PASZA

Peace AirShed Zone Association

2004 Annual Report

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1.0 Introduction

The Peace Airshed Zone Association (PASZA) is a multi-stakeholder non-profit organization consisting of industry, local government, environmental non-government organizations (ENGOs), Alberta Environment, Alberta Energy & Utilities Board, the local health authority, and members of the public. PASZA was formed in March 1999 in response to concerns over air quality in the Grande Prairie Region and because of the desire of industry, government, ENGOs and the public to work together to better understand and address these concerns.

The PASZA Mission Statement is:

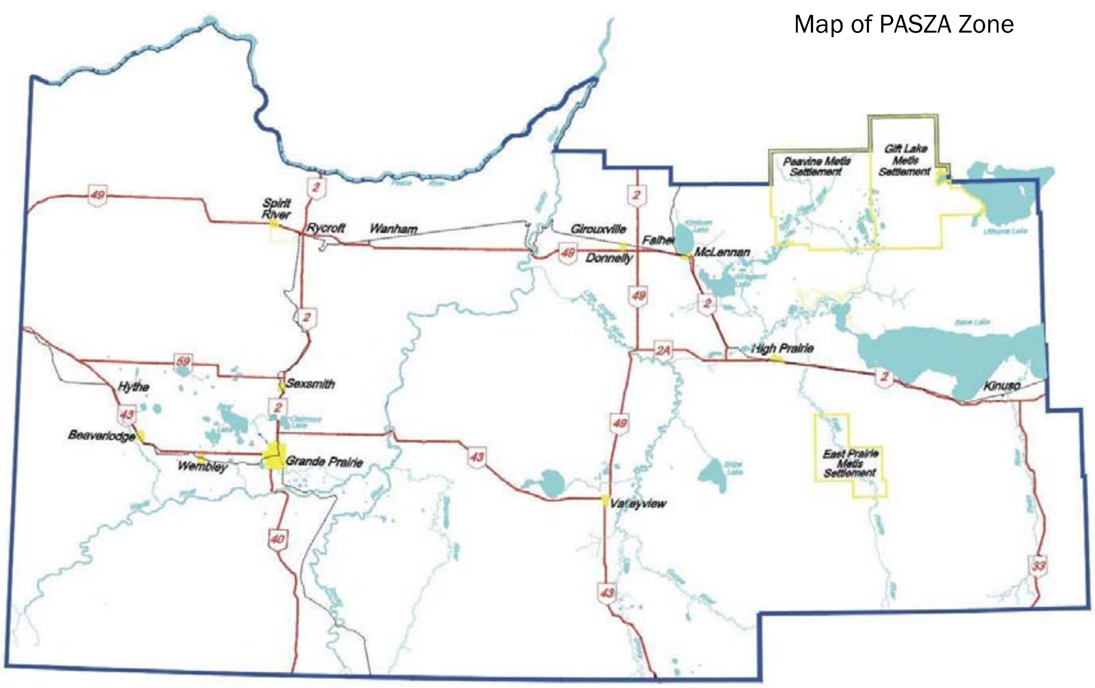
> *The Peace Airshed Zone Association will create and implement a process that provides relevant, scientifically credible information to stakeholders who will use the information to ensure continuous improvement of regional air quality, protect environmental health, and influence policy.*

PASZA was the fifth airshed management zone formed in Alberta and is a non-profit organization incorporated under the Societies Act. PASZA operates under guidelines put forth in the Clean Air Strategic Alliance's (CASA) Zone Air Quality Management Guidelines, including management by consensus, representation from affected stakeholders and public accessibility to data and information from its monitoring activities. Air Quality Management Zones are a key component in CASA's strategy for the management of air quality within Alberta.

The Peace Airshed Zone covers a 38,500 square kilometer area of northwestern Alberta, stretching from the Peace River south to the top of Township 64 and includes the area's two major population centres, Grande Prairie and High Prairie (see map below). Approximately 85,000 people live and work in this area. The zone's major industries are oil and gas processing, forestry, agriculture and tourism.

Funding of PASZA is proportioned fairly amongst its members at levels consistent with their relative impact on the zone's air quality as determined by annual emission inventories. In 2004, PASZA members' financial and in-kind contributions totaled approximately $460,000 and 1650 hours respectively.

Map of PASZA Zone



2.0 The Year In Review

2004 was an important year for the Peace Airshed Zone Association (PASZA) with the start-up of the continuous portion of the Association's Regional Air Quality Monitoring (AQM) Program.

Early in January, the continuous program's first AQM Station was installed in the City of Grande Prairie's scenic Muskoseepi Park The station is dedicated to the memory of Henry Pirker, a lifelong environmentalist, apiarist and resident of the Debolt area. Henry made important contributions to PASZA in its formative years and to other organizations, including CASA, all with the common goal of improving air quality. A very moving and well-attended dedication ceremony was held at the station on a blustery day in March.

The Henry Pirker station continuously monitors Grande Prairie's air quality by measuring concentrations of five pollutants: carbon monoxide, fine particulate matter, nitrogen dioxide, ozone and sulphur dioxide. From these measurements an hourly Air Quality Index (AQI) is calculated and published on the PASZA Website, www.pasza.ca. The AQI provides Grande Prairie's residents with an indication of their air quality that is simple and easy to understand.

The Henry Pirker Station is also an important part of the provincial monitoring network feeding data into the CASA Data Warehouse so that air quality issues can be better understood and addressed at a broader provincial level. In the near future the Henry Pirker Station will also be tied into the National Air Pollution Surveillance System so that its data can be used by this network to better understand national issues such as climate change, trans-boundary pollution and ground-level ozone.

Early in the year, sixteen member facilities received amendments to their Alberta Environment Operating Approvals that recognized their participation in the passive monitoring portion of the PASZA Regional AQM Program.

Throughout the spring of 2004, work continued on the finalization of the design and implementation plan for the remainder of the PASZA continuous AQM program. Data collected by PASZA's fourty-three station Passive AQM Network has proven especially useful in the siting of four of the five additional continuous stations planned for deployment from 2005 through 2007. This work was completed by the PASZA Technical Committee in June and in July, a new joint application was made to amend the operating approvals of eight member facilities based on the implementation of the continuous program.

At the close of the year the majority of the application's participants had received their amendments with the remainder expected in early 2005. Work had also begun on the preparation of two continuous monitoring sites, one located just southeast of Grande Prairie and the other in the Smoky Heights area of the zone approximately 55 km northeast of Grande Prairie.

Communication with the public is a fundamental principle of the association and to this end, PASZA participated in several community events and locally held trade-fairs including the Communities in Bloom Showcase in July and the Northern Care Conference in early September.

3.0 Report from the Chair

The year 2004 was a milestone year for the Peace Airshed Zone Association with the start-up of our first continuous monitoring station, dedicated to preserving the memory of board member Henry Pirker. I consider it a privilege to have been the Chairman of the Board during such an exciting time in the history of our association.

We have now completed the first ten months of the Henry Pirker Station's operation and the second full year of operation for our passive network. The data collected is providing a much better understanding of the air quality throughout the region and especially Grande Prairie. This data is helping us learn more about the effects of air emissions, not only from our various industries, but from our own lifestyles as well.

The plans put in place for 2005 are ambitious and will undoubtedly make the year another rewarding one for our members.

I wish to thank all the Board of Directors, our technical committee, program manager, and administrative and monitoring program contractor for their dedication, diligence and the support they gave me through this past year. The existence of PASZA is only possible through the financial and in-kind support of companies, municipalities and other stakeholders and I wish to acknowledge their contribution also.

I not only look forward to the coming year with a great deal of excitement but also back with a great deal of pride in what we have accomplished to date. I am confident that PASZA will be successful in meeting all new challenges.

Richard Harpe
Chairman

4.0 Organization

In 2004 the Peace Airshed Zone Association made major changes to its organizational structure. These changes have streamlined a number of processes and improved the overall efficiency of PASZA's administration, management and program operations. Responsibilities that had been assigned to three committees were transferred to individual members serving on the board of directors on an "as needed" basis or to the Focus Corporation who are contracted to provide administrative support to the association.

The finance committee was replaced by the treasurer who handles all receivables and payables and now works directly with the program manager and Focus to ensure that accurate records of all financial transactions are maintained.

The fundraising committee's responsibilities were transferred to Focus who works with the program manager and board members as needed, to ensure that the emissions-based funding formula is equitably applied, that sufficient funds are available to ensure that the air quality monitoring program is implemented and sustainable, and that other activities planned by the association can be accomplished.
The communication committee's duties were also taken over by Focus, who working with the program manager and board members as needed, is communicating information about the association to its various stakeholders and others, both locally and outside the zone.

The technical committee is still responsible for overseeing the operation of the regional air quality monitoring program. With the completion of the program design, implementation plan and the submission and approval of the continuous monitoring joint application however, there was no longer the need for it to meet as frequently. As many of the committee members were also board members it was decided that meetings of the technical committee and the board of directors would be combined for the foreseeable future and monitored on an ongoing basis.

5.0 Links to CASA and Other Airsheds

The Peace Airshed Zone Association was established under the umbrella of the Clean Air Strategic Alliance (CASA), adopting the CASA principles of consensus-based multi-stakeholder representation and following its Zone Air Quality Management Guidelines. PASZA is an independent entity that provides progress updates to CASA, shares some common members and directors, and whose members contribute significantly to the following CASA project teams:

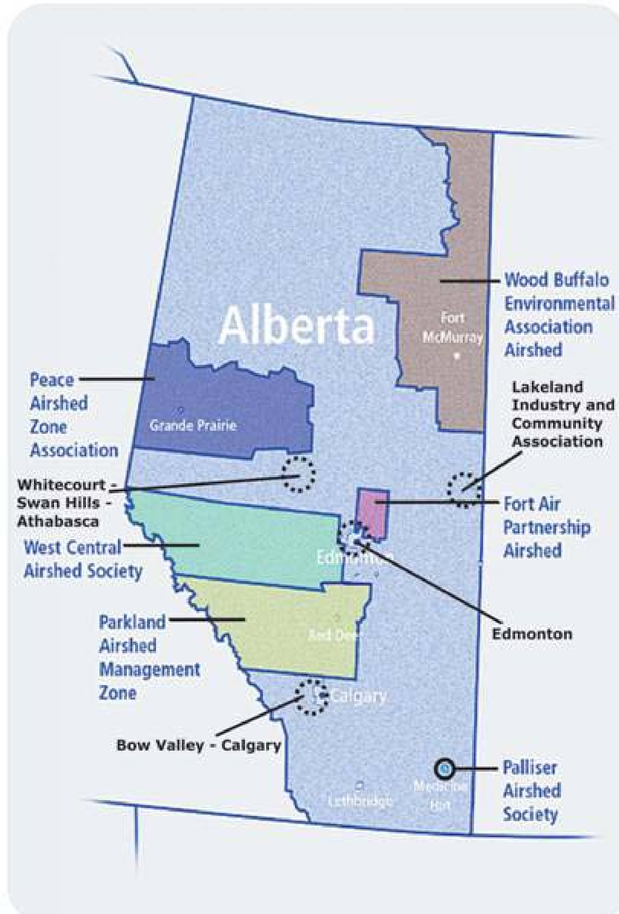
- Airshed Zones Committee
- Ambient Air Quality Monitoring Operations Steering Committee
- Air Monitoring Strategic Planning Committee
- Ecological Effects Workshop Organizing Committee

PASZA shares information with the other existing regional airshed management zones and new zones as they establish their management plans and develop their monitoring programs.

The West Central Airshed Society (WCAS), is located approximately 80 kms south of PASZA's southern boundary and includes the towns of Hinton, Edson, and Drayton Valley. WCAS was established in January 1995 and was the first air quality management zone to be formed in Alberta. In 2004, the society operated a regional air quality monitoring network consisting of eight continuous monitoring stations.

The Parkland Airshed Management Zone (PAMZ) is located south of the WCAS Zone and covers an area of approximately 42,000 sq. km. and includes the City of Red Deer. In 2004 it operated a regional monitoring network that consisted of four continuous and thirty-three passive stations. The priority issues for this zone include human health, livestock health, and emissions from confined feeding operations.

The Wood Buffalo Zone, operated by the Wood Buffalo Environmental Association (WBEA), has implemented a monitoring network in the Regional Municipality of Wood Buffalo. This Zone covers an area of 68,500 sq. km. stretching south from the Alberta/ Northwest Territories border to the south of Fort McMurray and includes the regions two major population centers, Fort Chipewyan and Fort McMurray. In 2004, the association operated a regional air quality monitoring network that consisted of thirteen continuous and ten passive monitoring stations as well as an extensive terrestrial effects monitoring program.



The Fort Air Partnership Zone located northeast of Edmonton covers an area of 6,000 sq. km. encompassing Fort Saskatchewan and the surrounding area. In 2004, the partnership operated a regional air quality monitoring network consisting of eight continuous monitoring stations. The area's stakeholders plan to use the information gathered from the network to manage regional air quality, protect environmental health and influence policy.

The province's newest airshed, the Palliser Airshed was formally established in the Medicine Hat-Redcliff area in 2003. For 2004, its air quality monitoring network consisted of one continuous and four passive stations.

During 2004, efforts continued in the establishment of airshed management zones in the Edmonton, Calgary, the Whitecourt-Swan Hills-Athabasca and Bonnyville-Cold Lake-Elk Point regions of the province.

6.0 PASZA Regional Air Quality Monitoring Program

The first step in the process of developing, implementing and evaluating strategies to address the zone's air quality issues is the collection of data by a comprehensive Regional Air Quality Monitoring (AQM) Program in order to better understand the air quality within the zone's boundaries. Informed decision-making concerning air quality issues requires information that has been derived from data that are complete, comprehensive and scientifically credible.

Henry Pirker Air Monitoring Station

For 2004, The PASZA Regional AQM Program consisted of its zone-wide 43-station Passive Monitoring Network and the Henry Pirker Continuous AQM Station, located in Grande Prairie, which began operations in February.

The startup of the Evergreen Park and Smoky Heights School continuous stations originally scheduled for the fall, were not operational in 2004. Approval of PASZA's joint application, to amend the operating approvals of eight member facilities based on the implementation of the continuous portion of PASZA's Regional AQM program, was not received until the end of the year. Surveying and preparation of the sites for the stations had begun by the year's end with installation and start-up planned for early 2005.

The Evergreen Park station will be located on the southeast boundary of Grande Prairie at a Telus Cellular Tower Site near Resources Road. This station will provide data that will help PASZA to understand the levels of emissions entering and leaving Grande Prairie.

The Smoky Heights School station will be located approximately 55 km northeast of Grande Prairie where passive monitoring has indicated that annual average ground-level concentrations of Sulphur Dioxide are among the highest observed in the zone.

Both the Evergreen Park and Smoky Heights School stations will be housed in shelters that will be donated by Weyerhaeuser Canada and will also utilize some of the instrumentation, analyzers and associated monitoring equipment that were used for ambient monitoring of their Grande Prairie Mill Operations. This program has been replaced by the PASZA Regional AQM Program.

Also In 2005, PASZA will take over the operations of the Beaverlodge station. This is an existing AQM Station located near the community of Beaverlodge at the Agriculture Canada Research Farm. It is currently owned and operated by Alberta Environment. It has been operating continuously for two decades and provides usable data both from a historical and a provincial monitoring perspective.

In future years PASZA plans to add two more continuous AQM Stations into its Regional AQM Program.

The Valleyview station will be located approximately 14 km southeast of Valleyview where passive monitoring has indicated that annual average ground-level concentrations of Sulphur Dioxide are among the highest observed in the zone. Significant ground-level concentrations of Nitrogen Dioxide are also present in this area due primarily to the vehicle emissions associated with Highway 43. The station will utilize an existing industry-operated station already located at the site.

The Rover Station will be a portable trailer equipped to monitor a broad range of air quality parameters and will be designated as the zone's second human health "superstation". It will be moved to various locations in the zone where the passive monitoring program has indicated high levels of ozone and/or other monitored parameters.

6.1 Continuous Air Quality Monitoring

Continuous monitoring involves drawing air through a commercial analyzer calibrated to produce an output that is proportional to the ambient concentration of the compound being monitored. This methodology provides the greatest resolution but is also the most costly.

PASZA's Henry Pirker Station is configured for monitoring a number of parameters from a wide range of natural, industrial, non-industrial and mobile emission sources. The air quality and meteorological parameters monitored are consistent with those in other Airsheds within Alberta and the Alberta Ambient Air Quality Monitoring System (AAAQMS) Network. These include: sulphur dioxide (SO_2), total reduced sulphur compounds (TRS), various oxides of nitrogen (NO_2, NO and NO_X), ozone (O_3), carbon monoxide (CO), total hydrocarbons (THC), and fine or respirable particulate matter 2.5 microns in diameter and smaller ($PM_{2.5}$).

The analyzers used in the program are capable of detecting extremely low level concentrations of compounds. The intensive Quality Assurance and Quality Control (QA/QC) program associated with the monitoring and the data management make it possible to detect subtle changes and trends in data. This allows for assessment of the impacts of various emission-producing operations within the zone.

Air quality depends on the rate that pollutants are emitted to the atmosphere and the rate at which these compounds are dispersed away from the sources. Air pollution transport and dispersion are influenced by wind speed and direction, the temperature structure of the atmosphere, the solar cycle, turbulence and changes in these elements induced by local topography.

The interpretation of the continuous and passive data is supported by basic meteorological measurements. Meteorological parameters measured in support of PASZA's Regional Air Quality Monitoring Program are:

- wind speed and direction
- temperature
- relative humidity
- rainfall
- solar radiation.

Above - Air Quality Monitoring Instrumentation inside the Henry Pirker Air Monitoring Station
Below - Aerial View of the Henry Pirker Site (X) located in Grande Prairie's Muskoseepi Park

6.1.1 Air Quality Index

The Air Quality Index (AQI) is a system developed to provide the public with a meaningful measure of outdoor air quality that is simple and easy to understand. From the AQI, we can effectively rate air quality Good, Fair, Poor or Very Poor.

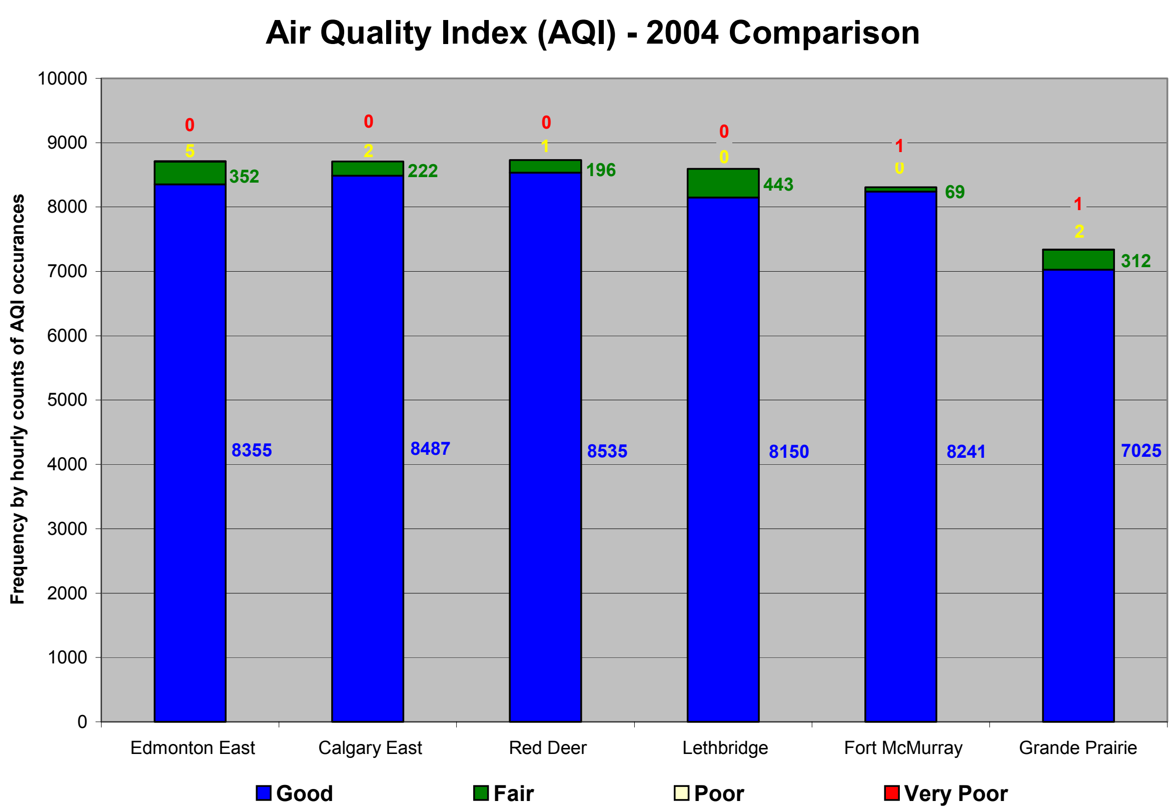
The AQI converts concentrations of five major air pollutants to a single numerical value and matching description. A rating of 0-25 indicates Good air quality, 26-50 is Fair, 51-100 is Poor, and more than 100 is Very Poor.

The AQI is based on outdoor concentrations of carbon monoxide, fine particulate matter ($PM_{2.5}$), nitrogen dioxide, ozone and sulphur dioxide. A minimum of four of the above listed pollutants is required to calculate the AQI.

The summary of the 2004 AQI Information for Grande Prairie and other stations throughout the province summarized in the graph below. The Grande Prairie AQI was calculated from data collected at the Henry Pirker Monitoring Station. As discussed earlier, this station was not operational until February 2004 and is based on a total of 7,340 of hours of data.

For February-December 2004, the AQI for Grande Prairie was Good 95.7% of the time and Fair 4.2 % of the time. The AQI was poor for two hours, from 1900-2100 hrs on August 13, due to high concentrations of $PM_{2.5}$ in smoke from forest fires burning upwind of Grande Prairie. The AQI was poor for one hour only, from 2200-2300 hrs on December 31, again due to high smoke-born concentrations of $PM_{2.5}$. In this instance the smoke came from a nearby New Years Eve Fireworks Display just northwest of the station.

With the exception of Lethbridge, the percentage of hours with a good or fair AQI in Grande Prairie was slightly less than in the other large Alberta cities detailed in the graph below. Similar to Lethbridge, the reason for this is difference is primarily the higher ozone levels typically observed in and around Grande Prairie (discussed further in Section 6.1.3) and the influence of high particulate levels arising from occasional events (discussed further in Section 6.1.8).



6.1.2 Nitrogen Oxides

Oxides of nitrogen (NO_X), mostly in the form of nitric oxide (NO) and nitrogen dioxide (NO_2), are products of all types of combustion, but are primarily produced by combustion at higher temperatures. For the purposes of air quality monitoring, oxides of nitrogen are considered to be the sum of nitric oxide and nitrogen dioxide. Most oxides of nitrogen are emitted in the form of nitric oxide. Nitric oxide reacts rapidly in the atmosphere through various mechanisms to form nitrogen dioxide. Nitrogen dioxide is a reddish-brown gas with a pungent irritating odour.

Oxides of nitrogen emissions are produced by transportation sources (automobiles, trucks, trains), industrial sources (oil and gas industries) and power generation plants. Other sources of oxides of nitrogen include natural gas combustion (e.g. home heating), heating fuel combustion and forest fires. The largest urban source of oxides of nitrogen is emissions from motor vehicles.

At higher concentrations, nitrogen dioxide is an irritating gas that may constrict the airways of asthmatics and increase the susceptibility to infection in the general population. It is a major component of atmospheric photochemical reactions that lead to smog formation, acid rain and ground level ozone formation and destruction. Exposure of vegetation to high concentrations of oxides of nitrogen results in observable effects such as leaf colouring and impairment of leaf function.

Alberta Environment's Alberta Ambient Air Quality Objective (AAAQO) for nitrogen dioxide, the major nitrogen oxides component of concern in the ambient atmosphere, are:

- 212 ppb averaged over a one-hour period
- 106 ppb averaged over a twenty-four hour period
- 32 ppb as an annual arithmetic mean

No exceedences of the annual average AAAQO (32 ppb) for nitrogen dioxide were observed in Alberta during 2004.

The annual average nitrogen dioxide concentration observed at Grand Prairie's Henry Pirker Station in 2004 was 9.9 ppb. This result is somewhat consistent with the size of the population of the City of Grande Prairie when compared with levels in other cities in the province. It is lower than the averages of 22.6, 16.2, and 12.8 ppb for the larger cities of Calgary, Edmonton, and Red Deer respectively. It is higher than the averages of 9.2, 8.2 and 7.0 ppb observed in the cities of Fort McMurray, Medicine Hat and Lethbridge respectively. According to the 2001 Population Census all these cities are more populated than Grande Prairie. When compared to these last three stations, the higher annual average observed at the Henry Pirker Station is likely more a function of its proximity to a major roadway (Highway 43) and the associated motor vehicle traffic.

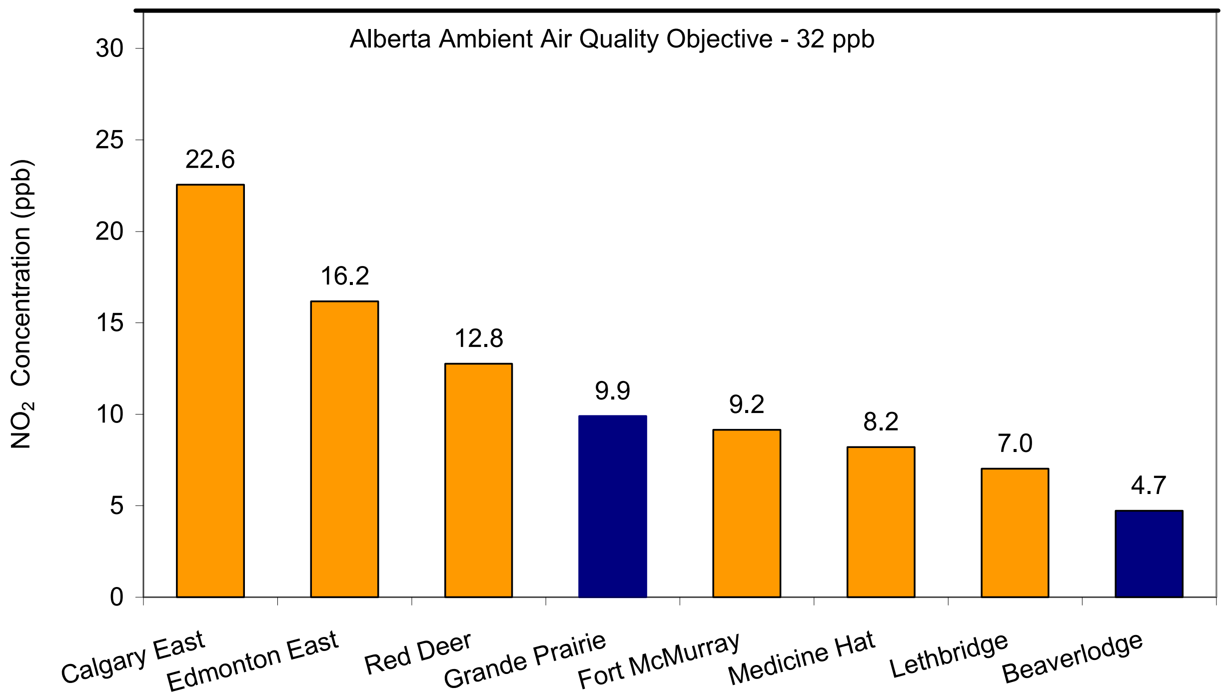
The annual average nitrogen dioxide concentration observed at the Beaverlodge Station in 2004 was 4.7 ppb. This result is consistent with the stations rural location and its distance away from major motor vehicle traffic.

No exceedences of the one-hour average AAAQO for nitrogen dioxide (212 ppb) were observed at the Henry Pirker and Beaverlodge Stations in 2004. The maximum one-hour average nitrogen dioxide concentrations observed at Grande Prairie's Henry Pirker Station (71 ppb) and the Beaverlodge Station (45 ppb) were 33% and 21 % of the one-hour average AAAQO respectively. These results are both consistent with the two stations' proximities to motor vehicle traffic and occurred when the winds were from directions associated with motor vehicle traffic.

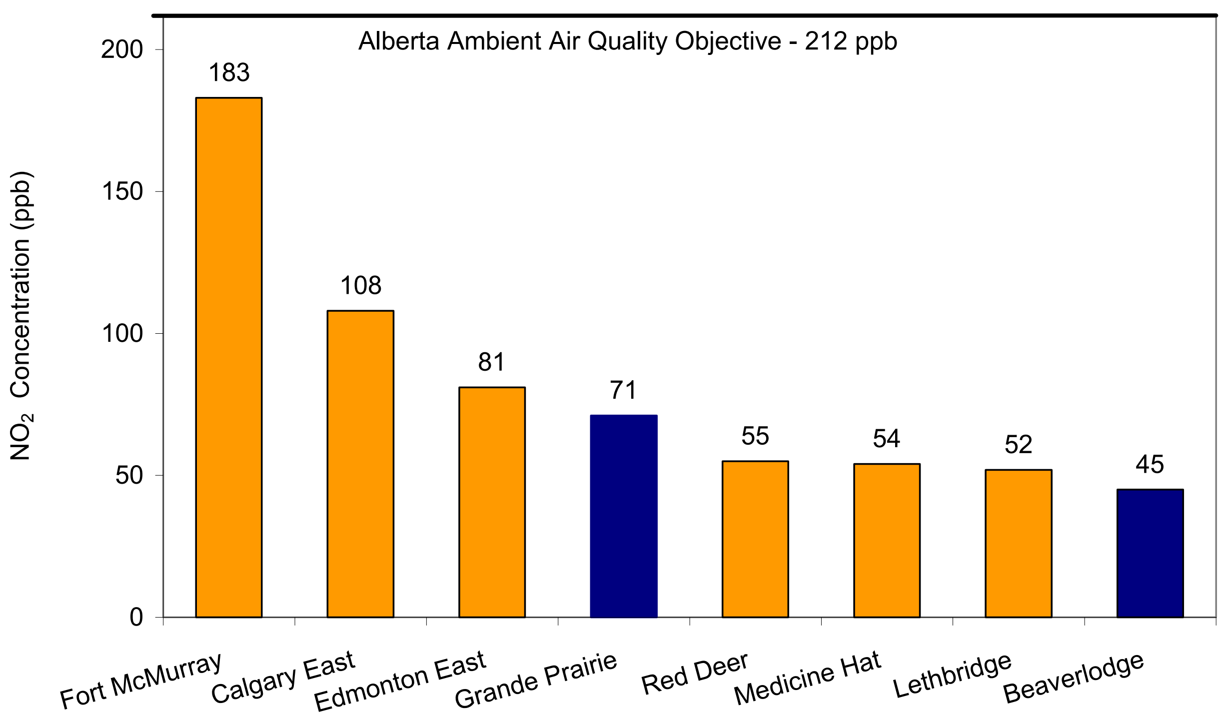
The hourly maximum of 71 ppb observed at the Henry Pirker Station occurred during the morning of February 12 with near calm southeasterly winds. The hourly maximum of 45 ppb observed at the Beaverlodge Station occurred during the morning of February 24 with light west winds.

Again, when ranked with other stations in Alberta cities, the results are similar to the annual averages ranking with Grande Prairie near the middle and Beaverlodge being the lowest.

Nitrogen Dioxide (NO_2) - Alberta 2004
Ambient Annual Averages



Nitrogen Dioxide (NO_2) - Alberta 2004
Maximum Ambient Hourly Averages



6.1.3 Ozone

Ozone (O_3) is a colorless gas that at normal outdoor concentrations is odourless. However, ozone does have a distinctive sharp odour when found at higher concentrations, such as those associated with electrical discharges from lightning storms or photocopiers.

At higher concentrations, ozone's health effects can include reduced lung function; aggravated existing respiratory illness; and irritated eyes, nose, and throat as it is a strong oxidizer. High concentrations can reduce crop yields. Chronic exposure can cause permanent damage to the alveoli of the lungs.

The ozone layer in the upper atmosphere (stratosphere) absorbs UV radiation and creates a warm layer of air in the stratosphere. The ozone layer is, therefore, responsible for the thermal structure of the stratosphere. Stratospheric ozone shields the Earth against harmful rays from the sun, particularly ultraviolet B radiation. Ozone that is present at ground level (troposphere) is a pollutant, as it is involved with oxides of nitrogen in the photochemical production of many of the constituents of air pollution. It is also a primary constituent of smog.

Globally, ground-level ozone is mostly anthropogenic. However ozone is different from other pollutants in that it is not emitted directly into the air. It is a "secondary" pollutant because it is produced when two "primary" precursor pollutants, nitrogen oxides and volatile organic compounds (VOCs), react in the presence of heat and sunlight under stagnant meteorological conditions. VOCs are emitted from a variety of sources, including motor vehicles, chemical plants, refineries, factories, consumer and commercial products, other industrial sources and forests. Ozone and the precursor pollutants that cause ozone can also be transported into an area from pollution sources, such as urban centers and industrial complexes, that are located hundreds of kilometers upwind. A major source of VOCs in rural areas is natural emissions from trees and vegetation.

Ozone can be destroyed through reactions with nitric oxide. In Alberta, ozone concentrations are generally lower at urban locations than at rural locations, most likely because of the destruction of ozone by nitric oxide emitted by motor vehicles. In Alberta, maximum ozone values are generally recorded during the late spring and summer when ozone production in the lower atmosphere is at a maximum due to a peak in incoming sunlight combined with stagnant weather conditions. At other times of the year, high daily average ozone values may be influenced by dynamic atmospheric processes such as tropopause folding and episodes of stratospheric ozone intrusion.

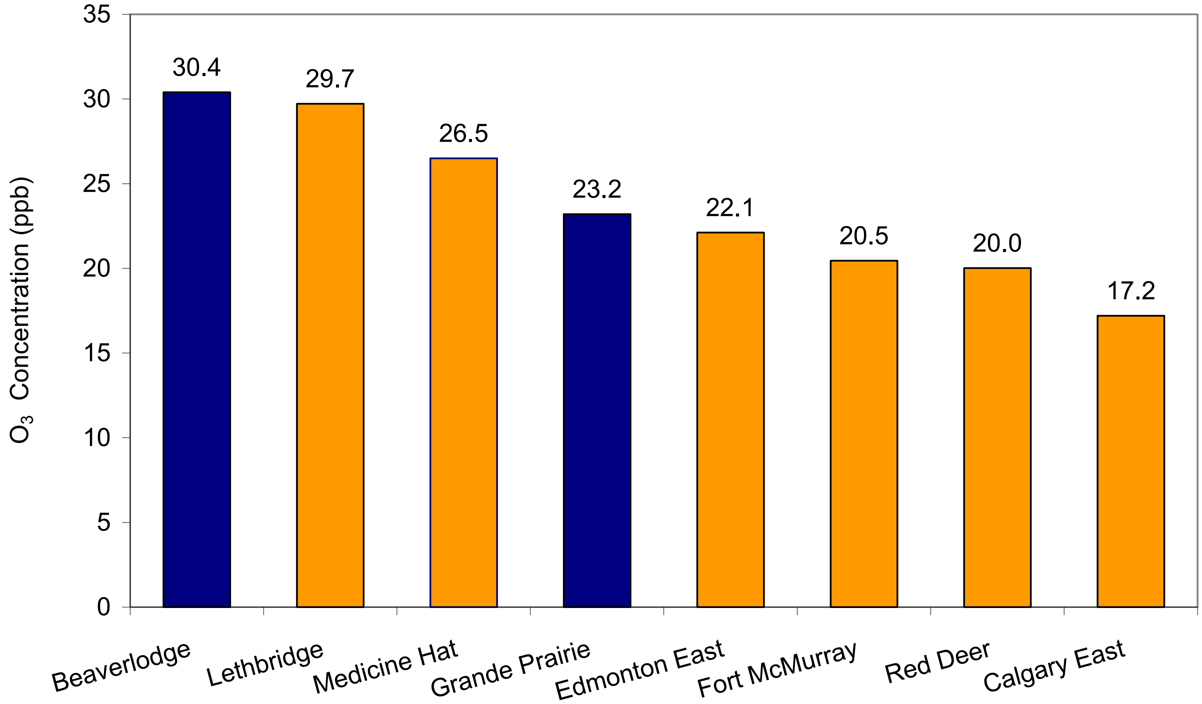
A Canada Wide Standard for ozone has been issued. It is 65 ppb based on an 8-hour running average. Achievement of the standard will be based on averaging the annual 4th highest daily 8-hour average ozone value over 3 consecutive years. The AAAQO for ozone based on the prevention of adverse effects to human health and vegetation is:

- 82 ppb averaged over a one-hour period

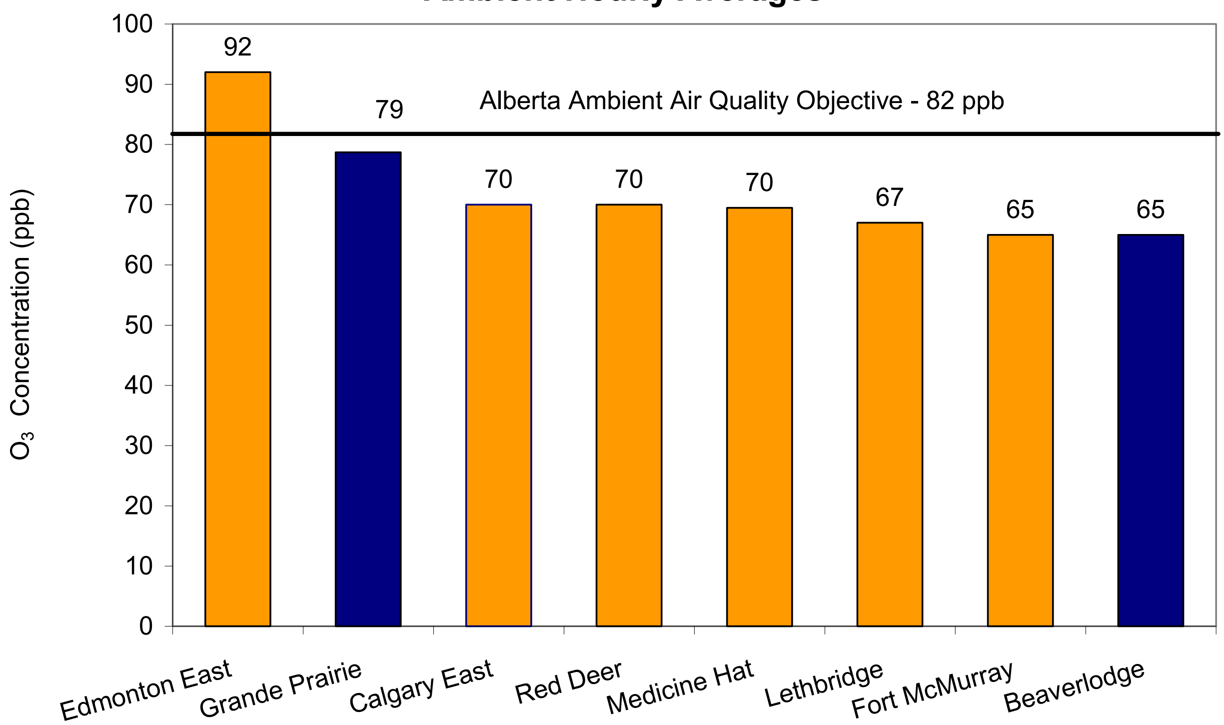
The annual average ozone concentration observed in Beaverlodge and Grande Prairie in 2004 was 30.4 and 23.2 ppb respectively. These values are consistent with, and typical of, the values observed at other rural and urban locations where continuous ozone monitoring is conducted in Alberta. In general, the larger the city, the larger its volume of traffic and the associated emissions of nitric oxide. The nitric oxide reacts with ozone and thus limits ozone levels. In general then, the larger the city, the lower the annual average ozone level as evidenced by the top graph on the opposite page.

There were no exceedences of the one-hour average O_3 AAAQO observed in Beaverlodge or Grande Prairie during 2004. The maximum one-hour average ozone concentration observed in Grande Prairie was the 79 ppb reading observed mid-day on July 23, a day with high solar radiation levels and warm temperatures, two conditions conducive to ozone formation. The maximum one-hour average ozone concentrations observed in Beaverlodge were the two 65 ppb readings observed in the early evening of June 27 and mid-afternoon of June 30; these were also two days with high solar radiation levels and warm temperatures.

Ozone (O_3) - Alberta 2004 Ambient Annual Averages



Ozone (O_3) - Alberta 2004 Maximum Ambient Hourly Averages



6.1.4 Sulphur Dioxide

Sulphur dioxide (SO_2) is a colorless gas with a strong, suffocating odour. It can be detected by taste and odour at concentrations as low as 300 parts per billion (ppb).

Short-term (acute) exposures to high concentrations of sulphur dioxide can trigger constriction of the airways, causing particular difficulties for asthmatics. Children can experience increased respiratory tract infections and healthy people may experience sore throats, coughing, and breathing difficulties. Sensitive vegetation may be injured by exposure to high concentrations of sulphur dioxide. Long-term (chronic) exposure has been associated with increased risk of mortality from respiratory or cardiovascular disease.

Sulphur dioxide is formed during the processing and combustion of fossil fuels that contain sulphur such as gasoline, natural gas, oil, coal and oil sands. Volcanic eruptions provide a natural source of sulphur dioxide in the atmosphere. The largest sources of sulphur dioxide in the Peace Airshed Zone are the large incinerator stacks at local gas processing plants. Other zonal sources include smaller oil and gas plant, battery and well flares. Elsewhere in the province heavy oil and oil sands facilities, coal-fired power generation plants, pulp and paper mills and fertilizer plants are major sources.

Sulphur dioxide is emitted directly into the atmosphere where it can persist for days, allowing for wide distribution of the gas. In the atmosphere, some sulfur dioxide can be oxidized by ozone and hydrogen peroxide to form sulfur trioxide. Both sulfur trioxide and sulfur dioxide are soluble in water and if they are present in the atmosphere when condensation occurs, tiny droplets of sulfuric acid (acid rain) are formed.

The Alberta Ambient Air Quality Objectives (AAAQO) for sulphur dioxide are:

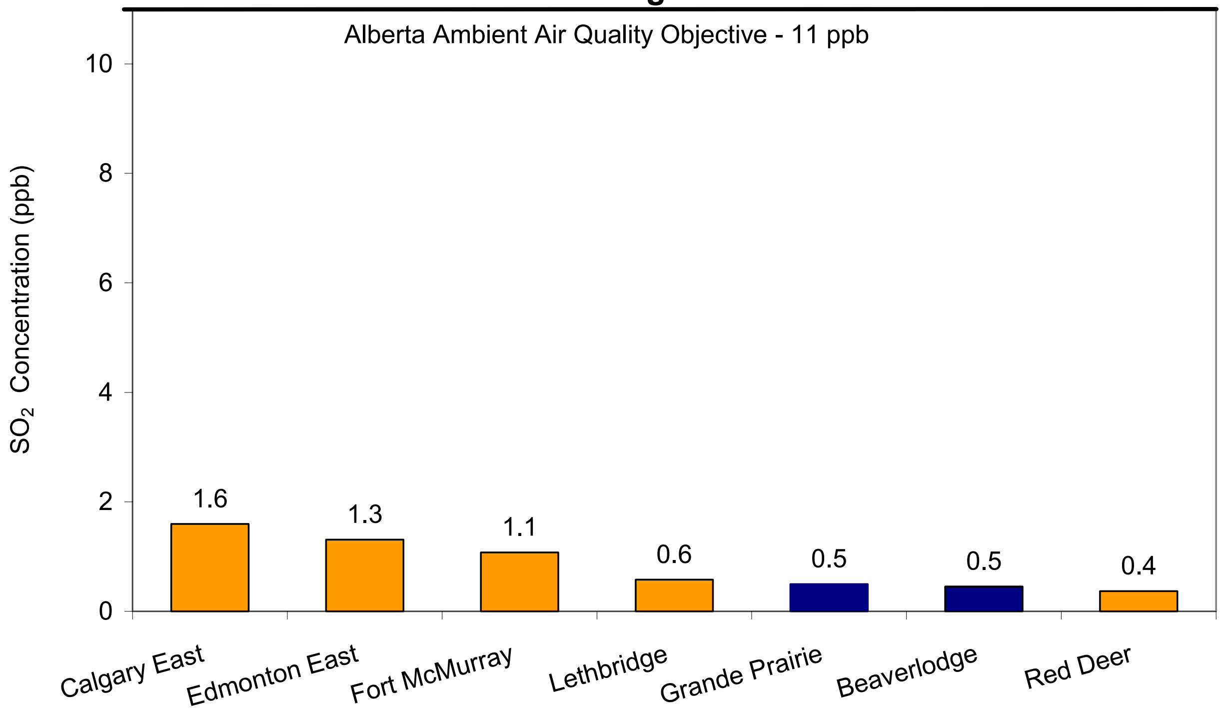
- 172 ppb averaged over a one-hour period
- 57 ppb averaged over a twenty-four hour period
- 11 ppb as an annual arithmetic mean

The annual average sulphur dioxide concentration observed at the Henry Pirker Station located in Grande Prairie and the Beaverlodge Station were both 0.5 ppb. These annual averages were below the averages observed in all other major cities in Alberta where sulphur dioxide is being monitored with the exception of Red Deer (0.4 ppb). All of the these values were well below the annual average AAAQO of 11 ppb.

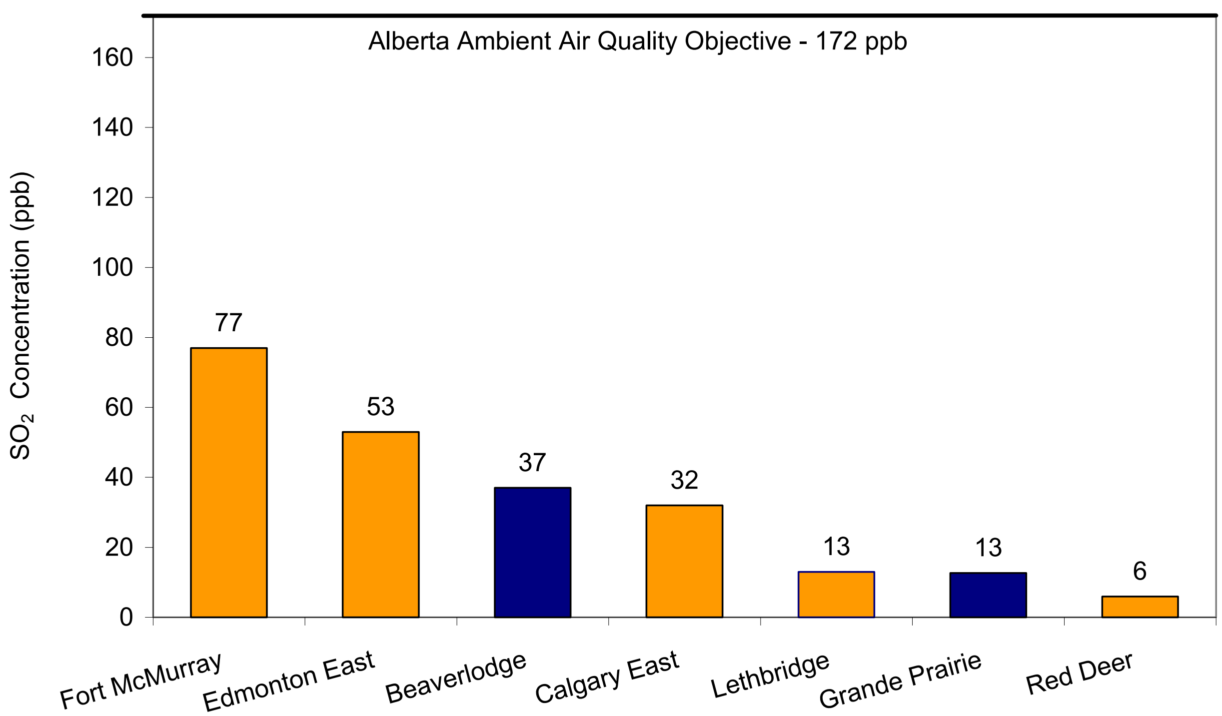
No exceedences of the one-hour average AAAQO for sulphur dioxide (172 ppb) were observed at the Henry Pirker and Beaverlodge Stations in 2004. The maximum one-hour average sulphur dioxide concentrations observed at Grande Prairie's Henry Pirker Station (13 ppb) and the Beaverlodge Station (37 ppb) were 8% and 22% of the one-hour average AAAQO respectively. These results are both consistent with the two stations' relative proximities to sour oil and gas operations, the primary source of sulphur dioxide within PASZA.

The hourly maximum of 13 ppb observed at the Henry Pirker Station occurred during the morning of October 9 with moderate westerly winds. The hourly maximum of 37 ppb observed at the Beaverlodge Station occurred at noon on November 8 with light southeasterly winds.

Sulphur Dioxide (SO_2) - Alberta 2004 Ambient Annual Averages



Sulphur Dioxide (SO_2) - Alberta 2004 Maximum Ambient Hourly Averages



6.1.5 Total Reduced Sulphurs

The term "total reduced sulphur compounds" (TRS) is used to describe hydrogen sulphide, mercaptans and other reduced sulphur compounds such as carbonyl sulphide (COS) and carbon disulphide (CS_2). All of these compounds have characteristic unpleasant odours that are detectable by people at very low concentrations.

A major component of the TRS observed by the PASZA continuous monitors is hydrogen sulphide. The decomposition of organic matter by bacteria under anaerobic conditions (no oxygen) produces hydrogen sulphide. Natural sources of hydrogen sulphide include sulphur hot springs, sloughs, swamps, muskegs and lakes. Hydrogen sulphide is also produced by chemical reactions within the deeply buried sedimentary rocks found in the foothills of the Canadian Rockies. "Sour" gas is natural gas containing hydrogen sulphide. Industrial sources of hydrogen sulphide include fugitive emissions from sour gas processing plants, sulphur pouring and remelting operations, flaring, petroleum refineries, tank farms, oil sands facilities, sewage and manure treatment facilities, pulp and paper plants which use the kraft pulping process and various intensive livestock operations.

Hydrogen sulphide (H_2S) is a colourless gas with a rotten egg odour. While most people can smell hydrogen sulphide at approximately 10 ppb, there are some sensitive individuals who can detect it at concentrations as low as 0.5 ppb. Hydrogen sulphide is heavier than air and is generally emitted at lower temperatures, so it does not disperse rapidly when stagnant meteorological conditions are present and may linger in low-lying areas such as valleys.

At concentrations of 1,000-5,000 ppb, H_2S causes a moderate to strong offensive odour and people may experience nausea, tearing of the eyes, headaches or loss of sleep following prolonged exposure. By 10,000 ppb, the symptoms may increase or persist with lung irritation and damage to eyes occurring at levels of 20,000 ppb. The maximum hourly ambient concentrations of total reduced sulphur (including hydrogen sulphide) observed at the Henry Pirker Station in 2004 (5 ppb) was far, far below these levels.

The sources of the other reduced sulphur compounds are treatment lagoons associated with kraft paper mills, incomplete combustion in sour gas flares and fugitive emissions from pipelines (mercaptans are used as an odorant in natural gas).

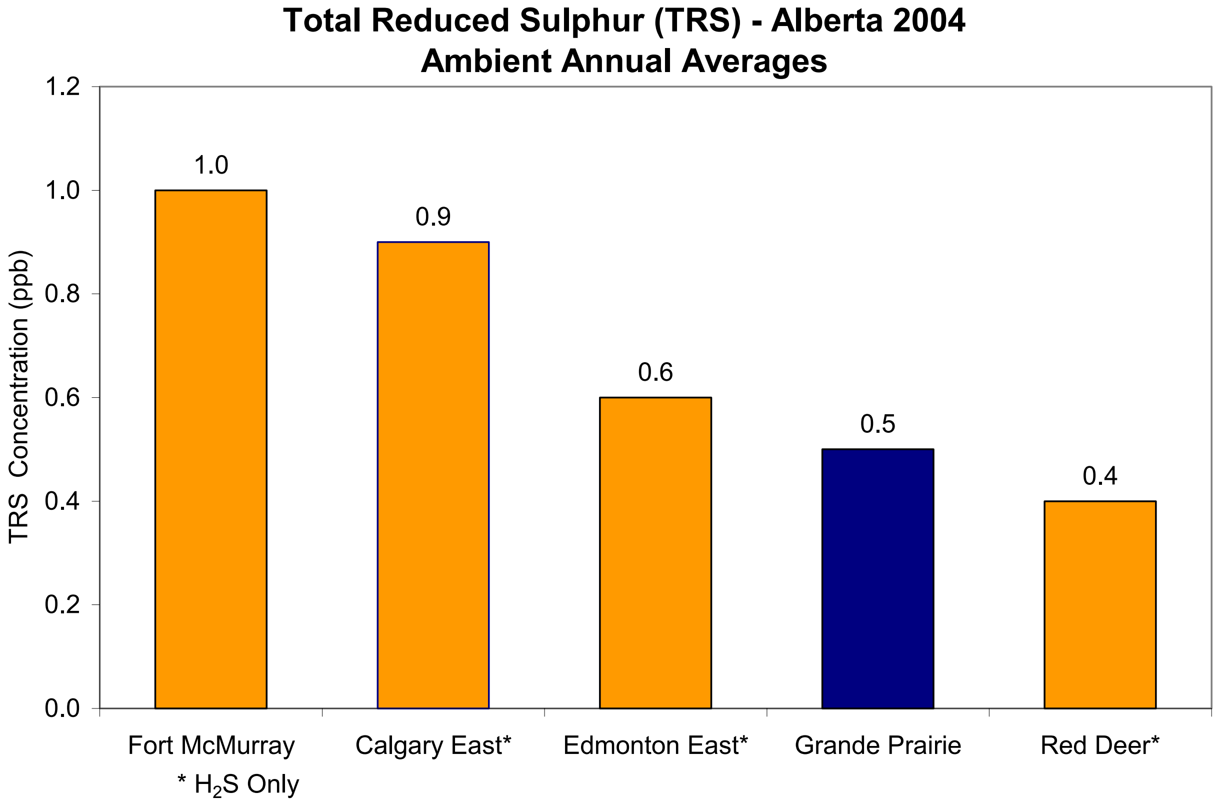
While there are currently no AAAQO for TRS in general, there are guidelines for H_2S specifically and these are being used by PASZA for reporting TRS. The AAAQO for hydrogen sulphide are based on an odour threshold of 10 ppb. The guidelines for hydrogen sulphide are:

- 10 ppb averaged over a one-hour period
- 3 ppb average over a twenty-four hour period

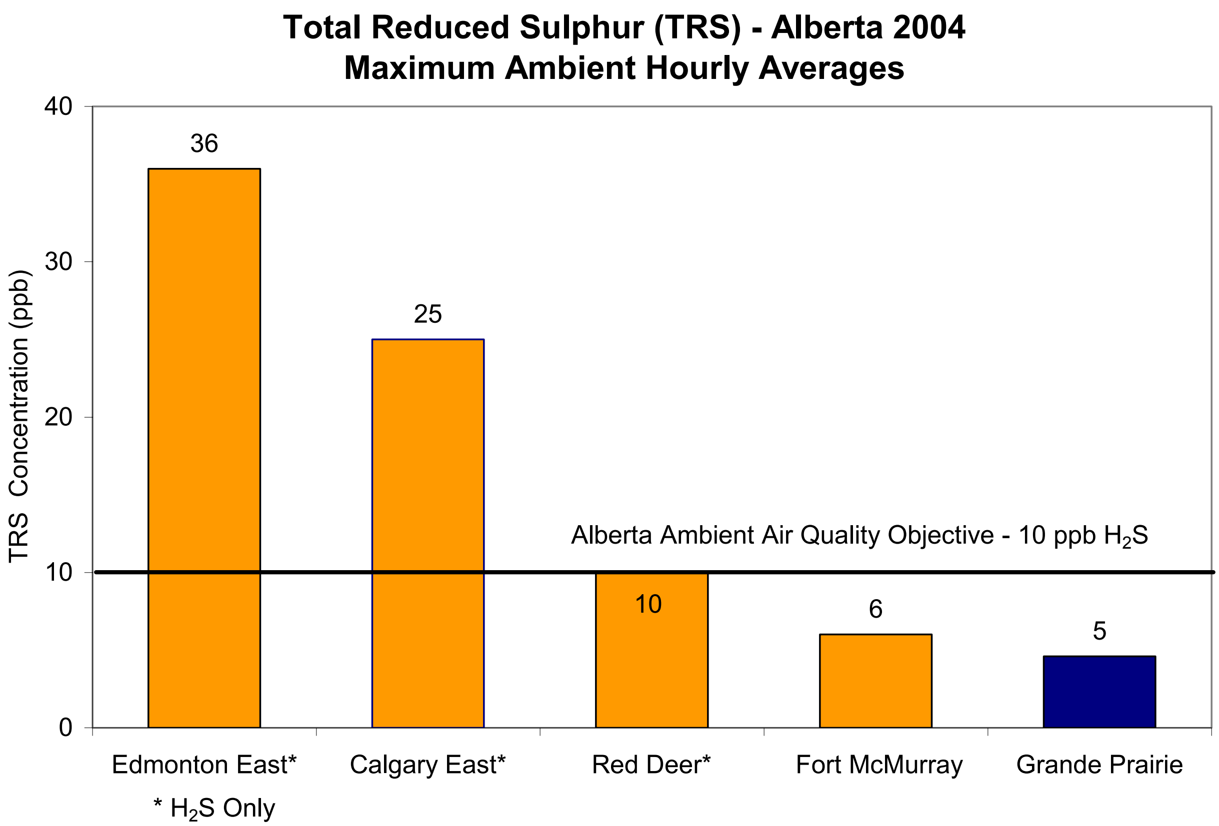
The annual average total reduced sulphur concentration observed at the Henry Pirker Station in Grande Prairie in 2004 was 0.5 ppb, a value lower than those calculated for similarly located stations in Fort McMurray (1.0 ppb), Calgary (0.9 ppb), and Edmonton (0.6 ppb). Neither TRS nor H_2S are monitored at the Beaverlodge Station.

No exceedences of the H_2S AAAQO were observed at the Henry Pirker Station during 2004. For comparison purposes, there were a total of 7 and 4 exceedences of the one-hour average H_2S AAAQO observed at the Calgary East and Edmonton East Stations respectively in 2004.

The maximum hourly average TRS concentration observed at the Henry Pirker Station in 2004 was 5 ppb. It occurred on two occasions. The first reading occurred the evening of October 25 with moderate northeast winds. The second occurred the evening of December 31 and was associated with emissions from a fireworks display just northwest of the station that has been discussed previously. These hourly maximum concentrations were below the H_2S concentrations observed at the Calgary East (36 ppb), and Edmonton East (25 ppb) stations.



Total Reduced Sulphur (TRS) - Alberta 2004
Ambient Annual Averages
TRS Concentration (ppb)
1.2
1.0
0.8
0.6
0.4
0.2
0.0
1.0
0.9
0.6
0.5
0.4
Fort McMurray
Calgary East*
Edmonton East*
Grande Prairie
Red Deer*
* H_2S Only



Total Reduced Sulphur (TRS) - Alberta 2004
Maximum Ambient Hourly Averages
TRS Concentration (ppb)
40
30
20
10
0
36
25
10
6
5
Alberta Ambient Air Quality Objective - 10 ppb H_2S
Edmonton East*
Calgary East*
Red Deer*
Fort McMurray
Grande Prairie
* H_2S Only

6.1.6 Hydrocarbons

Hydrocarbons are divided into two broad categories, "reactive" and "non-reactive" hydrocarbons. The term "total hydrocarbons" (THC) refers to a broad family of chemicals that contain carbon and hydrogen atoms and includes both reactive and non-reactive hydrocarbons.

Reactive hydrocarbons include many volatile organic compounds such as alkenes, alkynes, benzene, toluene, ethylbenzenes and xylenes and other aromatics. Reactive hydrocarbons are important because they can react with oxides of nitrogen in the presence of sunlight to form ozone and may be toxic to humans, animals or vegetation. Polycyclic aromatic hydrocarbons are of particular interest because they are less volatile than other reactive hydrocarbons and many are known carcinogens.

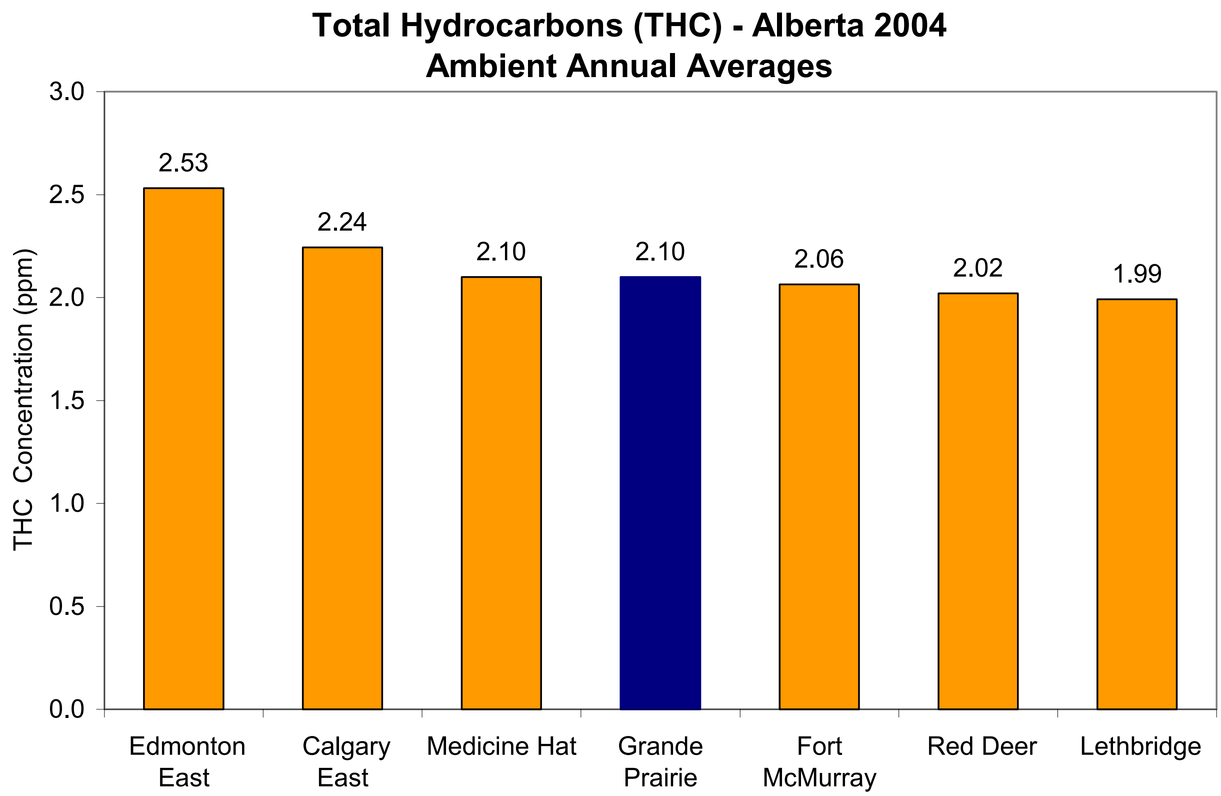
Trees and plants are major natural emitters of reactive hydrocarbons with other significant sources being intensive livestock operations, vehicular emissions, gasoline marketing and storage tanks, petroleum and chemical industries, dry cleaning, fireplaces, natural gas combustion and aircraft traffic. Motor vehicles are the major source of hydrocarbons in urban areas.

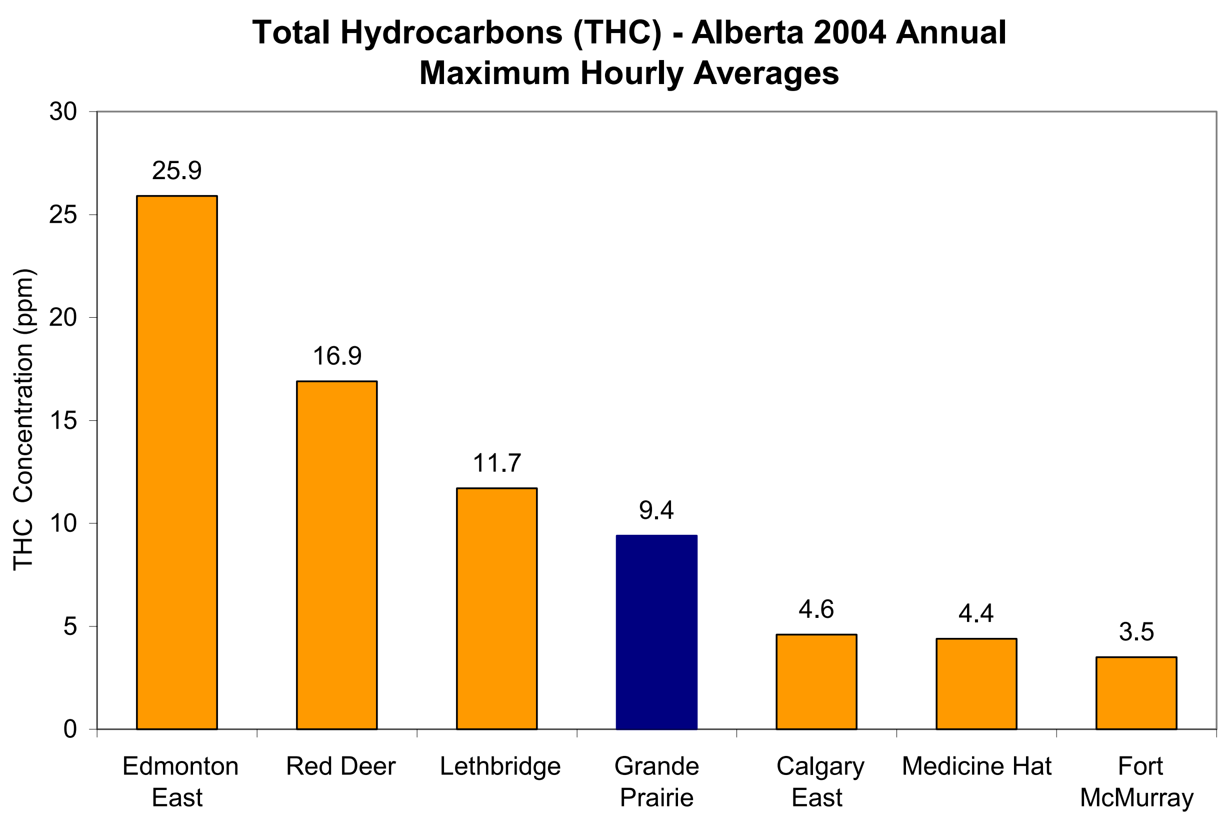
The major non-reactive hydrocarbon in the atmosphere is methane, which is a naturally occurring colorless, odorless gas that is regarded by many to be a major contributor to the greenhouse effect. Large amounts of methane are produced naturally from bogs, shallow lakes and soils through the decay of vegetation under anaerobic conditions. The global background total hydrocarbon level is currently about 1.8 ppm consisting primarily of methane. Human activity is contributing to a worldwide increase in ambient methane concentrations of approximately 2-8 ppb/year in recent years.

While Alberta Environment does not have objectives for ambient (outdoor) concentrations of total hydrocarbons it does have guidelines for some specific reactive hydrocarbons such as benzene and styrene. The establishment of guidelines for more reactive hydrocarbons is currently being considered.

The annual average total hydrocarbon concentration observed at the Henry Pirker station in Grande Prairie in 2004 was 2.10 ppm This value was slightly lower than the averages observed in Edmonton, Calgary and Medicine Hat and higher than the averages observed in Fort McMurray, Red Deer and Lethbridge. THC concentrations are not monitored at the Beaverlodge Station.

The maximum one-hour average THC concentration observed at the Henry Pirker Station was the 9.4 ppm reading observed in the evening of July 23 with moderate easterly winds.


Total Hydrocarbons (THC) - Alberta 2004
Ambient Annual Averages
THC Concentration (ppm)
3.0
2.5
2.0
1.5
1.0
0.5
0.0
2.53
2.24
2.10
2.10
2.06
2.02
1.99
Edmonton East
Calgary East
Medicine Hat
Grande Prairie
Fort McMurray
Red Deer
Lethbridge


Total Hydrocarbons (THC) - Alberta 2004 Annual
Maximum Hourly Averages
THC Concentration (ppm)
30
25
20
15
10
5
0
25.9
16.9
11.7
9.4
4.6
4.4
3.5
Edmonton East
Red Deer
Lethbridge
Grande Prairie
Calgary East
Medicine Hat
Fort McMurray

6.1.7 Carbon Monoxide

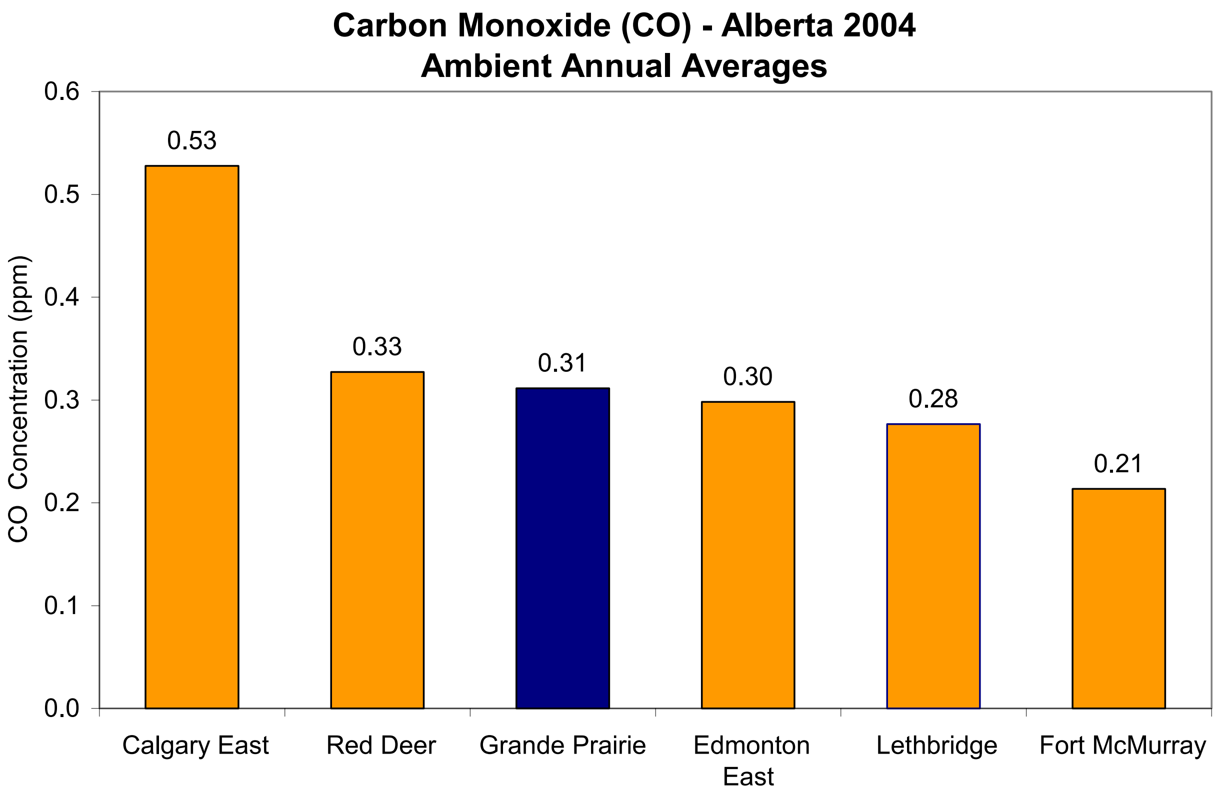
Carbon monoxide (CO) is a colourless, odourless gas formed when carbon-based fuels such as gasoline, oil, and wood burn with an insufficient supply of oxygen. Except for carbon dioxide, it is one of the longest lived naturally occurring atmospheric carbon compounds. The major source of CO in urban locations is motor vehicle exhaust emissions. Forest fires are also an important natural source of CO. Minor sources include fireplaces, industry, aircraft and natural gas combustion.

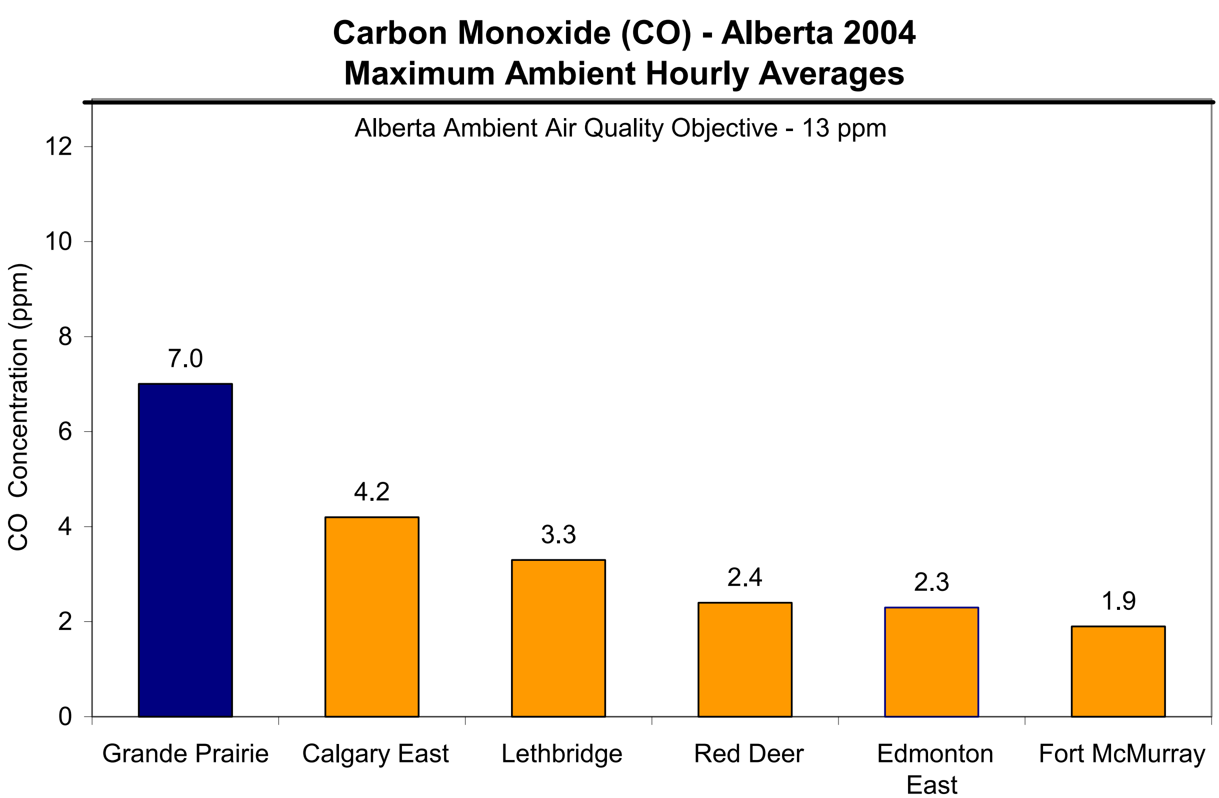
CO interferes with the blood's ability to carry oxygen to the body's tissues and results in numerous adverse health effects. The AAAQO for CO are based on the prevention of adverse human health effects. Alberta has adopted Environment Canada's most rigorous ambient air quality objective for CO. The AAAQO are:

- 13 ppm averaged over a one-hour period
- 5 ppm averaged over an eight-hour period

The annual average carbon monoxide concentration observed at the Henry Pirker Station in Grande Prairie in 2004 was 0.31 ppm, a value lower than those calculated for Calgary (0.53 ppm) and slightly lower than Red Deer (0.33 ppm) and higher than those calculated for Edmonton, Lethbridge and Fort McMurray. CO is not monitored at the Beaverlodge Station.

No exceedences of the CO one or eight-hour AAAQO were observed at the Henry Pirker Station during 2004. The maximum hourly average CO concentration observed at the Henry Pirker Station in 2004 was 7.0 ppm. It occurred on the morning of February 12 with very light southerly winds.


Carbon Monoxide (CO) - Alberta 2004
Ambient Annual Averages
CO Concentration (ppm)
0.6
0.5
0.4
0.3
0.2
0.1
0.0
0.53
0.33
0.31
0.30
0.28
0.21
Calgary East
Red Deer
Grande Prairie
Edmonton East
Lethbridge
Fort McMurray


Carbon Monoxide (CO) - Alberta 2004
Maximum Ambient Hourly Averages
Alberta Ambient Air Quality Objective - 13 ppm
CO Concentration (ppm)
12
10
8
6
4
2
0
7.0
4.2
3.3
2.4
2.3
1.9
Grande Prairie
Calgary East
Lethbridge
Red Deer
Edmonton East
Fort McMurray

6.1.8 Fine Particulate Matter

The term inhalable particulates, or PM_{10}, refers to particles that have a diameter of less than 10 microns and are suspended in the air for an indefinite period of time. PM_{10} is a mixture of various substances. These substances occur in the form of solid particles or as liquid drops. Some particles are emitted directly into the atmosphere. Other particles result from gases that are transformed into particles through physical and chemical processes in the atmosphere.

PM_{10} can be divided into two groups of particles based on size: fine particles and coarse particles. The fine particles are those particles that are less than about 2.5 microns in diameter and are known collectively as $PM_{2.5}$. In contrast, the coarse particles are those that are greater than about 2.5 microns in diameter.

Generally, the fine particles pose the greater health risk because these particles can be deposited deep in the lung and contain substances that may be harmful to health. In addition to their health impacts, the fine particles are the main contributors to reduced visibility. The particles give smog its colour. This fine fraction is also known as respirable particulate. Particulate pollution can cause eye, nose and throat irritation and other health problems. Numerous studies have linked respirable particulate matter to aggravated heart and lung diseases such as asthma, bronchitis and emphysema.

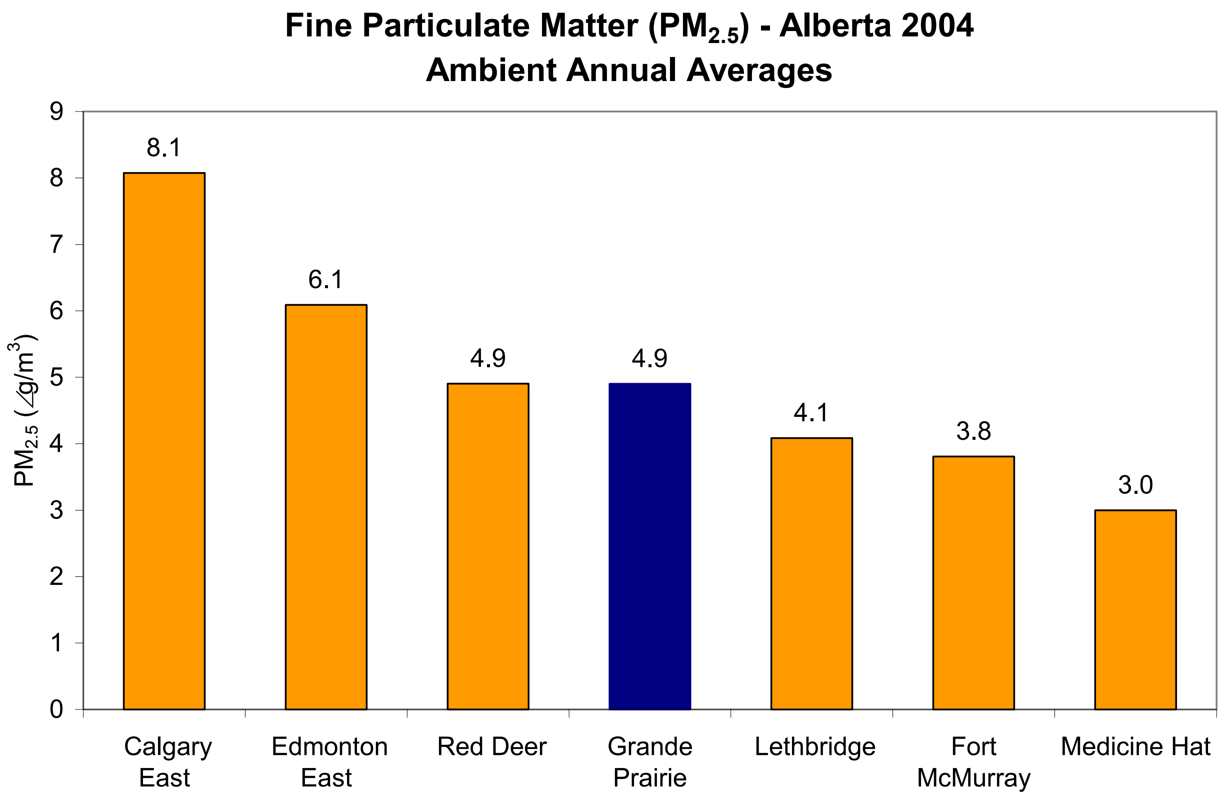
In Alberta, sources of inhalable particulates include soil, road dust, dust resulting from other human activities (e.g. harvesting), smoke from forest fires, smoke from recreational sources (e.g. campfires and fireplaces), smoke from other various sources (e.g. stubble-burning), vehicle exhaust emissions, and industrial emission sources (e.g. power plants, cement manufacturing facilities, coal mining operations and the forest products industry).

There are currently no Alberta Environment Objectives for PM_{10} or $PM_{2.5}$. A Canada Wide Standard (CWS) for $PM_{2.5}$ has been issued. The CWS for $PM_{2.5}$ is a 24 hour average of 30 micrograms per cubic meter (μg/m^3) based on the 98th percentile ambient measured annually, and averaged over 3 consecutive years.

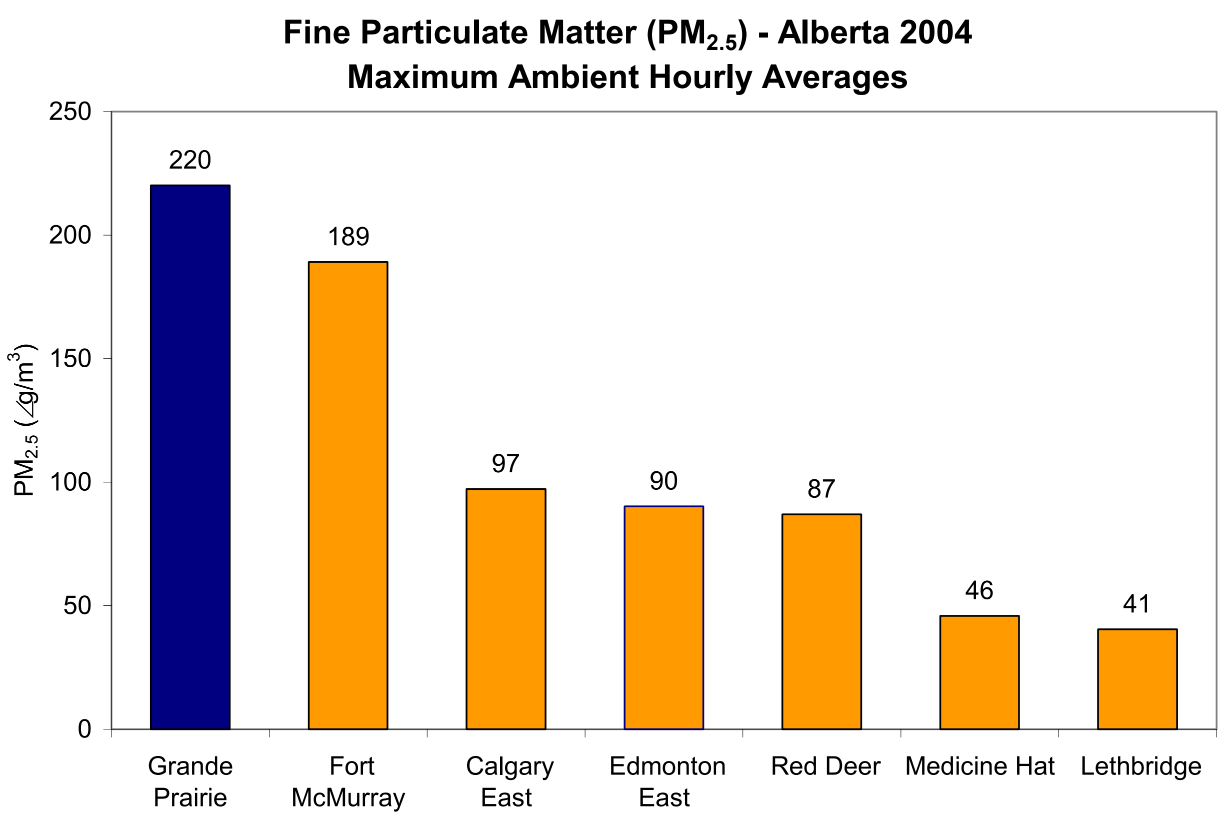
For 2004, the annual average PM_{10} concentration at the Henry Pirker Station in Grande Prairie was lower than those observed in other Alberta cities including Edmonton, Calgary and similar to that observed in Red Deer. The average was slightly higher than the averages observed in the cities of Lethbridge, Fort McMurray and Medicine Hat. At all these urban locations a significant portion of the $PM_{2.5}$ monitored can be attributed directly to motor vehicle traffic.

During 2004, all of the recorded daily averages at the Henry Pirker Station were below the absolute $PM_{2.5}$ CWS level of 30μg/m^3. For comparison purposes, this level was exceeded once in Edmonton and once in Red Deer. On both occasions the exceedences occurred on very cold days where there was limited dispersion of emissions from motor vehicles and other combustion sources.

The highest hourly average $PM_{2.5}$ concentration (220μg/m^3) observed at the Henry Pirker Station was associated with the heavy smoke from a nearby New Years Eve fireworks display that has been discussed previously. This value was higher than those recorded in any other cities in Alberta during 2004 but should be treated as an anomaly due to the unique nature of the reading. 99% of the hourly averages observed at the Henry Pirker Station during 2004 were below 27μg/m^3.



Fine Particulate Matter (PM2.5) - Alberta 2004
Ambient Annual Averages
PM2.5 (µg/m3)
9
8
7
6
5
4
3
2
1
0
8.1
6.1
4.9
4.9
4.1
3.8
3.0
Calgary East
Edmonton East
Red Deer
Grande Prairie
Lethbridge
Fort McMurray
Medicine Hat



Fine Particulate Matter (PM2.5) - Alberta 2004
Maximum Ambient Hourly Averages
PM2.5 (µg/m3)
250
200
150
100
50
0
220
189
97
90
87
46
41
Grande Prairie
Fort McMurray
Calgary East
Edmonton East
Red Deer
Medicine Hat
Lethbridge

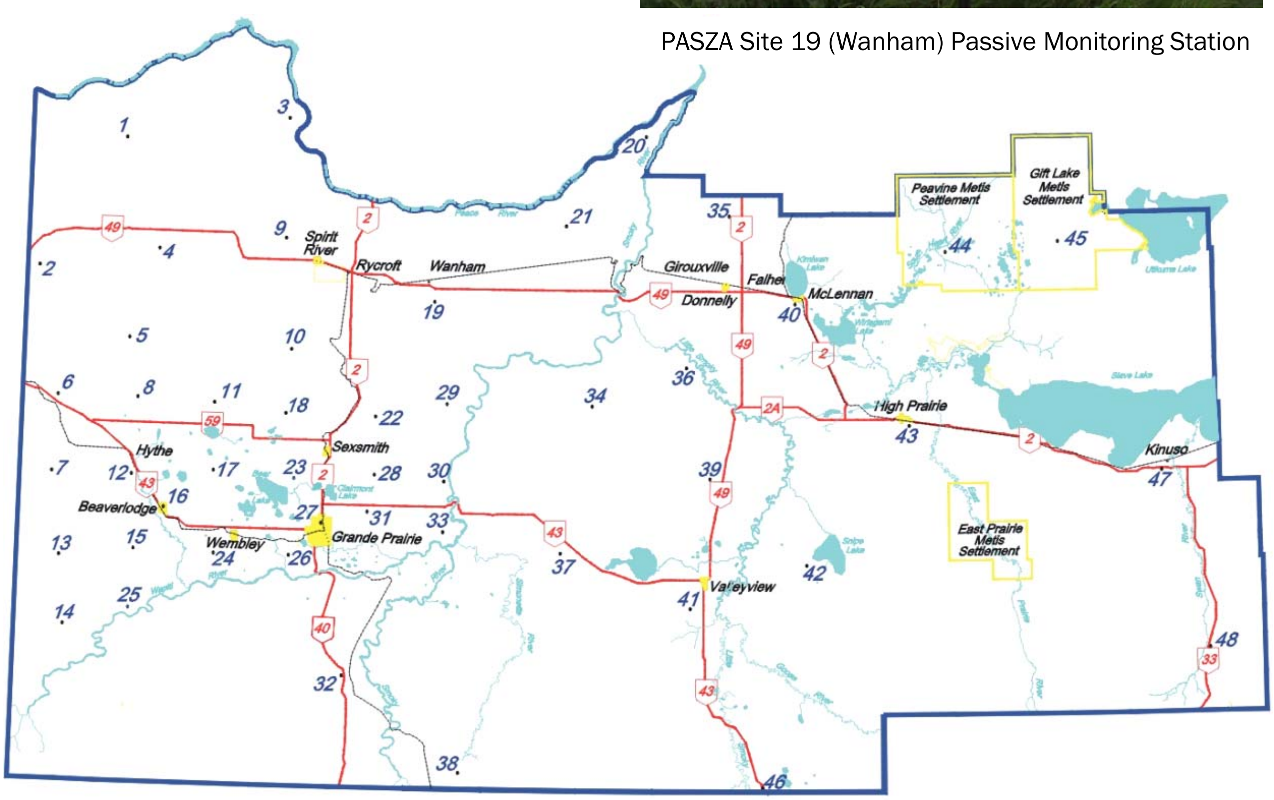
6.2 Passive Air Quality Monitoring

PASZA Site 19 (Wanham) Passive Monitoring Station

The PASZA AQM Program uses an extensive network of passive monitors to collect air quality data over a large region (38,500 sq. km.). The resulting database is suitable for the identification of long term air quality trends and assessing spatial variability, a typical approach in making regional-scale air quality assessments. The advantages of the passive samplers used by PASZA are their accuracy, low detectable limits, simple design, ease of use and cost effectiveness.

Passive samplers rely on the principles of permeation and diffusion to physically uptake the specific compound being sampled. This method is an alternative to active sampling or continuous monitoring where an air sample is drawn or forced mechanically into or through a collection device or past a detector.

For 2004, the PASZA Passive Monitoring Network consisted of fourty-three permanent stations configured to monitor SO_2, NO_2 and O_3. Passive monitoring is conducted year-round on a monthly interval with duplicate samples rotated through 10% of the sites for quality assurance purposes.



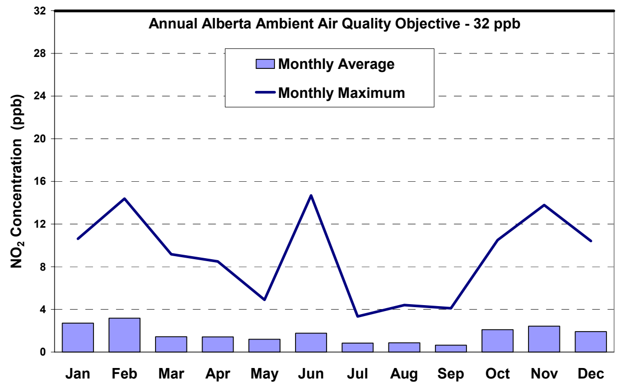
Location of the PASZA Passive Monitoring Stations for 2004

6.2.1 Nitrogen Dioxide

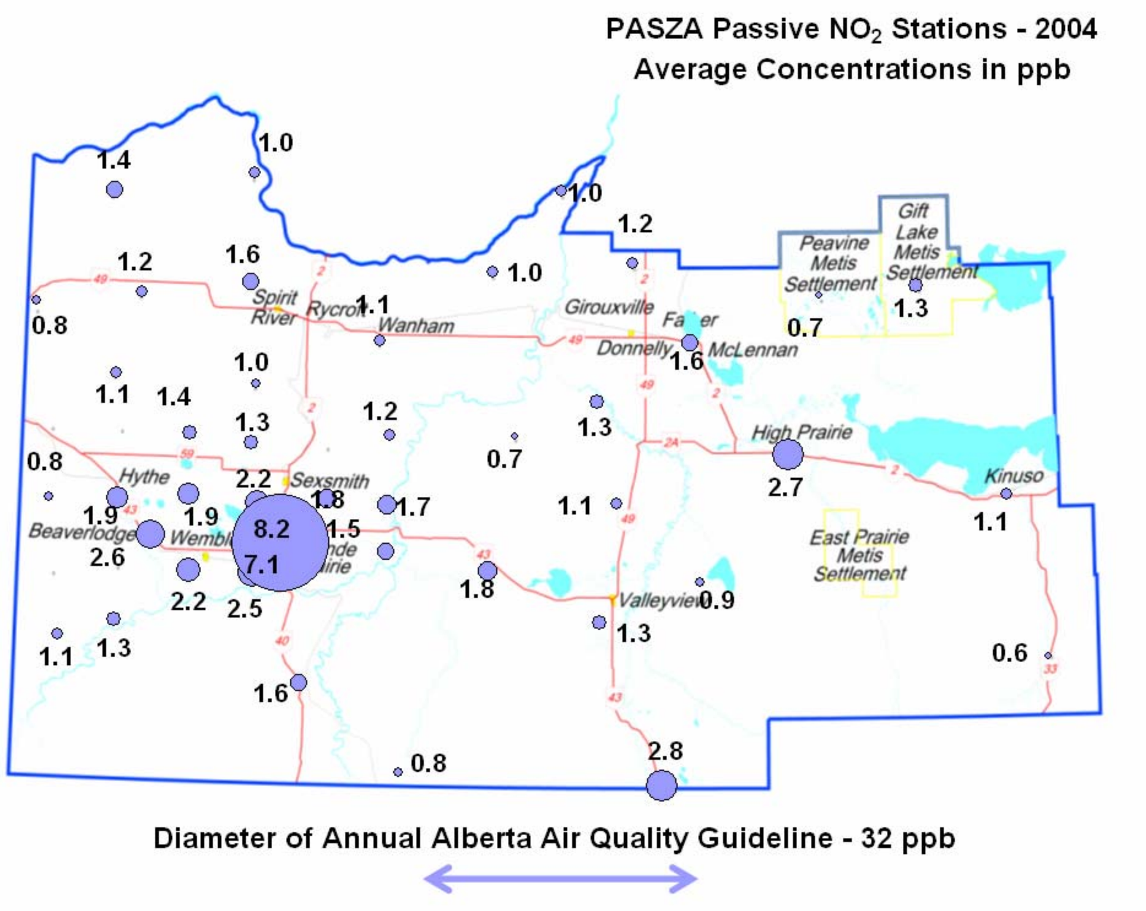
The average Nitrogen Dioxide (NO_2) concentration for the entire passive monitoring network for 2004 was 1.7 ppb, which was slightly below the 2003 average of 1.9 ppb. These levels are both significantly below the Alberta Air Quality Annual Average Objective of 32 ppb which is based on the prevention of human health effects.

In general, NO_2 levels were higher in or around larger population centers and near major highways. This trend was expected and is consistent with the effect of NO_X emissions from motor vehicle traffic. Site 27 (Grande Prairie Industrial) again had the highest annual average concentration, measuring 8.2 ppb. The site with the lowest annual average concentration was Site 48 (Deer Mountain) measuring 0.6 ppb. This site is located along the zone's southeastern boundary in a location far away from any major population centre.

The highest monthly average for the passive NO_2 network was observed during February, one of the colder months during the year, and a time when the amount of thermally-induced mixing of the atmosphere would be at a minimum. The lowest monthly average was observed in July when there would have been much higher dispersion of NO_2 emissions due to the greater amount of thermal mixing brought about by higher solar radiation levels.



PASZA Passive AQM Network - 2004 Nitrogen Dioxide (NO_2)

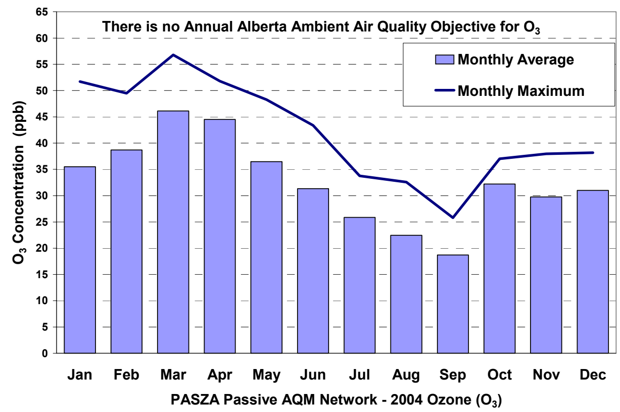


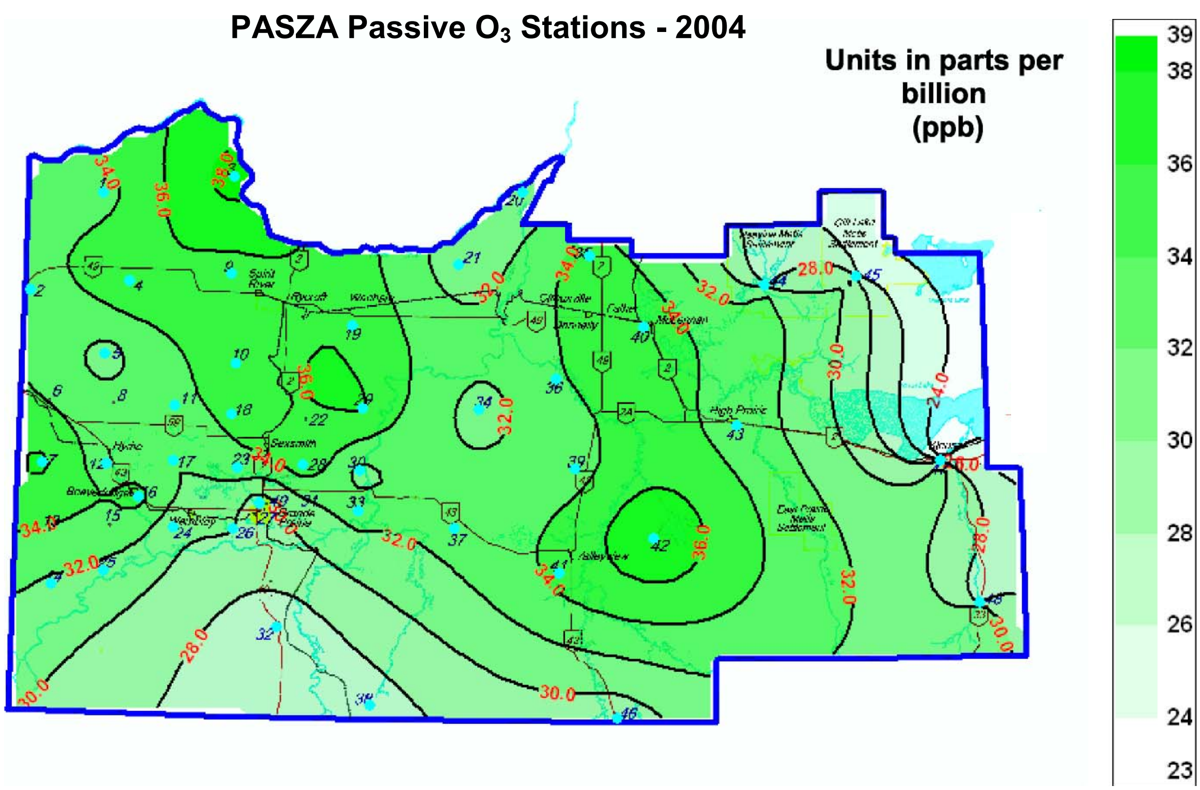
6.2.2 Ozone

The average ozone (O_3) concentration for the entire passive monitoring network during 2004 was 32.7 ppb which was 18% higher than the 2003 average of 27.8 ppb. There is no Alberta Air Quality Annual Average Objective for ozone. There is currently only an hourly average guideline (82 ppb) and it is based on the prevention of adverse effects to human health and vegetation.

In general, O_3 levels were relatively homogenous throughout the rural areas of the zone and significantly lower in or around larger population centers and near major highways. The lower levels at these sites are consistent with the reaction of ozone with NO_X emissions from motor vehicle traffic. Site 3 (Fourth Creek) again had the highest average concentration, measuring 39.0 ppb. This site is located close to the zone's northern boundary and potentially upwind of most of the region's emission sources that could contribute to any anthropogenic ozone formation. The site with the lowest average concentration was again Site 32 (Gold Creek) measuring 26.7 ppb. This site is located near the zone's southern boundary in a location downwind of Grande Prairie in the vicinity of a major highway, Highway 40.

In general, ambient O_3 concentrations observed in or downwind of the more populated regions of the zone indicated seasonal variations typical of anthropogenic ozone formation, with the highest values observed in the late spring. Concentrations observed in the less-populated areas indicated levels and seasonal variations that may be more attributable to naturally-occurring meteorological phenomena.



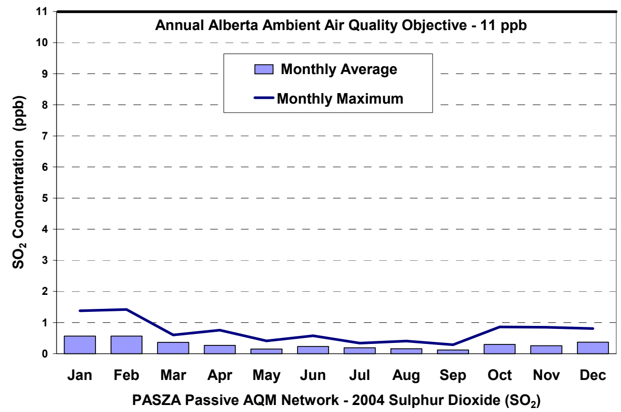


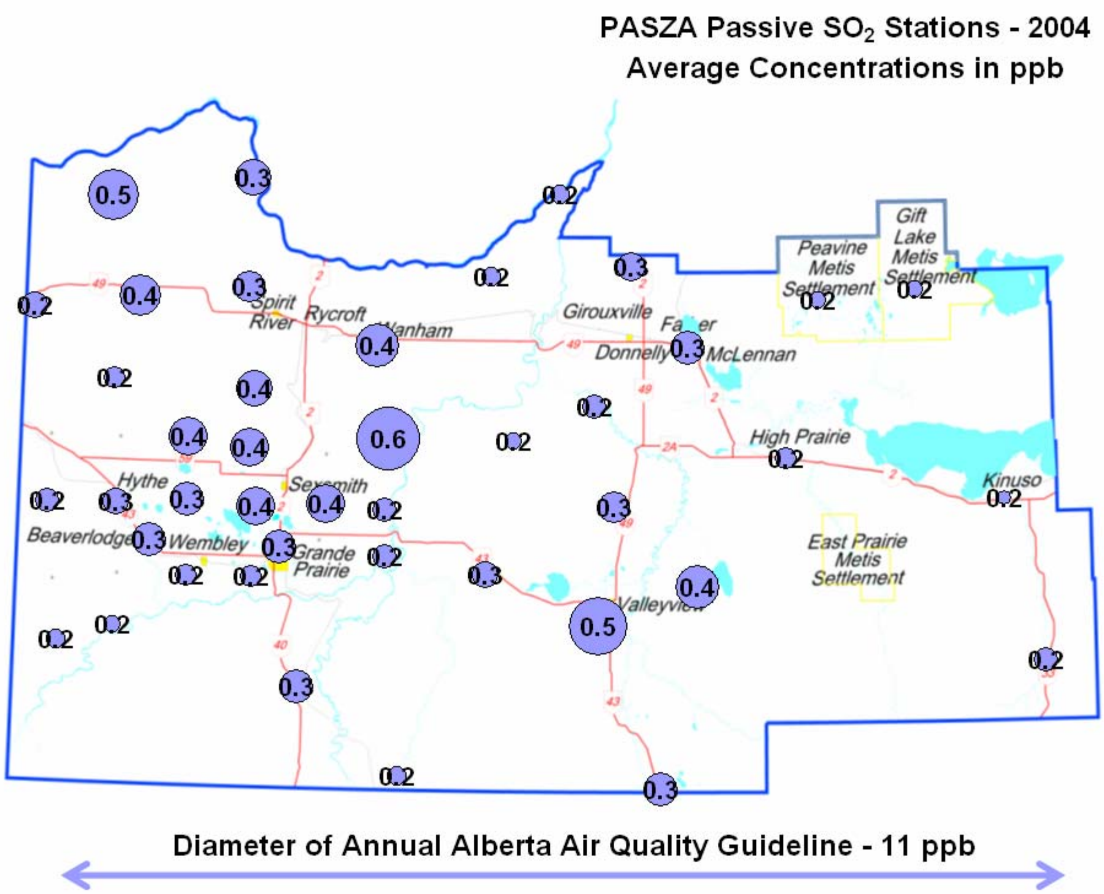
6.2.3 Sulphur Dioxide

The average Sulphur Dioxide (SO_2) concentration for the entire passive monitoring network for 2004 was 0.29 ppb, slightly lower than the 2003 average of 3.0 ppb. Both these levels are significantly below the Alberta Air Quality Annual Average Objective of 11 ppb which is based on the prevention of effects to vegetation.

In general, SO_2 levels were higher in or near areas with sour gas or pulp and paper production facilities as was the case for Site 29 (Smoky Heights) which again had the highest annual average concentration for the period, measuring 0.59 ppb. This trend was expected and is consistent with that observed in other Alberta Airsheds. The site with the lowest annual average concentration was Site 47 (Kinuso) measuring 0.16 ppb. This site is located close to the zone's eastern boundary in a location upwind of sour gas or pulp and paper production facilities.

Ambient SO_2 concentrations observed throughout the zone displayed predictable seasonal variations similar to the NO_2 results and for the same reasons. The highest monthly average for the passive SO_2 network was observed during January, the coldest month of 2004, while the lowest monthly average was observed in September, similar to the trend observed for the NO_2 passives.





7.0 Financial Report

Peace Airshed Zone Association

Financial Report* for the Year Ended December 31, 2004

			Actual		Budget
Revenue:	Contributions	$	459,360	$	283,270
	Interest Income		21		9
			459,381		283,279
Expenses:					
	Advertising & Promotion		564		2,368
	Bank Charges and Interest		60		151
	Contracted Administration		85,200		85,200
	Equipment Lease		48,970		12,244
	Honoraria and Travel		786		262
	Insurance		4,716		1,216
	Monitoring Contracts		201,177		127,626
	Office		461		465
	Professional Fees		2,033		1,700
	Program Management Fees		30,069		27,579
	Rent		279		-
			374,315		258,811
Excess (Deficiency) of Revenues over Expenses			85,066		24,468
Unrestricted Net Assets, beginning of year			24,214		(254)
Unrestricted Net Assets (Deficit), end of year		$	109,280	$	24,214

	ASSETS				
CURRENT					
Cash		$	149,699	$	90,515
Accounts receivable			-		-
		$	149,699	$	90,515
	LIABILITIES				
CURRENT					
Accounts payable and accrued liabilities		$	40,419	$	66,301
	MEMBER EQUITY				
NET ASSETS					
Unrestricted net assets			109,280		24,214
		$	149,699	$	90,515

* A copy of the audited financial report is available from the PASZA Treasurer upon request.

8.0 Membership

8.1 Board of Directors

Victor Begin	MD of Smoky River	Government	
Rod Burr	Alberta Environment	Government	Secretary
Joyce Dvornek	MD of Big Lakes	Government	
Dale Gervais	MD of Greenview #16	Government	
Richard Harpe	County of Grande Prairie	Government	Chair
Jim Meagher	Peace County Health	Government	Vice Chair
Bob Savage	Alberta Energy & Utilities Board	Government	
Uli Wolf	Aquatera	Government	
Doug Bagget	Ainsworth Lumber Co.	Industry	
Garth Gress	Suncor Energy Ltd.	Industry	
Roger Henault	EnCana	Industry	
Bill Nalder	Canadian Natural Resources Limited	Industry	
Lori Pollock	Talisman Energy	Industry	Treasurer
Bob Cameron	South Peace Environmental Assn.	NGO	
Mike Weeks	Saddle Hills Awareness Comm.	NGO	Vice Chair
Milton Hommy		Public	
Teresa Von Tiesenhausen		Public	

8.2 Technical Committee

Rod Burr	Alberta Environment	Government
Bob Savage	Alberta Energy & Utilities Board	Government
Uli Wolf	Aquatera	Government
Robert Boyce	Devon Canada Corporation	Industry
Tammy Kehl	EnCana Corporation	Industry
Ed Lamy	Weyerhaeuser Canada	Industry
Craig Langford	Devon Canada Corporation	Industry
Bob Cameron	South Peace Environmental Assn.	NGO
Mike Weeks	Saddle Hills Awareness Comm.	NGO
Gary Cross	Focus Corporation	Contractor
Gerald Feschuk	Focus Corporation	Contractor
Kevin Warren	Amarok Consulting	Program Manager

8.3 Funding Members

Companies

Acclaim Energy Inc.
Ainsworth Lumber Co.
Alliance Pipeline Ltd.
American Leduc Petroleums Limited
Anadarko Canada Corporation
ARC Resources Ltd.
ATCO Power
Bonavista Petroleum Ltd.
BP Canada Energy Company
Burlington Resources Canada Energy Ltd.
Canadian Natural Resources Limited
Chariot Energy Inc.
Compton Petroleum Corporation
ConocoPhillips Canada Energy Partnership
Devon Canada Corporation
Duke Energy Field Services Canada Ltd.
EnCana Corporation
Fortune Energy Inc.
Grey Wolf Exploration Inc.
Husky Oil Operations Limited
NCE Petrofund
Northrock Resources Ltd.
Paramount Resources Ltd.
Penn West Petroleum Ltd.
PrimeWest Energy Inc.
Resolute Energy Inc.
Shiningbank Energy Ltd.
Suncor Energy Inc.
Talisman Energy Canada
Ultima Energy Trust
Vintage Petroleum Canada Inc.
Westbow Energy Inc.
Weyerhaeuser Canada

Municipalities

Birch Hills County
City of Grande Prairie
Town of Hythe
MD of Big Lakes
MD of Greenview
MD of Smoky River
MD of Spirit River
Saddle Hills County
Town of Beaverlodge
Town of Sexsmith
Town of Valleyview

Acknowledgements

The Peace Airshed Zone Association would like to acknowledge the hard work and contributions of all stakeholders of the association. With a lot of hard work, we have made significant strides in 2004 towards achieving our vision. Our member companies and municipalities have continued to provide experience and financial stability to PASZA. Members from the public, health, environment, and municipal sectors have contributed to ensuring accountability, sustainability, and transparency of the association.

Amarok Consulting, specifically Kevin Warren, has continued to provide leadership in the technical management of the air quality monitoring program and many other areas as well. The Focus Corporation has provided exemplary service to PASZA in the administrative management of the program, and in establishing, operating and maintaining the air quality monitoring network. Focus staff members Gary Cross, Kelly Baragar, Kevin McCullum and a local contract employee, Gerald Feschuk all have all played key roles in that success.

Thanks are due to the CASA Secretariat, who through the early years of PASZA's existence have provided a substantial amount of support and resources enabling us to build a strong and sustainable foundation.

Special thanks are also due to past members of the association who made significant contributions of their time and spirit and have been valuable resources for PASZA during its formative years.

Glossary

Acid Deposition: A comprehensive term for the various ways acidic compounds precipitate from the atmosphere and deposit onto surfaces. It can include: 1) wet deposition by means of acid rain, fog, and snow; and 2) dry deposition of acidic particles (aerosols).

Alberta Ambient Air Quality Objective (AAAQO) : Concentration value adopted by the province of Alberta with the intention of preventing deterioration of air quality. Guidelines for SO2, NO2, O3 and several other pollutants are based on the prevention of adverse human health and vegetation effects. Guidelines may be for 1 hour, 24 hours, or 1-year average concentrations.

Anthropogenic: Made by or arising from man, not of natural origin.

Average Annual Concentration: The sum of the 1-hour average concentration measurements for the year divided by the number of hours that measurements were made within that year. It can be compared against the Alberta Ambient Air Quality Guideline for the same period to assess absolute air quality, against data collected at other locations with similar characteristics (sources, population, etc.) for the same period for assessment purposes or against other years' data to assess improvement or degradation of air quality at the same location.

Carbon Monoxide (CO): A colorless, odorless gas resulting from the incomplete combustion of hydrocarbon fuels. CO interferes with the blood's ability to carry oxygen to the body's tissues and results in numerous adverse health effects. Over 80% of the CO emitted in urban areas is contributed by motor vehicles.

Greenhouse Gases: Atmospheric gases such as carbon dioxide, methane, chlorofluorocarbons, nitrous oxide, ozone, and water vapor that slow the passage of re-radiated heat through the Earth's atmosphere.

Hydrocarbons: Compounds containing various combinations of hydrogen and carbon atoms. They may be emitted into the air by natural sources (e.g., trees) and as a result of fossil and vegetative fuel combustion, fuel volatilization, and solvent use. Hydrocarbons are a major contributor to smog. Hydrocarbons include aromatics and volatile organic compounds, many of which are toxic.

Hydrogen Sulphide (H_2S): A colorless, flammable, poisonous compound having a characteristic rotten-egg odor. About one third of the gas produced in Alberta contains H_2S.

Inversion: The atmospheric property of temperature increasing with height.

Micron (μm): One one-millionth of a meter ($1X\ 10^{-6}$ m)

Mobile Sources: Sources of air pollution such as automobiles, motorcycles, trucks, off-road vehicles, boats, and airplanes.

Natural Sources: Non-manmade emission sources, including biological and geological sources, wildfires, and windblown dust.

Nitric Oxide (NO): Precursor of ozone, NO_2, and nitrate; nitric oxide is usually emitted from combustion processes. Nitric oxide is converted to nitrogen dioxide (NO_2) in the atmosphere, and then becomes involved in the photochemical processes and/or particulate formation.

Nitrogen Oxides (Oxides of Nitrogen, NO_X): A general term pertaining to compounds of nitric oxide (NO), nitrogen dioxide (NO_2), and other oxides of nitrogen. Nitrogen oxides are typically created during combustion processes, and are major contributors to smog formation and acid deposition. NO_2 at higher concentrations is associated with numerous adverse health effects.

Non-Methane Hydrocarbon (NMHC): The sum of all hydrocarbon air pollutants except methane. NMHCs are significant precursors to ozone formation.

Ozone (O_3): A strong smelling, pale blue, reactive toxic chemical gas consisting of three oxygen atoms. It is a product of the photochemical process involving the sun's energy and ozone precursors, such as hydrocarbons and oxides of nitrogen. Ozone exists in the upper atmosphere ozone layer (stratospheric ozone) as well as at the Earth's surface in the troposphere (ozone). Ozone in the troposphere is associated with numerous adverse health effects. It is a major component of smog.

Particulate Matter (PM): Any material, except pure water, that exists in the solid or liquid state in the atmosphere. The size of particulate matter can vary from coarse, wind-blown dust particles to fine particle combustion products.

PPB or PPM: Parts per billion by volume or parts per million by volume

$PM_{2.5}$: Includes tiny particles with an aerodynamic diameter less than or equal to a nominal 2.5 microns. Their small size allows them to make their way to the air sacs deep within the lungs where they may be deposited and result in adverse health effects.

Sulfur Dioxide (SO_2): A strong smelling, colorless gas that is formed by the combustion of fossil fuels. Sour gas processing plants, oil sands processing plants and coal-fired power generating plants are major sources of SO_2. SO_2 and other sulfur oxides contribute to the problem of acid deposition.

Total Hydrocarbons (THC): The sum of all hydrocarbon air pollutants.

Total Organic Compounds (TOC): Gaseous organic compounds, including reactive organic gases and the relatively unreactive organic gases such as methane.

Total Reduced Sulphur Compounds (TRS): Sulphur-containing family of compounds consisting of hydrogen sulphide, mercaptans and others.

Volatile Organic Compounds (VOCs): Carbon-containing compounds that evaporate into the air (with a few exceptions). VOCs contribute to the formation of smog and/or may themselves be toxic. VOCs often have an odor, and some examples include gasoline, alcohol, and the solvents used in paints.

PASZA
Peace AirShed Zone Association

Box 21135
Grande Prairie, AB
T8V 6W7

(780) 539-2298
www.pasza.ca