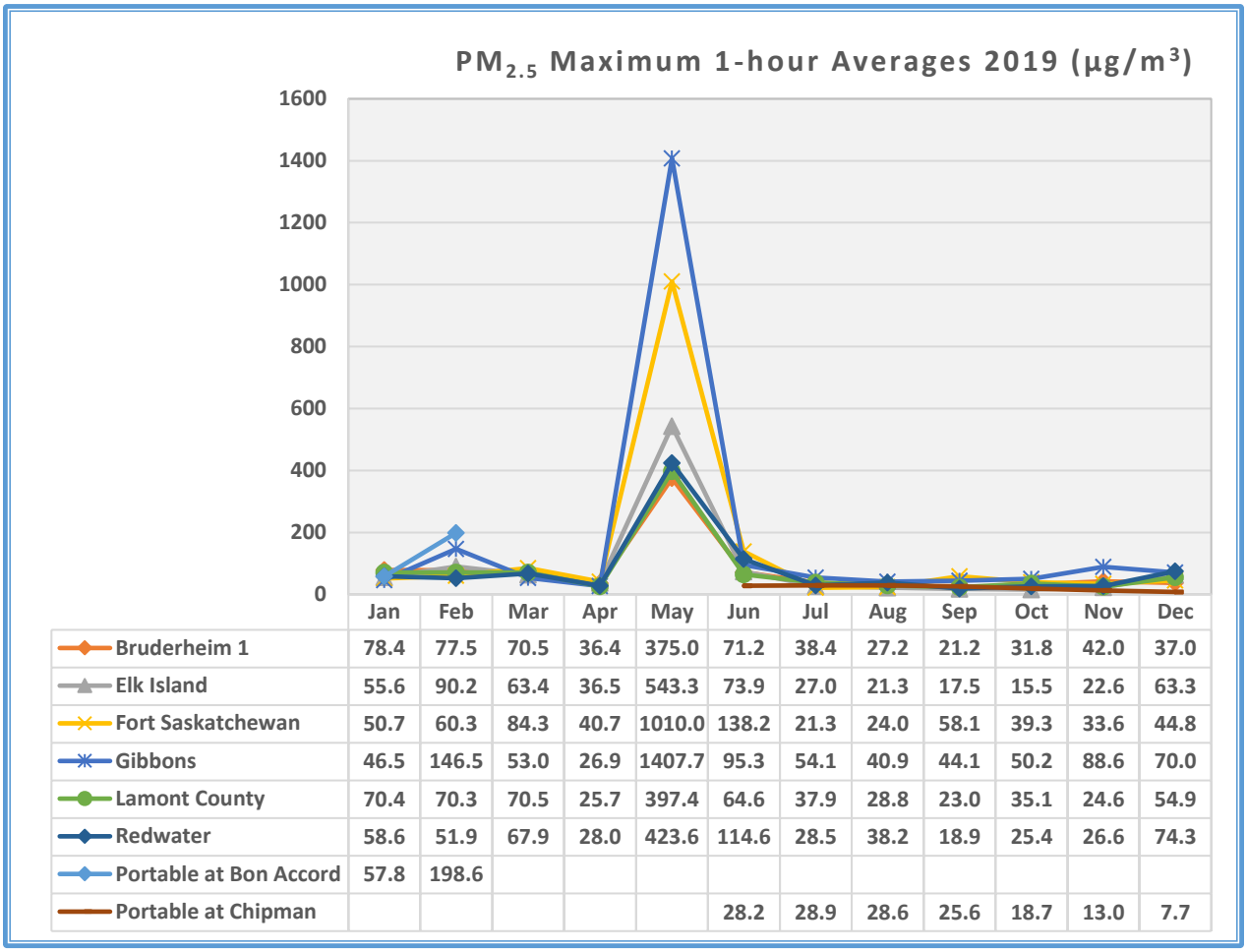
Figure 24 below shows monthly average $PM_{2.5}$ concentrations recorded in 2019 at individual stations. Figure 25 shows the annual average at each FAP station from 2012 to 2019. Figure 26 gives the maximum 1-hour average concentrations recorded each month while

Fine Particulates (continued)

Figure 27 shows the maximum 24-hour average each month. Figure 28 shows annual averages at FAP stations compared to others across Alberta for the past 3 years.

Fine Particulates (continued)

Figure 24: Monthly average $PM_{2.5}$ concentrations in 2019

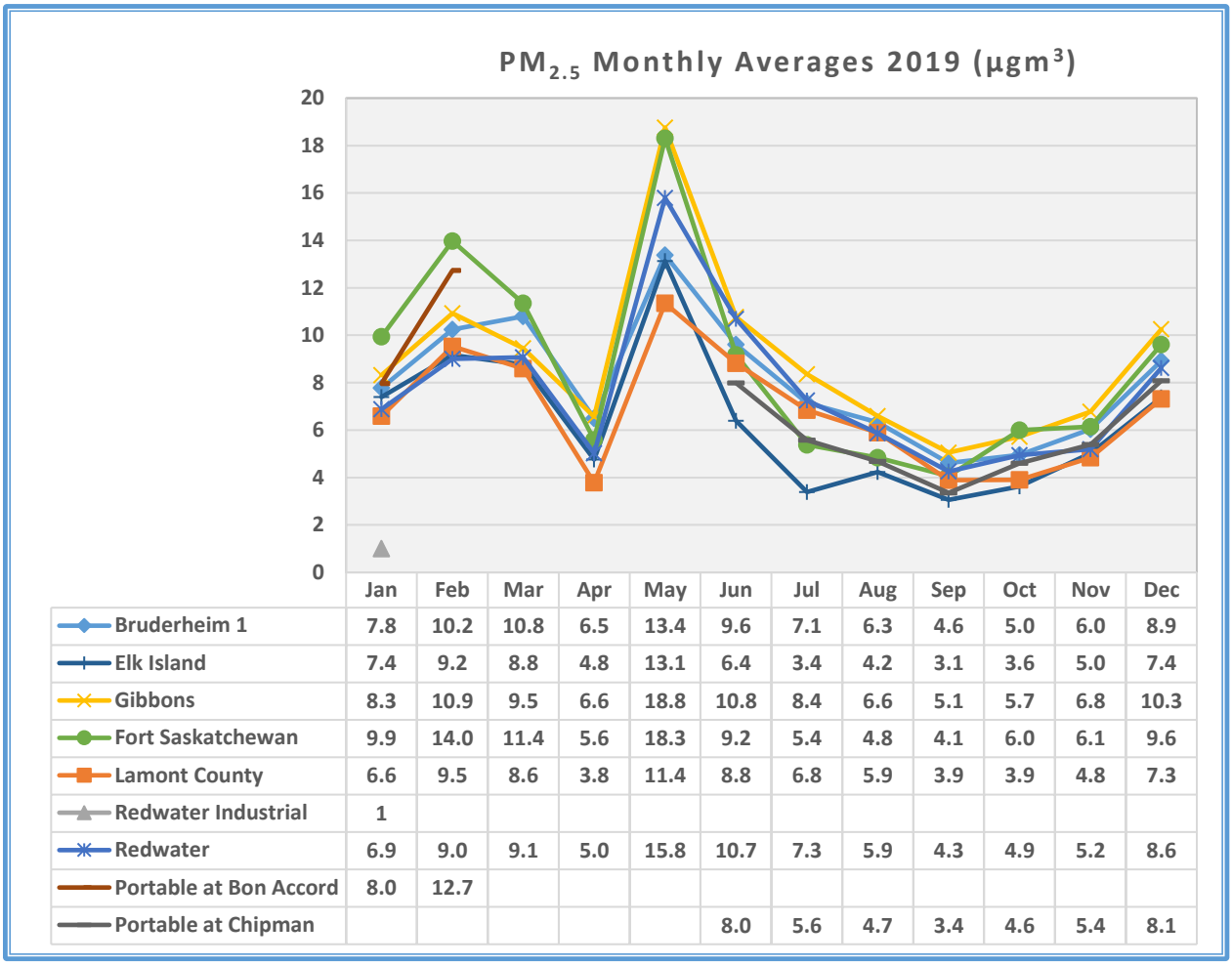


	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Bruderheim 1	78.4	77.5	70.5	36.4	375.0	71.2	38.4	27.2	21.2	31.8	42.0	37.0
Elk Island	55.6	90.2	63.4	36.5	543.3	73.9	27.0	21.3	17.5	15.5	22.6	63.3
Fort Saskatchewan	50.7	60.3	84.3	40.7	1010.0	138.2	21.3	24.0	58.1	39.3	33.6	44.8
Gibbons	46.5	146.5	53.0	26.9	1407.7	95.3	54.1	40.9	44.1	50.2	88.6	70.0
Lamont County	70.4	70.3	70.5	25.7	397.4	64.6	37.9	28.8	23.0	35.1	24.6	54.9
Redwater	58.6	51.9	67.9	28.0	423.6	114.6	28.5	38.2	18.9	25.4	26.6	74.3
Portable at Bon Accord	57.8	198.6										
Portable at Chipman						28.2	28.9	28.6	25.6	18.7	13.0	7.7

Elevated averages in May were due to wildfire smoke.

Fine Particulates (continued)

Figure 25: Annual average $PM_{2.5}$ concentrations at FAP stations

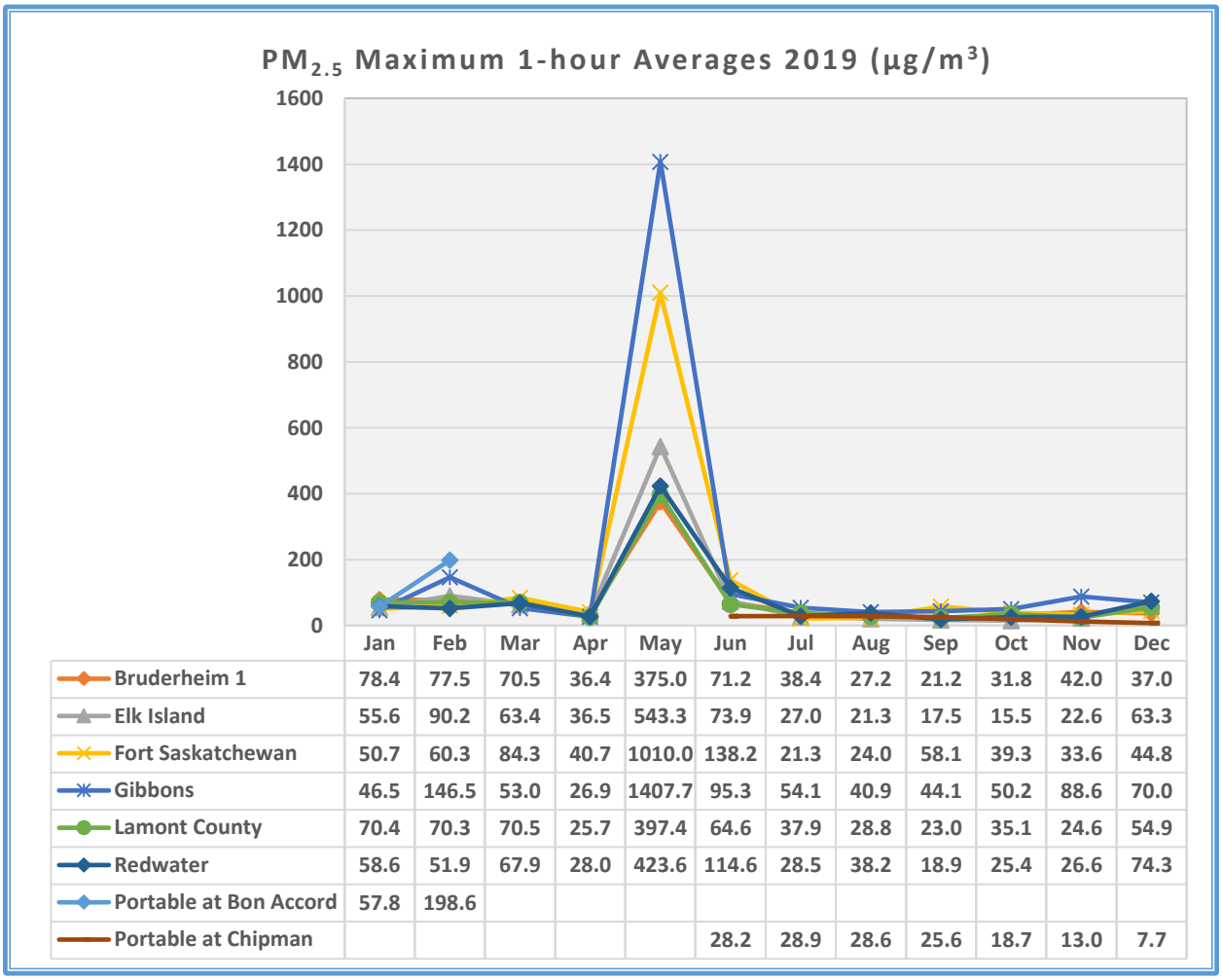


	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Bruderheim 1	7.8	10.2	10.8	6.5	13.4	9.6	7.1	6.3	4.6	5.0	6.0	8.9
Elk Island	7.4	9.2	8.8	4.8	13.1	6.4	3.4	4.2	3.1	3.6	5.0	7.4
Gibbons	8.3	10.9	9.5	6.6	18.8	10.8	8.4	6.6	5.1	5.7	6.8	10.3
Fort Saskatchewan	9.9	14.0	11.4	5.6	18.3	9.2	5.4	4.8	4.1	6.0	6.1	9.6
Lamont County	6.6	9.5	8.6	3.8	11.4	8.8	6.8	5.9	3.9	3.9	4.8	7.3
Redwater Industrial	1											
Redwater	6.9	9.0	9.1	5.0	15.8	10.7	7.3	5.9	4.3	4.9	5.2	8.6
Portable at Bon Accord	8.0	12.7										
Portable at Chipman						8.0	5.6	4.7	3.4	4.6	5.4	8.1

*The Bruderheim station was moved in 2016 and renamed Bruderheim 1
Bruderheim 2016 average includes data from both Bruderheim and Bruderheim1 stations. The Gibbons station began operations in 2016.

2018 $PM_{2.5}$ annual averages were higher than other years due to the impact of wildfire smoke from British Columbia for most of August that year.

Figure 26: Maximum 1-hour average $PM_{2.5}$ concentrations at FAP stations

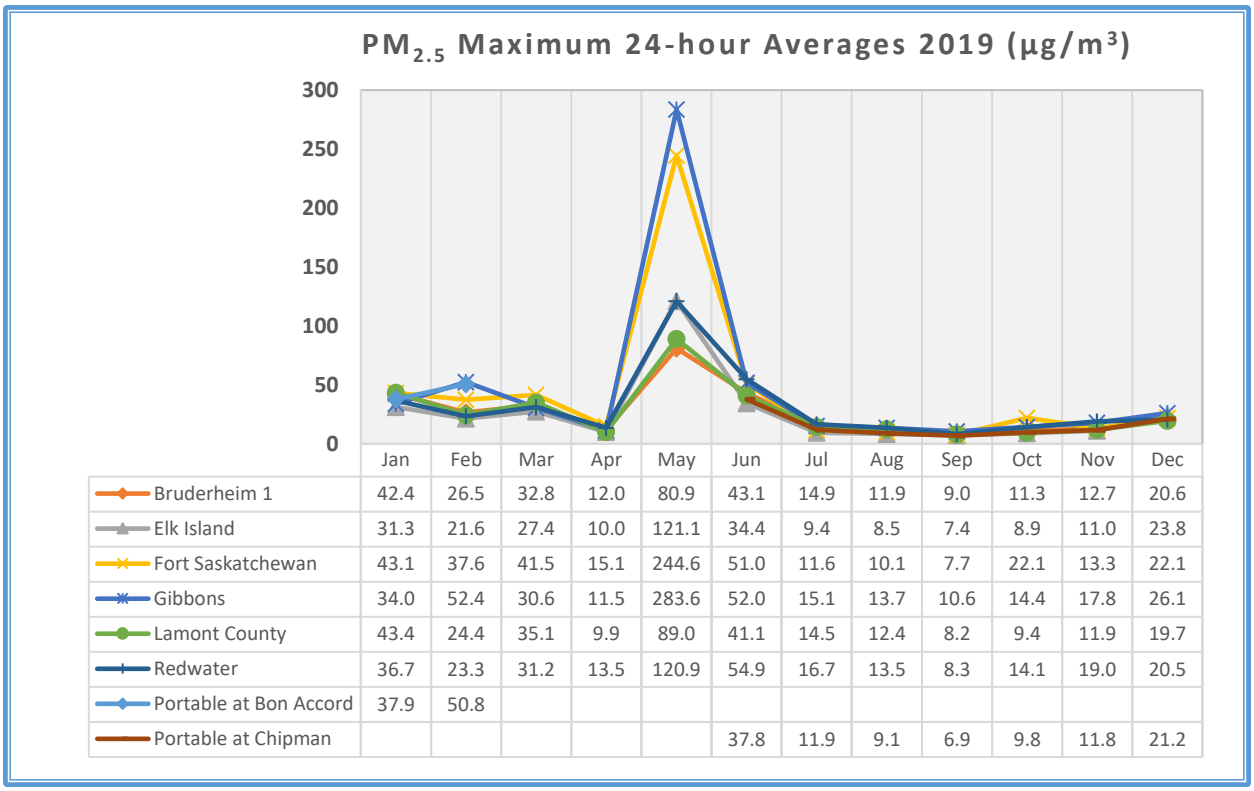


	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Bruderheim 1	78.4	77.5	70.5	36.4	375.0	71.2	38.4	27.2	21.2	31.8	42.0	37.0
Elk Island	55.6	90.2	63.4	36.5	543.3	73.9	27.0	21.3	17.5	15.5	22.6	63.3
Fort Saskatchewan	50.7	60.3	84.3	40.7	1010.0	138.2	21.3	24.0	58.1	39.3	33.6	44.8
Gibbons	46.5	146.5	53.0	26.9	1407.7	95.3	54.1	40.9	44.1	50.2	88.6	70.0
Lamont County	70.4	70.3	70.5	25.7	397.4	64.6	37.9	28.8	23.0	35.1	24.6	54.9
Redwater	58.6	51.9	67.9	28.0	423.6	114.6	28.5	38.2	18.9	25.4	26.6	74.3
Portable at Bon Accord	57.8	198.6										
Portable at Chipman						28.2	28.9	28.6	25.6	18.7	13.0	7.7

Elevated maximus in May were due to wildfire smoke.

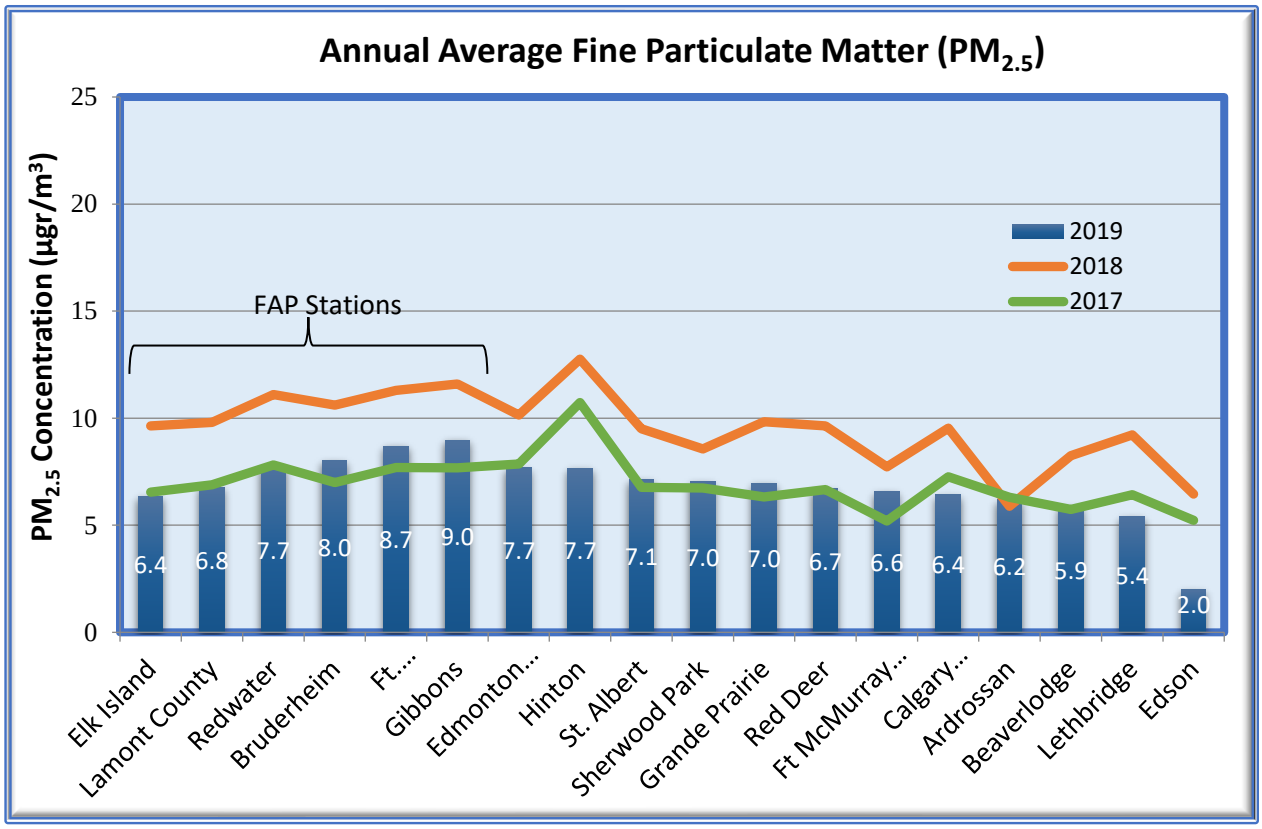
Fine Particulates (continued)

Figure 27: Maximum 24-hour average $PM_{2.5}$ concentrations at FAP stations



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Bruderheim 1	42.4	26.5	32.8	12.0	80.9	43.1	14.9	11.9	9.0	11.3	12.7	20.6
Elk Island	31.3	21.6	27.4	10.0	121.1	34.4	9.4	8.5	7.4	8.9	11.0	23.8
Fort Saskatchewan	43.1	37.6	41.5	15.1	244.6	51.0	11.6	10.1	7.7	22.1	13.3	22.1
Gibbons	34.0	52.4	30.6	11.5	283.6	52.0	15.1	13.7	10.6	14.4	17.8	26.1
Lamont County	43.4	24.4	35.1	9.9	89.0	41.1	14.5	12.4	8.2	9.4	11.9	19.7
Redwater	36.7	23.3	31.2	13.5	120.9	54.9	16.7	13.5	8.3	14.1	19.0	20.5
Portable at Bon Accord	37.9	50.8										
Portable at Chipman						37.8	11.9	9.1	6.9	9.8	11.8	21.2

Figure 28: Annual average $PM_{2.5}$ concentrations in Alberta



Hydrocarbons

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.

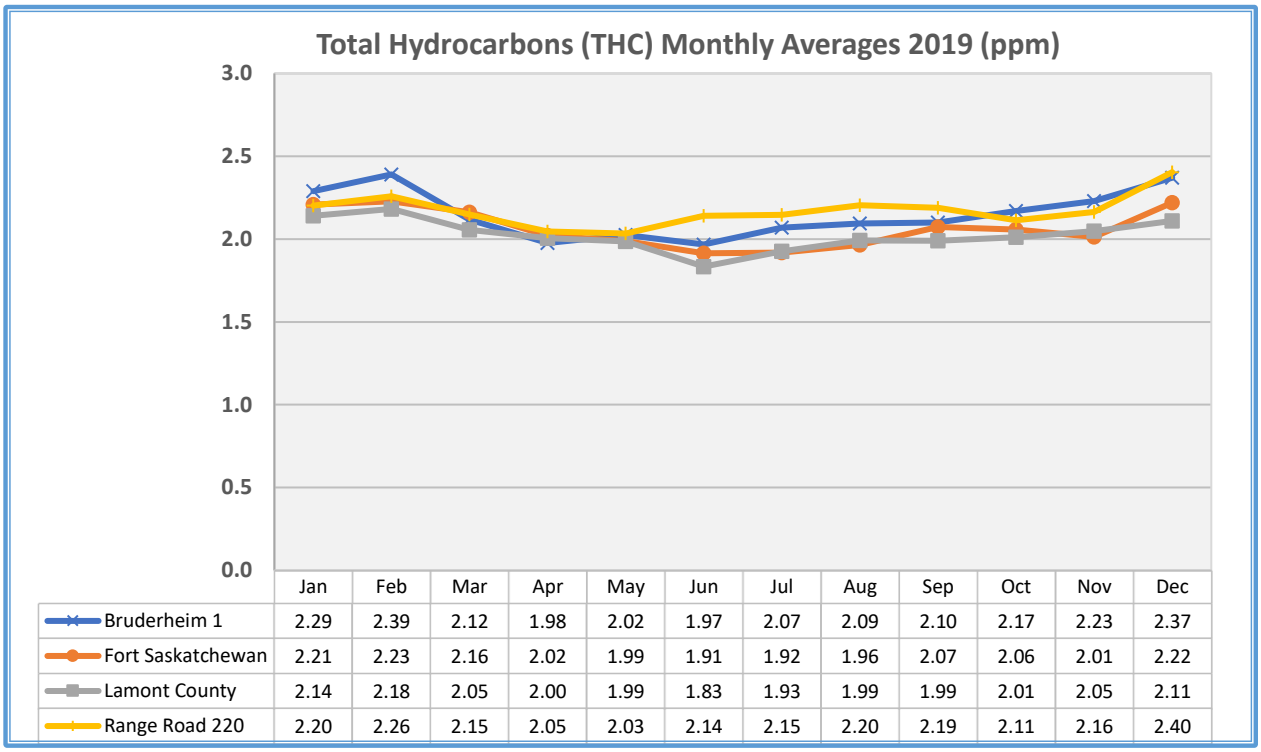
The major reactive hydrocarbon in the atmosphere is methane. Major worldwide sources of atmospheric methane include wetlands, ruminants such as cows, energy use, landfills, and burning biomass such as wood. Methane is the primary component of natural gas.

The reactive (or non-methane) hydrocarbons consist of many volatile organic compounds (VOC's), 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.

A summary of hydrocarbon concentrations recorded in 2019 at individual stations is presented in Figure 29 though Figure 31 below. Plots showing 2019 along with the previous 7 years are presented in Figure 32 through Figure 34 below. Note that the Bruderheim station was moved in March 2016 and renamed Bruderheim1.

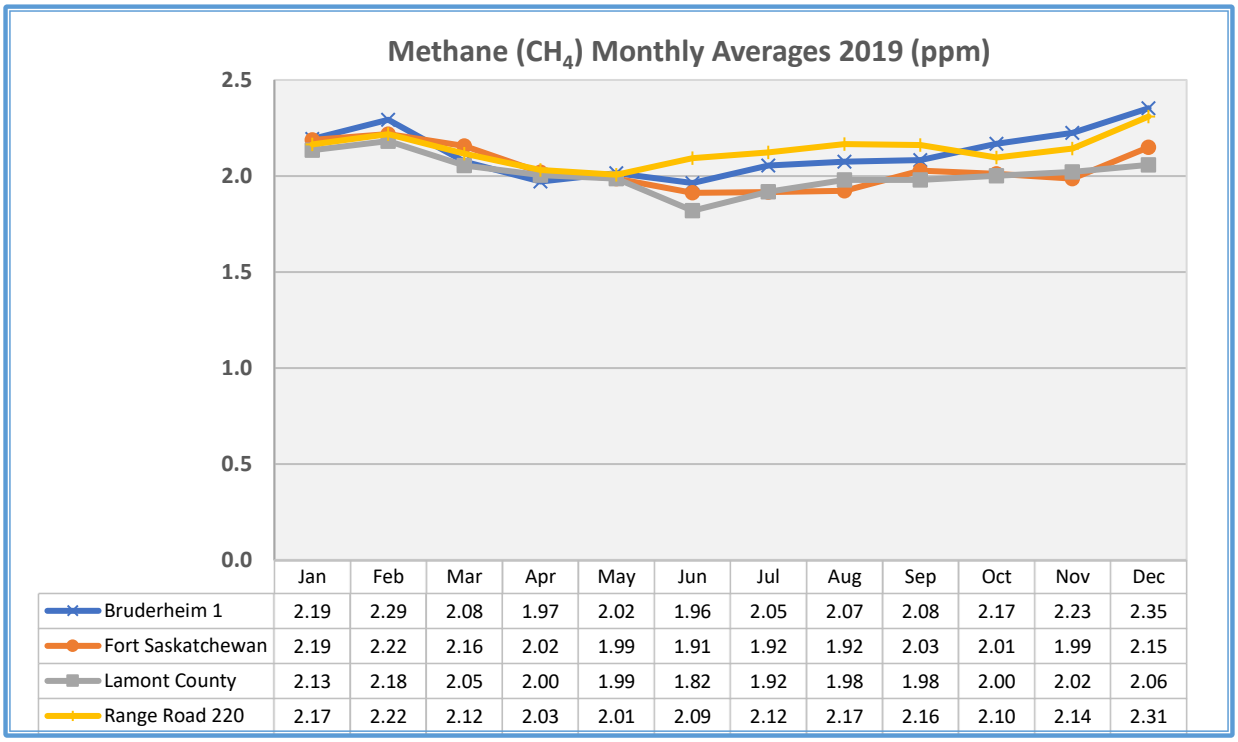
Figure 29: Monthly average Total Hydrocarbons in 2019



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Bruderheim 1	2.29	2.39	2.12	1.98	2.02	1.97	2.07	2.09	2.10	2.17	2.23	2.37
Fort Saskatchewan	2.21	2.23	2.16	2.02	1.99	1.91	1.92	1.96	2.07	2.06	2.01	2.22
Lamont County	2.14	2.18	2.05	2.00	1.99	1.83	1.93	1.99	1.99	2.01	2.05	2.11
Range Road 220	2.20	2.26	2.15	2.05	2.03	2.14	2.15	2.20	2.19	2.11	2.16	2.40

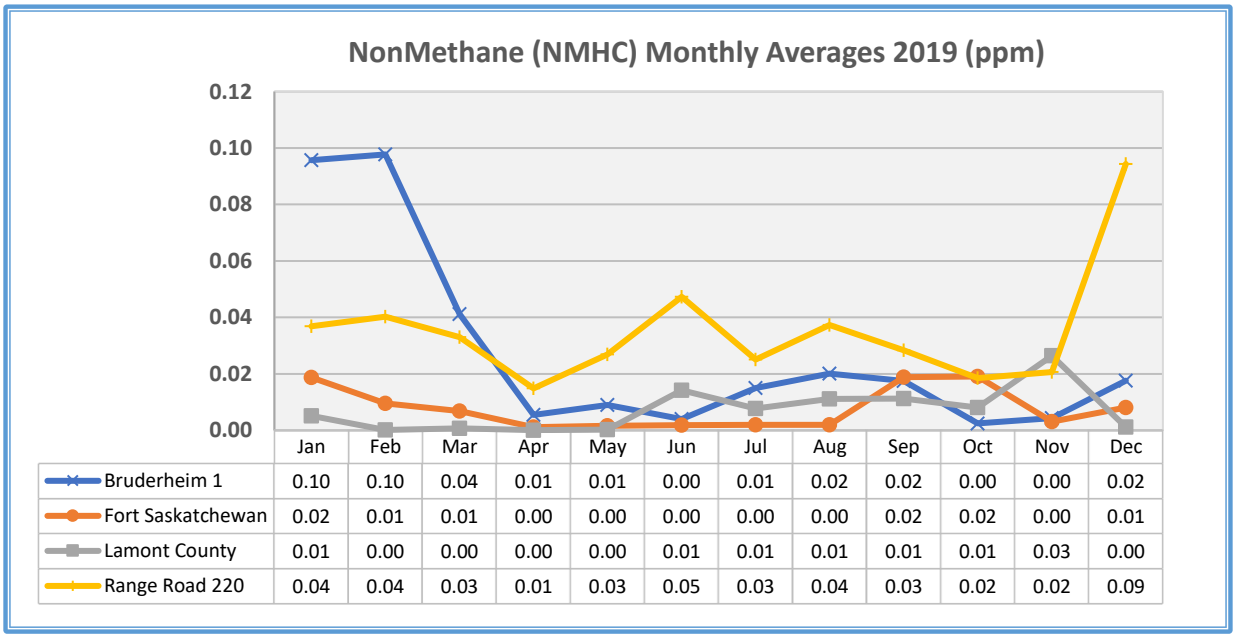
Hydrocarbons (continued)

Figure 30: Monthly average Methane concentrations in 2019



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Bruderheim 1	2.19	2.29	2.08	1.97	2.02	1.96	2.05	2.07	2.08	2.17	2.23	2.35
Fort Saskatchewan	2.19	2.22	2.16	2.02	1.99	1.91	1.92	1.92	2.03	2.01	1.99	2.15
Lamont County	2.13	2.18	2.05	2.00	1.99	1.82	1.92	1.98	1.98	2.00	2.02	2.06
Range Road 220	2.17	2.22	2.12	2.03	2.01	2.09	2.12	2.17	2.16	2.10	2.14	2.31

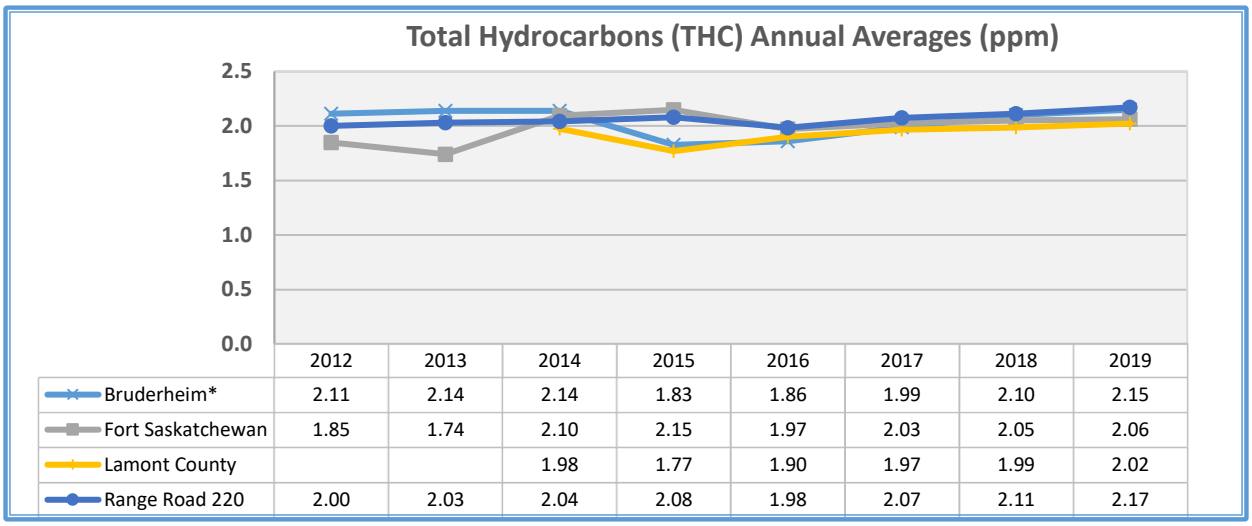
Figure 31: Monthly average Non-Methane Hydrocarbon concentrations in 2019



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Bruderheim 1	0.10	0.10	0.04	0.01	0.01	0.00	0.01	0.02	0.02	0.00	0.00	0.02
Fort Saskatchewan	0.02	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.02	0.02	0.00	0.01
Lamont County	0.01	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.03	0.00
Range Road 220	0.04	0.04	0.03	0.01	0.03	0.05	0.03	0.04	0.03	0.02	0.02	0.09

Hydrocarbons (continued)

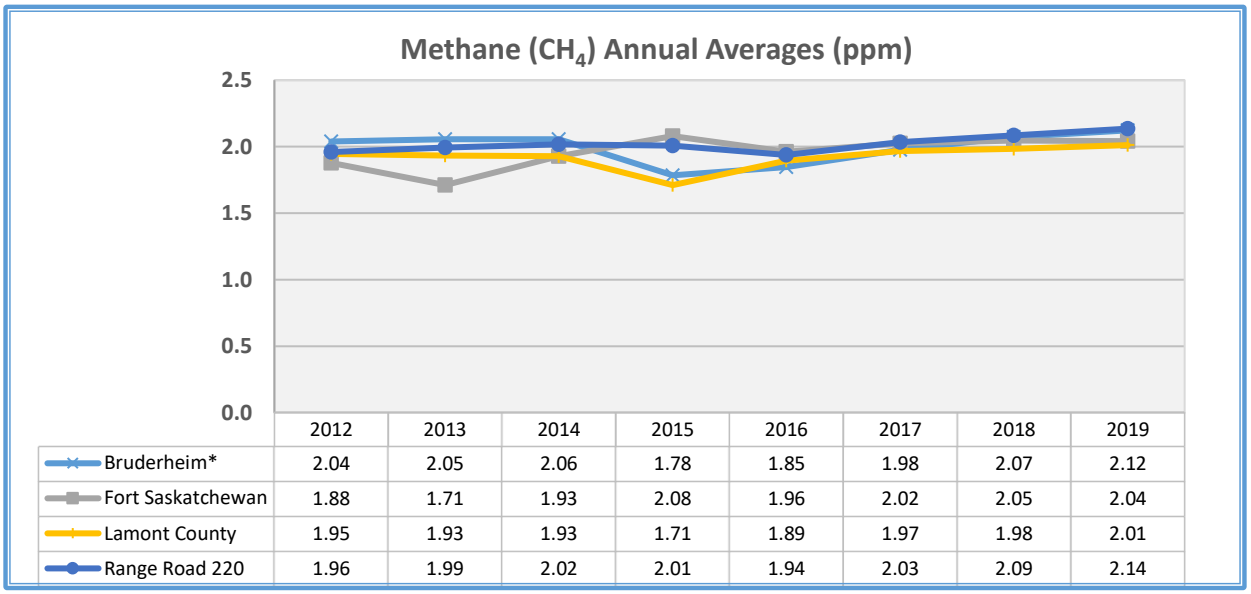
Figure 32: Annual average THC concentrations



	2012	2013	2014	2015	2016	2017	2018	2019
Bruderheim*	2.11	2.14	2.14	1.83	1.86	1.99	2.10	2.15
Fort Saskatchewan	1.85	1.74	2.10	2.15	1.97	2.03	2.05	2.06
Lamont County			1.98	1.77	1.90	1.97	1.99	2.02
Range Road 220	2.00	2.03	2.04	2.08	1.98	2.07	2.11	2.17

*The Bruderheim graph combines data from both locations in Bruderhiem.
The Total Hydrocarbon measurement was added ot the Lamont County station in 2014.

Figure 33: Annual average CH_4 concentrations

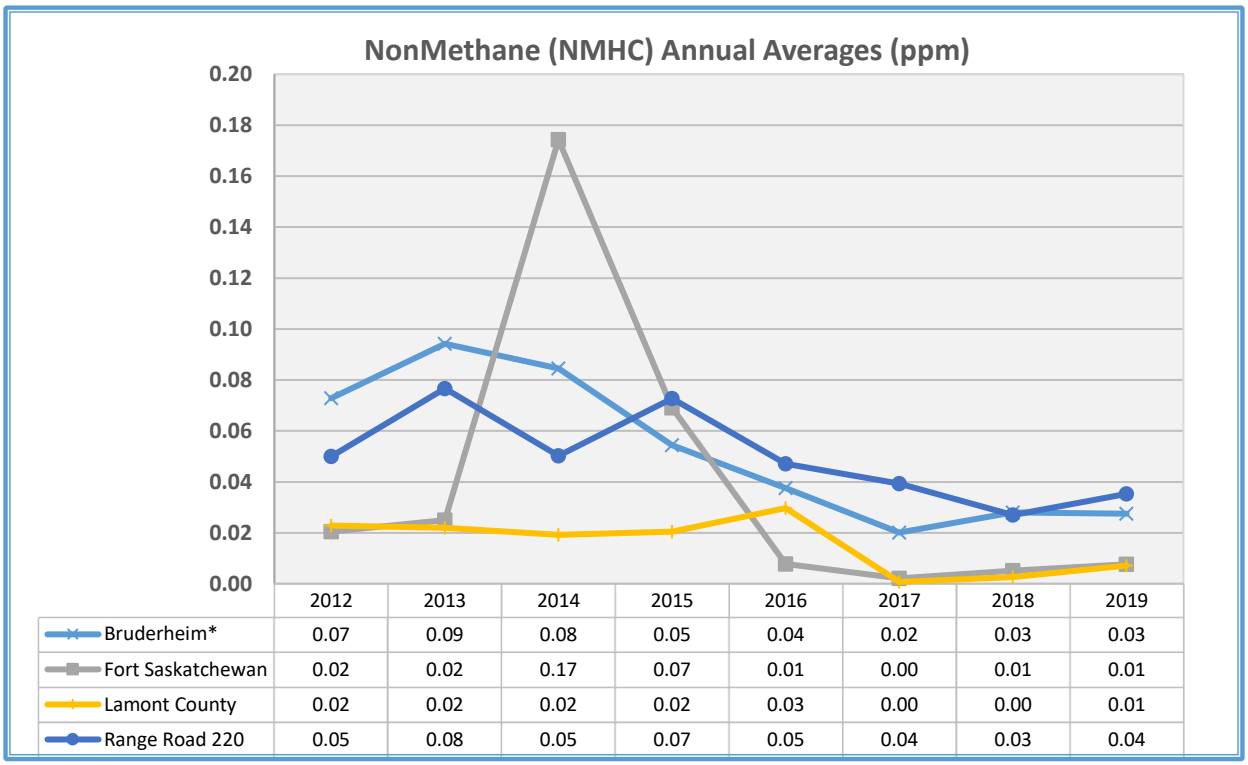


	2012	2013	2014	2015	2016	2017	2018	2019
Bruderheim*	2.04	2.05	2.06	1.78	1.85	1.98	2.07	2.12
Fort Saskatchewan	1.88	1.71	1.93	2.08	1.96	2.02	2.05	2.04
Lamont County	1.95	1.93	1.93	1.71	1.89	1.97	1.98	2.01
Range Road 220	1.96	1.99	2.02	2.01	1.94	2.03	2.09	2.14

*The Bruderheim graph combines data from both locations in Bruderhiem

Hydrocarbons (continued)

Figure 34: Annual average NMHC concentrations



	2012	2013	2014	2015	2016	2017	2018	2019
Bruderheim*	0.07	0.09	0.08	0.05	0.04	0.02	0.03	0.03
Fort Saskatchewan	0.02	0.02	0.17	0.07	0.01	0.00	0.01	0.01
Lamont County	0.02	0.02	0.02	0.02	0.03	0.00	0.00	0.01
Range Road 220	0.05	0.08	0.05	0.07	0.05	0.04	0.03	0.04

*The Bruderheim graph combines data from both locations in Bruderhiem

Hydrocarbons (continued)

Although the average and maximum hydrocarbon values recorded are similar at the various monitoring sites, it should be noted that the Bruderheim station has historically measured brief hydrocarbon "spikes" that the other stations have not. The source has not been determined but it is likely from a nearby source due to the short duration of these events and the volatile nature of hydrocarbons. Table 16 provides the maximum 1-hour average for each hydrocarbon species as measured as each FAP stations each month.

Table 16: Maximum 1-hour average Hydrocarbon concentrations (ppm) in 2019

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Total Hydrocarbons THC (PPM)												
Bruderheim 1	6.75	4.96	5.10	4.11	3.90	3.40	3.62	4.59	4.90	3.26	3.73	5.93
Fort Saskatchewan	3.89	3.23	3.55	2.81	2.44	2.60	2.58	2.62	3.12	2.85	2.60	3.52
Lamont County	4.22	2.67	2.70	4.38	2.81	2.31	2.93	2.77	2.62	2.35	2.40	2.57
Range Road 220	4.54	4.10	4.15	4.47	6.76	6.96	4.49	6.87	4.47	3.96	3.26	5.17
Portable at Chipman						3.11	4.11	4.08	3.35	2.64	2.36	3.24
Methane CH_4 (PPM)												
Bruderheim 1	5.23	4.08	3.98	3.49	3.45	3.12	3.29	3.93	3.77	3.13	3.35	4.89
Fort Saskatchewan	3.72	3.01	3.53	2.81	2.44	2.20	2.51	2.42	2.51	2.57	2.47	2.99
Lamont County	4.09	2.67	2.70	4.37	2.80	2.20	2.90	2.56	2.48	2.30	2.34	2.42
Range Road 220	3.47	3.82	3.16	2.73	2.62	2.50	2.87	3.30	3.25	2.63	2.75	3.09
Portable at Chipman						3.02	4.05	4.04	3.35	2.63	2.36	3.24
Non-Methane Hydrocarbons NMHC (PPM)												
Bruderheim 1	1.51	0.89	1.12	0.62	0.45	0.30	0.36	0.73	1.13	0.21	0.39	1.03
Fort Saskatchewan	0.44	0.48	0.57	0.21	0.20	0.56	0.33	0.62	1.05	0.36	0.63	1.18
Lamont County	0.35	0.02	0.21	0.02	0.05	0.14	0.10	0.37	0.50	0.13	0.15	0.24
Range Road 220	1.75	1.55	1.82	2.38	4.80	4.79	2.20	3.87	2.20	1.88	1.14	2.80
Portable at Chipman						0.14	0.11	0.09	0.01	0.02	0.00	0.00

Hydrogen Sulphide

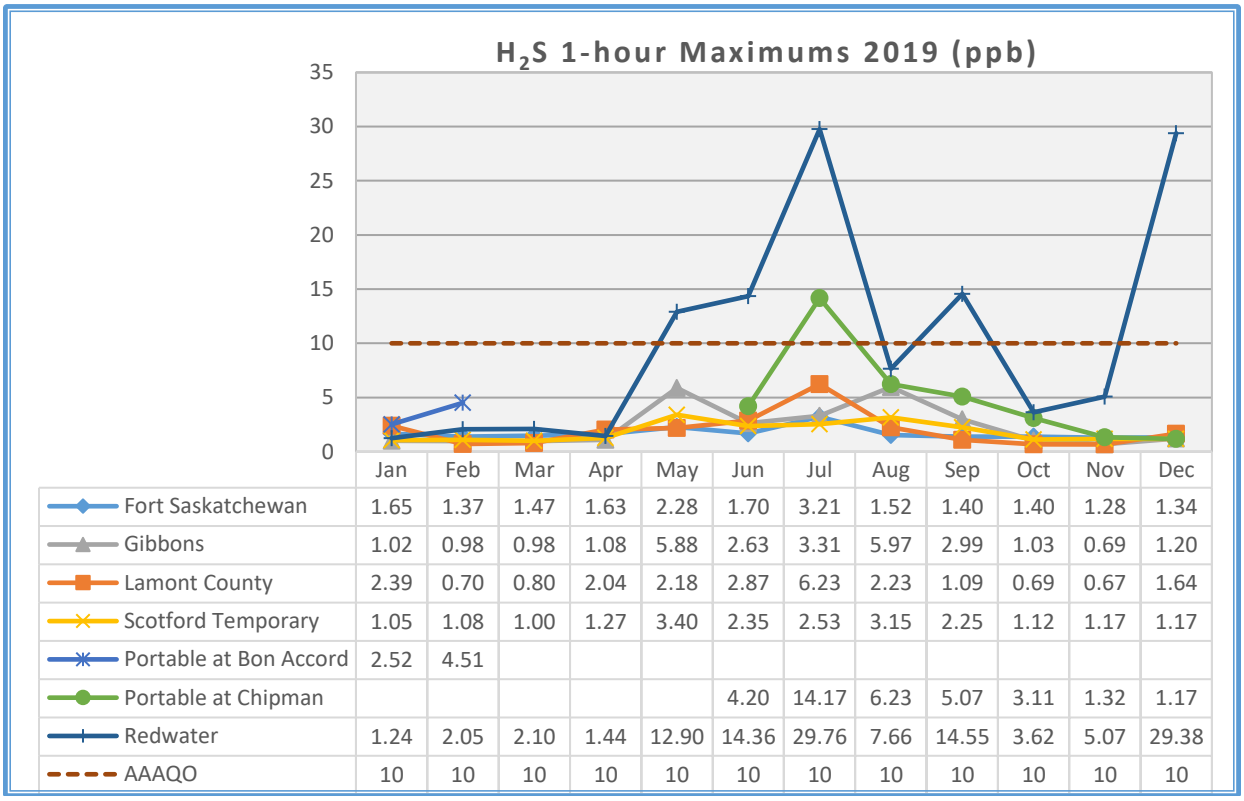
Hydrogen sulphide (H_2S) is a colourless gas with a rotten egg odour. Industrial sources of H_2S include fugitive emissions (leakages) from petroleum refineries, tank farms for unrefined petroleum products, natural gas plants, petrochemical plants, sewage treatment facilities, and animal feedlots. Natural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

The AAAQOs for H_2S are:

- 1-hour average concentration 10ppb
- 24-hour average concentration 3ppb

There were nine exceedances of the 1-hour guideline and one 24-hour exceedance of the AAAQO for H_2S in 2019. Details of these exceedances are provided earlier in this report. Figure 35 presents maximum 1-hour average measurements each month at FAP stations.

Figure 35: Maximum 1-hour average H_2S concentrations in 2019

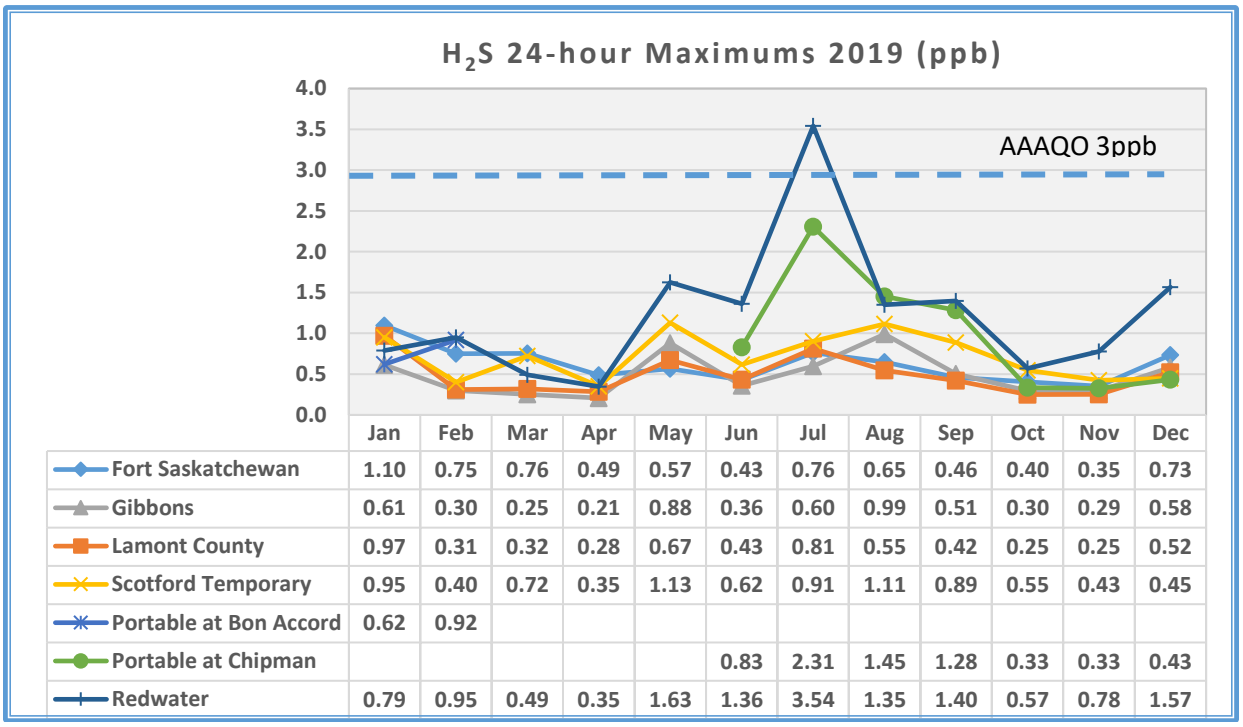


	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Fort Saskatchewan	1.65	1.37	1.47	1.63	2.28	1.70	3.21	1.52	1.40	1.40	1.28	1.34
Gibbons	1.02	0.98	0.98	1.08	5.88	2.63	3.31	5.97	2.99	1.03	0.69	1.20
Lamont County	2.39	0.70	0.80	2.04	2.18	2.87	6.23	2.23	1.09	0.69	0.67	1.64
Scotford Temporary	1.05	1.08	1.00	1.27	3.40	2.35	2.53	3.15	2.25	1.12	1.17	1.17
Portable at Bon Accord	2.52	4.51										
Portable at Chipman						4.20	14.17	6.23	5.07	3.11	1.32	1.17
Redwater	1.24	2.05	2.10	1.44	12.90	14.36	29.76	7.66	14.55	3.62	5.07	29.38
AAAQO	10	10	10	10	10	10	10	10	10	10	10	10

A summary of the monthly average H_2S concentrations recorded in 2019 at individual stations and annual averages back to 2012 is presented in Figure 36 and Figure 37 below.

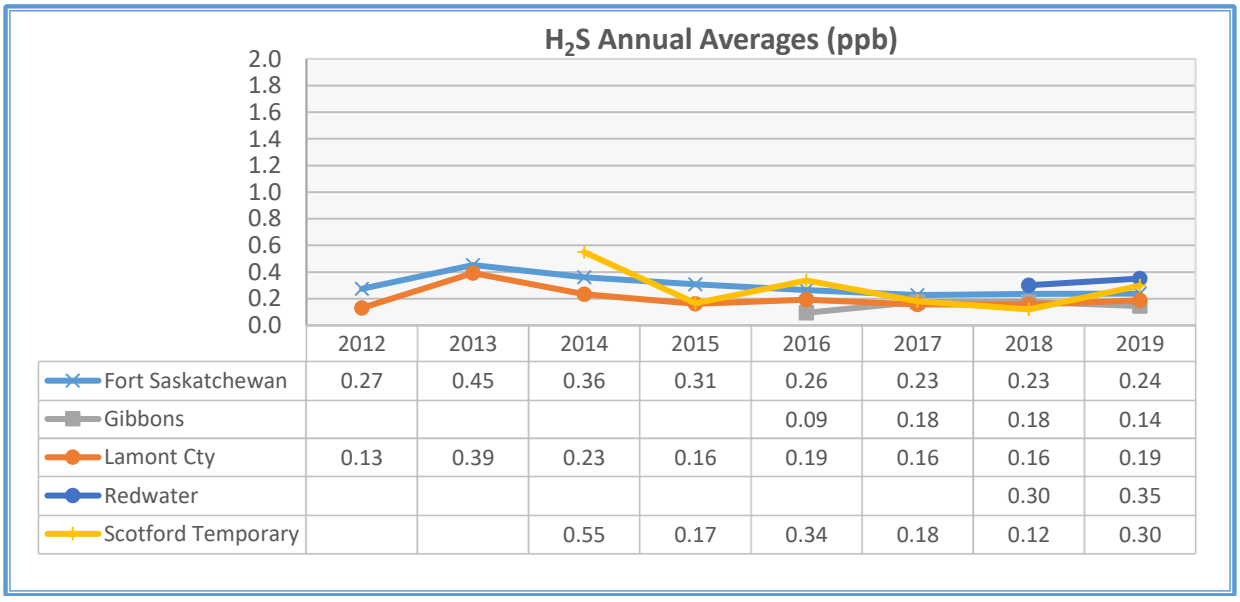
Hydrogen Sulphide (continued)

Figure 36: Monthly average H_2S concentrations in 2019



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Fort Saskatchewan	1.10	0.75	0.76	0.49	0.57	0.43	0.76	0.65	0.46	0.40	0.35	0.73
Gibbons	0.61	0.30	0.25	0.21	0.88	0.36	0.60	0.99	0.51	0.30	0.29	0.58
Lamont County	0.97	0.31	0.32	0.28	0.67	0.43	0.81	0.55	0.42	0.25	0.25	0.52
Scotford Temporary	0.95	0.40	0.72	0.35	1.13	0.62	0.91	1.11	0.89	0.55	0.43	0.45
Portable at Bon Accord	0.62	0.92										
Portable at Chipman						0.83	2.31	1.45	1.28	0.33	0.33	0.43
Redwater	0.79	0.95	0.49	0.35	1.63	1.36	3.54	1.35	1.40	0.57	0.78	1.57

Figure 37: Annual average H_2S concentrations



	2012	2013	2014	2015	2016	2017	2018	2019
Fort Saskatchewan	0.27	0.45	0.36	0.31	0.26	0.23	0.23	0.24
Gibbons					0.09	0.18	0.18	0.14
Lamont Cty	0.13	0.39	0.23	0.16	0.19	0.16	0.16	0.19
Redwater							0.30	0.35
Scotford Temporary			0.55	0.17	0.34	0.18	0.12	0.30

Note: The Redwater station began operations late in 2017
The Gibbons station began operations in February 2016.
The Scotford 2 station was moved in April 2014 and became Scotford Temporary

Nitrogen Dioxide

Oxides of nitrogen (NO_x) are the total of nitrogen dioxide (NO_2) and nitric oxide (NO). During high temperature combustion, such as burning of natural gas, coal, oil and gasoline, atmospheric nitrogen may combine with molecular oxygen to form NO. NO is colourless and odourless. Most NO in the ambient air will react with O_3 to form NO_2. NO_2 is a reddish-brown gas with a pungent odour and is partially responsible for the "brown haze" observed near large cities.

Transportation (automobiles, locomotives and aircraft) is the major source of NO_x in Alberta. Other significant sources include industrial sources (oil and gas industries). Smaller sources of NO_x include natural gas combustion, heating fuel combustion, and forest fires.

The AAAQOs for NO_2 are:

- 1-hour average concentration 159 ppb
- Annual average concentration 24 ppb

Comparing the air quality monitoring data in the FAP region during 2019 against the AAAQOs, it was observed that there were no exceedances of the 1-hour AAAQO for NO_2. The annual average concentration at each FAP station was well below the AAAQO.

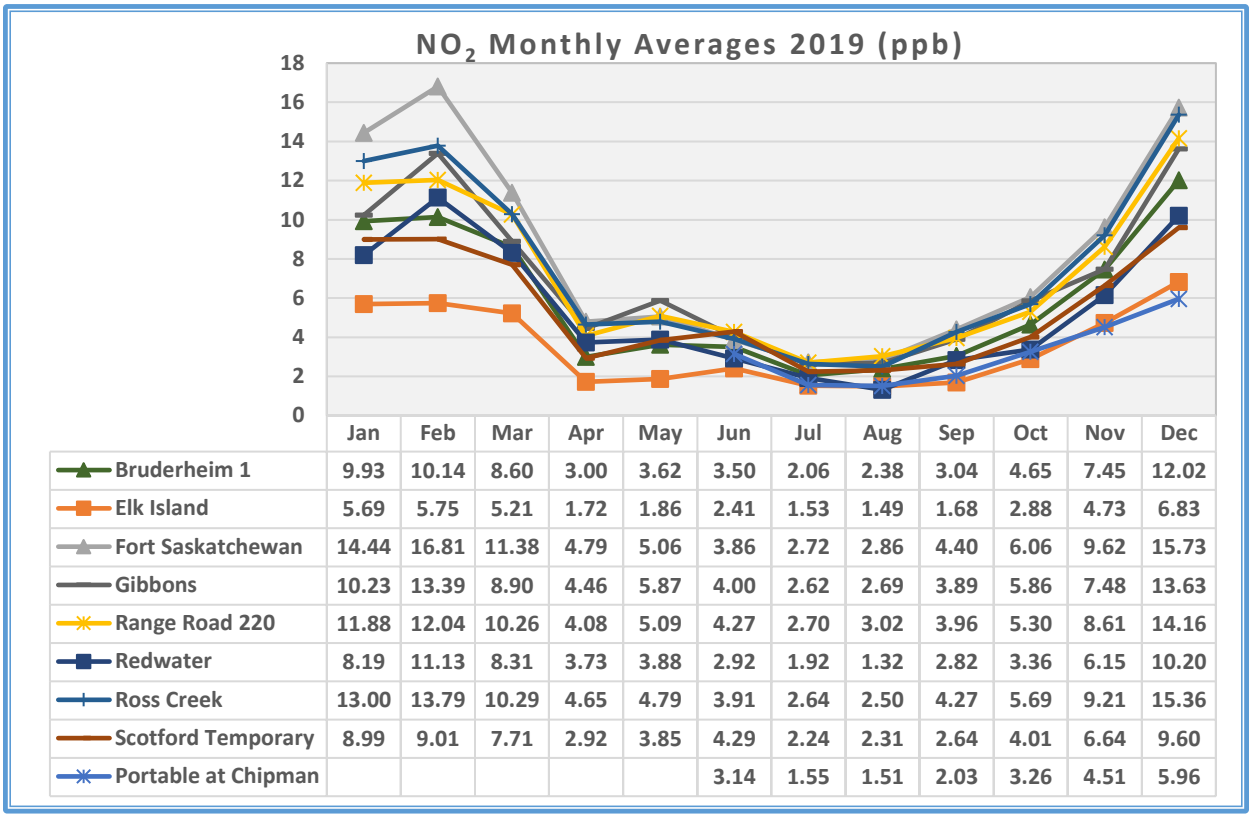
The maximum annual average NO_2 concentration measured was 8.1 ppb at the Fort Saskatchewan station (34% of the annual AAAQO).

While there is no AAAQO for monthly average concentrations of NO_2, the monthly averages values are useful to show that variation in NO_2 concentrations is seasonal. The maximum monthly NO_2 values occur during the winter months of November to February (refer to Figure 31). This normally occurs due to lower atmospheric mixing heights during colder weather where emissions tend to accumulate near the ground and not disperse as readily, this is commonly referred to as a temperature inversion.

A summary of NO_2 concentrations recorded at individual stations and a comparison with the previous 7 years are presented in Figure 38 and Figure 39 below respectively. Figure 40 is a view of the annual average in 2019 compared with the previous 2 years.

Nitrogen Dioxide (continued)

Figure 38: Monthly average NO_2 concentrations in 2019

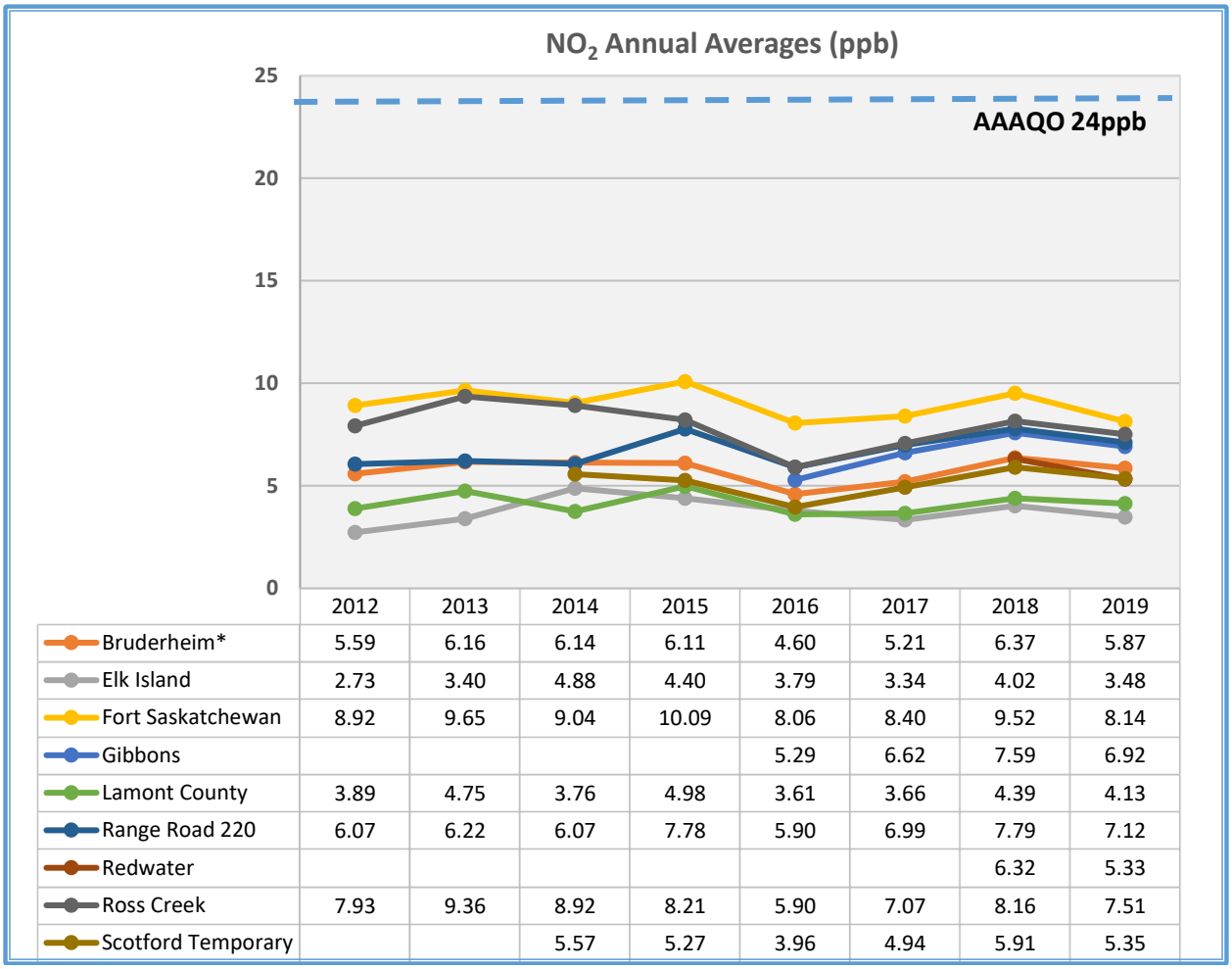


	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Bruderheim 1	9.93	10.14	8.60	3.00	3.62	3.50	2.06	2.38	3.04	4.65	7.45	12.02
Elk Island	5.69	5.75	5.21	1.72	1.86	2.41	1.53	1.49	1.68	2.88	4.73	6.83
Fort Saskatchewan	14.44	16.81	11.38	4.79	5.06	3.86	2.72	2.86	4.40	6.06	9.62	15.73
Gibbons	10.23	13.39	8.90	4.46	5.87	4.00	2.62	2.69	3.89	5.86	7.48	13.63
Range Road 220	11.88	12.04	10.26	4.08	5.09	4.27	2.70	3.02	3.96	5.30	8.61	14.16
Redwater	8.19	11.13	8.31	3.73	3.88	2.92	1.92	1.32	2.82	3.36	6.15	10.20
Ross Creek	13.00	13.79	10.29	4.65	4.79	3.91	2.64	2.50	4.27	5.69	9.21	15.36
Scotford Temporary	8.99	9.01	7.71	2.92	3.85	4.29	2.24	2.31	2.64	4.01	6.64	9.60
Portable at Chipman						3.14	1.55	1.51	2.03	3.26	4.51	5.96

Note: The Portable at Chipman began operation in June 2019

Nitrogen Dioxide (continued)

Figure 39: Annual average NO_2 concentrations at FAP stations

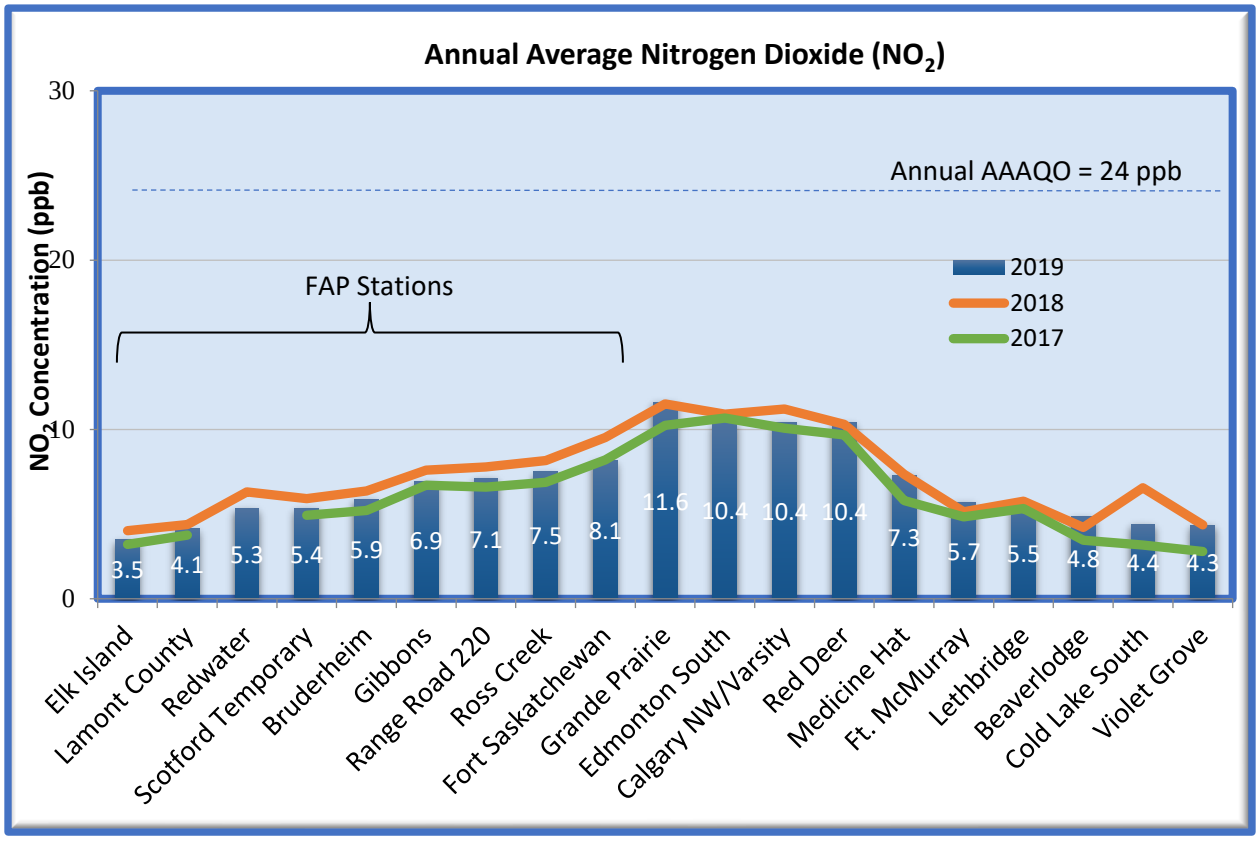


	2012	2013	2014	2015	2016	2017	2018	2019
Bruderheim*	5.59	6.16	6.14	6.11	4.60	5.21	6.37	5.87
Elk Island	2.73	3.40	4.88	4.40	3.79	3.34	4.02	3.48
Fort Saskatchewan	8.92	9.65	9.04	10.09	8.06	8.40	9.52	8.14
Gibbons					5.29	6.62	7.59	6.92
Lamont County	3.89	4.75	3.76	4.98	3.61	3.66	4.39	4.13
Range Road 220	6.07	6.22	6.07	7.78	5.90	6.99	7.79	7.12
Redwater							6.32	5.33
Ross Creek	7.93	9.36	8.92	8.21	5.90	7.07	8.16	7.51
Scotford Temporary			5.57	5.27	3.96	4.94	5.91	5.35

*The Bruderheim station was moved and was renamed Bruderheim 1 in March 2016. The annual averages include data from both Bruderheim and Bruderheim1 stations
The Gibbons station began operations in February 2016
The Redwater station began operation October 2017

Nitrogen Dioxide (continued)

Figure 40: Annual average NO_2 concentrations in Alberta



Nitric oxide (NO) and oxides of nitrogen (NO_x) are also measured at FAP monitoring stations. Data for these parameters are available through the Government of Alberta data warehouse.

Ozone

Unlike other pollutants, ozone (O_3) is not emitted directly by anthropogenic 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. O_3 is also transported to the ground from the "ozone rich" upper atmosphere by natural weather processes. O_3 and its precursors, such as NO_x and VOCs, may also be carried from upwind sources such as urban centers and industrial complexes. This phenomenon can be observed particularly in summer in Alberta when warm temperatures (~30 °C) 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. This is due to the destruction of O_3 by nitric oxide (NO) that is emitted by the combustion of fossil fuels. A significant natural source of VOCs in remote and rural areas in Alberta is emissions from trees and vegetation. O_3 levels are usually higher during the spring and summer months due to increased transport from the upper atmosphere and more sunlight, which allows O_3 forming chemical reactions to occur more rapidly.

At normal outdoor concentrations, O_3 is a colourless, odourless gas. However, O_3 does have a characteristic sharp ‘very fresh air’ odour at very high concentrations, such as that experienced immediately after lightning storms. However, the highest maximum one-hour values tend to occur later in the summer, during hot summer afternoons under low wind conditions. In 2019 this occurred during hot weather in May and did not happen again during the somewhat cooler, wetter summer months as shown in Figure 41. Peak concentrations for ozone are relevant because of potential health effects. However, the highest monthly average concentrations tend to occur during the spring months, as seen in Figure 42, when the overall background ozone levels are highest.Figure 42

The AAAQO for ozone is:

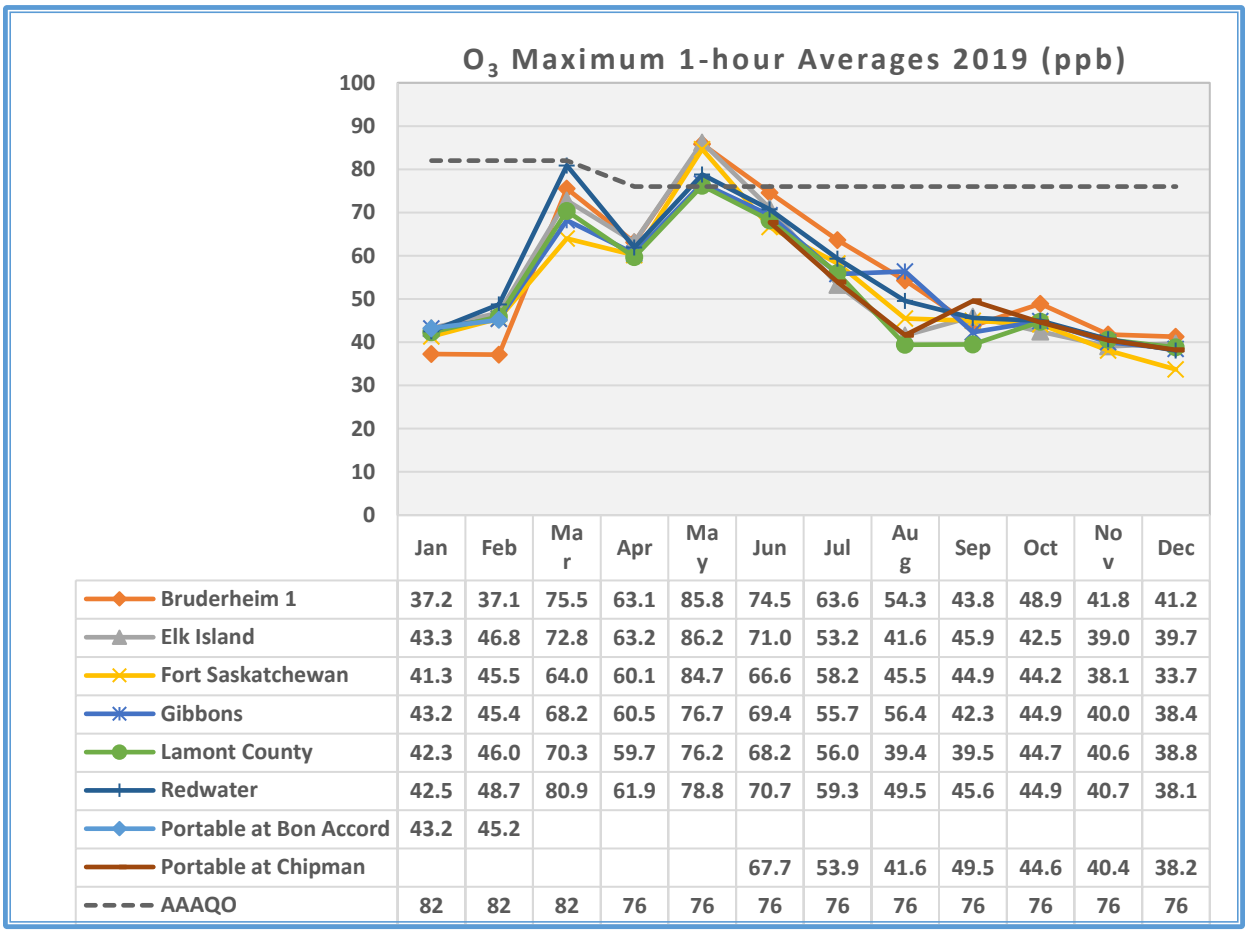
- 1-hour average concentration 82 ppb (until April 1, 2019)
- As of April 1, the 1-hour average AAAQO was 76 ppb. Note the AAAQO change in Figure 42.

There were 24 exceedances of the 1-hour AAAQO for ozone at FAP stations in 2019. The highest 1-hour average for ozone was 86.2 ppb occurring on May 28th at the Elk Island station. The 24 exceedances occurred at six different stations all on May 28th and 29th. All these exceedances were attributed to summertime smog.

Figure 43 below shows annual averages of O_3 for all FAP stations going back to 2012. Figure 44 plots annual averages at FAP sites alongside selected stations across Alberta for the last 3 years.

Ozone (continued)

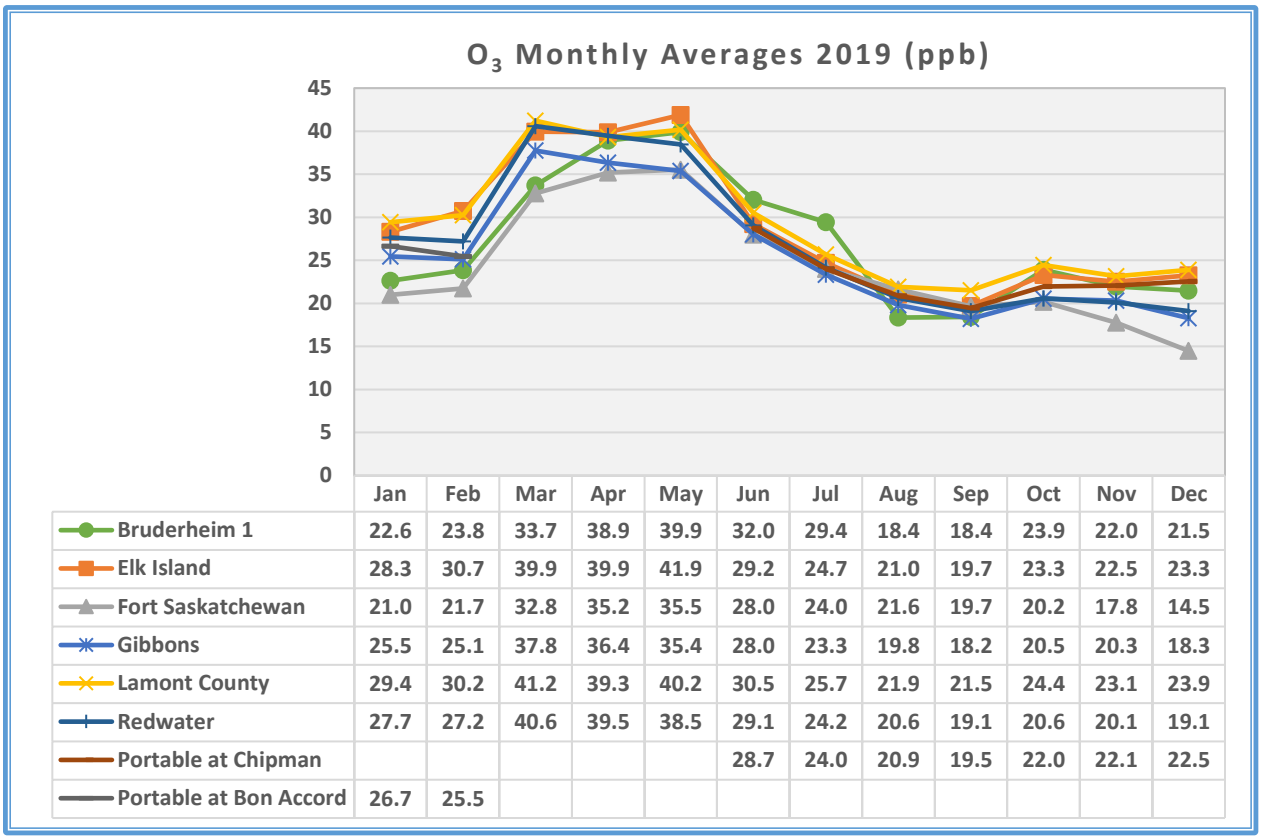
Figure 41: Maximum 1-hour average Ozone concentrations in 2019



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Bruderheim 1	37.2	37.1	75.5	63.1	85.8	74.5	63.6	54.3	43.8	48.9	41.8	41.2
Elk Island	43.3	46.8	72.8	63.2	86.2	71.0	53.2	41.6	45.9	42.5	39.0	39.7
Fort Saskatchewan	41.3	45.5	64.0	60.1	84.7	66.6	58.2	45.5	44.9	44.2	38.1	33.7
Gibbons	43.2	45.4	68.2	60.5	76.7	69.4	55.7	56.4	42.3	44.9	40.0	38.4
Lamont County	42.3	46.0	70.3	59.7	76.2	68.2	56.0	39.4	39.5	44.7	40.6	38.8
Redwater	42.5	48.7	80.9	61.9	78.8	70.7	59.3	49.5	45.6	44.9	40.7	38.1
Portable at Bon Accord	43.2	45.2										
Portable at Chipman						67.7	53.9	41.6	49.5	44.6	40.4	38.2
AAAQO	82	82	82	76	76	76	76	76	76	76	76	76

Ozone (continued)

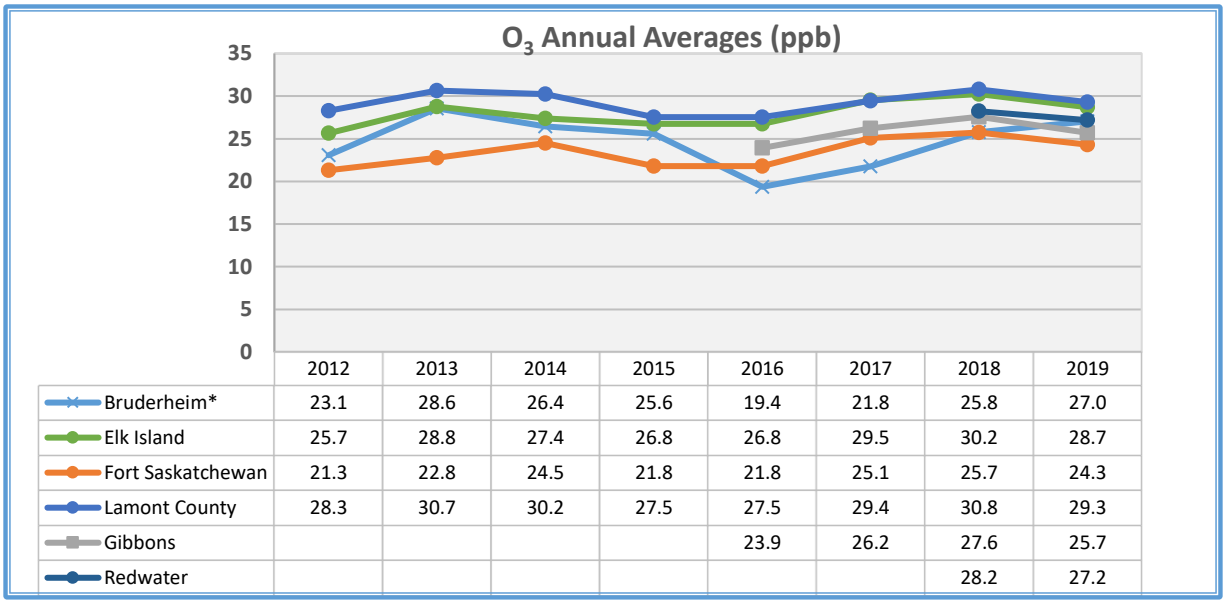
Figure 42: Monthly average O_3 concentrations in 2019



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Bruderheim 1	22.6	23.8	33.7	38.9	39.9	32.0	29.4	18.4	18.4	23.9	22.0	21.5
Elk Island	28.3	30.7	39.9	39.9	41.9	29.2	24.7	21.0	19.7	23.3	22.5	23.3
Fort Saskatchewan	21.0	21.7	32.8	35.2	35.5	28.0	24.0	21.6	19.7	20.2	17.8	14.5
Gibbons	25.5	25.1	37.8	36.4	35.4	28.0	23.3	19.8	18.2	20.5	20.3	18.3
Lamont County	29.4	30.2	41.2	39.3	40.2	30.5	25.7	21.9	21.5	24.4	23.1	23.9
Redwater	27.7	27.2	40.6	39.5	38.5	29.1	24.2	20.6	19.1	20.6	20.1	19.1
Portable at Chipman						28.7	24.0	20.9	19.5	22.0	22.1	22.5
Portable at Bon Accord	26.7	25.5										

Figure 43 Below shows the annual average O_3 concentrations in the FAP network going back to 2012.

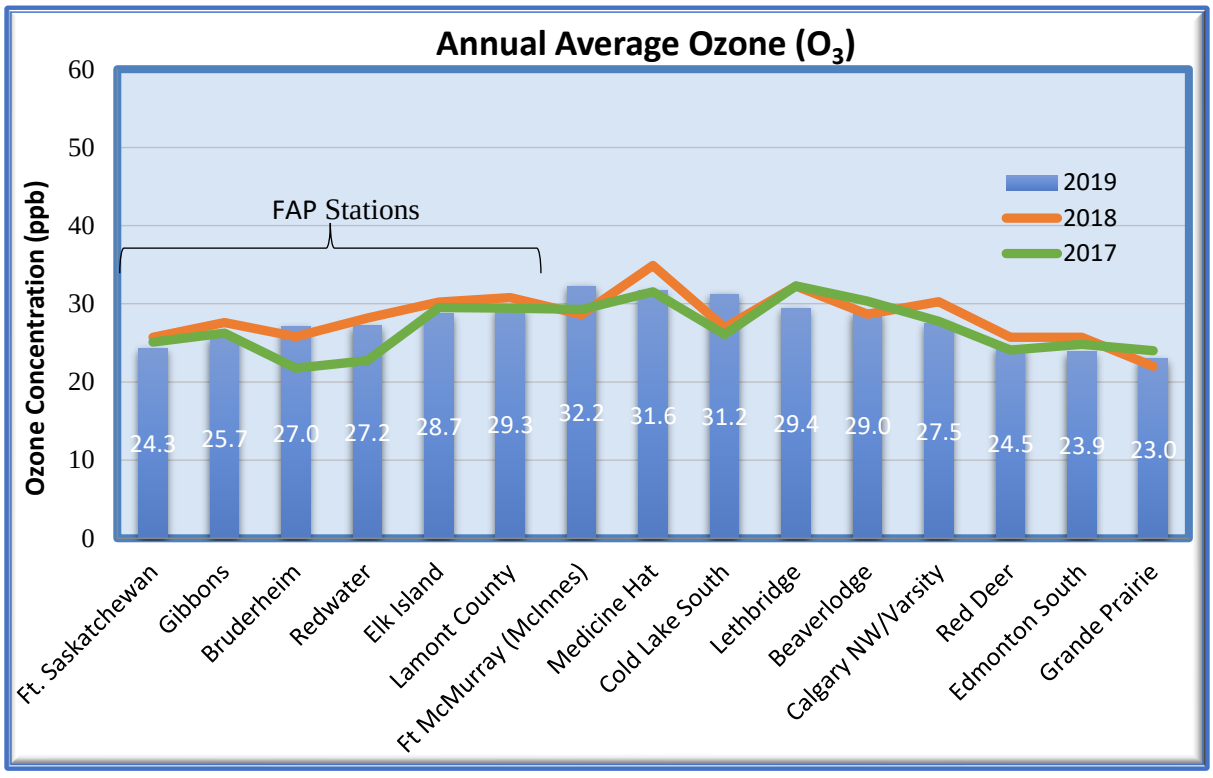
Figure 43: Annual average O_3 concentrations at FAP stations



	2012	2013	2014	2015	2016	2017	2018	2019
Bruderheim*	23.1	28.6	26.4	25.6	19.4	21.8	25.8	27.0
Elk Island	25.7	28.8	27.4	26.8	26.8	29.5	30.2	28.7
Fort Saskatchewan	21.3	22.8	24.5	21.8	21.8	25.1	25.7	24.3
Lamont County	28.3	30.7	30.2	27.5	27.5	29.4	30.8	29.3
Gibbons					23.9	26.2	27.6	25.7
Redwater							28.2	27.2

*The Bruderheim station was moved in 2016 and renamed Bruderheim 1
Bruderheim 2016 average includes data from both Bruderheim and Bruderheim1 stations

Figure 44: Annual average O_3 concentrations in Alberta



Sulphur Dioxide

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. SO_2 measured in the Airshed is primarily from industrial sources, from both within and outside the FAP boundary.

The AAAQOs for sulphur dioxide are:

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

There were no exceedances of any of the AAAQOs for SO_2 at any of the FAP monitoring stations in 2019.
Comparing air quality monitoring data in the Fort Air Partnership region for 2019 against the AAAQO, it was observed that the maximum 1-hour average was 39% of the AAAQO while the highest 24-hour average was 16.2% of that AAAQO. The maximum 1 and 24-hour averages at each FAP continuous monitoring station are shown in Table 17 below.

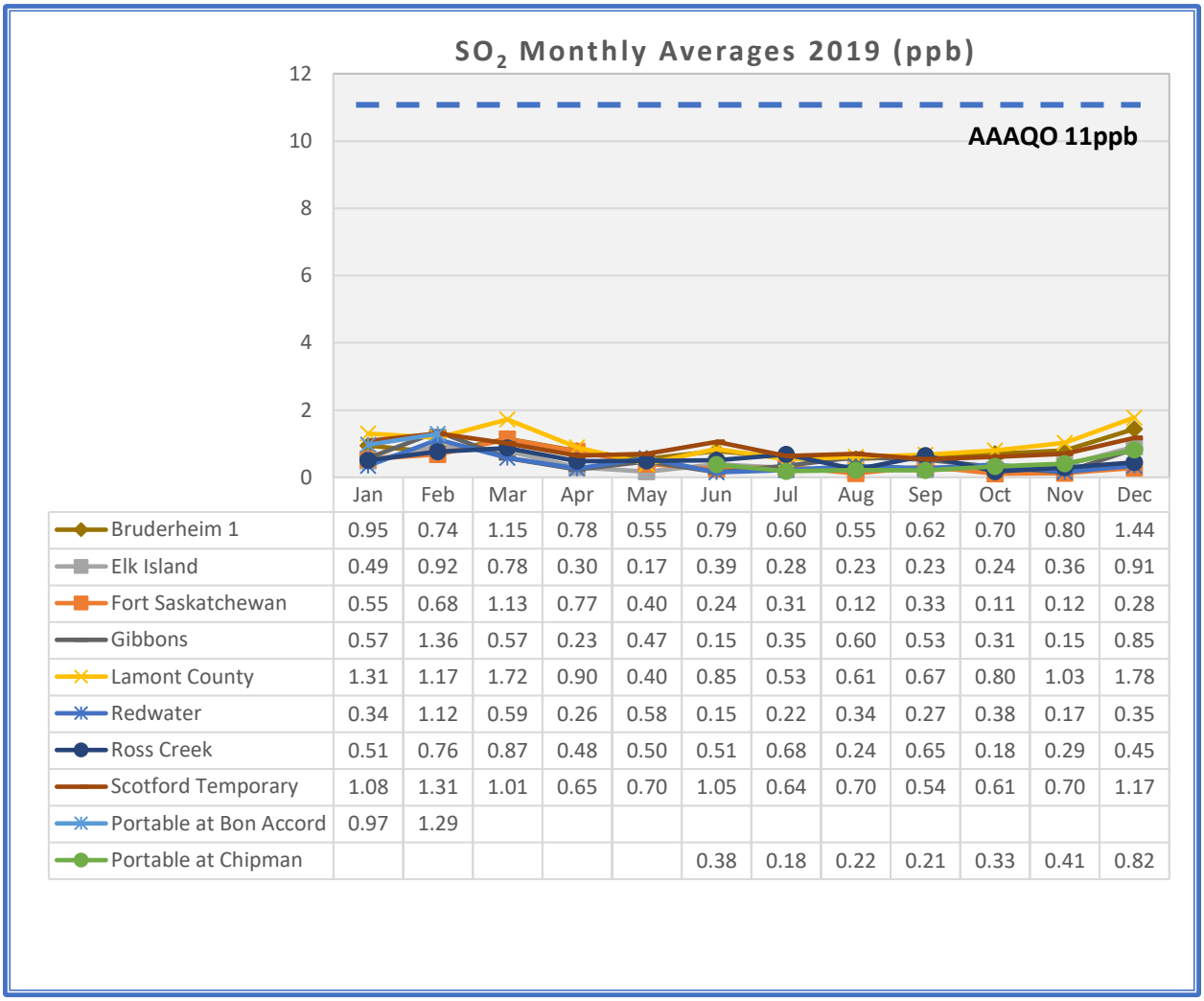
Table 17: 2019 maximum averages and AAAQOs for SO_2 (ppb)

Station	Highest 1-hour average (ppb)	% of AAAQO	Date Time	Highest 24-hour average (ppb)	% of AAAQO	Date
Bruderheim 1	23.0	13.4%	May 28 09:00	6.1	12.7%	Dec 26
Elk Island	25.8	15.0%	Mar 22 13:00	6.1	12.7%	Mar 22
Fort Saskatchewan	26.6	15.5%	Mar 20 12:00	4.3	9.0%	Mar 20
Gibbons	21.6	12.5%	Aug 12 11:00	4.0	8.3%	Feb 15
Lamont County	28.2	16.4%	May 28 09:00	7.4	15.5%	Dec 26
Redwater	67.1	39.0%	Feb 09 17:00	7.8	16.2%	Feb 09
Ross Creek	40.1	23.3%	Mar 20 13:00	4.9	10.1%	Mar 20
Scotford Temporary	21.2	12.4%	May 31 06:00	5.2	10.8%	May 31
Portable at Bon Accord	17.6	10.2%	Feb 14 15:00	4.4	9.2%	Feb 15
Portable at Chipman	25.7	15.0%	Jun 26 11:00	3.1	6.5%	Dec 26

Sulphur Dioxide (continued)

A summary of SO_2 concentrations recorded in 2019 at individual stations is presented in Figure 45 below and a comparison of annual averages back to 2012 is shown in Figure 46. Figure 47 shows the annual averages of SO_2 at FAP stations back to 2012

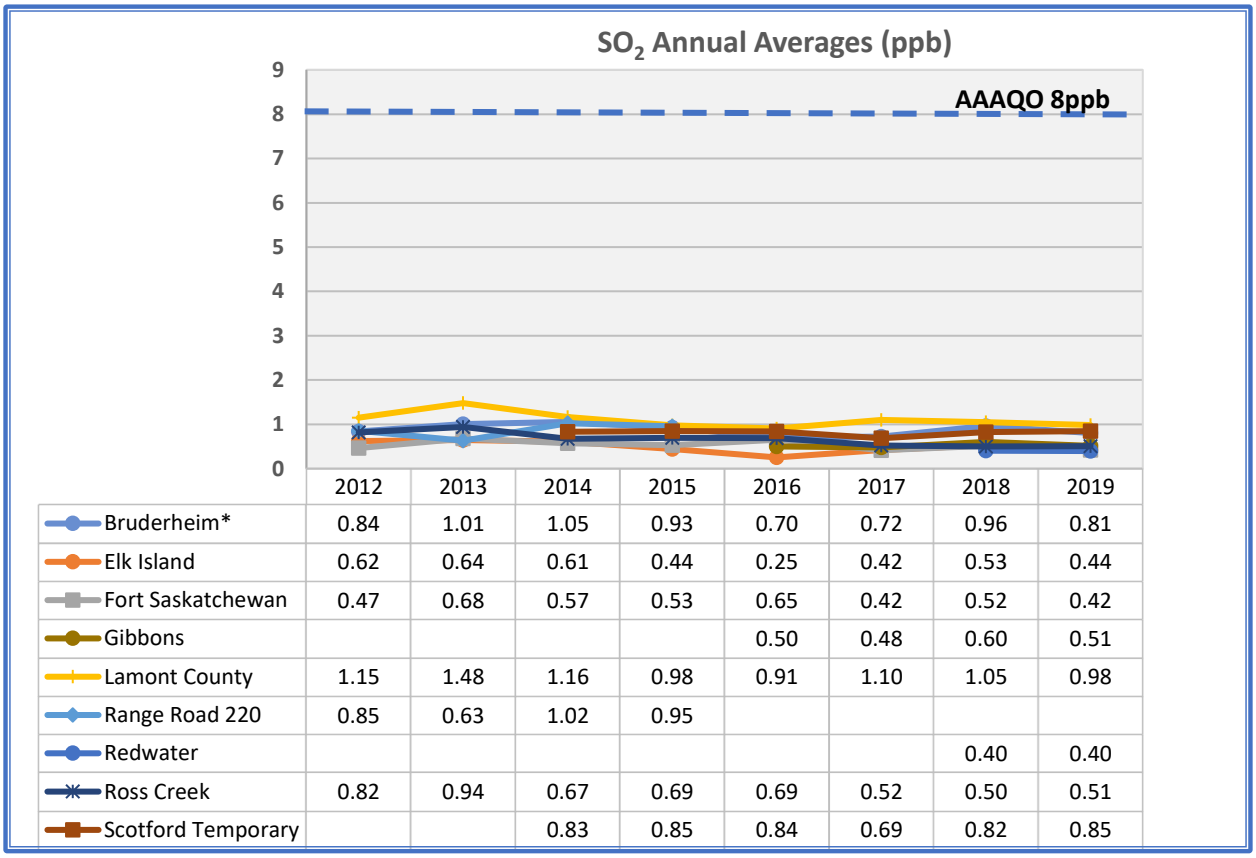
Figure 45: Monthly SO_2 averages in 2019



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Bruderheim 1	0.95	0.74	1.15	0.78	0.55	0.79	0.60	0.55	0.62	0.70	0.80	1.44
Elk Island	0.49	0.92	0.78	0.30	0.17	0.39	0.28	0.23	0.23	0.24	0.36	0.91
Fort Saskatchewan	0.55	0.68	1.13	0.77	0.40	0.24	0.31	0.12	0.33	0.11	0.12	0.28
Gibbons	0.57	1.36	0.57	0.23	0.47	0.15	0.35	0.60	0.53	0.31	0.15	0.85
Lamont County	1.31	1.17	1.72	0.90	0.40	0.85	0.53	0.61	0.67	0.80	1.03	1.78
Redwater	0.34	1.12	0.59	0.26	0.58	0.15	0.22	0.34	0.27	0.38	0.17	0.35
Ross Creek	0.51	0.76	0.87	0.48	0.50	0.51	0.68	0.24	0.65	0.18	0.29	0.45
Scotford Temporary	1.08	1.31	1.01	0.65	0.70	1.05	0.64	0.70	0.54	0.61	0.70	1.17
Portable at Bon Accord	0.97	1.29										
Portable at Chipman						0.38	0.18	0.22	0.21	0.33	0.41	0.82

Sulphur Dioxide (continued)

Figure 46: Annual average SO_2 concentrations at FAP stations



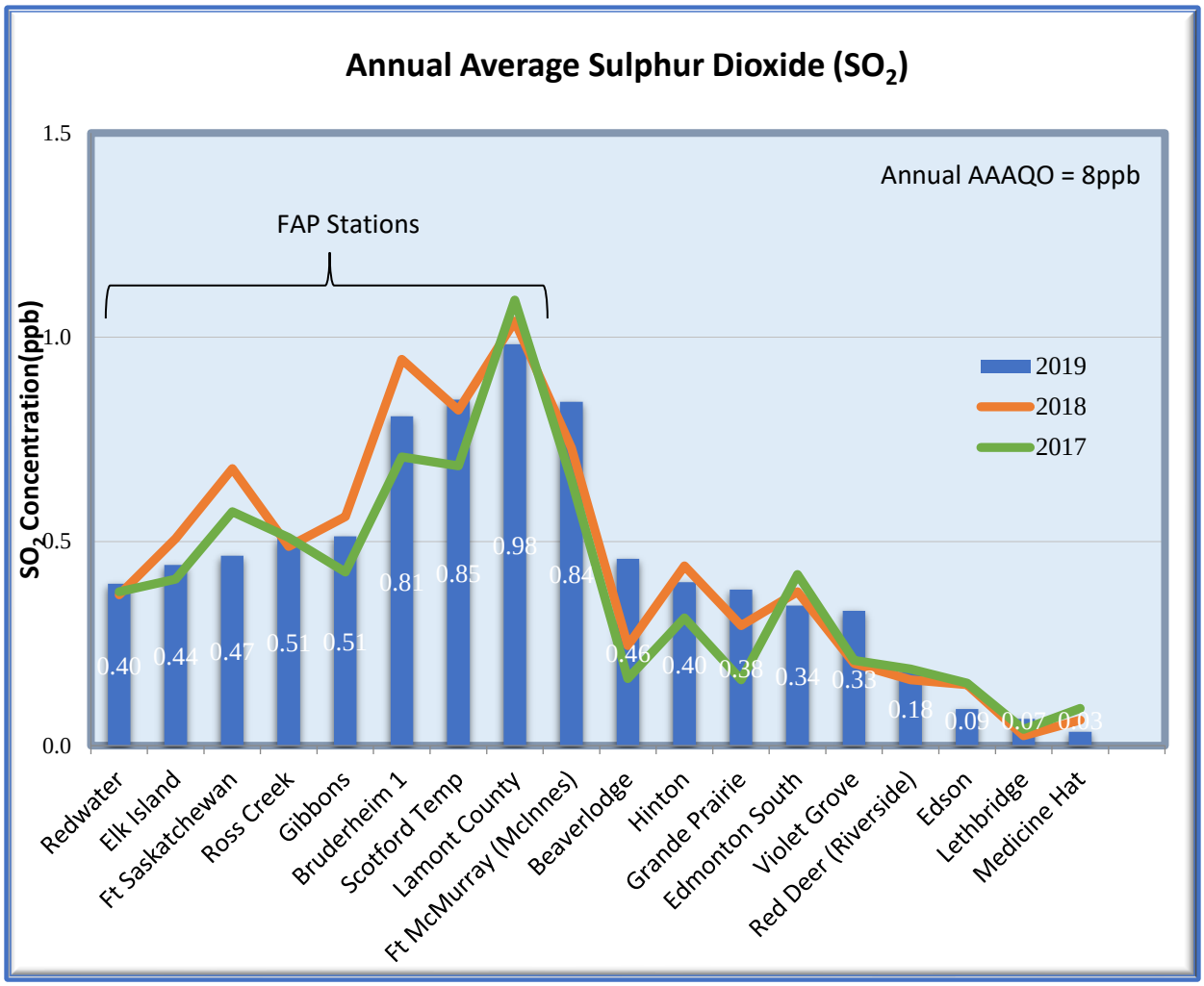
	2012	2013	2014	2015	2016	2017	2018	2019
Bruderheim*	0.84	1.01	1.05	0.93	0.70	0.72	0.96	0.81
Elk Island	0.62	0.64	0.61	0.44	0.25	0.42	0.53	0.44
Fort Saskatchewan	0.47	0.68	0.57	0.53	0.65	0.42	0.52	0.42
Gibbons					0.50	0.48	0.60	0.51
Lamont County	1.15	1.48	1.16	0.98	0.91	1.10	1.05	0.98
Range Road 220	0.85	0.63	1.02	0.95				
Redwater							0.40	0.40
Ross Creek	0.82	0.94	0.67	0.69	0.69	0.52	0.50	0.51
Scotford Temporary			0.83	0.85	0.84	0.69	0.82	0.85

Notes:

- The Bruderheim* station was moved in 2016 and renamed Bruderheim 1. The Bruderheim 2016 annual average includes data from both Bruderheim and Bruderheim1 stations
- SO_2 monitoring was stopped at Range Road 220 in January 2017
- The Redwater station began operation October 2017

Sulphur Dioxide (continued)

Figure 47: Annual average SO_2 concentrations in Alberta



Volatile Organic Compounds (VOCs)

Benzene, toluene, ethylbenzene, o-xylene, mp-xylenes, and styrene (BTEX/S) fall into the group of compounds known as VOC's. These compounds are typically found in petroleum products, such as gasoline and diesel fuel with each having a characteristic strong odour. Significant sources of VOCs in Alberta are vegetation, automobile emissions, gasoline dispensing and storage tanks, petroleum and chemical industries, dry cleaning, fireplaces, natural gas combustion. The major source of VOCs in most urban areas is vehicle exhaust emissions.

BTEX/S has been measured on a semi-continuous (up to four samples per hour) basis at the Scotford 2 and subsequently at Scotford Temporary stations since January 2007.

The AAAQOs for the following VOCs are:

- Benzene
  - 1-hour average concentration 9 ppb
  - Annual average concentration 0.9 ppb
- Toluene
  - 1-hour average concentration 499 ppb
  - 24-hour average concentration 106 ppb
- Ethylbenzene
  - 1-hour average concentration 460 ppb
- Xylenes (all isomers)
  - 1-hour average concentration 530 ppb
  - 24-hour average concentration 161 ppb
- Styrene
  - 1-hour average concentration 52 ppb

There were no exceedances of any AAAQO for any of the BTEX/S compounds in 2019. Table 18 below lists the maximum measurements of the 1 and 24-hour average periods compared to the AAAQO if applicable.

Volatile Organic Compounds (continued)

Table 18: Maximum BTEX/S measurements recorded compared to AAAQO (ppb)

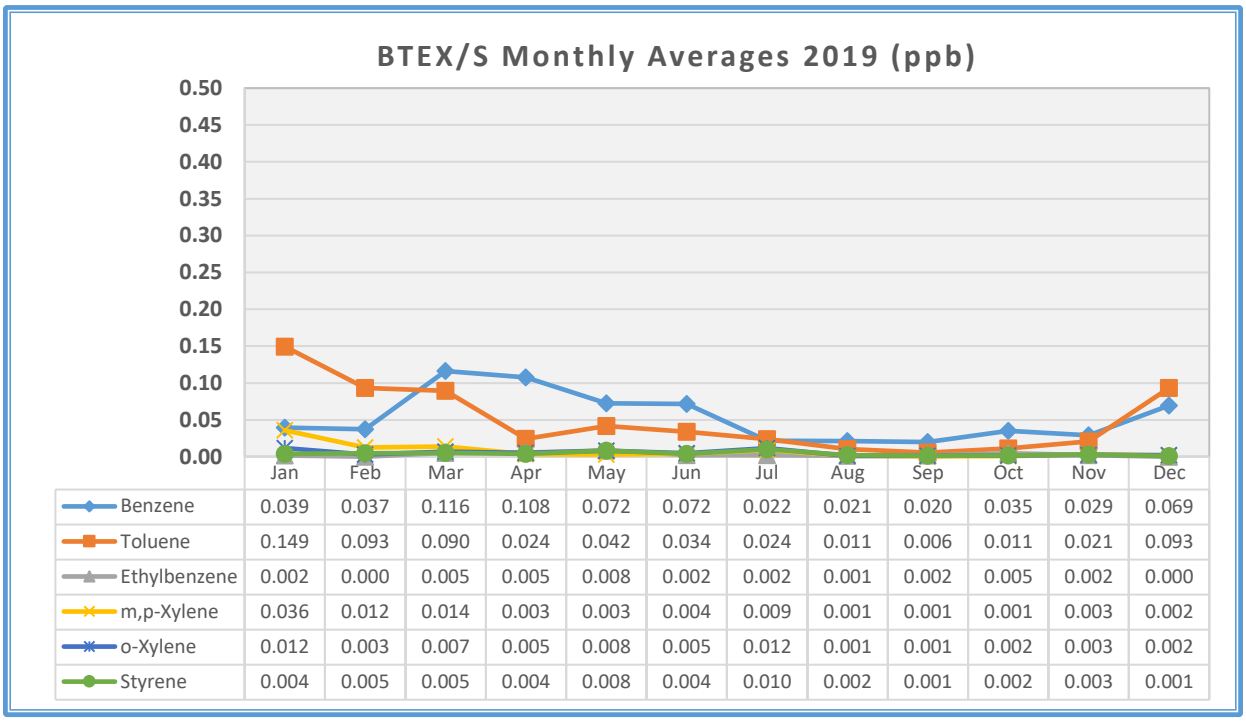
Station	Highest 1-hour average (ppb)	Date Time	% of AAAQO	Highest 24-hour average (ppb)	Date	% of AAAQO
Benzene	6.68	Apr 01 23:00	74.26%	1.21	May 30	n/a
Toluene	4.68	Mar 10 18:00	0.94%	1.08	Jan 13	1.02%
Ethylbenzene	1.10	May 17 15:00	0.24%	0.21	May 17	n/a
m, p-Xylene	2.73	Jan 05 00:00	0.51%	0.22	Jan 13	0.14%
o-Xylene	1.42	Jul 30 07:00	0.27%	0.21	May 17	0.13%
Styrene	1.10	May 17 15:00	2.12%	0.21	May 17	n/a

A plot of the monthly average BTEX/S concentrations recorded in 2019 at the Scotford Temporary station is presented in Figure 48. A comparison of 2019 annual average BTEX/S concentrations with the previous 7 years is shown in Figure 49 below.

The increase of toluene the 2017 annual average was due to off-gassing of a sealant used to repair the roof of the monitoring station shelter itself.

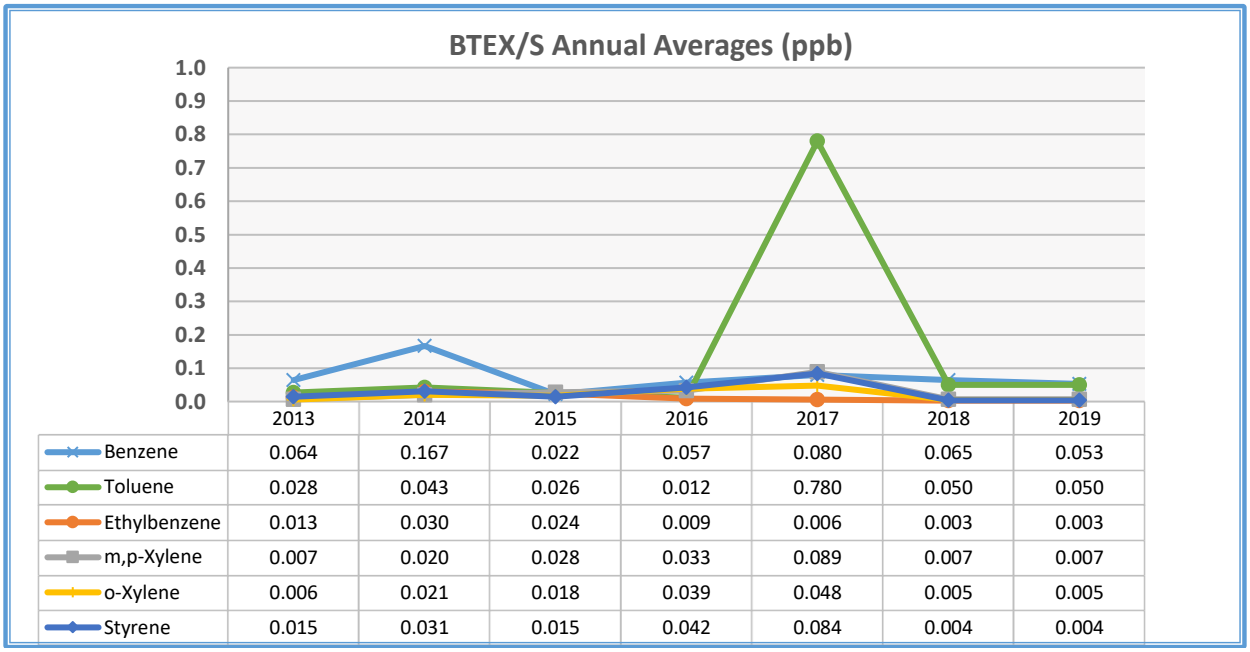
Volatile Organic Compounds (continued)

Figure 48: Monthly average BTEX/S concentrations in 2019



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Benzene	0.039	0.037	0.116	0.108	0.072	0.072	0.022	0.021	0.020	0.035	0.029	0.069
Toluene	0.149	0.093	0.090	0.024	0.042	0.034	0.024	0.011	0.006	0.011	0.021	0.093
Ethylbenzene	0.002	0.000	0.005	0.005	0.008	0.002	0.002	0.001	0.002	0.005	0.002	0.000
m,p-Xylene	0.036	0.012	0.014	0.003	0.003	0.004	0.009	0.001	0.001	0.001	0.003	0.002
o-Xylene	0.012	0.003	0.007	0.005	0.008	0.005	0.012	0.001	0.001	0.002	0.003	0.002
Styrene	0.004	0.005	0.005	0.004	0.008	0.004	0.010	0.002	0.001	0.002	0.003	0.001

Figure 49: Annual average BTEX/S concentrations

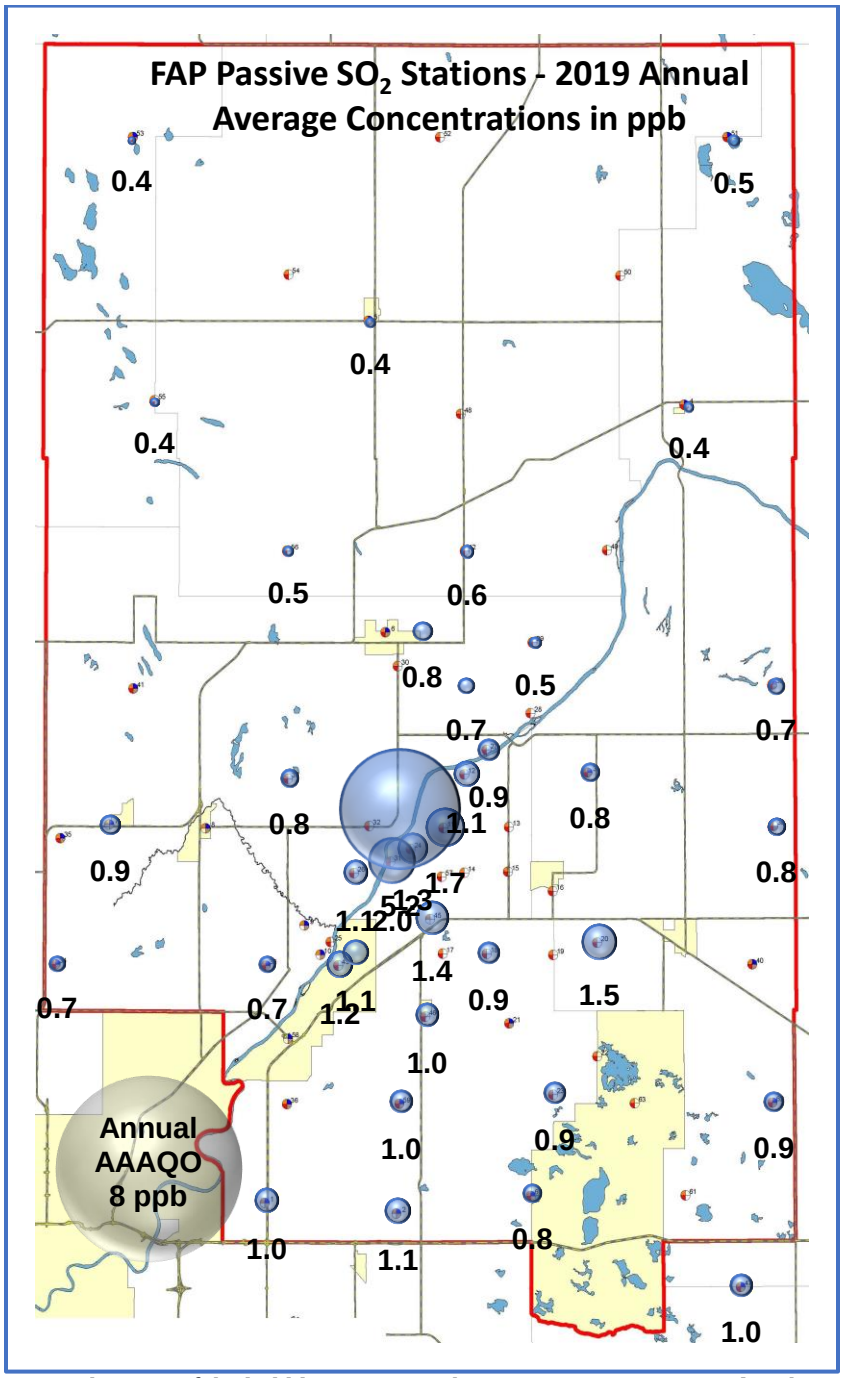


	2013	2014	2015	2016	2017	2018	2019
Benzene	0.064	0.167	0.022	0.057	0.080	0.065	0.053
Toluene	0.028	0.043	0.026	0.012	0.780	0.050	0.050
Ethylbenzene	0.013	0.030	0.024	0.009	0.006	0.003	0.003
m,p-Xylene	0.007	0.020	0.028	0.033	0.089	0.007	0.007
o-Xylene	0.006	0.021	0.018	0.039	0.048	0.005	0.005
Styrene	0.015	0.031	0.015	0.042	0.084	0.004	0.004

2019 Passive Monitoring Results

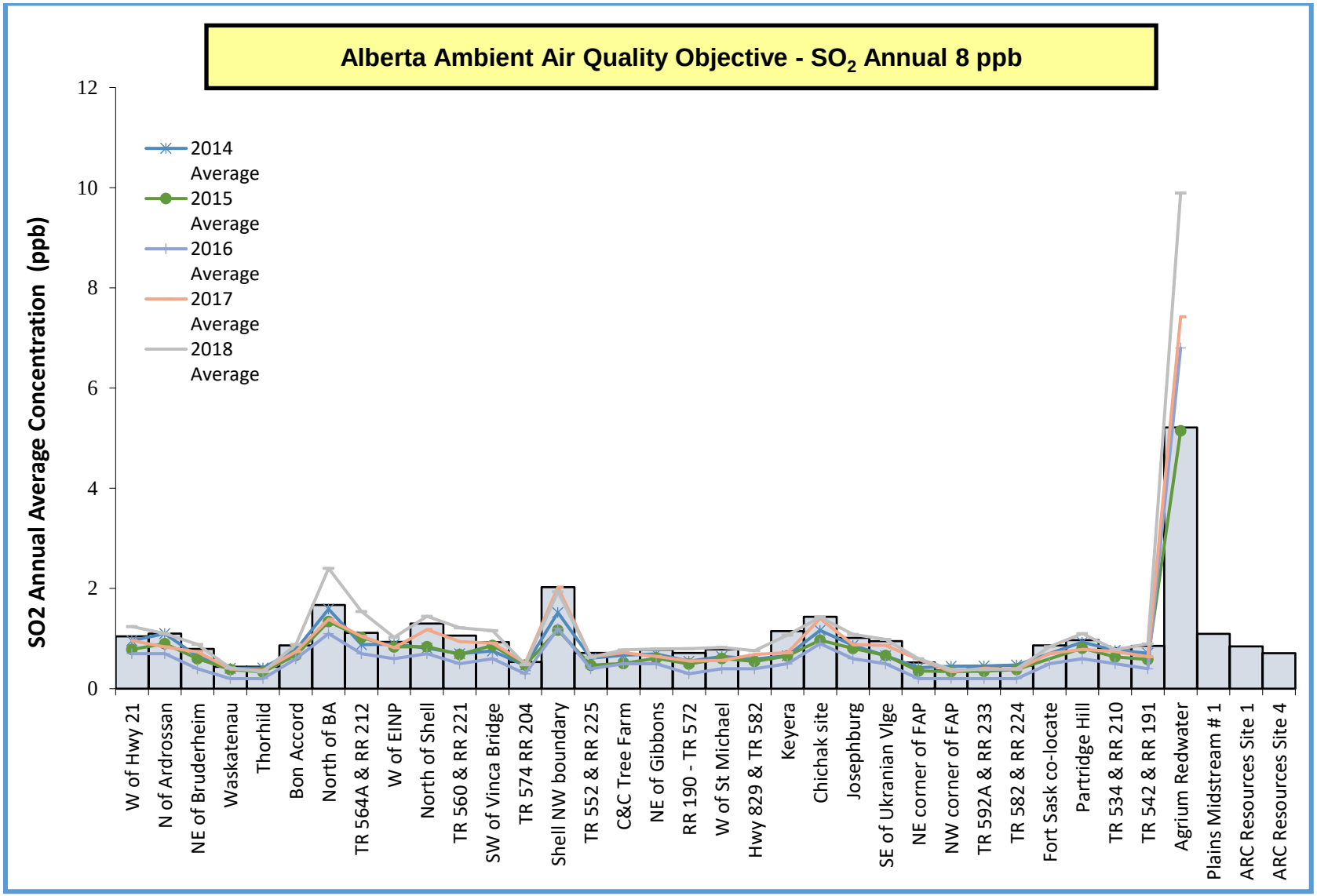
Sulphur Dioxide

Figure 50: 2019 Map of Annual average SO_2 concentrations



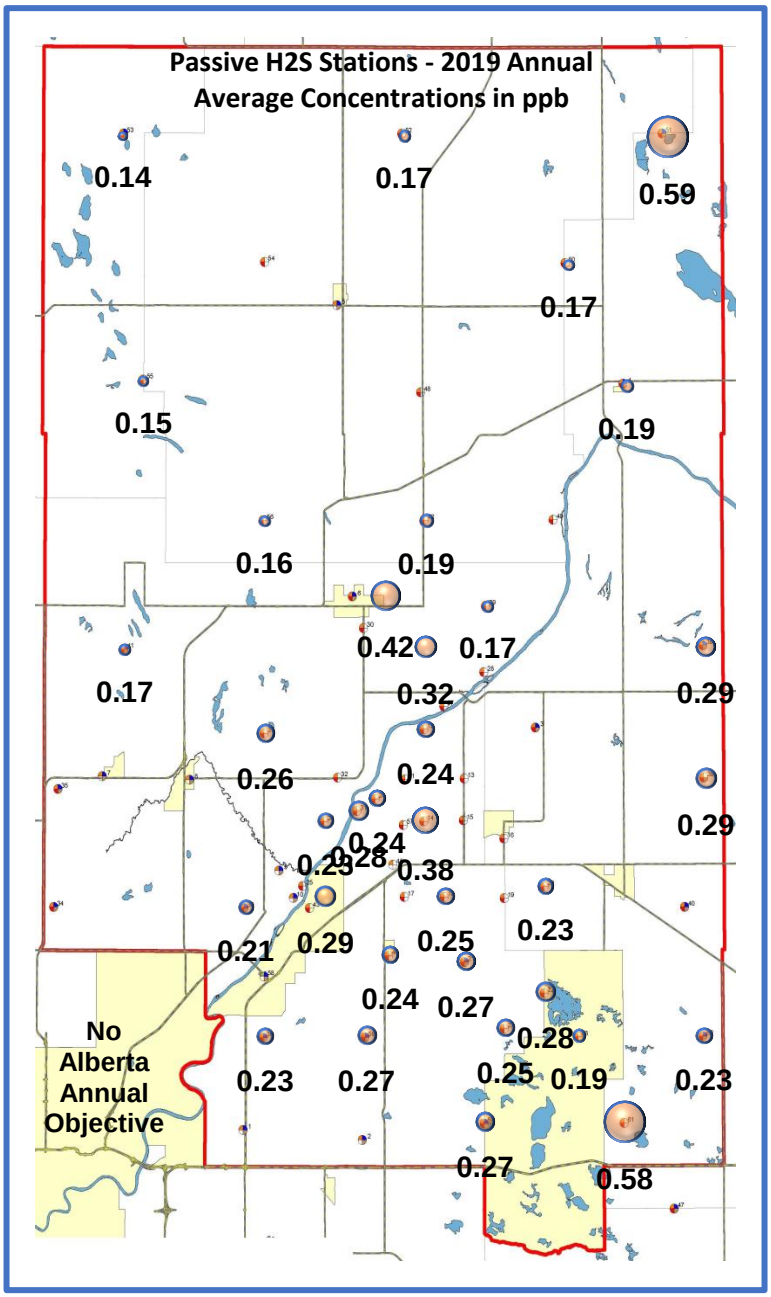
Note: The area of the bubble represents the concentration measured at the geographic center of the bubble, not the geographic area affected

Figure 51: Passive monitoring annual averages: SO_2 - historical



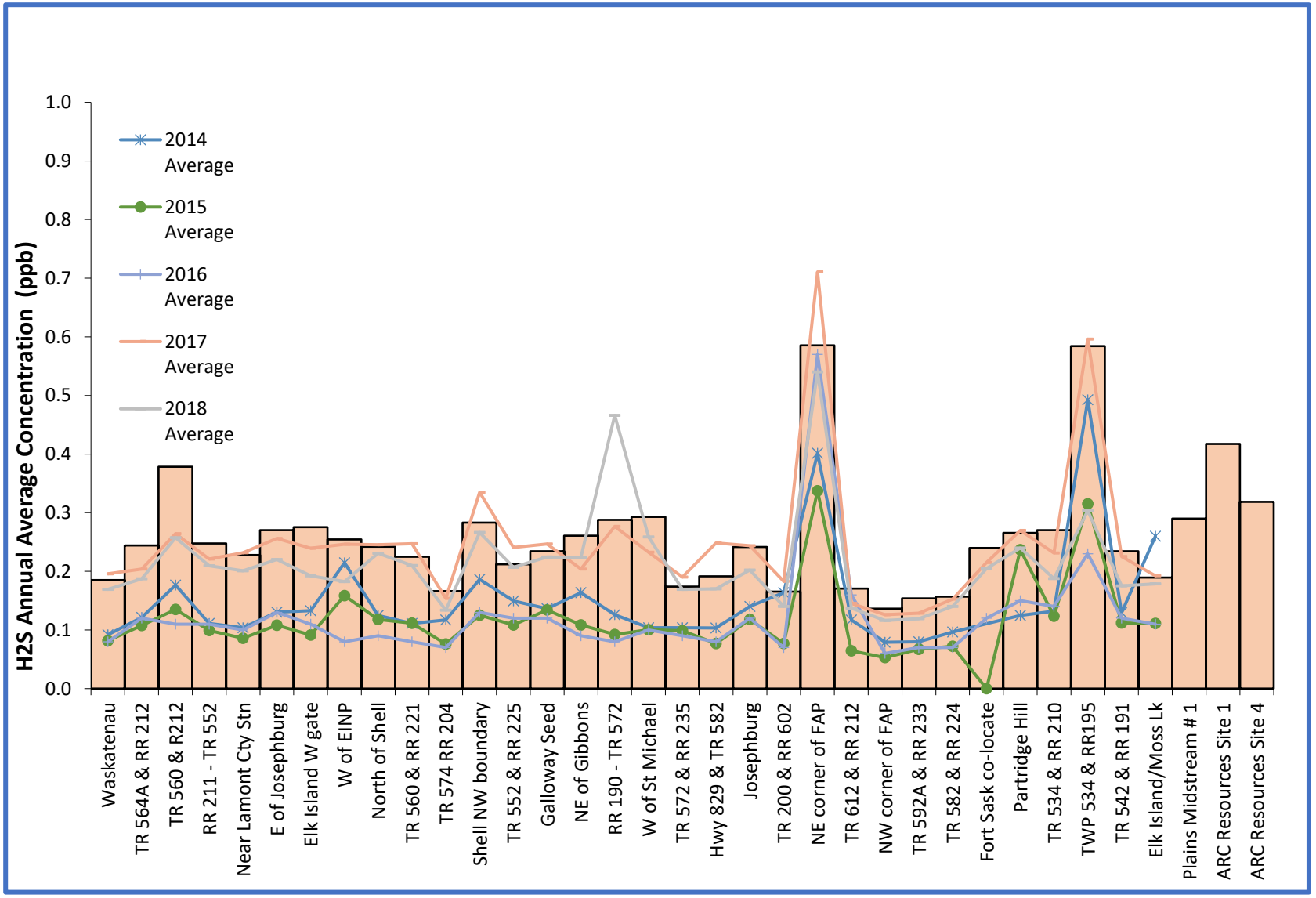
Hydrogen Sulphide

Figure 52: 2019 Map of Annual average H_2S concentrations



Note: The area of the bubble represents the concentration measured at the geographic center of the bubble, not the geographic area affected

Figure 53: Passive monitoring annual averages: H_2S



Other Technical Airshed Programs and Activities

Monitoring Plan Update

Airsheds in Alberta, including FAP, were required to file monitoring plans with the Alberta Government up until December 2019. Due to this requirement, in 2015, a detailed 5-year FAP Monitoring Plan was submitted and approved by the Alberta Government. Updates to the monitoring plan were filed every 6 months detailing progress towards proposed changes in monitoring and identifying any further new projects or changes to the monitoring network, up until June 2019. FAP has decided to continue the upkeep of a monitoring plan for internal purposes, the design of the plan will be determined in 2020.

Following is a listing of the FAP network changes or new projects that were proposed in the 2015 Monitoring Plan. All changes were approved by the Alberta Government. The date of implementation or status is included in italics.

- New permanent station in the vicinity of Gibbons
  (new station in Gibbons began operation February 2016)
- New portable monitoring station
  (station began operation April 2018)
- Relocation of the Redwater Industrial monitoring station
  (new station in Redwater began operations October 2017)
- Relocation of the Scotford 2 Monitoring Station
  (the shelter has been at the Scotford Temporary location since 2014. A new permanent site was identified and approved. The shelter was finally moved in early 2020)
- Discontinue redundant monitoring analyzers
  (SO_2 and NH_3 removed from Range Rd 220 station January 2017)
- Organic Hydrocarbons Sampling
  - Subproject 1: VOC Sampling project at Bruderheim
    (Phase 1 of the sampling had been completed July 2014-March 2015)
    (Phase 2 sampling ran from August 2017 till July 2018)
  - Subproject 2: VOC Sampling in Area of Oil and Gas Development
    (nonmethane hydrocarbon sampling will be added to the portable station depending on sampling objectives at a given site)
- Upgrade $PM_{2.5}$ technology
  (Completed October 2017 with start-up of the Redwater station. All stations with PM2.5 now operate approved equivalent method samplers)
- $PM_{2.5}$ Co-located filter sampling
  (2-year project, sampling from July 2015 to August 2017. Report completed December 2017)

All planned projects have been implemented or are underway.

Volatile Organics Speciation Project

FAP completed a Volatile Organic Compound (VOC) speciation project at the Bruderheim 1 station that ran from August 2017 to July 2018. 24-hour samples were taken every 6 days while additional 1-hour samples were triggered on elevated measurements of the continuous non-methane hydrocarbon analyzer on site.

VOC Speciation was recommended in a network assessment completed for the FAP network in 2012 and included as a project in the FAP Monitoring Plan submitted to Alberta Environment and Parks in 2015. The results of this project may be valuable to help understand the impact of the oil and gas wells on air quality in the region, especially a populated area such as Bruderheim.

The Air Quality Health Index (AQHI) is currently the primary means to report potential air quality impact to human health. In the 2012 Network Assessment, it was noted that while acute exposures are the most important from a public health awareness perspective, chronic exposures also need to be considered. These long-term exposures expanded the list of pollutants of interest.

In a previous 19-month, short-term monitoring study of volatile organic compounds (VOCs) in the airshed in 2006, it was determined that most VOCs were at much lower concentrations than at other National Air Pollutant Surveillance (NAPS) sites throughout Canada where VOCs had been monitored. However, all other monitoring sites compared were in much more populated areas (with much higher urban emissions) than at the FAP sites (e.g., Edmonton, Ontario). Moreover, the addition and expansion of industrial facilities and increase in oil and gas wells within the airshed may have increased local VOC emissions since 2006.

A report for the 2017-2018 VOC Speciation Project is under development as of the date of this report.

Fine Particulates Speciation Project

FAP began a 3-year fine particulate matter speciation project in Fort Saskatchewan in 2018. This speciation work was initiated to partially address a recommendation for a permanent "superstation" (a station that includes monitoring to address all monitoring questions in the network) in the 2012 network assessment. A report on the results will be compiled following the completion of the sampling phase of the project in 2021. Results from this project will add an additional piece of information that can help to inform the Capital Region Particulate Matter Response Plan for of which FAP is a part of.

Fine Particulate Matter Response Plan

Fort Air Partnership continued to support the Capital Region Oversight Advisory Committee implementation of a Fine Particulate Matter Response Plan for the Capital Region throughout 2019. The Fine Particulate Matter Response Plan includes recommended actions to:

- reduce $PM_{2.5}$ concentrations in the outside air
- improve knowledge of $PM_{2.5}$ in the Capital Region
- engage with people about their responsibilities to reduce ambient $PM_{2.5}$

Implementation of the Fine Particulate Matter Response Plan will be evaluated and reported against the new Canadian Ambient Air Quality Standards (CAAQS) that have been adopted nationally for $PM_{2.5}$. Measurements of $PM_{2.5}$ taken by Fort Air Partnership and other Airsheds will be compared to these new CAAQS.

Fort Air Partnership's air monitoring stations measure the amount of fine particulate matter in the air. Higher measurements are often recorded in cold winter months. Cold temperatures and stagnant air can create a build-up of pollutants near the ground, particularly during a weather phenomenon called a temperature inversion where cold air is trapped near the ground by a layer of warm air. The warm air acts like a lid, holding these pollutants down until wind, rain or snow storms helps to disperse them. Some examples of actions that people can take during the wintertime to reduce their contribution to $PM_{2.5}$ include carpooling, not idling their cars when parked and working from home if possible.

Trending and Comparison Report

A Trending and Comparison Report was completed in 2019 to provide trending and comparison information for fine particulate matter, sulphur dioxide, nitrogen dioxide, carbon monoxide and ozone. All these substances, with the exception of ozone, are referred to as criteria air contaminants by the Government of Canada's Environment and Climate Change department. Criteria air contaminants are classified as such because they contribute to smog, poor air quality and acid rain. Ozone was also included in this report since it is a substance that has an established Canadian Ambient Air Quality Standard (CAAQS) and is used in the calculation of the Air Quality Health Index (AQHI).

Comparisons for each of these 5 substances were made among stations within FAP's Airshed. A comparison was also made between FAP's Fort Saskatchewan station (the longest operated station within the Airshed) with other cities in Alberta, as well as with national and international locations.

Many of the trends and comparisons show notable changes from year to year that can be tied to major natural events like forest fires, or changes over a longer time period attributed to the introduction of environmental policies or the application of new technologies. However, it should be noted that in some cases, there was insufficient data or supplementary information available to draw conclusions about why certain trends were occurring, or the results of comparisons.

The full report can be found on the FAP website:

Live to Web Data Feed

FAP continues to provide a free, on-line data feed that allows anyone to check out air quality readings at any time. Users can search by station, or by substance, and get hour-by-hour current or historic raw data in an easy-to-understand format. The technical sister to this public service allows regulators, technical group users and emergency responders to receive minute-by-minute data in near real time.

The data available on the FAP live data site are raw numbers but quality controls ensure the data is validated before being permanently stored in the Alberta Government Air Data Warehouse. As of the date of this report the new Alberta Government data warehouse was still under construction with data not yet available to download.

Appendices

Appendix A: Technical Working Group Members

(As of December 31, 2019)

Harry Benders
(Chair)
Network Manager
Fort Air Partnership

Patrick Andersen B.Sc.
Andersen Science Consulting

Nadine Blaney, B.Sc.
Executive Director
Fort Air Partnership

Saminda Chandraratne, B.Sc., PGD., EP
EHS Supervisor
Chemtrade Logistics

Michael Cody MSc., RPF
Specialist, Land and Biodiversity
Cenovus Energy Inc.

Jeff Cooper C. Tech
AQM Operations Manager,
WSP

Doug Hurl
EHS Manager
Umicore Canada Inc.

Stephanie Kozey
EH&S Regulatory Specialist
Dow Chemical Canada ULC

Gerry Mason CRSP
Manager, EHS
Oerlikon Metco (Canada) Inc.

Maxwell Mazur M.Sc.
Air Quality Specialist
Alberta Environment and Parks

Christophe Nayet
Air Quality Technician
Environment and Climate Change Canada

Moe Ouellet
Environmental Specialist
Pembina Pipeline Corp.

Keith Purves
FAP Vice Chair and Public Member
Fort Air Partnership

Marianne Quimpere EP
Environmental Advisor
Sherritt International Corporation

Stephen Raye
Regulatory and Advocacy Focal
Shell Scotford

Ali Schweitzer B.Sc. G.I.T.
Environmental Advisor
Inter Pipeline Ltd.

Shane Taylor
Alberta Environment and Parks

Quinton Thiessen B.Sc.
Environmental Advisor
Nutrien

Jocelyn Thrasher-Haug M.Sc., P.Ag., P.Biol.
Manager, Environmental Planning
Strathcona County

Darcy Walberg
Operations Environmental Specialist
Northwest Redwater
Partnership

Alan Wesley
Public Member
Fort Air Partnership

Gerry Zulyniak, P.Eng.
Environment Lead Accel Energy

Technical Working Group Corresponding Members

Laurie Danielson, PhD., P. Chem.
Executive Director
Northeast Capital Industrial Association

Kathryn Dragowska
Chemtrade Logistics

Jeff Hamilton
Pembina Pipeline Corp.

Appendix B: Monitoring Objectives

Table 19: FAP Monitoring Objectives

Ranking	Objective
Priority 1	*Understand spatial distribution of pollutants in the region.*
	Identify regional air quality trends.
	Provide flexibility to characterize emerging issues, sources, and locations.
Priority 2	*Provide appropriate information for evaluating population exposure to ambient air quality.*
	Provide information required to understand air quality impacts on the health of the environment.
Priority 3	*Improve the ability to identify and apportion pollutant sources for purposes of air quality management.*
	Provide suitable input and validation information for air quality models.

Appendix C: Industry Participants in FAP

Industry Participants in FAP (Dec. 31, 2019)

A.
As funders of FAP through Northeast Capital Industrial Association and participation on the FAP Board of Directors

- Sherritt International Corp.
- Dow Chemical Canada ULC

B.
As funders of FAP through Northeast Capital Industrial Association and participation in the Technical Working Group

- Accel Energy
- Cenovus Energy
- Chemtrade Logistics
- Dow Chemical Canada ULC
- North West Redwater Partnership
- Nutrien
- Pembina Pipeline Corp.
- Shell Scotford (Shell Chemicals, Shell Refinery and Shell Upgrader)
- Sherritt International Corp.
- Oerlikon Metco (Canada) Inc.
- Umicore Canada Inc.

C. As funders of FAP through Northeast Capital Industrial Association

- Accel Energy
- Access Pipeline
- Air Liquide Canada Inc.
- Aux Sable Canada
- Cenovus Energy
- Chemtrade Logistics (CSC)
- Chemtrade Logistics (Sulphides)
- Dow Chemical Canada ULC
- Evonik
- Keyera Energy
- MEGlobal Canada Inc.
- MEG Energy
- North West Redwater Partnership
- Nutrien Fort Saskatchewan
- Nutrien Redwater
- Oerlikon Metco (Canada)
- Pembina NGL Corp.
- Plains Midstream Canada
- Praxair Canada Inc.
- Shell Scotford (Shell Chemicals, Shell Refinery and Shell Upgrader)
- Sherritt International Corp.
- Umicore Canada Inc.
- Value Creation

Appendix D: Passive Data Summary Tables

Table 20: 2019 Passive monitoring monthly averages: SO_2 (ppb)

Site	Location	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Avg	Max
1	Stocks Greenhouses	0.8	1.6	1.4	0.9	0.8	0.9	0.9	0.9	1.0	0.7	1.3	1.1	1.0	1.6
2	Ardrossan northeast	1.2	1.8	1.8	0.6	0.5	0.9	0.9	1.0	0.6	0.6	1.2	1.5	1.1	1.8
3	Bruderheim northeast	0.9	1.1	1.0	0.6	0.5	0.6	0.8	1.1	0.8	0.4	1.0	0.9	0.8	1.1
4	Waskatenau	0.6	0.7	0.7	0.4	0.3	0.4	0.5	0.4	0.3	0.3	0.2	0.6	0.4	0.7
5	Thorhild	0.4	0.8	0.5	0.3	0.4	0.4	0.4	0.6	0.6	0.3	0.1	0.5	0.4	0.8
7	Bon Accord	0.9	1.4	1.1	0.7	0.6	0.5	0.9	0.8	0.6	0.7	0.4	1.4	0.9	1.4
11	North of BA	2.5	2.6	3.3	3.8	0.7	1.5	1.2	1.5	1.1	1.0	0.9	0.8	1.7	3.8
12	TwpRd 564A RgeRd 212	1.5	1.9	2.6	1.2	0.9	0.8	0.7	0.8	1.1	0.5	0.6	0.8	1.1	2.6
23	Goodhope	1.0	1.6	1.4	0.6	0.5	1.0	0.8	0.6	0.6	0.6	0.9	1.6	0.9	1.6
24	North of Scotford	1.5	1.7	2.3	1.3	1.3	1.5	1.3	0.9	0.8	0.8	0.9	1.3	1.3	2.3
26	Twp Rd 560 Rge Rd 221	1.6	1.5	1.4	1.4	0.9	1.1	1.6	0.9	1.2	0.5	0.3	1.0	1.1	1.6
27	Boat Launch	1.2	1.5	1.9	1.0	0.6	0.7	0.7	0.8	0.8	0.6	0.7	1.1	0.9	1.9
29	Redwater Natural Area N	0.5	1.1	1.3	0.7	0.4	0.3	0.5	0.5	0.4	0.3	0.2	0.4	0.5	1.3
31	Northwest of Scotford	1.8	2.2	2.4	2.6	1.8	2.7	2.7	3.1	1.5	2.0	1.3	1.2	2.0	3.1
33	Twp Rd 552 Rge Rd 225	0.9	1.3	1.0	0.5	0.5	0.6	0.6	0.7	0.7	0.5	0.4	0.8	0.7	1.3
34	C&C Tree Farm	1.1	1.4	0.8	0.5	0.7	0.5	0.6	0.6	0.5	0.5	0.4	0.7	0.7	1.4
37	Twp Rd 564 Rge Rd 224	1.0	1.0	0.9	0.6	1.0	0.5	0.7	0.9	1.1	0.5	0.2	0.8	0.8	1.1
38	Peno	1.0	1.0	1.0	0.5	0.4	0.7	0.6	0.6	0.5	0.3	0.5	1.0	0.7	1.0
39	Saint Michael	0.8	1.4	1.5	0.3	0.4	0.8	0.7	0.8	0.5	0.3	0.5	0.8	0.8	1.5
42	Radway - Val Soucy	0.6	1.0	1.1	0.5	0.5	0.4	0.6	0.4	0.5	0.3	0.3	0.8	0.6	1.1
43	Keyera Site	1.2	1.5	1.5	1.3	0.9	1.0	1.4	1.1	1.3	0.7	0.7	1.2	1.2	1.5
45	Scotford east	2.2	2.0	1.3	1.2	1.0	1.4	1.4	1.1	1.5	1.4	1.5	1.3	1.4	2.2
46	Josephburg	1.0	1.6	1.4	1.0	0.6	0.8	1.1	0.9	0.7	0.6	1.0	1.2	1.0	1.6
47	Southeast of FAP	1.2	2.2	1.3	0.6	0.5	1.0	0.7	0.7	0.8	0.5	0.9	1.2	1.0	2.2
51	Hollow Lake	0.6	0.9	0.4	0.4	0.4	0.6	0.9	0.5	0.8	0.2	0.1	0.6	0.5	0.9
53	Tawatinaw - Clearbrook	0.5	1.0	0.5	0.2	0.3	0.2	0.4	0.3	0.2	0.3	0.0	0.6	0.4	1.0
55	Taylor Lake	0.3	0.9	0.6	0.3	0.4	0.3	0.4	0.5	0.3	0.4	0.0	0.5	0.4	0.9
56	Opal	0.6	0.9	0.5	0.5	0.4	0.3	0.4	0.3	0.5	0.4	0.4	0.4	0.5	0.9
58	Fort Saskatchewan	0.8	1.5	1.2	1.0	0.7	0.7	0.9	0.5	0.9	0.6	0.9	0.9	0.9	1.5
59	Partridge Hill	1.1	1.9	1.4	0.7	0.5	0.9	0.9	0.5	0.6	0.6	1.1	1.6	1.0	1.9
60	Oxbow Lake	0.9	1.3	0.8	0.5	0.5	0.9	1.1	0.6	0.6	0.7	0.8	1.0	0.8	1.3
62	FAP East Boundary	1.4	1.7	1.5	0.7	0.3	0.7	0.9	0.6	0.5	0.5	0.9	0.6	0.9	1.7
64	Agrium Redwater	13.6	11.5	8.3	7.7	4.2	3.3	3.9	3.5	3.8	1.9	1.0	1.3	5.2	13.6
66	Plains Midstream # 1	1.2	1.2	1.3	0.9	0.9	1.0	1.3	0.6	1.1	0.7	1.4	1.3	1.1	1.4
68	ARC Resources Site 1	0.6	0.9	0.8	0.9	0.8	0.7	1.4	1.1	0.8	0.5	0.7	0.8	0.8	1.4
71	ARC Resources Site 4	0.7	1.2	1.3	0.7	0.6	0.5	0.8	0.5	0.5	0.8	0.3	0.8	0.7	1.3
	Average	1.4	1.7	1.5	1.0	0.7	0.9	1.0	0.9	0.8	0.6	0.7	1.0	1.0	
	Max	13.6	11.5	8.3	7.7	4.2	3.3	3.9	3.5	3.8	2.0	1.5	1.6		13.6

N/A: no sample I/D: insufficient data Reportable Detection Limit: 0.2 ppb

Table 21: 2019 Passive monitoring monthly averages: H_2S (ppb)

Site	Location	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Avg	Max
4	Waskatenau	0.19	0.20	0.10	0.09	0.18	0.21	0.21	0.35	0.27	0.12	0.09	0.15	0.19	0.35
12	TwpRd 564A RgeRd 212	0.22	0.24	0.14	0.11	0.35	0.49	0.28	0.37	0.40	0.19	0.14	0.13	0.24	0.49
14	Astotin Creek	0.24	0.25	0.20	0.13	0.57	0.71	0.47	0.66	0.70	0.21	0.18	0.22	0.38	0.71
18	Rge Rd 211 TwpRd 552	0.20	0.24	0.23	0.13	0.29	0.34	0.31	0.37	0.35	0.19	0.16	0.19	0.25	0.37
20	Rge Rd 202	0.26	0.20	0.11	0.13	0.23	0.32	0.34	0.42	0.33	0.13	0.10	0.19	0.23	0.42
21	Josephburg east	0.24	0.21	0.17	0.15	0.31	0.41	0.47	0.44	0.41	0.15	0.13	0.19	0.27	0.47
22	Elk Island Park west gate	0.20	0.17	0.12	0.09	0.47	0.51	0.50	0.36	0.53	0.15	0.12	0.17	0.28	0.53
23	Goodhope	0.19	0.18	0.12	0.13	0.40	0.54	0.53	0.35	0.35	0.14	0.14	0.17	0.25	0.54
24	North of Scotford	0.21	0.22	0.16	0.14	0.31	0.29	0.34	0.35	0.46	0.20	0.14	0.23	0.24	0.46
26	Twp Rd 560 Rge Rd 221	0.32	0.20	0.16	0.12	0.27	0.29	0.29	0.35	0.30	0.15	0.15	0.20	0.23	0.35
29	Redwater Natural Area N	0.15	0.15	0.09	0.11	0.16	0.15	0.19	0.35	0.26	0.12	0.10	0.18	0.17	0.35
31	Northwest of Scotford	0.30	0.24	0.20	0.19	0.36	0.30	0.35	0.42	0.44	0.34	0.19	0.22	0.28	0.44
33	Twp Rd 552 Rge Rd 225	0.25	0.18	0.14	0.13	0.21	0.26	0.32	0.34	0.31	0.21	0.13	0.18	0.21	0.34
36	Galloway Seed	0.27	0.21	0.15	0.15	0.25	0.34	0.30	0.33	0.31	0.17	0.15	0.18	0.23	0.34
37	Twp Rd 564 Rge Rd 224	0.19	0.20	0.14	0.07	0.34	0.34	0.37	0.54	0.45	0.15	0.13	0.22	0.26	0.54
38	Peno	0.24	0.20	0.17	0.14	0.35	0.54	0.55	0.51	0.45	0.13	0.10	0.22	0.29	0.55
39	Saint Michael	0.21	0.21	0.13	0.10	0.30	0.59	0.52	0.76	0.50	0.11	0.11	0.18	0.29	0.76
41	Lily Lake	0.25	0.15	0.02	0.09	0.20	0.20	*N/A*	*N/A*	0.34	*N/A*	0.10	0.19	0.17	0.34
42	Radway - Val Soucy	0.21	0.18	0.11	0.08	0.22	0.22	0.22	0.39	0.26	0.12	0.11	0.16	0.19	0.39
43	Keyera Site	0.28	Sampling site removed due to construction											0.00	0.00
46	Josephburg	0.20	0.18	0.13	0.11	0.23	0.29	0.40	0.47	0.37	0.12	0.12	0.17	0.24	0.47
50	Sprucefield	0.22	0.17	0.10	0.06	0.17	0.16	0.19	0.30	0.24	0.12	0.08	0.17	0.17	0.30
51	Hollow Lake	0.46	0.22	0.14	0.07	0.56	1.02	0.90	1.04	1.39	0.13	0.07	0.26	0.59	1.39
52	Abee	0.17	0.19	0.09	0.07	0.16	0.16	0.19	0.50	0.25	0.11	0.09	0.15	0.17	0.50
53	Tawatinaw - Clearbrook	0.16	0.22	0.09	0.06	0.13	0.16	0.16	0.18	0.14	0.09	0.07	0.16	0.14	0.22
55	Taylor Lake	0.18	0.15	0.08	0.06	0.13	0.15	0.19	0.35	0.19	0.10	0.08	0.16	0.15	0.35
56	Opal	0.16	0.10	0.09	0.07	0.19	0.19	0.18	0.30	0.21	0.13	0.10	0.15	0.16	0.30
58	Fort Saskatchewan	0.23	0.24	0.17	0.14	0.17	0.29	0.29	0.36	0.34	0.16	0.17	0.21	0.24	0.36
59	Partridge Hill	0.17	0.20	0.16	0.12	0.22	0.38	0.51	0.39	0.47	0.16	0.12	0.16	0.27	0.51
60	Oxbow Lake	0.19	0.16	0.11	0.14	0.28	0.37	0.53	0.49	0.34	0.13	0.11	0.18	0.27	0.53
61	Drygrass Lake	0.24	0.21	0.15	0.15	0.76	1.35	1.76	1.02	0.87	0.18	0.12	0.20	0.58	1.76
62	FAP East Boundary	0.19	0.19	0.16	0.12	0.25	0.42	0.41	0.39	0.30	0.13	0.09	0.16	0.23	0.41
63	Elk Island Park	0.16	0.18	0.12	0.09	0.18	0.37	0.32	0.29	0.23	0.10	0.09	0.14	0.19	0.37
66	Plains Midstream # 1	0.25	0.18	0.17	0.14	0.27	0.34	0.45	0.55	0.56	0.17	0.18	0.22	0.29	0.56
68	ARC Resources Site 1	0.33	0.22	0.15	0.16	0.78	0.60	0.59	0.77	0.57	0.19	0.26	0.39	0.42	0.78
71	ARC Resources Site 4	0.20	0.24	0.12	0.08	0.32	0.32	0.25	0.31	0.25	1.27	0.12	0.34	0.32	1.27
	Average	0.23	0.20	0.13	0.11	0.30	0.39	0.41	0.45	0.40	0.18	0.12	0.19	0.25	
	Max	0.46	0.25	0.23	0.19	0.78	1.35	1.76	1.04	1.39	1.27	0.26	0.39		1.76

N/A: no sample
I/D: insufficient data
Reportable Detection Limit: 0.02 ppb

Appendix E: Continuous Monitoring Methods, Limits and Sampling Details

Table 22: Continuous monitoring methods, limits, and sampling details (Dec 31, 2019)

Parameter	Instrument Make and Model	Units	Sampling Duration and Frequency	Full Scale Range	Detection Limit	Method of Detection	Calibration Method	Precision	Accuracy
Sulphur Dioxide (SO_2)	Thermo 43i	ppb or ppm	1-second samples averaged to 1-min & 1-hr	0 - 500 ppb	1 ppb 0.4ppb RMS 0.5ppb RMS	Pulsed fluorescence	Dynamic dilution of compressed gas standard	1% of reading or 1ppb (whichever is greater)	43i NA
Hydrogen Sulphide (H_2S)	Thermo 45C Thermo 450i	ppb or ppm	1-second samples averaged to 1-min & 1-hr	0 - 100 ppb 0 - 0.1 ppm	1 ppb 0.4 ppb RMS	Pulsed fluorescence with converter	Dynamic dilution of compressed gas standard	45C and 450i 1% of reading or 1ppb (whichever is greater)	45C NA 450i NA
Nitric Oxide, Oxides of Nitrogen, Nitrogen Dioxide (NO, NO_x, NO_2)	Thermo 42C Thermo 42i Thermo 17C Thermo 17i	ppb or ppm	1-second samples averaged to 1-min & 1-hr	0 - 500 ppb	0.4 ppb 0.4 ppb 1.0ppb	Chemi-luminescence	Dynamic dilution of compressed gas standard	42C and 42i ± 0.4ppb (500 ppb range) 17C NA	42C NA 42i NA 17C NA 17i NA
Ammonia (NH_3)	Thermo 17C Thermo17i	ppm	1-second samples averaged to 1-min & 1-hr	0 - 5 ppm	1.0 ppb	Chemi-luminescence with total nitrogen converter	Dynamic dilution of compressed gas standard	17C NA 17i ± 0.4ppb 500 ppb range	17C NA 17i NA

Table 22: Continuous monitoring methods, limits, and sampling details (Dec 31, 2019) - continued

Parameter	Instrument Make and Model	Units	Sampling Duration and Frequency	Full Scale Range	Detection Limit	Method of Detection	Calibration Method	Precision	Accuracy
Ozone (O_3)	Thermo 49c Thermo 49i	ppb or ppm	1-second samples averaged to 1-min & 1-hr	0 - 500 ppb 0 - 0.5 ppm	1.0 ppb 0.5ppb RMS	Ultraviolet photometry	O_3 Reference Bench	49c 1.0ppb 49i 1.0ppb	49i NA
Ethylene	Peak Performer	ppb	200 seconds (18 samples per hour)	0 - 2000 ppb	1 ppb	Gas chromatography with flame ionization detector	Dynamic dilution of compressed gas standard	NA	NA
Carbon Monoxide (CO)	Thermo 48i	ppm	1-second samples averaged to 1-min & 1-hr	0 - 50 ppm	0.04 ppm	Gas filter correlation	Dynamic dilution of compressed gas standard	±1% or 0.02 ppm	±1% or 0.02 ppm
Hydrocarbons (methane-NMHC or THC)	Thermo 55C Thermo 55i	ppm	2.5 minutes with 24 samples per hour	0 - 20 ppm methane 0 - 20 ppm NMHC 0 - 40 ppm THC	20 ppb Methane 50 ppb NMHC (as propane)	Gas chromatography with flame ionization detector	Dynamic dilution of compressed gas standard	±2% of measured value	±2% of measured value
Particulates $PM_{2.5}$	SHARP 5030 SHARP 5030i	µg/m^3	Continuous sampling data stored in 1-min & 1-hr averages	0 - 1000 µg/m^3	0.2 µg/m^3	Hybrid beta attenuation and nephelometer	Light transmitting foils	±2 µg/m^3<80 µg/m^3 ±5 µg/m^3>80 µg/m-3	±5% (compared to 24-hr FRM)

Table 22: Continuous monitoring methods, limits, and sampling details (Dec 31, 2019) - continued

Parameter	Instrument Make and Model	Units	Sampling Duration and Frequency	Full Scale Range	Detection Limit	Method of Detection	Calibration Method	Precision	Accuracy
Particulates $PM_{2.5}$	Grimm 180	$\mu g/m^3$	Continuous sampling data stored in 1-min & 1-hr averages	0 - 1000 $\mu g/m^3$	0.2 $\mu g/m^3$	Spectrometry	Factory	±5%	±2%
Benzene, Toluene, Ethylbenzene, Xylene, Styrene	Spectras GC955	ppb	Samples taken every 15 or 30 minutes	Benzene & Ethylbenzene 0 – 20ppb Toluene, Styrene Xylene	0.02ppb	Gas chromatography with FID detection	Dynamic dilution of compressed gas standard	<3% at 1 ppb for benzene	NA
Wind Speed Wind Direction (WS / WD)	RM Young 5305	km/hr	1-second samples averaged to 1-min & 1-hr	0 – 100 km/hr 0 - 360 degrees	WSP 0.4 m/s WDR 0.5 m/s	3 cup anemometer and wind vane	Known RPM Standard or Factory	NA	NA
Temperature	Vaisala HMP60	°C	1-second samples	-40 to +60	NA	Platinum resistance detector	Comparison to Reference Standard	NA	±0.6°C
Barometric Pressure	Setra 270	mmHg	1-second samples averaged to 1-min & 1-hr	500 - 900 mmHg	±2 mmHg	Ceramic sensing capsule coupled with capacitive sensor	Comparison to Reference Standard	±0.01	±0.05%

Table 22: Continuous monitoring methods, limits, and sampling details (Dec 31, 2019) - continued

Parameter	Instrument Make and Model	Units	Sampling Duration and Frequency	Full Scale Range	Detection Limit	Method of Detection	Calibration Method	Precision	Accuracy
Relative Humidity	Vaisala HMP60	%	1-second samples averaged to 1-min & 1-hr	0 - 100%	NA	capacitive relative humidity sensor	Factory	NA	0°to +40°C ±3% (0 to 90% RH) ±5% (90 to 100% RH) -40° to 0°C and +40° to +60°C: ±5% (0 to 90% RH) ±7% (90 to 100% RH)
Solar Radiation	Kipp and Zonen SP Lite	watts/m2	1-second samples averaged to 1-min & 1-hr	400-1100 nm spectral range	60 to 100 µV/W/m2 (Sensitivity)	Photodiode detector	Factory	NA	NA
Vertical Wind Speed	Gill Model 27106	km/hr	1-second samples averaged to 1-min & 1-hr	1	0.3 m/s	Helicoid propeller with tech-generator transducer	Mechanical RPM standard	NA	NA
Delta Temperature	Met One 064-1 (two probes)	°C	1-second samples averaged to 1-min & 1-hr	-30 to +50	NA	Solid state multi element thermistor	Comparison to Reference Standard	NA	±0.15°C (0.27°F) throughout range

Appendix F: Data Acquisition, Validation and Reporting Procedures

Air quality monitoring instrumentation is connected digitally to a data logger at each station. The data logger stores monitoring information in engineering units each second. One-minute and one-hour average values are calculated by the data logger. These one-minute and hourly-average data packets along with operational information on each sensor and the site itself are retrieved every minute from the data logger through the internet via automatic polling.

Automatic alarm set points trigger a notification to technicians of any data that is above a predetermined set point, (including levels that exceed the AAAQOs). The technician will assess the situation and notify the Alberta Government and FAP.

Operation alarms are also configured so technicians get automatic alerts if the operational parameters of an analyzer are outside set points. These alarms also automatically invalidate the data. The operator can then verify these operational alarms and confirm the corrective actions.

Data Quality Control Procedures

In order to assure data collection quality and operational uptime, the following general procedures are performed.

- Gas analyzers are automatically subjected to a daily zero and single high-point test.
- The data acquisition system automatically flags analyzer operational parameters that are outside normal operating ranges.
- Daily review of the daily zero and single point tests from each analyzer is completed by FAP's contractors, with technicians dispatched to investigate/correct as necessary.
- Daily review of the data, including inspection for anomalies and any flags that may have been applied automatically by the data logger, with technicians dispatched to investigate/correct as necessary.
- Daily data review includes cross-network comparison of measurements of the same substances or meteorological conditions to look for anomalies at one station that might indicate a problem.
- For compounds that are subject to Alberta Guidelines or Objectives, alarm set-points are automatically triggered when ambient concentrations exceed the Guidelines or Objectives. This initiates a reporting protocol to AEP, including an investigation into the likely cause.

- Each analyzer is subjected to an up scale and zero as-found test and at least a 4-point calibration each month. BTEX and ethylene analyzers that are non-linear by design are tested with a zero and 5 upscale points. Calibration reports are retained, and copies are submitted to AEP monthly. Calibration forms use automatic formatting to highlight results that approach the limits set by AEP. Calibration factors arising from this calibration may be applied to the data as appropriate.
- Alberta Environment and Parks personnel conduct performance audits of analyzers once a year, verifying that each analyzer is working properly in accordance with the AMD. Auditors also make suggestions for improvements to the monitoring operation at the stations. Follow-up actions to the audit, if necessary, are defined and implemented per the AEP Audit Follow-up Protocol.
- The FAP TWG conducts reviews of data and zero/span charts at each meeting.
- FAP uses a subcommittee of the TWG to review data validation outcomes at selected stations for selected months from time to time. FAP also may contract an independent data validation contractor to run a parallel data validation on selected months and stations.
- Operations contractors are observed performing calibrations. The procedure they use is compared to the AMD and their own applicable SOPs. Where noted, corrections are recorded and made and reported to the TWG.
- FAP uses a process to verify operation and validity of the in-situ calibrators and dedicated gases used at each continuous monitoring station. This includes:
  - Calibration gas standards used in FAP network certified by the manufacturer to +/- 2% or better. These gases are subject to a further verification by the AEP audit lab prior to use in the network.
  - Annual calibration system verifications at the AEP audit lab against AEP standards.
  - Replacement of calibration cylinders before manufacturer posted expiry dates even if they are not empty.
  - Photometer verifications by AEP for NO_2 and O_3 calibrations if gas phase titration (GPT) procedure is not used.
  - Regular flow measurements, flow calibrations and calibration system maintenance as specified by the AMD and manufacturer specifications, or if flow anomalies are suspect.
- Test equipment such as flow and temperature measurement devices used by FAP contractor have current calibration certificates.

Data Validation Processes

Data validation is conducted by a contractor to FAP. Secondary checks of data reports are done by the FAP Network Manager as well as Technical Working Group members every month. Validated data and daily span tests are reviewed holistically by the Technical Working Group monthly to identify any possible anomalies and trends that may warrant another look. Every three months a Data Subcommittee of the Technical Working Group reviews and tracks daily spans on key analyzers going back up to 12 months as compared to the expected and calculated span concentrations with the intention to explain or investigate any sudden hits or prolonged negative or positive trends.

The following data validation procedures are performed by the Data Validation Contractor to FAP every month.

- One-minute, 60-minute, 24-hr, and monthly averages are calculated from 1-second data the data logger gathers from each sensor.
- Data is baseline-corrected by interpolation between consecutive valid zero points.
- Data is reviewed in several ways:
  - Data is plotted and examined together, comparing complementary or related parameters within a station.
  - Information in operational logs, the daily zeroes and spans, and calibration reports are considered.
  - Outliers, flat lines, and other data irregularities are investigated.
  - Data flags are applied as required.

Raw data is maintained unaltered within the central database.

Higher level data validation is performed monthly by the FAP Network Manager for all station in in the network, with an additional validation step by Approval Holders for some stations, prior to submitting reports or posting data to the Government data warehouse.

Reporting Protocol

Reporting of FAP's continuous and passives data and monitoring operations is required by the Alberta Government is accomplished in a number of ways:

- Near real time raw un-verified data is sent hourly to the Alberta Government website for public availability. This data is used for AQHI reporting and forecasting and is available in near real time on several subsequent websites across Canada and North America.

- Exceedances of AAAQOs are reported to Alberta Government's Environmental Service Response Centre as per timelines FAP has established and are followed up with further information within 7 days.

- Instrument operational time below 90% in a month is reported to Alberta Government's Environmental Service Response Centre as soon as it is known and followed up with further information and a corrective action letter within 7 days.

- An ambient air quality monitoring report is prepared with validated data for each continuous monitoring station is submitted monthly to the Alberta Government along with the laboratory report with analysis of all passive devices . The report's contents are prescribed by the Air Monitoring Directive.

- Validated data is posted to the Alberta Government ambient air quality database each month.

- Validated data from FAP stations is downloaded from the Alberta Government database annually by Environment and Climate Change Canada and incorporated into the national database managed for use in national trend analysis and policy construct.

- A summary report is prepared for each monitoring station and all passive sites and submitted annually to the Alberta Government. The report's contents are prescribed by the Air Monitoring Directive.

- This Technical Annual Report provides additional information. It documents the status of the monitoring network and summarizes the regional air monitoring results with historical comparisons and details of AAAQO exceedances as well as comparisons of key parameters over time and with other locations across Alberta.

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