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Annual Report 2002

WCAS

West Central Airshed Society

Contents

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Executive Summary

Established in 1995, the West Central Airshed Society (WCAS) has now completed its seventh year of operations. Many changes were made in 2001 in the way the monitoring program was managed and a year later, the results have been very positive. The Society achieved several key goals this year across all facets of its operations.

A new data acquisition system was installed in June, allowing the real-time communication of data to the public via the revamped website. This was a big step forward in improving the ability of the WCAS to get monitoring information out to the public in a timely manner. As well as implementing changes to the network, the technical and engineering staff were able to achieve a remarkable level of "up time" for network operations, as overall instrument performance for 2002 exceeded 97%.

In the fall, Alberta Environment recognized the expansion of the zone boundaries to encompass the Wabamun-Genesee area, previously to the north and east of the zone. A comprehensive monitoring plan for the expanded zone will involve WCAS in the operation of four continuous air quality monitoring stations to be located in the new section. Other activities planned for the Wabamun-Genesee area include a human health study. Some WCAS members as well as the program manager are participating in the planning of the study. The boundary expansion will have many benefits and the Society will continue to work with stakeholders throughout the zone to better understand air quality in the region.

Significant effort was devoted to communications and management in 2002 with very good results. The Society was represented at numerous events during the year throughout the zone and the first newsletter, published in the fall, was distributed widely. Staff were able to simplify and streamline many administrative procedures and were a big factor in keeping the WCAS within its budget.

This was an important year for the bio-monitoring program, as the agriculture committee is now confident that it has enough data to test the model for predicting plant injury in response to sulphur dioxide. Running the model and preparing the report for publication in a scientific journal will be key tasks for 2003.

The air quality monitoring program had another successful year. Overall emissions of **sulphur dioxide** in the zone rose in 2002 due to the expansion of the zone boundaries and subsequent incorporation of four major coal-fired power plants and a number of small oil and gas facilities. At the same time, SO_2 emissions inventory from the oil and gas sector decreased by approximately 30%, and past year comparisons of average measurements at all the monitoring locations do not indicate a trend toward lower or higher annual concentrations. Sulphur dioxide concentrations reached a maximum of 30% of the Alberta 1-hour guideline at Tomahawk, 13% at Violet Grove, and 17% at Carrot Creek.

An increase in emissions of **nitrogen dioxide** over the previous year is attributed mainly to the increased size of the zone and the resultant incorporation of four major coal-fired power plants, as well as a larger inventory of compressor facilities and gas processing plants. The average annual concentrations of NO_2 in 2002 ranged from 0.6 parts per billion (ppb) at the Hightower Ridge location to a high of 6.9 ppb at the Carrot Creek location. Nitrogen dioxide annual average concentrations decreased slightly from 2001 at all five locations. All locations have values that are less than 25% of the Alberta guideline of 32 ppb for an annual average ambient NO_2 concentration. The maximum 1-hour value recorded in 2002 was 52.0 ppb measured at the Carrot Creek site.

Atmospheric concentrations of **total hydrocarbons** (THC) were measured at Violet Grove in 2002. The average THC concentration was 2.0 parts per million (ppm). This is slightly more than the average of 1.9 ppm recorded in 2001. The maximum 1-hour average value was 11.1 ppm.

Summer weather conditions in 2002 contributed to the production of higher ozone levels in the zone. In July, a total of sixteen 1-hour readings at the Tomahawk location, three at the Violet Grove location and five at the Carrot Creek site exceeded the Alberta 1-hour guideline of 82 ppb. The 2002 annual averages for the stations ranged from 29 ppb at Carrot Creek to 44 ppb at Hightower Ridge.

Particulate matter is measured as both PM_{10} and $PM_{2.5}$. Concentrations of PM_{10} particles at Tomahawk in 2002 averaged 11.9 micrograms per cubic metre ($\mu g/m^3$) with a maximum 1-hour concentration of 214 $\mu g/m^3$, which occurred when a forest fire was burning in the region. During the same period the $PM_{2.5}$ concentration averaged 4.2 $\mu g/m^3$. Previous analysis showed PM_{10} particles to be composed mainly of windblown dust, as indicated by the high calcium content. Sulphate and nitrate derived from industrial emissions of SO_2 and NO_x were the major constituents of the $PM_{2.5}$. PM_{10} concentrations at the Hightower Ridge background monitoring site averaged 6.1 $\mu g/m^3$.

Hourly average temperatures at the Tomahawk station ranged from a minimum of -34.6 °C to a maximum of 34 °C during 2002. Average annual temperatures were similar for the Violet Grove, Carrot Creek, Tomahawk and Steeper sites, ranging from 2.1 °C to 2.8 °C. The Hightower Ridge location, with its higher elevation, had an annual mean temperature of 1.5 °C.

After seven years, the Society remains strong, with a respected presence in the zone. We remain committed to maintaining and enhancing the monitoring program, and we look forward to working with all stakeholders to improve our understanding of air quality and its health and environmental effects in the west central area of Alberta.

Purpose

The West Central Airshed Society was formed to:

(a) Provide a forum for discussion and co-ordination of matters related to the management of an airshed monitoring and management program for the Zone. Monitoring programs will be designed to identify and quantify air quality concerns and the Board will develop and implement options to address concerns identified.

(b) Promote understanding between the Society, governments, stakeholders, the public, other airshed zones and other organizations about environmental impacts of activities inside and outside the airshed in regard to air quality within the airshed.

(c) Identify and quantify on a credible basis air quality concerns, and use the data to recommend and implement airshed management solutions for the zone.

(d) Coordinate and integrate airshed monitoring and management activities within the Zone with the provincial policies and guidelines as developed by Clean Air Strategic Alliance (CASA) and/or provincial air quality stakeholders in their respective areas of authority.

1.0 Introduction

The West Central Airshed Society (WCAS) established the first airshed management zone in Alberta in February 1995. Since then, four more zones[1] have been created in the province and others are being planned. Each airshed zone is independent, but operates under the umbrella of the Clean Air Strategic Alliance (CASA).

The main purpose of managing airsheds on a regional basis is to monitor air quality and seek remedies for air quality problems within a region. In the West Central zone, the potential impact of air quality on soil acidity, crops, and forests was a major concern of stakeholders in the area. To better understand these concerns, the WCAS established a bio-monitoring research project, which has been operating for seven years and now has enough data for a full analysis and assessment.

The Society's work is funded by contributions from major industries operating in the region, with the amount paid being proportional to a company's contribution to air pollution. Other members, including municipalities, make in-kind as well as monetary contributions. The 2002 budget was $715,000 but cost savings through the year resulted in actual expenditures of $675,000, broken down as follows:

- ambient air monitoring operations - 54%
- office and administration - 25%
- agriculture bio-monitoring - 18%
- contingency planning - 3%

Bob Scotten continued as the program manager in 2002, and Barbara Johnson was the environmental engineer responsible for data quality assurance and quality control (QA/QC). Greg Swain and Jeff McClintock were engaged as the network air monitoring technicians and Elaine Ryl remained as the contractor for the agriculture operations.

The Agricultural Committee and the Agricultural Science Team have been working together for several years on the bio-monitoring program. Board members on the committee for 2002 were: Cecil Andersen, Jim Bolton, Mary Griffiths, Dwayne Kruger, Larry Paslawski, Robert Raimondo, and John Whaley. The Agricultural Science Team was composed of Dr. Sagar Krupa, Dr. Allan Legge, Dr. Milo Nosal, and Elaine Ryl.

A new multi-stakeholder committee was formed in 2002 to examine the expansion of the zone boundaries. Members agreed to continue as a technical committee to review the air quality monitoring program on an ongoing basis and to plan the monitoring program for the expanded region. Members serving on the Boundary/Technical Committee in 2002 were: Cecil Andersen, Jim Bolton, Greg Gabert, Mary Griffiths, Dwayne Kruger, Rick Phaneuf, Robert Raimondo, John Whaley, and Larry Williams.

[1] The other four zones are the Wood Buffalo Environmental Association, the Parkland Airshed Management Zone, the Ford Air Partnership and the Peace Air Shed Management Association.

2.0 Chairman's Report

This was another successful year for the West Central Airshed Society (WCAS). In 2002, the WCAS grew in membership, added 10,000 square kilometres to the region, and substantially improved our operational, QA/QC, and reporting performance. Our financial position has improved through continuing cost savings, and diligent membership contributions.

Communications and involvement with the public reached new plateaus through the development of the website, presentations to stakeholders and others, displays, and the publication of our first newsletter. Live ambient air quality data, WCAS reports, and air quality information are available on our website at **www.wcas.ca**. The live data is accessible in charts and graphs, on a 30-day rolling basis, and historical data is available on the website of the Clean Air Strategic Alliance at **www.casadata.org**.

Enhanced network performance along with an improved data acquisition system and the excellent work done by our agriculture contractor has supplied the agriculture bio-monitoring program with the data points required to complete the comprehensive six-year study. We look forward to receiving the results of this study in the fall of 2003. The study is expected to provide a model showing the correlation between air quality and alfalfa crop health and should be a model that can be used to predict crop damage relative to air quality.

Cecil Andersen

All in all, this was a very busy year for our staff, a year that saw a marked improvement in our field operations as well as the continued excellent work of Barb Johnson in the office. Our manager, Mr. Bob Scotten, has once again shown his ability to move projects forward through the many pitfalls of brokering agreements with various public interest groups, government agencies, and industry. Once again, thank you to all our staff for another successful year and I am looking forward to the implementation of many of the projects before us in 2003.

Cecil Andersen
Chairman

3.0 Activities & Progress

The Air Quality Monitoring Program

Since 1995, the WCAS has maintained an extensive program to monitor air quality in the zone. Sites and stations in the network are strategically located to provide a good understanding of short- and long-term air quality in the region. This network includes:

- five continuous monitoring stations that measure air quality and emissions (sulphur dioxide, oxides of nitrogen, ozone, coarse and fine particulates, and ammonia), as well as meteorological conditions (wind speed anddirection, temperature, solar radiation, photosynthetically-active radiation, precipitation, relative humidity, and surface wetness);
- five agricultural bio-receptor monitoring sites; and
- two forestry bio-monitoring sites.

The map on pages 30-31 shows the zone boundaries as well as the locations of all monitoring stations and sites.

The WCAS continued to improve the network in 2002 by replacing the existing data acquisition system. The new system was installed in June and the WCAS website (**www.wcas.ca**) is now able to communicate data in real time. This is a significant achievement in meeting our open communication policy.

Another achievement was improving the network operation "up time," due largely to the talent and dedication of the technical and engineering staff. Overall instrument performance for 2002 exceeded 97%.

Air quality monitoring and reporting methods used by the WCAS are compatible with those of Alberta Environment. Continuous monitoring is required to meet Alberta Environment's compliance standards for maximum hourly concentrations of pollutants, and to link any symptoms of stress observed on test crops to changes in air quality. Trace level monitors measure the wide range of pollutant concentrations encountered in the zone and accurately assess changes in air quality. WCAS uses passive monitoring systems at two bio-monitoring sites to provide approximate average measurements of a pollutant concentration over extended periods of time.

Discussions began in 2002 with Weldwood of Canada and Weyerhaeuser Company Limited to integrate their Drayton Valley, Edson, and Hinton air monitoring stations into the WCAS network.

Boundary Expansion

In October, Alberta Environment indicated that the WCAS could expand its boundaries to include the Wabamun and Genesee area. This was a key achievement for the society, providing improved capacity to monitor in the region. Emission sources in these areas were important to the west central region but were just outside the original zone boundaries. The expansion will enable the society to gain a better understanding of air quality in the wider region and how it may be changing, and will also improve the overall efficiency of the monitoring network.

The West Central Airshed Society and members TransAlta Utilities and EPCOR worked together in 2002 to develop a comprehensive monitoring plan for the region covered by the expanded boundaries. A proposed monitoring plan has been filed with Alberta Environment and a response is expected in early 2003. The plan calls for strategic placement of four continuous air quality monitoring stations in the Wabamun and Genesee regions. The stations will comply with Alberta Environment standards and will run at the same high operational levels as the existing WCAS stations. A human health monitoring study is also being planned for the Wabamun-Genesee area, and WCAS is involved in the planning process for that work.

Communications and Management

Communications was a high priority in 2002. The program manager continued to make presentations throughout the region, initiating some of the events, but also responding to requests from stakeholders and others for more information about the society and its activities. Special information sessions were delivered to community stakeholder groups, including the Genesee Local Area Residents and Lake Wabamun Enhancement and Protection Association. Other presentations were given to representatives of the Hinton Public Advisory Committee, Westview Regional Health Authority, the Town of Edson, and the Counties of Leduc, Woodlands, and Parkland. The zone's first newsletter was produced and widely distributed in the fall, and our website is being continuously upgraded.

Administrative operations ran smoothly in 2002, with revenues exceeding expenditures, which were held under budget. Reporting and invoicing procedures were simplified, reducing stress and improving schedules considerably. The administrative technical teams are working well together and continue to exceed expectations in every facet of the operation.

The WCAS has erected signs at all its monitoring stations to advise the public about the monitoring program and tell them where they can get more information.

3.1 Bio-Monitoring

At the time the West Central Airshed Society was formed, members identified potential impacts of air quality on vegetation as a very important issue. The two main concerns were:

- soil acidification, and
- possible adverse effects of air pollution on agricultural crops and forest plant species.

Soil acidification can indirectly affect vegetation due to changes in nutrient availability and leaching of essential elements. Poor air quality can produce visible injury to the leaves and can also reduce growth and yield in plants, with or without any visible damage.

To investigate these concerns, saskatoon, or serviceberry (*Amelanchier alnifolia* Nutt.), was used as a biological indicator to assess plant response to sulphur dioxide exposure, and alfalfa (*Medicago sativa* L.) was used to examine both leaf injury and air quality-induced effects on its growth and yield. Both these plant species are known to be sensitive to sulphur dioxide, and alfalfa is also known to be sensitive to soil acidification and to ground level ozone (a regional problem in many parts of the world). Sulphur is an essential element for plant growth and thus, accumulates in plants. Soil is the major source of sulphur and when plants are also exposed to sulphur dioxide from the air, overload occurs, leading to injury and adverse effects.

Bio-monitoring plots were established in 1996 (except for Carrot Creek, which was established in 1998) and have been maintained since then at five sites in the zone: Carrot Creek, Violet Grove, Tomahawk, Alder Flats, and Breton. The sites are maintained with the assistance of landowner cooperators. Three air quality parameters are measured at each site: ozone, sulphur dioxide, and oxides of nitrogen. However, at the Alder Flats and Breton sites these are measured only during the growing season (April to August), using passive monitors. The climate variables are temperature, solar radiation, relative humidity, and precipitation. The influence of air quality and climate on weeds and species other than alfalfa in the study plots is also examined.

During 2002, as in previous years, alfalfa growth and yield were measured. Clippings were taken from each sub-plot approximately every ten days, and the rate of plant growth was obtained by determining the dry weight of successive sub-plot clippings until harvest. At harvest, the dry weights of both alfalfa and non-alfalfa species in the study plots were determined separately.

The 2002 growing season began with a late cold spring, followed by a hot, dry, windy summer and a cool wet autumn. Disease incidence and insect damage were moderate at the bio-monitoring sites in 2002. The grasshopper problems encountered at the Tomahawk site in 2001 did not recur this year. This year's alfalfa seedlings established well at Violet Grove, Tomahawk, and Carrot Creek, while those at Breton and Alder Flats suffered from stress. Some foliar damage was noted at both Carrot Creek and Violet Grove.

Some leaf injury to saskatoons, potentially due to ozone, was observed on the initial visit to the Tomahawk site, and observations of this injury were followed throughout the summer. The Tomahawk site was found to be the most stressed, and the fruit at this site had a different taste from fruit at other sites.

A major goal of the agricultural bio-monitoring program was to gather enough data to develop and test a computer model that could predict plant injury in response to sulphur dioxide. The agriculture committee is now confident that it has enough data to test the model. The intention in 2003 is to run the model and prepare a final report that will be peer reviewed and then released to the public. The agricultural program will be scaled down, but will continue to gather data so the model can be further tested and refined.

The WCAS forest bio-monitoring program is a joint venture partnership with the Canadian Forest Service and was established in 1997. Beginning in 2000 the program changed to a five-year assessment period from the previous annual assessment. This was in keeping with the schedule for the entire Acid Rain National Early Warning System of plots. The vast majority of trees at the Hightower and Steeper sites were in a healthy condition with no evidence of air pollution stress.

3.2 Air Quality Monitoring

The WCAS air quality monitoring program focuses on three main aspects: acid-forming gases, air quality parameters that may affect vegetation, and parameters that are of interest to health professionals. Emphasis is placed on obtaining credible and scientifically defensible data. The quality control and quality assurance program includes daily checks of calibration and instrument performance, together with regular multi-point calibrations and government audits. Data is examined for long-term systematic errors and all raw and quality controlled data is archived.

Data from the West Central zone is part of the province-wide integrated data management system developed through the Clean Air Strategic Alliance, and available through the Alliance's website at www.casadata.org. Real-time hourly data is currently available for viewing at our website location, www.wcas.ca. Specific requests for information may be directed to the WCAS Program Manager.

The West Central Airshed Society air quality monitoring program measures the following pollutants using continuous monitors: sulphur dioxide, oxides of nitrogen, hydrocarbons, ozone, and particulate matter. Ammonia is measured using an integrated sampling method. Appendices I and II provide more details on ambient air monitoring results.

3.2.1 Sulphur Dioxide (SO_2)

Characteristics

Sulphur dioxide (SO_2) belongs to the family of sulphur oxide gases (SO_x). These gases dissolve easily in water. Sulphur is prevalent in all raw materials including crude oil and coal, as well as in ore that contains common metals like aluminum, copper, zinc, lead, and iron. SO_x gases are formed when fuels containing sulphur, such as oil and coal, are burned and when gas is processed, or metals are extracted from ore. SO_2 dissolves in water vapour to form acid, and interacts with other gases and particles in the air to form sulphates and other products that can be harmful to humans and their environment.

Sulphur dioxide is a colourless gas that is about 2.5 times as heavy as air. It has a sweet pungent odour, and can be detected by taste and smell at concentrations as low as 300 parts per billion (ppb). It causes a wide variety of health and environmental impacts because of the way it reacts with other substances in the air. Peak levels of SO_2 can cause temporary breathing difficulties for asthmatic individuals who are active outdoors. Long-term exposure may increase the risk of developing chronic respiratory disease. Particularly sensitive groups include children, the elderly, and those with existing heart or lung disease.

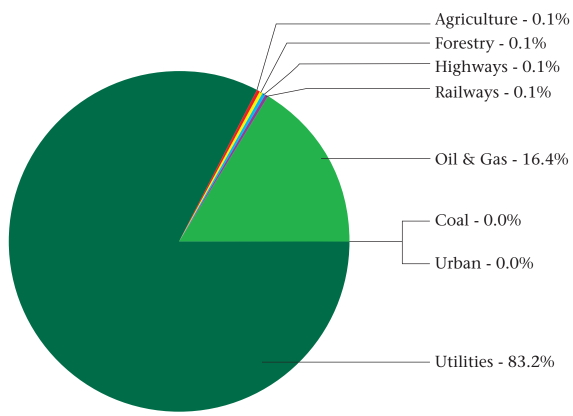
Acids formed when SO_2 and nitrogen oxides (NO_x) react with other substances in the air may be carried great distances before being falling to earth as rain, fog, snow, or dry particles. Acid rain damages forests and crops, changes the chemical makeup of soils, and increases the acidity of lakes and streams. Continued long-term exposure will affect the natural variety of plants and animals in an ecosystem.

As well as contributing to smog, SO_2 emissions cause aesthetic damages and accelerate the decay of building materials and paints.

Sources

The 2002 inventory of SO_2 emissions in the West Central zone includes measurements made by Alberta Environment as well as emissions calculated from the Alberta Energy and Utilities Board records of fuel usage and flare volumes. Overall SO_2 emission inventories rose in 2002 due to the expansion of the zone boundaries and subsequent incorporation of four major coal-fired power plants and a number of small oil and gas facilities. At the same time, SO_2 emissions from the oil and gas sector decreased by approximately 30% as pro-active industrial members continually look for ways to reduce their emissions, including the use of advanced technology. Changes in process management, such as acid gas re-injection programs at some of the larger sour gas facilities, have made a large difference in the amount of SO_2 released. Sulphur dioxide emissions for the West Central zone in 2002 were estimated at 90,000 tonnes. The utility sector emitted approximately 83% of the airshed's sulphur dioxide while the oil and gas sector contributed approximately 16%. Other sectors are relatively small emitters of SO_2, as the figure below shows.

West Central Airshed Zone Sulphur Dioxide Emissions by Sector*



*2002 Emissions data and fuel consumption records provided by Alberta Environment and the Alberta Energy and Utilities Board. Emissions are from sour and sweet gas plants and compressor stations. Emissions from well testing are not included nor are the relatively small emissions from oil batteries.

Alberta Guidelines

Alberta Environment has adopted Environment Canada's most rigorous objectives for sulphur dioxide. The Alberta SO_2 guidelines for ambient air are:

- 1-hour average 172 ppb
- 24-hour average 57 ppb
- annual average 11 ppb

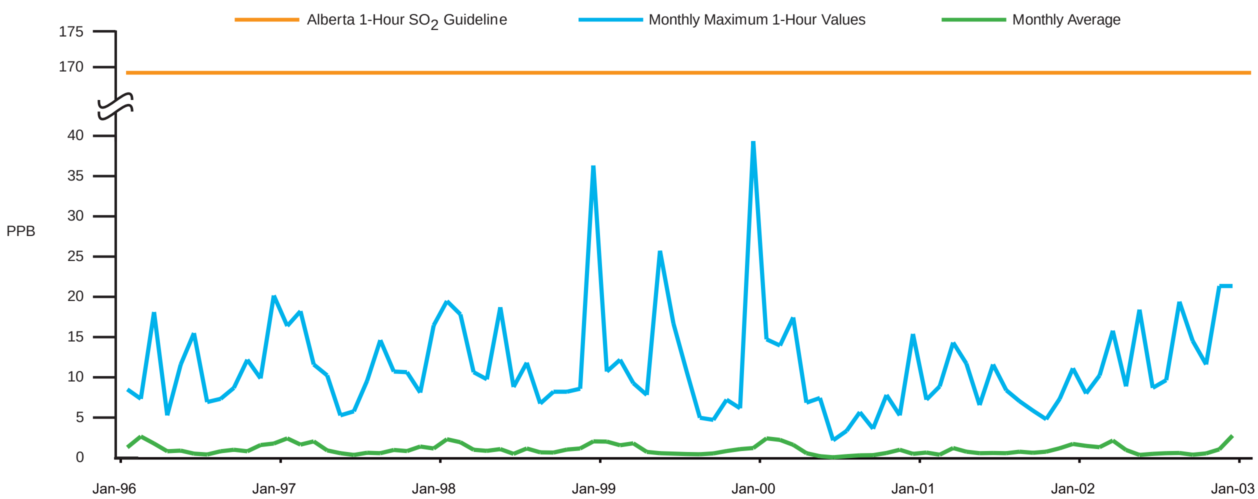
Monitoring Results

In 2002, the average sulphur dioxide concentration in the ambient atmosphere was highest at the Violet Grove, Tomahawk, and Carrot Creek locations. Measurements at these locations were 1.0, 1.1, and 1.0 ppb respectively. Lower average concentrations were observed at the Hightower Ridge and Steeper sites. These sites generated yearly averages of 0.2 and 0.1 ppb. These ranges of concentrations are consistent with the location of the monitoring sites, as Hightower Ridge and Steeper are far from major sources of pollutants. Past year comparisons of average measurements at all the monitoring locations do not indicate a trend toward lower or higher annual concentrations.

Sulphur dioxide concentrations reached a maximum of 30% of the Alberta 1-hour guideline at Tomahawk, 13% at Violet Grove, and 17% at Carrot Creek. Periods of higher readings were of short duration and often associated with increased levels of nitric oxide, indicating emissions from local sources rather than reflecting overall regional air quality. Over the year, the highest average SO_2 values at Violet Grove and Carrot Creek occurred when winds were from the northeast and southwest. At Tomahawk the highest average concentrations occurred with winds from the east-northeast, and at Steeper the highest concentrations also were when the wind was from the east-northeast. Highest concentrations at Hightower Ridge occurred with southeast winds.

(Please see accompanying graph on the following page)

Maximum and Average Sulphur Dioxide Concentration by Month 1996 - 2002 at Violet Grove



3.2.2 Oxides of Nitrogen (NO_x)

Characteristics

Oxides of nitrogen (NO_x) are the generic term for a group of highly reactive gases, all of which contain nitrogen and oxygen in varying amounts. Many nitrogen oxides are colourless and odourless, although one common pollutant, nitrogen dioxide (NO_2), can combine with particles in the air to produce a reddish-brown layer, often seen over many urban areas. Nitrogen oxides form when fuel is burned at high temperatures as in the combustion process. Although nitrogen oxide (NO) is the predominant species emitted by combustion sources, it rapidly changes to NO_2 in the atmosphere.

Nitrogen oxides contribute to a wide variety of health and environmental effects because of various compounds and derivatives in the family of nitrogen oxides, including nitric acid, nitrogen dioxide, nitrous oxide, nitrates, and nitric oxide. Oxides of nitrogen play a major role in atmospheric photochemical reactions and in the formation and destruction of ground level ozone. In addition, NO_x contributes to global warming, the formation of acid rain, impaired visibility, and nutrient overload, which reduces water quality. NO_x reacts to form nitrate particles, acid aerosols, and NO_2, all of which cause respiratory problems.

Sources

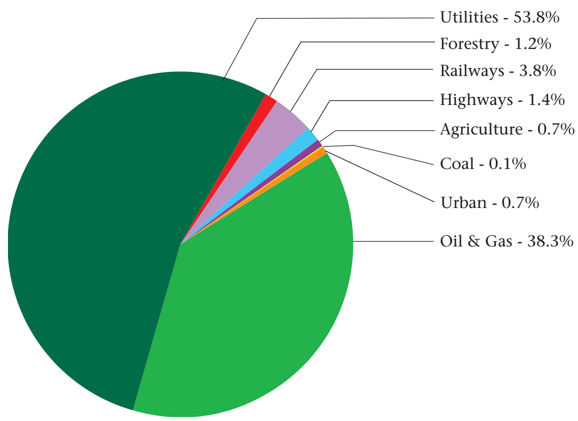
Emissions of nitrogen oxides in the West Central region, excluding transport from outside the zone, were estimated at 110,000 tonnes in 2002. Major sources were the utility and the oil and gas sectors, together contributing 92% of the total NO_x emissions. An increase in NO_x emissions over the previous year is attributed mainly to the increased size of the zone and the resultant incorporation of four major coal-fired power plants, as well as a larger inventory of compressor facilities and gas processing plants.

Alberta Guidelines

Alberta Environment guidelines are based on the prevention of human health effects and are the most rigorous of Environment Canada's ambient air quality objectives. The Alberta guidelines for nitrogen dioxide, the major component of nitrogen oxides in the ambient atmosphere, are:

- 1-hour average 212 ppb
- 24-hour average 106 ppb
- annual average 32 ppb

*West Central Airshed Zone Oxides of Nitrogen Emissions by Sector**



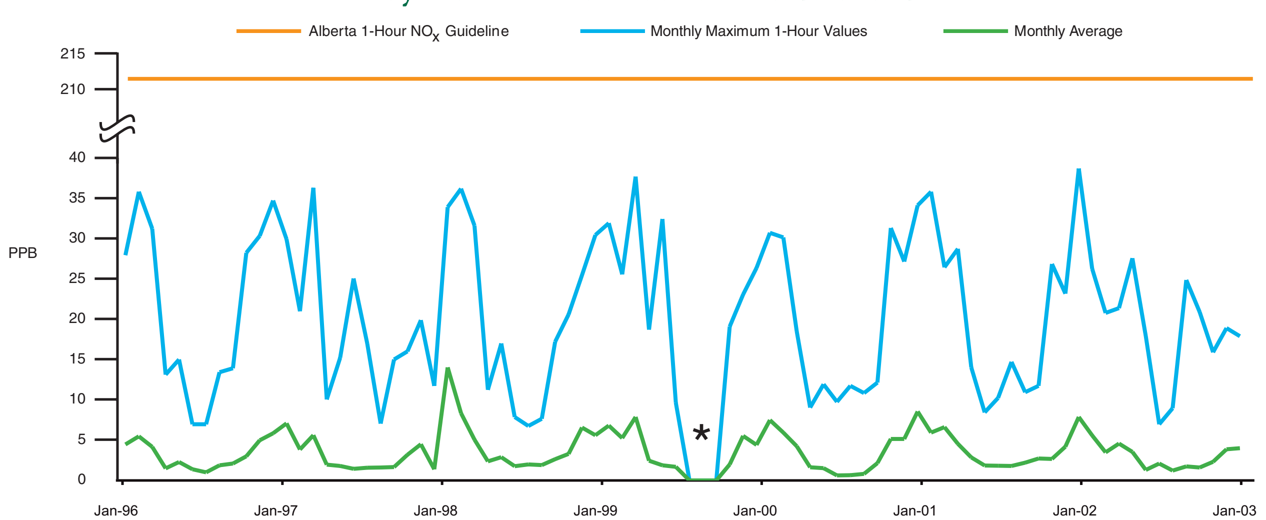
*2002 Emissions data and fuel consumption records provided by Alberta Environment and the Alberta Energy and Utilities Board. Emissions are from sour and sweet gas plants and compressor stations. Emissions from well testing are not included nor are the relatively small emissions from oil batteries.

Monitoring Results

Ambient atmospheric concentrations of nitrogen dioxide (NO_2) are monitored at all locations in the West Central zone. The average annual concentrations of NO_2 in 2002 ranged from 0.6 ppb at the Hightower Ridge location to a high of 6.9 ppb at the Carrot Creek location. The Carrot Creek station is near a major highway and the higher average NO_2 concentrations reflect emissions from motor vehicle traffic as well as farm equipment operating near the site. Nitrogen dioxide annual average concentrations decreased slightly from 2001 at all five locations. All locations have annual average values that are less than 25% of the Alberta guideline of 32 ppb for annual average ambient NO_2 concentration. The averages recorded in 2002 in the West Central zone are relatively small compared to the averages of 24 ppb and 26 ppb measured by Alberta Environment in the cities of Edmonton and Calgary respectively. Motor vehicle emissions are the major source of ambient NO_x in the cities.

The maximum 1-hour value recorded in 2002 was 52.0 ppb measured at the Carrot Creek site. This is 25% of the Alberta guideline of 212 ppb for a 1-hour NO_2 average.

Maximum and Average Nitrogen Dioxide Concentration by Month 1996 - 2002 at Violet Grove



* Equipment not operational during this period.

3.2.3 Hydrocarbons

Characteristics

Hydrocarbons are organic compounds made up primarily of carbon and hydrogen, but they can also contain oxygen, nitrogen, and halogens. They are divided into two broad categories - “non-reactive” and “reactive” hydrocarbons. The major non-reactive hydrocarbon in the atmosphere is methane, which is a naturally occurring, colourless, odourless gas recognized as a major contributor to the greenhouse effect. The reactive hydrocarbons consist of many volatile organic compounds (VOCs), some of which react with oxides of nitrogen in the atmosphere to form ozone. VOCs include ethylene, propane, butane, benzene, and a host of other hydrocarbons. Reactive VOCs include the aromatic compounds benzene, toluene, ethylbenzene, and xylene (often referred to collectively as BTEX). When present in sufficient quantities, these compounds can affect human health. Less volatile hydrocarbons include polycyclic aromatic hydrocarbons (PAHs), which are known to be carcinogenic. Total hydrocarbons (THC) include both reactive and non-reactive hydrocarbons.

Sources

Large amounts of methane are produced naturally through the decay of vegetation. Trees and plants are major natural emitters of reactive hydrocarbons, with other significant sources being oil and gas operations, automobiles, and chemical solvents. Formation of polycyclic aromatic hydrocarbons may be attributed to the burning of substances such as coal, gas, and wood.

Alberta Guidelines

There are no Alberta guidelines for ambient hydrocarbon concentrations.

Monitoring Results

Atmospheric concentrations of total hydrocarbons (THC) were measured at Violet Grove in 2002. The average THC concentration was 2.0 ppm. This is slightly more than the average of 1.9 ppm recorded in 2001. The maximum 1-hour average value was 11.1 ppm.

The highest hydrocarbon readings were associated with local oilfield activity and were not representative of regional air quality. The total hydrocarbon concentrations were generally highest with winds from the southeast.

3.2.4 Ground Level Ozone

Characteristics

Ozone is both a natural component of the atmosphere and a major constituent of photochemical smog. Ozone is not usually emitted directly into the air, but at ground level is created by a chemical reaction between oxides of nitrogen and volatile organic compounds in the presence of heat and sunlight. Ozone has the same chemical structure (O_3) whether it occurs at ground level or many kilometres above the Earth’s surface. Depending on the location of the ozone it can be considered harmful or helpful. Ozone that occurs naturally in the stratosphere, approximately 16 to 50 kilometres (about 10 to 30 miles) above the Earth’s surface, forms a layer that protects life on this planet from the sun’s harmful ultraviolet rays. However, at ground level, ozone can adversely affect human health even at low concentrations. Ozone is a strong oxidizer and can irritate eyes, nose, and throat and trigger a variety of health problems including aggravated asthma, reduced lung capacity, and increased susceptibility to respiratory illnesses. Ground level ozone can also have detrimental effects on plants and the ecosystem by reducing crop and forest yields and increasing plant vulnerability to disease, pests, and harsh weather.

At normal atmospheric concentrations, ozone is an odourless, colourless gas. However, at concentrations higher than 1 ppm - a level found near photocopier machines and electrical discharges - it has a sharp distinct odour.

Sources

Motor vehicle exhaust and industrial emissions, gasoline vapours, and chemical solvents are some of the major sources of NO_x and VOCs that help to form ozone. Sunlight and hot weather cause ground level ozone to form in harmful concentrations. As a result, ozone is known as a summertime pollutant. Ozone is a natural component of the upper atmosphere and may be transported, along with other chemicals that react to form it, to ground level by meteorological processes.[2]

Alberta Guidelines

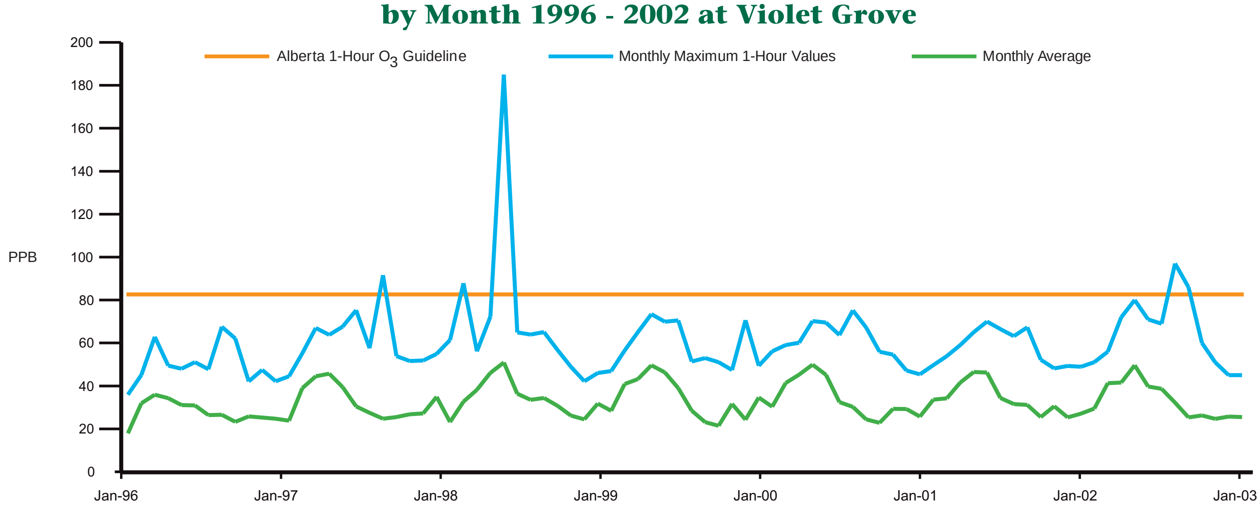
Alberta Environment guidelines for ozone are:

- 1-hour average 82 ppb
- 24-hour average 25 ppb

Monitoring Results

In 2002, the summertime weather in west central Alberta was exceptional, as there were many hot, dry days with little wind and little or no cloud cover. These stagnant summertime conditions were conducive to the production of peak ozone levels that exceeded Alberta Environment's 82 ppb 1-hour average guideline. In July, sixteen 1-hour readings at the Tomahawk location, three at the Violet Grove location, and five at the Carrot Creek site exceeded the guideline. The highest 1-hour mean concentrations were 97 ppb, recorded at Tomahawk and Violet Grove, and 94 ppb at Carrot Creek. In August, Violet Grove had one 1-hour reading of 86 ppb. One incident of a 1-hour ozone exceedence occurred at the Hightower Ridge location in September when the peak concentration reached 90 ppb. The 2002 annual averages for the stations ranged from 29 ppb at Carrot Creek to 44 ppb at Hightower Ridge. The 2002 averages for Violet Grove, Steeper, and Tomahawk were 33, 39, and 31 ppb respectively.

Maximum and Average Ozone Concentration by Month 1996 - 2002 at Violet Grove



[2] Additional analysis of earlier data from West Central's Hightower Ridge site was undertaken by a consultant for CASA's PM and Ozone project team as part of its work on a Canada-wide Standard. Of the ten ozone exceedances recorded at Hightower between 1996 and 2000, eight were attributed to long-range transport, one to forest fires, and one was undetermined.

3.2.5 Particulate Matter (PM_{10} and $PM_{2.5}$)

Characteristics

Ambient particulate matter consists of a mixture of particles of varying sizes and chemical composition. Particulate matter (PM) includes dust, dirt, soot, smoke, and drops of liquid. Particulates give smog its colour, which may be brown, dark grey, or white, depending on the type of particles. Small particles less than 10 micrometres in diameter (PM_{10}) are known as inhalable particulates. They have a significant impact on human health, especially to those who have heart or lung disease. Of special concern are the fine particles that are less than 2.5 micrometres in diameter ($PM_{2.5}$). These are known as respirable particulates. Respirable particulates can penetrate deep within the lungs and cause adverse health effects, including aggravated asthma, coughing, and chronic bronchitis. Particulate matter can be carried over long distances by the wind and remain suspended in the air for long periods of time. Where the particulates settle can affect the environment in many ways. Particulates that settle to water bodies may cause an increase in acidity or change the nutrient balance of the water. Ground-settling particulates may be responsible for depleting nutrients in soils, thereby contributing to damage to sensitive forests and crops, which affects the diversity of ecosystems. In addition, PM may also cause aesthetic damage. Soot, a type of PM, stains and damages stones and other materials such as monuments and statues.

Sources

Particulates may be emitted directly into the air or formed in the air from the chemical change of gases. Particulates are emitted directly to the atmosphere from sources as diverse as vehicles, construction sites, tilled fields, unpaved roads, and wood burning. Respirable particulates are formed when gases from combustion processes (e.g., motor vehicles, power plants, other industrial processes) react with sunlight and water vapour.

Alberta Guidelines

Guidelines for ambient atmospheric concentrations of PM_{10} and $PM_{2.5}$ are under consideration by the Alberta and federal governments. A provisional Canada-wide standard has been adopted for $PM_{2.5}$ of 30 micrograms per cubic metre ($\mu g/m^3$), 24-hour averaging time, by the year 2010.

Monitoring Results

In the West Central zone, continuous monitors are used to measure particulate matter. PM_{10} and $PM_{2.5}$ data is collected at the Hightower and Tomahawk locations while PM_{10} data is collected at the Steeper site.

Concentrations of PM_{10} particles at Tomahawk in 2002 averaged 11.9 $\mu g/m^3$ with a maximum 1-hour concentration of 214 $\mu g/m^3$, which occurred when a forest fire was burning in the region. During the same period the $PM_{2.5}$ concentration averaged 4.2 $\mu g/m^3$. Previous analysis showed PM_{10} particles to be composed mainly of windblown dust, as indicated by the high calcium content. Sulphate and nitrate derived from industrial emissions of SO_2 and NO_x were the major constituents of the $PM_{2.5}$.

PM_{10} concentrations at the Hightower Ridge background monitoring site averaged 6.1 $\mu g/m^3$ compared to 7.6 $\mu g/m^3$ at Steeper. The Steeper monitoring site may be influenced by dust from a nearby gravel road. The $PM_{2.5}$ concentration at the Hightower Ridge site averaged 1.8 $\mu g/m^3$.

3.2.6 Ammonia

Low concentrations of pollutants that cannot be recorded by continuous monitors can be measured using an integrated sampling method. Samples are collected over a two-week period and then analyzed in a laboratory. Ammonia is a colourless gas with a pungent odour and is produced by natural anaerobic decay processes.

Major agricultural sources are animal wastes from the cattle industry, and fertilizers widely applied in the cultivation of grain.

Ammonia concentrations are highest in the agricultural areas of the West Central zone, averaging 0.33 $\mu g/m^3$ at Violet Grove in 2002, compared with 0.16 $\mu g/m^3$ at the background Hightower Ridge monitoring station.

3.2.7 Meteorology and Air Quality

Influence of Meteorology

Air quality depends on the rate that pollutants are emitted to the atmosphere and the rate at which these pollutants 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, precipitation, and changes in these elements induced by local topography.

Precipitation may remove pollutants from the atmosphere, depositing them on soils and vegetation. Rates of deposition of pollutant gases are highest when vegetation and soils are wet. Vegetation is more susceptible to damage during periods of highest growth.

Monitoring Program

Meteorological parameters measured as part of the West Central Airshed Society air quality monitoring programs are:

- wind speed and direction
- temperature
- difference in temperature at two heights
- solar radiation
- photosynthetically-active radiation (PAR)
- amount of precipitation
- relative humidity
- surface wetness

Precipitation samples are also collected and chemically analyzed for acidity and major constituents.

Monitoring Results

Hourly average temperatures at the Tomahawk station ranged from a minimum of -34.6 °C to a maximum of 34 °C during 2002. Average annual temperatures were similar for the Violet Grove, Carrot Creek, Tomahawk, and Steeper sites, ranging from 2.1 °C to 2.8 °C. The Hightower Ridge location, with an elevation of 1441 metres, experienced a lower annual mean temperature of 1.5 °C.

Winds at Violet Grove and Carrot Creek were predominantly from the west. At the Tomahawk location the winds were mostly from southwest. Winds at Hightower Ridge were mainly from the west and at Steeper from the southwest, reflecting the influence of the adjacent mountain valley. Maximum scalar wind speeds were observed at the Hightower Ridge and Steeper sites, reaching a high in the winter months of 60 and 46 kph, respectively.

Annual Wind Speed and Direction Summary

Station	Annual Average Wind Speed (kph)	Primary Wind Direction	Total Annual Percentage*	Secondary Wind Direction	Total Annual Percentage
Violet Grove	11.5	west	23.8	southwest	19.3
Tomahawk	10.8	southwest	19.5	north	15.7
Carrot Creek	8.6	west	27.3	southwest	21.4
Hightower Ridge	13.6	west	28.2	northwest	19.4
Steeper	7.8	southwest	33.6	south	29.3

** Total annual percentage is the percentage of time in the year that the wind blew from the direction indicated.*

Fourteen precipitation samples were collected at each of the Hightower Ridge and Violet Grove stations. The acidity of precipitation (pH) at Violet Grove and Hightower Ridge in 2002 was similar to levels recorded in 2001. The volume-weighted average pH at Violet Grove was 5.03, and 5.14 at Hightower Ridge. Major constituents of the precipitation samples were sulphate, nitrate, and calcium.

Please refer to Appendix III for additional detail on meteorological observations at each WCAS station.

Characteristics

The amount of a pollutant flushed from the atmosphere by precipitation (wet deposition) or deposited to the landscape in the form of gases and particles (dry deposition) determines the eventual effect on the environment.

Precipitation removes some pollutants from the atmosphere, depositing them on soils and vegetation. Prolonged high deposition rates of acidifying chemical species may result in long-term acidification of susceptible soils and lakes. The SO_2 Management Project Team of CASA recommended that Alberta adopt critical and target loads for deposition of acidifying pollutants to protect aquatic and terrestrial ecosystems. The recommended method of determining the total acid input is based on the difference between the total wet and dry deposition of acidifying and neutralizing substances. A critical load of 0.25 kiloequivalents of total acidity per hectare per year (keq $ha^{-1}y^{-1}$) was recommended in order to protect sensitive areas of the province from long-term harmful effects.

Soil acidity (pH) varies naturally during the growing season and from year to year. To determine changes in soil acidity caused by atmospheric input, measurements must be made over an extended period of time. Data on soils is being collected by the WCAS as a continuation of the soil monitoring work previously performed under the Brazeau-Pembina Sulphur Deposition and Agriculture Study, 1989-1994.

Monitoring Results

Alberta Environment uses potential acid input (PAI) as a means of evaluating the level of acid deposition to an area. PAI is calculated from both wet and dry deposition of sulphur and nitrogen species and deposition of base cations, which mitigate acidity.

The PAI of wet deposition at Violet Grove during 2002 was estimated to be 0.06 keq H^+ $ha^{-1}y^{-1}$ and 0.02 keq H^+ $ha^{-1}y^{-1}$ at Hightower Ridge.

The amount of dry deposition of a pollutant is a function of its atmospheric concentration and its deposition velocity. The deposition velocity is controlled by meteorological conditions, the type of landscape (forest, grassland, agricultural land), and landscape condition (wet, dry, snow covered). Dry acidic deposition in the eastern part of the West Central Zone was estimated to be 0.17 keq H^+ $ha^{-1}y^{-1}$. This estimate was based on measurements of pollutant concentrations made at Violet Grove, with the effects of surface wetness and the influence of each vegetation type in the zone being taken into consideration.

About two-thirds of the PAI was the result of sulphur deposition in the form of sulphur dioxide, while the remainder was caused by nitrogen deposition in the form of nitrogen dioxide and nitrogen oxide. The PAI value at the Hightower monitoring station in the western part of the zone was estimated to be 0.03 keq H^+ $ha^{-1}y^{-1}$.

Soil acidity in the West Central agricultural plots has varied since the monitoring program began in 1995. Although pH fluctuates from year to year, in 2002 lower measurements of pH (more acidity) were observed at the Tomahawk, Violet Grove, and Carrot Creek sites as compared to first measurements at the start of the agriculture program. The pH values recorded in 2002 ranged from 4.8 to 6.6; the lowest value (most acidic) was found at the Carrot Creek site while the highest value was reported at the Breton location. In 1995, pH values ranged from 5.5 to 6.6; at that time the lowest value was shared at the Tomahawk and Breton plots and the highest was at the Violet Grove site. The table below illustrates the changes in soil pH over the last seven years.

Soil pH at WCAS plots 1995 - 2002

	1995		2000		2001		2002	
Location	**Depth**	**pH**	**Depth**	**pH**	**Depth**	**pH**	**Depth**	**pH**
Violet Grove	0 - 15 cm	6.6	0 - 12 cm	7.2	0 - 12 cm	6.6	0 - 12 cm	6.4
Tomahawk	0 - 15 cm	5.5	0 - 12 cm	5.5	0 - 12 cm	4.9	0 - 12 cm	5.1
Alder Flats	0 - 12 cm	5.8	0 - 12 cm	6.3	0 - 12 cm	5.6	0 - 12 cm	6.3
Breton	0 - 19 cm	5.5	0 - 12 cm	6.1	0 - 12 cm	5.8	0 - 12 cm	6.6
Carrot Creek	0 - 15 cm	5.1**	0 - 12 cm	5.5	0 - 12 cm	5.3	0 - 12 cm	4.8

**Carrot Creek plot moved in 1997 ** pH value for 1997*

4.0 Links to the C.A.S.A.

The **Clean Air Strategic Alliance** (CASA) provides the framework within which the West Central Airshed Society and other airshed zones operate. CASA is a non-profit stakeholder partnership composed of representatives from government, industry, and non-government organizations. It has been given shared responsibility by its members, including the Government of Alberta, for strategic planning, organizing and coordinating resources, and evaluation of air quality in Alberta through a collaborative process. CASA stakeholders work together to develop practical and innovative responses to air quality issues. Air quality management in airsheds is one such approach.

The regional airshed approach works well for problems that are regional in nature and allows those within a region to work together to resolve air quality issues. The CASA document, "Zone Air Quality Management Guidelines" sets out the vision and principles of the Alliance under which airshed zones operate. Airshed zones follow the CASA model of consensus decision-making, in which stakeholders seek to resolve their concerns in a collaborative manner. CASA also invites representative from the WCAS and other airshed zones to join in CASA projects and working groups, where appropriate.

The WCAS submits its air quality monitoring data to CASA and it can be viewed on the WCAS page of the CASA website at: http://www.wcas.ca/livedata/livedata.html

In 2002, the WCAS was represented on the CASA PM and Ozone project team, the Data Issues Group, and the Alberta Ambient Air Quality Monitoring System Operations Steering Committee. Of particular note, to help it develop recommendations concerning implementation of the Canada-wide Standard for PM and ozone, the CASA PM and Ozone team retained a consultant to analyze relevant monitoring data and determine the background influences during days of ozone exceedances. Because of its role as an "up-wind" station, the Hightower Ridge site, northwest of Hinton in the West Central zone, was one of the sites chosen for analysis. Of the ten ozone exceedances (>65 ppb for a daily 8-hour averaging period) recorded at Hightower between 1996 and 2000, eight were attributed to long-range transport, one to forest fires, and one was undetermined.

5.0 Financial Report

The WCAS Board systematically evaluates and measures the success of the WCAS program and operations. In an effort to meet the changing needs of our stakeholders, we continue to modify and improve the air monitoring program and the equipment associated with it. Our goal is to maintain a credible and affordable program respected by industry, regulatory agencies and the general public.

Below is the audited Statement of Revenue and Expenses for the West Central Airshed Society for the year ended December 31, 2002. A complete set of audited financial statements is available upon request.

West Central Airshed Society
Statement of Revenue and Expenses for the year ended December 31, 2002

Revenue:	
Membership fees	$ 757,227
Interest	1,689
Network cost-sharing	13,000
	771,916
Direct Expenses:	
Ambient Air Monitoring	378,501
Agricultural Bio-monitoring	103,359
Administrative Expenses:	
Project management	90,492
Office rentals	14,429
Advertising	11,695
Telephone, internet and fax	11,446
Insurance	8,611
Miscellaneous	4,864
Office Supplies	4,314
Board	3,955
Interest on long-term debt	3,026
Meetings	1,465
Office repairs and maintenance	1,319
Accounting and legal fees	2,292
Interest and bank charges	185
Total Administrative Expenses	58,093
Land honorariums	2,100
	642,053
Excess of revenues over expenses, from operations	129,863
Amortization	38,869
Loss (gain) on disposal of equipment	(4,000)
Excess of revenues over expenses	**$ 94,994**

Appendix I: Ambient Air Monitoring Data - 2002

1 - Hour Average Sulphur Dioxide Concentrations (ppb) for 2002

	% Instrument Uptime	Average	Minimum	Maximum
Violet Grove	95.5	1.2	0.0	22.0
Tomahawk	97.6	1.1	0.0	52.0
Carrot Creek	97.6	1.0	0.0	29.5
Hightower Ridge	96.8	0.2	0.0	10.0
Steeper	95.9	0.1	0.0	19.0

1 - Hour Average Nitrogen Dioxide Concentrations (ppb) for 2002

	% Instrument Uptime	Average	Minimum	Maximum
Violet Grove	95.3	3.0	0.0	27.7
Tomahawk	97.8	4.7	0.0	38.7
Carrot Creek	97.6	6.9	0.0	52.0
Hightower Ridge	96.8	0.6	0.0	16.1
Steeper	95.7	0.9	0.0	28.0

1 - Hour Average Ozone Concentrations (ppb) for 2002

	% Instrument Uptime	Average	Minimum	Maximum
Violet Grove	95.5	33.3	0.0	97.0
Tomahawk	97.8	31.0	0.0	97.0
Carrot Creek	97.6	29.1	0.0	94.0
Hightower Ridge	94.1	43.6	1.0	90.0
Steeper	95.3	38.5	0.0	71.6

1 - Hour Average Particulate Matter ($PM_{2.5}$) Concentrations ($\mu g/m^3$) for 2002

	% Instrument Uptime	Average	Minimum	Maximum
Tomahawk	98.1	4.2	0.0	121.0
Hightower Ridge	96.5	1.8	0.0	47.0

1 - Hour Average Particulate Matter (PM_{10}) Concentrations ($\mu g/m^3$) for 2002

	% Instrument Uptime	Average	Minimum	Maximum
Tomahawk	98.8	11.9	0.0	214.0
Hightower Ridge	96.2	6.1	0.0	92.0
Steeper	96.7	7.6	0.0	112.0

1 - Hour Average Total Hydrocarbon Concentrations (ppm) for 2002

	% Instrument Uptime	Average	Minimum	Maximum
Violet Grove	93.2	2.0	0.8	11.1

Appendix II: Integrated Sampling Data - 2002

Ammonia Concentrations - Two Week Interval Sampling ($\mu g/m^3$) for 2002

	Average	Maximum
Violet Grove	0.33	0.73
Hightower Ridge	0.16	0.93

Appendix III: Meteorological Observations - 2002

1 - Hour Average Temperature Readings (°C) for 2002

	% Instrument Uptime	Annual Average	Minimum	Maximum
Violet Grove	97.0	2.8	-33.1	32.0
Tomahawk	98.2	2.6	-34.6	34.0
Carrot Creek	99.3	2.4	-34.2	32.0
Hightower Ridge	98.3	1.2	-30.4	29.0
Steeper	97.5	2.1	-33.2	28.0

1 - Hour Average Wind Speed Measurements (km/hr) for 2002

	% Instrument Uptime	Average	Minimum	Maximum
Violet Grove	97.0	11.5	0.0	43.0
Tomahawk	99.5	10.8	0.0	42.9
Carrot Creek	99.0	8.6	0.0	36.3
Hightower Ridge	98.0	13.6	0.0	59.8
Steeper	96.9	7.8	0.0	46.0

1 - Hour Average Relative Humidity Readings (%) for 2002

	% Instrument Uptime	Average	Minimum	Maximum
Violet Grove	97.0	68.4	20.6	100.0
Tomahawk	99.0	69.6	15.0	100.0
Carrot Creek	99.3	68.4	16.7	100.0
Hightower Ridge	98.4	60.5	10.0	100.0
Steeper	96.3	59.5	6.0	100.0

1 - Hour Average Solar Radiation Readings (W/m^2) for 2002

	% Instrument Uptime	Average	Minimum	Maximum
Violet Grove	97.0	149.4	0.0	1113.0
Hightower Ridge	98.2	134.3	0.0	1079.0
Steeper	97.6	127.2	0.0	1017.0

1 - Hour Average Photosynthetic Radiation Readings (W/m^2) for 2002

	% Instrument Uptime	Average	Minimum	Maximum
Tomahawk	99.6	90.7	0.0	600.0
Carrot Creek	97.8	92.4	0.0	669.0

Appendix IV: WCAS Board of Directors

SECTOR	DIRECTORS
Agriculture	**Cecil Andersen, Chairperson** Pembina Agricultural Protection Association **Cliff Whitelock, Alternate Director** Pembina Agricultural Protection Association
Forestry	**Mike Woods, Vice Chairperson** Weyerhaeuser Canada Ltd. **JoAnne Volk, Alternate Director** Weldwood of Canada
Provincial Government of Alberta	**Larry Williams, Secretary** Alberta Environment **Larry Paslawski, Alternate Director** Alberta Energy and Utilities Board
Oil and Gas Producers	**Greg Gabert, Treasurer** Penn West Petroleum Ltd **Dave Stewart, Alternate Director** Talisman Energy Canada
Coal Mining	**Al Watson, Director** Luscor Ltd. Coal Valley Mine **Alternate Director - Vacant**
Electrical Utilities	**Jim Bolton, Director** TransAlta Utilities Corp. **Robert Raimondo, Alternate Director** EPCOR
Environmental Organizations (non-governmental)	**Mary Griffiths, Director** Pembina Institute for Appropriate Development **Paul Belanger, Alternate Director** Green Foundation
Gas Transmission	**Sandra Barnett, Director** TransCanada Pipelines Limited **Srikanth Venugopal, Alternate Director** TransCanada Pipelines Limited
Municipalities	**John Whaley, Director** County of Leduc **Ron Sekura, Alternate Director** County of Brazeau No. 77

Appendix V: Staff, Contractors & Cooperating Landowners

WCAS Team:

Bob Scotten, Program Manager

Barb Johnson, Environmental Engineer

Greg Swain, Senior Air Monitoring Technologist

Jeff McClintock, Air Monitoring Technologist

The West Central Airshed Society expresses its appreciation to the contractors and cooperators listed who helped make our 2002 air monitoring program a success.

Contractors:

Marc Brulotte, Website Design and Maintenance

Jacques Whitford, Environmental Limited Consulting Services

Dr. Warren Kindzierski, WBK & Associates, Inc.

Dr. Sagar Krupa, University of Minnesota

Dr. Allan Legge, Biosphere Solutions

Maxxam Analytics, Inc., Laboratory Analysis

Eric Peake, EPCM Associates Ltd.

Elaine Ryl, Agricultural Crop Operations

Kim Sanderson, Green Planet Communications, Inc.

Gene's Maintenance

Cooperators:

Deeluw Farms, Landowners and Road Maintenance

Ian and Pauline Dunn, Landowners

Bill and Sylvia Flesher, Landowners

Dave and Gloria Jouan, Landowners and Road Maintenance

Garth and Rosemary Parker, Landowners

Cliff and Audrey Whitelock, Landowners and Road Maintenance

The WCAS also gratefully acknowledges the following for their contributions to our work:

- **Larry Paslawski** and **Rosanne Pfannmuller** with the Alberta Energy and Utilities Board for the hours of time they have devoted to providing the Society with information on land locations, fuel and flare volumes, and other details that are so important to the management of the monitoring program.
- **Petro-Canada** (Robb-Hanlon Gas Plant) for their continuing assistance with road maintenance at remote locations.

Appendix VI: WCAS Members

Industry

AEC Oil and Gas
Apache Canada Ltd
ATCO Midstream Ltd.
BP Canada Energy Co.
Bumper Development Corporation Ltd.
Burlington Resources Canada Ltd.
Calpine Canada
Canadian Forest Oil Ltd.
Canadian National Resources Ltd.
Central Alberta Midstream
Chevron Canada Resources
Compton Petroleum Corporation
Conoco Canada Limited
Devon Canada Corp
Drayton Valley Power
Duke Energy Midstream Services Canada Ltd.
Elk Point Resources Inc.
EOG Resources Canada
EPCOR
ExxonMobil Canada Energy
Gauntlet Energy Corporation
Glencoe Resources Ltd.
Husky Oil Operations Limited
Imperial Oil Resources
Keyspan Energy Canada
Luscar Ltd. Coal Valley Mine
Marathon Canada Limited
Meota Resources Corp.
Murphy Oil Company Ltd.
NCE Resources Group Inc.
Northrock Resources Ltd.
NorthStar Energy Inc.
Penn West Petroleum
Petro Canada Oil and Gas
Rider Resources Inc.
Rio Alto Exploration
Signalta Resources Ltd
Star Oil and Gas Ltd.
Suncor Energy
Sundance Forest Industries Ltd.
Talisman Energy Canada
Texaco Canada Petroleum Inc.
TransAlta Utilities Corporation
TransCanada Pipelines Limited
Vermilon Resources
Weldwood of Canada

Municipalities

County of Brazeau #77
Leduc County
MD of Yellowhead #94
Parkland County
Town of Drayton Valley
Town of Hinton

Government

Alberta Energy and Utilities Board
Alberta Environment
WestView Regional Health Authority

Environmental Agencies *(non governmental)*

Alberta Research Council
Clean Air Strategic Alliance (CASA)
Parkland Airshed Management Zone
Pembina Agricultural Protection Association
Pembina Institute for Appropriate Development

Glossary of Terms

Alberta Guideline: Concentration value adopted by the Province of Alberta with the intention of preventing deterioration of air quality. Guidelines for SO_2, NO_2, O_3 and several other pollutants are based on the prevention of adverse human health and vegetation effects. Guidelines may be for 1-hour, 24-hours, or 1-year average concentrations.

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.

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 recommended guideline for the same period to assess absolute air quality or against other year's data to assess improvement or degradation of air quality in the same air.

BTEX: Benzene, toluene, ethylbenzene, and xylene are aromatic volatile compounds. When found in sufficient quantities can adversely affect human health.

Cation: An ion with a positive charge.

Clean Air Strategic Alliance (CASA): A multi-stakeholder society sponsored by the Departments of Health, Energy, and Environment that provides a forum to discuss and address issues related to air quality in the province.

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

Hydrocarbons: Compounds containing various combinations of hydrogen and carbon atoms. They may be emitted into the air by natural sources 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.

Methane (CH_4): A colourless, odourless gas that is the most common hydrocarbon in the earth's atmosphere. It is of significance as a greenhouse gas responsible for global warming. About 20% of the total greenhouse effect is attributable to methane.

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

Nitric Dioxide (NO_2): Also called nitrogen dioxide, this is the most abundant of the oxides of nitrogen in the atmosphere. It is a reddish-brown gas. The Alberta guidelines of a 1-hour average concentration of 210 ppb, a 24-hour average concentration of 110 ppb, and an annual average concentration of 3 ppb, are based on the prevention of human effects. $N0_2$ at higher concentrations is associated with numerous adverse health effects.

Nitric Oxide (NO): Precursor of ozone, $N0_2$ 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), and other oxides of nitrogen. Nitrogen oxides are formed when nitrogen combines with oxygen during the combustion of fossil fuels. Other sources are the natural degradation of vegetation and the use of chemical fertilizers. Oxides of nitrogen affect visibility and lead to ozone formation. For monitoring purposes, nitrogen oxides are considered to be the sum of nitric oxide and nitrogen dioxide.

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. At high concentrations it may contribute to crop damage and cause respiratory problems. It is a major component of smog. Ozone at ground level is generated from emissions of NO_x and hydrocarbons. The Alberta guideline for ozone is 82 ppb for a 1-hour average. In the stratosphere it protects the earth from excessive ultraviolet radiation.

pH: The measurement of the degree of acidity on a scale of 1 to 14; a pH of 1 is very acidic, 7 is neutral and 14 is very alkaline. The natural pH of precipitation in the absence of pollution is thought to be 5.6.

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.

$PM_{2.5}$: Particles less than 2.5 micrometers (microns) in diameter, small enough to be inhaled and reach the lungs. Concentrations greater than 20 $\mu g/m^3$ are thought to adversely affect pulmonary function.

PM_{10}: Includes tiny particles with an aerodynamic diameter less than or equal to 10 microns (approximately 1/7 the diameter of a single human hair). Small enough to be inhaled but they do not reach the lungs.

Sulphur Dioxide ($S0_2$): A strong smelling, colourless 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 $S0_2$. $S0_2$ and other sulphur oxides contribute to acid deposition.

Stakeholders: Industry activities often affect surrounding areas and populations. People with an interest in these activities are considered stakeholders. They may include nearby landowners, urban municipalities, upstream oil and natural gas industries, mining, forestry, utilities, aboriginal communities, recreational land users, non government organizations, environmental groups, provincial and federal governments and regulators.

Target Load: The maximum level of acidic atmospheric deposition that affords long-term protection from adverse ecological consequences, and that is practically and politically achievable.

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

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

Volume-weighted pH: The average pH of precipitation throughout the year when the volume of rainfall and the H^+ concentration of each precipitation sample is considered.

Units of Measure

μm – one one-millionth of a meter (10^{-6}m)

ppb – parts per billion by volume

ppm – parts per million by volume

$\mu g/m^3$ – micrograms per cubic meter

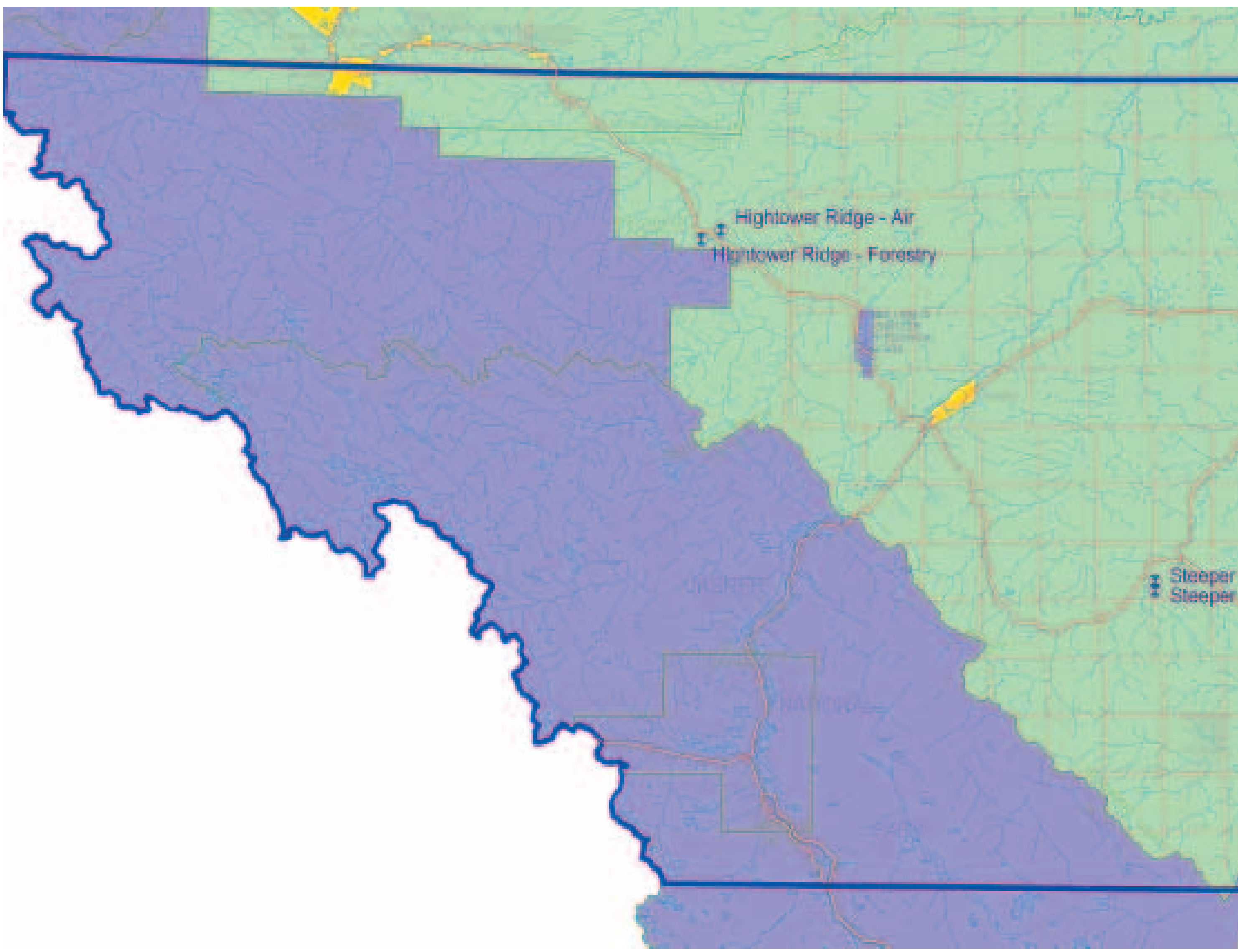
keq $ha^{-1}yr^{-1}$ – kiloequivalents per hectare per year

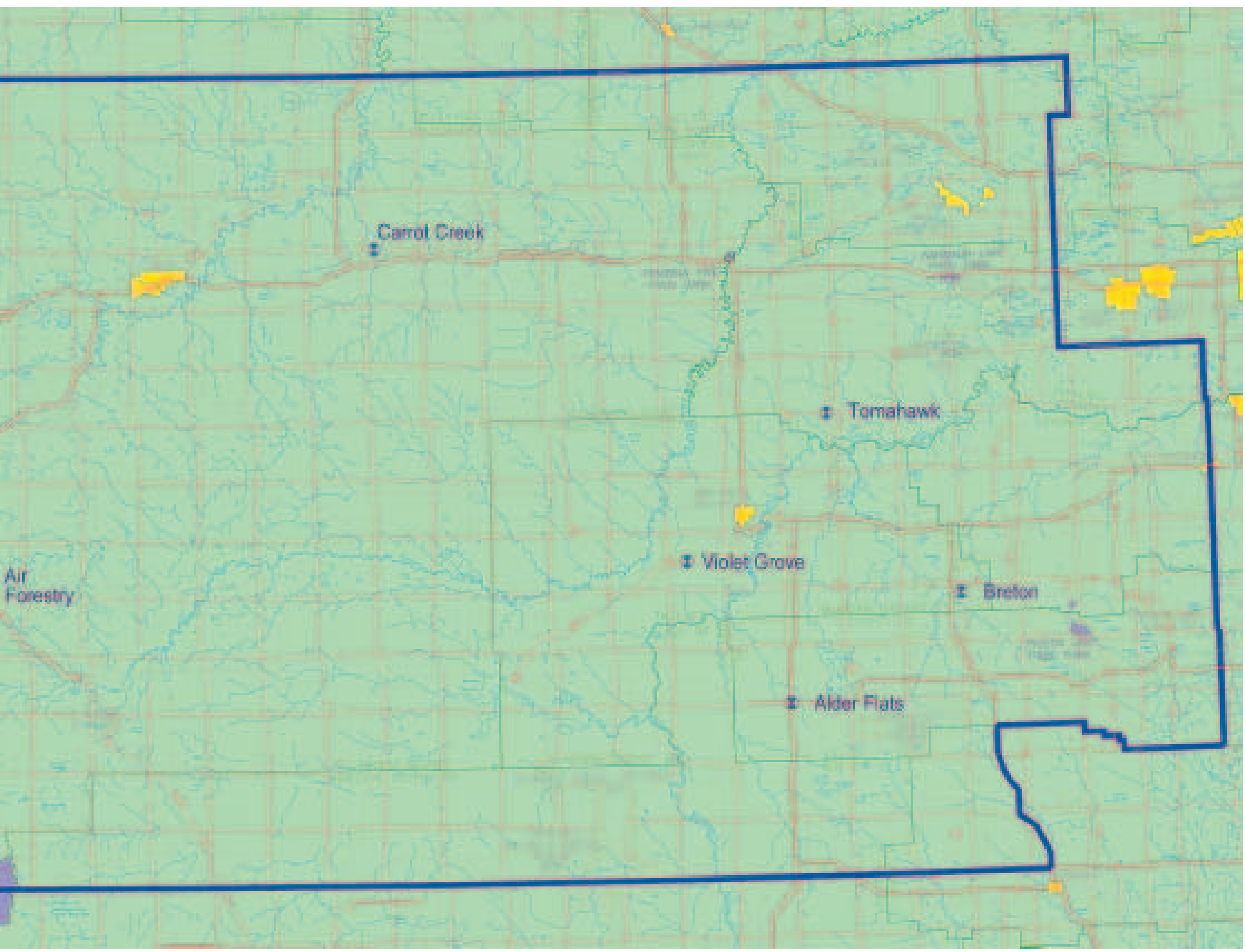
kg $ha^{-1}yr^{-1}$ – kilograms per hectare per year

West Central Airshed Society

Geographical Boundary

- Bottom of Twp 43 & Hwy 20
- North along Hwy 20 to intersection of Northern Boundary of Ponoka County
- East along Ponoka County Boundary to Hwy 795
- North along Hwy 795 to intersection of Hwy 39
- Directly north of Hwy 39 to Hwy 627
- West along Hwy 627 to intersection of Hwy 777
- North to connect Hwy 777 and continued north to top of Twp 56
- West along Twp 56 to the BC border




Carrot Creek
Tomahawk
Violet Grove
Air
Forestry
Breton
Alder Flats