2003 Annual Progress Report

on

The Canada-Wide Acid Rain Strategy for Post-2000

Federal/Provincial/Territorial
Ministers of Energy and Environment

ISSN 1488-948X

PN 1351

ISSN 1488-948X

PN 1351

The Canada-Wide Acid Rain Strategy for Post-2000

In October 1998, federal, provincial, and territorial Energy and Environment Ministers signed *The Canada-Wide Acid Rain Strategy for Post 2000*. The primary long-term goal of *The Strategy* is "to meet the environmental threshold of critical loads for acid deposition across Canada". As steps towards the achievement of this goal, *The Strategy* calls for a number of actions, including:

- pursuing further emission reduction commitments from the United States;
- establishing new sulphur dioxide (SO_2) emission reduction targets in eastern Canada;
- preventing pollution, and keeping "clean" areas clean;
- ensuring the adequacy of acid rain science and monitoring programs; and,
- annually reporting on SO_2 and nitrogen oxides (NO_X) emissions and forecasts, on compliance with international commitments, and on progress in implementing *The Strategy*.

Introduction

The Canada-Wide Acid Rain Strategy for Post-2000 provides Energy and Environment Ministers with a framework for addressing the remaining acid rain problem in eastern Canada and ensuring that new acid rain problems do not occur in other parts of Canada. Since its signing in 1998, governments have been responsible for implementing each of the commitments as steps towards achieving the long term goal - meeting the threshold for critical loads for acid deposition across Canada.

In September 2003, at the Canadian Council of Ministers of the Environment (CCME), joint National Air Issues Coordinating Committee - Other Air Issues (NAICC-A) / Stakeholder Advisory Committee meeting, stakeholders indicated the need to have more involvement in the implementation of The Strategy. As a result, the NAICC-A committed to establish a new multi-stakeholder Acid Rain Task Group by extending a formal invitation to stakeholders to participate in the work on acid rain. The new Task Group will co-ordinate the implementation of The Strategy.

The first task of the Task Group is the production of this fifth report, which will describe the progress of the four eastern provinces in developing measures to implement their new sulphur dioxide (SO_2) emission reduction targets, and highlight actions to reduce acidifying emissions in areas not currently exceeding critical loads and recent actions from the United States that when implemented will result in a further reductions in transboundary flows of acidifying emissions. The report will also present evidence of the continued exceedance of critical loads for both aquatic and terrestrial ecosystems in eastern Canada.

Domestic Actions to Reduce Acidifying Emissions

1. In Areas Exceeding the Critical Loads

The province of Nova Scotia drafted proposed amendments to its Air Quality Regulations, intended to implement SO_2 and nitrogen oxides (NO_X) reduction commitments announced in Nova Scotia's Energy Strategy (2001). The draft regulations propose a reduction in the existing provincial SO_2 cap by 25% to 141,750 tonnes beginning in 2005. A corresponding 25% cap reduction for the province's largest SO_2 emitter (Nova Scotia Power Inc., NSPI) was also proposed.

The Energy Strategy set out a target 50% reduction in SO_2 emissions from existing sources (to 94,500 tonnes) by 2010. The draft Air Quality Regulation amendments propose a further 25% reduction in NSPI's SO_2 emission cap in 2010, and the submission of SO_2 emission reduction plans by large industrial emitters. The Energy Strategy additionally includes a commitment to reduce NO_x emissions by 20% from 2000 levels by 2009. The draft regulatory amendments propose a corresponding cap on NSPI's NO_x emissions.

In addition to prescribed SO_2 and NO_x emissions reductions, the Nova Scotia Energy Strategy specifies several other measures for improving environmental performance and preventing pollution. These include requirements for best available technologies for new and upgrading facilities, improving information for assessing the effectiveness of emission reduction initiatives, maintaining a regulatory framework that encourages the use of cleaner and alternative fuels, and a 2% sulphur content limit on heavy fuel oil which will be included in the new Air Quality Regulations.

Nova Scotia is also participating in national initiatives to reduce emissions (including acidifying emissions) from several industrial sectors. A number of planned air quality management activities are set out in the province's draft Implementation Plan for the Canada-Wide Standards (CWS) for Particulate Matter (PM) and Ozone. Several of the proposed measures in the draft plan relate to the management of SO_2 and NO_x emissions.

New Brunswick is committed to meeting its SO_2 emission caps of 122.5 kilotonnes by 2005 and 87.5 kilotonnes by 2010 despite the operating uncertainty of various NB Power generating stations. Uncertainty remains with respect to the supply of Orimulsion fuel to the Coleson Cove thermal generating station, New Brunswick's largest source of electrical generation. However, regardless of the nature of the fuel source, NB Power is expected to realise the reductions in the emissions of SO_2, NO_X and PM (77%, 70% and 75% respectively by 2005) from this facility as originally proposed. In addition, major industrial point sources of air emissions are controlled through approvals, which are normally reviewed on a five-year cycle. These approvals are considered by applying a multi-pollutant approach to maximise emission reduction opportunities. New SO_2 emission caps are being applied to many existing facilities as these approvals are renewed, to fulfill New Brunswick's commitments to new SO_2 reduction targets.

In Québec, Noranda Inc. has reiterated its commitment to increase recovery of SO_2 at its Horne copper smelter in Rouyn-Noranda from the current 75% to 90% by 2006. Plus, the Murdochville smelter, also owned by Noranda Inc., was permanently closed in April 2002, leading to an ongoing reduction in SO_2 emissions. Emission forecasts for 2005 and 2010 will be adjusted accordingly. Québec has already reduced emissions to its 2010 cap of 250 kilotonnes per year and efforts are being made to maintain this achievement.

Ontario is committed to reducing its emissions of SO_2 by 50 percent from its Countdown Acid Rain Cap and NO_X by 45% from the province's 1990 level by 2015. By 2000, Ontario had reduced its SO_2 by 33% and its NO_X by 15% from these respective base lines. Since 2000, Ontario has implemented other key regulatory initiatives to achieve further reductions. For example, Ontario's Emissions Trading regulation (O. Reg. 397/01) that establishes SO_2 and NO_X emission caps from Ontario Power Generation's fossil plants and the electricity sector requires the coal-fired Lakeview Generating Station in Mississauga to cease burning coal by April 2005 (O. Reg. 396/01). Through provincial Orders, INCO and Falconbridge are required to reduce their allowable SO2 emissions by 34 percent, effective 2007.

Subsequent to the initial posting in October of 2001 of proposed emission reduction measures under the Clean Air Plan for Industry, consultations have taken place with environmental groups, health groups, and industrial groups on these proposed measures. Based on these consultations, in

December of 2002, the government posted a discussion paper on this plan for public comment that summarizes key issues and lays out proposals for setting emission limits for these major industrial sectors.

Historically, sulphur in gasoline accounted for one to two per cent of the total sulphur emissions that go into Ontario's air. Through O. Reg. 212/02, manufacturers, importers and blenders of gasoline for sale or use in Ontario are required to submit quarterly reports on the sulphur content of their gasolines. In general, the sulphur content of Ontario's gasolines continues to be reduced towards the federally-regulated 30 ppm sulphur limit effective January 1, 2005. We continue to collect and report this information to the public enabling them to make informed choices.

Newer dynamic models applied to catchments in central Ontario demonstrate that soils will continue to acidify even though stream and lake chemistry will improve in response to proposed reductions in sulphur emissions/deposition. In July of 2003, Ontario issued a Declaration Order containing new rules for forest management in Ontario. The Declaration Order extends and amends the existing Class Environmental Assessment Approval for Timber Management and complements the forest management planning principles of the 1994 Crown Forest Sustainability Act. Forest health and sustainability are the major principles of the Declaration Order. For example, a new condition with respect to *"Clear-Cutting"* now promotes timber harvesting in such a way as to leave the forest in a state that is closer to what nature would leave behind after a forest fire or another natural disturbance.

Ontario's *OnAIR* program found at http://www.ene.gov.on.ca continues to give the public access to more information on air pollution. Through its associated regulation (O. Reg. 127/01), electrical, industrial, commercial, institutional and municipal facilities are required to report their emissions if their emissions meet or exceed any of the stated thresholds on over 350 contaminants including NO_X and SO_2.

2. In Areas Achieving Critical Loads

For those areas in Canada not currently exceeding critical loads, The Strategy commits them to put in place measures to keep clean areas clean and prevent pollution to protect their sensitive ecosystems. Currently, western and northern Canada, northern Ontario, northern Quebec, and parts of Atlantic Canada including Newfoundland and Labrador receive acid deposition below critical loads.

As part of the CCME initiative on CWS for PM and ozone, a national guidance document on continuous improvement/keeping clean areas clean (CI/KCAC) is being developed. Because acid rain and PM share the same precursor emissions, transformation pathways, meteorology and deposition pathways, this document may guide the actions taken by jurisdictions in areas where critical loads are not currently being exceeded. The reduction of these precursor pollutants will also be part of jurisdictional implementation plans to reduce ambient PM and ozone in areas where the CWS are not being achieved. For example, in the Atlantic Region, many jurisdictions are taking a multi-pollutant approach, recognizing that it is more efficient to deal with a suite of pollutants and several air quality issues simultaneously rather than one at a time or issue-by-issue. In New Brunswick and Nova Scotia, for example, KCAC and pollution prevention (P2)

actions and programs in support of *The Strategy* are being identified through their implementation planning under the PM and ozone CWS process.

In British Columbia, oil and gas, pulp and paper and transportation are the three predominant sources of SO2 and NOx emissions. To date, there has not been a need for a provincial acid rain management framework and, given the diverse range of climatic zones, studies are typically undertaken on a region by region basis. For example, Environment Canada is currently developing critical loads for SO2 and NOx deposition to forest and aquatic ecosystems in the Georgia Basin (Lower Mainland and portions of Southern and Eastern Vancouver Island).

BC's implementation of the CWS for PM and ozone and CI/KCAC is expected to co-benefit SO_2 and NO_X emission reductions as well. Activities related to the CWS and CI/KCAC implementation in BC include the Airshed Improvement Initiative (for clean and impacted airsheds), Regional Airshed Planning, and the Border Initiative (to address transboundary pollution under the Georgia Basin/Puget Sound International Airshed Strategy).

Additionally, BC has also produced a Climate Change Plan which will guide the province's approach as it works with the federal government, industry, local government and individual to address climate change. The plan includes 40 actions, of which many will benefit the reduction of SO_2 and NO_X emissions through transportation and energy efficiency initiatives.

In Alberta in 2003, Clean Air Strategic Alliance (CASA) stakeholders agreed to a framework for implementing the CWS for PM and ozone. The recommended framework has been forwarded to the provincial governments. It requires a regional "trigger level" approach to ensure achievement of the CWS. Areas of the province with ambient levels of PM and/or ozone above the management trigger but below the CWS level will implement a management plan designed to prevent an exceedance of the CWS. Any areas of the province with ambient levels of PM and or ozone above the CWS will implement a management plan designed to reduce ambient air quality to below the CWS levels. The recommended PM/ozone framework can be viewed at http:\\casahome.org/uploads/PMO3_AB_Guidance DocumentSEP-18-2003.pdf.

CASA stakeholders also agreed to a new management framework for air pollutant emissions from the electric power sector in Alberta. The provincial government formally adopted the recommendations from CASA. The framework is projected to bring about substantial reductions in SO_X, NO_X, PM and mercury emissions, while still allowing for an increase in total generation to meet projected demand for electricity. The predicted emissions reductions from 2003 levels are a 50% for mercury by 2009, 51% in fine PM by 2025, 46% in SO_X by 2025, and 32% in NO_X emissions by 2025. The recommended framework can be viewed at http://www.casahome.org/electricity/index.asp.

Alberta is carrying out the second assessment on the status of acid deposition relative to receptor sensitivity in Alberta and Saskatchewan. A five-year review of the Alberta Acid Deposition Management Framework is also being conducted.

Manitoba's SO_2 emissions arise primarily from base metal smelting activities. Year-to-year fluctuations in emissions occur due to varying operational schedules and shutdowns, some unplanned. Emissions continue to be well within limits specified by provincial regulation.

As part of the regulatory process, all proposals for environmental licensing continue to be scrutinized for emissions management of acidifying and others emissions. Pollution prevention opportunities for existing facilities continue to be pursued though no major reductions in acidifying emissions have been realized in recent years.

Actions taken by the federal government in 2003 contribute to reducing emissions of SO_2 and NO_X, and sulphur and nitrogen deposition across the country. In July 2003, the federal government added ozone and PM precursors to Schedule 1 of the Canadian Environmental Protection Act (CEPA 1999). This includes the acidifying pollutants SO_2, NO_X, NO_2, and gaseous ammonia (NH_3). This action provided the federal government with the authority to taken action as necessary to meet domestic and international commitments on improving air quality.

Non-ferrous mining and smelting and electric power generation were the industrial sectors emitting the largest quantities of SO_2, 33% and 27% respectively, of total Canadian emissions in 2000. For the smelting sector, consultations continued in 2003 on the development and implementation of the CEPA 1999 toxics management strategy for the base metal smelting and refining sector. This initiative is addressing SO2 emissions released from base metal smelters, as well as particulate matter containing metals. Three instruments were under consideration including regulations, notices requesting the development and implementation of P2 plans, and release guidelines/codes of practise with environmental performance agreements. CEPA 1999 requires that an instrument respecting preventive or control actions in relation to emissions from the smelters be proposed no later than September 28, 2004. Further information on this initiative is available at http://www.ec.gc.ca/TOXICS/EN/detail.cfm?par_sectorID=3&par_actn=s2.

The federal government's new source emissions reductions guidelines for thermal power plants across Canada came into force in 2003. These contain more stringent emission limits for NO_X, SO_2 and PM based on the performance of the best available economically feasible technologies.

Transportation continues to be the largest source of NO_X emissions in Canada. In 2003, Environment Canada implemented additional regulatory initiatives as part of the ten-year Plan of Action for cleaner vehicles, engines and fuels. These included regulations for more stringent emission standards for on-road vehicles and engines and off-road small spark-ignition engines and new regulations for limiting the sulphur content in diesel fuel.

Details on many of these initiatives can be found online as part of the report Clean Air in Canada: 2003 Progress Report on Particulate Matter and Ozone (http://www.ec.gc.ca/air/PM_resp_03/s2_e.htm).

Reducing Transboundary Flows of Acidifying Emissions

Commitments in the Acid Rain Annex to the Canada-United States Air Quality Agreement (the Agreement) have resulted in significant reductions in SO_2 and NO_X emissions since 1990. The more recent Ozone Annex is expected to achieve reductions in transboundary ground level ozone pollutants, including NO_X, an acidifying pollutant.

In June 2003, Canada and the United States (US) jointly announced the Border Air Quality Strategy, aimed at better addressing transboundary air issues. There are three major air quality pilot projects: maintaining air quality in a transboundary air basin: Georgia Basin-Puget Sound; Great Lakes Basin Airshed Management Framework; and a feasibility study for cross-border cap and trade of NO_X and SO_2 emissions. These projects will serve as a foundation for developing new strategies to contribute to a further reduction in transboundary air pollutants.

In October 2003, Canada and the US agreed on a path forward to address transboundary PM, which will have co-benefits in terms of further reducing acid rain causing pollutants. The first step deliverable for December 2004 was a joint transboundary PM science report to the Canada-US Air Quality Committee. In terms of the science report, acid rain endpoints were included. The joint science report concluded that there is sufficient evidence to support a recommendation that Canadian and US environment ministers should consider negotiating a PM annex to the Agreement. The next step included preparations for a June 2004 meeting of the Air Quality Committee to discuss whether to consider negotiation of new commitments to reduce transboundary PM and related air pollutants under the Agreement.

In the summer of 2003, the US Environmental Protection Agency (EPA) issued its final rule on the changes to the Clean Air Act's New Source Review Program that deals with how facilities, particularly 'grandfathered' facilities in the mid-West, reduce their emissions when they modify their operations. These changes have the potential to undermine the existing emission reduction commitments for SO_2 and NO_X emissions as they contribute to both acid rain and ambient air quality. Environment Canada expressed its concern over transboundary pollution through two formal comments to the US (http://www.ec.gc.ca/pdb/can_us/FinalComment2003_e.cfm).

Last year's annual progress report provided details on the US Clear Skies multi-pollutant initiative by the US Congress. In December 2003, the US EPA proposed a parallel strategy to Clear Skies through the promulgation of new Clean Air Act regional transport rules. The proposed Interstate Air Quality Rule (IAQR) is the first step in EPA's strategy for implementing the fine particle (PM2.5) and 8-hour ozone standards. The IAQR expands on the 14-year old Acid Rain Program by proposing further caps on emissions of SO_2 and NO_X from power plants in 29 States and the District of Columbia. EPA is proposing that the emission caps be implemented in two phases, with the first phase beginning in 2010 and the second phase beginning in 2015. The phase 1 caps would be 3.9 million tons for SO2 and 1.6 million tons for NO_X. The phase 2 caps would be 2.7 million tons for SO2 and 1.3 million tons for NO_X. Compared to emissions that would otherwise occur in 2010 and 2015, the IAQR would reduce SO_2 emissions by 3.6 million tons (40%) and NO_X emissions by 1.5 million tons (49%) in 2010, and reduce SO_2 emissions by 3.7 million tons (44%) and NO_X emissions by 1.8 million tons (58%) by 2015. However, Canada is concerned that the IAQR tells industry to do nothing about pollution until

the last minute, therefore, Environment Canada prepared comments on the proposed rule in 2004 (http://www.ec.gc.ca/pdb/can_us/canus_links_e.cfm).

Current and Projected SO_2 and NO_X Emissions

The collection and reporting of SO_2 and NO_X emissions is a provincial responsibility. Under CCME, the Emission and Projections Working Group (EPWG) works to coordinate the delivery of emissions data to a central agency who compiles a national inventory. Once an inventory is compiled, it can be included in this report. Until 2002, the reporting of annual emissions was a combination of actual and forecast emissions due to the delays between collecting the data, verification, and reporting (up to four years).

Beginning in 2002 criteria air contaminant emissions, including acid rain-causing emissions that are emitted from facilities where emissions exceed a specified threshold, must be reported through the National Pollutant Release Inventory (NPRI). The year 2002 NPRI data were made available to the public in September 2003, a much shorter timeline than compiling the national inventory. However, this inventory excludes emissions data from small point sources and area sources such as residential fuel combustion. Once this information is included, by mid-2005, the national 2002 inventory will be published on the EPWG website.

As a result of delays in generating up-to-date emissions data, along with the almost continual improvement in methods and techniques for estimating area source emissions, the emissions data presented in Tables 1 and 2 are not updated from last years annual progress report.

Forecast emissions data is used to meet the annual reporting requirements under the United Nations Economic Commission for Europe (UN ECE) Long-range Transboundary Air Pollution Convention and its various protocols. In 2002, Canada's total projected SO_2 emissions were 2.4 million tonnes, 25% below the national cap of 3.2 million tonnes in the First Sulphur Protocol. Emissions in the Sulphur Oxide Management Area (SOMA) were 1.1 million tonnes, 36% below the 1.75 million tonne cap in the Second Sulphur Protocol. The latest forecast predicts a lessening in the decline SO_2 emissions over the next few years. This could be the result of increased development in western Canada or hemispheric or intercontinental transport of emissions.

Table 1 Total SO_2 Emissions by Province and Sector (kilotonnes)

	1994-99 cap	2005 cap	2010/15 cap[c]	1990	1995	2000[*]	Forecast 2001	Forecast 2005	Forecast 2010
British Columbia									
Upstream oil and gas						86	110	113	116
Non-ferrous mining and smelting						3	13	15	17
Pulp & Paper						16	10	10	10
Transportation						30	25	25	26
Other						14	20	21	22
Total	**N/A**	**N/A**	**N/A**	**152**	**176**	**149**	**178**	**184**	**191**
Alberta									
Upstream oil and gas						223	256	238	230
Oil sands						94	98	117	162
Electric power generation						125	125	129	131
Other						34	35	34	36
Total	**N/A**	**N/A**	**N/A**	**567**	**610**	**476**	**514**	**518**	**559**
Saskatchewan									
Electric power generation						95	119	119	120
Upstream oil and gas						11	10	11	11
Other						15	13	13	13
Total	**N/A**	**N/A**	**N/A**	**88**	**131**	**121**	**142**	**143**	**144**
Manitoba									
Non-ferrous mining and smelting						353	402	432	432
Other						11	11	10	9
Total	**550[a]**	**N/A**	**N/A**	**516**	**365**	**364**	**413**	**442**	**441**
Ontario**									
Non-ferrous mining and smelting						254	264	279	245
Petroleum Refining						60	59	64	67
Other industrial sources						70	70	61	62
Electric power generation						166	150	158	131
Other						40	45	34	32
Total	**885**	**N/A**	**442.5**	**1166**	**604**	**590**	**588**	**596**	**537**
Quebec									
Non-ferrous mining and smelting						143	115	95[f]	75[f]
Aluminium industry						40	45	48	48
Petroleum Refining						15	14	15	15
Pulp and paper						22	25	23	23
Other						76	80	83	60
Total	**500**	**300**	**250**	**383**	**362**	**296**	**279**	**264[f]**	**221[f]**
New Brunswick									
Non-ferrous mining and smelting						12	12	14	14
Pulp and paper						13	13	12	11
Electric power generation						97	110	58	47
Other						18	15	15	15
Total	**175**	**122.5**	**87.5**	**181**	**114**	**140**	**150**	**99**	**87**
Nova Scotia									
Electric power generation						140	134		
Other Industrial						17	20		
Other						10	10		
Total	**189**	**142**	**94.5 [e]**	**178**	**166**	**167**	**164**	**142 [d]**	**94.5 [e]**

Table 1 Total SO_2 Emissions by Province and Sector (kilotonnes) Continued

	1994-99 cap	2005 cap	2010/15 cap[c]	1990	1995	2000[*]	Forecast 2001	Forecast 2005	Forecast 2010
Prince Edward Island									
Electric power generation						1	2	2	2
Other						3	2	2	2
Total	**5**	**N/A**	**N/A**	**4**	**2**	**4**	**4**	**4**	**4**
Newfoundland									
Petroleum refining						25	22	17	17
Iron ore mining						8	6	7	8
Electric power generation						11	12	14	14
Other						11	8	10	10
Total	**45[a]**	**N/A**	**N/A**	**66**	**65**	**55**	**48**	**48**	**49**
Yukon									
Total	**N/A**	**N/A**	**N/A**	**N/A**	**<0.5**	**<0.5**	**<0.5**	**<0.5**	**<0.5**
Northwest Territories									
Mining and rock quarrying							<0.5	<0.5	<0.5
Upstream oil and gas							1	5	5
Other							1	1	1
Total	**N/A**	**N/A**	**N/A**	**17**	**16**	**<0.5**	**3**	**6**	**7**
Nunavut[b]									
Total	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**<0.5**	**N/A**	**N/A**	**N/A**
SOMA									
Total	**1750**	**1750**	**1750**	**1872**	**1227**	**1149**	**1128**	**1106**	**818**
Canada									
Total	**3200**	**3200**	**3200**	**3260**	**2611**	**2362**	**2483**	**2445**	**2333**

[a] Cap applied to 1994 only
[b] Numbers for Nunavut are included in the NWT totals for all years except 2000
[c] Caps for Quebec, New Brunswick and Nova Scotia are for 2010; cap for Ontario is for 2015[a]
[d] Represents the provincial emission cap; breakdown by sector not available
[e] Nova Scotia's forecast 94.5 kt by 2010 is a reduction target for existing sources and is not meant to be a cap
[f] As a result of the permanent closure of the Murdochville smelter, the 2005 and 2010 forecasts will be reduced by 30 kilotonnes..

Note: Numbers may not add due to rounding.
N/A: Not applicable
Source: Data provided by the Emissions and Projections Working Group of the CCME using the latest technical and statistical information available as of September 2003.

* Data for British Columbia, Saskatchewan, Manitoba, Ontario, Quebec, New Brunswick, Nova Scotia, and Newfoundland are actual data provided by each province for 2000. For all other provinces, emissions data in 2000 are based on the latest forecast available.

**Ontario has committed to reducing its SO_2 emissions by 50% from its Eastern Canada Acid Rain Program commitment of 885 kt by 2015. These further reductions are not included in the above projections.

Table 2 Total Anthropogenic NO_x Emissions by Province and Sector (kilotonnes)

				Forecast	
	cap for 1994 and beyond	1995	2000	2005	2010
British Columbia					
Stationary sources			75	73	70
Transportation			214	189	183
Total	**N/A**	**294**	**289**	**262**	**253**
Alberta					
Stationary sources			515	588	694
Transportation			227	167	132
Total	**N/A**	**686**	**742**	**755**	**826**
Saskatchewan					
Stationary sources			91	93	96
Transportation			85	60	53
Total	**N/A**	**173**	**176**	**153**	**149**
Manitoba					
Stationary sources			15	19	17
Transportation			58	40	35
Total	**N/A**	**79**	**73**	**59**	**52**
Ontario *					
Stationary sources			200	166	152
Transportation			355	294	256
Total	**N/A**	**515**	**555**	**460**	**408**
Quebec					
Stationary sources			53	57	60
Transportation			297	219	200
Total	**N/A**	**363**	**350**	**276**	**260**
New Brunswick					
Stationary sources			34	31	28
Transportation			48	39	31
Total	**N/A**	**68**	**82**	**70**	**59**
Nova Scotia					
Stationary sources			42	45	46
Transportation			39	28	25
Total	**N/A**	**76**	**80**	**73**	**71**
Prince Edward Island					
Stationary sources			2	2	2
Transportation			8	6	5
Total	**N/A**	**8**	**10**	**7**	**7**
Newfoundland					
Stationary sources	**N/A**		16	19	22
Transportation			37	33	29
Total		**44**	**53**	**52**	**51**
Yukon					
Stationary sources			2	2	2
Transportation			4	2	2
Total	**N/A**	**5**	**5**	**4**	**4**
Northwest Territories					
Stationary sources			9	16	18
Transportation			3	2	2
Total	**N/A**	**9**	**12**	**18**	**19**
Nunavut[a]					
Stationary sources					
Transportation					
Total	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**
Canada					
Total	**1987 level**[b]	**2322**	**2427**	**2189**	**2159**

[a] Numbers for Nunavut are included in the NWT totals, but will be reported separately in the future.
[b] 1987 levels are under review

Notes: Stationary sources include both point and area sources
Numbers may not add due to rounding
N/A: Not applicable
Source: The emissions and projections were compiled using the latest technical and statistical information available as of July 2002. Data provided by the Emissions and Projections Working Group of the CCME.
More up-to-date data will be available on the Environment Canada website at http://www.ec.gc.ca/pdb/ape/cape_home_e.cfm.

* Through the Anti-Smog Action Plan, Ontario has committed to reducing its NO_X emissions by 45% from its 1990 base level of 659 kt by 2015. Again, these further reductions are not included in the above projections.

Continuing Acid Rain Science

The responsibility for maintaining an adequate science and monitoring program is jointly shared between the provinces, territories and federal government. In the southeast part of Canada, both levels of government operate deposition monitoring networks and participate in periodic sampling of water chemistry in sensitive areas. This information is used to calculate exceedances of critical loads and periodically update the critical loads for aquatic ecosystems.

Recently, the Forest Mapping Work Group of the New England Governors and Eastern Canadian Premiers calculated and mapped critical loads and exceedances for sulphur and nitrogen for upland forest soils in eastern Canada. The federal government funded a similar mapping activity in the provinces of Ontario. Forest critical loads describe the level of acid deposition that forest soils can receive without incurring harmful changes to soil chemistry; a key assumption of these critical loads is that by maintaining the chemistry of soils above a critical chemical limit, forest health and productivity will be ensured.

The results of these critical load and exceedance mapping efforts are illustrated in Figures 1 and 2. The maps reveal that critical loads are high in areas where soils are deep and/or derived from calcareous substrate with high rates of mineral weathering (e.g., southern Ontario). Low critical loads are found in areas where soils are shallow and mineral weathering is low (e.g., southwestern Nova Scotia and on the Canadian Shield).

Critical load exceedances are high where atmospheric deposition rates are high, and where critical loads are low. Highest exceedances occur in eastern Ontario and southern Quebec. On average, critical load exceedances covered approximately 52% of the mapped area of upland forest soils in southeastern Canada.

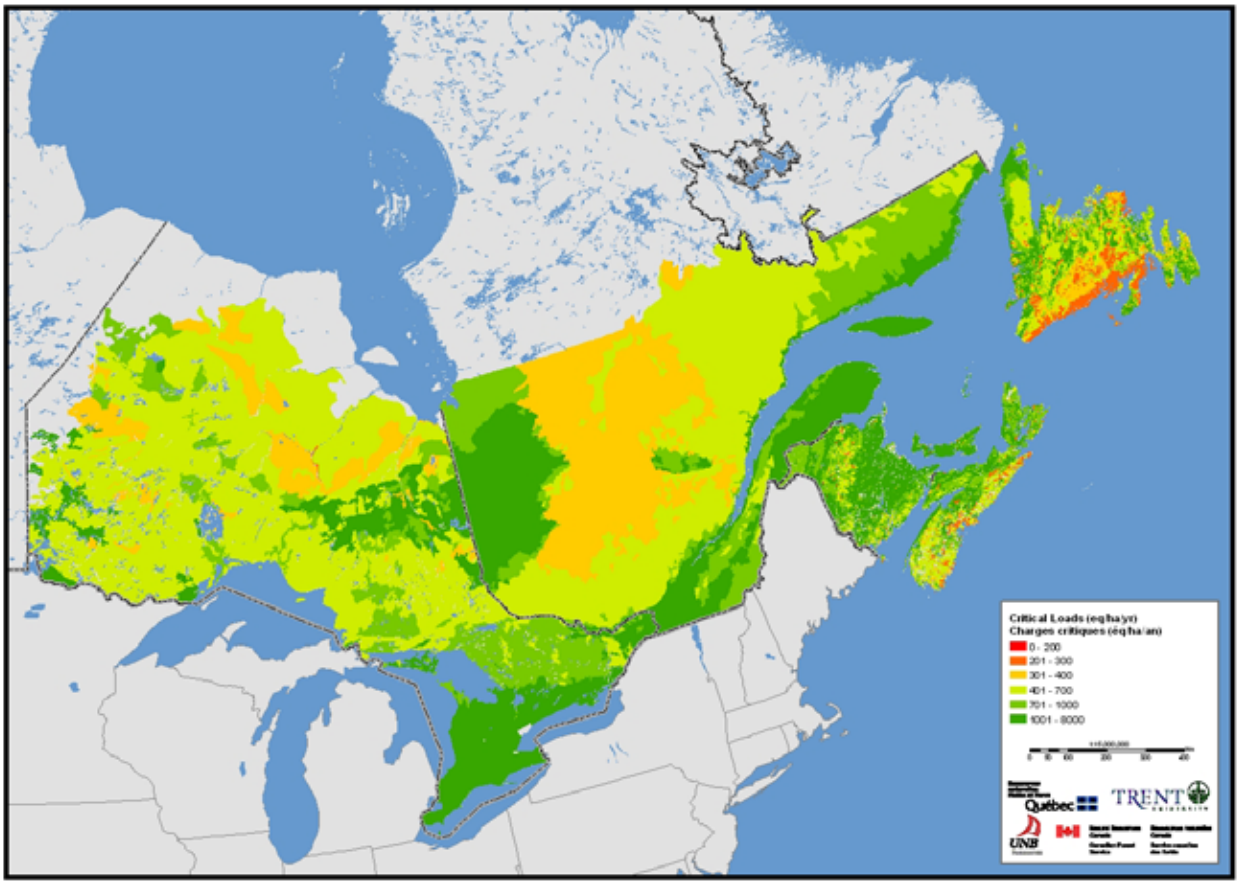

Figure 1: Critical loads for upland forest soils in southeastern Canada in eq/ha/yr assuming no forest harvesting.

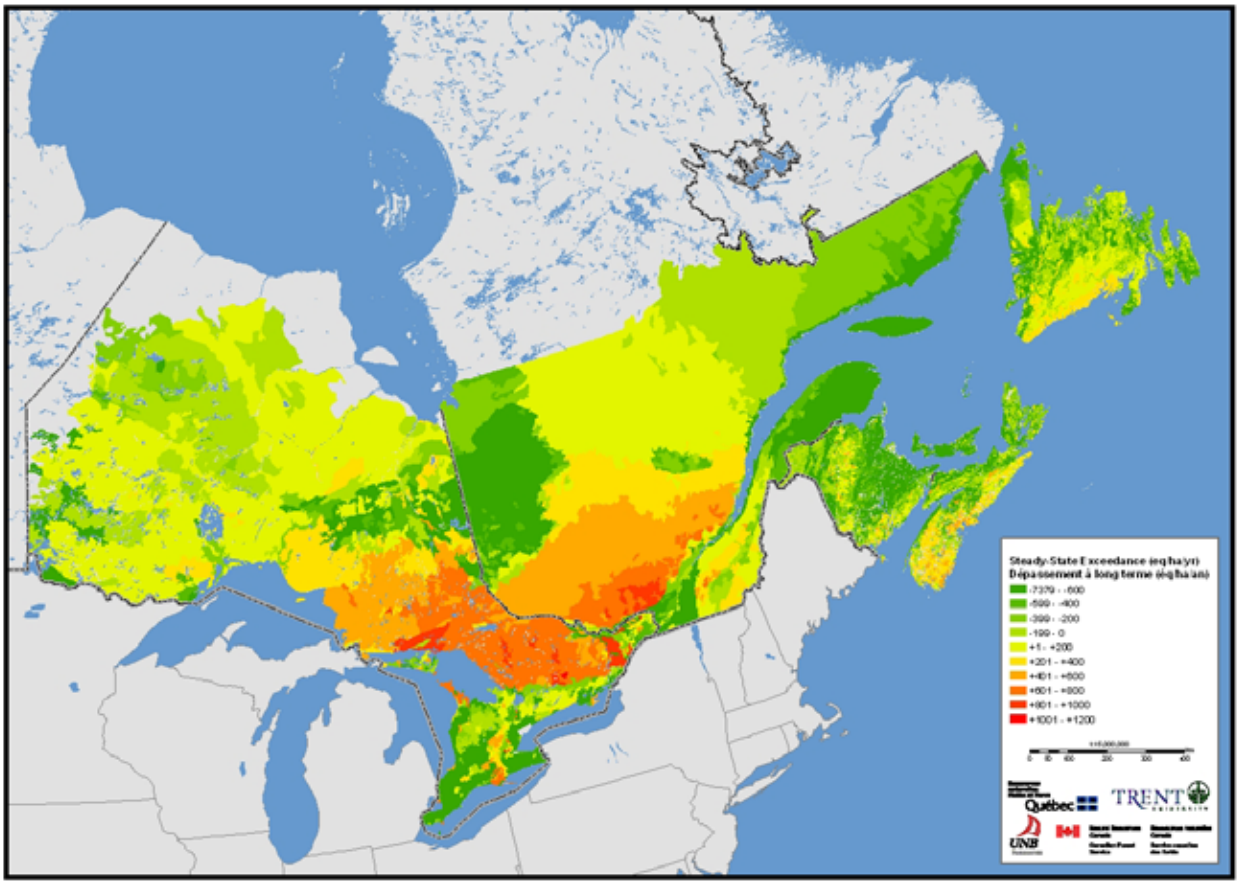

Figure 2: Upland forest soil steady-state critical load exceedances for southeastern Canada in eq/ha/yr assuming no forest harvesting.

1. Dynamic Modelling

Dynamic acidification models are being used to forecast the effects of emission reductions on ecosystems. Such projections allow politicians, managers and industry to understand how decisions regarding the production of acidifying emissions will affect the rate and extent of achievement of critical loads. Of the models available currently, it is widely recognized that the Model of Acidification of Groundwater in Catchments (MAGIC) developed by Dr. B.J. Cosby of the University of Virginia is one of the best. Dr. Paul Arp from the University of New Brunswick has also developed a Dynamic Model for Forest Soil Geochemistry.

The Acid Rain Work Group hosted a workshop on dynamic modelling of nitrogen and sulphur emissions reductions in soils and lakes in 2003. Attendees included acid rain researchers from federal and provincial governments and academia. The workshop succeeded in transferring knowledge of dynamic models to the Canadian acid rain research community. The presentations led to energetic discussions on potential applications of the models in Canada.

The forest soil critical loads for Ontario (and eastern Canada) were mapped using a steady state approach and provide no indication as to when the critical chemical limit in the soils will be

exceeded. Recently, researchers applied the dynamic model, MAGIC, to catchments in central Ontario in order to predict the time to recovery (or damage) of ecosystems under current and future levels of acid deposition. The results of this work indicate that despite improvements in the capacity of streams to neutralise acids in response to current and proposed SO_2 emission reductions, soils will continue to acidify decades into the future (Aherne et al., 2003).

A missing part of the current assessment of the effects of acid deposition on forest soils is the exclusion of the impacts of forest harvesting on the buffering capacity of soils. Harvesting plays a significant role in base cation depletion and increases the sensitivity of soils and surface waters to acid deposition. As such, it is important that the impacts of forest harvesting are included in the dynamic modelling.

To address this lack of information, Environment Canada is contracting an evaluation of the relative impacts of changes in acid deposition and harvesting on soil and surface water chemistry. The project will focus on the application of MAGIC to three intensively studied catchments in central Ontario that represent a gradient in sensitivity. The work, scheduled for completion in fall, 2004, will evaluate how harvesting should be treated in dynamic models, and determine the relative impact of harvesting and sulphate deposition under the different harvesting scenarios used in Ontario.

2. 2004 Canadian Acid Deposition Science Assessment

Work continues on the Acid Deposition Science Assessment, a synthesis of the state of knowledge on acid deposition. Development of the Assessment began in the fall of 2002 with the development of a list of key science questions by scientists and policy-makers, the answers to which would support future acid rain management. The key science questions helped shape the table of contents of the Assessment which was solidified at a workshop in April 2003.

The Assessment builds upon the results presented in the 1997 Canadian Acid Rain Assessment and presents the latest research related to the following:

- progress towards reducing acid-causing emissions;
- response of the atmosphere to past, present, and future changes in emissions;
- new critical load estimates for aquatic and terrestrial ecosystems;
- effects on forests, soils, aquatic ecosystems, wildlife, and human health;
- current and proposed emission control programs and how acid deposition will be affected;
- recovery of aquatic ecosystems;
- critical loads and exceedances;
- ongoing efforts to quantity the costs and benefits associated with reducing acid deposition;
- co-benefits and linkages to other pollutants; and,
- conclusions, scientific gaps, and future work.

Early results show that despite substantial reductions in SO_2 emissions in North America, acid rain continues to be a serious issue. Critical loads for aquatic ecosystems and, as new results show, for terrestrial ecosystems, are still being exceeded across much of southeastern Canada. Lakes located in affected areas generally exhibit declining sulphate levels in response to emission

reductions but, as yet, do not exhibit widespread increases in pH or alkalinity. The only exception to this response is lakes located near smelters in Ontario and Quebec that have dramatically reduced emissions.

The lack of chemical recovery of many aquatic ecosystems in southeastern Canada is affecting the rate of biological recovery. As with the chemical response, there is little evidence of biological recovery (e.g., improved loon breeding success) outside of lakes located near smelters in Ontario and Quebec that have dramatically reduced emissions.

Recent research on the effects of acid deposition on forests indicates that damage is occurring over large regions of eastern Canada. Observed effects include depletion of nutrients from the soil, which results in decreased growth rates and increased susceptibility of trees to climate, pest and pathogen stress. The overall impact is reduced timber yield.

As with the 1997 Assessment, the 2004 Assessment is revealing significant gaps in knowledge and data about water and soil chemical and biological status and trends, particularly in western Canada. Research continues to show confounding links and interactions with other air quality issues such as climate change, PM and ozone. Although progress has been made, we are still unable to quantify the economic costs and benefits of acid deposition and mitigation. Many questions remain to be answered.

External peer review of Assessment chapters was scheduled for mid-2004. The finalisation of the Assessment is targeted for March 2005 and the product will be a CD-ROM. A stakeholder outreach meeting in 2005, hosted by the Acid Rain Task Group, will officially announce the publication of the assessment.

Next Steps

Five years after the signing of the 1998 acid rain strategy, the Task Group is conducting a review of progress. The output will be recommendations on next steps for implementing The Strategy and further actions needed to achieve critical loads.

One action that will be required in the future is the development of SO_2 (and NO_X) emission reduction targets for 2010 that can be incorporated into the UN ECE Protocol on Acidification, Eutrophication and Ground-level Ozone. Canada has signed this protocol; to ratify it, Canada will need to develop specific numeric pollutant emission targets for SO_2, NO_X and volatile organic compounds (VOC) for 2010 in the Pollutant Emission Management Area (PEMA). Canada will continue to investigate how best to develop a package of provisions for its ratification.

In order to deal with the residual problem, more action will be needed to meet critical loads for lakes and soils and to address the emerging concern about the sustainability of Canada's forests. Action is also needed to sustain an adequate base of monitoring and science to ensure understanding of emerging threats and to track progress and policy results.