Towards an Air Quality Management Strategy for the Prince George Region.

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Abstract

The purpose of this study was to investigate and evaluate air quality management strategies and plans in existence today and compare them to the ongoing air quality management planning process in Prince George.

The study was conducted by reviewing the literature related to management and control of air pollution, and air quality legislation in Canada, documenting a variety of approaches to air quality management in other regions; and administering questionnaires to people involved with air quality. An in-depth case study was completed documenting the attempts taken in Prince George to produce an air quality management plan (AQMP).

The literature review defined air pollution, identified many of the possible control and monitoring strategies available for use in regulating the amounts and types of pollution emitted into the air, the effects of geography and climate on air quality, the influences of government and the general public, the economic feasibility of air quality management plans, and alternative air quality management strategies including watershed and ecosystem management approaches. The review also documented legislation in Canada, British Columbia and local municipalities.

The case studies of regions in Canada and elsewhere provided in-depth information on air quality management plans in existence today. Included in the case studies is information on scope and focus of the plans, planning processes, responsible persons and agencies, implementation structure, and the mandates or mission statements for each air quality management plan. Commonalities and differences were identified among the case studies.

The questionnaire process provided information related to the procedures involved in preparing an air quality management plan. Respondents were asked to comment on the constraints of preparing an air quality management plan, the general public’s understanding of air quality issues, the types of air quality management approaches they considered most effective, what goals each person had for air quality, and who should make air quality planning decisions. Specific questions were asked related to the involvement of government, stakeholders, and the general public in the process, structures of committees and any improvements that could be made in hindsight to the approaches taken in their air quality management process.

The process of integrating the information found in the case studies with the interview responses and existing management literature enabled the researcher to identify criteria that can be used to evaluate air quality management strategies and make recommendations for an effective air quality management process.

In conclusion, many of the air quality management plans in existence today integrate some of the evaluative criteria, but to what degree they have been successful is difficult to say at this time. From the in-depth case study of Prince George, it was determined that inclusive stakeholder and public participation was absent from the onset of the Prince George air quality management process, there was a lack of funding available to the process compared to other regions, such as the Greater Vancouver Regional District, and scientific data unavailable at the time of the planning process may have been constraints to the overall success of this air quality management process. This is not to say that the process will not produce the intended results, but the many economic and political constraints delayed the process and cast doubt on its successful implementation.
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B. To be continued...

I would like to dedicate this project to my Nana, your love of life and encouragement of me has been an inspiration.
1.0 Introduction

Air pollution, taken by itself, can already be controlled if there is the will to do so.

(Stem, 1976)

Air pollution controls in Canada as well in many other countries focus primarily on National and Provincial/State standards and regulations through the use of permits/licenses. These permits/licenses monitor the release of individual pollutants mainly from point sources such as industry rather than examining the impact of the combination of pollutants in the ambient air. Air quality in a given region may have numerous different non-point sources that may remain unregulated. Methods beyond the permitting process may be required and these may involve the coordination of a number of different air quality management approaches, agencies, stakeholders, and the public.

The purpose of this study is:

1. to document air pollution problems, technology such as controls and monitoring, and legal solutions in practice today;

2. to investigate attempts of air quality management strategies that have been adopted by different regions such as California and Colorado, United States; Waikato, New Zealand; Sydney, Australia, and Vancouver, Canada;

3. to assess the perceptions and judgements of experts in the field of air quality planning and management with respect to issues involving air quality management planning and the effectiveness of different control strategies;

4. to identify evaluative criteria as a basis for assessment of present efforts of air quality management plans in Prince George and elsewhere;

5. to identify obstacles to effective air quality management planning;

6. based on the above, to make recommendations for an air quality management process for agencies who may wish to plan a comprehensive strategy for controlling air pollution in their regions.
1.1 Background

Public demand for clean and healthy air are important driving forces behind the development of air quality management plans (Mennell, 1995). In a survey conducted locally, sixty-five (65%) of Prince George residents stated that air quality is an important issue in their quality of life (Oster, 1997).

Since the introduction of numerous industrial processes, such as pulp and paper mills, sawmills, and an oil refinery, to the Prince George area in the 1960s; as well as subsequent increases in the population, there have been significant increases in the amount of pollutants released into the local airshed (PGATMC, 1996). Airshed for the purpose of this study is defined as the “mass of air contained within the municipal boundaries or regional boundaries, and specifically the air mass contained and affected by natural topographical features” (PGATMC, 1996). Even with the advances in the technology of pollutant controls and decreases in the amount of pollutants released into the local airshed in the last decade, there are still concerns related to human health and the well being of the physical environment (Michalos, 1995 and Ministry of Health, 1996).

The results of this study will provide information that may aid planners and policy makers of this region and others, concerning location of future industries, changes to zoning requirements, modification of local air pollution regulations, and in general, an increased number of management strategies for improving human health and the environment. The benefits of this study are potentially considerable for the Prince George region where recent analysis of the respiratory health of the local population indicate that this region’s respiratory health is one of the worst in the province of BC (Ministry of Health, 1996). There could be many reasons for this
health status, but it has been suggested that air pollution may be one of the contributing factors (Ministry of Health, 1996). The outcomes of the present research may also indicate ways in which air quality in the local airshed can be improved by looking at additional or alternative control mechanisms.

2.0 Statement of the Problem

Much of the information related to air quality management is technical and targeted to specific pollutants and sources. As will be shown in the review of the literature, there are many choices available for both control and monitoring technologies, but the current predominant approach is the “end of pipe”, or permitting of major point sources approach. Monitoring provides information on the state of the airshed and the priority pollutants for planners and decision-makers, but the obstacles to a planning process begin when the government, and possibly the stakeholders, gather to make decisions on how to reduce ambient concentrations to acceptable levels.

Dissatisfaction with single strategy approaches, the inability to adapt national policies to individual airsheds and their unique characteristics, and recent thinking about environmental management utilizing watershed and ecosystem management approaches have led to a reconsideration and experimentation with more varied and comprehensive strategies. These approaches include targeting both point and non-point sources of pollution, by a range of strategies including land use planning and community education.

Theoretically, a more comprehensive approach would move away from the sole reliance on a single strategy, for example, “end of pipe” permitting. It would
investigate and document all sources of air pollution and would design approaches that address all or many of these sources. This process, by its nature, would also involve many different agencies, jurisdictions, and stakeholders. Researchers, policy makers, and others involved in air quality management hypothesize that these more comprehensive approaches have the potential for more effective solutions to environmental problems (Ryding, 1994).

In the air quality arena, these findings imply that traditional air quality management would be more effective if (Ryding, 1994 and Sadler, 1995):

i) the strategies were more comprehensive in nature, utilizing permitting approaches in addition to other approaches,

ii) increased sources and combinations of pollutants were identified,

iii) a broader spectrum of participants (government, industry, health, and the general public) were involved, and

iv) there was more focus on the unique qualities and characteristics of a region or airshed.

2.1 Research Questions

The research questions relate to the purposes of this study by seeking answers that will identify air quality management approaches that utilize traditional planning strategies, but also provide alternatives for non-point sources of pollution in an airshed. The findings will also provide evaluative criteria and recommendations of air quality management approaches that are identified as effective and successful by those involved in air quality and the literature.
This research project was designed to answer the following questions:

1. Which air quality management strategies have been adopted by different regions? What is the range of possible approaches in practice today? How can these approaches be evaluated?

2. What criteria should be used to evaluate the effectiveness of air pollution control strategies?

3. What do people involved with existing air quality management approaches see as successful elements of air quality management strategies?

4. How successful does the Prince George air quality management approach have the potential to be? Using the evaluative criteria, how can air quality management planning be improved?

5. What are the obstacles to effective air quality management planning and strategies?
3.0 Literature Review

Today, the sea, the air, the waterways, the earth, the land and what it produces have all become commons, and all are vulnerable to overuse. Appeals to altruism are futile, and in one sense foolhardy. Technology alone will not get us out of this dilemma because these are human problems.

Garrett Hardin from "Tragedy of the Commons"

3.1 Introduction

The intent of this literature review is to document current knowledge of air quality and is the first step of information gathering in an air quality management planning process. The literature was reviewed in the following areas:

1. general review of air pollution issues;
2. identification of major air pollutants in Prince George;
3. technological advances, with regards to air pollution controls and air pollution monitoring;
4. relevant legislation which affects air quality management at the federal, provincial, and municipal levels in Canada; and
5. strategies and approaches to air quality management

In addition to the preceding points, this review of the literature will investigate the politics involved with air pollution; the general public's perception of air quality; the health affects of particulate matter as a priority pollutant in many regions; and the economic feasibility of pollution prevention.

3.2 Air Pollution-Definition

Clean air in the atmosphere moves across the earth's surface collecting the products of both natural and anthropogenic events. These potential pollutants called primary pollutants, mix with the churning air and can result in a reaction with another
pollutant or with the basic components of the air to form new pollutants, called secondary pollutants (Miller, 1982). The physical and chemical components of these pollutants can affect the earth on global, regional, or local scales. The physical and the chemical characteristics of air determine ambient air quality, which in tum determines its acceptability for human and environment health. Air quality impacts are generally defined by numerical criteria for individual contaminants, based on human health or other environmental studies; and may also include taste and smell as indicators (PGATMC, 1996).

3.3 Outdoor Air Pollutants Identified

There are approximately five classes of outdoor air pollutants identified in most industrialized countries (Draper, 1998):

- Carbon oxides (Carbon monoxide (CO) and carbon dioxide (CO₂));
- Sulphur oxides (Sulphur dioxide (SO₂) and sulphur trioxide (SO₃));
- Nitrogen oxides (Nitrogen oxide (NO), nitrogen dioxide (NO₂) which are often called NOₓ);
- Volatile organic compounds (VOCs) (Methane (CH₄), benzene (C₆H₆), and chlorofluorocarbons (CFCs); and
- Suspended particles (solid particles- dust, soot, asbestos, lead, nitrate, and sulfate salts and liquid droplets- sulphuric acid, PCBs, dioxins, pesticides).

In many small towns and outside cities, the main causes of air pollution are smoke (from slash burning, beehive burners, and household woodburning stoves), dust consisting of particulates from industrial and agricultural activities, industrial emissions (such as sulphur-bearing compounds from the oil and gas and pulp and
paper industries), and methane (primarily from landfills) (Environment Canada, 1997).

In the Prince George region, PM$_{10}$ or particulate matter less than 10 micrometres in diameter has been selected as a priority contaminant (PGATMC, 1996).

3.4 How Geography and Climate Affect Air Pollution Conditions

During the day the sun warms the air near the earth's surface. Normally this heated air expands and rises, carrying low-lying pollutants higher into the troposphere. Cooler, denser air from surrounding high-pressure areas then sinks into the low pressure area created when the hot air rises. The continual mixing of air helps keep pollutants from reaching dangerous concentrations near the ground (Miller, 1982).

Hills and mountains tend to reduce the flow of air in valleys below and allow pollutant levels to build up at ground level. Buildings in cities generally slow wind speed, thereby reducing dilution and removal of pollutants.

Sometimes, however, weather conditions trap a layer of dense air, cool air beneath a layer of less dense, warm air in an urban basin or valley— a phenomenon called a temperature inversion or a thermal inversion. In effect, a lid of warm air covers the region and prevents ascending air currents (that would disperse pollutants) from developing. These inversions usually only last for a few hours; but sometimes, when a high-pressure air mass stalls over an area, they last for several days. In this situation air pollutants at ground level may build up to harmful concentrations (Miller, 1982).
3.5 Government and the General Public

Public demand for clean and healthy air has been an important driving force behind the development of air quality management plans. The general public, for the most part, regards personal health and standard of living of utmost importance (Mennell, 1995). Yet in the end, the final decision regarding air quality management is a political one; however, there are many factors that go into the decision making process such as the readiness of the general public and industry to agree to the measures that may be required.

Most air quality or resource departments rely on permits which set the “end of pipe” concentrations to control pollutants. In this approach, the first step in dealing with air pollution is to examine the technical and scientific options and identify the ‘best available control technology’ (BACT). How these technical and scientific solutions are incorporated into legislation and administration becomes a political decision with economic considerations, an integral part of the decision-making process.

In his paper, Administrative and Legal Aspects, Persson explains that “the growing complexity of government and the increasing pressure for public participation points to a decentralization, but the planning process and the need for national policies tend to concentrate power at the centre” (Persson, 1976). This statement is applicable to many countries of the world including Canada.

In Canada, the three administrative levels of government are federal, provincial (British Columbia), and municipal (Prince George). Persson (1976), it demonstrates that the responsibility for controlling pollution by regulation should be at the lowest level of government capable of dealing effectively with the problem in
its entirety. He states that the “locally controlled programs permit quicker response
to the problems, closer control over operations, and the mobilization of local
resources. However, there are problems associated with local control. Local
authorities often do not have the financial resources to operate an adequate
program. Moreover, industrial and commercial interests sometimes have a very
strong influence on the actions of local government” (Persson, 1976).

With the reality of increasing environmental risks and the complexity of air pollutant interactions, the need for environmental policy coordination among the policy-making bodies is acute. Coordination of these policy-making bodies would allow for optimal implementation and increase effectiveness of enforcement.

3.7 Current Air Pollution Controls

Air pollution control, in Canada, involves reducing the emission of primary pollutants, which may have a dual role in causing adverse effects in their original unreacted form or by reacting chemically to form secondary pollutants (Boubel, et al 1994). The application of control technology to air pollution problems assumes that a source can be reduced to a pre-determined level to meet a regulation or a known minimum value. However, one of the factors necessitating a more comprehensive approach is the fact that governments have been unable to regulate industrial sources so that air quality objectives are not exceeded (PGATMC, 1996 and GVRD, 1994).

There are generally three different methods for controlling emissions (Ryding, 1994):

1) process change to a less polluting process or to a lowered emission from the existing process through a modification or change in the operation,

2) fuel change to a fuel which will give the desired level of emissions,
3) installation of control equipment between the point of pollutant generation and its release to the atmosphere.

For pollution removal to be accomplished, the polluted carrier gas must pass through a control device or system, which collects or destroys the pollutant and releases the cleaned carrier gas to the atmosphere. Various pollution controls have been developed in order to clean effluent streams of gas and/or particulates.

In the Prince George region, particulates are the major source of air pollution; thus, the remaining discussion will be specific to this problem.

Particulates can be removed by a variety of air pollution control systems, such as: electrostatic precipitation which use electric forces to separate suspended liquids and/or solid particles from gases; filters which intercept solid particles inside and outside of bags (fabric filters) or on filter beds., mechanical collectors where particles are collected either by the action of gravity or by inertial effects on the particles or a combination of both; and wet scrubbers which removes gases by absorption in a medium which may be a liquid or a liquid-solid slurry (Sterling, 1990).

We are at the point in our society, where the general public demands that industry utilize the necessary control equipment in its plant operations and insists that the government regulate and enforce these processes. On the contrary, perceptions of industry are often that control equipment is a tremendous capital expenditure when having to incorporate these modern air control technologies into existing processes. However, it can be possible to achieve compliance with local air quality standards through some relatively simple changes in many of the industry's operating procedures. An environmental audit may prove to be worthwhile in these instances. Though sometimes time consuming, an audit may assist a plant
operation by assessing its air pollution control alternatives. An environmental audit would review the usage of raw materials; assess the process and operating procedures; inventory the contaminants being released from the plant (whether gaseous or particulate); and lastly, examine the most realistic alternatives available on the market.

There is no shortage of technical means for abating dust. Such systems range from simple, cheap, settling chambers, through various types of cyclone arrestor, to large and expensive bag-filter plants and electrostatic precipitators.

When considering economic realities it is essential that phrases such as "undue economic hardship" or "economically practicable" are defined and both the decision-makers and the general public have a complete understanding of the concepts. The following is a possible interpretation of the above terms. "Undue economic hardship and economically practicable do not imply that a token reduction of emissions is accepted for the sake of maintaining high profits. On the contrary, industry is forced to go as far as it can, short of losing economic viability, towards reducing its emissions to a level where they are without effect on health and amenity" (Craxford, 1976).

3.8 Air Pollution Monitoring

With the increasing knowledge of scientists and sophistication of monitoring equipment regarding contaminants in the ambient air and the growth of information accessible to the general public, there have been increasing demands on the government to impose monitoring regulations on industry, and distribute these data to the public.
The detection of pollutants through monitoring is necessary to do the following:

- ensure compliance with government regulations regarding maximum employee exposures to hazardous substances;
- ensure compliance with government regulations governing maximum ambient air contamination regarding human health of general public;
- verify that control measures are performing adequately;
- locate sources of contamination
- provide an early warning of malfunctions that could result in dangerous conditions, and;
- comply with environmental protection regulations and control orders limiting gaseous and particulate emissions.

( Sterling, 1990)

In Prince George, there are several locations where air pollution monitoring takes place. This includes the Plaza 400 building downtown Prince George, which has equipment that monitors PM$_{10}$, PM$_{2.5}$, Total Reduced Sulphur, NO$_x$, SO$_2$, and Ozone. There are other locations in Prince George, for example, on top of local schools, the airport, the jail, and the CBC tower.

As discussed previously, air contaminants of concern in the Prince George region are primarily particulates. Particle collection is more difficult than gas sampling because of particle presence, size, mass agglomeration, charge and shape (Sterling, 1990). Collection methods for particulates include thermal precipitators, inertial and gravitational collectors, filter media, and electrostatic precipitators.
3.6 Air Management Strategies and Economic Feasibility

At present, the perceptions of the general public of the need for funding air quality management and the actual funding for these programs by the government are at odds. The public does not look at health and the environment as a function of a cost-benefit analysis, but policy makers are forced to recognize the trade offs and assign monetary value to human life and the environment. Any economically attainable strategy for managing the quality of the air must take into account the relationship between the cost of attaining each increment of improvement and the benefit obtained from that increment in terms of improved health or visibility (Stern, 1976).

Stern (1976) explains that the principal objective of any air quality management strategy should be to maximize overall net benefits given the fact that there will be multiple sources of pollution affecting multiple receptors. Basic requirements for this optimization objective are:

1) information about emissions (i.e., a complete inventory of sources);
2) knowledge about the relationship between the volume of the pollutants and nature of the discharges and the cost of the control (i.e., the cost of the control functions);
3) knowledge about the transportation and the diffusion of the pollutants and the resulting ground level concentrations at various locations in the airshed (i.e., atmospheric models to relate sources and receptors);
4) an understanding of the environmental and health effects of varying concentrations of the pollutants, both singly and in combination (i.e., environmental models relating dosage and damage).

3.9 Air Pollution Legislation in Canada

There are many levels in which the Federal government has authority over air pollution in Canada. Much of this power comes from the statutes in the Canadian
Constitution granting the federal government influence over legislative acts and regulations. The following paragraphs summarize the Sections of the Canadian Constitution which deal with air pollution and the resulting legislative acts which control aspects of air pollution in Canada.

In the Constitution’s formation period “there is no indication that the environment was even understood as a concept, and consequently authority in relation to environmental management must be deduced from various heads of power and from the general allocation of public property to the provinces (Tingley, 1987).” It is obvious that in 1867 there were few concerns about the decreasing quality of the air or the then inconceivable amount of contaminants and hazardous waste that are now released into the environment. Consequently, with each new environmental issue that is brought to the attention of the governments at both levels, there are many problems in dealing with the divisional powers set out by the Constitution.

Sections 91 and 92 of the Canadian Constitution are undoubtedly the key sections concerning the division of legislative powers of environmental management, specifically in this case to air pollution issues. These sections have been used to illustrate the proposition that the Fathers of Confederation assigned economic authority to the federal government, while vesting in the provinces’ jurisdiction with respect to cultural and local matters (Kennett, 1991).

With respect to the Constitution, the legislative responsibility for safeguarding the environment is shared between the federal and provincial governments in various ways. In Section 109 of the Constitution the Provinces are entitled to legislate and regulate activities on their Crown Lands; accordingly, the Provinces have direct management responsibility for most environmental and resource matters.
within their borders, and therefore exercise control over air pollution. Having said this, there are sections of the Constitution that give management responsibility to the federal government; but are limited to:

- Administering the environmental laws that fall within its legislative mandate;
- Establishing national standards for adoption and enforcement by the provincial governments;
- Providing scientific and statistical support and information to federal departments and agencies, provincial governments, the private sector and the general public;
- Encouraging uniformity in resource management by provinces and the private sector;
- Providing financial assistance to provincial programs through various cost sharing arrangements and to private sector programs through grants and contributions; and

The Acts outlined in the Constitution giving power to the federal government are outlined as follows:

- **Canadian Shipping Act** (1970)
  - Air pollution Regulations (C.R.C 1978)
- **Canadian Environmental Protection Act** (S.C. 1988,c.22)
  - Ambient Air Quality Objectives No.1-3 (C.R.C 1978)
  - Asbestos Mines and Mills Regulations SOR/90-341
  - Benzene in Gasoline Regulations SOR/97-493
  - Chlor-Aikali Mercury Release Regulations SOR/90-130
  - Chlorobiphenyls Regulations SOR/91-152
  - Chlorofluorocarbon Regulations SOR/90-127
• Contaminated Fuel Regulations SOR/91-485
• Diesel Fuel Regulations SOR/97-110
• Domestic Substances List SOR/94-311
• Export and Import of Hazardous Wastes Regulations SOR/92-637
• Federal Mobile PCB Treatment and Destruction Regulations SOR/90-5
• Fuels Information Regulations SOR/77-597
• Gasoline Regulations SOR/90-247
• List of Hazardous Wastes Authorities SOR/92-636
• List of Toxic Substance Authorities SOR/94-162
• Masked Name Regulations SOR/94-261
• Ocean Dumping Regulations, 1988 SOR/89-500
• Ozone-Depleting Substances Regulations SOR/94-408
• Ozone-Depleting Substances Products Regulations SOR/95-584
• PCB Waste Export Regulations SOR/90-453
• PCB Waste Export Regulations, 1996 SOR/97-108
• Phosphorus Concentration Regulations SOR/89-501
• Polybrominated Biphenyls Regulations, 1989 SOR/90-129
• Prohibition of Certain Toxic Substances Regulations SOR/96-237
• Pulp and Paper Mill Defoamer and Wood Chip Regulations SOR/92-268
• Pulp and Paper Mill Effluent Chlorinated Dioxins and Furans Regulations SOR/92-257
• Registration of Storage Tank Systems for Petroleum Products and Allied Petroleum Products on Federal Lands Regulations SOR/97-10
• Secondary Lead Smelter Release Regulations SOR/91-155
- Storage of PCB Material Regulations SOR/92-507
- Toxic Substances Export Notification Regulations SOR/92-634
- Vinyl Chloride Release Regulations, 1992 SOR/92-631
- **Canadian Environmental Assessment Act** (S.C. 1992, c. 37)
  - Comprehensive Study List Regulations SOR/94-638
  - Regulations Respecting the Coordination by Federal Authorities of Environmental Assessment Procedures and Requirements SOR/97-181
  - Exclusion List Regulations SOR/94-639
  - Federal Authorities Regulations SOR/96-280
  - Inclusion List Regulations SOR/94-637
  - Law List Regulations SOR/94-636
  - Projects Outside Canada Environmental Assessment Regulations SOR/96-491
- **Canadian Environmental Protection Act** R.S. 1985, c. 16 (4th Supp.)
  - Wood Pulping Industry National Emission Guidelines (Department of Environment, 1979)
  - Lead Free Gasoline Regulations (C.R.C. 1978)
  - Ozone –Depleting Substances Regulations No.1

Examples of legislation concerning environmental issues at the federal level are the **Canadian Environmental Protection Act** (CEPA, 1988) and the **Canadian Environmental Assessment Act** (CEAA, 1995). Their importance is significant in defining the environmental issues under federal control and encouraging the provinces to create or strengthen their own environmental acts. Though sections
tend not to be specific to air quality and air pollution, the environment under the act is all encompassing and includes the land, water, and air.

Within the framework of responsibility given to the federal government by the Constitution, the department accountable for environmental issues is Environment Canada. These environmental responsibilities are carried out through programs designed to:

- Prevent, reduce, or eliminate harmful air emissions and liquid effluents by ensuring that industry and other government departments comply with the Department’s guidelines or standards relating to environmental quality and the prevention/control of pollution;
- Contain or restrict the use of hazardous substances by ensuring that industry and government departments comply with the Department’s regulations on the introduction, production, use, transport and disposal of toxic chemicals;
- Restore environmental quality and maintain it at acceptable levels by ensuring that spills are cleaned up;
- Ensure that new federal projects, programs, and activities are assessed early in the planning process for any potentially adverse effects on the environment.

(Environment Canada, 1997)

In Environment Canada’s Report on Plans and Priorities 1998-99 (Environment Canada, 1998), the agency details its goals and actions concerning air quality. Excerpts from the report also identify the programs administered by Environment Canada (EC) with regards to air quality and management:

**Goal: Clean air to breathe in Canada and existing clean Canadian airsheds to be protected from deterioration.**

- The Canadian Environmental Protection Act (CEPA) Federal-Provincial Working Group on Air Quality - was set up to bring uniformity to provincial control programs through establishing air quality objectives, setting monitoring protocols, and conducting chemical analyses.
- National Air Pollution Surveillance Network (NAPS)- the network monitors pollutants levels and assesses the quality of ambient air in Canadian towns and cities. It provides the basis for evaluating air pollution control strategies, determining urban air quality trends and warning of emerging air pollution
issues. The NAPS Network also supports the national Air Quality Index, which condenses all of the air monitoring data into a single number which can be used to give some indication of overall air quality.

- National Incinerator testing and Evaluation Program- designed to touch on all aspects of incineration and will seek to define the optimal design and operating conditions of municipal incinerators to minimize or eliminate emissions of concern.

- International Environmental Air Pollution Concerns:
  - UN ECE Persistent Organic Pollutants (POPs) and heavy metals protocols signed in 1998. UN Environmental Program (UNEP) global POPs convention completed by end 2000.
  - Ozone Layer Depletion- preparing a two-phase program of new regulations under CEPA which will reduce the consumption of CFCs to 50% of 1986 levels by 1999 and will freeze consumption of halogens to the 1986 level in 1992.
  - Acid Rain and The Long Range Transport of Air Pollution- the negative effects from SO2 and NOx emissions on aquatic and terrestrial ecosystems, human health and materials to be minimized. The development of a National Nitrogen Oxides and Volatile Organic Compounds Management Plan for Canada- implementing the Canadian Acid Rain Control program and developing a plan of action for further management of NOx and VOC emissions.
  - Initiatives to Reduce Climate Change.

3.10 Air Pollution Legislation in British Columbia

Responsibilities given to the province of British Columbia through the Canadian Constitution are extensive, yet are controlled to some degree by the federal government and its Canadian Environmental Protection Act. The legislation relevant to air quality issues in British Columbia is as follows:

- Environmental Impact Assessment Regulation (O.C. 1752/81)
- Environmental Appeal Board Procedure Regulation (B.C. Reg. 182, as amended)
- Ministry of the Environment Act (S.B.C. 1980, c.30)
- Motor Vehicle Act (R.S.B.C 1979, c.288)
  - Motor Vehicle Regulations-Part 29; Air Pollution Control on Motor Vehicles (B.C. Reg. 229/70, as amended)
- Waste Management Act (S.B.C. 1982, c.41, as amended)
- Pollution Control Objectives for the Forest Products Industry
- Pollution Control Objectives for Mining, Smelting and Related Industries
- Pollution Control Objectives for the Chemical and Petroleum Industries
- Pollution Control Objectives for Municipal Type Waste Discharges
- Waste Management Fees Regulation (B.C. Reg 304/87, as amended)
- Waste Management Regulation (B.C. Reg 432/82, as amended)

(BC Ministry of Environment, Lands and Parks, 1997)

The Environmental Management Act (1981, amended in 1988) is British Columbia’s principal legislative instrument for environmental management. This act establishes an overall management framework for the ministry. It enables the Minister to (BC MELP, 1997):

- permit planning, design, construction or alteration of any operation;
- conduct research;
- set resource management objectives;
- conduct inquiries and investigations, constituting enforcement;
- develop policies; and prepare and publish policies, strategies, objectives, and standards, and;
- hold public inquiries into any major environmental issue.

The Act also establishes policies for dealing with environmental emergencies, including the cessation of developments that are causing or likely to cause damage.
to the environment. The Environmental Appeal Board is created under this act to hear appeals on specific activities undertaken by the ministry (BC MELP, 1997).

Air quality issues are largely the responsibility of the Air Resources Branch which supports the Environment and Resource Management Department, formerly called the Waste Management Branch. The Air Resource Branch is also responsible for:

- Establishing air quality standards and monitoring major airsheds in the province to ensure the standards are maintained;
- Developing and implementing airshed management systems to ensure air quality conducive to good health and to maintain the province’s natural resources;
- Providing atmospheric data and expert services to ministry programs and other agencies.

(Sterling, 1990)

The authority for the Environment and Resource Management Department is granted under the province’s Waste Management Act, passed in 1982. The Department’s powers include permitting of discharges of pollutants into the air; and setting terms and conditions specifying the required pretreatment, duration, quantity and quality of the release.

The Waste Management Act is the chief tool for the regulation of air quality in the province. It allows for direct participation by the government in the development of waste management plans for municipalities and any developments within its boundaries.

In the Waste Management Act, under Enforcement (Part 4), a Pollution Abatement Order (section 22 and 23) can be issued in which the regional manager or minister has the authority to do the following, if satisfied on reasonable grounds that a substance is causing pollution. The manager/minister may order:
a) the person/municipality who had possession, charge or control of the substance at the time it escaped or was emitted, spilled, dumped, discharged, abandoned, or introduced into the environment,

b) any other person/ municipality who caused or authorized the pollution, or

c) the person/ municipality who owns or occupies the land on which the substance is located or on which the substance is located immediately before it escaped or was emitted, spilled, dumped, discharged, abandoned, or introduced into the environment to do any of the things referred to in subsection (2) as follows.

Subsection 2, requires a person/ municipality, at his own expense, to

a) provide to the manager/minister information that the manager/minister requests relating to the pollution,

b) undertake investigations, tests, surveys and any other action that the manager/minister considers necessary to determine the extent and effects of the pollution and report the results to the manager/minister,

c) acquire, construct, or carry out any works or measures that are reasonably necessary to control, abate, or stop the pollution,

d) adjust, repair, or alter any works to the extent reasonably necessary to control, abate, or stop the pollution,

e) abate the pollution, and

f) carry out remediation in accordance with any criteria established by the director and any additional requirements specified by the manager/minister.

In this case, sections 22 and 22.1 are combined, including the minister's authority to exercise power with respect to municipalities who have caused pollution of the environment.

When the Waste Management Amendment Act was brought into force in 1989, it increased the penalties for conviction for a contravention of the Waste Management Act and legitimized the enforcement, which usually is lacking in this type of legislation (Sterling, 1990).
3.11 Municipal Air Pollution Legislation

There are few areas in the Municipal Act that directly relate to the environment, and specifically to air pollution. The following parts of the Municipal Act have some relevance or can be interpreted to allow for pollution control and prevention.

Part 18. Health and Welfare (Division 1 - Health)

Section 692 - Health Regulation

1) Subject to the Health Act, the council may by bylaw

   a) Regulate persons, their premises and their activities, to further the care, protection, promotion and preservation of the health of the inhabitants of the municipality;

2) Subject to the Health Act, the council may undertake the measures deemed necessary to preserve public health and maintain sanitary conditions in the municipality, including the chlorination and fluoridation of the water supply.

Part 28. Miscellaneous (Division 5 - Sundry Regulations and Provisions)

Section 932 - Nuisances and Disturbances

The council may by bylaw

   i) require the owners or occupiers of real property, or their agents, to eliminate or reduce the fouling or contaminating of the atmosphere through the emission of smoke, dust, gas, sparks, ash, soot, cinders, fumes, or other effluvia; and prescribe measures and precautions to be taken for the purpose; and fix limits not to be exceeded for those emissions

   j) require manufacturers and processors to dispose of the waste from their plants in the manner directed by the bylaw.

Part 28.1 Regional Growth Strategies (Division 1 - Application and Content of Regional Growth Strategy)

Section 942.11 Purpose of a regional growth strategy
1) The purpose of a regional growth strategy is to promote human settlement that is socially, economically, and environmentally healthy and that makes efficient use of public facilities and services, land and other resources.

2) Without limiting subsection (1), to the extent that a regional growth strategy deals with these matters, it should work towards but not be limited to the following:

   g) reducing and preventing air, land, and water pollution;

Part 29 Management of Development (Division 1- Official Community Plan) Sections 945 Content of community plans

1.1 To the extent that an official community plan deals with these matters, it should work towards the purpose and goals referred to in section 942.11 (Purpose of a regional growth strategy- as above).

3.12 Alternative Air Pollution Management Planning and Strategies

"Pollution Prevention" is currently a term used to describe strategies and technologies that reduce the generation of pollutants at their source. The U.S. Environmental Protection Agency (U.S. EPA) defines "pollution prevention" as:

*the use of materials, processes or practices that reduce or eliminate the creation of pollutants or wastes at the source. It includes practices that reduce the use of hazardous materials, energy, and water and promotes resources and practices that protect natural resources through conservation or more efficient use.*

(Boubel, et al, 1994).

From the definition of pollution prevention, it is obvious why scientists would consider it essential for the future health of the population and the environment to initiate strategies that prevent pollution and manage the ecosystem.

Mainstream urban and regional planning focuses on the people, economies, development, and infrastructure through a process of goal setting objectives, policies, and implementation; the process is similar in environmental planning, yet an
additional element is involved- the biophysical environment. The concept of environmental planning is not a new one, and for many decades non-traditional planners have integrated the biophysical and socio-economic conditions of a region into the planning of communities. A shift is now being seen with urban and regional planners integrating the environment into Official Community Plans and other planning processes. A quote from Slocombe (1993) determines that, “there can be little question that planning, and planning frameworks, which fully integrate environmental planning and development planning, would improve this situation.”

Recently, a new concept has come to the attention of those in the planning and scientific community- ecosystem management. This has many other terms related to it such as comprehensive management, watershed and airshed management, and holistic management. The need for taking a holistic approach towards planning and conservation has long been recognized. Developing an appropriate framework within which coordinated action can occur is a challenging and ongoing process (Environment Canada, 1996). Many agencies have now taken responsibility for including the biophysical and socio-economic elements of a community into its planning processes. The EPA has recognized that compliance with media-based (eg, air, water, solid waste) regulations can not ensure the protection of entire ecosystems and have begun the shift to a place-driven and ecosystem-based strategy (Slocombe, 1993). Also, Environment Canada has created an Action Plan which identifies creating partnerships with all sectors of society and strengthening its ecosystem approach to science as an important part of changing the way they operate (Environment Canada, 1996).
To begin to understand the concept of ecosystem management, it is important to comprehend the definition of an ecosystem. There are many definitions in the literature, but for this review, Environment Canada's definition will be used (Environment Canada, 1996):

An ecosystem is a functioning, integrated unit comprised of all living things, including humans, and their non-living, spatial and temporal environment. Ecosystems occur at many scales, from a drop of water to the entire biosphere.

Ecosystem management is the synthesis of ecosystem science and ecosystem approaches to provide interdisciplinary frameworks that link the biophysical and socioeconomic research and practice in a region or ecosystem through an holistic, ecological, and participatory methodology (Slocombe, 1993). In other words, ecosystem management is a methodology of looking at the biophysical and socio-economic aspects of an actual ecosystem like a water shed or a wetland area, rather than administratively defined areas such as cities or parks. The following is the definition adopted by Environment Canada (1996) for an ecosystem approach and management:

An ecosystem approach to planning and conservation promotes long term maintenance of evolutionary and ecological processes by providing a holistic, systems perspective that recognizes the interdependence of all levels of ecological relationships (species, communities, populations, landscape) within a complex socio-political framework; predicts the effects and response of the environment to stresses; and then acts to maintain ecological integrity. Taking an ecosystem perspective results in working across administrative and political boundaries, making multi-stakeholder cooperation mandatory. This approach combines ecology with an understanding of the socio-economic factors that shape human attitudes, perceptions, and behaviour, within an ecologically meaningful spatial framework.

The discussion to this point has been about ecosystem management without direct reference to air quality. How might air quality plans incorporate the principles or priorities of ecosystem management?. I say 'priorities' because the concept of
ecosystem management can be overwhelming for a single management plan, though some regions have completed Regional Management Plans that included land, water and air (Waikato Regional Council, 1998). A comprehensive or holistic air quality management plan that adopts the principles of ecosystem management (Environment Canada, 1996) might include the following:

- the plan must take a broad view;
- boundaries should be ecologically based and work across administrative boundaries;
- the focus should be on resource issues that promote local action and involvement;
- strategies, implementation and conservation must be based on best available science, data and monitoring;
- the plan should include interagency cooperation with full participation of all stakeholders; and,
- the plan should recognize the dynamic nature of the ecosystem.

The literature was also combed to identify some possible evaluative criteria for air quality management plans and their effectiveness. In Sadler's, Study on Effectiveness of Environmental Assessment (EA) (1996), he determines some main distinctions, in terms of the purpose and yardsticks of evaluation, that will also be applied to air quality management plans in this study.
The main criteria are:

- **Procedural**: does the EA process conform to established provisions and principles?
- **Substantive**: does the EA process achieve the objectives set, e.g., support well informed decision making and result in environmental protection? and,
- **Transactive**: does the EA process deliver these outcomes at least cost in the minimum time possible, i.e. is it effective and efficient?

Many of the evaluative given by Sadler (1996) for the effectiveness of environmental assessment may be used in the context of air quality management planning also. Changes will be made to the context of the evaluation but the principles remain the same.

### 3.13 Conclusion

Air pollution and air quality planning have become significant issues for all who live in today's technological and industrial society. Those involved with government, who have the decision-making capabilities, and the general public, who can influence the politicians with their votes, select which environmental issues will be most important. In the literature, an interesting concept of perception was brought forth by Lang and Armour (1980),

*Perception plays an important role in environmental problem-solving and planning. Decisions to change an environment are based less on the environment as it is than on the environment as it is perceived by the decision-maker. Perception refers to an individual's immediate evaluation or reaction when confronted with a reality while image refers to the picture of reality, not necessarily more accurate, that an individual forms after deliberation.*

This literature review has explored the major tools at our disposal for the management of our airsheds including a brief look at the technical aspects in
controlling and monitoring air pollution, the legislation existing at the federal, provincial, and municipal levels, and the some alternative management approaches.

The traditional approach to protecting the environment used by governments throughout most of the industrial world is command and control, “end of pipe”, or permitting (ARA Consortium et al, 1995), but there is a growing dissatisfaction with the effectiveness of these strategies which has led to attempts to develop new, more comprehensive strategies. Approaches that deliver environmental and other benefits effectively ...result in successful reduction, avoidance, and mitigation of adverse environmental effects (Sadler, 1996). In the context of air quality management, multi-approach air quality management plans may have the potential to bring about highly effective and successful strategies that aim to prevent the impacts of air pollution on an ecosystem basis and are comprehensive in nature.

4.0 Methods

The major methods for this study consisted of a literature review, a case study analysis, and a questionnaire. A review of the literature provided existing research on air quality and the strategies involved in the abatement of air pollution. The case studies were examined through the internet and personal referrals to give examples of current air quality management plans and their processes and content. The questionnaires provided the “behind the scenes” information from those involved in air quality management, information beyond that given in the text of the AQMP or media releases. All of these sources of information were important in providing understanding of the processes and content of the plans and providing a basis for the recommendations and conclusions.
4.1 Literature Review

The review of the literature involved research from many different sources of information—reference material, journal articles, existing Air Quality Management Plans, government agency publications, and internet sources. The information from the review provides background knowledge of air pollution issues, the technological advances with regards to air pollution controls and air pollution monitoring, the strategies and approaches to air quality management, and the relevant legislation in Canada that can influence the process of air quality management planning. All of these components assist in the creation and implementation of an air quality planning process.

4.2 Case Studies

Twelve air quality management plans from different regions were examined and five of those were investigated in great depth (California and Colorado, United States, Waikato, New Zealand, the Greater Vancouver Regional District, Canada, and the Australian Clean the Air Plan). Prince George provided the focus of the main case study.

The sample used in the case study example research began with an internet search of municipalities, states/provinces, and countries that are in the process or have begun to implement an air quality management plan. For each site that was accessed the researcher emailed the address provided and contacted those people involved in the process. Another source of information was the Ministry of Environment office in Prince George and the Greater Vancouver Regional District Air Quality Office in Burnaby. At each location, personnel provided information about
experts involved in air pollution and other regions that had initiated air quality management plans. The last source was the email respondents who recommended other people and regions involved with air pollution and air quality management.

The next step was to determine the management approach taken by each region, for example, a command and control approach, or a comprehensive management approach. The case study examples included specific information on content of the Plan and processes used by the region to reach the implementation stage.

4.3 Participant Observation- the Prince George In-depth Case Study

The Prince George case study is comprised of a participant observation component of one and a half (1.5) years and analysis of the relevant documents and reports. The participant observation time included the release of the first draft to City Council, stakeholders and the general public; public and stakeholder consultation; and release of the final draft to City Council, the Regional District Council, and the Provincial government. Observations of the process and participation in the committee meetings and the stakeholder consultation period provide the researcher with the ability to evaluate and discuss the commonalities and obstacles of the Prince George process in comparison with other regions. This case study is specific to the process taken by the Prince George Airshed Technical Management Committee.

The creation of the Prince George Airshed Technical Management Committee came about because of a concern for air quality in the Prince George region and the recognized need for a more comprehensive approach than the existing permit approach which only targets industrial sources.
An inventory of pollutant sources was completed at the behest of this committee and is reported in the Background Report (PGATMC, 1996). Subsequently, the CALPUFF model has altered the inventory significantly in some areas, such as road dust and woodburning appliances, though changes have not been made to the selection of priority pollutants from the Background Report (PGATMC, 1996). This priority pollutant list of the Prince George airshed will allow concerned individuals to focus on and study the possible affects of these pollutants on human health and the environment. With the initial assessment having taken place, policies and planning can now be modified to help assess locations of future industrial polluting sources.

4.4 Questionnaires

A questionnaire was developed to provide an understanding of the perceptions of people involved in the planning processes with the purpose of finding information that could not be ascertained from the management plans. The subjects of this study were selected using their positions in government associated with air quality (federal, provincial/state, and municipal/regional; job titles in corporations and industry; membership in environmental groups; names associated with advisory or technical committees involved with air quality management plans; and those associated with universities). The subjects were approached through email correspondence with a letter inquiring whether they would be willing to be interviewed by email. The email interviews were conducted from March to August 1998.

The interview guidelines and type of interview method were taken from the text *Designing Qualitative Research* by Marshall and Rossman (1995). The method
is referred to as elite interviewing. This is a specialised case of interviewing that focuses on a particular type of interviewee. 'Elite' individuals are considered influential, knowledgeable persons in an agency, organisation, or community and are selected for interviews on the basis of their expertise in areas relevant to the research. So, in the case of Prince George air quality management, representatives from the Ministry of Environment- Air Quality section, City of Prince George- Environment and Planning sections, and environmental consulting firms who specialise in air quality monitoring or prevention were asked for an interview.

Answers to all email questionnaires were messages on the researcher’s Microsoft Outlook program. Once their country/city and profession was identified by occupational title or association, the respondent’s name was deleted and a paper copy was used for reference. Upon completion of the data analysis, the paper copies were destroyed.

Those who were contacted for an interview are listed below by the candidate’s state or country and the list of questions from the questionnaires are given. International, defined for the purpose of this research, are countries other than Canada. National is defined as Canada, and local as Prince George.

**Respondents from the Prince George Region**

5 participants were involved

**Professional associations not included for confidentiality reasons**

**National (Canadian) Respondents**

- Greater Vancouver Regional District (GVRD)
- People involved with the GVRD Air Quality Management Plan on Advisory committees, etc
- Government agencies in Prince Edward Island
- Government agencies in New Brunswick
- Clean Air Strategy members in Alberta
International Respondents

- South Coast, California - South Coast Air Quality Management District
- Waikato, New Zealand
- Canterbury, New Zealand
- Whakatane, New Zealand
- Taranaki Air Quality Regional Council, New Zealand
- Wellington Regional Council, New Zealand
- Michigan DEQ Air Quality Division
- New South Wales, Australia
- Mesa County Health Department, Colorado State, United States
- Grand Junction, Colorado State
- Missouri, United States
- Illinois, United States
- Wisconsin, United States
- Louisiana, United States
- Ohio, United States

4.3.1 International and Canadian Email Questionnaire

General Questions

1. Which of the air quality management approaches do you consider more effective (end of pipe, ecosystem, holistic, etc.)? In what ways are they more effective?

2. What do you consider the constraints to improving air quality in your city and country?

3. Can you comment on what other municipalities are doing to improve their air quality?

4. What goals do you have for air quality?

5. Do you feel there is a good understanding of air quality among the general public?

6. Who should make airshed planning decisions?

Specific Questions

1. What are the major concerns in your region with respect to air quality?

2. What are the geographical features of your city? Or the region in which the air quality management plan includes?
3. Briefly, what methods, such as controls and technologies, do you know of that are used to successfully improved air quality in your city or country?

4. At the beginning of the air quality planning process in your locale, did you look at previous research or existing plans?

5. Was the length of time the process would take decided upon before the process was started?

6. How was the government involved? Stakeholders? The General Public?

7. Was there consensus in the process?

8. What was the structure of the committees used in your process?

9. How did you integrate public participation?

10. How were decisions made on the actions to be taken and the necessary technologies that would need to be used?

11. How were land use strategies and zoning integrated into the plan?

12. How could the approach taken by your City or region been improved in hindsight?

4.3.2 Local (Prince George) Email Questionnaire

1. Do you feel that it is necessary to make changes to the air quality in Prince George?

2. What methods, such as controls and technologies, do you know of that are used to improve air quality?

3. Which of the air quality management approaches do you consider the most effective (end of pipe, ecosystem, holistic, etc.)? In what ways are they more effective?

4. What do you consider the constraints to improving air quality in Prince George?

5. Can you comment on what other municipalities are doing to improve their air quality?

6. What are some recommendations that you could make towards improving the Prince George airshed?

7. What policy, zoning, or regulation changes could be made or initiated to improve the air quality in Prince George?
8. What goals do you have for air quality?

9. Do you feel there is a good understanding of air quality among the general public?

10. Who should make airshed planning decisions?

11. What do you consider as the highest priority issue affecting air pollution in Prince George?

The Prince George questionnaire and the international/Canadian questionnaires were worded slightly differently with respect to the specific questions. The international and Canadian responses enabled the researcher to assess the effectiveness of existing air quality management approaches; while the local (Prince George) interviews provided information about the present local planning process. General question number one asks the respondent about effective air quality management approaches; these approaches were not determined by the researcher except when clarification was necessary. For this reason, there are approaches that have not been discussed in the literature and have not been defined.

Sampling error was minimal in the case of email interviews, since all questionnaires had exactly the same questions and coding was unnecessary since all comments were recorded in the results. Potential sources of bias were that some questions in the questionnaire were not applicable; the respondent did not understand the question; the respondent did not have the background to answer the question; or the question was left blank. Reasons for this may have been a lack of time of the interviewee, the differences in defining an Air Quality Management Plan, or the respondent had no association with an Air Quality Management Plan.
4.5 Evaluative Criteria

A set of evaluative criteria was generated using all of the available research in the literature (e.g. Sadler, 1996), the case study examples, and the questionnaires. The criteria were applied to several existing air quality management plans. The potential effectiveness of the plans was indicated by using a checklist that establishes the compliance with the criteria (Refer to Table 1). It should be noted that it is too soon to tell whether many of these air quality management plans can be defined as effective or that for a plan to be effective it must be comprehensive. This can only be shown by regions that have finalized the implementation of the plan and have determined whether or not they have met the goals and objectives set out by their plan. So, the evaluative criteria, at this point, can only be used to assess the potential effectiveness as indicated by the existing literature and the views of those interviewed, who are involved in air quality management approaches.

The set of evaluative criteria was applied to the Prince George case study to determine its potential effectiveness in comparison to the case study examples. The case study examples include: California and Colorado, United States, Sydney, Australia, the Greater Vancouver Regional District, and the Waikato, New Zealand AQMPs.

4.6 Sample Characteristics

There were fifty (50) interview email letters mailed, with 34 positive (answered 'yes' to request) responses (68%), 7 negative (answered 'no' to request) responses (14%), and 9 non-responses (18%). Once the positive response was received, the lists of questions were emailed and a return date was determined. The results of the
questionnaires will be discussed in Section 6.0. The number of positive responses in relation to location (International, national, and local) are listed below:

- 15 international respondents (United States (US), New Zealand (NZ), and Australia (Aus));
- 14 Canadian respondents (New Brunswick (NB), Prince Edward Island (PEI), British Columbia (BC); and
- 5 Local respondents from Prince George (PG).

Thirty-four (34) of the fifty requests that were emailed were completed. For the purpose of analysis, the respondents were placed into several categories. The range of the categories are broad since the people who were interviewed came from differing backgrounds with respect to air pollution and air quality management planning. For some of the questions it is unnecessary to separate the categories, while others, such as the one for Prince George, had specific questions that differed slightly. The following are the categories in which the respondents were placed:

- International
  - Government
  - Academics
  - Industry
  - Consulting
  - Environmental Group
  - Health

- National (Canadian)
  - Government
  - Academics
  - Industry
  - Consulting
  - Environmental Group

- Local (Prince George)
  - Government
  - Academics
Figure 1 exhibits the distribution of completed questionnaires in relation to professional association. Of those interviewed, the greatest number of people involved were in government positions (61.7%), then academics (11.7%), Industry (8.9%), Environmental (8.9%), Consulting (5.9%), and Health (2.9%).

In further analysis, it was shown that many of the participants were on some type of committee that was directly associated with an air quality management plan. Of the thirty-four responses, Figure 2 graphs the distribution of people on a variety of committees. These committees were identified as:

- technical committees (provides scientific and legislative information);
- advisory committees (provides scientific, community, industrial opinions);
- Air Quality planning committees (government agency and stakeholder based);
• United States State Implementation Plan committees (directed by the Federal Implementation Plan, a provision of the Clean Air Act); and

• people who are not involved with an air quality management committee.

Figure 2: Number of Respondents on an Air Quality Management Plan Related Committee

5.0 Case Studies

The following case study examples are an analysis of air quality management plans from different regions of the world and were investigated for their content and processes, commonalities and constraints. The case study examples were selected through recommendations from respondents and government and air quality websites on the internet. Twelve case study examples were analyzed and five were
chosen as examples. The “success” of these case study examples will be examined using the evaluative criteria. All of the examples were in the implementation stage of their processes, but each varied in the number of years in existence, and therefore in the stage of implementation.

Of the twenty-one (21) respondents who replied to the question concerning research conducted prior to initiating their own plan, seventeen (17) (81%) of the respondents replied ‘yes’. This affirms that case study research is important in the planning process, and that it can provide specific information with respect to mission statements, committee structures, legislative controls, and implementation strategies. The case study information is taken from the published document (booklet or internet form) and have all been approved by the region’s elected officials.

Of importance to this research is the type of air quality approach taken by each region, for example “end of pipe” or ecosystem management. Of the twelve case study examples investigated, many used multi-approaches. Mobile sources/transportation, command and control/traditional, and holistic/comprehensive each were practiced by three regions, with the national approach/legislation used by two regions, and lastly, systems and land use planning had one region each who used that approach (as defined by the respondents in the interview process and by the case study analysis).

The literature review indicates that an effective AQMP will need to incorporate point and non-point sources to succeed in achieving its goals and objectives (Sadler, 1996 and Ryding, 1994). This means that approaches beyond the scope of “end of pipe” and permitting are used to achieve the goals and
objectives. The reasoning behind this statement is that management of any resource needs to involve more than governmental agencies and industry, all of the stakeholders should be involved so that personal and corporate responsibility is taken (Sadler, 1996). Also, the airshed, as a whole, should be analyzed and all sources should be included in the AQMP. The five case study examples are: California and Colorado, United States; Greater Vancouver Regional District, Canada; Waikato, New Zealand; and Sydney, Australia.

In the next chapter, the Results and Discussion, these case study examples will be assessed using the evaluative criteria, and their potential effectiveness will be analyzed.

5.1 New Zealand

5.1.1 Waikato Regional Council

In New Zealand, the Resource Management Act (RMA) regulates that each region carry out a regional plan, which is comprehensive in nature. The plan should provide the management framework for considering adverse effects on ambient air quality and local air quality from the discharge of contaminants. The approach, as indicated in the RMA, must focus on an effects-based approach (Waikato Regional Council, 6), which necessitates a move towards the philosophy of Air Quality Management. Fundamental to Air Quality Management is the control of contaminants to air within levels set by air quality guidelines or standards. Within the philosophy set out by the RMA the requirements placed on the emission sources are based on the desired air quality within an area. This approach requires the knowledge of the cumulative effects of discharges on the ambient levels in a specific area. This is obviously similar to the concepts of ecosystem management and
comprehensive strategies. The issues, objectives, policies, and implementation methods of the Waikato AQMP are outlined in Waikato’s Regional and Local Air Management Plan (Waikato Regional Council, 1998).

The first issue that is outlined in the plan is:

> The discharge of odour, particulate matter, combustion products and chemicals into the air adversely affects ambient air quality and air quality in local areas. These discharges change the characteristics of air quality and adversely impact on:
> (1) human health
> (2) the health of flora and fauna
> (3) amenity values
> (4) the relationship tangata whenua (indigenous peoples) have with the air.

The objectives stated are “to protect the significant characteristics of acceptable and high air quality and to enhance the significant characteristics of degraded air quality”. There are three policies outlined.

Policy 1: Regional and Local Air Quality Management which describes the ability of discharging contaminants into the air while ensuring that there are no adverse or objectionable effects on human health or the environment.

Policy 2: Guidelines for Decision-making. This policy details the procedure for making decisions on a resource consent application (pollution permit), or when considering the effects of any discharge of contaminants into the air. The procedure includes an analysis of the Regional Ambient Air Quality Guideline levels as set out by the RMA and the internationally accepted air quality guidelines or standards for managing and understanding the effects of contaminants on human health and the environment.

Policy 3: to investigate the sensitivity of the receiving environment and any cumulative effects as a result of the discharge on the receiving environment.
All of these policies tend towards the traditional approaches of air quality management planning, but it is in the implementation stage that the Waikato plan adopts the principles of ecosystem management (Refer to Section 6.1.1.1.5, Waikato Regional Council, 1998). This range of actions will enable Environment Waikato to make intelligent resource management decisions. Many of the following implementation methods are used with respect to Regional and Local air quality management, and the management of transport sources.

1) Ambient Air Quality Monitoring- Environment Waikato will continue to develop and implement a program to monitor air quality in the Waikato Region. Ambient air quality monitoring will focus on:

   1) further identifying and confirming ambient air quality indicators
   2) developing long trend information
   3) peak monitoring, to identify levels of contaminants in the air where there is a known impact, and
   4) developing regional air quality maps showing areas of varying air quality and air quality characteristics within the Region.

2) Monitoring of Community Perceptions- Environment Waikato will, in conjunction with local communities in the Region:

   1) monitor the community perceptions about the state of the air resource,
   2) determine the air quality characteristics within their local areas.

3) Investigation and Reporting- Environment Waikato will:

   1) develop and implement a regional emissions inventory which will identify the scale and distribution of discharge of contaminants to the air
   2) coordinate and contribute to research on regional air quality issues and ensure this information is shared between relevant agencies
   3) report on air quality data collected as part of its ambient air quality monitoring programme, and
   4) undertake a re-assessment of air quality monitoring needs and achievements within four years of the Plan becoming operative.
Promotion- Environment Waikato will promote to relevant agencies, the need for the development of:

5) national guidelines for sampling, characterizing and measuring contaminants
6) a national air quality monitoring data base
7) national ambient air quality indicators, and
8) other projects that will help Environment Waikato to achieve its functions regarding air quality management.

4) Environmental Education- Environment Waikato will provide the information generated from the methods to improve the regional community's understanding of air quality issues in the Region.

Land use planning by the individual territories is encouraged by Environment Waikato in the Plan through the use of District plans and land use consent applications. The leading agency outlines several steps to fully developing a district plan such as: considering the air quality characteristics of an area; controlling new land uses that are sensitive to the discharge of contaminants; making available to the public information about significant sources of discharge; and requiring effective particulate management programs for all activities not regulated by Environment Waikato. This non-regulatory method specifically recognizes the importance of land use planning as a tool in avoiding conflicts between land uses.

The planning process has taken several years with many levels of government and stakeholders involved. There are five major committees involved in the drafting and implementing of the Plan. The stakeholders, which are a group of resource users (industry), resource management practitioners, government, and environmental groups have been involved in the process from the earliest stage. The Current Mailing List is a group who has expressed an interest in the Plan and have been communicated to through a newsletter. The Regional Community has
been communicated to through open houses and an educational campaign. The last two groups are the internal staff of Environment Waikato and the elected Councillors who approve the Plan for its completion.

The environmental results anticipated by the Regional and Local Air Management Plan are many, but this is not far reaching when considering the five years that it has taken to produce the final draft (Section 6.1.1.1.21, Waikato Regional Council, 1998).

The following are the results anticipated:

1. Ambient air quality with Regional Guideline levels.
2. Discharges of particulate matter at a level where there are no objectionable adverse effects.
3. Discharges of odour at a level where there are no objectionable adverse effects.
4. Discharges of hazardous contaminants at a level where there is no risk of causing adverse effects on human health and the health of the flora and fauna.
5. Discharges to the air that do not significantly change visibility on a local or regional scale.
6. Discharges to air that do not cause corrosive effects on structures.
7. Minimization of short and long term contamination of soil and water as a result of the discharge of contaminants to air.
8. Air management outcomes that are consistent with the values held by tangata whenua.

5.2 United States

The Environmental Protection Agency and federal law mandates that each state must submit a State Implementation Plan (SIP) that meets or exceeds the National Ambient Air Quality Standards (NAAQS) and the proposed Federal Implementation Plan (FiP). The SIP must include sources and types of pollutants, acceptable emissions levels, and a compliance-monitoring plan.

The federal Clean Air Act (CAA) places most of the responsibility on the states to prevent air pollution and control air pollution at its source, in order for a
state to conduct certain air quality programs, the state must adopt a plan and obtain approval of the plan from the Environmental Protection Agency (EPA). Federal approval provides for some consistency in different state programs and ensures that a state program complies with the requirements of the CAA and EPA rules.

5.2.1 California State

The California SIP achieves the same objective as the proposed FIP for Sacramento, the South Coast and Ventura with a different combination of state, local, and federal measures, and will therefore, nullify the FIP upon approval by the U.S. EPA.

Within the framework of the state and local governments, there is shared responsibility for air pollution control. The Air Resources Branch has ultimate air district accountability, where this State Board has the necessary statutory authority to assure compliance with the requirements of §110 of the Clean Air Act relating to the attainment of national standards.

California and Los Angeles are among the leaders of the world in solving environmental problems and their air quality plan is considered to be the most comprehensive air quality management plan in existence (Ryding, 1994). The key elements of the plan are the goals, objectives, and strategies; but also of significance are the committees and structures involved in the process.

5.2.2 California Air Resources Board

The California Air Resources Board (ARB) has the final decision making capability with respect to the specific strategies and associated activities that are
required to attain each goal of the Strategic Plan. The plan provides a road map for accomplishing the goals implicit in ARB’s mission statement:

*To promote and protect public health, welfare, and ecological resources through effective and efficient reduction of air pollutants in recognition and consideration of the effects on the economy of the state. These elements combined provide a framework to ensure California stays on course in achieving clean air.*

The Air Resources Board consists of 11 members appointed by the Governor with the consent of the Senate.

- Five members must be chosen from the boards of local air quality management districts: one each from the San Diego Air Pollution Control District, San Francisco Bay Area Air Quality Management District, San Joaquin Valley Unified Air Pollution Control District, South Coast Air Quality Management District (greater Los Angeles region), and one from any other district.

- Three other members fill specific categories. One must have expertise in automotive engineering or a closely related field. One must have expertise in science, agriculture, or law. One must be a physician and surgeon, or health effects expert.

- One of the three remaining members must have expertise in air pollution control, or must meet the qualifications of one of the three categories mentioned above.

- The remaining two members are public members.

5.2.3 South Coast Air Quality Management District

The Management District is made up of committees who are involved with the State Implementation Plan including government agencies, directly responsible for emissions control plans and programs, and task forces used in the consultation process of the Air Quality Management Plan.

The agencies involved in the State Implementation Plan and Air Quality Management are the:

- California Air Resources Board (chaired by the Governor)
- California Energy Commission
- California Bureau of Automotive Repair California
Those people involved with the task forces of the Air Quality Management Plan are the following:

- District Governing Board (comprised of elected officials)
- PM10 Task Force (56 individuals representing business, industry, government, academia, and environmental groups)
- SCAG, The Southern California Economic Partnership (business interest)
- California Air Resources Board (ARB) (chaired by the Governor)
- U.S. Environmental Protection Agency.

The ARB Comprehensive Work Plan (California EPA, 1997) is the most recent publication which summarizes many of the ARB’s on-going programs, and focuses on major new and expanded activities needed to meet the challenges for the years to come. This section will look at the goals, the objectives, and the strategies of the Comprehensive Work Plan.

Goal #1: Continuously improve our understanding of the nature and causes of California’s air quality problems. The ARB maintains an extensive network of air quality monitors and an up-to-date inventory of air pollutant emission sources. In addition, the ARB oversees a wide variety of studies to determine the effect of air pollution on public health. Strategies place particular emphasis on particulate health studies, statewide inventories, mobile source inventory improvements, and future air quality based on current and projected control strategies.

Goal #2: Increase the effectiveness of adopted air pollution control strategies, and integrate these strategies with other regulatory approaches. This includes strategies such as motor vehicle certification; heavy duty vehicle inspection program;
adoption of regulations and guidance of districts on how to allow the use of emission reduction credits; and streamline permitting and enforcement to ensure that permitted stationary sources meet applicable air quality regulations.

Goal #3: Promote the development of new technologies, and adopt control strategies to attain air quality standards and reduce public exposure to air toxics. The objectives identified under this goal is the promotion of development of new technologies to meet the Clean Air Act requirements, the development of new regulations and programs to further reduce emissions from motor vehicles and consumer products. Some of the strategies for obtaining these objectives are the Zero emissions vehicle objective; accelerated vehicle retirement; market-based transportation pricing measures that reduce congestion and emissions; and reduce emissions from volatile organic compounds from consumer products.

Goal #4: Strengthen public education, stakeholder outreach, and quality improvement activities. The objectives identified include the increase in understanding of air pollution problems and the encouragement of personal responsibility for improving air quality through awareness campaigns and school curriculum. The use of evaluation systems to identify the needs, expectations, and satisfaction of ARB's stakeholders through stakeholders forums, customer service surveys and trainings.

It is obvious by the scope and timeline (10 years) of this air quality management plan that air quality planning is an ongoing process involving research and dedication from the California EPA, the ARB, the stakeholders, and public of California. Improvements noted by the South Coast Air Quality Management District include a decrease of thirty percent has been seen in the average peak concentrations of ozone, despite a twenty-one percent increase in California's population and even
higher growth in driving rates since 1985 (California EPA, 1997). Monitored levels of particulate matter have decreased by twenty-five percent since 1990 (California EPA, 1997) and air toxic emissions have been reduced by almost sixty percent since 1986 as a result of State control measures for cancer-causing pollutants, such as benzene (California EPA, 1997).

5.2.4 Colorado State

Colorado’s Plan has emission standards equal to the NAAQS except for a few cases where local governments have set stricter standards to protect public health. The State of Colorado maintains a list of major and minor pollution sources, including pollution “devices” and their corresponding allowable pollution thresholds for NO\(_x\), SO\(_x\), VOC, and particulates.

One important consideration in the establishment of the Colorado State plan was the consideration of the local economic impacts of stricter air pollution standards. Costs of these strategies to citizens and industry include millions of dollars for inspection fees and fines, alternative fuels for Coors, PSC and RTD, woodburning to natural gas conversions, cleanup and update of emissions-related equipment at large industrial and power plants, road dust reduction measures, use of low sulfur diesel fuels, and lost jobs at Coal mines. Cumulatively, the estimated cost of implementing stricter air pollution standards was over 100 million dollars.

The plan’s 10-point strategy addresses Colorado’s major emission sources - vehicle emission, factories and power plants, wood stoves and fireplaces, refineries, and road debris. The ten target strategies are:

1. Inspection and maintenance of diesel vehicles;

2. Implementation of mass transit;
3. Gas conversion for power plants and industry;
4. Post-cleanup for power and industrial plants;
5. Alternative fuels for diesel vehicles;
6. Reduction of residential woodburning emissions;
7. Reduce emissions from oil, gas, & chemical plants;
8. Sell low sulfur diesel fuels in Colorado;
9. More stringent inspection & maintenance programs; and,
10. Reduction of airborne re-entrained dust.

The committees that were established were three tier with a Governing Board, which included the Governor, a Senator, and a Representative of the House. Their duties are to:

- Appoint members of the Technical Advisory Panel and designate its chair;
- Define the goals and work products of the Plan;
- Approve the final report;
- Appoint the Technical Advisory Panel and designate its chair; and,
- Act as a final arbiter in disputes between and among those connected with the Plan.

The Technical Advisory Panel which was comprised of representatives from the Colorado Department of Public Health & Environment, the Regional Air Quality Council, the Environmental Defense Fund, the Colorado State Senate President, the League of Women Voters, Cyprus Amorax Minerals Company, Colorado Interstate Gas, a Colorado State Representative, and a General Motors Corporation representative. Its duties included the following:

- Reviews the work plans and budgets for the Plan;
- Makes technical recommendations to the Board and Contractor;
• Reviews and approves data reports and analyses and interpretation of data that are to be presented to outside groups and/or to the general public;

• Reviews and approves the final report.

The last of the three tier committee structure is the Contractor/Technical Project Manager (Colorado State University). It duties are to:

• Perform necessary administrative, management, monitoring and coordination tasks;

• Coordinate public information activities through its public relations office and serves as spokesman for the Plan;

• Establish and convene a design team of nationally recognized scientific experts to provide technical input and guidance to the Plan;

• Provide staff support to the Technical Advisory Panel and participate in meetings of the Quality Control Committee; and,

• Assure preparation of the final report.

Figure 3 diagrams the three tier committee structure.

Figure 3: Colorado’s Three Tier Committee Structure
5.3 Australia

5.3.1 Sydney--Air Pollution in Major Cities- The Natural Heritage Trust, Commonwealth Government

Australians rank air pollution as their major environmental concern, according to a recent survey by the Australian Bureau of Statistics (Natural Heritage Trust, 1998).

While the day to day management of air quality is the State and Territory's responsibility, there are a growing number of air quality management issues that are common across Australia. These require coordinated national action to improve urban air quality. The Air Pollution in Major Cities Program (Commonwealth Government) focuses on the six pollutants to which the majority of Australians are exposed. These are carbon monoxide, nitrogen dioxide, ozone, lead, particles, and sulfur dioxide.

Air quality issues confronting the towns and cities of Australia are being addressed in five major areas:

- national standards developed mainly under the National Environment Protection Council and the Motor Vehicles Environment Committee.
- strategies for the implementation of practical solutions to air quality problems;
- monitoring of air quality across Australia;
- research to inform air quality policy; and
- community education on air quality issues.

The Commonwealth Government commissioned the Australian Academy of Technological Sciences and Engineering to conduct an independent inquiry into Urban Air Pollution, as part of the Air Pollution in Major Cities program.
Clear the Air (Natural Heritage Trust, 1998) is the first step in the Commonwealth's response to the recommendations of the inquiry. Clear the Air projects are funded by the Commonwealth Government's Natural Heritage Trust through the Air Pollution in Major Cities Program providing the national action in five key areas: transport; industry; residential; monitoring; and coordination.

At the Commonwealth level, the Natural Heritage Trust is administered by a Ministerial Board comprising the Minister for the Environment and Heritage, and the Minister for Agriculture, Fisheries and Forestry. The Trust creates the foundation for a cooperative effort between the Commonwealth, State and Territory governments, Local Government, community groups and individuals to enhance Australia's natural environment.

A Clean the Air committee was established from the Air Managers Forum, a working level exchange of ideas and information chaired by the Commonwealth that would assist in the coordination of air quality actions. It identifies common problems, shares information, involves other portfolio interests as required, and oversees the management of national or shared air quality initiatives, including research and community education. The committee will concentrate on the recommendations of the Air Inquiry and will complement existing cooperative action undertaken by National Environment Protection Council (NEPC) and the Motor Vehicle Environment Committee (MVEC).

The principles of the Clean the Air committee are as follows:

1) To manage air quality into the future there should be an enhancement of coordination, at all levels of government, of transport, urban infrastructure and environmental management responsibilities. This coordination should include:
a) the ongoing formal relationship embodied in the National Environmental Protection Council and extensions such as the Memorandum of Understanding between the NEPC and the National Road Transport Commission;

b) integrated plans for optimal development in terms of:
   - urban form
   - transit and transport systems including intermodal connections;

c) attention to pollution sources other than vehicles, especially among the agencies and levels of government operating within a particular airshed; and

d) integrated planning systems which predict conditions conducive to high urban air pollution and provide that deliberate burns for hazard reduction are avoided in such periods.

Education has been identified as one of the major areas in which the governments can create change. This will be accomplished through wide promotion of air quality management measures which receive the support of governments at Commonwealth, State, and municipal level through educational and information programs.

A variety of recommendations and implementation strategies are identified in the Clean the Air (Natural Heritage Trust, 1998) document. The following is a brief summary of strategies being put to use by the Commonwealth, State, and municipal governments with funding from the Natural Heritage Trust.

1) Airshed Monitoring

   a) States, with the Commonwealth, should continue to collaborate in the ongoing development and implementation of nationally based methods for monitoring, data analysis, modelling and prediction and reporting. For this purpose they should continue to draw on the expertise resident within their own EPAs, CSIRO, Bureau of Meteorology and other agencies, universities and private consultancies.

   b) Monitoring and air quality interpretation for the airsheds should include the following:
monitoring stations for the key pollutants located so as to sample the major zones of the airshed. Their appropriateness of location should be determined by airshed modelling and data analysis;

data interpretation modelling and prediction moved to a GIS based methodology;

personal exposure estimates based on population demographics;

long term pollution trends in Australian cities in addition to exceedence events analysed on the basis of median and percentile one hour maxima and conducive synoptic day 24 hour response data;

on a periodic basis studies of the origin species and size distribution of the particulates causing brown haze over major metropolitan airsheds should be conducted; and

the information obtained on airborne particulates and their sources should be used to modify or extend emission standards and air quality goals.

2) For wood heaters all States and Territories should adopt uniform legislation and coordinate their policies with respect to:

- tightening of the current emission standard by 25% to 4 g/kg (by 2001);
- effective community education on correct heater operation;
- restrictions on resale of old heater models which do not comply with standards;
- an industry sponsored program to buy back old heaters;
- media warning of high air pollution days so that people with alternative heating will not use open fireplaces or old model heaters; and
- banning of all new open fireplaces in urban areas.

3) In any towns or cities where winter smoke is a problem backyard burning should not be permitted.

4) Promote consumer awareness of the air quality benefits of actions such as:

- use of low emission lawn mowers;
- the use of water based acrylic paints including those with zero volatile matter; and
- minimising household energy use.
5) Urban Infrastructure

- Adopt planning strategies which deliberately channel and concentrate additional population and non-polluting industry into specific zones or locations served by transport, employment and service facilities, either existing or new, so as to maximise self-containment of housing, jobs and services and minimise unproductive travel.

- As well as improving the quality and choice of transit systems along the corridors which serve such development, enhance the orbital connectivity between corridors and their major nodes.

The process involving the *Clean the Air* initiative (Natural Heritage Trust, 1998) is relatively new in Australia with much of the research and planning strategies occurring in the last two years. However, there have been other initiatives such as the Clean Air 2000 Strategic Action Plan that have been in existence for at least five years. The following is a summary of the key directions that the Clean Air 2000 Advisory Task Force in Sydney, New South Wales believes should be pursued in order to reduce Sydney's traffic congestion and air pollution levels. This is not considered to be an integrated air quality management plan for the Sydney airshed, instead it deals almost exclusively with transportation issues.

The strategies have been developed to complement the transport-related air quality strategies being advanced by the State Government (Air Quality Management Plan) and the Federal Government (transport aspects of the National Greenhouse Response Strategy). There is a hope that by mobilizing all of the levels of community (government, business, industry, public) towards the adoption of the strategies and actions that there will be reduction in urban air pollution and traffic congestion.
5.4 Canada

In Canada, air pollution and its quality is a provincial issue as described in the literature review chapter on provincial and federal legislation. There have been very few air quality management plans initiated in this country. To note are the plans in Vancouver, Toronto, Alberta, and now Prince George. Many of the issues dealing with air pollution come under provincial jurisdiction, with acts such as the Waste Management Act in British Columbia and Environmental protection acts in other provinces. The problem which exists is that these pieces of legislation deal with "end of pipe" permits rather than the airshed as a whole or an ecosystem management approach. This section deals the Greater Vancouver Regional District's efforts to improve air quality. It has been chosen since it reflects the same comprehensive nature that the California AQMP does. The Prince George in-depth case study will be discussed separately in its own chapter heading.

5.3.1 Greater Vancouver Regional District (GVRD), British Columbia

The GVRD Air Quality Management Plan is defined through its mission statement (GVRD, 1994):

The GVRD air quality management program (AQMP) will work cooperatively with the community to shape regional land use and transportation, encourage clean air lifestyles, and manage emissions from human activity so as to protect human health and ecological integrity both within the region, in neighbouring jurisdictions in the Lower Fraser Valley airshed, and globally.

As with many of the air quality management plans discussed in this case study chapter, committees are an important part of the process. The following flow chart (Figure 4) defines the committees and shows the hierarchy used in the Vancouver plan.
Figure 4: Committee Structure for the GVRD AQMP

The GVRD began its process with consultation with the South Coast Management District (California) since the air quality and population concerns were similar. The first step of their process was to complete a comprehensive air emission inventory in May 1988 and the AQMP Stage 1 Report assessing the current and future air quality was published in 1989. The AQMP Stage 2 Report was released in Draft in May 1992, extensive advisory committee and public consultation occurred with the release of the final draft of the plan in December of 1994. Progress is still occurring with ongoing consultation and production of further publications updating and forecasting for the future.

The GVRD set out a number of steps in the development of a solution-oriented strategy for the improvement and protection of air quality and created a “comprehensive regional air basin approach” (GVRD, 1994, 6-1). This is similar to an ecosystem approach which targets specific air quality problems within an airshed
and produces results based on a wide range of indicators. The steps include adopting regional goals within a framework of national and provincial standards and objectives; recognizing health, environmental, and economic aspects; identifying issues and problems by monitoring and characterizing the existing and potential future air quality in the region; and establishing priorities for action (GVRD, 1994).

Regional goals that the GVRD set in their AQMP are (GVRD, 1994):

- The GVRD will in all air quality management activities, proactively encourage clean air lifestyles and business practices by the community by:
  - applying equitable and effective strategies to minimize emissions from all sources under its jurisdiction, and
  - cooperatively supporting reduction strategies of other regulatory authorities and members of the community.
- GVRD air quality management program strategies will prioritize air quality issues, action plans, and implementation schedules to target programs at specific problems and make optimum use of all of the available resources in the community.
- New commercial and industrial operations should incorporate the most up-to-date control technology. This technology must, as a minimum, be equivalent to the most stringent standards of the federal or B.C. governments.
- All existing commercial and industrial operations should reduce their emissions with the most up-to-date retrofit technology based on a schedule which considers air quality management priorities and economic concerns.

The priorities of action within the plan and the techniques used for implementation included studies conducted on a cost-benefit analysis of an air quality management plan, wood stove and backyard burning studies, transportation and land use studies, and periodic status reports.

An air quality management plan is a continuous and evolving process, but with positive results already seen in the reduction of ozone and particulate matter in the Greater Vancouver Regional District. The GVRD is hopeful that the long term goals set will be realistically attainable.
5.3.2 Prince George, British Columbia

In this case study, the researcher was a participant observer for 16 months (August 1997- January 1999) of the Prince George air quality management planning process. During this time, the members of the technical management committee developed strategies for improving air quality in the Prince George airshed and produced the Prince George Air Quality Management Plan- Phase One.

At the commencement of this study, the committee had already initiated meetings and produced a Background Report in 1996, that identified priority air pollutants in the Prince George airshed. The Prince George City Council and the Fraser Fort George Regional District Board reviewed the Report and authorized a public consultation process and a public perception survey in the city of Prince George (Oster, 1997).

The Prince George Airshed Technical Management Committee consists of members from the City of Prince George Public Works and Development Services Departments, the Regional District of Fraser Fort George Environmental and Development Services Departments, the Ministry of Environment, Lands and Parks Environmental Section, the Northern Interior Health Unit, the University of Northern British Columbia, and the College of New Caledonia. The committee integrated governmental stakeholders, academics, and health. Absent from the committee structure in comparison to other case studies were a Steering committee made up of political representatives, and an advisory committee with representatives from the community and industry. However, this may not be negative point since when speaking with members on some of the advisory committees in other regions, there was little influence on the process or the plan anyway.
Dynamics of the committee were interesting with each person bringing their occupational position and background knowledge of air quality to the table. Each member of the committee was an expert in their own field with knowledge of transportation, development services, health, monitoring, air quality planning, and the environment and the sharing of this information enabled all members to make informed decisions. Decisions were made through consensus with all opinions viewed equally. This is not the case with most of the case studies, for example, in London, England, the governmental agencies and research scientists were the decision-makers, without consultation of other interested parties.

No time line was set to complete the plan, but a decision was made to separate the process into phases. Phase one dealt with the priorities of air quality issues in Prince George and Phase two will deal with the implementation of the plan. At each point, the committee presented their progress to City Council and the Regional District Board before going to the next step in the process.

The process began in December of 1995, with Phase One completed and passed by City Council in December 1998. It took three years to complete Phase One. Some of the reasons for this length of time included the different schedules of the committee members, the length of time taken for public consultation processes, and occupational responsibilities.

The consultation process involved open houses, industrial workshops, and facilitated stakeholder workshops. At three points during the process, the public and stakeholders were involved with comments on the plan. An open house and industrial workshop was held to receive feedback on the Background Report (PGATMC, 1996) and direction in which the plan should take. Written and oral
responses were examined and integrated into the plan. The next major consultation period involved the first draft of Phase One. A facilitator was hired to provide an unbiased discussion of the plan with members of the technical management committee recording in small groups. All of the written submissions and comments expressed in the workshop were compiled into the document *Prince George Draft Air Quality Management Plan Consultation Feedback Report* (Penner, 1998).

Revisions were made to the PGAQM plan through discussion of the committee and justification was given for each decision made.

Most of the decision making and documentation of the plan was in the 16 months of observation by the researcher. This included:

- the first draft of the Prince George Air Quality Management Plan was presented to City Council in December 1997;
- the hiring of a Facilitator for the public consultation and workshops in April 1998;
- Air Quality Workshops on April 22 and 23, 1998, 55 people attended from all sectors of industry, business, health, and the public. Comments were gathered by Facilitator Raymond Penner from the Strategic Action Group;
- feedback and revisions of the plan with information from the consultation process- Prince George Air Quality Management Plan- Phase One, *Consultation Draft One*;
- release to workshop and consultation participants of *Consultation Draft One*, with feedback and revisions of the plan from workshop and consultation participants;
- Prince George Air Quality Management Plan- Phase One, Revised *Consultation Draft* (September 10, 1998) given to Raymond Penner with the PGAQTMC revisions and responses to comments from workshop participants;
- The Strategic Action Group produced a Prince George Air Quality Management Plan Consultation Feedback Report (October 22, 1998) which stated the comments of workshop participants and the PGATMC’s responses in tabular form for each recommendation and was released to workshop participants;
the Revised Consultation Draft was released to workshop participants; and finally,

the final draft of the Prince George Air Quality Management Plan- Phase One was presented to City Council.

December 1998 ended the Prince George Air Quality Management Plan-Phase One, with approval by the Prince George City Council and the Fraser Fort George Regional District to begin phase two, the implementation stage of the plan.

Mission statements and objectives were important in the process and wording was debated upon for many revisions. The outcome through consensus by the PGATMC are the following principles and objectives (PGATMC, 1998):

**The Guiding Principles for Preparation and Implementation of the Management Plan**

1) Acceptable air quality is everyone’s right; protecting air quality is everyone’s responsibility.
2) Air quality is an important community social, economic and environmental factor.
3) This airshed should be considered a priority for air quality management in the province.
4) Achieving air quality objectives requires that local and provincial government agencies work together with the public and industry.

**Management Plan Objective**

To achieve and maintain acceptable air quality by reducing the emission of those air contaminants that are causing unacceptable air quality, and by preventing future air quality problems from developing.

The plan itself is divided into five sections of recommendations, then a section on funding needs and cost sharing and ongoing consultation and involvement. In each section a number of recommendations are given under each topic.

(1) Industrial recommendations

(a) Pulpmill sources
(b) Value added projects
(c) Beehive burners
(2) Residential recommendations
   (a) Backyard open burning
   (b) Wood burning appliances.

(3) Municipal recommendations
   (a) Dust from street sanding, unpaved areas and other sources
   (b) Community and regional planning

(4) Preventative Measures recommendations
   (a) Prevention of air quality problems
   (b) Management of poor air quality episodes

(5) Monitoring and Research recommendations
   (a) Monitoring
   (b) Research (health study)

There are a number of constraints specific to the Prince George planning process that may not have occurred in other air quality plans that are legislated by the country’s federal government. These include funding constraints and economic/industrial influences on political decision making. Many of the other plans discussed in the case studies were fully funded through government agencies, grants, and industrial/business permits and staff was provided to document the plan and coordinate the members. The Prince George process had minimal funding which caused time pressures on some members and did not allow for additional research to be done. This is in comparison to other regions that spent time doing research on important topics related to air quality and were able to conduct educational campaigns, expressing the importance of individual responsibility.

At this point, the Prince George planning process has been successful in developing Phase One of its plan, with the important implementation process just beginning. Statements of absolute success for this plan and many others are
difficult to declare since the planning process has only just begun. For most, success can only be determined down the road when the goals and objectives of decreasing air pollutants or maintaining levels have been researched and conclusions are made.

5.4 Conclusions

There were many commonalities among the case study examples with respect to format, time allotment, funding sources, research and studies conducted, committee structure, and each plan's mission statements or principles (See Figure 5).

The format, or direction, of an air quality management plan is important in the beginning of each of the planning processes. The greatest influence on the direction of the approach taken by a region is the differing levels of involvement of politicians and stakeholders in the process. All of the plans involved government agencies, the differences were in the active participation of industrial stakeholders, health officials, and academics. The other influence is the degree in which the plan is technically oriented. This means whether or not the environmental government agencies lead the policy making decisions and regulations, or the process was guided by an interdisciplinary committee arrangement, where knowledge was shared, and in some cases consensus was sought.

In the United States, all of the air quality management plans were under the direction of the federal Environmental Protection Agency, and each state was legislated to submit a State Implementation Plan in accordance with the Clean Air Act. There were three countries regulated by the federal government and were
identified as the leading agency for control of air quality management plans—United States, Australia, and New Zealand.

Many of the plans involved a steering or administrative committee overseeing and having final decision making capabilities; a local or municipal government (political) committee for representation of the electoral districts; a variety of government agencies (environment, health, transport, finance, development services); and an advisory committee or working groups for consultation of the plan and input (includes industry, academics, public, environmental groups, health, and other interested parties). These committees differed with respect to the level of government most influencing the plan. In some regions, there were no advisory committees or working groups, instead the committee held workshops for stakeholders and open houses for the public. Written and oral submissions were taken and revisions were made based on the content and agreement of the committee.

For an effective planning process to occur it is important to involve elected government officials at all stages of the process and consult with all interested stakeholders with each draft. This way there are no surprises when final approval is needed by local, provincial/state, or federal elected officials.

Time allotment was a function of pressure by the politicians for solutions to air quality issues or the commitment available by the committee members. In most of the cases the timeline was over several years for the first phase of the plans, with implementation of the plan within five years of its conception.

Funding sources were determined by the involvement of government agencies in the process. In many of the regions, the plans are defined within a
state/provincial regulation, therefore are funded through permits and fines from industry or business. If regulated federally, funding could be designated through grants and other funding sources. In most cases funding was not discussed in the interviews or available through the internet contact.

Research and studies were carried out by all of the committees by contract, academics, working groups, or the governmental agencies. In most cases, studies were done on emission inventories, priority pollutants (ozone, NOx, and particulates), monitoring, health, land use and transportation issues, and public opinion or perception studies. Funding for these projects and expert knowledge base were most likely the greatest constraints when it came to completing necessary research; at least in the case of smaller centers of population, where there are concentrations of industry, and few air quality specialists or academics. Funding for these studies was particularly difficult for the Prince George region.

To conclude this chapter, a summarized process is presented in flow chart form (Figure 5), which identifies the common procedural aspects of the case study examples.
Background Research and Studies
- Assessment of Current Air Quality
- Air Pollutant Priorities
- Air Quality Monitoring Data

Public Consultation Period
- Public Open Houses
- Stakeholder Workshops
- Public Perceptions of Outdoor Air Quality Study

Draft plan using government agency staff. Develop goals, objectives, and recommendations.

Set Up Advisory Committee (non-governmental)
- Industry
- Environmental Groups
- Public Interest
- Consulting Companies
- Public Health

Advisory Committee to comment on Draft

Public Consultation period- review of the Draft document and comments

Advisory Committee for last revision

Final Plan
Present to Municipal and Regional Governments

Adoption and Implementation

Figure 5: Common procedural aspects of AQMP case study examples.
6.0 Results and Discussion

The integration of the literature review, case study examples, and questionnaires have produced valuable information for those initiating an air quality management plan. This knowledge can provide the information necessary for making recommendations and conclusions for effective air quality management and planning.

6.1 Questionnaires

This section summarizes the results of the interviews of the respondents involved in air quality initiatives in Canada and other countries.

The results are grouped under the questions comprising the interview instrument. Section headings follow the questionnaire format for the general questions, which were included in all of the questionnaires (international, national, and local participants).

The specific questions were incorporated into three main topics that incorporate similar responses and allow for the varied degree of involvement of the participants in air quality management plans. The responses to the specific questions were grouped into the topics below:

- government, stakeholder, and public involvement in the process;
- the structure of the committees used in the air quality planning process; and,
- any improvements that the respondents could make in hindsight to the approaches taken in any of the air quality management planning processes.

All questions were open-ended allowing the respondent to answer each question in whatever way they wished. Responses were categorized into international, national, and local and the professional association of each respondent.
was noted. It was interesting that the analysis of the responses to interview questions revealed trends that were not distinguished by international borders, but rather by professional association, in other words, the job or organization in which the respondent was representing in the interview.

6.1.1 General Questions

**Question #1:**

Do you feel there is a good understanding of air quality among the general public?

An understanding of air quality management issues is very important for all levels of government, industry, and health. However, policies and legislation brought forth by government are difficult to enforce unless the general public is willing to respond to these changes positively. The level of understanding for the general public may only need to be the identification of an odour or a haze, and an understanding that there are many sources of this pollution and that individual sources are of great concern.

The general trend of responses to this question was that the general public does not have a good understanding of air quality issues or of air pollution, in general. There were few differentiating factors between international, national, and local. The responses were similar with respect to the lack of the public's understanding of air quality issues, in addition to the lack of initiative taken by the public to take on personal responsibility. The majority of participants (60%) answered the question in the negative with only 4% of respondents saying that the general public has a good understanding of air quality. Those participants who believed that the general public's understanding was improving spoke of educational programs and increases in awareness over the last 20 years (improving knowledge,
36%). Refer to Figure 6- Responses to ‘Do you feel that there is a good understanding of air quality among the general public?’ which includes international, national and local responses.

The respondents were not divided among international, national, and local categories, since the respondents interviewed reside in regions that are involved in air quality issues. Therefore, borders do not affect the public’s understanding of air quality issues.

Why does the general public lack the understanding of air quality issues? Some respondents identified the lack of funding for education, the lack of understanding of scientific jargon, and the level of misinformation which causes confusion. In the end, most were hopeful that a concern for air quality management would become more focussed in the future.
Figure 6: Responses to ‘Do you feel that there is a good understanding of air quality among the general public?’ (Figure includes international, national and local responses.)

Question #2:

What do you consider the constraints to improving air quality in your city or country?

The constraints identified by many of the respondents dealt with issues beyond their control, such as national initiatives and the enforcement of policies affecting the individual. The importance of this question for other regions commencing an air quality management process is to identify the constraints and incorporate solutions into their process.

There was a range of responses to this question, though this time, there were differences in the distribution of constraints between international (Figure 7), national (Figure 8), and Prince George (Figure 9) responses. A large number of respondents (international- 33%, national- 38%) felt that the lack of political will or the lack of straightforward legislation and national goals were a
significant constraint. Others felt that the unwillingness of the public to take responsibility was a constraint (international- 33%, national- 14%, and local- 18%). Many responses dealt with the lack of cooperation between government, industry, and the public; and the lack of solid scientific information for monitoring, analysis and justification for changing technology.

The greatest difference between international, national and local were the constraints associated with industry from the national perspective (19%) and local (18%) compared to the international responses (4.7%). The lack of cooperation between industry and government and the unwillingness of industry to spend for additional technology were identified as major constraints by national and local respondents. Economic constraints affected all areas. This included such examples as the cost of replacing existing infrastructure; the funding necessary for an air quality management planning process and public education; or the potential financial costs to industry who will not invest capital expenditures for technology given the knowledge gap which exists.
Type of Constraints

Figure 7: International Responses to the question 'What do you consider the constraints to improving the air quality in your city or country?'

Type of Constraints

Figure 8: National Responses to the question 'What do you consider the constraints to improving the air quality in your city or country?'
Question #3-

What goals do you have for air quality?

It is important for all stakeholders involved in an air quality management process to have a goal that is achievable by the end of the process. Many of the respondents identified goals directly associated with their profession or agency such as those involved with government identifying National Ambient Air Quality Standards as their goal. Overall, the respondents answered this question in relatively the same way: meeting ambient air quality standards that will allow for no significant deleterious effects on the health of humans. Respondents who wish to meet their National Ambient Air Quality Standards identified this and the desire to have urban areas achieve healthy air (60%) (Figure 10). Those without national
ambient air quality standards wished that basic air quality standards (28%) would be met and became more stringent over time. Several respondents identified the need for economic factors to be incorporated into the decision making process.

![Figure 10: Responses to the question 'What goals do you have for air quality?' includes international, national and local respondents.](image)

**Question #4:**

**Who should make airshed planning decisions?**

Airshed planning decisions can be dealt with at a variety of levels. Different levels of government through policies, legislation, and official community plans can make these decisions. On the other hand, these same decisions can be made by a committee of representatives from the community including government, industry, academia, and the general public.
The trends of these responses were divided between government officials and all other respondents. The major difference was in the amount of involvement that all stakeholders would have in the process of decision making. Many of the government officials (66.6%) considered that the various levels of governments should make the decisions, while the others (government, academic, industry, and health) emphasized community representation, with industry, business, academia, and the general public having direct involvement. Figure 11 indicates the responses of the international, national, and local respondents. It is shown that the majority of respondents (Figure 11, 60%) feel that government should be a final decision body. This tendency was identified by responses, such as, “the controlling authorities need to make the hard decisions”, or “it must be nested process- international/ federal, federal/ provincial, and provincial/ municipal with a close link to stakeholders.”

Those who felt that it should be a multi-stakeholder process (40%) focussed on the compulsory nature of public consultation and the need for public involvement from the standpoint of individual responsibility. Multi-stakeholder committees included the general public, the scientific community, representatives from industrial groups, business, city councils, and governmental agencies involved in air quality management.
Figure 11: Responses to question ‘Who should make airshed planning decisions?’ Total responses international = 14, national = 7, and local = 4.

Question #5-
Which of the air quality management approaches do you consider more effective (end of pipe, ecosystem, holistic, etc.)? In what ways are they more effective?

The ability to integrate the details of air quality management approaches is essential for any planning process. It is necessary to identify the type of approach that will be initiated before decisions can be made to the scope and involvement of the stakeholders. For example, an ecosystem or holistic approach uses strategies that will affect the entire ecosystem, therefore, the approach is multi-disciplinary and different agencies of government (water, air, terrestrial), the scientific community, and all of the stakeholders must be included. On the other hand, an end of pipe or traditional approach only involves government, the specific industry and permits.
A total of 41 responses were gathered from this question with a variety of approaches identified. The approaches, which are similar in definition, were included under the same category. These categories were as follows:

Strategies that are utilized currently by different regions and were identified by the those involved with air quality management were:

- **Command and Control/Traditional/ End of Pipe/ Permits/ Best Available Control Technology (BACT) (17.1%)** - this regulatory approaches based on the premise that, because there is a lack of financial incentives to encourage polluters to change their behaviour to a sufficient degree, it is the regulator’s responsibility to control the activities that give rise to excessive pollution (ARA Consortium et al, 1995). This is achieved by restricting the behaviour and activities of industry and consumers through the implementation of regulations which prescribe the actions that polluters and the general public must take to address a given pollution problem (ARA Consortium et al, 1995). These command and control regulations generally specify the acceptable abatement methods and technologies that must be used to control emissions or performance standards which specify the allowable amount of emissions.

- **Market based/ Facility/ Emission Trading (9.7%)** - emission trading programs focus on the quantity of allowable emissions and can range from smaller scale programs to comprehensive multi-source interpollutant trading programs. The concept uses a set of coupons (defined for a given time period and denominated in physical units such as tonnes of a contaminant) which are distributed to emitters in the region. The number of coupons distributed is determined by the emissions limit, or the emissions cap, that is defined by the regulator. Each coupon distributed under the program represents an entitlement to allow an emitter a specific amount of discharge, and the emissions limits these coupons represent are transferable and can be bought and sold by emitters in the marketplace. Each emitter must hold coupons equal to the amount of a given contaminant that they emit in a given time period (ARA Consortium et al, 1995).

- **National/ Legislative/ Objectives (14.6%)** - this approach obviously deals with the objectives set out by the federal government and is enforceable through its legislative power. This type of approach tends to be used with most of the other types of approaches. The objectives sets out the ambient air quality criteria and by the use of the other approaches these are criteria are to be met.

- **Transportation/ Mobile Sources/ Traffic/ Clean Fuels (7.3%)** - this approach identifies the importance of mobile sources as significant emitters of air pollution and utilizes the technology of cleaner fuels and transportation initiatives to decrease air pollution. Some controls might include combustion
process innovations, but many more are likely to include behavioural changes that facilities promote and that individual drivers find rewarding.

- Public Education (4.9%)- the use of education campaigns through the media and schools can be effective for implementing an air quality management plan. The campaigns provide information on the types of priority air pollutants in their region, the regulations and enforcement of the plan, and the individual responsibility of air pollution.

- Episode Management (4.9%)- this allows the relevant agency to enforce shut-downs of industry and no public burning times during advisory periods (those times in which the ambient air quality objectives are above the acceptable levels set out in the regulations).

- Pollution Prevention (4.9%)- the approach where processes or practices are used that reduce or eliminate the creation of pollutants or wastes at the source use of materials. This includes practices that reduce the use of hazardous materials, energy, and water and promotes resources and practices that protect natural resources through conservation or more efficient use (Boubel, et al, 1994).

- Cooperative/ Company Flexibility (7.3%)- this approach provides a cooperative atmosphere where government and industry can gather information and voluntarily plan and implement the strategies. This allows for flexibility in pollution control and technology, while maintaining the federal objectives set by the government.

- Land Use Planning (2.4%)- this approach uses the knowledge of planners in the region when addressing air quality in their Official Community Plans and air quality management plans. This allows city officials to zone certain areas for heavy, medium, and light industries.

- Holistic/ Ecosystem Management/ Airshed (22.1%)

Figure 12 diagrams the respondent's replies to the question of theoretical and proven approaches used in air quality management processes. The figure indicates that the Holistic and Ecosystem Management approaches were preferred by twenty-two percent of the respondents, a five percent increase over the traditional methods of command control, end of stack, and BACT. Therefore, it can be shown that many air quality experts agree that holistic and ecosystem management principles should
be involved in air quality management planning. This information will be used in the evaluative criteria and in the conclusions and recommendations.

Figure 12: Responses to the question: ‘Which of the air quality management approaches do you consider more effective (end of pipe, ecosystem, holistic, etc.)? In what ways are they more effective?’

6.1.2 Specific Questions

Question #1-

What was the structure of the committees used in your process?

This question brought forth a spectrum of answers from “no committee” to a four (4) level committee involving a steering committee, an air quality committee with
elected local government members, an agency committee, and a stakeholder advisory committee. The differences in the structure of the air quality planning committees also depended on whether or not the region had state/provincial or national legislation which directed the process. In many of the cases this involved an Environmental Protection Agency (EPA), for instance California and the United States, Waikato, New Zealand, and Australia are directed by an EPA which has enforcement powers through relates acts of legislation.

For those not controlled by legislation, there were two main directions taken by the committees of a planning process went. One, the committee was set up with elected members of government who decided on the issues based on comments made by staff members and submitters. The other way was to create a multi-stakeholder committee with members drawn from the community, with the government as the facilitator. The majority of the committees were formal with a chairperson and sub committees, or working groups, all of whom addressed specific tasks.

Question #2-

How was the government involved? How were stakeholders involved? How was the general public involved?

This set of questions were asked to gain some insight into the amount of involvement in the planning process any of the above had. The results were interesting because, again there was a variety of degrees of involvement by each group.

The government could be defined as the group of political governing members and governmental agencies who formulated the policies and ultimately
made the final decision on the plan. These policies may have been federal EPA Clean Air Act legislation or local governments involved at each stage of the process through workshops and an approval process. The government's importance to the planning process is obvious, these elected officials make the final decisions on whether the plan will move from draft to policy.

The stakeholders mentioned by the respondents included resource users, resource management practitioners, environmental groups, local business and industries, the medical profession, academics, a board of realtors, and the community at large. The involvement of the stakeholders tended to be consultative rather than being incorporated into the development process. This meant being members of an advisory committee, or submitting comments on drafts of the plan before it was put to vote by the elected members of the government. Some respondents stated that the major polluters of the region would continuously lobby the governmental agencies and cooperation did not always occur.

The general public's involvement in many of the planning processes was determined by the presence of legislation dictating the active participation of the community at large. To deal with this mandatory consultative process, many regions involved the public through open houses, public meetings, announcements through various types of media, submissions, educational programs, mailing lists of those interested in the plan, and participation in advisory committees. Involvement of the public was deemed necessary not only by the legislation, but also by the realization of governmental agencies that the public must become educated in the planning process in order to become active participants in the finalized plan.
**Question #3:**

**How could the approach taken by your city or region been improved in hindsight?**

For those who have not yet begun their air quality planning process, this may be one of the most important questions asked of and answered by those already involved in this arduous task. The following are some examples of responses given to the above question.

- More information on ambient air quality through monitoring and emissions inventories to enable policies to be more focussed (government)
- More resources for data analysis to present state of the environment data to the regional air management committees, to assist their understanding of issues, more publicity perhaps
- Could have gotten the councilors more involved at regular intervals (government)
- A clearer process for defining best practise is needed (government)
- By having members for other communities who have participated in this process present their work in person to local elected officials (health)
- Stakeholder involvement should include planners and land experts from the outset (industry)
- More commitment to the implementation of land-use strategies needs to be made (academic)
- Better land use planning and control of population increase (government) (this response may have referred to the distribution of population)

A few notes about the responses, many from the United States did not answer this question because it is not relevant in their process which is legislated by federal mandate. Also, for many the process is ongoing, therefore, it is far from clear what is positive and what is negative, many of the respondents felt this way and considered the questions not applicable at this point in the process.
6.1 Evaluative Criteria

The evaluative criteria used to assess the potential effectiveness of the AQMPs were identified from the literature, the questionnaire responses, and the case study examples. These criteria were used to screen which air quality management approach holds the most promise for implementing a successful air quality management plan. The potential effectiveness of the plans will be determined by using a 'yes', 'no', and 'limited' scale that indicates the compliance with the criteria. Those with the greatest number of 'yes' answers will be considered comprehensive in nature.

The set of evaluative criteria were applied to the Prince George case study to determine its degree of comprehensiveness and potential effectiveness in comparison to the case study examples. The AQMPs chosen were from California, Colorado, United States, Sydney, Australia, the Greater Vancouver Regional District, and Waikato, New Zealand.

Recent literature has suggested that the comprehensive approach is an effective strategy to utilize when managing environmental management problems (Environment Canada, 1998, Sadler, 1996 and Ryding, 1994). The principles of ecosystem management vital to an air quality plan are that a broad view of the region is used; all sources are taken into consideration including mobile, residential and stationary industrial sources; and lastly, the process involves different levels of government, the stakeholders, and the general public. Table 1 represents the air quality management case study examples. By using the evaluative criteria discussed in the Literature Review and the expansion here, it is possible to apply the criteria to the air quality management plans and identify how comprehensive the
plans are and the extent to which the plans adhere to the ecosystem management principles and their potential for effective reduction of air pollution.

It may seem apparent the major criterion for a successful air quality management plan is a reduction of air pollution or an increase in air quality. Within that criterion, however, lie a number of other questions such as: what reduction in air pollution or increase in air quality is enough; what objectives or criteria do those involved follow; and how clean is clean? Since it is too soon to answer those questions for the regions investigated, the following assessment focuses primarily on the plans and processes themselves, rather than on outcome.
<table>
<thead>
<tr>
<th>Evaluative Criteria</th>
<th>Yes</th>
<th>No, or</th>
<th>Limited</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>California</td>
<td>GVRD</td>
<td>Waikato</td>
</tr>
<tr>
<td>A mission statement, goals, and objectives have been stated and recognize the nature of an ecosystem, where boundaries are ecologically based and works across administrative and political boundaries (Sadler, 1996)</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Source identification and quantification-emission baselines for the airshed have been completed and source sectors and individual contaminants have been identified</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Discussion of criteria pollutants and the incorporation of pollutants not included on the criteria pollutant's list</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td>California</td>
<td>GVRD</td>
<td>Waikato</td>
</tr>
<tr>
<td>----------------------------------------------------------------</td>
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<td>---------</td>
</tr>
<tr>
<td>Ambient air quality goals are stated (National or Federal objectives- certain reductions of criteria pollutants)</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Background research has been conducted on existing air quality management plans;</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Principles of Ecosystem management (Ryding, 1994)</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>A time element of meeting the goals- a timeline is given for completion of goals and implementation of plan (Sadler, 1996)</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Is there a consideration of cost for the process, the implementation, and the enforcement of the plan (Sadler, 1996)?</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Is there public participation (open houses, educational campaigns) (Sadler, 1996)?</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Question</td>
<td>California</td>
<td>GVRD</td>
<td>Waikato</td>
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<tr>
<td>-------------------------------------------------------------------------</td>
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<td>---------</td>
</tr>
<tr>
<td>Is there a steering committee involving directors of government agencies (ARA Consortium, 1995)?</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Is there a management committee involving elected officials (Sadler, 1996)?</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Is there a technical management committee involving air quality agency staff and researchers?</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Is there an advisory committee involving stakeholders groups (Sadler, 1996)?</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Is there a relationship between government policy and legislation with the recommendations of air quality management plan (Sadler, 1996)</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Has the feasibility of the implementation of the air quality management plan been considered? Has enforcement of the air quality plan been considered (Sadler, 1996)?</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
</tbody>
</table>
The checklist suggests that the Colorado, Sydney, and Prince George case study examples lack some elements, and therefore may have increased difficulty in implementing their objectives and defining the success of their plan. California, the GVRD, and the Waikato air quality management plans are comprehensive and potentially effective in their processes and content as indicated by the evaluative criteria set out in this study. This statement can be supported by the literature (Ryding, 1994) and the yearly status reports that state that these AQMPs have been proven successful with the meeting of their goals and objectives to this date (GVRD, 1997 and California EPA, 1997). California and the GVRD have reported reductions in their priority pollutants and have claimed to have met many of their goals and objectives set out in the plan. For many of the plans it is too soon to tell whether the case study examples chosen can be defined as effective, since implementation of the plans, however, are still under way and monitoring of air pollutants is ongoing. Success in air quality management planning should involve explicit goals and objectives, a relevant scope of consideration, the necessary support and guidance, efficient and predictable implementation, and the integration of point and non-point source management approaches in an airshed.
7.0 Conclusions

The purpose of this study was to investigate and evaluate air quality management strategies and plans in existence today and compare them to the ongoing air quality management planning process in Prince George. This was done by reviewing the literature, documenting case study examples from different regions, interviewing air quality experts worldwide, and setting evaluative criteria for potential effectiveness. The results of this investigation were:

- the identification of approaches taken in existing air quality management plans and those that are seen to be effective;
- the determination of a plan's potential successes and obstacles by applying evaluative criteria;
- the identification of variables that affect air quality and the resulting strategies; and finally,
- recommendations for improving air quality management planning.

In both the case study examples and the questionnaires, the approaches adopted by the committees dealt with technology/monitoring and compliance with the consideration of economics. Seventeen percent (17.1%) of the respondents in the interview considered the command and control/technological/end of pipe approach to be the most effective. This result is surprising since much of the research and development of air quality management approaches in Canada (Environment Canada) and the United States Environmental Protection Agency are moving towards a holistic or ecosystem management approach. This is not to say that the point source approach is not effective. A considerable number of air quality management plans that utilize this type of management process and are considered to be successful in reaching many of the goals set forth by their plan.
The different factors that affect the air quality of a region are numerous and include anything from pollution technology to public education. Pollution control technologies are utilized by industries in most airsheds and are specified in their operating permits. Federal, provincial, or municipal legislation will determine the scope of regulations and enforcement obtainable by the air quality management plan with respect to industry. These controls deal with point source pollutants and are "end of pipe" solutions.

The other side of the coin is the public's perception of non-point pollution from automobiles, burning of yard wastes and garbage, or wood burning in fireplaces. These actions tend to directly affect the air quality in the immediately surrounding community. Public education and bylaws such as a ban of open burning can produce positive results, with few lifestyle changes for the general public. This type of strategy involves an integrated approach, involving more than industry in the responsibility for air quality.

Each region tends to have a unique airshed, with geographical considerations and priority pollutants. Selection of one or more strategies should take into consideration the air quality and the unique conditions occurring within the airshed. Recent literature has identified that a holistic or ecosystem management approach, which looks at the combination of air, water, vegetation, and human impacts and identifies ways in which each is being impacted, is a desirable approach to take (Ryding, 1994 and Sadler, 1996). The reasoning behind these observations is that by identifying problems within an airshed, both point and non-point, that a greater overall benefit will occur for the region when management strategies adopt more than one approach to controlling air quality. Many of the plans did not use this
approach, but respondents did consider that the ecosystem/holistic approach (22%) to be an effective strategy for improving air quality.

The literature review and the case study examples identified a variety of obstacles and problem areas that may possibly constrain the process. Obstacles associated with air quality management planning include: increasing environmental risks and complexity issues; the general public's perceptions of air quality and associated health risks; and monetary decisions made by government dependent on cost/benefit analyses.

Analysis of the case studies and questionnaires determined a common trend concerning the processes of existing air quality management plans:

- there were several committees all working together towards a common goal;
- the steering committees or governing boards were made up of different levels of elected government officials;
- the technical committee was made up of related governmental agencies; and,
- the advisory committees or working groups were made up of a variety of environmental groups, transportation (bus, rail, highways), health, industry (large and small), businesses, First Nations, academics, consultants, and the general public.

Each of the committees had specific duties and goals to accomplish, all of which were related to the mission statement or principles that guided the air quality management process. The greatest differences in the processes of the examples illustrated in the case studies and questionnaires were related to the participation of stakeholders and the general public. In some cases, this was regulated by legislation that determined the extent of membership on committees, the number of open houses, education, and submissions available to the general public and the involvement of stakeholders in the process. In other cases, there was no direction,
so the committees and the educational process were determined by steering committees or by stakeholder and public pressure.

In addition to the common threads within the case study examples, results of the interviews and the literature provide some criteria of assessment for a successful air quality management plan. Sadler’s (1996) study on effectiveness of environmental assessment provided reference for many of the criteria. These include:

- the different types of committees and their composition (steering, management, technical, advisory);
- stakeholder and public participation throughout the process;
- comprehensive or multiple perspective approaches (Sadler, 1996);
- education campaigns in the media and in the schools;
- the meeting of goals within the time allotted; and,
- success of implementation of air quality management objectives and goals as determined in the plan.

The Prince George case study allowed the researcher to examine firsthand the constraints of an air quality management process including committee dynamics, public and stakeholder participation in a planning process, funding and time pressures, and governmental and economic obstacles for finalizing the air quality management plan. This is in addition to the countless hours spent by the PGAQTM committee wording and rewording the recommendations in the plan. The Prince George Air Quality Technical Management committee was successful in its representation of governmental agencies, academics, and health on its technical management committee. This allowed for diverse opinions, yet resolutions were obtained through consensus.
The Prince George process was deficient in several ways in comparison to the effective plans like California's Comprehensive Work plan. These insufficiencies included:

- the absence of a steering committee of top ranking government officials with final decision making capabilities and an advisory committee involved in the entire process;
- a lack of health studies justifying recommendations made in the plan; and,
- the lack of funding for the planning process and necessary educational campaigns.

The success or failure of the Prince George air quality management plan will not depend on the committee structure specifically, since public and stakeholder comments are reflected in the plan and all sources are identified and dealt with. The success or failure of the plan will depend on the Prince George City Council, the regional government, and the provincial governments implementing the recommendations from the plan.

California and the Greater Vancouver Regional District have been developing their AQMPS for at least ten years now and have successfully implemented many of their plan's recommendations (the GVRD has implemented 33 of 35 of their AQMP recommendations (GVRD, 1997)). By meeting the goals of their AQMP, it is possible to identify them as effective and successful air quality management plans.

Future research needs to be conducted in order to determine the connection among the evaluative criteria, the management strategies, and the results in terms of reductions in air pollution or in the improvement of air quality. This was outside the scope of this project primarily because many of the air quality management plans have yet to begin implementation and there is little data on their effectiveness.
8.0 Recommendations

This study indicates that a comprehensive strategy has the potential to be a more successful type of air quality management approach, though it is not without drawbacks. The following is a recommended process to achieve a comprehensive air quality management planning process. The process is based on evidence from the case study examples, the responses of the interviews.

1. INITIATE AN AIR QUALITY MANAGEMENT PLANNING (AQMP) PROCESS
   - Appoint a senior level, cross-departmental Steering Committee with elected officials and governmental agencies.
   - Appoint a chairperson and a multidisciplinary management committee drawn from all governmental agencies (municipal and regional) including environment, administration, finance, and health. Also include local academics with expertise in air pollution, planning, and public consultation;
   - Set timelines for completion of strategies for plan and implementation of plan.

2. ASSESS THE NATURE AND EXTENT OF EXISTING AIR QUALITY PROBLEMS
   - Identify current data on air quality conditions;
   - Review the broad impacts and implications of current air quality conditions in the local area;
   - Identify significant individual emitters or pollutant sources in the local area, such as large industrial complexes;
   - Identify, locate and map significant area sources such as industrial or commercial parks;
   - Describe and explain transport patterns and behaviour which affect air quality (road and train);
   - Review all air quality management approaches taken by existing air quality management plans, especially those with similar air quality conditions;
   - Determine the public’s perceptions of outdoor air quality (study—refer to Oster, 1997);
• review the city and regional government's own operations with regard to their impact on air quality;

• conduct health studies to provide knowledge and justification of an air quality plan.

3. DRAFT POLICIES FOR APPROVAL

• Examine all relevant legislation with respect to air quality (municipal, regional, provincial/state, and federal);

• Prepare a general statement of the committee's principles and intent for an AQMP, followed by specific statements and objectives for the AQMP;

• Determine an air quality management approach best suited for region (comprehensive, market based, ecosystem management);

• Present to steering committee for approval.

4. PUBLIC CONSULTATION PERIOD

• Conduct Open houses and stakeholder workshops;

• Allow for written submissions to one contact address;

• Have a phone line open and an email address for messages and comments with respect to the plan;

• Release principles and objectives of the AQMP to the media.

5. CREATE AN ADVISORY COMMITTEE

• Appoint a facilitator and determine the terms of reference for the committee;

• Determine a maximum number of persons for the committee to allow for all those involved to be heard;

• Invite representatives of stakeholders (industry, business, commercial developers), consultants, academics, public health, environmental groups, first nations, and the general public;

• Schedule regular meetings for discussion of progress of management committee.
6. DETERMINE STRATEGIES AND ACTIONS (in draft form)

- Identify options for action to control pollutant generation, emission and dispersion, focusing on the most critical areas highlighted through the research and studies completed;
- Options should relate to the full range of the committee’s functions – including transportation, land use and planning, health initiatives and education;
- Consult with the advisory committee;
- Create a document which spells out the mission statement and recommendations.

7. PUBLIC CONSULTATION PERIOD

- Conduct Open houses and stakeholder workshops, for those not involved with the Advisory committee;
- Allow for written submissions to one contact address;
- Have a phone line open and an email address for messages and comments with respect to the plan.

8. REVISE THE AQMP AND CONSULT WITH ADVISORY COMMITTEE

9. DRAFT FINAL DOCUMENT AND SUBMIT FOR APPROVAL TO STEERING COMMITTEE AND ELECTED OFFICIALS

10. IMPLEMENT STRATEGIES

- Steering committee needs to determine the group of people responsible for implementation (Technical committee);
- Establish clear accountability for performance, and responsibility for certain tasks by governmental agencies;
- Establish levels of commitment from stakeholders;
- Allocate adequate budgetary and personnel resources;
- Initiate an education program for school aged children and an advertising campaign in local media for adults.

11. MONITOR AIR QUALITY
12. EVALUATE ON A YEARLY BASIS

- Prepare an evaluation report looking at: outcomes and results of completed work in relation to objectives, lessons learnt in implementation;
- Review the objectives of the AQMP and determine whether the implementation of the plan has succeeded with respect to those objectives;
- Determine which further actions are required - including recommended changes.

This example of a recommended air quality management process has taken into consideration the many ways in which to improve an air quality management plan and increase the effectiveness of the strategies and implementation. There is a growing dissatisfaction with single approach strategies that attempt to control air pollution sources with end of pipe solutions and permitting processes, as evidenced in the increased use of ecosystem management approach by government and research (Sadler, 1996). A comprehensive air quality management plan may be an effective strategy with the potential to increase the success of the implementation and enforcement process. ‘End of pipe’ solutions and permitting are viable choices in determining strategies for air quality management, but many involved in air quality management processes are seeking new additional, or alternative strategies and the inevitable progression towards these alternatives show that we may have solved all that we can with the permitting process.

An air quality management plan should also take into consideration the unique geography of the region, and focus on specific issues in that airshed, such as the priority pollutants, the sources of pollution, and the climate of the region. A range of approaches need to be looked at, considering both point and non-point sources. Strategies identified through the case study examples include land use planning- locating of polluting industries, integration of air quality into the Official
Community Plan (OCP), and shutdowns of industry during pollution advisory days. Other examples include public education, so that there is a better understanding of the non-point source contributions to poor air quality, and public works- the choice of techniques in sanding and spring street cleaning. These strategies are in addition to alternative technologies such as catalytic converters in wood stoves and vehicles and cleaner fuel technologies.

Findings of this study indicate that a combination of more comprehensive planning plus air quality management that is more targeted to unique circumstances and dynamics of a given airshed or region, appear to have the potential to improve air quality.
9.0 References


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Greater Vancouver Regional District et al. 1995. Clean Air Benefits and Costs in the GVRD. Burnaby, B.C.. pp. 2-5- 4-13


Do you feel there is a good understanding of air quality among the general public?

Here are the responses for this question (gov-government, ind-industry, aca-academic, enviro-environmental organization):

International
- It has improved considerably as a result of publicity surrounding our studies, but is not yet good (gov)
- According to recent environmental surveys that the Council has undertaken the general public's awareness of ambient air quality in particular comes in noticeably last compared to water quality issues and land issues. Specific pockets of the public obviously have an awareness of local air quality issues where contentious or noticeable discharges are occurring (gov)
- For those concerned about air quality, yes. For those who don't want to change, no (gov)
- The general public now understands that air quality is the responsibility of the local government. Air quality for most of the public relates to effects that they personally experience - that is, most concern is for example over odour and smoke that they are personally subject to. There is little concern of a general nature, which may reflect that there is the perception of no widespread or regional issues (gov)
- No. I don't think the public is that aware of air quality concerns in relation to what they do to impact on air quality but they do tell us that they are unhappy with the air quality in their area (gov)
- I think that the general public has more knowledge today than in the past on the issues that exist. Information has become more readily available via the internet. I don't think the public has an understanding on the science that is involved in establishing air quality standards (gov)
- No there isn't. We have acknowledged this fact and presents a number of informational sites on the internet to combat some of the misinformation. Staff makes presentations to local and governmental groups upon request, but there are few requests (gov)
- Not yet, but we are working on it. We have quite an active communication and education program going. We've prepared a CD-ROM for students about air quality and are doing a lot with partners to educate folks through their workplace (gov)
- The public in Australia regard air pollution as the most important type of pollution, but I do not think they have a great understanding of air quality beyond visual pollution (gov)
- I think the public has a better understanding for air quality and air quality problems than they had 20 years ago; however, the public does not appreciate the range of air quality measurements that are due to natural variations in weather and climate (aca)
• The public knows about air quality but does not generally understand it. They are supportive of clean air actions but do not do a good job of seeing themselves as a significant factor in the air pollution problem (aca)
• Yes (ind)
• Air quality is a sensitive issue across much of the state, a public education program emphasizes voluntary compliance and local solutions which has steadily been gaining public support (health)
• No, but we are trying (enviro)
• No, I think it is probably the least understood of the environmental media. The current level of misinformation purposefully being provided by both sides of the global warming issue is causing even greater confusion among the american public (cons)

National (Canada)
• In certain high profile communities, generally no (gov)
• Good or at least reasonable on some issues (acid rain, smog) and poor or non-existent on others (organic contaminants, trace metals) (gov)
• No not at all. Need more monitoring, education, and scientific assessments (gov)
• An informed public is essential to promoting government and industry to implement air management policies, goals, and programs. Therefore, communication of issues to the members of the public is an ongoing need (gov)
• I do not feel the government or the public have a good understanding of secondary air pollution issues (ind)
• No, there is generally not, and I believe that air quality management bodies have an educational responsibility in this regard (aca)

Local (Prince George)
• No (aca)
• Yes and no. There appears to still be a high correlation between odour levels associated with TRS and the public perception of pollution levels even though our greatest concern is with PM10. Independent of this is a general acknowledgement that air quality must be improved and an apparent willingness to do something about it (gov)
• No (gov)
• No (gov)

What do you consider the constraints to improving the air quality in your city or country?

Here are the responses for this question (gov-government, ind-industry, aca-academic, enviro-environmental organization):

International
• The unwillingness of individual citizens to accept that their motor vehicles and smoky home fires are the main problems (gov)
• Few national directives regarding air quality management(gov)
• Difficulty in regulating non-point sources (gov)
• Level of awareness of air quality in the general public is relatively low. Length of time to educate and change attitudes can act as a constraint—though potential benefits are much greater than authorities making rules and regulations to manage effects (gov)
• Householder’s resistance to change from existing methods of home heating (gov)
• Outdated legislation, then begin again with new legislation (gov)
• Lack of monitoring data on the ambient levels of pollutants
• No national policy on vehicle emissions (gov)
• Poor environmental practices in other countries impact air in neighboring countries (gov)
• Inflexible federal regulations which force states to move monetary resources towards mandatory programs that achieve very little emission reductions (gov)
• Lack of common national goal of reduction for key pollution targets (gov)
• Limited ability to address mobile source sectors and other individual behavior linked types of pollution (gov)
• Motor vehicles and home heating (gov)
• Social inequalities (gov)
• Perceived cost of implementing controls (academic)
• Public and political will (academic)
• Technology exists today to solve most urban air quality problems with modest adjustments to lifestyles and the application of control technologies (aca)
• Stakeholders that believe that only one source should be targeted to achieve emission reductions (ind)
• Financial for both agency and community (health)
• Constraints for community participation in programs are usually misconceptions and change from ways of past (health)
• Local/regional governmental changes needed to replace sprawl with higher density, convenient, mixed use infill development around transit centers (enviro)
• Limits in tailpipe inspections and maintenance (enviro)
• Lack of political will (consult)

National (Canadian)
• The collaboration of the government—government is determining, initiating the driving force behind improving air quality in the region (consult)
• Division between industry and government (consult)
• Lack of scientific knowledge (gov)
• Political (law)
• Costs are specific to a particular company, yet the benefits are more general
• Importance of environmental benefits and how much we value human life and liveability (law)
• Difficult for government to tell if industry is telling the truth or whether they are exaggerating about costs (law)
• Local government buy-in (gov)
• The need for consensus (vs. regulation or prescription) means that large point sources can effectively veto any process (gov)
• governments have little funding support for publicity, studies, or legislation development, or even in some cases, the maintenance of basic monitoring programs (gov)
• long range transport, lack of clear measurements and objectives (gov)
• lack of resources to install up-to-date technologies (gov)
• lack of awareness (gov)
• many small sources (gov)
• political will (gov)
• increasing population/ emissions in areas that are subject to poor dispersion (industry)
• understanding cause and effect relationship of secondary pollutants (ind)
• cost of replacing existing infrastructure (ind)
• economics (ind)
• government funding for an airshed study is presently not available (ind)
• public apathy (ind)
• constraints depend on level of jurisdiction (aca)

Local (Prince George)
• knowledge- we don't really know which sources are most significant in impacting receptors (aca)
• financial- industry doesn't have/ or wants to money in this area, especially given the knowledge gap (aca)
• physical location of Prince George in a valley (gov)
• industrial park and their location relative to the population center (gov)
• potential financial costs to industry and the municipality to alter processes and practises (gov)
• established practises and attitudes of a segment of the population regarding subjects such as outdoor burning and wood burning (gov)
• economics (gov)
• enforcement and changing attitudes (gov)
• industry unwillingness to spend extra money (gov)
• lack of provincial regulations and commitment to improve air quality (gov)
• political importance of forestry in our community

What goals do you have for air quality?

Here are the responses for this question (gov-government, ind-industry, aca-academic, enviro- environmental organization):

International
• To move closer to a North America air quality management system wherein the three North American countries address air quality issues in comparable, compatible and coordinated ways (cons)
• Meet federal and state standards and reduce toxins to 1/1,000,000 standards (enviro)
• Ensuring that local areas remain an attainment area for NAAQS (health)
• Substantial reductions in reactive organic compounds, NoX and particulate matters (ind)
• All urban areas achieve healthy air. We also must deal with the global warming issue (aca)
• Reducing criteria pollutants levels that meet the EPA specifications
• Meet national goals for pollutants that have been set (gov)
• Attain and maintain all standards for pollution and eliminate emission of bioaccumulative compounds (gov)
• Meet the NAAQS for the 1-hr ozone standard and then meet the new 8-hr ozone standard (gov)
• To maintain all attainment areas in the state as such and to eventually achieve attainment status in the non-attainment areas (gov)
• To promote and maintain a high standard of air quality throughout the region including improving air quality in those areas of the region where air quality has been degraded (gov)
• Adverse effects on the environment from the discharge of contaminants into air are avoided, remedied or mitigated (gov)
• To meet an ambient air quality guideline of 50 micrograms per cubic meter for PM10 (gov)
• Significant characteristics of areas of high air quality protected and the quality of air within other parts of the region maintained or enhanced (gov)
• Goals for criteria pollutants (gov)

Vancouver
• Air quality to brought to the level that there is no significant deleterious effect on the health of human, animals and vegetation while maintaining a healthy economy (aca)
• I would like to see airborne particulates reduced substantially (ind)
• Conserve energy and products, and also employ efficient technology (ind)
• The goal is to achieve ambient air quality standards, which if attained will provide protection of human health and the environment (gov)
• Air quality objectives which are based on air quality guidelines embodied in CEPA (gov)
• Basic air quality standards, meeting them and progressing to meet a more stringent over time (gov)
• Reduce exposures to healthy levels (gov)

Prince George
• Clean air to breathe in the bowl, eliminate brown haze, improve health of citizens (gov)
• No more air quality advisories (gov)
• To have the best quality environment reasonably achievable (gov)
• Reduce exceedances of PM10 objectives to half their current frequency in the short term. Reduce them below 1% in the long term. If feasible reduce TRS levels below the nuisance threshold so that people are happy working and living in bowl (aca)

Who should make airshed planning decisions?

Here are the responses for this question (gov-government, ind-industry, aca-academic, enviro-environmental organization):

International
• State agencies with input from affected parties (gov)
• Joint effort between the general public, the scientific community and the effect sources (gov)
• Federal mandates and the expertise of scientists and technicians. In some areas task forces set up with government officials and representatives of industry groups in the geographical area(gov)
• I would like to say scientists but there are economic, social and political considerations so it has to be all groups (gov)
• Representative government bodies within the airshed (aca)
• Regional air quality agencies if overseen by a dedicated board or commission that is well connected onto the political pulse of the region (aca)
• multi-stakeholder driven process involving the general public, community leaders and regulators (ind)
• local community advisory groups working together with elected public officials (health)
• involvement of of knowledgeable individuals in the fields of air pollution control, meteorology, urban planners, transportation specialists, politicians, industry representatives, labour representatives, environmental groups, and an informed public. The key to making the right decisions is to place sufficient priority on ensuring a healthful air quality (cons)
• government with input from the environmental agency and the industrial development agency (gov)
• regional councils and central governments (gov)
• controlling authorities need to make the hard decisions. Should be prior education and consultation with the community on the pros and cons of different options before decisions are made (gov)
• regions based system than centralist approach- more knowledge and understanding, more accessible and less bureaucratic (gov)
• responsibility to local government and a council which has elected members of the public and technical information provided by government staff (gov)

National
• a body with administrative and political elements that is at a scale smaller than the entire province, but generally larger than a municipality. The body should
have responsibility for air quality within the physically defined airshed, including source and receptor regions. This region may well cross over political boundaries (aca)
- stakeholders, key representatives from the community, city council, industry, business, and the Ministry of the Environment (ind)
- government should make the decisions based on an understanding of the science and an appreciation of economics (ind)
- planning and decision making is necessarily a collective process that needs to involve all stakeholders (gov)
- it must be a nested approach- international/federal-provincial-provincial/municipal with close link to stakeholders (gov)
- governments at various levels have this mandate, consultation is politically mandatory these days, therefore a wider stakeholder and community involvement. (gov)
- ideally by consensus from all the parties affected, but by provincial regulation if necessary (gov)

Prince George
- the province should not download air quality regulations to municipalities. The regional district and city should cooperatively regulate land use in the greater PG area with input from MELP who should put money and regulations together with enforcement behind their efforts to reduce emissions in future (gov)
- province, regional district, and city (gov)
- province and municipal government in an objective, impartial, and informed manner (gov)
- governments (provincial, regional and municipal) in consultation with stakeholders, the public and experts (aca)

Which of the air quality management approaches do you consider more effective (end of pipe, ecosystem, holistic, ect.)? In what ways are they most effective?

Here are the responses for this question (gov-government, ind-industry, aca-academic, enviro-envIRONMENTAL organization):

International
- Systems approach- more efficient, long lasting, based on sound science
- Market based- for sophisticated sources, flexibility
- Command control- traditional, smaller sources
- National approach- set health standards with deadlines, though this has not been achievable
- Reformulated gasoline and clean fuel- measurable results
• Pollution prevention
• End of stack control technology
• Inspection/ maintenance/ testing- mobile sources
• Aggressive community education outreach program
• Traffic/ transit
• Holistic- beyond out current capacity
• Best practicable-technological approach
• Simple solutions to air quality issues, examples- banning backyard burning, removal of power generation in city, trains changed from coal to diesel, catalysts were applied to cars, industry was closely monitored
• Legislation, re-education, revaluation of heating of homes
• Facility approach- provision of trading among facilities – provides flexibility
• Multi-media approaches- legal and regulatory restrictions
• Market based control strategies- flexibility to the effective parties in controlling pollutants, since market driven the associated cost for controlling these pollutants are lowest
• Educating the dischargers followed by regulation- cooperative approach followed by enforcement
• Rules for particular activities of size and or region and 'resource consents' (a license) to operate with site-specific performance requirements
• Guides to good practise that are not compulsory but emitters are encouraged to regard
• Managing the effects of the activities rather than the activities themselves- the planning processes and resource consent decisions are primarily based on outlining what the acceptable environmental effects are and allowing any activity to discharge as long as the adverse effects are identified in the plan or resource consent do not occur
• Holistic approach
• In some circumstances where there is no much known about the effect that an activity can cause then the best practisable option- technological approach may apply
• Best Practise Environmental management- responsible companies, with flexibility in regulation
• Total emissions capped by environmental capacity

Canadian
• Ecosystem approach- strategies effect the entire ecosystem as opposed to the permit
• Regulatory prevention approach
• Holistic- discharge limit for at each industrial site, with limits of each source based on its contribution and what the ambient air quality target you are looking for
• Broad approach, beyond end of pipe
• Control strategies have to address the priorities of the emission sources
• No single management approach is most effective. What is needed is a diverse range of management tools to be able to address all aspects of an air quality problem
• Establishment of clear objectives
• Notion of airsheds is critical
• Design approaches which control technology or product parameters at a base level
• Large systems and consumer domestic areas operated centrally
• Episode management strategies make best use of poor technologies

Prince George
• Identify sources which impact receptors the most, then identify the mechanisms which result in the most reduction per dollar, and target those emissions for initial reduction
• Episode management
• Land use planning approaches should be done for new sources
• Public education/ regulation/ road sanding changes should be done
• Regulation always at the end of pipe, but with consideration given to the impact of decisions on the total ecosystem status
• Holistic approaches- looks at all sources
• I do no know

Specific Questions

How was the government involved?

• Policy is from the elected government- environmental agency is responsible for formulating the policies
• Local government involved at each stage of the process through workshops and its approval is required before moving to next step in process
• The political governing board must ultimately rule on the plan
• All parties at the table
• All were involved
• Government through the EPA draft control policies
• Interagency committee composed of all the heads of state agencies with some relationship to clean air

How were stakeholders involved?

• Heavily involved via mandatory consultative processes which are an integral part of developing the policy
• Helped develop the principles have interest in specific areas of the plan- two way communicative process for the duration of Plan development
Includes resource users, resource management practitioners, government environmental groups
Submissions
Submissions and liaison with industries
Major polluters continuously lobbied the governmental agencies
Municipal government, federal agencies, local business and industries, local university, medical profession, Board of realtors, and community at large
Stakeholder advisory board was established to work with the air quality staff
Draft control policies were released to industry groups for comment and discussions took place before the law was put to parliament
Federal government establishes the standards
Public comment periods
Clean air task force- 16 member entity that is composed of a variety of stakeholders—open to public
Advisory committee with facilitator
All stakeholders (government, industries, public) were involved through a series of consultation meetings, a stakeholder group, and the creation of a multi-stakeholder advisory committee

How was the General public involved?

- Heavily involved via mandatory consultative processes which are an integral part of developing the policy
- Mailing list, those who expressed an interest in the plan-to provide information and opportunities for future involvement
- Education programs and option discussion through mail drops and news media
- Public participation and resolution-submissions
- Public comments on all policy statements
- Education and involvement in actions
- Meeting were advertised as open to the public through local media
- A media slide show was developed and shown to local service leagues, city councils, county commissioners, and other organizations
- Public hearing process
- Public comment process
- Announcements to the general public through the media and several outreach tools, inviting members to participate
- Sign up on specific sub-issues
- Public members on advisory committee
- Public meetings in central location
- Open hearings on the problems and the proposed solutions
- Public comment periods
- Specific public hearings, but all meeting were open to the public
- Announcements in weekly media packets
- All regulations go through a separate public process and to our Natural resources Board (citizen members) ad the legislature for review
• Advisory committee meetings open to public
• Citizen representatives on committees, plus public meetings held

How could the approach taken by your City or region been improved in hindsight?

International
• More information on ambient air quality through monitoring and emissions inventories to enable policies to be more focussed (gov)
• Early in the process (gov)
• Could have got the councillors more involved at regular intervals (gov)
• A clearer process for defining best practice is needed (gov)
• By having members for other communities who have participated in this process presented their work in person to local elected officials (health)
• Stakeholder involvement should include planners and land experts from the outset (ind)
• More commitment to the implementation of land-use strategies needed to be made (aca)
• Better land use planning and control of population increase (gov)
• Many from the US did not answer this question because it is not relevant in their process which is legislated by federal mandate

National
• More resources for data analysis to present state of the environment data to the regional air management committees, to assist their understanding of issues,
• More publicity perhaps
• The process is ongoing, it is far from clear what is good and what is bad, many of the respondents felt this way and considered the questions not applicable at this point in the process

Prince George- What are some recommendations that you could make towards improving the Prince George airshed?
• Institute “no regrets” changes now- beehive burner elimination, road sanding changes, some residential burning changes (aca)
• Research- find more answers before implementing more costly changes (aca)
• Monitoring- keep track of how management actions are working by maintaining/enhancing ambient air monitoring (aca)
• Refer to management plan
• Implement the plan (gov)
• Expanded use of a larger grain material as part if snow removal and minimizing slippery winter roads (gov)
• Ban open fires in city (gov)
• Lobby government re industrial air emissions and car emissions (gov)
What was the structure of the committees used in your process?

- No committee structure
- Government through EPA, released to public and industry for comment
- There was a main committee that broke up into sub-committees to address specific tasks
- A chair and supporting interests
- An initial 12 member committee (later expanded to 14) was chosen by the Board of Health, it was allowed to set up its bylaws and elect a chairperson and vice-chairperson
- Elected members of council decides on the issues based on comments made by staff and the submitters
- Council has a Policy and Planning committee which oversaw the work of the Council staff
- 13 Councilors all of whom have been involved in the developmental stages of the Plan. The formal committee that makes the decisions on the Plan should have 4 members
- No formal committees. EPA developed the policies and coordinated consultation, then presented the final draft to the government for approval.
- Subcommittees- permits and fees, acid rain, ozone, global climate change, toxics with working groups under each
- Multi-stakeholder with members drawn from defined communities, government as facilitator
- 3 levels of committees involved- steering committee with heads of governmental agencies, air quality committee with elected local government members, and agency committee, and a stakeholder advisory committee