Human Health Project Team

Final Report
to
CASA Board of Directors

November 25, 1998

Table of Contents

Appendices

* To be submitted at the June 1999 CASA Board Meeting

List of Acronyms

CASA	Clean Air Strategic Alliance
HHRG	CASA Human Health Resource Group
HHPT	CASA Human Health Project Team
COPD	Chronic Obstructive Pulmonary Disease
PCDD/F	Polychlorinated dibenzo-p-dioxin and Polychlorinated dibenzofuran

1. Executive Summary

In February 1997 the CASA Board approved a framework for a human health monitoring system, that was developed by CASA's Human Health Resource Group, and endorsed the establishment of the Human Health Project Team (HHPT) to develop an implementation plan. The objectives of the HHPT are to:

- develop a proposal and recommendations for a monitoring system with the potential to identify, manage and address human health effects caused by air contaminants;
- evaluate the proposed monitoring system;
- make recommendations for its implementation;
- ensure that the proposed system is sufficiently robust for appropriate implementation;
- report to the CASA Board at key milestones.

This report constitutes the final report to the CASA Board by the HHPT. It covers the need for a human health monitoring system, a description of the proposed monitoring system, an implementation plan and recommendations to the CASA Board.

A comprehensive literature review, carried out by the Project Team, indicates that an association between levels of ambient concentrations of criteria pollutants currently occurring in Canada and significant health outcomes, which likely affect large populations, is well established through numerous investigations in different regions of Canada and the United States. Although ambient concentrations of criteria pollutants have generally been stable, or declining, in Alberta in recent years there is no assurance this trend will continue. Alberta has a higher than average in Canada mortality rate from asthma. In recent years, a number of issues have arisen that have caused public concern over health effects from air pollutants. A human health monitoring system to quickly identify/ detect health effects from air quality is a worthwhile investment in Alberta.

The proposed Framework for a Human Health Monitoring System has been conceptually tested through a peer review and several scenarios and has been found to be robust. It comprises five ongoing components: known human health effects; relevant event occurrences; ambient air monitoring; human health effects monitoring; and health symptoms and public health complaints recording, as well as three ongoing administrative functions: management; feedback; and communication. The system also involves a problem identification function, a decision function and the potential for special investigation/ monitoring. Much of what is required to make the system function already exists to some degree. For instance, Alberta Environmental Protection currently monitors air quality in some locations. Regional Health Authorities currently receive complaint from the public with respect to health issues. Alberta Health has carried out some special investigations in response to issues of concern to the public. For this reason, the HHPT recommends that the proposed Framework for a Human Health Monitoring System is implemented through a collaborative effort spearheaded by Alberta Health, Alberta Environmental Protection and CASA.

Because of the sheer magnitude and technical complexity of the job of implementing such a system province wide, it is recommended that the proposed Framework be implemented piece-by-piece and to learn while doing.

To evaluate the Framework, by applying it to the Alberta Oil Sands Community Exposure and Health Effects Assessment Program, the Project Team has retained Dr. Steve Hrudey of the University of Alberta. Dr. Hrudey is to identify gaps and issues that need to be addressed in implementing the Framework, particularly those related to the ongoing operation of the system, and his report will be used to provide guidance in implementing the proposed Framework. More specific recommendations for implementing the Framework, than are presently contained in this report, are to be derived by a subgroup of the HHPT after the evaluation is completed.

Both Dr. Hrudey's report and the subgroup's report on specific implementation recommendations are to form appendices to this report (Appendix K and Appendix L, respectively). These two appendices are to be submitted to the Board in June 1999.

A human health monitoring effort such as is envisioned can be quite costly. Note the cost of the pilot study of the Alberta Oil Sands Community Program was $ 535,000 and that of the main study was $1,550,000, making a total cost of $2.1 million. The human health effects that have been associated with air pollution, however, pose substantial costs as well, which are ultimately paid by both individuals and corporations. For instance, air pollution has been found to exacerbate asthma. Green et al. (1996) estimated the per capita cost of asthma in Canada in 1990 was $ 7.47. This suggests yearly asthma-related costs of about $ 20 million in Alberta.

In summary, then, the HHPT recommends that:

- **Recommendation 1**: the CASA Board reaffirms its approval of the proposed Framework for a Human Health Monitoring System (first given in February 1997);
- **Recommendation 2**: the CASA Board endorse the formation of a multistakeholder subgroup of the HHPT, under the joint leadership of Alberta Health and Alberta Environmental Protection, to develop specific recommendations, timelines, and workplan to implement the proposed Framework for a Human Health Monitoring System;
- **Recommendation 3**: the CASA Board incorporate a review of the implemented human health monitoring system into CASA's periodic strategic planning activities;
- **Recommendation 4**: the CASA Board endorse the proposed timelines to complete Appendices K (Evaluation Report) and L (Subgroup Report on Implementation) to this report before the June Board meeting and to submit them for approval at that time.

Operational PM's not evaluated.

2. Introduction

CASA is currently undergoing a strategic planning process through which long term goals and objectives, as well as priorities for the next three years, are to be determined. As part of this strategic planning process, four "key focus areas" (areas in which CASA needs to show results) have been identified: human health; ecological health; pollution prevention; and continuous improvement and socio-economic integration.

With respect to human health, the issue is the prevention of adverse short and long term effects due to outdoor and indoor contaminants. CASA's current focus is on ambient concentrations of air contaminants, however. In any case, in order to prevent adverse effects one must identify and detect them. To identify and detect adverse effects on human health due to contaminants in the air one must monitor human health and air contaminants appropriately.

2.1 Recommendations from the HHRG

During the Clean Air Strategy of Alberta consultation process (in 1991), the public repeatedly expressed concern over human health effects due to air quality and air toxics. In response to this concern, the Clean Air Strategic Alliance (CASA) established the Human Health Resource Group (HHRG) to provide guidance to CASA with respect to human health issues.

In November 1995, the CASA Board directed the Human Health Resource Group (HHRG) to develop a draft proposal for a human health monitoring system. A framework for a human health monitoring system (Appendix C) was presented to the CASA Board by the HHRG in February 1997. The overall objective of the framework was to facilitate the development of a province-wide system, including methods and techniques, for measuring and assessing human health effects in relation to air quality. The HHRG recommended that a multi-stakeholder project team be established to develop an implementation plan for the proposed human health monitoring system. In response to this recommendation, the Human Health Project Team (HHPT) was formed; a list of its members is in Appendix A.

2.2 Objectives of the HHPT and Project Status

The purpose of the HHPT is to develop recommendations for a system within which the effects of air contaminants on human health can be monitored and addressed. Given this mandate, the following objectives have been identified for the HHPT:

- develop a proposal and recommendations for a monitoring system with the potential to identify, manage and address human health effects caused by air contaminants;
- evaluate the proposed monitoring system;
- make recommendations for its implementation;
- ensure that the proposed system is sufficiently robust for appropriate implementation;
- report to the CASA Board at key milestones.

The HHPT held its inaugural meeting on May 23rd, 1997. In June 1998, the HHPT presented its final terms of reference (Appendix B) to the Board, as well as its plan for evaluating

the proposed human health monitoring system through application to the Alberta Oil Sands Community Exposure and Health Assessment Program (generally called the Fort McMurray study). This evaluation is currently underway and should be complete by February 1999. Completion of the evaluation will allow the HHPT to define, and direct to appropriate agencies, specific recommendations for implementing the proposed human health monitoring system. These specific recommendations will complete the tasks of the HHPT.

2.3 Other Relevant CASA Projects

Several of CASA's current and past projects are relevant to monitoring effects on human health due to air contaminants; the role of human health data within CASA is shown in the diagram in Appendix A.

The Ambient Monitoring Project and the air quality zones (West Central Airshed Society, Parkland Airshed Management Zone, Southern Wood Buffalo Zone) monitor the concentration of "conventional" air contaminants (SO_2, NO_x, O_3, PM_{10}, $PM_{2.5}$, H_2S, total reduced sulphur, hydrocarbons) on a routine basis in their area. Data from these projects will be valuable in any ongoing effort to monitor the effects of air contaminants on human health.

The Air Toxics Project Team considered potentially hazardous air contaminants present in Alberta air but not currently managed by an appropriate agency and recommended a way of dealing with such substances.

Several projects have been carried out by CASA or by CASA stakeholders with respect to some specific human health/ air quality issues. For instance, the Flaring Project Team sponsored an "assessment of respiratory disorders in relation to solution gas flaring in Alberta" (Alberta Health, 1998a) and Alberta Health (1996a) investigated the "geographic and temporal variations of selected respiratory diseases in Strathcona county and Fort Saskatchewan" . These studies, however, were short term programs that looked at historical evidence in relation to human health/ air quality issues in very specific areas or in relation to a very specific kind of industrial activity. These studies do not constitute an ongoing monitoring of air quality effects on human health. In fact, Alberta Health (1996a) concludes that "these findings support the necessity of on-going surveillance and monitoring of population health status on a provincial and sub-provincial basis, with the timely dissemination of information". But these studies can contribute considerably to an ongoing monitoring effort with respect to methodology and measurement/ analysis techniques.

Alberta Health (1997a) represents an initial step toward establishing a comprehensive human health/ air quality monitoring system; it deals with "the Alberta oil sands community exposure and health effects assessment program".

2.4 Report Content and Organization

This report constitutes the final report to the CASA Board by the HHPT. Note, however, that the last two appendices of this report will only be submitted to the Board in June 1999.

These are Appendix K, which gives the consultant's report on the evaluation of the proposed framework for a human health monitoring system, and Appendix L, which gives the report on specific implementation recommendations.

In order to reconfirm the need for a human health monitoring system in Alberta, Section 3 of this report discusses available information on: air contaminants and health effects; emissions and concentrations of air contaminants in Alberta; and Alberta-specific human health/ air quality issues. The human health monitoring system proposed by the HHPT is described in Section 4 of this report. A possible mechanism for implementing it, along with recommendations related to its implementation, are presented in Section 5. Section 6 gives conclusions and a summary of recommendations.

3. The Need for a Human Health Monitoring System in Alberta

The HHPT, and the HHRG before it, devoted considerable effort to understanding recent results from scientific studies related to human health and air quality. Because these scientific findings provide a major rationale for monitoring air quality and human health effects associated with air quality, a very brief summary of the results of these scientific studies is given below. A bibliography listing the various reports is given in Appendix D. As well, some information on emissions and ambient concentrations of contaminants in Alberta is given in the later subsections.

3.1 Known Health Effects from Air Contaminants

A considerable body of scientific research is devoted to the identification of health effects from criteria (conventional) pollutants. Most of this research relates to epidemiological studies of the association of health outcomes in a population with air pollution concentrations and concentration trends. Even though few diseases are uniquely associated with exposure to a single criteria pollutant in ambient air, these epidemiological studies all tend to focus on one or a few criteria pollutant(s). The focus on specific pollutants occurs because the regulatory structure, monitoring, and control technologies are pollutant specific.

Only a small number of chemicals known to be present in the atmosphere as air pollutants are actually routinely measured by agencies responsible for environmental regulation. The specific pollutants that are generally measured tend to be the ones for which air quality guidelines/ standards/ criteria exist, i.e. criteria pollutants. It is difficult, and possibly unimportant, to document health effects from pollutants whose concentrations and concentration trends are unknown. So researchers tend to focus on criteria pollutants when examining health outcomes for air pollution effects. (It must be noted that science tends to build on what is known: because criteria pollutants have long been known to be priorities for potentially causing health effects, they represent a good place to start a search for effects.) A list of the health outcomes that have been found to be associated with specific air pollutants is given in Table 1. Table 1 has been derived from the results of: Bates, 1995(a) and (b); Burnett et al., 1994, 1995, 1997, 1998; Green et al., 1996, 1997; Guidotti, 1995(a) and (b), 1996; Guidotti and Jhangri, 1994; Brown et al., 1997; CEPA, 1998; American Thoracic Society, 1996; and EPA, 1996.

Table 1:
Human Health Outcomes Associated with Criteria Pollutants

Pollutant	Population at Risk and Applicable Concentrations	Associated Health Outcome
Particualtes (PM_{10}, $PM_{2.5}$)	• healthy adults and particularly children, patients with chronic lung/heart disease, asthmatics. • effects have been observed at ambient concentrations at, near and even considerably below air quality guidelines/standards; there appears to be no threshold for adverse effects.	• increased mortality (excluding accidental deaths) in the general population • increased mortality from COPD, cardiovascular disease, and lung cancer. • increased morbidity from respiratory and cardiovascular disease. • increased hospital admissions for COPD, cardiovascular disease, and acute respiratory symptoms in children • increased emergency hospital visits for respiratory diseases. • acceleration of asthma and increased drug utilization by asthmatics. • increased respiratory symptom reports. • decreased lung function.
Volatile Organic Compounds	• healthy adults.	• toxic effects on the eyes, lungs, liver, heart, kidney, and nervous system. • many VOCs are known or suspected carcinogens.

Table 1 - Continued

Sulphur Dioxide (SO_2)	• healthy adults and in particular COPD patients and asthmatics and children. • effects have been observed at ambient concentrations near air quality guidelines/standards.	• increased mortality from cardiorespiratory diseases. • increased morbidity from cardiorespiratory diseases. • increased hospital admissions for asthma, COPD, and respiratory infections. • increased respiratory symptoms. • decreased pulmonary functions in normal school children. • increased lung functions decline with long-term exposure to relatively high levels.
Hydrogen Sulphide	• healthy adults	• nausea, vomiting, diarrhea, abdominal cramps, shortness of breath, coughing, asthma attacks, choking, sore throat, chest pain, headache, burning eyes, and fatigue .
Carbon Monoxide	• healthy adults and in particular patients with ischemic heart disease. • effects observed at ambient concentrations near, and somewhat above, air quality guidelines.	• increased mortality due to cardiovascular disease. • increased hospital admissions for cardiovascular disease. • adverse effects on angina and myocardial ishemia. • headaches.

Table 1 - Continued

Ozone (O_3)	• healthy adults and in particular children, athletes, outdoor workers, and asthmatics. • effects observed with concentrations at normal ambient levels.	• increased mortality from respiratory and cardiovascular diseases. • increased hospital admissions for asthma and other respiratory diseases. • increased general emergency visits. • increased emergency visits for asthma and other respiratory diseases. • increased physician visits for asthma. • increased medication use. • aggravation of asthma and increase in severity of asthma. • decrease in lung function and exercise capacity. • increased incidents and severity of respiratory infections. • increased airway reactivity and lung inflamation. • development of chronic respiratory bronchiolitis. • chronic respiratory effects due to long-term exposure to relatively high levels. • long-term exposure may be associated with an increased prevalence of asthma.

Table 1 - Continued

Nitrogen Dioxide (NO_2)	• healthy adults and in particular asthmatics and children.	• increased hospital admissions for respiratory infections in school children. • increased physician visits for respiratory infections in school children. • impairment of host defences against viral and bacterial infections. • increase in reports of respiratory symptoms. • decreased lung function, particularly in asthmatics and children. • long-term exposure to relatively high levels is associated with increased respiratory illness in children. • causes acute bronchiolitis at high concentrations.

Even though the health outcomes in Table 1 have been well established through numerous studies, at issue still is to what extent observed effects should be attributed to air pollution as a whole (i.e. to a complex mixture of air pollutants) or rather to a specific air pollutant for which criteria can be established. The reality is that many criteria pollutants commonly coexist and often co-vary so that it is difficult to separate out their effects and attribute an observed health effect to a single pollutant. As well, exposure to other environmental agents, including infectious organisms, radiation, temperature, and inherent characteristics/ lifestyle of the exposed individual are also important in determining these health outcomes. Furthermore, many effects of air pollution might act over prolonged periods or are consequences of repeated exposure and so these effects may not necessarily be associated with current concentrations or concentration trends. The effects of any pollutant have to be considered in relation to possible acute effects on the one hand and long term effects on the other hand. Finally, most people spend most of their time indoors and indoor concentration levels of most criteria pollutants are generally only weakly correlated with outdoor, ambient concentrations.

Increases in relative health risk due to air pollution have been observed at concentration levels well within the range of normal ambient concentrations and, for particulates, ozone and carbon monoxide, substantially below current standards and objectives. While the increases in specific health outcomes attributable to air pollutants have generally been small (1 to 10%), they nonetheless signify substantial numbers of avoidable death and disease due to the very large size of the populations impacted by air pollution. Note also that it may not only be the elderly who are being affected and dying from air pollution but also children, asthmatics, athletes, and even healthy adults.

3.2 Possible Health Effects from Trace Air Contaminants

Numerous chemical agents, that may be in the air, particularly in some specific work places, have been identified that cause asthma, for example toluene diisocyanate, phthallic anhydride, formaldehyde, diethylene triamine, spray paint (Green et al., 1996). Asthma affects about one Albertan in fifteen and is a very expensive disease. Chronic bronchitis is associated with many irritant gases, fumes, complex mixtures and dust in the work place. Many agents are associated with lung cancer (Table 2). Some specific agents may cause specific types of cancer, for example cancers of the pleura and peritoneum associated with asbestos exposure and leukemia associated with benzene. There are known carcinogens among volatile organic compounds in ambient air, e.g. benzene, benz(a)pyrene, 1,3-butadiene,, arsenic (Guidotti, 1996) and other volatile organic compounds are suspected of being carcinogens. The CASA Air Toxics Project Team has reported on this subject (CASA, 1998).

3.3 Prevalence in Alberta of Cardiorespiratory Diseases

Alberta Health has examined the various causes of death in Alberta and compared provincial data to those available for the rest of Canada (Table 3). Note that COPD refers to chronic obstructive pulmonary disease. The trends in COPD and asthma deaths are given in Appendix E, as well as other information about the diseases. Note that the Alberta mortality rate from asthma is higher than the Canadian average and mortality from COPD is increasing.

Table 2:
Agents Causing Lung Cancer in Humans
(from Green et al., 1997)

Agents Known to Cause Lung Cancer in Humans	Agents Suspected of Causing Lung Cancer in Humans	Agents Known Not to Cause Lung Cancer in Humans
- cigarette smoke	- silica dust	- coal mine dust
- asbestos	- diesel exhaust particulate	- carbon black
- radon and radon daughters		
- arsenic		
- chloromethylethers		
- mustard gas		
- nickel and its compounds		
- coke oven emissions		

Note: The American Conference of Governmental Industrial Hygienists (AGGIH) has concluded that insoluble nickel compounds (e.g. nickel oxides) and nickel subsulfide are confirmed human carcinogens but soluble nickel compounds (e.g. nickel sulfate and chloride salts) are **not** classifiable as human carcinogen and metallic nickel is not suspected as a human carcinogen.

3.4 Factors Affecting Life Expectancy in Alberta

Life expectancy at birth is a common and widely accepted measure of population health. Albertans have long enjoyed high rankings in both male and female life expectancy (Alberta Health, 1998b). Among Canadian provinces, in 1994, Alberta ranked second only to British Columbia in overall life expectancy. However, there are differences in life expectancy among Alberta's health regions. Analysis of the variations in life expectancy among Alberta's health regions, over the five-year period 1989 to 1993, revealed that an index of sociocultural discord (ISD[1]) and a measure of economic status (MES[2]) were able to explain 81% of the variation in life expectancy among Alberta's health regions. The value of ISD decreased as life expectancy increased. As the economic status of a region increased, so did its overall life expectancy. But

---

[1]ISD is derived from parameters such as (in order of importance): unemployment; out of wedlock births; aboriginal origin; teenage fertility; single-parent family; catholic religion; and adult children living at home.

[2]MES is derived mainly from the parameters: immigrant population; education; and household income

Table 3:
Number of Deaths by Cause and Alberta Rank, 1994
(10 = highest rate of mortality among Canadian provinces, 1 = lowest)

Selected Causes of Death	Alberta Rank	Number of Deaths
Motor Vehicle Collisions (MVC)	10	331
Suicide	9	420
Homicide	9	65
Injury other than M V C, Suicide, Homicide, Falls	9	417
Congenital Anomalies	8	136
Genitourinary other than Nephritis/Nephrosis	8	80
Circulatory other than Ischaemic Heart Disease and Stroke	7	1,686
All Mental Disorders, including Alzheimer's	7	353
Cervical Cancer	7	48
Breast Cancer	7	379
Asthma	7	44
Chronic Obstructive Pulmonary Disease (COPD)	6	616

Table 3 - continued

Selected Causes of Death	Alberta Rank	Number of Deaths
Prostate Cancer	6	290
Chronic Liver Disease/Cirrhosis	6	160
Pneumonia/Influenza	5	601
Infectious & Parasitic, other than Tuberculosis	5	203
Nutritional/Metabolic /Endocrine other than Diabetes	4	109
All Blood Causes	4	58
Parkinson's	4	58
Tuberculosis	3	9
Ischaemic Heart Disease	3	3,128
Cerebrovascular, including Stroke	3	1,144
Digestive other than Chronic Liver Disease and Cirrhosis	3	398
Nervous/Sensory other than Parkinson's	3	328
Diabetes	3	317
Nephritis/Nephrosis	3	163
Falls	3	139
Respiratory other than Asthma, COPD, Pneumonia	2	154
Lung Cancer	1	953
Cancer other than Lung, Breast, Prostate, Cervix	1	2,329
all causes of death not identified above		292

Source: Vital Statistics, Death File, April 1997 release

ISD had a greater impact on life expectancy than economic status. Air pollution was not amongst the factors considered in this analysis. These results are included in this report merely to indicate that other factors, notably stress and economic status, may have a greater impact on health than air pollution.

Alberta Health (1998c) has projected continuously increasing life expectancy for Albertans at least to 2016. It has also projected the median age of Alberta population to 2016 and concludes that issues surrounding an ageing population will become increasingly important through the next two decades in Alberta. Mortality rates from cardiorespiratory diseases rise sharply with age amongst the elderly. Even though the elderly are not the only ones affected by air pollution, Albertans may expect better air quality in the future. (See Appendix E for details.)

3.5 Current and Projected Emission Levels of Criteria Pollutants in Alberta

To ensure standardization of emission inventory data in Canada, the National Emissions Inventory and Projections Task Group (NEIPTG) was formed by the National Air Issues Coordinating Committee (NAICC) and it is the NEIPTG that now produces official emission inventories and forecasts for criteria pollutants.

The 1990 Canadian Emission Inventory of Criteria Pollutants is the latest published inventory. Preliminary values for the 1995 inventory are available, as are also published data from the 1985 inventory. Data from these inventories are presented in Appendix F. Also presented in Appendix F are the major Canadian sources of particulates, SO_x, NO_x, CO, and VOC emissions, as well as graphs showing the provincial distributions of total emissions of each pollutant in 1990.

Looking at data from the 1990 inventory and considering only anthropogenic, point-source emissions, it is seen that, of the 12 provinces and territories, Alberta ranks 3rd highest with respect to total particulate matter (TPM) emissions, 2nd highest with respect to SO_x emissions, 2nd highest with respect to NO_x emissions, 3rd highest with respect to CO emissions, and 2nd highest with respect to VOC emissions. These rankings are consistent with Alberta's status as being a major industrial centre in Canada and the kind of industries that comprise the Alberta economy. The rankings show that Alberta is a major emitter in Canada.

Forecasts of NO_x, VOCs, SO_x to the year 2010 have been prepared by the NEIPTG and are also shown in Appendix F. These projections suggest modest growth in SO_x and VOC emissions with somewhat more accelerated growth in NO_x emissions, particularly from stationary sources.

3.6 Current Ambient Concentrations of Criteria Pollutants in Alberta

The pollutants whose ambient concentration is continuously monitored by Alberta Environmental Protection and the locations where these parameters are monitored are given in Appendix G. Also given in Appendix G are historical trends in annual average concentrations, exceedances (from air quality guidelines) and comparisons with other Canadian cities.

Looking at the historical trends it is seen that annual average concentrations of CO, PM_{10}, $PM_{2.5}$, and benzene have steadily decreased over the years at all stations where they are monitored. Annual average concentrations of total hydrocarbons (THC) have remained fairly steady, but a tendency to rise in recent years is evident at Edmonton East and Edmonton Central. Calgary East shows a tendency for SO_2 concentrations to rise in recent years. NO_2 and NO_x concentrations seem reasonably steady except for Calgary East where they show a tendency to rise in recent years. O_3 concentrations have remained quite steady over the years, although they seem a little higher in Fort Saskatchewan. Total suspended particulates (TSP) concentrations show a tendency to rise in recent years in Calgary East, Edmonton East, and Edmonton Northwest. Thus ambient concentrations at most of the monitoring stations have remained steady over the years or have actually declined, in spite of substantial increases in emissions. However, there's a tendency evident for some parameters to begin to rise in concentration in recent years at Calgary East and Edmonton East.

With respect to exceedances, note the many exceedances of the 24 hour ozone guideline in 1997. The relatively large number of H_2S exceedances at Calgary East and Edmonton East are noticeable.

Comparing ambient concentrations in Alberta with those in other locations in Canada shows that Alberta falls in the middle of the pack for most monitored contaminants.

3.7 Alberta-Specific Human Health/ Air Quality Issues

A number of specific human health/ air quality issues have arisen in Alberta in recent years.

Widespread public concern over human health effects from solution gas flaring prompted a special study by Alberta Health (1998a). Concern over health impacts from increased oil sands development lead to the establishment of a community health assessment program by Alberta Health (1997a). This community health assessment program is discussed in detail in subsection 4.5.1 of this report.

An apparently higher incidence of asthma in Strathcona County prompted an investigation of the geographical and temporal variation of selected respiratory diseases in Strathcona County and Fort Saskatchewan by Alberta Health (1996a). This study concluded that there is no evidence of appreciably higher rates of mortality or hospital admissions from asthma, bronchitis, and emphysema in Strathcona County and Fort Saskatchewan. Although the rates of physician visits for asthma appear to be higher in both communities, this increase is offset by the decrease of bronchitis during the study period. As well, concern over the potential exposure of residents of Fort Saskatchewan and Dow Chemical employees to polychlorinated dibenzo-p-dioxin and polychlorinated dibenzofuran (PCDD/F) has prompted a number of studies, the latest being Alberta Health (1998d). In this study, cow's milk from farms which are potentially affected by PCDD/F emissions from various industries in Fort Saskatchewan were sampled and analysed for PCDD/F. The results were compared with samples from reference farms as well as

supermarket milk. The daily intake of PCDD/F from the consumption of whole milk from the Fort Saskatchewan area, it was estimated, would not exceed the tolerable daily intake for PCDD/F proposed by Health Canada. Note that the daily intake of PCDD/F comes mainly from the diet through commercial food sources.

The 1982 Lodgepole blow out, which involved an uncontrolled release of sour gas for a three-month period, gave rise to a number of concerns about health effects. No formal follow-up study was carried out. As a more recent example of a health issue in Alberta involving a sudden release of air contaminants, the discovery of a malfunction of a transformer furnace in October 1996 at the Swan Hills Waste Treatment Centre caused considerable concern over the possibility of increased exposure to PCBs, dioxins, and furans in the vicinity of the facility. In response to this concern a special investigation was launched by Alberta Health (1997b) and public warnings were issued with respect to eating wild fish and game from the vicinity of the facility.

A variety of herbicides, insecticides, and fungicides are applied on most of the arable land used for crop production in Alberta. These chemicals may become airborne during application and may cause respiratory problems for the local population (Alberta Health). In addition, livestock produce a number of by products, and have been identified as the source of a number of waterborne contaminants as well as airborne contaminants. The airborne contaminants include particulates, hydrogen sulphide, methane, and ammonia. Some of the airborne contaminants may cause respiratory problems in people living nearby.

3.8 Summary

Air quality is known to be associated with health effects, but the extent and significance of this in Alberta is not known. Until such time as more quantitative data is available it will be difficult to make good decisions relating to possible actions to improve air quality. A human health monitoring system is needed to provide this data.

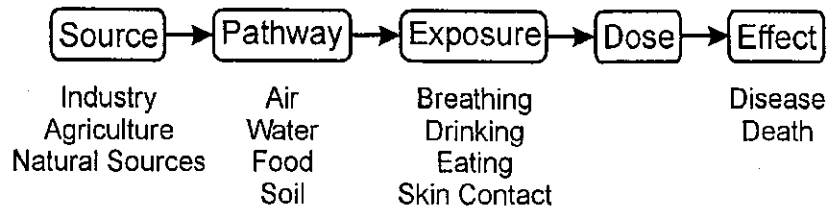
4. The Proposed Human Health Monitoring System

Before launching into a description of the human health monitoring system that the HHPT has developed, it is necessary to understand the relationship between emissions, ambient concentrations and exposure. As well, a few words of explanation are required with respect to the role of special monitoring/ investigation.

4.1 From Emissions to Exposure

The likelihood of an adverse response to pollutants is determined by the degree of exposure. In general, exposure can be defined as any contact between a substance, biological agent, or radiation and an individual or community. We are all exposed to low levels of contamination in the air we breathe, in the food we eat, the water we drink, and the consumer products we use. The concept of a continuum from source of contaminants to the final health effect is illustrated in Figure 1.

Figure 1:
Continuum of Exposure



In the case of health effects from air pollutants, the source of contaminants is emissions from natural and anthropogenic sources. Note that large quantities of volatile organic compounds are released from trees and nitrogen oxides from soils and forest fires.

The ambient concentration of a pollutant measures the amount of pollutant in a pathway, that is in the air, at a given location and time. The ambient concentration of a pollutant is dependent upon:

- the amount of the pollutant emitted/ released in the region;
- the amount that is carried into the region from other regions;
- the amount that is created or destroyed in the region through chemical reactions;
- the amount that is carried out of the region by wind or out of the air by wet or dry deposition.

Weather is an important factor in these processes. Although emitted pollutants are generally dispersed quite quickly in Alberta, on occasion temperature inversions occur and, when combined with little wind, pollutants can be trapped near the ground resulting in relatively high ambient concentrations.

Ambient concentrations are a measure of the amount of the pollutant in outdoor air at a fixed location. Fixed monitors do not accurately reflect pollution levels that individuals may be exposed to; outdoor air also does not accurately reflect the air an individual is exposed to. People spend a majority of their lifetime in indoor environments. Consequently, indoor pollutant levels are most important in determining personal exposure.

Indoor levels of pollutants are a function of :

- indoor sources;
- outdoor ambient concentrations;
- the fraction of air that penetrates indoor;
- filtration;
- air exchange; and
- particle decay and resuspension rates.

For example, in the presence of unvented combustion sources, such as cooking, NO_2 may reach much higher concentrations indoor than outdoors.

Alberta (1997a) found that nonparametric tests confirm that the central tendencies (i.e. mean values) differ among personal, indoor and outdoor exposure levels. As one might expect, the indoor and personal exposure levels are more variable across subjects in a community than are the outdoor exposures.

Alberta (1997a) further found that indoor and personal exposure levels are strongly associated but outdoor ambient levels are not generally strongly associated with either personal or indoor exposure levels. The exception to this rule is SO_2. For SO_2, personal, indoor and outdoor exposure levels are inter correlated with outdoor (ambient) levels generally being higher than indoor and personal exposure levels. For NO_2, indoor and personal exposure levels appear to be associated but are typically lower than ambient levels. For VOCs and particulates, indoor and personal exposure levels are strongly correlated and are generally higher than ambient levels.

The epidemiological studies that form the basis of Table 1 generally relied on ambient concentration levels to represent personal exposure. With respect to some pollutants, for example particulates and VOCs, ambient concentrations can be considered to represent a measure of minimum personal exposure; but for other pollutants, for example SO_2 and NO_2 (even though NO_2 is created by gas cooking) ambient concentrations may represent a measure of maximum personal exposure.

4.2 The Role of Special Studies and Special Monitoring

Most health outcomes attributed to air quality are nonspecific as to their cause. Furthermore, in almost all cases, epidemiology is limited by the absence or reliability of exposure measures, the presence of overwhelming confounding factors and the adequacy/ reliability of the data base on disease outcome. Thus, the main purpose of monitoring these outcome measures is to track and detect trends in health status of populations and to provide a basis for determining the need for more focussed investigations. Additional investigations may entail special monitoring, such as personal exposure monitoring.

4.3 Description of the Proposed Human Health Monitoring System

The proposed human health monitoring system is depicted in Figure 2. To fulfill the principles and objectives identified by the HHRG, a comprehensive human health monitoring system is required with the following ongoing components:

- known human health effects of air emissions
- relevant event occurrences
- ambient air monitoring
- human health effects monitoring
- human health symptoms and public health complaints

Certain essential elements are not depicted in the diagram in order to keep it simple but nonetheless are crucial:

- a management structure
- feedback loops

- public communication (including communication with all stakeholders)

These components are described below as a series of discreet steps, although all steps are reciprocally and otherwise interconnected. Implementation options for each component will be presented in Section 5 of this report.

The immediate result (product) produced by the ongoing components of the proposed human health monitoring system is the identification of a problem. If a problem exists, an investigation may be launched which may or may not include special monitoring. Once the identified problem is sufficiently analysed decisions are made, and announced, to enhance protection of human health and/ or the environment, if warranted. Thus the components of the proposed human health monitoring system that are labelled: problem identified; investigation; special monitoring; health decision; and environment decision are all results of the ongoing activities of the proposed human health monitoring system .But they are not ongoing activities in themselves and in general will only be undertaken on an "as need arises" basis. These products are described below as well as the ongoing components of the proposed human health monitoring system.

4.3.1 Ongoing Activity

Referring to Figure 2, the ongoing activity consists of province-wide monitoring that involves ongoing review of the known human health effects of air emissions, ongoing identification of relevant event occurrences, ongoing ambient air monitoring, ongoing human health effects monitoring, and human health symptoms and public health complaints recording and documenting. Results from these five components are reviewed continuously to determine if there is a link between a certain type of emission and a health symptom or effect. This ongoing process will determine the health status of the population on an ongoing basis and can provide an early warning of health effects in the population as a result of air emissions. The ongoing activity continually cycles and produces indications of possible emerging health problems. It requires a centralized data management system which is able to handle the collection, storage, and management of the data from the five components of the human health monitoring system. The development of a centralized data management system will be very difficult and take some time to implement.

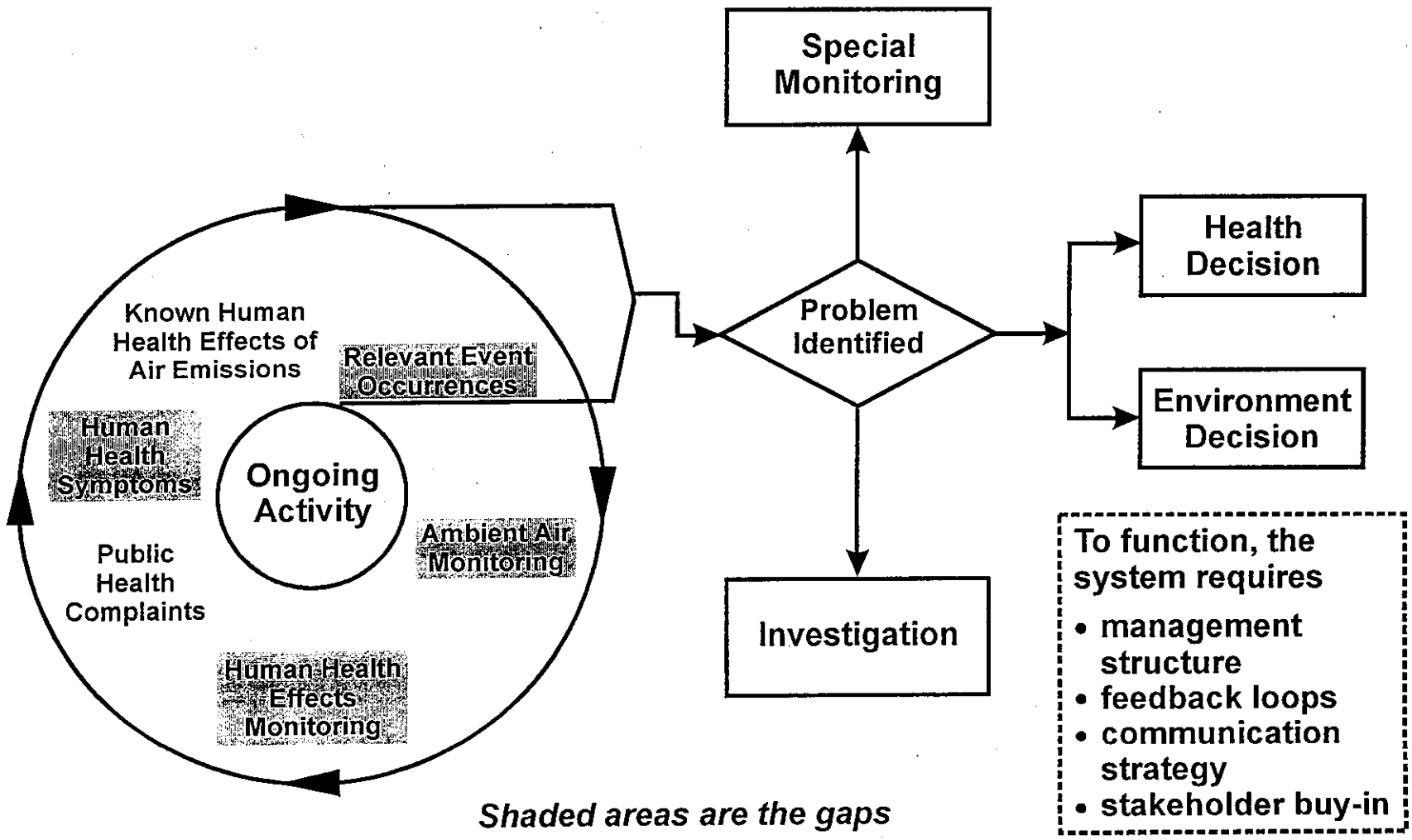
Parts of this ongoing activity are already in place in the province, but the various parts do not function as a whole and are not integrated into a total ongoing system.

4.3.2 Known Human Health Effects

Known human health effects associated with air quality are detailed in Tables 1 and 2. However, less serious symptoms such as irritation, itchiness, burning sensations of nose, throat or eyes, trembling, tingling, loss of feeling, weakness in extremities, feeling of suffocation or shortness of breath, tiredness or fatigue, coughing, wheezing or phlegm, and stomach discomfort, should also be considered. These are the kinds of symptoms that have often been identified by the public in the past in connection with concern over air quality. For example, subacute exposure to hydrogen sulphide has been associated with headache, dizziness, polyneuropathy, nausea, and diarrhea. A monitoring system for population health must include symptoms of this

Figure 2

Comprehensive Human Health Monitoring System



sort as well as health administration data (that is hospital admissions, emergency and doctor visits, etc.). Failure to address all symptoms, even to dismiss them, is to fail public expectations.

4.3.3 Relevant Event Occurrences

A relevant event is any event that could influence the health of populations in a way to produce symptoms that are commonly associated with air quality (4.3.2 above). Such relevant events could include occurrences of high or low temperature and/ or humidity; specific type of wind (chinook) or wind direction; high levels of allergens in the air; high level of forest fire activity or forest fires in close proximity; etc. Relevant events would also include sudden exceedances such as the Lodgepole blowout.

The recent outbreaks of forest fires, with noticeable impacts on air quality in both Edmonton and Calgary, may provide a meaningful example of a possible study on human health effects from a relevant event.

4.3.4 Ambient Air and Human Health Effects Monitoring

These two components comprise the operation of the traditional air monitoring and sampling system (now operated by Alberta Environmental Protection, Air Quality Zones, etc.) and the collection of administrative health data (now carried out by Alberta Health). Note that air monitoring must include monitoring relevant weather parameters (now carried out by Environment Canada and other agencies). Including these two components in the proposed human health monitoring system would mean that these two currently separate activities would be better coordinated for the purpose of finding associations between health outcomes at the population level and air quality. Better coordination of these two activities would also contribute to the assessment of long term trends of air pollution on a regional basis and the associated population health status.

4.3.5 Human Health Symptoms and Public Health Complaints

In order to provide an early warning of health effects in the population as a result of air emissions, the human health monitoring system must have a way of identifying possible health effects before they reach the stage where they become visible in the health administration data. The most effective way to accomplish this is for the public to register any symptoms they feel they have with the monitoring system. To some extent this occurs already in that the Regional Health Authorities now receive complaints about possible health effects from the public. Thus information received by the Regional Health Authorities may be adequate for the proposed human health monitoring system and all that is required is that this information be made available to the human health monitoring system. On the other hand, if information collected by the Regional Health Authorities is not adequate for the purpose of the human health monitoring system, it may be necessary to establish a 1-800 line to a central agency. The public could then telephone this 1-800 line and register their concerns, symptoms and complaints, no matter how small they may be. The central agency could then review the calls and forward them to appropriate agencies for action/ response. The central agency would also develop a data set of health symptoms and complaints that could then be analysed in conjunction with data from the other components of the human health monitoring system to identify health effects associated with air quality .

It may be worth noting that not all physicians are trained sufficiently in environmental medicine to be able to recognize groups of symptoms which have been documented by other physicians as constituting a particular disease. This suggests that if we are to remain true to this focus on population health, the human health monitoring system has to recognize that people will have:

- physical health complaints which are validated by a physician;
- physical health complaints which are no less real but have not been validated by a physician; and/or
- perceived health complaints that have to be treated as real.

Perceived health complaints may be divided into four types:

- complaints about the health effects of substances;
- complaints about illnesses which have a perceived environmental component;
- complaints about environmental issues which have an alleged health component; and
- complaints about groups of symptoms that are recognized by health experts trained in environmental health but are not recognized by local physicians.

All these various types of symptoms must be documented by the Human Health Symptoms and Public Complaints component of the human health monitoring system

4.3.6 Problem Identification

A potential problem may be identified through any of the components of the human health monitoring system. For instance, when a specified number of concerns are voiced/ recorded by the public in a region within a specified time period a potential problem may exist. In the event that a potential problem is identified, all relevant information from all the components of the human health monitoring system should be checked to confirm that a problem actually exists. Once confirmation of a problem exists, an investigation is launched.

4.3.7 Investigation

Once a specific problem is identified, an investigation may be launched. An investigation might entail a study like those conducted, and reported, by Alberta Health (1996(a), 1997(b), 1998(a)) in the past. On the other hand, available information may not suffice to define a definitive solution to the specific problem. In such a situation, special monitoring may need to be initiated to obtain needed information to resolve the specific problem.

4.3.8 Special Monitoring

Special monitoring may be carried out to obtain, for example, data on individual exposure (as was done in Alberta Health, 1997(a)), on individual health symptoms or to obtain more data on ambient concentrations of air contaminants. Once this needed extra data is obtained, all available data relevant to the specific problem is jointly analysed with a view to finding an association between some air quality parameter(s) and some health effect(s). If an association is found and documented, the specific problem moves to the decision point. If no association is found then more investigation and/ or special monitoring may be needed.

4.3.9 Health and/ or Environment Decision

At this point, the cause of the specific problem is known and mechanisms can be put in place to alleviate the problem. The mechanisms can range from public education to public warnings to regulation. Public education might entail raising public awareness of the existence of a problem and trying ti motivate the public to make healthy choices (e.g. cigarette smoking). Public warning might entail the issuance of guidelines with respect to consuming certain kinds of foods (e.g. Alberta Health, 1997b), exercising outdoors, etc. Regulation might entail reviewing/ changing an ambient guideline or some such action.

4.3.10 Management Structure

A multistakeholder management structure for the system is needed for ongoing strategic review and policy management, prioritization of effort and communication. This is distinct from the centralized data management required to operate the system.

4.3.11 Feedback

The envisioned human health monitoring system consists of an ongoing activity as well as possible special studies and investigations. A decision-making activity is also included in the system. Furthermore, the ongoing activity comprises many components which may be carried out by different people and/ or organizations. These various components of the system must communicate effectively. Each component must know what the other components are doing and what they have achieved. For instance, if new known health effects are identified through independent scientific research (as part of the "known human health effects" component) this information must be transmitted to all the other components of the system so that they can all take this new information into account in their activities/ decisions. As well, if members of the public are involved in identifying a problem (the "human health symptoms and public health complaints" component) they may wish to be involved in further investigation of the problem (the "investigation" component) and must be informed as to progress. Similarly, any environment or health decision which may impinge on any other part of the system has to be fed back appropriately.

4.3.12 Communication

Each component of the human health monitoring system is to contain a communication activity/ function. Communication is an integral part of the system and its importance cannot be stressed too much. Communication should be completely open, flexibly responsive, and coordinated. Communication is vital not only amongst all components of the human health monitoring system but also amongst the components of the system and the stakeholders and the public. Much of the success of the system will depend upon the responsiveness of the public to the system. If the public does not report health symptoms to the system, the system will fail. If the system does not respond adequately to the public, the public will lose faith in the system and will stop interacting with it and the system will fail. At the very least, the communication activities must comprise the following:

- at each step, inform stakeholders and the public of actions proposed and taken;
- responding to public input regarding specific complaints and keeping them informed;
- forwarding complaints not related to air pollution to appropriate authorities;
- producing regular reports on air quality and human health.

As well, the various components of the system must give the same message to stakeholders and to the public and so the communications between the stakeholders and the public and the various components of the system must be coordinated.

4.4 Robustness of the Proposed Human Health Monitoring System

The overall robustness of the proposed human health monitoring system was tested using two approaches: (1) peer review by experts in the field; and (2) review by project team members using specific case studies (scenarios). A peer review process was undertaken by two individuals:

- Dr. Richard Burnett of Health Canada and author of many peer reviewed articles on this topic (see Section 4.4.1), conducted a general overview of the proposed system;
- Dr. Steve Hrudey of the University of Alberta, an Alberta expert in the area of health and risk management, is in the process of conducting a comprehensive review based on the Fort McMurray area (see Section 4.5).

The review by project team members used specific case studies focussed on:

- a sudden release scenario; and
- an urban air quality scenario (Section 4.4.3)

4.4.1 Peer Review by Dr. Burnett

The proposed human health monitoring system just described was reviewed by Dr. Richard Burnett of Health Canada. Dr. Burnett (Burnett et al., 1994; Burnett et al., 1995) found the proposed system to be viable but advised the HHPT to start small and to focus on issues that are either unique to Alberta or are areas in which Alberta already has generated a critical capacity (e.g. long term data on H_2S exposure). Furthermore, Dr. Burnett advised the Team to pick concrete issues or specific components from the framework, and to slowly build up the framework using a layered approach, as opposed to tackling the entire framework at once. During the meeting with Dr. Burnett, concern was expressed over the HHPT's lack of attention to methodology and technical analysis as well as over the fact that a lot of time and attention needs to be given to "functional" aspects of the system (i.e. the management structure, feedback loops, stakeholder buy-in, etc.). The Team needs to learn by doing one step at a time.

4.4.2 Sudden Release Scenario

The HHPT explored three very distinct hypothetical sudden release events:

- critical sour gas well blow-out;
- forest fire;
- transportation disaster.

and considered what was required, or what would be obtainable, for each of the components of the proposed human health monitoring system. The results of these deliberations are given in Appendix H. The Team concluded that the proposed human health monitoring system framework would work if applied in situations such as these. Note that the situation investigated in Alberta Health (1997b) is an example of the kind of occurrence considered here.

4.4.3 Urban Air Quality Scenario

The HHPT also explored application of the Framework to urban air quality issues. The

results of these considerations are in Appendix I. The Team concluded that the Framework would work if applied to urban air quality problems. The situation investigated in Alberta Health (1998d) is an example of this kind of problem.

4.5 Evaluation of the Framework

The final test of the robustness of the Framework was to be an application of the Framework to the Alberta Oil Sands Community Exposure and Health Effects Assessment Program. This community program is discussed in 4.5.1 below and the evaluation of the Framework in 4.5.2. The status of the evaluation is discussed in 4.5.3.

4.5.1 The Alberta Oil Sands Community Exposure and Health Effects Assessment Program

The Alberta Oil Sands Community Exposure and Health Effects Assessment Program was developed to ensure that a long-term, systematic approach to data gathering was implemented that would improve our knowledge about the link between the environment and human health. To date a pilot study has been completed. The purpose of the pilot study was to develop the methodology to be used in the main investigation and to address the technical, laboratory, and logistical aspects of the Program. This included developing the appropriate exposure assessment techniques, field activities, analytical laboratory testing procedures, and data analysis capabilities.

Specifically, the objectives of the pilot study were to develop a data collection method for personal/ population exposure assessment of exposure to sulphur dioxide, nitrous oxides, ozone, volatile organic compounds, particulates, and heavy metals using the Total Exposure Assessment method, including development of the protocols for field data collection, laboratory analysis, and quality assurance; development of methods for the collection of individual ancillary data on exposure conditions, health status, and nutrition; conducting a feasibility study on a convenience sample of the population; and development of a statistical analysis methodology for the environmental data.

The total cost of the pilot study was $ 535,000. The cost of the remainder of the program is $ 1,550,000. This cost can be broken down as follows:

- technical support services $ 1,210,000
- in kind contributions $ 200,000
- project management $ 75,000
- other support services $ 65,000

The in kind contributions were provided by Northern Lights Regional Health Authority, Alberta Health, Suncor Energy, Syncrude Canada, Regional Municipality of Wood Buffalo, Fort McMurray Environmental Association. This provides some idea of the potential cost of a human health monitoring effort in a specific community.

4.5.2 Evaluation of the Framework

The HHPT engaged a consultant, Dr. Steve Hrudey, to evaluate the Framework against the Alberta Oil Sands Community Exposure and Health Effects Assessment Program. The terms

of reference for this evaluation are in Appendix J. The evaluation is to identify gaps and issues that need to be addressed in implementing the Framework, particularly those related to the ongoing operation of the system.

4.5.3 Status of the Evaluation

The evaluation of the Framework through application to the Alberta Oil Sands Community Exposure and Health Effects Assessment Program is to be completed in February 1999. The HHPT will then review the report and derive from it specific recommendations with respect to implementing the Framework. The consultant's report on the evaluation will form Appendix K to this report. The HHPT's further thoughts on implementing the Framework will form Appendix L of this report. Both Appendix K and Appendix L will be submitted to the CASA Board at their meeting in June 1999.

5. Proposed Implementation Mechanism

The HHPT feels that a number of parts of the various components of the Framework already exist within a number of organizations in Alberta and so it should be feasible to implement the Framework through collaborative partnership arrangements. To investigate the feasibility of establishing such a collaborative partnership arrangement, the HHPT conducted a gaps analysis in the course of which they identified the parts of the Framework that already exist and those that need to be developed.

The results of the HHPT's deliberations on gaps in the components of the Framework are detailed in Table 4. Thus Table 4 represents the proposed implementation mechanism.

Listed in Table 4, are the essential activities that must be carried out on an ongoing basis if the Framework is implemented. The parts of the "component" that already exist in Alberta and the parts that must yet be developed are identified. How the "gap" is to be developed is specified under "recommended actions" and by whom it is to be developed is specified under "recommended delivery mechanism". Note that Alberta Health, CASA, and Alberta Environmental Protection are generally given responsibility for delivery. This is not surprising since these three agencies, in general, already deliver the existing parts of the Framework. Also noteworthy is the fact that many of the "recommended actions" involve multistakeholder or multi-sectoral groups or processes.

The HHPT recognizes that there are gaps in Table 4, that is not all the activities and delivery mechanisms required have been specified. This deficiency will be removed once the evaluation of the Framework is completed. For this reason, the appendix (L) on further thoughts on implementation will be prepared. Appendix L is to be prepared by a subgroup of the HHPT lead jointly by Alberta Health and Alberta Environmental Protection and is to be completed by May 1999.

Table 4:

FRAMEWORK FOR HUMAN HEALTH MONITORING SYSTEM - DRAFT GAPS ANALYSIS and RECOMMENDATIONS TO FILL GAPS

Component	Current Initiative	Gap	Potential Delivery Mechanism	Recommended Action
1. Relevant Health Data collected -administrative -health effects	Alberta Health and Regional Health authorities collect and compile administrative date and **some** health effects data	comprehensive health effects data Integrated data	Alberta Health	That Alberta Health collect the necessary data That Alberta Health integrate health effects data
2. Data analysed and assessed to detect adverse effects or potential risks	Project specific assessments (e.g. Swan Hills, Fort McMurray Health Assessment Study)	No ongoing broader assessment process	Alberta Health MSG process	Alberta Health to develop on-going process with input from Human Health Project Team
3. Public Health Complaints	Has mechanism in place	Systems technology		
4. Human Health Symptoms responded to	Currently occurs as a result of special studies or incidents (e.g. Swan Hills, Lodgepole blowout) Population Health Surveys cover some aspects	Need on-going mechanism	Co-locate with existing 1-800 number (e.g. Poison Control Centre) Alberta Health	Establish 1-800 number to collect data Integrate with Human Health Monitoring System
5. Data linked with air quality data (to detect variations in health effects as a result of air quality)	Alberta Ambient Air Quality Monitoring System (AAAQMS)	Technical and scientific expertise to interpret data Technical Advisory Committee Specific geographical data	Joint-venture between Alberta Health, CASA Zones, AAAQMS, Human Health Project Team and researchers	Establish integrative mechanism and process

Table 4 - continued

HUMAN HEALTH MONITORING SYSTEM

Component	Current Initiative	Gap	Potential Delivery Mechanism	Recommended Actions
6. Information/results of analysis responded to	Ad Hoc or Project Specific	Need MSG Management Component Communications Strategy to disseminate information	CASA, Alberta Health, Alberta Environmental Protection	Establish multi-sectoral process
7. Process for Prioritizing Human Health Issues requiring a management response	Currently issue driven (i.e. Swan Hills, Flaring)	Need on-going MSG process	CASA, Alberta Health, Alberta Environmental Protection	Establish multi-sectoral process
8. Special Monitoring (e.g. relevant events responded to)	Currently issue driven	???	Alberta Health, Alberta Environmental Protection	Test through implementation plan for Human Health Monitoring System
9. On-going management structure	None	Need open and transparent multi-sectoral process	CASA, Alberta Health, Regional Health Authorities	Establish multi-sectoral management group

The HHPT believes strongly that the human health monitoring system, once it has been implemented, should be reviewed, evaluated and possibly revised several years after implementation. An appropriate mechanism for conducting this review might be to incorporate it into CASA's strategic planning process.

6. Recommendations

The HHPT makes the following recommendations with respect to the proposed human health monitoring system:

Recommendation 1
The HHPT recommends that the CASA Board reaffirms its approval of the proposed Framework for a Human Health Monitoring System (first given in February 1997);

Recommendation 2
The HHPT recommends that the CASA Board endorse the formation of a multistakeholder subgroup of the HHPT, under the joint leadership of Alberta Health and Alberta Environmental Protection, to develop specific recommendations, timelines, and workplan to implement the proposed Framework for a Human Health Monitoring System;

Recommendation 3
The HHPT recommends that the CASA Board incorporate a review of the implemented human health monitoring system into CASA's periodic strategic planning activities;

Recommendation 4
The HHPT recommends that the CASA Board endorse the proposed timelines to complete Appendices K (Evaluation Report) and L (Subgroup Report on Implementation) to this report before the June Board meeting and to submit them for approval at that time.

7. Conclusions

An association between levels of ambient concentrations of criteria pollutants currently occurring in Canada and significant health outcomes, which likely affect large populations, is well established through numerous investigations in different regions of Canada and the United States. Alberta is a significant emitter of criteria pollutants. Although ambient concentrations of criteria pollutants have generally been stable, or declining, in Alberta in recent decades there is no assurance this trend will continue. Alberta has a higher than average, in Canada, mortality rate from asthma. In recent years, a number of issues have arisen that have caused large public concern over health effects from air pollutants. A human health monitoring system to quickly identify/ detect health effects from air quality is a worthwhile investment in Alberta.

The proposed Framework for a Human Health Monitoring System has been conceptually tested through a peer review and several scenarios and has been found to be robust. It comprises five ongoing components: known human health effects; relevant event occurrences; ambient air monitoring; human health effects monitoring; and human health symptoms and public health complaints, as well as three ongoing administrative functions: management; feedback; and communication. The system also involves a problem identification function, a decision function

and the potential for special investigation/ monitoring. Because of the sheer magnitude and technical complexity of the job of implementing such a system province-wide, it was decided to implement the system piece-by-piece and to learn while doing. To evaluate the Framework, by applying it to the Alberta Oil Sands Community Exposure and Health Effects Assessment Program, the HHPT has engaged a consultant, Dr. Steve Hrudey of the University of Alberta. The consultant is to identify gaps and issues that need to be addressed in implementing the Framework, particularly those related to the ongoing operation of the system, and his report will be used to provide guidance in implementing the proposed framework.

The HHPT proposes that the Framework be implemented in a case-by-case manner, through a multistakeholder, collaborative effort spearheaded by Alberta Health, Alberta Environmental Protection and CASA. More specific recommendations for implementing the Framework, than are presently contained in this report, are to be derived by a subgroup of the HHPT after the evaluation is completed.

Both the consultant's report on the evaluation and the subgroup's report on specific implementation recommendations are to form appendices to this report (Appendix K and Appendix L). These two appendices are to be submitted to the Board in June 1999.

A human health monitoring effort such as is envisioned can be quite costly. Note the cost of the pilot study of the Alberta Oil Sands Community Program was $ 535,000 and that of the main study was $1,550,000, making a total cost of $ 2.1 million. The human health effects that have been associated with air pollution, however, pose substantial costs as well which are ultimately paid by both individuals and corporations. For instance, air pollution has been found to exacerbate asthma. Green et al. (1996) estimated the per capita cost of asthma in Canada in 1990 was $ 7.47. This suggests yearly asthma-related costs of about $20 million in Alberta.

In summary then the HHPT recommends that the CASA Board:

- reaffirms its approval of the proposed Framework for a Human Health Monitoring System;
- endorse the formation of a multistakeholder subgroup of the HHPT to develop specific recommendations, timelines, and workplan to implement the proposed Framework for a Human Health Monitoring System;
- incorporate a review of the implemented human health monitoring system into CASA's periodic strategic planning activities;
- endorse the proposed timelines to complete Appendices K (Evaluation Report) and L (Subgroup Report on Implementation) to this report before the June Board meeting and to submit them for approval at that time.

APPENDICES

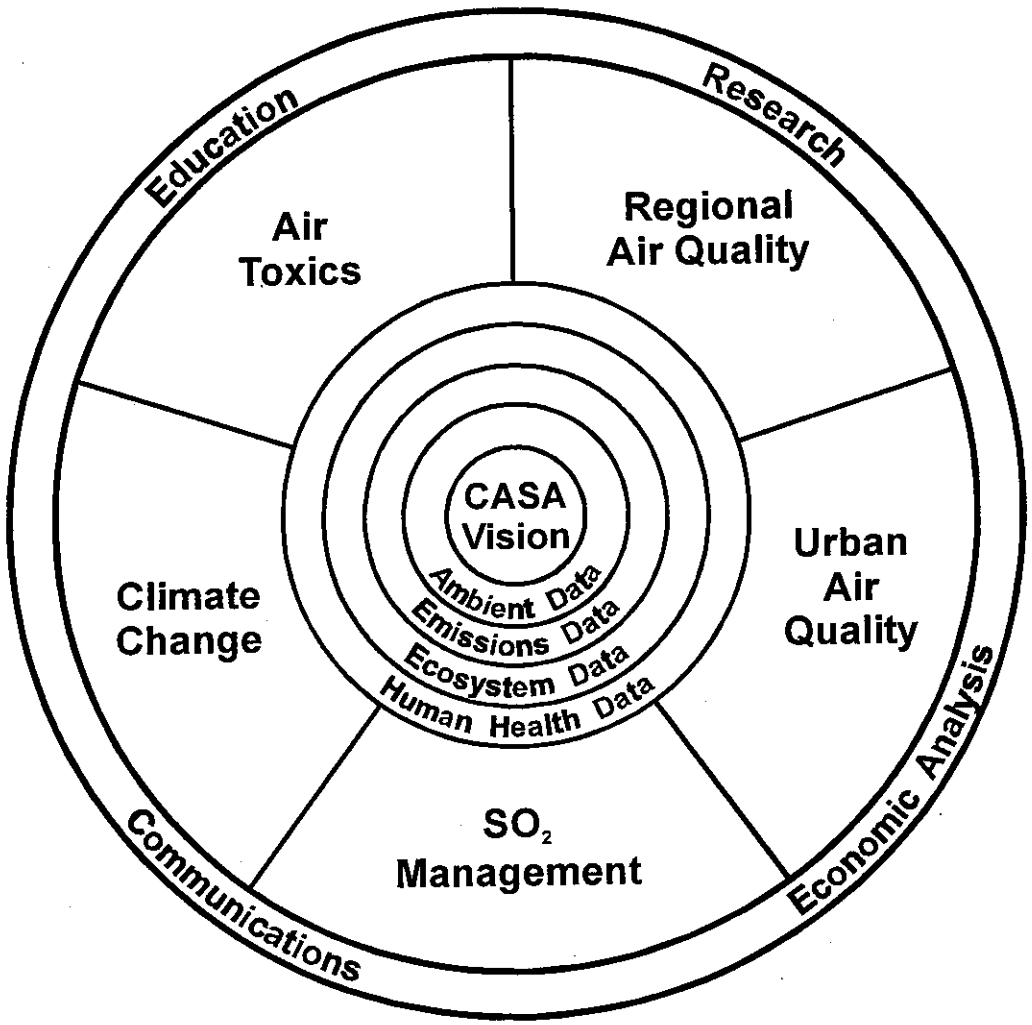
Appendix "A"
Human Health Project Team
List of Members

Name	Organization Name	Phone/Fax	E-mail Address
Chris Baker	Pembina Institute	542-6272/542-6464	cbaker@piad.ab.ca
Vic Benz	Sherritt International	992-7131/992-7575	vbenz@@sherritt-intl.com
Tim Gondek	Suncor	743-6556/743-7607	tgondek@suncor.com
Geoff Granville	Shell Canada	691-2220/691-2224	granvil@shell.ca
Jerry Hall	Alberta Lung Assoc	283-1333/283-1558	jhall@lung.ab.ca
Les Johnston	EPCOR	448-3488/412-3364	ljohnsto@edpower.com
Don Macdonald	AB Dep't of Energy	422-7872/427-2278	macdond@enr.gov.ab.ca
Christine Macken	CASA	427-9793/422-3127	casa@incentre.net
Alex MacKenzie	Alberta Health	422-4419/427-1470	gaboss@health.gov.ab.ca
Eric Peake	AB Research Council	297-7532/297-7548	peake@arc.ab.ca
Dennis Stokes	AEP	427-8850/422-4192	dstokes@env.gov.ab.ca
Kent Stuehmer	Inland Cement	420-2571/420-2528	kstuehmer@inland.lehighcement.com
Rudy Zimmer	D. Thompson Health Authority	341-2166/341-2188	rzimmer@acs.ucalgary.ca

Past Members:

Peter Cordingly	Sherritt International
Stephan Gabos	Alberta Health
Lloyd Harman	Alberta Forest Products

CASA Strategic Overview



Appendix "B"

CASA Human Health Project Team **Terms of Reference**

Purpose

The mandate of the CASA Human Health Project Team (HHPT) is to develop recommendations for a system within which the effects of air contaminants on human health can be monitored and addressed.

Objectives

In collaboration with other organizations and stakeholder groups, the Human Health Project Team will:

- Develop a proposal and recommendations for a monitoring system with the potential to identify, manage and address human health effects caused by air contaminants;
- Evaluate the proposed monitoring system;
- Make recommendations for implementation;
- Ensure that the proposed monitoring system is sufficiently robust for appropriate implementation;
- Report to the CASA Board at key milestones.

Tasks

1 Collect and summarize information on air contaminants and human health effects.
2 Determine the significance of this information for Alberta (based on sources/volumes of emissions, health effects data, ambient air quality data, management practices, etc).
3 Identify and prioritize Alberta-specific human health/air quality issues that would benefit from the establishment of the proposed monitoring system.
4 Recommend an appropriate management approach [*framework*] to ensure that the monitoring system can respond to identified issues and concerns.
5 Determine the feasibility of implementing the system through collaborative partnership arrangements with existing agencies (e.g. Alberta Health, the Alberta Ambient Air Quality Monitoring System, local health authorities, CASA zones).
6 Make recommendations for implementation, including a management and funding structure, taking into consideration the need for a system that is responsive to province-wide as well as local/regional issues.

Estimate of Time

Tasks 1, 2, 3 and 4 will be completed by June 1998
Tasks 5 and 6 will be completed by October 1998
A final report and recommendations will be presented to the CASA Board in November 1998.

Estimate of Costs

The initial cost for the project team to develop its recommendations is estimated to be approximately $20,000. The CASA Board approved the amount, to be found by the Project Team stakeholders.

Background:

The work of this Project Team is consistent with the CASA vision and mandate: namely
the air will have no measurable short- or long-term adverse effects on people...

To achieve the vision, CASA will: *Implement a comprehensive air quality management system in Alberta that allows for identifications of problems, prioritization of issues [and] development of action plans.*

The terms of reference for this Project Team fit within the priorities, values, and expectations of the Board and is in accordance with the CASA vision for air quality.

Coordination with the following CASA projects will be established to promote synergies, avoid duplication and ensure optimal use of resources: Air Toxics, Ambient Air Quality Monitoring System, Vehicle Emissions and the three approved Zones.

Membership on Project Team

A list of Project Team members and their respective stakeholder groups is attached as an Appendix to the Terms of Reference.

Responsibilities of Project Team members

Project team members are responsible for communicating regularly with their stakeholder groups and for seeking feedback on recommendations and proposals developed by the Project Team. The project leaders will be responsible for ensuring that the CASA Board is provided with regular updates and final recommendations.

Appendix "C"

Clean Air Strategic Alliance

Executive Framework For A Human Health Monitoring System

Prepared by
The CASA Human Health Resource Group

HUMAN HEALTH MONITORING SYSTEM

This document outlines the framework for a generic human health monitoring system for Alberta. It has been developed, and is supported by, the members of the CASA Human Health Resource Group, which includes representatives from industry, government, health and environment NGOs, and other stakeholders.

The proposed monitoring system cannot answer all questions about health effects and air quality. Instead, the system is a tool that can be used to gather information on the health of people for the purpose of detecting trends and associations between air quality and health related variables. The *process* consists of an on-going systematic collection, analysis, and interpretation of selected data on health outcomes, air quality parameters, and population exposure. Despite its apparent simplicity, this is not an easy process to develop, as can be confirmed by the lack of available models on which to base a system.

GOALS

The goals of the proposed system are:

- to ensure the availability of timely, high quality data while respecting issues of privacy and confidentiality;
- to ensure that information about human health relative to air quality is made available to the public and to decision-makers; and
- to encourage studies and pilot projects on human health, especially lung health, and to correlate results with ambient air quality data and other relevant data.

OBJECTIVE

To facilitate the development of a province-wide system, including methods and techniques, for measuring and assessing human health effects in relation to air quality.

THE MONITORING SYSTEM

Figure 1 (attached) depicts the capability of the system to integrate, on an ongoing basis, ambient air quality and human health effects data. The system can also respond to community driven health concerns, and can investigate concerns of a local, regional or zonal nature through the use of specialized studies and specialized data collection. The system has the following components:

1. Ongoing Monitoring

Central to the proposed human health system is the collection of ambient air monitoring data which would be correlated with data on health effects (symptoms) at the population level. This component serves as a first level of assessment of human exposure to air contaminants on a provincial basis. This component serves to:

a) Provide better linkages between the existing ambient air quality and health effects data,
b) Provide a province-wide framework (technical and organizational) for carrying out detailed exposure and health effects monitoring and, if necessary, special studies,
c) Contribute to the assessment of long term trends of air pollution and associated population health status.

2. Public Health Concerns

This component is initiated when a number of health concerns received from a region or community warrant a comprehensive investigation. These concerns may be identified by members of the public, or may emerge from activities occurring in other components of the human health monitoring system. This component will:

a) Provide a fast, cost-effective, mechanism to respond to public concerns,
b) facilitate identification of emerging hot spots or areas of concerns, and
c) facilitate validation of community concerns.

3. Special Monitoring

This component is triggered as a result of concerns that cannot be resolved through either of the above components (1 or 2), and involves the use of periodic exposure and health effects surveys for different pollutants. For example, these studies could attempt to assess human exposure in specific regions or the exposure of selected population groups (e.g. children, highly sensitive or highly exposed people) to specific pollutants. Two generally accepted methods for this type of monitoring are:

-collection of individual exposure data through the use of personal exposure monitors
-collection of special ambient data.

At this level, data on personal exposure is compared with special ambient data to provide further evidence of linkages between ambient emissions and a possible health effect. This component will:

- provide detailed exposure and health effects data for air contaminants considered to be of priority by the communities participating in the study
- promote the research and development of personal exposure assessment methodologies
- provide better support and data for epidemiologic studies on health effects of air pollution
- provide the rational, if necessary, for health or regulatory decisions.

CONCLUSION

The proposed monitoring system provides a comprehensive model for stakeholder involvement, ongoing monitoring, continual assessment, and response to public concerns, with each component having steps of increasing technical complexity, and each step relying on problem identification before initiation.

The Human Health Effects of Major Air Emissions

Adapted from (Guidotti, 1995a:220)

Human Health Monitoring System

	Effects of relevant concentrations	Contributing factors
Sulphur dioxide	Airways irritation, bronchitis [1], broncho constriction, Provocation of asthmatic episodes	exercise, particulates, asthma[2]
Nitrogen dioxide	Mild airways irritation, cough, reduced airflow, bronchiolitis[3], reduced host defences	exercise, respiratory tract infection, asthma
Ozone	Airways irritation, provocation of asthmatic episodes, chest tightness, cough, reduced airflow, bronchitis, reduced host defences, diminished athletic performance	exercise, respiratory tract infection, asthma
Carbon monoxide	Symptoms of mild carboxyhemoglobinemia: headache, irritability, angina in some persons with coronary heart disease	coronary heart disease
Particulates (PM_{10})	Airways irritation, bronchitis, increased hospital Admissions, overall mortality from many causes	Sulphur dioxide, sulphuric acid, heat, humidity, exercise
Hydrogen sulphide	Foul odour, airway irritation	regional problem, incidental release
Sulphates, sulphuric acid	Severe airways irritation, possibly provocation of asthmatic episodes, increased hospital admissions	particulates
Peroxy-acetyl nitrate	Eye irritation	other aldehydes may contribute

1 Inflammation of one or more bronchi.

2 Recurrent attacks of paroxysmal laboured or difficult breathing, with wheezing due to spasmodic contraction of the bronchi.

3 Inflammation of the lungs.

Proposed Implementation Plan

Human Health Monitoring System

Methods & Techniques	*Mechanism in Place*	*Potential Delivery Mechanism/ Agency*
Assessment & analysis of health care utilization data	Yes	Alberta Health to lead
Assessment & analysis of health effects data	No	Multi stakeholder process
Correlation of health care utilization data and health effects data with ambient air quality data	Partly - to be further developed;	Alberta Health, Ambient Air Quality Monitoring Project Team, Health & Environment NGOs, Industry, etc.
Process to prioritize issues and ensure further necessary studies are recommended	Yes (Figure 1 attached)	Test process through implementation plan
Evaluation process	Yes	Test through implementation plan
Guidelines for cost-effective action, and evidence-based decision-making	Yes	Test through implementation plan
Communications plan	Draft in progress	To be completed as part of implementation plan
Budget	No - it is expected that system will be delivered within current departmental/agency budgets	To be developed during implementation stage

Continuous Improvement

Human Health Monitoring System

Continuous Improvement is a long-term philosophy or approach to issue management which means: when things change, they will change for the better. This philosophy can be interpreted to mean improvements in knowledge, issue definition, risk/benefit analysis, system and facilities management, and education initiatives.

Applied to a Human Health Monitoring System, a Continuous Improvement philosophy would focus on improvements in the collection, management, and analysis of human health data. This would include improvements in the quality and quantity of data collection.

It is an approach that is applied to human health and ambient air indicators where there is concern and uncertainty regarding human health effects. It is a statement that improving the collection and management of data in meaningful ways is a positive approach.

Continuous Improvement is not applied where an immediate threat to human health exists. That will be dealt with directly. Continuous Improvement is also not a demand for immediate action, but to integrate improvement in meaningful ways in longer-term planning.

Appendix "D"
Bibliography

Alberta Health 1996(a): Geographic and Temporal Variations of Selected Respiratory Diseases in Strathcona County and Fort Saskatchewan.

Alberta Health, 1996(b): Analyzing the Influence of Ambient Air Quality on Health in Human Populations: Health Outcome Indicators.

Alberta Health, 1997(a): Re: Alberta Oil Sands Community Exposure and Health Effects Assessment Program - Phase I: Plant Study.

Alberta Health, 1997(b): Swan Hills Special Waste Treatment Centre Human Health Impact Assessment.

Alberta Health 1998(a): Assessment of Respiratory Disorders in Relation to Solution Gas Flaring Activities in Alberta.

Alberta Health, 1998(b): Life Expectancy in Alberta: Socioeconomic Perspectives.

Alberta Health, 1998(c): Population Projections for Alberta and its Health Regions 1996-2016.

Alberta Health 199?: Health Trends in Alberta.

American Lung Association, 1995: Out of Breath: Populations-at-Risk to Alternative Ozone Levels, Washington, D.C.

Bates D,V, 1995: Ozone: A review of recent experimental clinical and epidemiological evidence, with notes on causation, Part 1. Canadian Respiratory Journal, Vol. 2, 25-31.

Bates, D.V., 1995: Ozone, A review of recent experimental clinical and epidemiological evidence, with notes on causation, Part 2, Canadian Respiratory Journal, Vol. 2, 161-171.

Brown, G.L., R.M. Wilson, D. Yee, M.B. Schroeder, R. Olson, and M. Woods, 1997: Integrated Human Health Risk Assessment of Air Emissions from an Oriented Standard Mill, Sawmill and Wood-Fried Power Plant near a Rural Alberta Community. In "Emerging Air Issues for the 21st Century" 355-364.

Burnett, R.T., R.E. Dales, M.E. Raizenne, D. Krewski, P.W. Summers, G.R. Roberts, M. Raad-Young, T. Dann, and J.R. Brook, 1994: Effects of Low Ambient Levels of Ozone and Sulfates on the Frequency of Respiratory Admissions to Ontario Hospitals. Environmental Research, 65, 172-194.

Burnett, R.T., D. Krewski, R. Vincent, T. Dann, J.R. Brook, 1995: Associations Between Ambient Particulate Sulfate and Admissions to Ontario Hospitals for Cardiac and Respiratory Diseases.

Appendix "D"
Bibliography - Continued

CEPA/FPAC Working Group on Air Quality Objectives and Guidelines, 1998: National Ambient Air Quality Objectives for Particulate Matter - Part 1: Science Assessment Document.

Committee of the Environmental and Occupational Health Assembly of the American Thoracic Society, Parts 1 and 2, 1996: Health Effects of Outdoor Air Pollution. American Journal of Critical Care Med., Vol. 153, pp 3-50 and 477-498.

Fu, Long, 1997: Carbon Monoxide Exposure Assessment for Urban Residents in Edmonton, Alberta. In "Emerging Air Issues for the 21st Century," 365-375.

Green, F.H.Y., S.C. Tough, A. Karkharnis and M Cudmane, 1996: Joffre Plant Site Expansion Project Air Quality and Human Health. Report prepared for NOVA Chemicals Ltd.

Green, F.H.Y., S. Boser, S.H. Roth, K. Nikula, F. Hahn, and V. Vallathan, 1997: Comparative Pulmonary Responses of Humans and Animals to Air Pollutants: A Commentary. In "emerging Air Issues for the 21st Century: The need for Multi-disciplinary Management." Air and Waste Management Association, Canadian Prairie and Northern Section. 338-348.

Guidotti, T.L. and G.S. Jhangri, 1994: Mortality from Airways Disorders in Alberta, 1927-1987: An Expanding Epidemic of COPD, but Asthma Shows Little Change. Journal of Asthma, 31(4), 277-290.

Guidotti, Tee L., 1995: Ambient Air Quality and Human Health: Current Concepts, Part 1, Can Respir J. Vol. 2, 211-222.

Guidotti, T.L., 1995: Trends in Mortality from chronic obstructive pulmonary disease in Alberta: back to the future: Canadian Respiratory Journal Vol. 2, 97-103.

Guidotti, Tee L., 1996: Ambient Air Quality and Human Health: Current Concepts, Part 2, Canadian Respiratory Journal, Vol. 3, 29-37.

Kindzierski, W.B., 1996: Health Outcomes Associated with Air Pollution: Preliminary Summary and Recommendations of Health Outcomes for use in Epidemiological Analysis. Unpublished draft report.

Northern River Basins Human Health Monitoring Program.

Sandhu, H.S., 1998: Ambient Particulate Matter in Alberta Sandhu, H.S., 1998: Ambient Particulate Matter in Alberta. Report prepared for Alberta Environmental Protection.

US Environmental Protection Agency, 1996: Particulate Matter Research Needs for Human Health Risk Assessment.

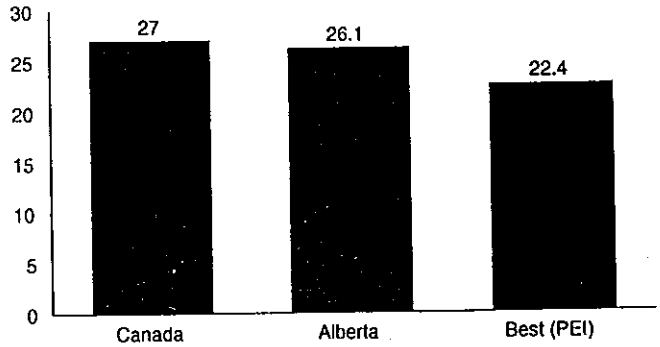
D.4 Respiratory Diseases

D.4A Chronic Obstructive Pulmonary Disease (COPD)

COPD includes emphysema and chronic bronchitis. In Alberta, the 1994 mortality rate from COPD was 26.1 per 100,000. This is slightly lower than the national average (27 per 100,000), and somewhat higher than the best province, PEI (22.4 per 100,000)

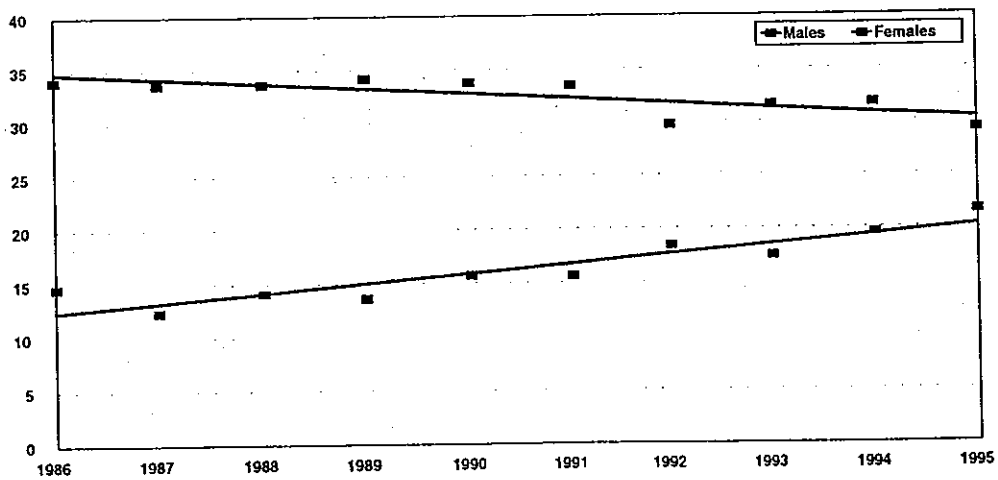
Males are at higher risk of dying from COPD than females, although this is changing. The 10 year trend shows that the mortality rate is decreasing for males and increasing for females. Changing patterns of smoking may account for some of this change.

Figure D.4A.1
Mortality Rates for COPD, 1994 (Alberta, Canada, Best Province) (Deaths per 100,000 population, age standardized)



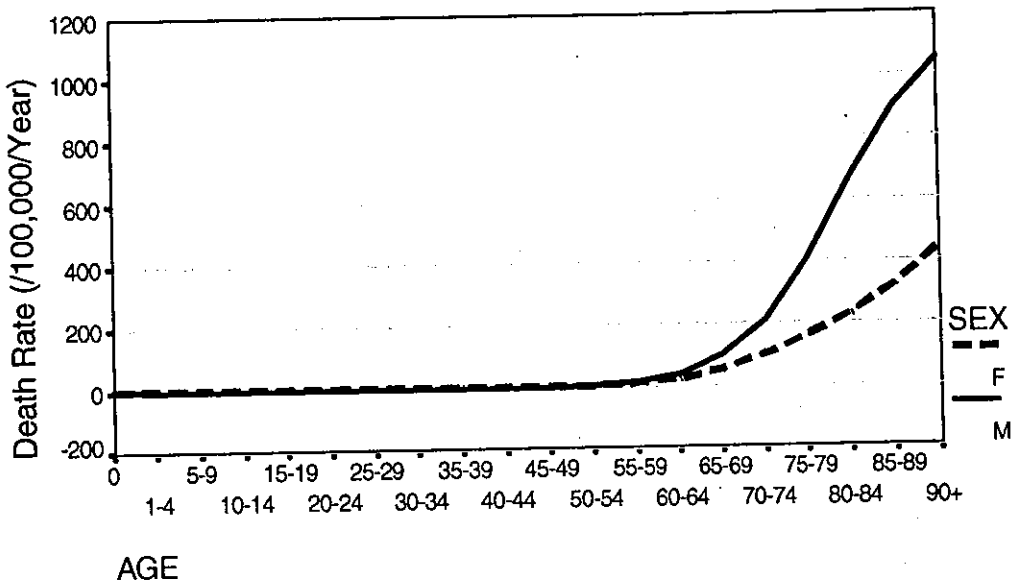
Sources: Vital Statistics, Death File, April 1997 release;
Statistics Canada Canadian Mortality Database

Figure D.4A.2
Mortality Rate for Chronic Obstructive Pulmonary Disease in Alberta 1986-95 (Deaths per 100,000 population, age standardized)



Source: Vital Statistics, Death File, April 1997 release

Figure D.4A.3
Age Specific Death Rates for COPD in Alberta, 1993-95



Source: Vital Statistics, Death File, April 1997 release

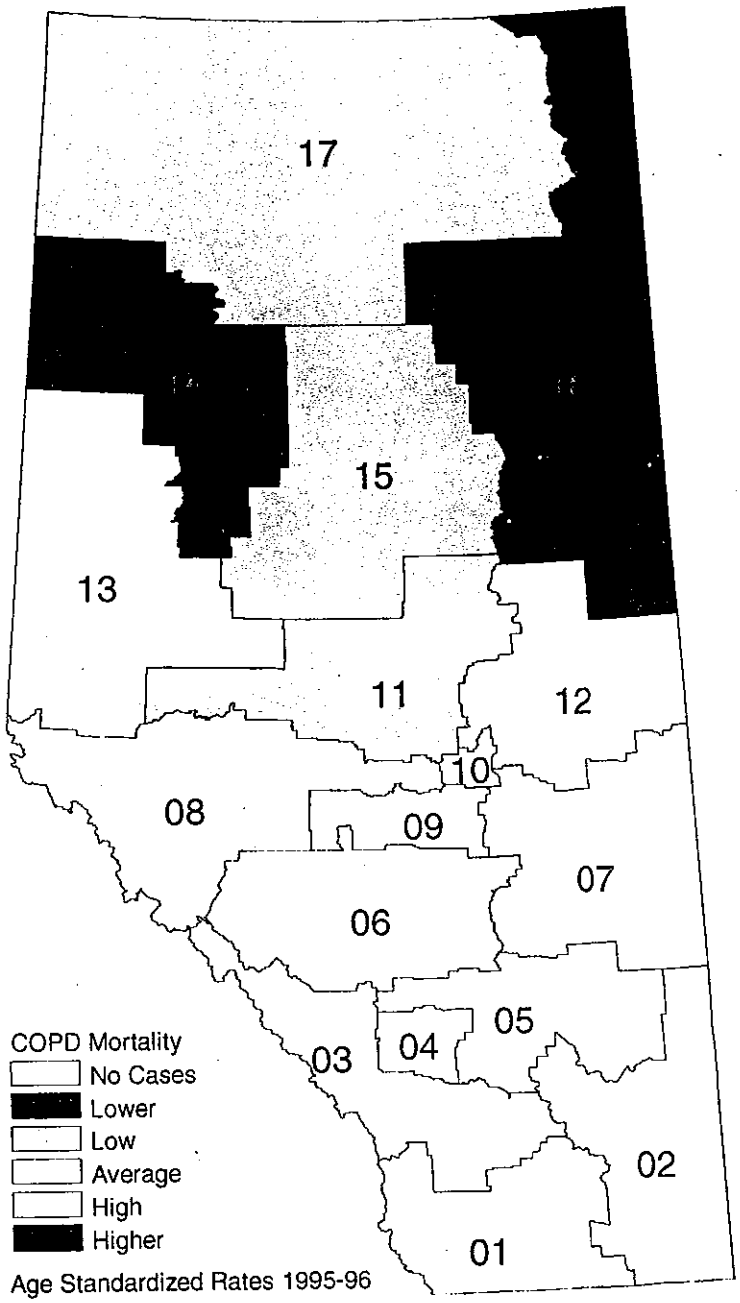
Provincial Initiatives

- Alberta Tobacco Reduction Plan -- A collaborative, comprehensive plan has been developed by about 50 stakeholders. The plan identifies strategies to reduce tobacco use in the province.

- Alberta Teen Tobacco Reduction Project -- Television ads have been developed by teens in four northern Alberta communities to discourage youth aged 10 to 14 years from smoking. The ads will be broadcast in northern Alberta from late February to May, 1998.

- Alberta Health supports a number of community agency projects, including the Class Blast Program, Smoke-Free Homes Project and the Alberta Tobacco Control Centre.

Figure D.4A.4
Regional Differences in COPD Mortality Rates (Alberta, 1995/96)



Source: Vital Statistics, Death File, April 1997 release

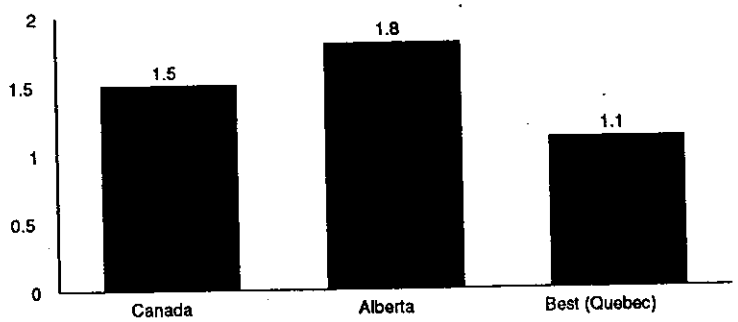
Mortality attributed to COPD is higher in the northern part of the province, particularly in the Northern Lights and Peace health regions.

D.4B Asthma

Concerns have been raised frequently about rates of asthma in Alberta. This respiratory disease often first appears in childhood and can have a significant impact on physical activities.

Rates of mortality, though, are generally quite low. In Alberta in 1994, the mortality rate from asthma was 1.8 per 100,000. This rate is higher than the Canadian average (1.5 per 100,000) and that of the best province, Quebec (1.1 per 100,000).

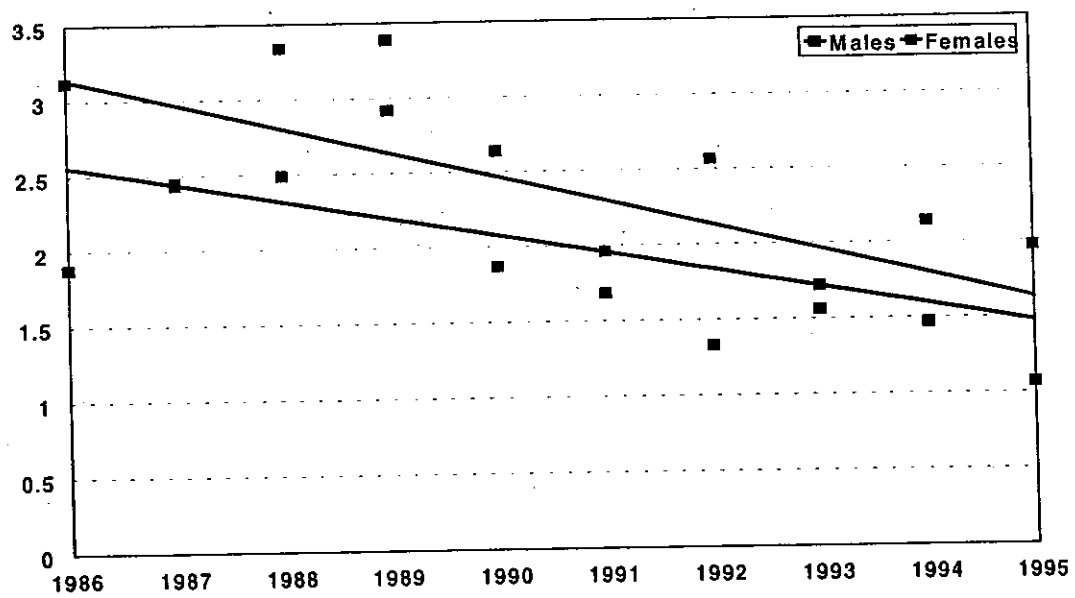
Figure D.4B.1
Mortality Rate for Asthma, 1994 (Alberta, Canada, Best Province) (Deaths per 100,000 population, age standardized)



Sources: Vital Statistics, Death File, April 1997 release; Statistics Canada, Canadian Mortality Database

The difference between mortality rates for males and females is slight, with mortality decreasing for both sexes. Females have a slightly higher risk of dying from asthma than males. Improved medications are making it easier to live longer with this disease.

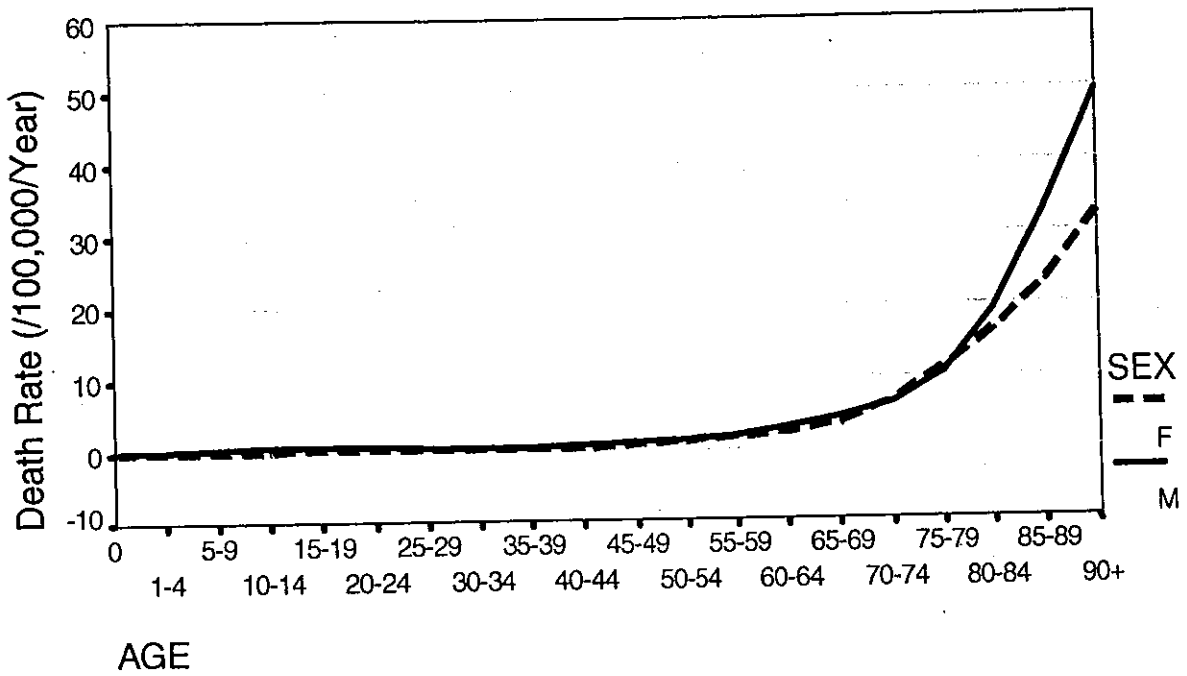
Figure D.4B.2
Mortality Rate for Asthma in Alberta 1986-95
(Deaths per 100,000 population, age standardized)



Source: Vital Statistics, Death File, April 1997 release

While the rates of mortality for males and females are comparable throughout most of the life span, in the older age groups, the risk is higher for males.

Figure D.4B.3
Age Specific Death Rates for Asthma in Alberta, 1993-95



Source: Vital Statistics, Death File, April 1997 release

Provincial Initiatives

- Alberta Tobacco Reduction Plan -- A collaborative, comprehensive plan has been developed by about 50 stakeholders. The plan identifies strategies to reduce tobacco use in the province.

- Alberta Teen Tobacco Reduction Project -- Television ads have been developed by teens in four northern Alberta communities to discourage youth aged 10 to 14 years from smoking. The ads will be broadcast in northern Alberta from late February to May, 1998.

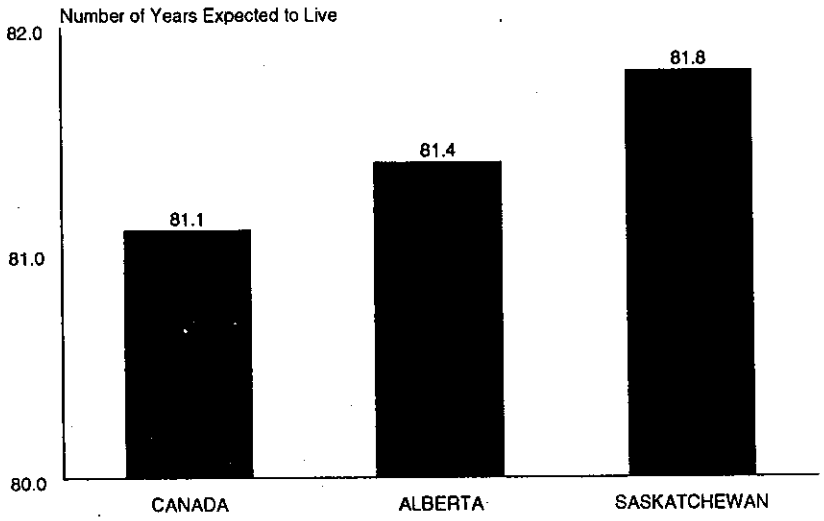
- Alberta Health supports a number of community agency projects, including the Class Blast Program, Smoke-Free Homes Project and the Alberta Tobacco Control Centre.

- Alberta Health is a member of a provincial committee of the Clean Air Strategic Alliance (CASA), which is establishing air quality guidelines.

A.4 LIFE EXPECTANCY

Life expectancy is 'the average number of years an individual of a given age is expected to live if current mortality rates continue to apply' (Last, J. *Dictionary of Epidemiology*. 3rd edition, Oxford University Press, New York. 1995. p.59). An increasing life expectancy at birth is frequently interpreted as an indicator that a population is healthy, has adequate access to health care, has healthy diets, and is protected from the effects of environmental, workplace, or other hazards that would shorten life.

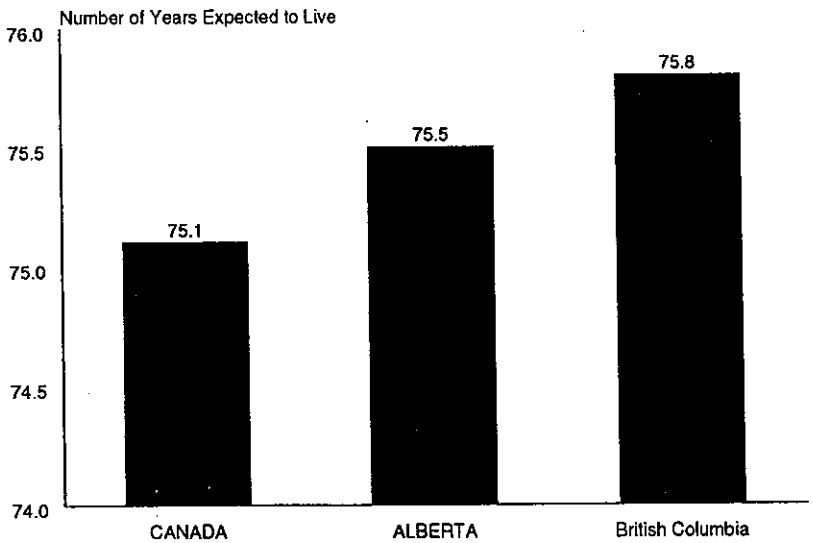
Figure A.4.1(a)
Female Life Expectancy at Birth, 1994 (Canada, Alberta, Best Province)



Source: Current Demographic Situation in Canada: 1994, Statistics Canada

Life expectancy is calculated using estimates of age-specific mortality rates for a defined population over a circumscribed time period. Because these estimates depend upon large populations for stability, life expectancy is most often interpreted for large populations. Measures of variability should be calculated if the measure is to be employed on smaller regional populations.

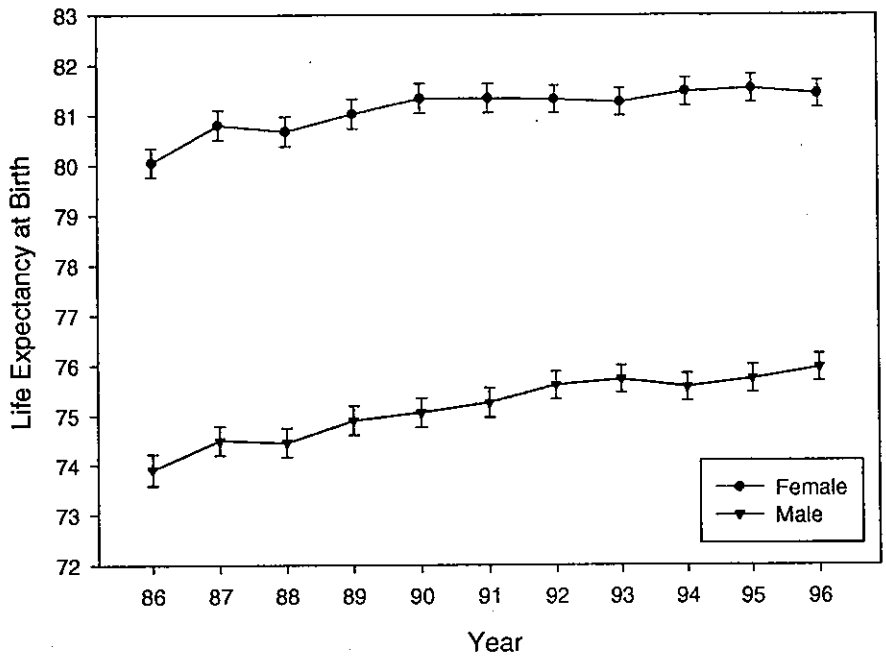
Figure A.4.1(b)
Male Life Expectancy at Birth (Canada, Alberta, Best Province)



Source: Current Demographic Situation in Canada: 1994, Statistics Canada

The figure below shows the life expectancy at birth (and its 95 per cent confidence interval) for Alberta males and females over the past decade. There is a general upward trend, more marked for males than for females.

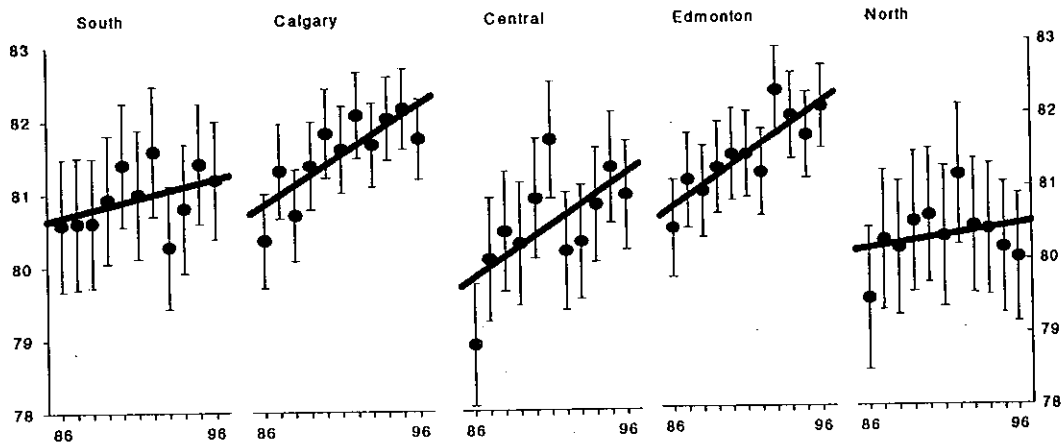
Figure A.4.2
Trends in Alberta Life Expectancy at Birth 1986-96



Source: Health Surveillance Branch, Alberta Health, 1997

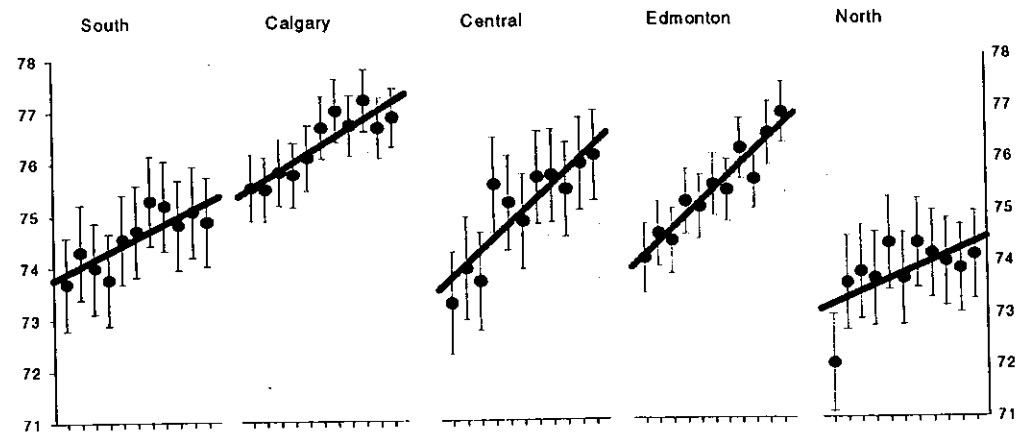
The figures which follow are calculated on smaller regions and show larger variability (as indicated by width of the 95 per cent confidence around each point). For both females and males, life expectancy has increased at the regional level as indicated by the upward sloping trend lines, though for individual regions there is considerable fluctuation around this trend line. These figures also show that gains in life expectancy have been greater for the major urban areas (Calgary and Edmonton) than for the predominantly rural areas.

Figure A.4.3(a)
Female Life Expectancy at Birth by Region 1986-1996



Source: Health Surveillance Branch, Alberta Health, 1997

Figure A.4.3(b)
Male Life Expectancy at Birth by Region 1986-1996



Source: Health Surveillance Branch, Alberta Health, 1997

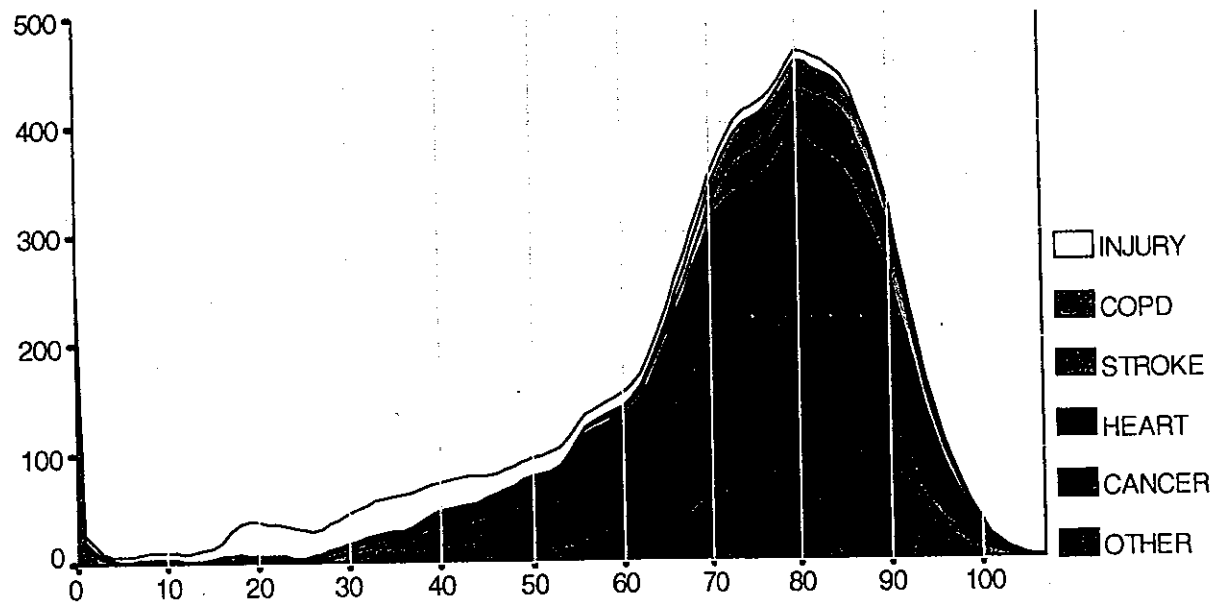
D. CHRONIC DISEASE AND INJURY

CAUSES OF DEATH

In this, the first edition of this report, this section examines the various causes of death in Alberta and compares provincial data to those available for the rest of Canada (as data become available, it will also examine causes of morbidity). Comparisons are possible because there is a common coding system (ICD-9: Ninth International Classification of Diseases) used by every health jurisdiction in the country. As well as having a standard classification, we have access to consistently collected data through Statistics Canada.

Figure D.1 illustrates the distribution of deaths in Alberta by major cause (COPD = chronic obstructive pulmonary disease) and by age group. As can be expected, the vast majority of deaths occur in the 50-and-over age categories. Deaths due to injury begin the upward curve at a much earlier age, indicating that determinants other than age are involved, which may make more of these deaths preventable.

Figure D.1
Distribution of Deaths in Alberta, 1995



Source: Vital Statistics, Death File, April 1997 release

Appendix "F"
Historical Trends and Projections of Emissions of Criteria Pollutants in Alberta and Elsewhere

Total Anthropogenic Emissions from Point Sources in Alberta of Criteria Contaminants

	Emissions in tonnes/yr		
	1985	**1990**	**1995**
Particulates	218,723	194,448	109,404
SO_x	538,695	566,515	525,545
NO_x	447,233	486,713	600,015
VOC	227,691	637,653	761,721
CO	1,276,600	1,303,013	1,612,885
THC	392,225		
PM_{10}			71,828
$PM_{2.5}$			55,929

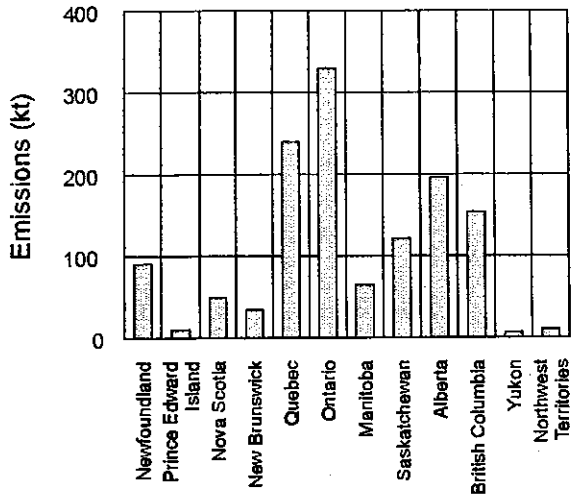
Projections of Emissions of Criteria Contaminants for Alberta

Year	*Contaminants: Emissions in kilotonnes/yr*		
	SO_2	**NO_x**	**VOCs**
1990	566.50	486.72	706.88
1995	636.80	494.71	719.91
2000	554.30	524.99	718.30
2005	565.00	542.88	735.40
2010	588.80	547.81	754.68

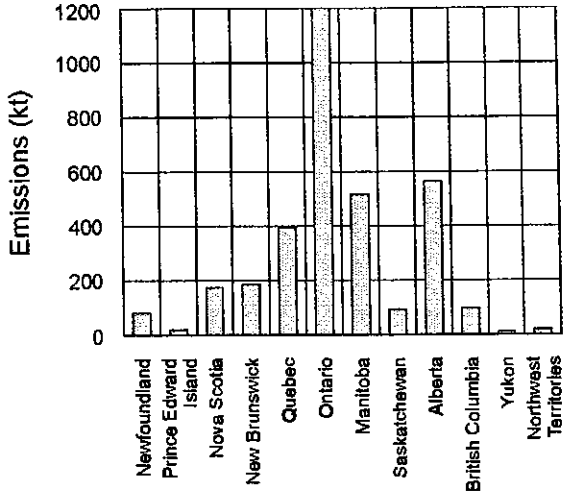
1. No_x and NO_2
2. VOCx as total non-methane hydrocarbons

Provincial Distribution of Emissions of Criteria Pollutants

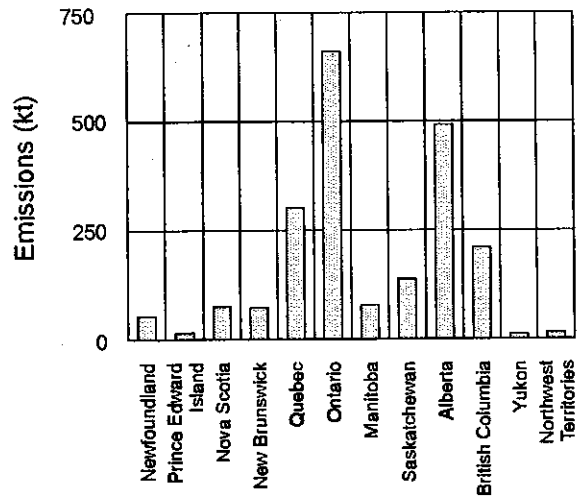
Provincial TPM Distribution
Total 1,281 kilotonnes



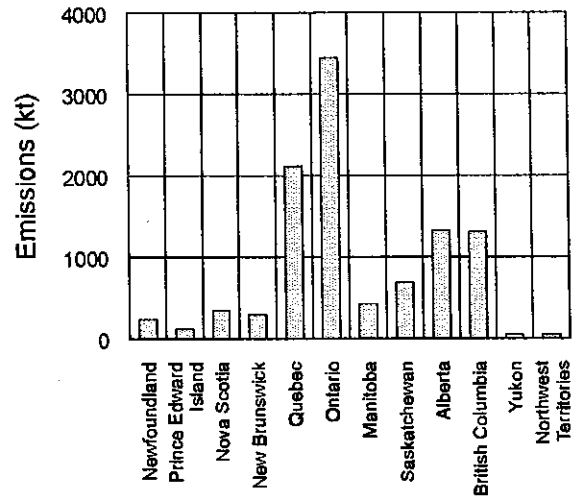
Provincial SOx Distribution
Total 3,296 kilotonnes



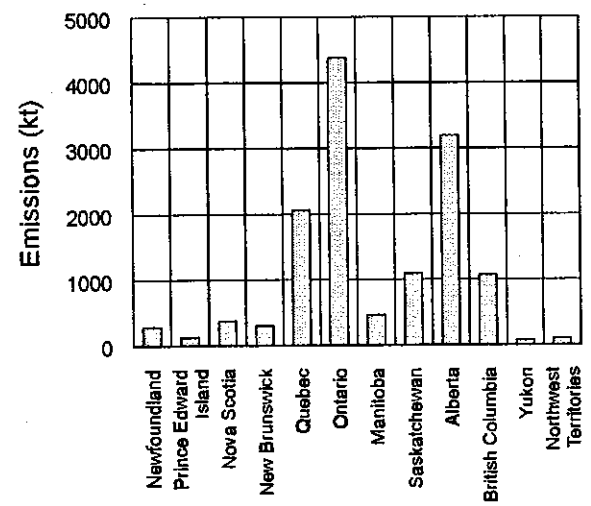
Provincial NOx Distribution
Total 2,062 kilotonnes



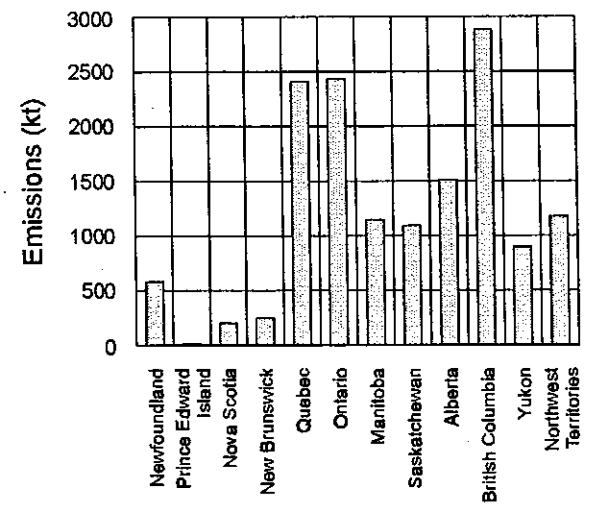
Provincial CO Distribution
Total 9,922 kilotonnes



Provincial VOC Distribution
Total 2,579 kilotonnes

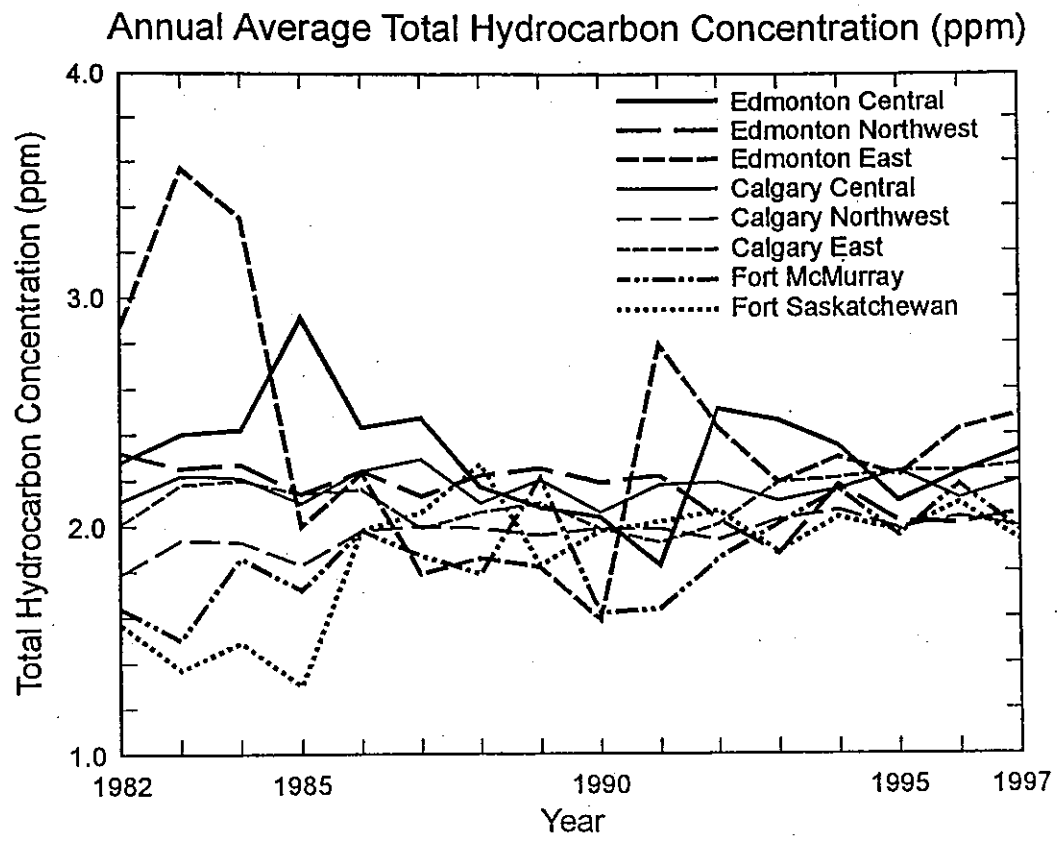


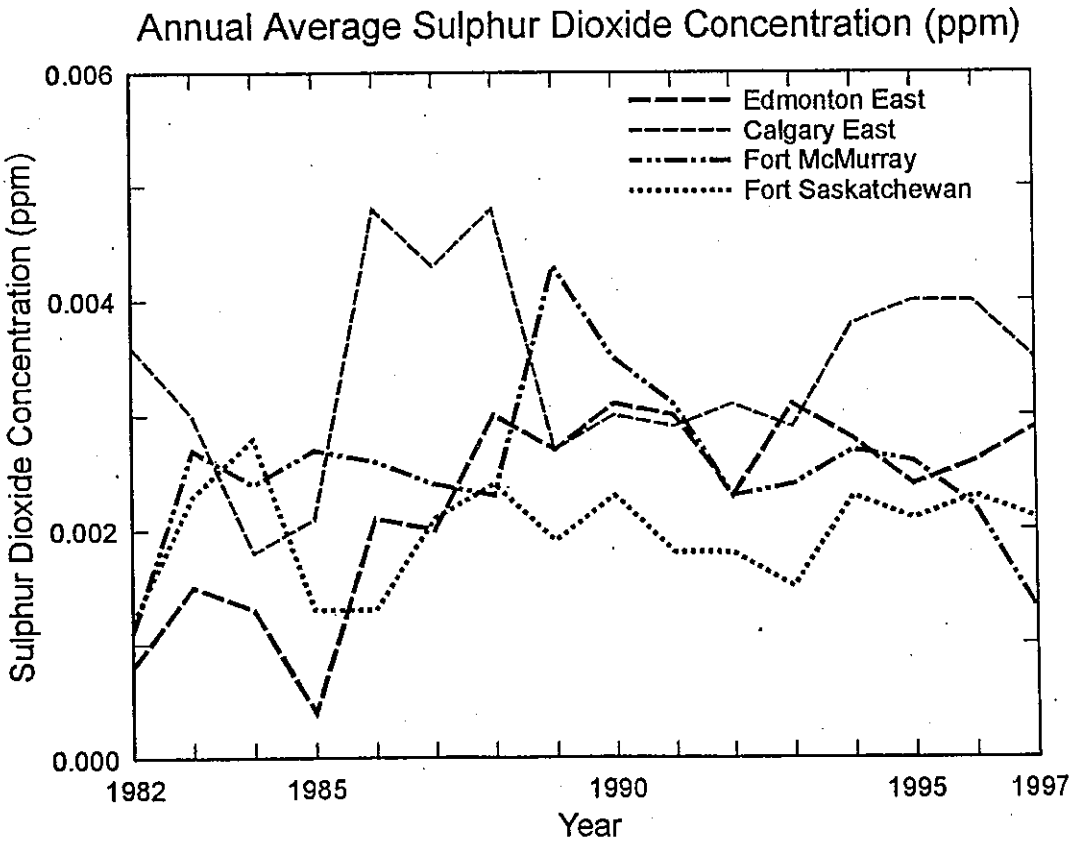
Provincial Biogenic VOC Emissions
(note: biogenic = from vegetation)
Total 14,197 kilotonnes

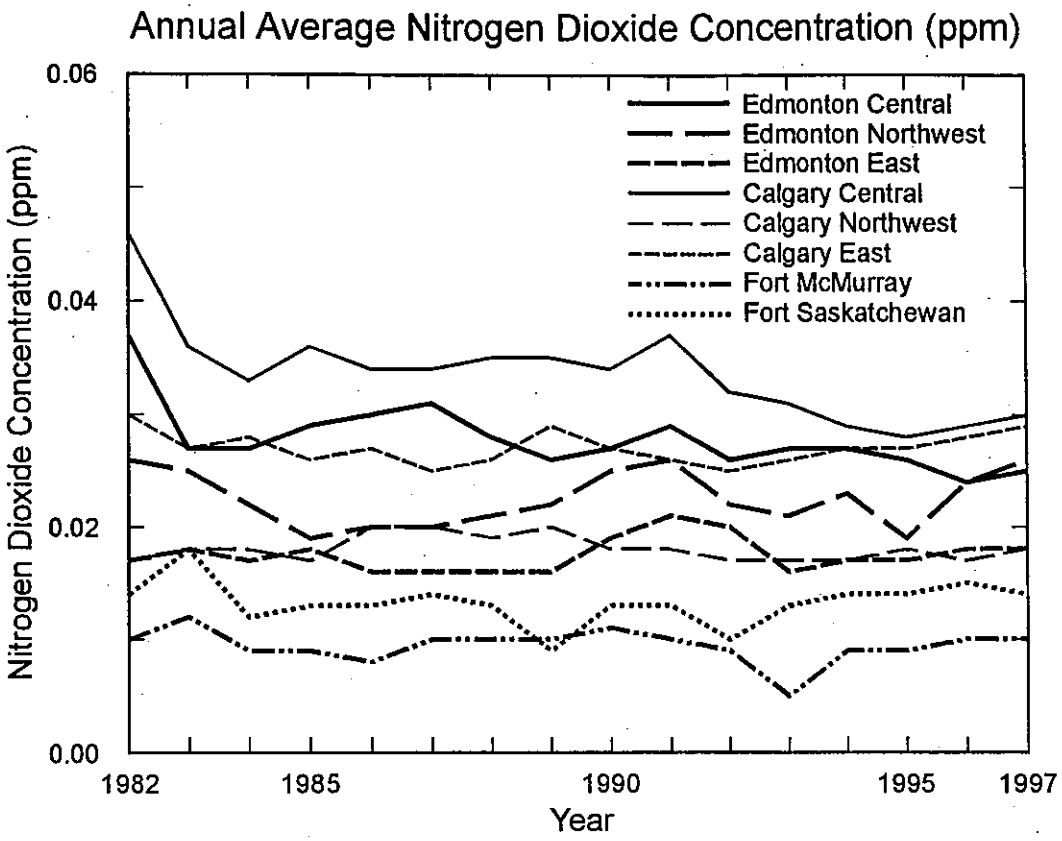


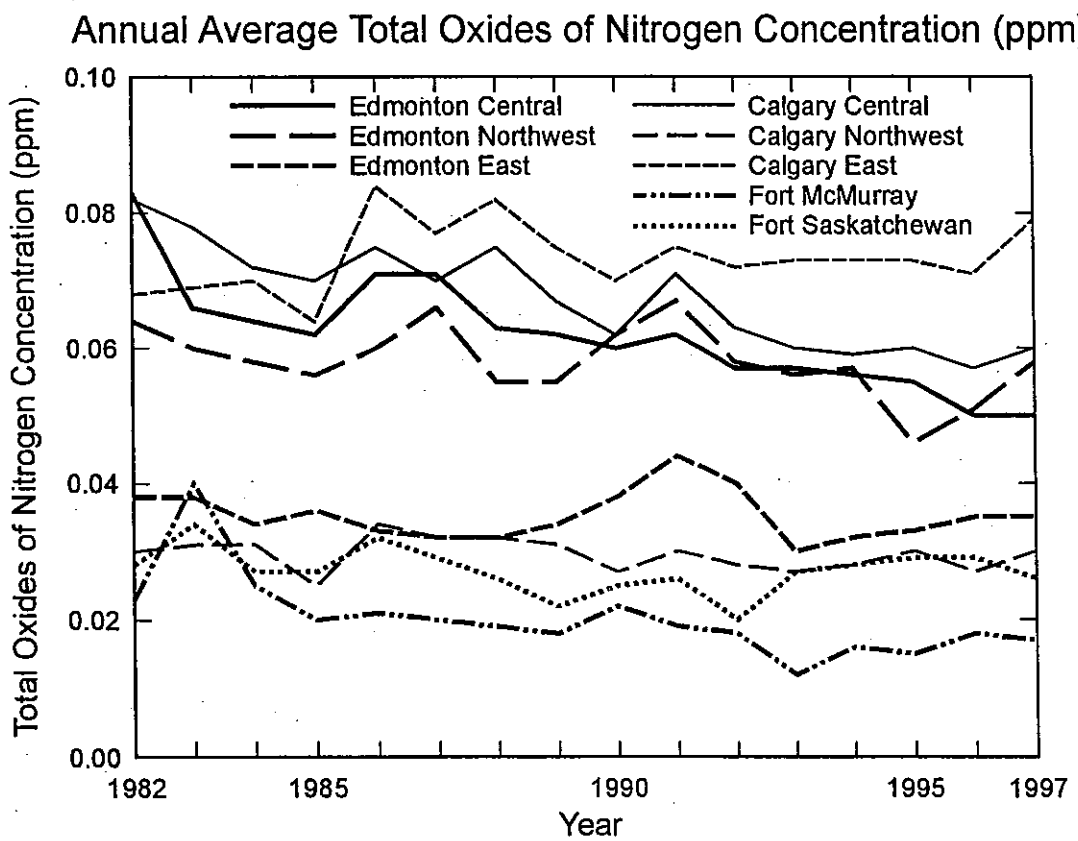
Source: Canadian Emissions Inventory of Criteria Air Contaminants (1990)

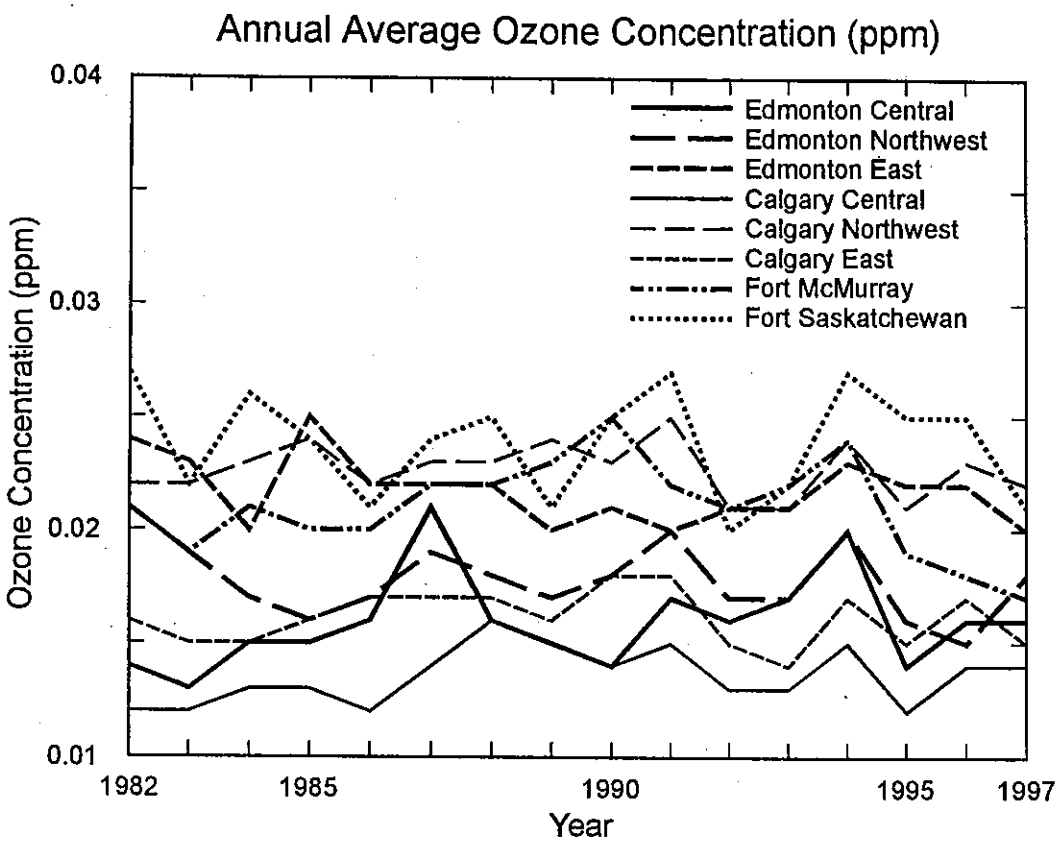
Appendix "G"
Historical Trends of Ambient Concentrations of Criteria Pollutants in Alberta

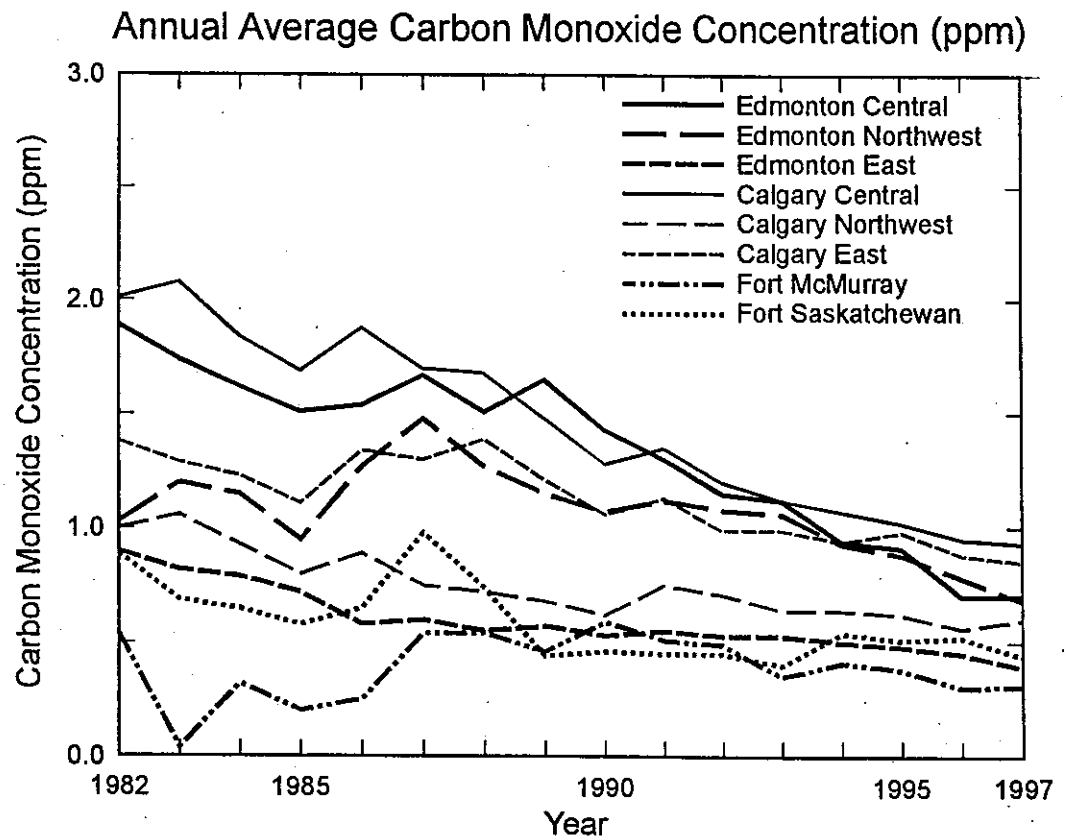





Annual Average Nitrogen Dioxide Concentration (ppm)
Nitrogen Dioxide Concentration (ppm)
0.06
0.04
0.02
0.00
1982
1985
1990
1995
1997
Year
Edmonton Central
Edmonton Northwest
Edmonton East
Calgary Central
Calgary Northwest
Calgary East
Fort McMurray
Fort Saskatchewan


Annual Average Total Oxides of Nitrogen Concentration (ppm)
Total Oxides of Nitrogen Concentration (ppm)
0.10
0.08
0.06
0.04
0.02
0.00
1982
1985
1990
1995
1997
Year
Edmonton Central
Edmonton Northwest
Edmonton East
Calgary Central
Calgary Northwest
Calgary East
Fort McMurray
Fort Saskatchewan


Annual Average Ozone Concentration (ppm)
Ozone Concentration (ppm)
0.04
0.03
0.02
0.01
1982
1985
1990
1995
1997
Year
Edmonton Central
Edmonton Northwest
Edmonton East
Calgary Central
Calgary Northwest
Calgary East
Fort McMurray
Fort Saskatchewan


Annual Average Carbon Monoxide Concentration (ppm)
Carbon Monoxide Concentration (ppm)
3.0
2.0
1.0
0.0
1982
1985
1990
1995
1997
Year
Edmonton Central
Edmonton Northwest
Edmonton East
Calgary Central
Calgary Northwest
Calgary East
Fort McMurray
Fort Saskatchewan

Human Health Effects Monitoring Effects data is currently available within Alberta Health, and can be added to, by including such components as medication use. The data will need detailed analysis and manipulation, as the challenge is to investigate the relationships between air monitoring data and health effects. This requires specific expertise in epidemiology, biostatistics and public health; such researchers will also require funding.

Known Health Effects The literature includes numerous reviews of health effects associated with air quality. The effects are often summarized in the form of a pyramid, in which the apex comprises a relatively small number of the most severe effects, including death. The base comprises a much higher number of (minor) subclinical effects. In the middle are (in descending order of importance(hospital) admissions, emergency room visits, physician office visits, reduced physical performance, medication use, and impaired pulmonary function. Impacts on health are most likely to be found in susceptible sub-populations such as the elderly, and people of all ages with existing conditions like cardiovascular or respiratory disease. Children may also be more susceptible as they may be outdoors more than most adults. Given the absence of high levels of pollution in Alberta's urban areas relative to many other cities where such studies have been carried out in the past, it is unlikely that additional effects, not described above, would be identified.

Special Monitoring Ideally, a study on UAQ would include specific monitoring of volunteers to allow for better determination of human exposure to air pollutants. Personal monitoring studies are generally agreed to be important in order to understand the relationship between ambient levels of pollutants and actual human exposure. Such information will improve our understanding of the relationship between exposure and effects, and allow for better future decisions.

Investigation It is very important to base any decisions related to the management of UAQ on a solid foundation, because policy implications can be profound. Potential solutions to UAQ concerns include land planning changes for urban regions, new transportation management policies (including new public transit, and controls on private and industrial transportation), location of industrial facilities, and further controls on domestic space heating. Therefore the investigation of impacts of UAQ on health must be well planned and funded.

Health Decision/Regulatory Decision Possible decisions may range from public education programs and health advisories, to major changes eg new transportation policies.

Appendix "J"

June 2,1998 draft

CASA HUMAN HEALTH MONITORING SYSTEM
TERMS OF REFERENCE FOR EVALUATION

Purpose

The purpose of this project is to evaluate the proposed Framework for a Human Health Monitoring System (the Framework) against the Alberta Oil Sands Community Exposure and Health Effects Assessment Program (the Fort McMurray study). The objective of the Fort McMurray study is to improve the knowledge base about the link between environment, particularly air contaminants, and human health. The evaluation will allow completion of Tasks 4 and 5 identified in the Terms of Reference for the Human Health Project Team.

Objectives

1. Evaluate the proposed Framework against the Fort McMurray study
2. Identify gaps and issues that need to be addressed through the proposed Framework, particularly those related to the ongoing operation of the system. These include, but are not limited to:
    - a workable multi-stakeholder management structure
    - administrative requirements
    - critical assessment of required linkages (e.g. sources of information and assessment, including methodological, technical and analytical aspects
    - communications strategy/dissemination plan; and
    - the need to maximize stakeholder commitment and on-going support
3. Report on finding and make recommendations to the Human Health Project Team.

Scope of the Project

The Human Health Project Team will manage this project and will request regular updates on progress. The consultant will be expected to interview people involved in the Fort McMurray study and members of the HHPT, in order to clarify objectives of the Framework, and identify gaps and other issues that may make the Framework difficult to establish in practice.

Estimate of Time

A draft final report to the HHPT will be expected six months after initiation of the project.

Cost Estimate

Costs will not exceed $20,000.

Communications

All communications will be between the consultant and the co-chairs of the Human Health Project Team.