WOOD BUFFALO
ENVIRONMENTAL ASSOCIATION
W B E A

Wood Buffalo Environmental Association

2020 Annual Report

Contents

Cliff Dimm

Message from the
President

2020 was a year that required most people to make adjustments. Businesses specifically had to make huge changes to their operations, and the WBEA was no different. These changes were easy for some, and tougher for others to manage, especially considering isolation requirements. COVID-19 and its impacts on the province, country, and economy forced us all to rethink what works, and how we can continue to make progress. As the situation evolved, the WBEA was able to make moves to continually reduce the risk, while keeping critical monitoring activities going. As the WBEA demonstrated during the 2016 Horse River Wildfire, adaptability is part of how this organization and its people work. The WBEA had a strong COVID-19 pandemic response: created a mitigation plan, motioned to move all WBEA meetings to online platforms, and developed safety protocols for all field work conducted. While not knowing how long we would continue to be in a modified work mode, staff continued to demonstrate their ability to continue world class monitoring. The extent to which we are willing to be nimble, creative, and experimental will determine how successful we are coming out of the end of this. The WBEA's demonstrated ability to find ways to make the work happen safely is something that we know will continue. We express our appreciation to Sanjay for his leadership and all of the WBEA employees for being part of making this work.

The Governance Committee (GC) considered how the WBEA's strategic goal of being scientifically credible, along with its ability to deliver and report on high-quality monitoring programs and data, has helped secure funding for the WBEA's monitoring programs. Additionally, sub-regional monitoring is ideal to engage communities and represent unique regional concerns and issues, and this is what is being advocated for when WBEA stakeholders and GC members attend Oil Sands Monitoring (OSM) Program committee meetings. We thank our Members for their commitment and advocacy, and the significant difference that this, and the WBEA's active membership, has made. This engagement is what makes the WBEA unique from other airsheds.

The WBEA began preparing for the 2022-2026 Strategic Plan process by putting together the Steering Committee, comprised of members from the WBEA's General Members Board (GM) and Technical Committees. During the WBEA's last Strategic Planning sessions in 2016, we were working with a new provincial government, and we were trying to develop a better understanding of expectations on the role of environmental monitoring. We built a plan that assumed holding the course, and acknowledged that we would adapt if needed. As we enter another Strategic Planning cycle early next year, we are continuing to seek clarity. I believe that it's reasonable to hold the same approach this time. We are comfortable in both the "what" of the WBEA work scopes, and confident in the "how." As we move through the next year, we will continue to adapt as needed, and deliver the results that all of our members expect. Our best product will come with engagement and participation, and I would like to thank all of those who have stepped up to be part of the Strategic Planning team. I think this is another great example of the increased participation from our Members over the course of this year.

I would like to again thank the WBEA membership for your participation, and I look forward to another great year.

Sanjay Prasad

Message from the

Executive Director

The past year was full of challenges and opportunities for the WBEA, which were also experienced by people and organizations in the region and around the world. Our staff responded well, and through operational, business continuity, and COVID-19 mitigation planning, along with our collective ability to adapt to new and developing situations, the WBEA was able to maintain 90% of our operations throughout the height of the pandemic. Our focus was maintaining the safety of our staff, while we also wanted to ensure that the WBEA continued to provide leading air quality monitoring programs and data reporting.

The WBEA worked to implement best practices, developed business cases for sharing the WBEA Centre with Alberta Environment and Parks (AEP) and establishing the Analytical Services Group, and conducted a legal review of all WBEA contracts. These opportunities will bring operational improvements and sustainable cost savings to the WBEA. We were pleased to receive 100% compliance with the AEP's audit of the WBEA's ambient air monitoring network, and the WBEA was awarded a Gold Certificate of Excellence in Business by the Member of Parliament (MP) for the Fort McMurray- Cold Lake region.

To further develop a transparent relationship with AEP, the WBEA relayed concerns regarding operational impacts as a result of changes to or interpretations of the Air Monitoring Directive (AMD) and Alberta Energy Regulator (AER) amendments to Environmental Protection and Enhancement Act (EPEA) clauses. The WBEA also provided comments to AEP on the Draft Total Reduced Sulphur (TRS) Guideline and Ambient Air Quality Objective/ Guideline (AAQO/G) clarifications.

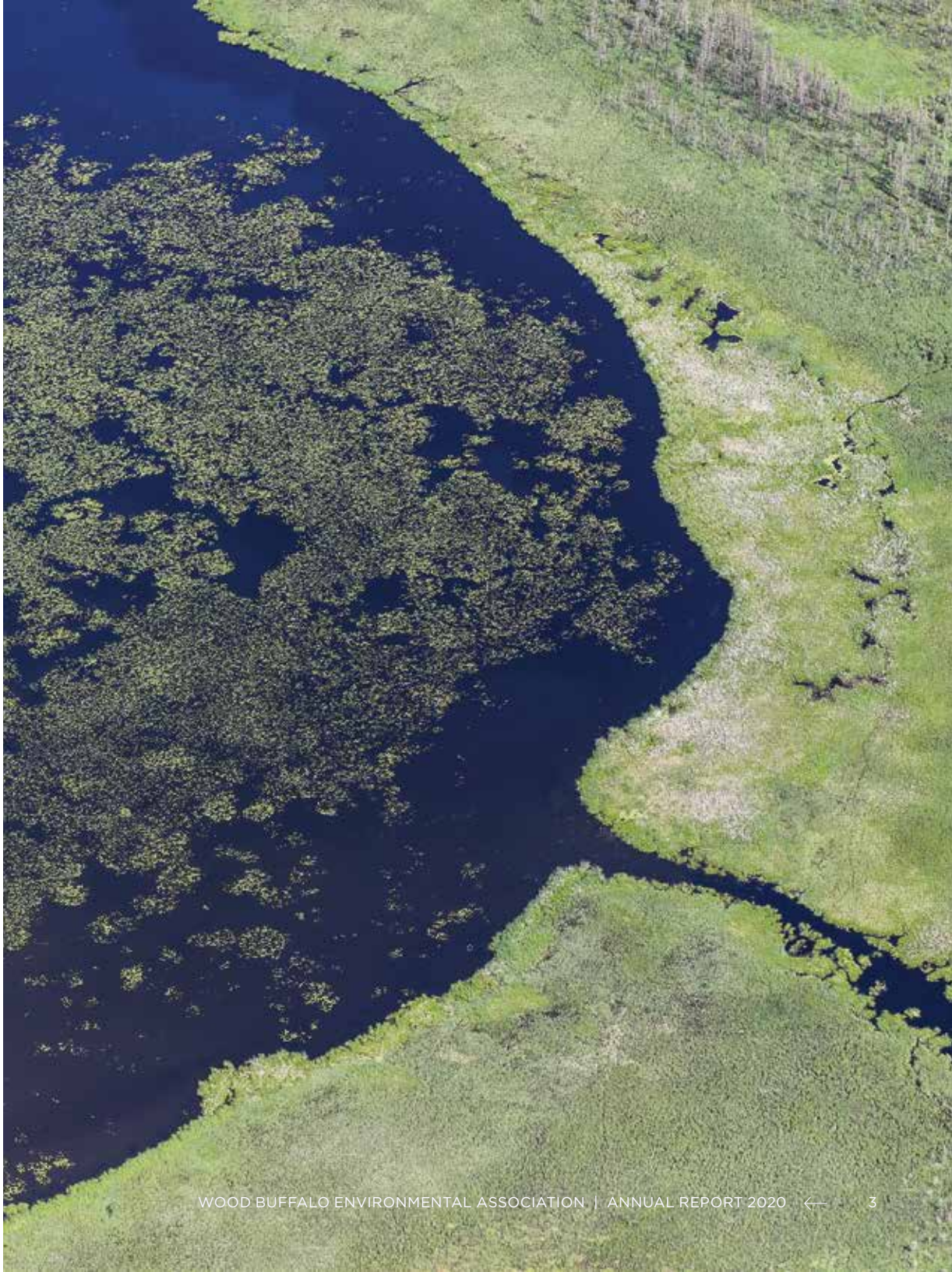
In August, the WBEA was notified of the Oil Sands Monitoring (OSM) Program's funding decisions for 2020/2021 work plans. From a dollar-value perspective, the WBEA received 97% of its requested funding for core monitoring programs. The budget demonstrated that the WBEA continues to reduce its costs and becomes more cost effective as an organization each year. The WBEA regularly submitted progress reports to the OSM Program to demonstrate the advancement and achievement of project deliverables.

There were a number of improvements made at the WBEA Centre and within our monitoring network. This included the completion of a leasehold improvement of our second-floor conference room. The boardroom was named in honor of Freddy Castor, a landowner who supported the WBEA and its placement of an air monitoring station in Fort Chipewyan.

The WBEA continued to participate in various air quality initiatives in the province, which included contributing to AEP's State of the Environment Report, and being a representative for the Alberta Airshed Council (AAC) on the Clean Air Strategic Alliance (CASA) Air Quality NO2/SO2 subgroup for the Alberta Ambient Air Quality Objectives (AAAQOs) and the Canadian Ambient Air Quality Standards (CAAQS) Achievement project. The WBEA continually works with the AAC on developing key priorities for the Airsheds to align with government priorities and to engage Albertans on the importance of clean air.

I would like to thank the members of our Governance Committee and General Members Board for your continued guidance, support, and engagement over the past year. Your collective knowledge and expertise are invaluable to the Association. We look forward to working together to accomplish our common monitoring objectives to maintain an efficient monitoring organization in the Regional Municipality of Wood Buffalo to deliver high-quality environmental monitoring programs. I also want to acknowledge the dedication and support of WBEA staff and Science Advisors in working toward and delivering on our organizational goals.

Sanjay Prasad, WBEA Executive Director



Who is the WBEA?

Your independent air quality reporter.

The Wood Buffalo Environmental Association (WBEA) monitors the environment of the Regional Municipality of Wood Buffalo (RMWB) in north-eastern Alberta

24
hours/day
365
days/year

Strategic Plan

The WBEA 2017–2021 Strategic Plan captures, in a single document, what the WBEA is about and what it seeks to achieve over the next five years. The plan focuses on four major goals:

1. Provide state-of-the-art environmental monitoring
2. Support meaningful stakeholder engagement and strategic partnerships
3. Recognize traditional knowledge as an important source of wisdom and information
4. Establish socially and fiscally responsible business practices

All of the WBEA's 40-member organizations contributed to the planning process. The development of the plan involved reflecting on past years of operation, gathering feedback and perspectives from all participants and setting goals to successfully carry the organization into the future.

Vision

People are empowered to make informed decisions to ensure a safe and healthy environment.

Mission

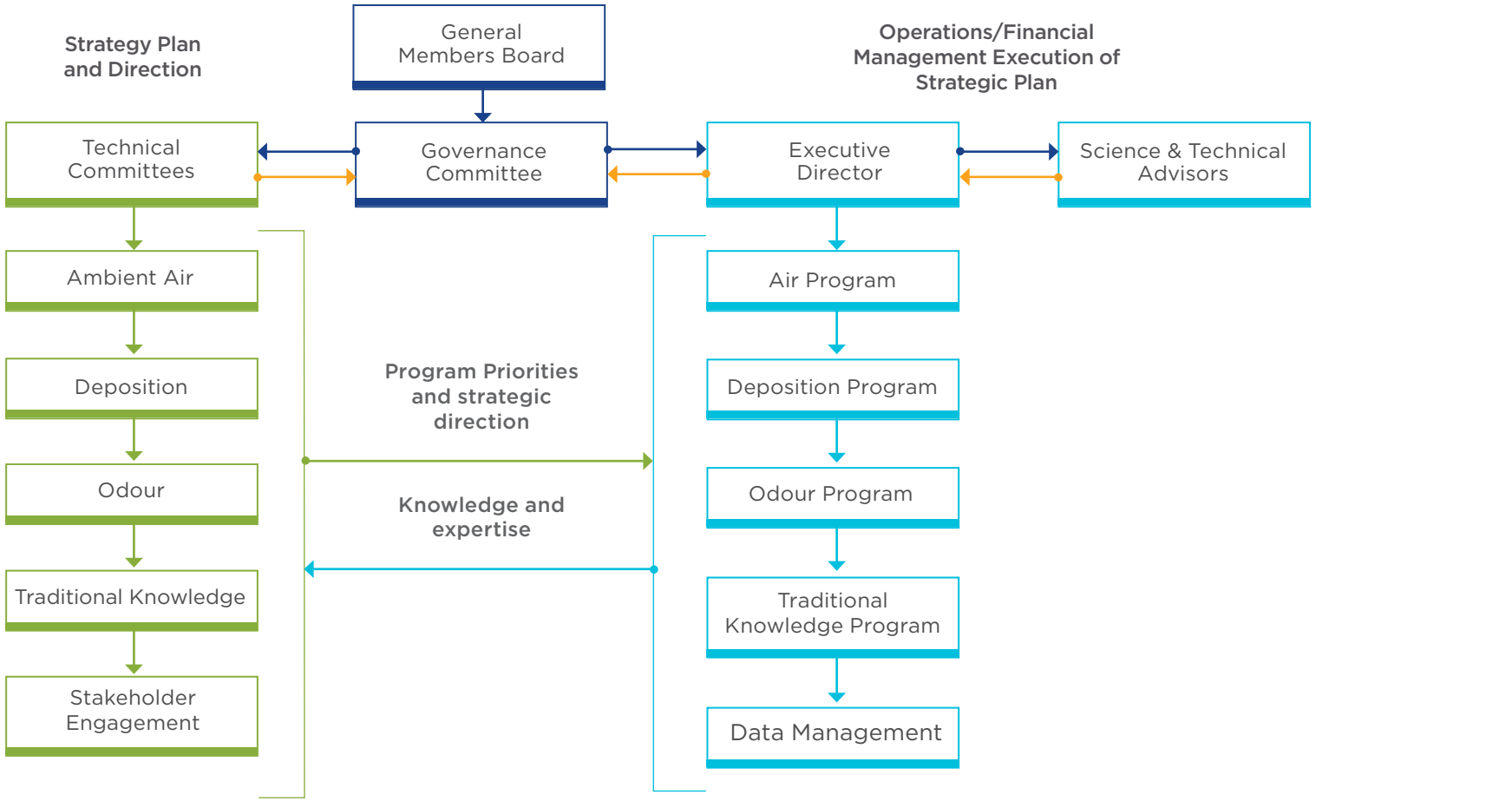
The WBEA is a multi-stakeholder, consensus-based organization that leads in state-of-the-art environmental monitoring to enable informed decision-making.

Core Values

- We are scientifically independent.
- We recognize, respect, and use traditional knowledge.
- We are transparent and timely in communicating accurate and accessible data.
- We are dedicated to using best available practices and technology.
- We support diverse stakeholder participation to achieve consensus-based decisions.

Organizational Structure

The diagram below depicts how the WBEA operates and shows the relationships between the General Members Board, Governance Committee, Technical Working Groups, and the WBEA staff. The General Members Board and Governance Committee provide strategic direction and oversight for the organization. The Technical Committees determine the strategic plans and direction for each of the WBEA's monitoring programs. The Executive Director provides operational direction for the WBEA staff, engaging science and technical advisors as required, to ensure stewardship to the overarching direction set by the General Members Board and Governance Committee.



Alberta Environment and Parks

Oil Sands Monitoring Branch

Alberta Environment and Parks (AEP) is responsible for monitoring, evaluating, and reporting on key air, water, land, and biodiversity indicators. The mandate within the ministry is to provide open and transparent access to scientific data and information on the condition of Alberta's environment, including specific indicators as well as cumulative effects, both provincially and in specific locations. The Oil Sands Monitoring (OSM) Program is a joint federal and provincial initiative between the Government of Alberta and Environment and Climate Change Canada. The mandate of the program is to implement an ambient environmental monitoring program in the oil sands region that integrates air, water, land, and biodiversity. The OSM Program strives to improve characterization of the state of the environment and enhance understanding of the cumulative effects of oil sands development.

The WBEA has entered into a contractual agreement with AEP. As a working partner, the WBEA is one of the agencies helping to ensure that the OSM Program is delivered with the best expertise possible.

For more information, visit **environmentalmonitoring.alberta.ca**.

Alberta

OIL SANDS MONITORING PROGRAM

WBEA within Alberta Airsheds

Alberta's Airsheds Council

The WBEA is a member of the **Alberta Airsheds Council (AAC)**, which is a partnership of Alberta's Airsheds and provides leadership in support of healthy air quality for Albertans and the environment.

Initiated in 2006, the AAC includes membership from all ten Airsheds in Alberta and was formed to represent the collective interests of this collaborative group.

The AAC provides a forum for Airsheds to work and learn together, to continue to advance effective and efficient air monitoring, reporting and outreach, and to address regional matters.

The **2020 Alberta Airsheds Air Quality Report** provides a summary of the air quality data that is monitored and collected in our province by Alberta's Airsheds.

Peace River Area Monitoring Program Committee (PRAMP)

Peace River region

Peace Airshed Zone Associations (PAZA)

Grande Prairie and region

West Central Airshed Society (WCAS)

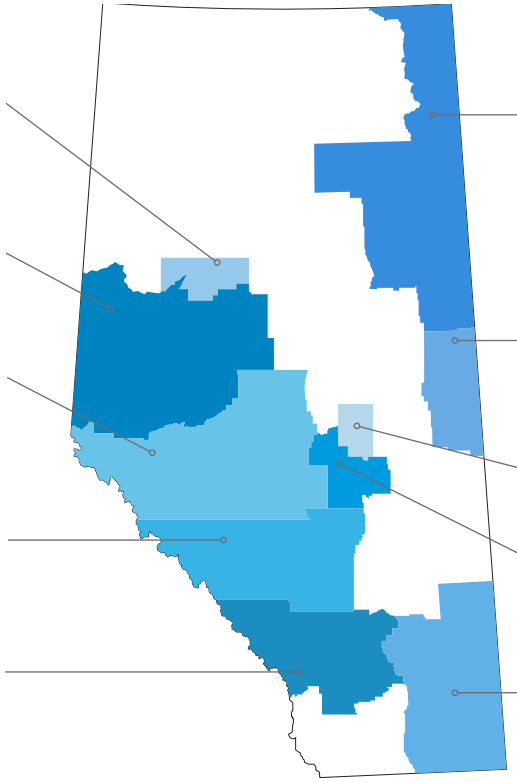
Jasper, Hinton, Edson, Lake Wabamun, Drayton Valley, Pigeon Lake and surrounding region

Parkland Airshed Management Zone (PAMZ)

Red Deer, Rocky Mountain House, Sundre, Banff and surrounding region

Calgary Region Airshed Zone (CRAZ)

Calgary and region



Wood Buffalo Environmental Association (WBEA)

Fort McMurray and the Wood Buffalo region

Lakeland Industry and Community Association (LICA)

Bonnyville, Cold Lake, St. Paul and region

Fort Air Partnership (FAP)

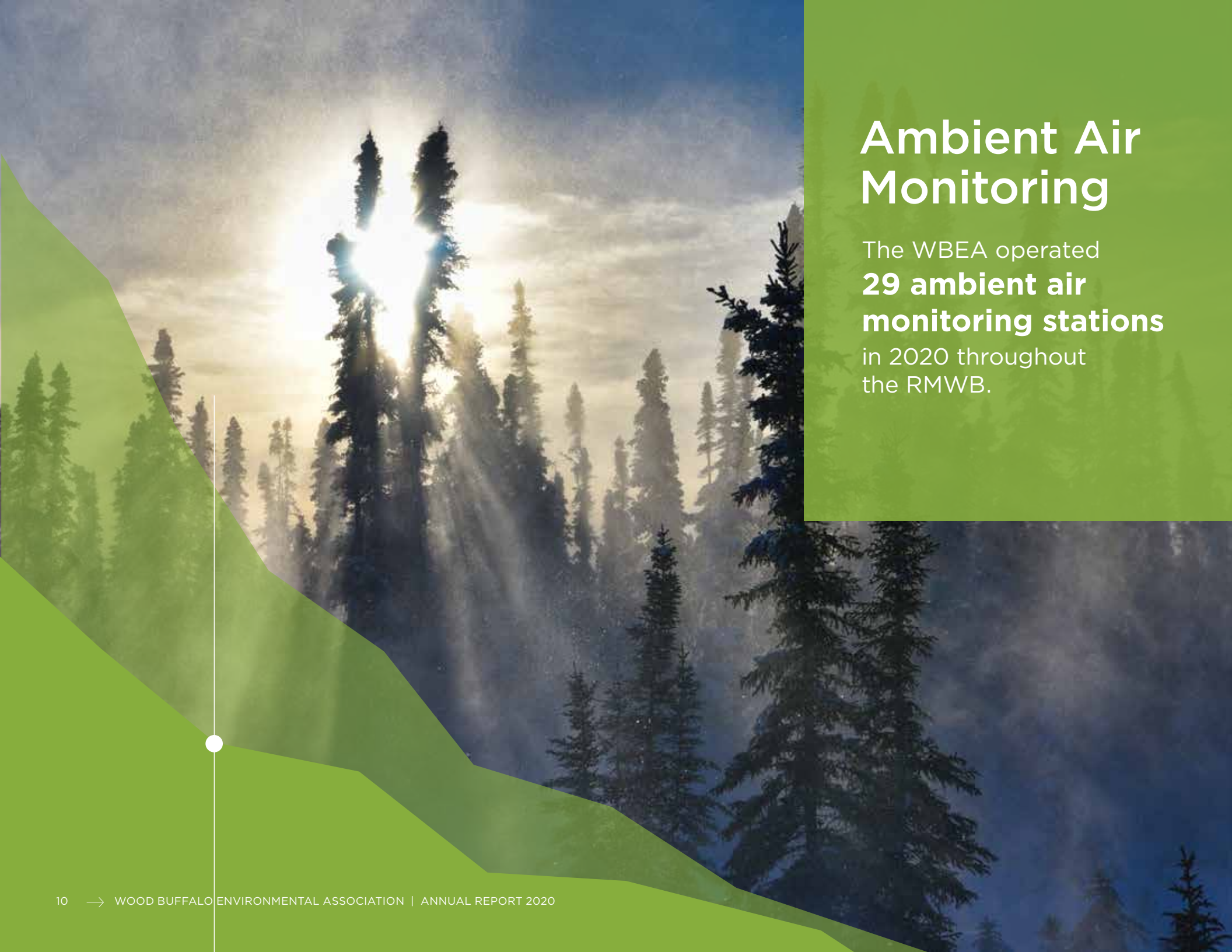
Fort Saskatchewan region

Alberta Capital Airshed (ACA)

Edmonton region

Palliser Airshed Society (PAS)

Medicine Hat, Redcliffe and surrounding region



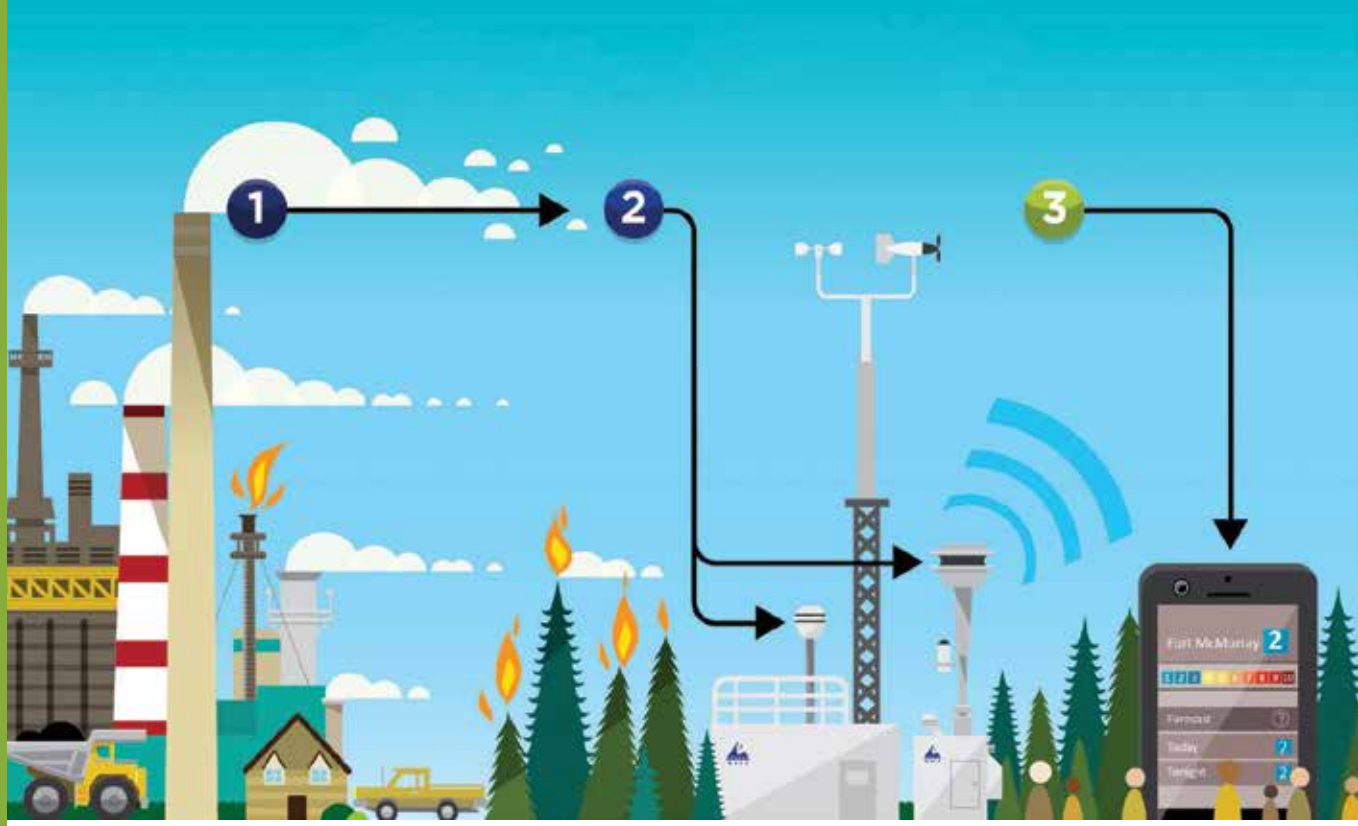
Ambient Air Monitoring

The WBEA operated **29 ambient air monitoring stations** in 2020 throughout the RMWB.

These included industrial, attribution, community, background, and meteorological stations. The image on the right demonstrates how the WBEA collects ambient air data through continuous analyzers and time-integrated samplers to ensure residents and stakeholders have the information they need to make informed environmental decisions.

The WBEA provides all air monitoring data online via the following ways:

- All WBEA air monitoring data are fully quality-assured and then sent by the end of the following month to **airdata.alberta.ca**, an AEP on-line database for all of Alberta's ambient air quality data.
- All of the WBEA's data can also be found on our website at **wbea.org**.
- The **WBEA's Ambient Air Annual Report 2020** contains detailed information related to the data collected in the WBEA's monitoring network.
- To see various ambient air monitoring trends within the WBEA's network, visit **annualtrends.wbea.org**.



1

Source

Pollution is emitted into the air from a variety of sources

2

Measure

The WBEA ambient air monitoring stations measures the concentrations of pollutants in the air

3

Share

The information the WBEA collects is available to view on **wbea.org** and is used to calculate the air quality health index (AQHI)

Air Quality Health Index

The Air Quality Health Index, or AQHI, is a provincial scale designed to help people understand what air quality means to their health. It is a tool designed to help individuals make decisions to protect their health by limiting short-term exposure to air pollution and adjusting activity levels during increased levels of air pollution.

The AQHI includes concentrations of nitrogen dioxide (NO_2), fine particulate matter ($PM_{2.5}$), and ground-level ozone (O_3), which are three compounds that can cause respiratory effects. Additionally, in Alberta, hourly pollutant concentrations are compared against **Alberta's Ambient Air Quality Objectives** (AAAQOs). If an AAAQO is exceeded, the AQHI value is overridden with a HIGH or VERY HIGH risk value. However, odour causing compounds measured in the WBEA network are not considered in the AQHI. Therefore, this index gives an idea of air quality based on some pollutants, but it does not describe the potential for odour events.

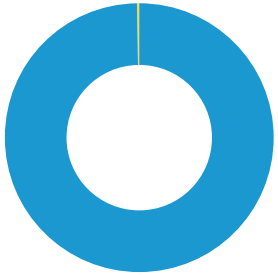
The WBEA reports AQHI ratings from nine of its continuous monitoring stations in the Wood Buffalo region, as shown in the pie charts on page 13. In their **2020 Alberta Airsheds Air Quality Report**, the Alberta Airshed Council (AAC) **compared AQHI data collected across ambient air monitoring stations throughout Alberta** and found stations indicated a low risk range more than 90% of the time in 2020.

The community of Fort McKay has also developed its own Fort McKay Air Quality Index (FMAQI), based on the data collected by the WBEA at its Bertha Ganter-Fort McKay air monitoring station. The FMAQI is independent of the provincial AQHI, and includes compounds that can indicate odours, such as Total Reduced Sulphur (TRS), total hydrocarbons (THC), and sulphur dioxide (SO_2). For more information on the FMAQI, visit **wbea.org/air/fort-mckay-air-quality-index-aqi/**.

To find out more, visit **wbea.org/air/air-quality-health-index**.

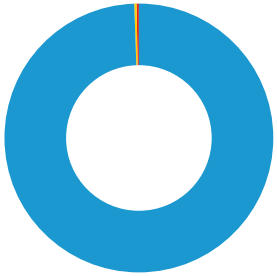
LOW RISK	MODERATE RISK	HIGH RISK	VERY HIGH RISK
1 2 3	4 5 6	7 8 9 10	+

2020 Hourly AQHI by Station



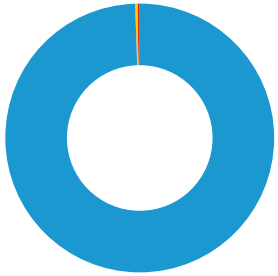
Anzac

99.93% Low Risk
0.07% Moderate Risk
0.00% High Risk
0.00% Very High Risk



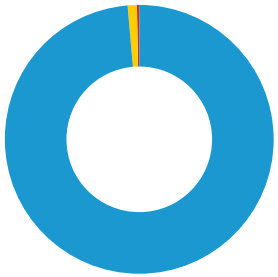
Conklin

99.52% Low Risk
0.39% Moderate Risk
0.09% High Risk
0.00% Very High Risk



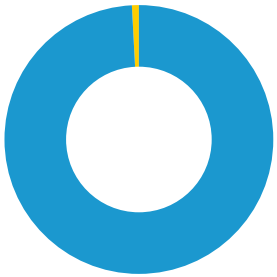
Fort Chipewyan

99.67% Low Risk
0.22% Moderate Risk
0.11% High Risk
0.00% Very High Risk



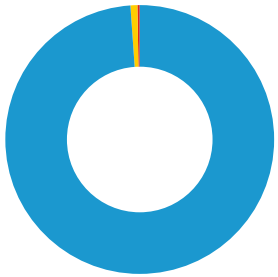
Bertha Ganter - Fort McKay

98.74% Low Risk
1.24% Moderate Risk
0.02% High Risk
0.00% Very High Risk



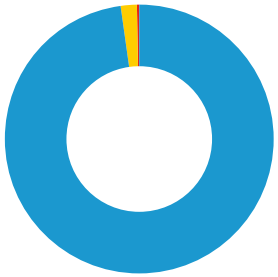
Fort McKay South

99.19% Low Risk
0.81% Moderate Risk
0.00% High Risk
0.00% Very High Risk



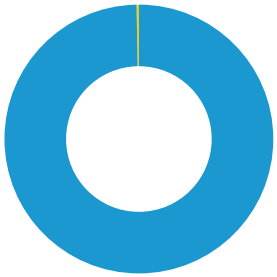
Athabasca Valley (Fort McMurray)

98.93% Low Risk
1.06% Moderate Risk
0.01% High Risk
0.00% Very High Risk



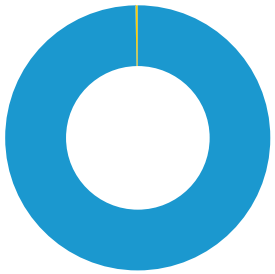
Patricia McInnes (Fort McMurray)

97.92% Low Risk
2.07% Moderate Risk
0.01% High Risk
0.00% Very High Risk



Janvier

99.74% Low Risk
0.26% Moderate Risk
0.00% High Risk
0.00% Very High Risk



Stony Mountain

99.88% Low Risk
0.10% Moderate Risk
0.01% High Risk
0.00% Very High Risk

Ambient Air Quality Standards

The WBEA's ambient air quality data is compared to several established air quality thresholds, triggers, and limits, including the **World Health Organization Air Quality Guidelines**, the **Canadian Ambient Air Quality Standards**, **Alberta's Ambient Air Quality Objectives and Guidelines**, and the **Lower Athabasca Regional Plan's** trigger levels and limits.

World Health Organization Air Quality Guidelines

The World Health Organization (WHO) Air Quality Guidelines offer guidance on threshold limits for key air pollutants that pose health risks and provide a reference for setting air pollution targets at regional and national levels to improve air quality. The WHO provides additional details in their **guideline publication**.

The table below provides a summary of the WHO Air Quality Guidelines.

Parameter	Averaging Period	Objective or Guideline Value	Units
Fine Particulate Matter ($PM_{2.5}$)	24-hour 99th percentile	25	µg/m³
	Annual	10	
Nitrogen Dioxide (NO_2)	1-hour	105	ppb
	Annual	21	
Ozone (O_3)	8-hour daily maximum	100	ppb
Sulphur Dioxide (SO_2)	24-hour	48	ppb
	Annual	20	

Canadian Ambient Air Quality Standards

The Canadian Ambient Air Quality Standards (CAAQS) are national air quality standards that are designed to protect human health and the environment. The CAAQS inform the development of management plans and appropriate management actions required to improve air quality. The CAAQS, which are based on three years of data, are targeted to assess air quality issues that can be controlled locally through management actions (such as emissions reductions). The Government of Alberta provides additional information about CAAQS on their **website**.

The table below provides a summary of the CAAQS for 2020 and 2025.

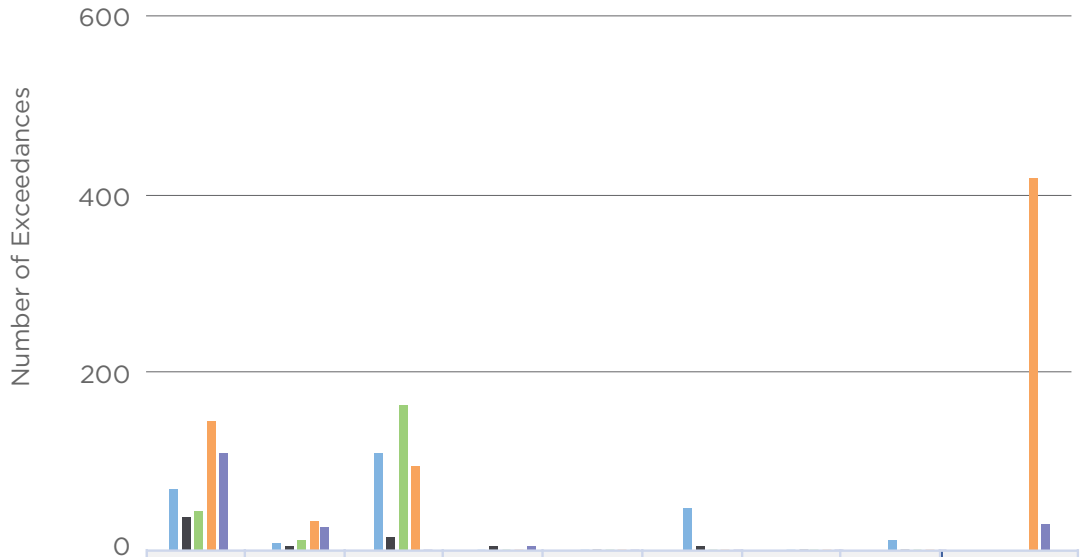
Contaminant	Average Time	Numerical Value Effective		Statistical Form of the Standard (Metric)
		2020	2025	
NO_2 (ppb)	Annual	17	12	Arithmetic average over a single calendar year of all NO_2 1-hour average concentrations in the year
	1-hour	60	42	3-year average of the annual 98th percentile of the NO_2 daily maximum 1-hour average concentrations
SO_2 (ppb)	Annual	5	4	Arithmetic average over a single calendar year of all SO_2 1-hour average concentrations in the year
	1-hour	70	65	3-year average of the annual 99th percentile of the SO_2 daily maximum 1-hour average concentrations
O_3 (ppb)	8-hour	62	60	3-year average of the annual 4th highest of the daily maximum 8-hour average ozone concentrations
$PM_{2.5}$ ($\mu g/m^3$)	Annual	10	8.8	3-year average of the annual average of all 1-hour concentrations
	24-hour	28	27	3-year average of the annual 98th percentile of the daily 24-hour average concentrations

Alberta Ambient Air Quality Objectives & Guidelines

Alberta's Ambient Air Quality Objectives (AAAQOs) and Ambient Air Quality Guidelines (AAAQGs) were developed under the Alberta Environmental Protection and Enhancement Act (EPEA) to protect Alberta's air quality. AAAQOs help assess industry compliance and evaluate facility performance, and AAAQGs are a general performance indicator used to help with airshed planning and management. Both are established for a variety of averaging periods depending on the characteristics of the pollutant.

The first graph on the right presents a total count of air quality event exceedances at all WBEA ambient air monitoring stations over a five-year period for AAAQOs from 2016–2020. Since the $PM_{2.5}$ 1-hour AAAQG was established in 2019, exceedance data available from 2019 and 2020 are included in the graph. The second graph shows the exceedances for 2020 based on station locations.

Air Quality Events in Excess of AAAQOs and AAAQGs (2016-2020)



	H_2S TRS – 1-hour	H_2S TRS – 24-hour	$PM_{2.5}$ – 24-hour	SO_2 – 1-hour	SO_2 – 24-hour	O_3 – 1-hour	NO_2 – 1-hour	CO – 1-hour	$PM_{2.5}$ Guideline 1-hour
	AAAQO								AAAQG
2016	68	9	109	1	0	49	1	10	0
2017	36	4	16	2	0	3	0	0	0
2018	44	10	163	1	0	0	0	0	0
2019	146	31	95	0	0	0	0	0	420
2020	110	27	0	2	1	0	0	0	30

Note: Forest fire season was considered to be from March 1 – October 31, 2020. There were no $PM_{2.5}$ AAAQO exceedances in 2020; however, there were 14 $PM_{2.5}$ AAAQG exceedances outside the forest fire season.

Note: The WBEA began reporting $PM_{2.5}$ AAAQG exceedances in 2019 as per the Alberta Air Monitoring Directive (AMD) requirements; the graph shows exceedance data for only 2019 and 2020.

2020 Exceedances by Station

	1 hr H_2S	24 hr H_2S	24 hr $PM_{2.5}$	1 hr O_3	1 hr SO_2	1 hr $PM_{2.5}$
	AAAQO					AAAQG
Anzac						
Athabasca Valley						1
Barge Landing						2
Bartha Ganter - Fort Mckay						1
Buffalo Viewpoint	7				1	
Christina Lake	1					
Conklin						7
Firebag						
Fort Chipewyan						5
Fort Hills						2
Fort McKay South					1	
Horizon						9
Jackfish 1						
Jackfish 2/3						
Janvier						2
Kirby North	1					
Kirby South						
Leismer						
Lower Camp	9	2				
Lower Camp Met Tower	9	2				
Mackay River						
Mannix	54	17				1
Mildred Lake	9	5				
Patricia McInnes						1
Sawbones Bay						
Stony Mountain						
Surmont						
Surmont 2						
Wapasu						
Waskow Ohci Pimatisiwin						

Forest fire season was considered to be from March 1 – October 31, 2020. There were no $PM_{2.5}$ AAAQO exceedances in 2020; however, there were 14 $PM_{2.5}$ AAAQG exceedances outside the forest fire season.

Reporting Air Quality Events

When ambient concentrations of any air pollutant that the WBEA measures exceed the AAAQO, the WBEA has an Immediate Reporting Protocol that is put into action:

1. The data collection system automatically sends out alarm notifications to the WBEA personnel and an independent third-party alarm monitoring company.

2. The alarm company acknowledges the incoming alarm and reports the data and supporting information such as wind conditions, locations, time, etc., to AEP in real time, or as soon as becoming aware of it. AEP uses the data and information from the WBEA to follow-up as appropriate.

3. If the exceedance occurs at an industry station, the owner is informed that they have exceeded an AAAQO, and provided with the same information that was given to AEP. They are then required to follow up with AEP and/or the Alberta Energy Regulator (AER) and submit a report within seven days of the exceedance.

The AAAQGs are not intended for compliance monitoring and the Air Monitoring Directive clarifies that 24-7 or "on-call" reporting by Alberta airsheds is not required. The WBEA reports exceedances during business hours and does not use a third-party alarm contractor. The WBEA notifies stakeholders and partners of the exceedance via email.

The following table shows the objectives and guidelines for the parameters which have established AAAQOs and AAAQGs within the WBEA monitoring network. Where there is a dash (-) in the table below AAAQOs or AAAQGs do not currently exist.

Parameter	1-hour Average	8-hour Average	24-hour Average	30-day Average	Annual Average
AAAQOs					
Sulphur Dioxide (SO_2)	172 ppb	-	48 ppb	11 ppb	8 ppb
Nitrogen Dioxide (NO_2)	159 ppb	-	-	-	24 ppb
Ozone (O_3)	76 ppb	-	-	-	-
Total Reduced Sulphurs (TRS)/Hydrogen Sulphide (H_2S)*	10 ppb	-	3 ppb	-	-
Particulate Matter 2.5 ($PM_{2.5}$)	-	-	29 µg/m^3	-	-
Carbon Monoxide (CO)	13 ppm	5 ppm	-	-	-
Ammonia (NH_3)	2 ppm	-	-	-	-
AAAQG					
$PM_{2.5}$	80 µg/m^3	-	-	-	-

**In the WBEA network TRS concentrations are reported using the H_2S AAAQOs.*

WBEA's Air Quality Events (AQE) App

The WBEA created an Air Quality Events (AQE) app to provide near real-time information about air quality events that occur in the network to its stakeholders and partners. The AQE app is available for download on Android and Apple platforms, and the AQE app stores historical and near real-time air quality events information on the WBEA **AQE webpage**.

LARP Triggers & Limits

The Lower Athabasca Regional Plan (LARP) came into effect in September 2012 and was the first regional plan developed under the Alberta Land-Use Framework.

The LARP air quality objective is to manage releases from multiple sources so they do not collectively result in unacceptable air quality. LARP sets out trigger levels and limits for NO_2 and SO_2 as described in the table on the right. When a trigger is exceeded, AEP is required to create a regional management response.

The WBEA provides AEP with the air quality data that is used to calculate the annual LARP triggers and limits.

The following graphs show the annual average and hourly 99th percentile concentrations of NO_2 and SO_2 at each station location compared to the respective triggers and limit for each parameter. The use of the hourly 99th percentile data is a statistical measure to indicate upper limits of the data. Increases in the 99th percentile beyond the LARP triggers can be an early warning to help inform appropriate management actions to prevent future exceedances.

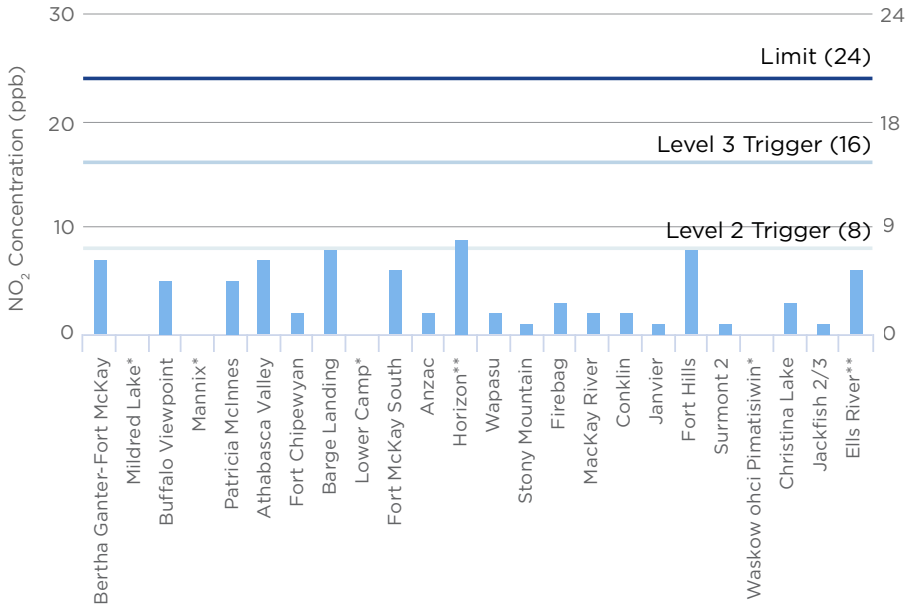
Learn more about LARP

Description	Management Intent
Level 4	
Ambient air quality exceeding air quality limits	Improve ambient air quality to below limits
Limit	
Level 3	
Ambient air quality below but approaching air quality limits	Proactively maintain air quality below limits
Trigger	
Level 2	
Ambient air quality below air quality limits	Improve knowledge and understanding, and plan
Trigger	
Level 1	
Ambient air quality well below air quality limits	Apply standard regulatory and non-regulatory approaches

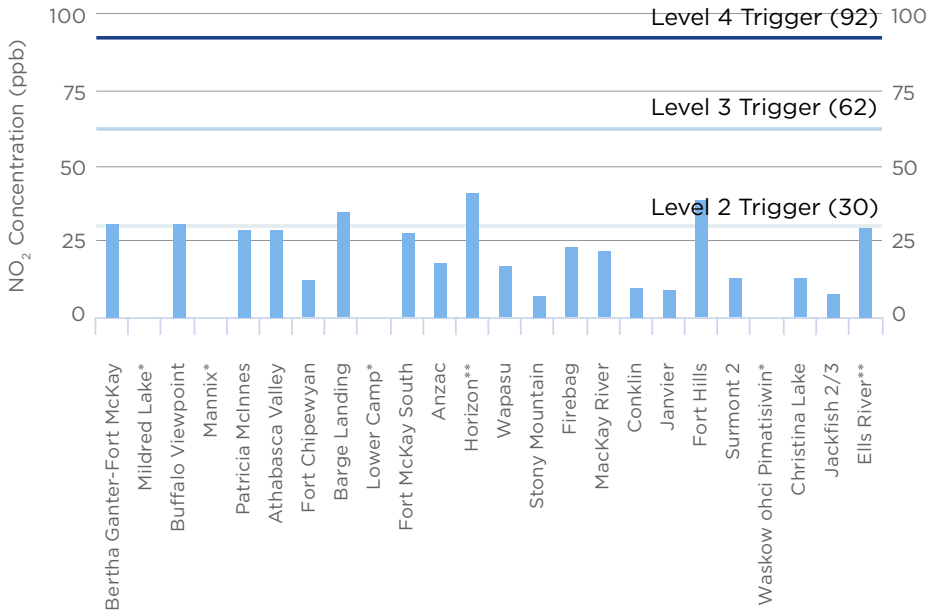
Note: The ambient air quality values based on the 99th percentile of hourly data are all established as triggers in the management framework

Stations

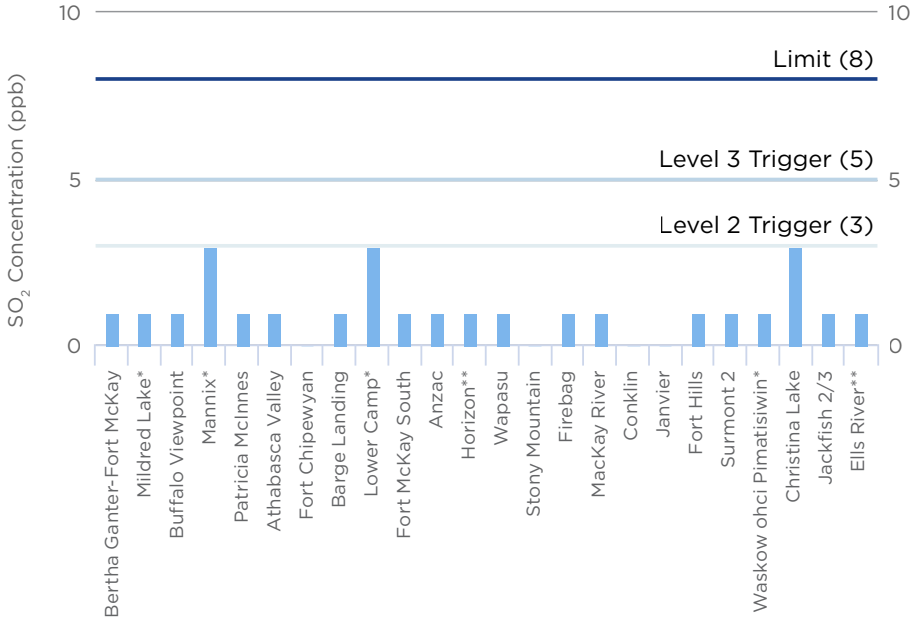
LARP NO_2 Annual Average



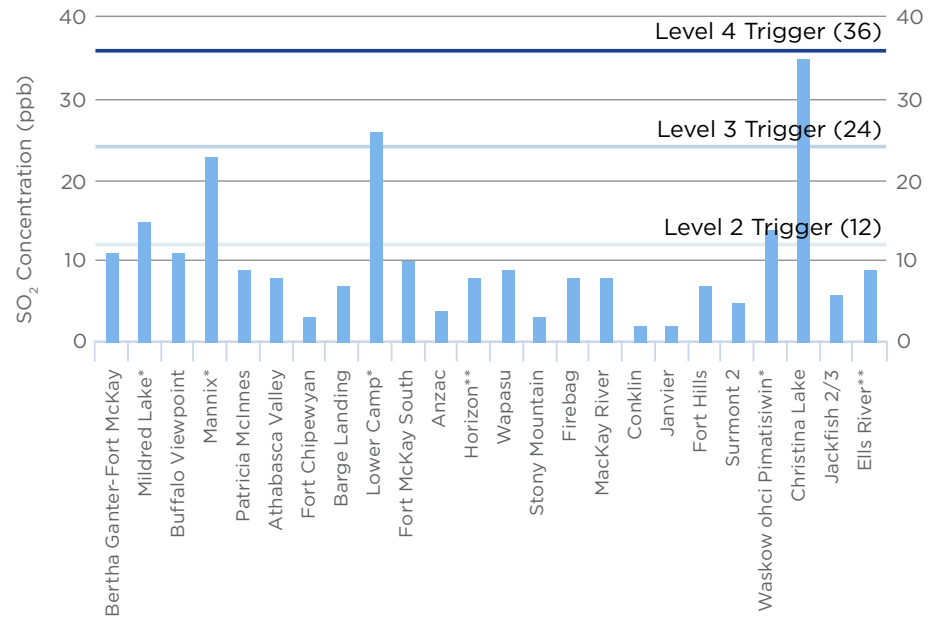
LARP NO_2 Hourly 99th Percentile



LARP SO_2 Annual Average



LARP SO_2 Hourly 99th Percentile



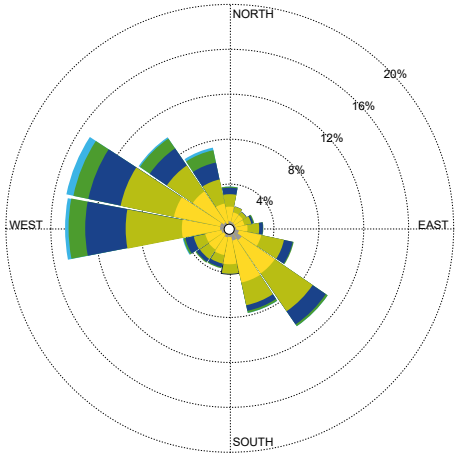
*Note: *Parameter not measured at station; **Stations operational less than 75% of the time in 2020.*

Regional Wind Profiles

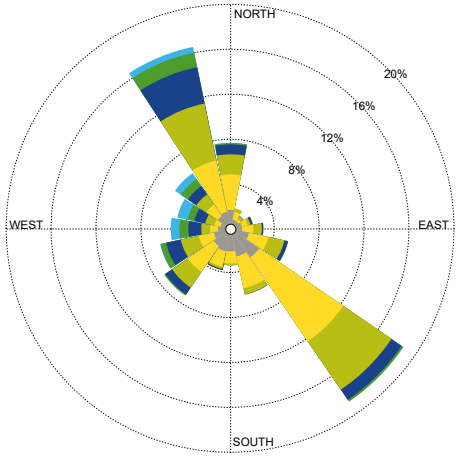
WIND SPEED (km/h)

0.5 - 5 | 5 - 10 | 10 - 15 | 15 - 20 | 20 - 25 | > = 25

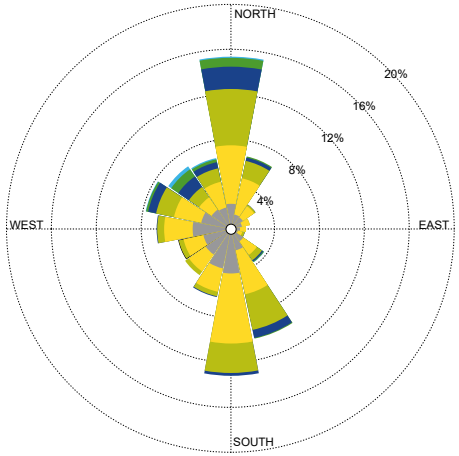
Anzac
Calms: 0.09% | Tower Height: 20m



Athabasca Valley (Fort McMurray)
Calms: 0.32% | Tower Height: 10m



Bertha Ganter - Fort McKay
Calms: 0.27% | Tower Height: 10m

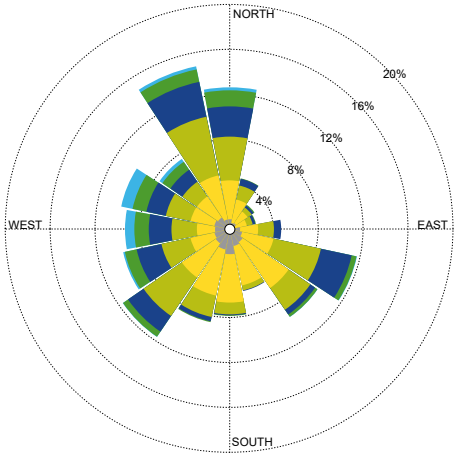


Air pollution transport, dispersion, transformation, and deposition are influenced by meteorological parameters, such as wind speed, wind direction, the vertical temperature structure of the atmosphere, humidity, atmospheric pressure, precipitation, and solar radiation.

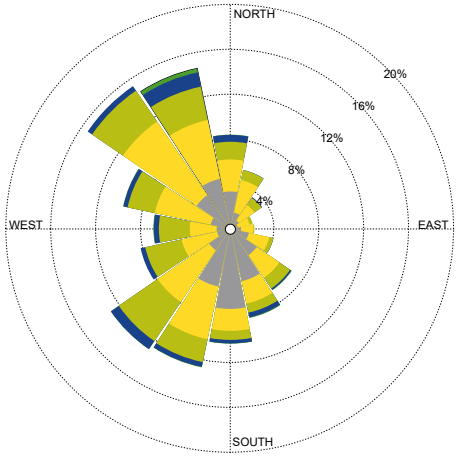
The wind rose plots provided show the direction, speed, and frequency of winds at each community station in the network in 2020. The legend for the wind speed is shown on the previous page. The colours within each wind rose triangle denote the frequency of the wind speed. Calms are shown for each community as a percentage of time that wind speeds are below 0.5 km/h.

For example, the largest triangle in Fort Chipewyan wind rose shows the wind comes from the east, just 18% of the time in 2020. The yellow colour in this triangle shows the wind was between 20 and 25 kilometers per hour (km/h) 4% of the time. Wind speeds were less than 0.5 km/h in Fort Chipewyan 0.13% of the time (calms).

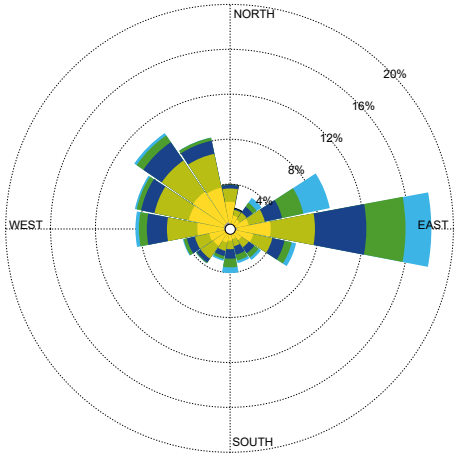
Patricia McInnes (Fort McMurray)
Calms: 0.14% | Tower Height: 10m



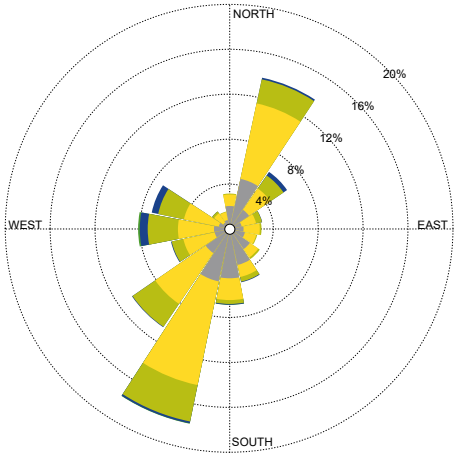
Conklin
Calms: 1.68% | Tower Height: 10m

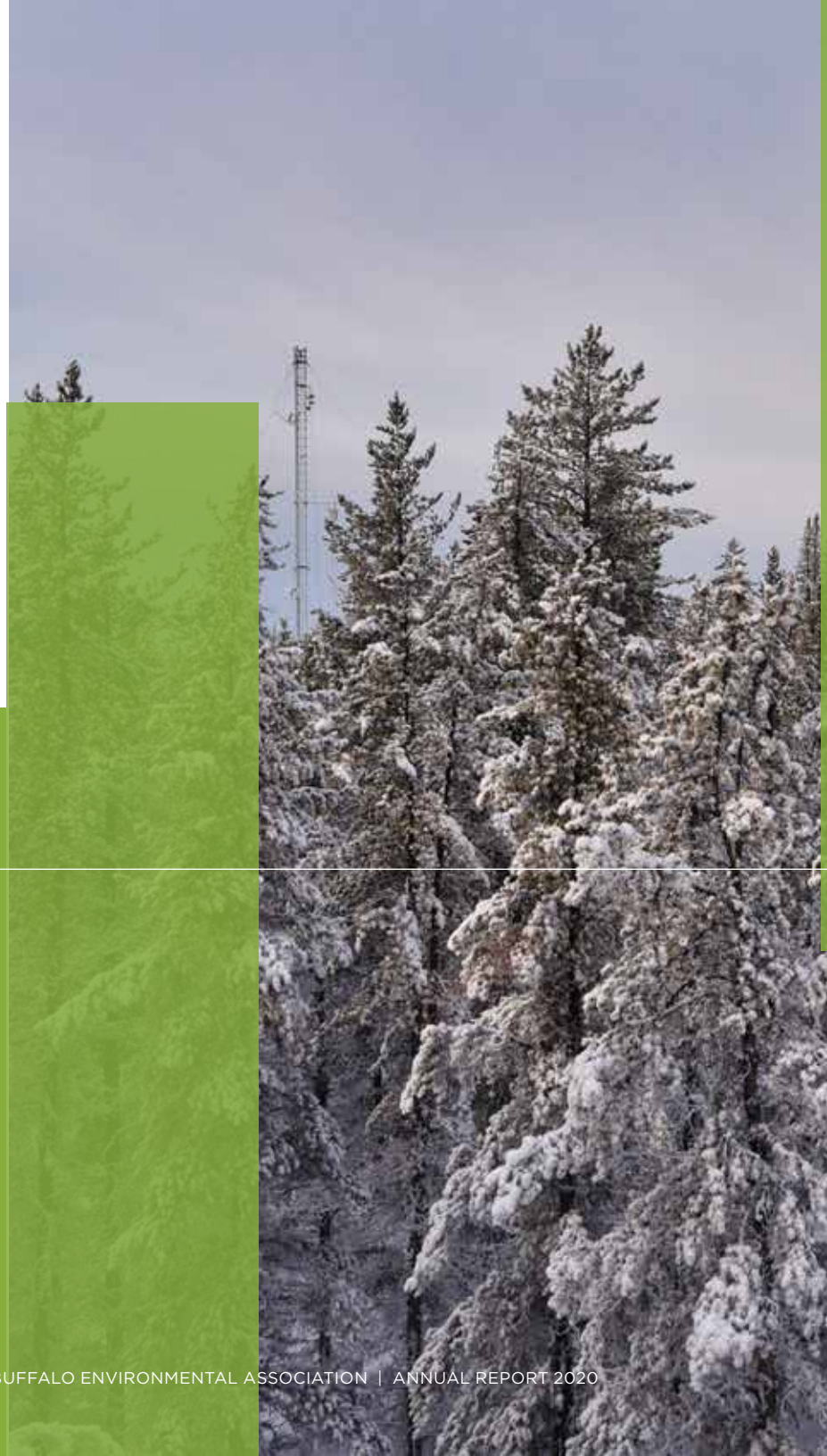


Fort Chipewyan
Calms: 0.13% | Tower Height: 10m



Janvier
Calms: 0.78% | Tower Height: 10m





Parameters Monitored at WBEA Stations

The WBEA's ambient air quality monitoring program is conducted through both continuous and time-integrated (non-continuous) sampling methods. The following graphs provide general information for each parameter measured and the corresponding data collected for 2020.

Summary of stations and parameters measured continuously at WBEA sites.

WBEA ID	Type	Station Name	SO_2	$NO/NO_2/NO_x$	O_3	$PM_{2.5}$	TRS	H_2S	THC	Methane NMHC	CO	CO_2	NH_3
1	Community	Bertha Ganter-Fort Mckay	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
2	Compliance	Mildred Lake	✓					✓	✓	✓			
3	Meteorological	Lower Camp Met Tower											
4	Compliance	Buffalo Viewpoint	✓	✓	✓	✓		✓	✓	✓			
5	Compliance/Meteorological	Mannix	✓					✓	✓	✓			
6	Community	Patricia Mcinnes	✓	✓	✓	✓	✓		✓	✓			✓
7	Community	Athabasca Valley	✓	✓	✓	✓	✓		✓	✓	✓		
8	Community/Compliance	Fort Chipewyan	✓	✓	✓	✓					✓	✓	
9	Attribution	Barge Landing	✓	✓		✓	✓		✓	✓			
11	Compliance	Lower Camp	✓					✓	✓	✓			
13	Compliance/Attribution	Fort Mckay South	✓	✓	✓	✓	✓		✓	✓			
14	Compliance/Community	Anzac	✓	✓	✓	✓	✓		✓	✓			
17	Compliance	Wapasu	✓	✓	✓	✓		✓	✓				
18	Background	Stony Mountain	✓	✓	✓	✓	✓		✓	✓	✓	✓	
19	Compliance	Firebag	✓	✓				✓	✓				
20	Compliance	Mackay River	✓	✓				✓	✓				
21	Community	Conklin	✓	✓	✓	✓	✓		✓	✓			
22	Community	Janvier	✓	✓	✓	✓	✓		✓	✓			
23	Compliance	Fort Hills	✓	✓		✓	✓		✓	✓			
25	Emergency Response	Waskow Ohci Pimatisiwin	✓					✓					
26	Compliance	Christina Lake	✓	✓				✓					
27	Compliance	Jackfish 2/3	✓	✓				✓					
29	Compliance	Surmont 2	✓	✓		✓		✓	✓				
30	Compliance	Ells River	✓	✓		✓	✓		✓	✓			
501	Compliance	Leismer	✓	✓				✓					
505	Compliance	Sawbones Bay	✓	✓				✓					
506	Compliance	Jackfish 1	✓	✓				✓					
508	Compliance	Kirby North	✓	✓				✓	✓				

Summary of stations and meteorological parameters measured continuously at WBEA sites.

WBEA ID	Type	Station Name	Temperature	RH	BP	Wind Speed	Wind Direction	Vertical Wind Speed	Solar Radiation	Precip	Leaf Wetness
1	Community	Bertha Ganter-Fort Mckay	✓	✓		✓	✓		✓	✓	✓
2	Compliance	Mildred Lake	✓	✓		✓	✓				
3	Meteorological	Lower Camp Met Tower	✓	✓		✓	✓	✓			
4	Compliance	Buffalo Viewpoint	✓	✓		✓	✓				
5	Compliance/Meteorological	Mannix	✓	✓		✓	✓	✓			
6	Community	Patricia Mcinnes	✓	✓		✓	✓				
7	Community	Athabasca Valley	✓	✓	✓	✓	✓				
8	Community/Compliance	Fort Chipewyan	✓	✓		✓	✓		✓		✓
9	Attribution	Barge Landing	✓	✓	✓	✓	✓				
11	Compliance	Lower Camp	✓	✓		✓	✓				
13	Compliance/Attribution	Fort Mckay South	✓	✓		✓	✓				
14	Compliance/Community	Anzac	✓	✓		✓	✓				✓
17	Compliance	Wapasu	✓	✓		✓	✓			✓	
18	Background	Stony Mountain	✓	✓		✓	✓		✓	✓	✓
19	Compliance	Firebag	✓	✓		✓	✓				
20	Compliance	Mackay River	✓	✓		✓	✓			✓	
21	Community	Conklin	✓	✓		✓	✓				
22	Community	Janvier	✓	✓		✓	✓				
23	Compliance	Fort Hills	✓	✓		✓	✓				
25	Emergency Response	Waskow Ohci Pimatisiwin	✓	✓		✓	✓				
26	Compliance	Christina Lake	✓	✓		✓	✓				
27	Compliance	Jackfish 2/3	✓	✓		✓	✓				
29	Compliance	Surmont 2	✓	✓		✓	✓				
30	Compliance	Ells River	✓	✓		✓	✓		✓		
501	Compliance	Leismer	✓	✓		✓	✓				
505	Compliance	Sawbones Bay	✓	✓		✓	✓				
506	Compliance	Jackfish 1	✓	✓		✓	✓				
508	Compliance	Kirby North	✓	✓		✓	✓				

Summary of parameters measured using integrated methods at WBEA sites.

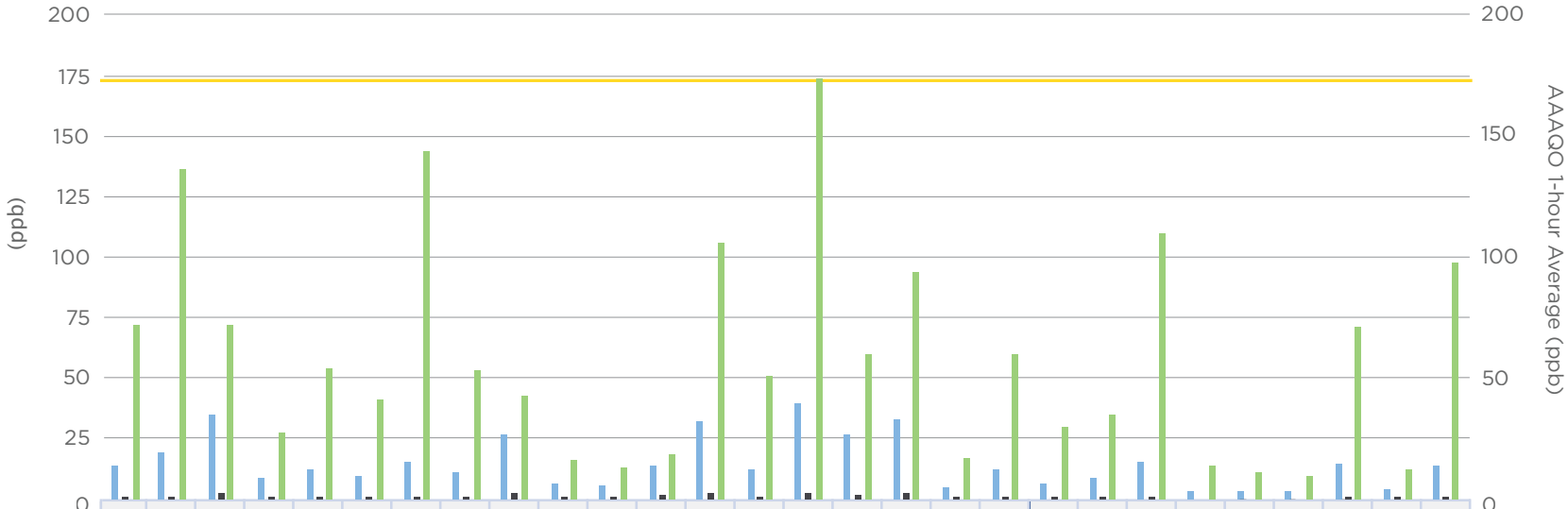
WBEA ID	Type	Station Name	VOC	$PM_{2.5}$ Mass, Metals and Ions	$PM_{2.5}$ Mass, ECOC	MP_{10} Mass, Metals and Ions	PAH	Precip
1	Community	Bertha Ganter-Fort Mckay	✓	✓	✓	✓	✓	✓
6	Community	Patricia Mcinnes	✓	✓		✓	✓	
7	Community	Athabasca Valley	✓	✓		✓	✓	
9	Attribution	Barge Landing	✓					
13	Compliance/Attribution	Fort Mckay South	✓			✓		
14	Compliance/Community	Anzac	✓	✓		✓	✓	
17	Compliance	Wapasu			✓			✓
18	Enhanced Deposition/Background	Stony Mountain			✓			✓
21	Community	Conklin	✓	✓		✓	✓	
22	Community	Janvier	✓	✓		✓	✓	
30	Compliance	Ells River	✓			✓		

Continuous Monitoring

Continuous ambient air monitoring uses analyzers that constantly measure the concentrations of different pollutants in the air. All stations also continuously measure temperature, relative humidity, and wind speed and direction. The WBEA's continuous sampling data is available to everyone at **wbea.org/network-and-data/historical-monitoring-data**. The data for continuous monitoring is presented in the following graphs as the annual hourly average (mean) concentrations of each parameter, along with the annual hourly 99th percentile and maximum concentrations. Please note, the averages may be too small to be visible on some graphs. The annual hourly 99th percentile is used to show the high end of concentrations measured at the WBEA air monitoring stations, after removing the highest 1% of events which may be outliers.

Sulphur Dioxide (SO_2)

Sulphur dioxide is produced from the combustion of sulphur-containing fossil fuels. Sulphur dioxide in the air at high concentrations can make breathing difficult, particularly for children, the elderly, and people with asthma. Sulphur dioxide reacts in the atmosphere to form sulphuric acid and acidic aerosols, which contribute to acid deposition and acid rain.

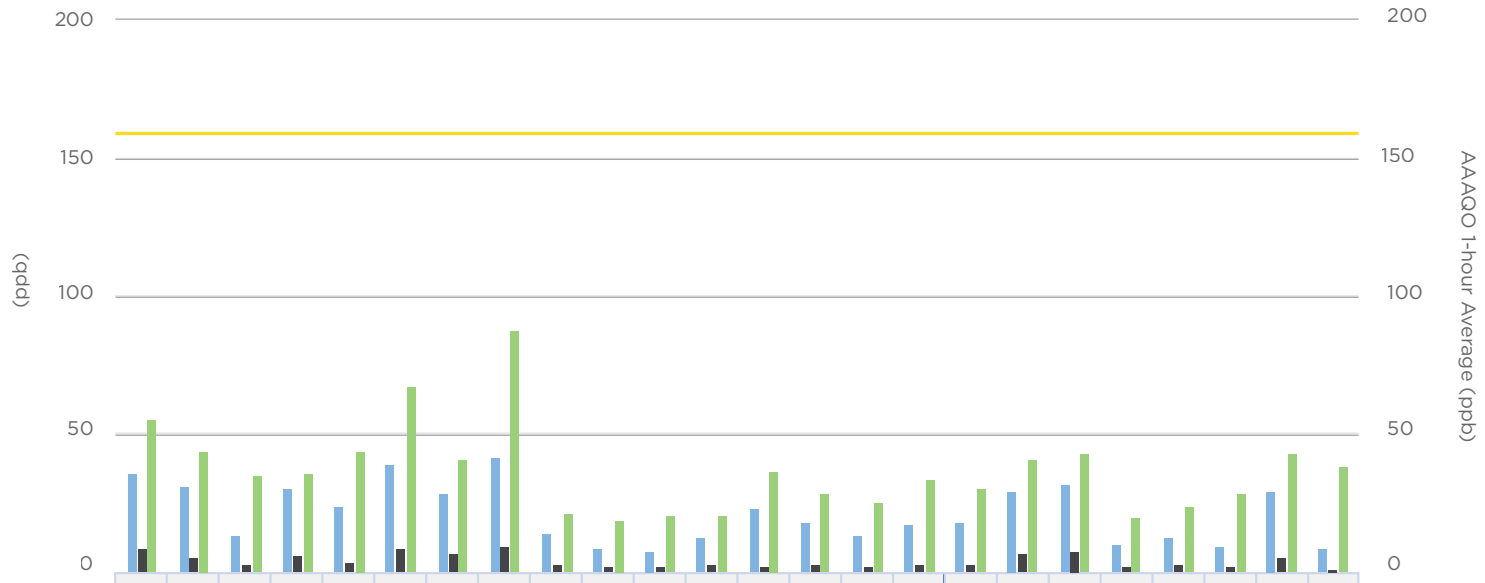


	BARGE LANDING	BUFFALO VIEWPOINT	CHRISTINA LAKE	ELLS RIVER**	FIREBAG	FORT HILLS	FORT MCKAY SOUTH	HORIZON**	JACKFISH 1**	JACKFISH 2 3	KIRBY NORTH	LEISMER**	LOWER CAMP	MACKAY RIVER	MANNIX	MASKWA**	MILDRED LAKE	SURMONT 2	WAPASU	ANZAC	ATHABASCA VALLEY	BERTHA GANTER FORT MCKAY	CONKLIN	FORT CHIPEWYAN	JANVIER	PATRICIA MCINNES	STONY MOUNTAIN	WASKOW OCHI PIMATISIWIN
99th Percentile	14.0	19.3	34.8	9.0	11.9	9.3	15.2	11.3	26.6	6.5	5.8	13.9	32.1	12.5	39.5	26.8	33.1	5.0	12.5	6.1	9.2	15.1	3.5	3.5	3.0	14.6	4.4	13.9
Average	0.9	1.2	2.8	0.6	1.1	0.8	1.0	1.0	2.1	0.8	0.7	1.4	2.7	1.0	2.6	1.6	2.4	0.5	1.1	0.6	0.7	1.0	0.4	0.2	0.3	1.2	0.5	1.1
Max	72.0	136.4	71.5	27.2	53.7	41.1	143.6	52.9	42.9	16.5	13.2	18.8	105.3	51.1	173.0	60.0	93.4	16.8	59.6	29.9	34.7	109.4	13.5	11.5	9.8	70.6	12.1	97.7
AAAQO 1-hour avg.	172																											

**Stations operational less than 75% of the time in 2020.

Nitrogen Dioxide (NO_2)

Nitrogen dioxide is a reddish-brown gas with a pungent, irritating odour that is produced by combustion of fossil fuels. It plays a major role in atmospheric photo-chemical reactions, ground level ozone formation and destruction, and can also interact with water to form acid rain.

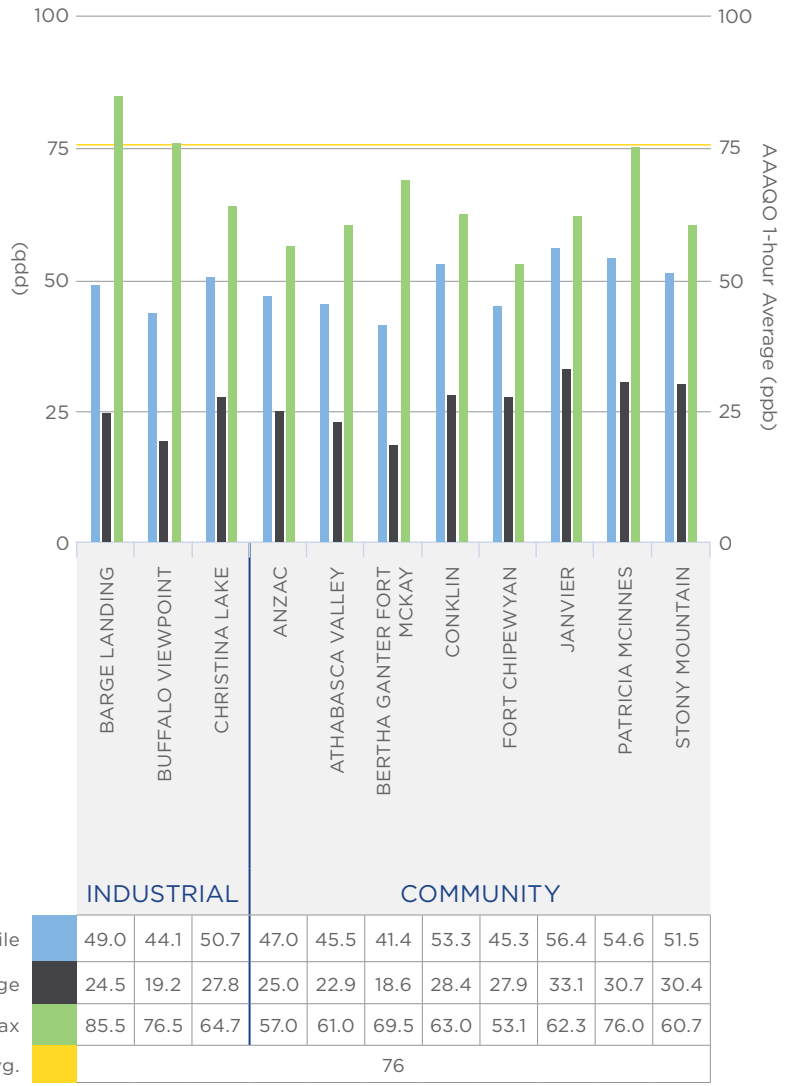


	BARGE LANDING	BUFFALO VIEWPOINT	CHRISTINA LAKE	ELLS RIVER**	FIREBAG	FORT HILLS	FORT MCKAY SOUTH	HORIZON**	JACKFISH 1**	JACKFISH 2 3	KIRBY NORTH	LEISMER**	MACKAY RIVER	MASKWA**	SURMONT 2	WAPASU	ANZAC	ATHABASCA VALLEY	BERTHA GANTER FORT MCKAY	CONKLIN	FORT CHIPEWYAN	JANVIER	PATRICIA MCINNES	STONY MOUNTAIN
99th Percentile	35.4	30.7	12.6	29.9	23.2	38.7	28.4	40.9	13.4	7.8	7.3	12.1	22.4	18.0	13.2	16.8	17.7	28.8	31.4	9.5	11.8	9.1	29.3	7.8
Average	8.2	4.8	2.8	5.7	3.2	8.1	6.5	8.9	2.3	1.5	1.4	2.8	2.0	2.8	1.5	2.6	2.1	6.7	7.3	1.7	2.1	1.4	5.2	1.2
Max	54.6	43.4	34.9	35.7	43.2	67.2	40.4	87.5	21.0	18.2	20.2	20.5	36.6	28.1	25.2	33.4	29.7	40.3	42.9	19.6	23.0	28.3	42.9	37.9
AAAQO 1-hour avg.	159																							

***Stations operational less than 75% of the time in 2020.*

Ozone (O_3)

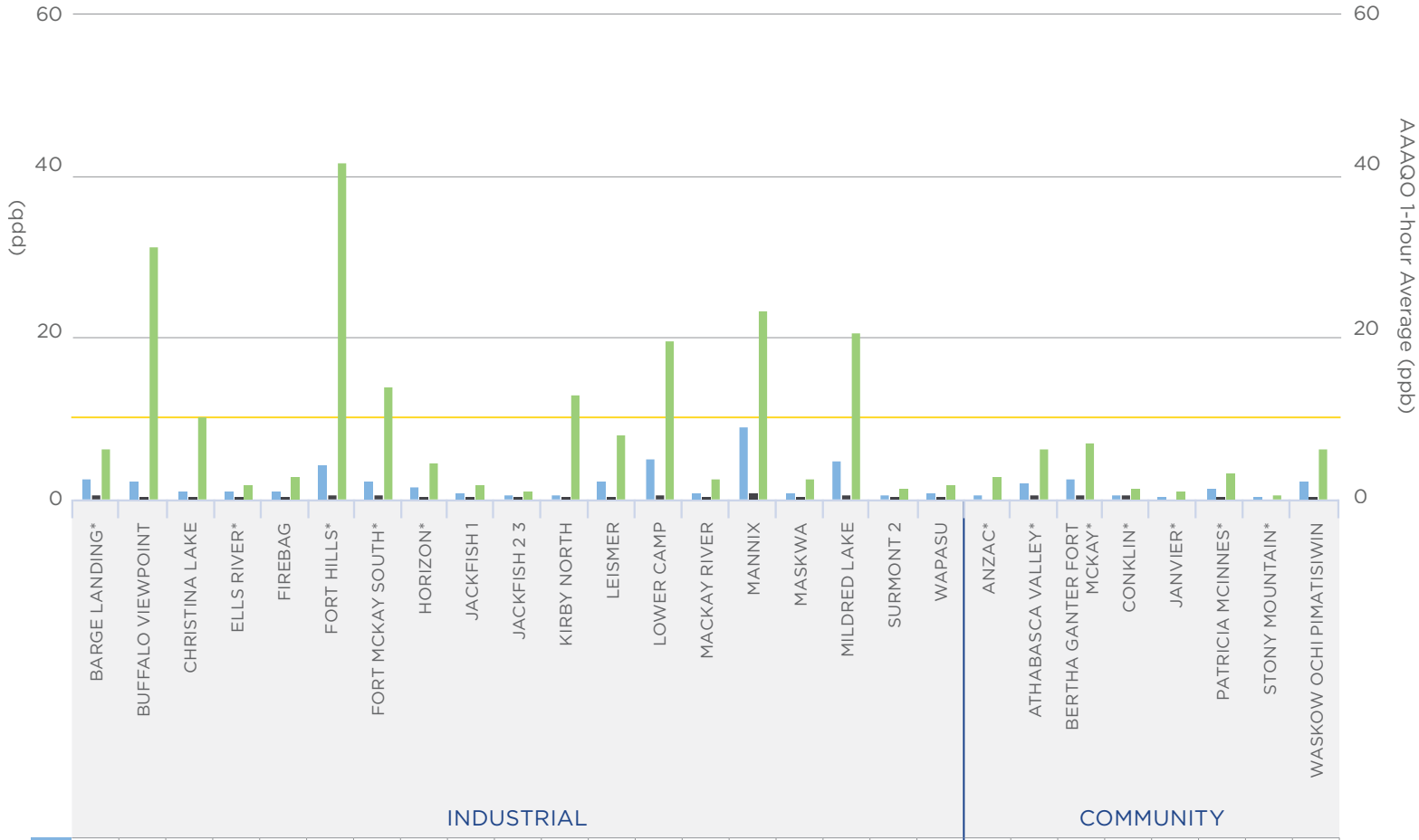
Ozone at ground-level is not emitted directly into the air but formed by chemical reactions of NO_x and volatile organic compounds (VOCs), from vehicular and industrial emissions. At high concentrations, breathing ozone can affect respiratory function, and cause coughing, throat irritation, and airway inflammation. Children, the elderly, and people with asthma are the most susceptible. Ozone can affect sensitive vegetation, by slowing plant growth and making them more susceptible to disease.



	BARGE LANDING	BUFFALO VIEWPOINT	CHRISTINA LAKE	ANZAC	ATHABASCA VALLEY	BERTHA GANTER FORT MCKAY	CONKLIN	FORT CHIPEWYAN	JANVIER	PATRICIA MCINNES	STONY MOUNTAIN
99th Percentile	49.0	44.1	50.7	47.0	45.5	41.4	53.3	45.3	56.4	54.6	51.5
Average	24.5	19.2	27.8	25.0	22.9	18.6	28.4	27.9	33.1	30.7	30.4
Max	85.5	76.5	64.7	57.0	61.0	69.5	63.0	53.1	62.3	76.0	60.7
AAAQO 1-hour avg.	76										

Total Reduced Sulphurs/Hydrogen Sulphide (TRS/H_2S)

Hydrogen sulphide is a colourless gas with a rotten egg odour. It is produced through industrial processes. The term "Total Reduced Sulphurs" covers a larger group of sulphur-containing compounds, including H_2S, carbonyl sulphide, mercaptans, etc. These substances have the potential to cause odours in the region. In the WBEA airshed most industrial TRS and H_2S emissions are from upgraders and tailings ponds, though there is a natural background ambient air concentration of the reduced sulphur compound carbonyl sulphide of approximately 0.5 ppb.



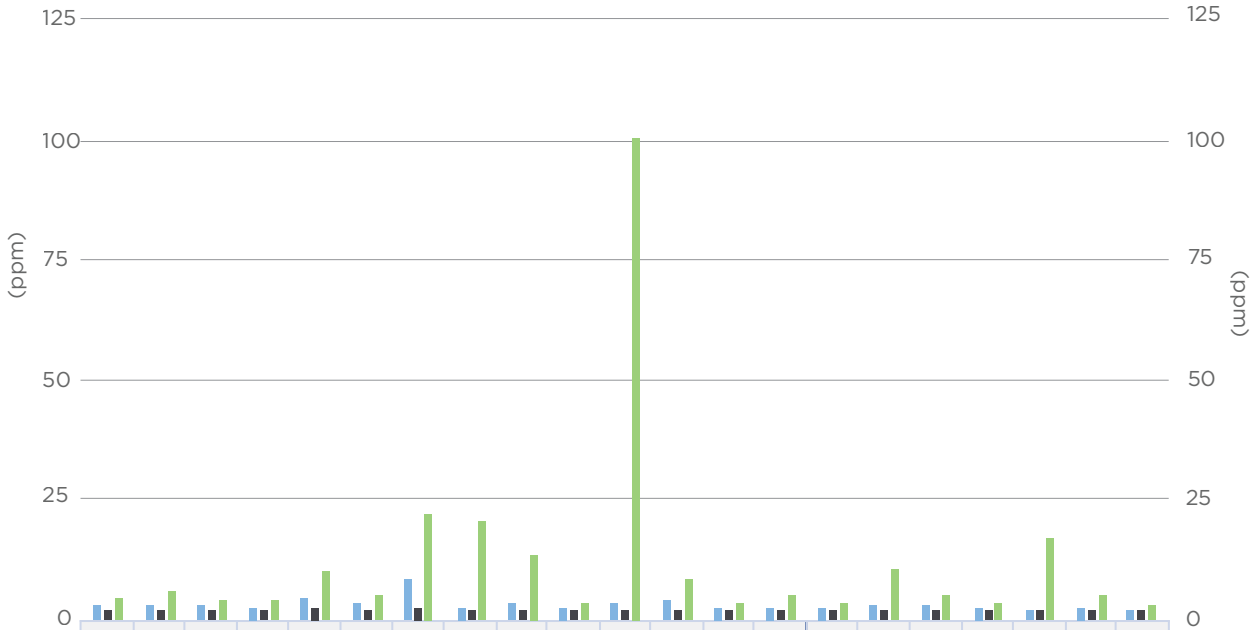
	BARGE LANDING*	BUFFALO VIEWPOINT	CHRISTINA LAKE	ELLS RIVER*	FIREBAG	FORT HILLS*	FORT MCKAY SOUTH*	HORIZON*	JACKFISH 1	JACKFISH 2 3	KIRBY NORTH	LEISMER	LOWER CAMP	MACKAY RIVER	MANNIX	MASKWA	MILDRED LAKE	SURMONT 2	WAPASU	ANZAC*	ATHABASCA VALLEY*	BERTHA GANTER FORT MCKAY*	CONKLIN*	JANVIER*	PATRICIA MCINNES*	STONY MOUNTAIN*	WASKOW OCHI PIMATISIWIN
99th Percentile	2.4	2.3	1.1	0.9	1.0	4.2	2.2	1.6	0.7	0.5	0.6	2.1	4.9	0.8	8.8	0.7	4.6	0.5	0.8	0.6	2.0	2.5	0.5	0.3	1.3	0.2	2.1
Average	0.5	0.3	0.3	0.2	0.2	0.5	0.5	0.2	0.2	0.2	0.2	0.2	0.6	0.2	0.8	0.2	0.6	0.2	0.2	0.1	0.4	0.6	0.4	0.1	0.3	0.1	0.3
Max	6.2	31.2	10.2	1.7	2.8	41.6	13.8	4.4	1.7	0.9	12.8	7.9	19.6	2.5	23.3	2.5	20.5	1.2	1.8	2.8	6.1	6.8	1.2	0.9	3.2	0.6	6.1
AAAQO 1-hour avg.	10																										

**denotes TRS analyzer*

Total Hydrocarbons (THC)

Methane (CH_4) is the most abundant hydrocarbon on earth, while reactive non-methane hydrocarbons (NMHCs) can react with other compounds in atmosphere to form ozone. Total hydrocarbons (THC) are the combined concentrations on both methane and non-methane hydrocarbons. Some stations in the WBEA network only measure THCs, while certain stations measure CH_4, NMHC, and THC. Many hydrocarbons are emitted from natural sources, while others can come from industrial and vehicular emissions. The natural background level of THC, composed mainly of CH_4, is generally around 1.8 ppm.

Note: THC does not currently have an AAAQO.



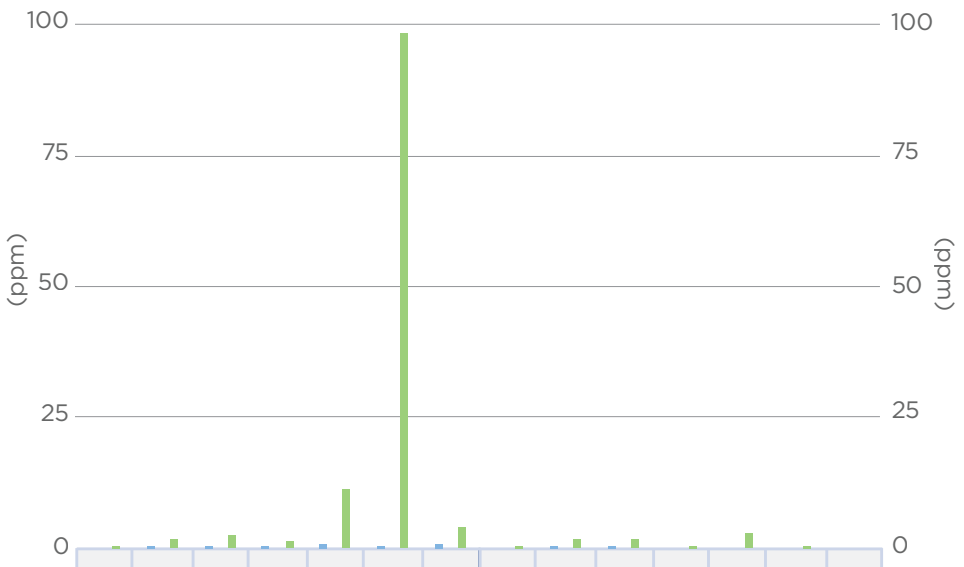
	BARGE LANDING	BUFFALO VIEWPOINT	ELLS RIVER**	FIREBAG	FORT HILLS	FORT MCKAY SOUTH	HORIZON**	KIRBY NORTH	LOWER CAMP	MACKAY RIVER	MANNIX	MILDRED LAKE	SURMONT 2	WAPASU	ANZAC	ATHABASCA VALLEY	BERTHA GANTER FORT MCKAY	CONKLIN	JANVIER	PATRICIA MCINNES	STONY MOUNTAIN
	INDUSTRIAL														COMMUNITY						
99th Percentile	3.1	3.2	2.8	2.5	4.6	3.3	8.6	2.6	3.5	2.7	3.5	3.9	2.5	2.5	2.4	2.8	3.1	2.6	2.1	2.7	2.2
Average	2.1	2.1	2.0	2.2	2.3	2.2	2.6	2.2	2.2	2.2	2.1	2.2	2.1	2.2	2.0	2.0	2.1	2.1	1.9	2.1	2.0
Max	4.7	5.8	3.8	4.0	10.1	5.2	22.2	20.9	13.8	3.7	101.0	8.8	3.3	4.9	3.5	10.4	4.8	3.5	17.3	5.0	3.1

***Stations operational less than 75% of the time in 2020.*

Non-Methane Hydrocarbons (NMHC)

Methane (CH_4) is the most abundant hydrocarbon on earth, while reactive non-methane hydrocarbons (NMHCs) can react with other compounds in atmosphere to form ozone. Total hydrocarbons (THC) are the combined concentrations on both methane and non-methane hydrocarbons. Some stations in the WBEA network only measure THCs, while certain stations measure CH_4, NMHC, and THC. Many hydrocarbons are emitted from natural sources, while others can come from industrial and vehicular emissions. The natural background level of THC, composed mainly of CH_4, is generally around 1.8 ppm.

Note: THC does not currently have an AAAQO.



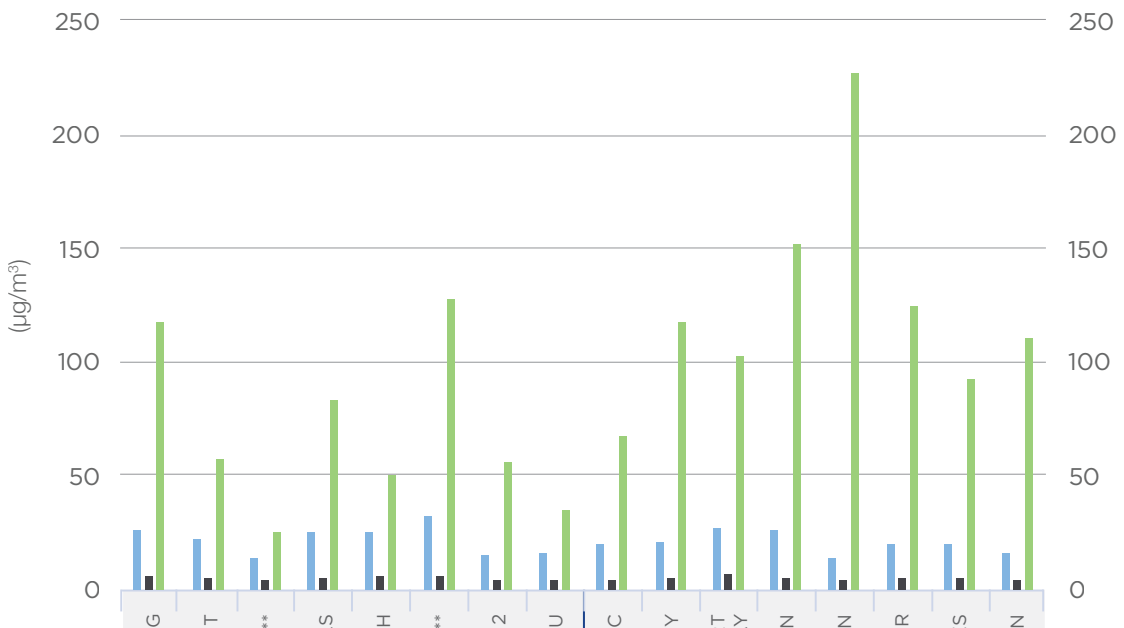
	BARGE LANDING**	BUFFALO VIEWPOINT	FORT HILLS**	FORT MCKAY SOUTH**	LOWER CAMP	MANNIX	MILDRED LAKE	ANZAC	ATHABASCA VALLEY	BERTHA GANTER FORT MCKAY	CONKLIN	JANVIER	PATRICIA MCINNES	STONY MOUNTAIN
99th Percentile	0.1	0.4	0.6	0.3	0.7	0.4	0.7	0.1	0.3	0.4	0.1	0.0	0.1	0.0
Average	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.0	0.0	0.1	0.0	0.0	0.0	0.0
Max	0.5	1.7	2.4	1.2	11.3	98.8	4.0	0.4	1.7	1.6	0.4	3.0	0.6	0.2

***Stations operational less than 75% of the time in 2020.*

Fine Particulate Matter ($PM_{2.5}$)

Particulate matter consists of a mixture of solid particles and liquid droplets found in the air. Fine particulate matter is 2.5 Qm in diameter or less, and is produced mainly by combustion processes, including forest fires. In 2019, all exceedances of the $PM_{2.5}$ AAAQO in the WBEA network were a result of forest fires. Fine particles are composed primarily of sulphate, nitrate, ammonium, inorganic and organic carbon compounds, and heavy metals. Fine particulate matter poses a health risk as the particles can be inhaled deep into the lungs.

Note: The data in the graph is presented using 1-hour concentration averages. Fine Particulate Matter ($PM_{2.5}$) does not currently have a 1-hour average AAAQO.

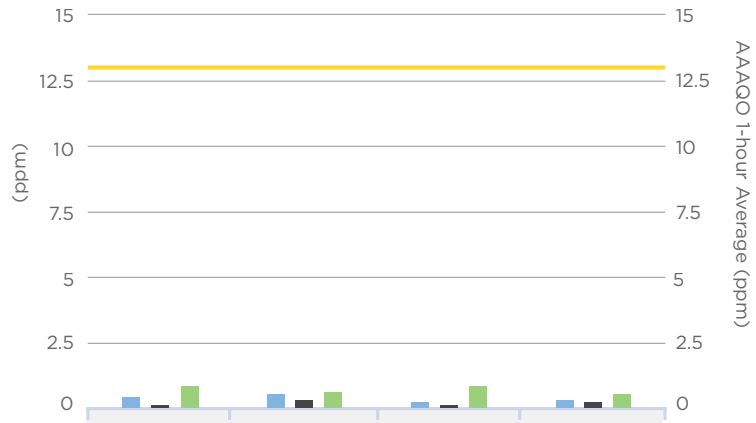


	BARGE LANDING	BUFFALO VIEWPOINT	ELLS RIVER**	FORT HILLS	FORT MCKAY SOUTH	HORIZON**	SURMONT 2	WAPASU	ANZAC	ATHABASCA VALLEY	BERTHA GANTER FORT MCKAY	CONKLIN	FORT CHIPEWYAN	JANVIER	PATRICIA MCINNES	STONY MOUNTAIN
99th Percentile	25.8	21.7	13.7	25.6	25.7	32.1	14.9	15.9	20.6	20.8	27.2	26.6	14.2	19.7	20.6	15.8
Average	5.9	4.6	3.7	4.7	5.6	6.3	3.9	4.0	4.1	5.5	6.7	4.7	3.7	5.3	5.2	4.0
Max	117.7	57.0	25.0	84.1	50.1	127.9	56.0	35.0	68.0	117.8	102.5	152.5	228.1	125.5	92.6	110.4

***Stations operational less than 75% of the time in 2020.*

Carbon Monoxide (CO)

Carbon monoxide is formed from the incomplete combustion of carbon in fossil fuels. Transportation and vehicle emissions are the major source of carbon monoxide with elevated concentrations during the morning and evening rush hours. Breathing carbon monoxide decreases the amount of oxygen carried by the blood stream.

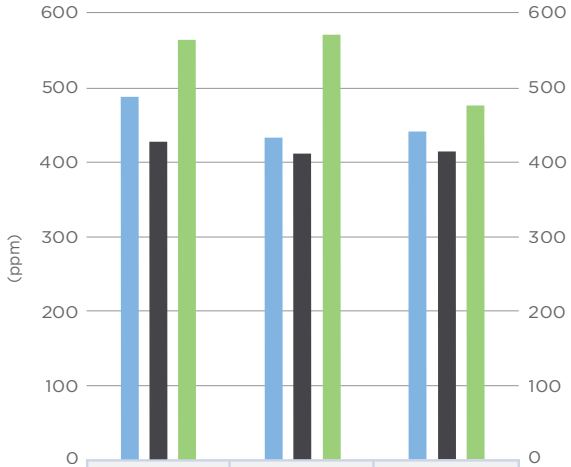


	ATHABASCA VALLEY	BERTHA GANTER FORT MCKAY	FORT CHIPEWYAN	STONY MOUNTAIN
99th Percentile	0.4	0.5	0.2	0.3
Average	0.1	0.3	0.1	0.2
Max	0.8	0.6	0.8	0.5
AAAQO 1-hour avg.	13			

Carbon Dioxide (CO_2)

Carbon dioxide is a natural component of the air we breath. It is a colorless, odourless gas produced by respiration of plants and animals, and through combustion of fossil fuels. Ambient carbon dioxide is generally not a human health concern and is monitored in the network to help differentiate between origins of emissions such as forest fires and anthropogenic sources.

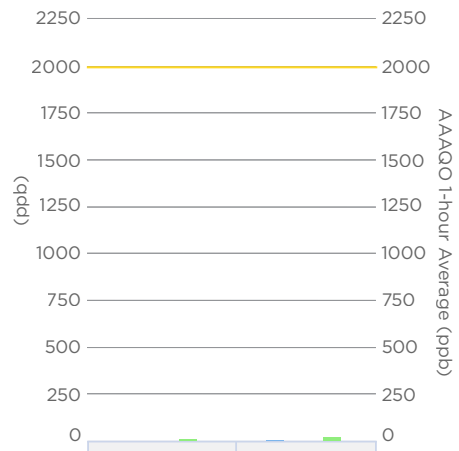
Note: CO_2 does not currently have an AAAQO.



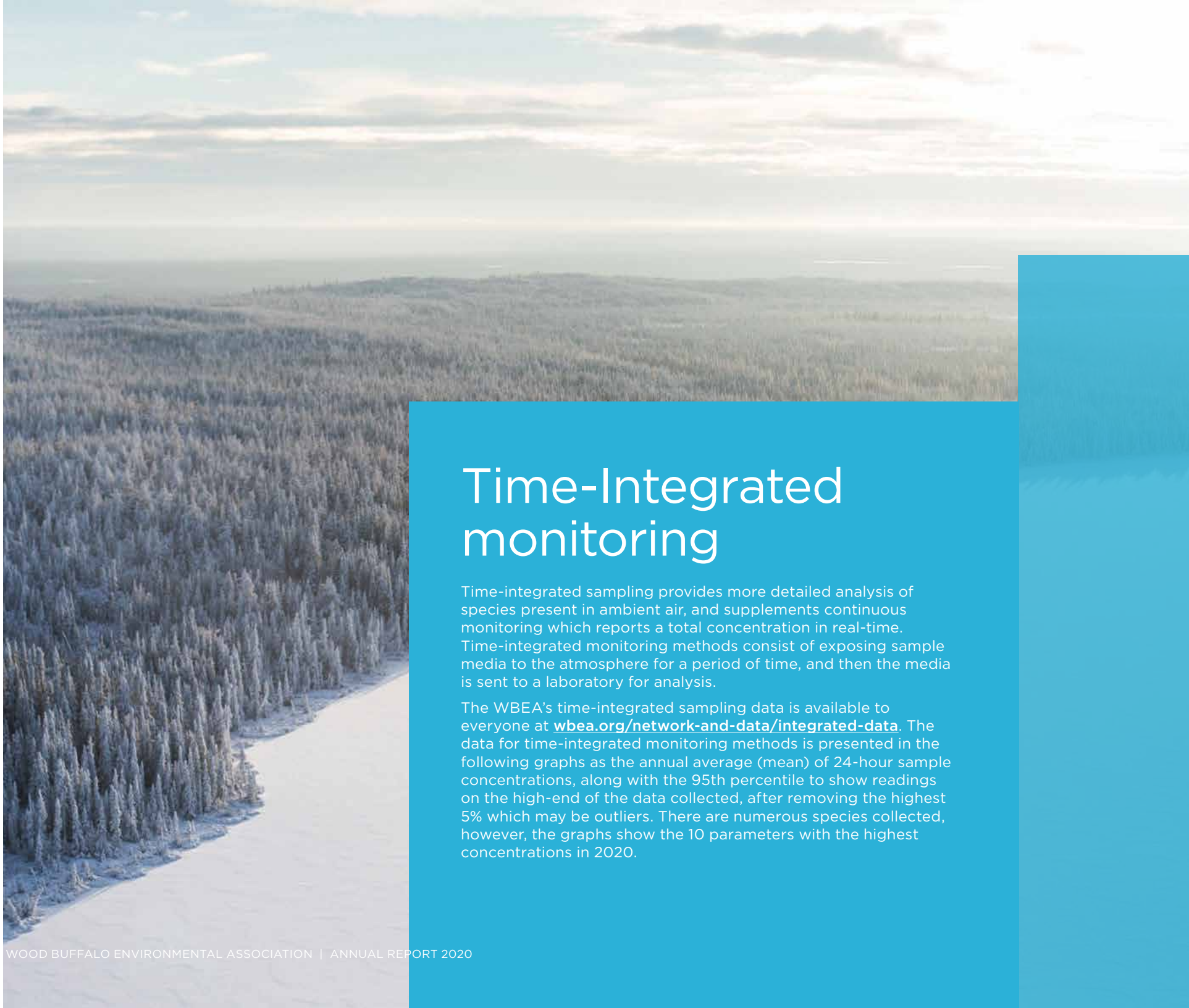
	BERTHA GANTER FORT MCKAY	FORT CHIPEWYAN	STONY MOUNTAIN
99th Percentile	486.7	432.8	439.7
Average	426.7	411.0	413.9
Max	563.7	570.4	474.5

Ammonia (NH_3)

Ammonia is a natural compound found in the environment as part of the nitrogen cycle and can also come from human activity. Ammonia is monitored by the WBEA because it is used by one industry member to help reduce SO_2 emissions. Exposure to elevated concentrations of ammonia can cause irritation of the nose, throat, and respiratory tract.



		BERTHA GANTER FORT MCKAY	PATRICIA MCINNES
99th Percentile		0.0	6.7
Average		0.0	0.2
Max		9.9	17.9
AAAQO 1-hour avg.		2000	



Time-Integrated monitoring

Time-integrated sampling provides more detailed analysis of species present in ambient air, and supplements continuous monitoring which reports a total concentration in real-time. Time-integrated monitoring methods consist of exposing sample media to the atmosphere for a period of time, and then the media is sent to a laboratory for analysis.

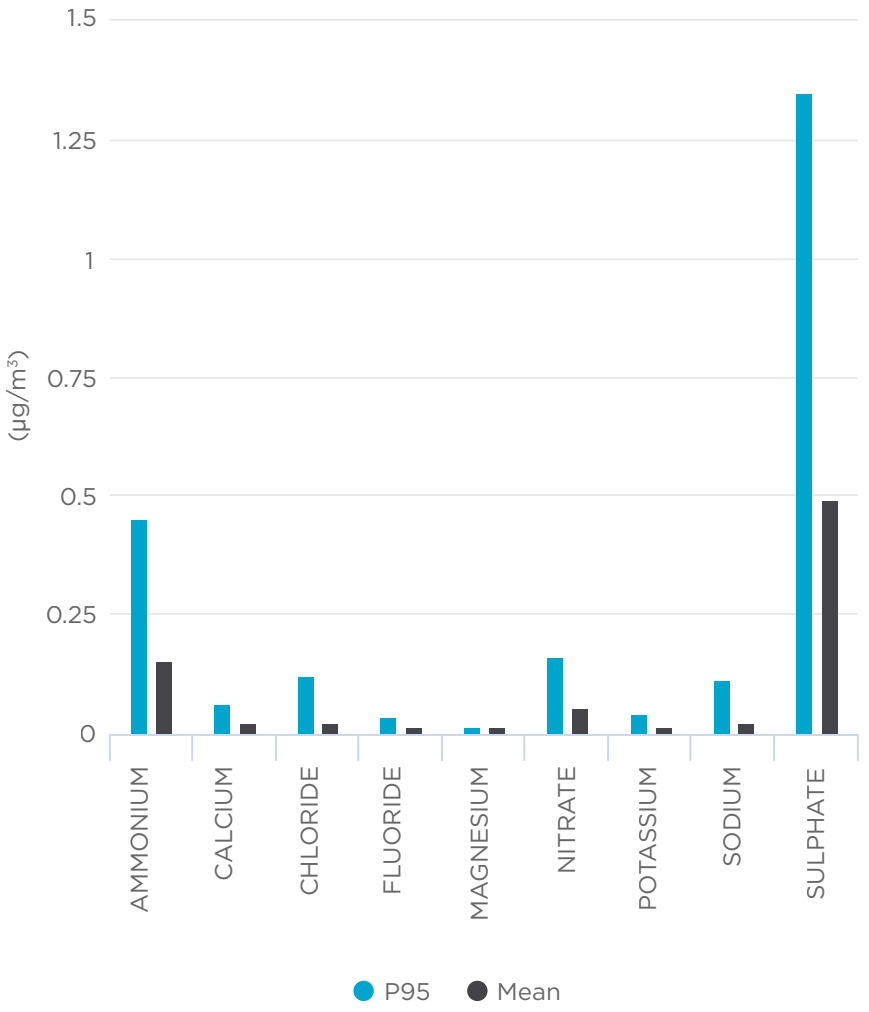
The WBEA's time-integrated sampling data is available to everyone at **wbea.org/network-and-data/integrated-data**. The data for time-integrated monitoring methods is presented in the following graphs as the annual average (mean) of 24-hour sample concentrations, along with the 95th percentile to show readings on the high-end of the data collected, after removing the highest 5% which may be outliers. There are numerous species collected, however, the graphs show the 10 parameters with the highest concentrations in 2020.

Particulate Matter 2.5 ($PM_{2.5}$) Ions

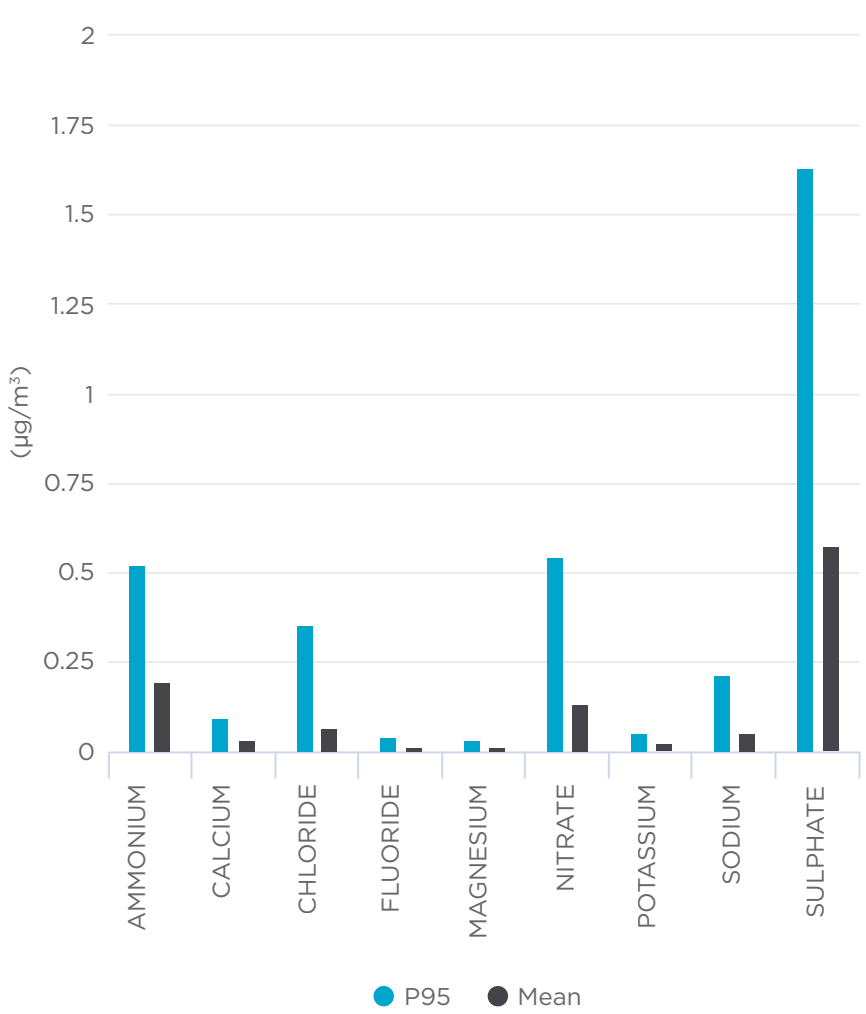
$PM_{2.5}$ refers to particles in the fine fraction (2.5 µm in diameter or less) that are produced mainly by combustion processes and by atmospheric reactions between precursor gases such as sulphur dioxide, nitrogen oxides, ammonia and some volatile organic compounds. In the coarse fraction (between 2.5 and 10 µm in diameter), particles are mainly from re-suspended road dust, windblown dust, and material handling, grinding and crushing operations. PM_{10} includes both the fine and coarse fractions and is sometimes referred to as inhalable particulate matter. Particulate matter consists of a mixture of solid particles and liquid droplets found in the air. Fine particulate matter ($PM_{2.5}$) is 2.5µm in diameter or less, while coarse particulate matter (PM_{10}) is 10µm in diameter or less.

In the time-integrated sampling program, particulate matter (both $PM_{2.5}$ & PM_{10}) is collected on a filter for a 24-hour period, every six days. $PM_{2.5}$ samples were collected at six community stations (Bertha Ganter-Fort McKay, Patricia McInnes, Athabasca Valley, Anzac, Janvier, and Conklin) and one industrial location (Horizon). PM_{10} samples were taken at the same six community stations and three industrial stations (Fort McKay South, Horizon, and Muskeg River). These filters are then sent to the lab for sample analysis to learn the chemical compositions including ionic and metal species. Ions are electrically-charged, water-soluble particles, while metals are neutral species.

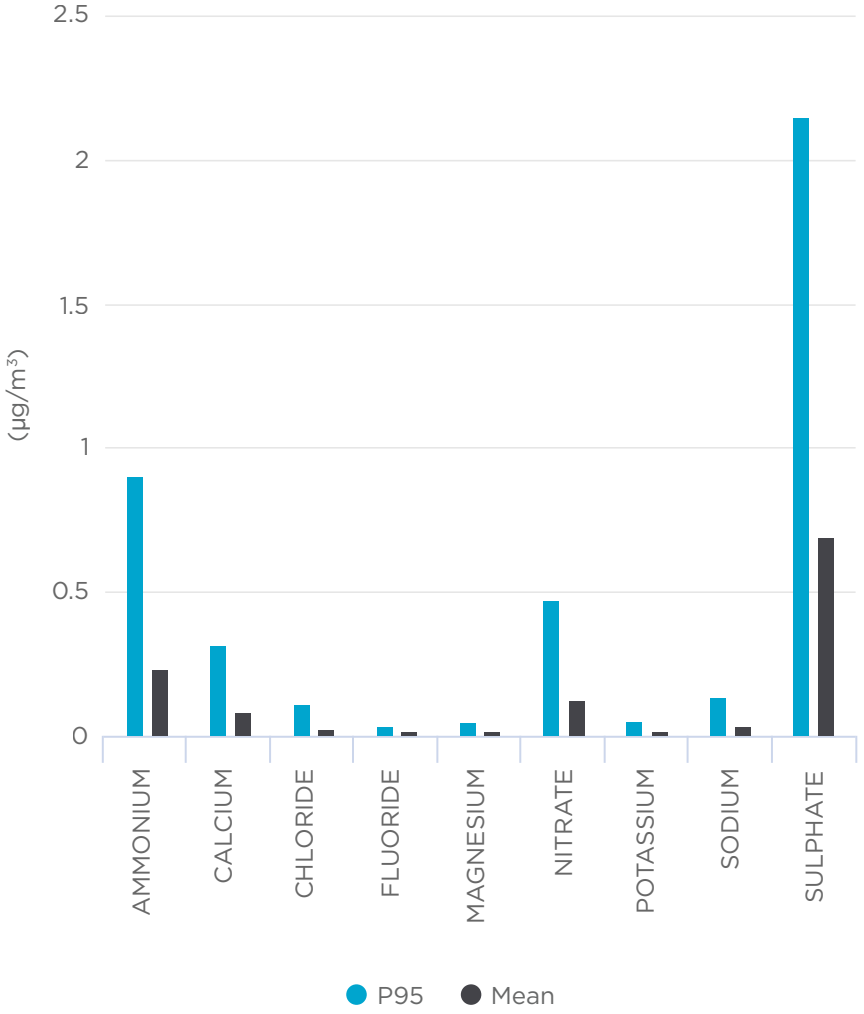
The continuous analyzer can tell us the concentration of particulate matter in the air at any given time, while a time-integrated sample can tell us what is making up the composition of the particulate matter in the air.



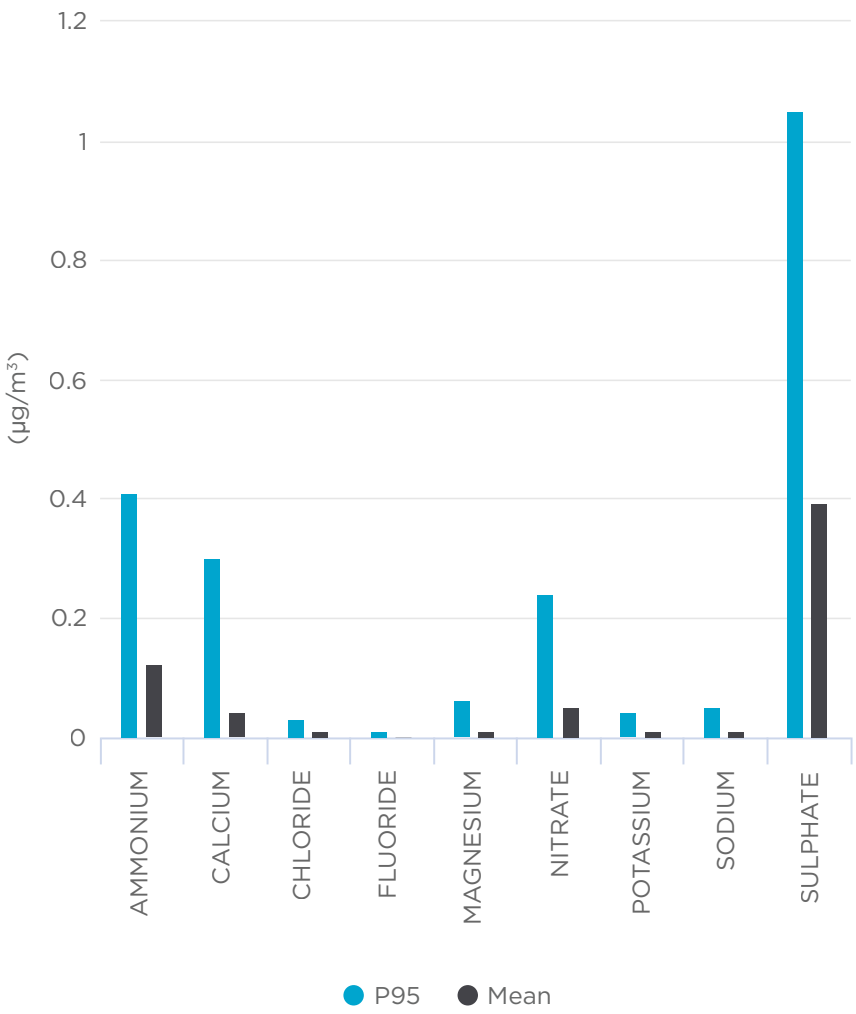
Athabasca Valley



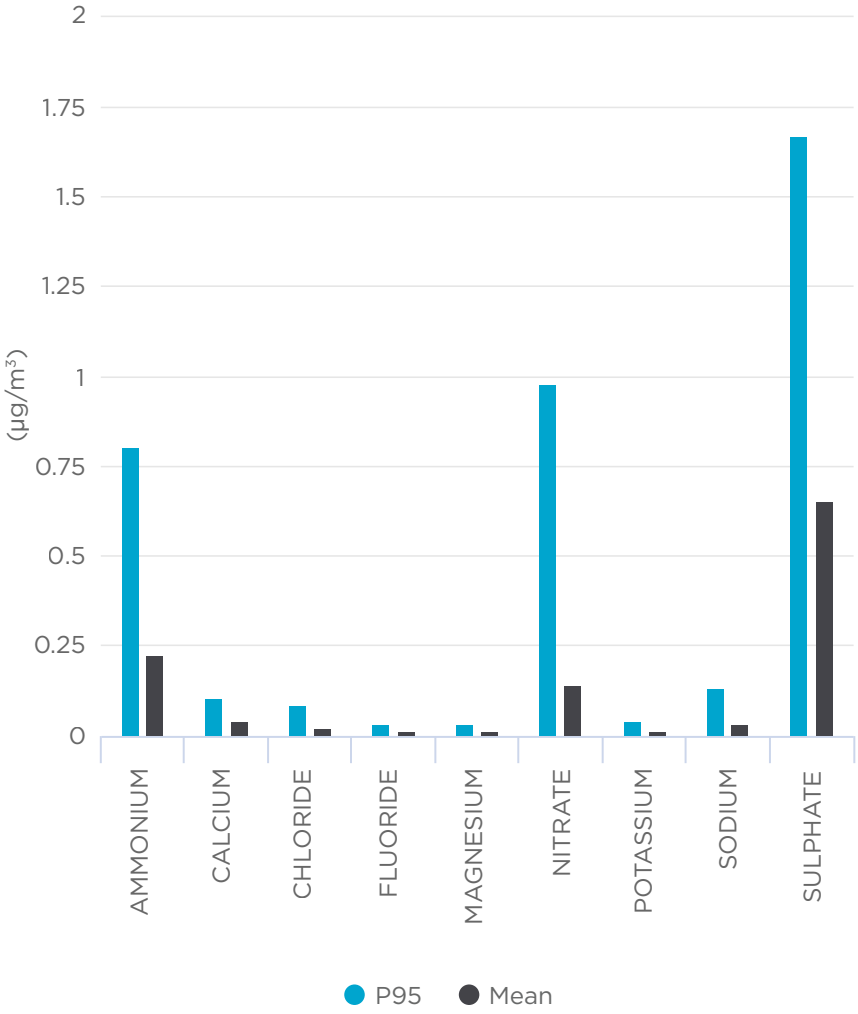
Bertha Ganter - Fort McKay



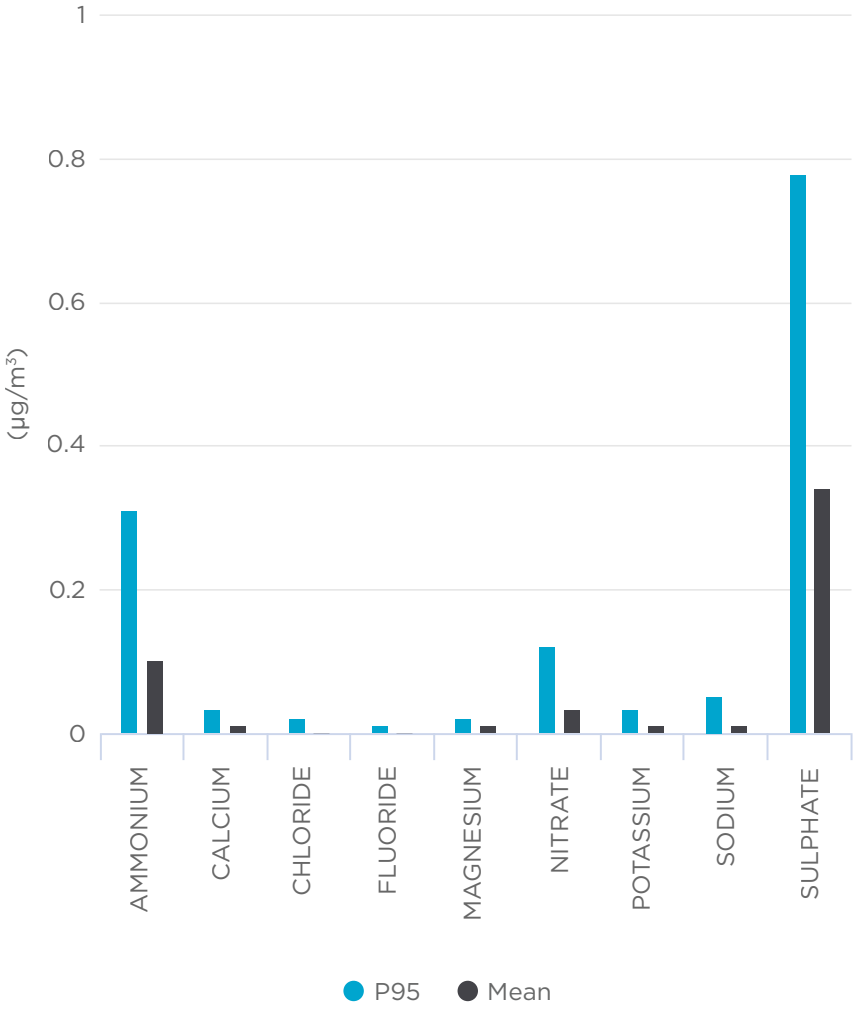
Conklin



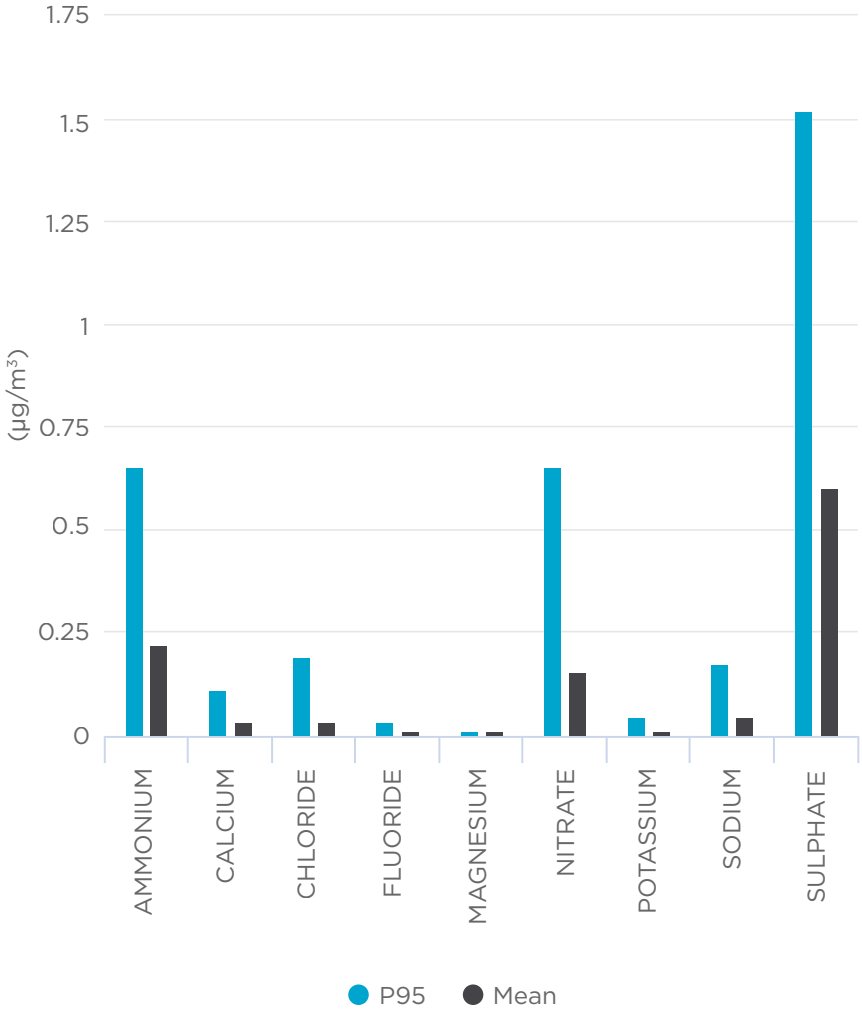
Horizon

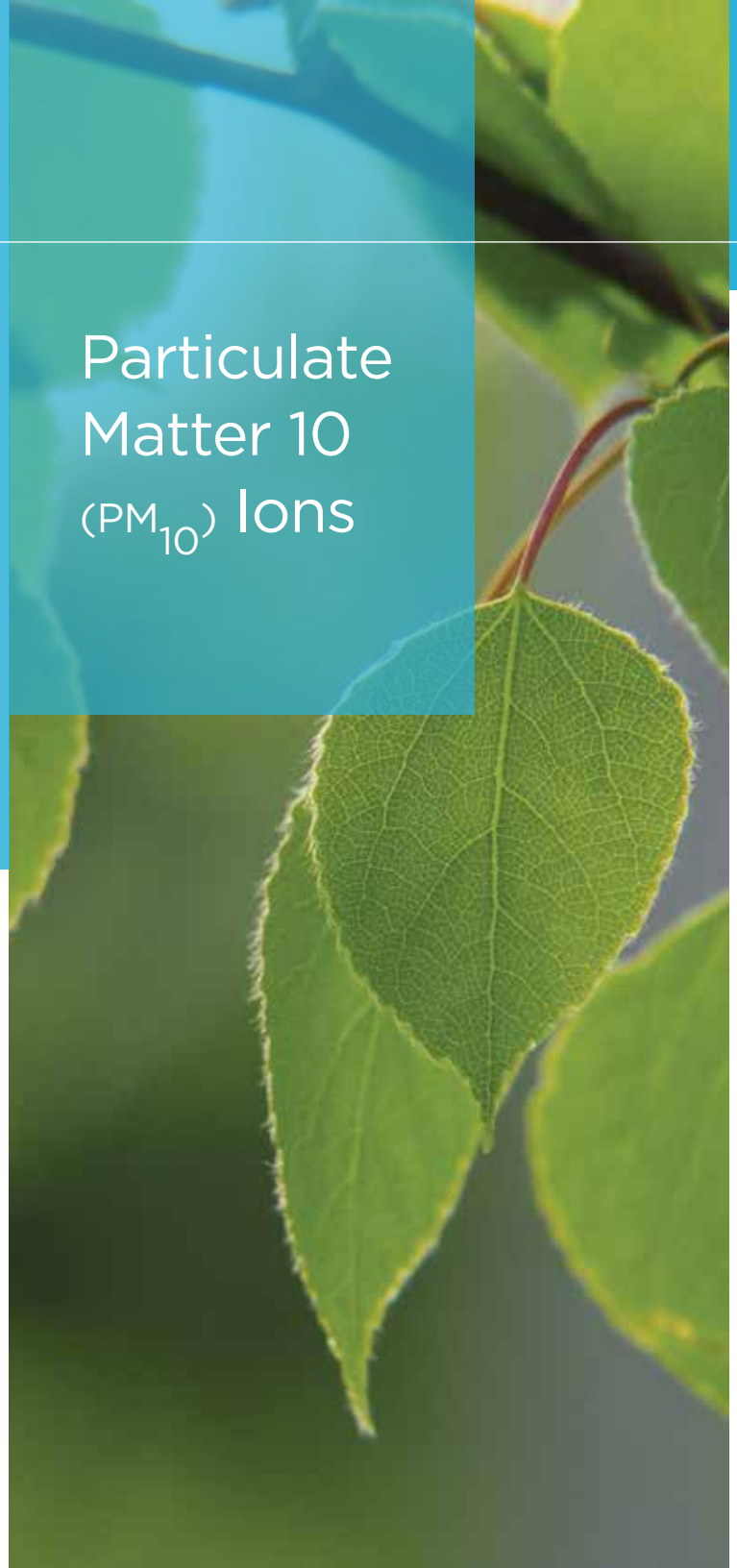


Janvier



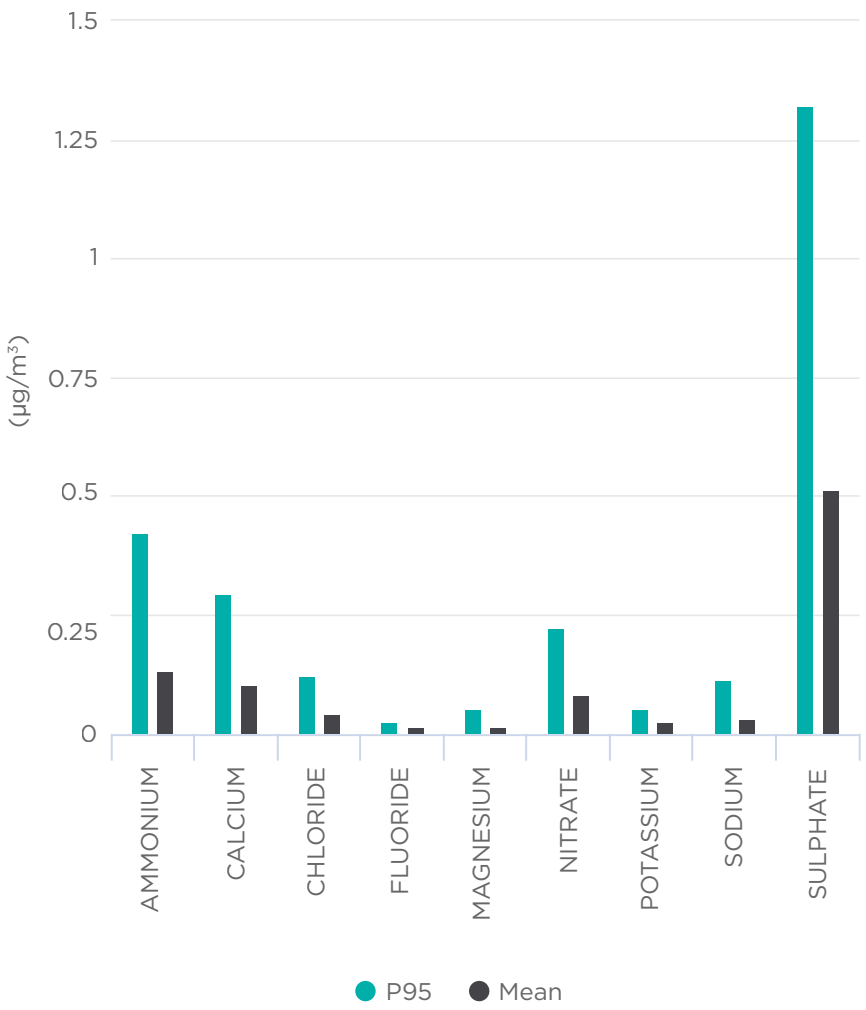
Patricia McInnes



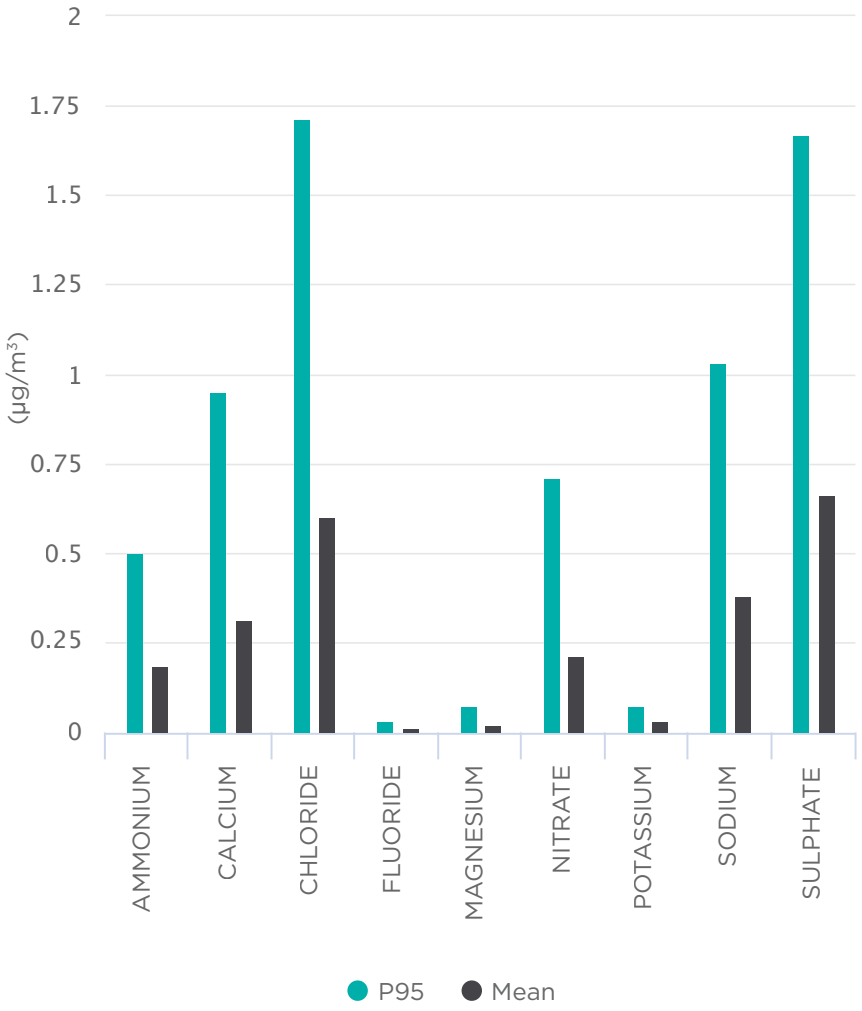


Particulate Matter 10 (PM_{10}) Ions

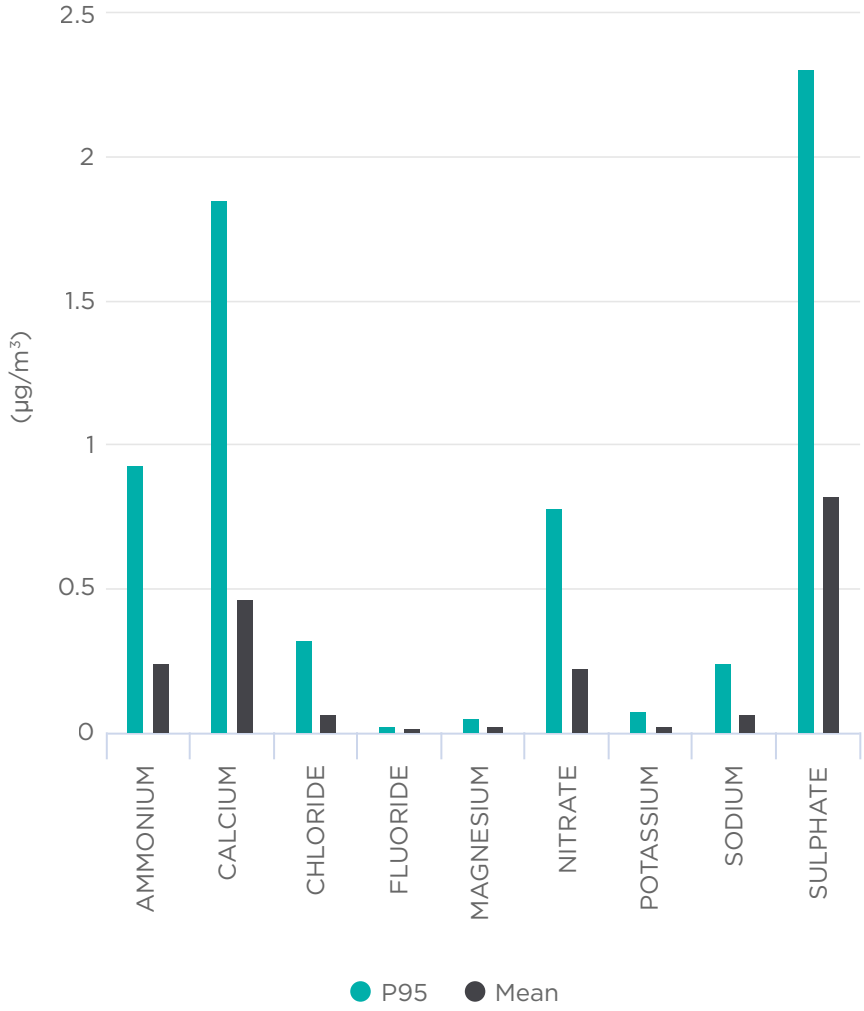
Anzac



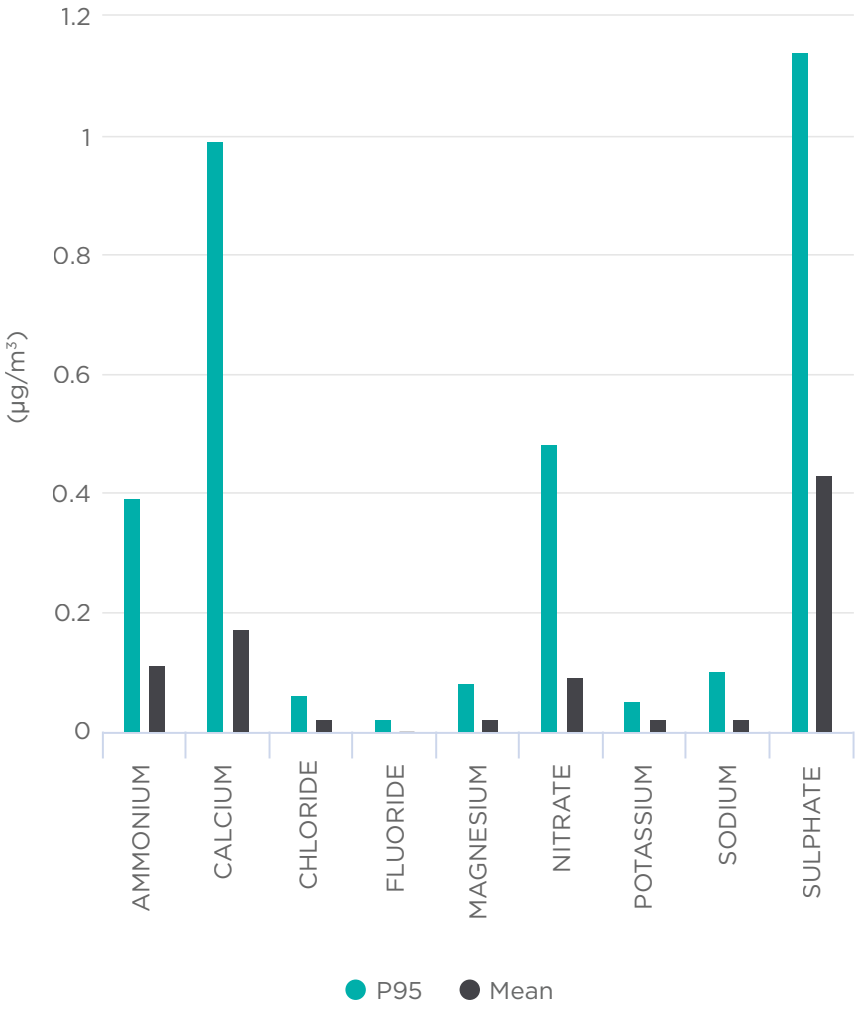
Athabasca Valley



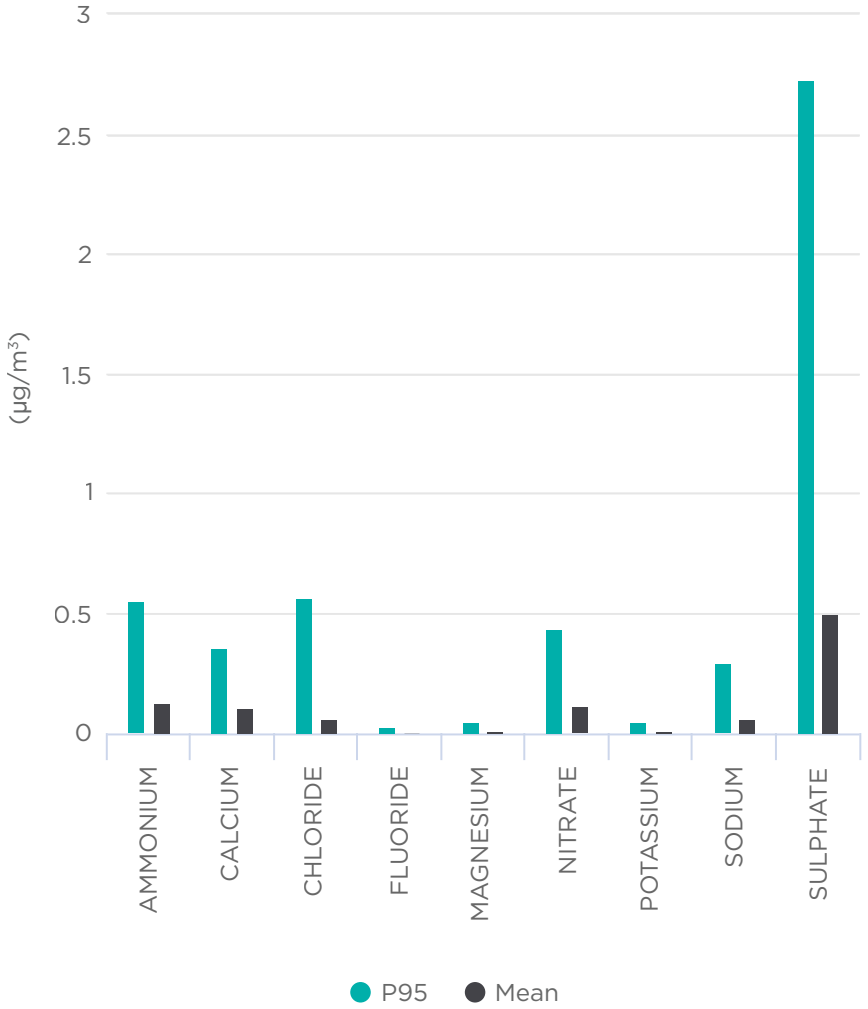
Bertha Ganter - Fort McKay



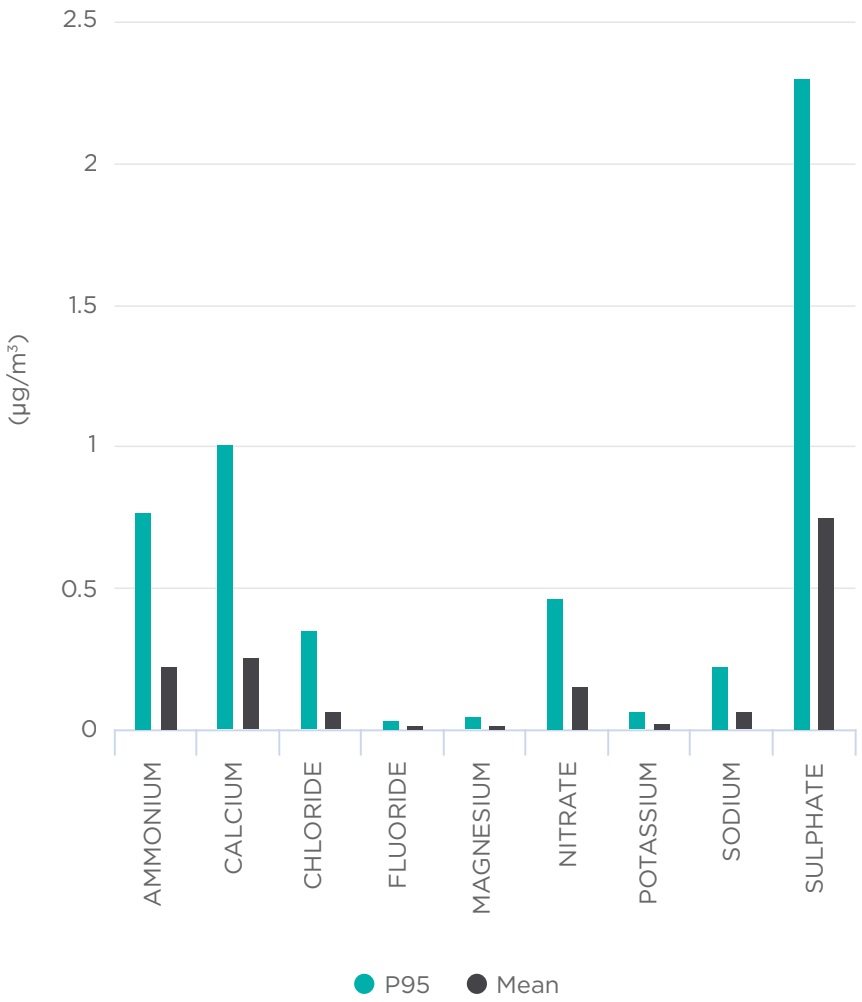
Conklin



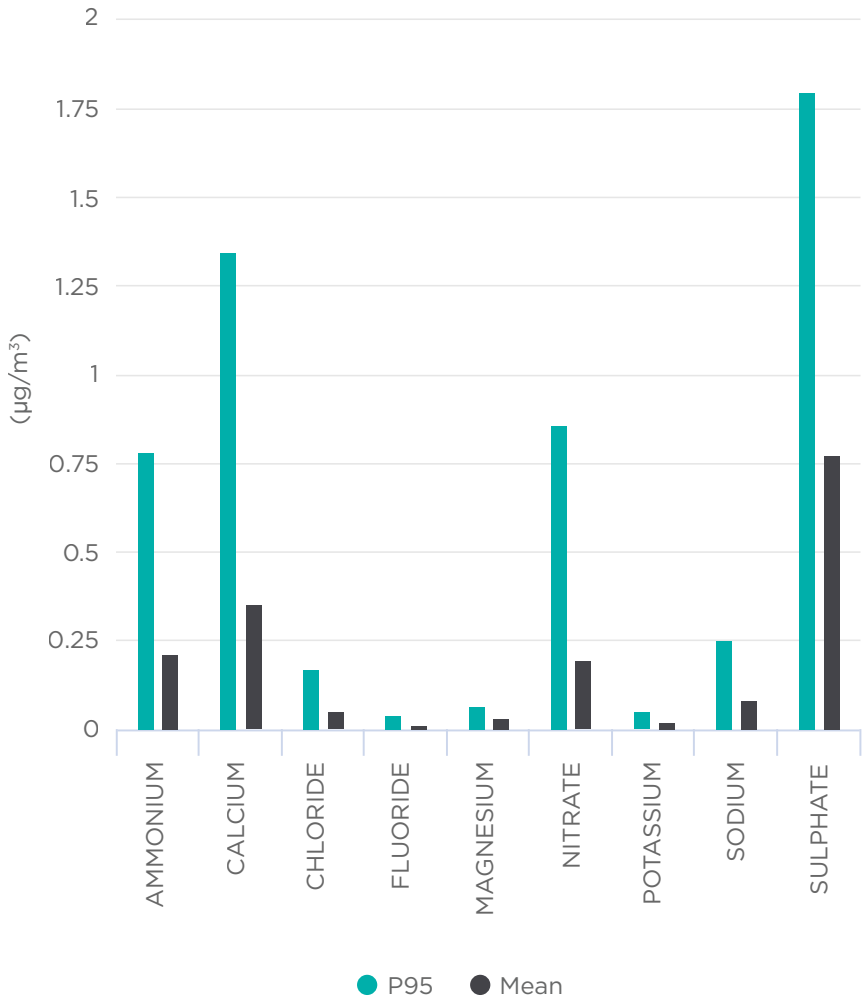
Ells River



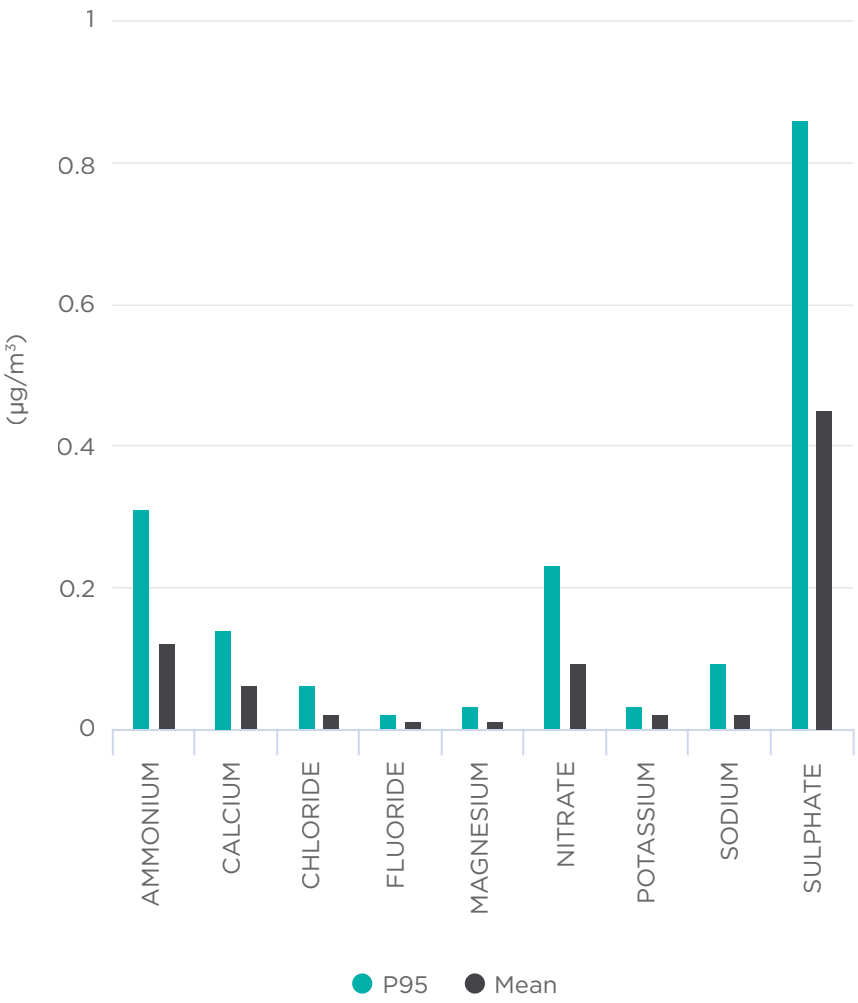
Fort McKay South



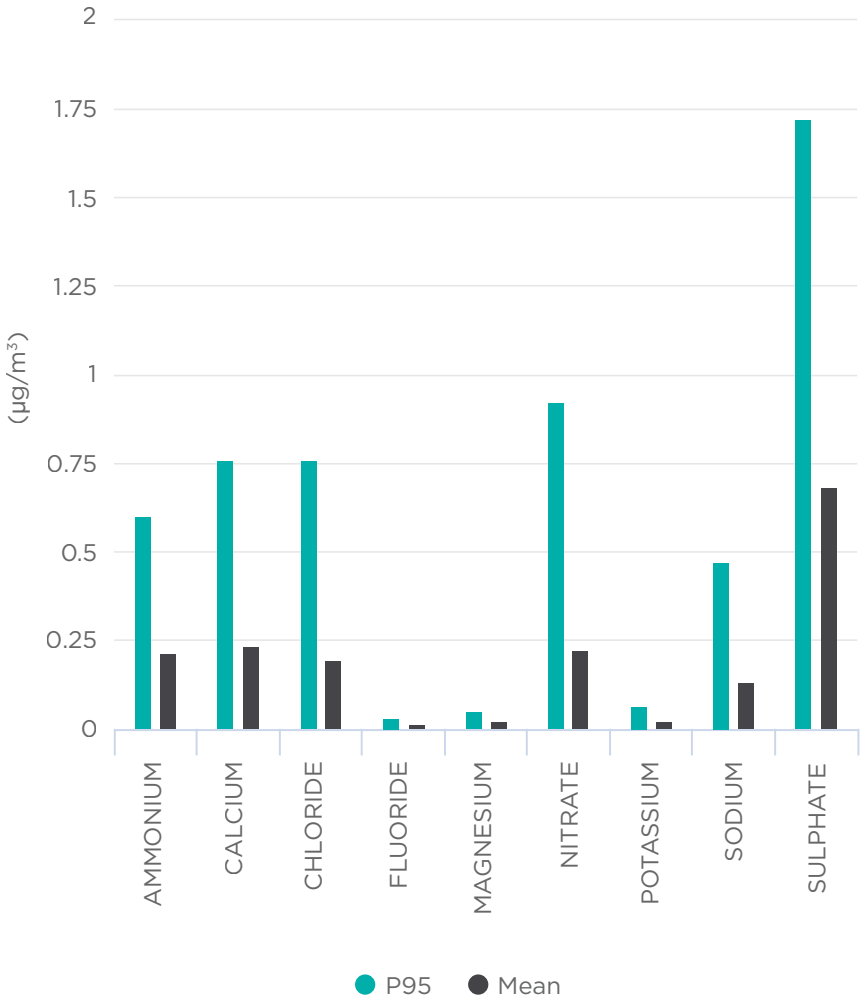
Horizon



Janvier

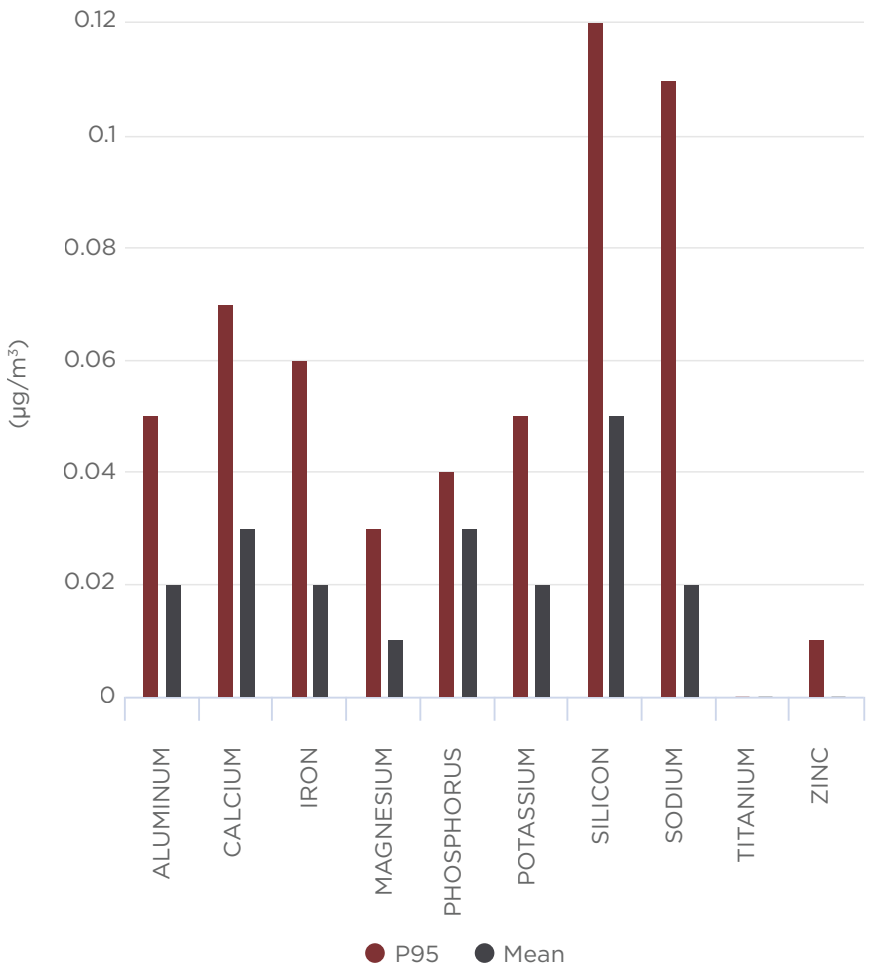


Patricia McInnes

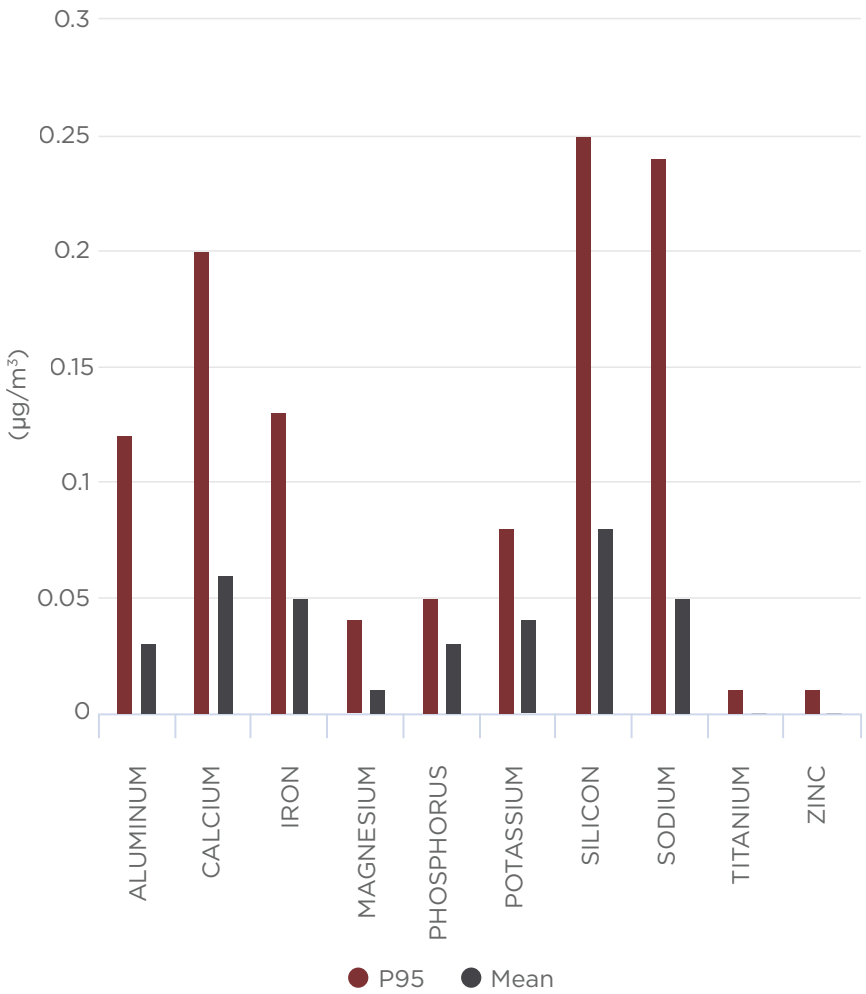


Particulate Matter 2.5 ($PM_{2.5}$) Metals

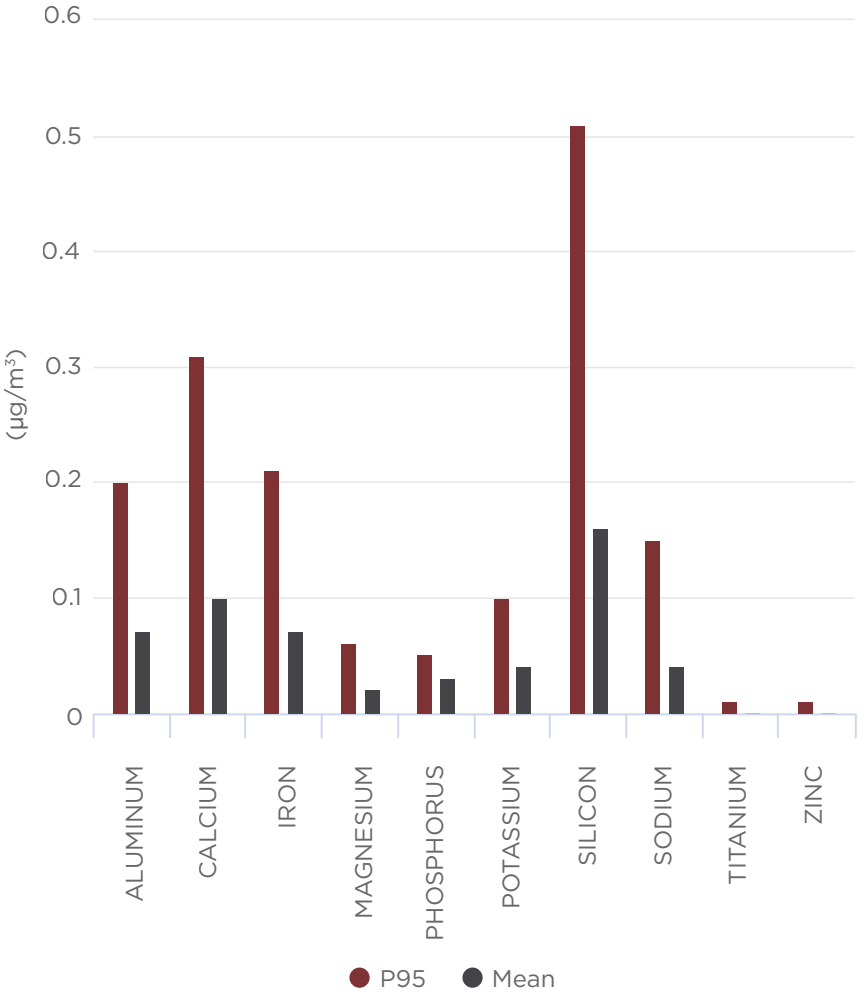
Anzac



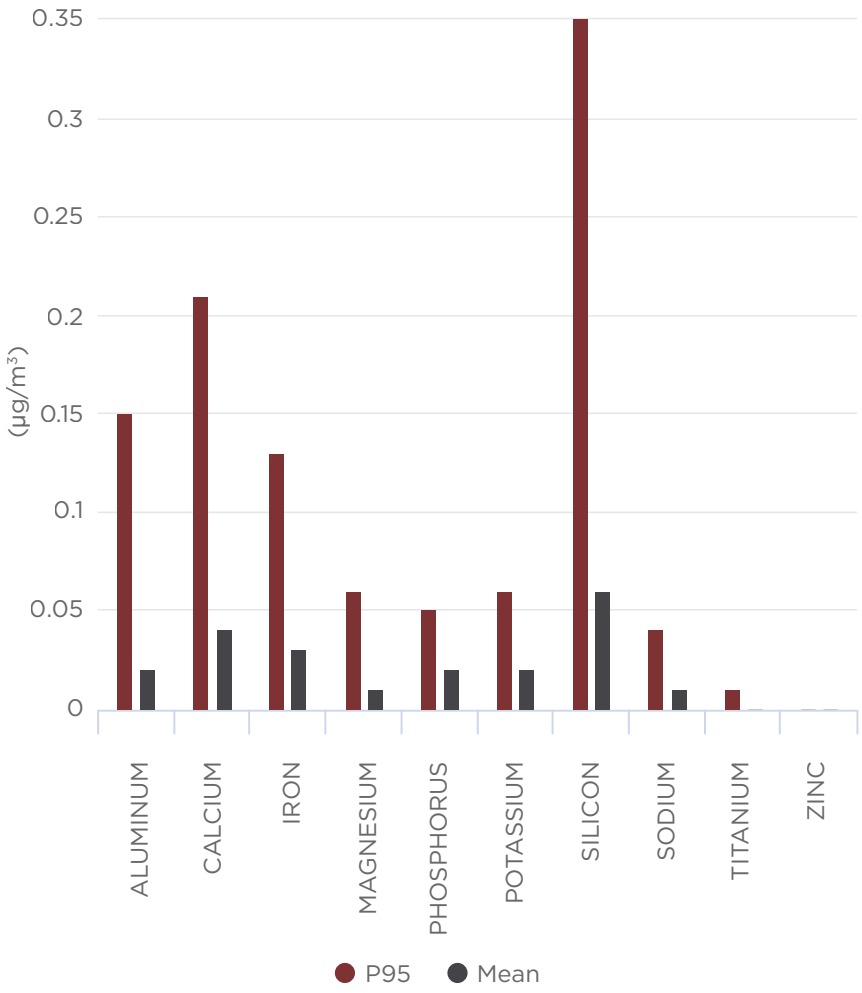
Athabasca Valley



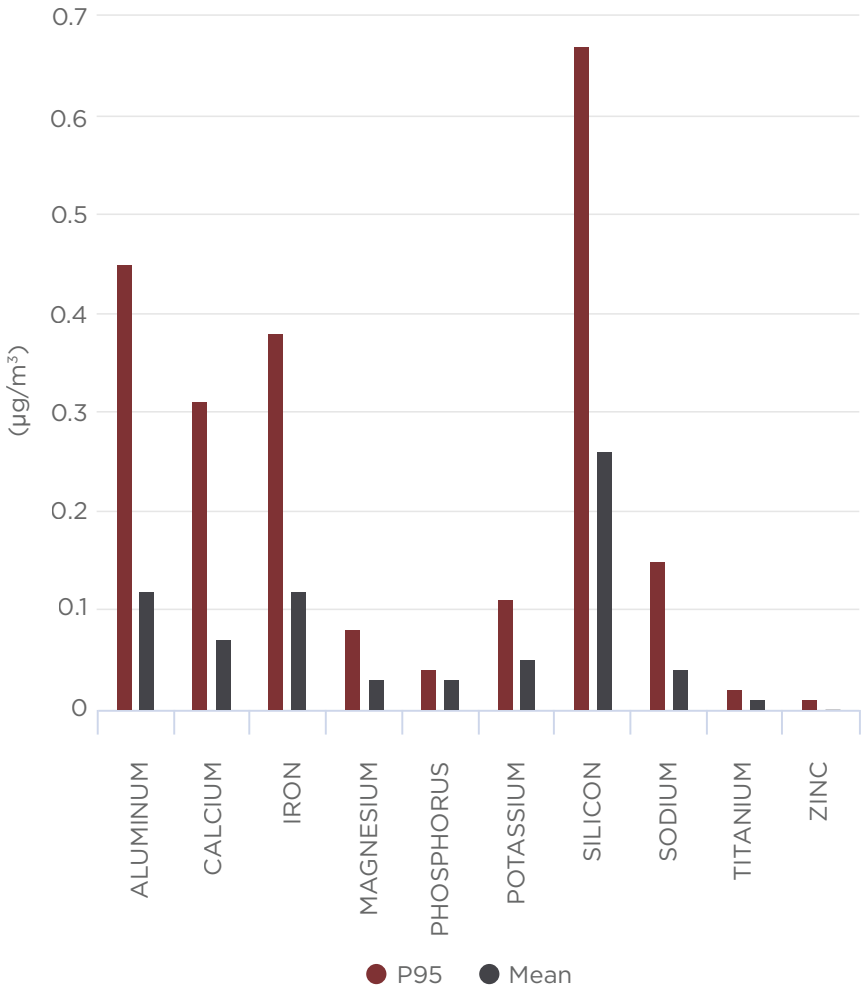
Bertha Ganter - Fort McKay



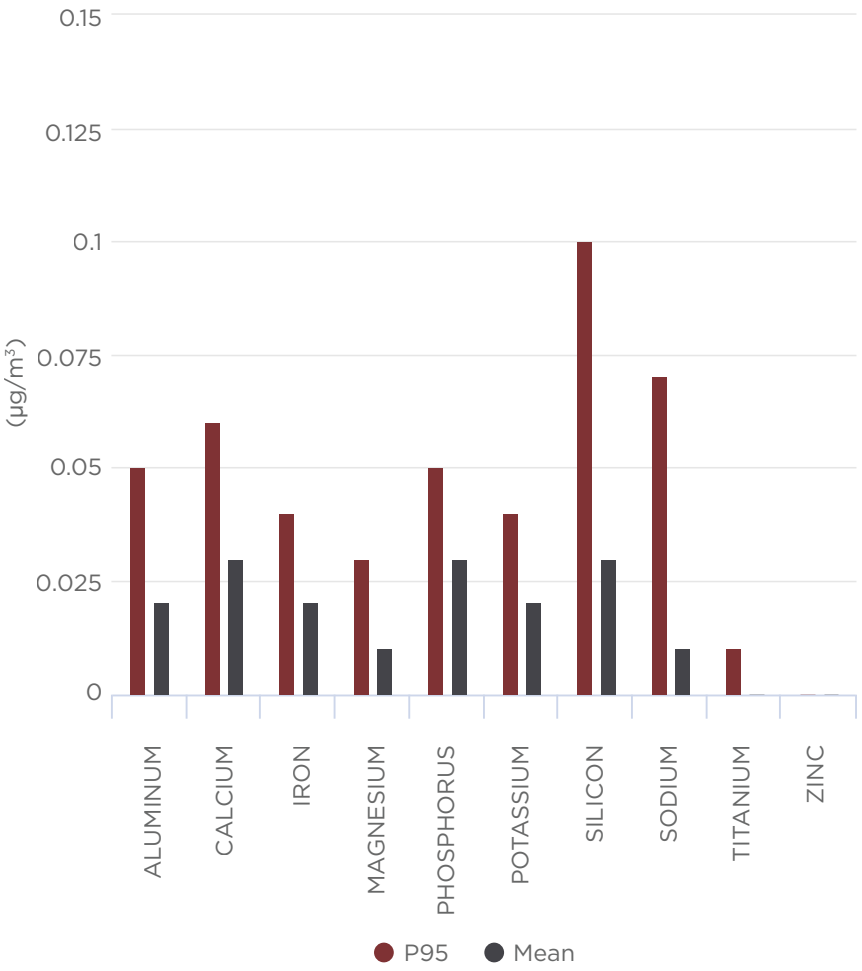
Conklin



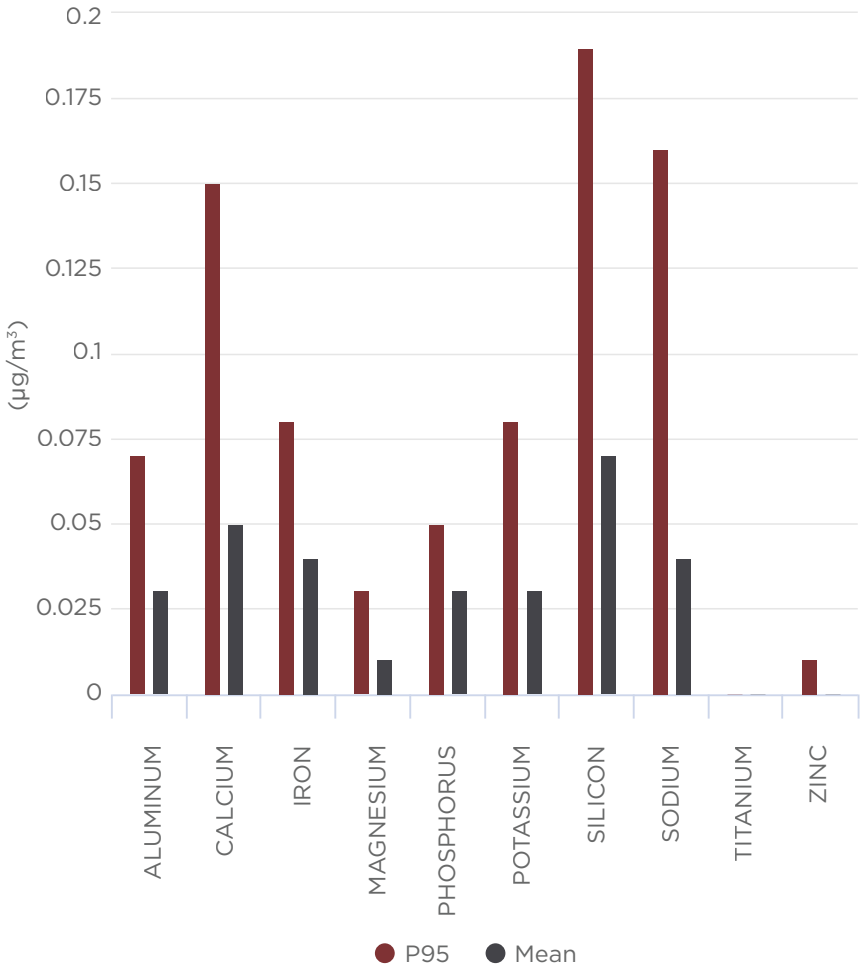
Horizon



Janvier

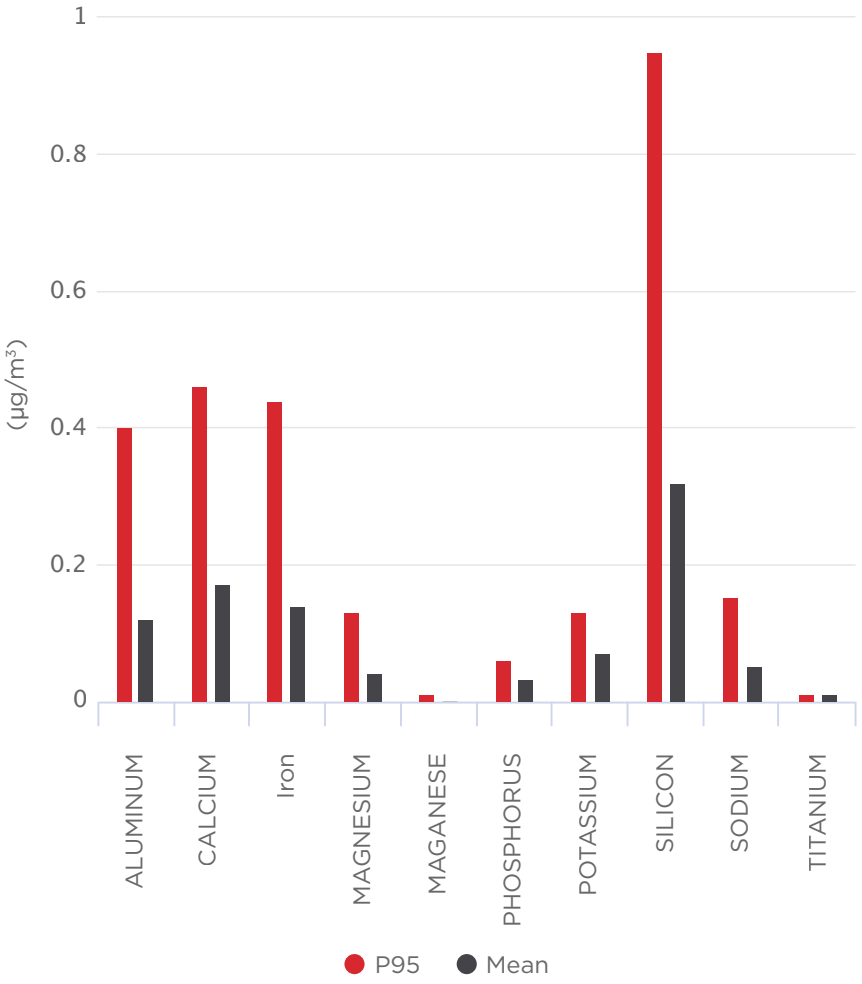


Patricia McInnes

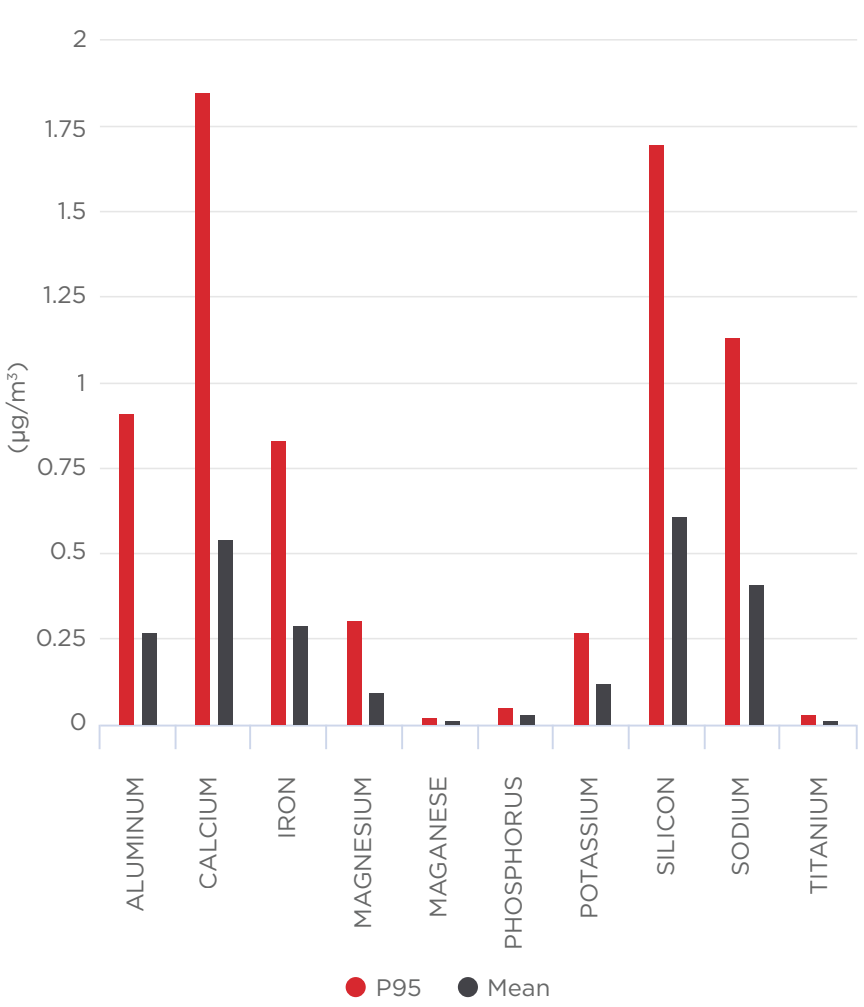


Particulate Matter 10 (PM_{10}) Metals

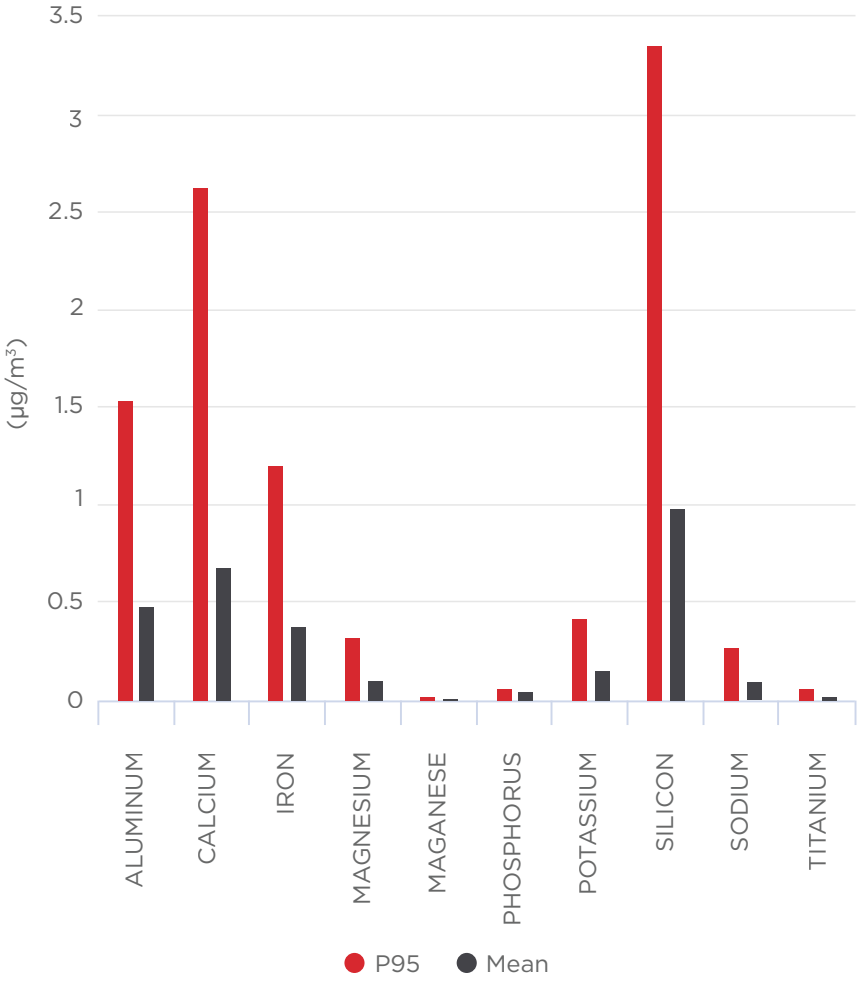
Anzac



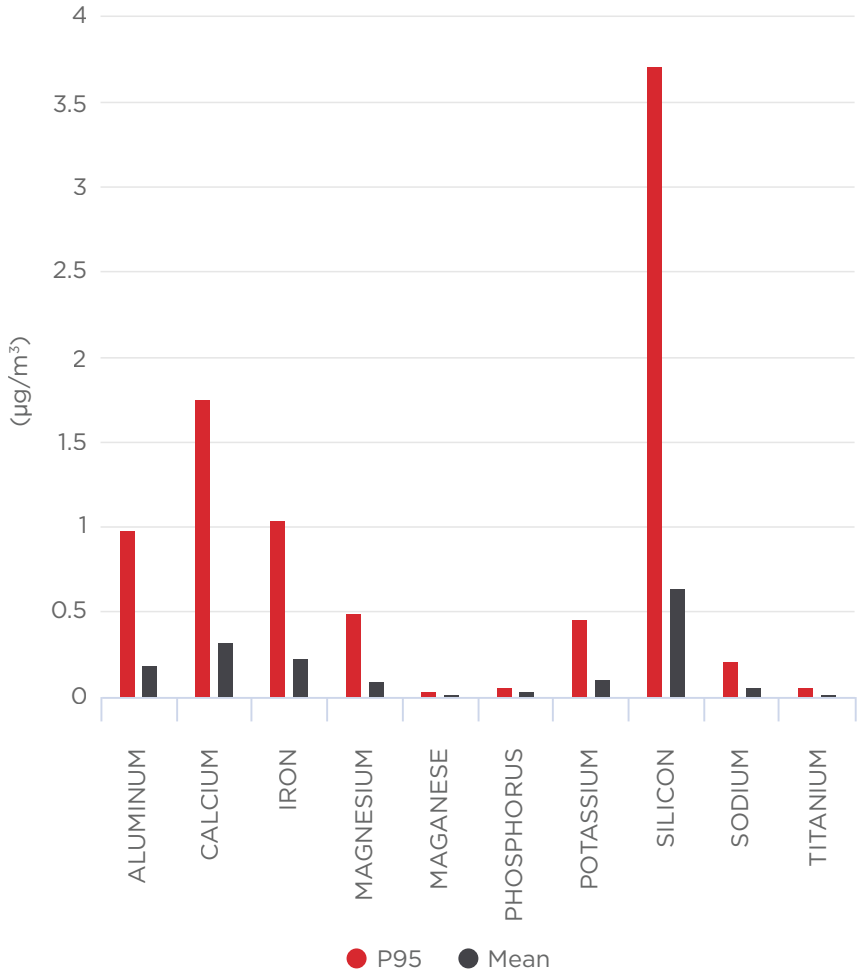
Athabasca Valley



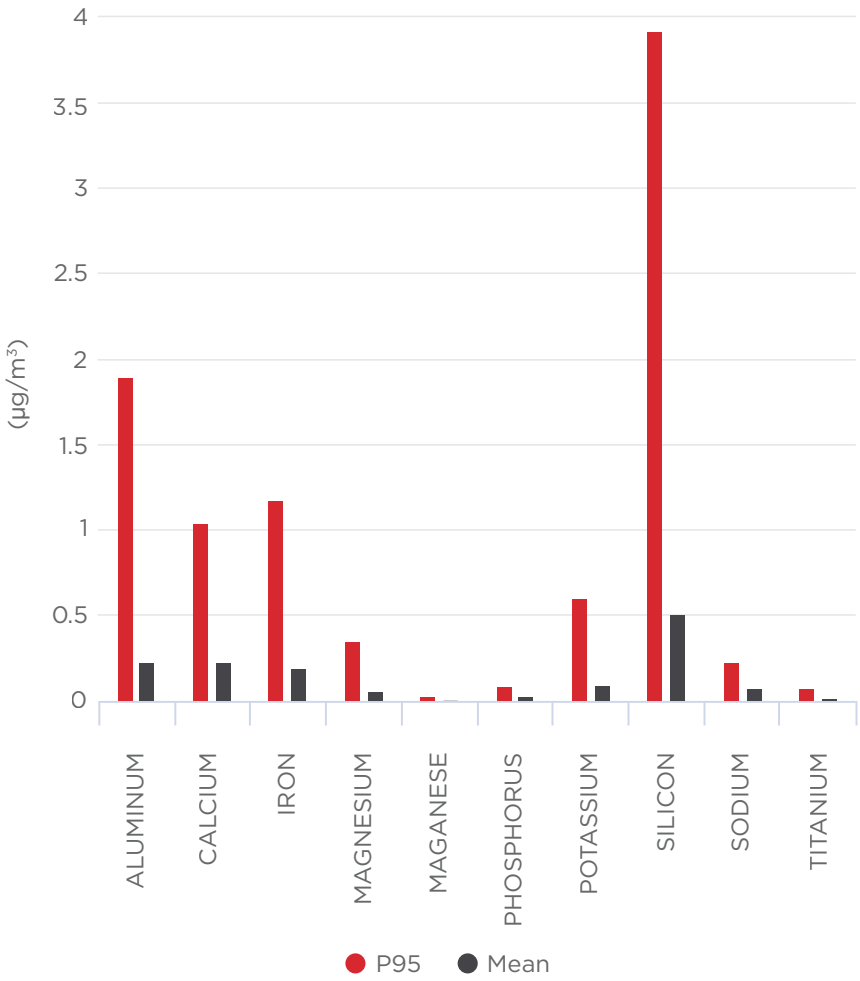
Bertha Ganter - Fort McKay



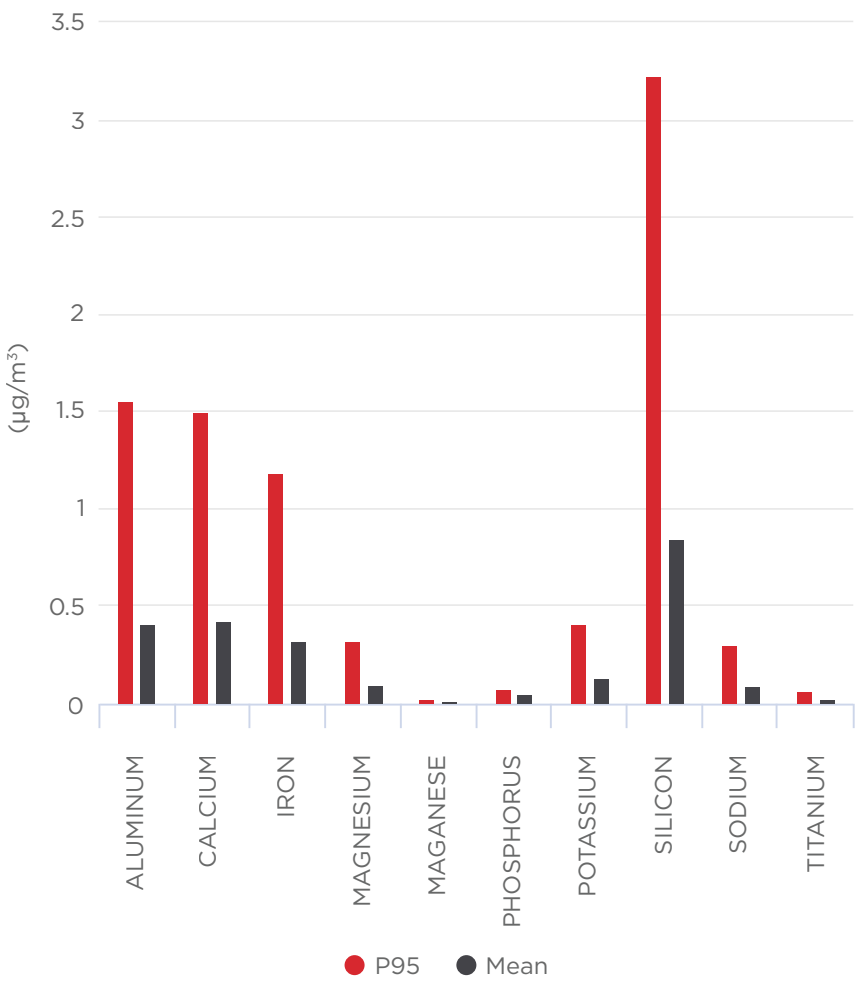
Conklin



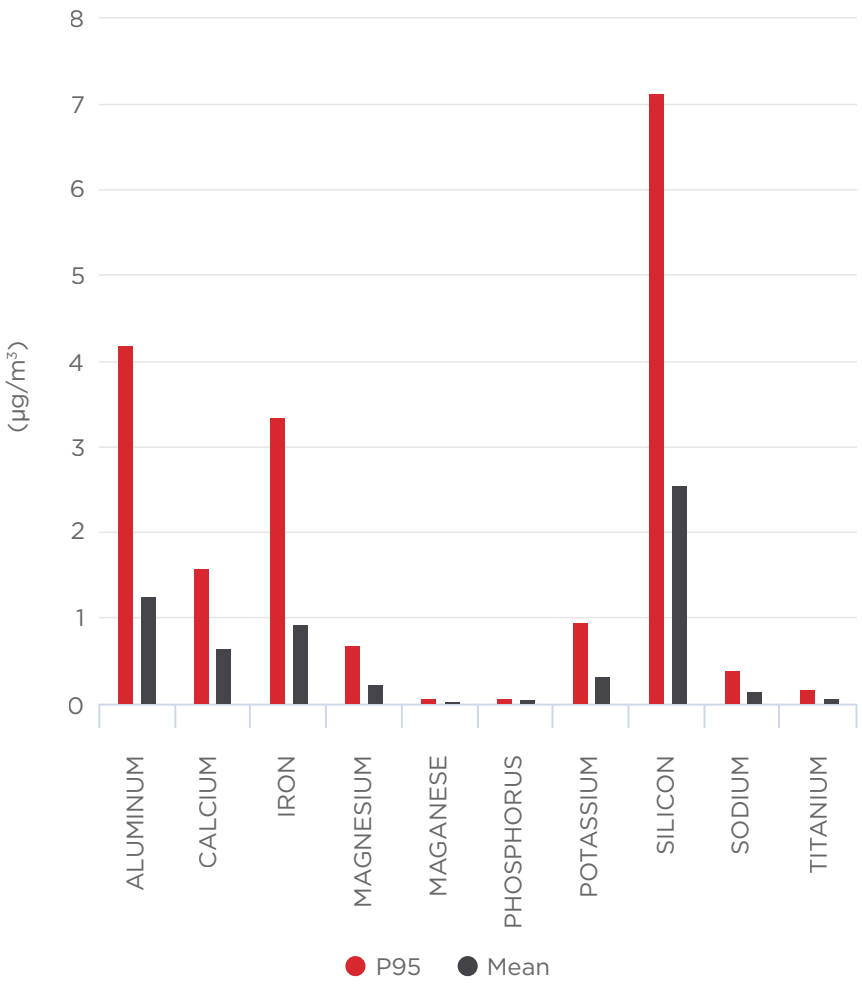
Ells River



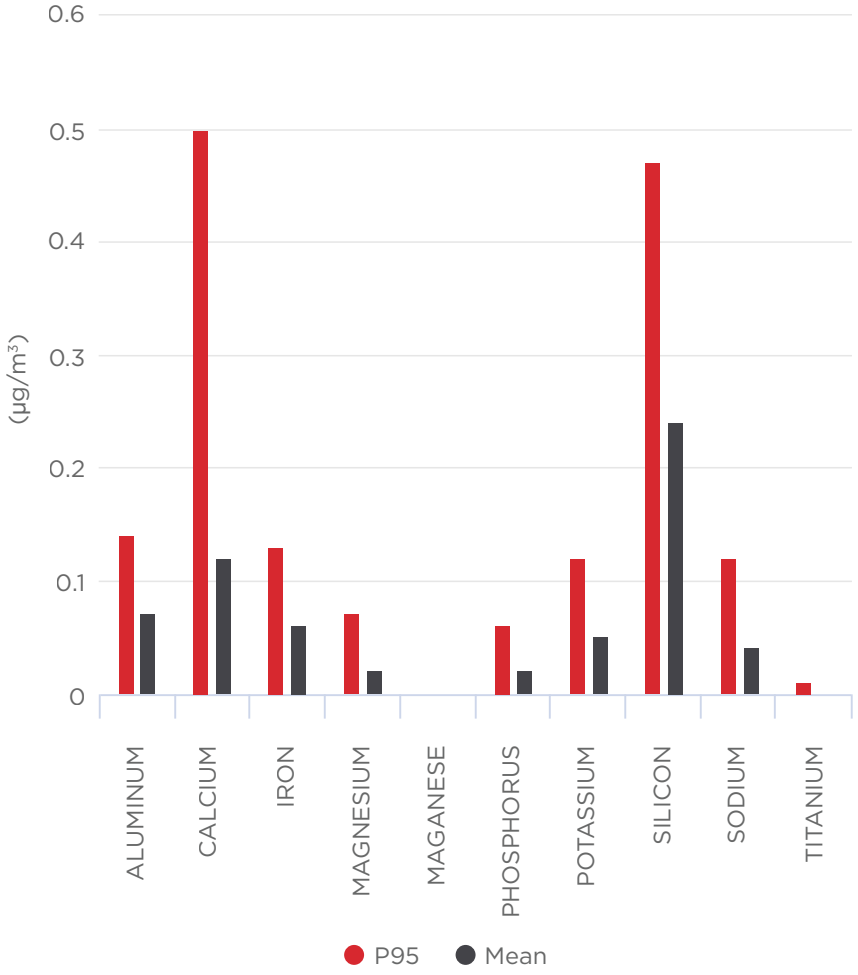
Fort McKay South



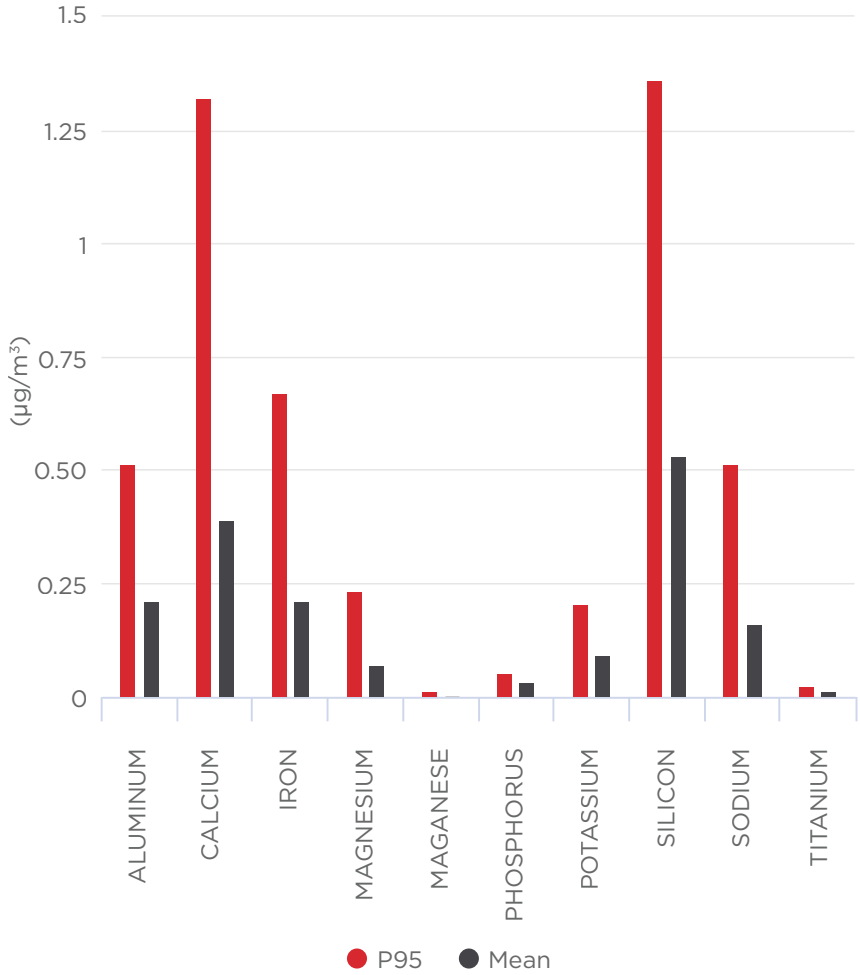
Horizon

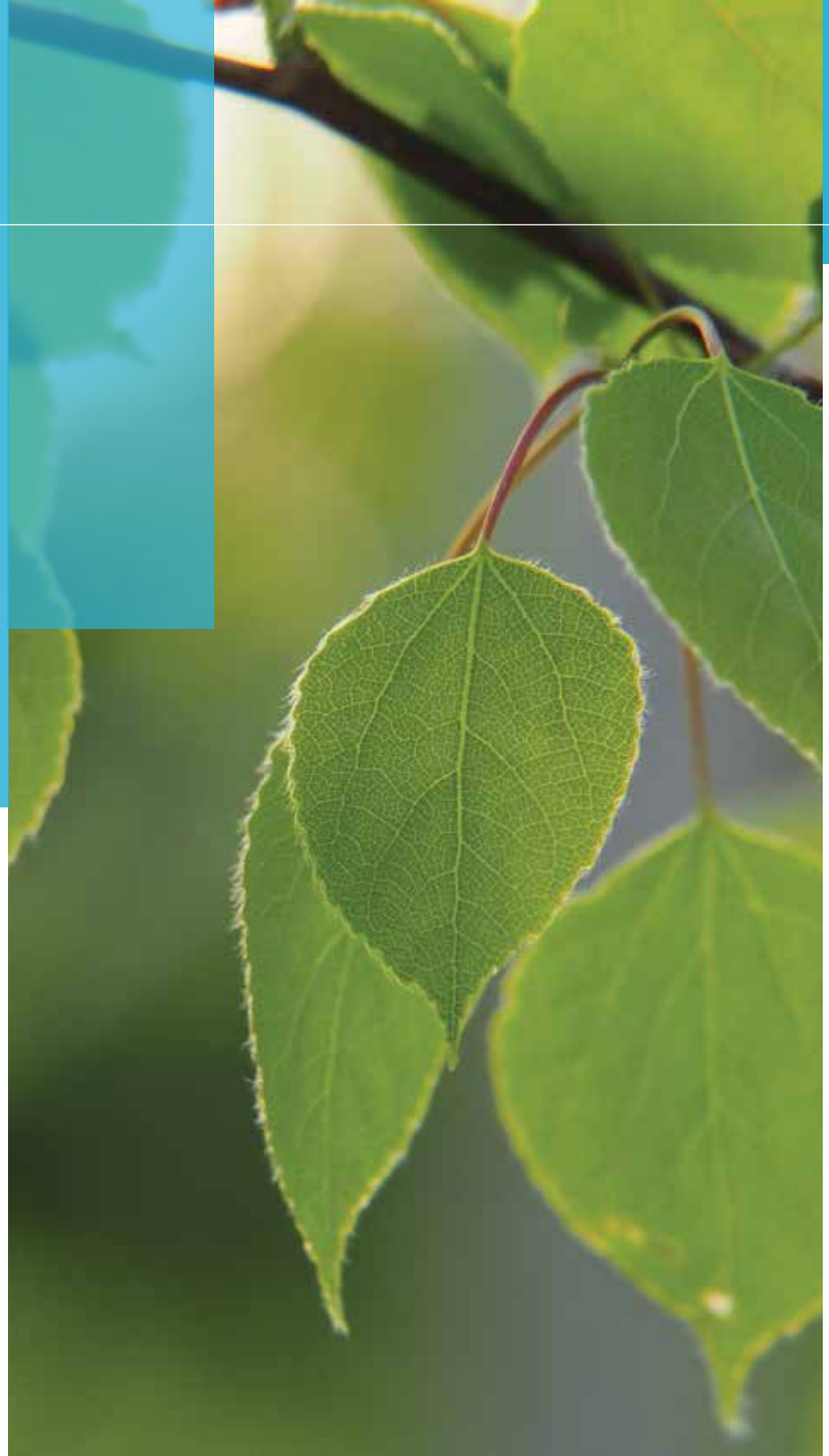


Janvier



Patricia McInnes

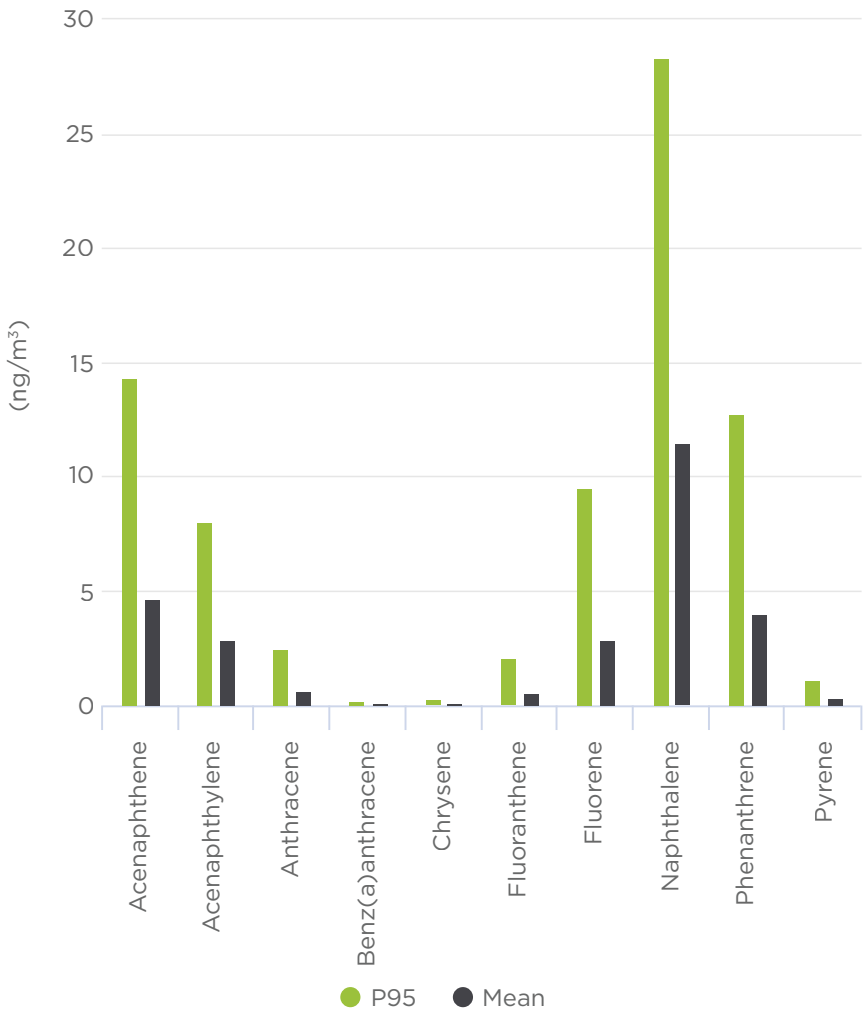




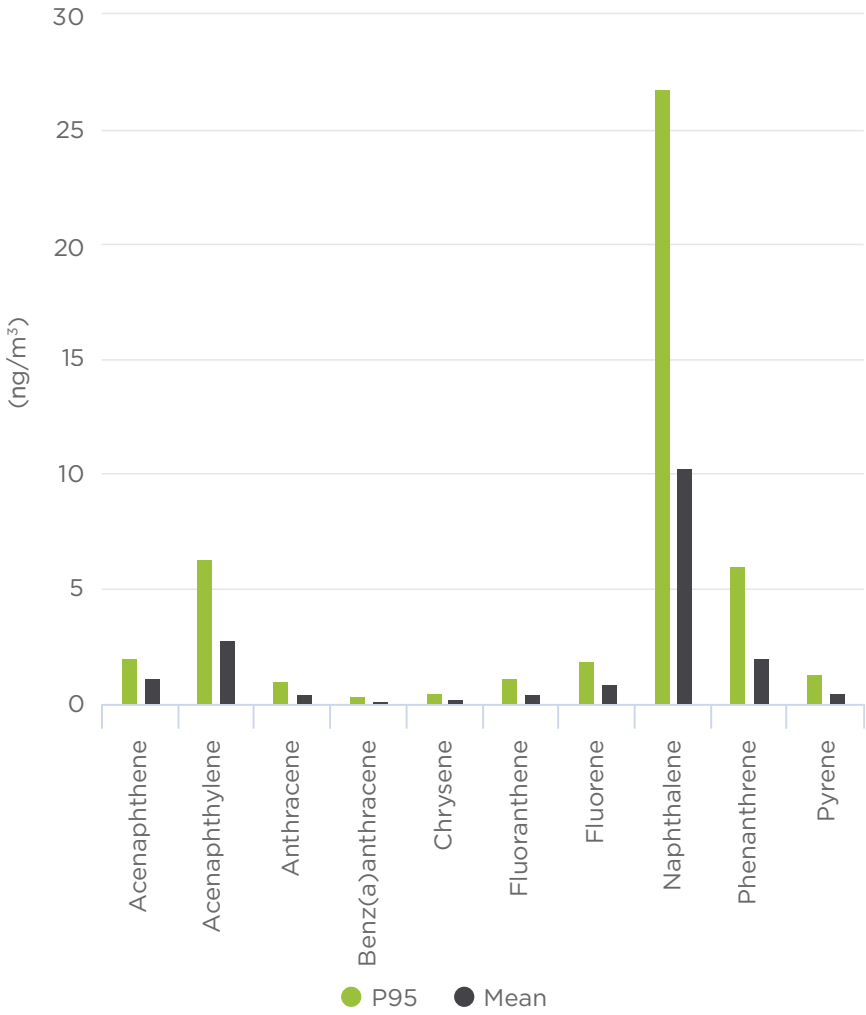
Polycyclic Aromatic Hydracarbons (PAHs)

Polycyclic aromatic hydrocarbons (PAHs) are a class of chemicals that occur naturally in coal, crude oil, gasoline and oil sand deposits. They also are produced when coal, oil, gas, wood or garbage are burned. PAHs generated from these sources can bind to or form small particles in the air. There are hundreds of different PAHs – some of which can be detrimental to human health and the environment.

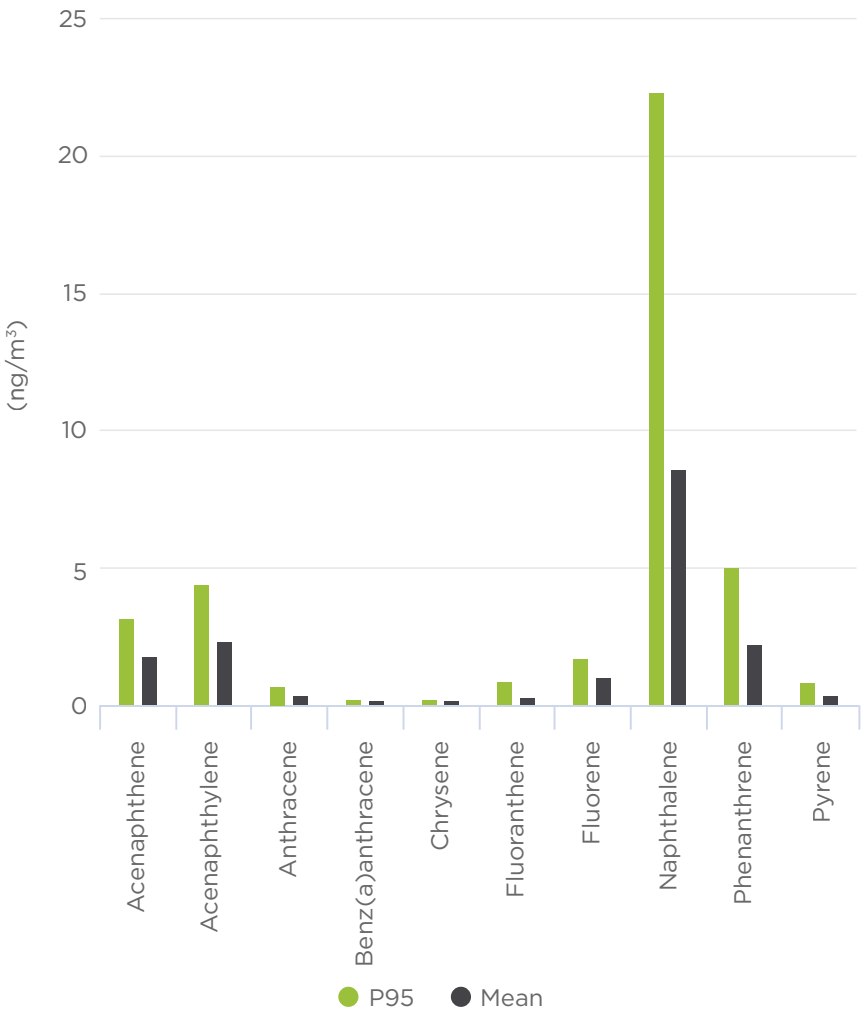
Anzac



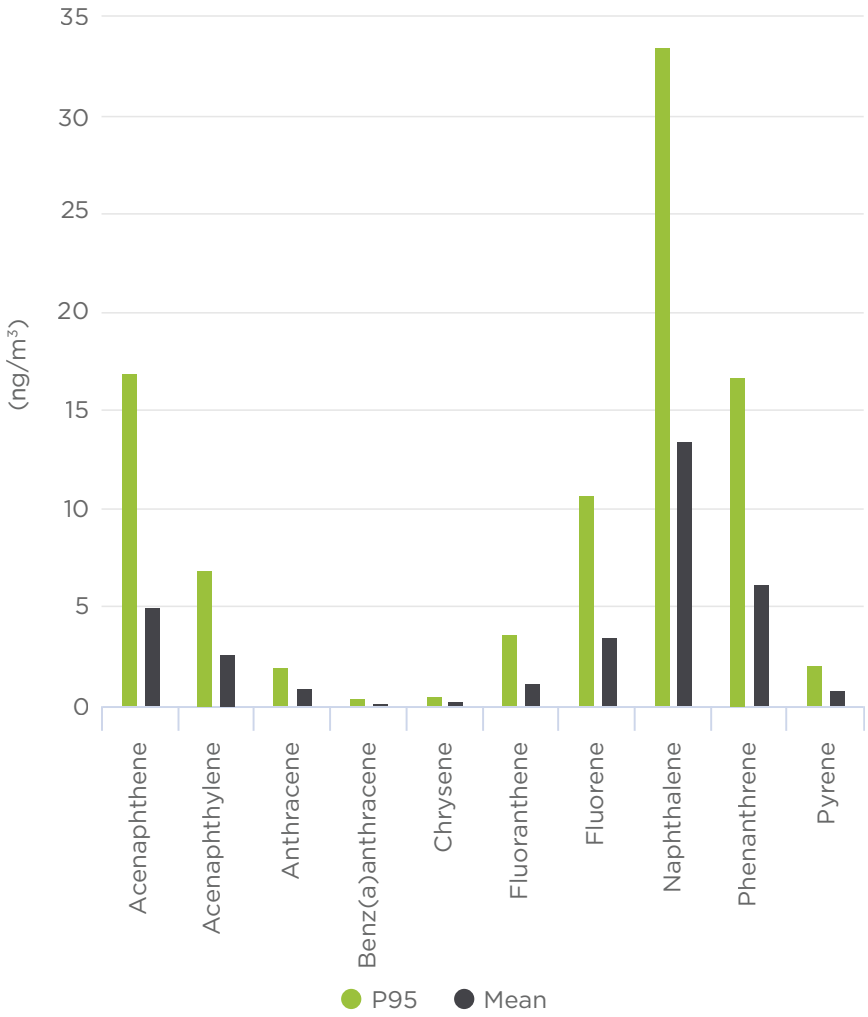
Athabasca Valley



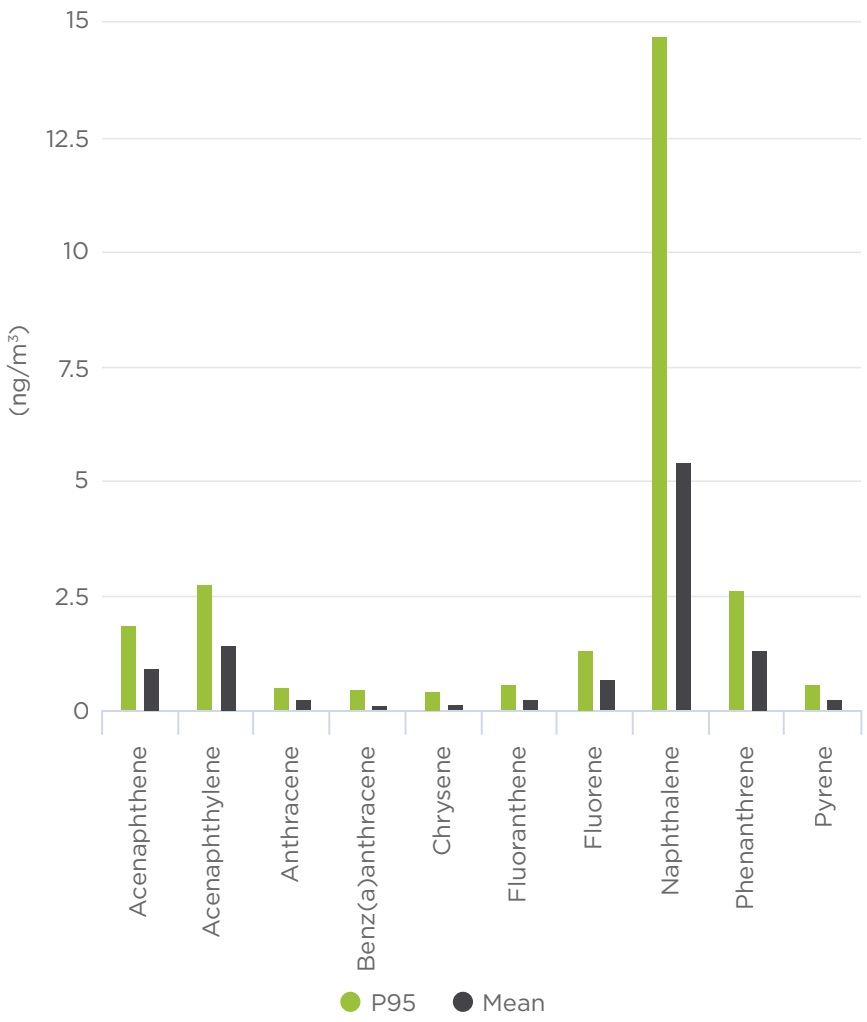
Bertha Ganter - Fort McKay



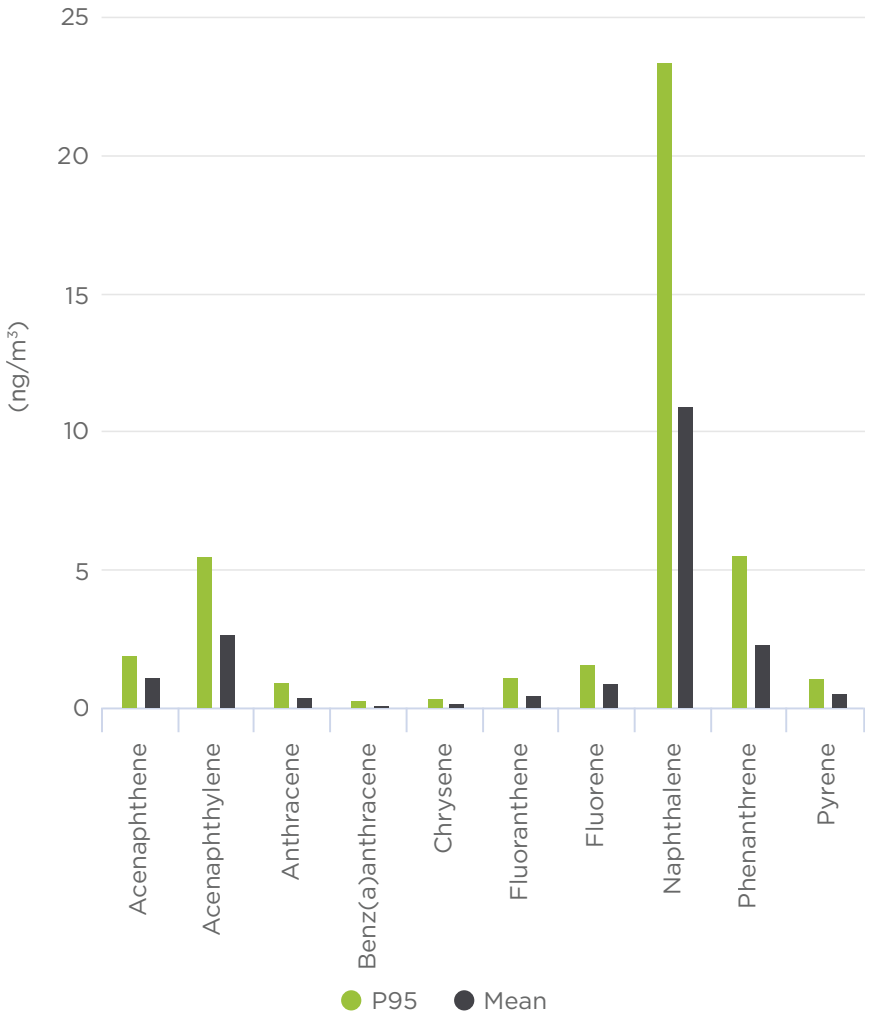
Conklin

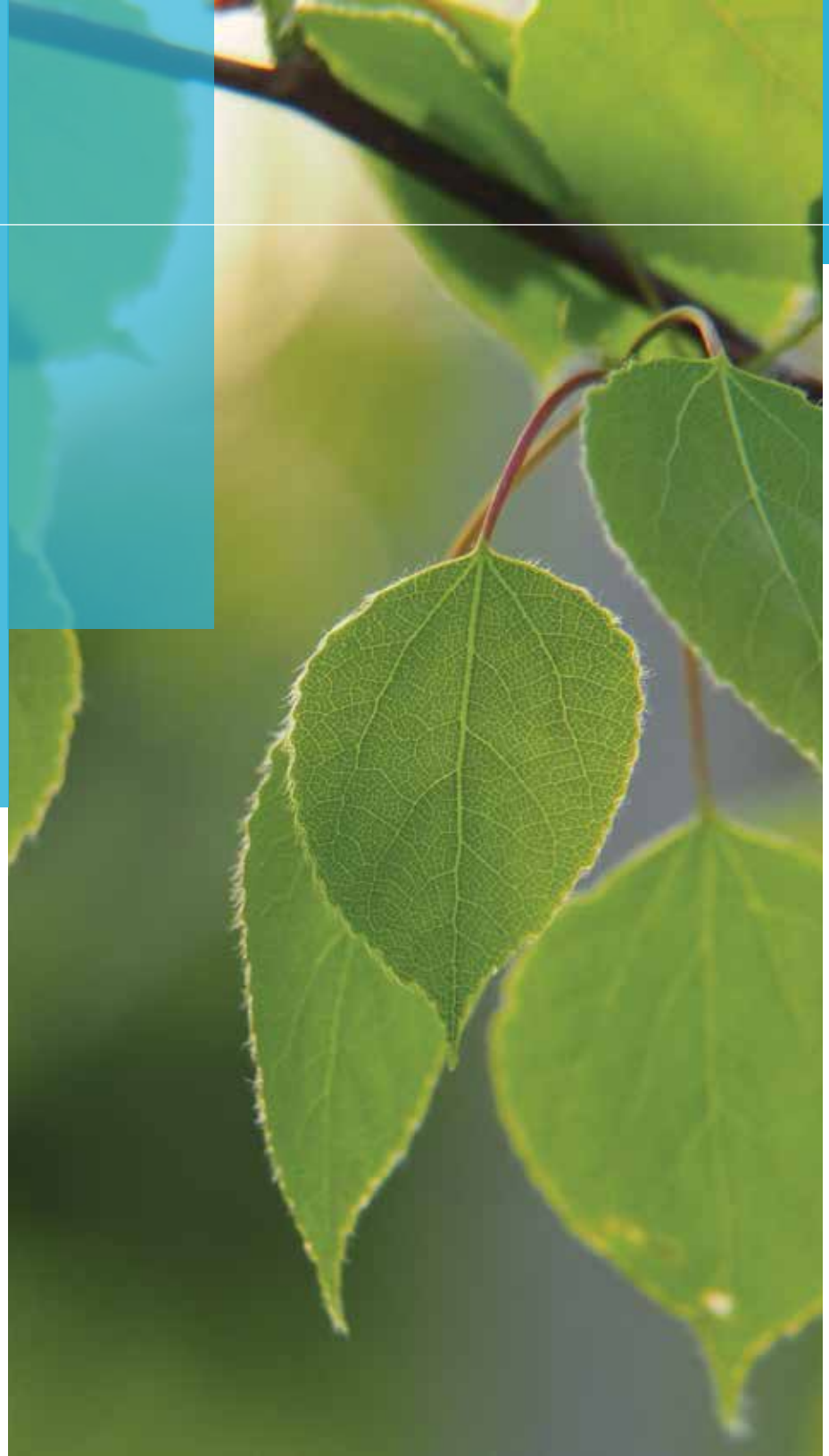


Janvier



Patricia McInnes

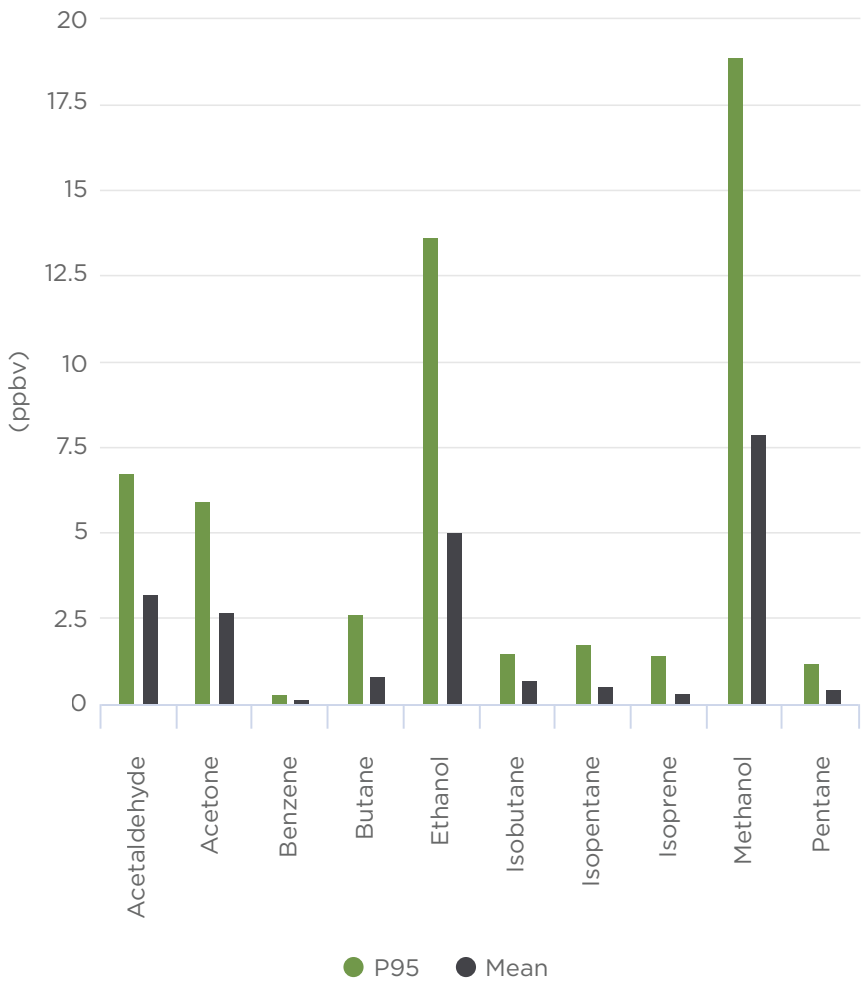




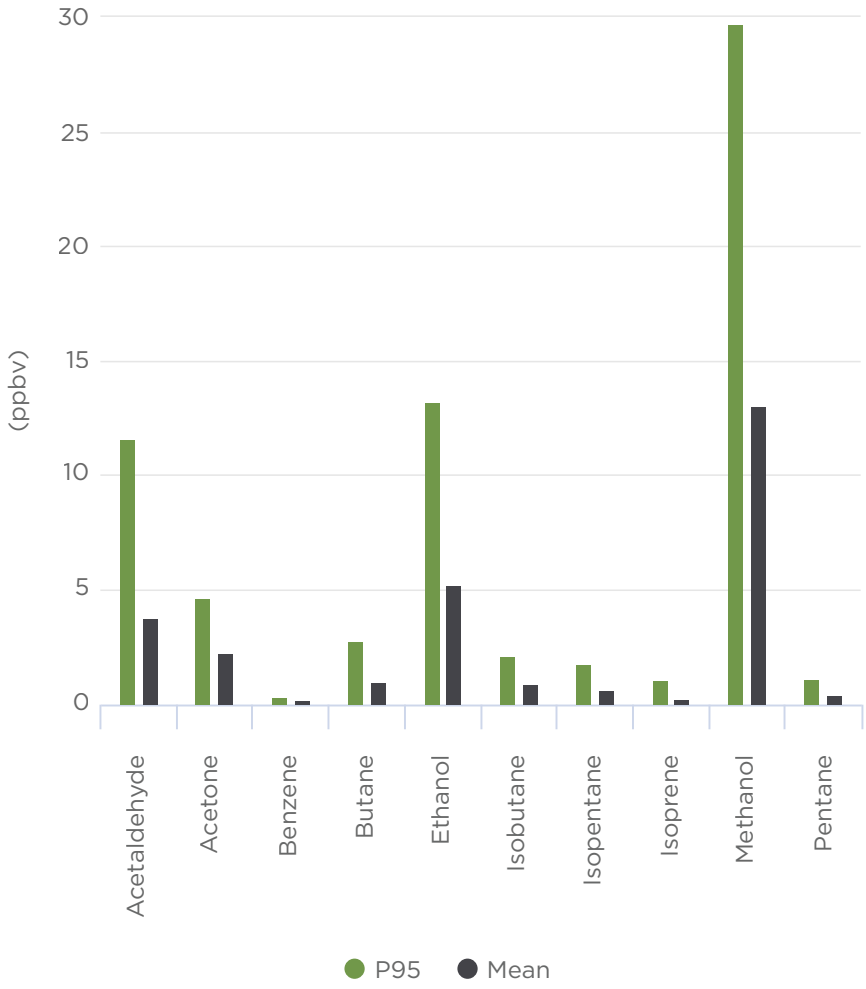
Volatile Organic Compounds (VOCs)

Volatile organic compounds (VOCs) are a group of chemical species that contain carbon, and whose composition makes it possible for them to evaporate under normal atmospheric conditions of temperature and pressure. They may contain additional elements such as hydrogen, oxygen, fluorine, chlorine, bromine, sulphur, or nitrogen. VOCs are numerous, and come from both natural and human sources, and certain VOCs may contribute to ozone formation, odours, and long-term health-effects.

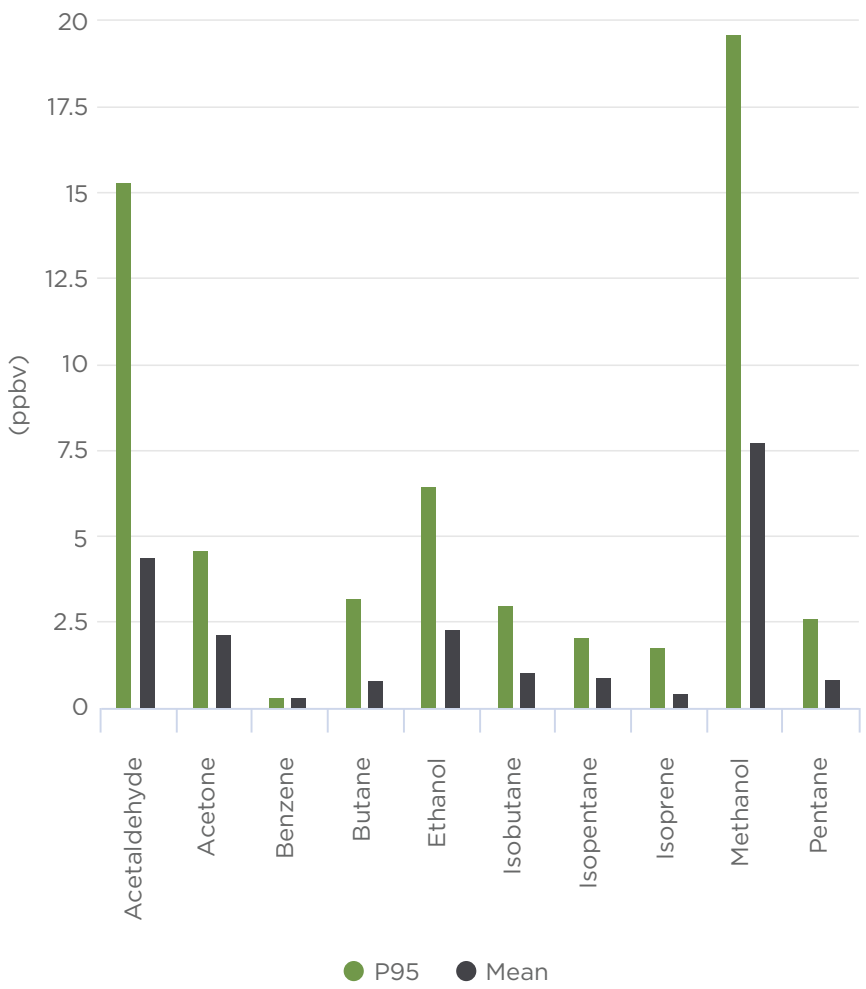
Anzac



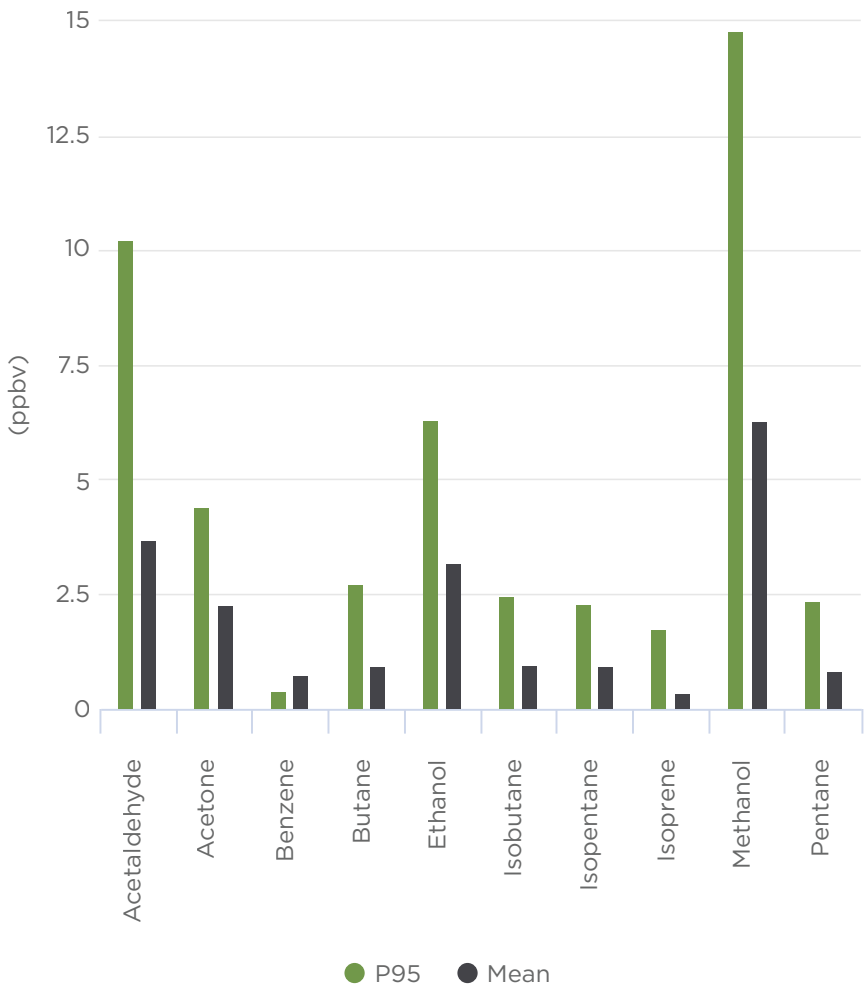
Athabasca Valley



Barge Landing



Bertha Ganter - Fort McKay



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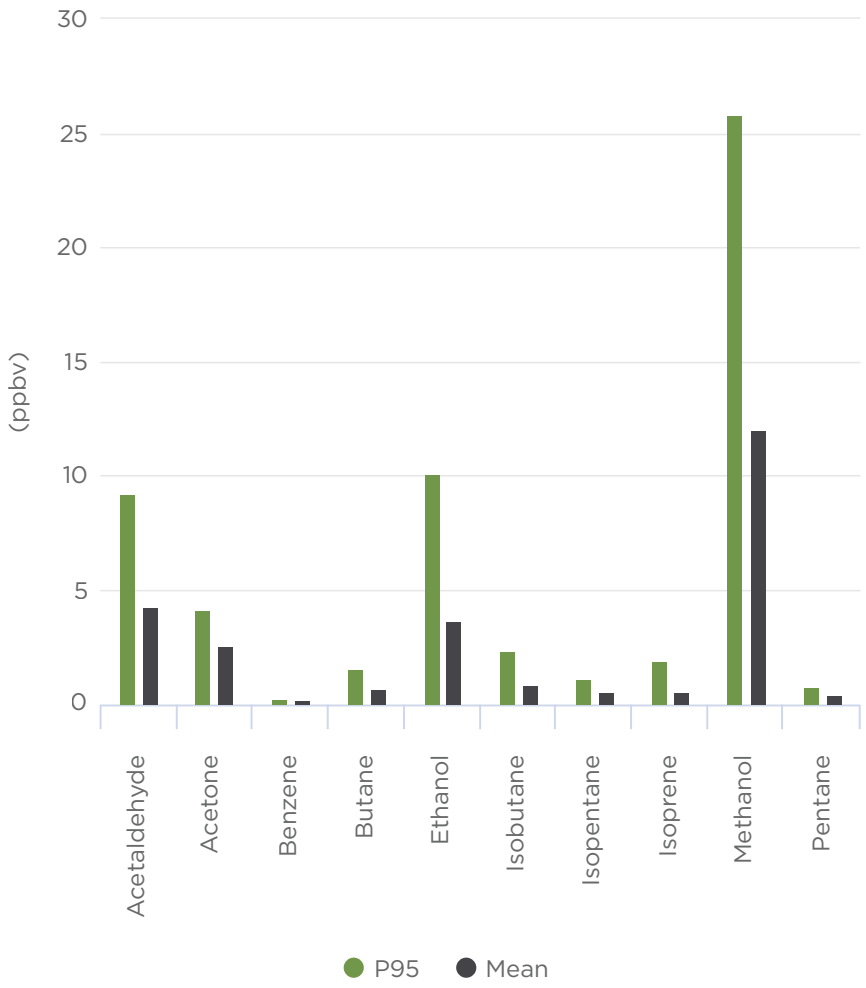
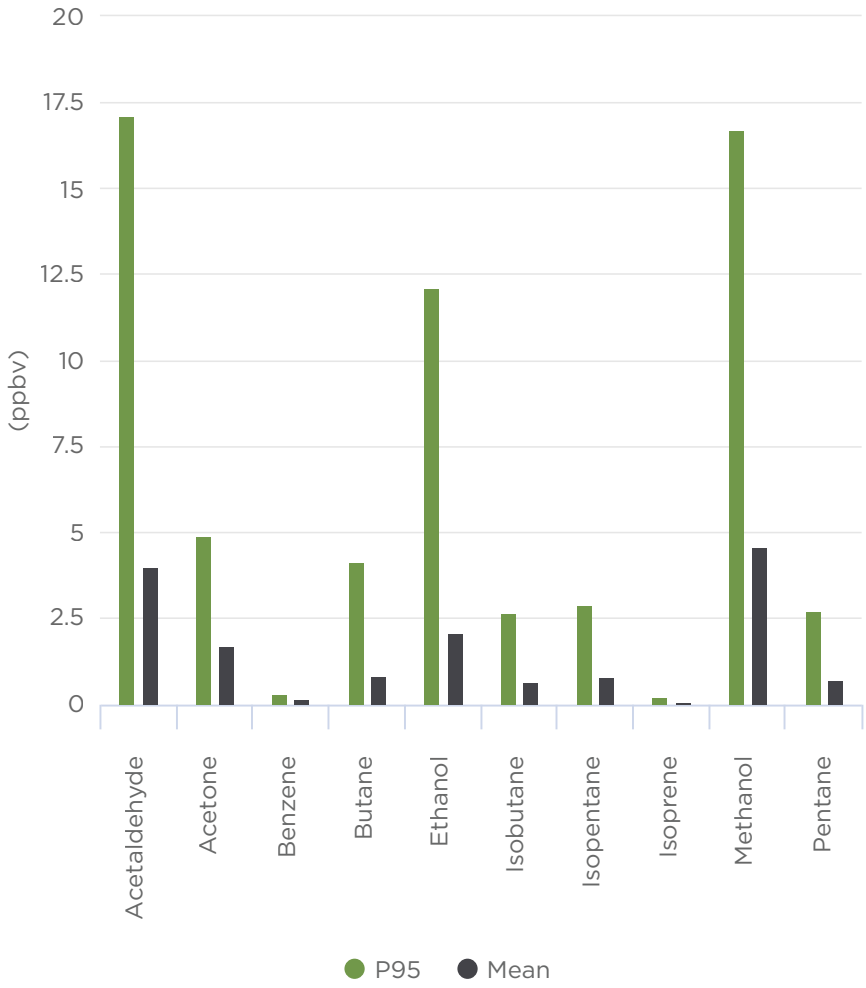
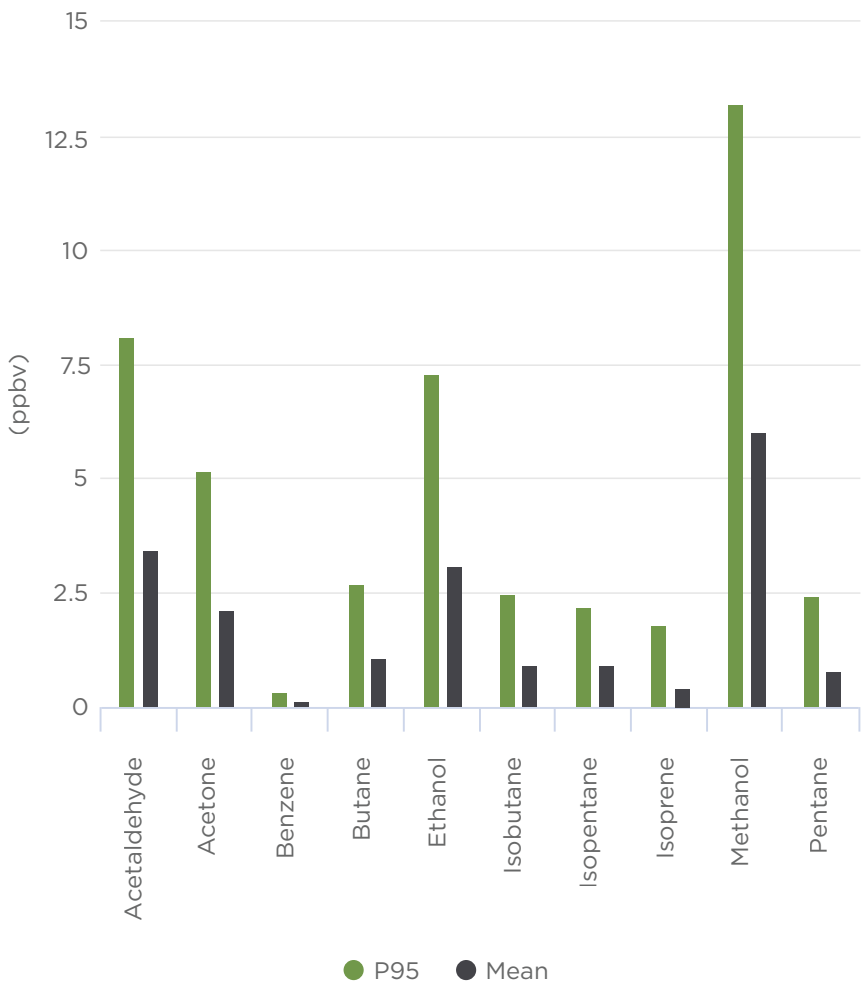


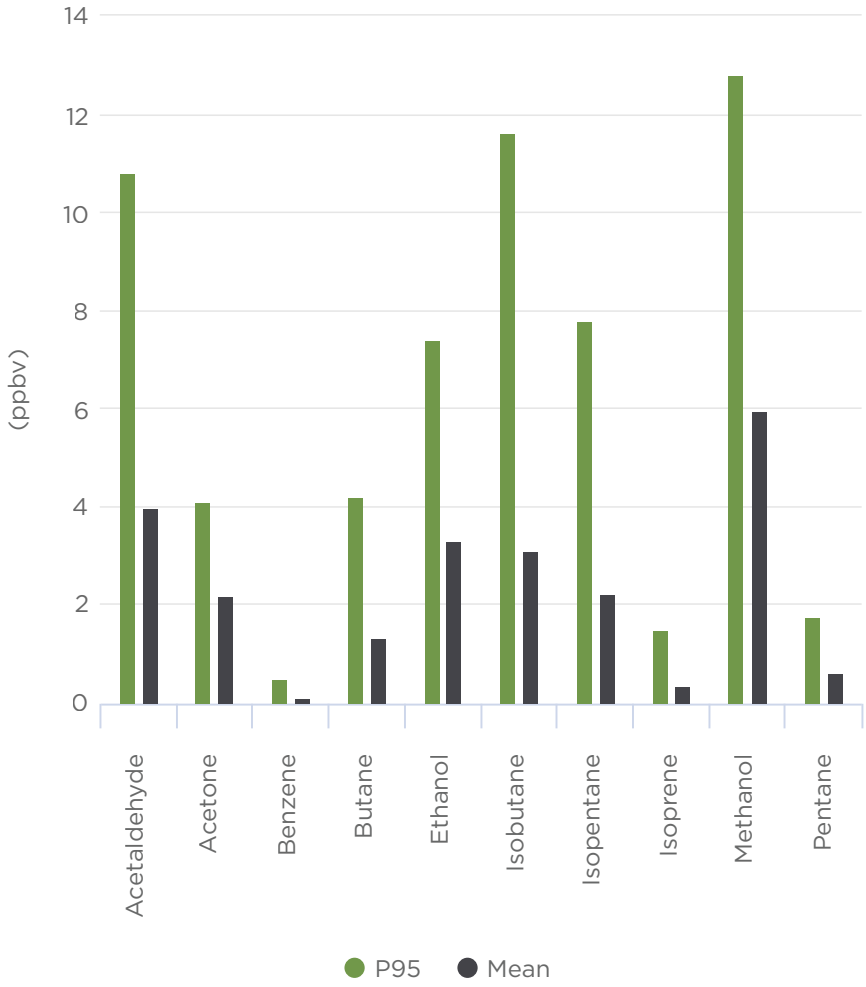
Ells River



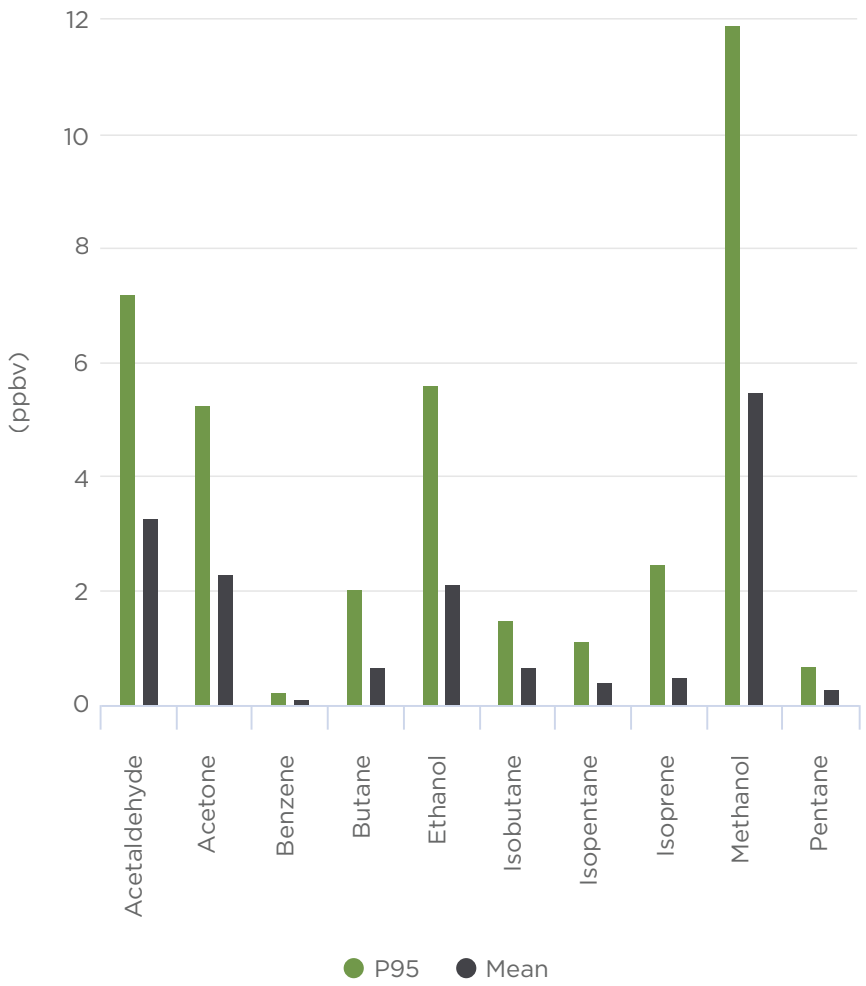
Fort McKay - South



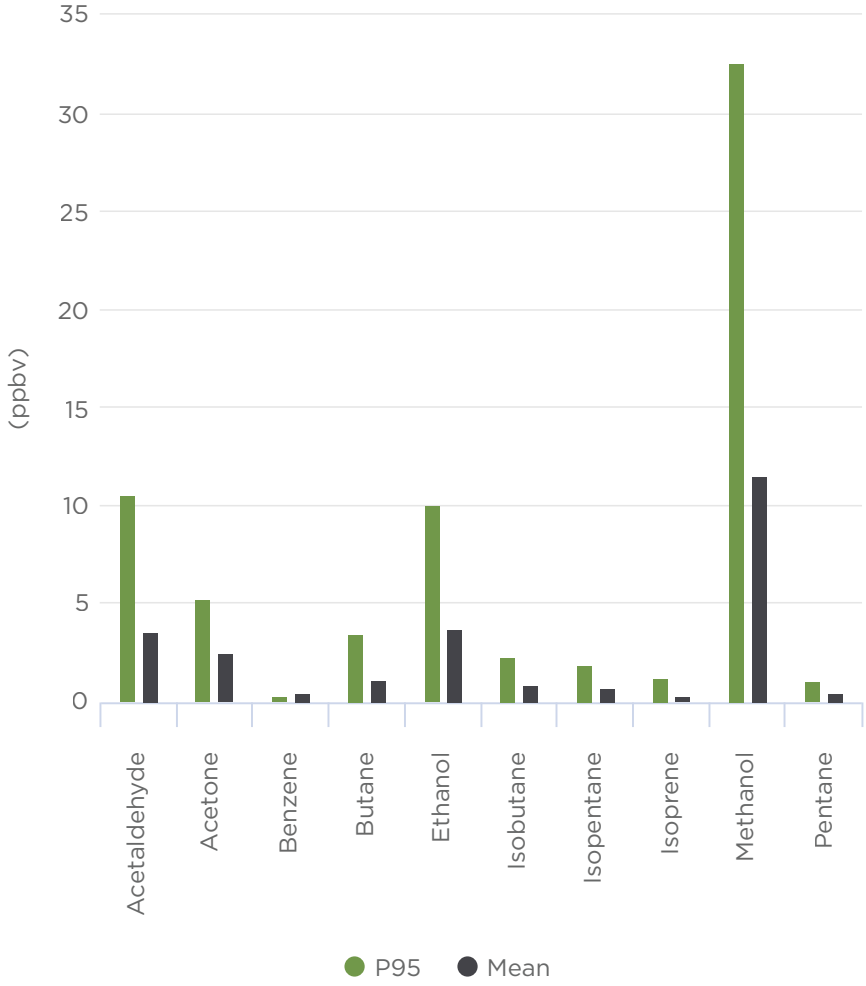
Horizon



Janvier



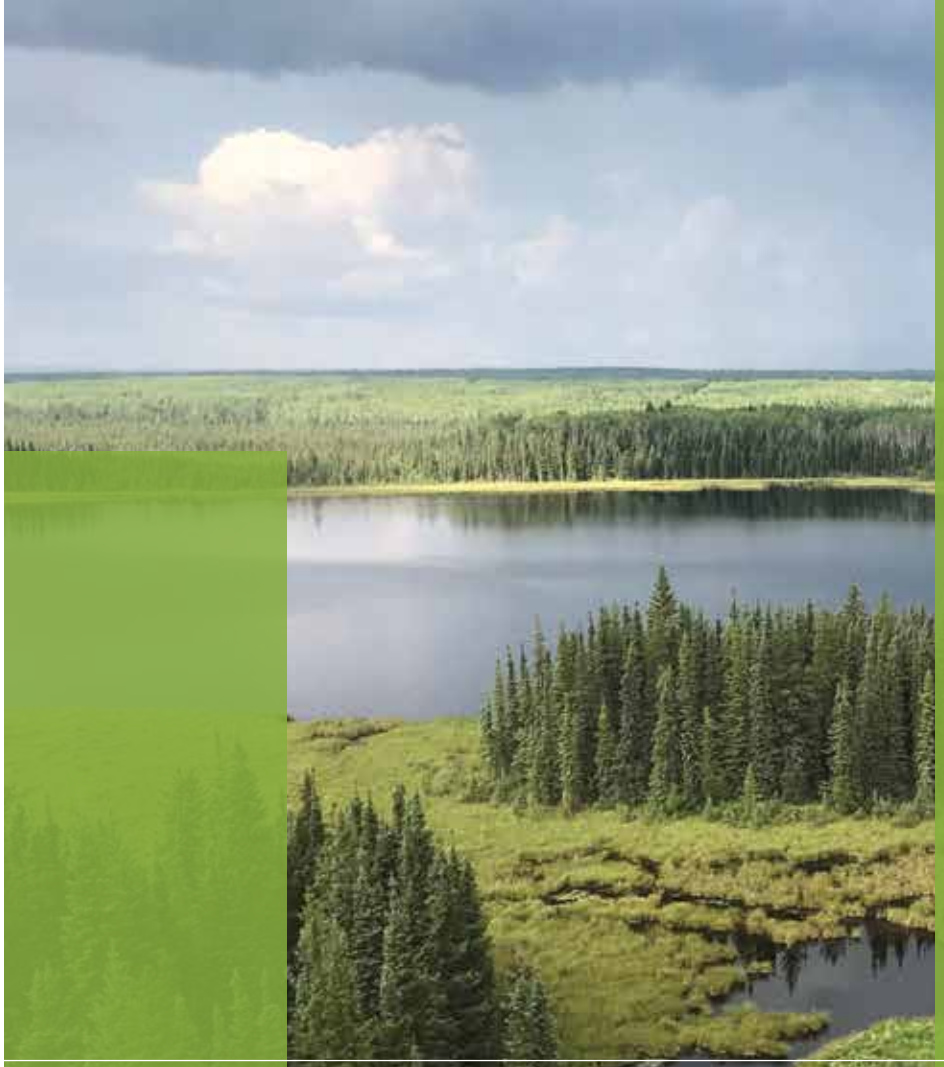
Patricia McInnes



WBEA Ambient Air Monitoring Trends

Since 1997, the WBEA monitoring network has grown to include and operate 29 ambient air monitoring stations throughout the RMWB. The WBEA created a monitoring trends website that is intended to compare data annually and visually present data trends over time. There are currently three primary sections to view data trends: **continuous and time-integrated data for specific air quality parameters**, **ground-level concentration exceedances**, and **analyzer average operational time**.

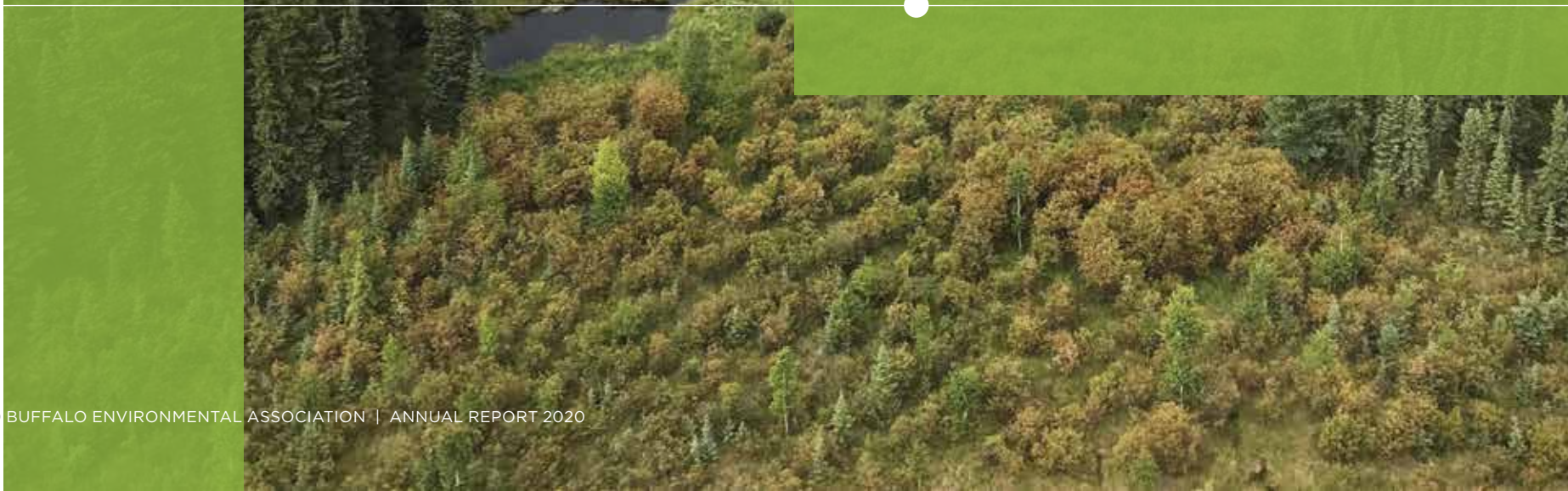
For more information visit the WBEA Annual Trends website at **annualtrends.wbea.org**

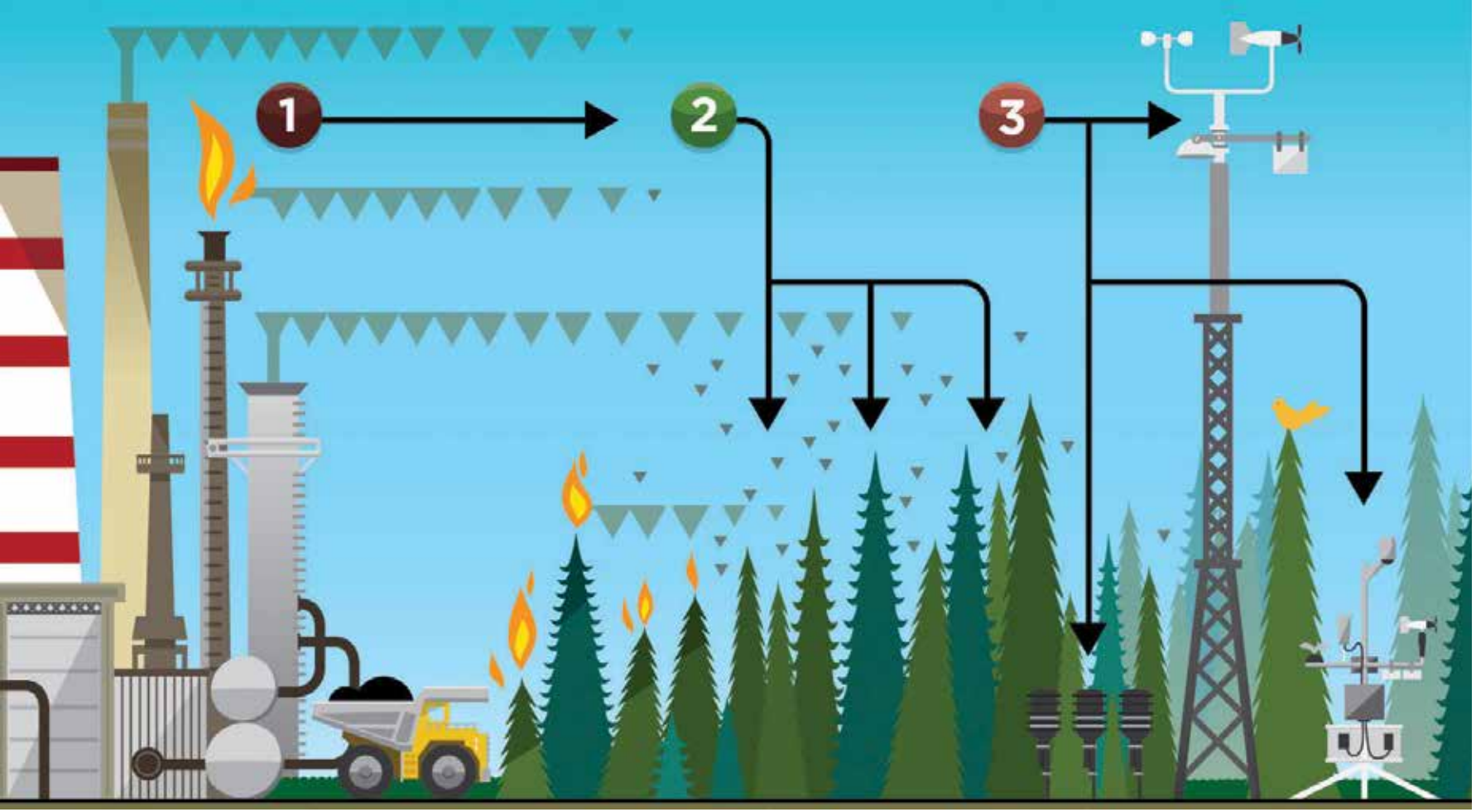


Deposition Monitoring

The Deposition Monitoring program, also referred to as the Terrestrial Environmental Effects Monitoring (TEEM) program, was established to address community, industry, and government concerns about impacts to regional forests resulting from industrial development.

The objective of the program is to determine cause-effect relationships between air pollutants and forest ecosystem health in the region. To meet this objective the WBEA operates both a long-term Forest Health Monitoring Program and an Atmospheric Pollutant Deposition Monitoring Program which monitor stressors (acidification/ eutrophication) along the pathway (atmospheric transport) from source (industrial emissions) to the receiving environment (jack pine forests). This integrated program, as depicted in the image on the following page, allows for the determination of cause-effect relationships between air pollution and forest health.





1

Source

Pollution is emitted into the air from a variety of sources

2

Deposit

The pollution may be deposited onto the surrounding forest

3

Measure

The WBEA collects samples and information to measure the effects of pollution on the enviroment

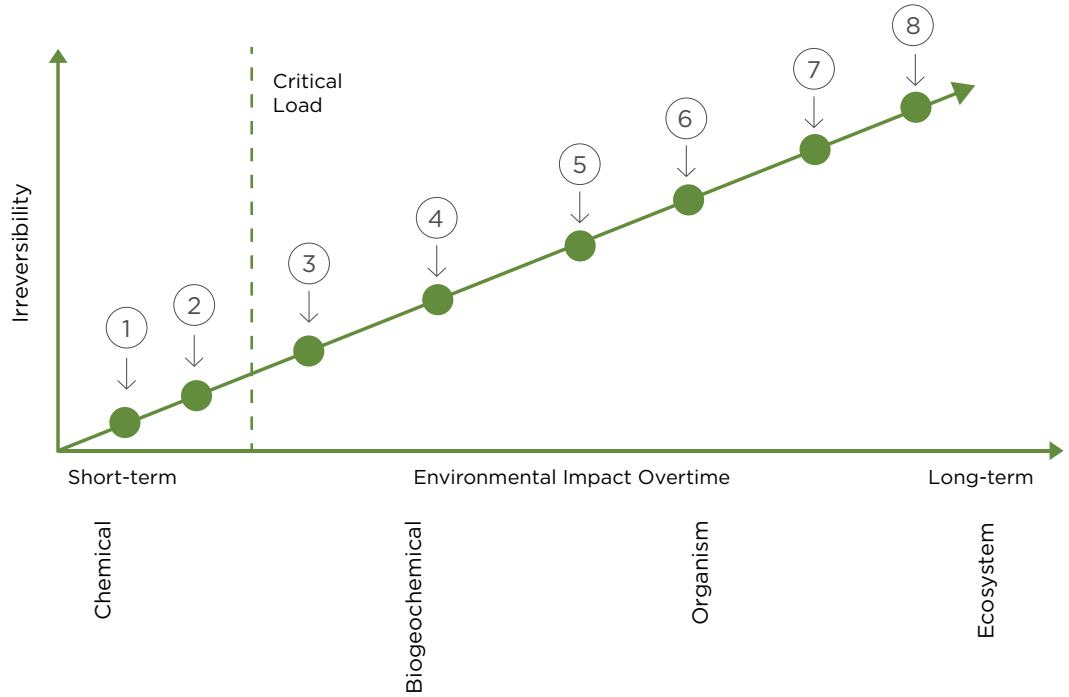
Forest Health Monitoring

The Forest Health Monitoring program monitors jack pine forest sites to assess whether there are changes to biological, physical, and chemical indicators through a sampling campaign of soils and vegetation every 6-years, as well as lichen sampling at varying intervals. During initial program development, the upland jack pine (Pinus banksiana) ecosystem was identified as the most sensitive receptor to acidification due to their characteristically dry, nutrient poor soils with limited buffering capacity. In these ecosystems, the effects of acid deposition are expected to be observed in a cascading manner from soils to vegetation, first impacting individual organisms, then the stand, and onward to landscape level impacts. This concept is depicted in the following graph.

In 2019, the WBEA completed the analysis of historical data collected through the Forest Health and Deposition monitoring programs, in combination with data collected by the Ambient Air Monitoring program, and published nine open access manuscripts in a Virtual Special Issue of the journal Science of the Total Environment.

The special issue, entitled “Relationships Between Air Pollutants and Forest Ecosystem Health in the Oil Sands Region, AB, Canada” is available online, **click here**. To access key messages from the manuscripts or view the June 18, 2019 public presentation, **click here**.

In 2020, an additional report was finalized using data derived from the WBEA’s fourth intensive forest health sampling campaign in 2018, which included soil and needle sample collection, tree core collection, and documentation of various jack pine and forest stand characteristics. The report, which is intended to be published, supplemented the 2019 data analysis, presenting findings that continued to broaden the understanding of impacts to regional forests resulting from industrial development.



1. Emissions (stack, fleet)
2. Deposition (wet, dry) below CL & no effect
3. Altered jack pine soil chemestry (BC:AI, BS% C:N, nutrients)
4. Altered jack pine growth
5. Altered jack pine understory community composition
6. Altered aspen soil chemistry (BC:AI, BS% C:N, nutrients)
7. Altered aspen growth
8. Altered aspen understory community composition

Critical Load = the highest load that will not cause chemical changes leading to long-term harmful effects on the most sensitive ecological systems.

Atmospheric Pollutant Deposition Monitoring

To better understand the nature and quantity of the compounds deposited on the regional landscape, and to inform the Forest Health Monitoring program, the WBEA operates a network of air quality monitoring (using passive and active air quality samplers) and deposition monitoring sites (using ion exchange resins) in remote locations across the RMWB for evaluation of a broad set of compounds (particulate matter, organic compounds, metals). The WBEA's deposition monitoring data is available to everyone at **wbea.org/network-and-data/integrated-data**, and is searchable using the **WBEA's Time-Integrated Data Search tool**. For a list of the parameters measured at deposition monitoring sites, see pages 73-76.

Passive Air Sampling – Passive Samplers

Passive air sampling, specifically using passive samplers, is a cost-effective method for coverage of a broad spatial range, including remote locations, because they have no moving parts and require no power. The WBEA uses passive samplers to monitor sulphur dioxide (SO_2), nitrogen dioxide (NO_2), nitric acid (HNO_3), ammonia (NH_3), and ozone (O_3) across the Athabasca Oil Sands Region and this data, along with meteorological data, is used to model deposition trends. Data collected in 2020 is presented on the following concentration maps, the bigger the circle the larger the concentration.

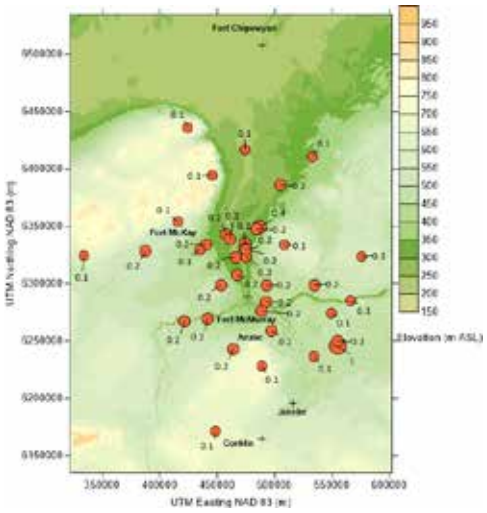
The list of parameters measured at deposition monitoring sites using passive air sampling is included in the table to the right.

Site Name	HNO_3	NH_3	NO_2	SO_2	O_3
1001	✓	✓	✓	✓	✓
1002	✓	✓	✓	✓	✓
1004	✓	✓	✓	✓	✓
1007	✓	✓	✓	✓	✓
1008	✓	✓	✓	✓	✓
1023	✓	✓	✓	✓	✓
1027	✓	✓	✓	✓	✓
1947	✓	✓	✓	✓	✓
1991	✓	✓	✓	✓	✓
1992	✓	✓	✓	✓	✓
1993	✓	✓	✓	✓	✓
1994	✓	✓	✓	✓	✓
1995	✓	✓	✓	✓	✓
1996	✓	✓	✓	✓	✓
1997	✓	✓	✓	✓	✓
1998	✓	✓	✓	✓	✓
2001	✓	✓	✓	✓	✓
2005	✓	✓	✓	✓	✓
2010	✓	✓	✓	✓	✓
2013	✓	✓	✓	✓	✓

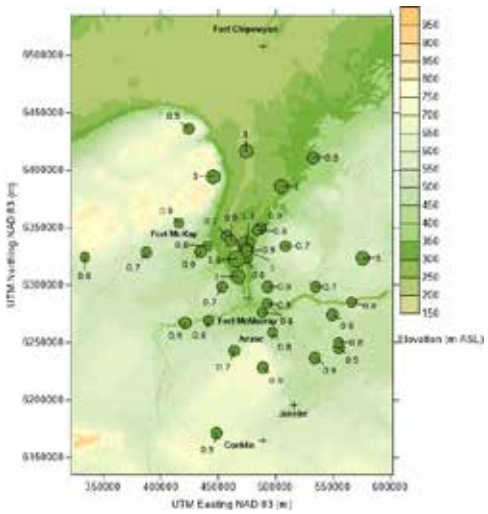
Site Name	HNO_3	NH_3	NO_2	SO_2	O_3
2054	✓	✓	✓	✓	✓
3009	✓	✓	✓	✓	✓
3011	✓	✓	✓	✓	✓
3016	✓	✓	✓	✓	✓
3083	✓	✓	✓	✓	✓
3086	✓	✓	✓	✓	✓
3088	✓	✓	✓	✓	✓
3092	✓	✓	✓	✓	✓
3096	✓	✓	✓	✓	✓
3212	✓	✓	✓	✓	✓
4000	✓	✓	✓	✓	✓
4001	✓	✓	✓	✓	✓
4002	✓	✓	✓	✓	✓
4003	✓	✓	✓	✓	✓
4004	✓	✓	✓	✓	✓
4014	✓	✓	✓	✓	✓
ATHV	✓	✓	✓	✓	✓
BGFM	✓	✓	✓	✓	✓
MILD	✓	✓	✓	✓	✓

2020 Passive Concentration Maps

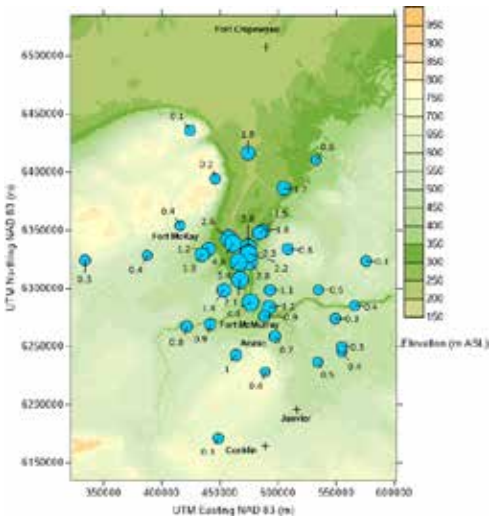
ANNUAL SPATIAL PLOT OF HNO_3 CONCENTRATIONS



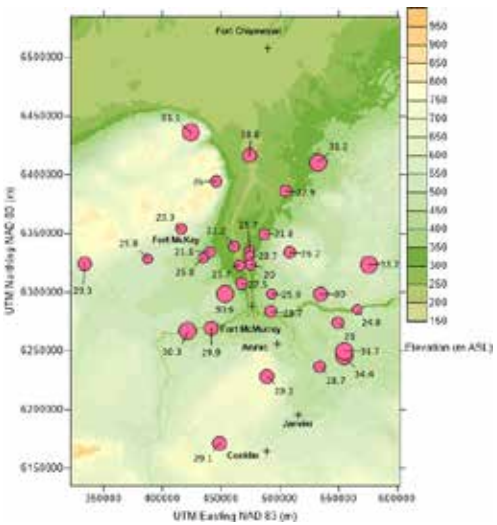
ANNUAL SPATIAL PLOT OF NH_3 CONCENTRATIONS



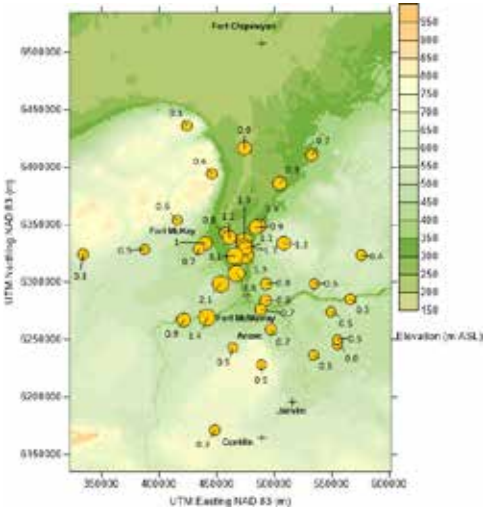
ANNUAL SPATIAL PLOT OF NO_2 CONCENTRATIONS



ANNUAL SPATIAL PLOT OF O_3 CONCENTRATIONS



ANNUAL SPATIAL PLOT OF SO_2 CONCENTRATIONS



Active Air Sampling – Denuders and Remote Ozone Analyzers

Active air sampling uses a pump to provide a known volume of air to a continuous analyzer or sample media. For this reason, in addition to a low detection limit, active air sampling provides higher quality data than passive air sampling, however, because they require power, they can be more costly and less versatile. Ammonia (NH_3), nitric acid (HNO_3), and particulate matter ($PM_{2.5}$) are monitored year-round by active sampling using a solar-powered denuder system. Ground-level ozone (O_3) has been monitored seasonally with solar-powered continuous analyzers; however, the O_3 program was paused for 2020. The WBEA's active air sampling data is available to everyone at wbea.org/network-and-data/integrated-data.

	Low-Power Denuder							Portable Ozone Monitor
Site Name	HNO_3	NH_3	$PM_{2.5}$	Trace Elements	NH_4^+	NO_3^-	SO_4^{2-}	O_3
1004	✓	✓	✓	✓	✓	✓	✓	
1007	✓	✓	✓	✓	✓	✓	✓	
2001	✓	✓	✓	✓	✓	✓	✓	
2013	✓	✓	✓	✓	✓	✓	✓	
3502								✓
3501								✓
3513								✓

Passive Deposition Sampling - Ion Exchange Resin

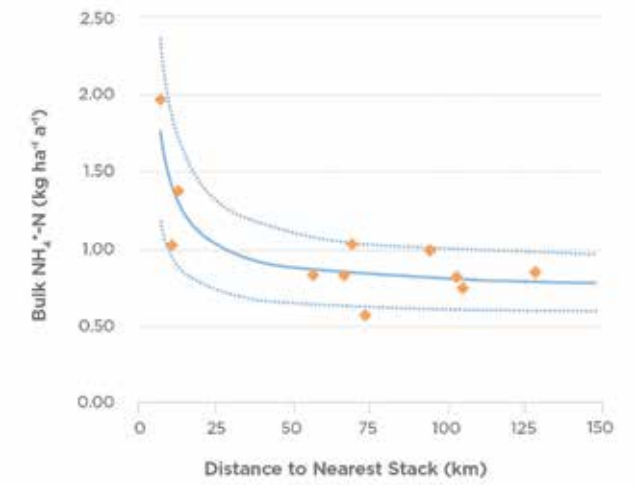
Ion exchange resin technology (IER) are a passive sampling technology, comprised of a column of resin beads that capture charged chemical species (ions) in precipitation water. IERs are critical to the deposition program as they provide actual measurements of deposition which are required to validate the critical loads mapping and modeling exercises. Using the WBEA's most recent quality assured IER data, the following graphs depict the deposition of ammonium (NH_4^+), nitrate (NO_3^-), sulphate (SO_4^{2-}), and calcium (Ca^+) in relation to distance from the nearest emission source (stack) and indicates that deposition is higher close to emission sources.

Site Name	NH_4	NO_3	PO_4	SO_4	Base Cation
2054	✓	✓	✓	✓	✓
2513	✓	✓	✓	✓	✓
3083	✓	✓	✓	✓	
3092	✓	✓	✓	✓	
3102	✓	✓	✓	✓	✓
3111	✓	✓	✓	✓	
3116	✓	✓	✓	✓	✓
3153	✓	✓	✓	✓	✓
3172	✓	✓	✓	✓	✓
3207	✓	✓	✓	✓	✓
3210	✓	✓	✓	✓	✓
3211	✓	✓	✓	✓	✓
3212	✓	✓	✓	✓	
3308	✓	✓	✓	✓	✓
3309	✓	✓	✓	✓	
3311	✓	✓	✓	✓	
3398	✓	✓	✓	✓	
3550	✓	✓	✓	✓	
ANZC	✓	✓	✓	✓	
BGFM	✓	✓	✓	✓	
1001	✓	✓	✓	✓	
1004	✓	✓	✓	✓	✓
1006	✓	✓	✓	✓	

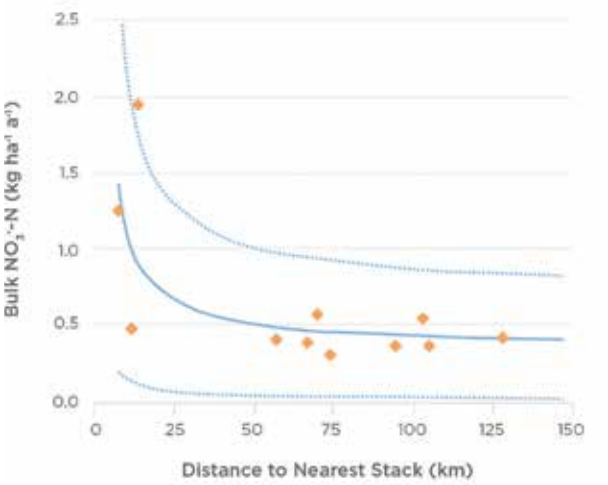
Site Name	NH_4	NO_3	PO_4	SO_4	Base Cation
2001	✓	✓	✓	✓	
2010	✓	✓	✓	✓	
2012	✓	✓	✓	✓	
2013	✓	✓	✓	✓	
2050	✓	✓	✓	✓	
2554	✓	✓	✓	✓	
3003	✓	✓	✓	✓	
3008	✓	✓	✓	✓	
3009	✓	✓	✓	✓	
3011	✓	✓	✓	✓	
3052	✓	✓	✓	✓	
3072	✓	✓	✓	✓	
3098	✓	✓	✓	✓	
3107	✓	✓	✓	✓	
3202	✓	✓	✓	✓	
3253	✓	✓	✓	✓	
4000	✓	✓	✓	✓	
4001	✓	✓	✓	✓	
4002	✓	✓	✓	✓	
4003	✓	✓	✓	✓	
4004	✓	✓	✓	✓	
4014	✓	✓	✓	✓	

Deposition Gradients

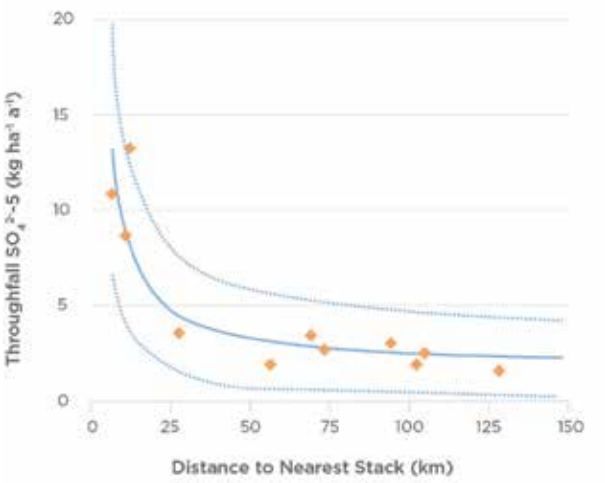
Bulk ammonium, as nitrogen



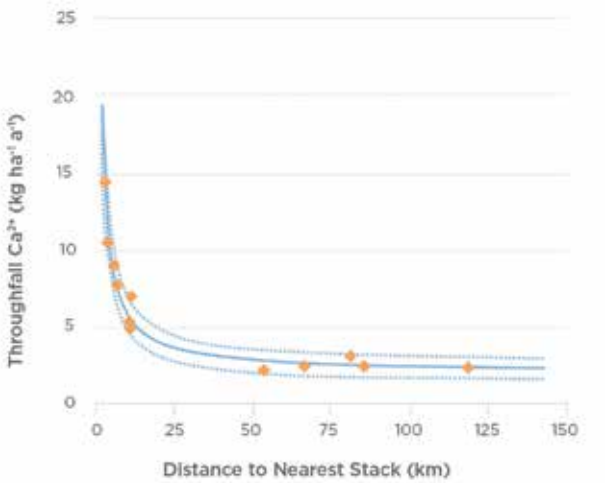
Bulk nitrate, as nitrogen

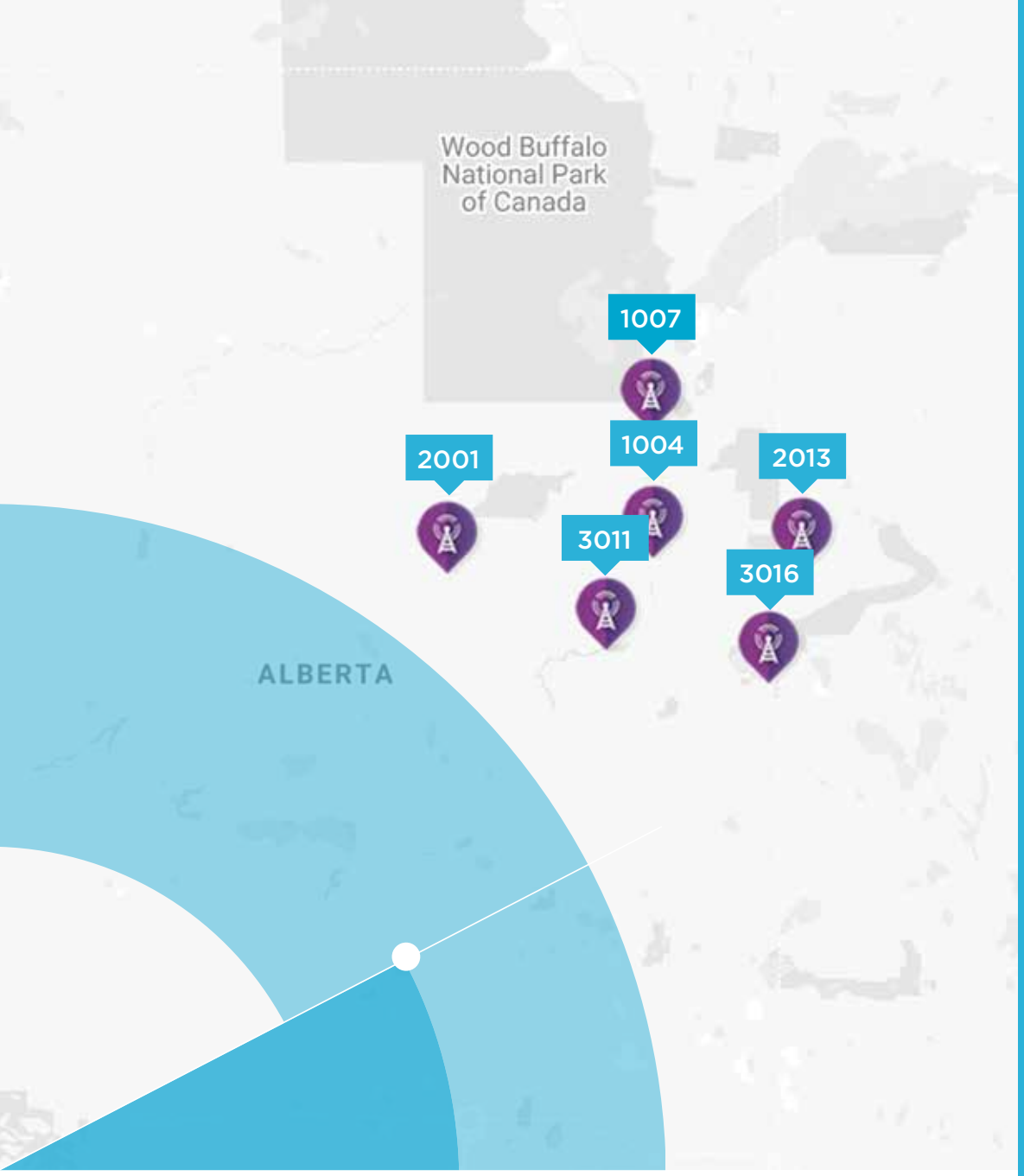


Throughfall sulphate, as sulphur



Throughfall calcium





Instrumental Regional Meteorological Network

The WBEA's regional meteorological network provides key data for calculating deposition rates and evaluating ecological data. The network is comprised of six 30-meter instrumented towers ("met towers") and six instrumented tripods ("met tripods") that provide continuous, hourly data on climatic conditions throughout the Wood Buffalo region. Each met tower is co-located with a Forest Health Monitoring (FHM) site and monitors air temperature, relative humidity, wind speed, wind direction, and solar radiation at four levels within and above the jack pine canopy, as well as temperature and volumetric water content within forest soil. Each met tripod is positioned in natural peatland clearing adjacent to a FHM site and monitors air temperature, relative humidity, wind speed, wind direction, and solar radiation.

Data collected at the met towers can be viewed at **https://wbea.org/historical-monitoring-data/**

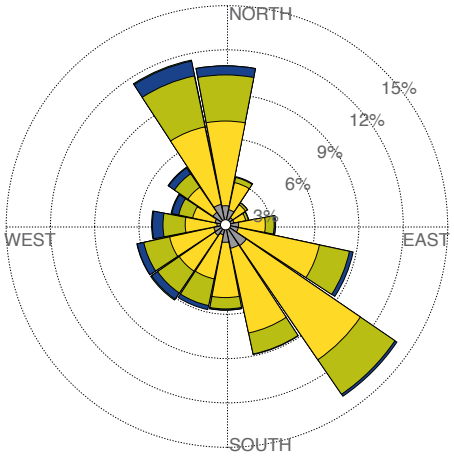
The map shows where each of the six 30-meter meteorological towers are located within the WBEA network. The wind data collected from these towers, measured above the tree canopy, are used to characterize wind flow in a wider geographical area, calculate emission deposition, and evaluate ecological data. The corresponding wind roses for each tower are on the following page.

2020 Meteorological Tower Wind Roses

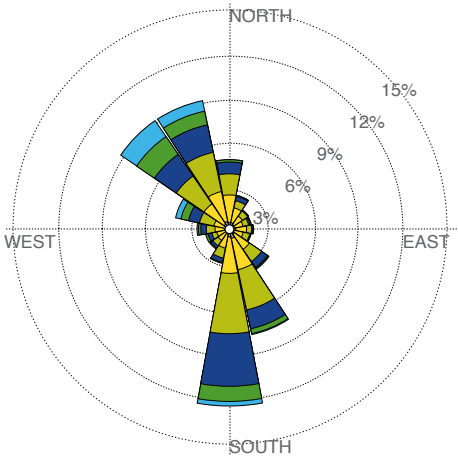
WIND SPEED (km/h)

0.5 - 5 | 5 - 10 | 10 - 15 | 15 - 20 | 20 - 25 | > = 25

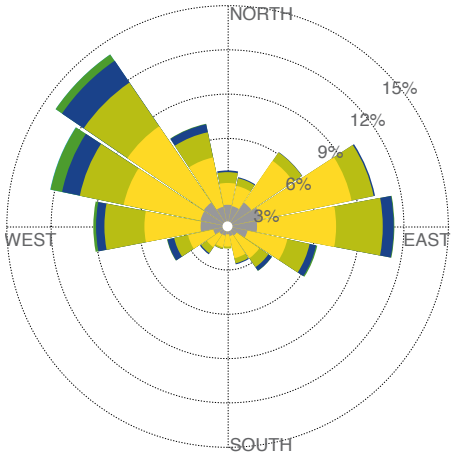
Meteorological Tower 1004



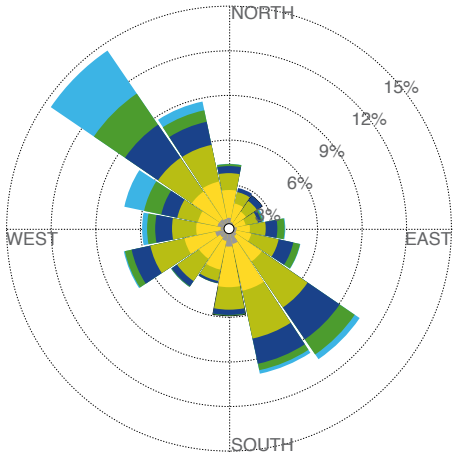
Meteorological Tower 1007



Meteorological Tower 2001



Meteorological Tower 2013



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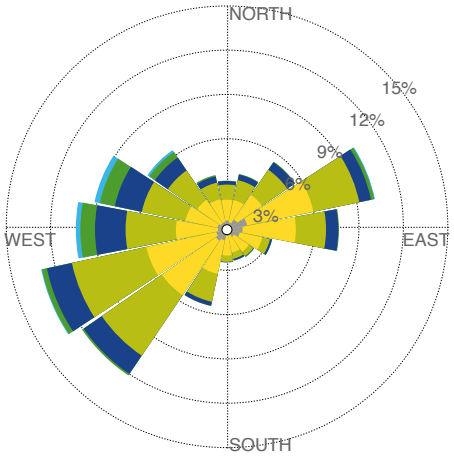

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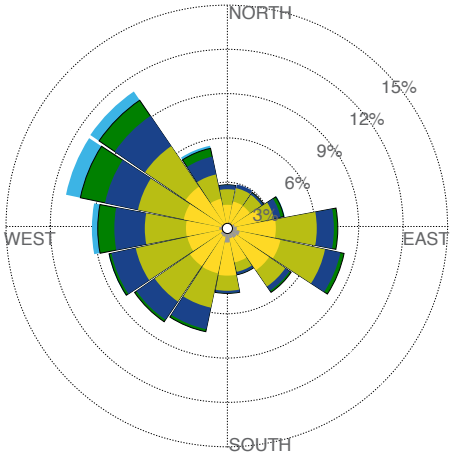


Traditional Knowledge

The WBEA has fostered collaborative relationships with Indigenous communities in the Wood Buffalo region since its formation. To coordinate these partnerships, the WBEA established a Traditional Knowledge Committee (TKC) to help develop and oversee long-term, traditional knowledge based, community monitoring programs; the recent focus has been on the Community-Led Berry Contamination Study.

The Community Led Berry Contamination Study is a multi-year community-based monitoring project that builds upon work initiated by Fort McKay First Nation, with support from the Wood Buffalo Environmental Association, since 2010. The project has grown to include Conklin Métis, Fort McKay Métis, Fort McMurray Métis, and Fort McMurray First Nation 468.

The study objective is to monitor berries from culturally significant patches to inform the community questions, including "are the berries safe to eat?" and is driven by the concerns of the participating community members about changes to berry quality and health due to oil sands-related development. The cultural identity of Indigenous peoples is intertwined with their food sovereignty and food security, therefore, the continued access to cultural keystone species of berries is paramount for community health and well-being.

Monitoring is achieved when participants visit each berry patch to spend time on the land, share lived experience and knowledge, observe environmental condition, harvest berries for laboratory analysis of health compounds and contaminants, and in previous years, collect soil samples for laboratory analysis of contaminants.

The study has produced qualitative and quantitative data for each community that has provided meaningful insight on their berry condition. While the WBEA provides support to the communities, the WBEA does not share the data on the communities' behalf; however, there is some indication from this project that levels of contaminants of concern are elevated in berries from patches considered unclean by Indigenous members, which are located closer to oil sands development, versus berries from patches considered clean or sacred by Indigenous members, which are located farther away from development.

Going forward, the study will continue to use best practice methodologies that appropriately braid Indigenous and Western knowledge systems to build trusted relationships between participating Indigenous communities, academic researchers, and provincial and federal government scientists.

Odour Monitoring

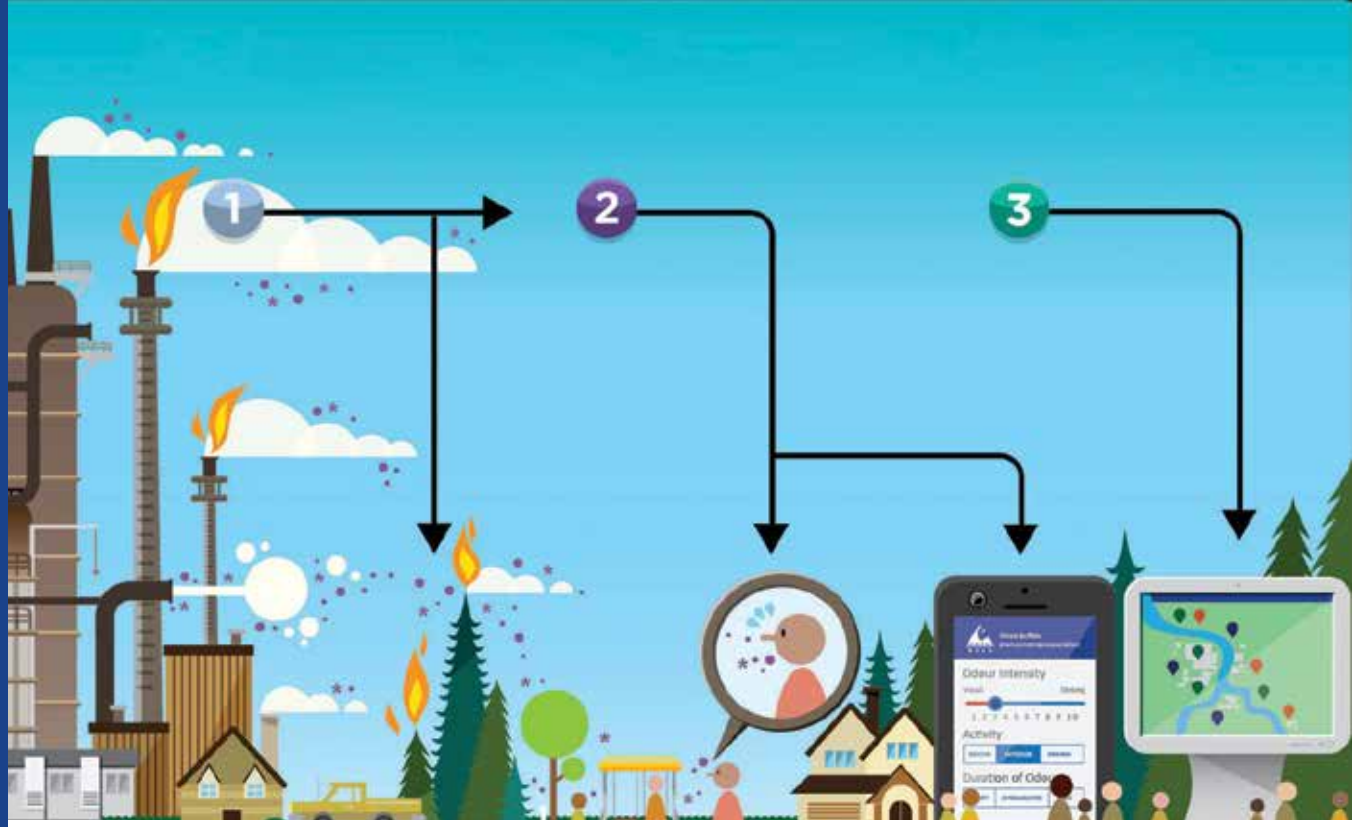
Community Odour Monitoring Program

The WBEA created the Community Odour Monitoring Program (COMP) app as an opportunity for people to provide information about the odours they experience throughout the RMWB, as outlined in the following image. Currently, analyzers can measure the concentration of specific pollutants or groups of pollutants, but they cannot measure if an odour is present or how strong the odour would be. Therefore, the app allows the WBEA to compare the information people provide about odours to the ambient air data collected at WBEA air monitoring stations. The intent is to find whether there are trends in the ambient data when odours are present—such as elevated concentrations of odour-causing compounds. Observations are displayed in near-real time on the **COMP website**.

From the COMP app's release in September 2017 until December 2020, there have been a total of 1020 odour observations reported in the RMWB using the app. In 2017-2018 there were 376 odour observations, while in 2019 and 2020, there were 415 and 229 odour observation submissions, respectively. In 2020, the WBEA received odour observations from 55 unique users, and in 2018 and 2019 received observations from 95 unique users. The dominant odour type for 2020 and 2019 was 'Ammonia/Cat Urine', whereas for 2018 was 'Asphalt/Tar'. The fraction of odour observations characterized as being of high intensity*, have been steadily increasing over the past three years.

For more information about the COMP, the 2020 COMP Annual Report, as well as links to download the app on iOS and Android devices visit **comp.wbea.org**.

**Scale of 1 to 10, with 10 being the highest intensity*



1

Source

Pollution is emitted into the air from a variety of sources

2

Smell

The pollution may cause odours - anyone who experiences an odour in the RMWB can submit their observations via the WBEA's COMP app

3

Share

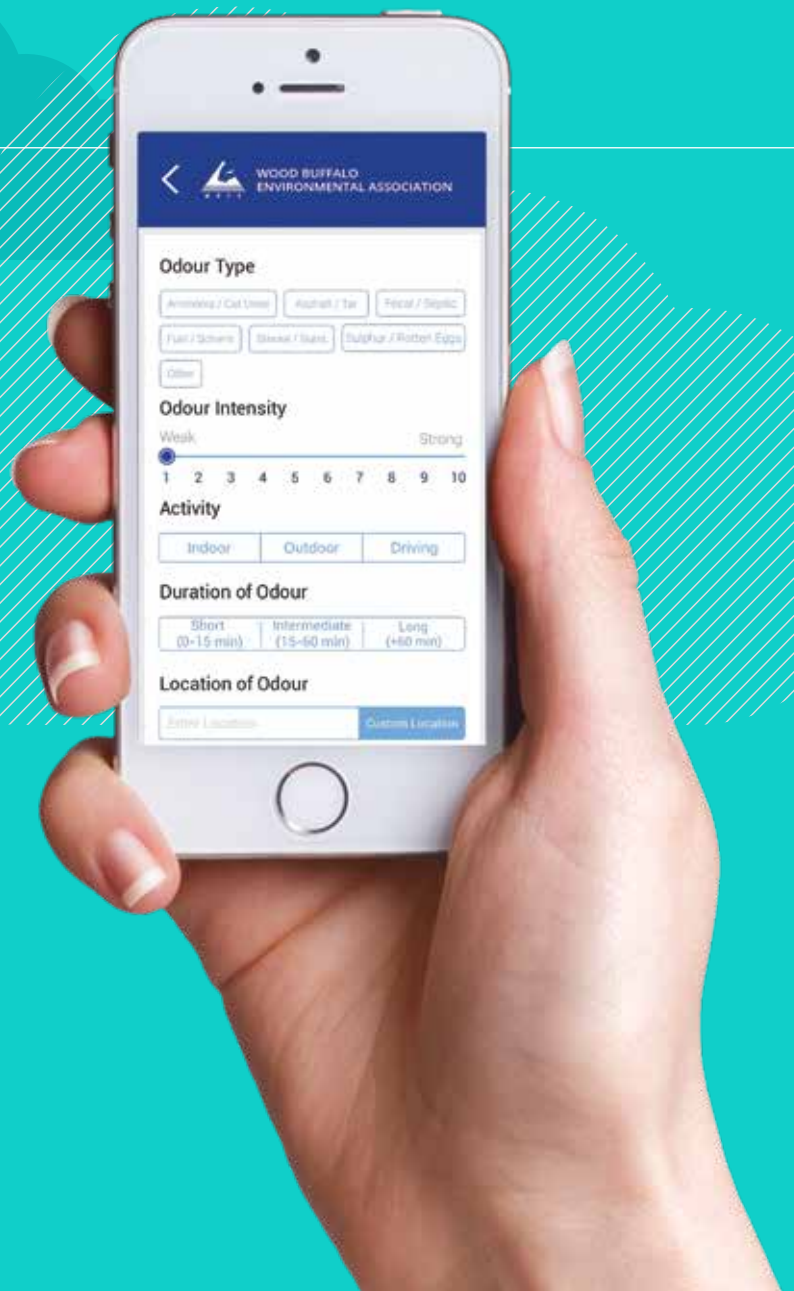
Users can learn about odours and view all observations submitted at **comp.wbea.org**

COMP Needs You!

The Community Odour Monitoring Program is still going on. To participate and provide information on the odours you experience in the Regional Municipality of Wood Buffalo:

1. Download the COMP App for **iPhone** or for **Android** devices
2. When you smell an odour in the air, submit an observation in the App

The information collected is anonymous and will be used for research purposes only.



WBEA 2020 Membership

INDIGENOUS MEMBERS

Athabasca Chipewyan First Nation
Chipewyan Prairie Dene First Nation
Christina River Dene Nation Council
Conklin Resource Development Advisory Committee
Fort McKay First Nation
Fort McKay Métis Nation
Fort McMurray #468 First Nation
Lakeland Métis Community Association
McMurray Métis
Mikisew Cree First Nation

NON-GOVERNMENT ORGANIZATION MEMBERS

Keyano College
Pembina Institute

GOVERNMENT MEMBERS

Alberta Energy Regulator
Alberta Environment and Parks
Alberta Health
Alberta Health Services
Environment and Climate Change Canada
Health Canada
Parks Canada
Regional Municipality of Wood Buffalo

INDUSTRY MEMBERS

Athabasca Oil Corporation
Canadian Natural
Cenovus Energy Inc.
CNOOC International
Connacher Oil and Gas Ltd.
ConocoPhillips Canada
Hammerstone Infrastructure Materials Ltd.
H.J. Baker Sulphur Canada ULC
Husky Oil Operations Ltd.
Imperial Oil Limited
Inter Pipeline Limited
MEG Energy Corp.
Parsons Creek Aggregates
PetroChina Canada Ltd.
Suncor Energy Inc.
Sunshine Oilsands Ltd.
Surmont Energy
Syncrude Canada Ltd.
Teck Resources Ltd.
Titan Tire Reclamation Corporation

WOOD BUFFALO
ENVIRONMENTAL ASSOCIATION

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