Alberta Airsheds
2020 Air Quality Report

AAC
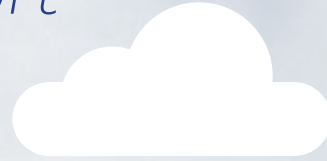
ALBERTA AIRSHEDS
COUNCIL

Contents

Clean Air For Albertans

Air quality has significant impacts on human health and the environment.

Alberta's Airshed organizations are key strategic and place-based ambient air monitoring organizations, implementing reliable and independent air quality monitoring for the past 20 years. Airsheds also undertake significant on-the-ground community outreach and air literacy projects in communities across the province.

As part of this outreach, the Alberta Airsheds Council has prepared this 2020 Alberta Airsheds Air Quality Report to provide a summary of the air quality data that is monitored and collected in our province by Alberta's Airsheds. This information is important to share with Albertans because air quality affects our health and our environment.

Understanding air quality and its impacts helps Albertans make educated choices related to their health.

WHAT IS AN AIRSHED?
Alberta's Airsheds are organizations that operate regional networks responsible for monitoring, analyzing, and educating on outdoor air quality. As an important part of Alberta's Clean Air Strategy, 10 Airsheds were formed between 1996 and 2017. *Refer to the map on page 5 to see the boundaries of the 10 Alberta Airsheds.*

WHAT IS AIR QUALITY?
Air quality is a measure of how clean, or polluted, the air is. Monitoring air quality is important because polluted air can be bad for our health and the environment.[1]

Within the 10 Alberta Airsheds there are 87 continuous monitoring stations (see map, page 5) and hundreds of other monitoring sites that measure a variety of air quality parameters using an assortment of monitoring technologies.

AIR QUALITY PARAMETERS MONITORED BY AIRSHEDS

- ammonia (NH_3)
- benzene, toluene, ethylbenzene, xylene (BTEX)
- carbon dioxide (CO_2)
- carbon monoxide (CO)
- coarse particulate matter (PM_{10})
- fine particulate matter $(PM_{2.5})$
- hydrogen sulphide (H_2S)
- methane/non-methane hydrocarbons $(CH_4/NMHC)$
- nitric oxide (NO)

- nitrogen dioxide (NO_2)
- nitrogen oxides (NO_X)
- ozone (O_3)
- polycyclic aromatic hydrocarbons (PAH)
- sulphur dioxide (SO_2)
- total hydrocarbons (THC)
- total reduced sulfur (TRS)
- total suspended particulate (TSP)
- volatile organic compounds (VOCs), ethylene, styrene

- meteorological data, including:
  - air temperature
  - barometric pressure
  - precipitation
  - relative humidity
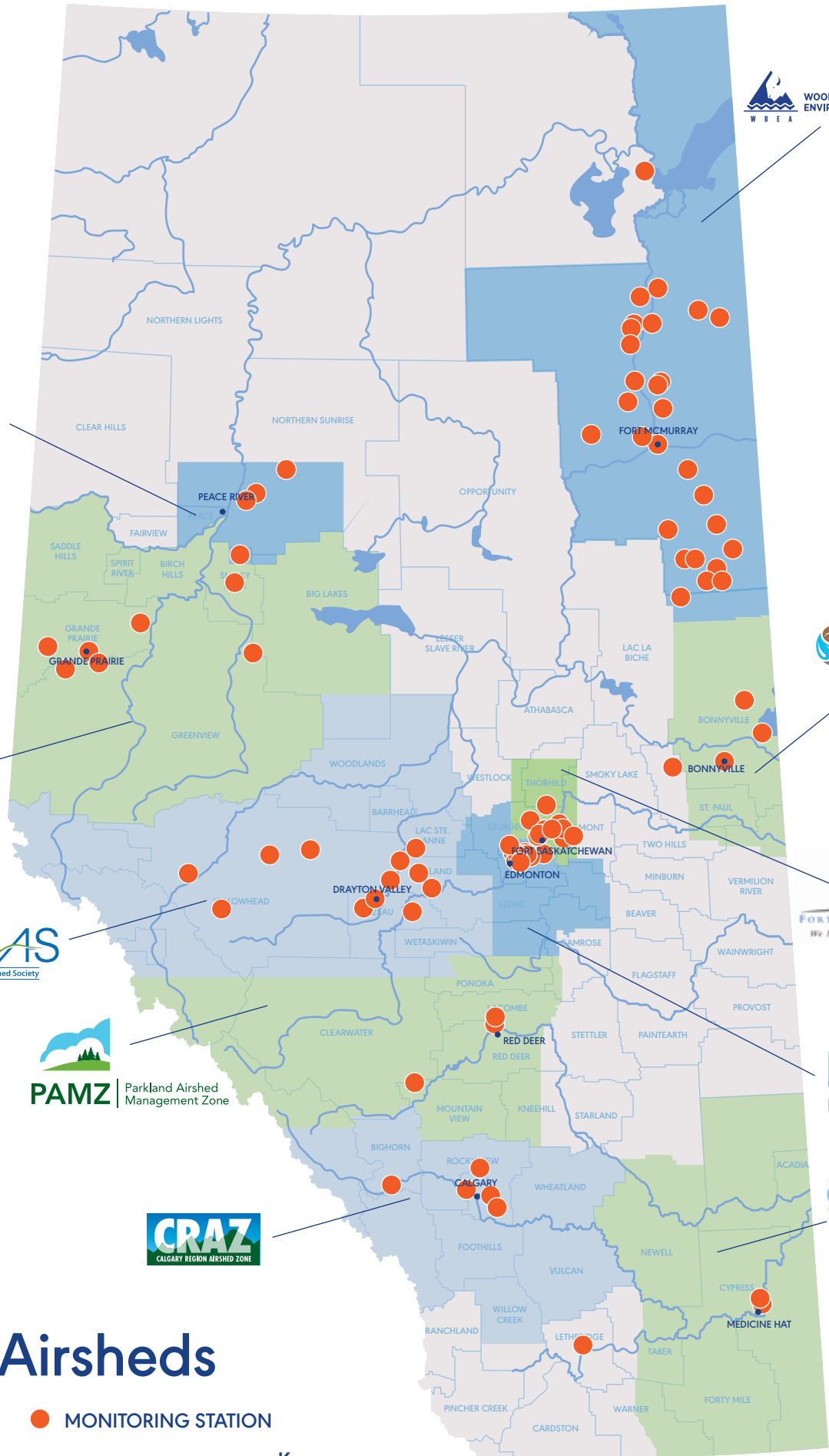 - solar radiation
  - wind speed and direction

MONITORING TECHNOLOGIES USED THROUGHOUT THE PROVINCE

Continuous - Near instantaneous measurements of pollutants; many stations provide data for calculating the Air Quality Health Index (AQHI). Most continuous monitoring stations are located permanently at their respective sites; a number of Airsheds also employ portable continuous monitoring stations that monitor air quality at temporary sites.

Passive - These monitors do not require power and consist of a series of filters and chemicals that air passes through and reacts with. They detect low sample amounts and provide monthly average measurements of specific air quality parameters.

Time-Integrated - Integrated sampling methods, including canisters, specialized instruments and analyzers are used for measurement of specific air quality parameters over selected time periods of minutes to hours to days.

Micro-Sensor - Community-based sensors can be used to provide an indication of real-time air quality at the neighbourhood level. Handheld or wearable air quality sensors can be utilized by the public as part of a citizen science or educational program to understand air quality.

Alberta Airsheds

(July 2020)

● MONITORING STATION

N

WOOD BUFFALO
ENVIRONMENTAL ASSOCIATION
WBEA

pramp
PEACE RIVER AREA MONITORING PROGRAM

LICA
ENVIRONMENTAL STEWARDS

PAZA
Peace Airshed Zone Association

FORT AIR PARTNERSHIP
We Monitor the Air You Breathe

WCAS
West Central Airshed Society

Alberta Capital Airshed

PAMZ | Parkland Airshed Management Zone

CRAZ
CALGARY REGION AIRSHED ZONE

palliser airshed society

Km
0   50 100   200   300   400

5

Across Alberta, Airsheds monitor a variety of pollutants and meteorological conditions, including the four common pollutants of nitrogen dioxide NO_2, sulphur dioxide SO_2, fine particulate matter $PM_{2.5}$ and ozone O_3.

These pollutants are managed in Canada through the Canadian Ambient Air Quality Standards (CAAQS) as they can lead to smog, acid rain and health issues. Sources of these pollutants are many and include human-made sources such as combustion from large industries, vehicles, and individual homes, as well as natural sources such as wildfires. **This report will focus on the 2020 annual data collected for these four common pollutants across Alberta.**

FEDERAL AND PROVINCIAL GUIDELINES AND STANDARDS

In order to understand and protect air quality, ambient levels of pollutants are compared to guidelines and standards. In Alberta, this involves the Alberta Ambient Air Quality Objectives (AAAQO), Alberta Ambient Air Quality Guidelines (AAAQG) and the national Air Quality Management System (AQMS), which includes Canadian Ambient Air Quality Standards (CAAQS) and regional action plan management levels for each air zone. There are 1-hour, 8-hour, 24-hour, 30-day and annual averages for AAAQOs and AAAQGs. More information on the guidelines and standards can be found at **AlbertaAirshedsCouncil.ca**. This report highlights annual data compiled from 1-hour averages to provide context for the measured concentrations, which is presented as annual averages for each pollutant.

HOW TO REVIEW 2020 RESULTS

The results of 2020 monitoring of common air pollutants (NO_2, SO_2, $PM_{2.5}$ and O_3) are presented in the following sections. Data are presented using graphs displaying **annual averages** (solid coloured bar) and a 95th percentile marker (black line). The black lines, also known as "whiskers", show readings on the high end of the data collected at the monitoring stations, which helps to highlight the 95th percentile data. The highest five percent has not been reported here as it may contain "outliers" (observations that are distant from the rest of the data that might be caused by extreme events from upsets to natural conditions such as wildfires).

Where shown, red lines on the graphs indicate the relevant threshold (acceptable provincial or federal levels) for the guideline or standard for the air contaminant.

Alberta's Air Monitoring Directive[2], requires a minimum operating time of 75% or more to calculate annual averages for air pollutants in a given location for a given year.

2020 AIR QUALITY MONITORING PROFILES

Overall, the trends of criteria pollutants in monitored areas within Alberta demonstrate that **air quality is either improving or has remained the same** over the last decade.

A temperature inversion occurs when cold air becomes trapped under a layer of warm air that acts like a lid. During temperature inversions, pollutants are trapped at ground level where they can cause harm. The pollutants in the cooler, lower layer cannot be dispersed and the pollutants stay concentrated at ground level.[3] In Alberta, these most frequently occur in the winter months and lead to the formation of wintertime smog.
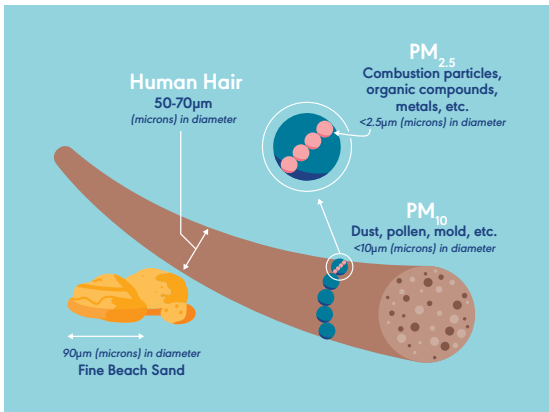
Airsheds strive to achieve 100% operating time; however, station relocations, new equipment installations, or unexpected power outages are just a few factors that affect annual operating time.
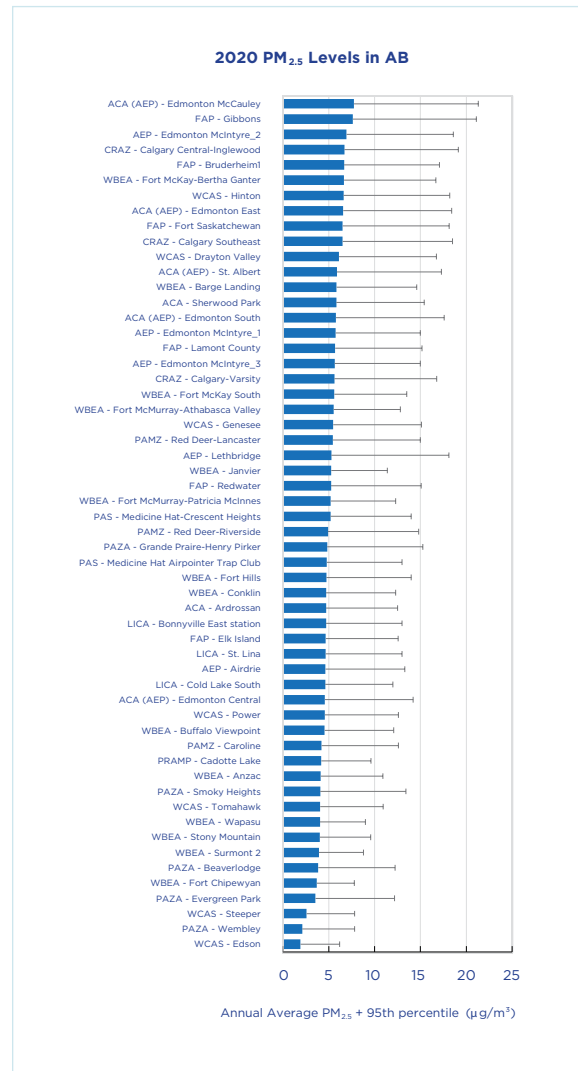
PM~2.5~

FINE PARTICULATE MATTER

Fine particulate matter is less than 2.5 micrometres in diameter. In comparison, a human hair is about 70 micrometres in diameter.

Fine Particulate Matter (PM$_{2.5}$)

These fine particles are small enough to get into the lungs and can be a human health concern. PM$_{2.5}$ may form in the atmosphere or be emitted by any combustion source including automobiles, industry and wood burning. Smoke from forest fires and other types of biomass burning can also be a major source.

PM$_{2.5}$ has been linked to many health issues. Long-term exposure has been associated with increased lung and heart problems and even premature death.[4]


2020 PM$_{2.5}$ Levels in AB

Annual Average PM$_{2.5}$ + 95th percentile (µg/m³)

PM$_{2.5}$

2020 ALBERTA DATA

Of the 67 stations monitoring and reporting PM$_{2.5}$ data in 2020, 42 stations collected this data at least 75% of the total annual operating time.

Results from these stations show an annual average range of PM$_{2.5}$ levels of 1.9µg/m³ to 7.8µg/m³ in 2020. Based on these monitoring results, there were a total of 66 readings above the 1-hour (>80 µg/m³) AAAQG and 78 readings above the 24-hour (>29 µg/m³) AAAQO[5] for a total of 144 exceedances (1hr+24 hr). In comparison, there were 1,298 exceedances (1hr+24hr) in 2019. Of important note, there were fewer wildfires experienced in 2020 than in 2019.

AVERAGE PM$_{2.5}$ PROFILE IN 2020

PM$_{2.5}$ in µg/m³
○ 0 - 2
● 2 - 4
● 4 - 6
● 6 - 8
● 8 - 10

0   150   300 km
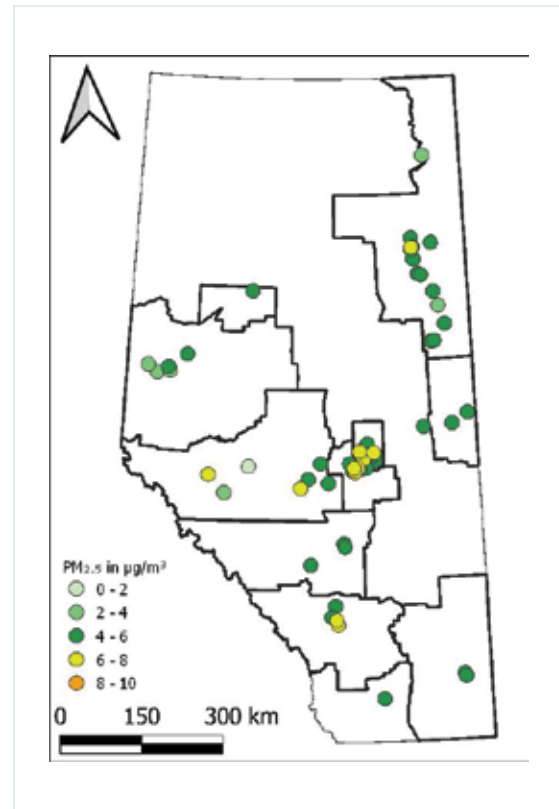
Issues of concern to Albertans include health risks related to wildfire smoke and the anticipated increase of grass/forest and seasonal fires. Most extreme PM$_{2.5}$ exceedances are attributed to wildfires with other exceedances related to wintertime temperature inversions, localized activities, vehicle emissions and smog.

"As Alberta's leaders in air monitoring and reporting, Airsheds collaborate on innovative outreach initiatives and technical expertise through the Alberta Airsheds Council."   – AAC Co-Chairs Karla Reesor & Nadine Blaney

NO$_2$

NITROGEN DIOXIDE (NO$_2$)

Nitrogen dioxide is a reddish-brown gas with a pungent irritating odour. It has been linked to respiratory disease and contributes to acid rain. NO$_2$ plays a major role in atmospheric photochemical reactions and ground level ozone formation and destruction.

The main contributors of the total NO$_2$ emissions generated in the province are transportation, oil, gas and power generation sources[6]; however, any combustion sources will emit NO$_2$ (e.g., home and commercial heating). Some natural sources include forest fires, lightning and biological decay.

Short-term exposure to NO$_2$ can cause airway inflammation. Individuals with pre-existing conditions such as asthma, chronic obstructive pulmonary disorder (COPD) or chronic bronchitis can be more sensitive to exposure.[7]

2020 NO$_2$ Levels in AB

Annual Average NO$_2$ + 95th percentile (ppb)

NO$_2$
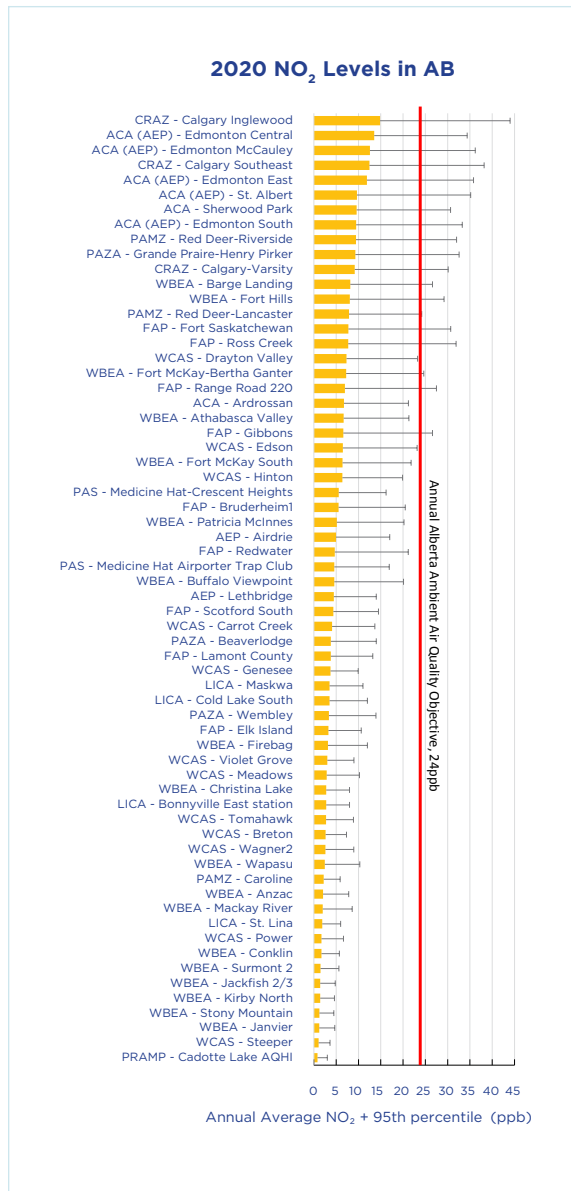
2020 ALBERTA DATA

Of the 77 stations monitoring and reporting NO$_2$ data in 2020, 65 stations collected this data at least 75% of the total annual operating time.

Results from these 64 stations show an average annual range of NO$_2$ concentrations in 2020 from 0.8ppb to 14.8ppb, all below the AAAQO of 24ppb annual limit.

There was only one recorded exceedance of the 1-hour AAAQO (>159 ppb) for all of the NO$_2$ monitoring conducted in 2020.

Average NO$_2$ from the five monitoring stations reporting the highest averages in 2020 (all urban stations) have a slight decrease over the 2019 average, from 13.6ppb to 12.8ppb; however, the 95th percentile increased from 42.7ppb to 44.0ppb.

AVERAGE NO$_2$ PROFILE IN 2020
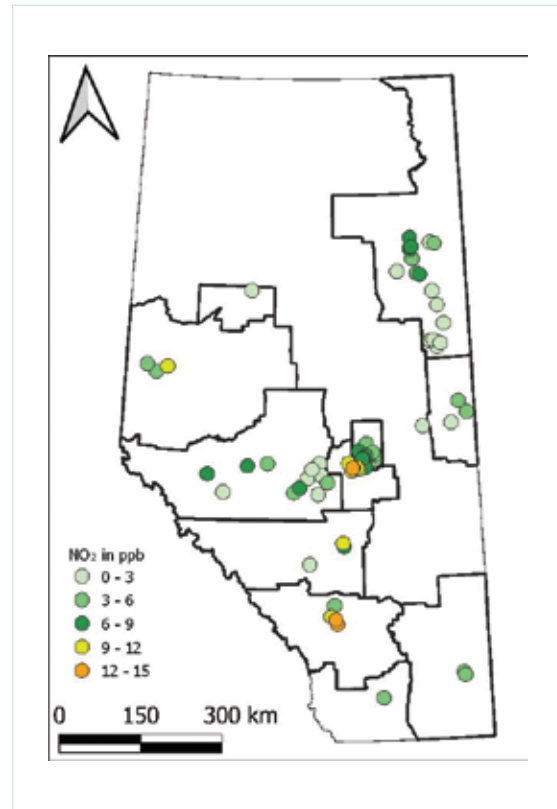
An **urban area** is defined as having a population of at least 1,000 and a density of 400 or more people per square kilometre. All territory outside an urban area is defined as a **rural area**.[8]

SULPHUR DIOXIDE (SO$_2$)

Sulphur dioxide is generated both naturally and by human activities, including the processing and combustion of fossil fuels. It is a colourless gas with a pungent odour (similar to a lit match).

SO$_2$ reacts in the atmosphere to form sulphuric acid and acidic aerosols, which contribute to acid rain (SO$_2$ accounts for about 70% of total acid rain). It combines with other atmospheric gases to produce fine particles, which may reduce visibility.

Brief exposure to high concentrations of SO$_2$ can produce human health effects, irritating the upper respiratory tract and aggravating existing cardiac and respiratory disease.[9]

Long-term exposure may increase the risk of developing chronic respiratory disease. People with asthma may have increased symptoms such as chest tightness and difficulty breathing.

2020 SO$_2$ Levels in AB

Annual Average SO$_2$ + 95th percentile (ppb)

SO$_2$
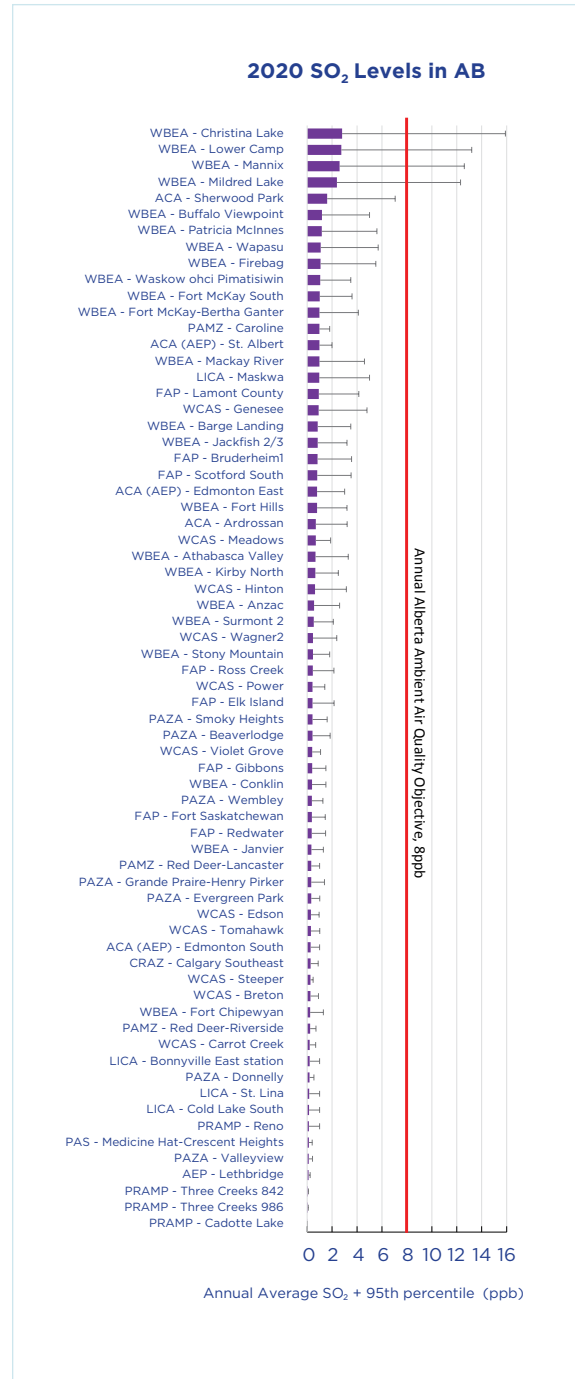
2020 ALBERTA DATA

Of the 78 stations monitoring and reporting SO$_2$ data in 2020, 68 stations collected this data at least 75% of the total annual operating time.

2020 results from these stations show the range of SO$_2$ concentrations from 0.0ppb to 2.8ppb. There was a total of four readings above the 1-hour (>172 ppb) AAAQO and one reading above the 24-hour (>48 ppb) AAAQO. There were no readings above the 30-day or annual objectives.

In comparison, there were no readings above the AAAQOs in 2019.

AVERAGE SO$_2$ PROFILE IN 2020
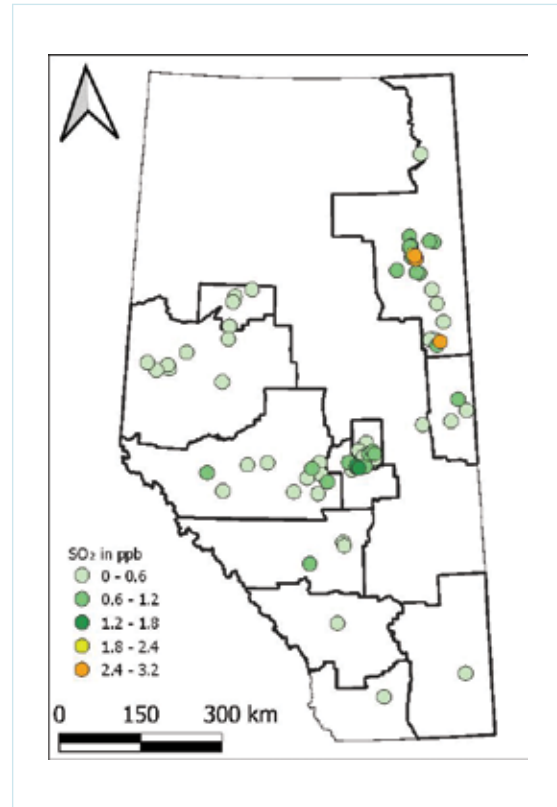
Interested parties in Drayton Valley area (West Central Airshed Society) were the first to organize a novel, multi-stakeholder approach to air quality monitoring – known as the **Airshed model**.

OZONE (O₃)

Ozone in the upper atmosphere protects life on earth by filtering the sun's ultraviolet rays; however, O_3 on the ground is a pollutant and a component of smog. During hot weather, emissions of chemicals from automobiles, industry and other non-natural sources can produce high O_3 levels through chemical reactions in the atmosphere.

People most at risk from exposure to higher levels of O_3 include those with asthma, children, older adults and those who are active outdoors, especially outdoor workers. Children are at greatest risk because their lungs are still developing.[10]

High levels of O_3 can cause the muscles in the airways to constrict, trapping air inside the tiny air sacks within the lungs (alveoli). This can lead to wheezing, shortness of breath and can be serious in people with lung diseases such as asthma.[10]

2020 O₃ Levels in AB

Annual Average O₃ + 95th percentile (ppb)

O$_3$
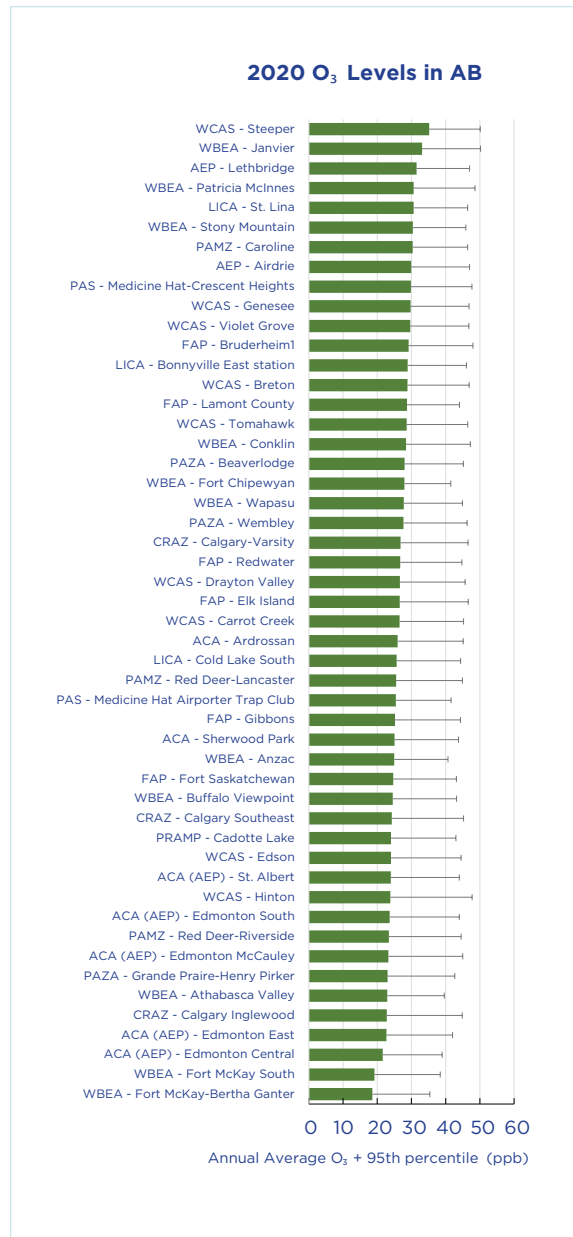
2020 ALBERTA DATA

Of the 57 stations monitoring and reporting O$_3$ data in 2020, 50 stations collected this data at least 75% of the total annual operating time.

Results from these stations show the range of O$_3$ concentrations in 2020 from 18.6ppb to 35.2ppb. There was a total of two readings above the 1-hour daily maximum (>76 ppb) AAAQO.

In comparison, there were 58 readings above the AAAQO in 2019.

AVERAGE O$_3$ PROFILE IN 2020
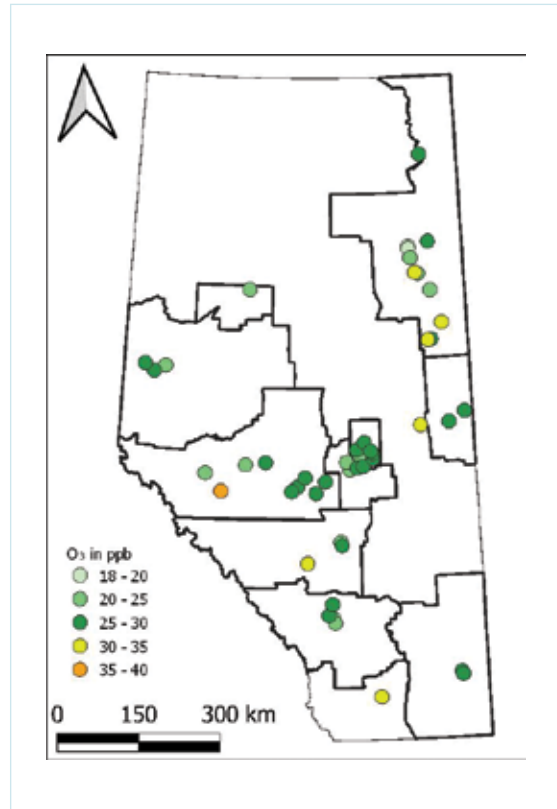
AIR QUALITY AND HEALTH

Health Canada estimates that above-background air pollution, including air pollution from human sources in North America, contributes to 15,300 premature deaths per year in Canada.[11]

Data collected by Alberta's Airsheds contributes to the Air Quality Health Index (AQHI), a real-time air quality rating which is reported in over 35 Alberta communities and indicates potential health risks caused by air pollution.

The AQHI provides a rating to indicate the level of relative health risk associated with local air quality. The higher the number, the greater the health risk and the need to take precautions. Occasionally, during extreme pollution events such as a wildfire, AQHI levels may reach 10 or higher, indicating a very high health risk.

1	2	3	4	5	6	7	8	9	10	+

Low Risk — Moderate Risk — High Risk — Very High Risk
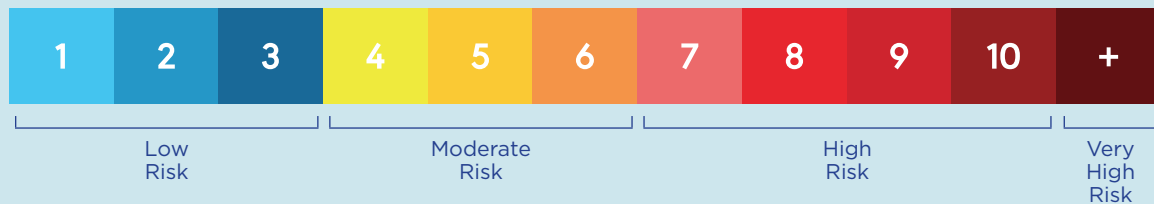
In 1968, the first monitoring station with continuous analyzers was established in Edmonton on the 6th floor of the Federal Building by the provincial health department - prior to the formation of an environmental department in the province.

2020 AQHI Ratings in Alberta

In Alberta, all monitoring stations saw low risk range of 90% to 100% of the 2020 year, with a provincial average AQHI reading of 2.0 (based on 311,770 hours of data).

Legend: Low Risk | Moderate Risk | High Risk | Very High Risk

Stations (top to bottom):
CRAZ - Calgary
ACA (AEP) - Edmonton
ACA (AEP) - St. Albert
FAP - Gibbons
PAZA - Grande Praire
FAP - Bruderheim
FAP - Fort Saskatchewan
WCAS - Drayton Valley
ACA - Strathcona County
PAMZ - Red Deer
WCAS - Hinton
FAP - Redwater
AEP - Airdrie
FAP - Lamont County
AEP - Lethbridge
FAP - Elk Island
PAS - Medicine Hat
WBEA - Fort McKay
PAMZ - Caroline
WCAS - Genesee
PAZA - Beaverlodge
WBEA - Fort McKay South
LICA - St. Lina
WCAS - Steeper
WBEA - Fort McMuray
LICA - Bonnyville
WBEA - Fort Chipewyan
WCAS - Tomahawk
WBEA - Conklin
PRAMP - Cadotte Lake
WCAS - Edson
LICA - Cold Lake
PAZA - Wembley
WBEA - Janvier
WBEA - Anzac
WBEA - Stony Mountain

Exposure to air pollution may result in a variety of health effects ranging from slight discomfort to increased hospital admissions and emergency room visits, to increased risk of premature death. In particular, individuals with respiratory and cardiovascular conditions, children and the elderly may notice symptoms due to poor air quality conditions. Individuals should monitor their symptoms and take precautions recommended by their physicians.[12]

Download the free AQHI app on your mobile device

Download on the App Store

GET IT ON Google Play

WORKING TOGETHER FOR CLEAN AIR

ALBERTA'S AIRSHEDS ARE VITAL CONTRIBUTORS TO MANAGING AIR QUALITY.

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

The efforts of each of Alberta's Airsheds ensures valuable community oversight and involvement in our collective goal of clean air.

Resources, including links to each of Alberta's Airsheds, can be found at: **AlbertaAirshedsCouncil.ca.**

For information on local air quality monitoring and programs in your community, contact your regional Airshed.

AlbertaAirshedsCouncil.ca | @albertaairsheds

REFERENCES

1   https://scijinks.gov/air-quality/

2   https://www.alberta.ca/air-monitoring-directive.aspx

3   https://www.canada.ca/en/environment-climate-change/services/air-pollution/issues/smog-causes-effects/winter.html

4   https://www.canada.ca/content/dam/eccc/documents/pdf/aqhi/20181205-03.pdf

5   https://open.alberta.ca/dataset/0d2ad470-117e-410f-ba4f-aa352cb02d4d/resource/97d1afdf-b66b-4805-be41-a5a3f589c988/download/aaqo-summary-jun29-2017.pdf

6   https://www.canada.ca/en/environment-climate-change/services/environmental-indicators/air-pollutant-emissions.html#NOx

7   https://www.canada.ca/en/health-canada/services/publications/healthy-living/human-health-risk-assessment-ambient-nitrogen-dioxide.html

8   https://www.statcan.gc.ca/eng/subjects/standard/pcrac/2016/introduction

9   https://www.canada.ca/en/health-canada/services/publications/healthy-living/human-health-risk-assessment-sulphur-dioxide-executive-summary.html

10 https://www.epa.gov/ground-level-ozone-pollution/health-effects-ozone-pollution

11 https://www.canada.ca/en/health-canada/services/publications/healthy-living/2021-health-effects-indoor-air-pollution.html

12 Alberta Health – Be Air Aware (https://bit.ly/3crT09S)

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