Air Quality Monitoring Results 2011

HIGHLIGHTS

- Continuing air quality improvement trends
- Province-wide achievement of Canada-wide standards
- Lower benzene levels in Saint John
- Special Project: Mobile air quality reporting from Atholville

Department of Environment and Local Government

New Nouveau Brunswick

Contents

Air Quality Monitoring in New Brunswick

This report provides an overview of the air quality monitoring activities currently being undertaken in the province of New Brunswick. Air quality information, in relation to regulated ambient air quality limits, is also provided.

Air quality monitoring in New Brunswick is a partnership between the Federal Government (Environment Canada) and the Provincial Department of Environment and Local Government (DELG). This partnership has been formalized under a long-standing National Air Pollution Surveillance (NAPS) agreement.

Through the NAPS agreement, Environment Canada provides all of the necessary monitoring equipment and a centralized national database for the air quality information collected. It is the Province's responsibility to deploy and maintain the equipment, operate the stations, perform necessary calibrations, and otherwise ensure that data is accurate.

Air quality monitoring equipment. A Volatile Organic Compound (VOC) sampler (left/near-field), and a Particulate Matter monitor ($PM_{2.5}$) (right/far-field).

A typical air quality monitoring station (Moncton).

The provincial network is comprised of 16 air quality monitoring stations. There are a total of 61 instruments operating at these stations at all times.

The stations and monitors have been established for a number of purposes:

- to detect and quantify impacts from regulated pollution sources;
- to assess and track ambient background levels of various pollutants;
- to monitor transboundary migration of pollution into New Brunswick; and,
- to provide real-time data to public health reporting systems such as the Air Quality Health Index.

The Province also requires the operators of large industrial facilities to participate in air quality monitoring. During the 2011 reporting year there were 34 industry-operated stations dedicated to monitoring the ambient concentrations of industry-specific contaminants in nearby communities.

What We Measure

Each air quality monitoring station is different, with monitors set up to suit the pollution sources in that particular area. The most common parameters to monitor are:

Ground Level Ozone
Nitrogen Dioxide
Volatile Organic Compounds
Carbon Monoxide
Particulate Matter
Wind Speed
Sulphur Dioxide
Total Reduced Sulphur
Wind Direction

Site maps and monitor inventories are provided on pages 5 and 6.

Understanding Air Pollution

Air quality is constantly changing from season to season, and is affected by a wide variety of factors, including the weather, long range movements of air from other parts of the world, natural events, industry cycles, and other human activities.

Below, we look at some of the more common air pollutants: what they are, where they come from, and how they can affect our environment and our health.

Overview of Key Air Pollutants - Sources and Effects		
Air Pollutant	**What is it?**	**What does it do?**
Sulphur Dioxide (SO_2)	A colourless gas with a sharp odour, like that of a struck match. It is produced by the burning of sulphur-bearing fuels such as oil and coal.	High concentrations can damage plants, and corrode metals. It can irritate the eyes, throat, and lungs. It also contributes to acid rain, which impacts sensitive lakes and rivers.
Total Reduced Sulphur (TRS) and Hydrogen Sulphide (H_2S)	A variety of gases with a characteristic "rotten egg" odour. It is produced by natural decomposition (e.g., in marshes and tidal flats), and certain industrial processes (e.g., kraft pulp mills, and oil refineries).	Causes nuisance odours. At very high concentrations it can cause respiratory irritation and related health concerns. It also contributes to acid rain.
Nitrogen Dioxide (NO_2)	A reddish-brown gas with a sharp odour. It is generated through combustion, especially motor vehicle exhaust and fossil fuel burning electrical power generation.	Similar effects as listed for SO_2. NO_2 also reacts with other pollutants to cause the formation of ground level ozone.
Particulate Matter ($PM_{2.5}$)	Tiny (invisible) airborne specks of solid or liquid material (e.g., dust & soot). It is generated by natural sources (e.g. wind-blown dust and forest fires), and through fuel burning (especially fossil fuels and wood).	Causes and aggravates a variety of human cardiovascular ailments. It also contributes to haze.
Ground Level Ozone (O_3)	An invisible and odourless gas. Ozone is formed through chemical reactions between a variety of "ozone precursor" pollutants, which are released by industrial facilities and motor vehicles. Most of New Brunswick's ozone is carried here by air masses originating in the United States and central Canada.	Irritates the lungs and makes breathing difficult. Also damages plants, weakens rubber, and attacks metals and painted surfaces.
Carbon Monoxide (CO)	Another invisible and odourless gas. It is created when there is incomplete (inefficient) combustion of fuels. Motor vehicles are a significant source.	CO interferes with the blood's ability to carry oxygen to vital organs and tissues. Exposure to higher concentrations can be fatal.
In addition to the key pollutants described above, there are a variety of other air contaminants that are monitored on a case-by-case basis, depending on local emission sources.		

Provincial Air Quality Monitoring Networks

Provincially Operated Air Quality Monitoring Stations

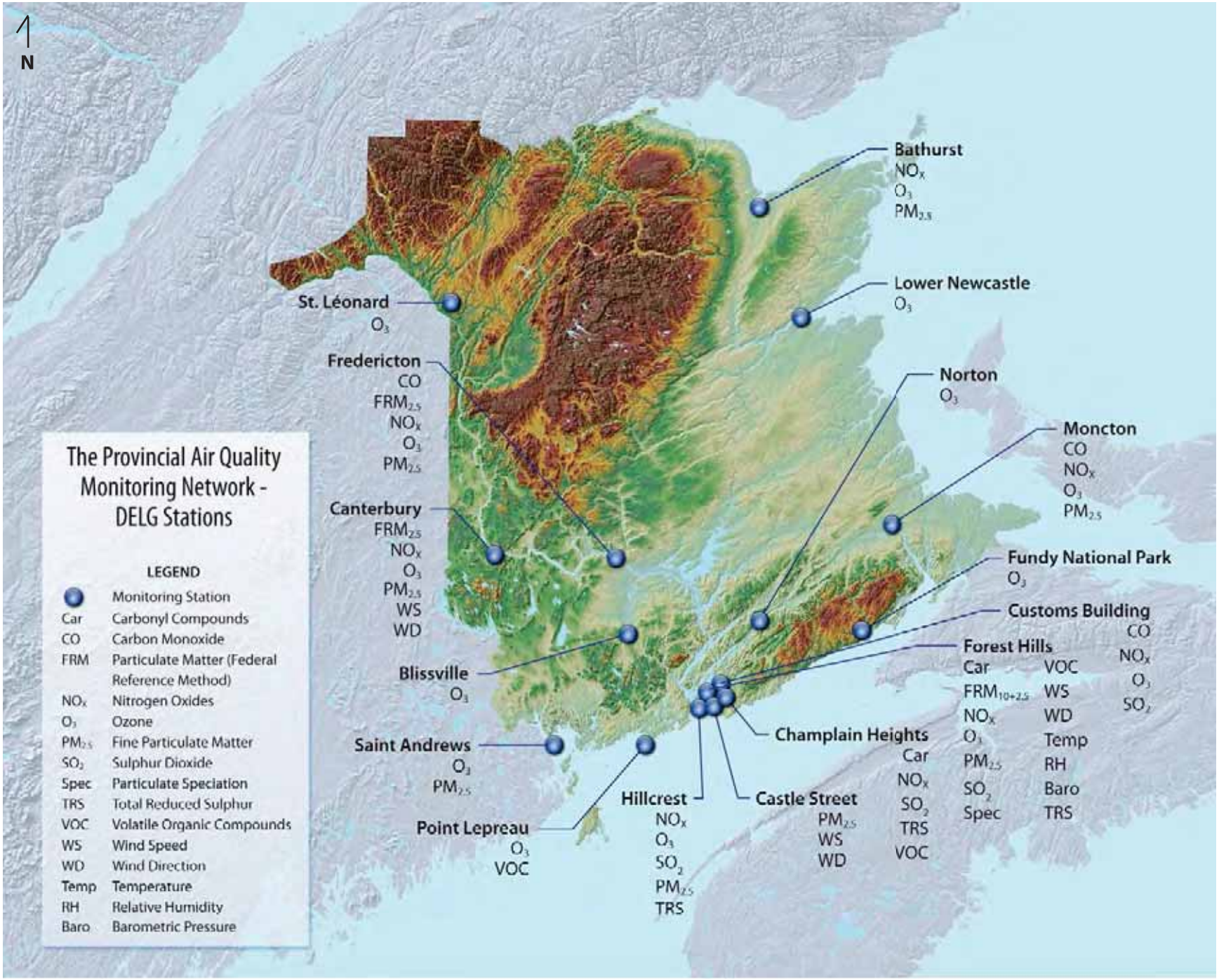
New Brunswick's 16 provincially operated air quality monitoring stations collect data continuously, year-round. Most monitors record a measurement every five minutes. Collectively, this generates over five million data points each year. The majority of this data is immediately transmitted to a central data management system. Operation and oversight of the network and data management system requires the constant attention of a team of three dedicated air quality technicians.

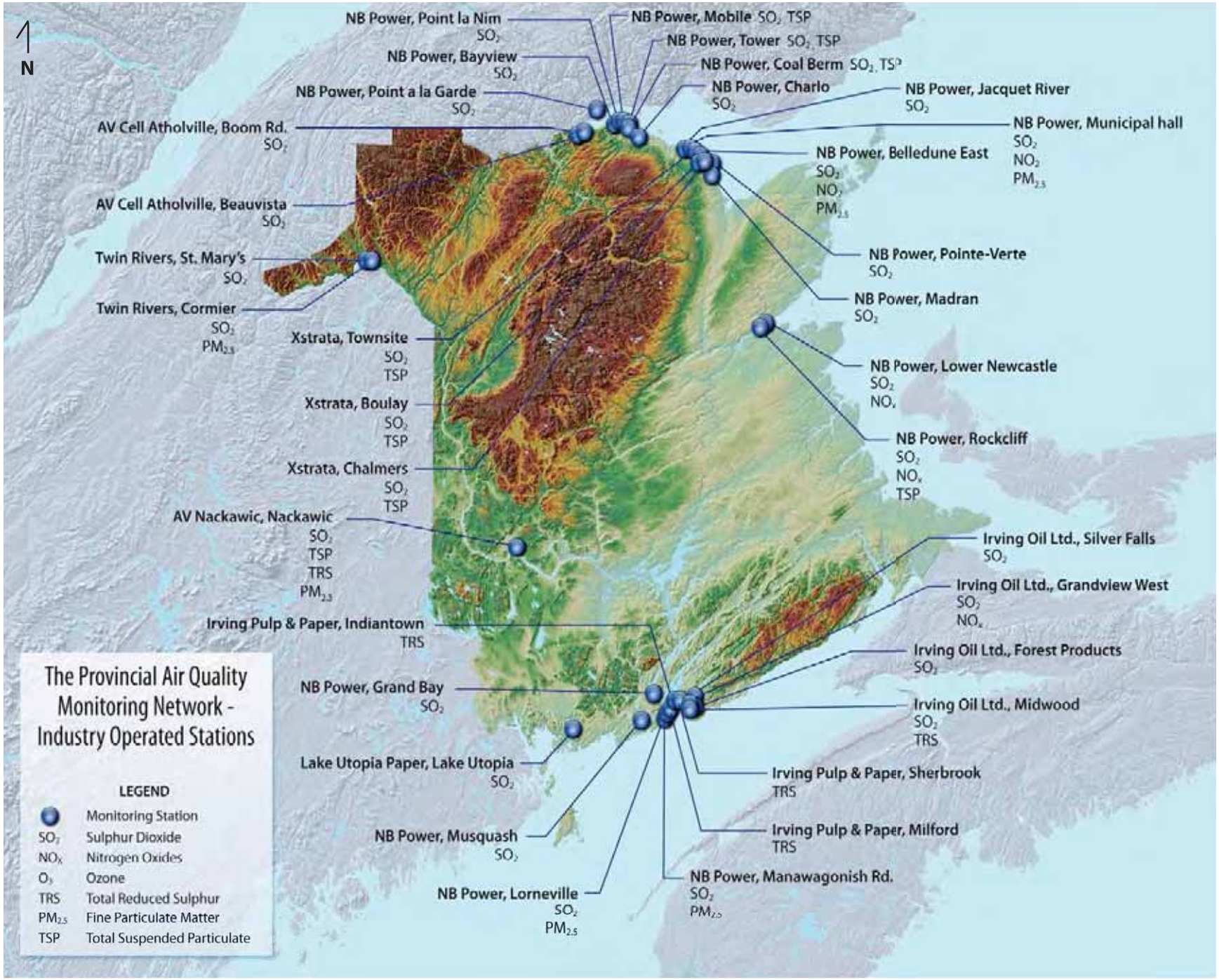
The stations are also audited by Environment Canada to ensure that monitors are appropriately maintained and data is accurate. Since the beginning of the program in the early 1970s these audits have consistently confirmed the high quality of the Province's reported data.

Industry-Operated Air Quality Monitoring Stations

As with provincial stations, New Brunswick's industry-operated stations are also operated continuously, year-round. This data is submitted annually to DELG.

DELG audits the industry operated sites to ensure accuracy of reported data.


N
The Provincial Air Quality Monitoring Network - DELG Stations
LEGEND
Monitoring Station
Car Carbonyl Compounds
CO Carbon Monoxide
FRM Particulate Matter (Federal Reference Method)
NO_x Nitrogen Oxides
O_3 Ozone
$PM_{2.5}$ Fine Particulate Matter
SO_2 Sulphur Dioxide
Spec Particulate Speciation
TRS Total Reduced Sulphur
VOC Volatile Organic Compounds
WS Wind Speed
WD Wind Direction
Temp Temperature
RH Relative Humidity
Baro Barometric Pressure
Bathurst
NO_x
O_3
$PM_{2.5}$
Lower Newcastle
O_3
St. Léonard
O_3
Fredericton
CO
$FRM_{2.5}$
NO_x
O_3
$PM_{2.5}$
Norton
O_3
Moncton
CO
NO_x
O_3
$PM_{2.5}$
Canterbury
$FRM_{2.5}$
NO_x
O_3
$PM_{2.5}$
WS
WD
Fundy National Park
O_3
Customs Building
CO
NO_x
O_3
SO_2
Forest Hills
Car
$FRM_{10+2.5}$
NO_x
O_3
$PM_{2.5}$
SO_2
Spec
VOC
WS
WD
Temp
RH
Baro
TRS
Blissville
O_3
Champlain Heights
Car
NO_x
SO_2
TRS
VOC
Saint Andrews
O_3
$PM_{2.5}$
Hillcrest
NO_x
O_3
SO_2
$PM_{2.5}$
TRS
Castle Street
$PM_{2.5}$
WS
WD
Point Lepreau
O_3
VOC


N
NB Power, Point la Nim
SO_2
NB Power, Mobile SO_2 TSP
NB Power, Tower SO_2 TSP
NB Power, Bayview
SO_2
NB Power, Coal Berm SO_2 TSP
NB Power, Point a la Garde
SO_2
NB Power, Charlo
SO_2
NB Power, Jacquet River
SO_2
AV Cell Atholville, Boom Rd.
SO_2
NB Power, Municipal hall
SO_2
NO_2
$PM_{2.5}$
NB Power, Belledune East
SO_2
NO_2
$PM_{2.5}$
AV Cell Atholville, Beauvista
SO_2
NB Power, Pointe-Verte
SO_2
Twin Rivers, St. Mary's
SO_2
NB Power, Madran
SO_2
Twin Rivers, Cormier
SO_2
$PM_{2.5}$
Xstrata, Townsite
SO_2
TSP
NB Power, Lower Newcastle
SO_2
NO_x
Xstrata, Boulay
SO_2
TSP
NB Power, Rockcliff
SO_2
NO_x
TSP
Xstrata, Chalmers
SO_2
TSP
AV Nackawic, Nackawic
SO_2
TSP
TRS
$PM_{2.5}$
Irving Oil Ltd., Silver Falls
SO_2
Irving Oil Ltd., Grandview West
SO_2
NO_x
Irving Pulp & Paper, Indiantown
TRS
Irving Oil Ltd., Forest Products
SO_2
NB Power, Grand Bay
SO_2
Irving Oil Ltd., Midwood
SO_2
TRS
Lake Utopia Paper, Lake Utopia
SO_2
Irving Pulp & Paper, Sherbrook
TRS
NB Power, Musquash
SO_2
Irving Pulp & Paper, Milford
TRS
NB Power, Manawagonish Rd.
SO_2
$PM_{2.5}$
NB Power, Lorneville
SO_2
$PM_{2.5}$
The Provincial Air Quality Monitoring Network - Industry Operated Stations
LEGEND
Monitoring Station
SO_2 Sulphur Dioxide
NO_x Nitrogen Oxides
O_3 Ozone
TRS Total Reduced Sulphur
$PM_{2.5}$ Fine Particulate Matter
TSP Total Suspended Particulate

Provincial Air Quality Objectives

One of the key purposes of this report is to describe the Province's success in achieving the provincial air quality objectives (listed below), which were established under the *Clean Air Act* in 1997.

Please note that the parameters listed below, and elsewhere in this report, are described in units of "parts per million" (ppm), "parts per billion" (ppb), or "micrograms per cubic meter" ($\mu g/m^3$).

New Brunswick Air Quality Objectives				
Pollutant	Averaging Period			
	1 Hour	8 Hour	24 Hour	1 year
Carbon Monoxide	30 ppm	13 ppm		
Hydrogen Sulphide	11 ppb		3.5 ppb	
Nitrogen Dioxide	210 ppb		105 ppb	120 $\mu g/m^3$
Sulphur Dioxide*	339 ppb		113 ppb	23 ppb
Total Suspended Particulate			120 $\mu g/m^3$	70 $\mu g/m^3$

* The standard for sulphur dioxide is 50% lower in Saint John, Charlotte, and Kings counties.

As indicated below, there were very few instances of non-compliance with the regulated standards in 2011. Please see the analysis provided on page 8 to see how current air quality results compare to historic values.

Compliance Statistics for 2011		
Parameter	Number of Exceedances	Location/Notes
Carbon Monoxide	0	
Hydrogen Sulphide (as Total Reduced Sulphur)	68*	10 exceedances of the one-hour objective were observed in Saint John, primarily at the stations monitoring the Irving Oil Refinery and Irving Pulp and Paper. These 10 events resulted in 58 exceedances of the 24-hour objective, which uses a rolling average calculation.
Nitrogen Dioxide	0	
Sulphur Dioxide*	6	3 exceedances of the 1-hour objective were detected in Saint John at the Grandview Avenue monitoring station, and 3 exceedances of the 1-hour objective were detected in Belledune.
Total Suspended Particulate	1	One exceedance was detected in Belledune.

* One additional exceedance was detected during a special mobile monitoring study in Atholville. See page 12.

Long Term Air Quality Improvement

In addition to examining current air quality, it is also informative to consider how air quality may be changing over the years, and whether emission control measures that have been applied to industrial operations and consumer products (notably vehicles and fuel) are positively impacting long-term air quality.

As shown in the table to the right, New Brunswick has been successful in reducing ambient concentrations of many key pollutants in recent years. The pollutants that have not followed the trend are carbon monoxide, which occurs at near background concentrations throughout the province, and ozone, which comes to us mostly from areas outside New Brunswick.

Pollutant	Percent Change 2000 - 2011
Sulphur Dioxide (SO_2)	↓ 87%
Nitrogen Dioxide (NO_2)	↓ 43%
Particulate Matter ($PM_{2.5}$)	↓ 17%
Total Reduced Sulphur (TRS)	↓ 4%
Ozone (O_3)	No Change
Carbon Monoxide (CO)	No Change

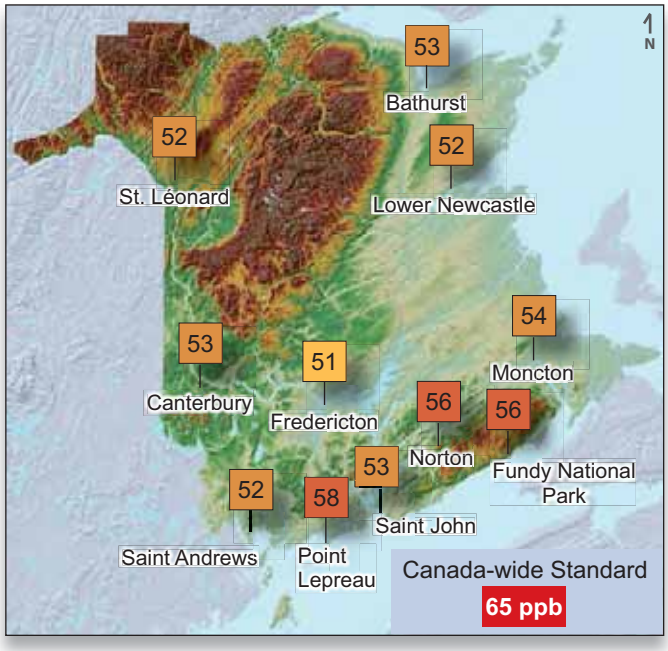
Ambient concentration trends for key pollutants at urban sites (based on amalgamated annual averages for Saint John, Fredericton, Moncton and Bathurst).

Canada-wide Standards

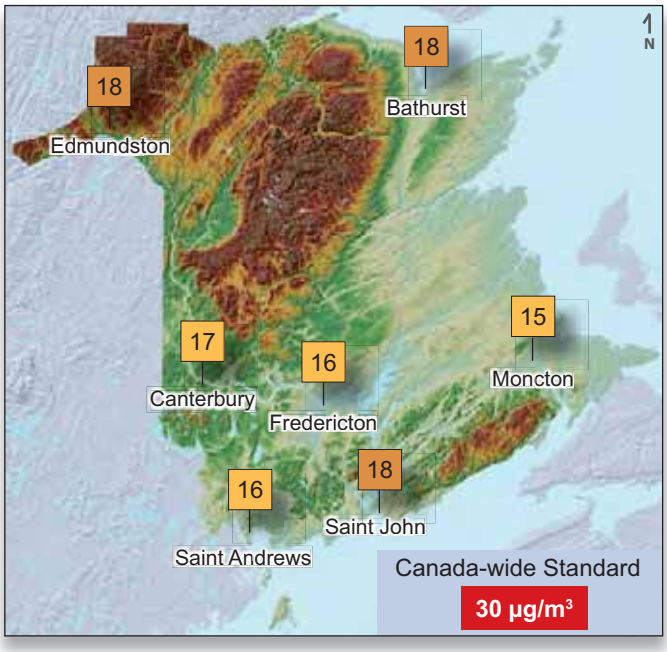
In 2000, the Canadian Council of Ministers of Environment (CCME) developed a statistical approach for tracking long-term trends for particulate matter and ground level ozone. These "Canada-wide Standards" (CWS) do not rely on a simple averaging of data, but rather apply a more sophisticated analysis that focuses on some of the worst air quality days experienced at a given site (specifically, the 98th percentile day for fine particulate matter, and the fourth worst day for ground level ozone), averaged over a three year period.

The CWS came into effect in 2010. As illustrated below, New Brunswick is maintaining CWS compliance at all reporting sites.

Ground Level Ozone (O_3)
Canada-wide Standard (ppb)



Particulate Matter ($PM_{2.5}$)
Canada-wide Standard (ug/m³)



Volatile Organic Compounds in the Saint John Region

Volatile Organic Compounds (VOCs) is the name given to a large group of carbon-containing chemicals. Some VOCs are gases, others are liquids that readily evaporate. They are produced by evaporation of solvents (e.g., paint thinner and gasoline), by a variety of industrial processes, and through combustion.

VOCs are important to monitor because they can impact ground level ozone levels and contribute to smog. Also, some VOCs carry potential human health impacts. Some VOCs are useful as indicators of certain kinds of industrial activity, and some are of interest to climatologists. It should also be noted that some VOCs are generated naturally by various plants and animals.

SUMMA Canisters for sampling VOCs.

VOCs have been monitored in the Saint John region since 1992. Within the city, VOC data is being collected in Forest Hills and Champlain Heights. Background reference data is also being collected at Point Lepreau. All samples are analyzed for more than 150 compounds.

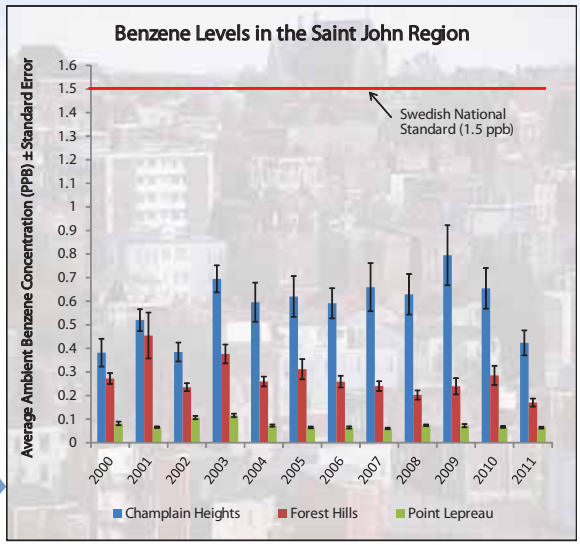
Unlike the other parameters in the provincial network, VOCs are not monitored continuously. Rather, air samples are periodically collected in stainless steel canisters, which are shipped to a laboratory for analysis. As a consequence, there can be a significant delay between sample collection and availability of data.

Key Pollutant: Benzene

Benzene is one of the key VOCs that is monitored in Saint John. It is an aromatic (i.e., shaped as a ring) hydrocarbon molecule. It is colourless, very flammable, and is described by some as smelling "sweet". Exposure to benzene can cause a variety of health problems, and reducing exposure is a national and international concern. Major sources of benzene include evaporation from petroleum products (especially gasoline), and combustion.

There is a notable difference in benzene levels between the two VOC monitoring sites in Saint John. However, there has been a marked improvement at Champlain Heights over the past three years.

As New Brunswick does not typically experience high ambient benzene concentrations, no provincial ambient air quality standard has been developed for this pollutant. Similarly, there is no national air quality standard for benzene in Canada. However, in lieu of a local standard, results can be compared against standards that have been adopted elsewhere in the world. Illustrated below, the Saint John results have been compared against Sweden's national standard, which is the most stringent currently available. Levels at both Saint John sites remain low.



Note: the black error bars on the graph represent the "Standard Error" of the average. This is a statistical tool meant to illustrate the variability of the data that contributed to each average value. Wider error bars indicate a larger amount of variability.

Getting Air Quality Information - *When You Need It*

Although daily fluctuations in ambient pollution levels may pass unnoticed by many, for people with reduced lung function from respiratory disease and other types of environmental sensitivity, such changes can have significant impacts on their daily lives. Recognizing this, tools have been developed to provide timely information to the public about current and forecasted pollution levels in different areas of the province.

Air Quality Advisories

Using DELG data, Environment Canada prepares and disseminates daily pollution forecasts. When forecast data indicate that air quality objectives will be exceeded or closely approached, air quality and health advisories are issued to the media to provide advance notice to the public.

In 2011, only one forecast advisory was issued. It was for the southern half of the province. However, the forecasted levels did not occur and the advisory was cancelled.

2011 IQUA and AQHI Coverage

Air Quality Indices

Index of the Quality of the Air (IQUA)

The IQUA (also known as the Air Quality Index - AQI) system has been used in New Brunswick since 1979. The purpose of the index is to help make air quality monitoring results easier to communicate and understand. Data for key pollutants are converted into a scale value that ranges from 1-100+, and classed as "good" (index 0 to 25), "fair" (26 to 50), "poor" (51 to 100) or "very poor" (over 100). The air quality is then categorized based on the highest value. Current IQUA information is available via the DELG web site:

www.gnb.ca/environment

Air Quality Health Index (AQHI)

The AQHI, which was first introduced in New Brunswick in 2008, offers an alternative approach to describing air quality conditions. Developed in Canada, this national index focuses on the relationship between air quality conditions and associated health risks.

The index is based on the three key health-related pollutants: nitrogen dioxide (NO_2), ozone (O_3), and fine particulate matter ($PM_{2.5}$). It uses a scale of 1-10+, with higher values representing greater health risks and the need to take precautions. Additional information about the AQHI is available via the following Department of Health website:

www.gnb.ca/health

In 2011 the AQHI was available in Fredericton, Moncton, and Saint John. Additional sites are being added over time.

Current AQHI information is available via the following national websites: *www.airhealth.ca* or *www.weatheroffice.ec.gc.ca*. AQHI information is also made available through The Weather Network, and via a Smartphone App.

For the overwhelming majority of 2011 (>97% of the time) air quality was in the "good/low" IQUA and AQHI categories at all stations.

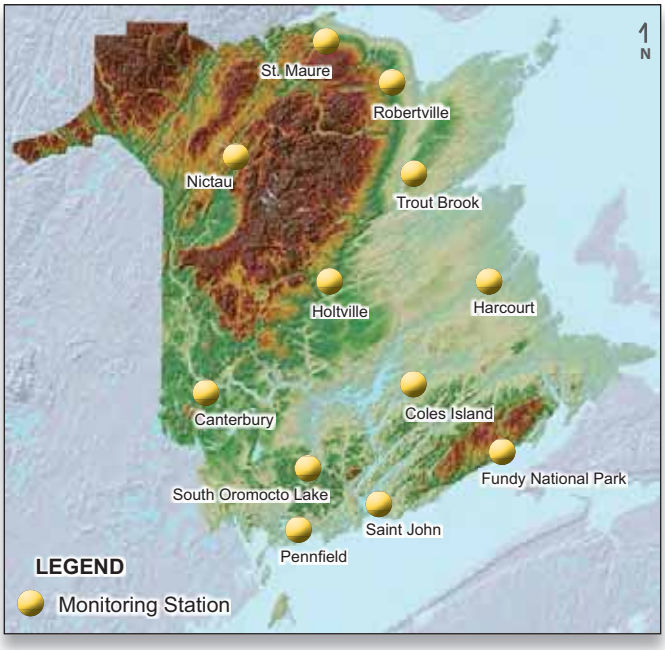
Acid Rain Monitoring

Some air pollutants (especially SO_2) can be transformed in the atmosphere into acidic particles that ultimately fall out as acid rain (or snow, hail, etc). The emissions that cause acid rain typically travel long distances, hundreds or even thousands of kilometers, before returning to the surface as rain or snow.

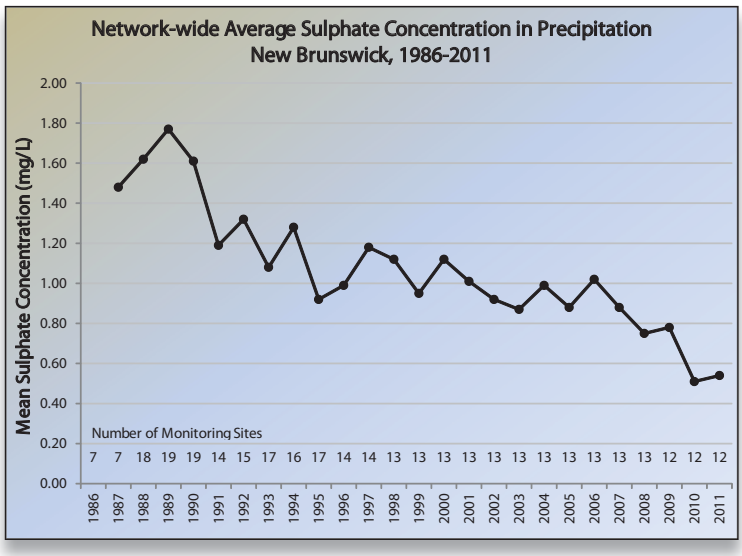
The adverse impacts of acid rain have been recognized since the early 1980s. Acid rain harms sensitive ecosystems by changing the chemistry of lakes, streams, and forest soils. It can also damage trees and agriculturally important plants. Infrastructure is also impacted by acid rain, as it can degrade paints and protective coatings, which accelerates corrosion.

Measures to reduce emissions that contribute to acid rain have been undertaken in North America since the late 1980s. Most recently, this has included commitments to reduce emissions under the Canadian Council of Ministers of Environment's "Post-2000 Canada-wide Acid Rain Strategy". Over the past two decades SO_2 emissions from major sources within New Brunswick have been reduced significantly.

2011 Acid Precipitation Network Map



In an effort to track the results of our pollution reduction efforts, DELG has operated an extensive acid precipitation (rain and snow) monitoring network in cooperation with NB Power since the early 1980s. The above map shows the location of the 12 acid precipitation monitoring sites in New Brunswick. Samples are collected at each of these sites by a local site operator every day, and sent to the DELG laboratory for analysis. DELG staff coordinate the monitoring program, perform data quality assurance, and maintain the official data archive.



As reflected in the chart to the left, emission reduction strategies have significantly reduced sulphate concentrations in precipitation over the past 25 years.

Although levels have declined, the acid rain issue remains important for New Brunswick because some sensitive areas are still being impacted. As a result, continued efforts to reduce emissions are required to reduce acid deposition further and ensure that our most sensitive lakes and rivers are provided with long-term protection from acid damage.

Special Study: *Mobile Air Quality Monitoring in Atholville*

In addition to the fixed network of permanent air quality monitoring stations, DELG operates a mobile air quality monitoring unit that can be moved from place to place to carry out special monitoring projects. In 2011 the unit was deployed to Atholville to an area just south of the AV Cell pulp mill. AV Cell is required to operate two permanent air quality monitoring stations nearby. The purpose of the DELG project was to verify that these two stations are suitably located to detect pollution impacts from the mill. The study began in August 2011 and lasted three months.

Study Parameters

The DELG mobile air quality monitoring unit (pictured right) was used for the study. The unit was equipped with monitors for:

- Wind speed
- Wind direction
- Ground level ozone
- Carbon monoxide
- Sulphur dioxide
- Nitrogen dioxide
- Fine particulate matter
- Total Reduced Sulphur

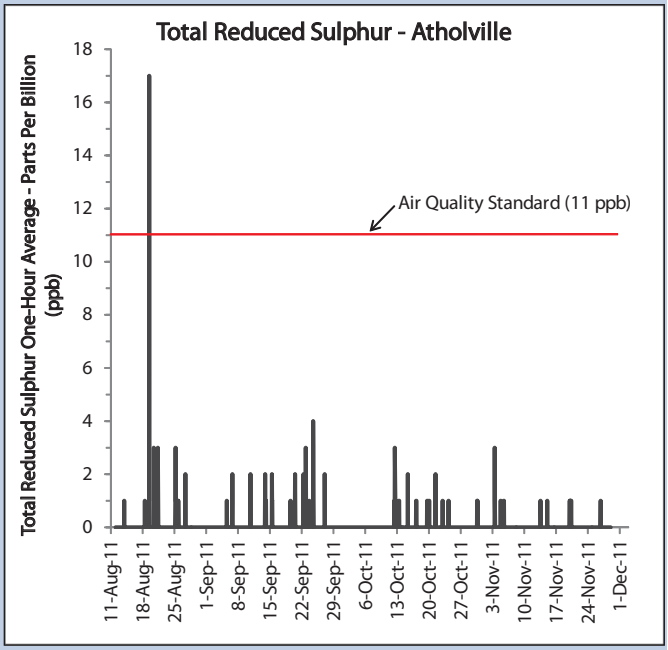
DELG's mobile air quality monitoring unit in Atholville, NB.

Findings

By analyzing the wind patterns measured during the study it was confirmed that the existing monitoring sites for the AV Cell pulp mill are appropriately placed, with prevailing winds tending to carry air contaminant emissions toward the stations.

Air quality in Atholville was found to be generally good for all parameters monitored. However, one incident of elevated Total Reduced Sulphur (TRS) was detected on August 19, 2011 (see graph, right). TRS compounds are not a health hazard at these concentrations. They do, however, cause nuisance odours.

Investigations carried out immediately following the TRS event revealed the source to be a stockpile of organic waste material (sludge) at the mill. The material had been allowed to sit for too long in the mill yard and had begun to decompose and generate the gases. AV Cell has since committed to ensuring that sludge is transported offsite in a more timely manner.



Additional information can be found in the Atholville Air Quality Report, which is available on the DELG website: *www.gnb.ca/environment*

Conclusion

As reflected in this report, air quality in New Brunswick is very good, and the province continues to benefit from air pollution reduction initiatives that have been implemented over the past decade.

The New Brunswick Department of Environment and Local Government remains committed to air quality surveillance throughout the province, and comprehensively reporting air quality information to New Brunswickers in a timely manner.

Learn More about Air Quality

In addition to this overview, complete site-specific monitoring results are available in the "Air Quality Monitoring Results - Supplementary Data 2011" companion document, which is available electronically via the DELG website:

www.gnb.ca/environment

Feedback...

We are interested in your feedback on this report. All suggestions will be considered, and if possible, incorporated in future reports. Please forward any comments to:

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Department of Environment and Local Government

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