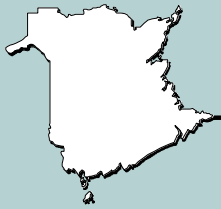
Environment Canada Environnement Canada

Southern New Brunswick Smog Prediction Pilot Project, 1997

EVALUATION REPORT



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Aussi disponible en français

Cat. No. EN-56-88/1998E
ISBN 0-662-26467-3

Printed on recycled paper

Southern New Brunswick
Smog Prediction Pilot Project, 1997
Evaluation Report

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February 1998

T A B L E O F C O N T E N T S

TABLE OF ACRONYMS

AEB..... Atmospheric Environment Branch (Environment Canada)
AES..... Atmospheric Environment Service (Environment Canada)
AQPP..... Air Quality Prediction Program
ARMA..... Air Resources Management Area
ASD..... Atmospheric Science Division
ATAD..... Automatic Telephone Answering Device
AVIPADS..... Automated Voice Information Processing and Distribution System
CANFIS ..... CART (Classification and Regression Tree) Adaptive Neuro Fuzzy Inference System
C.A.N.DO..... Clean Air Now
CARD..... Climate and Atmospheric Research Directorate (AES)
CCCA..... Citizens Coalition for Clean Air
CIRAC..... Canadian Institute for Research in Atmospheric Chemistry
CMC..... Canadian Meteorological Centre (AES)
CO..... Carbon Monoxide
COH..... Coefficient of Haze
GEM..... Global Environmental Model
IQUA..... Index of Quality of the Air
LRT..... Long Range Transport
Maine DEP..... Maine Department of Environmental Protection
MRB..... Meteorological Research Branch (AES)
mb..... millibars
NB..... New Brunswick
NBDOE ..... New Brunswick Department of Environment
NBHCS..... New Brunswick Health and Community Services
NBLA..... New Brunswick Lung Association
NBWC..... New Brunswick Weather Centre
NO..... Nitric Oxide
NO_2..... Nitrogen Dioxide
NOx/VOC..... Nitrogen Oxides/Volatile Organic Compounds
O_3..... Ozone
ppbv..... parts per billion by volume
SO_2..... Sulfur Dioxide
UV..... Ultra-Violet
WADS..... Weather Analysis and Display System

*** Please note that the terms smog and ozone are used interchangeably throughout this report.**

ACKNOWLEDGEMENTS

No major undertaking can be successfully completed without the dedication and contribution of many people, and so it has been with this report.

The authors wish to express their sincere appreciation to the following individuals who provided substantial comments on earlier drafts of this report: Real Daigle - New Brunswick Weather Centre, Billie Beattie - ASD-Bedford, Paul Galbraith - ASD-Bedford, Dave Wartman - AEB-Bedford and Anne-Marie Leger - Regional Communications Branch - Dartmouth. The participation and contributions from the following individuals are also acknowledged: Alan MacAfee - AEB-Bedford for programming support, Warren Gash - AEB - Dartmouth for graphic support, Dave Penney and Jaymie Gadal - New Brunswick Weather Centre for their graphical and computer support.

Layout and Design was provided by KT Graphics Plus of West Chezzetcook, Halifax Municipality.

EXECUTIVE SUMMARY

The Air Quality Prediction Program (AQPP) was established by Environment Canada in 1996 in response to the commitment of the department's Clean Air Strategy. This policy stated that every Canadian has the right to know the quality of the air that they breathe. The impetus for this initiative is due in part to recent medical studies which have identified an increase in hospital admissions with deteriorating air quality. As such it has been recognized that Environment Canada's environmental prediction capabilities should play a more significant role towards addressing this issue.

To meet this need, Environment Canada, under the auspices of the Smog Advisory Program, began in 1993 the production of a special bulletin to alert the public when smog concentrations were expected to exceed 80 ppbv in Southern New Brunswick. With this pre-existing expertise in smog prediction and well-developed partnerships, the New Brunswick Weather Centre was selected to conduct the Smog Prediction Pilot Project for Southern New Brunswick with emphasis on the Greater Saint John region.

The Air Quality Prediction Program (AQPP) led to the development of the Smog Prediction Pilot Project in the summer of 1997. Under this project, daily predictions of the smog index along with public health and educational

messages were prepared by the New Brunswick Weather Centre in Fredericton and issued twice daily for public dissemination through various media. Air quality research has contributed to increased scientific knowledge of smog behavior. This, together with the existing strong partnerships, has been crucial to the success of this project.

For a period of three months, the Smog Prediction Pilot Project tested many of the objectives foreseen to comprise a part of future permanent programs. These tests successfully demonstrated that many of the premises of the Smog Pilot Project planning are valid and achievable. As a result of this experience it has been concluded that:

- The necessary scientific skill and expertise required to produce a quality and usable product has been developed.
- Partnerships were a key element to the realization and subsequent success of this project.
- Environment Canada's participation in various activities related to air quality has contributed to an increased public awareness of the issue.

Based on the experiences of the Smog Pilot Project and the above results, the following recommendations are presented for consideration:

- A permanent program be implemented beginning with the 1998 smog season.
- An expansion of the program take place to increase the range of pollutants and to geographically include a greater portion of the province of New Brunswick.
- The seasonal period of coverage be extended to include the period of May to October inclusive.
- Environment Canada and other agencies must continue to develop scientific understanding, computer modeling and expertise in atmospheric pollution.
- Output from various numerical tools such as CANFIS and the Air Quality package produced by the Canadian Meteorological Centre be made an integral part of the forecast process.
- Partnerships continue to be nourished and developed and suitable private sector partners be identified and approached for input into the program.
- Efforts continue to enhance the public education and awareness of the air quality issue.

The Smog Prediction Pilot Project, through AQPP, has been seen as both a necessary and worthwhile endeavor by all participating agencies. Expansion of the program to other parts of the country is encouraged as Canadians enter the new millennium.

CHAPTER 1

INTRODUCTION

The growth of both human civilization and industry has occurred at an unprecedented rate during the twentieth century. This has placed a growing stress on our environment as pollution from anthropogenic sources is introduced into the atmosphere. Various pollutants are transported, transformed and deposited into different ecosystems, affecting both humans and the biosphere. As such, Environment Canada is well positioned to respond to these changes by taking advantage of its existing expertise in atmospheric science.

Environmental prediction can be thought of as expanding our forecasting expertise from weather to climate change, air quality and other environmental variables. In response, the Government of Canada is committed to securing for current and future generations, a safe and healthy environment and a sound and prosperous economy. The AQPP, and more specifically the Southern New Brunswick Smog Prediction Pilot Project, are seen as positive steps in addressing this responsibility and building a strong foundation for the Environmental Prediction Program in Canada.

CHAPTER 2

BACKGROUND AND HISTORY

2.1 History of Air Quality Initiatives

The Southern New Brunswick region was identified by studies in the 1970s as an area susceptible to elevated smog concentrations. Studies in the 1980s indicated that smog was affecting human health. In 1990, the NOx/VOC Management Plan of the Canadian Council of Ministers of the Environment and subsequent Environment Canada programs supported those studies and identified this region as being a "smog-prone" area. The resulting initiatives led to the implementation of Environment Canada's Smog Advisory Program and was launched in 1993 with the purpose to advise the general public when hourly ozone concentrations were likely to exceed 80 ppbv (parts per billion by volume). This level is defined as the National Ambient Air Quality Objectives maximum acceptable limit.

NBDOE personel performing calibration of air quality monitoring instrumentation.

The focus on air quality prediction was highlighted by Environment Canada's Clean Air Strategy in the spring of 1996 which stated that "every Canadian has the right to know about the quality of the air they will be breathing." It also stated that Environment Canada would provide federal leadership in pollution forecasting. The AQPP is a National effort aimed at standardizing air quality forecasting with the thrust of providing Canadians with daily forecasts of ground level ozone concentrations.

2.2 Building on Partnerships and the Smog Advisory Program

Extensive cooperation amongst the Atmospheric Environment Service (AES), Atmospheric Environment Branch (AEB) Atlantic Region, New Brunswick Department of the Environment (NBDOE), and New Brunswick Health and Community Services (NBHCS) was integral to the success of this project. During the development of the pilot project, cooperation was expanded to include the New Brunswick Lung Association (NBLA), the Saint John Citizens Coalition for Clean Air (CCCA) and the Saint John - Fundy Air Resources Management Area (ARMA).

Further partnerships have been fostered with the Maine Department of Environmental Protection (Maine DEP) which has facilitated the International exchange of data and information. This International cooperation has developed as a result of initiatives from the Acid Rain program, where long range transport (LRT) of pollutants has been highlighted.

2.3 Building on Our Knowledge of Smog Behavior

Many International and National air quality research studies conducted in the Atlantic provinces during the 1980s and 1990s, have contributed to improve our understanding of smog behavior. Weather plays a significant role in the formation, transformation, transport and deposition of ozone and its precursors. Meteorologists have been working cooperatively with air quality scientists to refine computer models which will aid in air quality prediction.

During the summers of 1995 and 1996, at the request of NBDOE, the New Brunswick Weather Centre provided guidance on expected ground level ozone concentrations. Results from this experiment were shared with various partners who contributed to the improvement of both the forecast and delivery mechanisms.

CHAPTER 3

EFFECTS OF GROUND-LEVEL OZONE EXPOSURE

3.1 Health Issues

Scientific evidence verifies that poor air quality adversely affects human health. Acute and chronic effects such as asthma and increased respiratory infections have been positively correlated with poor air quality. Recent medical studies have identified an increase in hospital admissions with deteriorating air quality (Stieb, Beveridge et al, 1996) even when smog concentrations were observed to be higher than the National objective of 80 ppbv.

3.1.1 Fulfilling a Mandate

The primary mandate of Environment Canada is to serve the Canadian population through science by providing environmental and weather information for the safety, security and economic well-being of all citizens. As reflected in several surveys, the general population is increasingly concerned about its health and the air quality issue in general. As such, the evaluation project is seen as a positive step forward in enhancing this commitment to Canadians.

Science indicates that several factors may affect human susceptibility to prolonged smog exposure. These include age, smoking and nutritional status, environmental stresses, and exercise levels. Epidemiological studies of asthmatics (Burnett et al., 1994) suggest that ozone exposure is associated with increased asthma attacks and hospital admissions. Other risk subgroups include those with already poor lung function such as those patients with chronic obstructive pulmonary disease (chronic bronchitis, emphysema). Questions still remain on whether repeated exposure in children will influence lung maturation. With a strong positive correlation between adverse health effects and deteriorating air quality, the provision of a daily forecast of the Index of the Quality of the Air (IQUA) based on ozone concentrations is seen as beneficial. This information allows an individual to implement the necessary steps to ensure a minimum health impact due to exposure.

3.1.2 Upwind Emissions Affecting the Air Quality in Southern New Brunswick

The LRT of air pollutants is the single largest component that contributes to poor air quality in the province of New Brunswick. Air pollution can be transported downwind by as much as 800 kilometers in a single day and its precursors can remain aloft for a longer period and travel much farther (CEC, 1997). Even though local emissions and production may be modest, the advection of smog from distant locations can result in poor air quality in Southern New Brunswick.

3.1.3 Public Education Requirements

Previous surveys (McCarty, 1996; Corporate Research, 1997) have indicated the need and requirement for increased public awareness of the potential health effects due to smog exposure. Additional studies verify that the residents in the Greater Saint John area felt poorly informed about air quality. The principal objectives of the Smog Prediction Pilot Project were to increase public awareness of potential health effects due to smog, the steps that can be taken to protect individual health and reduce air pollution and the atmospheric conditions which favor smog formation. In spite of the fact that much of the pollution is transported into the area from other regions, there are actions which individuals can take to minimize exposure and to lower local contributions.

3.2 Vegetation and Materials

Studies have shown that exposure to sufficiently high levels of ozone can adversely affect vegetation, and some organic and synthetic materials. The availability of a smog forecast was seen as a positive step by agricultural and industrial interests. Procedures could be implemented by these various users to mitigate the adverse effects of smog exposure.

CHAPTER 4

SMOG PREDICTION PILOT PROJECT IN NEW BRUNSWICK

The implementation of the Smog Advisory Program in 1993 was viewed as an opportunity by both Environment Canada and NBDOE for the enhancement of their partnership in air quality issues. Beginning with the installation of New Brunswick's first air quality monitoring station in 1961, NBDOE has established itself as a leader on air quality issues in Canada. The department is recognized as being the first jurisdiction in Canada to adopt the present air quality index as well as implementing the most stringent SO_2 emission standards in the country.

With the recognition of the necessity for continual improvement of our scientific knowledge and the development of expertise, a new internal product in the form of a smog advisory assessment bulletin was developed (refer to Annex I). Beginning in 1995, this internal air quality product was shared between Environment Canada, NBDOE and NBHCS. The objective was to provide the stakeholders of the Smog Advisory Program with the best possible information on how current and forecast weather conditions would affect air quality within the Greater Saint John area. Weather information was also used by NBDOE in support of regulatory actions through calculation of such variables as the ventilation index. Information such as the general weather pattern, wind speed and direction, as well as mixing height were provided. In addition, at the request of NBDOE, the New Brunswick Weather Centre provided a daily forecast of the expected smog concentrations for a twenty-four hour period. This experience has proved invaluable in gaining expertise in environmental prediction by fostering skill development related to the day-to-day quantitative ground level ozone forecasting.

NBWC Meteorologists discuss the latest air quality information.

At the termination of each forecast season an accuracy evaluation was performed by Environment Canada taking into account forecast precision and making the appropriate recommendations to be implemented the following year. Results for both 1995 and 1996 were presented at various National meetings addressing the smog issue (Côté, 1996).

With this new AQPP initiative of Environment Canada, the New Brunswick Weather Centre has strategically placed itself in the forefront of environmental prediction due to high public interest, a relatively long history of air quality monitoring, a constructive relationship with stakeholders and practical experience in forecasting smog concentrations. For the above mentioned reasons, the Southern New Brunswick region was selected for the pilot project. This program was viewed as a natural extension of the Smog Advisory Program and the opportunity to solidify Environment Canada's reputation as a leader in environmental prediction.

CHAPTER 5

OBJECTIVES

The motivation for the Smog Prediction Pilot Project is spearheaded by Environment Canada's commitment to environmental prediction. This undertaking is based on improved scientific knowledge of the issue and addresses the evolving needs of Canadians.

The Smog Prediction Pilot Project is considered as an important component in addressing the environmental and health issues in New Brunswick. The pilot project supplemented existing air quality programs by providing a forecast of anticipated air quality conditions related to smog and by enabling the public to better plan its outdoor activities.

The following is a list of objectives formulated through the AQPP for the Smog Prediction Pilot Project:

- Improve public understanding of the health effects associated with ground level ozone exposure.
- Increase public awareness of pollution emission sources, favorable meteorological conditions and variability.
- Take expected pollution levels into account in day-to-day planning when appropriate.
- Take action to reduce air pollution.
- Those predisposed to cardiorespiratory problems take precautionary measures when smog levels which are significant to the individual are forecast.

CHAPTER 6

PARTNERS

The development of this program would not have been possible without the commitment and dedication of many organizations. The active participation of all stakeholders was a key element to the success of this project (refer to Appendices).

6.1 New Brunswick Department of Environment (NBDOE)

Over the years, the Provincial and Federal Environment departments have formulated cohesive responses to their common interests. As such, the Air Quality Prediction Program presented a unique opportunity for the two agencies to strengthen the partnership through this new initiative.

Forest Hills (East Saint John) air quality monitoring station.

In December 1996, the AQPP initiative was presented to NBDOE and since that time, NBDOE has delivered on its commitment to Environment Canada to aid in the development and subsequent implementation of the smog forecast in the summer of 1997. The province continues to share its knowledge, professional expertise and technical resources as well as real time and historical data. It has demonstrated leadership in the domain of data collection, equipment maintenance and calibration. Furthermore, NBDOE, in partnership with Environment Canada, is interested in communicating to the public the benefits of air quality forecasts and the health risks associated with exposure to various air pollutants. This new alliance will enhance an already strong relationship that has flourished through the Smog Advisory Program. The NBDOE remains our principal partner in addressing air quality.

6.2 New Brunswick Health and Community Services (NBHCS)

As reflected in several surveys, the general population is increasingly concerned about health and air quality. In this endeavor, Environment Canada has

continued a partnership with NBHCS, thereby enhancing a relationship that had flourished through previous cooperation on the Smog Advisory and UV programs.

One of the objectives of NBHCS is to inform and educate the general population on health issues related to the deterioration of air quality and to inform concerned citizens on ways to minimize the adverse health impact.

6.3 New Brunswick Lung Association (NBLA)

The NBLA has long been on the leading edge of public education and awareness of air quality issues. This has been accomplished through the C.A.N.DO (Clean Air Now) National program, televised panel discussions and various public fact sheets providing general information on air quality. An initiative hosted by the NBLA each June (Clean Air Month) in the Greater Saint John area is the highly popular vehicle emission campaign. This National event has been well received in the region, with the province of New Brunswick ranking first in Canada in terms of participation. The NBLA has also invited Environment Canada and other stakeholders to participate in this activity in order to promote good air quality.

During the developmental phase of Smog Prediction Pilot Project, NBLA has worked closely with Environment Canada in various communication aspects. With its expertise in public relations and promotion, the NBLA has played a major role in the development of various promotional articles such as posters, magnets and special signboards designed for the Saint John Transit bus fleet, resulting in increased public awareness.

Beginning in July 1997, an enhanced air quality package was included with their C.A.N.DO booklet and is available for public distribution. The dedication and professionalism exhibited by NBLA have allowed the existing relationship with Environment Canada to strengthen allowing both organizations to increase their efficiency in provision of air quality information to the public.

6.4 Saint John - Citizens Coalition for Clean Air (CCCA)

The Citizens Coalition for Clean Air (CCCA) is an organization of concerned citizens whose mandate is to ensure the right to clean air for all residents. This group was formed several years ago in Saint John and has been both active and aggressive in addressing air quality in the Saint John area.

Throughout the development of the Smog Prediction Pilot Project, the CCCA was part of the consultation process and thus invited to attend the various planning meetings. Members of this group represent a good cross section of the target users of the air quality products.

The CCCA has given support to Environment Canada through the development phase of the Pilot Project and provided pertinent information throughout the process. In October 1997, the CCCA presented to Environment Canada a general evaluation and recommendation of the pilot project.

A strong partnership with CCCA is seen as necessary to the overall success of the program as this group is well established in the Greater Saint John area and hence is aware of the public's need and the health impact associated with the deterioration of air quality. The CCCA has also excelled in media relations and this strength has been an enormous aid to Environment Canada in enhancing the visibility of air issues and increased public awareness.

6.5 Saint John - Fundy Air Resource Management Area (ARMA) Committee

The Saint John-Fundy Air Resource Management Area (ARMA) Committee has been a valued partner with Environment Canada since its foundation in February 1995. The group consists of members from all walks of life including the provincial government, business leaders and private citizens. The ARMA mandate is to advise the government on its development of an air resource management plan.

The Saint John-Fundy ARMA Committee was consulted throughout the design and development phase of the various products and has demonstrated its willingness to participate in the advancement of the air quality issue.

6.6 Additional Partners

From the design and development of the pilot project, through to implementation and evaluation stages, many agencies and organizations have committed their effort and energy. The realization and subsequent success of this program would not have been possible without National support from Environment Canada. In this respect the Canadian Meteorological Centre (CMC), based in Montreal, provided various tools to the operational staff at the New Brunswick Weather Centre in Fredericton in order to assist meteorologists in performing an air quality analysis, diagnosis and prognosis. Further details of various tools used by operational meteorologists will be presented in Section 11.5. In addition, CMC is responsible for the management

of data and the subsequent archiving of information from the meteorological and air quality observing networks.

The Climate and Atmospheric Research Directorate (CARD) has been heavily involved in recent medical studies helping to improve the understanding of the links between health and air quality. CARD has also been involved in the development of operational tools to assist meteorologists in their assessment of air quality. An elaborate statistical model (CANFIS) was developed to assist the meteorologist in air quality prognostication. The model will be presented in more detail in Section 14.4.1.

Environment Canada has historically enjoyed a strong working relationship with the state of Maine DEP. As previously mentioned, a significant source of air quality degradation is due to long range transport of air pollutants, notably ground level ozone from the Northeastern United States and Great Lakes region. The continual sharing and exchange of information is, and will continue to be, of prime importance for both organizations. Technology has played a major role in the enhancement of communication systems making it easier to obtain the latest air quality readings and smog forecasts for New England. Consultation between Environment Canada and the Maine DEP occurs on a regular basis especially when atmospheric dynamics indicate the potential for deteriorating air quality.

CHAPTER 7

RESULTS AND RECOMMENDATIONS

7.1 General Project Evaluation

The objectives set out in this pilot project were met and in many cases exceeded. Stakeholders participated actively in the project and partnerships turned out to be a key element to that success. Many activities conducted throughout the evaluation period led to greater public awareness of the air quality issue. Public opinion surveys and feedback from various user groups confirm that improved methods of dissemination as well as the availability of information were positively received by all users. In addition, Environment Canada personnel possess the skill, expertise and scientific knowledge necessary to produce a high quality product to meet the needs of the consumer.

The public now has easy access to various air quality information via the Environment Canada Automatic Telephone Answering Device (ATAD). This is seen as a valuable asset where all information is available at one location. The health and education segment of the daily forecast provides the opportunity to enhance their understanding of air quality issues thereby allowing users to coordinate their daily activities.

Expansion of the program in New Brunswick, geographically as well as the range of forecast pollutants, is seen as a necessary and logical step since users have clearly demonstrated the need for enhanced air quality information and education. We must continue to build on partnerships and improved scientific understanding of atmospheric pollution to remain on the cutting edge of this issue. Expansion of the current air quality monitoring network is necessary in order to provide the quality database required by the scientific community. It is desirable that the expansion of the network continue through the strengthening of the existing partnership between Environment Canada and NBDOE. This will permit a natural extension of the smog forecast program to all regions of the province of New Brunswick. Air issue advocacy groups in various parts of the province have indicated their interest in collaborating with existing organizations to provide better air quality information in their particular area. The expansion of this network will allow for the increased smog forecasting expertise necessary for future program development.

7.1.1 Program Delivery

Beginning in July 1997, residents of Southern New Brunswick were presented with a broad range of air quality products ranging from the present status of air quality (IQUA) to forecasts of smog concentrations along with additional information to improve their understanding of the air quality issue. A telephone line was provided to solicit feedback from the general public. The air quality bulletins were also made available through various media including the Internet, radio, television, newsprint and telephone (ATAD).

The design of the bulletin format (refer to section 12.1) was based on input by all stakeholders and from the recommendations of the focus group study (Qualitative Research Air Quality Prediction Program).

With the media being the principal means of delivery, a concerted effort to improve partnerships with them is imperative. This can be accomplished through seasonal seminars, refreshers and soliciting commercial sponsorship for air quality information.

7.1.2 Scientific Limitation

The scientific community has made major progress over the past decade in the general understanding of smog behavior, the interaction of various precursors leading to photochemical reactions and the LRT of pollutants in the atmosphere. Research and development in this field is an ever evolving process and, as such, Environment Canada continues to improve its understanding of atmospheric dynamics and its behavior.

Due to the complexity of the atmosphere and the delicate interactions of its various components, further research is essential. Improved scientific understanding and support to numerical modeling is necessary, taking into account the spatial and temporal variability of smog concentrations and the relationship between smog, smog precursors and meteorological variables. Environment Canada and its various partners should continue to be proactive in this endeavor for the benefit of all Canadians.

7.2 Specific Results and Recommendations

The following provides a comprehensive summary of results and recommendations:

Results

- The pilot project was positively received by the public.
- Environment Canada, and more specifically the staff of the New Brunswick Weather Centre in Fredericton, has demonstrated the necessary scientific skill and expertise required to produce a quality and usable product.

- CANFIS has demonstrated significant skill in forecasting ground level ozone values.
- The development and strengthening of partnerships is a key element to the realization and subsequent success of this project.
- Environment Canada's participation in various activities related to air quality has contributed to an increased public awareness of the issue.

Recommendations

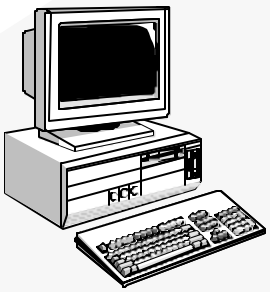
- The pilot project was successful in its goal to have a better informed and knowledgeable population from an air quality perspective; thus a permanent program should be implemented beginning with the 1998 smog season.
- It is recommended that an expansion of the program take place to geographically include a greater portion of the province of New Brunswick. In addition, steps should be taken to increase the range of pollutants included in the forecast.
- The seasonal period of coverage be extended to include the period from May to October inclusive.
- Environment Canada and other agencies must continue to develop their scientific understanding and expertise in atmospheric pollution. This can be accomplished through a continuation of research and development programs in both the public and private sectors.
- Output from various numerical tools such as CANFIS and the Air Quality package produced by the Canadian Meteorological Centre be made an integral part of the forecast process.
- Minimum air quality training standards (preferably National) be established for all operational meteorologists.
- The expansion of the air quality monitoring network is seen as both a logical and a necessary step. It is imperative that scientists have the necessary information at their disposal. Improved access to quality data is essential for the analysis, diagnosis and prognosis of air quality.
- Improved public access to air quality information be encouraged to allow the user to make an informed decision. This can be accomplished in part through efficient use of the technologies currently available.
- Partnerships are seen as a key element to the success of this project and as such should continue to be nourished and developed for the benefit of all parties. Additional partners, for example, the private sector, should be identified and approached for input into the program.
- The public education process regarding the air quality issue is seen as an evolving one. Environment Canada, through its various partnerships, is encouraged to continue this initiative.
- The promotion of air quality products through the media should be enhanced through various exercises contributing to an improvement and understanding of the information available.

CHAPTER 8

PROJECT EVALUATION / VERIFICATION

8.1 Dissemination System Evaluation

Several technologies were used to maximize the overall dissemination of air quality information. The use of each of these technologies provided the user with free access to the various air quality products.



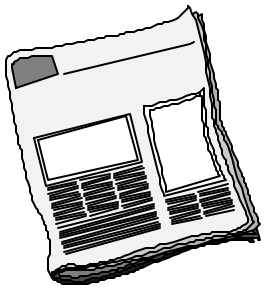
8.1.1 Regional Air Quality Internet Web Site

The regional air quality Internet web page was developed by Environment Canada. Feedback from the various users to this initiative has been positive since this newer type of technology has allowed for both easier and alternate access to the latest air quality information. Although this type of delivery vehicle proved to be highly dependable, occasional technical difficulties demanded the attention of meteorologists resulting in several short periods of inaccessibility.

8.1.2 Automatic Telephone Answering Device (ATAD)

The smog forecast as well as the IQUA bulletin were continually available and updated several times per day in both official languages on the Environment Canada ATAD located in Saint John. The convenience and flexibility afforded the client by this mode of delivery proved popular and was well received. With the automation of this process, it is anticipated that more frequent updates to air quality observations will be made available during the upcoming smog season.

No major technical problems were encountered with the ATAD system; however, IQUA bulletins were removed at the discretion of the meteorologist when updates were not available from NBDOE.



8.1.3 Mass Media (Radio, Television, Newspaper)

The smog forecast and IQUA index were widely distributed by all media. Radio has proved to be the most popular means of delivery to the general population due to its mass dissemination potential.

The mass media regularly used and disseminated the information however some outlets tended to be more diligent than others (refer to Appendix V, CCCA).

8.2 Client Evaluation

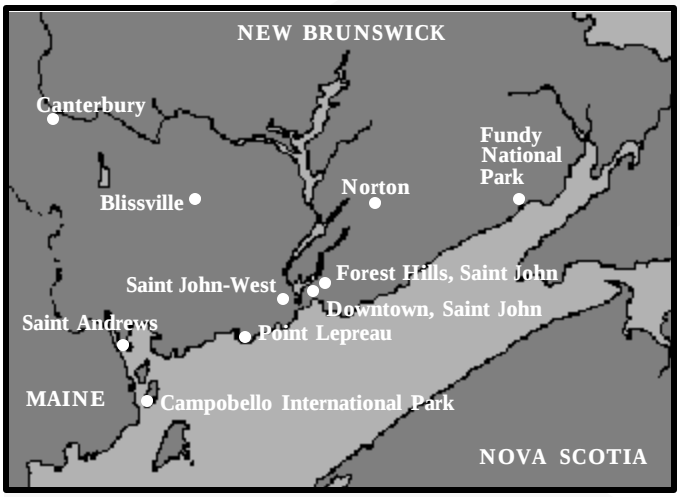
A public opinion survey was conducted in the pilot project area in late November to evaluate the effectiveness of the project. The following presents the highlights of the findings and a complete report of the survey is available on request (Evaluation of the Air Quality Prediction Program - Greater Saint John).

- Smog is considered by the majority of residents to be a serious hazard to the health of people in the area, resulting in problems related to respiratory illness such as asthma or lung disease.
- Residents are most likely to recall seeing or hearing the smog forecast on the radio or television.
- Smog is considered by the majority of residents to be a serious hazard to health. Primary sources of smog forecast information were considered by the majority of area residents to be reliable at least most of the time.
- Two-thirds of area residents are of the opinion that it is at least “somewhat” important they hear smog forecasts when they are issued.
- Area residents are generally satisfied with the ease of getting and understanding the smog forecast for their area as well as the type and accuracy of the information provided.
- The majority of area residents are of the opinion that the smog forecast program should be extended.

CHAPTER **9**

IQUA TO AQPP

9.1 History



Southern New Brunswick Ground Level Ozone Air Quality monitoring network.

The air quality monitoring program in New Brunswick began in July 1961, with the implementation of three monitoring stations in the Saint John area. The network has since expanded to include ten stations equipped with various instrumentation to measure specific pollutants.

In 1979, the province of New Brunswick, through NBDOE, became the first province to implement IQUA. The index has since been adopted by other jurisdictions across the country.

9.2 The Air Quality Index (IQUA)

The IQUA was originally developed by a subcommittee of the Federal-Provincial Advisory Committee of Air Quality in the late 1970's. The goal of the IQUA system is to provide public information on the adverse effects of the five common air pollutants, sulfur dioxide (SO_2), carbon monoxide (CO), nitrogen dioxide (NO_2), ground level ozone (O_2) and coefficient of haze (COH). The philosophy of the index is to produce a simple, useful index that does not underestimate the complexity of the subject. The index identifies the worst effect that may be caused by the mixture of pollutants being measured and is designed to describe the prevailing air quality. The IQUA is categorized according to the National Objectives of desirable, acceptable and tolerable concentrations of each pollutant. For increased understanding these standards have been respectively translated into the categories of good, fair, poor and very poor air quality.

9.3 IQUA Sub-Index Related to Ozone

The selection of the Greater Saint John region for the pilot project was a logical one, considering the fact that NBDOE was the pioneer in adopting the IQUA system, that a Smog Advisory Program had been implemented in New Brunswick since 1993 and that the New Brunswick Weather Centre had developed expertise in forecasting smog in previous years.

The Smog Pilot Project was focused towards forecasting ground level ozone concentrations. The graph in Annex II shows the typical threshold values for the various concentrations of ozone. A similar sub-index applies for each pollutant.

Since the general population was already familiar with the IQUA system, it was decided to use the IQUA Sub-Index related to ozone during the pilot project to take advantage of the existing public level of comprehension. Ozone concentration reports and forecasts were translated into an air quality index which was more suitable to the general public. Throughout the project evaluation period, initiatives from various stakeholders contributed to enhance the public understanding of the IQUA categories and associated health effects.

CHAPTER 10

PROMOTION AND AWARENESS

Various public awareness activities were led by several organizations during the evaluation period. Environment Canada was supportive of these initiatives whose objectives were to raise the profile of the air quality issue.

10.1 Focus Group Study

A focus group study took place in Saint John during the spring of 1997 (Qualitative Research Air Quality Prediction Program). The objectives of the study were:

- To determine the level of public awareness of air quality in their community, including their understanding of health concerns, pollution levels and the functionality and effectiveness of the current air quality program.
- To test a format for the new proposed smog forecast.
- To determine the attitude of the population towards the current air quality program and its effectiveness in meeting public needs.
- To determine the public need for additional air quality information, in particular, air quality prediction.
- To determine the public attitude towards proposed formats and names for the new air quality product.
- To determine the public attitude towards new information on the health effects of smog at levels below the current National threshold.

The study was sub-contracted to Corporate Research Associates Inc. of Saint John and supervised from the Regional Communications Branch in Dartmouth, Nova Scotia. Funding for this survey was provided by Environment Canada, with discussion and consultation between the AEB Communication branches in both Downsview, Ontario and Dartmouth as well as the New Brunswick Weather Centre in Fredericton. The ultimate goal of this study was to contribute to the overall development of a new forecast product which would be easily understood by Canadians and assist in the enhancement of the general health of the population.

The following is a list of conclusions that were drawn out of the focus group:

- Residents in the Greater Saint John area felt poorly informed about air quality. They cite a lack of readily obtainable information but, at the same time, appear to be unaware of such information that currently exists.
- Of the environmental information currently available, IQUA, UV rating and smog advisory appear most familiar to Greater Saint John area residents.
- The AQPP forecast and IQUA bulletin were seen as desirable and valuable information resources; however, a comprehensive introductory program would be necessary to explain the forecasting concept and particularly to facilitate understanding and use of the Air Quality Forecast index and its scale.
- The AQPP forecast and its format were positively received; however, delivery of the information should be presented in a clear and precise manner.
- Scientific terminology should be limited as much as possible in the bulletin and if used, be defined. Likewise, acronyms should be avoided if not eliminated entirely.
- The education/health messages were found to be an important element of the bulletin. Participants suggested messages must be informative, brief and simple, and that to appeal to a wider group of listeners, a variety of messages be used.

The recommendations from the focus group study were:

- To develop a strong educational process to introduce and explain the air quality prediction program.
- To introduce an air quality forecast telephone line or broaden the existing IQUA report line to provide specific forecast information.

Results and recommendations from the focus group study were considered throughout the development and design of the smog bulletin format.

10.2 Media Conference

On May 22 1997, the NBDOE hosted a news conference and technical briefing in Saint John regarding the IQUA. The purpose of the event was to describe the IQUA and its improvements and impact on the general population. One of the key elements of the event was the fact that the IQUA would be updated on a more regular basis and be made available through the Environment Canada ATAD in Saint John. As of that date, the NBDOE began recording the IQUA message on the Saint John ATAD; this is considered a major improvement in service. The ATAD includes five (5) lines, offers the

Smog Logo courtesy of Environment Canada Atlantic Region Communications Branch.

choice of both official languages, is menu driven and offers an array of air quality information in addition to the regular weather information. The availability of the IQUA on the ATAD provides one stop shopping where the user has access to the latest air quality index, a static message providing a general description of IQUA (refer to Annex III), and a daily smog forecast (refer to Annex IV). Plans are progressing to fully automate the IQUA in such a way that the index can be updated and loaded through the automated voice system (AVIPADS).

10.3 Launch Event

The official launch of the daily smog forecast took place in Saint John on July 16, 1997. Full media coverage was afforded to the new project over the initial few days of the project in both the Maritime provinces and Quebec. This was driven by interest and concern from both the general public and the local media.

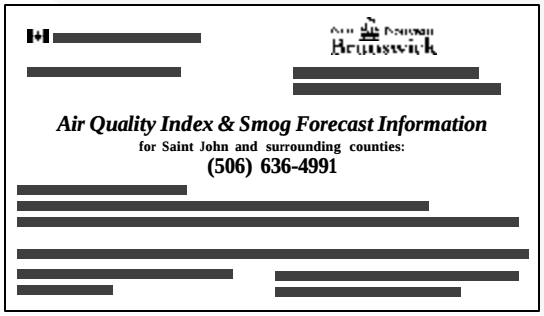
10.4 Ministerial Visit

Minister of the Environment, the Honorable Christine Stewart (centre) and Saint John CCCA stakeholders Judy LeBlanc and Gordon Dalzell.

Several activities and events revolving around the air quality issue took place in the Greater Saint John area throughout the summer. All were aimed at promoting the use of various air quality products while increasing the awareness of the air quality issue. Included among these activities was a visit by the Minister of the Environment, the Honorable Christine Stewart in mid-August.

10.5 Others

New fact sheets were developed by Environment Canada and NBLA in view of recent medical studies and scientific research into smog behavior. One of the issues identified in the focus group study was a need to provide better direction on accessing air quality information. To accomplish this, a promotional card was developed in the form of business cards and magnets**.** This card provided direction on how to access various air quality products through both telephone and Internet. The cards were distributed at various locations including drug stores, schools, ecetera. Another promotional item was a "smog poster" which provided information similar to the promotional card. The poster was displayed on the Saint John Transit bus fleet for a period of several weeks.



Promotional Business Card

CHAPTER 11

FORECAST PRODUCTION

11.1 Introduction

The occurrence of elevated smog concentrations in the Southern New Brunswick region is dependent on many factors, including local production due to photochemical reactions and local and regional meteorological conditions. The LRT of pollutants is a very significant component of smog concentrations in Southern New Brunswick, and has been estimated to contribute as much as 85 percent of the smog during episodes. Meteorologists thus require a solid understanding not only of local meteorological, formation and deposition mechanisms, but of the past and current weather in the upstream areas since this is crucial to the forecasting process. Pattern recognition, synoptic set-up which leads to high smog concentrations, and an appreciation for the climatology associated with elevated smog concentrations, all contribute to forecast production.

11.2 Smog Climatology

Elevated smog concentrations are episodic and most prevalent during the summer months (see figure 1) when meteorological factors are most favorable for both smog formation and transportation into the region. This transport component has been studied through back-trajectory analysis (Dann and Peters, 1997) and points to the heavily populated Northeastern United States and the Windsor-Montreal corridor as the major source regions. Although the seasonally averaged smog concentrations show smooth diurnal ozone patterns, sites in the Southern New Brunswick region are strongly affected by LRT of ozone and its precursors, with mixing ratios of 100 ppbv or more having occurred. Climatological studies conducted by Environment Canada staff at the Atmospheric Science Division (ASD) of Environment Canada in Bedford, Nova Scotia, (Tordon, 1995), show the occurrence of elevated smog concentrations in the overnight period when there is no local photochemistry, which indicates the significance

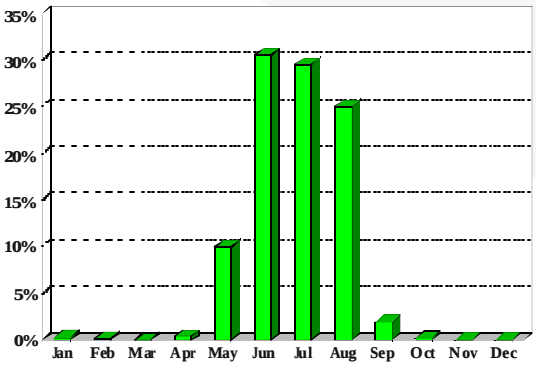


Figure 1: Percentage of ozone exceedances by month of year. Includes all data from Maritimes sites, for the period 1980-1994. (Tordon et al)

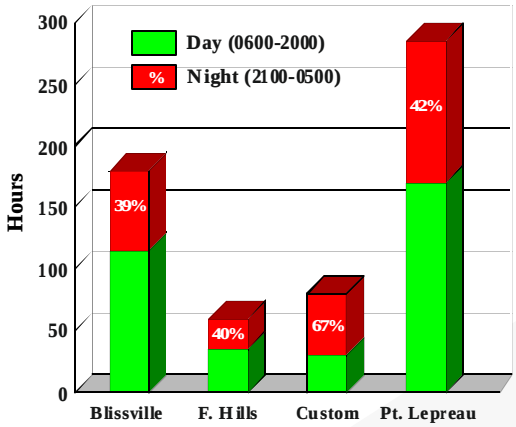


Figure 2: Percentages of night time exceedances at selected NB sites. Number of night exceedances expressed as a percentage of total hours of exceedances at each site. Data for May -Sep 1987-1994. Time is local time. (Tordon et al)

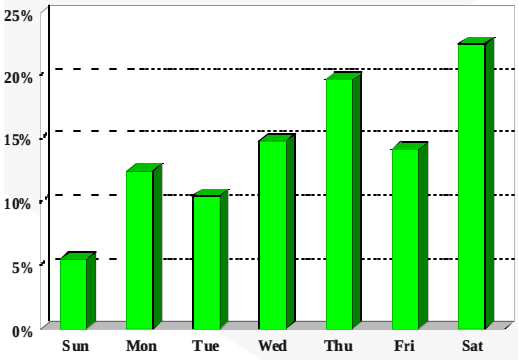


Figure 3: Percentage of ozone exceedances by day of the week. Includes all data from Maritimes sites for the period 1980-1994. (Tordon et al)

of the LRT component. (see figure 2). Meteorologists also benefit from the knowledge of a greater likelihood of high smog concentrations at the end of the week (see figure 3).

The location of the monitor and local topography also play a significant role in the understanding of smog behavior. Much of the evaluation area lies at the southern end of the Saint John River Valley and is bordered to the south by the Bay of Fundy; therefore, local inversions, both in the valley and over the marine areas, play a significant role in the overall air quality.

A contrast is evident in the climatology between the coastal monitoring sites, which are affected by the marine boundary layers and sea breeze regimes, the urban sites where local scavenging by nitric oxide (NO) is significant and the rural sites which have a "typical" diurnal trend of a distinct overnight minimum and an afternoon or early evening maximum.

11.3 Pattern Recognition

Upwind emission sources play such an important role in the resulting air quality in Atlantic Canada that the atmospheric conditions over the emission areas must be considered before deciding if there is a potential for elevated smog concentrations in the Saint John area. Weather patterns which allow for strong photochemistry and precursor build-up, along with a favorable synoptic pattern which pushes the formed ozone and precursors into the Southern Atlantic region, are signatures of elevated smog concentrations.

11.4 Synoptic Set-Up

An appropriate pattern for elevated ozone concentrations involves a high pressure area with strong ridging in the middle atmosphere over the emission regions of the Northeastern United States and Southern Ontario. This pattern would include:

- strong photochemistry
- a temperature inversion to minimize vertical mixing
- maximum temperatures in the upper 20 degrees celsius
- light winds
- a lack of precipitation to minimize "washout"

These conditions must persist for a minimum of two days to allow for sufficient smog formation and build-up. In addition, a low pressure system or frontal trough over the Great Lakes and the Saint Lawrence River Valley would provide the necessary southwesterly flow which would push ozone and its precursors towards the Southern Atlantic region. (See figure 4). Appropriate weather conditions are required over the receptor area including:

- atmospheric circulation from source regions
- insolation to aid local smog production
- breakdown of the inversion to permit mixing of precursors down to the surface

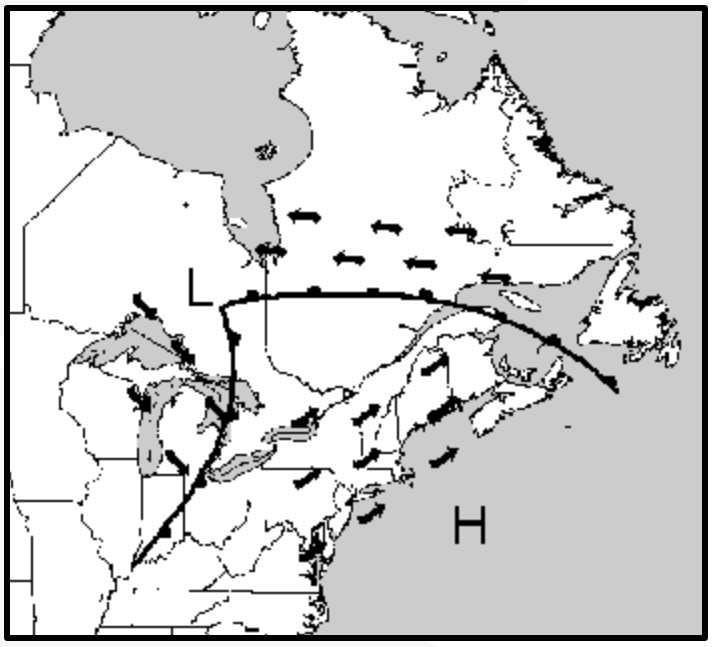


Figure 4: "Typical" weather map showing positions of high and low pressure areas during periods of high smog concentrations in the southern NB region. Arrows indicate the predominate wind-flow directions.

A westerly circulation from the industrial northeast can result in a buildup of pollutants in the "reservoir" over the Gulf of Maine. Subsequent sea breeze and synoptic southwesterly flows can advect these pollutants onshore at the coastal sites even in foggy conditions. Generally, for inland sites, sunny conditions and temperatures in the mid to upper twenties celsius support elevated smog concentrations.

11.5 Tools and Support

The following is a listing of the bulletins and computer model output which were an integral part of the forecasting process:

- Smog Bulletins from Ontario, Prince Edward Island, New Brunswick and Nova Scotia
- Maine DEP bulletins and forecast discussions Computer guidance
- Global Environmental Model (GEM)
- Air Quality package (including mixing layer heights, streamlines, winds at specified levels, wind mileage and ventilation coefficients)
- Other numerical guidance
- Weather Analysis and Display System (WADS) for prognosis of inversions and velocity fields, etc.
- Back-trajectories for nine sites in the Atlantic region
- Classification and Regression Tree Adaptive Neuro Fuzzy Inference System (CANFIS) (Burrows et al., 1996). For further details see section 14.4.1

This support was available from CMC, Meteorological Research Branch (MRB) and Maine DEP.

11.6 Procedures

The meteorologist initiates an assessment of the various factors which affect smog concentrations by integrating meteorological and air quality information within a conceptual understanding of smog behavior. Following the evaluation of current conditions and identifying the various factors responsible, a daily forecast of smog was produced for the Southern New Brunswick region.

A one value forecast is considered to be representative of the regional smog concentration in the Southern New Brunswick area. This value was then verified against the average of the top three stations within the area. In addition when smog concentrations were expected to exceed 80 ppbv, the NBDOE and NBHCS were contacted for consultation and consensus before an advisory bulletin was issued.

Dissemination methods are discussed in detail in section 12.2.

CHAPTER 12

SMOG FORECAST CONTENT AND DISSEMINATION

The format of the smog forecast bulletin was developed in consultation with all stakeholders. Although Environment Canada and the NBDOE were tasked with data assimilation and forecast production, all partners participated actively in the development and presentation of the product.

The forecast was issued twice daily at 5:00 AM and 4:00 PM. The morning bulletin provided information for the current day with an outlook for day two while the late afternoon issue covered the tonight period and day two.

The bulletin was made available to all media outlets through the Environment Canada telecommunication network. The forecast and other air quality related information were also available on the Saint John ATAD and the Environment Canada Regional Web Site.

12.1 Bulletin Content

12.1.1 Acknowledgment of Partnership(s)

In addition to the principal components of the smog bulletin (refer to Annex IV), the header also acknowledged the contribution of the principal partners involved in its production, Environment Canada and NBDOE.

12.1.2 Regional Forecast

The bulletin consisted of a regional smog forecast similar in format to other bulletins issued by AEB. The principal objective of this product was to provide information on the expected evolution of the smog index for a period up to forty-two hours in the Greater Saint John region. Various tools and scientific knowledge were integrated to produce a single numerical forecast value (sub-IQUA) and a categorical value for day one. A categorical value was also issued for the outlook period (day two).

A general synopsis followed the forecast section relating the expected air quality conditions to atmospheric variables. This section presented the meteorologist with the opportunity to explain in plain language the correlation between the atmospheric conditions and the anticipated smog index. The bulletin also provided specific information for accessing the latest air quality reports through the Saint John ATAD. A public telephone line was installed to provide general feedback, comments and concerns regarding the forecast.

12.1.3 Health and Education Messages

One of the principal objectives of the pilot project was to build an environmental prediction capacity within Environment Canada to meet the evolving needs of Canadians. Information gained from recent medical studies related to smog exposure as well as a need for additional public education on air quality were also taken into account. These objectives were nourished through the inclusion of a health and education segment.

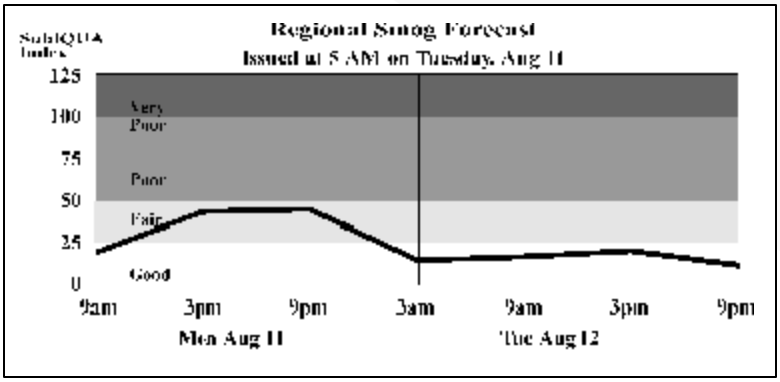
A suite of six education and five health messages were designed to inform and increase the public awareness of the air quality issue. This section of the bulletin provided enhanced public information on the health effects related to ozone exposure. The messages were selected by the meteorologist on a rotational basis depending on the specific synoptic situation (refer to Annex V).

12.2 Air Quality Information Access

Several technologies were made available to maximize dissemination of the air quality information. The use of each of these technologies provided the user with free access to the various air quality products.

12.2.1 Internet

The Regional Air Quality Web Site, which can be accessed through the Atlantic Region Green Lane site **(http://www.ns.ec.gc.ca)**, was developed to serve two basic purposes; first, to widen the presentation and public exposure of the daily smog forecast and air quality products, and second, to produce a user friendly graphical display of air quality information. In addition, the fully worded smog forecast is located directly below the graphical representation. Links



Internet graphical display of the daily smog forecast.

to associated sites are also included at the bottom of the page. These links include access to the IQUA index, which is provided by NBDOE, and relays both the IQUA number as well as a descriptor for the eight monitoring stations in Southern New Brunswick. Access is also provided to NBHCS and NBLA, who both provide background information on air quality and associated health issues.

12.2.2 ATAD

The smog forecast, as well as the IQUA bulletin, are loaded several times per day on the Environment Canada ATAD located in Saint John. The French language versions are remotely loaded from the New Brunswick Weather Centre of Environment Canada in Fredericton whereas the English versions are loaded by NBDOE staff in Saint John. Upon accessing the ATAD, the public is provided with a menu offering a number of choices including the latest smog forecast and/or IQUA index. In addition, a static message is available which provides general information regarding the various measured pollutants as well as the specific categories of the air quality index (see Annex III). The IQUA bulletin is currently being loaded using interfaced digitized data. This permits automatic loading of the aforementioned data into a voice generated message using Environment Canada's AVIPADS system. These messages are then loaded on the Saint John ATAD to be accessed by the various users.

12.2.3 Mass Media

The smog forecast was available to the local media via various news services such as the Canadian Press which permitted the broadcasting or printing of the product. The primary delivery mode was via the various radio, television and print media outlets (refer to Appendix, CCCA).

CHAPTER 13

TRAINING

The ability to maintain as well as enhance the scientific integrity of the product is central to any training thrust. Although some local expertise in air quality prediction had previously been developed by Environment Canada through the Smog Advisory Program over the past several years, additional training needed to be made available to all New Brunswick Weather Centre operational forecast staff. The goal was to build upon existing expertise by developing, incorporating and testing new tools and procedures. In addition, it was felt that any training should include a non-technical component which would be beneficial to our partners. Their ability to understand all aspects of development and implementation of the product through the educational process helped to strengthen the relationships between the various stakeholders. Several key training thrusts were initiated to achieve our objectives and are discussed below.

13.1 Operational Workshop

An AQPP one day workshop, developed by New Brunswick Weather Centre in conjunction with CARD and ASD, was held in early May 1997. All operational staff of New Brunswick Weather Centre received a full day information/training session. The workshop was also made available and attended by staff and individuals from various partners and interest groups. Among the topics presented were:

- Introduction to the Smog Prediction Pilot Project in Southern New Brunswick
- Presentation of the CANFIS statistical model
- Update on the climatology of Ozone in the Atlantic region
- Refresher on Ozone formation/characteristics and atmospheric transport
- Presentation on IQUA
- Air Quality monitoring network in New Brunswick
- Forecasting tools
- Case study

13.2 Canadian Institute for Research in Atmospheric Chemistry (CIRAC) and Others:

Additional training was provided from funding identified by the National Learning Fund. The goal was to increase the scientific capability within the region in air quality issues and to position Environment Canada to respond to the air quality needs of Atlantic Canadians.

Four staff members from the Atlantic region (two meteorologists from both the New Brunswick and Maritimes Weather Centres) attended an intense one week training course in Toronto on atmospheric chemistry. The course was administered and presented through CIRAC and York University of Toronto. This course was seen as a necessary and worthwhile endeavor and greatly enhanced the background knowledge of air quality science of the participants. Among the topics included were:

- Global atmospheric change
- Sources of gases to the atmosphere (natural and anthropogenic)
- Emission inventories and models
- Atmospheric transformations
- Toxic chemicals and aerosols

A one-day workshop in atmospheric chemistry is planned for April 1998 in Fredericton for New Brunswick Weather Centre operational staff and interested stakeholders. This workshop will highlight the topics presented at the CIRAC course as well as additional associated material.

CHAPTER 14

TECHNICAL EVALUATION AND VERIFICATION

14.1 Forecasting Smog Concentrations in Southern New Brunswick

The New Brunswick Weather Centre, at the request of NBDOE, began producing an internal forecast of smog concentration in 1995 (refer to Annex I). This bulletin provided the following information for day one; the expected ground level ozone concentration, mixing height, regional wind velocities and other environmental variables. This product was then distributed on a daily basis to identified stakeholders. Since its inception, the internal bulletin has continued to gain considerable attention due to its success. This product was continued during the pilot project and was seen to complement the public daily smog forecast.

14.2 Forecast Verification

Over the years, the Atlantic Region of Environment Canada, through the Smog Advisory Program, has produced warnings to advise the public when ground level ozone concentrations were expected to reach or exceed the National objectives. Ozone episodes are defined as a minimum of three air quality observing stations with concentrations in excess of 80 ppbv for a duration of at least three hours. Similar criteria were used to verify ozone forecast accuracy in 1995 and 1996. Following discussions with the principal partners, it was also agreed that the average concentration of the three stations reporting the highest hourly concentration be representative of the regional air quality status for the evaluation area. This standard was used for the Smog Prediction Pilot Project.

Eight air quality monitoring stations are located within the affected area, allowing for the analysis of marine, urban and rural environments. Real time observations were not always available for all stations due to technical difficulties. However, the entire data set was archived and was included for verification purposes.

Although the official launch of the pilot project took place in July 1997, the New Brunswick Weather Centre began issuing the internal bulletin on May 20th. The information contained in the internal product was more technical in its presentation than that presented in the public bulletin. The ozone forecast data from the internal bulletin were thus used for verification purposes.

14.3 Verification Skills

The graph, shown in figure 5, illustrates the general results for the evaluation period.

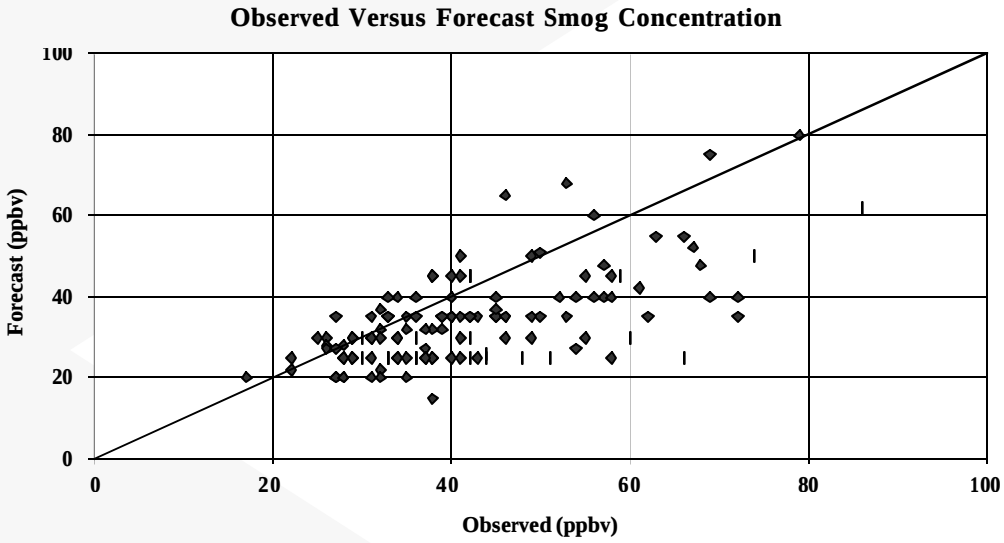


Figure 5: Graph representing observed versus forecast smog concentration (seasonal).

The observed values along the X axis represent the average of the daily maximum of the three stations reporting the highest hourly concentration. The daily maximum forecast value is plotted along the Y axis. A point lying close to the median value represents a more accurate forecast while increased distance from the median identifies less accuracy. The table shows two main regions of interest. The first cluster with observed concentrations less than 50 ppbv has a denser population and the data points are closer to the median. The second cluster with observed concentrations greater than 50 ppbv is sparsely populated and has a much wider distribution. It can be seen in figure 6 that the average observed value for the season is 42 ppbv compared to a forecast average of 34 ppbv.

	Average Observation (ppbv)	Average Forecast (ppbv)	Standard Deviation (ppbv)
Good Cat.	36	31	8
Fair Cat.	61	44	14
Season	42	34	13

Figure 6: Summary table of forecast accuracy.

These numbers suggest that there was a tendency to under forecast smog concentrations by an average of 8 ppbv. The standard deviation for the forecast evaluation period is approximately 13 ppbv.

The verification scores have also been divided into the various air quality categories. Figure 7 presents the graph for the good category (observed concentrations from 0 to 50 ppbv verified against the forecast values).

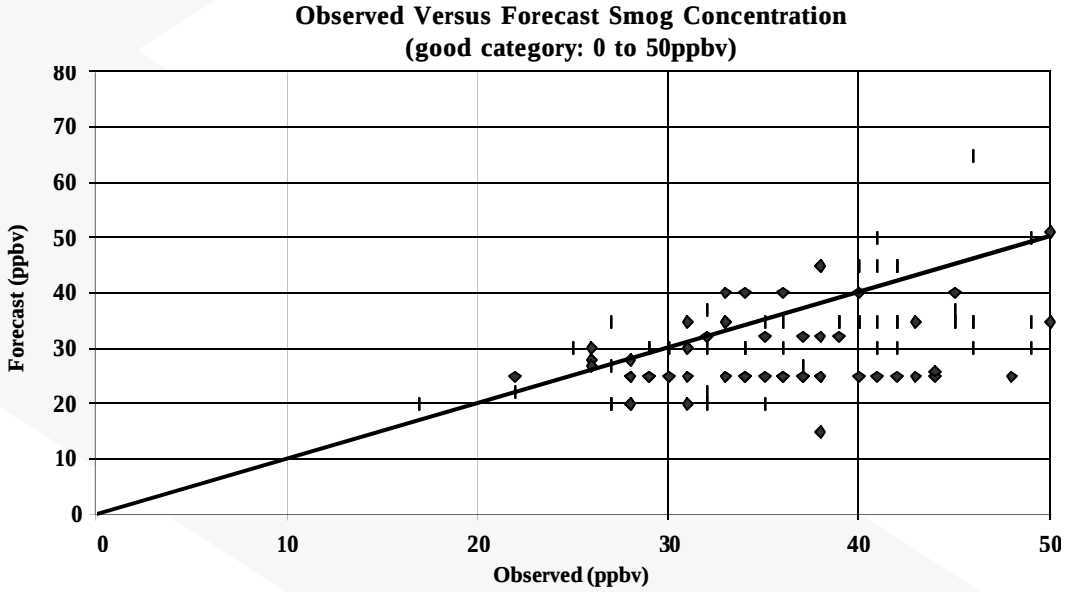


Figure 7: Graph representing observed versus forecast smog concentration in the "good" air quality category.

It can be seen that the data population was centered somewhat closer to the median relative to the seasonal graph. The difference between the average observed and forecast values was less than 5 ppbv with a standard deviation of 8 ppbv. This suggests that greater forecast accuracy is achieved as values migrate towards the climatological mean.

Figure 8 presents the graph for the fair category (observed concentrations from 51 to 80 ppbv verified against the forecast values).

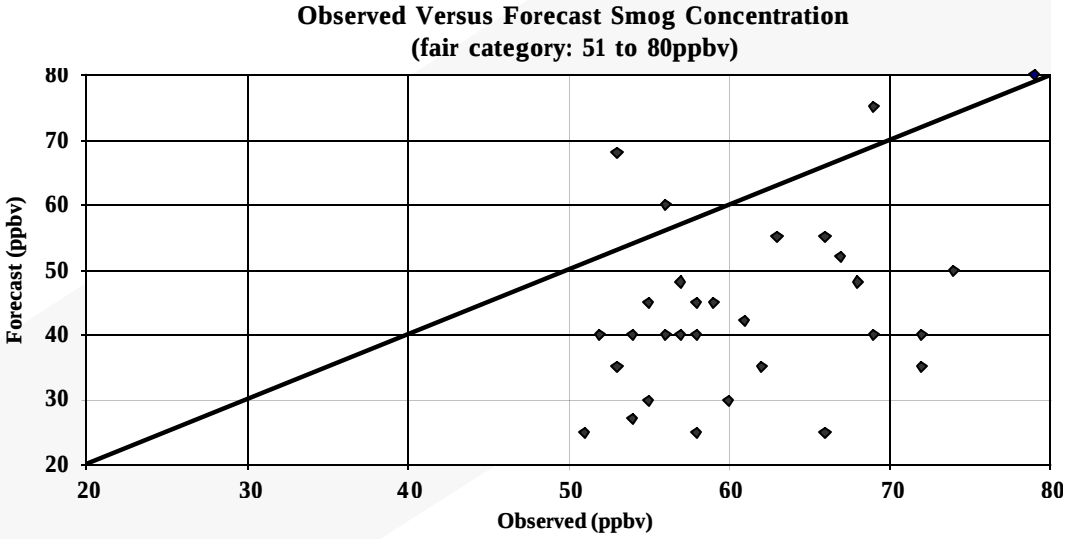


Figure 8: Graph representing observed versus forecast smog concentration in the "fair" air quality category.

The data population is limited and the distribution more scattered around the median. The difference between the average observed and forecast values was 18 ppbv with a standard deviation of 14 ppbv.

These numbers support the general trend of under forecasting ground level ozone concentration.

14.4 CANFIS Verification

14.4.1 Description

The **C**ART (Classification and Regression Tree) **A**daptive **N**euro **F**uzzy **I**nference **S**ystem (CANFIS) was developed by the Meteorological Research Branch (MRB) of Environment Canada (Burrows et al, 1996). It is a statistical modeling methodology combined with numerical weather model output. This model provides the following advantages:

- low-cost solution to the forecast problem
- good trade-off between significance and precision
- good fit between the body and tail of the predictand (the variable being predicted) distribution
- can predict extreme events

- produces a single valued answer when given a predictor (a variable used to determine what is being predicted).
- input values and response are continuous
- updateable

One disadvantage of CANFIS is that it should not be used to predict values outside of the extreme contained in the learning database. This limitation becomes less relevant with increased database size. Another disadvantage is that sufficient data base volume is required to build the model. As such it is not capable of direct prediction for sites which have a lack of archived observations.

The principal predictors for the Atlantic region are:

- previous day's observed ozone value
- 850-1000 millibars (mb) potential temperature difference
- presence of haze
- maximum temperature

Forecast values were produced during the pilot project and output was available for evaluation by the meteorologists.

CANFIS was designed to generate output values of hourly maximum smog concentrations during a twenty-four hour period along with a maximum three hour average and a maximum six hour average. For the purposes of this evaluation, only the output values of the twenty-four hour maximum smog concentrations were verified at the following six stations:
Saint John Customs, Saint John Forest Hills, Point Lepreau, Blissville, Norton and Fundy Park.

14.4.2 Verification Results

Verification of CANFIS output included the period from July 8 to September 30, 1997 inclusive. Data prior to July 8 were considered as unreliable.

Comparison was made between the average of three stations reporting the highest concentrations for both the CANFIS forecast and the observed value (referred to as the TOP3). The following results have been identified from the CANFIS verification:

- Predicted the proper range (10 ppbv) forty percent of the time.
- Greatest reliability in predicting the 21-30 ppbv range.

- Over-forecast of the 41-50 ppbv range and under-forecast the 51-60 ppbv range.
- Low skill in predicting extreme values.

The graph, shown in figure 9, illustrates the general results for the evaluation period.

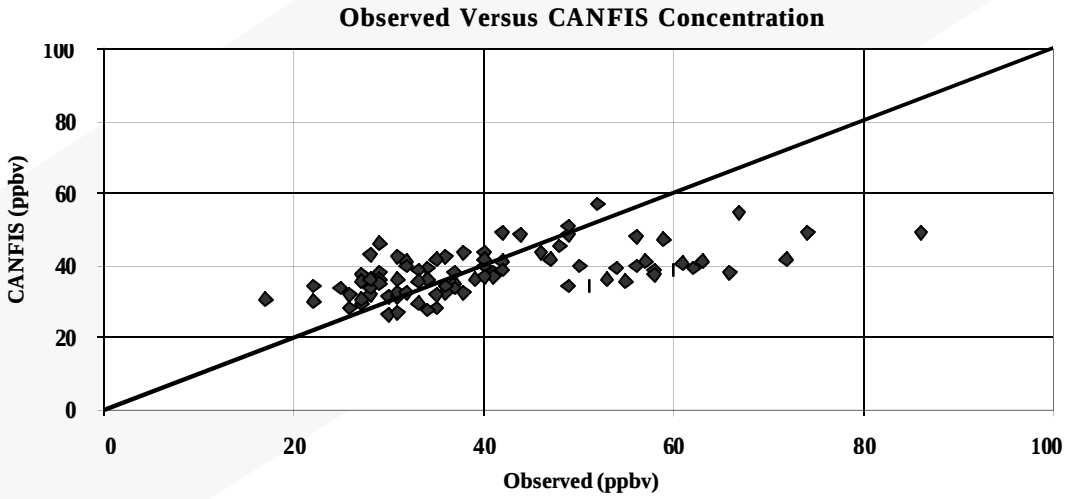


Figure 9: Graph representing observed versus CANFIS forecast smog concentration (seasonal).

The observed seasonal values along the X axis represent the average of the daily maximum of the three stations reporting the highest hourly concentration. The daily maximum CANFIS forecast value is plotted along the Y axis. The graph shows data convergence towards the median as the ground level ozone concentration approaches the climatological mean. Figure 10 shows that the average observed value for the season is 41 ppbv compared to a forecast average of 38 ppbv.

	Average Observation (ppbv)	Average Forecast (ppbv)	Standard Deviation (ppbv)
Good Cat.	35	37	7
Fair Cat.	62	42	12
Season	41	38	11

Figure 10: Summary table of CANFIS forecast accuracy.

Comparison of the CANFIS and New Brunswick Weather Centre forecast values reflect the same trend, that of under-forecasting smog concentrations. The standard deviation for the CANFIS forecast was approximately 11 ppbv.

Again the verification scores have been divided into the various air quality categories. Figures 11 and 12 present the graphs for the good and fair categories.

Similar to the New Brunswick Weather Centre forecasts, CANFIS indicates increased skill as values approach the climatological mean.

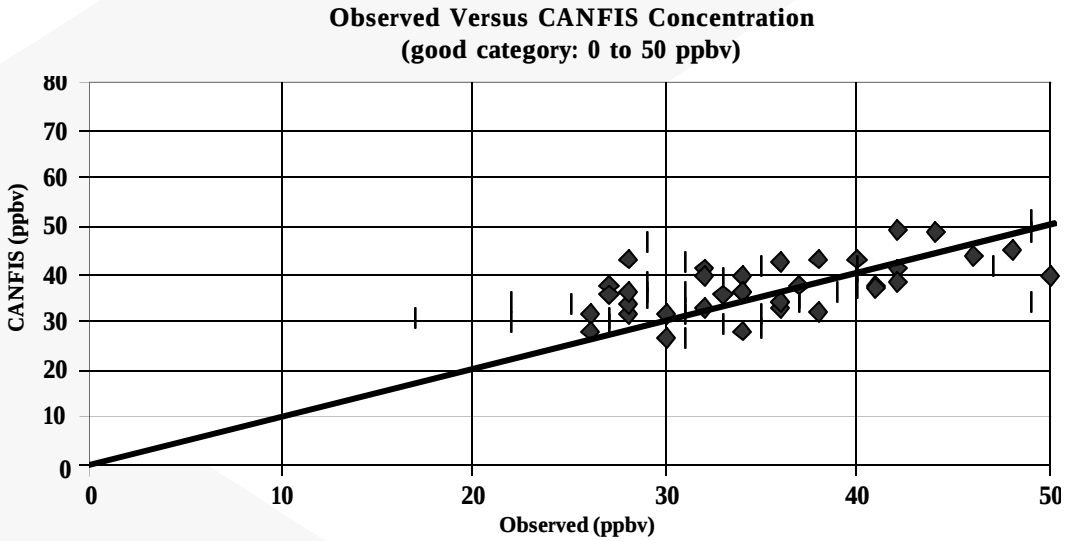


Figure 11: Graph representing observed versus CANFIS forecast smog concentration in the "good" air quality category.

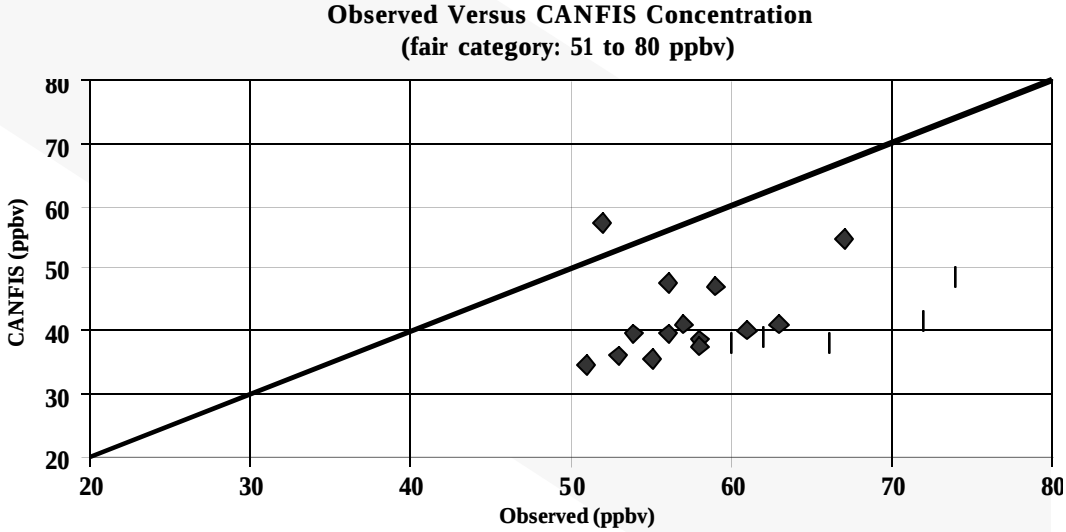


Figure 12: Graph representing observed versus CANFIS forecast smog concentration in the "fair" air quality category.

14.5 Conclusion

Verification results show that Environment Canada meteorologists have exhibited skill in forecasting daily concentrations of ground level ozone. Accuracy is shown to be greater in the lower categories as values approach climatological averages and air quality is said to be good. As observed concentration values depart from the climatological mean, forecasts show a slight deterioration in accuracy.

The CANFIS results indicate a similar trend, although it should be recognized that the CANFIS verification data set was much smaller in size than that used for the meteorologist forecast product verification.

Due to technical difficulties, the CANFIS output was not readily available during the evaluation period for use by the meteorologist. Therefore, the verification results of CANFIS and the forecast product should be taken independently.

It is likely that integration of the meteorologist's expertise, CANFIS output and other numerical tools such as the CMC Air Quality package will result in improved forecast accuracy. Furthermore, an increased understanding of smog behavior combined with CANFIS model improvements due to an increased learning database, will lead to improved forecast skill.

APPENDICES

Endorsement Letters from Various Stakeholders.

I New Brunswick Department of Environment (NBDOE)

II New Brunswick Health and Community Services (NBHCS)

III New Brunswick Lung Association (NBLA)

IV Saint John-Fundy Air Resources Management Area (ARMA) Committee

V Saint John-Citizens Coalition for Clean Air (CCCA)

Appendix I

New Brunswick Department of Environment (NBDOE)

Environment L'Environnement

New Nouveau Brunswick

Réal Daigle
Manager
New Brunswick Weather Centre
Atmospheric Environment Branch
Frederick Square
77 Westmorland St., Suite 400
Fredericton
New Brunswick
E3B 6Z3

January 19, 1998 File 6125-S1-5

Dear Réal,

Subject: Air Quality Prediction Program Pilot Project in New Brunswick, Summer 1997

The Air Quality Prediction Program (AQPP) pilot effort during the summer of 1997 was by all accounts a successful joint endeavour by our two Departments. I understand that your office is conducting a review and analysis of the program, with assistance from other Environment Canada staff. That is certainly good news: we shall await the results with interest. In particular, the results of the survey of public awareness and attitudes will be very useful as we consider how to enhance the program in future.

The AQPP is certainly a good example of a resource-sharing exercise, where both the public and ultimately the environment stand to benefit. By pooling our expertise and information, we were able to provide a new air quality information service to the public, as well as distribute a range of environmental messages. Following the conclusion of the pilot, our respective staff members have continued to collaborate on new ways in which to deliver air quality index details to the public. The computerised voice message system is a definite bonus, and is another concrete example of what we can achieve by working closely together.

We look forward to a continuation of this collaboration, both to improve upon existing work and to develop new programs.

Sincerely,

J.F.L. Knight
Director, Environmental Quality Branch

Appendix II

New Brunswick Health and Community Services (NBHCS)

Health and Community Services **Santé et Services communautaires**

New Nouveau Brunswick

Public Health Services
Health & Community Services
P.O. Box 93
Saint John, NB
E2L 3X1
Telephone: 506-658-3022
Fax: 506-658-3067

January 16, 1998

Mr. Real Daigle, Manager
New Brunswick Weather Centre
Atmospheric Environment Branch
77 Westmorland St., Suite 400
Fredericton, NB
E3B 6Z3

Dear Mr. Daigle:
I would like to present you a few of my impressions of the Environment Canada Air Quality Prediction Program (AQPP).

Last summer was a very good season when considering ozone. To the best of my knowledge, we didn't have any actual "episodes" and only had one instance where an episode was predicted by the AQPP. I also received very little public or media interest regarding air quality issues, other than related to the availability of information such as through the AQPP and the New Brunswick Department of Environment. I find it therefore difficult to judge what the public reaction has been. However, I could take the relative public quiet to mean that they are getting enough information now through the radio, the telephone messages, and the Internet site.

Personally, I find the AQPP to be very effective as it helps me to plan for possible upcoming episodes. I especially appreciate the e-mail messages that are automatically sent to me each afternoon and morning. Using these messages, I am never caught off guard when it comes to a ground-level ozone episode. If I have to issue an advisory (which I only do if there actually is an episode), I will have had time to prepare beforehand. I find it personally useful to receive the messages that give the predicted ozone concentration in parts per billion.

Although I don't have research evidence of the effectiveness of the AQPP, I nevertheless feel that the AQPP is very beneficial and is the right thing to do. For those members of the public who find it important to have access to information on air quality, the AQPP is an important component along with "live" readings. People want to know, "What is it like outside now?" and "What will it be like outside later today or tomorrow?" The AQPP helps to answer one of those questions.

I would make the request again that the forecast program starts slightly earlier in the year and end slightly later. I realize that this would be helpful for what would be relatively rare events (for example, an ozone episode in mid-October), however, I prefer not to be caught off guard.

In preparation for the 1997 smog season, Environment Canada organized numerous meetings, especially in leading up to the announcement of the new smog forecast for Saint John and surrounding area. Although I was not able to attend all of these meetings, in reviewing my records, I note that special efforts were made (especially for the meetings held in Saint John) to invite other stakeholders such as NB Lung Association, Saint John Citizens Coalition for Clean Air, and the Saint John-Fundy ARMA Committee. In between the meetings, there were opportunities to comment on the multiple drafts of the health and education messages. At the meetings, the focus group results were presented along with sample messages. I must underscore that Environment Canada was very thorough in its recording and dissemination of information collected at these meetings and in other venues. There were also ample opportunities to prepare for the news conference which was held in July. I appreciate that the organization of such news conferences can be difficult especially since there were other stakeholders who wanted to share the limelight.

I wish to thank Environment Canada staff for all your hard work and your friendly and efficient service. I am looking forward to next year since both your program and the NB Department of Environment program always seem to be improving and collaborating more effectively.

In summary, Environment Canada has certainly shown leadership in communication with other agencies, such as the one I represent. I hope to see more of the same in the future.

Sincerely yours,

Monir Taha, MD, MHSc, CCFP, FRCPC
Medical Officer of Health
Public Health Services, Region II, Saint John

MT/rcb

Appendix III

New Brunswick Lung Association (NBLA)

NEW BRUNSWICK LUNG ASSOCIATION
L'ASSOCIATION PULMONAIRE DU NOUVEAU-BRUNSWICK

Mr. Réal Daigle, Manager
New Brunswick Weather Services
Atmospheric Environment Branch
77 Westmorland St., Suite 400
Fredericton, NB
E3B 6Z3

December 19,1997

Dear Mr. Daigle:

I am writing in regards to the Smog Forecast Pilot Project that was run in the summer and fall of 1997. We were very pleased to have been a working partner and contributor in this exciting community and environmental pilot project and look forward to the possibility of working with you again in the future. To that end, we will be submitting a partnership proposal in January 1998 detailing opportunities on which the New Brunswick Lung Association can enhance and contribute to the 1998 Smog Forecast Program.

The Smog Forecast Project was an excellent opportunity to work closely with Beverley Boyd of Environment Canada in the development of a number of community outreach and promotional initiatives, namely the design of interior bus posters; the production of newspaper advertisements; the development of a fact sheet; and the incorporation of Smog Forecast messages into signage for a future self-guided interpretative trail in the Saint John area that will promote air quality. Together, all of these initiatives will help promote the Smog Forecast initiative and to educate the public about important air quality information and its accessibility.

Both the bus posters and newspaper advertisements helped draw attention to a very successful launch of the Smog Forecast Project. While the C.A.N. DO Fact Sheets have been completed, it has been mutually agreed upon to produce and print the Fact Sheets upon finalization of details for the 1998 launch of the program.

The details for the self-interpretative trail to be built in Rockwood Park in Saint John have now been finalized. The Trail is scheduled to be designed in the winter of 1998 and launched in the spring/summer of 1998. To this end, we will be forwarding invoice for this component of the program.

The New Brunswick Lung Association sees both the opportunity of working closely with Environment Canada and its Smog Forecast Project as winning opportunities to assist the public and make improvements in air quality. We look forward to partnering again with Environment Canada on the next phase of the Smog Forecast Project. Remember,

"it's A Matter of Life and Breath"

Sincerely,

Kenneth H. Maybee
Executive Director

Appendix IV

Saint John - Fundy Air Resources Management Area (ARMA) Committee

January 12, 1998

City of Saint John

Mail and Fax: (506)451-6010
Mr. Joseph E. Shaykewich
Manager, Program Evaluation
Policy, Program and International Affairs Directorate
Environment Canada
Suite 400, Frederick Square
77 Westmorland Street
Fredericton, NB
E3B 6Z3

Dear Sir:

Re: Smog Forecasting Program for Saint John/Fundy area

I am writing to confirm what is generally accepted that your pilot project of Smog Forecasting has been successful, that the objectives were met and that the project should continue.

An important point made in the Report of the Saint John/Fundy ARMA Committee is the need to educate our citizens on air quality issues. There is a perception that the air quality is lacking and there is a need to get better on time-on line information out to those members of our communities who are more sensitive to the fluctuations in the air quality readings.

The pilot program has demonstrated:
- a high level co-operation between the regulatory agencies; and
- has met an important community need in education; and
- has developed a good planning process between all the partnerships; and
- has provided a two-way communication process between the partnerships; and
- has provided those in our community who are more susceptible to the air quality an improved time line within which they can make the necessary lifestyle adjustments to their living patterns.

The ARMA Committee believes that the program has been successful and would strongly encourage its continuation.

Respectfully submitted,

J. Claude MacKinnon, P.Eng.
Chairman of ARMA
JCM/mmf

cc Claude Côté

Appendix V

Saint John - Citizens Coalition for Clean Air (CCCA)

October 21, 1997
Joseph E. Shaykewich
Manager, Program Evaluation
Policy, Program and International Affairs Directorate

Evaluation Report

RE: New Smog Forecasting program for Saint John and surrounding area including Saint John, Kings and Charlotte counties.

The Saint John Citizens Coalition For Clean Air wishes to take this opportunity to more formally document our feedback on this first in Canada pilot project of Smog Forecast. This pilot project was launched here in Saint John July 16, 1997. Environment Canada partners in this unique and valuable program included the New Brunswick Department of the Environment who provided air quality data from its monitoring stations. The New Brunswick Lung Association was another partner.

Our Air Quality Advocacy group Citizens Coalition For Clean Air were amply consulted by Environment Canada prior to the program being officially launched by Federal Environment Minister Hon. Christine Stewart and New Brunswick Environment Minister Vaughan Blaney.

Even before the program commenced it is most encouraging from a community perspective to see the high level of cooperation between the two regulatory agencies in partnership with community groups and local citizens whose health conditions are affected by air quality. This level of cooperation we believe was one of the main reasons this program was such an outstanding success. Anytime a program like this is considered it is critically important to consult with the public. Our organization had input into the public information messages about the new Smog Forecast were relevant and useful.

So even before this program was launched we gave good marks to the planning process that included all the important partners. This kind of planning we believe will be valuable in further programs that we hope would be eventually available across the country in the future.

First of all we wish to state that we found this Smog Forecast met an important community need considering our vulnerable airshed and the health impact smog has on the health of our citizens. We have long recognized that Southern New Brunswick Saint John and areas is one of the four regions in the country most prone to poor air quality (see ARMA report for further analysis). The other affected areas include Southwestern and Central Ontario, Southern Quebec and lower mainland of British Columbia. It was very appropriate to test this program in our city and surrounding area. The program was a success in our view for many reasons.

1. The Smog Forecast predicted expected levels of ground level ozone over two day periods with updates three times per day 5 am 230 pm and 730 pm.

The information was made available to local media outlets that permitted them to broadcast or print the information as part of the regular weather forecast. The key to the public exposure rested to a great degree

with the Radio/TV print media centres. We noted, for example, that CBC Radio and TV (Rose Arsenault CBC TV Supper Time Show used the information in a consistent, integrated manner as part of the weather forecast. The public broadcaster appeared to have a more social responsibility to provide this information as a public service. The private Radio Stations CFBC-FM, CHSJ, K100 did not integrate the information as much as the public broadcaster. Some reasons mentioned to me included (1) cost they would have had a sponsor (2) information not as available for early morning shows (3) some reluctance to broadcast the information for fear of civil liability of listeners got incorrect information and went out and exerted themselves.

One of the most attractive features of the program was its easy access with one phone number (506) 636-4991 should stay the same with the Air Quality Index and Smog Forecast Information all easily available with right touch tone access on our phones. Then of course access on the Internet. We liked having (1) Air Quality Index Report (IQUA) (2) Smog Forecast (3) Air Quality general information (4) Smog Advisory if required. The capacity to be able to leave information for feedback was another positive feature via a separate number.

Other positive features we liked include:

This Smog Forecast assisted respiratory patients in scheduling their outdoor activities. As we know, smog is a mixture of pollutants with ground-level ozone as the main component which can be harmful even for the population who do not suffer from respiratory illness. For example, I know that many parents of school age children would access this service so they could prevent their children from spending too much time outdoors in strenuous activity. Similarly for joggers, this service served an important need here as well.

One point we wish to make is the level of 51 when a Smog Advisory is issued by the Public Health Office. It is our belief that many people are sensitive to and react at a level far below 51 in which the public are officially alerted. The point however is that this Smog Forecast service allows the public to get the needed information they require to make necessary lifestyle adjustments to their living patterns. Therefore this program enhances the opportunity for the public to take more responsibility for themselves by giving them the information they require so they can adequately protect themselves and their family.

Another positive aspect of the program is the public education feature. The public who used the program have learned a great deal about air quality problems and the weather conditions that contribute to it. Having a more informed public results in the public taking more interest in and advocating for changes. For example, the public had a crash course in what causes smog where we learned that on hot and sunny summer days, stagnant air can trap pollutants and, when combined with sunlight, results in unacceptable levels of ground-level ozone. We learned in the messages that most of the ground level ozone over southern New Brunswick comes from the contribution of long range transport of pollutants from the industrial areas of the U.S. such as the Boston to Washington corridor and the Ohio Valley.

When the public start to learn the truth that about 95 percent of nitrogen oxides that lead to the formation of smog, are produced when we burn fuels in our cars and trucks or generate energy using combustion engines; then we may start seeing a trend for people to cut back on car use or look at alternate fuel sources or save energy. Therefore a program like this has a public awareness or consciousness raising on the root causes of air pollution hopefully helping them to change lifestyle decisions. Programs like this, therefore, draw a secondary value in terms of addressing root causes of ozone, hopefully stimulating the public to start changing their personal habits or advocating for tougher standards and practices.

One of the reasons the public seem to be passive on the air pollution issue is a lack of knowledge in understanding the complexity of the problem. This program with its separate number allowed the public to give feedback, ask questions and communicate with Environment Canada. This is a very important and valuable aspect of this service.

The program recognizes that smog has a negative and harmful health dimension as we all know in this region. Recently our group commissioned Dr. David Pengally, McMaster University to present his research to Public Hearings of National Energy Board on Sable Gas Project being considered. He predicted by scientific calculation that 35 people a year die in this region from health impacts of air pollution.

Another important feature of this program centres around engaging the public and other community stakeholders on solution making, with good public consultation participation and making them part of the program to help themselves. The program gets a lot of credibility this way because the public interact all the way through both in planning and more importantly in using the service day to day.

Now lets turn our attention to those areas of the program that need attention or improvement.

(1) Not all the media outlets used the information as part of the weather forecast. We would like to see them use it like they do for UV index.
   (A) Need to work with media outlet more to help them understand they have a public service role;
   (B) Development of sponsorships suggest various corporations in respiratory health field be contacted to sponsor and pay for the forecast information to be aired (Glaxo Welcome Drug Manufacturers for asthma medication etc.

(2) The information from monitors needs to be put on line as part of electronic updating that Department of Environment use. Have it on an hourly basis, so that media outlets can access it more regularly. We would like the updated data before 230 pm so one can plan the days activities more readily.

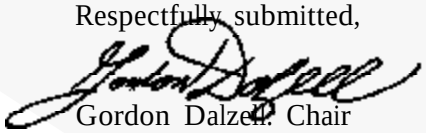
The Fundy National park monitoring information was NOT AVAILABLE 38 out of 42 days we checked. This technical problem needs to be corrected. We recognize however that the 3 ozone monitors along with a new one on the west side of Saint John provides adequate monitoring to give the public the accurate information it requires.

I would like to point out here that the efforts of the local Provincial Environment office staff need to be recognized because of their efforts in maintaining reading and servicing those important monitors.

Its therefore important for the public to recognize the Provincial partnership here along with the Federal role in ensuring the success of this program. Its important as we have seen a good working relationship between the two regulatory partners. As we know, this new initiative builds on the existing national Smog Advisory Program and complements New Brunswick's daily Air Quality Index (used to be given twice per day). The whole IQUA model was the brainchild of our New Brunswick Department of the Environment set up almost 20 years ago.

There was none of this bureaucratic competitiveness or rivaliness sometimes evident when large government agencies work on mutual projects. This project, from what I observed, was free from those tensions resulting in a first class field project that the public welcomed and used.

Respectfully submitted,



Gordon Dalzell, Chair
Citizens Coalition For Clean Air

ANNEX

I Internal Air Quality Assessment

II Graph of the IQUA Sub-Index and categories related to ground-level ozone.

III Air Quality Index Static Message (available through the Saint John ATAD)

IV Regional Smog Forecast

VI Health and Education messages (incorporated in the daily smog forecast)

ANNEX I

Internal Air Quality Assessment

FPCN99 CWZF 110700
AIR QUALITY ASSESSMENT FOR SOUTHERN NEW BRUNSWICK ISSUED BY THE NEW BRUNSWICK WEATHER CENTRE OF ENVIRONMENT CANADA IN FREDERICTON AT 4.00 AM ADT MONDAY 11 AUGUST 1997.

AIR QUALITY ASSESSMENT FOR TODAY…

A RIDGE OF HIGH PRESSURE LOCATED OVER NEW ENGLAND WILL BEGIN TO MOVE EASTWARD EARLY THIS MORNING. LIGHT WINDS OVER THE GREATER SAINT JOHN AREA COMBINED WITH CLEAR SKIES OVERNIGHT PRODUCED A STRONG SURFACE TEMPERATURE INVERSION RESULTING IN POOR VENTILATION. SOME EARLY MORNING READINGS WERE ALREADY INTO THE 40S PPB. THE COMBINATION OF LOCAL PHOTOCHEMICAL PRODUCTION AND A FORECAST LIGHT SOUTHWESTERLY CIRCULATION DEVELOPING THIS MORNING WILL RESULT IN GRADUAL DETERIORATION OF AIR QUALITY. YESTERDAYS MAXIMUM READINGS IN SOUTHERN MAINE REACHED THE 90S PPB. IMPROVING CONDITIONS ARE EXPECTED LATE THIS EVENING AS COLD FRONT CROSSES THE AREA.

AIR QUALITY ASSOCIATED WITH OZONE CONCENTRATION…NEAR 40 PPB INCREASING GRADUALLY TO NEAR 80 PPB THIS AFTERNOON. CONDITIONS IMPROVING LATE THIS EVENING WITH FRONTAL PASSAGE.

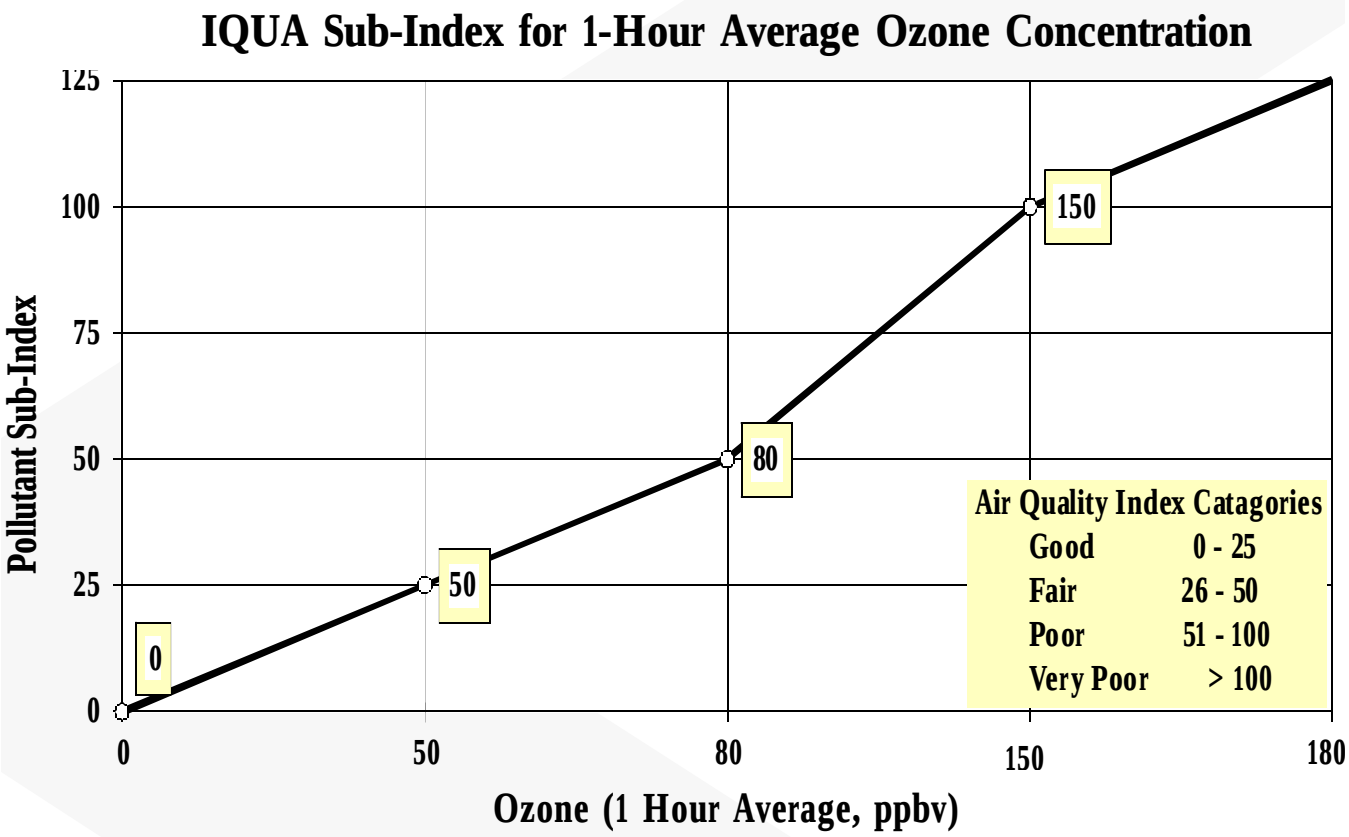
MIXING HEIGHT…NEAR 100 FEET RISING NEAR 1000 BY NOON.

WINDS FOR TODAY (KM/H)…VRBL03 BECMG SW10 BY NOON.

END
$$$$

ANNEX II

Graph of the IQUA Sub-Index and categories related to ground-level ozone.



ANNEX III

Air Quality Index Static Message (available through the Saint John ATAD)

Air Quality Static Message

The ***Air Quality Index*** is compiled by the New Brunswick Department of the Environment, and is updated several times a day.

The ***index*** is calculated using data collected from 3 urban stations in Saint John.

Ozone, Sulphur dioxide, Nitrogen dioxide, Carbon monoxide, Hydrogen sulphide and the coefficient of haze are monitored to calculate the Air Quality Index at the urban sites.

The categories of the index are as follows:
0 to 25, ***Good***
26 to 50, Fair
51 to 100, Poor
above 100, Very Poor.

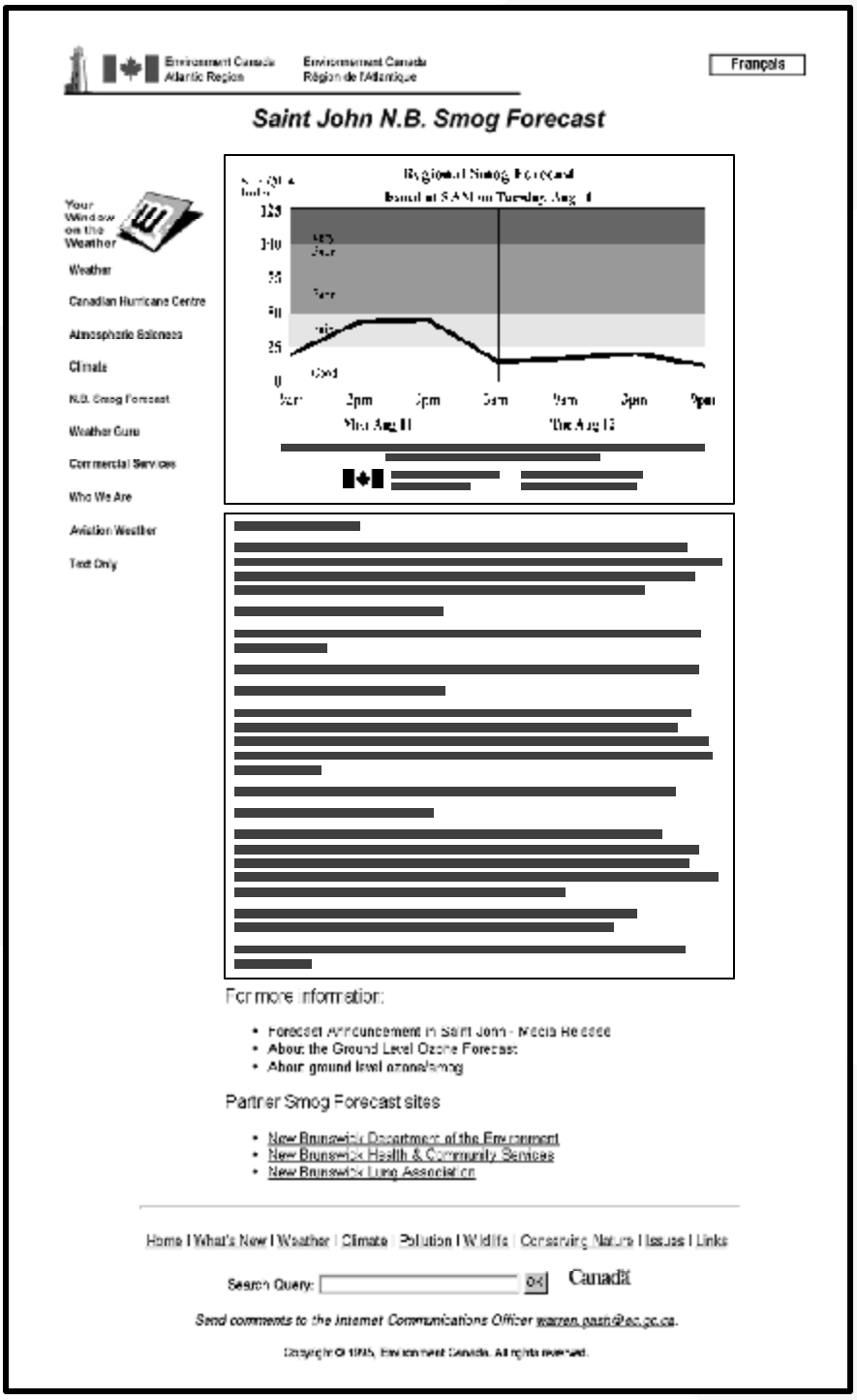
The ***Air Quality Index*** reported for a station is based on the ***worst*** pollutant. For example, if ***3*** pollutants are ***good*** and ***1*** is ***Fair***. The ***Index*** reported for that location would be ***Fair.***

The ***Index*** is calculated using a ***Standardized*** approach, based on ***Canada's National Air Quality Objectives.***

For more information, during regular working hours, please call the Saint John regional office of the New Brunswick Department of the Environment at (506) ***658-2558***.

ANNEX IV

Regional Smog Forecast



ANNEX V

Health and Education messages (incorporated in the daily smog forecast)

HEALTH / EDUCATION MESSAGES

Education

• Ozone is not always formed in the same way! The stratospheric ozone layer in the sky is called high level ozone, and protects us from the sun's ultraviolet rays. Ozone at ground level is harmful. It is a pollutant formed in the air when nitrogen oxides (referred to as NOx), from combustion engines, are mixed with volatile organic compounds (referred to as VOC's) , from the evaporation of liquid fuels and react in the presence of sunshine.

• A city's size, its industries, weather patterns and geography all influence the extent of ground level ozone formation. Winds can transport ground level ozone and its components hundreds of kilometres from the source. In southern New Brunswick, ozone episodes are attributed largely to imported pollutants from the eastern United States.

• Transport of ground level ozone can reach far downwind. It can damage crops and trees and deteriorate some materials such as rubbers and textiles.

• Ground level ozone is the major component of smog. Smog is that brownish-yellow haze that hangs over your area on occasion during the summer months. The haziness and brown colour are caused by the accumulation of tiny pollutant particles and nitrogen dioxide. During these events, be sure to listen to your daily Air Quality Index and forecast for your area!

• You can help improve air quality by using your automobile responsibly, car pooling, biking, walking, turning off the engine while waiting at the store or by using public transit. Every contribution is a step towards a cleaner and healthier environment.

• The Air Quality Prediction Program is a federal initiative in partnership with the province of New Brunswick. This new program can increase your awareness of health effects associated with air quality. The improved availability of air quality reports and daily forecasts can assist you in planning your daily activities. Be sure to listen to the latest report and forecast.

Health

• Ground level ozone, the major component of smog, can be a powerful irritant and can have harmful effects on your lungs. Symptoms are most likely to occur if you are physically active outdoors. People with heart or lung disease, especially asthma, may experience a worsening of their condition.

• Common symptoms associated with exposure to ground level ozone include irritation of the nose and throat, coughing, and chest tightness. Minimize your exposure by avoiding outdoor exercise when ground level ozone concentration is expected to be high. Pay attention to the air quality index and forecast.

• Children tend to be more sensitive to ground level ozone exposure because they breathe faster and, in the summer, spend more time outdoors being physically active. You can reduce your child's exposure by encouraging outdoor activities early in the day when pollutant levels are usually lower.

• In collaboration with Health Canada and Environment Canada, various organizations are continuing to assess the effect of exposure to ground level ozone and other pollutants. The results of these studies will allow further development of effective standards and guidelines to help protect the health of Canadians.

• Persons with greater sensitivity to air pollution may develop symptoms or experience worsening of their conditions during episodes of air quality that is labeled "fair" by the current air quality index. If you, or someone you know, are sensitive to deteriorating air quality, be sure to listen to your area's daily index and forecast.

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