

From: LICA Reception <lica2@lica.ca>
Subject: LICA- 2023 AAC Annual Air Quality Report
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To: Undisclosed recipients;

Hello LICA Members,

The Alberta Airsheds Council (AAC) has shared their 2023 Annual Air Quality Report. To view the full report, click the link below.

In honor of Clean Air Day, the Alberta Airsheds Council (AAC) has prepared their 2023 Annual Air Quality Report to provide a summary of the air quality data that is monitored and collected in our province by Alberta's Airsheds. To view the full 2023 Annual Air Quality Report, visit [Air Quality Reports — Alberta Airsheds Council](#).

The AAC is made up of Alberta's 10 Airsheds, which are regional air quality organizations responsible for independent ambient air monitoring, stakeholder engagement, public awareness, and education. Alberta's Airsheds operate 86 continuous monitoring stations, plus various technologies at hundreds of other locations, that monitor the air in which Albertans breathe. The AAC and Alberta's Airsheds work in partnership with the Government of Alberta and other stakeholders.

For more information on how AAC serves its members by leveraging resources, building capacity, and facilitating strategic collaboration with external stakeholders, visit our website at <https://www.albertairshedsCouncil.ca/>.

Sheri Rice
Administrator
administrator@albertairshedsCouncil.ca
Alberta Airsheds Council
website: [albertairshedsCouncil.ca](https://www.albertairshedsCouncil.ca)

Lori Jodoïn

Administrative Professional
LICA – Environmental Stewards
5107W – 50 Street, PO Box 8237
Bonnyville, AB T9N 2J5
(780) 812-2182





ALBERTA AIRSHEDS
COUNCIL

Alberta Airsheds

2023 *Air
Quality Report*





Airsheds serve in the public interest by meeting or exceeding the highest air monitoring standards, ensuring unbiased data and analysis is available to all stakeholders and partners, being responsive to community concerns, and raising awareness through community engagement and education.

Cover photo: 2023 Clean Air Day Photo Contest winner Heather Sinton, "Sprig of Heather"

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Clean Air for Albertans

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

Alberta's ten Airsheds are regional air quality organizations, responsible for independent ambient air monitoring as well as stakeholder engagement, public awareness, and education.

The Alberta Airsheds Council has prepared this 2023 Alberta Airsheds Air Quality Report to provide a summary of the air quality data collected and verified by Alberta's Airsheds, on behalf of all of Alberta's air quality stakeholders and partners.

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



WHAT IS AN AIRSHED?

Alberta's Airsheds are multi-stakeholder, non-governmental organizations that monitor, evaluate, and report ambient air quality. Formed between 1996 and 2017 as a critical component of Alberta's Clean Air Strategy, Alberta's Airsheds now operate 86 continuous monitoring stations and an array of other sites equipped with passive monitors and microsensors. These monitoring activities are conducted in collaboration with air quality stakeholders and partners.

Refer to the map on page 8 to see the boundaries of the 10 Alberta Airsheds.

WHAT IS AIR QUALITY?

Air quality is determined by air pollutants and meteorology. Primary pollutants come from a variety of human-made and natural sources and can mix with one another forming secondary pollutants.

What We Monitor and Why

Air quality is affected by pollutants, and the interaction between pollutants and meteorological conditions. For example, winds can disperse pollutants, bringing them in, or moving them out of an area, while barometric pressure can cause temperature inversions, trapping

pollutants close to ground level. Airshed monitoring measures the air quality of communities, by monitoring common air pollutants, as well as measures the impact of large emission sources, by monitoring other, specific air pollutants close to industrial sources.

AIR QUALITY PARAMETERS MONITORED BY AIRSHEDS

COMMON AIR POLLUTANTS

- nitrogen dioxide (NO₂)
- ozone (O₃)
- particulate matter (PM_{2.5})
- sulphur dioxide (SO₂)

METEOROLOGICAL CONDITIONS

- air temperature
- barometric pressure
- precipitation
- relative humidity
- solar radiation
- wind speed and direction

OTHER AIR POLLUTANTS (MONITORED AT SELECT SITES)

- ammonia (NH₃)
- benzene, toluene, ethylbenzene, xylene (BTEX)
- carbon dioxide (CO₂)
- carbon monoxide (CO)
- particulate matter (PM₁₀)
- hydrogen sulphide (H₂S)
- methane/non-methane hydrocarbons (CH₄/NMHC)
- nitric oxide (NO)
- nitrogen oxides (NO_x)
- polycyclic aromatic hydrocarbons (PAH)
- total hydrocarbons (THC)
- total reduced sulfur (TRS)
- total suspended particulate (TSP)
- volatile organic compounds

Air Quality Monitoring Technology

Airsheds use a variety of technologies throughout the Province of Alberta to monitor air quality parameters and collect air quality monitoring data:

Continuous Monitoring Stations provide 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; several Airsheds also employ portable continuous monitoring stations that monitor air quality at temporary sites.



Other monitoring technologies used throughout the province include:

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

Intermittent - Time-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.

Sensor - Community-based sensors can be used to provide an indication of real-time air quality at the neighbourhood level. Stationary, 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.

Monitoring Guidelines and Standards

To understand and protect air quality, data collected for ambient levels of pollutants is compared to both National and Provincial guidelines and standards established to protect human health.

The National Air Quality Management System (AQMS) includes Canadian Ambient Air Quality Standards (CAAQS) and regional action plan management levels for each national air zone established within the AQMS.

There are 1-hour, 8-hour, 24-hour, 30-day and annual averages for ambient air quality objectives and guidelines. In the Province of Alberta, comparisons are made against:

- Alberta Ambient Air Quality Objectives (AAAQO)
- Alberta Ambient Air Quality Guidelines (AAAQG)
- Alberta's Air Monitoring Directive requires a minimum operating time of 75% or more to calculate annual averages for air pollutants in a given location for a given year

More information on the guidelines and standards can be found at [AlbertaAirshedsCouncil.ca](https://www.albertairshedsCouncil.ca).

How Air Quality Monitoring Works



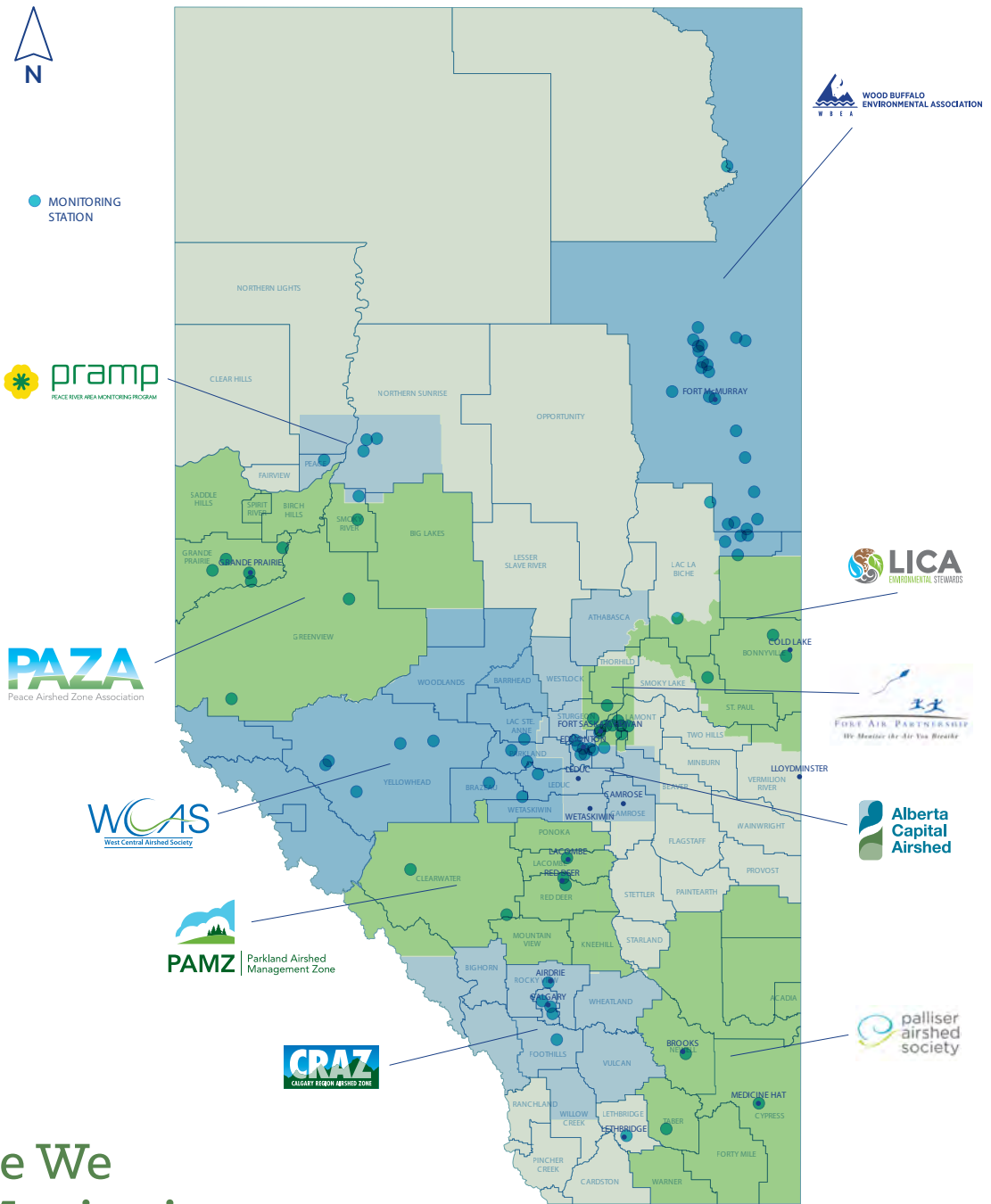
1 Air Pollution Sources
Pollution is emitted into the air from a variety of human-made and natural sources.

2 Monitoring
Technician oversight of ambient air monitoring stations to measure concentrations of pollutants in the air.

3 Public Information
The real-time data is streamed on Airshed websites and informs the Air Quality Health Index, also available through the WeatherCAN mobile app.

4 Quality Assurance and Validation
All data and reports are scrutinized to ensure accuracy.

5 Data Reports
This data is used for reporting to regulators, stakeholders and partners. It is analyzed for insights and trends in air quality.



Where We Are Monitoring - Provincial Network Map

Within the 10 Alberta Airsheds, there are 86 continuous monitoring stations and hundreds of other monitoring locations using various technologies to measure air quality parameters. The AAC Monitoring Network Map shows the geographical boundaries of the Airsheds, and the network of continuous monitoring stations located across the province.

2023 Air Quality Monitoring Profiles

HOW TO REVIEW 2023 RESULTS

The sources of the common air pollutants (NO₂, SO₂, PM_{2.5} and O₃) are provided using pie charts, and the data from continuous monitoring stations are presented using graphs displaying annual averages (solid coloured bar) and 95th percentile markers (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 levels) for the guideline or standard for the air pollutant.

This report highlights 2023 annual data compiled from 1-hour averages to provide context for the measured concentrations, which is presented as annual averages for each pollutant.



NO₂

NITROGEN DIOXIDE (NO₂)

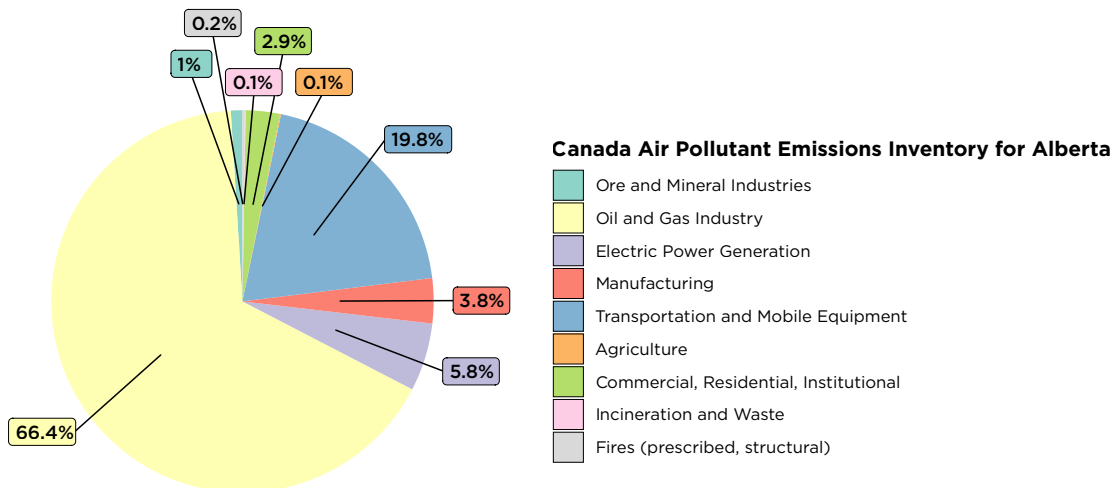
IMPACT TO HUMAN HEALTH

Nitrogen dioxide is a reddish-brown gas with a pungent irritating odour. It has been linked to respiratory disease and contributes to acid rain. NO₂ plays a major role in atmospheric photochemical reactions and ground-level ozone formation and destruction. Short-term exposure to higher levels of NO₂ 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.¹

SOURCES OF NO₂

When combusted, any source can release emissions of nitrogen oxides that lead to the formation of NO₂, including home and commercial heating and power generation. Wildfires, lightning and biological decay are natural sources of emissions of nitrogen oxides.

From Canada's Air Pollutant Emissions Inventory for Alberta (2022), oil and gas activities and transportation account for approximately 86% of the nitrogen emissions in Alberta.



Source: [Canada's Air Pollutant Emissions Inventory - Alberta](#)

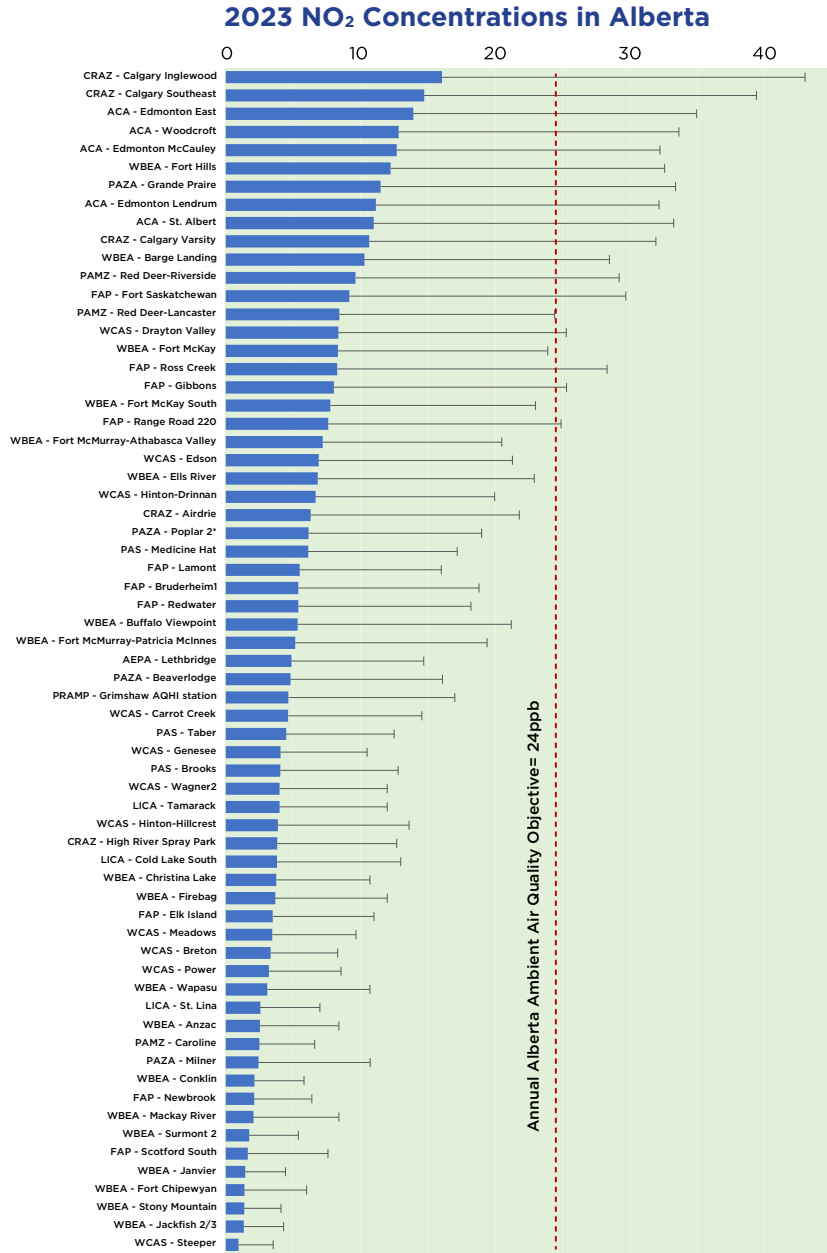
Note: 2022 data set is most current available at time of production of this report; historical trends are consistent over time for these pollutant sources.

NO₂

2023 ALBERTA NO₂ DATA

In 2023, 572,634 hours of NO₂ data were collected from 76 stations. Of these 83 stations, 65 stations collected NO₂ data at least 75% of the total annual operating time. Results from these 68 stations show an average annual range of NO₂ concentrations in 2023 from 1.0 to 16.0 ppb, all below the AAAQO annual limit (>24 ppb).

There were no recorded exceedances of the 1-hour AAAQO (>159 ppb) for all the NO₂ monitoring conducted in 2023, with the highest reading recorded at 89.2 ppb. Average NO₂ readings from the five monitoring stations reporting the highest annual averages from 2020 - 2022 (all urban stations) showed averages ranging from 12.7-16.0 ppb. The highest 95th percentile increased from 39.0 ppb to 43.0 ppb between 2022 and 2023.



Annual Nitrogen Dioxide + 95th percentile (in ppb)

O₃

OZONE (O₃)

IMPACT TO HUMAN HEALTH

People most at risk from exposure to higher levels of O₃ 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.²

High levels of O₃ 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.

SOURCES OF O₃

Ozone in the upper atmosphere protects life on earth by filtering the sun's ultraviolet rays; however, O₃ 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 O₃ levels through chemical reactions in the atmosphere. Non-natural sources can produce high O₃ levels through chemical reactions in the atmosphere. As a secondary pollutant which forms from these reactions, a source emission pie chart is not available because there are no direct emission sources for O₃.

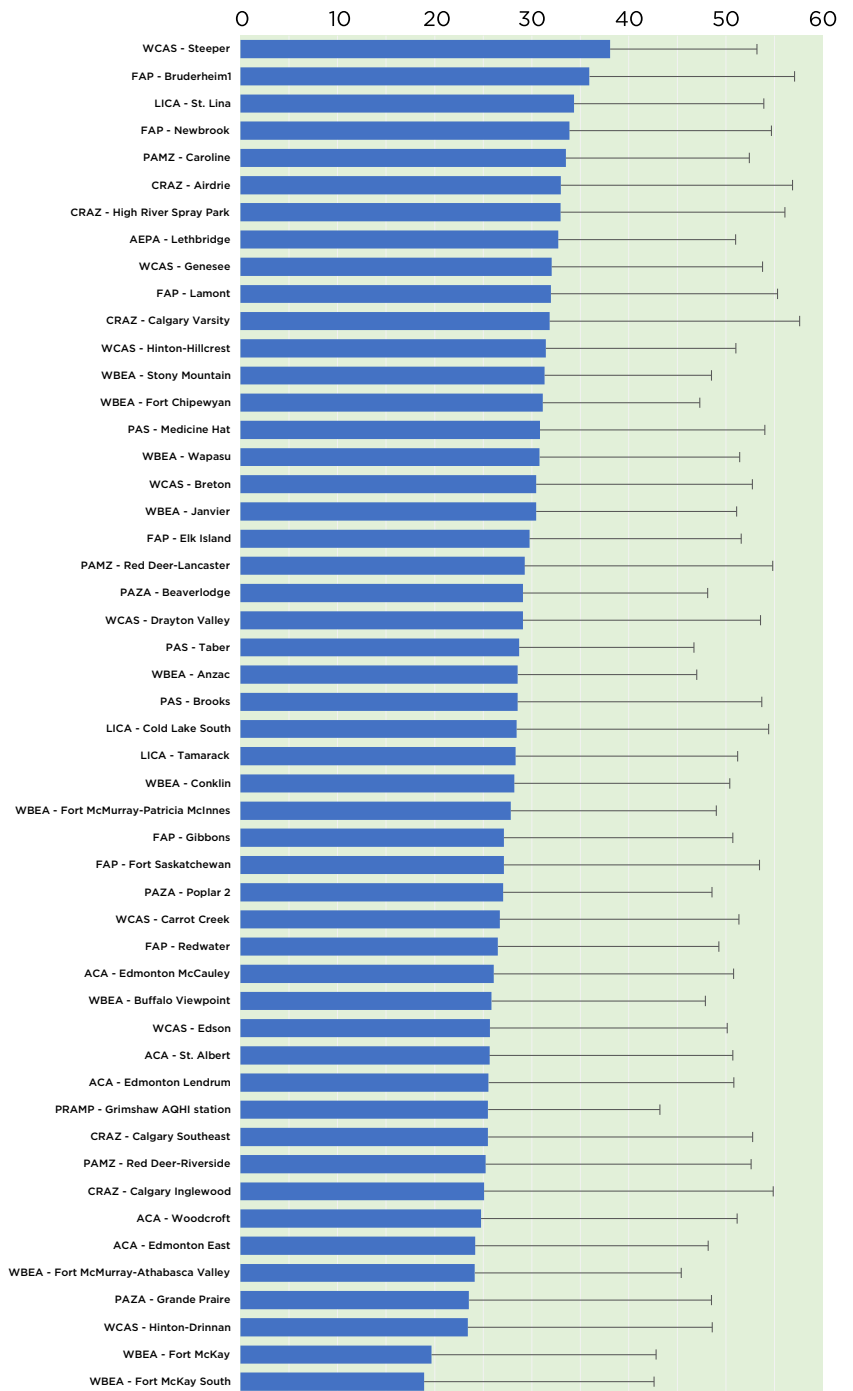
Ozone can be transported long distances and can be responsible for large regional air pollution episodes. During wildfire smoke events, elevated ozone levels can occur due to a complex set of chemical reactions involving pollutants emitted by the fires, including nitrogen oxides (NO_x) and volatile organic compounds (VOCs). These emissions result from the burning of vegetation, organic matter, and other materials. When sunlight and heat are present, these pollutants undergo photochemical reactions in the atmosphere, leading to the formation of ozone.

2023 ALBERTA O₃ DATA

In 2023, there were 425,560 hours of O₃ data collected from 59 stations. Of these 59 stations, 50 stations collected O₃ data at least 75% of the total annual operating time. Results from these stations show the range of annual average O₃ concentrations in 2023 from 18.9 ppb to 38.1 ppb.

There were 498 readings above the 1-hour maximum AAAQO (>76 ppb), with the highest reading recorded at 103.4 ppb. In comparison, there were a total of 58, 2, 66, and 6 readings above 76 ppb in 2019, 2020, 2021, and 2022 respectively.

2023 O₃ Concentrations in Alberta



Annual Ozone + 95th percentile (in ppb)

Note: There is no annual AAAQO for O₃.

PM_{2.5}

PARTICULATE MATTER (PM_{2.5})

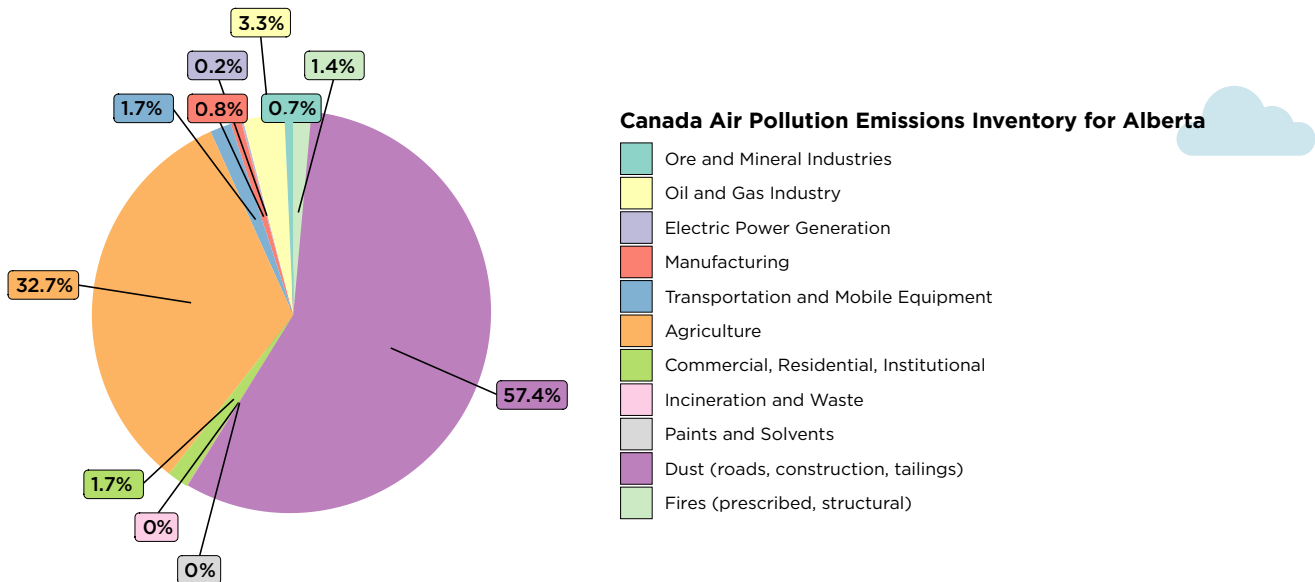
IMPACT TO HUMAN HEALTH

These fine particles are small enough to pass into the lungs and can be a human health concern. 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.³

SOURCES OF PM_{2.5}

PM_{2.5} particles are formed from gases released to the atmosphere by combustion processes such as from motor vehicles, power plants, gas processing plants, compressor stations, household heating, and wildfires. Particulate matter can also be comprised of biological material such as mould, bacteria, and pollen fragments.

From Canada's Air Pollutant Emissions Inventory for Alberta (2022), dust (from roads, construction, mine tailings) and agriculture account for approximately 90% of the particulate matter emissions in Alberta.



Source: [Canada's Air Pollutant Emissions Inventory - Alberta](#)

Note: 2022 data set is most current available at time of production of this report; historical trends are consistent over time for these pollutant sources.

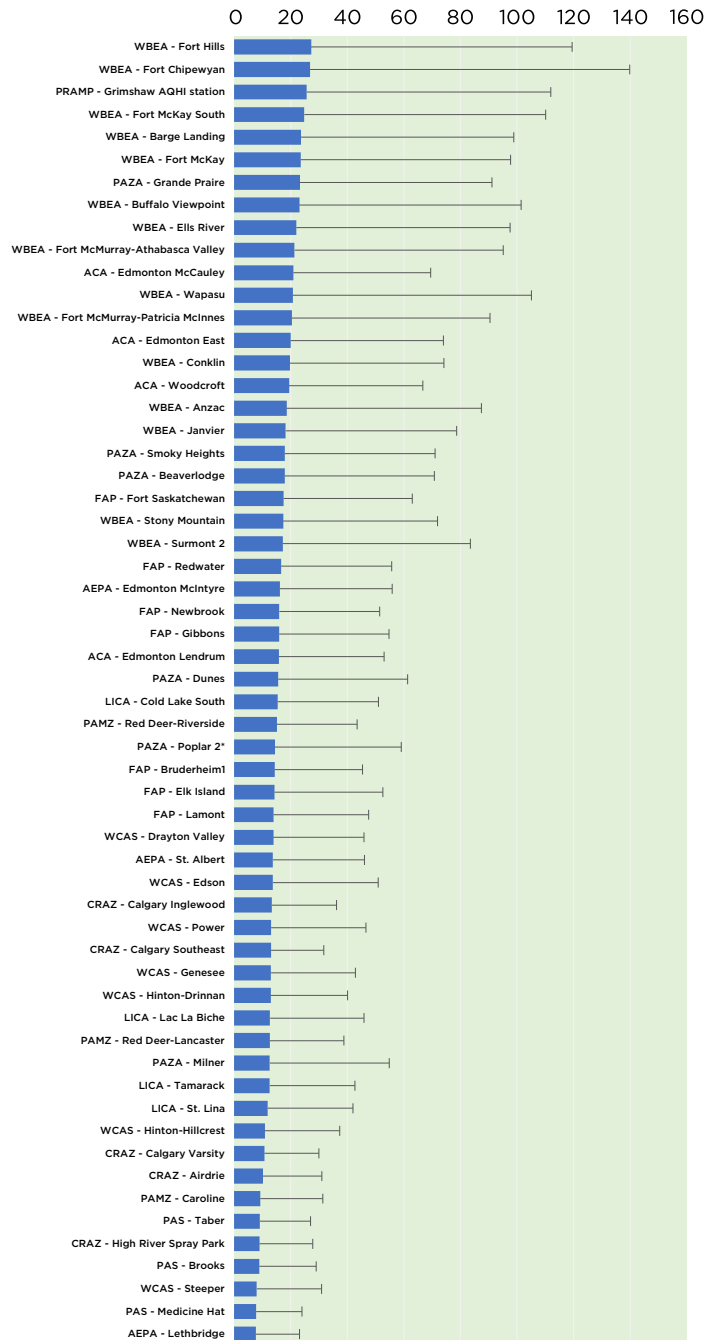
PM_{2.5}

2023 ALBERTA PM_{2.5} DATA

In 2023, there were 508,035 hours of PM_{2.5} data collected from 63 stations. Of the 63 stations, 58 stations collected PM_{2.5} 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 7.7 to 27.2 µg/m³ in 2023. Based on these monitoring results, there was a total of 18,137 readings above the 1-hour AAAQO (>80 µg/m³), with the maximum reading recorded at 1,333 µg/m³.

There were 2,600 readings above the 24-hour AAAQO (>29 µg/m³), with the maximum recorded reading at 536 µg/m³. Over the past five years (2019-2023) there has been a fluctuation of elevated PM_{2.5} readings, often correlating to wildfire events throughout the province and when smoke is blown in from other regions. 2023 was an exceptional year for wildfire activity and smoke. As noted above, there were 2,600 24-hour and 18,137 1-hour exceedances recorded in 2023 compared to 286 24-hour and 540 1-hour exceedances recorded in 2022, a 9-fold increase in 24-hour exceedances and 33 times the number of 1-hour exceedances reported in 2022.

2023 PM_{2.5} Concentrations in Alberta



Annual Particulate Matter (PM_{2.5}) + 95th percentile (in µg/m³)

Note: There is no annual AAAQO for PM_{2.5}

SO₂

SULPHUR DIOXIDE (SO₂)

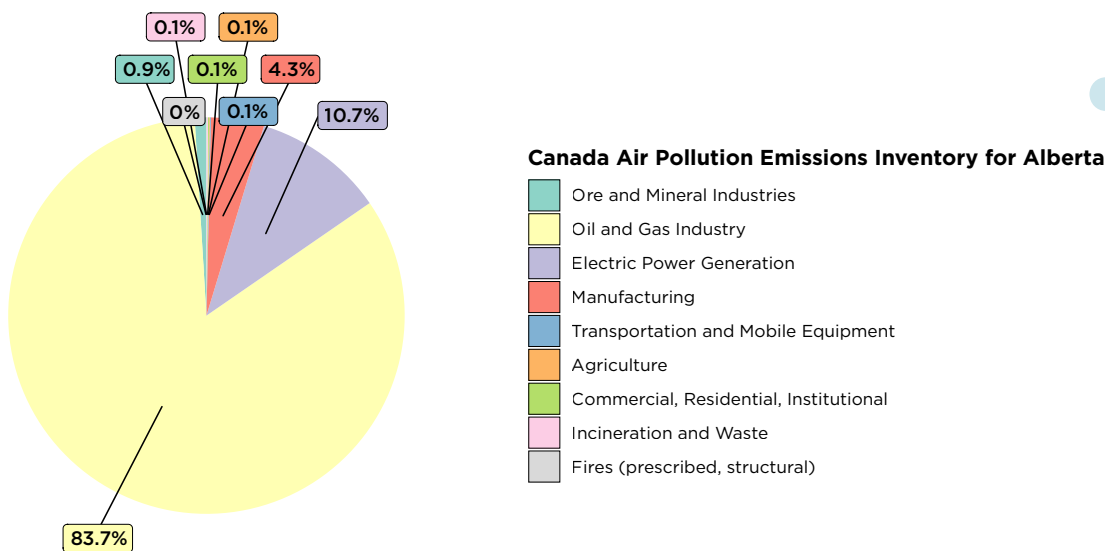
IMPACT TO HUMAN HEALTH

Brief exposure to high concentrations of sulphur dioxide and its products can irritate the upper respiratory tract and aggravate existing cardiac and respiratory conditions. 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.⁴

SOURCES OF SO₂

SO₂ in Alberta is generated predominately through human activities, including the processing and combustion of fossil fuels containing sulphur. It is a colourless gas with a pungent odour (like a lit match) and can be detected by taste and odour at concentrations as low as 300 ppb. SO₂ reacts in the atmosphere to form sulphuric acid and acidic aerosols, which contribute to acid rain. SO₂ combines with other atmospheric gases to produce fine particles, which may reduce visibility.

From Canada's Air Pollutant Emissions Inventory for Alberta (2022), oil and gas activities and electric power generation account for approximately 94% of the sulphur emissions in Alberta.



Source: [Canada's Air Pollutant Emissions Inventory - Alberta](#)

Note: 2022 data set is most current available at time of production of this report; historical trends are consistent over time for these pollutant sources.

SO₂

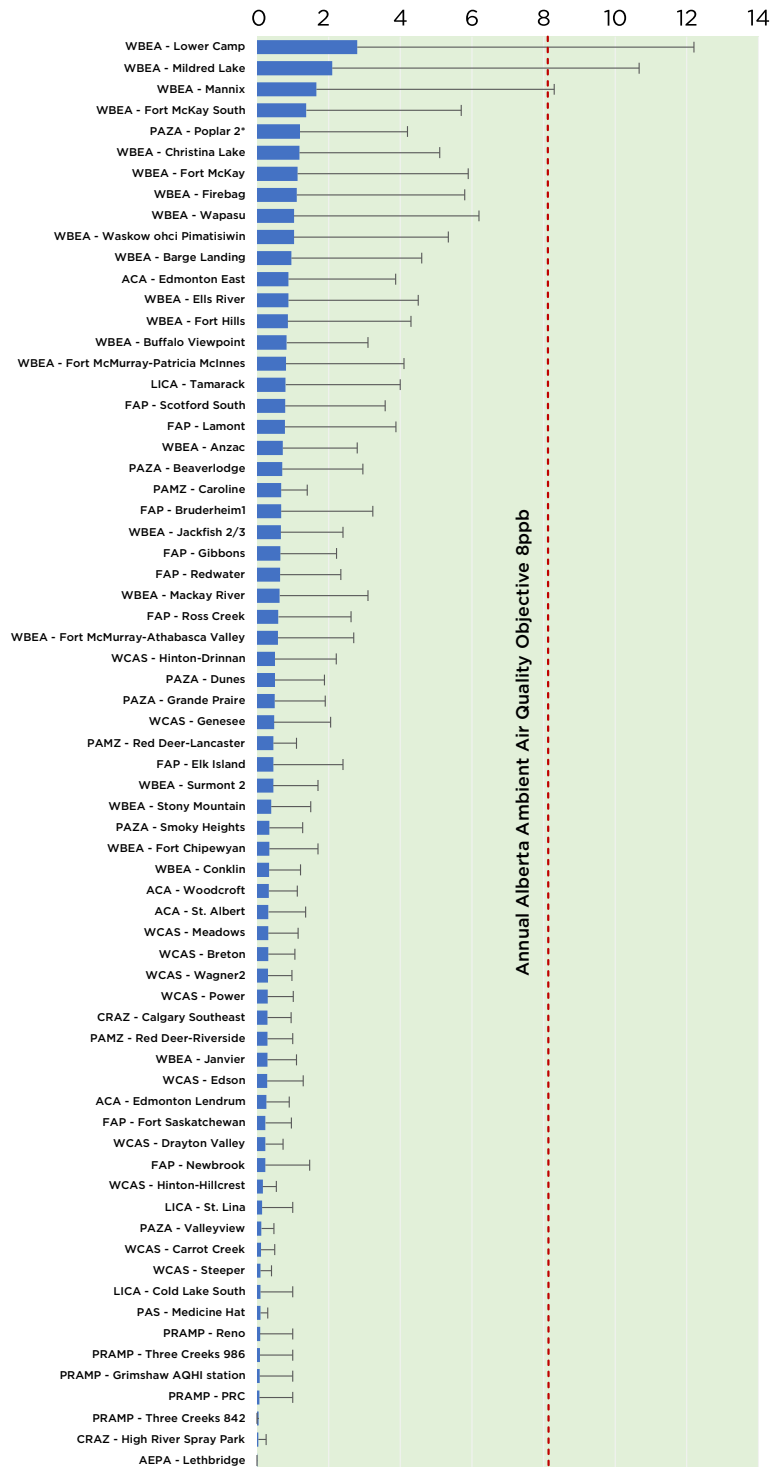
2023 ALBERTA SO₂ DATA

In 2023, there were 597,308 hours of SO₂ data collected from 83 stations. Of the 83 stations, 68 stations collected SO₂ data at least 75% of the total annual operating time. 2023 results from these stations show the annual average SO₂ concentrations were less than 2.8 ppb.

There were no readings above the 30-day SO₂ AAAQO (>11 ppb), with a maximum monthly average of 6.6 ppb. There were 8 readings above the 1-hour AAAQO (>172 ppb), with the highest reading recorded at 424 ppb. There were no readings above the 24-hour SO₂ AAAQO (>48 ppb), with a maximum daily average of 36 ppb.

In comparing data over the last five years (2019-2023), the maximum annual SO₂ reading has been less than 3 ppb, with the 95th percentiles being less than 15 ppb for all four years.

2023 SO₂ Concentrations in Alberta



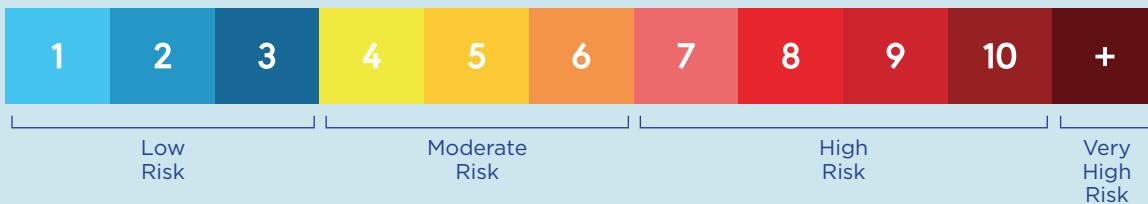
Annual Sulphur Dioxide + 95th percentile (ppb)

Air Quality Health Index (AQHI)

In 2023, 43 sites in 38 communities reported AQHI, with a total of 326,841 monitoring hours. On average, the AQHI for all monitoring stations in Alberta was rated "low-risk" 86.4% of the time (ranging between 67.8% and 99.3%). The most common AQHI reading for four urban stations was 3, and 2 for all other stations. From 2019 to 2023, the typical AQHI value has been 2 or lower. More "high-risk" and "very-high risk" category readings were recorded in 2023 than in previous years due to the exceptional wildfire events.

The AQHI rating indicates the relative level of 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.

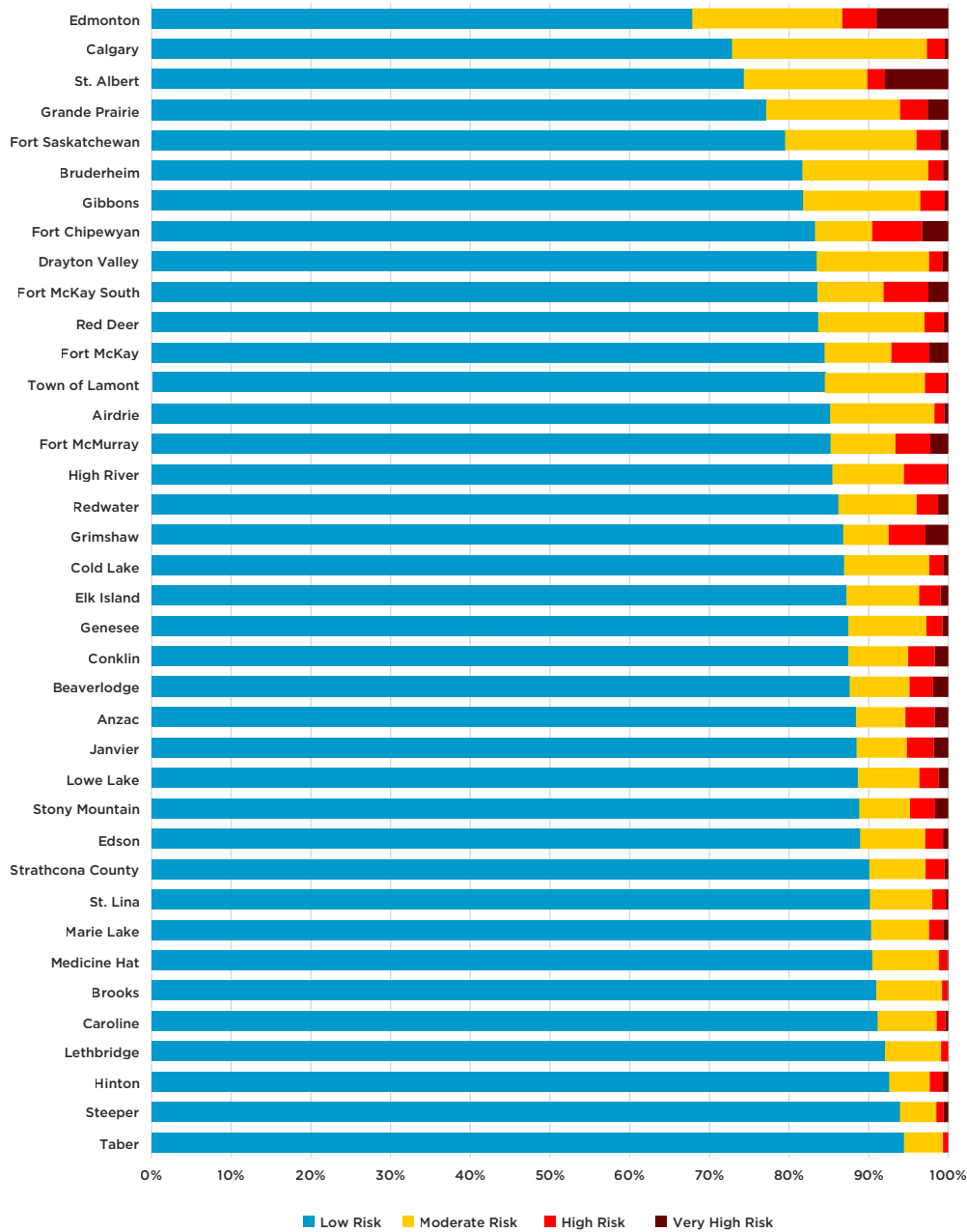
AQHIs can be found on your local Airshed's website, and on the WeatherCAN app or mobile devices.



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.⁵



2023 AQHI RATINGS IN ALBERTA



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.

Download the free WeatherCan app on your mobile device



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](https://albertairshedsCouncil.ca).

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



[AlbertaAirshedsCouncil.ca](https://albertairshedsCouncil.ca) |    @albertairsheds



References

- ¹ *Human Health Risk Assessment for Ambient Nitrogen Dioxide* (Government of Canada).
<https://www.canada.ca/en/health-canada/services/publications/healthy-living/human-health-risk-assessment-ambient-nitrogen-dioxide.html>
- ² *Health Effects of Ozone Pollution* (United States Environmental Protection Agency).
<https://www.epa.gov/ground-level-ozone-pollution/health-effects-ozone-pollution>
- ³ *Air Pollution: What is Particulate Matter* (Health Canada).
<https://www.canada.ca/en/health-canada/services/air-quality/indoor-air-contaminants/fine-particulate-matter.html#4>
- ⁴ *Human Health Risk Assessment for Sulphur Dioxide* (Government of Canada).
<https://www.canada.ca/en/health-canada/services/publications/healthy-living/human-health-risk-assessment-sulphur-dioxide-executive-summary.html>
- ⁵ *Health Impacts of Air Pollution in Canada - 2021* (Government of Canada).
<https://www.canada.ca/en/health-canada/services/publications/healthy-living/2021-health-effects-indoor-air-pollution.html>



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