Draft Environmental Impact Statement

Second Sydney Airport Proposal

Volume 1
Main Report

COMMONWEALTH DEPARTMENT OF
TRANSPORT AND REGIONAL DEVELOPMENT

PPK
Environment & Infrastructure

Draft Environmental Impact Statement

Second Sydney Airport Proposal

Volume 1
Main Report

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TRANSPORT AND REGIONAL DEVELOPMENT

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Approximate

Approximate Boundaries
Option A
Option B
Option C

Photograph 1
Sites of Badgerys Creek Airport Options
(from south-west looking north-east)

Explanatory and Limitations Statements

This Draft Environmental Impact Statement (Draft EIS) has been prepared in accordance with the scope of work set out in the contract between Rust PPK Pty Ltd and the Commonwealth Department of Transport and Regional Development (DoTRD) and completed by PPK Environment and Infrastructure Pty Ltd (PPK). In preparing this Draft EIS, PPK has relied upon data, surveys, analyses, designs, plans and other information provided by DoTRD and other individuals and organisations, most of which are referenced in this EIS. Except as otherwise stated in this Draft EIS, PPK has not verified the accuracy or completeness of such data, surveys, analyses, designs, plans and other information.

This Draft EIS has been prepared for the exclusive use of DoTRD. PPK will not be liable to any party other than DoTRD and assumes no responsibility for any loss or damage suffered by any other party arising from matters dealt with in this Draft EIS, including, without limitation, matters arising from any negligent act or omission of PPK or for any loss or damage suffered by any other party in reliance upon the matters dealt with and opinions and conclusions expressed in this Draft EIS.

Acknowledgments

Data used to develop the figures contained in this document have been obtained and reproduced by permission of the Australian Bureau of Statistics, NSW Department of Land and Water Conservation, NSW National Parks and Wildlife Service (issued 14 January 1997), NSW Department of Urban Affairs and Planning and Sydney Water. The document is predominantly based on 1996 and 1997 data.

To ensure clarity on some of the figures, names of some suburbs have been deleted from inner western, eastern, south-eastern and north-eastern areas of Sydney. On other figures, only 'Primary' and 'Secondary' centres identified by the Department of Urban Affairs and Planning's Metropolitan Strategy, in addition to Camden, Fairfield and Sutherland, have been shown.

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Part A

Introduction

Chapter 1

Overview of the Proposal

Chapter 1
Overview of the Proposal

This chapter provides a brief history of the development of aviation facilities in Sydney and describes the need for a second major airport, and the objectives of the Second Sydney Airport proposal.

1.1 A Brief History

The question of where, when and how a second major airport may be developed for Sydney has been the subject of investigation for more than 50 years. The investigations and associated decisions are closely related to the history of the development of Sydney's existing major airport, located at Mascot.

The site of Sydney Airport was first used for aviation in 1919. It was acquired by the Commonwealth Government in 1921, and was declared an *International Aerodrome* in 1935. In 1940 the first terminal building and control tower were opened.

In 1945 the airport had three relatively short runways. A major expansion began in 1947, and by 1954 the current east-west runway was opened. The north-south runway was first opened in 1954 and was extended to its current length in 1972. The present international terminal was opened in 1970.

Planning and investigations for a site for a second Sydney airport first started in 1946. *Figure 1.1* summarises the major studies and decisions since that year. A large number of possible sites both within and outside the Sydney Basin have been investigated. They are shown in *Figure 1.2*.

1946	International Airport Study
1971	Benefit Cost Study of alternative airport sites (106 sites investigated)
1973	Galston selected for Second Sydney Airport (subsequently overturned)
1976	Major Airport Needs Study. Two preferred sites including Badgerys Creek
1982	Parallel runway at Sydney Airport announced (subsequently overturned)
1983	Second Sydney Airport Site Selection Program (10 sites selected for preliminary investigation)
1985	EIS for the Badgerys Creek and Wilton sites
1986	Badgerys Creek announced as site for the Second Sydney Airport
1989	Taskforce reviews capacity of Sydney Airport and announces the third runway proposal and planning at Badgerys Creek. EIS for third runway commenced
1991	Decision to proceed with third runway
1994	Development at Badgerys Creek by 2000 Olympics announced. Third runway opened
1996	EIS for major airport at Badgerys Creek announced
1996	Inclusion of Holsworthy Military Area in EIS
1997	Holsworthy Military Area eliminated from further consideration

Figure 1.1
Major Studies and Decisions on the Second Sydney Airport

Figure 1.2
Potential Airport Sites Previously Shortlisted for Consideration In and Around the Sydney Basin
Source: Kinhill Stearns, 1985

The *Second Sydney Airport Site Selection Program Draft Environmental Impact Statement* (Kinhill Stearns, 1985) re-examined all possible locations for the second airport and chose 10 for preliminary evaluation. Two sites, Badgerys Creek and Wilton, were examined in detail and an environmental impact statement (EIS) was prepared. In February 1986 the then Commonwealth Government announced that Badgerys Creek had been selected as the site for Sydney's second major airport.

The Badgerys Creek site, which is about 46 kilometres west of Sydney's Central Business District and is 1,700 hectares in area, was acquired by the Commonwealth between 1986 and 1991. A total of $155 million has been spent on property acquisition and preparatory works.

Since 1986, planning for Sydney's second airport has been closely linked to the development of the third runway at Sydney Airport. In 1989 the Government announced its intention to construct a third runway. An EIS was undertaken and the decision to construct the runway was made in December 1991.

At the same time as investigations were being carried out on the third runway, detailed planning proceeded for the staged development of the second airport at Badgerys Creek. In 1991 it was announced that initial development at Badgerys Creek would be as a general aviation airport with an 1,800 metre runway.

The third runway at Sydney Airport was opened in November 1994. In March 1995, in response to public concern over high levels of aircraft noise, the Commonwealth Senate established a Senate committee to examine the problems of noise generated by aircraft using Sydney Airport and explore possible solutions. The committee's report, *Falling on Deaf Ears?*, was tabled in parliament in November 1995 (Senate Select Committee on Aircraft Noise in Sydney, 1995).

During 1994 and 1995 the Government announced details of its proposed development of Badgerys Creek, and of funding commitments designed to ensure the new airport would be operational in time for the 2000 Olympics. This development included a 2,900 metre runway for use by major aircraft.

The decision to accelerate the development of the new airport triggered the environmental assessment procedures in the *Environment Protection (Impact of Proposals) Act 1974*. In January 1996 it was announced that an EIS would be prepared for the construction and operation of the new airport.

In May 1996, the present Commonwealth Government decided to broaden the environmental assessment process. It put forward a new proposal involving the consideration of 'the construction and operation of a second major international/ domestic airport for Sydney at either Badgerys Creek or Holsworthy on a site large enough for future expansion of the airport if required' (Department of Transport and Regional Development, 1996). A major airport was defined as one 'capable of handling up to about 360,000 aircraft movements and 30 million passengers per year' (Department of Transport and Regional Development, 1996).

Following the substantial completion of a Draft EIS on the Badgerys Creek and Holsworthy airport options, the Government eliminated the Holsworthy Military Area as a potential site for Sydney's second major airport. The environmental assessment showed that the Badgerys Creek site was significantly superior to the Holsworthy Military Area. As a result this Draft EIS was prepared which examines only the Badgerys Creek site.

1.2 Need for a New Airport

World demand for aircraft travel has grown substantially over the past 30 years as air travel has become more affordable. Australia generally, and Sydney in particular have shared in this growth. The number of passenger movements through Sydney Airport has increased from 2.6 million in 1965/66 to over 20 million in 1995/96.

The Department of Transport and Regional Development (1997a) is currently forecasting that total passenger movements in Sydney will increase to 25.8 million in 1999/2000, 40.4 million in 2009/10 and 63.2 million in 2024/25 (*Figure 1.3*).

The number of aircraft movements through Sydney has also increased substantially over the last 30 years and is expected to continue to increase. In 1965/66 there were about 70,000 scheduled aircraft movements at Sydney Airport and by 1995/96 this had increased to 245,000. Total aircraft movements (both scheduled and non scheduled) using a major airport (Sydney Airport or the proposed Second Sydney Airport) in the Sydney basin are forecast by the Department of Transport and Regional Development (1997a) to reach 316,000 in 1999/2000, 426,000 in 2009/10 and 565,000 in 2024/25 (*Figure 1.4*).

The most significant potential constraint on this growth is insufficient provision of major airport and airspace facilities. Primarily this means airport facilities such as runways and taxiways, terminals and aprons and road and rail access. The capacity of

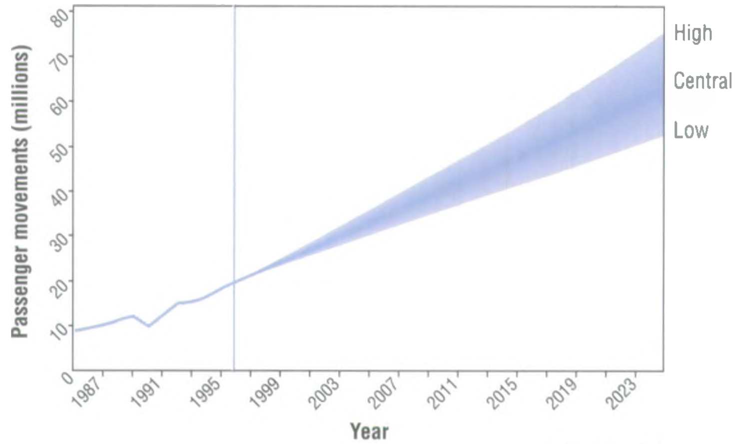


Figure 1.3
Forecasts of Passenger Movements for the Sydney Basin 2024/25 (Unconstrained Outlook)
Source: Department of Transport & Regional Development, 1997a

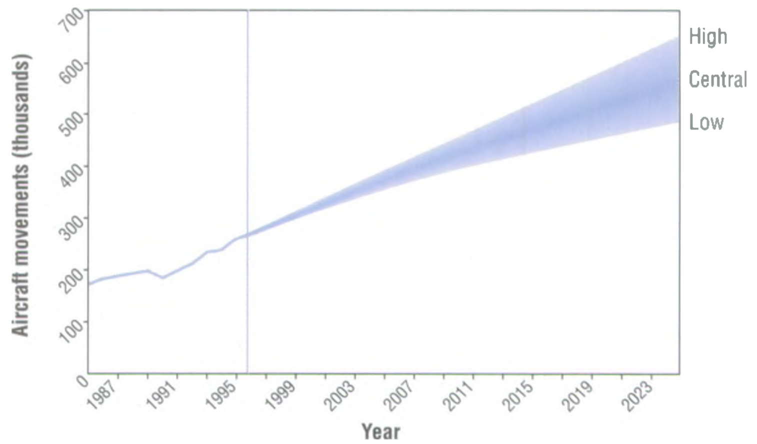


Figure 1.4
Forecasts of Aircraft Movements for the Sydney Basin 2024/25 (Unconstrained Outlook)
Source: Department of Transport & Regional Development, 1997a

these facilities at Sydney Airport to accommodate passenger and aircraft growth is limited. The Government and many communities surrounding the airport also believe that the ultimate capacity of Sydney Airport is substantially constrained by the adverse environmental impacts created by its operation, especially the noise impact. Other constraints on aviation may include regulatory and economic measures such as a Government imposed cap on aircraft movements.

The establishment of new or the expansion of existing physical airport and airspace facilities is required in order to accommodate the forecast growth in air passengers and aircraft movements. The timing of this further development can be delayed to some extent by the Commonwealth Government's application of regulatory and/or economic measures. Nevertheless, additional airport facilities will be needed if suppression and diversion of air travel demand is to be avoided.

A number of options are available. The two main options are either an expansion of Sydney Airport or the development of a new major airport. The Commonwealth

Government has stated a commitment to reducing the environmental impacts caused by Sydney Airport, in line with its policy 'Putting People First'. It has introduced a number of initiatives including a cap of 80 aircraft movements per hour, and airspace management procedures that share the noise more equitably. The Government has also proposed building a second major airport to a full international standard in the Sydney region. Any action on this commitment is subject to consideration of the results of the current environmental assessment process.

1.3 The Proposal

The Commonwealth Government proposes the development of a second major airport for Sydney capable of handling up to 30 million domestic and international passengers a year. By comparison, Sydney Airport is expected to handle about 20 million passengers in 1997. The *Second Sydney Airport Site Selection Program Draft Environmental Impact Statement* anticipated the new airport would accommodate about 13 million passengers each year (Kinhill Stearns, 1985).

In the Government's view, Sydney needs a second major airport to handle the growing demand for air travel and to control the level of noise experienced by Sydney's residents (Coalition of Liberal and National Parties, 1996).

Government policy (Coalition of Liberal and National Parties, 1996) indicates:

- an intention that Sydney's second airport will be more than just an overflow airport and will, in time, play a major role in serving Sydney's air transport needs; and
- a desire to reduce the noise and pollution generated by Sydney Airport as much as possible and to ensure that the noise burden around Sydney Airport is shared in a safe and equitable way.

Certain assumptions are made in this Draft EIS on how the Second Sydney Airport would operate, and in the master plans which set out the broad framework for future physical development of the airport; these assumptions are based on an operational limit of 30 million passengers a year. The general features of an airport that would operate at this level are illustrated by the generic master plan shown in *Figure 1.5*. The main features include parallel runways, a cross wind runway, and the provision of the majority of facilities between the parallel runways.

The Draft EIS also considers how the airport might be expanded in the future and the subsequent environmental implications. Such an expansion could not proceed, however, unless a further detailed environmental assessment and decision making process was undertaken by the Government.

Three airport options are considered in this Draft EIS, as well as the implications of not proceeding with the proposal. Broadly, the airport options are:

- Option A develops the site in a form generally consistent with the planning undertaken since 1986. The airport would be developed within land presently owned by the Commonwealth (1,700 hectares), with two parallel runways constructed on an approximate north-east to south-west alignment;
- Option B would adopt an identical runway alignment to Option A, but provides greater distance between the parallel runways, an expanded land area (additional 1,200 hectares) and also a cross wind runway; and

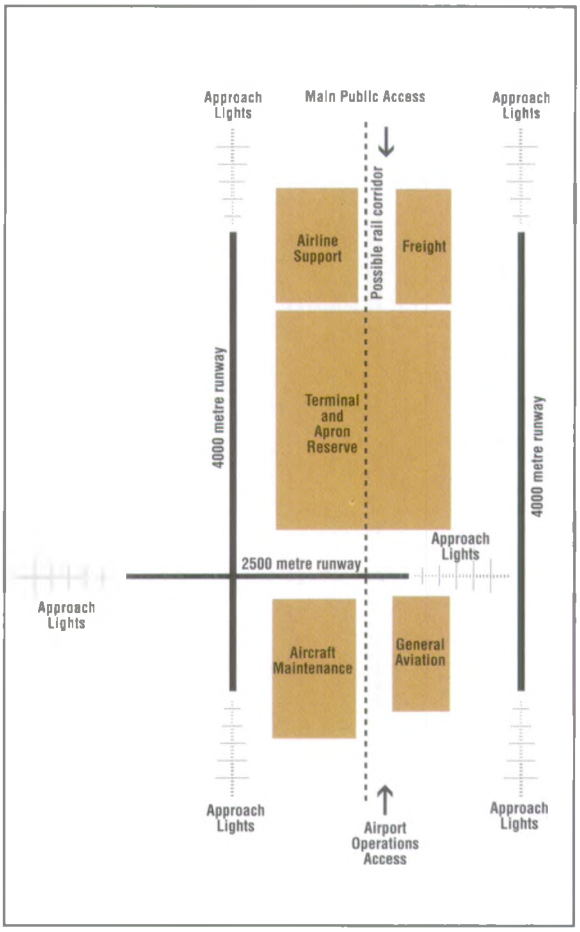


Figure 1.5
Generic Master Plan
Source: Second Sydney Airport Planners, 1997a

- Option C would provide two main parallel runways on an approximate north to south alignment in addition to a cross wind runway. Again, the land area required would be considerably more extensive (an additional 1,150 hectares) than that presently owned by the Commonwealth.

To ensure that the likely range of impacts are identified, a number of assumptions have been made about how the different airport options would be developed and operated. These relate to the number and types of aircraft that may operate from the airport, the flight paths used and the direction of take offs and landings.

It is clear that the number of flights into and out of the proposed airport would depend partly on the types of aircraft using it, and the associated numbers of passengers in each aircraft. The proposal put forward by the Government anticipates a major airport handling 30 million passengers and up to 360,000 aircraft movements per year.

The air traffic forecasts developed for this Draft EIS have been based on an examination of the number and type of aircrafts liable to be using the airport as it approaches the proposed operating level, and on the assumption that a relatively high percentage of international flights would operate from the Second Sydney Airport. This examination has shown that if the airport accommodated about 245,000 aircraft movements each year, the number of air passengers would approach 30 million.

Therefore it is appropriate for this Draft EIS to assess the airport operating at a level of 245,000 aircraft movements per year, rather than the 360,000 originally anticipated by the Government. It has been assumed that this level of operation could be reached by about 2016.

Chapter 2

The Decision Making Process

Chapter 2
The Decision Making Process

This chapter outlines the decision making process, identifies the proponent and describes the requirements and procedures for the environmental assessment. The role and structure of the Draft EIS and associated technical papers are outlined, and related legislation, agreements and conventions are identified.

2.1 The Environmental Assessment Process

The proposed Second Sydney Airport requires a decision of the Commonwealth Government and is therefore subject to Commonwealth environmental legislation. The main legislation of relevance is the *Environment Protection (Impact of Proposals) Act, 1974*, and its regulations and administrative procedures. The environmental assessment process established by this legislation is illustrated in *Figure 2.1*.

While the legislation establishes general requirements, of more importance for the preparation of this Draft EIS are detailed guidelines prepared by Environment Australia; these are provided in *Appendix A*.

2.2 The Environmental Auditor

The Commonwealth Government has supplemented the standard EIS process by adopting many of the findings of the Senate Select Committee on Aircraft Noise in Sydney (1995). The Committee's recommendations included the need for extensive consultation and a transparent and independent audit of the EIS process.

SMEC Australia Pty Ltd was appointed as the independent auditor of the EIS process by the Minister for the Environment in November, 1996. The role and responsibilities of the auditor are outlined below (Schedule 1 of Auditor Contract):

> The auditor will be required to report on the appropriateness and adequacy of the data and methodologies utilised by the Department of Transport and Regional Development and its consultants in the preparation of the Environmental Impact Statement (EIS). On the basis of the data presented, the auditor will also be required to report on the correctness or reasonableness of any assumptions or conclusions made in the Draft EIS and Supplement and in the working papers supporting the Draft EIS.
>
> The audit task will extend to all matters which fall within the scope of the EIS. Without limiting this generality, the audit will need to address the following key assessment issues: airport planning and operations; airport noise; air quality; land transportation; land use planning; community health issues; water quality and hydrology; risk assessment; flora and fauna; heritage; and socio-economic issues.
>
> The auditor will be required to liaise closely with the Department of Transport and Regional Development and its consultants during the preparation of the Draft EIS. To the extent practicable, the auditor will review the proposed study methodologies and working proposals at an early stage in the assessment process and provide advice, as appropriate, to the proponent prior to the finalisation of the Draft EIS.

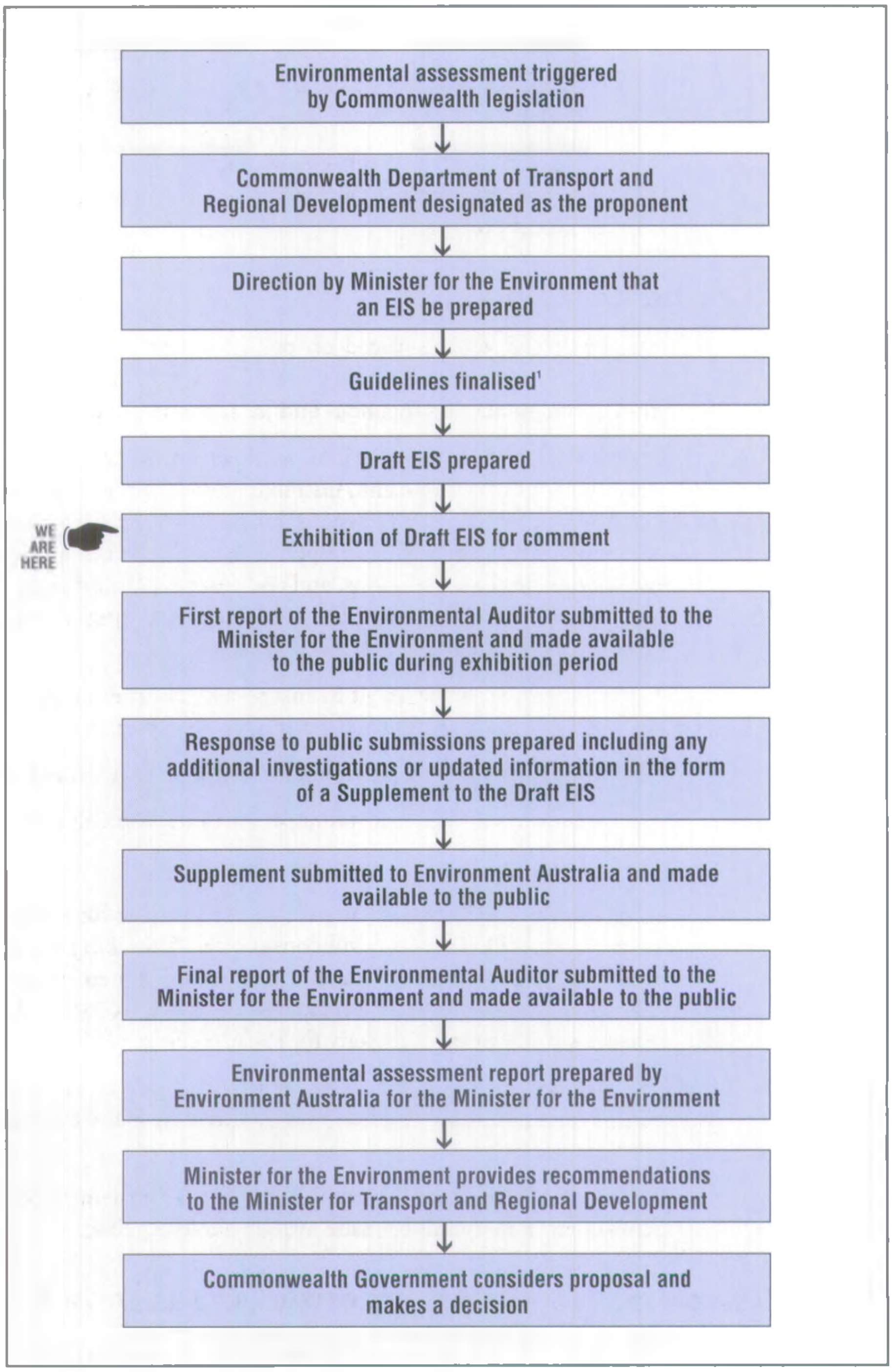


Figure 2.1

Environmental Assessment Process

Note: 1.Guidelines are based on those issued in November 1996 for the proposal to construct an airport at Badgerys Creek or Holsworthy Military Area and the public submissions on the Guidelines received during 1996.

The auditor will be required to prepare two audit reports, one on the Draft EIS and one on the Supplement. The auditor will provide to the Minister for the Environment an audit report on the Draft EIS in accordance with Clause 9A. Similarly, an audit report on the Supplement shall be submitted to the

Minister for the Environment in accordance with Clause 9A. The audit of the Supplement will need to address the proponent's response to the issues raised in public submissions on the Draft EIS. Both audit reports will be made available to the public.

The auditor should engage in community interaction to the extent necessary to gain an appreciation of community concerns about the Second Sydney Airport proposal.

2.3 Making the Decision

The Draft EIS will be placed on public exhibition for 12 weeks. Advertisements advising of the places where this Draft EIS can be purchased or reviewed have been placed in national, metropolitan and local newspapers.

During this review phase, any interested person, group or authority is invited to make a submission to Environment Australia on the Draft EIS. Environment Australia will forward a copy of all submissions received to the Department of Transport and Regional Development for a response. The Department will provide responses to issues raised in the submissions, and any additional information that may be relevant, in a Supplement to this Draft EIS. The Draft EIS together with the Supplement will be submitted to Environment Australia so they can:

- examine the document to ensure that the intent and requirements of relevant legislation and the Guidelines have been met;
- determine whether additional information is required;
- assess the environmental impacts of the proposal; and
- formulate recommendations.

Environment Australia will prepare an Assessment Report to the Minister for the Environment. The Minister will consider the EIS taking account of the Assessment Report and may make comments and/or recommendations to the Minister for Transport and Regional Development. These recommendations would include measures he considers necessary for the protection of the environment.

The Minister for the Environment may also decide at any time prior to the project being completed that an inquiry be conducted on any environmental aspect of the development.

The reports of the Environmental Auditor, the Supplement to this Draft EIS and the Assessment Report will be made available to the public.

2.4 Scope of the Environmental Assessment

This Draft EIS assesses the proposal relying on the range of studies and assessments identified as necessary by the Guidelines issued by Environment Australia. Available information is supported by field survey and research where required for potential impacts to be determined.

However, for a proposal of such complexity and an EIS of such extensive scope as this, some limits to the investigations must be established to ensure the EIS is technically achievable. Some of these limits were set by Government, others as a result of professional decisions taken by the EIS study team. The Draft EIS and associated documents identify where limits exist that affect the results or assessment in one or other specialist area. Three key limitations of the environmental assessment are discussed below. Further details are provided in *Chapter 27*.

The contents of this Draft EIS and supporting technical papers make a significant contribution to the understanding of the potential environmental impacts of the Second Sydney Airport proposal. Nevertheless, the adequacy of the overall scope of the environmental assessment is subject to review during and after the exhibition of this document and will be a matter for consideration for the Commonwealth Government during their deliberations on the proposal.

2.4.1 Off Airport Site Infrastructure

This Draft EIS is not the primary process for assessing the environmental impacts of infrastructure that would be provided off the airport sites in order to support the proposal. Such infrastructure would be the subject of separate environmental assessment processes under either NSW or Commonwealth legislation, depending on which authority is the proponent. New road, rail links and railway stations; relocation of transmission lines; new gas, fuel or water supply lines; and off-site water storage and sewerage systems would all be required.

This Draft EIS identifies the need for and potential locations of these developments and provides a discussion of environmental issues that may arise.

2.4.2 Potential Expansion of the Airport

The Commonwealth Government is proposing construction and operation of an airport capable of handling up to 30 million passengers each year. The environmental assessment process has involved the further development and refinement of this proposal.

The Department of Transport and Regional Development (1997a) estimates that by 2025 there will be a need to cater for 63 million passengers wishing to fly into and out of Sydney. Current planning for Sydney Airport assumes it will ultimately handle about 30 million passengers a year. Hence, it is apparent that if the Second Sydney Airport proceeds, there may be a demand to expand it in about 30 years time.

It is not feasible for an EIS to examine potential impacts of a major airport within Sydney over a timeframe of more than 20 years into the future. Predictions about how the airport would operate and the extent of impacts would not be accurate. Nevertheless, this Draft EIS provides some detail about how the airport options might be expanded in the future and the potential environmental implications of the expansion. Such an expansion could not proceed, however, unless a further detailed environmental assessment and decision making process were undertaken by the Government.

2.4.3 Impacts on Other Airports

Investigations have been undertaken into airspace management issues as part of this environmental assessment process. At this early stage in the airport planning process, however, it is not possible to prepare 'final' flight paths for the Second Sydney Airport. It would, for example, be necessary to review the preliminary flight paths following the assessment of noise and other environmental issues. Between now and the opening of the airport, it might also be necessary to adjust the flight paths for operational and other reasons which cannot be foreseen at this time.

It is therefore not possible to calculate in quantitative terms the impacts on other airports in the Sydney region. Similarly it is not possible to assess the environmental implications, such as noise, that may be caused by changes in operations at the other airports.

2.5 Role and Structure of this Draft Environmental Impact Statement

2.5.1 Role of this Draft Environmental Impact Statement

The environmental assessment process seeks to ensure all relevant environmental matters are examined and that the community and interest groups are involved. The EIS is an important part, but not the only part of this process.

The EIS provides information about the proposal to decision makers, other relevant authorities, interest groups and the community and provides the basis for these stakeholders to convey their views on the proposal to the Government. It quantifies and assesses potential adverse impacts and documents likely benefits associated with a proposal. The data and information contained in this Draft EIS also provide a baseline for use in future monitoring of the environmental performance of the proposal.

This Draft EIS assists the decision makers, but does not make a decision. It provides an assessment of the proposal but does not attempt to weigh up or place values on all the issues the Government will consider when reaching a decision. It does, however, provide information to the Commonwealth Government, other governments, various authorities, interest groups and the community to enable them to form opinions as to which are the most important and the least important issues to consider. The EIS assists in ensuring that the Government makes the decision with full available knowledge of the adverse environmental impacts and also of the benefits of the proposal.

2.5.2 Development of the Draft Environmental Impact Statement

This Draft EIS has been prepared by PPK Environment and Infrastructure Pty Ltd (formerly Rust PPK) and specialist subconsultants retained by PPK. The study team is listed in *Appendix B*.

PPK was appointed by the Department of Transport and Regional Development in September 1996 to examine the potential environmental impacts of both the Badgerys Creek and Holsworthy airport proposals. While the initial scope of work undertaken by PPK was largely defined by the Guidelines issued by Environment Australia (*Appendix A*), the Department outlined a broad scope of work in a study brief. Following the elimination of the Holsworthy Military Area, the study brief was modified.

A wide range of inputs from a variety of organisations is required to undertake a comprehensive environmental assessment of a proposal as complex as the Second Sydney Airport. The process of developing the proposal and the Draft EIS is outlined in *Figure 2.2*.

A broad proposal was initially developed by the Commonwealth Government as outlined in *Chapter 1*. A detailed airport planning process was then undertaken to further develop the proposal and ensure that sufficient information was available to allow the assessment of potential environmental impacts.

To assist with this planning work, the Department of Transport and Regional Development retained the services of the Second Sydney Airport Planners, a

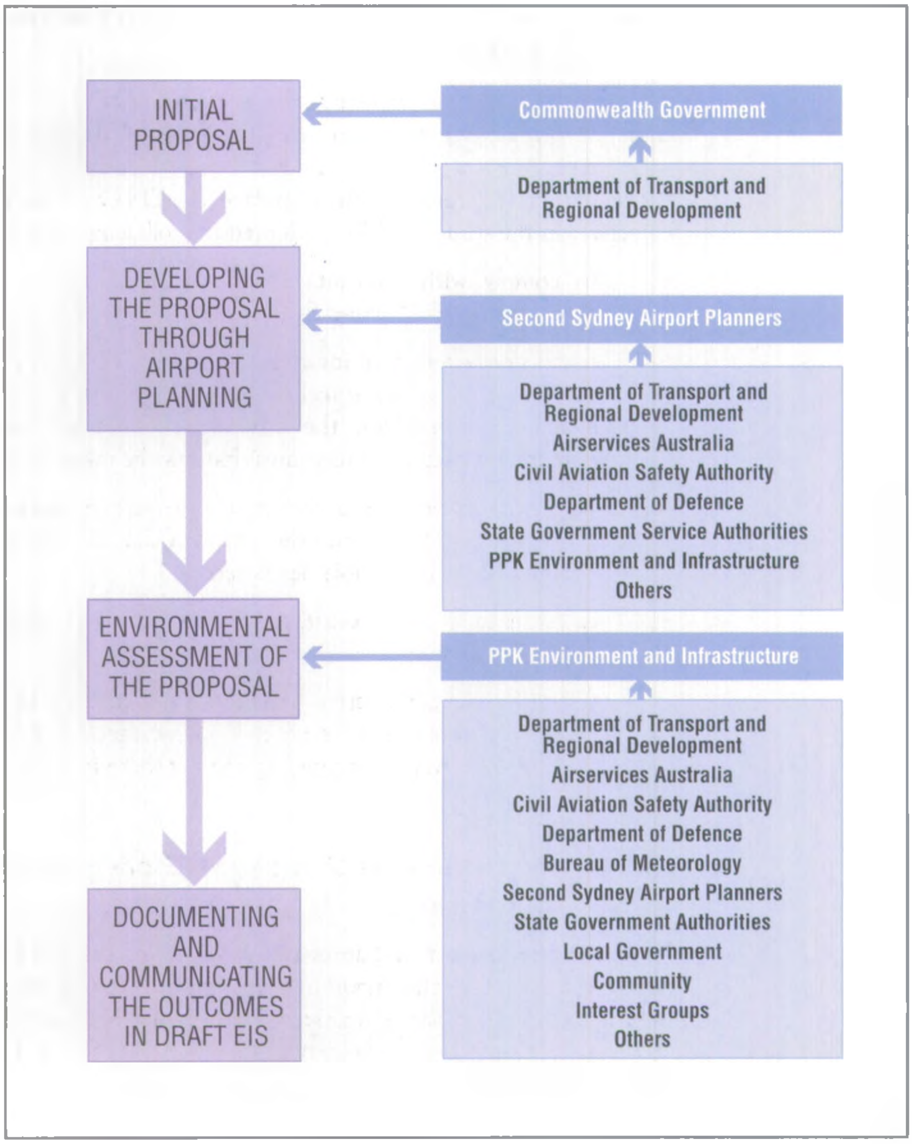


Figure 2.2
Development of the Proposal Prior to the Draft Environmental Impact Statement

consortium of firms led by Airport Planning Pty Ltd (Airplan). The primary objectives of this consultancy were to prepare master plans for each of the airport options and to describe how the airport options may be constructed. A number of Commonwealth and State Government authorities would influence the construction and operation of the Second Sydney Airport and therefore the Second Sydney Airport Planners were assisted by inputs from those organisations.

The information developed by the Second Sydney Airport Planners was used by PPK to assess potential environmental impacts. Other information was also sought by PPK from a range of authorities, interest groups and the community. The results of the assessment process are documented in the following chapters and associated technical papers.

2.5.3 Objectives of this Draft Environmental Impact Statement

The objective of the *Environment Protection (Impact of Proposals) Act, 1974* is 'to ensure, to the greatest extent that is practicable, that matters affecting the environment to a significant extent are fully examined and taken into account' (*Section* 5). Having regard to this objective, the EIS Guidelines (*Appendix* A) and the objectives in the study brief, PPK adopted the following objectives for this Draft EIS:

- to comply with relevant legislative requirements for the environmental assessment of the Second Sydney Airport proposal;
- to provide a source of information to the Commonwealth Government, the community and other stakeholders, concerning the need for the proposal, any available alternatives, the environment the proposal would affect, the potential impacts, and measures that may be taken to mitigate those impacts;
- to provide an overview of the cumulative adverse impacts and benefits of each of the airport options, and the ability of the proposal to satisfy the principles of ecologically sustainable development;
- to facilitate public consultation and informed public comment on the proposals; and
- to provide, in conjunction with the Supplement, a framework within which the Commonwealth Government will consider the environmental impacts of the proposal, and community opinion of those impacts, in its decision making process.

2.5.4 Structure of this Draft Environmental Impact Statement

Figure 2.3 provides an outline of the structure of the Draft EIS and the primary resource documents relied upon in preparing it. A list of other resource documents used is contained in the References. The relationship between the documentation and the EIS Guidelines is also provided. A separate Summary of the Draft EIS has also been prepared.

2.6 Legislation, Agreements and Conventions

Appendix C summarises legislation, agreements and conventions relevant to this environmental assessment process. While all legislation and agreements are important the following are highlighted:

- *Commonwealth Environment Protection (Impact of Proposals) Act, 1974*, together with the Regulations, Administrative Procedures and Guidelines;
- *Inter-Governmental Agreement on Environment, 1992;*
- *Rio Declaration on Environment, 1992;*
- *Convention on Biological Diversity, 1992*; and
- *Airports Act, 1996.*

In addition, legislation relating to airport operations and management is relevant to the development and assessment of the three airport options. The *Airports Act, 1996* (the Airports Act) sets out lease ownership limitations and establishes the leasing arrangements and the regulatory arrangements that will apply to leased Federal

Relevant EIS Guidelines	Draft EIS	Main Resource Documents
2 Introduction 10 Consultation and Studies	PART A INTRODUCTION Chapter 1 Overview of the Proposal Chapter 2 The Decision Making Process Chapter 3 Consultation	All Resource Documents Technical Paper No.1 Consultation
3 Background 4 Project Justification and Need 5 Options and Alternatives	PART B NEED FOR A SECOND MAJOR AIRPORT FOR SYDNEY Chapter 4 A Historical Perspective of Aviation in Sydney Chapter 5 Future Passenger and Aircraft Movements Chapter 6 Strategic Alternatives Chapter 7 Assessment Scenarios for the Second Sydney Airport	Air Traffic Forecasts Airport Planning and Design Report
6 Description of the Proposal • Airport Infrastructure • Airport Construction • Airport Operations • Ultimate Airport Development	PART C THE PROPOSALS Chapter 8 Airport Planning Chapter 9 Badgerys Creek Airport Options	Airport Planning and Design - Design Report Airport Planning and Design - Regional Infrastructure
7 Environmental Issues and Impacts • Land Use and Planning	PART D PLANNING AND LAND USE IMPACTS Chapter 10 Planning and Land Use	Technical Paper No.2 Planning, Land Use and Social Airport Planning and Design - Regional Infrastructure
7 Environmental Issues and Impacts • Airport Noise • Health Impacts (Noise)	PART E NOISE IMPACTS Chapter 11 Effects of Aircraft Noise Chapter 12 Aircraft Overflight Noise Chapter 13 Other Noise	Airport Planning and Design Report Technical Paper No.2 Planning, Land Use and Social Technical Paper No.3 Noise Technical Paper No.4 Property Values Technical Paper No.5 Meteorology
7 Environmental Issues and Impacts • Air Quality • Airport Hazards and Risks • Health Impacts (Air) • Ground and Surface Water • Flora and Fauna • Geology and Soils • Waste Minimisation and Management	PART F PHYSICAL AND BIOLOGICAL IMPACTS Chapter 14 Meteorology Chapter 15 Air Quality Chapter 16 Geology, Soils and Water Chapter 17 Flora and Fauna Chapter 18 Resources, Energy and Waste Chapter 19 Hazards and Risks	Airport Planning and Design Report Technical Paper No.5 Meteorology Technical Paper No.6 Air Quality Technical Paper No.7 Water Technical Paper No.8 Flora and Fauna Technical Paper No.9 Resources, Energy and Wastes Technical Paper No.10 Hazards and Risks
7 Environmental Issues and Impacts • Land Transport • Social/Community Issues • Archaeology and Heritage • Landscape and Visual Issues • Economic Analysis	PART G SOCIAL AND ECONOMIC IMPACTS Chapter 20 Aboriginal Cultural Heritage Chapter 21 Non-Aboriginal Cultural Heritage Chapter 22 Transport Chapter 23 Visual and Landscape Chapter 24 Economic and Financial Costs Chapter 25 Social and Economic	Airport Planning and Design Report Technical Paper No.11 Aboriginal Heritage Technical Paper No.12 Non-Aboriginal Heritage Technical Paper No.13 Land Transport Technical Paper No.14 Visual and Landscape Technical Paper No.2 Planning, Land Use and Social Technical Paper No.15 Economics
8 Environmental Safeguards, Monitoring Proposals and Environmental Management Plans	PART H ENVIRONMENTAL MANAGEMENT Chapter 26 Overview of Potential Environmental Management	All Resource Documents
7 Environmental Issues and Impacts • Cumulative Impacts 9 Consultation and Studies	PART I COMPARISON AND CONCLUSIONS Chapter 27 Overview of Impacts Chapter 28 Comparison and Conclusions	All Resource Documents

Figure 2.3

Structure of the Draft Environmental Impact Statement

airports. The Airports Act and Regulations combine to form a comprehensive regime for the ongoing regulation of activities at leased Federal airports. This regime displaces current Commonwealth oversight of these airports through ownership by the Federal Airports Corporation.

Under the arrangements for leased Federal airports, the Commonwealth Government will exercise controls over land use, planning and building. A company holding an airport lease must submit for the approval of the Minister for Transport and Regional Development:

- airport master plans;
- major development plans; and
- strategies for managing environmental issues at airports.

Through Regulations, the Commonwealth will also control all building activities, pollution and other impacts on the environment, and arrangements for pricing and service quality and other airport activities, including retail trading and the sale of alcohol.

An important convention that has been adopted by the Commonwealth is the principle of ecologically sustainable development. While no universally accepted definition exists of what constitutes such development, in 1990 the Commonwealth Government suggested the following definition for ecologically sustainable development in Australia:

> Using, conserving and enhancing the community's resources so that ecological processes, on which life depends, are maintained, and the total quality of life, now and in the future, can be increased (Commonwealth of Australia, 1992).

The *National Strategy for Ecologically Sustainable Development* defines the goal and establishes appropriate core objectives and guiding principles. The goal is identified as 'development that improves the total quality of life, both now and in the future, in a way that maintains the ecological processes on which life depends' (Commonwealth of Australia, 1992). The core objectives are:

- to enhance individual and community well-being and welfare by following a path of economic development that safeguards the welfare of future generations;
- to provide for equity within and between generations; and
- to protect biological diversity and maintain essential ecological processes and life support systems (Commonwealth of Australia, 1992).

In relation to environmental impact assessment, Objective 15.1 of the *National Strategy for Ecologically Sustainable Development* seeks to:

- ensure the guiding principles of ecologically sustainable development are incorporated into environmental impact assessment, with emphasis on clarity of application and process, community access and post approval accountability; and
- increase the level of consistency and certainty and avoid unnecessary duplication of the environmental impact assessment process across the nation (Commonwealth of Australia, 1992).

The core objectives and guiding principles of the *National Strategy for Ecologically Sustainable Development* have been reduced to four principles for environmental impact assessment in NSW. These principles are set out below and have been adopted as the basis for consideration of ecologically sustainable development in this Draft EIS:

- the precautionary principle. If there are threats of serious or irreversible environmental damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation;
- inter-generational equity. The present generation should ensure that the health, diversity and productivity of the environment is maintained or enhanced for the benefit of future generations;
- conservation of biological diversity and ecological integrity; and
- improved valuation and pricing of environmental resources.

Figure 2.4 illustrates the assessment framework for ecologically sustainable development used in this Draft EIS.

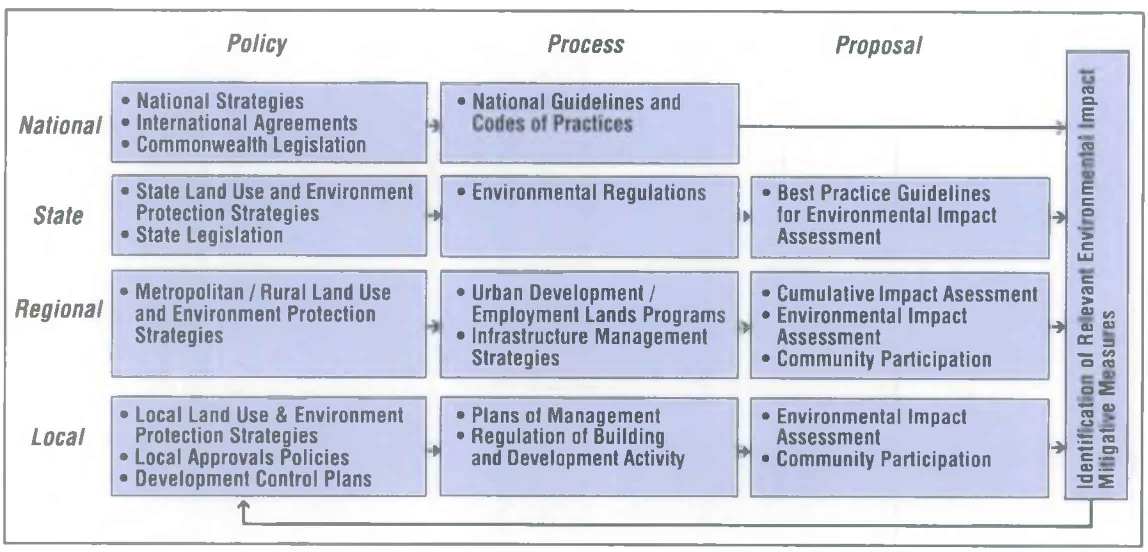


Figure 2.4

Assessment Framework for Ecologically Sustainable Development

Chapter 3

Consultation

Chapter 3
Consultation

The consultation strategy prepared as a part of the EIS process was developed when the studies for the assessment of Badgerys Creek and the Holsworthy airport options commenced. Much of the consultation undertaken as part of this strategy took place during the course of these studies.

This chapter describes the objectives of the consultation strategy, the philosophy underpinning them, the role of consultation in the EIS process and some of the challenges faced as the strategy evolved. It also outlines the areas targeted by the consultation strategy, the stakeholders identified, elements of the consultation strategy and the community response to the proposal. As the Commonwealth Government decided to exclude the Holsworthy Military Area from further consideration in September 1997, the community response to the proposal summarised in this chapter does not include reference to Holsworthy. Technical Paper No. 1 provides further detail on the consultation strategy undertaken prior to September 1997 and covers community response to both the Badgerys Creek and the Holsworthy airport proposals.

3.1 Requirement for Community Consultation

Formal processes for environmental assessment of major proposals have been in existence across Australia for over 20 years and most of the legislation defining such processes contains requirements for community consultation. This has usually consisted of exhibiting a report outlining potential environmental impacts and taking into account any submissions made during the exhibition period before a decision is made on the proposal.

While most environmental legislation does not formalise a requirement for consultation prior to the preparation of a Draft EIS, the value of and demand for community input into the entire environmental assessment process is increasingly being recognised. In accordance with the recommendations of the Senate Select Committee on Aircraft Noise in Sydney (1995), the Commonwealth Government in its brief for this Draft EIS, and in other documents, has stated its desire to involve the community throughout the EIS process.

The *Environment Protection (Impacts of Proposals) Act 1974* contains specific provisions for community consultation including a minimum period of 28 days for public review of this Draft EIS. The public review period has been extended to 12 weeks.

3.2 Consultation for Development of the EIS Guidelines

The EIS Guidelines for the Second Sydney Airport proposal were developed in a number of stages. This is because the proposal evolved from an assessment of a proposed airport at Badgerys Creek and then was expanded to include the Holsworthy Military Area as an alternative site. In September 1997, after studies had been substantially completed on the assessment of these two sites, the Government decided to exclude the Holsworthy Military Area from further consideration.

Draft Guidelines, prepared by the Commonwealth Department of the Environment, Sport and Territories, were released for public comment in January 1996 for the proposal at Badgerys Creek and 224 submissions were received. Additional public input was required following the decision to assess Holsworthy Military Area as well. Exhibition of revised draft Guidelines commenced in July 1996 and 51,000 submissions were received from an estimated 12,000 individuals and groups.

The draft Guidelines were finalised after considering the submissions received during both stages of the consultation process and released in November 1996. Copies of the final Guidelines for the assessment of the Badgerys Creek and Holsworthy Military Area were then distributed and made available during consultation activities.

Following the September 1997 decision by the Commonwealth Government to exclude the Holsworthy Military Area from further consideration, new Guidelines were prepared for this Draft EIS (*Appendix A*). The new Guidelines are based on those issued in November 1996 and, apart from the removal of references to the Holsworthy Military Area, the substance of the Guidelines has remain unchanged. In view of the relatively straightforward changes to the Guidelines, additional public input was not sought during their finalisation.

3.3 Consultation Strategy

3.3.1 Philosophy and Approach

The community consultation process provides the opportunity for community issues and concerns to influence the extent of the EIS studies and the way they are conducted. It involves sharing information with the community and responding to concerns. It does not imply that the community has control over the assessment or decision making process, which is the role of the Commonwealth Government, but rather that the process will be open and responsive to the views of those consulted.

The consultation strategy was developed to be responsive to community concerns. The phases of the process (see *Figure 3.1*) included identifying interested communities and developing a body of information; sharing the information with the communities, consulting with them and seeking their feedback. The issues raised then provided a direct input to the Draft EIS studies.

The development of the consultation strategy evolved in response to issues raised by the community. This approach allowed for constant evaluation of the nature, type and location of activities to ensure that the consultation program was appropriate, relevant and responsive to community needs.

3.3.2 Objectives of the Consultation Strategy

Consultation was an integral part of the preparation of the Draft EIS, just as it will be integral to the Supplement. The consultation process does not, however, exist separately from the process of producing the Draft EIS and Supplement. The objectives of the consultation strategy are to:

- design and implement an appropriate consultation program to operate for the duration of the EIS process;
- identify key stakeholders and understand their interest in the project;
- liaise as required with community groups, industry groups and other stakeholders on matters that arise during the course of the study;
- provide appropriate opportunities for the community to raise issues on the proposals and to provide appropriate responses from the study team;

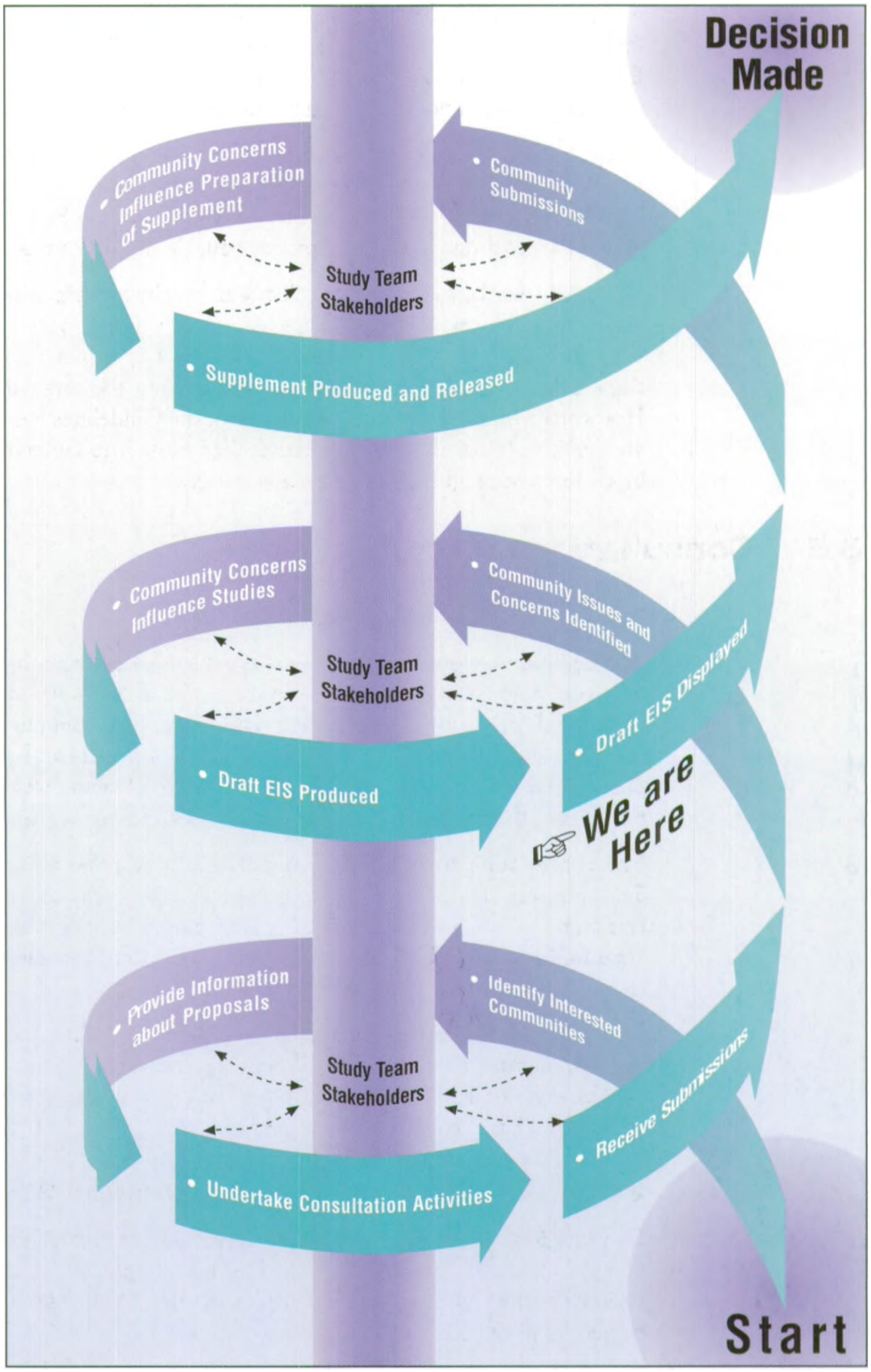


Figure 3.1

Community Influence on the Studies and EIS Process

- determine the crucial issues of community concern;
- obtain general community and stakeholder acceptance of key issues and move towards agreement on the means to resolve issues; and
- build confidence in the EIS process.

The tasks involved in delivering the consultation strategy included:

- preparing and distributing information about the EIS process, the proposals and aspects of the EIS studies;
- providing a range of opportunities for two way exchange of information;
- providing a range of ways of receiving submissions; and
- ensuring community concerns and issues were considered in the studies.

3.3.3 Influences on the Consultation Strategy

The consultation strategy was designed to be responsive to community issues and concerns. The process of assessing the Second Sydney Airport proposal is highly dynamic and subject to a range of influences, many of which have had a bearing on the evolution of the approach to consultation.

A primary role of the consultation process is to provide accurate, up-to-date information about the proposals. In addition to the role PPK played in formal consultation, a wide range of people, organisations and events have shaped community knowledge and understanding of the proposal and the EIS. Some of these are indicated in *Figure 3.2*. There have been a large number of community meetings, protest meetings and rallies. There has also been significant involvement from Members of Parliament, both State and Commonwealth councils and groupings of councils, as well as a high level of coverage in electronic and print media. It is not possible to fully evaluate the impact of these activities, but they have certainly had a significant influence on general community understanding of the proposals.

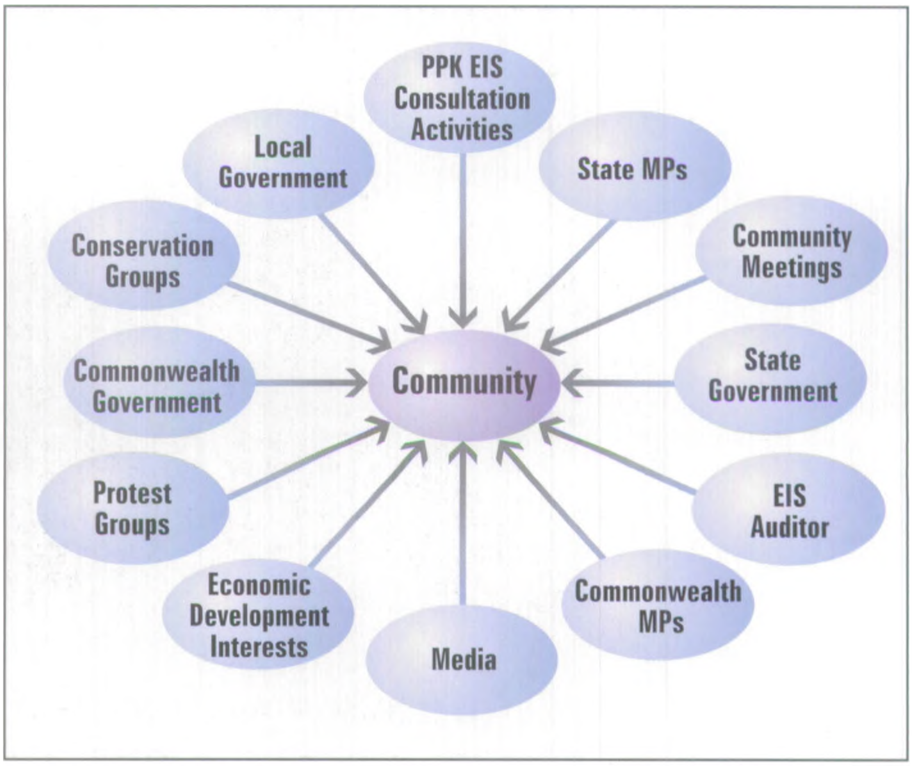


Figure 3.2
Influences on Community Knowledge and Understanding

Another major influence on the consultation strategy was the unexpected nature of most of the airport options. While the communities around Badgerys Creek had been familiar with an airport proposal for more than 10 years, Options B and C at Badgerys Creek were unexpected. The response to these new options was frequently very intense and can be interpreted as a response, by some members of the community to a perceived threat to a familiar lifestyle.

The very large potential audience with an interest in the Second Sydney Airport proposal has also posed significant challenges for the consultation strategy. As interest in the proposals developed and community groups formed to respond to the proposals, the strategy needed to change to better meet community needs and ensure equity in the process.

3.3.4 Scope of Consultation

General interest in the Second Sydney Airport proposal is on a national scale. Direct and particular interest in the process of environmental assessment has come from members of the community as widely separated as the Blue Mountains in the west, Baulkham Hills in the north, Hurstville and Cronulla in the east, Wollongong in the south and Picton on the south-western outskirts of Sydney. The population of this area is about 1.8 million people.

Consultation activities commenced in October 1996 and will continue until after the release of the Supplement to the Draft EIS. The initial phase focussed on providing information about the EIS process and the proposals for Badgerys Creek and the Holsworthy Military Area. From October 1996 to May 1997, ten separate documents were released and over 400,000 copies distributed in the community (*Figure 3.3*). In addition, non-English language documents were produced in 14 languages and over 20,000 copies distributed. Advertisements in seven languages were placed on ethnic radio. Four types of display posters were produced and 700 copies distributed. Over 140 advertisements were placed in metropolitan and local newspapers. A weekly

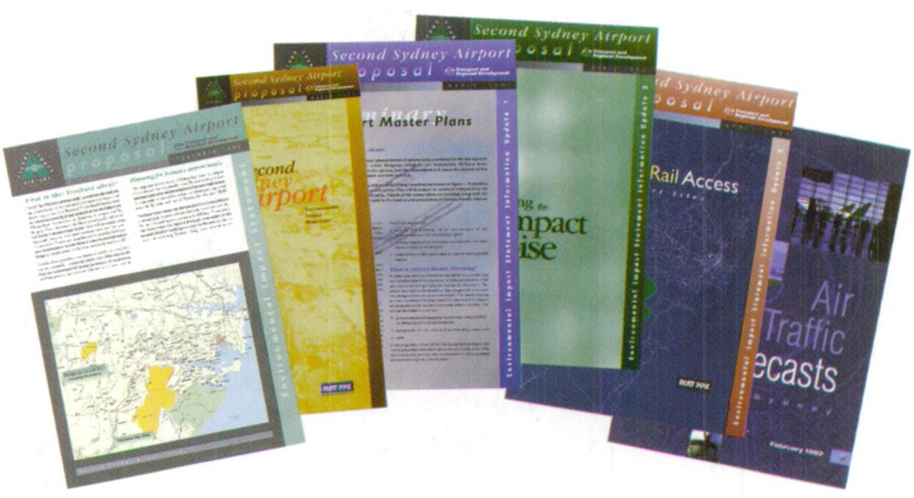


Figure 3.3
Some of the Consultation Material Released

Local Government Bulletin provided information to councils about local activities.

Opportunities for direct contact and two-way exchange of information with the community occurred through meetings and telephone conversations, information days and displays at shopping centres, (photographs 2, 3 and 4) and by responding to written submissions. Through these activities, over 20,000 members of the community directly participated in consultation activities.

Photograph 2
Information Day at Penrith

Approximately 2,000 days of staff time were spent on consultation activities. This involved a large team of technical and support staff and community access to specialist consultants.

Photograph 3
Mobile Display at Thirroul

Photograph 4
Information Day at Springwood

Perhaps of more consequence, comments made in written submissions or via the freecall Telephone Information Line were processed through a database designed to group together and describe the issues raised. The results of this process were progressively provided to specialists undertaking environmental studies, so that continual input from the community became an integral part of the assessment process.

3.4 Results of Consultation

Key issues and community concerns were identified through public meetings and submissions received, through discussions on the Telephone Information Line and through a Community Access Centre located at Liverpool.

Submissions were entered into a database and grouped in a manner similar to the structure of this Draft EIS. They were then supplied to the specialist consultants undertaking the studies so that they could be taken into account during the course of the studies. Concerns raised in relation to each of the issues are briefly summarised at the beginning of each relevant chapter of this Draft EIS and in more detail in *Technical Paper No. 1*.

Figure 3.4 shows the issues raised by submissions received between October 1996 and 30 April 1997, and the proportion that relates to each part of this Draft EIS. During this time around 950 submissions relating specifically to Badgerys Creek or to both site options were received and entered into the database. Since then, between May and 3 September 1997, approximately 500 additional submissions were received. No new or different issues were raised by the later submissions. Almost 70 percent of the issues and concerns raised related to individual impact issues and just under 30 percent to concerns about the EIS proposals and options.

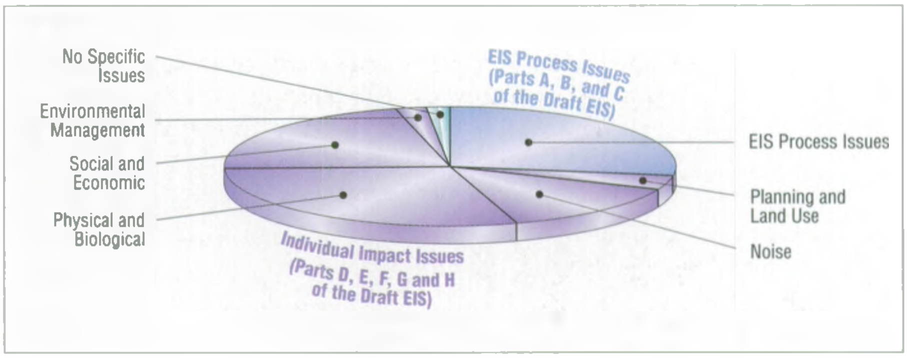


Figure 3.4
Issues and Concerns Raised by the Community
Note: October 1996 to April 1997

In relation to the Badgerys Creek airport options the key issues were:

- *the planning process*. Almost 30 percent of submissions focussed on the proposal itself rather than individual aspects of it. Most respondents expressed the view that the Second Sydney Airport should not be located within the Sydney basin;
- *potential aircraft noise impacts*. Aircraft noise was one of the most significant issues. This concern was compounded by the anticipation of a no-curfew airport. The basis of concern about noise included conversation disturbance, sleep disturbance, associated stress, and potential effects on learning and child behaviour;
- *air quality and impacts on community health*. The prevalence of asthma was claimed to be especially high in the western and south-western areas of Sydney. This factor, combined with general community apprehension over the possible relationship between air pollution and asthma made the issue a major source of concern. Similar concerns were raised about aircraft emissions and this potential to cause or predispose susceptible individuals to cancer;
- *water quality issues*. A high value was attached to clean drinking water supplies, catchment areas, stream habitat value and water quality. The proximity of the airport options to Warragamba Dam, Sydney's primary water supply, was strongly associated in public perception with diminished water quality;
- *loss of lifestyle and amenity*. Communities that have located in regions surrounding the airport options have created and maintained an outdoor lifestyle with an emphasis on recreational activities. These communities considered that the airport options and resulting noise and air pollution and extra traffic would effectively destroy this keenly sought lifestyle;
- *hazards and risks*. The risk of a plane crash into urban areas or other facilities such as Warragamba Dam was noted as a major concern; and
- *decision making*. The history of decision making in relation to the Badgerys Creek proposals has led to long-term uncertainty. While an airport was proposed at Badgerys Creek over 10 years ago, no substantial development has begun, and it was claimed that this uncertainty has had considerable impact on community stability. Many community members are seeking a decision to enable them to plan their future. In addition, the introduction of Options B and C exposed new populations to uncertainty regarding potential impacts of an airport development.

3.5 Issues Raised about the Consultation Process

The extent of the consultation program undertaken prior to the release of this Draft EIS was unique in Australia. There is no legal requirement for community consultation prior to the release of a Draft EIS and it is generally not undertaken to such a degree until after the Draft EIS is placed on public exhibition. There was, however, a high level of awareness and interest in the Second Sydney Airport proposal and the consultation strategy was developed to commence immediately work started on the airport planning and environmental studies.

As part of the consultation strategy, it was proposed to identify any perceived inadequacies in the EIS process or gaps in information that might inhibit the consultation process. This section examines some of the difficulties encountered.

3.5.1 Release of Information

The primary aim of the early consultation program was to provide information about the proposals and the EIS process. Many members of the community, however, wanted the consultation to provide details about the range of impacts anticipated from the airport development proposals and then consult the community in order to document their response to these likely impacts. The fact that detailed information about likely impacts could not be provided until the completion of the studies was not well understood and provided a source of continuing confusion and frustration.

There was community concern about the accuracy of base maps and the lack of a scale in the initial newsletter distributed in November 1996 outlining the proposal. Subsequently, a geographic information system database was developed to provide accurate base maps for all future information. Accurate base maps were used in all subsequent material.

It was intended that information expanding on the proposal, such as preliminary flight paths for each option, would be released in time for community responses to be incorporated into the Draft EIS. It was also proposed that where technical studies were completed in advance of the Draft EIS, information summarising the main findings would be released to assist with community understanding of the proposals.

In fact, it took longer than anticipated to prepare and gain approval for release of information. Some crucial studies were not prepared by the EIS study team, but were developed and approved by other consultants and government agencies. These included the Air Traffic Forecasts, the Preliminary Master Plans and the material on Preliminary Flight Paths. Due to the timing of release of information on flight paths, submissions made on this information could not be considered in the Draft EIS.

The consultation process started in October 1996. At that stage it was understood that environmental assessment would be undertaken on two airport options (one at Badgerys Creek and one at Holsworthy Military Area) The scope of work was not, however, finalised until November 1996 when it was determined that the assessment should proceed on five options (three at Badgerys Creek and two at Holsworthy). This had a number of implications. Firstly, it significantly expanded the scope of work and meant that very few studies were completed in advance of the completion of the entire Draft EIS, too late for prior release. Secondly, the target areas for consultation needed to be expanded to cover the five options. As the Preliminary Master Plans and later the flight path material were developed, it became clear that the target areas for consultation needed to expand still further. As the scope of work and consultation had been greatly enlarged, the original timetable proved unrealistic; delays in providing information, for instance concerning flight paths, were unavoidable, but led to a degree of frustration in the community.

3.5.2 Implications of the Decision to Eliminate Holsworthy Military Area

On 3 September 1997, after examining the studies undertaken for the two sites, the Commonwealth Government announced that Holsworthy had been eliminated as a potential site for Sydney's second major airport; it had concluded from the studies that the development of a major airport at Holsworthy would be environmentally unacceptable. However, the Government did release the Summary of the work undertaken for the Draft EIS. The decision to eliminate Holsworthy led to the formulation of new guidelines and the development of this current Draft EIS assessing only the three Badgerys Creek options.

Assessment and decisions on proposals such as that contained in this Draft EIS are made after balancing the information contained in technical studies with the input received from the community. In this case there was substantial early input from the community, prior to the time when the Government made its decision to eliminate Holsworthy.

From the start of preparation, the consultation and the responses received during the assessment of the two site options were recorded separately for Badgerys Creek and Holsworthy. Hence, the issues and concerns raised in relation to Badgerys Creek can now be treated separately in the current Draft EIS.

The level of consultation activity undertaken to date has been very extensive and has enabled the objectives set out in *Section 3.3* to be substantially met. In the circumstances it has not been possible to meet all community expectations for detailed information; however, the perceived deficiencies will be substantially made up by information contained in this Draft EIS.

The principal difficulties encountered in the consultation process to date have been associated with timing and the release of information. The scale of the studies undertaken, and uncertainties about the timing of completion of the studies and release of the Draft EIS have contributed to a climate of confusion and mistrust about the EIS process.

Experience gained from the initial consultation has been invaluable, and will be reflected in the consultation strategy for future stages.

3.6 Ongoing Consultation

Ongoing community consultation will be carried out during the 12 week exhibition of this Draft EIS. Advertisements advising where it can be either viewed or purchased will be placed in national, metropolitan and local newspapers. All interested individuals and groups are invited to make submissions in writing to Environment Australia. Guidelines explaining how to make a submission are outlined in the Summary of this Draft EIS.

All submissions will be considered during several stages of the decision making process as outlined in *Chapter 2*.

Part B

The Need for a Second Major Airport for Sydney

Chapter 4

An Historical Perspective of Aviation in Sydney

Chapter 4
An Historical Perspective of Aviation in Sydney

Providing capacity for Sydney's airport needs has been the subject of considerable attention since 1919, when the current site of Sydney Airport was first used for aviation purposes. This chapter aims to show the background for some of the developments that have influenced and will continue to influence decisions on the Second Sydney Airport.

4.1 Planning and Control of Aviation

4.1.1 Overview

Planning and control of civil (non-military) aviation facilities in Australia has always been a responsibility of the Commonwealth Government; in the 1980s the majority of these functions were vested in two new statutory authorities. The Federal Airports Corporation was established to own and operate most of Australia's major international and domestic airports, and its capital city general aviation airports. The Civil Aviation Authority was established at about the same time to assume responsibility for airspace management and aviation safety regulation.

In 1995 the Civil Aviation Authority's responsibilities were separated. Airservices Australia took over air space management, while the Civil Aviation Safety Authority was made responsible for safety regulation. At the same time, the Government announced a plan to sell off (by means of long-term leases) all the airports owned by the Federal Airports Corporation. In 1996 Brisbane, Melbourne and Perth airports were offered for sale through a tender program; these sales were completed on 1 July 1997. The sale of Sydney Airport and the general aviation airports at Bankstown, Camden and Hoxton Park has been deferred until a decision is made on the Second Sydney Airport proposal.

4.1.2 Operation of Facilities

The major civil airports and airfields in the Sydney region comprise Sydney, Bankstown, Camden and Hoxton Park (*Figure 4.1*). They are owned and operated by the Federal Airports Corporation, which assumes responsibility for the provision of aircraft movement and parking areas; airfield lighting and visual navigation aids; international passenger handling facilities; roads and car parking facilities; and perimeter and some security services.

Major airport facilities and services not provided by the Federal Airports Corporation include:

- domestic passenger handling facilities (provided by airlines);
- air traffic control services and electronic navigation aids (Airservices Australia);
- rescue and fire fighting services (Airservices Australia);
- customs, immigration and quarantine services (Commonwealth Government);

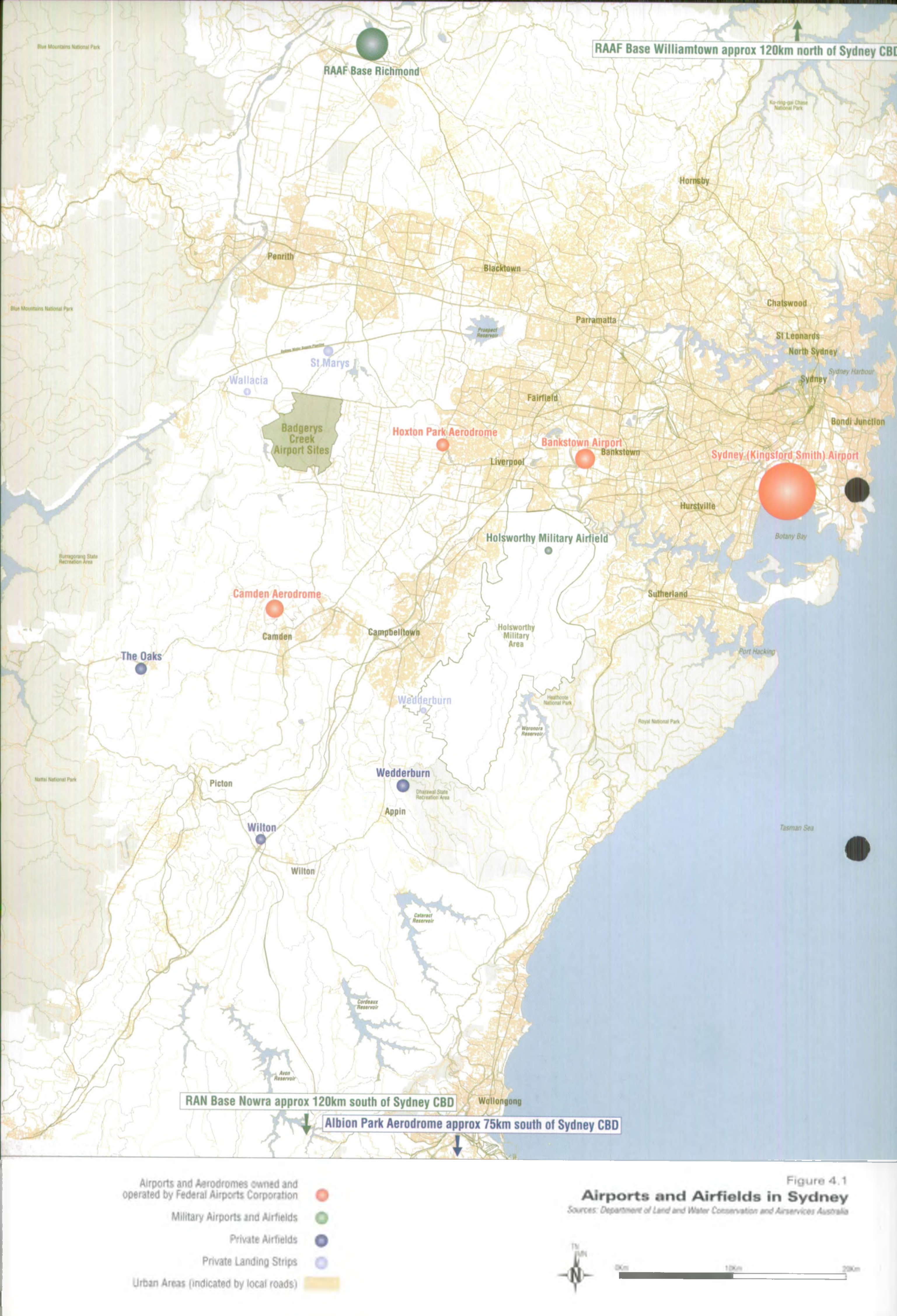


Figure 4.1
Airports and Airfields in Sydney
Sources: Department of Land and Water Conservation and Airservices Australia

- freight and airline support services including maintenance (airlines); and
- the supply of aircraft fuel (oil companies).

4.1.3 Airspace Management

Airspace management, which is the responsibility of Airservices Australia, is carried out through the establishment of a number of *control areas*. They include airport control (arriving and departing aircraft up to 55 kilometres from the airport), terminal area control (within 55 to 90 kilometres from the airport) and en-route control (between major centres).

Airservices Australia is responsible for the design of flight paths for Sydney Airport, which are currently under review. Such a design takes account of safety, aircraft movement demand and noise impacts. In July 1996, Airservices Australia also assumed responsibility for the handling of aircraft noise complaints.

4.1.4 Safety

The Civil Aviation Safety Authority was established in 1995 to develop and enhance the safety of civil aviation, in cooperation with the aviation industry. The highest priority is assigned to the protection of passengers.

The work of the Authority is done within a legislative framework based on a comprehensive set of international standards established by the International Civil Aviation Organisation, a United Nations agency. In addition to ensuring adherence to safety rules, the Authority's role includes controlling the entry of new participants into the aviation business, through licensing and certification.

4.1.5 Environmental

Airservices Australia is responsible for matters relating directly to noise and air emissions from aircraft while in the air. Its responsibilities include aircraft noise monitoring, noise certification of aircraft and the generation of maps showing noise contours.

The Federal Airports Corporation is responsible for environmental matters on the ground and in the vicinity of its airports. It convenes *Airport Consultative Committees* at individual airports (except for Sydney, which has the Sydney Airport Community Forum) where industry, State and local government and, in some cases, the community can raise and seek resolution of matters of concern.

All Federal Airports Corporation airports have set up environmental management plans that cover issues such as atmospheric emissions, water, waste, fuel spillage, and any impacts on the wider environment. When airports such as Sydney Airport are leased in the future, each operator will, under the provision of the *Airports Act 1996*, be responsible for implementing an environmental management strategy.

The Department of Transport and Regional Development retains policy oversight of aviation environmental issues and is responsible for the development of legislation. It is directly involved, for example, in administering the *Sydney Aircraft Noise Insulation Project*, the *Aircraft Noise Levy Act*, and the *Sydney Airport Curfew Act 1995*. The Department is also involved in developing and implementing of *Long Term Operating Plan for Sydney Airport* (Airservices Australia, 1996a).

4.2 Reviews of Sydney's Airport Needs

4.2.1 Early Development of Sydney Airport

The Commonwealth Government first acquired control of Sydney Airport in 1921. It was progressively expanded in the 1920s and 1930s until, in 1935, it was declared an *International Aerodrome*. In 1940 the first terminal building and control tower were opened. In 1945 the Airport had three relatively short runways (*Figure 4.2*).

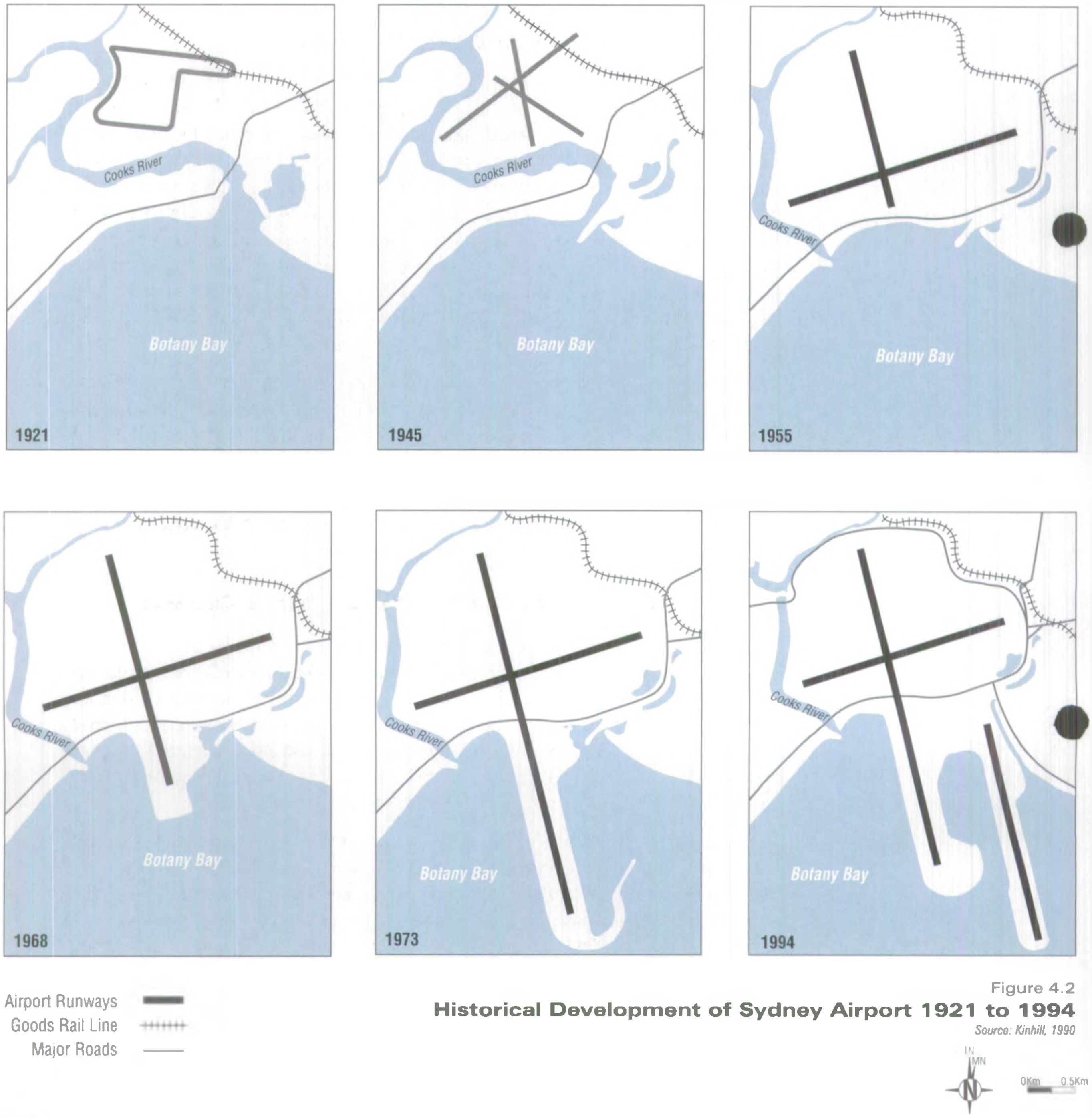


Figure 4.2
Historical Development of Sydney Airport 1921 to 1994
Source: Kinhill, 1990

A major expansion began in 1947, and by the time it was completed in 1954 the Airport had the current east-west runway of 2,530 metres, and the northern section of the current main north-south runway, and its international terminal had been extended.

The continued growth of air traffic and aircraft size triggered further expansion in the late 1960s and early 1970s. The north-south runway was extended in 1968 and attained its current length of 3,962 metres in 1972. A new international terminal was, opened in 1970 (Kinhill, 1990).

4.2.2 Development of Other Airports

The need for an airfield to support fighter aircraft production during World War II saw an airport developed on a 255 hectare site at Bankstown in 1940. After the war, Bankstown Airport was considered, along with a number of other locations, as a possible site for the development of Sydney's international airport. Although it was rejected primarily because of approach and other site limitations, it was nevertheless identified as an ideal airport for light aircraft. Control of Bankstown was transferred from the RAAF to the Department of Civil Aviation in 1948. Thereafter Bankstown Airport was used for both military and civil aviation and much of the light aircraft, private flying and small aircraft manufacture was transferred there from Sydney Airport. In the early 1980s, the RAAF ceased any use of Bankstown. In 1988 ownership and management was transferred to the Federal Airports Corporation.

Camden Airport started out as an airfield built by the Camden district's famous merino farming Macarthur family in the early 1900s (the original Macarthur hangar still exists). It was acquired by the Commonwealth Department of Air during World War II as a pilot training facility. In 1988 it too was transferred to the Federal Airports Corporation.

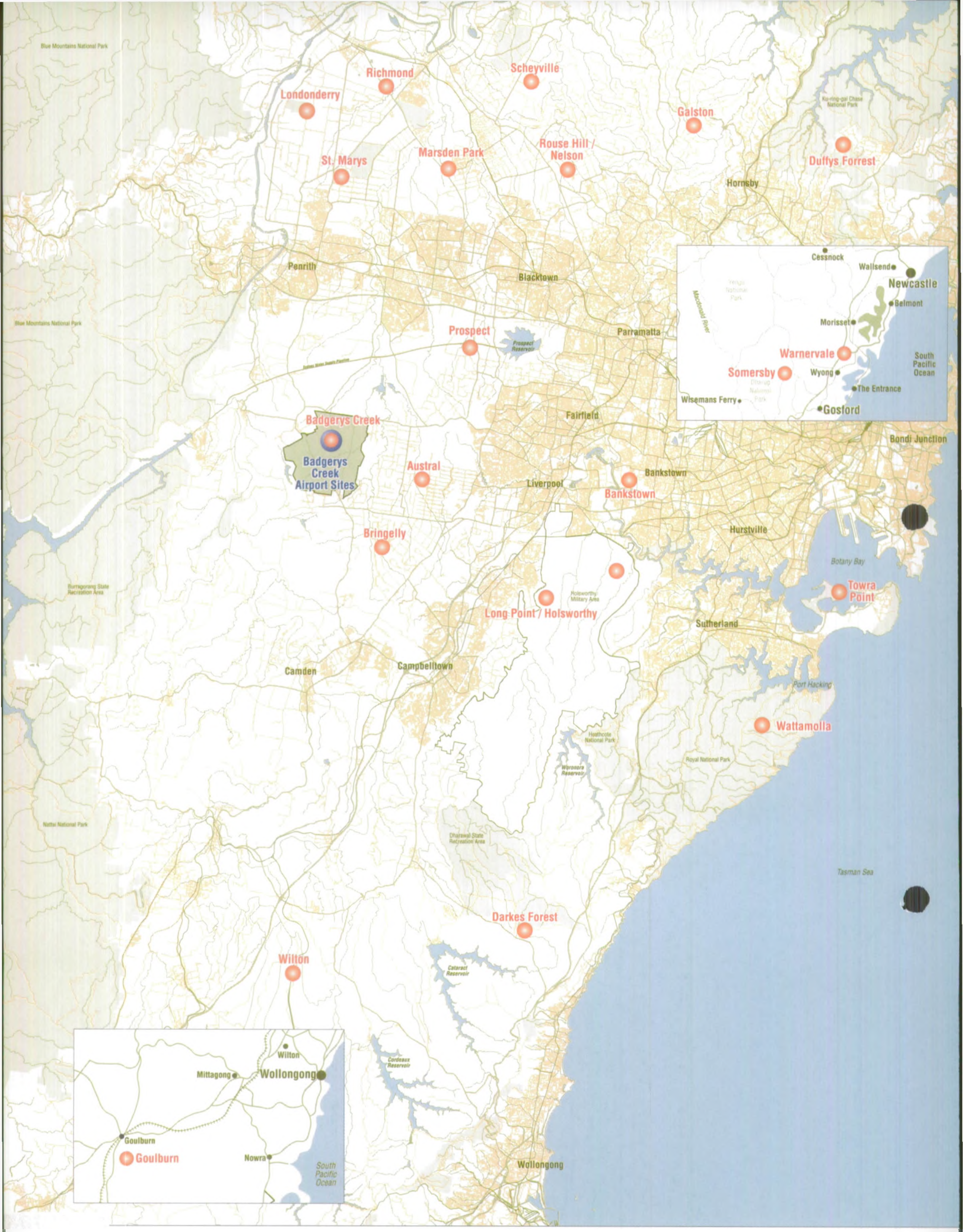
Hoxton Park Airport was established in 1942 as a Department of Air relief facility for Bankstown Airport in the event of an enemy air attack.

4.2.3 Early Reviews of Sites for Sydney's Second Airport

The significant expansion in civil aviation in the post World War II years triggered not only a major expansion of Sydney Airport, but also concern about provision for future growth in air transport. A *Report on the Development of an International Airport at Sydney* released in 1946 was conducted to find the best location for further airport development in the Sydney Region. The three sites selected were Towra Point (refer *Figure 4.3*) and the existing airports at Mascot and Bankstown.

While a major expansion of Mascot began in 1947, the Towra Point site was considered a good candidate for the location of a future second airport. Bankstown, however, was rejected. Negotiations over the Towra Point site continued between the Commonwealth, State and local governments for more than 20 years, before a decision was taken in 1969 that it was beset with too many environmental difficulties (Kinhill, 1990).

Following the rejection of the Towra Point site and another inquiry by a Commonwealth Inter-Departmental Committee, which undertook *The Major Requirements for Sydney Study* (released in 1970), a new study was begun in 1971, the *Benefit Cost Study of Alternative Airport Proposals* (R. Travers Morgan and Partners, 1973).



Sites considered for Second Sydney Airport 1946 to 1997

Site considered by this Draft EIS

Urban Areas (indicated by local roads)

Figure 4.3
Potential Second Sydney Airport Sites Shortlisted for Consideration 1946-1986
Source: Kinhill Stearns, 1985

TN MN N

0Km 10Km 20Km

This study identified 106 possible sites for a second Sydney Airport. The number was reduced, through a process of elimination based on cost and environmental considerations, to a short list of five sites: Towra Point, Rouse Hill/Nelson, Long Point, Marsden Park and Bringelly (*Figure 4.3*). The study recommended development of a parallel runway at Sydney Airport as the first step in addressing Sydney's airport capacity needs. No site was chosen from the short list, however, as the study was terminated in 1973 when the then Commonwealth Government announced that Galston would be the site for a second airport. That decision was subsequently reversed following further consideration, and as a result of public opposition (Kinhill, 1990).

In 1976, a further study was initiated by the Commonwealth and State Governments jointly, called *The Major Airport Needs of Sydney Study* (Major Airport Needs of Sydney Study Committee, 1979). Whereas previous studies had considered all possible sites, this study examined only those areas capable of accommodating a major six-runway airport. The study selected six possible sites for detailed economic and environmental evaluation. These were Londonderry, Scheyville, Badgerys Creek, Austral, Long Point and Bringelly (*Figure 4.3*).

From this evaluation Badgerys Creek and Scheyville were shortlisted. The Commonwealth members of the study team, however, considered that a major second airport could not be justified before the development of a parallel north-south runway at Sydney Airport. Badgerys Creek was the preferred site for a new airport on economic, financial and environmental grounds. In 1982 the then Minister of Aviation announced the Government's intention to construct a parallel runway at Sydney Airport (Kinhill, 1990).

4.2.4 Second Sydney Airport Site Selection Program

Although taxiway and other developments continued at Sydney Airport, in 1983 a new Commonwealth Government chose not to pursue the parallel runway proposal. Rather, in September 1983 the Minister of Aviation in that Government and the New South Wales Minister for Environment and Planning jointly announced a program that would lead to the selection and acquisition of a second airport site for Sydney.

The *Second Sydney Airport Site Selection Program Draft Environmental Impact Statement* (Kinhill Stearns, 1985) re-examined all possible airport locations and chose Badgerys Creek, Bringelly, Darkes Forest, Goulburn, Holsworthy, Londonderry, Scheyville, Somersby, Warnervale and Wilton for preliminary evaluation. These sites were evaluated against a range of factors covering the natural and socio-economic environment, access to the city, airport operations, the cost of acquisition and provision of infrastructure.

A site selection process was then undertaken by dividing the Sydney sites into two groups: a group of closer sites and a group of mid-distance sites. Goulburn was considered separately, but was eliminated early, on grounds of distance and travel time to Sydney. A preferred site was selected from each group. Badgerys Creek was considered to be the best of the closer sites, and Wilton the best of the mid-distance sites.

Badgerys Creek and Wilton were then assessed in detail as sites for a major airport with a pair of parallel runways. The results of the assessment were presented in the *Second Sydney Airport Site Selection Program Draft Environmental Impact Statement* (Kinhill Stearns, 1985) which was placed on exhibition in June 1985. A total of 423 submissions were received and a supplement to the Draft EIS was released in December 1985.

In February 1986 the Commonwealth Government announced that Badgerys Creek had been selected as the site for Sydney's second major airport. The main reasons for its selection were its proximity to central Sydney, lower development cost and fewer impacts on the natural environment.

The Badgerys Creek site is 46 kilometres west of Sydney's Central Business District and has an area of 1,700 hectares. It contained over 240 properties which were acquired by the Commonwealth between 1986 and 1991 at a cost of $155 million (including the costs of preparing the airport property). No significant construction activity has taken place.

4.2.5 Third Runway Proposal

The debate on Sydney's airport needs continued over the next two years; in April 1988 the Commonwealth Minister for Transport and Communications and the Premier of NSW established a Task Force to consider the issue. The Government, in response to the Task Force's report (Joint Commonwealth/NSW Government Task Force, 1988) announced in March 1989 a program to:

- implement traffic management measures at Sydney Airport to ensure that traffic demand could be met until a new runway was constructed;
- construct a third runway at Sydney Airport subject to the satisfactory completion of an Environmental Impact Statement; and
- proceed with detailed planning for a staged development of Sydney's Second Major Airport at Badgerys Creek, the first stage of which was to be a general aviation facility.

In December 1991, following completion of the *Proposed Third Runway Sydney (Kingsford Smith) Airport Draft Environmental Impact Statement* (Kinhill, 1990), and the decision to proceed with its construction, it was decided that the initial development at Badgerys Creek would be a general aviation airport with an 1,800 metre runway. The airport site was subsequently leased to the Federal Airports Corporation on condition that the Corporation would be responsible for building and operating the new airport.

4.2.6 The Sydney West Airport Proposal

In May 1994 the Government announced that the airport at Badgerys Creek would be accelerated by the construction of a 2,900 metre runway suitable for use by major aircraft. Over the next 12 months detailed planning for this development was undertaken and in the 1995 Budget the Government provided details of a terminal and other facilities that would be built as a first stage. This first stage was to be completed in time for the Olympics in the year 2000.

The 1995 announcement coincided with the release of details of a strategy to sell long term leases for the 22 federally owned airports. It was also announced that Sydney Airport and the second Sydney airport would be leased jointly.

4.2.7 Consideration of the Holsworthy Military Area

In January 1996 it was announced by the then Minister for the Environment that an EIS would be prepared for the construction and operation of the airport at Badgerys

Creek. In May 1996, following an election, the new Government decided to broaden the environmental assessment process to include the Holsworthy Military Area as an alternative site to Badgerys Creek and to examine the possibility of reserving a site large enough for future expansion if required. The location of the Holsworthy Military Area and the airport sites considered are shown in *Figure 4.4*.

The Government indicated that Holsworthy warranted detailed examination as it has major advantages in terms of its proximity to the Sydney Central Business District, road and rail accessibility, its size and Commonwealth ownership (Minister for Transport and Regional Development, 1996).

Holsworthy was not shortlisted for detailed assessment in the 1985 EIS (Kinhill Stearns, 1985), principally because of engineering problems associated with the topography, unexploded ordnance, airspace issues, the cost of relocating Defence facilities and a wide variety of environmental issues. The Government considered that technical and other advances over the intervening years could overcome the engineering and unexploded ordnance issues (Minister for Transport and Regional Development, 1996).

Following the substantial completion of the environmental assessment of the potential use of Badgerys Creek or the Holsworthy Military Area as a site for the Second Sydney Airport, the Government decided to eliminate the Holsworthy Military Area from further consideration. The reasons for this decision are discussed in greater detail in *Chapter 6*.

4.2.8 The Current Second Sydney Airport EIS

Following the elimination of the Holsworthy Military Area as a potential site for the Second Sydney Airport, a new proposal was developed by the Department of Transport and Regional Development to consider only the Badgerys Creek site. This Draft EIS assesses the environmental consequences of that proposal.

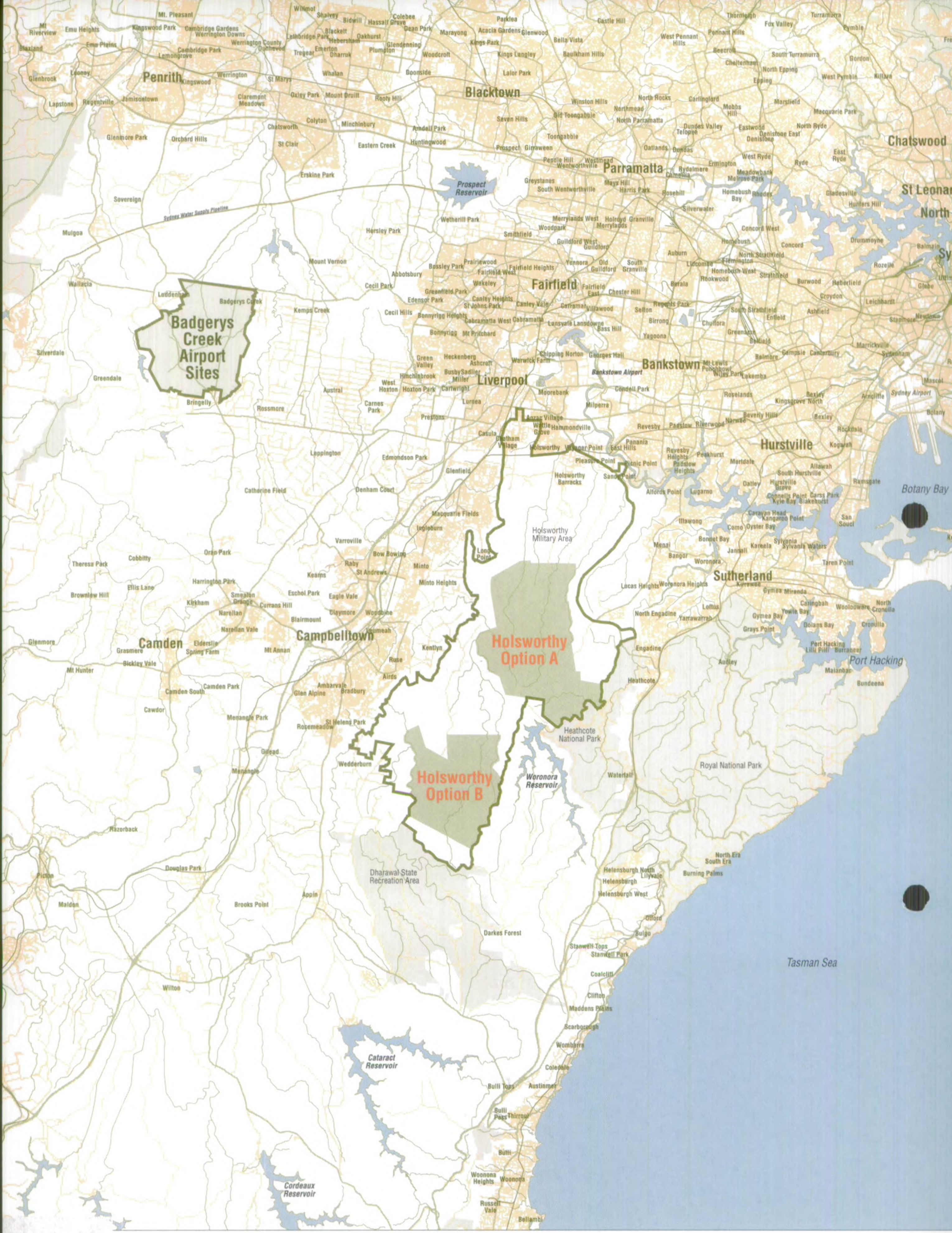
4.3 Recent Development of Sydney Airport

In November 1991, following completion of an EIS, the Commonwealth Government granted the Federal Airports Corporation approval to construct a third runway at Sydney Airport. The Federal Airports Corporation was also requested to prepare management plans for noise, air quality and the impact of the runway on Botany Bay.

The *Draft Noise Management Plan for Sydney Airport* (Mitchell McCotter and Associates, 1994) was released for public comment in June 1994. In October 1994 the Government decided on a property acquisition and home insulation program for selected properties close to the airport. These measures arose from proposals put forward in the draft management plan and from public comment on the draft. Operations from the third runway began on 4 November 1994.

In March 1995, in response to public concern, the Commonwealth Government established a Senate Committee to inquire into the issue of aircraft noise at Sydney Airport and to explore possible solutions to the problem. The Committee's report, *Falling on Deaf Ears?* (Senate Select Committee on Aircraft Noise in Sydney, 1995), was tabled in November 1995.

In March 1996 the Minister for Transport and Regional Development directed Airservices Australia to prepare a long term operating plan for Sydney Airport. Following public exhibition of a draft plan, the final plan was released by the Minister in May 1997 (Airservices Australia, 1996a).



Urban Areas (indicated by local roads)

Figure 4.4
Location of Holsworthy Airport Sites Considered in 1996/97

TN MN N

0Km 10Km

4.4 Current Operations at Sydney Airport

4.4.1 Overview

Sydney Airport is currently Australia's busiest primary airport in terms both of passenger and aircraft movements. As shown in *Table 4.1* it operates on a relatively small site (881 hectares) compared to other Australian and international major city airports. This places significant emphasis on efficient management of day to day airport operations, as well as on efficient utilisation of land.

Sydney Airport is very close to the Central Business District of Sydney, which is only seven to eight kilometres away. This is closer than most major international airports to their city centres. The density of urban development around the airport has resulted in significant noise disturbance to residents and others in the vicinity from its operation. As a consequence, the operation (and capacity) of Sydney Airport is constrained by a number of Commonwealth Government policies which include a night-time curfew and a planned cap on the number of hourly movements.

Despite these constraints, Sydney Airport has handled growing numbers of domestic and international passenger and aircraft movements for the past decade. This has been achieved through significant investment in aircraft and passenger handling capacity as well as in supporting infrastructure such as car parks and roads. Further substantial capital investment is planned in the lead up to the Sydney 2000 Olympic Games.

Table 4.1 Sizes of Major Airports Compared with Sydney Airport

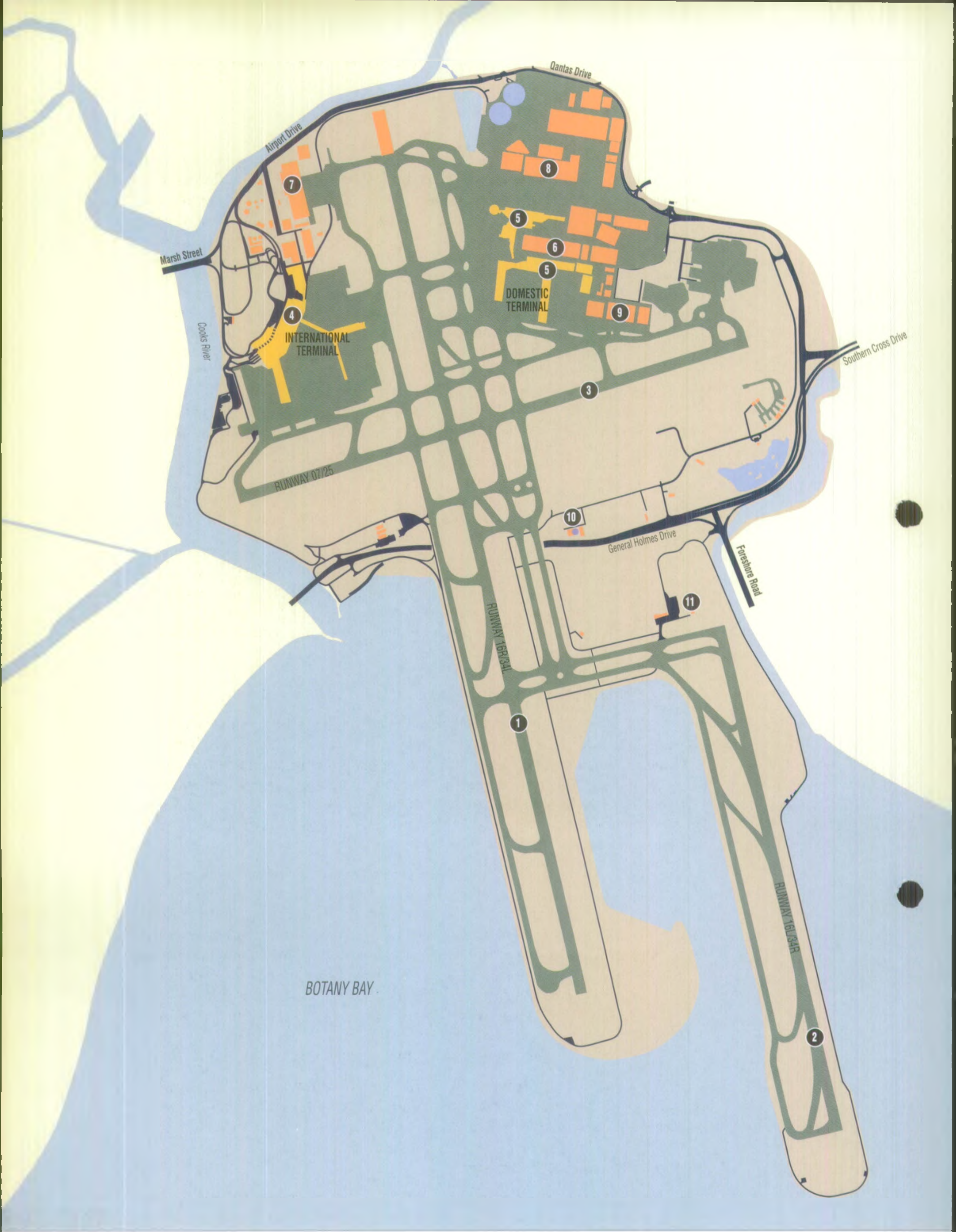
Region	Airport	Area (Hectares)
Australia	Brisbane	2,685
	Melbourne	2,365
	Perth	2,110
	Sydney	**881**
Asia	New Seoul	5,615
	New Kuala Lumpur	5,000
	Singapore (Changi)	1,633
	Hong Kong (Chep Lap Kok)	1,248
	Tokyo (Narita)	1,065
	Osaka (Kansai)	511
USA	Denver	13,765
	Dallas Fort Worth	7,138
	Los Angeles	1,418
Europe	Paris (Charles de Gaulle)	3,110
	London (Heathrow)	1,000
	Munich	1,540

Source: Second Sydney Airport Planners, 1997a.

4.4.2 Infrastructure

Sydney Airport has three runways, one set of parallel north-south runways and one east-west cross runway (*Figure 4.5*). It has three major passenger terminals, two domestic and one international, and a number of smaller terminals supporting regional airlines and other services.

The domestic terminals at Sydney Airport are owned and operated by the major domestic airlines, Ansett and Qantas. They are located on land leased on a long term



Runways and Taxiways
North-south runway 1.
Parallel (north-south) runway 2.
East-west runway 3.

Passenger and Airline Facilities
International Passenger Terminal 4.
Domestic Passenger Terminal 5.
Multi-storey car park 6.

Cargo and Aircraft Facilities
International cargo complex 7.
International aircraft maintenance 8.
Domestic aircraft maintenance 9.

Support Facilities
Control tower 10.
Rescue fire fighting station 11.

Figure 4.5
Existing Facilities (1997) at Sydney Airport

Sources: Federal Airports Corporation, 1997 (unpublished)
Sinclair Knight and Bechtel Aviation, 1993

basis from the Federal Airports Corporation. The airlines are responsible for the capacity of these facilities. The Federal Airports Corporation is responsible for providing associated infrastructure such as aircraft parking aprons. These terminals and associated apron infrastructure provide parking positions for 48 domestic aircraft, 27 of which are directly connected to the terminal by an aerobridge (Federal Airports Corporation, 1996).

The international terminal is owned and operated by the Federal Airports Corporation which also retains responsibility for ensuring it has sufficient capacity to manage the growth of international traffic. The terminal provides 27 passenger aircraft parking positions with two positions for freight aircraft. The current passenger processing capacity of the international terminal is around 6.5 million passengers a year. There are plans in place to expand capacity to around 10.4 million passengers a year by the year 2000 (Parliamentary Standing Committee on Public Works, 1997).

A substantial investment in road transport links to Sydney Airport has been made over the last 50 years. Further major expenditure is planned by the year 2000. In addition, the New Southern Railway linking the airport to the city and the southern suburbs is currently under construction and scheduled to open in the year 2000.

There are almost 400 non-airline businesses in airport-related industry located in and around Sydney Airport. This infrastructure includes four major hotels, three major in-flight catering facilities, car parking providers, car/limousine/bus hire providers, taxi companies, freight forwarders and customs agents, duty free and other retail operations, cleaning, maintenance engineering and training organisations (Institute of Transport Studies, 1993 and 1996).

4.4.3 Operations

Apart from its space limitations and the ability of the surrounding infrastructure to support its growth, the operation of Sydney Airport, as mentioned above, is constrained by government policy formulated in response to community concerns about aircraft noise and other environmental issues. The most significant operational constraints are noise abatement measures; these include preferred runway and flight path procedures, a night-time curfew, and plans to impose a cap of 80 aircraft movements an hour.

The responsibility for establishing and changing movement curfews rests with the Commonwealth Government, not with the Federal Airports Corporation or Airservices Australia. The curfew rules are contained in the *Sydney Airport Curfew Act, 1995*. From 11.00 pm until 6.00 am, aircraft movements are limited to relatively low noise propeller and jet aircraft (mostly business and small freight aircraft). Up to 24 international passenger services a week are allowed to operate in the hour inside each end of the curfew, 11.00 to 12.00 pm and 5.00 to 6.00 am, providing these aircraft meet the strictest International Civil Aviation Organisation noise standards. During the curfew, aircraft must operate over Botany Bay, that is taking off to the south and landing from the south. Curfew breaches attract fines of up to $100,000.

The Commonwealth Government has legislated to cap aircraft movements at Sydney Airport at 80 per hour through the implementation of a slot system. These controls are described in more detail in *Sections* 6.2.3 and 6.2.4.

4.4.4 Existing Activity

Domestic and international passenger traffic at Sydney Airport have both grown strongly over the past five years. As shown in *Figure* 4.6 domestic traffic has grown at an average rate of 8.3 percent per annum, while international traffic has grown even faster at 9.2 percent per annum.

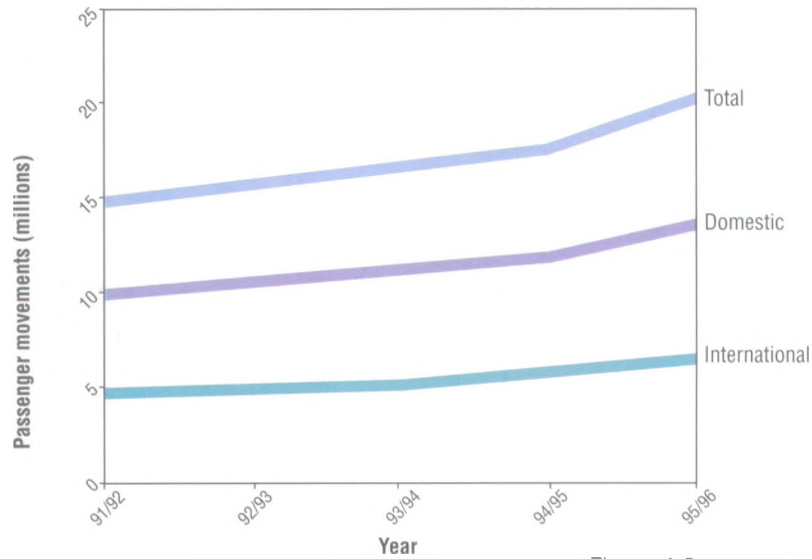


Figure 4.6
Sydney Airport Passenger Traffic
1991/2 to 1995/6

Note: Passenger numbers do not include transit or domestic on-carriage passengers

Source: Federal Airports Corporation Annual Reports

The annual growth of domestic and international freight has averaged 10.2 percent and 10.4 percent respectively over the last five years. As shown in *Figure 4.7* nearly 400,000 tonnes of freight moved through Sydney Airport in 1995/96. This freight is moved by only a handful of dedicated air freighters. About 80 percent of air freight is carried in the belly holds of passenger aircraft (Federal Airports Corporation, 1997).

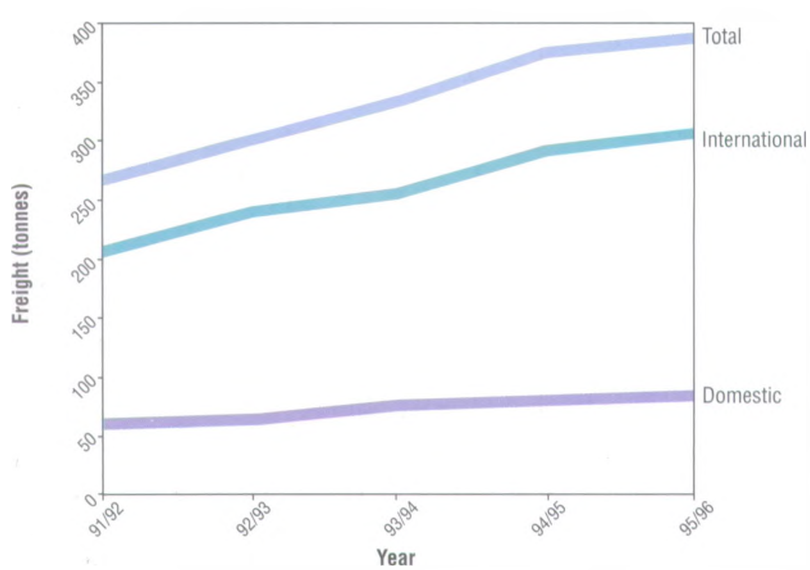


Figure 4.7
Sydney Airport Freight Traffic
1991/2 to 1995/6

Source: Federal Airports Corporation Annual Reports

General aviation and military traffic account for almost 24,000 aircraft movements or almost nine percent of the Airport's total traffic. It comprises mainly corporate, military and official aircraft, freight and overnight express aircraft. In proportion to the overall traffic, this traffic has fallen off over the last three years as a result of the increased landing fees and congestion levels at the Airport.

The number of aircraft movements at Sydney Airport has increased in line with the increase in passenger traffic (*Figure 4.8*). Over the past decade the rate of growth of aircraft movements has been less than the growth of passengers due to a reduction in the proportion of empty seats on aircraft and the replacement of smaller aircraft by larger aircraft on some routes.

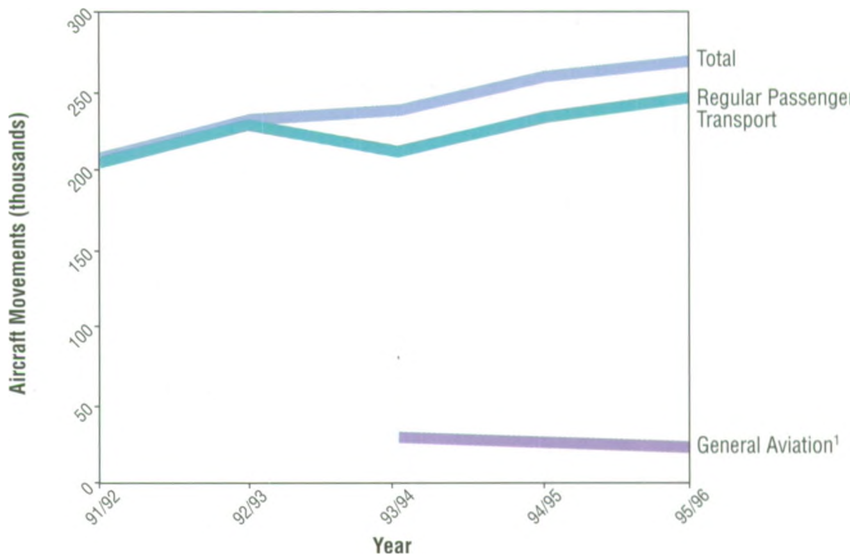


Figure 4.8
Sydney Airport Aircraft Movements 1991/2 to 1995/6

Note: 1. Movements data published by Federal Airports Corporation only separated into Regular Passenger Transport and General Aviation from 1993/4

Source: Federal Airports Corporation Annual Reports

4.5 General Aviation

'General aviation' is the name given to that sector of the aviation industry that is non-military and that excludes the larger airlines operating scheduled passenger services. The general aviation sector undertakes a diverse range of passenger and freight activities, including charter operations, flying training, aerial agriculture, aerial work, private and business flying and sports related activities.

The three main general aviation airports in Sydney are those at Bankstown, Camden and Hoxton Park; they are owned and operated by the Federal Airports Corporation. As discussed below, there are also a number of smaller facilities.

4.5.1 Bankstown

Bankstown airport is Sydney's primary general aviation airport. It acts as an overflow airport for non-scheduled and general aviation traffic from Sydney Airport, and is the major general aviation training, maintenance and support facility in Australia. Bankstown covers 313 hectares and lies 23 kilometres west of the Sydney central business district. It has five runways (one unsealed and four sealed), ranging in length from 800 metres to 1,415 metres.

In Bankstown's peak year of activity, 1989/90, more than 450,000 movements were recorded, which is approximately the full capacity of the airport.

Bankstown is a major flying training airport, with approximately 48 percent of its traffic using it for this purpose. It is also used by a number of charter operators and 46 percent of its traffic arises from intrastate travel. Helicopter activity makes up the remaining six percent. Bankstown is also a major distribution centre for general aviation parts. A number of non-aviation related businesses are located at the airport (Federal Airports Corporation, 1996).

4.5.2 Camden

Camden airport is located 60 kilometres south-west of Sydney and has an area of approximately 195 hectares. It has a sealed and an unsealed runway (1,464 and 723 metres respectively), and two grassed glider strips.

Camden is an overflow airport for Bankstown for flying training, charter and maintenance, and it also provides facilities for gliding and ballooning. Use of the sealed runway is restricted to aircraft with a maximum take-off weight of less than 5,700 kilograms. Camden plays an important role in aviation training as it is used frequently for instrument flight rules training and instrument rating renewal tests. Camden's Non Directional Beacon navigational aid is the only one available for this purpose in Sydney.

The capacity of the airport is about 180,000 aircraft movements per annum; for 1996 they were estimated to be 118,000. There are currently close to a hundred fixed wing aircraft, 35 gliders and a small number of balloons based on the airport (Federal Airports Corporation, 1996).

Four non-aviation related activities are located on the airport. Aviation activities on site include flying training, sports operations, maintenance organisations, fuel suppliers, and one aircraft component manufacturer.

4.5.3 Hoxton Park

Hoxton Park airport is located approximately eight kilometres from Liverpool, and has an area of approximately 89 hectares. It has a single north-south sealed runway (about 1,100 metres long), and an estimated capacity of approximately 120,000 movements per annum. Its runway is restricted to use by aircraft of less than 1,350 kilograms maximum take-off weight for operational reasons. Approximately 100,000 movements were recorded at Hoxton Park in 1995/96 (Federal Airports Corporation, 1996).

Hoxton Park's primary role is as an overflow airport for Bankstown, catering for general aviation traffic such as light aircraft, helicopters and flight training (including touch and go/circuits and bumps practice). The mix of operations at the airport is estimated to be 85 percent fixed wing training, 10 percent helicopter, and five percent charter. There are currently 25 aircraft based at Hoxton Park and a small number of helicopters.

Most organisations on the airport are related to flying training, but there is one aviation fuel supplier and two non-aviation organisations located there.

4.5.4 Other Airfields and Aviation Activity

In addition to the 24,000 general aviation and military aircraft movements a year currently at Sydney Airport there are a number of non Federal Airports Corporation airfields in the Sydney area which cater for general aviation activities. These include Wilton, Wedderburn, Menangle, Albion Park, Wyong and Katoomba. These airfields are used mainly for sporting activities and include the major parachuting centres for the region. The coastal escarpment near Stanwell Park to the south of Sydney is an important centre for hang gliding. There are also several sites in the Sydney area used for flying model aircraft.

4.6 Military Activities

4.6.1 Richmond

The RAAF Air Lift Group activity at Richmond involves training and transport operations with Boeing 707, C130 Hercules and Caribou transport aircraft. Transport operations out of Richmond are a significant number of the total air movements at the Base. In addition to Richmond being the Australian Defence Force's main air transport hub, all of the RAAF's transport aircraft operate through Richmond at various times.

There are also a number of small scale exercises that are conducted out of Richmond each year. These often involve aircraft from other nations as well as aircraft from the other Australian Services. Exercises normally occur over one to two weeks.

Defence activity at Richmond is not expected to change markedly in the future, although the planned introduction of new flight simulators over the next five years will lead to training being transferred from actual flights to simulators. This will result in a small reduction in the number of aircraft movements. In 1996 there were about 48,000 such movements.

The *Defence Efficiency Review* (Department of Defence, 1997) makes reference to the possible closure of RAAF Base Richmond. However a decision on the closure of the Base will not be made until further studies have been conducted by Defence.

4.6.2 Williamtown

The RAAF Tactical Fighter Group based at Williamtown operates F/A-18 fighters and Macchi and PC9 trainer aircraft. A number of significant exercises are conducted out of this base, involving F/A-18 and F-111 strike aircraft as well as Boeing 707 tanker aircraft. Some of these exercises involve large numbers of aircraft from overseas countries such as New Zealand, the United States and various South East Asian nations. Transit activities include transport and maritime patrol, strike and training aircraft. Williamtown is also the primary airport for the city of Newcastle. Consequently, there are a number of civilian movements, which include scheduled transport flights. The total number of aircraft movements at Williamtown in 1996 was about 49,000.

The introduction of the new lead-in-fighter, the *Hawk*, is not expected to result in any significant change to the level of activity.

4.6.3 Holsworthy

There is a small airstrip in the Holsworthy Military Area, which is occasionally used by military transport aircraft and helicopters.

4.6.4 Nowra

The Royal Australian Navy has conducted flying operations at Nowra since the late 1940s. These operations include jet, helicopter and parachute training. In addition some RAAF transit activity, transport support and support to the Parachute Training School takes place there. The total number of aircraft and helicopter movements are about 24,000 a year.

4.7 Role of Aviation

Airports and aviation are significant contributors to the activity, economy and defence of Sydney, as they are to the structure and activities of all modern capital cities. They also have significant impacts on the community and environment, both beneficial and adverse.

Sydney Airport, servicing the population, commerce and industry of the city and the State, is Australia's busiest international and domestic airport. Sydney Airport is a very significant direct employer and generates a substantial number of jobs indirectly. It is the most important airport in Australia for international and domestic air travel by both residents and overseas visitors. It is also a very significant port in terms of value of import and exports of air freight.

Overall, it is believed that almost 500 firms benefit significantly from airport related activities at Sydney Airport (Institute of Transport Studies, 1993 and 1996). These firms directly employ about 35,000 people, around 60 percent of whom are employed by the 50 or so airlines using the Airport. In addition, a further 33,000 jobs are generated indirectly. Further, it is also estimated that over $7 billion a year in economic activity is directly or indirectly generated by the Airport.

Other aviation activities taking place in the Sydney region and described in *Section 4.5* also contribute to the economy of the city and the lifestyle of many of its residents, while significant military aviation activities and facilities (*Section 4.6*) contribute to the defence and security of the country.

Chapter 5

Future Passenger and Aircraft Movements

Chapter 5
Future Passenger and Aircraft Movements

Any decisions on the planning and design of a Second Sydney Airport will need to consider likely future air traffic. The Commonwealth Department of Transport and Regional Development has developed forecasts of what this may be. This chapter explains how such forecasts were arrived at for the Sydney basin as a whole and how the level of commercial air traffic in Sydney is likely to increase over the period to 2025. Further details of air traffic forecasts can be found in Department of Transport and Regional Development (1997a).

5.1 Issues Raised During Consultation

5.1.1 Issues Raised During Consultation

During initial consultation, submissions made in relation to air traffic forecasts for Sydney suggested projected air travel demands were not realistic. It was considered that building a second major airport would not be justifiable because:

- analysis of demand used unconstrained growth as a basis for future predictions;
- reported diminishing global fossil fuel supply was likely to suppress the demand for air travel by increasing costs; and
- projected future use of telecommunications would reduce the need for air travel.

5.1.2 General Response to Issues Raised

Forecasts attempt to determine the future demand for aviation services in the Sydney basin as an aid to establishing whether, in fact, there is a need for a second major airport in Sydney. To impose airport infrastructure constraints onto this process would necessarily understate the demand for aviation services.

There is no evidence currently available to indicate that total airline operating costs, of which fuel contributes less than 20 percent, will rise in the medium term. The forecasts assume no change in real airline yields. Industry estimates vary from a small decrease to a small increase in real airline yields. It is considered unlikely that such changes will have a significant effect on demand for air travel.

There is considerable debate about the long term availability of fossil fuels. Recently this debate intensified, upon the release of a forecast of the world's oil potential which showed lower than previously estimated volumes of oil reserves. It should be noted, however, that known reserves of oil have almost doubled between 1969 and 1994. Since 1989 new discoveries, additions and revisions have broadly matched the world's production and consumption, leaving total reserves virtually unchanged (British Petroleum Company, 1995). This debate has not produced definitive findings and there is insufficient evidence to suggest that fossil fuel supply will significantly affect air travel demand in the foreseeable future.

The effect on demand for air travel of improved telecommunications technology is unclear. Although there is some opinion that such technology will reduce the demand for air travel, there is also a view that improved telecommunications stimulate economic activity to the extent that there could be a net increase in the demand for air travel. Due to these countervailing factors, improvements in telecommunications were assumed to have no net effect on demand for air travel.

5.2 Use of Air Traffic Forecasts

The continuing growth of air traffic in the Sydney region is the principal reason why studies, such as this Draft EIS, are undertaken into the need for, and location of, a Second Sydney Airport. Forecasts of the future growth in air traffic are fundamental building blocks in assessing the need for, the capacity and the staging schedule of development of any second major airport for Sydney.

Forecasts are intrinsically unreliable. Worldwide, the variability in air traffic forecasts can be plus or minus 20 percent after five years and much wider still for a period 10 or more years hence (De Neufville, 1997). Demand is difficult to predict accurately because of the number of and variability in the underlying forces driving air traffic growth, namely:

- growth in the economy in general and, more specifically, in income levels;
- relative price of air travel compared with other goods and services;
- growth in international tourism; and
- level of airline services offered, that is, frequency, size and speed of aircraft, number of transfers and directness of routing.

Thus there is a need to treat all forecasts of air traffic with caution. This is particularly so when using forecasts for determining the timing of the development of airport infrastructure, as this typically is high cost, long-term and difficult to reverse.

5.3 Historical Growth of Air Traffic

World demand for commercial aviation services has grown substantially over the past thirty years as air travel has become more affordable. Australia has experienced growth significantly higher than world averages as a result of a number of factors such as:

- the size of the continent and the distance between major cities;
- its isolation from the rest of the world; and
- the growth in importance of tourism as a major industry.

As Australia's largest city and a major world business and tourism centre, Sydney has developed into an important destination in the international commercial aviation market. It is Australia's primary international gateway, accounting for almost half of all visitors to Australia. Despite the rapid development of Queensland as an attractive international tourism destination, Sydney has maintained its share in a strongly growing inbound tourism market.

Sydney also enjoys a prominent position in the Australian domestic market because of its large population base and its role as a business centre. Its location makes it a natural hub for east coast air traffic.

Figure 5.1 shows the increase in passenger movements through Sydney Airport for the period 1965/66 to 1995/96. During this period the number of domestic airline passengers increased from 2.2 million in 1965/66 to 13.7 million in 1995/96. International passengers increased from 0.4 million in 1965/66 to 6.6 million in 1995/96. The total number of passengers through Sydney therefore increased from 2.6 million to just over 20 million over 30 years, representing an average annual increase of 7.1 percent, compared with the world average of about six percent.

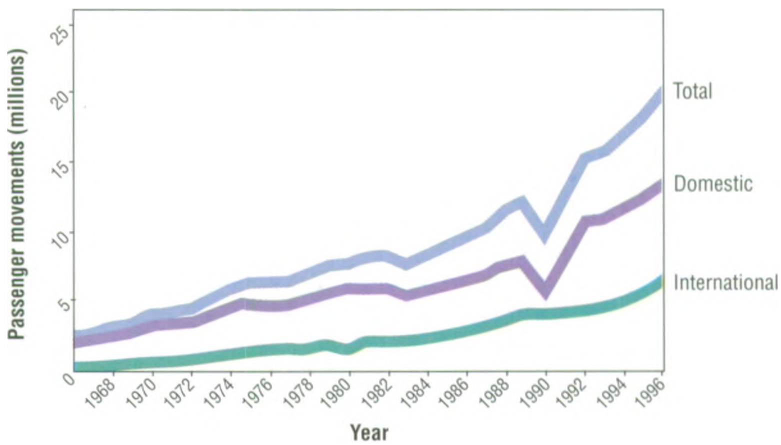


Figure 5.1
Total Passenger Movements at Sydney Airport from 1965/66 to 1995/96
Source: Department of Transport & Regional Development, 1997a

The growth in passenger movements at Sydney Airport has meant an increase in the number of aircraft movements. However, the size of commercial aircraft has increased significantly over the past thirty years and this, along with improved management of bookings which ensures that aircraft fly with fewer empty seats, has meant that increase in aircraft movements has been slower than increase in passenger numbers.

Figure 5.2 shows the trend in scheduled aircraft movements through Sydney Airport for the period 1965/66 to 1995/96. The number of domestic aircraft movements has

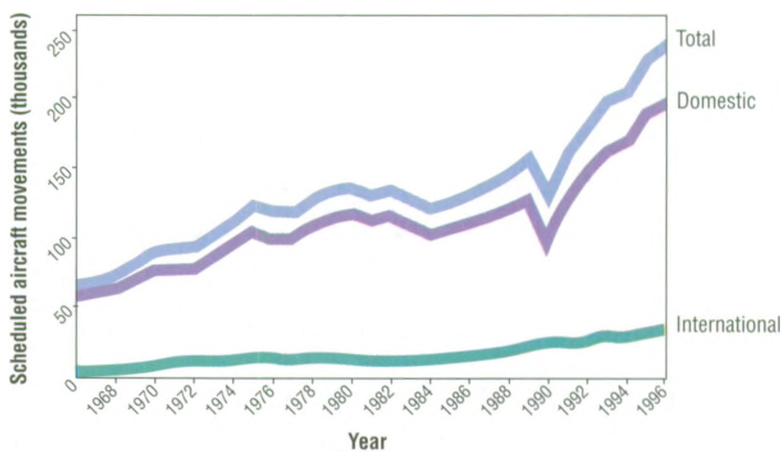


Figure 5.2
Scheduled Aircraft Movements at Sydney Airport from 1965/66 to 1995/96
Source: Department of Transport & Regional Development, 1997a

increased from 61,500 in 1965/66 to 202,500 in 1995/96. International aircraft movements have increased from 8,500 in 1965/66 to 42,000 in 1995/96. Total scheduled aircraft movements have therefore increased from 70,000 to 244,500 in the thirty years to 1995/96.

5.4 Forecasting Methodology

Income levels and the price of travel are the most significant among numerous factors affecting demand for air travel. By analysing past trends in national income levels and air fares, and observing how these have coincided with demand for air travel, it is possible to make predictions about future demand using modelling techniques. To ensure realistic outcomes, qualitative judgements concerning long term industry developments also need to be considered.

The Department of Transport and Regional Development sought a wide range of expert opinions on this issue, consulting with the airlines, the Federal Airports Corporation, Airservices Australia, NSW Air Transport Council, Tourism Forecasting Council, Bureau of Tourism Research and the Bureau of Transport and Communications Economics and Tourism Futures.

The resulting forecasts were developed for the international and domestic sectors, and a sensitivity analysis was carried out to predict likely effects of higher or lower levels of economic growth. The forecasts assume that there will be adequate airport infrastructure to meet the forecast demand for air services. In other words, the forecasts developed were for unconstrained conditions.

5.5 Forecasts of Air Traffic Growth

5.5.1 International Passengers and Aircraft Movements

Almost half of all international passengers coming to or leaving Australia use Sydney as the gateway (Department of Transport and Regional Development, 1997a). Sydney is expected to remain a key destination in its own right for international visitors, with the strong growth of the last decade continuing into the early part of the next century.

The outlook for international passenger movements for Sydney to 2024/25 is shown in *Figure 5.3*. The total of such movements is expected to grow at an average rate of 8.7 percent per annum to 1999/2000, then at 5.9 percent per annum from 1999/2000 to 2009/10 and 3.6 percent per annum from 2009/10 to 2024/25. Thus the total of international passenger movements at Sydney would increase from 6.6 million in 1995/96 to 9.2 million in 1999/2000, 16.2 million in 2009/10 and 27.4 million in 2024/25.

The trend towards increasing sizes of aircraft observed over the last 30 years is likely to continue, but at a reduced rate. There will be scope for airlines to introduce larger aircraft on international routes as low capacity routes increase in popularity. Plans for new aircraft larger than the current B747s are reported to be well advanced by the European Airbus Consortium, one of the two major global civil aircraft manufacturers.

The use of larger aircraft and further improvements in increasing seat occupancy are expected to produce a net increase in the average number of passengers per aircraft. These trends may, however, be offset to some extent by the introduction of new routes using smaller aircraft, and by more frequent services on existing routes.

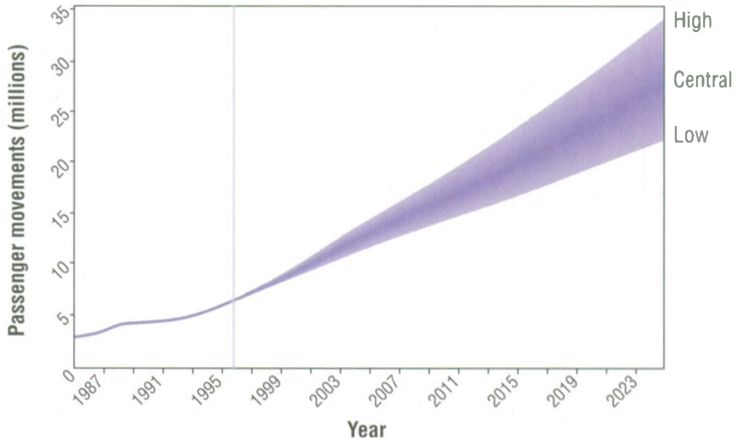


Figure 5.3
Forecasts of International Passengers for the Sydney Basin to 2024/25 (Unconstrained Outlook)
Source: Department of Transport & Regional Development, 1997a

International aircraft movements at Sydney are expected to grow at an average rate of 6.9 percent per annum to 1999/2000, 4.5 percent per annum to 2009/10 and 2.5 percent per annum from 2009/10 to 2024/25. This would result in international aircraft movements increasing from 42,000 in 1995/96 to 55,000 in 1999/2000, 85,000 in 2009/10 and 123,000 in 2024/25 (*Figure* 5.4).

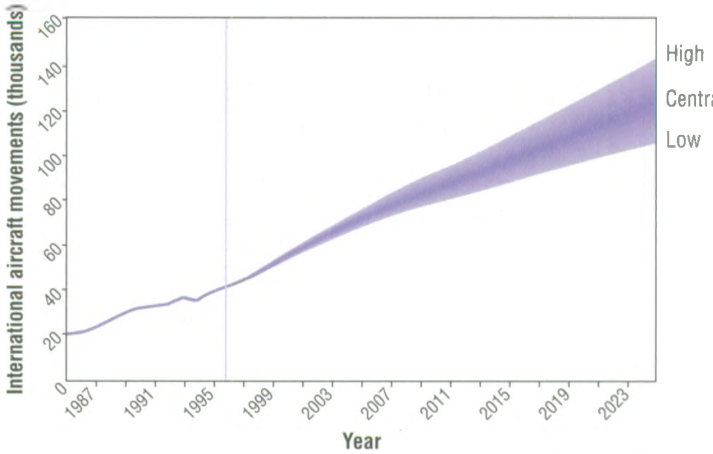


Figure 5.4
Forecasts of International Aircraft Movements for the Sydney Basin to 2024/25 (Unconstrained Outlook)
Source: Department of Transport & Regional Development, 1997a

5.5.2 Domestic Passengers and Aircraft Movements

As Australia's biggest city, Sydney is the primary port on the Australian domestic network. The three busiest routes begin and end at Sydney (Sydney-Melbourne, Sydney-Brisbane and Sydney-Coolangatta) (Department of Transport and Regional Development, 1997a).

Domestic passenger numbers have grown strongly since the Australian domestic market was deregulated in 1990. While this growth has now moderated, it is expected to continue into the next century as shown in *Figure* 5.5.

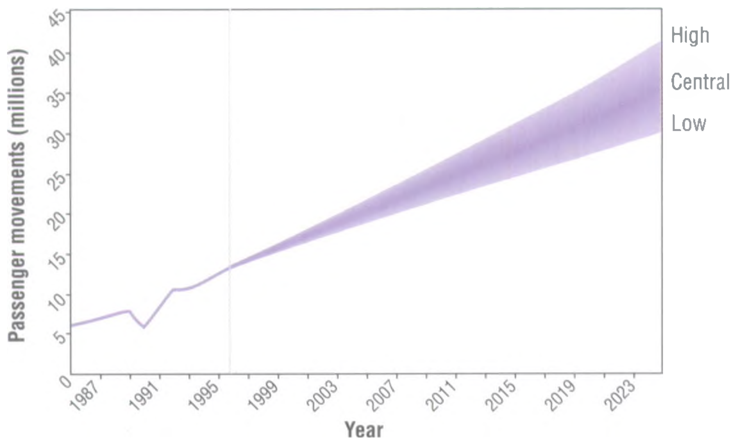


Figure 5.5
Forecasts of Domestic Passengers for the Sydney Basin to 2024/25 (Unconstrained Outlook)
Source: Department of Transport & Regional Development, 1997a

Domestic passenger movements at Sydney are expected to grow at an average rate of 4.8 percent per annum to 1999/2000, 3.8 percent per annum from 1999/2000 to 2009/10 and 2.6 percent per annum from 2009/10 to 2024/25. This would result in domestic passenger movements increasing from an estimated 13.7 million in 1995/96 to 16.6 million in 1999/2000, 24.2 million in 2009/10 and 35.7 million in 2024/25.

The factors affecting the numbers of passengers on each domestic flight are similar to those affecting international flights. The advantages to airlines of using larger aircraft to avoid airport congestion and achieve lower costs need to be balanced against customer demand for adequate frequency of service and point to point services.

There have recently been moves to introduce a greater number of larger wide-bodied aircraft onto the major trunk routes such as Sydney-Melbourne and Sydney-Brisbane, to make the most efficient use of peak hour capacity at Sydney Airport. As demand increases in the future it is possible that still larger aircraft will be introduced on these routes.

On the other hand, these initiatives could to some extent be offset by moves to increase frequencies and introduce new services on some lower volume routes. The recent introduction of more frequent services using smaller aircraft on the Sydney-Canberra route is one example of this trend.

Overall, the number of passengers per aircraft on domestic services into and out of Sydney is expected to keep on increasing slightly over the next several decades. This means that the rate of growth of aircraft movements in this sector will remain lower than the rate of growth for passenger numbers.

Domestic aircraft movements at Sydney are expected to increase at an average rate of 3.8 percent per annum to 1999/2000, 2.9 percent per annum to 2009/10 and 1.8 percent per annum from 2009/10 to 2024/25. This would result in domestic aircraft movements increasing from an estimated 202,500 in 1995/96 to reach 235,000 in 1999/2000, 312,000 in 2009/10 and 408,000 in 2024/25 as shown in *Figure* 5.6.

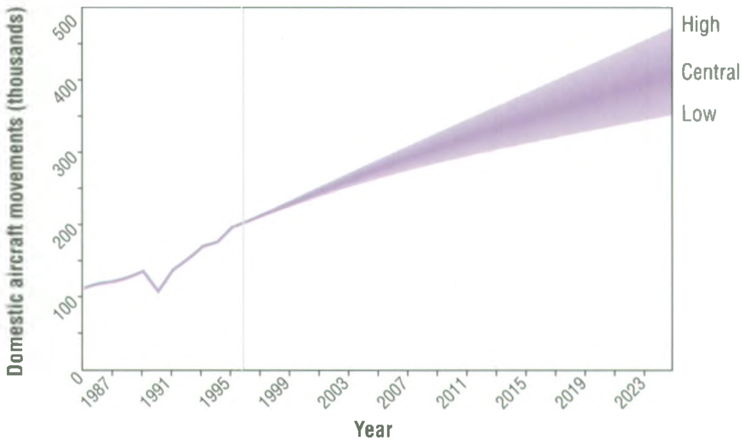


Figure 5.6

Forecasts of Domestic Aircraft Movements for the Sydney Basin to 2024/25 (Unconstrained Outlook)

Source: Department of Transport & Regional Development, 1997a

5.5.3 Air Freight and Non-Scheduled Aircraft Movements

Carriage of freight by air is forecast to continue its strong growth over the coming decades as world trade continues to expand under increasingly liberalised trading arrangements. Forecasts prepared by the International Civil Aviation Organisation, Boeing, Airbus and McDonnell Douglas have predicted worldwide annual average growth in air freight of between 6.5 percent and 7.8 percent per annum. The outlook for the Asia/Pacific region is stronger still, with the region forecast to generate an increasing share of world trade into the next century (Department of Transport and Regional Development, 1997a).

Although there are some dedicated air freighters, most of the world's air cargo is carried in the belly holds of passenger aircraft; the current proportion is 80 percent (Federal Airports Corporation, 1997). While some high value cargo will continue to be imported into Australia by dedicated freighter aircraft, the effect of any such increase on aircraft movements in the Sydney basin is expected to be relatively small, with most air freight being accommodated by the increased number of passenger aircraft arriving in and departing from Australia.

Activity of freight-only aircraft in line with current trends has been factored into the forecasts. It is not expected that movement of air freight will add significantly to the number of total aircraft movements.

Non-scheduled general aviation and military aircraft activity has decreased significantly at Sydney Airport since 1990. It is expected that this decrease has now stabilised and that the remaining non-scheduled movements are largely represented by high priority VIP and corporate aircraft, air ambulance, military aircraft and air freighters which will continue to require the use of a major airport.

While it is difficult to predict future levels of non-scheduled aircraft movements using a major airport in the Sydney region (where a major airport refers to either Sydney Airport or the proposed Second Sydney Airport), it is considered reasonable to expect an underlying growth rate of around one percent per annum. This reflects an expected growth somewhat lower than that of the overall economy. However, this outlook would be strongly influenced by airport management strategies for Sydney Airport and the Second Sydney Airport.

A one percent annual growth of this non-discretionary traffic would result in the number of non-scheduled movements at major airports in Sydney increasing to 26,500 in 1999/2000, 29,000 in 2009/10, and 34,000 in 2024/25 (*Figure 5.7*).

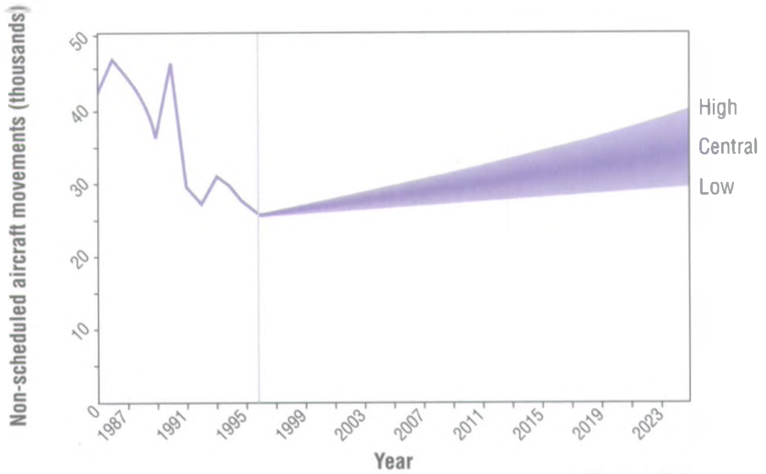


Figure 5.7

Forecasts of Non-Scheduled Aircraft Movements Using a Major Airport in the Sydney Basin to 2024/25 (Unconstrained Outlook)

Source: Department of Transport & Regional Development, 1997a

5.5.4 Total Passengers and Aircraft Movements

Figure 5.8 shows central, high and low case projections for total passenger movements into and out of Sydney, based on the preceding international and domestic forecasts, for the period to 2024/25.

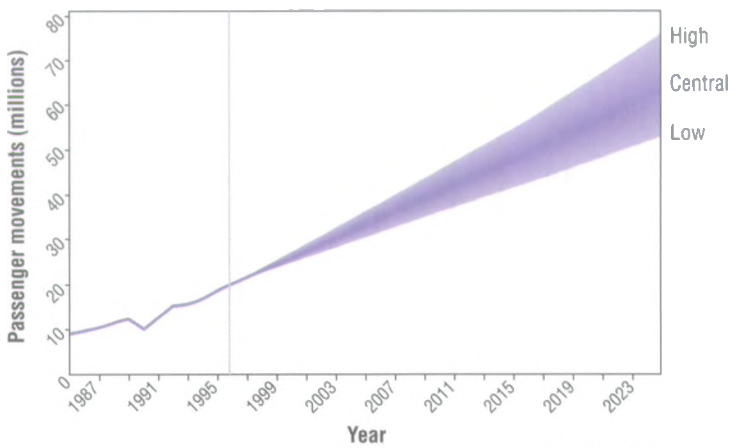


Figure 5.8

Forecasts of Total Passenger Movements for the Sydney Basin to 2024/25 (Unconstrained Outlook)

Source: Department of Transport & Regional Development, 1997a

Total passenger movements at Sydney are expected to increase at an average rate of 6.1 percent per annum to 1999/2000, 4.6 percent per annum to 2009/10 and 3.0 percent per annum from 2009/10 to 2024/25. This compares with a total world passenger growth outlook of about 4 percent per annum to the year 2003. Total passenger movements are expected to increase from 20.3 million in 1995/96 to 25.8 million in 1999/2000, 40.4 million in 2009/10 and 63.2 million in 2024/25.

Figure 5.9 shows central, high and low case scenarios to 2024/25 for total aircraft movements requiring the use of a major airport in Sydney (where a major airport refers to either Sydney Airport or the proposed Second Sydney Airport).

Total aircraft movements in Sydney are expected to increase at an average rate of 4 percent per annum to 1999/2000, 3 percent per annum to 2009/10 and 2 percent per annum from 2009/10 to 2024/25. This would result in total aircraft movements increasing from 270,000 in 1995/96 to reach 316,000 in 1999/2000, 426,000 in 2009/10 and 565,000 in 2024/25 as shown in *Figure* 5.9.

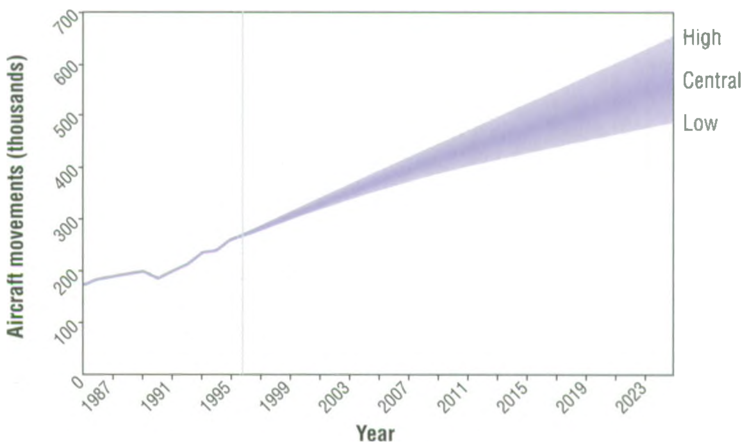


Figure 5.9

Forecasts of Total Aircraft Movements Using a Major Airport in the Sydney Basin to 2024/25 (Unconstrained Outlook)

Source: Department of Transport & Regional Development, 1997a

5.6 General Aviation Movements

At present, general aviation in Sydney operates principally out of the four Federal Airports Corporation airports: Sydney Airport, Bankstown, Camden and Hoxton Park. Activity levels on other general aviation aerodromes in the area are not recorded. *Figure 5.10* shows total general aviation movements recorded at the four principal airports for 1983/84 to 1994/95.

General aviation activity increased steadily up to 1989/90; growth between 1983/84 and 1989/90 averaged 8.3 percent per annum. Part of the increase in 1989/90 occurred during a long-running industrial dispute between pilots and the airlines. As a result, much activity was transferred from scheduled to unscheduled services. Recent years, however, have seen a decline in activity.

General aviation movements across all Sydney airports decreased at an average rate of 2.7 percent per annum between 1989/90 and 1994/95. The largest components in this downturn were private flying and flight training.

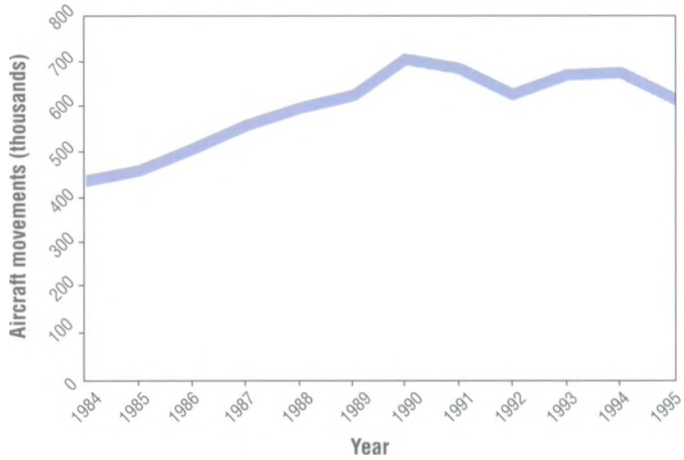


Figure 5.10
Total Sydney Basin General Aviation Aircraft Movements from 1983/84 to 1994/95
Source: Federal Airports Corporation Annual Reports 1985 to 1996

The reasons for the decrease of recent years are not well understood, but there are likely to be several factors involved. While there are capacity constraints at some busy times, there is still unutilised capacity available for flight training and private flying. The downturn does not appear to be due to supply constraints.

5.7 Potential Constraints on Airline Activity

The two most significant potential constraints on airline activity in Sydney are the insufficient provision of physical aviation infrastructure capacity and the widespread environmental concerns of the communities affected by aircraft noise and other emissions. The Government and many communities surrounding Sydney Airport believe the ultimate capacity of the airport is substantially constrained because of unacceptable environmental impacts created by its operation, especially the impact of noise. This Draft EIS examines the environmental constraints of providing additional airport capacity at Badgerys Creek.

Infrastructure capacity consists of:

- airspace (including ground based navigation aids and air traffic control);
- runway and taxiways;
- terminal and apron; and
- surface accessibility to the airport(s).

In addition to physical infrastructure capacity, other potential constraints on commercial aviation are regulatory and economic in nature. Regulatory constraints include a night-time curfew, aircraft movement caps, slot controls and direct Government regulation of aircraft types, services or operators permitted to use a particular airport. Possible economic constraints include high flat fee charging, peak pricing and aircraft noise taxes.

Chapters 6 and 7 detail these constraints and their potential effects on air traffic demand.

Chapter 6

Strategic Alternatives

Chapter 6
Strategic Alternatives

This chapter reviews the strategic alternatives available for providing increased airport capacity to meet the forecast growth in passengers and aircraft movements. The alternatives considered include alternative sites and increasing of the capacity of Sydney Airport, other Sydney airports and other major airports in Australia. In addition, alternative airport systems are described, and the consequences of not developing a second major airport for Sydney are discussed.

6.1 Issues Raised During Consultation

Comments on strategic alternatives focussed on various reasons why the Second Sydney Airport should not be located within the Sydney region. It was suggested that the Government should examine other alternatives immediately and amend the guidelines (*refer Appendix A*) for this Draft EIS accordingly. Goulburn, RAAF Base Williamtown and RAAF Base Richmond were suggested as alternative sites which should be investigated. Other strategic alternatives were not widely discussed.

Some comments offered qualified support for a second airport while others were not in favour of a second airport anywhere in the Sydney region. Suggestions were made that all airport facilities should remain at Sydney Airport as this airport was not operating at capacity and that lifting the curfew and operating to full capacity would satisfy the likely growth in aviation demand. Comments were also received advocating the replacement of Sydney Airport by an offshore airport large enough to preclude the need for the second major airport.

6.2 Available Alternatives

Many alternatives for providing significant additional aviation capacity for Sydney are available for consideration. As outlined in *Chapter 4*, studies carried out over the last 50 years have examined many of these alternatives These alternatives can be broadly described as:

- alternative sites for a second major airport, both within and outside the Sydney metropolitan area, which have been the subject of significant investigation between 1946 and 1985;
- alternative sites considered in detail by the present Commonwealth Government as part of this environmental assessment process. Two airport sites were considered within the Holsworthy Military Area and three airport options are being considered in the Badgerys Creek area; and
- the alternative of not developing a second major airport for Sydney.

Alternatives that may be considered should a second major airport not be developed for Sydney include expanding the capacity of Sydney Airport, Sydney's secondary airports or other capital city airports. Literally doing nothing is another alternative which would present a range of consequences.

While it was not within the scope of this Draft EIS to examine alternative sites in detail, this chapter broadly examines a number of the alternatives that are available as well as considering the types of airport systems that could be put in place should a second major airport be developed.

6.3 Alternative Sites for a Second Major Airport

6.3.1 Site Selection Studies

As discussed in *Chapter 4*, the *Second Sydney Airport Site Selection Program Draft Environmental Impact Statement* (Kinhill Stearns, 1985) re-examined all potentially feasible airport locations and chose ten sites for preliminary examination. The ten sites were grouped as follows:

- closer sites - Badgerys Creek, Bringelly, Holsworthy, Scheyville and Londonberry;
- mid-distance sites - Darkes Forest, Somersby, Warnervale and Wilton; and
- an outlying site - Goulburn.

One closer site (Badgerys Creek) and a mid-distance or outlying site (Wilton) were then shortlisted and assessed in detail before Badgerys Creek was chosen as the site for Sydney's second major airport by the then Government in 1986.

In recent times, there has been considerable community debate about the potential for a second major airport to be provided at a site outside the Sydney region, such as Goulburn or Newcastle or off the coast of Sydney.

6.3.2 Outlying Sites

Goulburn was included in the group of ten sites examined in the site selection process (Kinhill Stearns, 1985) not only as a possible site in its own right, but as a general example of sites that might be found at some distance from Sydney.

The desire to consider a proposal to develop a major airport at an outlying site arose from the potential benefits the area would receive from employment creation associated with airport construction and operation, the potential for fewer environmental impacts (particularly aircraft noise) and the benefit of avoiding airspace conflicts with Sydney's existing airports. In some instances, there would be support from sections of the local community for a major airport proposal.

There are, however, major disadvantages with Goulburn and other possible outlying sites. The major difficulty would be the distance from Sydney which would make it relatively time consuming, costly and inconvenient for airport users to travel to and from the city area or to connect with Sydney's existing airport. It would therefore be extremely difficult to attract passengers and airlines to use a second airport at a remote site. For some sites there also be significant costs in providing suitable transport links and other support services such as fuel.

The *Second Sydney Airport Site Selection Program Draft Environmental Impact Statement* (Kinhill Stearns, 1985, p. 131) summarised the consideration of Goulburn as follows:

> Goulburn had been included in the group of ten sites not only as a possible site in its own right but as a general example of sites that might be found at designated non-metropolitan growth centres some distance from Sydney, such as Bathurst-Orange. The logic in placing an airport at one of these decentralised locations is that the growth centre would receive the stimulus of employment creation associated with airport development and operation. The success of such a growth strategy would rely upon the long-term viability of a second Sydney airport at a decentralised location, as employment generated would be broadly related to the level of passenger activity. However, the further a second airport is from its planned markets, the more constraints on

its role (and hence on its viability) would have to be accepted. The uncertainties associated with the practical aspects of implementing some form of high speed inter-city ground transport system are also considerable and include basic issues such as whether or not a broader social or economic justification exists for such a system, the availability of funding, and the timing of implementation. Resolution of these issues would have to precede consideration of the appropriateness of placing a second Sydney airport at some point along the inter-city line, and whether or not Goulburn (as distinct from other locations) was the best location.

These uncertainties, which could not be resolved within the timing of this current study, and the intrinsically poor access attributes of the Goulburn site (and, by definition, other decentralised sites) relative to the closer and mid-distance sites led to the conclusion that Goulburn did not merit shortlisting as a second Sydney airport site.

The Government has indicated that it is not considering Goulburn or other outlying sites as locations for the second Sydney airport.

6.3.3 Offshore Airport

There has been a recent proposal to replace the existing Sydney Airport with a two runway airport built on a concrete platform supported on piers driven into the seabed and located off the coast north of Botany Bay.

While the proposal claims that existing technology could be used for airport construction, there are presently no examples elsewhere in the world where a whole airport has been developed on this concept.

In the light of the long term forecasts prepared by the Department of Transport and Regional Development, a two runway airport alone is not expected to cope with the forecast growth in aviation traffic in the Sydney region.

Other considerations are the costs of constructing the airport and the associated infrastructure (bridges, roads and rail facilities etc.), the lack of major aircraft maintenance and engineering facilities and the compensation which would be sought by airlines if required to relocate from Sydney airport. The environmental impacts of the airport and access corridors would also be likely to be significant.

For these reasons, the offshore airport concept was not examined in detail as a possible solution to Sydney's long term airport needs.

6.4 The Badgerys Creek and Holsworthy Alternatives

As discussed in *Section 4.2.7*, the present Commonwealth Government initiated a detailed examination of options for a potential airport at Badgerys Creek or the Holsworthy Military Area. Three airport options at Badgerys Creek were compared with two at Holsworthy. The comparison of environmental issues presented by these alternatives (PPK Environment and Infrastructure, 1997) showed that Badgerys Creek was significantly superior to the Holsworthy site. A Summary of the environmental assessment was released in September 1997 which concluded that 'the comparative assessment .... shows the Badgerys Creek airport options perform better than the Holsworthy options against most of the criteria assessed .... The scale of impacts on the physical, biological and cultural environments that would be caused by the Holsworthy airport options are not normally contemplated, except where no viable alternative exists.'

On the basis of this assessment, the Minister for Transport and Regional Development, in consultation with the Minister for the Environment, decided to eliminate the Holsworthy Military Area from further consideration. A copy of the comparative assessment of the five airport options considered (PPK Environment and Infrastructure, 1997) is separately available and the information on which the assessment was based can be found in the technical papers to this Draft EIS.

No decision has been made on the merits of the three remaining airport options at Badgerys Creek which are the subject of the remainder of this Draft EIS.

6.5 No Second Major Airport

Should a second major airport for Sydney not proceed, initiatives to satisfy future air traffic demand would need to be developed in line with Government policy at the time and in the context of a separate environmental assessment process. Some of the initiatives that could be considered and are discussed below include:

- expanding the capacity of Sydney Airport;
- expanding the capacity of other capital city airports;
- expanding the capacity of secondary airports in Sydney; or
- literally doing nothing.

6.5.1 Capacity at Sydney Airport

Planned Capacity of Sydney Airport

Facilities existing and planned for Sydney Airport aim to fulfil its planned capacity of about 353,000 aircraft movements a year, giving a total of about 30 million passengers (Kinhill, 1990; and Sinclair Knight/Bechtel Aviation, 1993). In 1996 the airport handled about 277,000 aircraft movements carrying about 20 million passengers.

Calculating the capacity of a major airport such as Sydney requires complex judgements concerning the operational capacity of the physical infrastructure such as runways, terminals and transport access, and the capacity of the airspace management system. Environmental impacts are also often taken into account, and these too can limit overall operations. Therefore an airport's capacity is not just a calculation based on theory, but often represents a balance between meeting the needs of airport users in an efficient and effective manner and managing the environmental consequences of its operation.

Sydney Airport is currently owned and operated by the Federal Airports Corporation; because of its economic importance and the impacts of operation on the physical and social environment of surrounding communities, Government policy has influenced the operation and potential capacity of the airport and will continue to do so, notwithstanding the proposed private leasing of the facility.

The Commonwealth Government has a policy of reducing 'the noise and pollution generated by the airport as much as possible' and sharing 'the noise burden in a safe and equitable way' (Coalition of Liberal and National Parties, 1996). In response to this policy, three actions have been taken or initiated: increased use has been made of the east-west runway, legislation limiting movements to 80 per hour has been enacted by Federal Parliament, and a *Long Term Operating Plan for Sydney Airport* (Airservices Australia, 1996a) is being implemented to reduce and share noise impacts.

Clearly, these policy initiatives may affect the capacity of the airport. Only limited study has been undertaken into the future capacity of the airport under alternative operating scenarios.

Planned Facilities for Sydney Airport

The Federal Airports Corporation, Airservices Australia, the NSW Government and the airlines are investing substantially in runway, terminal, air traffic management and surface access facilities at Sydney Airport to meet projected demands into the early part of the next decade.

The capacity of the runways at Sydney Airport is mostly dependent on weather conditions and the way the runways are used. The practical capacity of the runways can vary between in excess of 80 movements per hour using the parallel runways in good conditions, down to less than 40 movements per hour when cross wind conditions require the single exclusive use of the east-west runway. Airservices Australia is planning to commission a Parallel Approach Radar Monitor (PARM) around the middle of 1998 to improve the proportion of time that the airport can operate at 80 movements per hour.

A development plan has been formulated for the International Terminal (Parliamentary Standing Committee on Public Works, 1997) and the Federal Airports Corporation plans to spend over $350 million upgrading the facility. The proposed redevelopment of Sydney Airport's International Terminal has been examined by the Parliamentary Standing Committee on Public Works. The Committee tabled its report on 24 June recommending that it is expedient to carry out the proposed work. The House of Representative passed a motion to this effect on 25 June. The Minister for the Environment approved the project under the *Environment Protection (Impact of Proposals) Act 1974* on 29 August 1997 subject to an independent review of noise study and other noise amelioration measures. Plans are for:

- ten additional wide bodied aircraft parking positions;
- extensions to the aircraft taxiway system;
- new departure lounges and associated retail facilities;
- additional check in and baggage claim facilities;
- related engineering and building services improvements; and
- improvements to roads, carparks and ground transport systems.

The domestic terminals at Sydney Airport are leased by Australia's two major airlines, Ansett and Qantas. Both airlines have announced major plans to boost the capacity of their terminals. Qantas is investing $212 million and its terminal will ultimately have 16 terminal gates, including six non-jet positions for Eastern Airlines with the capacity to cater for 2,350 passengers an hour. The existing Ansett terminal has 23 gates with a capacity to process 5,000 passengers an hour. Ansett is planning to redevelop its terminal through the construction of a second level, and increasing the capacity of check in and baggage facilities.

A number of initiatives are being undertaken to improve surface access arrangements within Sydney Airport and to improve access to and from the airport. These include:

- developments at the International Terminal to improve traffic flow, kerbside movements, carpark capacity and the relocation and expansion of bus and taxi storage areas;

- construction of a new elevated roadway at the domestic terminals that will double the available kerbside area, allow improved access from satellite bus and hire car storage areas and improve access to and from the carpark; and
- construction of the New Southern Railway linking the airport with Sydney's suburban rail network at Central Rail Station, the East Hills rail line and the Illawarra rail line.

The Federal Airports Corporation has also commissioned a number of studies examining road access to and from the airport (Masson and Wilson, 1996a and 1996b). These studies, being undertaken for the Sydney 2000 Olympic Games, will clarify whether road traffic demands to and from the airport can be met at least up to the year 2000.

The NSW Government has recently approved the Eastern Distributor proposal, which will provide a motorway standard link from Sydney Harbour Bridge and the Sydney Harbour Tunnel to Mill Pond Road at the eastern boundary of the airport. It is also considering the construction of the M5 East proposal, which would extend the M5 Motorway from Beverley Hills to General Holmes Drive, adjacent to the southern boundary of the airport.

Operational and Environmental Management Initiatives at Sydney Airport

In March 1996, the Government directed Airservices Australia to review current operating procedures and associated airspace at Sydney Airport and develop a *Long Term Operating Plan* for the airport. It's aim in directing the development of the plan is to reduce and share aircraft noise, while maintaining appropriate safety levels. In February 1997, the Minister for Transport and Regional Development released for public comment a report submitted by Airservices Australia on the Long Term Operating Plan. In May 1997, the Minister announced the Government's decision on the Plan. The Government's noise sharing targets are to direct about '55 percent of aircraft movements to the south over water, 17 percent of aircraft movements to the north of the airport, 15 percent to the west and 13 percent to the east' (Minister for Transport and Regional Development, 1997a). Prior to any new procedures being implemented, the Government is required to comply with the provisions of *Environment Protection (Impact of Proposals) Act, 1974*. The plan was considered under environmental impact assessment procedures and in July 1997 the Minister for the Environment made a number of recommendations aimed at improving community consultation, monitoring and reporting.

The Government also proposes the introduction of a slot management system at Sydney Airport. It's aim is to ensure compliance with the cap by allocating no more than 80 movements per hour, and to 'substantially relieve congestion problems associated with peak period cluster scheduling' (Minister for Transport and Regional Development, 1997b). Legislation limiting movements at Sydney Airport to 80 per hour and establishing a framework for a slot management regime has been enacted by Federal Parliament. The detailed slot management scheme is being progressively developed in consultation with industry and is expected to be tabled in Parliament early in 1998.

A slot is the right to schedule an aircraft arrival or departure on a specified day and at a specified time. The slots provided to individual aircraft will give them a designated landing or arrival time. This will ensure airlines do not schedule too many flights during any single period, thereby causing delays. By allocating no more than 80 movements per hour, the future number of aircraft able to use Sydney Airport will be fixed, with the impact most noticeable during peak hours. A separate pool will be reserved for regional airlines as part of the Government's stated commitment to continue to provide access for regional NSW to Sydney Airport (Minister for Transport and Regional Development, 1997b). It is anticipated that the slot system will be fully implemented by March 1998.

Other environmental management initiatives being undertaken by the Government include a property acquisition and noise insulation program. Acquisition occurs within the 40 Australian Noise Exposure Forecast (ANEF) contour, while dwellings qualify for noise insulation if they are located within the 30 ANEF contour. Public buildings such as schools, pre-schools, hospitals, health care facilities and churches are insulated if they are located within the 25 ANEF contour.

In addition, a night-time curfew operates at Sydney Airport from 11.00 pm until 6.00 am. The rules associated with the curfew are contained in the *Sydney Airport Curfew Act, 1995*. Aircraft movements during the curfew period are restricted to specific types of aircraft and operations.

Under the Act up to 24 international passenger services a week are allowed to land between 5.00 am and 6.00 am, provided that they meet International Civil Aviation Organisation noise standards and that there are no more than five such landings a day during this time. During the curfew aircraft must operate over Botany Bay. Breaches may attract fines of up to $110,000.

6.5.2 Potential for Meeting Long Term Air Traffic Demand at Sydney Airport

If long-term air traffic demands are to be met, beyond those of the coming decade, then Sydney Airport would require further expansion of airport facilities and/or the introduction of management measures that would result in significantly higher levels of passengers per aircraft.

Further Expansion of Facilities

Sydney Airport has an area of 881 hectares; this is small by international standards (refer *Table 4.1*) and is less than half the size of Brisbane, Melbourne and Perth airports. It is surrounded on three sides by intensive urban development and is adjoined by Botany Bay to the south. There have been three previous major extensions of the airport into Botany Bay, resulting in growing community concern about environmental impacts on the aquatic environment. Other environmental impacts of the expansion of the airport have likewise been the subject of well documented community debate.

While there may be scope for limited increases in terminal facilities within the existing boundary of the airport site, significant expansion of facilities would require an increase in its overall land area. The environmental implications of such an expansion would be significant. Government policy does not allow the operator of Sydney Airport 'to undertake major infrastructure developments that would increase the runway capacity of the airport' (Coalition of Liberal and National Parties, 1996).

Alternative Traffic Management

The previously estimated Sydney Airport capacity of 353,000 movements a year (Kinhill, 1990) was based on a wide range of assumptions about how the airport would operate.

The hypothetical unconstrained capacity of Sydney Airport would probably be greater than the 353,000 movements previously calculated. For example, London's Heathrow Airport accommodates over 420,000 movements on a runway configuration similar to Sydney Airport. This is not necessarily achieved through greater numbers of aircraft movements during the peak operating hours of the airport, but spreading of the peak across a greater number of hours during the day.

Another factor affecting capacity is the average occupancy of aircraft. Aircraft flying into and out of Sydney Airport carried, on average, about 76 passengers each in 1996. London's Heathrow Airport presently carries, on average, about 130 passengers per aircraft, while the new Chek Lap Kok Airport at Hong Kong is forecast to carry about 227 passengers per aircraft. A number of factors influence these average aircraft occupancies, including the local characteristics of the aviation market and airport capacity.

Increasing the average aircraft occupancy and/or scheduling aircraft movements outside peak hours could substantially increase the capacity of Sydney Airport to accommodate air travellers, thereby delaying the need for a second airport for some time. While current forecasts suggest that there will be an increase in average aircraft occupancy in Sydney to 111 by 2024/25 (Department of Transport and Regional Development, 1997a), a substantial increase above this level (probably to over 150) would be required to allow Sydney Airport to satisfy the forecast air traffic demand for Sydney over this period.

The proposed slot management system for Sydney Airport will establish scheduling committees to allocate slots to airline operators in accordance with established guidelines. A separate pool of slots is to be established for the use of regional airlines, in compliance with the Government's stated commitment that regional airlines will continue to have access to Sydney Airport (Minister for Transport and Regional Development, 1997c).

A slot management system could be used to increase passenger movements through the Airport, if slots were *auctioned to the highest bidder*. A slot would then become a commodity that could be traded. Airlines with aircraft operating to and from large markets, such as overseas or Australian capital cities, and having high aircraft occupancy rates would be able to pay more for desired slots. Such a system would have obvious implications for smaller, new and less affluent operators and would almost certainly contravene current Government policy on access to Sydney Airport for regional airlines. This type of slot management has rarely, if ever, been implemented at any airport around the world.

A variety of economic regulations could assist in achieving a higher level of usage of the Airport, while avoiding unacceptable delays. Alternatives include peak period surcharges and flat fee pricing.

Peak period surcharges were introduced by the Federal Airports Corporation at Sydney Airport in April 1989. A refinement to that system was introduced in April 1990 (Federal Airports Corporation, 1996), with all aircraft movements incurring a $250 surcharge during the morning and evening peak hours. These were in addition to smaller surcharges which applied to aircraft movements in the four shoulder periods either side of the peak periods. This system of peak period pricing significantly reduced regional and general aviation traffic during the peak periods. It had little effect on domestic or international traffic (Kearney and Favotto, 1994).

Further increases in peak period surcharges might reduce accessibility to Sydney Airport for some regional airlines and general aviation activities. This again would be contrary to current Government policy. As there appears to be a relatively low price elasticity associated with airport pricing for other types of airlines, significant increases in peak period surcharges would be required to substantially alter average aircraft occupancy and increase the number of aircraft movements outside of existing peak periods.

The Federal Airports Corporation currently uses aircraft weight as the basis of its airport pricing and a minimum charge of $27.50 on aircraft. The alternative of a flat fee would result in the same landing charge for all aircraft. Such a pricing scheme would increase operating costs for small aircraft and consequently reduce demand for use of Sydney Airport by those aircraft.

Without the development of a second major airport, periods of peak aircraft movements at Sydney would extend in duration. Larger aircraft would be used to move greater numbers of passengers during the peak periods. There would also be pressure to use the slot management system to facilitate the trend to larger aircraft at the expense of regional airlines.

It is difficult to quantify the extent to which these trends would satisfy air traffic demands beyond the early part of the next decade. Airline preferences for a high frequency of service to meet customer demands, together with relatively low price elasticity associated with airport pricing, indicate limitations on how far operations at Sydney Airport can be expected to meet medium to long term air traffic demands. Further limitations would be imposed by physical and environmental constraints to the expansion of capacity at Sydney Airport.

Altering Current Environmental Management Measures

To reduce noise impacts the Government plans to impose a cap of 80 movements an hour at Sydney Airport and to retain the night-time curfew; it has been suggested that removal of these restrictions would significantly increase the capacity of the airport.

Modelling work commissioned by Airservices Australia indicates that the theoretical capacity of Sydney Airport is up to 87 movements per hour. Therefore removing the cap would be unlikely to have a major effect on airport capacity. As discussed above, changing the characteristics of aircraft using the airport would have a greater impact on capacity. This could be achieved without necessarily significantly increasing the number of aircraft movements during peak periods.

The potential effects of operating a no curfew airport in Sydney were examined as part of the environmental assessment of the impacts of the Second Sydney Airport. Forecasts were developed to estimate the number of flights that may occur during the night (Second Sydney Airport Planners, 1997d). Experience at Brisbane and Melbourne airports and possible future international demands for scheduling arrivals and departures at night were examined. The analysis showed that about seven percent of total flights might occur during the curfew and that there would be very little change in the overall usage of the airport. Consequently, removing the curfew at Sydney Airport would have only a minor effect on its overall capacity.

6.5.3 Capacity at Other Capital City Airports

An alternative to providing additional airport capacity within Sydney is the diversion of air traffic to other major airports such as Melbourne, Brisbane or Canberra. Such an alternative by itself would not suppress demand for air travel to Sydney as it would be unlikely that alternative access to Sydney would be regarded as being convenient by air travellers. *Table 6.1* shows the time it takes to travel between Sydney and other capital cities by alternative modes of travel.

Table 6.1 Trip Times Between Sydney and Other Capital Cities by Alternative Modes

Sydney To/From	Bus/Coach	Car	Train
Melbourne Via Hume Highway (865 km)	11 to 13 hours	10 ½ hours	10 to 11 hours
Brisbane Via Pacific Highway (964 km)	13 to 16 hours	12 hours	13 to 14 hours
Canberra Via Hume Highway (285 km)	4 hours	3 ½ hours	4 hours

Source: Greyhound Pioneer Express, NRMA, Countrylink.

Possible trip times by the proposed very high speed train between Canberra and Sydney could be as low as one hour 20 minutes. Current proposals, however, are for services at a frequency of one hour, or less during off peak periods. The frequency of service would need to be significantly increased for an airport such as Canberra to service the Sydney market effectively. The financial feasibility of such a frequency of service is unknown. Nevertheless, it is apparent that the costs of developing and operating such a train system would be substantial.

International travellers would consider the prospect of a long surface journey following an international flight to be particularly unattractive. Similarly business travellers from interstate would be unlikely to accept such an alternative. It is also important to note that the Sydney-Melbourne and Sydney-Brisbane routes are the two busiest air routes in Australia, accounting for over 31 percent of all passengers carried in Australia on domestic routes (Department of Transport and Regional Development, 1997b).

Some tourist destinations outside Sydney might benefit from this alternative as tourists might decide to visit other destinations. Melbourne and Brisbane might benefit from a drift of businesses and head offices away from Sydney. Road and rail based transport services would also benefit, and there would be flow on economic benefits from the construction of land transport infrastructure.

It is likely that diverting air traffic from Sydney to another major Australian airport would only artificially reduce the demand for additional airport capacity in Sydney. Such an action would likely result in adverse economic impacts for Sydney, and even for Australia, potentially, if international travellers decided to choose other international destinations because of the perceived inconvenience of travelling to Sydney.

6.5.4 Capacity at Secondary Airports in Sydney

Regional and general aviation aircraft currently account for about 41 percent of all traffic at Sydney Airport. This proportion is not expected to change over the next 20 years (Second Sydney Airport Planners, 1997a).

Bankstown Airport could be considered as an alternative for all regional turbo prop and most general aviation aircraft presently using Sydney Airport. This would in turn cause the displacement of a considerable amount of other general aviation traffic from Bankstown Airport to other airports in the Sydney region.

Bankstown Airport is constrained by its inability to cater for multiple operations by aircraft operating under Instrument Flight Rules in adverse weather conditions. For scheduled operations, additional navigation aids would be required and airspace would need to be substantially modified. In addition, the compatibility of basic training and scheduled aircraft would be a major consideration for Government and for the aviation industry. Other significant issues to be addressed would include the provision of additional terminal facilities, surface access, the environmental impacts on surrounding communities and the capacity to handle interlining transfer passengers. Also, the cost of establishing such facilities might have to be borne by a relatively small number of regional operators.

RAAF Base Richmond has a 2,134 metre runway that could accommodate regional and general aviation traffic. However, the Blue Mountains serves as an obstacle to the west of the airport, and would constrain instrument approaches from that direction. In addition, there are urban areas located at either end of the runway, and these would be subject to increased aircraft noise and would constrain future extensions of the runway. The overall size of Richmond and the need to expand its facilities are also relevant factors in any consideration of expanded civilian aircraft use. Its location would make it inconvenient for interlining transfer passengers, and its use for civil aviation activities would impact on Defence activities.

It is clear that under current operating arrangements, and without changes that would involve major impacts on existing general aviation and military operations, the secondary Sydney airports located at Bankstown and Richmond could provide only minor capacity to satisfy Sydney's long term air traffic needs. Increased use of these facilities would also result in a range of increased environmental impacts on surrounding communities.

6.5.5 Implications of Not Developing a Second Major Airport

Value of Aviation to Sydney and Australia

Sydney serves as a gateway for over 45 percent of international visitors to Australia (Bureau of Tourism Research, 1995 and 1996). It is a popular arrival and departure point for visitors partly because of the frequency of the city's air services and the range of destinations available.

Over 60 percent of all international visitors to Australia spend time in Sydney; this is equivalent to the number visiting the whole of Queensland. Sydney Airport plays a major role in moving around a third of all domestic and international passengers in the country, while Melbourne accounts for about 22 percent and Brisbane about 15 percent (Bureau of Transport and Communication Economics, 1995).

In 1996 international visitors spent about $7 billion in Australia, of which $3.7 billion was spent in NSW and $1.5 billion in Sydney (Bureau of Tourism Research, 1996; Tourism NSW, 1997). The reasons why Sydney attracts such a large percentage of this expenditure are varied; nevertheless, it is apparent that the provision of attractive air services is one major reason.

A substantial proportion of Australia's economic and financial activity is conducted in Sydney. About 60 percent of all of business passengers arriving in Australia come through Sydney (Bureau of Tourism Research, 1995). The continued provision of adequate air services is important if Sydney is to maintain its existing economic and financial role.

Air transport services in Sydney play a crucial role in the development of Australia's international trade. Sydney is a major provider of air freight services carrying 36 percent or $5.8 billion of the country's air freighted export and 60 percent or $13.5 billion of its air freighted imports (Australian Bureau of Statistics, 1997a).

On a broader level, Sydney plays a substantial role in Australia's overall international trade. While air freight through Sydney accounts for only 0.3 percent by weight of all of the nation's exports, it accounts for eight percent of exports by value. About 17 percent of the value of Australia's overall imports passes through Sydney Airport (Australian Bureau of Statistics, 1997a).

Business and tourist air travel through Sydney plays an important role in Australia's invisible export earnings. Earnings from service related exports reached $22 billion in 1996 (Australian Bureau of Statistics, 1996), while tourism export earnings reached $16 billion (Bureau of Tourism Research, 1997). About $8 billion of this trade is facilitated through Sydney Airport, representing about seven percent of the credits on Australia's current account.

Sydney Airport directly and indirectly employs about 66,000 people (Institute of Transport Studies, 1996) across a wide range of industries. This represents five percent of employment in the Sydney region. Tourism in NSW employs about 174,000 people, and while it takes 177 domestic passenger trips to generate one tourism job, only 18 international visitors are needed to do the same (Tourism NSW, 1997).

Implications of Not Developing a Second Major Airport

Not building a second major airport for Sydney would generally change the pattern of aircraft movements at Sydney Airport, potentially resulting in the diversion and suppression of demand.

Queuing and delays to aircraft at Sydney Airport would occur if there were no attempt to manage demand. The costs of queuing can be high, up to $200 a minute for arriving aircraft (Board of Airline Representatives of Australia, 1993). The proposed slot management system for Sydney Airport aims to avoid such delays and improve the quality of service for passengers.

Should a second major airport not be developed the increasing air travel demand would result in the unavailability of slots to meet demand. To an extent, this would move flights that would normally attempt to fly into or out of Sydney Airport during peak periods to other times of the day. The times of the peak periods would therefore lengthen. Passengers may not always be able to arrive and depart at preferred times.

There is anecdotal evidence that airline passengers have a relatively low tolerance of delays and inconvenience. For example, business travellers from interstate with an early morning appointment in Sydney, may bear the expense and inconvenience of travelling to Sydney the previous night rather than put up with delays during the morning peak period. These types of responses have economic costs as well as social costs.

As demand for slots increased and airlines were forced to accept less desirable schedules, diversion of air travel away from Sydney would become a more regularly accepted option. Intrastate passengers might find it more convenient to drive to Sydney or, alternatively, divert to other airports and travel to Sydney by other means.

Tourists might decide not to visit Sydney, and business travellers might decide on occasions not to do business here.

It is difficult to identify the extent of inconvenience that would be required to significantly suppress demand for air travel into and out of Sydney. Should airport capacity not be significantly increased in the coming decade, it is likely that demand for air travel into and out of Sydney would be significantly diverted or suppressed. The economic consequences would be significant. The economic activity generated by each air traveller has been estimated to be $700 (Institute of Transport Studies, 1993). This economic activity may be diverted to other regions in NSW, other States of Australia, or even be lost to Australia should airport capacity limitations in Sydney suppress demand for international travel here.

The changes to the nature of operations at Sydney Airport that would be caused by delay in or abandonment of the development of a second major airport would likely have significant environmental implications for communities surrounding Sydney Airport. Smaller aircraft currently using the airport would be likely to be replaced by larger aircraft and non-peak periods would become busier. This would result in increased noise and air pollution. The capacity of the on airport and off airport infrastructure required to service passengers would probably be exceeded. Increased road traffic and upgrading of road infrastructure would be the most significant implication of a range of likely cumulative environmental impacts.

6.6 Airport Systems

6.6.1 International Experience

Multi-airport systems appear to be inevitable for major metropolitan areas. Countries or regions develop them as part of the expansion of airport capacity for a metropolitan area when a single airport does not provide an appropriate level of service for the region. A new, second airport may be established when:

- the major airport is both too congested and constrained (for example, London, Osaka and Kuala Lumpur); and/or
- the existing airport has technical limitations. In this case, the second airport is established so that a whole range of traffic, particularly international flights, can be accommodated (for example, Chicago, Dallas/Fort Worth, Washington and Taipei).

Worldwide experience suggests that a certain level of air traffic needs to originate from a region before a second passenger airport can develop successfully. The current threshold figure for the successful development of a multi-airport system is about 12 million originating passengers a year. All metropolitan regions generating this level of traffic or higher feature two or more airports with substantial passenger traffic (De Neufville, 1997). Conversely, no metropolitan region with less than this threshold figure operates a secondary airport with significant passenger traffic, unless strong technical or political forces constraint the division of traffic.

The threshold of 12 million originating passengers implies a total level of traffic for the metropolitan region of about 30 million passengers a year or higher (De Neufville, 1997). Sydney will reach this figure in about 2004. It is important, however, to recognise that the threshold level of traffic for the successful development of a second passenger airport has been rising over the years. In 1980, the threshold was about eight million originating passengers a year. The threshold rises because the use of larger aircraft allows runways at the primary major airport to serve more passengers, and therefore there is less need to develop or use additional airport capacity at another airport.

Worldwide experience suggests that airport planners need to consider the development of second airports well in advance of reaching the threshold level of 30 million total passengers a year. This would imply that metropolitan regions such as Sydney, which already has about 15 to 20 million total passengers a year, and an annual increase of up to 10 percent, should be actively planning for a second airport.

While it is useful to review experience in other parts of the world and to draw some general conclusions, it should also be noted that each metropolitan area and aviation market is different. Primary airports also differ in their constraints on expansion, the environmental issues they raise and their previous investment history.

6.6.2 Operational Alternatives for the Second Airport

While airport capacity for Sydney could certainly be increased by the provision of a second airport, the type of airport needed, the extent of additional capacity and facilities required would be determined by the operational alternatives adopted for it. For instance, operational alternatives to providing the proposed major international and domestic second airport include providing a new general aviation airport or a new charter and freight airport.

A general aviation airport would provide facilities for general aviation aircraft only, and hence would be expected to have only a minor impact on meeting the growth in demand in Sydney. General aviation represents about nine percent of Sydney Airport's current movements (Second Sydney Airport Planners, 1997a). The general aviation traffic now using Sydney Airport would be reluctant to move away from its locational advantages.

Charter operators tend to be price sensitive and would likely be early commercial users of the Second Sydney Airport if airport charges were cheaper there. Some dedicated international freight operators may also find some advantages in moving to the Second Sydney Airport if it operated without a night-time curfew.

Establishing a new general aviation or charter airport would have little impact on Sydney's overall airport capacity unless significant reductions in the numbers of smaller aircraft using Sydney Airport were achieved.

6.6.3 Preferred Airport System

A variety of measures could be used to increase the capacity of Sydney Airport, but the overall result would be likely to delay rather than overcome the need for a second major airport. Many of the measures would have environmental and economic consequences.

The Government has concluded that the most appropriate solution to accommodating Sydney's air transport needs is the development of a major new airport in the Sydney basin.

Chapter 7

Assessment Scenarios for the Second Sydney Airport

Chapter 7
Assessment Scenarios for the Second Sydney Airport

This chapter examines and explains the potential roles of a Second Sydney Airport. Assumptions made about how the airport might operate are outlined. These assumptions have been used to assess potential environmental impacts.

7.1 Issues Raised During Consultation

Issues raised about the potential role of the second airport related to:

- the way a dual airport system for Sydney would function and concern that it might not be feasible to operate two major airports in Sydney;
- the role of the airport as a second facility, and whether Sydney Airport would be substantially downgraded or closed and all of Sydney's air traffic directed to the new facility;
- the potential to retain international operations at Sydney Airport and reserve the second facility for domestic and freight use; and
- the possibility that particularly noisy aircraft might be retained at Sydney Airport and quieter aircraft directed to the new airport to reduce noise.

The latter two comments were related to concerns about noise impacts.

7.2 International Experience

7.2.1 Types of Operations

Worldwide experience suggests that second and third airports in a multi-airport system will neither be the same size, nor fulfil the same function as the first airport. On average, the largest second airports accommodate about one third the traffic of the primary airport (De Neufville, 1997).

Cases in which the newer, second airports grow to surpass the former primary airport are rare. A current example of this phenomenon is Paris, where the newer Charles de Gaulle airport has, after about 20 years, finally grown to exceed only in the number of passengers handled. The general case is that the second airports remain relatively smaller, unless the older airports have technical limitations. Examples of this phenomenon include Gatwick (London), Kansai (Osaka), Narita (Tokyo) and Dulles (Washington) airports.

Some second airports serve particular segments of the air transport market. Specific examples are:

- Gatwick (London), which in its early years focussed on serving the charter package holiday operators;
- Luton (London), which is almost exclusively used by package holiday tours;
- Newark (New York), a hub for Continental Airlines and its affiliates;
- Narita (Tokyo), devoted to international travel;

- Oakland (San Francisco), which services regional markets and express cargo carriers; and
- Dulles (Washington), which is a hub for United Airlines and services international traffic.

As these examples of second airports in metropolitan regions indicate, their roles can be defined in a number of possible ways. They can represent particular forms of traffic (freight, local passengers), a particular geographic region that has difficult access to the primary airport, or a specific class of transport service such as tourist or cheap fares (this is frequently the situation in North America and Europe).

In general, the assignment of domestic traffic exclusively to one airport in the multi-airport system and international traffic at the other has not been successful. This is because passengers often want to transfer between international and domestic flights, and because airlines want to provide this kind of service in a single aircraft. For example, passengers may arrive in Australia at Sydney and want to transfer directly to their final destination in Melbourne, preferably without changing aircraft.

Metropolitan regions that force international traffic to one airport and domestic to another can be at a disadvantage with respect to their competitors. This is demonstrated by the experience of Tokyo. As it is very difficult to connect from the Narita International airport to any domestic airport, travellers to other parts of Japan avoid travelling through Tokyo. If Sydney places its international airline traffic at one airport, and domestic traffic at another, some Australian passengers bound for overseas may tend to avoid Sydney, preferring to travel through Brisbane, for example. Foreigners coming to other parts of Australia may likewise tend to avoid having to connect between two airports in Sydney. Airlines would tend to schedule flights to meet these desires. Sydney would lose market share, business and employment as a result.

It is clear that cities around the world that have developed second major airports have responded to their particular needs in different ways. For example, the original airport in Dallas, United States, is now used for short range traffic that does not connect with other flights. Second airports in New York and Washington serve as a hub for a particular airline. In Taipei, Taiwan, smaller domestic aircraft use the down-town airport and larger international flights use a newer airport 40 kilometres from the city.

In every case, each metropolitan area has its own characteristics and the development of multi-airport systems respond to particular local circumstances. The precise role and consequential staging of development of the Second Sydney Airport is difficult to predict and would be the subject of future Government decisions.

7.2.2 Policies and Implementation

Successful implementation of a second airport proposal involves building the appropriate facility for the actual level and type of traffic that may arise. A flexible strategy is required for dealing with the potential risks resulting from uncertainty about how air traffic may develop. Worldwide, the range of likely error in traffic forecasts is plus or minus 20 percent after only five years, and very much greater for the 10 to 15 years of the planning period for a new airport (De Neufville, 1997). Neither the level of traffic, nor the routes or patterns of the airlines, can be predicted with any precision. It is therefore important to devise a plan that can adjust to the levels and patterns of traffic that actually do develop.

Planning for a second airport may be more risky than planning for a replacement airport. Traffic for the second airport is particularly difficult to quantify because the overall level of traffic to the metropolitan area and the share of traffic to the new airport are both uncertain.

It is prudent to plan the development of a second airport incrementally. Investments should be made according to the needs as they develop, while allowing for large future development that might eventually occur. In this way the developer will avoid investing in facilities that are not used or are underutilised. Examples of second airports that have experienced lower than initially planned traffic levels include Stansted (London) and Mirabel (Montreal).

Planners for second airports need to consider how traffic might develop at the new airport. Established airlines at the primary airport will be reluctant to move their traffic to the second airport, as they would find it expensive to duplicate facilities, and also difficult to split their operations between the two airports because of problems with scheduling crews, maintenance and flights.

Successful implementation requires that planners:

- allow for larger levels of traffic (by reserving sufficient land), in the event that these occur;
- identify the types of traffic and the airlines that are most likely to develop services at the second airport, so that the appropriate initial facilities can be created;
- implement the new facilities gradually, according to the traffic that actually occurs; and
- develop future increments flexibly according to the levels and types of traffic that occur.

While overseas experience is of interest in regard to the planning of Sydney's airports, it is clear that its circumstances are different from cities elsewhere. The geography, demography, air traffic and routing characteristics, environmental and social concerns, and planning history are all different. Sydney has to find its own solution.

7.3 Potential Role of the Second Sydney Airport

7.3.1 Need to Make Assumptions

An essential precursor to any environmental assessment process is a definition of the proposal that is to be assessed. In the case of the Second Sydney Airport, this definition has to include forecasts of the air traffic at the Second Sydney Airport, including its growth and changing makeup over time (international, domestic and general aviation). This has implications for the timing of construction of facilities at the Second Sydney Airport, surface access and infrastructure needs, and also will influence the extent of potential environmental impacts including the impacts of aircraft noise.

Defining traffic forecasts for the Second Sydney Airport requires splitting the Sydney basin air traffic forecasts described in *Chapter 5*. In turn, splitting these overall forecasts involves making assumptions on the future role of the Second Sydney Airport.

The remainder of this chapter describes the assumptions that were made on the role of the Second Sydney Airport, and the associated air traffic forecasts that are used throughout the rest of this Draft EIS.

Air traffic forecasts have been made for both Sydney and the Second Sydney Airport for two key years, namely 2006 and 2016. Although the timing of the opening of a new Second Airport is not known, 2006 has been taken to represent a time not long after the opening of the Second Sydney Airport when one of the parallel runways could be constructed and in operation.

The year 2016 represents a point when both parallel runways and the cross wind runway (where proposed) could be in operation, and the new airport could be handling a substantial volume of traffic.

7.3.2 Overview of Assumptions on the Role of the Second Sydney Airport

To date, the Government has not indicated a role for the Second Airport, except that it would be considerably more significant than that envisaged in the *Second Sydney Airport Site Selection Program Draft Environmental Impact Statement* (Kinhill Stearns, 1985) and the *Proposed Third Runway, Sydney (Kingsford Smith) Airport Draft Environmental Impact Statement* (Kinhill, 1990) and that it would cater for international traffic. Air traffic forecasts compatible with different Second Sydney Airport roles were developed to explore the range of possible air traffic build ups at the new airport.

Three possible scenarios were considered for the role of the airport, namely:

- *Air Traffic Forecast* 1 where the Second Sydney Airport would provide only for demand that cannot be met by Sydney Airport. This is an overflow forecast, but would nevertheless result in a significant amount of traffic being diverted to the Second Sydney Airport. The proportion of international and domestic traffic is assumed to be similar at both airports;
- *Air Traffic Forecast 2* where the Second Sydney Airport would be developed to cater for 10 million passengers a year by 2006 and all further growth after this would be directed to the Second Airport rather than Sydney Airport. The proportion of international and domestic traffic is also assumed to be similar at both airports; and
- *Air Traffic Forecast 3*, which is similar to Forecast 2 but with more international flights directed to the Second Sydney Airport. This would result in the larger and comparatively noisier aircraft being directed to the Second Sydney Airport.

The annual passenger movement forecasts for each of the three scenarios are shown in *Table 7.1* and *Figure 7.1*, and the annual aircraft movement forecasts for each traffic scenario are shown in *Table 7.2* and *Figure 7.2*.

Table 7.1 Forecast[1] of Annual Passenger Movements (millions) for Sydney's Major Airports[2]

	Air Traffic Forecast 1			Air Traffic Forecast 2			Air Traffic Forecast 3		
	International Passengers	Domestic Passengers	Total Passengers	International Passengers	Domestic Passengers	Total Passengers	International Passengers	Domestic Passengers	Total Passengers
2006									
Sydney Airport	11.7 m	18.3 m	**30 m**	9.7 m	15.2 m	**24.8 m**	2.7 m	17 m	**19.7 m**
Second Sydney	1.9 m	2.9 m	**4.8 m**	3.9 m	6.1 m	**10.0 m**	10.9 m	4.2 m	**15.1 m**
Total for Sydney	13.6 m	21.2 m	**34.8 m**	13.6 m	21.2 m	**34.8 m**	13.6 m	21.2 m	**34.8 m**
2016									
Sydney Airport	11.7 m	18.3 m	**30 m**	9.7 m	15.1 m	**24.8 m**	2.7 m	17 m	**19.7 m**
Second Sydney	8.7 m	10.3 m	**19 m**	10.7 m	13.5 m	**24.2 m**	17.7 m	11.6 m	**29.3 m**
Total for Sydney	20.4 m	28.6 m	**49 m**	20.4 m	28.6 m	**49 m**	20.4 m	28.6 m	**49.0 m**

Source: Second Sydney Airport Planners, 1997a.
Notes:
1. Excludes transit/transfer passengers.
2. Sydney Airport and the proposed Second Sydney Airport.
3. Some numbers do not add correctly due to rounding.

Table 7.2 Annual Aircraft Movement Forecasts for Sydney's Major Airports[1]

	Air Traffic Forecast 1				Air Traffic Forecast 2				Air Traffic Forecast 3			
	International Movements	Domestic[2] Movements	GA[3] Movements	Total Movements	International Movements	Domestic[2] Movements	GA[3] Movements	Total Movements	International Movements	Domestic[2] Movements	GA[3] Movements	Total Movements
2006												
Sydney Airport	64,500	244,600	14,000	**323,100**	53,500	201,900	14,000	**269,400**	14,900	227,300	14,000	**256,200**
Second Sydney Airport	10,500	38,800	14,100	**63,400**	21,500	81,500	14,100	**117,100**	60,000	56,100	14,100	**130,200**
Total for Sydney	75,000	283,400	28,100	**386,500**	75,000	283,400	28,100	**386,500**	75,000	283,400	28,100	**386,500**
2016												
Sydney Airport	57,500	244,400	15,600	**297,500**	47,600	185,200	15,600	**248,400**	13,300	208,500	15,600	**237,400**
Second Sydney	42,700	126,300	15,500	**184,500**	52,600	165,500	15,500	**233,600**	86,900	142,200	15,500	**244,700**
Total for Sydney	100,200	350,700	31,100	**482,000**	100,200	350,700	31,100	**482,000**	100,200	350,700	31,100	**482,000**

Source: Second Sydney Airport Planners, 1997a.
Notes:
1. Sydney Airport and the proposed Second Sydney Airport.
2. Trunk and regional aircraft.
3. General Aviation.
4. Some numbers do not add correctly due to rounding.

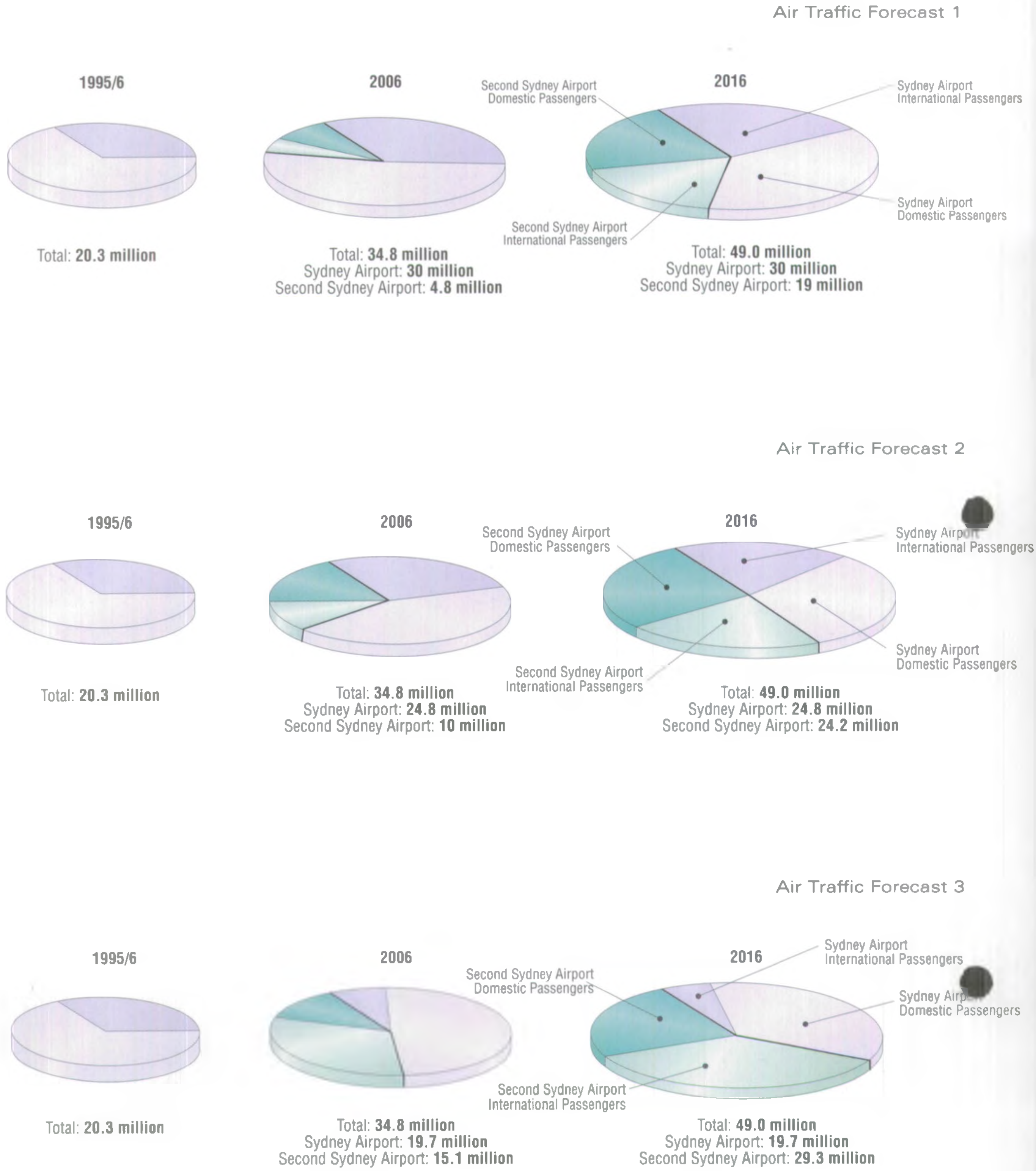


Figure 7.1

Summary of Passenger Movement Forecasts Used for Environmental Assessment

Source: Second Sydney Airport Planners 1997a

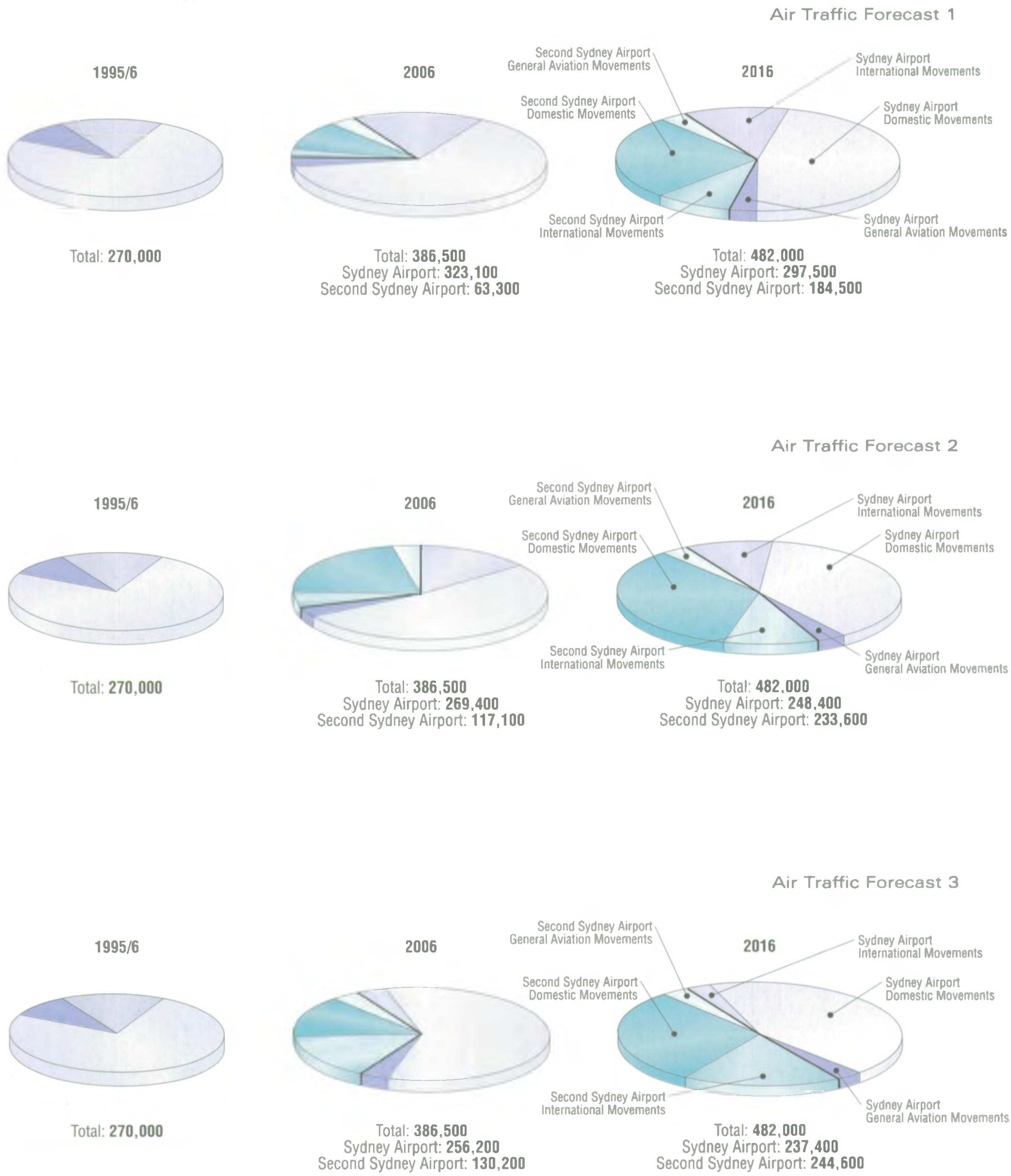


Figure 7.2

Summary of Aircraft Movement Forecasts Used for Environmental Assessment

Note: Totals may not match individual figures due to rounding

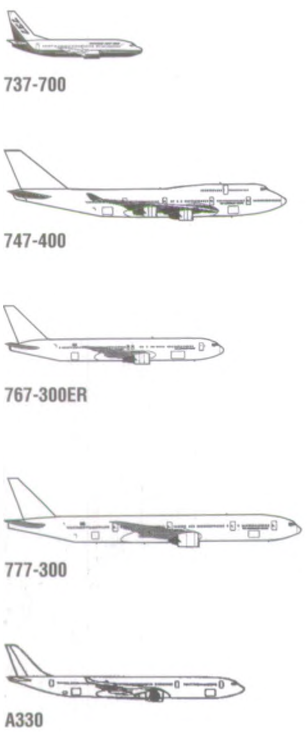
Source: Second Sydney Airport Planners 1997a

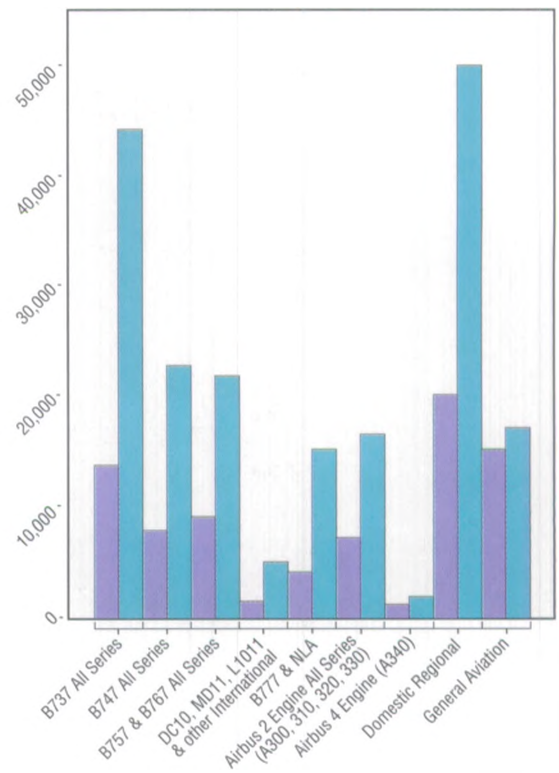
A summary of the forecast annual aircraft movements by aircraft type for each assessment scenario is provided in *Tables 7.3* to *7.5* and *Figures 7.3* to *7.5*.

Table 7.3 Aircraft Type Operating (annually) from the Second Sydney Airport Under Air Traffic Forecast 1 (no curfew)

Aircraft Type	2006			2016		
	Day[1]	Night[2]	Total	Day[1]	Night[2]	Total
B737 All Series	11,883	499	12,382	41,291	1,482	43,773
B747 All Series	3,359	2,452	5,811	19,361	3,051	22,412
B757 and B767 All Series	6,216	767	6,978	20,276	1,463	21,739
DC10 and MD11	444	56	500	2,754	196	2,950
B777 and NLA[3]	95	1,674	1,769	10,709	992	11,701
Airbus 2 Engine All Series ((A300, 310, 320)	3,925	236	4,161	14,792	958	15,750
Airbus 4 Engine (A340)	91	28	119	866	66	932
Domestic Regional and General Aviation	28,243	3,323	31,566	59,031	6,292	65,323
Total	**54,256**	**9,030**	**63,286**	**169,080**	**15,500**	**184,580**

Source: *Second Sydney Airport Planners, 1997a.*
Notes:
1. *Day 6.00 am to 10.00 pm.*
2. *Night 10.00 pm to 6.00 am.*
3. *New large aircraft.*





2006 Movements
2016 Movements

Figure 7.3
Aircraft Types Assumed to Use the Second Sydney Airport
Air Traffic Forecast 1
Source: Second Sydney Airport Planners, 1997a

Table 7.4 Aircraft Type Operating (annually) from the Second Sydney Airport Under Air Traffic Forecast 2 (no curfew)

Aircraft Type	2006			2016		
	Day[1]	Night[2]	Total	Day[1]	Night[2]	Total
B737 All Series	24,562	1,456	26,018	54,006	3,240	57,246
B747 All Series	11,258	674	11,932	25,410	2,263	27,673
B757 and B767 All Series	13,983	588	14,571	26,561	1,349	27,910
DC10 and MD11	959	82	1,041	3,536	77,143	3,756
B777 and NLA[3]	3,466	168	3,634	13,328	1,142	14,470
Airbus 2 Engine All Series ((A300, 310, 320)	8,270	474	8,744	19,408	1,186	20,594
Airbus 4 Engine (A340)	236	12	248	1,137	72	1,209
Domestic Regional and General Aviation	45,778	5,110	50,888	73,385	7,403	80,788
Total	**108,512**	**8,564**	**117,076**	**216,771**	**16,873**	**233,646**

Source: *Second Sydney Airport Planners, 1997a.*
Notes: 1. *Day 6.00 am to 10.00 pm.*
2. *Night 10.00 am to 6.00 pm.*
3. *New large aircraft.*

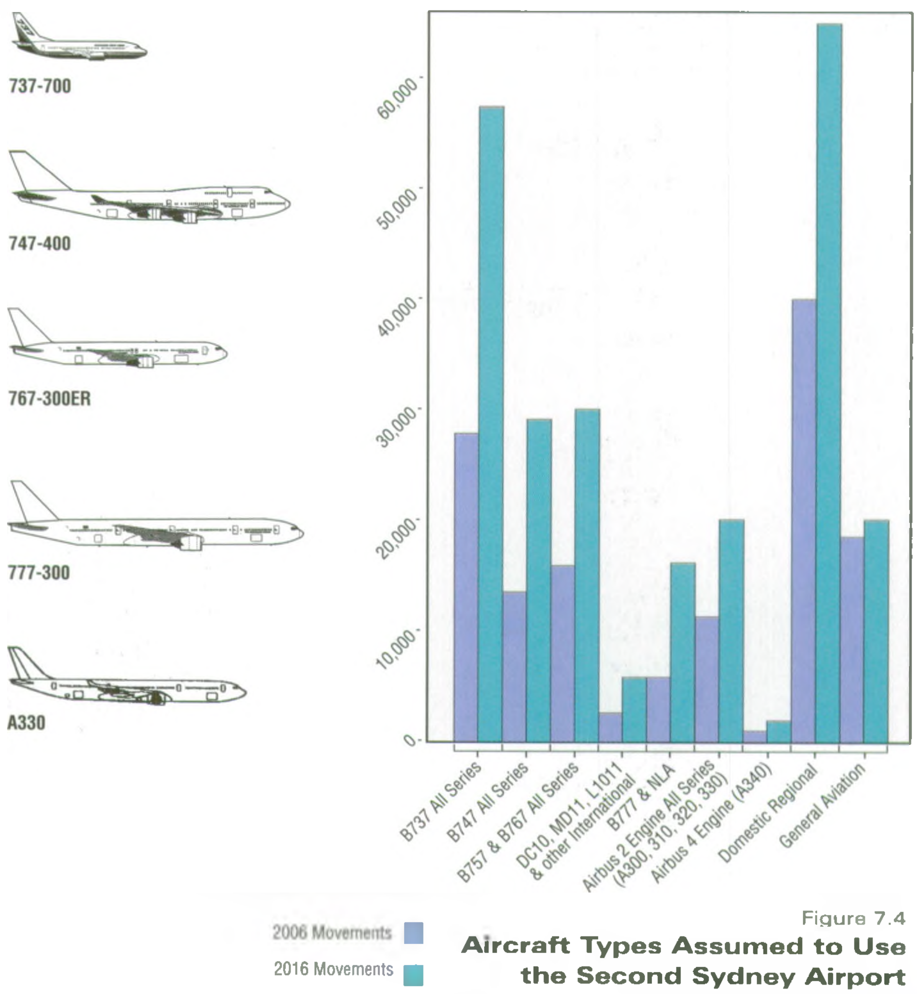


Figure 7.4
Aircraft Types Assumed to Use the Second Sydney Airport
Air Traffic Forecast 2
Source: Second Sydney Airport Planners, 1997a

Table 7.5 Aircraft Type Operating (annually) from the Second Sydney Airport Under Air Traffic Forecast 3 (no curfew)

Aircraft Type	2006			2016		
	Day[1]	Night[2]	Total	Day[1]	Night[2]	Total
B737 All Series	18,723	1,175	19,898	47,690	3,029	50,719
B747 All Series	30,984	1,916	32,900	41,139	3,269	44,408
B757 and B767 All Series	18,085	985	19,070	29,353	1,669	31,022
DC10 and MD11	1,948	144	2,092	4,196	378	4,574
B777 and NLA[3]	9,208	488	9,696	21,365	1,535	22,900
Airbus 2 Engine All Series ((A300, 310, 320)	6,447	364	6,811	17,258	1,042	18,300
Airbus 4 Engine (A340)	322	22	344	1,130	68	1,198
Domestic Regional and General Aviation	35,075	4,339	39,414	64,813	6,794	71,607
Total	**120,792**	**9,433**	**130,225**	**226,944**	**17,784**	**244,728**

Source: *Second Sydney Airport Planners, 1997a.*
Notes: 1. *Day 6.00 am to 10.00 pm.*
2. *Night 10.00 pm to 6.00 am.*
3. *New large aircraft.*


737-700


747-400


767-300ER


777-300


A330

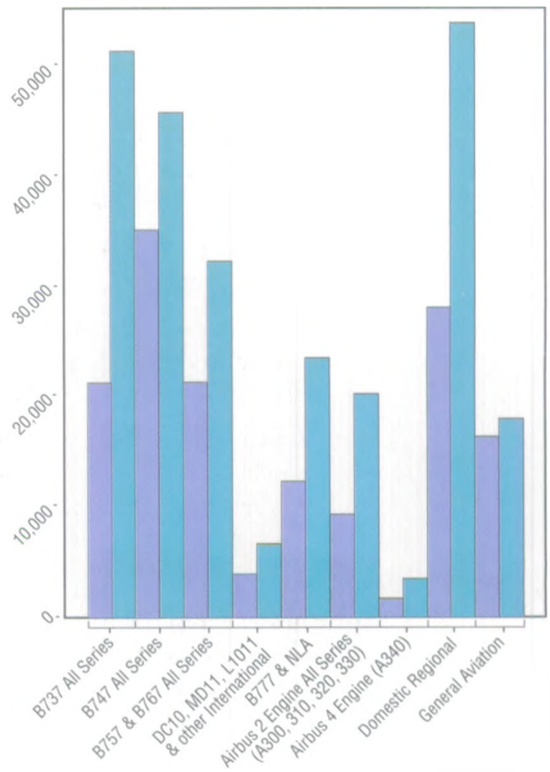


Figure 7.5
Aircraft Types Assumed to Use the Second Sydney Airport
Air Traffic Forecast 3
Source: Second Sydney Airport Planners, 1997a

The potential noise impacts of the Second Sydney Airport were examined in the Draft EIS assuming the airport operated both with and without a night-time curfew. Forecasts were developed to estimate the number of flights that would occur between 10.00 pm to 6.00 am, the critical period for potential disturbance to sleep. Experience at Brisbane and Melbourne Airports and possible future demands for scheduling arrivals and departures at night were examined. This analysis showed that about seven percent of flights could occur during this period.

7.4 Potential Measures to Manage the Growth of the Second Sydney Airport

7.4.1 A Managed Overflow Airport

The overflow airport that would develop from *Air Traffic Forecast 1* is based on an assumption that only minor changes are made to the current pricing structure at Sydney Airport.

Influences on an Overflow Airport

As air transport demand for passengers and freight to and from Sydney continues to grow, airlines would schedule additional flights, but subject to the constraints of the aircraft movement cap and slot controls. Demand would grow to exceed the supply of slots in the morning and afternoon peaks.

Possible responses to this situation at Sydney Airport would be:

- air carriers would re-schedule to less convenient times outside the peaks;
- air carriers would move greater volumes of passenger and freight per movement in the peak period by using larger aircraft types and increasing seat occupancy; and
- the airport would adjust the level and duration of the peak period surcharge to encourage the airlines to redistribute traffic outside the peaks.

The implications of these changes could include demand suppression, less convenient schedules, and smaller (regional) aircraft being priced out of the peaks due to their lower capacity to absorb or pass on the peak period surcharge.

At some point, aircraft operators would make a judgement about the profitability of moving some or all of their services from Sydney Airport. Those most likely to make the first move are low cost operators, in particular, charter operators and some general aviation.

At Sydney Airport, corporate jet, twin and single engined general aviation and miscellaneous traffic represent about nine percent of all movements (Department of Transport and Regional Development, 1997a). Clearly there is an opportunity for some or most of these to relocate to a new airport, but this might require substantial increases in airport charges. This is particularly the case for corporate jets when the relativity of airport charges to total operating expenses and executive expectations is considered.

If the Second Sydney Airport were made curfew free, this attribute could be marketed to encourage overflow to use it. However, curfew constrained late night and early morning movements are few compared to the total number of daily movements. Air carriers would therefore be reluctant to split their operations or relocate to the new airport to ease the scheduling difficulties they experience.

Freight, unlike passenger traffic, is less concerned about the time at which it arrives and departs the airport. At Sydney Airport, however, air freight moves predominantly in passenger aircraft and hence arrives and departs with the passenger traffic. Sydney Airport currently has an average of seven to eight dedicated international freight aircraft movements a day (Daily Commercial News, 1997). While pure freight operations can schedule around the passenger peaks, there is no incentive for them to relocate their operations to a Second Sydney Airport, which would be less conveniently located and would require duplication of infrastructure, such as terminals, ground handling equipment, security, forwarder facilities and government agencies.

Time-critical freight operations such as fresh primary produce, mail, courier and express parcel services could develop at the Second Sydney Airport as capacity limitations impose restrictions on the operation of Sydney Airport. This type of service could benefit from a curfew-free status (should such status exist at the Second Sydney Airport), which would enable it, say to make overnight deliveries to and from Asia.

As space constraints and other capacity limitations restrict operations at Sydney Airport it might become necessary to relocate some maintenance facilities in order to accommodate higher priority developments. While there would always remain a requirement for line maintenance at the airport, heavy maintenance could be transferred to another airport, as could engine and component overhaul activity.

Aircraft heavy maintenance requires airfield facilities, hangar accommodation, support workshops, storage and warehouse facilities, technical support and a highly skilled workforce. While all this infrastructure could be provided at a Second Sydney Airport, airlines would prefer to carry out heavy maintenance at an on-line airport because of the significant costs associated with operating an empty aircraft to and from an off-line maintenance base. For these reasons any relocation of heavy maintenance from Sydney Airport would probably go to Melbourne or Brisbane (where much of the required infrastructure already exists) rather than to a Second Sydney Airport, which may be off-line and would initially lack infrastructure.

As the Sydney basin traffic demand continues to grow, incumbent airlines will tend to protect their access to Sydney Airport. In turn the airport operator may attempt to satisfy as much traffic demand as possible, and hence may use strategies to encourage the use of larger aircraft with high payloads per movement. It would be likely that new entrant carriers would be forced to operate from the Second Sydney Airport.

The degree to which air traffic shifted to the new airport would also be influenced by the degree to which terminal and surface access facilities at Sydney Airport can be expanded to cater for growth in demand. There are limitations to this expansion.

If the future expansion of Sydney Airport is limited to its current planned capacity of about 30 million passengers a year, the Second Sydney Airport would develop into a major airport by 2016, accommodating about 19 million passengers a year. If factors such as increasing average aircraft size and spreading peak congestion periods change operating conditions at Sydney Airport, the Second Sydney Airport would probably establish from a slow beginning as an overflow development to a small regional airport with some intrastate, interstate and international operations by 2016.

Under *Air Traffic Forecast 1*, Sydney Airport would grow to its capacity with a gradual overflow to the Second Sydney Airport. Phased development of the Second Sydney Airport driven by demand would be appropriate.

Marketing of an Overflow Airport

To assist in encouraging the growth of Second Sydney Airport, marketing could highlight various positive attributes such as no curfew (should no curfew exist at the Second Sydney Airport), minimal congestion, low charges, easy surface access, and proximity to markets.

While a curfew-free status does offer some opportunities for early development of the airport, it would not attract any significant amount of passenger traffic. As most freight travels on passenger services, it would only be through service to a niche market such as overnight processing of fresh primary produce, mail, courier and/or express parcel services that the Second Sydney Airport could be expected to develop as an attractive proposition for overnight freight handlers.

The lack of congestion, at least initially, could be an attractive attribute on which to develop a marketing strategy. Access to Sydney Airport at peak times may become increasingly difficult, and the alternative airport could be successfully promoted. Assuming that there is a price incentive to relocate, some general aviation and charter operators in particular could be expected to respond.

Any strategy to market the airport would need to include a price incentive, including lease terms and concessional landing charges. Pricing policy would need managing in such a way that, when demand had risen to a reasonable level, more realistic prices could be introduced.

Marketing it as a new destination would need, as one factor, convenient access; an appropriate level of land transport infrastructure would therefore be required.

Marketing options discussed above could be used by the owner/operator of Sydney's two major airports to help increase the early use and economic return of the Second Sydney Airport. A strong marketing campaign would be expected to have only a marginal influence on growth above the overflow development outlined in *Air Traffic Forecast 1*.

7.4.2 Encouraging Development of a Major Airport

An alternative to the overflow airport scenario discussed above is early development of the Second Sydney Airport as a major additional airport. This is the assumption on which *Air Traffic Forecasts 2 and 3* are based. It would handle a significant proportion of all types of air traffic including international, interstate domestic and regional from its opening.

If the development of the Second Sydney Airport is left solely to market forces, it is likely to develop taking only overflow traffic from Sydney Airport. However, pricing initiatives, policy initiatives, and administrative or regulatory measures could be applied to reduce the attractiveness of Sydney Airport and accelerate the growth of activity at the new Airport.

The Government has indicated that Sydney Airport and the Second Sydney Airport would be leased together, and that the Second Sydney Airport would be developed as a major airport. The steps the Government might consider taking to influence demand for the Second Sydney Airport can generally be described as either economic regulation or administrative measures.

Economic Regulation

Pricing initiatives could be used to achieve an even distribution of air traffic between the two airports. Such initiatives could include peak period surcharges, flat fee pricing and noise charges, while start up charges at the Second Sydney Airport could be kept low.

Application of the current peak period surcharge of $250 per movement has been successful in achieving a substantial reduction in general aviation traffic at Sydney Airport during peak periods and in significantly increasing the average size of regional aircraft. Other price sensitive traffic such as charter operations also avoid peak periods. If the flat peak surcharge were increased, small aircraft would move out of the peaks in greater numbers. Domestic carriers would schedule larger aircraft to meet the travel requirements of their customers. To maintain some acceptable level of service, intrastate carriers might consider developing regional hubs and consolidating traffic onto larger aircraft into Sydney.

The more vulnerable operations would progressively accept less and less convenient schedules, until the point is reached where the costs of congestion and inconvenient schedules outweigh the costs associated with a less convenient Second Sydney Airport. Application of peak period pricing policies would therefore spread the peaks at Sydney Airport as traffic grows, but would not necessarily force traffic to the Second Sydney Airport until the practical capacity of Sydney Airport is approached.

Implementing a flat landing-fee would be similar to applying the peak period surcharge for the entire day. Regional operators may develop hubs and consolidate traffic into Sydney Airport on larger aircraft. Depending on the size of aircraft used, this initiative would mostly have little impact on charter operations. There would also be no incentive to schedule out of peaks as charges would be unrelated to the time of operation. Therefore, a flat landing-fee would be unlikely to reduce congestion at Sydney Airport.

Initially at least, flat fee pricing would result in some reduction in the level of aircraft movements at Sydney Airport as small aircraft operators such as regional service providers consolidate to regional hubs. Peaking would become more pronounced and peak period congestion and delays would increase. This measure would therefore be less effective at distributing traffic between the airports and produce greater congestion and delays than a peak period surcharge regime.

Low start up charges could be applied at the Second Sydney Airport to encourage air traffic and business development. Even if landing charges were waived and rents set at peppercorn rates for an introductory period, however, it is unlikely that this initiative would attract significant air traffic to the Second Sydney Airport. Major airlines using Sydney Airport may also be reluctant to subsidise competitors using the Second Sydney Airport.

An aircraft noise tax at Sydney Airport may be successful in persuading operators of noisy aircraft to use the Second Sydney Airport. To be successful, the tax would need to be high enough to warrant the substantial expenditure involved in airlines relocating to the Second Sydney Airport. A tax at this level would be strongly resisted by the aviation industry, and the flow on effects on economic activity in NSW and Australia could be significant. It would also be likely to lead to community demands to implement a corresponding tax at the Second Sydney Airport.

International experience suggests that the application of pricing initiatives would be unlikely to lead to significant traffic transferring from Sydney Airport to the Second Sydney Airport. As observed in the *Proposed Third Runway, Sydney (Kingsford Smith) Airport Draft Environmental Impact Statement*, 'a fundamental observation about multi-airport systems is that it is impractical if not impossible to force airline traffic and passengers to use an unpopular airport' (Kinhill, 1990).

Administrative Measures

A number of administrative measures could be considered by the Government to encourage desired use of the Second Sydney Airport. These would include slot controls and market segregation.

The slot control system to be adopted for Sydney Airport is described in *Chapter* 6. The main objective of a slot system is to reduce delays. Its introduction would not directly lead to activities shifting to the Second Sydney Airport, unless the available slots at Sydney Airport were being fully utilised. Services are likely to be forced by slot availability to off peak times and less convenient schedules, and this may ultimately encourage a shift to the Second Sydney Airport. Initially, the slot control system would have little effect on accelerating the use of the Second Sydney Airport, but might have more influence as Sydney Airport approaches capacity.

Market segregation could be used to encourage use of the Second Sydney Airport. This might involve incentives to encourage use of the airport by particular airlines or traffic segments such as charter, freight, regional, domestic or international services.

Charter operators are typically more price sensitive than other industry segments and hence may be attracted to a less congested and less expensive site. In addition, charter passengers have less critical time constraints and may be better able to tolerate a less convenient airport location. Charter operators may eventually become large enough to develop scheduled services from a Second Sydney Airport. Costs associated with provision of facilities, however, might be substantial.

New entrant airlines, both domestic and international, could be required or encouraged to operate from the new airport. Because of its location, and if there were also a low frequency of services and poor connections, the new entrant might be at a substantial competitive disadvantage. The cost penalties of infrastructure provision, as noted above for charter services, would also apply.

Another service segment that might be considered for segregation is the freight industry. As discussed earlier, particular freight markets such as overnight express or fresh produce exports may be encouraged by an uncongested curfew-free environment. Mainstream freight, however, is unlikely to relocate voluntarily to a new airport. The costs of infrastructure provision would again be substantial in developing this operation.

Regional traffic is another service segment that might be segregated. Regional traffic accounts for around 28 percent of all movements at Sydney Airport and, because it uses turboprop type aircraft, it would not require costly development of the new airport at an early stage. Issues associated with this segregation would be:

- a significant proportion of regional passengers interline onto other domestic and international services;
- regional services have the attractive attributes of permitting clients to conduct their business on the basis of a one day visit. Excessive travel time to and from a Second Sydney Airport could impact on this ability. Competition from road or rail transport, particularly to relatively close destinations, would become a threat to regional air operations; and
- the Commonwealth Government is committed to ensuring continued access to Sydney Airport for regional airlines.

Just as there are a number of ways in which service segments could be segregated, there are also numerous ways air traffic could be split between airports. An option previously considered (Kinhill, 1990) was to establish Sydney's International Terminal at Badgerys Creek. This was suggested on the basis that additional travel time incurred between Badgerys Creek and the Central Business District is a smaller percentage of the total journey time for international visitors than for other travellers. International airline operators may also have a preference for using a curfew-free airport. Capital expenditure would, however, be considerable for the airport operator. Furthermore, international air travel demand could be suppressed or transferred to other airports such as Brisbane or Melbourne (Kinhill, 1990).

Numerous changes to Australian aviation policy have occurred that make the above initiative even more difficult. In particular, Ansett and Qantas now operate both international and domestic services. There is no longer a clear separation between the two carriers, and the requirement to operate either international or domestic services from a particular airport would severely reduce the current level of operational flexibility they enjoy. Apart from the cost of relocating operations and providing excess capacity, there would be a requirement for both Ansett and Qantas to split their operations between airports.

Other alternatives that would split operations would include:

- splitting Ansett and Qantas operations between the two airports and allocating other carriers to one or the other airport to equalise the traffic operating from each; and
- allocating a set of carriers to each airport. That is, Ansett and its service partners would operate from one airport and Qantas and its service partners would operate from the other.

Substantial costs would be incurred by the airlines under both of these options and one of the airlines would be likely to operate at a competitive disadvantage under the latter option.

It is beyond the scope of this Draft EIS to determine the types of measures that would be required to realise the Government's objective of establishing a second major airport for Sydney. Substantial additional analysis would be required.

7.4.3 A Replacement Airport

The planned capacity of Sydney Airport would allow it to handle about 30 million passengers a year. This may be reached around 2004, which corresponds with the earliest practical opening date for the Second Sydney Airport. If Sydney Airport were to be closed, the Second Sydney Airport would be close to capacity on its first day of operation.

The Government's proposal for the Second Sydney Airport limits its operation to about 30 million passengers a year. A substantial expansion of the proposal would be required to allow Sydney Airport to close. While *Chapter 11* of this Draft EIS provides a discussion of how each of the airport options being considered may be expanded, a separate environmental assessment process would need to be undertaken to allow any approval of such an expansion.

The development of an expanded airport as described in *Chapter 11* and the closure of Sydney Airport would only be achieved at substantial cost and would provide little additional air traffic capacity for the Sydney region. Between 1988 and 1996 the Federal Airports Corporation spent more than $750 million in capital works at Sydney Airport and tenants at the airport have invested additional hundreds of millions of dollars. Compensation for this investment would likely be required if Sydney Airport were to close.

Substantial investment has also been made in the provision of infrastructure and commercial support services for Sydney Airport. The full benefits of this investment would not be realised if Sydney Airport were to be closed.

The construction of a replacement airport to cater for all of Sydney's air traffic needs would be costly, but would potentially result in substantial environmental benefits to communities surrounding Sydney Airport and some financial benefit from the sale of the site. These benefits, however, may be offset by potential adverse impacts on the regions surrounding the new airport site.

Part C

The Proposals

Chapter 8

Airport Planning

Chapter 8
Airport Planning

This chapter outlines the purpose of the airport planning process; it discusses airspace management issues, the airport operation scenarios considered in this Draft EIS and the preliminary airport options considered in the planning process; and finally it highlights the ongoing design stages that would occur if the proposal proceeds. The airport planning process would be similar regardless of the airport option selected. The information provided in this chapter is based on studies undertaken by the Second Sydney Airport Planners (1997a, 1997b, 1997c and 1997d).

8.1 Issues Raised During Consultation

During the initial consultation stage, concern was expressed as to whether the extent and scope of studies being undertaken would provide adequate information to assess the impacts of the proposal; also, it was felt that some future activities could not perhaps be defined clearly enough to determine the extent of impacts.

Submissions suggested that in order to provide a realistic assessment of likely impacts the Draft EIS needed to fully examine an expanded airport proposal which included four or five runways; and to detail the potential impacts of associated infrastructure and services, such as freight handling facilities. In addition, it was suggested that the preliminary master plans should have indicated the proposed location of such off airport site infrastructure as fuel pipelines.

Doubt was expressed about whether it would be possible to realistically assess flight path impacts, given that these are likely to change over time. Many submissions sought assurances that the master plans and flight zones relating to the Second Sydney Airport proposals were designed with Sydney Airport's current and future operating scenarios in mind.

Changes to Government policy and the introduction of new noise management and operational plans were noted as potential causes of change to flight paths. Attention was drawn to airspace management issues such as potential conflicts in operations between Sydney Airport and the Second Sydney Airport and the need to meet safety and noise standards.

8.2 The Purpose of Airport Master Plans

Airport master plans provide the broad framework for the possible long-term development of an airport. A master plan provides an indication of the size, extent, nature and timing of facilities required for an airport to support projected airline operations and other aviation activities. The master plan also needs to be flexible to enable change, such as accommodating new aircraft types.

Airport master plans are developed using a range of information including the site characteristics and potential environmental impacts. Factors that influence the scale and general layout of an airport include:

- air traffic forecasts that help to determine the likely level of activity at the airport and the necessary size of terminal buildings, aircraft parking aprons, car parking and other support facilities;
- the type of existing and future aircraft the airport must accommodate;

- the required configuration of the airport, which is influenced by runway orientation, runway length requirements, aircraft capacity, the direction of prevailing winds, topography, obstacles to aircraft flight paths and airspace management considerations; and
- the required capacity of passenger terminals and the nature of support facilities including navigation aids, air traffic control, freight forwarding, aircraft maintenance and related factors.

8.3 Airport Facilities and Requirements

Many of the requirements for the Second Sydney Airport would be similar regardless of the airport option considered. The generic features of a master plan for an airport capable of accommodating up to 30 million passengers a year is shown in *Figure 8.1*. The range of parameters affecting the development of master plans that are common to all airport options are discussed below. The detailed master plans for each airport option are described in *Chapter 9*.

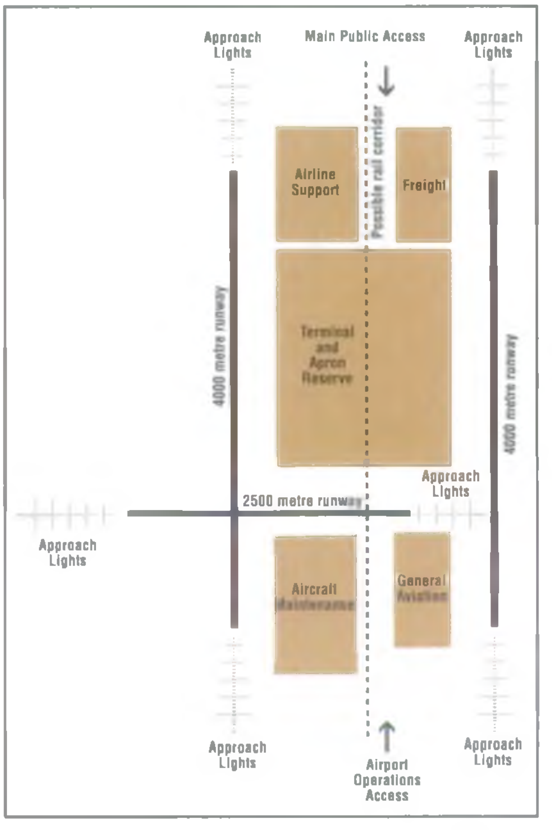


Figure 8.1
Generic Master Plan
Source: Second Sydney Airport Planners

8.3.1 Airfield

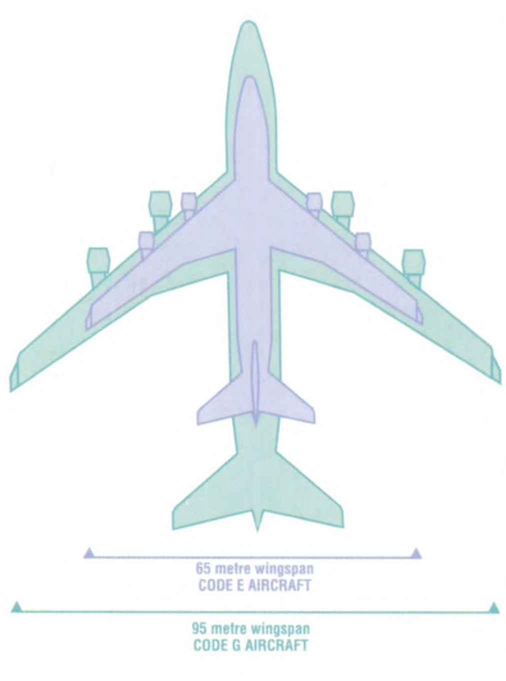
Design Aircraft

A *design aircraft* is selected to determine the appropriate geometric design and dimensions of airport facilities such as runways and taxiways. These facilities are primarily influenced by the wingspan of aircraft.

Australian and international standards for various sizes of airports are classified by codes based on the class of aircraft that will use the airport. The larger aircraft categories that have been considered in the planning of the Second Sydney Airport are:

- *Code E* aircraft, which has a wingspan up to 65 metres and includes the B747-400, B777 and Airbus A330/340;
- *Code F* aircraft, which has a wingspan up to 84 metres and would include the new large aircraft types currently being considered by Boeing and Airbus; and
- *Code* G aircraft, with a wingspan up to 95 metres. Planning for Brisbane Airport and the previous design (Gutteridge Haskins and Davey, 1991) for an airport at Badgerys Creek were based on this design aircraft.

The difference between a Code E and Code G aircraft is shown in *Figure 8.2*. Current evidence suggests that aircraft with Code F dimensions may comprise the practical upper limit for new large aircraft, especially considering most airports in the world would not be able to handle larger aircraft. Airfield planning criteria adopted for the Second Sydney Airport are based on allowing unrestricted access to Code F aircraft. The design would also allow landings and take offs by Code G aircraft, with limitations on taxi routes and parking at the passenger terminal.



Code F aircraft up to 84 metre wingspan

Figure 8.2
Aircraft Dimensions
Source: Second Sydney Airport Planners

Airport Layout

Worldwide experience and theoretical analysis shows that parallel runway systems have greater capacity for aircraft movements than the same number of runways in other configurations. Widely spaced parallel runways capable of independent operations can accommodate the planned aircraft movement limit of the Second Sydney Airport. They would also provide flexibility and efficiency in the layout of airport infrastructure by enabling passenger terminals and other major facilities to be located between the runways.

The minimum distance required between parallel runways for independent operations is 1,035 metres. However, this is dependent on the availability of suitable radar and communications equipment. A more typical minimum runway separation specified in international standards for independent parallel approaches is 1,525 metres.

To allow suitable space for terminals and other supporting facilities, a greater separation is desirable. Previous planning for the Badgerys Creek airport site (Gutteridge Haskins and Davey, 1991) was based on a runway separation of 1,670 metres. Given the increased passenger capacity now being considered, and the need to provide for a range of possible terminal configurations, a distance of 2,300 metres between parallel runways is considered desirable for the Second Sydney Airport.

The orientation of the runways is affected by factors such as the direction of prevailing winds, topography, obstacles to aircraft flight paths surrounding the airport, the location of noise sensitive land uses and airspace management considerations. In considering the prevailing winds, the selected runway alignment should maximise the useability of runways. Australia has adopted a planning goal for useability of 99.8 percent for capital city airports. The provision of a cross wind runway at the Second Sydney Airport would help to maximise airport useability.

Runway Length

The length of a runway required for the operation of any aircraft is dependent on a number of factors such as the weight of aircraft as they take off, the type and thrust of engines, atmospheric pressure, ambient temperature, wind strength and direction, and the altitude and longitudinal gradient of the runway. *Table 8.1* lists examples of indicative take off runway lengths required for typical international and domestic aircraft types, at maximum take off weight and in specified conditions, that could be expected to use the Second Sydney Airport. It is anticipated that new large aircraft will generally operate within the same airfield performance parameters as current aircraft types.

A survey of a number of overseas airports showed that runways of about 4,000 metres are commonly provided. A desirable runway length of 4,000 metres has been adopted for the main runways at the Second Sydney Airport. Based on *Table 8.1*, this would provide some safeguard against any unforeseen future changes in aircraft performance.

A cross wind runway is also considered to be desirable for the Second Sydney Airport. This would allow the airport to remain operational when cross winds restrict the use of the main parallel runways, particularly by smaller aircraft. The requirement for use of the cross runways is relatively limited, and therefore a shorter runway length of 2,500 metres is considered adequate.

Table 8.1 Indicative Take Off Runway Lengths

Aircraft	Engines	Indicative Take off Runway Lengths
International Aircraft		
B747-400	RB211-524G2	3,670 metres
B777-200IGW	RR Trent 800	3,620 metres
B767-300ER	CF6-80C2	3,400 metres
A340-300E	CFM56-5C4	3,200 metres
A330-300	RR Trent 700	2,800 metres
MD11	CF6-80C2	3,250 metres
Domestic Aircraft		
A320-200	CFM56-A1	3,110 metres
B737-400	CFM56-3C	2,930 metres

Source: Second Sydney Airport Planners, 1997a.

The desirable configuration for the runways at the Second Sydney Airport is shown in *Figure 8.3*.

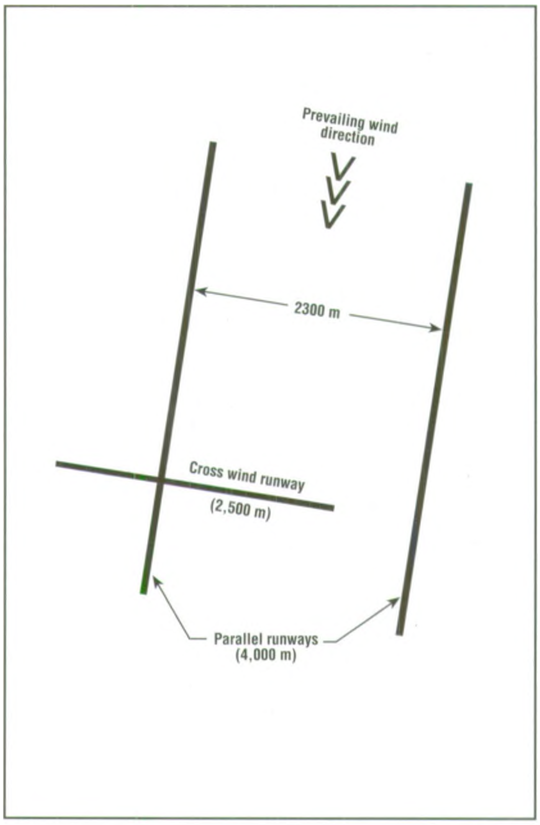


Figure 8.3
Desirable Runway Configuration
Source: Second Sydney Airport Planners

Taxiways

Each of the main runways would be linked by rapid exit and other taxiways to two full length parallel taxiways. A dual taxiway link would be provided between the two parallel runways. The taxiways would be designed to accommodate Code F aircraft and allow for restricted operations of possible future Code G aircraft. A typical taxiway layout is shown in *Figure 8.4*.

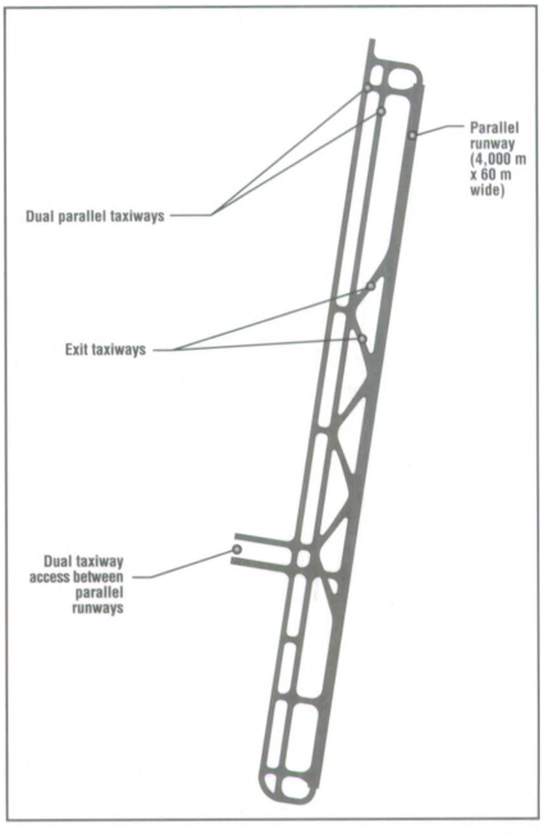


Figure 8.4
Typical Runway/Taxiway Layout
Source: Second Sydney Airport Planners

The cross wind runway would be linked by rapid exit and other taxiways to two full length parallel taxiways designed to accommodate Code F aircraft for the section between the parallel runway system, and Code E outside the parallel runways.

Obstacle Limitation Surfaces

The airspace surrounding an airport must be free from any obstructions that could be hazardous to aircraft operating near it or on approach or take off. Obstructions can be natural features such as hills or trees, or man-made features such as towers, masts and buildings. The development of an airport may require the removal of potential obstacles and the imposition of controls to prevent new obstructions from being built.

Protection of airspace in the vicinity of an airport is provided for by the definition of a set of Obstacle Limitation Surfaces, which identify the lower limits of the airspace above which objects may become obstacles to aircraft operations.

8.3.2 Operational Requirements

Facilities required to allow an airport to operate safely and efficiently include:

- air traffic control facilities for aircraft operating near the airport or taxiing on the ground. Air traffic control of the remainder of the Sydney region would continue to be exercised from Sydney Air Traffic Control, located at Sydney Airport;
- facilities for rescue and fire fighting services, including a separate training area;
- visual navigation and landing aids such as an aerodrome beacon, runway taxiway and high intensity approach lights, visual approach slope indicator system, illuminated movement area guidance system, illuminated wind indicators, and apron flood lighting;
- a range of electronic navigation aids such as an instrument landing system for each runway, a very high frequency omnidirectional range, distance measuring equipment and terminal area radar; and
- facilities to allow observation and reporting of meteorological conditions by the Bureau of Meteorology.

The passenger terminal is one of the most important features of any major airport. Passenger terminals are large, complex buildings containing the services and systems essential for passenger and baggage handling and airline operations. The master plans developed for each airport option provide a sufficient reserve to accommodate the terminal building (or buildings) and concourses, airport administration, aprons for parking and manoeuvring of aircraft, access roads, people movers, short term car parking and commercial and other facilities associated with the processing of passengers.

The Second Sydney Airport would require a terminal building or buildings having a gross floor area of approximately 500,000 square metres. Up to 80 aircraft gates would be required to cater for the anticipated numbers of aircraft needed to handle up to 30 million passengers a year.

Although detailed planning of terminal design and layout has not been undertaken, broad functional relationships have been considered in the development of the master plans based on a range of assumptions. The assumptions include:

- passenger terminals would be multi-level, allowing vertical separation of departing and arriving passengers;
- aerobridges (elevated bridges allowing passengers to board the aircraft) would connect with aircraft;
- automated baggage handling systems would be provided;
- international arriving and departing passengers would be separated;
- suitable retail and commercial space would be provided;
- an elevated road would give direct vehicle access to upper terminal levels;
- a rail link would be provided at some time in the future; and
- terminals would be planned to enable incremental expansion.

Various facilities would also be required to provide fuel, oils and lubricants to airport users. These would include:

- a delivery system from the refinery to the airport. Most major airports pipe jet fuel direct from a refinery or the nearest oil distribution terminal. This would most likely be established prior to the airport reaching a level of operation of approximately 10 million passenger movements a year. Aviation gasoline and oil products (in cans and drums) would be delivered to the airport by tanker and delivery trucks respectively;
- on-airport storage, settling tanks and provision for quality control. An airport fuel depot would be required. It would contain storage and settling tanks for jet fuel and aviation gasoline, pumps, filtration equipment, oil store, administration building, quality control laboratory, tanker loading gantries mechanical workshop and vehicle parking areas; and
- a delivery system to aircraft. Jet fuel would be delivered to aircraft by a system of underground pipes with hydrant points at each aircraft gate and appropriate stand-off positions. Aviation gasoline would be provided to general aviation aircraft either directly by tanker or from a fixed bowser installation.

8.3.3 Airline Support and Aircraft Maintenance Facilities

Master planning for the airport has been undertaken on the basis of typical area requirements for international and domestic freight. Adequate apron space would be provided for parking of eight new large aircraft, vehicle manoeuvring and parking, and container storage. Based on projected volumes of one million tonnes per year for international freight and 55,000 tonnes per year for domestic freight, a floor area of about 100,000 square metres would be required to accommodate freight. About 32 hectares of land would be provided to accommodate the full range of freight facilities, including the freight terminals.

Approximately 70 hectares of land would be provided for aircraft maintenance. This would include space for hangars and workshops, external aprons, stores administration and landside circulation and parking.

An area of 40 hectares would be provided for airline support facilities, such as areas for ground service equipment, flight catering, airline administration and supply storage facilities.

Although the primary role of a major international and domestic airport is to serve scheduled passenger and freight traffic, some general aviation traffic would be included in the mix of air traffic at the Second Sydney Airport. This general aviation activity would typically comprise corporate jets and other heavy general aviation aircraft types, as well as government flights. A separate area of 21 hectares would be provided for general aviation to accommodate aprons, hangars and workshops, terminals and fixed based operators.

8.3.4 Airport Management and Maintenance

The airport owner/operator would require office space to accommodate administrative staff. This could be provided within the passenger terminal or in a separate building adjacent to the terminal area. Hence, allowance for office space has been made within the terminal building.

An area of up to 10 hectares may be required for airport maintenance. This would comprise offices, electrical and mechanical workshops, stores, vehicles and plant shelters/parking and outside materials storage areas.

8.3.5 Airport Access and Utilities

The master plans developed for each airport option would provide various facilities for access into and around the airport and appropriate engineering services and utilities, many of which would be located underground.

Roads would be provided for public vehicle access to the major areas within the airport. The road system would separate passenger and freight/commercial traffic wherever possible. It would operate on a one way loop system within the passenger terminal area, with multi-level roads at the front of the terminal to provide separate kerbside access for departing and arriving passengers. A separate road network would be provided to link key areas within the airport for airport staff and emergency vehicles.

Short term public car parking would be provided adjacent to the passenger terminal. These parking areas would be extended over time from a ground level carpark to a multi-storey carpark.

External access to the airport would be from a motorway system with multi-level intersections, called grade separated interchanges, ultimately provided at the main entrance to the airport. The airport would be designed to facilitate a future rail link.

A range of commercial developments could be expected to develop on the airport site. Serviced sites would usually be provided by the airport owner/operator in designated areas. Possible developments could include hotels, office complexes, car rental depots, airport related government agencies, service stations and convenience retail services.

8.4 Staging of the Airport

Major airports are usually developed in stages with facilities gradually being provided to meet growing demands. This is done to ensure that there is an adequate return on the money invested in the development of the airport.

As outlined in *Chapter 7*, it is difficult to predict how quickly the Second Sydney Airport would grow. For the purposes of this environmental assessment, the air traffic forecasts adopted assume three different levels of aircraft movements that may occur by 2006, which is assumed to be a few years after the opening of the airport. This first stage of the airport development would not require all the facilities outlined in the master plans to be constructed. Only a single 3,600 metre long runway and associated taxiways and aprons would be required. A passenger terminal or terminals with a gross floor area of approximately 160,000 square metres would be necessary to process about 10 million passengers a year. There would still be a need for serviced sites for a freight terminal, aircraft maintenance, general aviation and airline support facilities such as catering. A control tower, fuel storage and distribution facilities, rescue and fire fighting services, navigation and landing aids, meteorological facilities and various utility services would also be developed.

8.5 Airspace Management

8.5.1 Overview of Airspace Operation

Airspace is the three dimensional space in which aircraft are able to fly. Elements of airspace include terminal airspace, controlled airspace and restricted airspace.

Terminal airspace is generally to within 55 to 90 kilometres (30 to 50 nautical miles) from a major airport. In the case of Sydney Airport it extends from ground level up to about 6,000 metres (20,000 feet) close to the airport. As the distance from the airport increases, the lower boundary of this zone rises in steps to about 2,300 metres (7,500 feet) at the outer edges of the Sydney region.

Controlled airspace includes terminal airspace and also the airspace along the flight paths between airports. Restricted airspace is all airspace that has restrictions placed on its use. This is generally associated with military installations or other situations where safety is an issue, for example explosives storage facilities.

Australian airspace is largely available for civil aviation use, with overall responsibility shared by Airservices Australia and the Department of Defence. The Civil Aviation Safety Authority sets policies and standards governing the use of the non-military portion of the airspace. Airservices Australia manages the airspace and provides the necessary air traffic control services and equipment to maintain a safe, orderly and efficient flow of air traffic.

Day to day management of the airspace is achieved through air traffic controllers who direct the various phases of flight. Management procedures are published for each airport including standard instrument departures, standard arrival routes and noise management procedures.

The efficient use of airspace in Sydney would be influenced by the geographic location of the airport sites in relation to Sydney Airport and other existing airports. The relatively close proximity, in airspace terms, of Badgerys Creek to Sydney Airport means that operations at the two airports would closely interact.

Runway orientation at the Second Sydney Airport is the major factor that would determine the aircraft traffic flow patterns and airspace requirements necessary for compatible operations of the Second Sydney Airport and Sydney Airport. Wherever operationally feasible, it is also desirable that traffic flow patterns are sufficiently flexible to minimise the effects of aircraft noise on surrounding residential and other noise sensitive areas.

The most efficient management of airspace in Sydney would occur if the runways of the Second Sydney Airport were generally parallel to those at Sydney Airport, that is the main parallel runways oriented 16/34 and the cross wind runway oriented 07/25 (refer *Figure 8.5*).

A qualitative assessment of airspace management issues has been prepared based on extensive air traffic and airspace management experience, and discussions with Airservices Australia. This has been supported by preliminary quantitative modelling of airspace operations undertaken by Airservices Australia. The results of these studies are reported in *Chapter 22*.

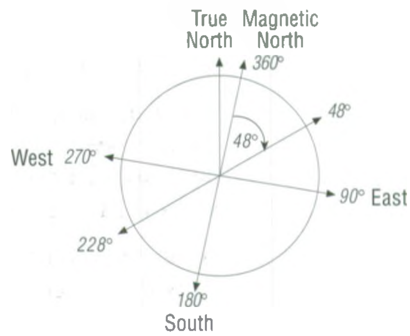
8.5.2 Development of Preliminary Flight Paths

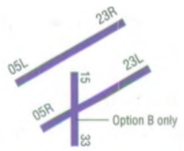
Flight paths define the anticipated routes of aircraft arriving and departing from an airport when operating on standard instrument departures or conducting approaches under instrument and visual meteorological conditions.

Ideally, aircraft fly by the most direct route and at the optimum altitude for reasons of economy and efficiency of flight operations. However, it is not always possible for aircraft to fly optimum routes because of noise and safety considerations, and the competing demands of other airspace users.

The orientation of runways is described using a 360 degree circle. For example in Option A at Badgerys Creek the runways are oriented at 48 and 228 degrees as shown below.

This orientation is then rounded to 50 and 230 degrees and the runways are described as 05/23. The parallel runways are distinguished by describing them as either left or right, as viewed by a pilot approaching the airport.





Badgerys Creek Options A and B

Badgerys Creek Option C

Figure 8.5
Describing Runway Orientation

Some of the most obvious factors that influence flight paths are:

- runway orientation;
- the need to separate arriving and departing aircraft;
- the need to provide an appropriate safety buffer around aircraft following the same path or on intersecting paths;
- the need to integrate the flight paths for each airport in the region;
- limitations of aircraft performance;
- the need to avoid obstructions;
- the need to minimise noise impact wherever possible;
- the need to avoid restricted airspace; and
- the pursuit of efficiency in use of airspace.

At this early stage in the airport planning process it is not possible to develop a *final* set of flight paths for each airport option. Should one of the airport options be selected, proposed flight paths would be refined to take account of operational and other factors which cannot be foreseen at this time, and also the results of environmental assessments.

Preliminary flight paths have been developed to allow an environmental assessment to be made of each of the airport options. They represent the range of flight paths that may be used if any of the airport options are developed, taking into account existing management of Sydney's airspace and the need to ensure safe and efficient aircraft operations.

While flight paths are often depicted as single lines of travel, it is not possible for all aircraft following a particular flight path to fly precisely along the same line. In practice, flight paths tend to be corridors that can be anything up to several kilometres wide.

When departing from an airport, an aircraft follows a predetermined flight path from the end of the runway until it is established on a route that leads ultimately to its destination. Because of the greater manoeuvring options available for aircraft after take off, there is greater flexibility in determining flight paths for departing aircraft than for aircraft landing at an airport.

Whereas flight paths show where the aircraft fly most of the time, in this Draft EIS *flight zones* are also shown to describe in more general terms the airspace that may be used by aircraft operating to and from the airport.

The flight zones include all the flight paths and adjacent airspace that may be used by aircraft for safety and other operational reasons. At some time or other, aircraft would potentially be seen and heard anywhere in the flight zone around the airport.

The preliminary flight paths for each of the airport options are shown, together with the master plans in *Chapters* 9. The flight paths and flight zones are identified up to about 19 kilometres from each airport site. This is the region where aircraft are operating at low altitudes and create most noise. Aircraft would, of course, also be seen and heard outside this area.

Should one of the airport options be selected, ongoing detailed planning would need to take into account:

- the actual operating plan for Sydney Airport at that time;
- detailed analysis of areas under the flight paths in relation to noise impacts;
- the staging of the development of the new airport; and
- technological developments in airspace and air traffic management.

8.6 Airport Operation Scenarios

At any airport, aircraft operations are allocated to runways (which implies both the physical runway and the direction in which it is used) according to a combination of wind conditions and airport operating policy. The allocation is normally performed by Air Traffic Control personnel.

Standard airport operating procedures (Airservices Australia, 1997) indicate that a runway may not be selected for either approach or departure if the wind has a downwind component greater than five knots, or a cross wind component greater than 25 knots. If the runway is wet, it would not normally be selected if there is any downwind component at all. This applies to all aircraft types, although larger aircraft would be capable of tolerating relatively higher wind speeds. Wind conditions at the airport site therefore limit the times when particular runways may be selected. However, there would be a substantial proportion of the time, under low wind conditions, when the choice of runways would be determined by airport operating policy.

For this environmental assessment, the maximum and minimum likely usage for each runway and runway direction was estimated and the various impacts of each case calculated. The actual impact would then lie between these values and would depend on the operating policy applicable at the time.

Three airport operation scenarios were adopted for the environmental assessment, namely:

- *Airport Operation 1* shown in *Figure* 8.6. Aircraft movements would occur on the parallel runways in one specified direction (arbitrarily chosen to be the direction closest to north), unless this is not possible due to meteorological conditions. That is, take offs would occur to the north from the parallel runways and aircraft landing would approach from the south, travelling in a northerly direction. Second priority is given to operations in the other direction on the parallel runways, with operations on the cross wind runway occurring only when required because of meteorological conditions;

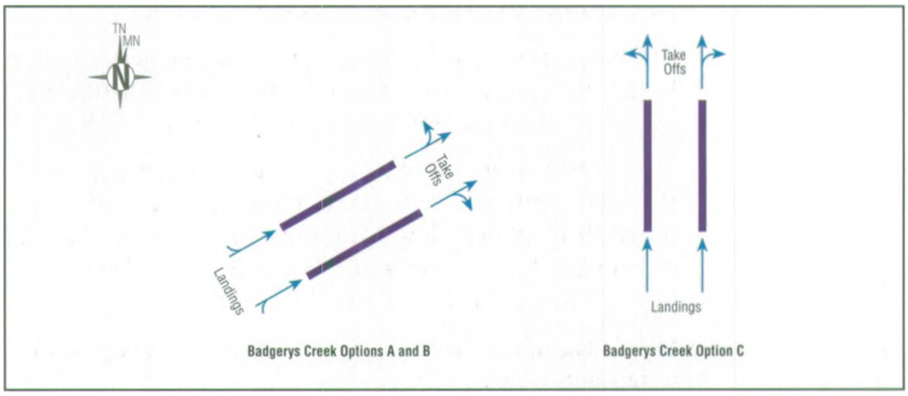


Figure 8.6
Predominant Directions of Movement of Aircraft for Airport Operation 1
Note: Cross wind runway used only when required because of meteorological conditions

- *Airport Operation 2* shown in *Figure* 8.7. Aircraft movements would adopt a similar pattern to Operation 1, but with the preferred direction of movements on the parallel runways reversed, that is to the south; and

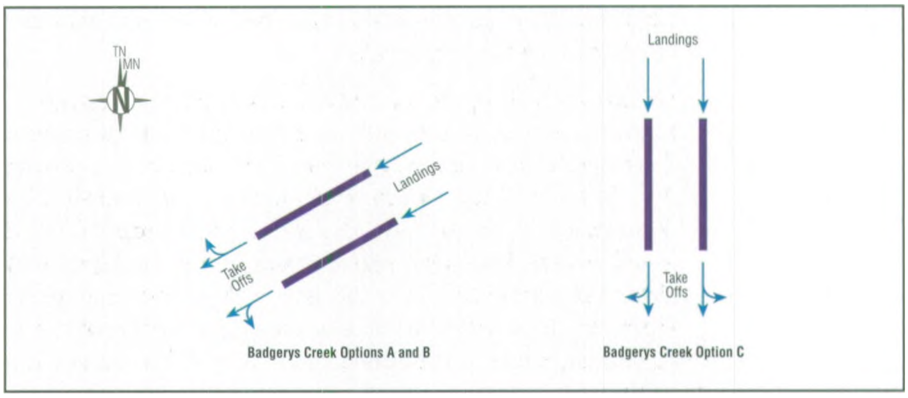


Figure 8.7
Predominant Directions of Movement of Aircraft for Airport Operation 2
Note: Cross wind runway used only when required because of meteorological conditions

- *Airport Operation 3.* Deliberate implementation of a noise sharing policy under which seven percent of movements are directed to occur on the cross wind runway (equal numbers in each direction) with the remainder distributed equally between the two parallel runway directions.

As a cross wind runway is not proposed for Option A, only Operations 1 and 2 were considered for that option.

For Operations 1, 2 and 3, runway allocations were calculated for each airport site using the meteorological data sets outlined in *Technical Paper No. 5*. These calculations assume that the preferred runway direction would be used, except when meteorological conditions require otherwise. However, in practice, when the non-preferred direction is used as a result of meteorological conditions, the use would be switched back to the preferred runway direction after a *time lag*.

By this method, the assumed runway use under Operations 1, 2 and 3 for each airport option for each key year were determined. The actual runway allocations are provided in detail in *Technical Paper No. 3*.

Having determined the runway use, it was necessary to allocate aircraft movements to individual flight paths. This process relied on the origin and destination information provided with the air traffic forecasts.

For noise modelling, flight paths were defined primarily by operational constraints, rather than by reducing noise impacts. The possibility of achieving noise mitigation through modifications to the flights allocated to each flight path are discussed in *Chapter 12*.

To take account of potential variations to the flight paths during operation of the airport, each flight path was modelled as five separate paths. Apart from the central original path, additional paths were dispersed at angles of 1.5 and 3 degrees for arrivals and 4.5 and 9 degrees for departures. Operations on the nominal paths were allocated 40 percent to the central path, 20 percent to each of the closer dispersed paths and 10 percent to each of the wider dispersed paths.

8.7 Preliminary Airport Options Considered in the Planning Process

Following investigations leading to the development of a generic airport master plan a number of preliminary airport options were identified and considered (Second Sydney Airport Planners, 1997a). These included:

- an alignment corresponding to the planning for Badgerys Creek that has been undertaken since 1985;
- a north-south runway configuration; and
- a runway configuration approximately parallel to the main runways at Sydney Airport.

These alternatives are generally shown in *Figure 8.8*.

Using the assessment criteria shown in *Table 8.2*, the various preliminary options for Badgerys Creek and options identified for the Holsworthy Military Area were reviewed at a workshop held in September 1996. This was attended by representatives of Department of Transport and Regional Development, Environment Australia, Department of Defence, Airservices Australia, Bureau of Meteorology, the Second Sydney Airport Planners and PPK.

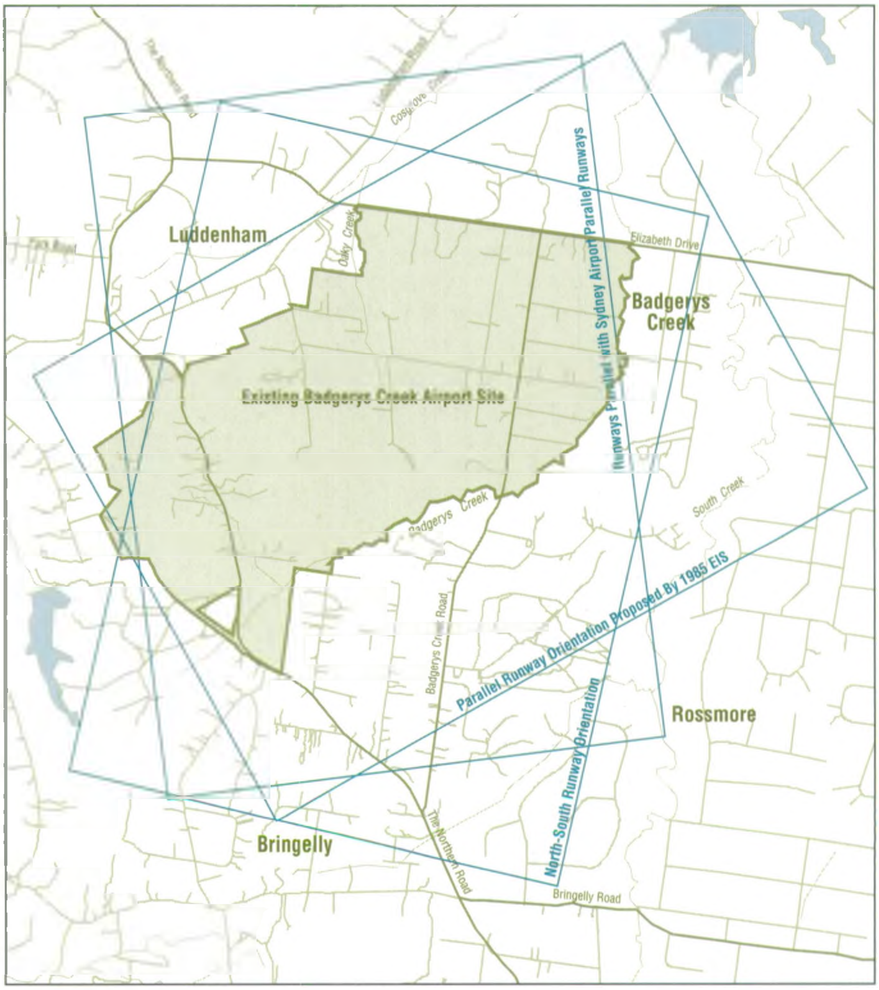


Figure 8.8
Preliminary Airport Alternatives

Following the further investigations recommended by the workshop, it was determined that no single preliminary airport option could be clearly identified as being preferable at either Badgerys Creek or Holsworthy. Three options were identified for further investigation at Badgerys Creek and two within the Holsworthy Military Area. Consequently, master plans were developed for five airport options. Following consideration of the environmental assessment of the airport options, the Government eliminated the Holsworthy Military Area as a potential site for the airport. The master plans for the three remaining options under consideration are described in *Chapter 9*.

Table 8.2 Summary of Criteria Used for Comparative Assessment of Preliminary Airport Options

Criterion	Issues Considered
Site Constraints	Adjacent land use for compatibility with airport operations
	Incidence of penetrations of Obstacle Limitation Surfaces
	Impacts on electricity transmission lines if re-routing is required
	Ownership of land adjacent to the airport
Airspace Considerations	Conflicts with operations at other airports
	Capability to design flight paths to be clear of restricted areas and noise sensitive land uses
Runway Usability	Runway orientations relative to prevailing wind speed and direction
Defence	Defence establishments in and adjacent to the airport and potential restrictions on aircraft operations
Design/Construction/Cost	Bulk earthworks required to create a level platform to accommodate airport facilities
	Potential for flooding of the airport
	Impacts on existing water courses and containment of surface runoff volumes and pollutants
	Likely demand and provision of required utility services (roads and car parks, railway, electrical power, potable and fire fighting water, sewage reticulation and treatment, gas, telecommunication, aircraft fuel)
	Influences of site topography, soil types, source of imported materials and type of construction on the construction plan
	Preliminary cost estimates for site preparation works
Regional Planning	Impacts on future regional planning
	Land use planning compatibility with aircraft operations
Aircraft Noise	Noise impacts from aircraft operations
Other Environmental Issues	Flora and fauna
	Aboriginal cultural heritage
	Non-Aboriginal cultural heritage
Community Expectations	Community expectations resulting from previous planning of a second Sydney airport

Source: Second Sydney Airport Planners, 1997a.

8.8 Ongoing Planning and Design Process

Should the Commonwealth Government decide to proceed with the Second Sydney Airport proposal, an ongoing planning and design process would be initiated prior to commencement of construction.

8.8.1 Initial Requirements

A range of matters requiring negotiation and agreement with and between governments and private interests would need to be initially resolved. These would likely include:

- acquisition of land for the airport site;
- detailed arrangements with State authorities regarding provision of off airport infrastructure including easements;
- preparation of environmental impact assessments, where appropriate, for the provision of off airport infrastructure such as major roads, rail and electricity transmission lines; and
- Parliamentary Standing Committee on Public Works inquiry if the Commonwealth is to finance the construction of the airport, and probably an inquiry by the NSW Public Works Committee for State based infrastructure.

8.8.2 Airport Planning, Design and Construction

The planning, design and construction of the airport would involve a number of stages that would take the preliminary master plan for the selected option through to a detailed master plan, with architectural and engineering design, programming and construction requirements defined. The process would involve:

- detailing the master plan for the selected option;
- preparation of a detailed construction program with cost estimates;
- preparation of an environmental management plan for the airport construction process;
- architectural and engineering design of facilities;
- preparation and release of construction tender documents and selection of contractors;
- construction of the project, with the construction period and program dependent on the selected option; and
- commissioning of the airport.

Detailed planning, design, tendering and construction would also be required for all off airport infrastructure. The external infrastructure likely to be required is outlined in *Chapter 12*.

8.8.3 Airport Management

A range of initiatives would be taken on airport management; these would include:

- establishment of an airport management organisation;
- development of a commercial plan for the airport;
- preparation of a detailed environmental management plan for airport operations dealing with issues such as the management of air traffic and noise;
- leasing of sites to airlines and other operators such as freight handlers, aircraft maintenance, in-flight catering, fuel suppliers and commercial facilities;

- leasing of commercial tenancies/concessions for services such as those within the airport terminal, including retail and service facilities; and
- preparation of a manual (a handbook) detailing airport emergency procedures.

8.8.4 Other Facilities and Functions

A range of facilities would be owned and constructed by airlines for their own use. These facilities would be planned, designed, tendered and constructed by the airlines. Processes would include planning the new facilities, possibly transferring operations to the new airport, and commissioning the new facilities.

Airservices Australia would require facilities such as a control tower, navigation aids and rescue and fire fighting services. These would be planned, designed, tendered, constructed and commissioned by Airservices Australia. Detailed airport operating plans would also be prepared by Airservices Australia for the airport.

Chapter 9

Airport Options

Chapter 9
Airport Options

This chapter describes the three airport options under consideration. The probable design, staging, construction and operation of each option is discussed. Further details about the airport options can be obtained from studies undertaken by the Second Sydney Airport Planners (1997a, 1997b and 1997c).

9.1 Characteristics of the Airport Sites

The area containing the three airport sites under consideration is located about 15 kilometres west of Liverpool town centre, 12 kilometres south of Penrith town centre and 46 kilometres west of the Sydney Central Business District (*Figure 9.1*). Aerial photographs of the sites are shown on *Figures* 9.2 to 9.4.

The airport sites are situated in a transitionary area between the relatively flat Cumberland Plain and the foothills of the Blue Mountains. The general area is undulating, with rolling hills and valleys, large areas of grassland, and some areas of flat land. The sites have an average elevation of approximately 80 metres above sea level, ranging from approximately 45 metres in the north-east to 120 metres in the north-west.

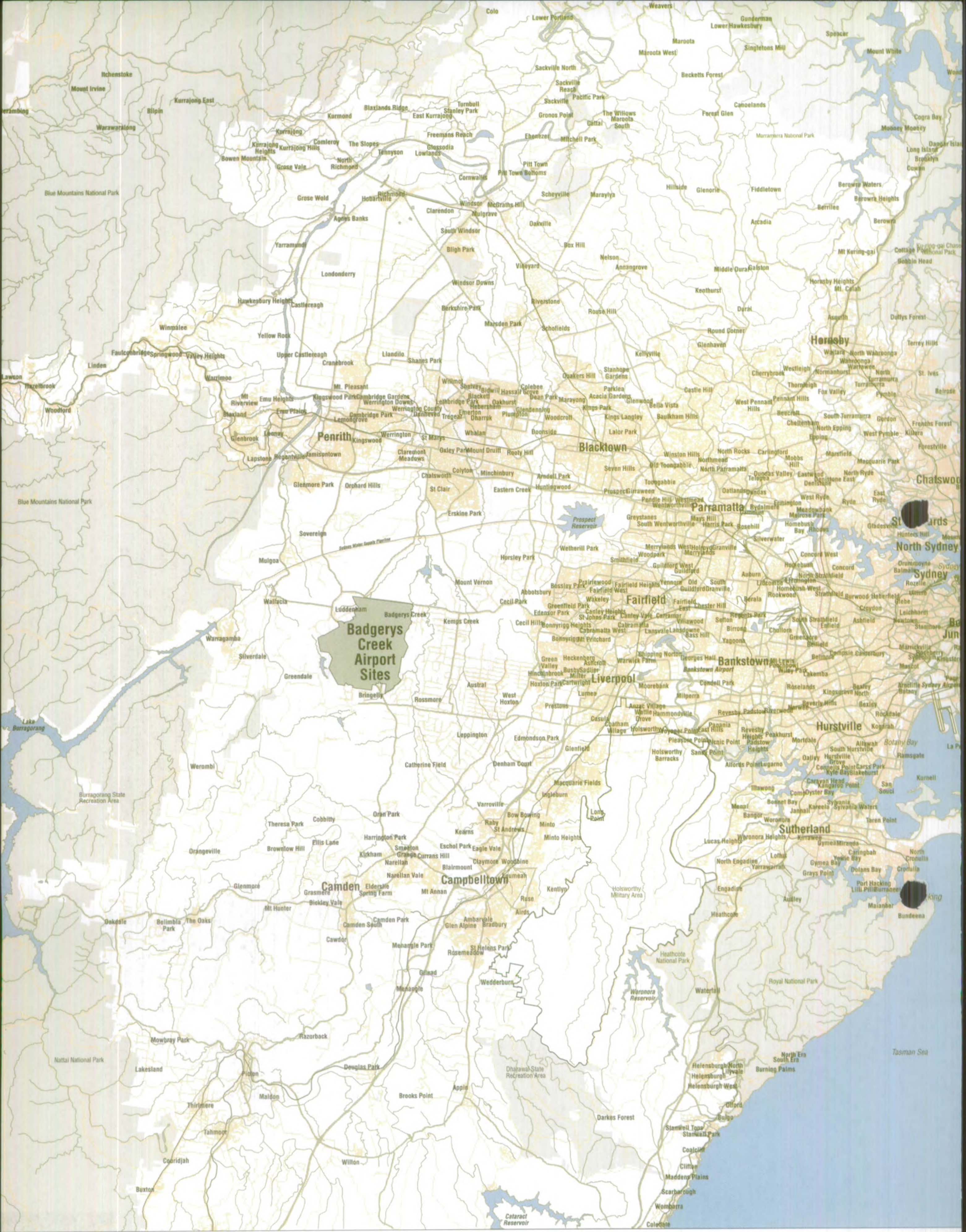
Numerous farm dams are located within the sites, as well as sections of Badgerys, Oaky and Cosgrove creeks. These creeks flow into South Creek which ultimately flows into the Hawkesbury River. Streams in the Badgerys Creek area are generally nutrient enriched but they support a diverse ecosystem. Algal growth is excessive and macroinvertebrate levels suggest poor ecological water quality.

The three-sites area contains substantial native vegetation, although it is scattered and generally in poor condition. Remnants of Cumberland Plain Woodland exist, but these are considered to be too small and altered to be assigned State significance. Generally, fauna habitats have been highly altered and the invasion of introduced plants and animals is evident. Overall, the airport sites are considered to have regional significance for nature conservation.

The airport sites are used for agricultural purposes and low density rural residential development. About 1,700 hectares of the sites were purchased by the Commonwealth following the decision to proceed with an airport at Badgerys Creek in 1986.

There are major aviation activities existing in the surrounding region including Hoxton Park airport which is located approximately nine kilometres to the east. It is a major general aviation airport, accommodating about 100,000 aircraft movements a year. Camden airport is located approximately 16 kilometres to the south; it serves about 118,000 aircraft movements a year.

Badgerys Creek village is located within the three-sites area. Luddenham village is located to the north-west and Bringelly village to the south. Other surrounding villages and communities include Kemps Creek, Wallacia, Mulgoa, Sovereign, Warragamba, Silverdale, Greendale, Rossmore, Austral, West Hoxton, Leppington, Catherine Field, Oran Park, Cobbitty, Theresa Park and Werombi. The nearby rural residential communities of Mount Vernon and Horsley Park have expanded over recent years through the construction of a substantial number of new rural residential



Urban Areas (indicated by local roads)

TN MN

0Km 10Km

Figure 9.1
Location of Airport Sites

Figure 9.2
Aerial Photograph of Option A

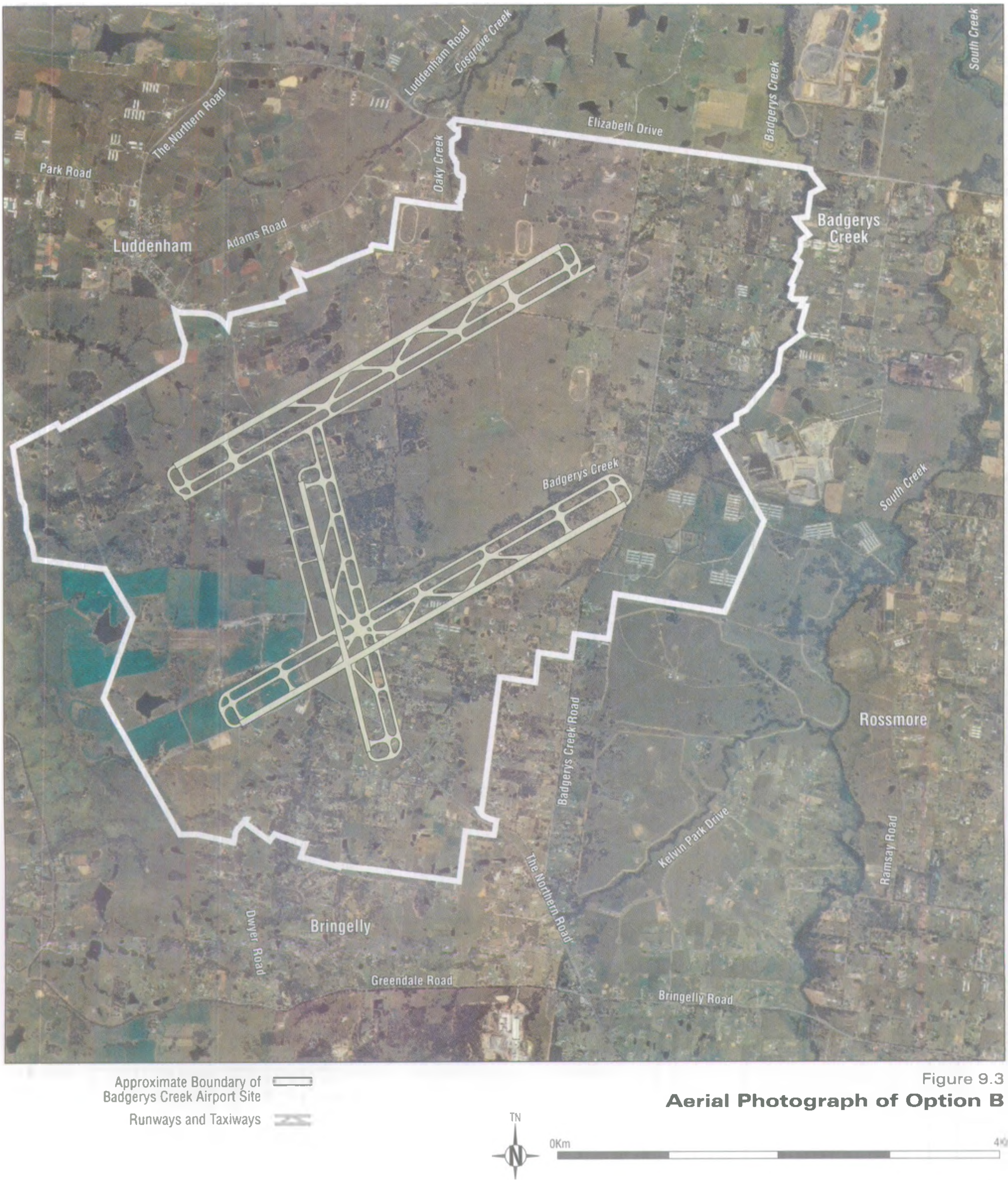


Figure 9.3
Aerial Photograph of Option B

Figure 9.4
Aerial Photograph of Option C

dwellings. Further away from the sites are the urban areas of Glenmore Park (10 kilometres), St Clair (eight kilometres), Erskine Park (eight kilometres), Bossley Park (10 kilometres), Abbotsbury (nine kilometres), Cecil Hills (eight kilometres), Carnes Hill (nine kilometres) and Harrington Park (13 kilometres away).

At different points in the surrounds of the airport sites are the Telstra Bringelly High Frequency Radio Station, the RAAF Bringelly Remote Receiving Station, the Department of Defence Orchard Hills weapons storage facility, the University of Sydney research farms, several commercial poultry farms, and the Elizabeth Drive landfill. Land to the north of the sites was previously used by CSIRO; it was sold in 1996.

The potential closure of Defence Establishment Orchard Hills, a weapons storage and maintenance facility, is mentioned in the *Secretarial Papers* of the recent Defence review *Future Directions for the Management of Australia's Defence* (Department of Defence, 1997a). Its possible closure will be the subject of further Government consideration following detailed studies of the feasibility and benefits of such a closure.

The Northern Road, Badgerys Creek Road and a 330 kilovolt electricity transmission line pass through the sites.

9.2 Option A Proposal

9.2.1 Major Elements

Option A would be located on the land already owned by the Commonwealth, an area of about 1,700 hectares, and on a portion of The Northern Road that crosses the airport site. The option is generally based on the original runway layout developed for the *Second Sydney Airport Site Selection Program Draft Environmental Impact Statement* (Kinhill Stearns, 1985), which considered locating an airport at Badgerys Creek. *Figure* 9.5 shows the proposed Stage 1 development of the site and *Figure* 9.6 shows the master plan for longer term development.

The master plan would provide all the facilities required for an airport accommodating about 30 million passengers a year. Two parallel runways would have approximate north-east to south-west orientation and be separated by 1,670 metres. The south-eastern runway would be 4,000 metres long. Typically it would be used for take offs by aircraft operating fully laden on long haul sectors.

The north-western runway would be 3,000 metres, an increase in length of 500 metres over the runway proposed in 1985. A longer runway could not be provided within the site boundaries. It would, however, provide sufficient runway length for operations by all anticipated aircraft types, except when fully laden and/or on the hottest days. Option A would not have a cross wind runway.

The runway separation distance of 1,670 metres is consistent with the planning for the site since 1985. This separation distance places restrictions on the flexibility of the site for development of terminals and associated aprons. Consequently, the configuration of the terminal would be different for Option A compared with that for Options B and C. A linear terminal configuration with car parking and commercial areas is proposed.

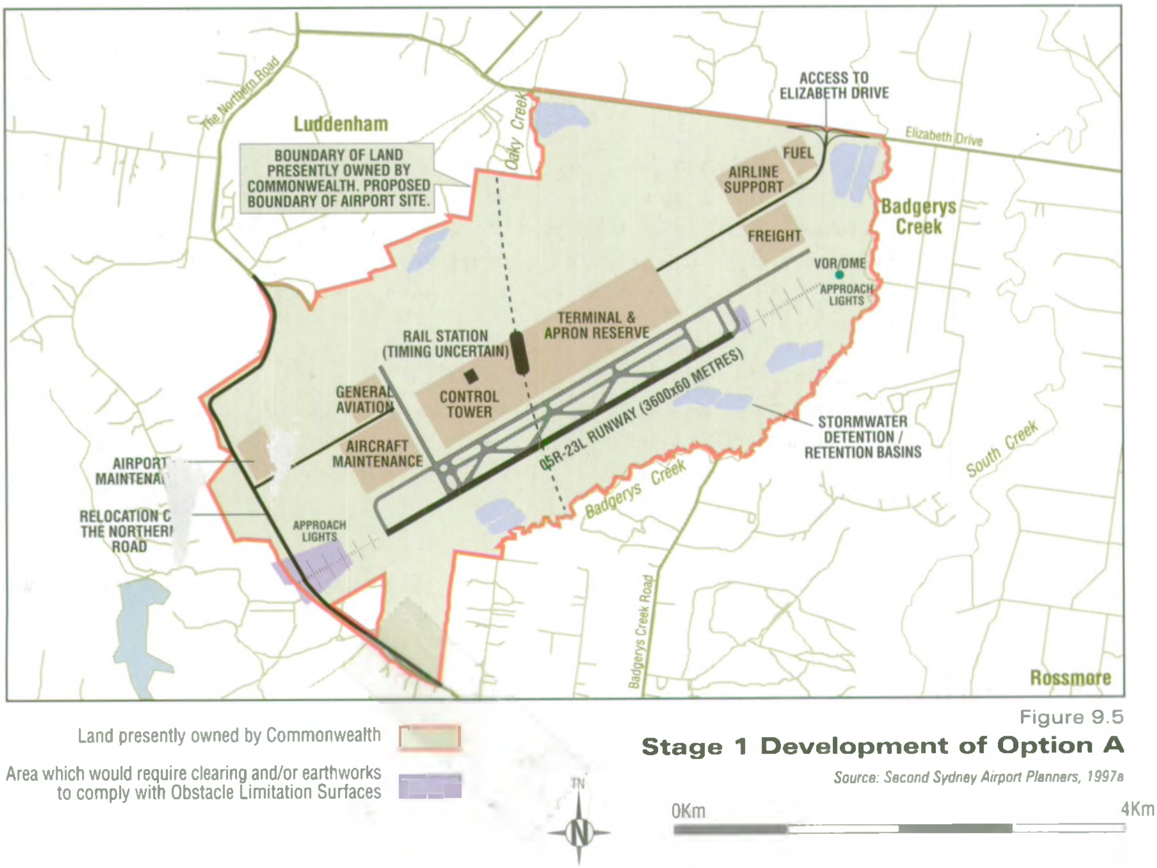


Figure 9.5
Stage 1 Development of Option A
Source: Second Sydney Airport Planners, 1997a

No acquisition of land would be required for Option A except the portion of The Northern Road that crosses the airport site. Acquisition would occur after realignment of The Northern Road.

The proposed road access would be similar for all three options. It is anticipated that the principal access for passengers, meeters and greeters, freight and some commercial traffic would be from Elizabeth Drive. A second access could be provided by upgrading Bringelly and The Northern Roads; this would provide access to the maintenance and general aviation facilities proposed for the southern areas of the airport. Further details of road access to the airport sites are discussed in *Chapter 22*.

The Northern Road would be relocated within the airport site to allow the construction of runways and other airport facilities; Badgerys Creek Road would be closed at the airport boundary.

Alternatives for providing rail access to the airport have been the subject of investigation by the State and Commonwealth Governments over recent years. A connection to the airport is proposed from the Cumberland and East Hills lines, taking off at Glenfield; this is discussed in *Chapter 22*.

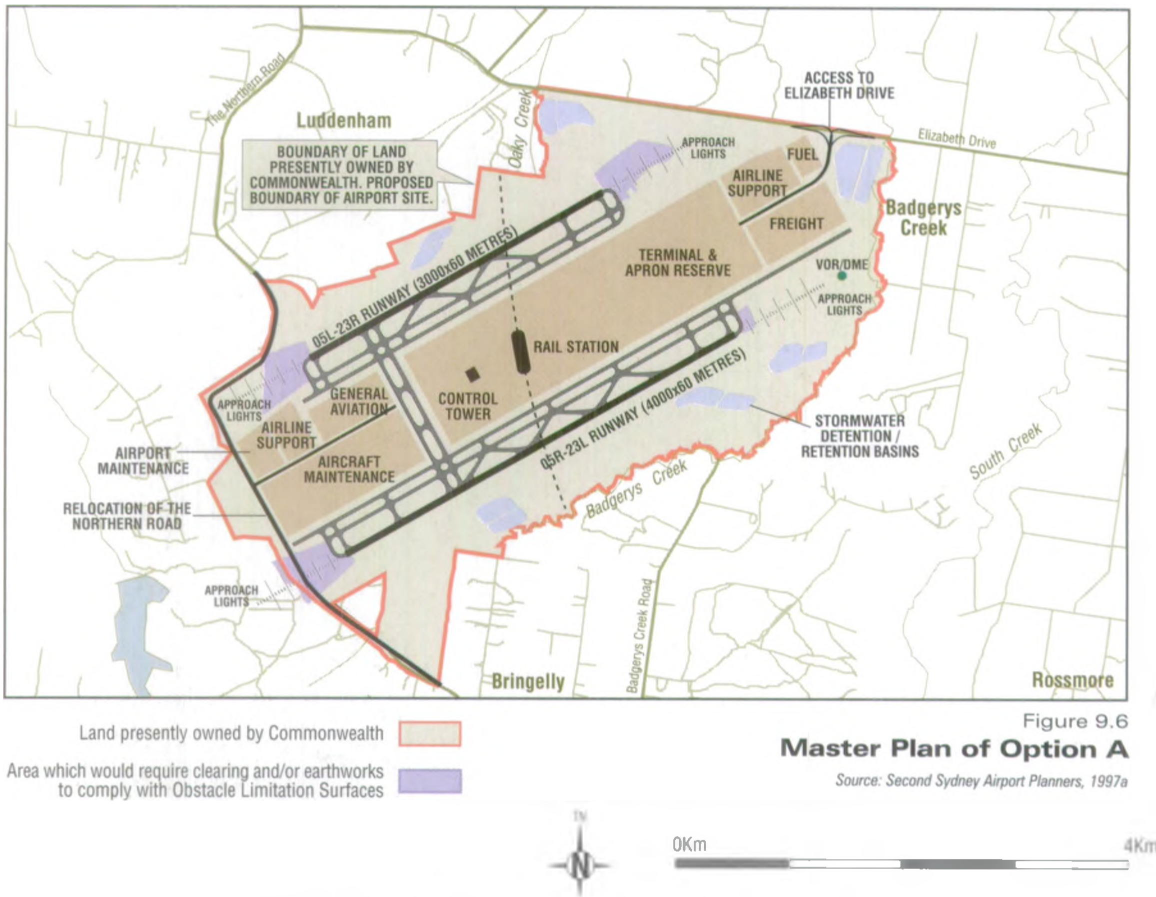


Figure 9.6
Master Plan of Option A
Source: Second Sydney Airport Planners, 1997a

9.2.2 Operation

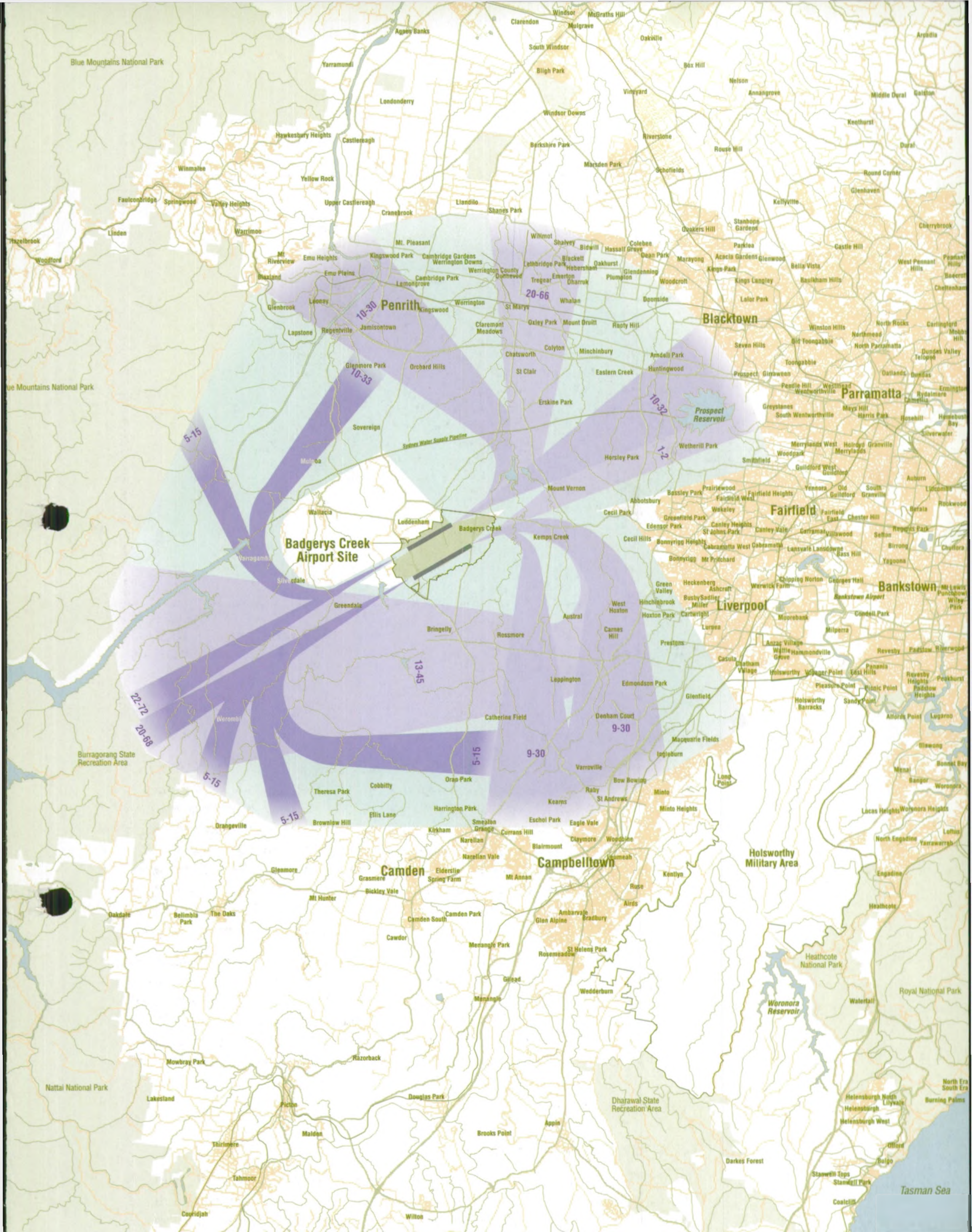
The preliminary flight paths and flight zones for Option A are shown in *Figures* 9.7 and 9.8. Each figure shows a different way the airport may operate; for example, *Figure* 9.7 shows the flight paths and zones when aircraft are landing from the south-west and taking off to the north-east. *Figure* 9.8 shows the flight paths when the airport is operating in the reverse mode, that is, with aircraft landing from the north-east and taking off to the south-west. With the runways orientated 048/228 degrees magnetic, complex airspace management procedures for arriving and departing aircraft would need to be established to ensure the safety and regularity of operations. This is because of potential interactions with aircraft operating from Sydney Airport.

The two operating scenarios adopted for the environmental assessment of Option A are explained in *Section* 8.6. The forecasts of air traffic that may operate from the Second Sydney Airport in 2006 and 2016 are described in *Section 7.3*. The estimated number of flights that would occur on each flight path on an average day in 2016 are also shown on *Figures* 9.7 and 9.8. These are provided as a range of movements representing the two operating scenarios modelled as explained in *Section* 8.6.

9.3 Option B Proposal

9.3.1 Major Elements

Option B would have the same north-east to south-west orientation for the parallel runways as Option A, but would provide two 4,000 metre parallel runways with a separation distance of 2,300 metres. Additionally, a cross wind runway 2,500 metres



Urban Areas (indicated by local roads)

Preliminary Landing Flight Paths

Preliminary Take Off Flight Paths

Flight Zones

Range of assumed aircraft movements per day (on average) for Air Traffic Forecast 3 in 2016 — 9-30

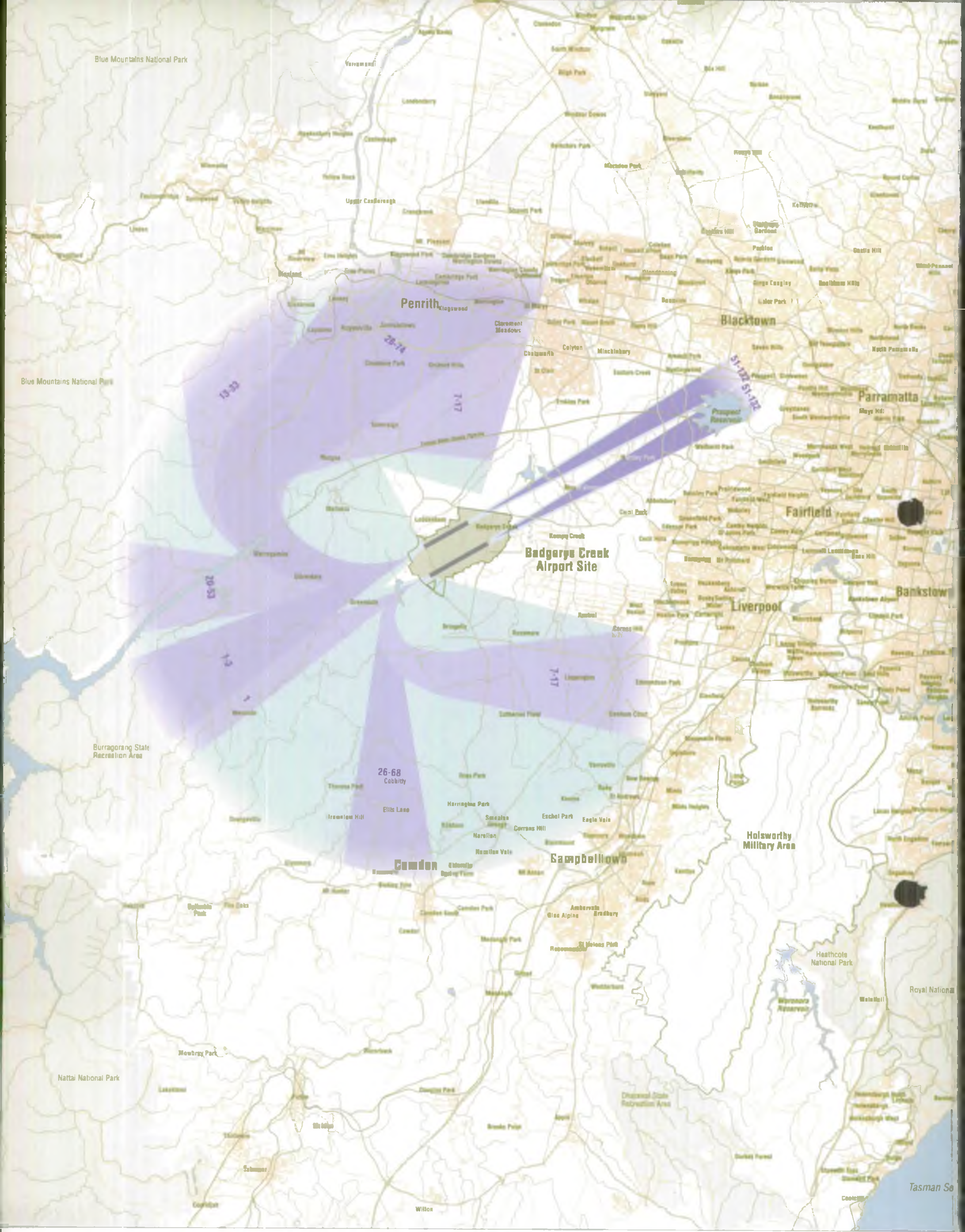
Figure 9.7

Preliminary Flight Paths for Option A: Landings From the South-West and Take Offs to the North-East

Source: Second Sydney Airport Planners, 1997a

Note: Flight Paths and Zones provided to a distance of about 19 kilometres. Aircraft would be seen and heard beyond that distance.

0Km 10Km



Urban Areas (indicated by local roads)
Preliminary Landing Flight Paths
Preliminary Take Off Flight Paths
Flight Zones
Range of assumed aircraft movements per day (on average) for Air Traffic Forecast 3 in 2016 — 26-68

Figure 9.8

Preliminary Flight Paths for Option A: Landings From the North-East and Take Offs to the South-West

Source: Second Sydney Airport Planners, 1997a

Note: Flight Paths and Zones provided to a distance of about 19 kilometres. Aircraft would be seen and heard beyond that distance.

long with a north-north-west to south-south-east orientation would be provided. *Figure* 9.9 shows Stage 1 of the development and *Figure* 9.10 shows the master plan for longer term development of the site.

The site for Option B incorporates the area described for Option A, but requires the acquisition of an additional 1,200 hectares of land to the south, south-west and south-east of the site of Option A.

Surface access would be similar to that proposed for Option A, with Elizabeth Drive forming the main vehicular access route to the passenger terminal and other public facilities. The Northern Road would be diverted further to the south and west of the airport than the route identified for Option A. The diverted road would provide access to the airport's commercial areas located to the west of the cross wind runway in a similar manner to that described for Option A, with no public access provided from this area to the terminal or other public facilities. Badgerys Creek Road would be closed at the airport boundary.

A future rail connection could be provided as described for Option A.

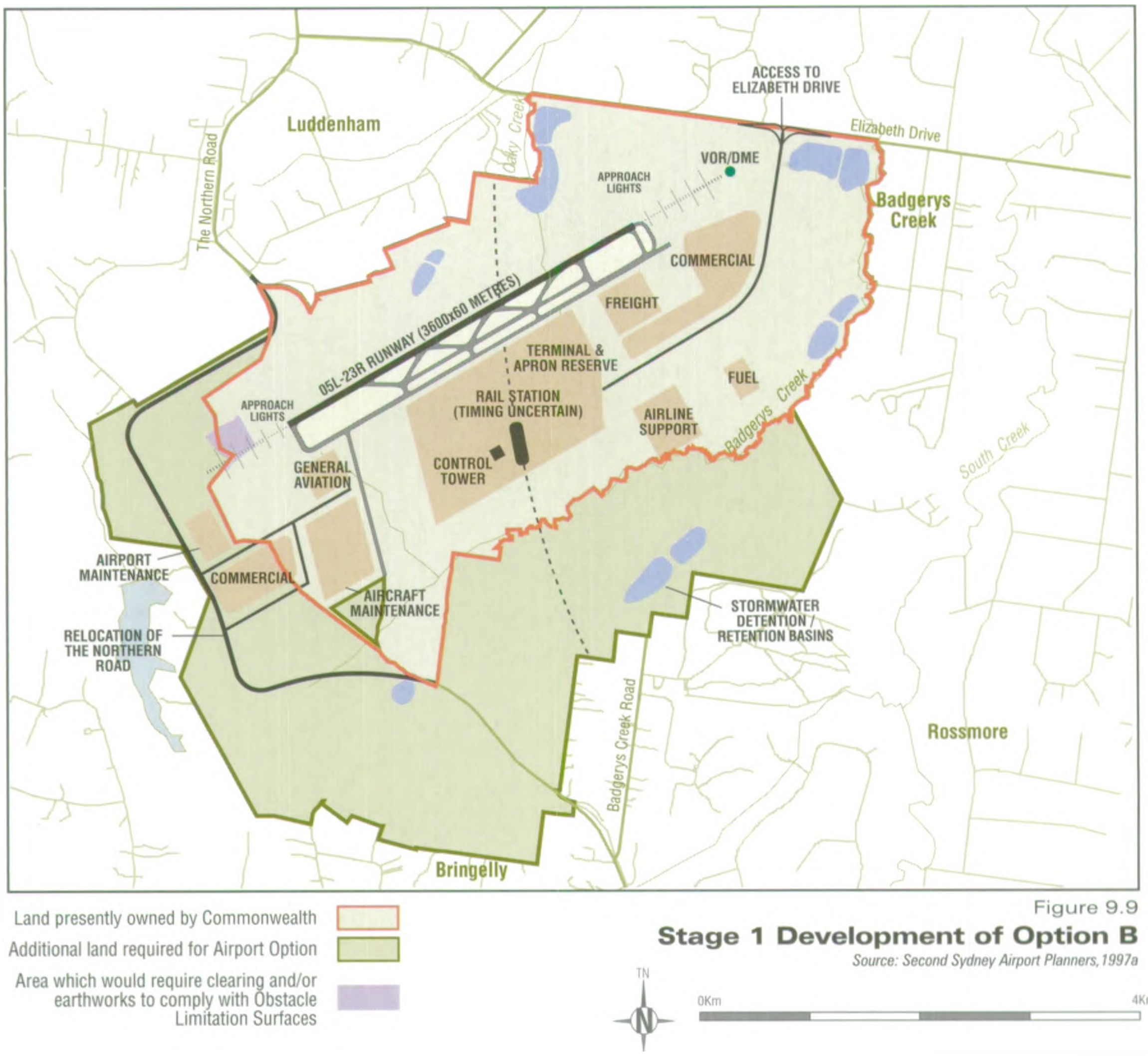


Figure 9.9
Stage 1 Development of Option B
Source: Second Sydney Airport Planners, 1997a

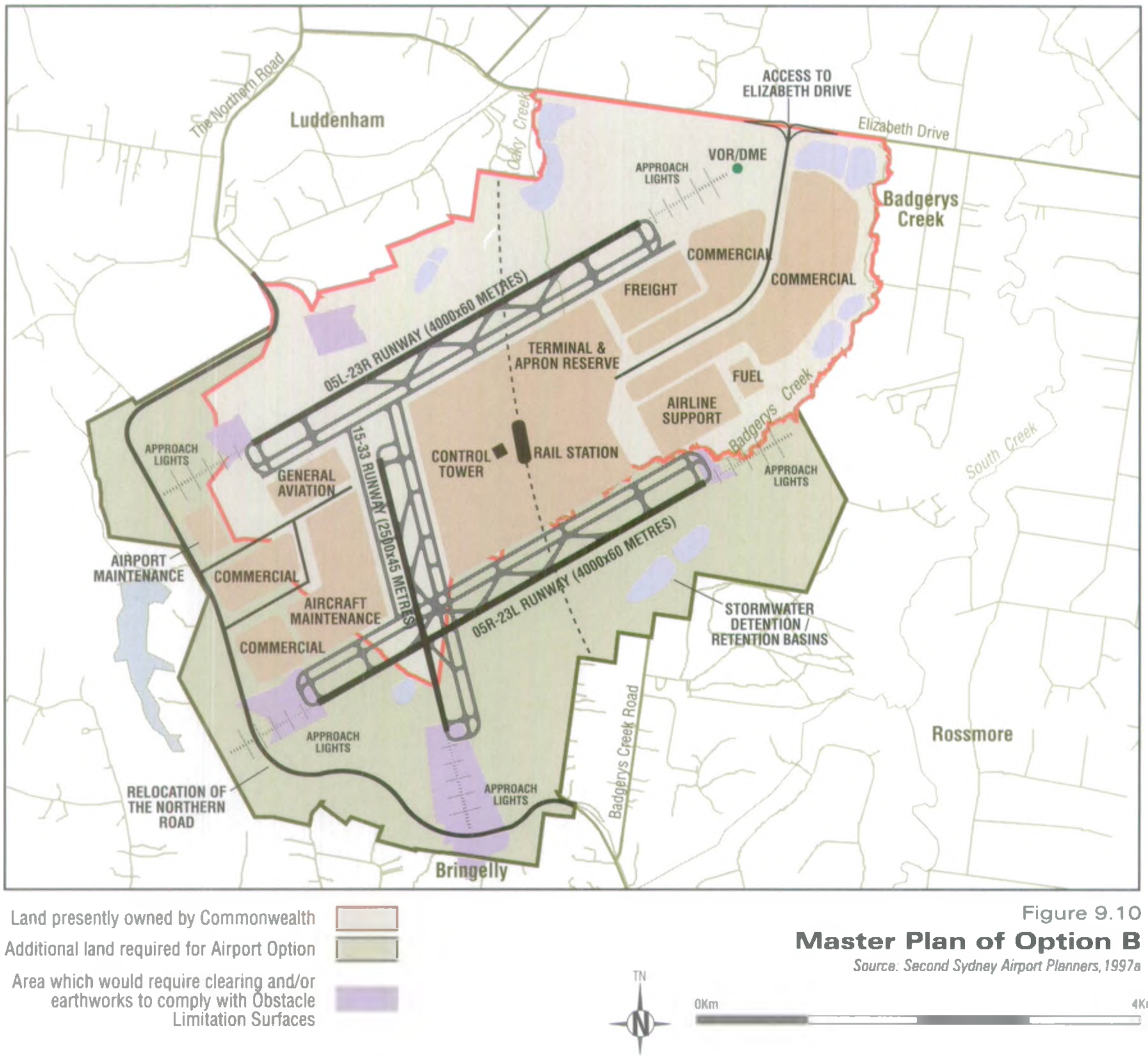


Figure 9.10
Master Plan of Option B
Source: Second Sydney Airport Planners, 1997a

9.3.2 Operation

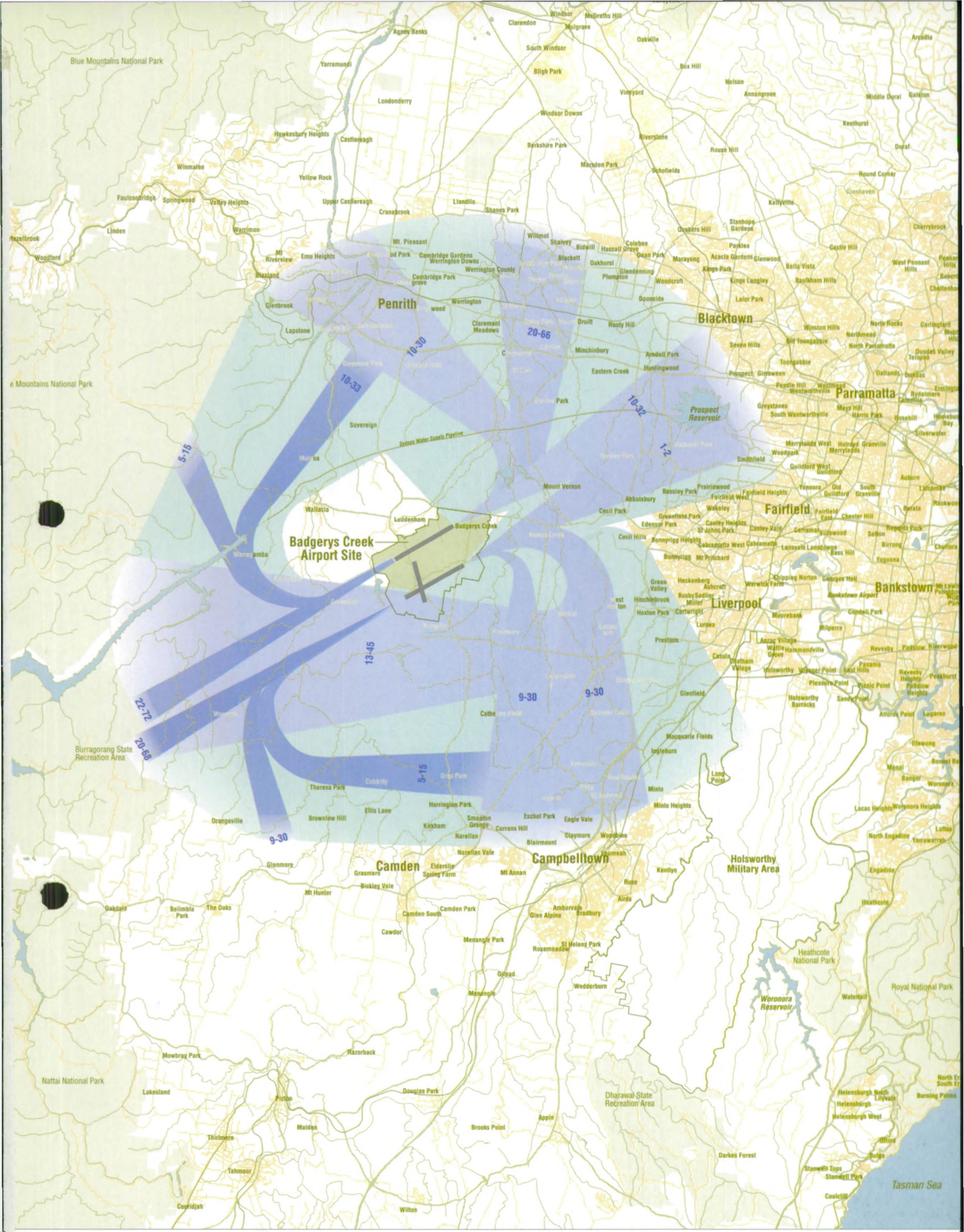
The preliminary flight paths for Option B are shown on *Figures 9.11* to *9.14*. This option is a modification of Option A and incorporates more widely spaced parallel runways, with the same orientation, and a cross wind runway. The cross wind runway would be used when wind conditions restricted the use of the parallel runways or for noise management purposes.

The three operating scenarios adopted for the environmental assessment of Option B are explained in *Section* 8.6. The forecasts of air traffic that may operate from the Second Sydney Airport in 2006 and 2016 are described in *Section 7.3*. The estimated number of flights that would occur on each flight path on an average day in 2016 are also shown on *Figures* 9.9 to *9.12*. These are provided as a range of movements representing the three operating scenarios modelled as explained in *Section* 8.6.

9.4 Option C Proposal

9.4.1 Major Elements

Option C would be similar to Option B, save that it proposes a north to south orientation for the main parallel runways. This orientation would be more similar to the orientation of the parallel runways at Sydney Airport than Options A and B. A



Urban Areas (indicated by local roads)

Preliminary Landing Flight Paths

Preliminary Take Off Flight Paths

Flight Zones

Range of assumed aircraft movements per day (on average) for Air Traffic Forecast 3 in 2016 — 9-30

Figure 9.11

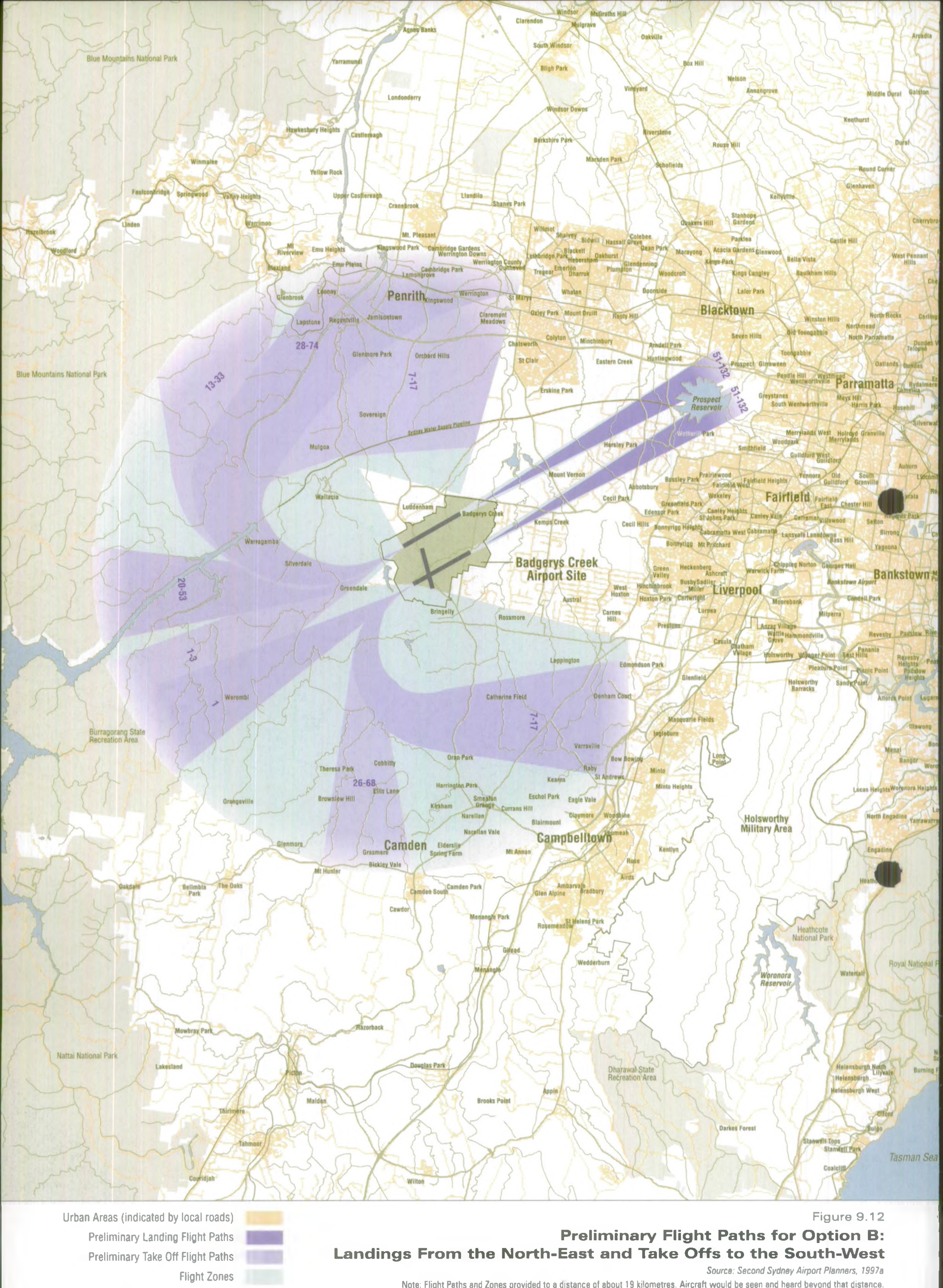
Preliminary Flight Paths for Option B: Landings From the South-West and Take Offs to the North-East

Source: Second Sydney Airport Planners, 1997a

Note: Flight Paths and Zones provided to a distance of about 19 kilometres. Aircraft would be seen and heard beyond that distance.

TN MN

0Km 10Km



Urban Areas (indicated by local roads)

Preliminary Landing Flight Paths

Preliminary Take Off Flight Paths

Flight Zones

Range of assumed aircraft movements per day (on average) for Air Traffic Forecast 3 in 2016 — 51-132

Figure 9.12

Preliminary Flight Paths for Option B: Landings From the North-East and Take Offs to the South-West

Source: Second Sydney Airport Planners, 1997a

Note: Flight Paths and Zones provided to a distance of about 19 kilometres. Aircraft would be seen and heard beyond that distance.

Urban Areas (indicated by local roads)

Preliminary Landing Flight Paths

Preliminary Take Off Flight Paths

Flight Zones

Range of assumed aircraft movements per day (on average) for Air Traffic Forecast 3 in 2016 (< 1 means less than one on average) 0-3

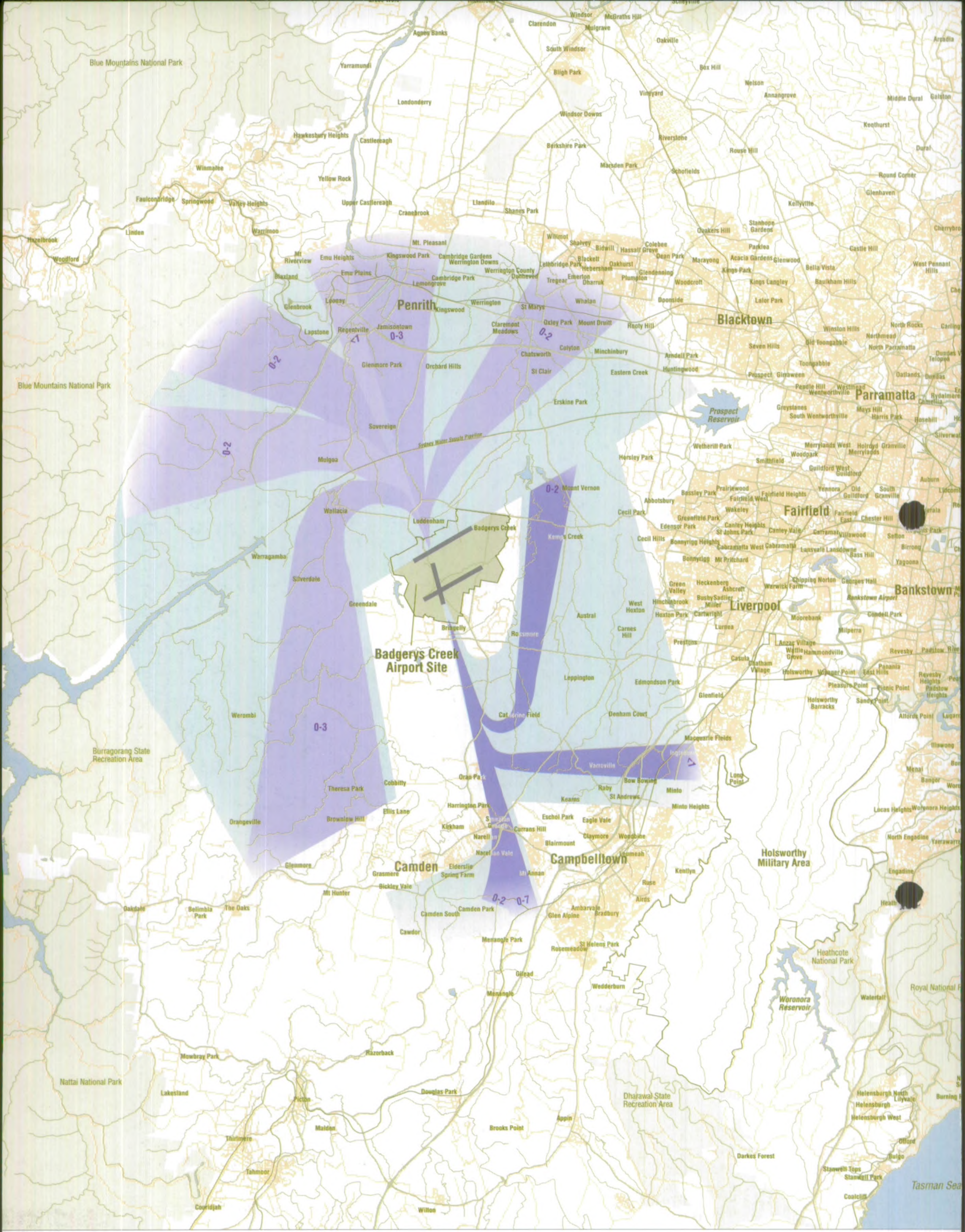
Figure 9.13

Preliminary Flight Paths for Badgerys Creek Option B: Landings From the North and Take Offs to the South

Source: Second Sydney Airport Planners, 1997a

Note: Flight Paths and Zones provided to a distance of about 19 kilometres. Aircraft would be seen and heard beyond that distance.

0km 10km



Urban Areas (indicated in local roads)
Preliminary Landing Flight Paths
Preliminary Take Off Flight Paths
Flight Zones
Range of assumed aircraft movements per day (on average) for Air Traffic Forecast 3 in 2016 (<1 means less than one on average) 0-0

Figure 9.14

Preliminary Flight Paths for Option B: Landings From the South and Take Offs to the North

Source: Second Sydney Airport Planners, 1997a

Note: Flight Paths and Zones provided to a distance of about 19 kilometres. Aircraft would be seen and heard beyond that distance.

TN MN N

0Km 10Km

2,500 metre cross wind runway with an east to west orientation would also be provided. *Figure 9.15* shows Stage 1 of development of the site and the longer term master plan is shown in *Figure 9.16*. The layout differs from Options A and B because of the different runway orientation, although facilities would be similar.

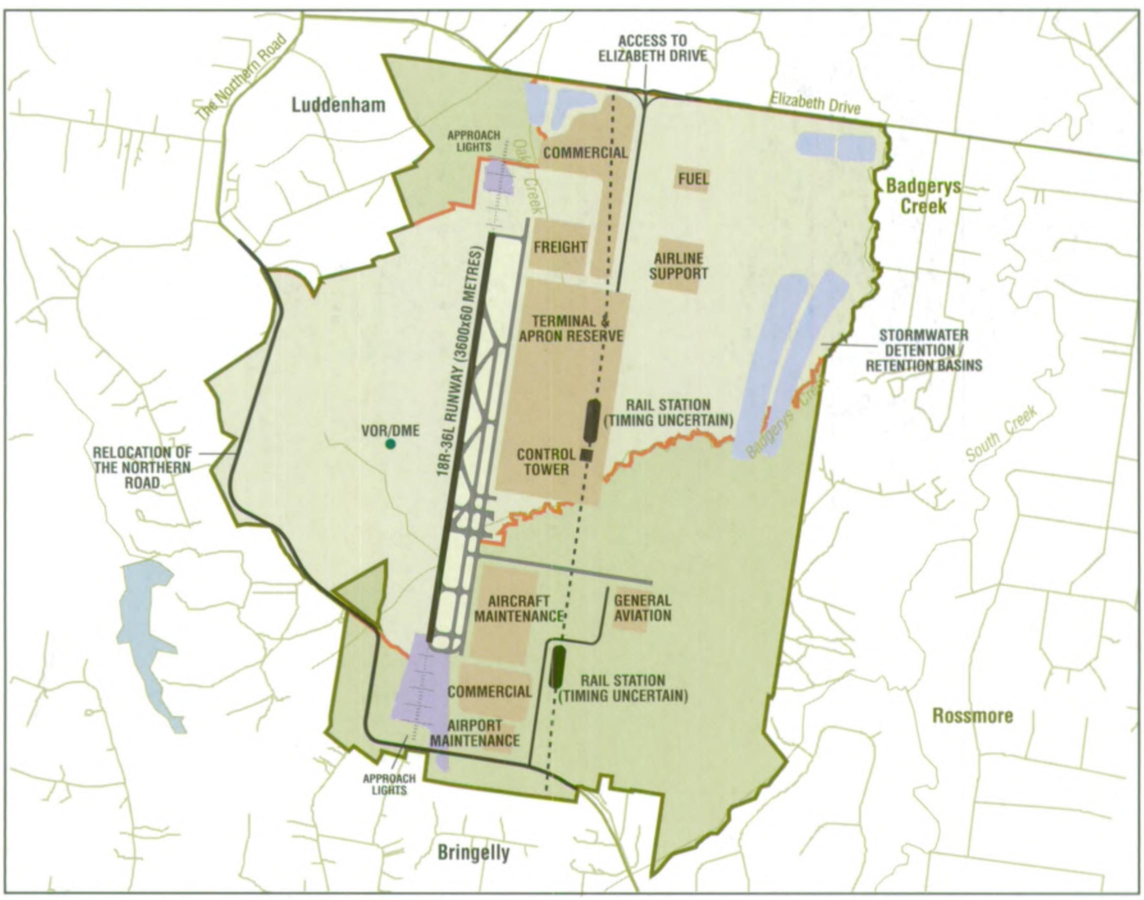
The site incorporates the area of Option A, but requires the acquisition of a further 1,150 hectares of land to the south and south-east.

Road access would be similar to that for Options A and B, with primary road access from Elizabeth Drive; once again a substantial diversion of The Northern Road would be required. Badgerys Creek Road would be closed at the airport boundary.

Rail access would be similar to that for Options A and B; however, for urban planning reasons an alternative rail corridor through Rossmore may be more appropriate. The rail alternatives are discussed further in *Chapters 10 and 22*.

9.4.2 Operation

The preliminary flight paths for Option C are shown on *Figures 9.17* to *9.20*. The cross wind runway would be used when wind conditions restricted the use of the parallel runways or for noise management purposes.



Land presently owned by Commonwealth

Additional land required for Airport Option

Area which would require clearing and/or earthworks to comply with Obstacle Limitation Surfaces

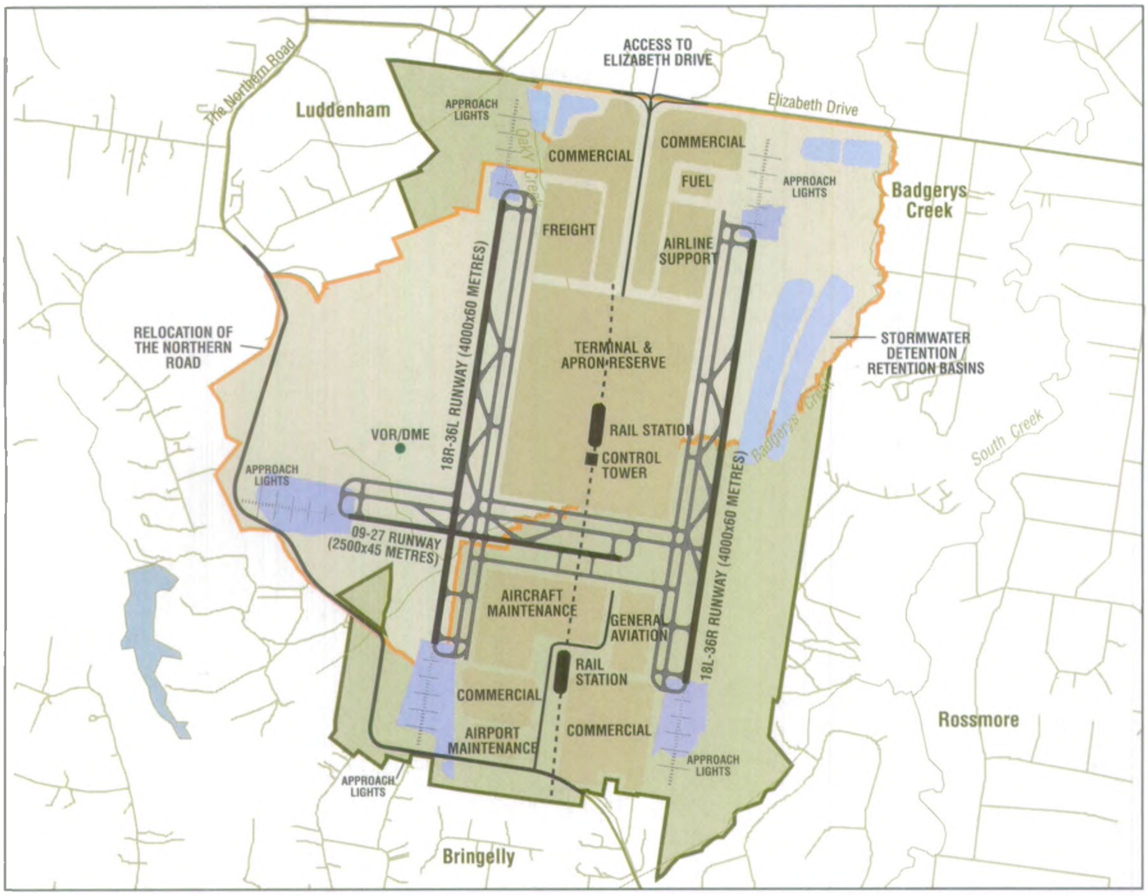
TN

0Km 4Km

Figure 9.15

Stage 1 Development of Option C

Source: Second Sydney Airport Planners, 1997a



Land presently owned by Commonwealth

Additional land required for Airport Option

Area which would require clearing and/or earthworks to comply with Obstacle Limitation Surfaces

0Km 4Km

Figure 9.16

Master Plan of Option C

Source: Second Sydney Airport Planners, 1997a

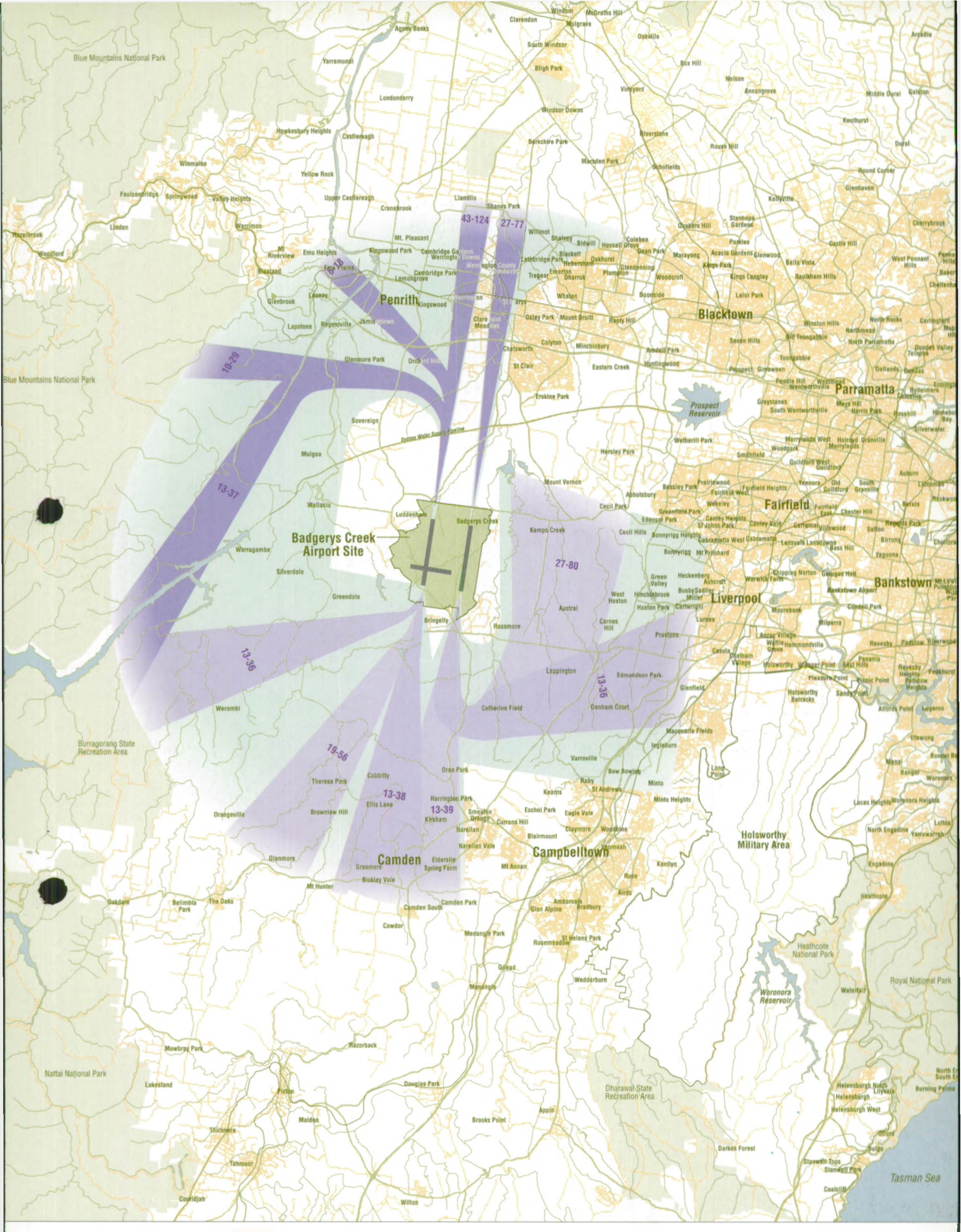
The three operating scenarios adopted for the environmental assessment of Option C are explained in *Section* 8.6. The forecasts of air traffic that may operate from the Second Sydney Airport in 2006 and 2016 are described in *Section 7.3*. The estimated number of flights that would occur on each flight path on an average day in 2016 are also shown on *Figures 9.17* to *9.20*. These are provided as a range of movements representing the three operating scenarios modelled as explained in *Section* 8.6.

9.5 Airport Construction

The construction processes, equipment usage, management and programming that would be necessary to construct the Second Sydney Airport at Badgerys Creek are outlined below (Second Sydney Airport Planners, 1997a). This description relates to construction within the area of the airport sites. It does not address infrastructure external to the sites.

Two construction scenarios are discussed, namely:

- construction of a first stage development (typically, one runway and associated facilities capable of handling about 10 million passengers a year); and
- construction of the airport to its master plan configuration (two or three runways and associated facilities capable of handling about 30 million passengers a year) in one continuous construction effort.



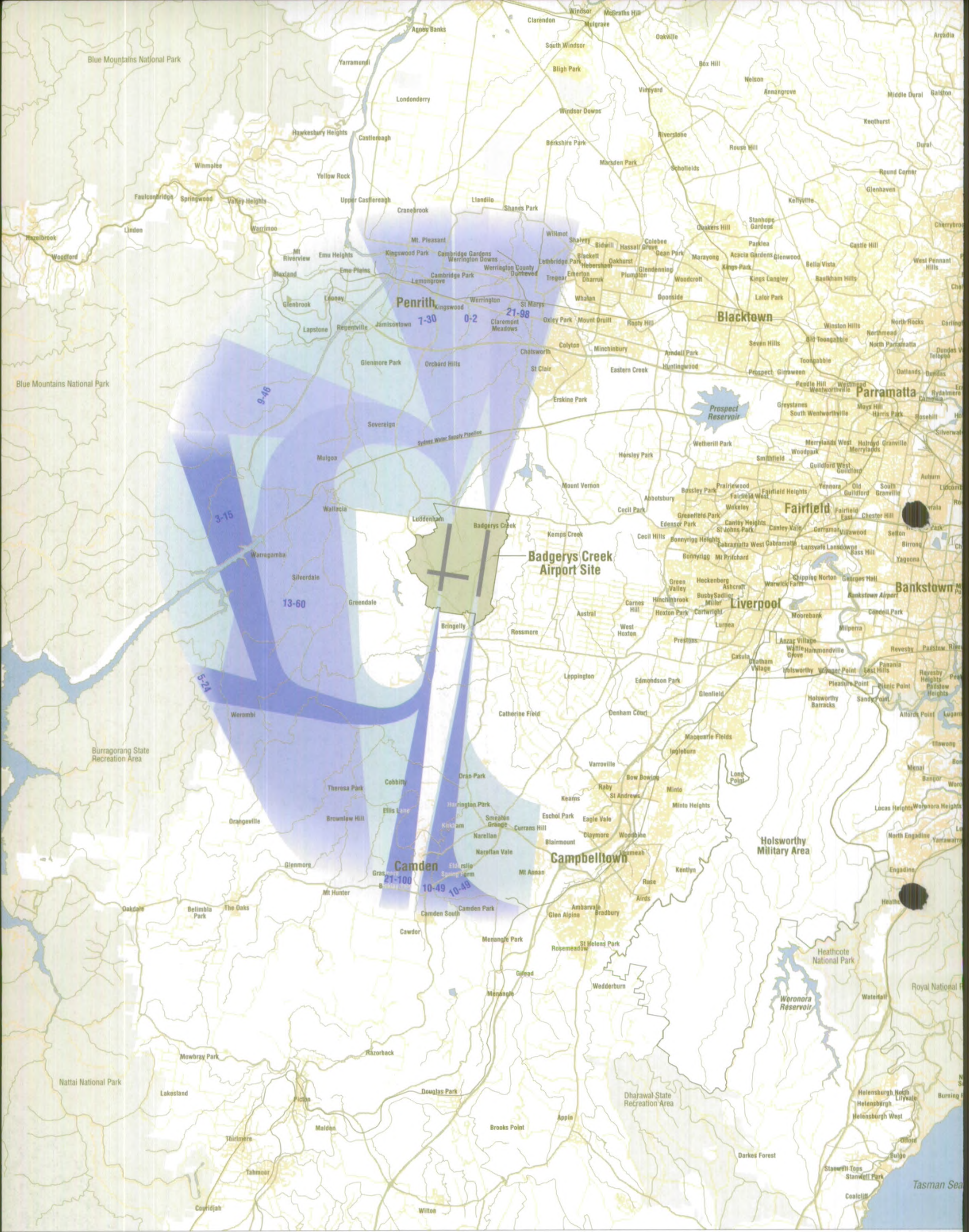
Urban Areas (indicated by local roads)
Preliminary Landing Flight Paths
Preliminary Take Off Flight Paths
Flight Zones
Range of assumed aircraft movements per day (on average) for Air Traffic Forecast 3 in 2016 — 13-36

Figure 9.17

Preliminary Flight Paths for Option C: Landings From the North and Take Offs to the South

Source: Second Sydney Airport Planners, 1997a

Note: Flight Paths and Zones provided to a distance of about 19 kilometres. Aircraft would be seen and heard beyond that distance.



Urban Areas (indicated by local roads)

Preliminary Landing Flight Paths

Preliminary Take Off Flight Paths

Flight Zones

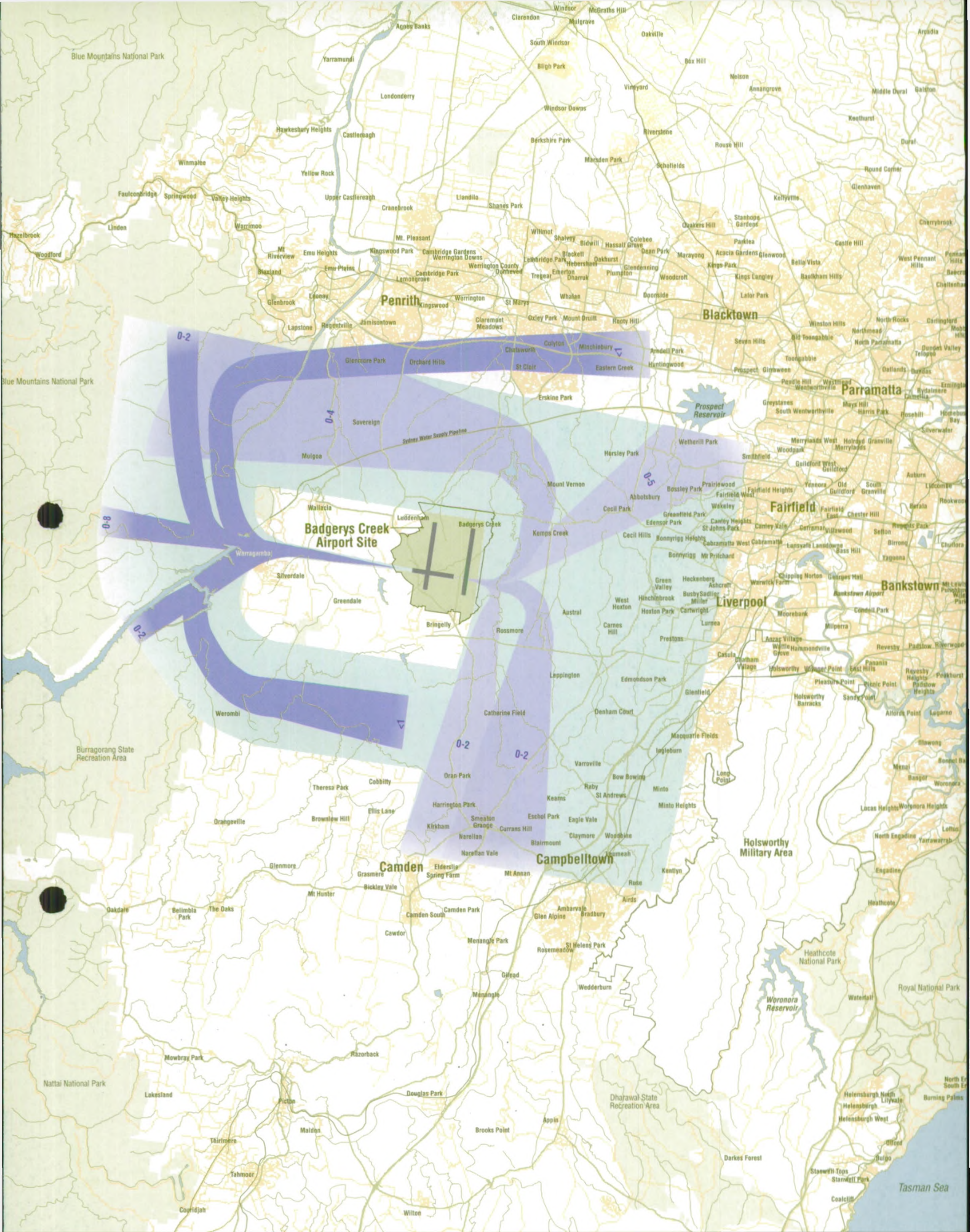
10-49 Range of assumed aircraft movements per day (on average) for Air Traffic Forecast 3 in 2016

Figure 9.18

Preliminary Flight Paths for Option C: Landings From the South and Take Offs to the North

Source: Second Sydney Airport Planners, 1997a

Note: Flight Paths and Zones provided to a distance of about 19 kilometres. Aircraft would be seen and heard beyond that distance.



Urban Areas (indicated by local roads)

Preliminary Landing Flight Paths

Preliminary Take Off Flight Paths

Flight Zones

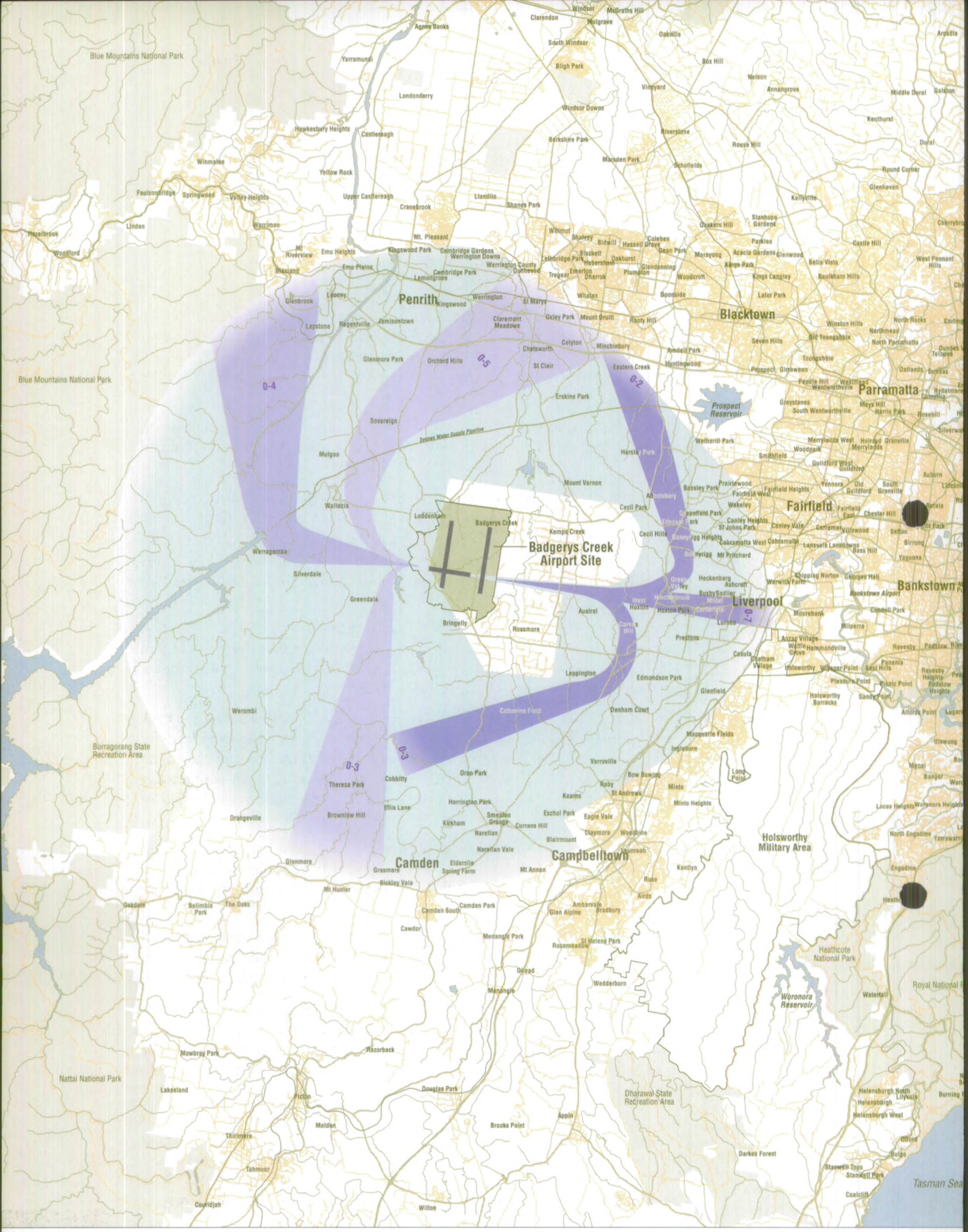
Range of assumed aircraft movements per day (on average) for Air Traffic Forecast 3 in 2016 (<1 means less than one on average) — 0-2

Figure 9.19

Preliminary Flight Paths for Option C: Landings From the West and Take Offs to the East

Source: Second Sydney Airport Planners, 1997a

Note: Flight Paths and Zones provided to a distance of about 19 kilometres. Aircraft would be seen and heard beyond that distance.



Urban Areas (indicated by local roads)

Preliminary Landing Flight Paths

Preliminary Take Off Flight Paths

Flight Zones

Range of assumed aircraft movements per day (on average) for Air Traffic Forecast 3 in 2016 — 0-3

TN MN N

0Km 10Km

Figure 9.20

Preliminary Flight Paths for Option C: Landings From the East and Take Offs to the West

Source: Second Sydney Airport Planners, 1997a

Note: Flight Paths and Zones provided to a distance of about 19 kilometres. Aircraft would be seen and heard beyond that distance.

The approach to construction would be generally consistent between airport options, apart from a few differences that are based solely on the variation in specific site characteristics.

9.5.1 Preconstruction and Site Preparation Activities

Early in the construction process, a secure contractors' compound would be established to contain facilities such as site offices, storage, vehicle and equipment parking and repairs. Appropriate services would be connected including power and telephone. Deliveries and access to the site would be made on approved access routes.

Temporary potable water supplies would be obtained from the existing mains, which source water from reservoirs at Cecil Park, and reticulated to the project office and contractors' areas.

Substantial quantities of water would be required for concrete batching operations. During the months of peak construction, one to two megalitres per day would be required for compaction of bulk earthworks. About 60 to 90 days supply of water would be collected on site in dams from runoff from the site prior to bulk filling operations. The dams would be located around the perimeter of the site and may form part of the permanent drainage system.

Site clearing and building demolition work would commence after land acquisition (if required). Initially a building inventory would be prepared, which would also identify buildings containing asbestos. The demolition would involve the complete removal of each building including footings and services.

Some materials salvaged from the demolition effort would be reused and/or recycled, while other material would be transported off site and deposited at local landfills. Existing building sites would be graded following removal of the structures to ensure drainage and to avoid ponding and erosion of top soils. Over 2,000 metres of existing pipes, 21 kilometres of roadway and four to five drainage culverts would also be removed.

Local areas of vegetation would be cleared other than areas not affected by the airport development. Merchantable timber would be sold. All other trees and bushes would be felled, chipped and stockpiled to provide woodchip and bark mulch for landscaping and revegetated areas.

Topsoil stripping would be undertaken by bulldozer or scrapers and stockpiled adjacent to the woodchips. Mulch and woodchip stockpiles would be covered or treated to prevent erosion, and topsoil stockpiles would be sown with grasses.

The site would require careful management of stormwater during construction to prevent soil erosion and sedimentation. Permanent stormwater management would be established in the very early stages of development. Earthworks would be constructed to be self draining as far as practicable to ensure all-weather accessibility for earth moving equipment.

Extensive on site creek works would be required, involving culverting or diversion into channels, temporary diversions, the use of detention basins and permanent storage. Badgerys Creek would be the most demanding in terms of water flow, followed by Oaky Creek and Cosgrove Creek. It may not be necessary to fill all the creeks for the first stage of development, depending on the particular option adopted.

Following clearing and initial drainage works, excavation and earthworks would commence and consist of:

- cut and fill to create the graded areas for runways, taxiways and aprons, airport facilities and associated infrastructure;
- trench excavation for utility services, fuel pipelines, airfield lighting and communications conduits and stormwater drainage; and
- additional cut (if required) to achieve the terrain profiles required for obstacle limitation surfaces.

Figure 9.21 illustrates typical sections proposed for runways for the airport options. *Table 9.1* provides estimated quantities and duration of the earthworks.

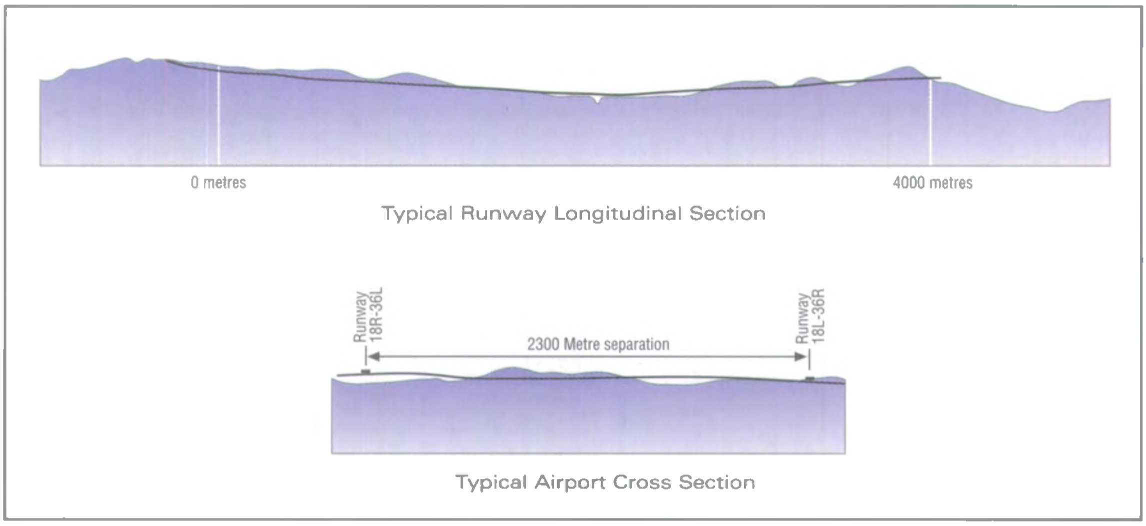


Figure 9.21

Typical Sections of Airport Site

Note: Longitudinal section has 10:1 vertical to horizontal exaggeration, cross section has 5:1 vertical to horizontal exaggeration.

Source: Second Sydney Airport Planners, 1997a

Table 9.1 Estimated Quantities and Duration of Earthworks for the Airport Options

		Option A		Option B		Option C	
		Stage 1	**Master Plan**	**Stage 1**	**Master Plan**	**Stage 1**	**Master Plan**
Volume of earthworks (million cubic metres)	*Cut*	11	24	26	36	13	27
	Fill	14	27	7	36	15	29
Time		1.5 years	2.2 years	2.2 years	2.8 years	1.5 years	2.3 years

Source: Second Sydney Airport Planners, 1997a.

Bulk earthworks would be designed where possible to achieve a balanced cut to fill, as most site material would be suitable for fill in non-structural areas. Finished slopes would not exceed one in four, so that rubber tyred earth moving equipment could be used. Bulldozers and motor scrapers, with spreading and compaction by bulldozers, graders and tamping foot compacters would be used. Vibrating smooth drum rollers and motor graders would be used for final surface compaction and grading. Loaders and haulers would shift material as required. The need for drilling and blasting would be minimal.

9.5.2 Main Construction Activities

Construction activities would be undertaken in accordance with appropriate standards such as those specified by the *Building Code of Australia* (White et al, 1996), the NSW Roads and Traffic Authority, Sydney Water and WorkCover Authority of NSW.

The main construction activities would comprise major drainage works, laying pavements, and construction of the terminals and other facilities.

Drainage

Creeks would be disrupted during construction from the start of site preparation through to the completion of airport infrastructure; initially creeks may be temporarily diverted.

Stormwater drainage flow generated on the airport site would be mainly from passenger terminals and the airfield into detention ponds, which would be designed to accommodate up to two hours' drainage flows before releasing water into the creeks. Additional means of separating contaminants from local water would be installed in drainage infrastructure around the passenger terminals, support facilities and airfield structures. The permanent drainage lines and structures would be constructed progressively following the completion of bulk earthworks and would take approximately two years to complete.

Aircraft Pavements

For each of the airport options a combination of pavement types would be used, taking into account functional requirements as well as future maintenance and economics. The aprons, except the general aviation apron, and most of the taxiways would be constructed as concrete pavements. The runways, some taxiways and the general aviation apron would consist of flexible pavements surfaced with asphalt. The areas of different pavement types that would be required for the three options are shown in *Table 9.2*.

Both the pavement types, concrete and flexible pavement, would be constructed on densely compacted earthworks. The top surface of the earthworks, called the sub-grade would be specially prepared by proof rolling and trimmed close to level and smoothness tolerances.

Concrete pavements would require construction of a crushed rock base course. Stockpiles of high quality, durable aggregates, crushed rock and sand would be established on site together with a concrete batching plant, cement silos and a pugmill, which would be supplied by rubber tyred front end loaders.

Predetermined patterns of contraction, construction and expansion joints would be cut using large concrete cutting saws; curing would then be completed over an extended period, and the forms removed, cleaned and reused.

Table 9.2 Areas of Pavement Types for the Airport Options (square metres x 1,000)

	Option A		Option B		Option C	
	Stage 1	Master Plan	Stage 1	Master Plan	Stage 1	Master Plan
High Strength Flexible	232	459	225	690	248	693
High Strength Concrete 475 mm thick	433	1,056	461	1,372	479	1,362
High Strength Concrete 450 mm thick	583	1,242	662	1,621	662	1,621
High Strength Concrete 400 mm thick	0	246	143	395	143	395
General Aviation and Shoulder	402	851	371	1,050	390	988

Source: Second Sydney Airport Planners, 1997a.

The flexible pavements would be made up of a number of layers of high quality durable crushed rock. Stockpiles of material would be established on site together with a pugmill.

Similarly, stockpiles of materials used in the manufacture of asphalt would be established on site together with the asphalt batch plant and supporting equipment.

Passenger Terminal

The passenger terminal building would be a large structure, designed and equipped with a variety of complex systems. It would be constructed in the following stages:

- foundations and floor slabs, structural framing and intermediate floors;
- roofing;
- exterior wall systems;
- vertical circulation and interior fit out;
- automated systems and security systems; and
- commissioning.

Following completion of the main structure, the building would be fitted out; this would include installation of baggage and communication systems, closed circuit television, vertical transport, and electrical, mechanical and hydraulic services. The airport owner, the airlines and other operators and tenants such as customs/ immigration and retail outlets, would be responsible for fitting out their own areas.

Surface Access and Parking

Temporary roads would be established early during the construction process to serve construction traffic; in some cases these would be built on the alignment of permanent roads. Main roads would generally be constructed of flexible pavements, but in some areas concrete pavements may be more appropriate. The design and type of construction of airport roads would depend on the volume and loads they are expected to carry.

During construction, sections of The Northern Road and Badgerys Creek Road would be diverted or closed, temporarily or permanently. Adams Road would be improved.

A ground level carpark would be constructed using flexible pavements. Should it need enlarging to a multi-level structure, it would probably be constructed with concrete floor slabs and ramps. Techniques and equipment would be similar to that used for pavement and/or terminal buildings.

The anticipated rail link would be built when demand warrants. Provision has been made in the airport master plans for a rail link; however, the final route, number and location of stations and whether the line would be at ground level or underground cannot be determined at this stage. Should an underground rail link be provided, and depending on the option chosen, a tunnel for the rail line under the airport site would be up to three kilometres long. This and an airport station could take up to three years to complete. A double track would be provided and platforms would be 170 metres long. A ground level rail link would be considerably cheaper and could be constructed in a shorter time.

Other Airport Facilities and Services

Aircraft maintenance facilities would be constructed by airlines or third party maintenance operators. A graded site with engineering services and road access would be provided, and buildings constructed as required.

Permanent services such as water supply, electrical reticulation, sewerage and waste water recycling would be constructed as soon as service corridors were cleared. Trenching for services might require ripping, but to a large extent excavation would be undertaken with hydraulic equipment without the need for blasting. Usually the job is completed progressively, with sections/zones becoming operational prior to completion of the entire service.

Airservices Australia would be providing facilities for rescue and fire fighting services, air traffic control and navigation aids. These facilities would be coordinated with the construction program and installed progressively through the construction process. While these buildings are relatively simple to construct, some time is required for equipment installation and testing.

Site Restoration and Landscaping

Upon completion of each of the various stages of the construction program the surrounding areas would be prepared to final condition and landscaped. Sufficient topsoil would be available at Badgerys Creek to spread on the disturbed areas which would be protected with fencing or road barriers. Recycled effluent would be used to maintain the landscaping.

9.5.3 Materials

Pavement materials for runways, taxiways and aprons would generally be imported from outside the site. Substantial volumes of high quality granular materials would be required for base and sub-base layers, and large volumes of asphaltic and concrete materials for surfacing.

Pavement sub-base is likely to be crushed sandstone from quarries at Glenfield or Camden, or else recycled concrete demolition materials. Alternative sources may include processed blast furnace slag from Port Kembla, material from smaller sandstone quarries, or excavated sandstone from basements and foundations of large Sydney building projects.

Higher quality base course materials would be available in sufficient quantities from various quarries in the Kiama and Shellharbour areas. Materials from the same sources would also be used in the manufacture of concrete and asphalt surfacing products. These would be transported to the site using tip truck and trailer combinations or semi-tippers.

Concrete would be a major construction material for both structures and pavements. For Stage 1 development, the anticipated volume of concrete for building construction would be in the order of 100,000 cubic metres, while 600,000 cubic metres would be required for pavement construction. For construction of the master plan, 250,000 cubic metres and 1,400,000 cubic metres of concrete would be required respectively.

Batching and mixing would be undertaken within the airport site. At least two batching plants would be required, supplying large quantities of concrete of varying specifications. Soil aggregate cement mixes would be manufactured on site using a pugmill or laid using *in situ* stabilising equipment.

There are no known deposits of suitable concrete aggregates available at the site. Aggregates for quality concrete would probably be sourced from the South Coast area while local aggregate from quarries at Prospect may be used for lower strength grades. Aggregates from recycled crushed concrete from demolition work in Sydney could be used as an alternative source for other than the strongest quality mixes. Concrete aggregates would be delivered by truck and trailer combinations or semi-tippers carrying up to 40 tonnes.

Pulverised fly-ash would be sourced from power stations, generally to the north of Sydney, and slag aggregates would be delivered from Port Kembla. Bulk cement and fly-ash would be delivered to the site plants in 30 tonne bulk tankers.

Suitable concrete sand may be available from the Nepean area in the short term, but the main source would be the Penrith Lakes area. Cartage from these sources would likely be by road transport using truck and trailer combinations carrying up to 40 tonnes a load.

The principal use of cement would be in the manufacture of structural concrete. After delivery by bulk carrier, the cement would be transferred pneumatically into vertical steel storage silos at the batching or mixing site. A limited amount of bagged cement would also be required. Sources for cement would probably be Picton, Portland or Marulan, outside the Sydney region.

Reinforced concrete pipes and box culverts would probably be used for major drainage works. Precast concrete pipes and other materials such as galvanised steel or fibre reinforced cement would be manufactured off site at existing plants in Sydney or elsewhere.

In all, some three million tonnes of material would be transported to the airport site during the construction of the Stage 1 airport. Up to eight million tonnes would be needed for the construction of the master plan airport. *Table 9.3* shows estimates of materials required to be transported to the site and total volumes of truck movements.

Where possible, the existing Badgerys Creek Road and The Northern Road alignments would be used to distribute materials to specific parts of the site during

Table 9.3 Transport of Materials to the Airport Sites (approximate only)

	Option A		Option B		Option C	
	Volume (Tonnes)	Truck Loads[1]	Volume (Tonnes)	Truck Loads[1]	Volume (Tonnes)	Truck Loads[1]
Stage 1						
Base Course	840,000	24,000	850,000	24,000	860,000	24,000
Cement	230,000	8,000	240,000	8,200	240,000	8,200
Select Material	950,000	27,000	980,000	28,000	980,000	28,000
Aggregates	880,000	25,000	900,000	26,000	900,000	26,000
Master Plan						
Base Course	1,400,000	40,000	2,200,000	62,000	2,200,000	62,000
Cement	400,000	11,500	610,000	17,500	610,000	17,500
Select Material	1,700,000	48,000	2,600,000	75,000	2,600,000	75,000
Aggregates	1,600,000	45,000	2,400,000	68,000	2,400,000	68,000

Source: Second Sydney Airport Planners, 1997a.
Note: 1. Assumes 38 tonne loads which is considered a likely average load. Assumptions about truck movements used for traffic assessment (refer Chapter 25) adopted a worst case situation of relatively small trucks being used (18 tonne loads).

early parts of construction. Bringelly Road would provide access for transport from the south, and might be upgraded before major construction commenced. Elizabeth Drive and The Northern Road (realigned) would be used after some roads are closed and removed as part of the construction program.

Oversize and overweight load permits would be required. Also, the proximity of residential areas would require that deliveries to the sites should be between 6.00 am and 10.00 pm. Therefore most deliveries of construction materials would be made in the late afternoon or early evening to ensure materials were available at the site.

Table 9.4 indicates the estimated quantity of fuel that would be consumed, based on the quantity of work to be undertaken in Stage 1 and in the master plan development. This volume would require about 1,350 and 3,000 tanker loads over the construction period of Stage 1 and master plan respectively, mostly during the bulk earthworks operations. At any one time, no more than two to three days supply, or 200,000 litres, would be stored on site.

9.5.4 Management

Normal construction activity at the site would be undertaken between the hours of 7.00 am and 5.00 pm, Monday to Saturday. Sunday work might be required on occasions to maintain the construction schedule. Work periods might be extended during the summer months.

The major concrete and asphaltic paving operations for the runways, taxiways and aprons would very likely be carried out 24 hours per day, as they require intensive use of specialist construction equipment.

Table 9.4 Estimates of Fuel Consumption for Construction of the Airport Options

Component	Fuel Consumption (litres)	
	Stage 1	Master Plan
Earthworks	20 million	50 million
Pavements	10 million	30 million
Building Works	5 million	5 million
Sundry Works	5 million	5 million
Total	**40 million**	**90 million**

Source: Second Sydney Airport Planners, 1997a

Fuelling of construction plant, servicing and parking, would be confined to designated hard stand areas surrounded by earth bunds and impervious ground treatment. Strict safety procedures would be instituted and appropriate medical equipment, personnel, ambulance service and treatment procedures would be available.

Fixed plant installations would be separately bunded and regularly inspected to identify and clean up any minor spillages. These areas would be drained to a suitable concrete flame/trap separator where hydrocarbons would be separated prior to discharge to the stormwater system. Traps would be cleaned regularly and any hydrocarbons collected by a sludge tanker.

Liquid and solid waste would be generated during construction, including waste building materials and packaging, discarded parts and lubricants from plant servicing and waste water from site amenities. The following disposal practices would be adopted:

- solid and putrescible material would be collected from the site and transported to a waste transfer station or landfill;
- recyclable materials would be sorted and removed from the waste;
- packaging material and dry waste would be transported to a landfill tip;
- trade waste not appropriate for a landfill site would be transported to the nearest NSW Environment Protection Authority designated disposal site; and
- a temporary on-site portable sewage treatment plant would be used for primary and secondary treatment of sewage generated by the large workforce on the site. Prior to establishment of the plant a regular raw-sewage tanker collection service would be used.

It would be essential to enforce dust control by:

- regular water spraying of large areas of the site;
- priming or sealing of the more heavily used construction roads;
- early establishment of permanent roads for construction traffic; and
- seeding bare areas as soon as practicable after excavation activities.

9.5.5 Estimated Construction Costs, Workforce and Construction Programs

Construction Costs

Tables 9.5 and 9.6 provide indicative cost estimates for each of the Stage 1 and master plan developments. The estimates include works within the airport boundary that would be the responsibility of the airport owner/developer, including all airport terminal buildings. The estimates do not include the cost of the commercial/support facilities to be developed by the airlines and other airport tenants, such as retail and dedicated airline facilities within the terminal buildings, freight facilities, ground handling and catering, and such developments as hire car services and airport hotels. All estimates are in current (1997) prices. Estimates for major items of external infrastructure are provided in *Chapter 24*.

Table 9.5 Indicative Cost Estimates for Stage 1 Development of Airport Options[1]

Item	Cost Estimates		
	Option A	Option B	Option C
Land Acquisition	$0	$255 million	$240 million
Airport Development			
Project Development	$175 million	$180 million	$175 million
Site Preparation	$45 million	$50 million	$55 million
Construction Facilities and Preliminaries	$15 million	$15 million	$15 million
Site Development	$260 million	$395 million	$315 million
Site Services	$110 million	$110 million	$110 million
Aircraft Pavements	$255 million	$275 million	$285 million
Airfield Lighting	$20 million	$25 million	$25 million
Buildings, Structures, Roads	$620 million	$635 million	$630 million
Contingency	$150 million	$180 million	$170 million
Total Airport Development Costs	**$1,650 million**	**$1,865 million**	**$1,780 million**
Airservices Australia Facilities	$40 million	$40 million	$40 million

Source: Second Sydney Airport Planners, 1997a.
Note: 1. Cost estimates prepared utilising a bottom up methodology and achieve an accuracy in the order of 10 percent below the final (actual) cost to 20 percent above the final (actual) cost total.

Workforce

The approximate annual workforce required for the construction of the Stage 1 and master plan developments of the airport options is shown in *Table 9.7*.

Estimated Construction Programs

A typical airport development constructed on a greenfield site would involve a wide range of connected activities implemented in a logical sequence to meet the programmed opening of the airport. Construction programs were prepared for the

Table 9.6 Indicative Cost Estimates for Master Plan Development of Airport Options[1]

Item	Cost Estimates		
	Option A	Option B	Option C
Land Acquisition	$0	$255 million	$240 million
Airport Development			
Project Development	$295 million	$310 million	$320 million
Site Preparation	$55 million	$55 million	$55 million
Construction Facilities and Preliminaries	$20 million	$20 million	$20 million
Site Development	$520 million	$685 million	$595 million
Site Services	$150 million	$150 million	$150 million
Aircraft Pavements	$560 million	$750 million	$745 million
Airfield Lighting	$45 million	$60 million	$60 million
Buildings, Structures, Roads	$1,660 million	$1,600 million	$1,595 million
Contingency	$340 million	$410 million	$390 million
Total Airport Development Costs	**$3,645 million**	**$4,040 million**	**$3,930 million**
Airservices Australia Facilities	$50 million	$50 million	$50 million

Source: Second Sydney Airport Planners, 1997a.
Note: 1. Cost estimates prepared utilising a bottom up methodology and achieve an accuracy in the order of 10 percent below the final (actual) cost to 20 percent above the final (actual) cost total.

Stage 1 and master plan development of the airport options. Major activities were identified, many of them common to all options. Indicative bar chart programs that illustrate time durations for the main activities for the construction of the options, assuming commencement is at the start of a financial year, are shown on *Figures 9.22* and 9.23. Estimated total development times from the commencement of design to opening of Stage 1 and of the master plan for each airport option are shown in *Table* 9.8.

Indicative programs to provide the external infrastructure items for the airport for both the Stage 1 and master plan level of airport development have also been investigated. It is estimated that this infrastructure would take five years to complete.

9.6 Ultimate Airport Development

9.6.1 Purpose of Developing Conceptual Plans

The Commonwealth Government is proposing construction and operation of a major airport capable of handling up to 30 million passengers a year. The environmental assessment process has involved the further development of this proposal.

The Department of Transport and Regional Development (1997a) estimates that by 2025 over 63 million passengers may fly into and out of Sydney annually. Current planning assumes that Sydney Airport will ultimately handle about 30 million

Table 9.7 Estimated Workforce for the Construction of Airport Options[1]

Year	Stage 1			Master Plan		
	Option A	Option B	Option C	Option A	Option B	Option C
1	220	220	220	310	310	330
2	570	620	610	650	650	670
3	1,300	1,360	1,340	1,960	1,960	1,950
4	**1,330[1]**	**1,400[1]**	**1,370[1]**	**2,150[1]**	**2,200[1]**	**2,200[1]**
5	940	980	980	1,960	1,960	2,000
6	40	40	40	1,730	1,730	1,750
7					50	50

Source: Second Sydney Airport Planners, 1997a.
Note: 1. Highlighted figures indicate peak workforce.

Figure 9.22
Construction Program for Stage 1 Development of Airport Options
Source: Second Sydney Airport Planners, 1997a

Figure 9.23
Construction Program for Master Plan Development of Airport Options
Source: Second Sydney Airport Planners, 1997a

Table 9.8 Development Periods for the Airport Options

	Option A	Option B	Option C
Stage 1 Development Period	4.5 years	5.0 years	4.5 years
Master Plan Development Period	6.0 years	6.5 years	6.0 years

Source: Second Sydney Airport Planners, 1997a.

passengers a year. Consequently, it is apparent that if the Second Sydney Airport proceeds the need may be felt to expand it, possibly in about 30 years time.

Planning needs to provide for possible expansion of facilities at some time well into the future. Conceptual planning provides the broad framework for considering potential impacts, even though concepts for ultimate development cannot be relied upon with any certainty.

It is not feasible for an EIS to examine potential impacts of a major airport within Sydney over a timeframe of more than 20 years into the future. Predictions about how the airport would operate and the extent of impacts would not be accurate. Nevertheless, this section provides some details about how the airport options might be expanded in the future. The potential environmental implications of such expansion are discussed in *Chapter 27*. The expansion could not proceed, however, unless a further detailed environmental assessment and decision making process were undertaken by the Government of the day.

Various master plan configurations used overseas were examined to develop the conceptual plans. It was evident that the most economical way to handle future traffic increase would be to add one or more parallel runways outside the initial wide spaced parallel runways. Conceptual plans developed for this type of expansion would allow for a double wide-space parallel runway system that could substantially increase aircraft handling capacity. Further, this growth might well be accompanied by increased seating capacity in the average aircraft of that time.

A generic airport layout was developed to illustrate the typical land area required for a double wide-spaced parallel runway configuration and requisite airport facilities. This indicated that a rectangular area, approximately six kilometres by five kilometres, would be required. The potential for increased capacity beyond the master plan airport design is possible with only small additional land requirements.

9.6.2 Conceptual Plans for Airport Options

A conceptual plan was not prepared for Option A as the intention is to confine this option within the previously defined site boundaries. Conceptual plans were developed for the remaining two airport options. The sizes and locations of these plans are only indicative, as the actual plans would be dependent on actual air traffic growth. In general terms the conceptual plans would require:

- an expanded site area beyond the master plan boundaries;
- two additional parallel runways;
- additional airport facilities and terminal areas; and
- provision for increased infrastructure services on site and increased access capacity.

Figures 9.24 and *9.25* illustrate the conceptual plans for Options B and C.

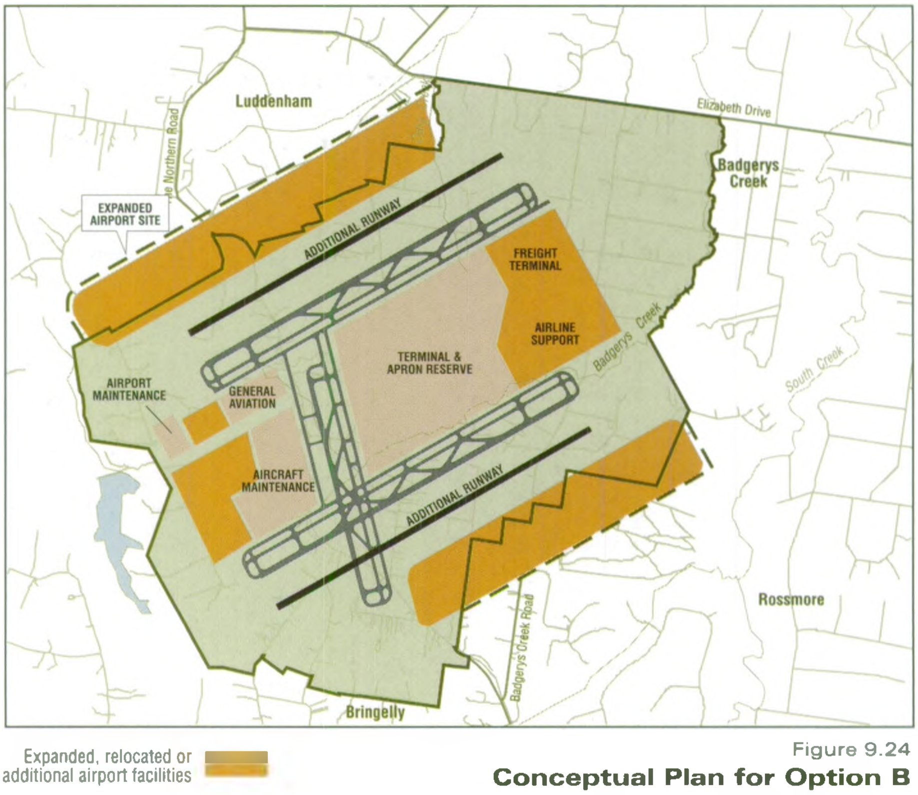


Figure 9.24
Conceptual Plan for Option B
Source : Second Sydney Airport Planners, 1997a

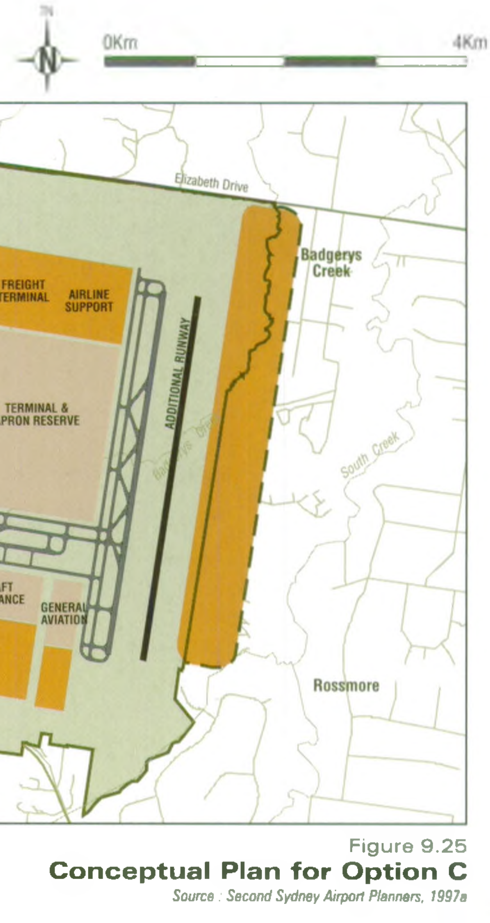


Figure 9.25
Conceptual Plan for Option C
Source : Second Sydney Airport Planners, 1997a

9.6.3 Potential Operating Scenarios for Conceptual Plans

The development of airspace management arrangements for a double wide-spaced parallel runway system, as envisaged in the conceptual plans, would be influenced by factors similar to those affecting the development of arrangements for the operation of the master plan options. However, factors such as future aircraft types and technological developments in airspace and air traffic management can be expected to change substantially, given the long term timeframe associated with the conceptual plans. At this time only hypothetical operating scenarios can be considered for the conceptual plans.

One operating scenario might involve the use of the two inner parallel runways for aircraft departures with the outer two parallel runways being used for arrivals, assuming a uniform direction of traffic flow. This scenario would take advantage of independent operations made possible by the wide runway spacing. Aircraft movement capacity would be enhanced by enabling dedicated use of runways for either landings or take offs.

Another operating scenario could involve all aircraft take offs on one pair of closely spaced parallel runways and all landings on the other pair of runways. While this would be feasible, it might not achieve a suitable increase in overall aircraft movement capacity, due to the need to maintain appropriate separations between aircraft using a pair of closely spaced runways. This scenario would create some traffic management issues because of wake turbulence, but could be used for noise mitigation purposes.

Part D

Planning and Land Use Impacts

Chapter 10

Planning and Land Use

Chapter 10
Planning and Land Use

This chapter examines potential impacts of the airport options on metropolitan, regional and local planning, and on existing and future land uses. It also describes the potential infrastructure that would be required to support each airport option. Technical Paper No. 2 provides a more detailed analysis.

10.1 Issues Raised During Consultation

Comments were received during consultation concerning the potential impacts of an airport on future planning for population growth and local infrastructure. It was noted that housing near the options has been approved and constructed without noise insulation and that land and house sales have been made on the understanding that new owners would not be adversely affected. It was highlighted that planning in the Badgerys Creek area has proceeded assuming the Option A runway configurations, rather than the configurations associated with Options B and C. Some people also commented that years of uncertainty regarding the airport proposal at the Badgerys Creek site has prevented them from making significant personal decisions and that they hoped for a speedy and decisive resolution of the current process.

Submissions requested that the assessment include an examination of potential implications for all nearby residents, businesses and other developments in relation to future zoning and development approval implications.

The relocation of power lines and other infrastructure such as roads, rail lines and sewage services were all identified as potentially affecting the health and welfare of nearby residents.

It was commented that the 1996 Census data would not be available in sufficient time to be used by the study team and therefore the full extent of new suburban areas would not be represented, and impacts would not be adequately measured.

10.2 Methodology

If the proposal proceeds, the Second Sydney Airport would not be operational for a number of years, possibly not until 2004 or 2005. Operations at the airport would not reach the air traffic levels on which this Draft EIS is based until probably at least some time after 2016. It is therefore important that the assessment of the potential impacts of the proposal are based on predictions of the characteristics of the environment in future years. These predictions have been made for the region most likely to be affected by the development of an airport, comprising 15 local government areas surrounding the airport options.

This Draft EIS has nominated two dates in the future as the years on which to base its assessment. The year 2006 has been chosen because it would indicate potential impacts during the early years of the operation of the airport, while 2016 has been adopted as indicative of the time when the airport might reach the operational level of about 30 million passengers processed yearly.

A large contributing factor to the character of the Sydney region in 10 or 20 years time is the type and location of urban development that may occur over the intervening period. One objective of the planning and land use studies undertaken for this Draft EIS has been the development of scenarios predicting the influence of each airport option on Sydney's urban development up to 2016. Information drawn from these scenarios has assisted in the preparation of the noise, air quality, hazards and risk, and land transport studies.

The steps in developing the scenarios for future urban development included:

- examining all relevant demographic and planning information sourced from State Government authorities, local Government and the Australian Bureau of Statistics;
- supplementing information about existing land uses through the use of 1996 aerial photography and photogrammetry of a 3,000 square kilometre area of western, southern and south-western Sydney; and
- developing assumptions about growth of population and employment within Sydney based on information obtained from and discussion with planners working with State Government authorities and local councils.

To verify these assumptions a land use transport model was developed that predicts both residential population and employment growth for the whole of Sydney. Impacts of the airport options on other land uses and off-airport site infrastructure have been assessed based on the above analysis and assumptions. To assess employment land impacts, the assessment region was divided into catchments. These were assessed to predict the existing and future supply of employment land, and the demands created by each airport option.

10.3 Historical Planning Context

10.3.1 Metropolitan and Regional Planning

The Report on the Planning Scheme for the County of Cumberland (Cumberland County Council, 1948) was Sydney's original postwar master plan. It reflected the planning philosophy of the period with an emphasis on green belts to contain Sydney's growth. It also emphasised the development of a suburban residential environment separating housing, schools and the local community from industrial and any other uses of land that were thought at the time to be incompatible.

Two decades later, the *Sydney Region Outline Plan* (State Planning Authority, 1968) was released. This plan proposed a network of self contained cities to accommodate the growth of Sydney to an estimated population of 5.5 million by the year 2000. It was anticipated that the cities of Campbelltown and Camden in the south west of Sydney would grow to populations of 340,000 and 100,000 respectively. A further 60,000 people were to be accommodated in Appin, bringing the total population in the Macarthur region to 500,00 by the year 2000.

The Sydney Region Outline Plan expanded the concept of the greenbelts proposed in the *Planning Scheme for the County of Cumberland* to serve the dual purpose of accommodating utilities and special uses along with open space provision. The Hoxton Park and Horsley Park corridors, located between the airport site and Liverpool and Fairfield, were part of those proposals.

A plan for the Macarthur Growth Centre, *The New Cities of Campbelltown, Camden and Appin: Structure Plan*, (Department of Planning, 1973) was produced in 1973. The Macarthur Development Board was established in 1975 to coordinate and implement these proposals.

In 1979 the Environmental Planning and Assessment Act was introduced to direct planning in NSW. Cultural and economic changes prompting this new legislation included the development of low density suburbs at the fringes of the city, heightened community awareness of environmental issues, changing household occupancy patterns and a changing economic and employment environment.

A new metropolitan strategy was released in 1988 to meet the challenges posed by these changes. *Metropolitan Strategy - Sydney into its Third Century* (Department of Planning, 1988) planned for a population of 4.5 million by the year 2011. Eight new areas were identified for possible development to accommodate this growth. These areas were Scheyville, Maraylya, Londonderry, Macarthur South, South Somersby (Gosford West), Warnervale, Bringelly/South Creek Valley, and Rouse Hill.

In the 1980s and early 1990s, several studies of the south-western area of Sydney were undertaken to determine the development constraints and potential of the region. *The Macarthur Regional Environmental Study* (Department of Environment and Planning, 1986) was produced to provide a framework for managing the then rapid urban growth in this region. A further review, *South-Western Sydney, A Vision for Environmentally Sensitive Development* (Department of Planning, 1990a) confirmed the development potential of urban release areas identified earlier in Campbelltown, Camden and Wollondilly local government areas. The strategy also identified potential urban land in the South Creek Valley and Macarthur South, and foreshadowed the release of regional environmental studies for these areas. The airport options are located in the South Creek Valley area.

In 1991, the *South Creek Valley Regional Environmental Study* (Department of Planning, 1991a), the *South Creek Valley Draft Regional Environmental Plan* (Department of Planning, 1991b) and the *Macarthur South Regional Environmental Study* (Department of Planning, 1991c) were placed on exhibition. *The South Creek Valley Draft Regional Environmental Plan*, shown in *Figure 10.1* examined more than 16,000 hectares of land between Penrith (Orchard Hills) and Camden (Oran Park) to determine its suitability for accommodating growth in the Sydney region. It identified approximately 10,000 hectares capable of urban development, but raised a number of economic and environmental issues to be further investigated before commitments to major urban development were made. The economic concerns related to the demand for, and the timing of, release of significant areas of land for employment and industrial use. Environmental concerns included cumulative impacts on air and water quality. The *South Creek Valley Draft Regional Environmental Plan* (Department of Planning, 1991b), which identified Oran Park as the first potential development area, was not formally adopted.

The Macarthur South Regional Environmental Study (Department of Planning, 1991c) aimed to establish guidelines for the future development of Macarthur South in the context of the environmental sensitivity of the area and the need for viable and cost effective development. The strategies for development identified in the study proposed a series of distinct urban villages based around Menangle, Appin and Wilton, each with a high level of self-containment. A potential population of 140,000 to 160,000 was identified in a development period of approximately 30 years. Coal reserves, air and water quality issues and the high quality natural environment were identified as significant issues requiring further study.

In 1992, the then NSW Department of Planning carried out a review of the *South-Western Sydney Strategy* (Department of Planning, 1992), in response to environmental concerns over the release of land in the region. These concerns included the capacity of the Hawkesbury Nepean River to accept increased volumes

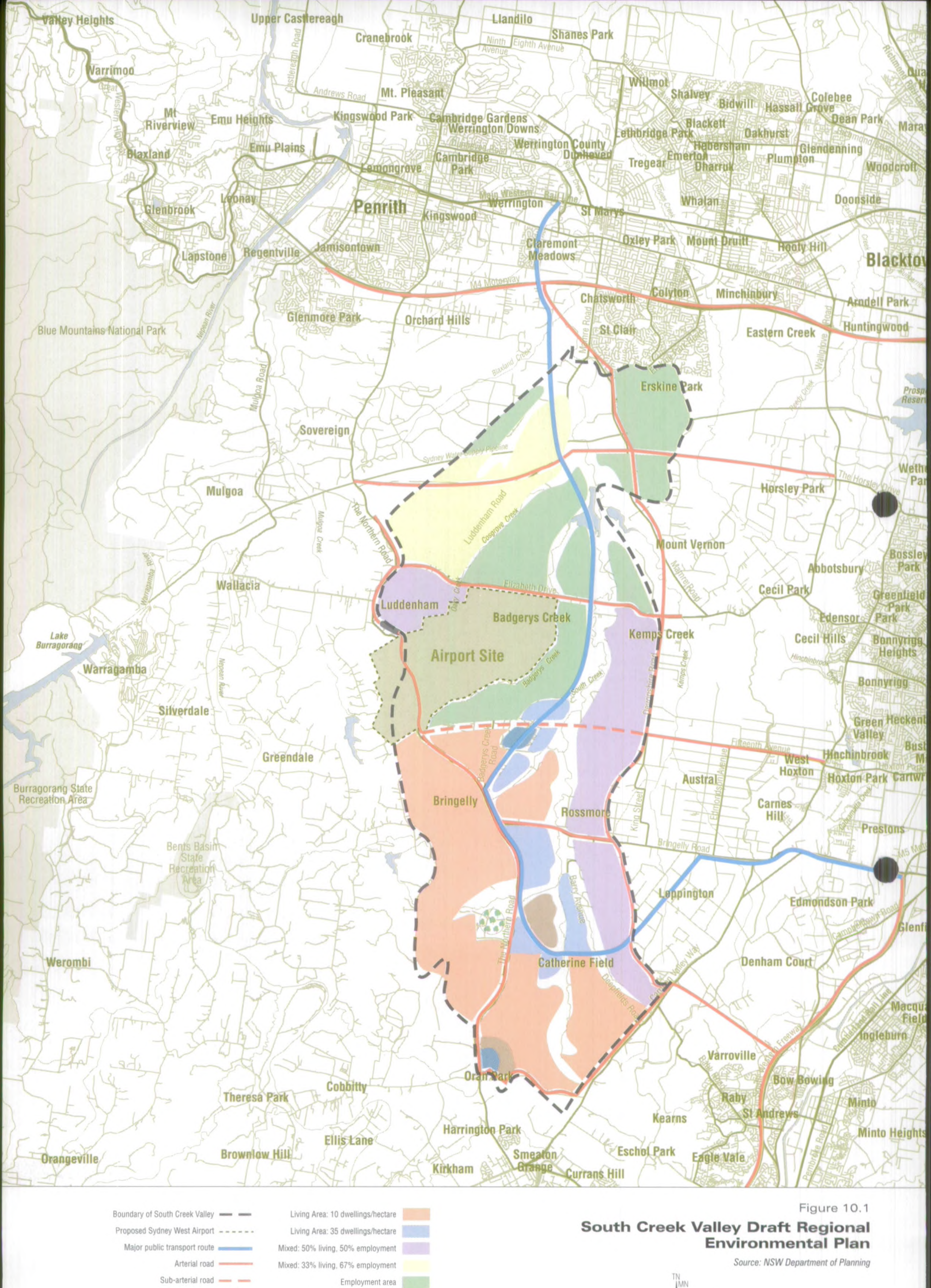


Figure 10.1

South Creek Valley Draft Regional Environmental Plan

Source: NSW Department of Planning

of pollutants associated with further urban development, as well as concerns over air quality, transport, provision of human services, urban design and planning. It was concluded that rezoning of a number of proposed new communities would be deferred to allow further environmental and planning studies to be undertaken.

In 1993, the Department of Planning published a discussion paper, *Sydney's Future* (Department of Planning, 1993). It presented a planning strategy based on a review of the 1988 metropolitan strategy. This document provided the basis for the development of the most recent metropolitan strategy released in 1995 and is discussed in *Section 10.4*.

10.3.2 Characteristics of Sydney's Growth

Sydney's growth is influenced by a number of factors. The most important are the levels of overseas and internal migration to and from the region. Overseas migration to Sydney has compensated for domestic migration from the region to areas such as Queensland and Western Australia. Commonwealth Government policy dictates the level of overseas migration allowed each year, and changes in policy make it difficult to predict with any precision the rate and characteristics of Sydney's growth in future years.

Over the last two decades significant urban growth has occurred in areas such as the south-western and western regions of Sydney, the Blacktown and Baulkham Hills area, the Fairfield and Liverpool area, and in Gosford and Wyong. Over the same period, many established urban areas of Sydney have experienced declining populations. Some local governments have reversed this trend in recent times by encouraging infill housing and higher density residential development.

Since the early 1980s the State Government has been concerned about the rapidly increasing size of the Sydney metropolitan area, the phenomenon commonly referred to as *urban sprawl*. For example, the *Sydney Region Outline Plan* (State Planning Authority, 1968) assumed that by the year 2000 the population of Sydney would increase to 5.5 million. Urban development has commenced in almost all areas identified in that plan to accommodate new growth yet it has been estimated that if the present densities of urban development persist, the capacity of the region even with these areas fully developed may be as low as 4.3 million (Roseth, 1988).

The population of Sydney in 1986 was about 3.4 million. The Australian Bureau of Statistics (1997b) estimated that by 1996 the population had grown to about 3.8 million.

The most obvious reasons for Sydney's sprawl include the declining population of the inner areas and a significant change in the structure of the population and of Sydney's households since the late 1960s. For example in 1986, about 3.5 people (on average) were living in each Sydney home. The Department of Urban Affairs and Planning expects this occupancy rate to decline to 2.7 people per home by 2016 (Department of Urban Affairs and Planning, 1995a).

Other considerations influencing the desire to restrict Sydney's urban sprawl are the escalating cost of servicing residential land and the environmental costs of new urban development, especially on air and water quality and ecological impact.

Today, Sydney is a large and complex city with an important place in the urban and economic structure of NSW and Australia. Over 60 percent of the people of NSW live in Sydney (Australian Bureau of Statistics, 1997b). The latest State Government strategic planning initiatives for its future development are discussed in *Section 10.4*.

It will be appreciated that it is difficult to predict the structure, size and locations of the future population. The city's growth is influenced by Australian and international economic trends and also by local, State and Commonwealth Government policies. Major investments and development initiatives such as the 2000 Olympics, and potentially the Second Sydney Airport, are examples of Government policies that may influence the way the city grows.

Consequently the planning of Sydney is a dynamic process and urban planning of strategies, by necessity, are constantly under review. The prediction of population at around the turn of the century, for instance, has varied from 5.5 million by 2000 (the 1968 forecast), to 4.5 million by 2011 (1988 and 1993); and now, in the mid 1990s, the prediction is that this figure of 4.5 million people will not be reached until 2021.

10.3.3 Strategic Planning Associated with the Second Sydney Airport

The 1986 Commonwealth Government decision to build a second airport for Sydney at Badgerys Creek has influenced State and local Government planning for the western and south-western area of Sydney during the past decade. In 1995, a Taskforce comprising Commonwealth, State and local Government representatives was established to co-ordinate the preparation of a strategic plan for the area known as the *Sydney West Airport Sub-Region* (Taskforce on Planning for the Sub-Region Surrounding Sydney West Airport, 1995). When the Holsworthy Military Area was announced as a potential airport site in 1996 the Taskforce was disbanded. The strategic planning component of its work had, however, been substantially completed.

Stage 1 of the Taskforce Study identified planning options for the sub-region which maximised the benefits from the airport, its infrastructure and access corridors. Stage 2 produced the *Sydney West Airport Sub-Region Draft Strategic Plan* (Taskforce on Planning for the Sub-Region Surrounding Sydney West Airport, 1996a). *Figure 10.2* provides a summary of some of the potential planning initiatives that have been investigated by this process.

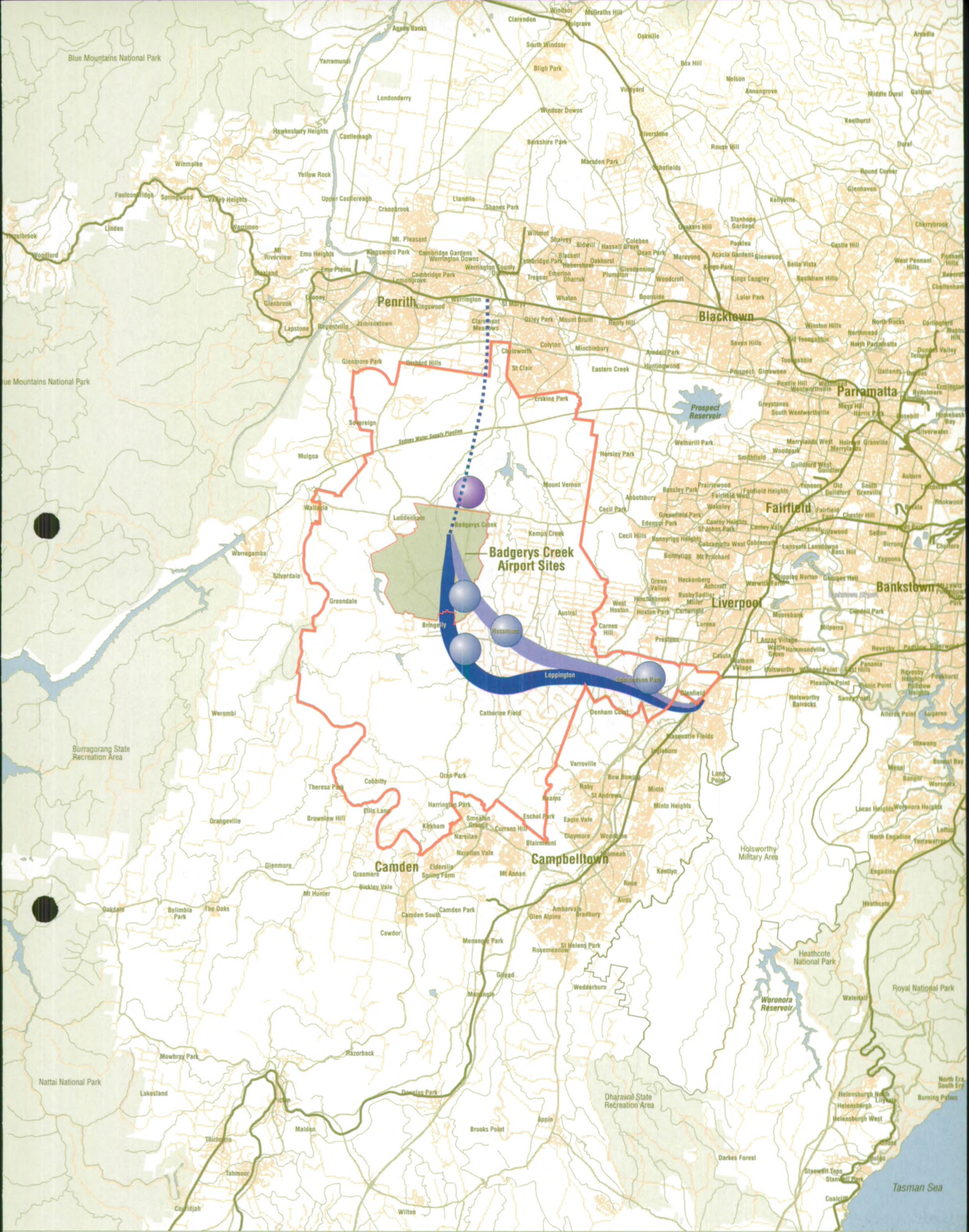
The Sydney West Airport Sub-Region Draft Strategic Plan (Taskforce on Planning for the Sub-Region Surrounding Sydney West Airport, 1996a and 1996b) and specialist studies have provided much of the framework for the development of the regional land use scenarios for Options A, B and C. In particular, the conclusion that a rail connection to the airport would only be viable if supported by urban development has been adopted for the development of regional land use scenarios. It should be noted, however, that the strategy has not been adopted formally by either the State or Commonwealth Governments.

10.4 Existing Planning

Planning within Sydney occurs at three levels, namely, metropolitan, regional and local. *The Environmental Planning and Assessment Act 1979* is the basis for planning in NSW. The Minister and Department of Urban Affairs and Planning are responsible for implementing the Act.

10.4.1 Metropolitan and Regional Planning

Cities for the 21st Century (Department of Planning, 1995) and the *Integrated Transport Strategy* for the greater metropolitan region (Department of Transport, 1995) provide strategic planning direction for the greater metropolitan region of Sydney, which includes Newcastle, the Central Coast and Wollongong. Together they form the current metropolitan strategy for the development of Sydney.



Sub-Region Boundary
Bringelly Rail Corridor
Rossmore Rail Corridor
Possible Extension of Rail Line to Main Western Line
Existing Rail Lines
Potential Urban Villages
Potential Employment Area
Urban Areas (indicated by local roads)

Figure 10.2
Draft Planning Strategies for Sydney West Airport Sub-Region

Source: Various reports, Taskforce on Planning for the Sub-Region Surrounding Sydney West Airport, 1996

Note: Rail corridors are indicative only as precise routes have yet to be determined

Cities for the 21st Century forecasts the population of the Sydney region will reach 4.48 million by 2021. The key principles adopted for planning and managing that population growth are encouraging more compact cities and developing an ecologically sustainable region, including integration of land use and transport planning, and overseeing the effective implementation of the strategy.

The principle of compact cities places emphasis on redevelopment and infill of established areas as a means of slowing the rate of urban development at the fringe of Sydney. This policy therefore has implications for the urban growth anticipated in the local government areas adjoining the sites of the airport options. The strategy also states that where population growth cannot be ecologically and socially sustained in Sydney, it is to be encouraged in the Newcastle and Wollongong regions.

The areas of Warnervale, South Creek Valley (Bringelly) and Rouse Hill are identified as having the potential to accommodate new urban development. Development in the South Creek Valley area is contingent on the resolution of several issues, including a possible rail link to an airport at Badgerys Creek, and environmental concerns.

In accordance with the objective of a more compact city, *Cities for the 21st Century* seeks to concentrate retail, commercial and service employment and reduce car dependence for journeys to work. The proposed Second Sydney Airport is recognised as a catalyst for economic development in western Sydney and could, in part, reduce the current imbalance between residential population and employment in that region. The strategy advocated for Sydney, Newcastle, the central coast and Wollongong is shown in *Figure 10.3*.

The Integrated Transport Strategy for the Greater Metropolitan Region (Department of Transport, 1995) also seeks a comprehensive approach to land use and transport planning. The *Draft State Road Network Strategy* (Roads and Traffic Authority, 1994) and the *State Rail Strategic Plan* (State Rail Authority, 1994) were developed to support the broader strategic plan. The *Integrated Transport Strategy* and the *Draft Strategic Road Network Strategy* are shown in *Figures 10.4 and 10.5*.

The *Integrated Transport Strategy* supports the concept of urban containment with the objective of making more efficient use of highly accessible areas, through increased residential densities and concentrated employment patterns. To achieve this the strategy identifies 10 priority transport corridors, several of which influence the potential development of the Second Sydney Airport. They are:

- Liverpool-Hornsby link;
- access to the Badgerys Creek Airport site;
- the south-west link (M5); and
- inter-city corridors between Sydney, Canberra and Wollongong.

The *Integrated Transport Strategy* highlights the road corridors that impact on the potential development of the Second Sydney Airport at Badgerys Creek. The *State Rail Strategic Plan* also identifies a possible 'Sydney West Airport rail link' and development work at Campbelltown and Glenfield stations.

In addition to the broader metropolitan wide strategic planning documents, there are a number of specific planning policies that may influence the development of a Second Sydney Airport, or the development of land near where the airport is established. These include:

- directions made under Section 117 of the *Environmental Planning and Assessment Act, 1979*, which seek to influence how local governments zone

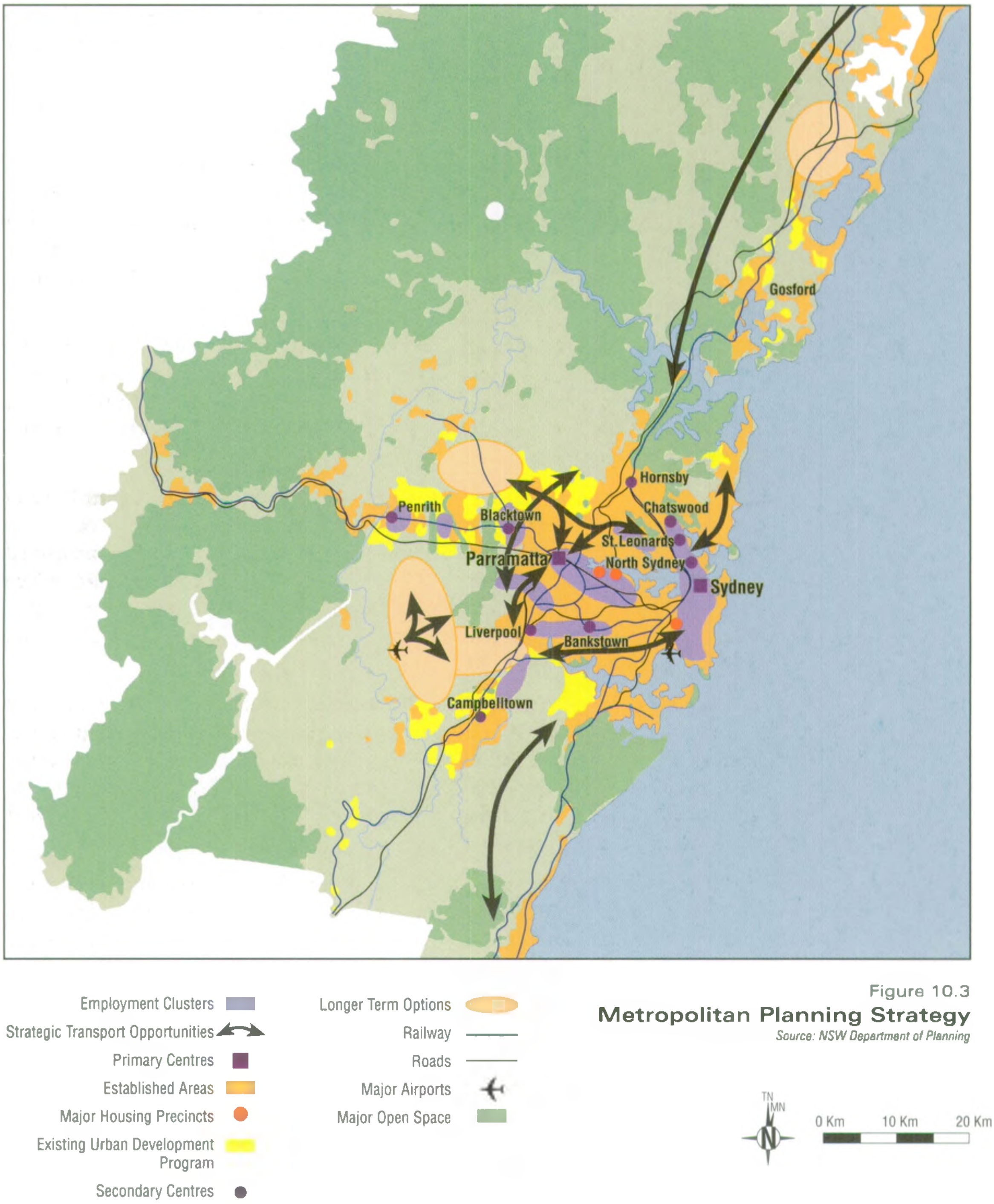


Figure 10.3
Metropolitan Planning Strategy
Source: NSW Department of Planning

land. Relevant directions include those relating to the Second Sydney Airport at Badgerys Creek (S19), development near licensed aerodromes (S25), environmental protection zones (G12), airport noise (G16), planning in bushfire prone areas (G20), conservation of environmental heritage and ecologically significant items and areas (G21), and flood liable land (G25);

- State Environmental Planning Policies (SEPP) on traffic generating developments (SEPP11), bushland in urban areas (SEPP19), the western

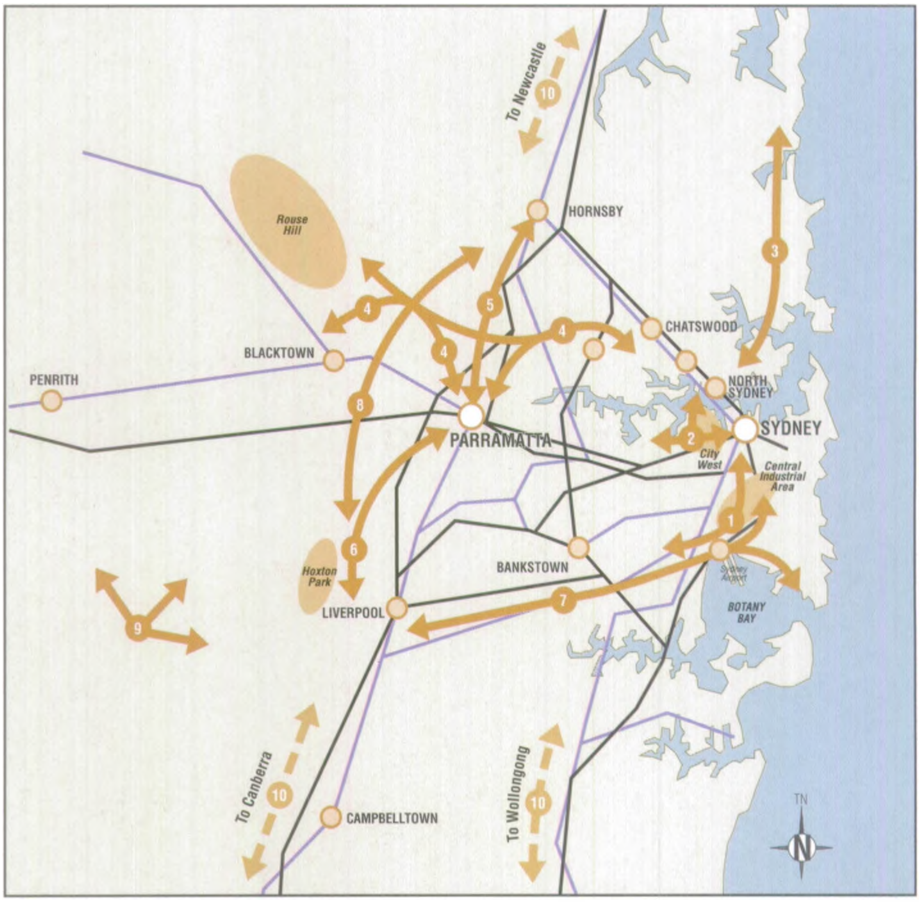


Figure 10.4
Integrated Transport Strategy
Source: NSW Department of Transport

Major roads	
Railways	
Residential/employment growth	
Primary activity centres	
Secondary activity centres and other employment nodes	
Strategic transport opportunities	
Enhanced existing corridors	

Corridors:	
Airport-Central Sydney	1
Inner West	2
Warringah	3
Macquarie-Parramatta-Castlereagh	4
Parramatta-Hornsby	5
Hoxton Park	6
South West Link	7
Liverpool-Hornsby	8
Sydney West Airport access	9
Inter-city	10

Sydney Recreation Area (SEPP29), hazardous and offensive development (SEPP33), major employment generating industrial development (SEPP34), koala habitat protection (SEPP44), and major putrescible landfill sites (SEPP48); and

- Regional Environmental Plans for Sydney (SREP) on extractive industry (SREP9), public transport corridors (SREP18), the Hawkesbury Nepean River (SREP20) and Orchard Hills (SREP25).

The two planning policies of most relevance are the Section 117 directions on the Second Sydney Airport (S19) and development near licensed aerodromes (S25). These are currently under review by the Department of Urban Affairs and Planning. The former seeks to ensure that no development occurs around the airport site that would hinder the development of the airport, while the latter seeks to control the heights of buildings around airports to minimise the risk of obstacles to aircraft.

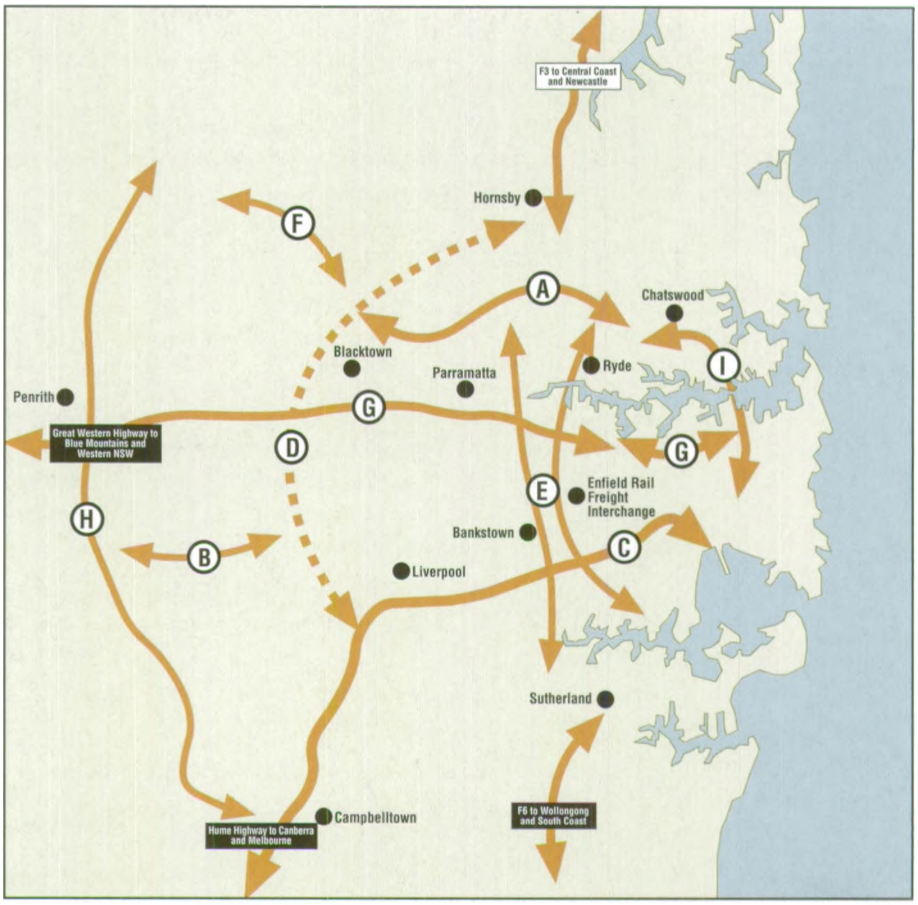


Figure 10.5
Draft Strategic Road Network Strategy
Source: NSW Roads and Traffic Authority

Strategic corridors for development

National Highway metropolitan link under investigation

North West Link (M2)	A
Badgerys Creek (Elizabeth Drive)	B
South West Link (M5)	C
National Highway metropolitan link under investigation	D
King Georges and Silverwater corridor (Routes 33 and 45)	E
North West Sector (Windsor and Old Windsor Roads)	F
City-West corridor (Western Distributor-City West Link-M4)	G
Northern Road Peripheral: Campbelltown-Penrith- Windsor/North West Sector	H
Gore Hill Link-Harbour Tunnel/Bridge-Eastern Distributor	I

Generally, the development of an airport by the Commonwealth on land owned by the Commonwealth would not be subject to State planning legislation and policies. Nevertheless, the legislation and policies are relevant matters to consider as they assist in providing an understanding of the way Sydney will develop in the future. They would also influence the variety of development that would be required to support the Second Sydney Airport such as roads, rail lines, services and commercial and industrial development.

In addition to regional planning policies and instruments, there are a number of organisations with a regional coordinating role. They include the various associations of local councils called the Regional Organisations of Councils and the Greater Western Sydney Economic Development Board. The latter comprises representatives of the commercial sector of greater western Sydney. It seeks to promote economic and investment opportunities, and promote proposals that will act as catalysts for growth in western Sydney over the next decade. Neither the Regional Organisation of

Councils nor the Greater Western Sydney Economic Development Board have direct control over urban planning, but they seek to influence the strategies of planning authorities.

10.4.2 Implementation of Metropolitan And Regional Planning

Urban Development Program

In recent years there has been a shift from a narrow focus on planning to a wider, whole of government approach to metropolitan and regional strategic planning.

At the metropolitan level in Sydney there are a number of State Government agencies with significant responsibility for urban planning issues. These agencies include the transport agencies (Department of Transport, City Rail, Rail Access Corporation and the Roads and Traffic Authority), the Environment Protection Authority, the service authorities including Sydney Water, and most recently the Ministry of Urban Infrastructure Management.

The Urban Development Program is one of the most important State government initiatives designed to coordinate metropolitan and regional planning. The Program coordinates the planning and servicing of new residential land in identified release areas in Sydney; these are shown in *Figure 10.6*. Introduced in 1981, the Program now accounts for 40 percent of new dwellings commenced in Sydney each year.

The local government areas of Liverpool (7,650 residential lots), Penrith (2,760 residential lots), Campbelltown (2,185 residential lots) and Camden (3,270 residential lots) represent more than half of the current five year urban development program in Sydney. Other significant areas of development are Baulkham Hills (4,060 residential lots) and Blacktown (5,490 residential lots) (Department of Urban Affairs and Planning, 1996).

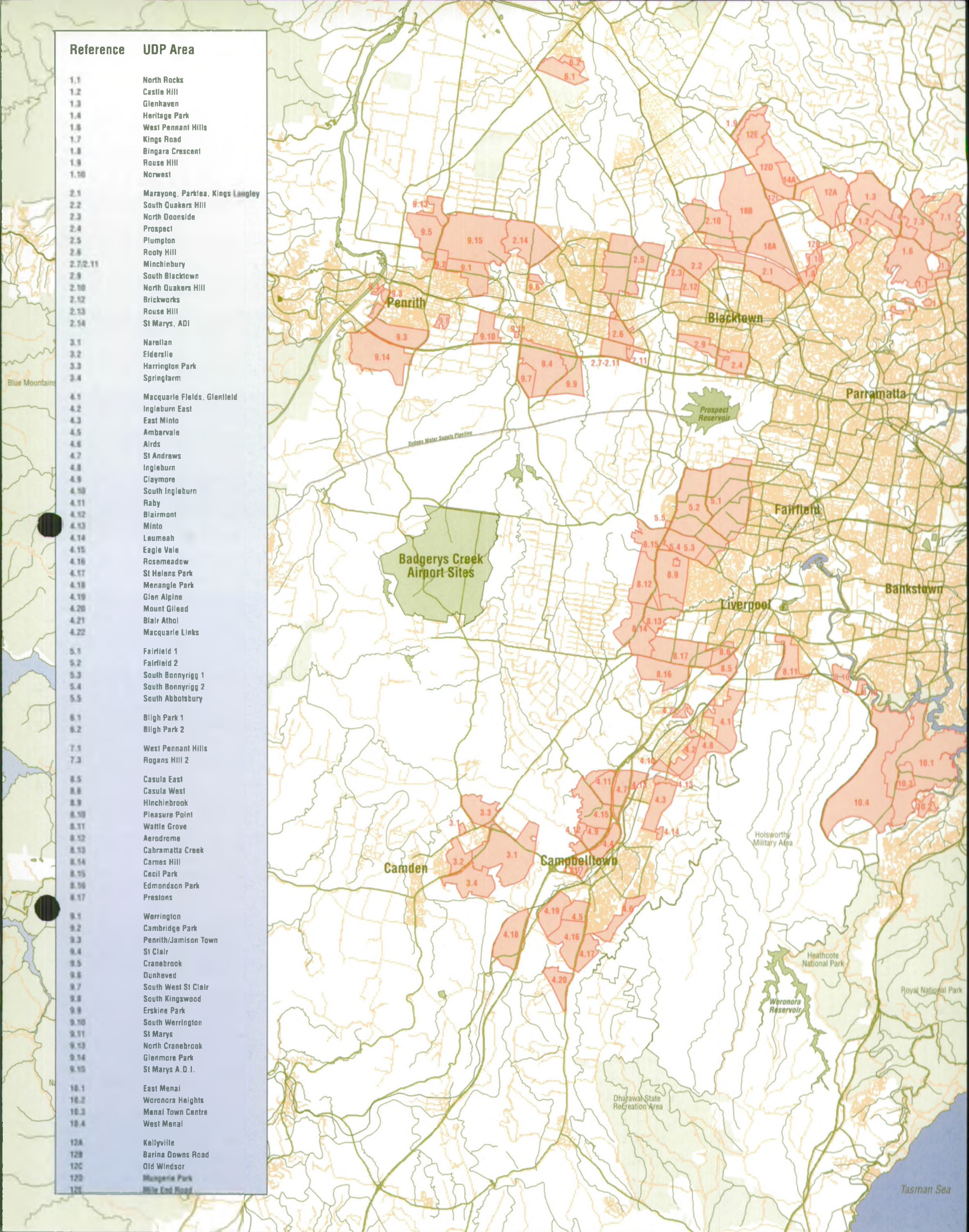
Local Residential Planning Initiatives

Residential development generally, and the Urban Development Program in particular, form the catalyst for the provision of a wide range of urban infrastructure including roads and physical and social services. Ultimately, the Program forms the basis of the urban structure of Sydney, and underpins local planning initiatives taken by many of the local councils surrounding Badgerys Creek.

The Penrith Urban Development Program is forecast to produce 2,760 lots over the next five years. Many of the currently identified release areas including Glenmore Park, South Werrington and Erskine Park will be substantially developed within this time frame.

The Australian Defence Industries site at St Marys represents significant development potential in the Penrith and Blacktown local government areas. The master plan for the site *ADI St Marys - The Environmental and Urban Development Master Plan* (ADI Limited and Lend Lease, 1996) shows that the 1,535 hectare site may be developed as a series of four urban villages within a 600 hectare open space system. The site has the potential to accommodate 30,000 people; however, some environmental issues would need resolving before this capacity is reached. The remaining urban release areas in Blacktown are largely infill projects with development nearing capacity over the next five years.

The Urban Development Program in Fairfield is expected to be substantially developed by 2001. The release area of Abbotsbury previously identified in the



Urban Development Program Release Areas

Existing Urban Areas (indicated by local roads)

Figure 10.6

Urban Development Program Release Areas

Source: NSW Department of Urban Affairs and Planning

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program has now been deleted and will become part of the open space corridor identified by the Department of Urban Affairs and Planning. In 1994, Fairfield City Council altered its minimum lot size requirements for non urban residential from two hectares to one hectare. This initiative will potentially increase the number of dwellings in the rural residential zonings in the west of the local government area.

The Liverpool Urban Development Program, with a five year production forecast of 7,650 residential lots, represents a significant proportion of the total new residential lot production scheduled for Sydney. To the west of Liverpool, it is anticipated that Cecil Park, Hinchinbrook, parts of Cabramatta Creek and Prestons will be developed in the short term (approximately five years) while the remainder of Cabramatta Creek and Prestons, along with Carnes Hill, will be developed over a longer time frame. Land identified as Aerodrome, near Hoxton Park, is still in the early planning stages and the release of the urban development area of Edmondson Park is viewed by Council as dependent on the Second Sydney Airport and decisions on the development of a rail line through the area to the airport site. The completion of Wattle Grove and the development of Pleasure Point are short term urban release programs. The *Liverpool Rural Lands Study* (Liverpool Council, 1994) recommended no further release of land for rural residential development beyond that already zoned.

Campbelltown will contribute 2,185 residential lots over the next five years, largely in the form of infill development throughout the local government area. Menangle Park and Mt Gilead represent longer term urban development in the area.

Two major urban release areas in Camden, Narellan and Harrington Park, are anticipated to contribute 3,270 lots to the Urban Development Program over the next five years. Lots in Elderslie and Springfarm are not scheduled for release in the next five years.

Because of its largely rural environment, Wollondilly is not within the current Urban Development Program. *The Wollondilly Draft Residential Development Strategy* (Wollondilly Shire Council, 1996) seeks to manage urban growth to protect the agricultural viability and rural nature of much of the Shire. Residential expansion is therefore limited to selected towns, which have been targeted for modest growth.

The Urban Development Program in Sutherland will be largely completed by 2001. As West Menai is likely to be removed from the program, future residential development in Sutherland will be focussed on redevelopment and renewal.

10.4.3 Local Planning

Planning at a local level is controlled by councils primarily through statutory planning instruments. These instruments describe the nature and scale of development that may be approved by each council in their local government areas.

The development of the Second Sydney Airport by the Commonwealth on Commonwealth land would not be subject to these local planning controls. Nevertheless, they provide an indication of the type of development the councils believe is appropriate for particular areas. It should be noted, however, that these local planning controls are constantly subject to review, especially when local councils become convinced of the merits of a particular proposal, notwithstanding inconsistencies with existing planning controls.

The *Liverpool Local Environmental Plan 1997* was gazetted on 29 August 1997. Liverpool Council had proposed that the Option A airport site be zoned 5(e) Special

Uses - Airport; however, the proposed zoning was deferred by the Minister for Urban Affairs and Planning because of uncertainty over the choice of the airport site.

Where determination of the zoning of land has been deferred the previous planning controls and zonings continue to apply. On this basis, for the area of the Option A airport site, the applicable planning instruments are *Interim Development Order 74* and *Liverpool Planning Scheme Ordinance, 1972*. The deferral does not, however, include the additional lands required to accommodate the Options B and C airport sites such that the *Liverpool Local Environmental Plan, 1997* is now the applicable planning instrument for these lands. The zonings that currently apply to each of the airport options as shown on *Figure 10.7* are:

- Option A: 1(a) Non-Urban; 2(a1) Residential; and 5(a) Special Uses - School;
- Option B: as for Option A, with the additional land zoned 1(a) Rural; and
- Option C: as for Option A, but the additional lands are zoned 1(a) Rural and 5(a) Special Uses - Telecommunications.

An airport is prohibited within the zones applying under the *Liverpool Interim Development Order No. 74* and *Liverpool Planning Scheme Ordinance, 1972*, and an airport would be inconsistent with the zonings applicable to the additional lands under the *Liverpool Local Environmental Plan, 1997*. Liverpool Council had intended that the area of the Option A site be zoned Special Uses 5(e) - Airport, to reflect the intention within the local planning controls of locating a major airport in the Badgerys Creek area.

10.5 Existing Land Uses and Ownership

10.5.1 Regional Land Uses

Existing land uses have been assessed for the region surrounding the airport options. They have been determined from land use zoning maps for each of the council areas within the region, aerial photographs, visits to each site and immediately adjoining areas, and reference to information provided by councils. *Figure 10.8* shows regional land uses within the study area defined for noise impact assessment (refer *Chapter 12*).

Figure 10.8 shows the extent of current residential development and land zoned for future residential purposes. A variety of residential land uses are found in the region, including older established areas, new and developing communities, rural residential development, and more isolated rural houses.

The closest major commercial centres to the airport sites include Liverpool, Campbelltown, Penrith, Bankstown and Blacktown. Major areas of industrial activity closest to the sites are:

- Prestons/Crossroads;
- Wetherill Park;
- Erskine Park;
- Smeaton Grange;
- Minto/Ingleburn; and
- Arndell Park/Huntingwood.

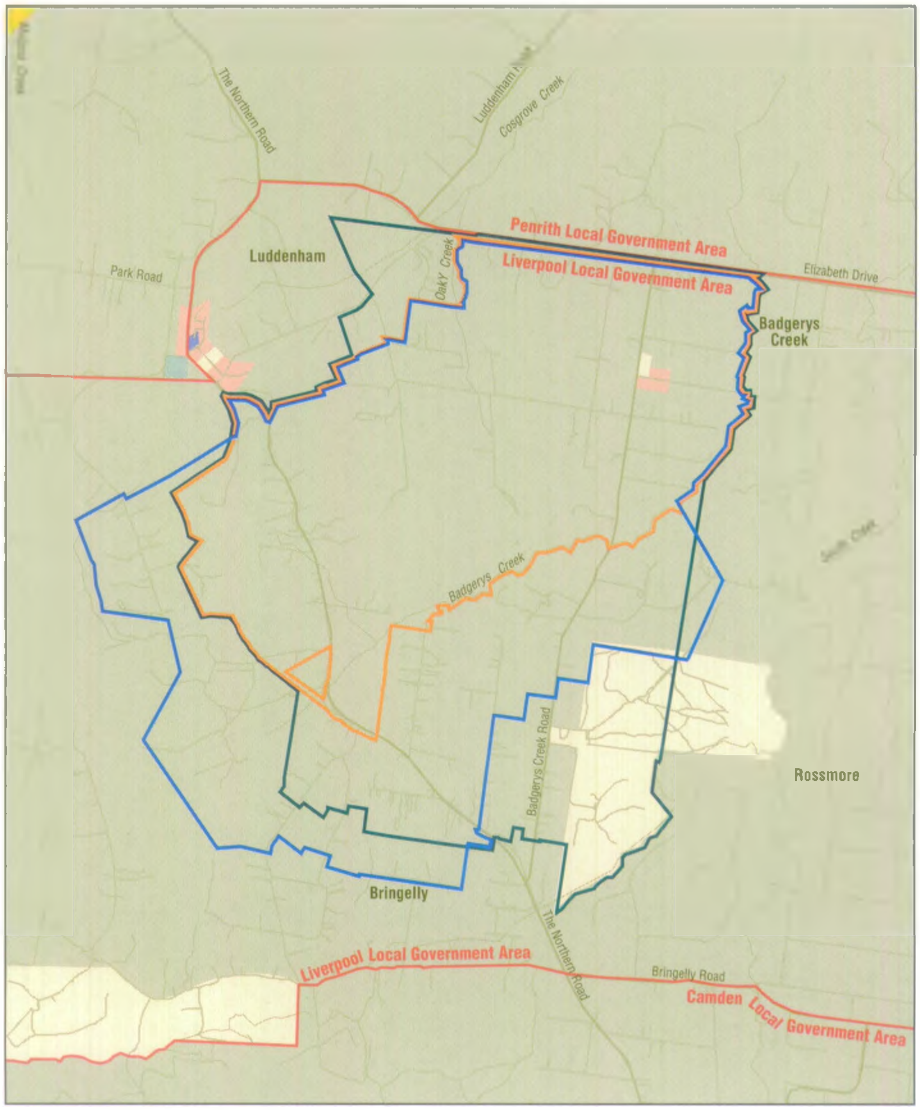


Figure 10.7
Zoning In and Around Badgerys Creek Airport Options

Note: Zonings are as per Penrith, Liverpool and Camden local government area planning instruments

Some of these have significant areas of vacant land such as Wetherill Park (160 hectares), Prestons/Crossroads (140 hectares), Ingleburn (170 hectares), Smeaton Grange (200 hectares) and Erskine Park (300 hectares).

Currently, there are over 2,000 hectares of vacant employment land within a potential employment catchment of the proposed Second Sydney Airport. This represents more than 60 percent of zoned vacant employment land in Sydney.

Badgerys Creek is surrounded by rural areas. The western region of the Liverpool local government area and the northern region of the Camden local government is a significant agricultural producer within the Sydney region. There are a number of intensive agricultural activities such as market gardens and intensive livestock production. A number of substantial rural residential developments have also established in the area around the airport options.

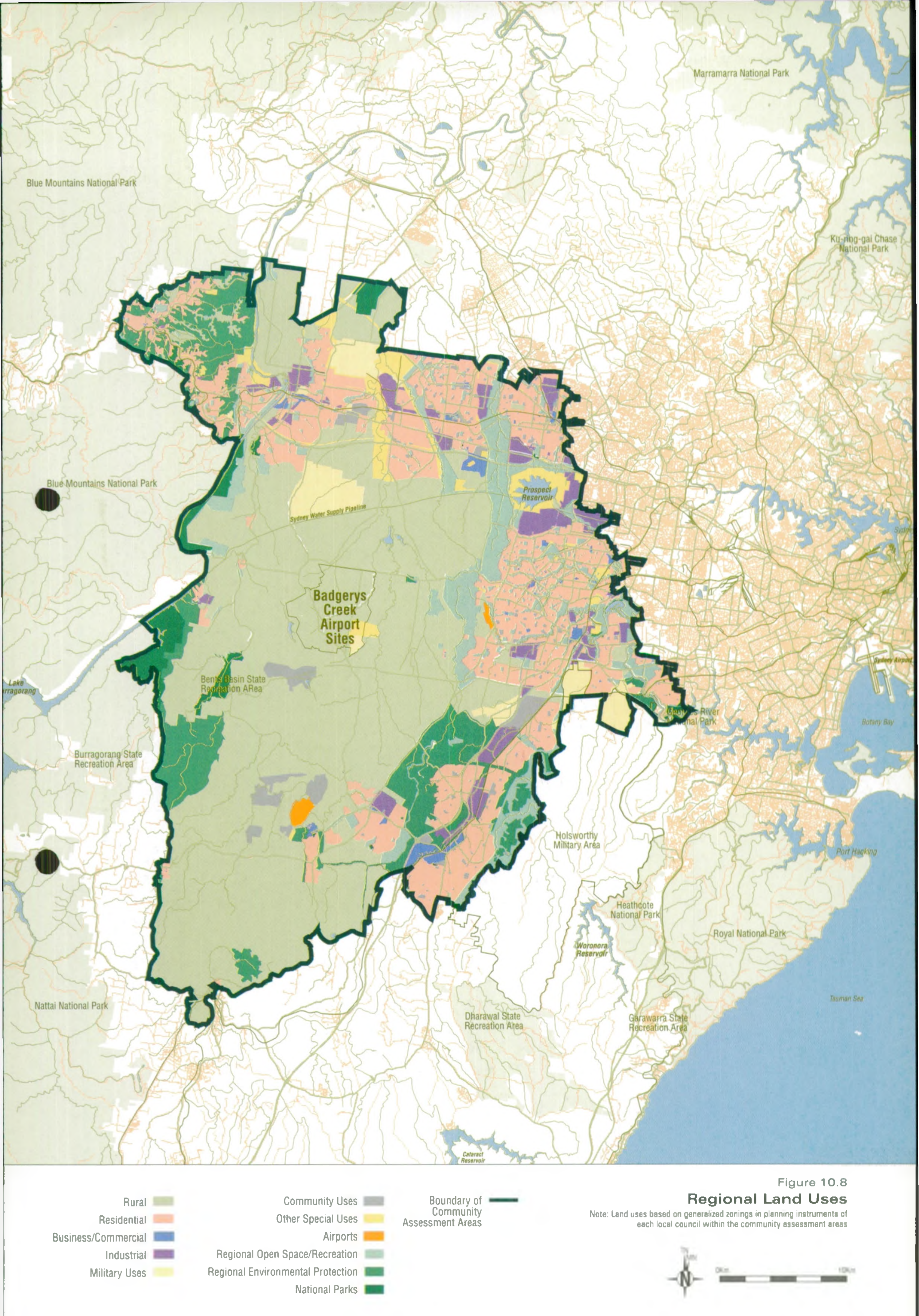


Figure 10.8

Regional Land Uses

Note: Land uses based on generalized zonings in planning instruments of each local council within the community assessment areas

Special uses shown on *Figure 10.8* are defined as one-off uses, not falling within the other land use categories listed. They include the Royal Australian Air Force Receiving Station and the Telstra High Frequency Radio Station at Bringelly; the Defence Establishment Orchard Hills; Hoxton Park Airport; and Elizabeth Drive Waste Disposal and Recycling Centre. The University of Sydney also operates farms to the north and south of the site, and the former CSIRO Division of Animal Health farm was located immediately north of Elizabeth Drive.

Other uses shown on *Figure 10.8* are primarily areas of open space, recreation and environmental protection. These include national parks, state recreation areas, environment protection zones and passive and active public open space. The significant areas are:

- Blue Mountains National Park;
- Burragorang State Recreation Area; and
- Bents Basin State Recreational Areas.

Areas of environmental protection are dispersed in pockets throughout the region. These consist of:

- the proposed Western Sydney Regional Park extending from the Prospect Reservoir to the west of the airport options; and
- water catchment areas for the Warragamba Dam, Woronora Dam and other dams within the metropolitan water catchment area.

10.5.2 Defence Activities

The Second Sydney Airport proposal has the potential to affect three Defence facilities, namely, Defence Establishment Orchard Hills, Bringelly High Frequency Receiving Station and RAAF Base Richmond. These facilities are shown on *Figure 10.9*.

Defence Establishment Orchard Hills

Defence Establishment Orchard Hills contains the Navy's Kingswood Armament Depot, the Navy' s Missile Maintenance Establishment and the Air Force' s Number One Central Ammunition Depot. A small outposted element of the Defence National Storage and Distribution Centre responsible for the storage and distribution of small arms ammunition is located within the Air Force' s facilities. The Air Force operate a rifle range, a proofing yard and a demolition range on the site. The site also includes logistic support, training, administration, accommodation, sport and recreation facilities. Approximately 260 military and 280 civilian personnel are employed at Defence Establishment Orchard Hills.

The most recent review of Defence activities (Department of Defence, 1997a) made reference to the potential disposal of the Orchard Hills property in the period 2001 to 2006. However, like all other recommendations contained in this review, final decisions will be the subject of further Government consideration following detailed studies of the feasibility and benefits of the recommendations. At this stage, the future of the facilities at Orchard Hills is uncertain, and it is therefore not clear whether the explosive storage and maintenance activities at Orchard Hills would cease prior to commencement of operations at the Second Sydney Airport.

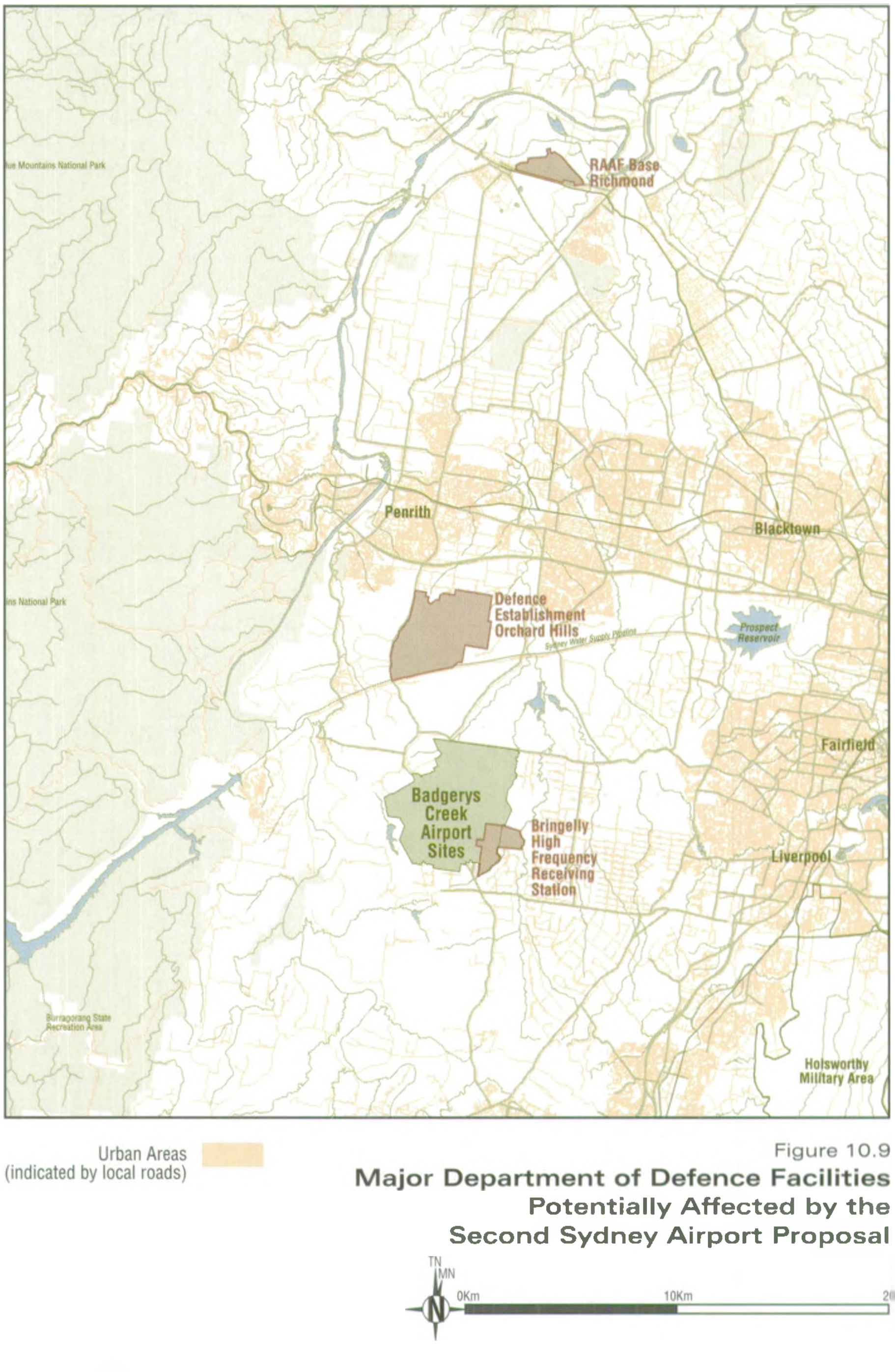


Figure 10.9
Major Department of Defence Facilities Potentially Affected by the Second Sydney Airport Proposal

Bringelly High Frequency Receiving Station

The Bringelly High Frequency Receiving Station consists of administration buildings and an antenna farm. The antennae receive high frequency radio communications from Defence establishments, forming part of the Defence Strategic Communications Network.

Defence activity at the site is due to cease around the year 2000, when it will be replaced by another communication network presently being developed. Defence proposes to dispose of the property at that time.

RAAF Base Richmond

RAAF Base Richmond is the home base of the Air Force's Air Lift Group which consists of two squadrons of Hercules C-130 aircraft, one squadron of Boeing 707 aircrafts and one Caribou aircraft. The facilities at Richmond include an airfield with a single 2,134 metre long runway and associated airfield infrastructure such as hangars, maintenance facilities and flight simulators.

Defence activity at Richmond is predominantly aviation based, consisting of Air Lift Group activity and transit activity. Air Lift Group activity includes air crew training as well as transport operations and aerial delivery training. During 1996, there were 47,850 aircraft movements at Richmond.

On current planning, it is not anticipated that Defence activity at Richmond will change markedly, though a reduction in use of Richmond airspace for training activities is likely to occur over the next five years with the planned introduction of high fidelity simulators for the B707 and C-130 aircraft.

The recent review of Defence efficiency (Department of Defence, 1997a) made reference to the potential closure of RAAF Base Richmond in the period 2001 to 2006. This recommendation will be subject to further Government consideration following studies on disposition being conducted by Defence. The future of RAAF Base Richmond is therefore uncertain.

10.5.3 Land Uses on the Airport Sites

Figure 10.10 shows the major land uses occupying the proposed Second Sydney Airport sites. The airport sites are primarily used for rural and rural residential activities. Other uses include the Badgerys Creek Primary School, Badgerys Creek Park, two cemeteries, Badgerys Creek Scout Headquarters, the Telstra Coastal Communication Station and Bringelly Remote Radio Receiving Station.

10.5.4 Land Ownership

All land within the site proposed for Option A is owned by the Commonwealth Government with the exception of The Northern Road. While the Commonwealth owns at least 65 to 70 percent of the land for the other options, 194 land owners would be affected by full or part acquisition of their properties for Option B, and 206 for Option C.

10.5.5 Services and Infrastructure

Existing services and infrastructure supporting the area surrounding the airport options are shown on *Figure 10.11*. The area is relatively well serviced by natural gas, telecommunications, electricity and water supply. The airport sites are located outside the Sydney telephone zone. Currently there is no sewerage infrastructure in the Badgerys Creek area. Sydney Water has long term plans for the area which falls within the Nepean-Hawkesbury River Catchment System. This would involve the establishment of a major sewer main along South Creek with a sewage treatment works located near the existing Sydney Water Supply Pipeline. Existing road and rail infrastructure are described in *Chapter 22*.

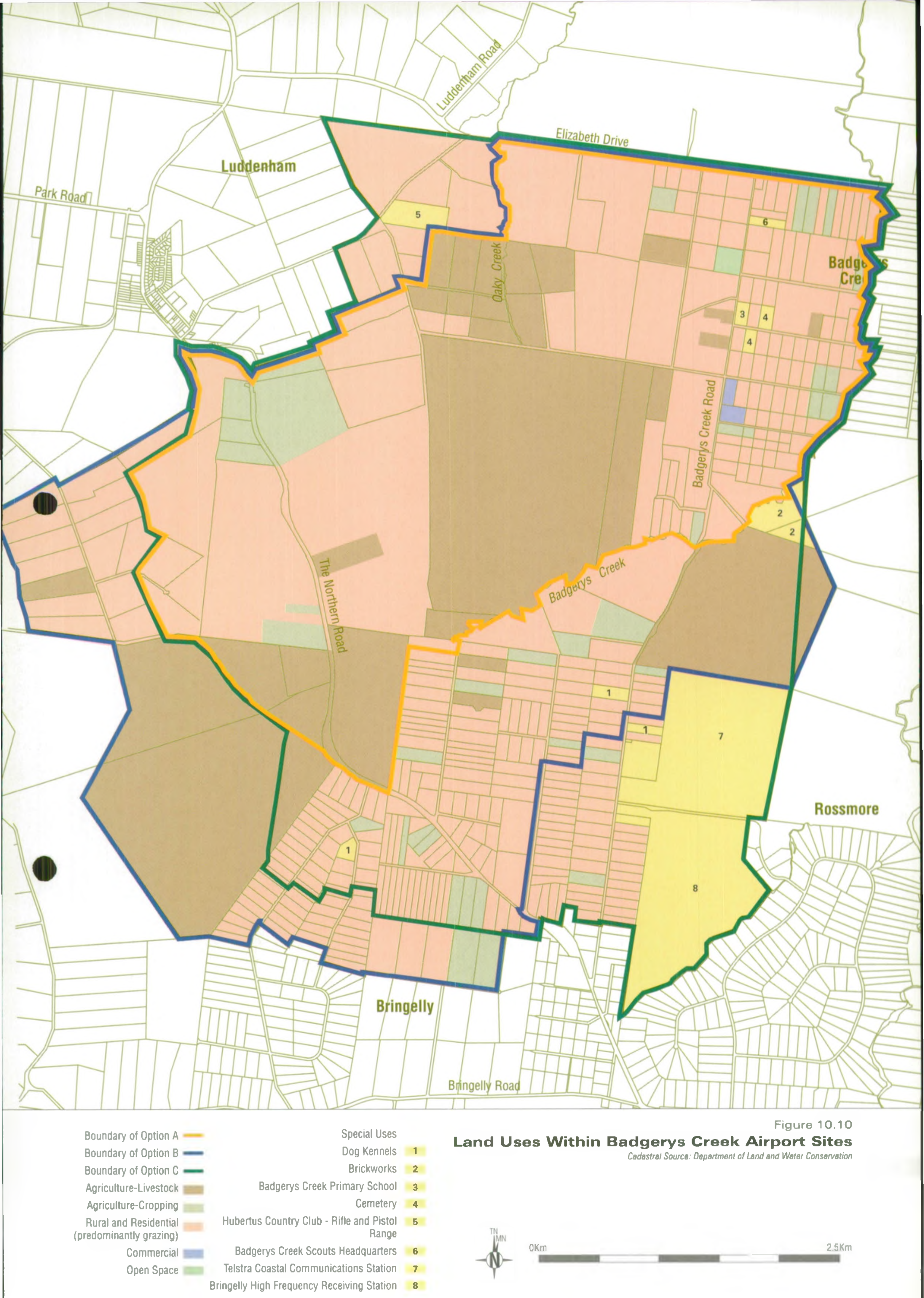


Figure 10.10

Land Uses Within Badgerys Creek Airport Sites

Cadastral Source: Department of Land and Water Conservation

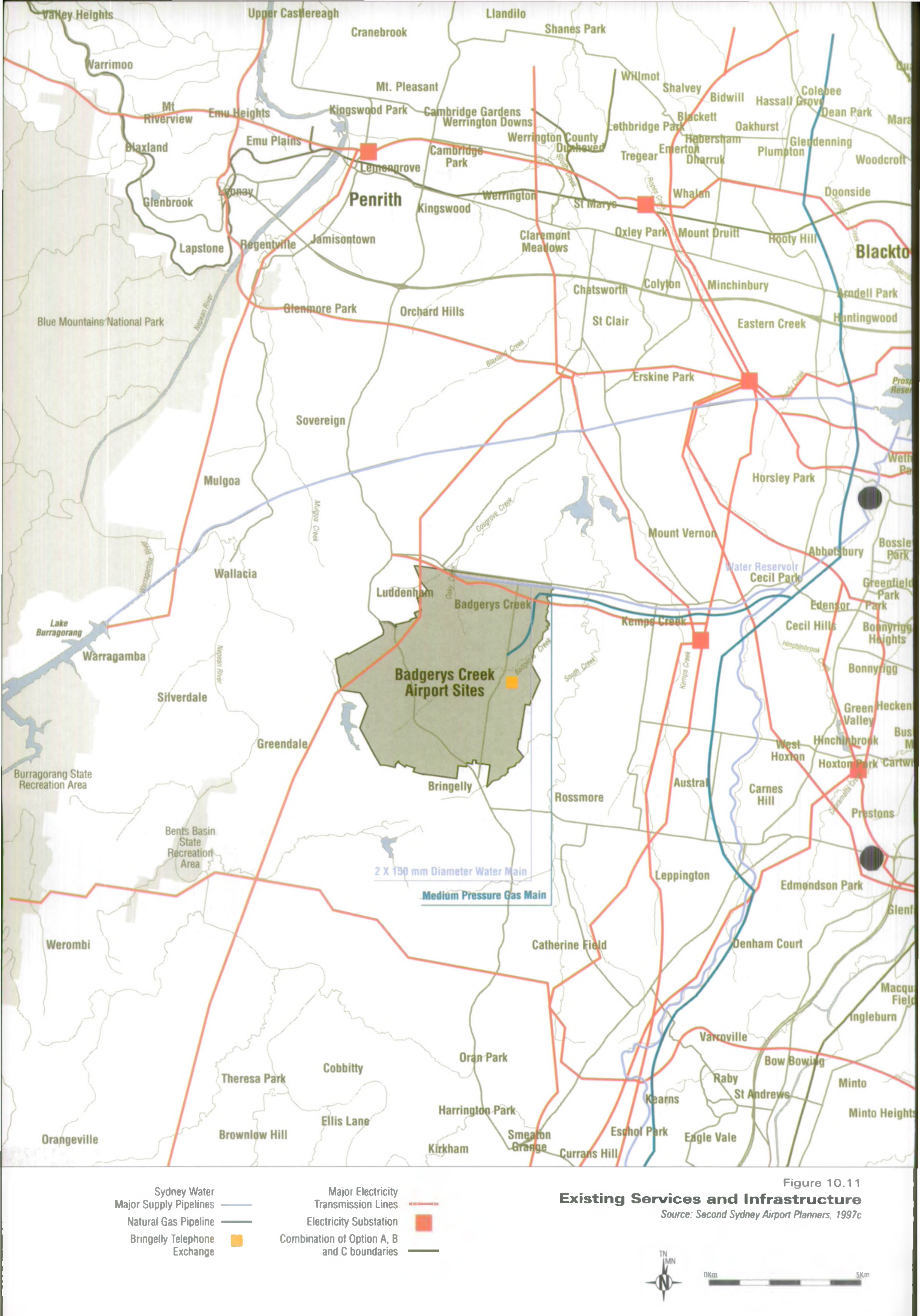


Figure 10.11

Existing Services and Infrastructure

Source: Second Sydney Airport Planners, 1997c

10.6 Impacts on Planning and Future Land Uses

10.6.1 Planning Assumptions

To assess the potential impacts of the Second Sydney Airport proposal on metropolitan and regional planning, two future land use scenarios were developed to describe how planning and future development may change as a result of the airport options. One future land use scenario was developed for Options A and B as they would have the same parallel runway alignment and therefore would have a similar impact on surrounding land use planning controls. The cross wind runway incorporated into Option B would have only a limited impact on future land uses. A second future land use scenario was developed for Option C. These future land use scenarios were compared to a base case of development that would be consistent with the State Government's existing metropolitan planning.

The future land use scenarios have been based on a number of common assumptions. The first assumption was that all new release areas identified in the Urban Development Program would be available for development. It is, however, conceded that a number of environmental issues would need to be resolved before some of these areas were developed. Such areas include Edmondson Park, Springfarm, Elderslie, West Menai and the former ADI site.

The second common assumption was that the population forecasts developed by the Department of Urban Affairs and Planning are desirable growth rates for the western, south-western and southern areas of Sydney. Therefore it has been assumed that these areas of Sydney would at least maintain their present share of residential growth as a proportion of the entire growth of the Greater Metropolitan Sydney Region.

Development of future land use scenarios was based on the potential impacts of aircraft overflight noise. Various State Government planning controls and *Australian Standard 2021* suggest that new residential development, schools, hospitals and churches should not be allowed in areas exposed to noise levels greater than 20 Australian Noise Exposure Forecast (ANEF). The potential impacts of aircraft overflight noise for each of the airport options is described in *Part E* of this Draft EIS.

Future land use scenarios were developed on the basis of a number of key assumptions. Growth rates were assumed to be lower, if an airport were developed, in those rural areas that might be affected by aircraft noise greater than 15 Australian Noise Exposure Concept (ANEC) (for an explanation of the terms ANEF and ANEC refer to *Chapter 11* of the Draft EIS). Further, new urban areas would not be allowed to establish on greenfield sites that might be subject to noise levels greater than 15 ANEC. It was also assumed that existing populations that may be affected by levels of aircraft overflight noise lower than 15 ANEC would not decline because of that impact. Although noise sensitive residents could be presumed to be more likely to move from noise affected areas, new residents would nevertheless move in to replace them. The impacts of noise on property values is discussed in *Part E* of the Draft EIS.

The potential impacts of the airport options on populations, employment and infrastructure are discussed below.

10.6.2 Population

Options A and B

Figure 10.12 shows the future land use assumptions should Option A or B be developed. *Table 10.1* shows population forecasts for the five local government areas

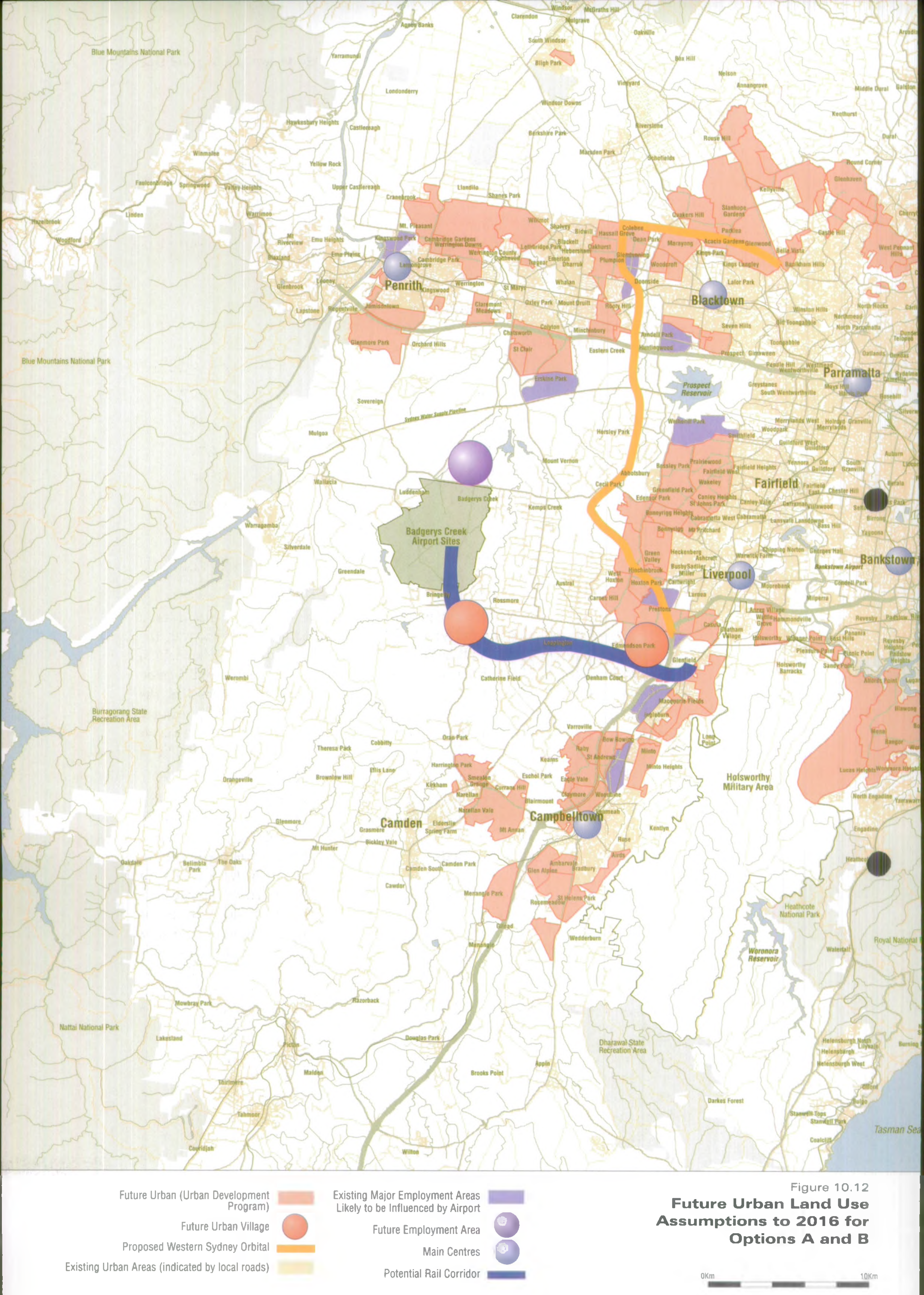


Figure 10.12

Future Urban Land Use Assumptions to 2016 for Options A and B

whose future population may be significantly influenced by the development of the airport options.

No Urban Development Program release areas are likely to experience aircraft noise impacts to a level that would require their future development to be slowed or abandoned.

Table 10.1 Population Changes Assumed to Occur with Options A and B

Local Government Area	1996 Population[1]	Population Without Airport in 2016[1]	Population With Airport in 2016
Camden	32,000	62,000	69,500
Campbelltown	152,000	162,000	160,000
Liverpool	120,000	178,000	185,000
Sutherland	201,000	222,000	221,000
Wollondilly	34,000	46,000	46,000
Total	**539,000**	**670,000**	**681,500**

Note: 1. Department of Urban Affairs and Planning (1995).

Options A and B would create the opportunity to establish new urban release areas. The possibility of this opportunity was established by the studies undertaken by the joint Commonwealth, State and local Government Taskforce for the Development of the Sydney West Airport Sub-Region (Taskforce on Planning for the Sub Region Surrounding Sydney West Airport, 1995, 1996a). The Taskforce identified the possibility of creating urban villages at Edmondson Park and Bringelly along a proposed rail line to the Second Sydney Airport. The ultimate capacity of these areas could be in the order of 35,000 people and 30,000 people respectively. Such population levels would, however, not be reached until some time after 2016.

Development of these areas would absorb a significant amount of the residential demand for the south-western region of Sydney. Consequently, some urban growth in Camden, Campbelltown and Sutherland is assumed to be diverted to the new urban village at Bringelly, and to Edmondson Park with accelerated development of the release area there. Development of the Elderslie and Springfarm release areas in Camden and the West Menai release area in Sutherland may be delayed. It has been assumed that the urban village at Bringelly would achieve a population of about 12,000 by 2016 and reach its capacity of 30,000 further into the future. The release area of Edmondson Park has been assumed to develop to a population of 7,000 by 2016 even without the development of the Second Sydney Airport at Badgerys Creek. With the possible provision of a rail line to the airport, it has been assumed that the growth of Edmondson Park would be accelerated to approximately 14,000 by 2016.

Rural and rural residential areas surrounding these airport options within the local government areas of Penrith, Liverpool and Fairfield would be affected by relatively high levels of noise. These areas were assumed to have lower growth rates than would have been expected if the airport did not proceed. Reducing these growth rates would, however, have only a marginal impact on the overall population forecast for the region. For example, the population in the rural western areas of Liverpool local government area grew by only 2.3 percent between 1986 and 1991 (Liverpool Council, 1995). A reduction in this growth rate would therefore not significantly affect overall population growth.

The impact of the development of either Options A or B would have on metropolitan and regional planning would depend largely on planning initiatives taken by the Commonwealth, State and local Governments. Provision of a rail line to the airport, and other infrastructure, would create the potential for new urban villages to be created in the south-western area of Sydney at Bringelly and Edmondson Park. These urban villages could be developed in a manner that is consistent with the principles of the State Government's *Metropolitan Strategy*, although concerns over air and water quality issues arising from urban development in the South Creek Valley area have previously been investigated by the joint Commonwealth, State and Local Government Taskforce. Possible declines in the anticipated growth of other urban release areas in Sydney could also be expected due to populations being drawn to these urban villages. This could result in the deferral of the development of some of these urban areas such as Elderslie and Springfarm to the north of Camden.

Option C

Figure 10.13 shows the future land use assumptions should Option C be developed. *Table 10.2* provides population forecasts for the five local government areas whose future population may be significantly influenced by the development of this airport option.

Table 10.2 Population on Changes Assumed to Occur with Option C

Local Government Area	1996 Population	Population Without Airport in 2016[1]	Population With Airport in 2016
Camden	32,000	62,000	69,500
Campbelltown	152,000	162,000	160,000
Liverpool	120,000	178,000	185,000
Sutherland	201,000	222,000	221,000
Wollondilly	34,000	46,000	46,000
Total	**539,000**	**670,000**	**681,500**

Note: 1. Department of Urban Affairs and Planning (1995).

The overall effect of the development of Option C on metropolitan and regional planning would be similar to the effect of Options A and B. The potential would exist to create new urban villages along a rail line to the proposed airport; however, given the north-south alignment of the runways, urban development in the Bringelly area would not be desirable in view of potential noise impacts. The Sydney West Airport Sub-Region Taskforce investigated an alternative rail corridor that would allow an urban village to be created in the Rossmore area. Urban development in this area, however, may be more difficult than in Bringelly because of fragmented land ownership and environmental constraints. At this stage there has not been sufficient investigation undertaken to substantiate the feasibility of developing an urban village for this option.

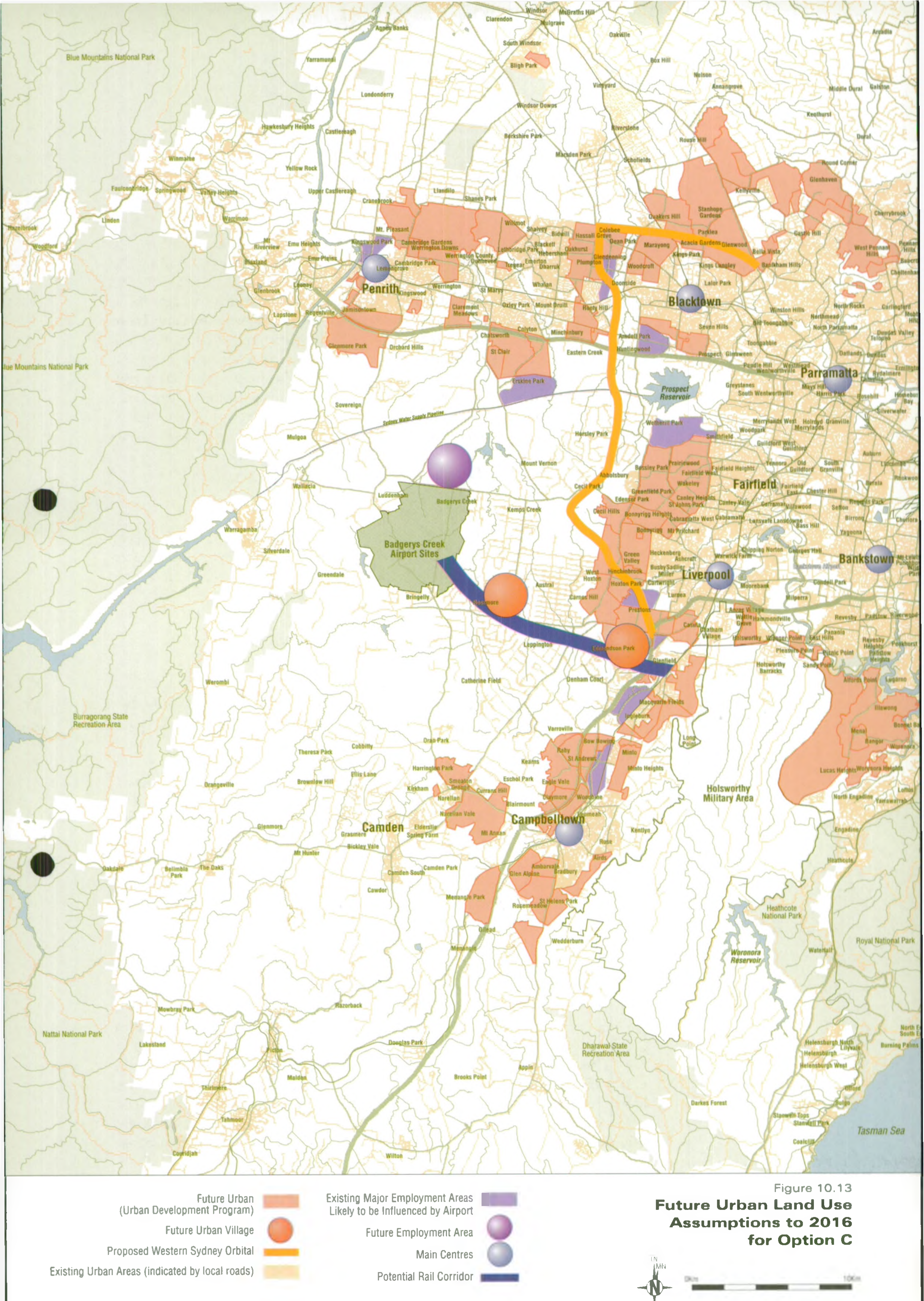


Figure 10.13

Future Urban Land Use Assumptions to 2016 for Option C

Because of the employment generated by the airport and the potential to create new urban villages, the future land use scenario developed is similar to that for Options A and B. It has been assumed that an additional 11,500 people would be drawn to the south-western region of Sydney by 2016 if the airport were developed.

10.6.3 Employment

The influence of a Second Sydney Airport on major employment-generating land uses has been assessed by reference to an employment catchment region. This is the region in the immediate vicinity of the airport options or within reasonable distance of airport related development and some flow-on employment. The region used in the assessment was made up of several local government areas surrounding the airport sites, and included Blacktown, Camden, Campbelltown, Fairfield, Liverpool, Penrith and Wollondilly local government areas.

Historically there has been an imbalance between population and employment growth within the region. This has resulted in dependence on employment outside the catchment area, high unemployment, and only moderate take up of vacant employment land (average of 131 hectares over the past eight years).

With the significant increase in population within the region, this is now being redressed to a certain extent. This trend is expected to continue, facilitated by improvements in infrastructure, accessibility, and major regional development, such as the proposed Second Sydney Airport, the proposed Western Sydney Orbital and the continued expansion of existing centres such as Liverpool, Parramatta and Penrith.

However, total employment within the region is still significantly less than the number of employed residents living in these areas and accordingly, for areas such as Campbelltown, approximately half of the employed residents have to travel outside the region to work. This has resultant economic, social and environmental disbenefits.

The operation of a Second Sydney Airport at Badgerys Creek is forecast to directly and indirectly generate between 80,000 and 107,000 jobs (refer to *Chapter 25* for a fuller discussion on this employment generation). The proposed airport therefore represents a significant generator of additional employment within the regions surrounding the airport options.

With the exception of Option A, most direct employment could be accommodated on the airport site. The balance of development and consequent indirect employment could be adequately accommodated within existing vacant employment land in the surrounds of each airport site. The estimated area of employment land required to service the Second Sydney Airport is shown in *Table 10.3*. For Option A, where direct airport related development could not be accommodated at the airport itself, the need would arise for additional employment land in the vicinity. Such a development could be accommodated on land north of Elizabeth Drive or at other sites close to the airport. Alternatively, airport related development might possibly be located within existing employment areas where sufficient vacancies exist, changing the current pattern of poor take up rates.

Table 10.3 Employment Land Requirements Within Airport Site and Surrounding Region

Airport Options	Employment Land Requirement	Employment Land Within Airport Site
Option A	185 hectares	0
Option B	185 hectares	194 hectares
Option C	185 hectares	187 hectares

Source: Second Sydney Airport Planners, 1997a.

Such sites for each of the airport options are shown in *Table 10.4*. The table also lists existing commercial centres likely to benefit from additional airport related and flow-on employment.

Table 10.4 Existing Employment and Commercial Areas Likely to Benefit from Proposed Second Sydney Airport

Airport Option	Employment Areas	Commercial Areas
Options A, B and C	Erskine Park (319 hectares)	Liverpool
	Preston/Crossroads (138 hectares)	Penrith
	Huntingwood/Arndell Park (130 hectares)	Blacktown
	North Penrith (103 hectares)	Campbelltown
	Wetherill Park (162 hectares)	Parramatta
	Minto/Ingleburn (308 hectares)	

Note: Estimates of vacant employment land.

Land requirements to accommodate employment activities generated by the Second Sydney Airport would be modest for all options especially for Options B and C. This is because land designated for employment purposes is available on each airport site. Whichever option is pursued, there is sufficient vacant employment land within the surrounding regions to accommodate forecast growth to 2016.

It is also likely that some growth would be accommodated within existing centres. This would serve as additional impetus for growth in line with State Government policy. Centres likely to benefit would include Liverpool, Campbelltown, Bankstown, Penrith, Blacktown and Parramatta.

10.6.4 Defence Activities

Defence Establishment Orchard Hills

The sites of the airport options are located approximately five kilometres south of Defence Establishment Orchard Hills. The potential risks of an aircraft crashing into this facility, the increased risk of aircraft crashes due to an explosion at the facility, the possibility of Defence personnel being distracted by aircraft passing overhead and the potential for radio transmissions from aircraft affecting electro-explosive devices are examined in *Chapter 19*. These matters will be subject to further consideration by the Department of Transport and Regional Development, in consultation with the Department of Defence, the Civil Aviation Safety Authority, Airservices Australia and the Australian Ordnance Council.

Should the Government proceed with the development of one of the airport options, a decision would need to be made as to whether Defence Establishment Orchard Hills and the airport could co-exist. If they were to co-exist, potential impacts on Defence activities would include:

- the need to cease all explosive demolitions on the site. This would expose Defence personnel working with explosives and the surrounding community to increased risk associated with moving unstable explosives to alternative demolition sites;
- cessation of the use of the rifle range requiring Defence personnel to travel to Holsworthy to conduct weapons training;
- noise impacts on residential accommodation for Defence personnel and families on site and in nearby suburbs. These impacts are outlined in *Chapters 11, 12* and *13*; and
- in the event of an aircraft crashing onto the Orchard Hills facilities, Defence's ability to maintain certain Navy and/or Air Force weapons systems could be diminished for a period of time.

If the Government determines that the risks associated with aircraft overflying Orchard Hills is too great to permit the co-existence of the facility and airport, the facility would have to be relocated. Considerable costs would be incurred to replace the facilities, some of which may only be required for a relatively short period of time because the weapons systems they support may be withdrawn from service in the medium term. The actual costs that would be incurred have yet to be determined.

Bringelly High Frequency Receiving Station

As Defence plans to cease use of the Bringelly facility around the year 2000, the development of an airport would not impact on the present or proposed use of the site. The site, however, could not be offered for private sale if Option C were to proceed as it would be included within the airport boundary. If Options A or B were to proceed the site may be affected by road and rail proposals.

RAAF Base Richmond

Flight paths that may be adopted for the dual operation of Sydney Airport and a second major airport at Badgerys Creek would likely result in changes to other aviation activities in Sydney. For example, general aviation training areas in western Sydney may need to be relocated. While there may be no direct impact on the Richmond Air Traffic Control Zone, the area may be examined in the future as a possible location to accommodate relocated general aviation training areas. Overall, the development of the Second Sydney Airport would likely result in pressure for increased civil use of Richmond' s airspace. The Department of Defence would need to negotiate the use of the airspace to ensure that Defence aviation operations out of Richmond can continue at adequate levels in the future.

10.6.5 Services and Infrastructure

Proposals for Off Airport Site Infrastructure

Alternatives for the provision of road and rail access, water, wastewater, electricity, telecommunications, aviation fuel and natural gas have been considered for the three airport options. Preferred alternatives are described below. Alternative road and rail access proposals and other road network improvements are described in *Chapter 22*.

Proposals for electricity, telecommunications, aviation fuel and natural gas for the three airport options would utilise existing infrastructure but would require new connections via pipelines or transmission lines from existing substations, telephone exchanges, fuel storage facilities and the Sydney-Moomba gas pipeline. These connections would for the most part follow the routes of existing or proposed road corridors and existing electricity transmission lines directly to the airport options. The preferred alternatives for this off airport site infrastructure are shown on *Figure 10.14*.

Major new infrastructure required to support the development of an airport is likely to include a water filtration plant north-west of the airport sites and associated pumping stations and storage reservoirs; and a new sewage treatment works on South Creek. This latter proposal is an alternative to on-site sewage treatment.

Regional Development and Planning

Developing the airport options has significant advantages for regional planning and development. The proposal for a new water filtration plant north of Elizabeth Drive would most likely provide capacity to service developing urban areas in the south of Penrith local government area including Glenmore Park. The provision of a new sewage treatment works on South Creek is consistent with Sydney Water's long term plans for the region.

Proposed road access along Elizabeth Drive linking with the proposed Western Sydney Orbital utilises routes already proposed primarily to achieve planning objectives that are unrelated to the development of the Second Sydney Airport. The proposed Western Sydney Orbital is part of a larger program of transport improvements for the Sydney region. It is part of the National Highway link through Sydney which would also be an integral component of Sydney's road network, completing a high standard orbital road linking major employment and residential areas of Sydney.

Provision of a rail link to the airport site would facilitate urban development to the south and east of Badgerys Creek in both the Liverpool and Camden local government areas. These areas are identified in the current metropolitan strategy *Cities for the 21st Century* (Department of Planning, 1995) as growth areas along with some areas included in the Urban Development Program. The rail link is identified in the *Strategic Rail Plan* (State Rail Authority, 1994). The *Sydney West Airport Sub Region Draft Strategic Plan* (Taskforce on Planning for the Sub Region Surrounding Sydney West Airport, 1996) indicates that a rail connection to an airport at Badgerys Creek is only financially viable, however, if it is supported by urban development. A rail line would also offer significant advantages to developing areas south of Penrith because it could be extended north to provide a cross regional link to the Main Western rail line. As it would use Glenfield as a transfer station, it would also provide additional capacity for the developing areas of Campbelltown (such as Menangle Park and Mt Gilead) and eventually Macarthur South.

10.7 Environmental Management

Significant investigations have been undertaken by a joint Commonwealth, State and local Government Taskforce into an appropriate strategic planning response to the development of an airport similar to Option A or Option B. Should either of these airport options proceed the principles and results of this strategic planning exercise would need to be made available for public comment and then finalised. A decision to proceed with Option C would require some of the strategic planning investigations to recommence.

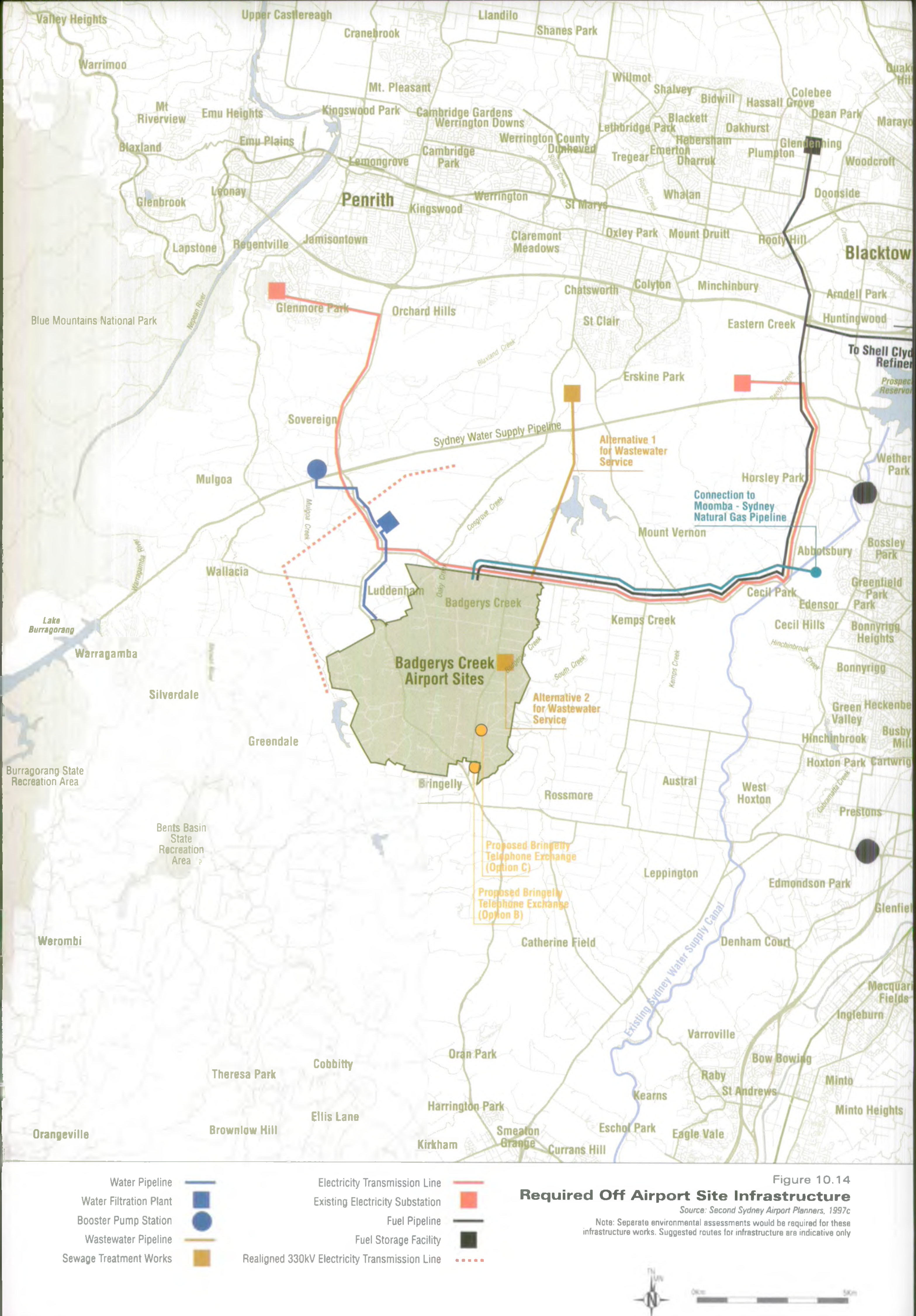


Figure 10.14

Required Off Airport Site Infrastructure

Source: Second Sydney Airport Planners, 1997c

Note: Separate environmental assessments would be required for these infrastructure works. Suggested routes for infrastructure are indicative only

A decision to proceed with any of the airport options would require a body to be established with the authority to coordinate the orderly and economic development of the region. The staging of airport development, the nature of airport operations and the airports relationship with the operation of Sydney Airport would each be critical factors in determining how land use planning, transport planning, environmental management, infrastructure planning, urban form and employment generating development in the region is coordinated, planned and managed. The development of flight paths, for instance, and their relationship to the location of existing and future urban development would require on-going coordinated management of both airport operations and local planning controls.

A framework of statutory planning controls, comprising a combination of State Environmental Planning Policies, Regional Environmental Planning policies, Local Environmental Plans and Development Control Plans, would be needed to guide future development and ensure appropriate land use relationships are created or maintained. Changes to the existing zoning provisions might be required to regulate the land uses within identified noise affected areas in accordance with the Australian Standard 2021 - 1994. Presently, directions made under *Section 117* of the *Environmental Planning and Assessment Act 1979* are the main instrument used to ensure that urban development does not encroach on the existing airport site. In the short term, due to the uncertainty about how the airport may develop and expand in the future, a conservative approach involving the application of greater restrictions to land use planning in areas outside of the 20 ANEC may be appropriate.

10.8 Summary of Impacts on Planning and Land Uses

Development of the Second Sydney Airport would influence urban planning decisions and the resultant nature of land uses in the region surrounding the airport. There are major implications for urban planning, both positive and negative. The positive include the commercial and employment attractions of the airport and supporting urban infrastructure, roads and a rail line. Set against these there are negative impacts on residential amenity, particularly from noise, and the impacts on air and water quality arising from urban development more generally.

Projected population growth with an airport would result in an additional 11,500 persons within the region by 2016. Population growth of this magnitude would not greatly alter the type and scale of urban development planned for the western, south-western and southern regions of Sydney up to 2016. Rural and rural residential areas within the local government areas of Penrith, Liverpool and Fairfield would be affected by relatively high levels of aircraft overflight noise. While this could be expected to slow population growth in these areas the overall impact on population growth would be minor. Should development of urban villages at either Edmonson Park, Bringelly or Rossmore proceed along a proposed rail line to the Second Sydney Airport it could be expected that urban growth in other release areas of Sydney would slow, with population diverted to these villages. The environmental impact of urban development, both planned and projected within the region, and in particular South Creek Valley, would require further detailed investigation to determine ways of minimising the problems inherent in traditional urban development.

The historical imbalance between population and employment growth within the region has meant a reliance on employment outside the region. The Second Sydney Airport is forecast to directly and indirectly generate up to 107,000 jobs. Sufficient vacant employment lands exist to accommodate this growth within the region, with most direct employment capable of being accommodated within the sites of Options B or C.

New connections, mostly following routes of existing or proposed road corridors, would be required to existing services and infrastructure, thereby lessening the environmental impacts normally associated with the provision of infrastructure. A new water filtration plant and sewage treatment plant would be required to service the airport and the developing urban areas in the region.

Impacts on Defence facilities would be limited. The Bringelly High Frequency Receiving Station is programmed to close by the year 2000. Possible relocation of general aviation training areas in western Sydney and the use of airspace would need to be managed to enable the coexistence of RAAF Base Richmond and the Second Sydney Airport. All explosive demolition's at Defence Establishment Orchard Hills would cease should the airport proceed and the continued operation of the facility reviewed.

Development of the Second Sydney Airport would result in a range of direct and indirect land use impacts, including the displacement of commercial rural activities and rural residential development on the sites of the airport options, and within corridors and areas assessed as suitable for future urban development and the provision of associated infrastructure.

Part E

Noise Impacts

Chapter 11

Effects of Aircraft Noise

Chapter 11
Effects of Aircraft Noise

A literature review of the potential effects of aircraft noise was undertaken for this Draft EIS and is documented in Technical Papers No. 3 and 4. The main findings and conclusions of the review are summarised in this chapter. The predicted quantifiable effects of aircraft noise from the airport options being considered on the most relevant health and other issues are addressed in Chapters 12 and 13.

11.1 Issues Raised During Consultation

Comments about the effects of aircraft noise focussed on two key themes, health effects of aircraft noise and impacts on property values, including the availability of compensation.

11.1.1 Health Effects of Aircraft Noise

Comments on health stated that a second major airport development within the Sydney basin would have negative impacts on the health of the communities of western and south-western Sydney. Diminished air quality and increased noise levels were identified as the factors associated with an airport that would contribute most significantly to a decline in the health of residents.

Potential health impacts identified as a result of increased aircraft noise levels included sleep disturbance, stress, and psychological factors such as anxiety, nervousness, irritability, anger and a feeling of powerlessness. It was suggested that information on health risks associated with an airport operation, as documented in *Falling on Deaf Ears?* (Senate Select Committee on Aircraft Noise in Sydney, 1995) should be taken into account in the assessment of the options. Comments quoted from this report or separate submissions to the Committee noted:

- aircraft noise affects sleep patterns and often disturbs sleep;
- intermittent noise such as aircraft overflights is more disturbing than continuous noise;
- older people are generally more disturbed by noise than younger people;
- workplace performance can be reduced by a lack of sleep and feelings of tension;
- aircraft noise has potential impacts on shift workers and their ability to rest;
- symptoms of depression are related to aircraft noise and reduced property values; and
- there would be a rise in general hostility because of the noise disturbance.

Submissions from residents who moved away from existing aircraft noise-affected areas focussed on the effects of sudden and constant exposure to aircraft noise, including a range of physical and psychological symptoms associated with anxiety, sleep disturbance and lifestyle loss. They commented on secondary impacts including financial loss and disruption associated with the potential need to relocate. It was proposed that mitigation of the impacts on community health should include financial compensation for loss of property value, enabling people to choose to move elsewhere. It was suggested too, that compensation would also assist in overcoming the sense of powerlessness and anger that is one of the causes of psychological and physical reactions to aircraft noise.

11.1.2 Property Values

Comments were made on the potential for a relatively large decline in property values; they referred to the effects of the third runway at Sydney Airport which lead to a reduction in property values in noise affected suburbs. It was suggested the Second Sydney Airport would bring about a similar result.

Other comments were made on the time it would take to make a decision about the proposal and the effect of this on decisions about property purchases. It was suggested that individual lives are being put on hold because people are unable to make a decision to buy or sell property in areas potentially affected by the airport options. In addition, impacts were noted as happening already in those areas currently subject to fluctuating real estate prices because of the proposals.

It was requested that impacts on property values be evaluated and the method of calculating impacts be fully explained. It was requested that the wider implications for house and land devaluation in outer western Sydney suburbs be assessed, as this area is essentially the last remaining land available for Sydney's urban expansion. It was commented that the airport proposals would sterilise available land, now and for the future.

Information was requested on how people might apply for compensation for loss of property value. There is an expectation that compensation would be provided. It was commented that some people would make a substantial profit from the proposals, and some people would suffer to the extent that their lifestyle would become unbearable, and that this latter group must be compensated at values prior to the proposal or alternatively be compensated for full relocation.

11.2 Measuring Noise

11.2.1 General Measures of Noise

For the purposes of this Draft EIS, noise may be defined as *unwanted sound*. Many characteristics of sound affect human response including loudness, pitch, duration of the sound, rate of increase of the sound and tonality. Other factors also influence human response such as the time of day, perceived controllability of the noise and whether the noise is viewed as a signal for alarm.

Most noise in the community is measured in decibels (dB). The ear responds to pressure fluctuations in the air; the range it can detect lies between approximately 0.00002 pascals and approximately 600 pascals, a large range and one that is difficult to use as a measure in practical situations. For this reason, the decibel scale was introduced relying on a logarithmic function. It is an unusual scale because the noise levels do not appear to relate to the loudness of a noise. For example, if a noise is increased by 10 dB, say from 60 dB to 70 dB, then the noise appears to be approximately twice as loud. Equally, two noise sources each of which generates a noise level of 60 dB at a particular point do not result in a total level of 120 dB, but a total level of 63 dB.

Because the ear responds to different tones of noise (frequencies) in different ways, the A-weighted decibel measure (dBA) has been developed. The dBA measure gives a close mathematical representation to the perceived loudness of any noise. Some typical noise levels measured in dBA are shown in *Figure 11.1*. Since the noise level generally falls off with increasing distance from any noise source, the figure also shows a distance from the noise source at which the particular level would be heard.

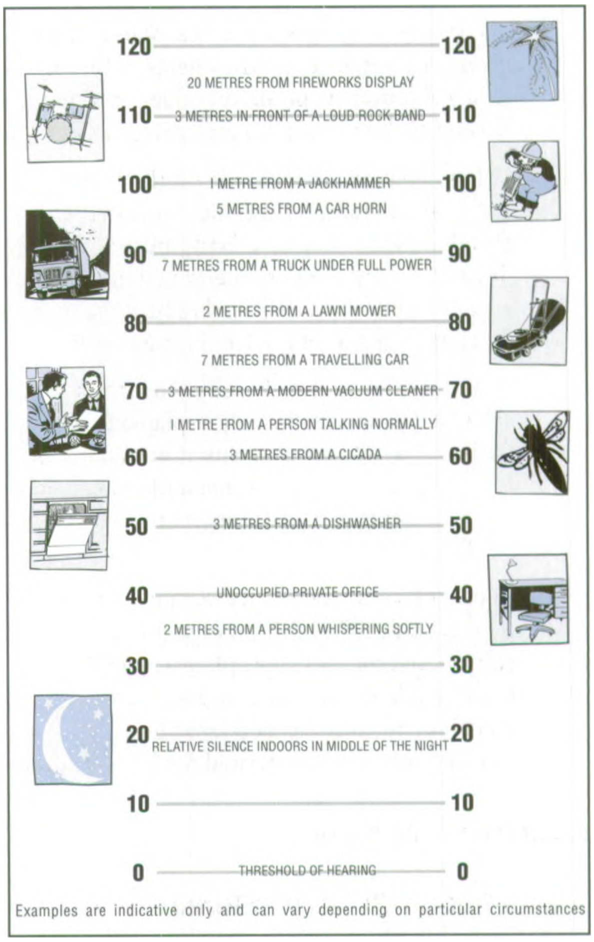


Figure 11.1
Typical Noise Levels [dBA]

The dBA scale is suited to the measurement of steady (non-varying) noise. Most noise environments within the community, however, involve noise levels that vary continually, such as motor vehicles passing, aircraft flying overhead, people talking, and wind in the trees. For this reason, noise descriptors have been developed to allow interpretation of such typical noise environments.

It is sometimes useful to convert the measurement of varying noise to an equivalent continuous noise level for a given period of time. This is called *Equivalent Continuous Sound Level* or L_{Aeq}. It is measured in dBA. It is often used to determine the noise level over a 24 hour period but it can be calculated over any time period, such as night time between 10.00 pm and 6.00 am.

11.2.2 Measures of Aircraft Overflight Noise

Most areas around airports that are affected by aircraft noise experience a series of relatively high noise levels generated as aircraft fly overhead, separated by significant periods of lower background or ambient noise levels. Suitable aircraft noise descriptors are therefore needed to take account of this type of noise environment.

The relationship between the response of a community affected by aircraft noise and the noise itself is complex. The noise is changeable; it comes and goes and the amount of noise can vary from day to day, depending on the way the airport is operated. Surveys have also found a large variation in individual response. Some people are highly sensitive to noise while others are less so.

The most common measure of aircraft noise exposure in Australia is the Australian noise exposure forecast system. This measurement takes into account the noise level of each aircraft passing overhead, the number of these movements and the time of day or night. The system was originally designed for planning the use of land near airports rather than providing all the information required to explain potential noise impacts on residents surrounding airports.

The approach developed for measuring aircraft overflight noise in a community is similar to the methods used to describe the noise impact on communities of factories, roads and other land uses. These estimate the total amount of noise the community has been exposed to over a given period of time; the results are then generally displayed in the form of contours on a map.

Australian Noise Exposure Forecast (ANEF) contours are certainly useful in assisting with future land use planning but they have limitations when used to describe noise impacts. For example, the contours become less accurate as the distance from the airport increases because flight paths and aircraft altitudes become more difficult to predict. Moreover, ANEF contours do not allow the community to understand the potential noise impacts due to individual aircraft overflights.

There are three different types of aircraft noise exposure measures produced under the ANEF system depending on the purpose for which the measures is required. The different types are:

- Australian Noise Exposure Forecast (ANEF) which shows the forecast of noise exposure for some future year;
- Australian Noise Exposure Concept (ANEC), which is used to describe potential impacts of an airport development and is based on indicative data on aircraft types, flight paths, etc; and
- Australian Noise Exposure Index (ANEI), which is based on actual flight data from a previous year. It shows the average daily aircraft noise exposure for that year.

Chapter 12 and *Technical Paper No. 3* provide contours using the ANEC measure for each proposed airport option. These data have been used to indicate the impacts of aircraft noise for future land use planning.

An alternative way of describing aircraft noise is to refer to the maximum noise level of the particular aircraft. This is the highest noise level that occurs as the aircraft flies over and it is commonly measured in dBA.

High maximum noise levels from aircraft flying low over communities cause a number of impacts, including disruption to normal conversation, interference with television viewing and disturbance to sleep. The maximum noise levels from aircraft that may occur in particular communities and the number of times these levels occur allow an estimate of speech and sleep interference to be made. *Chapter 12* and *Technical Paper No. 3* provide estimates of the number of aircraft movements and the maximum noise levels of those movements over a large number of communities.

Ways of measuring aircraft noise that convert numbers of individual overflights to a cumulative measure such as ANEC and L_{Aeq}, do not provide a good indication of potential impacts such as disturbance to conversation, sleep or teaching at schools. A significant amount of research into noise induced sleep disturbance over recent years has identified the following factors as contributing to the degree of disturbance:

- maximum noise levels of individual noise events;
- number of noise events;
- *emergence* of the maximum noise levels above the general background noise; and
- duration of the individual noise events.

A method for the assessment of sleep disturbance using a descriptor termed *Sleep Disturbance Index* has recently been developed (Bullen, Hede and Williams, 1996). The Sleep Disturbance Index is numerically equivalent to the estimated average number of noise induced awakenings during one night. The method assumes, at least for low numbers of events, that the number of noise induced awakenings is proportional to the number of noise events.

Although the Sleep Disturbance Index provides a method of comparing the level of sleep disturbance at various locations and for various airport operational conditions, there are as yet no firm guidelines or criteria regarding acceptability. Some context can be provided to this assessment by noting that current understanding of sleeping patterns indicates that on average people have about 1.5 awakenings each night for reasons unrelated to noise (Bullen, Hede and Williams, 1996).

11.3 Effects of Aircraft Noise on People

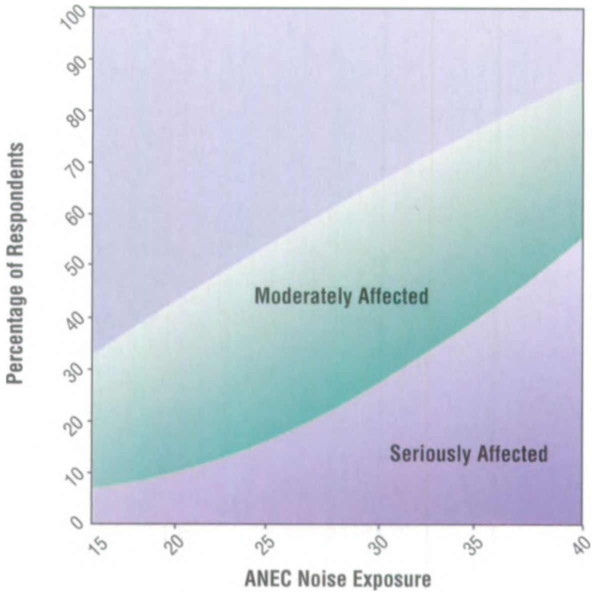
11.3.1 Reaction to Aircraft Noise

The effect of aircraft overflight noise can, in part, be measured by the degree of reaction or annoyance caused within residential communities. This is generally assessed using social survey techniques, by asking people to rate how much they are 'annoyed' or 'affected' by aircraft noise in their area. In such studies, it has been consistently found that there is a high degree of individual variation in residents' reaction to aircraft noise. For this reason, results are generally quoted in terms of the proportion of people experiencing a particular level of reaction.

Around major airports the majority of the population perceive noise as disturbing to at least some daily activities. Although large individual variations in reaction exist, relationships between the level of aircraft noise and people's reactions have been studied and conclusions drawn. The most accepted conclusions are based on the results of two major Australian studies of aircraft noise (Hede and Bullen, 1982; and Bullen, Job and Burgess, 1985). These studies led to the development of *Australian Standard 2021-1994*, from which the relationship shown in *Figure 11.2*, between ANEC levels and the proportion of people who could be described as 'seriously affected' and 'moderately affected' is described.

Figure 11.2 has been developed from surveys of people living around existing Australian airports. As expected, it shows that people react differently to different levels of noise. For example about 10 percent of respondents to the survey indicated they regarded themselves as being seriously affected and about 45 percent considered themselves moderately affected by a noise exposure of 20 ANEC. At 25 ANEC almost 20 percent considered themselves seriously affected and over 55 percent regarded themselves as moderately affected.

Although 20 ANEC is the lowest level generally plotted on contour maps, *Figure 11.2* shows that noise levels below this may still have a significant effect on residential communities.



The above figure indicates the relationship between levels of community response to aircraft noise and the ANEC measure. People react differently to different levels of noise. In a study undertaken by the National Acoustic Laboratories approximately 10% of people regarded themselves as being seriously affected by noise and 45% regarded themselves as being moderately affected at a noise exposure of 20 ANEC. At 25 ANEC almost 20% of respondents were seriously affected and over 55% regarded themselves as moderately affected.

Figure 11.2

General Reactions to Aircraft Noise

Source: Australian Standard 2021

The likelihood of a negative reaction to aircraft noise is increased for people who have a negative attitude to the noise source (aircraft, the airport or airport authorities); for individuals who are fearful of the health and/or safety impacts of aircraft noise; for noise-sensitive individuals; and for those who view the noise as uncontrollable. Australian data suggest that older residents are less likely than younger residents to report negative reactions to the noise, although the effect of age is quite small.

Low frequency aircraft noise, particularly at high levels, can cause minor vibration of building components due to the resonant interaction with those components. While the perception of this vibration is different from that of noise, the relationship shown in *Figure 11.2* accounts, in general, for this effect.

11.3.2 Adaptation to Aircraft Noise

While adaptation to noise might be expected to occur, evidence suggests that only some responses to noise adapt with time. Some sleep disturbances apparently adapt. However, many sleep effects and reaction (annoyance, etc) do not appear to adapt.

Evidence exists (Geoplan, 1992; Griffiths and Raw, 1986; and Brown, 1987) that communities with previous exposure to noise are likely to demonstrate lower average reaction from a particular noise level than other communities without pre-exposure. The difference may well result from the fact that, over a period of time, residents who are genuinely less sensitive to noise move into noise affected areas whereas those who are more sensitive to noise tend to move out. The overall result is that the communities in the noise affected areas are generally less sensitive to noise than those who choose to live in the quieter areas.

The studies noted above have estimated that there is a difference in sensitivity to noise between pre-exposed communities and newly exposed communities. The general findings are that this difference can be accounted for by a noise level difference of about eight decibels. In the case of aircraft noise, this can be interpreted as a noise level difference of eight ANEC points.

Figure 11.3 demonstrates the likely relationship between ANEC and the percentage of residents who may regard themselves as being seriously or moderately affected within those areas around a Second Sydney Airport where there would be an abrupt change in the noise environment from what they had been accustomed to. This figure has been prepared by adjusting *Figure 11.2* by eight ANEC points.

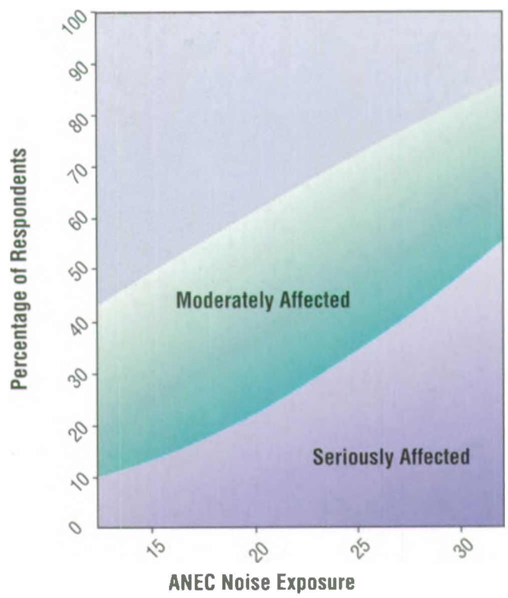


Figure 11.3
Reaction to Aircraft Noise in Newly Exposed Areas

It cannot be assumed that the opening of a Second Sydney Airport would result in an abrupt change to the noise environment, since the number of aircraft movements at the airport is likely to increase gradually over a period of time. Nevertheless, the presence of the airport would result in a significant change in the noise environment over the medium term.

Following the opening of a Second Sydney Airport, it is likely that community reaction would fall somewhere between *Figure 11.2* and *Figure 11.3*. The research is unclear as to the time required for full adaptation of a community and therefore the time at which the community reaction would be generally in accordance with *Figure 11.2* is not fully known. When the second parallel runway and cross wind runway were constructed and commenced operation, further communities would be newly affected by noise and, in this case, the buildup of noise would be faster than that following the opening of the first runway. Again, these newly affected communities are likely to demonstrate a reaction somewhere between *Figure 11.2* and *Figure 11.3*, ultimately changing to somewhere around that shown in *Figure 11.2* after time for adaptation.

11.3.3 Health Effects

The following discussion has been developed from a search of Australian and international literature which is documented in *Technical Paper No. 3*. Health was considered from the point of view of the broad World Health Organisation definition, namely 'not merely the absence of disease or infirmity but ... a positive state of physical, mental and social well-being' (World Health Organisation, 1994).

Numerous methods have been used to study the effects of noise on people, including both laboratory and field studies. Notwithstanding the vast number of studies, many of them suffer from flawed methodologies, which limit the applicability of their findings. Despite these research problems, it is possible to draw reasonable conclusions regarding the effects of noise on people, and the current state of knowledge on this subject is summarised below.

Vulnerable groups have been identified for a range of potential outcomes of aircraft noise. However, people in other groups may also be vulnerable if they are sick, have impaired sleeping functions, are more sensitive to noise, or are subject to other environmental pressures.

Effects on Hearing

Relatively high noise levels can cause hearing loss after an extended period of exposure. This is particularly relevant in the work place, where some work personnel are exposed to high noise levels for much of their working day.

Australian Standard 1269-1989 provides information which allows an assessment of the effects of noise exposure over a period of time on hearing performance. A constant level or an L_{Aeq} level of 80 dBA during eight hours of each working day over a lifetime, is likely to result in a hearing impairment of approximately two decibels in five percent of the population.

The level of 80 dBA during an eight hour day is equivalent (in terms of hearing loss prediction) to a level of 75 dBA over a 24 hour day. It would therefore follow that, to substantially avoid hearing loss in the population, an overall $L_{Aeq,\,24\,hour}$ level less than 75 dBA (approximately equivalent to 40 ANEC) would be required.

In some cases, levels of noise experienced in the home may add to those experienced in the workforce. The worst case would be represented by a worker in a noisy night-shift occupation, who would also experience daytime aircraft noise at home. In this case, to avoid additive effects, exposure in the home may need to be limited to an $L_{Aeq,\,24\,hour}$ level of 70 dBA.

This is generally consistent with the US Environmental Protection Agency's recommendation of 70 dBA $L_{Aeq,\ 24\ hour}$ as a maximum, to avoid hearing loss within the community.

Evidence for permanent hearing loss resulting from typical exposures to aircraft noise is inconclusive and there is no relationship between aircraft sound levels and the hearing ability of residents, including children. While a continuous equivalent level of 75 dBA (ANEC 40) is unlikely to be exceeded by aircraft noise in a residential setting around airports, aircraft noise could contribute to permanent hearing loss when combined with other residential, recreational or occupational noise exposures or with ototoxic drugs or chemicals (which are not uncommon).

Sounds may be uncomfortable at levels of 80 to 100 dBA, while the threshold for aural pain is around 110 to 130 dBA, with large individual differences in sensitivity. Thus, residents close to airports may experience discomfort but are not likely to experience pain. Susceptible people such as those with certain abnormalities including inflammation or hearing aids not adjusted to limit the sound pressure level, may experience discomfort or pain at lower levels.

Psychological Health

Evidence of the effects of noise on psychological health is not consistent and is methodologically difficult to obtain, but suggests that aircraft noise may be harmful to mental health.

Individuals with pre-existing tendencies to mental illness are more likely to demonstrate psychiatric illness as a result of exposure to noise. It is not clear whether mental illness is exacerbated and/or whether some new mental illness is initiated. Research indicates that certain groups (for example, highly anxious residents) may be more susceptible to mental illness associated with noise. However, it is not clear whether these anxious people should be regarded as having an illness that is exacerbated, or being predisposed to mental illness by their underlying anxiety. Noise sensitivity has also been found to be a risk factor for noise induced psychiatric illness, but may itself be a marker of depression. Individuals who perceive the noise as uncontrollable may be at increased risk of feelings of helplessness and depression.

Other Health Effects

Other health effects that are sometimes linked to aircraft noise include balance and visual effects; startle and orienting responses; heart and circulatory systems effects and hormonal effects. The conclusions of the literature search in regard to these potential effects are summarised below.

Aircraft overflight noise is unlikely to affect people's balance, although some effects may be experienced by people with pre-existing damage to their hearing system. Effects on vision are also considered unlikely.

People are only likely to be startled by aircraft noise when they fear that noise. Unlike other noise effects, an individual's likelihood to startle reduces as he or she becomes accustomed to the noise events. People who are more sensitive to noise are more likely to be startled.

Sonic booms from aircraft can startle people. Sonic booms are caused by a very small number of aircraft capable of going faster than the speed of sound such as Department of Defence aircraft and the Concorde. Very few of these aircraft would use the Second Sydney Airport and they are restricted to sub-sonic speeds over the Sydney region.

Noise may evoke a number of reflexive responses through that part of the nervous system which regulates bodily functions. Repetition of these responses may result in permanent changes such as elevated blood pressure and coronary heart disease. Noise produces acute (short term) narrowing of the blood vessels (vasoconstriction), increased blood pressure and increased heart rate. In children vasoconstriction may occur with aircraft noise of 70 dBA.

Noise generally causes an acute increase in blood pressure. Community studies of aircraft noise (for example, Cohen et al, 1986; Ising et al, 1980; Knipschild, 1977a, 1977b; Knipschild and Oudshoorn, 1977) suggest elevated blood pressure in children and possible elevations and greater antihypertensive medication use in adults exposed to aircraft noise. Claims of other cardiovascular effects of aircraft noise generally are limited by poor methodology. There is a study of communities around Sydney Airport currently underway which is examining the effect of noise on blood pressure of children. At this stage only baseline data has been collected.

Type A personalities are regarded as being more susceptible to heart and circulatory system effects generally characterised by hostility and aggression. This effect may also be evident for women, those with a family history of elevated blood pressure, people with additional exposure to non-aircraft noise (workers in noisy industries for example) and those who perceive aircraft noise to be uncontrollable or to be a signal of danger.

Noise causes increases in endocrine hormones such as catecholamines, which influence the heart and circulatory system and immune systems. Noise is a stressor, and stressors depress immune system functioning. However, evidence of effects of noise on immunity, other than through sleep loss, are inconclusive.

Suggestions of increased mortality as a result of aircraft noise are based on poorly controlled investigations. Similarly, effects of noise on the health of unborn or newly born infants cannot be determined with confidence from the reported investigations, which suffer from confounding factors.

Finally, no studies have determined whether the effects of noise on people in hospitals or nursing homes are greater (for example, because they are already old or ill) or lesser (for example, because they are able to rest more throughout the day or night) than the general population.

11.3.4 Disturbance to Sleep, Communication and Performance of Tasks

Sleep Disturbance

The prominent and well established effects of noise (including aircraft noise) include disturbance to sleep. Effects on sleep may be caused by intermittent noise that occurs at 45 dBA indoors or at lower levels (40 dBA) in quiet background conditions.

It has been suggested that shift workers may be more at risk of aircraft noise-induced sleep disturbances than the general population, because they sleep during the day, when there may be more aircraft noise events and sleep tends to be lighter. There is insufficient data, however, to identify whether shift workers are at increased risk of aircraft noise-induced sleep disturbance over and above their exposure to general noise when they are trying to sleep during the day.

The probability of awakening as a result of noise increases with age, whereas children are more likely than adults to demonstrate a heart rate response for a given sound level. Women are probably more sensitive to noise-induced sleep disturbance than men. Evidence also suggests that anxiety and noise sensitivity may increase susceptibility to sleep disturbance.

Communication Disturbance

Aircraft overflight noise has the potential to disturb voice communication within residential areas, schools, churches, commercial buildings and in some public buildings where communication is important. Most of this communication occurs within the building, but some occurs in outdoor areas, such as residential backyards, playgrounds and at outdoor sporting facilities.

Within the domestic environment, the disturbance could take the form of interference to personal conversation, television viewing, radio listening or telephone conversation. Such interference can be generally addressed by considering the likely disturbance to conversation.

A number of laboratory studies have been carried out into speech interference by intruding noise (Webster, 1979). These studies show that a normal voice (inside) provides satisfactory communication at a distance of two metres provided the intruding background noise level does not exceed 60 dBA. To ensure total intelligibility, however, the background noise level should not exceed 40 dBA. A raised voice will provide the same standard in the same background noise at a distance of four metres. Since television is commonly set to the same level as a raised voice, and radio may often be set even higher, 60 dBA represents the level at which intruding aircraft noise begins to cause significant disturbance to voice communication in domestic situations. This level of 60 dBA, measured indoors with the windows open, is the equivalent of an outdoor level of about 70 dBA; for outdoor communication the external level is, of course, the relevant one.

The degree of disturbance to voice communication indoors from aircraft flying overhead will depend upon the number of times, and the duration, the noise levels exceed 70 dBA (measured outside the residence); for outdoor communication the level that should not be exceeded in 60 dBA. Since each overflight produces near maximum noise levels for a few seconds, depending upon the height and speed of the aircraft, the number of aircraft movements with maximum levels exceeding these values will generally indicate the degree of disturbance.

Although these levels have been determined for domestic situations, they are generally applicable to other situations such as commercial premises and libraries where windows may be left open. For buildings, mainly commercial and public buildings, where windows are fixed or kept closed, higher external noise levels are used for the assessment of communication disturbance.

However, in some more acoustically sensitive buildings, lower noise level thresholds from aircraft overflights are appropriate. In classrooms and churches, speakers normally use a raised voice or project their voice; the following maximum internal aircraft noise levels will just allow communication over the distances indicated:

- at 55 dBA speech in classrooms is audible and intelligible over a distance of eight metres; and
- at 50 dBA speech in churches is audible and intelligible over a distance of 20 metres.

These internal noise levels are those recommended in *Australian Standard 2021-1994* for normal domestic areas within houses, teaching areas within schools, and churches. The levels recommended in this Australian Standard for commercial buildings of 55 dBA for a private office and 65 dBA for an open office, are generally consistent with the 60 dBA internal noise level discussed above.

Certain groups may be more susceptible to the effects of intruding noise on their ability to understand speech. They include the hearing impaired, the elderly, young children and people for whom the language being spoken is not their own first language. For these groups, intruding noise levels would need to be five to 10 dB lower to ensure satisfactory communication.

A summary of aircraft noise levels likely to disturb communication is provided in *Table 11.1*.

Table 11.1 Outside Aircraft Noise Levels Likely to Cause Significant Disturbance to Communication

Playgrounds, Residential Backyards, Outdoor Restaurants, University Campuses, etc	60dBA[1]
Inside Homes, Libraries, Commercial Buildings with Windows Open	70dBA[1]
Classrooms with Windows Open	65dBA[1]
Churches with Windows Open[2]	60dBA[1]

Source: Broadbent (1979) and Australian Standard 2021-1994
Notes: 1. Noise levels would need to be five to 10 dB lower to ensure satisfactory communication for some groups such as the hearing impaired, the elderly, young children and people for whom the language being spoken is not their first.
2. Assumes no electronic public address system.

Interference With Tasks

Noise may improve or impair task performance. It may improve the performance of people who are tired (low arousal), by raising their arousal to a more optimal level. In contrast, noise has been found generally to impair cognition and reading in children, especially those in higher school years. Noise sensitivity increases the probability that noise exposure will interfere with task performance and reduce productivity.

11.3.5 Effects of Aircraft Noise on Enjoyment of Natural Areas

The western and southern regions of Sydney contain and are adjoined by significant areas of natural bushland. They include national parks, State recreation areas, and Sydney Water's protected catchment areas (*Figure 11.4*). Noise from aircraft overflights associated with the proposed Second Sydney Airport has the potential to affect people who seek to enjoy the natural characteristics of these areas, although it is noted that access to Sydney Water's protected catchment areas is generally restricted.

The natural areas in question are visited, at least from time to time, by people for the purpose of bush walking, recreation and camping. Although it is unlikely that there would be many people within each area at any time, the people in question are endeavouring to engage in an experience that is close to nature, and are likely to be more sensitive to noise than residents in normal domestic situations.

For the purposes of this environmental assessment, natural areas are considered to be those areas where nature predominates and there are few signs of human activity. In

National Parks and Recreation Areas

Natural areas within Holsworthy Military Area

Water Catchment Areas

Urban Areas (indicated by local roads)

Figure 11.4

Natural Areas Surrounding Airport Options

Source: National Parks and Wildlife Service and Sydney Water general this implies that significant amounts of aircraft noise are not compatible with natural areas. For wilderness areas, the principle of *natural quiet* has been advocated, particularly within the United States.

There is limited information regarding the impacts of aircraft overflight noise on visitors to wilderness areas. The most meaningful information is included in a report to the US Congress prepared by the United States Department of Agriculture Forest Service (1992). This report is the culmination of a number of investigations into a range of issues associated with aircraft overflights of natural areas, including noise impacts. The most relevant conclusions of the report are:

- three of the most mentioned reasons for visiting natural areas were experiencing peace and quiet, viewing scenic vistas without hearing sounds of civilisation and hearing the sounds of nature;
- for the same level of aircraft noise exposure, the prevalence of annoyance among respondents was greater than that of residential populations; and
- a theory based interpretation of the reactions of respondents to aircraft noise exposure suggests that people are approximately 10 decibels less tolerant of noise in natural settings than in residential settings.

In relation to aircraft noise descriptors, the third conclusion does not automatically lead to a clear interpretation. It is likely that respondents in natural areas are 10 decibels less tolerant of noise than those pre-exposed populations whose response is indicated in *Figure 11.2*. This is roughly equivalent to the response indicated by *Figure 11.3* for previously unexposed populations.

11.4 Effects of Aircraft Noise on Property Values

There have been many studies of aircraft noise impacts on property values overseas and several in Australia. The most recent Australian studies were associated with the *Proposed Third Runway Sydney (Kingsford Smith) Airport, Draft Environmental Impact Statement* (Kinhill, 1990).

Virtually all previous research has used ANEF measures which take account of the intensity and duration of aircraft noise events, frequency of events and their distribution between day and night. The contribution of aircraft noise to property values is frequently estimated using cross sectional studies, often described as hedonic price models which measure the effects of housing and environmental characteristics on house prices at a given time. Other techniques can be used such as interviews with households or real estate agents and analysis of house price movements between areas over time when a change in aircraft noise has occurred.

For this Draft EIS, a review of both quantitative and qualitative methods of assessing property value impacts, and also a review of past results from both Sydney Airport and other studies were undertaken. Given that the three proposed airport options would generate aircraft movements over areas generally not affected by high aircraft noise levels, the assessment of noise impacts on property values was based on existing airport related research. Also, given the variability of results associated with overseas studies, these were not adopted for this analysis. In contrast, the results from studies of Sydney Airport were considered more consistent and directly comparable.

The opening of the Sydney Airport third runway provides a basis on which to test the results of previous research. It also allows for a *before* and *after* assessment of housing value changes at various points along the flight paths.

Large areas under the flight paths associated with the proposed Second Sydney Airport options are below ANEC 20. The statistical significance of the results from previous studies at ANEC levels under 20 has been consistently very low. Nevertheless it is important to establish, at least approximately, whether or not there is likely to be any effect on housing prices below ANEC 20.

Investigations into the potential property value effects of the Second Sydney Airport as outlined in *Technical Paper No. 4* involved:

- utilisation of results from previous research undertaken in the vicinity of Sydney Airport;
- analysis of price movements in selected areas under existing and new Sydney Airport flight paths, before and after the opening of the third runway; this was broadly undertaken using data at postcode level and followed by a more specific analysis using areas defined by ANEI levels; and
- a qualitative analysis of perceptions of the impact of aircraft noise on property values in areas where ANEI levels are below 20, based on surveys of real estate agents and valuers.

11.4.1 Past Results for Sydney Airport

Previous research (BIS Shrapnel, 1990) suggests that the opening of the third runway at Sydney Airport would have reduced housing prices in areas under existing and new flight paths to the north of the airport and increased values in areas previously affected by the east-west runway because of its limited use in late 1994.

Analysis of the changes in property values between 1992 and September 1996 does not provide a basis for firm conclusions; however, it does provide some evidence as to what level of aircraft noise (ANEC) constitutes a reasonable cut-off point for estimating any likely impact on housing values. Based on the analysis undertaken, the following conclusions were drawn:

- there was a high level of variability in the effects of changes in aircraft noise caused by the opening of the third runway at Sydney Airport. The variability of results at the small area level was due in part to the different characteristics of the housing stock, relatively small number of sales and the influence of other factors; for instance, on the one hand, recent years saw an increasing popularity in inner suburbs real estate but, on the other hand, the year 1995 coincided with a general housing market slow-down;
- several areas such as Marrickville (1995 ANEI 30-35) and Drummoyne (1995 ANEI 20-25) displayed a significant housing price shift between 1994 and 1995. However, nearby areas such as Marrickville/Stanmore (1995 ANEI 25-30) and Petersham, Enmore, Lilyfield and Leichhardt did not appear to suffer any housing price impact in 1994/95;
- the analysis suggests that an ANEC 20 cut-off for housing price impacts may be too high, especially in areas with higher priced housing. A price effect was evident in the 15-20 ANEI band following the opening of the third runway; and
- the results do support previous research that higher priced areas are more likely to suffer a greater percentage price effect from changes in aircraft noise.

11.4.2 Survey of Real Estate Agents

A survey of real estate agents was undertaken to gather further information on the likely impacts of aircraft noise and overflying in areas below the ANEC 20 level. They were asked to compare the expected current sale price of identical dwellings in two nearby areas; one under the flight path within the 10 to 15, 15 to 20 or 20 to 25 ANEI (1995) and another area below 10 ANEI, which was used as a control area.

A survey of this type could not provide results in a precise statistical form because in each locality there were only a few real estate agents. Hence the results are not intended to be definitive, but rather provide further input to the analysis, and put the median and mean price analysis into context.

Given identical properties in the subject and control areas, the majority of real estate agents believed the impact of aircraft noise explained between zero percent and 25 percent of the difference in values. The remaining differences in values were explained by other environmental and amenity factors.

As a result there was considerable variation in the estimated impact of aircraft noise in each interview area. Maximum impacts were generally below three percent. In many areas at least one agent believed noise had no effect on relative values. If selected at all, aircraft noise was never the most important contributor to house price differences. The results of the survey suggest that aircraft noise may affect the values of dwellings under the 20 ANEC but the effect is likely to be quite small.

11.4.3 Devaluation Estimates

Generally, the research conducted in Australia and overseas points to a significant negative influence of aircraft noise and overflying on housing values. However, the results of previous research and that undertaken for this study are highly variable. The assumed housing price devaluation rates used in this study to determine the forecast change in property values as a result of the proposed Second Sydney Airport are summarised in *Table 11.2*.

Table 11.2 Housing Price Devaluation Factors

ANEC Band[1]	Devaluation Range	Assumed Devaluation[2]
Under 15	Nil	Nil
15-20	0 to -6%	-3%
20-25	-5.9% to -13.6%	-8%
25-30	-8.6% to 19.6%	-15%
30-35	-10.9% to -24.3%	-20%

Notes: 1. No devaluation estimates for ANEC >35 because dwellings located in this noise level are assumed to be acquired.
2. Compared to under 15 ANEC.

The assumed devaluation factors above 30 ANEC are slightly higher than those previously adopted in the *Proposed Third Runway, Sydney (Kingsford Smith) Airport, Draft Environmental Impact Statement* (Kinhill, 1990). A higher devaluation factor close to the airport was used because analysis undertaken previously (JLW Research and Consultancy, 1993) showed house prices were more seriously affected within very close proximity to the airport. There was also a more significant fall in prices between 1994 and 1995 in these areas. This suggests a higher sensitivity to increased noise events very close to the airport.

In the 20 to 25 and 25 to 30 ANEC ranges, assumed devaluation factors compared to sub ANEC 10 areas are eight percent and 15 percent respectively. These are in line with previous analysis (BIS Shrapnel, 1990).

Under ANEC 20 any price impacts are likely to be quite low and highly variable depending upon the locality. The results from the analysis show that some areas of Sydney such as West Lane Cove experienced a fall in housing prices in 1995 following the opening of the Sydney Airport third runway, but prices recovered in 1996. In other areas under the 20 ANEI the increase in aircraft noise in 1995 had no apparent impact on prices. The survey of real estate agents likewise revealed a wide range of opinions, but provided support for some price impacts below 20 ANEI. It is also recognised that most areas that would be overflown as a result of the proposed Second Sydney Airport would be under flight paths for the first time, and community awareness of aircraft noise would be likely to turn very high. Hence a three percent price reduction is assumed for properties in the 15 to 20 ANEC.

11.4.4 Estimating Property Value Impacts

The effects of aircraft noise and overflying on residential property values have been estimated for each airport option. The analysis is based on Air Traffic Forecast 3 and the results are provided as a range, representing the potential effects of different airport operating scenarios. For each airport option, the devaluation estimates described in the previous section were applied to dwelling values in areas with noise exposure of ANEC 15 to 20, 20 to 25, 25 to 30 and 30 to 35. No devaluation has been included for dwellings with noise exposure above ANEC 35 as it is assumed that these dwellings would be acquired. The total net devaluation for each airport option at 2016 was then derived by applying total dwelling forecasts for that year.

The output for each airport option is the aggregate net devaluation on residential dwellings for 2016. This is provided in *Chapter 12*.

11.5 Effects of Aircraft Noise on Wildlife

Little is known about the effects of noise on wildlife, in view of the diverse reactions that might be expected from the different species, and the different levels and character of noise likely to be experienced. Even in general terms, it is very difficult to comment on the effects of noise on animals. There are numerous species of birds, insects, mammals and others, all of which vary greatly in psychology, habitat and behavioural patterns.

Throughout this diverse group, the most important effect of noise would be possible masking of communication signals. However, interference with mating is also a major issue, if noise interfered with recognition calls or inhibited mating by producing a generally disturbed, startled response.

In interpreting the effect of human made noise upon wildlife, it should not be assumed that the natural environment is silent. For example, a large waterfall sets up a continuous loud noise. Species living in dense and large colonies, for example, Sulphur Crested Cockatoos, produce social noises that are often very loud. Further, there are many examples in the literature of the adaptation of animals to high noise levels. A few examples may be listed here:

- dolphins appear to be attracted to ships, including warships sailing at full speed;

- birds appear to rapidly adapt to living with explosive devices designed to frighten them from orchards and airport runways; and
- rats and mice often live in noisy subways and manufacturing plants.

A report to the US Congress prepared by the United States Department of Agriculture Forest Service (1992) documents a literature search into the effects of aircraft overflights on wildlife. It draws the conclusion that invertebrates, fish, reptiles and amphibians are likely to be affected by aircraft noise to a minor degree. However, few studies have been done on this topic.

Some studies have reported effects on egg laying and reproduction in birds due to human intrusion. Studies found that some birds avoided unpredictable noise, but appeared to return after the noise had ceased. Overall, there appears to be little evidence that aircraft noise affects bird reproduction.

Noise is reported to affect some mammals. Rodents found at airports appear not to demonstrate any significant effect from high levels of noise; but if the same animals are taken into a laboratory and subjected to high noise levels they have exhibited stress, although their reproduction has not necessarily been affected.

Carnivores are well known to respond intelligently to human intrusion, but the effect of aircraft noise on these animals is not thoroughly understood; there is no evidence, however, that their sleep is disturbed by aircraft noise.

Several studies have reported on the effect of aircraft noise on large herbivores, including domestic animals. These animals react to aircraft noise, but there is no evidence of an affect upon reproduction. Aircraft overflights at distances of 50 to 100 metres have produced reaction in large herbivores, but the reactions falls off quickly with increasing distance.

Overall, studies have found that human intrusion and habitat destruction has had a profound impact on animals. It is therefore commonly assumed that aircraft overflights are equally damaging. However, the literature suggests that animals respond differently to aircraft overflights. While overflights can be startling, animals often adapt to them very well under most circumstances.

The findings of studies into the impacts of noise on wildlife researched for this Draft EIS did not provide any clear relationship of behaviour to quantified noise levels. It must be assumed at this stage that it is not known how much bearing noise levels have on wildlife behaviour.

The research points to the same conclusion for domestic animals and birds, namely, that there is no known relationship between noise levels and behaviour. However, there is anecdotal evidence that horses can be affected by high noise levels, as can domestic birds such as chickens and turkeys.

11.6 Conclusions

While a number of potential impacts of aircraft noise have been conjectured on, research at this stage does not provide sufficient information about many of its likely impacts on particular vulnerable groups to be useful in predictions. It does, however, show there are some impacts that can reasonably be predicted. These may be summarised as follows:

- sleep disturbance, which may be predicted using the Sleep Disturbance Index;
- impairment of voice communication, which may be predicted by the number of external noise events of loudness of 65 dBA to 70 dBA and above;

- emotional reaction, which may be predicted by the ANEC measure. In this case, it is important to recognise that exposure to new noise or changes to noise exposure are likely to elicit greater reaction; and
- devaluation of housing values by up to 25 percent in some areas.

The noise modelling undertaken for this Draft EIS has structured its methodology in part to predict these types of impacts. Assessment of the impacts is documented in *Chapter 12*.

While there is evidence that exposure to aircraft noise can potentially impact on health in a number of ways, as discussed in *Section 11.3*, it is not possible to measure or reliably predict these.

Sleep disturbance, impairment of voice communication and reaction to noise have been identified as being appropriate for assessment because noise-effect relationships have been studied in appropriate detail. Other effects have been suggested in the literature but noise-effect relationships have not been well established (for example, cardiovascular effects). Still other mainly health effects have not been included because studies claiming the effects lack rigorous methodology.

Chapter 12

Impacts of Aircraft Overflight Noise

Chapter 12
Impacts of Aircraft Overflight Noise

A major issue associated with the operation of any airport is that of aircraft noise, particularly its impact on residences and communities in the vicinity. This chapter deals with overflight noise, the noise of aircraft taking off or coming in low in order to land, as it is experienced at ground level. The fact that aircraft use multiple flight paths, as well as the level of noise, leads to impacts being felt over a wide area of the airport surrounds. While the chapter treats noise and effects for all three Badgerys Creek airport options, more detailed description and explanation can be found in Technical Paper No. 3.

12.1 Issues Raised During Consultation

12.1.1 Issues Raised During Consultation

General concern was expressed about the adverse effects of overflight noise including:

- impacts on schools and learning, and on the use of community halls, libraries and outdoor sporting facilities;
- impacts on lifestyle and communications;
- impacts on sleep;
- financial impacts of having to insulate residences and the associated cost of running airconditioning; and
- financial impacts of loss of investment in outdoor facilities.

Comments on noise impacts also related to the frequency of predicted noise; for example, noise might be experienced every two minutes or 24 hours a day. As noise pollution can be a punishable offence, the imposition of aircraft noise was seen as being inconsistent with social and legal expectations.

The location and duration of background noise monitoring was questioned, as was the inherent difficulty of measuring noise impacts, given their subjective nature. Some respondents commented that the scope of the EIS should be extended to cover the impact of increased noise on animals, both domestic, such as dogs barking at aircraft, and non-domestic, such as interruption to the reproductive cycle of native animals, and fauna migrating away from particularly affected areas.

A number of comments related to how the noise study would be conducted. They included the problems associated with the noise assessment of the third runway proposal at Sydney Airport, the effects of topography and meteorology on noise, and the influence of existing aircraft noise on the study.

Other comments regarding impacts on property values and health issues as they may be affected by overflight noise, are discussed in *Chapter 13*.

12.1.2 General Response to Issues Raised

The above issues have been taken into account in the preparation of the noise study for this Draft EIS; however, the following specific comments are highlighted.

Sydney Airport Experience

After the opening of the third runway at Sydney Airport in 1994, there was a strong community reaction to the impact of aircraft noise. The Senate Select Committee, established in 1995 to inquire into aircraft noise in Sydney (Select Senate Committee on Aircraft Noise in Sydney, 1995), identified a number of issues of concern with the noise study associated with the *Proposed Third Runway, Sydney (Kingsford Smith) Airport, Draft Environmental Impact Statement* (Kinhill, 1990). These issues included:

- inadequate attention given to potential impacts on residential areas affected by low or moderate levels of aircraft noise;
- incorrect predictions of the level of use of each runway; and
- insufficient emphasis on the greater reaction to aircraft noise of those communities now newly affected, as compared with communities previously affected by aircraft noise.

The methodology developed for assessing noise impacts adopted for this Draft EIS has taken account of the above issues. It is based on more than one approach and extends well beyond the 20 ANEC level. The study area for the present noise assessment is shown in *Figure 12.1*.

Considerable emphasis has been placed on estimating runway use, taking into account the effect of prevailing winds and the possibility of a number of different policies being applied to the operation of the airport. Since the analysis extends to 2016, it is not possible to predict precisely the way the airport would operate and the level of use of each runway, particularly as the use can depend on the future operating policy of the government of the day or the airport owner. Accordingly, three scenarios for the operation of each airport option have been considered, with the objective of providing a realistic range of potential noise impacts.

The results of research on the different community reaction in areas previously not exposed to aircraft noise have been incorporated into the present noise assessment. The noise assessment provides results for two selected years in the future, namely, 2006 and 2016. For the key year 2006, a date assumed to be shortly after opening of the airport, a greater community sensitivity to noise is assumed than has been measured around existing airports. This is despite the fact that after the opening of the Second Sydney Airport, the air traffic is likely to build up slowly, resulting in a gradual increase in noise level, rather than an abrupt change. By the year 2016 community sensitivity to noise, it is assumed, would be similar to that around existing airports, although some communities would be affected by new, additional, noise resulting from construction of the second parallel and cross wind runways.

Effect of Topography on Aircraft Noise

Concern has been raised regarding the ability of the noise assessment to take into account the topography of areas surrounding the airport sites. This is particularly relevant in the Blue Mountains, where substantial areas are significantly higher than the airport sites.

The procedure for calculating aircraft overflight noise incorporates the effects of the topography. The elevation of any potentially affected ground location (relative to aircraft overflying) is accounted for in the noise calculations. Although the issues of 'reverberation' and 'amphitheatre effect' have been raised by the community in relation to the calculations, these effects would be minor in relation to total noise levels and so have not been included.

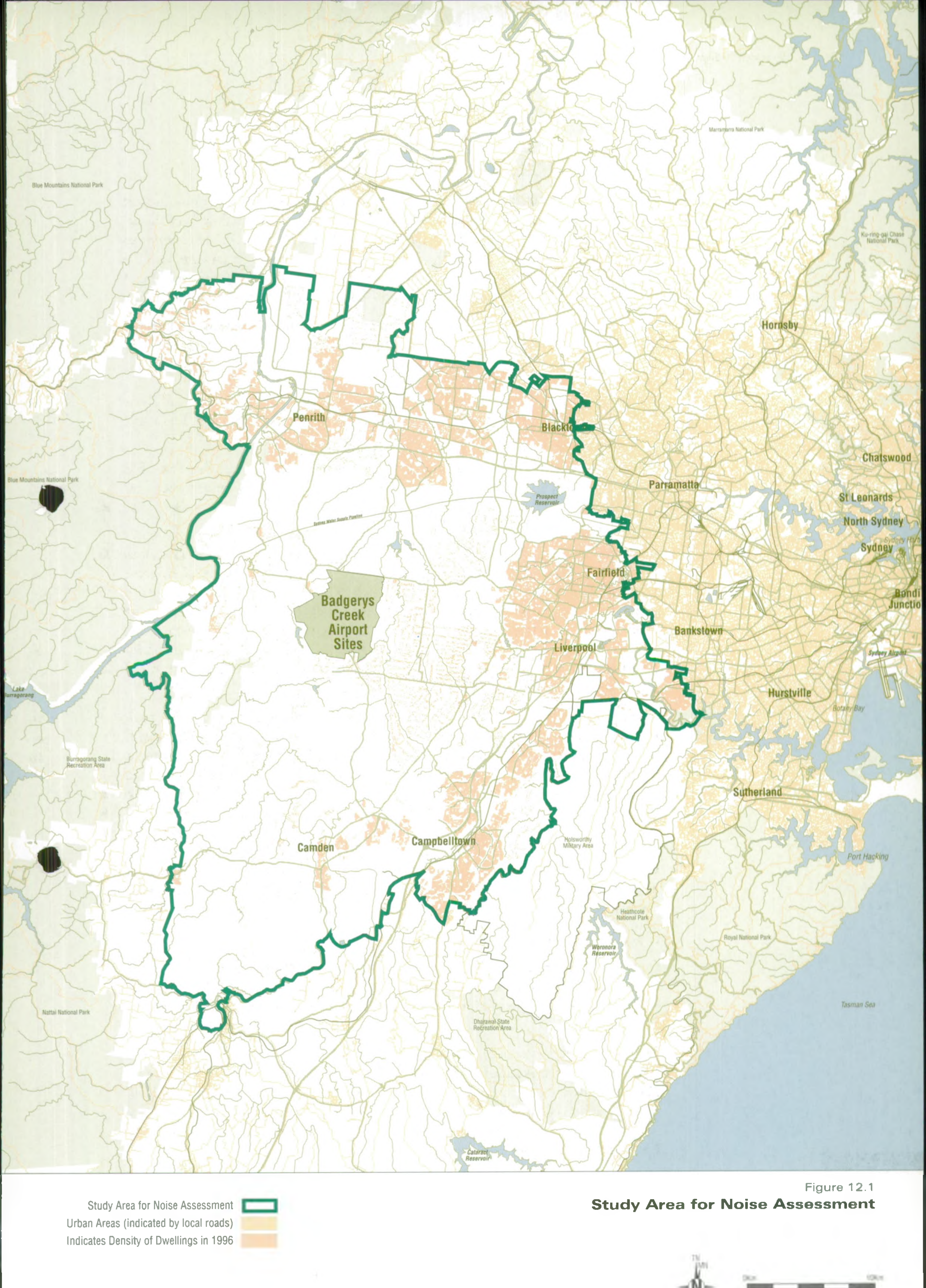


Figure 12.1

Study Area for Noise Assessment

Meteorology

It has been suggested that wind patterns and particularly temperature inversions can affect the level of aircraft overflight noise.

The procedure used for calculating aircraft overflight noise is not capable of incorporating the effect of wind and temperature on the way noise spreads. Since aircraft flying over are generally above the affected areas, and temperature gradients (including temperature inversions) are vertical phenomena, the effect of these on noise propagation to the receiver locations is of minor consequence. Although winds generally travel horizontally, the wind velocity gradients are mostly vertical and, consequently, the effect of these on noise propagation to receiver locations below is also of minor consequence.

Although the effects of meteorology on noise levels directly under aircraft overflights are minor, the effects at ground locations to the side of the flight paths is greater. Noise propagation to these locations is not vertical, but is at an angle to the vertical direction resulting in a horizontal component. The horizontal component is affected by the meteorological conditions discussed above resulting in an effect upon the received noise level.

Temperature inversions have a greater influence on noise when aircraft are operating on the ground. These influences are considered in *Chapter 13*.

Effect of Existing Aircraft Movements on Existing Noise Levels

Existing noise levels in potentially affected areas have been measured. During the period of the existing-noise survey it was suggested by some members of the community that aircraft movements in some of the areas surveyed were more frequent than in previous years.

In 1996 the Commonwealth Government decided to increase the use of the east-west runway at Sydney Airport with the objective of spreading the noise associated with aircraft overflights, and thus reducing its intensity over any one locality. This had the effect of changing the number of aircraft movements over certain areas.

Even though some areas would have been affected by more aircraft overflights during the noise survey than during previous years, the results of the existing-noise survey, reported in *Section 12.3*, demonstrate that background noise levels in almost all areas surveyed are low. The results are consistent with semi-rural or quiet residential uses.

The L_{A90} background noise levels reported in *Section 12.3* would not be affected by the intermittent noise of aircraft overflights, since these levels represent close to the minimum noise levels that would occur between aircraft movements. The L_{Aeq} levels reported are likely, to some limited extent, to be affected by the noise of aircraft overflights. However, the L_{Aeq} levels have been used only as a basis for determining the sleep disturbance effect of potential future aircraft movements, during the night. Since a curfew prevails at Sydney Airport during night hours, the elevation of night time L_{Aeq} levels measured during the survey is very limited. The overall effect of the existing movements on the assessment of potential future noise levels would therefore be negligible.

Effect of Aircraft Noise in Natural Areas

Many members of the community visit national parks and other similar natural areas out of a desire for peace and quiet. Hence the effect of aircraft noise on these areas has been an issue of concern during consultation. In particular, the principle of 'natural quiet' has been discussed.

The noise assessment discusses the effect of noise on natural areas based on overseas research reports.

12.2 Methodology

The methodology for this aspect of the Draft EIS has been developed with the objective of assessing the impact of aircraft overflight noise fully and accurately. The assessment therefore covers a sufficiently wide area that even low noise impact is taken into consideration, and it uses more than one method of describing the aircraft noise impact, so that the effect of the impact is both quantified and understandable.

12.2.1 Air Traffic Forecasts

Aircraft noise levels have been calculated for each airport option for two key assessment years, 2006 and 2016. The year 2006 has been used as it would represent a time not long after the airport opened, with one parallel runway operational. The year 2016 represents a point where both parallel runways would be in operation as well as any cross wind runway.

The air traffic forecasts for these two key years have been provided by the Second Sydney Airport Planners (1997a), as described in *Chapter 7*.

The air traffic forecasts have been set out by aircraft type. In addition, the direction of origin or destination of the aircraft movements has been shown, to allow allocation of the aircraft movements to assumed flight paths. The stage length (distance of first leg of flight) for each take off was also provided by the Second Sydney Airport Planners (1997a) to assist in the noise calculations.

12.2.2 Airport Operation

The three airport operation scenarios modelled were as outlined in *Chapter 8*:

- *Airport Operation 1*. Aircraft movements would occur on the parallel runway(s) in one specified direction (arbitrarily chosen to be the direction closest to north), unless this is impossible because of meteorological conditions. That is, take offs would occur to the north from the parallel runways while aircraft coming in to land would approach from the south, travelling in a northerly direction. Second priority is given to operations in the other direction on the parallel runways, with operations on the cross wind runway occurring only when required because of meteorological conditions;
- *Airport Operation 2*. As for Operation 1, but with the preferred direction of movements on the parallel runways reversed (to the south); and
- *Airport Operation 3*. Deliberate implementation of a 'noise sharing' policy under which seven percent of movements are directed to occur on the cross wind runway (with equal numbers in each direction) with the remainder distributed equally between the two parallel runway directions.

Since a cross wind runway is not proposed at Option A, only Operations 1 and 2 were considered for that option.

Having determined the runway use, it is necessary to allocate aircraft movements to individual flight paths. This process relied on the origin and destination information provided with the air traffic forecasts.

Airservices Australia analysed the air space requirements for each airport option and the amount of interaction (if any) with other airports, particularly Sydney Airport. Accordingly, it identified a series of flight zones around each airport option for all runway uses considered.

Within each flight zone, a series of flight paths were identified as being the most likely paths to be followed by aircraft with origins or destinations in each sector. For each runway direction, at least one 'arrival' and one 'departure' path was allocated for aircraft arriving from or departing to each geographical sector.

For initial modelling, flight paths were defined primarily by operational constraints, and not with any aim of reducing noise impacts. Possibilities for achieving noise mitigation through modifications to the adopted flight paths are discussed in *Section 12.8*.

To take account of potential variations to the flight paths during operation of the airport, each flight path was modelled as five separate paths. Apart from the central original path, additional paths were dispersed at angles of 1.5 and three degrees for arrivals and 4.5 and nine degrees for departures. Operations on the nominal paths were allocated 40 percent to the central path, 20 percent to each of the closer dispersed paths and 10 percent to each of the wider dispersed paths.

12.2.3 Noise Modelling

Calculations of aircraft overflight noise were carried out using the Integrated Noise Model (INM), which has been developed by the US Federal Aviation Administration. The INM model includes the most recently available information on noise levels from current aircraft types. This is obtained from detailed test data, generally gathered during aircraft noise certification trials.

One important class of aircraft specified in air traffic forecasts has been labelled *New Large Aircraft*, and represents aircraft currently under development by both Boeing and Airbus Industries. Noise level test data for these aircraft are obviously not available. Current information from the manufacturers indicates that noise levels from both aircraft should be within those of current generation 747-400 aircraft on both approach and departure. As a conservative measure, however, the noise level from a New Large Aircraft was set at two dBA higher than that from a 747-400 aircraft.

In recent years there has been a marked decline in the operation of older, noisy aircraft in Australia. This reflects the increased regulation of aircraft noise here through the *Air Navigation (Aircraft Noise) Regulations*, and a move towards greater use of aircraft that comply with the latest, more stringent International Civil Aviation Organisation noise standards. Engine manufacturers are continuing to develop quieter engines, to maintain compliance with increasingly strict international aircraft noise standards.

The INM model does not allow for calculation of the effect of atmospheric conditions such as wind and temperature inversions on the way noise spreads. These factors are known to have a strong influence on noise generated at ground level. For sources that are significantly higher, however, such as an aircraft in flight, the influence of wind and temperature inversions is much lower, and has not been as thoroughly studied. In many cases, the major impact of adverse wind and temperature gradient conditions on noise from ground level sources comes through the removal of the effect of intervening barriers. However, this effect is not relevant for noise from a source such as an aircraft in flight. The INM model does take into account the elevation of noise receivers in the calculation, by the incorporation of topography of the area surrounding the airport.

Apart from the rigorous test data on which INM noise level calculations are based, validation of some of the noise level predictions for individual aircraft operations has been provided by Airservices Australia's *Noise and Flight Path Monitoring System*, which continuously records maximum A-weighted noise levels from aircraft operations around a number of airports in Australia. A report by Airservices Australia (1996b) concludes that at least for aircraft noise events with maximum noise levels exceeding 60 to 65 dBA, INM provides a prediction of the mean maximum noise level that is generally accurate to within approximately two dB. Such events as these are considered to be the most important for noise assessment, and this level of accuracy is considered acceptable for the purpose of this noise assessment.

12.2.4 Aircraft Overflight Noise Descriptors

Descriptors Used for this Assessment

Environments around airports that are affected by aircraft noise experience a series of relatively high noise levels generated as aircraft fly overhead, separated by considerable periods of lower ambient noise levels. Suitable aircraft noise descriptors therefore need to take into account this specific noise environment.

The descriptors used are:

- ANEC to determine impacts on property values and land use planning;
- L_{Aeq} for the average 24 hour period and the night-time period of 10.00 pm to 6.00 am;
- maximum noise levels for individual flights, and estimates of the number of flights that may result in noise levels exceeding 60 dBA, 70 dBA, 80 dBA and 90 dBA. These estimates have been calculated for an average 24 hour or full day period, and for a night-time period of 10.00 pm to 6.00 am, assuming no curfew would operate at the airport;
- estimates of the number of flights that may produce noise levels in excess of 65 dBA between 9.00 am to 3.00 pm as an indication of potential impacts on educational facilities; and
- Sleep Disturbance Index as an indication of the average number of awakenings that may be caused by aircraft overflight noise.

ANEC, 70 dBA maximum noise level and the estimated number of flights that may result in noise levels exceeding 70 dBA (N70 dBA) have been presented graphically as noise contours. The first of these is intended to provide information relevant to land use planning and also detailed information on the likely spatial distribution of noise in areas relatively close to the airport sites. The second and third are intended to indicate the spatial spread and frequency of lower level noise impacts. The 70 dBA maximum contours represent the area over which the predicted maximum noise level from a 747 400 aircraft, performing any operation on any flight path, exceeds 70 dBA. The N70 dBA contours represent the number of times on an average day an area may experience noise levels of 70 dBA or more from overflying aircraft.

The ANEC contours were calculated for the two assessment years, 2006 and 2016, and for each of the air traffic forecasts and operating scenarios. This provided six sets of contours for each airport option for 2006 and nine for each airport option for 2016 (Option A has only six sets of contours for 2016 because it would not have a cross wind runway).

Noise level contours, as described above, can provide general information on the spatial extent of certain types of noise impact. Most of the descriptors, however, are difficult to convey in this way. In addition, contours become less meaningful at large distances from the airport, as the distance between two adjacent contours may be very large.

To provide more meaningful information on the likely pattern of noise exposure at specific locations, detailed noise level calculations were undertaken for 85 *Community Assessment Areas*. These areas have also been used to define demographic population characteristics and assess existing noise exposure. They are shown in *Figure 12.2*. Community Assessment Areas cover a much broader geographical area around each airport than the ANEC noise level contours described above. Where these Community Assessment Areas are close to the airport sites, they have been subdivided to give more accuracy to the noise assessment.

The Community Assessment Areas were used to allow noise impacts on individual communities to be described and to relate the noise impacts to estimates of 1996 population, forecasts of the populations in 2006 and 2016, and numbers of noise sensitive land uses such as educational facilities.

The method used to develop these estimates and forecasts is described in *Technical Paper No. 3*.

Alternative Noise Descriptors

Apart from the measures of aircraft noise exposure described above, a number of alternative measures are used or have been proposed for use in the assessment of various types of noise impacts. The more important of these include the DNL index, DNNI index, other equal energy and related measures developed in other countries, TA(X), and other measures of sleep disturbance such as the proposal developed by Griefahn (1992). The reasons for not using these descriptors in the noise assessment for this Draft EIS are described in *Technical Paper No. 3*.

12.3 Existing Noise Environment

To assist in the understanding of potential aircraft noise levels associated with the five airport options, existing noise levels were measured in an area extending about 20 kilometres from the airport sites.

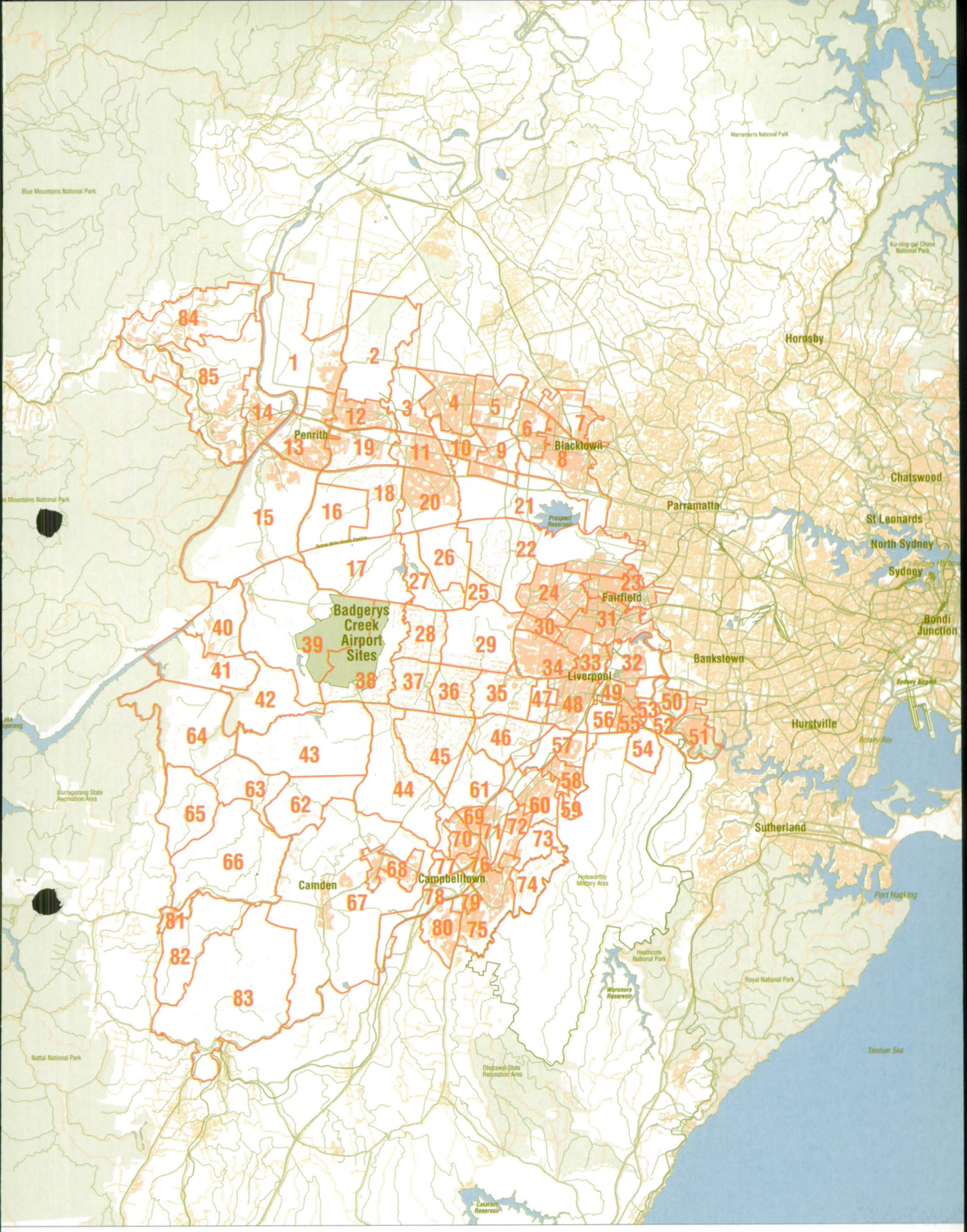
12.3.1 Measurement Locations and Times

The regions around the airport options were divided into 85 distinct areas termed *Community Assessment Areas* (shown in *Figure 12.2*) as discussed above. They were divided to provide areas with common characteristics and similar likely exposure to noise.

Noise measurements were made at 111 locations within the Community Assessment Areas. A summary of the results of these measurements is provided in *Appendix D*.

In general, within each Community Assessment Area a measurement point typical of the quietest location was selected by avoiding locations near major roads and industrial areas. However, in some areas where there is a distinct variation in existing noise environment an attempt was made to present the range of noise levels by measuring at more than one point.

The noise measurement survey was conducted over a period of approximately three months from mid October 1996 to mid January 1997. Measurements were made over a period of at least five days at each location. General weather information was recorded from various meteorological stations in the areas including Bankstown,



Urban Areas (indicated by local roads)

Indicates Density of Dwellings in 1996

Figure 12.2

Community Assessment Areas

Penrith, Appin, Badgerys Creek and Tahmoor to determine whether weather conditions were suitable for measurement. For those locations and periods when the weather was considered to be intermittently unsuitable, the measurement period was increased to up to seven days. This ensured that at least three full days of non-weather affected results were obtained within each Community Assessment Area.

12.3.2 Measurement Procedure

The noise monitoring equipment consisted of Environmental Noise Loggers. This equipment is capable of remotely monitoring and storing noise level descriptors for later detailed analysis.

The logger determines L_{A1}, L_{A10}, L_{A90}, and L_{Aeq} levels of the ambient noise. The L_{A1}, L_{A10} and L_{A90} levels are the levels exceeded for one percent, 10 percent and 90 percent of the sample time respectively. The L_{A1} is indicative of maximum noise levels due to individual noise events, such as the occasional passby of a heavy vehicle. The L_{A10} is the descriptor used to assess annoyance and the L_{A90} level is normally taken as the background noise level. The L_{Aeq} level is the Equivalent Continuous Sound Level as described in *Chapter 11*.

12.3.3 Measurement Results

The detailed measurement results are presented for each measurement location in *Appendix D*. The results are summarised and discussed in this section.

The periods of each day for which noise measurement results were formulated were determined, having regard to the potential impact of noise generated by the airport and its associated operations at different times of the day.

The following periods were used for analysis of the existing noise environment:

- Early morning 6.00 am - 7.00 am;
- Daytime 7.00 am - 7.00 pm;
- Evening 7.00 pm - 10.00 pm;
- Late evening 10.00 pm - 11.00 pm; and
- Night-time 10.00 pm - 6.00 am and 10.00 pm - 7.00 am.

Two night-time periods have been used to analyse the measurement results. The first night-time period is an eight hour period particularly relevant to sleep disturbance assessment. The second period from 10.00 pm to 7.00 am overlaps with the early morning period of 6.00 am to 7.00 am and has been used since it is the most common definition of the night-time period for noise assessment purposes.

Since most of the Community Assessment Areas are in rural or low density population areas and the measurement location was selected in the quieter part of each Community Assessment Area, the most appropriate NSW Environment Protection Authority recommendations for comparison purposes are those for rural and residential areas. Those recommendations suggest acceptable background levels (L_{A90}) of 45 dBA during the day and 35 dBA during the night.

Most background levels (L_{A90}) measured during the day were less than 40 dBA, with all but one location being less than 45 dBA. During the night, most background levels were less than 35 dBA. These levels are consistent with recommendations of the NSW Environment Protection Authority for noise levels in rural and residential areas.

There are no clear recommendations for acceptable L_{Aeq} levels. It is probably more appropriate to assess these levels by comparing them with the background noise levels measured during the same period. During the day, the measured L_{Aeq} levels were about 15 dBA above the background noise levels. This is fairly typical of residential areas where passing traffic tends to elevate the L_{Aeq} above the background level. However, during the night it is anticipated that there would be less traffic to affect the L_{Aeq}. The analysis of night-time L_{Aeq} values shows a larger spread than for the day, but in very general terms the measured night-time L_{Aeq} levels were in the vicinity of 10 dBA above the background level. This is again generally consistent with residential areas.

Overall, the whole area surveyed is typical of quiet rural and residential areas.

12.4 Impacts of Aircraft Overflight Noise on People

12.4.1 Noise Level Predictions

Predictions of Noise Levels Within Community Assessment Areas

The anticipated aircraft overflight noise impacts associated with the three airport options have been described in detail, including noise level predictions for each Community Assessment Area. Reference may be made to these predictions, contained in *Appendix D,* to find out impacts on individual communities.

Single Noise Events

Different types of aircraft produce different levels of noise. Also, the same type of aircraft will produce different levels of noise depending on its destination and corresponding weight. For example, there is a significant difference between the maximum noise level generated by a long haul flight of a B767-300 (Stage 7 or over 8,300 kilometres) and a short range domestic flight (Stage 2 or between 926 kilometres and 1,852 kilometres).

Figures 12.3 and *12.4* provide examples of the extent of 'single event' contours for a straight approach and departure for Boeing 747-400, 767-300 and 737-300 aircraft (refer *Photographs 5, 6* and *7*). *Figures 12.5, 12.6* and *12.7* provide an indication of the height of these aircraft at a range of distances from the end of a runway. The height would vary depending on whether the aircraft is landing or taking off, and on the load carried by the aircraft, the weather conditions, separation requirements imposed by air traffic control, and the actions of the pilot. In each case the distance shown is the length of the flight path of the aircraft, which is often curved, and therefore greater than a straight line distance from the end of the runway. *Figures 12.5, 12.6 and 12.7* also indicate the range of noise levels that would be experienced by a person standing directly under the flight path.

Number of Noise Events

For single event noise level information to be meaningful it should be accompanied by some indication of how often each of these single event noise levels occur. *Figures 12.8* to *12.15* are contours showing estimates of how many aircraft noise events exceeding 70 dBA would occur on an average day in 2016 for each type of airport operation assessed. Information on the number of events for other levels of noise is provided in *Appendix D.*

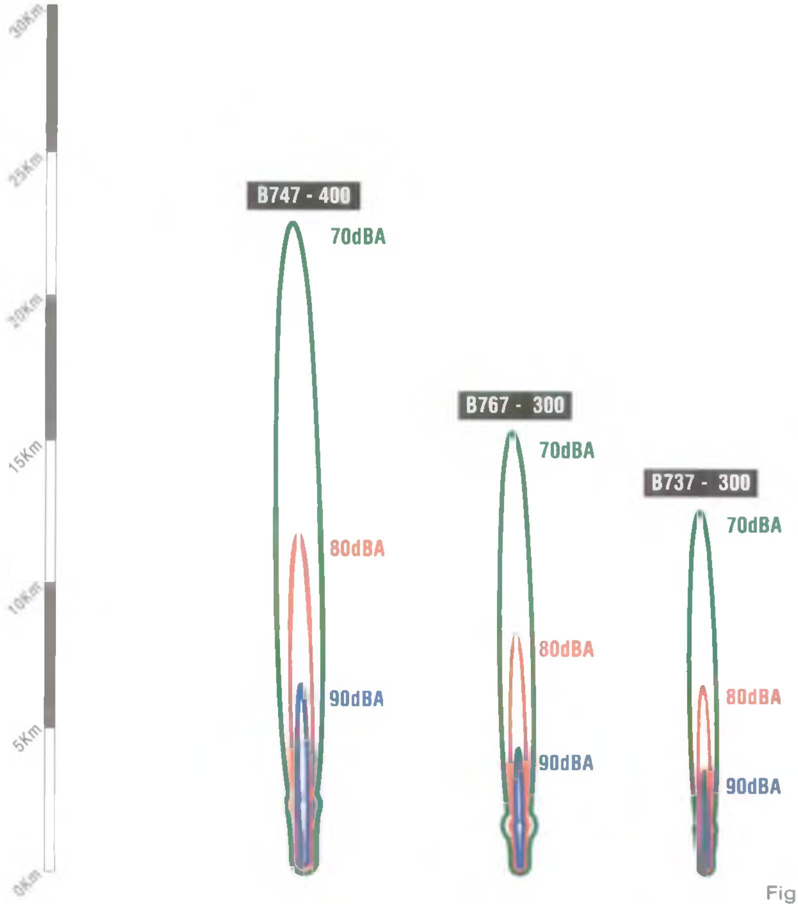


Figure 12.3
Single Noise Event Arrival Contours for Some Typical Aircraft (LAmax)
Source: Department of Transport and Regional Development
Note: Modelling assumptions based on the Sydney Airport Long Term Operating Plan ANEC assumptions

Photograph 5
Boeing 747-400 Aircraft

Photograph 6
Boeing 767-300 Aircraft

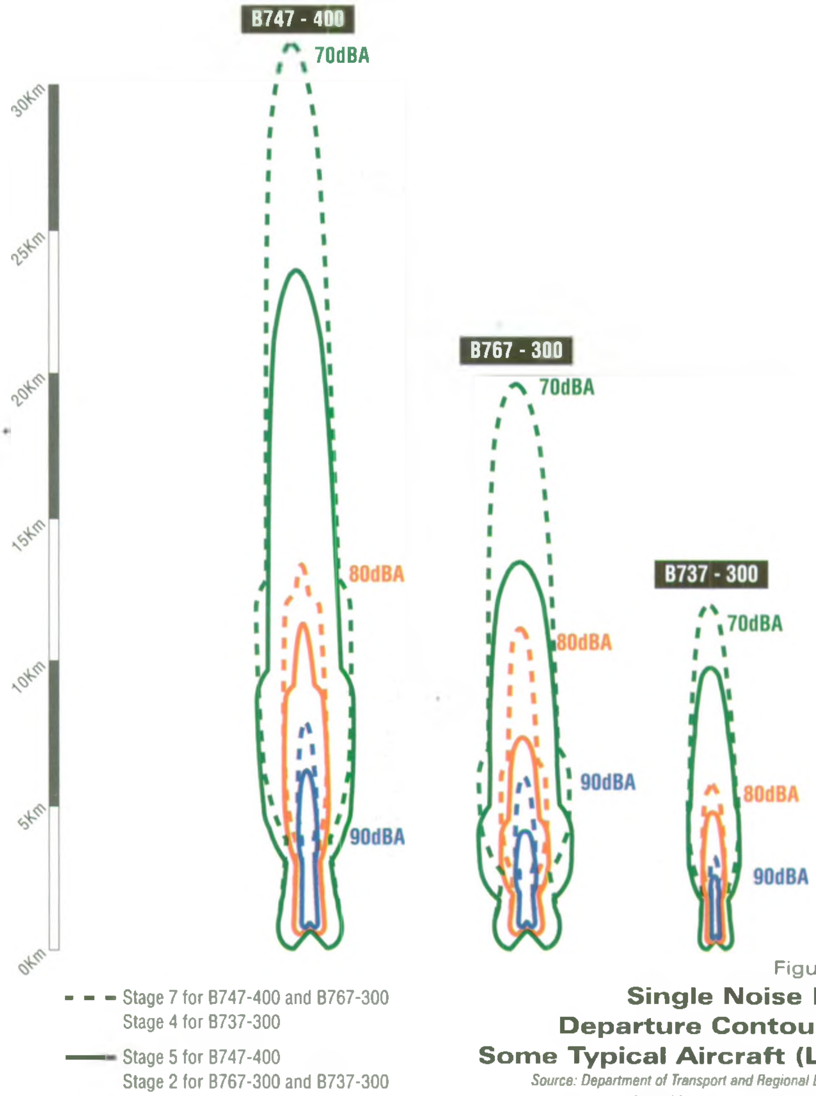
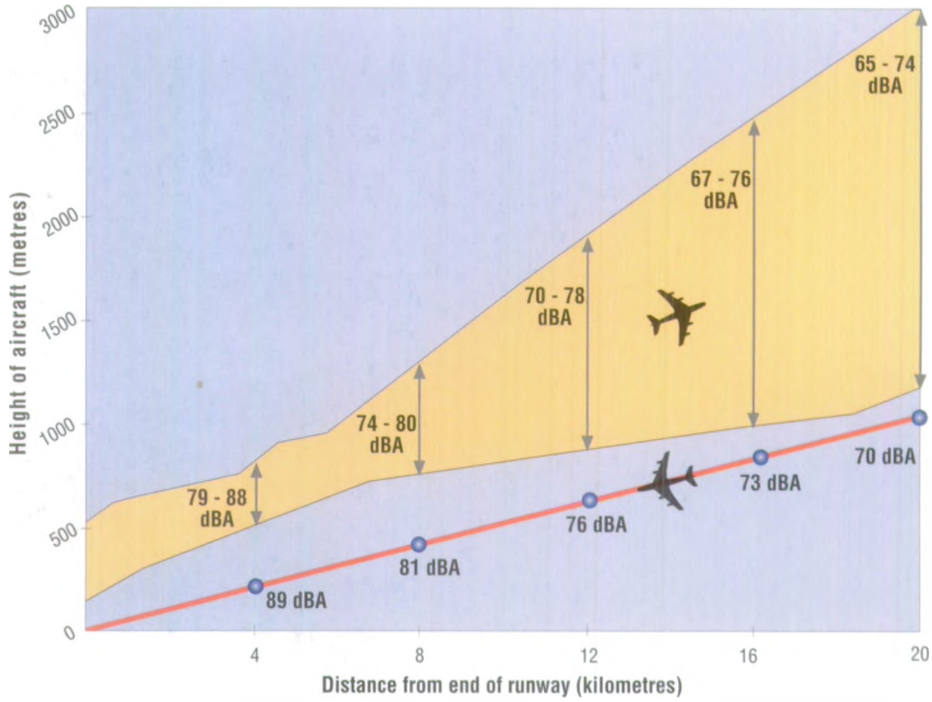


Figure 12.4
Single Noise Event Departure Contours for Some Typical Aircraft (LAmax)
Source: Department of Transport and Regional Development
Note: Modelling assumptions based on the Sydney Airport Long Term Operating Plan ANEC assumptions

Photograph 7
Boeing 737-300 Aircraft

Maximum Extent of 70 dBA Noise Level

Contours showing the maximum extent of the 70 dBA noise level for a Boeing 747-400 aircraft using all the predicted flight paths, are shown in *Figures 12.16* to *12.18*. These contours represent the maximum noise level that would be generated by a 747-400 aircraft using any departure or arrival flight path with maximum stage length.

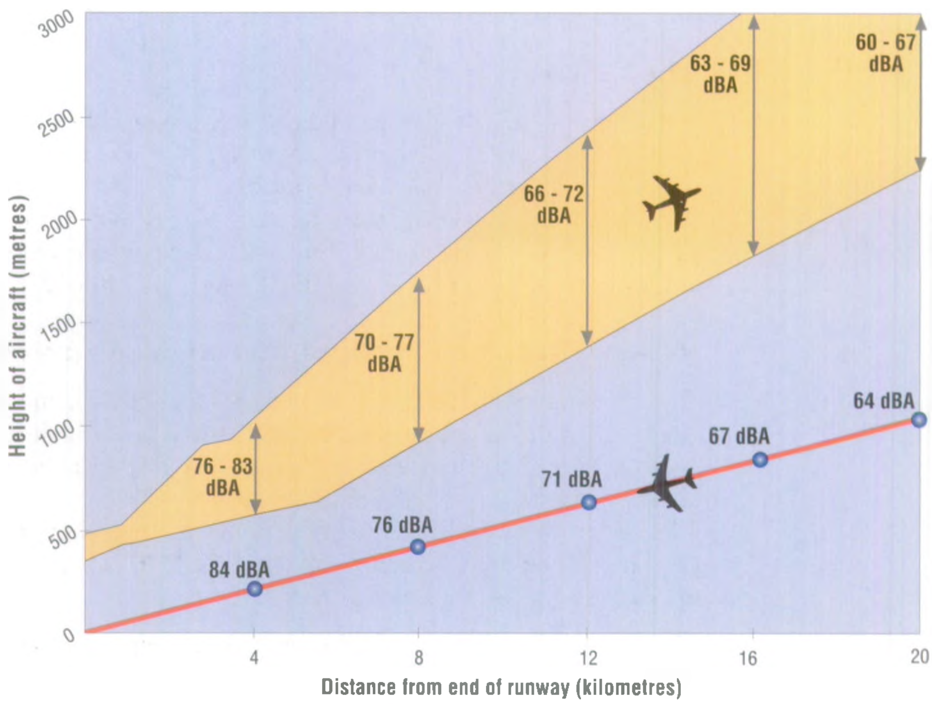


Indicative height and noise level of aircraft landing at airport

Indicative range of heights and noise level for aircraft taking off from airport

Figure 12.5
Range of Heights and Maximum Noise Levels of a B747-400 Landing and Taking Off

Note: Noise levels are for aircraft directly overhead and are indicative only. The heights of departing aircraft will vary depending on the load carried by the aircraft, weather conditions, separation requirements imposed by air traffic control and the actions of the pilot.



Indicative height and noise level of aircraft landing at airport

Indicative range of heights and noise level for aircraft taking off from airport

Figure 12.6
Range of Heights and Maximum Noise Levels of a B767-300 Landing and Taking Off

Note: Noise levels are for aircraft directly overhead and are indicative only. The heights of departing aircraft will vary depending on the load carried by the aircraft, weather conditions, separation requirements imposed by air traffic control and the actions of the pilot.

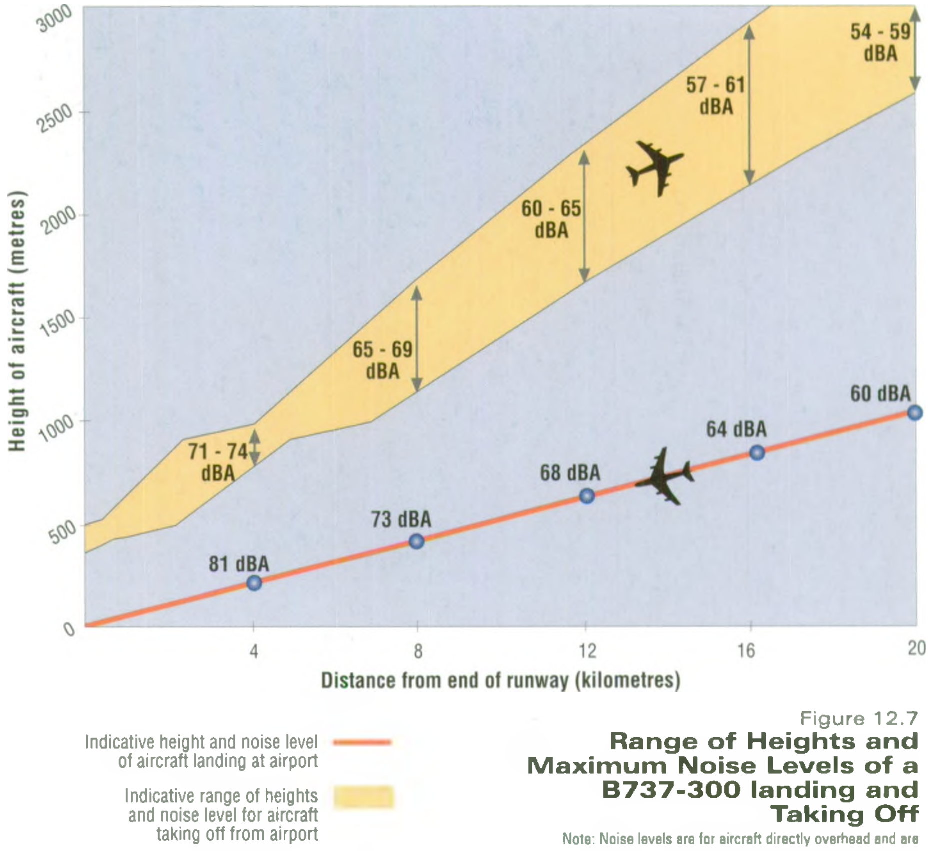


Figure 12.7
Range of Heights and Maximum Noise Levels of a B737-300 landing and Taking Off

Note: Noise levels are for aircraft directly overhead and are indicative only. The heights of departing aircraft will vary depending on the load carried by the aircraft, weather conditions, separation requirements imposed by air traffic control and the actions of the pilot.

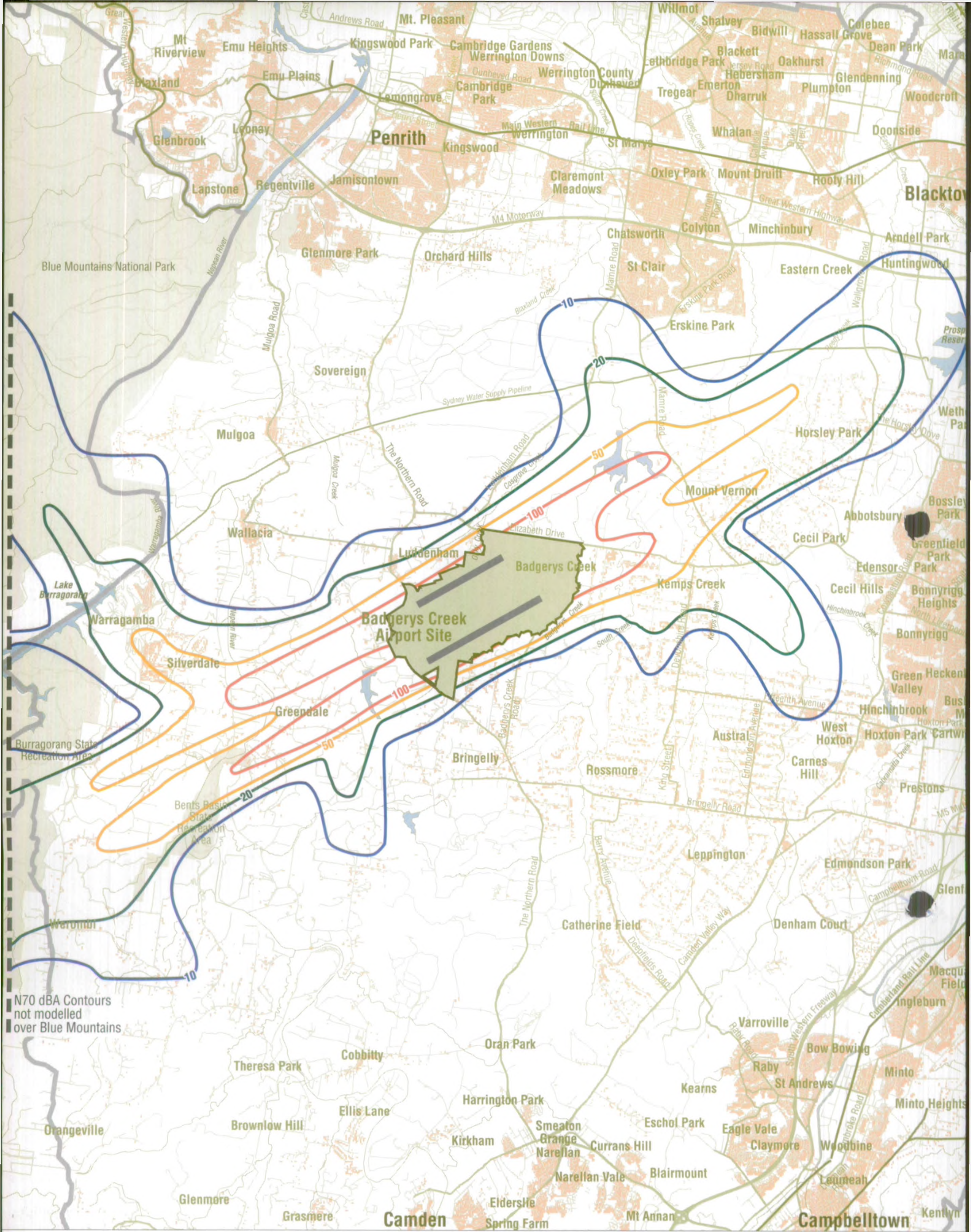
ANEC Contours

The maximum modelled extent of the ANEC contours calculated for the years 2006 and 2016 are shown in *Figures 12.19* to *12.24*. These contours show the outside extent of the range of ANEC levels resulting from the three air traffic forecasts and three airport operations analysed. They have been derived by firstly plotting the noise contours for each of the air traffic forecasts and airport operations. Examples of these contours are shown for the year 2016 in *Figures 12.25* to *12.27*.

12.4.2 Overview of Potential Impacts on People

The following general comments on potential noise impacts from each airport option are based on the highest level of air traffic forecast, of 15 million passengers by 2006 and 30 million by 2016. The affected populations referred to in the comments are the numbers forecast to be living in a particular area at the time, that is in 2006 and 2016. For each airport option, restrictions have been assumed on population growth in noise affected areas generally within the 20 ANEC contour, and the populations quoted reflect these restrictions.

The comments relate to annual average noise impacts. These impacts may vary significantly from day to day, depending on a number of factors such as runway usage patterns, variations in actual aircraft locations, and variations in individual aircraft noise levels. Runway usage at any of the proposed airport sites would depend to some extent on meteorological conditions, which vary within hourly, daily and seasonal timeframes. When meteorological conditions force the use of a cross wind runway, the pattern of noise exposure around the airport would change significantly with



Area within these two contours is estimated to receive between 10 and 20 aircraft overflights louder than 70dBA on an average day —10— —20—

Area within these two contours is estimated to receive between 20 and 50 aircraft overflights louder than 70dBA on an average day —20— —50—

Extent of Dwelling Data

Area within these two contours is estimated to receive between 50 and 100 aircraft overflights louder than 70dBA on an average day —50— —100—

Area within this contour is estimated to receive more than 100 aircraft overflights louder than 70dBA on an average day —100—

Indicates Density of Dwellings in 1996

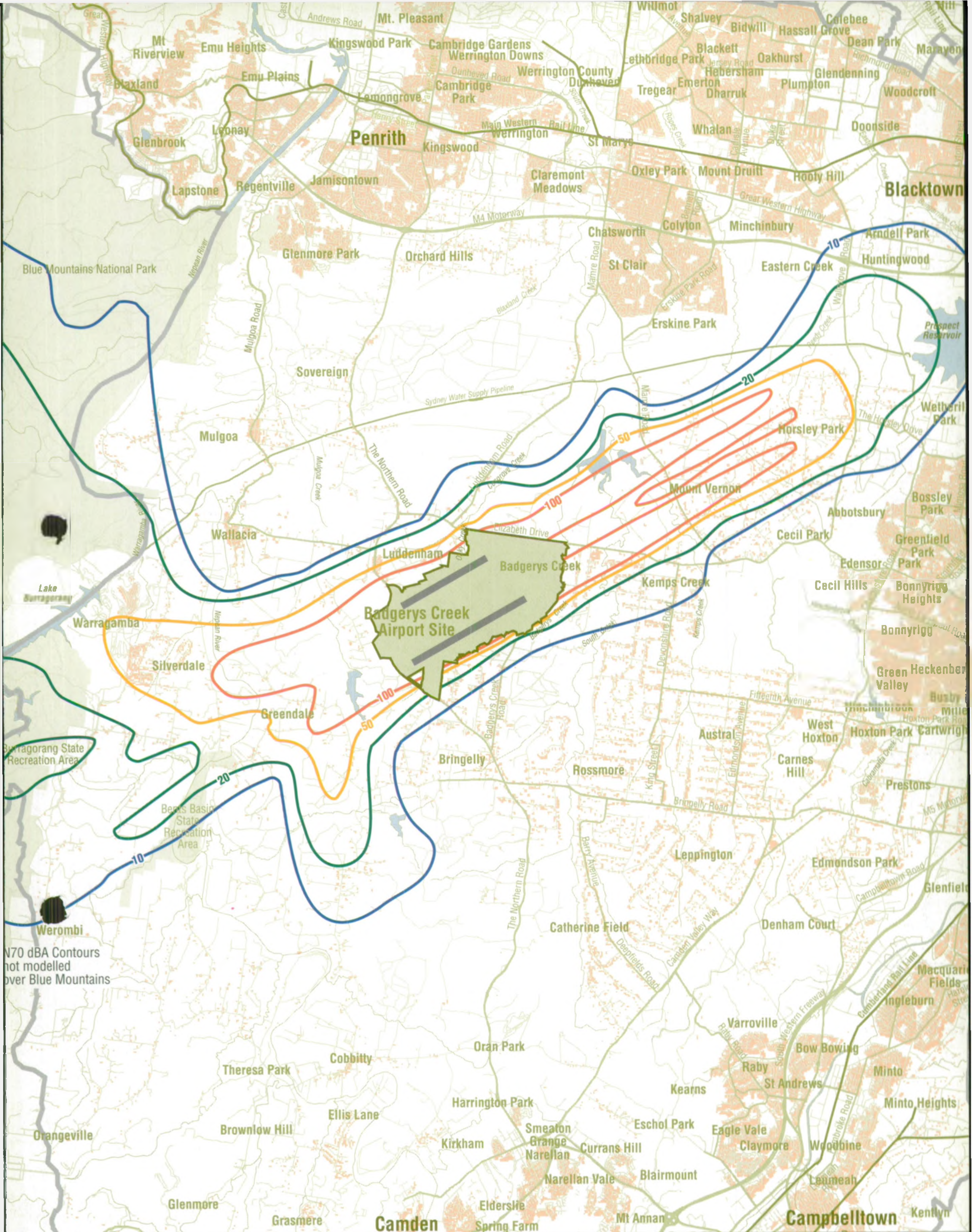
Figure 12.8

2016 N70 dBA Contours for Option A (Airport Operation 1)

Note: Refer to Section 8.6 for an explanation of what Airport Operation 1 means.

TN MN N

0Km 5Km



Area within these two contours is estimated to receive between 10 and 20 aircraft overflights louder than 70dBA on an average day —10— —20—

Area within these two contours is estimated to receive between 20 and 50 aircraft overflights louder than 70dBA on an average day —20— —50—

Extent of Dwelling Data

Area within these two contours is estimated to receive between 50 and 100 aircraft overflights louder than 70dBA on an average day —50— —100—

Area within this contour is estimated to receive more than 100 aircraft overflights louder than 70dBA on an average day —100—

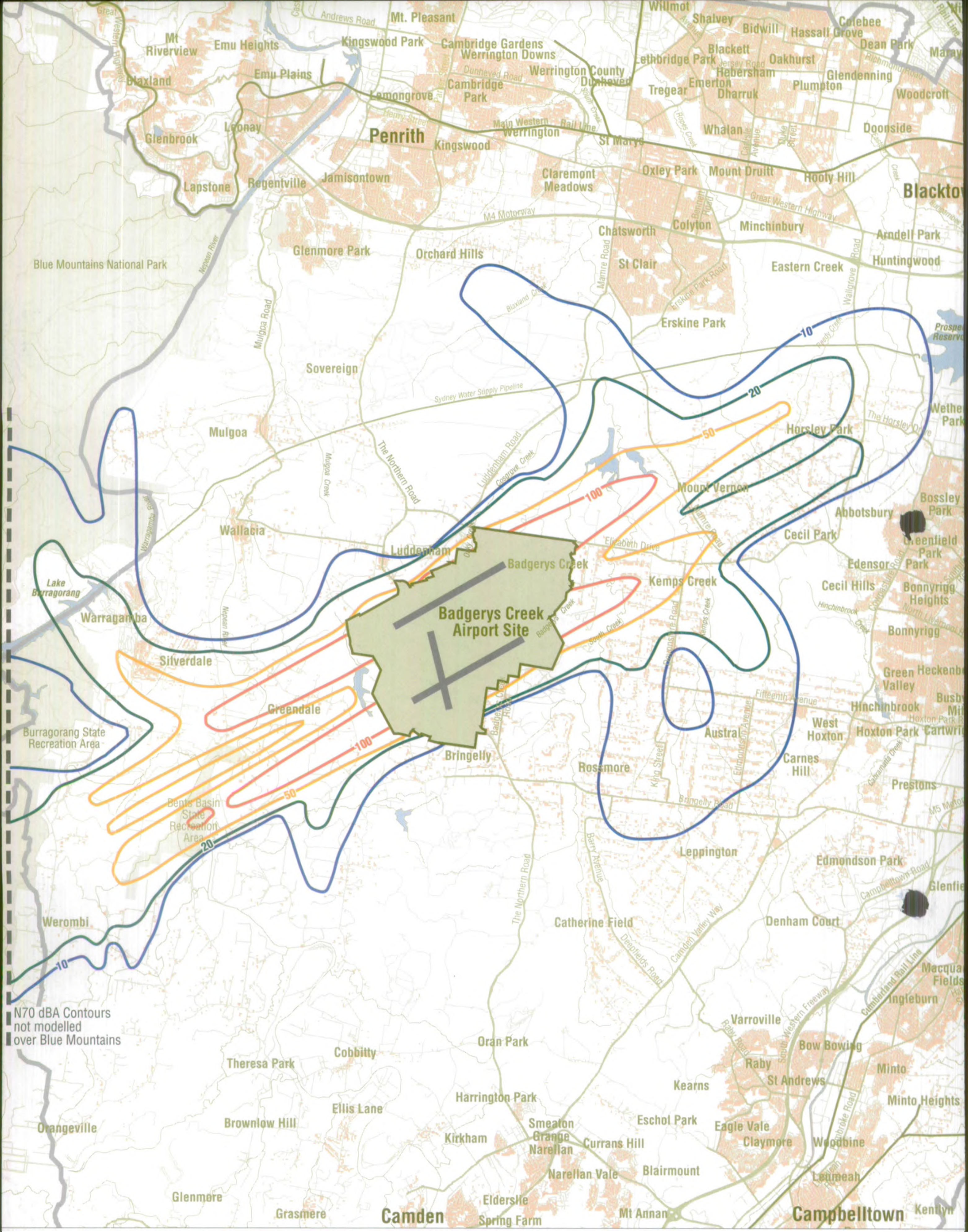
Indicates Density of Dwellings in 1996

Figure 12.9

2016 N70 dBA Contours for Option A (Airport Operation 2)

Note: Refer to Section 8.6 for an explanation of what Airport Operation 2 means.

0Km 5Km



Area within these two contours is estimated to receive between 10 and 20 aircraft overflights louder than 70dBA on an average day	—10— —20—	Area within these two contours is estimated to receive between 50 and 100 aircraft overflights louder than 70dBA on an average day	—50— —100—
Area within these two contours is estimated to receive between 20 and 50 aircraft overflights louder than 70dBA on an average day	—20— —50—	Area within this contour is estimated to receive more than 100 aircraft overflights louder than 70dBA on an average day	—100—
Extent of Dwelling Data		Indicates Density of Dwellings in 1996	

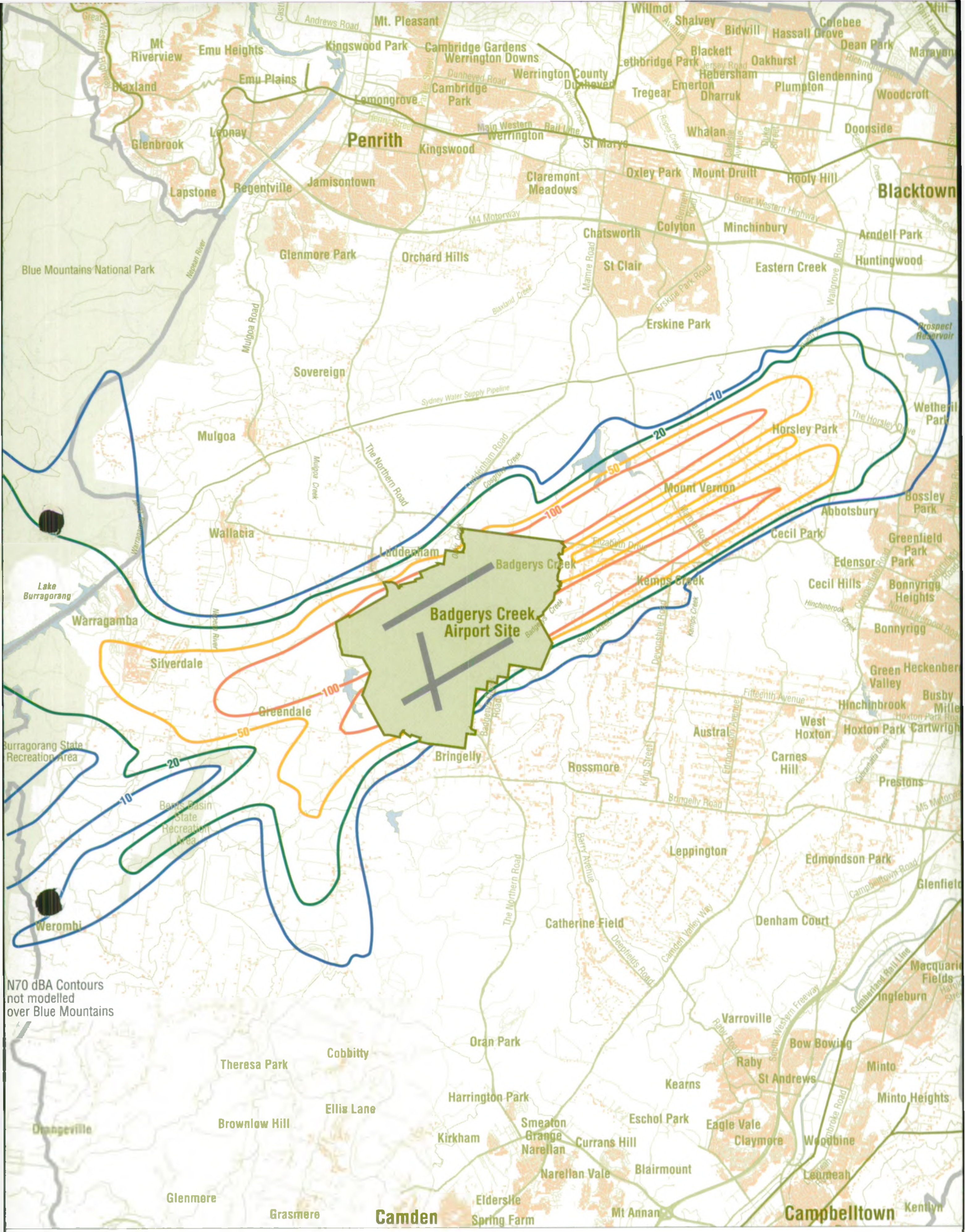
Figure 12.10

2016 N70 dBA Contours for Option B (Airport Operation 1)

Note: Refer to Section 8.6 for an explanation of what Airport Operation 1 means.

TN MN N

0Km 5Km



Area within these two contours is estimated to receive between 10 and 20 aircraft overflights louder than 70dBA on an average day —10— —20—

Area within these two contours is estimated to receive between 20 and 50 aircraft overflights louder than 70dBA on an average day —20— —50—

Extent of Dwelling Data

Area within these two contours is estimated to receive between 50 and 100 aircraft overflights louder than 70dBA on an average day —50— —100—

Area within this contour is estimated to receive more than 100 aircraft overflights louder than 70dBA on an average day —100—

Indicates Density of Dwellings in 1996

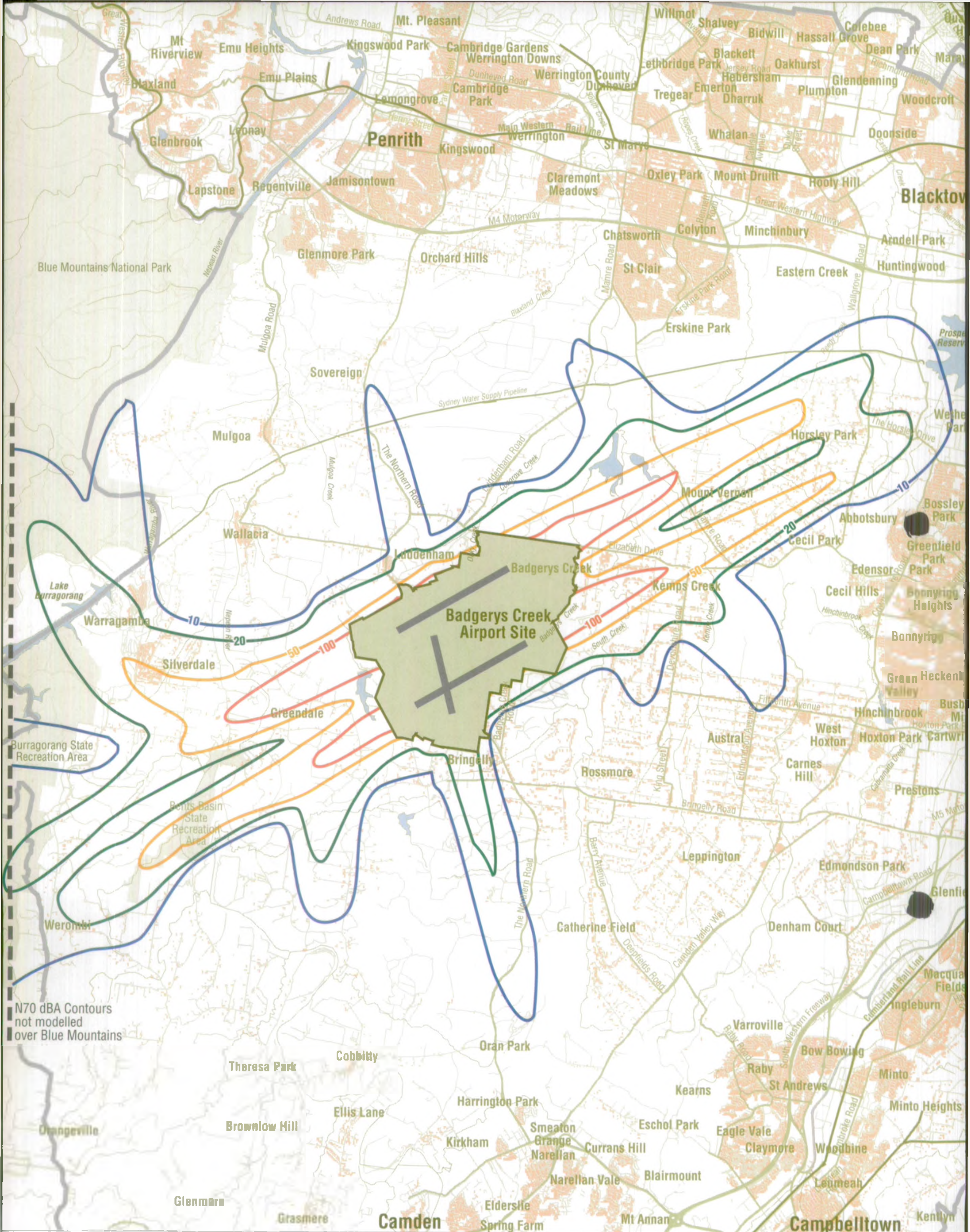
Figure 12.11

2016 N70 dBA Contours for Option B (Airport Operation 2)

Note: Refer to Section 8.6 for an explanation of what Airport Operation 2 means.

TN MN N

0Km 5Km



Area within these two contours is estimated to receive between 10 and 20 aircraft overflights louder than 70dBA on an average day —10— —20—

Area within these two contours is estimated to receive between 20 and 50 aircraft overflights louder than 70dBA on an average day —20— —50—

Extent of Dwelling Data

Area within these two contours is estimated to receive between 50 and 100 aircraft overflights louder than 70dBA on an average day —50— —100—

Area within this contour is estimated to receive more than 100 aircraft overflights louder than 70dBA on an average day —100—

Indicates Density of Dwellings in 1996

Figure 12.12

2016 N70 dBA Contours for Option B (Airport Operation 3)

Note: Refer to Section 8.6 for an explanation of what Airport Operation 3 means.

TN MN N

0Km 5Km

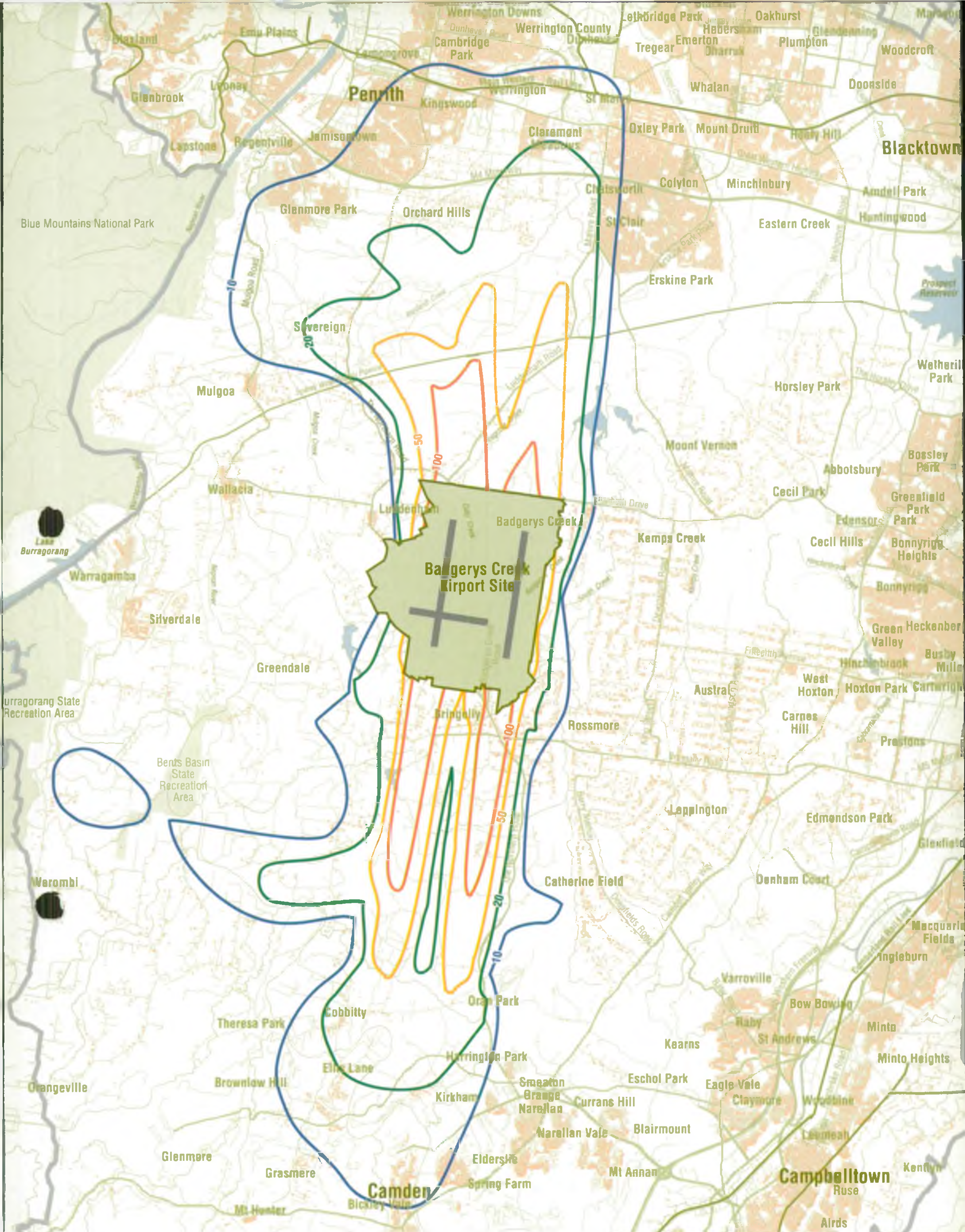


Figure 12.13
2016 N70 dBA Contours for Option C (Airport Operation 1)

Note: Refer to Section 8.6 for an explanation of what Airport Operation 1 means.

Area within these two contours is estimated to receive between 10 and 20 aircraft overflights louder than 70dBA on an average day — 10 — 20

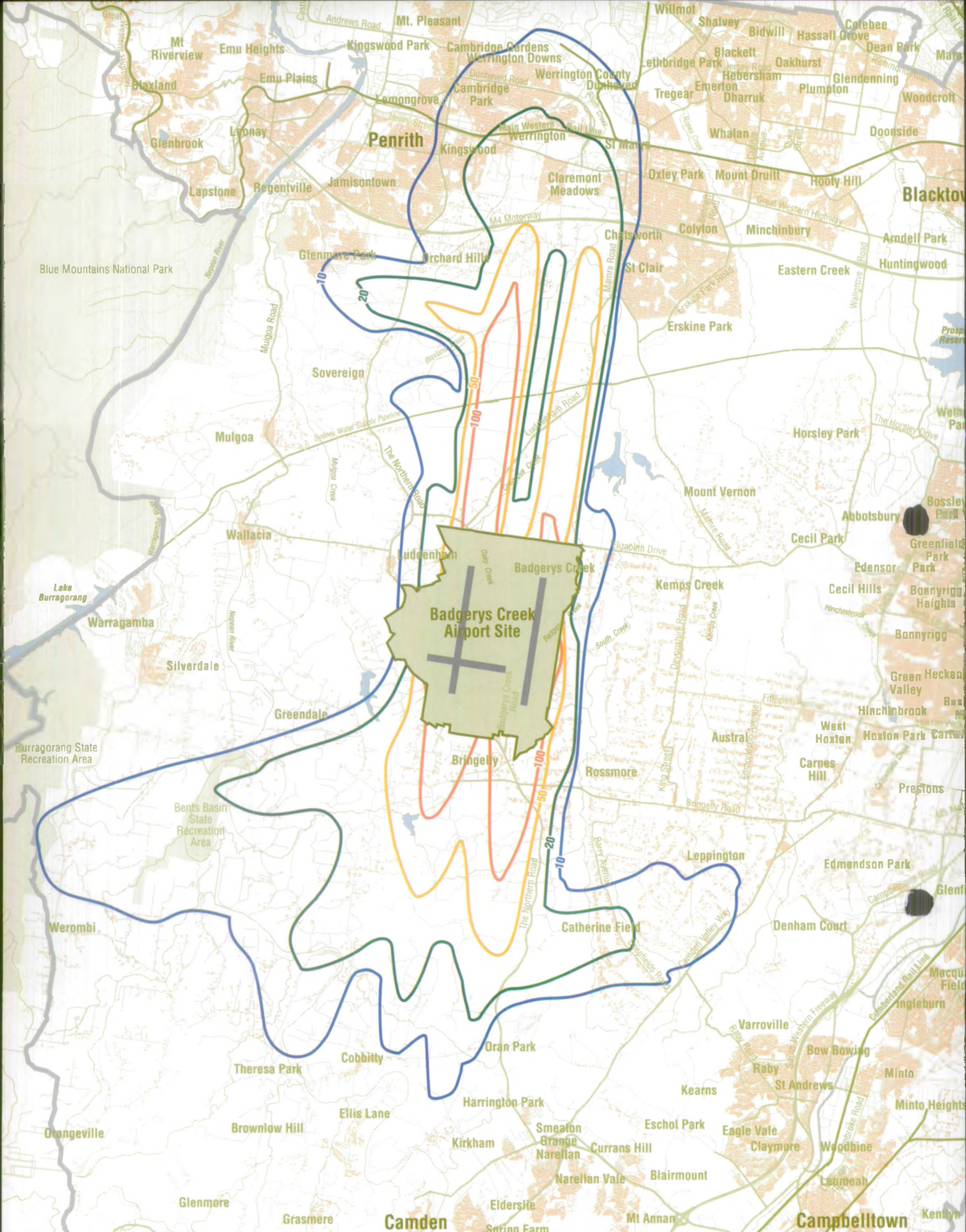
Area within these two contours is estimated to receive between 20 and 50 aircraft overflights louder than 70dBA on an average day — 20 — 50

Extent of Dwelling Data

Area within these two contours is estimated to receive between 50 and 100 aircraft overflights louder than 70dBA on an average day — 50 — 100

Area within this contour is estimated to receive more than 100 aircraft overflights louder than 70dBA on an average day — 100

Indicates Density of Dwellings in 1996



Area within these two contours is estimated to receive between 10 and 20 aircraft overflights louder than 70dBA on an average day —10— —20—

Area within these two contours is estimated to receive between 20 and 50 aircraft overflights louder than 70dBA on an average day —20— —50—

Extent of Dwelling Data

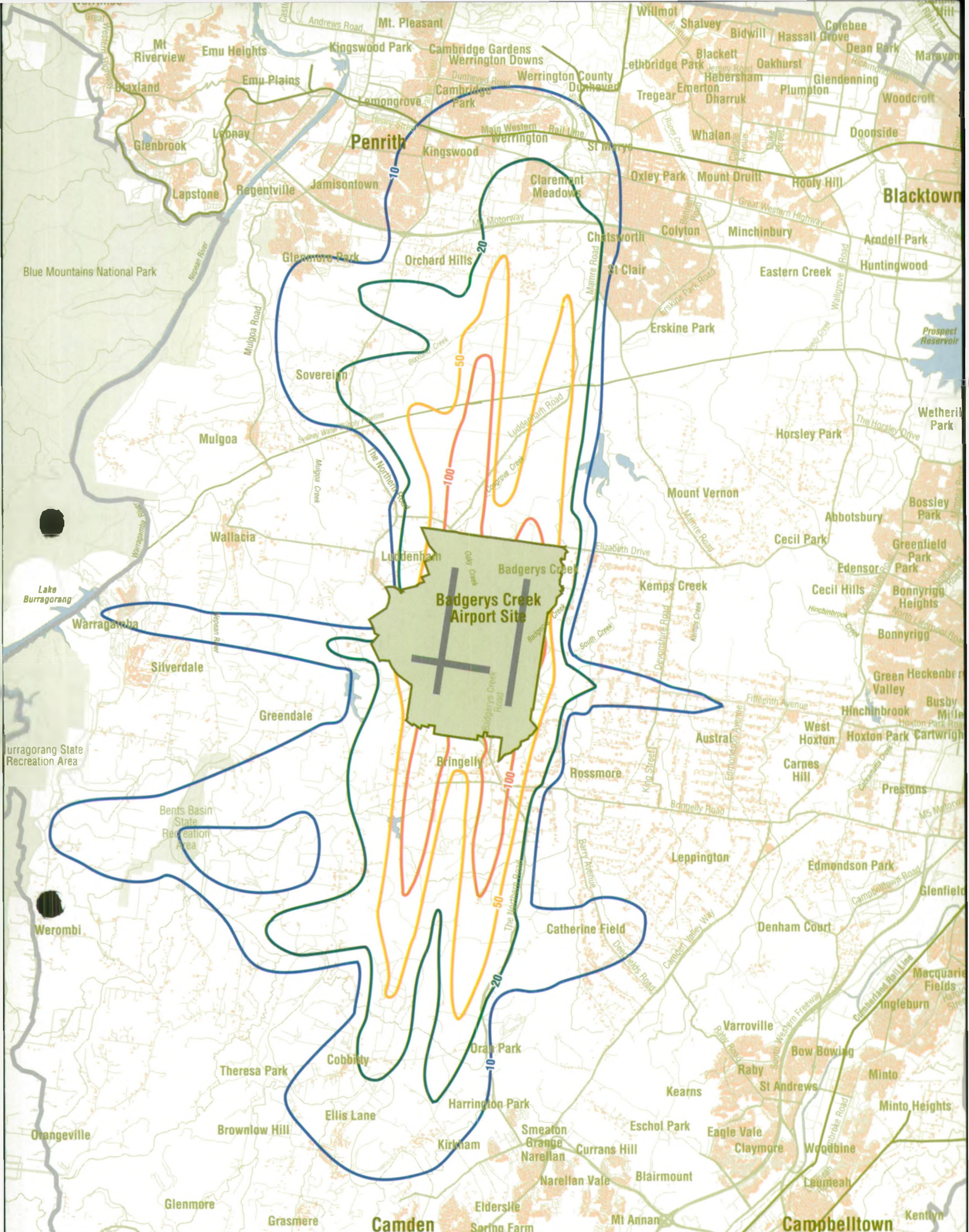
Area within these two contours is estimated to receive between 50 and 100 aircraft overflights louder than 70dBA on an average day —50— —100—

Area within this contour is estimated to receive more than 100 aircraft overflights louder than 70dBA on an average day —100—

Indicates Density of Dwellings in 1996

Figure 12.14
2016 N70 dBA Contours for Option C (Airport Operation 2)

Note: Refer to Section 8.6 for an explanation of what Airport Operation 2 means.



Area within these two contours is estimated to receive between 10 and 20 aircraft overflights louder than 70dBA on an average day —10— —20—

Area within these two contours is estimated to receive between 20 and 50 aircraft overflights louder than 70dBA on an average day —20— —50—

Extent of Dwelling Data

Area within these two contours is estimated to receive between 50 and 100 aircraft overflights louder than 70dBA on an average day —50— —100—

Area within this contour is estimated to receive more than 100 aircraft overflights louder than 70dBA on an average day —100—

Indicates Density of Dwellings in 1996

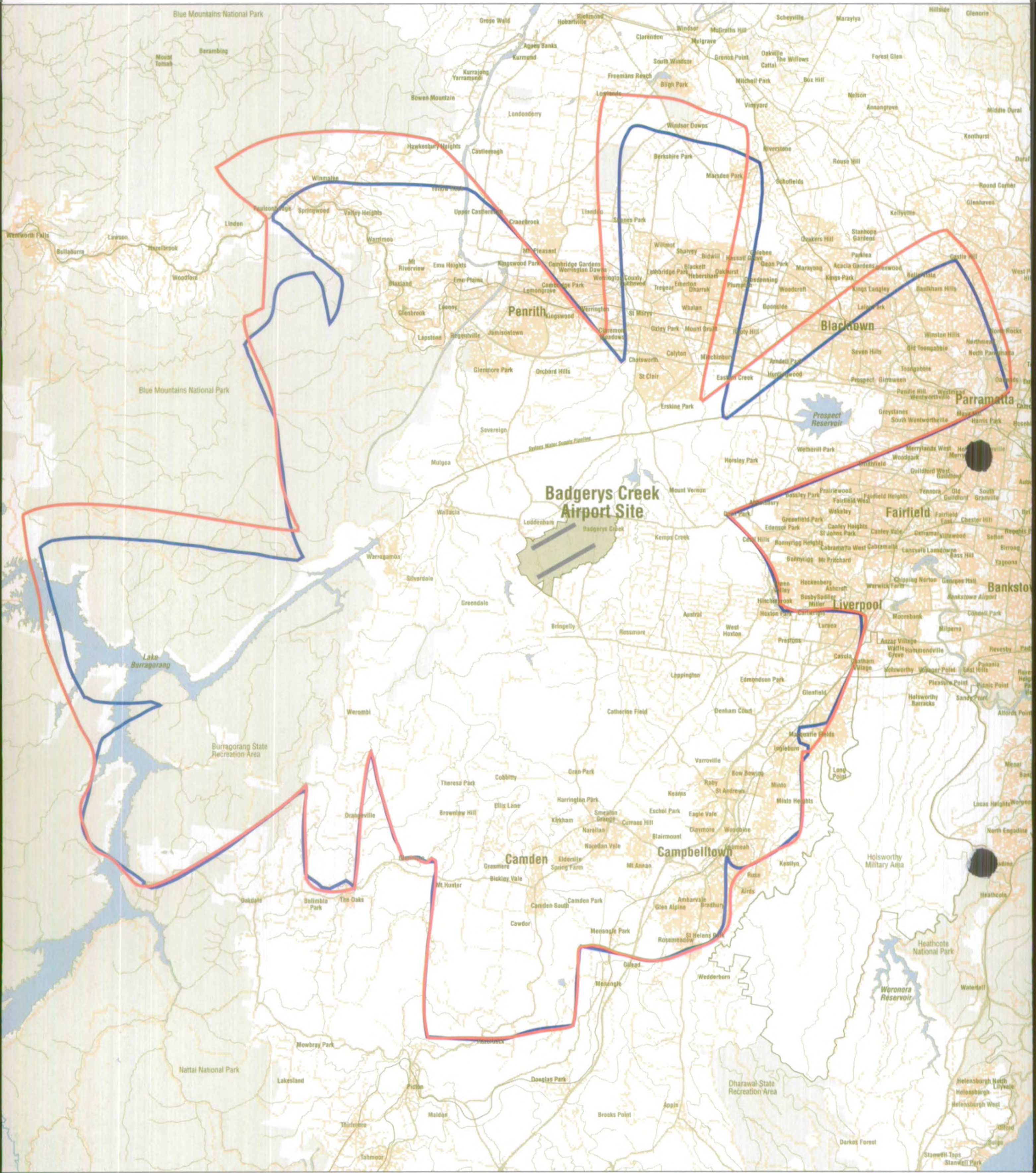
Figure 12.15

2016 N70 dBA Contours for Option C (Airport Operation 3)

Note: Refer to Section 8.6 for an explanation of what Airport Operation 3 means.

TN MN N

0Km 5Km



2006
2016
Urban Areas (indicated by local roads)

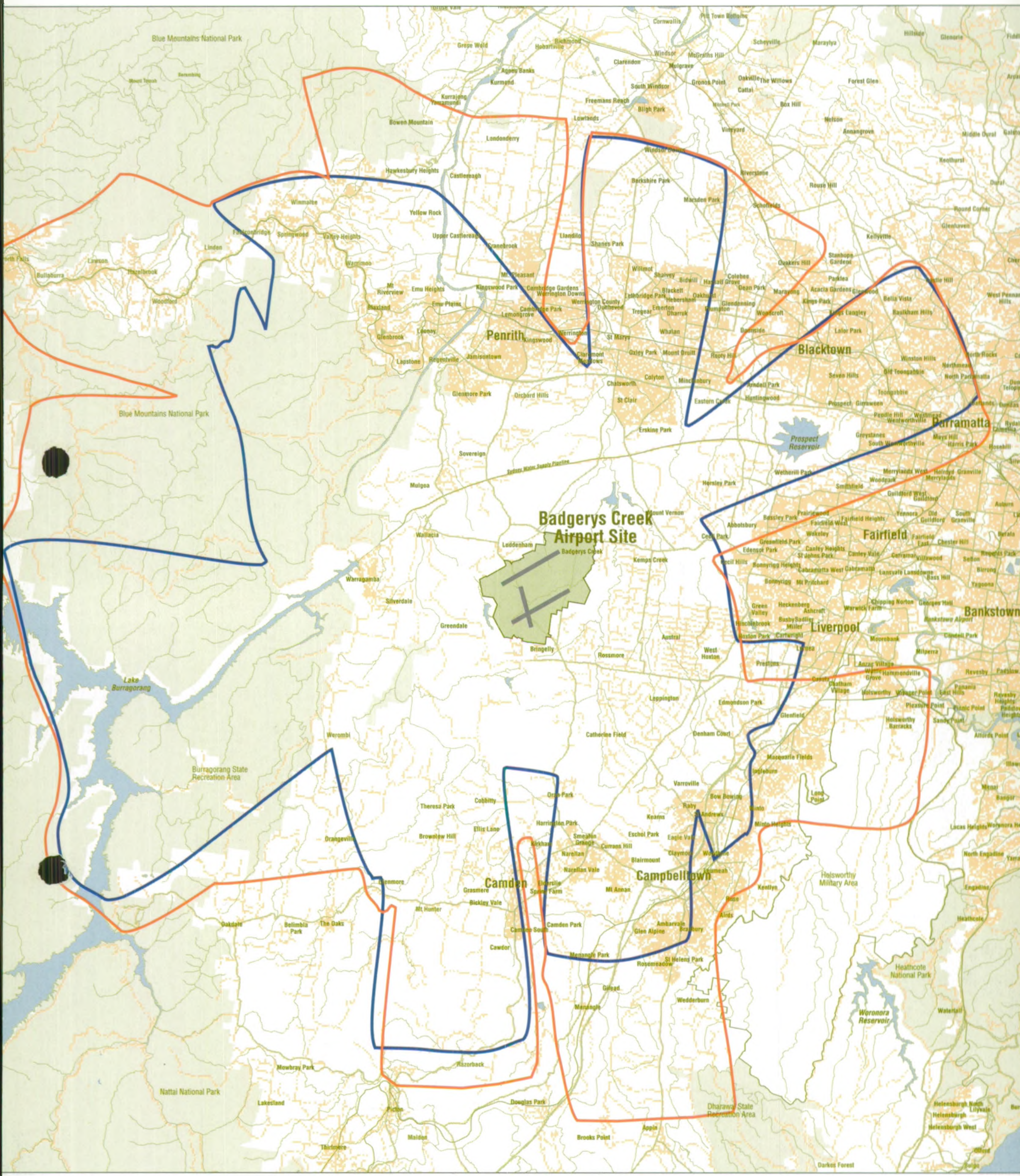
Figure 12.16

Amalgamated 70dBA Maximum Contour (B747-400) for Option A

Note: Shows an amalgamation of 70dBA contours that would be generated by a 747-400 aircraft in 2006 and 2016 on all of the defined flight paths. Only a small part of the area shown would be affected by a single movement of a 747-400 aircraft movement. Some areas within this contour would rarely experience this level of noise.

TN

0Km 10Km 20Km



2006
2016
Urban Areas (indicated by local roads)

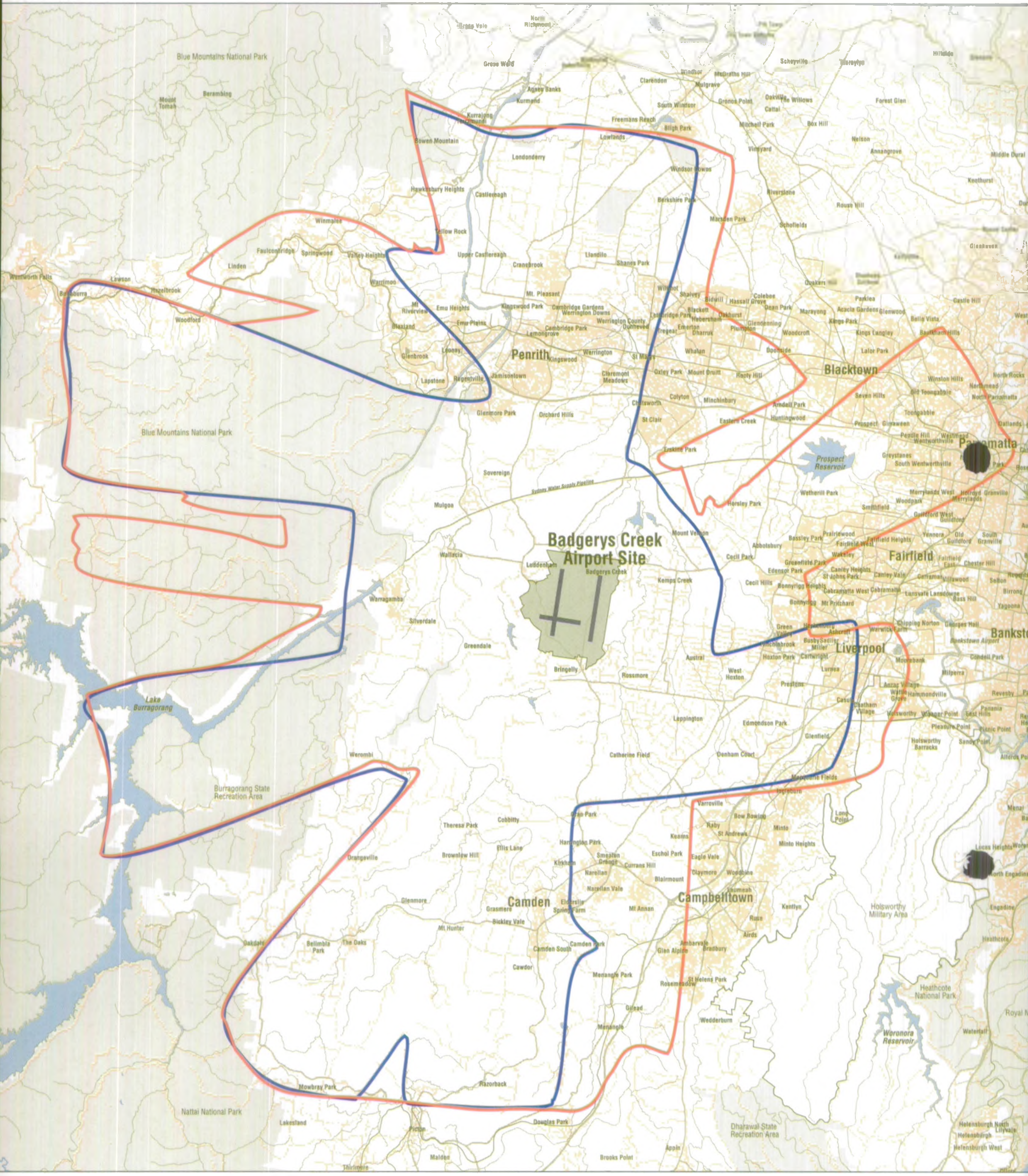
Figure 12.17

Amalgamated 70dBA Maximum Contour (B747-400) for Option B

Note: Shows an amalgamation of 70dBA contours that would be generated by a 747-400 aircraft in 2006 and 2016 on all of the defined flight paths. Only a small part of the area shown would be affected by a single movement of a 747-400 aircraft movement. Some areas within this contour would rarely experience this level of noise.

TN

0Km 10Km 20Km



2006

2016

Urban Areas (indicated by local roads)

Figure 12.18

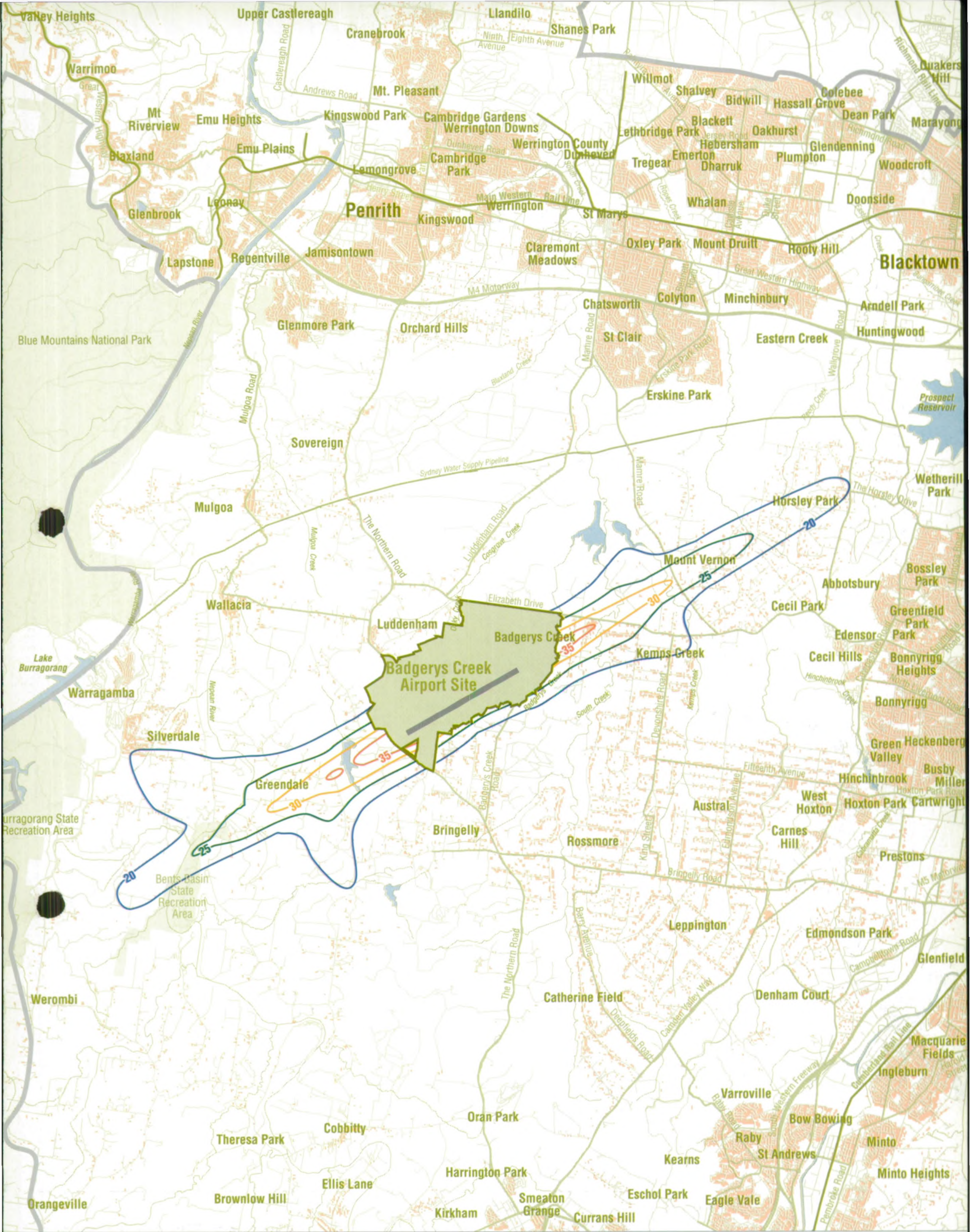
Amalgamated 70dBA Maximum Contour (B747-400) for Option C

Note: Shows an amalgamation of 70dBA contours that would be generated by a 747-400 aircraft in 2006 and 2016 on all of the defined flight paths. Only a small part of the area shown would be affected by a single movement of a 747-400 aircraft movement. Some areas within this contour would rarely experience this level of noise.

TN

N

0Km 10Km 20Km



Indicates Density of Dwellings in 1996

Extent of Dwelling Data

Figure 12.19

Modelled Maximum 2006 ANEC Contours for Option A

Indicates Density of Dwellings in 1996

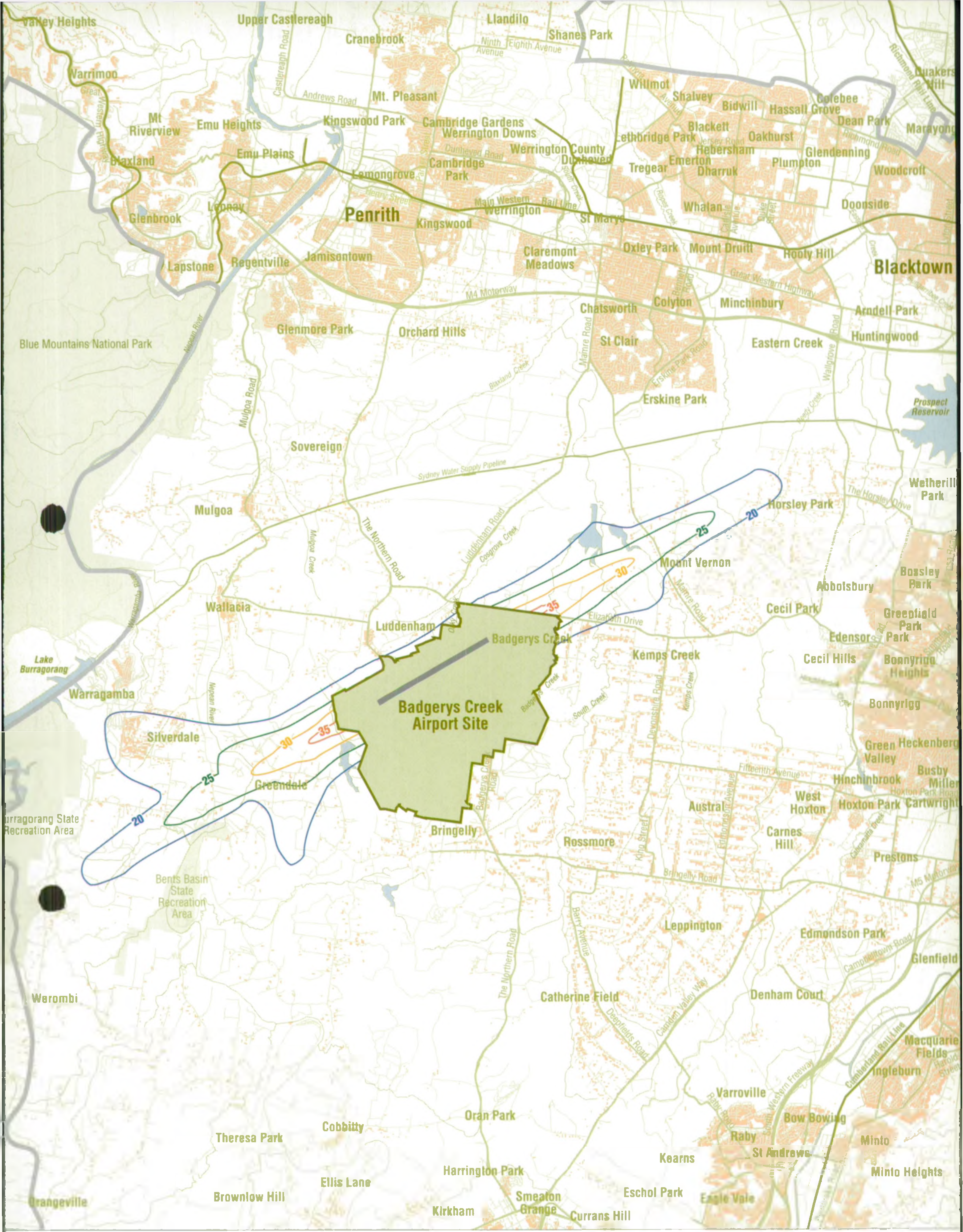
Extent of Dwelling Data

Figure 12.20

Modelled Maximum 2016 ANEC Contours for Option A

TN MN

0Km 5Km



Indicates Density of Dwellings in 1996

Extent of Dwelling Data

Figure 12.21
Modelled Maximum 2006 ANEC Contours for Option B

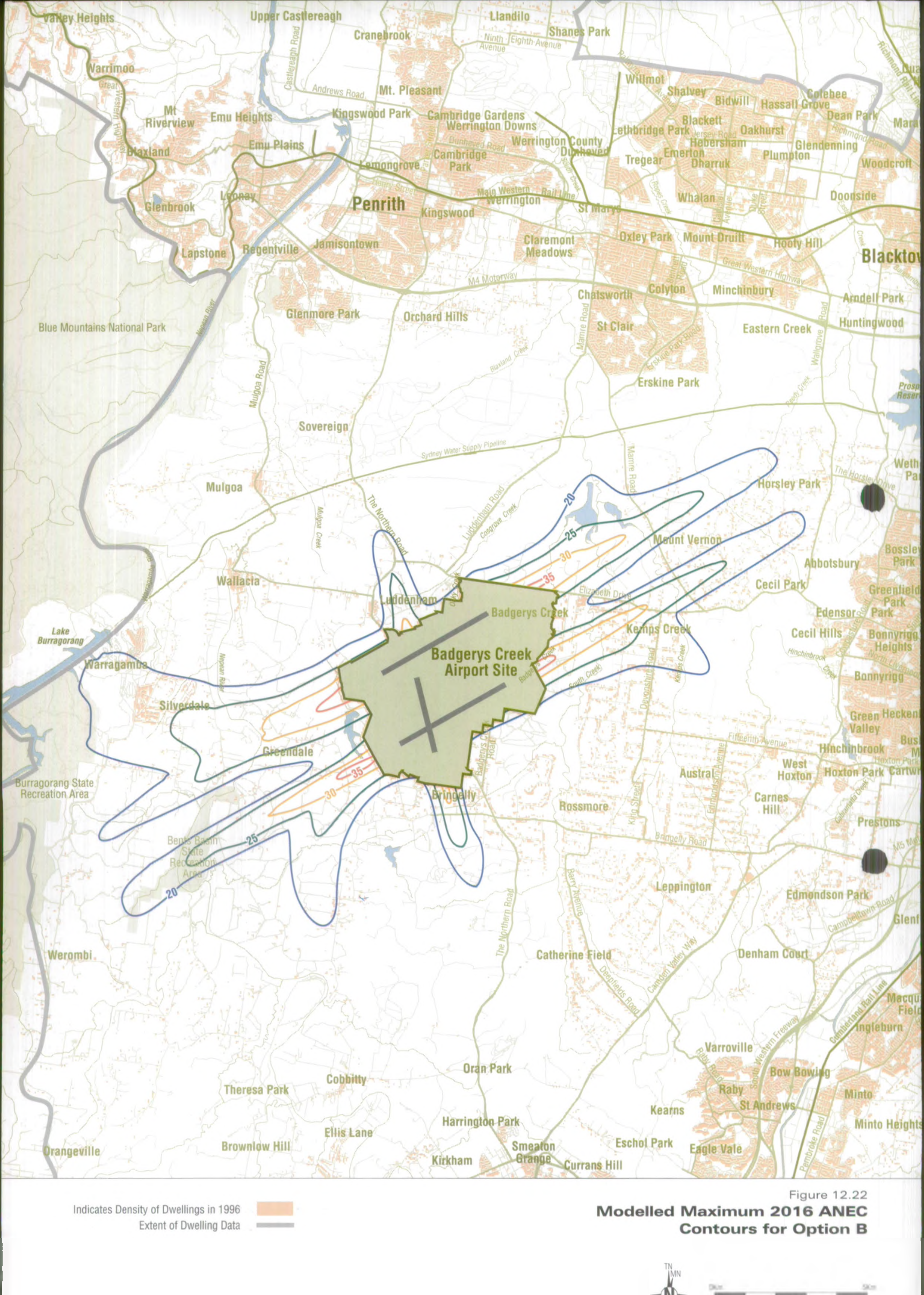
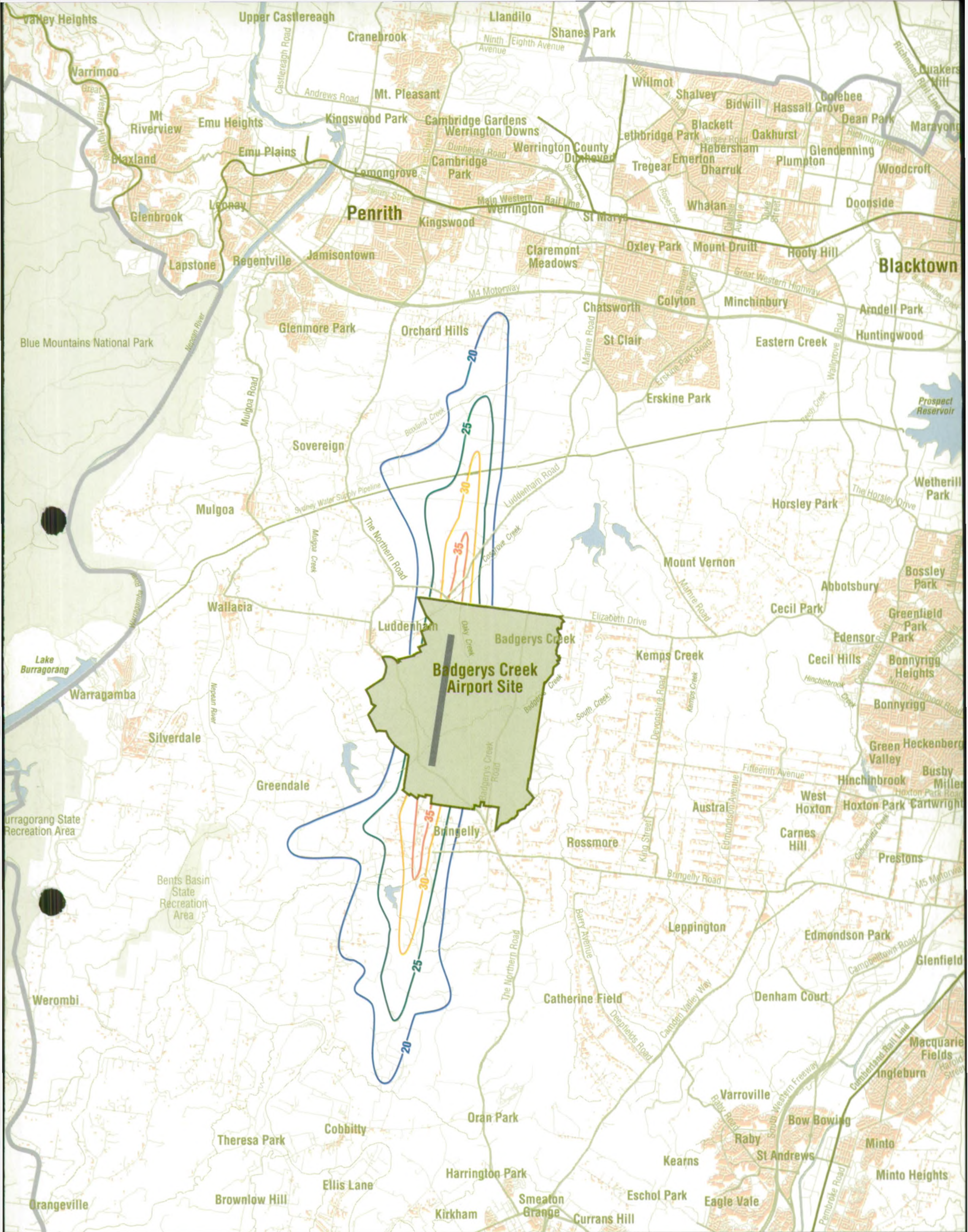


Figure 12.22
Modelled Maximum 2016 ANEC Contours for Option B



Indicates Density of Dwellings in 1996

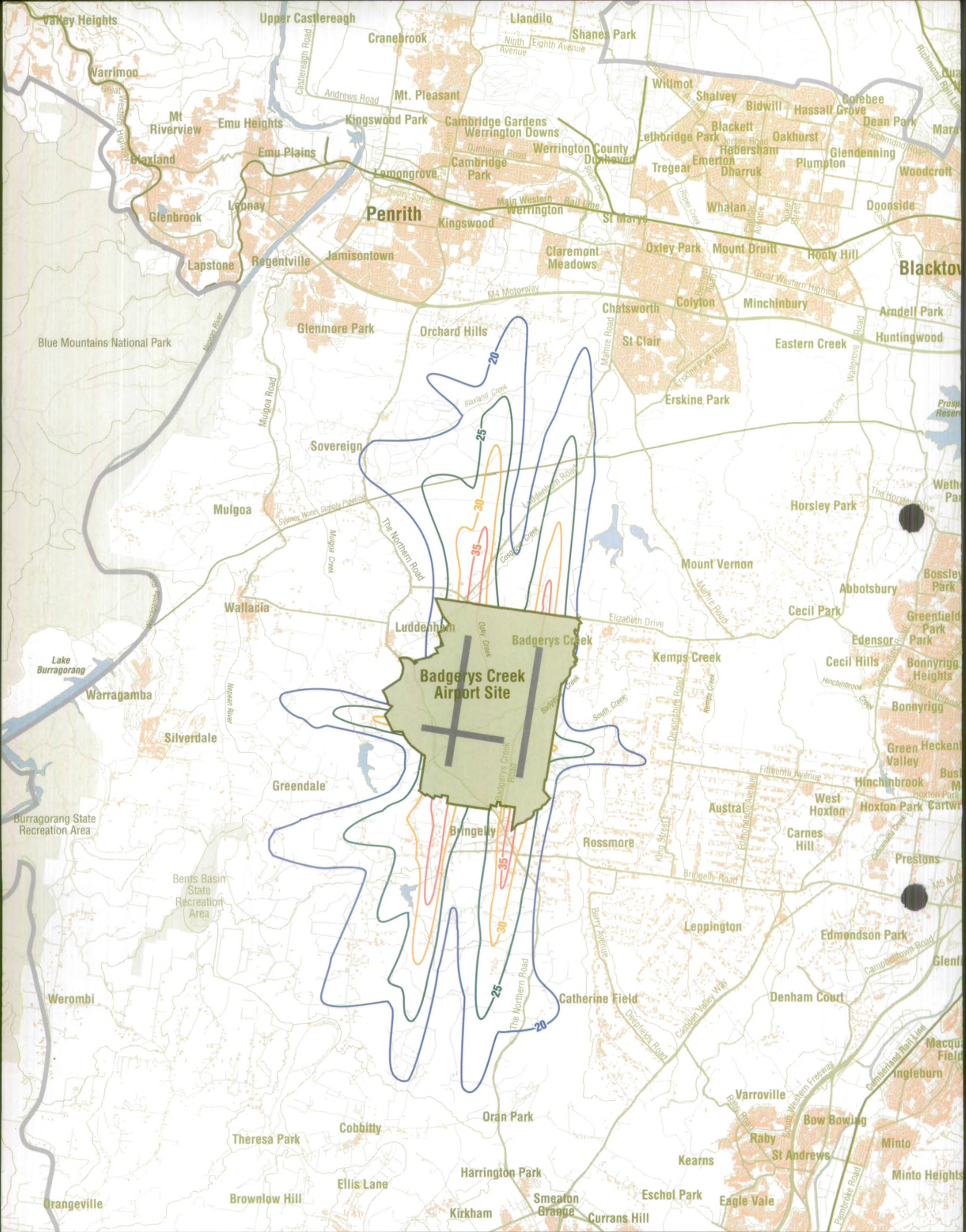
Extent of Dwelling Data

Figure 12.23

Modelled Maximum 2006 ANEC Contours for Option C

TN MN

0Km 5Km



Indicates Density of Dwellings in 1996

Extent of Dwelling Data

Figure 12.24

Modelled Maximum 2016 ANEC Contours for Option C

- the impact of noise from a newly introduced source is not well understood, although it is known to be higher than that from a source that has been in an area for some time; and
- even where relatively accurate estimates of numbers of people affected can be obtained, an approach that simply ranks the airport site options according to these estimates does not provide sufficient information to assess possibilities for noise mitigation through changes to flight paths or operating procedures, programs for acquisition or insulation of buildings, or land use planning.

Chapter 13

Other Noise Impacts

Chapter 13
Other Noise Impacts

Considerable noise can be generated at an operational airport as a result of activities such as ground running of aircraft engines, taxiing and use of reverse thrust. Several other aspects of the development of a Second Sydney Airport could also lead to adverse effects from noise. During the construction phase, noise from building activities may well affect the surrounding area. Other potential noise problems may arise from proposed road and rail developments serving the airports. This chapter assesses potential noise impacts of the Second Sydney Airport other than those arising from aircraft overflight noise, which is dealt within Chapter 12. Technical Paper No. 3 provides more details.

13.1 Issues Raised During Consultation

13.1.1 Issues Raised During Consultation

Noise from ground operations was not a major issue during consultation as this potential source of impacts was not easily identified by the community at this early stage.

Comments on the general impact of operational noise noted the effects of topography and meteorological conditions. These issues were commented upon in relation to all airport options and were considered to be likely to 'magnify' potential noise emissions.

The issue of construction noise was not commented on in any detail. Construction noise was not readily identified as a significant issue. The effects of topography and meteorological conditions on construction noise were, however, noted.

Noise from increased traffic levels as a result of the airport was also commented upon, particularly on the M4 Motorway.

13.1.2 General Response to Issues Raised

Although no specific issues regarding ground operation noise were raised from the consultation, the following general comments may answer some common community questions.

Topography and ground cover can affect the spread of ground operation noise into the surrounding areas. In particular, high ground may shield the noise source from the noise receiver and the degree of shielding is taken into account in the assessment. The type of ground can also affect the rate the noise spreads.

Both wind and temperature gradients can affect the spread of noise from ground level sources to receivers. When winds blow across normal ground, the friction at ground level tends to reduce its velocity close to the surface, resulting in higher velocities at locations above ground level, and thus producing a vertical wind velocity gradient. This gradient results in noise spreading at different rates at different heights above ground level.

Overall, the effect is that noise spreads more quickly downwind than upwind. While this effect can be taken into account in the calculations, the alternative course is generally followed of assuming that temperature inversion conditions prevail. Temperature inversions tend to increase the spread of noise in all directions simultaneously.

Temperature inversions occur when cold air is trapped at ground level resulting in the air temperature increasing with height for some distance above ground level. Since the noise spreads more quickly in warmer air than in cooler air, the sound velocities are lower at ground level than above ground level. This results in a bending of the sound rays resulting in an increase in the spread of noise. This increase has been taken into account in the calculations of ground operation noise when calculating for temperature inversion conditions.

It should be noted that, while temperature inversion conditions would increase the spread of noise from an airport site, the more common condition is a temperature lapse, which is inclined to reduce sound propagation.

13.2 Impacts of Ground Operation Noise

13.2.1 Methodology

Noise is generated from within an airport site as a result of activities such as ground running of aircraft engines, taxiing and using reverse thrust.

The use of reverse thrust during landing generates relatively high noise levels, but in the majority of jet landings the noise goes on for only a short-time. On the other hand, while noise during taxiing can be continuous or nearly continuous, the levels from this activity are substantially below the levels of take off, reverse thrust and ground running.

Noise associated with ground running is likely to have the greatest impact of all of the operational noises generated within the airport. This is because aircraft engines are often *run up* for some period of time on full power, for maintenance purposes. This activity can occur during either the day or the night.

For an airport which does not yet exist, such as the Second Sydney Airport, no detail of the amount of ground running is available. The amount of time it would occur would depend upon future policies on aircraft maintenance. Nevertheless it would be sure to occur sometimes. Assessment of ground operation noise in this Draft EIS is based on high powered run up, since the other maintenance phases, with engines idling or on low power, are not likely to have a noise impact at a significant distance from the airport.

Run up noise levels surrounding the Second Sydney Airport sites have been calculated using the Environmental Noise Model. This model allows for the noise emission level associated with typical ground running, attenuation with distance, shielding by natural topography and the effects of air absorption, ground conditions and meteorological conditions.

The noise emission level used for the calculations was that for a typical Boeing 747 aircraft under high power run up conditions. No allowance was made for directionality, since aircraft running up are commonly operated with the nose facing the wind, and hence have no fixed orientation. Accordingly, a conservative assumption was made that the aircraft noise emission was not directional.

Noise calculations were performed for two relatively common meteorological conditions:

- neutral conditions (strictly isothermal atmospheric conditions, where temperature is constant with height); and

- a temperature inversion of three degrees Celsius per 100 metres. This occurs when the temperature increases uniformly by three degrees Celsius above ground temperature up to a height of about 100 metres.

Specific run up locations have not been identified at this stage for the potential airport options. The assumption was made that the run up bays would be near the area allocated for maintenance. Since the airport options would have maintenance areas in similar positions, only one bay location was assumed for the three options.

13.2.2 Calculation Results

The noise contours calculated are shown in *Figures 13.1* and *13.2*. The contours shown are for both neutral conditions and temperature inversion conditions.

The two sets of contours cover the range of noise levels from average to high, but do not show lower noise levels, such as might occur during temperature lapse conditions and upwind.

In view of the probabilities of when light winds and temperature inversions would prevail (refer *Chapter 14*), the contours for neutral conditions for run up of aircraft during the day are appropriate, and the contours for temperature inversion conditions for run up of aircraft at night are appropriate. The impact at night is therefore likely to be substantially greater, and would extend a substantial distance from the airport.

13.2.3 Run up Noise Criteria

For continuous noise, the NSW Environment Protection Authority generally recommends a noise criterion of five dBA over the background (L_{A90}) noise level. However, the acceptable noise level would be increased where the noise is not continuous.

It is likely that high powered run up would occur for approximately five minutes a day, either by day or night. However, since the orientation of the aircraft would vary, the higher noise impacts could be expected during approximately 25 percent of this time. As a maximum, therefore, it is anticipated that run up noise would be significant for just over one minute during any day and one minute during any night. For this duration of intermittent noise, the NSW Environment Protection Authority recommends that the acceptable level be increased by 20 dBA during the day and 10 dBA at night. Accordingly, the noise criteria set for assessment of run up noise are:

- 25 dBA above day time background noise levels; and
- 15 dBA above night-time background noise levels.

The background night-time noise levels within areas potentially affected mostly fall in the range 30 to 35 dBA, but are sometimes below or above. Based on an assumed background night-time noise level of 35 dBA, the night-time noise criterion for aircraft run up at high power would be 50 dBA. In view of the likely increase in background noise levels in the general vicinity of a developed Second Sydney Airport, the 50 dBA criterion is considered appropriate for all areas potentially affected.

13.2.4 Assessment of Impacts

On the assumption that sometimes high power run up would occur during the night, the contours for temperature inversion conditions are the most appropriate to consider. These cover a greater area than the contours for neutral atmospheric conditions as a result of the focussing effects of the temperature inversion.

Noise contour measured in dBA — 45 —

Urban Areas (indicated by local roads)

Indicates Density of Dwellings in 1996

Extent of Dwelling Data

Figure 13.1

Ground Operation Noise Contours (Neutral Conditions)

TN MN N

0Km 10Km

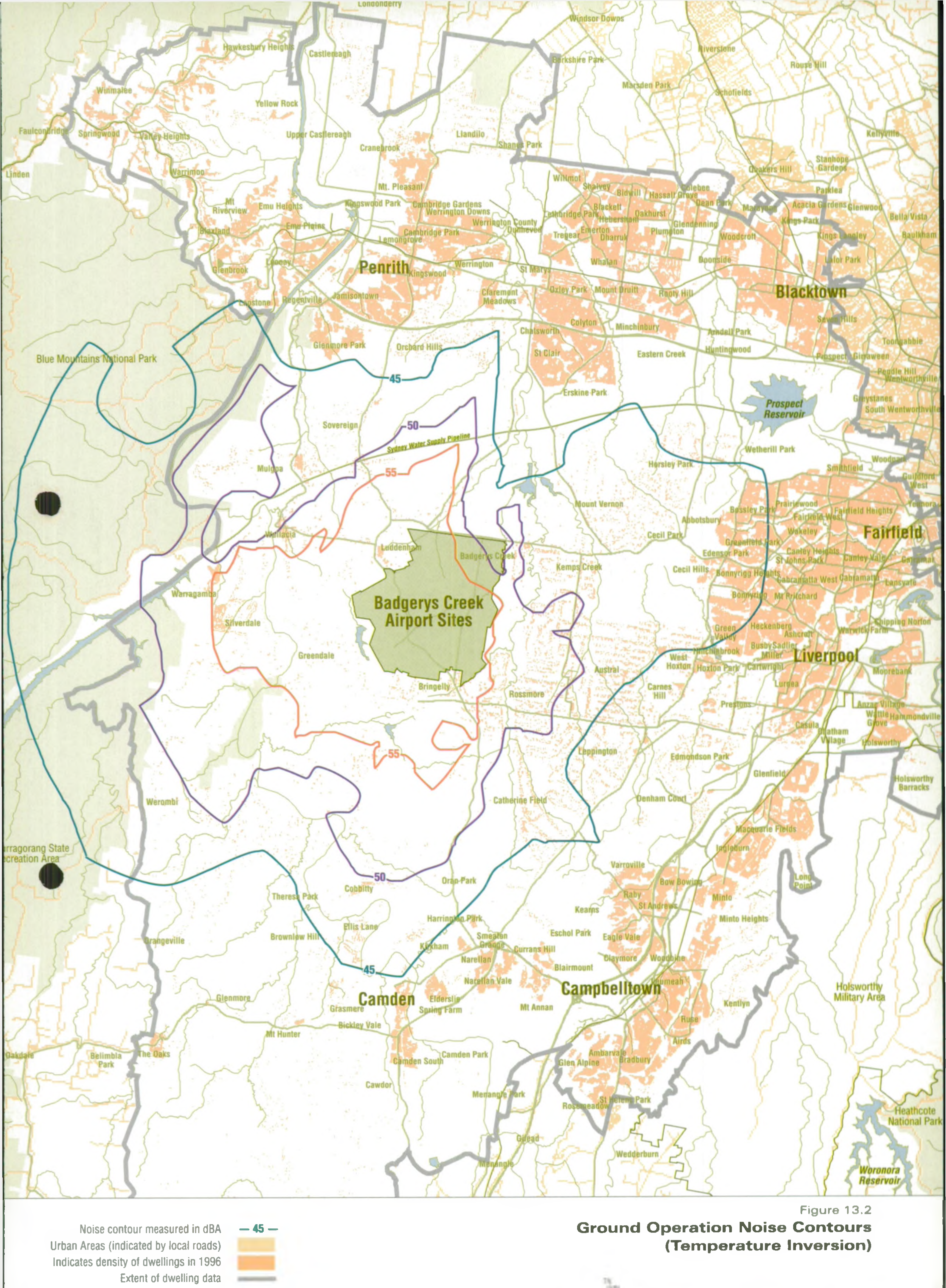


Figure 13.2
Ground Operation Noise Contours (Temperature Inversion)

The 50 dBA noise contour shown on *Figure 13.2* represents the outer extent of potentially significant noise impact from night-time ground running. It will be seen that the contour covers a wide area, and the noise impact would extend over much of the rural and rural residential land and associated villages surrounding any one of the airport sites.

13.2.5 Environmental Management

Aircraft Orientation

During run up, it is normal practice to point the aircraft's nose into the wind. During still or light breeze conditions, however, it may be possible to orient aircraft in a specific direction, for example, to the east, to minimise the noise impact.

Night-time Curfew for Run up

Aircraft engines are run up after routine servicing, but also from time to time as a result of some unforeseen incident or need. It might be possible to limit normal maintenance run up to day time both to avoid the night hours and to reduce the probability of noise focussing as a result of temperature inversions. There would still occasionally be the need to run up an engine at night, for unscheduled maintenance associated with early morning scheduled takeoff.

Limiting most high power run up activity to daytime would have a substantial effect on the impact of ground running noise on surrounding areas.

Noise Shielding

Some of the proposed airport buildings, including maintenance hangars and passenger terminals, would shield ground running noise in some directions. In view of the present conceptual nature of the proposed airport options, potential shielding from the airport development has not been included in the calculations.

It might also be practicable to provide noise shielding around the run up bay. This could be in the form of earth bunding or a specific noise barrier. Shielding 10 metres high would provide about 10 dBA noise reduction in the surrounding area, depending upon factors such as meteorological conditions at the time and the degree of shielding already provided by surrounding topography. The benefit of this form of noise control would be substantial.

13.2.6 Summary of Potential Ground Operation Noise Impacts

The approximate number of people and educational facilities likely to be affected by ground running noise have been estimated using the noise contours shown in *Figures 13.1* and *13.2* for the year 2016; the numbers are shown in *Table 13.1*. These are 'worst case' impacts as no environmental management measures have been adopted for the assessment. Some potential exists to reduce the impact of ground operation noise by adopting environmental management measures. These are discussed below.

The effects of ground running noise as indicated in the contours and *Table 13.1* probably represent an overestimate of the true impact. Jet aircraft demonstrate directional noise characteristics, where more noise is emitted towards the rear of the aircraft during run up than towards the sides and front. This means that under normal run up conditions, the noise contours would be expected to extend significantly further in one quadrant than in the other three. However, as the orientation of the aircraft during run up may vary from day to day, according to wind direction, the contours have been drawn to show the greatest extent of noise impact that would occur from time to time, assuming that maximum noise level is emitted from the aircraft in all directions simultaneously. In other words, the contours represent the overall extent of possible impact during the long term, rather than the extent of impact on any particular occasion.

Table 13.1 Ground Operation Noise Impacts in the Year 2016

Noise Indicator	Option A Population[1] Affected	Option B Population[1] Affected	Option C Population[1] Affected
Neutral Conditions			
50-55 dBA	1,000	1,000	600
Over 55 dBA	1,500	700	700
Temperature Inversion Conditions			
50-55 dBA	12,000	12,000	10,000
Over 55 dBA	9,000	8,500	5,500

Note: 1. Population projection for 2016. Estimates greater than 10,000 rounded to the nearest 1,000; estimates between 1,000 and 10,000 rounded to nearest 500; estimates below 1,000 rounded to nearest 100.

Overall, the three methods proposed in *Section 13.2.5* to control the spread of ground operation noise, or any combinations of these, would not change the relative impacts of the airport options.

Ground operation noise is likely to affect some areas that would also be affected by aircraft overflight noise. The cumulative effect of these two noise levels is therefore of interest. It is considered that aircraft overflight noise is very likely to substantially dominate the noise environment even if ground operation noise is experienced. In this case, the cumulative effect of ground operation noise when added to overflight noise would be negligible. The final relationship between these two types of noise would, however, depend on the noise management measures ultimately adopted for the chosen airport option.

13.3 Impacts of Construction Noise

13.3.1 Methodology

The noisiest stage of construction is establishing the earthworks, in this case a substantial undertaking. It is anticipated that the site earthworks would be carried out during daytime hours only and for a period in the vicinity of two years for Stage 1 development and three years for the master plan. The work is likely to involve a number of scrapers and trucks moving earth around the site, supported by loaders, dozers and compactors. No blasting is proposed during construction.

Construction noise levels surrounding the Second Sydney Airport sites were calculated using the Environmental Noise Model. This model allows for the noise emission level associated with individual items of construction equipment, but also takes into account attenuation with distance, shielding by natural topography and the effects of air absorption, ground conditions and meteorological conditions.

For each airport option, a scenario has been developed for construction of the first parallel runway, using information obtained from Second Sydney Airport Planners (1997a). Individual items of plant have been assigned locations and noise emission levels.

Two meteorological conditions may influence noise levels during construction:

- neutral conditions (strictly isothermal conditions involving temperature constant with height); and
- a temperature inversion of three degrees Celsius per 100 metres.

As mentioned earlier, neutral conditions are fairly common during the day, and temperature inversions at night. Therefore the former have been assumed for the day time calculations applying to the construction of the airport options.

13.3.2 Calculation Results

Construction noise contours are shown in *Figure 13.3*. These contours indicate the noise levels likely to result from the main earthworks associated with levelling of the site and runway construction. Higher noise levels might occur at the site when some construction operations were proceeding close to the boundary. As these higher noise levels would be of limited duration, they would be assessed against higher noise criteria.

13.3.3 Construction Noise Criteria

The NSW Environment Protection Authority has issued recommendations for maximum permitted noise levels on construction sites. These recommendations take into account the duration of the activity, and assume that construction is carried out generally during daytime hours.

The recommended hours of construction are:

- Monday to Friday 7.00 am to 6.00 pm; and
- Saturday 7.00 am to 1.00 pm, if inaudible nearby on residential premises; otherwise, 8.00 am to 1.00 pm.

Based on these times, the following levels are recommended:

- construction period of four weeks and under:

  The L_{A10} level measured over a period of not less than 15 minutes when the construction site is in operation must not exceed the background (L_{A90}) level by more than 20 dBA.

- construction period greater than four weeks and not exceeding 26 weeks:

  The L_{A10} level measured over a period of not less than 15 minutes when the construction site is in operation must not exceed the background (L_{A90}) level by more than 10 dBA.

Although not stated by the NSW Environment Protection Authority, it is interpreted that criteria for long term noise exposure are appropriate for construction periods in excess of 26 weeks. Accordingly, the long term criterion of five dBA above background (L_{A90}) noise levels is appropriate for the assessment of Second Sydney Airport construction noise.

Noise contour measured in dBA — 45 —

Boundary of Options A, B and C

Figure 13.3
Construction Noise Contours for Options A, B and C (Neutral Conditions)

TN MN N

0Km 2.5Km

During the daytime period, the measured background noise levels in the vicinity of the airport sites generally fall in the range 35 to 40 dBA. Assuming the upper end of this range, specifically allowing for the temporary nature of construction noise, a construction noise criterion of 45 dBA is appropriate. The assumed background noise levels are considered consistent with the long term background noise levels, since background noise levels in the area would be likely to go higher as a result of development the Second Sydney Airport.

13.3.4 Construction Noise Impacts

The likely extent of impact from construction as defined by the 45 dBA noise criterion is shown in *Figure 13.3* by way of a 45 dBA noise contour. Since this contour only marginally extends beyond the airport boundaries, the impact of construction noise is expected to be minor, so long as construction activities are confined to during daytime hours.

Figure 13.3 shows the contours for construction of Stage 1 of Option A. The noise contours for construction of Options B and C would be similar, with a slight increase in noise level to the south, largely within the airport boundaries. During construction to the stage of the master plan, additional noise would be generated to the north for Options A and B, and to the south-east for Option C.

As construction noise impacts are expected to be minor, noise control is not proposed at any site at this stage of planning for the airport. More detailed modelling would be undertaken when be construction plans became available during the detailed design phase. Noise levels would monitored during construction and, if necessary, appropriate action would be taken to ensure that the criteria are not exceeded at nearby residences.

13.4 Potential Noise Impacts of Off Airport Road and Rail Infrastructure

A preliminary assessment has been undertaken calculating potential noise impacts of proposed road and rail infrastructure for the airport development. It is documented in *Appendix B* of *Technical Paper No. 3*, *Volume 1*. The main findings and conclusions are summarised below.

13.4.1 Noise Criteria

The noise criteria that apply to construction of proposed new access corridors are different from those for upgrading of existing road or rail lines.

Road Noise Criteria

The NSW Environment Protection Authority has recently revised its road traffic noise policy; early information regarding the revised policy gives the following noise criteria for new roads:

- $L_{Aeq,15hr}$ 55 dBA - 7.00 am to 10.00 pm; and
- $L_{Aeq,9hr}$ 50 dBA - 10.00 pm to 7.00 am.

Because of a lack of night-time traffic data, the 15 hour daytime criterion only has been adopted for this preliminary assessment. For existing roads, the criterion adopted is a maximum L_{Aeq} noise level increase of two dBA; such an increase is considered barely noticeable on an existing road.

Rail Noise Criteria

The NSW Environment Protection Authority has published rail noise criteria applying to new rail lines as follows:

- $L_{Aeq,24hr}$ 55 dBA; and
- L_{Amax} 80 dBA.

The $L_{Aeq, 24 hour}$ criterion has been adopted for this assessment, since it includes both train noise level and number of movements. For existing rail lines, the criterion adopted is an increase in $L_{Aeq,24 hour}$ levels of two dBA; once again, such an increase is considered barely noticeable.

13.4.2 Existing Noise Levels

Ambient noise levels have been measured over four to seven day periods along existing roads and rail lines in the vicinity of the airport options and also near proposed upgrades. The results of measurements were taken at 17 locations are provided in *Technical Paper No. 3*.

$L_{Aeq, 24\ hour}$ levels at the three locations near potential rail lines serving the airport options are less than the 55 dBA criterion. The $L_{Aeq, 15\ hour}$ levels measured at any existing roads that have the potential to be affected by the aircraft options are mostly above the 55 dBA criterion, with the exception of one location at Bringelly.

13.4.3 Road Noise Assessment

Anticipated traffic volumes generated by the Second Sydney Airport would be the same for all three options, and are described in detail in *Chapter 22*. For most roads affected, the increase in $L_{Aeq,15\ hour}$ levels as a result of developing the airport and its access corridors would be less than the criterion of two dBA in 2016. At some locations along Bringelly Road, Camden Valley Way, Denham Court Road, Devonshire Road, Elizabeth Drive, Fifteenth Avenue, Luddenham Road, Mamre Road and The Northern Road, noise increases would be greater than two dBA, resulting in some noise impact at adjacent residential locations. However, the expected increases might be reduced to a maximum of two dBA, or even eliminated, by measures such as using open graded asphalt or roadside noise barriers in front of residential locations.

13.4.4 Railway Noise Assessment

In the event of the Second Sydney Airport developing to master plan stage, forecasts have been made of the increase in $L_{Aeq,24\ hour}$ noise levels to be expected by the year 2016. In nearly all cases, at places the increase in noise levels would be less than the two dBA criterion. The exception is the East Hills rail line, where increases are forecast to be significant. The rail noise criterion would be met at a distance of approximately 50 metres from any potential new rail line to the airport, but would probably be exceeded at places any closer than 50 metres.

13.4.5 Summary of Potential Road and Rail Noise Impacts

A preliminary assessment of road and rail access proposals shows that development would result in significant increases in noise levels on some existing roads, whichever airport option were selected. Noise levels could, however, be reduced to the two dBA criterion by the use of open graded asphalt road paving and, in some cases, the use of roadside noise barriers.

The rail link to the airport options would utilise the existing rail network in addition to a new rail link. It is expected that increases in noise level on the existing rail network would be unnoticeable, except in the case of the East Hills rail line. On this line, the overall increase in noise level would be approximately six dBA, and this would create noise impacts for adjacent residents.

Noise levels on the potential new rail line to the airport would probably achieve compliance with NSW Environment Protection Authority recommendations at a distance of about 50 metres from the line. It might be possible to construct the entire line on an alignment no closer than 50 metres to any residence. If further noise control were required, it could be provided by the use of noise barriers.

Part F

Physical and Biological Impacts

Chapter 14

Meteorology

Chapter 14
Meteorology

This chapter examines the influence of meteorological conditions on airport runway useability and air quality in the vicinity of the airport options. It also outlines adverse meteorological factors that could affect aircraft or airport operations. Further details are provided in Technical Paper No. 5.

14.1 Issues Raised During Consultation

Issues raised during community consultation included the incidence of heavy fog in the vicinity of all three airport site options, as well as the danger of storm activity and wind turbulence; these factors could impinge on aircraft operations and also on surface traffic.

Concerns included the extensiveness (or otherwise) of meteorological data, in particular the period of data collection. It was commented that even five years of data should not be considered sufficient, and a history of meteorological events over the past 10 years should be examined for the impact assessment.

14.2 Methodology

The scope of work comprised:

- collection of background information relating to regional and local meteorology of the Sydney region;
- identification of appropriate sources of meteorological data and assessment of the suitability and limitations of data for use in noise impact and air quality modelling;
- review of meteorology and its influence on air quality in the vicinity of the airport options;
- provision of meteorological information for noise impact studies;
- review of the prevalence of adverse meteorological conditions in the vicinity of Badgerys Creek; and
- assessment of likely useability of the airport options due to wind and adverse meteorological conditions.

Information sources for investigation of meteorological influences on air quality and noise included:

- Bureau of Meteorology records from Sydney, Bankstown and Richmond Airports and other monitoring sites;
- the *Metropolitan Air Quality Study Final Report* (Environment Protection Authority, 1997a), and NSW Environment Protection Authority measurements from the Summer Campaign of February, 1995;
- measurements of wind and other meteorological parameters from the Australian Nuclear Science and Technology Organisation at Lucas Heights, and monthly average fine particle and lead levels measured in Sydney as part of the Aerosol Sampling Project;

- Australian Water Technologies wind speed and rainfall data from selected sewage treatment plants, and rainfall data from stations in the vicinity of Badgerys Creek;
- Federal Airports Corporation air quality and meteorological data from Sydney Airport and Botany;
- Macquarie University measurements of surface winds from different sites in Sydney, including Badgerys Creek; and lower atmospheric wind and temperature profiles measured during previous air quality investigations in Sydney; and
- previous investigations, by Macquarie University and other institutions, of air quality and meteorology in Sydney.

A set of air quality and meteorological data for the period July 1994 to June 1995 was purchased from the NSW Environment Protection Authority. However, there were discrepancies in the wind directions recorded at some stations and it proved impossible to resolve these in time to use this data in the Draft EIS. None of this dataset is contained in the analysis of meteorological conditions, which draws on data from a wide range of other sources instead.

The effect of wind on runway useability was assessed by the Second Sydney Airport Planners (1997a), while study of the prevalence of adverse meteorological conditions and useability due to factors other than wind was based on work undertaken by the Bureau of Meteorology (1997). Data on rainfall, wind speeds and directions and the frequency of temperature inversions were analysed for suitability, and provided to the noise consultants for use in noise impact modelling. Details of the use of these data are contained in *Technical Paper No. 3*.

14.3 Existing Environment

14.3.1 Meteorology of the Sydney Basin

Topography of the Sydney basin is a critical factor causing differences in the weather experienced at various locations (Bureau of Meteorology, 1997). In general terms, weather experienced at any particular point depends upon proximity of the point to the ocean or some other body of water, its elevation, and the surrounding topography. These factors influence daily and seasonal temperature ranges and variability, humidity, rainfall, fog occurrence, and wind gustiness, direction and speed.

A number of studies have examined the influence of synoptic, regional and local meteorology on air quality in Sydney. While these investigations have focussed on air quality issues, many of the main factors identified as important for limiting dispersion of air pollutants, such as ground based inversions and local and regional wind flows at night, can also affect transmission of noise. The amount of information about meteorology contained in the *Second Sydney Airport Site Selection Program Draft Environmental Impact Statement* (Kinhill Stearns, 1985) was extremely limited.

Wind direction in Sydney is generally governed by a large-scale pattern of atmospheric circulation, but it is also influenced by regional and local wind flows, and by the topography of the Sydney basin. The Sydney basin is generally defined as the region bounded by high ground in the vicinity of Mittagong in the south, the Illawarra Escarpment to the east, the Blue Mountains to the west, and the high ground north of Richmond.

Within the Sydney basin there are several regional scale topographic features that are important for air quality. These include the Hawkesbury and Liverpool basins, the Parramatta River Valley and the Blacktown ridge. They are shown in *Figure 14.1*. Within the Hawkesbury basin, there are several smaller scale topographic features, such as the South Creek Valley, which control the direction of near-surface winds under stable atmospheric conditions at night.

Important meteorological conditions or features that influence the dispersion of air pollutants include temperature inversions, synoptic winds, mixing layers and stable layers, regional wind flows, sea breezes and cold air drainage flows. A temperature inversion occurs when the temperature of the air in the atmosphere increases with height, rather than decreasing as is normally the case. A stable layer of cold air near the earth's surface can prevent air pollutants from rising into the atmosphere and being carried away by air currents (Wark et al, 1981). Deeper inversions usually occur in the colder months.

In a well mixed atmosphere, temperature decreases with height at a rate of approximately 10 degrees Celsius per kilometre. The depth of the mixing layer below this can vary between tens of metres to several kilometres. In a stable layer, temperature decreases with height at a rate of less than 10 degrees Celsius per kilometre, and with increasing stability this temperature gradient can eventually become positive, leading to formulation of a temperature inversion close to the ground.

The time taken for a ground based temperature inversion to break down depends on its depth at sunrise and the amount and rate of heating of the lower atmosphere after sunrise. During summer, shallow ground based inversions will break down quickly after sunrise; however, in the cooler months, decreased solar radiation means that it can take several hours for deeper ground based inversions to erode away.

Synoptic winds arise from differences in barometric pressure. In the southern hemisphere, winds blow anti-clockwise around regions of high pressure, and clockwise around low pressure systems. Regions of high pressure continually move from west to east across the continent, with an average frequency of five to six days (Gentilli, 1972). In summer, the mean path of these regions of high pressure is through Bass Strait, and the prevailing synoptic wind directions in Sydney are onshore. In winter, the mean path is north of Sydney, and the predominant synoptic wind directions in Sydney are west to south west.

While it is the prevailing synoptic weather pattern that produces day to day and seasonal changes in surface winds, temperatures, cloud and rainfall, the proximity of Sydney to the coast and the topography of the Sydney basin combine to create regional and local wind systems such as sea breezes and cold air drainage flows. These act to moderate or change the direction of synoptically driven winds (Bureau of Meteorology, 1991).

Sea breezes are primarily caused by daytime temperature differences between land and sea surface temperatures (the breeze moves towards the warmer of the two). Cold air drainage flows occur when air in contact with the earth's surface cools more rapidly than air at the same height (above sea level) but a greater distance from the surface. In this situation, the cooler, more dense air at the surface begins to flow downhill where it gradually merges and combines with other air flowing downhill, forming local and regional drainage flows. *Figure 14.2* shows the development of sea breezes and the interaction with local and regional drainage flows in the Sydney basin over the course of a typical day, when no temperature inversions are present.

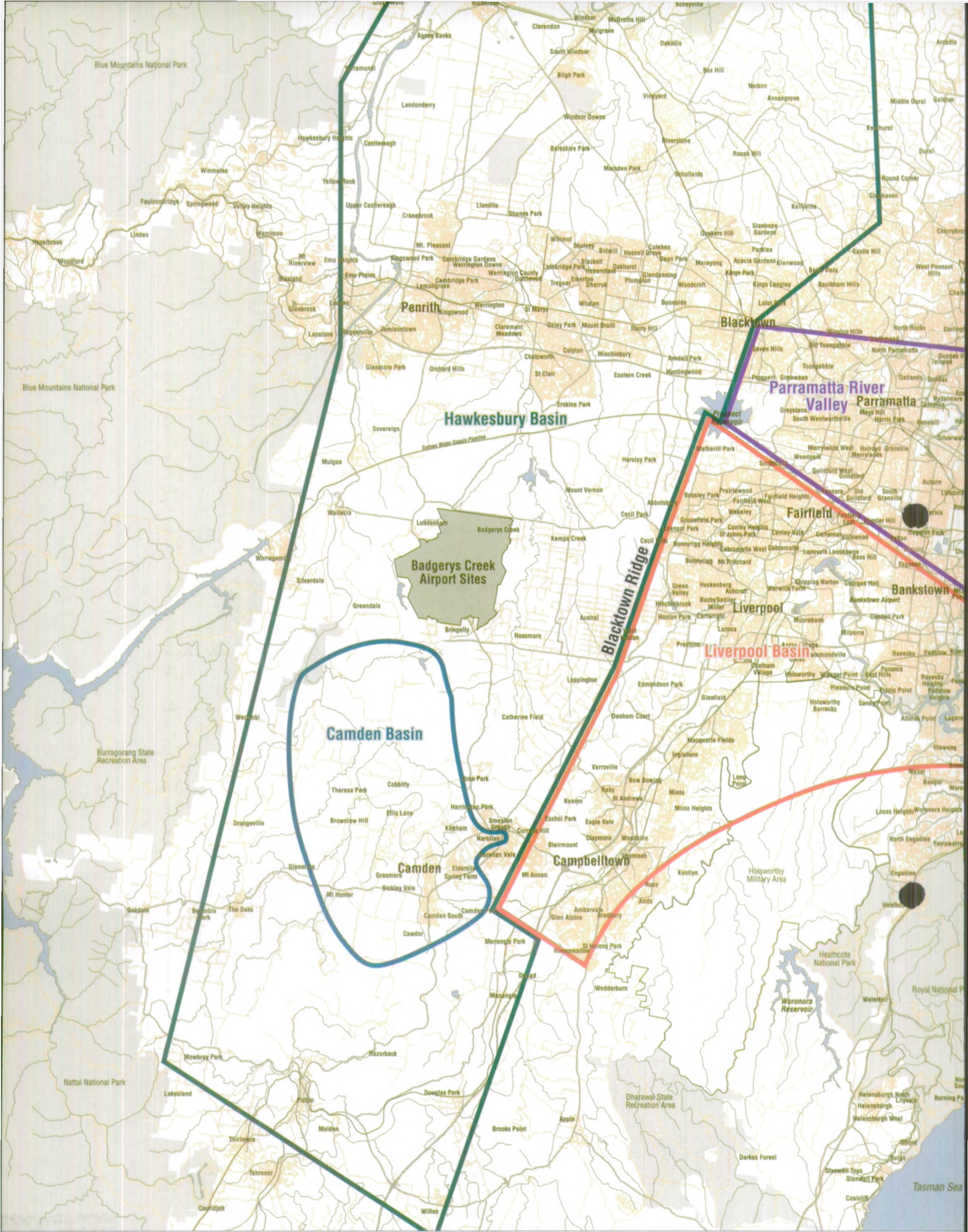


Figure 14.1
Topographic Basins within the Sydney Airshed

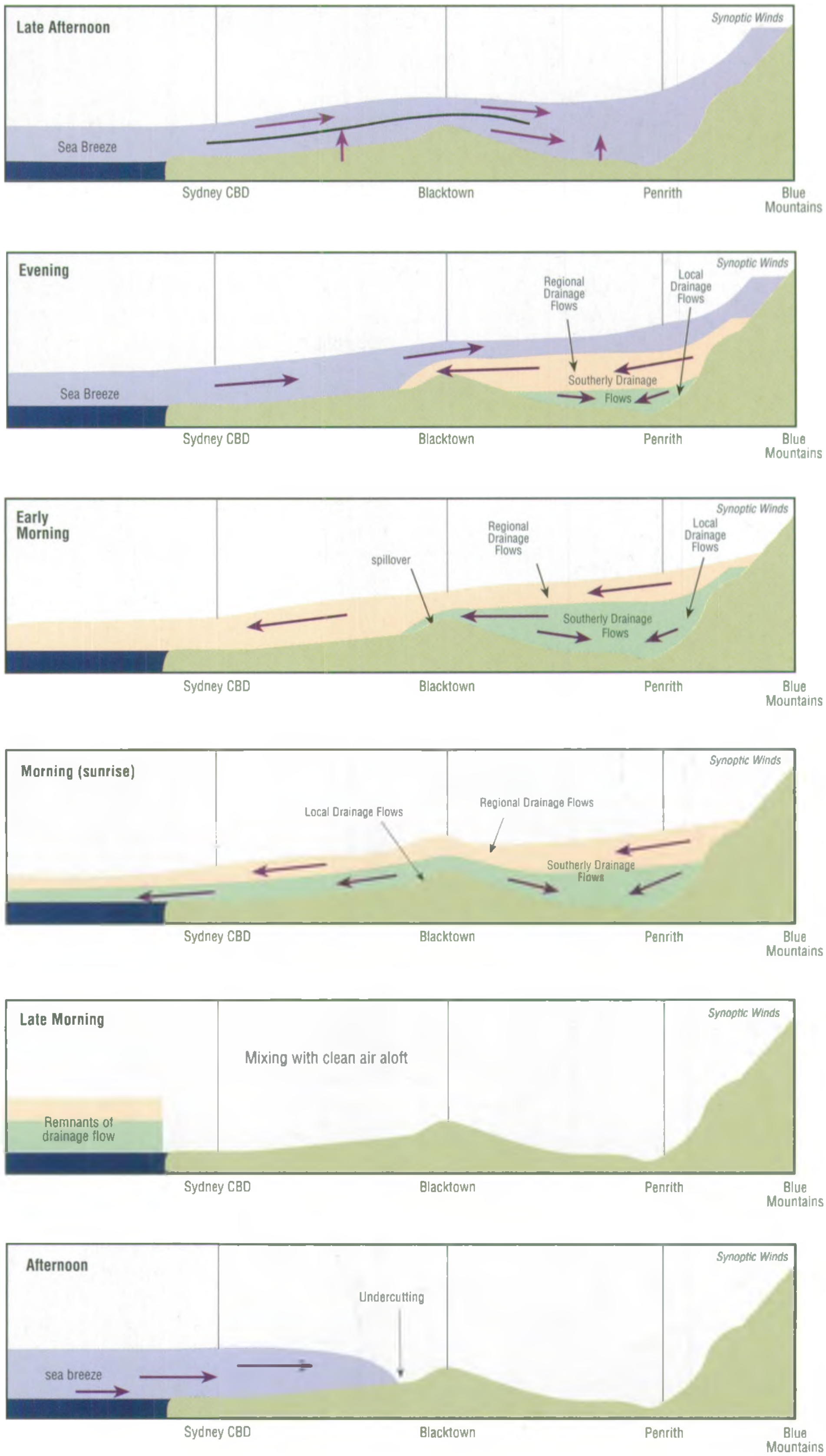


Figure 14.2
Sea Breezes and Drainage Flows

14.3.2 Meteorology of the Badgerys Creek Area

Badgerys Creek is located in the far west of the Sydney basin, relatively close to the Great Dividing Range.

The seasonal distribution of winds at Badgerys Creek is characterised by dominant south-westerly winds in autumn and spring. In winter there is an increase in the frequency of winds from the west-north-west and north-west directions.

Estimates of the frequency of temperature inversions at Badgerys Creek were made without the benefit of on site measurements of the vertical structure of temperature in the vicinity. Wind speeds commonly observed during periods of drainage flows, when a ground based inversion or stable layer would be expected, were used to indicate when inversions may most likely occur.

Combining measurements from different sources has indicated that temperature inversions would most likely occur at Badgerys Creek on 60 to 75 percent of nights in summer, and 60 to 95 percent of nights in the winter months. Deep ground based inversions would be expected occasionally during summer, but could occur often in winter. Inversions are expected to form more quickly at night at Badgerys Creek than they would in more exposed locations. In summer, these inversions would be expected to erode away quickly after sunrise; however, in winter the erosion could take several hours.

The Bureau of Meteorology (1997) estimated that Badgerys Creek experiences a median rainfall of between 700 and 800 millimetres per annum. This is less than most of the Sydney metropolitan area, where rainfall ranges between 800 and 1,200 millimetres per annum.

14.4 Impacts of Meteorology on the Airport Options

14.4.1 Runway Useability Due to Wind

The strength and direction of wind can influence how often a runway can be used. A cross wind is wind perpendicular to the direction of travel of the aircraft which, in the case of landings and take offs, coincides with the orientation of the runway in use. Generally, the lighter the aircraft and the slower its design speed, the more difficulty it will have in compensating for cross winds during landing and take off. *Table 14.1* shows runway useabilities for the master plan runway orientations. Australia has adopted a planning goal for runway useability of 99.8 percent at capital city airports and 99.5 percent for other aerodromes (Second Sydney Airport Planners, 1997a).

Table 14.1 Runway Wind Useabilities for Airport Options

Airport Options	Overall Wind Useability		
	10 Knot Cross Wind	13 Knot Cross Wind	20 Knot Cross Wind
Option A	94.15%	97.25%	99.84%
Option B	97.75%	99.30%	99.96%
Option C	99.23%	99.91%	99.99%

Source: Second Sydney Airport Planners, 1997a

Aircraft are grouped according to their reference field lengths, with larger aircraft able to cope with higher cross wind components (20 knots) than small (10 knots). While none of the airport options meets the useability criterion (Australian adopted planning goal) for all cross wind component values for all aircraft types, operations by larger aircraft would be able to achieve the required useability level. For some part of the time, operations by aircraft with lower cross wind capability would be restricted.

Vertical wind shear and mechanical turbulence are likely to be significant for aircraft operations at Badgerys Creek when there is strong westerly flow over the Great Dividing Range, and when surface winds are strong (Bureau of Meteorology, 1996).

14.4.2 Useability Due to Factors other than Wind

Precipitation

Airport useability can be adversely affected by heavy rain (precipitation) due to the reduction in friction between the tarmac and aircraft tyres, and as well as the reduction in visibility. Badgerys Creek would experience rainfall of 700 to 800 millimetres per annum, but is not prone to high intensity precipitation events. Therefore runway useability would not be reduced significantly by precipitation.

Thunderstorms and Lightning

The Bureau of Meteorology (1997) used a number of sources of information to analyse thunderstorm and lightning activity at Badgerys Creek. Its review of long-term data indicated that higher storm probability areas are located to the east of Badgerys Creek, while analysis of shorter term lightning detection data suggested that Badgerys Creek is slightly less prone to lightning strikes and thunderstorms than surrounding areas. It is clearly less affected than areas to the west of the ranges and to the north (Bureau of Meteorology, 1997).

The proximity of Badgerys Creek to the Great Dividing Range would give only a short lead time for thunderstorm warnings associated with thunderstorm cells generated over the range. The impact of thunderstorms and lightning on aircraft operations would depend upon take off and landing flight paths used.

Low Cloud

Airports use specific criteria relating to cloud heights and visibility to assess whether it is safe to land. The term 'alternate minima' is used to describe this criteria for an airport. If weather conditions are worse than those described in the alternate minima definition for the particular aircraft type, then that aircraft must carry sufficient fuel to fly to and safely land at another airport.

The formation of low cloud is a function of factors such as wind direction in the lower layers of the atmosphere, atmospheric stability and moisture availability, elevation above sea level and topography.

A low cloud event, which corresponds with an alternate minima event in this case, occurs when more than four octas (50 percent of the sky) is covered at a defined height. A height of less than 220 metres above ground level was used to specify low cloud events for this analysis.

In the absence of site specific data, low cloud events recorded at Sydney and Bankstown airports were used by the Bureau of Meteorology (1997) to approximate the likely incidence of low cloud events at Badgerys Creek. The number of low cloud (alternate minima) events at Badgerys Creek was examined over a 57-year period . On average, low cloud events are estimated not to exceed eight per month in January, and be less than four per month for most other months.

Influence on Operations

The decision to proceed with a landing or a take off in conditions of poor visibility rests with the individual pilot concerned and is usually based on the pilot's training, experience, aircraft type, standard of electronic navigation equipment aboard the aircraft, and the requirements specified in the company operations manual. It is therefore not possible to estimate the proportion of time that an airport would not be useable because of weather conditions other than wind.

14.4.3 Influence of Meteorology on Air Quality

The vertical dispersion of near-surface air pollution emissions is likely to be inhibited at Badgerys Creek on many nights of the year because of the high frequency of ground based inversions. When winds are blowing from a north-easterly direction, these trapped emissions could be carried towards the Camden basin. It is likely, however, that steep ground-based inversions would separate air within the basin from emissions carried towards it from Badgerys Creek.

Alternatively, these emissions could travel towards the Nepean River Valley where they might become entrained in local and regional drainage flows, and be carried northwards along the axis of the Hawkesbury basin. This would occur at night.

When local drainage flow along South Creek Valley is absent, near-surface emissions could be carried east towards the Blacktown ridge and into the Liverpool basin. This would occur when westerly cold air drainage flows or stable synoptic winds were present at Badgerys Creek.

On the basis of currently available air quality measurements, it appears that near-surface air quality at Badgerys Creek would not be influenced by urban pollution from eastern Sydney, in particular the Liverpool basin.

During winter, temperature inversions as deep as 600 metres are often present at sunrise, and it can take several hours for these inversions to be eroded away. During that period, near-surface and elevated emissions would be carried towards the north until the drainage flow had gone, and then would be carried downwind away from the airport by the direction of the wind above.

In summer, if an elevated inversion were present above the Hawkesbury basin, northerly winds would carry near-surface and elevated emissions towards Camden and Campbelltown, and could contribute to photochemical smog in the region. Alternatively, near-surface and elevated emissions could contribute to photochemical smog levels in air carried across Badgerys Creek within the sea breeze and contribute to ozone levels as the air moves inland into the lower Blue Mountains.

Elevated emissions during the day from aircraft in the vicinity of Lake Burragorang would be dispersed rapidly by vertical mixing due to winds and convection. At night, it is unlikely that these elevated emissions would reach the surface, because of the formation of a layer of stable air above the lake. *Chapter 16* discusses potential impacts of air pollutants on drinking water supplies.

14.5 Environmental Management

Weather conditions other than wind can affect the useability of an airport. Air traffic procedures for dealing with poor visibility at an airport, such as in fog or heavy rain, are developed by Airservices Australia in conjunction with the Civil Aviation Safety Authority. The procedures are based on prescribed visibility minima for landings or take offs.

In the absence of site specific meteorological data, analysis of meteorology was based upon data extrapolated from the nearest most representative locations and applied to the proposed sites. Hence, many of the conclusions reported need to be reviewed and validated when site specific data are obtained. This issue is discussed further in *Chapters* 26 and 27.

14.6 Summary of Meteorological Influences

Meteorological factors such as wind speed and direction, rainfall, inversion layers and mixing heights influence the useability of the proposed airport sites, as well as the dispersion and transportation of air pollutants and the transmission of noise from aircraft and airport operations.

Analysis has been hampered by a lack of site-specific data and has had to rely on extrapolating data from the nearest most representative sites. Additional data based on site-specific monitoring would need to be collected to verify assumptions made here.

In the circumstances, quantitative assessment of the extent to which adverse meteorological conditions would affect runway useability at each site has not been undertaken. Preliminary conclusions only have been drawn.

While none of the airport options meets the criterion (Australian adopted planning goal) for all cross wind component values for all aircraft types, operations by larger aircraft would still be able to achieve the required useability level. Operations by aircraft with lower cross wind capability would be restricted some of the time, for all airport options.

Because of its close proximity to the Great Dividing Range, an airport at Badgerys Creek might experience thunderstorms which would arrive with relatively little warning.

Large commercial aircraft with modern navigational aids may be able to overcome adverse meteorological conditions such as high intensity rainfall, thunderstorms, low cloud and fog. The impacts of such phenomena for other aircraft may be significant. Wind shear and mechanical turbulence affect aircraft of all sizes and are not able to be measured or predicted as readily as other phenomena, without additional observational data and study.

Decisions on whether to proceed with landing or take off in conditions of poor visibility are based upon a range of factors; hence it is not possible to estimate the proportion of time that any of the airport options would be unuseable because of weather conditions other than wind.

At Badgerys Creek, pollutant emissions from the airport would combine with photochemical smog formed from urban and industrial emissions upwind. This would likely be carried inland within the sea breeze and would impact on the lower Blue Mountains.

Ozone can be present in western Sydney within light northerly sector winds before the arrival of the sea breeze.

Emissions from the airport site could combine with this photochemical smog and potentially impact on the populated areas of Campbelltown and Camden. However, the vertical structure of winds and temperature during these periods of pre-sea breeze ozone is unknown, and therefore it is not possible at present to assess these impacts.

The analysis suggests that air emissions would not reach the surfaces of Lake Burragorang, near Badgerys Creek, at night because of formation of layers of stable air in the vicinity of each catchment. Air emissions generated during the day would be dispersed from this area. *Chapter 16* discusses the potential impacts of air pollutants on drinking water.

Chapter 15

Air Quality

Chapter 15
Air Quality

An air quality study was undertaken for this Draft EIS to assess current air quality and to investigate potential changes in air pollutant levels arising from the construction and operations of a Second Sydney Airport at Badgerys Creek, and potential local, regional and health impacts. The study is documented in Technical Paper No. 6; this chapter summarises its main findings and conclusions.

15.1 Issues Raised During Consultation

The majority of issues raised in community discussions related to concern over current levels of air pollution in western and south-western Sydney. Increased aircraft and vehicle emissions would exacerbate existing problems. Concern over this issue was a reason for many respondents to suggest that the airport should not be located in the Sydney basin.

Comments noted that existing levels of ozone in photochemical smog in western Sydney exceeded the guidelines of the World Health Organisation. It was suggested that further sources of nitrogen dioxide would create a dangerous health environment. The air pollution that would be generated by a second airport was suggested as being equivalent to a residential development of 80,000 people.

It was noted that the dispersal of pollutants in the western areas of Sydney is impeded by wind conditions and that previous studies recommended industrial development should be avoided in those areas that are intrinsically poorly ventilated and experience persistently stable atmospheric conditions.

Comments were also made about the potential impacts of increased air pollution form aircraft and vehicular emissions on water quality in the catchment area, Lake Burragorang and Prospect Reservoir.

The impacts of air pollution on community health were another concern. The Second Sydney Airport proposal, it was felt, had the potential to increase the incidence of asthma and cancer amongst people living in surrounding areas.

Comments were made regarding a direct causal link between air pollution and respiratory problems, including asthma and various forms of cancers. Furthermore, it was claimed that these diseases are already more prevalent in western and south-western Sydney because of poor air quality and locally restricted air movement patterns. Concern was also expressed about the health implications of increased exposure to benzene. Other potential health impacts that were mentioned included skin ailments resulting from exposure to air borne aviation fuel.

15.2 Sydney Air Quality Issues

15.2.1 Potential Effects of Air Pollutants

The presence of pollutants in air, such as ozone, carbon and sulphur dioxides, and oxides of nitrogen can lead to a range of harmful environmental effects. On the global scale, these include an increase in the level of greenhouse gases and the formation of acid rain.

In an urban or regional context, potential impacts include a deterioration in amenity due to the presence of photo-chemical smog and brown haze; possible contamination of drinking water supplies; an exacerbation of respiratory problems; and short and long term health impairment, including an increased risk of contracting certain forms of cancer. One class of pollutant in particular, the air toxics, has been identified as having carcinogenic (cancer causing) properties. Air toxics include benzene, formaldehyde, 1-3 butadiene and diesel soot (Roads and Traffic Authority, 1995). Common sources include chemical plants, motor vehicles, metal plating plants, dry cleaners, petrol stations, solid fuel home heaters, backyard burning and bushfires (Environment Protection Authority, 1996a).

15.2.2 Air Quality Issues

The main regional air pollution impacts in Greater Sydney (an area that includes Newcastle and Wollongong) are photochemical smog and brown haze, and nitrogen dioxide from vehicles (Roads and Traffic Authority, 1995).

Photochemical Smog

Photochemical smog, which sometimes appears as a white haze, is formed by chemical reactions between oxides of nitrogen and reactive organic compounds, in the presence of sunlight. The main constituent of photochemical smog is ozone. Although ozone occurs naturally and is needed high in the lower atmosphere to absorb harmful ultraviolet radiation, high concentrations of ozone can have adverse effects on human health, vegetation and materials.

Heightened levels of photochemical smog can occur when calm, sunny weather conditions prevail for several consecutive days. Polluted air can be effectively trapped in the Sydney airshed on some occasions by the combined effect of sea breezes and elevated land to the north-west and south. Cool air containing pollutants, which normally drains down river valleys overnight and out to sea in the morning, can be blown back onto land by sea breezes (Roads and Traffic Authority, 1995). Impacts of meteorology on air quality are discussed in more detail in *Chapter 14*.

Typical morning drainage flows and afternoon sea breezes in the Sydney basin are illustrated in *Figure 15.1*. As a result of such trapping of pollutants, heightened levels of ozone can be formed downwind of sources of pollution.

Brown Haze

The phenomenon of brown haze is caused by the presence in the air of fine particles, smaller than 10 microns, which are very effective at scattering light. On some winter mornings it can be seen as a brownish layer which reduces visibility (Hyde et al, 1982; Environment Protection Authority, 1996b).

While photochemical smog is generally more prevalent in summer, because of the stronger sunlight, brown haze can be observed mainly on calm winter days. Particulate matter from motor vehicles, industry, solid fuel home heating and bushfire hazard reduction burning (Roads and Traffic Authority, 1994), can be trapped by temperature inversions. The phenomenon of temperature inversion and other aspects of meteorology that can affect air quality are discussed in *Chapter 14*.

Brown haze sources include backyard incinerators, motor vehicle emissions, and industry. An emissions inventory prepared as part of the Metropolitan Air Quality Study (Environment Protection Authority, 1997a) indicates that in 1992, 46 percent of particulate emissions were from industry, 24 percent from motor vehicles, 23

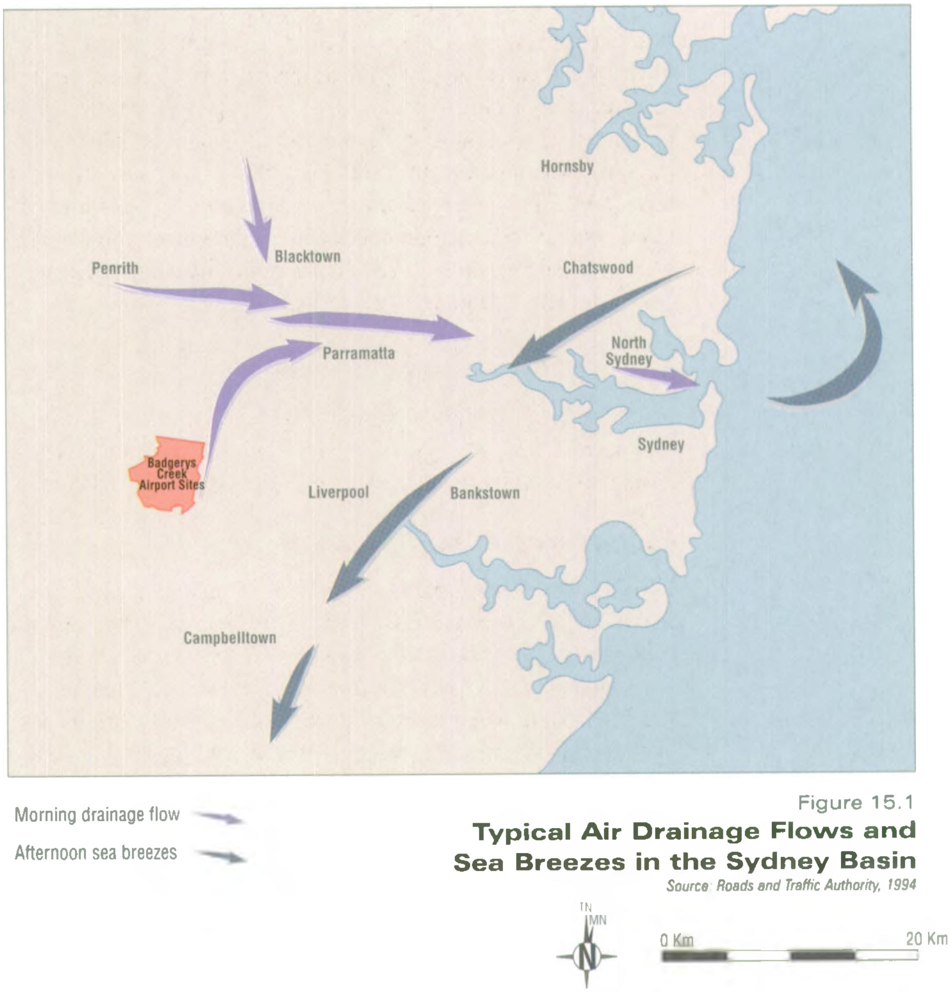


Figure 15.1
Typical Air Drainage Flows and Sea Breezes in the Sydney Basin
Source: Roads and Traffic Authority, 1994

percent from domestic solid and liquid fuel consumption, with the remaining seven percent from commercial shipping.

Motor Vehicle Emissions

Motor vehicle emissions are a major influence on air quality in Sydney. The air emissions performance of individual motor vehicles has improved dramatically since 1976, largely because of better technology. It is anticipated, however, that in the next five to 10 years, increases in motor vehicle numbers and their usage are likely to outweigh the gains made from lower emissions per vehicle, unless traffic growth is moderated (Roads and Traffic Authority, 1995).

Health Effects

During consultation, many members of the community made clear their concern about the health effects of air pollution in Greater Sydney. Many said that they believed that asthma and respiratory diseases were more common in Western Sydney; and that air pollution had made them even more prevalent. Some respondents also made a direct link between pollutants, such as ozone and particulates, and respiratory problems. These topics have recently been the subject of several studies.

In 1996, a NSW Government Green Paper (Environment Protection Authority 1996b) confirmed some health impacts of photochemical smog, but could not corroborate a link with asthma. Issues identified included:

- ground level ozone irritates the eyes and air passages and might interact with allergens to trigger asthma attacks. It might also increase susceptibility to infection. At exposure levels experienced in the Sydney region, health effects appear to be short-lived, although the long term significance of exposure is not known;
- air pollution and photochemical smog in particular have been blamed for increasing the prevalence of asthma but, as yet, there is little scientific evidence to support this. The risk factors for asthma do, however, appear to be largely environmental, and include high allergen concentrations, exposure to environmental tobacco smoke, respiratory infections early in life, and even diet. Some air pollutants, especially ozone, could, however play a role in exacerbating asthma. Air pollution has also been implicated in a range of other health problems; and
- the likelihood of an adverse response to an inhaled pollutant depends on the degree of exposure to the pollutant and the susceptibility of the exposed person. Those at greatest risk include children, the elderly, patients with lung disease such as asthma and chronic obstructive pulmonary disease, and smokers (Environment Protection Authority, 1996b).

Existing statistics about health in western Sydney show somewhat inconclusive results. A survey undertaken by the NSW Health Department in 1994 (Health Promotion Survey 1994, Health Promotion Branch, NSW Department of Health) indicated that asthma is no more common among adults in western, south-western or southern Sydney, than in other parts of Sydney or NSW.

A survey conducted in 1995 by the South Western Sydney Area Health Service (1995) indicated that the rates of diagnosis of asthma (this includes all people who have ever been diagnosed with asthma, and not only those who presently have it) are lower than the area average for Fairfield and Bankstown local government areas. Rates of diagnosis were higher than the area average for Campbelltown, Liverpool and the combined Camden, Wollondilly and Wingecarribee local government areas. However, these rates are influenced by a perceived inclination among doctors to diagnose asthma, and the likelihood that patients will recall this diagnosis (Burney, 1992).

Hospitalisation data and local death rates provide other indicators of the prevalence of asthma, respiratory and heart diseases in certain areas. These data provide information on a combination of factors, including the frequency of severe or fatal exacerbations, the inclination of doctors to hospitalise patients, and the standard of medical care available; hence they do not bear directly on the present issue. The data indicate that, within southern and south-western Sydney, only Blacktown local government area had admission rates that were higher than the State average, and rates in Auburn, Bankstown and Campbelltown were higher than the average for metropolitan Sydney. Among children, hospitalisation rates for asthma were significantly higher than the Sydney average in Blacktown and Bankstown. Death rates due to diseases of the respiratory system were higher than the State and metropolitan Sydney average in Auburn, Bankstown, Hurstville and Parramatta.

A further concern in the community was the likelihood of increased cancer risk, due to air pollution from greater numbers of motor vehicles. It has previously been estimated that about 16 cancer cases per year are associated with motor vehicle air pollution in Melbourne (Hearne, 1994); this estimate was based on addition of risk from exposure to individual air quality pollutants due to motor vehicle emissions. Sydney statistics are likely to be similar although no specific studies have been undertaken.

Particulates such as those from diesel fumes could potentially contain air toxics, such as polycyclic aromatic hydrocarbons. They could therefore contribute to cancer risks, as well as cause respiratory problems, if inhaled. Deposition of such particles on roofs and in water storages, such as rainwater tanks and reservoirs, could result in ingestion of particulates, which would potentially pose other health risks. This issue is discussed in *Chapter 16*.

15.2.3 Air Quality Goals

A recent released report by the National Environment Protection Council (1997) has proposed national ambient air quality standards. However, these standards are only intended for comment at this stage. In the absence of national standards, the air quality studies for this Draft EIS have used the indicators that are currently recognised. Many of these are routinely monitored by the NSW Environment Protection Authority through its regional air quality monitoring network (*Table 15.1*).

Table 15.1 Air Quality Goals

Parameter	Current Goal Recognised by NSW Environment Protection Authority	Averaging Time	Significance
Ozone	10 parts per 100 million [1] 8 parts per 100 million [1]	1 hour 4 hours	Affects respiration
Nitrogen dioxide	16 parts per 100 million [1] 5.3 parts per 100 million [1]	1 hour 12 months	May affect lung function in people with respiratory illness
Oxides of Nitrogen	No goal set	1 hour 12 months	Contains nitrogen dioxide (see above)
Fine particles smaller than 10 micrometres	150 micrograms per cubic metre [2] 50 micrograms per cubic metre [2]	1 hour 12 months	Linked with respiratory complaints and deaths due to cardiac and respiratory diseases
Lead	1.5 micrograms per cubic metre [1]	3 months	Cumulative toxic element Can affect mental development in children
Carbon Monoxide	87 parts per 100 million [3] 25 parts per 100 million [3] 9 parts per 100 million [1]	15 minutes 1 hour 8 hours	Asphyxiant Dangerous at high concentrations
Sulphur Dioxide	12.5 parts per 100 million [3]	1 hour	Affects respiration of sensitive groups Component of acid gases
Air toxics	No limit set for individual compounds		Individual compounds associated with long term health impacts and cancer risk.

Notes: 1. *Goal set by National Health and Medical Research Council.*
2. *Goal set by United States Environment Protection Agency.*
3. *Goal set by World Health Organisation.*

Recent studies by the Environment Protection Authority for the NSW Government have been aimed at developing an overall management plan to improve Sydney's air quality. The Metropolitan Air Quality Study identified the sources of photochemical smog precursors and the processes by which they form smog. Some of its key findings, as stated by the Environment Protection Authority (1996b) include:

- concentrations of both oxides of nitrogen and reactive organic compounds need to be managed;
- reactive organic compound management, which past strategies have focussed upon, will continue to be important; however it will not ensure long-term achievement of air quality goals;
- the summer sea breezes frequently transport emissions from Sydney towards the west of the Sydney basin, therefore ozone levels in western Sydney cannot be reduced simply by managing emissions in the west;
- strategies to manage emissions throughout Sydney, particularly from cars and trucks, are essential;
- concentrations of ozone in western Sydney are particularly sensitive to the addition of new sources of oxides of nitrogen, which can lead to significantly higher concentrations of ozone downwind; and
- nitrogen dioxide (a component of oxides of nitrogen) is emerging as a pollutant of concern in the Sydney region in its own right, apart from the role it plays in the formation of ozone.

In the context of the above issues, the term 'manage' would mean anything from slowing down increases in emissions to achieving real reductions in emissions over a period of time.

15.3 Existing Air Quality

15.3.1 Existing Local Air Quality

In the immediate vicinity of concentrated emission sources, such as busy roads or industrial sites, the NSW Environment Protection Authority considers carbon monoxide, sulphur dioxide, lead and air toxics as key indicators of local air quality. It would be important to monitor these in the vicinity of any new airport development.

Carbon Monoxide

The one hour goal for carbon monoxide has not been exceeded in Sydney in the last decade. Only the air quality monitoring station in the centre of Sydney has recorded occasions of the eight hour goal (nine parts per 100 million) being exceeded.

Sulphur Dioxide

Sulphur dioxide is an acidic gas which, when mixed with water, forms acid capable of causing irritation to breathing and corrode metals. It is produced by combustion of hydrocarbon fuels containing sulphur. The sulphur content of fuels is regulated and, as a result, concentrations of sulphur dioxide in Sydney are well within the goal value of 12.5 parts per 100 million, according to the Environment Protection Authority (1997b).

Lead

Lead is a poison that can accumulate in the body if there is continuing exposure. High blood lead levels (over 60 micrograms per decilitre) result in dysfunction of the brain and kidney damage. At lower levels, symptoms are less obvious, but levels as low as 10 micrograms per decilitre are linked with behavioural and learning disorders in children.

As noted in *Section 15.2.2*, lead concentrations in Sydney air have reduced markedly in recent years and are now well below the National Health and Medical Research Council goal of 1.5 micrograms per cubic metre (Roads and Traffic Authority, 1995).

Since the introduction of unleaded petrol in 1985, ambient lead levels in Sydney (in areas other than those affected by point source emissions) have decreased to levels below the National Health and Medical Research Council goal of 1.5 micrograms per cubic metre (Environment Protection Authority, 1994a). This is illustrated in *Figure 15.2*. As the proportion of cars using leaded petrol continues to decrease, further improvements in atmospheric lead levels may be achieved.

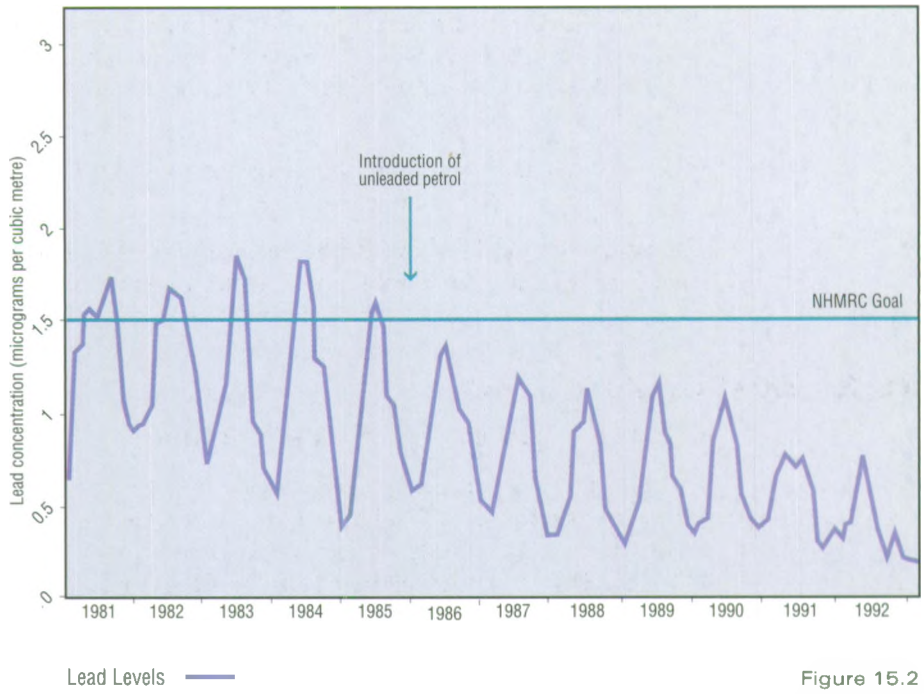


Figure 15.2
Monthly Average Lead Levels for Sydney
Source: Environment Protection Authority

Air Toxic Compounds

Air toxic compounds can cause effects harmful to humans as a result of prolonged exposure. Air toxic compounds considered in the Draft EIS are acetaldehyde, benzene, 1,3 butadiene, formaldehyde, phenol, toluene, xylenes and benzo(a) pyrene. These compounds have been linked with incidence of cancer or other long term health impacts.

Benzene is released to the air from evaporative emissions from petrol and from incomplete combustion of motor vehicle and aircraft fuel. It is classified by the US.

Environment Protection Agency as a known human carcinogen, and is linked with leukemia as a result of occupational exposure (US Environment Protection Agency, 1997).

1,3 butadiene is found in aircraft and motor vehicle exhaust. It is photochemically active and tends to break down quickly in the urban atmosphere. It is classified as a probable human carcinogen based on inhalation studies carried out on mice. There is insufficient evidence to confirm that it is a human carcinogen.

Formaldehyde is present in exhaust from aircraft and motor vehicles. It has been shown to cause nasal cancers in rats and mice and is classified as a probable human carcinogen.

Acetaldehyde is present in exhaust from aircraft and motor vehicles. It is classed as a probable human carcinogen based on mutagenicity and animal studies. Acetaldehyde is destroyed in the atmosphere by photochemical reactions.

Benzo(a)pyrene is one of a number of polycyclic aromatic hydrocarbons found in emissions from motor vehicles and aircraft. It is associated with particulate emissions and classified as a probable human carcinogen.

Records of the current levels of these compounds are sparse. Benzene concentrations in the vicinity of two parts per billion in Sydney have been reported (Nelson, 1994; Nelson and Quigley, 1982; and Duffy and Nelson, 1996). Monitoring of a range of air toxics including benzene and toluene in Sydney central business district showed an average summer benzene concentration of 4.1 parts per billion and an average winter benzene concentration of 7.6 parts per billion (Dawson et al, 1996). Background 1,3 butadiene concentrations below 0.1 parts per billion have been reported in suburban Sydney (Duffy and Nelson, 1996).

15.3.2 Existing Sydney Regional Air Quality

Regional monitoring of air quality is carried out at a series of stations operated by NSW Environment Protection authority and by industry. The results of this monitoring are presented in the form of quarterly reports published by NSW Environment Protection Authority. *Figure 15.3* shows the Environment Protection Authority Air Pollution Monitoring Network (Environment Protection Authority, 1997b).

Ozone, fine particulates and nitrogen dioxide are considered to be the air pollutants of key importance by the NSW Environment Protection Authority, as they occur widely within the Sydney region and contribute to the regional problems of photochemical smog and brown haze.

Ozone

Figure 15.4 shows peak ozone concentrations in Sydney in comparison with other cities in Australia and some international cities. Peak levels in Sydney, in 1992, of approximately 15 parts per 100 million, were comparable with Melbourne at approximately 13 parts per 100 million and Perth at approximately 12 parts per 100 million. In contrast, peak levels in Los Angeles were of the order of 20 parts per 100 million (Western Power and Department of Environmental Protection, 1996).

Occasional breaches of the ozone guidelines occur in Sydney (Environment Protection Authority, 1996a). The goal for peak one hour ozone concentrations was reduced from 12 parts per 100 million to 10 parts per 100 million in 1995. Generally, ozone levels exceed health goal levels of 12 parts per 100 million for less than 10 days

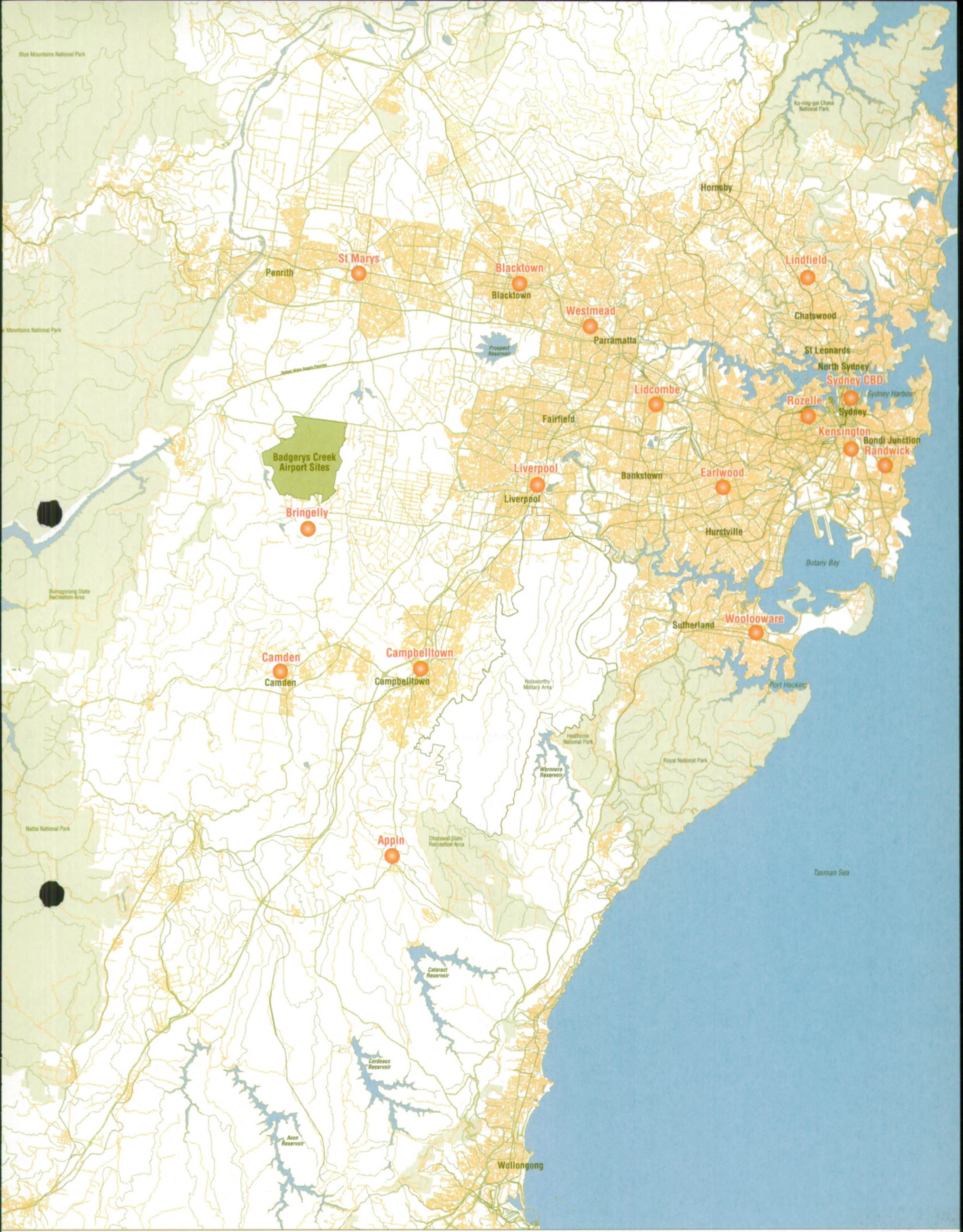


Figure 15.3

NSW Environment Protection Authority Air Pollution Monitoring Network

Source: Environment Protection Authority, 1997b

NSW Environment Protection Authority (or industry) Air Quality and Meteorology Monitoring Station

Urban Areas (indicated by local roads)

TN MN N

0Km 10Km 20Km

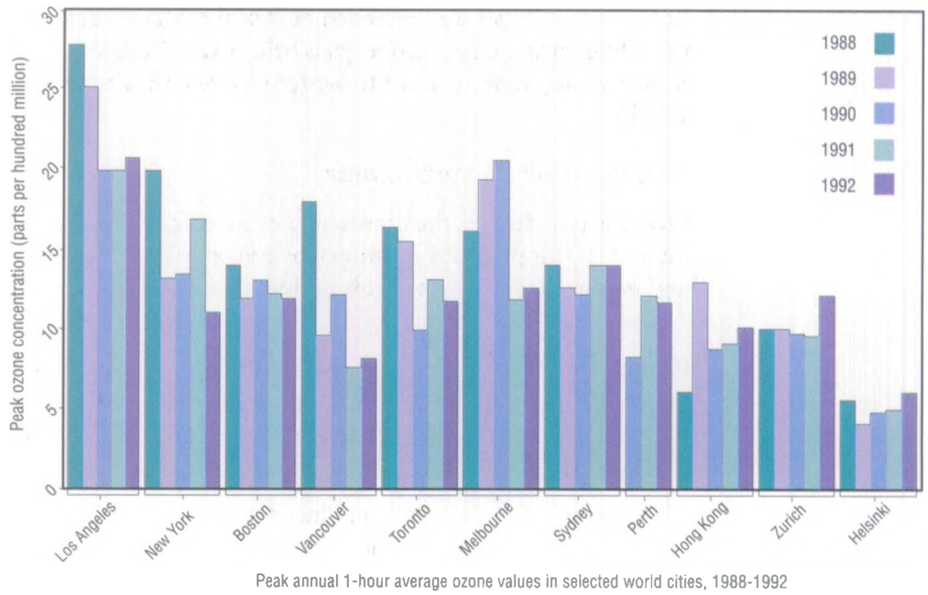


Figure 15.4
Ozone Concentrations for International Cities
Source: Western Power and Department of Environmental Protection, 1996

per year. *Figure 15.5* shows the number of days for which the former, current and planned future goals for ozone were exceeded for the period 1979 to 1994 (Environment Protection Authority, 1996a).

In 1995, Botany Monitoring Station, which is maintained by the Federal Airports Corporation, recorded the only incidence of the current ozone goal of 10 parts per 100 million (one hour average) being exceeded. The eight parts per 100 million goal

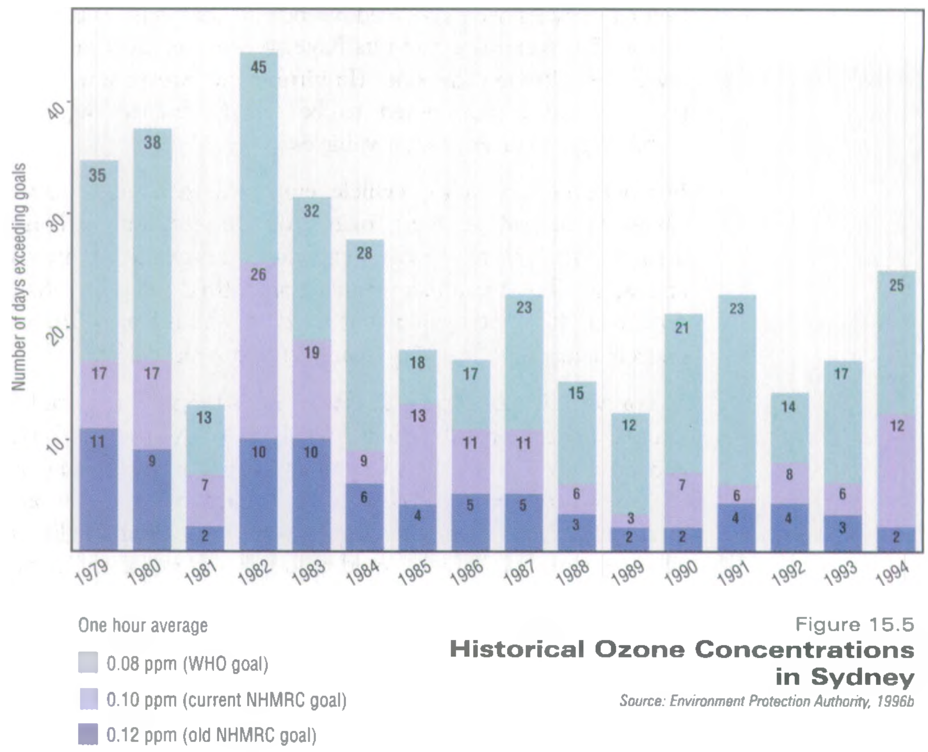


Figure 15.5
Historical Ozone Concentrations in Sydney
Source: Environment Protection Authority, 1996b

(four hour average) was exceeded at this and other locations, during 1995. During the 1990s, incidences of ozone goals being exceeded occurred more widely across the Sydney basin; from the coast to western Sydney (Environment Protection Authority, 1997b).

Brown Haze and Particulates

Over the past decade, the brown haze in Greater Sydney has been occurring with less intensity. This partly results from Government policies prohibiting backyard burning and improved emission controls on industry and motor vehicles (Roads and Traffic Authority, 1995).

Particulates come from motor vehicle emissions and combustion of solid and liquid fuels for domestic heating. Current concentrations of fine particles ranged between 20 and 26 micrograms per cubic metre in 1993, in Greater Sydney (Roads and Traffic Authority, 1995).

Quarterly monitoring reports produced by NSW Environment Protection Authority (1997b) show that the maximum 24 hour concentrations of airborne particulates are generally less than one third of the NSW Environment Protection Authority goal of 150 micrograms per cubic metre. The highest values tend to occur in the winter months, although there is a high level of variability, with elevated levels well above average appearing at irregular intervals.

The Environment Protection Authority is current developing a Brown Haze Action Plan. The NSW Government has gazetted a regulation under the Clean Air Act, 1961 specifying emission standards for new solid fuel home heaters. Motor vehicle controls proposed under the NSW Smog Action Plan would also result in reduced motor vehicle particulate emissions (Environment Protection Authority, 1996b).

Nitrogen Dioxide

Only one incidence of the nitrogen dioxide goal of 16 parts per 100 million (one hour average) having been exceeded has been recorded in Sydney since 1990, as shown in *Figure* 15.6. Monitoring results have shown a gradual decline in the peak monthly levels of nitrogen dioxide (Environment Protection Authority, 1996a). This improvement is considered to be largely due to improved emissions control technology in current motor vehicles.

Improvements in motor vehicle emissions technology have resulted in reduced emissions of hydrocarbons, oxides of nitrogen and carbon monoxide from cars manufactured since 1985. Significant improvements in overall motor vehicle emissions will occur as older vehicles are retired and post 1985 vehicles become more dominant. It is anticipated that by 2016, the motor vehicle fleet would be almost entirely made up of vehicles manufactured after 1985.

Motor vehicle emissions standards are strongly influenced by conditions in the United States. The Australian regulations (Australian Design Rules ADR37/01) become consistent with the prevailing United States emission limits in 1997. The US Environment Protection Agency has indicated its intention to introduce further restriction of air emissions from passenger vehicles and light trucks (including diesel powered vehicles). These would reduce emissions of oxides of nitrogen to less than half current levels per vehicle, while keeping total hydrocarbons and carbon monoxide emissions unchanged (Anyon and Munro, 1992).

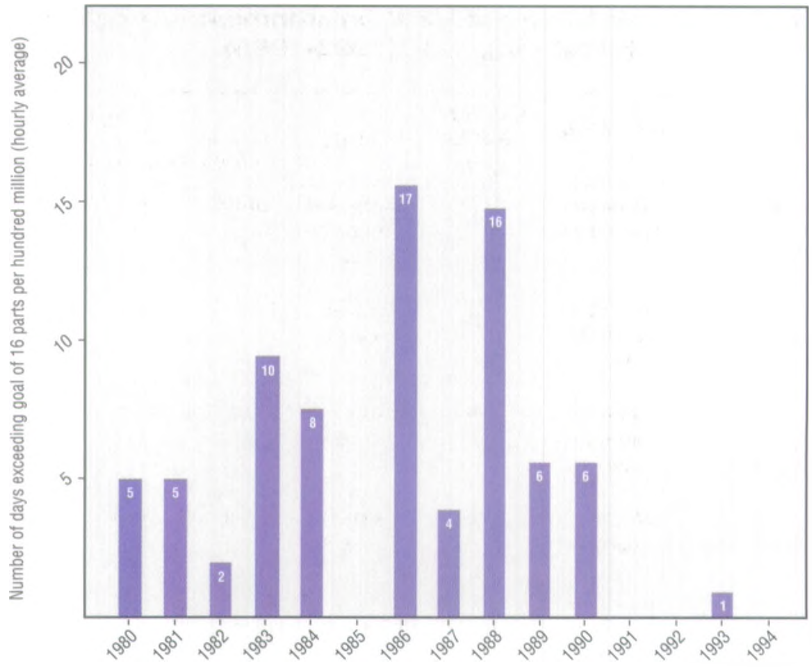


Figure 15.6
Annual Exceedences of Nitrogen Dioxide Goal in Sydney
Source: Environment Protection Authority 1996a

15.3.3 Existing Western Sydney Air Quality

In 1995, a State Government Task Force on Planning for the Sydney West Airport Sub Region assessed the impacts of an airport at Badgerys Creek on urban development and employment and the consequential environmental effects of this development, including air quality impacts. Findings of the task force presented in a Stage 1 Investigations Report (Task Force on Planning for the Sub Region Surrounding Sydney West Airport, 1995) included:

- the Sydney West Airport Sub Region (the area in the vicinity of the Badgerys Creek site) is a receptor area for air pollutant emissions from the eastern half of the Sydney Metropolitan Area;
- air quality with the Sub Region was within current health guidelines but summer ozone levels regularly approached the health goal prevailing at that time. A more stringent ozone health goal was anticipated which would mean that air quality in the region would exceed the health goal more frequently; and
- air quality was considered a primary constraint on the development of the Sub-Region. Development of the Sub Region was recommended to be limited in the event that air quality standards could not be met.

Levels of pollutants recorded by NSW Environment Protection Authority Air Monitoring Stations in western Sydney are contained in *Table 15.2*. Approximate ranges of concentrations, obtained from quarterly monitoring reports are illustrated.

Air pollutant levels at Bringelly would most closely represent those at Badgerys Creek; however, not all air quality parameters have been monitored at Bringelly. St Marys is located to the north, Blacktown to the north east, Liverpool to the east and Campbelltown to the southeast of Badgerys Creek. These stations would be fairly representative of the western region of Sydney.

Table 15.2 Summary of NSW Environment Protection Authority Air Monitoring Data (1992-1995)

Pollutants	Sampling Period	Current NSW Goal	Unit	Approximate Range				
				Bringelly	St Marys	Blacktown	Liverpool	Campbelltown
Particulates below 10 microns	Maximum 24-hour level	150	Micrograms per cubic metre	20-190[1]	-[2]	20-190[1]	-[2]	10-130[1]
Carbon Monoxide	Maximum one hour level	25	parts per million	-[2]	1-6	1-9	2-10	-[2]
Ozone	Maximum one hour level	10	parts per 100 million	3-13	2-12	3-12	1-14	3-14
Nitrogen Dioxide	Maximum one hour level	16	part per 100 million	1-6	1-8	3-10	3-12	3-26
Sulphur Dioxide	Maximum one hour level	12.5	parts per 100 million	1-3	-[2]	1-3	-[2]	-[2]

Notes: 1. Attributed to severe bushfires generally - maximum values recorded for Bringelly and Campbelltown did not exceed 50 and 20 micrograms per cubic metre respectively.
2. Not monitored at this site.

It can be seen that the NSW goal for particulates has been exceeded at a number of stations, and the ozone goal has been exceeded, in all of the stations shown. The nitrogen dioxide goal was exceeded at Campbelltown, on one occasion only. Carbon monoxide and sulphur dioxide goals have not been exceeded at any of the stations shown since 1992.

The air quality goal for ozone was exceeded at Bringelly, which is adjacent to the sites of the airport options and at Campbelltown, Liverpool, Woolooware and Appin.

15.3.4 Summary of Existing Situation

Air quality in the Sydney Region is regularly monitored by a network of stations operated by the NSW Environment Protection Authority; in addition, recent scientific study has given a better understanding of the characteristic problems and put forward some recommendations to address them. In the case of some pollutants, such as those from motor vehicles, this is already having some beneficial effects. The Sydney Region's major pollution problems are photochemical smog and brown haze. The overall picture shows that, the quality of Sydney air is acceptable for the majority of the time, in most areas. However, it is recognised that the influence of local topography and air currents tends to carry pollutants towards Western Sydney, where they can be slow to disperse under certain weather conditions.

15.4 Methodology

Emissions inventories for Sydney and other metropolitan areas in Australia show that major airports contribute substantial volumes of pollutants into the atmosphere. These have the potential to impact on air quality at a local scale. Pollutant emissions can react chemically to form photochemical smog, which has the potential to impact on air quality at a regional scale.

15.4.1 Scope of Work

Air quality issues considered in this Draft EIS include:

- dust fall-out during construction;
- increased concentrations of carbon monoxide, oxides of nitrogen, particulate matter, hydrocarbons (including benzene, kerosene and benzo-pyrenes), reactive organic compounds, sulphur dioxide, lead, odours and air toxics;
- increased formation of ozone resulting from chemical reaction of oxides of nitrogen and reactive hydrocarbons emitted due to airport operation;
- emergency fuel dumping procedures and the effects of fuel dumping on air quality;
- odour impacts arising from fuel emissions and possible sewage treatment;
- greenhouse gas emissions;
- potential impacts on the fabric of buildings; and
- potential health impacts arising from increased concentrations of air pollutants.

Effects of aircraft emissions and fuel discharges on water quality in reservoirs and domestic water tanks are discussed in *Chapter 16*.

15.4.2 Assessment of Existing Air Quality

Assessment of existing air quality involved reviewing available monitoring data and relevant air quality studies. This included data from the *Sydney Metropolitan Air Quality Study Final Report* (Environment Protection Authority, 1997a), which produced detailed emissions estimates for the Sydney region and provided results of numerical analysis for selected periods of poor air quality. Apart from odour measurements, no field monitoring of air quality was undertaken specifically for this Draft EIS. Existing air quality data from Quarterly Reports for western Sydney has been summarised in *Table 15.2*.

15.4.3 Air Quality Impacts

Air quality impacts were assessed by predicting the air pollutant emissions produced by the construction and operation of each of the airport options, and then applying a range of modelling techniques to calculate increases in ground level concentrations of air pollutants.

The air emissions inventory included aircraft emissions to a height of 1000 metres, motor vehicles operating within the airport, evaporative losses of fuel, maintenance emissions and plant operating within the airport. Emissions inventories were developed for the construction period, initial operation of the airport in 2006 and for proposed operating levels in 2016.

As airport construction would require substantial earthworks, with potential to generate dust, deposition of dust during construction was modelled for each of the airport options, using computer software known as the Fugitive Dust Model.

Modelling of dispersion of air emissions resulting from airport operations was carried out using computer software known as AUSPLUME, to assess the impact on ground level concentrations within 10 kilometres of the airport boundaries. This was undertaken for the anticipated early operation of the airport in 2006 and for the highest level of aircraft movements in 2016 (*Air Traffic Forecast 3*). Pollutants considered were carbon monoxide, oxides of nitrogen, particulates, and air toxic compounds (including benzene, 1,3 butadiene, formaldehyde and benzo(a)pyrene). Modelling of kerosene odours associated with airport operation was also carried out for the highest level of aircraft movement in 2016.

Increases in ground level concentrations were interpreted in terms of existing air quality, air quality guidelines and health effects on populations downwind of the airport options.

Modelling of ozone impacts was considered to be important as current air quality goals for ozone are already sometimes exceeded in the vicinity of the sites of the airport options. Ozone would not be emitted directly from the airport by aircraft, but would be formed as a result of chemical combination of oxides of nitrogen and hydrocarbons downwind of the sites of the airport options.

Two independent approaches were used to model changes in ozone concentrations that would result from airport operations. A Lagrangian Atmospheric Dispersion Model was used to carry out trajectory modelling of ozone formation, for two specific sets of conditions particularly conducive to formation of photochemical smog. In the model, chemical data gathered by the NSW Environment Protection Authority (from two historical events that resulted in high ozone levels and formation of photochemical smog in Western Sydney) were combined with wind directions generated internally by the model and predicted emissions from the airport options.

A second approach, known as footprint analysis, was used to provide a comparison with the results of trajectory modelling. This was to be undertaken using a detailed dataset of air quality and meteorological records for the period July 1994 to June 1995, obtained from NSW Environment Protection Authority, as well as records from other organisations such as Sydney Water and the Federal Airports Corporation. Uncertainty in wind directions in some of the Environment Protection Authority data, however, prevented this dataset from being used, and a much smaller set of records, from the Bureau of Meteorology and private industry were used instead.

Establishing a Second Sydney Airport could result in shifts in people and motor vehicle traffic within the Sydney basin. These changes have the potential to cause air quality impacts. Therefore an assessment of ozone concentration changes due to the combination of these effects, together with the effects of airport emissions, was also undertaken.

15.4.4 Potential Health Effects of Air Quality

A review of the health effects of changes in air quality on respiratory health was undertaken. This involved a literature review of the human health impacts of exposure to the airborne pollutants of ozone, nitrogen dioxide and particulates.

Where evidence of an association between pollutant exposure and health outcomes existed, the magnitude of the health risk associated with a change in pollutant exposure was estimated. Health impacts of sulphur dioxide, carbon monoxide and lead were not examined in detail, because modelling indicated that increases in their concentrations due to the airport options would not result in levels that exceeded current health guideline values.

Chronic health impacts due to long term exposure to average increases in concentration of air toxic compounds arising from airport operation were assessed. Risks of contracting cancer, assuming a lifetime exposure to a combination of air toxics predicted to be generated by the various airport options were also estimated.

The estimate used a risk assessment methodology that assesses risks for a worst case scenario. This may be explained by the case of a hypothetical individual who is sensitive to each pollutant and lives permanently outside the airport at the point of maximum level of each pollutant. If such an individual did not suffer ill health, then members of the local population, who would be subjected to less extreme exposure, would also be protected (Bridges et al, 1995).

15.5 Emissions from the Airport

The volume of emissions produced by construction and operation of the Second Sydney Airport, under a range of operating scenarios, was estimated. Emissions of hydrocarbons, oxides of nitrogen, carbon monoxide, sulphur dioxide, fine particulates and greenhouse gases (carbon dioxide, methane and nitrous oxide) were considered. Sources of these pollutants include aircraft exhaust, motor vehicle operation within the airport, combustion of gaseous fuels in boilers, evaporative losses from fuel storage tanks, use of surface coatings (paints and thinners) and losses due to refuelling and maintenance operations.

For the assessment of impacts of air toxic compounds, and for modelling of chemical reactions leading to production of photochemical smog, emissions of hydrocarbons were subdivided into the proportion represented by individual compounds.

15.5.1 Air Pollutants Due to Airport Operations

Table 15.3 presents predicted airport emissions in 2006 for *Air Traffic Forecast 2* and 2016 for *Air Traffic Forecast 3*. The 2016 operational scenario results in the greatest emissions rates.

Table 15.3 Estimates of Air Pollutant Emissions Due to Airport Operations

Pollutant	2006[1]			2016[1]			Typical Motor Vehicle Emission Rates Over a 20km^2 Area[4] of Urban Sydney
	Emissions (kilograms per day)						
	Ground	Elevated[3]	Total	Ground	Elevated[3]	Total	
Hydrocarbons	914	71	985	2,280	190	2,470	2,600
Oxides of nitrogen	1,260	2,390	3,650	4,300	7,700	12,000	2,800
Fine particulates less than 10 microns	205	215	420	550	620	1,170	220
Carbon monoxide	3,260	190	3,450	8,030	440	8,470	20,000
Sulphur dioxide	71	106	177	262	325	587	80

Notes:
1. *Based on Air Traffic Forecast 2.*
2. *Based on Air Traffic Forecast 3.*
3. *Elevated refers to emissions more than seven metres above ground level and includes aircraft takeoff, climbout and approach.*
4. *Source for motor vehicle emissions - Sydney Metropolitan Air Quality Study report on air emissions.*

Table 15.3 also shows typical daily motor vehicle emissions for an urban area of comparable size to the airport options (20 square kilometres) for Sydney (based on 1992 figures). This would be equivalent to about two thirds the size of Auburn local government area, which has a population of about 50,000 people. This is one basis for assessing the relative impacts of the airport, in comparison with potential future urban development.

15.5.2 Emissions from Associated Developments and Motor Vehicles

Changes in urban development and the volume and distribution of motor vehicle traffic resulting from operation of the Second Sydney Airport would result in increases in air pollutant emissions over and above those generated by aircraft and other sources within the airport boundaries. In particular, increases in motor vehicle usage would occur along the main road links to the airport sites, but the resulting emissions would probably be spread over a wide area.

Table 15.4 shows estimated increases in regional emissions of various air pollutants due to industrial and residential development associated with the airport options and motor vehicle emissions resulting from airport induced traffic.

Table 15.4 indicates that there would be significant increases in hydrocarbons, and carbon monoxide emissions from sources indirectly associated with the airport. Increases in oxides of nitrogen would also increase, but not to the same extent as other pollutants. These increases are primarily associated with motor vehicle traffic with less than 10 percent of the increase in hydrocarbons and less than one percent of increased oxides of nitrogen and carbon monoxide arising from non-vehicle sources.

Table 15.4 Increases in Air Pollutant Emissions Due to Associated Developments and Motor Vehicles

Pollutant	2016 Emissions (kilograms per day)	
	Emissions Predicted for Airport Options Only[1]	Increased Regional Emissions Due to Associated Development and Motor Vehicles
Hydrocarbons	2,470	10,300
Oxides of nitrogen	12,000	9,600
Carbon monoxide	8,470	48,000

Note: 1. Refer to Table 15.3 for details of these figures.

15.5.3 Greenhouse Gas Emissions

Natural undisturbed forests are not considered to be a human induced source or sink for carbon dioxide and are not normally considered in calculations of greenhouse gas. Plants withdraw carbon dioxide from the atmosphere during photosynthesis. As plants grow, carbon from the carbon dioxide is converted to plant tissue. Carbon is also lost by respiration, respiration of animals which eat plant tissue and by decay of dead material. On average, the net movement of carbon dioxide is reasonably in balance in the absence of human activity (National Greenhouse Gas Inventory Committee, 1996).

Land clearing during airport construction would cause a one-off impact on greenhouse gases, which would be spread over the construction period. The rural setting at Badgerys Creek means that the amount of land clearing necessary over the construction period would have substantially lower greenhouse impacts than those predicted as a result of airport operations in 2016.

Annual greenhouse gas emissions from the airport alone in 2016 are predicted to be 633 gigagrams of carbon dioxide equivalent (comprised of emissions of carbon dioxide, methane and nitric oxide). This would be equivalent to 0.3 percent of the total NSW greenhouse gas emissions on the basis of current NSW projections extrapolated to 2016.

15.5.4 Fuel Dumping

Concern has been expressed about the possibility of fuel dumping in residential areas overflown by aircraft. Fuel dumping is required when it is necessary for an aircraft to return to land or divert to an airport and needs to reduce weight to its maximum landing weight prior to landing.

The procedures to be adopted by air traffic controllers when there is a need for an aircraft to dump fuel are outlined in the *Australian Manual of Air Traffic Services* (Airservices Australia, 1997).

Investigations have shown that if fuel is dumped above 1,000 feet, there is little likelihood of any flammable mist developing near the ground or that humans and animals will suffer ill effects (Airservices Australia, 1997). Nevertheless, fuel dumping is only permitted at least 6,000 feet above ground level. An additional safety requirement is that any fuel dumping associated with landing at Sydney Airport must take place in an allocated area over the Tasman Sea. This requirement would also apply for Sydney's second airport, and regulations would not be changed to permit national parks or water catchments such as Lake Burragorang to be used for the purpose.

Last year, fuel dumping occurred two or three times, and over water, and there is no record of aircraft in emergency situations being forced to dump fuel at low altitude over built up areas (Bureau of Air Safety Investigation, 1997). However, accidental fuel venting has been known to occur occasionally, because of faults in an aircraft's fuel valve system. No records are kept of such events. Fuel dumping and venting is not considered to be a major emission in terms of affecting air quality.

15.6 Air Quality Impacts

15.6.1 Construction Impacts

The principal impact of airport construction on air quality would come from atmospheric dust produced by the activities of earthmoving equipment and wind erosion of exposed surfaces. Other adverse effects, such as those resulting from exhaust emissions of earthworks plant and gaseous emissions during detonation of explosives, would be small by comparison. Estimates of emissions were made for each airport option, taking account of the likely composition of the construction equipment fleet, the construction method, and the areas in progress of construction at a given time.

Impacts of the construction on dust deposition and ground level concentrations of fine particles were modelled. The results of dispersion modelling indicate that during construction, there would be potential for dust deposition to occur beyond the airport boundary at rates in excess of the generally allowable limit of two grams per square metre per month. Only areas within one to two kilometres of the airport boundary would be affected by such levels.

Concentrations of airborne fine particulates would also be increased as a result of construction activity. Peak daily concentrations of particulates smaller than ten microns could be increased by 100 micrograms per cubic metre or more, up to five kilometres from the airport boundary. This would only occur under worst case conditions, such as when earthmoving activities were going on close to the airport boundary. Impacts would not generally be as severe as shown in *Figures 15.7*, *15.8* and *15.9*. A particulate concentration increase of 100 micrograms or more would potentially result in concentrations higher than the NSW Environment Protection Authority goal of 150 micrograms per cubic metre.

Dust emissions during construction could potentially result in deposition of dust on washing being dried and dust in swimming pools and rainwater tanks. The amount of dust would depend upon the effectiveness of dust control measures.

15.6.2 Increases in Air Pollutants Due to Airport Operation

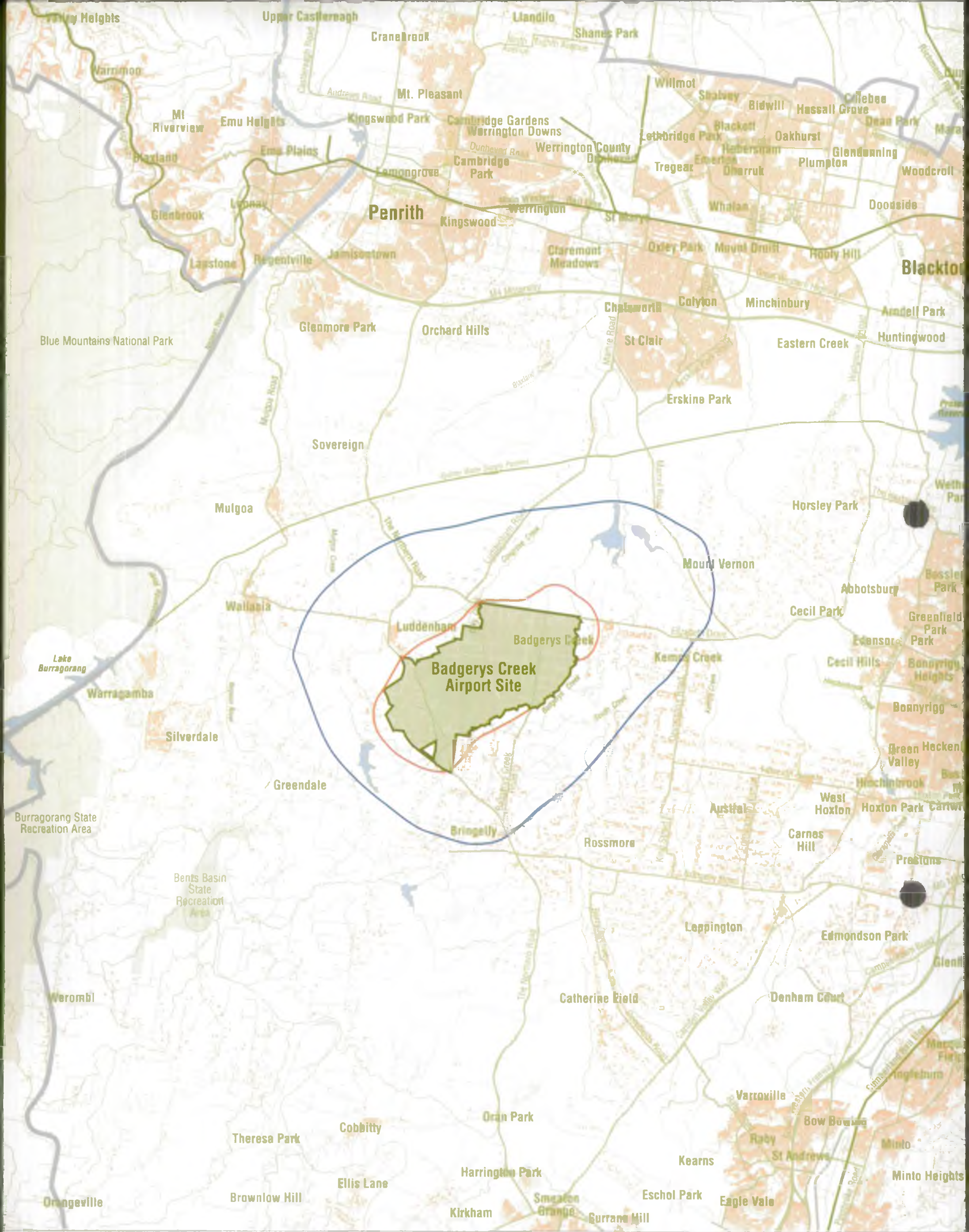
Table 15.5 provides the estimated maximum increases in ground level concentrations at the airport boundary.

If a conservative assumption was made that the maximum airport impact and maximum background concentration occurred simultaneously, concentrations of carbon monoxide, sulphur dioxide, nitrogen dioxide and particulates would not exceed the goal values. Ozone levels, however, would exceed goal values.

Table 15.5 Predicted Increases in Ground Level Concentrations of Air Pollutants Due to Operation of Airport Options

Parameter	Current NSW Goal	Typical Maximum Background[1]	Predicted Maximum Increase 2016[2]		
			Option A	Option B	Option C
One-hour Ozone (parts per hundred million)	10	10	2.4	2.4	2.4
One-hour Nitrogen Dioxide (parts per hundred million)	16	5	10	8	8
Daily particulates below 10 micron (micrograms per cubic metre)	150	50	20	12	20
One-hour Carbon Monoxide (parts per million)	25	5	5	3	5
Eight-hour Carbon Monoxide (parts per million)	9	3	1	0.7	0.7
One-hour Sulphur Dioxide	12.5	4	5	5	4

Notes:
1. *Typical maximum background concentrations have been based on results from available monitoring data for the western Sydney region. Data from non-representative events, such as bushfires and abnormal meteorological conditions indicate some higher peak figures than have been shown in this table.*
2. *Maximum increase predicted for areas outside the airport boundary.*



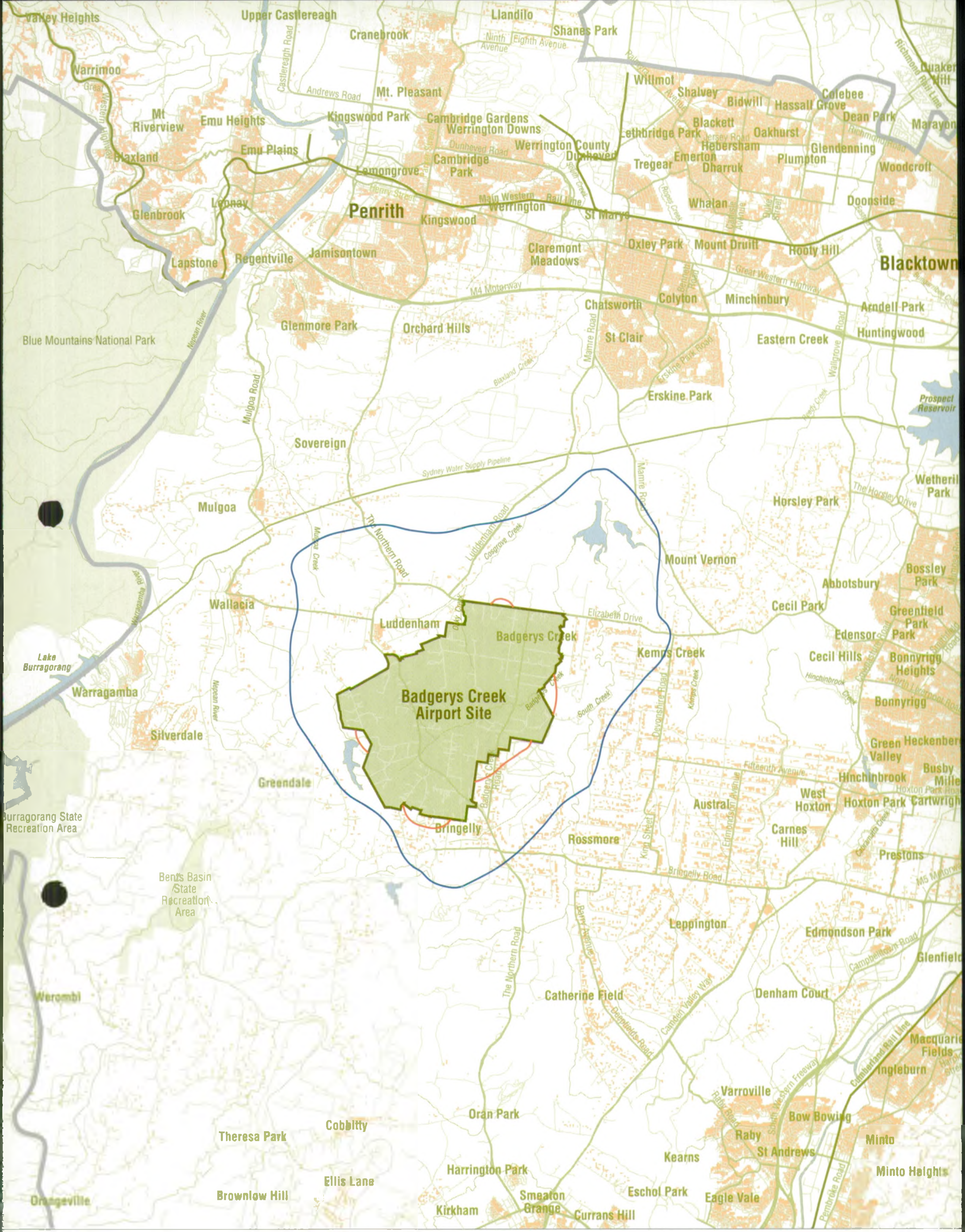
2 grams per square metre per month deposition increase

Peak daily particulate (PM_{10}) 100 micrograms per cubic metre concentration increase

Indicates Density of Dwellings in 1996

Extent of Dwelling Data

Figure 15.7
Maximum Construction Dust Impacts for Option A



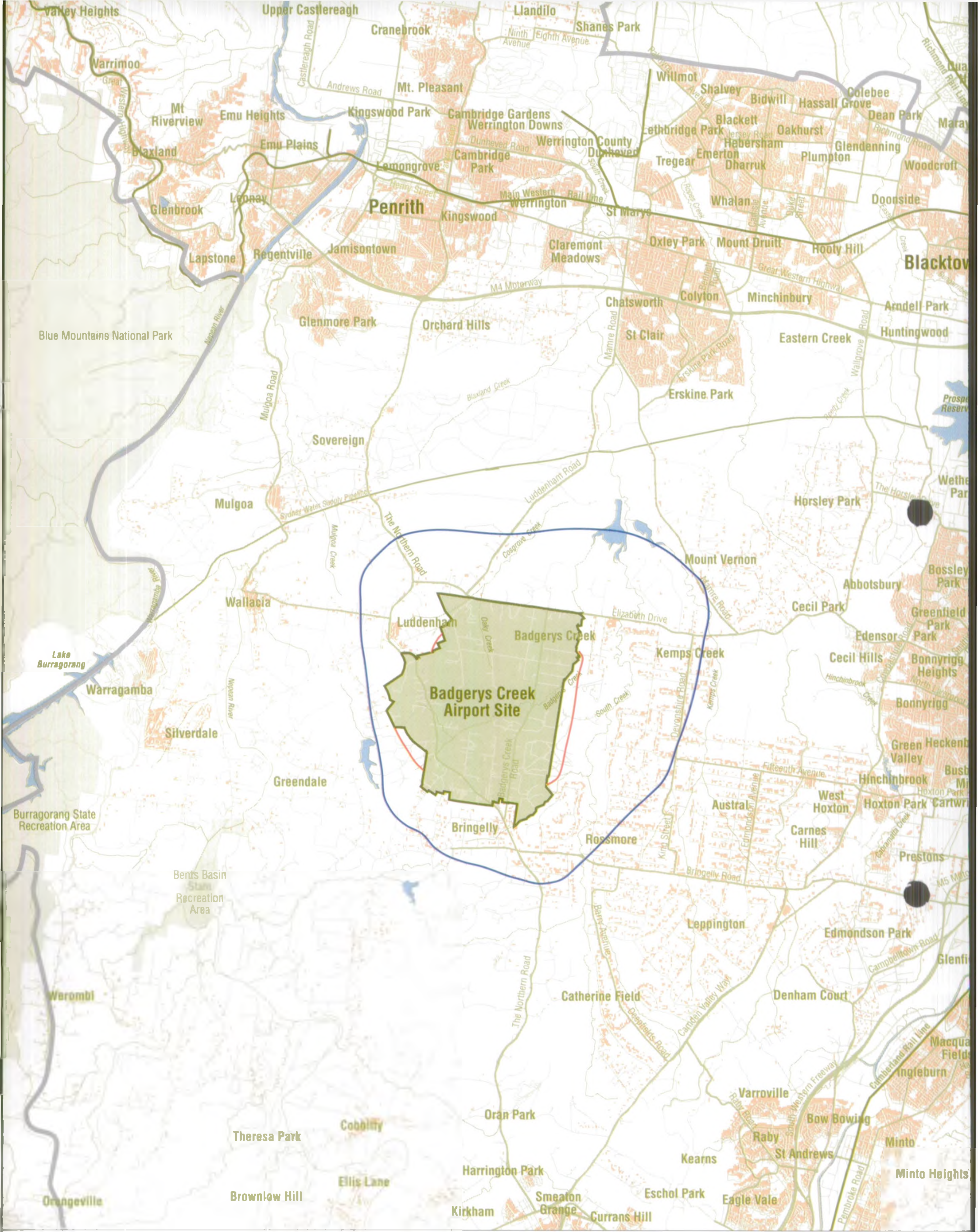
2 grams per square metre per month deposition increase

Peak daily particulate (PM_{10}) 100 micrograms per cubic metre concentration increase

Indicates Density of Dwellings in 1996

Extent of Dwelling Data

Figure 15.8
Maximum Construction Dust Impacts for Option B



2 grams per square metre per month deposition increase

Peak daily particulate (PM_{10}) 100 micrograms per cubic metre concentration increase

Indicates Density of Dwellings in 1996

Extent of Dwelling Data

Figure 15.9

Maximum Construction Dust Impacts for Option C

15.6.3 Odour

Odour impacts of the airport were assessed by calculating ground level hydrocarbon concentrations. The odour associated with a nominated ground level concentration was calculated by applying a factor developed by sampling of air emissions from aircraft exhaust. Odour strengths and hydrocarbon concentrations for eight samples were measured at Sydney Airport and used to assess a factor for prediction of odour level based on hydrocarbon concentration. Based on this analysis it is predicted that kerosene type odours would be detected at distances of up to three kilometres from the airport boundary 0.5 percent of the time. This represents detectable odour levels during 44 hours in a year (in 2016) by between 1,000 and 1,500 people.

It is proposed to construct a sewage treatment plant to service the airport. This would have the capacity to meet the demands of an equivalent population of 84,000 people. Dispersion modelling of odour impacts predicts that odours from the sewage treatment plant would be able to be detected for 44 hours or more per year at distances of up to 500 metres from the airport boundary, in the vicinity of the plant.

15.6.4 Health Impacts

Respiratory Health

Ozone is a secondary air pollutant and an indicator of photochemical smog. It is formed by chemical reaction involving oxides of nitrogen and reactive organic compounds under the action of sunlight. The maximum ozone concentration that can be produced within a parcel of air is proportional to the concentration of oxides of nitrogen within the air. The time to reach this maximum ozone concentration depends upon temperature, sunlight exposure and the concentration of reactive organic compounds.

During summer, the time for a parcel of air to reach maximum ozone concentration is measured in hours. In winter, the rate of production of ozone is markedly lower than in summer, because of lower temperatures and reduced sunlight exposure. Ozone generation ceases at night. As the formation of ozone takes a significant time to occur, ozone impacts due to air pollutant emissions are felt at considerable distances downwind from the source of pollution.

Modelling of impacts of the airport on ozone concentration was based on historical data showing that high background ozone concentrations, above the current goal, can occur on some sensitive days when certain meteorological conditions prevail.

One-hour ozone impacts of airport operation are predicted to result in increases in concentrations of up to 2.4 parts per 100 million downwind of the airport after arrival of the sea breeze. The amount of increase in ozone concentration due to the airport is sensitive to the chemistry of the air reaching the airport. These increases would be likely to result in an increased incidence of ozone levels in excess of the goal of 10 parts per 100 million on these sensitive days. *Figure 15.10* shows the area of current high background concentrations of ozone (occurrences greater than 10 parts per 100 million) that are predicted to be affected by an increased ozone concentration of at least one part per 100 million. This would occur about six times per year. The number of people living in these areas in 2016 is estimated to be approximately 8,000 for each of the Badgerys Creek airport options.

Adverse health effects may occur on these days when peak ozone concentrations are significantly increased by airport operations. On the basis of the affected number of people shown above it is estimated that two to three extra hospital admissions and one death could occur each 100 years as a result of the operation of the airport.

Area predicted to be affected by at least one part per hundred million increase in peak one hour ozone concentrations due to airport operations in 2016

Urban Areas (indicated by local roads)

Figure 15.10

Area of Predicted Ozone Increases in 2016

Note: Assumes Air Traffic Forecast 3 Level of Operation in 2016

TN MN N

0Km 10Km

Figures 15.11, 15.12 and *15.13* show the increases in peak hourly nitrogen dioxide concentrations that are predicted to result from airport operations in 2016. The maximum predicted increase in nitrogen dioxide concentrations is 10 parts per 100 million, for Option A. *Table 15.4* shows that even if the conservative assumption is made, that this maximum increase in nitrogen dioxide concentrations occurs in an area which already has maximum background levels, the current nitrogen dioxide goal would not be exceeded.

Assessment of the increase in ground level nitrogen dioxide concentration was based on 10 percent of the oxides of nitrogen emitted from the airport occurring as nitrogen dioxide. Rapid conversion of nitric oxide to nitrogen dioxide takes place in air containing ozone.

The value of 10 percent adopted for the Draft EIS was based on comparison of measured peak monthly concentrations of nitrogen dioxide and total oxides of nitrogen from NSW Environment Protection Authority Quarterly Reports (Environment Protection Authority, 1997b), for eight monitoring stations (Bringelly, Blacktown, St Marys, Liverpool, Woolooware, Campbelltown, Earlwood and Appin). These results show that increases in peak monthly concentration of total oxides of nitrogen are roughly 10 times the accompanying increase in peak monthly nitrogen dioxide concentration.

Health impacts associated with the predicted increases in nitrogen dioxide concentrations were not able to be quantified because available data do not allow quantification of changes in lung function at levels below 30 parts per 100 million.

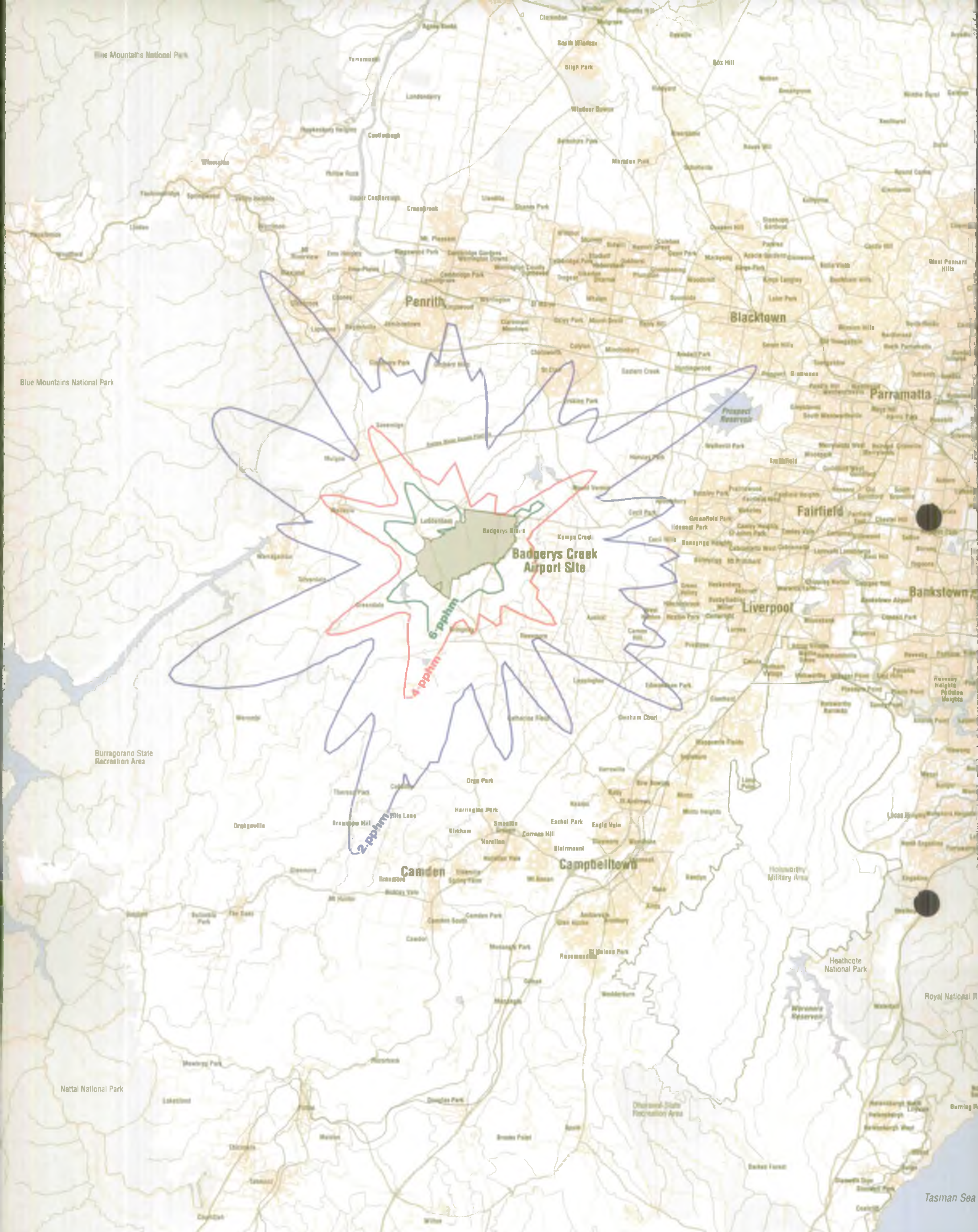
Particulates can have undesirable health impacts. Particle size is important, as only particles small enough to enter the lungs (less than 10 micrometres in diameter) are clinically important. Air quality modelling results shown in *Table 15.3* indicate that predicted increases of such particulates would not result in current goals being exceeded. The health implications of these increased concentrations on the affected number of people at Badgerys Creek show that an increase of between 160 and 170 person days of reported cough is predicted to occur due to an increase in particulate concentrations of three micrograms per cubic metre. The number of additional people who would be hospitalised for respiratory disease is predicted to increase by approximately two to three per 100 years, due to episodes of increased particulates, while the projected numbers of additional deaths on a given day is predicted to increase by less than one per 100 years for the Badgerys Creek options.

It should be noted that predicted numbers of hospital admissions and deaths due to ozone and particulates are likely to be over estimates, because some admissions and deaths would have occurred in any case. Airport related emissions would probably hasten these deaths rather than cause them.

Cancer Risks of Air Toxics

Figures 15.14, 15.15 and *15.16* present an assessment of the increased lifetime risk of cancer as a result of predicted air toxic emissions from airport Options A, B and C. These risks are for a worst case situation as they would apply to a person who spent 24 hours per day for his or her entire life (assumed 70 years) at a location near the airport.

Integration of the modelled cancer risk with the projected number of people in the areas surrounding the airport options gives a worst case range of three cases of cancer per 100 years for all three airport options. The main contributors to cancer risk are 1,3 butadiene and particulates. The possible presence of polycyclic aromatic



Predicted increase in peak one hour nitrogen dioxide concentrations of:

- 2 parts per hundred million
- 4 parts per hundred million
- 6 parts per hundred million
- Urban Areas (indicated by local roads)

Figure 15.11

Predicted Increase in Nitrogen Dioxide Concentrations for Option A in 2016

Note: Assumes Air Traffic Forecast 3 Level of Operation in 2016

Predicted increase in peak one hour nitrogen dioxide concentrations of:

- 2 parts per hundred million
- 4 parts per hundred million
- 6 parts per hundred million
- Urban Areas (indicated by local roads)

Figure 15.12

Predicted Increase in Nitrogen Dioxide Concentrations for Option B in 2016

Note: Assumes Air Traffic Forecast 3 Level of Operation in 2016

TN MN N

0Km 10Km

Predicted increase in peak one hour nitrogen dioxide concentrations of:

- 2 parts per hundred million
- 4 parts per hundred million
- 6 parts per hundred million
- Urban Areas (indicated by local roads)

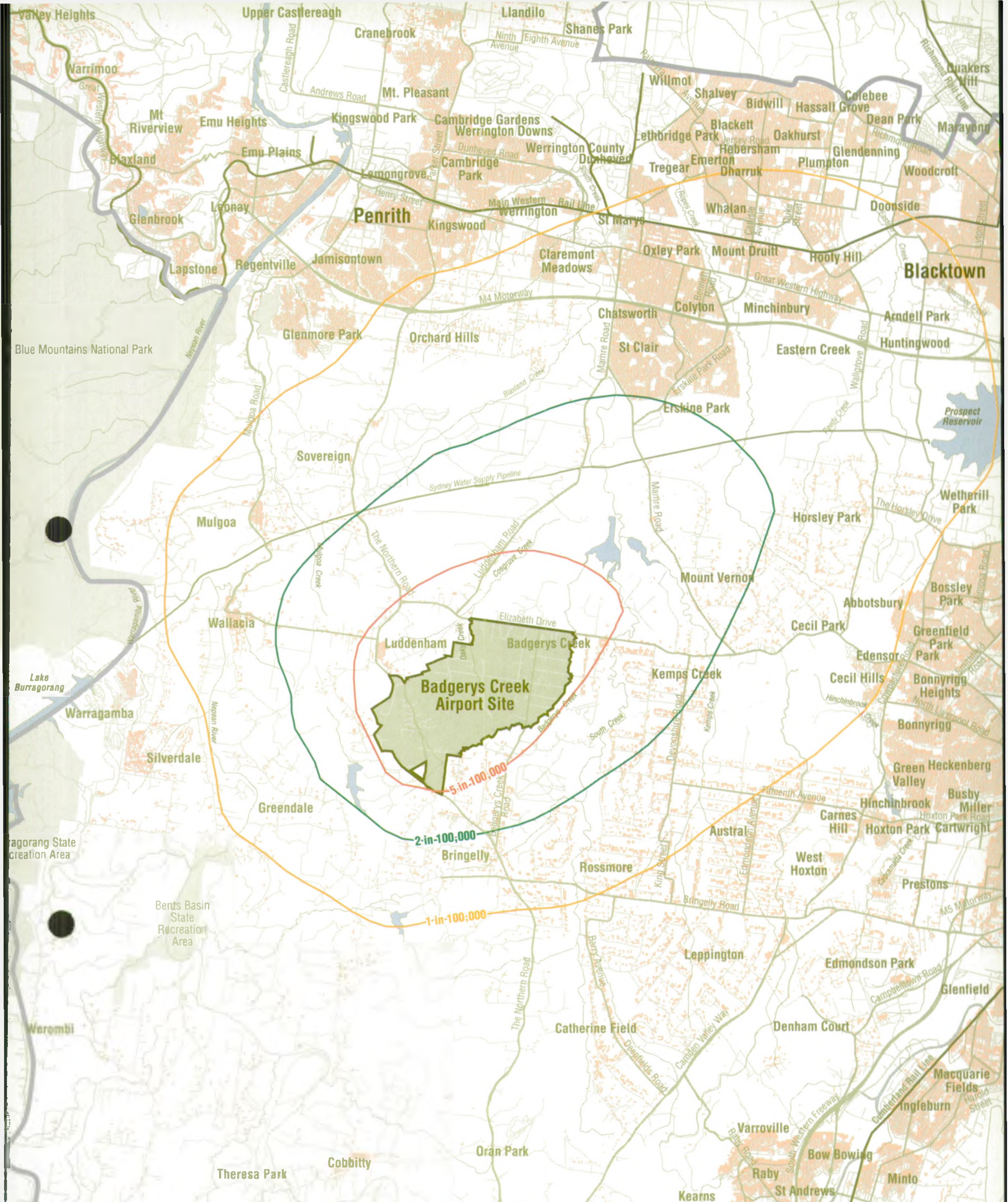
Figure 15.13

Predicted Increase in Nitrogen Dioxide Concentrations for Option C in 2016

Note: Assumes Air Traffic Forecast 3 Level of Operation in 2016

TN MN N

0Km 10Km



1 chance in 100,000

2 chances in 100,000

5 chances in 100,000

Indicates Density of Dwellings in 1996

Extent of Dwelling Data

Figure 15.14

Predicted Increase in Long Term Probability of Contracting Cancer Due to Lifetime (70 Years) Exposure to Air Toxics from Option A

Note: Assumes Air Traffic Forecast 3 level of operation in 2016

TN MN N

0Km 5Km

1 chance in 100,000

2 chances in 100,000

5 chances in 100,000

Indicates Density of Dwellings in 1996

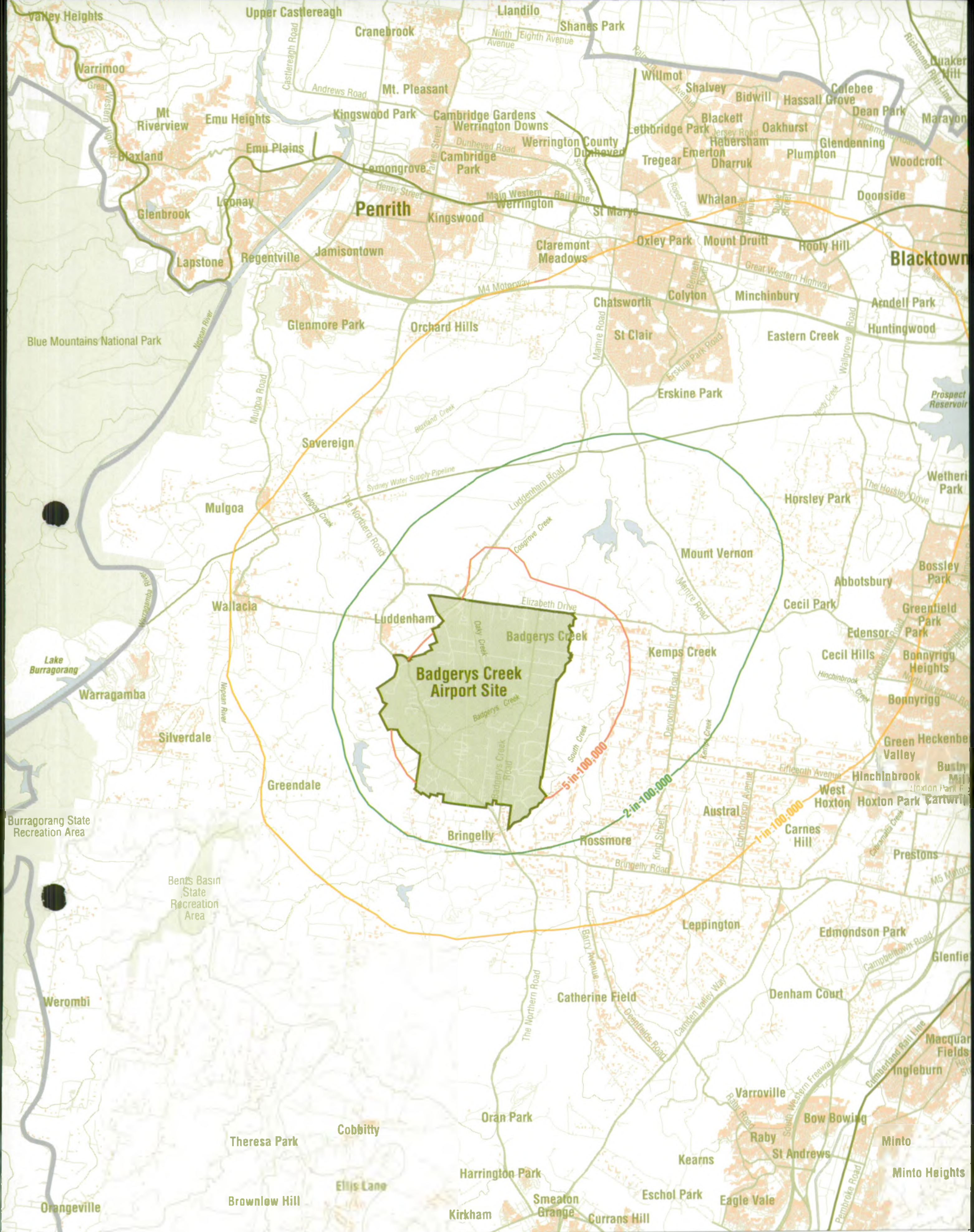
Extent of Dwelling Data

Figure 15.15

Predicted Increase in Long Term Probability of Contracting Cancer Due to Lifetime (70 years) Exposure to Air Toxics from Option B

Note: Assumes Air Traffic Forecast 3 level of operation in 2016

0Km 5Km



1 chance in 100,000
2 chances in 100,000
5 chances in 100,000
Indicates Density of Dwellings in 1996
Extent of Dwelling Data

Figure 15.16

Predicted Increase in Long Term Probability of Contracting Cancer Due to Lifetime (70 years) Exposure to Air Toxics from Option C

Note: Assumes Air Traffic Forecast 3 level of operation in 2016 hydrocarbons, including benzo(a)pyrene in particulates was assumed to present a cancer risk. These two pollutants typically account for about 80 percent of the total cancer risk.

Chapter 16 discusses the potential impacts of air emissions on drinking water.

Non-Cancer Impacts of Air Toxics

An assessment of non-cancer health impact due to air toxic compounds (acetaldehyde, benzene, formaldehyde, phenol, toluene and xylenes were considered) was made by comparing average ground level concentrations with inhalation reference exposure levels (California Air Pollution Control Officers Association, 1993). None of the individual contaminant concentrations exceeded the reference exposure level. The combined exposure calculated by summing the fractional exposure levels was also less than 0.3 (acceptable exposure is less than one) outside the airport boundary, indicating that the non-cancer impact due to these air toxic compounds was within accepted limits.

15.6.5 Impacts of Associated Development and Motor Vehicles

Changes in urban development and the volume and distribution of motor vehicle traffic resulting from operation of the Second Sydney Airport would result in increases in air pollutant emissions over and above those generated by aircraft and other sources within the airport boundaries. Increases would be primarily due to increased motor vehicle use. Non-vehicle related increases (due to population changes) would comprise less than 10 percent of the total predicted increase for hydrocarbons and less than one percent of the increase for oxides of nitrogen and carbon monoxide.

In particular, increases in motor vehicle usage would occur along the main road links to the airport sites, but the resulting emissions would probably be spread over a wide area. Motor vehicle emissions of nitrogen dioxide would be likely to amplify the increases in ozone levels predicted for the airport alone by 20 to 30 percent. This could potentially expand the area affected by ozone impacts.

While this assessment of impacts of associated development and motor vehicle traffic is subject to certain limitations because of the modelling process and availability of data, it provides a useful comparison of possible indirect impacts associated with each of the airport options.

15.6.6 Other Impacts Due to Airport Operation

Acidic gases have the potential to damage buildings by such mechanisms as erosion of mortar from brickwork and chemical attack of concrete. These effects are generally associated with high levels of sulphur dioxide which, when combined with water, forms sulphurous acid. Emissions of sulphur dioxide from the Second Sydney Airport would be comparable to the level of emissions from vehicle traffic associated with a similar area of urban development. It is estimated that the average increase in sulphur dioxide levels occurring as a result of the operation of the Second Sydney Airport would be less than one part per billion. At this level it is considered unlikely that the fabric of buildings would be materially affected.

15.7 Environmental Management

15.7.1 Management Measures

Environmental Management During Construction

As the construction program would involve substantial earthworks activity over an extended period, appropriate dust management practices would be essential. This would involve use of water sprays, restriction of the areas of active earthworks taking place at any one time and prompt sealing or revegetation of exposed surfaces. As there is potential for dust and fine particulates to impact upon populated areas outside the airport site boundaries, stringent adherence to dust management measures would be required. Careful monitoring of dust levels outside the airport boundary would be necessary, and flexibility in work locations and programs might be needed if dust and particulates were to be kept below allowable limits on days when wind conditions were unfavourable.

Environmental Management During Operation

Measures that can improve the environmental performance of operating airports have been identified by the US Federal Aviation Administration and the US Department of the Air Force (1997). These include:

- reduction in the number of aircraft engines in use during taxi and idle;
- take off under reduced engine power;
- reduced use of reverse thrust;
- turning off of the auxiliary power unit while aircraft are docked; and
- improvement in emissions of the ground support fleet by use of low emissions engines such as those powered by electricity.

Adoption of the above measures would be contingent on meeting acceptable safety standards and the improvements would depend upon the proportion of the aircraft fleet able to adopt these measures. A number of the measures could result in cost savings as well as improvement to airport emissions.

In addition to the above measures, air traffic control practices that result in reduced queuing and taxi time would assist in minimising aircraft emissions. Procedures should be employed to ensure that aircraft using the airport complied with prevailing maintenance and control standards. Efficient management of the passenger vehicle fleet to avoid congestion would also assist in minimising emissions from the airport.

15.7.2 Monitoring

The NSW Environment Protection Authority's monitoring station at Bringelly performs a number of air quality monitoring functions. The Bureau of Meteorology monitors wind speed at Badgerys Creek. There is significant uncertainty regarding the vertical temperature and wind profile during the year at Badgerys Creek. Such profiles are important in prediction of ozone impacts. A program for monitoring the upper wind and temperature profile using remote sensing equipment such as radio-acoustic sounding systems would need to be carried out for a minimum of a twelve month period.

An air quality management plan would be included within an overall environmental management system developed for the construction and operation of the Second Sydney Airport.

15.8 Summary of Potential Air Quality Impacts

The NSW Environment Protection Authority regards carbon monoxide, sulphur dioxide, lead and air toxics as local air quality indicators of potential air quality impacts from particular developments.

Carbon monoxide is produced in motor vehicle and aircraft exhaust. Sulphur dioxide is an acidic gas which, when mixed with water, forms acids that can cause irritation to breathing. It is produced by combustion of fuel containing sulphur. Lead is a poison that can accumulate in the body with continuing exposure. As a result of various initiatives to reduce concentrations of these air quality indicators, recorded levels are generally within accepted goals.

Air toxics compounds have been linked with incidence of cancer and other serious health issues. Goals have not been established in NSW for concentrations of air toxics due to lack of scientific knowledge about their impacts.

Ozone, nitrogen dioxide and fine particulates are considered to be regional air pollutants and contribute to problems of photochemical smog and brown haze. Ozone levels in Sydney have occasionally exceeded air quality goals, while levels of nitrogen dioxide and fine particulates are more regularly within relevant goals.

Construction of the airport options would generate dust and fine airborne particulates. Modelling carried out for the Draft EIS indicates that dust and fine particulate levels outside the airport boundaries could exceed appropriate goals. Extensive dust management measures would be required during the construction of the airport to reduce this impact to an acceptable level.

Air quality studies carried out for this Draft EIS predict increased concentrations of nitrogen dioxide, fine particulates, carbon monoxide and sulphur dioxide due to airport operations. Given existing background levels this would not, however, result in the concentrations of these pollutants exceeding the goals adopted by the NSW Environment Protection Authority.

The operation of any one of the airport options would increase ozone concentrations in areas already experiencing occasional occurrences of high background ozone levels. Ozone at ground level can irritate eyes and air passages and might interact with allergies to trigger asthma attacks. Health impacts are also predicted due to increased levels of air toxics and particulates associated with aircraft emissions.

Some residents living near the airport options would experience kerosene odours from the operation of the airport.

Table 15.6 summarises the predicted numbers of people in 2016 who would be affected by health impacts due to increased ozone, particulates and air toxics concentrations. Also provided is the predicted numbers of people who would be able to detect significant kerosene odours emitted from each of the airport options.

The Draft EIS predicts that all of the airport options would increase peak ozone concentrations in areas where ozone levels occasionally currently exceed the NSW Environment Protection Authority goal of 10 parts per 100 million. The number of people exposed to this significant increase in ozone concentration is approximately the same for all three airport options. Emissions from assumed increases in residential development and road traffic resulting from the airport options would probably shift or extend the areas of ozone impacts.

Overall, the increase in hospital admissions and deaths caused by air emissions from the operation of the airport would be low. Ozone is a regional air quality issue, particularly for western Sydney. The Second Sydney Airport would worsen this existing problem, and would increase the need for the successful implementation of Sydney-wide strategies to manage emissions.

Table 15.6 Air Quality and Health Impacts of the Second Sydney Airport in 2016[1, 2]

Predicted Impact	Option A	Option B	Option C
Number of people exposed to increased peak hourly ozone concentration by more than 1 part per 100 million during high ozone events	8,000[3]	8,000[3]	8,000[3]
Number of people who would be able to detect kerosene odours for more than 44 hours per year	1,500[3]	1,000[3]	1,500[3]
Increase in hospitalisation of persons each 100 years due to ozone	2	2	3
Increase in deaths each 100 years due to ozone	1	1	1
Increase in hospitalisation of persons each 100 years due to particulates below 10 microns in size	4	3	4
Increase in deaths each 100 years due to particulates below 10 microns in size	less than 1	less than 1	less than 1
Increase in number of cancer cases each 100 years due to exposure to air toxics	3	3	3

Notes:
1. *Population estimate for 2016.*
2. *Effects of associated developments and motor vehicles are not included in figures in this table.*
3. *Rounded to nearest 500.*

Fuel dumping by aircraft in emergency situations is not considered to be a major air quality issue. While no specific records on fuel dumping are kept, anecdotal evidence suggests it occurs infrequently (about twice a year) and in controlled situations, while flying above the ocean. Deliberate dumping has never been reported to occur over built up areas of Sydney, but there has been occasional accidental fuel venting caused by faulty equipment on aircraft.

The air quality analysis outlined in this Draft EIS provides an assessment of the impact of the proposal on local and regional air quality. This information is sufficient to provide a basis for decision making in terms of air quality impacts. It would, however, be prudent to obtain further data and carry out additional modelling at future stages in the environmental assessment and design processes. These issues are discussed further in *Chapters 26* and *27*.

Chapter 16

Geology, Soils and Water

Chapter 16
Geology, Soils and Water

This chapter examines the geology and soils of the airport site options and surface and ground water quality in the region. Impacts on surface water quality and potential health impacts on drinking water supplies are investigated. Further details are provided in Technical Paper No.7.

16.1 Issues Raised During Consultation

Issues raised during consultation included the suitability of local soils for an airport development, including the high quality of soils in the Badgerys Creek area. Respondents noted the value of regional soils in the Badgerys Creek area, currently being used for food production, and pointed out that constructing the airport would mean a loss of land productivity.

Comments were made about water quality impacts of aircraft emissions and the potential pollution of drinking water catchment areas adjacent to the airport sites. Potential contamination of tank water from aircraft emissions was mentioned as some communities are dependent on tank water for drinking water supplies. The related issue of potential impacts on dam water used for irrigation and animal watering was also raised.

Other issues commented on included the potential for runoff from the airport site contributing to siltation of local waterways such as Badgerys, Thompson and South Creeks, which already carry high concentrations of nutrients (phosphorous and nitrogen). It was noted that the Hawkesbury River is already polluted and an airport development would worsen this situation.

16.2 Methodology

Soil types each of the airport sites options were identified and the potential for soil erosion and acid sulphate soils was assessed. Information on geology, soil characteristics and flooding was obtained from existing references. Assessment of flooding impacts was based on hydrological work especially undertaken to assist with the airport planning and design (Second Sydney Airport Planners, 1997a). Existing groundwater bore locations were obtained from the Department of Land and Water Conservation, and field survey work was carried out to verify groundwater quality.

An extensive amount of data was gathered from various sources to assist with assessment of existing surface water quality and potential impacts of the airport options. Water quality was sampled in the vicinity of the sites.

Potential for pollution of drinking water reservoirs by gaseous emissions and particulates from aircraft was also assessed. This was done by estimating concentrations of indicative compounds in water that would result from predicted aerial pollutant levels and comparing these concentrations with drinking water and ecosystem guidelines. Potential impacts on water quality in rainwater tanks from gaseous emissions and particulates were also examined.

16.3 Existing Environment

16.3.1 Geology and Soils

The airport options are located in the south-west portion of the Cumberland Plain, on the eastern side of the elevated ridge system dividing the catchments of the Nepean River and South Creek. The Cumberland Plain has an average elevation of about 20 metres above sea level in the north, rising to about 150 metres in the south around Bringelly, Camden and Campbelltown, a distance of about 50 kilometres. The topography of the airport site options is shown in *Figure 16.1*.

The sites overlay Mid Triassic sedimentary rocks belonging to the Bringelly Shale, the uppermost unit of the Wianamatta Group. The Wianamatta Group has a maximum thickness of approximately 140 metres beneath the airport sites (Penrith 1:100,000 Geology Map).

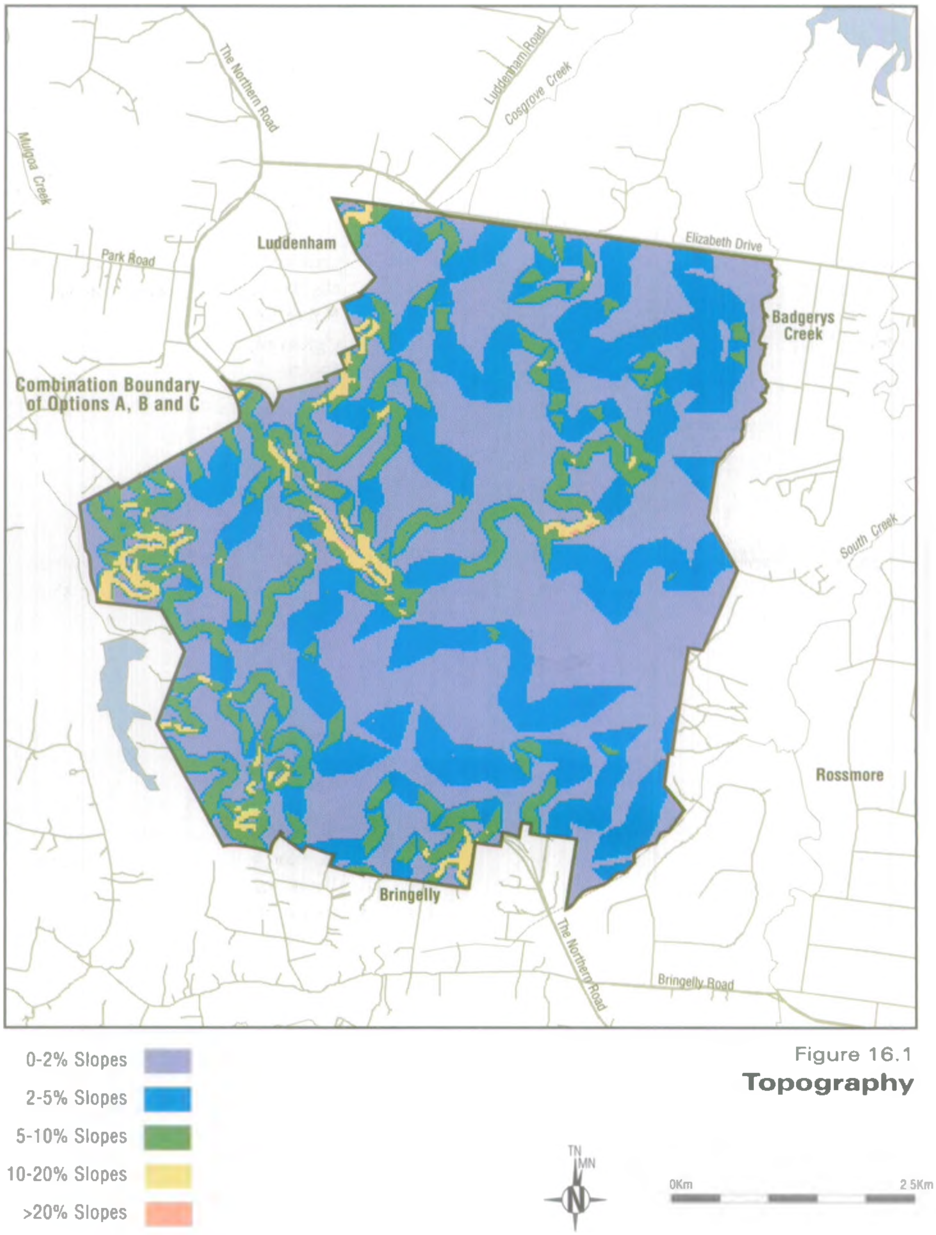


Figure 16.1
Topography

Quaternary alluvium typically consisting of sand, silt and clay overlies the Bringelly Shale along Badgerys Creek and Cosgrove Creek, the two main watercourses on the sites.

The Luddenham Dyke transects the western side of the sites, forming an elevated ridge that extends south-east from Luddenham. The dyke is a natural subsurface wall composed of olivine basalt. It is two to three metres wide and about eight kilometres long.

Three identifiable soil landscapes occur at the airport site options: the Luddenham, Blacktown and South Creek units. All three have moderate to high erosion potential, as illustrated in *Table 16.1*. *Figure 16.2* illustrates the soil landscapes. The sites are unlikely to contain acid sulphate soils, because of their elevation and the absence of marine or estuarine sediments.

It is quite likely that surface soil on parts of the airport sites could contain low levels of agricultural chemical residues. This is discussed in *Chapter 19*.

Table 16.1 Characteristic of Soil Landscapes

Soil Landscape Unit	Topography	Local Relief	Slopes	Soil Types	Dominant Soil Material	Soil Depth	Intrinsic Fertility	Existing Erosion	Erosion Hazard
Luddenham Erosional Soil Landscape Unit	Low rolling to steep low hills	50 to 120 metres	5 to 20 percent	Dark podsolic and massive earthy clays on crests; red podsolic soils on upper slopes; yellow podsolic and prairie soils on lower slopes and drainage	Loam and/or clay loam A Horizon, light to medium clay B Horizon	Less than 1.5 metres	Moderate to high	Minor gully and moderate sheet erosion	Moderate to very high
Blacktown Residual Soil Landscape Unit	Gently undulating rises	Less than 30 metres	Less than 10 percent	Red and brown podsolic soils on crests; yellow podsolic soils on slopes and drainage lines	Loam and/or clay loam A Horizon, lightly mottled clay B Horizon	Less than 1 metre	Moderate to high	Minor sheet and gully erosion	Slight to moderate for non-concentrated flows; moderate to high for concentrated flows
South Creek Fluvial Soil Landscape Unit	Flat terrace tops dissected by small drainage lines	Less than 10 metres	Less than 5 percent	Red and yellow podsolic soils on terraces, structured plastic clays	Loam and/or clay loam A Horizon, light medium clay B Horizon	Often very deep (greater than 2 metres)	Low to moderate	Stream bank and sheet erosion of floodplain	Potentially very high to extreme

16.3.2 Water

Badgerys Creek and South Creek both have the potential to cause flooding. Areas adjacent to the airport site options, and downstream, are within the one in 100 year flood zone (Taskforce on Planning for the Sub-Region Surrounding Sydney West

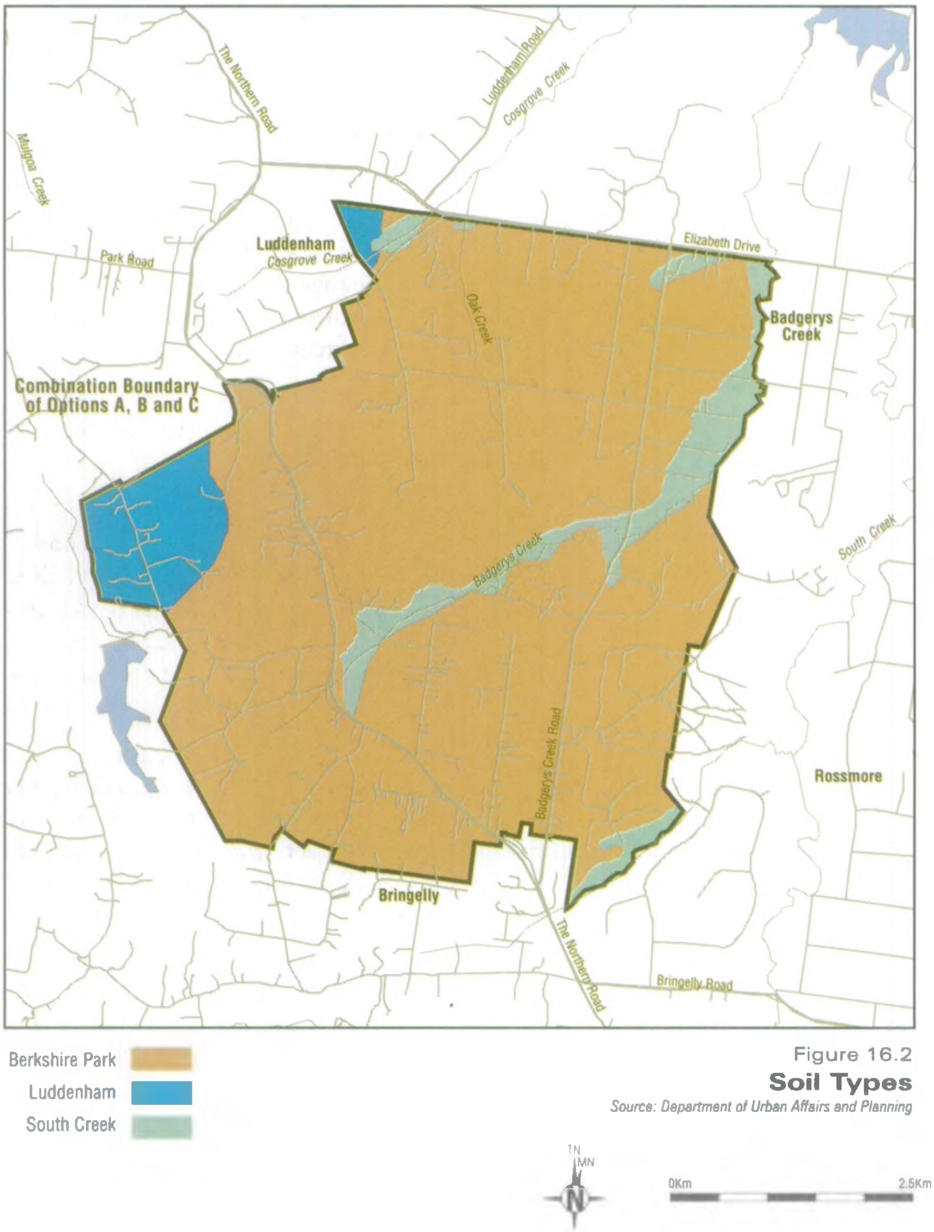


Figure 16.2
Soil Types
Source: Department of Urban Affairs and Planning

Airport, 1995). An accepted planning criterion in Sydney is to exclude urban development from such flood prone land unless protective measures are put in place and the impact on the creek system is understood.

The sites are part of the South Creek catchment, a subcatchment of the Hawkesbury-Nepean catchment. Major tributaries entering South Creek from the east include Rileys, Kemps, Ropes and Eastern creeks. Other tributaries are Thompson, Badgerys, Oaky, Cosgrove and Blaxland Creeks which enter South Creek from the west.

Groundwater

Salinity information from bores within the Wianamatta Group (Old, 1942) indicates that groundwater is generally too saline for most practical uses, particularly within the centre of the Cumberland Basin. No beneficial users or uses for groundwater within the Wianamatta Group have been identified within or near the airport site options.

Existing Surface Water Quality

Water quality in South Creek is currently poor, with concentrations of suspended solids, dissolved solids, total phosphorus and faecal coliforms generally elevated during or immediately after wet weather. A description of water quality parameters is contained in *Appendix F*. Sewage treatment plants at St Marys, Quakers Hill and Riverstone discharge into the lower reaches of the South Creek system, providing a continuous flow and further sources of nutrients.

The Nepean River, west of the sites, is important for a wide range of activities including swimming, boating, fishing and passive recreation. The river also supplies water for agriculture and potable use.

The water quality of the Nepean River fully complies with National Water Quality Guidelines (Australia and New Zealand Environment Conservation Council, 1992) upstream of the West Camden Sewage Treatment Plant. Downstream of this point nitrogen levels are approximately twice the Australia and New Zealand Environment Conservation Council guidelines. Phosphorus and faecal coliform levels tend to increase in wet weather. Adjacent to the recreational area at Bents Basin, nutrients are still elevated but recreational guidelines for swimming are met.

The zone of the Hawkesbury River downstream of South Creek has been problematic in terms of eutrophication, at times producing blue green algal blooms. Nutrients frequently exceed water quality criteria. The river is also often turbid and at times exceeds primary contact criteria for faecal coliforms (Environment Protection Authority, 1994a, Australian Water Technologies, 1995). South Creek is a major influence on the river, particularly contributing nutrients and suspended solids.

Lake Burragorang is the major water supply for Sydney and parts of the Blue Mountains. Currently the lake provides approximately 70 percent of the water for over 3.7 million people. The waters within Lake Burragorang and the Kowmung River are classified Class S (Specially Protected Waters) under the *Clean Waters Act 1970* which prohibits the discharge of any waste to these waters. All other tributaries are Class P (Protected Waters).

Current water quality at the dam wall abstraction point has consistently achieved compliance with the *Australia and New Zealand Environment Conservation Council Guidelines for Raw Water for Drinking Water Supply*, with the exception of iron, manganese, faecal coliforms and turbidity (Sydney Water and National Parks and Wildlife Service, 1997a). High levels of iron, aluminum and manganese are associated with runoff from the surrounding geological strata and soils. High faecal coliforms and turbidity are the result of surrounding land use activities. They generally occur after flood events, but are removed through filtration and disinfection processes before entering the drinking water supply system.

Prospect Reservoir operates as an emergency supplier of water. It has not been used for routine water supply since Prospect Water Filtration Plant was connected directly to Lake Burragorang via the Sydney Water Supply Pipeline. Approximately 85 percent of the Sydney Metropolitan area is serviced from this water treatment plant. Prospect Reservoir is used during periods when the water supply from Lake Burragorang is of poor quality or is interrupted for maintenance.

Streams in the Badgerys Creek area are generally nutrient enriched but nevertheless support a diverse ecosystem. Nutrient levels compliance rates with *Australia and New Zealand Environment Conservation Council Guidelines for the Protection of Aquatic Ecosystems* are poor to fair (Sydney Water, 1995). Algal growth was found to be excessive in all creeks at Elizabeth Drive and dissolved oxygen concentrations were occasionally low.

A summary of water testing result for some of the creeks surveyed for this Draft EIS is shown in *Table 16.2*. These results confirmed the eutrophic status of local streams, particularly in terms of nitrogen enrichment. Water quality sampling locations are shown in *Figure 16.3*.

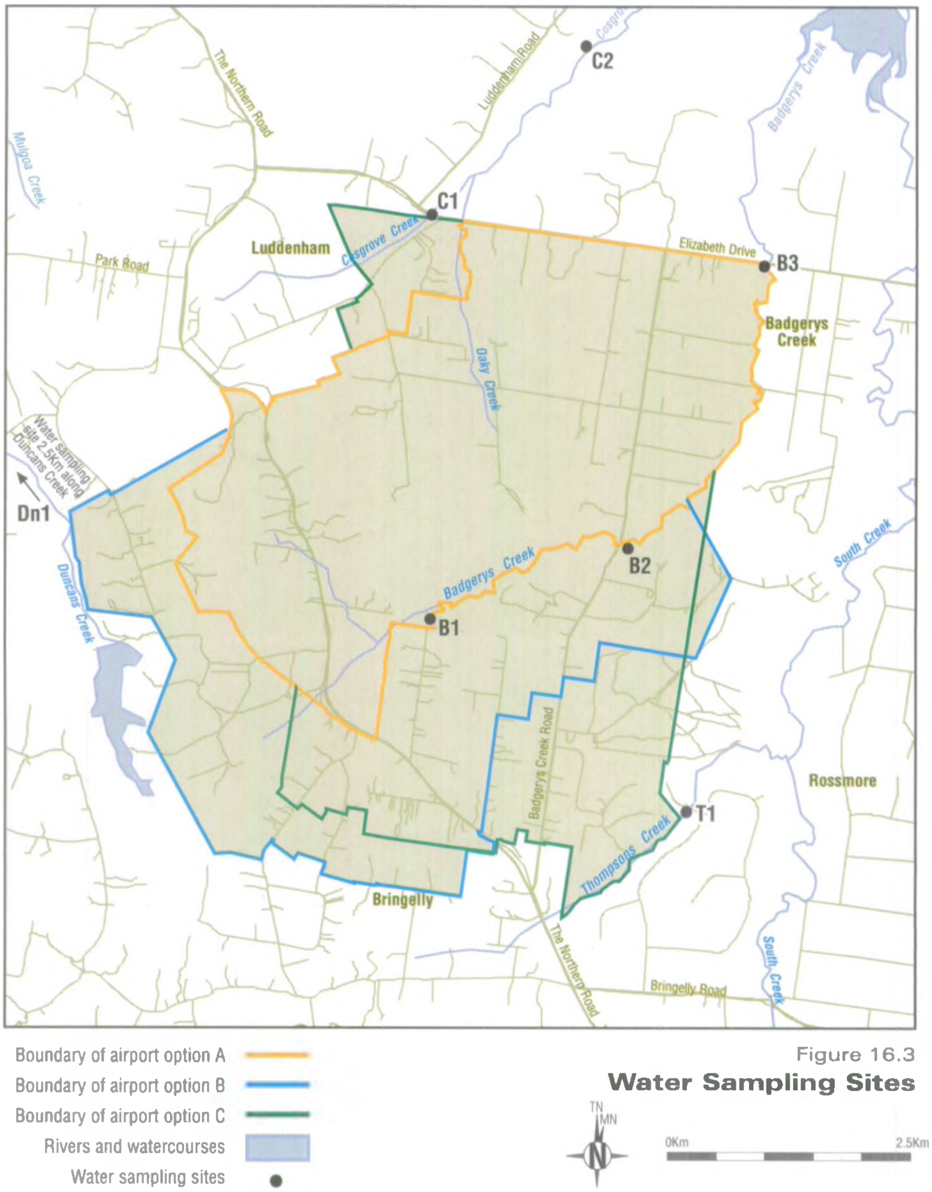


Figure 16.3
Water Sampling Sites

Table 16.2 Existing Water Quality in Creeks

Water Quality Parameter	ANZECC[1] Guideline	Water Sampling Locations: Badgerys Creek B1	Badgerys Creek B2	Badgerys Creek B3	Cosgrove Creek C1	Cosgrove Creek C3	Thompsons Creek T1	Duncans Creek Dn1
Dissolved Oxygen (mg/L)/ Percent Saturation (%)[2]	6 (80 - 96%)	4.5 (63%)	12.2 (150%)	2.2 (24%)	3.1 (34%)	2.2 (25%)	2.2 (23%)	1.3 (15%)
pH	6.5	6.9	7.3	6.7	7.4	6.7	6.4	6.7
Suspended Solids (mg/L)	-	2	33	14	2	5	5	13
Turbidity (NTU)	-	1.1	7	5.1	0.7	2.9	4.9	5.2
Nutrients:								
Total Nitrogen (mg/L)	0.5 - 0.75	0.6	3.3	0.9	0.5	1.01	0.6	<0.75
Total Phosphorus (mg/L)	0.05 - 0.1	<0.02	1.2	0.26	<0.02	<0.02	<0.02	<0.02
Ammonia Nitrogen (mg/L)	1.4	0.054	0.38	0.21	0.064	0.12	0.13	0.025
Metals:								
Nickel (mg/L)	0.015 - 0.15	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Copper (mg/L)	0.002 - 0.005	0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Chromium (mg/L)	0.01	<0.005	0.01	0.005	0.05	<0.005	0.005	<0.005
Zinc (mg/L)	0.005 - 0.05	0.013	<0.01	<0.01	<0.01	0.018	0.018	<0.01
Lead (mg/L)	0.001 - 0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Cadmium (mg/L)	0.0002 - 0.002	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Iron (mg/L)	1.0	0.22	1.8	1.1	<0.05	<0.05	4.9	0.53
Mercury (mg/L)	0.0001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Organics:								
Total Petroleum Hydrocarbons (mg/L)								
C6 - C9	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
C10 - C14	-	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04
C15 - C28	-	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
C29 - C36	-	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Volatile Aromatic Compounds (mg/L)	-	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Volatile Halogenated Compounds (mg/L)	-	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Phenols (mg/L)	0.05	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Polycyclic Aromatic Hydrocarbons (mg/L)	0.003	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Methylene Blue Active Substances (mg/L)	-	<0.02	<0.22	<0.12	<0.2	<0.02	<0.02	<0.02

Notes: 1. *Australia and New Zealand Environment Conservation Council.*
2. *Abbreviations: mg/L = milligrams per litre, < means less than, NTU = nephelometer turbidity units.*

Faecal coliform levels were elevated in wet weather, with some high results during dry weather suggesting contamination from water fowl, animals or human sources such as on-site treatment systems. Compliance rates with *Australia and New Zealand Environment Conservation Council Guidelines for Recreational Waters* were poor in Badgerys Creek and poorer in South Creek and Kemps Creek.

Previous surveys (Snowy Mountains Engineering Corporation, 1991) indicated that water in Oaky Creek occasionally contained organochlorine pesticides but metal concentrations were at or below detection levels. Cosgrove Creek samples were below detection levels for pesticides and all metals except trace amounts of zinc. Low levels of heavy metals were present, apart from copper, chromium and zinc. Copper and zinc were at concentrations near guideline values. Chromium levels were five to ten times guideline criteria at two sites, possibly due to historical agricultural chemical sources.

Macroinvertebrate communities provide a sensitive indicator of ecological health and long term water quality. One commonly used water quality index is the *Signal Index* (Chessman, 1995), which was developed specifically for Australian waters. It takes into account the number and abundance of pollution sensitive animals. A signal index of less than 4 indicates probable severe pollution, 4-5 indicates probable moderate pollution, 5-6 mild pollution and greater than 6, clean water. Signal indices for four creeks sampled are summarised in *Table 16.3*. They varied from 4.4 to 5.3 (moderate to mild pollution) with Badgerys Creek at Elizabeth Drive showing the poorest ecological water quality. This suggests that the ecosystem is slightly impoverished but still allows the development of some sensitive aquatic fauna.

Table 16.3 Macroinvertebrate Data

Name of Stream	Sites	Number of Species	Signal Index	Pollution Indicated
Badgerys Creek	B1	37	5.1	Mild Pollution
	B2	26	5.1	Mild Pollution
	B3	23	4.4	Moderate Pollution
Cosgrove Creek	C1	23	5.3	Mild Pollution
	C3	14	4.8	Moderate Pollution
Thompsons Creek	T1	25	5.1	Mild Pollution
Duncans Creek	Dn1	21	5.1	Mild Pollution

16.4 Impacts on Soils and Water

16.4.1 Construction Impacts

Table 16.4 shows the estimated lengths of creeks that would be directly impacted by the airport options.

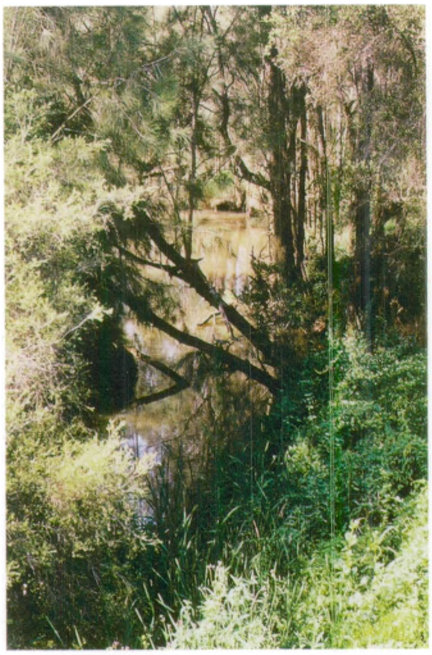
Table 16.4 Estimated Lengths of Creeks that would be Infilled or Taken Up with Stormwater Detention Structures by Construction of Airport Options

Name of Stream	Estimated Length		
	Option A	Option B	Option C
Badgerys Creek	0	5.4 kilometres	5.7 kilometres
Cosgrove Creek	1.8 kilometres	1.5 kilometres	0
Oaky Creek	3.0 kilometres	3.0 kilometres	3.9 kilometres
Total	**4.8 kilometres**	**9.9 kilometres**	**9.6 kilometres**

Source: Second Sydney Airport Planners, 1997a

Badgerys Creek carries the highest flow of the three creeks listed in *Table 16.4*. Creek diversions would involve temporary excavations to appropriate dimensions and standards. Work is proposed to commence on the north side of the airport site and progress in a southerly direction. Once the permanent stormwater drainage is completed, the temporary creek diversions would be filled in and water would be allowed to flow through the permanent system.

During the construction of Option A there would be potential impacts on the quality of water in Badgerys, Cosgrove and Oaky Creeks (refer *Photographs 8* and 9), and further downstream within South Creek. In addition, the construction of Option B would impact on Duncans Creek, a tributary of the Nepean River, and Thompsons Creek, as potential receiving waters. Thompsons Creek would also receive water from Option C.



Photograph 8
Badgerys Creek within Airport Sites

Photograph 9
Oaky Creek within Airport Sites

Even with implementation of rigorous sediment and erosion control measures, it is anticipated there would be some occasions when turbid water would flow into streams. High turbidity can have adverse effects on stream fauna and affect the photosynthetic processes of algae and aquatic plants. Particles would also transport pollutants such as nutrients. Short term impacts are considered to be minimal given the adaptation of local streams to periodic high turbidity, however there could be more significant long term impacts in terms of nutrient loading due to sediments.

Adverse effects on groundwater due to airport construction would consist of temporary changes in levels. These effects would be minor.

16.4.2 Operational Impacts

Impacts on Flooding

As the developed airport would contain large areas of paved or impervious surfaces and an efficient drainage system, site runoff would have a quicker response time and losses by infiltration would be lower than at present. Therefore post development runoff would exceed pre-development runoff.

Preliminary design of airport drainage infrastructure at Badgerys Creek has been based upon sizing of detention ponds so that they can temporarily detain stormwater produced by severe storm events up to one in 100 years Average Recurrence Interval. This was based on the assumption that to prevent increased flooding, the rate of volume discharge should be limited to 20 percent less than existing peak values (Second Sydney Airport Planners, 1997a). To verify this assumption, it would be necessary to carry out flood modelling for the whole of South Creek catchment. This work is yet to be undertaken.

Impacts on Surface Water Quality

Potential water quality impacts of Options A and B are shown in *Figure 16.4*. Potential water quality impacts of Option C are shown in *Figure 16.5*.

Gross-pollutant traps would intercept and retain coarse sediment, trash and debris, and flame traps would limit the escape of oils and fuel spills. Extended detention ponds would contain surface booms for trapping any hydrocarbons that escape the flame traps during high flow conditions. These detention ponds would enable pollutant removal through settlement of fine particles. Gravel filter beds would further improve the quality of runoff water discharged from the extended detention ponds.

Nutrients would be the most significant contaminants. The predicted nutrient load from treated stormwater is close to the present nutrient loading in the catchment, which is elevated due to runoff from agricultural land. Estimates of current and future nutrient loadings on Badgerys Creek are shown in *Table 16.5*.

Table 16.5 Estimated Pollutant Loadings on Badgerys Creek from Airport Catchment

Contaminant	Existing Loading[1]	Airport Loading[2]		Total Future Loading[2]
		Stormwater	Sewage Plant Effluent	
Nitrogen	11.6 tonnes per year	10 tonnes per year	41 tonnes per year	51 tonnes per year
Phosphorus	1.9 tonnes per year	1.9 tonnes per year	2.5 tonnes per year	4.4 tonnes per year

Notes: 1. *Existing loading from catchments within airport site.*
2. *Future loading from catchment with full development of the airport.*

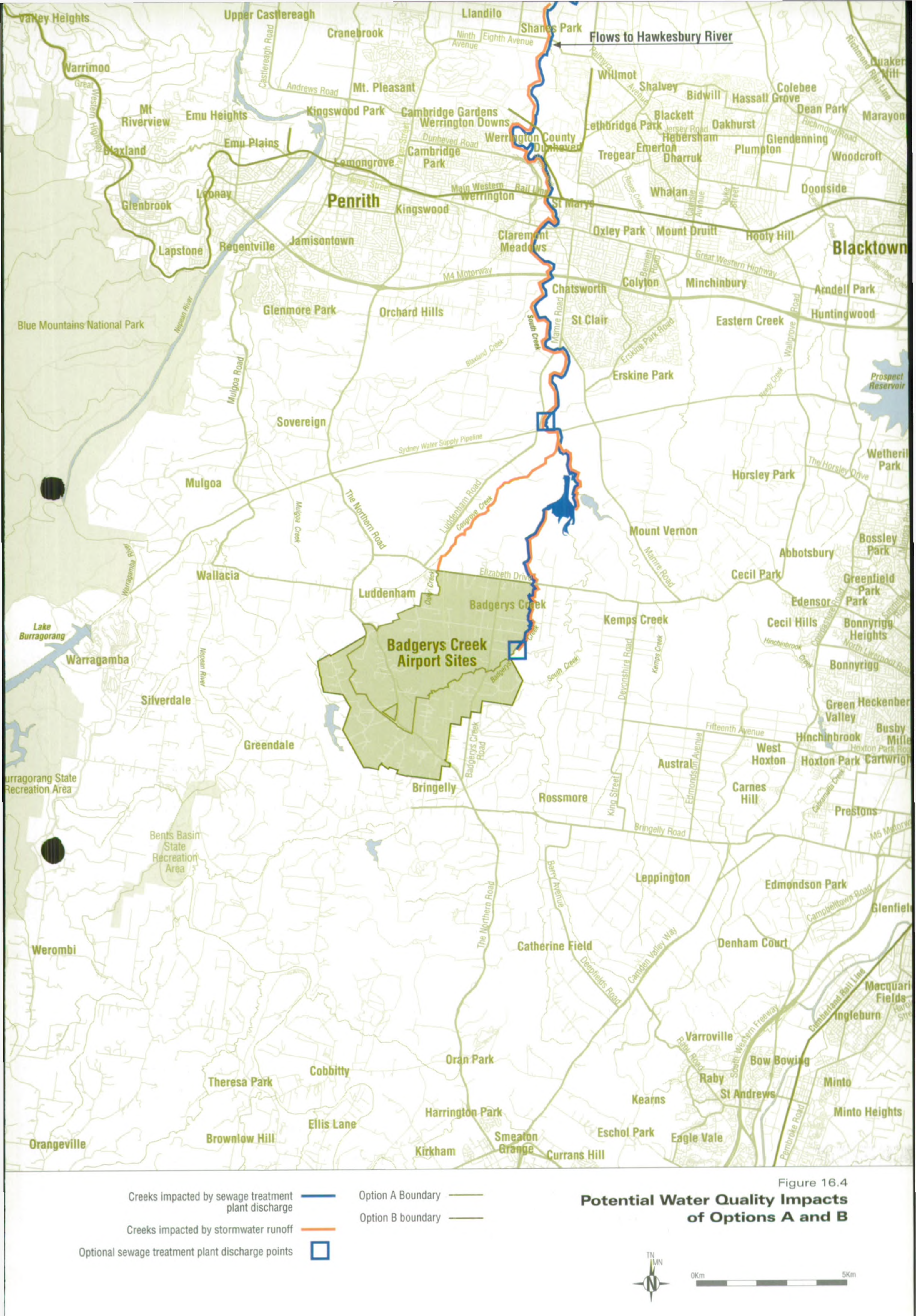
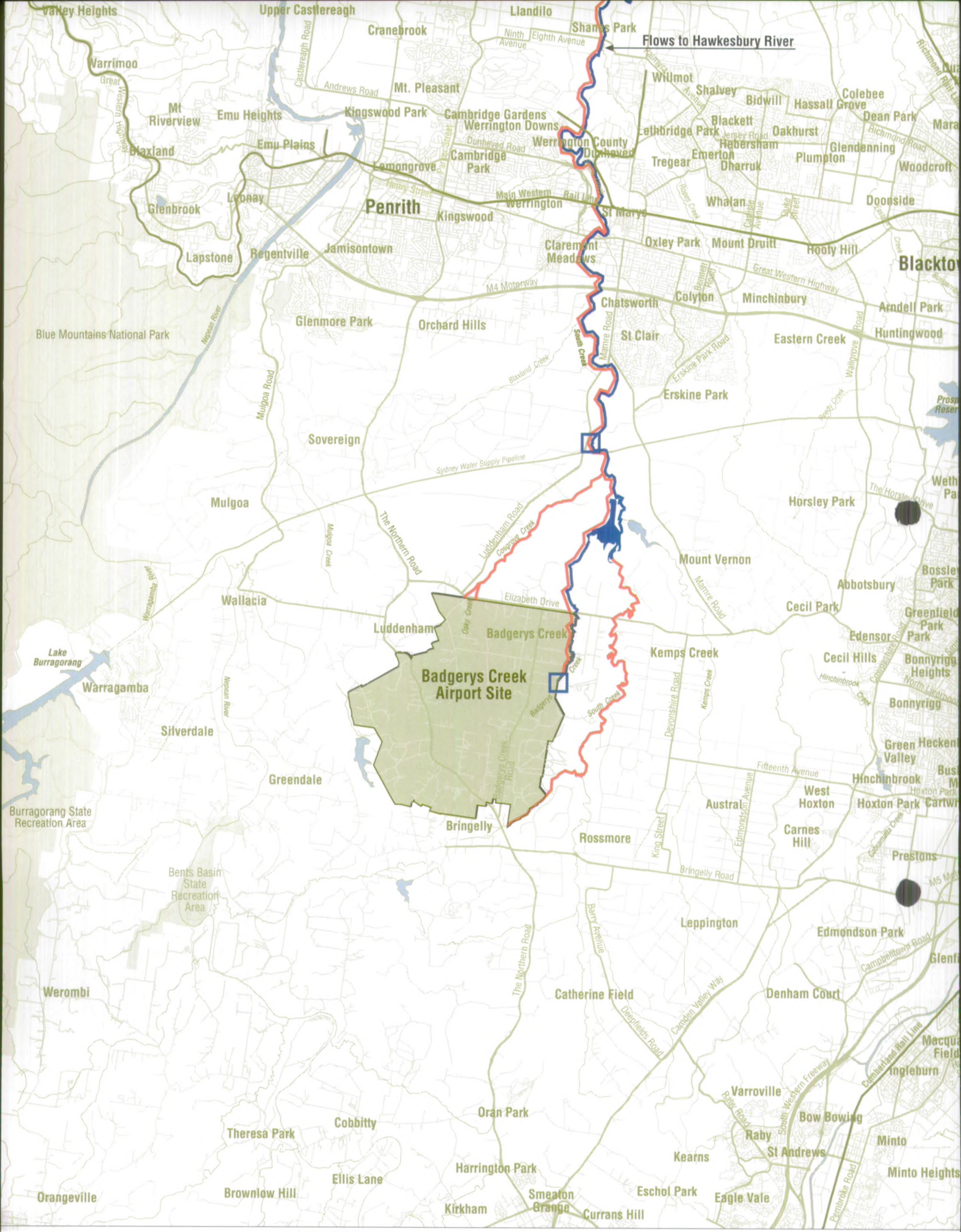


Figure 16.4
Potential Water Quality Impacts of Options A and B



Creeks impacted by sewage treatment plant discharge

Creeks impacted by stormwater runoff

Optional sewage treatment plant discharge points

Figure 16.5

Potential Water Quality Impacts of Option C

TN MN N

Department of Transport and Regional Development

Depending on the treatment option adopted, sewage treatment plant effluent could be discharged into Badgerys Creek after tertiary treatment and disinfection. This discharge would change the flow pattern in the stream from an intermittent creek to a perennial medium flow pattern and would alter aquatic ecosystems to more fluvial forms.

Acute or chronic toxicological problems are not expected to result from the discharges because of the expected quality of sewage treatment effluent. Suspended solids loads from the discharges are not considered problematical nor is any depression in dissolved oxygen expected from discharged biochemical oxygen demand. Predicted faecal coliform concentrations would conform to primary contact recreational guidelines (Second Sydney Airport Planners, 1997c).

Phosphorus loads from sewage treatment plant discharges would be almost twice existing loads and nitrogen contributions would increase fourfold (*Table 16.5*). During dry weather, when Badgerys Creek offers virtually no dilution, sewage treatment plant discharge would result in a concentration of 0.3 milligrams per litre of phosphorus and five milligrams per litre of nitrogen. Existing total phosphorus and nitrogen concentrations recorded during the water sampling program ranged from 0.6 to 3.3 and less than 0.02 to 1.2 milligrams per litre respectively in Badgerys Creek (*Table 16.2*).

Eutrophication of streams would potentially lead to a reduction in sensitive species of aquatic fauna and so to aesthetic impacts. Human health implications would be low, as the upper catchment is generally not considered suitable for harvesting fish or shellfish, or for primary contact recreation.

Existing nutrient loads in the Hawkesbury River from South Creek are of the order of 9,600 and 400,000 kilograms per year of phosphorus and nitrogen respectively (Environment Protection Authority, 1994a). This is largely due to discharges from existing sewage treatment plants. Proposed introduction of improved nutrient removal at these treatment plants would mean that the relative impact from the airport discharges would increase, although the total nutrient load entering the Hawkesbury River would decline. Further nutrient contributions, however, are expected as a result of increased urban development in the South Creek Valley.

Impacts on Groundwater

Airport development would result in a lowering of groundwater levels due to reduced infiltration in paved areas. This effect may be locally counteracted by rising levels beneath proposed detention dams. Potential effects on soils of changes in groundwater levels would be taken into account in civil design. There is a possibility of groundwater contamination from a number of sources; however, properly engineered surface water drainage facilities, and fuel storage and delivery systems would protect it from obvious sources of pollution. Therefore overall impacts to groundwater are not likely to be significant.

Impacts of Aircraft Emissions on Drinking Water Quality

Options A and B would be likely to have a number of flight paths directly over Lake Burragorang and Prospect Reservoir. An assessment of potential pollution of these water storages by air emissions from aircraft was done by predicting concentrations of dissolved pollutants and comparing these against drinking water guidelines (National Health and Medical Research Council, 1996), and ecosystem protection guidelines (Australia and New Zealand Environment Conservation Council, 1992).

Benzene and benzo(a)pyrene (a polycyclic aromatic hydrocarbon) were chosen as representing the more toxic of constituents potentially generated by an airport. Benzene would also typically represent the behaviour of such gaseous emissions as formaldehyde, toluene and xylene. Benzo(a)pyrene is an indicator of non gaseous compounds capable of attaching to particles in the atmosphere.

On the basis of concentrations of benzene in air predicted by air quality modelling, levels of benzene predicted in Lake Burragorang and Prospect Reservoir for Options A and B were more than ten thousand times lower than the drinking water guideline of one microgram per litre and more than 10 million times lower than ecosystem protection guidelines. As gases such as benzene would dissolve in water, they would be in a state of equilibrium with atmospheric concentrations. This would mean that concentrations of gaseous pollutants such as benzene in Prospect Reservoir could vary, depending upon the benzene levels in the surrounding air, and such pollutants would not accumulate in the water over time. The impacts of Option C on the reservoirs would be lower because of the limited number of flight paths likely to occur over the reservoirs.

Compounds that adhere to particulates are of concern, due to the potential for accumulation of deposits in the environment. Likely benzo(a) pyrene concentrations in Lake Burragorang and Prospect Reservoir could not be predicted due to a lack of data on aircraft emissions of benzo(a) pyrene, and to uncertainty about incorporation of this compound into water by partitioning or adsorption to particulates. Airports have not been identified as a major source of benzo(a) pyrene. The major environmental sources of polycyclic aromatic hydrocarbons in Sydney have been identified as commercial and industrial incinerators, wood burning stoves and bushfires (Environment Protection Authority, 1991).

Furthermore, settling, filtration and coagulation processes in water filtration plants in the Sydney Water system would be capable of reducing the concentration of benzo(a) pyrene to less than one nanogram per litre (ten times lower than the recommended guideline), even if the influent concentration is high. It is likely that concentrations of other polycyclic aromatic hydrocarbons would be similarly reduced (National Health and Medical Research Council, 1996).

The potential risk to domestic rainwater tanks could not be fully quantified. For gaseous emissions, the equilibrium concentrations of benzene determined for reservoirs would also apply to rainwater tanks. These are well within guideline values. The situation for particulate emissions, such as polycyclic aromatic hydrocarbons, is more complex. There is a lack of data on the likely concentrations of these compounds in aircraft emissions, and the effects of microclimatic factors in transferring particles into water are not well understood. However, given the potential for particulates and associated pollutants from various sources to accumulate in rainwater tanks it would be desirable for any rainwater tanks, used as a source of drinking water to have appropriate filtration or other treatment prior to use. Further data would need to be collected and modelling undertaken into the transfer of particulate emissions into water tanks to assess the relative importance of these types of aircraft emissions.

The potential for fuel dumping and venting is discussed in *Chapter 15*. Significant impacts on water supply are unlikely, given the rarity of such incidents. If fuel did reach the surface of a reservoir it would float. Water could be drawn off at a lower depth to minimise any risk of contamination to drinking water supplies. The possibility of an aircraft crashing into a reservoir is discussed in *Chapter 19*; however, it is likely that any potential health risks could be overcome. By drawing water at different depths, any spilt fuel could be avoided; and existing filtration and disinfection systems would treat other possible contamination.

16.5 Environmental Management

16.5.1 Management Measures

Dispersive soil properties at Badgerys Creek, and the proposed large area of disturbance, would require diligent adherence to soil and sediment control to minimise export of sediment into receiving streams. Dosing of flocculants for turbidity control in sediment basins would need to be undertaken as well as adequate desludging of basins. Sediment control near to the source of disturbance is recommended, using measures such as drainage diversion or interception. All sediment control structures should be regularly inspected and maintained.

Dust control should be managed through the diligent use of water sprays and stabilising or covering of stockpiles. Any storage of materials such as chemicals, fuel or concrete components should be bunded to contain any spills. Procedures should be established to clean up any spillage promptly.

Additional dosing of flocculants in extended detention ponds, when monitoring detects excessive nutrients escaping the system, would enhance sediment and nutrient removal from stormwater.

Adequate management and maintenance programs would be essential for the continued efficacy of these measures. This includes regular cleaning of traps and desilting of sediment basins. The reed beds would need to be monitored for clogging and short-circuiting, and reed plants replaced as necessary.

The proposed wastewater treatment system for the airport incorporates tertiary processes, including disinfection and a relatively high level of nutrient removal. To achieve a higher effluent quality would require processes such as reverse osmosis filtration and biological or chemical nutrient removal, which would involve substantially higher costs and occupy additional area on the site. To ensure maximum efficiency from the treatment plant, it would be necessary to optimise and monitor plant operation, to provide sufficient redundancy for essential plant components and to develop an appropriate contingency response plan.

16.5.2 Monitoring

Further baseline monitoring of receiving streams should be undertaken before any construction work began. During construction, regular monitoring should occur and include three locations on Badgerys Creek and two locations on Cosgrove Creek. Sampling should be undertaken, once a month during dry weather, and during rain events to capture peak flow from the site. A rainfall event is classified as over 10 millimetres in the preceding 24 hours. The program should aim to capture about 12 events a year.

Monitoring should include flow rate and cumulative discharge, suspended solids, total phosphorus, total nitrogen, faecal coliforms, oils and grease, polycyclic aromatic hydrocarbons, total petroleum hydrocarbons, volatile organic compounds, and heavy metals. Once the airport is operational, stormwater discharge points should also be added to the monitoring program.

To permit discharge of treated sewage effluent to Badgerys Creek, a licence would need to be issued by the Environment Protection Authority. This would specify effluent quality requirements and a monitoring regime. It is recommended that the monitoring program incorporate biological assessment of Badgerys Creek to provide a direct measurement of any ecosystem impacts as well as additional water quality information.

A thorough understanding of the hydrogeological environment at the sites would be required in order to enable any risks to groundwater from airport construction and operation to be identified. A groundwater monitoring network should be installed, ideally 12 months before the start of construction activities to enable this to be achieved.

Monitoring bores should be installed in particular areas, such as around fuel storage facilities, to ensure that the integrity of containment measures is maintained.

16.5.3 Further Study

The potential for downstream flooding associated with each of the airport options has not yet been assessed. Preliminary design of airport drainage infrastructure has been based upon the assumption that detention ponds limiting maximum downstream rates of volume discharge to 20 percent less than current peak rates, for storms with an Average Recurrence Interval of one in 100 years, would prevent increased flooding. Flood modelling of part of the South Creek catchment would need to be undertaken to confirm this.

16.6 Summary of Potential Impacts

Potential water related impacts of the airport options include:

- removal of approximately five kilometres, 10 kilometres and 10 kilometres of stream habitats for Options A, B and C respectively;
- minimal short term impacts of potential sediment releases during construction, but more significant longer term impacts due to nutrient loading of sediments;
- minor impact on Badgerys Creek from discharges of treated stormwater from the airport, due to existing elevated nutrient loadings;
- eutrophication and higher levels of in-stream algae in the South Creek system from discharge of treated sewage plant effluent into Badgerys Creek;
- minor impacts on groundwater;
- some potential regional impacts for recreation, fishing and agricultural uses;
- moderate local and regional impacts from effluent discharges, particularly from nutrient additions;
- potential human health impacts from contamination of rainwater tanks (the possible extent of such impacts could not be quantified); and
- very low concentrations of benzene in Lake Burragorang and Prospect Reservoirs associated with overflights from Badgerys Creek Options A and B, predicted as being more than ten thousand times lower than drinking water guidelines and 10 million times lower than ecosystem protection guidelines.

Contamination of water supply reservoirs by fuel due to accidental venting or aircraft crashes could be overcome by drawing water from below the surface. Existing filtration and disinfection processes for drinking water would be likely to overcome potential health risks associated with aircraft crashes. The risk of aircraft crashes is discussed in *Chapter 19*.

Chapter 17

Flora and Fauna

Chapter 17
Flora and Fauna

A flora and fauna study was undertaken for this Draft EIS and is documented in Technical Paper No.8. A summary of the main findings and conclusions of the study is provided in this Chapter.

17.1 Issues Raised During Consultation

Commentary on the airport options did not focus on flora and fauna impacts. It was, however, suggested that the little remaining flora and fauna within the sites of the airport options is important to the western Sydney region and should not be further degraded, but should be preserved as remnant bushland.

Previous studies were noted, which identified plant species classified as protected under Commonwealth and State legislation or as having local conservation significance.

17.2 Methodology

Studies undertaken on flora, fauna and freshwater fish and crayfish involved:

- researching and collating any existing data that related to the airport site options;
- consulting with government organisations, experts and other interested parties; and
- conducting field assessment and surveys to address gaps in existing information.

The assessment of potential impacts on flora and fauna relies on the water quality assessment presented in *Technical Paper No. 7*, on bushfire and bird and bat strike assessments presented in *Technical Paper No. 10* and noise assessments presented in *Technical Paper No. 3*. Impact assessment was restricted to the airport options and their immediate surrounds; proposed access corridors outside the airport sites were not sampled.

Full details of the scientific methods employed during data collection, and the impact assessment work undertaken are contained in *Technical Paper No. 8*. Impact assessments for all flora and fauna species listed in the *NSW Threatened Species Conservation Act 1995* are also included.

Assessment of national significance of fauna is based upon listing of species under *Schedules 1* and *2* of the *Endangered Species Protection Act, 1992*, while state significance is based upon listing in *Schedules 1* and *2* of the *NSW Threatened Species Conservation Act, 1995*. National and State significance of flora is generally based upon listing in the same schedules; however, listings of Rare or Threatened Australian Plants (ROTAPs) are also taken into account. Bird species listed under Australian international agreements are those included in the *Japan-Australia Migratory Birds Agreement* (JAMBA) and the *China-Australia Migratory Birds Agreement* (CAMBA).

Table 17.1 shows the criteria used in this chapter to describe the scale of potential impacts on fish and crayfish while *Table 17.2* summarises the timeframes over which such impacts would occur.

Table 17.1 Scale of Potential Impacts on Fish and Crayfish

Scale of Impact	Effects on Fish and Crayfish
Minor	• Small reductions in the abundance of sensitive native fish and crayfish species. • Small community composition changes favouring pollution tolerant taxa. • Slight reductions in reproductive success.
Major to Very major	• Substantial reduction in the majority of native fish taxa down affected tributaries and possibly affecting trunk streams. • Moderate community composition changes favouring pollution tolerant taxa. • Moderate reductions in reproductive success.
Severe to Very Severe	• Virtual elimination of the majority of native fish taxa down affected tributaries and well into trunk streams. • Elimination of all crayfish taxa. • Cessation of reproductive activities.

Table 17.2 Timescale of Aquatic Impacts

Timescale	Years
Short Term	About one month
Medium Term	Up to one to two years
Long term	Beyond three to four years

17.3 Existing Environment

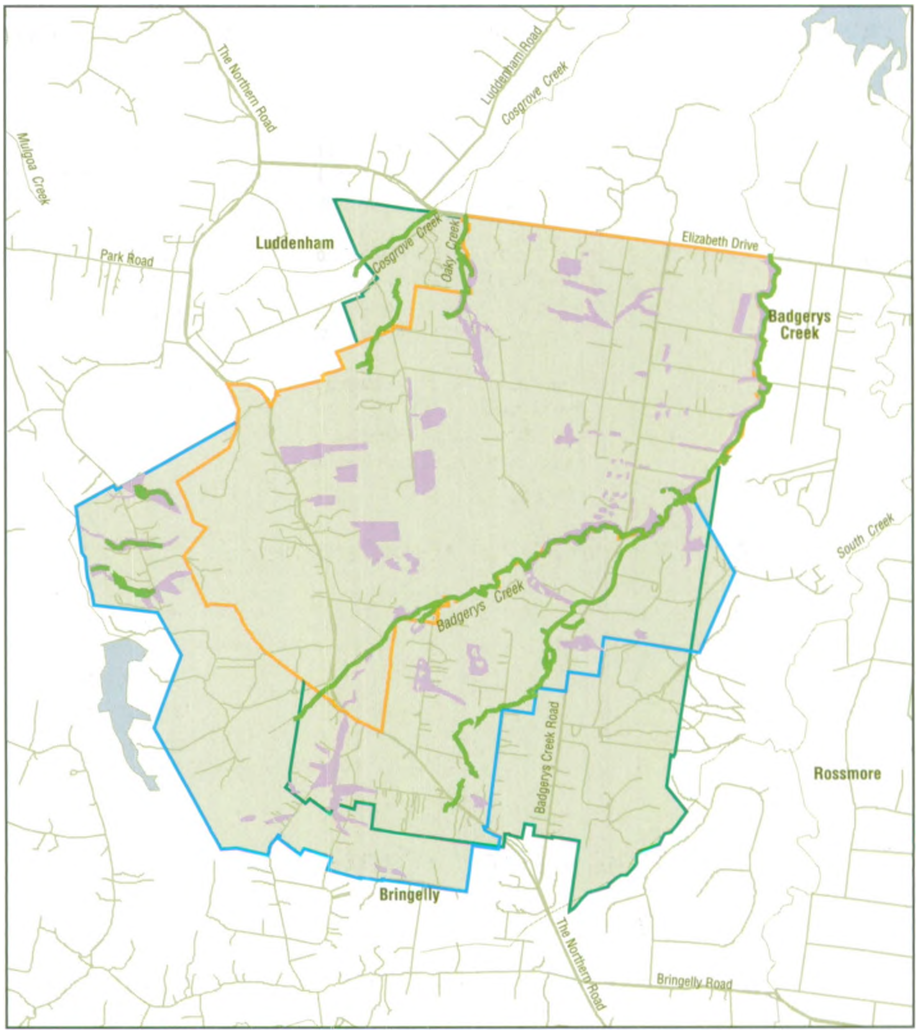
17.3.1 Flora

The sites of the airport options contain substantial indigenous vegetation. More species are likely to have been present prior to disturbance, which included extensive clearing, grazing by livestock and weed invasion of remnant habitats. Little if any undisturbed vegetation remains and remnant habitats are generally in poor condition. Figure 17.1 shows the vegetation communities recorded on the sites of the airport options; one plant species of national significance (refer *Photograph 10*) and 48 species of regional significance have been recorded on the sites.

Four habitat types, supporting a particular range of terrestrial fauna species, occur within the sites. Figure 17.2 shows terrestrial and aquatic fauna sampling sites.

© Murray Fagg - Australian National Botanic Gardens

Photograph 10
Pultenaea parviflora **(plant of national significance recorded within the sites of the airport options)**



Boundary of airport option A
Boundary of airport option B
Boundary of airport option C
Grey Box Woodland
River-Flat Forest/Freshwater River Swamps

TN MN N

0Km 2.5Km

Figure 17.1
Native Vegetation

17.3.2 Fauna

Generally the condition of fauna habitats has been highly altered and invasion of introduced plants and animals is evident. A total of 18 terrestrial fauna species of conservation significance has been recorded within the sites, including two species of State significance and 16 species of regional significance (refer *Photographs 11* and *12*). Additional, significant terrestrial fauna species have been recorded in the vicinity of Badgerys Creek and may occur within the sites. It is possible that habitat for two species of national significance, 13 species of State significance and 38 species of regional significance could be affected by construction of the airport options; habitat for five bird species listed under Australian international agreements, such as CAMBA and JAMBA could also be affected.

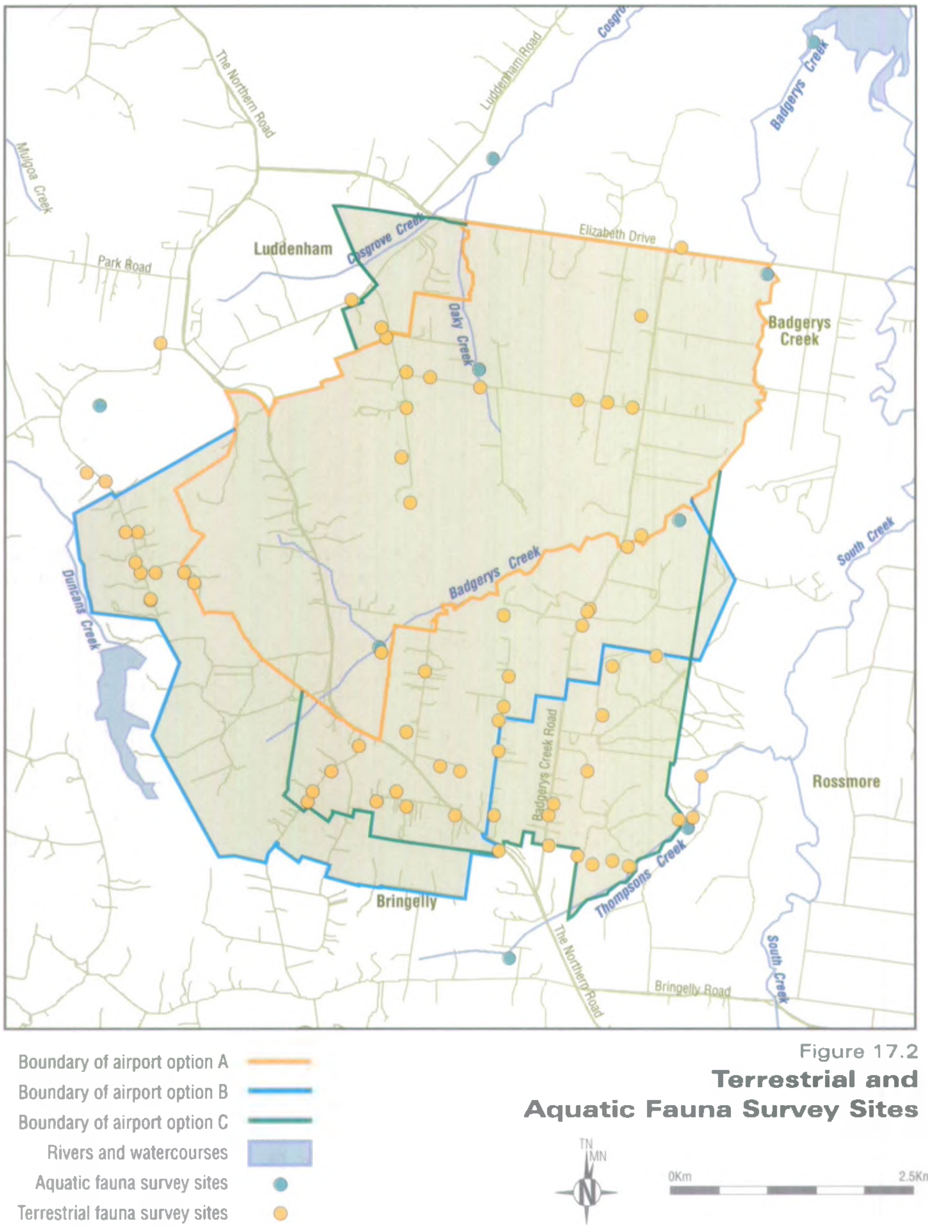


Figure 17.2
Terrestrial and Aquatic Fauna Survey Sites

One fish species and possibly one crayfish of high conservation value and three fish species of high recreation value were recorded within and around the airport sites. Habitat diversity indices for streams indicated low to moderate habitat diversity. Although these streams provide local freshwater habitat, they are generally degraded and are considered to have only local conservation significance.

Badgerys Creek is considered to have regional significance for nature conservation. Tables listing significant flora and fauna species on the sites of the airport options are contained in *Appendix F*.

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Photograph 11
Double-barred Finch (*Taeniopygia bichenovii* - bird of regional significance recorded within the sites of the airport options)

© John McCann - Nature Focus

Photograph 12
Lace Monitor (*Varanus varius* - reptile of regional significance recorded within the sites of the airport options)

17.4 Flora and Fauna Impacts

17.4.1 Option A

Construction Impacts

Construction of Option A would require removal of approximately 121 hectares of native vegetation, including one species of national significance and 33 species of regional significance. Scattered examples of Grey Box Woodland (Cumberland Plain Woodland) exist within the site. This vegetation community has recently been listed as an endangered community under *Schedule 1* of the *Threatened Species Conservation Act, 1995*. Although woodland surveyed during the present study was not considered to be significant due to its small size and altered condition, this may need to be reviewed once significance criteria are clearly defined.

One significant fauna species, the Common Bent-wing Bat (refer *Photograph 13*), was recorded within the site of Option A. The habitat types represented within the site provide potential habitat for a number of other significant species. Three species of regional significance were recorded within or adjacent to the site, but more are likely to be found there. Native vegetation that would be removed is habitat of high local significance.

Photograph 13
Common Bent-wing Bat (*Miniopterus schreibersii* - mammal of State significance recorded within the sites of the airport options)

Removal of native vegetation together with the erection of a fence around most of the site is likely to form a movement barrier for terrestrial and arboreal fauna. It would also form a substantial barrier across Badgerys Creek, which is a wildlife corridor of high local significance.

Construction would involve substantial filling of gullies and complete removal of habitat and aquatic biota. It is also possible that fine sediments escaping detention ponds during storm events would be transported into receiving streams and ultimately into South Creek. Aquatic impacts are therefore likely to be high for local amphibian populations.

Habitat removal and degradation within the airport site, together with downstream impacts such as sedimentation, eutrophication and miscellaneous contaminant inputs, would mean that fish and crayfish within Cosgrove, Oaky, Duncan and Badgerys Creeks and downstream would be subject to major impacts. These impacts would be likely to persist in the long term. They would include changes in abundance and community composition of populations, elimination of some species, proliferation of pollution tolerant species and a reduction in reproductive success.

As habitat in the area is patchy in its distribution, few native fauna are expected to occur adjacent to the sites of the airport options. Therefore any impacts of construction noise on fauna are expected to be low. Lighting associated with security would be unlikely to have a significant impact on fauna outside the airport boundary.

The impact of the airport options on road kills of fauna would not be high in the vicinity of the site, as few remnant habitat patches remain in the area and existing roads were constructed some time ago.

Weeds are already predominant within the understoreys of forest vegetation at Badgerys Creek. Weed invasion would therefore not be a major management issue, although care would need to be taken not to further exacerbate weed problems.

Further clearing and fragmentation of native vegetation associated with the construction of the airport would likely place local native flora and fauna under increasing pressure to locate suitable habitat. However, indirect impacts would not be expected to have a significant impact, as weeds and feral animals are already abundant within and around the site.

Operational Impacts

Impacts of aircraft noise and airport lighting on native fauna would probably be low because of the patchy distribution and relatively small amounts of native habitats in the area.

Potential impacts of fire on native flora and fauna would not be expected to change significantly as a result of development of an airport. Loss of significant species due to fire or fuel reduction burning would be closely linked to changes in the existing fire regime in habitats surrounding the airport sites. Bushfire impacts are discussed further in *Chapter 19*.

There would be moderate risk of loss to significant species as a result of birds or bats striking aircraft. The diversity and abundance of species at risk would be partly dependent on the management of stormwater and other potential habitat in the vicinity of the airport. Risk associated with bird and bat strike is discussed further in *Chapter 19*.

Alteration of flow characteristics in Badgerys, Oaky and Cosgrove Creeks, and potential eutrophication of Badgerys Creek and South Creek, would affect aquatic fauna habitats and would very likely have a high impact on amphibian species utilising these habitats.

Because of the direct impacts of habitat removal and degradation within the airport site, and downstream impacts such as sedimentation, eutrophication, biological and miscellaneous contaminant inputs, it is likely that fish and crayfish within Cosgrove, Oaky, Badgerys and Duncan Creeks and downstream would be subject to major impacts. These would include changes in abundance and community composition of populations, elimination of some species, proliferation of pollution tolerant species and reduction in reproductive success. Potential impacts of aerial pollutants such as benzene and polycyclic aromatic hydrocarbons on flora and fauna are considered to be minor for all options, based upon work undertaken for the Draft EIS and reported in *Chapter 16*.

Some of the air traffic associated with an airport at Badgerys Creek would approach and/or take off over Blue Mountains National Park, nature reserves and several State recreation areas. Previous research has shown that the behaviour and reproductive success of fauna inhabiting these natural areas are unlikely to be affected by overflights. Potential noise impacts on wildlife are discussed in *Chapter 11*. Under normal circumstances, the impacts of accidental fuel discharges would be minor over conservation reserves. The likelihood of fuel discharges from aircraft is discussed in *Chapter 15*.

17.4.2 Option B

Construction Impacts

Construction of Option B would require the removal of approximately 212 hectares of native vegetation, including one species of national significance and 34 species of regional significance. Scattered examples of Grey Box Woodland (Cumberland Plain Woodland) exist within the site, but were not considered to be significant, for the same reasons as outlined for Option A.

Two significant fauna species, the Common Bent-wing Bat and the Eastern False Pipistrelle, were recorded within the site of Option B. The habitat types represented within the site provide potential habitat for a number of other significant species. Seven regionally significant species were recorded within or adjacent to the site, and more species would be likely to be found there.

Potential impacts of fencing, road kills, clearing and fragmentation of native vegetation, and weed invasion would be similar to those associated with Option A.

Impacts of construction on aquatic species would be similar to Option A, except that Badgerys Creek would also be infilled, creating additional impacts. Fish and crayfish within Thompsons Creek would likely be subjected to minor impacts in the short and medium term.

Operational Impacts

Impacts of operations on aquatic species would be similar to Option A; however, additional minor impacts would be likely in Thompsons Creek and its tributaries.

As with Option A, impacts on bird and bat populations of significant species in the vicinity of the site would probably be moderate; however, the extent of impact would depend on management of potential habitat within and around the airport.

17.4.3 Option C

Construction Impacts

Construction of Option C would require the removal of approximately 183 hectares of native vegetation, including one species of national significance and 37 species of regional significance. Scattered examples of Grey Box Woodland (Cumberland Plain Woodland) exist within the site, but were not considered to be significant, for the same reasons as outlined for Option A.

Potential impacts of fencing, road kills, clearing and fragmentation of native vegetation and weed invasion would be similar to those associated with Options A and B.

Two significant fauna species, the Common Bent-wing Bat and the Eastern False Pipistrelle, were recorded within the site of Option C. The habitat types represented within the site provide potential habitat for a number of other significant species. Five species of regional significance were recorded within or adjacent to the site, and more species are likely to be found there. Native vegetation that would be cleared is habitat of high local significance.

Construction impacts on aquatic species would be similar to those for Options A and B; however, fish in Thompsons Creek could also be subjected to major impacts in the long term. Fish and crayfish in Cosgrove and Duncans Creeks would likely be subject to minor impacts in the long term.

Operational Impacts

Impacts of airport operations on aquatic species would be similar to those for Options A and B; however, additional minor impacts would be likely in Cosgrove and Thompsons Creeks and their tributaries.

As with Options A and B, impacts on bird and bat populations of significant species in the vicinity of the site are expected to be moderate; however, they would depend on management of potential habitat within and around the airport.

17.5 Environmental Management

17.5.1 Management Measures

Construction of any of the airport options would result in the complete removal of vegetation within the boundary of the airport site. Thus all species of flora and fauna within the airport boundaries would perish or be displaced.

Management measures therefore would apply mainly to the protection of flora and fauna and habitats at the periphery of the sites, within adjacent high quality areas, and along transport and service corridors associated with the airport development. These measures mainly relate to minimising and controlling edge effects (for example weeds, feral animals, downstream aquatic habitat).

A major component of an environmental management plan for airport construction and operation would be an emergency rescue plan for fauna. It is possible that individuals might become isolated, trapped or injured during the construction phase. Individual fauna species and fauna guilds that would benefit from a rescue plan include koalas, amphibians, reptiles, medium size mammals, raptors, and hollow-dependent fauna, including arboreal mammals, bats, owls and other bird species. However, the nature and scale of the development might preclude a variety of small or highly mobile fauna species from rescue.

Other flora and fauna management measures that might reduce potential off site impacts of the airport options are described below.

Environmental Management During Construction

Environmental management measures adopted during the construction period should include:

- ensuring that river and stream crossings for vehicles are constructed so that downstream water quality is not adversely affected;
- installing permanent detention ponds on the lower end of all catchments that would be disturbed by construction activities;
- avoiding overdosing with flocculating agents;
- collecting rare plants for future propagation under the necessary permits and conditions before construction commences;
- using non-invasive plant species for soil stabilisation and weed control;
- educating construction workers in identifying flora and fauna species of conservation significance;
- checking all sheds, buildings and culverts for the presence of bats before demolition;

- preventing and managing bushfires during construction;
- implementing procedures so that construction vehicles are driven in a manner that avoids road kills;
- adopting weed and dieback control strategies; and
- using trench plugs to allow movement of wildlife across trenches where appropriate.

Environmental Management During Operation

Environmental management measures adopted for the operation of any one of the airport options should include:

- applying habitat management measures and bird scaring techniques to reduce the incidence of bird and bat strike;
- ensuring that bushfire prevention and control outside the option boundaries takes into account flora and fauna impacts;
- designing stream crossings so that they do not inhibit movement of aquatic species;
- monitoring stormwater and erosion control measures;
- creating wetlands as part of stormwater management; and
- considering alternative methods of disposing of treated sewage effluent such as land disposal.

17.5.2 Monitoring

A monitoring strategy with clear priorities and flexible response measures would be prepared as part of the environmental management plan for the airport.

The basis of any monitoring program is accurate baseline data. These data should be collected during pre-construction surveys, which would aim to locate populations of species and provide site specific information on their habitat requirements. The surveys would enable the establishment of long term monitoring of fauna populations.

Monitoring should target indicator species (those known or suspected to be sensitive to habitat loss and fragmentation), bird deterrents, feral pests, fire and fire control, weeds, aquatic environments and environmental compliance. Although its scope and usefulness is limited due to the degraded nature of the sites of the airport options, it would provide important information on the effectiveness of mitigation measures employed.

17.6 Summary of Potential Impacts on Flora and Fauna

A summary of the potential construction and operational impacts of the airport options is provided in *Tables 17.3* and *17.4*, respectively.

Construction of the airport options would result in the loss of terrestial and stream habitats and create a barrier across a wildlife corridor of high local significance. However, Option A minimises the area to be developed and consequently the potential loss of biodiversity from the area. Indirect impacts are not expected to be significant for any of the options.

The Badgerys Creek area has not been identified as being a site of conservation significance for terrestial fauna in the *Urban Bushland Biodiversity Survey* undertaken

Table 17.3 Impacts of Construction on Flora and Fauna

Potential Impacts	Option A	Option B	Option C
Loss of terrestrial habitat of local and regional significance	120 hectares of habitat of high local significance	210 hectares of habitat of high local significance	183 hectares of habitat of high local significance
Loss of stream habitat	Oaky Creek (4 km); Cosgrove Creek (2 kilometres)	Badgerys, Oaky, Cosgrove creeks (10 kilometres)	Badgerys, Oaky Cosgrove creeks (10 kilometres)
Fragmentation and barriers	Creates a barrier across a wildlife corridor of high local significance	Creates a barrier across a wildlife corridor of high local significance	Creates a barrier across a wildlife corridor of high local significance
Aquatic impacts	Frogs - major; fish and crayfish - 3 streams very major impacts, 1 stream major impact;	frogs - major; fish and crayfish - 4 streams very major impacts, 1 stream major impact;	frogs - major; fish and crayfish - 5 streams very major impacts, 2 streams minor impact;
Impacts of noise	Noise - minor; lighting - minor	Noise - minor; lighting - minor	Noise - minor; lighting - minor
Loss of significant vegetation	None[1]	None[1]	None[1]
Potential loss of significant flora species	National - 1 species; regional - 33 species	National - 1 species; regional - 34 species	National - 1 species: regional - 37 species
Potential loss of significant fauna species	Potentially 2 species of national, 12 species of State, and 38 species of regional significance; 5 species listed under International agreements	Potentially 2 species of national, 12 species of State, and 38 species of regional significance; 5 species listed under International agreements	Potentially 2 species of national, 12 species of State, and 38 species of regional significance; 5 species listed under International agreements

Note: 1. May need to be reviewed for Cumberland Plain Woodlands once significance criteria are defined under the Threatened Species Conservation Act, 1995,

Table 17.4 Impacts of Airport Operation on Flora and Fauna

Potential Impacts	Option A	Option B	Option C
Impact of feral animals	Low	Low	Low
Impact of weeds	Low	Low	Low
Cumulative impacts	Low	Low	Low
Noise	Low	Low	Low
Fire	Low	Low	Low
Bird and bat strikes	Moderate	Moderate	Moderate
Wilderness	Nil to low	Nil to low	Nil to low
Aquatic impacts	Frogs - major; 4 streams major impact	Frogs - major; 4 streams major; 1 stream minor impact	Frogs - major; 3 streams major; 2 streams minor impact
Road Kills	Low	Low	Low

in western Sydney by the National Parks and Wildlife Service (1997). Although Badgerys Creek provides a corridor of some significance, habitat on the airport sites is not likely to wholly support any fauna species or populations nor provide significant resources for nomadic species such as the Regent Honeyeater. Overall, the impact of the airport development on terrestial fauna biodiversity is considered to be high local. Detailed impact assessments for significant species likely to occur on the site are provided in *Technical Paper No. 8.*

Similarly, the Badgerys Creek area does not constitute a core biodiversity area for terrestial flora in western Sydney (National Parks and Wildlife Service, 1997). The site supports some Cumberland Plain Woodland, a community which has been listed as an endangered community under *Schedule 1* of the *Threatened Species Conservation Act, 1995*. However, the woodland surveyed is not considered to be significant due to its small size and highly altered condition; this may need to be reviewed once significance criteria are clearly defined by the National Parks and Wildlife Service.

Although 48 plant species of regional significance were found on the sites of the airport options (refer *Appendix F*), the vast majority of these were considered to belong to plant groups which are common to widespread and are unlikely to become regionally extinct in the near future (National Parks and Wildlife Service, 1997). However, at least three species are described as belonging to vulnerable plant groups which, due to rarity, restricted distribution or range limits, may face extinction in western Sydney the next 10 years. Because the airport development has the potential to alter the distributions of these species at a regional level, the overall impact on terrestial flora biodiversity is considered to be at least regional. A detailed impact assessment for the only species of national significance, *Pultanaea parviflora*, is given in *Technical Paper No. 8.*

Given the existing degraded stream conditions and the associated low conservation values of streams, the predicted major stream impacts from the airport options are unlikely, in an absolute sense, to result in profound deleterious changes to the stream biota. It is likely that the fish fauna would become even more dominated by pollution tolerant species and therefore subject to an even greater decrease in the biodiversity of native fish species. The scale of impacts expected from each airport option is considered to be local; however, Option A would result in fewer impacts to fewer streams than Option B and C.

Chapter 18

Resources, Energy and Waste

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This chapter examines a range of potential impacts of the three airport options, such as sterilisation of mineral resources, loss of agricultural productivity, energy usage, and waste generation and disposal. Further details are provided in Technical Paper No. 9.

18.1 Issues Raised During Consultation

A range of comments were received relating to impacts of the proposal on natural resources such as agricultural land, the utilisation of energy and the management of waste.

The agricultural value of land around the sites of the three options was raised during consultation. It was noted that a number of agricultural uses would no longer be possible if the airport development proceeded.

The future availability of fossil fuels and the implications of an anticipated global shortage in fuel was raised. In light of predicted fuel shortages it was suggested that the feasibility of alternative modes of transport such as a very fast train network throughout Australia should be investigated. The need to explore alternative power generation sources for the airport proposal was also mentioned.

Issues were raised relating to the generation of waste from the proposal and to management techniques. Respondents mentioned a range of potential sources of contaminants likely to be generated during airport construction and operation, such as contaminated food and water, sulphuric acid, emulsified oil, grease, decarbonising solvent cleaners, detergents, paint strippers, acid, fluorocarbon, hydrocarbon solvents, trade wastes, aircraft fuel, rubber detritus, pesticides and herbicides. Other concerns were raised about the disposal of quarantine waste (waste from aircraft whose port of origin is outside Australia) because of the potential to introduce new pests to Australia.

It was commented that waste water would need to be treated on site to avoid impacting the existing over-burdened local sewerage system at Badgerys Creek.

18.2 Methodology

Potential sterilisation of mineral resources such as coal and light firing clays was examined by consulting with the NSW Department of Mineral Resources, and reviewing other available information from previous studies. Potential impacts of the various airport options on agricultural activities in the vicinity of the proposed sites was examined by reviewing existing data and conducting telephone surveys and field visits.

Details of predicted energy usage for airport construction and operation were obtained from Second Sydney Airport Planners (1997a). Waste generation and disposal at Sydney Airport and Melbourne Airport were investigated to enable predictions to be made about the amount and type of wastes likely to be generated by operations at the Second Sydney Airport. Construction waste estimates were obtained from Second Sydney Airport Planners (1997a).

18.3 Impacts on Resources, Energy and Waste

18.3.1 Construction Impacts

Natural Resources

Preliminary investigations (Department of Mineral Resources, 1996) indicated that while light firing clay/shale is present in the Badgerys Creek area, there is low potential for significant economic deposits within the proposed airport sites. Surface minerals, however, can be mined before or during airport construction, and therefore would not be sterilised by the proposed development.

Three seams of the Illawarra Coal Measures, consisting of medium ash thermal and coking or coking blend coal, are known to underlie the sites of the airport options at a depth of over 800 metres. Preliminary estimates of coal resources that might potentially be sterilised by the need to avoid ground subsidence beneath sensitive structures at the airport are provided in *Table 18.1*.

The coal resources at Badgerys Creek appear to be of lower quality than similar deposits in the region. They have a seam thickness and are at a depth that makes mining difficult and costly, and may require mining technology not currently used in Australia. They are also beyond areas of current mining (Department of Mineral Resources, 1997).

Table 18.1 Potential Coal Sterilisation Resulting from Airport Options

	Potential Coal Resource Sterilisation	
	Runways/Platform	Entire Site
Option A	57 million tonnes	63 million tonnes
Option B	64 million tonnes	84 million tonnes
Option C	63 million tonnes	84 million tonnes

Source: Department of Mineral Resources (1997)

Agriculture

Badgerys Creek is in the agricultural fringe of Sydney, and contains a number of large agricultural enterprises including a poultry multiplication unit and a portion of a 1,500 cow dairy. These enterprises play a significant part in the regional supply of agricultural produce. Extensive grazing of beef cattle and agisted horses occurs, and a large number of small scale market gardens and nurseries producing fruit, vegetables and plants for the Sydney market exist in this area. *Table 18.2* summarises present agricultural land use for the airport site options.

The value of annual agricultural production that could be lost from each of the potential airport sites is estimated at $0.6 million for Option A, $2.3 million for Option B, and $1.7 million for Option C. Some existing agricultural operations, including the large poultry enterprise and the high quality horse establishments, could be expected to relocate elsewhere within the Sydney region. The total value of agricultural production at Badgerys Creek is small relative to the total Sydney regional output, which is estimated by NSW Agriculture at about $1 billion (Department of Agriculture, 1995).

Table 18.2 Present Agricultural Land Use at Badgerys Creek

Industry	Option A		Option B		Option C	
	(Hectares)	Percent	(Hectares)	Percent	(Hectares)	Percent
Extensive Grazing						
Beef Cattle	756	50	1,016	42	1,013	46
Horse agistment/thoroughbred horse	150	10	170	7	185	8
spelling	80	5	80	3	119	5
Mixed grazing						
Semi Intensive Grazing	40	3	175	11	70	3
Dairying	190	12	200	8	190	9
Trotting horse training/spelling						
Intensive Livestock						
Poultry	10	1	185	8	143	6
Intensive Cropping	50	3	155	6	148	7
Rural Small Holdings[1]	250	16	363	15	354	16
Total Agriculture	**1,526**	**100**	**2,344**	**100**	**2,222**	**100**
Other[2]	180		458		616	
Total Area of Options	**1,700**		**2,900**		**2,850**	

Source: *Hassall and Associates surveys.*
Notes: 1. *The deer and ostrich farms are included in the Rural Small Holdings as they are not the major source of income for the owners.*
2. *Other land use includes non-agricultural businesses, vacant land and residential blocks with no agriculture.*

Other potential impacts on agriculture include dusts generated from construction operations, which could impair livestock activities and reduce the quality of produce, especially in market gardening and nursery operations surrounding the airport, and elevated noise levels associated with airport construction and operations.

Energy

Construction of the proposed airport development would consume a significant amount of energy. Approximately 3,240,000 gigajoules of energy (equivalent to 90 million litres of fuel) would be expended to construct the airport to its proposed capacity. The major part (up to 70 percent) of this energy would be used in earthworks.

Waste

Existing buildings and infrastructure would be removed from the airport site. A detailed survey would be undertaken to identify and locate any potentially hazardous wastes (such as asbestos in buildings), and readily re-useable or recyclable items (such as concrete pipes and culverts).

It is estimated that up to 50 percent of the demolition wastes could be recycled either on-site in this fashion, or offsite in a recycling yard. The remaining waste materials would be disposed of to an off site landfill.

Trees and shrubs would be processed on-site into wood chip or mulch, which would be stockpiled for subsequent use in re-vegetated areas. Top soil would also be stripped and stockpiled for re-use on site. Any merchantable timber would be harvested and sold (Second Sydney Airport Planners, 1997a).

Preliminary investigations indicated that a balanced cut-to-fill approach in bulk earthworks design would be achievable for all airport options. It has been estimated that about 30 to 40 million cubic metres of material would be excavated and placed in embankments on site. This balanced earthwork approach avoids the generation of significant quantities of surplus spoil.

Surface soil on certain parts of the site is expected to contain low levels of agricultural chemical residues. A detailed site investigation would need to be conducted prior to airport construction to locate and determine the extent of contamination. It is expected that the quantities involved would be insignificant relative to the earthworks to be undertaken. This is discussed in *Chapter 19*.

It is proposed to install a temporary on-site sewage treatment plant to treat sewage generated during airport construction. Residual solids from the plant would be disposed of in an off-site sanitary landfill.

Other construction wastes would include garbage and office wastes from site compounds, and waste oils and fluids from maintenance workshops, as well as quantities of packaging materials and waste building materials.

Separate bins would be provided in site offices for general garbage and recyclable materials to facilitate collection and recycling by a waste contractor. Waste oils and fluids would be stored in dedicated tanks for collection by waste contractors. Used drums and containers would be returned to suppliers or collected by a recycling contractor. No garbage or waste oils would be disposed of on site. Off-specification concrete or asphalt would be either recycled into the on site batching plants or utilised as general fill in bulk earthworks (Second Sydney Airport Planners, 1997a).

18.3.2 Operational Impacts

Agriculture

Excessive noise levels could adversely affect agricultural operations outside the airport sites, by affecting egg laying, animal health and milk production. The extent of this impact depends upon many factors such as environment and genetics. Insufficient research has been done to determine with any certainty at what noise level such effects occur.

Energy

Annual energy consumption during the operation of the airport would be about 830,000 gigajoules at a capacity of 30 million passengers. Major energy demand centres are expected to include the international and domestic terminals (collectively about 50 percent), and the aircraft bases (about 30 percent). Aircraft fuel requirements would be approximately eight million litres per day when the airport reaches a capacity of 30 million passengers.

Design of airport facilities, such as buildings, would be in accordance with accepted energy efficiency principles. This would reduce energy consumption over the operating life of the facilities, and reduce the potential generation of greenhouse gases.

Layout of runways and taxiways to reduce taxiing distances and times, and efficient scheduling and control of take offs and landings would minimise the amount of fuel wasted by aircraft on the ground.

Waste

For an airport capacity of 30 million passengers per annum, up to 9,000 tonnes of quarantine waste and up to 6,000 tonnes of general solid waste per annum could be generated.

Quarantine wastes would be sterilised to permit co-disposal with general non-quarantine waste in an off site landfill. Waste oils and fluids would be stored in dedicated tanks for collection by a recycling contractor. Used drums and containers would be returned to suppliers or collected by a recycling contractor. Discarded machine parts would be returned to manufacturer or collected by a scrap metal recycler.

Solid residuals from the on-site sewage treatment plant would comprise sludge, and possibly grit and screenings, depending on the final process selection. Sludge would be a beneficial component to any on-site composting operation by providing a valuable nitrogen source, or it could be utilised off site. Screenings and grit would be disposed of to an off-site sanitary landfill.

18.4 Environmental Management

18.4.1 Natural Resources

Technologies enabling underground mining to occur simultaneously with operation of an airport (by eliminating ground subsidence) would need to be used if coal reserves at Badgerys Creek were mined at some time in the future.

Alternatively, special foundation designs could be used for key airport elements, such as runways, to allow for the possibility of future mining. As mining related subsidence could have other undesirable effects such as damage to underground services, ground subsidence would also need to be taken into consideration in service design. These measures are unlikely to be very cost effective. The depth of the coal reserves, their remoteness from existing coal mining areas and the relatively poor quality of the coal suggests that it would be unreasonable to allow for major ground subsidence in airport design, since the coal is unlikely to be mined in the future.

18.4.2 Agriculture

Direct impacts of building an airport on land currently used for agricultural production would be mitigated to a certain extent by compulsory acquisition payments to farmers and producers who were forced to relocate. Factored into these payments would be the value of the agricultural enterprise that is being acquired. This would enable them to set up elsewhere, and reduce the potential value of lost agricultural production.

Mitigation of problems caused by airborne dust could be achieved by minimising dust generation and implementing dust suppression measures at the airport construction site. Long term noise impacts on agricultural activities such as animal grazing and egg production are not clear from current research. Noise mitigation measures such as insulation of farm buildings would have limited effectiveness. Producers living on noise affected properties might qualify for acquisition in a similar manner to particular residential owners affected by aircraft noise.

18.4.3 Energy

Large amounts of energy would be consumed in the construction of any of the airport options. Energy conservation measures should be adopted for the design and construction of the airport and for ongoing airport operations. An ongoing energy consumption monitoring program should be implemented.

18.4.4 Waste

Construction wastes would be minimised by appropriate forward planning to avoid inexact ordering of materials, incorporation of waste minimisation practices into design of airport facilities, waste minimisation planning of on-site construction activities and implementation of a waste minimisation and management plan for the entire project.

For operational wastes, secure and effective segregation of quarantine and non-quarantine wastes would be necessary to minimise the risk of cross-contamination of these two waste streams; this would also have the effect of minimising the quantity of waste to be sterilised prior to landfill disposal. To achieve this, the design of the proposed airport would need to facilitate waste segregation and airport personnel would need training in correct handling procedures. Separate collection and handling systems should be provided and regular waste audits undertaken.

Other measures to minimise waste generated during the operation of the airport would include:

- evaluating the feasibility of including waste minimisation requirements into contracts with domestic and international airlines;
- providing agreed waste minimisation targets in contracts with commercial and industrial tenants;
- providing separate receptacles for wastes to facilitate collection of recyclable materials;
- composting food wastes (non-quarantine) with the resulting product used in airport landscaping works; and
- benchmarking the performance of the Second Sydney Airport in waste minimisation against international best practice.

18.5 Summary of Potential Impacts

Coal resources would be sterilised beneath the potential airport sites unless cost effective techniques can be developed to mine coal beneath the sites without causing subsidence. Coal resources at Badgerys Creek are not considered to be of great significance, as they are remote from existing mining areas and are of relatively poor quality. They are also at such a depth that mining would likely be uneconomic. Therefore sterilisation of such coal reserves by the airport options is not considered to be a significant impact.

Displacement of agricultural activities could potentially cause an annual loss of production of $0.6 million for Option A, $2.3 million for Option B, and $1.7 million for Option C. In comparison with the Sydney regional output ($1 billion) this loss of production would not be significant. Some existing agricultural operations could be expected to re-establish elsewhere, and this would reduce the potential loss of production from the region. Dust and noise from airport construction and operation could affect a number of properties in close proximity to the airport options, and potentially cause losses in production. The value of this cannot be estimated because of the lack of scientific knowledge on the effects of noise on animals.

Regardless of the type of energy conservation measures adopted, construction of the airport involves the unavoidable consumption of a large amount of energy, (3,240,000 gigajoules). The operation of the airport would also consume large amounts of energy (approximately 830,000 gigajoules annually, plus eight million litres of aircraft fuel per day). However, energy efficient design of the airport facilities, and good ground management of aircraft and airport facilities could reduce these amounts.

Up to 9,000 tonnes of quarantine waste and 6,000 tonnes of general solid waste would be generated by the airport annually. Quarantine wastes would be sterilised prior to disposal. Effective segregation of the waste streams would be necessary to minimise the quantity of waste to be sterilised and permit co-disposal of quarantine waste with general non-quarantine waste in an off-site licensed landfill.

Adoption of comprehensive waste management strategies aimed at maximising resource conservation, from design and construction stage through operation and maintenance, would ensure that waste generation was minimised, re-use recycling and reprocessing were maximised and the overall impact of the waste stream reduced.

Chapter 19

Hazards and Risks

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This chapter discusses the hazards and risks that would arise from construction and operation of any one of the airport options. Further details are provided in Technical Paper No. 10.

19.1 Issues Raised During Consultation

The community expressed concern about the possibility of an air crash in a residential area. Respondents considered that suburbs near the airport options would be in a 'disaster corridor' in the event of an aircraft accident. Again, the risk of an aircraft crashing into a dam, potentially polluting drinking water supplies and causing downstream flooding was a possibility discussed in connection with Warragamba Dam and Prospect Reservoir. Specific issues included:

- aircraft crashing into power lines near the sites of the Badgerys Creek airport options;
- the proximity to flight paths of the Defence Establishment Orchard Hills;
- the potential for bushfires in the Blue Mountains impacting on airport operations;
- the potential for engine failure in aircraft due to bird strike;
- danger to aircraft operations and to surface traffic from storm activity, wind turbulence and heavy fog;
- the risk of serious road accidents involving vehicles carrying fuel or quarantine waste; and
- the risk of civil reaction to overflight noise, particularly people attempting to physically impede the progress of airport construction earthworks and resorting to sabotage.

19.2 Methodology

19.2.1 Background

People face many risks in daily life, whether voluntary or otherwise. Voluntary risks are risks an individual takes with free choice and full knowledge; while non-voluntary risks are ones of which he or she does not have full knowledge, or situations where he or she is not entirely free to choose avoidance or exposure. In reality, most types of risk involve elements of voluntary and non-voluntary exposure.

Risks associated with particular development proposals, such as a potential airport or industrial facility, are usually perceived as non-voluntary. These risks may be borne by some people more than others and the public benefits arising from the facility may also be unevenly distributed.

Over the years, official regulators in many countries have recognised the need of some criteria for acceptable levels of risk to the public, to help governments in making decisions. They have formulated the general principle that risks should be low relative to other known and tolerated risks. The development of such criteria has made it possible to assess risks from new proposals on a uniform basis. There is still a need, however, to balance risks against benefits; and hence compliance with such standards, or criteria, is only one of the factors considered by governments in the decision making process.

When planning a new hazardous facility, it is appropriate to consider risks to people outside the boundaries of the proposed facility so that the acceptability of risk levels can be judged in relation to the nature of land use in the vicinity. This process ensures that new hazardous facilities are sufficiently separated from sensitive land uses such as residential areas. Similarly, when new residential development is planned in the vicinity of existing hazardous facilities, it is a requirement to consider the acceptability of existing risk levels at the proposed location.

In making a quantitative risk assessment, one measure often used is individual fatality risk. This is the risk of death per year to a person at a particular point outside the boundary of the facility due to a particular event. This risk is reduced significantly by distance. One of the ways in which individual fatality risk can be expressed is by means of risk contours plotted on maps. Individual fatality risk is calculated at many locations and distances from the facility and contours for nominated individual risk levels (for example, one chance in a million) are produced.

Another measure of risk that may be used is societal risk. This describes the risks from an installation or activity to society as a whole, and takes into account the actual number of people outside the facility who are exposed to various levels of risk. The most commonly used representation of societal risk is a societal risk curve, which expresses the risk to the population in the study area as a whole, independent of geographical location. It is a graphical representation of the chance of an accident occurring plotted against the number of fatalities that would result from that accident.

19.2.2 Issues Investigated

Hazard and risk issues were investigated, either quantitatively (by generating probabilities of events and predicting the number of crashes or potential fatalities), or qualitatively (by describing potential risks and consequences without numerical analysis). Quantitative risk assessment was used to investigate:

- the potential for an aircraft crash onto an industrial and/or residential area;
- risks associated with aircraft overflying the Defence Establishment Orchard Hills; and
- risks and potential consequences of an aircraft crash into Sydney's water supply infrastructure.

Qualitative risk assessment was used to investigate:

- adverse meteorology, and potential for seismic activity at the sites of the airport options;
- potential risk of bird and bat strikes;
- potential safety and environmental risk associated with supply and storage of aircraft fuels;

- contaminated sites; and
- bushfire risks.

19.2.3 Scope of Assessment

Individual fatality risk and societal risk from aircraft crashes were assessed for a study area measuring approximately 2,025 square kilometres centred on the airport options. *Air Traffic Forecast 3* in 2016 potentially has the highest number of aircraft movements, and so would have the worst risk impacts. Hence, it was used to investigate risk impacts for each airport option, in three possible modes of operation.

Historical crash data from Australia and overseas were analysed to predict crash rates in 2016, and to determine the probability of crashes at different locations relative to particular flight paths. The consequences of crashes in populated areas were also analysed. Factors specific to each airport option were taken into account in the risk modelling work. These included preliminary flight paths and the number and types of aircraft movements on each flight path and the predicted population densities in areas under the flight paths.

The likely prevalence of adverse meteorological conditions, which could potentially affect aircraft operations and ground traffic at the airport options, was investigated by the Bureau of Meteorology (1997). *Chapter 14* discusses the results of that assessment.

Potential hazards associated with bird and bat strike were investigated for each of the airport options. Information from the flora and fauna assessment undertaken for this Draft EIS was used to provide site specific data on bird and bat species. Physical inspections of the sites were also undertaken. Factors used to broadly classify bird and bat hazard risk at a particular location were the physical size of the birds or bats, their known movements and the likely size of the bird flocks or bat colonies.

A preliminary assessment was undertaken of the possibility that the airport site options contained contaminated soils or other materials because of previous and current activities. The assessment comprised a review of existing and historical information including aerial photographs taken at different times, and contamination reports for a specific part of the airport sites. Field inspections of the sites were also undertaken.

The potential for bushfires at Badgerys Creek was investigated and current fire management practices were identified by reviewing historical records, conducting site inspections and interviewing people with local knowledge. The potential impact of airport construction and operation on bushfire risks, and the potential effects of fire on airport construction and operation were examined. Possible management strategies for fighting bushfires and site evacuation were investigated, and fire prevention measures were reviewed.

As the airport options would involve establishing regular flight paths over the Defence Establishment Orchard Hills, a quantitative risk assessment of aircraft crashes into explosives storage facilities was conducted. The potential implications for existing air space restrictions were examined by consulting with regulatory bodies and the Department of Defence. All work was based on scenarios contained in the quantitative risk assessment for aircraft crashes.

The potential for aircraft crashes into water supply infrastructure was investigated. Such infrastructure included Prospect Reservoir and Warragamba Dam, and the major water supply pipeline between the two.

19.3 Existing Environment

19.3.1 Existing Risks to People in New South Wales

In NSW, risks associated with many everyday circumstances have been documented. For instance, each year people in New South Wales face 110 chances in a million of dying due to an accident at home, 60 chances in a million of dying due to an accidental fall, 35 chances in a million of dying as a pedestrian struck by a motor vehicle, and 18 chances in a million of dying due to accidental poisoning (Department of Planning, 1990b). *Table 19.1* summarises these risks.

Table 19.1 Risks to Individuals in New South Wales

Risks Averaged over the Whole Population	Chances of Fatality per Person per Year
Cancers from all causes	1,800 chances in a million
Accidents at home	110 chances in a million
Accidental falls	60 chances in a million
Risk criteria for industrial land uses[1]	50 chances in a million
Pedestrians struck by motor vehicles	35 chances in a million
Homicide	20 chances in a million
Accidental poisoning	18 chances in a million
Fires and accidental burns	10 chances in a million
Risk criterion for commercial land uses[1]	5 chances in a million
Electrocution (non-industrial)	3 chances in a million
Falling objects	3 chances in a million
Therapeutic use of drugs	2 chances in a million
Risk criterion for residential land use[1]	1 chance in a million
Risk criterion for hospitals, schools, etc.[1]	0.5 chances in a million
Cataclysmic storms and storm floods	0.2 chances in a million
Lightning strikes	0.1 chances in a million
Meteorite strikes	0.001 chances in a million

Sources: Department of Planning, 1990b and Kinhill, 1990.
Note: 1. The risk criterion relates to the risk generated from a particular hazardous facility or activity. It represents an additional level of risk above risks that already exist.

By taking into account these and many other known and tolerated risks, the NSW Department of Urban Affairs and Planning (Department of Planning, 1990b) has suggested that people in residential areas should not be exposed to more than a one in a million chance of a fatality each year due to accidents at hazardous industrial facilities. More sensitive areas, such as hospitals and schools, should not be exposed to a chance greater than 0.5 in a million of a fatality each year due to accidents at nearby hazardous industrial facilities. The criteria for less sensitive commercial and industrial land uses are set higher, at five in a million and 50 in a million chances of fatality each year. These risks from particular facilities or activities are additional to risks that already exist.

The NSW Department of Urban Affairs and Planning takes the view that irrespective of the numerical value of any risk criteria, all risks from a major hazard should be avoided or reduced where practicable. This necessitates the investigation of alternative locations and alternative technologies, wherever applicable, to ensure that risks are not introduced in an area where feasible alternatives are possible and justified (Department of Planning, 1990b). Existing air traffic in Sydney already imposes certain levels of risk on populated areas. Risks of aircraft crashes due to the Second Sydney Airport would be additional to existing risk levels from all sources. Certain facilities already established in the Badgerys Creek area would increase the hazard to the population in the event of an aircraft crashing.

19.3.2 Factors Contributing to Aircraft Crash Risks

Certain environmental factors place airport operations at hazard, and hence increase the risk of an aircraft crash. Such factors include inclement weather, and bird or bat strike.

Chapter 14 discusses the prevalence of adverse meteorological conditions such as fog, thunderstorms and lightning, and high intensity rain at the sites of the airport options. Quantitative assessment of the extent to which adverse meteorological conditions occur at each of the airport sites was not undertaken by the Bureau of Meteorology (1996) because of the lack of site specific meteorological data. Therefore, only preliminary conclusions can be drawn about the prevalence of such conditions.

Collisions with individual birds, especially large ones, or with flocks of birds can result in damage to aircraft windscreens, wings, tails, aerials, lights and engines. Damage to structures and systems can cause control and visibility difficulties, sometimes resulting in the loss of the aircraft, especially if bird strike occurs during critical phases of flight such as take off and landing. Likewise, ingestion of a bird or birds into a turbo prop or turbo fan engine can cause damage to fan blades and other components. In Australia there have been a number of examples of bird strikes in which all engines on the passenger aircraft have been damaged. Worldwide in 1988, one fifth of civil passenger aircraft losses and fatalities were related to bird strike incidents.

Bats, especially fruit bats or flying foxes, which may weigh up to 1.3 kilograms, could also cause significant damage to aircraft. In passing, it may be mentioned that small birds or bats are unlikely to cause damage to aircraft unless they occur in very large numbers. Most birds and bats fly at relatively low height above the ground and thus about 80 percent of all bird strikes occur below 70 metres, in the zone where aircraft are taking off or landing.

Bats roost in lofts and roof spaces of buildings, as well as in tree hollows scattered throughout forests or rock crevices, and overhangs along gullies. No large microbat roosts or breeding sites are known to occur within the sites of the airport options. A major fruit bat breeding colony is located at Cabramatta Creek near Warwick Farm Racecourse. This is approximately 20 kilometres east of the potential airport sites. Individual fruit bats have been observed at Badgerys Creek, feeding in trees and gardens.

19.3.3 Existing Risks to Water Supply Infrastructure

Sydney's water supply infrastructure includes major dams and storage reservoirs, major aboveground pipelines and canals, water filtration plants, water pumping stations, and serviced reservoirs. Infrastructure facilities are generally designed and operated to achieve certain levels of reliability and safety. Some elements of Sydney's water supply infrastructure, such as Prospect Reservoir and the Sydney Water Supply Pipeline are overflown by aircraft from Sydney and Bankstown Airports. Thus, the potential for aircraft crashes already poses risks to people and property downstream at this infrastructure and that some interruption to supply is possible. There is; however, always some risk of interrupting water supply due to events, such as equipment failure, extreme weather conditions or earthquakes.

19.3.4 Restricted Airspace

Defence Establishment Orchard Hills is located about five kilometres north of the airport sites and contains approximately 150 purpose built buildings that are licensed to store explosive ordnance used by the Australian Defence Forces. The site also contains a demolition range. As described in *Chapter 10*, the future of facilities at Orchard Hills is uncertain with the disposal of the Orchard Hills property possible in the period 2001 to 2006.

Current flight restrictions over Orchard Hills are based on demolition activities on site rather than storage of ordnance. The Department of Defence has indicated that permanent flight restrictions relating to demolition of explosives could possibly be removed. As there is an ongoing need to demolish small quantities of explosive ordnance from time to time; however, the Department of Defence and Airservices Australia have discussed the possibility of such demolition activities being undertaken with temporary airspace restrictions.

Flights of aircraft over an explosives storage facility are potentially hazardous to both the explosives and to the aircraft. The Australian Ordnance Council (1992) has developed guidelines on the control of airspace above explosives facilities and sites of planned detonation. It recommends that flights over explosives facilities should be restricted to essential transit. Where flights are unavoidable they should not be permitted at heights lower than the minimum heights already stipulated for the surrounding urban or rural areas (305 metres and 152 metres respectively).

Permanent flight paths associated with the operation of a major airport are not considered to be essential transit (Australian Ordnance Council, 1997). If it is necessary to have flight paths passing over the Defence Establishment Orchard Hills, at heights less than those calculated in the guidelines, a full hazard and risk analysis would need to be conducted.

19.3.5 Contamination of the Airport Sites

The only known contaminated area within the sites of the airport options is at Lot 4 The Northern Road, Luddenham. Contamination occurred as a result of dumping of materials by a former liquid waste contractor. Remediation of this site has been completed (DASCHEM, 1997).

Other activities that might have some contaminating effects include market gardening, poultry farming, truck repair, and storage of fuel and chemicals. It is expected that most of the soil on the site of the potential airport development would contain low levels of agricultural pesticides and chemicals.

19.3.6 Bushfire Risk

The three airport options are set in a grassy gently sloping landscape that has no history of bushfires. Keeping grass cover short by animal grazing or regular slashing and mowing would lower the risk of fire breaking out through carelessness, accident or arson.

19.4 Impacts of Hazards and Risks

19.4.1 Risk of Aircraft Crashes

Perhaps the most obvious of the additional hazards and risks associated with establishment of a Second Sydney Airport would be that of an aircraft crashing into a populated area. The risk to people on the ground can be expressed in three different ways. Simply put these three ways answer the questions;What is the probability of an aircraft crashing? How likely is it that I shall be underneath it? Which airport option or mode of operation would create the least risk to where I live?

Figures 19.1, 19.2 and 19.3 provide contours showing the probability of an aircraft crash per square kilometre per year in the areas surrounding the various airport options.

Individual fatality risk is the risk of death per year to a person at a particular point outside the boundary of the airport. *Figures 19.4, 19.5 and 19.6* present another set of contours, this time showing estimated individual fatality risks of 10 in a million, one in a million and one in 10 million (0.1 in one million) chances per year. From the figures it can be seen that areas outside the one in a million per year contours would meet the Department of Urban Affairs and Planning (1990b) criterion for the location of residential areas near hazardous industries. The numbers of people who would be exposed to risk levels above this criterion in 2016 is estimated as 2,500 for Options A and B and 9,000 for Option C.

The third way of expressing the risk from an aircraft crash to people on the ground is shown in *Table 19.2*. This method calculated predicted fatality rates arising from each of the three airport options for *Air Traffic Forecast 3*. The predicted fatality rate for Option A ranges from 1.8 to 2.5 persons per 100 years, depending on how the airport might operate. For Option B, it ranges from 1.5 to 2.2 persons per 100 years and for Option C, from four to five persons per 100 years.

Table 19.2 Predicted Fatality Rates (Persons Per 100 Years)

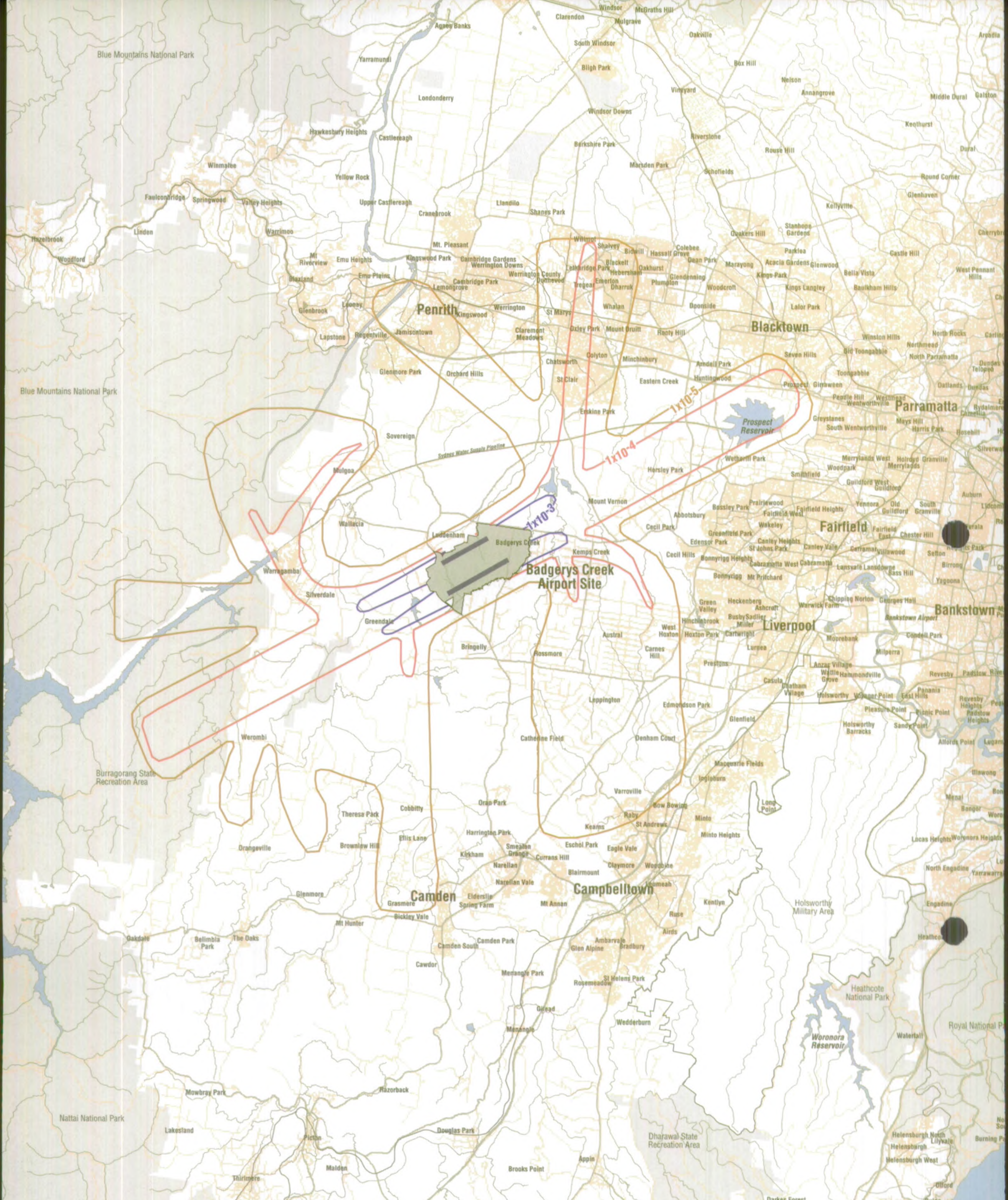
Airport Options	Mode of Operations		
	Airport Operation 1	Airport Operation 2	Airport Operation 3
Option A	2.5	1.8	not applicable
Option B	2	1.5	2.2
Option C	4	5	4.6

Societal risk curves have been developed for the airport options for the mode of operation shown to have the highest fatality rate. *Figure 19.7* shows these curves. For crashes involving less than 100 fatalities on the ground:

- the societal risks for Options A and B are very similar; and
- the societal risk for Option C is higher than for Options A and B.

Alternatively, for crashes involving more than 100 fatalities:

- the societal risk for Option B is the highest;



Predicted Maximum Frequency
of Aircraft Crashes per Square Kilometre

$1x10^{-3}$ (1 crash per thousand years)

$1x10^{-4}$ (1 crash per 10 thousand years)

$1x10^{-5}$ (1 crash per 100 thousand years)

Urban Areas (indicated by local roads)

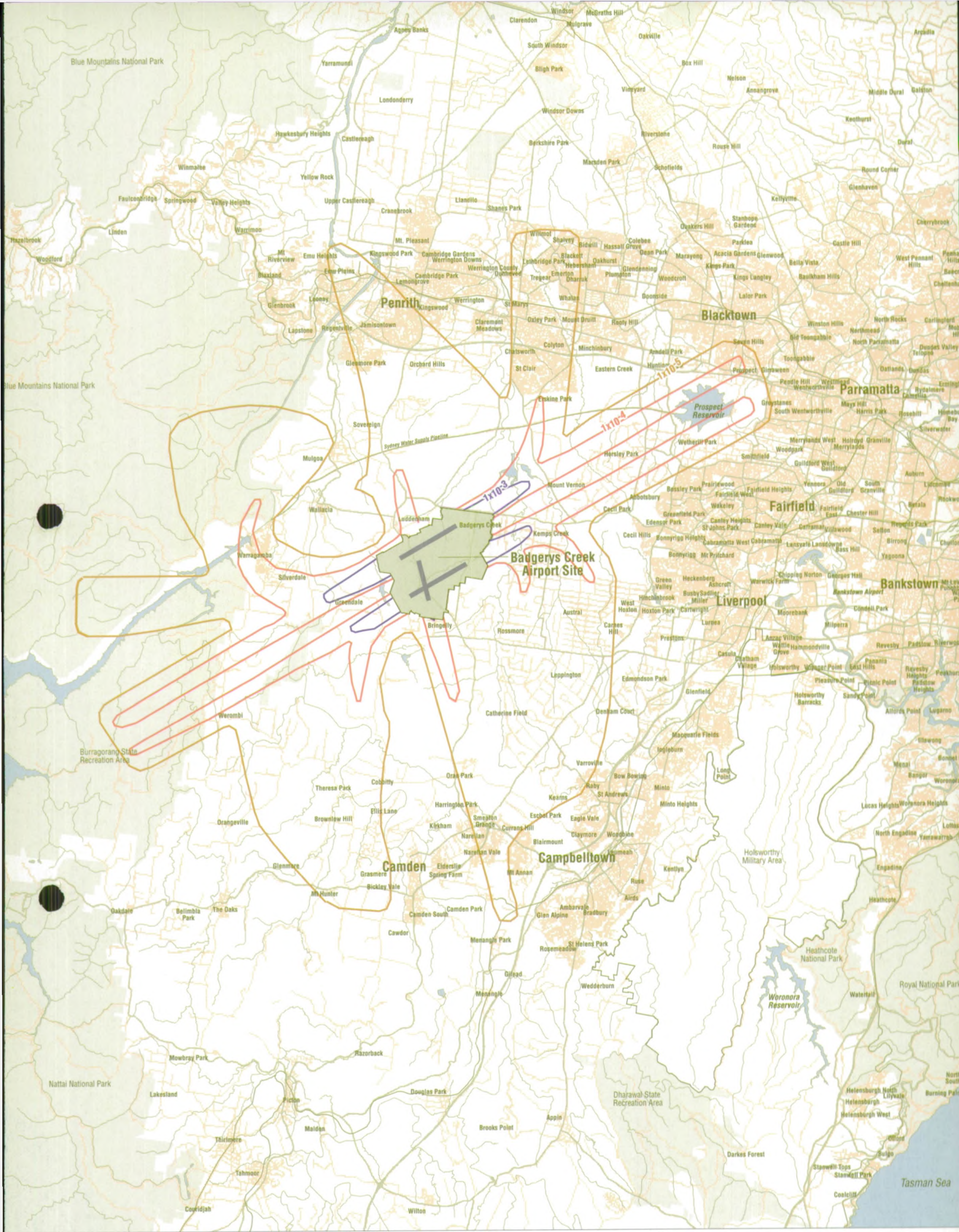
TN MN N

0Km 10Km

Figure 19.1

Predicted Maximum Frequency of Aircraft Crashes for Option A

Note: Based on Air Traffic Forecast 3 in 2016 and Airport Operation 1. This type of operation would have the highest overall risk of fatality. Other airport operations have different risk profiles.



Predicted Maximum Frequency
of Aircraft Crashes per Square Kilometre

$1x10^{-3}$ (1 crash per thousand years)

$1x10^{-4}$ (1 crash per 10 thousand years)

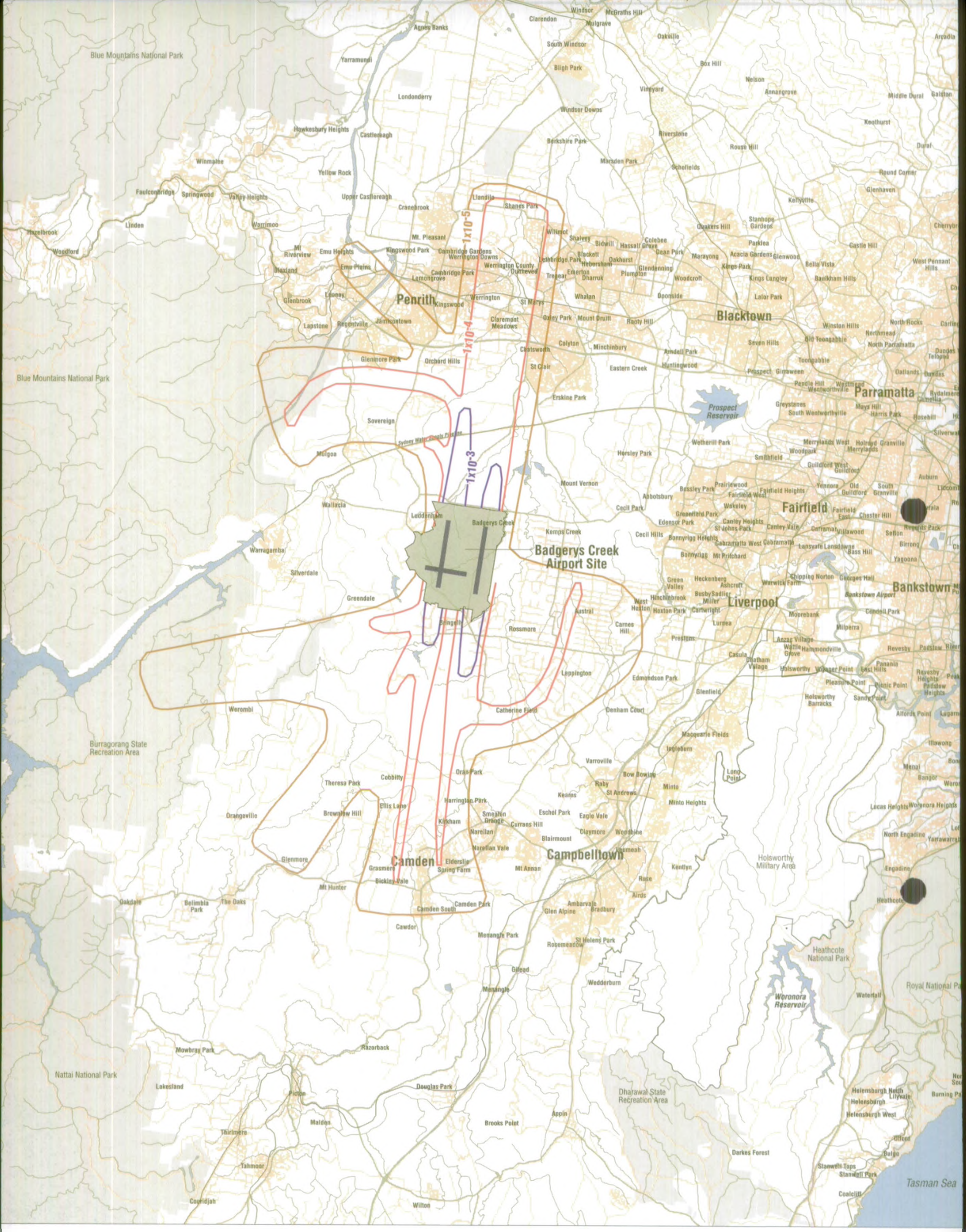
$1x10^{-5}$ (1 crash per 100 thousand years)

Urban Area (indicated by local roads)

Figure 19.2

Predicted Maximum Frequency of Aircraft Crashes for Option B

Note: Based on Air Traffic Forecast 3 in 2016 and Airport Operation 3. This type of operation would have the highest overall risk of fatality. Other airport operations have different risk profiles.



Predicted Maximum Frequency
of Aircraft Crashes per Square Kilometre

1×10^{-3} (1 crash per thousand years)

1×10^{-4} (1 crash per 10 thousand years)

1×10^{-5} (1 crash per 100 thousand years)

Urban Areas (indicated by local roads)

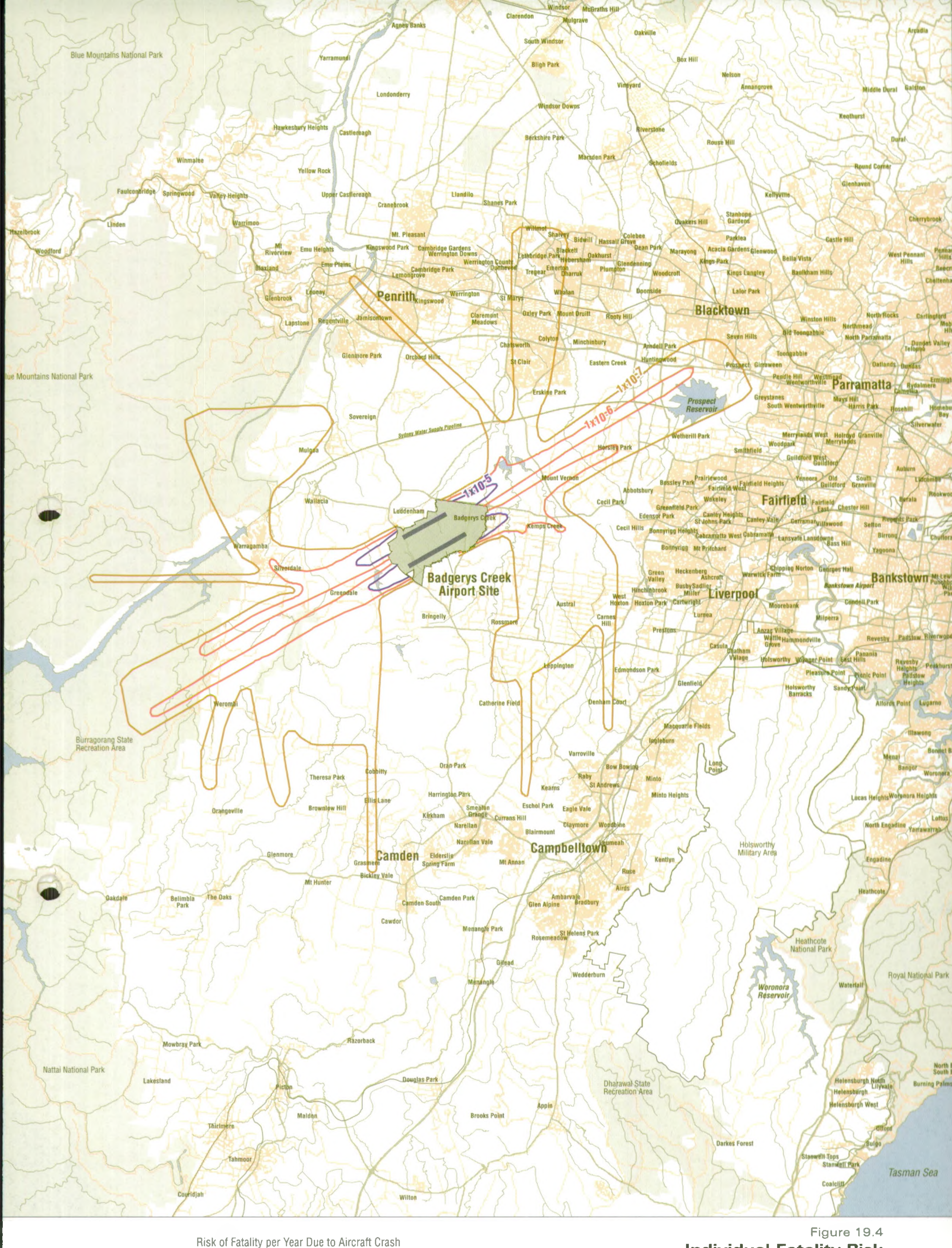
Figure 19.3

Predicted Maximum Frequency of Aircraft Crashes for Option C

Note: Based on Air Traffic Forecast 3 in 2016 and Airport Operation 2. This type of operation would have the highest overall risk of fatality. Other airport operations have different risk profiles.

TN MN N

0Km 10Km



Risk of Fatality per Year Due to Aircraft Crash

1×10^{-5}	(10 chances in 1million of a fatality due to aircraft crash)	
1×10^{-6}	(1 chance in 1 million of a fatality due to aircraft crash)	
1×10^{-7}	(0.1 chances in 1 million of a fatality due to aircraft crash)	
	Urban Areas (indicated by local roads)	

Figure 19.4

Individual Fatality Risk Contours for Option A

Note: Based on Air Traffic Forecast 3 in 2016 and Airport Operation 1. This type of operation would have the highest overall risk of fatality. Other airport operations have different risk profiles.

TN MN N

0Km 10Km

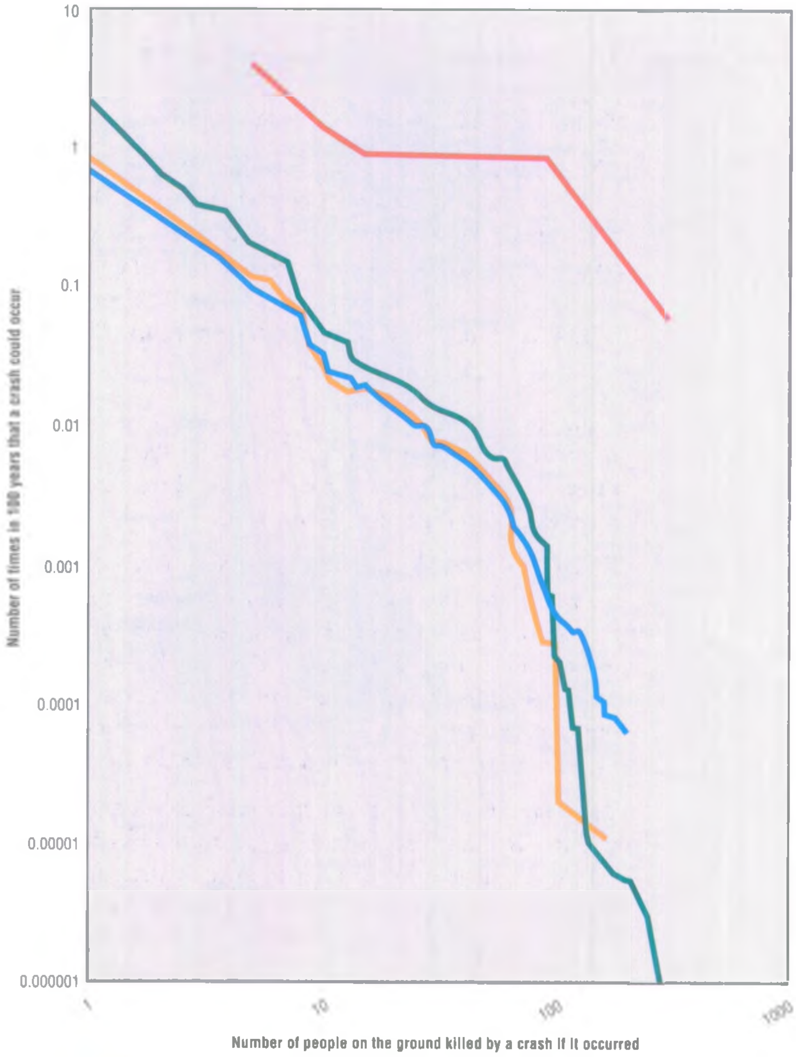


Figure 19.7
Societal Risk Comparison
Note: Based on Air Traffic Forecast 3 in 2016

- the societal risk for Option A is generally the lowest; while
- the societal risk for Option C falls below the level for Option B and is marginally below the level for Option A.

Also shown for comparison is the societal risk curve for Sydney Airport in the year 2010. It can be seen that the societal risks from the proposed second airport options are a few orders of magnitude lower than the societal risk from Sydney Airport for the entire range of crashes.

19.4.2 Risk Associated with Adverse Meteorological Conditions

For the most part, large commercial aircraft are able to overcome adverse meteorological conditions such as high intensity rainfall, thunderstorms, low cloud and fog, by using modern navigational aids. The impacts of such phenomena on some other types of aircraft may be more significant.

Airservices Australia, in conjunction with the Civil Aviation Safety Authority, have developed air traffic procedures for dealing with poor visibility at an airport, such as may be experienced in fog or heavy rain. The procedures are based on prescribed visibility minima for landings or take offs.

The decision to proceed with a landing or take off in conditions of poor visibility rests with the individual pilot concerned and is usually based on the pilot's training and experience, the aircraft type, the standard of electronic navigation equipment on board, and the requirements specified in the company operations manual.

19.4.3 Risk Associated with Defence Establishment Orchard Hills

Flight paths to and from the airport options would potentially pass over the Defence Establishment Orchard Hills. The most direct routes would be from the parallel runways of Option C and the cross wind runway of Option B. This would create a number of potential hazards and risks.

Defence personnel working with explosives could potentially become distracted by aircraft passing overhead. This could increase the possibility of an accident. There is also a potential for electromagnetic radiation from aircraft to accidentally detonate electrically activated explosive devices. Electro explosive devices removed from weapons during maintenance would be susceptible for the time that they remained outside their protective shield. This risk is considered to be low, however, and could be reduced by various engineering and procedural controls.

The consequences of an aircraft crash into one of the explosives storage buildings within Defence Establishment Orchard Hills would include ground shock, the release of high velocity projectiles, and fire. Due to the location of the storage facilities in relation to the boundaries of the site, fatalities outside of the Defence Establishment would not be expected if a crash occurred.

Aircraft flying over or in the vicinity of an accidental explosion at the site could be affected by blast fragments. The extent of this risk would depend on a number of factors including the quantity of explosives involved, and the separation between the explosion and the aircraft.

The likely frequency of aircraft crashes into any one kilometre square area of the Defence Establishment Orchard Hills would be approximately one crash in 1,000 years for Option C and one crash in 100,000 years for Options A and B. This takes into account the entire number of flights predicted by *Air Traffic Forecast 3*. The risk to any aircraft flying over the facility of crashing due to an accidental explosion at the facility would be approximately 8.6 in a billion chance.

19.4.4 Other Major Risks

There are no known regular significant bird or bat movements that may conflict with any of the runway orientations, and hence no significant bird or bat hazards are anticipated, provided no waste disposal facilities that might attract birds are established in the vicinity of the airport.

Risks associated with fuel supply and storage for the airport options would be low. Pipelines are considered to be a safe and conventional mode of transporting petroleum. A Jet A1 fuel pipeline could be designed, constructed and operated such that risk levels were within acceptable limits for various land uses in the likely vicinity of the pipeline. The same applies for the proposed fuel storage depot within the airport site.

In terms of potential for land contamination, there would be little difference between the sites; Options B and C include the site of Option A, and similar activities have been conducted on all three. It is likely that the amount of contaminated soil with concentrations exceeding acceptable levels for commercial land use would be insignificant in comparison with the volume of earthworks proposed.

On-site disposal of any contaminated soil by using it as fill material may be possible; otherwise it would be disposed of appropriately off-site.

The risk of bush or grass fires would increase slightly during airport construction because of the use of machinery and improved access to areas containing grass and vegetation. If fire broke out, it could destroy fuel and combustible material stored on site and produce enough smoke to limit visibility on roadways in the vicinity.

There would be only minor risk of bush or grass fires occurring when the airport became operational because of the nature of the landscape following development. Fires within airport facilities would be unlikely to spread beyond the boundary; however, lands surrounding the airport would remain a potential fire hazard if current land uses continued. Grass fires can produce dense, dark smoke that could impact on visibility for aircraft and ground operations.

Aircraft operating from an airport at Badgerys Creek could potentially crash into major water supply infrastructure. It should be noted that this potential already exists, because the operation of Sydney and Bankstown Airports results in aircraft overflying infrastructure, such as Prospect Reservoir and the Sydney Water Supply Pipeline.

Figures 19.1 and 19.2 show the estimated crash frequency contours for Options A and B. Major infrastructure, such as Warragamba Dam and parts of Prospect Reservoir are contained within the one in 10,000 chance contours. Thus the predicted frequency of aircraft crashing into a one kilometre square area containing such major infrastructure is estimated at about one crash in 10,000 years, for the total number of flights expected to operate from Options A and B. The risks to different sections of the water supply pipeline connecting those facilities would vary; however, for Options A and B the predicted frequency would be significantly less than one crash in 1,000 years per square kilometre of pipeline.

The risk of aircraft operating from airport Option C crashing into either Warragamba Dam or Prospect Reservoir would be substantially lower than the risk created by Options A and B, because of the different orientation of the runways and associated flight paths. Part of the Sydney Water Supply Pipeline (about one lineal kilometre) connecting those facilities would, however, be subject to a predicted frequency of greater than one crash in 1,000 years per square kilometre.

The risk of aircraft crashing into a particular crucial item of water supply, such as the dam gate or one special length of pipeline would be substantially less than the risks outlined above because such crucial elements would have an area of less than one square kilometre. Although dam stability under such conditions has not been quantified, an aircraft crashing into a dam wall would not necessarily result in dam failure. It should be noted that small aircraft are more likely to crash than large, the consequences of a small aircraft crashing into a dam wall would generally be less severe than for a large aircraft.

While the probability of an aircraft crashing into some crucial element of water supply infrastructure would be relatively low, the consequences could be catastrophic. Furthermore, it would cause long term difficulties with the supply of water to the Sydney region. A crash directly into the gates of the wall of Warragamba Dam could result in significant downstream flooding, and it would take several years to replace the loss of such large volumes of stored water. A crash into the Sydney Water Supply Pipeline could disrupt water supplies for a large proportion of Sydney's population for an extended period, while the area was cleared of debris and the pipeline repaired.

19.5 Environmental Management

The risks of an aircraft crash on a populated area could be reduced by adopting various measures, such as:

- keeping to a minimum concentrated aircraft movements over densely populated areas and major water supply infrastructure; and
- establishing planning controls for the vicinity of the airport so that in the future risk sensitive land uses would be avoided in areas where risks exceeded criteria outlined in guidelines released by the NSW Department of Urban Affairs and Planning (Department of Planning, 1990b). Such controls should also prevent waste disposal or other activities that might attract birds and bats.

The consequences of an aircraft crash into crucial elements of water supply infrastructure could be reduced by having ready an appropriate contingency plan, and by physically protecting sections of pipeline that were particularly vulnerable. Placing sections of the pipeline underground may be an effective solution.

Other initiatives to manage hazards and risks associated with the construction and operation of the Second Sydney Airport might include:

- carrying out appropriate quantitative risk assessments during the design stage of a potential fuel pipeline to the airport and developing a safety management system covering procedures, emergency plans, periodic independent audits and emergency responses in relation to the pipeline;
- carrying out appropriate investigative work to determine the extent of contaminated soils before and during construction;
- developing appropriate bushfire control and management procedures in conjunction with owners of land adjoining the sites of the airport options;
- developing appropriate response procedures for dealing with security related incidents such as criminal or terrorist activity. Such procedures would be jointly developed by the airport operator, airlines, NSW police and Commonwealth agencies; and
- preparing an airport emergency plan, which would involve extensive consultations with on airport and off airport agencies, and local, State and Commonwealth Governments. The emergency plan would comply with Civil Aviation regulations and would cover emergencies that are caused by or may affect airport operations, details of exercises to test emergency plans and establishment of an Airport Emergency Committee, which might include some off airport agencies such as State Emergency Services, the Defence forces and police.

19.6 Summary of Potential Impacts of Hazards and Risks

Development of a Second Sydney Airport, if it went ahead, would result in some increase of hazards and potential risks to local communities and their environment. Potential impacts might arise from a number of possibilities: aircraft crashing, perhaps as a result of inclement weather or bird/bat strike; fire breaking out in surrounding bush and grassland, particularly in the construction phase; fuel catching fire while being transported or stored on site; contaminated soils being uncovered during construction. There are also potential hazards and risks to individual facilities such as Defence Establishment Orchard Hills, and Sydney's water supply infrastructure.

All these potential impacts have been discussed in the preceding sections.

The most common risk perceived to be associated with airports is that of aircraft crashes into nearby areas. This risk can be expressed in a number of ways including individual fatality risk and overall societal risks. Individual fatality risk is the probability that, over one year, a particular area on the ground is exposed to the lethal consequences of an aircraft crash. Whether the area is actually populated or not is irrelevant to the calculation of individual risk. This risk is expressed here as a series of contours and in addition, the number of people that would be living within each contour in 2016 is estimated.

The risk of an individual dying in everyday life can be expressed as a probability or chance of dying over a certain time period, such as a year. For example, individuals in Sydney, on average, have a 10 in one million chance of dying in a fire each year or a three in one million chance of dying from electrocution each year. The chance of being struck by lightning and dying, is one chance in 10 million each year.

The NSW Department of Urban Affairs and Planning (Department of Planning, 1990b) suggests that the individual fatality risk from a hazardous facility experienced in residential areas should be no greater than a one in one million chance of a fatality per year. The estimated number of people living near the airport options in 2016 that would exceed this criterion would be 2,500 for Options A and B and 9,000 for Option C. Another way of expressing this risk is the number of fatalities that may be caused by the operation of each airport option every 100 years. This would range from 2.2 fatalities every 100 years for Option B (for *Airport Operation 3*) to five fatalities every 100 years for Option C (for *Airport Operation 2*). The maximum figure for Option A is 2.5 fatalities every 100 years for *Airport Operation 1*.

Societal risk is the probability of a certain number of people being killed as a result of an aircraft accident in a one year period. Societal risk calculations take into account the density of population in the study area. Generally, the societal risks that would occur from the operation of all five airport options would be lower than the societal risks for Sydney Airport.

Other conclusions of the hazards and risks study include:

- the Defence Establishment Orchard Hills would be exposed to an aircraft crash risk of one crash per 1,000 years under Option C and one crash per 100,000 years under Options A and B. The risk of an aircraft crash due to an accidental explosion at the facility would be approximately an 8.6 in a billion chance per year;
- adverse meteorological conditions such as high intensity rainfall, thunderstorms, low cloud and fog should not be a significant constraint to large commercial aircraft because of modern navigation aids. Other smaller aircraft may be at risk from adverse meteorological conditions; however, more data would be required to fully quantify this risk;
- no regular bird or bat movements are known of that may conflict with any of the runway configurations. Provided no activities that might attract birds were undertaken in the vicinity of the airport site, the risk of bird or bat strike would not be significant; and

- the operation of any of the airport options being considered would result in some risk to crucial elements of water supply infrastructure. The highest level of risk (one crash per 1,000 years per square kilometre) would be from Option C to the section of Sydney Water Supply Pipeline connecting Warragamba Dam and Prospect Reservoir. However, other water supply facilities, such as Prospect Reservoir and Warragamba Dam, would face aircraft crash risks of one crash per 100,000 years per square kilometre from Options A and B. Modifying flight paths, where possible, to minimise such risks would need to be considered.

Part G

Social and Economic Impacts

Chapter 20

Aboriginal Cultural Heritage

Chapter 20
Aboriginal Cultural Heritage

An investigation was done of Aboriginal cultural heritage within the three proposed airport sites. This study is documented in Technical Paper No. 11; a summary of its main findings and conclusions is presented in this chapter.

20.1 Issues Raised During Consultation

Concern over potential impacts on areas of Aboriginal heritage value was expressed; suggested impacts included possible site destruction during construction of the airport, continuing degradation of heritage sites during its operation and in addition, the impacts of road and rail links to the airport sites.

It was also suggested that impacts could occur to places of Aboriginal heritage value outside the airport sites, including in the Blue Mountains.

Submissions sought assurance that adequate consultation was occurring between relevant local Aboriginal land councils and groups and the study team.

Comments on the methodology for the Aboriginal cultural heritage study showed concern that:

- the Draft EIS might not be considering the airport sites as significant for Aboriginal heritage; and
- the impact of off airport site infrastructure should be considered in detail.

20.2 Methodology

The methodology adopted for the assessment of Aboriginal cultural heritage included:

- review of previous work;
- investigation and documentation of the cultural heritage context of the study area;
- a program of Aboriginal consultation (continuous throughout the Draft EIS program) including the dissemination of information throughout local Aboriginal communities; discussion of survey results and assessment of heritage values and other issues such as native title within the local Aboriginal communities; and identification of the views of any relevant organisation on the proposed airport options;
- investigation of contemporary Aboriginal cultural heritage issues and values;
- formulation of a survey and sampling strategy aimed at covering a representative sample of the topographic variation within the study area and achieving at least a 33 percent sample size;
- a surface field survey, and the recording of surface archaeological features. No subsurface excavation or testing was conducted;
- analysis of results;

- assessment of significance. The assessment was based on the following data: site recordings made prior to this Draft EIS and produced as a result of selective or non-comprehensive survey; site recordings made as a result of comprehensive field survey coverage; and a set of predictive statements describing the probable occurrence and nature of archaeological sites in areas not comprehensively surveyed;
- assessment of impacts of the proposed airport options; and
- development of potential mitigation and environmental management strategies.

The study area and areas of field survey shown on *Figure 20.1* can be defined as the area within the boundaries of all three of the proposed airport options.

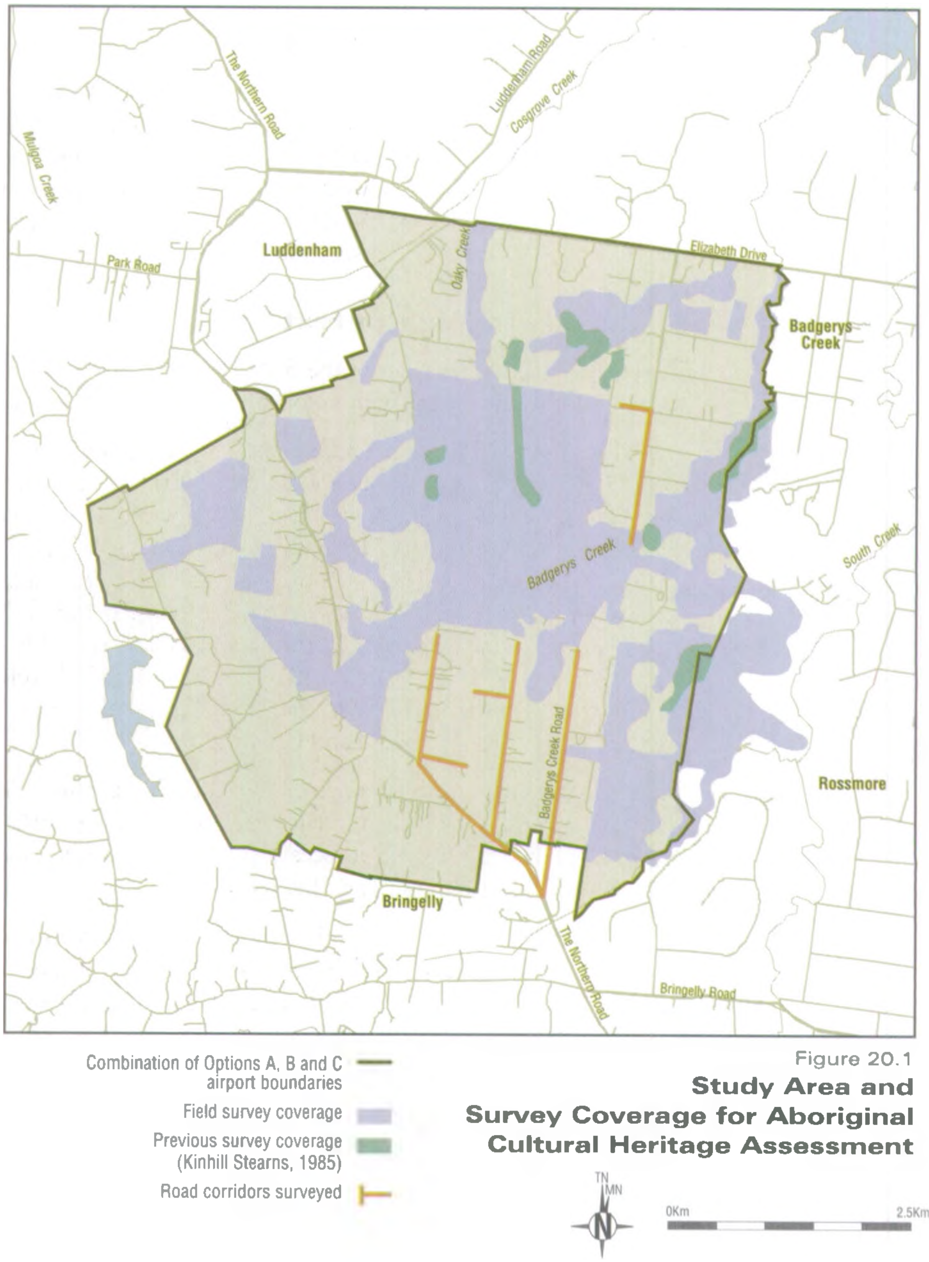


Figure 20.1
Study Area and Survey Coverage for Aboriginal Cultural Heritage Assessment

A range of information sources were consulted or reviewed for this study. These included contemporary and historic written reports and documents, interviews with local Aborigines and Aboriginal community representatives, local land owners and administrators, archaeologists and amateur recorders, and Government authorities and site registers. Commonwealth, State and local authorities were consulted, and relevant site registers, and published and unpublished reports were reviewed. Authorities consulted included the NSW National Parks and Wildlife Service, the Australian Heritage Commission and the National Native Title Tribunal.

20.3 Cultural Heritage Context

The cultural context of the study area is important in establishing the environmental, historical and archaeological features that contribute to or influence the Aboriginal resource contained in each area.

20.3.1 Statutory Context

Relevant statutes include primary legislation offering protection to Aboriginal sites enacted by individual States, such as (in NSW) the *National Parks and Wildlife Act 1974*, the *NSW Land Rights Act 1983* and the *National Trust Act 1990*. Several Acts administered by the Commonwealth are also relevant, including *The Aboriginal and Torres Strait Islander Heritage Protection Act 1984*, the *Australian Heritage Commission Act 1975* and the *Native Title Act 1993*.

20.3.2 Historical Context

References to the Aborigines of the Sydney region are found in the journals, diaries and general writings of the early colonists, explorers and settlers.

The exact boundaries between different Aboriginal groups as they existed at 1788 are impossible to reconstruct because of the lack of reliable data available from that time. There have been numerous attempts at mapping the pre-contact and contact territories of Aboriginal people in the Sydney region (Capell, 1970; Eades, 1976; Kohen, 1986, 1988; Mathews, 1901a, 1901b; Ross, 1988; Tindale, 1974). Although the boundaries and size of areas attributed to the Dharug and Gandangara people vary in different interpretations, the study area falls within Dharug boundaries (according to all save Tindale, 1974). Today, Local Aboriginal Land Council boundaries are so situated that the study area falls within the jurisdiction of Gandangara Local Aboriginal Land Council.

Local information about Aborigines on the Cumberland Plain is restricted to generalised comments, which relate opinions or events where Aborigines were encountered on the Plain. References from the early explorers indicate that there was little contact between coastal and inland tribes.

Although no reliable appraisal of the number of Aborigines living in the Sydney area was made by early observers, it has been estimated that the population density for the region was between five and 10 individuals per square mile (Maddock, 1972).

Aboriginal people were granted small portions of land in some parts of the Sydney basin; however, no references have been found to grants within the study area (Kohen, 1993). An extensive survey of the literature did not provide any evidence of Aboriginal occupation, other than as labourers or domestic workers on surrounding properties.

The history of Aboriginal people around the study area is one of very early disruption and major change. Dharug and Gandangara descendants are now scattered throughout Sydney, surrounding areas and the north and south coast of NSW.

20.3.3 Archaeological Context

Sydney Basin

The Sydney basin has been the subject of intensive archaeological survey and assessment for many years, resulting in the recording of thousands of Aboriginal sites and a wide range of site types and features.

The most prevalent sites or features include:

- isolated finds usually of single stone artefacts;
- camp sites or open artefact scatters;
- freshwater/estuarine shell middens where shellfish food remains to form a deposit;
- rock shelters containing surface artefacts and/or occupation deposit and/or rock art;
- open grinding grooves, that is, rock surfaces repeatedly used by Aborigines to sharpen and grind the edges of stone implements; and
- open engraving sites.

Rare site types found in Sydney include scarred trees, quarry and procurement sites, burials, stone arrangements, carved trees, and traditional story or other ceremonial places. Potential archaeological deposits are also recorded by archaeologists. These are areas where subsurface artefacts are considered likely but no surface evidence exists.

Cumberland Plain

The study area is located in the western section of the Cumberland Plain, a region typified by low undulating topography and a medium drainage line density. Hundreds of Aboriginal sites, predominantly open artefact scatters (also referred to as open camp sites) have been recorded for this region. They vary greatly from small sparse scatters to large concentrations of artefacts. Other types of site include scarred trees, raw material extraction/procurement sites, stratified deposits, and grinding grooves in places where there are exposures of Minchinbury sandstone in the Wianamatta shales and clays.

The picture of Aboriginal utilisation and occupation of the Cumberland Plain is constantly being updated as methods improve and more data becomes available. Recent investigations have confirmed that sites occur widely across the landscape, on hilltops and slopes and near creeks. Larger sites with higher artefact densities are more likely to be near permanent water.

As a result of surveys of the surrounding suburbs, 25 sites are listed on the NSW National Parks and Wildlife Service Register of Aboriginal Sites as occurring within the 20 square kilometre environs of the study area. One open artefact scatter site is located within the study area.

Previous Investigations

Three previous archaeological investigations have been done of the study area, or parts of it. Sections were surveyed in 1978 for a preliminary study of possible sites for

Sydney's second airport; no sites were located within the present study area in the course of this survey (Haglund, 1978).

Lance and Hughes (1984) compiled a predictive study, and Lance (1984) carried out a sample survey of the study area for the *Second Sydney Airport Site Selection Program Draft Environmental Impact Statement* (Kinhill Stearns, 1985). This involved about 70 hectares (about four percent) of the study area. One artefact scatter was found. The proposed airport site was assessed as having relatively low archaeological sensitivity, and no further archaeological assessment was recommended (Kinhill Stearns, 1985).

Brayshaw (1995) undertook an assessment of a section of Elizabeth Drive from Luddenham Road to Wallgrove Road. A survey including an area extending south of Elizabeth Drive between Badgerys Creek and Badgerys Creek Road located no sites or potential archaeological deposits. This area is located within the present study area. Two artefact scatters and several areas of potential archaeological deposit were, however, located north of Elizabeth Drive, and a site comprising eight artefacts was located near a small drainage line south of Elizabeth Drive and east of Mamre Road.

Predictive Models and Conclusions

Based on the results of the previous work reviewed, predictive statements were made about the nature of the surviving archaeological resource within each of the study area. These are contained in *Technical Paper No. 11*.

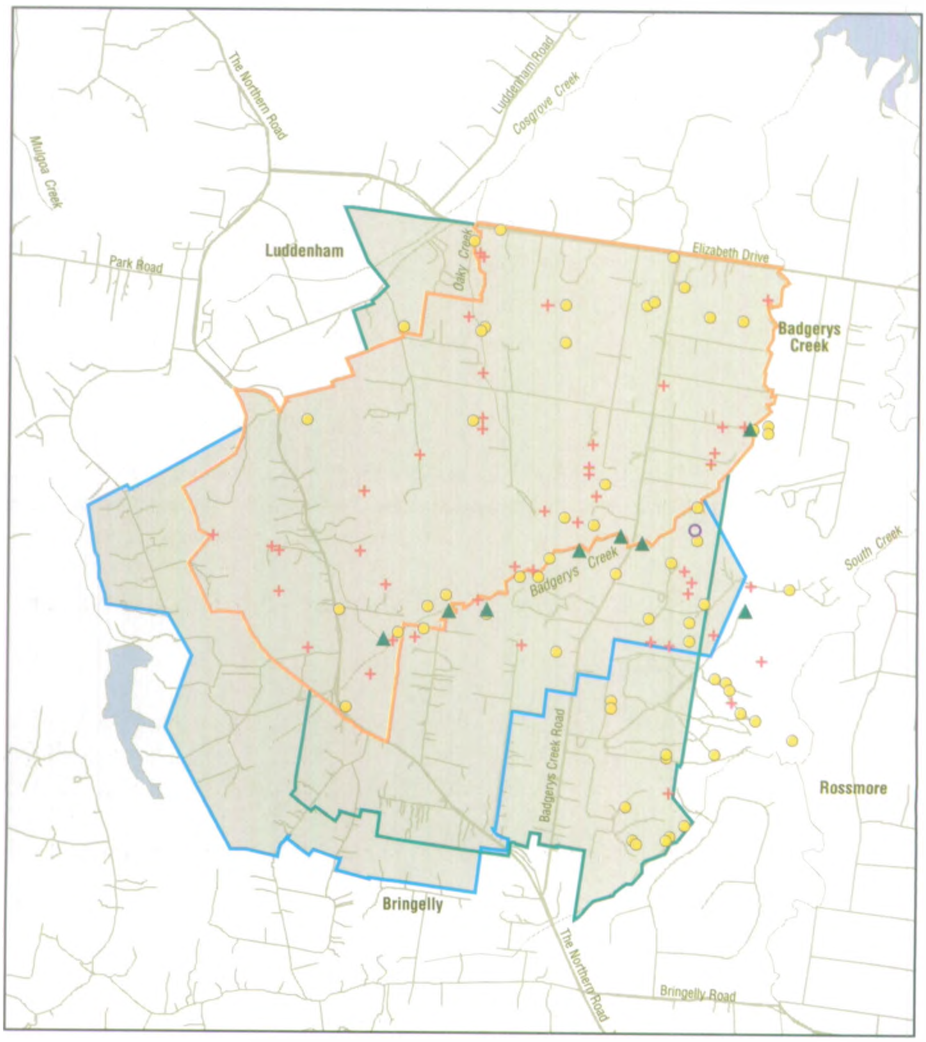
20.4 Results and Significance of Survey Findings

20.4.1 Results of Survey

A total of 110 recordings were made during the field survey of the study area; these comprised 58 open artefact scatters (refer *Photograph 14*), eight scarred trees (refer *Photograph 15*), 44 isolated finds and one open potential archaeological deposit. One additional recording was added to the study area database from a previous survey conducted by Lance (1984) for Kinhill Stearns (1985). Apart from the scarred trees, no other forms of natural resource exploitation were noted The location of sites recorded by field survey within the study area is shown on *Figure 20.2*.

Photograph 14
Open Site Containing Numerous Aboriginal Artefacts

Photograph 15
Possible Aboriginal Scarred Tree Adjacent to Badgerys Creek



Boundary of airport option A
Boundary of airport option B
Boundary of airport option C
Open site (including artefact scatters and grinding groove sites)
Isolated find
Scarred tree
Potential archaeological deposit (only) in open context

Figure 20.2
Aboriginal Recordings

TN MN N

0Km 2.5Km

The average surface site density for the whole study area is 4.1 sites per square kilometre, or 6.9 sites and isolated finds per square kilometre. Secondary and minor creek corridors contain the highest site and isolated find densities. Alluvial flat, valley floor and adjacent slopes are the most archaeologically sensitive within the study area. The majority of sites are, however, located on the slopes within the overlapping creek corridors. Middle and upper slopes have low densities and low archaeological potential.

Area Analysis of Airport Options

Based on the results of the sample survey and a stratified extrapolation of site densities across all landform types, it is predicted that a 100 percent surface survey of the area of Option A would identify about 72 surface sites and 47 isolated finds; Option B about 118 surface sites and 78 isolated finds; and Option C about 126 surface sites and 79 isolated finds. The main distinction between the various options is the extent of secondary and minor creek corridors included within each proposed site boundary.

Potential Archaeological Deposits

Potential archaeological deposits were not systematically or individually recorded during the field survey. Following initial survey and reconnaissance inspection, it became apparent that the core potential archaeological deposit areas were consistently situated on slopes, locally elevated, and level or low gradient areas within and immediately adjacent to valley floors and close to water (within 100 metres). Wherever ground surface exposures existed within these contexts, artefacts were consistently recorded.

Within the study area, only one potential archaeological deposit was identified in the field survey; however, zones of archaeological potential can be reliably defined by the area of the minor and secondary creek corridors.

Survey Coverage and Visibility Variables

Over 35 percent of the study area was surveyed, but factors such as the extent of vegetation and the proportion of useable archaeological exposures reduced the effectiveness of the survey coverage to about five percent of the total study area.

20.4.2 Aboriginal Issues and Consultation

Overview

Anthropological consultation was undertaken with local Aboriginal communities and organisations for this Draft EIS. Consultation regarding the study area was undertaken with the Gandangara Local Aboriginal Land Council, the Darug Tribal Aboriginal Corporation, the Korewal Elouera Jerrungarugh Tribal Elders Aboriginal Corporation and the Campbelltown City Council Aboriginal Advisory Committee.

There is general opposition by the Gandangara Aboriginal community to an airport being developed in western Sydney. Other Aboriginal groups and individuals consulted have expressed a similar opinion.

Previously Recorded Aboriginal Views

The *Second Sydney Airport Site Selection Program Draft Environmental Impact Statement* (Kinhill Stearns, 1985) documented the views of the Aboriginal people to the then proposal to site an airport at Badgerys Creek. The conclusion at the time that 'generally, there was considerable opposition to the concept of airport development in the area and fears were expressed about the changes to Aboriginal lifestyles which this would cause' (Kinhill Stearns, 1985), highlights the settled nature of local Aboriginal feeling towards an airport at Badgerys Creek.

Darug Tribal Aboriginal Corporation

The Darug Tribal Aboriginal Corporation is a koori group based at Blacktown whose area of interest includes Badgerys Creek. Consultation with this group indicated that some of its members live in the Badgerys Creek region, but that they saw no need to talk with the anthropologists because they have 'lost all traditional knowledge'.

Korewal Elouera Jerrungarugh Tribal Elders Aboriginal Corporation

Members of this organisation have submitted a large Native Title claim over a portion of the southern Sydney basin which includes all Crown Lands within the study area. The claim is on behalf of the *Gundu-Ngura* people.

In discussions held with relevant members of the Elders Corporation, the basis for the submission of the Native Title claims for the study area was described in terms of descent from ancestors of known local tribal affiliations. The submissions state that the area contains 'much rock and cave art and lore, and sacred sites and places'.

20.4.3 Assessment of Significance

Assessment Criteria

The Burra Charter of Australia defines cultural significance as 'aesthetic, historic, scientific or social value for past, present and future generations' (Australia ICOMOS, 1987). The assessment of the cultural significance of a place is based on this definition but often varies in the precise criteria used according to the analytical discipline and the nature of the site, object or place.

In general, Aboriginal archaeological sites are assessed using five potential categories of significance:

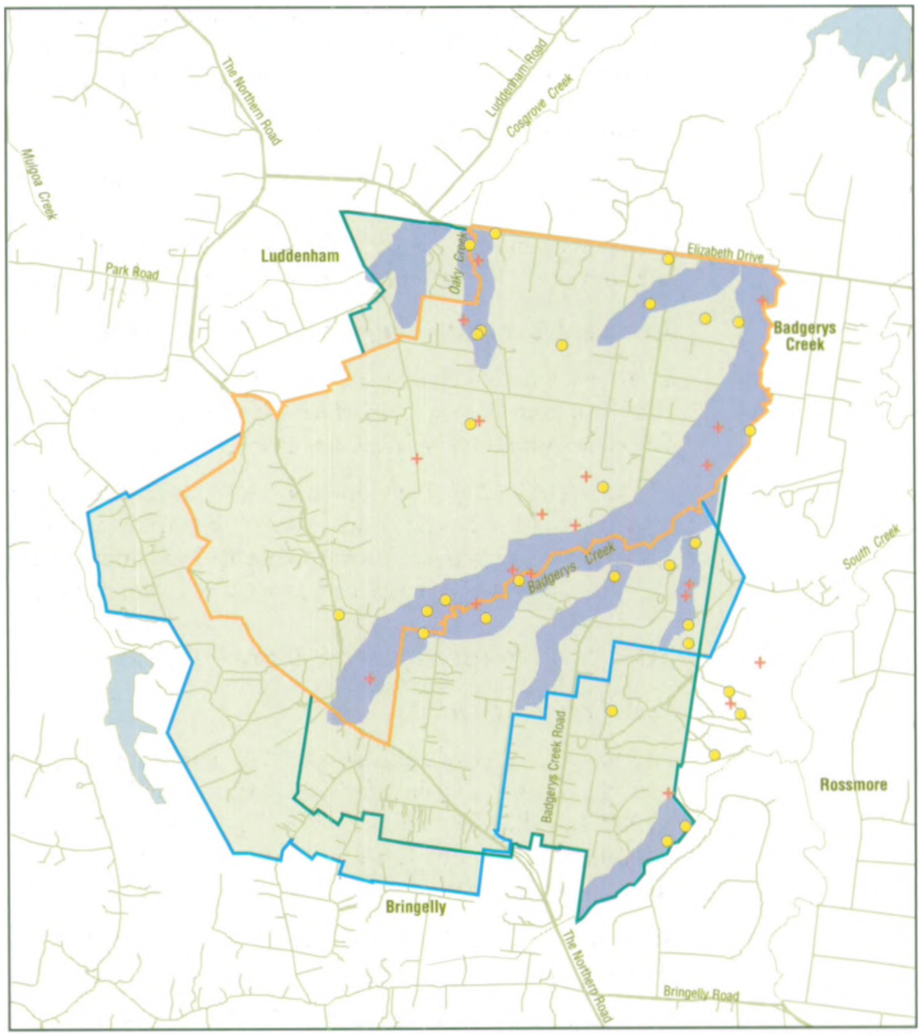
- significance to contemporary Aboriginal people;
- scientific or archaeological significance;
- aesthetic value;
- representativeness; and
- value as an educational and/or recreational resource.

All sites and isolated finds located within Options A, B and C and have been assessed using these criteria.

The significance of a site has also been classified as either being low, moderate or high within a local, regional or national context. The local context is defined as the Cumberland Plain. The regional context is the Sydney-Bowen Sedimentary Basin which extends north to the Central Coast and west to the Great Dividing Range. This rating system should not be taken to imply that places/sites of local significance warrant less conservation than regionally rated places/sites. A place of high local significance may have a comparable level of value within its local context, to a place of high regional or national significance.

Airport Options

Ninety seven sites or isolated finds and one potential archaeological deposit have been assessed. The archaeological sensitivity of the study area is shown on *Figure 20.3*.



Boundary of airport option A
Boundary of airport option B
Boundary of airport option C
Areas of moderate or high archaeological sensitivity
Isolated find
Open site (including artefact scatters and grinding groove sites)

TN MN N

0Km 2.5Km

Figure 20.3
Zones and Sites of Moderate or High Archaeological Potential

Sixty eight percent of the sites and isolated finds are considered to have low local significance, 30 percent to have moderate local significance, and two percent to have high local significance. Their collective value is considered to be low.

The study area is valued by the local Aboriginal community both for the Aboriginal sites which survive there, and its remaining natural environment which 'although somewhat disturbed by European occupation, still has an affiliation with the Aboriginal people as it contains significant tangible (visible) and intangible (invisible) cultural significance that is a part of Australia's true history'.

20.5 Aboriginal Cultural Heritage Impacts

The impacts of the options on Aboriginal archaeology have been assessed assuming that no mitigative measures are in place. Some of these impacts (mostly the indirect) could be reduced or ameliorated by implementing the management measures proposed in *Section 20.6*.

20.5.1 Option A

A total of 60 known Aboriginal sites or isolated finds are located within the proposed area of Option A. The predicted archaeological resource of the Option A area is in the order of 119 surface sites and isolated finds with potential areas of in situ subsurface archaeological material occurring mostly within minor and secondary creek corridors. All but a small minority of the archaeological resource located in Option A would be destroyed by the construction of the Second Sydney Airport.

Given the type and already disturbed nature of the adjacent surviving archaeological resource, there is only a limited number of indirect impacts that could pose a significant threat.

Potential indirect impacts of Option A may be erosion or siltation of Aboriginal sites downstream as a result of changed sediment and flow regimes both during construction and airport operation; impacts to adjacent living scarred trees as a result of changes in air quality and increased insect attack due to a smaller resident or visiting bird population; increased visual and noise impacts to the contextual landscape of Bents Basin located to the south of the airport site; and impact to Aboriginal sites as a result of potentially increased development of land adjacent to the proposed airport site.

The majority of these types of potential indirect impacts could be mitigated by implementing measures proposed in *Section 20.6* and *Appendix G*.

The impact to Aboriginal cultural values has been described by the Gandangara Local Aboriginal Land Council as a significant loss involving archaeological sites and the integrity of the natural environment. Impact on the natural filtration and other functions of the creeklines is also stated as a concern.

20.5.2 Option B

A total of 85 known Aboriginal sites or isolated finds are located within the proposed area of Option B. The predicted archaeological resource of the Option B area is in the order of 196 surface sites and isolated finds with potential areas of in situ subsurface archaeological material occurring mostly within minor and secondary creek corridors. Most of the significant archaeological resource located in Option B would be destroyed by the construction of the Second Sydney Airport.

Just as for Option A, potential indirect impacts of Option B may include erosion and siltation of Aboriginal sites downstream; impacts to existing scarred trees from changes in air quality; increased visual and noise impacts to the contextual landscape of Bents Basin; and impacts to Aboriginal sites as a result of potentially increased development of land adjacent to the proposed airport site.

Impacts to Aboriginal cultural values for Option B are similar to those identified for Option A.

20.5.3 Option C

A total of 94 known Aboriginal sites or isolated finds are located within the area of Option C. The predicted archaeological resource of the Option C area is in the order of 205 surface sites and isolated finds with potential areas of in situ subsurface archaeological material occurring mostly within minor and secondary creek corridors.

Most of the significant archaeological resource located in Option C would be destroyed by the construction of the Second Sydney Airport.

Just as for Option A, potential indirect impacts of Option C may include erosion and siltation of Aboriginal sites downstream; impacts to existing scarred trees from changes in air quality; increased visual and noise impacts to the contextual landscape of Bents Basin; and impacts to Aboriginal sites as a result of potentially increased development of land adjacent to the proposed airport site.

Impacts to Aboriginal cultural values for Option C are similar to those identified for Options A and B.

20.6 Environmental Management

20.6.1 Scope of Environmental Management

Management measures for the mitigation of potential adverse impacts of developing an airport are limited because the option of permanently reserving a representative sample of the significant resource by allowing for in situ conservation of selected sites is mostly unavailable.

As a consequence, the best strategy available for impact mitigation is the selective salvage of physical materials and information prior to construction. Salvage is an inferior alternative to in situ conservation of representative samples, the former being a controlled form of destruction, incorporating the archaeological techniques of excavation, collection and data recording. Conservation, in contrast, maintains the full amenity of the resource to future research techniques and programs of inquiry.

The scale and extent of the potentially impacted archaeological resource is a limiting factor. Any program of salvage is likely to be required to operate within a limited chronology and would have to be prioritised according to research aims and practical sampling considerations. The diversity and scope of the Options A, B and C resources each have the constraint imposed by small salvage samples.

20.6.2 Management Measures

Mitigation of direct impacts would need to focus on a prioritised program of salvage because of the limited scope for conservation in situ. The presence of a narrow margin of minimal construction impact along sections of Badgerys Creek would necessitate a management program to ensure the conservation of sites or potential archaeological deposits within both construction and operational contexts.

During Construction

Surface Survey

Surface survey of the remaining unsurveyed areas of the proposed direct impact areas would be a preliminary requirement to ensure all sites and areas of significant archaeological potential were identified. Conducted prior to any clearing or land surface disturbance that may adversely affect sites or potential archaeological deposit, the surface survey would aim to provide an accurate, high coverage, and stratified inventory of surface manifestations of Aboriginal sites within the proposed construction area. This would facilitate the development of appropriate research designs for subsequent subsurface testing programs. The surface survey would also identify:

- by examining the construction plans, sites or potential archaeological deposits that could be conserved in situ within the airport site; and

- sites potentially at risk due to indirect impacts such as siltation, creek bank erosion and reduced tree health.

Subsurface Testing

A program of subsurface testing in areas of defined archaeological potential would be required to accurately identify the nature and distribution of the subsurface arachaeological resource. Testing would be carried out using both hand and mechanical digging and include sampling methods such as multiple shallow spade excavations, back hoe trenches, and grader scrape transects. The aim of this program would be to identify the best areas in which to conduct full scale salvage excavation.

Subsurface Salvage

Salvage excavations would be conducted in a range of locations, according to the priorities and criteria identified in the preceding testing program. It is anticipated that the greatest focus would be on the creek corridors and sedimentary contexts below the plough zone.

Emphasis should be placed on large and open area excavation if sites with low levels of disturbance can be identified that warrant this approach. Deep narrow trenches may also be required to test and characterise older sedimentary facies.

Tree Scar Salvage

Where considered appropriate by Aboriginal custodians, the scarred sections of Aboriginal scarred trees would be salvaged after appropriate field recording. Selected examples would be the subject of a program of research with the aim of further identifying the origin and age of the scarring.

Monitoring Indirect Impacts

A program of regular monitoring of indirect impacts on sites would be instigated with the aim of developing and assessing the effectiveness of mitigation strategies.

Develop and Implement Strategies to Minimise Indirect Impacts

Based on the results of the above monitoring program, environmental protection measures would be reviewed and, if necessary, redesigned to mitigate indirect impacts, such as for the control of water flow velocities and sediment loads into relevant drainage lines. Where necessary, sites would be fenced, or the physical environment of sites stabilised and reinforced if impacts are likely to be significant either during or after construction.

Develop and Implement Strategies for the Emergency Salvage of Significant Sites

In consultation with Aboriginal representatives and construction managers, a set of strategies would need to be adopted that define the actions required in the event that a significant site (such as a burial) is uncovered during construction works. This would normally include the following actions:

- interrupt construction works;
- notify any required statutory authorities (the NSW National Parks and Wildlife Service, and in the case of a burial, also the NSW Police);
- obtain identification and assessment of the site by an archaeologist and suitably qualified Aboriginal representative; and
- determine and carry out an appropriate management strategy.

Conservation and Management Plans for In Situ Site Conservation

If sites have been identified that can be effectively conserved in situ and are significant enough to warrant conservation, then management plans would be formulated and instigated for each site. In situ site maintenance involves the long-term conservation of a site or artefact in its original context and configuration within the landscape. This may involve active intervention to protect a site (by exclusion of defined impacts or activities) or restoration and stabilisation of a site such as a dead standing scarred tree. Sites adjacent to the airport that might suffer indirect impacts would also be the subject of management plans.

Subsequent Curation and Care of Salvaged Materials

Any salvage program must provide permanent, appropriate storage of salvaged materials, and this would be an important funding consideration. Care and control would often be placed in the hands of local Aboriginal communities.

Monitoring of Ground Surface Disturbance

Qualified archaeologists and/or members of representative Aboriginal groups would need to act as observers of construction activities.

Monitoring in an archaeological context has limited application because, with the possible exception of burials, artefactual material is rarely salvaged as a result of simple visual monitoring. Further, any salvaged material is of limited archaeological value as it no longer has any contextual integrity, and may also have been damaged during construction work. Based on the assumption that an appropriate program of survey, subsurface testing and site salvage has been carried out at Badgerys Creek, the purpose of archaeological monitoring would simply be to ensure appropriate strategies are followed if a burial or some atypical artefactual material is uncovered. It would probably only be required in aggrading sedimentary contexts.

During Operation

Monitoring of Local Area Indirect Impacts

Monitoring and strategy review processes established during the construction phase for creek bank erosion, siltation risk and scarred tree health would continue into the operational phase. This program would need to collect baseline data prior to construction activities.

Monitoring of the Potential Impact of Airborne Pollutants

A monitoring program, including collection of baseline data, would be required to test and assess the potential effects of airborne pollutants and their possible role in rock surface instability in a regional sample of shelter pigment sites and open grinding groove and engraving sites. The study would aim to identify what impacts, if any, can be attributable to airport derived pollutants, and to recommend mitigation strategies where appropriate. Sites for study would include occurrences on the nearby Burragorang Plateau.

Assessment of Aboriginal Sites in Areas Adjacent to the Airport Site

To ensure that any Aboriginal sites were found and assessed prior to the potential development of freehold land adjacent to the airport site, local government organisations would be encouraged to ensure that development approvals are conditional on conducting adequate levels of archaeological survey assessment, and where necessary, mitigation. These procedures would ensure that existing State government legislation protecting Aboriginal sites is effectively applied.

Aboriginal Participation

Representatives of key local Aboriginal community organisations would be involved in both the design and implementation of all management measures. The inclusion of Aboriginal community representatives in relevant decision making and steering committees could be an appropriate means of ensuring local Aboriginal involvement.

A report containing strategies relevant to the mitigation of possible Aboriginal cultural values has been received from the Gandangara Local Aboriginal Land Council and is included in *Technical Paper No. 11*. The following strategies and actions are proposed:

- investigating and analysing the study area further, including test excavation and significance assessment;
- monitoring of development procedures by Aboriginal personnel;
- caring and controlling recovered cultural materials by the Land Council; and
- compensating the Land Council for the loss of sites, cultural materials, and the natural and cultural values of the areas impacted.

20.6.3 Statutory Obligations

Prior to any construction works, and at various stages in the archaeological investigations, statutory approval, permits and consent would be necessary under the *NSW National Parks and Wildlife Act 1974* before Aboriginal sites could be disturbed. Consent would also be required before disturbing or removing a relic as defined by this Act.

20.7 Summary of Potential Aboriginal Cultural Heritage Impacts

All the airport options contain a similar and limited range of surface archaeological indications, with open artefact scatters predominating.

All the recorded sites and features within the study area are considered to fall within a local context of archaeological significance. The main determinant of this assessment is the upper catchment context and the widespread nature of these landforms on the Cumberland Plain.

Most of the surface sites identified have low scientific value, due to extensive levels of disturbance and low artefact densities. Subsurface investigation of comparable landforms on the Cumberland Plain, however, indicate that surface indications can be deceptive and the value of archaeological material below the surface may be considerable. For this reason, most of the scientific value of the airport options is vested in the sedimentary facies of the creek corridors.

The surviving archaeological resource within each of the options has low to minimal collective value as a scientifically significant suite or complex of Aboriginal sites. However, all of the archaeological sites and the remaining natural environment of the study area are valued by the local Aboriginal community for their cultural significance. The Gandangara Local Aboriginal Land Council is opposed to their destruction.

The archaeologically significant resource is mostly situated subsurface (with the exception of some scarred trees), and within contexts that are already under threat from residential and commercial development. In the long term, archaeological salvage could have the advantage of recovering information that might otherwise be lost or never sought. The topographic spread of the potential resource is limited and it would be possible to develop a sampling strategy that at least fulfils contemporary research requirements.

The airport options would all involve a limited range of potential indirect and operational impacts. The magnitude of potential impact on the archaeological resource is bounded by the already degraded nature of much of the surrounding Cumberland Plain.

The potential impacts of any of the airport options on Aboriginal cultural heritage can be placed within a local scale. Similar scales of development in upper catchment Cumberland Plain contexts have occurred in the recent past, and are continuing as part of the urbanisation of western Sydney.

Chapter 21

Non-Aboriginal Cultural Heritage

Chapter 21
Non-Aboriginal Cultural Heritage

An investigation was done of non-Aboriginal cultural heritage within the area of the three proposed airport sites and their immediate vicinity. This study is documented in Technical Paper No. 12; a summary of its main findings and conclusions is presented here.

21.1 Issues Raised During Consultation

Concern over potential impacts of a Second Sydney Airport on non-Aboriginal heritage values was one issue raised during consultations with the community. The potential degradation of heritage sites was an important concern.

Lists of non-Aboriginal heritage items have been submitted by respondents, drawn from the local environmental plans of the councils of the City of the Blue Mountains, Campbelltown, Wollondilly, Penrith, Liverpool, Camden and Fairfield.

Some comments pointed out that heritage items located under flight paths could potentially be affected by vibration from overflight noise.

On the methodology, it was felt that any assessment of the non-Aboriginal heritage impacts should include the impact of all infrastructure associated with the airport proposals.

21.2 Methodology

The Australia ICOMOS Charter for the Conservation of Places of Cultural Significance (the Burra Charter) and its Guidelines (Australia ICOMOS, 1987) has provided the methodological basis for this assessment of non-Aboriginal cultural heritage. The Burra Charter defines the basic principles and processes to be followed in the conservation of important places.

The study made use of the historical guidelines, evaluation criteria and draft inventory format published in the *NSW Heritage Manual* (Department of Urban Affairs and Planning and NSW Heritage Office, 1996); a separate database, however, has been used in formatting the inventory of heritage items and values.

21.2.1 Study Areas

The study area reported on here generally comprised the area contained within the boundaries of the three airport sites. However, sites immediately adjoining these boundaries were also assessed.

21.2.2 Identification of Heritage Items

A combination of ways were used to identify non-Aboriginal cultural heritage items and sites; field surveys were undertaken, primary and secondary research, a scrutiny of existing heritage studies, and reviews of existing heritage listings. The latter included lists of items identified by the Australian Heritage Commission, the National Trust of Australia (NSW), and by Liverpool Council in its *Draft Local Environmental Plan 1997*. Generally, the historical context for the study area was established from secondary sources. Then primary research was done to determine the history and archaeological potential of individual sites identified from the field surveys and historical maps, and to supplement available secondary source material. Then site inspections were carried out to record and assess physical evidence and verify historical research.

To help in identifying heritage items and issues, the various relevant heritage organisations were consulted, including the Australian Heritage Commission, National Trust of Australia (NSW) and the NSW Heritage Office. The local residents of Badgerys Creek, Luddenham and Bringelly were also consulted to provide information on specific areas within the study areas.

21.2.3 Assessment of Significance

An assessment of significance was done for each heritage item, using the criteria given in the *NSW Heritage Manual* (Department of Urban Affairs and Planning and NSW Heritage Office, 1996). For each item, an inventory form containing an assessment of significance in both a matrix and written format was prepared. The matrix also indicates the level of significance (local, regional or State) of each item. Items previously identified by heritage agencies or by local councils were reassessed against the *NSW Heritage Manual* criteria.

The terms local, regional and State heritage significance relate to both the geographical and historical context of an item's significance; an item that is of local significance, for example, will be of historic, aesthetic, social or technical/research significance in a local geographical context, or to an identifiable contemporary local community. The item will be of significance only within the locality in which it is found, although it may be of undoubted interest to people from outside the locality. For the purposes of this study, the local context is the local government area in which the item is located.

An item may have regional significance – that is, it is significant in a regional historical or geographical context, or to an important and identifiable contemporary regional community. Here, the region is the Sydney basin as shown in the *NSW Heritage Manual*.

An item may have State significance – that is, it is significant in a State-wide historical or geographical context, or to an important and identifiable contemporary State-wide community.

The *Australian Heritage Commission Act 1975* specifies criteria for the assessment of the significance (or national estate value) of a place. There are three broad groups of values – indigenous, natural, and 'historic' (that is, non-Aboriginal) cultural heritage values, and eight criteria used to determine national estate values.

The criteria for assessment of historic national estate values can be directly correlated with the NSW Heritage Assessment Criteria used here. *Technical Paper No. 12* compares the national estate criteria with the corresponding NSW Heritage Assessment Criteria.

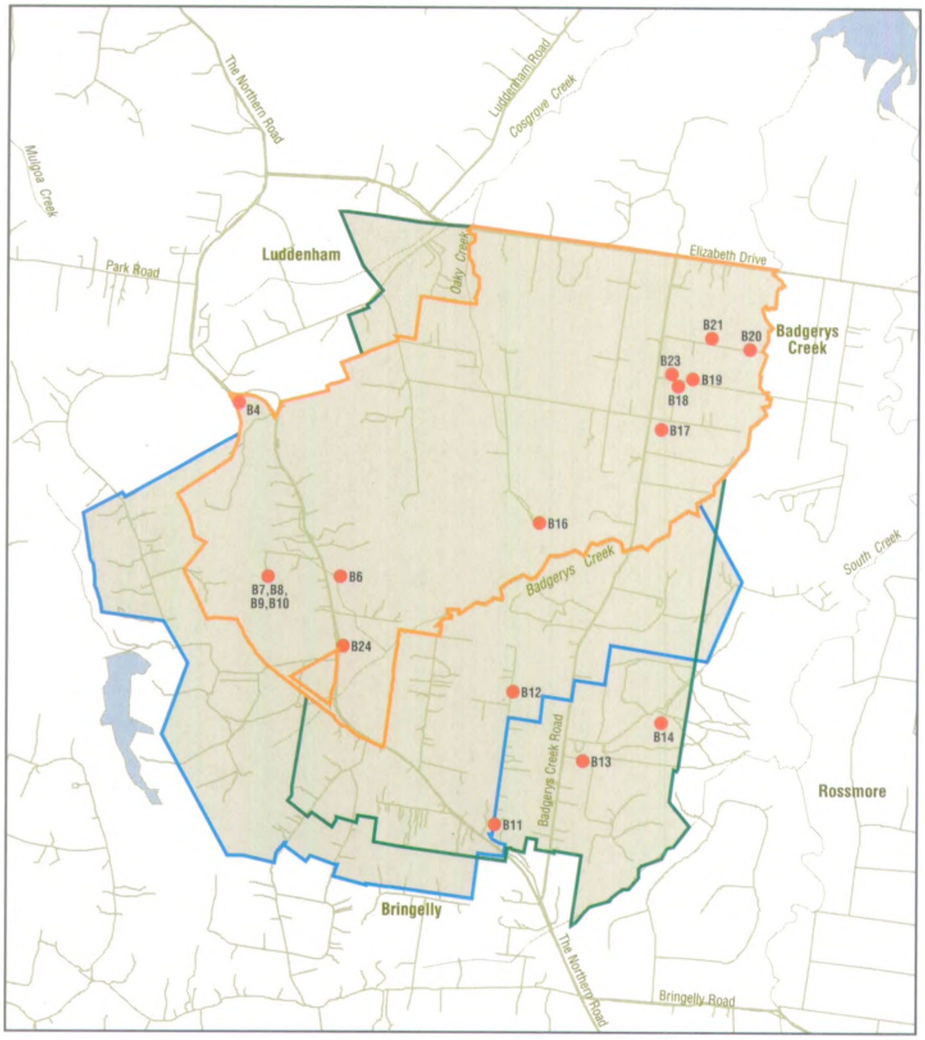
21.3 Existing Environment

21.3.1 Non-Aboriginal Heritage Items

The non-Aboriginal cultural heritage items identified in the study area are listed in *Table 21.1*. Their location is shown on *Figure 21.1*.

Table 21.1 Non-Aboriginal Cultural Heritage Items in Study Area

No.	Name and Address	Significance	Affected by Option		
B1	Luddenham Public School; The Northern Road, Luddenham	Local			
B2	Dairy shed c1930; Lot 10 Adams Road, Badgerys Creek	Local			
B3	Luddenham Uniting Church, Cemetery and Progress Hall; The Northern Road, Luddenham	Regional			
B4	Lawson's Inn site - archaeological site; The Northern Road, Luddenham	Regional	A	B	C
B5	Luddenham Anglican Church and Cemetery (St James); The Northern Road, Luddenham	Regional			
B6	Anchau vineyard site - c1910 archaeological site; The Northern Road, Luddenham	Local	A	B	C
B7	Vicary's Vineyard - c1880s Original Homestead; The Northern Road, Luddenham	Regional	A	B	C
B8	Vicary's Vineyard - c1910 winery building; The Northern Road, Luddenham	Regional	A	B	C
B9	Vicary's Vineyard - c1880s woolshed; The Northern Road, Luddenham	Local	A	B	C
B10	Vicary's Vineyard - c1880s shearers quarters; The Northern Road, Luddenham	Regional	A	B	C
B11	'Evergreen' homestead - c1900 small farm house; off Derwent Road, Bringelly	Local		B	C
B12	'Mount Pleasant' homestead - c1900 small farm house; Shannon Road, Bringelly	Local		B	C
B13	Two elevated water tanks - two c1950 RAAF steel elevated water tanks; Badgerys Creek Road, Bringelly	Local			C
B14	Overseas Telecommunications Commission Bringelly Remote Receiving Station - c1955 overseas radio receiving station; Badgerys Creek Road, Bringelly	Regional			C
B15	Kelvin Park Homestead- c1820 estate homestead and associated buildings off Kelvin Park Drive, Bringelly	State			
B16	Braeburn Homestead - turn of the century homestead; private road off Longleys Road,	Local	A	B	C
B17	Former Badgerys Creek butchery - c1880s building; Badgerys Creek Road, Badgerys Creek	Local	A	B	C
B18	St Johns Anglican Church Site and Cemetery - approximately 30 graves; Pitt Street, Badgerys Creek	Local	A	B	C
B19	Badgerys Creek Uniting (Methodist) Church Cemetery - two graves; Pitt Street, Badgerys Creek	Local	A	B	C
B20	Farm Cottage - c1900 weatherboard cottage; Gardiner Road, Badgerys Creek	Local	A	B	C
B21	Group of Farm Outbuildings - c1930s timber slab buildings; Gardiner Road, Badgerys Creek	Local	A	B	C
B22	Bridge over Badgerys Creek - steel truss bridge; Pitt Street, Badgerys Creek	Local			
B23	Original Badgerys Creek Public School Building - c1895 Public School building; Badgerys Creek Road, Badgerys Creek	Regional	A	B	C
B24	The Northern Road (between Luddenham and Bringelly)	Regional	A	B	C



Boundary of airport option A
Boundary of airport option B
Boundary of airport option C

Figure 21.1
Non-Aboriginal Cultural Heritage Items

MN
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0Km
2.5Km

21.3.2 Heritage Significance

The heritage significance of the study area has been analysed in terms of the major phases of activity that have occurred in the area. It has environmental heritage significance because of:

- evidence of its association with the disposition of land ownership in the early years of the colony and the events leading up to and following the 'Rum Rebellion', a seminal event in the history of the colonial administration of NSW (*Historic Significance*). Items of major significance include the name of the area as Badgerys Creek, recording the farmer, James Badgery, and the resultant layout of the properties in the area which reflect the original property boundaries derived from the events surrounding the land grants made at that time;

- evidence of the expansion of the colony from its early centres into the rural hinterland prior to the crossing of the Blue Mountains, the first road routes through the district, and the type of agriculture and people employed in these developments (*Historic and Aesthetic Significance*). Items of major significance include the site of Lawson's Inn and the route of The Northern Road;
- evidence of early 19th century 'gentleman farmer' residential housing and the form and extent of buildings necessary for the operation of a remote grazing property in the period (*Historic, Aesthetic and Research Significance*). Items of major significance include 'Kelvin Park' homestead and its outbuildings;
- evidence of the form and materials of the homesteads and outbuildings associated with small farming properties in the late 19th century and the development of small townships that service these communities (*Historic, Aesthetic, Research and Social Significance*). Items of major significance include 'Evergreen' (refer *Photograph 16*); 'Mt Pleasant' and the Gardiner Road cottage; the farm outbuildings at Vicary's Winery and in Adams Road and Gardiner Road; the churches and schoolhouse at Badgerys Creek and at Luddenham and the bridge over Badgerys Creek; and
- evidence of the gradual decline in the agricultural viability of the Cumberland Plain, the rise and fall of the wine and grape industry and the development of alternative uses for former pastoral land associated with 20th century technology (*Historic Significance*). Items of major significance include Vicary's Winery; the site of Anchau's vineyard; the Overseas Telecommunications Centre and the military radio stations and two water tanks associated with these.

Photograph 16
Evergreen Homestead

21.4 Non-Aboriginal Cultural Heritage Impacts

21.4.1 Option A

Construction of Option A would result in the loss of 13 of the 24 non-Aboriginal cultural heritage items identified within the study area. Of these, five are items of regional significance and eight are of local significance. Concerning one further item, The Northern Road (of regional significance), the section within the proposed airport boundary would be demolished, but the road would remain intact beyond the airport boundary.

Seven of the 13 features that would be lost are listed as heritage items in Liverpool Council's *Draft Local Environmental Plan 1997*. These are the site of Lawson's Inn (B4); the Vicary's Vineyard Homestead (B7), Vicary's Winery (B8) (refer *Photograph 17*), Vicary's Woolshed (B9) and Vicary's Shearers Quarters (B10); St Johns Anglican Church Site and Cemetery (B18) and Badgerys Creek Public School (B23). No other heritage items impacted by this option are listed by a heritage body. The location of items affected is shown on *Figure 21.1*.

Photograph 17
Vicary's Vineyard - The Winery Buildings

The demolition/destruction of these individual heritage items would, in most cases, result in the total loss of their historic, aesthetic, social and technical/ research values. It would also impinge on the heritage significance of the study area as a whole. The impact mainly relates to the loss of evidence of aspects of the area's history and, hence, its heritage significance, in particular:

- evidence of the expansion of the colony from its early centres into the rural hinterland, prior to the crossing of the Blue Mountains (Site of Lawsons Inn and a portion of The Northern Road);
- evidence of the form and materials of the homesteads and outbuildings associated with small farming properties in the late 19th century and the development of small townships that service these communities (Vicary's Vineyard Homestead, Woolshed and Shearers Quarters; the original Badgerys Creek Public School building; St Johns Anglican Church Site and Cemetery; Badgerys Creek Uniting (Methodist) Church Site and Cemetery; and the Farm Cottage and Outbuildings in Gardiner Road, Badgerys Creek); and
- evidence of the gradual decline in the agricultural viability of the Cumberland Plain and the rise and fall of the grape and wine industry (Vicary's Winery; and Anchau's Vineyard).

Other evidence of the first two aspects of the area's history would remain through the retention of heritage items not affected by Option A, although not of the third, the rise and fall of the grape and wine industry.

In addition to these construction impacts, the ambience and historic setting of the retained heritage items and the study area as a whole, would be affected to some degree by visual, noise and/or vibration impacts associated with the operation of an airport nearby.

21.4.2 Option B

Construction of Option B would result in the loss of 15 of the 24 non-Aboriginal cultural heritage items identified within the study area. Of these, five are items of regional significance and 10 are of local significance. Concerning one further item, The Northern Road (of regional significance), the section within the proposed airport boundary would be demolished, but the road would remain intact beyond the airport boundary.

Eight of the 15 features that would be lost are listed as heritage items in Liverpool Council's *Draft Local Environmental Plan 1997*. These are the Site of Lawsons Inn (B4); the Vicary's Vineyard Homestead (B7), Vicary's Winery (B8), Vicary's Woolshed (B9) and Shearers Quarters (B10); Mount Pleasant Homestead (B12); St Johns Anglican Church Site and Cemetery (B18) and Badgerys Creek Public School (B23). No other heritage items impacted by this option are listed by a heritage body. The location of items affected is shown on *Figure 21.1*.

The demolition/destruction of these individual heritage items would, in most cases, result in the total loss of their historic, aesthetic, social and technical/research values. It would also impinge on the heritage significance of the study area as a whole. The impact mainly relates to the loss of evidence of aspects of the area's history and, hence, its heritage significance, in particular:

- evidence of the expansion of the colony from its early centres into the rural hinterland, prior to the crossing of the Blue Mountains (site of Lawson's Inn and a portion of The Northern Road);
- evidence of the form and materials of the homesteads and outbuildings associated with small farming properties in the late 19th century and the development of small townships that service these communities ('Evergreen' Homestead, 'Mount Pleasant' Homestead, Vicary's Vineyard Homestead, Woolshed and Shearers Quarters; the original Badgerys Creek Public School building; St Johns Anglican Church site and Cemetery; Badgerys Creek Uniting (Methodist) Church Site and Cemetery; and the Farm Cottage and Outbuildings in Gardiner Road, Badgerys Creek); and
- evidence of the gradual decline in the agricultural viability of the Cumberland Plain and the rise and fall of the grape and wine industry (Vicary's Winery; and Anchau's Vineyard).

Virtually all evidence of these three aspects of the heritage significance of the study area would be lost as a result of constructing Option B. No other items would remain that are able to demonstrate the aspects of significance currently evidenced by these heritage items.

In addition to these construction impacts, the ambience and historic setting of the retained heritage items and the study area as a whole would be affected to some degree by visual, noise and/or vibration impacts associated with the operation of an airport nearby.

21.4.3 Option C

Construction of Option C would result in the loss of 17 of the 24 non-Aboriginal cultural heritage items identified within the study area. Of these, six are items of regional significance and 11 are of local significance. Concerning one further item, The Northern Road (of regional significance), the section within the proposed airport boundary would be demolished, but the road would remain intact beyond the airport boundary.

Ten of the 17 items that would be lost are listed as heritage items in Liverpool *Draft Local Environmental Plan 1997*. These are the site of Lawsons Inn (B4); the Vicary's Vineyard Homestead (B7), Winery (B8), Woolshed (B9) and Shearers Quarters (B10); Mount Pleasant homestead (B12); two elevated water tanks (B13); the Overseas Telecommunication Commission receiving station (B14); St Johns Anglican Church Site and Cemetery (B18) and Badgerys Creek Public School (B23). No other heritage items impacted by this option are listed by any heritage body. The location of items affected is shown on *Figure 21.1*.

The demolition/destruction of these individual heritage items would, in most cases, result in the total loss of their historic, aesthetic, social and technical/ research values. It would also impinge on the heritage significance of the study area as a whole. The impact mainly relates to the loss of evidence of aspects of the area's history and, hence, its heritage significance, in particular:

- evidence of the expansion of the colony from its early centres into the rural hinterland, prior to the crossing of the Blue Mountains (site of Lawson's Inn; and a portion of The Northern Road);
- evidence of the form and materials of the homesteads and outbuildings associated with small farming properties in the late 19th century and the development of small townships that service these communities (Vicary's Vineyard Homestead, Woolshed and Shearers Quarters; the original Badgerys Creek Public School building; St Johns Anglican Church Site and Cemetery; Badgerys Creek Uniting (Methodist) Church Site and Cemetery; and the Farm Cottage and Outbuildings in Gardiner Road, Badgerys Creek); and
- evidence of the gradual decline of the agricultural viability of the Cumberland Plain, the rise and fall of the wine and grape industry and the development of alternative uses for former pastoral land associated with 20th century technology (Vicary's Winery; Anchau's Vineyard; the Overseas Telecommunications Commission site; and the two elevated water tanks).

Virtually all evidence of these three aspects of the heritage significance of the study area would be lost as a result of constructing Option C. No other items would remain that are able to demonstrate the aspects of significance currently evidenced by these heritage items.

In addition to these construction impacts, the ambience and historic setting of the retained heritage items and the study area as a whole, would be affected to some degree by visual, noise and/or vibration impacts associated with the operation of an airport nearby.

21.5 Environmental Management

Table 21.2 contains specific management measures for each heritage item impacted upon by the airport options, with a view to mitigating the impacts.

Table 21.2 Proposed Management Measures for Airport Options

Measure	Airport Options		
	A	B	C
Protect during construction	B1, B2, B3, B5, B11, B12, B13, B14, B15, B22	B1, B2, B3, B5, B13, B14, B15, B22	B1, B2, B3, B5, B15, B22
Investigate options for retention	B4	B4, B11, B17,B23	B4, B11
Archaeological assessment	B4, B6, B18, B19, B24	B4, B6, B18. B19, B24	B4,B6, B18, B19, B24
Archaeological excavation	B4,B6	B4,B6	B4,B6
Archival recording	B6, B7, B8, B9, B10, B16, B17, B20, B21, B23, B24	B6, B7, B8, B9, B10, B11, B12, B16, B17, B20, B21, B23, B24	B6, B7, B8, B9, B10, B11, B12, B13, B14, B16, B17, B20, B21, B23, B24
Investigate options to reduce visual impact of security fence	n/a	n/a	B15
Relocate headstones, grave furniture and burial remains	B18, B19	B18, B19	B18, B19
Test excavation	B24	B24	B24

Generally the preferred method of managing impacts on identified heritage items, including archaeological sites, is conservation in situ, that is, the site should remain undisturbed by any activity, including archaeological excavation. This method retains the historic resource for the future, when more highly developed conservation and management techniques may exist. Therefore, particular sites like Lawson's Inn, that have been earmarked for possible retention would be the subject of further investigation during the detailed design stage of the airport.

Monitoring should also be undertaken to identify if any vibration impacts associated with the airports' operation occur. If there is evidence of any adverse impacts on any non-Aboriginal heritage items, an assessment of damage would be undertaken and a plan of action to mitigate any further impacts developed if necessary.

Archaeological Management

Archaeological assessment is proposed for all sites identified as having archaeological potential as a precursor to other management procedures. This would ensure, that the extent of management for any given site is defined in detail. It would be undertaken prior to construction and would involve:

- defining the probable nature and extent of archaeological resources;
- assessing their significance in detail;
- determining the most appropriate archaeological management procedures; and
- defining the boundaries for archaeological management procedures.

Assessment and excavation are proposed for items judged to have high archaeological potential or rare representation within the study area. For example archaeological excavation of the Anchau Vineyard is proposed as this site is considered to represent the local wine growing industry and its resources, as well as the domestic lifestyle of that community.

Test excavation, usually involving machine or hand excavation of a small trench, is proposed for sites where the amount of retrievable information likely to be gained from below ground remains unknown. A site specific archaeological assessment prior to test excavation, as well as a more detailed search of historic records, would assist in determining the boundary of the area to be investigated. Test excavation would enable an archaeologist to determine whether the site merits any further action.

Archaeological monitoring is not proposed for any of the sites as an initial action. However, it is likely that some of the sites that undergo test excavation would not warrant a full archaeological excavation and, in these cases, archaeological monitoring of the site is considered an adequate mitigating measure.

Archival Recording

Archival recording is generally proposed for buildings and other standing structures that are to be demolished. The record would vary according to the type of heritage item and its level of significance. In general, an archival record should include all background information, such as the subject of the record, why the record was made, an outline of the history, a statement of heritage significance and a location plan. For items of local significance, the record should also contain an imagery of existing archival documents, black and white photography and colour slides as a minimum requirement. Items of regional significance need to be recorded in the same way as items of local significance, with the added requirement for measured drawings. These would be managed in accordance with the standard procedures of the NSW Heritage Office. Archaeological sites would be fully recorded both graphically and photographically at the time of excavation, test excavation or monitoring.

Retention and Conservation

During the detailed design process for the airport, as much fabric and physical evidence of heritage items as possible would be retained. Care would also be taken to protect heritage items during the construction stage. This might mean boarding up some buildings or using hoardings to isolate items from activities that might damage them. It would also be desirable to make a dilapidation survey of retained items before construction started, so their condition could be regularly monitored both during and following construction of the airport.

Additionally, where graves within the church cemeteries of the St Johns Anglican Church and Badgerys Creek Methodist Church, would be removed, it is desirable that the original headstones and grave furniture should be transferred with the human remains. Where this is not possible, these items would be archivally recorded and arrangements made for their storage.

21.6 Summary of Potential Non-Aboriginal Cultural Heritage Impacts

The various impacts associated with each airport option on identified heritage items and the respective areas are numerically summarised in *Table 21.3*.

Of the 13 heritage items that would be lost as a result of Option A, seven are listed as heritage items in Liverpool *Draft Local Environmental Plan 1997*. Five of the 13 items are also assessed in this study as being of regional significance.

Option B would destroy the same items destroyed by Option A. Two further items would also be destroyed. Both of these are of local significance. One of these items is also listed as a heritage items in *Liverpool Draft Local Environmental Plan 1997*.

Option C would destroy all of the items destroyed by Option B (and Option A). Two further items would also be destroyed, one of which is assessed as being of regional significance. Both of these items are also listed as heritage items in Liverpool *Draft Local Environmental Plan 1997*. None of the items that would be destroyed under any of the airport options is listed by the National Trust, Australian Heritage Commission or the NSW Heritage Council.

If the heritage significance of the study area is regarded as a whole (as identified in the statement of heritage significance), Option A would result in the loss of evidence of three aspects of significance. However, other evidence of these aspects would remain. Options B and C would affect these same three aspects of significance but, unlike Option A, would result in the loss of virtually all evidence of these aspects.

Table 21.3 Impacts of Airport Options on Non-Aboriginal Cultural Heritage items

	Option A	Option B	Option C
Number of Heritage Items Demolished/Destroyed	13	15	17
Number of Heritage Items Partially Demolished/Destroyed	1	1	1
Number of Heritage Items Fully Retained	10	8	6
Total	**24**	**24**	**24**

Chapter 22

Transport

Chapter 22
Transport

This chapter outlines the potential transport impacts, both for land and aviation, of the Second Sydney Airport. It summarises the results of studies documented in Technical Paper No. 13 and Second Sydney Airport Planning and Design *(Second Sydney Airport Planners, 1997a).*

22.1 Issues Raised During Consultation

It was suggested during consultation that development of the Second Sydney Airport would result in significant increases in surface traffic, on both local and regional roads. Noise and air quality concerns were also raised in relation to any potential traffic growth. Comments noted the absence of any commitment to providing a rail link to the airport, given the need for its approval and operation by State and local authorities.

Comments suggesting that existing traffic congestion would be exacerbated by the airport referred specifically to Ferrers Road, Doonside Road, Mamre Road, the M4 Motorway, The Horsley Drive, Elizabeth Drive and the Cumberland Highway.

Submissions observed that the proposal would mean that residents in the western and south-western suburbs of Sydney had shorter distances to travel to an airport. However, they drew attention to the potential community and environmental impacts of the road and rail proposals. Concerns included the dislocation of communities because of traffic noise, severance of local access and communities by airport access routes and the impact of higher air pollution from increased traffic volumes.

A range of potential aviation impacts were also identified by the community including interactions between aircraft movements at the new airport and those of Sydney Airport and other regional airports.

22.2 Methodology

22.2.1 Land Use Assumptions

Future land use scenarios were employed to present a picture of how Sydney might look in the future, in terms of the distribution of population and employment. This allowed future demands on public transport services and the road network to be determined. Two future land use scenarios were developed to reflect possible land use patterns that might occur as a result of the airport options (refer *Chapter 10*). In addition, a base case scenario was developed to reflect the land use pattern if no new airport was developed. Each scenario was projected forward to 2006 and 2016. *Technical Paper No. 2* outlines the underlying assumptions for each scenario.

22.2.2 Public Transport

There would be a number of public transport options available to serve the Second Sydney Airport, including commuter trains, transit buses, coaches and taxis. The choice of travel mode to the Second Sydney Airport has been considered in an integrated manner. Once public transport trips were estimated and removed from the total travel demand, the remaining travellers were assigned to the road network in private vehicles.

22.2.3 Traffic Modelling

Strategic traffic modelling for metropolitan Sydney was developed in two stages. Firstly, the land use scenarios and a possible future Sydney road network were used to arrive at a range of future road travel estimates in terms of vehicle trips between specific origin and destination zones. Secondly, each forecast trip was assigned to its quickest route through the road network, allowing for delay caused by other traffic. This process produced forecast traffic volumes and travel speeds.

The strategic traffic model covers an area bounded by the Hawkesbury/ Nepean river system to the north and west, and extends south to Picton, Appin and Waterfall (*Figure 22.1*). *Figure 22.2* shows the road network modelled around the airport sites. Areas outside the modelled area, such as the Blue Mountains, were represented by external traffic streams on the major approach route to Sydney.

Future traffic models were developed for the years 2006 and 2016. The 2006 year was selected to represent a Second Sydney Airport's first stage of development, serving around 10 million passengers annually (Air Traffic Forecast 2). The assessment of a Second Sydney Airport at the proposed operating limit of about 30 million passengers per year (Air Traffic Forecast 3) was undertaken for 2016. The existing mode of travel at Sydney Airport was derived from various studies (Masson and Wilson, 1996a and 1996b; Kinhill, 1994). Future mode split scenarios (cars/coaches/bus/rail) for the Second Sydney Airport were estimated taking into account potential public transport usage.

To produce a realistic model of the future road system, a number of likely future road improvements were added to the present road network. Their inclusion in the 2006 and 2016 road networks was made after discussion with State Government authorities, but they do not necessarily constitute approved forward plans.

22.3 Existing Transport Network

22.3.1 Existing Policy Context

The *Integrated Transport Strategy for the Greater Metropolitan Region* was prepared in 1995 (Department of Transport, 1995) to support the metropolitan planning strategy, *Cities for the 21st Century* (Department of Planning, 1995). The purpose of this joint process was to bring land use and transport planning into a comprehensive strategy so that they could be mutually supportive and work toward common goals.

The Integrated Transport Strategy is a strategic framework within which more detailed planning of transport systems and operations by individual transport agencies such as the Roads and Traffic Authority and CityRail could occur. These strategic approaches take account of the population growth and employment distribution described in the metropolitan planning strategy. The report proposes a transport corridor approach as discussed in *Chapter 10*. The strategy concluded that a potential transport corridor, which provided high quality road and rail access to an airport site at Badgerys Creek would support employment and economic efficiency objectives.

In a case study, *Transport Planning for Sydney West Airport* (Department of Transport, 1995), the *Integrated Transport Strategy* discusses the need for corridor development. The rail corridor is described as an extension of the East Hills rail line via Glenfield Station. With the construction of the New Southern Railway to Sydney Airport, a direct connection by rail between the two airports would exist, as well as access to all communities served by Sydney's rail network. In terms of a road connection,

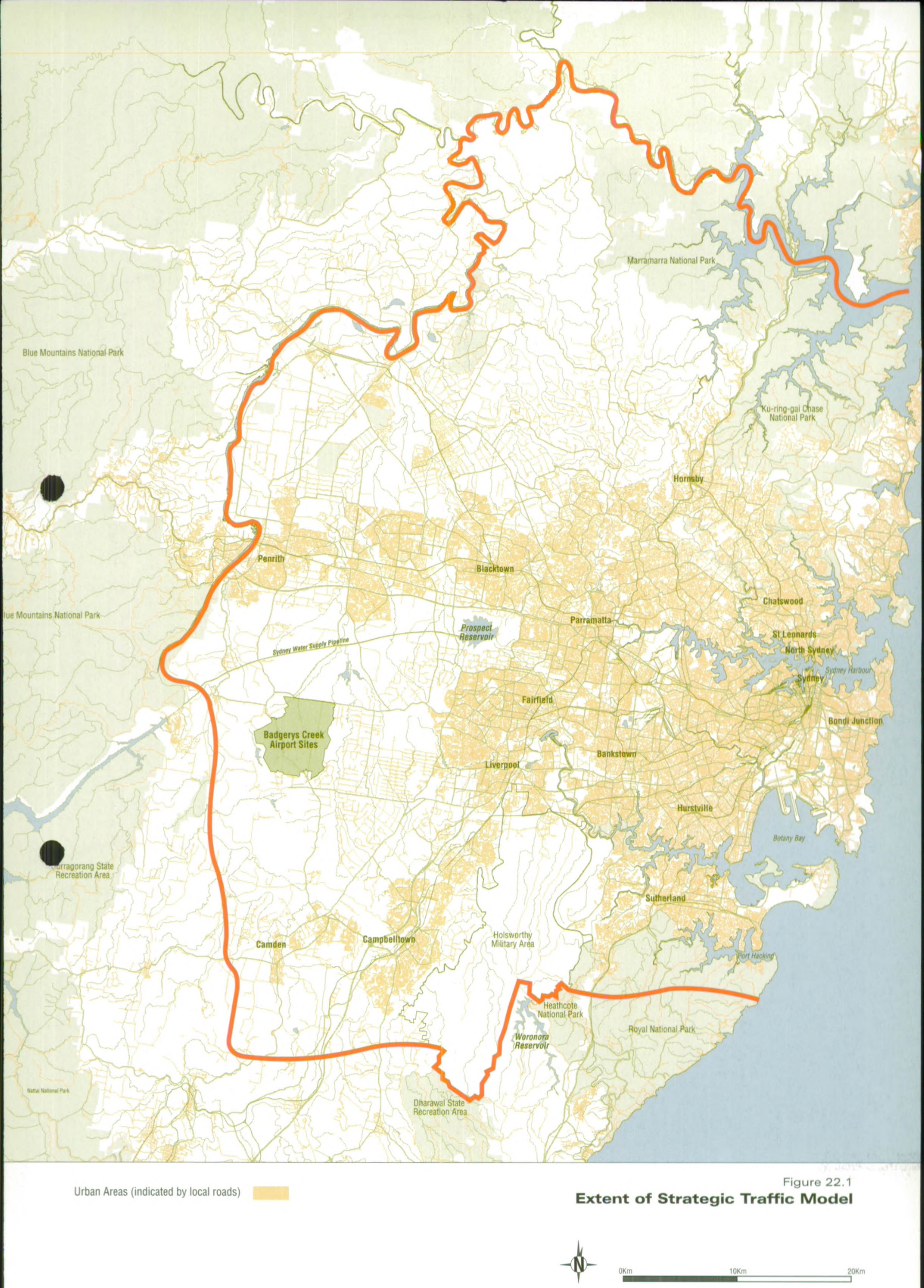


Figure 22.1
Extent of Strategic Traffic Model

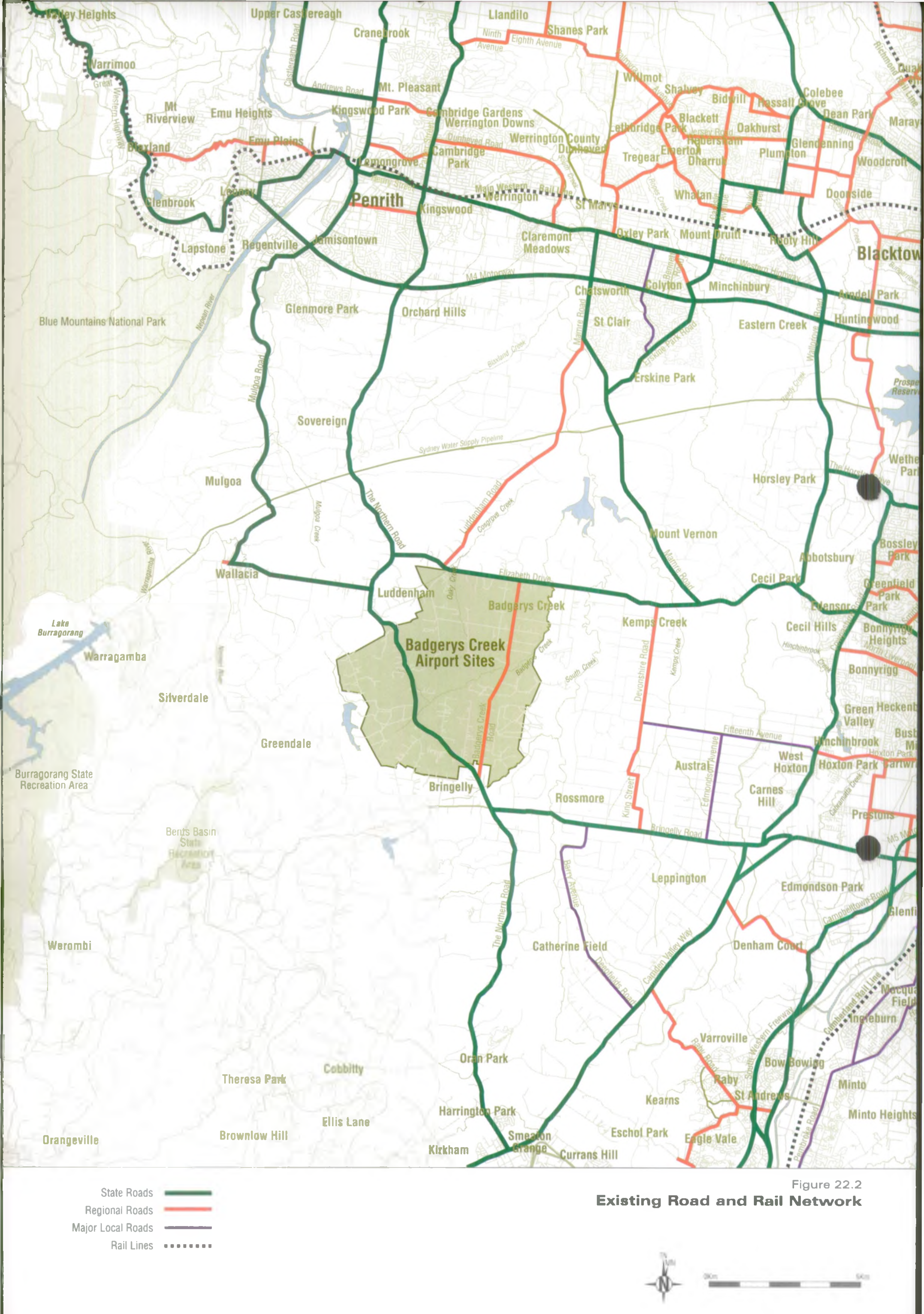


Figure 22.2
Existing Road and Rail Network

advantages were seen in combining the construction of the 'missing link' of the National Highway between Liverpool and Hornsby with airport access. A direct connection to the M5 Motorway and F3 Freeway would also provide benefits, particularly if the M5 Motorway were to be extended east to the freight facilities at Port Botany.

The State Rail Draft Strategic Plan (State Rail, 1994) sets out the State Rail Authority's response to the passenger demand and travel patterns expected in the Sydney region to the year 2011. The plan includes a number of significant infrastructure investments identified in the *Integrated Transport Strategy*, including the link between Glenfield and the second Sydney airport site.

The Draft Strategic Plan also identifies the following infrastructure requirements on the network:

- additional track capacity between Riverwood and Turrella on the East Hills rail line to cope with growth in the south-west;
- more operational capacity at Sydenham Junction to cope with additional south-west rail traffic; and
- access to the Second Sydney Airport.

22.3.2 Existing Transport Network

Figure 22.2 shows the transport network around the airport site. The rail lines shown are radial and continue to the Sydney Central Business District, except for the new Cumberland line which runs between Blacktown and Campbelltown. The road networks not only provide facilities for the majority of private vehicle travel, but they also accommodate public transport services.

Bus services in Sydney operate under business contract areas. The government-operated Sydney Buses serve the Central Business District, eastern suburbs, northern beaches, inner-western suburbs and the lower north shore. Private bus operators serve the remaining areas within the metropolitan area. The airport site is within the contract areas of a private bus operator.

Around the airport sites, Westbus serves the western end of Elizabeth Drive. Current planning has identified the eastern section of Elizabeth Drive as a transit priority corridor where bus priority measures would be implemented if bus service reliability is threatened by congestion. The busiest point for bus services in the area is at the intersection of Elizabeth Drive and Mamre Road, where there are 35 scheduled services per day, including school buses.

Two scheduled bus services use Elizabeth Drive between Badgerys Creek Road and Wallgrove Road, and then continue to the east. Westbus Route 836 runs seven times a weekday to Liverpool Station and eight times a day back to Badgerys Creek Post Office. Route 835 runs between Liverpool Station and Penrith Station five times a weekday into Liverpool and six times a day into Penrith. It uses Elizabeth Drive between Mamre Road and Cowpasture Road. It gives passengers in its catchment access to interchange at the Main Southern, Cumberland and Main Western Railway Lines.

About 4,500 taxis serve the Sydney metropolitan area. The level of taxi service to the Second Sydney Airport would be based primarily on customer demand (NSW Taxi Council, personal communication, 1997).

The peak hour capacity, citybound, of the Sydney metropolitan rail network has been reached on most lines in recent years despite the introduction of a totally double decked fleet of rolling stock. The greatest passenger growth has come from the west and south of the network.

A recently completed addition to rail infrastructure is the Harris Park Y-Link. The link provides a two-way connection between the Main Southern and Main Western rail line, west of Harris Park. Direct services between the subregional centres of Campbelltown, Liverpool, Parramatta and Blacktown are now possible. This new service is called the Cumberland rail line.

22.4 The Transport Network Without a Second Sydney Airport

Before the transport impacts of a Second Sydney Airport could be assessed, it was necessary to obtain an understanding of how Sydney's transport would operate without a second airport. Modelling road traffic patterns without a Second Sydney Airport allows a distinction to be made between *background* traffic conditions and any additional traffic associated with a particular Second Sydney Airport option. Background traffic is defined as the estimated traffic that would occur in the future if the Second Sydney Airport does not proceed.

Modelling showed that a number of road improvements would be needed to accommodate background traffic growth as shown in *Figure 22.3*. The most significant of these improvements include:

- Western Sydney Orbital by 2006 as a four lane motorway between Elizabeth Drive and the M5 Motorway; and by 2016 as a six lane motorway between the M4 and M5 Motorways, and as a four lane motorway between the M4 Motorway and the Castlereagh Freeway;
- Wallgrove Road as a four lane divided road by 2006, and by 2016 closed and replaced by the Western Sydney Orbital;
- Cowpasture Road widened to four lanes by 2006, with a four lane extension to Bringelly Road by 2016;
- Castlereagh Freeway (M2 Motorway) extended to Richmond Road by 2006 and to Stony Creek Road by 2016;
- Werrington Arterial completed by 2016;
- South Western Freeway and M5 Motorway widened to six lanes from Brooks Road to King Georges Road, and to eight lanes between the Hume Highway and Moorebank Avenue by 2006;
- Camden Valley Way widened to four lanes by 2006;
- Brooks Road widened to four lanes between Williamson Road and the South Western Freeway by 2006;
- route between Glenfield and Campbelltown upgraded to four lane standard;
- Elizabeth Drive widened to four lanes between Cowpasture Road and Cabramatta Road by 2006; and
- Prospect Arterial built to two lanes between the Great Western Highway and The Horsley Drive by 2016.

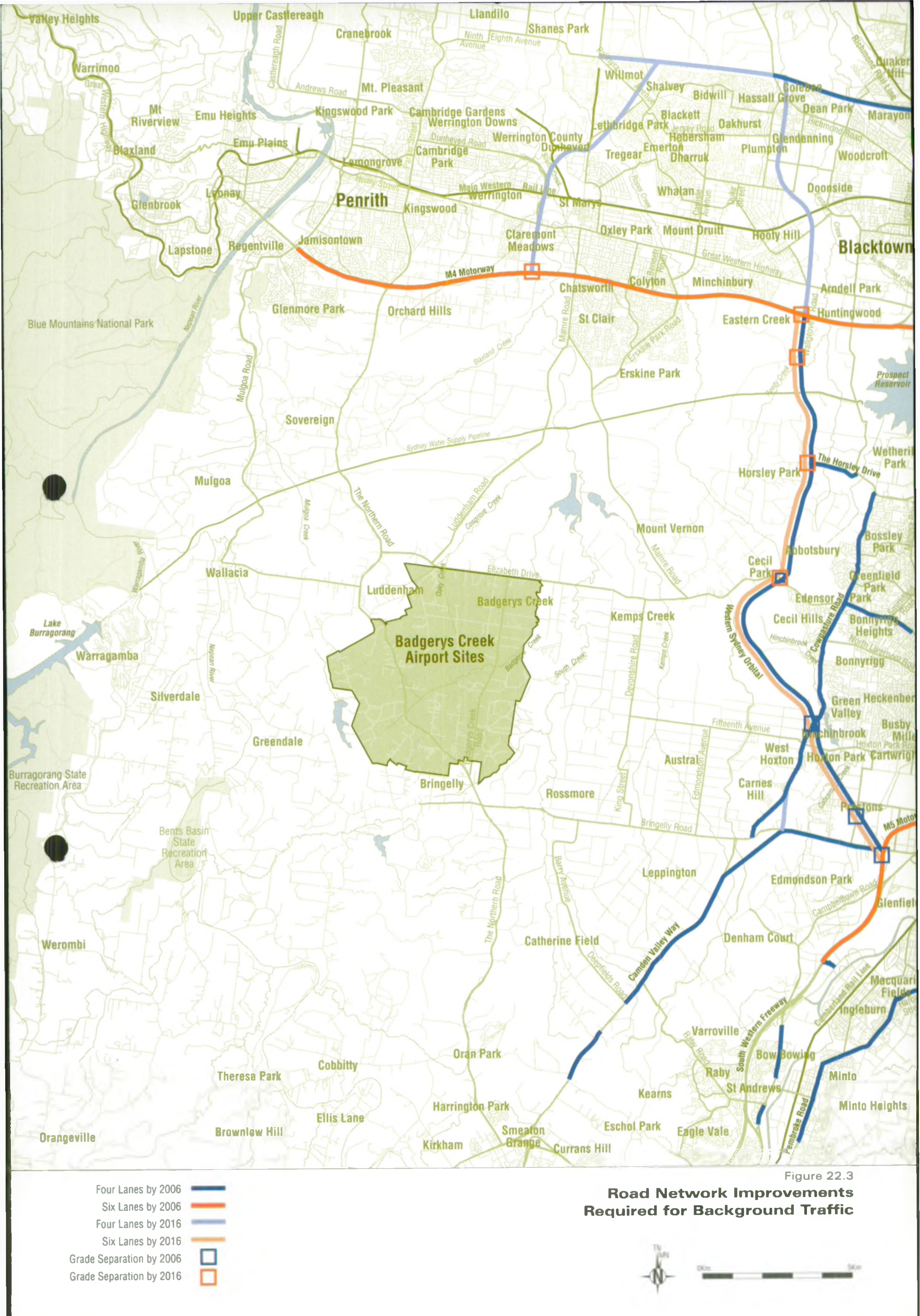


Figure 22.3

Road Network Improvements Required for Background Traffic

All potential road improvements needed to accommodate predicted future background traffic would be subject to State and local government planning and policy considerations, and separate environmental assessment procedures.

22.5 Land Travel Demand with a Second Sydney Airport

22.5.1 Future Travel Demand from a Second Sydney Airport

The background traffic case was developed to measure changes in demand for land transport infrastructure generated by future land use changes, but assuming no Second Sydney Airport proceeds. Two land transport scenarios were then developed for each airport option, namely:

- 10 million air passengers and a workforce of 16,000 employees at a Second Sydney Airport in 2006; and
- 30 million air passengers and a workforce of 48,000 employees at a Second Sydney Airport in 2016.

As the air travel demand is the same for all airport options, total daily airport trips are also the same, since employees and meeters and greeters are derived from passenger numbers. By 2016, about 140,000 person trips are expected to take place to and from the Second Sydney Airport on the 70th percentile design day. The 70 percentile day was adopted for road design and traffic planning purposes. This means that 70 percent of days or about 255 days a year would have the same or fewer passengers using the airport than is assumed for the traffic assessment. This planning criterion was used because constructing roads to meet peak demand (100 percentile day) is usually uneconomic.

22.5.2 Choice of Travel Mode

Table 22.1 shows the anticipated mode of travel to Sydney Airport after the opening of the New Southern Railway. Travel behaviour to the Second Sydney Airport is expected to be very similar to future patterns at Sydney Airport, as can be seen in *Table 22.2*. In order to forecast how travel would be split across transport modes for the Second Sydney Airport, a future with and without a rail service was generated to allow traffic impacts to be considered if a rail service were not available when airport operations begin.

Table 22.1 Expected Daily Share of Travel by Mode to Sydney Airport when Rail is Available

Mode of Travel	Employees	International Passengers/ Meeters and Greeters	Domestic Passengers/ Meeters and Greeters
Car drivers	69%	22%	28%
Car passengers	4%	36%	26%
Taxis	4%	12%	23%
Bus	4%	5%	3%
Coaches	0%	6%	2%
Rail	19%	19%	18%

Source: Kinhill, 1994.

Table 22.2 Expected Daily Share of Travel by Mode to a Second Sydney Airport

Mode of Travel	Employees		International[1]		Domestic[1]	
	No Rail	Rail	No Rail	Rail	No Rail	Rail
Car drivers	85%	72%	28%	25%	33%	30%
Car passengers	8%	5%	46%	40%	31%	28%
Taxis	2%	1%	15%	12%	28%	22%
Bus	5%	2%	5%	2%	6%	3%
Coaches	0%	0%	6%	6%	2%	2%
Rail	0%	20%	0%	15%	0%	15%

Note: 1. Includes passengers and meeters and greeters.

All airport options are forecast to have the same choice of travel modes because:

- all rail options rely on the same existing lines for access to the airport, and so constraints on capacity, frequency of service and rolling stock would be similar;
- the boarding station for a trip to the airport would be the same; and
- the relative advantages of car, rail and taxi would be constant.

The above is premised on the assumption that there would be the active funding and support to offer an attractive rail service.

A rail line has formed part of the transport strategy for a Second Sydney Airport since the early 1970s. Assuming that the new airport would be at Badgerys Creek, a rail extension is incorporated into both the *Integrated Transport Strategy* and the *Draft State Rail Strategic Plan*.

The mode split forecasts in *Table 22.3* reflect past planning commitments to a rail link for a Second Sydney Airport in the assumptions used to assign trips. These include:

- the airport would be served by a station within easy access of all the terminal facilities;
- travel times to the city would be minimised by express-style service;
- rail service would be at least on a 15 minute frequency in the off peak;
- fares would be low enough to encourage use of the suburban rail system;
- some restrictions on car parking would be implemented on the site for passengers, employees and casual visitors; and
- residents and employees within a five kilometre catchment of the airport would have a direct feeder bus service to the new station(s).

The forecast suggests the proportion of people arriving by train at a Second Sydney Airport could be slightly higher than expected at Sydney Airport, because of less competition from bus services and the higher average cost of taxis. The proportion driving would also increase slightly.

For passengers, coach use is expected to be constant with or without a rail service. Taxi use would remain constant for international travellers, but decline slightly for domestic users, as many are expected to come from directions with little traffic congestion and high average distances, which improves the attraction of private cars compared to taxis. While 20 percent of air passengers are expected to travel by rail, the impact of meeter and greeter trips in this category reduces the overall rail share to 15 percent.

Table 22.3 presents estimated person trips to and from the Second Sydney Airport. They are derived from applying the modal splits in *Table 22.2* to the passenger forecast scenarios adopted for this Draft EIS.

Table 22.3 Forecast Daily Person Trips To and From Second Sydney Airport

Mode of Travel	Employees	International[1]	Domestic[1]	Total
Air Traffic Forecast 2: 2006				
Without Rail				
Car drivers	5,600	5,400	6,800	17,700
Car passengers	500	8,900	6,300	15,700
Taxis	100	2,900	5,700	8,800
Bus	300	1,000	1,200	2,500
Coaches	0	1,200	400	1,600
Rail	0	0	0	0
Total	**6,500**	**19,400**	**20,400**	**46,300**
With Rail				
Car drivers	4,700	4,900	6,100	15,700
Car passengers	300	7,700	5,700	13,800
Taxis	100	2,300	4,500	6,900
Bus	100	400	600	1,100
Coaches	0	1,200	400	1,500
Rail	1,300	2,900	3,100	7,300
Total	**6,500**	**19,400**	**20,400**	**46,300**
Air Traffic Forecast 3: 2016				
Without Rail				
Car drivers	15,700	23,300	12,200	51,200
Car passengers	1,500	38,200	11,500	51,200
Taxis	400	12,500	10,400	23,300
Bus	900	4,200	2,200	7,300
Coaches	0	5,000	700	5,700
Rail	0	0	0	0
Total	**18,500**	**83,200**	**37,000**	**138,700**
With Rail				
Car drivers	13,300	20,800	11,100	45,200
Car passengers	900	33,200	10,400	44,500
Taxis	200	10,000	8,100	18,300
Bus	400	1,700	1,100	3,200
Coaches	0	5,000	700	5,700
Rail	3,700	12,500	5,600	21,800
Total	**18,500**	**83,200**	**37,000**	**138,700**

Note: 1. Includes air passengers and meeters/greeters. For every two international passengers, there would be a meeter and greeter trip to and from the airport, while for every four domestic air travellers, a meeter or greeter trip is generated.

22.5.3 Effect of Fast Train Proposals

Several high speed rail schemes have been proposed for the Sydney-Canberra-Melbourne corridor, and several are still under investigation. Any realisation of these schemes would be due to a combination of financial market and government initiatives, but all the proposals are likely to use the rail corridor from Sydney Terminal (Central Station) through the Macarthur, via East Hills rail line to the Main Southern rail line.

The high speed rail proposals achieve their high speed through infrequent stops. If sufficient air passenger demand is generated from markets such as the Southern Highlands and Canberra, the most likely response would be to ensure that connecting trains or shuttle buses linked the high speed train stop for southern Sydney with the Second Sydney Airport.

The impact of the fast train on vehicle traffic generation for the Second Sydney Airport would be small. Underlying models of demand for the airport assign very few trips to these outer areas.

22.5.4 Future Vehicle Trips

Vehicle trips were derived by applying appropriate vehicle occupancies to the person trip totals. By 2016, between 66,000 and 77,000 daily vehicle trips to and from the Second Sydney Airport are forecast. The lower figure assumes a rail service would be available.

22.5.5 Traffic Generated During Construction

Information obtained from the Second Sydney Airport Planners (1997a) was used to establish the likely traffic generation due to construction activity, particularly of heavy vehicles. The expected timeframe for the construction of each airport option is described in *Part* C of this Draft EIS.

Night work was part of construction planning. This approach would save energy, and control costs, and would make efficient use of personnel and equipment. The major concrete and asphaltic paving operations for the runways, taxiways and aprons might be undertaken 24 hours a day for efficiency. Temporary roads would be established early during the construction period for construction traffic on the alignment of future permanent airport access roads.

Table 22.4 shows how the construction assumptions (Second Sydney Airport Planners, 1997a) would translate into vehicle numbers. The assumptions about truck movements are considered to be a worst case situation as a relatively small average truck size (18 tonne load) has been assumed.

Table 22.4 Traffic Generated During Construction of Option B or C[1]

Staging	Daily Traffic[2]			AM Peak[3]		PM Peak[3]	
	Car	Truck	Totals	In	Out	In	Out
Stage 1	2,700[4]	700	3,400	800	200	200	800
Master Plan	3,800	900	4,700	1,100	300	300	1,100

Notes:
1. *Traffic generated by Option A would be marginally less.*
2. *Two-way traffic volumes to and from the site.*
3. *Total cars and trucks.*
4. *Figures rounded to nearest 100.*

22.5.6 Transport of Aircraft Fuel

The alternatives available for the supply of aircraft (Jet A1) fuel to the airport site options are by road, rail or direct pipeline from the Shell Clyde Refinery near Parramatta. Fuel storage requirements for the Second Sydney Airport at its full capacity would be approximately 50 million litres. For the distance involved from refineries to the airport sites, a rail link is not considered appropriate by the fuel companies (Second Sydney Airport Planners, 1997c).

Based on Stage 1 development air traffic forecasts, and experience in Australian and overseas airports, a fuel pipeline is considered necessary (Second Sydney Airport Planners, 1997c). Nevertheless, forecasts were developed of the traffic impacts in the event a pipeline was not operating by 2006, but was operating by 2016.

If a pipeline is not available at the new airport, all fuel supply would be transported there by either standard articulated tankers (40,000 litres) or B-doubles (60,000 litres). The NSW Roads and Traffic Authority specifies routes to be followed by B-double tankers.

The number of truck movements would depend on the ratio of articulated tankers to B-double tankers. In 2006, truck transport of aircraft fuel is estimated to require between 40 trucks (assuming all B-doubles) and about 65 (assuming all articulated standard tankers) per day, or a mixed fleet of about 50 trucks per day. This would result in about 100 two-way trips per day along the routes between the Clyde Refinery or Plumpton storage facility and the airport site. The demand for piston engined aircraft fuel (AvGas) for general aviation and regional airlines is about 30,000 to 35,000 litres per day, or the equivalent of one additional tanker.

This level of truck traffic would be insignificant in comparison to background traffic flow on the roads used by the trucks, and would not have any measurable impact on the level of service along the selected routes.

22.6 Land Transport Impacts

22.6.1 Construction Impacts

As Options B and C are larger in area than Option A, and require a larger construction workforce, they were used as a basis for construction traffic assessment. During construction, temporary and permanent diversions of The Northern Road, Badgerys Creek Road and some improvements on Adams Road would be needed. Where possible, the existing Badgerys Creek Road and The Northern Road alignments would be used for distribution of materials during early stages of construction. Elizabeth Drive and The Northern Road (realigned) would be used for access after these initial alignments were absorbed into works at the site. The majority of the materials would be brought to the site by road from the south (Second Sydney Airport Planners, 1997a).

Table 22.5 provides a summary comparing the construction traffic impact with existing traffic levels. Traffic volumes along The Northern Road and Elizabeth Drive would experience the highest increase as a result of construction traffic. It is expected that the level of service along the two lane section of Elizabeth Drive would deteriorate to poor. The section of The Northern Road between Elizabeth Drive and Adams Road, which is the possible access to the airport site during construction, would need to be widened to four lanes.

Table 22.5 Daily Construction Traffic[1] for Airport Options

Major Approach Roads	Daily Traffic Volumes			
	Existing Traffic[2]	Construction Traffic	Total During Construction	Increase
Bringelly Road, east of The Northern Road	5,000	950	5,950	19%
Elizabeth Drive, east of The Northern Road	5,500	2,490	7,990	45%
The Northern Road, south of Elizabeth Drive	8,600	3,290	11,890	38%

Notes: 1. In equivalent passenger car units. Assumes construction to master plan stage.
2. From Roads and Traffic Authority and commissioned counts.

While other approach roads such as Bringelly Road and Wallgrove Road would also carry construction traffic, they would continue to operate at acceptable levels of service. Bringelly Road is expected to attract about 60 percent of the truck traffic, which would be 530 vehicles per day.

Public transport is considered to have little or no role in the construction phase. Even if it were decided to construct an extension of the East Hills rail line, it is not expected to be operating before the airport is opened. Local bus services, which interchange with train services at Liverpool and Penrith stations, are relatively infrequent but might carry a few employees. The buses are included in the forecast traffic numbers for the surrounding road network.

22.6.2 Rail Service

Alternatives for providing rail access to an airport at Badgerys Creek have been the subject of investigation by the State and Commonwealth Governments over recent years. There are two alternatives for Options A and B, a rail connection is proposed from the Cumberland and East Hills rail line junction at Glenfield Station to the airport sites (*Figure 22.4*).

The main corridor under consideration passes through Edmondson Park and Bringelly (Rail Alternative 1 on *Figure 22.4*). The State Government is also considering the long term potential of connecting the rail line to the Main Western rail line near Werrington. One advantage of this connection was to have been its use as an alternative rail freight path off the congested passenger routes. However, freight use of the new line may be precluded by noise impacts and the proposed tunnel under the airport.

For Option C, rail access would be similar to that for Options A and B; however, for urban planning reasons, an alternative rail corridor (Rail Alternative 2 on *Figure 22.4*) through Rossmore may be considered more appropriate.

A rail extension west from Glenfield Station was originally proposed to serve residential development in Ingleburn and South Creek. Planning for an airport at Badgerys Creek has considered a further extension to that rail line from early concept planning stages. Investigations into the feasibility of this line have all been done using passenger and employment data from the *Second Sydney Airport Site Selection Program, Draft Environmental Impact Statement* (Kinhill Stearns, 1985). With an increase in potential airport passenger numbers from 13 million annually to 30 million in 2016, the case for a rail link for Stage 1 of airport operation is strengthened.

Studies undertaken for the Taskforce on Planning for the Sub-Region Surrounding Sydney West Airport (1996) preferred Rail Alternative 1 (refer *Figure 22.4*) over Rail

Figure 22.4
Rail Access Alternatives

Source: Second Sydney Airport Planners, 1997c

Note: Rail corridors are indicative only and not drawn to scale. Actual rail line would be narrower.

Alternative 2, because it offered greater access to the South Creek development area. Any final selection of a rail route has been deferred pending resolution of the airport' s location and configuration.

The railway would be constructed at grade, except in the airport site itself where it would be placed underground to facilitate access to the airport and terminal area. Given the length of the route, a dual track system is envisaged. Both rail alternatives incorporate an extension of the East Hills rail line from Glenfield. This line would allow a further direct rail connection with the Main Southern and Cumberland rail lines at Glenfield, if appropriate junction infrastructure was also added to the capital works program. If such a junction were provided, then trains could run from Blacktown or Campbelltown, and even from the Southern Highlands and Canberra directly into the airport. Otherwise, passengers would need to transfer from these lines at Glenfield Station.

The airport service would be integrated with other CityRail services. The extension is part of the East Hills rail line, which is being progressively duplicated to four tracks from Central to Riverwood. The New Southern Railway provides the additional two tracks between Central and Turrella. New track amplification works are proposed between Turrella and Riverwood, but they are not expected to be completed before the year 2000.

Further capacity has been added to the East Hills rail line by the construction of a grade-separated junction where it crosses the Illawarra rail line. Capacity has been increased by building a facility that allows the two lines to function independently. A new station, North Arncliffe, will also allow passengers to transfer between the two rail lines; this would be a great advantage for passengers travelling between Illawarra, the South Coast and a new airport.

Table 22.6 contains the combined forecasts for rail patronage on the entire extension from Glenfield to an airport at Badgerys Creek. The passengers and meeters and greeters would be by far the biggest source of patronage for the rail line. In 2006 they would represent over 38 percent of all daily travel. This would increase to 50 percent with the full operation of the airport in 2016. The rail line would rely on activity levels at the airport for the bulk of its revenue, even with the development of new urban centres along the route.

Table 22.6 Potential Daily Rail Passengers on Glenfield Rail Extension to Airport

	2006	2016
Employees[1]	1,300	3,700
Passengers and meeters/greeters[1]	6,000	18,000
Non-airport employees[2]	1,600	3,800
Residential[2]	6,700	10,300
Total Passengers	**15,600**	**35,800**

Notes: 1. From patronage forecasts in Table 22.3.
2. From Long Technical travel modelling.

On a daily basis, about 20 percent of employees would be expected to use the rail. Airport employees would represent under 10 percent of rail passengers on the extension. Additional patronage for the rail would come from employees in ancillary services such as freight forwarding, catering, and hotels, as well as business attracted to the area by the improved access and serviced land. The mode split for this group would be lower than for airport employees because they would be further from the station and less restricted in their parking options. Non-airport employees would be expected to generate about 10 percent of patrons on the rail extension by 2016.

About 30 percent of rail trips by 2016 would be generated by the residential catchment along the proposed railway line. As long term employees are expected to cluster in residential areas near the site, the better the rail connection between the airport and the residential areas, the more likely that rail would be selected as a travel mode in competition with private car travel.

The extension of CityRail services to the Second Sydney Airport has been studied and has formed part of the *Draft State Rail Strategic Plan*. Physically, the extension of the East Hills rail line has been demonstrated to be feasible. The extension can be accommodated within the operating plan of the rail network, although some circumstances have changed in the land use profile assumed in earlier studies.

By increasing the proposed operating limit of the Second Sydney Airport from 13 million (Kinhill Stearns, 1985)to 30 million passengers annually, the airport would contribute significantly more to the long term viability of the rail link. Through the attraction of a larger airport, the likely employment in the neighbourhood of the site would also increase. Traffic generated by these activities would also increase, and might act to improve the competitive characteristics of rail.

Some aspects of the rail service deserve further detailed analyses given the changed circumstances. If a larger airport were developed, then consideration should be given to:

- the advantages of a Y-junction at Glenfield to allow trains to travel to the airport directly from Campbelltown and the southern regions of NSW;
- the possibility of advancing the start of work on an extension of the airport rail spur to the Main Western rail line near St Marys; and
- a re-examination of the radii of curves proposed for the new line to achieve faster travel times.

At a 15 minute service frequency, a capacity for 6,400 passengers per hour would be available at the airport. Passengers boarding at the airport would board an empty train. Yet passengers travelling to the airport during the peak evening commuter flow might find it difficult to get seats on express trains to the west. Most employees would be travelling in the reverse direction to peak flows. This would assist the economic viability of the rail link.

Rail travel between Options A and B and the Parramatta and Sydney central business districts would be 33 minutes and 48 minutes respectively. The equivalent travel times for Option C would be 30 minutes and 45 minutes if the shorter rail route (Rail Alternative 2) is assumed. These rail times are not subject to congestion costs beyond those already reflected in the timetable for November 1996 from which they were derived.

22.6.3 Road Access

It is anticipated that the main road access for passengers, meeters and greeters and some commercial traffic to the airport would be via Elizabeth Drive. An EIS on the proposed upgrading of Elizabeth Drive was released in 1995 (Rust PPK, 1995). That proposal envisaged a high standard, six lane road linking the airport entrance to Wallgrove Road and the proposed Western Sydney Orbital. The Western Sydney Orbital proposal is part of an emerging orbital high standard road linking major employment and residential areas of Sydney. The development of this road is presently the subject of separate environmental investigations.

A second access road to the airport sites has also been investigated. It would involve the upgrading of Bringelly Road and The Northern Road and would provide access to the freight, maintenance and general aviation facilities proposed for the southern areas in each of the airport options. It would provide access from the airport to the Western Sydney Orbital, M5 Motorway and South Western Freeway.

For all three airport options, The Northern Road would need to be relocated to allow the construction of runways and other airport facilities. The master plans also propose the closure of Badgerys Creek Road. The Northern Road would provide a link around the airport between the two access roads to the airport.

The routes for the potential transport of aviation fuel by road to the airport sites would be Silverwater Road, M4 Motorway, Wallgrove Road and Elizabeth Drive. Direct road access to the airport site would be via Elizabeth Drive. Alternatively, road tankers transporting aviation fuel could travel along Silverwater Road, Great Western Highway, Wallgrove Road and Elizabeth Drive.

A risk assessment of the above routes would have to be undertaken to select a preferred route, with the least risk factor, for fuel supply to the airport site.

22.6.4 Role of Roads in Public Transport Provision

Roads would not only serve private and business travel; they would also be major routes for public transport services to the Second Sydney Airport. At least three percent of employees and 20 percent of air passengers and meeters and greeters would arrive in road based public transport vehicles. This would increase to seven percent and 26 percent respectively, if no rail service were available.

Local bus services are currently available in the study area, but they are infrequent. Westbus routes travel into the area with a terminus at either Penrith or Liverpool Station. The addition of a rail station at the airport would also allow existing services to offer access to the East Hills Line, which is the fastest way into the inner city from this sub-region. Improving road networks would increase the efficiency of bus routes, and new employment locations along the routes would improve the density of demand within the service corridors.

New bus services may be developed with such a major generator located in the area. As well as serving local residents, new markets would be found in offering airport access to sectors not well served by rail such as the Hills District and St Marys, if a northern rail extension is not built. Accommodation for airport passengers may generate demand to destinations such as Australia's Wonderland and Penrith Lakes. A service would be needed, if a viable catchment is to be accessed by the airport rail station, to bring local residents to the airport and the rail station for interchange. Buses would also distribute employees to the workplaces in the catchment of the airport station. Provision for local buses should be included in the roadways, including any measures necessary to give them priority through potentially congested areas.

Tourist coaches are a major feature of the growth in international tourism. They provide the door-to-door link between the airport and major accommodation and activity sites. Non-English speaking tourists would rely heavily on coach travel, and the mode share for coaches is expected to remain at about six percent, whether or not a rail link is provided.

Coaches would primarily travel in an express mode from the Central Business District and use the limited access road system to the airport. While the number of vehicles involved is not high, these vehicles need to provide a high level of service and must be able to negotiate the access systems proposed for the terminals.

Taxis are a very important mode for air passengers. Taxi users pay a premium for speed and comfort of travel, so they are sensitive to congestion and other delays. Even with the high quality rail service proposed, a low diversion rate from taxi to rail is anticipated, since many taxi users are reimbursed by their employers, are carrying luggage, and/or wish to reach destinations not well served by the public transport network.

Travellers typically select their mode on the basis of time and cost for the door-to-door trip; thus for public transport to achieve the highest potential mode share, major access corridors would not allow public transport vehicles to be subject to congestion delays, and the modes would relate easily to the terminals. Priority would be seen to be given to bus, coach and taxi vehicles over private cars. Terminal design would need to ensure quality access for the vehicles to passenger services.

22.6.5 Impact on the Road Network

Table 22.7 summarises the total airport traffic generation assumed in the model for the two forecast years. Volumes entering and leaving the airport in the morning and evening peak are shown separately. Peak traffic generation associated with the airport includes ancillary on site development. In 2006, substantial traffic would be generated by the airport itself, with little associated with secondary development. By 2016, however, it is assumed that secondary development would contribute substantial traffic in the peak hours.

Table 22.7 Peak Hour Traffic To and From the Airport

Year		Airport Terminals	Other On Site Developments	Total
2006	morning	2,720	1,950	4,670
	evening	2,550	1,950	4,500
2016	morning	7,430	3,150	10,580
	evening	6,660	3,150	9,810

The model results indicate that the following main routes would be used by traffic accessing the airport site:

- from the north, access between the airport and the M4 Motorway would use either Mamre Road/Luddenham Road/Elizabeth Drive or the Western Sydney Orbital (Wallgrove Road in 2006) and Elizabeth Drive;
- from the north-west, access would be via The Northern Road or Mulgoa Road;
- from the east, access would be via the M5 Motorway onto the Western Sydney Orbital, and using Elizabeth Drive to connect with the airport; and
- from the south-east, access would be via the South Western Freeway and Bringelly Road, connecting with The Northern Road entrance to the airport.

Loading the high morning and afternoon peak traffic volumes associated with the airport onto the unimproved forms of these roads would result in widespread congestion and unacceptable levels of service particularly on current two lane roads such as Luddenham Road, The Northern Road and Bringelly Road. *Table 22.8* provides summary results for key locations.

The model indicates that from a regional perspective, the closure of Badgerys Creek Road would not require provision of a replacement link. Adequate service between Elizabeth Drive and Bringelly Road would be provided by Devonshire Road and King Street.

Table 22.8 Future Traffic Volumes[1] on Key Approach Roads to Second Sydney Airport (Average Daily Traffic)

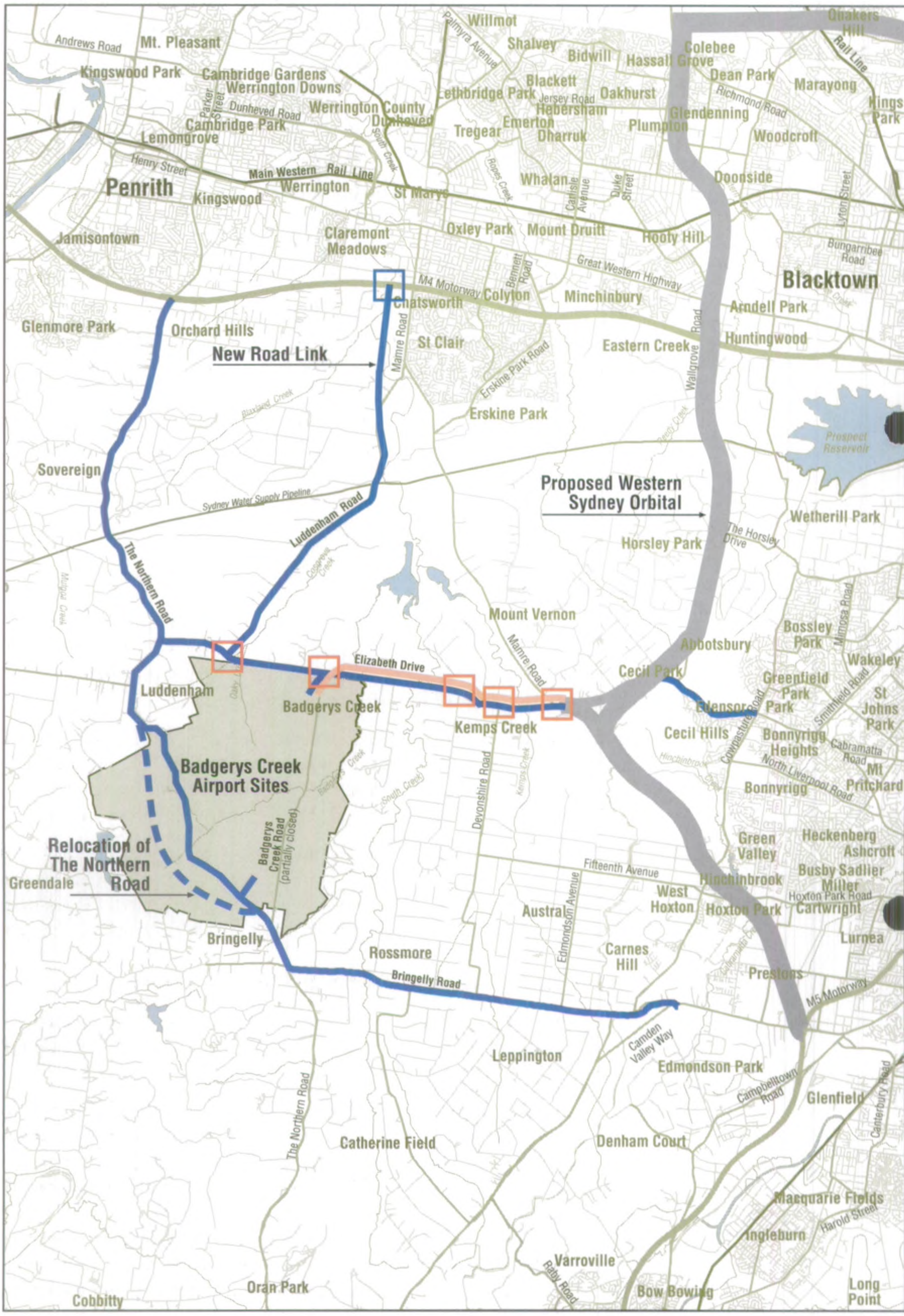
Location Description	Without Airport 2006	With Airport (Forecast 2) 2006	Increase	Without Airport 2016	With Airport (Forecast 3) 2016	Increase
Airport Entrance (Elizabeth Drive)	n/a	24,600	n/a	n/a	61,400	n/a
Airport Entrance (The Northern Road)	n/a	8,800	n/a	n/a	20,200	n/a
Bringelly Road west of Cowpasture Road	23,200	29,200	26%	18,700	31,800	70%
Elizabeth Drive west of Wallgrove Road	23,200	30,200	30%	20,300	37,400	84%
Elizabeth Drive west of Mamre Road	14,000	26,600	90%	17,500	43,600	149%
Luddenham Road north of Elizabeth Drive	7,100	24,500	245%	4,600	55,000	1,100%
M4 Motorway east of Wallgrove Road	128,000	141,600	11%	131,200	160,000	22%
Mamre Road south of M4 Motorway	33,600	46,800	39%	26,800	68,600	156%
The Northern Road north of Bringelly Road	17,900	29,000	62%	18,700	47,800	156%
	80,900	85,000	5%	106,200	119,500	13%
M5 Motorway east of Moorebank Avenue	n/a	n/a	n/a	85,400	88,000	3%
Western Sydney Orbital south of M4 Motorway	37,800	37,800	0%	70,900	75,400	6%

Note: 1. Figures rounded to nearest 100.

A number of intersections near the airport sites have been identified as being in need of upgrading in the future, as a result of airport activities. These upgradings include the provision of traffic signals or grade separated junctions.

Substantial improvements to the road network surrounding the airport sites would be required to achieve satisfactory access to the airport and to maintain an acceptable level of service to existing land uses in the vicinity. *Figure 22.5* shows minimum requirements. These improvements are in addition to those previously identified to cater for background traffic growth, and include:

- establishment of a direct access route from the airport site to the M4 Motorway of four lane divided carriageway standard, by 2006. This could connect with the M4 Motorway at either Mamre Road or at the site of the future Werrington Arterial (connecting the M2 Motorway to the M4 Motorway) to the west of Mamre Road;



Four Lanes by 2006
Six Lanes by 2016
Grade Separation by 2006
Grade Separation by 2016

Figure 22.5
Road Network Improvements Required for Airport Options

Note: Road corridors are indicative only and not drawn to scale. Actual roads would be narrower.

- upgrade of Elizabeth Drive between The Northern Road and Wallgrove Road to four lane divided carriageway standard by 2006, and six lanes by 2016;
- relocation and upgrade of The Northern Road north of Bringelly Road to the M4 Motorway to provide a four lane carriageway by 2006;
- upgrade of Bringelly Road between The Northern Road and its junction with Camden Valley Way to four lanes, by 2006; and
- provision of appropriate traffic controls at critical intersections.

Road travel times between the airport and Sydney's Central Business District during the morning peak are likely to be 74 minutes from the airport and 60 minutes to the airport. The corresponding travel times between the airport and Parramatta's Central Business District would be 42 minutes and 38 minutes respectively.

Costs associated with the above road improvements are outlined in *Chapter 24*. The improvements do not include a number of major road projects which have been proposed to meet a number of strategic transport objectives including benefiting the operation of the Second Sydney Airport. These projects include the Western Sydney Orbital and M5 East Motorway where environmental approvals and funding arrangements have yet to be finalised.

22.7 Impacts on Aviation

22.7.1 Overview

Each airport option would have an impact on activities at other airports in the Sydney basin. The degree of impact depends upon the proximity of the proposed site to other airports, its runway orientation and configuration and the compatibility of operations with those at the existing Sydney Airport.

The terminal airspace requirements for each airport option under consideration have been assessed for their impact on Sydney Airport, on other airports and airfields at Bankstown (including access lanes and flying training areas), Hoxton Park, Camden, Wilton and RAAF Base Richmond (Second Sydney Airport Planners, 1997a).

In considering these issues, a qualitative assessment was undertaken by the Second Sydney Airport Planners (1997a). In addition, discussions were held with Airservices Australia, which had undertaken some preliminary quantitative modelling of airspace operations in the Sydney region in relation to the Second Sydney Airport options.

22.7.2 Interaction with Sydney Airport

The operation of Option C would be compatible with the operation of Sydney Airport. Significant interactions would, however, occur between the operations of Options A and B and Sydney Airport.

Aircraft departing runway 05 or landing on runway 23 would interact with aircraft operating in the same modes on runways 34 and 16 respectively at Sydney Airport (for an explanation of runway descriptors see *Figure 8.5*). The area of interaction would occur approximately 28 kilometres north-west of Sydney Airport. There would be a significant number of aircraft in this general area which covers a well populated part of Sydney. As this area of convergence is close to each airport and directly related to the critical operational phases of final approach and initial departure, only limited flexibility exists in devising acceptable air traffic management procedures (Second Sydney Airport Planners, 1997a).

It could be anticipated, therefore, that there would be a significant increase in the number of aircraft operating in the lower altitudes below about 1,800 metres than at present. For example, aircraft departing runway 05 in Options A or B would be in conflict with aircraft departing runway 34 left at Sydney Airport and consequently, one of the departing aircraft would be required to maintain a given level while the other reached a level of 300 metres above it. The complex air traffic management procedures required to handle this would result in airborne and ground delays under peak traffic conditions, to the extent that the capacity of each airport would experience additional constraint.

22.7.3 Interactions with Secondary Airports

The existing north-west general aviation access to and from Bankstown Airport might not be possible because of the operation of Option A. An alternative access would be via the south-west. This would involve an increased transit distance of approximately 37 kilometres for aircraft travelling to and from the west. Modifications would be needed to current instrument approach and departure procedures at Bankstown. Existing flying training areas used by aircraft based in the Sydney basin would also need to be relocated (Second Sydney Airport Planners, 1997a).

Impacts of Option A would likely result in the closure of Hoxton Park Airport. Camden Airport's control zone might be reduced to accommodate departures and the current instrument approach would cease. The airport would revert to operations under Visual Flight Rules only. Powered aircraft operations could take place only to the south of Camden and circuit height would be limited to 305 metres. Glider flying operations would also need to be relocated from Camden Airport.

Modifications would be required to the RAAF Base Richmond military control zone to accommodate a civil control zone around Option A. In addition, there would be increased use of Richmond military airspace to accommodate arriving and departing civil aircraft, because of its close proximity to the proposed site.

Option B would have the same impacts as Option A, except for RAAF Base Richmond and Camden Airport. The addition of the cross wind runway (15/33) might increase the need for civil access to military airspace at RAAF Base Richmond, to process arrivals on runway 15 and departures on runway 33. Additional airspace limitations might also be imposed over Camden Airport (Second Sydney Airport Planners, 1997a).

The impacts on Bankstown and Hoxton Park airports from the operation of Option C would be the same as those from Options A and B. Since final approach paths for runways 36 left and right and departure tracks from runways 18 left and right would overlie Camden, the operational capacity of this airport would be reduced significantly, in the event of Option C becoming operational. The impact of Option C on RAAF Base Richmond would be similar to the impacts of Option A, but with increased need for civil use of the Richmond military control zone and associated restricted areas (Second Sydney Airport Planners, 1997a).

22.7.4 Impacts of Restricted Airspace

The three airport options would be constrained to varying degrees because of the proximity of the restricted airspace over Defence Establishment Orchard Hills. The potential closure of Defence Establishment Orchard Hills is mentioned in a recent Defence review (Department of Defence, 1997a), and will be the subject of further Government consideration.

The impacts that restricted airspace would have on the airport options should these facilities not be relocated are:

- Options A and B — intrusion into circuit area on downwind leg to runway 05L/23R; and
- Option C — serious operational impacts for approach and departure to the parallel runways. The airport capacity would be significantly reduced.

The Australian Ordnance Council has advised that it is reviewing the Orchard Hills restricted airspace in the light of the airport proposals. The dimensions of the existing restricted airspace are predicated on current aviation activity in the area, which is essentially general aviation of a random nature. However, should a major airport be established at Badgerys Creek while Defence facilities remain at Orchard Hills, the Council considers that additional special airspace might need to be established, given the increased number and type of aircraft that would be using the contiguous airspace. Such additional special airspace could cover a larger area than currently exists and could be active for up to 24 hours a day. Under this scenario, the proposed 18/36 runways of Option C would be unable to operate effectively and the operation of Options A and B would be adversely affected because of airspace restrictions in the circuit areas (Second Sydney Airport Planners, 1997a).

22.7.5 Impacts on Other Aviation

Parachute activities near Menangle would be severely restricted as a result of overflying aircraft using any of the airport options. In addition, continued parachute activities at Wilton would be a function of traffic and airspace management.

There would be a need to relocate the existing general flying training areas, which are to the west of Sydney, under all of the airport options. These areas are used extensively by flight training organisations at Bankstown, Hoxton Park and Camden. Readily available access to flight training areas is an intrinsic element for the continued viability of these organisations. Relocation in the general vicinity of Wollongong, Warnervale or Richmond may be feasible.

It would be necessary too, to consider which airport(s) should be developed to accommodate operations displaced from their current location(s) because of the impact of the Second Sydney Airport. For example, if Camden or Hoxton Park airports were to be downgraded or closed, then up to 120,000 or 100,000 annual aircraft movements, respectively, would need to be catered for elsewhere (Second Sydney Airport Planners, 1997a).

22.8 Environmental Management

While the Second Sydney Airport would be a very large construction project, most consent authorities have extensive experience in managing the externalities of construction activity. The principles of dust abatement, vehicle cleaning, on-site materials storage and security fencing would apply, even if the scale were greater than usual. Roads that appear unable to cope with the extra construction traffic at current lane provision have been identified.

Potential routes that could be used for fuel haulage have been identified. A risk assessment where alternative routes are possible is recommended. Its purpose would be to reduce the safety risks for drivers and others, reduce potential environmental damage and preserve amenity. The greatest reduction in risk and environmental impact would arise from the transport of fuel by pipeline.

The development and use of a Second Sydney Airport offers considerable economic and employment opportunities to the metropolitan area. Throughout the consultation process, views were expressed that these opportunities should not be compromised or overwhelmed by the negative impact of traffic generation to the new airport. A coherent traffic management strategy would be required.

Train service would be a major component of the traffic management strategy for the Second Sydney Airport. For 2016, a rail service would carry approximately 36,000 people a day to the airport.

To achieve the modal share indicated for public transport, the following characteristics are assumed for the rail service and traffic management plan:

- frequent rail service of at least four departures and arrivals an hour during the off peak;
- good access from the airport station to all airport passenger facilities;
- skip stop or express operations between Glenfield Station and North Arncliffe Station to allow transfers but minimise travel time;
- restrictions on car parking on the airport site; and
- fares that are competitive with other modes.

All of these imply active funding and operational support from all levels of government toward a rail link to the airport.

22.9 Summary of Potential Transport Impacts

22.9.1 Land Transport

General observations that should be noted about the transport impacts of the Second Sydney Airport include:

- restricting Sydney to its single existing airport would constrain growth in air travel because, among other aspects, Sydney Airport is constrained by its ability to accept significant further growth in surface traffic;
- the growth in traffic levels predicted from the development of the metropolitan area places enormous demands upon the existing road network. The additional roadworks required for the airport itself are relatively small, assuming the background demand has been addressed. The airport would benefit from the backgrounds works, but is not sufficient itself to justify the works;
- a strong and viable rail service was assumed in each option. If a rail link is not developed, an additional 11,000 vehicles a day would travel to and from the airport; and
- the predictions of the airport traffic impacts on surrounding motorways were based on preliminary modelling, where the 2006 and 2016 networks did not include some capacity improvements required to accommodate predicted traffic demand, even without a second airport.

The Second Sydney Airport would impact on public transport systems and the road network during both construction and operation. During the peak construction period there would be about 900 trucks a day travelling to and from the airport site and up to 3,800 vehicle trips a day by construction workers. A number of roads around the airport would require upgrading to handle this traffic.

It is estimated that in 2016, up to 139,000 people would travel to and from the airport by car, truck, taxi, bus or train each day. This would result in between 66,000 and 77,000 vehicle trips to and from the airport each day. The lower figure assumes a rail line would be provided, and the higher figure has been calculated to assess transport impacts if the rail line were not provided.

Alternatives for providing rail access to an airport at Badgerys Creek have been the subject of investigation by the State Government and Commonwealth Government over recent years. The main corridor being considered passes through Edmondson Park and Bringelly. A further rail corridor direct from Rossmore to the airport site may be considered to serve Option C.

For all the airport options considered, the major impact of vehicular traffic associated with the airport would be to increase flows on motorways in the current off peak direction. This would result in more effective utilisation of existing and future road network capacity and minimise additional road infrastructure requirements. The level of road network improvements associated with the airport is small in comparison with likely Sydney-wide investment in road infrastructure arising from background increases in road demand.

The airport site is in a region currently characterised by low volume rural roads. The expanded traffic volumes associated with the Second Sydney Airport would require substantial upgrading of these roads to provide access to the surrounding freeway system, including the M4 Motorway, the Western Sydney Orbital and the M5 Motorway. With these improvements, the site is well situated to distribute traffic across a variety of approach corridors.

22.9.2 Other Aviation Activities

Options A and B would lead to significant interactions between aircraft using the second airport and aircraft using Sydney Airport. The anticipated level of interaction may adversely impact on the capacity of the two airports. Both these options would also adversely impact operations at Bankstown and Camden airports. Hoxton Park Airport would have to be closed and parachute activities at Menangle and Wilton would be severely curtailed.

Option C is compatible with operations at Sydney Airport, but would be unable to operate effectively if the Defence Establishment Orchard Hills continued to impose restrictions on airspace use. It would also significantly reduce the capacity of Camden Airport, and there would be some impacts on operations at RAAF Base Richmond. It would have the same impacts as Options A and B on Bankstown, Hoxton Park and parachute activities at Menangle and Wilton.

Chapter 23

Visual and Landscape

Chapter 23
Visual and Landscape

A visual and landscape study of the proposed airport site area was undertaken for this Draft EIS and is documented in Technical Paper No. 14. A summary of the main findings and conclusions of the study is presented here.

23.1 Issues Raised During Consultation

The visual impact of aircraft flying overhead was a concern raised during consultation with comments referring to potential loss of scenic character.

Some comments noted that the airport options would impair the view to the west from Wallgrove Road, the view of the night skies visible from Horsley Park and the renowned vistas to Blue Mountains National Park. By contrast, some submissions have commented that an airport at Badgerys Creek could 'end suburban wasteland out west'.

The Orchard Hills area was a focus for comment, as some of the areas in the preliminary flight path of Option C have been zoned as 'Agriculturally Protected' in *State Regional Environmental Plan No.25 - Orchard Hills* (Department of Planning, 1991d). One of the aims of this Plan is to protect the scenic quality of the area.

23.2 Methodology

The aims of the visual and landscape assessment were to:

- describe the existing landscape and visual quality of each of the airport sites;
- analyse the landscape and visual impacts of the construction of an airport on each of the airport sites; and
- propose appropriate measures to minimise the landscape and visual impacts.

These aims are reflected in the methodology used. The existing landscape of the airport sites and their surroundings/context were described in terms of topography, vegetation and land use patterns. From this information, views into the site that would be affected by the construction of an airport were identified and mapped and the level of visual sensitivity and sensitivity to change for each site assessed.

Potential impacts of the airport options for the construction and the operational phases of the proposal have been identified. Landscape and visual impacts have been described separately. Landscape impacts are those that change the general fabric and pattern of the existing landscape and its component parts; visual impacts relate solely to alterations to views of the site or to viewing opportunities. From the available information the likely magnitude of the potential impacts has been estimated and the significance of the various impacts assessed. Strategies and techniques for reducing the potential landscape and visual impacts have then been determined.

23.3 Existing Environment

The three sites, Options A, B and C are located in the South Creek valley in a transitional landscape zone between the relatively flat Cumberland Plain and the footslopes that rise to the Blue Mountains.

Topography of the sites is gently undulating with broad rounded crests and ridges with gentle sideslopes. Major ridge lines occur along The Northern Road and perpendicular to it, in the western part of the sites. The lower and flatter parts of the sites are to the east in the vicinity of Badgerys Creek.

Approximately 90 percent of the vegetation cover of the site consists primarily of cleared pastures and grasslands with the balance comprising small clusters of remnant/regrowth woodland and cleared/scattered woodland and shrubland.

The existing landscape of the sites and the general environs is typical of the larger South Creek valley area, being essentially rural in character and having parkland qualities. These characteristics result from the combination of gently undulating terrain, creeklines, cleared pastureland and scattered groupings of trees. This landscape type is well represented in the region and therefore is not considered significant in regional terms.

Items of landscape heritage, including both cultural landscapes and areas of remnant vegetation within and surrounding the sites of the airport options, have been listed by several heritage studies. They are listed in *Table 23.1*.

Table 23.1 Heritage Landscapes Within and Surrounding the Airport Options

Heritage Item	Description	Listings
Cosgrove Creek, remnant native vegetation corridor	An area of regional importance as a natural area, wildlife habitat and scenic area. Has pockets of excellent creekside vegetation varying in size along its length.	SCHS[1]
Badgerys Creek, remnant native vegetation corridor	An area of regional importance as a natural area, wildlife habitat and scenic area. Has pockets of vegetation varying in size along its length.	SCHS
South Creek, remnant native vegetation corridor	An area of regional importance as a natural area, wildlife habitat and scenic area. Has pockets of vegetation varying in size along its length.	SCHS
Kemps Creek, remnant native vegetation corridor	An area of regional importance as a natural area, wildlife habitat and scenic area. Has pockets of vegetation varying in size along its length.	SCHS
McMaster Field Station Scenic Landscape, Elizabeth Drive, Badgerys Creek	A pastoral landscape with lake-like expanses of water, native creek vegetation and a backdrop of green hills. Of regional significance. Absence of intrusive transmission wires is important.	SCHS
Remnant vegetation along Elizabeth Drive	Indigenous roadside Eucalyptus forming a natural avenue with other native trees for around one kilometre along Elizabeth Drive. Is recognised as having regional significance.	SCHS
South Creek Basin	An area of high local visual/natural importance consisting of undulating hills with remnant vegetation along the creeks and in paddocks.	PHS[2]

Notes: 1. *South Creek Heritage Study (Permual Murphy, 1990)*
2. *Penrith Heritage Study (Fox Associates, 1987)*

23.4 Visual and Landscape Impacts

23.4.1 Option A

Construction Impacts

Major impacts during construction would result from modification of the existing undulating landform of broad crests and gentle slopes generally between Badgerys Creek in the south-east and Cosgrove Creek in the north-west, as a result of formation of the basic airport platform. Associated with this landform modification would be the loss of the upper section of Oaky Creek and numerous other swale formations feeding Cosgrove and Badgerys Creeks. The area in which the landform would be modified is shown in *Figure 23.1*. Virtually all the existing vegetation would be cleared from the western, elevated portion of the site.

The existing rural visual character of undulating cleared pasture land with a scattered vegetation cover over the site would be replaced by a large scale, flat industrial/ commercial environment. Restricted views and viewing opportunities of the site are generally experienced from peripheral roads. Views of the site from other locations further away, such as Wallgrove Road, are not possible as they are generally obscured by the intervening terrain, vegetation or urban development.

Operational Impacts

Realignment of The Northern Road further to the west would remove the opportunity for panoramic views to the east over the site and beyond to Cecil Hills. Views to the east along the central and northern sections of the new alignment would generally be restricted.

Views into the site from Elizabeth Drive would be restricted by the fill embankments proposed along northern and eastern margins of the airport platform and by the development of airport support facilities in the general vicinity of the intersection of Badgerys Creek Road and Elizabeth Drive. The airport terminal and associated facilities would most likely create a *built form* skyline.

As the northern section of Badgerys Creek Road between Badgerys Creek and Elizabeth Drive would be removed, views from this section would not be possible. Views from the southern portion are unlikely to change as the topography—remaining scattered woodland vegetation and riverine vegetation along Badgerys Creek—would effectively screen the airport from view.

From Lawson Road the removal of part of the western ridgeline and vegetation cover would be apparent; however, it is unlikely that any of the runway, apron areas or other ground surfaces would be visible. Parts of the terminal building, however, might be visible above the vegetation line along Badgerys Creek.

Some landscape and visual impacts would result from the subsequent development of areas around the airport, resulting in further landform modification and possible loss of existing vegetation. These visual impacts resulting from the operational phase would probably be much greater than the potential landscape impacts, and would arise from the subsequent development of the fringe areas of the airport. Such fringe areas would become key elements in controlling the visual perceptions of the airport and its environs.

The ability of land surrounding the airport sites to accommodate future urban development would be influenced by potential impacts on the heritage landscapes listed in *Table 23.1*. Regional planning guidelines would also need considering, such as *Sydney Regional Environmental Plan No. 20 - Hawkesbury-Nepean River* (Department of Planning, 1989) and *State Regional Environmental Plan No. 25 - Orchard Hills* (Department of Planning, 1991d).

Night lighting would have some impact on the existing visual environment, but it is uncertain how much. Impacts on adjoining properties would depend upon separation distances from the airport boundary.

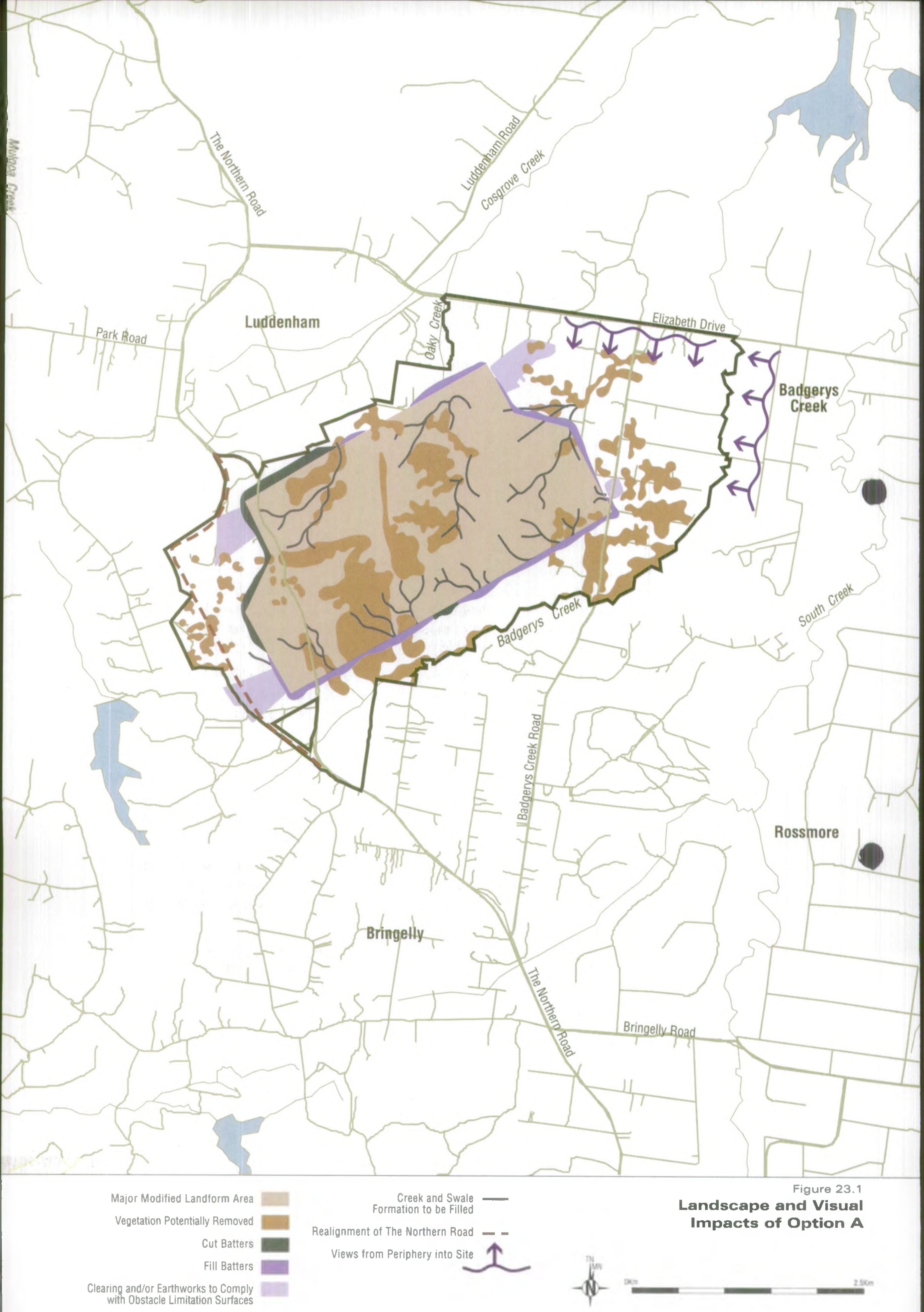


Figure 23.1
Landscape and Visual Impacts of Option A

23.4.2 Option B

Construction Impacts

The visual impact of Option B during the construction phase would be similar to that for Option A, and relates essentially to modification of landform and clearing of existing vegetation (*Figure 23.2*).

Modification of the existing undulating landform arising from the development of the basic platform for the runways would be more extensive than for Option A, with the platform extending further to the south and west. The southern runway would be virtually on top of the uppermost section of Badgerys Creek; the upper section of Oaky Creek would need to be removed along with numerous other swale formations feeding Cosgrove Creek to the north and Duncans Creek to the west.

The impact on vegetation would be more extensive than for Option A. It would includes the loss of all of the remnant/regrowth woodland and scattered groupings of trees on the elevated western portion of the site; the riverine vegetation along the upstream section of Badgerys Creek; and the scattered woodland to the south of this section.

Operational Impacts

Realignment of The Northern Road to the west would remove the opportunity for panoramic views to the east over the site, and beyond to Cecil Hills. Along the southern section, the road alignment rises across the elevated lands to the south of the crosswind runway, and from this elevated section expansive views to the north over the airport site may be possible.

Views into the site from Elizabeth Drive would be restricted by the fill embankments proposed along the northern and eastern margins of the airport platform. As for Option A, the airport terminal and associated facilities would most likely create a *built form* skyline.

The northern and central sections of Badgerys Creek Road would be removed. Along the southern section, views would be unlikely to change as the topography and remaining scattered woodland vegetation would largely screen the airport from view. Nevertheless some sections of the southern edge of the airport might be visible, as existing vegetation along Badgerys Creek would be removed.

From Lawson Road, much of the airport would probably not be seen; however, parts of the terminal building might be visible above the vegetation line along Badgerys Creek, as well as other building elements associated with the airport support facilities and services in the north-eastern portion of the site.

Operational impacts arising from subsequent development of adjoining areas, and the impact of night lighting, would be much the same as for Option A.

23.4.3 Option C

Construction Impacts

The visual impact of Option C during the construction phase would be similar to that for Options A and B, and relates essentially to modification of landform and clearing of existing vegetation (*Figure 23.3*).

Construction impacts for Option C would be similar to those for Options A and B in terms of the modification to the undulating landform from the basic platform for the

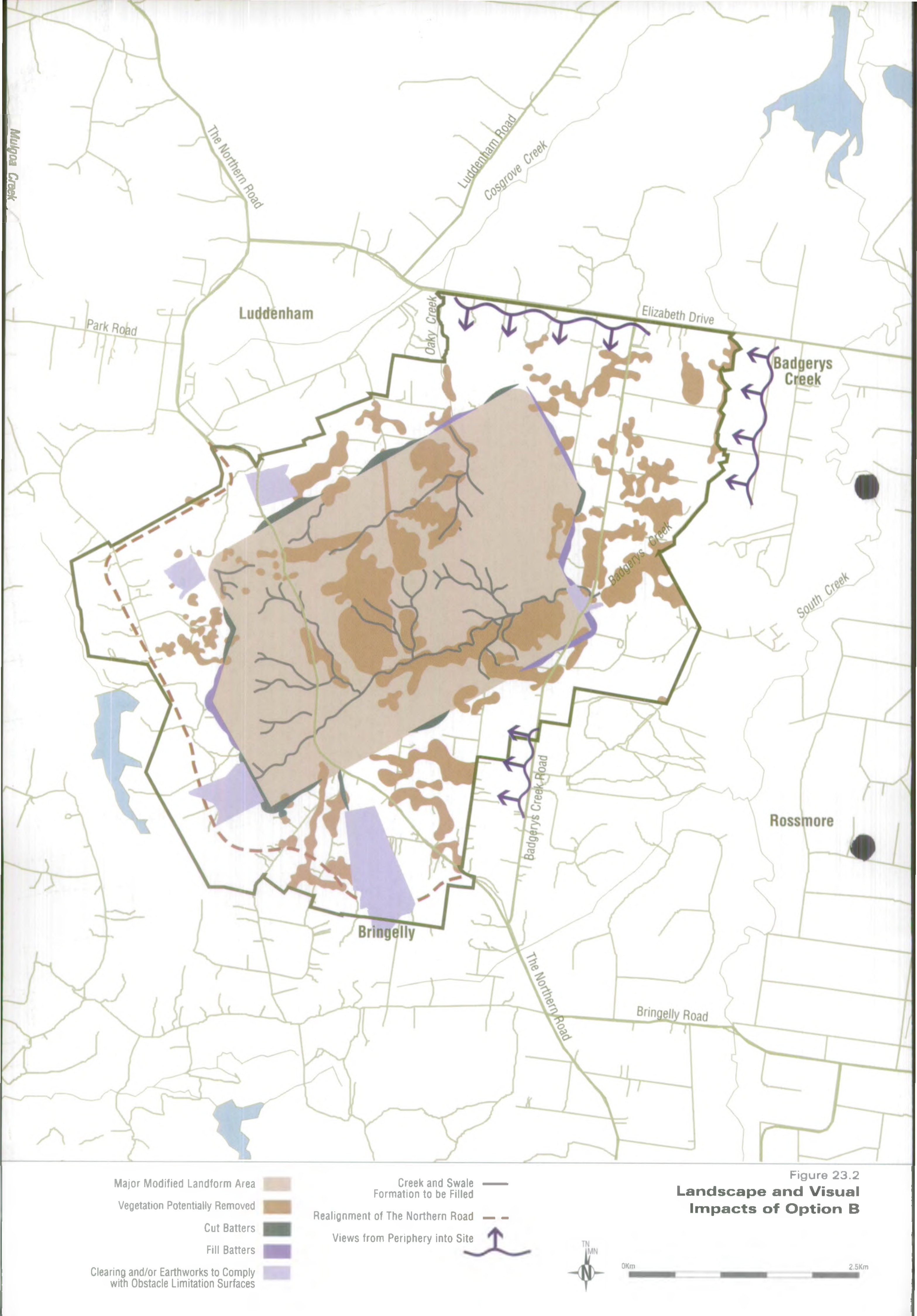


Figure 23.2
Landscape and Visual Impacts of Option B

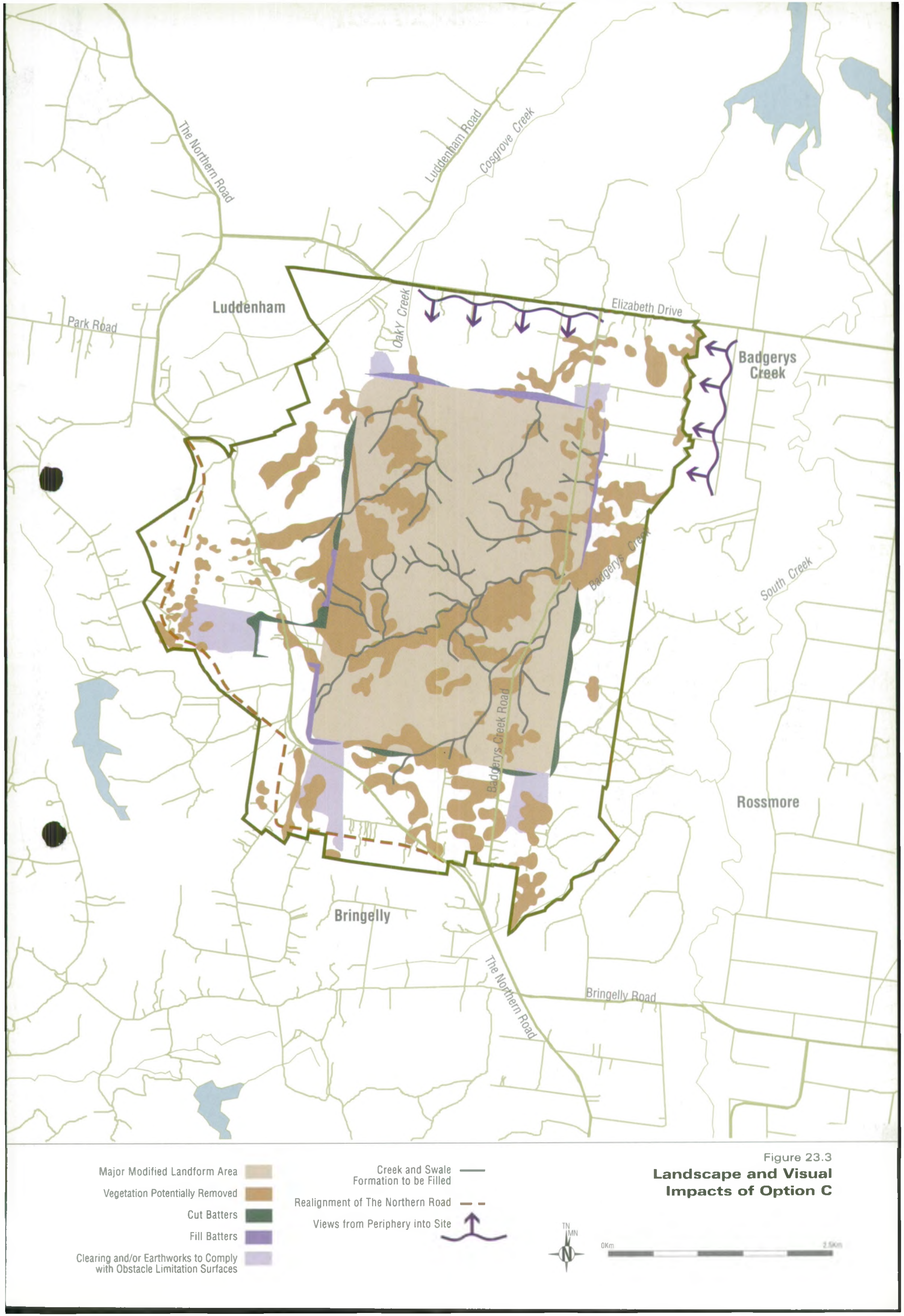


Figure 23.3
Landscape and Visual Impacts of Option C

runways, taxiways, terminal and apron reserve areas. The platform would be established essentially by filling the upstream section of Badgerys Creek, cutting the elevated areas south and north of the creek, and filling the lower northern areas of the site. Unlike Options A and B most of the western ridgeline would remain; only a small section would be cut. Impacts on vegetation would be similar in extent to those for Option B.

Operational Impacts

Realignment of The Northern Road further to the west would remove the opportunity for panoramic views to the east over the site, and beyond to Cecil Hills. Views to the east from the roadway along the northern sections of the new alignment would most likely be of the existing pastureland and scattered trees.

Views into the site from Elizabeth Drive would be restricted by the fill embankments proposed at the northern and eastern margins of the airport platform and by the development of airport support facilities. As for Options A and B, the airport terminal and associated facilities would most likely create a *built form* skyline to views from Elizabeth Drive.

Virtually all of Badgerys Creek Road would be removed, with the loss of the viewing opportunities it provides.

From Lawson Road, the existing riverine vegetation along Badgerys Creek would screen much of the airport from view. Parts of the terminal building, and other building elements associated with the airport support facilities and services in the north-eastern portion of the site, might be visible above the vegetation line along Badgerys Creek.

Operational impacts arising from subsequent development of adjoining areas, and the impact of night lighting would be much the same as for Options A and B.

23.5 Environmental Management

Careful planning and control of the staging of construction operations and the site development sequence would minimise visual and landscape impacts. It would be possible to screen a large proportion of the development from general public view.

Landscape Character

The development of an airport would completely modify the existing landscape. Consequently, the perimeter zones would be the only areas in which the visual characteristics and landscape perceptions of the locality could be maintained and enhanced, using landform modification and vegetation. Effective mitigation measures would require provision of substantial portions of peripheral land to permit retention of as much existing vegetation as practical, and to permit the reprofiling of existing topography for the purpose of controlling views into and out of the site.

Earthworks

Where possible, all cut and fill embankments that occur at the edges of the airport platform should be established using profiles capable of merging with the existing terrain, with no abrupt or obvious change in grade. Variable slope profiles in the range of 10 to 25 percent may be appropriate. The plan arrangement of these edge profiles should also be variable where other constraints permit, and should avoid rectilinear shapes derived from the shape of the airport platform. Instead, profiles should respond to the curvilinear formations of the existing topography. These slope profiles and plan arrangements, of course, would be implemented only where space permits, and this would be determined largely by the location of existing vegetation.

Beyond the immediate airport platform in the peripheral areas running out to the airport boundaries, earthworks should be established, controlling views into the site and screening various areas. This would involve creating profiles compatible with the scale and character of the existing topography. The extent and coverage of reprofiling and shaping in these areas would be decided in the context of overall airport planning and design; it is important that it be implemented at the beginning of the construction process. If planned and designed correctly, the entire core area of the site and the construction process could be screened from view.

Vegetation

The site of the airport options has little vegetation cover at present, and would have even less following the initial clearing operations for the airport. Essentially all remaining vegetation beyond the immediate footprint of the airport platform should be retained and protected where practical. Measures would include locating, identifying and fencing all the vegetation to be protected prior to commencing site preparation or establishment work. Other site development requirements such as erosion and sedimentation control, stormwater retention, construction facilities, services and infrastructure should be planned and designed to maximise the retention of existing vegetation. Equally crucial would be ongoing monitoring and assessment of the condition of remaining vegetation throughout the construction phase of the airport.

Revegetation of the peripheral areas would also be essential. An opportunity exists with whatever options were chosen, to revegetate and increase the amount of vegetation cover over the site provided revegetation does not impede airport operations or aircraft safety. Revegetation work should be implemented in conjunction with peripheral earthworks at the earliest possible time in the construction process. Revegetation should seek to achieve a re-establishment, as far as practical, of the woodland plant communities that would once have covered the site. This should be the overall theme of any revegetation work, but variations on the theme, or other landscape treatments, would be possible at specific locations or areas, such as the airport entry road and the arrival zone.

Drainage

The existing drainage pattern and proliferation of farm dams across the site are important elements in the perception of the airport site. The new drainage patterns required for the airport should, wherever practical, reflect the scale and character of the existing site drainage patterns. New drainage formations should be responsive to the existing undulating terrain and existing vegetation.

Fencing

Fencing has a significant impact on the way a place is perceived. Where the airport boundary occurs adjacent to a public road the location of a security fence along the boundary would be visually undesirable. In these locations the security fencing should be set back substantially from the boundary, so that it is not visible from any point along the road edge.

23.6 Summary of Potential Visual and Landscape Impacts

A summary of potential visual and landscape impacts is contained in *Table 23.2*.

Table 23.2 Summary of Potential Visual and Landscape Visual of Airport Options

Airport Option	Landscape Impact	Visual Impact
Option A	• Terrain modification approximately 800 hectares. • Cut embankments up to 16 metres, fill embankments up to 13 metres. • Loss of upper section of Oaky Creek, approximately 1 kilometre. • Loss of existing vegetation from area of terrain modification.	• Existing rural visual character completely modified • Loss of views from The Northern Road (realigned) to the east. • Views south from Elizabeth Drive restricted. • Viewing opportunity from northern section of Badgerys Creek Road lost (road removed).
Option B	• Terrain modification approximately 1,200 hectares. • Cut embankments up to 13 metres, fill embankments up to 10 metres. • Loss of upper section of Badgerys Creek, approximately 5 kilometres. • Loss of upper section of Oaky Creek, approximately 1 kilometre. • Loss of existing vegetation from area of terrain modification.	• Existing rural visual character completely modified • Loss of views from The Northern Road (realigned) to the east. • Views south from Elizabeth Drive restricted. • Viewing opportunity from northern and southern sections of Badgerys Creek Road lost (road removed). • Views over airport possible from southern section of The Northern Road realigned and residential areas adjoining southern airport boundary.
Option C	• Terrain modification approximately 1,100 hectares. • Cut embankments up to 9 metres, fill embankments up to 13 metres. • Loss of upper section of Badgerys Creek, approximately 4 kilometres. • Loss of upper section of Oaky Creek, approximately 1 kilometre. • Loss of existing vegetation from area of terrain modification.	• Existing rural visual character completely modified • Loss of views from The Northern Road (realigned) to the east. • Views from Elizabeth Drive restricted to the south. • Viewing opportunity from northern and southern sections of Badgerys Creek Road lost (road removed).

The airport options would all have similar impacts and would involve complete modification of the existing landscape and visual environment. Option A would have the least impact, primarily because it would require the smallest land area. The loss of remnant woodland vegetation would be significant, even though the sites have already been extensively cleared and modified for agricultural purposes. Development of an airport would add to the ongoing incremental loss of vegetation cover in western Sydney.

The scale and configuration of peripheral areas could permit the creation of substantial landscape environments as opposed to more conventional methods of screening along boundaries. This would allow the visual characteristics and landscape perceptions of the area to be maintained and enhanced.

Chapter 24

Economic and Financial Costs

Chapter 24
Economic and Financial Costs

This chapter provides an outline of the available costs of the proposal; not all costs could be quantified during the preparation of this Draft EIS.

24.1 Issues Raised During Consultation

Issues raised during consultation noted the potentially adverse and also potentially beneficial economic impacts of the proposal. Beneficial impacts could include employment generation and giving a general economic *kick start* to the western region of Sydney. Other submissions noted the loss of small businesses such as restaurants due to aircraft overflight noise, in addition to a range of other economic costs.

Requests were made for a full cost benefit analysis to be undertaken in the Draft EIS. It was suggested in some submissions that the analysis should include the costs of potential damage to the environment and long term loss of businesses and loss of jobs, to set beside claimed short term gains in employment in the service and construction industries. Some respondents considered that it is not acceptable to place a higher value on income from an airport than on the overall well being of the community.

24.2 Methodology

The Second Sydney Airport proposal would have a range of potential costs as shown in *Figure 24.1*. It is possible to translate some of these into a monetary value, while others are more difficult to quantify. This chapter presents an outline of available costs, including both the financial costs and the economic. Financial costs are those incurred by the provider and operator of the infrastructure, whereas economic costs reflect the flow-on effects for third parties plus the opportunity cost. The financial costs are for construction of the airport, the regional and service infrastructure, and transport access infrastructure items. Economic costs include those of property devaluation.

A comprehensive cost benefit analysis was not undertaken because of the difficulties associated with defining a single 'do nothing' option (refer *Chapter* 6), and the complexity and lack of precision in placing a value or cost on environmental impacts. Producing an accurate and credible base case, or do nothing option, would have required making a range of speculative judgements, many of which could not be substantiated. Evaluating all environmental impacts requires specialised survey techniques considered beyond the scope of this Draft EIS. In addition there is no professional or community agreed methodology for finding the value (or cost) of many environmental impacts.

An alternative approach to a complete cost benefit analysis would have been to undertake a cost effectiveness analysis; but again, this would have required a number of speculative assumptions that could not be supported by quantitative evidence in the Draft EIS.

The approach adopted, therefore, has been to develop an overall summary of the key financial and economic costs. Most costs are incurred across a number of years, and in most cases there is some doubt regarding the exact timing of the expenditure. True costs would vary, as both the financial and economic costs would be incurred over varying timeframes.

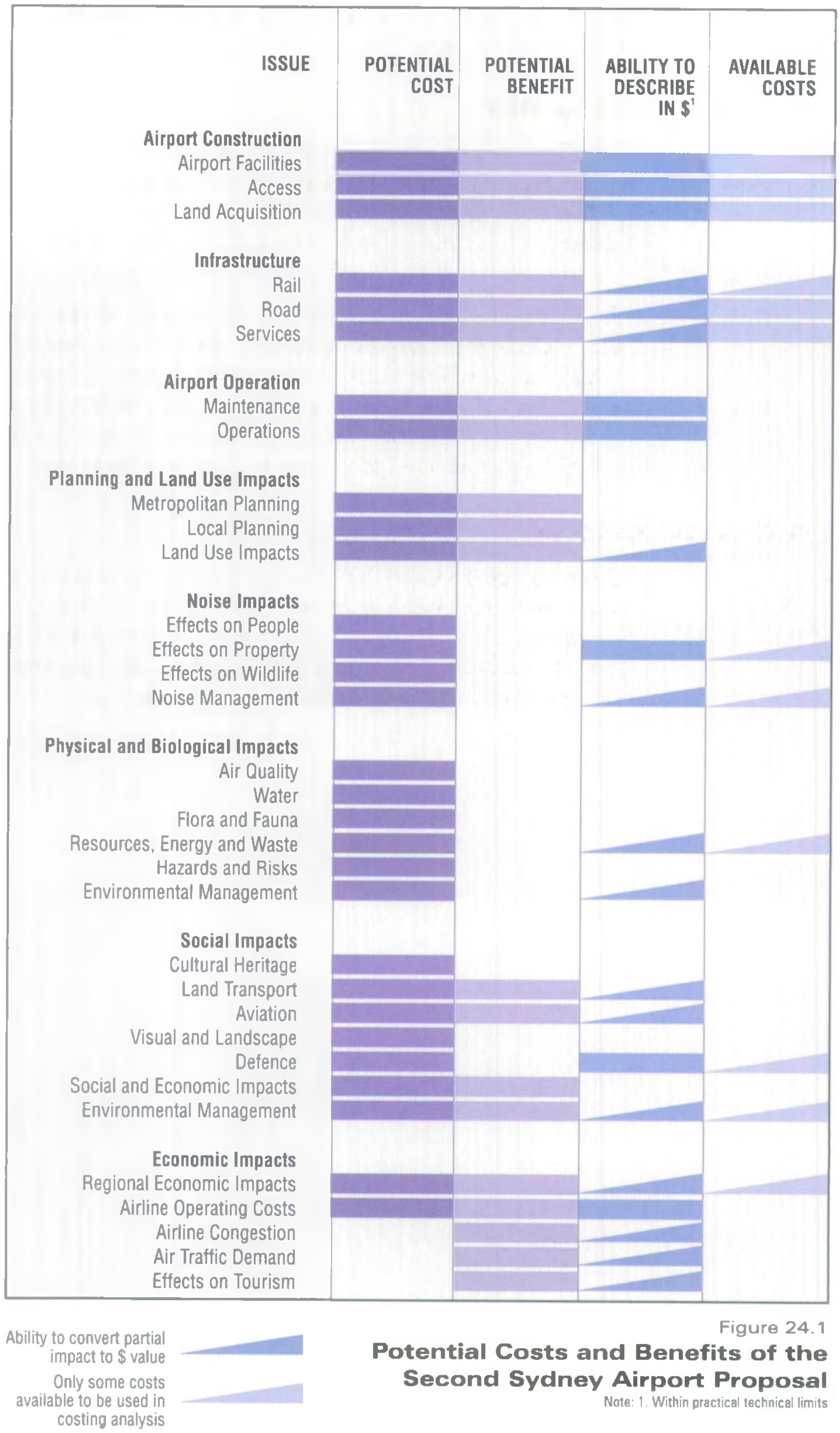


Figure 24.1

Potential Costs and Benefits of the Second Sydney Airport Proposal

Note: 1. Within practical technical limits

Future costs have not been discounted to represent a present value of costs for each option because the timing of some expenditures is uncertain and a number of potentially significant costs are currently unquantified which could change the relative cost of each option.

24.3 Proposal Costs

Available proposal costs are shown in *Table 24.1*. These include the costs of construction, airport operation and site infrastructure required to service the airport. A limited range of external costs are also included here, such as the cost of noise mitigation and property devaluation due to noise impacts. *Table 24.1* does not attempt to give totals for each airport option, as not all costs were available.

Potentially significant costs that were not available for the preparation of this Draft EIS include the costs of relocating the Defence facilities from the Defence Establishment at Orchard Hills, the costs of potential impacts on the operation of Bankstown, Hoxton Park and Camden Airports, the potential sterilisation of mineral resources, and the net changes to transport costs to access a major airport. Insufficient information was available to quantify these costs.

24.4 Conclusions

During the preparation of this Draft EIS, a range of costs has been estimated for each airport option. However, a number of potentially significant costs have not yet been quantified, nor is the timetable for expenditure settled. Furthermore, the aviation benefits of some of the airport options may vary, and insufficient investigation has yet been undertaken to quantify the extent of the variation.

Table 24.1 Available Estimated Proposal Costs ($millions)[1]

	Option A	Option B	Option C
Land Acquisition[2]	$0	$205-$280m	$190-$265m
Airport Development[2 and 3]	$2,915-$4,010m	$3,230-$4,445m	$3,145-$4,325m
Airservices Australia Facilities[2]	$40-$55m	$40-$55m	$40-$55m
Transmission Line Relocation[4]	$25m	$25m	$25m
Total Airport Construction Costs	**$2,980-$4,090m**	**$3,500-$4,805m**	**$3,400-$4,670m**
Roads[4]	$470m	$470m	$470m
Rail Line[4 and 5]	$345-$400m	$345-$400m	$345-$400m
Total Access Costs	**$815-$870m**	**$815-$870m**	**$815-$870m**
Water[4]	$40m	$40m	$40m
Waste Water[4] (on-site treatment)	$30m	$30m	$30m
Power[4]	$30m	$30m	$30m
Telecommunications[4]	$15m	$15m	$15m
Aviation Fuel Pipeline[4]	$25m	$25m	$25m
Natural Gas Pipeline[4]	$6m	$6m	$6m
Total Services Costs	**$146m**	**$146m**	**$146m**
Direct Property Devaluation[6]	$49-$67m	$52-$60m	$25-$31m
Residential Property Acquisition[7]	$6-$11m	$0	$12-$27m
Acoustical Treatment[8] 25 to 35 ANEC	$12-$19m	$7-$9m	$6-$12m
Acoustical Treatment[8] 30 to 35 ANEC	$3m	$1-$3m	$2-$5m
Total Available Noise Impact and Management Costs[9]	**$67-$97m**	**$59-$69m**	**$43-$70m**

Notes:

1. *All costs rounded to nearest $million. Expressed as $ 1997 except property devaluation at $ 1996.*
2. *Source is Second Sydney Airport Planners, 1997a. Range of costs due to assumed level of accuracy.*
3. *Airport development costs are for complete master plan development. It is likely, however, that the costs would be expended in stages. Costs do not include the cost of commercial/support facilities that would be developed by the airlines and other airport tenants.*
4. *Source is Second Sydney Airport Planners, 1997c.*
5. *Costs of rail line to Badgerys Creek airport options vary depending on the route selected. Rail costs do not include any network improvements that might be required.*
6. *Net direct devaluation in 1996 for 2016. Source is Technical Paper No.4. Direct estimated residential property devaluation. Does not include indirect changes to property values such as changes to the future development potential of land. Range of costs due to the range of noise impacts created by the different assumptions about how the airport may operate.*
7. *Source is Technical Paper No.3. Calculated on acquisition of residential properties affected by more than 35 ANEC. Range of costs due to the range of noise impacts created by the different assumptions about how the airport may operate. Property prices calculated by examining average sale prices and adding a 20 percent contingency. Actual costs may vary significantly due to large variation in the value of properties that occur around the airport sites.*
8. *Source is Technical Paper No.3. Acoustical insulation assumed for all residential properties within 25-35 ANEC contour. Average cost of insulation assumed to be $50,000 per dwelling. Range of costs due to the range of noise impacts created by the different assumptions about how the airport may operate.*
9. *Cost of acoustical treatment for 30-35 ANEC is included as part of 25-35 ANEC and is therefore not added in to the total separately.*

Chapter 25

Social and Economic

Chapter 25
Social and Economic

This chapter discusses the various socio-economic impacts of the Second Sydney Airport proposal. The social and economic impacts are a combination of a number of factors discussed in previous chapters, in Parts D, E, F and G of this Draft EIS. A more detailed treatment of the topic can be found in Technical Papers No. 2 and No. 15.

25.1 Issues Raised During Consultation

A range of factors arising from the Second Sydney Airport proposal were identified as potentially affecting people's quality of life. For many communities a high value was placed on an outdoor lifestyle. Submissions expressed the view that, if the proposal to build an airport went ahead, it would detract from people's ability to maintain current activities and lifestyles.

Factors identified as tending to influence or change the quality of life included:

- psychological impacts of aircraft noise such as stress and anxiety;
- sleep disturbance from aircraft overflight noise;
- the possible need to live in noise insulated houses, when many residents now enjoy an outdoor lifestyle;
- property devaluation resulting in economically depressed areas;
- health impacts of air pollution; and
- loss of recreational facilities.

Other comments focussed on the cumulative impacts on families. They pointed out that it was common for several generations to reside in the same area or region for support and to keep in close contact, and they would not be able to get relief from the impacts of the airport by leaving their own home and visiting with other family members.

The potential loss of public facilities or limitations on their use because of aircraft noise was noted. These facilities included schools, hospitals, cinemas, community halls and parks.

The potential to create jobs and opportunities for local businesses was acknowledged by the community; however, some also commented that an airport would be likely to result in considerable economic and employment losses to local businesses in the suburbs surrounding the site of the airport options.

Some submissions considered that a Second Sydney Airport would be economically beneficial for western Sydney, especially in terms of employment generation. Others commented that there would be a negative impact on small businesses, such as restaurants, due to noise from overflying aircraft, and suggested the proposal would be economically detrimental. Potential tourism and resulting economic impacts were noted because of the reduction in viability of tourist destinations such as national parks and the Blue Mountains.

Potential secondary impacts were mentioned, such as loss of workforce due to health impacts from increased aircraft noise. Respondents commented that sleep disturbance and other impacts could reduce the local workforce able to benefit from employment opportunities, or cause a population shift. Businesses which could be affected by population shifts included private schools, retirement villages, restaurants, service industries and recreational enterprises.

Favourable comment was expressed on the potential of the Second Sydney Airport to attract significant amounts of new international activity with a resultant growth in transport activities, hotel development, and business parks; there would be opportunity for the development of technology with high export content. It was commented that the proposed airport would be within 30 minutes of most western Sydney commercial and industrial areas, and would provide a direct gateway to service the western Sydney economy. It would also offer many opportunities for the development of commercial areas of airport related activities.

25.2 Methodology

25.2.1 Social Impact Assessment

The social impact of the proposed airport has been assessed by examining the characteristics of the surrounding region, both by statistical analysis and by a more qualitative examination of the areas affected. Data from the 1991 Australian Bureau of Statistics Census and the NSW Department of Urban Affairs and Planning (1995) have been used, in addition to updated information from local councils, where this is available. Statistics on unemployment were obtained from the Department of Employment, Education, Training and Youth Affairs (1996).

The demographic statistics from the 1991 Census were compared with those of the Sydney Statistical Division, thus permitting an assessment of community characteristics in relation to one another and to Sydney as a whole.

Demographic characteristics analysed to provide an understanding of the potentially affected region included:

- population and age structure;
- labour force status;
- ethnicity;
- education;
- household composition and status;
- household income; and
- journey to work.

The character and social cohesion of the communities immediately affected by each option were also considered. Such factors were examined as community lifestyles, character, activities and interrelationships, in terms of use and dependence on facilities and services.

25.2.2 Economic Impact Assessment

Economic assessment included an examination of:

- impacts on employment in particular, but also on businesses;
- agricultural displacement;
- property devaluation from noise impacts; and
- displacement of businesses.

The main focus of the analysis of employment and overall economic activity was at a regional level. The region used in the assessment was made up of several local government areas surrounding the airport options, including Blacktown, Camden, Campbelltown, Fairfield, Liverpool, Penrith and Wollondilly local government areas.

Impacts on employment were calculated using input-output models. Multipliers were produced and future economic development at the regional level was forecast for employment and expenditure. The input output tables used Australian Bureau of Statistics data which separated industry into 113 separate categories before estimating expenditure and employment relationships between them. Forecast levels of activity at the proposed airport were used to determine future job levels in terms of direct and indirect employment.

Two terms are commonly used to describe the types of employment generated by a large infrastructure facility, they are *direct* and *indirect* employment. Direct employment is created by the initial impact of an operating airport. This includes employment on the airport site and employment off site resulting directly from the airport's operation as well as related ancillary activities and services such as airline catering companies, air freight forwarders and airport transport including taxis. Therefore direct employment would be jobs created by industry and activities needed to operate and service the airport. Indirect employment is created from expenditure originating from the consumption and production patterns generated by the operation of the airport.

25.3 Existing Environment

25.3.1 Regional Social Characteristics

Regional social characteristics were examined for 13 local government areas surrounding the sites of the airport options. These were Auburn, Bankstown, Blacktown, Blue Mountains, Camden, Campbelltown, Fairfield, Holroyd, Hurstville, Liverpool, Parramatta, Penrith and Wollondilly local government areas. A number of these local government areas are located on Sydney's urban fringe and the region is one of the fastest growing in NSW.

In 1991, the region had a population of 1,373,042 which represents 39 percent of the Sydney Statistical Division population. By 1996, this population had risen to 1,472,837.

The local government areas within the region are characterised by broadly similar age structures; as compared with Sydney as a whole, they have:

- a higher proportion of people under 14 years of age as a result of the high number of young families with children;
- broadly similar numbers of people within the 15 to 29 age groups and the 30 to 64 (working); and
- a lower proportion of people over 65 years of age, once again reflecting the large number of new release areas and the generally young age composition of the communities.

The occupations of people living within the region can be summarised in the following general statements:

- the labour force represents 36 percent of the labour force of Sydney;
- nearly half of Sydney's labourers and trades people come from here;

- most local government areas here have significantly fewer professionals and para professionals than for Sydney as a whole;
- there is a lower proportion of managers and administrators (exceptions are Wollondilly, Blue Mountains and Camden); and
- other employment categories are similar to those of the whole Sydney Statistical Division.

Unemployment in most of the local government areas in the region is higher than for the rest of Sydney. In some instances (Fairfield and Liverpool), unemployment is more than double the average for Sydney as a whole. The reasons for this include an imbalance between numbers of people and jobs within the region; the higher than average numbers of young people without work experience; and the higher than average number of blue collar workers from the manufacturing industries, which are currently in decline.

The region is characterised by a high number of people born in non-English speaking countries; the ethnic origins of these communities vary widely. Established local government areas such as Auburn and Fairfield have the wider mix of origins, the most common being Europe, the former USSR, the Middle East, North Africa and Asia.

A high proportion of the population have no formal professional or trade qualifications; the percentage with a university education is lower than the Sydney average. The school leaving age also tends to be lower, with a large proportion of students leaving school at 15 years of age or less.

The composition and social status of households are characterised by:

- high proportions of home ownership within established local government areas (Hurstville and Bankstown);
- higher rates of rented and Department of Housing accommodation for most of the region compared with the rest of Sydney;
- a higher proportion of one parent families; and
- a higher proportion of households earning less than $30,000, and a lower proportion of households earning more than $50,000, in comparison with Sydney as a whole.

Journey to work patterns reflect the availability of public transport and the location of the region within greater Sydney. Public transport is generally relied on more within established areas (Parramatta, Bankstown, Fairfield and Liverpool), while residents in the more peripheral areas rely on private transport.

To help in forming an understanding of the character of communities surrounding the airport sites, an examination was made of comments gathered during the consultation process for this Draft EIS. General features of this community character are described below.

Communities surrounding the sites of the airport options are characterised by a large number of established rural land holdings. The character is one of a rural area featuring low density development and a level of tranquillity and lack of congestion. Small scale primary industry is predominant, with many residents being relatively self-sufficient.

Comments raised during the consultation process indicated that important networks exist between landholders and their families in this area, sometimes with a number of generations of the same family residing in the locality. This interdependence within the community is an important factor in the operation of local businesses and support networks.

While the possibility of an airport development in the Badgerys Creek area has been recognised by the community for some time, the introduction of two new airport options with additional land requirements, and the resultant changes in potential noise impacts, has undermined confidence within the community. There is also concern about the scale of development above the level that had been envisaged in the *Second Sydney Airport Site Selection Program, Draft Environmental Impact Statement* (Kinhill Stearns, 1985).

25.3.2 Regional Economic Characteristics

Table 25.1 provides a summary of the economic characteristics of the defined economic region and compares these characteristics with those of the Sydney Statistical Division. Key economic indicators for comparison between the regions are:

- the participation rate (calculated as the employed and registered unemployed as a proportion of the total potential workforce) is notably higher in the Badgerys Creek region when compared to Sydney as a whole;
- unemployment is higher in the Badgerys Creek region than in Sydney generally;
- the levels of employment in the manufacturing and trade sectors for Badgerys Creek region are larger than for Sydney as a whole; and
- agriculture across Sydney as well as in the Badgerys Creek region is relatively minor as a source of employment.

Table 25.1 Economic Characteristics of Defined Economic Regions

Indicator	Badgerys Creek Region	Sydney Statistical Division
Participation rate	64%	62%
Unemployment rate	14%	10%
Employment in manufacturing (% of regional employment)	22%	14%
Employment in trade (% of regional employment)	18%	13%
Employment in agriculture (% of regional employment)	1%	1%
Labour force	385,000	1,743,000
Percentage of total Sydney workforce	22%	n/a

Source: Australian Bureau of Statistics 1991, CDATA91.

The current industry and employment composition of the defined economic region was compared to that of a similar region around Sydney Airport, made up of the local government areas of Botany, Rockdale and South Sydney. *Table 25.2* lists the ten most significant industries within these two regions.

Table 25.2 Top Ten Industries by Employment Category as a Percentage of the Workforce (1996)

Industries	Badgerys Creek Region	Sydney Airport Region	Australia
Retail Trade	13.5%	5.8%	11.1%
Wholesale Trade	8.0%	11.0%	7.5%
Other Construction	7.1%	-[1]	6.7%
Education	6.6%	4.9%	6.4%
Health Services	5.2%	5.6%	5.4%
Road Transport	3.7%	4.5%	4.6%
Accommodation, Cafes and Restaurants	3.0%	4.0%	4.0%
Government Administration	2.7%	2.9%	2.8%
Other Business Services	2.5%	-	2.7%
Other Electrical Equipment	2.3%	-	2.2%
Air and Space Transport	-	8.6%	-
Defence	-	7.1%	-
Services to Transport Storage	-	3.6%	-

Note: 1. Indicates not in top ten.

Total employment in each region is 385,000 for Badgerys Creek and 189,000 for the Sydney Airport region. In the Badgerys Creek region, the top ten industries make up 52 percent of all employment.

The Badgerys Creek region has an industry and employment composition similar to Australia as a whole, whereas the Sydney Airport region has a higher proportion of employment in wholesale trade, air and space transport, services to transport storage, and Defence. The majority of these indicate the influence of the airport and Port Botany on employment within this region.

There are a number of similarities and differences between the industry types for the Badgerys Creek and Sydney Airport regions. A number of employment categories remain consistent across the regions as well as being representative of Australia as a whole. There are, however, a number of significant differences. Three industries, which make up nearly 20 percent of employment in the Sydney Airport region (air and space transport, Defence and services to transport storage), currently do not appear in the top ten industries at Badgerys Creek. The development of a second major airport for Sydney would result in the long term industry and employment composition of the region becoming more similar to that of the Sydney Airport region. The reliance of the Badgerys Creek region on trade and manufacturing would mean that the economy of the region would take some time to adapt to the predominantly service oriented needs of an airport.

Table 25.3 lists the top ten industries by turnover in each region. Turnover is the total amount of money that passes through a business including profit, wages, running costs and costs of buying goods and services. The Table indicates that the profile of industry turnover for the Badgerys Creek region is largely similar to that of Australia as a whole. The industry categories of ownership of dwellings and wholesale and retail trade were among the top three industries due to the residential nature of the regions.

The Sydney Airport region has different key industries by turnover. The two main industries here are air and space transport and wholesale trade. These reflect the region's role, and the twin influences of the airport and Port Botany.

Table 25.3 Top Ten Industries by Turnover as Percentage Share of Total Turnover (1996)

Industries	Badgerys Creek Region	Sydney Airport Region	Australia
Ownership of Dwellings	8.4%	3.2%	6.5%
Wholesale Trade	5.7%	7.2%	5.5%
Retail Trade	5.8%	2.3%	4.8%
Residential Building	4.3%	-	2.8%
Other Construction	4.6%	-	3.6%
Petroleum and coal products	-	-	-
Coal, Oil and Gas	2.8%	-	-
Other Electrical Equipment	-	-	-
Health Services	3.0%	3.0%	3.9%
Road Transport	3.1%	3.4%	-
Education	3.0%	-	2.9%
Basic Non Ferrous Metals	2.7%	-	-
Air and Space Transport	-	18.9%	-
Defence	-	6.1%	-
Service to Transport Storage	-	4.1%	-
Communication	-	3.0%	2.7%
Government Administration	-	2.2%	3.8%
Legal, Accounting, Marketing	-	-	2.9%
Share of Total Turnover	**43.4%**	**53.4%**	**39.4%**

Note: 1. Indicates not in top ten.

25.4 Social Impacts

25.4.1 Potential Nature of Social Impacts

Potential social impacts of a proposed Second Sydney Airport would include its effects on individuals and on communities. The *Local Government Social Impact Assessment Handbook* (NSW Local Government Association, 1995) identifies potential issues and impacts related to major transport infrastructure projects, such as airports. The range includes:

- changes in access patterns;
- effects on residential amenity and/or character;
- severance or instability;
- changes to traffic patterns;
- effects on individual properties and the resultant dislocation, uncertainty and in some cases hardship; and
- effects on individual health.

Because of potential changes in land use patterns there would also be impacts on the demographic composition and the provision of community services and facilities in some areas.

The social impacts discussed in this section refer to all the Badgerys Creek airport options except where indicated. The assessment is based on the potential nature of social impacts identified in this section, future land use assumptions outlined in *Chapter 10* and environmental impacts outlined in *Parts D, E, F* and G of this Draft EIS.

25.4.2 Social Impacts of Constructing the Airport Options

The major impacts during the construction phase would be experienced in the immediate vicinity of the airport sites, both within and adjacent to the area bounded by Elizabeth Drive, Badgerys Creek Road, The Northern Road and Adams Road. Given the proximity of rural residences to the sites, the impacts would be severe during this period.

Major impacts would be related to construction traffic, air quality, vibration, noise, water quality and lighting. Some disruption of the peace and quiet of the area would be expected, including disturbance to community facilities such as Kemps Creek and Luddenham Primary Schools. Significant truck traffic would be generated and would have an adverse impact on the character and amenity of land uses adjoining major roads.

25.4.3 Social Impacts of Operating the Airport Options

The following social impacts of the operation of the Second Sydney Airport have been considered:

- changes to population distribution;
- changes in access patterns;
- effects on residential amenity/character;
- community severance/instability;
- impacts on social infrastructure;
- displacement and effects on individual properties;
- effects on individual health; and
- any other social impacts.

Changes to Population Distribution

Changes to population distribution may occur either through the relocation of the existing population, or else through changes to expected future populations as a result of the impact of the airport proposal.

Changes to the population of the community surrounding the airport options would occur because of the relocation of residents currently leasing property within the boundaries of Option A; acquisition of properties within the extended boundaries of Options B and C; and potential acquisition of residential properties within the 35 ANEC. Displaced residents may relocate within the existing area or further afield; however, as the supply of rural residential land on the outskirts of Sydney is gradually diminishing, some difficulty in finding desirable alternative properties would be likely. This relocation possibly could reduce the demand for existing services and facilities within the area to such an extent that some might close. This would impact on the quality of life of remaining residents.

Changes to expected future populations may occur to take advantage of perceived urban development opportunities and to minimise the effects of aircraft noise. The extent of these changes would depend on State and local government responses to the airport. The airport options would create opportunities to establish new urban villages on a potential rail line to the airport sites. This may increase the planned population growth of Liverpool and Camden local government areas. As a result, growth may be diverted from other areas such as Campbelltown and Sutherland local government areas. In addition, improvements to the local and regional road system may act as a potential stimulus to urban growth in these areas.

While these changes to future planned populations would not be significant over the whole of the south and south-western regions of Sydney, Liverpool local government area may experience substantially more growth than is currently planned by the NSW Department of Urban Affairs and Planning. The creation of new urban release areas would impact on the existing rural environment and increase demands for urban services and facilities.

Local population centres would also be affected by the proposed airport options. As described further on, the village of Badgerys Creek would cease to exist. The villages of Luddenham and Bringelly would still retain their roles as rural service centres, however the extent to which their role changes because of the existence of a nearby airport would depend on Council policy and development controls.

Changes to Access Patterns

The presence of an airport would result in greater use of State and regional roads in the locality. Elizabeth Drive, Bringelly Road, The Northern Road and Luddenham Road would all become busier. Upgrading these roads would alter access patterns for adjoining communities. It is likely that some inconvenience would be created through restricted access to local roads and individual properties. Communities likely to be affected include Bringelly, Rossmore, Kemps Creek and Mount Vernon. Badgerys Creek Road would be closed, whichever airport option was selected. Alternative access between Elizabeth Drive and The Northern Road would be required either via King Street and Devonshire Road, or through Luddenham village.

Regional access to the Sydney Central Business District and other regional and sub-regional centres would be improved with the upgrade of access corridors required to service the airport and the completion of the proposed Western Sydney Orbital.

Due to the existing rural nature of the area, pedestrian access and movement is not significant and would not be jeopardised, other than on the immediate airport site. It is expected that there would be improvements to the public transport network serving this area.

Effects on Residential Amenity and Character

Residential amenity is characterised by a range of factors including lifestyle, accessibility, visual appearance and access to open space. Changes in one or all of these factors can undermine the amenity of a community, the impact of which can be different for different people.

The current rural character of the site of the airport options and surrounds would be dramatically altered. As a result, changes to residential amenity including the physical environment, the amount of traffic, levels of noise, visual appearance and air quality would be experienced.

It is likely that several communities in the vicinity of the airport would become more urbanised as a result of increases in population, the amount of through traffic and increasing pressure for development on land adjoining or within the airport site. Communities that would be significantly impacted include Luddenham, Silverdale, Badgerys Creek, Kemps Creek, Bringelly and Rossmore; the lifestyle of the residents might be undermined as a consequence of increased urbanisation. The extent to which individuals respond to these changes cannot be quantified; however, it is reasonable to assume that those who value the rural character of the area would experience a significant loss of residential amenity.

Several areas of local open space would be severely impacted by aircraft noise, namely Kemps Creek Reserve and Eugenie Byrne Park in Silverdale for Options A and B, and Bringelly Recreation Reserve and Luddenham Croatia Soccer Club for Option C. Areas of regional open space that would be impacted to some degree include the Blue Mountains National Park, the proposed Western Sydney Regional Park, and to a greater degree, Bents Basin State Recreation Area and the Warragamba Special Area. Badgerys Creek Park would be located within the airport sites and would therefore be lost as a recreational resource.

The extent to which the use of such areas would be reduced is dependent on individual response to noise impacts. However, it is likely that the use of local open space would be compromised and regional open space might be less utilised, especially where major facilities are located within relatively high noise areas, as is the case for Bents Basin State Recreation Area and the Warragamba Special Area.

If people considered the operation of the airport would create a risk to their safety or the safety of their family and friends, this would constitute a further impact on their amenity and way of life. Individuals would perceive this threat to varying degrees.

Community Severance and Instability

Clearly, Badgerys Creek is the main community that would experience a significant degree of severance as a result of the development of the proposed airport. The village would cease to exist as a community under all of the airport options, resulting in the severance of family and business networks, especially where additional land (not previously identified for Option A) is required for Options B and C.

As well as the loss of Badgerys Creek as a place to live, residents would lose specific community services and uses such as Badgerys Creek Public School, the Post Office and the convenience store. Residents would be obliged to rely on facilities and services provided elsewhere. The closest public schools, at Kemps Creek and Bringelly, either do not have the capacity or would require additional resources to accommodate students from Badgerys Creek Public School.

Major severance to other communities would be caused by the upgrading of some roads and development of new rail lines necessary to access the airport. This would disrupt local access to facilities and schools, and in some cases would sever land under the one ownership. Communities affected would include Kemps Creek, Rossmore, Bringelly and Luddenham. Conversely, these routes offer the potential for improved access and infrastructure within the area, to the benefit of those communities.

Displacement and Effects on Individual Properties

Displacement and major effects on property would be caused by:

- acquisition of properties on the airport site;
- potential reduction in value of properties, arising from increased noise and a reduction in overall amenity; and
- loss in agricultural production on each airport site.

Table 25.4 shows the number of dwellings and estimated population on each of the three sites under consideration for the airport. The Commonwealth Government already owns all dwellings on the Option A site. However, for Option B an additional 158 dwellings would need to be acquired and an additional 198 for Option C. In addition, displacement would occur where properties might be voluntarily acquired to overcome the burden of increased aircraft noise. This could include up to 16 dwellings for Option A and up to 53 for Option C, depending on the way the airport operates and the extent of noise impacts.

Table 25.4 Estimated Number of Dwellings and Population on the Potential Airport Sites in 1996

Airport Options	Number of Dwellings	Estimated Population
Option A	162	500
Option B	320	1,000
Option C	360	1,200

Some residents may choose to relocate because of their individual reaction to increased noise. Linked to this are secondary effects of displacement including:

- diminishing demand for services;
- potential closure of services and facilities;
- social change; and
- decrease in morale and lack of community spirit.

The assessment in *Chapter 12* indicates that there would be some depreciation in property values arising from aircraft noise at levels over 15 ANEC. This could present hardship to those concerned, especially where people are prevented from relocating because of a loss in value of their existing dwelling, and are reluctant to relocate to properties which might not offer the lifestyle advantages they previously enjoyed.

Displacement would also arise where agricultural activities required to be relocated. While these pursuits might be re-established elsewhere, it is unlikely this would be in the immediate vicinity of the proposed airport site.

Effects on Health

Potential adverse effects on the health of individuals was highlighted during consultation for this Draft EIS. The main issues raised included lack of sleep, depression, stress, pollution, asthma and mental health.

While there is evidence that exposure to aircraft noise can potentially impact on health in a number of ways, as discussed in Section 11.3, it is not possible to measure or reliably predict these.

The extent to which individuals (especially potentially vulnerable groups such as the mentally or physically ill, children or elderly) might suffer from any of these adverse effects cannot be quantified. It is possible that some people particularly affected may want to move away from the area. However, they may be prevented from doing so due to financial or other restrictions.

25.5 Economic Impacts

25.5.1 Employment Impacts of Constructing the Airport Options

Within the defined Badgerys Creek economic region employment in the construction sector would be significantly boosted if the airport proposal were to go ahead. However, because of the highly capital-intensive nature of airport construction, the employment impacts would be less than might be expected, given the size of expenditure involved. For any one of the airport options, average on site employment levels over the construction period (for the master plan) would be 1,400 (*Table 25.5*).

Table 25.5 Regional Employment in the Construction Sector Relative to Proposal Demands[1]

Year	Employment During Construction of Airport Options	Badgerys Creek Regional Employment in Construction Sector
1998	704	18,575
1999	543	19,586
2000	1,506	20,598
2001	2,178	21,610
2002	2,232	22,622
2003	1,240	23,634

Source: Second Sydney Airport Planners, 1997a.
Note: 1. Assumes a nominal 1998 start to construction, and construction to master plan operational levels. Staging of airport construction would also be possible.

Direct and indirect employment effects of the construction phase within the region are provided in *Table 25.6*. Once again, because the construction of the Second Sydney Airport is capital intensive–as a consequence of the large scale of the enterprise and the large earthmoving and pavement construction tasks involved–indirect employment impacts would be limited. About 8,400 person years of on site labour is projected for the airport options. Additional indirect employment over the course of construction of about 17,000 person years would occur within the regional economy. Overall, construction of the airport would result in substantial indirect effects on employment levels.

Table 25.6 **Estimated Direct and Indirect Employment (person years) Generated by the Airport Proposal[1]**

Year	Direct Employment	Indirect Employment
1998	704	1,452
1999	543	1,119
2000	1,506	3,106
2001	2,178	4,490
2002	2,232	4,603
2003	1,240	2,556
Total	**8,403 person years**	**17,326 person years**

Note: 1. Additional employment based on construction expenditure. Assumes a nominal 1998 start to construction, and construction to master plan operational level. Staging of airport construction would be possible.

25.5.2 Employment Impacts of Operating the Airport Options

Two major studies (Institute of Transport Studies 1993 and 1996) have been done, measuring the level of direct employment at Sydney Airport. The more recent study estimated that the level of direct employment generated by the airport was 33,509 in 1995. This estimate was for a defined airport region made up of a number of local government areas (Ashfield, Bankstown, Botany, Canterbury, Drummoyne, Hurstville, Kogarah, Leichhardt, Marrickville, Randwick, Rockdale, South Sydney and Sutherland). It was based on a survey of 500 businesses covering 97 percent of the categories of business activity, and an estimate of the level of direct employment at Sydney Airport across a number of key categories, as shown in *Table 25.7*.

Table 25.7 **Estimated Direct Employment at Sydney Airport by Main Category in 1996**

Employment Category	Jobs
Major Airlines	21,769
General Aviation	832
Airport Government Services (Quarantine, Customs, Immigration)	1,760
Airline Support Services (Fuel, catering)	1,652
Airport Concessions and Duty Free	1,366
Transport and Taxis	1,383
Accommodation	752
Freight Forwarder and Customs Agent	3,992
Total	**33,506**

Source: Institute of Transport Studies, 1996

Forecasting how much employment would be generated by the operation of the Second Sydney Airport involved developing a set of employment projections for both Sydney Airport and the Second Sydney Airport, covering the likely levels of both direct and indirect employment. This procedure made it possible to estimate the net contribution from the Second Sydney Airport.

Passenger growth numbers at Sydney Airport and the Second Sydney Airport were used to predict the total economic impact. The passenger throughput was used as the promoter of economic growth for the airport, as this is the determinant of airport size and employment levels over the long term.

Total direct and indirect employment impacts were estimated for the Badgerys Creek region as well as for Sydney Airport for the base year 1996, and forecast years 2006 and 2016. The passenger demand scenarios used in the employment forecasts were Air Traffic Forecast 2 for 2006 and Air Traffic Forecast 3 for 2016. Results are summarised in *Table* 25.8. A range of employment impacts is provided, based on different assumptions about productivity gains. A midpoint in the employment forecasts is considered the most likely impact of the Second Sydney Airport proposal.

Table 25.8 Estimated Direct and Indirect Employment Generation for Sydney

	1996	2006	2016
Direct Employment			
Sydney Airport	34,000	37,000–41,000	21,000–26,000
Second Sydney Airport	0	15,000–17,000	44,000–53,000
Sydney Total	34,000	52,000–58,000	65,000–79,000
Indirect Employment			
Sydney Airport	34,000	37,000–41,000	21,000–26,000
Second Sydney Airport	0	15,000–17,000	44,000–54,000
Sydney Total	34,000	52,000–58,000	65,000–80,000
Total Employment			
Sydney Airport	68,000	74,000–82,000	42,000–52,000
Second Sydney Airport	0	30,000–34,000	88,000–107,000
Sydney Total	68,000	104,000–116,000	130,000–159,000

The overall employment impact of the Second Sydney Airport proposal would, at the least, result in a redistribution of employment throughout Sydney, if compared to a base case in which Sydney Airport is allowed to continue its expansion and no second airport is constructed. However, if compared to a case in which Sydney Airport is restricted to about 30 million passengers a year and no second airport is constructed, the realisation of this proposal would generate between 52,000 and 63,000 jobs in Sydney by 2016; the range reflects assumptions made about productivity gains.

25.5.3 General Economic Impacts

The Second Sydney Airport would be a large development and would significantly influence the regional economy. The complexity of this facility would require the development of new service and ancillary industries to supply the airport's needs; few of these services and industries exist at present. The Badgerys Creek region has a manufacturing and trade industry base, which may be able to adapt readily to the proposed airport's demands. In the long term, new higher technology industries would be expected to develop or relocate from the Sydney Airport region, providing airport and airline operators with services, and also generating other spin-off products and services marketable both within Australia and overseas.

Implementing the airport proposal could result in a loss of agricultural production, ranging from $400,000 to $1.9 million per annum. These amounts are relatively small, and are transitional losses in agricultural production which would most likely be replaced by increases in agricultural activity elsewhere in the region or State.

Aircraft overflight noise from the operation of the proposed airport would have a direct impact on residential property values within the 15 ANEC contour. Depending on the individual airport option selected and the mode of operation adopted for the airport, the total cost of this property devaluation would range from $25 to $67 million. There would also be indirect impacts on property values, caused by changes in the development potential of land.

Relatively poor quality coal is known to exist below the surface of the Badgerys Creek region in seams that are difficult to mine. While the estimated volumes is somewhere between 80 and 140 million tonnes, it is unlikely that these resources would ever be economically mined.

25.6 Environmental Management

As discussed previously, social and economic impacts are a combination of other impacts described in *Parts D, E, F* and G of this Draft EIS. For these various impacts a range of environmental management measures have been outlined throughout this Draft EIS. The implementation of those measures would assist in reducing potential social and economic impacts.

A crucial factor in managing the social impacts of a proposal such as the Second Sydney Airport is the need to ensure continuing consultation and implementation of measures in conjunction with the relevant local council(s), which should work with affected community groups.

If the proposal is to proceed, further initiatives may include ongoing consultation, especially the involvement of the community in the development of environmental management plans. Ongoing monitoring, auditing and release of information about the performance of environmental management measures to the community would assist in overcoming their sense of alienation from the airport development process.

25.7 Summary of Potential Social and Economic Impacts

The potential social impacts of the proposed Second Sydney Airport include effects on individuals, on communities, and on specific areas or facilities. The major impacts would be:

- potential relocation of existing residents and reordering of future urban release areas; both these measures would result in changes to the population of areas affected;
- subsequent change in demand for and potential closure of community services and facilities;
- loss of residential amenity and impacts on quality of life;

- potential impacts arising from severance, due to the access corridors required to service the airport; and
- reduction in ability to use community facilities, in particular open space and recreation areas.

Significant social impacts would arise from all of the airport options. The effects on individuals would vary depending on the value they give to a range of different factors that influence their quality of life, and their reaction to changes in those factors.

The range of economic impacts includes effects on employment levels in the region, and on the structure of local and regional industry. The proposed airport options would result in:

- significant demand on site and off site for construction employment, as well as indirect effects on other industries during construction;
- substantial increases in the level of direct and indirect employment in the Badgerys Creek region over the period to 2016; and
- considerable changes in the structure of local industry towards a greater number of value added services and manufactures.

Part H

Environmental Management

Chapter 26

Overview of Potential Environmental Management

Chapter 26
Overview of Potential Environmental Management

Parts D, E, F and G of this Draft EIS have described and assessed the potential environmental impacts of the three options put forward for the Second Sydney Airport. Environmental management measures to address specific impacts identified in these chapters have also been proposed. The approach taken in this Draft EIS has been, as a first preference in accordance with the precautionary principle, to seek to avoid adverse effects, and only if avoidance is not possible, to mitigate the effects by using environmental management measures.

This chapter provides an overview of the recommended approach to environmental management; the aim is to ensure that the Second Sydney Airport is managed to the highest international standards of environmental responsibility. It summarises the key legislative and policy obligations applying to the airport, including a summary of the environmental safeguards to be implemented. The organisations responsible would be expected to establish comprehensive environmental management systems for both the construction and operational phases of the airport.

26.1 Issues Raised During Consultation

The issue of environmental management received little attention in submissions because of a refusal, in most cases, to countenance any of the proposed options. Where comments concerning pollution control were made they applied to both construction and operation, and urged the need to establish appropriate environmental controls.

Pollution of the air, beaches, ocean, bushland, waterways and water catchments by aircraft emissions and unburnt fuel was a concern and it was pointed out that pollution problems already existed from other sources, such as industry. It was commented that meteorological conditions such as thermal inversions required consideration during the design of any pollution mitigation measures.

Respondents noted the possibility that the proposed airport might lead to pollution of Lake Burragorang and Prospect Reservoir; flight paths, it was stated, should avoid these water storages. In any case, extensive pollution mitigation measures would need to be implemented.

The need for an environmental management plan for construction impacts was noted.

Respondents wanted discussions to take place with State and local government on certain issues:

- possible restrictions on development around the airport through local planning controls, to ensure that appropriate development took place;
- the need to change development controls within the vicinity of the airport options to accommodate noise insulation measures;
- local flood management on the South Creek, Nepean, Hawkesbury and Parramatta river systems; and

- the need for coordination of specialist emergency services to ensure a rapid response to potential accidents.

26.2 Approach to Environmental Management

26.2.1 Overview

The approach to environmental management for the Second Sydney Airport is described in *Figure 26.1*. The guiding principles adopted are those embodied in the Commonwealth Government's *National Strategy for Ecologically Sustainable Development* (Commonwealth of Australia, 1992).

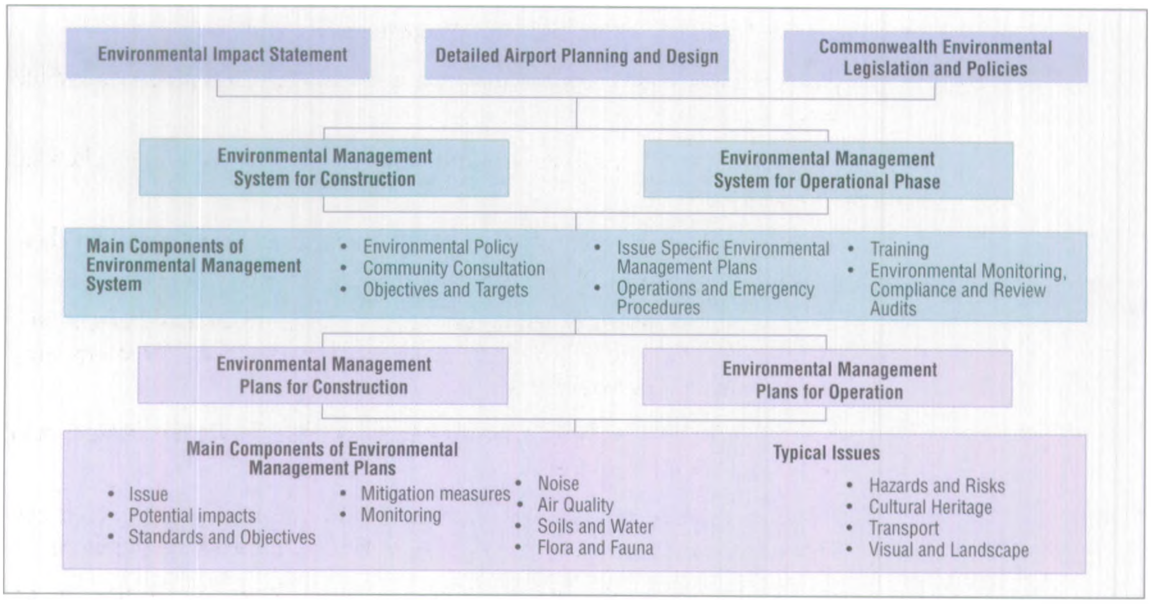


Figure 26.1
Approach to Environmental Management (Based on ISO 14001)

Standards Australia has adopted, as its interim standard, effective from November 1995, the international standard for environmental management systems, ISO 14001. In the hands of responsive organisations, this standard provides for effective ongoing management of activities which have environmental implications; the system affirms the commitment of the organisation and outlines the means of managing environmental aspects of any task or project. The construction and operation of the Second Sydney Airport would be undertaken by organisations which have established environmental management systems in compliance with the requirements of the international ISO 14001 standard.

These systems would take account of the measures in this Draft EIS proposed to counter identified environmental impacts, and would incorporate them, in specific environmental management plans. *Appendix* G outlines possible environmental management plans for the airport options; they would include environmental objectives for the identified issues and recommended mitigation measures.

26.2.2 Environmental Management in the Context of Ecologically Sustainable Development

The *National Strategy for Ecologically Sustainable Development* has established what the goal, core objectives and guiding principles of such development should be. It states as the goal:

> development that improves the total quality of life, both now and in the future, in a way that maintains the ecological processes on which life depends.

The three core objectives are to:

- enhance individual and community wellbeing and welfare by following a path of economic development that safeguards the welfare of future generations;
- provide for equity within and between generations; and
- protect biological diversity and maintain essential ecological processes and life support systems.

These objectives can be achieved by processes which encompass the following guiding principles:

- decision making processes should effectively integrate both long and short term economic, environmental, social and equity considerations;
- where there are threats of serious or irreversible environmental damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environment degradation;
- the global dimension of environmental impacts of actions and policies should be recognised and considered;
- the need to develop a strong, growing and diversified economy which can enhance the capacity for environmental protection should be recognised;
- the need to maintain and enhance international competitiveness in an environmentally sound manner should be recognised;
- cost effective and flexible policy instruments should be adopted, such as improved valuation, pricing and incentive mechanisms; and
- decisions and actions should provide for broad community involvement on issues which affect them (Commonwealth of Australia, 1992).

These principles have been taken into account in the development the following measures for ongoing environmental management. It therefore follows that adherence to these measures should contribute to meeting the goals of ecologically sustainable development.

26.2.3 Environmental Management Systems for the Second Sydney Airport

Compliance of any environmental management system with the ISO 14001 standard is not compulsory; nevertheless regulators expect that the majority of organisations aspiring to best practice in environmental management will operate in accordance with this standard, which has widespread international acceptance. ISO 14001 is structured logically and includes elements ranging from environmental policy, environmental planning and implementation, checking and corrective action, right through to periodic review of the system.

Construction Phase

The organisation responsible for the construction of the Second Sydney Airport would develop and implement an Environmental Management System consistent with the requirements of ISO 14001; the policy document would be made publicly available. The system would contain the following elements:

- environmental policy;
- organisational commitment;
- objectives and targets;
- legal and other requirements;
- issuing of specific environmental management plans;
- responsibilities and reporting structure, including all contractors and subcontractors;
- training and awareness;
- communications, including community consultation;
- document control;
- operational control;
- emergency response;
- non-conformance correction and preventative action;
- record keeping; and
- environmental monitoring, compliance and review audits.

Construction would not commence until the relevant authorities were satisfied that the environmental management system had identified all relevant legislative requirements and was consistent with the undertakings and conditions of approval following the determination of the Second Sydney Airport proposal.

The Environmental Management System would clearly assign responsibilities for specific management plans and actions to the lead authority/company responsible for the construction of the Second Sydney Airport. A suitably qualified environmental management representative would be appointed. She or he would be responsible for ensuring that the environmental management system was being complied with and that the environmental targets and mitigation measures were met. Regular reporting of environmental issues to the Commonwealth would be an additional responsibility.

This system for the construction phase would incorporate environmental management plans consistent with the outline plans provided in *Appendix* G. Further details about how an Environmental Management System that is consistent with ISO 14001 should be developed are provided in *Appendix H*.

Operational Phase

In a similar manner, the organisation responsible for the airport's operation would develop and implement an Environmental Management System meeting the requirements of ISO 14001; the policy document would be made publicly available. The system would have the same elements as those described above for the construction phase environmental management system.

The system established for the operational phase would likewise incorporate environmental management plans consistent with the outline plans provided in *Appendix* G.

26.2.4 Environmental Regulation

The *Airports Act 1996* establishes the regulatory arrangements for leased Commonwealth airports, and it is assumed here that they would apply to the Second Sydney Airport. The Act enables the Commonwealth to exercise control over land use, planning and building of a Second Sydney Airport. The Act further requires a company holding a lease for a Second Sydney Airport to submit an airport master plan and an environmental strategy for approval by the Minister for Transport and Regional Development. The latter, the environmental strategy, must be submitted for public comment before being sent to the Minister for approval, and, following approval, the airport lessee company and other users of the airport must take all reasonable steps to comply with it. In all this procedure, the aim is to bring about improved environmental outcomes at the airport.

This strategy would be the regulatory mechanism through which the environmental safeguards and monitoring proposals of this Draft EIS would be implemented. Thus the Environmental Management Systems referred to above for airport construction and operation would need to take into account the regulatory requirements of the *Airports Act* and *Regulations*.

Part 6 of the Act makes provision for setting environmental standards that must be met; empowering the Minister to require monitoring of pollution, concurrent with mitigation or remediation. It also stipulates penalties for offences in relation to:

- environmental pollution (including air, water or soil pollution) generated at airport sites;
- impacts on biota or habitat;
- interference with sites of heritage value;
- interference with sites of significance to Aboriginal or Torres Strait Islander people;
- emission of noise generated at airport sites (other than aircraft overflight noise); or
- disposal or storage of waste at airport sites.

The *Airports (Environment Protection) Regulations* were enacted in 1997 to give effect to these powers; they aim (as stated in regulation 1.02):

- to establish, in conjunction with National Environment Protection Measures made under section 14 of the *National Environment Protection Council Act, 1994*, a Commonwealth system of regulation and accountability for activities at airports that generate, or have the potential to generate, pollution or excessive noise; and
- to promote improved environmental management practices for activities carried out at airport sites.

The intent of the *Regulations* is to promote awareness of environmental issues and to ensure that management systems are established to deal with the pollution, noise and other environmental impacts produced at airports, with a view to reducing those impacts and increasing public amenity over time. Airport environmental officers would be appointed by the Secretary of the Department of Transport and Regional Development; it would be a part of their job to enforce the *Regulations* and liaise with their opposite numbers in the organisations responsible for operation of the Second Sydney Airport. An overview of the *Airports (Environment Protection) Regulations* is provided in *Appendix I*.

Other legislation relevant to the ongoing environmental management of the airport would be both Commonwealth and State legislation relating to environmental impact assessment. This legislation would be triggered by any new or modified proposals relating to the airport's development and operation for which the Commonwealth would be responsible, and any proposals for off airport site infrastructure which would be the responsibility of State and/or local government. As outlined in *Chapter 2*, the main legislation in this regard is the *Commonwealth Environment Protection (Impact of Proposals) Act, 1974* and the *NSW Environmental Planning and Assessment Act, 1979*. Both acts have provisions providing for community consultation. It should be noted that any private individual or company who is proposing any type of development on land surrounding the airport would also be subject to the town planning, environmental impact assessment and community consultation provisions of the *NSW Environmental Planning and Assessment Act, 1979*.

26.3 Monitoring and Auditing

The systems adopted for construction and operation of the airport would include provision for environmental monitoring and auditing on a regular basis, both of these are essential components of any environmental management systems that is to comply with ISO 14001.

Monitoring of baseline conditions has been undertaken for some environmental issues as part of this Draft EIS, and in some cases, additional baseline monitoring has been recommended. These instances are referred to in the outline environmental management plans in *Appendix* G and in more detail in the relevant chapters of this Draft EIS and supporting technical papers. In these same chapters, specific recommendations are made for continued monitoring during the construction and operational phases of the airport project.

An environmental audit is a means of verifying that the appropriate measures are being followed and the desired objectives are being met. If they are not, an audit can identify what corrective action should be taken. The Environmental Management Systems would specify audit programs, including the possible use of independent third party auditors at regular intervals.

26.4 Regional Environmental Management

Conducting a comprehensive environmental impact study such as the one undertaken for this Draft EIS is a preliminary step in the process of ensuring that guiding principles of ecologically sustainable development are incorporated into the overall approach to environmental management. The development of a second major airport for Sydney would influence the existing economic and urban structure of western Sydney and the future planning of the region. It would therefore be appropriate that the environmental management of the airport not only be approached at a project specific level as outlined in this chapter but at a regional level by all three levels of Government, namely Commonwealth, State and Local. Some of the issues that should be addressed by these three levels of Government are discussed below.

26.4.1 Strategic Planning and Environmental Management

Extensive strategic planning studies have been undertaken of the area surrounding Badgerys Creek by a joint Commonwealth, State and local Government taskforce over recent years. This initiative was helpful in the assessment of the airport options, however, those studies assumed a development of similar proportions to the 1985 proposal for Badgerys Creek.

Further planning studies carried out for this Draft EIS have broadly documented the potential metropolitan and regional implications of the airport options presently being considered. The Draft EIS, however, is not intended to be a comprehensive strategic planning exercise. Should a decision be made to proceed with the airport, refinement of previous strategic planning studies and additional studies would be required to take account of the new scale of the airport and potentially new runway locations and directions.

Strategic regional planning would also need to take account of regional environmental issues such as air quality, water quality, traffic and public transport and aircraft overflight noise. Most of the potentially significant environmental impacts of the airport could only be effectively managed in the context of the overall management of both existing and proposed future urban development. For example, the Second Sydney Airport would worsen existing ozone impacts in the region and would increase the need for the successful implementation of Sydney wide strategies to manage emissions. Also, operational plans for the airport and State and local government strategic planning, especially for new residential development, should be closely coordinated to ensure that the aircraft overflight noise impacts of the airport are minimised.

The State Government's strategic planning proposes the housing of approximately 190,000 additional people (Department of Urban Affairs and Planning, 1995; Australian Bureau of Statistics, 1997b)) in the six local government areas surrounding Badgerys Creek (Penrith, Blacktown, Liverpool, Fairfield, Camden and Campbelltown) over the next 20 years. The Second Sydney Airport proposal would influence the way that growth is managed. Likewise new urban development would influence the environmental management of the airport. Therefore whole of Government responses to environmental issues are required to assist in achieving acceptable environmental management of the Second Sydney Airport and to ensure the future development of western Sydney proceeds in accordance with the four basic goals of Sydney's Metropolitan Planning Strategy (Department of Planning, 1995), namely:

- equity - fairness and equality of opportunity;
- efficiency - making best use of resources;
- environmental quality - using integrated environmental management to strive for ecologically sustainable development; and
- livability - adding to the quality of life.

26.4.2 Meteorological Monitoring

The air quality analysis presented in this Draft EIS predicts that the airport would result in regional scale impacts on air quality under adverse meteorological conditions. This is especially so in the case of ozone which is an air quality indicator of photochemical smog.

Significant data on the vertical profile of the atmosphere in western Sydney do not exist. Details of this vertical profile are important because the vertical structure of wind and temperature influences the magnitude of the concentration of air pollutants. The limitations of these data contribute to uncertainty regarding the extent of ozone impacts for major developments such as the Second Sydney Airport and residential urban development programs.

Information on the vertical profile of the atmosphere would improve the accuracy of the environmental assessment of the airport It would therefore be appropriate that a program for monitoring be initiated both for the future environmental assessment of the detailed development of the airport and the associated air quality management plan and to allow more accurate assessment of the impacts of other major urban development proposals.

Part I

Comparison and Conclusions

Chapter 27

Overview of Impact Assessment

Chapter 27
Overview of Impact Assessment

This chapter provides an overview of the assessment documented in this Draft EIS and a summary of the ways in which it assists the decision making process. The cumulative impacts of the proposal and the likely environmental implications of the potential future expansion of the Second Sydney Airport are also examined.

27.1 Impact Assessment

27.1.1 Impact Assessment in Context

The assessment documented in this Draft EIS adds significantly to the available knowledge concerning the environmental impacts that might follow the construction and operation of the Second Sydney Airport at Badgerys Creek. Not only will it assist the Commonwealth Government in making a decision, but it also provides information to the community, thus allowing informed input into that decision making process. This information includes:

- an analysis of three different rates of growth of the airport (Air Traffic Forecasts 1, 2 and 3), and three different types of operation (Airport Operations 1, 2 and 3) thus it provides a conservative range (including likely worst case) of potential impacts;
- an extensive strategic planning investigation which identified the potential characteristics of future urban development and allowed an appropriate environmental context to be developed for the assessment;
- a detailed noise assessment, which allows predictions for a wide range of potential aircraft overflight noise impacts including relatively low levels of impact down to zero ANEC (refer *Appendix D*); and
- an assessment of a large number of environment issues, which in most cases involved extensive field investigation.

While the Draft EIS is an important component of the decision making process, the Government will also consider the submissions made during the exhibition of the Draft EIS; the Supplement to the Draft EIS, which will be prepared following consideration of those submissions; an Assessment Report prepared by Environment Australia; and other matters.

As with all studies of this nature, there is a limit to how much quantitative analysis can be developed as part of the environmental assessment process. Some limits are inherent in the study brief, but most relate to limits of data, current knowledge and scientific assessment techniques. Despite these limits, it has still been possible to objectively assess the environmental implications of the airport proposals.

Chapter 2 mentioned four limitations of the assessment. They relate to the restricted extent of environmental assessment of:

- airport options other than those that are available in the Badgerys Creek area. Consequently, options such as Goulburn, Newcastle, or off the coast of Sydney were not subjected to a comprehensive environmental assessment;

- off airport site infrastructure, which would be the subject of detailed environmental assessment under State environmental legislation;
- the potential expansion of the airport past a limit of 30 million passengers per year; and
- the impacts of an airport at Badgerys Creek on other major airports.

Other methodological issues encountered in the preparation of this Draft EIS include the following:

- insufficient information was available to allow an assessment of potentially adverse noise impacts or noise benefits that might come about at other airports, especially Sydney Airport through changes caused by the Second Sydney Airport proposal. The flight paths of the Second Sydney Airport would need to be considered in conjunction with flight paths at Sydney Airport when initial operational plans are developed:
- as part of the air quality analysis, it was planned to use the airshed model developed for the *Metropolitan Air Quality Study* (NSW Environment Protection Authority, 1997a) for analysis of the regional impacts of the airport options and associated development. However, access to this model for the purposes of the Draft EIS was not possible. Therefore the analysis of regional impacts and associated developments depended upon a less sophisticated, but nevertheless valid methods. The prediction of regional impacts of the airport options was made for this Draft EIS by using a box model approach, rather than an airshed model. This approach did not take into account variations in wind speed with height, or emissions outside of a six kilometre area near major roadways. Coefficients used for assessing photochemical smog impacts were estimated from values based on monitoring data; while ambient air chemistry was based upon data from monitoring sites which were relatively distant from the sites of the airport options;
- health impacts of air toxic emissions were examined on the basis of dispersion modelling results and published risk factors associated with individual air toxic compounds. These risk factors contain a high level of uncertainty as, in many cases, they are based on extrapolation of testing on animals; and
- the economic analysis was limited in its scope. As with any major proposal, it is not possible to carry out a complete cost benefit analysis. There is, for instance, no agreed methodology for valuing, in monetary terms, many significant adverse environmental impacts. Likewise, many benefits could not be fully quantified because of a lack of sufficient information. It was also not possible to define a robust '*do nothing*' base case, to allow comparison with the Second Sydney Airport proposal. It is not reasonable simply to adopt a base case that assumes all air traffic demand above the 30 million passengers per year proposed for Sydney Airport would be diverted to other major cities in Australia. The result of comparing the Second Sydney Airport proposal to such a base case would be to overvalue the proposal. To define an alternative base case such as the expansion of Sydney Airport to accommodate significantly more than 30 million passengers would require considerable investigation of airport planning and operational and environmental consequences. This is not feasible nor necessarily appropriate within the existing scope of this EIS process.

The Draft EIS and related technical papers provide information to the Commonwealth Government, the community and other stakeholders so that they may participate in and help to progress the assessment of the environmental viability of the Second Sydney Airport proposal. This information has been developed in accordance with the precautionary principle of ecologically sustainable development which,in part, states that a proposal should not proceed if there is sufficient scientific uncertainty about its environmental impacts. The environmental assessment has been based on a wide range of assumptions and scenarios, including many that would demonstrably result in worst case impacts. It is, however, anticipated that there will be substantial community and stakeholder response to the exhibition of the Draft EIS, and further matters may need to be examined in the preparation of a Supplement. Some additional matters that should be considered for further study prior to any decision being reached on the proposal include:

- further analysis of pollutant concentrations measured at air quality monitoring stations in the vicinity of Badgerys Creek and analysis of ozone impacts, using one year of meteorological and air quality data available from NSW Environment Protection Authority, would improve the accuracy of the existing air quality analysis. That analysis was limited because of difficulties in resolving apparent orientation problems in wind monitoring data initially purchased from the NSW Environment Protection Authority. It would also be prudent at that time to undertake a sensitivity analysis of the results of the air quality study. This would be advisable because of the lack of vertical profile data and would use different assumptions about mixing depths in the modelling process; and
- flood modelling of the South Creek catchment to verify design assumptions relating to the water management of the airport options.

Undertaking the above investigations would be consistent with the precautionary principle of environmental assessment. It is, however, considered unlikely that these further investigations would significantly alter the conclusions of this Draft EIS.

27.1.2 Overview of Potential Environmental Impacts

Table 27.1 provides an overview of the potential impacts of the development of the airport options. The order reflects the structure of this Draft EIS, that is, the table progresses through the categories of planning, noise, physical and biological impacts, and social and economic impacts.

Table 27.1 Overview of Potential Environmental Impacts

Community Issues[1]	Major Outcomes of Draft
Metropolitan, Regional and Local Planning (Chapter 10)	
• *Local and regional planning would be affected by increased airport operations and provision of cross wind runway in Option B.* • *Alignment of runways in Option C and resultant noise impacts would affect local and regional planning.*	• Despite increased operational level and cross wind runway in Option B, the planning initiatives suggested by the joint Commonwealth, State and local Government taskforce which investigated the planning of the region surrounding the airport site could still be achieved if Options A or B were to proceed. • These planning initiatives might also be possible for Option C, but further investigation is required.

Table 27.1 Overview of Potential Environmental Impacts (cont.)

Community Issues[1]	Major Outcomes of Draft EIS
Land Use (Chapter 10)	
• *Impacts on existing and proposed residential land uses.* • *Loss of agricultural land uses.* • *Impacts on Defence Establishment Orchard Hills.* • *Redevelopment of properties near airport for new airport related industries.*	• Additional land acquisition required for Options B and C. • Additional loss of productive agricultural land as a result of Options B or C. • Impacts on a range of land uses because of acquisition. • Potential voluntary acquisition of noise affected properties outside the site boundaries for all options. • Potential creation of new urban release areas of Bringelly (Options A and B) or Rossmore (Option C). • Potential development of new employment area north of Elizabeth Drive. • Limited impacts on Defence facilities, with the exception of the impacts of Option C on Defence Establishment Orchard Hills. These impacts would probably require some Defence activities to be curtailed.
Servicing (Chapter 10)	
• *Impacts of roads.* • *Removal of telecommunication facilities.* • *Supply of fuel to airport options.*	• Significant regional planning benefits of off airport site infrastructure provision such as improved roads and sewerage connections. • Proposed road and rail access is consistent with metropolitan and regional planning strategies. • Defence telecommunication facilities proposed to be closed. • Range of environmental impacts during construction of off airport site infrastructure. These impacts would need to be examined by separate environmental impact assessment processes. • Fuel supply could be achieved by a pipeline which would be located in main road corridors.
Aircraft Overflight Noise (Chapters 11 and 12)	
• *Increase in existing low background noise levels.* • *Sleep disturbance especially to shift workers.* • *Disturbance to educational activities.* • *Health effects of noise.* • *Impacts on wildlife and wilderness values.*	• Most existing background noise levels (L_{A90}) measured during the day were less than 40 dBA and most measured during the night were less than 35 dBA. These levels are consistent with recommendations of the NSW Environment Protection Authority for noise levels in rural and residential areas. • The level of impact from aircraft overflight noise would be dependent on a number of factors, including the way the airport may operate and an individual's reaction to aircraft noise. Many potential effects of aircraft overflight noise were investigated, including potentially adverse effects on health. Studies of these effects have in the main yielded inconclusive results; therefore only a limited range of noise impacts can be quantified. Nevertheless a detailed and broad range of aircraft overflight noise data has been developed and is presented for individual communities in *Appendix D*. • In terms of overall impacts, cumulative data may be found in *Tables 12.5* and *12.6*. Predictions were made of the numbers of people that would be impacted by aircraft overflight noise from the proposed maximum level of operation of the airport (estimated to be at least 19 years in the future). A summary is provided below. • In the case of the lower levels of noise modelled (more than 10 noise events greater than 70 dBA during an average day), it is predicted that between 12,000 and 49,000 people would be impacted by this level of aircraft overflight noise in 2016 depending on the airport option and type of operation considered. • Of those people impacted by the lower levels of noise, some would be impacted by the mid range levels of noise modelled (ANEC more than 15 or more than 20 noise events greater than 70 dBA during an average day). It is predicted that between 3,000 and 17,000 people would be impacted by this level of aircraft overflight noise in 2016, depending on the airport option and type of operation considered. • Some of those people would be impacted by the higher levels of noise modelled (ANEC more than 25, or more than 100 noise events greater than 70 dBA during an average day); it is predicted that between 200 and 1,000 people would be impacted by this level of aircraft overflight noise in 2016 depending on the airport option and type of operation considered.

Table 27.1 Overview of Potential Environmental Impacts (cont.)

Community Issues[1]	Major Outcomes of Draft EIS
Aircraft Overflight Noise (cont.)	
	• Up to 17,000 people might be awoken more than once every five nights due to aircraft overflight noise, if no curfew were imposed at the airport. Of those people, up to 1,000 people might be awoken every two nights, while up to 100 people might be awoken once every night. • Between three and 22 schools are predicted to receive, on average, more than 20 noise events greater than 65 dBA between 9am and 3pm in 2016, depending on the airport option and type of operation considered. Of those schools, between one and three would be impacted by more than 50 noise events greater than 65 dBA between those hours. • Between 700 and 8,000 people may experience noise induced vibration of building elements due to aircraft overflights in 2016, depending on the airport option and type of operation considered. • Estimated direct residential property devaluation in 2016 of between $49 and $67 million for Option A, from $52 million to $60 million for Option B, and from $25 million to $31 million for Option C, depending on the operation of the airport. • Potential increases in property values for properties in possible new urban areas and employment areas. • Options A and B would create most noise in the natural areas of the Blue Mountains. It is predicted that up to 25 noise events greater than 70 dBA would be experienced during an average day in these areas in 2016, including up to about five noise events greater than 80 dBA. • Adopting certain flight paths and airport operating modes may reduce the number of people affected by noise impacts. • Adoption of a curfew would also reduce the number of people likely to be affected by sleep disturbance. • Because of the uncertainty regarding how the airport may operate and the type of noise control measures that might be adopted, it is not possible to provide a ranking of the three airport options considered in terms of their potential noise impacts.
Other Noise Impacts (Chapter 13)	
• *Impact of ground and construction noise on nearby residential areas.* • *Impacts of noise from increased road traffic.*	• Construction noise criterion contour (50 dBA) extends just outside the airport site boundary. • Significant impact of ground operation noise for temperature inversion conditions to a maximum of approximately 15 kilometres from the airport site boundary. During these conditions, it is predicted between 15,500 and 21,000 people would be impacted by ground operation noise (over 50 dBA), depending on the airport option considered. Adoption of various environmental management measures could substantially reduce this impact. • A preliminary assessment of road and rail access proposals revealed that a range of noise impacts; however, most of these could be adequately managed with routinely used mitigation measures. The most significant impacts would occur along the existing East Hills rail line where an overall increase in noise level of approximately six dBA would be experienced.
Meteorology (Chapter 14)	
• *Unusual and strong air currents over the Blue Mountains might cause hazards to aircraft.* • *Occurrence of fog and other adverse meteorological conditions.* • *Thermal inversions may exacerbate air quality impacts.*	• Operations by larger aircraft would be able to achieve the adopted runway usability criteria for all options. Operations by aircraft with lower cross wind capability would sometimes be restricted. • Vertical wind shear and mechanical turbulence would be significant for operation of some types of aircraft in certain wind and atmospheric conditions. • Fog is predicted to occur 10 days per year on average at Badgerys Creek. • Overnight ground based inversions or stable layers could inhibit the vertical dispersion of air pollutants from the airport options.

Table 27.1 Overview of Potential Environmental Impacts (cont.)

Community Issues[1]	Major Outcomes of Draft EIS
Air Quality (Chapter 15)	
• *Pollutants might result in increases in levels of cancer and respiratory problems such as asthma.*	• Exceedence of ozone goals on days with existing high background ozone would occur downwind of the airport site for all options approximately six times per year at Badgerys Creek. Ozone at ground level can irritate eyes and air passages, and might interact with allergies to trigger asthma attacks. • Increase in peak hourly ozone level of more than one part per 100 million is predicted to affect approximately 8,000 people for Options A, B and C. • Predicted increases in hospitalisation due to ozone are between two and three people per 100 years, while prediction of early death associated with ozone is one person per 100 years. • Predicted increases in hospitalisation due to particulates are between three and four people per 100 years, while prediction of early death associated with particulates is less than one person per 100 years. • An increase of cancer cases of three per 100 years is predicted as a result of the generation of air toxics such as benzene. • Dust levels beyond the airport boundary during construction could potentially exceed commonly accepted guidelines; therefore appropriate dust management techniques would be required. • An estimated 1,500 people would be exposed to kerosene odours beyond the airport boundary for more than 44 hours per year for Option A, 1,000 for Option B and 1,500 for Option C. • Emissions from associated development and motor vehicles would probably amplify the impacts predicted from the airport itself.
Geology, Soils and Water (Chapter 16)	
• *Impacts on soils and potential loss of productivity.* • *Impacts on tank water.* • *Impacts on water quality in Lake Burragorang and catchment areas.* • *Impacts on water quality in Prospect Reservoir.* • *Pollution of the South Creek and Hawkesbury-Nepean River system.*	• Loss of agricultural activities within airport sites. • Low to moderate impacts from sediment in Badgerys, Cosgrove and Oaky creeks and downstream in South Creek, thereby impacting on aquatic fauna and raising nutrient levels. • Phosphorus and nitrogen levels would increase significantly because of sewage treatment plant discharges, resulting in higher levels of in-stream algae or aquatic plants in the South Creek system. • Infilling of various creeks is required. • Option A removes five kilometres of stream habitat, while Option B and C each removes 10 kilometres, as a result of infilling local creeks. • Moderate potential regional impacts from increased salinity. • Some potential regional impacts for recreation, fishing and agriculture. • Concentrations of benzene in drinking water catchments are unlikely to exceed existing ANZECC levels for drinking water. • Tank water could potentially be impacted by dust generated by construction activities and by aircraft emissions.
Flora and Fauna (Chapter 17)	
• *Recognition of existing degradation of the site.* • *Need to preserve remnant bushland in western Sydney.*	• The sites of the airport options are considered to have regional significance for nature conservation. • Option A (site only) would require removal of approximately 120 hectares of habitat with high local significance, including one flora species of national significance and 33 flora species of regional significance. Potential impacts on two fauna species of national significance, 12 species of State significance and 38 fauna species of regional significance, five species listed under international agreements.

Table 27.1 Overview of Potential Environmental Impacts (cont.)

Community Issues[1]	Major Outcomes of Draft EIS
Flora and Fauna (cont.)	
	• Option B (site only) would require removal of approximately 210 hectares of habitat with high local significance, including one flora species of national significance and 34 flora species of regional significance. Potential impacts on fauna species are the same as for Option A. • Option C (site only) would require removal of approximately 180 hectares of habitat with high local significance, including one flora species of national significance and 37 flora species of regional significance. Potential impacts on fauna species are the same as for Option A. • Examples of Cumberland Plain Woodland that would be cleared from the sites are considered to be too scattered and altered to be of State significance (may be appropriate to reassess once significance criteria have been established by the National Parks and Wildlife Service). • All options would create a barrier across a wildlife corridor of high local significance. • All options would have only minimal impact on aquatic fauna in Cosgrove, Oaky, Badgerys and Duncans creeks due to the existing degraded nature of the creeks and low conservation values.
Resources, Energy and Waste (Chapter 18)	
• *Loss of agricultural productivity.* • *Safe disposal of quarantine waste.*	• Displacement of agricultural activities potentially causing annual losses of production of $0.6 million for Option A, $2.3 million for Option B and $1.7 million for Option C. However, these activities and losses would probably be taken up by other regions. • Quarantine wastes could be sterilised and disposed of along with non-quarantine wastes, and volumes of quarantine waste can be minimised by effective waste segregation. • Potential sterilisation of 57 to 84 million tonnes of medium ash coking coal unless cost effective techniques can be developed that permit mining without causing significant subsidence. • Consumption of 90 million litres of fuel during construction.
Hazards and Risks (Chapter 19)	
• *Risk of aircraft crashes due to fog and wind shear.* • *Risk of aircraft crashes due to proximity to Blue Mountains.* • *Risk associated with aircraft crashes into a large number of facilities including the Defence Establishment Orchard Hills and Sydney Water drinking water supply facilities.* • *Traffic generated by airport would increase exposure to accidents.* • *Fuel supply*	• Adverse meteorological conditions such as high intensity rainfall, thunderstorms, low cloud and fog should not be a significant constraint to large commercial aircraft because of modern navigation aids. Other aircraft may be at risk from adverse meteorological conditions; however, more data is required to fully quantify this risk. • Maximum predicted fatality rates for people in surrounding areas from aircraft crashes range between 2.2 people for Option B and five for Option C every 100 years. The maximum rate for Option A is 2.5 people every 100 years. • Approximately 2,500 people would be exposed to risk of fatality of greater than one in a million (Department of Urban Affairs and Planning guidelines for residential areas near hazardous industries) for Options A and B; and approximately 9,000 people for Option C (based on 2016 population). • Traffic management plan required to minimise risk exposure in car travel. • Probability of aircraft crashes into Defence Establishment Orchard Hills is approximately one crash per 1,000 years for Option C and one crash per 100,000 years for Options A and B. • Probability of aircraft crashes into the Sydney Water Supply Pipeline is one crash per 1,000 years for Option C and one crash per 10,000 years for Options A and B. • Other items of water supply infrastructure, such as Warragamba Dam and Prospect Reservoir, are exposed to aircraft crash risk levels of one crash per 10,000 years, for Options A and B only. • Potential for increased number of traffic accidents has not been assessed; however, new or upgraded roads associated with the airport are likely to be safer than existing roadways. • Birds and bats would present a moderate but manageable risk to the operations of aircraft, provided that future land use in the vicinity of the airports is controlled to avoid attracting these fauna. • Fuel supply pipeline would be constructed to appropriate safety standards; however, a full risk assessment would be required.

Table 27.1 Overview of Potential Environmental Impacts (cont.)

Community Issues[1]	Major Outcomes of Draft EIS
Aboriginal Cultural Heritage (Chapter 20)	
• *Number of archaeological sites affected should be quantified.*	• Option A would impact on 60 known Aboriginal sites or isolated finds and a predicted 119 sites or isolated finds. • Option B would impact on 85 known Aboriginal sites or isolated finds and a predicted 196 sites or isolated finds. • Option C would impact on 94 known Aboriginal sites or isolated finds and a predicted 205 sites or isolated finds. • Loss of sites of local significance. • Collective value of archaeological resource is assessed as low.
Non-Aboriginal Cultural Heritage (Chapter 21)	
• *Items of local and regional heritage significance potentially affected by vibrations, aircraft emissions and other impacts.*	• Option A would result in loss of 13 heritage items, five of regional significance and eight of local significance. • Option B would result in loss of 15 heritage items, five of regional significance and 10 of local significance. Option C would result in loss of 17 heritage items, six of regional significance and 11 of local significance. • Partial destruction of The Northern Road (item of regional significance) within the airport boundary, whichever option were chosen.
Transport (Chapter 22)	
• *Exacerbation of existing problems on the M4 Motorway, Elizabeth Drive, Mamre Road and other roads in the area.* • *Impacts on RAAF Base Richmond.*	• *Impacts of Construction Traffic*. The Northern Road and Bringelly Road would receive significant traffic during construction. They would function acceptably if widened to four lanes before major construction started. Elizabeth Drive would also receive significant construction traffic, but would not require widening until the airport became operational. Option A would generate less construction traffic than Options B or C, which have similar traffic generation rates of about 900 trucks and 3,800 cars per day. • *Impacts on Public Transport*. Extension of East Hills Rail Line has been studied in detail and is feasible. It would serve airport and population centres with potential later extension to the Main Western Rail Line. Long term potential generation between Glenfield and airport of about 36,000 passengers per day, about half of which would be airport related. Local bus services to Liverpool and Penrith Stations would add major new destinations with potential rail interchange. • *Aviation*. Options A and B would lead to significant interactions between aircraft using the second airport and aircraft using Sydney Airport. The anticipated level of interaction may adversely impact on the capacity of the two airports. Both these options would also adversely impact operations at Bankstown and Camden airports. Hoxton Park Airport would have to be closed and parachute activities at Menangle and Wilton would be severely curtailed. Option C is compatible with operations at Sydney Airport, but would be unable to operate effectively if the Defence Establishment Orchard Hills continued to impose restrictions on airspace use. It would also significantly reduce the capacity of Camden Airport, and there would be some impacts on operations at RAAF Base Richmond. It would have the same impacts as Options A and B on Bankstown and Hoxton Park, and on parachute activities at Menangle and Wilton.
Visual and Landscape (Chapter 23)	
• *Views to the Blue Mountains would be impaired.* • *Views west from Mulgoa Road would be impaired.* • *General scenic and visual quality would be degraded.*	• Cut embankments up to a maximum of 16 metres and fill embankments up to a maximum of 13 metres. • Existing rural character completely modified. • Loss of view from The Northern Road (realigned) towards Cecil Hills, and restricted views into the site along Elizabeth Drive. • Viewing opportunity from northern and southern section of Badgerys Creek Road would be lost (Options B and C). • Views over airport possible from southern section of realigned The Northern Road (Option B); and residential areas adjoining southern airport boundary (Options B and C). • Limited other views into airport sites.

Table 27.1 Overview of Potential Environmental Impacts (cont.)

Community Issues[1]	Major Outcomes of Draft EIS
Costs (Chapter 24)	
• *Need for cost benefit analysis* • *Value of environmental costs*	• Similar costs would be incurred for any one of the Badgerys Creek options. Construction costs would range from $3 billion to $4.1 billion for Option A, $3.5 billion to $4.8 billion for Option B, and $3.4 billion to $4.7 billion for Option C. • The costs of infrastructure to service the airport would range from $961 million to $1,016 million for each option. • Limitations to extent of the cost benefit analysis that can be undertaken.
Social and Economic (Chapter 25)	
• *Need for final decision and action after planning uncertainty of last 10 years.* • *Whole family structures would be affected, as generations often live in the same area for mutual support.* • *Loss of outdoor lifestyle due to noise impacts.* • *Loss of recreational lifestyle due to overall impacts.* • *Impacts resulting in anxiety, stress and anger.* • *Employment and development opportunities.* • *Loss of commercial viability of agricultural businesses.* • *Expectation of job losses in certain business sectors and commercial impacts on real estate*	• Up to 8,400 person years of labour would be generated during construction. • Employment impact of the airport when operational would, at the least, constitute a redistribution of employment throughout Sydney, if compared to a base case of Sydney Airport being allowed to continue to expand with no second airport being developed. If compared to a case of Sydney Airport being restricted to about 30 million passengers a year and no new airport being developed, the proposal would generate between 52,000 and 63,000 jobs in Sydney by 2016. • Minor impacts on residential development strategies. • Displacement of approximately 500 people from leased properties within the existing airport site. • Displacement of an additional 500 people from properties to be acquired for Option B, and 700 people for Option C. • Displacement of community facilities, including a school, a post office and a local park. • Change to rural character/amenity, and impacts on residents' support networks. Creation of anxiety and stress. Uncertainty about development adds to anxiety and alienation from decision making process. Introduction of Options B and C has compounded these impacts. • Indirect amenity impacts on local and regional open space. • Disruption to local access patterns. • Potential community severance of villages such as Kemps Creek, Bringelly and Rossmore due to access corridors. • Short term disruption of agricultural activity, although this is likely to be offset by increases in agricultural activity elsewhere in the longer term.

Note: 1. Refers to most frequently mentioned issues.

27.1.3 Implications of the Alternatives to the Proposal

Many alternatives for providing significant additional aviation capacity for Sydney are available for consideration and many have been the subject of considerable debate by the community during the preparation of this Draft EIS. Studies carried out over the last 50 years have examined most of these alternatives They can be broadly described as:

- expanding the capacity of Sydney Airport;
- considering another site or sites for a second major airport; or
- literally doing nothing.

Each alternative would have a range of advantages and disadvantages, but clearly, all would have environmental implications. The precautionary principle of ecologically sustainable development suggests that a cautious approach should be adopted where there is any threat of serious of irreversible environmental damage resulting from a proposal. In the case of the Second Sydney Airport, not proceeding at all, or doing nothing could result in serious or irreversible environmental damage. In many cases the 'do nothing' initiatives would involve redistribution of both the adverse impacts and the benefits of a major airport from one region of Sydney, NSW or Australia to another region. In some cases, economic benefits may be lost from Australia as a whole, especially if air travel demand is significantly suppressed.

27.2 Cumulative Impacts

27.2.1 Assessing Cumulative Impacts

When considered individually, many development activities have relatively minor impacts; however, when considered collectively they may cause significant impacts on the environment. The consequences that may arise from the additive effects of incremental development are usually termed *cumulative impacts*.

The activities of human society exert pressure on the environment and change its state or condition; society responds to the changed state by developing or implementing policies or strategic initiatives, which in turn influence those human activities that exert pressure on the environment. This cycle of pressure on the environment followed by a policy response, which in turn leads to further pressure, has been identified by the Commonwealth Government as the *pressure state-response* model for the purpose of reporting on the state of the environment.

Identifying potential cumulative impacts of the proposed Second Sydney Airport assists in developing appropriate management measures, and also provides a basis for co-ordinated regional planning and environmental monitoring initiatives. Where an environmental impact assessment is being done on a specific proposal, an investigation of cumulative and regional/strategic impacts is particularly important if it is hoped to implement the principles of ecologically sustainable development. This is recognised in the *National Strategy for Ecologically Sustainable Development* (Commonwealth of Australia, 1992) and the *Intergovernmental Agreement on the Environment* (Council of Australian Governments, 1992), and is acknowledged by Environment Australia (JD Court and Associates and Guthrie Consulting, 1994).

27.2.2 Overview of Cumulative Impact Issues

Identification of Potential Cumulative Impacts

The potential cumulative impacts of developing any one of the three options proposed for Sydney's second airport are complex, and could arise as a result of various activities and flow on effects related to the proposed airport development. For instance, both adverse and beneficial cumulative impacts may arise from:

- local and regional planning effects;
- land use changes and urban developments that come about as a direct result of the airport, and which otherwise would not have occurred;
- off airport site infrastructure needed to support the operation of the airport;
- land transport access proposals; and
- changes to the noise environment, biodiversity, air and water quality, and risks associated with the operation of an airport.

The Guidelines issued by Environment Australia (*Appendix A*) recommended that this Draft EIS provide sufficient conceptual information, including a preliminary environmental assessment, so that the cumulative impacts of the Second Sydney Airport proposal could be identified. Issues considered in the Draft EIS relating to this aspect of the proposal include:

- cumulative impacts of the airport development and major support infrastructure including new road and rail links and major utility services (*Chapters 10* and *22)*;
- likely influence of the proposal in attracting other development/airport related industries, including any impacts (adverse or beneficial) associated with additional developments which otherwise would not have occurred (*Chapters 10* and *25*);
- cumulative impacts on the Sydney metropolitan area (including the community around Sydney Airport) in terms of net changes to noise, risk and air quality. Feasibility of Sydney's two major airports operating together to minimise the impact of aircraft noise on the Sydney community (*Section 2.4.3* outlines the problems associated with identifying the impacts of the Second Sydney Airport proposal on other major airport, and flow on environmental implications);
- cumulative impacts on the biodiversity of the site and region, with reference to the Hawkesbury Nepean catchment (*Chapter 17*) ;
- consistency with local and regional environmental plans, and other planning instruments (*Chapter 10*); and
- the question of whether the proposal would prevent, inhibit or improve the development of other forms of transport now or in the future, or affect the viability of other transport modes (*Chapter 22*).

The regions surrounding the airport options, which include the Hawkesbury Nepean catchment and the South Creek Valley, are recognised as being particularly sensitive to changes in the environment, especially in air and water quality. These concerns are documented in studies such as *South-Western Sydney, A Vision for Environmentally Sensitive Development* (Department of Planning, 1990a), *South Creek Valley Draft Regional Environmental Plan* (Department of Planning, 1991b), *Revised South-Western Sydney Strategy* (Department of Planning, 1992), and *Macarthur South Regional Environmental Study* (Department of Planning, 1991c). Plans make provision for 190,000 additional residents in the south-western region of Sydney by the year 2016. Consequently, there would be many influences on the environmental quality of this region. Any further development might contribute to cumulative impacts and would require co-ordinated management to minimise the size and extent of those that were negative.

The impact assessment undertaken for this Draft EIS considers a range of scenarios for air traffic passenger levels and airport operations. In most cases a range of potential impacts is described and in some, the assessment was undertaken using *Air Traffic Forecast 3*; this represents the highest level of usage envisaged for the proposed airport in 2016. Consequently, the assessment of potential impacts is conservative and provides a sensitivity factor that is consistent with the precautionary principle.

Cumulative impacts of land transport and public transport have been considered in the land transport modelling, which takes into account other transportation proposals and future land uses identified by and consistent with current local, regional and metropolitan planning in Sydney. The regional air quality impacts of additional road traffic generated by the airport have also been assessed.

Relationship between Cumulative Impacts and Ecologically Sustainable Development

The potential cumulative impacts of the airport options and their consistency with the principles of ecologically sustainable development are identified in *Table 27.2*. Only two of the four principles, namely, conservation of biological diversity and intergenerational equity, have been included in this table. These and also the two remaining, the precautionary principle and the need for improved valuation of resources, have been addressed in assessments undertaken in other parts of this Draft EIS.

In relation to the precautionary principle, the environmental mitigation measures are aimed at avoiding or minimising environmental damage, should a Second Sydney Airport proceed. It is recognised, however, that development of a major airport and the resultant cumulative impacts would create varying levels of environmental damage, which may in some cases be irreversible.

Detailed information was gathered during the consultation process, as documented in *Technical Paper No. 1*. This consultation has enabled community values and concerns to be identified, and has informed the environmental impact assessment process. Publication of this Draft EIS identifying the adverse and beneficial impacts of the airport options will provide further opportunity for informed community debate. In conjunction with the submissions made to the Draft EIS, this debate will help define what relative values are to be applied to issues, impacts and resources of importance to the community. Values such as these cannot be derived from traditional economic analysis. Specific examples of how consultation can contribute to improved valuation of resources include:

- involvement of Local Aboriginal Land Councils in archaeological field surveys, and in the preparation of reports documenting what value the Aboriginal communities place on Aboriginal cultural heritage resources found on each of the airport sites; and
- desktop review of published heritage studies, and development of area-specific thematic histories outlining the relative value to the community of aspects of non-Aboriginal cultural heritage.

Figure 27.1 presents an overview of the changes to the environment potentially caused by land uses and other influences arising from any decision to proceed with a Second Sydney Airport. For selected land uses and influences, environmental indicators that may be affected are shown by a symbol. When interpreting *Figure 27.1*, it should be noted that no attempt has been made to determine the relative significance of the cumulative impacts. Further, as the figure is intended to provide an overview of the potential interactions and relationships based on the assessments carried out for this Draft EIS, it does not provide a definitive cumulative impact assessment. Rather, the figure provides conceptual information as a guide to possible threats to the achievement of the principles of ecologically sustainable development.

27.2.3 Conclusions

Many influences already act upon the environmental quality of the region in which the Second Sydney Airport is proposed, often to its detriment. If developed, the Second Sydney Airport would be one more of these influences. The development of an airport would, however, have many positive benefits such as providing employment and services, and possibly offering opportunities to improve journey to

Table 27.2 Cumulative Impacts of Airport Options

Result of Proposal	Secondary (Cumulative) Impacts	Consistency with ESD Principles[1]
Physical Development of Airport Site		
• Construction activities over period of approximately 6 to 6.5 years	• Consumption of large amounts of non-renewable resources and energy.	• No feasible renewable alternatives. • Use of some non-renewable resources would affect intergenerational equity.
• Clearing of vegetation and habitat	• Creation of a barrier across wildlife corridor of high local significance. This increases habitat fragmentation, vulnerability to disease and predation, etc.	• Changes in species, ecosystem and genetic diversity, with resultant effects on biological diversity.
• Displacement of commercial rural and rural residential activities.	• Contribution to loss of productive agricultural land in western Sydney • Changes in social cohesion.	• Because of existing social structure, this could contribute to reduction in intergenerational equity for the Badgerys Creek community.
• Sterilisation of potential coal resources	• Resources potentially unavailable for future generations, in the short term, but potentially preserved in the long term.	• Reduction in intergenerational equity in short term.
• Increased noise	• Combined with noise from support infrastructure and other developments attracted to the area, would increase background noise levels.	• Not applicable.
• Increased loading on watercourses	• Changes in species with likely increases in pollution tolerant species. Impacts on downstream water quality.	• Changes in species, ecosystem and genetic diversity of aquatic flora/ fauna affecting overall biological diversity. Potential impact on future water quality of South Creek and Hawkesbury Nepean systems.
• Increased air emissions	• Combined with air emissions from support infrastructure and developments attracted to the area, would affect regional air quality, particularly the peak ozone levels.	• Effects on future quality of air in Sydney basin. • Greater viability of rail options could reduce car dependence.
• Land use changes in adjacent areas	• Increased noise and air emissions; further clearing of vegetation and habitat; changes to property values.	• Fragmentation of habitat further affects biological diversity. Additional effects on intergenerational equity.
• Loss of Aboriginal and Non-Aboriginal cultural heritage sites	• Combined with potential losses of sites as a result of other urban development and support infrastructure, reduces known archaeological resources in south-western Sydney.	• Reduces historic, aesthetic, social and technical significance and research potential of heritage resources for future generations.

Table 27.2 Cumulative Impacts of Airport Options (cont.)

Result of Proposal	Secondary (Cumulative) Impacts	Consistency with ESD Principles[1]
Aircraft Flying Over Areas Not Previously Affected; Increasing Aircraft Movements over Other Areas		
• Aircraft noise increases	• Changes to future urban development pattern. • Changes to property values.	• Not applicable
• Potential changes in air traffic movements at Sydney Airport	• Noise benefits to areas around Sydney Airport and potential changes to property values.	• Not applicable
• Increased risk of aircraft crashes	• Increased risk of fatalities due to aircraft crashes. • Increased risk of water supply contamination/disruption and of catastrophic events (such as flooding).	• Exposure of future generations to potential new risk.
• Increased air emissions	• Effects on regional air quality, particularly ozone levels.	• Effects on future quality of air in Sydney basin.
Proposals for Off Airport Site Support Infrastructure		
• Upgraded roads surrounding airpor (Elizabeth Drive, Bringelly Road and The Northern Road)	• Severance of communities to the south and south-east of the airport site. • Improved accessibility. • Increased traffic on airport access roads.	• Increased noise and air emissions potentially affecting local and regional air quality. Contribution to greenhouse gas emissions. Destruction of flora and fauna and visual landscapes affecting intergenerational equity.
• Utilisation of new road proposals such as the Western Sydney Orbital, which is not dependent on airport proposal	• Reduction in new environmental impacts to the region.	• Not applicable
• New rail link	• Impetus for developing urban villages which further exacerbate environmental impacts of urban development. • Opportunity to extend rail link north, which improves accessibility to public transport and potential employment lands.	• Urban development potentially affects biological diversity. Redresses imbalance between employment and population for future generations in western Sydney. Potential to reduce some greenhouse gas emissions associated with increased traffic on roads.
• Introduction of new water and sewerage services to the region	• Opportunities to serve future urban development.	• Improved services for future generations.
• Land use changes in adjacent areas due to improved infrastructure	• Increased noise and air emissions; further clearing of vegetation and habitat.	• Fragmentation of habitat further affects biological diversity.

Note: 1. Refers only to principles of conservation of biological diversity and intergenerational equity.

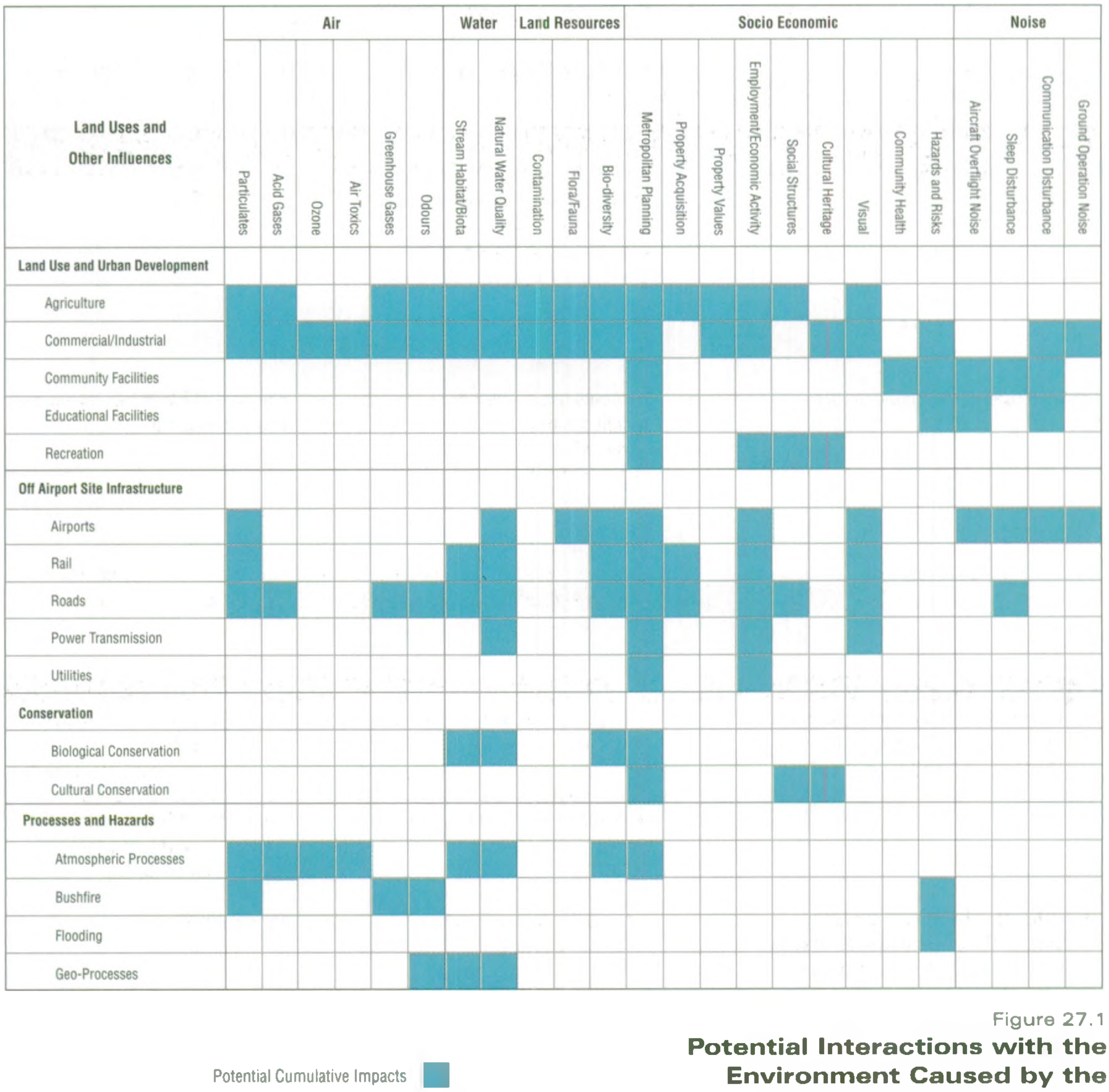


Figure 27.1
Potential Interactions with the Environment Caused by the Second Sydney Airport

work travel times. In addition, given the uncertainty about the airport proposal during the past ten years, a decision to develop the airport at Badgerys Creek would provide greater definition to the planning process and an impetus for closer co-ordination of local and regional planning. If the benefits of an airport are accepted and wanted, an opportunity exists to apply more stringent controls on other developments in the region, and to co-ordinate environmental management and monitoring initiatives to reduce adverse cumulative impacts.

27.3 Environmental Implications of Ultimate Airport Development

Chapter 9 documents conceptual plans developed for Options B and C. Environmental impacts, in addition to those identified for the master plan proposals, are likely to result directly from the expanded site area, and an increase in air traffic and access capacity. The nature of impacts would be similar to those for the master plans; however, the magnitude of impacts would be greater.

With regard to airspace, the application of the proposed operating scenarios to the conceptual plan for Option B could exacerbate the potential airspace conflicts with Sydney Airport, given the overall higher volumes of air traffic. In principle, the advantages in airspace management associated with the master plans for Option C should also translate to the conceptual plan for this option; at the same time, however, the potential for airspace conflict with operations at Sydney Airport would be greater given the higher volume of air traffic.

Table 27.3 provides a brief overview of the environmental implications of ultimate airport development. Expansion of the airport beyond an operational limit of 30 million passengers a year could not proceed unless a further detailed environmental assessment and decision making process were undertaken by the Government of the day.

Table 27.3 Environmental Issues for Ultimate Airport Development

Issue	Implications
Planning and Land Use	
Planning	• Undermines the potential application of Australian Standard 2021 1994 for limiting residential development within ANEC 20 (developed for master plan operations) because operations and hence noise contour configurations would change.
Land Use	• Additional acquisition of private land for expanded site area, and of potentially noise affected properties.
Noise	
Aircraft Overflight Noise	• Changes to aircraft noise patterns.
Ground Operation Noise	• Increased frequency of noise.
Construction Noise	• Additional periods of noise for Luddenham residents.
Property Values	• Potential devaluation of properties newly affected by aircraft noise.
Physical and Biological	
Air Quality	• Potential increase in pollutant emissions and adverse effects on local and regional air quality.
Soils and Water	• Loss of aquatic habitat due to infilling of additional creeks. • Increased loadings on waterbodies including sewage treatment plant and stormwater discharges.
Flora and Fauna	• Increased impacts to aquatic fauna in Cosgrove, Oaky and South creeks. • Increased impacts to aquatic fauna in South and Duncans creeks and potentially in Nepean River.
Resources, Energy and Waste	• Increased demand on resources and energy use. • Reduced agricultural productivity due to expansion of site. • Potentially, indirect impacts on agricultural productivity in surrounding areas. • Increased quantities of waste.
Hazards and Risks	• Increased risk of aircraft crashes. • Little effect on bushfire risk. • Little increase in risk of bird and bat strike.

Table 27.3 Environmental Issues for Ultimate Airport Development (cont.)

Issue	Implications
Social and Economic	
Aboriginal Cultural Heritage	• No direct impact on archaeologically sensitive landforms for Option B; • Increased direct impact on archaeologically sensitive landforms in sections of Upper Cosgrove Creek catchment, and the Badgerys Creek corridor for Option C.
Non-Aboriginal Cultural Heritage	• Direct impacts on one additional item (Option B) and two additional items (Option C); • Additional visual impacts on five items (Option B) and four items (Option C); • Impact on curtilage of Kelvin Park, which is of State significance.
Land Transport	• Increased land traffic on airport access roads. • Potential to increase congestion on major motorway routes in the region. • Potential to increase viability of rail link between the airport site and existing rail network. • Potential to increase congestion on existing rail network.
Aviation	• Greater need for compatibility with operation of Sydney Airport.
Visual and Landscape	• Marginal increase in impacts due to expanded site area.
Defence	• No additional direct impacts
Economics	• Increased direct and indirect employment. • Net increase in economic activity.
Social Impacts	• Severance of additional properties.

Chapter 28

Comparison and Conclusions

Chapter 28
Comparison and Conclusions

This chapter details assessment criteria used to compare the three airport options, documents the results of the comparative assessment undertaken and draws some conclusions from that assessment.

28.1 Comparison

The method used to compare the three airport options involved identifying significant issues, reviewing environmental studies to select appropriate assessment criteria, and comparing the performance of each option against the selected criteria.

Submissions made by the community during the preparation of the Draft EIS assisted in determining the issues most appropriate for the comparison of the airport options. Against this background, and on the basis of the studies undertaken, assessment criteria were developed for examining the performance of each option.

Table 28.1 presents, in summary form, the comparison of the airport options. The option which is considered to perform best against each criterion is coloured blue. Where two options are coloured blue, this indicates that there is no significant difference in their performance. Where there is no significant difference between all three options no ranking is shown.

It is not appropriate for the number of 'best performances' to be added together to make up a single 'best performance overall' as some issues and criteria may be more or less important than others. For example, some people may value potential hazards and risks as being more important than noise impacts. Others will have a different opinion.

In brief, comparison of the airport options revealed a similar range of potential impacts across a large number of the environmental issues examined; there were, however, a small number of significant differences. Those environmental issues that do not allow a clear distinction to be made between the options include the requirements for off airport site infrastructure; the overall impacts of high and mid range aircraft overflight noise; air quality impacts; effects on land transport systems and employment benefits. Those environmental issues that demonstrate a significant difference between the options include the following:

- Options B and C would allow greater flexibility and efficiency in design and operation than Option A, and are more capable of future expansion;
- Options A and B are more consistent with the metropolitan and regional planning carried out to date; however, further strategic planning investigation may show that Option C would have similar metropolitan and regional planning benefits;
- the three options would produce different aircraft overflight noise levels in the various communities surrounding the airport. The relative impacts of these differences would depend on individual reaction;
- because of the smaller site area, the impacts of Option A on stream and terrestial habitats and items of Aboriginal heritage would be less significant than those of Options B and C;

Table 28.1 Comparative Assessment of Airport Options[1] (Approximately 30 Million Passengers a Year in 2016)

Assessment Criterion / Performance Measure	Comparative Assessment: Option A
Airport Planning and Development (Chapters 8 and 9)	
Airfield Efficiency and Layout	
Efficiency and flexibility in design and operation	Inflexible for alternative terminal configurations; location of airport support facilities split; limited land for commercial development
Construction	
Ease of construction	27 million cubic metres of earthworks; 6 year construction program; transmission line to be relocated; flexibility for staging
Air Traffic Demands	
Capacity to satisfy long term demand for air travel	Planned to satisfy operational objective of 30 million passengers a year; potential limitations because of airspace management issues
Expandability	
Ease of future expansion	Not applicable
Planning and Land Use (Chapter 10 of Draft EIS)	
Metropolitan and Regional Planning	
Compliance with current metropolitan and regional planning	Complies with metropolitan planning objectives and creates opportunity for self contained new urban communities, close to employment opportunities and serviced by public transport; site accessible to existing employment centres; no significant changes to Urban Development Program
Support of employment centres	Airport site would be accessible to existing employment centres, and land surrounding site could be available for employment uses
Off Airport Site Infrastructure	
Benefit of off airport site infrastructure to regional planning	Road, rail and other services required for airport would also benefit existing and planned communities
Acquisition of Properties	
Numbers of properties to be acquired to allow airport development	1 (part of public road)
Defence Activities	
Impact on armaments logistic support	Low[2]
Relocation costs	No costs
Aircraft Overflight Noise (Chapters 11 and 12 of Draft EIS)	
Land Use Planning[3,4, 5, 6 & 7]	
People (2016 estimate) who may experience the following ANEC levels in 2016:	
- greater than 30 ANEC	200
- greater than 25 ANEC	700-1,000
- greater than 20 ANEC	4,500-7,000
- greater than 15 ANEC	11,000-15,000
Communication Disturbance[3, 5, 6 & 7]	
People (2016 estimate) who may experience, on average, the following number of noise events over 70 dBA a day in 2016:	
- greater than 100 events	500-1,000
- greater than 50 events	2,500-5,000
- greater than 20 events	8,000-9,500
- greater than 10 events	14,000-25,000
Sleep Disturbance[3,5, 6 & 7]	
People (2016 estimate) who may, on average, be awoken at night the following number of times in 2016:	
- once a night	<100
- once every 2 nights	500-1,000
- once every 5 nights	6,000-8,000
Disturbance to Learning[3,5, 6 & 7]	
Educational facilities (2016 estimate) which may experience, on average, the following number of noise events over 65 dBA between 9am and 3pm in 2016:	
- more than 100 events	0
- more than 50 events	2-3
- more than 20 events	6
- more than 10 events	6-13

Comparative Assessment

Option B	Option C
Flexibility for alternative terminal configurations; efficient layout of airport support facilities; sufficient land for commercial development	Flexibility for alternative terminal configurations; efficient layout of airport support facilities; sufficient land for commercial development
36 million cubic metres of earthworks; 6.5 year construction program; transmission line to be relocated; earthworks required to clear airspace obstacles at Bringelly; flexibility for staging	29 million cubic metres of earthworks; 6 year construction program; transmission line to be relocated; earthworks required to clear airspace obstacles at Bringelly; flexibility for staging
Planned to satisfy operational objective of 30 million passengers a year; potential limitations because of airspace management issues	Satisfies operational objective of 30 million passengers a year
Good capability for expansion	Good capability for expansion
Complies with metropolitan planning objectives and creates opportunity for self contained new urban communities, close to employment opportunities and serviced by public transport; site accessible to existing employment centres; no significant changes to Urban Development Program	Complies with metropolitan planning objectives and may create the potential for self contained new urban communities, close to employment opportunities and serviced by public transport: (this potential may be more limited than for Options A or B); site accessible to existing employment centres; no significant changes to Urban Development Program
Airport site would be accessible to existing employment centres, and land surrounding site could be available for employment uses	Airport site would be accessible to existing employment centres, and land surrounding site could be available for employment uses
Road, rail and other services required for airport would also benefit existing and planned communities	Road, rail and other services required for airport would also benefit existing and planned communities
194	206
Low[2]	Moderate to High
No costs	Not available[2]
<100-200 500-800 3,500-5,000 13,000-15,000	<100-300 200-700 200-1,500 9,000-11,000
200-700 2000-4,500 6,000-7,000 12,000-14,000	300-400 800-1,000 3,000-17,000 46,000-49,000
<100 300-800 3,500-6,000	<100-100 400-600 1,500-17,000
0 1-2 4-7 10-16	0 1 3-22 28-40

Table 28.1 Comparative Assessment of Airport Options[1] (Approximately 30 Million Passengers a Year in 2016)

Assessment Criterion / Performance Measure	Comparative Assessment Option A
Noise Induced Vibration	
People (2016 estimate) who may experience one noise event per 30 days capable of causing vibration to buildings (that is over 90 dBA)	700–1,000
Direct Property Devaluation	
Cost of direct property devaluation from noise impacts (1996$)	$49–67 million
Noise Management	
Cost of voluntary acquisition for dwellings affected by more than 35 ANEC (1997$)	$6–11 million
Cost of acoustical treatment for dwellings affected between 25 and 35 ANEC (1997$)	$12–19 million
Cost of acoustical treatment for dwellings affected between 30 and 35 ANEC (1997$)	$3 million
Ground Operation Noise (Chapter 13 of Draft EIS)	
During Neutral Conditions[6 & 8]	
People (2016 estimate) affected by noise levels over 50 dBA	2,500
During Temperature Inversion Conditions[6 & 9]	
People (2016 estimate) affected by noise levels over 50 dBA	21,000
Meteorology (Chapter 14 of Draft EIS)	
Runway Use	
Usability of runways due to wind conditions	94.15% for aircraft with 10 knot cross wind capability; 97.25% for 13 knot cross wind capability; 99.84% for 20 knot cross wind capability
Air Quality (Chapter 15 of Draft EIS)	
Ozone	
People (2016 estimate)[6] exposed to 1 part per 100 million increase in peak hourly ozone concentrations during high background ozone events	8,000
Increase in hospitalisation of persons each 100 years due to ozone	2
Increase in deaths each 100 years due to ozone	1
Air Toxics	
Increase in number of cancer cases per 100 years caused by air toxics	3
Particulates	
Increase in hospitalisation of persons each 100 years due to particulates	4
Increase in deaths each 100 years due to particulates	Less than 1
Odours	
People (2016 estimate)[6] affected by kerosene odours for more than 44 hours per year	1,500
Water (Chapter 16 of Draft EIS)	
Stream Habitat and Biota	
Length of stream habitat to be removed	5 kilometres
Natural Water Quality	
Impact on nutrient concentrations in receiving waters	Moderate
Drinking Water Quality	
Potential to exceed ANZECC guidelines for benzene levels in drinking water	Low
Flooding	
Capability of managing flooding impacts	High

Comparative Assessment	
Option B	Option C
500–2,500	6,000–8,000
$52–60 million	$25–31 million
$0	$12–27 million
$7–9 million	$6–12 million
$1–3 million	$2–5 million
1,500	1,500
21,000	16,000
97.75% for aircraft with 10 knot cross wind capability; 99.30% for 13 knot cross wind capability; 99.96% for 20 knot cross wind capability	99.23% for aircraft with 10 knot cross wind capability; 99.91% for 13 knot cross wind capability; 99.99% for 20 knot cross wind capability
8,000	8,000
2	3
1	1
3	3
3	4
Less than 1	Less than 1
1,000	1,500
10 kilometres	10 kilometres
Moderate	Moderate
Low	Low
High	High

Table 28.1 Comparative Assessment of Airport Options[1] (Approximately 30 Million Passengers a Year in 2016)

Assessment Criterion Performance Measure	Comparative Assessment Option A
Flora and Fauna (Chapter 17 of Draft EIS)	
Fauna	
Area of terrestrial habitat of local and regional significance affected by airport site and access corridors	120 hectares
Extent of fragmentation and barriers to fauna corridors	Impact on corridor of high local significance.
Disturbance to adjacent terrestrial habitat	None
Significant terrestrial fauna species potentially affected by airport site	2 species national significance, 12 species State significance; 38 species regional significance; 5 species listed under international agreements
Potential impacts of feral animals	Low
Flora	
Significant vegetation communities affected by airport site and access corridors	None
Significant flora species affected by airport site	1 species of national significance; 33 species of regional significance
Potential impacts of weeds	Low
Resources, Energy and Waste (Chapter 18 of Draft EIS)	
Mineral Resources	
Sterilisation of mineral resources	57–63 million tonnes of medium ash thermal coking coal
Agriculture	
Direct loss of agricultural productivity due to land acquisition	$0.6 million per year
Energy	
Fuel consumption during construction	90 million litres
Hazards and Risks (Chapter 19 of Draft EIS)	
Aircraft Crashing	
Maximum predicted fatality rate (persons per 100 years)	2.5
People (2016 estimate) on the ground exposed to a risk of fatality from aircraft crashes greater than one chance in 1 million	2,500
Exposure of Sensitive Land Uses	
Sensitive land uses exposed to predicted maximum frequency of aircraft crashes per square kilometre of: - 1 crash per 1,000 years	None
- 1 crash per 10,000 years	Prospect Reservoir; Warragamba Dam; Sydney Water Supply Pipeline
- 1 crash per 100,000 years	As above; Defence Establishment Orchard Hills
Bushfire	
Risk of bushfire to airport operations	Low
Bird and Bat Strike	
Risk of bird strike to aircraft operations	Manageable risk
Risk of bat strike to aircraft operations	Manageable risk
Land Contamination	
Environmental and health risks of existing land contamination	Low

Comparative Assessment

Option B	Option C
210 hectares	180 hectares
Impact on corridor of high local significance.	Impact on corridor of high local significance
None	None
2 species national significance, 12 species State significance; 38 species regional significance; 5 species listed under international agreements	2 species national significance, 12 species State significance; 38 species regional significance; 5 species listed under international agreement
Low	Low
None	None
1 species of national significance; 34 species of regional significance	1 species of national significance; 37 species of regional significance
Low	Low
64–84 million tonnes of medium ash thermal coking coal	63–84 million tonnes of medium ash thermal coking coal
$2.3 million per year	$1.7 million per year
90 million litres	90 million litres
2.2	5
2,500	9,000
None	Sydney Water Supply Pipeline; Defence Establishment Orchard Hills
Prospect Reservoir; Warragamba Dam; Sydney Water Supply Pipeline	As above
As above; Defence Establishment Orchard Hills	As above
Low	Low
Manageable risk	Manageable risk
Manageable risk	Manageable risk
Low	Low

Table 28.1 Comparative Assessment of Airport Options[1] (Approximately 30 Million Passengers a Year in 2016)

Assessment Criterion Performance Measure	Comparative Assessment Option A
Cultural Heritage (Chapters 20 and 21 of Draft EIS)	
Aboriginal Heritage Items	
Number of known sites and isolated finds of local and regional significance affected	60
Number of predicted sites and isolated finds of local and regional significance affected	119
Aboriginal Cultural Heritage	
Collective value of resource	Low
Expressed Aboriginal values	Site is subject to Native Title claim; Aboriginal sites, locations and natural environment are culturally important to Aboriginal people; Local Aboriginal Land Council opposes development of second airport in Sydney basin
Environmental Management	
Ability to manage adverse impacts on Aboriginal cultural heritage	Limited scope for in situ conservation; salvage may be possible
Non-Aboriginal Heritage Items	
Number of identified sites of local, regional or State significance affected	8 local; 5 regional; 1 partial loss (regional); 7 of these items listed by Liverpool Council
Environmental Management	
Ability to manage adverse impacts on non-Aboriginal cultural heritage	Potential to retain one item; able to relocate headstones/ burial remains, etc, removed from two churches
Transport (Chapter 22 of Draft EIS)	
Construction Traffic	
Impact of construction traffic on road network	Upgrading of Bringelly Road and The Northern Road required
Rail Transport During Operation	
Travel times between airport options and Sydney CBD	48 minutes
Travel times between airport options and Parramatta CBD	33 minutes
Compatibility with existing and future network	Opportunity for new transit oriented residential development; provides opportunity for creation of loop line to Main Western rail line; links to high frequency services at Glenfield station and East Hills rail line (allowing direct line to Sydney Airport); long term patronage of up to 36,000 passengers a day
Road Traffic During Operation	
Travel times between airport options and Sydney CBD (am peak)	74 minutes from airport; 60 minutes to airport
Travel times between airport options and Parramatta CBD (am peak)	42 minutes from airport; 38 minutes to airport
Compatibility with existing and future network	Accessible to Western Sydney Orbital which, if constructed, would provide a high level of service to many parts of Sydney; upgrading of Elizabeth Drive already approved; further improvements required on Luddenham Road, The Northern Road and Bringelly Road; compatible with the draft State Road Network Strategy; environmental constraints to the upgrade of Bringelly Road and The Northern Road; a key road network constraint would be the capacity of the M4 Motorway
Aviation	
Interaction with Sydney Airport	Significant impact, potentially reducing capacity of both airports
Impacts on secondary airports	Hoxton Park would close, moderate impacts on Camden and Bankstown
Impacts of restricted airspace	Defence Establishment Orchard Hills would have minor impacts on airport operations
Impacts on other aviation activities	High impacts on parachuting at Menangle and Wilton

Comparative Assessment

Option B	Option C
85	94
196	205
Low	Low
Site is subject to Native Title claim; Aboriginal sites, locations and natural environment are culturally important to Aboriginal people; Local Aboriginal Land Council opposes development of second airport in Sydney basin	Site is subject to Native Title claim; Aboriginal sites, locations and natural environment are culturally important to Aboriginal people; Local Aboriginal Land Council opposes development of second airport in Sydney basin
Limited scope for in situ conservation; salvage may be possible	Limited scope for in situ conservation; salvage may be possible
10 local; 5 regional; 1 partial loss (regional); 8 of these items listed by Liverpool Council	11 local; 6 regional; 1 partial loss (regional); visual impact on 1 item (State); 10 of these items are listed by Liverpool Council
Potential to retain four items; able to relocate headstones/ burial remains, etc, removed from two churches	Potential to retain two items; able to relocate headstones/burial remains, etc, removed from two churches; can reduce visual impact on Kelvin Park (State significance)
Upgrading of Bringelly Road and The Northern Road required	Upgrading of Bringelly Road and The Northern Road required
48 minutes	45 minutes
33 minutes	30 minutes
Opportunity for new transit oriented residential development; provides opportunity for creation of loop line to Main Western rail line; links to high frequency services at Glenfield station and East Hills rail line (allowing direct line to Sydney Airport); long term patronage of up to 36,000 passengers a day	Opportunity for new transit oriented residential development; provides opportunity for creation of loop line to Main Western rail line; links to high frequency services at Glenfield station and East Hills rail line (allowing direct line to Sydney Airport); long term patronage of up to 36,000 passengers a day
74 minutes from airport; 60 minutes to airport	74 minutes from airport; 60 minutes to airport
42 minutes from airport; 38 minutes to airport	42 minutes from airport; 38 minutes to airport
Accessible to Western Sydney Orbital which, if constructed, would provide a high level of service to many parts of Sydney; upgrading of Elizabeth Drive already approved; further improvements required on Luddenham Road, The Northern Road and Bringelly Road; compatible with the draft State Road Network Strategy; environmental constraints to the upgrade of Bringelly Road and The Northern Road; a key road network constraint would be the capacity of the M4 Motorway	Accessible to Western Sydney Orbital which, if constructed, would provide a high level of service to many parts of Sydney; upgrading of Elizabeth Drive already approved; further improvements required on Luddenham Road, The Northern Road and Bringelly Road; compatible with the draft State Road Network Strategy; environmental constraints to the upgrade of Bringelly Road and The Northern Road; a key road network constraint would be the capacity of the M4 Motorway
Significant impact, potentially reducing capacity of both airports	Operation of airports would be compatible
Hoxton Park would close, moderate impacts on Camden and Bankstown	Hoxton Park would close; moderate impacts on Bankstown; low impacts on RAAF Base Richmond; high impacts on Camden
Defence Establishment Orchard Hills would have minor impacts on airport operations	Conflicts with restricted airspace over Defence Establishment Orchard Hills would require relocation of Defence activities
High impacts on parachuting at Menangle and Wilton	High impacts on parachuting at Menangle and Wilton

Table 28.1 Comparative Assessment of Airport Options[1] (Approximately 30 Million Passengers a Year in 2016)

Assessment Criterion / Performance Measure	Comparative Assessment Option A
Visual and Landscape (Chapter 23 of Draft EIS)	
Terrain Modification	
Area of impact	1,700 hectares
Scale of earthworks	Up to 16 metres cut and 13 metres fill
Visibility	
Viewing opportunities	Views from The Northern Road, otherwise limited
Costs (Chapter 24 of Draft EIS)	
Costs	
Construction costs (1997$)[10]	$3–4.1 billion
Costs of infrastructure (1997$)[11]	$961–1,016 million
Social and Economic Impacts (Chapter 25 of Draft EIS)	
Employment and Economic Activity	
Generation of construction jobs	Up to 8,400 person years of labour
Generation of jobs during airport operation	Between 52,000 and 63,000 jobs in Sydney by 2016 when compared to a case of Sydney Airport being restricted to about 30 million passengers a year and no new airport being developed
Potential to support regional economic benefits	Region has relatively mature industry structure to take advantage of increased economic activity
Community Character and Lifestyles	
Potential to cause severance or alienation of communities	Community alienation would be experienced due to displacement of residents and facilities from within existing airport sites; and due also to the corridors accessing the airport (Kemps Creek, Badgerys Creek, Bringelly and Luddenham)
Potential to significantly change community character and individual lifestyles	Community character likely to change dramatically from rural to urban; overall amenity of nearby communities likely to decline, especially Badgerys Creek, Luddenham, Greendale, Bringelly, Rossmore, Kemps Creek, Mount Vernon, Warragamba, Wallacia, Silverdale and Horsley Park
Community Facilities and Services	
Change to provision of community facilities and support structures	Loss of community facilities (school, store, post office) at Badgerys Creek; breakdown of family and business support structures probable, given the historical development and agricultural industry; long term replacement with new commercial and social structures
Displacement of individuals or communities	Displacement of community at Badgerys Creek (approximately 500 people); displacement of residents due to acquisition of properties in 35 ANEC and individual reaction to noise

Notes:
1. The airport option considered to perform best against each criterion is shaded blue. Where two options are shaded blue, this indicates that there is no significant difference in performance. Where there is no significant difference between any of the options, no ranking is shown.
2. Based on the conclusion that Options A and B could co-exist with defence activities at Orchard Hills. It is uncertain whether Defence facilities at Orchard Hills would have to be relocated if Option C were developed.
3. Estimates of people impacted by noise vary because of the different assumptions made about how the airport may operate.
4. Impacts of levels of ANEC assume all residential properties within the 35 ANEC contour would be acquired.
5. There are limitations in the accuracy of predicting future aircraft noise levels and future population.
6. Estimates of population greater than 10,000 have been rounded to the nearest 1000; estimates of population between 1,000 and 10,000 have been rounded to the nearest 500; and estimates of population less than 1,000 have been rounded to the nearest 100. Estimates of population less than 100 are shown as <100, meaning less than 100.

Comparative Assessment	
Option B	**Option C**
2,900 hectares	2,850 hectares
Up to 13 metres cut and 10 metres fill	Up to 9 metres cut and 13 metres fill
Views from The Northern Road, otherwise limited	Views from The Northern Road, otherwise limited
$3.5–4.8 billion	$3.4–4.7 billion
$961–1,016 million	$961–1,016 million
Up to 8,400 person years of labour	Up to 8,400 person years of labour
Between 52,000 and 63,000 jobs in Sydney by 2016 when compared to a case of Sydney Airport being restricted to about 30 million passengers a year and no new airport being developed	Between 52,000 and 63,000 jobs in Sydney by 2016 when compared to a case of Sydney Airport being restricted to about 30 million passengers a year and no new airport being developed
Region has relatively mature industry structure to take advantage of increased economic activity	Region has relatively mature industry structure to take advantage of increased economic activity
Community severance and alienation would be experienced due to acquisition of the airport site and displacement of residents and facilities within existing site; and due also to the corridors accessing the airport (Kemps Creek, Badgerys Creek, Bringelly and Luddenham)	Community severance and alienation would be experienced due to acquisition of the airport site and displacement of residents and facilities within existing site; and due also to the corridors accessing the airport (Kemps Creek, Badgerys Creek, Bringelly, Luddenham and Rossmore)
Community character likely to change dramatically from rural to urban; overall amenity of nearby communities likely to decline, especially Badgerys Creek, Luddenham, Greendale, Bringelly, Rossmore, Kemps Creek, Mount Vernon, Warragamba, Wallacia, Silverdale and Horsley Park	Community character likely to change dramatically from rural to urban; overall amenity of nearby communities likely to decline, especially Badgerys Creek, Luddenham, Greendale, Bringelly, Rossmore, Kemps Creek, Erskine Park, Orchard Hills, Sovereign and Catherine Field
Loss of community facilities (school, store, post office) at Badgerys Creek; breakdown of family and business support structures probable, given the historical development and agricultural industry; long term replacement with new commercial and social structures	Loss of community facilities (school, store, post office) at Badgerys Creek; breakdown of family and business support structures probable, given the historical development and agricultural industry; long term replacement with new commercial and social structures
Displacement of community at Badgerys Creek (approximately 1,000 people); displacement of residents due to acquisition of properties in 35 ANEC and individual reaction to noise	Displacement of community at Badgerys Creek (approximately 1,200 people); displacement of residents due to acquisition of properties in 35 ANEC and individual reaction to noise

Notes:

7. The noise impacts shown in this table are for standard airport operational conditions which have not been optimised to reduce noise impacts. Optimising runway use and flight paths would likely significantly reduce the numbers of people affected
8. Isothermal (neutral) atmospheric conditions occur when temperature is constant above ground level notwithstanding height.
9. Temperature inversions occur when temperature increases uniformly with height above ground level, up to 100 metres.
10. Range of costs provided because of assumed level of accuracy.
11. Estimated costs of infrastructure required to service the airport including roads, a rail line, water supply, fuel pipeline, gas supply, electricity supply, telecommunications and sewage disposal services. They do not include costs of consequential upgradings of other parts of the rail network. A range of costs is shown because of rail alternatives available.

- Option C would potentially create a higher risk of fatality from aircraft crashes than Options A or B;
- Option C would be more compatible with the operation of Sydney Airport than Options A or B, although the extent of this constraint in the case of A and B has not been fully quantified; and
- Option A could be between $400 million and $700 million cheaper to build than Options B or C because of the smaller scale of infrastructure proposed.

28.2 Conclusions

Each of the airport options would result in a range of adverse and beneficial environmental and economic impacts. Any assessment of these should be considered in the context of the implications of not proceeding with the Second Sydney Airport proposal, commonly referred to as the 'do nothing option'. Adopting the do nothing option would likewise result in a range of environmental and economic impacts.

Chapter 3 outlined the main environmental issues of concern to the community, namely:

- potential aircraft noise impacts;
- air quality impacts, especially in regard to community health;
- water quality;
- loss of lifestyle and amenity; and
- hazards and risks.

It is also noted that many members of the community are seeking a firm decision on the proposal to enable them to plan their future. *Chapters 27* and *28* summarises much of the information required to make that decision. *Tables 27.1* and *28.1* indicate key matters for consideration, including the consistency of the options with metropolitan planning strategies, noise impacts, regional air and water quality issues, land transport, and airspace interactions of the proposed airport with the operation of Sydney Airport. Key differences between the options would be the level of aircraft overflight noise impacts on individual communities, the extent of biological and physical impacts, and airspace management issues.

The relative importance that should be placed on the potential adverse and beneficial impacts of the proposal and on the differences between the options is a matter for community comment during the exhibition of this Draft EIS, and ultimately a matter for judgement by the Commonwealth Government, when it is considering its decision on the Second Sydney Airport proposal.

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