

THE UNIVERSITY OF MANITOBA

LAND-USE PLANNING IN THE
VICINITY OF CANADIAN AIRPORTS

by

DONALD H. DRACKLEY

A THESIS

SUBMITTED TO THE DEPARTMENT OF CITY PLANNING
IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF
MASTER OF CITY PLANNING

DEPARTMENT OF CITY PLANNING

WINNIPEG, MANITOBA

OCTOBER, 1980

LAND-USE PLANNING IN THE
VICINITY OF CANADIAN AIRPORTS

BY

DONALD HERBERT DRACKLEY

A thesis submitted to the Faculty of Graduate Studies of
the University of Manitoba in partial fulfillment of the requirements
of the degree of

MASTER OF CITY PLANNING

©v1980

Permission has been granted to the LIBRARY OF THE UNIVER-
SITY OF MANITOBA to lend or sell copies of this thesis, to
the NATIONAL LIBRARY OF CANADA to microfilm this
thesis and to lend or sell copies of the film, and UNIVERSITY
MICROFILMS to publish an abstract of this thesis.

The author reserves other publication rights, and neither the
thesis nor extensive extracts from it may be printed or other-
wise reproduced without the author's written permission.

PREFACE

The importance of air transportation on a national and international scale is an indisputable fact, but at the same time it must be admitted that the impact of airport activities has raised substantial questions concerning their desirability in urban or rural areas. The problems of noise, property devaluation and land use control, for example, have only recently been considered. As a result, this thesis will address itself to land-use planning in the vicinity of airports. It is hoped that by reviewing problems and analysing present responses, alternative land-use planning techniques may be suggested which recognize the symbiotic relationship of airports and surrounding areas.

The disturbances caused by airport operations adversely affect those who live or work in the immediate vicinity. Unless these disturbances are solved or substantially ameliorated, the problem also threatens to stifle the development of air commerce itself. If the rising concern for the environment is any indication, the result may well be the banning of airports from economically attractive, convenient urban sites, to more distant rural areas. Conversely, the expansion of aviation facilities, especially within urban areas, has resulted in additional restrictions in respect to the use and occupation of private lands in the airport vicinity.

The potential effects and consequences of airport-related problems on the adjacent community, air safety and air commerce dictate that the control of land use throughout the area of airport influence is essential. In Canada, existing federal airport-related legislation generally prescribe height limitations and restrict hazardous uses or devices within the airport boundary and formally-defined adjacent property. However, the vast majority of airport-related legislation in this country contains no

provisions which would restrict specific types of land uses, proven to be incompatible with airport operations, from developing adjacent to airports. This responsibility has been shared by local and provincial governments, along with the private development sector, resulting in inadequate correlation with the existing or potential interests of the airport.

The intent of this investigative, or project-oriented thesis is to review existing airport zoning powers in terms of overall urban and regional development planning, and to investigate potential methods of regulating and controlling land use in the vicinity of Canadian airports. These methods will then be systematically analysed, in terms of effective land-use planning, as they affect airport operations, peripheral protection, and overall development planning.

The main acknowledgment for assistance with this thesis goes to the staff of the Winnipeg Area Airports System Study, Transport Canada, where initial theories and project directions were tested, and final methodologies developed. Special recognition is directed to Mr. H. Bell, Project Director, and Mr. H. Taylor, Airports Specialist, who provided the author with an indispensable library of technical data and a practical, airport-related working environment.

Structural assistance was provided by the thesis advisor, Professor M. Carvalho of the City Planning Department, University of Manitoba, who also assisted in the initial theory development and refinement. Similar recognition is offered to Professor R. Foster of the Geography Department, who acted as the major reader of the thesis and made specific recommendations regarding format and style.

TABLE OF CONTENTS

	Page
PREFACE	ii
Table of Contents	iv
Table of Figures	vi
Chapter	
I. INTRODUCTION	1
The Airport/Community Interface	2
The Off-Airport Planning Problem	10
Table of References	13
II. A REVIEW OF OFF-AIRPORT PROBLEMS AND CONCERNS	14
Environmental Concerns	14
Land-Use Planning Problems	18
Table of References	26
III. TECHNIQUES TO CONTROL OFF-AIRPORT LAND USE	27
Airport Related Legislation	27
Environmental Control Regulations	32
Land-Use Control Techniques	42
Distribution of Off-Airport Land Use	49
Airport/Community Comprehensive Planning	51
Table of References	54
IV. ALTERNATIVE OFF-AIRPORT PLANNING TECHNIQUES	55
Provincial Legislation and Special Zoning Powers of Provincial Government	57
Airport Vicinity Protection Areas	58
AVPA Administration	60
AVPA Land Use Schemes	62
Local Zoning Bylaws	63
Tripartite Planning	67
Edmonton Area Aviation Master Plan Study	69
Winnipeg Area Airports System Study	72
Land Ownership by the Airport Authority	77
Federal Legislation	81
Table of References	88
V. CONCLUSIONS	89

	Page
APPENDIX A - Airport Operational Guidelines	100
APPENDIX B - Examples: Land Use Compatibility Matrix	110
SELECTED BIBLIOGRAPHY	136

TABLE OF FIGURES

Figure		Page
1.	Passenger Aircraft Capacity Growth Trend	7
2.	Takeoff and Landing Field Length Trend	8
3.	Landside/Off-Airport Interaction: Edmonton Municipal Airport	19
4.	NEF Zones - 1979 Edmonton International Airport	36
A.1.	Flight Interference and Obstruction Clearance Areas	102
A.2.	Clear and Airport Hazard Areas	103
A.3.	Typical ILS System Site Configuration	105
A.4.	Bird Hazard Areas Winnipeg International Airport	107
A.5.	Airport Operational Zones (Airport Control Areas)	108

CHAPTER I

INTRODUCTION

An airport coexists in an intricate relationship with the community or region in which it is located. Over the years, historical, economic and political decisions have led to development in and around airports. At one time, most existing Canadian airports were located on the outer fringe of urban development, with few adjacent residences or non-agricultural land uses. Following World War II, an increase in civil air traffic coincided with rapid urbanization. Consequently, what was once an airport on the fringe of a city became an "airport in the city", surrounded by intensive urban development. This set the stage for a range of problems involving environmental, ecological, economic and social issues.

Efforts toward compatibility of the airport with its environs can be undertaken by proper airport planning, control of pollution generating sources, and proper off-airport land-use planning.¹ The purpose of such planning is to maintain or create an airport/community interface which protects the needs of the airport while providing for the requirements of the adjacent community and ecological environment. Only in this way will the future viability of the airport within an urban or rural setting be preserved.

Because of the potential social and economic impacts generated by the airport activities, airport planning must be recognized as an integral

part of the overall comprehensive planning area in which it is located. All physical aspects of airport operations must be coordinated with existing and potential patterns of adjacent residential, commercial, industrial, agricultural and recreational land use. Conversely, the growth and development of these community areas in the vicinity of an airport must reflect present and future airport operations. Planning of compatible airport/community relationships is a proper description of the process necessary to achieve an optimum relationship between an airport and off-airport land uses.²

It is the intent of this thesis to review existing Canadian airport zoning powers and operational regulations in terms of providing compatible airport/community relationships, and to investigate potential methods of regulating and controlling off-airport land use. The thesis will examine the hypothesis that existing airport zoning legislation and operational regulations have little effect in ensuring that off-airport land use is physically, socially and economically compatible to airport operations. Not only will existing control mechanisms be critically evaluated, but alternative techniques to provide land use compatibility will be investigated in terms of airport operations, peripheral protection, overall development planning, implementation and consequences.

The Airport/Community Interface

The existence of airport facilities and operations generates many significant physical, social and economic externalities on surrounding areas. The interface between airport operations and local industrial, commercial and residential land use results in both desirable and undesirable externalities.

Where airport operations are found to be incompatible with adjacent

off-airport land uses, the undesirable externalities involved often contribute to economic and social costs. Such externalities usually are a direct result of airport noise. For example, existing theories of noise effects hold that residential land use adjacent to airports creates an incompatible interface. Although airport noise levels are presently subjected to many control measures involving aeronautic engineering and design, restrictive flight procedures, and buffering techniques, there remains in many cases an unacceptably high level of noise exposure. In these cases, the economic impact of airport noise on residential property is often said to be reflected in a market depreciation of residential land values.

At least one recent study tends to discount the depreciation theory. The average selling price of residential property in each Noise Exposure Forecast (NEF) contour surrounding the Winnipeg International Airport failed to indicate a correlation between noise intensity and market sale price.³ An associate survey of social concerns and attitudes revealed that 63 per cent of residents questioned thought that their property value had remained constant.⁴ The survey also indicated that although 88 per cent of respondents were satisfied with their location, dissatisfaction with airport externalities such as noise and accident potential did exist in relation to the noise zone and proximity involved.⁵

The results of both the social concerns study and the economic significance study do not correlate with theories which define property devaluation and social concern as factors of negative airport impact. However, social concern studies and resident complaint statistics indicate that negative resident perceptions of airport operations increase or

decrease in direct proportion to the distance from the airport. It must also be noted that the Winnipeg study did not include quantitative comparisons of residential sales transactions, down zoning or land-use changes which might reflect social dissatisfaction with off-airport residential areas, or a filtering-down effect of uses within such areas.

A similar comparative analysis of the residential land-value situation in the vicinity of Toronto International Airport concluded that residential property values tend to fall during times of airport operational or facility expansion.⁶ Once noise-avoiders have sold their homes, property values return to comparable levels with unaffected property. The study concluded that while land values in affected areas are not depreciated over the long-term, occasional depressions occur as the type of resident and the land-use pattern shift toward an optimum state.⁷

It is common to assume that interface incompatibility is a direct result of airport operational factors alone, especially noise. However, certain adjacent off-airport land uses are found to be compatible with airport activities. Most industrial and manufacturing land uses in close proximity to airports are generally compatible since aircraft noise has little perceivable affect on their operations. Problems arise only when dense smoke, electronic interference or lights from these activities obstruct or confuse normal airport operations and navigation. In addition, certain agricultural uses, such as the cultivation of seed crops, may be incompatible with an adjacent airport because large numbers of birds often are attracted. Finally, the accident potential on residential land use below aircraft glide-paths has resulted in the enactment of aircraft operational guidelines. The aviation profession has voiced concern over such constraints since they tend to increase

take-off and landing risk. Therefore, in terms of aviation safety, both aircraft operations and proximal residential land use contribute to an undesirable interface.

When the relationship between an airport and adjacent community or area is operationally and socially compatible, a number of beneficial externalities are generated. The urban airport acts as a necessary element of the city's economic health through it's servicing of local primary and secondary industries. Local commercial enterprise also benefits from the availability of a major transportation terminus and increased business traffic, the access which is offered to otherwise inaccessible areas, and the employment opportunity demands.

The creation of additional employment at an airport generally has a multiplier effect by stimulating local employment. This multiplier seems to have two areas of effect: population and income. The effect of increased airport-related employment opportunities can lead to increased local population if the area's labour force cannot fill the employment positions. In addition, spending by the airport industry, its employees and associated population tend to stimulate further employment through support of local business. This in turn may result in demands for new housing, and community and social services. In summary, certain Canadian cities and regions find that the positive economic benefits of the urban or suburban airport tend to overshadow the negative aspects within the adjacent community.⁸

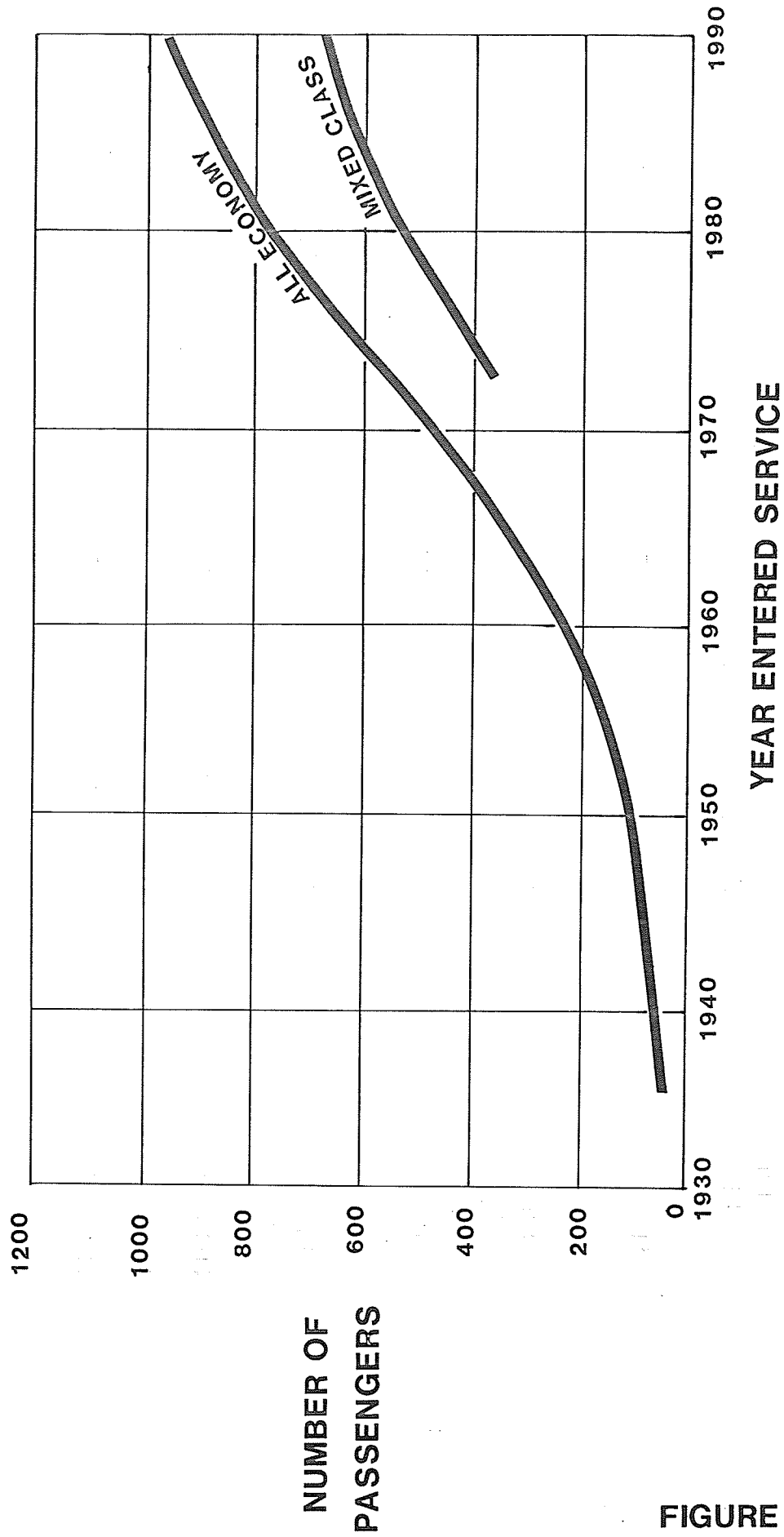
Since airport and community coexist in a complex relationship, certain demands may be generated by the community on the airport. Aviation and aviation-related operations have been adversely affected by organized citizen protest regarding the effects of airport activities on adjacent residential land use. The expansion of airside or groundside facilities

beyond existing airport boundaries may conflict with urban growth in the adjacent community. It is therefore incorrect to assume that all economies and diseconomies involved in the airport-community interface originate from the airport.

Reliance on an improved airport-community interface and reduced externalities through lower rates of air traffic does not seem a plausible approach to the problem. Present aircraft development activity remains subdued due to depressed air travel demand, the shortage of large-scale development capital and the establishment of new aircraft types.⁹ However, existing commercial airline fleets will be progressively phased out by the year 2000, with replacements coming from current subsonic aircraft designs, short-haul aircraft development, and the introduction of supersonic transport.¹⁰ The growth trend in passenger aircraft capacity, reflecting confidence in future passenger demand, will increase dramatically over the next 20 years, as illustrated in Figure 1. As an answer to uneconomical lengthening of runways at existing airports, Figure 2 indicates a stabilization in the trend toward longer take-off and landing distances. This levelling-off in the trend of longer take-off and landing distances can mainly be attributed to increased engine thrust and wing lift. Improved third-generation air traffic control systems at large and medium-sized airports will also facilitate increased airspace capacity.

In terms of air passenger traffic, forecasts are highly dependent on the state of the national, regional and local economies. In the past, air fares decreased relative to the overall cost of living, but the rapidly increasing price of oil in the 1970's altered this trend. Aviation officials agree that the recent major price rises were a singular event, and increases of similar magnitude will not occur again.¹¹ Airline costs in general are expected to follow the rate of inflation, and therefore

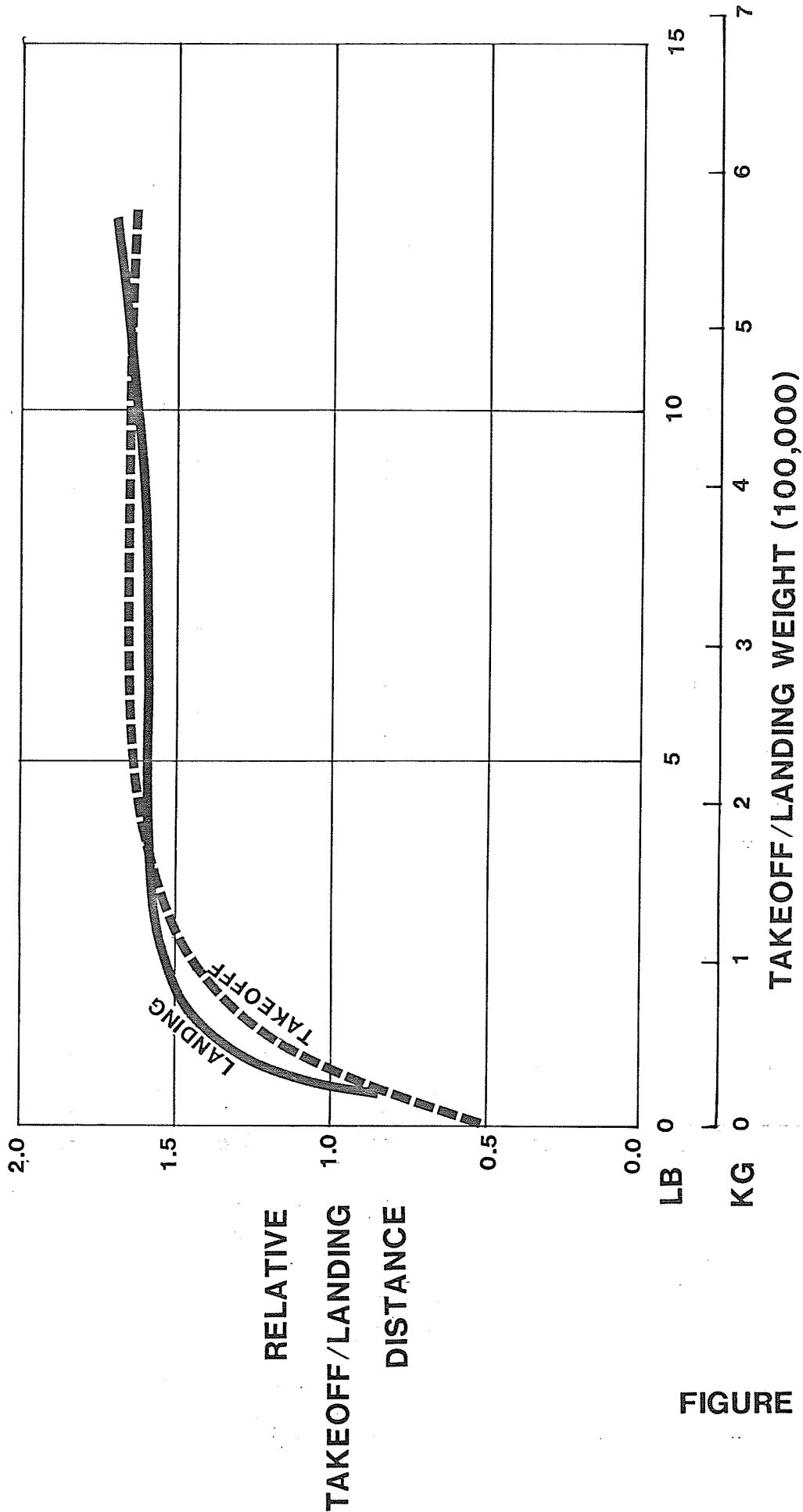
PASSENGER AIRCRAFT CAPACITY GROWTH TREND



SOURCE: TRANSPORT CANADA AND
AEROSPACE INDUSTRY ASSOCIATION OF AMERICA

FIGURE 1

TAKEOFF AND LANDING FIELD LENGTH TREND



SOURCE: TRANSPORT CANADA AND AEROSPACE INDUSTRY OF AMERICA

FIGURE 2

fares should increase at roughly the same rate as the rest of the economy.

The increase in unit costs and fares, coupled with a slower increase in disposable income for certain socio-economic segments of the population could result in decreased air passenger growth rates. A strong trend is also expected toward increased unit sizes, at the expense of flight frequency, in order that airlines can minimize cost increases.¹²

A recent study of the aviation industry to the year 2000, conducted by the Federal Aviation Administration (FAA) in the United States, indicated that overall aircraft noise will continue to be a major constraint on the growth of air transportation. This situation is expected to continue until the impact of newer aircraft, which meet stringent noise standards, is experienced in the 1990's.¹³ The same study forecasts that by the year 2000 the maximum increase in revenue passenger miles will be five times the 1974 total. Cargo revenue will grow at least six per cent per year for the remainder of the century. Finally, with moderate to high economic growth, new conventional aircraft of the 1000 passenger class, and 150 passenger jet STOL (short take-off and landing) will form a small percentage of the air carrier fleet by 2000.

The basic conclusion to be gained from the majority of recent forecasts of air traffic to the year 2000 is that aviation will continue to expand. However, future growth will proceed at much more conservative rates than have been experienced in the past 20 years.

The potential for a gradual but relatively constant increase in aviation activity in the next 25 years dictates that improved off-airport land-use control techniques must be implemented. The existing conflict within the airport-community interface must be alleviated or the airport will increasingly be viewed as a totally incompatible urban land use.

Associated problems may amplify to a state where existing technology and regulations will offer little solution, and the economically sensitive alternative of relocation will become the singular means of conflict alleviation. Also lost will be the advantages and economies offered by airport location within the community. Shifting socio-economic parameters may stimulate or depress specific aviation activities, but the entire field of air transportation seems destined to remain an integral part of the national transportation network. Subsequently, the aviation terminal, whether in the rural or urban setting, will continue as the prime component of the national or regional aviation system. How to properly plan and control development in the vicinity of these major airports represents an important new challenge to planners, urban specialists, and local officials.

The Off-Airport Planning Problem

In the past, airports have been developed and expanded in accordance with specific economic and transportation principles. Airport planning has typically been independent of other elements of planning. At the same time, municipal officials have seldom viewed the airport as a special land use. Although municipalities register airport zoning regulations in accordance with federal legislation, the affected off-airport lands are usually assigned a typical urban land-use designation which does not reflect the externality impacts of the neighbouring airport. In addition, the airport property itself tends to be zoned at the local level as a combination of manufacturing, industrial or agricultural designations. Only the Planning Act of Alberta contains legislation for the enactment of airport protection zones which provide compatible off-airport development.¹⁴

The impact of adjacent urban or suburban development on airport operations has been controlled to some extent by the federal airport

legislation found in the Aeronautics Act. This Act, which will be examined in greater detail in the following chapter, authorizes the Minister of Transport to regulate height, use and location of buildings and structures not only on airport property, but on certain lands adjacent to airports. The problem is that these regulations only apply for purposes relating to aircraft navigation and airport operation. Therefore, the resultant operational zoning affecting off-airport lands beneath runway approaches does not control the type or extent of development in the more general vicinity of the airport. This responsibility has been shared by local and provincial governments, along with the private development sector, resulting in inadequate coordination between adjacent development and the existing or potential interests of the airport.

Most cases of community concern over airport operations coincide with a strong disregard for the need to provide a compatible buffer of non-residential development between airports and adjacent residential areas. In this regard, the common approach is for the involved municipality to pass, by authority of the Aeronautics Act, zoning regulations which usually restrict building heights for the protection of runway approaches. Unfortunately, where airport operations adversely affect the surrounding environment, the federal government once again does not have, at this time, the authority to zone for appropriate buffer uses. It must rely on the provincial and municipal levels to adopt appropriate airport protection legislation and zoning. As stated previously, only one province has implemented such legislation, allowing local governments to control overall land use in the vicinity of airports. Fortunately, a bill to amend the Aeronautics Act to protect federal airports and airport sites from urban development encroachment where provincial authorities are

unwilling or unable to act has been introduced in Parliament.

The importance and growth of air transportation will remain a constant factor of our society in the projected future. It must also be admitted that the impact of airport activities has raised substantial questions concerning their desirability in the urban or suburban setting. The problems of noise, operational interference, property devaluation and land-use planning have only recently been considered.

Delegates at the eighth Air Navigation Conference of the ICAO (International Civil Aviation Organization) identified five specific measures worth examining as means of alleviating or reducing the conflicts within the airport/community interface. These measures involve the following approaches:

- 1) locating and orienting runways such that aircraft operations over populated areas are avoided;
- 2) introducing new aviation taxiing, take-off and landing techniques which would minimize noise exposure to the surrounding environment;
- 3) controlling the location and times of aircraft testing and scheduled flight operations;
- 4) implementing advanced aviation technology which would suppress aircraft noise;
- 5) practicing effective land-use planning in the vicinity of airports.¹⁵

To ensure that the advantages offered by aircraft noise certification, retrofit and noise-abatement operational techniques are not negated, the final issue of effective land-use planning must become a central component of all programs designed to improve the airport/community interface.

TABLE OF REFERENCES - Chapter I

1. International Civil Aviation Organization, Airport Planning Manual Part 2: Land Use and Environmental Control, Montreal: 1977, p. 2-1.
2. Ibid.
3. Transport Canada, A Study of the Economic Significance of Winnipeg Area Airports, Winnipeg: Winnipeg Area Airports System Study, August, 1976, p. 8-19.
4. Transport Canada, Social Concerns and Community Characteristics Study, Winnipeg: Winnipeg Area Airports System Study and the University of Manitoba, 1976, p. viii.
5. Ibid.
6. R.W.Crowly, The Effects of an Airport on Land Values, Ottawa: Ministry of State for Urban Affairs, 1972. p. 2.
7. Ibid.
8. Transport Canada, A Study of the Economic Significance of Winnipeg Area Airports, p. 8-23.
9. Transport Canada, Technological Implications for the Future Winnipeg International Airport, Winnipeg: Winnipeg Area Airports System Study, May, 1976, p. 7.
10. Ibid.
11. Transport Canada, Aviation Forecasts and Projections, Winnipeg: Winnipeg Area Airports System Study, 1976, p. 9.
12. Ibid., p. 10.
13. Department of Transportation, Aviation Futures to the Year 2000, Washington, D.C.: Federal Aviation Administration, February, 1977, pp. 3-4.
14. Province of Alberta Planning Act, Alberta Regulations 291/75: Airport Vicinity Protection Area General Regulations (pursuant to Section 93.2(1) of the Planning Act).
15. International Civil Aviation Organization, "ICAO Conference Identifies Measures to Improve the Aerodrome Environment", ICAO Bulletin, July 1974, p. 9.

CHAPTER II

A REVIEW OF OFF-AIRPORT PROBLEMS AND CONCERNS

A review of pertinent case studies and existing literature suggests two major focal points within the wider topic of off-airport land-use planning concerns. The first area of concern includes general airport operational problems which can be classified as environmental in nature and effect. The second sub-topic contains land-use planning problems which relate to the off-airport environs and its compatibility with the airport.

Environmental Concerns

In recent years, airport expansion and development have become embroiled in controversy over environmental concerns. The environmental effects of airport operations have become the most prominent and sensitive issues to off-airport residents. Many cases of local opposition to airport development, expansion or operation can be directly related to an initial insensitivity on the part of the airport authority, which is usually Transport Canada in the case of major airports. This insensitivity is usually manifested as environmental problems within the off-airport region. The environmental problems most commonly attributed to airport operations are noise, exhaust emissions, environmental pollution and ecological disturbance.

High levels of airport noise are most undesirable. Noise, itself,

is defined as unwanted or annoying sound.¹ The perception and effects of noise are also subjective in nature. The notable British report on noise states:

"...a noise problem must involve people and their feelings, and its assessment is a matter rather of human values and environments than of precise physical measurement."²

Noise associated with aircraft operations may cause the disturbance of human activities. Speech and sleep may be disrupted. These resultant effects, although present at all major airports or locations in close proximity, are not necessarily equal in degree and scope.

The major source of airport noise originates from aircraft engines, either through on-ground testing procedures or take-off and landing operations. The intensity and nature of aircraft engine noise at the source varies with the engine type and the nature of the flight operation. Community perception of such noise varies according to a number of airport and neighbourhood factors.

Airport factors affecting noise perception include the amount and type of sound abatement techniques in use, and the daily scheduling and frequency of aircraft operations. In the surrounding community, noise perception will be governed by the season (i.e., perception in winter months is less than in summer due to closed windows and less time spent outdoors), the provision of residential insulation and soundproofing, distance from the noise source and the overall familiarity of residents with airport noise.

In the majority of cases, airport noise has become the major issue of conflict between airports and neighbouring land uses. Jet aircraft are substantially noisier than earlier propeller-driven aircraft. Jet engine noise, due to its larger proportion of high frequency sound or whine, is

more objectionable than piston engine noise of the same pressure level or decibel rating. Jet engine noise output is also greatest during take-off. To become airborne at a sufficient cruising altitude requires the jet aircraft engines to operate at full or "over-rated" power. This operation creates jet noise due to the turbulent mixing of jet engine exhaust gases with the surrounding air. When landing, the primary noise source is high frequency noise generated by the air compressor and turbine blades of the jet engine.

As stated previously, noise perception and annoyance is subjective and dependent on a number of variables. The noise perception problem at Winnipeg International Airport, for example, would not fit into a generalized noise problem statement for major airports. Although the airport experienced over 150,000 scheduled and chartered aircraft movements in 1974, a recent social concerns study concluded that it does not create a major noise impact on the surrounding community.³ The airport states that the nature of the existing noise problem is technically similar to that of European and American cities, but the intensity and extent of the problem is much less in Winnipeg. This is a result of numerous intervening relationships, such as the relatively high percentage of propellor aircraft movements (68 percent in 1975).

In general, medical authorities recognize that long-term exposure to excessive noise levels is a danger to health in both a psychological and physical sense. Such exposure may contribute to tension and stress. Hearing may be damaged and in extreme cases deafness may result.

In some cases, an airport may contribute significantly to a region's air pollution problem, particularly when compared to other sources. Emissions from airport ground vehicles and terminal buildings contribute

to air pollution in the vicinity. In addition, a number of toxic pollutants such as carbon monoxide, unburnt hydrocarbons, nitrogen oxides and minute solid particles are found in aircraft exhaust emissions.

During the mid-1960's, concern over military and commercial aircraft engine exhaust led to the initiation of efforts to reduce such emissions. However, emission studies carried out during the late 1960's in Canada, Britain and the United States indicated that aircraft account for only one percent of the total air pollution.⁴ For example, studies of the air quality at Toronto and Vancouver International Airports and their adjacent regions have generally indicated that air pollution in these areas is primarily attributable to automobiles, airport ground vehicles and other urban pollution sources.⁵ Furthermore, it is believed that these emissions are more harmful to health than aircraft emissions.

Lastly, the utilization of land for both airside and landside airport operations inevitably creates disturbances to flora and fauna. In more rural settings, aircraft exhaust and noise may destroy the natural habitat and feeding grounds of wildlife and may eradicate certain flora important to the area's ecological balance.

As a result of vegetation clearing and interference with the watershed pattern, airport and surrounding lands may become vulnerable to soil erosion. Contaminants from the airport drainage system may also enter streams or waterways in the vicinity. Typical contaminants here would include petroleum products, fragments, soil sediments, detergents and other chemicals. For example, stormwater drainage systems which involve airport property may adversely affect adjacent agricultural lands. Runway de-icing chemicals such as fertilizers and glycol are potential hazards to a clean drainage system. However, both chemicals are usually absorbed into

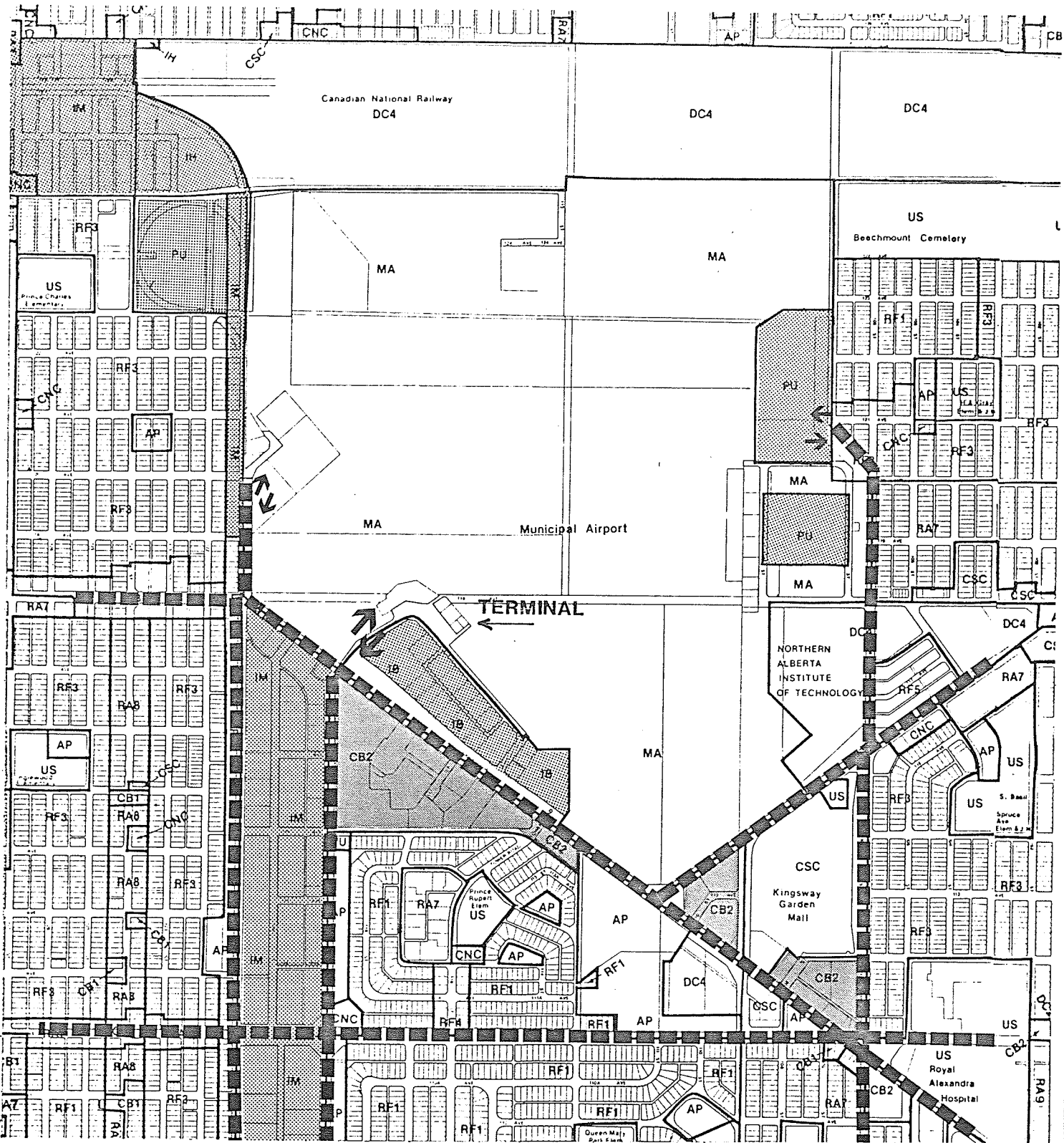
the soil and rarely contribute to surface water pollution. Absorption into underground water systems is usually avoided through an airport site selection and construction program which is sensitive to drainage courses and excessive slopes. In addition, water quality controls at all Canadian airports where there are adjacent waterways generally reduce indiscriminate contamination problems.

The potential ecological problems within the airport vicinity may influence both urban and recreational potentials. Erosion and drainage problems may reduce the development potential of off-airport lands. In cases of rural airport settings, ecological interferences from the airport may also reduce the recreational attractiveness of surrounding natural areas. The future recreational potential of the foreshore and riverbank lands of the North Fraser Delta has been hindered by the area's ecological and noise problems associated with Vancouver International Airport. The use of these areas for passive recreation is affected by the detrimental results of airport operations on the area's wildlife, vegetation and water quality.

Land-Use Planning Problems

The operational relationship between off-airport land uses and airside aviation activities have contributed to the development of regulations in areas such as building height and developmental compatibility. However, there also exists a strong affiliation amongst airport landside functions and off-airport activities, primarily airport access and off-airport passenger services, as shown in Figure 3.

Airport access refers to the portion of the overall airport trip that is accomplished on the local and regional transportation system outside the airport boundary. The successful operation of an air transport industry



AIRPORT PASSENGER SERVICES  **AIRPORT BUSINESS SERVICES**  **AIRPORT ACCESS ROUTES**  **AIRPORT ACCESS POINTS** 

LANDSIDE/OFF-AIRPORT INTERACTION Edmonton Municipal Airport

FIGURE 3

requires a supporting ground transportation system for the movement of goods, passengers and personnel to and from the air terminal. Except in the case of air express, these services are not provided by the air carriers or by the airport authority. As a result, facilities for passenger ground transport are provided independently.

Airport access is predominantly on surface transport facilities since few major airports offer access by air. The level of accessibility measured by both time and distance is a critical determinant of the overall value of the airport to its regional or local customers. Each incremental improvement in ground access facilities provides the airport with a comparative advantage, in turn strengthening its attractiveness to passengers, services and airport-related industries.

Airport access as a factor of convenience is determined not by the airport authority, but by external interests and jurisdictions. In many cases, these jurisdictional priorities relating to airport access do not match those of the airport authority. Although municipalities, for example, may recognize an airport's need for improved access, they also realize that airport access may be only one operational component of a multi-functional transportation route. Therefore, improvements to the route are made when the majority of components have reached a near-critical state. Improvements to the airport access component of an urban system such as Toronto's Highway 427 or Winnipeg's Route 90 may be delayed until a multitude of system components have reached capacity, and the appropriate government levels act to improve the entire system.

If the airport access component of a transportation system reaches a serious state of over-capacity, the resultant problems can include passenger delays, airline scheduling problems congested terminal facilities, highway

congestion and an unattractive setting for off-airport commerce and industry.

In terms of off-airport activities, the most common off-airport passenger service involves the accommodation industry. Lodging, food and entertainment establishments have recognized the airport as a customer hub, and passenger services have developed on off-airport property in close proximity to the terminal.

The direct access that off-airport services provide to the air passenger assists in the alleviation of terminal traffic congestion problems. Services, such as hotels, are also utilized in some cases as secondary airport terminals, complete with preliminary passenger processing functions. The off-airport passenger facilities are also capable of providing an economic benefit to the surrounding community. Urban, suburban or rural areas which may be unattractive to tourist facility development because of poor urban access and proximity, or adjacent industrial predominance, become especially suited to airport related commercial activities of various scales. As a by-product, the community receives additional taxation revenues, hotel and entertainment space, and convention facilities in areas other than the central business district (CBD).

Off-airport passenger facilities are especially susceptible to adjacent airport noise since most operate on a 24-hour or extended hour basis. Soundproofing and air conditioning must therefore be incorporated into the construction of such facilities to the extent necessary to reduce exterior noise to a level acceptable for internal business and accommodation purposes.

Finally, off-airport passenger services exist within a less secure business environment when compared to other areas of the city. Off-airport hotels and associated enterprises for example are almost completely dependent

on the airport for their operational success and prosperity. Critics who support urban airport relocation must realize that such an approach would be detrimental not only to airport-related industries, but to various passenger-related commercial enterprises in the periphery.

Probably the most obvious and the most critical aspect of the airport/off-airport land-use planning program involves aviation safety. The International Civil Aviation Organization (ICAO) world-wide aviation accident statistics indicate that by far the largest percentage of air vehicle crashes occur on take-off or landing. The majority of landing phase accidents involve aircraft "undershooting" the runway. Although it may be assumed that a substantial proportion of accidents are confined within the airport property boundary, there is a definite safety hazard imposed upon land uses which are located beneath aircraft approach or take-off paths in the vicinity of airports.

Additional aircraft accident statistics relating to runway under-shooting or over-shooting indicate that the majority took place within five kilometres (16,600 feet) of the end of the runway. This justifies the designation of crash paths as a part of clear area or airport hazard area zoning.

As aircraft safety relates to public opinion, certain research studies have listed "fear or aircraft crashing in the neighbourhood" as the most important non-acoustic factor in the airport-vicinity residential environment. The Winnipeg airport study, for example, revealed that respondent interest in aircraft crashes increased with NEF noise zone rating involved, although residents seemed generally unconcerned with aircraft accidents.

Aside from the strong resident concern for airport safety, it is

fair to say that living under a runway flight path can be less safe than not living under one. The degree of safety is difficult to determine statistically since accident frequencies are usually too low. Most studies by aviation-related groups show that the chances of a major accident involving persons on the ground are very remote and unpredictable.

In recognition of the inherent land-use conflicts between airports and surrounding activities, it has become standard procedure to include a compatible land-use matrix as part of recent airport/adjacent land-use studies. As an illustration, the following summary of land-use concerns have consistently been associated with their appropriate land-use designations:

1. NATURAL - Natural features in the approach and take-off paths of a runway may help to mitigate the aircraft noise problem. The development of adjacent natural features for recreation may be adversely affected by airport operations. Rivers, lakes, bays or swamps in the airport vicinity may cause bird problem.
2. AGRICULTURAL - Airport vicinity lands used for farming are still available for higher-level development at a later period. Crop cover on open lands in the airport vicinity will prevent soil erosion. Certain seed crop cultivation attracts birds, causing aircraft operational problems.
3. HIGHWAYS - Coordination with airport officials can result in the placement of highways under take-off and landing paths. Highways can also take the place of adversely affected housing and provide access to adjacent airport-related industrial and commercial uses.
4. RECREATION - Recreational land uses, such as golf courses, which require large amounts of undeveloped land and are not affected by airport operations, are usually appropriate for off-airport property. Certain recreational facilities are not appropriate in terms of noise and public hazard.

5. MUNICIPAL UTILITIES - Siting of such facilities near an airport is economical, logical and generally compatible. Municipal utilities which affect navigation aids, create visual problems or attract birds are considered hazards, and therefore incompatible.
6. COMMERCIAL - Since the bulk of commercial operations involve the daylight hours, and noise is usually not a substantial problem, such uses are generally compatible.
7. INDUSTRIAL - Because of the high noise levels common to industrial activity, such uses are found to be compatible to adjacent airports. Industry and business can take advantage of the nearby air transportation benefits, thereby becoming supporters of the airport. Industries emitting smoke or electronic interference may require special consideration.
8. RESIDENTIAL and INSTITUTIONAL - If the amount of residential sound insulation does not balance exterior airport noise, these two uses are socially incompatible. The climate and type of unit involved will affect compatibility since the amount of time spent outdoors or in close contact with the exterior environment is determined by these factors. Institutional uses may require more sound conditioning than residential units because a lower interior sound level is necessary (e.g., churches, schools, hospitals).

The matrix approach recommends the types of land uses which should be either permitted, conditionally permitted or restricted in certain airport peripheral areas, usually delineated by NEF noise cones. In most cases, these land-use tables do not carry any regulative authority, and are not considered an exhaustive listing. They are provided for reference purposes, and as examples of how various land uses would be assessed in terms of bird hazards, noise exposure forecasts, community response predictions, or a collection of all these factors. Specific land-use-zoning regulations become the administrative tool to implement the matrix

and the various land uses which have been omitted.

The Ontario Ministry of Municipal Affairs has developed a land use compatibility table for noise zones in the vicinity of Toronto International Airport. The purpose of the table is to guide the Minister in his statutory role of approving official plans, subdivision plans and urban renewal proposals. The only uses permitted within the various zones are those which are considered compatible with the expected noise level therein. This is an example of the type of airport zoning control which would seem to be clearly within provincial jurisdiction, and possibly federal jurisdiction. However, even if responsibility problems arose, it would be difficult to challenge the provincial action since it has no legislative basis, but constitutes simply a policy statement of the Minister.

As illustrated in Appendix B, most attempts at defining off-airport compatibility result in similar permitted/restricted tabulations. This overall similarity is a result of the basic concerns that are related to each off-airport land use involved. Unfortunately, the major criticism of these tabulations and of airport/off-airport land use planning in general is that the guidelines are rarely administered through proper legislation in order to protect not only land use in the vicinity of airports, of also the airport operation itself. As will be discussed in Chapter IV, attempts at regulating off-airport land use to reflect both aviation requirements and effects have only recently been initiated in certain cases through the use of airport vicinity protection area legislation.

TABLE OF REFERENCES - Chapter II

1. Most of the literature on aviation noise is highly technical. In this section of Chapter II, the aviation noise problem is discussed in non-technical, layman's terms.
2. Committee on the Problem of Noise, Noise - Final Report, London: H.M. Stationary Office, 1973, p. 2.
3. Transport Canada, Social Concerns and Community Characteristics Study, Winnipeg: Winnipeg Area Airports System Study and the University of Manitoba, 1976, p. 51.
4. J. Parker, Air Pollution at Heathrow Airport, SAE-DOT Conference on Aircraft and the Environment, London: 1971
5. Transport Canada, Air pollution and the New Toronto Airport, Toronto: Toronto Area Airports System Study, May, 1972. and
Transport Canada, Urban Issues: Governmental Objectives, Policies, Programs, and Plans in Relation to Airport Expansion, Vancouver: Vancouver International Airport Master Plan Project, June, 1975.

CHAPTER III

TECHNIQUES TO CONTROL OFF-AIRPORT LAND USE

The need for public controls over land in the vicinity of airports has been recognized since the early history of civil aviation. In general, such powers have been concerned with the control of height and specific uses which present possible hazards or obstructions to airport flight operations. The operational and land-use control mechanisms offered by existing legislation and approaches to off-airport planning incorporate two major areas of responsibility:

- 1) to provide for airport needs such as obstacle limitation areas, future airport development areas, etc.;
- 2) to ensure minimal interference to the environment and the public by locating non-compatible land uses away from excessive noise zones, and by preserving parkland, open spaces and other compatible buffer areas.¹

Airport Related Legislation

A number of techniques exist which regulate development or bring about conversion or modification of existing land uses to achieve greater compatibility between the airport and its environs. Whatever the technique used, federal jurisdiction over the field of aeronautics cannot be interfered with by the provinces or by municipal corporations. For example, a provincial legislature cannot empower a municipality to regulate the location of airports. This fact is illustrated in the precedent-setting case of *Johannesson vs. West St. Paul*.² The issue in this case was whether the Province of Manitoba had legislative power which would allow

municipalities to pass bylaws for the licensing, regulation and prevention of airport development and operation. The judgement in this case produced a number of relevant interpretations and precedents:³

- 1) it would appear that substantially the whole field of legislation in regard to aerial navigation belongs to the Dominion;
- 2) it follows that the Province cannot legislate in relation thereto, whether the precise subject matter of the provincial legislation has, or has not already been covered by the Dominion legislation;
- 3) the federal power to prescribe the aerial routes must include the right to designate where the terminus of any such route is to be maintained;
- 4) it would be intolerable that such a national purpose (aviation) might be defeated by a rural municipality.

Although there are certain *ad hoc* land control procedures, such as covenants and the Tort law, relating to nuisance by which control can be placed on off-airport land use in Canada, legislative action is presently the most significant means of implementing such regulations. The aviation oriented legislation at the federal level, the Aeronautics Act, gives the Minister of Transport authority to make regulations with respect to height, use and location of buildings and structures situated on lands adjacent to or in the vicinity of airports - section 6(1)(j).

In terms of off-airport planning, the main weakness of the Aeronautics Act is that section 6(1)(j) specifies that controls must relate to navigation, airport use and airport operation. Therefore, the Act is extremely limited in its ability to control overall urban encroachment. Typically, off-airport zoning regulations, based on section 6(1)(j) of the Act, are enacted by Order-in-Council and restrict building heights in order to protect navigation systems and approaches to runways. However, where airport operations affect the environment surrounding the airport, the federal government does not have the authority to zone for appropriate

land uses. Responsibility for the adoption of appropriate off-airport land-use compatibility measures is therefore left with provincial and municipal governments. Unfortunately, these authorities seldom ensure that sensitive areas in the vicinity of airports are developed with appropriate or compatible uses.

In addition to the enactment of airport zoning regulations, the Aeronautics Act also specifies zoning amendment procedures - section 6(9). Finally, compensation measures are included in section 6(10) for owners of property that has been injuriously affected by the operation of an airport-related zoning regulation.

Amendments to the Aeronautics Act have been debated in Parliament within the last three years. These amendments recognize that many existing airports could meet air travel needs for the next 20 years by expanding existing facilities with assured protection from incompatible off-airport development. Transport Canada also realizes that many federal airport operations will either have to be reduced or relocated at considerable cost to the taxpayer unless airports are protected from urban encroachment. For example, residential development in Thunder Bay, Regina and Windsor has been allowed to expand into airport peripheral areas. At the same time, Transport Canada is being petitioned to relocate these airports and thus eliminate noise impacts over the existing and proposed residential areas. In this way, additional residential development opportunities are also created.

Transport Canada has stressed the positive role that the provinces have in negotiations with Ottawa for compatible off-airport development. For a number of years the federal government has encouraged provincial authorities to enact airport protection area legislation, but at this time only Alberta has complied. Alberta's involvement in airport protection

legislation at the provincial level is reviewed in Chapter IV as an alternative approach to off-airport planning.

The ultimate responsibility for the proper establishment, maintenance and operation of both public and private airports lies with the federal government and Transport Canada by virtue of the Aeronautics Act. However, it is the provincial and local levels of government that are responsible for the actual control, development and encouragement of compatible land uses in the airport vicinity.

The difficulties involved in upgrading the Aeronautics Act, as outlined in Chapter IV, reflects the multiple vested interests which the federal, provincial and municipal levels of government have regarding off-airport land-use planning and airport protection. The federal level must not only protect its financial investment in aviation, but must also provide safe and operational air facilities within a national air transportation system. At this time, federal policy supports an increase in off-airport land-use control powers as an alternative to airport relocation caused by urban encroachment pressures.

Provincial governments must decide whether increased federal involvement in their areas of jurisdiction will be accepted. Expanded airport protection legislation at the provincial level must be viewed in terms of the potential benefits it would offer in the field of regional aviation. More important, such legislation should be viewed as an alternative to direct federal involvement in off-airport land-use planning.

Finally, the local levels of government must judge airport relocation from two perspectives. For a municipality, external relocation will not only result in the loss of a convenience, but grants in lieu of taxes from Transport Canada will be forfeited. In the Municipality of

Richmond, for example, relocation of the Vancouver International Airport would have meant the loss of \$2 million in real property taxes (including a grant-in-lieu of \$952,000 from Transport Canada) in 1973, which amounted to twelve percent of the municipality's total tax revenue.⁴ On the other hand, the relocation of the Transport Canada airport in Thunder Bay would provide that municipality with approximately 200 acres of prime development property to meet residential expansion demands. The financial and social benefits of suburban expansion in encroachment cases similar to Thunder Bay must be weighted against those offered by the existing airport.

Legislative power, vested in the provinces and delegated to local authorities, is the basis for zoning laws, land acquisition provision, building and housing codes and taxation policies. The provincial planning acts and municipal acts give municipalities varying degrees of authority for airport development and off-airport land use, subject to related acts of Parliament. For example, section 12(1)(j) of the Manitoba Planning Act allows municipalities, on the recommendation of the province, to establish special planning areas for any activities that may cause damage or interference to lands, sites or buildings. Airport noise areas should fit these categories, but as yet only operational height zones on runway approaches have been established as special planning areas by municipal Order-in-Council mechanisms, as a reflection of existing Aeronautics Act provisions. By virtue of section 12(4)(c) of the Manitoba Planning Act, an Order-in-Council establishing such areas also may suspend the operation of existing district or municipal development plans, zoning bylaws or building bylaws within these areas.

As a comparison, the relatively progressive Alberta Airport Vicinity Protection Area (AVPA) General Regulation 291/75 allows local authorities

to establish AVPA's for the purpose of controlling, regulating or prohibiting any use and development of land within such areas. Regional planning commissions or the Provincial Planning Director may also initiate such procedures if involved municipalities do not have jurisdiction in the affected area. The particular approach will be reviewed in detail under discussions of special zoning powers of provincial governments in Chapter IV.

Provinces may also delegate responsibility for aeronautics and related regulations to the local level by means of municipal act provisions. Under the Municipal Act of Manitoba, section 266 states that any municipality or group of municipalities may acquire or establish private air facilities, make airport regulations, and pass licensing, regulating and prohibitive bylaws for airport operations subject to federal acts or regulations. Unfortunately, such provisions are limited to the airport property, and do not provide for control over off-airport land use and development. Similarly, section 352(9) of the Municipal Act of Ontario also allows for municipal establishment of "air harbours or landing grounds", but does not include specific provisions for off-airport land-use control.

Environmental Control Regulations

A reduction in the environmental problems associated with an airport and its environs is necessary in the interest of airport operations and the protection of its surroundings. A number of abatement techniques have been adopted. Some involve legislative controls,⁵ while others are more functional in nature. In addition, they either limit problems at the source, or reduce the effects on the community and ecology. While environmental control measures should be applied generally throughout a

community, this discussion is limited to the specific application of controls for airport-related problems, namely environmental protection legislation, noise abatement and measurement, and pollution control.

The federal government has traditionally been reluctant to dictate what types of land uses and structures should be permitted in the vicinity of airports. The regulation of off-airport land use on environmental grounds is a matter of provincial jurisdiction, and by delegation municipal jurisdiction, under the British North America (BNA) Act. However, the stated objective of the Transport Canada Air Transportation Program is to provide and foster air mode transport consistent with the protection of the environment. The federal government therefore has an environmental responsibility, but the present lack of any effective land-use policy or environmental protection legislation would suggest that this responsibility is not being met.

Airport development and operation in the United States must conform to strict environmental criteria administered through the federal Environmental Protection Act. Canada lacks any similar overall federal legislation in this area, but an Environmental Assessment and Review Process (EARP) has been established within the federal government. The purpose of EARP is to ensure that all federal government departments and agencies consider environmental assessments, and incorporate such assessments into their policies, programs and projects.

Environment Canada has exercised an important and vital role in protecting the environment based on existing legislation, regulations and the EARP. Unfortunately, very little has been done to actually reduce the adverse environmental affects of air transportation. This inadequacy has two casual factors. First, the primary role of Transport Canada is to

provide for an economic, efficient and adequate transportation system, according to the 1967 National Transportation Act. It is clear that Transport Canada has no real, legislative incentive to improve the environmental setting in off-airport areas. Secondly, Environment Canada has not recognized its responsibility in reducing certain environmental effects, such as aircraft noise, which are directly related to airport operations. Respective areas of responsibility on the part of Transport Canada and Environment Canada dealing with environmental problems of off-airport lands do not seem to be clearly outlined.

In addition, the federal government has the right to specify certain environmental control, such as noise or emission levels from airports, but Transport Canada is limited in the application of these controls by the Aeronautics Act. The Act includes no control or policy provisions relating to either the environmental effects of aeronautics or the off-airport environment as a whole. A final policy inadequacy relates to the lack of a broad mechanism which would allow Environment Canada to become involved in transportation, and more specifically, airport environmental matters. There are no mechanisms which would allow Environment Canada to enter into the early planning stages of airport policy development, program design and project initiation. Instead of becoming an active leader in the promotion of an acceptable off-airport environment in terms of airport externalities, Environment Canada at best reacts to outside initiatives and demands for action.

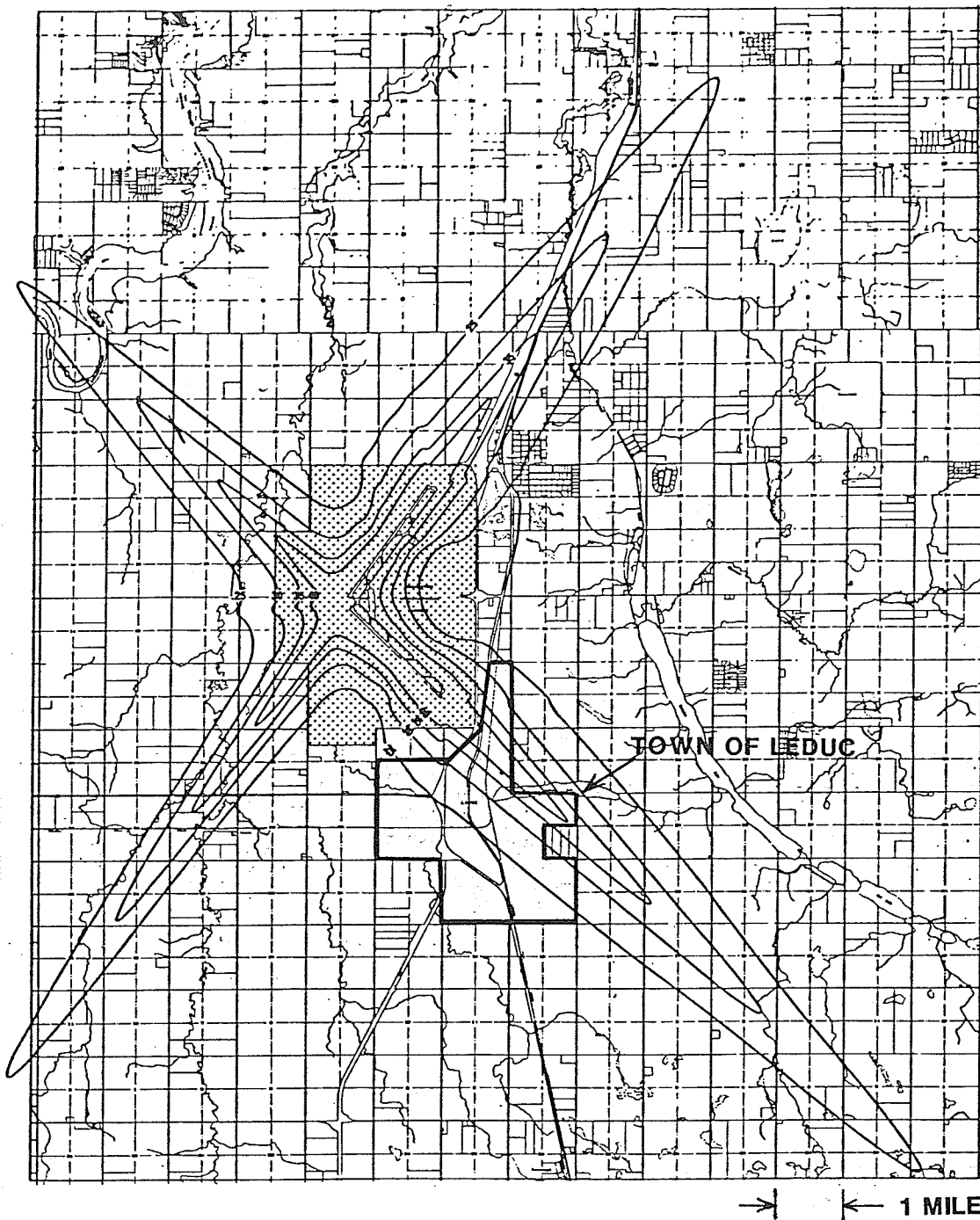
The extent of effects and potential disruption associated with aircraft noise is primarily determined by the use of the Noise Exposure Forecast (NEF). The NEF is a calculated index which provides an assessment of annoyance resulting from exposure to aircraft noise in the airport

vicinity. The NEF value provides a summation of the annoying noise-related effects of all aircraft operating on a particular airport runway. The calculation of NEF values utilizes data on the types of aircraft using the airport, the noise they generate, the number of take-offs and landings on each runway, and the time of day these operations occur. The noise generated by each individual aircraft type is measured in effective perceived noise decibels (EPNdB). Each EPNdB value accounts for the subjective annoying effects of the noise. This is computerized to produce either existing or future NEF contours. A sample NEF contour map of Winnipeg International Airport is provided in Figure 4.

Since aircraft engines are inherently noisy, and will continue to be in the foreseeable future, the major aim of all noise abatement measures of the functional type is to reduce the potential number of areas affected. Aircraft noise has been mechanically reduced at the source, and aircraft manufacturers have initiated costly refitting of older jet engines with noise suppressors. This attempt at meeting national, regional or local noise regulations has met with mixed success. Newer aircraft models have also been designed to emit lower engine noise outputs, and are much quieter than earlier generation jet aircraft.

Noise restrictions have necessitated the introduction of noise abatement flight procedures. In order to reduce noise levels in off-airport areas, take-off noise is reduced through full power, steep angle take-off procedures. There are no specific landing procedures for reducing noise because of the safety problems involved.

Aside from mechanical or procedural noise reduction at the source, scheduling procedures are also used in noise abatement. These measures consist of establishing noise limits at certain airports, banning night



NEF ZONES - 1979

Edmonton International Airport

flights and sharing traffic between several regional airports, as in the case of New York City.

Noise can also be reduced at the point of reception. Such techniques involve planning and construction authorities rather than manufacturers and airport authorities. Acoustical barriers have been used to screen certain areas from airport noise. In areas of intense noise, structural soundproofing is often the only means of rapidly reducing noise inconveniences. Furthermore, if the application of rational land-use planning remains a possibility, noise zoning may be applied to off-airport areas. Three distinct noise zones - 30 NEF, 35 NEF and 40 NEF as shown in Figure 4 - are usually defined within which land use and house construction is subjected to certain restrictions. Such zoning is generally administered by the local authority or external agencies such as the Central Mortgage and Housing Corporation. For example, new housing is usually restricted above the 30 NEF contour except in special cases relating to infilling of existing structures.

Economic penalties and incentives may complement or replace NEF noise regulations. These approaches include a passenger surtax or a noise surtax on the airlines as methods of financing noise abatement, in addition to landing charges already levied. Realistically, both approaches would meet with heavy opposition and would not directly affect existing noise problems. A final alternative would involve government subsidization of the airlines in order to eliminate certain types of noisier aircraft. This would be similar to the approach taken by the federal government on behalf of the shipping industry in discarding older tankers. Soundproofing grants, land purchases and noise easements are also possible economic tools, and will be reviewed in a further section of this chapter.

The entire field of noise measurement and regulation has been highly criticized on technical and sociological grounds. The modest net effects gained from the mechanical suppression of aircraft noise reflects the complex way in which residents perceive noise. Noise is difficult to measure since it is extremely variable. The perception of such noise is subjective in nature, and is dependent on a number of environmental and residential factors. Not all people react the same to noise. It is somewhat confusing to find various degrees of resident dissatisfaction with aircraft noise within different case studies, although each may involve similar noise levels and environmental factors. Numerous studies on noise and residential concern have either theorized or illustrated through case examples that airport noise is the prime motivating factor in off-airport resident dissatisfaction. However, there are similar reports of equal magnitude, such as the Winnipeg Airport Study, which have reflected a reduced priority on airport noise. Such diversity in findings would suggest that off-airport residents may tolerate airport noise differently, and that public reaction to noise is not a stable factor. The only real constant involved in noise assessment is that residential concern increases with the proximity to the noise source.

In terms of strict airport noise measurement, the proliferation of "perceived noise" rating scales in various countries has led to confusion and controversy.⁶ The lack of standard measurement techniques has provided ample grounds for contesting tentative noise standards or zoning in the courts. The enforcement of noise control zoning based on any of the available measurement techniques is also ambiguous, even to legal experts. For this reason, it has been difficult to take disciplinary action against violators such as urban airports.

It is evident that any type of airport noise measurement, monitoring or assessment is functionally useless if it cannot influence airport and aircraft operations. Noise measurement has become a major airport planning tool, but its influence on existing operations and schedules has been weak. This lack of effectiveness relates to the relatively imperfect way in which NEF noise zones describe aircraft noise. The NEF noise measurement can only be used for the most crude trend information as it applies to land-use planning, and therefore has no proper airport operational application.

Finally, in addition to the potential inadequacies relating to noise measurement and assessment, problems also exist with the various approaches to noise abatement. It has been determined, for example, that mechanical noise suppression of aircraft engines creates only four perceived decibels of noise attenuation.⁷ Furthermore, cost/effectiveness analysis of mechanical noise suppression may show, as it has in a number of cases, that the cost of general retrofitting may not be compensated by substantially decreased off-airport annoyance. If insufficient levels of noise suppression effectiveness are encountered, it is common for mechanical retrofitting of aircraft engines to receive a low priority within the airlines.

Inadequacies also exist in the area of residential soundproofing. In the case of rental properties surrounding Canadian airports, it has not yet been determined who pays for the application of this particular noise abatement technique, the resident (tenant) or the owner. Since tenants seldom direct large amounts of personal funds into residential improvements and owners of existing units are not obligated in any way to provide soundproofing, this technique may be largely overlooked in the airport environs. In addition, the question of whether partial or total soundproofing grants should be made available to residents, including both

owners and tenants, within certain high NEF zones has not been adequately considered or answered.

The use of flight operational restrictions as an approach to noise abatement is constantly criticized by airline crew personnel. Since the majority of these operational restrictions involve the potentially dangerous take-off and landing procedures, airline crews have vigorously opposed this abatement approach on the grounds of safety. Safety is one of the primary airline responsibilities, and therefore flight operational restrictions should be viewed only as an extremely limited solution.

Control of air and water pollutants can be similar to noise abatement in that control is directed at the cause, the listener or the connecting link between the two. Aircraft exhaust emission pollutants are primarily controlled through technological approaches. Mechanical systems are now available which eliminate smoke and gaseous emissions from most aircraft exhaust. Operational procedures also reduce emissions by limiting engine operation on the ground.

Emissions generated by airport-related access traffic can be reduced by providing more efficient traffic routes with less congestion potential, and by providing alternative means of transport such as electric bus shuttle services between airside and groundside operations.

Control of airport-related air pollutants at the receiver may be implemented through the use of airport traffic quotas, restrictions on pollution generators, land-use compatibility planning and the implementation of effective environmental impact assessments for both airport and off-airport development. All provinces also enact legislation regarding water quality and control. Local regulations usually cover the areas of discharge and waste water quality. Aside from general airport sanitary

waste which is directed to a nearby local treatment system, separate problems exist for airside and servicing area runoffs. Surface runoff may require separate treatment on site in order to avoid contamination of the airport area's groundwater system. Airport chemicals, such as runway rubber remover and de-icers, are usually selected to minimize water pollution problems. At Montreal's Mirable Airport, for example, a special central aircraft de-icing facility also controls runoff of de-icing chemicals.

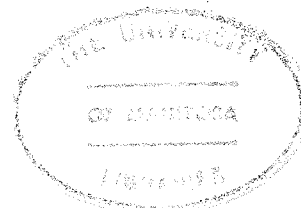
Recent studies have also shown that air pollution in the airport vicinity can often be more a result of vehicular traffic and airport landside operations than of actual aircraft emissions. In cases where this relationship is applicable, any attempt to reduce regional air pollution through reductions in aircraft emissions becomes a partial solution to the problem. The control of air quality in the airport vicinity must therefore be a multifunctional approach and include all sources of pollution, such as terminal access traffic and airside service traffic, as well as traffic emissions.

As indicated previously, Canada lacks any significant overall federal legislation in the area of environmental protection and assessment. As a further problem, an environmental assessment of federal airport projects, initiated under the Environmental Assessment and Review Process, does not necessarily take into consideration the future environmental effects of the project. Certainly the environmental assessment of new airport development includes a number of projected factors, such as future noise-affected areas and increases in levels of pollution. However, if the assessment or forecasting techniques used to develop future scenarios are found to be inappropriate or insufficient, then the entire view of future environmental effects will be questionable.

Any restrictive view of environmental effects will not be unanimously accepted. Much of the concern emerging from environmental assessment can be traced to the limits to growth issue, which may be transcendently important, but not debatable in the restricted context of air transportation. In addition, other issues which may be included in an environmental assessment, such as economic issues, are often the responsibility of traditional organizations or agencies, and not the assessment authority. Here again, the lack of cooperation between various areas of responsibility may result in a partial approach to environmental assessment and resultant policy formulation.

Land-Use Control Techniques

The resolution of land-use problems in the airport vicinity demands the involvement and application of all possible alleviation techniques. Proper land-use planning is recognized as a major contributor to problem avoidance and rectification. In most cases, benefits are attainable only in the long run, but should not be ignored because of the time required for effective results. This is especially appropriate in the case of existing urban airports where the application of effective land-use planning for immediate improvements is highly limited. However, long-range planning offers a higher potential for off-airport solutions than a complete absence of proper planning. The correct application of land-use planning techniques to new airport development offers substantial benefits from the initial phases of operation. It should be remembered, however, that the value of proper land-use planning should not be overstated. There are numerous regulatory and operational guidelines, previously covered in this chapter, which must also be applied in order to provide a successful airport/ community interface.



A number of land-use planning techniques are presently available to regulate development and to convert or modify existing off-airport land uses to provide a more compatible airport/communitiy relationship. These techniques include land-use zoning, property acquisition, building and housing codes, and taxation policies.

Zoning is the most commonly used tool to control land use at the municipal or local level. Unlike other approaches to land-use control, such as property acquisition, zoning is most effective when instituted during the airport master planning phase or within the local comprehensive planning process. Zoning regulations which control land use around airports consist of two types: zoning to achieve land uses compatible with the noise and other environmental effects of the airport, and hazard or airport zoning which controls the location of potential obstructions to air operations.⁸ In regard to these definitions, the Canadian experience with zoning of off-airport property has been limited to hazard or airport zoning as a reflection of operational and height provisions within the Aeronautics Act. There are very few examples of compatibility zoning, but hopefully the application of Airport Vicinity Protection Area (AVPA) regulations in Calgary and Edmonton will provide successful case studies.

The most direct approach to off-airport zoning is through the establishment of special purpose districts, as provided for by provincial legislation. The special district is typically a part of the local zoning ordinance, created to protect desirable uses in particular areas of significance from development pressures. The special purpose district is subject to controls on design and use, and it can provide various incentives and bonuses for compliance.

Although zoning is the most appealing long-term possibility to

ensure compatible off-airport land use, four areas of difficulty reduce its value, especially in existing populated areas. The first two are legal in nature, while the third and fourth involve political and practical problems.

The first problem attributed to zoning is its ineffectiveness in changing pre-existing uses because zoning does not apply retroactively. In addition, any designation of an "airport vicinity protection area" or a "noise-sensitive area" may invite litigation by residents in those areas, whether or not they were actually sensitive to airport operations prior to enactment. The second major difficulty, as reflected in the debates over Aeronautics Act amendments, is that off-airport zoning must be accompanied by compensation provisions if a "taking" of property results (actually a taking of property rights). The third, more practical problem with the zoning approach is that noise and other undesirable externalities of the airport would continue unabated. Finally, zoning as it applies to airport operations is basically administered at the local level. In many cases, both airport sites and airport externality areas overlap more than one municipal jurisdiction. For example, Winnipeg International Airport noise zones and the site itself involve both the City of Winnipeg and the Rural Municipality of Rosser. The Montreal International Airport at Dorval incorporates sections of the City of Dorval, and the Cities of St. Laurent and Lachine. Each of these jurisdictions administer local planning functions in addition to their involvement in the metropolitan Montreal Urban Community level of government. The proposed Pickering Airport site near Toronto involved seven separate localities, with two regional official plans and five local planning programs in effect.⁹

Difficulties with zoning coordination may arise because each jurisdiction has its own zoning bylaws and local planning programs. This

problem may be amplified since the governmental body which is responsible for operating an airport, Transport Canada, is not the same body that has authority over adjacent land-use zoning. Obviously, unless the affected communities or authorities form a joint governing or advisory board to formulate a single long-range plan with a coordinated zoning plan, the chances of implementing effective off-airport land-use controls are slight.¹⁰

The application of development control legislation as an alternative to zoning has been proposed in a number of cases. However, the majority of Canadian municipalities continue to use zoning as their major land-use control device. Local governments have refrained from developing or applying the development control approach if an established, effective zoning program is in effect.

Provincial and municipal authorities, along with Transport Canada, may apply the technique of property acquisition to ensure compatible off-airport development and protect the existing or future airport from encroachment. To be effective as a means of reducing impact, large-scale purchases, such as those in the vicinity of Mirabel International Airport (88,000 acres) are generally necessary.

There are several options to acquiring land, depending on the financial position of the purchaser and the price of the land involved, the local or regional land-use plans in effect, the area affected by future airport operations, and the particular airport development phase at the time of purchase. By purchasing land in fee title from the owner, the authority may lease back land for compatible purposes only. The two disadvantages here are the potentially large capital outlay involved and the loss of a municipal tax source to the local political jurisdiction.

The use of expropriation where landowners are unwilling to sell also

results in complete control over the acquired property. Of course, this approach tends to alienate the people forced to relocate, and may result in strong citizen protest and organized opposition. Although only directly affected lands over flight paths and at the ends of runways may be expropriated, the problem of determining just compensation through fair market value can be a complicated and drawn-out process. Provincial planning acts give municipalities the right to expropriate lands subject to the Expropriation Act as part of a development or official plan. It therefore may be argued that municipalities do not have power to expropriate for specific airport-related purposes.

Since property ownership involves a collection of "rights", it is possible for an authority to purchase a single right or set of rights in the form of an easement. In this way, land is not purchased, and the cost is usually less than that of outright fee title acquisition. This may be offset by the disadvantages resulting from less than complete control on the part of the authority. An easement also does not provide relief for the property owner in terms of noise and other externalities.

A variation of purchasing rights through easements is the concept of transfer development rights. This concept provides for a separation between a piece of land and its development potential by permitting the transfer of the development rights to lands where such development will not be hazardous or incompatible to airport operations. In this way, an owner of rural agricultural property with residential development potential for example, could recoup lost economic values incurred from the enactment of airport compatibility zoning on his land by selling the site's development potential.

Building and housing codes can be used to minimize indoor exposure to aircraft noise, particularly in new or renovated buildings. The codes

may contain provisions for soundproofing or conformance to construction performance specifications in areas affected by airport operations. An agency such as CMHC has no authority to control the use of land for residential purposes since this responsibility lies with the provinces and municipalities. However, CMHC supports and specifies methods which protect residential areas from airport effects, and discourages residential development in high noise areas. The CMHC involvement is related to the security of its direct financing, its insurance of the financing provided by approved lenders, and the quality of housing conditions encouraged by its financial support.¹¹ CMHC has directed housing codes to deal specifically with new residential development and defines off-airport areas where National Housing Act (NHA) financing will be made available. In certain areas the availability of such financing depends on the inclusion of sound insulation within the units.

The costs associated with improved building and housing codes for off-airport residential areas can be extensive. However, a recent study of code improvements in the Los Angeles Airport vicinity revealed that although the cost of soundproofing existing houses could equal 10 to 25 percent of the unit's construction cost, the cost in new dwellings would be 4 to 10 percent.¹²

Building codes which relate to specific types of residential construction may also be useful in providing a more compatible off-airport environment. Since soundproofing codes are far more stringent for apartment buildings than for single-family dwellings, multiple family residential development or redevelopment may be more compatible to airport operations than detached dwellings. This would be dependent on height regulations. In addition, the economies of scale would allow for lower soundproofing

costs per unit in medium or high-rise buildings where the opportunities for external noise perception are limited to balconies.

Preferential tax treatment can be used in a variety of ways to implement a more compatible airport/community interface. A program of real estate tax reductions can be designed to attract noise-compatible activities to those airport peripheral areas subjected to the highest noise exposure. Through a federal, provincial or local program, savings received from tax reductions could be redirected into soundproofing for existing off-airport residential units. A possible problem with this approach is that any tax abatement may increase the economic attractiveness of an incompatible use. Although residents in the 40 NEF noise zone of Winnipeg International Airport receive a \$27 per annum tax reduction, it is possible that a sufficient growth in this rate could act as an economic incentive for existing and future residents to remain in the area. However, just as land-use attractiveness can be affected through assessment, additional assistance and incentives can be offered to various desirable uses through the granting of specific exemptions, concessions and preferential rates.

It is clear that zoning, acquisition, building codes and taxation devices are useful and necessary in the coordination of land-use planning in the vicinity of existing and new air facilities. At airports where land-use encroachment has not taken place, or at newly constructed airports, appropriate land-use controls can prevent aviation-related land-use problems.¹³ Most provincial legislation and provisions however, will not contribute greatly to the alleviation of airport/community interface problems in densely developed urban and suburban areas. Municipal land-control devices, as applied in the majority of cases, also have little effect in providing a more compatible off-airport environment. It must be recognized that

comprehensive, compatible air transportation/land-use planning requires complete cooperation and involvement from all levels of government, public and private aviation, and the public in general.

Distribution of Off-Airport Land Use

Various factors must be taken into consideration when land-use control techniques are applied to a specific environmental and off-airport land-use problem. Regional and local economic factors and ecological consideration must be adopted in the application of compatible planning approaches. In recent planning programs, the most commonly applied factor has been the environmental issue of airport noise. All levels of jurisdiction have a responsibility to ensure that aircraft noise exposure is considered as one of the major off-airport planning issues.

In order to incorporate airport noise considerations into land-use planning, noise exposure forecasting methods have been developed. These forecasts are necessary for the implementation of programs which limit the total community noise exposure, and therefore provide a more compatible residential environment. However, effective programs can only be established if off-airport noise is described, measured and monitored.

The most common reflection of noise exposure in land-use planning is through the delineation of noise zones around the source. In the case of airports, a review of current practices reveal two basic approaches to noise zone definition. First, a broad approach is commonly used in Canadian cases, and usually defines three noise zones. This is based in part on the questionable accuracy of noise exposure measurement, which would make more specific delineation unnecessary, and the greater flexibility in application that a minimum number of zones allow. The three broad noise zones are described as:¹⁴

- Zone A: usually involves the 25 NEF to 30 NEF range where sporadic resident complaints are possible. Development and land uses need not be restricted by noise exposure considerations.
- Zone B: usually involves the 30 NEF to 40 NEF range where sporadic to repeated and vigorous resident complaints are possible, with group actions and appeals to authorities. Moderate noise exposure levels are encountered and there may be some need to restrict land uses and developments.
- Zone C: usually involves the over 40 NEF range where repeated and vigorous complaints are common and legal action from concerned groups can be expected. High noise levels are encountered and as a consequence, most land uses may need to be restricted and most developments not permitted.

Some planning authorities prefer five or more distinct noise zones. The justification here is that the finer gradation permits the best utilization of land area around airports. When applying noise zoning to existing airports, more specific zones also allow planners to specify the most effective remedial treatments. This approach is particularly effective for short-term planning and in the planning of adjacent industrial areas. European aviation authorities, in Britain, France and West Germany for example, tend to apply the more specific approach to noise zoning. Whatever the approach, the structure of noise zones must be inherently related to the particular environment in which they are applied.

Further planning factors which should be used in determining the spatial extent of land use in the off-airport environs include navigational aid/telecommunication zones, clear and airport hazard areas, building height surfaces and potential bird hazard areas. The delineation of a crash path, for example, is a result of aircraft accident statistics. These crash zones lie in the same direction as the high noise contours but are generally more confined in extent and width. Crash zones may be unnecessary if strong land-use restrictions are applied to the extremely high noise areas.

Since birds are incompatible with airport operations, general control areas defined by three to five mile circles around the airport are applied. Building height surfaces and navigation/telecommunication protection zones are a reflection of the strict Transport Canada Airport Operational Guidelines, which are summarized in Appendix A.

In practical application, the spatial definition of most off-airport land-use distribution restrictions is usually adjusted to follow the outer limits of the nearest convenient property line, section lines or appropriate linear man-made or natural features. This is necessary in order to avoid awkwardly-shaped protection areas which are difficult to recognize and administer.

Airport/Community Comprehensive Planning

Airport planning must be recognized as an integral part of an area-wide comprehensive planning program. The location, size and configuration of the airport should be coordinated with existing and future patterns of residential and other major land uses in the vicinity, as well as with transportation facilities and public services. Conversely, physical development of off-airport uses must recognize the operational aspects and space requirements of the airport, both in the present and future time period. The social and economic impacts, coupled with environmental effects of airport operation can be evaluated in order to guide compatible airport/community land development. When there is a choice, decisions on runway alignment, airport expansion and air traffic volumes, and types of users are as essential to ameliorate and prevent environmental conflicts as are the control and guidance of surrounding land uses.

The application of land-use controls forms only a portion of the total planning process. Local master planning, prepared at the municipal or inter-municipal level, provides the general objectives, policies and

studies necessary for compatible development. The master plans of local governments surrounding Mirabel International Airport, for example, have been coordinated and implemented within a regional master plan. This regional plan defines the major orientation for planning the airport region. The municipalities are required to respect this framework in the preparation of their own master plans. These local master plans consist of four main sections: structure plans, public facility and service programs, municipal planning bylaws, and special studies and plans.¹⁵

As a comparison, airport-related local master planning in Alberta is much less emphasized. Alberta airport legislation provides fairly rigid and inflexible regulations for local municipalities involved in the delineation and administration of airport vicinity protection areas. The provincial government feels that since the influence of an airport is usually on a regional basis, the control of developments that have an effect beyond local areas of jurisdiction should not be left with local municipalities.¹⁶ The regional master plan is therefore prepared as a type of contract between operators of the airport and the surrounding municipalities. Each participant recognizes responsibility to adhere to the conditions imposed. For example, the airport operator has to realize that decisions on land uses, often with a life expectancy of 25 years or more, will be made partially on the basis of NEF noise contours. If some change in airport operational characteristics is not implemented with proper local cooperation, the noise contours could be altered and the entire comprehensive planning process negated.

In Alberta, specific land-use schemes within airport/region master plans contain elements of a plan in that they consider long-term influences and effects of the airport, its role as a regional air transport facility,

and the direction of growth locally.¹⁷ As a land-use control bylaw, such schemes monitor how daily decisions on land uses will affect and be affected by the airport.

Within the overall context of dynamic changes and growth, airport and community planners face severe challenges. The costs and benefits of airport growth have been extensively studied, partly as a reaction to the emergence of a strong public concern for quality of life issues. Despite this, there seem to be few successful airport/community comprehensive planning programs in operation within this country. Although the urban airport forms a major land use and service, it is seldom integrated into the formal planning process of the surrounding community.

Special case examples, such as the Winnipeg Area Airports System Study, have stimulated a renewed cooperation between airport authority and community. However, in view of the urban encroachment and off-airport land-use problems confronting such studies, it is apparent that airport/community interaction within short-term projects must be replaced by an on-going, long-term approach to compatible, cooperative land-use planning.

There is increasing demand for air travel by the Canadian public, with the associated need for new or expanded facilities on the one hand, and growing public opposition to airport development and additional land-use controls on the other. It is against this background that some of the strategies and options open to airport and community planners during the next 15 to 20 years are identified and analyzed in the rest of this paper.

TABLE OF REFERENCES - Chapter III

1. International Civil Aviation Organization, Airport Planning Manual Part 2: Land Use and Environmental Control, Montreal: 1977, p. 2-2.
2. Johannesson vs. West St. Paul (1952) 1 S.C.R. 292, 69 C.R.T.C. 105 (1951) 4 D.L.R. 609.
3. Ibid.
4. Transport Canada, Vancouver International Airport Master Plan Project: General Information, Vancouver: 1974, p. 5.
5. The Environmental Protection Act in the United States, the Canadian National Housing Act provisions for housing in the vicinity of airports, and the Clean Environment Act of Manitoba for example.
6. Urban Systems Research and Engineering Incorporated, Land Use Control Strategies for Airport Impact Areas, Cambridge: October 1972, p. 42.
7. Ibid., p. 16.
8. Department of Transportation, Airports and Their Environment: A Guide to Environmental Planning, Washington D.C.: Office of the Assistant Secretary for Environmental and Urban Studies, September 1972, p. 175.
9. The Regional Municipality of Durham and the Towns of Pickering, Ajax and Whitby, plus the Regional Municipality of York and the Towns of Stouffville and Markham.
10. Department of Transportation, Airports and Their Environment: A Guide to Environmental Planning, p. 176.
11. Central Mortgage and Housing Corporation, New Housing and Airport Noise, Ottawa: Ministry of State for Urban Affairs, 1976, p. 3.
12. Department of Transportation, Airports and Their Environment: A Guide to Environmental Planning, p. 176.
13. Edmonton Regional Planning Commission, Regional Plan Project Position Paper No. 8: Air Transportation/Land Use Policy, Edmonton: December 1976, p. i.
14. Transport Canada, Land Use in the Vicinity of Airports, Civil Aeronautics Branch, Aviation Planning and Research Division, 1978.
15. Department of Municipal Affairs, Planning the Airport Region: Information Bulletin, Government of Quebec, March 1973, p. 53.
16. Letter from Chris Hall, Airport Vicinity Protection Area Planner, Alberta Department of Municipal Affairs to R. Gainer, Land Use Planner, Winnipeg Area Airports System Study, Winnipeg, 13 January, 1978.
17. Ibid.

CHAPTER IV

ALTERNATIVE OFF-AIRPORT PLANNING TECHNIQUES

Alternative and innovative approaches to planning the off-airport environment are being examined on an international scale. Although the techniques and applications may differ, the common objective is to provide an acceptable degree of harmony between the needs of air transport and those of its neighbours. In meeting this objective, Western European airport and off-airport planning, for example, has begun to rely heavily on planned public relations policies of open information exchange within the airport/community environment. Locational factors have also become more prominent in airport planning in that planning elements, such as topography, are being used to physically separate community from airport. At the other extreme are foreign airports with apparently insoluble problems where no degree of technology, land-use planning or public involvement will offer improvements. Both the problems and improvement techniques common to foreign airports are evident in the Canadian airport and off-airport planning field.

Based on the experiences of foreign airport authorities, it seems that the most common approach to the alleviation of airport/community interface problems has been the shifting of offending air traffic to newly-constructed airports. A prominent example here would be the construction of the new Roissy (Charles-de-Gaulle) Airport near Paris, which has diverted air traffic from the older Le Bourget and Orly airports. The new facility at Roissy lies in the centre of a sparsely populated district, and the French authorities took active steps from its inception to avoid future noise

problems.¹ In Japan, the new Tokyo International Airport at Narita was designed and built to inherit almost all Tokyo's international air service from Haneda Airport. However, the new facility has earned a reputation for inconvenience, public opposition and wasted government spending.

The use of zoning to control off-airport land use has not gained an international reputation for success. British and American civil aviation officials have determined that zoning regulations do not appear to be ideal long-term solutions for thickly populated areas in the vicinity of an airport. They feel that when the organizations directly concerned with air transportation succeed in containing airport effects within airport perimeters, then zoning will become unnecessary.²

On an international scale, the most commonly voiced long-term solution to airport/community interface problems seems to be the development of quieter aircraft and engines. However, countries such as Canada have implemented available noise suppression and anti-pollution technology as well as aircraft scheduling techniques, but problems still exist. It must be recognized that the difficulties incurred between two or more highly incompatible land uses are extremely varied. Therefore, any potential solution must meet the requirements of a variety of problem sources. Quieter aircraft will not strengthen weak off-airport land-use control. Improved scheduling will not subsidize residential soundproofing, or alter the municipal tax revenue liability which a public airport may place on the municipality in which it is located. Furthermore, aircraft and noise reduction technology are applicable to most airport situations, but the more basic legislative and planning approaches to off-airport land-use control vary from country to country.

Canadian aviation officials have modified a number of basic airport and off-airport planning approaches found in other nations. The result has

been the development of certain innovative techniques and policy orientations which can be applied to the Canadian situation. As a reflection of the provincial and municipal jurisdiction over off-airport land use in Canada, it is understandable that three out of the five alternative approaches to be discussed originated at the provincial or local level. These alternative planning techniques for the off-airport environment are:

- 1) Provincial Legislation and Special Zoning Powers of Provincial Government
- 2) Local Zoning Bylaws
- 3) Tripartite Planning
- 4) Land Ownership by the Airport Authority
- 5) Federal Legislation

Provincial Legislation and Special Zoning

Powers of Provincial Government

The experience of the Province of Alberta will be used as an example of provincial legislation in the area of off-airport planning. Previous to 1970, the Alberta Planning Act did not include any provisions for governing the development of land in the immediate vicinity of airports. Municipal zoning bylaws and development control provisions relating to airport-vicinity land use followed the guidelines set out by the Ministry of Transport (MOT). Without proper legislation and regulations with which to administer MOT guidelines and zoning recommendations, serious land-use incompatibility problems became increasingly evident in the vicinity of certain Alberta urban airports, notably Calgary International Airport and Edmonton Municipal Airport.

The Calgary Planning Department had been discussing height and construction limitations in the vicinity of the Calgary International Airport with the Ministry of Transport during 1969. Calgary City Council

eventually adopted a comprehensive plan for a specific neighbourhood adjacent to the airport and within the 30 NEF noise contour. Bylaw revisions necessary to implement such a policy were limited in their extent and control by the land-use provisions found in the existing Alberta Planning Act. Therefore, the resulting planning document, entitled "The Protection of Calgary International Airport", included recommendations dealing with the administration of this airport related land-use policy. Following tripartite meetings between local, provincial and federal officials, it was recommended that the issue of airport protection and adjacent land-use control be incorporated into the Planning Act. Eventually, the Province of Alberta Airport Vicinity Protection Area (AVPA) Regulation (Alberta Regulation 291/75) was prepared in response to the original initiatives of the City of Calgary. The Alberta AVPA General Regulations have been reproduced in Appendix B.2.

Airport Vicinity Protection Areas

In 1973, an amendment to the Province of Alberta's Planning Act permitted a municipality, with provincial approval, to establish an airport vicinity protection area for any airport within its jurisdiction. The primary role of an AVPA is to regulate land uses in close proximity to airports in order to facilitate the safe and efficient control of air traffic and to reduce the adverse impact of airport operations on surrounding communities.³ The regulation of land uses for traffic safety is a logical objective, and a significant body of technical information is available and adaptable to virtually every airport situation. This information covers the areas of aircraft noise, noise effect and noise abatement, height controls, electronic and visual interference and bird hazards. The reduction of adverse effects is more subjective and involves a higher degree of intuitive understanding of particular circumstances and a sensitivity to the

area in question.

As illustrated in Alberta Regulation 291/75, an AVPA regulation may be prepared by a municipality within which all or part of an airport lies, or by the Province in a situation where a municipality defaults on its option to do so. The general regulations refer to the development of a land-use control scheme for an AVPA. This is required because once the land use has been enacted as a specific regulation by the Province, the municipality or municipalities affected must amend their land-use or development control bylaws in accordance with the AVPA legislation.

The AVPA regulations specify the controls that must be exercised in an AVPA. The height controls are already enforced in areas adjacent to larger airports through Transport Canada airport zoning ordinances enacted under the National Aeronautics Act. The AVPA legislation allows for the enforcement of similar height controls for smaller, more rural airports which previously lacked such formal ordinances. Noise controls are based on Transport Canada NEF zone delineation. Modified general aviation noise contours are applied to smaller airports. Additional controls also deal with developments which can affect safe and efficient airport operations. These controls guard against smoke, electronic interference, bird attractions and other hazards which are detailed in the Transport Canada publication, "Land Use in the Vicinity of Airports".

Airport Vicinity Protection Areas are no longer referred to specifically as such in the new Alberta Planning Act (1977), but are encompassed in the regulations for "Special Planning Areas". However, the enacting legislation still provides that AVPAs will be established formally by Order in Council. The regulations remain unchanged, and are fairly rigid and inflexible, especially since no amendment procedure is available. One of the reasons for this exclusion is that, in most cases, the influence of an airport is of

a regional nature, and consequently it should not be left to the local municipality to control developments that have influences extending beyond their direct sphere of influence. However, in order to ensure consistency with the Planning Act, an appeal of an AVPA decision may be made to the Provincial Planning Board.

Essentially, the AVPA document is prepared as a contract of sorts between operators of the airport and surrounding municipalities. Each participant recognizes responsibility to adhere to the conditions imposed. The regulations also take precedence over existing regional plans, statutory plans or land-use bylaws. Within the regulation, the airport operator must realize that decisions on off-airport land use, often with a life expectancy of 25 years or more, will be made partially on the basis of NEF contours. If a change in operational characteristics of the airport appreciably alters the NEF contours, the existing planning process is negated and revised AVPA regulations and accompanying bylaws must be developed.

AVPA Administration

The administration of an AVPA involves a number of government levels, each with slightly differing objectives and authority. The federal government, through Transport Canada, clearly has a direct interest in maintaining the full operational potential of the airport, but still has limited authority in regulating land uses surrounding the facility. The local municipality usually recognizes the importance of maintaining the long-term viability of the airport due to its local economic base contributions. However, the municipality also tries to avoid any future revenue loss from strict land-use control which may prohibit certain developments, especially when local autonomy is forfeited to ensure impartiality between involved municipalities. The prohibition of certain incompatible developments applies

in most cases to residential land use. Housing is not a major source of local tax revenue for most municipalities, but may be seen as essential if a housing shortage is evident. The provincial government acts as a central authority, presumably directing its powers through the AVPA solely on the basis of how individual land uses affect or are affected by the operation of the airport.

Developing specific AVPA mechanisms to meet the legislation objectives without extending into areas of responsibility not directly related to the airport is extremely difficult. The Alberta legislation can interfere with local planning autonomy to a considerable extent by taking precedent both in terms of implementation and administration. However, this problem can be minimized by permitting the local authority to amend land-use designations under the AVPA regulations without a separate Order in Council. This modification may be difficult for the Province to accept at this time since the original intent of provincial authority would be superceded. Such a change is practical, however, since the Minister of Municipal Affairs would have to be assured that any proposed use or designated use suggested by a local government for an AVPA would not violate the intent of the protection area.

An additional problem associated with AVPA administration involves the requirement that all applications to develop land for a non-residential use must be submitted to various provincial departments to determine the suitability of the use adjacent to the airport. The purpose of the protection area regulation is to outline the limits to which development can take place. In this respect, provincial consideration is only necessary for those uses which may interfere with airport operations. This consideration does not automatically apply to all residential proposals, but only to those that are within the 30 NEF noise contour. Since the existing AVPA regulations now in

existence in various Alberta communities basically apply to building restrictions and land-use compatibility tables, precise limits and controls are not offered to specific land uses. This lack of detailed regulations has necessitated the overall circulation and review of development applications within an AVPA among a substantial number of involved agencies. It is obvious that all industrial and possibly commercial applications must be reviewed by provincial authorities in order to provide an acceptable degree of compatibility between the proposed use and the airport. However, for uses other than these, the local development officer or planning department should be sufficiently qualified and informed to determine which development proposals should be forwarded for provincial and Transport Canada approval, and which can be handled at the local level.

AVPA Land Use Schemes

Airport Vicinity Protection Areas are administered through specific land-use schemes which fall somewhere between a plan and a land-use control document. The document contains elements of a plan in that it considers long-term influences and effects of the airport, the role of the airport as a regional air transportation facility, and the direction of local growth. As a land-use control bylaw, the document monitors how current decisions on land uses will affect and be affected by the airport. This dual purpose is accomplished by incorporating the main elements of each into the regulations.

For example, all land uses permitted under any municipal land-use control bylaw⁴ within the protection area are listed in the regulation and assessed individually on the basis of their desirability within certain NEF zones. These uses are also assessed on the basis of where such development is likely to take place. However, categorizing land uses on the basis of noise contours alone will not always satisfy other compatibility considera-

tions, such as "proximity to airport operations". It is for this reason that in addition to including NEF zones, the AVPA regulations also establish land-use zones similar to those existing in a land-use bylaw. The basic distinction between the AVPA land-use zoning and land-use bylaws is that the protection area will not differentiate between categories of land use (R1, R2, or R3 for example), but will offer only general classifications (in this case Airport Residential).

The use of AVPA land-use zoning allows a more detailed analysis of individual uses as they relate not only to the airport, but to other external elements. To illustrate this flexibility, a large industrial sector within the Town of Leduc falls within the 40 NEF zone of the Edmonton International Airport Protection Area. Under the AVPA regulation, virtually all industrial uses, except those directly related to aviation, are prohibited in the 40 NEF zone. The Town complained to the Province that this prohibition would cause considerable hardship to the community in terms of lost industrial attraction and tax revenue. Certain industrial uses which would not interfere with airport operations or flight safety were subsequently permitted in the high noise zone to accommodate local needs. At the same time, the Province felt it would be undesirable to set a precedent which would have industrial uses generally permitted anywhere within the 40 NEF contour. It was determined that since the remaining industrially zoned lands in Leduc are not within the high noise contours, continued industrial development within the 40 NEF would not occur.

Local Zoning Bylaws

In practical terms, the adoption of local zoning bylaws provides an appropriate tool to control land use in the vicinity of airports. Height zoning within local bylaws has been commonly used in certain Canadian urban

centres with little opposition or criticism. This type of application has been readily accepted because large tracts of land are not involved, and because the limitations are based on strict federal aviation safety standards. However, these aviation standards have not included actual land-use restrictions other than for building height. Unless the Aeronautics Act is amended, the lack of federal legislation governing adjacent land use will result in future opposition to the use of land-use zoning as a tool to control off-airport land use.

Many opponents of the zoning bylaw approach state that zoning should not be used as a substitute for property expropriation in the vicinity of airports. Expropriation or land purchase by the airport authority provides compensation to owners. In the case of restrictive zoning, objections have been raised that property rights are expropriated without any compensation to the owner. The argument can be logically expanded to the point where all zoning bylaws are unfair in that property rights are limited. In practice however, zoning bylaws do not take away an owner's right to continue the existing use of the property, or to develop acceptable alternatives. Legal problems arise when quasi-zoning or local policy is exercised in place of formal zoning bylaws to control the use of land.

This problem was recognized in Calgary prior to the enactment of the Calgary International Airport Vicinity Protection Area regulations in 1977. Although Calgary was one of the first North American cities to include such a comprehensive land-use control mechanism in its local Zoning and Development Control Bylaw, City Council had previously relied on a single policy as the basis for judging land-use proposals in the vicinity of the airport.

In the early 1970's Calgary City Council followed a policy wherein further residential development in the area lying within the 30 NEF contour

of the Calgary International Airport would not be supported. Although this was a responsible action on the part of the City, it was not adopted as policy and incorporated into the City's zoning bylaw until 1974.

Fortunately, the majority of land in the vicinity of the airport, at that time, was unserviced and undeveloped. The majority of land had been placed in a "holding district" zone which did not allow any development whatsoever. Many landowners and developers were hardpressed by this zoning freeze, and the pressures that were consequently placed on the City resulted in the reclassification of these lands to allow for more flexible control. The result was the initiation of the "AP" or Airport Zone classification within the local zoning bylaw.

At the time of enactment, adjacent land to the north, south and west of the Calgary airport was included within the City of Calgary. To the east, the land fell within the jurisdiction of the Municipal District of Rockyview. In 1974, the adjacent land within the City had not been serviced, and therefore was not ready for intensive development. The land within the Municipal District was zoned Agricultural. It became the intent of the City to rezone all their lands adjacent to the airport as "AP" as servicing became available.

According to the 1973 report, "Protection of Calgary International Airport", the purpose of the Airport Zone is to provide for land development which does not conflict with the operation of the airport, and to provide compatible land use within the airport's 30 NEF noise contours.⁵ The Airport Zone became the legislative tool to restrict the introduction of residential development within the 30 NEF.

As a result of the application of a local zoning bylaw as an alternative to the freezing of land in the vicinity of an airport, the special "AP" zoning classification allowed for a variety of uses, with the only exception

being residential within a certain noise area. Within the Calgary Land Use and Development Control Bylaw, the "AP" designation stipulated clearly the basic requirement of the zone in terms of building height and materials, site development standards, and maintenance (which is important in order to avoid bird attractions). Specific land uses which are acceptable within certain noise zones are listed in terms of permitted and conditional uses.

The "AP" designation within the Calgary zoning bylaw provided an interim land-use control mechanism for the City from 1974 to 1977, when the AVPA regulation for the Calgary International Airport was enacted. This application of the local zoning bylaw is recognized as a positive land-use control technique, when compared to the land freeze approach of a "Holding Zone" designation. The City was aware, in 1973, that recommendations were being made to change the Alberta Planning Act to include specific regulations for the control of off-airport land use. However, the AVPA legislation, as enacted in Alberta Regulation 291/75, was not formalized until two years later. It seems evident that, had the AVPA legislation not been enacted, the City of Calgary would have still possessed a viable alternative in their application of the "AP" zone.

The use of the local zoning bylaw is not equally applicable in situations where more than one municipal jurisdiction exists in the vicinity of an airport. In these cases, it is possible to establish a comprehensive zoning pattern through proper coordination and cooperation among all local governments involved.

Local zoning bylaws can also be applied in a positive, constructive manner, as an alternative to the more restrictive land-freeze approach, which is typical of most off-airport zoning at the local level in Canada. This type of restrictive zoning can stagnate urban development, and has resulted in hesitant decision-making by local development approval authorities.

The positive utilization of the "AP" Airport Zone in Calgary has shown that the orderly development of off-airport land uses can be accomplished through the local zoning mechanism. The Airport Zone designation provides for land uses which are not only compatible with aviation operations, but which are economic prerequisites for a successful airport/community interface.

Tripartite Planning

Considerable federal-provincial friction has been generated recently on the matter of the location and operation of airports. Airport site location has been a federal decision, with only limited consultation with the affected province. This lack of communication was seen in the selection of sites for the new Montreal and Toronto international airports. However, the siting and viability of a major airport has far-reaching effects at the provincial level. A large airport provides employment opportunities and a general stimulus to the economy of the surrounding area. It also interferes with residential and other development in the immediate vicinity, but provides a locational attraction for commercial development in the area. In short, the airport exerts a general influence, by its location and operation, on patterns of urban growth and development in the surrounding region.

Large airport facilities impose a considerable servicing burden on the municipality in which they are located in terms of water, sewage and power utilities. At the same time, the airport may drastically reduce the municipality's tax base while encouraging other municipal revenue generating activities. It has been estimated that 65 to 70 per cent of the net cost of all publically-provided services, including highways, for a new airport are within the sphere of provincial-municipal jurisdiction.⁶

The federal acquisition of buffer areas, facility areas or noise lands in the vicinity of an airport has important implications for neighbouring municipalities in terms of available tax revenues. Retention of municipal land by the federal level will generally put such land beyond the reach of municipal property taxes, although grants in-lieu of taxes may be made by the Crown. However, these grants may be lower than the otherwise available tax yield of the land. Federal land purchases or controls may also prove incompatible with the adjacent zoning regulations.

The federal involvement in the airport zoning function is presently limited to the imposition of height controls on and adjacent to the airport. Whether this is a default of federal responsibility or not, the prime authority for control of land use in the airport vicinity presently rests with the provinces and their municipalities. Based on this factor alone, it seems evident that provincial and municipal governments should have a greater role in the planning and management of off-airport lands. Regarding zoning in the airport vicinity, the responsible jurisdiction in this case is primarily the province, with the federal level having certain authority within the Aeronautics Act to limit activities and structures which interfere with safe airport operations. However, the federal authority has not been extended to cover the regulation of peripheral land uses. In any case, the provinces may clearly act, in the absence of conflicting federal regulations, to reduce the land-use conflicts in the airport/community environment by restricting or controlling development in the airport vicinity.

Both the role and authority of the provincial and local levels of government in the planning of airport/community compatibility have been recognized by Transport Canada. For this reason, the national program of long range aviation planning for all major Canadian airports has involved a tripartite approach to airport master planning and off-airport land-use

planning. Two prime examples of this tripartite approach to planning are the Edmonton Area Aviation System Master Plan Study and the Winnipeg Area Airports System Study.

Edmonton Area Aviation System Master Plan Study

In the early 1970's, The Ministry of Transport undertook a major national program in long range aviation planning. The objective of this program was to provide a framework for the orderly and timely development of the various elements of the national air transportation system.⁷ The development of area master plans became an integral element of this program.

During the implementation of the specific aviation planning exercises, the local municipalities with jurisdiction over the airport or over land adjacent to the airport under study were included as integral participants of the planning team. Aside from the strictly aviation or national transportation system aspects of the area master plan, the plan included concerns which were relevant to the municipalities concerned. Obviously, the air-space of an airport affects the surrounding communities. However, the area master planning also made recommendations relating to local and regional air service, demography, geography, urban and regional ground transportation, and existing socio-economic indicators within the airport region.

In the past, aviation planning tended to be based on relatively short term criteria. The results of this approach are presently evident in Canada at some of our major airports where past inadequacies in the areas of transportation network planning and airport/community planning have led to increasing pressures from encroaching urbanization. Since the inception of area master plan programs in 1970, the role of the local municipality in successful regional airport operations has been reflected in the inclusion of additional study areas of particular interest to the municipality.

The inception of the Edmonton Municipal Airport Master Plan Study in 1971 provided an opportunity for the City and other Canadian municipalities involved in similar studies, to examine its position in air transportation. This examination not only included the general area of air service within an urban and regional network, but the physical, social, environmental and economic relationships between the community and the airport. The first stage of the Edmonton study, as with area master plan studies for all airports in the program, involved the determination of capacity, expandability, deficiencies and the forecasted level of aviation activity demand at the Edmonton Municipal Airport. The following matrix indicates the areas of responsibility within the Edmonton study assigned to MOT, the City and the Province of Alberta. Inputs were also required from other interested agencies, such as air carriers, general aviation companies and the Department of National Defense.

As can be seen from this matrix in Figure 4, Transport Canada's approach to tripartite airport systems planning has resulted in area master plans which have analyzed multi-governmental facets of the urban airport as a land use. In each planning exercise, a prime outcome has been the production of compatible land-use plans for the vicinity of each airport.⁸ Unfortunately, the effectiveness of these land-use plans as a means of controlling off-airport land use varies between municipalities. In effect, the plans are no more than planning guidelines which must be reflected in the decisions of local councils and provincial ministers.

Transport Canada has generally followed area master plan land-use guidelines in the expansion of existing facilities. Public opposition or criticism of airport/community relations tends to impact most heavily on this Ministry. As a reaction to potential governmental and public pressures, and in recognition of the role of Transport Canada as the senior partner in

Figure 4

CITY/MOT RELATIONSHIP OF STUDY ACTIVITIES
Edmonton Area Aviation System Master Plan Study

	<u>MOT</u>	<u>City</u>	<u>Prov. of Alta.</u>
1 Effects of Commercial operations at Edmonton Municipal Airport	X	X	
2a If Municipal Airport continues to operate			
(i) Necessity for traffic restrictions	X		
(ii) Effect of PWA airbus		X	
(iii) Control tower requirements	X		
(iv) Terminal Building requirements	I	X	
(v) Runway requirements	X	I	
(vi) Effect on development of the City	X	X	I
b If Edmonton Municipal operated as a satellite airport			
(i) Economic impact of moving all commercial operation to International Airport	I	X	
c Future Area Airports concepts			
(i) Wide body aircraft facilities at the International Airport	X		
(ii) Municipal Airport for STOL* and PWA service	I	X	STOL = Short Take-off and Landing Aircraft
(iii) A new General Aviation Airport	X	X	
d If Municipal Airport closed			
(i) Requirements for other airports	X	I	
(ii) Economic impact on Edmonton	I	X	
3 STOL concept as it applies to:			
a Effect on service to north	I	X	I
b Effect on Edmonton market area		X	
4 Commercial scheduled and non-scheduled services			
a Compatibility and desirability of portions or all at Municipal	X	I	I
b Possible distribution in alternative systems	X	I	I
5 Overall Transportation Picture			
a Road access	X	X	X
b Rapid transit	X	X	X
c STOL	X	I	I
d Downtown passenger processing	X		I
e Central freight depot	X	X	I

X = Studies major portion of that activity
 I = Has input to the study of that activity

tripartite planning programs, the federal government has accepted airport area master plans as its foremost airport planning guideline.

Municipalities do not tend to implement tripartite airport planning guidelines with the same degree of uniformity. The responsibility of providing for compatible off-airport land use lies primarily at the local level, where development decisions are based on more factors than the recommendations of an airport area master plan. However, where municipalities such as Calgary and Edmonton have followed their involvement in tripartite airport systems planning with the implementation of effective off-airport land-use bylaws, their continuing responsibility within a multi-leveled planning program is ensured.

The continued involvement and cooperation of tripartite governments in airport planning matters may lessen over time. As a result of a number of factors, such as the default of responsibility by one level to enact proper off-airport land-use legislation, the original effectiveness of the area master plan may be negated. With the recent introduction of spending restraints by all levels of government, the issue of financing airport/community compatibility plans has also tended to delay implementation.

Winnipeg Area Airports System Study

The Winnipeg Area Airports System Study (WAASS) was initiated in 1976 as a project of the federal government undertaken by the Central Region of Transport Canada. One of the main objectives of the study was to develop a compatible land-use plan for the lands in the vicinity of the Winnipeg International Airport to ensure the long term viability of the site and prevent future land uses which are environmentally unacceptable.

The main social consideration of the study was to remove noise exposure as much as possible from the urban area surrounding the airport.

Since the Winnipeg International Airport is surrounded by urban development on three of four boundaries, the reduction of noise effects on surrounding neighbourhoods involved the full cooperation of a tripartite planning committee made up of local, provincial and federal planning officials. In addition to the noise issue, six other elements of the study were addressed by the planning committee. These included safety, urban growth patterns, aviation-related industrial growth, public participation in the planning process, environmental protection and land-use planning.

This latter issue of land-use planning became crucial as the study progressed. Without compatible zoning around the airport, any of the airport planning and expansion alternatives which were produced by the WAASS planning team would be prejudiced, resulting in the extension or re-creation of community concerns which presently exist in the surrounding neighbourhoods.

The existing and future problems associated with both airport and community development had been identified in the early phases of the project. During these phases, there was a high level of community interest and input dealing with how the airport was and will continue to affect the lives of those in its vicinity. The public and technical inputs were received and translated into alternative airport development scenarios. Once the ultimate scenario had been chosen by Transport Canada, it was recognized that a tripartite governmental agreement was necessary in order to provide for future compatibility in the zoning and development of off-airport lands. In this way, the final airport master plan and expansion potentials would not be jeopardized, and past community concerns regarding airport operations and effects would be minimized.

In spite of the technical work by Transport Canada, and the assistance given to the project by public involvement, effective control of

incompatible or noise sensitive land uses can only come from the provincial and municipal levels of government. In the case of the WAASS project, the tripartite planning committee was to examine methods available to implement land-use controls, determine the restrictions to be applied to noise sensitive lands, and formulate an agreement of implementation which would be authorized at the appropriate level. This agreement would be binding on all parties, and would define the areas in which land-use controls would apply, along with the type of restrictions within each area. The land-use controls thus agreed to would enter the formal channels for development and formal enactment by the governments concerned.

A number of basic problems were encountered in the tripartite approach to the WAASS project. Firstly, the three levels of government provided varying and conflicting recommendations regarding the basic land-use control approach to be used. The recommended approach of one level of government either conflicted with the jurisdiction of another, was too difficult or complicated to develop and administer at the local level, or resulted in an unbalanced control situation which would favour one jurisdiction over another. Secondly, a land-use control technique which would be available to the federal level, for example, would require amendments to be made to the Greater Winnipeg Development Plan, and would also involve the possible production of new development plans for urban areas in the airport vicinity. Third, certain existing control mechanisms, such as the "Rural" designation in the Development Plan, would be limited in their application and adequacy. Such a general zoning designation is generally adequate for purposes of noise protection, but it is too restrictive in terms of the City's long-term development and growth.

The involvement of Transport Canada in an area of local and provincial responsibility may result in further tripartite planning problems.

The Winnipeg example showed that if Transport Canada evolves as the major participant in a land-use control strategy based on zoning, it may become overly-involved in the administration, especially in the area of zoning variances. Long-range planning controls are also required by Transport Canada in the control of off-airport lands. The Ministry requires a development plan which contains specific regulations for noise exposure, height restrictions, and land-use planning. Although the controls must be specific, they should not be concrete or inflexible since airport operational changes are usually expected over time.

Finally, any Transport Canada regulations to control off-airport land use would require legal authority similar to that found in the Aeronautics Act regarding height regulations. Such legal control techniques would best be administered through an intergovernmental arrangement with the local level and its zoning or development control bylaws acting as administrator. The local level has the staff and system to most effectively implement such responsibilities, although an agreement between Transport Canada and the municipality, in the form of a bylaw, would be necessary to define controls and responsibilities.

By using the WAASS project as an example of tripartite planning administration, three issues emerge which define the requirements of the intergovernmental approach. First, the land-use controls developed through this planning approach must be secure in nature so that amendments are not easily added. In this way the long-term viability of the off-airport controls is protected from incompatible urban encroachment. Secondly, the tripartite land-use control strategy should not require the ongoing vigilance of Transport Canada. With a minimum of administrative input required from the federal level, policies of a more site-specific nature can be determined by the local government participant or participants.

Finally, the control strategy and techniques must be simplified so that they may be readily applied and interpreted by all involved jurisdictions as well as the public.

The WAASS project in Winnipeg provides an excellent example of how these essential elements of a successful tripartite planning strategy have been integrated. Agreement was reached on an off-airport planning strategy which would utilize two existing land-use mechanisms available at the local level. The Greater Winnipeg Development Plan and Zoning By-law will be applied in governing land use for the various jurisdictions surrounding the airport. The use of the Development Plan was accepted because it is the basic planning document for the City and surrounding region, and as such requires land use in Greater Winnipeg to be compatible with its regulations. As an additional control mechanism, the use of urban community and rural municipality zoning bylaws for the areas surrounding the airport is the most desirable approach to specifically define areas affected by the airport. These revised bylaws would include land-use provisions for the "airport impacted" areas, which would be defined by the airport operational contours as described in Appendix A (clear and airport hazard areas, navigation aids/telecommunication protection areas, bird hazard areas, noise zones and building height surfaces). Land uses within these specific contours would be categorized as permitted, not permitted or conditionally permitted. These options would be incorporated into the various zoning or development control bylaws affecting the airport peripheral area. The compatibility of land uses within each operational contour would be specifically described in terms of the three development options, similar to the land-use compatibility matrix approach illustrated in Appendix B.

Land Ownership by the Airport Authority

A principal protective measure in the planning and control of the airport/community interface is space: the distance between potentially disturbing airport operations and the general community. Buffer zone planning will assist in reducing air pollution and noise since the concentrations of both of these airport elements will decrease as the distance from the source increases. It has become common practice throughout the world, and in Canada, to build new airports on large tracts of land, or in some countries such as Japan, on islands remote from the shore.

In addition to environmental considerations, the development of airports on large tracts of land provides a growth potential for the facility over its planned lifespan. For example, a facility such as the Regina Airport may have to be moved to a more open site in the next ten to fifteen years.⁹ It would seem that the best approach in such long-range airport planning would have Transport Canada or the provincial government acquire land for a future airport site in the Regina region. This land would then be leased back to farmers or whomever might conditionally use it, and eventually be developed when the need arises. In this way, complete airport operational, hazard and expansion areas adjacent to the future airport would be insured. However, until recently, there has been no policy to land bank for airports in Canada.

The long-range airport planning approach involving land banking through ownership by an airport authority has only recently been applied in the case of the new Montreal International Airport at Mirabel. The airport authority in this case is Transport Canada. As a result of the high cost of purchasing large tracts of land with no potential revenue available for ten to twenty years, the land ownership approach is basically limited to federally owned and operated airports.

The decision to proceed with the construction of a second international-class airport for Montreal was based on a twenty year forecast of air traffic increases. These forecasts indicated that the existing airport at Dorval would not only have required new terminal facilities but, by 1985, an extensive and costly land purchase program in a highly urbanized area would be necessary for runway network additions. As early as 1970, the Dorval airport site in Montreal was being threatened by extensive urban encroachment from the surrounding region. For this reason, expansion of the existing facilities at Dorval was believed to be physically and economically objectionable.

Transport Canada decided that the most logical solution to the Dorval problem would be the construction of a second international airport in the Montreal region. A second airport would not only ensure adequate air transportation services for Canada's eastern region in the Montreal area, but would discharge the growing public objection to Dorval expansion. In order to protect the lands around the planned airport site, approximately 85,000 acres of land were expropriated by the Crown. In this way, Transport Canada would be assured that the new Mirabel airport would be protected from urban encroachment, and future land use in the vicinity would be protected from possible airport encroachments.

At Mirabel, full compensation was provided to existing landowners in the airport vicinity because all necessary airport-affected areas (the 85,000 acres) were expropriated. The problem of expropriation without compensation, which has been attributed to strong airport zoning measures, has been avoided in the case of Mirabel. Claims for injurious effect compensation as a result of airport operations have been avoided with the total expropriation of all airport-affected lands in the region of the actual airport site.

The Government of Quebec has recently prepared a development plan for

the airport region. The objective of the plan is to provide for a rational distribution of activities in the vicinity of the airport.¹⁰ The main goal of the plan is the resolution of conflicts between human activities and the generation of noise.¹¹ At the same time, the municipalities within the region have developed elaborate master plans and zoning bylaws within the framework of the regional plan. The federal government has also established a plan of aircraft flight paths compatible with both existing and future urbanization.

Since the decision was made to establish a new airport in the Montreal region, the federal and provincial governments have collaborated in order to ensure that Mirabel can function efficiently twenty-four hours a day. The acquisition of the vast area around the airport proper responds in the first instance to the objectives of maximum efficiency in airport operation. Throughout the planning of the airport region, the two government levels have recognized that the objective of optimal exploitation of the region can be compatible with harmonious development.

The purchase of airport-vicinity lands by the federal government has met with occasional opposition and strong criticism. The major area of criticism, in terms of land-use control, has been that optimal exploitation of off-airport land could be accomplished without massive land purchases. The argument follows that if strong land-use controls for the region were implemented by a regional authority in cooperation with provincial and federal policies, there would be no need for the land acquisition approach. However, Transport Canada officials have stated that the land ownership solution might not have been applied in a case such as Mirabel if comprehensive zoning provisions for off-airport and airport lands had been available to the Ministry. These comprehensive zoning provisions are found in the proposal to amend the Aeronautics Act (Bill C-4) and in the Alberta

Planning Act.

A second attempt at overall land acquisition by an airport authority has been made in the case of the proposed second Toronto international airport at Pickering. Transport Canada originally planned to expropriate lands in the region surrounding the proposed site. However, the purchase cost of the necessary 88,000 acres was prohibitively high as a result of inflated dollar value, speculation in the Pickering area, and strong public opposition. As a result, the provincial government and Transport Canada reached a joint agreement which would result in 79,000 acres of land being reserved for airport lands near Pickering. This land acquisition approach differed greatly from the Mirabel example in that the Province of Ontario was to freeze development on 60,000 acres. The federal government would only have to expropriate 19,000 acres. No compensation was to be paid to landowners in the so-called freeze zone.

The Province of Ontario attempted to freeze the proposed off-airport lands through the use of its legislative zoning powers found in the Ontario Planning Act (Section 32(1) (a)). The provincial freeze has, since the beginning of the aborted Pickering airport project, been struck down by the Ontario courts but upheld by the Supreme Court of Canada. However, extremely strong public opposition to the provincial freeze of Pickering airport lands stressed the issue of provincial expropriation of property rights without compensation. As a result, the provincial activities within the Pickering project became an extremely sensitive political issue during the 1975 provincial election. The Ontario government pulled out of the federal-provincial partnership in the Pickering project, which in effect stopped the project before initial construction had begun.

Federal Legislation

The fifth alternative approach to off-airport land-use planning involves the enactment of effective federal legislation in this area. The Canadian experience in improved federal control of the off-airport environment has been limited to the creation of Bill C-4. Therefore, this section involves the expansion of federal legislation as proposed in this Bill.

Bill C-4 was introduced in Parliament in 1977, and provides amendments to the Aeronautics Act in order to protect federal airports and airport sites from urban encroachment and associated operational restrictions. The Bill includes provisions for federal intervention in land-use zoning in the vicinity of federal airports where municipal, regional or provincial authorities are unwilling or unable to act - clause 4.6(2). By extending the federal land-use control powers of the Aeronautics Act, the Bill would enable Transport Canada to establish protection areas around existing federal airports and proposed airport sites. These provisions were in response to the lack of provincial involvement and legislative responsibility in off-airport land-use planning, while recognizing the federal government's investment in the air transportation sector.

Unlike the existing Aeronautics Act, provisions in Bill C-4 differentiated between public and private airports. Public or federal airports are those where ownership is vested in the Crown. Private facilities are owned and operated by municipal corporations, provincial governments or private agencies. In both cases, the airport is licenced by Transport Canada. Within clause 4.3 of the Bill, private airports would continue to be protected by the general height, use and location provisions relating to navigation and airport operations that are presently found in section 6(1)(j) of the Act. However, the Minister of Transport is also empowered to regulate the use of lands surrounding federal airports where, in the

opinion of the Minister, such use is incompatible with the operation of an airport. More effective zoning, imcompatibility and compensation provisions under federal jurisdiction are offered to public airports in clause 4.6 of the Bill. In this way, both types of facilities are protected in terms of navigation and airport operations, but federal airports receive added consideration through protection area zoning and ultimate federal responsibility.

Additional public airport provisions in Bill C-4 would also permit existing non-conforming uses to continue within designated protection zones, unless specifically prohibited or restricted elsewhere in the Act or by the Minister. The compensation aspects of the Aeronautics Act are also amended to provide compensation only when an existing non-conforming use is prohibited or restricted. Compensation would be provided only in cases where the federal government exercises powers in excess of those enforced under provincial legislation. This approach was designed to avoid interference with planning controls and compensation laws that other government levels might exercise.

In addition to the protection area zoning, and incompatibility and compensation provisions within Bill C-4, amendments regarding user fees, licencing, carrier charges and facility inspections are also included. All provision areas have generated strong reaction from both the aviation industry and from the members of the Standing Committee on Transport and Communications. As a result of numerous and lengthy hearings, and the change in government, by 1980 there was no indication from Ottawa as to when or if Bill C-4 amendments would be implemented into the Aeronautics Act.

At the political level, the delays and problems associated with Bill C-4 stem from three major areas of contention. The first involves

the extension of federal power into an area of provincial jurisdiction. Transport Canada maintains the position that land-use controls around airports should properly be exercised by provincial and municipal governments. To guarantee protection of federal investment in aviation however, Transport Canada is also seeking legislative power to impose federal land-use controls where the provinces are unwilling or unable to act. In effect, clauses 6.1(1) to (12) of Bill C-4 provides Ottawa with the power to freeze large areas of land around existing and proposed federal airports.

A number of critics interpret these provisions as an economic tool in the control of off-airport property where land values are so high that the federal government cannot afford to expropriate large acreages. Other critics argue that by taking over the implementation of protection area zoning from a province which is unwilling to act, Transport Canada would be assisting a province which possibly acted illegally, or *ultra vires*, in not meeting its responsibility.

Finally, it is debatable whether potential involvement of the federal government in a provincial area of jurisdiction will be an incentive or disincentive for the provinces to act. Based on past examples of federal-provincial rivalry, and requests for increased provincial autonomy, it is speculated that additional federal power over off-airport land-use planning would act as an incentive for provinces to implement their own airport protection area legislation. This incentive would be especially strong in provinces which own and operate provincial airlines, such as Norontair and On Air in Ontario, or Pacific Western Airlines (PWA) in Alberta. These provinces would benefit from the establishment and implementation of provincial protection legislation as a means of protecting their public investment in provincial air services and provincial airlines.

It is also possible that federal involvement in an area of provin-

cial responsibility could act as a disincentive to provincial involvement. Provinces may not act in highly visible and politically-sensitive cases of urban encroachment, as in Thunder Bay or Regina, with the knowledge that Ottawa has the final responsibility for rectifying the situation. In this way, the federal government becomes involved in public disputes and criticisms, as well as possible compensation actions, while the provinces avoid any adverse reactions.

The second problem area relating to Bill C-4's zoning provisions involves the issue of compensation. The Aeronautics Act provides for compensation for injurious effect on property owners as a result of height zoning. The amending provisions are more restrictive, and would provide compensation only in cases where existing non-conforming uses are specifically prohibited or restricted by the zoning regulation in effect. In these situations, clause 6.10 of the Bill would allow compensation for expropriation of property rights. It would reflect any decrease in property value resulting from the implementation of the zoning regulations, minus any increase in value of the land which is attributed to the airport or airport site. Therefore, the compensation provision does not reflect the speculative value of property.

The provisions would provide compensation for the imposition of a restriction, but not for the imposition of an injurious effect. Critics argue that existing and future residents in the vicinity of airports would still have to contend with injurious effects such as noise with no opportunity for compensation.

The compensation provisions do not include any appeal procedures for such actions. In addition, no appeal rights are included to cover cases where residents, for whatever reason, either wish to be included or removed from a designated protection zone.

The third major problem area relating to the zoning provisions of Bill C-4 deals with the issue of separate conditions for public and private airports. The existing zoning powers for private airports are not increased in any way. At the same time, powers of the public airport and Transport Canada are substantially increased compared to the existing Aeronautics Act provisions. However, many private airports play an important role in regional and national air transportation. Private satellite airports such as the Winnipeg area's Morden airport or Buttonville airport near Toronto are privately owned and operated, but publicly licenced by Transport Canada. This type of facility accommodates flight training and recreational flying by non-jet, light aircraft, which in turn enhances safety and relieves projected congestion at major public airports. It is also true that private airport operations are as equally threatened or potentially affected by urban encroachment and incompatible off-airport land use as are public facilities.

All federal-provincial committees on regional air transportation were briefed on the proposed amendments to the Aeronautics Act in 1977. No complaints were registered from the provinces at that time, and increased provincial legislative responsibility in aviation and airport protection zoning was given initial support. However, as can be seen from the previously noted criticisms, the private aviation sector and a number of local government officials have opposed the overall direction and implications of the amendments. As a result, implementation of new federal off-airport planning legislation has been stalled indefinitely. Based on the political criticism of this Bill, and on the informed opinions of aviation industry and Transport Canada officials, it seems that it has been delayed as a result of governmental sensitivity to provincial

complaints. This reaction stems from the proposed increase in federal powers over provincial and local governments that would result from the Bill. Additional problems have also been noted which relate to the federal intervention in an area of historic provincial jurisdiction, namely land-use planning.

Conclusion

In conclusion, it should not be surprising that the five alternative planning approaches reviewed in this chapter deal with the legislative and administrative aspects of off-airport land-use control. There are a number of technological alternatives presently available to alleviate airport/community incompatibility problems. The mechanics of the technical approaches are adaptable to all airport situations. In fact, Canadian aviation authorities and Transport Canada have been extremely receptive to the experimentation and application of new noise and pollution reduction technology at major Canadian airports. However, suppression technology is a limited and interim approach which screens the problem for the present, but does not provide any long-term solutions. The basis of problem alleviation in the airport/community interface, and the development of improved conditions for both parties requires the implementation of more progressive land-use-control legislation.

As a reflection of the provincial and municipal jurisdiction over land use in the vicinity of Canadian airports, it is understandable that three of the five alternative planning techniques reviewed in this chapter have originated or are administered at the local and provincial levels. Transport Canada has no real legislative incentive to improve the off-airport environment. The responsibility has been left mainly with more localized authorities. However, the application of alternative off-airport

planning techniques, as covered in this chapter, does not insure uniform application throughout the country.

The majority of provincial authorities have not adequately faced the problem of improved off-airport land-use planning. Municipalities also have been known to make certain planning decisions in the airport vicinity which reflect municipal or developer interests rather than the specific needs of the airport and its adjacent neighbours. As a result, the varying degrees of professional assessment and political involvement in the application of the five possible alternatives to off-airport planning are seen as areas of both weaknesses and contention. Although certain incompatibility problems are common to all Canadian airport/community relationships, new off-airport planning legislation and techniques will not guarantee a uniform application in each airport case where individual assessments of local conditions and priorities are made.

TABLE OF REFERENCES - Chapter IV

1. Klaus Hohle, "European Airports Pressured by Problems", Interavia, 2/1975, p. 172.
2. Ibid., p. 174.
3. Alberta Municipal Affairs, "Airport Vicinity Protection Areas", unpublished material.
4. The revised Alberta Planning Act (1977) has replaced the term "zoning bylaw" with "land use control bylaw".
5. City of Calgary, The Protection of the Calgary International Airport: A Land Use Policy, Calgary Planning Department, 1973.
6. Colin H. McNairn, Aeronautics and the Constitution, University of Toronto/York University Joint Program in Transportation, March, 1972, p. 439.
7. Canadian Air Transportation Administration, Edmonton Area Aviation System Master Plan Study: Volume 1, Aviation Planning Requirements, Edmonton: April, 1971, p. 1.
8. The planning exercises have involved the development of Area Master Plans for the airports in Toronto, Vancouver, Montreal, Calgary, Edmonton, Winnipeg and Ottawa.
9. Transport Canada, Regina Airport Study, Central Region, Canadian Air Transportation Administration, September, 1977, p. 9.
10. New Montreal International Airport Planning Office, Land Use Standards Relating to the Mirabel Airport Region, Montreal, 1975, p. 3.
11. Ibid.

CHAPTER V
CONCLUSIONS

This thesis has investigated the issue of airports within the Canadian urban setting. The importance of air transportation now and in the foreseeable future is accepted. The element of convenience for passengers at urban airports is recognized in the form of time savings through airline scheduling and efficient operations. At the same time, urban growth pressures on the airport periphery not only increase the basic incompatibility between these two general land uses, but may, in fact, hinder the viability of the airport operation. The preceding review has shown that this incompatibility is generally manifested in the form of environmental problems and concerns.

The negative environmental impacts generated by an airport are generally used as the main basis of argument against their operation in urban areas. Increasing research over the past ten years has shown the harmful effects of airport noise. This basic element of airport operations is used as the prime example of the incompatibility between the airport and its neighbours. During the 1970's, this concern over noise and other negative airport impacts was only a part of a larger environmental consciousness. Research has shown the physical, mental and psychological dangers relating to excessive and/or constant noise. The effects of other pollutants are also documented. The result has been increased legislation and control over the environmental impacts of any operation, including airports.

The growth of this environmental protection legislation in Canada has been slow and relatively minor in effect when compared to other areas of federal control. For example, Transport Canada's mandate remains centered on the actual mode, and not the entire system which justifies the mode. The provision of an efficient and safe aviation mode is the primary mandate in terms of air transportation. The protection of the natural or urban systems surrounding the ground facilities is a secondary consideration. This is not surprising since Transport Canada has no legislative responsibility for environmental protection. However, major Canadian airport studies during the last decade do show a concerted effort in this area, including the evaluation and proposed protection of existing communities and environmentally-sensitive areas within the sphere of airport operation or expansion.

The environmental and social orientation in current airport planning is included as a prerequisite in most major federal projects. It also reflects a genuine concern for citizen involvement and environmental protection, if only to subdue or avoid future public opposition. This threat from organized public activism, as was demonstrated in the Pickering case for example, has created a strengthened awareness of environmental issues within federal airport planning. This awareness is not matched by environmental legislation. However, it should extend beyond the airport design or expansion stages to include an on-going environmental impact review program. In this way, potential negative impacts between the airport and its neighbours can be monitored, and hopefully avoided. The ability of the federal government to implement this mandate is limited, with more monitoring and control potential lying at the provincial and local government levels. Fortunately, new directions in land-use planning are emerging in some provinces to either take the place of or enhance the available federal airport-related legislation.

Although legislative controls and regulations may expand, noise remains the most recognized concern within the airport region. However, numerous technological advancements in sound attenuation at both the source and the receiver have begun to change this situation. For example, the retrofitting of jet engines has created a noticeable reduction in airport noise. Only the older-generation propellor aircraft and armed forces aircraft remain heavy noise generators. Unfortunately, established urban airports usually handle a high percentage of propellor aircraft traffic, while newer commercial jet operations are oriented to the larger, rural international airports.

Airport noise must not be viewed as a single, independent element of urban life. Urban airport noise is combined with other noise sources to create an overall urban problem. To measure airport noise in isolation is to ignore these other urban noises which tend to exceed the airport levels in many cases. Noise is relative, and must be studied in conjunction with other surrounding sounds in the urban environment. Aircraft operational noise may be more noticeable than road traffic noise, for example, but it is temporary over a fixed period of time.

Obviously, airport noise must be measured to determine areas of surrounding compatibility. However, to predict human reaction to general airport noise, and to condemn the airport as a negative urban feature is much too general an approach to the problem. Airport noise must be measured in relation to surrounding noise levels, land uses, and the time and extent of potential annoyance. These grey areas in noise perception must be recognized, and off-airport development planning should not relate to standardized response predictions.

The grey noise area should be considered within a revised NEF contour formula. In this way, the extent of background noise will be

calculated into a more responsive noise level prediction. Furthermore, it must be recognized that airport noise is declining as a source of concern in the urban airport environment. More subtle issues such as airport safety, compatibility zoning and ground transportation are becoming more pragmatic concerns in the off-airport community. Noise cannot be removed from the airport operations, but proper airport scheduling and sensitive off-airport planning and development will minimize its effects.

The negative environmental impacts associated with airport operations have been reviewed in order to define the problems inherent in off-airport land use planning. However, the main orientation of this thesis is to solutions, with the investigation covering both airport and off-airport land use control powers. The hypothesis is based on a perceived land use compatibility problem, and suggests that existing legislation and regulations have little effect in ensuring compatible off-airport development.

It must be recognized that most problems common to the airport/off-airport interface will never be solved owing to the basic incompatibility between airport operations and most neighbouring urban or rural land uses. Existing technology is capable of ameliorating certain problems created by this relationship. These effects are limited, however, to improving an existing situation and are not retroactive in terms of past damage. The airport and its surroundings remain in a delicately balanced relationship in which both negative and positive pressures are created. Since technology can only mask the problems, stronger land use control legislation is necessary in order to prevent incompatibility problems from occurring in the first place.

As outlined in Chapter III, there is relatively little federal, provincial or local legislation directed specifically at the protection of the off-airport environment. The primary function of the federal

legislation, as found in the Aeronautics Act, is to protect the airport property and any external elements of the airport operation. The basic goal is to ensure the safe and efficient operation of the facility. The control of adjacent land uses is a secondary consideration, except where these external uses interfere with airport operations. Structures which penetrate flight paths, activities which obscure vision or materials which disrupt electronic functions must be prevented in the airport vicinity. Both the public and involved authorities recognize this fact, with the goal of safety guaranteeing acceptance of federal legislation and regulations. However, if strong legislation exists to protect the airport from its surroundings, equally strong controls should also be available to protect those surroundings from the airport. It is impossible to develop a compatible balance of development unless both parties involved are responsible to equally effective controls and regulations.

Although the Aeronautics Act represents the federal legislation to control certain off-airport activities, many additional legislative control mechanisms are present at the provincial and local levels for use in off-airport protection. The federal authority is increasingly concerned about urban encroachment on established airports. Recent attempts to expand federal authority over the off-airport environment in order to prevent encroachment problems has met with little success. The basic rationale used against these proposals has been that adjacent provincial, regional and local authorities are presently capable of implementing their own airport protection mechanisms. Additional federal involvement in areas of provincial or local responsibility is not welcomed. At the same time, Transport Canada has continually stressed the positive role that the provinces have in ensuring compatible off-airport development. Provincial authorities have been encouraged to enact their own airport protection

legislation, but only Alberta has complied to date.

Provincial legislation and special zoning powers of the provincial government, as exemplified in Alberta's Airport Vicinity Protection Area legislation, has been reviewed as a possible solution to existing airport/off-airport compatibility problems. The major criticism against these provincial zoning powers is that they freeze the developability of land. In the case of Alberta, the owners' rights over his land have been limited or expropriated when included within AVPA zoning. A great deal of cooperation between all involved jurisdictions is also necessary. Protection zoning may encompass more than one municipality, with more than one development priority plan to be respected. The AVPA has generally been criticized at the local levels where local planning and development autonomy is threatened.

The application of local zoning or development powers is an effective off-airport protection tool for local administrations. The public has generally opposed increased local zoning or development control, unless these increased controls protect the owner's interest. Unfortunately, not all owners' interests are equal, with some supporting the results of off-airport restrictive zoning while others oppose this approach. Once again, a comprehensive zoning pattern must result from the application of local zoning bylaws where more than one jurisdiction is involved.

The issue of comprehensive planning has been ensured where tripartite airport planning is employed. Each involved government level is assigned specific areas of responsibility in both the airport development or expansion planning, and the off-airport protection issue. Unfortunately, continual tripartite planning occurs in Canada only when major airport studies are carried out by Transport Canada. In most day-to-day cases, the provincial, regional and local levels must cooperate in off-airport planning

since the federal level is unwilling to encroach on the lower levels of authority.

Outright ownership of all affected off-airport property by the airport authority seems the most obvious method of protecting both the airport and its surroundings. In this case, the protection is available on a continual 24-hour basis, allowing unrestricted operation and maximum efficiency. However, the cost issue greatly restricts the application of full ownership. In addition, strong and comprehensive off-airport planning techniques are capable of providing equally effective protection to both the airport and surrounding areas. Since the application of these comprehensive zoning powers is available only in Alberta at present, the ownership approach remains a possibility in the case of new airport construction, as shown in the Mirabel example.

Each of these alternative approaches to off-airport land use control are either available to the appropriate level of government, or have recently been applied in one or more off-airport protection cases. Certain new directions such as land ownership and increased federal legislation have met with questionable success. As a result of changing economic and political realities, alternatives such as these are not as effective in controlling off-airport land use as when originally proposed. Furthermore, the more viable alternatives, namely provincial zoning powers, tripartite planning or improved local zoning bylaws have only recently been applied in a limited number of test cases or existing off-airport problem situations. Most of these applications are centered on recent Alberta airport vicinity protection cases. Therefore, the success of these new approaches cannot be properly rated until their effects on airport/off-airport development relationships can be studied. At the same time, certain new alternatives have created new concerns in off-airport planning.

One area of concern involves the varying degrees of professional assessment and application required in new planning techniques involving provincial, regional or local government levels. Land-use planning controls may not be equally applicable to various sized communities with different levels of planning sophistication. Conversely, local planners with detailed knowledge of local conditions should be better able to administer detailed off-airport controls based on their own detailed analysis. In the case of smaller or rural communities, provincial planning authorities may be required to administer off-airport controls if no local planning expertise is available.

A second area of concern involves airport/community comprehensive planning. A basic incompatibility exists in the scope of airport planning versus adjacent community planning. Airports tend to plan in ten-year increments, while communities and residential developments are planned within a much longer time cycle.

Probably the most disruptive inadequacy and concern in off-airport planning relates to the varying development priorities which are held by the airport authority and the adjacent local planning authority. Local planning decisions in the airport environs are often based on factors such as the return on property investment, the local government's tax base, resident interest in maintaining or improving home value, the desire to keep the community in its present physical form, and the tendency of local officials to avoid radical changes and risks. On the other hand, development decisions of the airport authority are strongly influenced by the desire to provide safe and economical aviation facilities as part of a regional, national or international aviation system. The facilities must also operate on a cost-recoverable basis to the maximum practical extent. The sharp difference in priority of

these two participants can seriously degrade a sound comprehensive planning program and development policy.

A final concern relating to land-use planning techniques recognizes that whatever the technique or control policy used, they at best only mask or temporarily resolve the various problems within the airport/community interface. If the airport operation or adjacent, incompatible development are allowed to continue unchecked, no amount of traditional control devices will permanently rectify an interface problem to the optimum benefit of all involved participants.

In conclusion, the general public is aware that aviation is a sensitive issue in terms of safety and protection. The effects of airport operations may be criticized, but the safe operation of the airport is beyond dispute. It is a unique situation also seen in the medical or engineering fields, for example, where the results may be under question, but seldom are the techniques understood or disputed by the public. It is best that the airport authority continue its control over the specifics of aviation to ensure safe and efficient airport operations. Beyond the airport boundary, more local jurisdictions must become directly involved in compatible off-airport planning. In light of the many land-use control mechanisms presently available at the local, regional or provincial levels, their role in off-airport protection and development would seem a logical expansion of existing responsibilities.

At the same time, the role of Transport Canada should remain unchanged as the overall authority dealing with the location, operation and protection of the airport, and aviation in general. Federal encroachment into off-airport land-use control, as suggested by the Ministry in recent years, is seen as an example of unnecessary involvement in provincial, regional and local matters. However, the

provinces have also been lax in the development of relevant provincial off-airport protection legislation, with the exception of Alberta.

Local governments cannot create this type of protection legislation without the appropriate authority from the provinces, as reflected in Municipal Acts for example. However, it is the local level that is best qualified to administer off-airport land use controls in the form of bylaws, taxation policies or development agreements. In the case of small urban areas or rural municipalities, assistance from the provincial planning authority may be required to implement effective control mechanisms.

A more optimum situation in Canada for effective off-airport land-use planning would see both the airport and its surrounding area equally protected by effective control mechanisms. This conclusion is based partly on the disappointing history of federal control over off-airport growth which reflects an apparent inability of Transport Canada to control urban encroachment adjacent to increasingly constricted airports. Second, the mandate of the federal authority has remained unchanged - to ensure efficient, economic and safe aviation. Transport Canada has shown increased involvement in off-airport development matters, especially in the cases of highly visible encroachment situations. Unfortunately, the recommendations and guidelines of the Ministry which are beyond the sphere of the Aeronautics Act are not necessarily incorporated in all off-airport development programs. Based on recent case studies and government policies, it seems extremely unlikely that the legislative shortcomings of the Aeronautics Act will be rectified to provide for federal controls over off-airport land development.

Based on information gathered in this research, plus the political realities within the federal and provincial governments, it is felt that

Transport Canada should remain the overall airport regulatory authority, meeting both the aviation and airport needs. This responsibility must also ensure minimal interference in the off-airport environment where more local planning legislation is available. The enactment of provincial, regional or local off-airport protection legislation will further limit federal interference in off-airport development.

Finally, a typical element of proper land-use planning includes the old cliché "better communications". It must be recognized, however, that until recently both Transport Canada and the airlines were involved with airport-vicinity communities only in terms of public relations. The implementation of tripartite planning programs, and the increase in negative public response to adjacent airport operations, has stimulated an improved relationship between the public, the airlines and the airport authority. Any progress towards a more compatible airport/community interface must be measured not in terms of the sophistication of legal devices or the complexity of land-use control mechanisms developed by different levels of government. What is important is how these techniques and stimulants can be used to influence the private sector in their use of off-airport lands. Influence can range from the home-buyers' recognition of airport noise problems and abatement techniques to the developers understanding of airport operational constraints and compatibility standards which apply to off-airport development. The way this is done will necessarily differ from province to province, and from locality to locality. However, an informed public that understands the processes and competing pressures of urbanization and aviation, including what can be done to reasonably control this relationship through legal and equitable land-use planning, has taken a major step in the protection of both its environment and its airport.

APPENDIX A

AIRPORT OPERATIONAL GUIDELINES

The planning of compatible land use in the vicinity of airports must not only reflect applicable legislation, but also incorporate a number of airport operational characteristics which may influence off-airport land use. As part of the compatible land-use planning concept, the Canadian Air Transportation Administration has produced a set of airport operational guidelines relating to these operational characteristics.¹

The implementation of these guidelines is usually in the form of master planning for existing or new airports, but is also reflected in provincial and municipal legislation dealing with special planning areas, compatibility regulations and land-use zoning. The airport operational guidelines are divided into five areas of consideration: flight interference and obstruction clearance; navigation aids/telecommunication protection; bird hazards; aircraft noise; and reductions to visibility.

Flight Interference and Obstruction Clearance

These guidelines relate to the zoning of the airspace in the vicinity of an airport to ensure aircraft safety during landing and take-off operations. All airports licenced by Transport Canada have established airport operational zoning plans conforming interference and obstruction lines. The requirements provide a clear airspace above and surrounding the airport where no obstacles will penetrate the aircraft operational zones. These zones are enacted under the Aeronautics Act, and details of the registered zoning plans are held by Transport Canada and the Land Registry Office of the area involved.

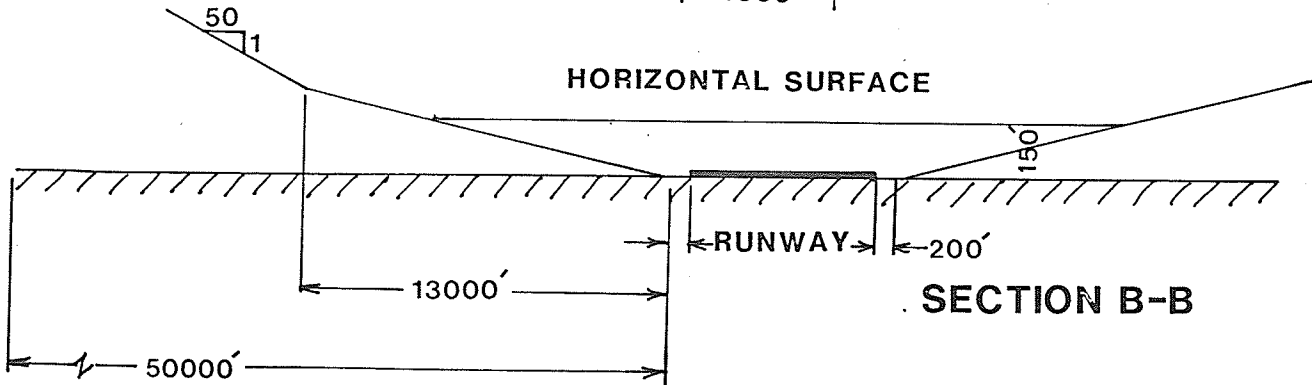
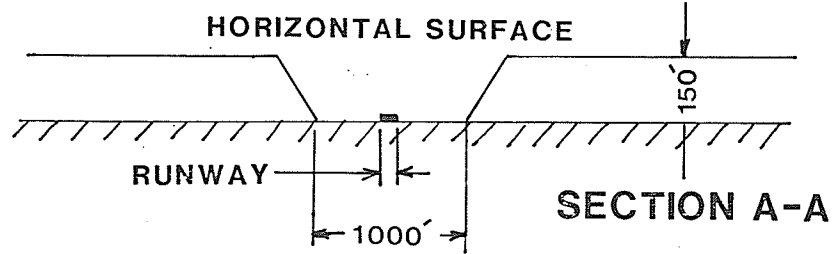
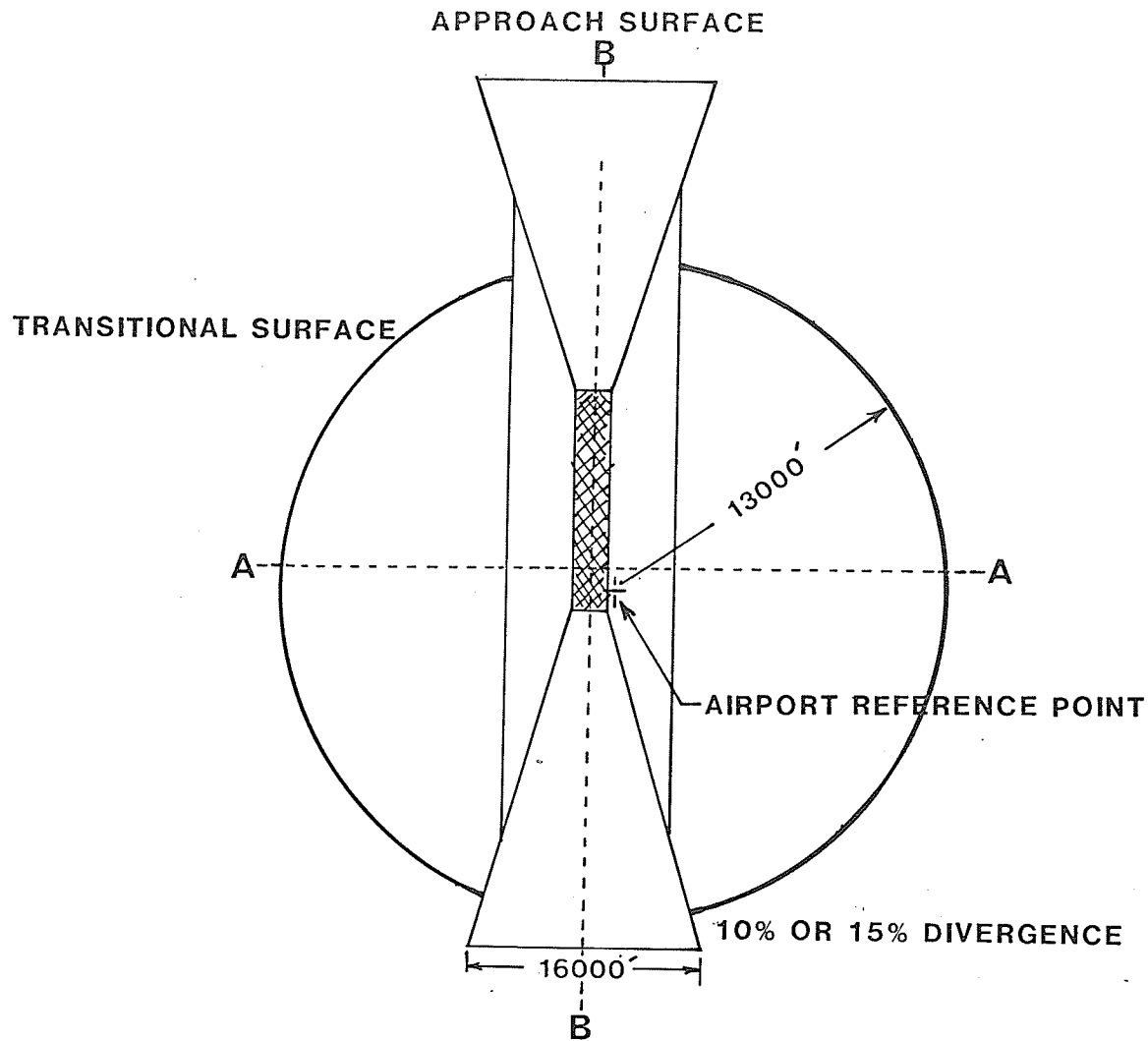
As illustrated in Figure A.1, interference and obstruction zoning involves three zoning surfaces:

Horizontal Surface - an imaginary horizontal surface normally having a basic radius of 13,000 feet and centred on and 150 feet above the airport reference point(s).

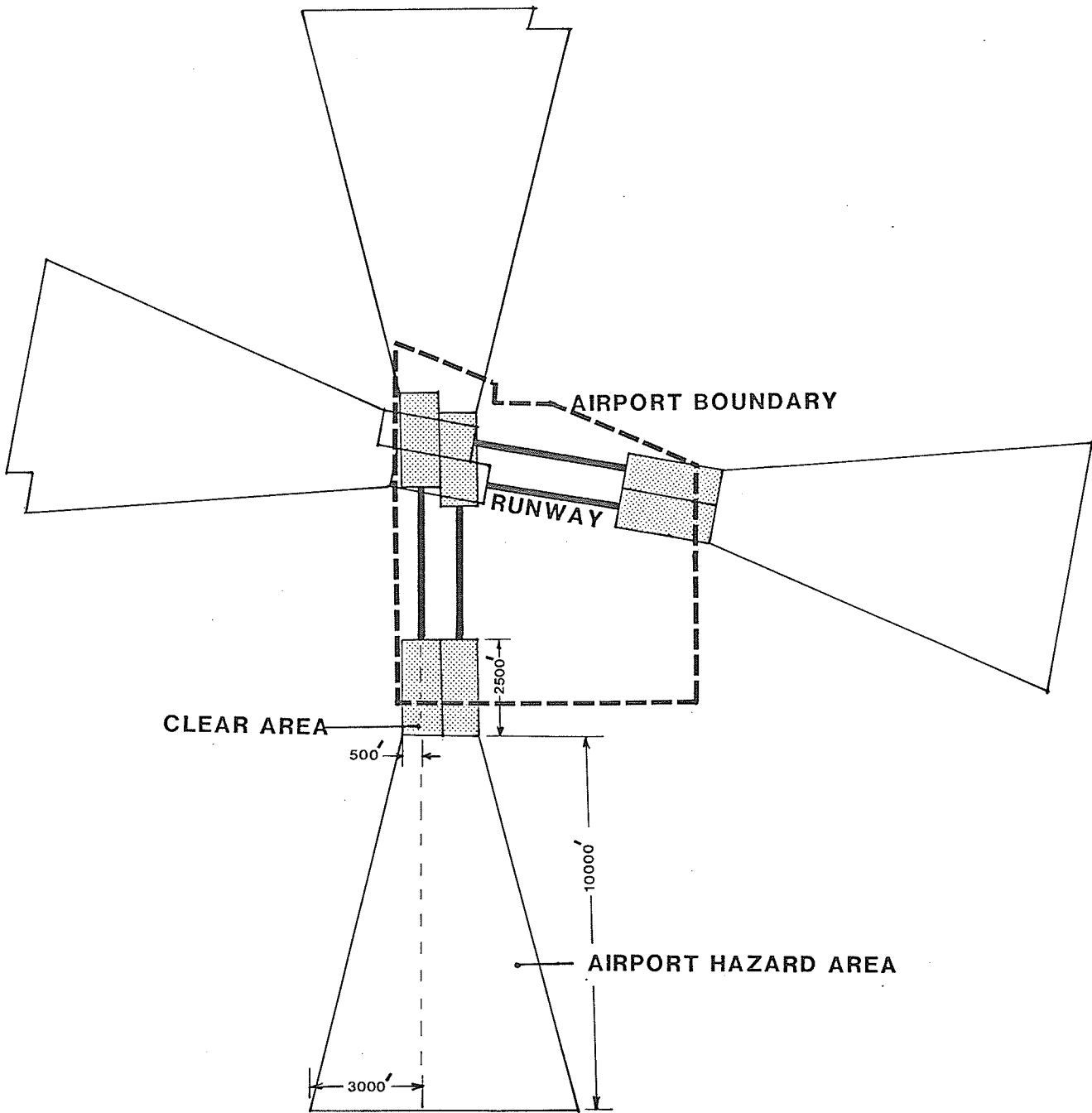
Approach/Take-Off Surface - begins 200 feet from the end of the runway. From an initial width of 1000 feet at ground level, it diverges each side of the runway centre line at a specified rate of either 10 or 15 per cent. The horizontal length of this zoning is normally 50,000 feet and usually covers adjacent non-airport areas. These surfaces rise at a slope of 2 per cent.

Transitional Surface - begins at each side of the runway and rises at a slope of 14.3 or 20 per cent to a maximum height of 150 feet where it meets the horizontal surface.

A number of airport authorities and planning agencies have used a variation of the interference and obstruction area technique. The Edmonton Regional Planning Commission, for example, has used an approach based on world-wide aviation accident statistics. A clear area extends 500 feet on either side of a runway centre line, and 2500 feet beyond both ends of the runway. This area is kept clear of all obstructions, including roads and railways, except those necessary for airport operations.² The airport hazard area also extends 500 feet on either side of the runway, but fans out to 3000 feet and extends 10,000 feet beyond the clear area, as indicated in Figure A.2. Land within this area is to be clear of concentrations of people associated with residential, institutional and public assembly uses.³ Building height restrictions are implemented through the standard delineation of Transport Canada registered airport operational zoning surfaces.



FLIGHT INTERFERENCE AND OBSTRUCTION CLEARANCE AREAS



CLEAR AND AIRPORT HAZARD AREAS

Navigation Aids/Telecommunication Protection

Radar - Buildings or other large structures within 1000 feet (300m) of the radar antenna cannot be higher than five feet (1.5m) below the top of the radar antenna tower platform. This area is normally protected by restrictive easements. In order to minimize reflection problems, buildings and other structures within 3000 feet (900m) of the radar antenna must be constructed of non-metallic materials. Within one-half mile (900m) of the runway, reflective objects, such as trees and buildings, must be removed.

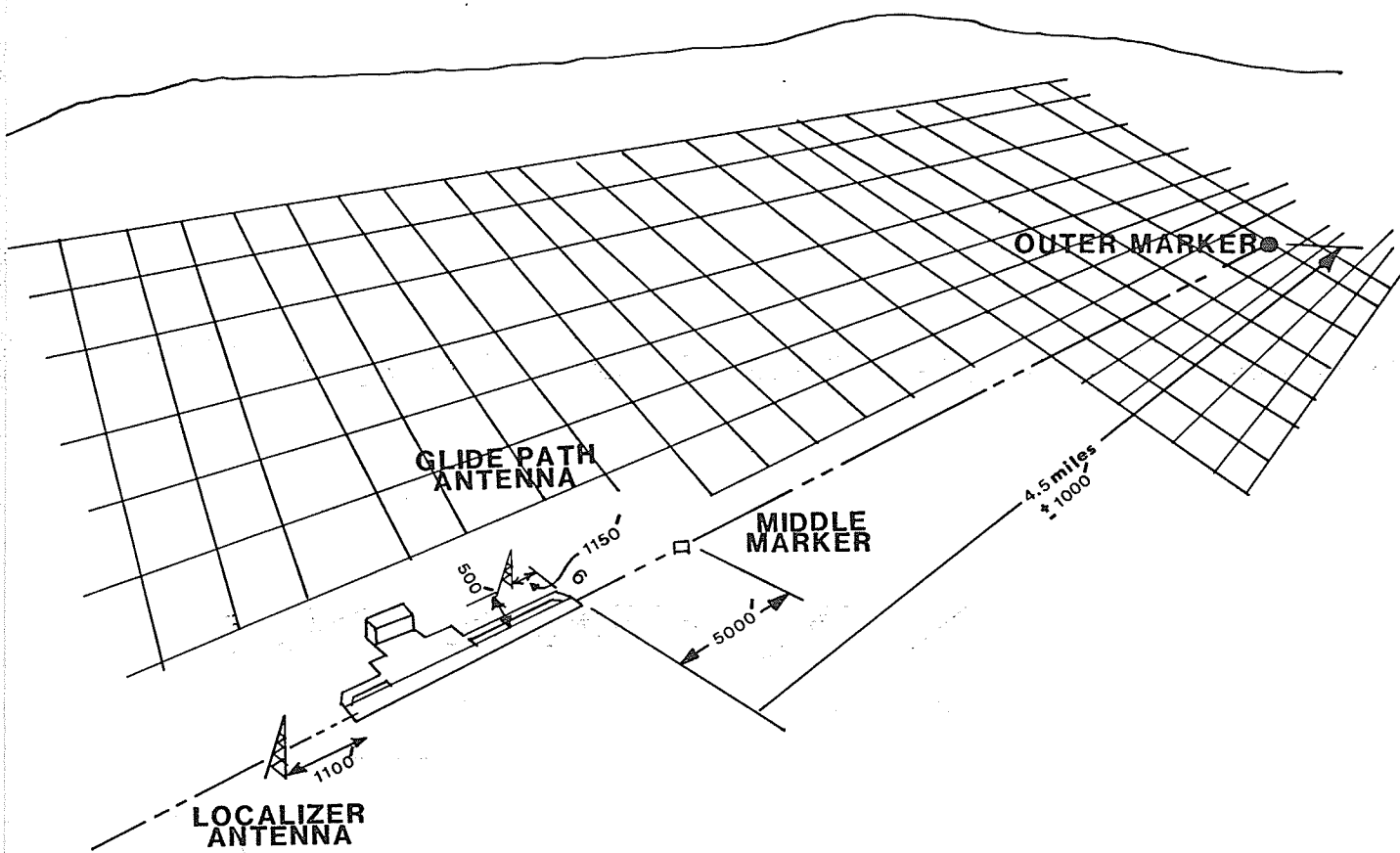
VHR Direction Finding Systems - Since equipment siting requirements do not involve land uses more than 400 yards (365m) from the system site, adjacent land uses are seldom involved.

Instrument Landing System (ILS) - An ILS system is made up of five major components; a Localizer, a Glide Path, and three markers. There are two ILS systems on each runway, one at each end. Land-use planning must take into consideration the placement of the system since it usually affects land use outside the airport boundaries, as can be seen in Figure A.3.

Bird Hazard

Birds and aircraft are a potential hazard to each other during all phases of flight. Guidelines relating to bird hazards minimize potential problems during take-off, landing and other manoeuvres in the vicinity of the airport and runways. Instituting land controls near an airport to reduce this hazard, and the natural attraction of birds to airports requires detailed planning which can be effective in providing long-term results.

Minimizing bird hazards at new airports involves an avoidance of potential sites which are part of established bird migration routes and areas of naturally attractive bird habitat. At both existing and new airports, adjacent land should be used for purposes which will neither



TYPICAL ILS SYSTEM SITE CONFIGURATION

SOURCE:TRANSPORT CANADA

FIGURE A.3

attract or support concentrations of birds. This would include the type of seed crops cultivated on adjacent agricultural property. Figure A.4 illustrates the bird hazard areas associated with the Winnipeg International Airport.

Aircraft Noise

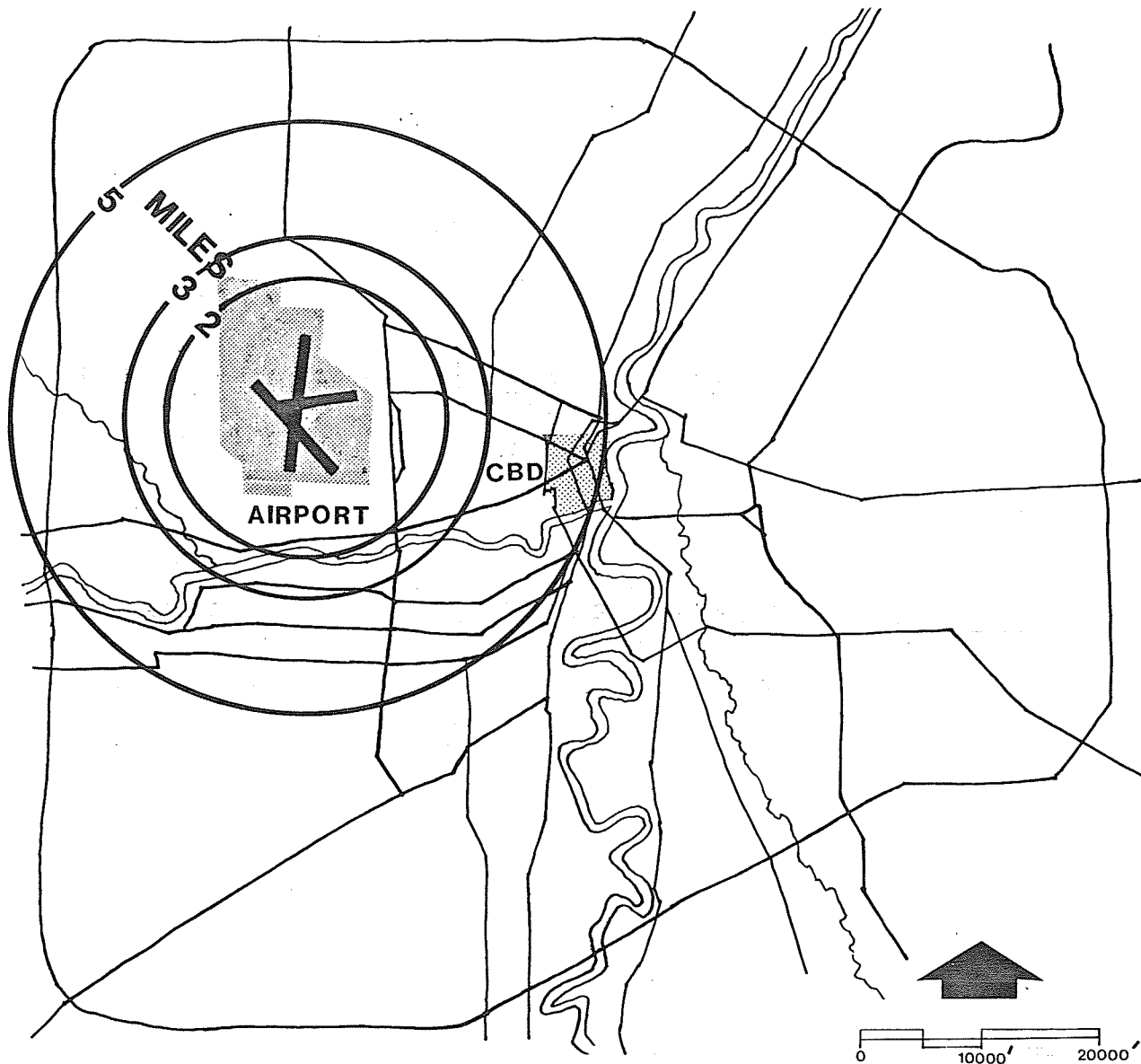
The question of aircraft noise is potentially the most important land-use consideration in off-airport planning. Aircraft noise during landing, take-off and testing procedures, especially from jet aircraft, affects the surrounding area to a higher degree than any other airport operational factor. The physical extent of this factor, in comparison with other land-use considerations, is illustrated in Figure A.5.

No specific guidelines for distances from the noise source are provided, but the compatibility of various land uses in relation to aircraft noise are available from various sources. A number of airport/community land use compatibility matrices, originating at the federal, provincial and local levels, are presented in Appendix B.

Restrictions to Visibility

Restrictions to visibility, other than deteriorating weather conditions, relate to certain industrial/manufacturing processes which generate smoke, dust or steam in sufficient volumes to restrict aircraft visibility in the airport vicinity. Examples of such operations include steel mills, pulp mills, quarries, incinerators and refineries.

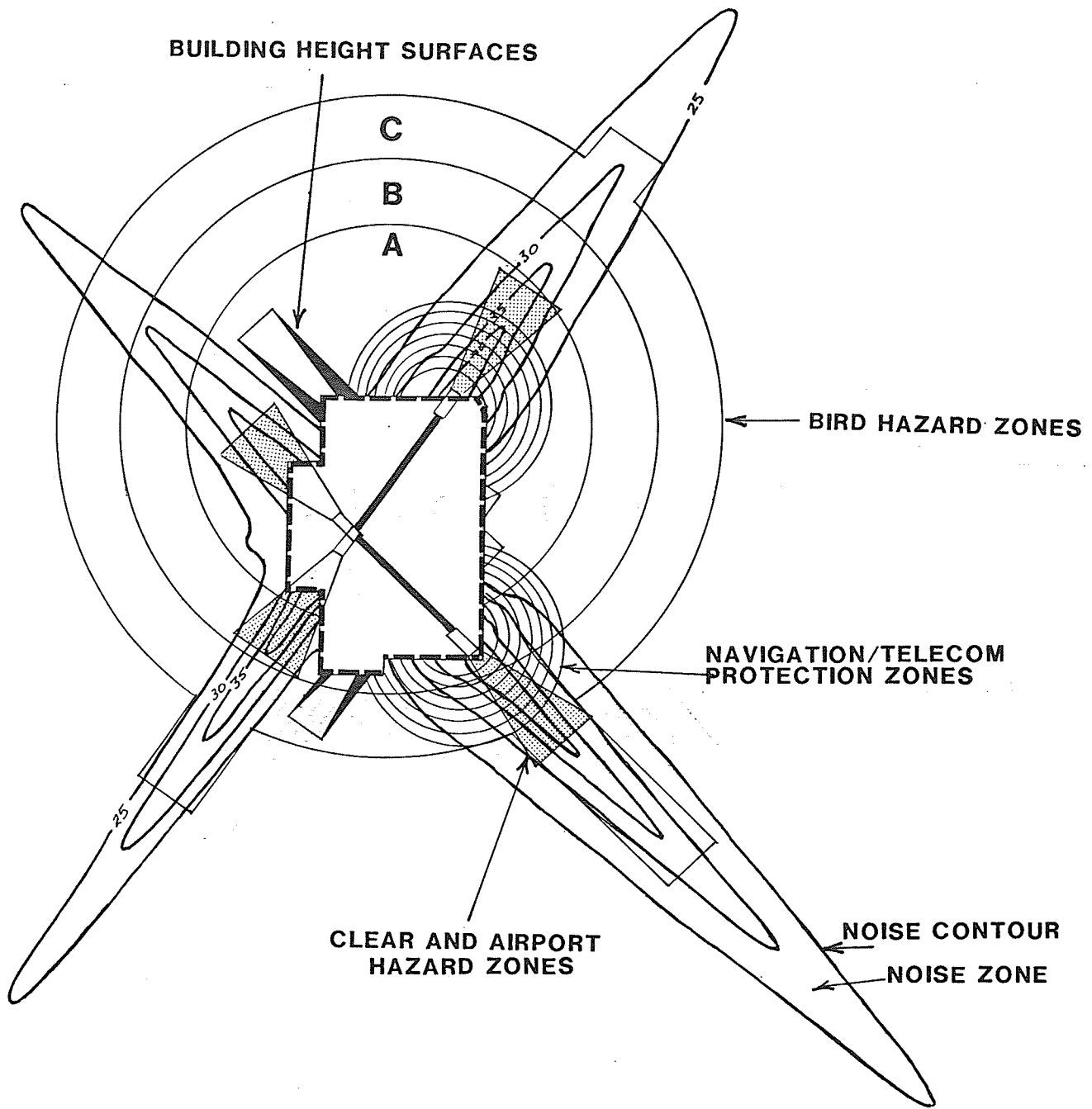
The visibility guidelines take into consideration the location of the industries as they relate to predominant wind directions. Transport Canada suggests that prospective industrial sites near an airport should be assessed on an individual basis due to the many local factors involved.



BIRD HAZARD AREAS Winnipeg International Airport

SOURCE: TRANSPORT CANADA
WINNIPEG AREA AIRPORTS SYSTEM STUDY

FIGURE A.4



AIRPORT OPERATIONAL ZONES

Airport Control Area

FIGURE A.5

TABLE OF REFERENCES - Appendix A

1. Canadian Air Transportation Administration, Land Use in the Vicinity of Airports: Planning Guidelines for the Use of Land Outside the Airport Property Boundary, Ottawa: Civil Aeronautics Branch, January 1978.
2. Edmonton Regional Planning Commission, Regional Plan Project Position Paper No. 8: Air Transportation/Land Use Policy, Edmonton, December 1976, p. 88.
3. Ibid.

APPENDIX B.1 - TRANSPORT CANADA LAND USE GUIDELINES RELATING TO AIRCRAFT NOISE CONSIDERATIONS*

AIRCRAFT NOISE CONSIDERATIONS ONLY

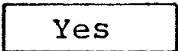
This land use tabulation should not be considered as an exhaustive listing, but merely as examples of how various land uses would be assessed in the Noise Exposure Forecast zones in terms of community response predictions.



- Indicates that new construction or development of this nature should not be undertaken



- This particular land use may be acceptable in accordance with the appropriate note and subject to the limitations indicated therein.



- The indicated land use is not considered to be adversely affected by aircraft noise and no special noise insulation should be required for new construction or development of this nature.

Noise Exposure Forecast Values	>40	40-35	35-30	<30
Response Areas	1	2	3	4
<u>LAND USE</u>				
<u>Residential</u>				
Detached and Semi-Detached	No	No	B	A
Town Houses, Garden Homes	No	No	B	A
Apartments	No	No	B	A

Source: Transport Canada, Land Use in the Vicinity of Airports, Civil Aeronautics, January 1978.

Noise Exposure Forecast Values	>40	40-35	35-30	< 30
Response Areas	1	2	3	4
<u>Public</u>				
Schools	No	No	D	C
Churches	No	No	D	C
Hospitals	No	No	D	C
Nursing Homes	No	No	D	C
Auditoriums	No	No	D	C
Libraries	No	No	D	C
Community Centres	No	No	D	C
Cemeteries	N	N	N	Ng
<u>Municipal Utilities</u>				
Electric Generating Plants	Yes	Yes	Yes	Yes
Gas and Oil Storage	Yes	Yes	Yes	Yes
Garbage Disposal	Yes	Yes	Yes	Yes
Sewage Treatment	Yes	Yes	Yes	Yes
Water Treatment	Yes	Yes	Yes	Yes
Water Storage	Yes	Yes	Yes	Yes

Noise Exposure Forecast Values	>40	40-35	35-30	<30
Response Areas	1	2	3	4
<u>Recreational - Outdoor</u>				
Athletic Fields	No	J	K	Yes
Stadiums	No	No	K	Yes
Theatres - Outdoor	No	No	No	H
Racetracks - Horses	No	K	K	Yes
Racetracks - Autos	Yes	Yes	Yes	Yes
Fairgrounds	K	K	Yes	Yes
Golf Courses	Yes	Yes	Yes	Yes
Beaches and Pools	Yes	Yes	Yes	Yes
Tennis Courts	No	K	Yes	Yes
Playgrounds	K	K	Yes	Yes
Marinas	Yes	Yes	Yes	Yes
Camping Grounds	No	No	No	H
Parks and Picnic Areas	No	K	Yes	Yes
<u>Commercial</u>				
Offices	F	E	D	Yes
Retail Sales	F	D	Yes	Yes
Restaurants	F	D	D	Yes
Indoor Theatres	No	G	D	Yes
Hotels & Motels	No	F	G	Yes
Parking Lots	Yes	Yes	Yes	Yes
Gasoline Stations	Yes	Yes	Yes	Yes
Warehouses	Yes	Yes	Yes	Yes
Outdoor Sales	E	K	Yes	Yes

Noise Exposure Forecast Values	>40	40-35	35-30	<30
Response Areas	1	2	3	4
<u>Industrial</u>				
Factories	(I)	(I)	Yes	Yes
Machine Shops	(I)	(I)	Yes	Yes
Rail Yards	Yes	Yes	Yes	Yes
Ship Yards	Yes	Yes	Yes	Yes
Cement Plants	(I)	(I)	Yes	Yes
Quarries	Yes	Yes	Yes	Yes
Refineries	(I)	(I)	Yes	Yes
Laboratories	No	(D)	Yes	Yes
Lumber Yards	Yes	Yes	Yes	Yes
Saw Mills	(I)	(I)	Yes	Yes
<u>Transportation</u>				
Highways	Yes	Yes	Yes	Yes
Railroads	Yes	Yes	Yes	Yes
Shipping Terminals	Yes	Yes	Yes	Yes
Passenger Terminals	(D)	Yes	Yes	Yes

Noise Exposure Forecast Values	>40	40-35	35-30	<30
Response Areas	1	2	3	4
<u>Agricultural</u>				
Crop Farms	Yes	Yes	Yes	Yes
Market Gardens	Yes	Yes	Yes	Yes
Plant Nurseries	Yes	Yes	Yes	Yes
Tree Farms	Yes	Yes	Yes	Yes
Livestock Pastures	(M)	Yes	Yes	Yes
Poultry Farms	(L)	(L)	Yes	Yes
Stockyards	(M)	Yes	Yes	Yes
Dairy Farms	(M)	Yes	Yes	Yes
Feed Lots	(M)	Yes	Yes	Yes
Fur Farms	(K)	(K)	(K)	(K)

APPENDIX B.2 - AIRPORT VICINITY PROTECTION AREA
GENERAL REGULATIONS

ALBERTA REGULATION 291/75

(Filed October 30, 1975)

THE PLANNING ACT

(O.C. 1378/75)

Approved and Ordered,

RALPH G. STEINHAEUER,
Lieutenant Governor.

Edmonton, October 29, 1975.

Upon the recommendation of the Honourable the Minister of Municipal Affairs, the Lieutenant Governor in Council, pursuant to section 93.2, subsection (1) of The Planning Act, makes the regulations in the attached Appendix, being the Airport Vicinity Protection Area General Regulations.

PETER LOUGHEED (Chairman)

AIRPORT VICINITY PROTECTION AREA GENERAL REGULATIONS

1. In this regulation,

- (a) "Act" means The Planning Act;
- (b) "airport" means
 - (i) an area of land or water, including the frozen surfaces thereof, or other supporting surface used or intended to be used either in whole or in part for the arrival and departure or servicing of aircraft, and
 - (ii) includes any building, installation or equipment in connection therewith
for which an airport license has been issued by the Ministry of Transport;
- (c) "basic strip" means the area of land immediately adjacent to and circumscribing the runway containing the airport reference point of assigned elevation as prescribed by the Ministry of Transport for each airport;
- (d) "Board" means the Provincial Planning Board;
- (e) "local authority" means
 - (i) the council of a city, town, village, county or municipal district, or
 - (ii) the board of administrators of a new town, or
 - (iii) the Minister of Municipal Affairs, in the case of a special area or improvement district;
- (f) "Minister" means the Minister of Municipal Affairs;
- (g) "municipality" means a city, town, village, summer village, new town, municipal district, county, special area or improvement district;
- (h) "N.E.F. Area" means that area of land situated between two successive noise exposure forecast contours;
- (i) "N.E.F. Contour" means a line based on the noise exposure forecast value used to determine N.E.F. areas on land in the vicinity of an airport, as prescribed by the Ministry of Transport for each airport;
- (j) "outer surface" means an imaginary surface consisting of a common plane established at a constant elevation of 150 feet above the assigned elevation of an airport reference point as depicted in Schedule B hereof and as prescribed by the Ministry of Transport for each airport;
- (k) "Protection Area" means an Airport Vicinity Protection Area established pursuant to section 93.1 of the Act;
- (l) "Specific Regulation" means a regulation made for a particular Airport Vicinity Protection Area;

- (m) "take off/approach surface" means an imaginary surface consisting of an inclined plane sloping upwards and outwards from the edge of the basic strip as depicted in Schedule B hereof and as prescribed by the Ministry of Transport for each airport;
- (n) "transitional surface" means an imaginary surface consisting of an inclined plane sloping upwards and outwards from the edge of the take off/approach surface and the edge of the basic strip as depicted in Schedule B hereof, and as prescribed by the Ministry of Transport for each airport;
- (o) "zoning scheme" means a set of plans or drawings or other descriptive material describing the manner in which the use and development and land in a particular Protection Area is to be controlled and regulated.

Applicability

2. This regulation applies to all the land included in an established Protection Area whether or not the land is situated wholly within a single municipality or partly within one or more adjacent municipalities.

Applications for the establishment of Airport Vicinity Protection Areas

3. A local authority may make an application to the Minister for the establishment of a Protection Area in any case where

- (a) the site of an existing or proposed airport is situated wholly or partly within the boundaries of the municipality, or
- (b) the site of an existing or proposed airport is situated wholly or partly within the boundaries of an adjoining municipality.

4. In the case where the site of an existing or proposed airport is situated wholly or partly in a municipality, and that municipality has not made an application for the establishment of a Protection Area, the Minister, if he is satisfied that it is in the public interest to do so, may, of his own initiative, recommend to the Lieutenant Governor in Council that an order establishing a Protection Area be issued.

5. Upon receipt of an application pursuant to section 3, the Minister may, if he is satisfied that it is in the public interest to establish a Protection Area, recommend to the Lieutenant Governor in Council that an order establishing the Protection Area be issued.

6. The boundaries of a Protection Area shall include all that land situated under the horizontal outer surface limiting the vertical height of any development proposed on land included in the Protection Area as prescribed by the Ministry of Transport for each airport, and without limiting the generality of the foregoing shall include

- (a) all land situated within the 30, 35 and 40 N.E.F. Areas, and
- (b) all land situated under the take off/approach surfaces, the transitional surfaces and the basic strip.

Zoning Schemes

7. Upon the establishment of a particular Protection Area, a zoning scheme shall be prepared covering all the land included in the Protection Area.

8. A zoning scheme for a particular Protection Area shall be included in a Specific Regulation to be known as
(name of airport)

Airport Vicinity Protection Area Regulation.

9. The Minister may require that a zoning scheme be prepared by:

- (a) a municipality which has jurisdiction within all or part of a Protection Area,

- (b) a regional planning commission, where the municipality or municipalities having jurisdiction in all or part of a Protection Area are situated in a regional planning area, or
- (c) the Provincial Planning Director, where the municipality or municipalities having jurisdiction in all or part of a Protection Area are not situated in a regional planning area.

10. A zoning scheme prepared pursuant to section 9 shall be submitted to the Board for its consideration and approval.

11. (1) The Board may in its discretion send a copy of the scheme to a local authority of a municipality having jurisdiction within all or part of a Protection Area, and also, publish a facsimile of the scheme and a notice stating the time and place at which the Board proposes to hold a hearing on the matter, which shall not be less than 30 days after the date on which the scheme is sent to the municipality.

(2) The local authority of a municipality claiming to be affected by the scheme shall, within 30 days of the date on which the scheme is sent to it, serve written notice of its objections, if any, to the Board.

(3) An owner of land situated within the Protection Area claiming to be affected by the scheme shall within 30 days of the publication of the notice referred to in subsection (1) serve written notice of his objection, if any, to the Board.

(4) The Board shall hold a hearing at the time and place stated in the notice pursuant to subsection (1) and at the hearing may hear

- (a) a municipality having jurisdiction over all or part of the land included in the Protection Area, claiming to be affected by the scheme;
- (b) any other municipality having jurisdiction over part of the land included in the Protection Area;
- (c) a regional planning commission, a municipal planning commission or the Provincial Planning Director having jurisdiction over all or part of the land included in the Protection Area;
- (d) an owner of land situated within the Protection Area.

(5) As a result of the hearing the Board may approve the zoning scheme as proposed or may make such amendments to it as it considers desirable and necessary in the public interest.

(6) A hearing need not be held if no written notice of objection from a municipality having jurisdiction over all or part of the land included in the Protection Area, or from an owner of land situated within the Protection Area, is received by the Board prior to the day on which the hearing is proposed to be held.

12. Upon being satisfied with the contents of a zoning scheme, the Board shall so report to the Minister, who may recommend to the Lieutenant Governor in Council that a Specific Regulation embodying the zoning scheme, as approved or amended by the Board, be made.

13. Upon the commencement of a Specific Regulation, the local authority of a municipality or municipalities which has or have jurisdiction over all or part of the land included in a Protection Area,

- (a) in the case where the municipality has passed a zoning by-law or development control by-law or development control resolution that is in effect covering all or part of the land within the municipality included in the Protection Area, shall forthwith amend the by-law or resolution in accordance with the Specific Regulation, or
- (b) in the case where the municipality has not passed a zoning by-law or development control by-law, shall forthwith enact a zoning by-law covering that part of the land within the municipality included in the Protection Area, in accordance with the Specific Regulation.

14. A Specific Regulation is binding upon any

- (a) a Regional Planning Commission, or
- (b) a local authority of a municipality, or
- (c) a municipal planning commission, or
- (d) a development appeal board, or
- (e) a development officer, or
- (f) the Provincial Planning Director, or
- (g) the Provincial Planning Board

having jurisdiction over all or part of the land included in a Protection Area.

15. A zoning scheme may include

- (a) a map or maps depicting
 - (i) the N.E.F. Contour values and N.E.F. Areas,
 - (ii) the outer surface, take off/approach surfaces, transitional surfaces and basic strips, and
 - (iii) the division of the Protection Area into zones and subzones of permitted and conditionally permitted or prohibited land uses classes of such number, size and shape as is considered desirable,
- (b) the uses of land and buildings that may be permitted, conditionally permitted or prohibited for each zone or subzone, and
- (c) the maximum heights to which a development on any land situated within the Protection Area shall be restricted.

Uses of Land and Buildings

16. (1) The uses of land and buildings that may be permitted or conditionally permitted in a zone or subzone shall be determined in part by the location of the N.E.F. Contour intersecting the zone or subzone, and shall be limited to any of those uses provided for in Schedule A to these regulations, or to any of those uses provided for in a Specific Regulation.

(2) A use of land or buildings not provided for in Schedule A hereof or in a Specific Regulation shall not be included in a zoning scheme.

Height Restrictions

17. The maximum height of any development on land situated within a Protection Area shall be determined with respect to its location in whole or in part within the outer surface, the take off/approach surface or the transitional surface.

18. (1) The maximum height of any development situated in whole or in part within the take off/approach surface shall not exceed the height of the sloping take off/approach surface as prescribed by the Ministry of Transport for each airport.

(2) The maximum height of any development situated within the transitional surface, or subject to subsection (1), partly within the transitional surface, shall not exceed the height of the sloping transitional surface as prescribed by the Ministry of Transport for each airport.

(3) Subject to subsections (1) and (2), the maximum height of any development situated within a Protection Area is 150 feet.

Application of By-Laws and Subdivision and Transfer Regulation

19. Unless otherwise provided in a Specific Regulation, an application to develop or subdivide land situated within a Protection Area shall be governed

- (a) in the case of a proposed development, by a zoning by-law, development control by-law or a development control resolution in effect, or

(b) in the case of a proposed subdivision, by the Subdivision and Transfer Regulation, filed as Alberta Regulation 215/67 as amended.

20. (1) The use or operation of a development of any land situated within a Protection Area must be such so as not to cause any objectionable or dangerous condition that would interfere with the safe and efficient operation of the airport, and without restricting the generality of the foregoing, the use and operation of a development situated within the Protection Area must not cause excessive

- (a) smoke, dust, steam and other emissions,
- (b) toxic and noxious matters,
- (c) radiation, fire and explosive hazards,
- (d) use of electric or electronic equipment, and
- (e) accumulation of any material or waste, edible, or attractive to birds.

(2) An application to develop land situated in a Protection Area for any use other than a residential use shall be referred by a development officer or a municipal planning commission to the Minister of the Environment (Alberta).

(3) The Minister of the Environment may refer the application to the Minister of Transportation for consultation with the Ministry of Transport, Edmonton, for an opinion on the application, and the Minister of the Environment shall determine whether or not in his opinion, an excess of any of the conditions specified in subsection (1) is likely to be generated by the proposed development.

(4) The Minister of the Environment shall advise the development officer or the Municipal Planning Commission of his determination in each case, and

- (a) where the determination is such that an excess of any of the conditions is not likely to be generated by the proposed development, the development officer, or the Municipal Planning Commission may proceed to approve the application, or
- (b) where the determination is such that excess of any of the conditions is likely to be generated by the proposed development, the development officer or the Municipal Planning Commission shall refuse the application.

SCHEDULE A

PERMITTED, CONDITIONALLY PERMITTED OR PROHIBITED USES OF LAND

This general land use table of permitted, conditionally permitted or prohibited uses of land should not be considered as an exhaustive listing. Other specific land uses may be permitted, conditionally permitted or prohibited in accordance with a Specific Regulation for a particular Protection Area.

yes

Indicates a prohibited use of land within a N.E.F. Area.

yes (A), (B), (C), (D) or (E)

Indicates a conditionally permitted use of land within a N.E.F. Area.

no

Indicates a prohibited use of land within a N.E.F. Area.

CONDITIONS ATTACHED TO A PERMITTED USE OF LAND

- A. Construction of residential units shall conform to Central Mortgage and Housing Corporation standards for sound proofing for sites situated in greater than 25 N.E.F. Contour Zones and detailed in the C.M.H.C. publication "New Housing and Airport Noise" — a supplement to the Site Planning Handbook — N.H.A. 5059, as may be amended or replaced hereafter.
- B. This land use shall be permitted only if related directly to aviation-oriented activities or services and special noise insulation features are incorporated into the building design.
- C. This land use shall be permitted only when noise insulation features are incorporated into the building design.
- D. This land use shall be permitted only when the building or facility is covered completely.
- E. This land use may be permitted when the infilling of an existing and partly developed subdivision of land is considered reasonable.

Noise Exposure Forecast Zones

LAND USE

1. RESIDENTIAL

	less than 30	between 30 - 35	between 35 - 40	over 40
All types of residential units, buildings and uses accessory to above	yes/A&E	yes/A&E	no	no

2. COMMERCIAL

Banks	yes	yes/C	yes/C	yes/B&C
Car Washes	yes	yes	yes/C	yes/B&C
Drive-in other than Theatre	yes	yes	yes	yes
Drive-in theatres	no	no	no	no
Gasoline Sales	yes	yes	yes	yes
Hotels and Motels	yes	yes/C	yes/B&C	no
Indoor Theatres	yes/C	yes/C	no	no
Laundries & dry cleaning outlets	yes	yes/C	yes/C	yes/B&C
Offices	yes	yes/C	yes/B&C	yes/B&C
Outdoor sales	yes	yes	yes	yes/B
Parking lots & structures	yes	yes	yes	yes
Restaurants	yes	yes/C	yes/C	yes/B&C
Retail sales	yes	yes/C	yes/C	yes/B&C
Studios	yes	yes/C	yes/B&C	yes/B&C
Veterinary clinics and hospitals	yes	yes/C&D	no	no
Warehouses	yes	yes	yes	yes

Buildings and uses accessory to above

	less than 30	between 30 - 35	between 35 - 40	over 40
3. INDUSTRIAL.				
Aircraft hangars	yes	yes	yes	yes/B
Aircraft sales, main- tenance and repairs	yes	yes	yes	yes/B
Building material mills, plants & storage	yes	yes	yes	no
Equipment sales, storage and repair	yes	yes	yes/C	no
Factories	yes	yes	yes/C	no
Laboratories	yes	yes	yes/C	no
Machine shops	yes	yes	yes/C	yes/B&C
Parking lots and structures	yes	yes	yes	yes/B
Refineries	yes	yes	no	no
Buildings and uses accessory to above				
4. MUNICIPAL UTILITIES				
Electric generating plants	yes	yes	yes	no
Garbage disposal units, nuisance grounds and sanitary land fills	no	no	no	no
Gas and Oil storage	yes	yes	yes	yes
Mobile equipment yards	yes	yes	yes	yes
Overhead utility lines and systems	yes	yes	yes	yes
Sewage treatment plants	yes/D	yes/D	no	no
Water treatment plants and storage	yes/D	yes/D	no	no
Buildings and uses accessory to above.				
5. TRANSPORTATION				
Highways, secondary roads and local roadways	yes	yes	yes	yes
Parking lots and structures	yes	yes	yes	yes/B
Passenger and freight terminals	yes	yes	yes/C	yes/B&C
Railroads and yards	yes	yes	yes	yes
Buildings and uses accessory to above.				

	less than 30	between 30 - 35	between 35 - 40	over 40
6. RECREATIONAL:				
Arenas and stadia	yes	yes/C	no	no
Athletic fields and playgrounds	yes	yes	no	no
Beaches & swimming pools	yes	yes	no	no
Camping grounds & picnic areas	no	no	no	no
Exhibition & fair grounds, carnivals	yes	no	no	no
Golf courses	yes	yes	yes	yes
Marinas	yes	yes	no	no
Parks & recreational areas	yes	yes	no	no
Race-tracks-autos	yes	yes	yes	no
Snowmobile courses & motorcycle runs	yes	yes	yes	no
Tennis courts & bowling greens	yes	yes	yes	no
Theatre outdoor	yes	no	no	no
Buildings and uses accessory to above				
7. RURAL				
Commercial radio & T.V. towers	yes	no	no	no
Crop farms	yes	yes	yes	yes
Dairy farms	yes	yes	yes	yes
Feed lots and feed mills	no	no	no	no
Fish farms and hatcheries	no	no	no	no
Fur farms	no	no	no	no
Game farms and reserves	no	no	no	no
Livestock pastures	yes	yes	yes	yes
Market gardens, greenhouses and nurseries	yes	no	no	no
Poultry farms	yes/D	yes/D	yes/D	no
Riding stables and trails	yes	yes	no	no
Stockyards	no	no	no	no
Tree farms	no	no	no	no
Veterinary clinics and hospitals	yes	yes/C&D	no	no
Buildings and uses accessory to above				

APPENDIX B.3 - CALGARY INTERNATIONAL AIRPORT
LAND USE RESTRICTIONS

Schedule I

CONDITIONS, RESTRICTIONS, AND USE LIMITATIONS IN THE CALGARY AIRPORT
VICINITY PROTECTION AREA

Conditions, restrictions, and use limitations for those land use categories not listed below shall be deemed to be those conditions, restrictions, and use limitations of the nearest appropriate land use category listed below.

P = Permitted use
P (number) = Conditional Use
- = Not a Permitted Use

Noise Exposure Forecast (N.E.F.)

<u>Land Use Categories:</u>	<u>0- 25</u>	<u>25- 30</u>	<u>30- 35</u>	<u>35- 40</u>	<u>40+</u>
Agricultural Uses:					
Crematoria	P	P	P	P	P
Crop Farms	P	P	P	P	P
Dairy Farms	P10	P10	P10	P10	P10
Feed Lots	-	-	-	-	-
Fur Farms	P10	-	-	-	-
Livestock Pastures	P	P	P	P	P
Market Gardens	P	P	P	P	P
Plant Nurseries and Greenhouses	P	P	P	P	P
Poultry Farms	P10	P10	P10	P4,10	-
Stock Yards	-	-	-	-	-
Tree Farms	P	P	P	P	P
Residential and Public Uses:					
Residential, all types	P	P1	P1,5	P1,5	P1,5
Auditoria	P	P3	P3	-	-
Cemetaries	P	P	P	P	P
Community Centres	P	P3	P3	P3,5	-
Churches	P	P3	P3	-	-
Correction and Detention Homes	P	P1	-	-	-
Funeral Houses	P	P3	-	-	-
Hospitals and Clinics	P	P3	-	-	-
Libraries	P	P3	-	-	-
Nursery Schools, Day Care facilities, and Kindergartens	P	P3	P3,5	-	-
Public and Quasi-public Buildings	P	P3	P3,5	-	-
Schools and Colleges	P	P3	P3,5	-	-
Recreational Uses:					
Athletic Fields	P	P	P8	P8	P8
Archery Ranges	P	P	P8	P8	P8
Bowling Greens and Tennis Courts	P	P	P8	-	-
Camping Grounds	P6	P6	P6	-	-

Noise Exposure Forecast (N.E.F.)

	0- 25	25- 30	30- 35	35- 40	40+
Recreational Uses (cont'd)					
Arenas (open-air) and Stadia	P	P6	P6,8	-	-
Arenas (covered)	P	P	P3	-	-
Exhibition and Fair Grounds	P	-	-	-	-
Golf Courses and Driving Ranges	P	P	P	P	P
Gun Clubs	P	P	P8	-	-
Parks	P	P	P	P	P
Picnic Areas	P	P6	P6	-	-
Riding Academies	P10	P10	P8,10	-	-
Snowmobile Courses and Motorcycle Runs	P	P	P	P	P
Swimming Pools	P	P	P	-	-
Theatres (outdoors)	P	P6	-	-	-
Zoological Gardens and Open Air, Museums	P	P	P	-	-
Commercial Uses:					
Auction Marts	P	P	P	P11	-
Banks and Credit Unions	P	P	P3	P3	-
Bakeries	P7	P7	P7	P3,7	P3,7
Billiard Halls, Bowling Alleys, and Amusement Arcades	P	P	P3	-	-
Bottling and Distribution Plants	P	P	P3	P3	P3
Boxing Arenas	P	P	P3	-	-
Car washes	P	P	P	P3	P2
Clubs and Lodges	P	P	P3	P2	P2
Cocktail Lounges	P	P	P3	P3	P2
Cold Storage Plants	P	P	P	P3	-
Dairies and Food Processing	P	P7	P3,7	-	-
Dancehalls	P	P	P3	-	-
Delicatessens	P	P	P3	P3	-
Drive-in Refreshment Stands	P	P6	P6	P6	P6
Drive-in Theatres	P	P	-	-	-
Fire and Police Stations	P	P	P3	P3	P2
Gymnasias	P	P	P3	-	-
Hotels, Motels, and Associated Uses	P	P	P3	P3	-
Outdoor Theatres	P	P	P3	-	-
Offices	P	P	P3	P9	P9
Outdoor Sales Lots	P	P	P	-	-
Parking Structures, Lots and Garages	P	P	P	P	P
Personal Services	P	P	P3	P2	P2
Post Offices	P	P	P3	P3	P2
Printing, Lithography, Photostating and Publishing Establishments	P	P	P3	-	-
Public Baths	P	P	P3	-	-
Race Tracks-auto	P	P	P6	-	-
Race Tracks-horse	P	P	P6	-	-
Radio and Television Repair	P	P	P3	-	-
Radio and Television Transmitting Stations, Towers and Equipment	P	P	P	P2	P2

Noise Exposure Forecast (N.E.F.)

	0- 25	25- 30	30- 35	35- 40	40+
Commercial Uses (cont'd)					
Restaurants and Catering Establishments	P6,7	P6,7	P3,6,7	P3,6,7	P2,6,7
Retail, Wholesale, and Second Hand Stores	P	P6,7	P3,6,7	P3,6,7	P2,6,7
Rinks (Commercial)	P	P	P3	-	-
Service Stations and Gas Sales	P	P	P	P	P
Tailor and Shoe Repair Shops	P	P	P3	-	-
Taxidermy Shops	P	P	P3	-	-
Veterinary Clinics and Animal Hospitals and Homes	P	P	P3,4	-	-
Industrial Uses:					
Aircraft Schools	P	P	P	P3	P3
Aircraft Sales and Repairs	P	P	P	P	P
Asphalt Manufacture	P	P	P11	-	-
Auto Body and Paint Shops	P	P	P3	P3	-
Automobile Wrecking	P	P	P11	P11	P11
Building Equipment and Materials Storage Yards	P	P	P	P11	P11
Bulk Oil and Gas Storage	P	P	P	-	-
Coal Yards	P	P	P	P	P
Concrete or Cement Products Manufacture	P	P	P	P	P
Factory	P	P	P3	P3,11	-
Feed and Fertilizer Storage	P	P10	P10	-	-
Gravel, Sand and Similar Building Material Storage	P	P	P	P	P
Laboratories	P	P	P	P3	P9
Lumber Yards and Saw Mills	P	P	P	P	P
Machine Shops and Metal Fabricating	P	P	P	P3	P3
Open Air Storage	P	P	P7,11	P7,11	P7,11
Petroleum and Natural Gas Wells, Drilling, Producing and Storage Equipment Yards	P	P	P	P	P
Powerlines	P	P	P	P	P
Refineries	-	-	-	-	-
Slaughter of Animals	-	-	-	-	-
Smoke Houses	P	P	-	-	-
Storage, Sorting, Collecting or Baling of rags, old paper, iron or junk	P	P	P4	-	-
Warehouses	P	P	P	P	P

Noise Exposure Forecast (N.E.F.)

	0- 25	25- 30	30- 35	35- 40	40+
Municipal and Utilities:					
Electric Generating Plants	P	P	P	P	P
Mobile Equipment Yards	P	P	P	P	P
Public Utility Buildings, Installations and Service Yards	P	P	P	P	P
Sewage Treatment (excluding lagoons)	P	P	P	P	P
Water treatment and Covered Water Storage	P	P	P	P	P
Transportation:					
Highways and Railroads	P	P	P	P	P
Passenger Terminals	P	P	P	P3	P3
Freight Terminals	P	P	P	P	P

Notes on Conditonal Uses:

- P1 Construction of residential units shall conform to Central Mortgage and Housing Corporation standards for sound proofing for buildings situated in greater than 25 N.E.F. Contour Zones and detailed in the C.M.H.C. publication "New Housing and Airport Noise" - a supplement to the Site Planning Handbook - N.H.A. 5059, as may be amended or replaced hereafter. Where replacement of residential units is permitted in areas where the 35 N.E.F. is exceeded, sound proofing of buildings up to the 35 N.E.F. standard will be required.
- P2 This land use shall be permitted only if directly related to aviation-oriented activities or services and special noise insulation features are incorporated into the building design.
- P3 This land use shall be permitted only when noise insulation features are incorporated into the building design, except in those instances where internally generated noise levels are equal to, or greater than, the exterior noise level created by aircraft.
- P4 This land use shall be permitted only when the building or facility is covered completely.
- P5 This land use may be permitted when unit replacement or infilling due to fire or natural disaster is considered reasonable, with the intention of implementing the policies contained in approved Land Use documents for the respective areas that fall within the Protection Area.
- P6 Provided areas are kept clean and free of box lunch remains, restaurant garbage and other wastes edible to birds.
- P7 Provided management does not create or maintain bird populations which create hazards to aircraft safety.
- P8 Not allowed if the intended use involves large spectator audiences.

- P9 When associated with a permitted use this use will be considered, taking into account all relevant factors including a detailed analysis of the noise reduction requirements to provide the environment necessary for the specific use.
- P10 Provided feed is not accessible to birds and that precautions are taken to ensure that the disposal of the excrement from livestock does not attract birds.
- P11 Applications for these specific uses or developments shall be submitted to the Minister of the Environment (Alberta) for their comments.

Source: The Calgary International Airport Vicinity
Protection Area Regulations

APPENDIX B.4 - SCHEDULE OF LAND USE PRESCRIPTIONS FOR NOISE
IMPACT ZONES: WINNIPEG INTERNATIONAL AIRPORT

The schedule of land use prescriptions for the noise impact zones included in this document is not meant to serve as an exhaustive listing, however, it may serve as a guide for decisions concerning unanticipated land uses.

The use of land situated in each of the noise impact zones shall be governed by the following prescriptions:

"P" signifies a permitted use of land with no special conditions attached

"C" with a number following, signifies that new development of that nature is conditional upon compliance with the stated restriction

(C1) No further subdivision of land for residential purposes or increase in existing residential densities will be permitted.

- (C2) It is recommended that consideration be given to the fact that noise levels may impact animal populations.
- (C3) This land use shall not be permitted unless a detailed analysis of noise reduction requirements is made and needed noise insulation features are included in the design.
- (C4) This land use shall not be permitted unless necessary noise insulation features are included in the building design to provide an indoor environment suitable to the specific function.
- (C5) It is recommended that this land use should be permitted if it can be directly related to aviation-oriented activities or services and a tolerance for increased noise levels can thereby be assumed.

(C6) This land use shall not be permitted unless a detailed analysis of noise reduction requirements is made, considering the fact that internally generated noise levels may affect the tolerance for aviation-generated noise.

(C7) Construction of residential units shall conform to CMHC standards for soundproofing as detailed in the CMHC publication "New Housing and Airport Noise" which is a supplement to the Site Planning Handbook - N.H.A. 5059 11/76.

"NA" signifies that development of that nature will not be allowed

SCHEDULE OF LAND USE PRESCRIPTIONS
FOR
NOISE IMPACT ZONES

LAND USE	NOISE IMPACT ZONE		
	A	B	C
<u>Agricultural Uses</u>			
Country Residences	NA	C1	C1
Crop Farms	P	P	P
Dairy Farms	C2	P	P
Feedlots	C2	P	P
Livestock Pastures	C2	P	P
Market Gardens	P	P	P
Plant Nurseries	P	P	P
Poultry Farms	C2	P	P
Stockyards	C2	P	P
<u>Commercial Uses</u>			
Auto, Truck and Farm Equipment, Sales and Service Establishment	C3	C3	C3
Billiard Rooms	NA	NA	C3
Bowling Alleys	NA	NA	C3
Business and Trade Schools	NA	NA	C4
Car Washing Establishments	P	P	P
Cinemas	NA	C3	C3

continued on the next page

LAND USE	NOISE IMPACT ZONE		
	A	B	C
Drive-in Restaurants	NA	NA	P
Drive-in Theatres	NA	NA	P
Dry Cleaning and Laundry Establishments	NA	C3	C3
Hairdressing Shops	NA	NA	C3
Hotels and Motels	NA	C3,5	C3,5
Moving and Cartage Firms	C3	C3	C3
Offices	C3,5	C3,5	C3
Outdoor Sales	NA	C5	P
Parking Areas	P	P	P
Private Clubs and Lodges	NA	C3,5	C3,5
Residential Dwelling Units above Commercial Development	NA	C3	C3
Restaurants	C3,5	C3,5	C3,5
Retail Sales	C3,5	C3,5	C3,5
Service Stations and Gas Bars	P	P	P
Tradesmen Workshops, Service and Repair Stations	C3,6	C3,6	C3,6
Warehouses	C4,6	C4,6	C4,6
Wholesale Equipment and Supplies	C4	C4	C4

continued on the next page

LAND USE	NOISE IMPACT ZONE		
	A	B	C
<u>Industrial Uses</u>			
Building Material Storage Areas	P	P	P
Cartage, Freighting, Truck Storage and Terminals	C3	C3	C3
Equipment Sales, Storage and Repair	C3,6	C3,6	P
Factories	C4,6	P	P
Laboratories	NA	C4	C4
Lumber Yards	P	P	P
Machine Shops	C6	P	P
Oil and Gas Storage	C5	C5	P
Quarries	P	P	P
Rail Yards	P	P	P
Refineries	P	P	P
Saw Mills	P	P	P
<u>Municipal Utilities</u>			
Electricity Generating Plants	P	P	P
Garbage disposal	P	P	P
Public Utility Regulating Stations	P	P	P
Sewage Treatment	P	P	P

continued on the next page

LAND USE	NOISE IMPACT ZONE		
	A	B	C
Water Storage	P	P	P
Water Treatment	P	P	P
<u>Public Uses</u>			
Arenas	NA	C4	P
Auditoriums	NA	C4	P
Cemetaries	P	P	P
Churches	NA	C3	P
Hospitals	NA	NA	C4
Kindergarten and Daycare Centres	NA	NA	NA
Libraries	NA	NA	C4
Nursing Homes for Senior Citizens	NA	NA	C4
Public and Quasi Public Buildings	NA	NA	C4
Schools	NA	NA	NA
Veterinary Clinics	NA	C2,3	C2,3
<u>Recreational Uses - Outdoor</u>			
Athletic Fields and Playgrounds	NA	P	P
Camping Grounds	NA	NA	NA
Golf Courses and Driving Ranges	P	P	P

continued on the next page

LAND USE	NOISE IMPACT ZONE		
	A	B	C
Marinas	P	P	P
Parks and Picnic Areas	NA	NA	P
Playgrounds	P	P	P
Racetracks - Auto	P	P	P
Racetracks - Horses	NA	NA	P
Stadiums	NA	NA	P
Swimming Pools	P	P	P
Tennis Courts	P	P	P
Theatres - Outdoor	NA	NA	NA
Trailer Parks and Campsites	NA	NA	NA
Zoos	NA	NA	C2,4
<u>Residential Uses</u>			
Single Family Dwellings	NA	C1	C3,7
Two Family Dwellings	NA	C1	C3,7
Multi Family Dwellings	NA	C1	C3,7
Boarding Houses	NA	C1	C3,7
Mobile Homes	NA	C1	C3,7
<u>Transportation Uses</u>			
Aviation	P	P	P
Highways	P	P	P
Railroads	P	P	P

SELECTED BIBLIOGRAPHY

BOOKS:

- Block, Jacques. Airports and Environment. Paris: John Murray, 1975.
- Branch, Melville C. Urban Air Traffic and City Planning: Case Study of Los Angeles County. New York: Praeger Publishers, 1973.
- Bugliarello, George. The Impact of Noise Pollution: A Socio-Technical Introduction. Toronto: Pergamon Press, 1976.
- Stevenson, Gordon M. The Politics of Airport Noise. Belmont: Duxbury Press, 1972.
- Straford, Allan. Airports and the Environment. London: McMillan Press, 1974.
- University of Toronto. Readings in Airport Planning. Toronto: The Centre for Urban and Community Studies, and the Department of Civil Engineering, 1972.

REPORTS and PUBLIC DOCUMENTS:

- Carvalho, Mario; Hum, Derek; and Falconer, Donald. A Study of Social Concerns and Community Characteristics. Winnipeg: Transport Canada, Winnipeg Area Airports System Study and the University of Manitoba. 1976.
- Central Mortgage and Housing Corporation. New Housing and Airport Noise. Ottawa: Queen's Printer, 1976.
- City of Calgary. The Protection of Calgary International Airport: A Land Use Policy. Calgary: Planning Department, August 9, 1971.
- CLM/Systems Incorporated. Airports and Their Environment: A Guide to Environmental Planning. Cambridge: U.S. Department of Transportation, Office of the Assistant Secretary, 1972.
- Crowley, R.W., The Effects of an Airport on Land Values. Ottawa: Ministry of State for Urban Affairs, 1972.
- Department of Transportation. Aviation Futures to the Year 2000. Washington D.C.: Federal Aviation Administration, 1977.
- Land Use Planning. Washington D.C.: Federal Aviation Administration, 1977.

- Edmonton Regional Planning Commission. Air Transportation/ Land Use Policy: Position Paper No. 8. Edmonton: Regional Planning and Research Division, 1976.
- The Environmental Effects of Residential Development in the Leduc/ International Airport Area: Report and Recommendations. Edmonton: Environment Conservation Authority, 1975.
- Government of Quebec. Planning of the Airport Region - Information Bulletin. Quebec City: Department of Municipal Affairs, 1973.
- International Civil Aviation Organization. Airport Planning Manual Part 1: Master Planning. 1977.
- _____. Airport Planning Manual Part 2: Land Use and Environmental Control. 1977.
- _____. Airport Planning Manual Part 3: Bird Control and Reduction. 1975.
- Lombard North Group. Environmental Impact Assessment of Residential Development in the Leduc/International Airport Area: Information Bulletin No. 3. Edmonton: Environment Conservation Authority, May 1975.
- McNairn, Colin H. Aeronautics and the Constitution. Toronto: University of Toronto/ York University Joint Program in Transportation, March 1972.
- McNeal, Hildebrand and Associates Ltd. A Study of the Economic Significance of Winnipeg Area Airports. Winnipeg: Winnipeg Area Airports System Study, 1976.
- Metropolitan Planning Commission. The Relationship of Stevenson Field to Urban Development in Greater Winnipeg. 1953.
- Miller, Gordon A. Constraints and Their Influence on Airport Landside Capacity. Washington D.C.: Transportation Research Board, National Research Council, 1975.
- New Montreal International Airport Planning Office. Land Use Standards Related to Noise Exposure. Office for the Planning and Development of Quebec, Planning Service of the Airport Region. (no date).
- Organization for Economic Co-operation and Development. Airports and the Environment. Paris: OCED, 1975.
- Pearce, David. Social Cost of Noise. University of Leicester, England.
- Regional Municipality of Waterloo. Noise Exposure Forecast in the Vicinity of Waterloo-Wellington Airport. Waterloo: City Planning Department, 1977.

- Schriever, Bernard, and William W. Seifert. Air Transportation 1975 And Beyond: A System Approach - Report Of The Transportation Workshop. Cambridge: The MIT Press, 1967.
- State of Wisconsin. A Guide for Land Use Planning Around Airports in Wisconsin. Department of Transportation, 1976.
- Transport Canada. Aircraft Noise Study: Paper No. 46. Winnipeg: Winnipeg Area Airports System Study, 1976.
- _____. An Airport System for Central Ontario: Background Discussion Paper. Toronto: Toronto Area Airports Project, 1973.
- _____. An Introduction to Aircraft Operations at Winnipeg International Airport: Paper No. 39. Winnipeg: Winnipeg Area Airports System Study, 1975.
- _____. Aviation Activity Forecasts and Projections: Executive Summary: Paper No. 47. Winnipeg: Winnipeg Area Airports System Study, 1976.
- _____. Aviation Safety and Winnipeg International Airport: Paper No. 62. Winnipeg: Winnipeg Area Airports System Study, 1977.
- _____. Environmental Factors in Canadian Air Transportation; Review and Prognosis, Ottawa: Aviation Planning and Research Division, Civil Aviation Branch, 1974.
- _____. Environmental Protection Planning. Airport Facilities Branch, 1976.
- _____. Land Use In The Vicinity Of Airports, Civil Aeronautics Branch, Aviation Planning and Research Division, 1978.
- _____. Technological Implication For The Future Winnipeg International Airport: Paper No. 42. Winnipeg: Winnipeg Area Airports System Study, 1976.
- _____. Toronto Area Airports Study, Project Team Report, Toronto: 1972
- _____. Vancouver International Airport Master Plan Project: Urban Issues. Vancouver: Airport Planning Committee, 1975.
- _____. Windsor Airport Socio-Economic Impact Study. Toronto: South-western Ontario Airports Study Program, 1976.
- Walker, R. L. and Partners, Consulting Engineers and Economists, An Evaluation Of The Land Use Component Of Airport Impacts, for Ministry of Transport, Environment Division, Airports Facilities Branch, May 1975.

"Zoning in Residential Developments Within The 30 NEF Scale." (April 26, 1973). Decision of City Council; City of Calgary. Calgary: City Clerk's Department.

JOURNAL and NEWSPAPER ARTICLES

- "Airport Housing Condemned". Edmonton Sun, 29 October 1978, p.C.10
- Basi, Pritan S. Airport Vicinities: The Development Of A Land Use Plan, Thesis M.C.P. University of Manitoba 1970.
- Gottlieb, Adrienne. "Land Use Controls for Airport Planning." The Urban Lawyer (Winter 1971): 266-276.
- Hamer, I.M., "Unsitting A Major Airport - A Canadian SNAFU." Canadian Aeronautics and Space Journal (December 1974): 27-38.
- Hohle, Klaus. "European Airports Pressured by Noise Problems." Interavia (2/1975): 171-175.
- "ICAO Conference Identifies Measures to Improve the Aerodrome Environment." ICAO Bulletin (July 1974): 9-17.
- Isberg, Gunnar C. "Airport The Zoning Minnesota Example." Urban Land (January 1973): 10-20.
- Lesser, Joseph. "The Aircraft Noise Problem: Federal Power but Local Liability." The Urban Lawyer (Winter 1971): 175-201.
- "Major Crash Here Termed Highly Unlikely". Edmonton Journal 1978, p.B.2 25 September.
- McNairn, C.H. "Airport Noise Pollution: The Problem and the Regulatory Response." The Canadian Bar Review (1972): Vol. I, No. 2, pp. 248-294.
- "Mirabel". Winnipeg Free Press, 27 July 1977, p. 45.
- "Mirabel - New Montréal International Airport". Quebec 73 Department of Industry and Commerce, Government of Quebec (September 1973).
- "Municipal Airport Termed Safe." Edmonton Journal, 26 September 1978, p.B.3.
- Roberts, John, J., Edward J. Croke and Samuel Booras, "A Critical Review of the Effects of Air Pollution Control Regulations on Land Use Planning." Journal Of The Air Pollution Control Association Vol. 25 No. 5

Roeseler, W.G., "Airport Development Districts: The Kansas City Experience".
The Urban Lawyer (Winter, 1971) Vol. 3, No. 2, p. 254.

Thomas, William, V., "An Airport Environs Plan: The Syracuse-Onondaga
County Experience". A.I.P. Journal, (Oct. 1971): Vol. ?, No. 7

"Tokyo's New Overseas Airport: A Japanese Version of Mirabel". Winnipeg
Free Press, 16 February 1978, p. 12.

ACTS, BYLAWS and PAPERS

Air Regulations and Aeronautics Act: Aeronautics Act Section. R.S.,
c. 2, s.1. Amendment No. 7. Ottawa: Queen's Printer.

Bill C-4. An Act to Amend the Aeronautics Act. First Reading, October
18, 1977. Ottawa: Queen's Printer

The City of Winnipeg Act. s.m. 1971., c. 105. Winnipeg: Queen's Printer.

City of Calgary. Airport Vicinity Protection Area. Calgary: Planning
Department, (no date).

Metropolitan Corporation of Greater Winnipeg, St. James - Assiniboia
Zoning By-law 1558, 1970.

Municipal Act. s.m. 1970. c.100. Winnipeg: Queen's Printer.

Ontario Municipal Board. Decision of the Board in the Matter of an
Application by the Corporation of the City of Thunder Bay for
Approval of its Restricted Area By-law 40-1977, January 12, 1978.

The Planning Act (1977) ch. 89. Edmonton: Queen's Printer.

The Planning Act (1977). s.m. 1975., ch. 29. Winnipeg: Queen's Printer.

The Planning Act: Airport Vicinity Protection Area General Regulations.
Alberta Regulation 291/75. Edmonton: Queen's Printer.

Transport Canada. Objection to City of Thunder Bay By-law 40-1977.
Central Region, January 24, 1978.

Winnipeg Area Airports System Study. Minutes of Meeting of Winnipeg
International Airport Land Use Control Technical Committee,
February 22, 1978.

Winnipeg Area Airports System Study. Tri-Level Committee Presentation
(No date).