New Brunswick Air Quality Monitoring Results

2010

Environmental Reporting Series

Department of Environment and Local Government
2012

NEW BRUNSWICK

AIR QUALITY MONITORING RESULTS

2010

New Brunswick Environmental Reporting Series

Environmental Evaluation and Reporting Branch
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EXECUTIVE SUMMARY

This report summarizes air quality monitoring data in New Brunswick for 2010. The report is intended to provide a convenient summary of results, with emphasis on air quality assessment in relation to existing air quality standards and objectives. Long-term trend data are also presented for representative sites.

Air quality has been monitored in New Brunswick since the 1960s, when several short-term studies were carried out in Saint John. Since that time, the air quality monitoring network has grown as interest in air quality has increased and monitoring technologies have improved. This report presents summary statistics from instruments at 56 monitoring sites in the province, with additional data (in chart form) in an appendix. The report also includes results from the acid rain monitoring network, and the monitoring of volatile organic compounds (VOCs). Details are also provided in the report on the quality assurance procedures used in the provincial air quality system.

There were no exceedances of New Brunswick air quality objectives for nitrogen dioxide (NO_2) or carbon monoxide (CO) at any of the provincial monitoring sites in 2010. Exceedances of sulphur dioxide (SO_2) were very infrequent throughout the province. The National Ambient Air Quality Objectives for ozone (O_3) were exceeded briefly at Fundy National Park and in the Village of Norton, primarily due to long range transport of pollution from elsewhere in the world. The number of exceedances of total reduced sulphur (TRS) in Saint John decreased slightly in 2010 compared to 2009. TRS exceedeances recorded in Nackawick significantly increased in 2010. However, this is not indicative of deteriorating air quality, but rather the improved detection capability provided by the mobile air quality monitoring trailer, which was deployed to an area very close to the AV Nackawic mill in 2010. Levels of $PM_{2.5}$ and O_3 remained below the Canada-wide Standards thresholds at all monitoring sites.

Acid rain deposition values at all sites in the acid rain monitoring network were lower in 2010 as compared to 2009. The overall trend is downward since 1989, with values from 2008 through 2010 being the lowest recorded to date. Although acid precipitation continues to decline, its effects remain to be of concern, particularly in the south-west, which is the area of the province that is most sensitive to acid rain impacts.

Long term air quality trends indicate that since the late 1970s and 1980s, air quality has improved for all pollutants currently being measured, with the possible exception of ground level O_3, for which no clear trend is apparent. Annual average levels of SO_2 have decreased significantly over the past 15-20 years. The long term levels of CO and NO_2 have also decreased.

Annual VOC concentration continued to decline at Champlain Heights, Saint John, in 2010, while levels elsewhere remained relatively unchanged.

Feedback

We are interested in your opinions and feedback on this report. All suggestions will be considered, and if possible, incorporated in future reports. You may contact the State of the Environment Branch, Department of Environment and Local Government (DELG) at (506) 457-4844, by fax at (506) 453-2265 or by e-mail at darrell.welles@gnb.ca with any comments.

Acknowledgements

Thanks to Reid McLean for producing the maps in the report. Numerous staff within DELG and from the industries operating monitoring networks provided valuable help with data provision and interpretation. Special thanks to Stan Howe, Eric Blanchard, and Mathieu Doucet of DELG for operation of the provincial monitoring sites, and the staff of the Saint John regional office of DELG for assistance with site operation in the Saint John area. Thanks to Stephanie MacDougall (formerly of DELG) for operation of the acid rain network and to NB Power for their continued support in this operation.

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Thanks are also extended to site operators in the provincial acid rain monitoring network, including Alphonse Boissoneault (St. Maure), Lynn Gardiner and Keith Rees (Canterbury), Daniel Boudreau (Robertville), Jeffrey Suttie (Pennfield), Bill Miller (Nictau), Murray MacFarlane (Holtville), Wanda Betts (Harcourt), Hugh and Darrellene MacGillivray (Lakewood Heights), Leo and Mary Mazerolle (Trout Brook), Gary and Nancy Kierstead (Coles Island), Louanne Brawn (South Oromocto Lake) and Thane Watts and staff (Fundy Park).

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List of Acronyms and Abbreviations

AQHI	Air Quality Health Index
CO	Carbon monoxide
CWS	Canada-wide Standard
DELG	Department of Environment and Local Government
H_2S	Hydrogen sulphide
IQUA	Index of the Quality of the Air
NAPS	National Air Pollution Surveillance
ppb	Parts per billion
ppm	Parts per million
$\mu g/m^3$	Micrograms per cubic meter
NO_2	Nitrogen dioxide
NO_x	Nitrogen oxides
O_3	Ozone
PAH	Polycyclic Aromatic Hydrocarbons
$PM_{2.5}$	Fine particulate matter
SO_2	Sulphur dioxide
TEOM	Tapered element oscillating microbalance
TRS	Total reduced sulphur
TSP	Total suspended particulate
VOCs	Volatile organic compounds

1. INTRODUCTION

This report summarizes air quality information gathered during 2010 at monitoring locations across New Brunswick. A summary of data from the provincial acid precipitation monitoring network is also included. The report focuses on ambient (i.e., outdoor) air, which provides an indication of environmental quality in terms of air pollution.

New Brunswick's air quality objectives are listed in section three of this report. Additional information on air quality standards and objectives, sources and effects of air pollutants, climate change and air quality may be found on the DELG web site at:

http://www.gnb.ca/0009/0010-e.asp

2. MONITORING NETWORKS

Compliance with air quality objectives or regulatory standards is determined by monitoring. For the most part, this is conducted on a continuous basis.

Monitoring locations are selected to represent the surrounding area. In cases where there is a known pollutant source, monitors are often placed in locations where the impact is expected to be greatest. Such locations are typically selected based on local knowledge, DELG staff expertise, and the results of computer dispersion models. These are computer programs that simulate the behaviour of contaminant plumes as they are released from smokestacks. Such models take into account the complete variety of weather conditions that may be experienced in the area, as well as features of the local landscape.

In New Brunswick, large industrial emission sources, such as electricity generating stations or pulp mills, are required to carry out ambient air quality monitoring as prescribed in their Approvals to Operate under the *Clean Air Act*. Such Approval conditions also detail the required equipment specifications, locations, and reporting frequency. In such cases, the monitoring equipment and maintenance procedures are checked periodically by DELG staff or independent auditors, to ensure the required standards for operation and technical accuracy are being met.

In the case of air pollutants that are transported long distances, and that may be found in rural, as well as urban areas, DELG establishes and operates its own monitoring sites. The Department also maintains sites in areas where there are multiple large industrial emission sources, such as greater Saint John.

Additionally, there are 12 provincial, and one federal, acid precipitation monitoring sites in New Brunswick. The operation of the provincial acid precipitation monitoring stations is undertaken in partnership with NB Power.

Federal support is provided for the operation of all DELG air quality monitoring sites across the province through the National Air Pollution Surveillance (NAPS) program.

The locations of air quality monitoring sites in New Brunswick are shown in Figure 1. More detail on the exact location of each site is provided in the following sections.

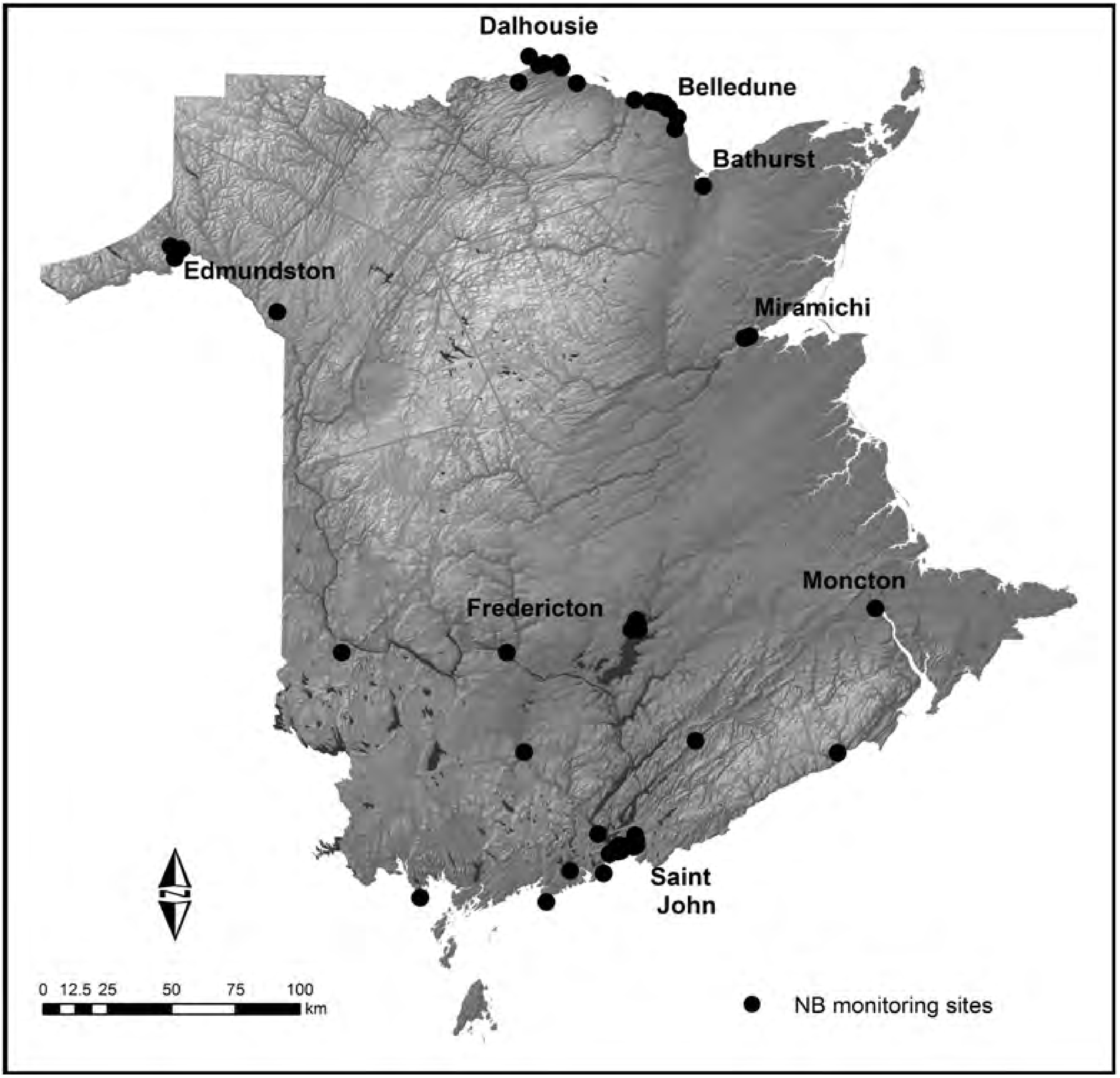

Figure 1. Locations of air quality monitoring sites in New Brunswick, 2010.

3. AIR QUALITY OBJECTIVES

New Brunswick recognizes a number of air quality objectives and standards, some of which are regulated, and some voluntary in nature. This section provides an overview of these objectives and their applicability.

A. New Brunswick Air Quality Objectives

Table 1 lists New Brunswick's Air Quality Objectives for five air pollutants: CO, hydrogen sulphide (H_2S), NO_2, SO_2 and total suspended particulate (TSP). These objectives are established under the *Clean Air Act*, which also includes a provision for required annual reporting to the Legislative Assembly on achievement of the objectives.

B. Other Air Quality Objectives

As there is no New Brunswick Air Quality Objective for ground level O_3, the national objectives for O_3 are included in Table 2 below. Compliance with these objectives is not legally required, but they serve as an excellent point of reference when considering provincial O_3 monitoring results.

New Brunswick is also a signatory to the Canada-wide standards (CWS) for fine particulate matter ($PM_{2.5}$) and O_3. These standards are different than the others listed as they apply to long term trends (averaged over three years) as opposed to the hourly and 24-hour standards previously discussed. However, in the absence of another benchmark for $PM_{2.5}$, for the purposes of this report, $PM_{2.5}$ values are compared to the CWS level of 30 µg/m^3. These standards are discussed further in section 7.

This report also makes reference to air quality standards or objectives from other jurisdictions (provincial, national, or international) and organizations to aid in the interpretation of air quality conditions in New Brunswick.

Table 1. New Brunswick Ambient 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	52 ppb
Sulphur dioxide*	339 ppb		113 ppb	23 ppb
Total suspended particulate			120 µg/m^3	70 µg/m^3

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

Table 2. National Ambient Air Quality Objectives for Ozone

Averaging Period	Desirable Level	Acceptable Level	Tolerable Level
1 Hour (O_3)	51 ppb	82 ppb	153 ppb
24 Hours (O_3)	15 ppb	25 ppb	-
Annual (O_3)	-	15 ppb	-

4. AIR QUALITY MONITORING RESULTS FOR 2010

Results are presented for each monitoring network in the province. The locations of the monitoring sites are shown on regional scale maps. Results are summarized in tables, and further details in chart form appear in Appendix 1. Explanatory notes are provided on each network, and a discussion of the results for each network is included.

A. Saint John

The greater Saint John area has the longest history of air quality monitoring in New Brunswick, beginning in 1961. Since that time, air quality has been monitored at more than 30 different locations in the city and surrounding area. There was a total of 16 air quality monitoring sites that were active in 2010. Identification of the various pollutants that were monitored at each of these sites, and ownership (DELG or industry) is shown in Table 3. Figures 2 and 3 show the locations of these sites, with Figure 3 showing four sites established in connection with the Coleson Cove generating station.

Most of these sites are electronically linked to a central computer system at the DELG central office in Fredericton. The system communicates with the monitors a minimum of once each hour and obtains the latest readings. The readings are then added to the existing data archive and some are used to prepare public information messages (i.e., Air Quality Health Index). Also, the information may initiate abatement actions required by industries and/or advisories by the Medical Officer of Health if concentrations rise above pre-determined trigger values.

A.1 Carbon Monoxide

This pollutant is monitored at the Customs Building site to provide data representative of the Saint John centre. Peak hourly values in any month seldom exceeded 1.0 ppm, and thus were well below the applicable objective of 30 ppm in 2010. In addition, there were no exceedances of the 8-hour objective of 13 ppm.

Table 3. Site locations and pollutants monitored in the Saint John Area, 2010.

Site	Pollutant							
	CO	TRS	SO_2	O_3	$PM_{2.5}$	NO_2	VOC	Other
Grand Bay			I					
Musquash			I					
Manawagonish Rd.			I		I			
Lorneville			I		I			
Hillcrest		E	E	E	E	E		
Sherbrooke St.		I						
Milford		I						
Indian Town		I						
Customs Building	E		E	E		E		
Castle St.					E			
Midwood Ave.		I	I					
Grandview West			I			I		
Forest Products			I					
Champlain Heights School		E	E		I	E	E	
Silver Falls			I					
Forest Hills		E	E	E	E	E	E	E
Totals	**1**	**7**	**12**	**3**	**6**	**5**	**2**	**1**

I = Industrial Site E = Department of Environment and Local Government Site

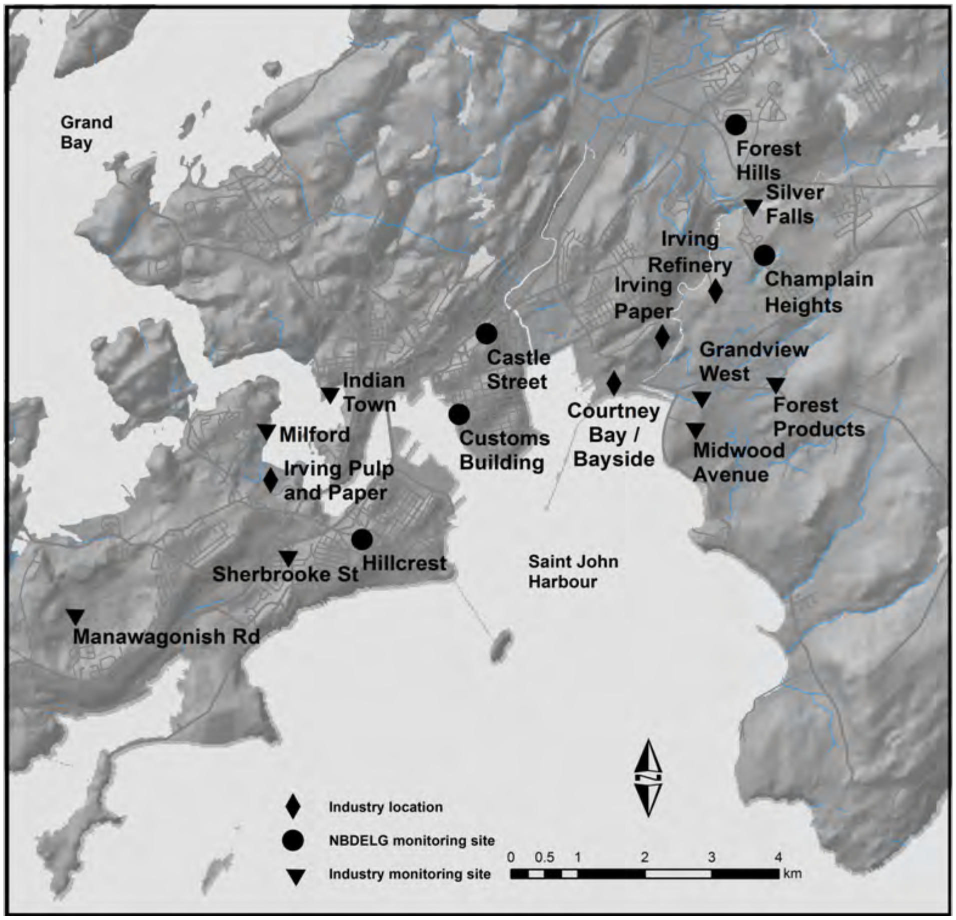

Figure 2. Air quality monitoring sites in Saint John, New Brunswick, 2010.

A.2 Nitrogen Dioxide

There were no exceedances of the 1-hour objective of 210 ppb at any site (Forest Hills, Customs Building, Champlain Heights School, Grandview West or Hillcrest) during 2010. There were also no exceedances of the 24-hour objective (105 ppb) or the annual objective (52 ppb).

A.3 Sulphur Dioxide

The 1-hour objective of 170 ppb for SO_2 was exceeded for eight hours total during four separate air quality events. The first occurred in May at the Forest Hills monitoring site, and lasted one hour. The second occurred in June at the Customs Building monitoring site, and also lasted one hour. The third event also took place at the Customs Building site, and lasted three hours. However the SO_2 levels achieved during this three-hour period were sufficient to elevate the rolling 24-hour average to above the 56 ppb limit for a 17-hour period. The final exceedance was recorded at the Grandview West monitoring site in November. Although this site recorded low values for the remainder of the year, there was a three-hour spike during the afternoon of November 7. Investigations have not identified a likely cause. Results are summarized in Table 4.

Overall, SO_2 levels have improved greatly at the Grandview West site since the commissioning of the new Hydrogenation Amine Tail Gas Unit (HATGU) at the Irving refinery in April 2008.

A.3.1 Sulphur Dioxide Episode Control

An episode control program is in place to prevent ambient SO_2 concentrations from reaching undesirably high levels in Saint John. Control actions are initiated by major industries in the city in response to measurements made at the fixed monitoring sites.

These control actions are made mandatory by being incorporated into the relevant Approvals to Operate issued by DELG. The episode control

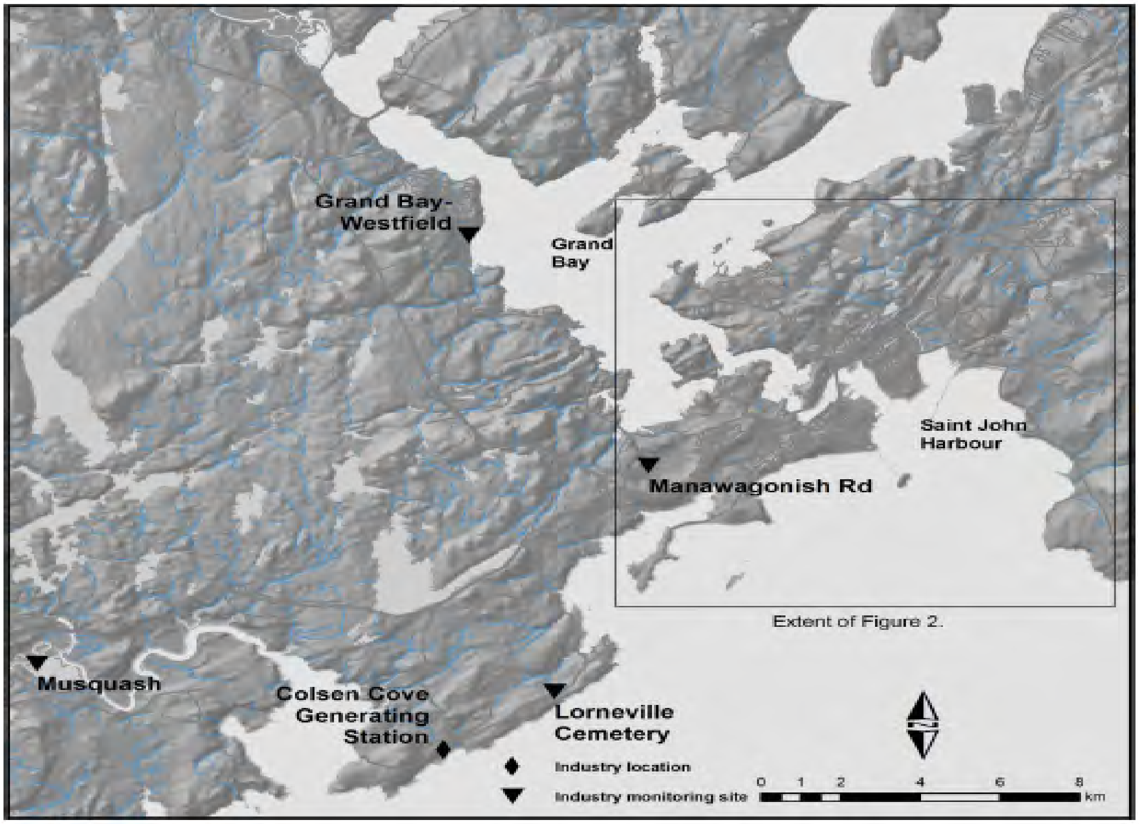

Figure 3. Locations of NB Power Coleson Cove network air quality monitoring sites in New Brunswick, 2010.

plans themselves are subject to continual review. DELG meets regularly with staff of the major industries in the city to review compliance with respect to SO_2.

All exceedance events are examined in detail and any shortfalls in the nature and extent of response actions are addressed. DELG staff sometimes request emission control actions separate from, or in addition to, those specified in the episode control plans. Such action may be warranted due to unusual conditions, such as poor dispersion, weather related incidents, or during periods when smog advisories are in effect.

Some of the ways in which industries respond to rising levels of SO_2 include switching to lower or near-zero sulphur fuels, and reducing production rates or electricity generating rate. Response action is initiated when concentrations reach 80 ppb, approximately half the 1-hour objective of 170 ppb.

A.4 Fine Particulate Matter

$PM_{2.5}$ is measured at six sites in the Saint John area using Beta Attenuation Mass (BAM) monitoring technology. Three of these sites are maintained by DELG, one by Irving Oil Ltd., and two are maintained by NB Power as part of their Coleson Cove monitoring network. Results are summarized in Table 5.

In 2010, the annual average value for $PM_{2.5}$ ranged from 5.1 µg/m^3 to 8.8 µg/m^3 in the Saint John area. The Lorneville site had the greatest 24-hour average 98th percentile value at 26.8 µg/m^3. The results also show that there were a few days when the daily average $PM_{2.5}$ levels reached above the CWS reference point of 30 µg/m^3. Additional analysis of these results in relation to the CWS is provided in section 7.

Table 4. Exceedances of provincial objectives for SO_2, Saint John, 2001-2010.

	Midwood Avenue	Champlain Hts	Customs Building	Forest Hills	Forest Products	Hillcrest	Grandview West 1	Silver Falls
1 HOUR OBJECTIVE								
2010	0	0	4	1	0	0	3	0
2009	0	0	0	0	0	0	3	0
2008	0	0	0	1	0	0	10	0
2007	0	0	0	5	0	0	11	0
2006	2	1	0	0	0	0	61	0
2005	0	3	0	1	0	0	135	4
2004		0	2	0	0	0	153	2
2003		1	0	1	2	0	153	10
2002		0	0	0	0	0		0
2001		1	0	0	0	0		4
24-HOUR OBJECTIVE								
2010	0	0	17	0	0	0	0	0
2009	0	0	0	0	0	0	0	0
2008	0	0	0	0	0	0	68	0
2007	0	0	0	35	0	0	13	0
2006	19	0	0	0	0	0	255	0
2005	0	0	0	0	0	0	331	16
2004		0	0	0	0	0	504	31
2003		47	0	23	3	0	429	117
2002		0	0	0	0	23		14

Table 5. Monitoring results for $PM_{2.5}$,Saint John Network, 2010.

	Forest Hills	Hillcrest	Champlain Heights	Castle St.	Lorneville*	Manawagonish Rd.*
Annual average (µg/m^3)	7.3	5.8	7.2	5.1	7.9	8.8
98th percentile value (CWS) (µg/m^3)	25.3	17.2	14.7	16.9	26.8	22.5
Days when daily average was >30 µg/m^3	5	0	0	1	4	2

* Coleson Cove Network

A.5 Ground Level Ozone

Ozone was monitored at three sites in the city during 2010: Forest Hills, Customs Building and in west Saint John at Hillcrest Church. Results are summarized in Table 6. During 2010, there were no exceedances of the 1-hour National Ambient Air Quality Objective for O_3 of 82 ppb. Statistics were also calculated in reference to the Canada-Wide Standard for O_3, which considers the 4^{th} highest daily maximum 8-hour value in a year, and is set at 65 ppb. The highest value in terms of the CWS metric was 53.1 ppb at Hillcrest.

Further details and analysis with respect to ground level O_3 follow in sections 5, 7, and 10.

A.6 Total Reduced Sulphur

TRS is monitored at Champlain Heights, Hillcrest and Forest Hills by DELG, as well as three sites operated by Irving Pulp and Paper (Milford, Indian Town and Sherbrooke St.) and one site by Irving Oil at Midwood Avenue.

In 2010, there were no exceedances of provincial objectives in east and west Saint John. Slightly elevated levels were detected during the month of October at the Indian Town monitoring site. However, abnormalities were noted with the monitor during this period. TRS monitoring results since 2001 are summarized in Table 7.

Note: for evaluation of TRS data, and in the absence of a specific objective for TRS, reference is made to the provincial objectives for hydrogen sulphide (see section 3).

Table 6. Monitoring results for O_3, Saint John Network, 2010.

	Forest Hills	Hillcrest	Customs Building
Annual average (ppb)	27.5	27.0	27.9
4^{th} highest daily maximum 8-hour average (CWS) (ppb)	50.1	52.3	54.1
Days when daily maximum 8-hour average was >65 ppb	0	0	0

Table 7. Exceedances of provincial objective for TRS (as H_2S) in Saint John, 2001-2010.

	Forest Hills	Champlain Hts	Midwood Avenue	Hillcrest	Indian Town	Milford	Sherbrooke St.
1 Hour Objective							
2010	0	0	0	0	0	0	0
2009	1	0	0	1	2	0	0
2008	0	1	0	0	1	1	0
2007	7	2	0*	0	3	2**	0**
2006		7		M	0	0	0
2005		2		0	0	3	0
2004		3		M	0	0	0
2003		0		0	0	0	1
2002				0	2	0	0
2001				0	0	1	9
24-Hour Objective							
2010	0	0	0	0	0	0	0
2009	0	0	0	0	0	0	0
2008	0	0	0	0	0	0	0
2007	33	14	0*	0	0	0**	0**
2006		21		0	0	0	0
2005		0		0	0	22	0
2004		0		M	0	19	0
2003		0		0	0	0	0
2002				0	11	0	0
2001				0	0	5	684

M = missing data
* Monitoring began in October
** No monitoring from January-April

A.7 Volatile Organic Compounds (VOCs)

VOCs have been measured at Forest Hills and Champlain Heights in east Saint John since 1992 and 2000 respectively. Measurements at Point Lepreau, approximately 40 km southwest of the city, began in 1992. The Lepreau site is predominantly upwind of Saint John and serves as a control or reference site, representative of rural southern New Brunswick. The monitoring program for VOCs is a collaborative one between DELG and Environment Canada. DELG staff maintain the monitoring sites and set up the equipment to take samples (normally every 6 days). Environment Canada performs the analyses on the collected air samples.

Sites in Saint John collect one 24-hour sample every 6 days and the rural site at Point Lepreau collects a 4-hour sample beginning at noon, every three days. All samples are analysed for over 150 compounds, which include VOCs that are involved in the formation of O_3, as well as other VOCs of interest. For example, some VOCs are indicators of various kinds of industrial activity, others are known to be carcinogenic (such as benzene).

Some of the VOCs that are measured are found at similar concentrations regionally or even globally (such as several CFC compounds). These substances are of interest in atmospheric research, but have less value for local air quality management.

There are no national ambient air quality standards for VOCs in Canada. In lieu of local standards, results are compared against standards that have been adopted elsewhere in the world and against guidelines published by other agencies, such as the World Health Organization (WHO). Even without local standards it is also informative to review trends over time (see section 10), and to compare differences between sites.

Table 8 lists results for 2010 for selected VOCs, compared with 24-hour and annual average guidelines recommended by various agencies. Where guidelines were available from more than one agency, the most stringent has been presented. This subset of VOCs contains compounds that have traditionally been classified as “air toxics”, and are considered potentially harmful to human health.

For the selected VOCs for which guidelines could be referenced, concentrations at all monitoring sites were found to be far below these targets.

Additional analysis of VOC data is included in section 10.

Table 8. Monitoring results for Volatile Organic Compounds, 2010.

VOC	Max 24-hour averages (ppb)		24-hour guidelines (ppb)	Annual averages (ppb)			Annual Guidelines (ppb)
	Forest Hills	Champlain Hts		Forest Hills	Champlain Hts	Point Lepreau	
Total VOC	125.45	251.06		28.40	51.26	5.20	
1,3 butadiene	0.12	0.10		0.03	0.02	0.00	1 (UK)
Benzene	1.16	2.38		0.29	0.55	0.07	1.5 (UK, (Sweden)
Toluene	2.03	5.46	24 (ON)	0.47	0.13	0.04	10-100 (Sweden)
Ethylbenzene	0.32	1.02	227 (ON)	0.07	0.21	0.01	
Xylenes	1.05	2.82	161 (AB)	0.22	0.61	0.01	
Styrene	0.03	0.02	56* (WHO)	0.01	0.00	0.01	
Chloromethane	0.89	0.78	3344 (ON)	0.60	0.56	0.59	
Vinyl chloride	0.00	0.00	0.4 (ON)	0.00	0.00	0.00	
1,1 dichloroethylene	0.00	0.00		0.00	0.00	0.00	
Dichloromethane	0.17	0.08	62 (ON)	0.07	0.06	0.08	100-250 (Sweden)
1,2 dichloroethane	0.02	0.04	159 (WHO)	0.02	0.02	0.01	100-150 (Sweden)
Carbon tetrachloride	0.10	0.10	0.4 (ON)	0.08	0.09	0.08	
1,2 dichloropropane	0.00	0.00		0.00	0.00	0.00	
Trichloroethylene	0.04	0.02	21 (ON)	0.00	0.00	0.00	100-200 (Sweden)
1,1,2 trichloroethane	0.00	0.00		0.00	0.00	0.00	
Ethylene dibromide	0.00	0.00	0.4 (ON)	0.00	0.00	0.00	
Tetrachloroethylene	0.05	0.04	34 (WHO)	0.01	0.01	0.00	
1,1,2,2 tetrachloroethane	0.00	0.00		0.00	0.00	0.00	
Formaldehyde	2.39	1.95	52 (ON)	0.80	0.52	0.00	
Acetaldehyde	1.44	1.55	274 (ON)	0.37	0.40	0.00	
MTBE	0.00	0.00		0.00	0.00	NA	

Notes: The guidelines marked with an asterisk (*) are for a weekly period. AB =Alberta; ON = Ontario; MB = Manitoba. Sources: WHO (World Health Organisation): 1987, 1994,1996 & 1997; Swedish standards: OECD, 1995; Swedish EPA, 2003. UK standards: HMSO, 2000. Alberta, Ontario, and Manitoba: Provincial Environment Departments.

B. Miramichi - NB Power

Figure 4 shows the locations of the two monitoring sites for NB Power's Millbank Generating Station network. The pollutants monitored include SO_2, NO_2, O_3, and TSP.

Since 1997, there have been no exceedances logged in this network. Monthly results are shown in Appendix 1.

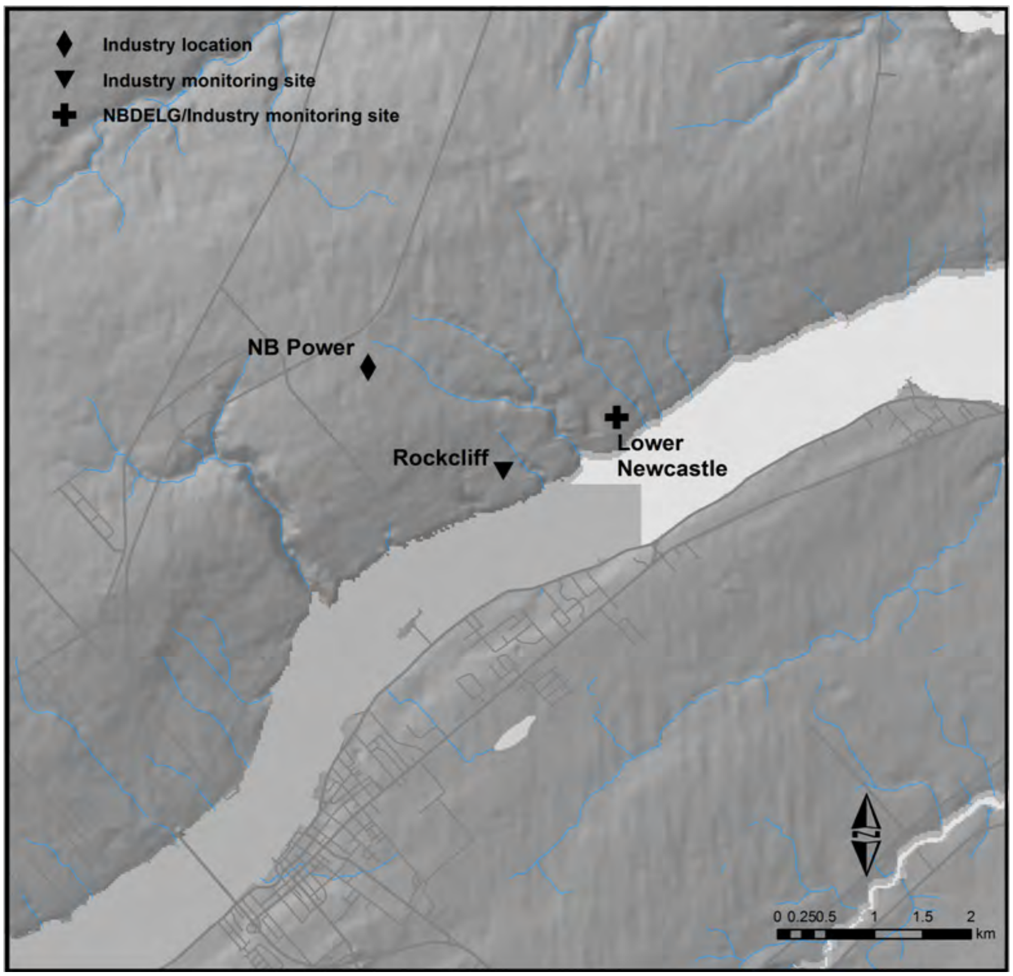

Figure 4. Air quality monitoring sites in the Miramichi Region, 2010.

C. Grand Lake - NB Power

Figure 5 shows the locations of the four monitoring sites in this network. These facilities were positioned to monitor the effects of the Grand Lake coal-fired electrical generating station and associated activities, which ceased operations in February 2010. The four monitoring sites continued to be operated by NB Power until March 31, 2010. Each site measured SO_2 and TSP.

There were no exceedances logged in this network for the portion of 2010 during which this network was operational. Complete results are provided in Appendix 1.

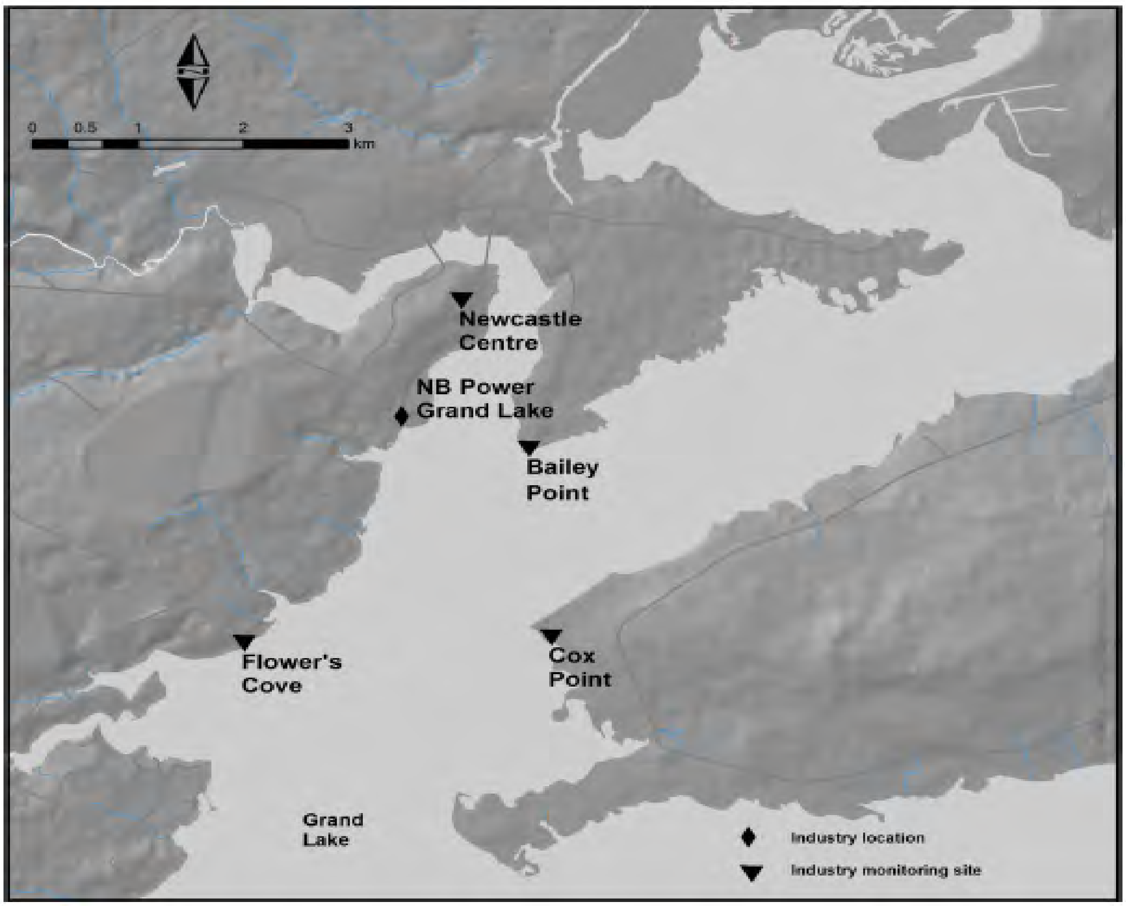

Figure 5. Air quality monitoring sites in the Grand Lake Network, 2010.

D. Lake Utopia Paper (J.D. Irving)

Lake Utopia Paper operates a SO_2 monitoring station. There were no exceedances of provincial objectives in 2010 at this station (see Appendix 1).

E. Edmundston – Twin Rivers Paper Company

Figure 6 shows the locations of the monitoring sites located to monitor the impacts of the Twin Rivers Paper Company pulp mill.

E.1 Sulphur Dioxide

In 2010, there was one exceedance of the 1-hour SO_2 objective at the Cormier School site. Compliance statistics for SO_2 since 2004 are shown in Table 9.

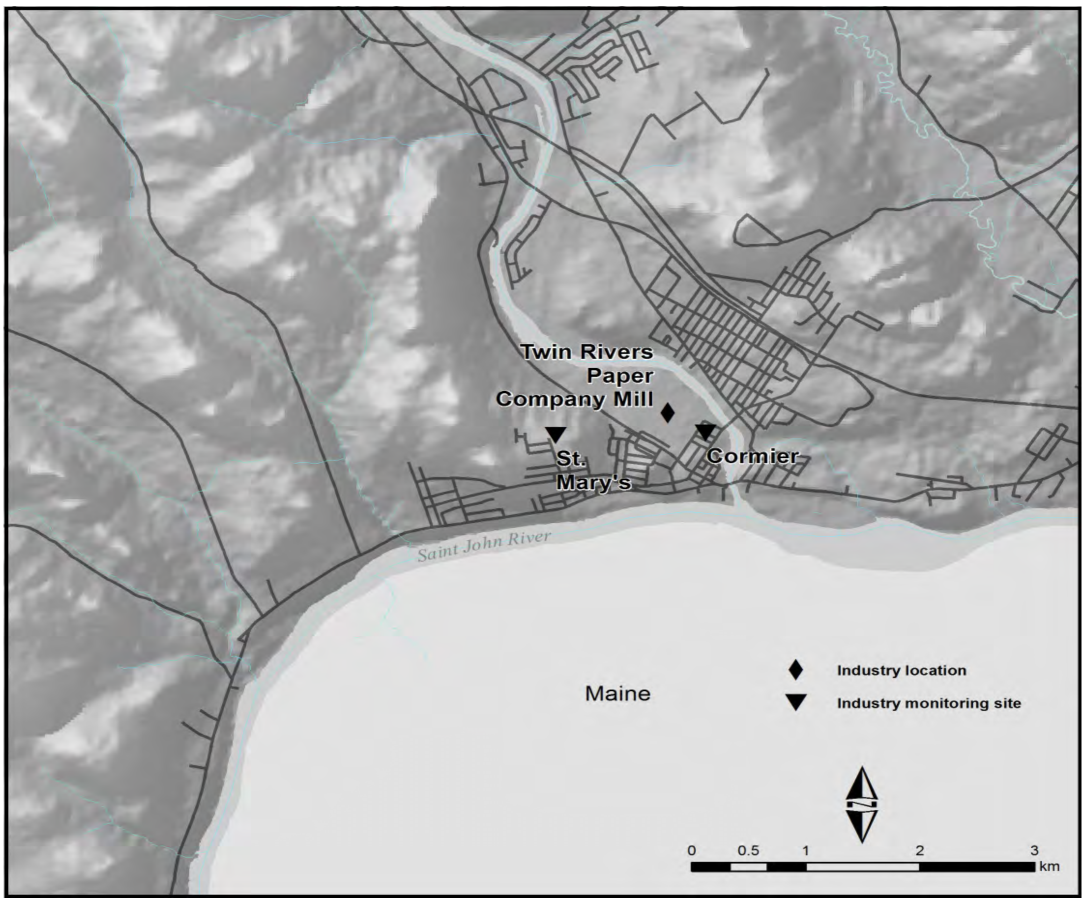

Figure 6. Air quality monitoring sites in Edmundston, 2010.

Table 9. Exceedances of provincial objectives for SO_2, Twin Rivers Paper Company, Edmundston Network, 2004-2010.

	Cormier School	St. Mary's
1 Hour Objective		
2010	1	0
2009	2	0
2008	1	0
2007	0	0
2006	0	0
2005	0	0
2004	0	0
24-Hour Objective		
2010	0	0
2009	0	0
2008	0	0
2007	0	0
2006	0	0
2005	0	0
2004	0	0

E.2 Fine Particulate Matter

Table 10 summarizes results for $PM_{2.5}$ measurements at the Cormier School site in 2010. This site employs tapered element oscillating microbalance (TEOM) technology for measuring $PM_{2.5}$.

There was one instance where the daily average value exceeded the CWS reference point of 30 µg/m^3. The annual average was 7 µg/m^3. Additional results are shown in Appendix 1.

Table 10. Monitoring results for $PM_{2.5}$ (TEOM), Twin Rivers Paper Company, Edmunston, 2010.

	Cormier
Annual average (µg/m^3)	7
98th percentile value (CWS) (µg/m^3)	20
Days when daily average was >30 µg/m^3	1

F. Belledune

There are a number of monitoring sites in the Belledune region. Three of these are located for the assessment of emissions from the Xstrata complex. A further five monitors are operated for the assessment of NB Power's coal-fired electrical generating station.

Figure 7 shows the locations of all the monitoring sites in the region.

F.1 Xstrata

All sites in the Xstrata network monitor SO_2 and TSP.

F.1.1 Sulphur Dioxide

In 2010, there was one exceedance of the 1-hour objective at the Townsite station. Compliance statistics for SO_2 since 2002 are shown in Table 11.

F.1.2 Total Suspended Particulate

In 2010, there were no exceedances of TSP at any of the Xstrata monitoring stations. Compliance statistics for TSP since 2002 are shown in Table 12.

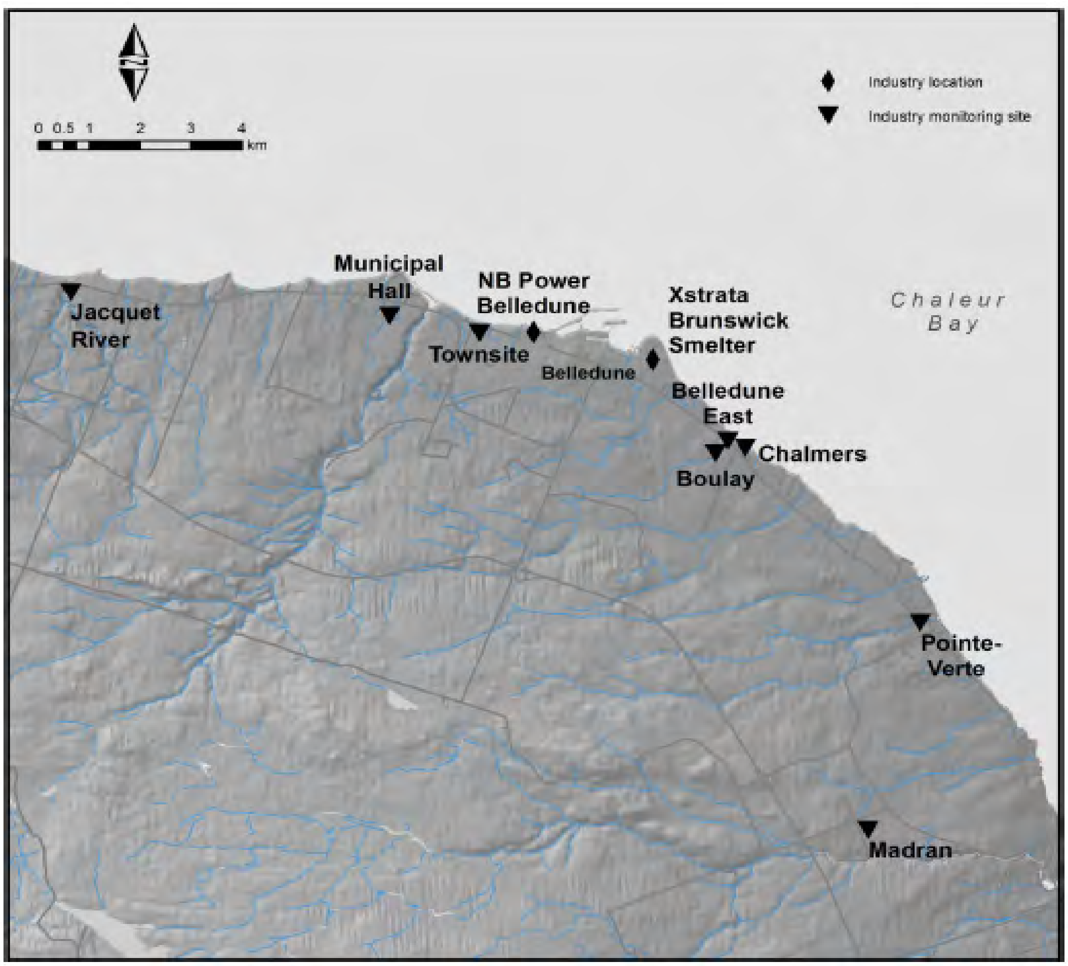

Figure 7. Air quality monitoring sites in the Belledune Network, 2010.

Table 11. Exceedances of provincial objectives for SO_2, Xstrata, 2002-2010.

	Boulay	Chalmers	Townsite
1 Hour Objective			
2010	0	0	1
2009	1	0	2
2008	2	0	0
2007	0	0	0
2006	1	0	1
2005	0	1	1
2004	0	0	0
2003	*	*	*
2002	1	3	0
24-Hour Objective			
2010	0	0	0
2009	0	0	0
2008	0	0	0
2007	0	0	0
2006	0	0	0
2005	0	0	0
2004	0	0	0
2003	*	*	*
2002	0	0	0

* In 2003, data was collected only for the January-June period.

Table 12. Exceedances of provincial objective for TSP, Xstrata, 2002-2010.

	Boulay	Chalmers	Townsite
24-Hour Objective			
2010	0	0	0
2009	1	0	1
2008	0	0	1
2007	0	0	0
2006	0	0	0
2005	0	0	0
2004	0	0	0
2003	*	*	*
2002	-	0	0

* In 2003, data was collected only for the January-June period.

F.2 NB Power

There are five sites in this network (see Table 13), all of which monitor SO_2. Belledune East and Municipal Hall also monitor $PM_{2.5}$ and NO_2.

F.2.1 Sulphur Dioxide

During 2010, there were two exceedances of the 1-hour SO_2 objective. Compliance statistics for SO_2 since 2002 are shown in Table 13.

F.2.2 Fine Particulate Matter

In 2010, the annual average value for $PM_{2.5}$ ranged from 6.1 µg/m^3 to 6.5 µg/m^3 in the Belledune area. The Belledune East site had the greatest 24-hour average 98th percentile value at 17.1 µg/m^3. At no point did the daily average $PM_{2.5}$ levels reach above the CWS reference point of 30 µg/m^3 at either site.

F.2.3 Nitrogen Dioxide

This contaminant is measured at Belledune East and Municipal Hall. There were no exceedances of the applicable 1-hour or 24-hour objectives in 2010 at either location. There have been no exceedances of NO_2 recorded in this network since 1999.

Table 13. Exceedances of provincial objectives for SO_2, NB Power Belledune Network, 2002-2010.

	Belledune East	Jacquet River	Madran	Municipal Hall	Pointe Verte
1 Hour Objective					
2010	1	0	0	1	0
2009	0	0	0	0	0
2008	1	0	0	0	0
2007	0	0	0	0	0
2006	1	0	0	1	0
2005	0	3	0	0	0
2004	0	0	0	0	0
2003	3	0	0	1	0
2002	4	0	0	0	1
24-Hour Objective					
2010	0	0	0	0	0
2009	0	0	0	0	0
2008	0	0	0	0	0
2007	0	0	0	0	0
2006	0	0	0	0	0
2005	0	0	0	0	0
2004	0	0	0	0	0
2003	0	0	0	0	0
2002	0	0	0	0	0

G. Dalhousie – NB Power

Figure 8 shows the locations of the sites in the Dalhousie region. The sites in this region are operated to monitor the effects of the NB Power Dalhousie electrical generating station. Six sites measure SO_2, one of these sites also monitors TSP, and there is one additional TSP site, for a total of seven sites. Because of potential pollution transport across the Bay of Chaleur, one of the stations is located in the Province of Québec.

G.1 Sulphur Dioxide

Compliance with the applicable 1-hour, 24-hour and annual objectives was 100% at all sites in 2010. There have been no exceedances of SO_2 standards recorded in this network since 1998.

G.2 Total Suspended Particulate

TSP was measured at the Coal Berm and Dalhousie Tower sites. There were no exceedances of the 24-hour objective of 120 $\mu g/m^3$ in 2010, and the annual geometric means for the Coal Berm and Tower sites were 11.7 and 12.1 $\mu g/m^3$, respectively (the standard is 70 $\mu g/m^3$). There have been no exceedances of TSP recorded in this network since 1998.

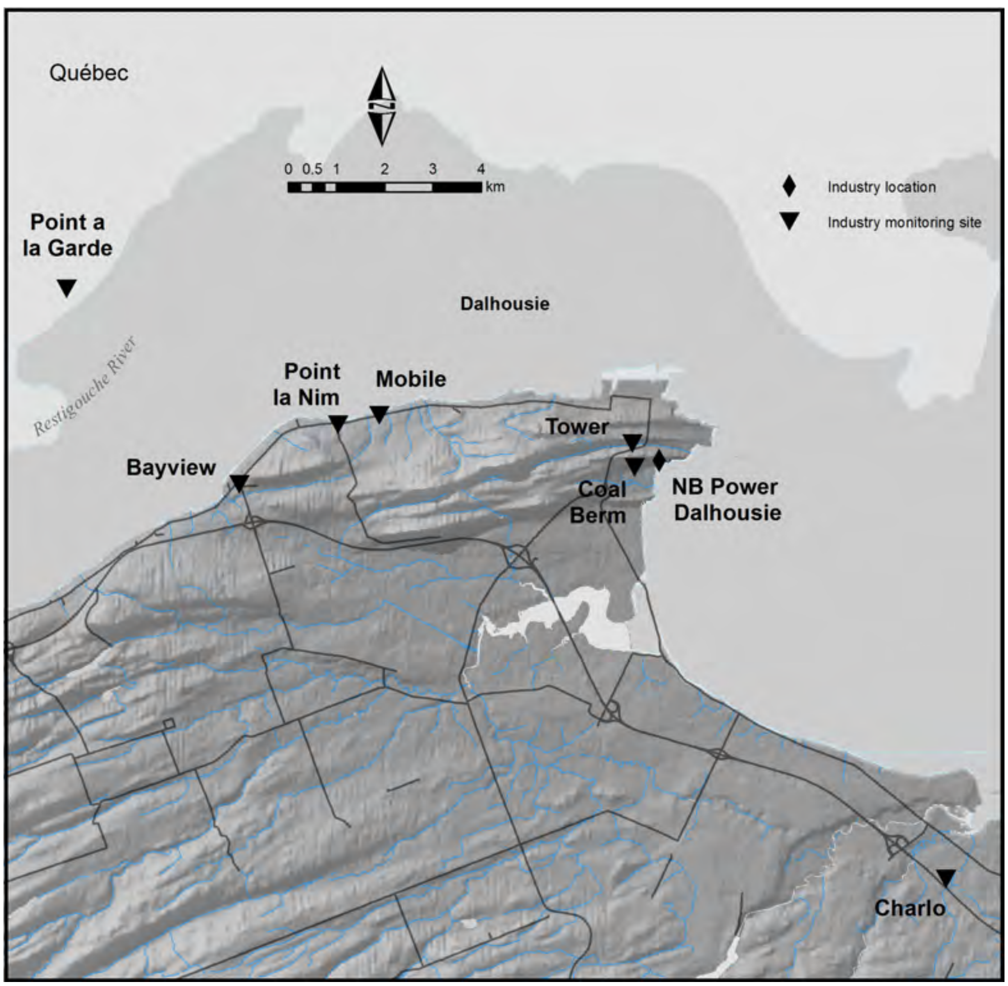

Figure 8. Air quality monitoring sites in the Dalhousie Network, 2010.

H. Atholville - AV Cell Inc.

H.1 Sulphur Dioxide

AV Cell Inc. operates a pulp mill in Atholville, and maintains two associated ambient air monitoring sites, Boom Road (to the east of the mill) and Beauvista (west). Sulphur dioxide is measured at both sites.

In 2010, there was one exceedance of the 1-hour objective (340 ppb) reported at the Beauvista monitoring site. Compliance statistics for SO_2 since 2000 are shown in Table 14.

Table 14. Exceedances of provincial objectives for SO_2, AV Cell Inc. Network, 2002-2010.

	Boom Rd (W)	Beauvista (E)
1 Hour Objective		
2010	0	1
2009	0	1
2008	0	0
2007	0	0
2006	0	0
2005	0	0
2004	0	0
2003	0	0
2002	0	0
24-Hour Objective		
2010	0	0
2009	0	0
2008	0	0
2007	0	0
2006	0	0
2005	0	0
2004	0	0
2003	0	0
2002	0	0

I. Bathurst

The DELG-operated Bathurst monitoring site is located on Rough Waters Drive. DELG has been working to gradually increase the capacity of this monitoring station. In late 2009, a NO_2 monitor was installed. Thus, 2010 marks the first year that annual NO_2 data is available.

I.1 Nitrogen Dioxide

No exceedances of the 1-hour or 24-hour objectives (210 ppb and 105 ppb respectively) were recorded for 2010. Unfortunately, due to an extended malfunction of the newly installed NO_2 monitor, data was not collected for a period of approximately 45 days in September - October.

I.2 Ground Level Ozone

There were no exceedances of the national 1-hour objective for O_3 during 2010. There is additional discussion of data from the O_3 network in sections 5, 7, and 10.

I.3 Fine Particulate Matter

Data obtained during 2010 indicated relatively low particulate concentrations. At no point did the daily average $PM_{2.5}$ levels reach above the CWS reference point of 30 µg/m^3 . $PM_{2.5}$ data are summarized in Table 15.

Table 15. Monitoring results for $PM_{2.5}$, Bathurst, 2010.

	Rough Waters Drive
Annual average (µg/m^3)	7.1
98th percentile value (CWS) (µg/m^3)	22
Days when daily average was >30 µg/m^3	0

J. Fredericton

The Fredericton site is on Aberdeen Street, in an area representative of the “downtown” residential and business district. This site is also considered representative of a wider geographical area for pollutants, such as O_3, which are regional in nature.

J.1 Carbon Monoxide

No exceedances of the 1-hour or 8-hour objectives (30 ppm and 13 ppm respectively) were recorded. There have been no exceedances of CO at this site since it was established in 1999.

J.2 Nitrogen Dioxide

No exceedances of the 1-hour or 24-hour objectives (210 ppb and 105 ppb respectively) were recorded. There have been no exceedances of NO_2 at this site since it was established in 1999.

J.3 Ground Level Ozone

There were no exceedances of the national 1-hour objective for O_3 during 2010. There is additional discussion of data from the O_3 network in sections 5, 7, and 10.

J.4 Fine Particulate Matter

Fine particulate matter ($PM_{2.5}$) was measured at the Aberdeen Street site. Data obtained during 2010 indicated relatively low particulate concentrations. At no point did the daily average $PM_{2.5}$ levels reach above the CWS reference point of 30 µg/m^3 . $PM_{2.5}$ data are summarized in Table 16.

Table 16. Monitoring results for $PM_{2.5}$, Fredericton, 2010.

	Aberdeen St.
Annual average (µg/m^3)	4
98th percentile value (CWS) (µg/m^3)	15
Days when daily average was >30 µg/m^3	0

K. Nackawic

Nackawic is home to the AV Nackawic bleached dissolving grade kraft pulp mill. Sulphur dioxide, TRS and TSP as well as wind speed and direction are measured at the Caverhill Road site, which is located some distance to the west of the mill.

In addition to AV Nackawic's Caverhill Road site, DELG operated its mobile air quality monitoring trailer for a four month period (late July to mid November) in the immediate vicinity of the plant (just outside the southern boundary of the mill property).

No exceedances were recorded for any of the contaminants monitored at the Caverhill Road site. However, the DELG mobile monitoring trailer, which was located much closer to the Mill, detected many exceedances of provincial TRS objectives. The compliance history for TRS since 2001 is shown in Table 17.

It should be noted that TRS odour is a known concern for this facility. AV Nackawic is currently undertaking actions to reduce TRS emissions in accordance with DELG's Air Quality Approval process.

No exceedances were recorded at the DELG-mobile trailer for any of the other contaminants measured (NO_2, SO_2, O_3, and $PM_{2.5}$).

Complete results for the Caverhill Road and DELG mobile trailer are shown in Appendix 1.

Table 17. Exceedances of provincial objectives for TRS (as H_2S), Nackawic Network, 2003-2010.

Year	Caverhill Road	DELG Mobile
1 Hour Objective		
2010	0	37
2009	1	-
2008	0	-
2007	1	-
2006	1	-
2005	M	-
2004	6	-
2003	1	-
24-Hour Objective		
2010	0	187
2009	0	-
2008	0	-
2007	181	-
2006	0	-
2005	M	-
2004	19	-
2003	0	-

Note: results for 2004 based on 8 months of operation. The Nackawic mill was shut down in September 2004 and was reopened under new ownership in January 2006.
M= missing data.

L. Moncton

The Moncton air quality monitoring site is situated at the Highfield Street water pumping station. The site location was chosen to provide readings representative of the central city. In addition, this site is influenced by emissions from vehicles and institutional heating systems, as well as regional pollutants such as O_3.

L.1 Carbon Monoxide

Readings remained well below air quality objectives for CO with no exceedances of hourly or 8-hourly objectives for CO occurring during 2010.

L.2 Nitrogen Dioxide

No exceedances of hourly or 24-hour standards for NO_2 were recorded during 2010. No exceedances of NO_2 objectives have been recorded since monitoring began in 1998.

L.3 Ground Level Ozone

There were no exceedances of the hourly objective for O_3 (82 ppb). More discussion of O_3 data may be found in section 5, 7, and 10.

L.4 Fine Particulate Matter

Levels of fine particulate matter ($PM_{2.5}$) during during 2010 were relatively low. At no point did the daily average $PM_{2.5}$ levels reach above the CWS reference point of 30 µg/m^3. $PM_{2.5}$ data are summarized in Table 18.

Table 18. Monitoring results for $PM_{2.5}$, Moncton, 2010.

	Highfield St.
Annual average (µg/m^3)	5.1
98th percentile value (CWS) (µg/m^3)	15.3
Days when daily average was >30 µg/m^3	0

M. St. Andrews

The St. Andrews monitoring station is located on the grounds of the Huntsman Marine Science Centre (H.M.S.C.).

M.1 Fine Particulate Matter

Data collected during 2010 indicated relatively low particulate concentrations. At no point did the daily average $PM_{2.5}$ levels reach above the CWS reference point of 30 µg/m^3 . $PM_{2.5}$ data are summarized in Table 19. Complete results are shown in Appendix 1.

M.1 Ground Level Ozone

There were no exceedances of the national 1-hour objective for O_3 during 2010. There is additional discussion of data from the O_3 network in sections 5, 7, and 10.

Table 19. Monitoring results for $PM_{2.5}$, St. Andrews, 2010.

	H.M.S.C
Annual average (µg/m^3)	5.1
98th percentile value (CWS) (µg/m^3)	16.8
Days when daily average was >30 µg/m^3	0

5. RURAL OZONE NETWORK

Figure 9 shows the locations of the sites that monitor ground level O_3 in New Brunswick. This network is operated by DELG to assess the impact of long-range transport. It focuses on the southern portion of the province, which is the region most affected by long range (transboundary) transport, as shown by special short-term monitoring studies and trajectory analyses (e.g. Fuentes and Dann, 1994; Tordon et al., 1994; Multistakeholder NOx/ VOC Science Program, 1997a, 1997b).

There were exceedances at two of the of the O_3 monitoring sites in 2010, both occurring on May 2nd. The 1-hour objective of 82 ppb was exceeded for a two hour period at the Fundy National Park monitoring site. This resulted in the 24-hour rolling average (65 ppb) also being exceeded for a period of eight hours. The second series of exceedances was recorded at the Norton monitoring station, where the 24-hour rolling average was exceeded for a four hour period.

No other exceedances were recorded in the network.

Detailed monitoring results for each site are provided in Appendix 1.

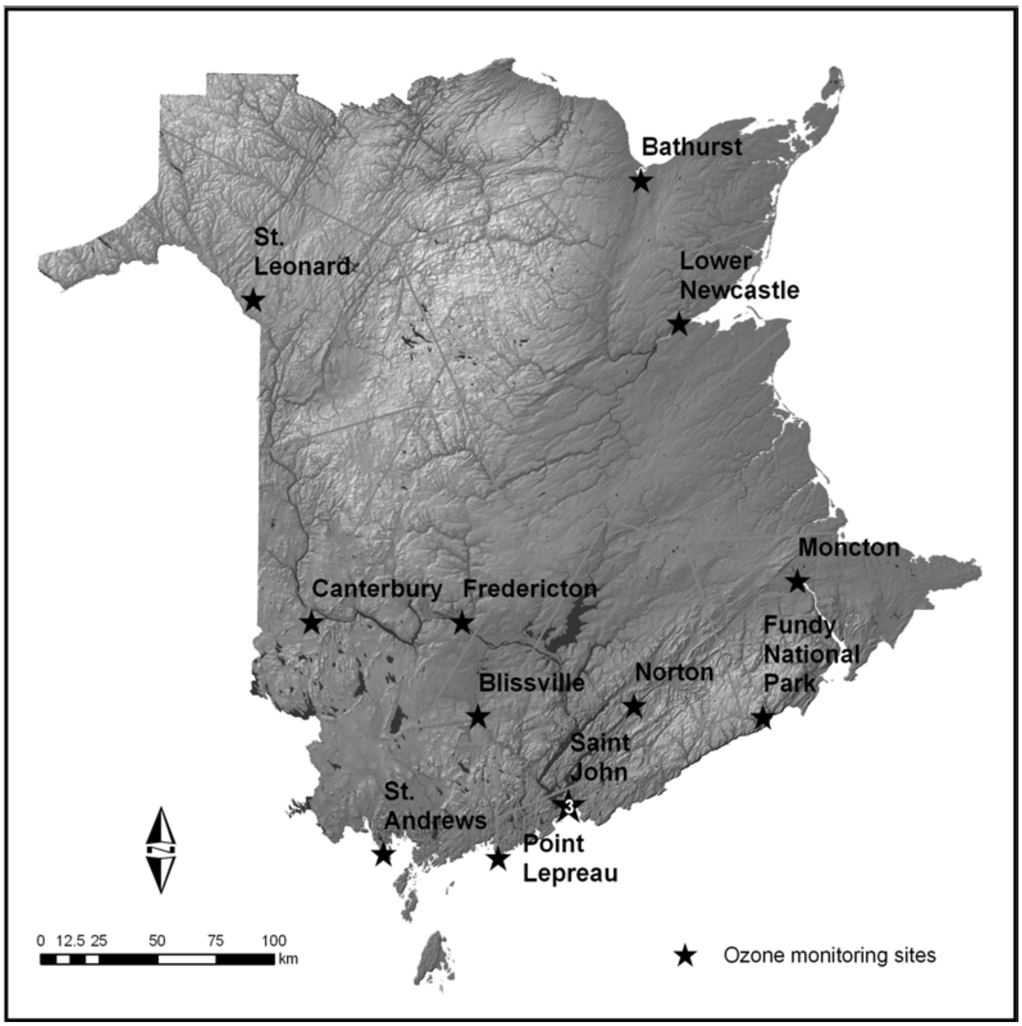

Figure 9. Locations of ozone monitoring sites in New Brunswick, 2010.

6. AIR QUALITY ADVISORIES

DELG works with Environment Canada and the Department of Health in the preparation and dissemination of 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. Advisories may be issued for specific regions of the province.

There were two air quality events during 2010 that resulted in advisories being issued:

Volcanic Ash

Two Special Air Quality Statements were issued during the April 20 - 21 period due to air quality impacts associated with volcanic ash from Eyjafjoll Volcano, Iceland.

Forest Fires

A series of Special Air Quality Statements were issued for northern and western New Brunswick during the May 29 - June 2 period due to smoke originating from forest fires in Quebec. Smoke from forest fires in the Saguenay Valley of Quebec also resulted in two air quality advisories being issued for the entire province of New Brunswick on June 18.

There were no smog advisories issued by Environment Canada in 2010.

7. CANADA-WIDE STANDARDS (CWS)

The Canadian Council of Ministers of the Environment endorsed standards for $PM_{2.5}$ and O_3 in June of 2000. These standards came into force for the 2010 reporting year.

The CWS for O_3 is 65 ppb. This value is calculated as a three-year rolling average of the 4th highest daily average in each year.

The CWS for $PM_{2.5}$ is 30 µg/m³. This value is calculated as a three-year rolling average of the 98th percentile (i.e., nearly the highest) daily average value in each year.

A. Canada-wide Standard for Ozone

Figures 10 and 11 show Canada-wide Standard values for rural and urban sites for the 2007 to 2010 period.

In 2010, all sites were below the standard. It should be noted that the Canterbury (2007), Fundy (2009) and Blissville (2009) statistics were averaged over a two year period rather than a three year period, due to insufficient data.

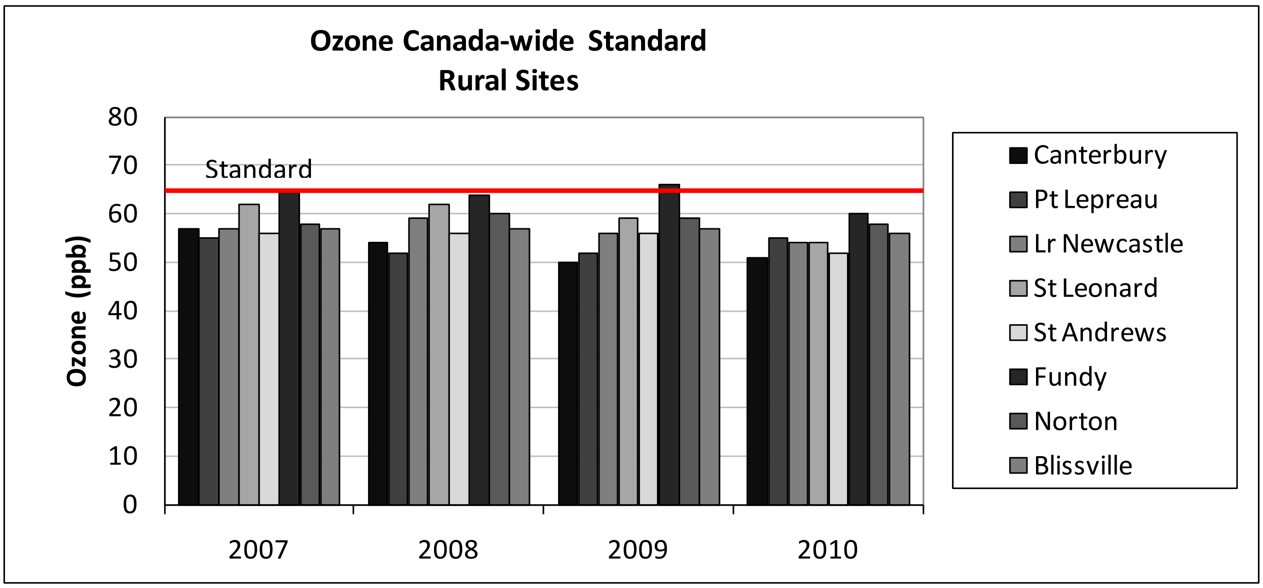

Figure 10. Canada-wide Standard results for ozone at rural sites, 2007-2010.

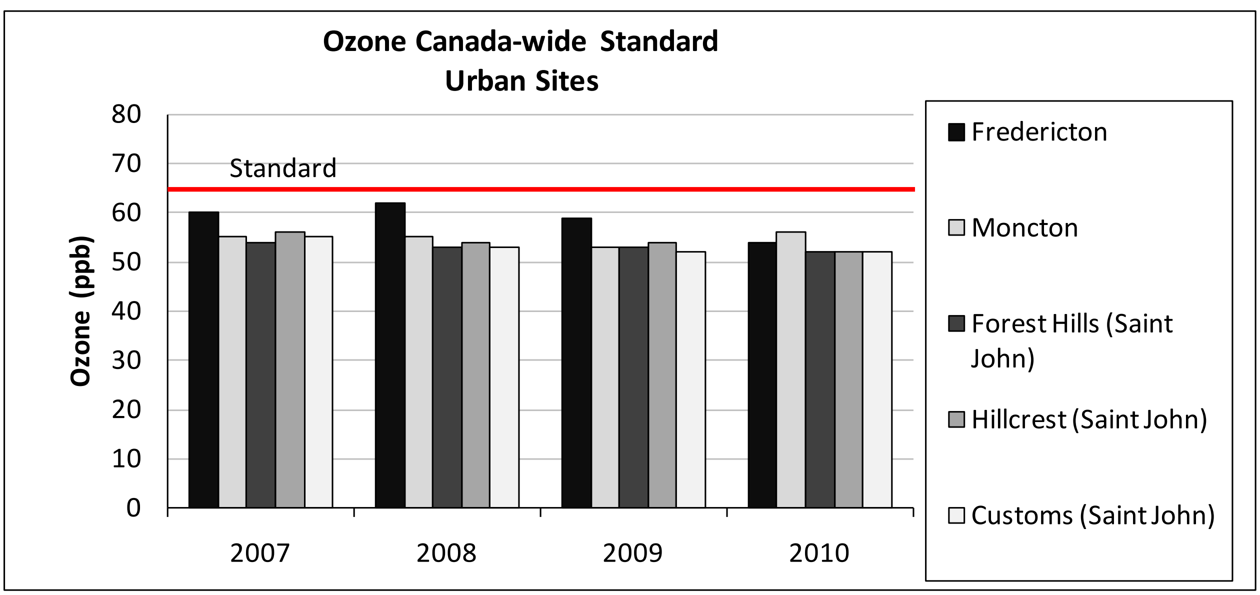

Figure 11. Canada-wide Standard results for ozone at urban sites, 2007-2010.

B. Canada-wide Standard for $PM_{2.5}$

Figures 12 and 13 show CWS results for $PM_{2.5}$ for New Brunswick and within Saint John. Results at all stations have remained below the CWS levels to date. Results for Edmundston are based on industry (Twin Rivers) data. The remainder is based on data from DELG monitoring stations.

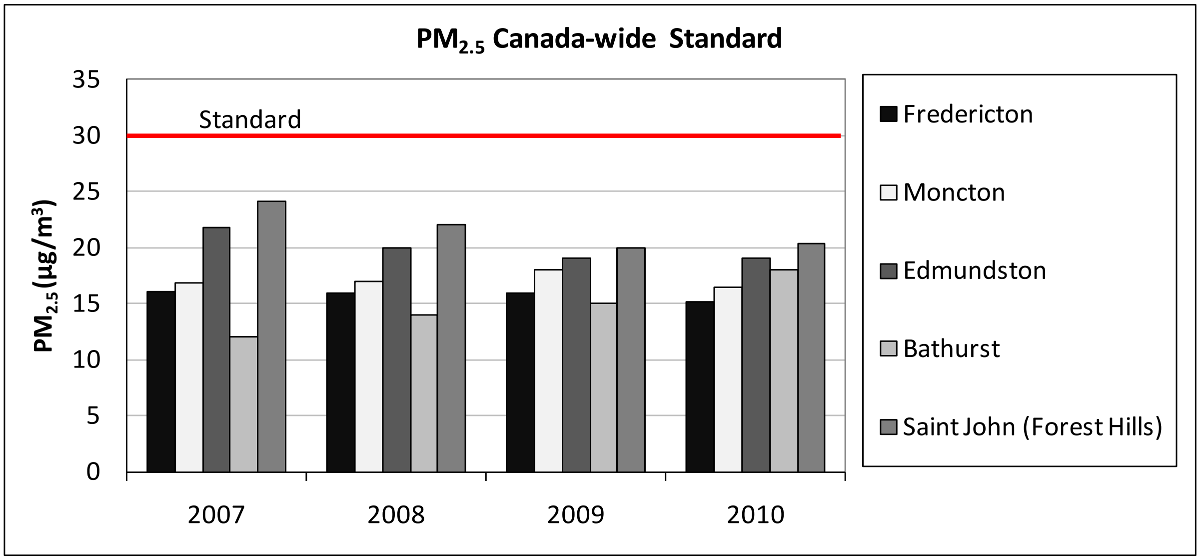

Figure 12. Canada-wide Standard results for $PM_{2.5}$, 2007-2010.

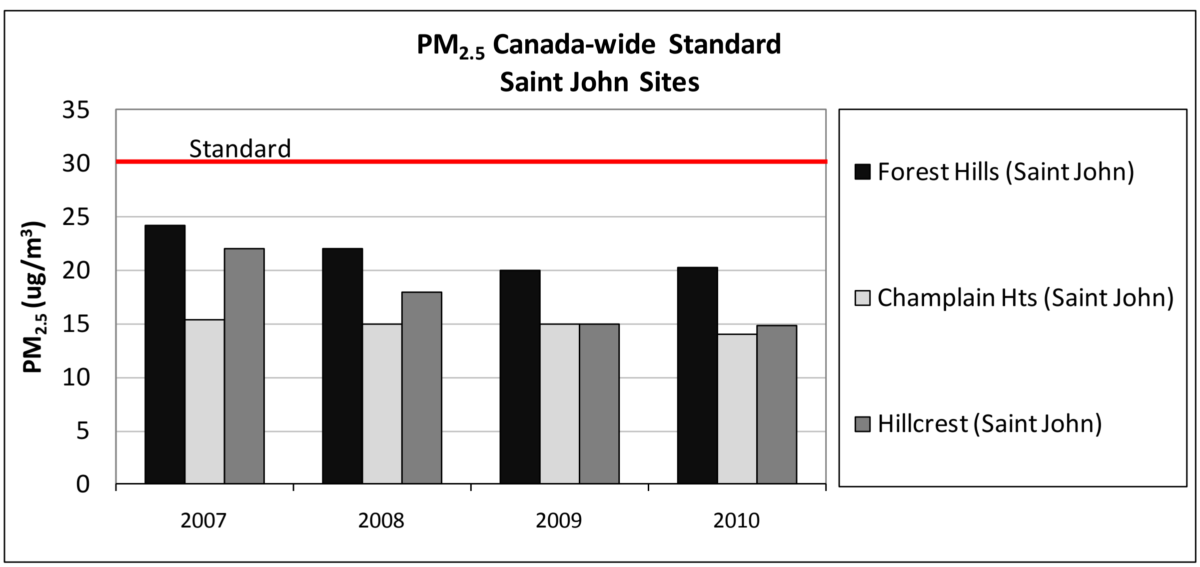

Figure 13. Canada-wide Standard results for $PM_{2.5,}$ Saint John sites, 2007-2010

8. ACID PRECIPITATION NETWORK

Emissions of SO_2 and nitrogen oxides can be transformed in the atmosphere into acidic particles that ultimately fall out as acid deposition, in both wet and dry form. Acid precipitation, or acid rain, refers to the wet form of acid deposition.

The potentially adverse impacts of acid precipitation have been recognized since the early 1980's. Acid precipitation effects occur at a broad regional level, not just close to the sources of the contaminants themselves. The emissions that cause acid precipitation typically travel long distances, hundreds or even thousands of kilometers, before returning to the surface as rain or snow. In New Brunswick, acid deposition is affected by local emissions and the emissions from several large industrial regions which are located upwind, including the American Midwest, southern Ontario and Québec, and the Washington-Boston region. The same emissions also contribute to regional haze and fine particulate pollution.

Consequently, measures to reduce emissions that contribute to acid rain have been underway in North America since the late 1980's. Most recently, this has included commitments to reduce emissions under the 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.

New Brunswick has operated an extensive acid precipitation (rain and snow) monitoring network since the early 1980s. Since 1987, this has been a partnership effort with logistical and financial support from NB Power. In 2009, DELG took over the logistical operation of the entire network with NB Power continuing with its financial support. Figure 14 shows the location of the acid precipitation monitoring sites in New Brunswick. All precipitation samples are ana-

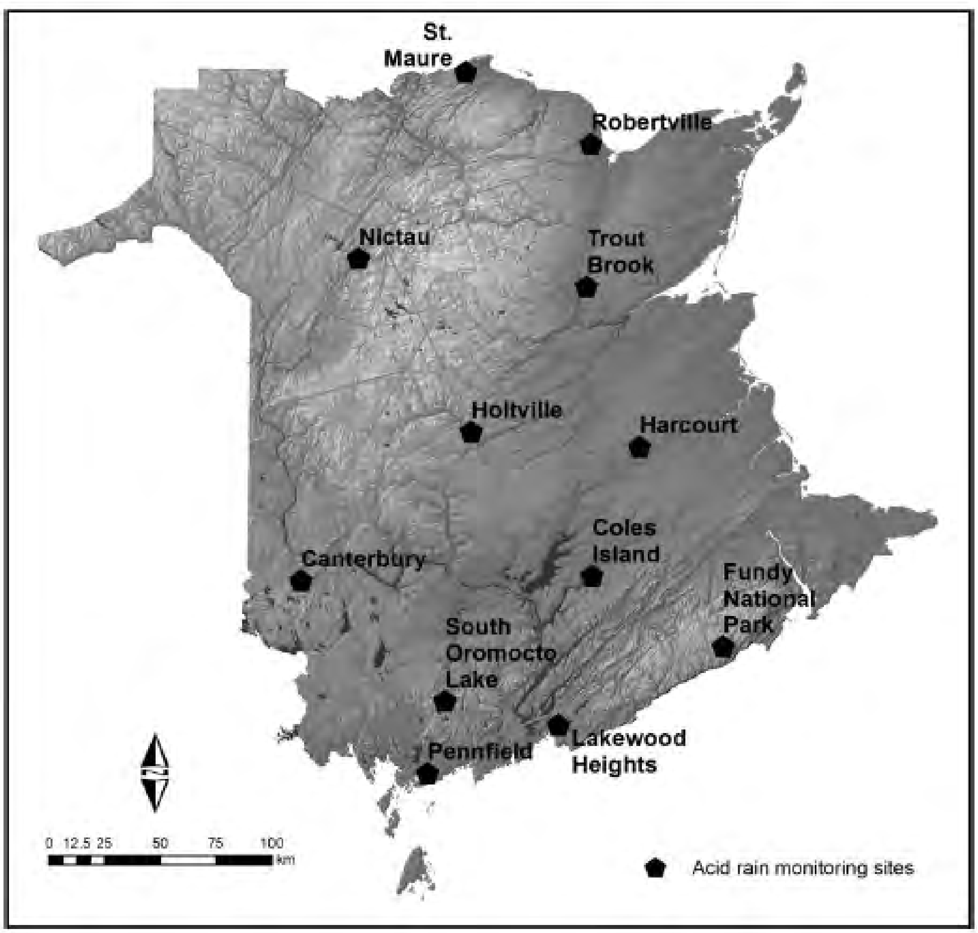

Figure 14. Location of acid rain monitoring sites in New Brunswick, 2010.

lyzed at the DELG laboratory, and DELG staff coordinate the monitoring program, perform data quality assurance, and maintain the official data archive. There were 12 acid precipitation monitoring stations in operation in 2010. These sites are predominantly located in remote rural areas.

The severity of acid rain impact is generally measured by computing how much sulphate (a measure of sulphuric acid) falls on each hectare of land over one year. For a given area, a "critical load" can be defined that reflects the level of acidic deposition that can be tolerated without harm. Critical loads take into account the nature of individual watersheds and their susceptibility to the effects of acidification. Critical loads for acidification in New Brunswick range from less than 8 up to 11 kg/ha/yr of acid sulphate deposition. The lowest values of less than 8 kg/ha/yr are designed to protect the most sensitive areas that typically have granite bedrock (e.g., areas of southwestern and central northern New Brunswick), and 11 kg/ha/yr for most of the rest of the province.

It is important to note that sulphate wet deposition results are currently reported as total sulphate (SO_4) and that in previous years they were reported as excess sulphate (eSO_4). Excess sulphate, or sea-salt corrected sulphate, is an indicator of anthropogenic SO_4. This change in reporting may cause results found in earlier versions of the New Brunswick Air Quality Monitoring Results report to appear lower than those listed below.

Sulphate wet deposition for the 10 year period of 2001-2010 is shown in Table 20. At all of the sites in the network (with the exception of St. Maure), acid deposition values in 2010 were lower as compared to deposition levels in 2009. Acid rain deposition in 2010 ranged from as low as 4.99 kg/ha/yr in Holtville, to as high as 12.49 kg/ha/yr in Pennfield.

Sulphate loading is a naturally variable indicator of acid deposition because it is closely associated with the amount of precipitation that falls during the course of the year at a given monitoring site. As a result, there will always be significant variability in annual deposition values as a function of rain and snow levels each year.

Annual precipitation for the province was in the normal range in 2010 except for regions in the southwest which received above normal precipitation. Further precipitation information can be found at:

http://www.gnb.ca/0009/0371/0007/2010/2010-E.asp

Table 20. Sulphate wet deposition (kg/ha/yr) at New Brunswick monitoring sites, 2001-2010.

Site	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
St. Maure	7.38	8.27	9.05	8.00	11.51	10.89	10.62	11.02	7.67	7.80
Robertville	8.51	11.24	8.14	8.56	14.20	13.34	10.49	10.32	8.76	8.06
Nictau	12.54	10.80	7.30	8.20	9.53	11.72	7.91**	8.21	6.44	5.01
Trout Brook	10.16	9.54	9.52	6.68	11.33	11.28	9.17	8.26	6.91	5.69
Holtville	9.11	11.12	11.18	8.83	12.63	12.64	9.26	11.43	8.93	4.99
Harcourt	7.67	10.35	10.55	7.78	10.72	10.90	8.79	10.92	8.52	6.76
Canterbury	8.70	12.00	9.97	7.52	13.86	---	---	9.92	7.29	5.49
Coles Island	7.79	11.03	11.13	8.64	9.86	9.62	9.38	8.39	7.43	5.44
South Oromocto Lake	10.19	11.89	12.37	---	---	12.96	11.55	11.89	9.80	6.77
Pennfield	11.54	16.43	14.55	14.01	19.67	18.85	14.41	17.81	15.20	12.49
Lakewood Heights	10.83	19.17	19.96	14.07	14.79*	16.64	13.32	15.67	13.48	8.29
Fundy	14.65	17.76	16.55	14.40	19.00	19.51	14.53	18.79	13.91	9.65

--- insufficient data
* 48 Weeks reporting
** 49 Weeks reporting

Another useful indicator of acid deposition is the average annual sulphate concentration in precipitation. This trend is shown in Figure 15, which also shows the number of sites that were in operation for at least a portion of each year. The trend overall is downward since 1989, with the last three years (2008, 2009, and 2010) having the lowest recorded concentrations to date, for both SO_4 and eSO_4. This downward trend confirms that reductions in SO_2 emissions in New Brunswick, elsewhere in eastern Canada and the United States have had a beneficial effect on acid rain in the province.

Although Canadian and US emissions of SO_2 and nitrogen oxides have continued to decline since 1990 (Canada-United States Air Quality Agreement: 2008 Progress Report), the acid rain issue remains important for New Brunswick because critical loads for acid rain continue to be exceeded in some areas. As a result, continued efforts to reduce emissions are required to reduce acid deposition further and ensure that the more sensitive lakes and rivers are provided with long-term protection from acid damage.

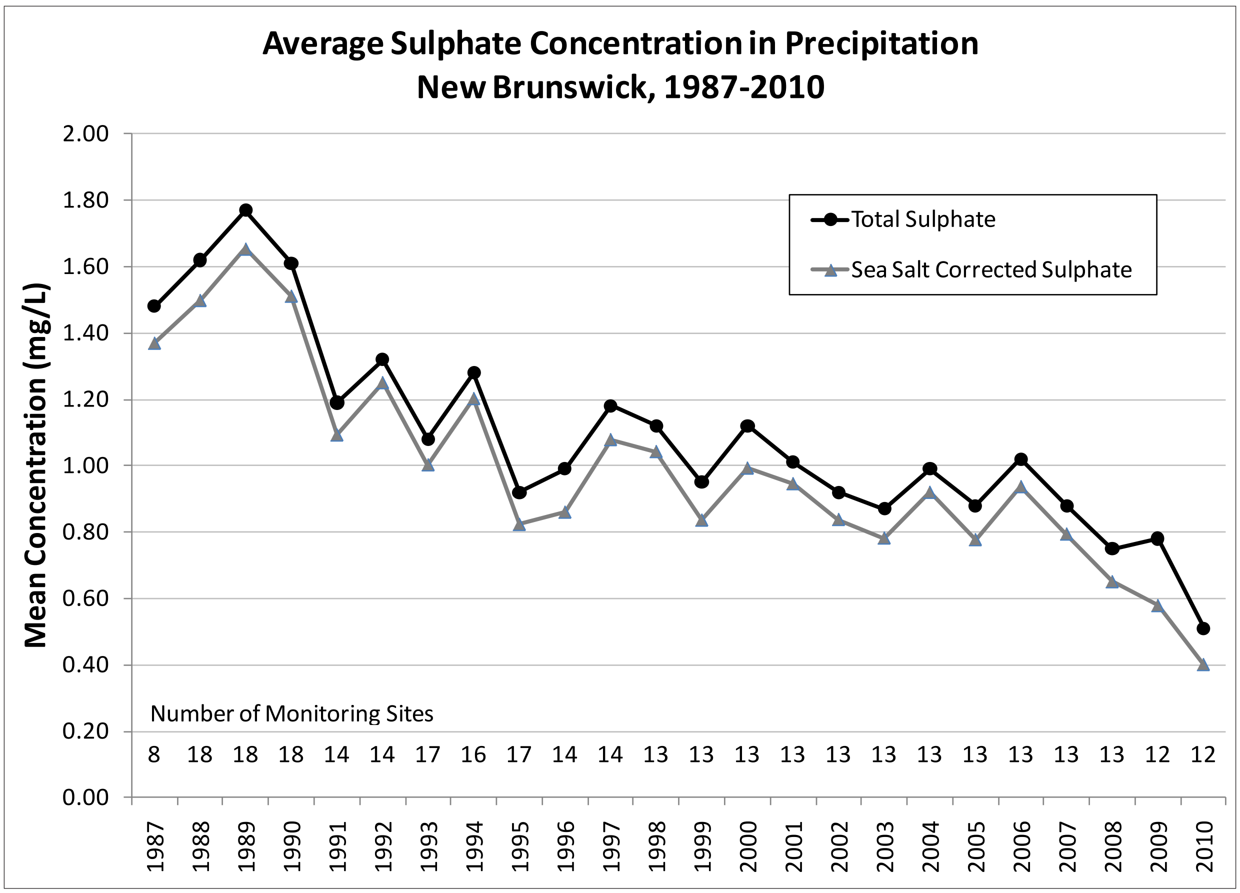

Figure 15. Network-wide mean annual sulphate concentration in precipitation in New Brunswick, 1987-2010.

9. MOBILE AIR QUALITY MONITORING

Since 2001 DELG has operated a mobile air quality monitoring unit to supplement monitoring carried out at established (non-mobile) monitoring sites. The unit can be moved to various areas of the province, fulfilling temporary monitoring needs. The current air quality monitoring unit was acquired from the National Air Pollution Surveillance (NAPS) program in 2007 (Figure 16).

The unit is typically outfitted to monitor the following pollutants: SO_2, NO_x, O_3, TRS, $PM_{2.5}$ and CO (added in 2009). The unit is also fitted with a retractable 10-metre mast with wind speed and wind direction instruments.

<u>2010 Operations</u>

From July 21 to November 19, 2010 the monitoring unit was deployed near the AV Nackawic Pulp Mill to better define general air quality in the area, with particular emphasis on $PM_{2.5}$.

The $PM_{2.5}$ levels detected during the study were generally low. The peak value detected was 24 µg/m^3 (24-hour average), which occurred on September 2, 2010.

Several exceedances of the 1-hour objective for TRS were detected during the study, peaking at 91 ppb on August 30, 2010. As explained in section 3, in the absence of a specific objective for TRS, TRS levels are compared against the standard for hydrogen sulphide.

Analysis of air quality data from this study in relation to provincial standards is provided in section 3. Full monitoring results for the AV Nackawic Study are provided in Appendix 1.

Figure 16. Mobile Air Quality Monitoring Trailer

10. LONG TERM AIR QUALITY TRENDS

In addition to examining air quality monitoring results for a given year, it is often informative to compare annual results to previous years, and consider longer term trends. This provides information on how air quality may be changing over the years, and whether emission control measures as applied to industrial operations and consumer products (notably vehicles and fuels) are positively impacting long-term environmental quality. As mentioned in the introduction, air quality monitoring has been ongoing in parts of the province since the 1970s, especially in the Saint John region. In this section, data for key locations with long-term records are presented to provide information on air quality trends.

A. Carbon Monoxide

Carbon monoxide levels in Saint John, Fredericton, and Moncton are predominantly influenced by motor vehicle emissions. Figure 17 shows the monitoring results of the period from 1991 to 2010. Average CO levels have remained very low over this period.

In recent years, at all three sites measuring CO, instruments have been recording values that are close to atmospheric background levels.

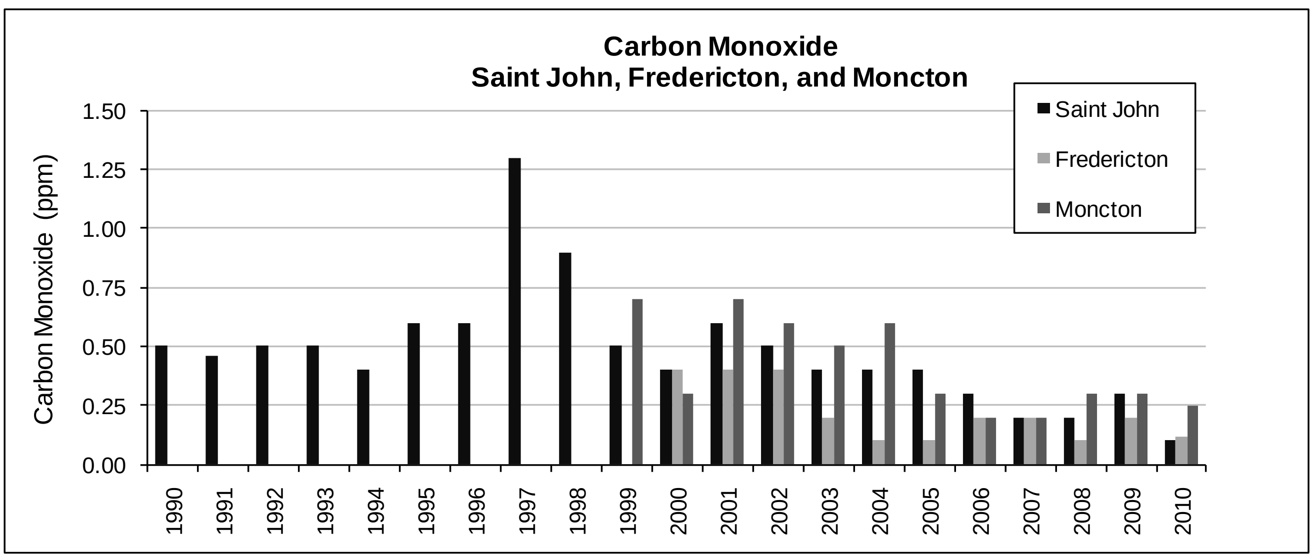

Figure 17. Annual mean carbon monoxide concentration in Saint John, Fredericton, and Moncton, 1990-2010.

B. Nitrogen Dioxide

NO_2 is another key pollutant emitted by motor vehicles, as well as industrial sources. Figure 18 shows that the overall NO_2 trend in Saint John, Fredericton, and Moncton has been downward since approximately 2002.

C. Sulphur Dioxide

There has been dramatic improvement in average SO_2 levels in Saint John over the 1992-2010 period, as reflected in Figure 19. This reflects emission reductions that have been achieved by several local industries including power generating stations, the pulp and paper industry and an oil refinery. The closure of the Lantic sugar refinery in 2002, regulations reducing the sulphur content of gasoline, and the increased use of natural gas have also contributed.

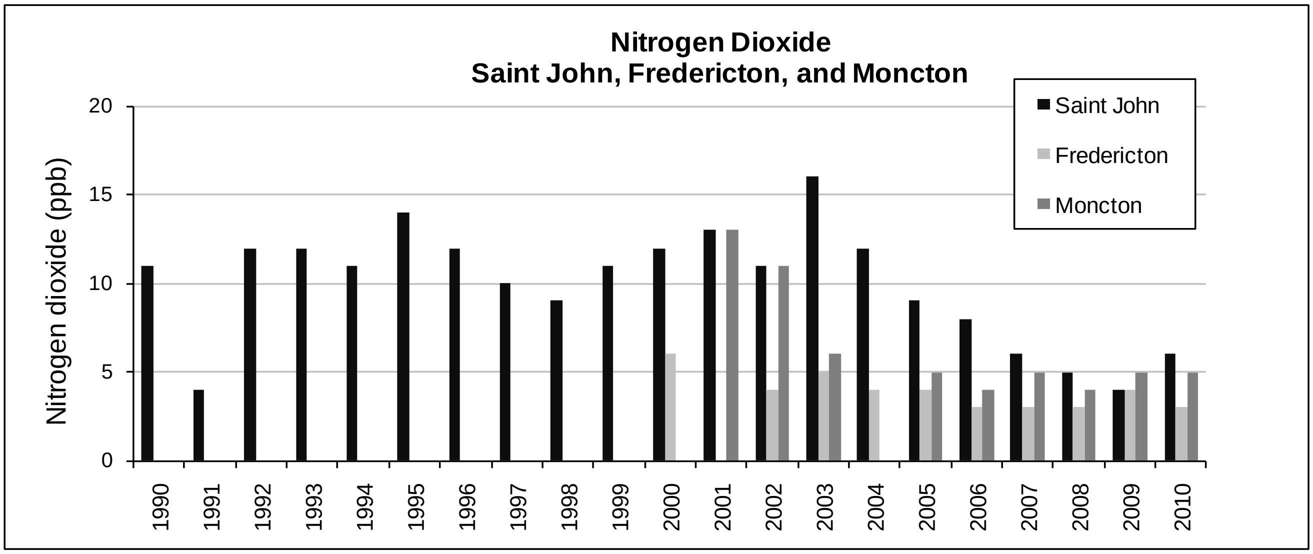

Figure 18. Annual mean nitrogen dioxide concentration in Saint John, Fredericton, and Moncton, 1990-2010.

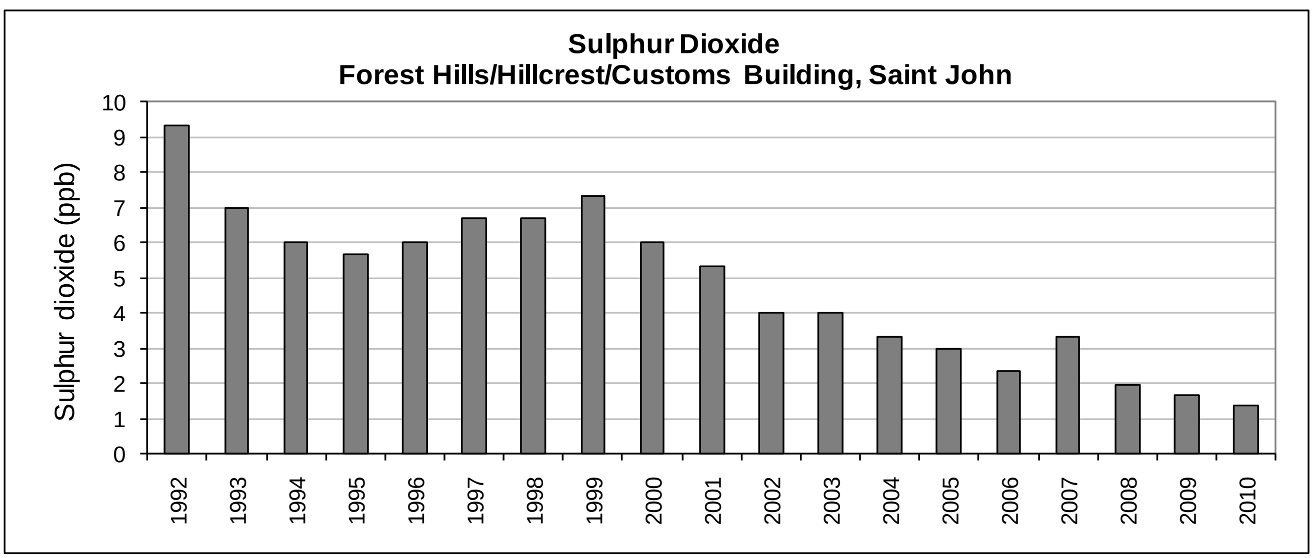

Figure 19. Annual mean sulphur dioxide concentration in Saint John (3 site composite), 1992-2010.

D. Ground Level Ozone

As explained in section 5, O_3 is a regionally transported pollutant which is not emitted directly from smokestacks or tailpipes, but which forms in the air when other pollutants mix and react with each other in the presence of high temperatures and sunlight. As such, trends in O_3 are principally due to changing emissions of the pollutants that lead to O_3 formation (NO_x and VOCs) originating in heavily populated regions of central Canada and the northeastern United States. Seasonal weather, especially summer conditions, also has a major influence on the amount of O_3 affecting New Brunswick.

Figure 20 shows a composite trend based on all O_3 sites in the province. The number of sites has increased substantially over the period of record, from three initially, to 14 in 2010. The latter half of the record is therefore more meaningful because there is greater spatial coverage and more data available.

Examining the record since 1990, a linear trend line indicates no change in the province-wide O_3 average.

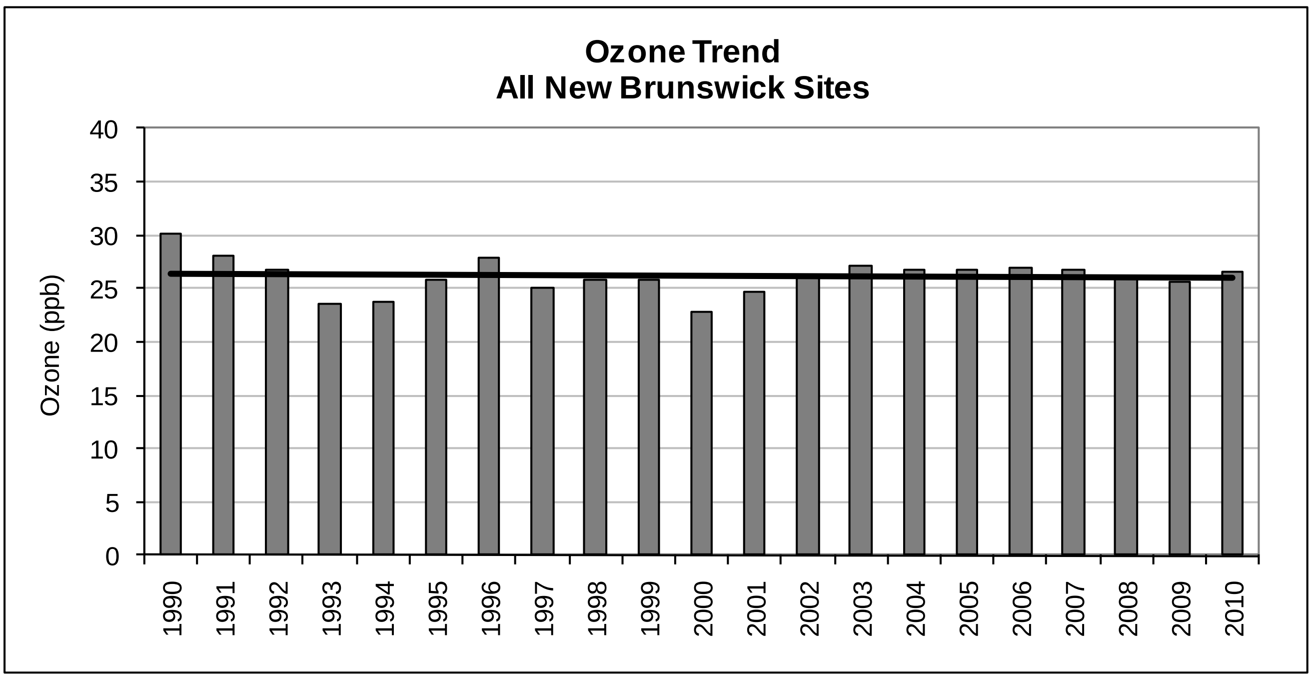

Figure 20. Trend in ozone concentration, composite average of all New Brunswick sites, 1990-2010.

E. Volatile Organic Compounds

Over 150 varieties of VOCs have been measured at two locations (Forest Hills and Point Lepreau) since 1992, as noted in Section 4. In July 2000, sampling began at Champlain Heights School, a site within 0.5 kilometers of the Irving Oil refinery complex in east Saint John. Trends for selected VOCs are presented in this section.

One clear finding from the VOC sampling program is that concentrations of most VOCs are found to be higher at Forest Hills and Champlain Heights than at Point Lepreau. This is consistent with the location of Forest Hills and Champlain Heights in an industrial/urban setting and Point Lepreau in a relatively remote, rural setting.

Figure 21 shows trends in average total VOC concentrations for all sites since 2000.

These results clearly show differences in average VOC levels between the three sites. There has been relatively little change at Point Lepreau. There were no results available from Point Lepreau in 2009, as the equipment was temporarily reassigned for a special project. At Forest Hills, annual average total VOC concentration was approximately the same in 2010 as it was in 2009. At Champlain Heights, the proximity of that site to the refinery complex is reflected in higher and more variable total VOC concentrations. There was a noticeable decline in total VOCs between 2009 and 2010 at this location. VOC monitoring will continue at these sites to further assess long term trends.

Compounds such as butane and isopentane (Figure 22), which are major volatile components of gasoline, follow a similar trend as the total VOC values at the two Saint John sites.

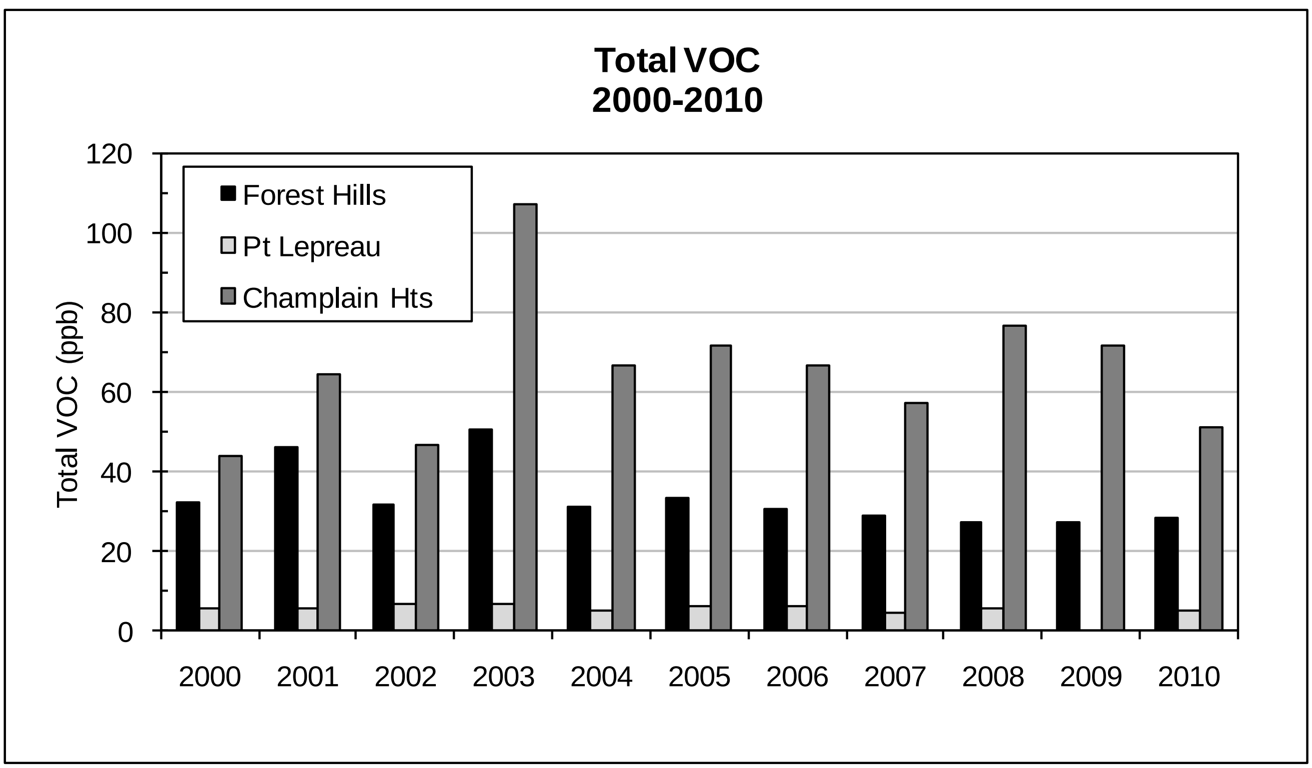

Figure 21. Average total VOC concentration at provincial VOC monitoring sites, 2000-2010.

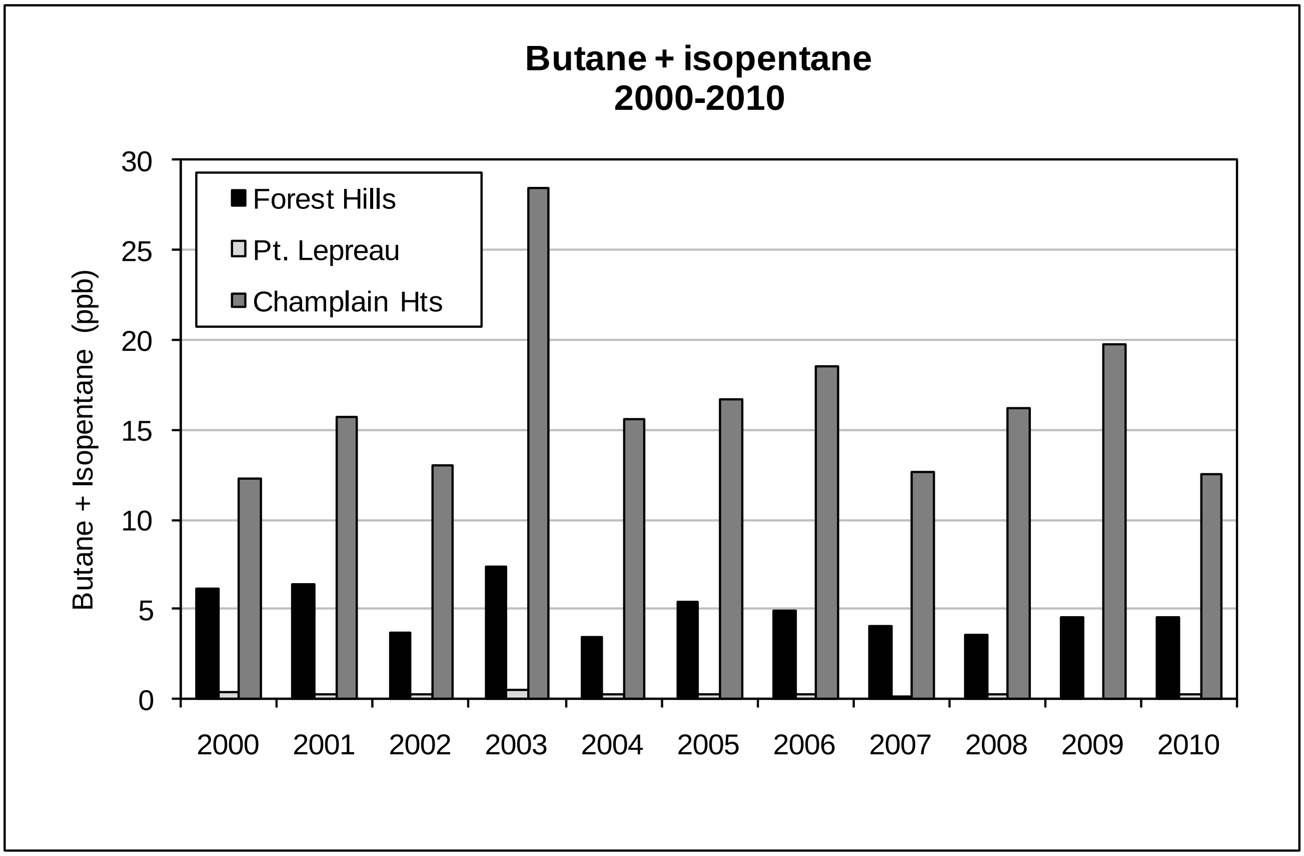

Figure 22. Annual average concentration of butane plus isopentane at provincial VOC monitoring sites, 2000-2010.

Annual average concentrations of potentially toxic VOCs are shown in Figures 23-25. Figure 23 shows the trend for benzene, Figure 24 for butadiene and Figure 25 for xylenes.

There is a clear difference between the rural (Pt. Lepreau) and urban sites with respect to benzene, which is an important component of gasoline. Although there are noticeable differences between the sites, there is no clear trend at any of the sites over the past several years.

Butadiene is emitted during petroleum refining and subsequent handling, as well as from internal combustion engines (e.g. CARB, 1992).

Xylenes are associated with vehicle exhaust (Multistakeholder NOx/VOC Science Program, 1997a). There was a slight increase in the level of xylenes sampled at both urban sites in 2010.

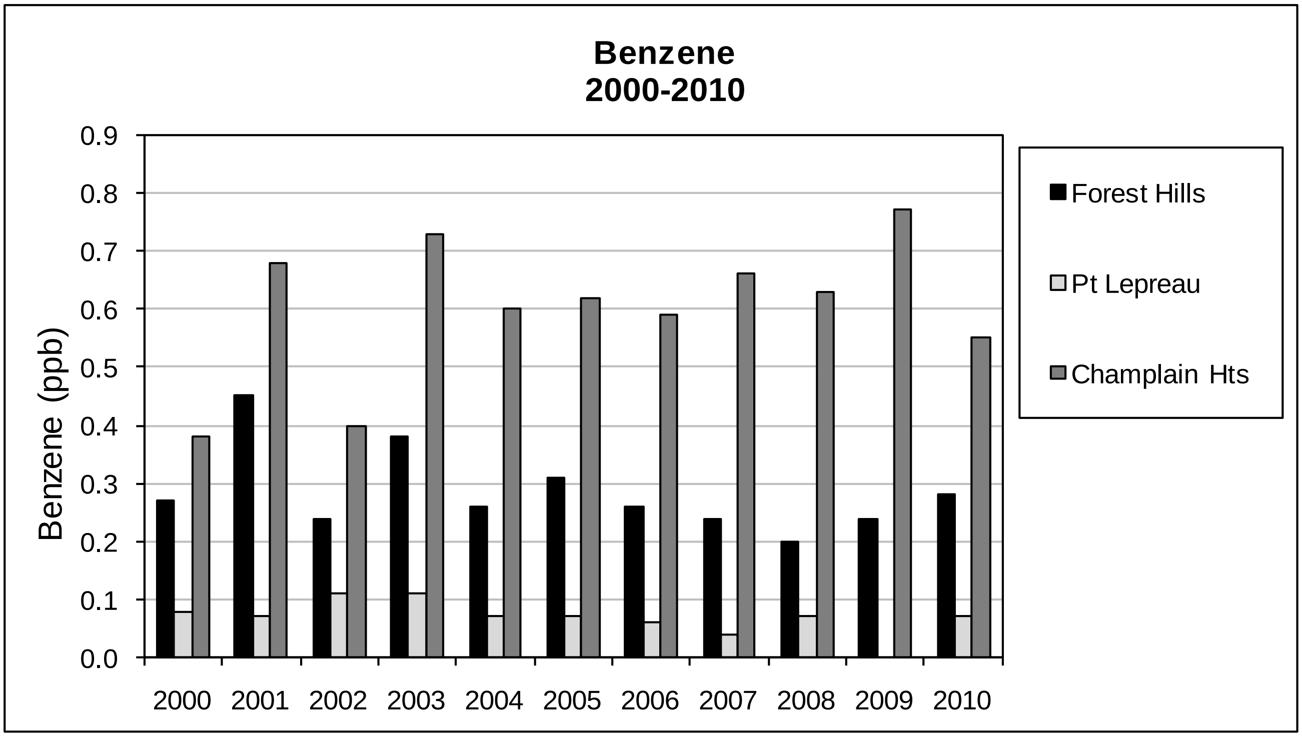

Figure 23. Annual average concentration of benzene at provincial VOC monitoring sites, 2000-2010.

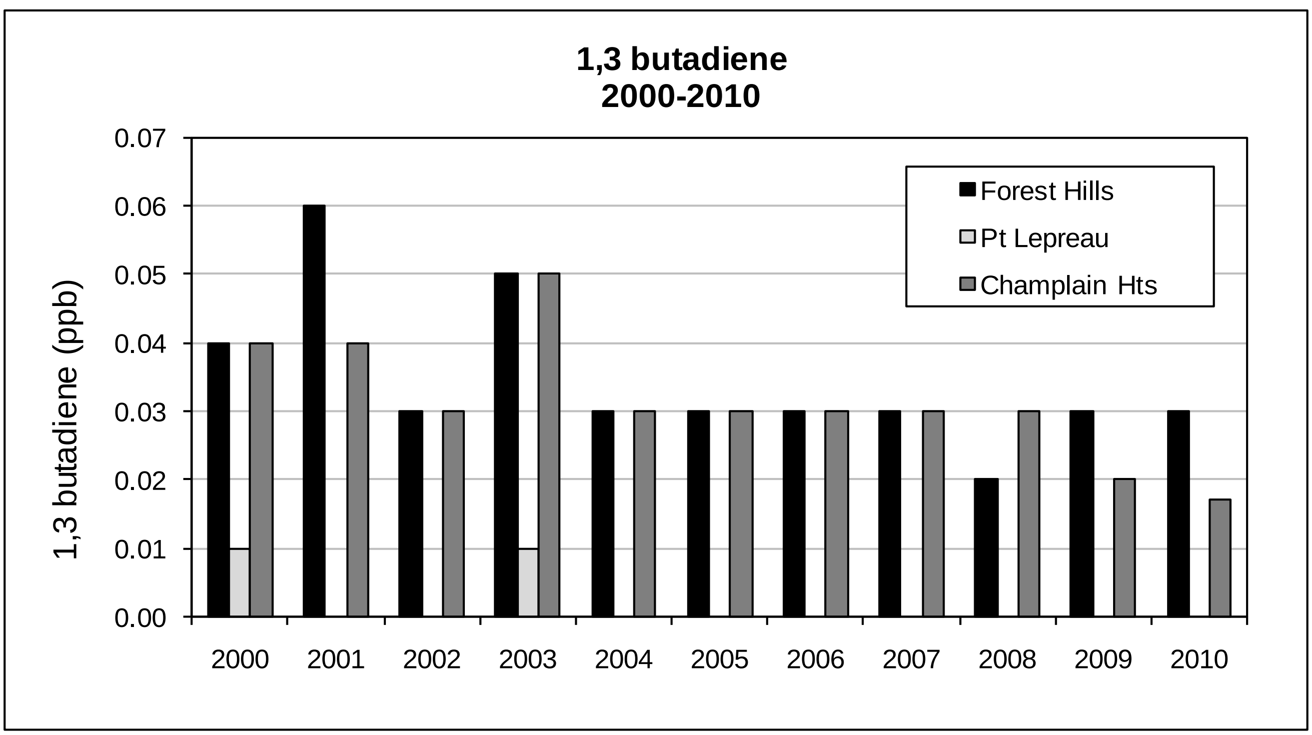

Figure 24. Annual average concentration of 1,3 butadiene at provincial VOC monitoring sites, 2000-2010.

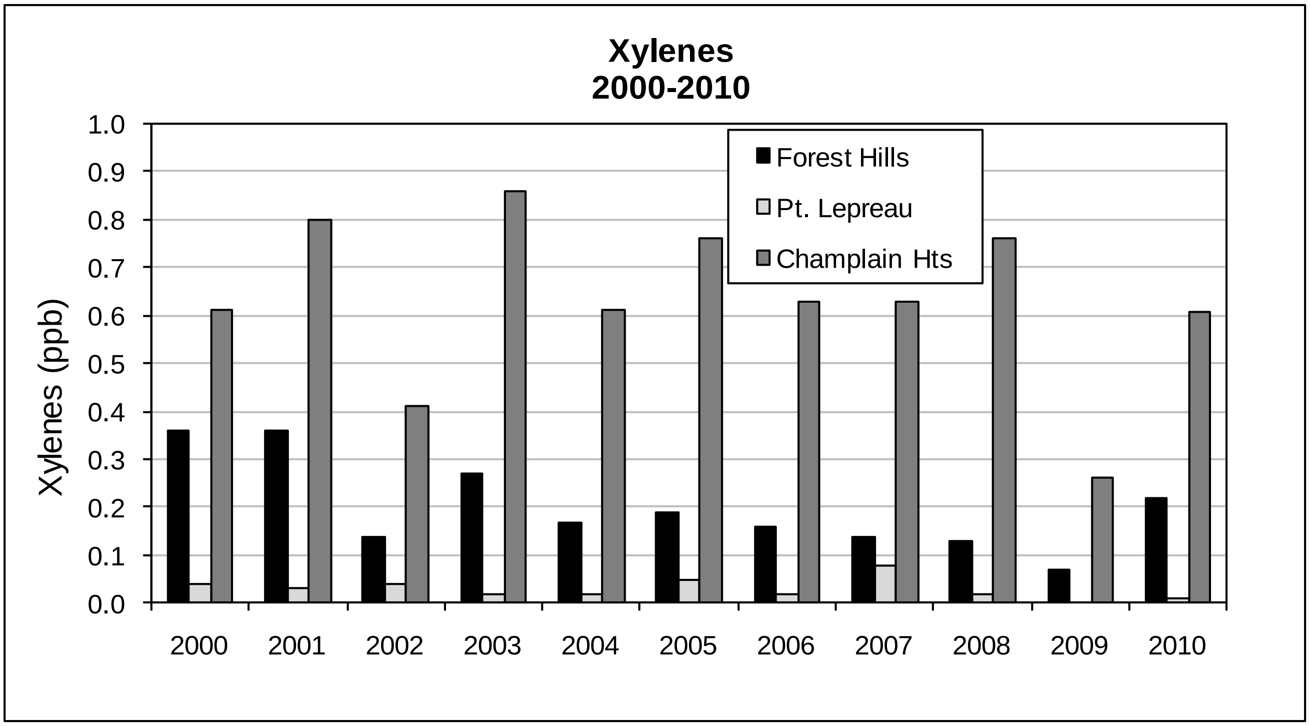

Figure 25. Annual average concentration of xylenes at provincial VOC monitoring sites, 2000-2010.

11. AIR QUALITY INDICES

A. 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 for over 25 years. The intent of the index is to help make air quality monitoring results easier to understand. Rather than reporting raw data to the public, results for key pollutants (SO_2, NO_2, CO, O_3, and TRS) are expressed on a scale 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.

Additional IQUA information is available via the DELG web site:

http://www1.gnb.ca/0355/0003/0000.asp

2010 IQUA results are summarized in Figure 26 for Saint John, Fredericton, and Moncton. For a large majority of the time air quality was in the "good" IQUA category during 2010.

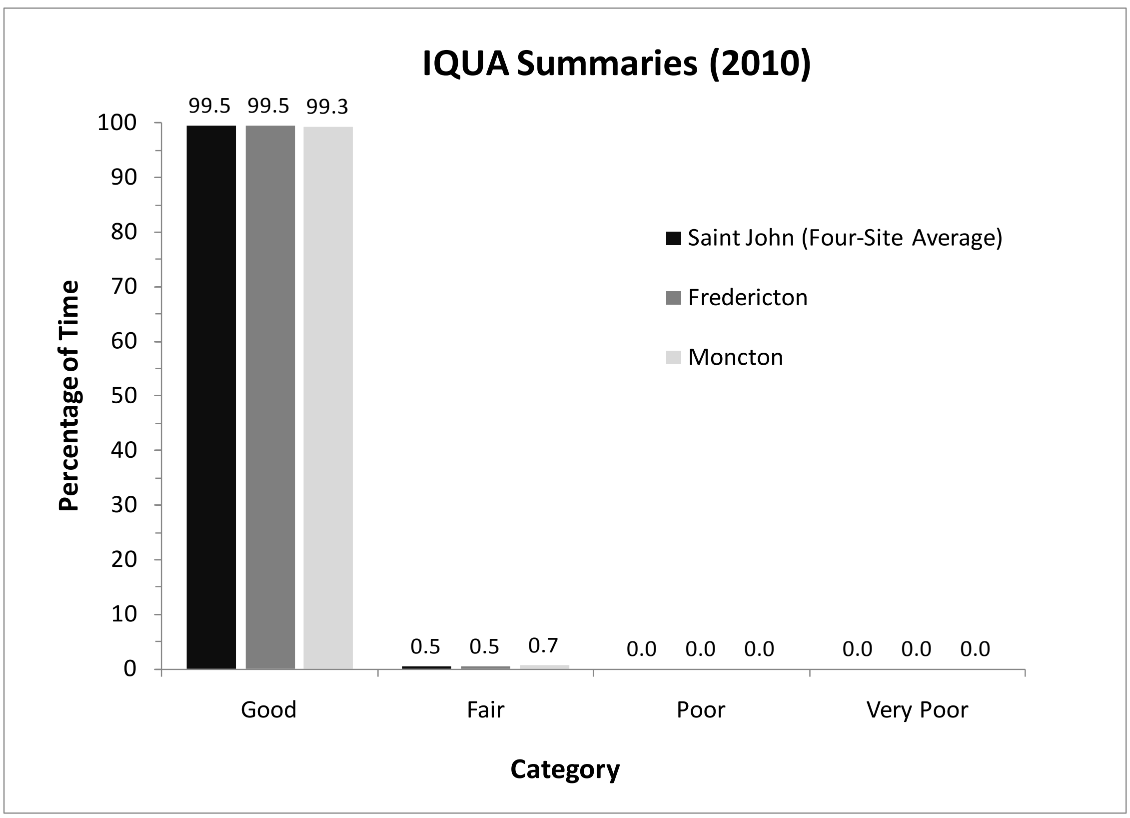

Figure 26. IQUA summaries for Saint John, Fredericton, and Moncton, 2010.

B. 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 focusses on the relationship between air quality conditions and associated health risks. The index provides specific advice for people that are especially vulnerable to the effects of air pollution as well as advice for the general public.

The index is based on the three key health-related pollutants: NO_2, O_3, and $PM_{2.5}$. It uses a scale of 1-10+, with higher values representing greater health risks and the need to take precautions. There are four categories of risk, low (1-3), moderate (4-6), high (7-10) and very high (>10). Each category has suggestions for individuals to reduce exposure, depending upon their sensitivity to air pollution.

In 2010 reporting of the index was expanded from Saint John, where it was initially launched, to also include Moncton and Fredericton.

2010 AQHI results for the three cities are summarized in Figure 27. The vast majority of this period was represented by the low risk category at all locations.

The AQHI is available via the following national websites: www.airhealth.ca or www.weatheroffice.ec.gc.ca.

Compared to IQUA, the AQHI is considered to be a better personal health protection tool and plans are being made to further expand the AQHI to other communities in New Brunswick. Eventually, as people become familiar with the AQHI, the IQUA program may be terminated.

Note that AQHI values for Saint John are based on averaged values from three monitoring locations, whereas Fredericton and Moncton values rely on a single station each.

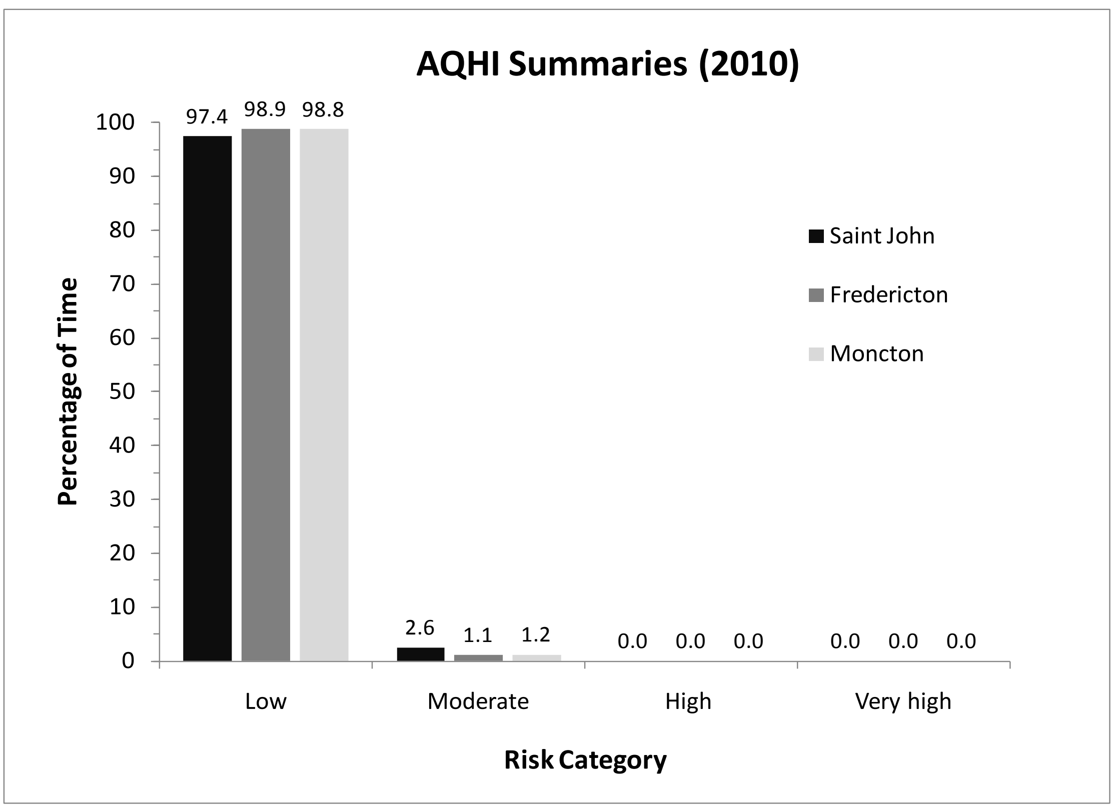

Figure 27. AQHI summaries for Saint John, Fredericton, and Moncton, 2010.

12. QUALITY ASSURANCE

A. Performance Testing of DELG Monitors

The provincial air quality network quality assurance program consists of a number of components, with involvement from both DELG and Environment Canada (EC). Sites managed by DELG are operated according to procedures and methods endorsed by the National Air Pollution Surveillance (NAPS) program, headquartered in Ottawa.

The objective of quality assurance procedures is to provide accurate, representative, comparable, high quality data using consistent operational protocols and standards. The NAPS agency provides calibration, reference standards, and technical support to DELG. Calibration gases are certified for accuracy and are either “primary reference standards” or are traceable to primary standards maintained by the National Institute of Standards and Technology (NIST) in Maryland.

Instruments used in both the provincial and industry networks must satisfy the requirements of the United States Environmental Protection Agency (EPA) or equivalent reference methods for ambient air monitoring. Methods not yet certified by the EPA are used if approved and tested by the NAPS agency.

Quality assurance tasks include regular site inspections, instrument response verifications, analyzer calibrations, and data review.

Air quality monitoring analysers are specialised instruments, requiring regular maintenance to ensure acceptable operation. In addition, calibration procedures are necessary to ensure accurate results are obtained. For instruments measuring pollutants in gas form, calibration involves introducing known concentrations of the pollutant gas to the analyser, and monitoring the response. Three or four concentration values are used when performing such a “multipoint” calibration. Certified flow, temperature and pressure standards are used for equipment that measures particulate matter.

The performance of DELG operated sites is periodically audited by EC. These randomly selected audits are completed every two years to ensure acceptable data quality. Since the beginning of the program, these audits have consistently confirmed the high quality of DELG’s reported data.

All monitors at the Moncton monitoring station were audited in 2010. The audit identified no issues that would invalidate any data collected. However, the NO_x analyser required calibration.

An interlaboratory testing program is typically also conducted annually. This consists of the analysis of gases supplied “blind” (i.e., with no information on the true concentration) by the NAPS laboratory. DELG technicians analyze the blind test gas using their calibration equipment and send the results to NAPS, who return a report on performance to the Province. This serves to standardize the performance of calibration systems within the province and across the country. EC did not exercise this system in 2010.

All data is also reviewed and validated by DELG. This involves examining results, taking into account instrument records, especially “zero and span drift” (measures of internal instrument changes), other site records, maintenance procedures, calibration of the analyzers, adjustments made to operating settings, performance and history of the analyzers, seasonal conditions, and changes and levels of other pollutants during a given time frame.

B. Oversight of Industry-Operated Monitors

Similar to the audit process conducted by Environment Canada for DELG monitors, DELG staff visit monitoring sites operated by industry in New Brunswick, and perform independent site audits. This performance testing helps identify and solve problems, prevent problems from developing, and assure data quality within the provincial monitoring system.

Results of air quality monitoring audits completed in 2010 are summarized in Table 21. A total of 17 instrument audits were carried out in 2010. Two instruments failed the audit, reporting errors greater than 10%. One instrument (Belledune East SO_2) also exceeded the 15% error limit for data reliability. Data reported from this station was subsequently investigated and a 10-day portion was removed from the reported results. Figure 28 illustrates audit results from 1998 to 2010. As shown, there has been substantial improvement in the amount of failed audits over this time period, as related to the industry network.

Table 21. Industry-operated air quality monitoring equipment performance tests, 2010.

Operator	Site	Instrument	Date	Error (%)	Pass/Fail
AV Cell Inc. - Atholville	Boom Rd.	SO_2	26-Oct-10	8	P
	Beauvista	SO_2	26-Oct-10	1	P
Irving Pulp and Paper Ltd.	Sherbrook	TRS	16-Sept-10	10	P
	Milford	TRS	16-Sept-10	5	P
Irving Oil Ltd.	Forest Products	SO_2	9-Dec-10	5	P
	Grandview West 2	NO_x	9-Dec-10	4	P
	Midwood Ave	SO_2	7-Dec-10	1	P
		TRS	7-Dec-10	3	P
	Champlain Heights	$PM_{2.5}$	22-Oct-10	1	P
NB Power Millbank	Lower Newcastle	NO_x	7-Oct-10	0	P
		SO_2	7-Oct-10	5	P
NB Power Belledune	Belledune East	NO_x	25-Nov-10	3	P
		SO_2	25-Nov-10	41	F
Lake Utopia Paper	Mobile	SO_2	22-Jan-10	14	F
Xstrata – Brunswick Smelter	Chalmers	SO_2	6-Oct-10	7	P
	Boulay	SO_2	6-Oct-10	7	P
	Townsite	SO_2	6-Oct-10	7	P

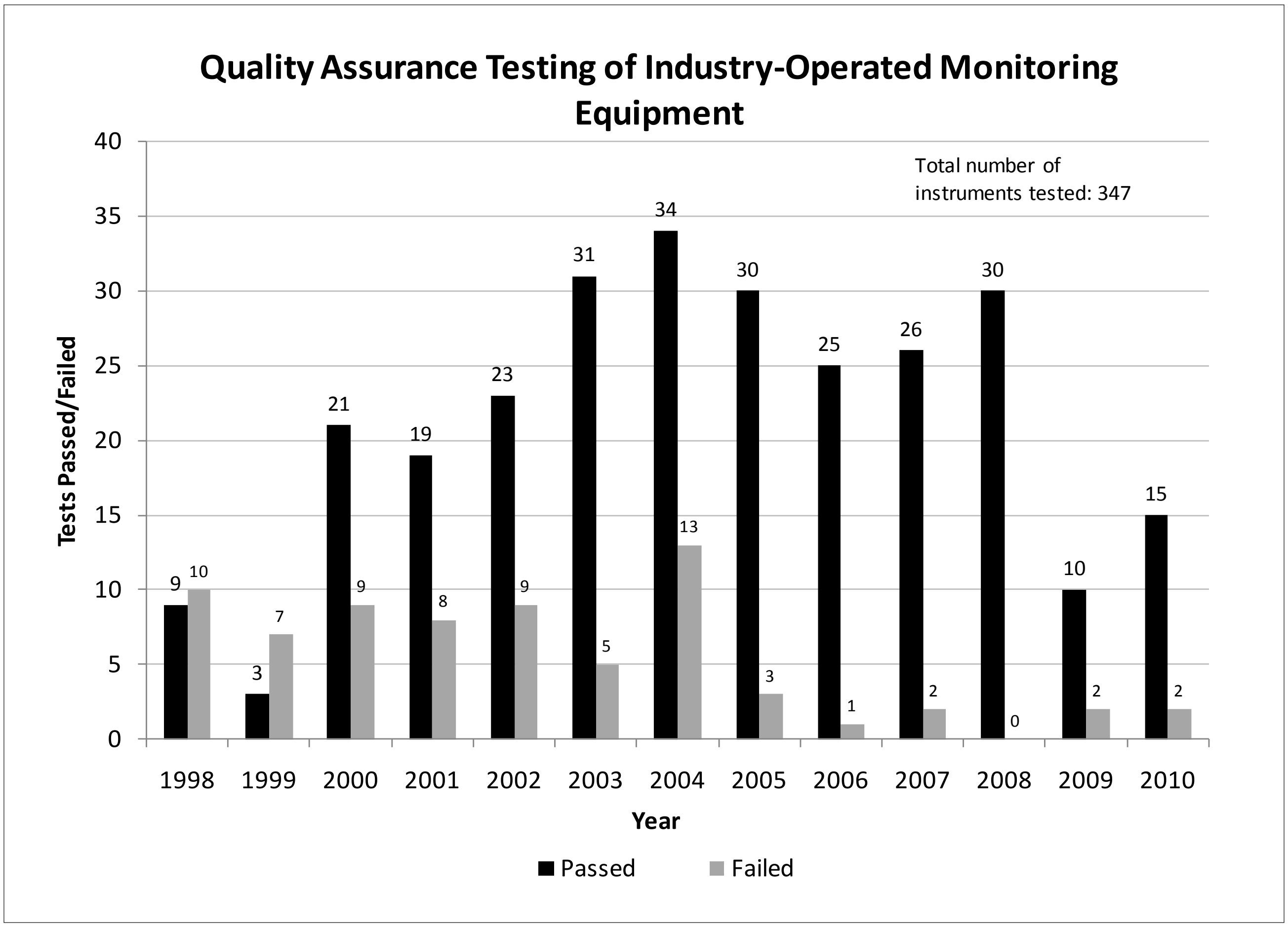

Figure 28. Industry-operated equipment testing, passed and failed for the years of 1998-2010.

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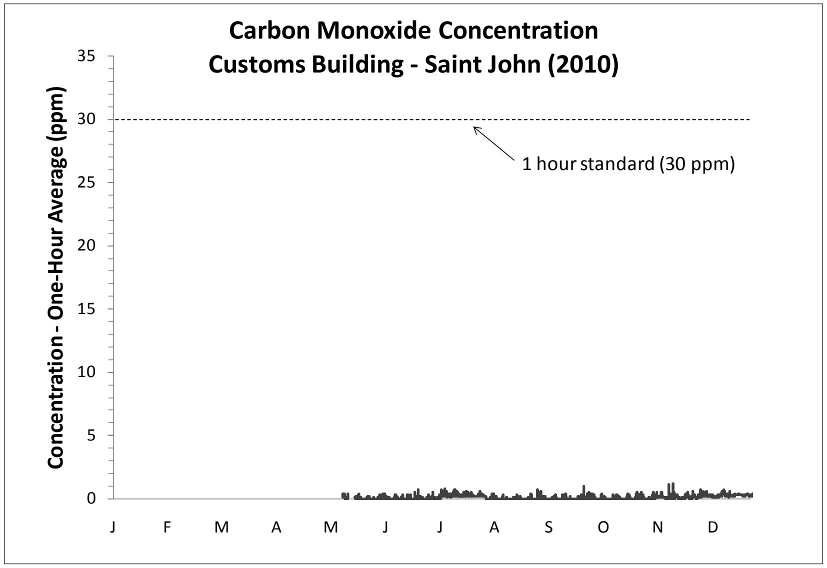
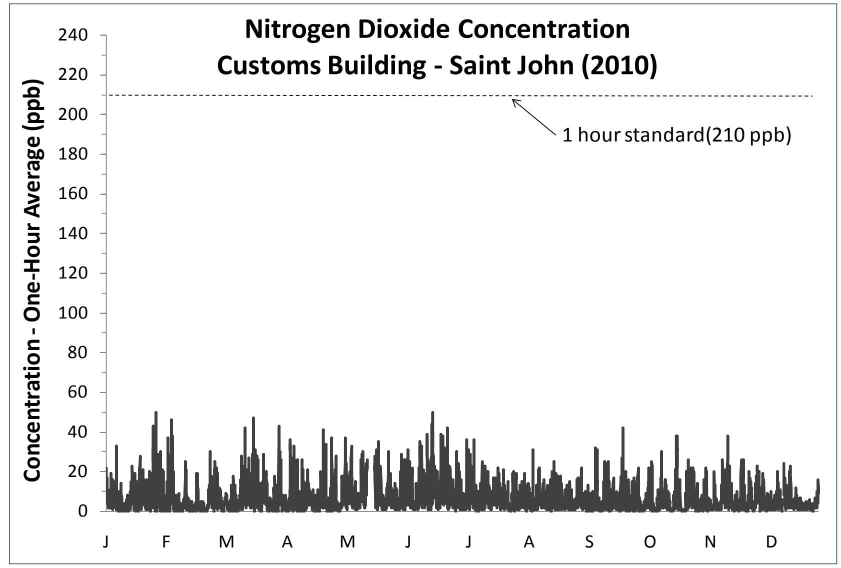
APPENDIX 1

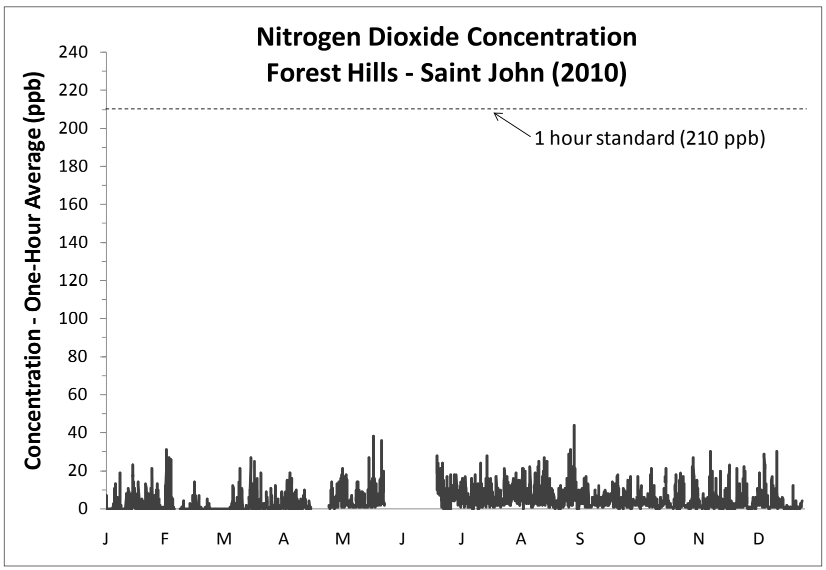
Detailed Monthly Air Quality Monitoring Results for 2010

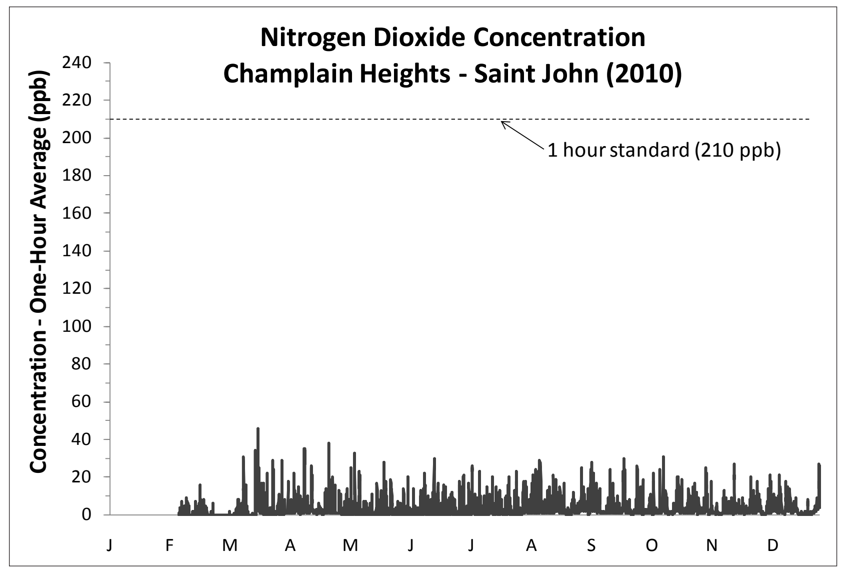
A. Saint John Air Quality Monitoring Network

Part I: DELG Monitoring Stations



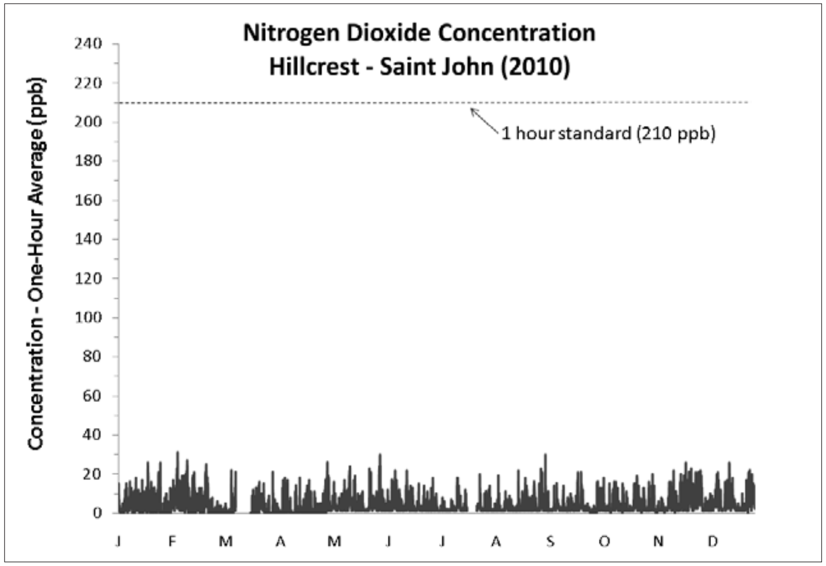


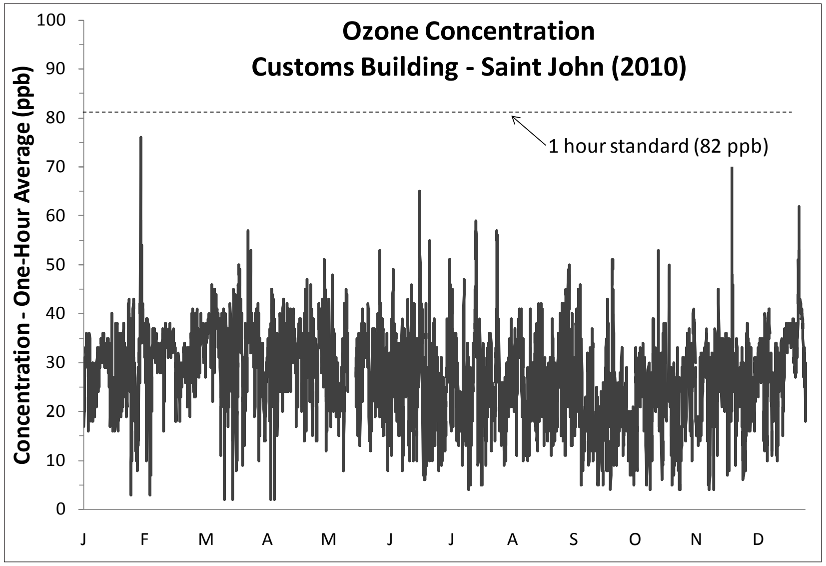


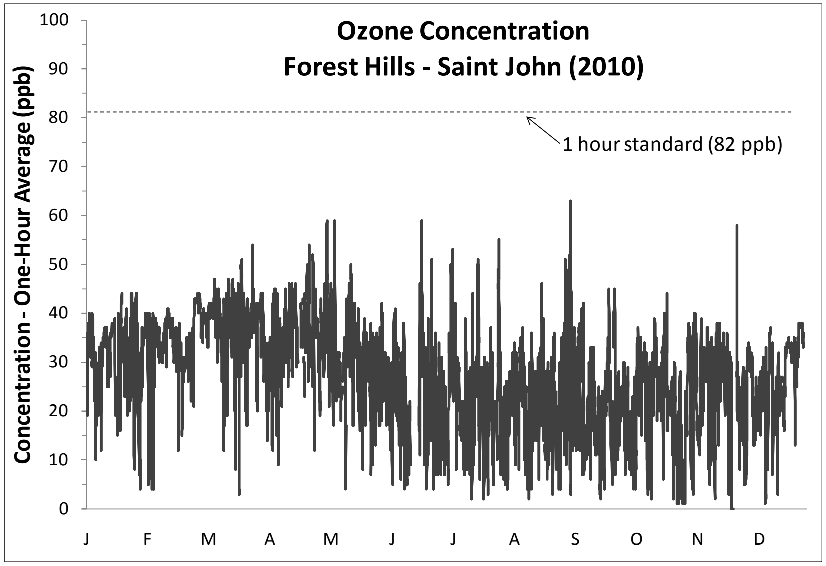


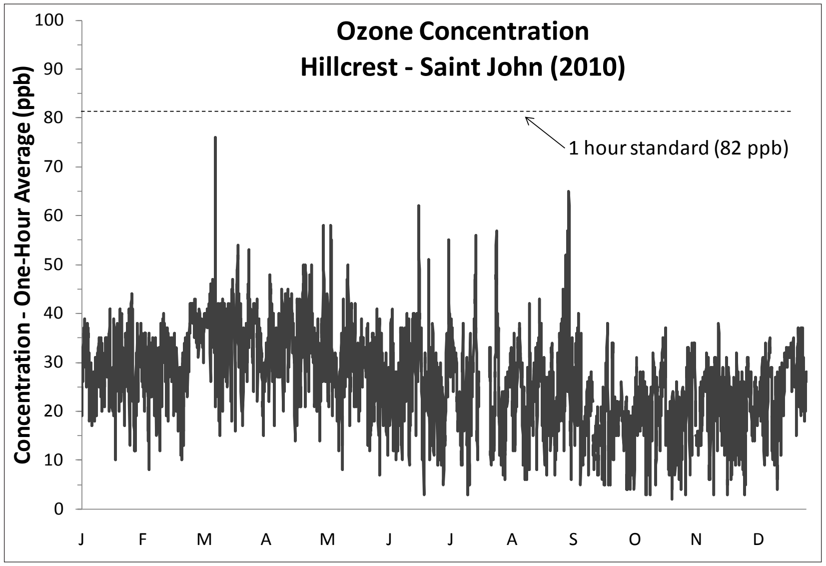
A. Saint John Air Quality Monitoring Network

Part I: DELG Monitoring Stations



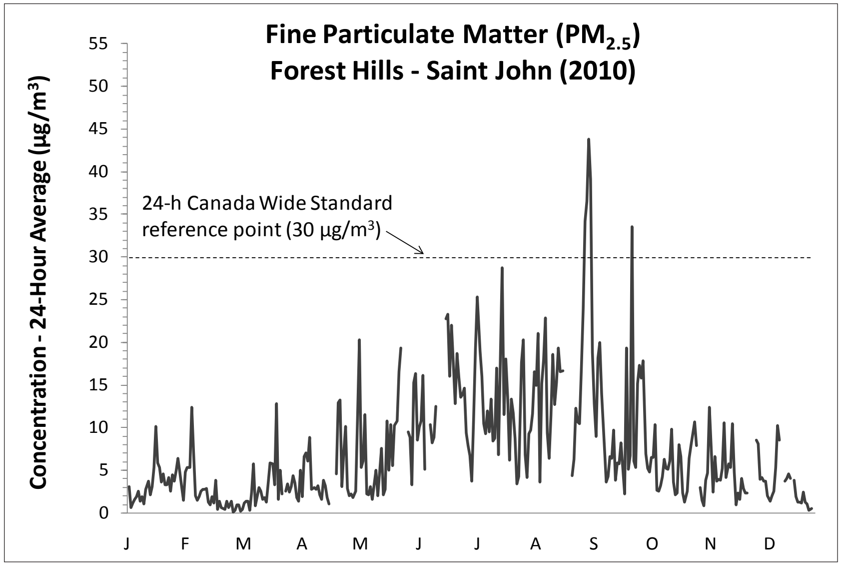


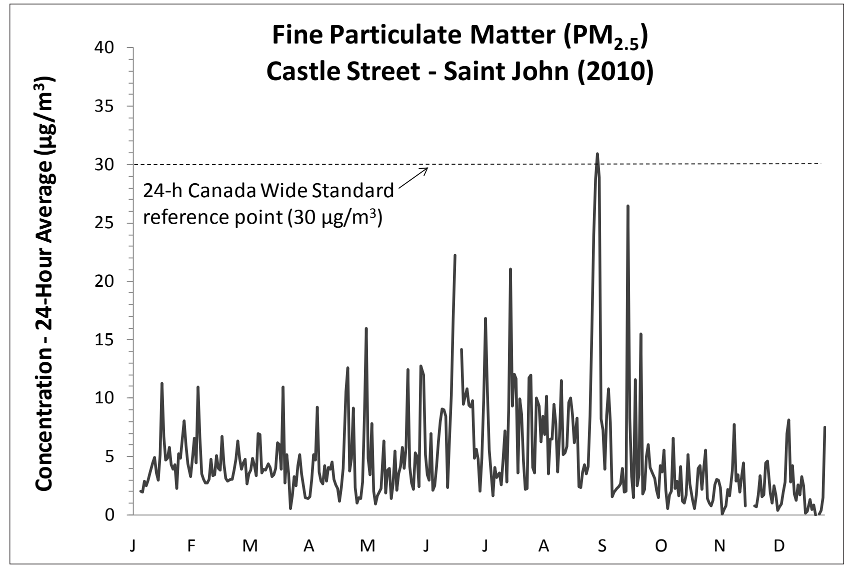


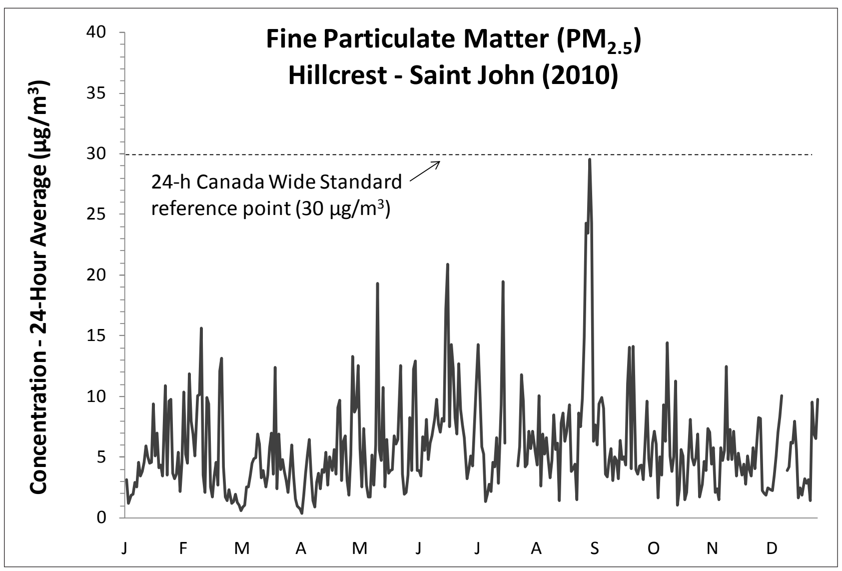


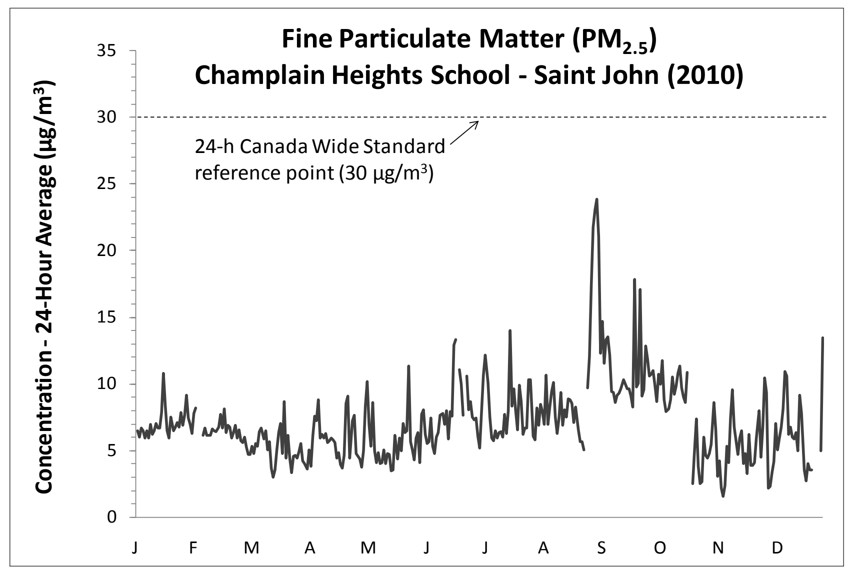
A. Saint John Air Quality Monitoring Network

Part I: DELG Monitoring Stations



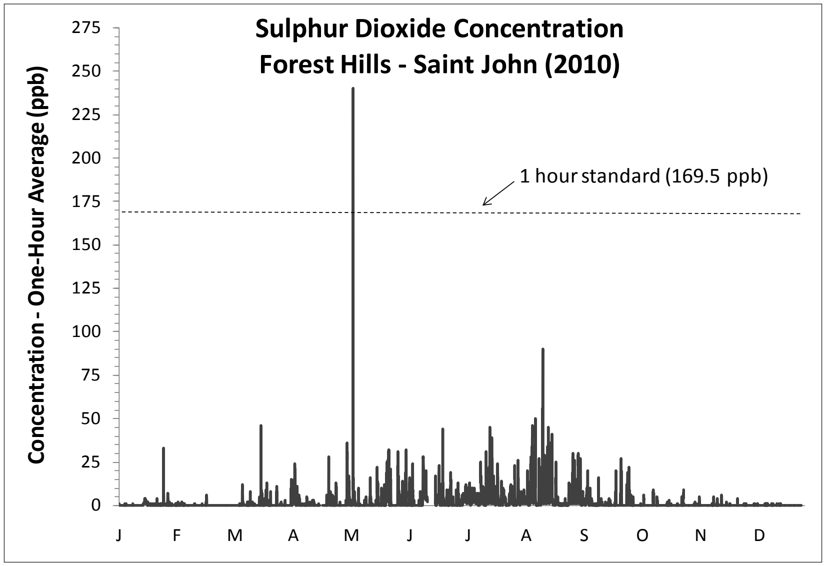


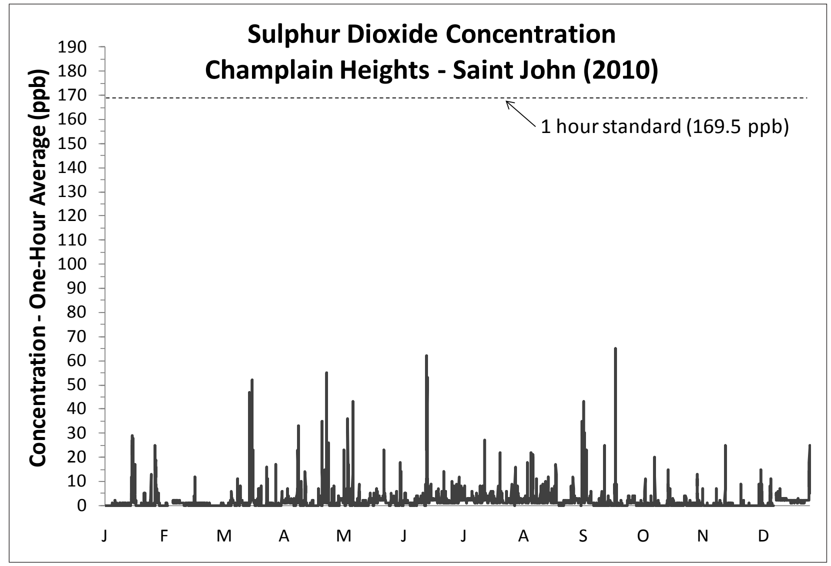


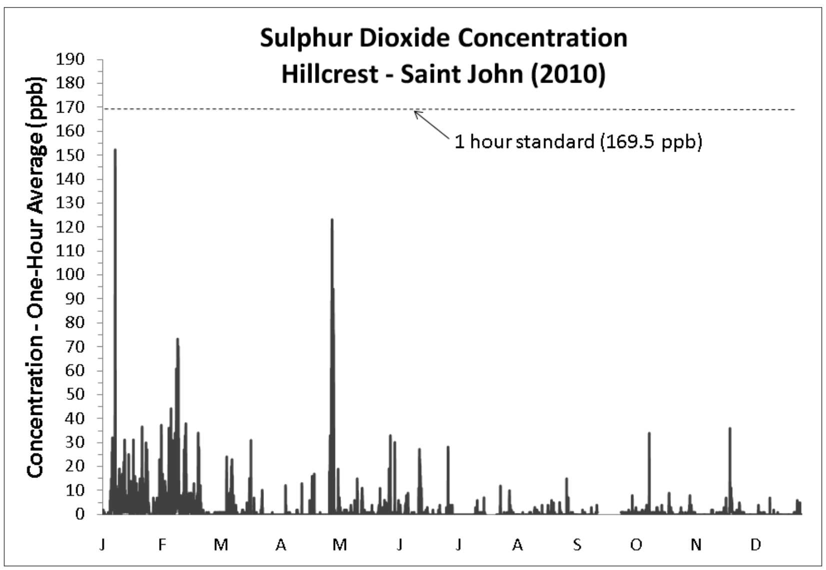


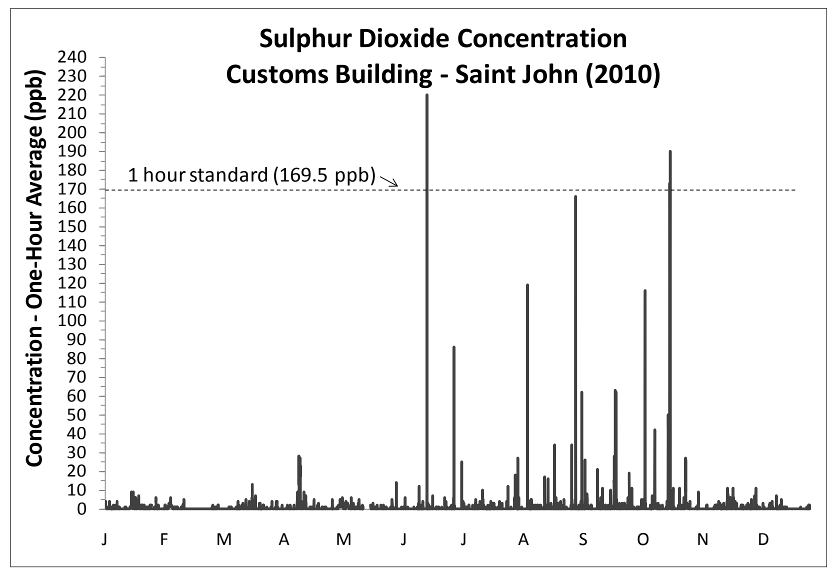
A. Saint John Air Quality Monitoring Network

Part I: DELG Monitoring Stations



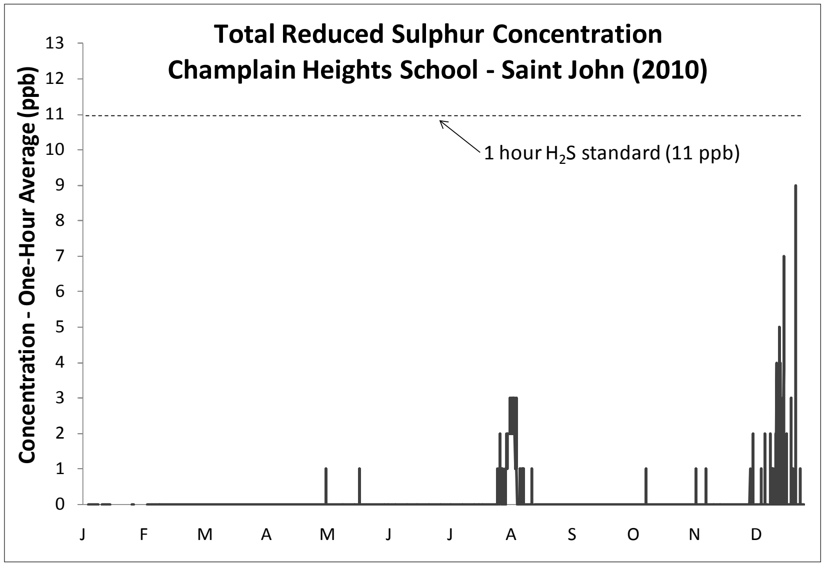


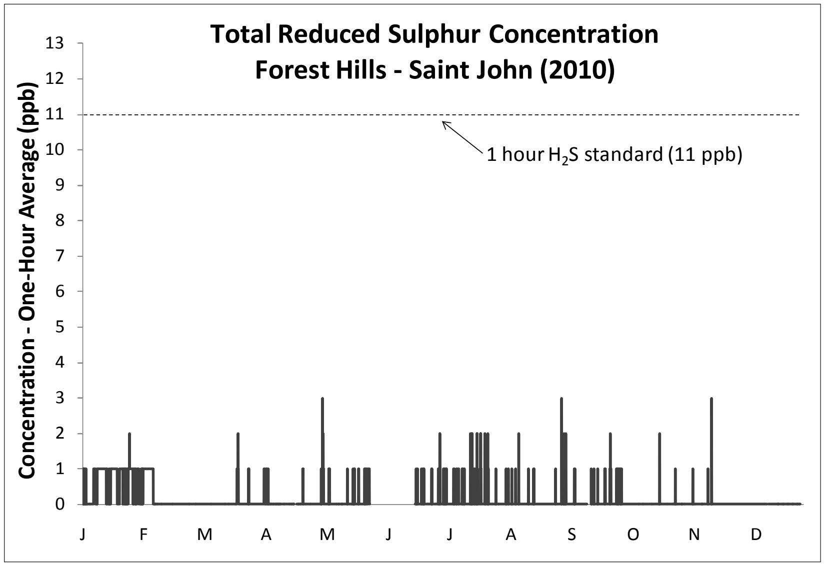


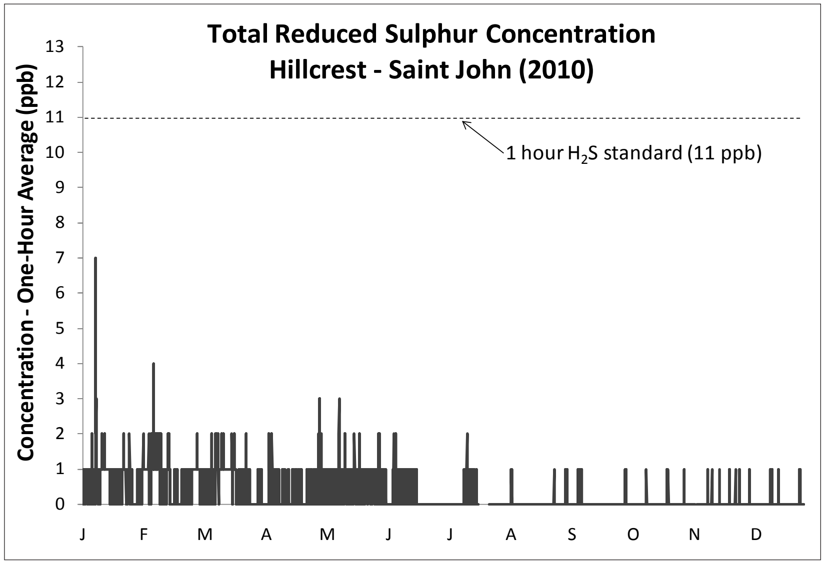


A. Saint John Air Quality Monitoring Network

Part I: DELG Monitoring Stations

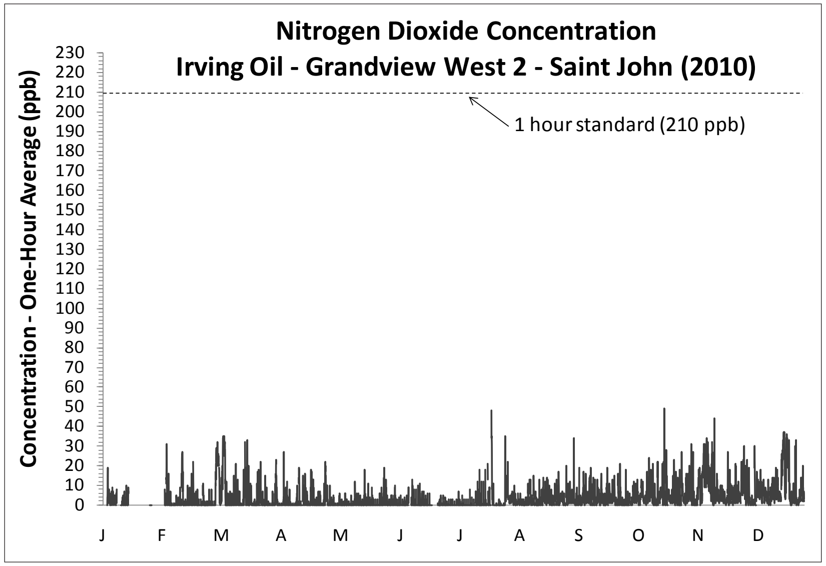


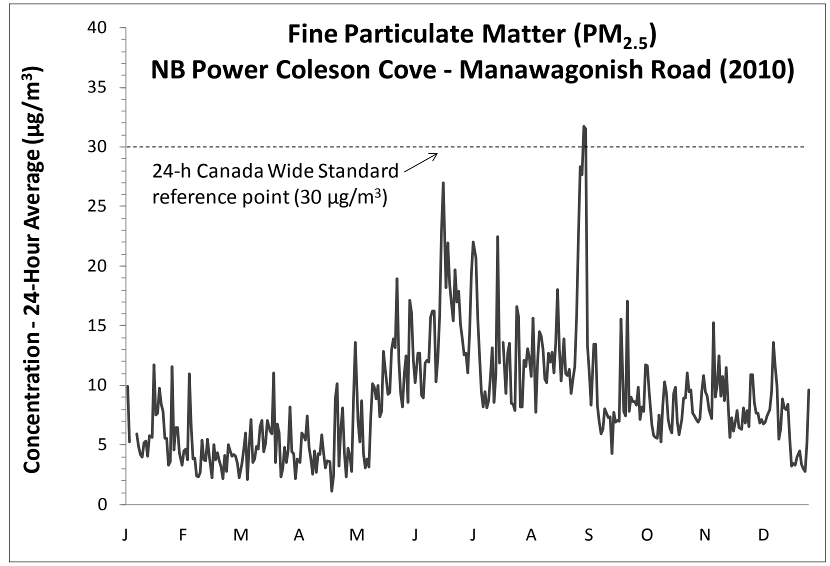


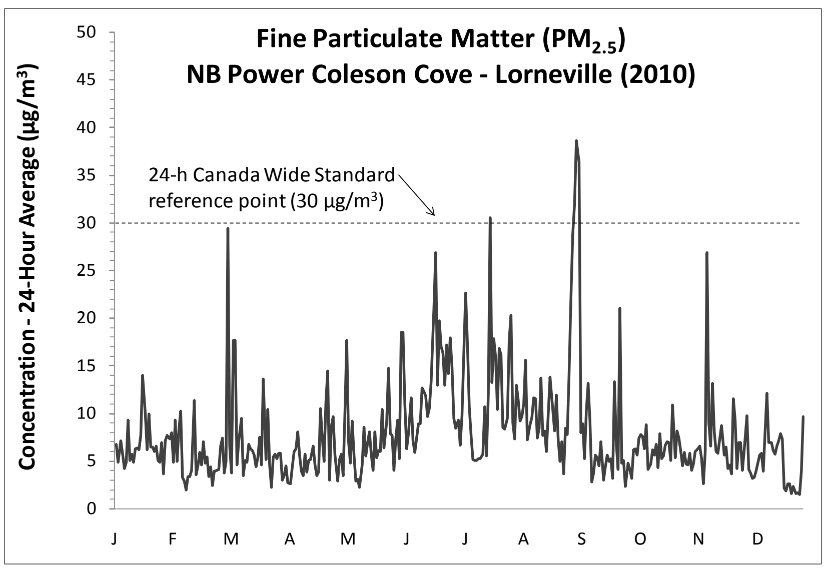


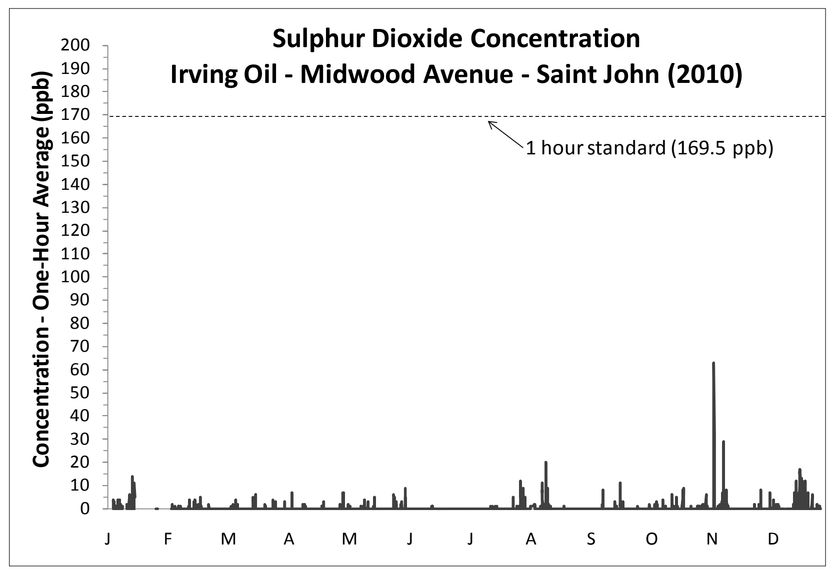
A. Saint John Air Quality Monitoring Network

Part II: Industry-Operated Monitoring Stations



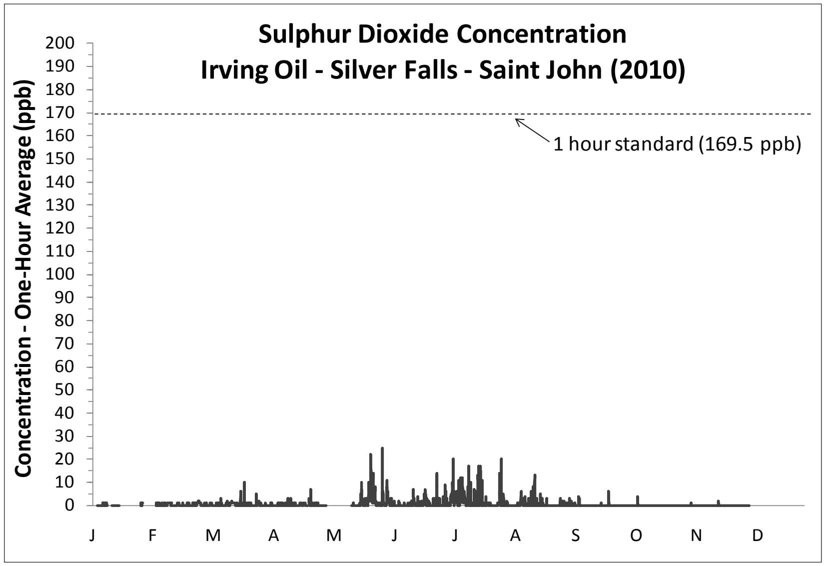


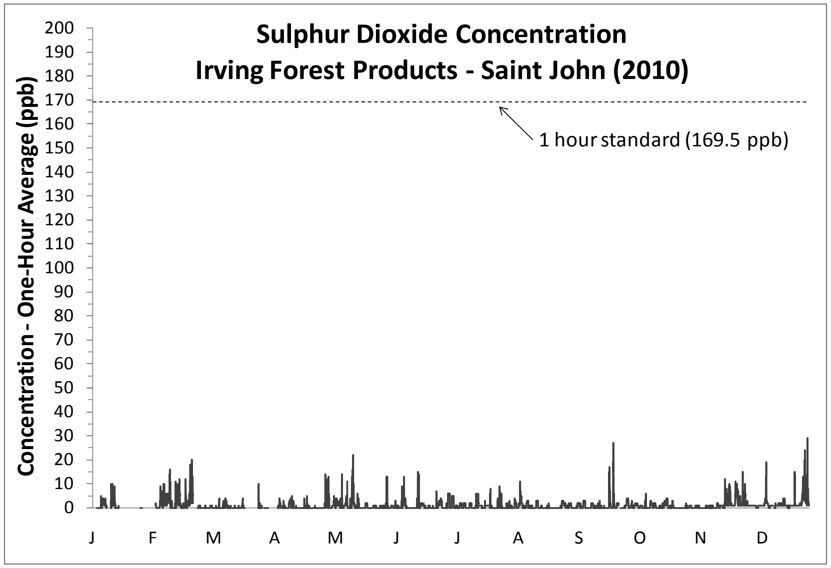


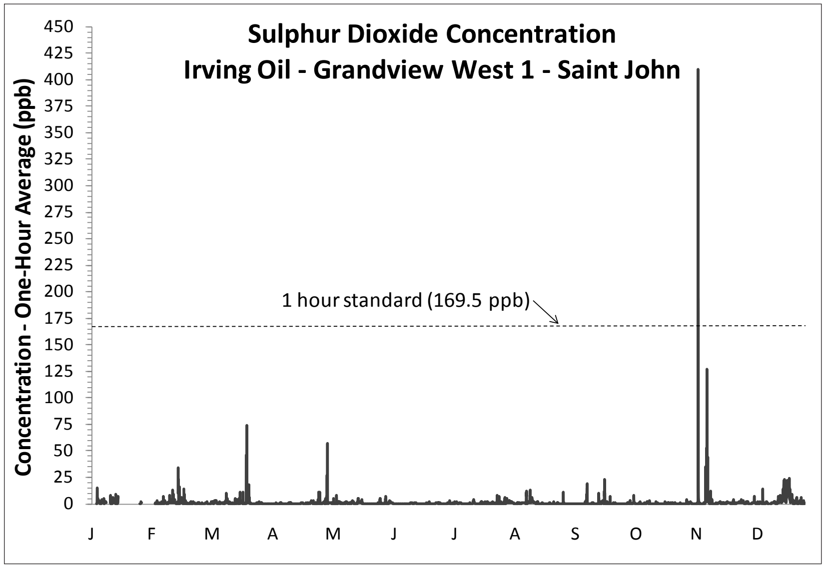


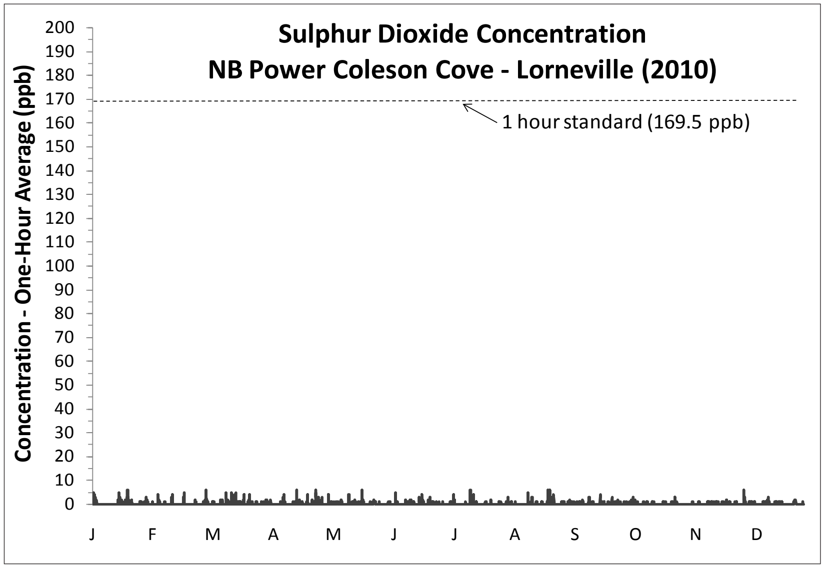
A. Saint John Air Quality Monitoring Network

Part II: Industry-Operated Monitoring Stations



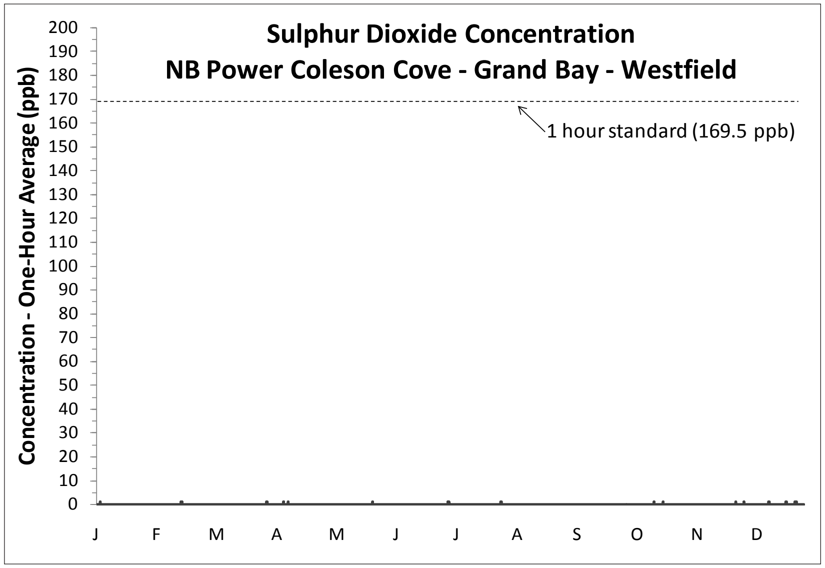


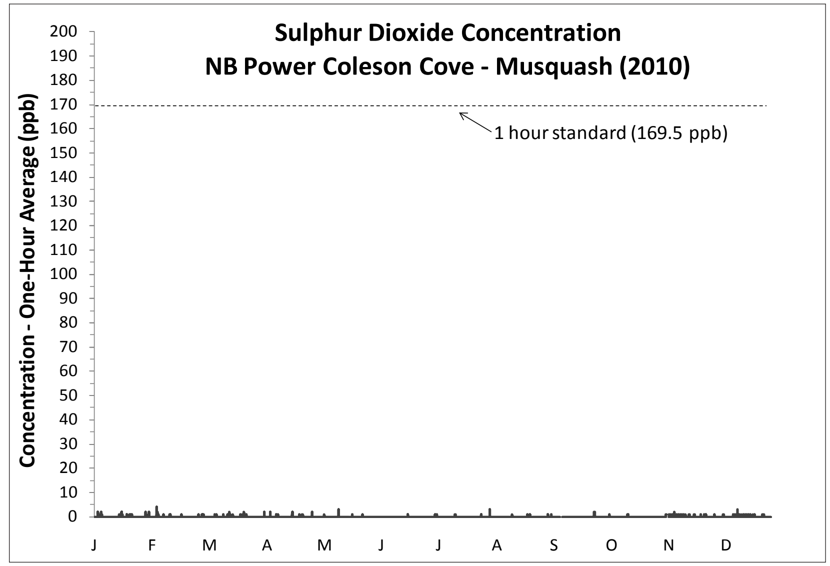


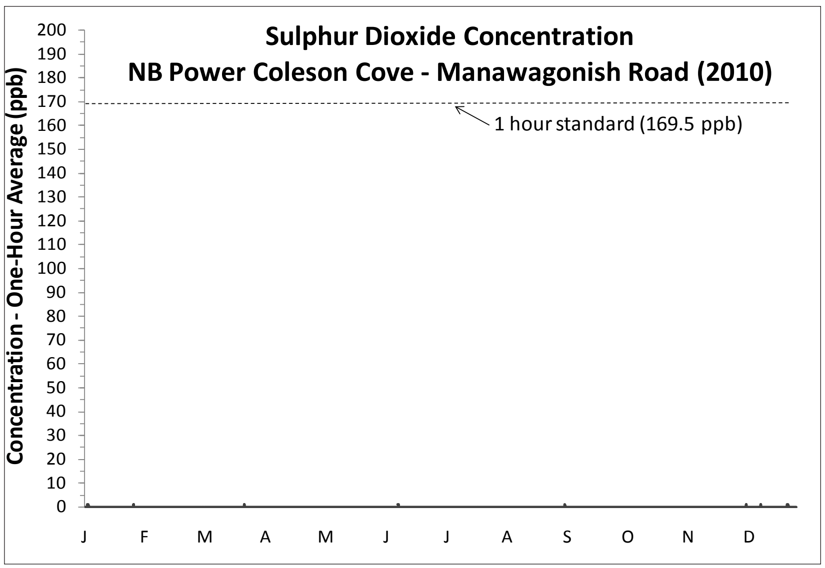


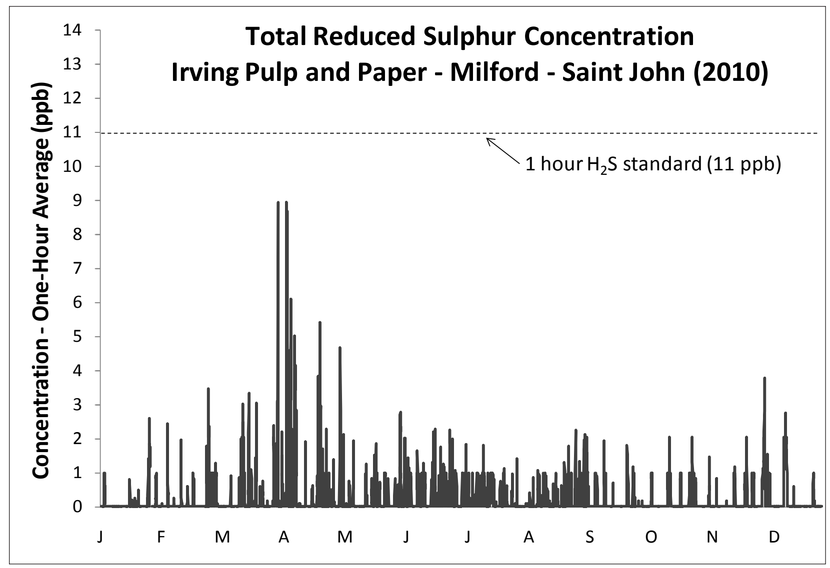
A. Saint John Air Quality Monitoring Network

Part II: Industry-Operated Monitoring Stations



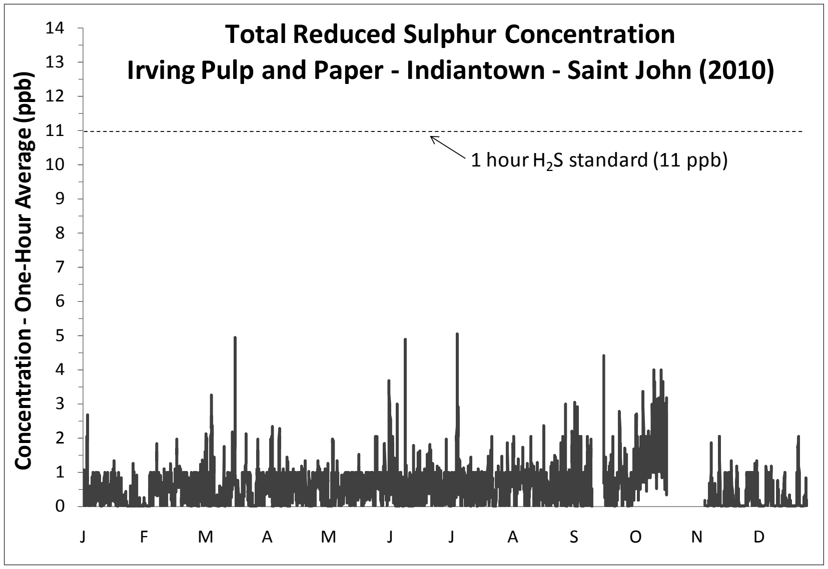


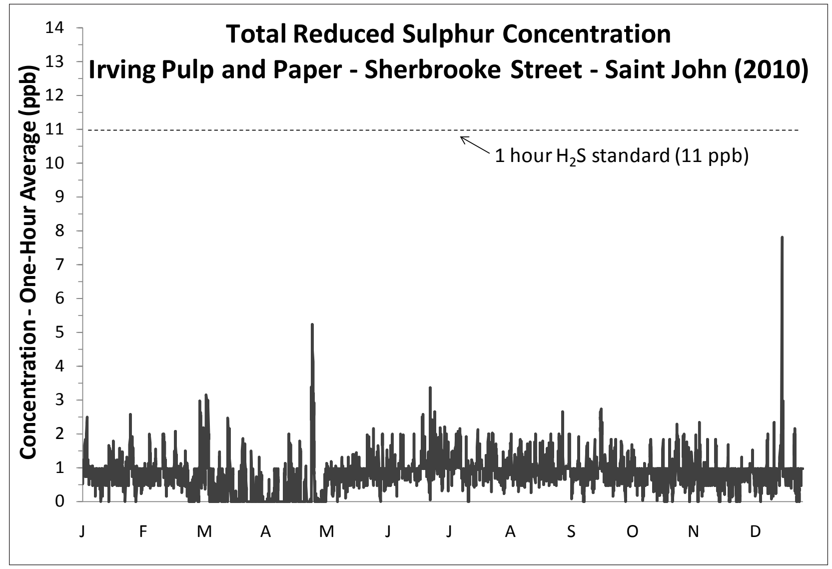


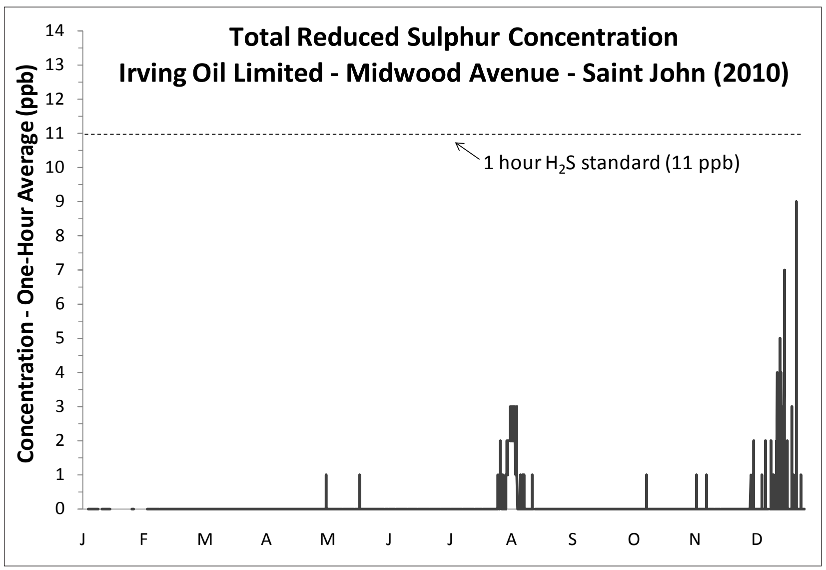


A. Saint John Air Quality Monitoring Network

Part II: Industry-Operated Monitoring Stations

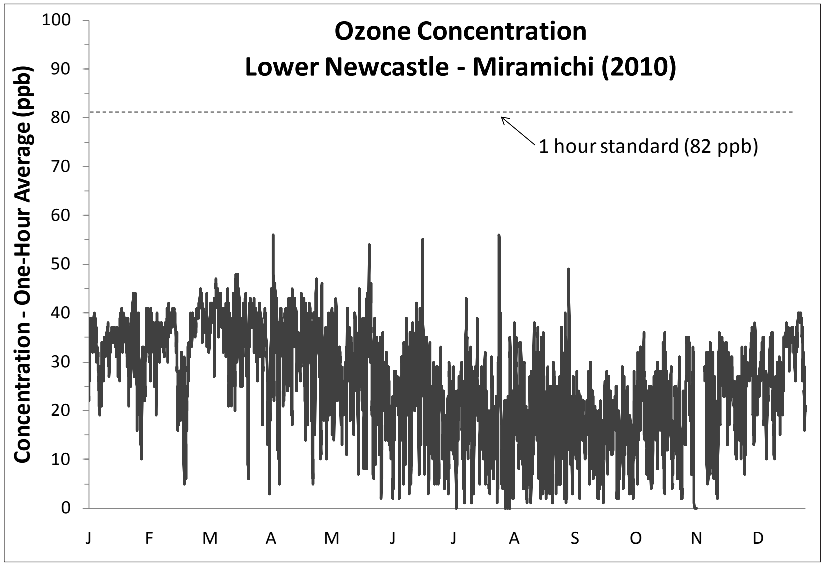






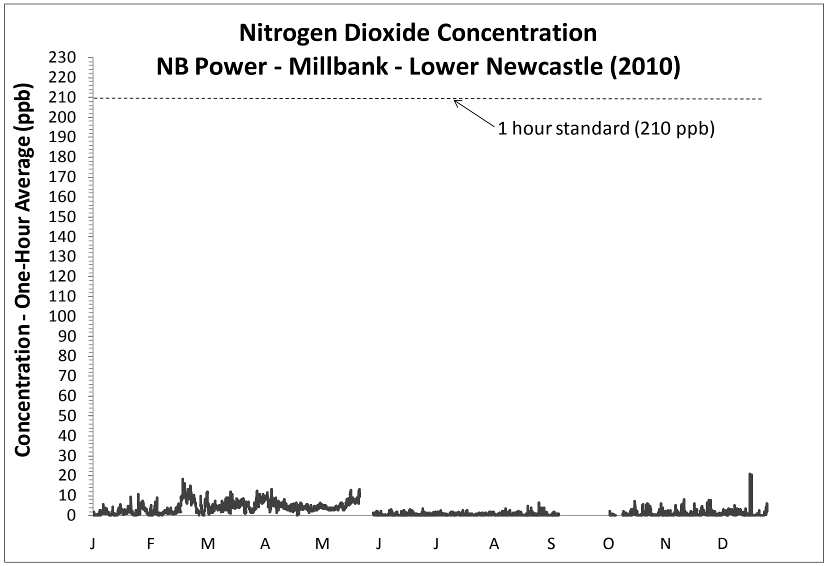
B. Miramichi Air Quality Monitoring Network

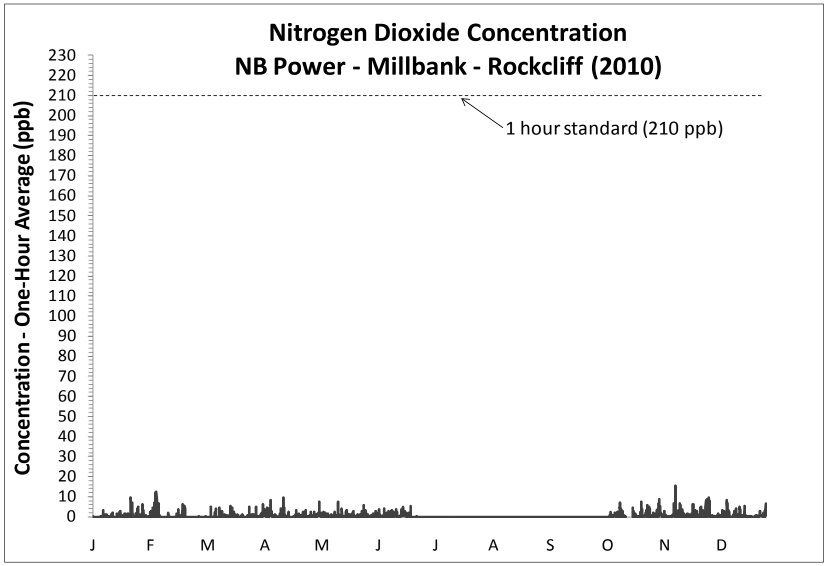
Part I: DELG Monitoring Station

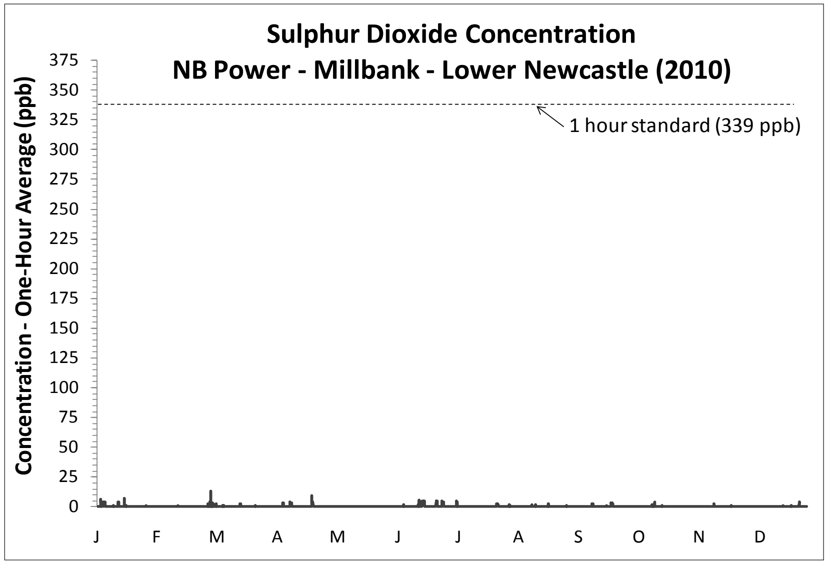


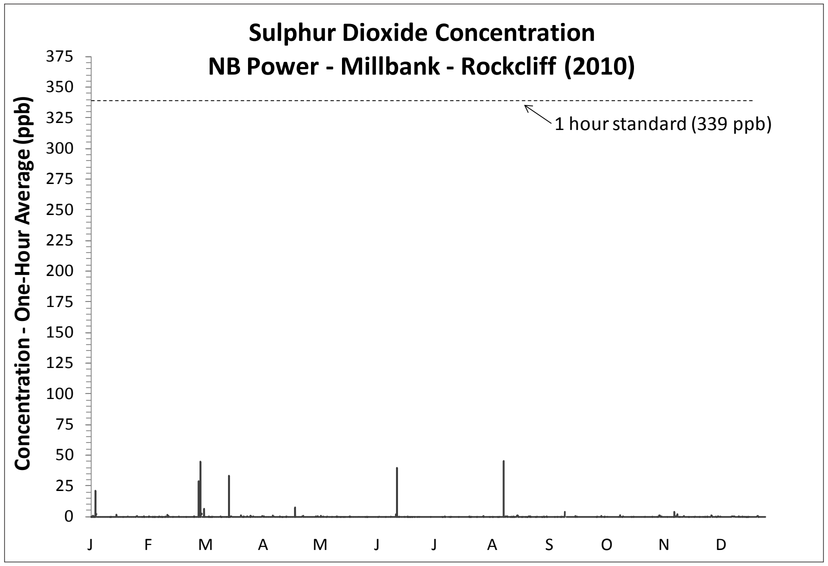
B. Miramichi Air Quality Monitoring Network

Part II: Industry-Operated Monitoring Stations



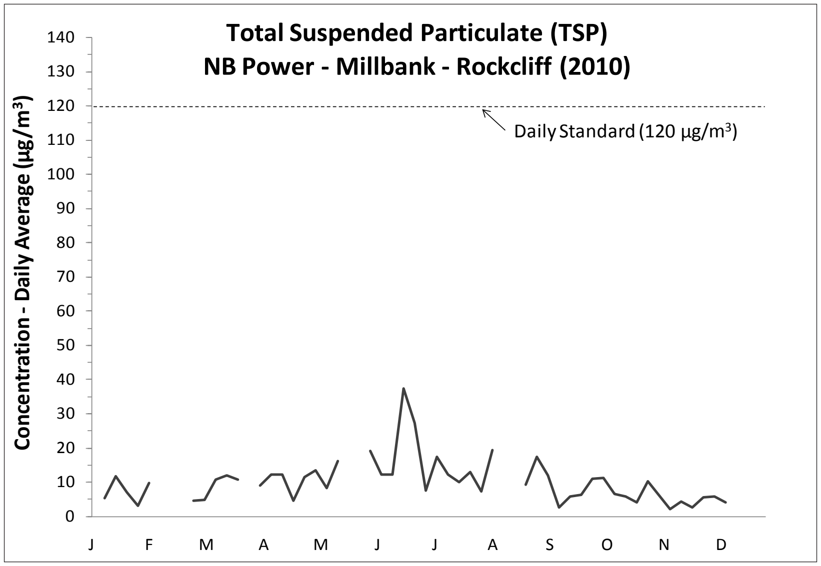






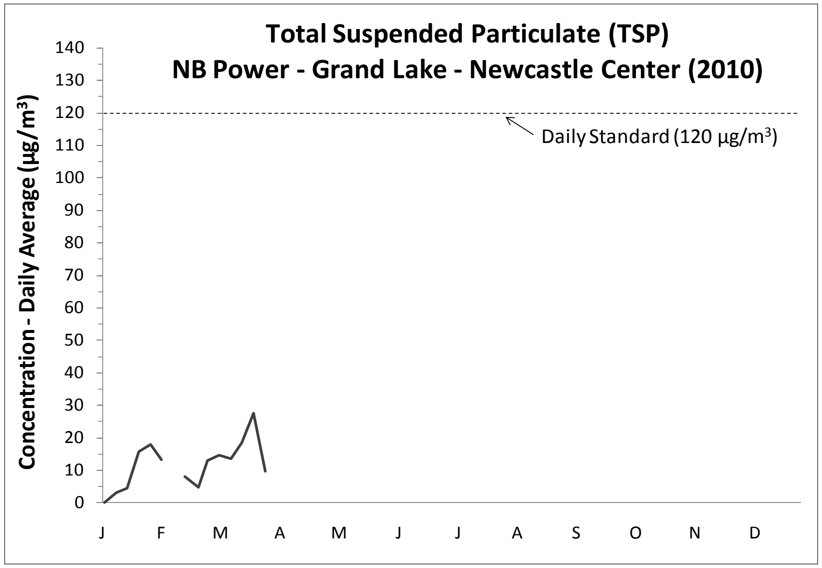
B. Miramichi Air Quality Monitoring Network

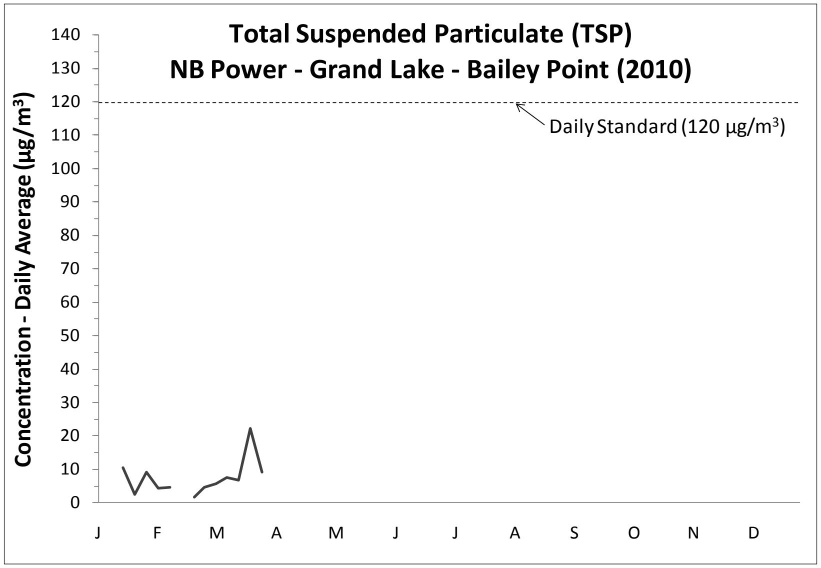
Part II: Industry-Operated Monitoring Stations

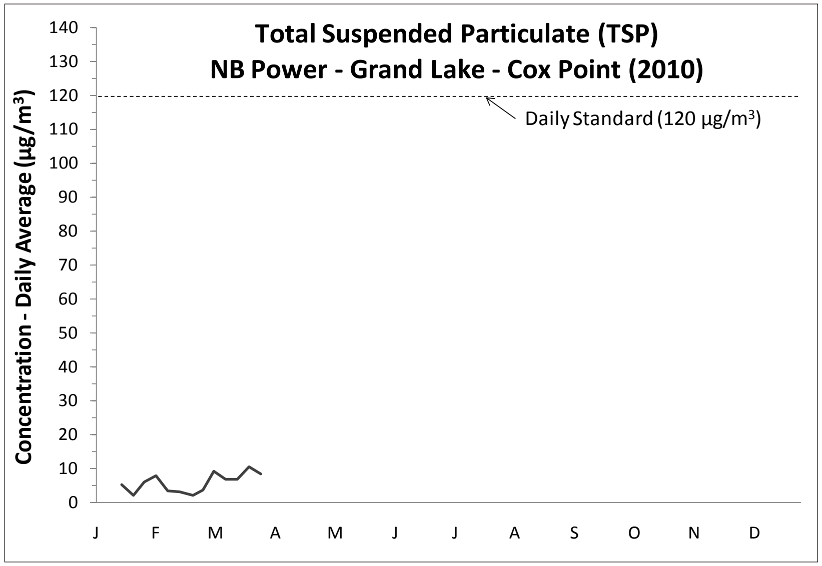


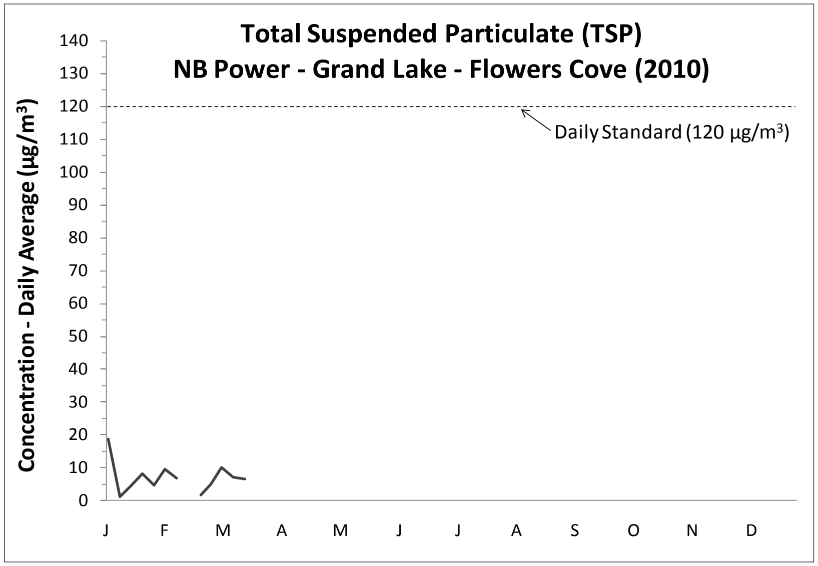
C. Grand Lake Air Quality Monitoring Network

Industry-Operated Monitoring Stations



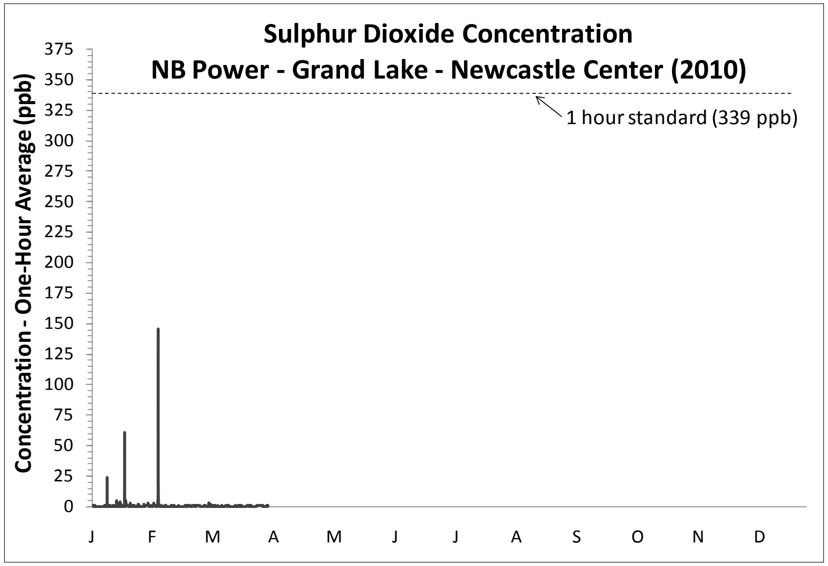


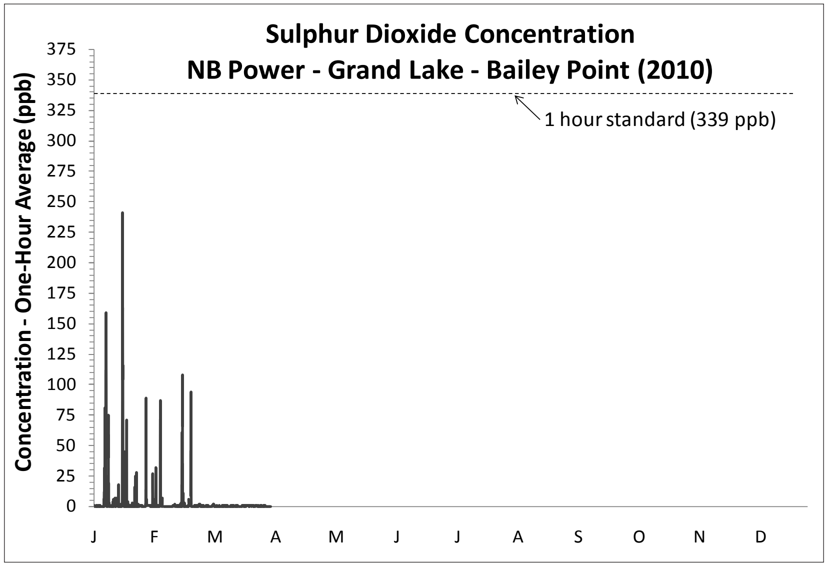


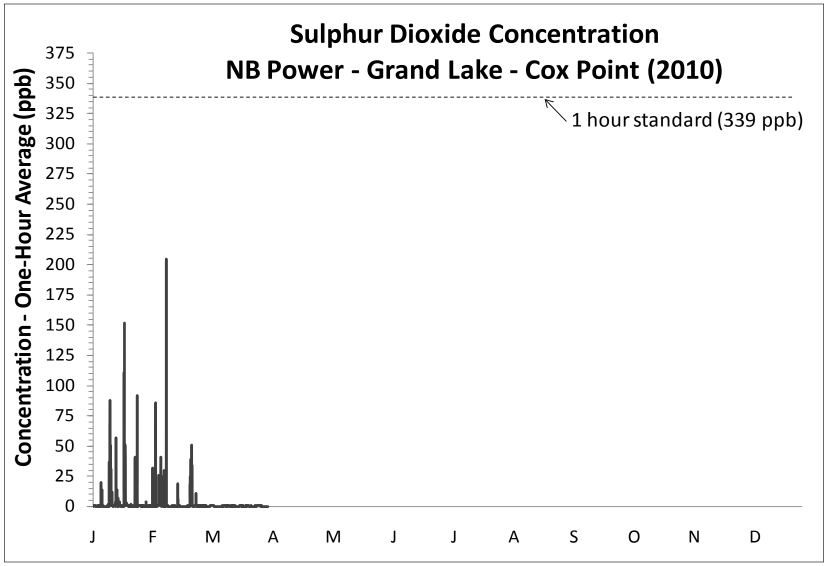


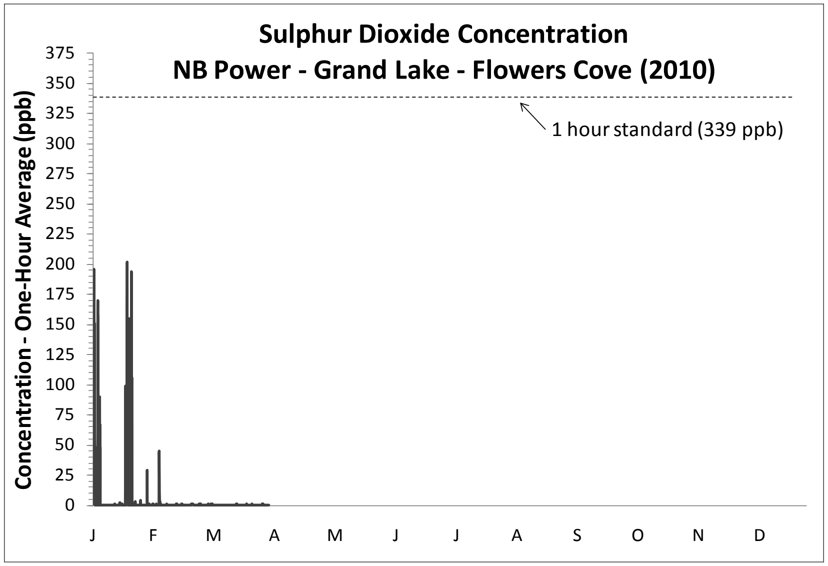
C. Grand Lake Air Quality Monitoring Network

Industry-Operated Monitoring Stations



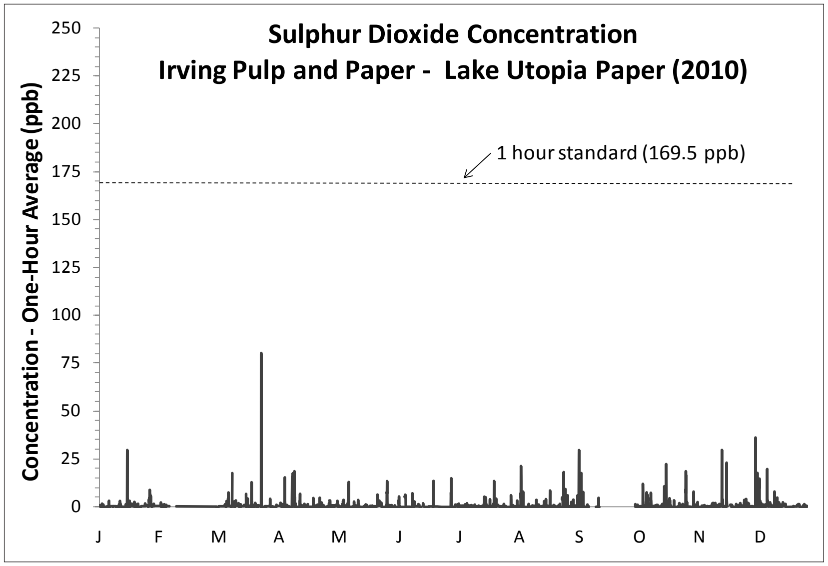






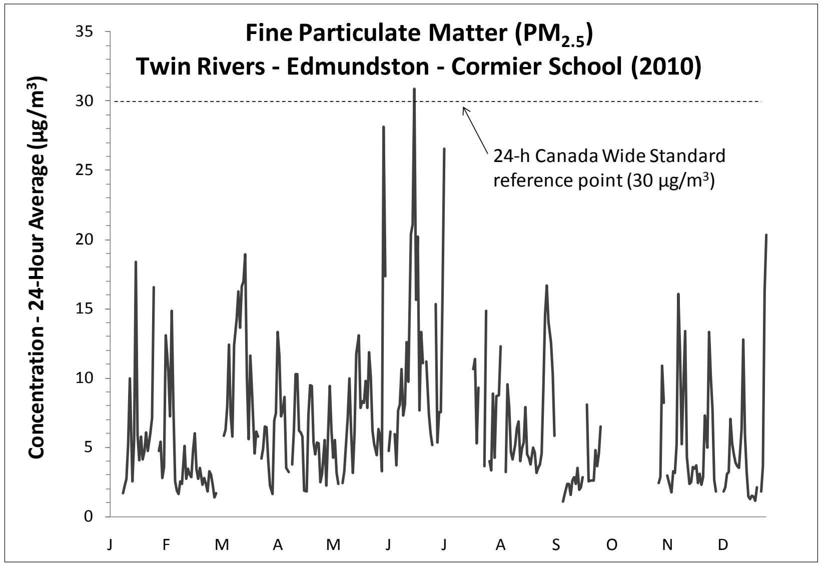
D. Lake Utopia Air Quality Monitoring Network

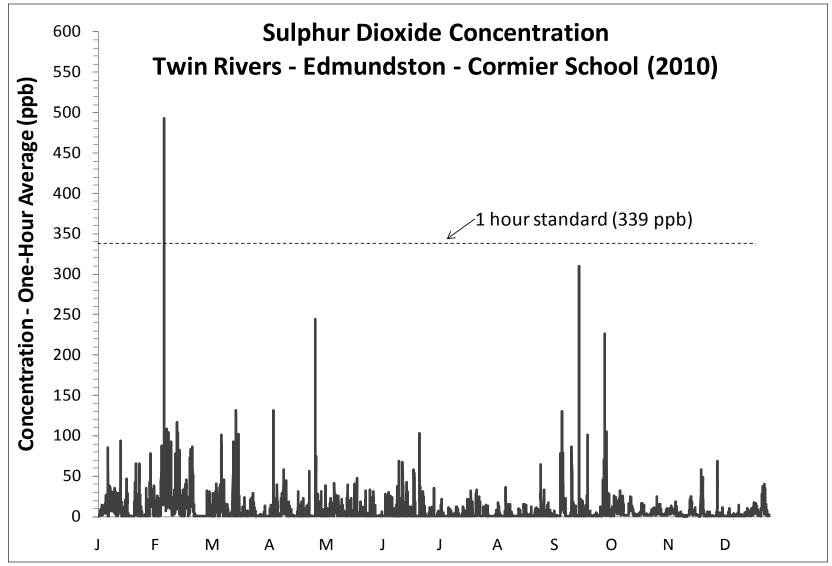
Industry-Operated Monitoring Station

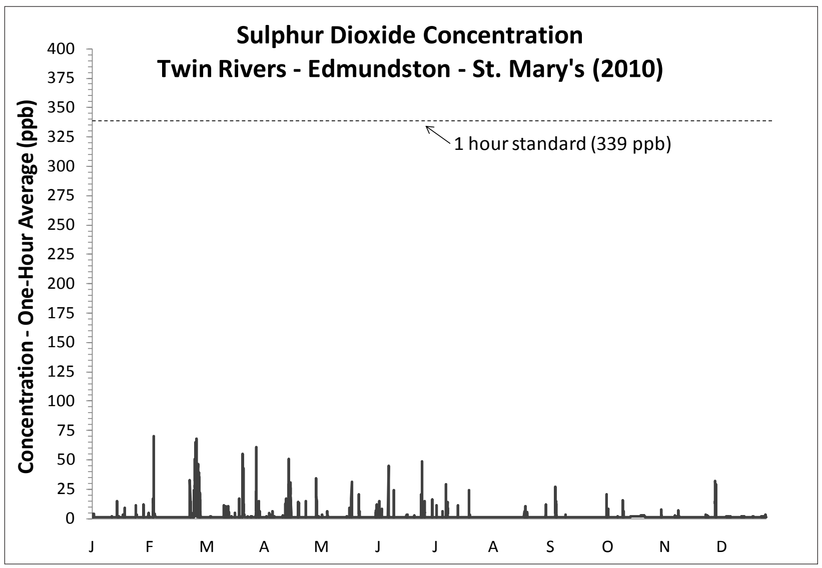


E. Edmundston Air Quality Monitoring Network

Industry-Operated Monitoring Stations

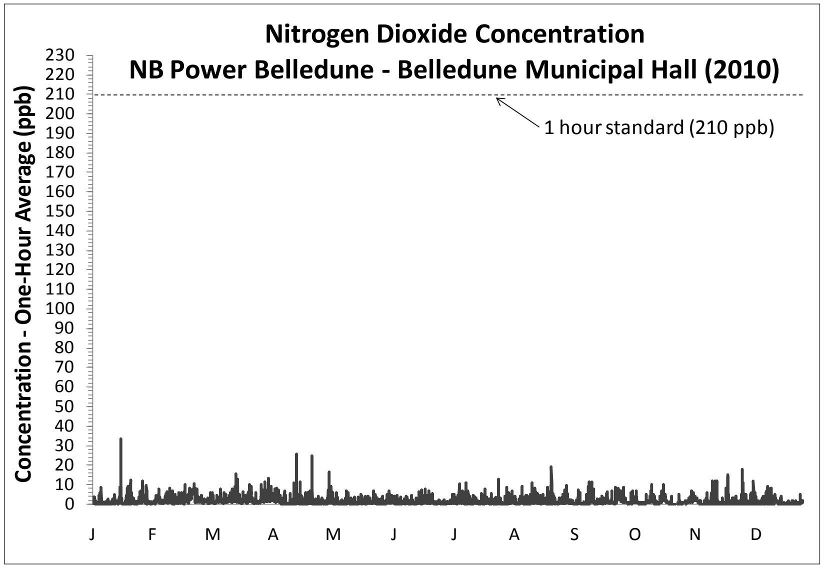


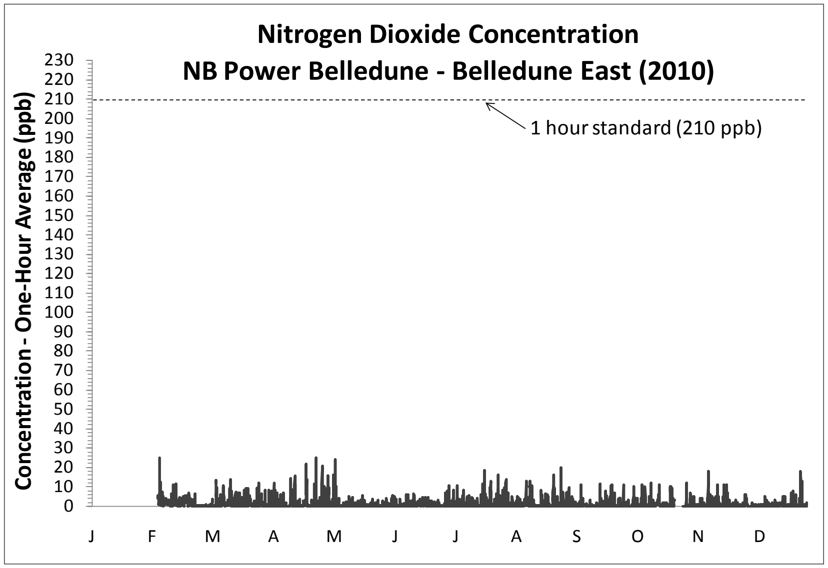


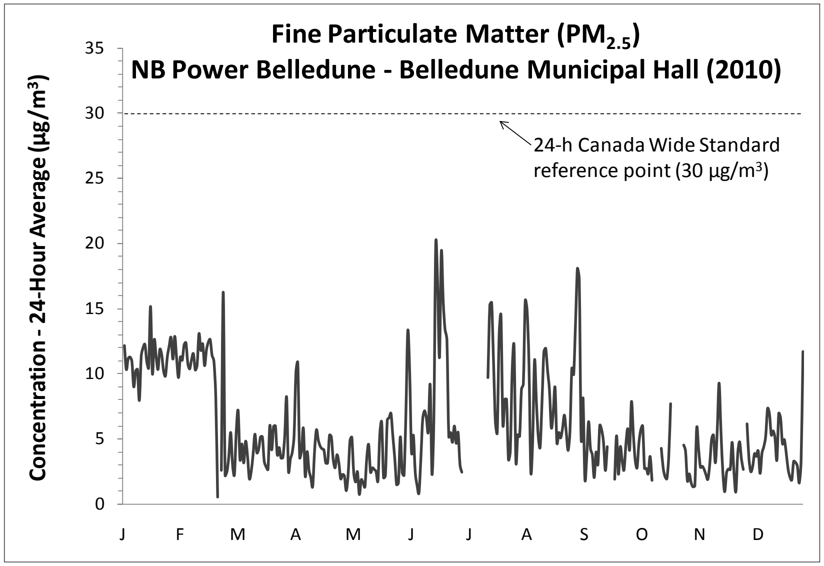


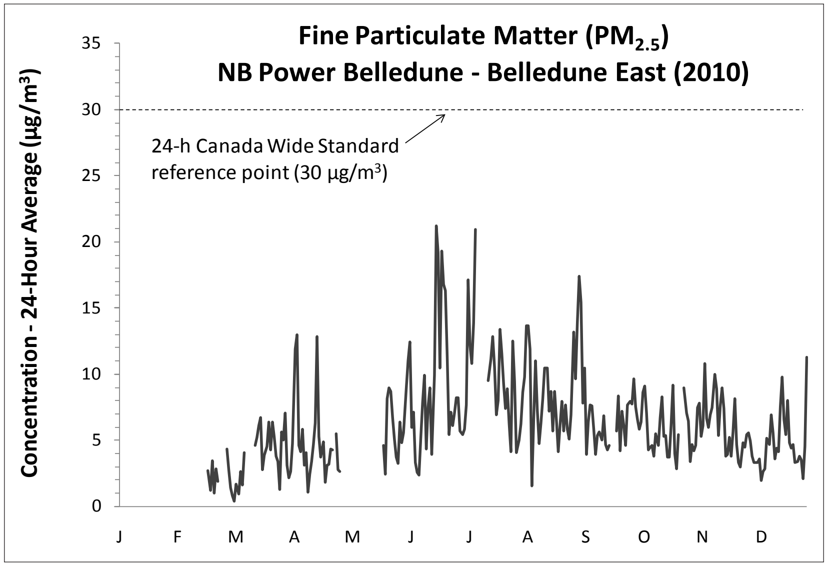
F. Belledune Air Quality Monitoring Network

Industry-Operated Monitoring Stations



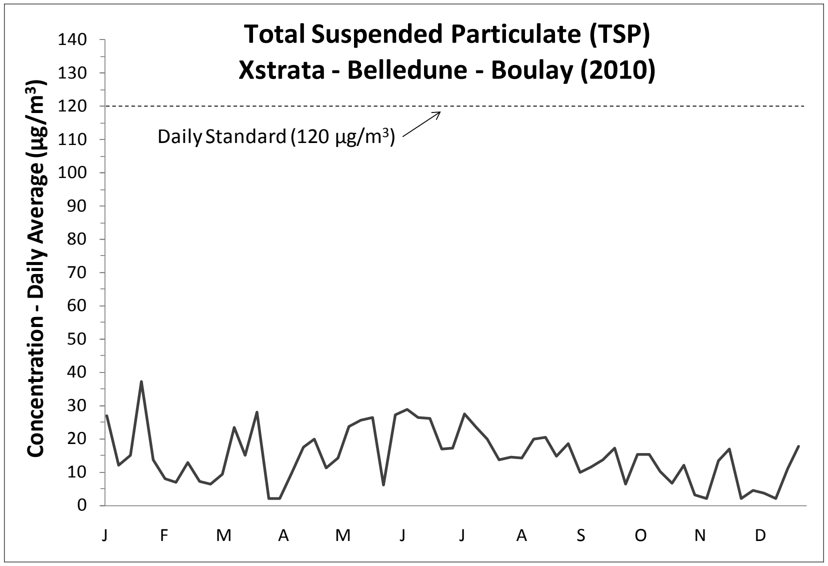


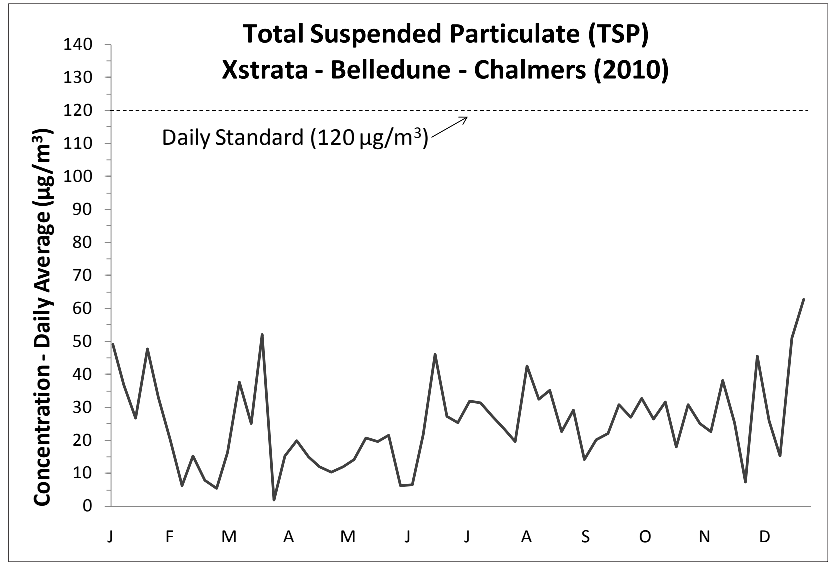


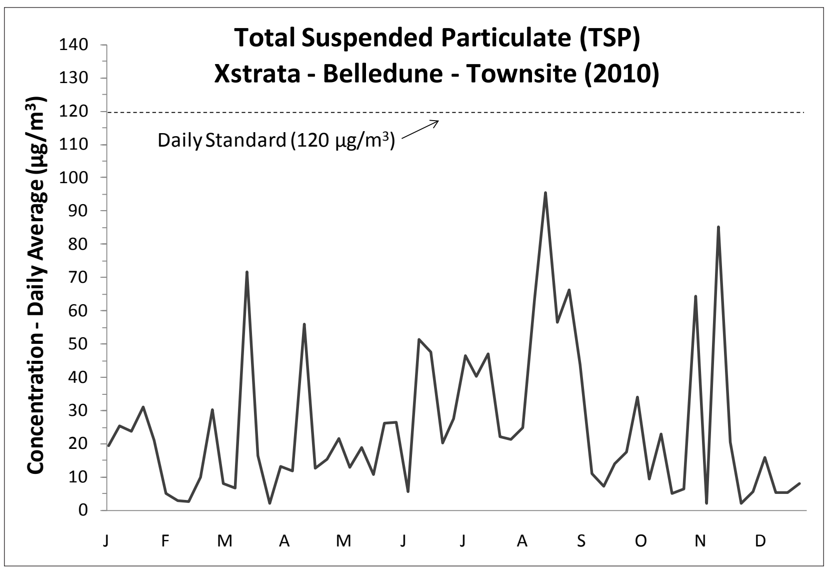


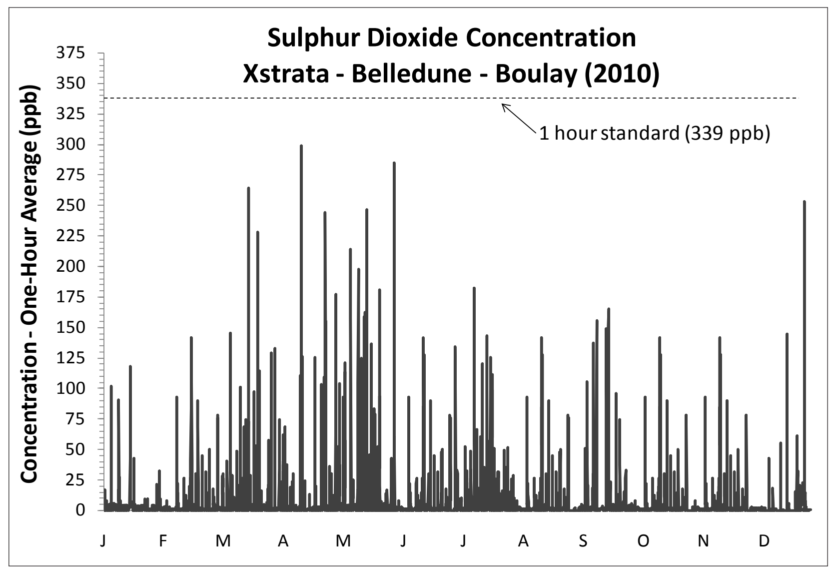
F. Belledune Air Quality Monitoring Network

Industry-Operated Monitoring Stations









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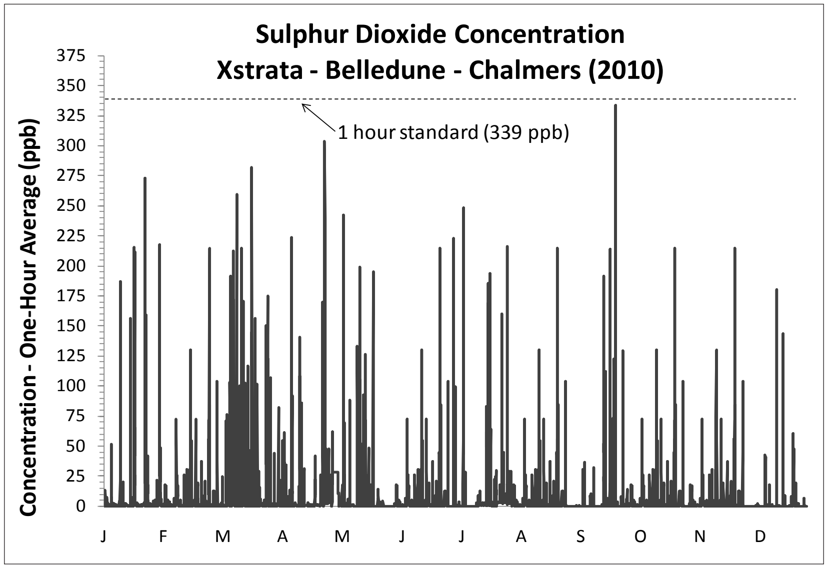
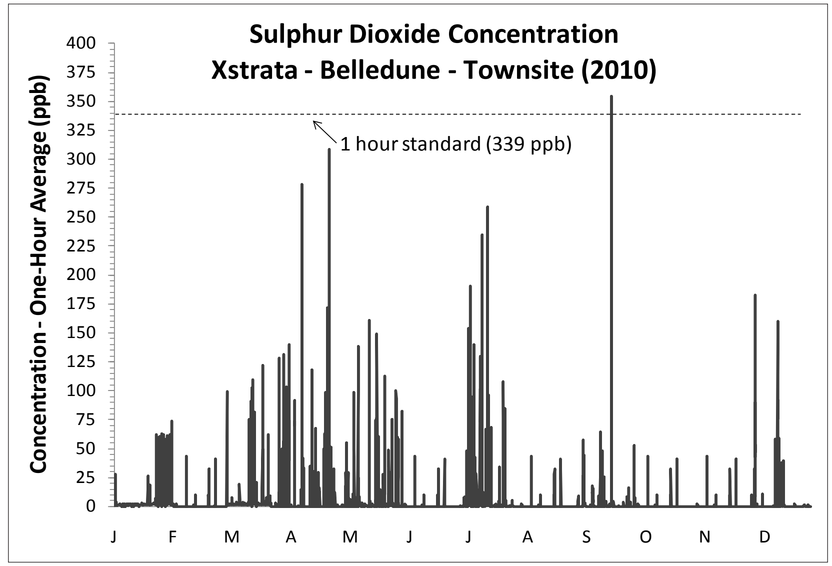
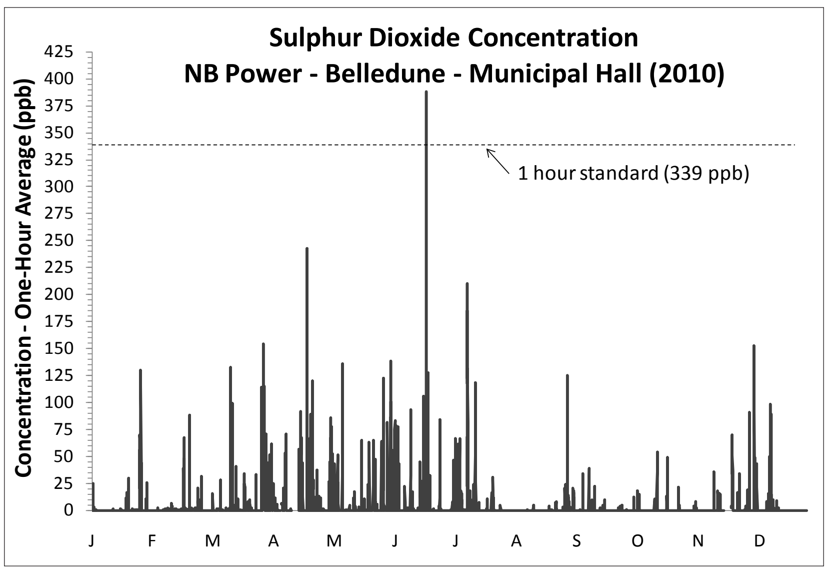
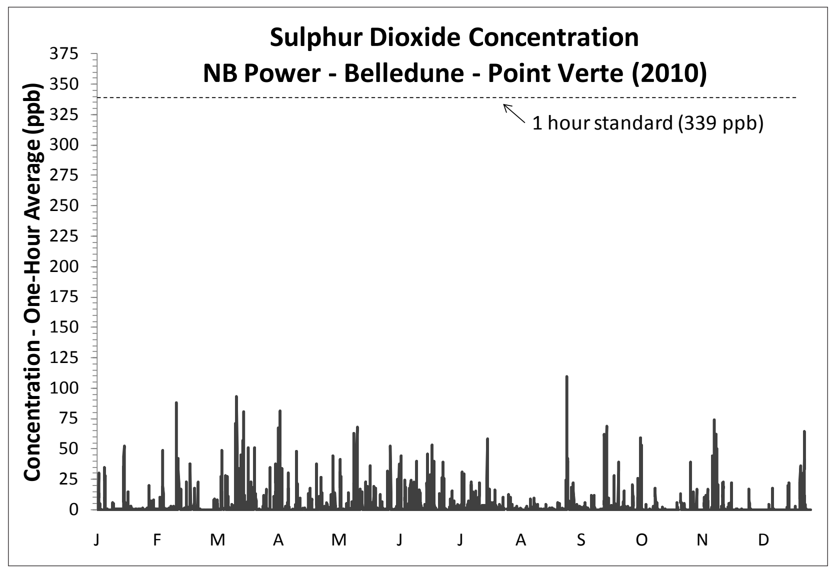
Industry-Operated Monitoring Stations



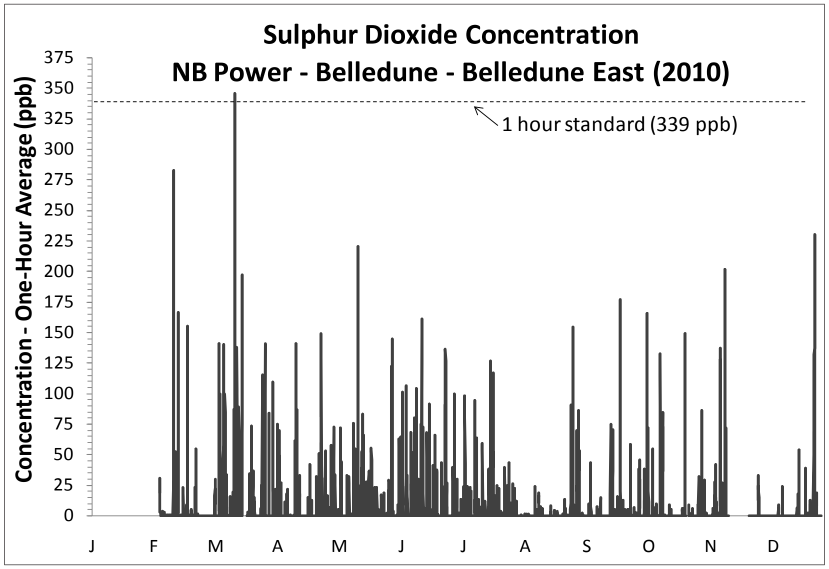


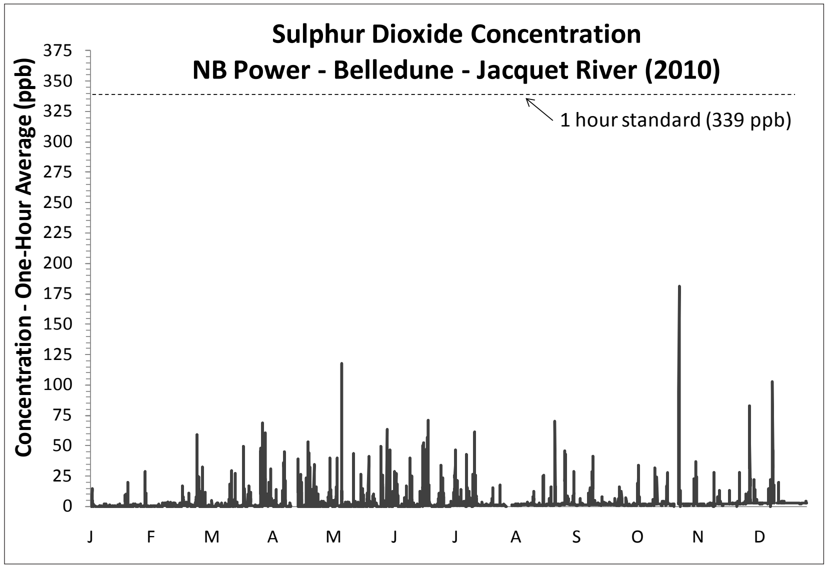


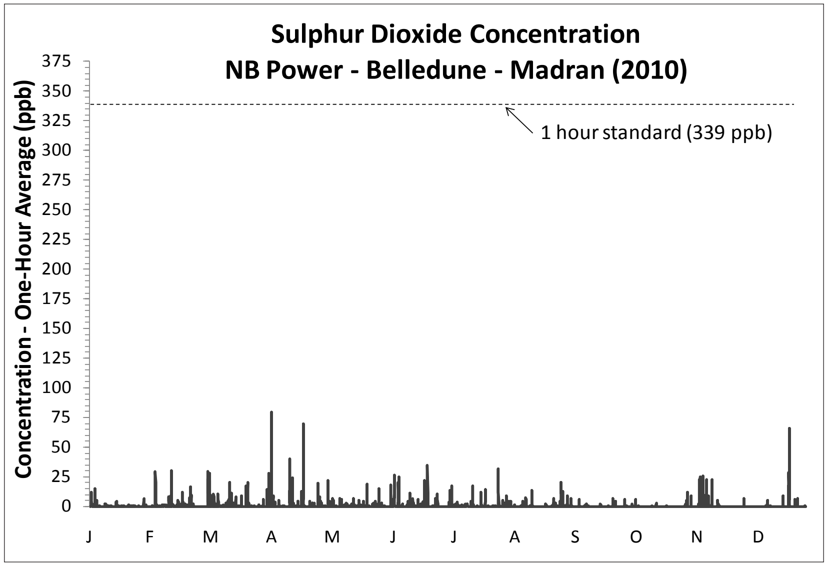


F. Belledune Air Quality Monitoring Network

Industry-Operated Monitoring Stations

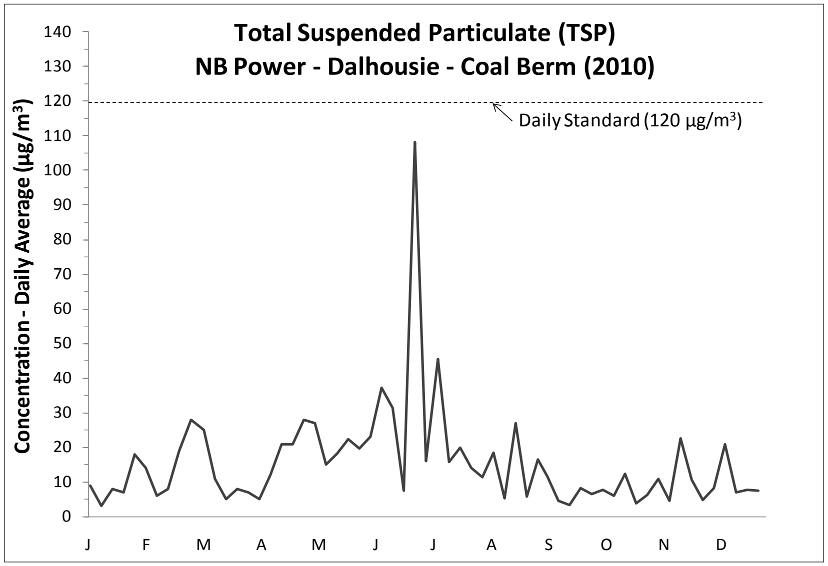


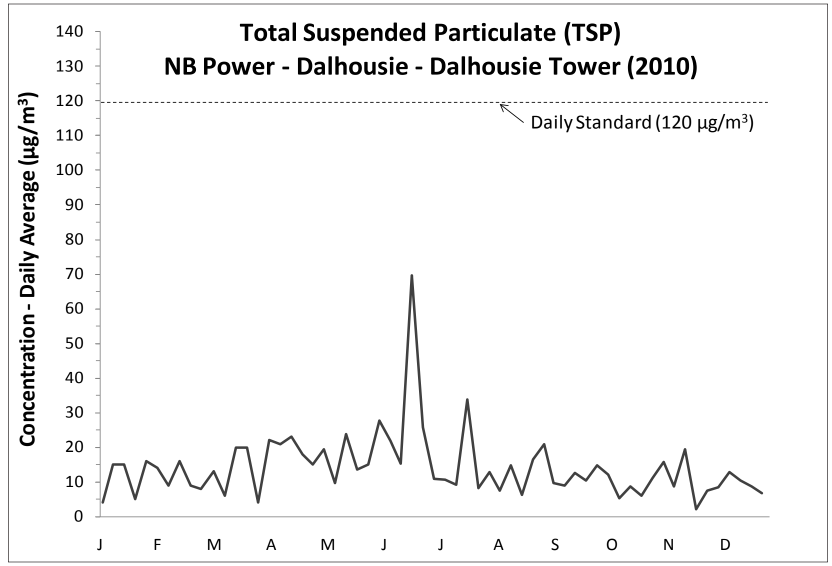


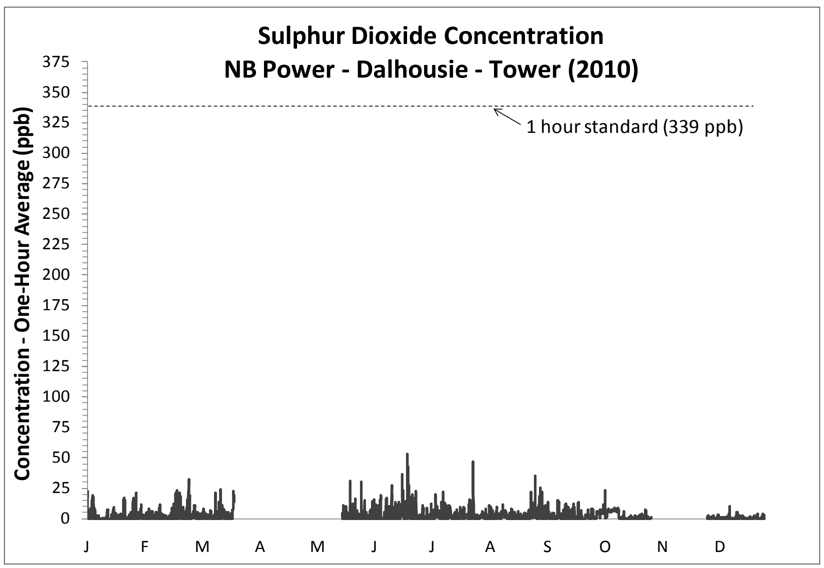


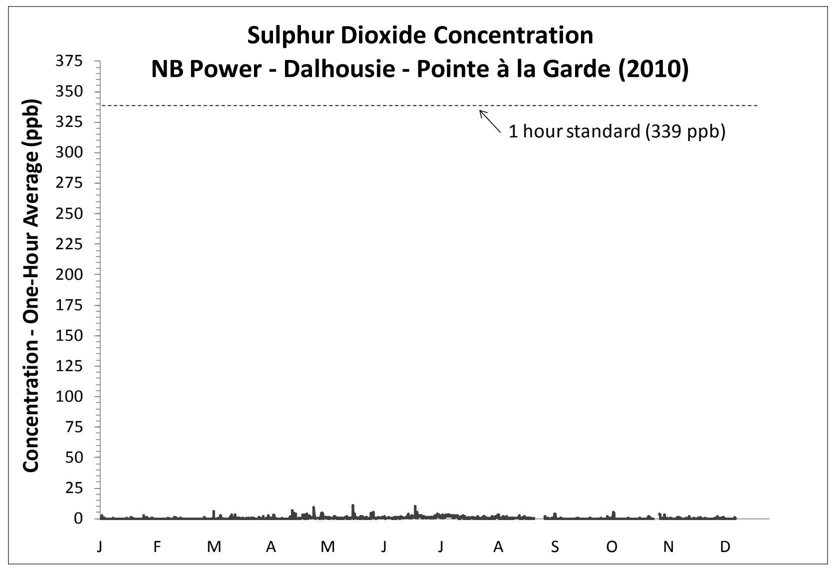
G. Dalhousie Air Quality Monitoring Network

Industry-Operated Monitoring Stations



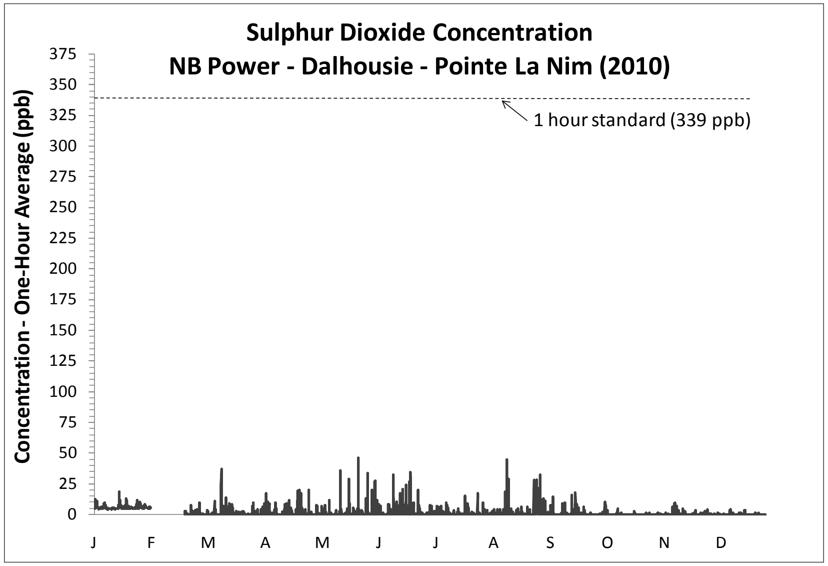


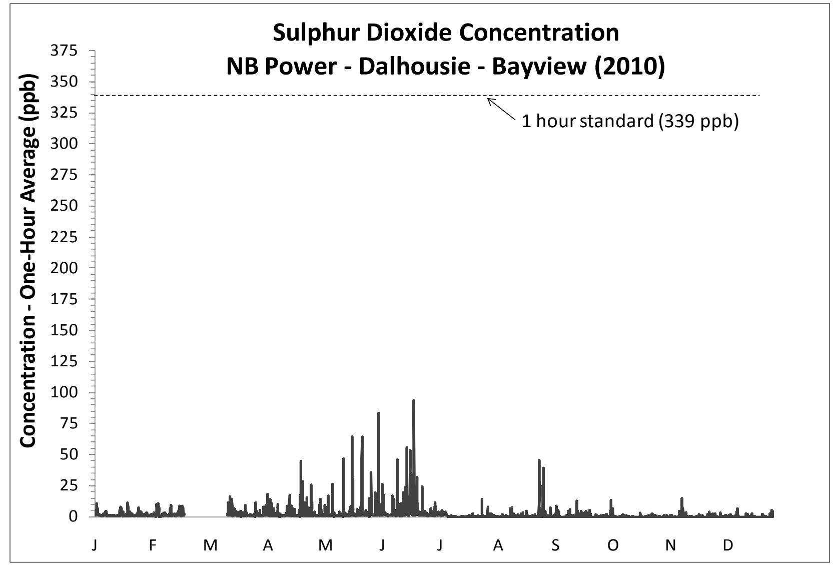


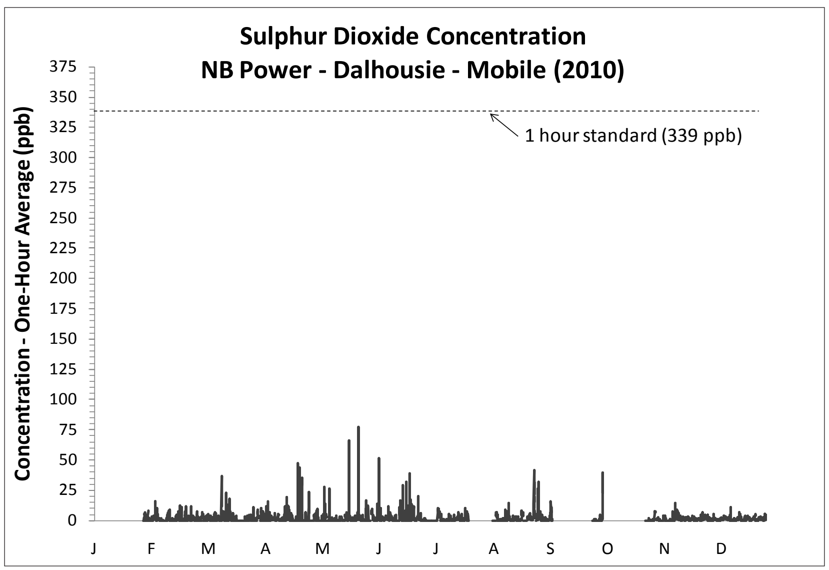


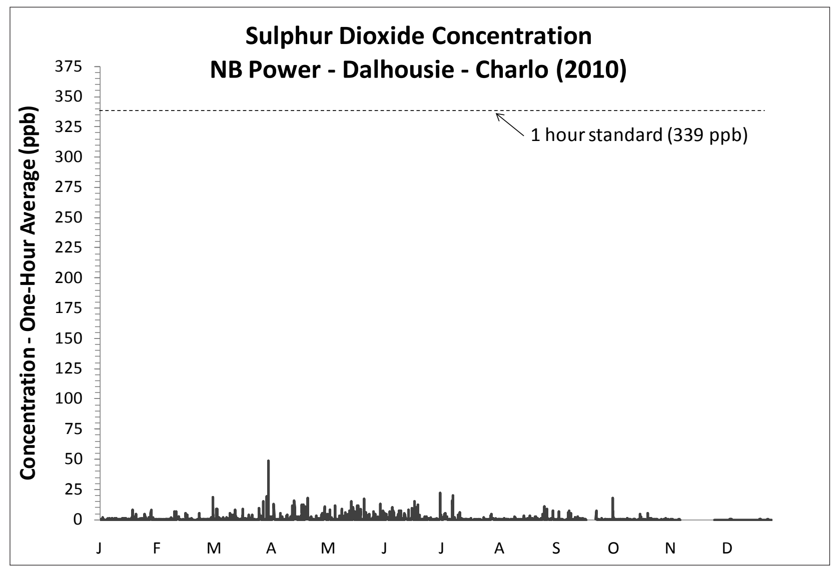
G. Dalhousie Air Quality Monitoring Network

Industry-Operated Monitoring Stations



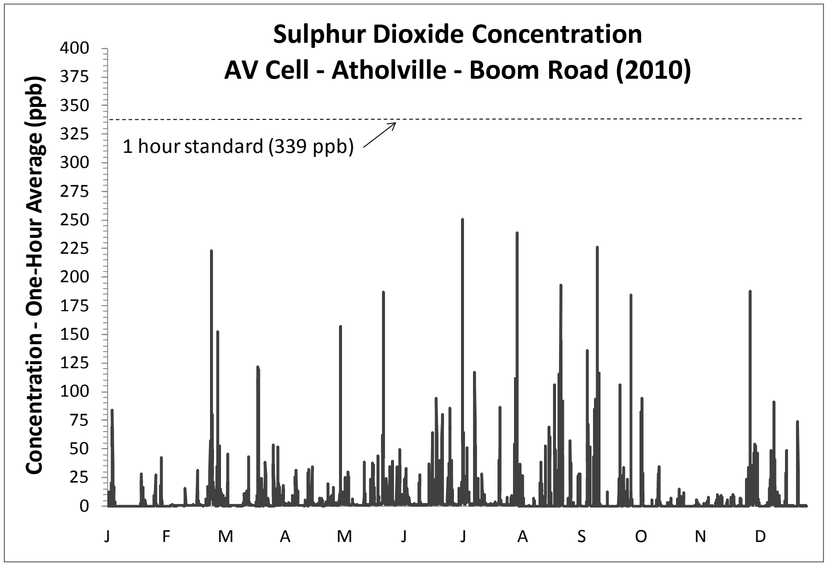


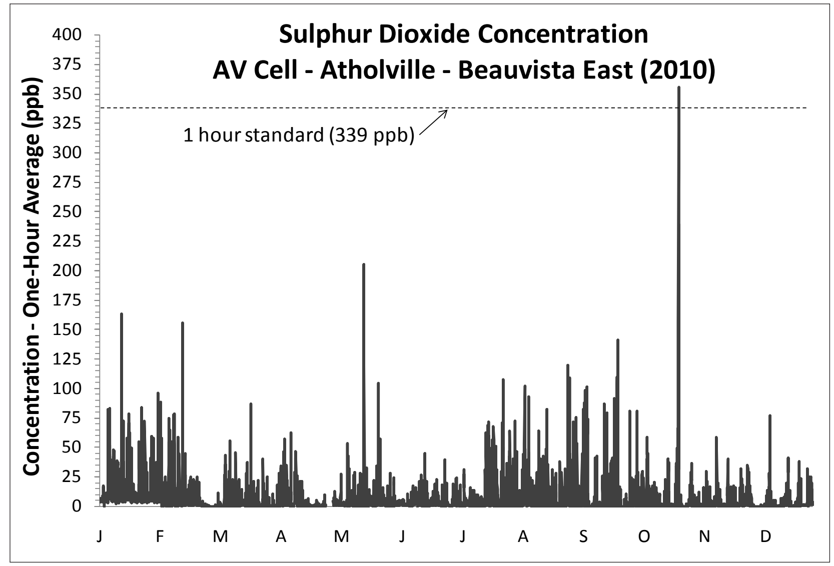




H. Atholville Air Quality Monitoring Network

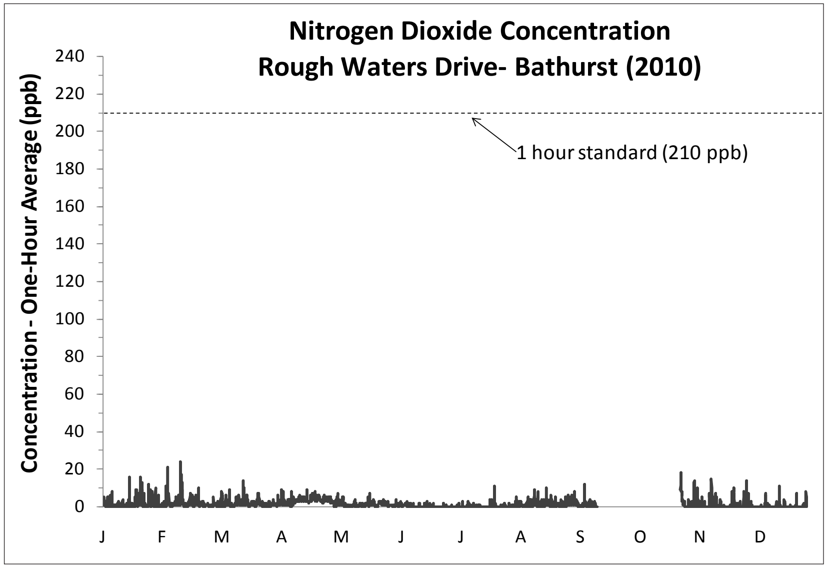
Industry-Operated Monitoring Stations

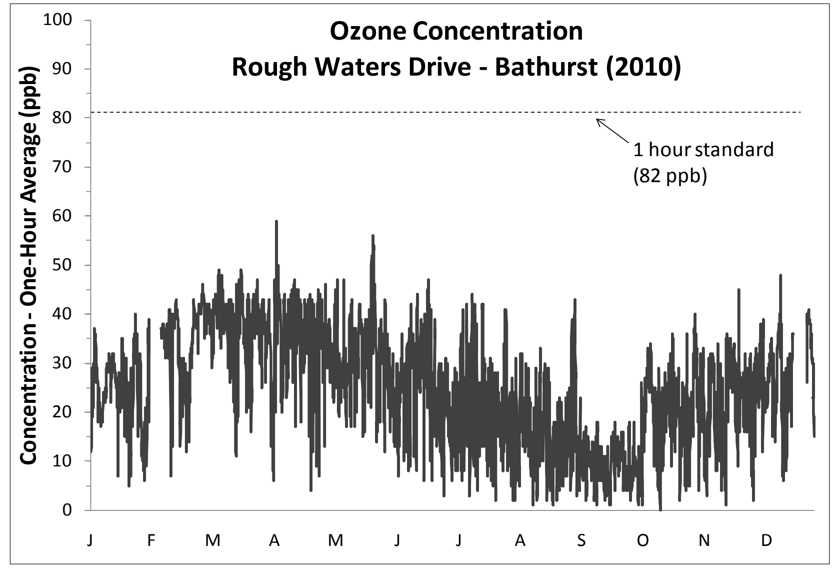


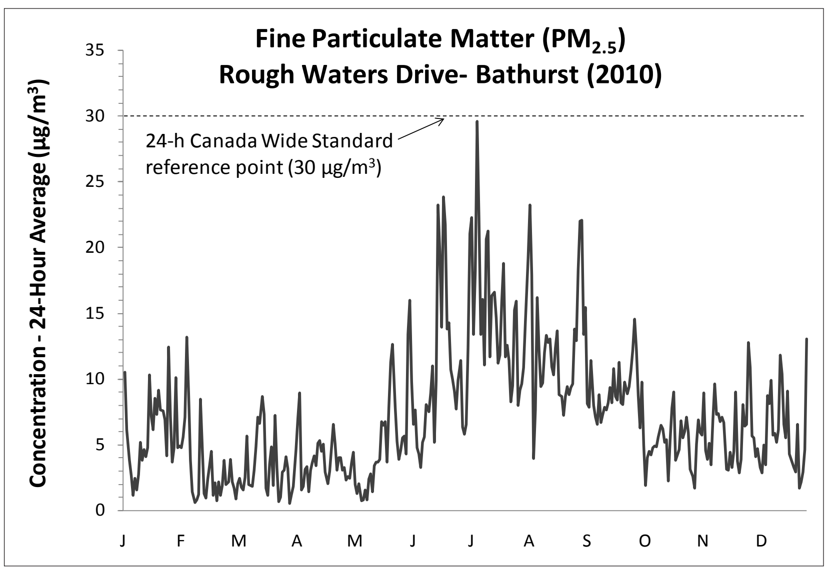


I. Bathurst Air Quality Monitoring Network

DELG Monitoring Station

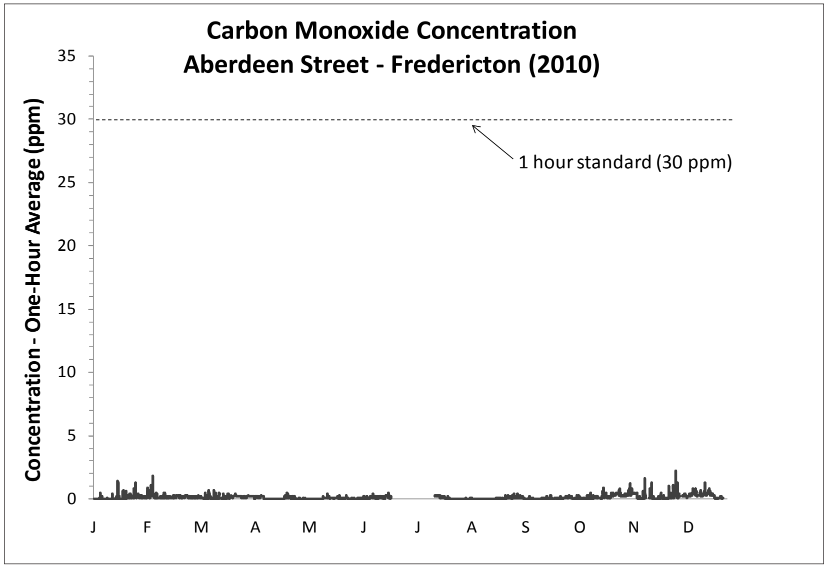


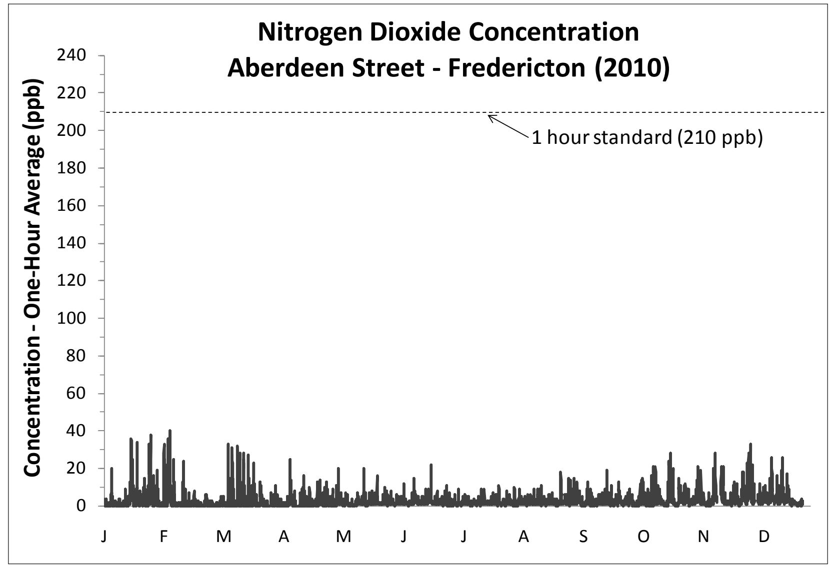


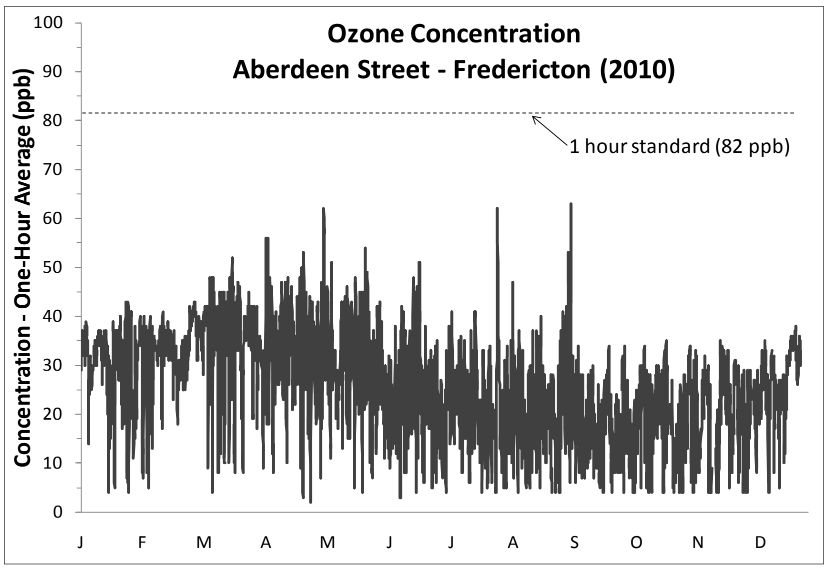


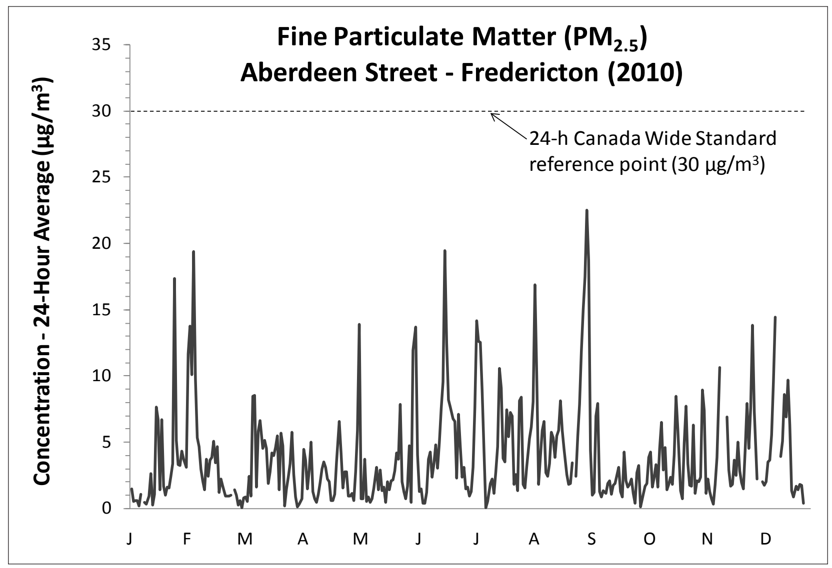
J. Fredericton Air Quality Monitoring Network

DELG Monitoring Station



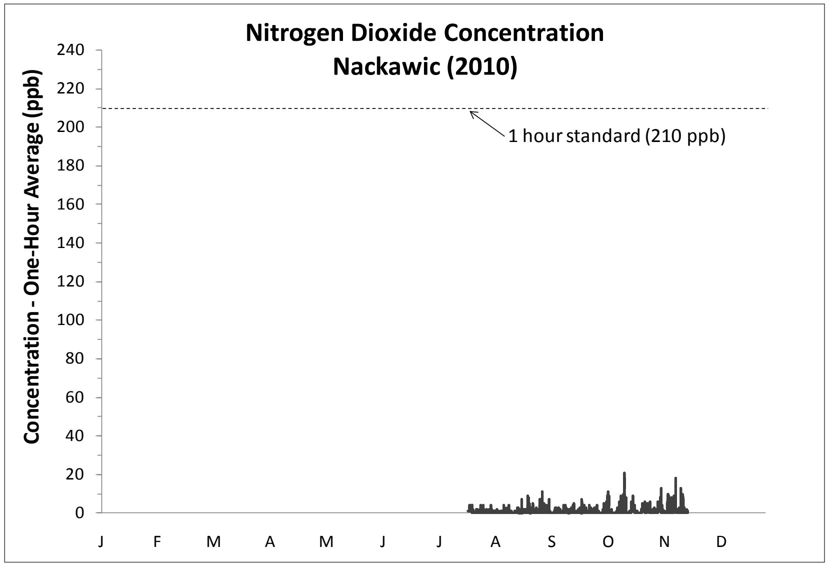


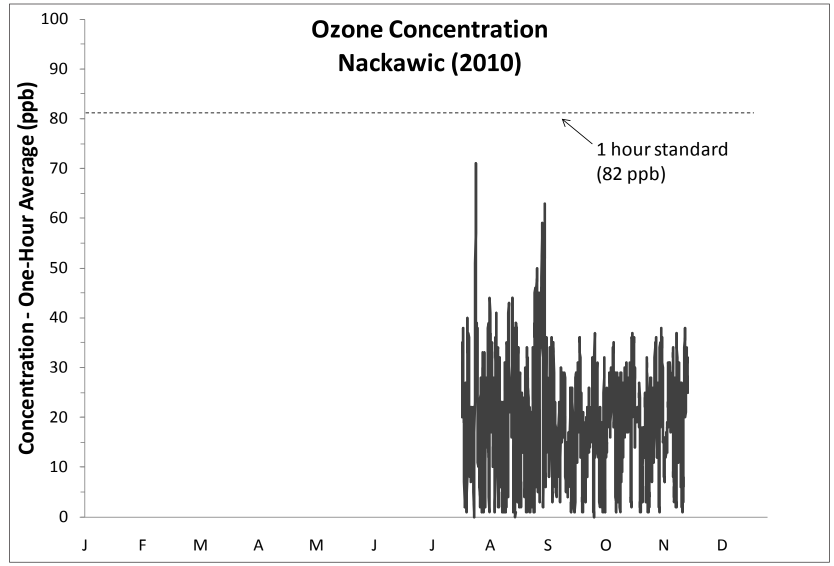


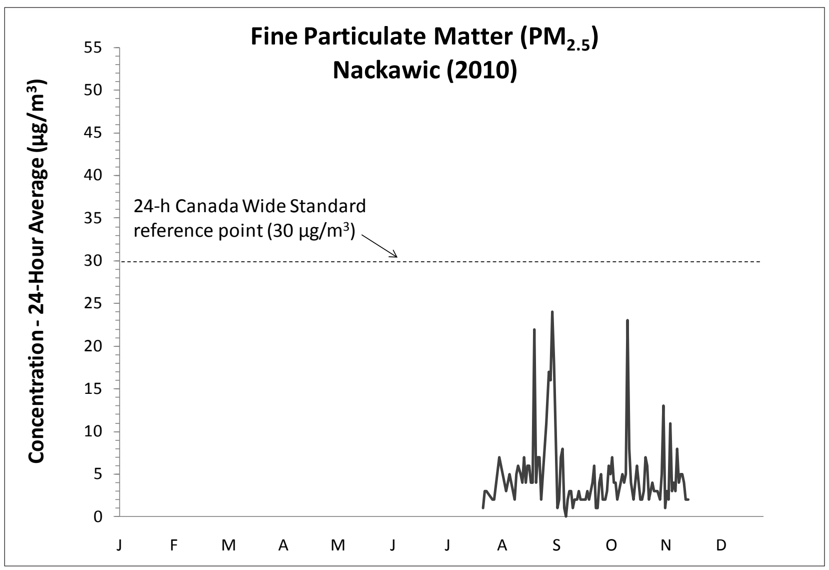


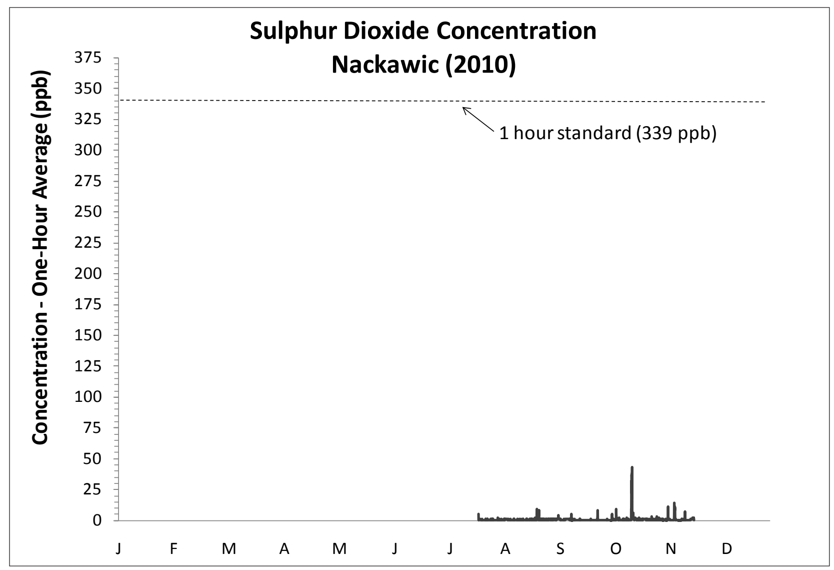
K. Nackawic Air Quality Monitoring Network

Part I: DELG Monitoring Station (2010 Mobile Air Quality Monitoring Study)



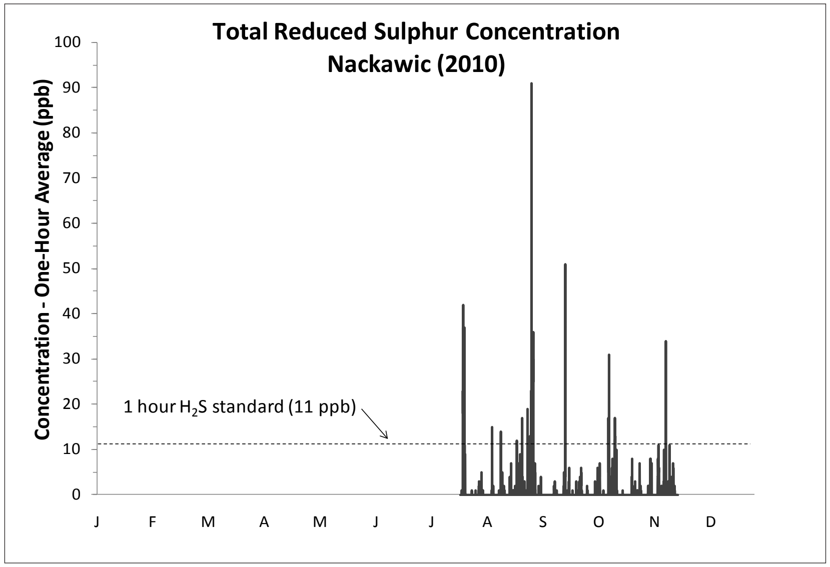






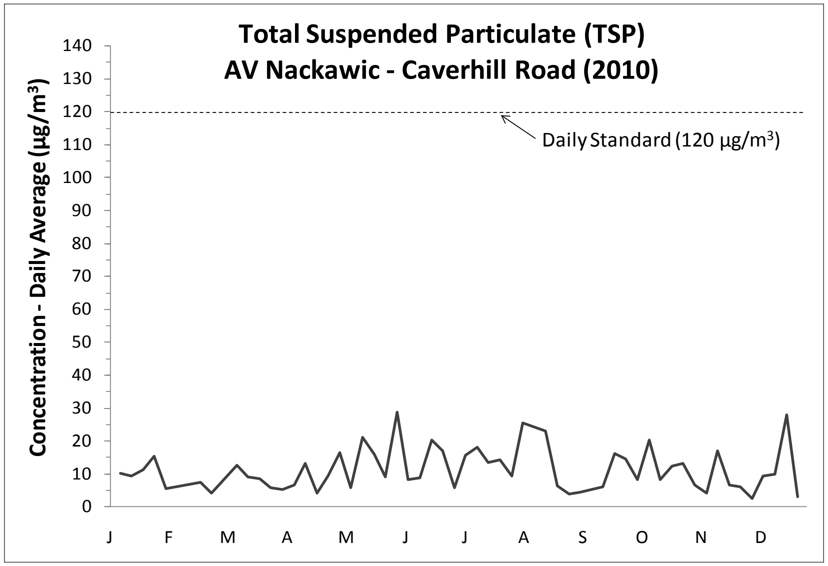
K. Nackawic Air Quality Monitoring Network

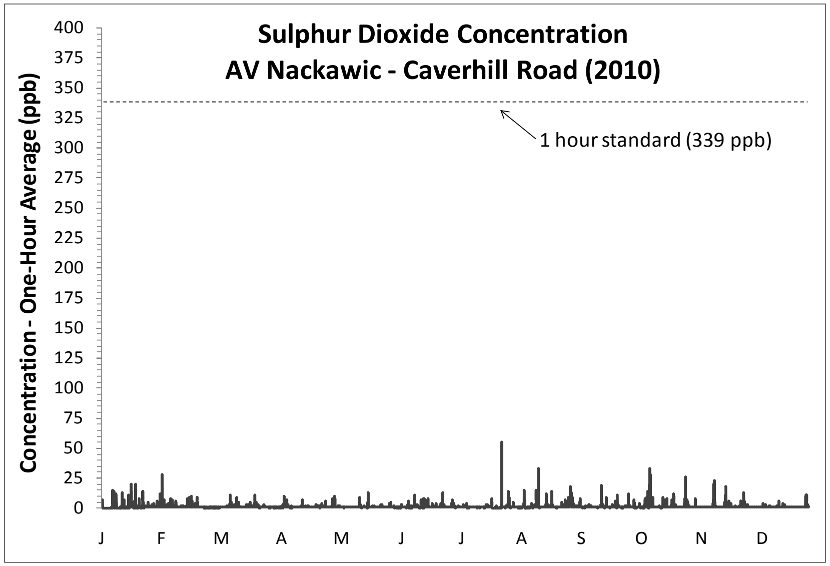
Part I: DELG Monitoring Station (2010 Mobile Air Quality Monitoring Study)

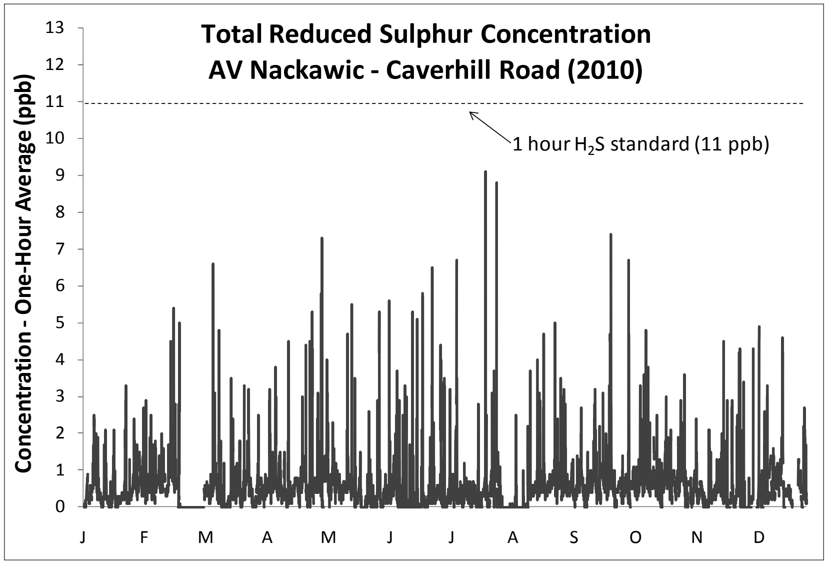


K. Nackawic Air Quality Monitoring Network

Part II: Industry-Operated Monitoring Station

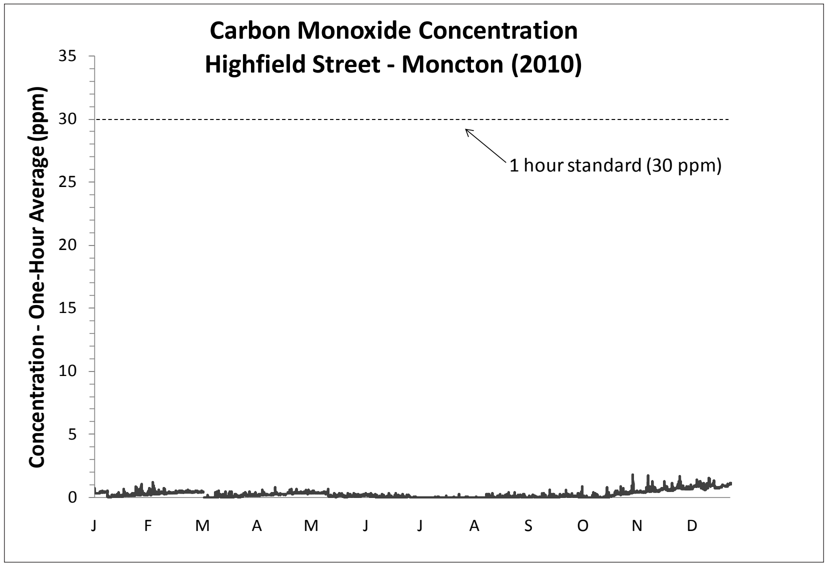


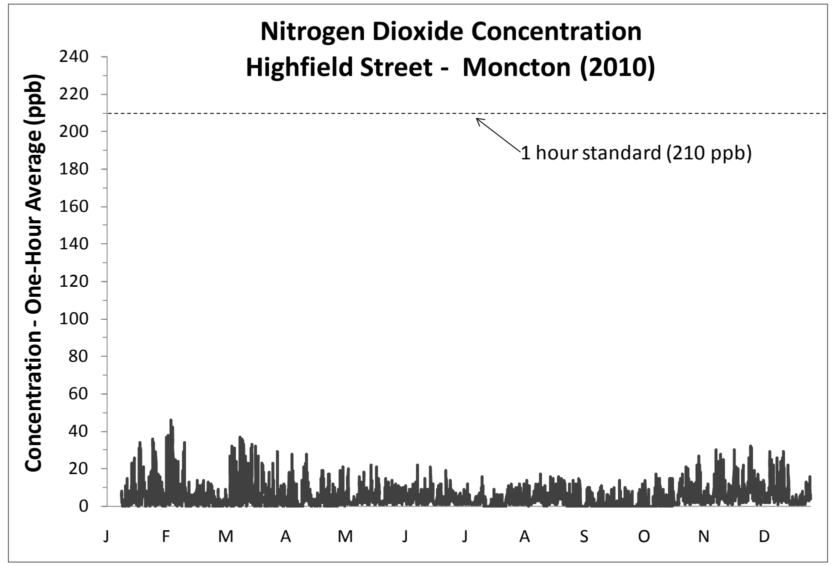


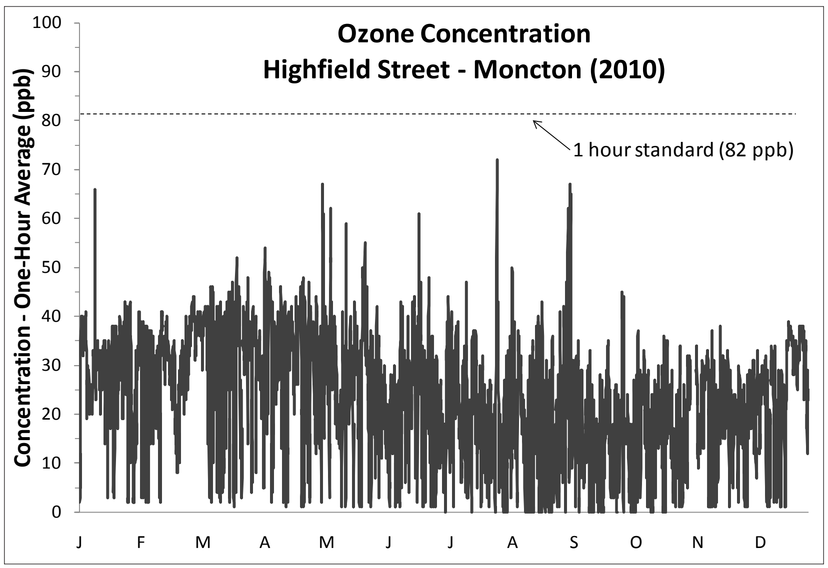


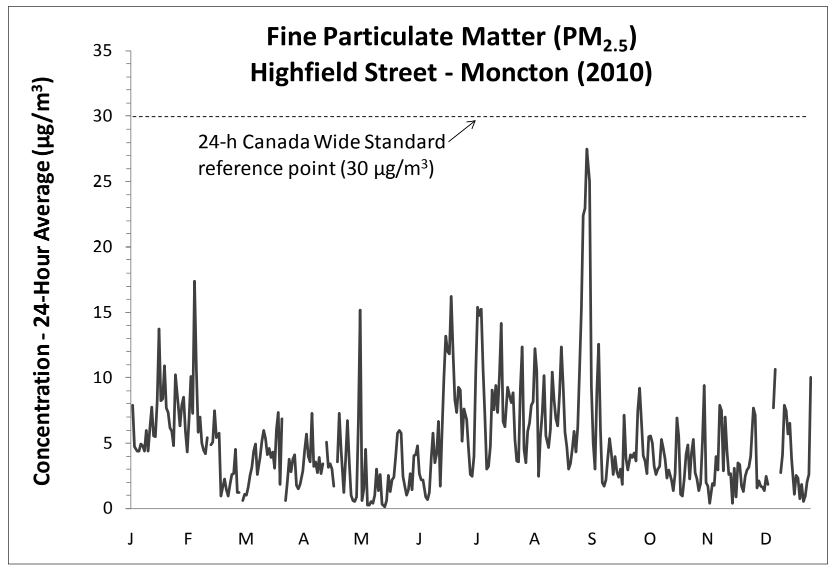
L. Moncton Air Quality Monitoring Network

DELG Monitoring Station



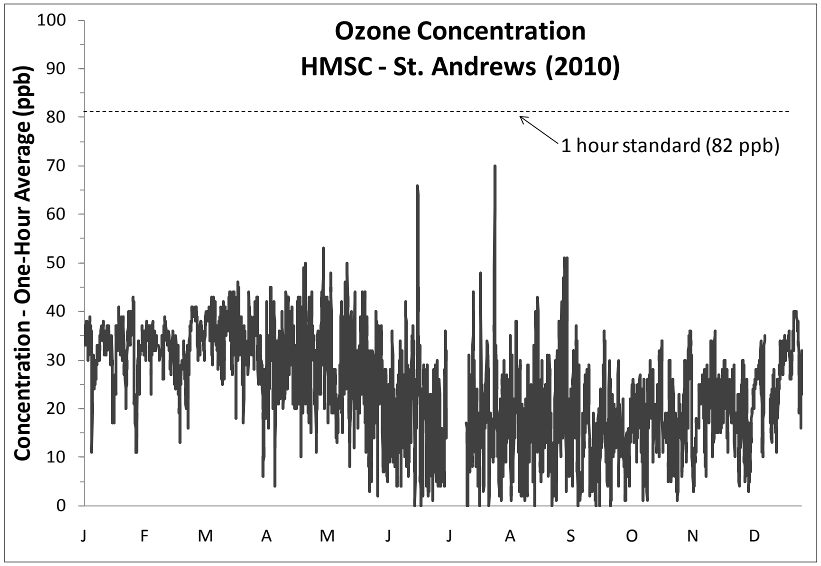


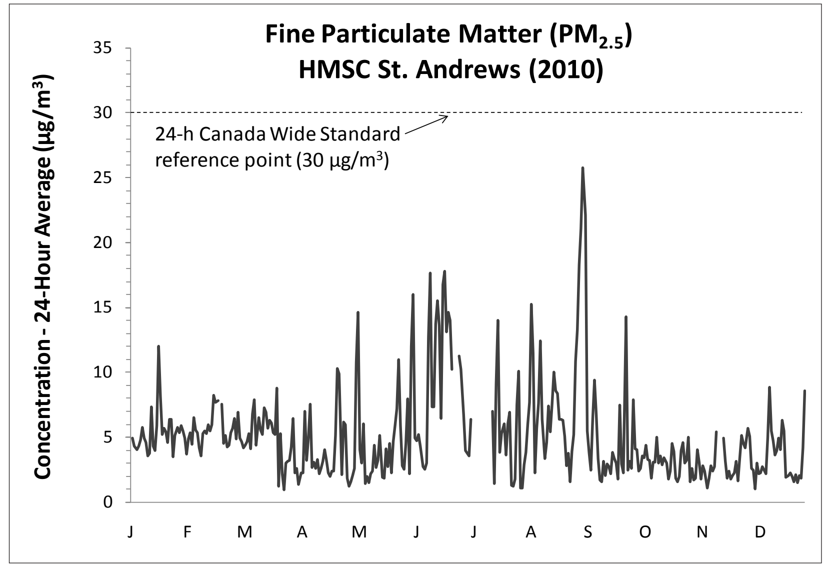




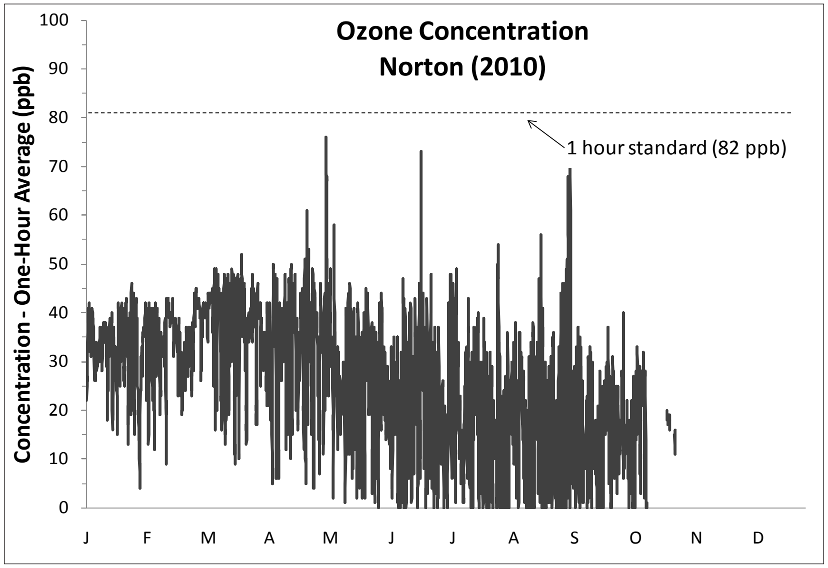
M. St. Andrews Air Quality Monitoring Network

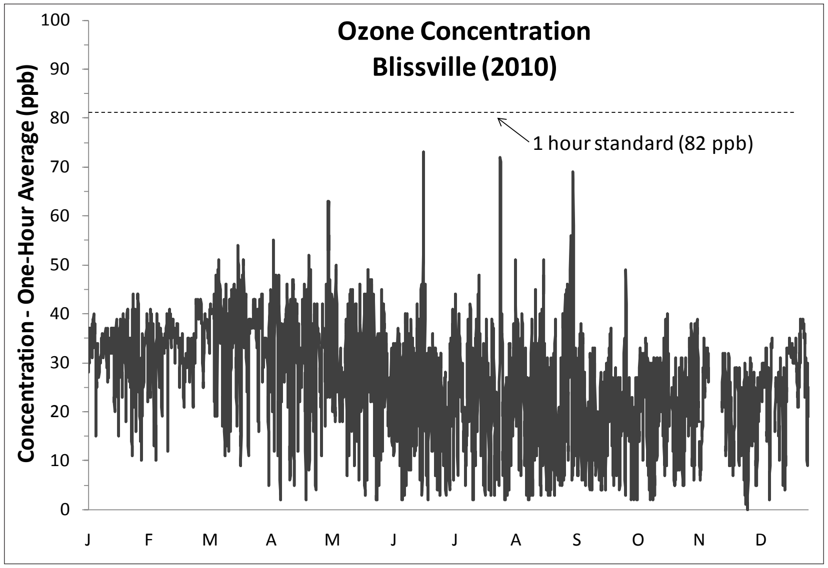
DELG Monitoring Station

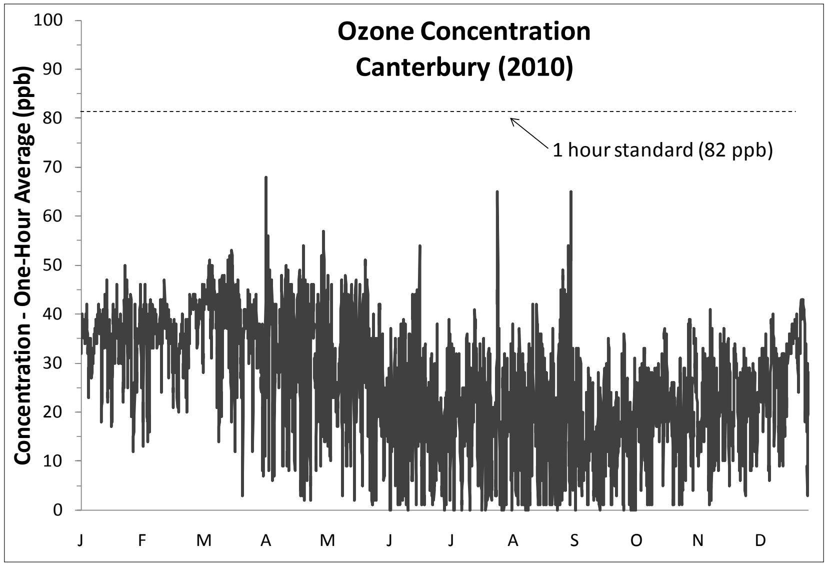


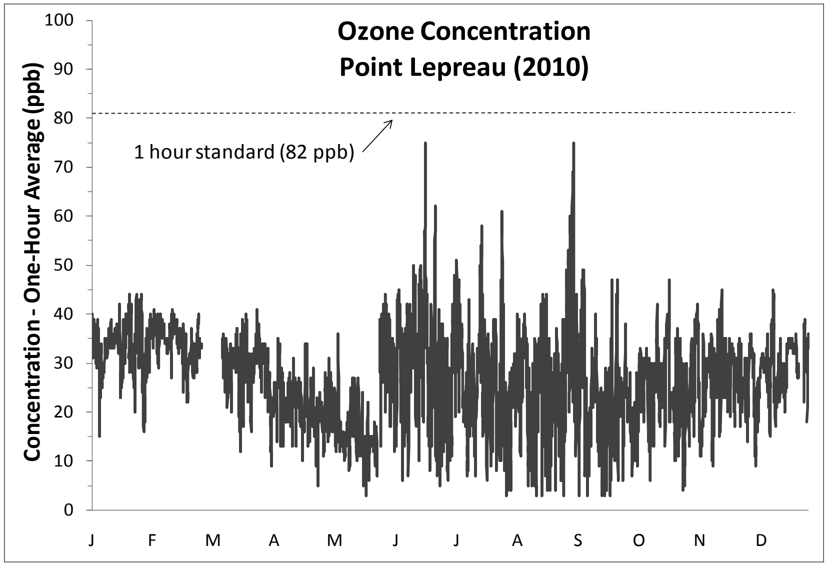


Rural Ozone Monitoring Network (DELG Stations)

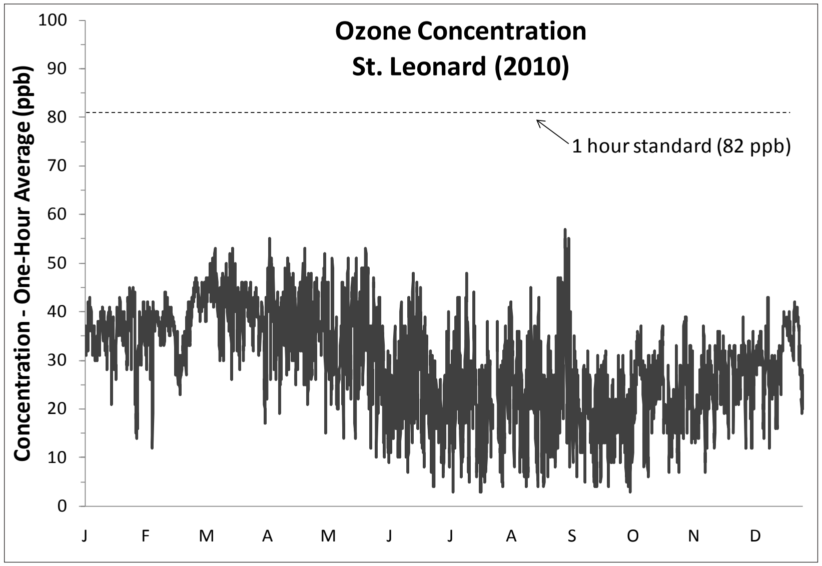


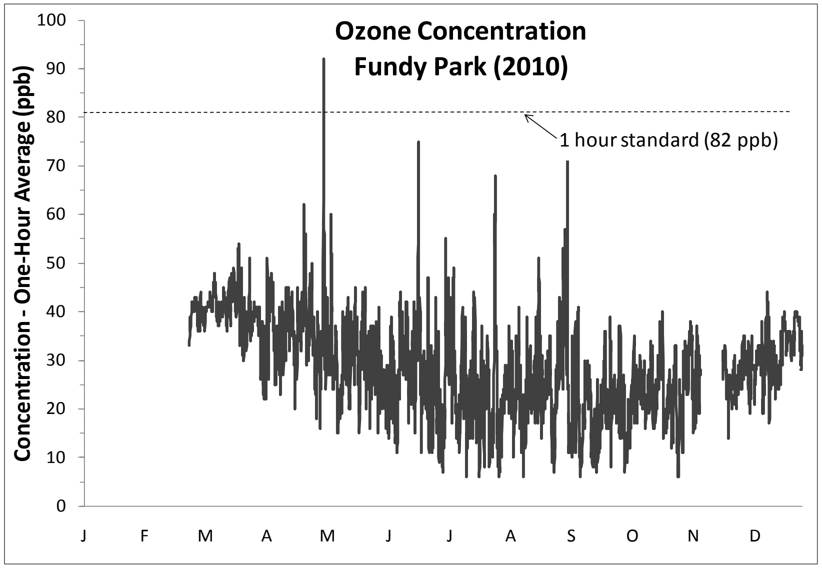






Rural Ozone Monitoring Network (DELG Stations)





Other Rural Monitoring (DELG Station)