PARKLAND AIRSHED MANAGEMENT ZONE

2004 Annual Report

Table of Contents

1. Executive Summary 1
2. Introduction 2
3. Report From The Chair 3
4. The Organization 4
5. Committee Reports 4
    5.1 Technical Working Group 4
    5.2 Human Health Committee 5
    5.3 Issues Response Group 5
    5.4 Communications Committee 6
    5.5 Funding Committee 6
6. Links to the Clean Air Strategic Alliance and Other Airsheds 7
7. Air Quality Monitoring Program 8
    7.1 Continuous Monitoring 9
        7.1.1 Sulphur Dioxide 12
        7.1.2 Total Reduced Sulphur 14
        7.1.3 Carbon Monoxide 16
        7.1.4 Oxides of Nitrogen 18
        7.1.5 Ozone 20
        7.1.6 Hydrocarbons 22
        7.1.7 Particulate Matter 25
    7.2 Passive Monitoring 29
        7.2.1 Sulphur Dioxide 30
        7.2.2 Nitrogen Dioxide 32
        7.2.3 Ozone 34
8. Meteorology 36
9. Financial Report 37

Appendices

Appendix I: Board of Directors 38
Appendix II: Funding Members 38
Appendix III: Committee Members 39
Appendix IV: Landowners 40
Appendix V: Acknowledgements 41

Glossary of Terms ..... Inside Back Cover

Cover Photograph “Nordegg Area” Image Credit: Deborah Hangartner

1. Executive Summary

2004 marked the sixth year of operation of the Parkland Airshed Management Zone Association's (PAMZ) Regional Air Quality Monitoring (AQM) Program. Data collected by the program provides a better understanding of air quality, long-term regional trends, and development and evaluation of strategies to address zonal air quality issues. Passive monitoring data collected by the program generally indicates average regional SO_2 levels have decreased by a third from the program's initiation in 1999. These results support the effectiveness of the strategies to reduce flaring volumes throughout the region and the efficiency improvements made to several large sour gas processing plants and also reflect the decline in throughput at some sour gas processing plants in the region.

Data from the passive network in 2004 indicated a continuation of the decreasing trend in NO_2 levels seen in earlier years. Ozone levels in the zone continued to increase in 2004 though not as significantly as in some of the previous years.

During 2004, the PAMZ Regional AQM Program's two fixed and two portable Continuous AQM Stations were located at a total of thirteen different sites and logged an impressive overall operating efficiency of 99.1%. For the first time in the history of the program, there were no exceedences of any of the Alberta Ambient Air Quality Objectives.

Throughout the year, monitoring capability was added to the Raven Portable AQM Station including Nitrogen Oxides and Total Hydrocarbons Analyzers. In 2004, this station was used primarily to help build a geographical air quality database for the zone, especially for medium-sized towns where historically there has been no air quality monitoring. In 2004, the residents of Rocky Mountain House, Innisfail and Sundre all benefited from a better understanding of the air quality in their communities. In the summer a prospective regional background site was established and operated at a picturesque site on Limestone Mountain, in the West Country approximately fifty-five km northwest of Sundre.

In May, a public meeting (to identify possible locations for the PAMZ Peregrine Air Quality Monitoring Station for 2005) was held in Crossfield. Based on the meeting, the five locations chosen were Acme, Bentley, James River, Gasoline Alley, and Malmo.

In June, PAMZ again hosted a two-day Environment Canada "Let's Drive Green" Vehicle Emissions Inspection Clinic in Red Deer at the Bower Mall Shopping Center. The event was even more successful than the previous year with 283 vehicles tested and a pass rate of 83%.

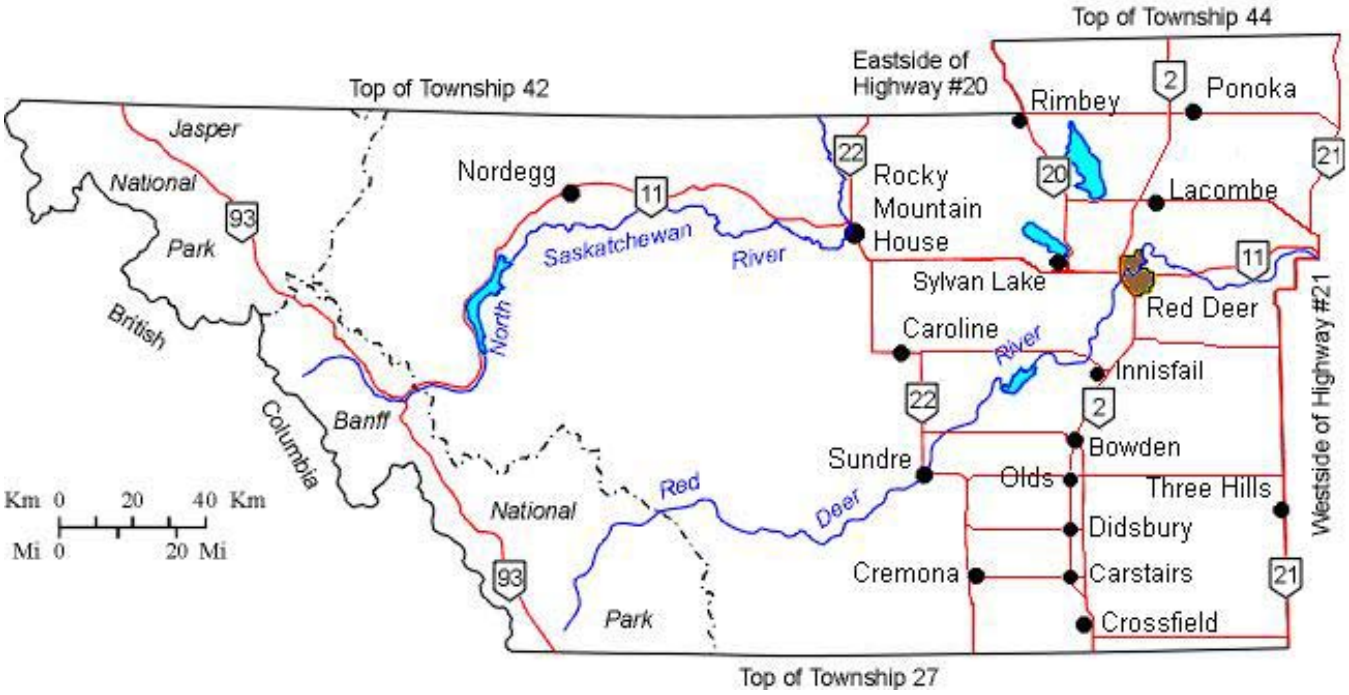
2004 "Let's Drive Green"
Vehicle Emissions Testing Clinic

July marked the conclusion of the Ozone Research Monitoring Program conducted at the Harlech Station, located northeast of Nordegg. The program began in December 2001 and evolved into a successful partnership between PAMZ, Environment Canada, the Saskatchewan Research Council and Alberta Environment. Environment Canada is currently reviewing the data collected by the program and a summary report of their findings is expected in the near future.

In 2005, PAMZ continued to work with the David Thompson Health Region and Alberta Health and Wellness on the design of a Community Exposure and Health Effects Assessment Program. Significant progress was made with the collection of seed funding and finalization of the design and the geographic boundaries. The program is planned to cover portions of Clearwater and Mountain View Counties. This area is targeted because it has a significant amount of oil and gas development along with long-standing concerns about the effects of air quality on human health.

During 2004, PAMZ continued its series of public presentations to raise public awareness and knowledge of Air Quality Issues including Flaring and Venting, New and Emerging Sulphur Recovery Technologies, the CASA Electricity Emissions Management Framework and Financial Incentives for Corporations to Reduce Greenhouse Gas Emissions.

Parkland Airshed Management Zone



2. Introduction

PAMZ is a multi-stakeholder, non-profit society established in 1997 in response to concerns regarding air quality issues within the zone as well as the emergence of a zonal air quality monitoring and management strategy under the Clean Air Strategic Alliance (CASA).

The PAMZ Mission Statement is: *The Parkland Airshed Management Zone (PAMZ) will implement a zonal approach to monitoring and managing air quality in the zone.*

Many of Alberta's air quality issues are local or regional, both in their causes and in the solutions required to deal with them. Establishing air quality management zones allows local stakeholders to design appropriate solutions for their problems. Zones are defined on the basis of emission sources and volumes, dispersion characteristics, impacts, and administrative characteristics such as land use.

The air quality concerns continually identified as high priority issues for the zone are:

- Human and Animal Health Effects
- Odours from Intensive Livestock Operations
- Sulphur Dioxide Emissions
- Transportation Emissions
- Pollution Prevention

PAMZ recognizes these issues are broad and an AQM Program can not address them alone. One of the first steps in the process of developing, implementing and evaluating strategies to address these issues is the collection of data by a comprehensive AQM Program operated within the zone's boundaries (see above) in order to understand the air quality within the region better.

PAMZ utilizes a public-based consensus decision-making process to identify and prioritize zonal air quality issues and to develop strategies and action plans to address these issues. The process has resulted in the establishment of various PAMZ committees to address some of these air quality issues. PAMZ is also actively involved in several important CASA Project Teams that have either developed or are developing strategies to address those issues common to all Albertans.

Funding of PAMZ is proportioned amongst its members at levels consistent with their contribution to emissions within the Zone, as determined by annual emission inventories. In 2004, PAMZ members' financial and in-kind contributions totaled approximately $545,000 and over 2500 hours, respectively.

3. Report From the Chair

2004 was my first year as Chairman of the PAMZ Board of Directors and it was a satisfying one. I am thankful for the work of all the committees and the help and support I received in my new role from the PAMZ executive, the board of directors and our members at large. Our membership is very diverse and full of interesting individuals and I am very much enjoying the relationships that I am building with them.

For me, the year's highlight was the progress that was made in soliciting the City of Red Deer's membership in PAMZ. The dedicated and persistent efforts of several key individuals within PAMZ and the City, throughout 2004 and over the last five years, were finally rewarded when Red Deer City Council made the decision to join PAMZ in February 2005. Mayor Morris Flewwelling, Councillors Larry Pimm and Lorna Watkinson-Zimmer and the City's Environmental Advisory Board all deserve special recognition for their staunch and unflagging support of PAMZ. Membership should help ensure that City management strategies and policies on air quality are coordinated with those of other PAMZ municipalities and industries and ultimately make the implementation of those strategies and policies more successful.

Another personal highlight was the very successful second edition of the Environment Canada "Let's Drive Green" Vehicle Emissions Testing Clinic co-hosted by PAMZ and Bower Place Shopping Centre in Red Deer in June. We were blessed with two sunny and warm days and as a result, were able to test 283 vehicles, 40 more than the previous year. I continue to be impressed by the contributions we get from our volunteers, as was Environment Canada Tester Andy Bastien, when he stated "The clinic exceeded all my expectations; the second highest in Canada this year in terms of number of vehicles tested. I'm extremely impressed with the collaboration and the effort by the volunteers."

Air quality issues associated with intensive livestock operations are a growing concern in our zone. It was gratifying to see some of the industries, regulators and non-government organizations associated with this sector recognize the value of participating in an inclusive, collaborative and consensus-based decision-making process to address the issues. In 2004 we welcomed the Alberta Cattle Feeder's Association, the Natural Resources Conservation Board and the Society for Environmental Responsible Livestock Operations into our membership fold. The air quality monitoring conducted by PAMZ has made and will continue to make an important contribution to a better understanding of the issues and in moving them forward.

In 2004, PAMZ's air quality monitoring capability played an important role in a joint investigation conducted by Alberta Environment, the Alberta Energy and Utilities Board and the David Thompson Health Region into the air quality concerns of a resident in the Prairie Creek area southwest of Rocky Mountain House. Data collected by our Peregrine Portable in February and August helped to identify the emission of concern, its possible source(s) and ultimately in the resolution of the issue.

Finally, I wish to acknowledge the financial and invaluable in-kind support of our member companies, government departments, municipalities and other various organizations. Support for PAMZ continues to grow as local stakeholders recognize the value of participating in our association. I wish to thank all the membership for their contributions and support toward PAMZ. I look forward to my second and final year as PAMZ chairman and the challenges that the future will bring.

Lenore Harris

Lenore Harris

4. The Organization

Parkland Airshed Management Zone Association is a non-profit organization whose membership is drawn from four stakeholder groups all united in a common purpose, to improve air quality. This goal is consistent with the objectives of CASA, PAMZ's parent organization. The association was incorporated as a society in April 1997, and operates under guidelines put forth by CASA.

The four stakeholder groups represented in the association are the public, industry, government, and non-government organizations (NGOs). The association's activities are managed by a Board of Directors. Each of the four sectors nominates directors and alternates to serve on the board. Individuals from local municipalities, provincial government departments, regional health authorities, the farming and ranching community, environmental organizations, industry and the general public represent their various sectors on the board which currently consists of fourteen members.

The current makeup of the board is:

- Five government members
- Four industry members
- Three public members
- Two NGO members

Committees for promoting the objectives or functions of the association are appointed and dissolved by the PAMZ Board. Each committee has a chairperson and reports to the board through that person. In 2004, there were six active PAMZ committees:

- Technical Working Group (TWG)
- Human Health Committee (HHC)
- Issues Response Group (IRG)
- Communications Committee
- Financial Committee
- Funding Committee

Kevin Warren of Amarok Consulting, is PAMZ's Program Manager. He is contracted to manage the PAMZ air quality monitoring program, oversee the implementation and evaluation of zonal air quality management strategies, serve on all committees and act as an ambassador for the association. Administrative support for Board Meetings is ably provided by Kim Sanderson.

RSLS Environet Inc., a Calgary-based AQM services company, operates and maintains the continuous monitoring portion of the air quality monitoring program and reports directly to the Program Manager.

The analysis of the samples associated with the passive monitoring network is contracted to an Edmonton-based laboratory, Maxxam Analytics Inc. The changeout of the network's passive samplers is accomplished by Gene Lesoway, an independent Leduc-based contractor. A Calgary-based Internet Services Company, Evolvs, hosts and maintains the PAMZ Website.

5. Committee Reports

5.1 Technical Working Group

The Technical Working Group's (TWG) primary tasks are the operation of the zonal AQM Program, assessing the data collected by the program and recommending management strategies based on that data to the PAMZ Board. The group meets regularly and works closely with the program manager in overseeing the operation of the program to insure that the program is credible, affordable and provides the data required by the association's stakeholders to help them gain an understanding of the region's air quality and the air quality issues identified by the association's stakeholders.

To accomplish all of these tasks, the TWG met on five occasions during 2004. In March and April, a smaller group comprised of TWG members and the program manager oversaw the compilation of the 2003 Annual Report.

In early September, Alberta Environment presented the TWG with a partnership opportunity concerning Alberta Environment's Red Deer Air Quality Monitoring Station. The station is owned and operated by Alberta Environment with some assistance from City of Red Deer Staff who visit the station regularly to verify proper operation and change out samples. Under the Alberta Environment proposal, PAMZ would be responsible for the operation of the Red Deer Station.

Throughout September and October, the TWG was kept busy reviewing the air quality monitoring program, studying Alberta Environment's partnership proposal, and formulating the program's requirements for the 2004 PAMZ Operating Budget. The budget was tabled and approved by the board in November and a formal response to Al-

berta Environment's proposal was finalized in late November. At year's end PAMZ's response was being reviewed by Alberta Environment.

In early December, the TWG also submitted a request to Alberta Environment for approval to conduct a Continuous $PM_{2.5}$ analyzer evaluation study. The group hopes to replace the PAMZ AQM Program's intermittent dichotomous samplers with continuous $PM_{2.5}$ analyzers to the PAMZ AQM Program in 2005. The evaluation study would provide the data needed to assess the performance and cost effectiveness of two different continuous monitoring technologies and determine which one is better suited for regional conditions and the PAMZ program. Assessing compliance with the Canada Wide $PM_{2.5}$ standard requires continuous monitoring as the calculation procedure requires three consecutive years of daily averages. This is discussed further in Section 7.1.7.

5.2 Human Health Committee

The PAMZ Human Health Committee (HHC) acts as a forum to explore and address issues affecting human health that may be associated with air pollution. To this end, the HHC is comprised of representatives from a wide variety of interests including health, environment, academics, industry, agriculture and the general public.

In 2004, the committee's focus was almost entirely devoted again to the design of the Community Exposure and Health Effects Assessment Program (CEHEAP). The overall purpose of the program is to enhance the overall understanding of the links between environmental exposure to airborne chemicals and human health in the PAMZ region. The goals and objectives of the program are consistent with those of three previous CEHEAP goals and objectives. These are:

- Describing the population (i.e., what % of the population is exposed to what contaminants) and personal distribution of exposure to airborne chemicals and particulates by estimating the distribution of selected airborne chemicals and particulates and characterizing the personal variation of exposure as a function of individual activity patterns.
- Quantifying the relative contribution of various exposure sources and pathways to airborne chemicals by quantifying the relative contribution of outdoor and indoor air to the total exposure.
- Describing associations between exposure to airborne chemicals and human health effects by analyzing occurrence relationships between selected exposures, biomarkers and health outcomes.

The development and implementation of the program is dependent upon the goodwill, teamwork and resources of many sectors. The creation of an ongoing monitoring function of this nature will act as a tool to help understand the impact of air quality on human health, a priority identified by PAMZ stakeholders.

Significant progress was made with the collection of funding with Alberta Environment providing a grant of $40,000 towards the program's operating costs. The program's design and geographic boundaries were finalized. The program is planned to cover portions of Clearwater and Mountain View Counties. This area is being targeted because it has a significant amount of oil and gas development along with long-standing concerns about the effects of air quality on human health. At year's end the committee was preparing a request to Alberta Health and Wellness for the balance of the funding needed for the study.

5.3 Issues Response Group

Throughout the year, work continued on the priority issues identified by PAMZ stakeholders. PAMZ members served on the various PAMZ committees and CASA project teams established to address specifically these issues.

In mid-May, a public meeting was held in Crossfield to solicit input from the public and generate recommendations for the IRG on issues and possible locations for the Portable AQM Trailer. The meeting resulted in the recommendation of four possible sites for the portable station from January through December 2004. These recommendations were adjusted and finalized by the Issues Response Group in July and accepted by the PAMZ Board of Directors in September.

In June, PAMZ hosted its second Environment Canada "Let's Drive Green" Vehicle Emissions Inspection Clinic at Bower Place Shopping Centre in Red Deer. Over the course of two days, 283 vehicles were tested, 40 more than the previous year. Of the vehicles tested by Environment Canada staff, 235 (83%) were within the Hydrocarbon and Carbon Monoxide limits of the idle emissions test. The success of the event was a testament to the enthusiasm and dedication of more than 30 volunteers who enjoyed some fantastic weather for a change.

Early in 2004, the IRG conducted follow-up reviews of the action plans developed at its 2002 Intensive Livestock Operations Air Issues Workshop and 2004 Pollution Prevention Workshop.

In September 2004, The Natural Resources Conservation Board, the Alberta Cattle Feeder's Association and the Society for Environmentally Responsible Livestock Operations (SERLO) all became PAMZ members. Collection of air quality data to better understand the air quality issues associated with intensive livestock operations remained a priority of the PAMZ AQM Program during 2004. Several PAMZ members are currently serving on the CASA working group developing the terms of reference for a project team that will develop a strategic plan to improve the management of air emissions from existing and future CFOs in Alberta and improve relationships between stakeholders.

Red Deer 2004 "Let's Drive Green"
Vehicle Emissions Testing Clinic

5.4 Communications Committee

In 2004, the PAMZ communications committee continued its implementation of a comprehensive communications and education plan whose development was begun by the committee in late 2002 and further enhanced throughout 2004. In addition to the goal of creating awareness of the work of PAMZ and its member companies and organizations, an equally important committee goal is raising awareness of some of the principles of environmental protection, personal environmental responsibility and pollution prevention.

Early in 2004, the group sponsored a "Name the Portables" Contest that resulted in the selection of the names Peregrine and Raven for the two PAMZ Portable Air Quality Monitoring Stations.

During 2004, three issues of the "The Zone" newsletter were published. This quarterly newsletter provides information about PAMZ and related organizations and events, its Regional AQM Program, and air quality issues of concern to PAMZ stakeholders. hard and digital copy.

Regular notices and media releases of upcoming PAMZ events and their results were developed and delivered by the committee throughout the entire year and they contributed greatly to the success of several of the events such as the Pollution Prevention Workshop and the "let's Drive Green" Vehicle Emissions Testing Clinic.

Public presentations on Air Quality Issues such as Flaring and Venting, Sulphur Recovery Technologies, the CASA Electricity Emissions Management Framework and Financial Incentives for Corporations to Reduce Greenhouse Gas Emissions.

Usage of the PAMZ website www.pamz.org by PAMZ members and others has increased steadily since it was revamped in late 2003. the site now averages 1450 visits per month with most users visiting the site to review data collected by the PAMZ AQM Program.

5.4 Funding Committee

The funding committee met three times in 2004. The committees continued discussions on various ways and means of achieving the committee's two primary objectives:

- Expand and diversify the funding base of the association to ensure its sustainability.
- Investigate amendments to the funding formula to ensure it remains fair and equitable.

The first step in an examination of the existing funding formula is the preparation of a more comprehensive emissions inventory of the region.

Funds were approved for an inventory in the 2005 budget and at year's end the group was working on the development of a request for proposals to conduct the work.

6. Links to the Clean Air Strategic Alliance and Other Airsheds

The Parkland Airshed Management 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. PAMZ is an independent entity that provides progress updates to CASA, shares some common members and directors, and whose members contributed to the following CASA project teams and working groups in 2004:

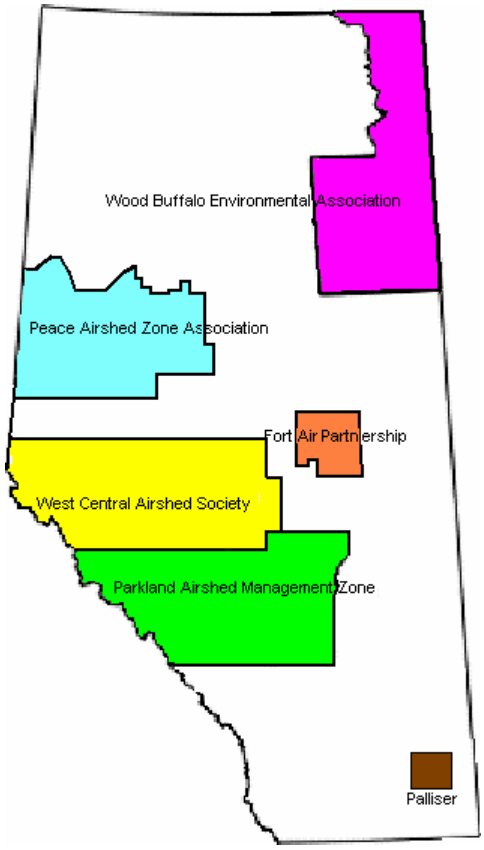
- Airshed Zones
- Ambient Air Quality Monitoring Operations Steering Committee
- Animal and Human Health
- Confined Feeding operations
- Ecological Effects
- Flaring and Venting
- Renewable and Alternative Energy

The Parkland Airshed Management Zone actively 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 immediately north of PAMZ's northern 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 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 square kilometers, 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 square kilometers, encompassing Fort Saskatchewan and the surrounding area. In 2004, the partnership operated a regional air quality monitoring network consisting of eight continuous monitoring stations and finalized plans for an eleven-station passive monitoring network for implementation in



June 2005. In September 2004, partnering with Environment Canada, they began a one-year study of Volatile Organics Compounds using intermittent samplers.

The Peace Air Shed Zone Association's (PASZA) zone covers an area of 38,500 square kilometers stretching south from the Peace River to the top of Township 64 and includes the area's major population center, the City of Grande Prairie. In 2004 PASZA operated a regional air quality monitoring network consisting of one continuous and fourty-three station passive monitoring stations. At year's end, PASZA was in the process of preparing the sites for two more continuous stations with startup scheduled for the first quarter of 2005.

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, the Lakeland Industry and Community Association (LICA) continued their effort to establishment an airshed management zone in the Bonnyville-Cold Lake-Elk Point Region of the province. Efforts are also underway to establish zones in the Calgary and Edmonton regions.

7. Air Quality Monitoring Program

The 2004 year represents the fifth full year of operation for the PAMZ Regional AQM Program.

The program's major components are:

- A thirty-four station passive AQM Network for sampling NO_2, O_3 and SO_2
- One continuous fixed AQM Station owned and operated by PAMZ.
- One continuous fixed AQM Station owned and operated by Alberta Environment.
- Two continuous portable AQM Stations (Peregrine and Raven) owned and operated by PAMZ.

The stations' monitored parameters represent emissions from a wide range of natural, industrial, non-industrial and mobile sources. The air quality and meteorological parameters chosen to be monitored are consistent with those being monitored in other air quality zones within Alberta and the Alberta Ambient Air Quality Monitoring System (AAAQMS) network.

In July 2004 the continuous Ozone Monitoring Station operated by PAMZ at Harlech was decommissioned. Operating funds for the station had been provided through a grant agreement with Environment Canada which expired in July. Data collected at the station during 2003 and 2004 is currently being analyzed by Environment Canada for evidence of episodes of stratospheric ozone intrusion. The continuous fixed Background AQM Station owned and operated by the West Central Airshed Society (WCAS) at Hightower Ridge was decommissioned in the fall of 2004 because of a significant increase to the rate charged for its power that was being provided by a dedicated diesel power generating unit located in the vicinity.

The locations of all the continuous sites within the PAMZ Boundaries are indicated on the map on page 29.

The four major goals of the PAMZ AQM Program are:

- Provide data to address the current and future air quality concerns/issues of the zone's various stakeholders.
- Contribute to the body of information required by the scientific community and other users to provide a better understanding of certain parameters including their sources, behaviors and effects.
- Be dynamic and evolutionary in nature, capable of responding to changing or emerging concerns, issues, technologies, and developments in other management zones/programs.
- Be effectively funded by the zone's stakeholders while allowing PAMZ to research, develop and implement other programs and activities.

The primary intent of the PAMZ Regional AQM Program is to provide high quality data required for the development and evaluation of strategies to address priority zonal air quality issues. PAMZ recognizes that the issues are broad and an AQM program can not entirely address all the issues. One step in the process of developing, implementing and evaluating strategies to address the issues is the collection of data by a comprehensive AQM Program to understand the air quality within the region better. Informed decision-making concerning air quality issues requires information that has been derived from data that are complete, comprehensive and scientifically credible.

Comprehensive and rigorous quality assurance and quality control (QA/QC) is an integral component of the PAMZ AQM program. It includes daily checks of calibration and instrument performance, regular multi-point calibrations and periodic government audits. Data are examined for long-term systematic errors and all raw and quality controlled data are archived. Data collected by PAMZ is part of the province-wide, integrated data management system developed through CASA. The data can be accessed freely through both the PAMZ website (www.pamz.org) and the CASA Data Warehouse (www.casadata.org).

In 2004, a number of changes and enhancements continued to be made to the PAMZ Regional AQM Program. A number of these were recommendations from The Jacques Whitford Environmental Ltd. (JWEL) Program and Data Assessment that was conducted in 2002 and detailed in the 2002 annual report. These include:

- Increasing the capability of the Raven Station. In July, an Oxides of Nitrogen Analyzer was added and in December a Total Hydrocarbon Analyzer was added.
- Replacing the existing Total Hydrocarbon/Methane/Non-Methane Analyzer in the Peregrine Station. A new analyzer was installed in November.
- Establishing a background site in the West Country. In July the Limestone Mountain Site was established and was operated for the entire third quarter. This monitoring site is discussed further in the next section of this report.
- Starting continuous $PM_{2.5}$ Monitoring at two, possibly three, of the PAMZ-owned continuous AQM Stations. At years end Alberta Environment was reviewing a proposal by PAMZ for a 6-month trial of a Beta Attenuation Monitor at the Caroline Station.
- Upgrading the Caroline Station Shelter. The existing shelter was replaced with a refurbished Station donated by BP Canada Energy in early December.

7.1 Continuous 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.

The PAMZ continuous monitoring program monitors a wider range of sources than those previously monitored in the zone. These include: sulphur dioxide (SO_2), hydrogen sulphide (H_2S), total reduced sulphur compounds (TRS), oxides of nitrogen (NO_X), ozone (O_3), carbon monoxide (CO), methane, non-methane and total hydrocarbons (CH_4, NMHC, THC), and ammonia (NH_3). Inhalable particulate matter 10 microns in diameter and smaller (PM_{10}) and respirable particulate matter 2.5 microns in diameter and smaller ($PM_{2.5}$) are monitored at the continuous stations using intermittently–operated samplers.

The continuous monitoring program utilizes data collected at four continuous monitoring stations. The analyzers used in the program are capable of detecting low level concentrations of compounds that may be associated with chronic human and livestock health disorders as well as the higher levels associated with the health concerns resulting from acute exposures. The intensive 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. Various meteorological parameters, such as wind speed and direction, are also monitored continuously to gain a better understanding of possible sources and behaviors of the different pollutants.

The first station is a permanently fixed station, owned and operated by PAMZ, located approximately 16 km south-southeast of the town of Caroline. It is situated at a location determined through past modeling studies to have a relatively high SO_2 deposition level for the region. The station has been operating continuously since 1991 and provides a historical record that current data can be compared to.

The second station, the Peregrine, is housed in a portable trailer that is used primarily to gather data to address regional air quality issues.

The third station, the Raven, is also housed in a portable trailer. This station is used primarily to gather data to address technical or geographic data gaps.

The fourth station is a permanently fixed station in the City of Red Deer located along Riverside Drive near Three Mile Bend. It is owned by Alberta Environment and in 2004 it was operated by Alberta Environment and the City of Red Deer as an AAAQMS Human Health Station. In September 2004, PAMZ was presented with a partnership proposal from Alberta Environment to assume the operations of the Station in 2005. At years end the proposal had been reviewed and negotiations concerning the takeover of the station were underway.

For the year 2004, the Caroline, Peregrine, Raven and Red Deer-Riverside AQM Stations had operating efficiencies of 98.8%, 99.7%, 99.5% and 98.4% respectively, for an overall network operating efficiency of 99.1%.

The criteria used to locate the two portable monitoring stations are different. The selection of the locations for the Peregrine Station is based on recommendations from the PAMZ Issues Response Group. As reported earlier, the Issues Response Group receives this input primarily at an annual public meeting held specifically for this purpose and also through stakeholder input received at

Raven AQM Station at the Limestone Mountain Site

regular board meetings. Using, the recommendations of the Issues Response Group, the Technical Working Group then selects the specific monitoring locations which are then finalized and secured by the Program Manager.

The selection of the locations for the Raven Station is made by the Technical Working Group based on a review of the technical and geographic data gaps that need to be addressed by the monitoring program. These sites are also finalized and secured by the Program Manager.

In 2004, the monitoring schedule for the Peregrine usually had it at a site for approximately 30 days, after which it was relocated to a new site, returning to the initial site after an interval of six months, so that data are collected during different seasons. In this manner it was located at six different sites during 2004. The Raven station was generally placed on sites for three continuous months with the exception of the first quarter where it was located at one site for January and another during February and March. In total, the Raven was located at five different sites during 2004.

On the following pages and for the purposes of this report, data collected from the continuous stations in the PAMZ Program during 2004 have been compared to data collected at stations with similar characteristics (sources, population, etc.) located in other Alberta zones or cities. Separate intercomparison graphs of the 2004 monthly average concentrations for the various monitoring locations within PAMZ have also been provided.

In 2004, the locations and primary months (monitoring typically extends slightly into the following month) where monitoring with the two portable stations was conducted were:

Peregrine

Dovercourt	January and June
Prairie Creek	February and August
Lloyd Creek	March and September
Zella-Bergen	April and October
Eckville	May and November
Red Deer-Woodlea	June and December

Raven

Rocky Mountain House	January
Innisfail	February and March
Crossfield-Carstairs	April, May and June
Limestone Mountain	July, August and Sept.
Sundre	October, Nov. and Dec.

For the first time in the history of the PAMZ Regional AQM Program, no exceedences of any of the Alberta Ambient Air Quality Objectives were observed. (See following table).

Alberta Ambient Air Quality Objectives Exceedences

		ppb	2000	2001	2002	2003	2004
CO	1-hr avg	13,000	0	0	0	0	0
	8-hr avg	8,000	0	0	0	0	0
H_2S	1-hr avg	10	2	1	28	5	0
	24-hr avg	3	0	0	3	0	0
NO_2	1-hr avg	212	0	0	0	0	0
	24-hr avg	106	0	0	0	0	0
	annual avg	32	0	0	0	0	0
O_3	1-hr avg	82	0	1	1	11	0
SO_2	1-hr avg	172	0	0	0	0	0
	24-hr avg	57	0	0	0	0	0
	annual avg	11	0	0	0	0	0
Total			2	2	32	16	0

Monitoring at the Dovercourt Site, approximately 26 km south-southeast of Rocky Mountain House, was conducted based on input received from area residents who had concerns about air quality relating to emissions from local oil and gas production operations. All monitored parameters were within the historical normal ranges observed by the PAMZ AQM Program and significantly below all applicable Alberta Ambient Air Quality Objectives.

Monitoring at the Prairie Creek Site, approximately 18 km south-southwest of Rocky Mountain House, was conducted in response to a request from Alberta Environment, the Energy Utilities Board and the David Thompson Health Region who were conducting an investigation into the air quality concerns of a local resident. The monitoring conducted by PAMZ established the emission type, sulphur dioxide, and indicated that the most likely source was a nearby gas production battery.

Monitoring at the Lloyd Creek Site, approximately 17 km north-northeast of Rimbey, was undertaken based on an analysis of AENV and EUB historical complaints records by the PAMZ Issues Response Group. This analysis indicated a history of air quality concerns in the Rimbey area. The monitoring was conducted in the vicinity of the Rimbey Sour Gas Processing Plant, a plant that had recently undergone major process improvements that had substantially increased its sulphur recovery efficiency and reduced its SO_2 emissions. All monitored parameters were within the historical normal ranges observed by the PAMZ AQM Program and significantly below all applicable Alberta Ambient Air Quality Objectives. There were two days in March where fine particulate matter concentrations exceeded the absolute Canada Wide Standard of 30 ug/m^3. An analysis of the samples themselves and the recorded wind directions was unable to establish a specific source or type, though it did rule out wood smoke or windblown soil.

Monitoring at the Zella-Bergen Site, approximately 13 km southeast of Sundre, was conducted based on input received from area residents who had concerns about air quality relating to emissions from local oil and gas and sulphur processing facilities. All monitored parameters were within the historical normal ranges observed by the PAMZ AQM Program and significantly below all applicable Alberta Ambient Air Quality Objectives.

Monitoring at the Eckville Site was conducted primarily to help build a geographic air quality database. There are a number of gas processing facilities in the area and there has been little continuous ambient air quality monitoring in the region. All monitored parameters were within the historical normal ranges observed by the PAMZ AQM Program and significantly below all applicable Alberta Ambient Air Quality Objectives. The average THC levels at the site in November were the highest observed by the PAMZ AQM Program in 2004. An analysis of the data did not provide any insight into the source(s) of the higher THC levels.

Monitoring in the Woodlea neighbourhood of Red Deer was conducted to provide an indication of the air quality in Red Deer's City Centre. Levels observed by PAMZ at the Woodlea Site were similar to those recorded at the Alberta Environment Monitoring Station located just off Riverside Drive during the same time period. The three exceptions were hydrogen sulphide, nitric oxide and total hydrocarbon levels. In the summer, hydrogen sulphide levels were higher at the Riverside Site most likely due to its closer proximity to the city's sewage treatment facilities. Nitric oxide and total hydrocarbon levels were higher at the Woodlea Site due to the greater amount of vehicle traffic around the site. During December, levels at the Woodlea Site were significantly higher than levels observed during July and August, primarily because of increased traffic, vehicle idling and the dispersion-limiting effects of the colder temperatures. All monitored parameters were significantly below all applicable Alberta Ambient Air Quality Objectives.

Monitoring at the Rocky Mountain House Site in January and early February, was a continuation of the monitoring that had started in December 2003. Little ambient air quality data exists for most of the medium-sized towns in Alberta and this monitoring was conducted in an effort to begin filling this data gap and build a geographic and historical air quality database for PAMZ. All monitored parameters were within the historical normal ranges observed by the PAMZ AQM Program and significantly below all applicable Alberta Ambient Air Quality Objectives.

From Rocky Mountain House, the Raven Station was then moved to Innisfail where it monitored the town's air quality for the rest of the first quarter. All monitored parameters were within the historical normal ranges observed by the PAMZ AQM Program and significantly below all applicable Alberta Ambient Air Quality Objectives.

Monitoring at the Crossfield-Carstairs Site, approximately 8 km northeast of Crossfield is conducted as part of the original design of the PAMZ AQM Program. Monitoring at this location provides data about the ambient levels of emissions from the City of Calgary and the Highway 2 Transportation Corridor on the southeastern portion of PAMZ. All monitored parameters were within the historical normal ranges observed by the PAMZ AQM Program and significantly below all applicable Alberta Ambient Air Quality Objectives.

The Limestone Mountain Site, approximately 55 km west northwest of Sundre, was identified as a candidate for a background monitoring site within PAMZ and also to make up for the loss of the Hightower Ridge Site. However, weather patterns observed during the third quarter were not typical for the region, with an atypical higher frequency of northeast winds. While the majority of the monitoring indicated ambient levels at or near the lower detectable limits, winds from the northeast brought SO_2 and TRS emissions from two large sour gas plants to the station. More monitoring at the site will be conducted in the second quarter of 2005, after which a decision on the future use of this site will be made.

Monitoring in Sundre during the fourth quarter was conducted in response to input received from some of the town's residents and neighbours who were concerned about air quality within the town. The average levels observed by PAMZ in Sundre were similar to those observed at PAMZ's Caroline Monitoring Station during the same period with the exception of NO_2 and SO_2. Levels of NO_2 were higher at the Sundre Site due to the greater amount of emissions from motor vehicles and home heating. The Caroline Station is permanently installed at a rural location 15 km northwest of Sundre. Levels of SO_2 were slightly higher at the Sundre Site though an analysis of the Sundre SO2 data did not indicate correlations to specific emission types or sources. Levels of all monitored pollutants were well below the applicable Alberta Ambient Air Quality Objectives.

The results of PAMZ's extensive SO_2, NO_2, and O_3 passive monitoring network are discussed later in this report beginning on Page 29.

7.1.1 Sulphur Dioxide

Sulphur dioxide (SO_2) is a colorless gas with a strong, suffocating odour. It can be detected by taste and odour by a majority of the population at concentrations of 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 are a natural source of sulphur dioxide. The largest sources of sulphur dioxide in the 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.

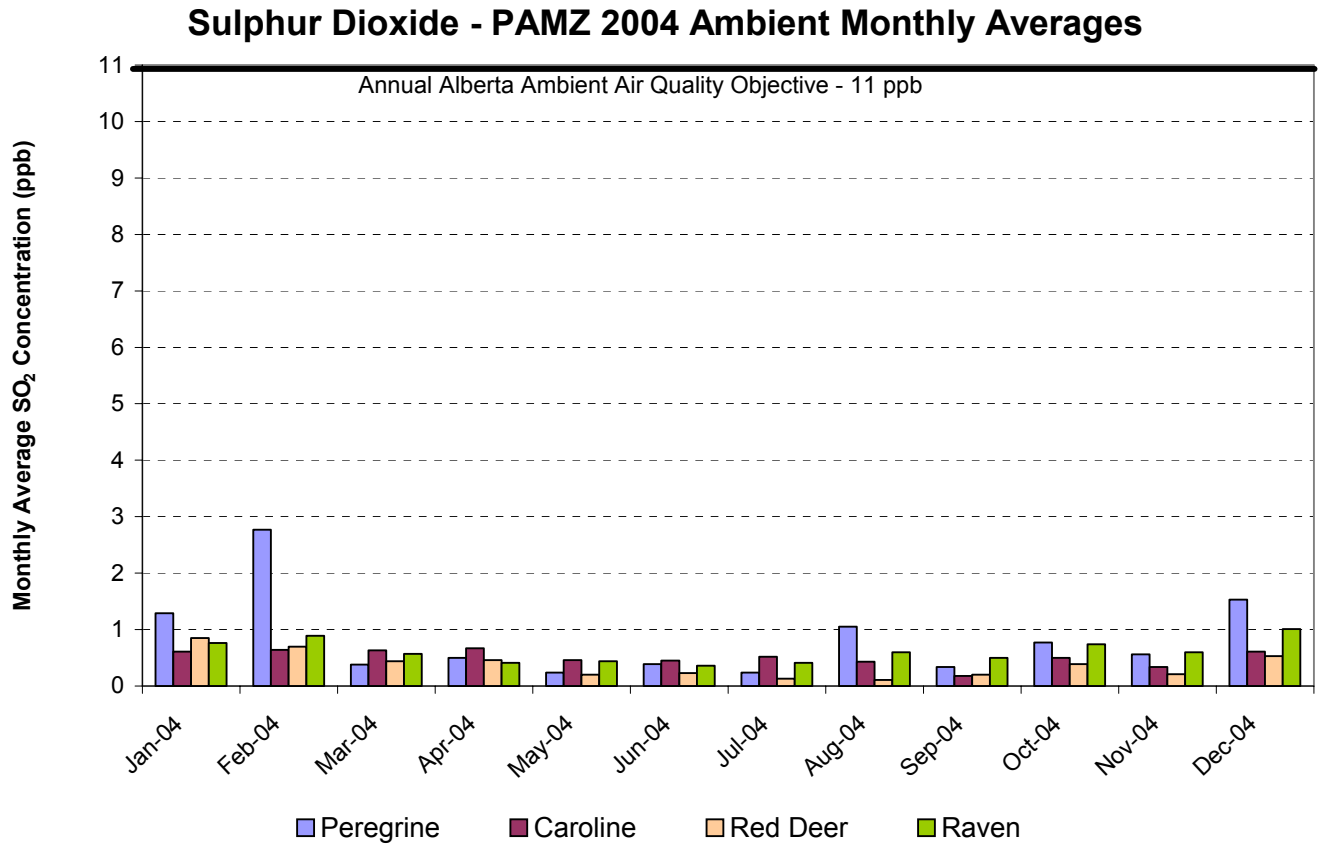
Sulphur dioxide is emitted directly into the atmosphere where it can persist for days, allowing for wide distribution of the gas. In the atmosphere, some sulfur dioxide can be oxidized by ozone and hydrogen peroxide to form sulfur trioxide. Both sulfur trioxide and sulfur dioxide are soluble in water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

SO_2 emissions within PAMZ fell by 15% from 2003 to 2004. It is estimated that sulphur dioxide emissions from industrial sources located within PAMZ totaled 39,558 tonnes in 2004, primarily from the oil and gas sector. Improved operating efficiencies, process improvements, lower sulphur inlet rates and an overall reduction in flaring all contributed to the decrease.

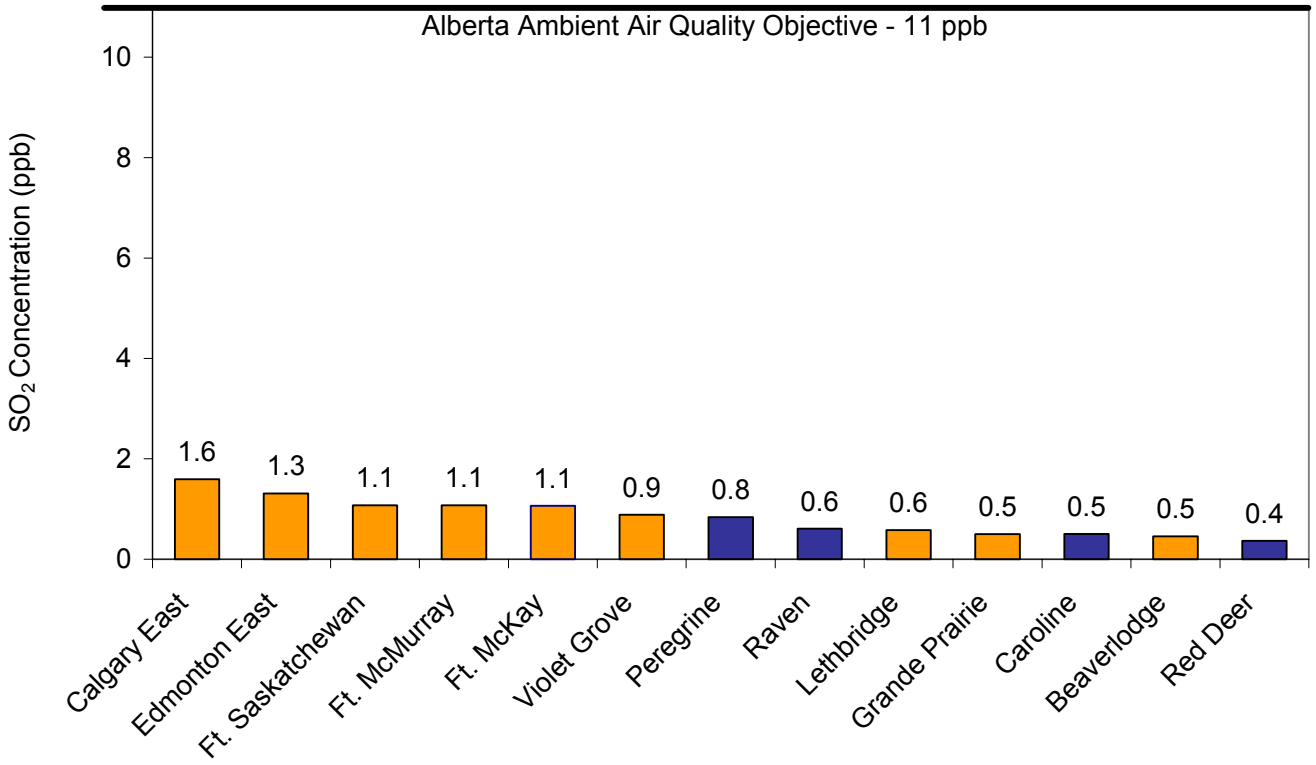
The Alberta Ambient Air Quality Objectives (AAAQO) for sulphur dioxide are:

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

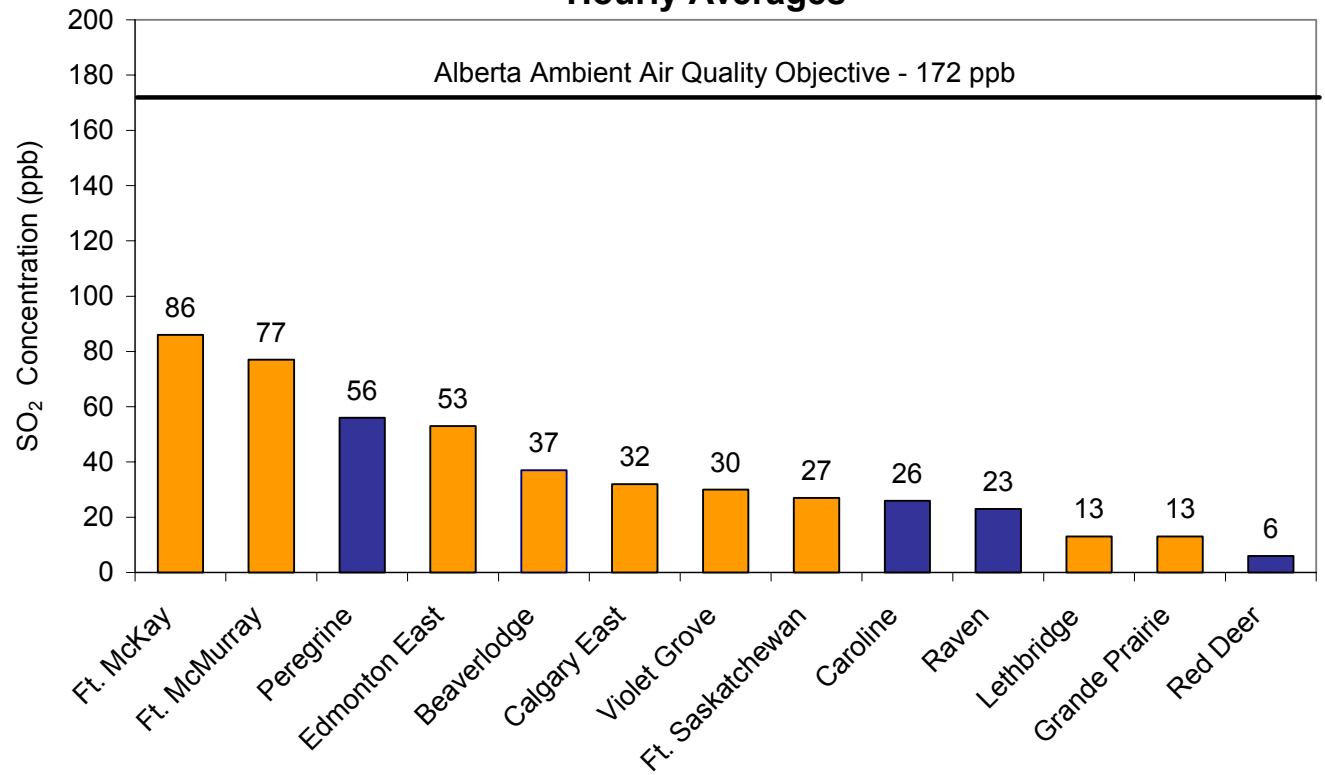
The annual average sulphur dioxide concentration ob-



Sulphur Dioxide - Alberta 2004 Ambient Annual Averages



Sulphur Dioxide - Alberta 2004 Maximum Ambient Hourly Averages



served at the Caroline Station in 2004 was 0.5 ppb, a slight decrease from 2003. The annual average sulphur dioxide concentration observed at the Red Deer-Riverside Station was 0.4 ppb. The Red Deer annual average was below the averages observed in all other major cities in Alberta where SO2 is being monitored. All of the these values were significantly below the annual average AAAQO of 11 ppb.

The annual average sulphur dioxide concentration observed with the Peregrine Station in 2004 was 0.8 ppb with the maximum monthly average concentration of 2.8 ppb observed while the station was located at the Prairie Creek site in February and March. The annual average sulphur dioxide concentration observed with the Raven Station in 2004 was 0.6 ppb with the maximum monthly average concentration of 1.0 ppb observed while the station was located in Sundre in December.

The maximum one-hour average sulphur dioxide concentrations observed at Prairie Creek (56 ppb), Caroline (26 ppb), Sundre (23 ppb) and Red Deer-Riverside (6 ppb) respectively were 33%, 15%, 13% and 3% of the one-hour average AAAQO of 172 ppb.

The maximum one-hour average sulphur dioxide value observed by the Caroline Station occurred in May, with winds from the west-northwest, a direction associated with a large local oil and gas production facility. The maximum one-hour average sulphur dioxide value observed by the Peregrine Station, occurred at the Prairie Creek Site in February, with winds from the southwest, a direction associated with a local gas production battery. The maximum one-hour average sulphur dioxide value observed at the Red Deer-Riverside Station, occurred in February with northeast winds. The maximum one-hour average sulphur dioxide value observed with the Raven Station, occurred at the Sundre site in November, with southwest winds.

7.1.2 Total Reduced Sulphur Compounds

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 odours that are detectable by people at very low concentrations.

The major component of the TRS observed by the PAMZ continuous monitors is hydrogen sulphide. 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.

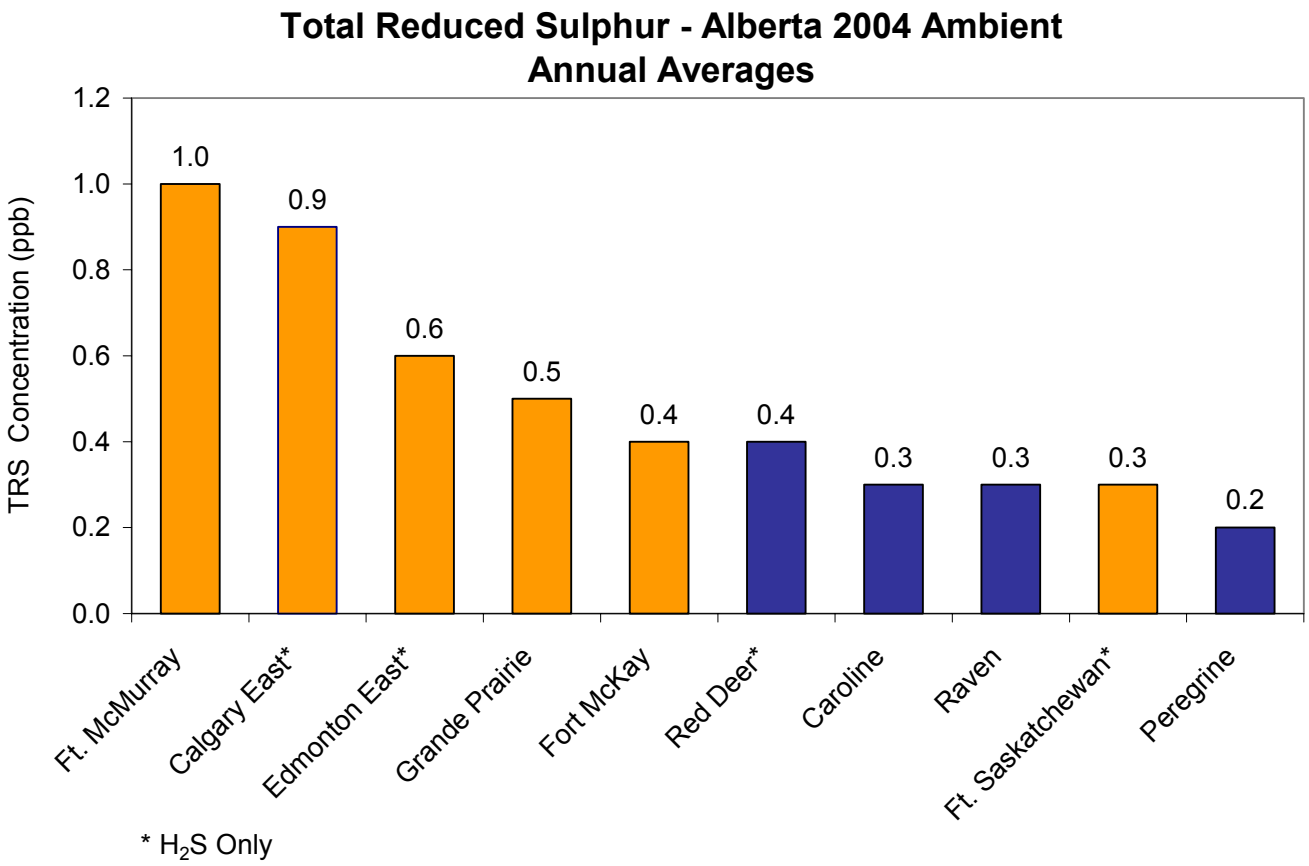
The decomposition of organic matter by bacteria under anaerobic conditions (no oxygen) produces hydrogen sulphide. Natural sources of hydrogen sulphide include sulphur hot springs, sloughs, swamps, muskegs and lakes. Hydrogen sulphide is also produced by chemical reactions within the deeply buried sedimentary 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. 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).

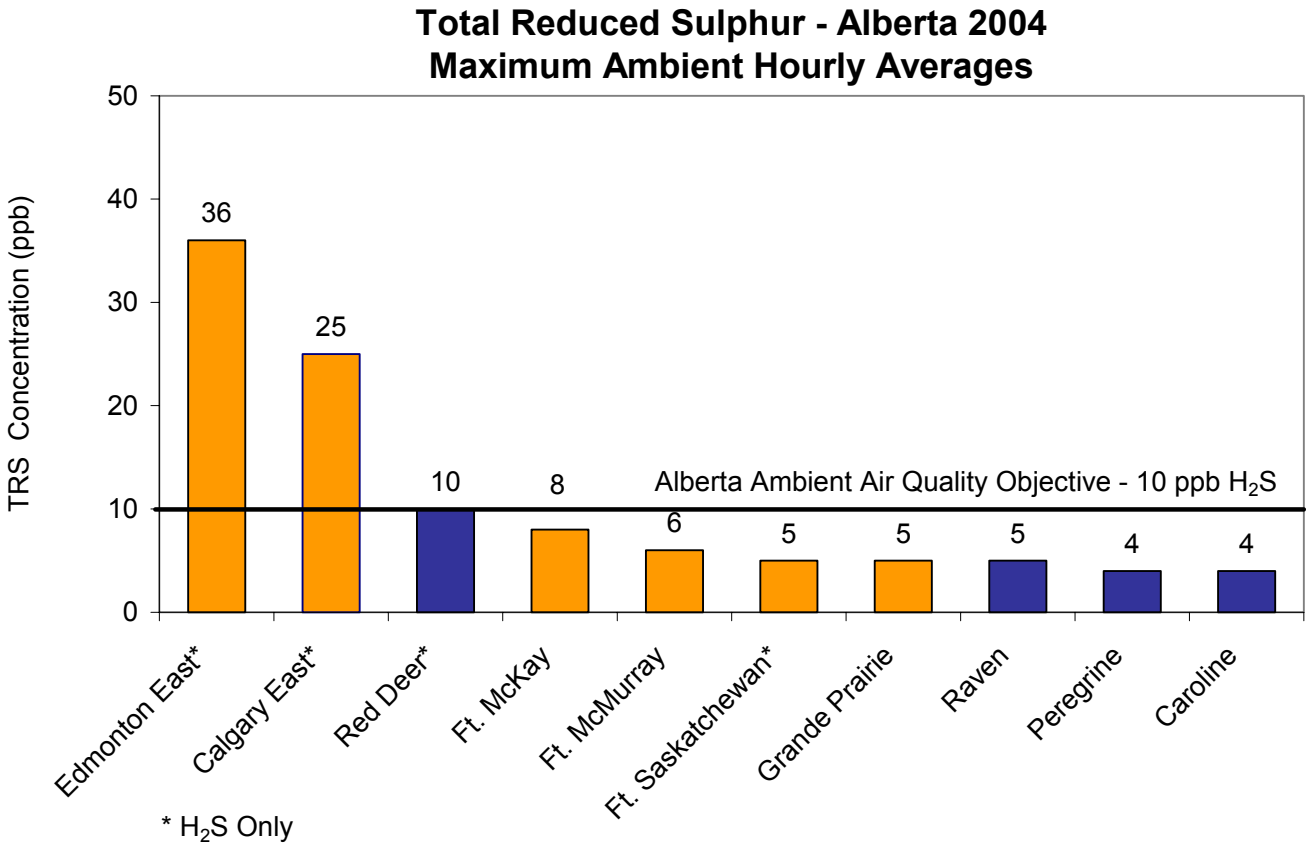
While there are currently no AAAQO for TRS, there are objectives for H_2S are based on an odour threshold of 10 ppb. The Objectives are:

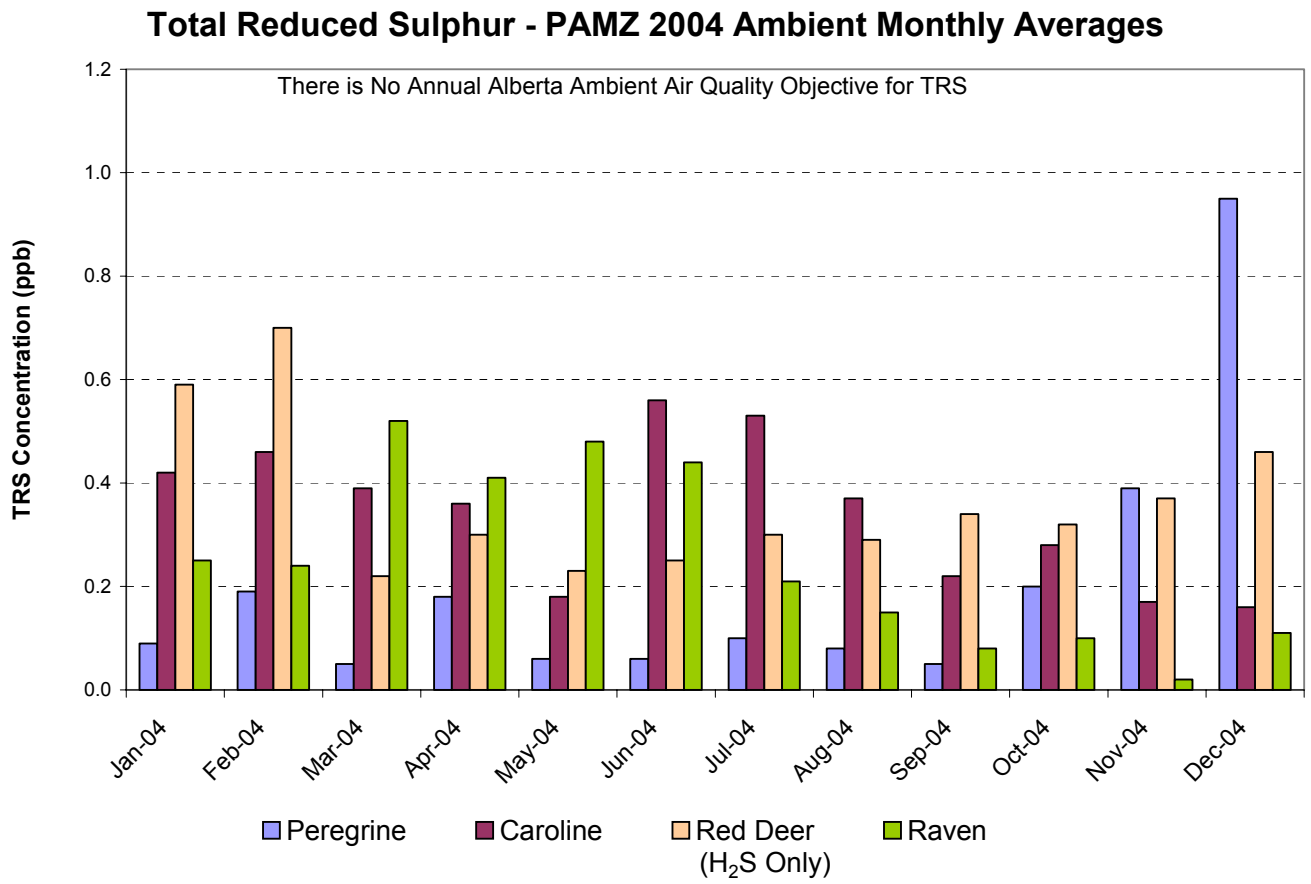
- 10 ppb averaged over a one-hour period
- 3 ppb average over a twenty-four hour period

The PAMZ AQM Program utilizes the H_2S Objectives when reporting TRS. TRS is monitored at the Caroline, Peregrine and Raven Stations while H_2S only is monitored at Red Deer-Riverside.

The annual average total reduced sulphur concentrations observed at the Caroline, Raven and Peregrine stations in 2004 were 0.3, 0.3 and 0.2 ppb respectively. These values are lower than the annual average concentrations observed at a number of cities in the province. The maximum monthly average concentrations of 1.0 ppb and 0.5 ppb observed at the Peregrine and Raven stations were observed in December and March when they were lo-


Total Reduced Sulphur - 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
0.4
0.3
0.3
0.3
0.2
Ft. McMurray
Calgary East*
Edmonton East*
Grande Prairie
Fort McKay
Red Deer*
Caroline
Raven
Ft. Saskatchewan*
Peregrine
* H2S Only


Total Reduced Sulphur - Alberta 2004 Maximum Ambient Hourly Averages
TRS Concentration (ppb)
50
40
30
20
10
0
36
25
10
8
6
5
5
5
4
4
Alberta Ambient Air Quality Objective - 10 ppb H2S
Edmonton East*
Calgary East*
Red Deer*
Ft. McKay
Ft. McMurray
Ft. Saskatchewan*
Grande Prairie
Raven
Peregrine
Caroline
* H2S Only



cated at the Red Deer-Woodlea and Innisfail sites respectively. The average hydrogen sulphide concentration observed at the Red Deer-Riverside Station in 2004 was 0.4 ppb, a value lower than those recorded for similarly located stations in Calgary (0.9 ppb), Edmonton (0.6 ppb), Grande Prairie (0.5 ppb) and Fort McMurray(1.0 ppb).

No exceedences of the H_2S AAAQO were observed by the PAMZ AQM Program 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 H_2S concentrations observed at all stations within the PAMZ network in 2004 were also below those observed at the Calgary East (36 ppb), and Edmonton East (25 ppb) stations.

7.1.3 Carbon Monoxide

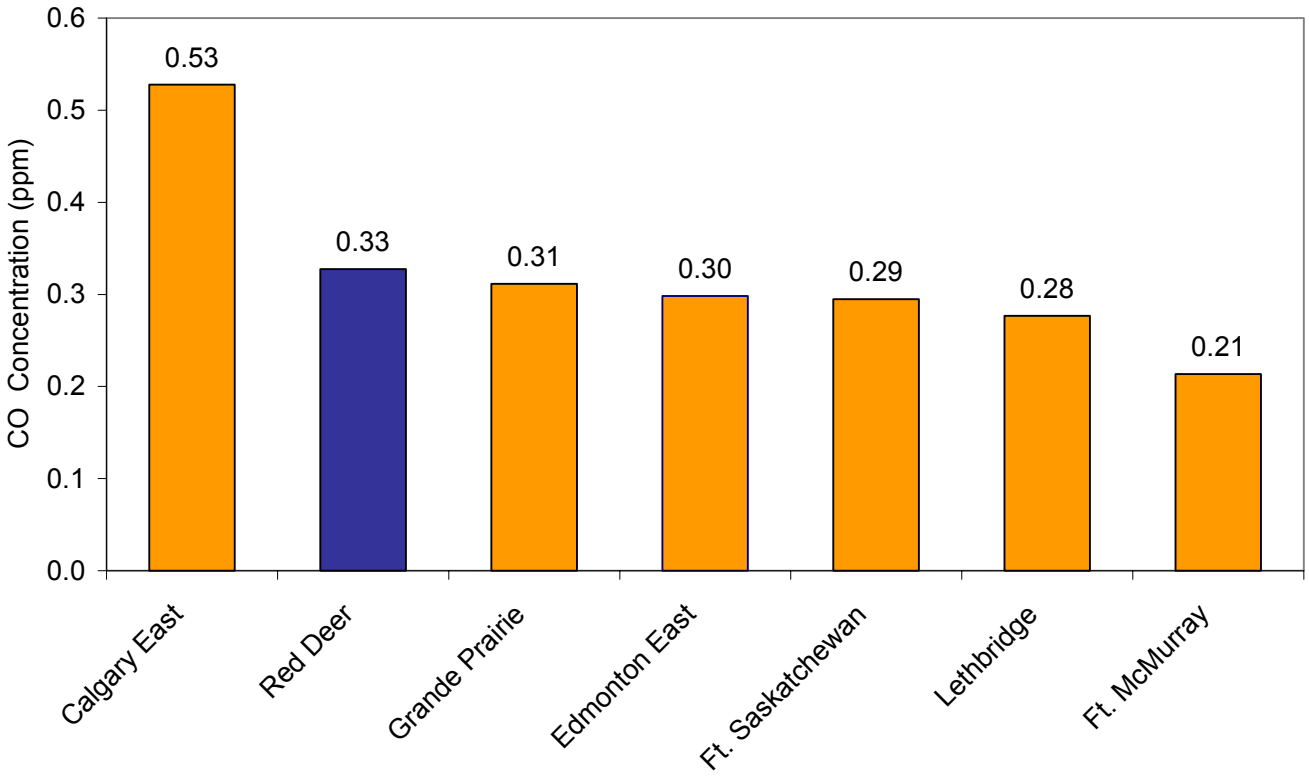
Carbon monoxide (CO) is a colourless, odourless gas formed when carbon-based fuels such as gasoline, oil, and wood burn with an insufficient supply of oxygen. Except for carbon dioxide, it is one of the longest lived naturally occurring atmospheric carbon compounds. The major source of CO in urban locations 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:

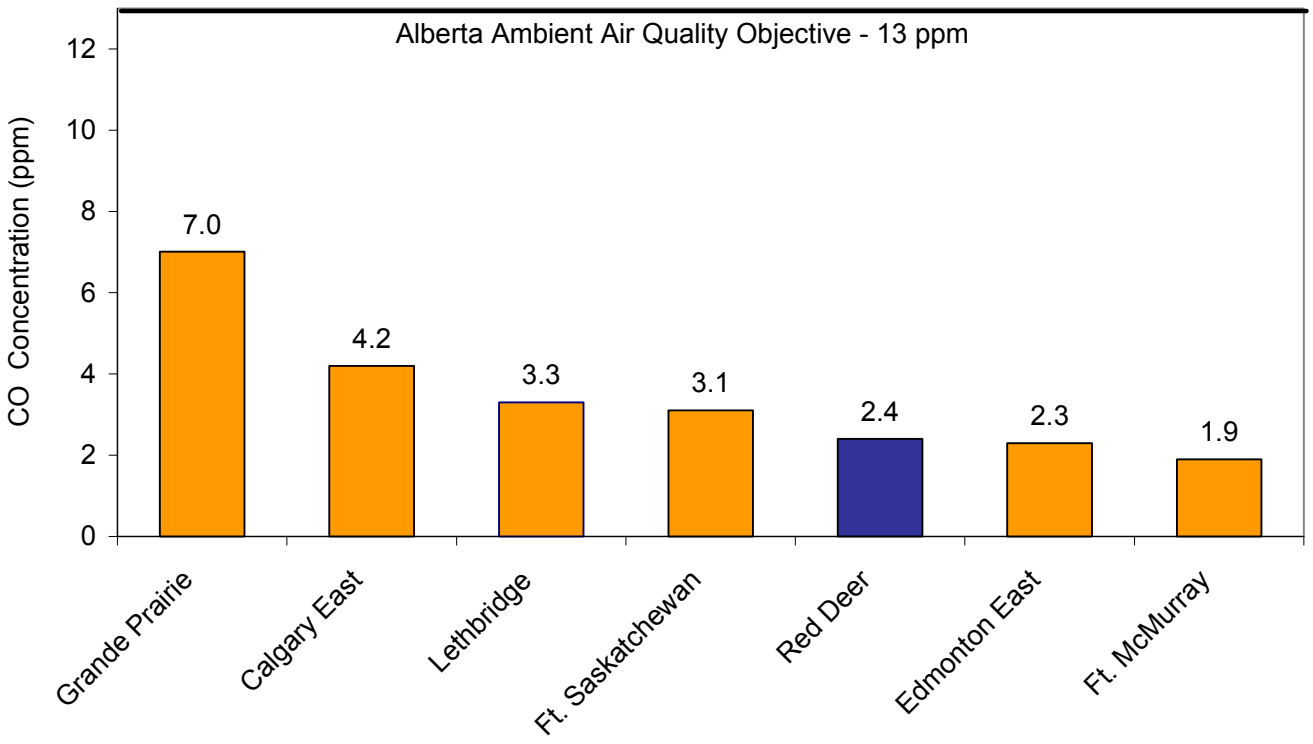
- 13 ppm averaged over a one-hour period
- 5 ppm averaged over an eight-hour period

Within PAMZ CO is monitored only at the Red Deer-Riverside Station. The 2004 annual average concentration of 0.33 ppm was lower than the Calgary average of 0.53 ppn and higher than the five other urban locations within Alberta where CO is also monitored. The maximum hourly average concentration of 2.4 ppm was less than the maxima observed at four other Alberta cities.

Carbon Monoxide - Alberta 2004 Ambient Annual Averages



Carbon Monoxide - 2004 Alberta Maximum Ambient Hourly Averages



7.1.4 Oxides of Nitrogen

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 (NO) reacts rapidly in the atmosphere through various mechanisms to form nitrogen dioxide. Nitrogen dioxide is a reddish-brown gas with a pungent irritating odour.

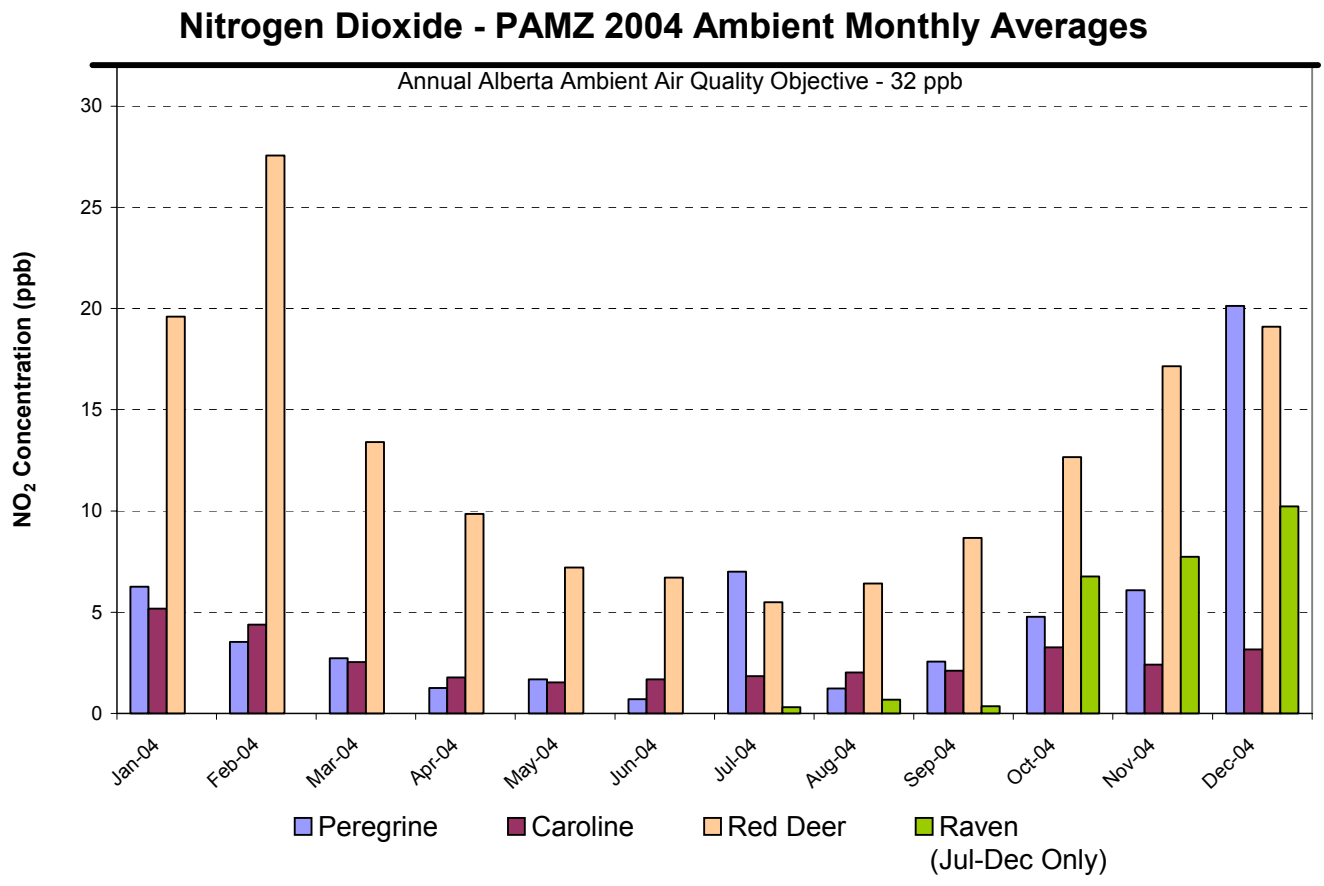
Oxides of nitrogen emissions are produced by transportation sources (automobiles, trucks, trains), industrial sources (oil and gas industries) and power generation plants. Other sources of oxides of nitrogen include natural gas combustion (e.g. home heating), heating fuel combustion and forest fires.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

The AAAQO for nitrogen dioxide, the major component of concern in the ambient atmosphere, are:

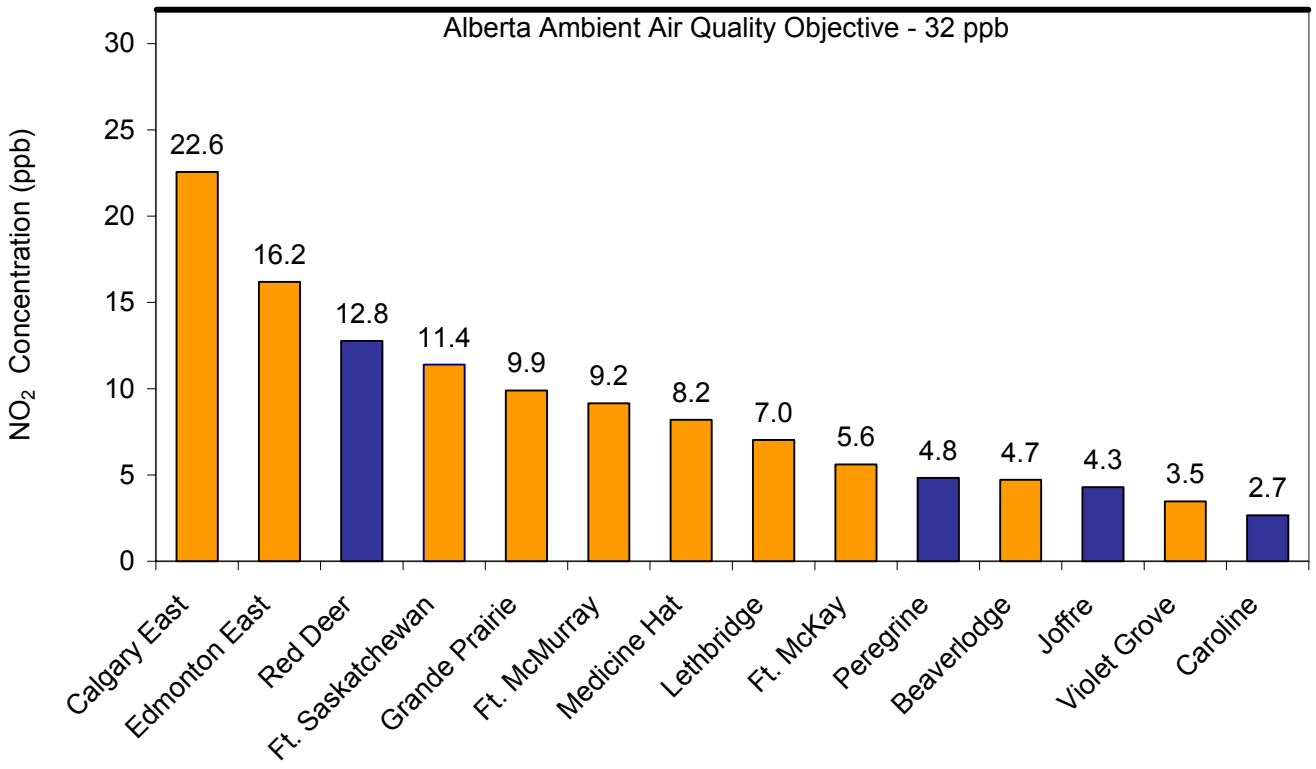
- 212 ppb averaged over a one-hour period
- 106 ppb averaged over a twenty-four hour period
- 32 ppb as an annual arithmetic mean

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.

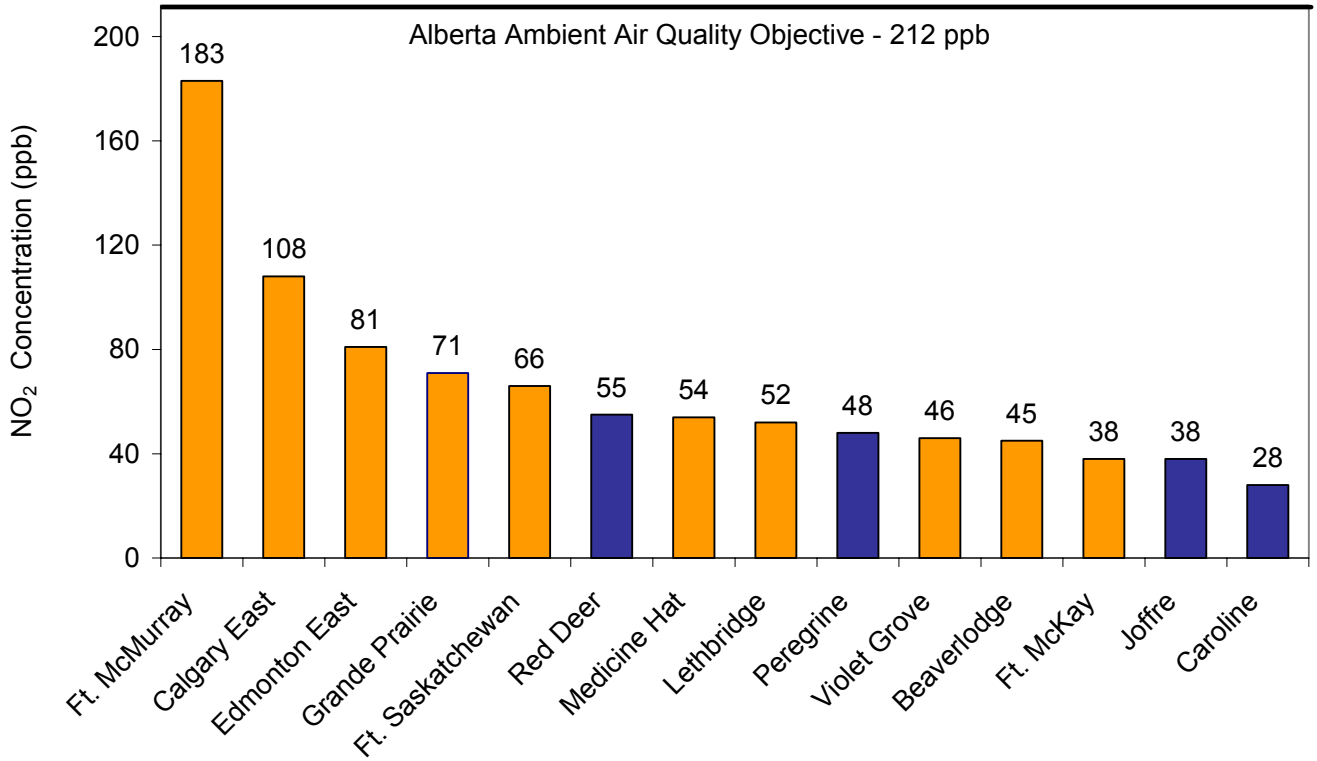
The annual average nitrogen dioxide concentration observed at the Caroline and Peregrine Stations in 2004 was 2.7 ppb and 4.8 ppb respectively. These levels are similar to those observed in 2003. The annual average nitrogen dioxide concentration observed at a station operated by NOVA Chemicals near Joffre, close to the PAMZ's eastern boundary was 4.3 ppb. The annual average nitrogen dioxide concentration observed at the Red Deer-Riverside Station in 2004 was 12.8 ppb, 33% higher than 2003. This result is consistent with the size of the population of the City of Red Deer when compared with levels observed in other cities in the province. It is lower than the averages of 22.6 and 16.2 ppb for the larger cities of Calgary and Edmonton and higher than the



Nitrogen Dioxide - Alberta 2004 Ambient Annual Averages



Nitrogen Dioxide - Alberta 2004 Maximum Ambient Hourly Averages



averages of 9.9, 9.2, 8.2 and 7.0 ppb observed in the cities of Grande Prairie, Fort McMurray, Medicine Hat and Lethbridge respectively. All of these results are consistent with the location of the stations relative to their distances from emission sources, primarily motor vehicle traffic and population centres.

Monitoring for nitrogen dioxide at the Raven Station did not commence until late July, so no average annual concentration has been calculated for 2004. The Peregrine and Raven stations' maximum monthly average concentration of 20.1 and 10.2 ppb were observed in December while the stations were located at the Red Deer-Woodlea and Sundre sites respectively. The annual average nitrogen dioxide concentrations for all sites in the PAMZ monitoring program network are less than 40% of the AAAQO of 32 ppb.

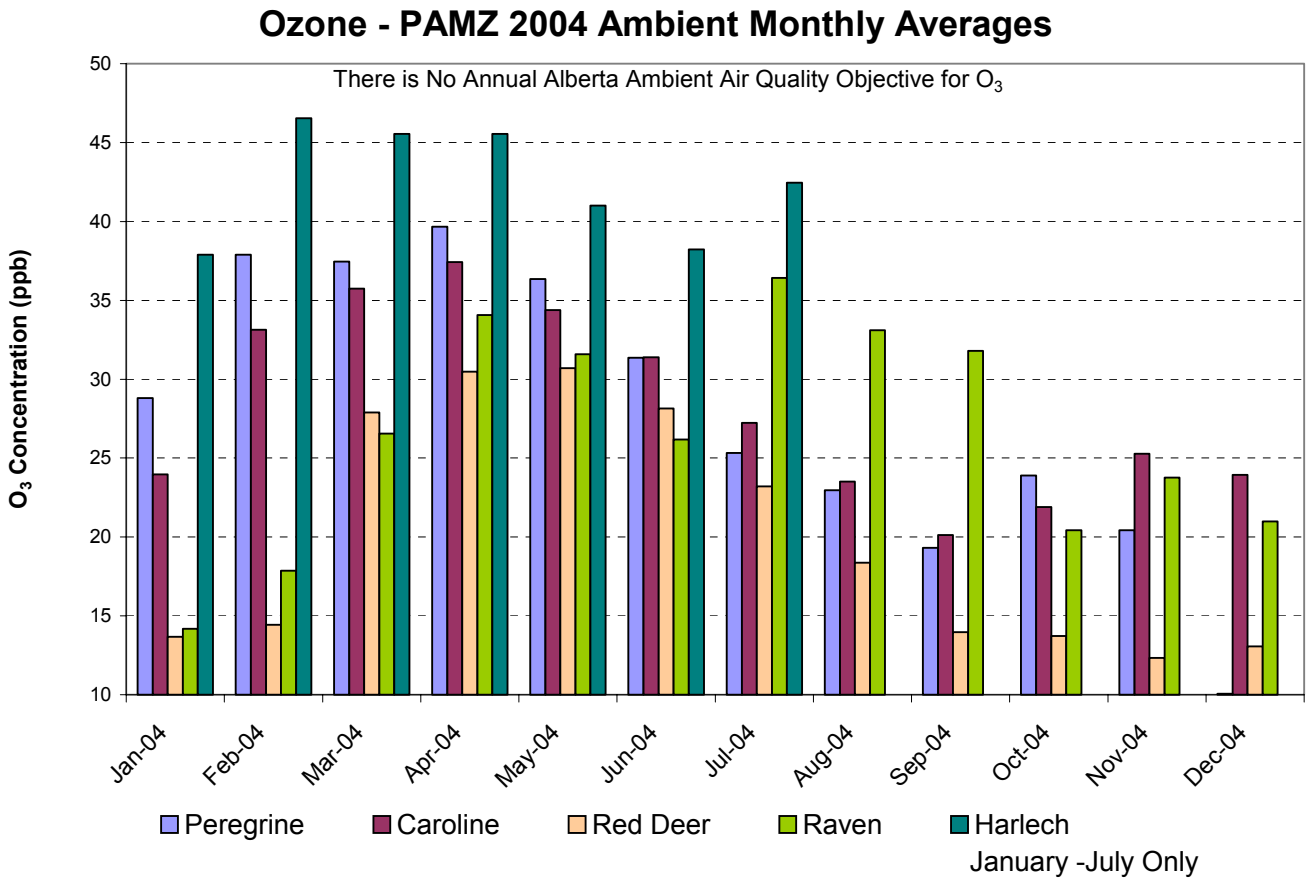
The maximum one-hour average nitrogen dioxide concentrations observed at the Red Deer-Riverside (55 ppb), Red Deer-Woodlea (48 ppb), Sundre (39 ppb), Joffre (38 ppb), and Caroline (28 ppb) respectively were 26%, 23%, 18%, 18%, and 13% of the one-hour average AAAQO. Again, these results are all consistent with the stations' proximity to motor vehicle traffic and population centres. The maximum hourly average nitrogen dioxide values at both Red Deer locations and Caroline and Sundre occurred when the winds were from directions associated with motor vehicle traffic.

7.1.5 Ozone

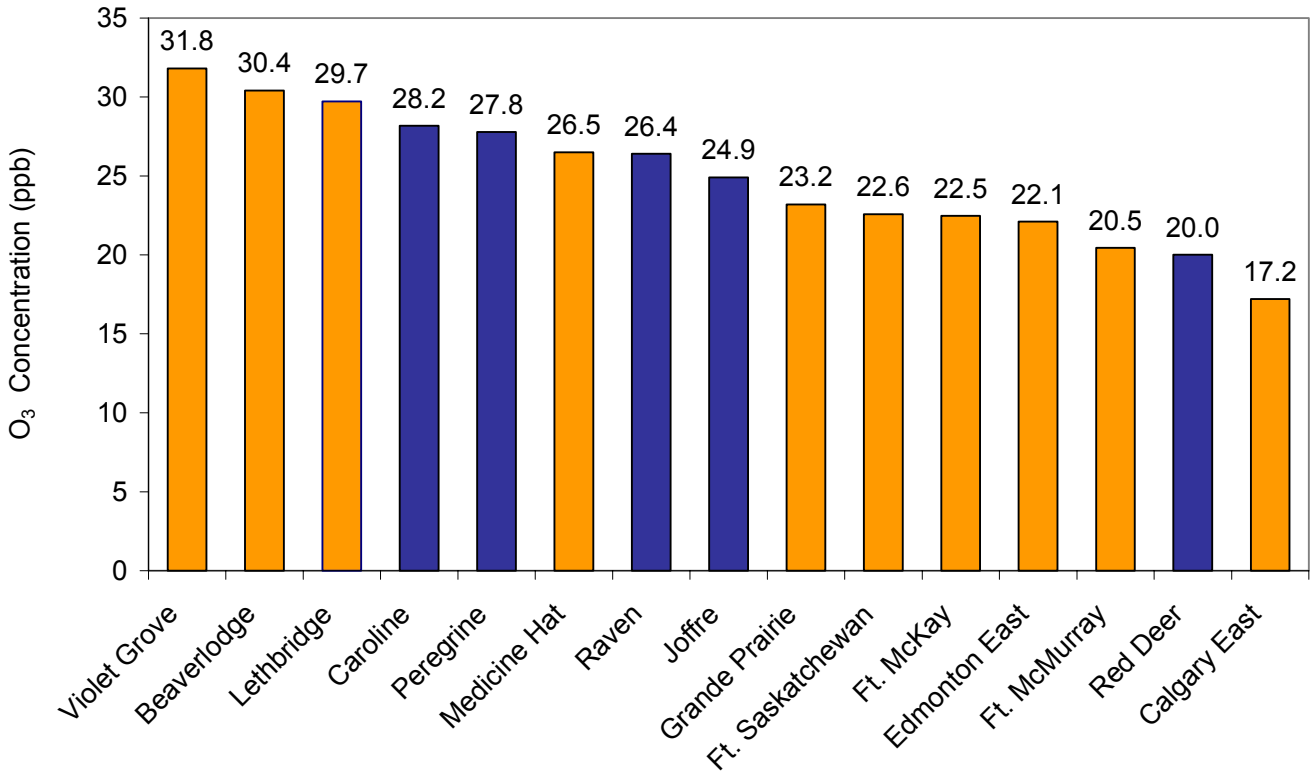
Ozone (O_3) is a colorless gas that at normal outdoor concentrations is odourless. However, ozone does have a distinctive sharp odour when found at higher concentrations, such as those associated with electrical discharges from lightning storms or photocopiers.

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.

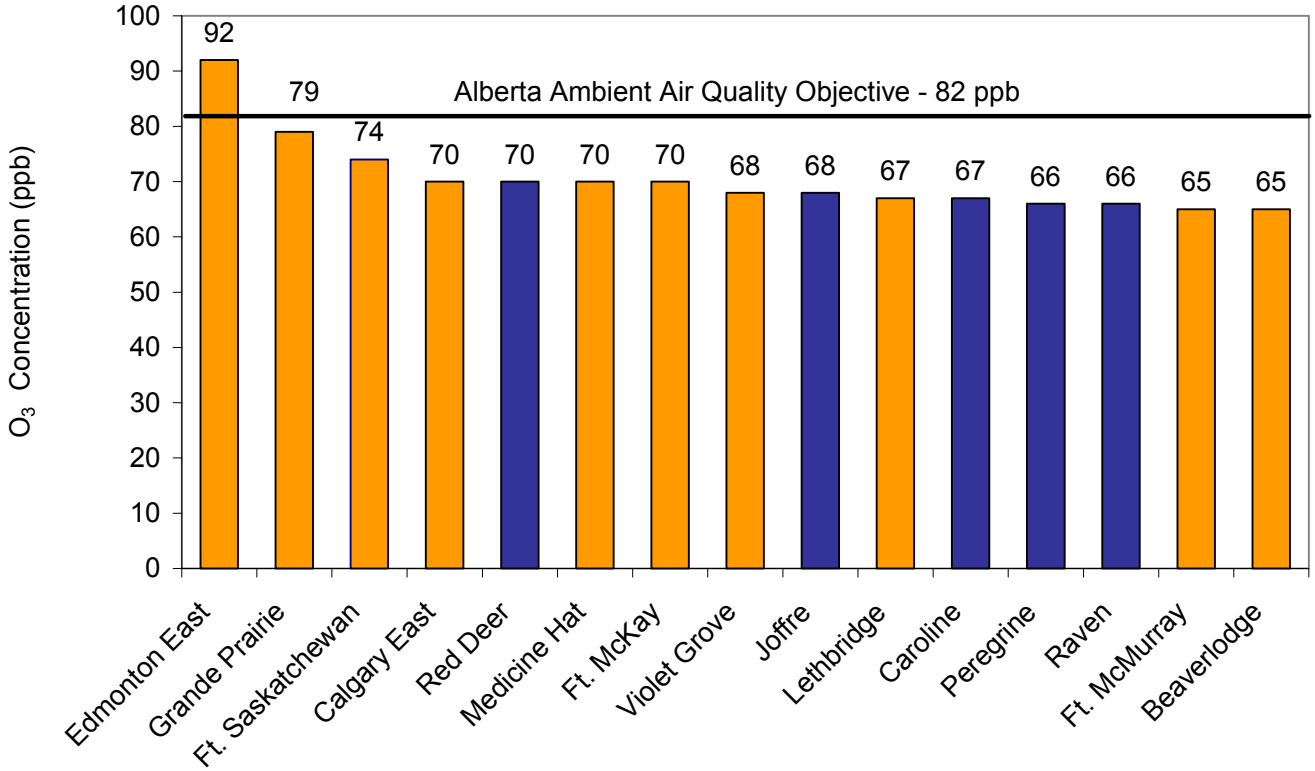
The ozone layer in the upper atmosphere (stratosphere) absorbs UV radiation and creates a warm layer of air in the stratosphere. The ozone layer is, therefore, responsible for the thermal structure of the stratosphere. Stratospheric ozone shields the Earth against harmful rays



Ozone - Alberta 2004 Ambient Annual Averages



Ozone - Alberta 2004 Maximum Ambient Hourly Averages



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. Recent studies conducted for the CASA Particulate Matter and O_3 Project Team and others have indicated that some of ground-level O_3 observed in Alberta may originate from the United States and Pacific Rim countries.

The AAAQO for ozone are based on the prevention of adverse effects to human health and vegetation and is:

- 82 ppb averaged over a one-hour period

The Canada-wide Standard (CWS) benchmark concentration for 8-hour O_3 concentrations is 65 ppb. The actual achievement statistic for the O_3 CWS is based on a complex calculation process that involves using the fourth highest measurement annually, averaged over three consecutive years. During 2004, there was only one day (June 4) at the Red Deer-Riverside site on which there were 8-hour average O_3 concentrations greater than 65 ppb. There were no days at the Caroline, Harlech, Peregrine or Raven Stations with 8-hour average O_3 concentrations greater than the 65 ppb.

There were no exceedences of the one-hour average O_3 AAAQO observed at any of the stations in the PAMZ AQM Program during 2004.

As discussed earlier, the Harlech and Hightower Ridge Stations were decommissioned in July so an annual average for 2004 cannot be calculated. The average annual ozone concentrations measured at the Caroline, Peregrine and Raven Stations were 28.2, 27.8 and 26.4 ppb respectively. The annual average ozone concentration observed at a NOVA Chemicals Station near Joffre, approximately 30 km. east of Red Deer was slightly lower at 24.9 ppb. The annual average concentration of 20 ppb observed at the Red Deer Station is significantly lower most likely due to the effect of motor vehicle emissions discussed earlier.

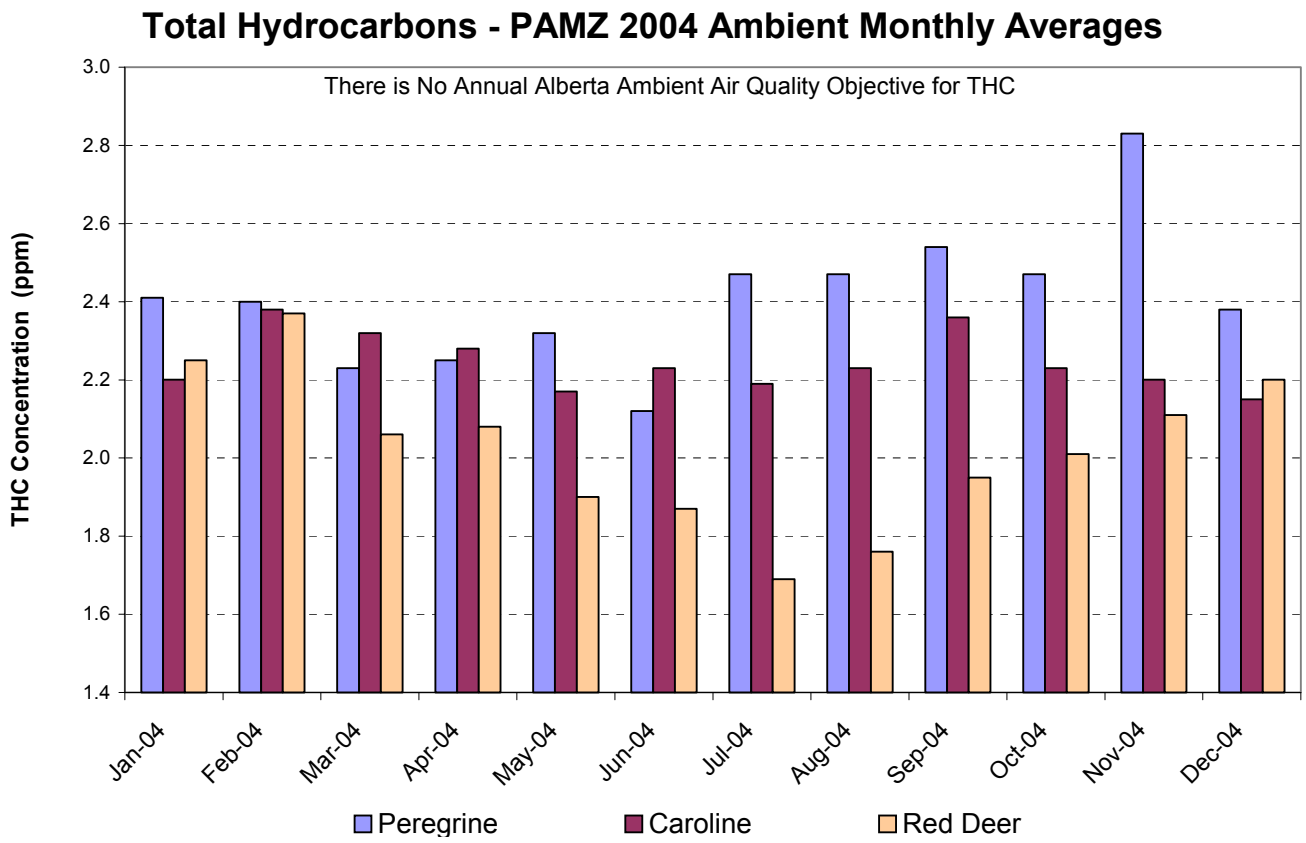
The maximum one-hour average ozone concentrations observed at the Red Deer, Joffre and Caroline Stations were 70, 68 and 67 ppb respectively. The maximum one-hour average ozone concentration of 66 ppb observed at both the Peregrine and Raven Stations was observed while they were located at the Dovercourt Site in June and Limestone Mountain site in August respectively. The highest ozone levels observed at the Harlech station while it was operational in 2004 were the 66 ppb readings observed in April and early July.

All 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.

7.1.6 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 some 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.

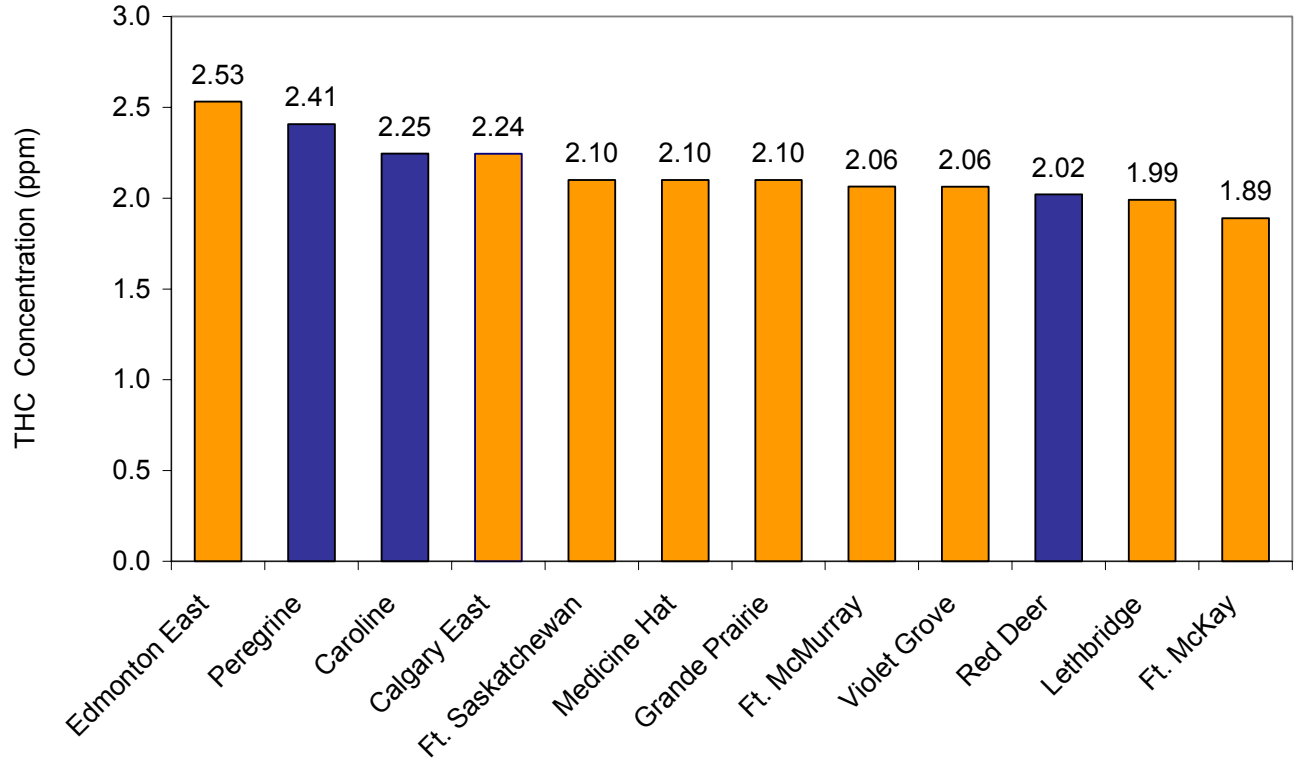
While Alberta does not have ambient air quality objectives for ambient (outdoor) concentrations of total hydrocarbons it does have objectives for some specific reactive hydrocarbons such as benzene and styrene. The establishment of objectives for more reactive hydrocarbons is currently being considered.

In 2004, the PAMZ program monitored both Total Hydrocarbons and Methane concentrations at its Peregrine station. Total Hydrocarbon concentrations were monitored at the Caroline Station and Red Deer Stations. Monitoring of Total Hydrocarbons at the Raven Station only commenced in December and that data has not been included in this report.

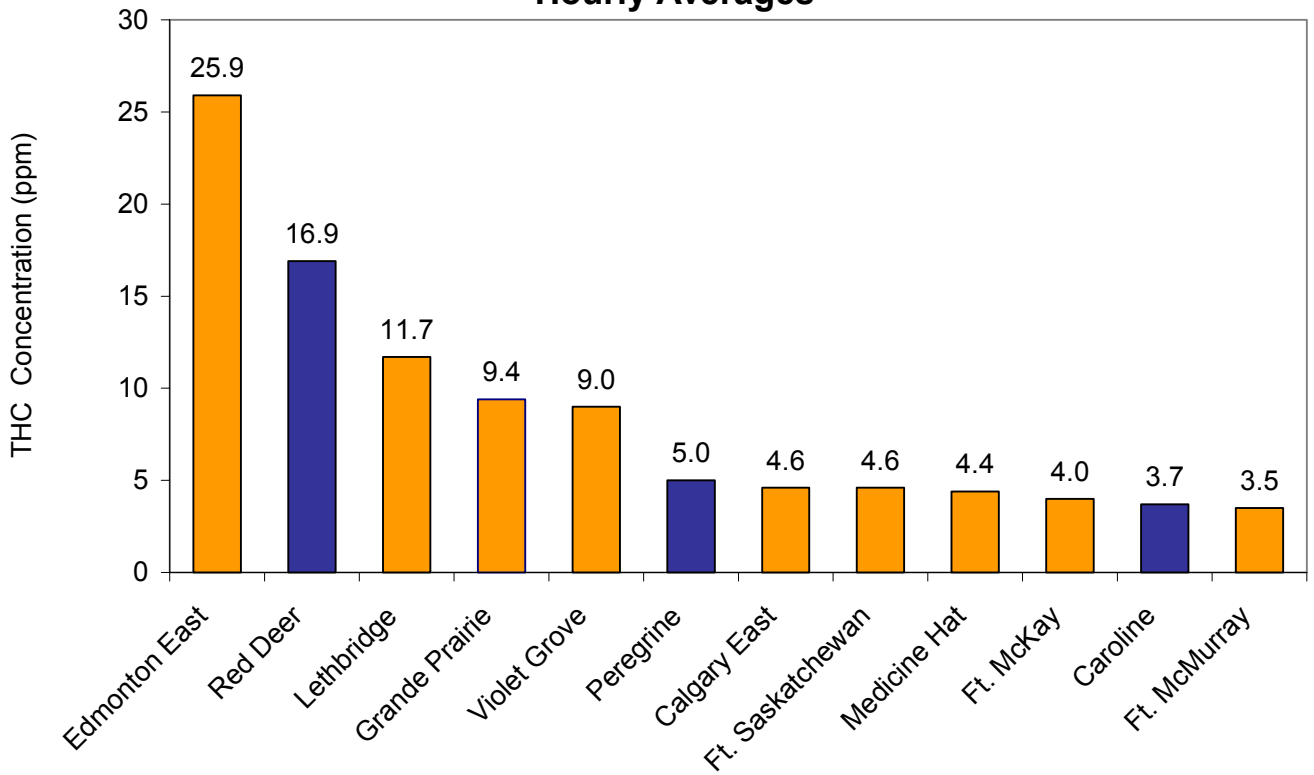
The annual average total hydrocarbon concentration observed at the Caroline Station in 2004 was 2.25 ppm. This average is slightly higher than that observed during the same time period at the Violet Grove Station (2.06 ppm), located near Drayton Valley. The annual average total hydrocarbon concentration observed at the Red Deer Station during 2004 was 2.02 ppm, which was slightly lower than the averages observed in other Alberta Cities with the exception of Lethbridge. The annual average total hydrocarbon concentration observed with the Peregrine Station in 2004 was 2.41 ppm, with the highest monthly average concentration of 2.83 ppm observed while the station was located at the Eckville site in November.

The maximum one-hour average THC concentration observed at the Caroline Station in March was 3.7 ppm and was associated with westerly winds, a direction associated with local oil and gas production activities. The maximum one-hour average THC concentration observed with the Peregrine Station was the 5.0 ppm recorded with moderate west-southwest winds while the station was located at the Eckville Site in November. The maximum one-hour average THC concentration of 16.9 ppm observed at the Red Deer Station in October occurred with light south winds, a direction associated with the downtown area of Red Deer.

Total Hydrocarbons - Alberta 2004 Ambient Annual Averages



Total Hydrocarbons - Alberta 2004 Maximum Ambient Hourly Averages



7.1.7 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.

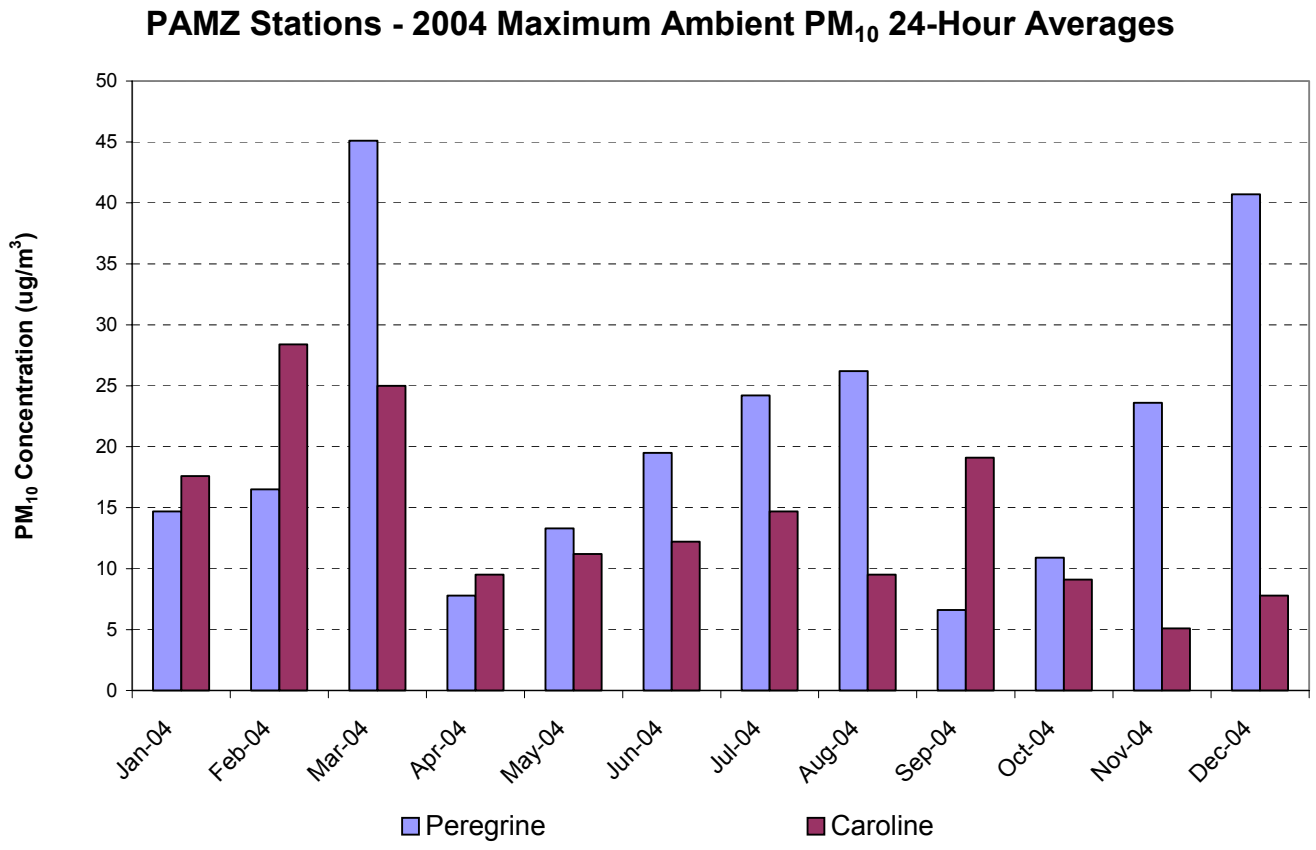
PM_{10} can be divided into two groups of particles based on size: fine particles and coarse particles. Fine particles, also known as respirable particulate, are those particles that are less than about 2.5 microns in diameter and are known collectively as $PM_{2.5}$. In contrast, coarse particles are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

The PAMZ Monitoring Program utilizes integrated particulate samplers to collect both PM_{10} and $PM_{2.5}$ at its Caroline and Peregrine Stations. $PM_{2.5}$ concentrations are monitored continuously at the Red Deer Station.

The PAMZ program collects intermittent particulate samples every six days for a twenty-four hour period, on the National Air Pollution Surveillance (www.etc-cte.ec.gc.ca/NAPS) Schedule, the same schedule used by most of the AQM Networks located throughout Canada. While the PAMZ program is currently focused on quantitative analy-



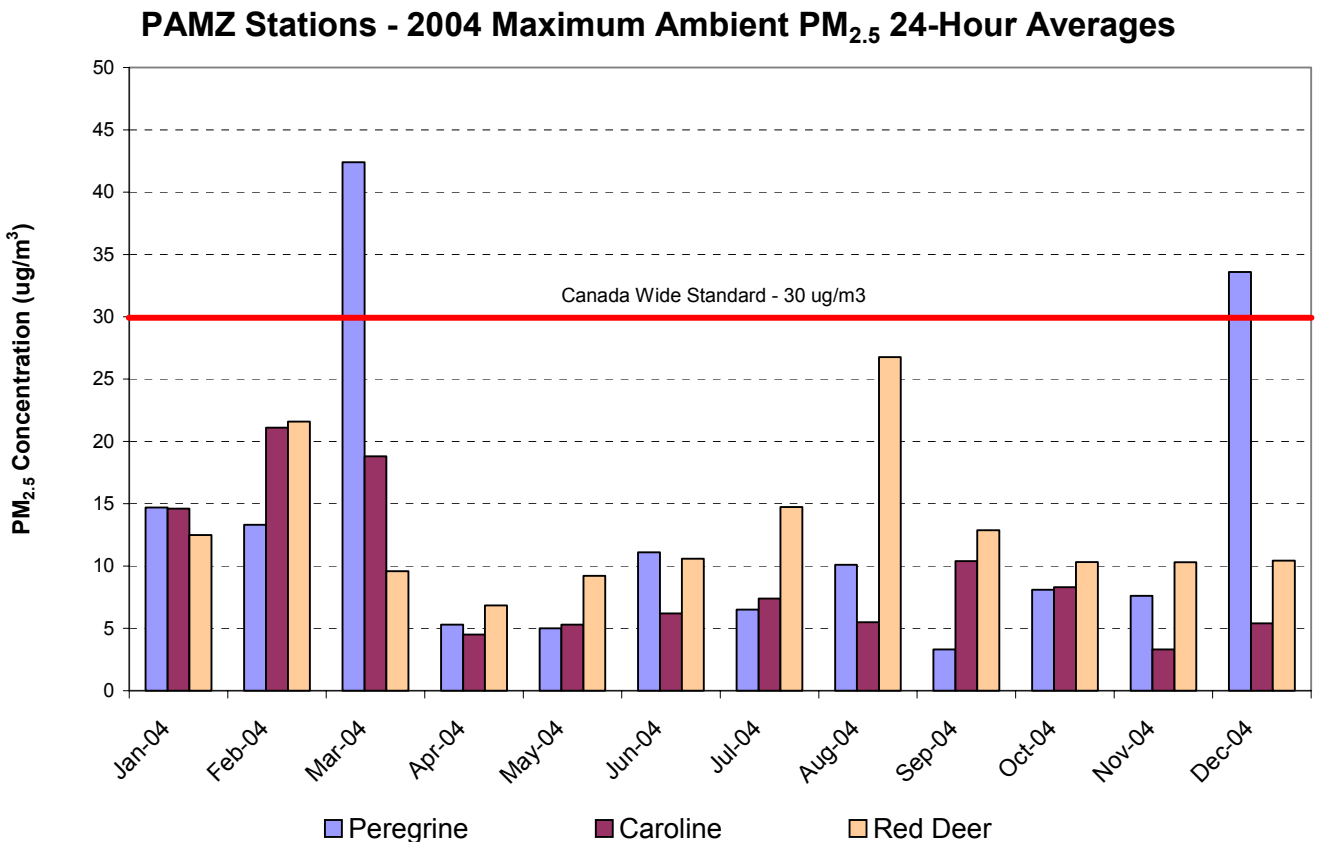
sis of the filters, these filters are retained and further analysis can be performed to determine the compounds that are present in the sample for the purposes of source apportionment or other reasons.

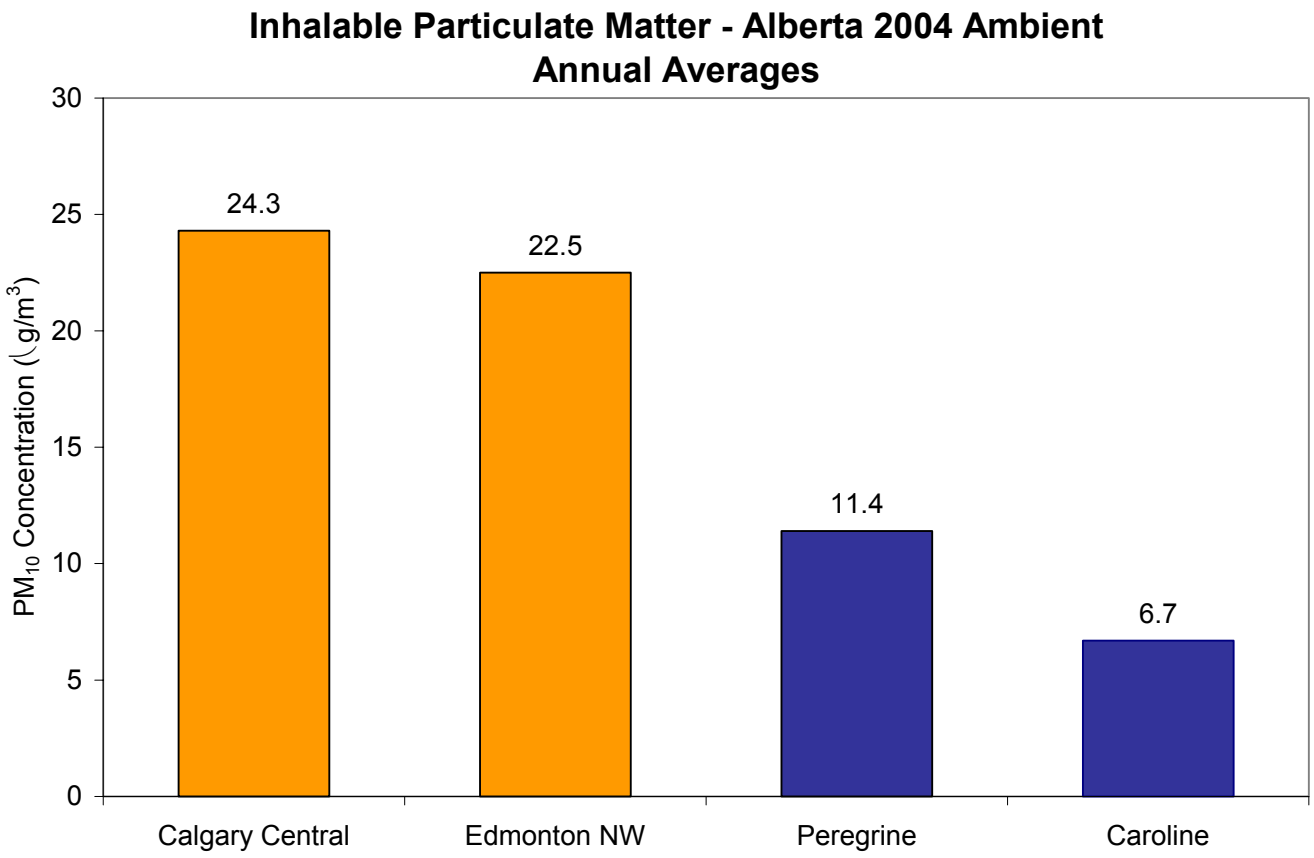
In the near future, the intermittent sampling program will be replaced by Continuous $PM_{2.5}$ Monitors. In 2004, the PAMZ TWG began an investigation into several different types and makes of Continuous $PM_{2.5}$ Monitors and at the year's end had submitted a proposal to Alberta Environment to conduct an evaluation study of a beta-attenuation type monitor at the Caroline Station for a six-month period in 2005.

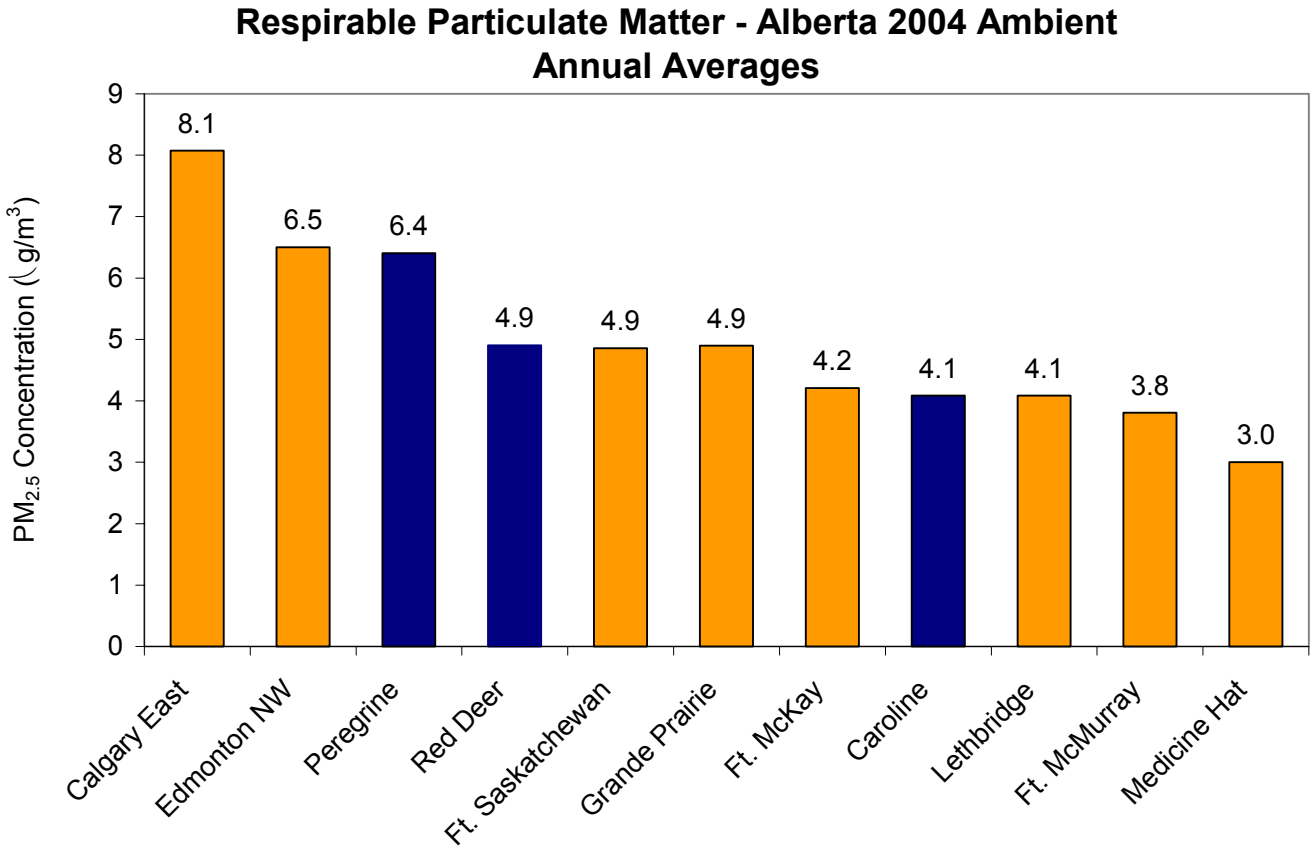
There are currently no Alberta Ambient Air Quality Objectives for PM_{10} or $PM_{2.5}$. A Canada Wide Standard (CWS) for $PM_{2.5}$ has been issued. The CWS for $PM_{2.5}$ is a 24 hour average of 30 micrograms per cubic meter ($\mu g/m^3$) based on the 98th percentile ambient measured annually, and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

For 2004, the average PM_{10} concentrations at the Caroline and Peregrine Stations were significantly lower than those observed at urban locations such as Edmonton and Calgary. For 2004, the average $PM_{2.5}$ concentrations at the Peregrine, Red Deer and Caroline Stations were slightly lower than those observed in the cities of Edmonton and Calgary, where a significant portion of the $PM_{2.5}$ monitored can be attributed directly to motor vehicle traffic.

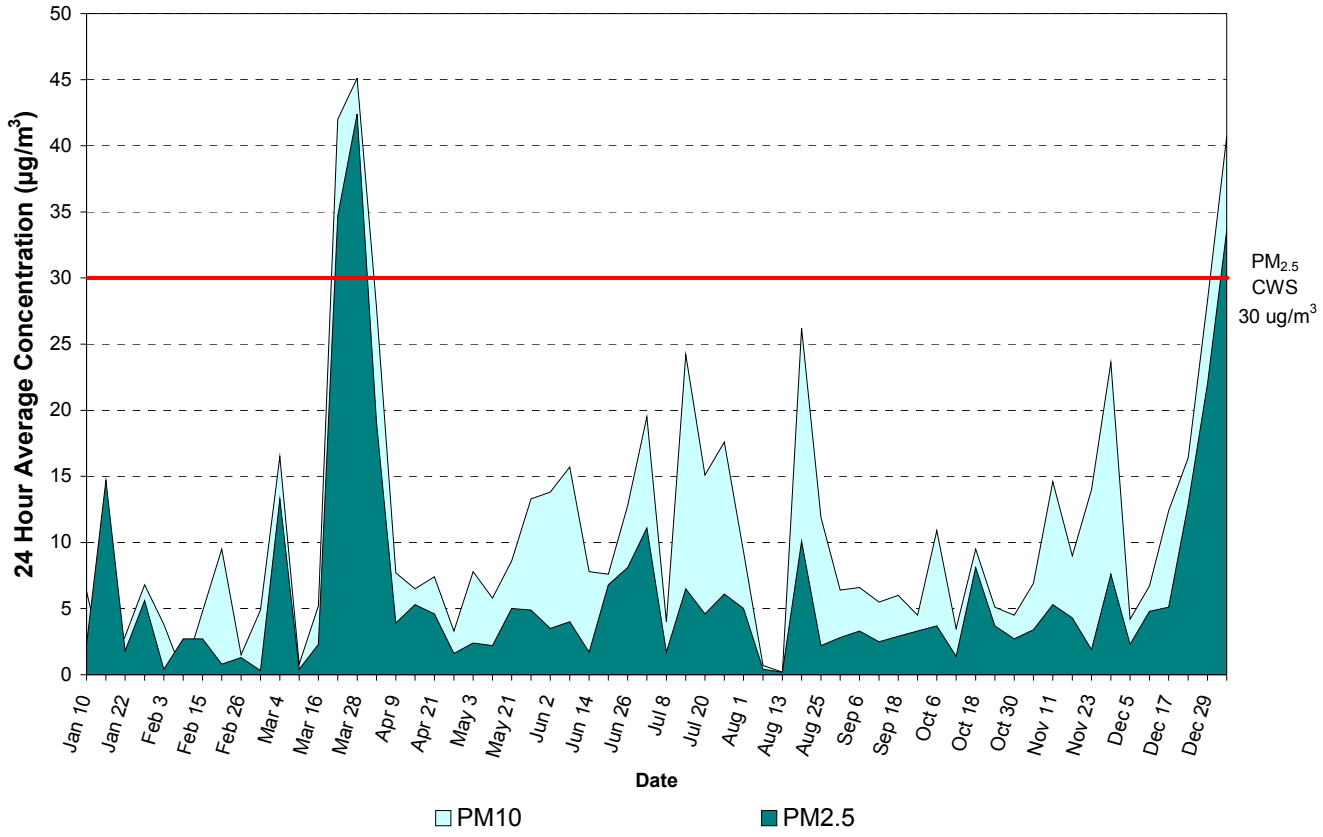
During 2004, there were three exceedences of the absolute $PM_{2.5}$ CWS level, two at the Peregrine Station while it was located at the Lloyd Creek Site in March and one at the Red Deer Site in December. No exceedences were recorded at the Caroline and Red Deer Stations. An investigation into the possible source(s) of the Lloyd Creek results involved analyzing the filters for the presence of crustal materials, metals and the products of wood combustion; the investigation was unable to identify a source. The High December result at the Red Deer-Woodlea Station is most likely associated with emissions from motor vehicles idling and traveling on a major traffic thoroughfare nearby.



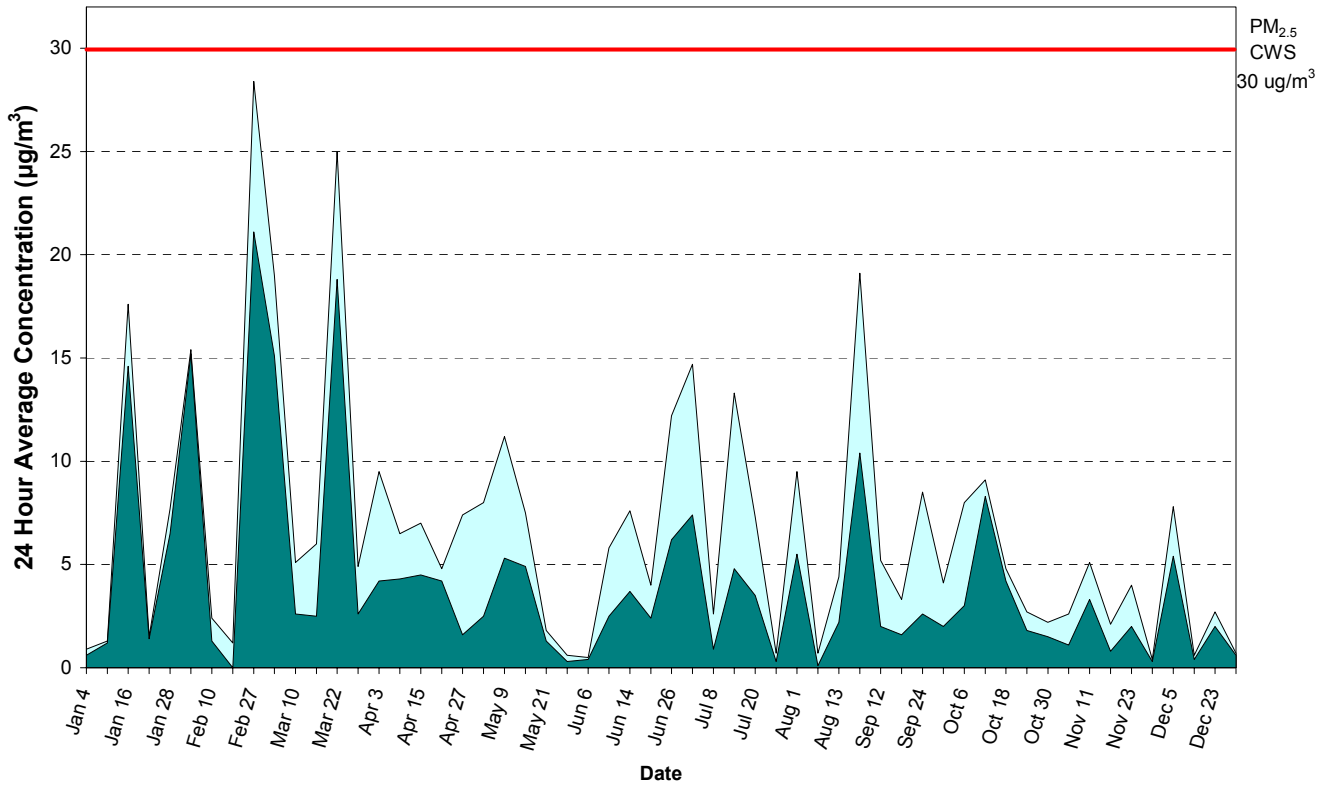

Inhalable Particulate Matter - Alberta 2004 Ambient Annual Averages
PM10 Concentration (µg/m3)
30
25
20
15
10
5
0
24.3
22.5
11.4
6.7
Calgary Central
Edmonton NW
Peregrine
Caroline


Respirable Particulate Matter - Alberta 2004 Ambient Annual Averages
PM2.5 Concentration (µg/m3)
9
8
7
6
5
4
3
2
1
0
8.1
6.5
6.4
4.9
4.9
4.9
4.2
4.1
4.1
3.8
3.0
Calgary East
Edmonton NW
Peregrine
Red Deer
Ft. Saskatchewan
Grande Prairie
Ft. McKay
Caroline
Lethbridge
Ft. McMurray
Medicine Hat

Inhalable & Respirable Particulate - Peregrine - 2004



Inhalable & Respirable Particulate - Caroline - 2004



7.2 Passive Monitoring

The PAMZ AQM Program uses an extensive network of passive monitors to collect air quality data over a large region (45,000 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 PAMZ are their accuracy, low detectable limits, simple design, ease of use and cost effectiveness.

Passive Sampling Station

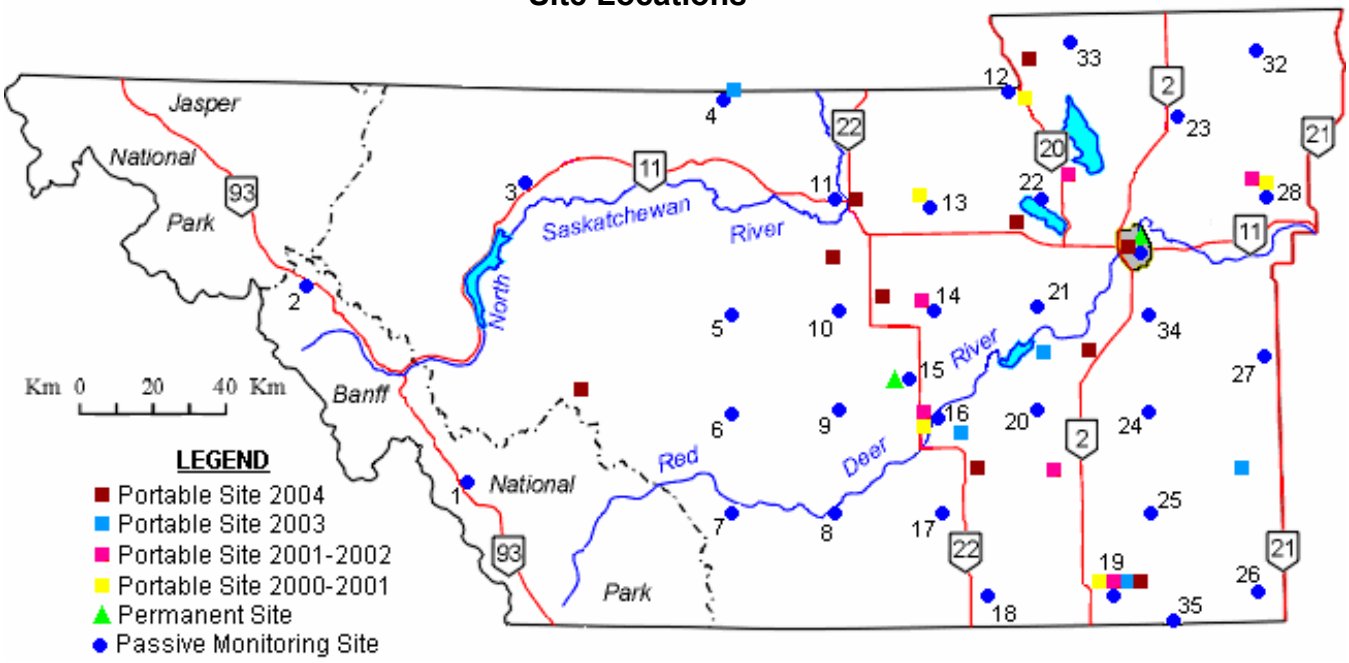
Passive samplers rely on the principles of permeation and diffusion to physically uptake the specific compound being sampled. This method is an alternative to active sampling or continuous monitoring where an air sample is drawn or forced mechanically into or through a collection device or past a detector.

For 2004 the PAMZ Passive Monitoring Network consisted of thirty-four permanent stations and included passive data collected at the Red Deer AQM Station. Currently the parameters measured in the network are SO_2, NO_2 and O_3. O_3 only is monitored at the Harlech location. In general, the passive monitoring stations are located throughout the zone on a 3 X 3 township grid system, though there is a bias to the more developed eastern part of the zone, due in part to the limited accessibility of the zone's western regions.

Passive monitoring is conducted year-round on a monthly interval with duplicate samples rotated through 10% of the sites for quality assurance purposes.

As in previous years, regression and correlation analyses of the monthly passive and continuous SO_2, NO_2 and O_3 data at the Peregrine Station concluded that the that the fit of the passive with the continuous data continues to be excellent with Pearson correlation coefficients of .981, .983 and .975 and r^2 of .96, .97 and .95 respectively.

PAMZ Air Quality Monitoring Network
Site Locations

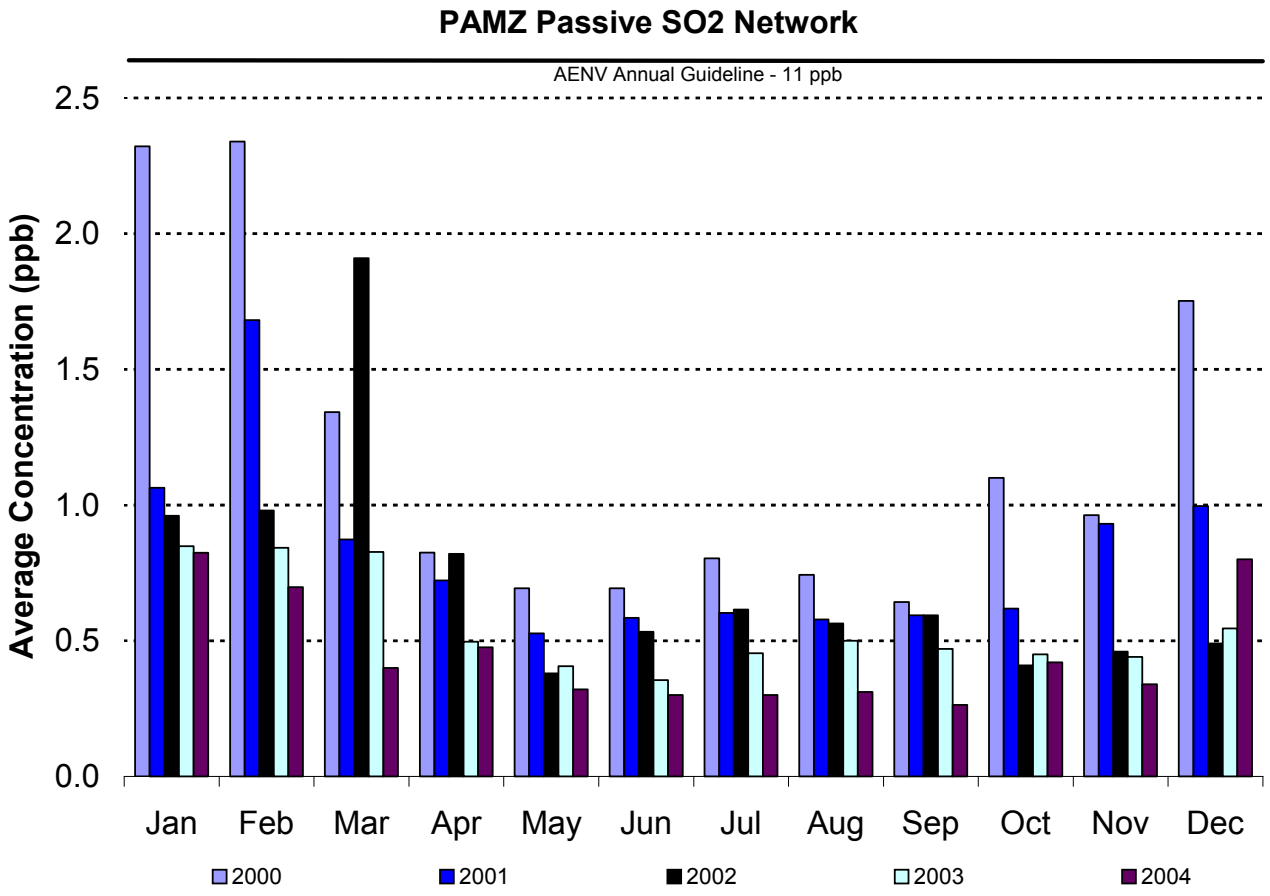


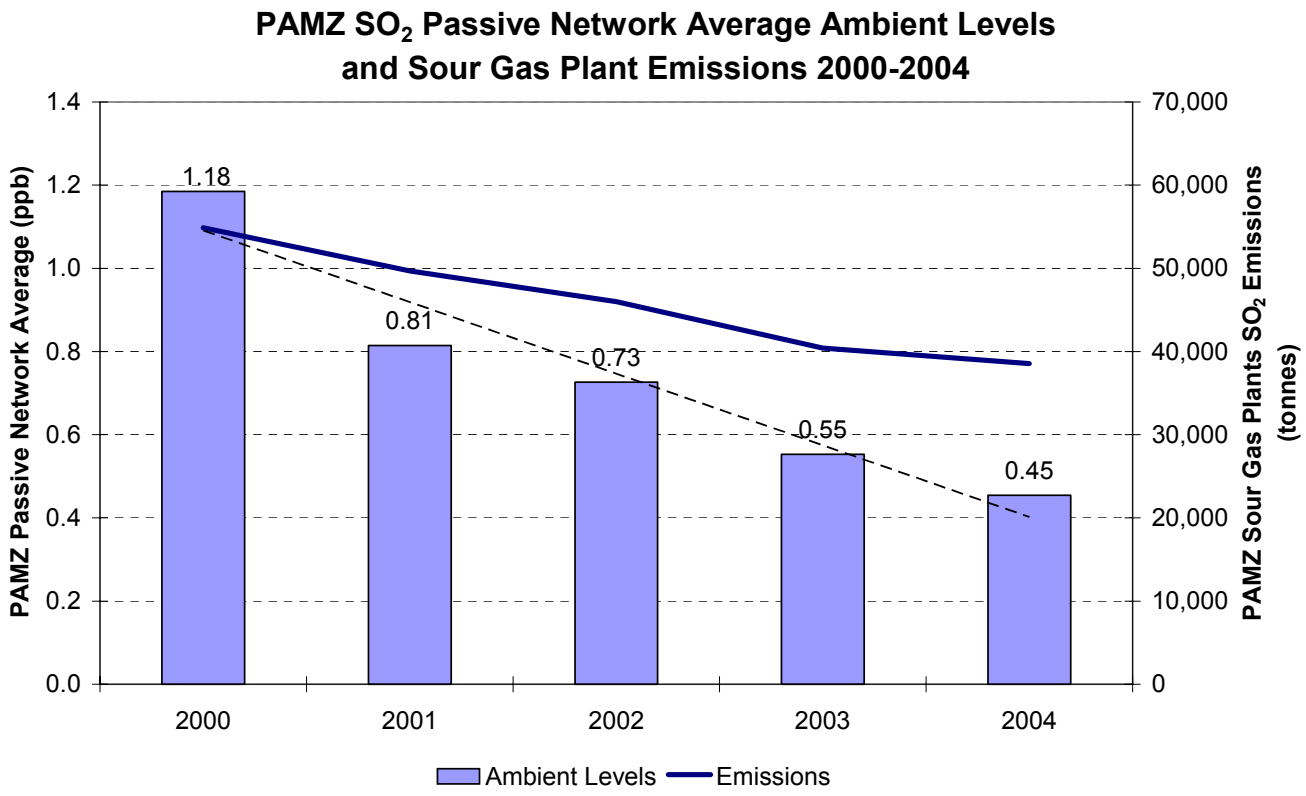
7.2.1 Sulphur Dioxide

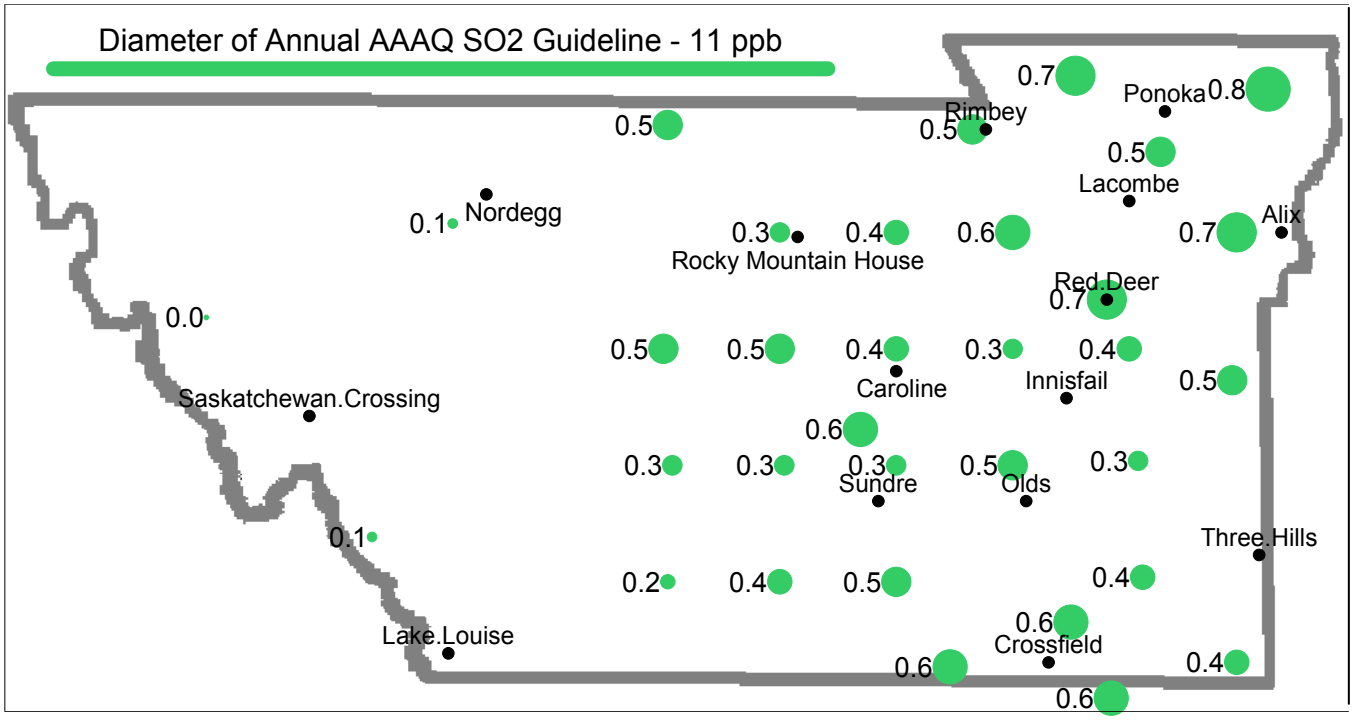
The 2004 annual average SO_2 concentration for the entire network was 0.45 ppb, significantly below the Alberta Environment annual guideline of 11 ppb and 22% lower than the 2003 average of 0.55 ppb. This decrease is consistent with the trend observed during the previous four years of the network's operation (see graph on opposite page). The decreasing trend (62% from 2000-2004) in ambient SO_2 levels complements the reductions in SO_2 emissions from sour gas plants within the zone (30% from 2000-2004). The emission reductions in the zone are due to the significant volume reduction in flaring, the efficiency improvements made to several large facilities located within the zone as well as declining throughput at some sour gas processing plants in the region.

For 2004, the site with the greatest annual average concentration, consistent with observations for the three previous years, was Site 32 (Samson) measuring 0.8 ppb. This station is located in the northeastern corner of the zone, a region that has consistently yielded the highest annual SO_2 averages in the PAMZ Passive AQM Network and frequently the highest monthly averages also. In 2005, the Peregrine Continuous AQM Station will be deployed to the region in an effort to determine the possible source(s) of these higher levels. The site with the lowest annual average SO_2 concentration was again Site 2 (Parker Ridge) measuring 0.1 ppb, the same average observed in 2003. This site is located in Banff National Park, far away from any industrial sources of sulphur dioxide.

In general, ambient SO_2 concentrations observed throughout the zone displayed seasonal variations similar to those observed in previous years. As in previous years, the production levels of the large sour gas processing facilities in the Zone, the major source of SO_2 emissions in the Zone, remained relatively consistent throughout the year. The highest monthly average for the passive sulphur dioxide network was observed during January which, for 2004, was once again the coldest month of the year, and a time when the amount of thermally-induced mixing of the atmosphere would be lowest. The lowest monthly average was observed in September when there would have been a much higher dispersion of sulphur dioxide due to the greater amount of thermal mixing brought about by higher solar radiation levels.

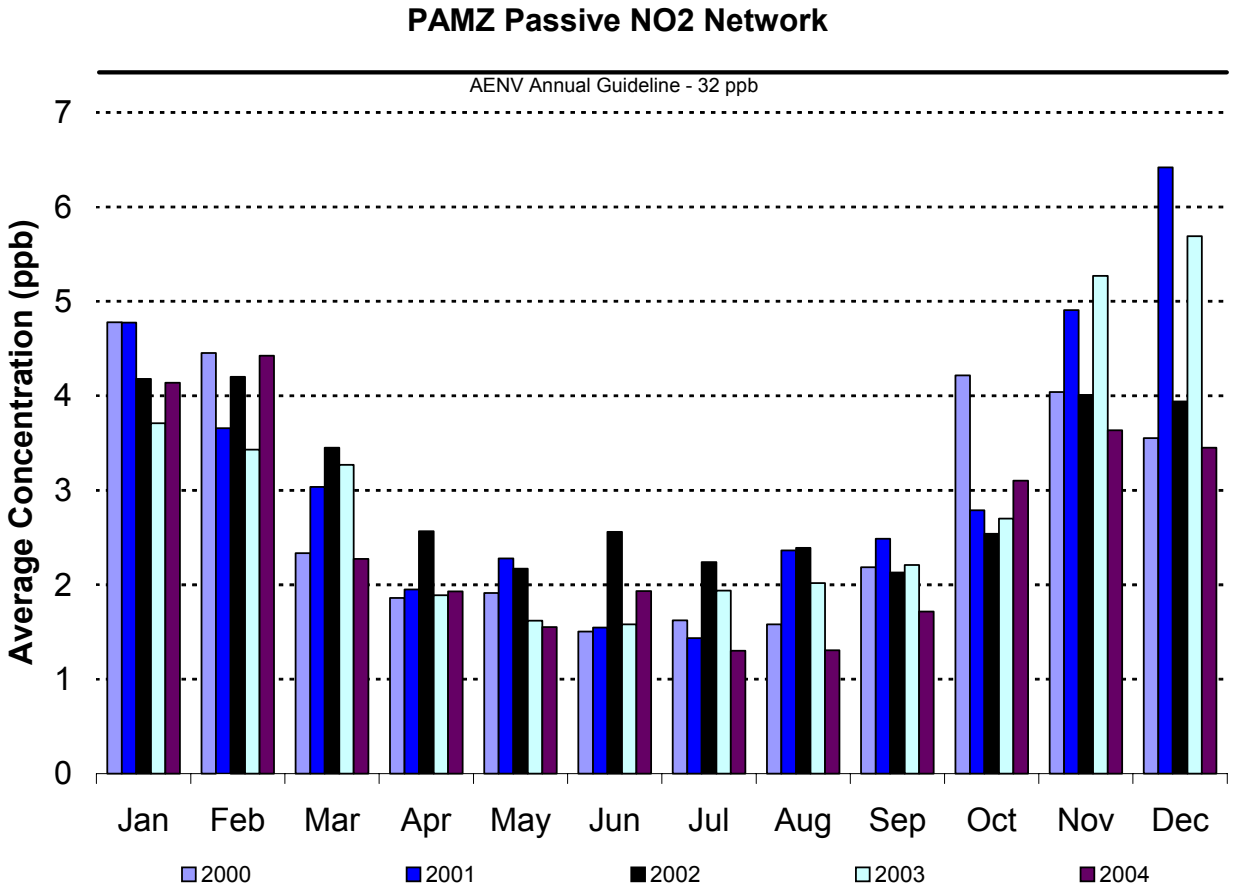






PAMZ Passive SO2 (ppb) - 2004 Station Averages

7.2.2 Nitrogen Dioxide

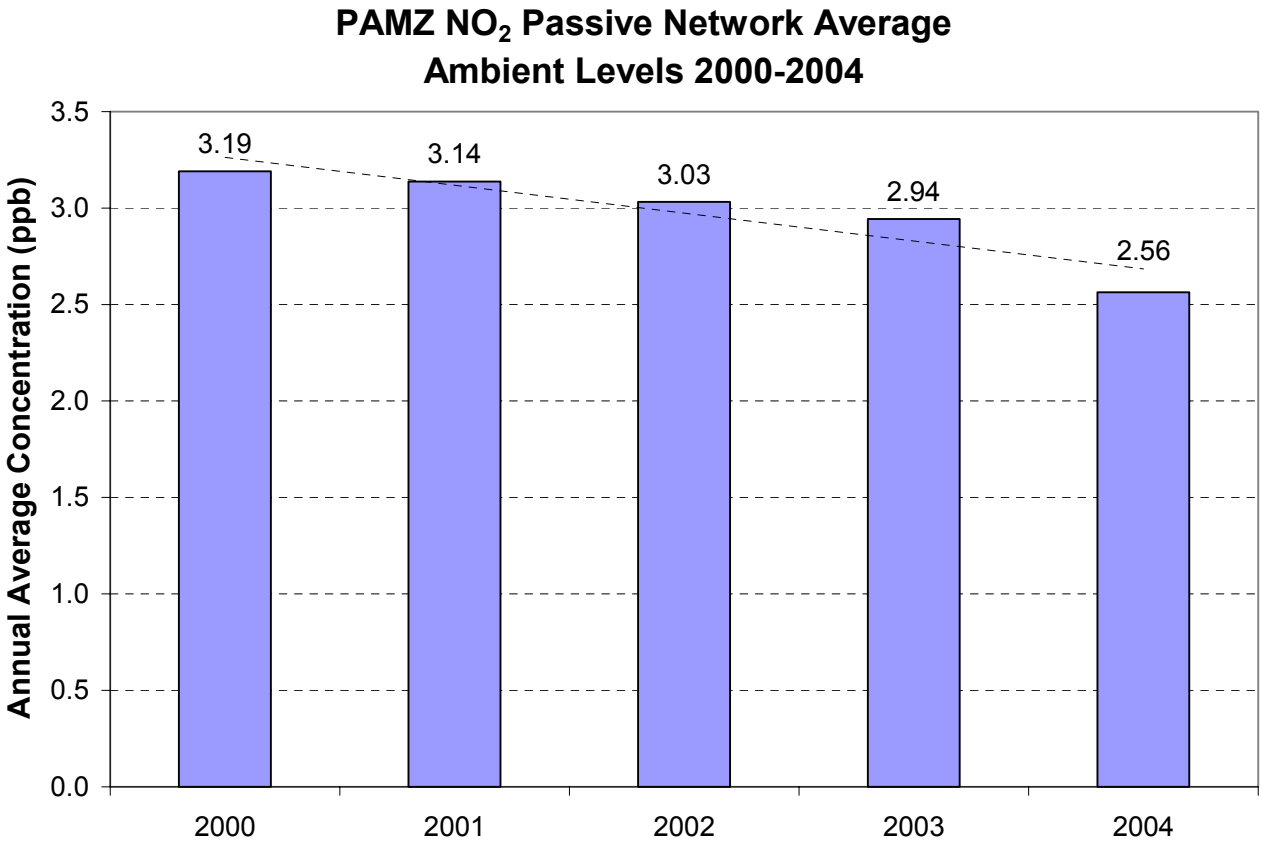


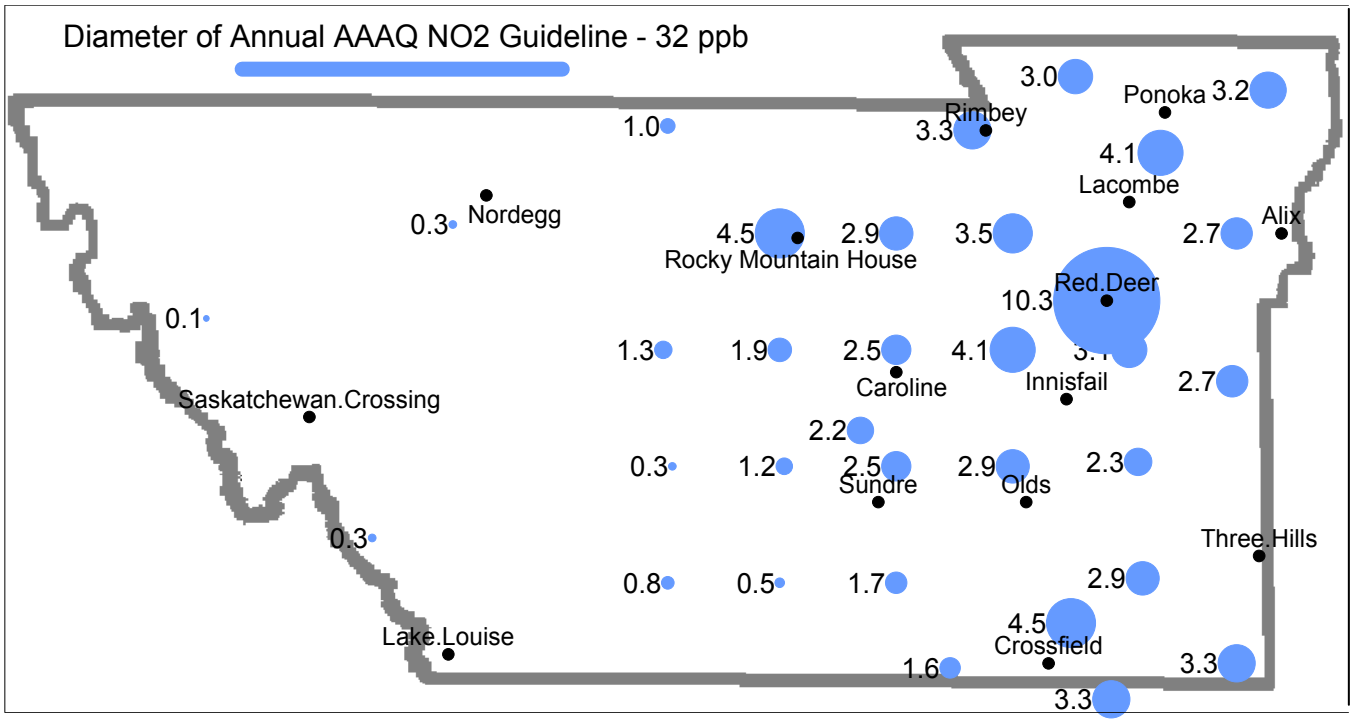
The 2004 annual average NO_2 concentration for the entire network was 2.56 ppb, significantly below the Alberta Environment annual guideline of 32 ppb and slightly lower than the 2004 average. This result is consistent with the decreasing trend (20% from 2000-2004) a trend made even more significant by considering that annual traffic counts in the zone have increased steadily since the first PAMZ emissions inventory was conducted in 1997.

In general, NO_2 levels are higher in the east of the zone. This is attributable to the greater population density and traffic volumes that occur in and around the Highway 2 corridor. The Red Deer site is an urban site with the greatest annual average concentration, measuring 10.3 ppb, down 24% from 2003. This site is located within the city of Red Deer in the Red Deer River Valley downwind from the downtown area to the south. The high concentrations observed at this site are consistent with the effect of NO_X emissions from motor vehicle traffic in and around the city. The moderately high levels of NO_2 found at Site 19 (Crossfield-Carstairs) are probably due to its proximity to Highway 2. Similar levels observed at Site 11 (Twin Lakes) may be influenced by its proximity to Highway 11 and the town of Rocky Mountain House. While oil and gas compressor facilities are a large source of NO_X emissions in the zone, ground-level based emissions from motor vehicles consistently appear to have the greatest influence on the passive monitoring results.

The site with the lowest annual average NO_2 concentrations was again site 2 (Parker Ridge) measuring 0.1 ppb. This site is located in Banff National Park some distance upwind of the Icefields Highway, the only significant source of NO_X emissions in the area.

Ambient NO_2 concentrations observed throughout the Zone displayed predictable seasonal variations consistent with those observed in previous years. Similar to the SO_2 results and for the same reasons, the highest monthly averages for the passive nitrogen dioxide network are observed during the coldest months of the year while the lowest monthly averages are observed during the summer when there is a greater amount of thermal mixing brought about by high solar radiation levels.





PAMZ Passive NO2 (ppb) - 2004 Station Averages

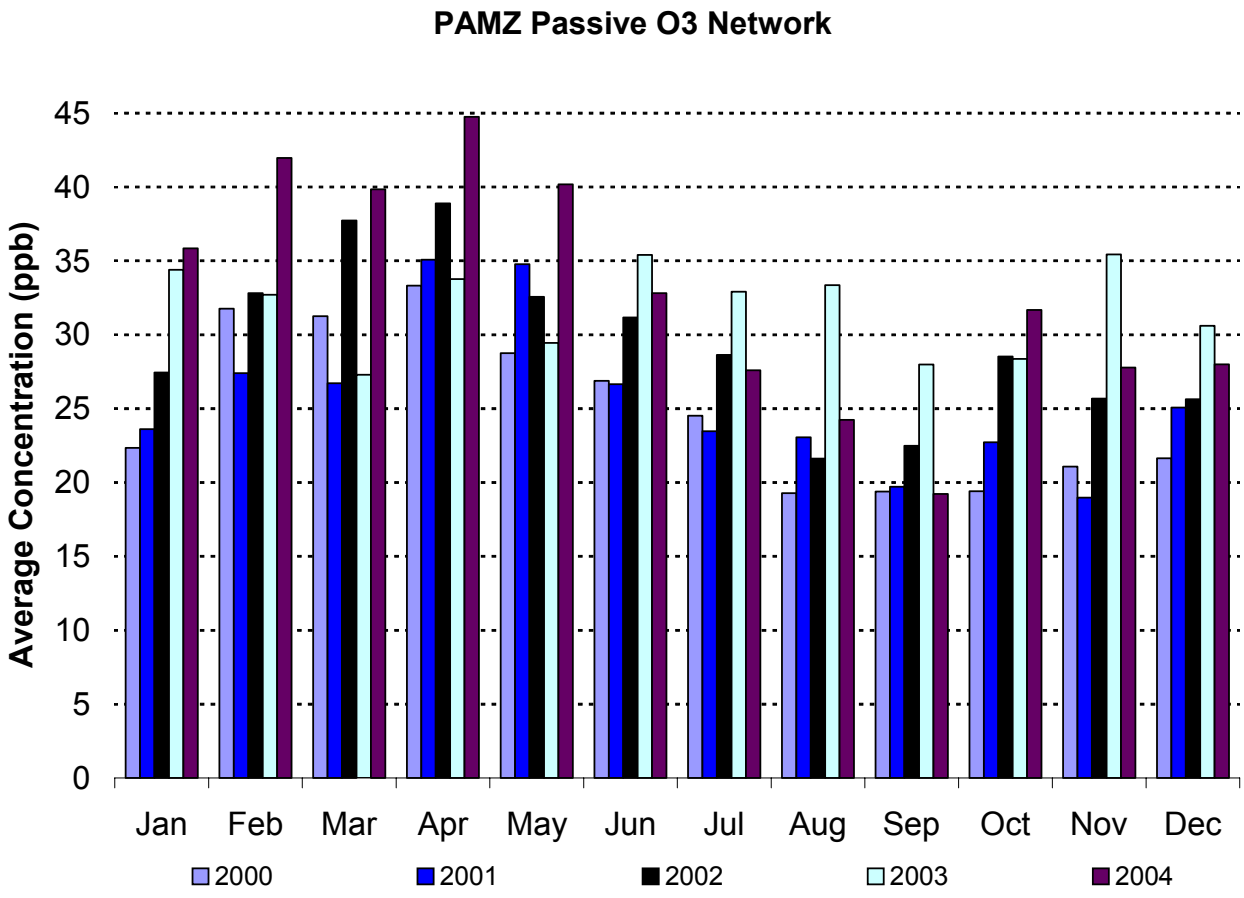
7.2.3 Ozone

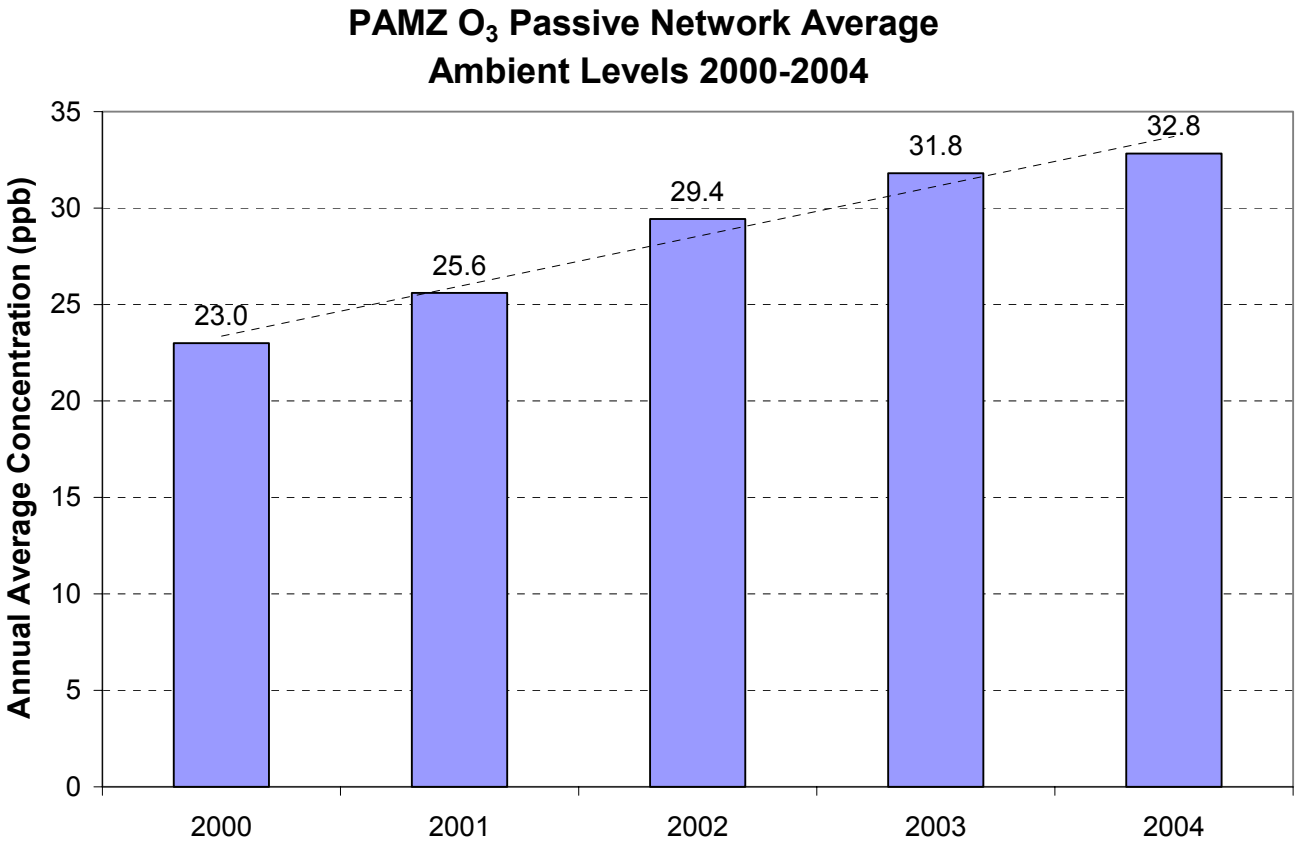
The 2004 annual average O_3 concentration for the entire network was 32.8 ppb, which was moderately greater (3%) than the 2004 average of 31.8 ppb. There is no Alberta Environment Objective for annual O_3 concentrations. This increase is consistent with the increasing trend (43% overall) observed since the startup of the PAMZ passive monitoring network in late 1999. The site with the greatest annual average concentration was again Site 5 (Baseline Mountain) measuring 44.4 ppb, a 19% increase from 2003.

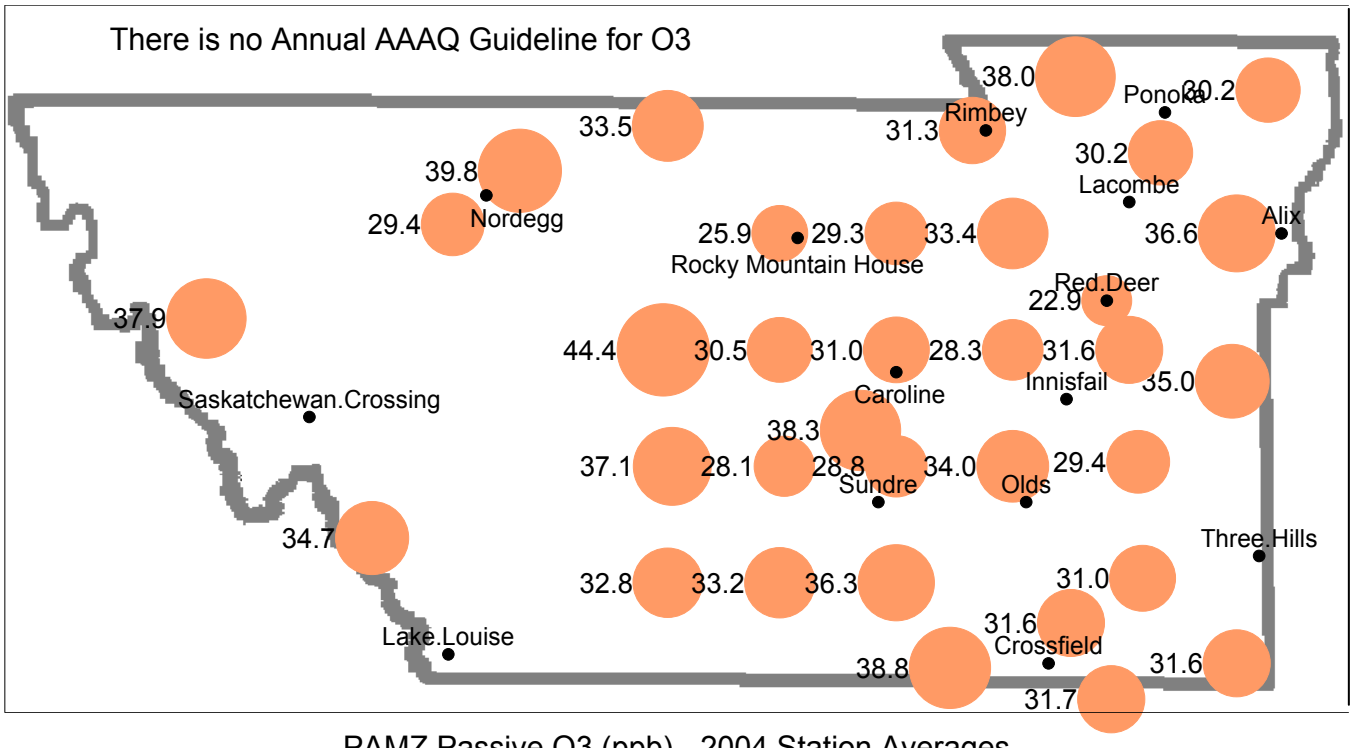
The Baseline Mountain Site is located at high altitude at treeline on a mountainous ridge approximately 40 km southwest of Rocky Mountain House. The consistently high levels observed at this site throughout the year are associated primarily with its elevation and remoteness and may also be influenced by long range transport, and during the spring and fall, episodes of stratospheric ozone intrusion.

The site with the lowest annual average O_3 concentration was Red Deer measuring 22.9 ppb, a 15% increase from 2003. This result is consistent with the scavenging effect of NO emissions from motor vehicle traffic in and around the city. Ambient O_3 concentrations observed throughout the populated eastern regions of the zone indicated seasonal variations consistent with anthropogenic ozone formation, with the highest values observed in the late spring.

Concentrations observed in the western region of the zone at more remote locations indicated levels and seasonal variations that may be attributable to their higher elevation and naturally-occurring meteorological phenomena described earlier. Recent studies conducted for the CASA Particulate Matter and O_3 Project Team and others have indicated that some of ground-level O_3 observed in Alberta may originate from the United States and Pacific Rim countries.







PAMZ Passive O3 (ppb) - 2004 Station Averages

8. Meteorology

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.

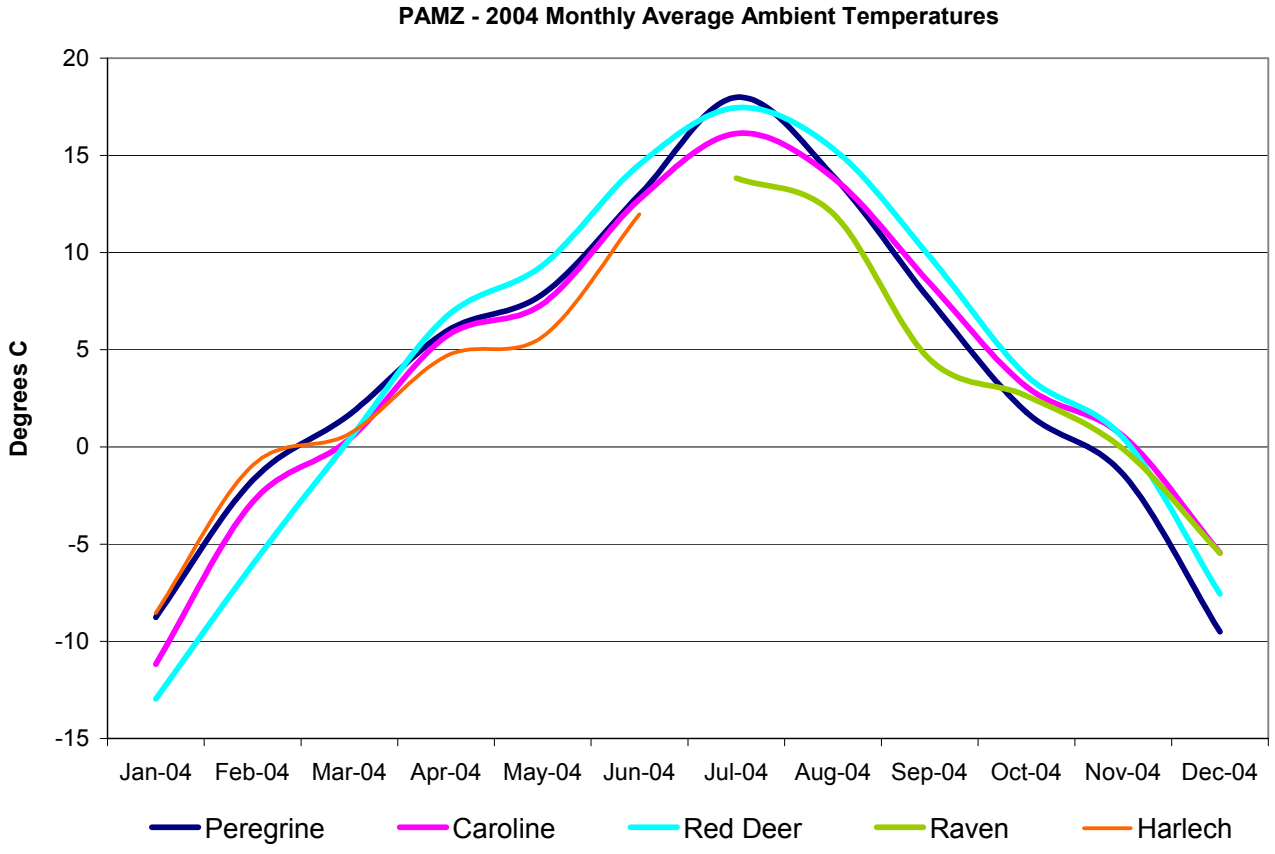
The interpretation of the continuous and passive data is supported by basic meteorological measurements of parameters that affect the transport and dispersion of emissions.

The meteorological parameters measured in support of the Parkland Airshed Management Zone's Air Quality Monitoring Program are:

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

For 2004, the average temperature for the Caroline Station was 4.1 degrees C, with a maximum of 30.0 degrees C and a minimum of –35.4 degrees C. The 2004 average temperature for the Peregrine Station was 4.1 degrees C, with a maximum of 33.2 degrees C (Red Deer-Woodlea) and a minimum of –37.9 degrees C (Dovercourt). The 2004 average temperature for the Red Deer-Riverside Station was 4.3 degrees, with a maximum of 33.1 degrees C and a minimum of –37.7 degrees C. Temperature measurements at the Raven station did not commence until January 2004 and so no annual summary is presented for this site.

Winds at the Caroline, Innisfail and Sundre locations the winds were predominantly from the southwest. At the Crossfield-Carstairs location the winds were predominantly from the northwest. At the Dovercourt, Lloyd Creek, Red Deer-Woodlea and Rocky Mountain House locations the winds were predominantly from the southwest. At the Eckville location the winds were predominantly from the west. At the Limestone Mountain location the winds were predominantly from the northeast. At the Prairie Creek location the winds were predominantly from the west-southwest. The winds at the Red Deer-Riverside Station were primarily from the south due to the influence of the Red Deer River valley in which the station is located.



9. Financial Report

Parkland Airshed Management Zone
Financial* Report for the Year Ended December 31, 2004

		2004		2003
Revenue:				
	Memberships	527,254		498,138
	Grants	17,404		10,514
	Interest Income	3,011		1,797
		547,669		510,449
Expenses:				
	Advertising & Website	6,290		5,573
	Consultant Fees & Reimbursements	88,786		83,982
	Insurance	17,561		12,622
	Meetings and workshops	7,623		6,765
	Monitoring Assessment			2,775
	Monitoring Contracts	321,408		275,101
	Office	5,096		6,133
	Professional fees	2,999		2,199
	Secretarial	2,026		2,122
		451,789		397,272
Excess of Revenues over Expenses		95,880		113,177
Amortization		51,733		32,416
Excess of Revenues over Expenses		$ 44,147		$ 80,761
Net change in non-cash working capital		(56,480)		(41,362)
Cash from (used for) operating activities		152,360		71,815
Purchase of Capital Assets		(67,441)		(17,519)
Increase (Decrease) in Cash		84,919		54,296
Cash, Beginning of Year		86,179		31,883
Cash, End of Year		$ 171,098		$ 86,179
Capital Equipment Reserve		(82,200)		(42,000)
Operating Reserve (Human Health Study)		(40,000)		(20,000)
Balance		$ 48,898		$ 24,179

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

Board of Directors

	Member	Alternate
Government	Ron Bronstein Alberta Environment	Larry Williams Alberta Environment
	Leo Touchette Alberta Energy & Utilities Board	Ron Wagener Alberta Energy & Utilities Board
	Greg Ritz David Thompson Health Region	Darren Barber David Thompson Health Region
	Alex Bolton Natural Resources Conservation Board	Jim McKinley Natural Resources Conservation Board
	Liz Negropontes Mountain View County	Vacant
Non-Gov. Organizations	Martha Kostuch Prairie Acid Rain Coalition	Ross Warner Society for Environmentally Responsible Livestock Operations
	Lenore Harris Red Deer River Naturalists	Vacant
Public	Lloyd Cumming Burnstick Lake	Bill Knight Tees
	Reg Watson Eagle Hill	Ila Johnston Sundre
	Kenneth Rundall Penhold	Vacant
Industry	Robin West N.A.L. Resources	Wendy Lyka NOVA Chemicals
	Brian Goliss Shell Canada Ltd.	James Brown Dow Chemical Canada Inc.
	Greg Calpas Husky Oil Operations Ltd.	Barry Lough Duke Energy
	Simon Cobban Alberta Cattle Feeders Association	Vacant

Funding Members

Acclaim Energy Inc.
Addison Energy Inc.
Agrium Inc.
Anadarko Canada Corporation
Apache Canada Ltd.
Bonavista Petroleum Ltd.
Border Paving Ltd.
BP Canada Energy Company
Burlington Resources Canada
Calpine Canada Resources
Canadian Natural Resources
CCS Energy Services
Coastal Resources Limited
Compton Petroleum Corporation
ConocoPhilips Canada Ltd.
Devon Canada Corp.
Dow Chemical Canada Inc.
Duke Energy Midstream
EOG Resources Canada Inc.
Esprit Exploration Ltd.
ExxonMobil Canada Ltd.
Fairborne Energy Corporation
FET Resources Ltd.
Flowing Energy Corporation
Husky Oil Operations Ltd.
Imperial Oil Resources Ltd.
Keyera Energy Ltd.
Mato Inc.
MGV Energy Inc.
Midnight Oil & Gas Ltd.
NAL Resources
New North Resources Partnership
Northrock Resources Ltd.
NOVA Chemicals
Paramount Resources Ltd.
Penn West Petroleum Ltd.
Petro-Canada
Plains Marketing Canada
Prime West Energy Corp.
Provident Energy Ltd.
Purcell Energy Ltd.
Rosetta Exploration Ltd.
Shell Canada Ltd.
Shiningbank Energy Ltd.
Solex Gas Processing Corp.
Suncor Energy Inc.
Sunpine Forest Products Ltd.
TransCanada Pipelines Ltd.
Trifecta Resources Corporation
Viking Energy Acquisitions Ltd.

Municipalities

Clearwater County	Mountain View County	Town of Bentley
Town of Ponoka	Town of Rocky Mountain House	Town of Sundre

Committee Members

Executive Committee

Chairman	Lenore Harris	NGO
1st Vice-Chair	Ron Bronstein	Government
2nd Vice-Chair	Brian Goliss	Industry
Past Chair	Reg Watson	Public
Treasurer	Greg Calpas	Industry
Secretary	Martha Kostuch	NGO
Program Manager	Kevin Warren	

Human Health Committee

Greg Ritz	David Thompson Health Region	Government	(Chair)
Larry Williams	Alberta Environment	Government	
Darren Barber	David Thompson Health Region	Government	
Dan Richen	David Thompson Health Region	Government	
Dr. Laura Mcleod	David Thompson Health Region	Government	
Pam Ulrich	David Thompson Health Region	Government	
Karina Bodo	Alberta Health & Wellness	Government	
Jonathan Robb	Alberta Health & Wellness	Government	
Larry Pimm	City of Red Deer	Government	
Martha Kostuch	Prairie Acid Rain Coalition	NGO	
Margaret Coutts	Red Deer River Naturalists	NGO	
Betty Harvey	Rimbey and District Clean Air People	NGO	
Ila Johnston	Sundre	Public	
Wayne Johnston	Sundre	Public	
Dr. Abimbola Abiola	Olds College	Public	
Geoff Granville	Shell Canada Ltd.	Industry	
Paul Walker	Keyera Energy Ltd.	Industry	
Kevin Warren	Amarok Consulting	Program Manager	

Technical Working Group

Brian Goliss	Shell Canada Ltd.	Industry	(Chair)
Barry Lough	Duke Energy Midstream	Industry	
David McCoy	Husky Oil Operations Ltd	Industry	
Donald Wainwright	Husky Oil Operations Ltd.	Industry	
Harold Gold	Bonavista Petroleum	Industry	
Dale Nylund	Solex Gas Processing	Industry	
Shane Lamden	NOVA Chemicals	Industry	
Sanjay Mukherjee	Agrium	Industry	
Scott Turner	Keyera Energy Ltd.	Industry	
Shirley Pohl	Prime West Energy Corp.	Industry	
Trent Claypool	Imperial Oil Resources	Industry	
Greg Ritz	David Thompson Health Region	Government	
Matilda Ricci	Alberta Environment	Government	
Bill Starling	Alberta Energy & Utilities Board	Government	
Larry Stockman	Alberta Energy & Utilities Board	Government	
Lloyd Cumming	Burnstick Lake	Public	
Reg Watson	Eagle Hill	Public	
Kevin Warren	Amarok Consulting	Program Manager	

Issues Response Group

Martha Kostuch	Prairie Acid Rain Coalition	NGO	(Chair)
David McCoy	Husky Oil Operations	Industry	
Wayne Johnston	Sundre	Public	
Ila Johnston	Sundre	Public	
Jim McKinley	Natural Resources Conservation Board	Government	
Wayne Boyd	Alberta Environment	Government	
Ron Wagener	Alberta Energy & Utilities Board	Government	
Kevin Warren	Amarok Consulting	Program Manager	

Communications Committee

Lenore Harris	Red Deer River Naturalists	NGO	(Chair)
Monica Bryan	Shell Canada Ltd.	Industry	
Rhonda King	Alberta Environment	Government	
Kevin Warren	Amarok Consulting	Program Manager	

Funding Committee

Greg Calpas	Husky Oil Operations Ltd.	Industry	(Chair)
Greg Ritz	David Thompson Health Region	Government	
Monica Bryan	Shell Canada Ltd.	Industry	
Shane Lamden	NOVA Chemicals	Industry	
Reg Watson	Sundre	Public	
Kevin Warren	Amarok Consulting	Program Manager	

Landowners

The Parkland Airshed Management Zone expresses their appreciation for the invaluable assistance of the cooperating landowners who have allowed PAMZ to locate the continuous and passive monitoring stations on their property and are providing all-season access to these sites.

Brian & Mary Brietsche - Grainger
Mr. & Mrs. Ivan Christensen - Dovercourt
Eskild Jacobsen - Olds
Glen & Phyllis Kneiper - Stauffer
Roger & Wayne Maser - Red Deer
Mr. & Mrs. William Murto - Eckville
Tony & Cheryl Peresinni - Crossfield
Henry Schmiemann - Caroline
Peter Smith - Leslieville
Simon & Ann Swier - Morningside
Joe & Anne Teeuwsen - Ferrybank
Town of Innisfail
TransCanada Pipelines - Rocky Mtn. House
Don Buckner - Sundre
Bill Hodgkinson - Elnora
Gail Kinsey - Sylvan Lake
Eldon Knight - Kersey
Mr. & Mrs. W. McGregor - Sundre
Mr. Page - Sunnyslope
Mr. & Mrs. R. Sawley - Rimbey
Shieling Mountain Lodge - Nordegg
Cheryl Sutton - Rocky Mtn. House
Shell Canada Ltd.
Mr. Teynor - Bergen
Town of Rocky Mountain House
Roy Westfall - Crossfield

Acknowledgements

Thank-you to the CASA Secretariat for their frequently-sought advice and assistance. Special thanks also to Bob Myrick of Alberta Environment, the administrator for the CASA Data Warehouse. Thanks are due to Patrick Kyle at Environment Canada for providing PAMZ with Meteorological Data collected from the Atmospheric Environment Services' Meteorological Stations located within the Zone's boundaries. Special thanks to Kim Sanderson, for her excellent and peerless administrative support at board meetings and in-between. The staff at RSLS Environet, especially Gary Eitzen and Matthew Eisentraut have provided exemplary service to PAMZ in the operation and maintenance of the continuous monitoring network. Gene Lesoway continues to deliver his usual high level of service in the operation of the passive monitoring network while Linda Lin and her staff at Maxxam Analytics do the same with the analyses of the samples. Thanks are also due to Mike Cook and his staff at Evolvs who do such a fine job maintaining the PAMZ website.

Special thanks are due to the following people who made significant contributions of their time and spirit and have been valuable resources for PAMZ during the year 2004 and also in previous years.

Tracy Bell	John Christensen	Sheryl Hergott	Karen McCallion
Jeff Bradshaw	Wendy Coons	Ryan Hornett	Jon Myles
Linda Burrell	Jim Dixon	Lynn Huntley	Nancy Papanikolaou
Sandy Campbell	Rob Elliot	Anne Jamieson	Helga Shield

GLOSSARY OF TERMS

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).
Acute Exposure: One or a series of short-term exposures generally lasting for a short period of time (e.g. minutes or hours).
Acute Health Effect: A health effect that appears for a brief period of time and, in general, promptly after exposure.
Alberta Ambient Air Quality Objective (AAAQO) : Concentration value adopted by the province of Alberta with the intention of preventing deterioration of air quality. Objectives for SO2, NO2, O3 and several other pollutants are based on the prevention of adverse human health and vegetation effects. Objectives may be for 1 hour, 24 hours, or 1-year average concentrations.
Ambient Air Quality: The concentration of pollutants in the ambient air. Generally the concentrations of gases or particles to which the general population would be exposed, as opposed to the concentration of pollutants emitted by a specific source.
Anthropogenic: Made by or arising from man, not of natural origin.
Aromatic: A type of hydrocarbon, such as benzene or toluene. Some aromatics are toxic.
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.
Bio-monitoring: The monitoring of a living organism, plant or animal, to measure its health and document any visible symptoms of coincident air quality effects.
Carbon Dioxide (CO_2): A colorless, odorless gas that occurs naturally in the Earth's atmosphere. Significant quantities are also emitted into the air by fossil fuel combustion.
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.
Chronic Exposure: Long-term exposure, usually lasting for a relatively long period of time (e.g. months or years).
Chronic Health Effect: A health effect that occurs over a relatively long period of time (e.g. months or years).
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.
Intermittent Sampling: Collect ing pollutants using reactive tubes, absorbents or filters and then analyzing them in a laboratory to determine air pollutant levels. Intermittent samples are usually collected over a 24-hour period every six days and presented as a 24-hour average.
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.
PM_{10}: An air pollutant consisting of small particles with an aerodynamic diameter less than or equal to a nominal 10 microns (about 1/7 the diameter of a single human hair). Their small size allows them to be inhaled but they do not reach the lungs.
Stratosphere: The layer of the Earth's atmosphere above the troposphere. It extends between 10 and 50 kms above the Earth's surface and contains the ozone layer in its lower portion.
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.
Tropopause: The boundary layer between the troposphere and the stratosphere characterized by its isothermal properties.
Troposphere: The lowest 10 km to 20 km of the earth's atmosphere characterized by decreasing temperature with height.
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.

For more information on the Parkland Airshed Management Zone Association please contact:

Parkland Airshed Management Zone
P.O. Box 1020
Sundre, AB
T0M 1X0
Phone: (403) 862-7046
Fax: (403) 238-6604
E-mail: kwarren@pamz.org
Website: www.pamz.org

For information on the Clean Air Strategic Alliance please contact:

Clean Air Strategic Alliance
10th Floor, 10035 - 108 Street
Edmonton, AB
T5J 3E1
Phone: (780) 427-9793
Fax: (780) 422-3127
E-mail: admin@casahome.org
Website: www.casahome.org