THE CLEAN AIR ACT
ANNUAL REPORT
1976-1977

Air Pollution Control Directorate
Environmental Protection Service
Fisheries and Environment Canada

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Minister
Fisheries and Environment Canada

Ministre
Pêches et Environnement Canada

His Excellency
The Right Honourable Jules Léger
Governor General and Commander-in-Chief of Canada

May It Please Your Excellency:

I have the honour herewith, for the information of Your Excellency and the Parliament of Canada, to present the Annual Report on the Clean Air Act for the fiscal year ended March 31, 1977.

Respectfully submitted,

L. D. Marchand

Len Marchand
Minister of State (Environment)

Deputy Minister
Fisheries and Environment Canada

Sous-ministre
Pêches et Environnement Canada

The Honourable Len Marchand
Minister of State (Environment)
Ottawa, Canada

Dear Mr. Marchand:

I have the honour to submit the Annual Report on the Clean Air Act for the fiscal year ended March 31, 1977.

Respectfully submitted,

J.B. Seaborn

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Air pollution.

At times we can see it, feel it, smell it, taste it, cough as a result of it or even be brought to tears by it. At other times its presence is so unobtrusive to our senses we don't realize it is there. At all times, it adversely affects, in varying degrees, our person and our environment.

An insidious foe, it derives its strength from our growing industrialization, and our love affair with the automobile. To worsen matters, it is aided and abetted by factors beyond our control - like the weather - as well as those within our control — like the bottom line of a financial report reflecting the costs of control.

But controlled it must be, if we value the quality of the air we breathe. And that's what this Clean Air Act Annual Report is all about.

Air pollution control involves the highly technical work of scientists and engineers specializing in its various aspects. This report therefore leans to the technical side. Hence a sampling of the year's highlights is presented here in a highly condensed form.

• The federal government is particularly concerned with substances deemed hazardous to health. So far lead, mercury, vinyl chloride, arsenic and asbestos have been named and the development of regulations for these is the top priority of the Air Pollution Control Directorate. This year, regulations for secondary lead smelters, asbestos mining and milling, and mercury cell chlor-alkali plants were published. The federal-provincial-industrial task forces which provided input to the development of these regulations also made progress on their contributions to the development of regulations to control atmospheric arsenic and vinyl chloride emissions from various industrial processes, and arsenic and mercury emissions from the primary metallurgical nonferrous industry.

• To assist the provinces in undertaking appropriate control action, the Directorate develops industrial sector guidelines for other air pollutants. This year, the Directorate announced emission guidelines for Arctic mining operations. Their adoption as minimum standards could reduce particulate matter emissions by 80 percent.

• With motor vehicles being a major source of urban air contamination, federal regulations play an important role in reducing tailpipe emissions. Some examples:

- under a national monitoring program, 144 samples of lead-free gasoline out of 3688 exceeded the limits for lead. The marketing companies took immediate corrective action;

- two consignments of gasoline, one in New Brunswick, the other in British Columbia, were seized under the leaded gasoline regulations when gross contamination was detected;

- to protect catalytic converters from deactivation by lead, fuel tank filler inlets of cars with converters must be smaller than the pump nozzles used for leaded gasoline. A survey in Quebec revealed that of the 3507 nozzles checked at leaded gasoline pumps, 17.8 percent were small enough to circumvent the protective measure. Provincial authorities and the federal Department of Consumer and Corporate Affairs were notified and appropriate remedial action requested;

- car manufacturers must certify that their new cars sold in Canada conform to federal emission standards. To ensure compliance, about 50 new representative vehicles were used in more than 350 emission tests under controlled driving conditions during the fiscal year.

• To identify control needs, the Air Pollution Control Directorate seeks detailed information on emissions of air pollutants through specific pollutant inventories. Inventories have been finished for the five pollutants mentioned above and for zinc, cadmium, manganese, beryllium, fluoride and vanadian. All inventory information is stored in the Directorate's computerized National Emission Inventory System. Designed for Canadian conditions, the System serves as the central reference point for Canada's air pollutant emission records.

• Federal and provincial air pollution control authorities investigated the presence of fluorides in both gaseous and particulate form on Cornwall Island in the St. Lawrence River. They found concentrations of fluorides in forage to be high and evidence of chronic fluorosis in livestock. The source of the pollution is an aluminum smelter in New York State.

• The National Air Pollution Surveillance (NAPS) network was expanded and improved. At the fiscal year-end it had 153 stations in 52 cities across Canada, with 541 instruments monitoring the major air contaminants. Results were published as monthly and annual summaries, providing information vital for air pollution control planning and assessment of air quality trends.

• Air pollution source testing took place at many industrial plants in cooperation with provincial authorities. Testing ranged from lead emissions at a brick kiln burning waste lubrication oil in Nova Scotia to arsenic emissions at a gold roaster in the Northwest Territories. The purpose was to evaluate techniques and gather data for legislative requirements.

• With the creation of the International Michigan-Ontario Air Pollution Board under the International Joint Commission in 1975, control programs in the transboundary area are now being jointly monitored. The Air Pollution Control Directorate provides the Board with the Canadian chairman and technical assistance.

• Mercury emissions from chlor-alkali plants and asbestos emissions from mining and milling operations have been tagged by Health and Welfare Canada as health hazards to be controlled. As part of the control process, standard measuring techniques were required and these were completed.

• During the year there were special studies on

- sulphate concentrations at 33 stations in eastern Canada and 22 NAPS network stations to help assess the impact of long range transport of air pollutants within and into Canada;

- sulphur dioxide concentrations in the ambient air at the proposed site for a new coal-fired power-generating station in Nova Scotia;

- atmospheric mercury concentrations near chlor-alkali plants at Lebel-sur-Quévillon, Quebec, and Cornwall, Ontario to evaluate the contribution made by these plants to ambient air levels of mercury;

- carbon monoxide concentrations in Whitehorse, Yukon, and at Lake Louise, Alberta to assess the impact of unusual winter climatic conditions on the ambient air levels of this pollutant.

• Financial aid was made available to industry on a cost-sharing basis to develop new technology for air pollution control. The first contract went to a British Columbia forest products company for a new type of scrubber to remove the salty smoke emitted from the burning waste of seawater-stored logs. If successful, it will have a wide application to other industries. The second contract went to a New Brunswick kraft pulp mill for a unique wet scrubber to remove both fine airborne particulates and odiferous sulphur compounds. This technique also has considerable potential for monetary benefits for the pulp and paper industry because it economizes the use of chemicals.

• The separation and analysis of pollutants in a sample of air call for high technology. During the year, X-ray fluorescent methods, developed for the direct determination of pollutant concentrations, have proved particularly successful for arsenic and lead.

• Keeping updated on the "state-of-the-art" in air pollution control requires sophisticated data-gathering methods and expertise. The Directorate has developed and now makes available such expertise. It has access to the U.S. Environmental Protection Agency's technical information system and handles all its Canadian enquiries. During the year, over 70 computerized searches were made for federal, provincial and municipal government agencies, and more than 2800 individual requests answered. The Directorate's microfiche library now holds 92 000 documents.

• Air pollution control, like charity, begins at home and this applies especially to federal government activities. If it is to lead in environmental protection, the federal government must set a good example. The Environmental Protection Service prepared a guide and made its technical skills available to federal departments regarding the air pollution control aspects of their proposed projects. Installations which came under close scrutiny included boilers and incinerators, traditional polluting sources. As an example, waste oil was successfully burned, from an environmental viewpoint, in a CNR heating plant in Moncton. The technique is to be applied elsewhere.

• In Alberta and British Columbia open-top trains carrying coal are now being subjected to coal-dust suppression treatment, thanks to successful field studies using a spray application of chemical binding agents.

• Reports were completed on the first intensive field study of the estimated impact of the Alberta oil sands development on the area's air quality.

• Long range transport of air pollution has become a vexatious problem dramatically shown in the increase of acid precipitation and atmospheric haziness in eastern Canada. This is now the subject of an extensive study by departmental experts. A cross-Canada network of 40 special monitoring stations was installed to be operational in April 1977. Of related interest is the investigation into the dispersal characteristics of the plume from the world's highest stack, at Sudbury, Ontario. It included the collection of air samples from the smelter plume by helicopter-borne instruments to evaluate the oxidation of sulphur dioxide to sulphuric acid and sulphates.

The foregoing, as stated, is only a sampling of the year's activities. For a full appreciation of the impact the Act is having nationally from the myriad of ongoing programs that emanate from it, the reader is referred to the main body of the report.

INTRODUCTION

The Clean Air Act was officially proclaimed on November 1, 1971. This report, submitted in accordance with Section 41 of the Act, covers operations for the period ending March 31, 1977.

The Clean Air Act provides the basis for the federal government's air pollution control activities and has three main objectives. The first and foremost is to protect the health of the public of Canada from air pollution. To this end, federal regulations are promulgated limiting the emission of hazardous pollutants such as lead, mercury, vinyl chloride, asbestos and arsenic. The second objective is to promote a uniform approach across Canada in the control of other pollutants. To achieve this and to provide appropriate leadership by the federal government, the Act enables the issuance of industrial sector guidelines aimed at preventing so-called "pollution havens", a matter that is of great concern to both federal and provincial authorities.

The third objective is to make provision for the mechanisms and institutions needed to ensure that all measures to control air pollution can be taken. Of major significance is the recognition that provinces have a direct responsibility in controlling air pollution and that joint cooperative efforts between provincial and federal authorities are required. To this end, the Act enables the federal government to enter into agreements with individual provinces and allows the establishment of arrangements for the implementation of regulations made under the Act; the Act also provides for direct action by the federal government when this is necessary.

RESPONSIBILITIES OF THE MINISTER

The responsibilities of the Minister under the Clean Air Act include:

(a) ensuring the development of regulations limiting the emissions of hazardous substances and guidelines recommending appropriate means of control for other substances;

(b) establishing, operating, and maintaining a system of air pollution monitoring stations throughout Canada;

(c) collecting, both through the operation of air pollution monitoring stations and from other appropriate sources, data on air pollution in Canada and processing, correlating, and publishing such data on a regular basis;

(d) conducting research and studies relating to the nature, transportation, dispersion, effects, control, and abatement of air pollution and providing consultative, advisory and technical services, and information related thereto;

(e) formulating comprehensive plans and designs for the control and abatement of air pollution and establishing demonstration projects, and publicizing, demonstrating, and making such projects available for demonstration; and

(f) publishing or otherwise distributing or arranging for the publication or distribution of all pertinent information which would serve to inform the public in respect to all aspects of the quality of the ambient air and of the control and abatement of air pollution.

ENVIRONMENTAL PROTECTION SERVICE

Within Fisheries and Environment Canada the Clean Air Act is administered by the Environmental Protection Service through its five regional offices across Canada and through the Air Pollution Control Directorate and the Federal Activities Branch in Ottawa. A resource summary for the Air Pollution Control Program is shown in Table 1.

Air Pollution Control Directorate

The responsibilities of the Air Pollution Control Directorate are divided among three branches.

The *Air Pollution Programs Branch* is responsible for development and coordination of Canada's National Air Pollution Surveillance (NAPS) Program as well as specific ambient air monitoring and source sampling surveys. Nationwide inventories of air pollutant emissions and national inventories of potentially hazardous air contaminants are developed as prerequisites to the national program of air pollution control and abatement. The Branch is responsible for the nontechnical aspects of emission standard regulations and guidelines development, including analyses of the

TABLE 1 AIR POLLUTION CONTROL PROGRAM RESOURCE SUMMARY

Fiscal Year	End of year strength	Salaries ($)	Goods and services ($)	Capital ($)	Total expenditure ($)
1970-1971	38	268 326	113 527	157 458	539 311
1971-1972	76	900 000	455 000	660 000	2 015 000
1972-1973	147	1 711 000	644 000	1 079 000	3 434 000
1973-1974	151	1 859 000	1 053 000	958 000	3 870 000
1974-1975	163	2 533 279	1 077 210	1 132 507	4 742 996
1975-1976	176	3 171 686	1 231 818	827 838	5 231 342
1976-1977	165	3 069 500	1 210 300	795 487	5 075 287

socioeconomic implications of air pollution control. The Branch coordinates the development and prescription of National Air Quality Objectives and is also responsible for interservice, intergovernmental and international liaison.

The *Abatement and Compliance Branch* is primarily concerned with the application of known technology to the capture and containment of pollutants from stationary and mobile sources. The Branch is the focal point of engineering and technical expertise on air pollution emissions and control and abatement methods. Technical assessments, state-of-the-art reviews and industry studies are prepared and used as technical bases for the development of air pollution control guidelines, regulations and standards. Joint government-industry task forces, planned, organized and chaired by the Branch, recommend abatement technology for use in establishing guidelines and regulations. Major stationary sources of air pollution, such as iron and steel mills, nonferrous smelters, pulp and paper mills, thermal power generating stations and incinerators are the responsibilities of three divisions of the Branch: Mining, Mineral and Metallurgical, Chemical Process Sources, and Combustion Sources. Emissions from motor vehicles, ships, railways and aircraft are the responsibility of the Mobile Sources Division, and a fifth division, Fuels, is responsible for the regulation of fuel production sources, for inventories of fuels and for fuel composition and additive regulations.

The *Technology Development Branch* has two primary responsibilities. One is to manage a cost-shared program with Canadian industry for the development and demonstration of new air pollution control technology and the other is to provide the technical and scientific services required by the Directorate. These services include the development and certification of analytical techniques required to support regulations and guidelines; the preparation of standard reference materials for analytical laboratories across Canada that are engaged in analysis of air pollutants; the operation of a motor-vehicle-testing facility which assesses the compliance and durability of pollution control equipment on new motor vehicles sold in Canada; the provision of a computerized information service on air pollution control; the editing, publication and distribution of all Directorate reports on its scientific and technical activities; and the training of inspectors, analysts and enforcement officers in federal, provincial and municipal jurisdictions. These functions are performed in three divisions: Engineering, Chemistry, and Publications and Training.

Environmental Protection Service Regional Offices

The primary points of contact with provincial environmental protection agencies are the five Environmental Protection Service Regional Offices located in Halifax, Montreal, Toronto, Edmonton, and Vancouver. Regional Directors are responsible for providing, within their region, direction and supervision of Environmental Protection Service programs arising from the Clean Air Act together with policies and commitments resulting from bilateral and international agreements. Regional Directors formulate and administer enforcement and other operational programs in accordance with national policies and guidelines.

Federal Activities Branch

The Federal Activities Branch was established to demonstrate the federal government's concern for its own activities. The Branch is Fisheries and Environment Canada's interface on pollution matters with all federal departments, agencies and crown corporations. It also represents the Department in negotiations on environmental matters with any organization receiving financial assistance or operating under permits granted by the federal government. The Branch is concerned with the treatment and disposal of waste water, toxic and hazardous substances, solid waste management, air pollution and noise for all land and off-shore facilities.

Centres for facilitating exchanges between the many organizations which have needs and those which have expertise have been established in the Environmental Protection Service Regional Offices. Guidelines, technical advice and assistance are arranged through these centres to ensure that all new federal projects are examined for possible environmental effects and that proper environmental protection measures are incorporated into project designs and operations. The Federal Activities Branch is also charged with defining pollution problems at existing facilities, developing courses of remedial action and, in consultation with other departments, recommending clean-up project priorities and allocating funds from a central Federal Activities Clean-Up Fund.

INTERAGENCY COOPERATION AND COLLABORATION

General

The Environmental Protection Service maintains close contact with all provincial pollution control agencies, with other federal government departments and agencies, and with foreign and international organizations responsible for air pollution control.

Because the provinces have jurisdictional control over most air pollution sources, it is essential for the federal government to maintain collaboration with provincial agencies. Control programs initiated by the Environmental Protection Service are frequently implemented by provincial agencies. Close liaison is also maintained with the Office of Air Quality Planning and Standards of the United States Environmental Protection Agency to facilitate information exchange.

The Environmental Protection Service participates with other federal agencies in a number of international environmental organizations.

Federal-Provincial

Federal-Provincial Committee on Air Pollution. This is the principal national mechanism for obtaining federal-provincial cooperation and for promoting provincial participation in specific national projects. The Committee was established on an ad hoc basis in 1969 by the Department of National Health and Welfare. With the formation of Environment Canada in 1971, the Committee was formally established under the aegis of the Minister of the Environment. The Committee provides a forum for the exchange of technical and scientific information and methodologies and for the regular surveillance of the state of air quality in Canada. During the review period a meeting of the Committee was held in Ottawa (May 11-13, 1976).

In 1970, a subcommittee of experts was established to recommend to the parent committee appropriate levels for National Air Quality Objectives. Recommendations of the subcommittee have permitted air quality objectives to be prescribed at the desirable and acceptable levels for sulphur dioxide, suspended particulates, carbon monoxide, oxidants and nitrogen dioxide. These objectives have been published in the

Canada Gazette. Additional objectives at the desirable and acceptable levels were proposed during the review period for hydrogen sulphide and hydrogen fluoride.

A separate subcommittee of the Federal-Provincial Committee on Air Pollution has been established to recommend Maximum Tolerable Levels of Air Quality. These levels denote concentrations of air contaminants that require abatement without delay to avoid further deterioration of conditions to an air quality that endangers the prevailing life-style or, ultimately, to an air quality that poses a substantial risk to public health. During the review period, following the recommendations of this subcommittee, Maximum Tolerable Levels were proposed for sulphur dioxide and particulate matter separately and in combination, and for carbon monoxide, oxidants and nitrogen dioxide. The two subcommittees are still active and continue to consider proposals for air quality objectives as the need arises.

Another subcommittee was formed in 1974 to recommend criteria for air-monitoring site selection. This subcommittee completed a document, tabled at the 1976 parent committee meeting, that outlines the recommended criteria for selecting sites for air monitoring instrumentation. The Committee accepted the subcommittee's report and approved the disbanding of the subcommittee.

An ad hoc subcommittee was established in 1975 to examine whether the Committee should involve itself with air quality indices and, if so, what form the indices should take. The subcommittee presented preliminary recommendations to the parent committee at the 1976 meeting. Formal recommendations for national air quality indices are to be presented at the 1977 meeting. The use of Coefficient of Haze values in the index was approved by the Committee.

The Federal-Provincial Committee on Air Pollution instituted an interlaboratory quality control program for methods of analysis of air pollutants. Approximately sixty laboratories are participating.

An important concern of the Committee is the National Air Pollution Surveillance (NAPS) network. The NAPS network is a cooperative effort of the federal and provincial levels of government that monitors the concentrations of locally significant air pollutants in all major centres of population. The network enables the monitoring of progress in air pollution control across the country. Its method of operation and other pertinent details are explained elsewhere in this report.

Because the provinces have jurisdiction over most air pollution sources, Fisheries and Environment Canada has adopted the basic strategy of promoting and supporting provincial control agencies through federal-provincial cooperation. Assistance to the provinces has included the free exchange of data, the training of enforcement officers, inspectors and technicians and the provision of monitoring equipment for the NAPS network and technical and advisory services.

Other Activities. During the summer of 1976, the Service cooperated with the Province of Ontario in a comprehensive survey of mercury concentrations in discharges from a chlor-alkali plant at Cornwall. Mercury concentrations in the ambient air and in vegetation were also determined. Another cooperative venture with the Province of Ontario concerned the determination of fluoride concentrations in the ambient air and vegetation of Cornwall Island. No adverse human health effects were determined but concentrations of gaseous and particulate fluorides in the ambient air were high. In limited areas, the concentrations of fluorides in forage were high and evidence was found of chronic fluorosis in livestock throughout the island. An aluminum smelter located in New York State is the source of the fluoride emissions. The Cornwall Island studies are continuing.

A federal-provincial committee concluded a review of process information supplied by Syncrude Canada Ltd. and identified the best practicable technology to contain sulphur dioxide emissions from the tar sands facility.

International

Environmental Protection Agency. Officers of the Environmental Protection Service maintain many contacts with officials of the United States Environmental Protection Agency to exchange information and services.

The Air Pollution Control Directorate acquired the computerized Emissions Inventory System from the Environmental Protection Agency and modified it to meet Canadian requirements. The new system, called the National Emissions Inventory System, became partially operational late in 1975. Emissions data accumulated manually over the years are now being incorporated into the system which will eventually be used for the development and maintenance of Canadian air pollutant emission inventories.

Through regular attendance at the United States National Air Quality Criteria Advisory Committee, which advises the Environmental Protection Agency, Fisheries and Environment Canada is kept informed on many areas pertaining to air quality research, priorities and programs. The Service continued to cooperate with the Environmental Protection Agency in quality assurance programs by testing the Agency's analytical methods and by exchanging samples for interlaboratory comparisons.

For the fourth consecutive year, the Environmental Protection Agency made the services of its Air Pollution Technical Information Center freely available to the Air Pollution Control Directorate. Details of the operation of this information service in Canada are provided elsewhere in this report.

International Joint Commission. The International Air Pollution Advisory Board is a Standing Board of the International Joint Commission (IJC). Air pollution problems that arise along the Canada-United States border are investigated by the Board and reported to the Commission. The Board is involved in resolving instances of transboundary air pollution and has participated in examining the potential for transboundary pollution from projects on both sides of the border. The Air Pollution Control Directorate provides the Canadian Chairman of the Board, a member and technical assistance.

A report on the study of transboundary air pollution in the Detroit-Windsor and Sarnia-Port Huron areas was issued by the International Joint Commission in 1972. The Premier of Ontario and the Governor of Michigan signed a Memorandum of Agreement in 1975 to implement an integrated cooperative program for the abatement of transboundary air pollution in the southeastern Michigan-southwestern Ontario area. As requested in the Agreement, the IJC created the International Michigan-Ontario Air Pollution Board to monitor the progress of air pollution control programs in the transboundary area. The Air Pollution Control Directorate provides the Canadian Chairman and technical assistance to this Board.

Other International Organizations. To ensure that Canada remains well informed with respect to international developments in air pollution control technology and fulfills its international obligations in air pollution control, the Environmental Protection Service continued to participate in several international programs. This

participation is coordinated through the Department of External Affairs and involves programs of the World Health Organization (WHO), the Organization for Economic Cooperation and Development (OECD), the Economic Commission for Europe (ECE), the North Atlantic Treaty Organization Committee on the Challenges of Modern Society (NATO/CCMS) and the United Nations Environment Program (UNEP). The Air Pollution Control Directorate provides Canada's delegate to the OECD Air Management Sector Group and participates through the Interdepartmental Committee on Environment in activities of the OECD Environment Committee and other sector groups. Canada is involved in activities such as the study of photochemical air pollution and the development of control strategies for sulphur dioxide pollution.

The Air Pollution Control Directorate provides Canada's representative to the annual meetings of the Economic Commission for Europe Working Party on Air Pollution Problems. A meeting was held in January, 1977 in Geneva. In this forum, the Directorate participated in a seminar on the air pollution problems of the inorganic chemical industry and prepared the sections on primary and secondary lead smelters in a document describing guidelines for the control of emissions from the nonferrous metallurgical industry. Canadian representatives are also participating in the technical aspects of an ECE study on the long-range transport of air pollutants.

The Directorate provided Canada's representative to meetings of the Assessment Methodology Panel of the Air Pollution Pilot Study of NATO/CCMS. Canada is involved in the preparation of NATO/CCMS documents on Emission Inventory Techniques and Data Handling, Emission Projection Techniques and Guidelines to Assessment of Air Quality.

In the development of analytical and sampling methodology, the Directorate maintains a close liaison with the American Society for Testing and Materials. During the review period, the Directorate became a corporate member of the Society. Directorate scientists serve as members and chairmen of analytical subcommittees of the Society's Committee D-22.

The Directorate provides program support to the Air Pollution Control Association.

Interdepartmental

Regular contact is maintained with the Environmental Health Directorate of Health and Welfare Canada on public health aspects of air pollution control. The Department of Indian and Northern Affairs is kept informed of Service activities related to air pollution control in the Yukon and Northwest Territories. Communications are maintained, as necessary, with other departments and agencies of the federal government such as the National Research Council, the Department of Industry, Trade and Commerce, the Department of Energy, Mines and Resources, the Economic Council of Canada and the Department of Regional Economic Expansion.

SURVEILLANCE ACTIVITIES

General

Section 3 of the Clean Air Act makes provision for the collection and publication of data on air pollution. This includes a responsibility for maintaining a continuing record of ambient air pollution levels in urban areas on a national basis, for defining problems through field investigations and for providing consultative services to federal or provincial agencies on air monitoring and surveillance.

Air Pollutant Emission Inventories

A prerequisite to an effective air pollution control program is an accurate definition of the pollution problem. Such a definition can be made only through the compilation of inventories of the sources and emissions of pollutants and through a determination of the concentration of various pollutants in the atmosphere. The latter is accomplished through the NAPS network and various ambient air quality studies which will be discussed in later sections; the former through the air pollutant emissions inventory program.

One of the first actions taken after passage of the Clean Air Act was to let a contract for the compilation of a Nationwide Emissions Inventory for Canada. The inventory provided an overview for 1970 of air pollution problems with respect to five major contaminants: sulphur dioxide, particulate matter, carbon monoxide, hydrocarbons and nitrogen oxides. The inventory was recently revised and updated by the Air Pollution Control Directorate to provide a similar overview of nationwide emissions for 1972. A further revision based on data for 1974 is now underway. The inventory will be updated regularly to provide a basis for assessing the effect of provincial and federal air pollution regulatory activities.

Inventories are also compiled on pollutants that may present a significant danger to health. These inventories provide problem definitions and assist federal and provincial control agencies in developing programs and establishing control priorities To date, eleven such inventories have been completed and published, ten of which were compiled by consultants under contract. A twelfth inventory, estimating emissions of selenium, has recently been completed by Directorate staff and will be released in the next fiscal year. In addition, data are being collected by a consultant for inventories of eleven additional pollutants. Inventories of this type will be updated as new data become available.

All inventory information acquired will be stored in a computer for rapid retrieval. The recently developed National Emissions Inventory System is now operational and information is being incorporated into the system An agreement has been reached with the Province of Ontario to include some of the air pollutant emissions data held by the Air Management Branch of the Ontario Ministry of the Environment. Data from the Province of Ontario are now being incorporated into the System. Similar agreements are being negotiated with other provinces.

National Air Pollution Surveillance Network

To ensure sound planning of activities within the air pollution control program, it is important to have a continously updated knowledge of the nature and extent of air pollution across Canada. The National Air Pollution Surveillance activity regularly provides data on ambient air levels of the major contaminants on a continuing basis. Short-term surveys are used to provide information in response to special requirements The National Air Pollution Surveillance (NAPS) network consists of air monitoring instruments located in major population centres across Canada. The accumulation of network data has permitted the detection of trends in the levels of pollution with changing industrial activity, population density and air pollution abatement progress. Information collected by the network can be used in epidemiological studies and in the development of air quality objectives.

During 1976-77, the NAPS network was expanded and improved. On March 31, 1977, the network comprised 541 instruments, including 252 continuous gaseous pollutant monitors, located at 153 stations in 52 cities. Expansion of the network

during the year included the installation of 8 suspended particulate samplers, 15 soiling index monitors, 11 sulphur dioxide monitors, 10 carbon monoxide monitors, 9 oxides of nitrogen monitors, 12 ozone monitors and 1 hydrocarbon monitor. There are now 41 stations in the network with continuous monitors for all pollutants of major concern. Figure 1 is a map showing the location of the sampling stations.

Data from these stations are compiled by the Directorate and published as monthly and annual summaries. Data compilation procedures and computer programs were revised during the review period to provide more accurate and informative summaries that are compatible with the format of National Air Quality Objectives. Measurements include soiling index, suspended particulates, lead, dustfall, sulphation rate, sulphur dioxide, carbon monoxide, ozone, nitrogen oxides and hydrocarbons. Data for suspended particulates, sulphur dioxide, carbon monoxide, ozone and nitrogen dioxide at selected locations are listed in Tables 2, 3, 4, 5 and 6.

A statistical analysis of ambient air quality in Canada during the period 1970-74, based on data compiled by the National Air Pollution Surveillance network, is continuing and results will be reported shortly. The analysis will be updated as new data become available.

Source Testing

Source tests were conducted at several industrial plants to evaluate or develop source sampling reference methods, to gather data for use in the development of emission guidelines and regulations, and to obtain information in response to specific requests. A test was done in cooperation with the Province of Nova Scotia on a brick kiln burning waste lubrication oil to determine the concentration of lead in the stack emissions. In another joint venture, the Environmental Protection Service and the Province of Ontario tested two sludge incinerators, two municipal waste incinerators, two capacitor plants and a transformer filling station for emissions of polychlorinated biphenyls. As part of the Yellowknife Environmental Survey, reports were completed on source tests undertaken by the Northwest Regional Office at Giant Yellowknife Mines Ltd. for emissions of arsenic during 1975-76. Other plants at which sampling tests were done included asbestos mining and milling plants, chlor-alkali plants, a municipal waste incinerator, sewage sludge incinerators, a gold roaster and an internal combustion engine power-generating station.

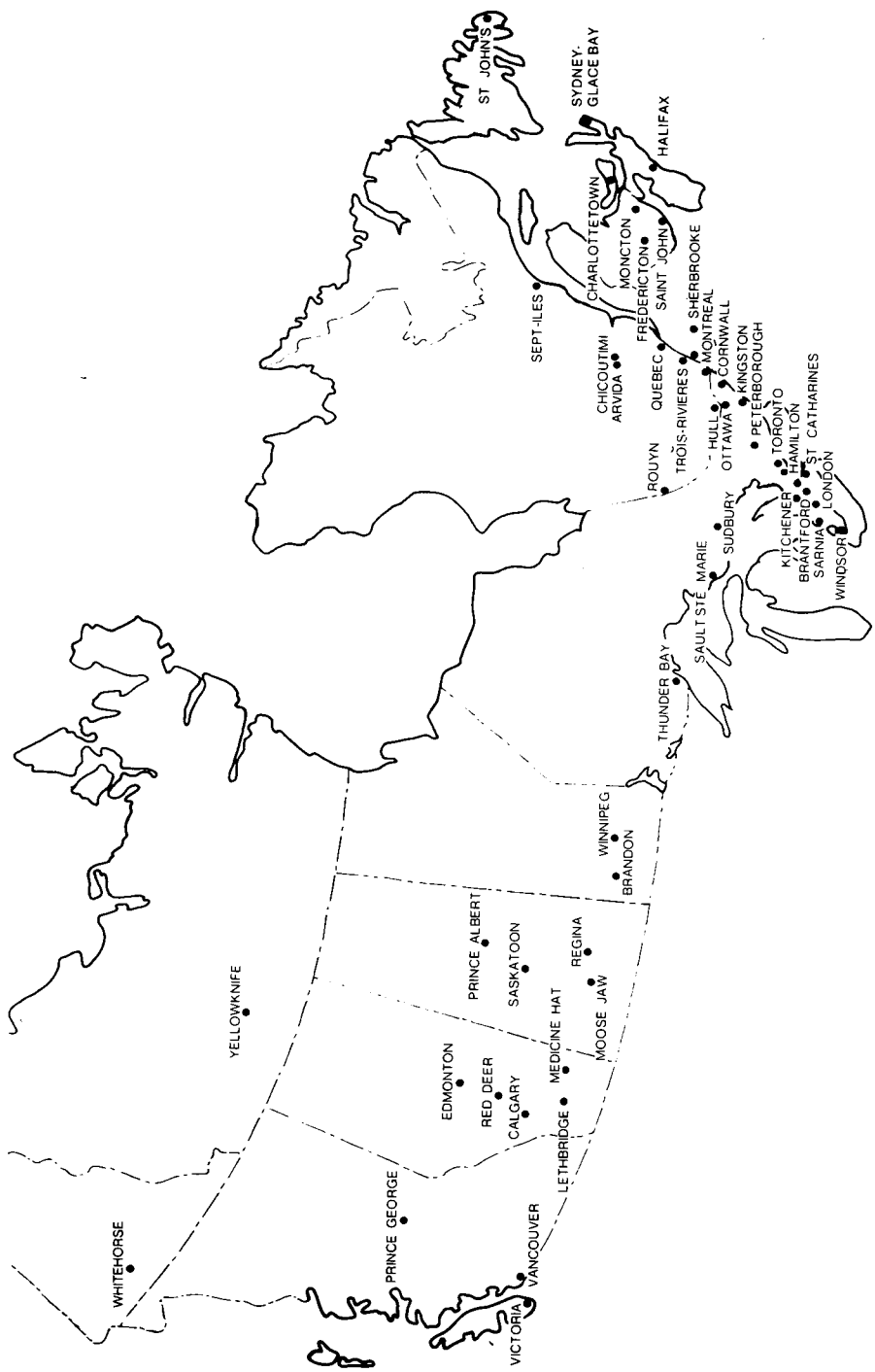

FIGURE 1 NATIONAL AIR POLLUTION SURVEILLANCE NETWORK (DECEMBER 1976)

TABLE 2 NATIONAL AIR POLLUTION SURVEILLANCE NETWORK FOR SUSPENDED PARTICULATES-SELECTED SITES

Location	Annual geometric mean (micrograms per cubic metre)						
	1970	1971	1972	1973	1974	1975	1976
St. John's, Duckworth & Ordinance			54	55	51	49	50
Charlottetown, Kent & Queen				50	49	43	44
Halifax, N.S. Tech. College			42	49	47	52	49
Sydney, County Jail			46	66	68	*	73
Fredericton, York						46	43
Saint John, 110 Charlotte	61	54	46	55	60	55	55
Montreal, 1212 Drummond		111	132	101	128	101	78
Montreal, Duncan & Decarie					167	136	112
Montreal, 2900 Boul. Concorde							68
Montreal, Boul. Laurentides							81
Hull, Rue Principale	77	73	69	72	79	80	*
Quebec, Parc-Autos Paquet-Laliberte			83	101	104	103	85
Sherbrooke, Wellington & Albert						*	54
Chicoutimi, City Hall			75	57	57	68	*
Ottawa, Slater & Elgin	109	92	75	87	91	77	60
Windsor, City Hall	142	122	91	121	122	80	76
Toronto, 67 College	111	99	92	101	81	71	63
Hamilton, Barton & Sanford	140	144	133	128	105	98	101
Sudbury, 19 Lisgar				63	55	50	46
Sault Ste. Marie, Prov. Ont. Bldg.	44	55	66	58	50	42	*

Thunder Bay, 14 Algoma	84	69	60	76	60	54	*
London, King & Rectory		125	95	94	92	73	64
London, 372 Dundas		83	60	69	59	51	48
Sarnia, 156 Victoria		105	98	104	89	73	74
Peterborough, 139 George			72	80	*	*	*
Brantford, Dalhousie & Queen							57
Winnipeg, 270 Osborne						75	80
Brandon, 11th & Princess				68	69	49	62
Regina, 12th & Smith	66	57	49	58	66	64	57
Saskatoon, City Library		72	68	65	71	77	91
Moose Jaw, Telephone Bldg.			48	65	69	74	74
Prince Albert, 49-12th St. E			51	69	77	68	73
Edmonton, 100 St. & 102 Ave.				65	71	117	137
Edmonton, 109 St. & 98 Ave.						73	88
Calgary, 316-7th Ave.	117	105	85	147	122	125	111
Red Deer, 4747 50th	74	59	58	61	62	57	63
Medicine Hat, 770 1st St. SE	67	57	57	74	88	71	78
Lethbridge, 13th St. & 9th Ave. S	38	41	38	57	45	37	46
Yellowknife, 50th Ave. & 51st St.				79	60	49	54
Vancouver, 970 Burrard						*	68
Victoria, Police Station	51	59	44	47	44	44	46
Victoria, 1106 Cook						*	47
Whitehorse, Federal Bldg.					85	52	51

*Insufficient data available to calculate valid annual geometric mean concentrations.

TABLE 3 NATIONAL AIR POLLUTION SURVEILLANCE NETWORK FOR SULPHUR DIOXIDE-SELECTED SITES

Location	Annual arithmetic mean (parts per hundred million)						
	1970	1971	1972	1973	1974	1975	1976
Charlottetown, Kent & Queen					1.1	1.1	1.1
Halifax, Barrington & Duke						1.8	1.3
Saint John, Post Office					2.5	1.4	*
Montreal, 1125 Ontario	5.4	4.1	3.7	2.0	2.7	2.5	2.4
Montreal, 1212 Drummond	9.9	8.0	6.6	4.7	5.2	3.6	2.7
Montreal, Duncan & Decarie					1.3	1.8	1.7
Montreal, Parc Pilon					*	1.3	*
Montreal, 2900 Boul. Concorde						*	1.0
Montreal, Boul. Laurentides						*	<1.0
Hull, Rue Principale	2.4	1.7	1.3	1.2	<1.0	1.0	*
Quebec, 155 Dorchester					*	*	2.4
Ottawa, Slater & Elgin	4.5	2.2	3.0	2.5	2.4	2.0	*
Ottawa, Rideau & Wurtemburg							1.8
Windsor, 471 University	3.6	4.3	3.6	3.2	3.3	2.9	2.7
Toronto, 67 College	7.1	5.2	3.0	1.4	1.2	1.5	1.5
Hamilton, Barton & Sanford	3.7	2.9	1.7	1.8	2.2	2.0	2.1
London, King & Rectory		1.4	<1.0	<1.0	<1.0	<1.0	1.3
Sarnia, 156 Victoria		2.7	1.9	1.7	2.6	2.3	2.4
Winnipeg, 270 Osborne						<1.0	<2.0

Brandon, 11th St. & Princess				*	<1.0
Regina, 12th & Smith	<1.0	<1.0	<1.0	<1.0	*
Saskatoon, City Library		<1.0	<1.0	<1.0	*
Moose Jaw, Telephone Bldg.		<1.0	<1.0	<1.0	*
Prince Albert, 125-1st Ave., E.				*	<1.0
Edmonton, 109th St. & 98th Ave.	<1.0	<1.0	<1.0	<1.0	<1.0
Calgary, 620-7th Ave. SW	<1.0	<1.0	<1.0	<1.0	<1.0
Vancouver, 970 Burrard				1.1	<1.0
Victoria, Police Station	1.1	<1.0	<1.0	<1.0	*
Whitehorse, Federal Bldg.			<1.0	<1.0	*

*Insufficient data available to calculate valid annual arithmetic mean concentrations.

TABLE 4 NATIONAL AIR POLLUTION SURVEILLANCE NETWORK FOR CARBON MONOXIDE-SELECTED SITES

Location	Annual arithmetic mean (parts per million)			
	1973	1974	1975	1976
Montreal, 1125 Ontario		2.5	2.4	2.7
Montreal, 2900 Boul. Concorde			*	0.7
Montreal, 677 Ste-Catherine, W.			*	5.4
Quebec, 155 Dorchester S.		*	2.4	2.4
Ottawa, Slater & Elgin	3.1	3.2	3.1	3.0
Ottawa, Rideau & Wurtemburg				0.9
Windsor, 471 University	4.7	5.1	4.8	*
Toronto, 67 College		1.9	1.3	1.1
Hamilton, Barton & Sanford	2.1	2.0	1.5	1.4
London, King & Rectory		1.0	1.5	1.7
Sarnia, 156 Victoria		*	0.9	1.3
Winnipeg, 270 Osborne			1.2	1.5
Regina, 12th & Smith		0.6	0.8	*
Saskatoon, City Library		1.0	0.7	*
Edmonton, 109th St. & 98th Ave.	2.1	2.0	1.3	1.5
Calgary, 620-7th Ave. SW	4.3	3.1	2.5	2.1
Victoria, 1106 Cook			1.2	1.8

*Insufficient data available to calculate valid annual arithmetic mean concentrations.

TABLE 5 NATIONAL AIR POLLUTION SURVEILLANCE NETWORK FOR OZONE-SELECTED SITES

Location	Annual arithmetic mean (parts per hundred million)			
	1973	1974	1975	1976
Halifax, Barrington & Duke			*	1.7
Montreal, 1125 Ontario	0.8	1.1	1.3	1.4
Montreal, Duncan & Decarie	1.7	1.0	1.0	1.0
Montreal, Parc Pilon			2.4	*
Montreal, Boul. Laurentides			*	2.2
Quebec, 155 Dorchester S.		*	1.8	1.2
Ottawa, Slater & Elgin			*	1.1
Ottawa, Rideau & Wurtemburg				1.7
Windsor, 471 University	1.9	1.3	1.7	2.0
Toronto, 67 College		2.0	2.4	1.7
Hamilton, Barton & Sanford	3.0	1.8	2.3	1.8
London, King & Rectory			1.6	1.9
Sarnia, 156 Victoria	2.6	1.7	2.4	1.9
Winnipeg, 270 Osborne		0.9	1.0	1.2
Edmonton, 109th St. & 98th Ave.	0.8	1.3	2.2	2.5
Calgary, 620-7th Ave. SW	0.9	1.3	1.4	1.1
Vancouver, 970 Burrard			1.3	0.8
Victoria, 1106 Cook			2.4	2.2

*Insufficient data available to calculate valid annual arithmetic mean concentrations.

TABLE 6 NATIONAL AIR POLLUTION SURVEILLANCE NETWORK FOR NITROGEN DIOXIDE-SELECTED SITES

Location	Annual arithmetic mean (parts per hundred million)			
	1973	1974	1975	1976
Halifax, Barrington & Duke		*	*	1.1
Montreal, 1125 Ontario		3.0	2.1	3.5
Montreal, 2900 Boul. Concorde			*	2.8
Montreal, Boul. Laurentides			*	2.3
Quebec, 155 Dorchester S.		*	2.0	2.4
Ottawa, Rideau & Wurtemburg				2.0
Windsor, 471 University	2.8	2.6	2.9	3.4
Toronto, 67 College	2.9	3.2	2.8	3.2
Hamilton, Barton & Sanford			*	3.9
Sarnia, 156 Victoria			*	2.5
Edmonton, 109th St. & 98th Ave.		3.6	4.8	5.2
Calgary, 620-7th Ave. SW			*	3.1

*Insufficient data available to calculate valid annual arithmetic mean concentrations.

Standard Reference Methods for Source Testing. Standard reference methods for measuring mercury emissions from chlor-alkali plants and asbestos emissions from asbestos mining and milling operations were completed. Reference methods for measuring nitrogen oxides, arsenic, vinyl chloride, hydrogen chloride and total reduced sulphur compounds in stack emissions are in preparation. A method for measuring emissions from internal combustion engine power generating stations is being developed.

Ambient Air Surveys

During August 1976, a study of the concentrations of sulphates in the ambient air was conducted jointly with the Atmospheric Environment Service. Concentrations of particulate sulphates were measured at thirty-three stations in eastern Canada. At the same time, sulphate concentrations were measured at twenty-two NAPS network stations. In New Brunswick, the Saint John-Lorneville air sampling network completed its third year of operation. This is a cooperative study by the Province of New Brunswick with the city of Saint John, the Atmospheric Environment Service and the Atlantic Regional Office of the Environmental Protection Service. Data from this study will be used in planning control strategies for the Lorneville industrial complex. Studies were completed on background concentrations of sulphur dioxide in the area where a new coal-fired power-generating station is planned in Nova Scotia. Reports were completed on earlier studies done in cooperation with the respective provinces at Charlottetown, P.E.I. and at Baie Verte and Labrador City in Newfoundland.

Further work was completed to measure ambient air concentrations of mercury near a chlor-alkali plant at Lebel-sur-Quévillon, Quebec. This study, conducted when the plant was operational, complements an earlier study done when the plant was shut down.

A project was initiated to measure trace organic substances in ambient air using a new type of mass spectrometer. Substances to be measured include nitrosamines, chlorinated aromatic compounds and organometallic compounds.

Special surveys to measure the concentrations of carbon monoxide in ambient air were completed in Whitehorse, Yukon and at Lake Louise, Alberta. During the review period, reports were completed on work done during 1975-76 as part of the Yellowknife Environmental Survey. These reports describe surveys of the concentrations of arsenic in the snow, soil, and ambient air.

A complete monitoring station was established in Abbotsford, British Columbia, to provide data for an extensive Vancouver area air quality survey.

Evaluation of Air Monitoring Instruments. The purpose of this program is to find the most reliable equipment, methods and procedures for monitoring air pollution levels. During the review period, four sulphur dioxide monitors were installed in a field station for long term performance tests. Evaluations of air monitors for other pollutants, of calibration devices, and ancillary equipment were finished and several instrument evaluation reports were completed.

The project to evaluate particulate sizing instruments continued. Four fractionators were evaluated at sites in Montreal and Windsor. A new study was initiated to evaluate continuous particulate monitors.

Effects Studies. The air pollution study done in cooperation with Health and Welfare Canada in Sydney, Nova Scotia was transferred to the Nova Scotia Department of the Environment.

Calibration. The calibration program for the NAPS network was continued. During the review period, cylinders containing known amounts of carbon monoxide were provided to network operators.

Quality Assurance. Standard methods and procedures are being developed and published to provide air monitoring agencies with uniform guidance in all phases of ambient air monitoring activities, including the collection, analysis, interpretation, validation and presentation of ambient air pollution data. Although the work is directed towards the NAPS network, it will be applicable to any air monitoring survey or network.

TECHNOLOGY DEVELOPMENT

Program for the Development and Demonstration of Pollution Abatement Technology (DPAT)

The effective control of air and water pollution depends upon the availability of technically sound and economically feasible methodology. Recognizing that it might be necessary for the federal government to encourage the development and demonstration of new control technology, the Clean Air Act makes provision for such a program in Section 3. Accordingly, the Environmental Protection Service

developed a program that provides for cost-shared agreements with industry to develop and demonstrate new control technology. The DPAT program became operational on April 1, 1975. In the air sector the initial emphasis was placed on the development of technology for the capture and containment of fine particulates and sulphur compounds. During the review period, this emphasis was broadened to include the pollutants for which regulations or guidelines had been announced or were being developed.

The first contract let by the Air Pollution Control Directorate was to British Columbia Forest Products Limited. The Company is developing a new type of dry, high-temperature impact scrubber to remove a salty smoke which results from the burning of waste from logs previously stored in salt water. During the process of combustion at high temperatures and in the presence of the wood char, some of the salt is converted to a corrosive chemical that could cause adverse health effects when inhaled. If this new technology development is successful, it will be widely applied in the forest products industry and will also be transferable to other industry sectors in Canada. The scrubbers have been installed and will become operational early in the 1978-79 fiscal year.

The second contract let by the Air Pollution Control Directorate was for the containment of a mixed gaseous and particulate emission from a kraft paper mill at St-Anne-Nackawic, New Brunswick. The technology under development is based on a wet scrubber that will simultaneously collect fine particulate emissions from a recovery boiler and dissolve a gaseous emission containing odiferous sulphur compounds. If successful, the technology will find wide application across Canada in the pulp and paper industry. In an average size plant, the new technology will permit the recirculation of several thousand dollars worth of chemicals that are daily being lost to the atmosphere as air pollutants. The project is on schedule and the wet scrubber system is expected to become operational during the 1978-79 fiscal year.

Standard Reference Methods

Every air pollution control standard regulation is supported by a sampling technique and a method of analysis for the regulated pollutant. During the review period, work continued on the development of standard reference methods for arsenic emissions from gold roasters, for arsenic and mercury emissions from non-ferrous smelters, for lead emissions from secondary lead smelters and for vinyl chloride emissions from vinyl chloride and polyvinyl chloride manufacturing operations.

In addition to standard reference methods developed in support of emission standard regulations, others are being developed in support of national emission guidelines. During the review period, standard reference methods were being developed for hydrogen chloride emissions from incinerators and for emissions of total reduced sulphur compounds from the wood pulping industry. In support of national air quality objectives, work proceeded on standard reference methods for hydrogen fluoride and hydrogen sulphide.

Air Sampling Technology and Analytical Method Development

In recent years, it has become evident that some complex chemicals can have serious environmental effects. Among these are polychlorinated biphenyls, which are manufactured for many uses such as insecticides, herbicides, plasticizers and heat transfer media. They are characterized by their persistence in the environment and their tendency to accumulate in the food chain. Another group of complex organic materials includes polycyclic aromatic hydrocarbons which are generated during the combustion of fossil fuels and are generally less stable than polychlorinated biphenyls. A typical sample of polluted air may contain one hundred and fifty separate and distinct materials. During the review period, work continued on the separation and analysis of these complex materials. Methods used included high pressure liquid chromatography and a computerized system combining gas chromatography and mass spectrometry.

Progress was made in developing and testing a method for collecting and measuring mercury in the ambient air.

During the review period, the development of X-ray fluorescence methods for the direct determination of pollutant concentrations was particularly successful. Methods were completed for measuring arsenic on filters and for measuring lead in gasoline samples and arsenic in aqueous solutions.

Instrument Development and Evaluation

Very few industrial processes operate steadily at a uniform rate. Usually there are wide process fluctuations with correspondingly wide variations in emission rates. The most reliable information on emissions can therefore be obtained only with continuous monitoring. During the review period, work continued on the development of a monitor to measure mercury concentrations in stack emissions containing high

concentrations of sulphur dioxide. Commercial instrumentation for the continuous monitoring of lead emissions was evaluated during the review period. This project, a cooperative venture of Fisheries and Environment Canada and the Province of Ontario, involved tests at a secondary lead smelter in Toronto.

Analytical Services

Analytical services for the NAPS network and for several ambient air surveys were provided during the review period. The pollutants analyzed routinely were heavy metals, particularly lead, cadmium, vanadium and manganese; sulphates and nitrates; arsenic; polychlorinated biphenyls and polynuclear aromatic hydrocarbons. Analytical services were provided in support of several source tests for arsenic, mercury, heavy metals and organic compounds. Dustfall measurements were also made. As part of the Service's enforcement program, measurements of lead concentrations in gasoline were made.

During the review period, the Service's laboratories were involved in several extensive interlaboratory quality assurance programs. Analyses undertaken included lead in gasoline, lead in suspended particulate matter, arsenic, and heavy metals.

SCIENTIFIC AND TECHNICAL INFORMATION

Air Pollution Information System

During the development of a regulation or guideline for a stationary source, a major "state-of-the-art" review for the industry under study is compiled. The information in it is drawn from many sources: published literature, consultants' reports and computerized information banks. To ensure that Service staff have access to all available information, an information system was established for air pollution control. It also serves current awareness requirements for senior staff, and the special air pollution information requirements for Canadian universities and industry. The system has full access to the Air Pollution Technical Information Center computer-stored information system in the Environmental Protection Agency of the United States and handles all Canadian enquiries to that system. During the review period more than 70 computerized literature searches were completed for federal, provincial and municipal government agencies in Canada and more than 2800 individual information requests were answered. The system has more than 92 000 documents available on microfiche. Over 12 000 were added during this review period.

Training in Air Pollution Control Technology

In support of the regulatory activities of air pollution control agencies across Canada, air pollution control training courses were again presented for enforcement officers of the federal, provincial and municipal governments. Six courses were offered this year. The subjects included air pollution control technology, stationary source testing, air pollution meteorology and the enforcement of regulations. The courses were attended by 120 students representing three levels of government enforcement agencies and industry. The training course in stationary source testing was again prepared and presented under contract by the Industrial Research Institute of the University of Windsor. The remaining courses were developed internally and presented by lecturers from Fisheries and Environment Canada, universities, Canadian and United States' industry and consulting firms.

With the exception of the course on stationary source testing, lectures were recorded on videotape. The tapes are available to enforcement agencies across Canada for training purposes. Other audiovisual material on air pollution control was added to the library which now contains about 250 videotaped lectures and 40 audio cassettes.

Courses for inspectors in the reading of plume opacity were held in the Quebec and Northwest regions of the Environmental Protection Service during the review period. Forty-one enforcement officers were certified. Courses will be held at six- or twelve-month intervals for recertification.

Publications

The Air Pollution Control Directorate edits, publishes and distributes the scientific and technical reports produced by its staff and consultants. During the review period 25 reports in four categories were published. Normal distribution is about 700 copies of each report. The clientele includes foreign governments, international organizations, universities, industries, involved members of the public, and federal, provincial and municipal government departments.

The reports published during the review period were the following:

Regulations, Codes and Protocols Series

EPS 1-AP-75-4	Standard Reference Method for the Determination of Lead in Airborne Particulates

Economic and Technical Review Series

EPS 3-AP-73-13	Lead and Cadmium Contamination Immediately Surrounding the Surette Battery Plant, Springhill, Nova Scotia
EPS 3-AP-75-5	A Nationwide Inventory of Air Pollutant Emissions. Summary of Emissions (1972)
EPS 3-AP-75-5F	Inventaire national des rejets de polluants dans l'atmosphère. Résumé des émissions en 1972
EPS 3-AP-75-6	Air Pollution Emissions and Control Technology. Chlor-Alkali Industry
EPS 3-AP-76-1	National Inventory of Sources and Emissions of Manganese, Fluoride, and Vanadium. Summary of Emissions for 1972.
EPS 3-AP-76-3	National Inventory of Sources and Emissions of Zinc, Cadmium, and Arsenic. Summary of Emissions for 1972.
EPS 3-AP-76-4	Air Pollution Emissions and Control Technology. Arctic Mining

Surveillance Series

EPS 5-AP-76-7	Study of Interlaboratory Count Correlation and Fibre Distribution on Asbestos Stack Samples
EPS 5-AP-76-8 to EPS 5-AP-76-13	National Air Pollution Surveillance Monthly Summaries for the year 1975, July to December inclusive
EPS 5-AR-76-11	Atmospheric Asbestos Fibre Concentrations in the Baie Verte Area, Newfoundland
EPS 5-AR-76-11F	Concentrations atmosphériques de fibres d'amiante dans la région de Baie-Verte à Terre-Neuve

Environmental Impact and Assessment Series

EPS 8-AP-73-1F	Émissions de polluants par les moteurs des véhicules automobiles. Analyse des tendances au Canada de 1960 à 1985

Air Pollution Control Directorate Series

APCD 75-5	National Inventory of Sources and Emissions of Arsenic (1972)
APCD 75-6	National Inventory of Sources and Emissions of Manganese (1972)
APCD 75-7	National Inventory of Sources and Emissions of Fluoride (1972)
APCD 76-1	National Inventory of Sources and Emissions of Zinc (1972)
APCD 76-2	National Inventory of Sources and Emissions of Cadmium (1972)
	Criteria for National Air Quality Objectives
	Air Pollution Control Directorate - Publications List

NATIONAL AIR QUALITY OBJECTIVES

General

National Air Quality Objectives are designed to protect public health and welfare by setting limits on levels of contaminants in the air. The Clean Air Act makes provision for three levels of air quality objectives: 'desirable', 'acceptable', and 'tolerable', for each major air pollutant.

The maximum desirable level defines the ultimate goal for air quality and provides a basis for an antidegradation policy for the unpolluted parts of the country and for the continuing development of control technology.

The maximum acceptable level is intended to provide adequate protection against adverse effects on soil, water, vegetation, materials, animals, visibility, personal comfort and well-being. It represents the realistic objective today for all parts of Canada. When this level is exceeded, control action by a regulatory agency is indicated.

The maximum tolerable level denotes a concentration of an air contaminant that requires abatement without delay to avoid further deterioration to an air quality that endangers the prevailing life-style or, ultimately, to an air quality that poses a substantial risk to public health.

National Air Quality Objectives published to date are shown in Table 7.

NATIONAL EMISSION GUIDELINES

General

Under Section 8 of the Clean Air Act provision is made for the promulgation of national emission guidelines. The purpose of these guidelines is to specify levels of emissions of air contaminants that reflect the application of best operating practices and best practicable technology in air pollution control to the industrial processes involved. These emission limits are intended to be minimum requirements for new or modified plants and objectives toward which control of emissions from existing plants should be directed. The adoption of these guidelines by appropriate regulatory agencies will result in significant reductions in emissions of air contaminants and thus prevent deterioration of ambient air quality. The guidelines also establish the minimum standards required for all works, businesses and undertakings involving the federal government.

The guidelines are published in a form that allows their ready adoption by regulatory agencies, in particular provincial air pollution control agencies, as minimum standards for industry located within their jurisdiction. It is recognized that local conditions, such as topography or density of industrial development, may necessitate the adoption of more stringent environmental requirements.

Guidelines have been published for the cement industry, the asphalt paving industry and the coke oven industry.

Arctic Mining

Emission guidelines for arctic mining operations, developed jointly by the federal, provincial and territorial governments together with industry representatives, were published in the Canada Gazette on July 17, 1976.

In 1973, there were twelve mines operating in the Yukon Territory and the Northwest Territories with a total mineral production valued at $310 371 000. Production increased substantially on 1972 values. Minerals recovered were lead, zinc, silver, gold, copper, cadmium, nickel, platinum, tungsten, asbestos and coal. Lead and zinc accounted for more than two-thirds of the total production. During 1973, 2500 persons were employed at producing mines in the territories.

Mining activities include both open pit and underground methods. Mineral concentrates are usually shipped to other locations for smelting and refining.

TABLE 7 NATIONAL AIR QUALITY OBJECTIVES

Air contaminant	Maximum desirable level	Maximum acceptable level	Maximum tolerable level
Sulphur dioxide			
Annual arithmetic mean	30 $\mu g/m^3$ (0.01 ppm)	60 $\mu g/m^3$ (0.02 ppm)	
Average concentration over a 24-h period	150 $\mu g/m^3$ (0.06 ppm)	300 $\mu g/m^3$ (0.11 ppm)	800 $\mu g/m^3$ (0.31 ppm)*
Average concentration over a 1-h period	450 $\mu g/m^3$ (0.17 ppm)	900 $\mu g/m^3$ (0.34 ppm)	
Suspended particulate matter			
Annual geometric mean	60 $\mu g/m^3$	70 $\mu g/m^3$	
Average concentration over a 24-h period		120 $\mu g/m^3$	400 $\mu g/m^3$*
Carbon monoxide			
Average concentration over an 8-h period	6 mg/m^3 (5 ppm)	15 mg/m^3 (13 ppm)	20 mg/m^3 (18 ppm)*
Average concentration over a 1-h period	15 mg/m^3 (13 ppm)	35 mg/m^3 (30 ppm)	
Oxidants (ozone)			
Annual arithmetic mean		30 $\mu g/m^3$ (0.015 ppm)	
Average concentration over a 24-h period	30 $\mu g/m^3$ (0.015 ppm)	50 $\mu g/m^3$ (0.025 ppm)	
Average concentration over a 1-h period	100 $\mu g/m^3$ (0.05 ppm)	160 $\mu g/m^3$ (0.08 ppm)	300 $\mu g/m^3$ (0.15 ppm)*

Nitrogen dioxide			
Annual arithmetic mean	60 $\mu g/m^3$ (0.033 ppm)	100 $\mu g/m^3$ (0.055 ppm)	
Average concentration over a 24-h period		200 $\mu g/m^3$ (0.11 ppm)	300 $\mu g/m^3$ (0.16 ppm)*
Average concentration over 1-h period		400 $\mu g/m^3$ (0.22 ppm)	1000 $\mu g/m^3$ (0.53 ppm)*
Sulphur dioxide times suspended particulate matter			
Average concentration over a 24-h period			125 000 $(\mu g/m^3)^2$*
Hydrogen fluoride			
Average concentration over a 70-day period		0.20 $\mu g/m^3$ (0.24 ppb)*	
Average concentration over a 30-day period		0.35 $\mu g/m^3$ (0.43 ppb)*	
Average concentration over a 7-day period	0.20 $\mu g/m^3$ (0.24 ppb)*	0.55 $\mu g/m^3$ (0.67 ppb)*	
Average concentration over a 24-h period	0.40 $\mu g/m^3$ (0.49 ppb)*	0.85 $\mu g/m^3$ (1.05 ppb)*	
Hydrogen sulphide			
Average concentration over a 24-h period		5.0 $\mu g/m^3$ (3.29 ppb)*	
Average concentration over a 1-h period	1.0 $\mu g/m^3$ (0.66 ppb)*	15.0 $\mu g/m^3$ (9.88 ppb)*	

*Proposed.

In addition to the producing mines, exploration is underway at a great number of locations. During 1973, 24 686 mining claims were recorded in the Yukon and Northwest Territories. Increased mining activity can therefore be expected in the future.

Particulate emissions during 1972 from the twelve mines were estimated at 41 562 tons. The emission guidelines recommend limits of:

(a) 0.040g of particulate matter per normal cubic metre of exhaust gas;

(b) 1.1g of sulphur dioxide per 1000 kilocalories from the combustion of fuel oil used in drying concentrates; and

(c) an opacity of 20%.

The territorial governments have indicated agreement in principle to adopt the guidelines as minimum standards for mining plants operating within their jurisdiction. If implemented, particulate matter emissions from arctic mining operations would be reduced by 80%.

Pulp and Paper Power and Steam Boilers

During the review period, an assessment of the air pollution emissions from pulp and paper power and steam boilers was completed and the appropriate air pollution control equipment evaluated. Recommendations for emission guidelines were made to the government-industry task force.

Other Industry Sectors

National emission guidelines now being developed for other industry sectors are listed below in the approximate order in which their completion is expected.

Natural gas processing industry
Thermal power generation industry
Petroleum refining industry
Pulp and paper industry
Iron and steel industry
Nonferrous smelting industry
Ferrous foundry industry
Ferro-alloy industry
Fertilizer industry
Incineration

NATIONAL EMISSION STANDARDS

General

Section 7 of the Clean Air Act empowers the Governor-in-Council to prescribe national emission standards for air contaminants which constitute a significant danger to human health. National emission inventories of such contaminants are essential to this activity and are reported under Surveillance Activities. The Air Pollution Control Directorate consults with the Health Protection Branch of Health and Welfare Canada to obtain recommendations on the potential health hazards of such contaminants. In response to Health and Welfare Canada's advice that it would be prudent to control atmospheric emissions of vinyl chloride and arsenic to minimize the danger to public health, development of regulations for these contaminants was initiated in the 1975-76 fiscal year. Health and Welfare Canada had previously made similar recommendations for lead, mercury and asbestos.

Secondary Lead Smelters

National Emission Standards Regulations for Secondary Lead Smelters were adopted by the Governor-in-Council and announced in Part II of the Canada Gazette during the review period. The Regulations became effective on August 1, 1976. The Quebec Region of the Service finalized an agreement on a joint working program with the Province of Quebec for the purpose of enforcing the Regulations. The Northwest Region negotiated an agreement with the Province of Alberta to audit the enforcement of Alberta's regulations. The Region has assumed full responsibility for the enforcement of the national emissions standard regulations in Manitoba. No action was required in Saskatchewan because that province has no secondary lead smelters. Negotiations continued between the Ontario Regional Office and the Province of Ontario. In the Atlantic Region, under a working arrangement with the Province of Nova Scotia, progress was made in obtaining emission test data from the only secondary lead smelter in the region. The Pacific Region, working with the Greater Vancouver Regional District, completed its program to ensure that all secondary lead smelters in the district were operating in compliance with the regulation.

Asbestos Mining and Milling

National Emission Standards Regulations for Asbestos Mines and Mills were published in Part I of the Canada Gazette on March 19, 1977.

In 1973, there were 14 active asbestos mines in Canada producing 112 400 short tons of ore per day. In the same year, Canadian producers shipped crude and milled asbestos fibres valued at $234 323 000 and employed 6430 persons. Between 1970 and 1973, production and employment in the industry increased substantially.

More than 95% of asbestos ore in Canada is mined in open pit operations. The asbestos extraction process is exclusively a dry milling operation. Ore from the mine is crushed, dried and stored in a dry-rock storage building. The dried ore is transferred to the mill where it is repeatedly crushed and screened, the freed fibres being aspirated at each stage. The asbestos collected in the initial aspiration is subjected to further screening and grading. Emissions of particulates containing varying amounts of asbestos fibres can occur at all stages of production from mining to shipping and tailings disposal. Control technology is available to provide a high degree of containment for these emissions.

The emission limits specified in the regulations are the same as those initially proposed in December, 1975. Certain changes in the administrative provisions were incorporated to strengthen the enforcement framework within the authority of the Clean Air Act. The concentration of asbestos in emissions is limited to a maximum of two asbestos fibres per cubic centimetre in gases emitted from the crushing, drying and milling operations and from dry rock storage. The emission limits will take effect on December 31, 1978.

Developmental work is continuing for other mining and milling sources. Asbestos emissions from the manufacturing sector of the industry are not included. They will be the subject of a separate future regulation.

Mercury

National Emission Standards Regulations for Mercury Cell Chlor-Alkali Plants were published in Part I of the Canada Gazette on March 19, 1977.

The chlor-alkali industry produces chlorine and caustic soda. These products are used principally by the pulp and paper industry which, in 1971, consumed about 50% of the chlor-alkali industry's production for its chemical pulping and bleaching processes. The production of industrial chemicals such as vinyl chloride and chlorinated solvents also requires large quantities of chlorine and caustic soda. In 1971, 47% of the chlorine and 35% of the caustic soda produced were used for these purposes. The remaining chlorine and caustic soda is used in a variety of industries

including mining, smelting and refining, soap and detergent manufacture, municipal water purification and in textile dyeing and finishing. In 1975, the chlor-alkali industry produced approximately 3500 tons of chlorine and 4000 tons of caustic soda per day.

There are two electrolytic methods used to manufacture chlorine and caustic soda. In the method addressed by these regulations, the mercury cell method, a moving mercury cathode is used. This is the source of the mercury that is emitted into the atmosphere. In 1976 there were 10 plants in Canada using the mercury cell method. Emissions of mercury from the chlor-alkali industry in 1970 were estimated to have been 26.4 tons. This represents about one-third of the total emissions of mercury in Canada during that year.

The regulations limit emissions of mercury for each 1000 kg of chlorine production design capacity to 5.0g from the cell room and 0.1g from each of the hydrogen stream, retorts and the combined end boxes and tanks. The total daily emission is limited to 1.68 kg. The regulations take effect on July 1, 1978 and the Service's Regional Offices' staff have begun their work to ensure that plants in their areas will be operating in compliance with the regulations at that time.

Arsenic

The major sources of emissions of arsenic into the atmosphere have been identified as the gold processing industry, the iron ore processing industry and the nonferrous primary metallurgical industry.

Two task forces consisting of federal and provincial government officials and industry representatives were established during the review period to develop regulations for arsenic emissions from these industries. Regulations are expected to be announced during the fiscal year 1977-78.

Vinyl Chloride

Emissions of vinyl chloride to the ambient air can occur during the manufacture of vinyl chloride monomer and polyvinyl chloride. A task force of representatives of the federal and provincial governments and the vinyl chloride and polyvinyl chloride manufacturing industries reviewed the state-of-the-art of manufacturing processes, emission sources and emission control technology to determine the best available control technology and control strategies. Based on task force recommendations, draft regulations proposing appropriate emission limits and operating practices were completed.

Metallurgical Industries Information Regulations

Section 6 of the Clean Air Act empowers the Minister to obtain information relating to any work, undertaking, or business, the operation of which the Minister has reasonable grounds to believe results in the emission into the ambient air of an air contaminant. During the review period work was completed on regulations relating to information on arsenic and mercury emissions from the primary metallurgical industry.

INSPECTORS AND ANALYSTS

Under Section 27 of the Clean Air Act the Minister may appoint any person to act as inspector or analyst for the purpose of enforcing regulations made under the Act. In 1976-77, thirty-two inspectors and nineteen analysts were designated. The training of these personnel for their enforcement duties continued during this review period.

FEDERAL ACTIVITIES PROTECTION

General

The federal government's conduct of its own activities, as perceived by the public, has a powerful potential to work for or against the endeavours of the government in its role as a leader in environmental protection. Fisheries and Environment Canada has direct responsibility for ensuring that the federal government minimizes adverse environmental effects from all of its works, undertakings and businesses. Policies concerning these operations have been developed and include:

- setting exemplary and comprehensive standards, guidelines and codes of good practice based on the best practicable technology for pollution control and protection of the environment;
- compiling an inventory of pollution problems associated with existing federal sources and activities;
- defining, through engineering investigations, all factors and circumstances pertinent to existing pollution problems and developing courses of remedial action and design concepts in consultation with operator departments and other departments with jurisdiction for environmental protection and with the provinces;

- recommending, in consultation with other government departments, government-wide project priorities and allocations on an annual basis for cleaning up existing pollution;
- arranging for or providing advice, assistance, and review of plans during design and construction phases;
- screening all new government facilities and activities for potential adverse effects on the environment;
- reviewing and assessing new projects to ensure that proper and adequate environmental control measures are provided;
- making measurements for surveillance and monitoring to ensure compliance with established environmental standards, guidelines, and codes of good practice;
- assessing the operations of crown corporations to ensure that they meet industrial standards as promulgated under the Clean Air Act;
- consulting with those departments and agencies responsible for environmental legislation to ensure the development of consistent federal regulations and requirements for pollution control, environmental protection and energy conservation; and
- assisting in the instruction of other government departments in the methods of implementing the codes and guidelines for federal facilities.

A guide is being developed for use by government departments in assessing the environmental consequences of proposed projects. The guide incorporates a screening system, which is the first phase in the evaluation process, to determine a project's level of environmental impact. Although each government department is responsible for environmental impact evaluation, the guide emphasizes that Fisheries and Environment Canada has the technical expertise available to assist government departments in fulfilling this responsibility.

In its pollution control programs, the federal government emphasizes leadership through a positive approach to the prevention, control and abatement of environmental pollution from federal activities. In this way, considerable leverage is exerted on other public agencies and on the private sector to examine their own responsibilities in establishing measures for pollution control. The onus has been

placed on Fisheries and Environment Canada to ensure consistency and effectiveness in the planning and implementation of the required programs. This includes identifying environmental problems, remedies, priorities, and monitoring. Examples of the types of projects managed under this program are given.

Incinerators

Several incinerator projects have been initiated at federal facilities to study exemplary equipment for air pollutant containment and solid waste processing. Among these are the following:

- heat recovery incinerators at Toronto International Airport, Vancouver International Airport, Canadian Forces Base (CFB) Downsview and CFB Summerside were assessed, costed and designed for installation in the near future;
- a solid waste-sewage incinerator suitable for vessels or arctic work camps was installed and tested at the Bedford Institute of Oceanography and a performance report was completed;
- a portable "pit-type" incinerator for remote locations was designed, purchased and installed to demonstrate the use of this equipment under adverse weather conditions.

Boilers

Projects to minimize air pollution emissions from federal boilers included:

- the purchase for the Experimental Farm heating plant of an oil-water emulsifier designed to reduce particulate emissions and save fuel-oil;
- the initiation of a project to purchase and install an oxygen-monitoring system to control automatically the burner inputs to the boilers at the Mackenzie Building in Toronto. This system will also reduce emissions of pollutants and save fuel-oil;
- the successful burning of clean waste oil in a Canadian National Railway heating plant in Moncton;
- the initiation of an investigation into the installation of a sulphur dioxide scrubber at CFB Gagetown to demonstrate an alternative to fuel switching as a method for reducing emissions of sulphur dioxide.

Guidelines

The following guidelines have been completed:

- Air Pollution Guidelines Applicable to Incinerators at Federal Establishments;
- Air Pollution Guidelines Applicable to Boilers at Federal Establishments;
- Guidelines for the Monitoring and Surveillance of Pollution Control at Federal Establishments.

Air Pollution Assessment Studies

Air pollution assessment studies were completed for various federal facilities including the Mackenzie Valley pipeline, the Simpson Timber Company, the Taglu gas gathering system, the National Harbours Board Grain Elevator in Halifax, the Interprovincial Steel Company, the Arvik mine, the Navisivik mine and numerous boilers, incinerators and agriculturally oriented plants.

Railways

An evaluation of the air pollution emissions from idling Canadian National diesel units at the Edmonton yard during the winter was completed. Appropriate control techniques were examined. Discussions were also held with Canadian National representatives on alternatives to open burning for the disposal of discarded railway ties. In the Pacific region, field studies on coal dust suppression techniques from open-top trains were conducted with the cooperation of four companies in British Columbia. As a result of the proven effectiveness of a spray application of chemical binding agents, all companies transporting coal in British Columbia and Alberta have agreed to install rail car spraying facilities. A program to implement coal dust suppression techniques from open-top trains was introduced within the Service's Northwest region.

TECHNICAL AND ADVISORY SERVICES

The Environmental Protection Service continued to provide advice and assistance in those areas of air pollution control where its scientific and technical staff have developed unique specialized skills and knowledge. During the review

period, technical assistance and advice were provide to other federal departments, provincial and municipal agencies, universities and industry. For example, the Service continued to provide assistance to the Department of External Affairs and the Province of Saskatchewan during negotiations with the State Department of the United States and the State of Montana concerning the possibility of transboundary air pollution from the proposed Poplar River thermal generating station. Among other advisory or technical services provided were:

- provision of advice to the Department of Public Works in the Ottawa Master Plan Study for Heating and Cooling for Government Buildings in the Ottawa - Hull area;
- participation in the Interdepartmental Committee on District Heating;
- provision of technical advice to the Province of Nova Scotia and to the company in the conduct of a mercury emissions study at a chlor-alkali plant;
- participation with the Atmospheric Environment Service in the technical assessment of a proposed coal-fired power-generating station in Lingan, Nova Scotia;
- provision of advice concerning analytical method development to the World Health Organization, the United States Environmental Protection Agency, the National Bureau of Standards and the American Society for Testing and Materials;
- participation with the Greater Vancouver Regional District in the assessment of air pollution emissions from a fluidized bed sludge incinerator;
- provision of technical advice to organizations such as the North Atlantic Treaty Organization, the Economic Commission for Europe, the World Health Organization and the United States Environmental Protection Agency;

- provision of advice and technical assistance to the Cooperative Pollution Abatement Research (CPAR) programs for the pulp and paper industry;
- participation in the technical assessment of a fluoride pollution problem in Newfoundland;
- provision of technical advice to the Province of Saskatchewan through the preparation of a report on the potash industry and by participation on a task force set up by the province's Air Pollution Control Branch for the development of emission control regulations for the industry;
- participation with the Province of Manitoba in meetings concerning a nonferrous smelter in Thompson, Manitoba;
- participation in international standards committee work to ensure international uniformity of analytical methods;
- provision of technical advice to industry concerning potentially useful technology transfers for air pollution control; and
- support of the work of professional societies engaged in air pollution control.

REGULATION OF FUELS AND FUEL ADDITIVES

General

Sections 22 through 26 of the Clean Air Act provide for the regulation of fuel composition and fuel additives and for the necessary administrative procedures to reduce emissions of air pollutants when fuels are burned. To develop appropriate limits for Section 22 of the Act, regulations were developed to obtain the required information on the current composition of petroleum fuels and their additives and on the impurities in crude oils. The regulations will be published in the next review period. Future regulations may be developed for natural gas and coal. In a study of residential heating units completed during the review period, the operation of such units was assessed and the associated air pollution emissions evaluated. A regulation concerning the composition of fuels for residential heating units is being considered.

Lead-Free Gasoline Program

During the review period, 3688 samples of lead-free gasoline were tested under the national monitoring program. One hundred and forty-four samples exceeded the allowable concentration of 0.06g of lead per imperial gallon of lead-free gasoline. Immediate corrective action was taken by the gasoline marketing companies. Two consignments of gasoline fuel were seized, one in New Brunswick, the other in British Columbia, when gross contaminations were detected. The alleged violators took prompt action to replace the contaminated fuel.

Leaded Gasoline Program

Refineries have been submitting quarterly reports to Fisheries and Environment Canada since September 1974 on the quantities of lead being added to gasolines at each refinery. In 1976, about 32 million pounds of lead were added to the premium and regular gasoline production. This represents a decrease of approximately 5% in lead consumption compared with the previous year. One company failed to report the importation of leaded gasoline that contained more than the allowable maximum content of 3.5g per imperial gallon. A consignment of gasoline was seized and legal proceedings are underway.

Lead-Free Gasoline Nozzle Program

Federal regulations made under the Motor Vehicle Safety Act limit the size of the gasoline task filler inlet on cars equipped with catalytic converters. These inlets are too small for the standard 15/16 inch diameter nozzles that are used to dispense leaded grades of gasoline. A survey completed by the Quebec Regional office of the Service showed that 17.8% of 3507 nozzles checked on leaded gasoline pumps were small enough to permit leaded gasoline to be introduced into cars equipped with catalytic converters. The Province of Quebec and the Department of Consumer and Corporate Affairs were notified so that appropriate remedial action could be taken.

MOBILE SOURCES

General

There are no direct provisions in the Clean Air Act for the regulation of air pollution emissions from mobile sources. Other federal acts provide the authority to regulate these sources. The Clean Air Act does, however, address itself to mobile as

well as stationary sources under its general provisions for air quality objectives, air quality monitoring and surveillance, fuel composition regulations, and federal-provincial cooperative programs.

With the passage of the Motor Vehicle Safety Act, the federal government initiated a program to combat air pollution from all new motor vehicles manufactured in or imported into Canada starting with 1971 models. Transport Canada was made responsible for the administration of the Motor Vehicle Emissions Regulations and Fisheries and Environment Canada for the execution of the required compliance testing and the provision of technical advisory services in support of the regulations.

The mobile source programs conducted by Fisheries and Environment Canada and in cooperation with other government agencies and industry provide technical test data for setting future emission standards and for reducing air pollution caused by in-use vehicles. These programs investigate the effects on emissions of the Canadian climate, of basic engine characteristics and fuels, of maintenance and driving habits, of variables in test equipment and procedures, and of commercial fleet operations. Scientific studies and evaluations include new power sources such as turbine and diesel, alternate fuels such as hydrogen and propane, inventions and test instruments. A fleet of eight test vehicles is maintained for these programs.

Compliance Monitoring Program

Automobile manufacturers are required to certify that new motor vehicles offered for sale in Canada conform to current emission standards. The federal government's compliance monitoring program is designed to ensure that emission rates from new automobiles do not exceed those standards.

Each model year, approximately 50 new motor vehicles representing the most popular makes, models and engine families and family combinations sold in Canada are tested for compliance with the emission standards. During the review period, more than 350 000 miles were accumulated on over 40 vehicles on a prescribed urban-rural route in the Ottawa area. More than 350 emission tests were completed. Complete servicing and maintenance of each vehicle is done by the Emission Testing Laboratory of the Technology Development Branch.

Cold Weather Programs

This continuing program was started in November 1972 to determine the effects of the Canadian climate on emissions. Under this program, a fleet of vehicles undergoes daily conditioning and emission testing (CVS-CH test procedure) at ambient temperatures in the range -23° to 16°C. Fifteen percent of the tests are done at baseline conditions (20° to 30°C) on a rotational basis for comparison. Data from more than 1000 tests on vehicles equipped with different emission control systems indicate that emission levels increase substantially as temperature decreases.

Control and Abatement of Air Pollution from Motor Vehicles

Emission Standards. To achieve significant reductions at low cost the federal government, in the past, followed the policy of paralleling United States' motor vehicle emission regulations. As a result, by meeting standards of 3.4, 39.0 and 3.0 grams per mile (CVS-CH test procedure) for hydrocarbons, carbon monoxide and oxides of nitrogen, respectively, 1973-74 model year cars were emitting only about one-third as much as uncontrolled vehicles. The Canadian standards for 1975 were established at 2.0, 25.0 and 3.1 grams per mile (CVS-CH test procedure) for hydrocarbons, carbon monoxide and oxides of nitrogen, respectively. These standards, which lead to a reduction in emissions of about 72% from uncontrolled values, will remain the same through the 1980 model year. Corresponding United States' standards for 1975-76 require about 82% control. A new standard limiting carbon monoxide emissions from idling motor vehicles, for application to cars of the 1980 and later model years is being developed. To facilitate the tuning of motor vehicles with respect to emissions, new labelling requirements are being considered.

Annual Vehicle Inspections. Although the control of emissions from in-use motor vehicles is outside federal jurisdiction, the dramatic increase in emissions from badly maintained vehicles is of great concern. A program to review and evaluate compulsory emission inspection systems used in Canada, the United States, and several European countries is continuing. The Air Pollution Control Directorate has proposed tentative guidelines for provincial and municipal motor vehicle inspection programs. The Emission Testing Laboratory continued to perform emission tests to determine the effects of maintenance on vehicle emissions and to evaluate test equipment that could be used in these inspections. A program is continuing in cooperation with taxi companies in the Ottawa-Hull area to determine the emissions from a fleet of vehicles throughout their lifetime.

ATMOSPHERIC ENVIRONMENT SERVICE

General

The Air Quality and Inter-Environmental Research Branch of the Atmospheric Environment Service undertakes each year many research projects in cooperation with other federal agencies, provincial organizations and universities. Major activities of the Branch during 1976-77 concerned measurement techniques, studies of atmospheric processes, the development of models and environmental impact assessments. During the review period, the Branch was involved in the Alberta Oil Sands Environmental Research Program, the Spruce Budworm Study in New Brunswick and the working group on the long range transport of air pollutants.

In addition to the science subvention program, scientific contracts totalling $290 000 were let.

During the review period, the Branch had a permanent staff of 68 and several post-doctorate fellows and temporary staff.

Environmental Monitoring

Ten stations continue to be operated at rural and remote locations across Canada as part of the global air quality monitoring network of the World Meteorological Organization. The objective is to develop long-term records on background atmospheric composition. Special emphasis is placed on those constituents which may influence climate. All stations measure atmospheric turbidity and collect precipitation samples for subsequent chemical analysis. The precipitation network was strengthened with the acquisition of new precipitation collectors and the adoption of new sample shipping procedures. Chemical analyses are now done by the laboratory of the Canada Centre for Inland Waters. The limits of accuracy of the data will be established when quality assurance programs are instituted.

During 1975, Alert, Northwest Territories and Sable Island were extensively tested for suitability as carbon dioxide sampling sites using a transportable carbon dioxide analysis system developed by the Service. Flask samples are now being obtained at both stations and analyzed for carbon dioxide concentrations by the Ocean Chemistry Division of Fisheries and Environment Canada in Victoria, British Columbia. Arrangements were made with the Geophysical Monitoring for Climatic Change group of the United States National Oceanic and Atmospheric Administration to obtain nuclei counts from a weather ship during 1976.

The Branch continued to be the lead agency in managing the Tall Tower Network. This cooperative network, involving three levels of government, universities and private agencies, now consists of some twenty towers across Canada. Measurements of wind speed, wind direction and temperature are made at various levels at maximum heights ranging from 60 to 300 metres. Data from the towers are collected, checked and stored in the Branch and are published quarterly in the "Meteorological Tower Bulletin".

Work continued with the University of Toronto and the National Research Council on the project to place instruments on the Canadian National Tower in Toronto. The project will provide data for research on structural design as well as information on the vertical variation in atmospheric structure and the vertical distribution of air pollutants.

Environmental Processes

Sudbury Dispersion Studies. The fifth in a series of tall stack dispersion studies, conducted jointly with the Province of Ontario, took place at Sudbury during two weeks in September. Two investigations designed to relate the physical characteristics of the plume from the 380-metre stack to the corresponding atmospheric structure were completed. In the first, time-lapse photographic observations of plume-rise and plume vertical dimensions were taken for comparison with simultaneous minisonde profiles of temperature and wind structure. A good set of data was obtained for the light wind, stable atmosphere condition. In the second investigation, multiple correlation spectrometers were used simultaneously at different distances downwind beneath the plume to study both the optimum methodology for sulphur dioxide mass flux determinations and the variation of the horizontal dispersion coefficient with downwind distance. Periods of atmospheric stability and fumigation conditions were investigated in detail.

Oxidation of Sulphur Dioxide. The oxidation of sulphur dioxide to sulphuric acid and sulphates was studied at Sudbury during September using a helicopter carrying instruments. Samples of particulate matter were collected to measure the sulphuric acid and metal content of the smelter plume at different downwind distances from the stack. A laboratory method is being developed to measure the ability of atmospheric aerosols to oxidize sulphur dioxide.

Transboundary Trajectory Analysis. In cooperation with the Province of Ontario, concentrations of ozone are being measured across southern Ontario and related to meteorological conditions. Trajectory analyses are being used to determine the effects of transboundary flows of photochemical precursors, large urban centres and lake-induced local circulations.

Toronto Oxidant Study. Continuous monitoring for oxidants and their precursors was done at two sampling sites from June to October. Measurements were recorded for ozone, nitrogen oxides and sulphur dioxide. Particulate matter was collected for analysis of its sulphate content. From the data, daily variations in oxidant levels will be determined with respect to the migration of air masses through the Toronto area.

Polar Boundary Layer. During the winters of 1974 and 1975, a small project was completed to investigate the energy changes above the surface of a frozen lake. Because of increasing Canadian and international interest in the Arctic, a major long term program is now planned. Its first objective is to reach an understanding of the dynamic and thermodynamic processes in the arctic planetary boundary layer and the interaction of this layer with the underlying surface. The second objective is to provide advice and consultation about the impact of this layer on arctic environmental problems including weather prediction and pollutant dispersion.

Environmental Modelling and Impact Assessment

Modelling. During the review period, a new unit dedicated to air quality monitoring was formed and a number of projects initiated.

An existing urban-mesoscale model was modified and improved to permit the rapid study of the effects of topography, boundary conditions and numerical integration schemes.

Mathematical models were developed for the dispersion and chemical transformation of pollutants in stack plumes. During the review period these models were used for the oxidation of sulphur dioxide in a smelter plume and the oxidation of nitric oxide in a coal-fired power-generating station plume.

A multiple-cell trajectory model was used to calculate the concentration of nitrogen oxides in the ambient air in Edmonton. The predictions agreed well with data collected during field studies. In the study of sulphur dioxide washout and redistribution in the atmosphere, a model was developed which has an improved description of droplet-air diffusion of the gas.

During the review period, developmental work continued on Models for the medium and long range transport of air pollutants. In the medium range, an air parcel trajectory model was developed and is now being used in studies of the sources of photochemical ozone and in sulphate aerosol measurements. In the long range, a three-dimensional trajectory model was developed. It can use emissions inventory data and Canadian Meteorological Centre historical data to compute poilution concentration fields anywhere in the northern hemisphere.

Reviews were completed of two major air quality impact studies, one for the Syncrude project in Alberta, the other for the proposed Afton mine, mill and smelter in British Columbia.

Impact Assessment. Trace substances from the atmosphere are deposited on the earth's surface in gaseous and particulate form by the scavenging action of precipitation and by fallout. More emphasis has been placed on research to assess the relative importance of these deposition processes under various combinations of atmospheric concentrations, surface characteristics and meteorological conditions. Deposition in precipitation appears to be the most important single contributor in many cases and field work this year was largely confined to precipitation chemistry.

Work began on the establishment of a new precipitation chemistry network of fifty stations across the country. The Canadian Network for Sampling Precipitation now incorporates the existing ten World Meteorological Organization Stations. Using data from the network, regional differences in the concentration and wet deposition of important ions will be studied. In conjunction with this network, the Service is providing assistance to the Inland Waters Directorate in the operation of a twelve-station precipitation network that will generate samples for the determination of organic compounds such as polychlorinated biphenyls.

During the review period, the Atmospheric Environment Service and the Environmental Protection Service cooperated on a project to study the distribution of sulphates over eastern Canada. This activity is described under Ambient Air Surveys.

Research on the effects of air pollutants on vegetation continued during the review period. Working with the University of Guelph under contract, progress was made in the investigation of ozone damage to tobacco crops. A literature survey was completed on fertilizers and their contribution to nitrous oxide concentrations in the atmosphere.

As part of the Saint John Regional Study, assessment of air pollution impact on vegetation continued and progress was made toward completion of an Index of Atmospheric Purity based on species frequency, distribution and coverage. To monitor the entry of selected pollutants into an ecosystem, samples from permanent vegetation plots were analysed for pollutants such as heavy metals.

Studies of the effects of air pollutants on arctic vegetation continued during the review period. Because of their importance in the arctic environment, lichens were selected as the subject of these experiments. In the laboratory, experiments to determine the effects of different pollutants on lichen physiology under different environmental conditions were started. Field studies of lichen communities in the Arctic continued to describe the energy budget and microclimatology of different vegetation types. As part of the Alberta Oil Sands Environmental Research Program, analysis of epiphytic lichens for heavy metals and sulphur was initiated to define deposition patterns around point sources.

To determine background concentrations of certain air pollutants, samples of vegetation from the high arctic were analysed. Comparisons can be made with European data to provide information on the long range transport of air pollutants.

Under a contract let last year, work continued at the University of Guelph on the development of air quality criteria for agricultural crops under different meteorological conditions. Planning began for a workshop on Canadian research into the development of criteria and standards for air pollutants.

Environmental Techniques Development

Several projects involving the development of new instruments were completed during the review period. A special counter was developed that will record field data on a paper strip chart in such a way that the results have a linear relationship with the elapsed distance travelled by a mobile research vehicle. This instrument, known as the Speed Proportional, Elapsed Distance counter was used successfully in field trials at Sudbury.

Other achievements included:

- the construction of a Kautsky device to measure the photosynthetic activity of a plant. The portable instrument can be used in the field to study air pollution damage to vegetation;

- the development of a gas chromatograph-electron capture detector system to measure concentrations of freons, other light halocarbons and nitrous oxide automatically. The system will be used in field projects to investigate seasonal variations in ambient concentrations of nitrous oxides and to validate trajectory analyses for freons;
- the assembly of a spectrophotometer to make diffuse solar irradiance measurements in Toronto. Direct solar irradiance measurements are planned. These data will be used in modelling photochemical air pollution;
- the development of air sampling instruments to measure the concentrations of sulphur dioxide and particulate sulphates in the same air sample. Analysis of the filters by an isotope dilution technique provided the sensitivity and accuracy to permit the measurement of low background concentrations of sulphur. The methods were used during field studies at Sudbury and at the Alberta oil sands.

A measurement technique for nitrous oxide, an important precursor of photochemical smog, is being developed. Data obtained will be used in the development of special chemical models for the formation of oxidants in urban atmospheres. In another project, an instrument is being developed to measure the amount of light scattered by aerosol particles. It will be used to determine the number and size of aerosol particles in air samples.

Technology and Information Transfer

During the review period, more than 100 publications and reports on the Branch's activities were completed. An air pollution potential climatology for Canada was accepted for publication in "Atmosphere". Joint frequency distributions of pollution potential variables for all Canadian upper air stations were placed on microfiche and a user's manual is being prepared. The Branch organized a three-day seminar on the Environmental Assessment and Review Process.

Science Subvention Program. During the review period a number of research programs were completed under the subvention program and through direct research grants. These activities fall into two broad categories: studies related to the physics and chemistry of the atmosphere, and those related to the effects of

meteorological conditions and air quality on water, soil and vegetation. Information from the second category of activities is used in assessing the applicability of cause-effect criteria to Canadian conditions. These criteria are then used in the establishment of national air quality objectives.

Federal-Provincial. The Service provides a member to the Federal Provincial Committee on Air Pollution and to its sub-committees on National Air Quality Objectives, Maximum Tolerable Levels, Air Quality Indices and Air Monitoring Site Selection.

International. Scientists of the Service continued to participate in various intergovernmental groups and international organizations involved in studies on topics such as the long range transport of pollutants (OECD and ECE Working Groups), multiple-source modelling of urban pollution (NATO/CCMS* Working Groups), environmental monitoring and assessment (WMO and WHO Working Groups; International Congress of Scientific Unions; United Nations Environment Program), climatic change and the assessment of human activities as a change-forcing mechanism (WMO Working Groups; Global Atmospheric Research Program),° and the input of airborne material to receptor surfaces (WMO Rapporteur on Plant Injury by Air Pollution). Such international contacts provided an exchange of information on a wide variety of air pollution problems.

Major Branch Projects

Long Range Transport of Air Pollution. In response to observations of the increasing extent of acid precipitation and of atmospheric haziness in Eastern Canada, the Service convened a meeting of Departmental scientists to review evidence of the occurrence and effects of long range air pollutant transport in Canada and to assess the adequacy of current research and monitoring programs. The report of this ad hoc group became the basis for a submission to the Departmental Management Committee in August, 1976, when it was decided that the Department should undertake, as a high priority item, the development of an integrated program on the long range transport problem with the Atmospheric Environment Service as the lead agency.

*Pilot study on Assessment Methodology and Modelling and associated Working Groups.

°Atmospheric chemistry and global pollution (WMO), the IJC Air Pollution Advisory Board.

The objectives of the program are to determine the state of the environment in Canada before the impact of emissions from increased coal burning in the United States and Canada, and to develop a clear understanding of the occurrence and effects of long range transport within and into Canada including the geographical extent, severity and socioeconomic costs. Initially, efforts will be concentrated on sulphur compounds in Eastern Canada.

In the meantime, the Service has undertaken two programs to provide data to evaluate the situation. A network of 40 precipitation chemistry monitoring stations is being installed across Canada, with emphasis on the east. It will become fully operational in April, 1977. During August, 1976, the Service completed a study of daily concentrations of particulate and precipitation sulphate at 30 relatively unpolluted stations across Eastern Canada in cooperation with the Environmental Protection Service.

The Atmospheric Environment Services role in the Departmental program on the long range transport of air pollution will involve three components: the development of trajectory analysis and improved long range transport modelling capabilities; the development of a network of stations to measure concentration and deposition of sulphur compounds; and supporting research. In addition, close contact will be maintained with similar European and American programs to ensure comparability of techniques and data and to provide information exchange.

Alberta Oil Sands Environmental Research Program. The Air Quality and Inter-Environmental Research Branch has continued to contribute to this program through participation in meteorological data acquisition, applied research and in the air quality modelling activities of the program's Meteorology and Air Quality Technical Research Committee.

The Branch has been striving towards the establishment of a meteorological data base for the oil sands area. Ten climatological stations are now providing data routinely and a 500' high meteorological tower is operational. Related data-handling procedures are being developed and tested. A mobile minisonde system with automatic data analysis and plotting was set up but the program of routine temperature and wind sounding of the lower atmosphere was delayed by slow delivery of equipment. A feasibility study on the application of balloon-tracking radar to the minisonde program, completed jointly with the Ministry of Transport, determined that this method would be successful. Reports on the first intensive field study, completed in March, 1976,

were written and seminars presented in Edmonton and Toronto. A second intensive field study in February, 1977, was completed. Measurements were made on the rate of in-plume sulphur dioxide oxidation and of the background air chemistry. Studies of patterns of pollutant uptake by snow and lichens were set back due to the snow conditions.

Research projects on the air pollution potential climatology and the climatology of low-level air trajectories for the oil sands area were completed. New and continuing research, in addition to that mentioned above, involves potential transformation processes for oil sands air pollutants, pollutant deposition processes and the derivation of plume dispersion coefficients from tower-mounted bivane measurements.

The impact of extensive oil sands development on the air quality of the area may in principle be estimated by using mathematical models to predict pollutant concentration distributions for appropriate source properties and meteorological conditions. Modelling activities are focussed on two projects. In the first, the simple Climatological Dispersion Model is being applied in an attempt to provide gross estimates of seasonal and annual average pollutant concentrations. In the second, a literature survey is being made to determine which regional dispersion models should be applied, adapted or pursued further in the program.

Date Due
