SULPHUR DIOXIDE MANAGEMENT IN ALBERTA

CLEAN AIR STRATEGIC ALLIANCE (CASA)

EDMONTON

February 13, 1997

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THE REPORT OF THE SO_2 MANAGEMENT PROJECT TEAM

February 13, 1997

This document is the final report of the SO_2 Management Project Team to the Clean Air Strategic Alliance. Members of the Project team have reached consensus agreement on the material and recommendations presented in this report.

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ACKNOWLEDGEMENTS

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Howard Seibert, Sherritt
Alastair Stewart, PetroCanada
Dennis Stokes, Alberta Environmental Protection

Many other individuals and organizations contributed to the success of this project, their participation was invaluable. Special mention is also extended to John Lilley of Lilley Environmental Consulting for writing this report, Pat Ruby of P.M. Ruby Consulting Inc., Terry Gibson of Terence Gibson and Associates Ltd., Kerry Lowe and Bruce Milne of Alberta Environmental Protection, and Brian Plesuk of Gulf, for workshop and project management support, along with David Schindler of the University of Alberta, and Doug Maynard of Canadian Forest Service.

EXECUTIVE SUMMARY

The Clean Air Strategic Alliance (CASA) established the SO_2 Management Project Team to recommend a comprehensive system for the management of SO_2 emissions in Alberta. The Team was a multi-stakeholder committee with representatives from government, industry, agriculture and the environmental community who worked together to reach consensus on a management system which meets the needs of all interests. The Team examined various aspects of SO_2 management including:

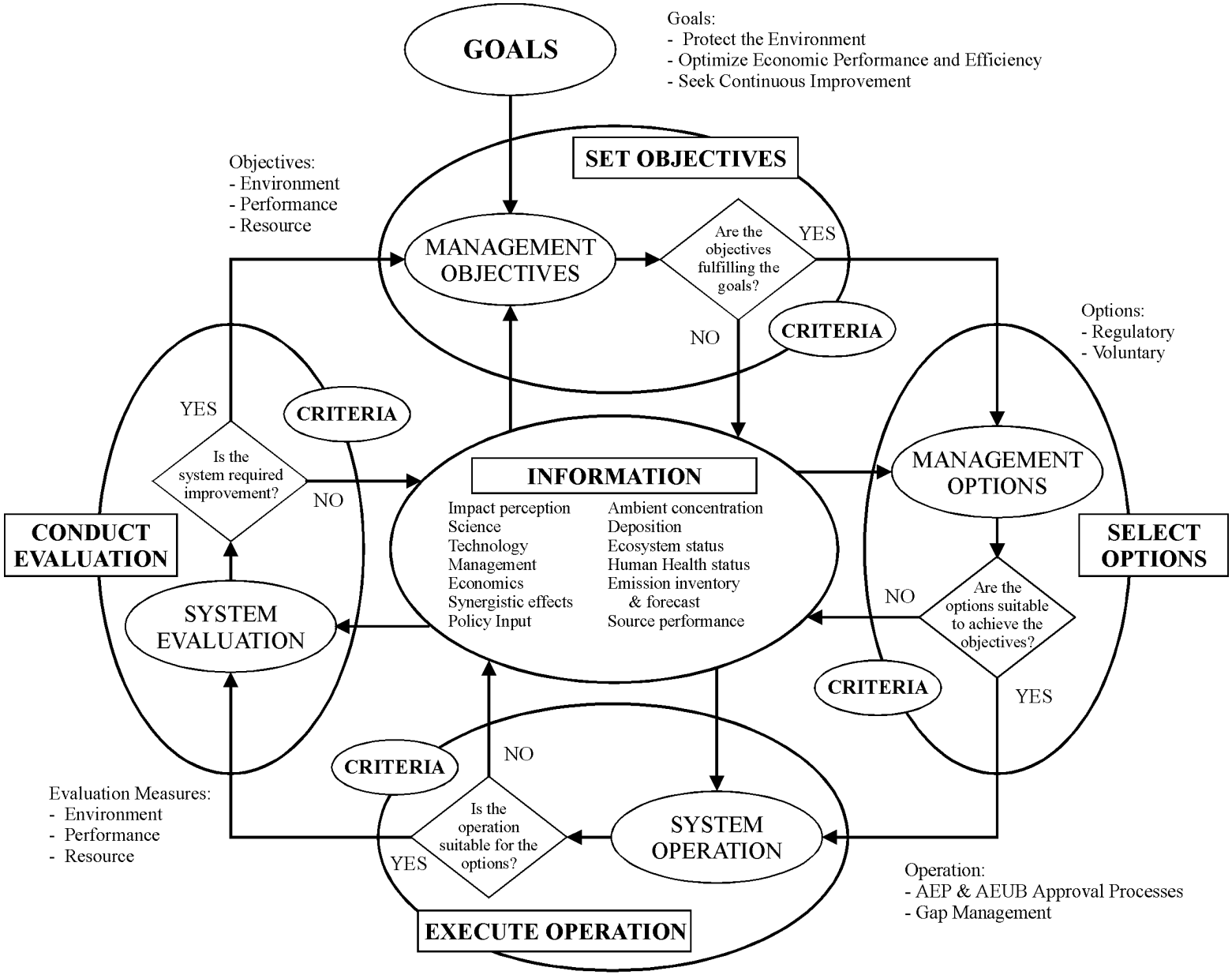
- stakeholder concerns,
- analysis of the current management system,
- current and projected emissions and loadings,
- development of system goals and objectives,
- identification and assessment of management options,
- management of information,
- the concept and application of critical and target loads,
- the most appropriate means for measuring acid loading, and
- approaches to communication about SO_2 management.

The result is a consensus on a system approach to managing SO_2 emissions and impacts in Alberta which is illustrated by the figure on the following page. This system explicitly links the day-to-day management of SO_2 emissions, goals and objectives for management, and the management tools, with provision for periodic evaluation and improvement. The intent is to manage SO_2 emissions in an environmentally-sound and economically-efficient manner.

The system would operate to achieve CASA's goals for air quality management in the management of SO_2 emissions and impacts:

- To protect the environment
- To optimize economic performance and efficiency
- To seek continuous improvement.

The Project Team's recommendations spell out roles and responsibilities for the various stakeholders in the implementation of the system and call for development of quantitative objectives to measure progress and performance of the management system and assist in improving it. The Project Team has recommended elements to be included in these objectives; however, Alberta Environmental Protection and Alberta Energy and Utilities Board should lead the development of a multi-stakeholder process which would establish their numerical values. The Project Team also recommends that deposition guidelines be applied to management areas in Alberta which would be defined based on their environmental sensitivity. An interim critical load recommended for the most sensitive areas in Alberta would be 0.25 kilogram equivalents of hydrogen ion per hectare per year. The multi-stakeholder process should develop depositional guidelines. This process also should evaluate critical loads as more information is gathered on ecosystem sensitivities and environmental limits.



SO_2 Management System Framework

The Project Team also examined the current SO_2 management approaches and assessed other options against system objectives and criteria. This analysis indicated the importance of regulatory mechanisms - technology standards, emission standards, ambient guidelines, and deposition guidelines - as core management tools for achieving the objectives. While the current approval process for facilities should remain as the central mechanism for ensuring objectives are achieved, it should be modified to incorporate the new objectives.

The Project Team recommends establishment of a multi-stakeholder process to coordinate implementation of the Team's recommendations, provide ongoing evaluation of the management system and report to the CASA Board on progress. This Implementation Coordination Team also would be responsible for developing plans for voluntary initiatives to encourage enhanced performance in SO_2 management and plans for managing the differences between existing environmental conditions and environmental limits to ensure that a preventative approach is taken in the management of SO_2 emissions.

Periodic evaluation of the management system is critical to continuous improvement in SO_2 management. In the recommended system, evaluation is a formal, documented, objective and open process within the context of the goals and objectives. The Implementation Coordination Team would undertake this evaluation and report to the CASA Board at least annually during the first three years on implementation and evaluation, and once every five years on system evaluation. To support these changes in SO_2 management, it is recommended that a comprehensive, reliable and integrated system be established for SO_2 atmospheric source and emission data capture and reporting, and emission forecasting.

Ongoing communication and information sharing among the stakeholders and with the public is an important role for CASA and the Implementation Coordination Team. In particular, CASA should develop a strategy for communicating the results of this project and the Project Team's recommendations to the stakeholders and the general public.

The SO_2 Management Project Team presents this report and its recommendations in fulfillment of its terms of reference. Implementation of these recommendations should lead to establishment of a system approach to SO_2 management in Alberta that results in environmental protection, and optimization of economic performance and efficiency, and provides opportunities for continuous improvement in both these areas.

SO_2 Management System Recommendations

The CASA Board has adopted three broad air quality management goals to reflect the values and long-term direction required to meet the vision of the Alliance.

These for the management of air quality are:

- To protect the environment
- To optimize economic performance and efficiency
- To seek continuous improvement.

These goals are not to be taken as individual and discrete components but rather are to be

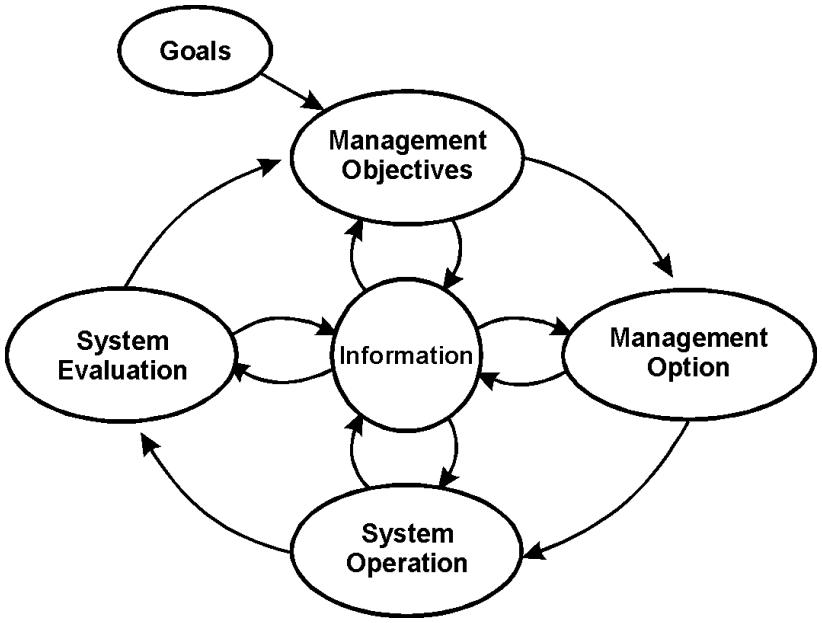
considered collectively with balance between elements. Charged by the CASA Board to review the current SO_2 management system, the SO_2 Management Project Team puts forth the following recommendations in eight categories: (A) Systems Approach; (B) Management Goals; (C) Management Objectives; (D) Management Options; (E) System Operation; (F) System Evaluation; (G) Information; and (H) Future Opportunities.

A. Systems Approach - organized components, or sub-systems linked together according to a plan to achieve specific goals and objectives.

It is recommended that:

1. The SO_2 Management framework shown below be adopted and used for the management of SO_2 in Alberta.

SO_2 Management System Framework



2. A multi-stakeholder group be created to coordinate the implementation of these recommendations, provide ongoing evaluation of the management system and report to the CASA Board on progress.

3. Organizations commit to their respective responsibilities as shown below for the implementation of the SO_2 management system.

RESPONSIBILITY AND ROLES FOR THE SO_2 MANAGEMENT SYSTEM

	AEP	AEUB /AE	EC	CASA	MSG	IND	ENGOs
GOALS	S	S	S	A/R	S	S	S
MANAGEMENT OBJECTIVES							
Environment	A/R	S	S	I	S	S	S
Performance							
environment-related	A/R	S	S	I	S	S	S
resource-related	S	A/R	I	I	S	S	S
Resource	S	A/R	I	I	S	S	S
MANAGEMENT OPTIONS	S	S	S	A	R	S	S
SYSTEM OPERATION							
Environment objectives	A/R	S	S	I	S	S	S
Performance objectives							
environment-related	A/R	S	S	I	S	S	S
resource-related	S	A/R	I	I	S	S	S
Resource objectives	S	A/R	I	I	S	S	S
SYSTEM EVALUATION	S	S	S	A	R	S	S
INFORMATION	S	S	S	A	R	S	S

AEP = Alberta Environmental Protection; AEUB/AE = Alberta Energy and Utilities Board / Alberta Energy; EC = Environment Canada; CASA = CASA Board of Directors; MSG = Multi-stakeholder Group recommended in 2; IND = Industry; ENGOs = Environmental Non-government Organizations.

A = Accountable, final approval; R = Responsible (only one per task); I = Inform; S = Support.

B. Management Goals - the ends to be achieved

It is recommended that:

4. The SO_2 management system apply the integrated air quality management goals adopted by the CASA Board.

C. Management Objectives - the quantitative expression of the goals

It is recommended that:

5. The scope and form of the objectives outlined below be adopted for establishment of numerical values or for future consideration. These objectives, including existing and new ones, cover environmental effect-based approaches, source emissions (performance) controls and resource conservation.

ELEMENTS TO BE INCLUDED IN THE MANAGEMENT OBJECTIVES

ENVIRONMENTAL OBJECTIVES	PERFORMANCE OBJECTIVES	RESOURCES OBJECTIVES
C Ambient Concentration Guidelines	C Max. emission levels	C Sulphur recovery
C Deposition Guidelines	C Facility emission performance target	C Energy consumption per unit
C Visibility	C Max. annual emission	C Unit cost of sulphur recovery
C Particulates	C Performance target emission levels	C Resource conservation
C Odour	C Effects based max. regional emission	
	C Target regional mass emission	
	C Stack height	
	C Stack temperature	
	C Flaring	
	C Odour complaint handling	

6. AEP and AEUB lead the development of a multi-stakeholder process which will result in the establishment of numerical values for the defined objectives.

D. Management Options - means applied to achieve the goals and objectives

It is recommended that:

7. Regulatory mechanisms continue to be used as the core management approach for achieving the objectives.

8. The multi-stakeholder group design, evaluate and develop an implementation plan for the use of effective voluntary initiatives as supplements to encourage and promote enhanced performance.

E. System Operation - the specific mechanisms and actions to apply the options

It is recommended that:

9. The AEP and AEUB Approvals process be applied as the central mechanisms to ensure objectives are achieved, and be modified to incorporate new objectives.

10. The differences between existing environmental conditions and environmental limits be managed to ensure a preventative approach is taken to ongoing management. The multi-stakeholder group investigate, evaluate and recommend mechanisms to manage this difference.

F. System Evaluation - assessment of success in achieving goals and objectives

It is recommended that:

11. The SO_2 management system be evaluated and enhanced, if necessary, by the multi-stakeholder group on the implementation of these recommendations and on the performance of the management system against the defined management goals and objectives of the system.

12. The multi-stakeholder group report to the CASA Board at least annually for the first three years on implementation and evaluation, and once every five years on system evaluation.

G. Information - new knowledge for ongoing support of the management system

It is recommended that:

13. AEP and AEUB establish a comprehensive, reliable and integrated SO_2 atmospheric source and emission data capture and reporting system. The system should use an acceptable electronic data information exchange standard that is compatible and can be

integrated with collected ambient monitoring data.

14. AEUB and AEP establish an SO_2 emission forecasting system that provides emission forecasts on an ongoing and timely basis.

15. CASA institute mechanisms, such as Internet, symposium/workshop, etc., for ongoing information sharing among stakeholders.

H. Future Opportunities - extension or supplemental actions which have been identified during project team discussion

It is recommended that:

16. CASA assess and examine the potential application of the management system framework, recommended above, for the integrated management of air quality in Alberta.

17. CASA support stakeholder activities related to the examination and implementation of other management instruments, such as economic instruments, which could be applied to the management of SO_2 emissions.

18. Using the recommendations put forth by the Target Loading Task Group, AEP establish deposition guidelines for the province using the multi-stakeholder process identified in Recommendation 6.

19. Stakeholders work to ensure local, provincial and national SO_2 management approaches and outcomes are complementary.

20. The CASA Board develop a strategy for communicating the results of this project to the stakeholders and the general public.

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1.0 INTRODUCTION

In 1990, a multi-stakeholder committee held extensive public consultations on air quality issues in Alberta. This committee recommended that the Government of Alberta implement a comprehensive air quality management system. This recommendation led to the establishment, in 1994, of the Clean Air Strategic Alliance (CASA) which is accountable to the provincial Ministers of Environmental Protection, Energy, and Health. CASA is a partnership of representatives from government, industry, and non-governmental organizations who collectively represent and report to their stakeholders. The Alliance shares decision-making responsibility for many strategic aspects of air quality with the Government of Alberta.

The Alliance's Vision for Air Quality in Alberta is:

> The air will be odourless, tasteless, look clear and have no measurable short- or long-term adverse effects on people, animals, or the environment.

Since its inception, CASA has been working on developing strategic management plans for a number of high priority issues that are expected to contribute to achieving this vision. Among the first of these was sulphur dioxide (SO_2) management.

Sulphur is found in most fossil-fuels and sulphur dioxide is an atmospheric pollutant produced from combustion or processing of these fuels. Prior to 1977, emissions of SO_2 in Alberta grew apace with industrial growth in the province (Figure 1). Total emissions were relatively stable between 1977 and 1993 (approximately 500 and 600 kilotonnes per year), with no significant overall upward or downward trend. The sources of these emissions can be divided among three major categories: natural gas processing (including sulphur recovery sour gas plants, flaring sour gas plants, sour oil batteries, and well test flaring); oil sands; and electric power generation. In 1993, production and processing of natural gas accounted for 48 per cent of industrial sulphur dioxide emissions; 28 percent came from upgrading of bitumen at oil-sands operations, power-generating stations contributed 21 percent, and the remaining 3 percent came from a variety of other sources.

Once in the atmosphere, sulphur, usually in the form of sulphur dioxide, can undergo processes that remove the chemical from the atmosphere. Sulphur dioxide can be deposited as a gas directly on plant and soil surfaces through processes known as dry deposition. In the presence of water, sulphur dioxide can form sulphuric acid which can be removed from the atmosphere by rain, snow, or fog in a process called wet deposition. Sulphur dioxide may react with other chemicals in the atmosphere to produce new compounds and may form acid aerosols. These aerosols can remain suspended for long periods of time and can be transported over long distances.

Other substances, such as nitrogen oxides from automobile emissions, ammonia from farming practices, and alkaline dust particles, may affect what happens to sulphur dioxide. The environmental effects of sulphur dioxide are related to the amount, the compounds that are formed, the process of deposition, and the level of exposure of the receptor. The sensitivity of

Figure 1: Alberta SO_2 Emissions: Industrial Sources

the receptor, which can be a single organism or an ecosystem, also is important. Organisms and ecosystem components appear to be able to absorb sulphur dioxide up to a certain point with little or no impact; however, exposure to too much sulphur dioxide or for too long can produce negative impacts.

The traditional means of safeguarding against environmental impacts from sulphur dioxide emissions was to use some form of ambient objectives for SO_2 concentrations. It was assumed that if the concentration of sulphur dioxide in the atmosphere remained below the objectives, there would be no negative environmental impact or that the impact would be acceptable. However, some bio-monitoring studies have shown, from work done in Alberta and elsewhere, that measurable changes and impacts related to air pollution are being detected in organisms in locations where the ambient concentrations do not appear to have significantly exceeded the ambient objectives. When environmental changes are detected, these changes need to be assessed for their significance and relationship to ambient concentrations of air pollutants and to other possible stress conditions. Improving our understanding of the effects of SO_2 emissions on plants, animals, and ecosystems depends on knowing where emissions end up and the rate at which they enter and impact different environments and organisms in various regions.

A working group with representatives from the electrical generation, petroleum, environmental, and government sectors was struck in 1993 to identify concerns regarding acid deposition in Alberta. The group's report to CASA identified these main areas of concern, which it was noted were not necessarily shared by all members:

- Environmental damage from existing acid deposition levels and from increased emissions.
- Potential inability of the existing management system to respond efficiently to national and international commitments.
- The existing management system may not be as cost effective as alternative systems.
- Controlling SO_2 may exacerbate other environmental problems such as climate change.

The working group also proposed a process to resolve these concerns. This work led CASA to establish the SO_2 Management Project Team in 1995. The Project Team was to recommend a comprehensive system for managing SO_2 emissions which addresses stakeholder issues and concerns (Appendix 1: SO_2 Management Project Team: Terms of Reference).

Specifically, the CASA Board directed the Project Team to determine:

- the issues and concerns with the current system of management,
- the management objectives for SO_2 in Alberta,
- the range of instruments available for the management of SO_2 emissions, and
- the most effective and efficient system for SO_2 management.

In establishing the Project Team, CASA agreed that Alberta's SO_2 management system must meet

the following principles:

- take a precautionary/preventative approach,
- recognize the evolving nature of scientific understanding,
- be sensitive to differences in the extent and scope of effects at different scales (i.e. local, regional, and long-range),
- recognize the complexity of air emissions and the interactions of pollutants,
- be sensitive to national/international commitments,
- recognize the need to act promptly to address areas identified to have damaging local impacts,
- balance the impact of emissions management strategies for other pollutants, and
- be cost-effective.

The Project Team was comprised of 20 representatives from government, industry, agriculture, and the environmental community who worked to reach consensus on solutions that meet the needs of all Albertans. This report and recommendations is the culmination of the Project Team's efforts. The Project Team used a twin-track approach to develop both an Interim Management Strategy and a long-term strategic management plan for SO_2 management. The Project Team held a number of workshops as well as hosting a major symposium on acidifying emissions in Red Deer, April 1996 (Appendix 2: Executive Summary). The main work of the Team began with the Interim SO_2 Management Workshop held at Terratima Lodge, April 3 and 4, 1995. The Executive Summary from that workshop is reproduced in Appendix 3. The purpose of the workshop was to develop recommendations regarding interim SO_2 management in Alberta that could be implemented over the following 2 to 3 years. Following the workshop, working groups were established to address:

- environmental objective setting,
- management options, actions, and implementation,
- assessment, monitoring, and new information requirements, and
- to develop recommendations for a comprehensive SO_2 management system.

Other groups reviewed and assessed acid deposition target loading for Alberta and electronic data management.

2.0 CURRENT MANAGEMENT FRAMEWORK

The current system for controlling SO_2 emissions in Alberta was developed in the late 1960s and early 1970s. The focus is on control of point source emissions through the use of appropriate technologies to ensure that ambient air quality meets Alberta's guidelines. Responsibility for air quality management is shared by Alberta Environmental Protection (AEP) and the Alberta Energy and Utilities Board (AEUB). In general terms, Alberta Environmental Protection is responsible for ensuring that emissions are minimized to protect human health and the environment. The Alberta Energy and Utilities Board is responsible for ensuring that energy resources are developed in a safe, efficient, and environmentally responsible manner. These regulatory bodies work together to ensure their respective objectives are achieved. The current system has worked well;

however, as noted above, there are concerns that need to be addressed.

Three goals are implicit in the current management system:

- emissions from industrial facilities are minimized through the use of "best available demonstrated technology" (BADT),
- ambient levels of SO_2 in the vicinity of industrial facilities do not exceed Alberta's guidelines, and
- sulphur resources are to be conserved.

Four main policies support these goals:

- emissions from each industrial source must be controlled using the best available demonstrated technology that is economically achievable,
- residual emissions must be dispersed through a stack designed to keep ambient concentrations below the Alberta ambient air quality guidelines,
- industrial operators must monitor emissions and air quality around their facilities and report the measurements to the government, and
- cumulative emissions from industrial sources are considered with respect to ambient guidelines and regional air pollution deposition.

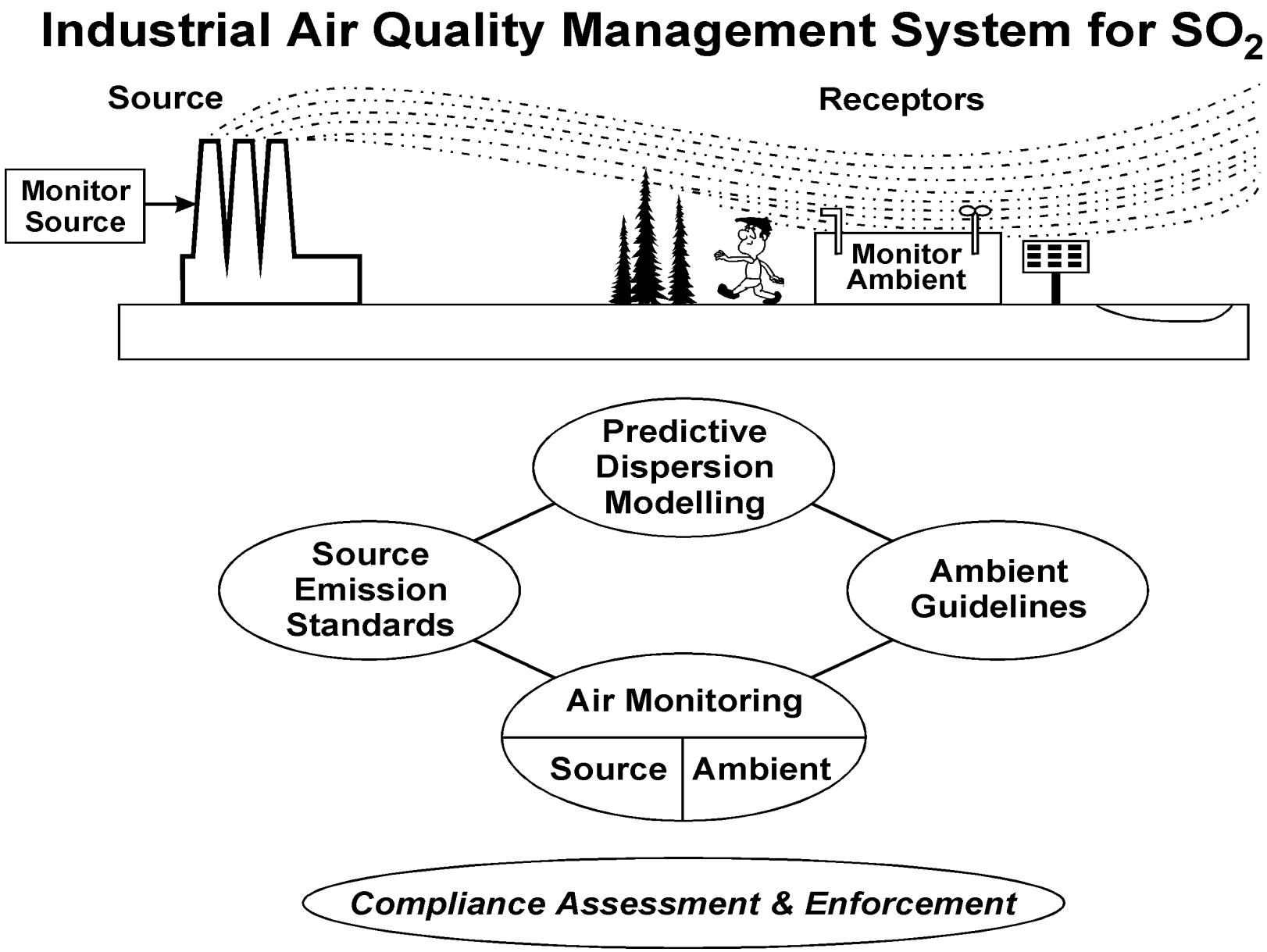
The main tools for SO_2 management in Alberta are the facility operating and environmental approvals issued by Alberta Environmental Protection and Alberta Energy and Utilities Board. The key components of the management system include: ambient guidelines, source emission standards, plume dispersion modelling, monitoring, reporting, approvals, inspection/abatement, and enforcement. Figure 2 illustrates the current management model. Source emissions are managed by setting technology-based emission standards for each facility. Predictive dispersion modelling is used to determine the required stack height to properly disperse any residual air contaminants and ensure that ambient air quality guidelines are met. Compliance assessment and enforcement are used to ensure that source emission standards and ambient guidelines are met.

Alberta has established province-wide Ambient Air Quality Guidelines, which specify maximum desirable ambient concentrations for several key air pollutants. Alberta's guidelines for sulphur dioxide (Table 1) are among the most stringent in Canada. For longer-term concentrations of sulphur compounds (including SO_2), Alberta has an ambient guideline for total sulphation of 0.50 mg SO_3 equivalent per day per 100 cm^2 as a one-month accumulated loading.

Table 1: Alberta's Sulphur Dioxide Guidelines

Averaging Time	Guideline Level
Annual	0.01 ppm (30 µg/m^3)
24 hour	0.06 ppm (150 µg/m^3)
1 hour	0.17 ppm (450 µg/m^3)

Figure 2


Industrial Air Quality Management System for SO_2
Source
Receptors
Monitor Source
Monitor Ambient
Predictive Dispersion Modelling
Source Emission Standards
Ambient Guidelines
Air Monitoring
Source
Ambient
Compliance Assessment & Enforcement

Alberta also has source emission standards for SO_2 based on the use of best available demonstrated technology (BADT). Once the BADT for a particular source has been determined, an emission limit for that source is set based on the anticipated residual emissions, with consideration for unexpected plant upsets. The emission limits, expressed as a maximum allowable rate of emission, and/or concentration, are specified in guidelines and in approvals for individual industrial facilities. Plume dispersion models link stack emissions to ambient concentrations and deposition levels, and are used to determine the required stack height to disperse residual air contaminants and ensure that ambient air quality guidelines are met.

Regulatory approvals, issued under the Environmental Protection and Enhancement Act, incorporate:

- source emission standards,
- a listing of required pollution control equipment and technologies, and allowable emission sources,
- operational procedures required to minimize emissions,
- stack design criteria to ensure ambient guidelines are met, and
- environmental monitoring and reporting requirements.

The Energy and Utilities Board also issues approvals for energy sector industries. For SO_2-emitting industries, these approvals have conditions related to sulphur recovery requirements, sulphur inlet maximums, and flaring restrictions.

While the Government of Alberta has primary responsibility for control of air emissions that originate in Alberta, the federal government has responsibility for transboundary air emissions including negotiation of treaties and international agreements. In 1983 an interim wet deposition objective for sulphate in precipitation of 20 kilograms per hectare per year was adopted by the federal and provincial environment ministers as an objective to protect moderately sensitive ecosystems in eastern Canada. In western Canada, wet sulphate deposition is not a direct measure of wet acid deposition because alkaline dust and ammonia act to neutralize the acidity, and sulphate is present in the dust. As a result of subsequent studies, interim objectives were recommended for Alberta and other western provinces.

In 1993, A Comprehensive Air Quality Management Framework for Canada was issued and the governments agreed to establish a cooperative framework and mechanism for coordinating actions by the federal, provincial, and territorial governments. The framework was aimed especially at issues with transboundary or global effects.

In 1994, the Energy and Environment Ministers of the federal, territorial, and provincial governments (excluding Quebec) issued a Statement of Intent on Long-Term Acid Rain Management in Canada. They agreed to formulate and cooperate in measures to mitigate the negative impacts from sulphur dioxide emissions.

In 1994, Canada also signed the United Nations Economic Commission for Europe (ECE), Second Sulphur Protocol: in 1996 the Canadian Ministers of Energy and Environment agreed that Canada should ratify this Protocol.

The Protocol commits Canada to:

- cap national SO_2 emissions at 3.2 million tonnes by 2000,
- cap regional SO_2 emissions in southeastern Canada at 1.75 million tonnes by 2000, and
- move towards critical loads, or that level of acid deposition that does not cause damage to a particular ecosystem.

The national approach for managing sulphur deposition is based on determining critical loading limits to protect sensitive ecosystems. In many areas of eastern Canada, sensitive aquatic ecosystems have been damaged by acidifying emissions, and protection of these ecosystems requires reducing depositional loading. An important component of the national strategy is a proposal to reduce acid deposition and close the "gap" between current levels of deposition and the critical load. Scientists have determined critical loads for sulphate deposition for aquatic ecosystems in eastern Canada and have begun work on nitrogen critical loads, because nitrogen deposition can lead to acidification. An Integrated Assessment Model is being used to analyze various gap closure scenarios. The model identifies source regions that need to reduce their emissions and by how much in order to reduce environmental damage due to sulphate deposition.

The national strategy is expected to include:

- an implementation plan and schedule,
- an integration mechanism with other air issues,
- a feedback loop to take into account new information,
- recommended scientific research,
- activities required to monitor emissions and ecosystem recovery,
- resources to implement the National Strategy, and
- a communications plan.

The national strategy is expected to provide direction for the provinces without being prescriptive. The federal government recognizes that individual provinces, working with industry, are in the best position to prescribe how to reduce SO_2 emissions in their own source regions. The national group is looking to Alberta's work to fill in the gap for western Canada through the development of target loadings for Alberta ecosystems. Close ties exist to the work of the Project Team in Alberta and much of the work is proceeding on parallel tracks.

3.0 GOALS FOR AIR QUALITY MANAGEMENT

CASA's Board has approved three broad goals for Comprehensive Air Quality Management. These goals are not hierarchical, but work together.

- To Protect the Environment
- To Optimize Economic Performance and Efficiency
- To Seek Continuous Improvement

These goals describe the ends to be achieved as a result of managing air emissions and apply to all aspects of air quality management in Alberta. They reflect the values and long-term direction which the Board views as essential to achieve its vision of clean air for Alberta (Table 2). A clear statement of goals, and the subsequent design of projects to work toward these goals, ensures that all initiatives of CASA are working in an integrated and coordinated fashion.

There is no hierarchy implied in the presentation of the goals. They are not individual and discrete components, but a collective and mutually supportive whole. These goals form inseparable parts of CASA's holistic approach to air quality management. They encompass protection of the environment while recognizing both the economic costs of impacts on the environment and human health, and the economic impacts of environmental protection. These goals are to be applied by all stakeholders in the management of air quality and provided guideposts for the SO_2 Management Project Team in developing its recommendations.

Table 2: Goals for Comprehensive Air Quality Management

To Protect the Environment

C minimize adverse effects (short- and long-term)
- people
- animals
- environment

C pursue environmental enhancement

C meet social expectations
- ensure that ecological integrity is maintained
- ensure needs of future generations are not compromised

To Optimize Economic Performance and Efficiency

C minimize adverse economic impacts

C ensure best use of resources (technological, human, financial, etc.)
- facilities, goods, services

C pursue economic enhancements on a full life-cycle basis

C meet societal expectations
- ensure that the integrity of the economy is maintained
- ensure the needs of future generations are not compromised

To Seek Continuous Improvement (eco-efficiency)

C minimize wastes (e.g. per unit of output)
- waste minimization and pollution reduction/prevention

C minimize resource inputs and use (e.g. per unit of output)
- resource conservation and energy efficiency

C enhance competitiveness

4.0 PROPOSED SO_2 MANAGEMENT SYSTEM

4.1 System Approach

The current approach to management of SO_2 emissions has functioned well in most areas of Alberta. However, improvements can be made, and a system is needed which addresses specific management objectives including the environmental effects of sulphur deposition, and responds to local and regional environmental sensitivities. The proposed system keeps a regulatory approach as the core management mechanism and combines the current approval process, which establishes facility-operating limits, with a regional approach that recognizes environmental sensitivities. It provides enhanced environmental protection in concert with flexibility, streamlining, and efficiency. The proposed system emphasizes improved understanding of the impacts of sulphur dioxide and of the ability of the environment to absorb and naturally neutralize emissions of acidic gases. It incorporates area-specific knowledge about the location of facilities relative to dispersion and deposition and the impact of emissions from these plants locally, regionally, and provincially. Area-specific information, combined with guidance on environmental limits, would provide industry with the flexibility to select plant sites and technology to meet management objectives.

The proposed system explicitly links management options and implementation to goals and objectives, with feedback loops to information and evaluation (Figure 3). The approach will optimize SO_2 management by establishing an integrated, strategic direction aimed at achieving specific environmental and economic goals and objectives and using explicit criteria for evaluating performance and accountabilities for SO_2 management. The system is designed to enhance understanding of the component parts and their linkages, and to collect and respond to new information.

Within the system framework, management objectives are set as measures against which to assess progress, and management options are selected to achieve these objectives. Implementation and the overall success of the system would be evaluated against criteria outlined in this report. This evaluation would determine areas for environmental and economic improvement and provide an assessment of the effectiveness of the management options in achieving the goals and objectives. The overall management system is supported by information and data that facilitate evaluation and support the goal of continuous improvement. It also calls for development of clear roles and responsibilities for all organizations involved in the management of sulphur dioxide emissions and for those organizations to commit to carrying out these responsibilities. The system approach provides a framework that is readily transferable to other air quality issues and may be applied in other jurisdictions and other areas of public policy. The work of the Project Team in developing the proposed management system clearly demonstrated the synergism achieved by government, industry, agriculture, and environmental groups working together toward common goals. A similar multi-party process should be used to coordinate implementation and ongoing evaluation of the system. CASA has an ongoing role in ensuring the system is functioning efficiently and effectively and remains flexible in responding to the needs of the stakeholders. Existing government departments retain responsibility for

ensuring that environmental and performance objectives are met through setting regulations, issuing licences and approvals, and undertaking enforcement.

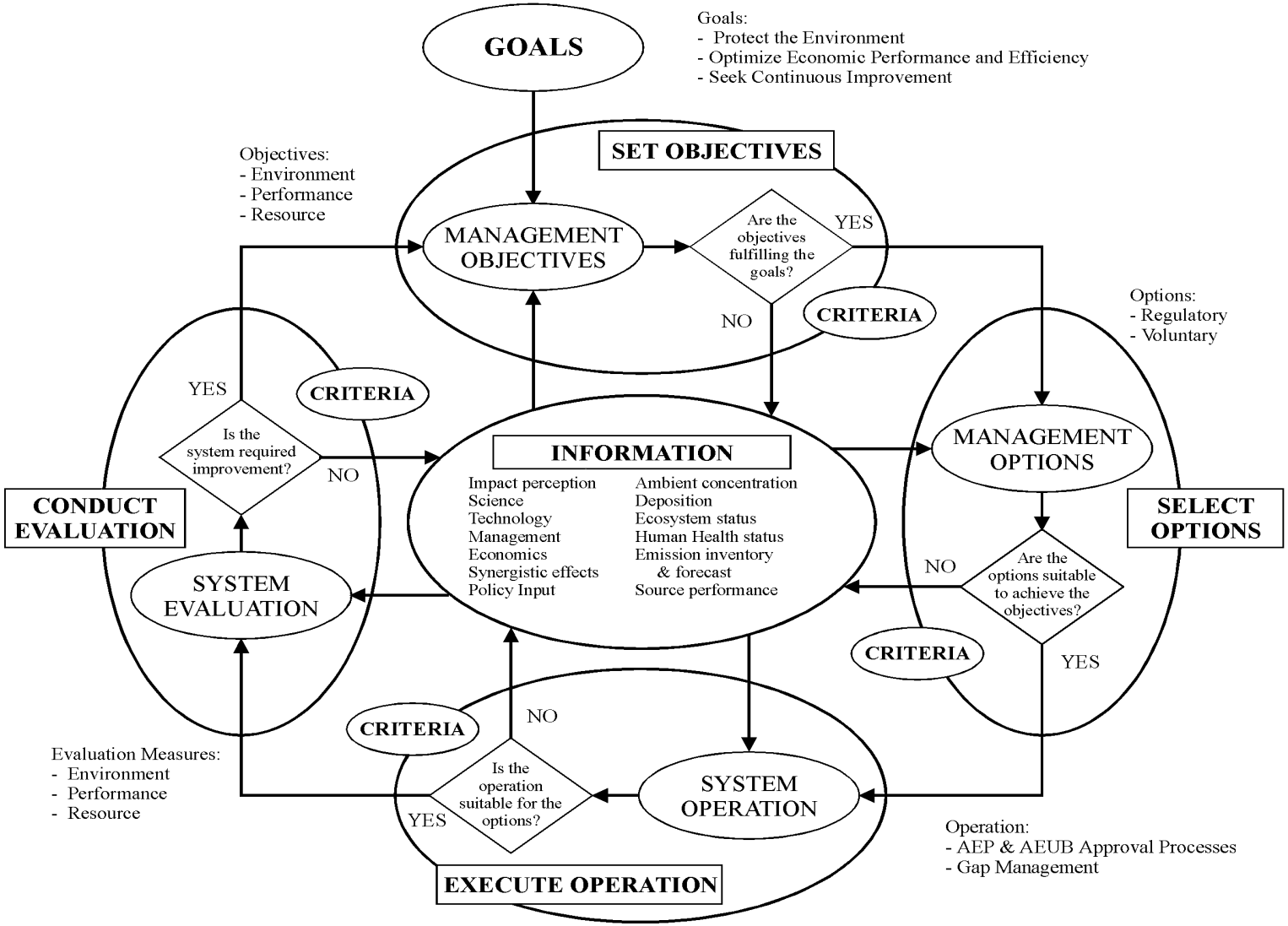
It is recommended that:

1. *The SO_2 Management framework shown in Figure 3 be adopted and used for the management of SO_2 in Alberta.*

2. *A multi-stakeholder group be created to coordinate the implementation of these recommendations, provide ongoing evaluation of the management system and report to the CASA Board on progress.*

3. *Organizations commit to their respective responsibilities as shown in Table 3 for the implementation of the SO_2 management system.*

Figure 3



SO_2 Management System Framework

Table 3

RESPONSIBILITY AND ROLES FOR THE SO_2 MANAGEMENT SYSTEM

	AEP	AEUB /AE	EC	CASA	MSG	IND	ENGOs
GOALS	S	S	S	A/R	S	S	S
MANAGEMENT OBJECTIVES							
Environment	A/R	S	S	I	S	S	S
Performance							
environment-related	A/R	S	S	I	S	S	S
resource-related	S	A/R	I	I	S	S	S
Resource	S	A/R	I	I	S	S	S
MANAGEMENT OPTIONS	S	S	S	A	R	S	S
SYSTEM OPERATION							
Environment objectives	A/R	S	S	I	S	S	S
Performance objectives							
environment-related	A/R	S	S	I	S	S	S
resource-related	S	A/R	I	I	S	S	S
Resource objectives	S	A/R	I	I	S	S	S
SYSTEM EVALUATION	S	S	S	A	R	S	S
INFORMATION	S	S	S	A	R	S	S

AEP = Alberta Environmental Protection; AEUB/AE = Alberta Energy and Utilities Board / Alberta Energy; EC = Environment Canada; CASA = CASA Board of Directors; MSG = Multi-stakeholder Group recommended in 2; IND = Industry; ENGOs = Environmental Non-government Organizations.

A = Accountable, final approval; R = Responsible (only one per task); I = Inform; S = Support.

4.2 Management Goals

The proposed system operates within the framework of CASA's goals for air quality management:

To Protect the Environment;
To Optimize Economic Performance and Efficiency; and
To Seek Continuous Improvement.

Collectively, these goals incorporate the essential elements of environmental protection, economic efficiency, and continuous improvement. They are the consensus of all CASA stakeholders. Working to attain these goals ensures the management of SO_2 works to achieve CASA's Vision and to meet the needs of the sectors and interests that form CASA.

It is recommended that:

4. *The SO_2 management system apply the integrated air quality management goals adopted by the CASA Board.*

4.3 Management Objectives

The Project Team established a Task Group to develop objectives for the management system. These objectives, when completed, will provide a quantitative expression of the goals, and will be used to measure progress and performance and assist in refining and improving the management system. They also provided direction to the management instruments task group in its assessment of management options.

The Task Group reviewed the style, form, and content of management objectives, environmental objectives, and air quality objectives from North America and Europe, and developed an extensive list of objectives that were specific, measurable, achievable, realistic, and time sensitive. Each objective was assessed against the management goals using the basic question: "could the objective be used to achieve the goals?" Then the objectives were rated for their usefulness as high, medium, or low and grouped of the basis on these ratings and appropriateness relative to each goal.

The task group also developed a list of criteria for assessment of the management objectives:

- environmental effectiveness/certainty of improvements,
- scientifically/technically sound,
- measurable,
- simplicity,
- precautionary,
- fairness/equity, and
- flexibility.

These criteria were weighted, the objectives tested against them, and a final list developed.

The Project Team provides recommendations for the scope and form of the objectives that should be adopted for establishment of numerical values or for future consideration.

The agencies responsible for implementing the management system, namely Alberta Environmental Protection and the Energy and Utilities Board, should develop measurable quantitative objectives for consideration. This step should be undertaken with input from appropriate stakeholders. These quantitative objectives then would be reviewed in the context of the goals and management options as part of the periodic evaluation of the system. The objectives must support and be compatible with the goals for air quality management to ensure the system for SO_2 management is integrated within the overall approach to air quality management.

It is recommended that:

5. *The scope and form of the objectives outlined below be adopted for establishment of numerical values or for future consideration. These objectives, including existing and new ones, cover environmental effect-based approaches, source emissions (performance) controls, and resource conservation.*

ELEMENTS TO BE INCLUDED IN THE MANAGEMENT OBJECTIVES

ENVIRONMENTAL OBJECTIVES	PERFORMANCE OBJECTIVES	RESOURCES OBJECTIVES
C Ambient Concentration Guidelines	C Max. emission levels	C Sulphur recovery
C Deposition Guidelines	C Facility emission performance target	C Energy consumption per unit
C Visibility	C Max. annual emission	C Unit cost of sulphur recovery
C Particulates	C Performance target emission levels	C Resource conservation
C Odour	C Effects based max. regional emission	
	C Target regional mass emission	
	CStack height	
	CStack temperature	
	CFlaring	
	COdour complaint handling	

6. *Alberta Environmental Protection and Alberta Energy and Utilities Board lead the development of a multi-stakeholder process which will result in the establishment of numerical values for the defined objectives.*

4.3.1 Target Loading

A Target Loading Subgroup was established in April 1995 to evaluate and make recommendations

to the Project Team on the feasibility and desirability of implementing critical and target loads in the SO_2 management system for Alberta. The subgroup commissioned two technical studies; Critical and Target Loadings of Soils and Vegetation in Alberta (Maynard 1996) and The Response of Aquatic Ecosystems in Alberta to Acidifying Emissions (Schindler 1996), which are included in the Scientific Appendix to the subgroup's Final Report (Appendix 4). These technical studies include a review of management research in other regions and countries, and discussion of the cause and effect relations of acidifying emissions on vegetation and aquatic ecosystems. The Subgroup submitted its Final Report to the Project Team in June 1996.

The concept of critical and target loads was developed in Canada to explain and manage the relationship between wet deposition of sulphur species and the response of aquatic and terrestrial ecosystems to this depositional loading. The concept is used in eastern Canada and western Europe to manage emissions of sulphur, nitrogen, and related compounds from largely anthropogenic sources.

The Critical Load is defined as the maximum level of acidic atmospheric deposition that will not cause chemical changes leading to long-term harmful effects on the most sensitive ecological systems. The critical load depends on the sensitivity of the ecosystem to acidic inputs and, for any given ecosystem, is a function of the chemistry of precipitation and the ability of the soil to add base cations or remove strong acid anions.

The Target Load is the maximum level of acidic atmospheric deposition that affords long-term protection from adverse ecological consequences and that is practically and politically achievable. Target loads provide clear and understandable objectives for government, industry, and the public, and a scientific basis for emission management strategies. Development of Alberta-specific target loads allows determination of loads most applicable to the sensitivities of Alberta's ecosystems as well as being sensitive to Alberta's social and economic context.

Critical loads should be based on the natural, physical, and chemical characteristics of the province or region and include consideration of both wet and dry deposition of sulphur and nitrogen. The sensitivity of the soil and aquatic receptors is determined largely by their chemical composition, and soils and water bodies in Alberta have vastly differing responses to acid deposition.

Alberta may choose one critical load value that applies across the province or apply a critical load for each management area depending on receptor sensitivity. The subgroup recommended the latter approach with a recognition that, in some non-sensitive areas, emissions likely would be limited by other guidelines developed for the protection of human health, or prevention of effects such as visibility degradation. In managing emissions on the basis of receptors, Alberta will need to consider the effects of exported emissions on receptors in other provinces and states.

The subgroup recommended that Alberta adopt the European (Scandinavian) method which includes development of critical and target loads based on ecosystem sensitivity and depositional loading calculations which include sulphur and nitrogen species as well as calcareous dust and base cations. The method should be tested and evaluated in Alberta for 3 to 5 years and modified

if necessary.

Based on monitoring data over 15 to 20 years, Maynard (1996) and Schindler (1996) concluded that, in Alberta, there appears to be no evidence of acidification of soil, forests, and aquatic ecosystem receptors at present and historical loading rates. Consequently, neither study suggested a specific critical load for Alberta. Nevertheless, the subgroup recommended that Alberta adopt an interim critical load of 0.25 kilogram equivalents per hectare per year (keq/ha/yr) potential acid input for sensitive areas. This interim critical load would be a starting point for establishing target loads and should be reviewed and refined as needed based on additional monitoring, research and experience.

The subgroup also agreed that target loads should be implemented similar to ambient guidelines in Alberta. The target loads would be considered in determining technological requirements, evaluation of approvals, adjustments to emission limits, conditions in approval renewals, and in planning industrial development within a management area. Critical and target loads should be established for high, medium, and low sensitivity aquatic and terrestrial receptors based on properties related to receptor (soil, water) buffering capabilities.

4.4 Management Options

A Task Group was established to determine and assess the range of options available for managing SO_2 emissions in Alberta. Any option chosen should have direct links to the goals and management objectives. The challenge is to ensure that the options used provide for environmental protection, particularly in sensitive regions, while optimizing economic performance and efficiency. Careful scrutiny against consistent criteria is necessary to determine the most appropriate tools. The Task Group prepared descriptions of various management options and developed screening criteria. The options were tested against the criteria and the management objectives to determine 'best-fitting' options. Then the options were assessed against the criteria, which had been re-phrased and prioritized as criteria for the overall management system. This testing culminated in a workshop on management objectives and options.

The screening criteria were:

High priority
- Sustainable development
  - * environmental effectiveness
  - * cost-effectiveness (inherent CASA value)
- Fairness/equity
- Assessability (review of progress)

Medium priority
- Simplicity
- Compatibility

Low priority

- Certainty

Analysis of management options indicated the importance of regulatory mechanisms as core management approaches. However, there is a need to ensure that these regulatory tools work together to meet the environmental, performance and resource objectives for SO_2 management. No consensus was reached by the Project Team on the application of other options but some of the options that which were assessed, if applied together with existing management tools, might result in regional improvement. CASA should support stakeholder activities related to the examination and implementation of other management instruments. There may also be opportunities to use voluntary emission reduction programs to complement or supplement regulatory mechanisms and provide for performance by industry leaders which exceeds that required by standards. Dialogue between the regulators and those responsible for system implementation will be important to ensure the management options work in concert. The multi-stakeholder, implementation coordination group should design, evaluate, and develop an implementation plan for the use of effective voluntary initiatives as supplements to encourage and promote enhanced performance. Further examination, discussion and implementation of other management options by the stakeholders are encouraged.

Regulatory Standards

In general, four types of regulatory standards may be used: technology standards, performance standards, product standards, and construction standards. Performance and technology standards are the most common and are in place in most jurisdictions. Performance standards require facilities to meet uniform or location-specific performance goals such as emission rates. For example, sulphur recovery guidelines for sour gas plants in Alberta require large new plants to recover 99.8 per cent of the sulphur, while for smaller new gas plants sulphur recoveries in the range of 70 to 90 per cent are required. Emission limits for SO_2 are set based on the sulphur recovery requirement and the maximum sulphur inlet rating for the plant.

Technology-based standards require the use of specified technologies - often best available demonstrated technologies (BADT). These standards may be applied to all enterprises within a particular industry sector or on a case-by-case basis. BADT implies an emission control technology based on the maximum degree of emission reduction that has been shown to be practicably and economically achievable for a given source and type. Its definition includes not only 'back end' emission control technology but also 'pollution prevention' technology such as selecting process technology, which minimizes the generation of emissions. Once BADT for a particular source has been determined, the emission limit is set. Emission limits based on the application of BADT for various industry categories in Alberta are specified in guidelines. These limits form the basis for the performance limits contained in approvals issued to industrial facilities.

Emission Trading

Emission trading describes a range of systems that involve trading of emission permits or credits from one source, which has achieved lower emissions than it is allowed, to another, which has emissions that are higher than allowed. Trading is conducted to achieve an overall emissions

objective. A typical closed market trading system would involve replacing performance or technology standards with legislation that establishes: an overall emission objective or cap; boundaries for the market area; initial emission allowance levels for sources; rules for trading emission allowances; and an administration system.

Closed market emission trading has been practiced in the United States, primarily dealing with SO_2 emissions as part of the acid rain control program. It has been relatively successful, but has been impaired by a number of factors including: difficulties in establishing emission objectives or caps and in apportioning initial emission allowances; narrow market definitions which eliminate many emission sources; and the overall complexity of the systems.

Closed market trading could be applied to SO_2 emission management in Alberta. Its effectiveness would depend on the area boundaries, number of sources, and the spread in marginal sulphur recovery costs between facilities. Changes would be required in Alberta's regulatory system to permit emissions trading. Emission trading can be used to implement a target load, particularly if the load is based on an annual mass emission rate for a particular region, but typically, on its own, does not ensure that hourly or daily ambient objectives or performance objectives are achieved.

An open market emission trading system is less structured and can be established to complement performance or technology standards, thus making the transition to the new system easier than for a closed emission trading system. A typical open market system has the following characteristics: performance or technology standards remain in place; sources which emit less than required under regulation are given emission reduction credits; and credits could be traded to other sources to help them meet their requirements. The market could be broad in scope, including area, and include mobile and non-regulated sources.

Open market systems are under development for oxides of nitrogen (NO_x) and Volatile Organic Compounds (VOCs) in the Northeastern United States and in Ontario. The number and variety of potential sources in Alberta, along with the variation in marginal control costs, indicate that emissions trading could work well. Emission trading can be used to implement a target load, particularly if the load is based on an annual mass emission rate for a particular region.

Emission Fees and Rebates

A fee can be attached to each unit of emission encouraging an emitter to reduce emissions to the point at which its marginal cost of control equals the emission costs. The aggregate emissions reduction depends on the size of the fee. There are several design considerations: whether to impose a common charge for all emitters or a charge which varies according to each region's environmental sensitivity or valuation of its environment; distribution of revenues; whether charges replace or supplement command and control regulations; how charges apply to individual point source emissions; and whether to retain current monitoring and ambient air quality standards. Several European countries have imposed SO_2 emission charges.

Under an emission charge/rebate system, large emission sources are charged on their emissions of a specific pollutant. The funds collected are redistributed among plants in proportion to their production. As a result, plants are stimulated to reduce emissions because plants that emit fewer pollutants per unit of production receive a rebate through the system from the more polluting

plants. The charge can complement an emission permit system.

Nitrogen oxide charges on energy production are in place in Sweden. There is little experience elsewhere. Charges and rebate schemes have some usefulness when considering annual ambient objectives, but typically do not ensure that hourly or daily ambient objectives are achieved.

Voluntary Emission Reduction Program

Under a voluntary reduction program, companies are encouraged to take voluntary action to reduce emissions. Voluntary actions can be part of a broader initiative whereby industry "pace-setters" are recognized, bench marking is utilized, or best practices promoted. Many voluntary programs require establishment of emission baselines, against which actual emissions can be tracked. Some programs use emission or emission rate targets toward which companies move.

Voluntary programs can be structured in a variety of ways but industry associations typically play a key role. Formal Memoranda of Understanding (MOUs), or agreements can be developed between government and specific companies or industrial associations. Alternatively, voluntary programs can rely on self-reporting and moral suasion as is the case with Accelerated Reduction and Elimination of Toxics (ARET) program. A large number of voluntary programs have been established over the past five years. Some are industry-directed; for example, the Canadian Chemical Producers Association's Responsible Care Program, while others such as the Canadian Voluntary Challenge and Registry Program for greenhouse gases respond to a particular issue.

It is recommended that:

7. *Regulatory mechanisms continue to be used as the core management approach for achieving the objectives.*

8. *The multi-stakeholder group design, evaluate and develop an implementation plan for the use of effective voluntary initiatives as supplements to encourage and promote enhanced performance.*

4.5 System Operation

The proposed management system is intended to ensure environmentally- and cost-effective management of SO_2 in Alberta. As a first step, clear identification of roles and responsibilities is required to help eliminate duplication and overlap in the system and aid in identification of areas where no organization has clear responsibility. Clear lines of accountability also will help in defining resource requirements to ensure that appropriate information is available for managing and assessing implementation of the system.

The issuance of facility approvals remains the primary means to implement the SO_2 management system and ensure that ambient objectives are met. Modification to the approvals process will be required to address deposition, existence of zone management initiatives, local concerns, national commitments and so on. A key principle in implementing the system is protection of sensitive

ecosystems. Based on the information available, there does not appear to be any depositional loadings at a regional scale in Alberta which exceed the proposed interim critical load of 0.25 keq/ha/yr. Managing the gap between the critical load and the desired performance level or target load requires a different approach than the current regulatory system was designed to accommodate. It also calls for a different approach in the use of critical and target loads than has been implemented in eastern Canada or Europe. In those locations, deposition loads often exceed critical loads or environmental limits and management strategies are aimed at reducing loadings to a performance level that is closer to but still above the environmental limit.

Alberta is in a favourable position of being able to set a desired performance level below the environmental limit and institute protective regulatory and monitoring systems prior to the onset of significant impacts. The Project Team discussed several options for managing the difference between the existing environmental conditions and the environmental limits. A preventative approach is required and particular attention should be paid to emission trends as they move toward the environmental limits and emissions managed to keep loadings below the environmental limit.

Two conditions need to be recognized as important in managing the gap: (1) the environmental limit cannot be exceeded; and (2) the desired performance level may or may not be exceeded under certain circumstances. Management of the gap cannot be determined without understanding: what is the gap to be managed, how it will be managed, and the costs and benefits of the desired management approach. Recommendations for mechanisms to manage the gap should be developed by the Implementation Coordination Team.

It is recommended that:

9. *The AEP and AEUB Approvals process be applied as the central mechanisms to ensure objectives are achieved, and be modified to incorporate new objectives.*

10. *The differences between existing environmental conditions and environmental limits be managed to ensure a preventative approach is taken to ongoing management. The multi-stakeholder group investigate, evaluate, and recommend mechanisms to manage this difference.*

4.6 System Evaluation

Periodic evaluation is fundamental to continued improvement of the management system. Evaluation provides feedback on the opportunities for improvement and benchmarks for comparing progress toward the vision and goals of CASA. System evaluation cannot be left to happenstance. It needs to be a formal process within the context of the system's goals and objectives. Evaluation also should measure the efficiency of the system: performance measures need to be developed for this assessment. Evaluation of the management system also will be partly achieved by comparing field results (deposition loadings, emissions, environmental impacts and so on) with projections provided in documents such as Environmental Impact Assessments.

An important aspect of the evaluation will be consideration of new information resulting from sources such as actual and forecasted emissions, monitored environmental impacts, and research findings. Appropriate information is required in a form that is useful for comparative purposes. Monitoring and reporting processes need to be modified to ensure this information is available.

To be credible, the evaluation must be transparent; conducted in a manner that is documented, objective, open, and responsive to the needs of the stakeholders. This transparency can be achieved if a multi-stakeholder group that is responsible to its stakeholder constituents and accountable to the CASA Board manages the evaluation process. This group should evaluate the SO_2 management system on a scheduled basis. In the first three years of implementation, the group should report annually on implementation and evaluation and it should evaluate the system and report to the CASA Board each five years.

It is recommended that:

11. *The SO_2 management system be evaluated and enhanced, if necessary, by the multi-stakeholder group on the implementation of these recommendations and on the performance of the management system against the defined management goals and objectives of the system.*

12. *The multi-stakeholder group report to the CASA Board at least annually for the first three years on implementation and evaluation, and once every five years on system evaluation.*

4.7 Information

The proposed system approach requires improved information on emissions, ambient concentrations, mass loadings, and environmental monitoring data. The system's operation also requires forecasts - on a regular and timely basis - of emissions of SO_2. This information will be important in the determination of target loads and strategies for managing the gap in areas of high environmental sensitivity.

Concerns about SO_2 management are shared by many stakeholders and information sharing is a key to maintaining their understanding and ongoing support for the management system. The difficulty of accessing information was dealt with in part by the Electronic Data Transfer subgroup and recommendations were made to improve data management (4.7.1). CASA also has a role in ensuring that information is available to all interested stakeholders. Various mechanisms for communication and information sharing are mentioned in Section 7.0.

4.7.1 Electronic Data Transfer

The Project Team established the Electronic Data Transfer Subgroup to consider data transfer methods which would add efficiencies and value to the current reporting system and address concerns related to cost effectiveness, simplified reporting, and greater availability of data.

At present, there are three principal reporting requirements for sour gas processing facilities in Alberta. They are required to submit reports of SO_2 emissions as collected by continuous source monitors, the results of manual stack surveys, and information from ambient monitoring near the facility. This information is supplied to Alberta Environmental Protection. In addition, sour gas processing and flaring facilities must report a comprehensive sulphur balance showing throughput and final disposition as required by the Energy and Utilities Board's Sulphur Recovery Requirements. The current system is primarily paper-based but, for the most part, paper reports submitted to the regulators are generated from computer data maintained by facility operators. Data are maintained by the regulators within a personal computer environment but the data are used primarily by each agency for its own purpose and external access to these data is limited.

Several alternative data transfer options were considered by the subgroup including submission of data on disk, down loading of monthly summaries, and real time data down loading. Down loading of monthly summaries to a central system appears to offer the greatest potential. Electronic data transfer would simplify reporting and streamline the data transfer and summarizing process. Additional hardware and software requirements would be minimal; however, there is not much upside to industry if both electronic and hard copy systems are required. Questions of security of access and storage need to be considered as well as the development of a common file format for recording and transferring data.

In order to get the system started, industry and government should be surveyed to determine current and planned data technologies and capabilities, and the need for upgrading of computer resources. In addition, there should be an examination of the data that are currently being transferred and the roles and responsibilities of government, industry and the public in submitting, analyzing, storing and using these data. A common file format would be required, as well as a permanent site for an Electronic Bulletin Board System. With these components in place, all data could be transferred electronically, eliminating the need for paper-based reporting.

It is recommended that:

13. *AEP and AEUB establish a comprehensive, reliable and integrated SO_2 atmospheric source and emission data capture and reporting system. The system should use an acceptable electronic data information exchange standard that is compatible and can be integrated with collected ambient monitoring data.*

14. *AEUB and AEP establish an SO_2 emission forecasting system that provides emission forecasts on an ongoing and timely basis.*

15. *CASA institute mechanisms, such as Internet, symposium/workshop, etc., for ongoing information sharing among stakeholders.*

4.8 Future Opportunities

The proposed management system represents a different approach to dealing with air quality issues in Alberta. While it is designed to address SO_2 management, it is supportive of the broader air quality management goals of CASA and applicable to other air quality issues. The system approach recommended here may offer the same benefits of improved efficiency and cost-effectiveness in dealing with other issues as it does for the management of SO_2.

It is important, for reasons of efficiency and effectiveness, that similar approaches for SO_2 management be implemented at the local, provincial, and national levels. Consistency, information compatibility and sharing, and common goals and management objectives, are some of the benefits. It is in the interest of the stakeholders to work toward consistency in SO_2 management across the country. The work of the Project Team has already influenced work at the national level. For example, the National Acidifying Emissions Task Group is considering a similar system to address regional issues related to SO_2 management in western Canada.

Additional work also is required concerning the expression of environmental limits and desired performance levels and the management of gap between them. This is a very complex matter and an area for ground-breaking decisions because performance levels less than environmental limits have not been applied elsewhere in Canada. The Target Loading Subgroup discussed critical loads at length and provided a recommendation for an interim critical load as well as other recommendations. Alberta Environmental Protection should take this work to the next level and develop target loads. This work should be carried out using a multi-stakeholder process to ensure that all interests are considered.

In the final analysis, it is important that the work of the Project Team, as reflected in this report, be made available to all stakeholders and the general public. The Project Team trusts that CASA, in its role in addressing strategic issues in air quality in Alberta, will actively communicate the results and recommendations of this report to all stakeholders and the public.

It is recommended that:

16. *CASA assess and examine the potential application of the management system framework, recommended above, for the integrated management of air quality in Alberta.*

17. *CASA support stakeholder activities related to the examination and implementation of other management instruments, such as economic instruments, which could be applied to the management of SO_2 emissions.*

18. *Using the recommendations put forth by the Target Loading Task Group, AEP establish deposition guidelines for the province using the multi-stakeholder process identified in Recommendation 6.*

19. *Stakeholders work to ensure local, provincial, and national SO_2 management approaches and outcomes are complementary.*

20. *The CASA Board develop a strategy for communicating the results of this project to the stakeholders and the general public.*

5.0 EVALUATION OF THE PROPOSED SYSTEM

The goals of the SO_2 Management Project include ensuring the best use of resources in the management of air quality and seeking continuous improvements from both an environmental and an economic perspective. These goals will be achieved if the proposed system offers environmental and economic improvements over the current management system. Table 4 shows a comparison of the proposed system to the current system.. The Project Team carried out a preliminary evaluation, which compared the proposed management system to the current system using the criteria and principles discussed earlier. These comparisons indicated that, overall, the proposed system has the potential to satisfy the principles in its implementation. Although the current system functions well, the proposed system offers significant improvements in many aspects of SO_2 management including: environmental effectiveness, scientific and technical soundness, consistency, certainty, and flexibility. In addition, it takes a precautionary approach to SO_2 management.

The current SO_2 management system was designed over 20 years ago. It focuses on regulation of individual facilities and the use of technology to reduce SO_2 emissions and achieve emission requirements and ambient guidelines. It addresses sulphur dioxide management in a separate, but coordinated manner specific to the interests of Alberta Environmental Protection and the Energy and Utilities Board. The system has worked well but today's management needs are somewhat different. The proposed system takes a strategic approach that will result in an integrated approach to managing total SO_2 emissions rather than managing individual emission sources. The system approach has been developed by a consensus-based, multi-stakeholder process and will be implemented in a similar manner. This ensures that all interests in SO_2 management are considered. The recommendations call for improvements in the way information is gathered and shared and, when implemented, will result in a common information base for all stakeholders and a common basis for evaluation of performance and accountability in system implementation.

Within the proposed system, the goals for SO_2 management are explicit and, because of the consensus approach used to develop them, shared by the stakeholders. Under the current system, the goals for management often are unclear to various interests, in part because they are not specifically stated and in part because they are specific and different for various industrial sectors.

Consistent and explicit management objectives also are part of the proposed management system. Like the goals, these objectives were developed through a clearly-defined process with input from interested stakeholders and are designed to be responsive and adaptable to the changing needs for SO_2 management at a regional, national, and international level. The objectives are broader in scope, and more responsive and adaptable than the current approach.

Table 4: Comparison of Current and Proposed SO_2 Management Systems

	Current System	Proposed System
System Approach	C operation oriented C organization specific	C strategic C multi-stakeholder involvement C responsive to changes C integrated C common information C common basis for evaluation, performance and accountability
Management Goals	C implicit and unclear to others C organization specific	C explicit C shared goals
Management Objectives	C parameters: - fixed - narrow scope - implicit linkage to organization goals C process - *ad hoc* - inconsistent - limited and uneven	C parameters: - responsive - broader scope - explicit linkage to integrated goals - adaptable C process: - planned - consistent - clearly defined process for multi-stakeholder inputs
Management Options	C fixed C government driven C regulatory - rigid - facility specific	C ability to examine other options C multi-stakeholder process C explicit criteria for assessing and choosing options C regulatory - flexible - facility and regional C supplemented by voluntary initiatives C examine other management options
System Operation	C organization specific C independent	C clearly defined roles and responsibilities toward common goals and objectives C integrated and coordinated activities C preventative, flexible management levels below regional environmental limits
System Evaluation	C exclusive - internal - operational component only C reactive	C inclusive - multi-stakeholder - integrated (entire system) - cohesive (toward common goals) C continuous improvement C scheduled
Information	C *ad hoc* C discontinuous C compartmentalized C weak communication links C compliance focus	C linked to all components of system C responsive to management need C regular exchange C common C accessible C efficient exchange C cost-effective C management focus

They also provide an explicit link to the goals for the SO_2 management. In contrast, the current management system does not have clear, consistent, and explicit management objectives. Those which do exist usually are expressed as ambient guidelines or recovery guidelines which do not have a explicit link to organizational goals, are narrow in scope, and lack flexibility to respond to changing conditions or concerns.

The options to manage SO_2 emissions are fixed within the current system - government determines the most appropriate technology for emission control and lists these technological requirements in a facility's approval. Under the proposed system, there will be flexibility to examine other options through a multi-stakeholder process. Explicit criteria have been developed for assessing and choosing the options with the best fit for a situation. While the management of SO_2 emissions still will occur within a regulatory framework, the proposed system would provide more flexibility to deal with facility-specific requirements and regional issues. Regulatory tools may be supplemented by voluntary initiatives: other management options such as economic or market-based programs will be examined.

The proposed system also lays out clearly-defined roles and responsibilities for all stakeholders in the management of SO_2 emissions. Through the coordinating role of CASA, various air quality management initiatives will be integrated and coordinated to achieve common goals and objectives. The proposed system also will provide a flexible and preventative approach to SO_2 management with performance levels expected to be below the regional environmental limits.

Another key component of the proposed management system is evaluation. The proposed system is designed to include all stakeholders in system evaluation through a multi-stakeholder process. Under the current system, government agencies have exclusive responsibility for evaluation and operations usually are reviewed from an internal and strictly operational perspective. Evaluation would be scheduled on a regular basis and consider the overall, integrated system approach including the goal of continuous improvement in the management system.

Information and feedback are at the heart of the proposed system. The information system would have a management focus linked to all system components and responsive to management needs. There would be a regular exchange of information among all stakeholders, information will be more accessible in a common format from a shared database, and information systems will be more cost-effective. The current system often results in information being collected on an ad hoc, discontinuous basis. There are weak communication links among different agencies and users, and information collection often is compartmentalized with access to information difficult.

The Project Team anticipates that any increase in operational costs of the proposed system will be modest. It is difficult to estimate the cost implications of the proposed system but they are probably similar to the costs of the existing system. These costs should be considered when the individual management objectives are set. An anticipated advantage of the system is that the preventative, flexible management of SO_2 levels below regional environmental limits may create opportunities for cost savings in SO_2 management. It is also anticipated that the system framework approach, if incorporated into business planning, will provide opportunities for cost savings in other areas.

6.0 IMPLEMENTATION STRATEGY

Implementation of these recommendations will fall to the CASA Board, its stakeholders and the responsible government departments and agencies. The CASA Board has responsibility and accountability to:

- provide strategic direction and management objectives,
- oversee system evaluation,
- respond to recommendations for changes and improvements to operation of the system, and
- share information among CASA stakeholders.

Day-to-day implementation of the system will be the responsibility of Alberta Environmental Protection and the Alberta Energy and Utilities Board. The Project Team has recommended establishment of a multi-stakeholder group - a SO_2 Management Implementation Coordination Team - to coordinate implementation of the recommendations, provide evaluation, and report to the CASA Board on progress. Draft Terms of Reference for this Team are presented in Appendix 5.

It is envisioned that this Team will include representatives of the stakeholders that make up the CASA Board. The team would have three main functions: coordination of implementation, development of plans for voluntary initiatives, management of the differences between actual conditions and environmental limits, and evaluation of the system's effectiveness. The team should report to the CASA Board on implementation and evaluation at least annually for the first three years and once every five years on system evaluation. The Board would be responsible for ensuring that the stakeholders implement necessary changes to the management system. As part of its work, the implementation coordination team should develop an implementation plan for the use of voluntary initiatives as supplements to regulatory mechanisms in the management of SO_2 emissions. The Team also should recommend mechanisms to manage the difference between existing environmental conditions and desired performance levels.

Another key component of implementation will be development of numerical values for the proposed management objectives. The Project Team recommends that Alberta Environmental Protection and the Alberta Energy and Utilities Board establish a multi-stakeholder process to establish these values including deposition guidelines. These agencies also will be responsible for applying their approval processes so as to ensure that the objectives are achieved.

All stakeholders have a role in implementation by ensuring that their constituents are informed of the recommendations and support their implementation and ongoing evaluation of the system.

7.0 COMMUNICATION

The Project Team's recommendations call for the CASA Board to develop a strategy for communicating the results of this project to the stakeholders and the general public. This communication strategy should recognize the relationship between the management of sulphur dioxide and other CASA activities and provide a consistent framework for communications for all of these initiatives. The Project Team offers the following ideas for CASA's consideration.

The primary objective of communications should be to enhance awareness and understanding of and support for the success of the SO_2 management system. The management system should be promoted as a socially progressive, environmentally responsible, and cost-effective approach to SO_2 management and the environmental, economic, and social advantages of the system should be recognized.

The communication strategy should address three main target audiences: key stakeholders, key influences, and the general public.

Key Stakeholders

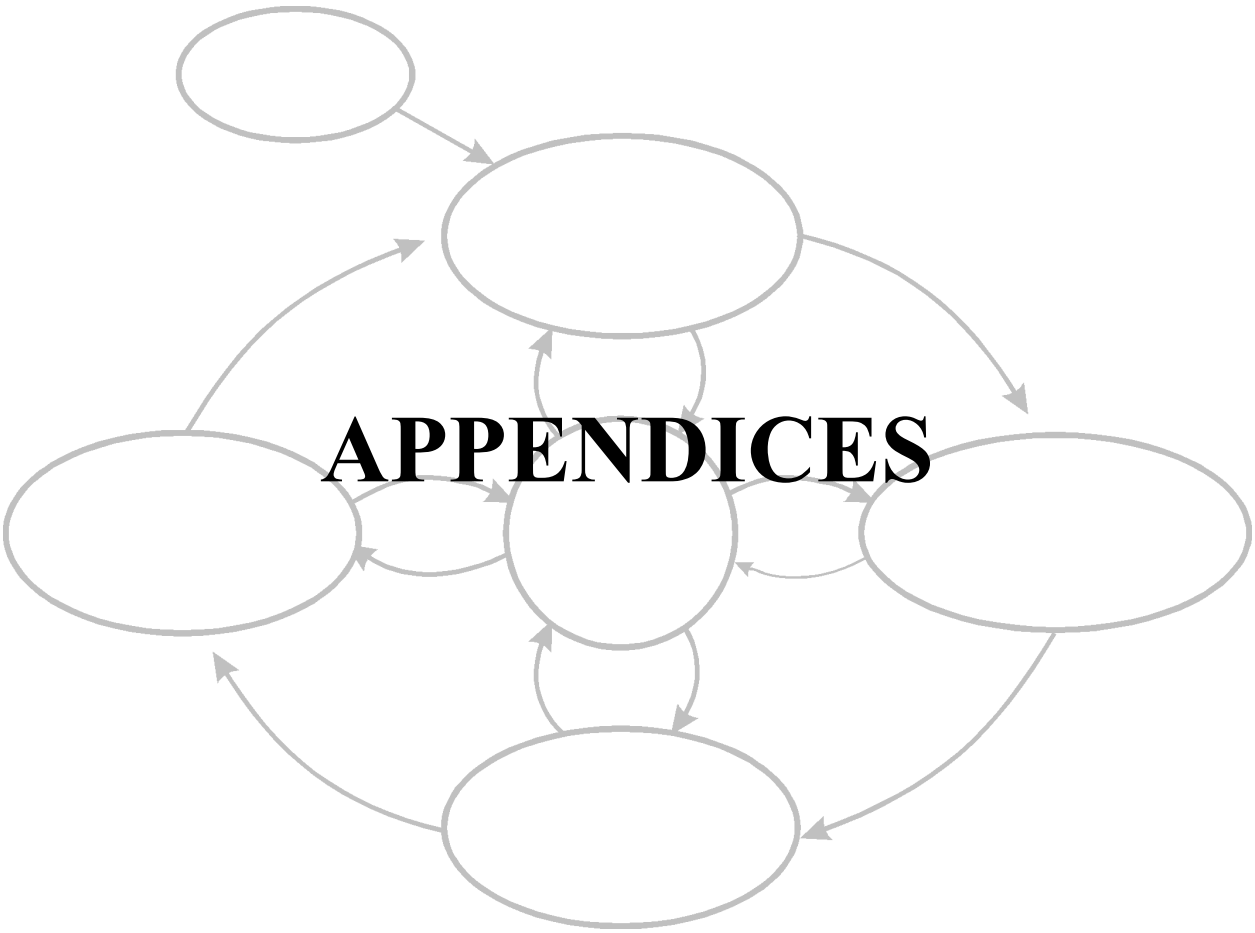
Key stakeholders are those who have been charged with roles in the management of SO_2 emissions. One of their prime responsibilities will be to provide an accurate and consistent accounting of the status of the system and its implementation. To facilitate this process, materials are required, on a timely basis, for the use in carrying the message back to their respective organizations. These key stakeholders include: the CASA Board, participants in other CASA initiatives, government departments, industry associations, and non-government organizations represented on the Project Team and on CASA.

Key Influences

There are several groups, associations and organizations that have an interest in the outcome and can influence the progress and direction of SO_2 management. These key influences require accurate data and a timely understanding of the status of SO_2 management. The key influences include: education, forestry, local authorities, business groups such as the Chamber of Resources, and chambers of commerce, academia and research-oriented organizations, community groups, boards of health and health units, First Nations and Metis people, environmental non-government organizations (ENGOs), and non-represented federal and other provincial government departments.

General Public

The SO_2 management system is to be, an open, inclusive process that values the interest and constructive opinions of the general public. The goal should be to ensure that accurate and timely information is disseminated to as wide a range of citizens as possible and that a workable mechanism is put in place to engage the general public at appropriate times to participate in the implementation of the proposed management system.



APPENDICES

Appendix 1. SO_2 Management Project Team. Terms of Reference.

SO_2 MANAGEMENT PROJECT TEAM

Preamble to Terms of Reference:

Justification of work proposed by the SO_2 Management Group

The current SO_2 management system in Alberta has its roots in the 1950s. Pursuit of the goal of a nonrenewable resource conservation in this period resulted in reduced sulphur emissions. The SO_2 management system developed in the 1960s and 70s was based mainly on the goal of environmental protection through license standards and compliance. While this SO_2 management system has been able to adapt and react to accommodate many stakeholders' concerns, and has resulted in continuous improvement in sulphur dioxide control, there still remain outstanding issues. The issues and concerns of Alberta stakeholders were presented to you in our May 1994 submission; the working group agreed and the following summarizes these issues:

1. There is concern regarding damage from existing acid deposition levels in Alberta and damage from increased emissions.
2. The existing SO_2 management system may not enable us to respond efficiently to national and international commitments.
3. The existing SO_2 management system may not be as cost-effective as alternative systems.
4. Some approaches to SO_2 management may cause or exacerbate other environmental problems such as climate change.

The SO_2 Management Project Task Force believes that as part of CASA's mandate, it is necessary to show leadership in this area by developing a comprehensive system for management of SO_2 in Alberta. This comprehensive management system will include: (see diagram)

- deign a process to establish/reaffirm short-term and long-term objectives based on the above stated issues,
- design a process for evaluation and selection of the best management instruments/options,
- provide a basis for implementation of the group's recommendations,
- ongoing assessment and evaluation of results, and
- have a process to incorporate new information on an ongoing and/or periodic basis.

Approved by CASA Board February 1995

CASA
SO_2 MANAGEMENT PROJECT TEAM

Terms of Reference

Purpose of the Project Team:

To recommend a comprehensive system for managing SO_2 emissions within the Province which addresses stakeholder issues and concerns.

Project Team Objectives:

To determine:

- the issues and concerns with the current system of management,
- the management objectives for SO_2 in Alberta,
- the range of instruments available for management of SO_2 emissions, and
- the most effective and efficient system for SO_2 management.

Timeline:

The project team will work to develop final recommendations for presentation to the CASA Board by June 1996. (A detailed timeline and critical path is attached.)

Budget:

To complete the work of the project team, it is estimated that expenditures will total approximately $165,000. In-kind contributions of the participating partners are estimated to be valued at approximately $450,000. over the 18 month period of the project. (A preliminary budget is attached.)

Key Deliverables / Anticipated Results:

- SO_2 management symposium,
- interim SO_2 management strategy,
- SO_2 management objectives for short and long-term,
- final report on the evaluation and selection of SO_2 management instruments, and
- recommendations to the CASA Board for a comprehensive system for SO_2 management.

Approved by CASA Board February 1995

Steps (not necessarily sequential):

1. Determine both the issues and concerns of stakeholders, and the scientific understanding relating to SO_2 management in Alberta.

Tasks:

1.1 Gather and compile issues and concerns around SO_2 management in the Province from all relevant stakeholders and report on these to the CASA Board.

- *Deliverables:*
  - compiled issues statement from relevant stakeholders
    - *COMPLETED* (presented to CASA Board May, 1994).

1.2 Host or participate in a symposium on SO_2 management which covers both science and policy related issues. This symposium would be most effective if combined with other issues into a larger symposium on air issues, hosted by CASA.

- *Deliverables:*
  - SO_2 management symposium
    - to be held in the fall of 1995 (October) or spring of 1996.
  - Proceedings from symposium.

2. Determine the objectives for SO_2 management in Alberta
Cost: $83,000.

Tasks:

2.1 Review the current SO_2 management objectives for Alberta.

2.2 Develop a process for establishing an interim SO_2 management strategy for Alberta.

Project team would host a one-day multi-stakeholder workshop to review the planning basis and to make recommendations for developing an interim SO_2 management strategy.

- *Deliverables/Achievements:*
  - Interim SO_2 management workshop
    - report on the results and recommendations,
    - workshop planned for February - March 1995.

2.3 Develop an interim SO_2 management strategy for Alberta.

An interim SO_2 management strategy would determine what needs to be done within the existing SO_2 management framework in the interim before the project team has made recommendations to address its objective of developing a comprehensive management system.

- *Deliverables:*
  - recommendations to the CASA Board for an interim SO_2 management strategy and implementation plan
    - for April 1995 CASA Board meeting.

2.4 Determine a set of short and long-term objectives for SO_2 management in Alberta based on an agreed upon process to support SO_2 management objective setting.

- *Deliverables:*
  - a recommended set of short and long-term SO_2 management objectives
    - by May 1996.

3. Determine and assess the range of instruments available for managing SO_2 emissions in Alberta, including those under the current system.
Cost: $20,000.

Tasks:

3.1 Compile, list, and understand the available management instruments.

3.2 Develop criteria for assessing available SO_2 management instruments and options, based in the approved principles.

3.3 Assess management instruments, or groupings of instruments - as options, against the established criteria and principles.

3.4 Report to the CASA Board on the results of the assessment of management options, including the assessment criteria, for use in this and other CASA initiatives.

- *Deliverables:*
  - preliminary report to the CASA Board on the results of the assessment
    - by September, 1995
  - recommended set of management instruments (options) for the Alberta SO_2 management system
    - by March, 1996.

3.5 Assess and determine the need for field testing of selected management options.

- *Deliverables*
  - if a need is determined - a recommendation to the CASA Board to scope and undertake a pilot testing project in Alberta.

4. To recommend a comprehensive system for managing SO_2 emissions within the Province which addresses stakeholder issues and concerns.
Cost: $22,000.

Tasks:

4.1 Develop a process for the ongoing or periodic integration of new information into the SO_2 management system for Alberta.

4.2 Develop a process to support current, ongoing, or periodic SO_2 management objective setting.

4.3 Develop a process to support the periodic assessment and evaluation of the management instruments that are used in the SO_2 management system.

4.4 Compile and integrate the component parts of the preferred SO_2 management system, as developed under items 1,2, and 3 above, including:
- stakeholder issues and concerns;
- the state of the science;
- processes for:
  - integrating new information,
  - objective setting,
  - evaluating the effectiveness of the instruments,
- the management of objectives; and
- the recommended management options.

4.5 Report to the CASA Board on recommendations for a comprehensive SO_2 management system for Alberta.

- *Deliverables:*
  - final report and recommendations to the CASA Board
    - by the end of June, 1996.

Appendix 2. Executive Summary. Symposium Workshops. Acidifying Emissions in Alberta Workshop. April 15 - 17, 1996. Red Deer, Alberta.

A series of 16 workshops was held to address issues and questions submitted by the Clean Air Strategic Alliance's (CASA) project teams, working groups and resource groups. Each delegate participated in two workshops; delegates chose the workshops of interest to them. Discussions, which took place during the workshops, were recorded by a facilitator and by a scribe. These notes were transcribed into poster presentations, and from these, the workshop summaries were generated.

The symposium steering committee has considered these summaries, recommendations and suggestions in the context of the symposium as a whole, and submits the following recommendations to the CASA Board of Directors:

- it is recommended that the CASA Board of Directors establish a strategy for communicating the air quality-related research needs which support management priorities to the research community in Alberta.
- it is recommended that the CASA Board of Directors consider the use of symposia and workshops as a means of facilitating communication between scientists and managers.
- it is recommended that the CASA Board of Directors support strategies to raise awareness of CASA and its initiatives, especially among stakeholder groups who are not presently involved in CASA.
- it is recommended that issues relating to air emissions and animal health be addressed within the CASA process.
- it is recommended that these proceedings, summaries and recommendations be forwarded by the CASA Board of Directors to the CASA project teams, working groups, and resource groups for their consideration, use and, if appropriate, implementation.
- it is recommended that the CASA Board of Directors direct the secretariat to periodically review the progress made in addressing and implementing these recommendations.
- it is recommended that the future steering or organizing committees of symposia consider including the following components in future symposia:

    *a presentation at the beginning of the symposium about CASA and the issues faced by CASA's project teams, working groups and resource groups.
    * a convener to assist the committee in completing the multitude of tasks associated with organizing this symposium.
    * a lead facilitator, both to organize workshop facilitation and to provide a consistent level of facilitator training and orientation, for any gathering which includes workshop components.

Appendix 3. Executive Summary. Interim SO_2 Management Workshop. Terratima Lodge, Alberta. April 3 and 4, 1995.

The purpose of the workshop was to develop, within the existing SO_2 management framework, an interim strategy for Alberta. This strategy was to consist of a series of actions that could be implemented in the near term (2-3 years).

Through consensus, the participants developed a number of actions that could be readily implemented within the interim time frame. A number of action items were also identified that would require a longer period for implementation. These longer-term actions are recorded in the appendices of the full report along with action suggestions that did not necessarily achieve consensus.

The recommended actions to be implemented as part of the interim SO_2 management strategy are:

C Management System

- develop and accelerate the identification of objectives for the longer term SO_2 management strategy which will take a comprehensive, integrated, coordinated, and possible impact-focused approach.

C Environmental Objective Setting

- establish a task group to review/assess acid deposition target loadings for Alberta,
- determine, and take action on the implications to Alberta of National Acidifying Emissions Task Group (formerly, Acid Rain Task Group) air initiatives,
- understand the links between the SO_2 Project Team and other CASA project teams, and
- determine public involvement/communication strategy.

C Instruments/Actions/Implementation

- develop a formal voluntary SO_2 recovery program,
- issue a "general bulletin" to industry, identifying acid gas injection as a means of emission abatement and the expectation that this option be fully investigated for the application process,
- identify barriers to plant consolidation, try to enhance plant integration, and preclude plant proliferation,
- explore opportunities to coordinate development plans to reduce temporary flaring and test well flaring,
- examine opportunities to improve economic signals for efficiency through royalty shifting upstream, and other options, and
- solution gas conservation.

C Assessment/Monitoring/New Information

- develop a task force to scope out an electronic data management system,
- deliver a timely, comprehensive, annual package of emissions and forecasting,
- identify the need for receptor-based monitoring, and
- identify ongoing existing receptor data, and make accessible.

C Investigate/Develop Protocols for Short-term SO_2 Concentrations and Costs

- establish protocols for wet and dry deposition monitoring and costs,
- support a literature review update to Acid Deposition Research Program (ADRP),
- develop and maintain an ongoing short list of SO_2 related research projects for researchers, and
- scope-out a process for ongoing tracking of Environmental Impact Assessment (EIA) predictions with post-project implementation assessments.

Appendix 4. Final Report of the Target Loading Subgroup on Critical and Target Loading in Alberta. June 1996.

and

Scientific Appendix to the Final Report of the Target Loading Subgroup on Critical and Target Loading in Alberta. ***(Available from the Clean Air Strategic Alliance)***

Appendix 5. SO_2 Management Implementation Coordination Team. Draft Terms of Reference

A multi-stakeholder Team to be established that could include the following stakeholder groups:

Alberta Energy
Alberta Environmental Protection (Air and Water Approvals)
Alberta Energy and Utilities Board
Agriculture (Alberta Cattle Commission)
Canadian Association of Petroleum Producers
Coal Association of Canada
Electrical Utilities
Environmental Non-Government Organizations
Fertilizer Industry
Municipalities

Purpose of the Implementation Coordination Team:

1. Co-ordinate the implementation of the SO_2 Management Project Team recommendations,

2. Develop plans for (a) voluntary initiatives for enhanced performance and (b) management of the differences between actual conditions and environmental limits, and

2. Evaluate and report on the implementation of the recommendations and the effectiveness of the enhanced SO_2 management system.

Schedule:

The implementation coordination team will work toward having the proposed SO_2 management system and the implementation of the SO_2 management project team's recommendations completed within three years. The team will report to the CASA Board annually the first three years on the implementation and the effectiveness of the enhanced SO_2 management system and once every five years on the evaluation of the SO_2 management system.

Key Deliverables/Anticipated Results:

1. The SO_2 management project team's recommendations are in place.

2. Reports to the CASA Board on the progress of implementing the recommendations and the evaluation of the SO_2 management system as scheduled.

Tasks:

1. Coordinate the actions of the designated agencies and organizations in implementing the revisions to the system.

2. Evaluate the implementation of the recommendations and performance of the management system against the defined management goals and objectives of the system.

3. Investigate, evaluate and recommend mechanisms to manage the difference between existing environmental conditions and environmental limits to ensure a preventative approach is taken to the ongoing management of SO_2.

4. Design, evaluate and develop an implementation plan for use of effective voluntary initiatives as supplements to the core regulatory mechanism to encourage and promote enhanced performance.

5. Report to the CASA Board as scheduled.

Approved by CASA Board February 1995