REPORT AND RECOMMENDATIONS by the DEPARTMENT OF CONSERVATION AND ENVIRONMENT ON PERTH AIRPORT MASTERPPLAN AND DRAFT ENVIRONMENTAL IMPACT STATEMENT

Bulletin No 134

February, 1983.

CONTENTS Page No

SUMMARY AND RECOMMENDATIONS 6

1. INTRODUCTION 9
1.1 Airport History 9
1.2 Background to the Proposal 9
1.3 Preparation of Draft EIS 11

2. EXISTING ENVIRONMENT 13
2.1 General 13
2.2 Climate and Meteorology 13
2.3 Biological Environment 14
2.3.1 Flora and Wetlands 14
2.3.2 Fauna 15
2.4 Human Environment 15
2.4.1 Surrounding Land Uses 16
2.4.2 Road Systems 16

3. THE PROPOSAL 17
3.1 Alternatives Considered 17
3.2 Proponent's Preferred Strategy 17

4. ENVIRONMENTAL ASSESSMENT 25
4.1 Public Interest 25
4.2 Adequacy of Draft EIS and Environmental Assessment Procedures followed 25
4.3 The Need for the Development 31
4.3.1 Aviation Activity at Perth Airport 32
4.3.2 Passenger Aspects of Perth Airport 36
4.4 Aircraft Noise 37
4.4.1 Factors influencing the impact of Aircraft Noise 37
4.4.1.1 Response of Individuals to Aircraft Noise 37
4.4.2 Statistical Indices for Measurement of Noise Exposure 39
4.4.2.1 Noise Exposure Forecast (NEF) 39
4.4.2.2 Noise Exposure Index (NEI) 41
4.4.2.3 Noise Exposure Concept (NEC) 41
4.4.3 Studies of Aircraft Noise at Perth Airport 41
4.4.3.1 Review of National Acoustic Laboratory Study 42
4.4.3.2 DCE Airport Noise Pilot Study 45
4.4.3.3 City of Canning Study of Community Reaction to Aircraft Noise 47
4.4.4 Limitations of the NEF Index 48

Page No

4.5 Impact of Aircraft Noise on the Human Environment 49
4.5.1 Description of Impact of the Alternatives 49
4.5.1.1 Do Nothing Option 55
4.5.1.2 Strategy 1 56
4.5.1.3 Strategy 2 57
4.5.1.4 Strategy 3 57
4.5.1.5 Strategy 4 57
4.5.1.6 Modified Strategy 4 (City of Belmont) 58
4.5.1.7 Ultimate Development 58
4.5.1.8 Relocation 60
4.5.1.9 Discussion 61
4.5.2 Physiological Effects of Noise 63
4.5.3 Psychological Effects of Noise 65
4.5.4 Historic Buildings 66
4.5.5 Cost-Benefit Analysis 67
4.5.5.1 Use of Differential Property Prices to Value Noise Nuisance 68
4.5.5.2 Department of Aviation's Approach to Cost-Benefit Analysis for Noise 71
4.5.5.3 Cost of Insulating Homes 74
4.5.5.4 Emissions Charge Approach to Noise Abatement 75
4.5.5.5 Surface Access Costs 76
4.5.5.6 Conclusions 76
4.6 Surface Access 77
4.7 Air Pollution 79
4.8 Impact on Biological Environment 80
4.8.1 Flora and wetlands 80
4.8.2 Vineyards 81
4.8.3 Fauna 81
4.8.4 Summary 81
4.8.5 Effects on Groundwater Resources 82
4.8.6 Bird Hazard 82
4.9 Environmental Management 83
4.9.1 Curfew 83
4.9.2 Ground Running and Training Flights 85
4.9.3 Noise Abatement Procedures 87
4.9.4 Vegetation and Wildlife 89

5. CONCLUSIONS 90

6. RECOMMENDATIONS 91

REFERENCES 93

LIST OF FIGURES

Page No.

FIGURE 1 - Suburbs near Airport and existing road system 1
FIGURE 2 - Perth Airport Provisional Master Plan, Alternative Strategy 1 2(
FIGURE 3 - Perth Airport Provisional Master Plan, Alternative Strategy 2 2:
FIGURE 4 - Perth Airport Provisional Master Plan, Alternative Strategy 3 22
FIGURE 5 - Perth Airport Provisional Master Plan, Alternative Strategy 4 23
FIGURE 6 - Perth Airport Provisional Master Plan, Ultimate Airport Layout 24
FIGURE 7 - Master Planning Process (according to Department of Aviation) 26
FIGURE 8 - Preferred Airport Planning and Environmental Assessment Process 28
FIGURE 9 - Noise Exposure Concepts for Strategies 1 and 2, 1985 Existing Runway System 50
FIGURE 10 - Noise Exposure Concepts for Strategies 3 and 4, 1985 Parallel Runway System 51
FIGURE 11 - Noise Exposure Concepts for Strategies 1 and 2, 1985 Existing Runway System 52
FIGURE 12 - Noise Exposure Concepts for Strategies 3 and 4, 1985 Parallel Runway System 53

LIST OF TABLES

TABLE 1 - Membership of Commonwealth/State Advisory Committee on W.A.'s Airport Needs 10
TABLE 2 - Essential Elements of the four Development Strategies 19
TABLE 3 - Summary of Aviation Activity, 1960 and 1979 32
TABLE 4 - Forecast Number of Aircraft Movements per annum 33
TABLE 5 - Comparison of Department of Aviation and Qantas Predictions 34
TABLE 6 - Comparison of Numbers of Noise Affected Residences i.e. within 25 NEF zone 61
TABLE 7 - Summary of Permitted Ground Running Times, Conditions and Purpose at Perth Airport 86

APPENDICES

Page No.

APPENDIX 1 Summary of Noise Abatement Procedures 95

NOTE :

During the preparation of this assessment report the Parliamentary Works Committee considering the funding of the Perth Airport Control Tower announced on 20 October, 1982, that it believed that the development of the airport should be in accordance with Strategy 4 and that funds for the control tower in that location would be approved.

On 22 October, 1982, the Minister for Aviation announced that he had instructed his Department that, subject to the approval of the Minister for Home Affairs and Environment, development at Perth Airport would take place in accordance with Strategy 4 in the long term and that work would begin immediately on construction of a centrally located International terminal complex and control tower in accordance with Strategy 4.

SUMMARY AND RECOMMENDATIONS

The draft EIS and Master Plan prepared by the Department of Aviati presented four proposed strategies for development at Perth Airpor assuming that Perth would continue to be the primary airport for the region.

In the Master Plan, the Department of Aviation indicated its preference for Strategy 1, the lowest cost option. This Strategy retains the existing runway configuration to the year 2000, concentrates the new international terminal and associated buildinc in the north-west corner of the airport and retains Brearley Avenue as the access to the airport complex.

The main area of environmental concern in the development is noise both from aircraft and from road traffic. Although the Department of Aviation has stated that there would not be an operational requirement for a wide-spaced parallel runway until after the year 2000, it now concedes that the parallel runway may be required for noise abatement purposes prior to that date.

The Department of Aviation has relied heavily on the Noise Exposure Forecast (NEF) system in reaching their conclusions about aircraft noise at Perth Airport. However, the indications from a Pilot Noise Study carried out by DCE are that the NEF System is unreliable as a predictor of noise annoyance and as a land-use planning tool.

The noise abatement measures presently employed by the DOA are derived to reduce noise and at the same time retain maximum cost advantage from saving fuel: the fuel-savings aspect is of paramount importance. Part of the noise abatement procedures includes a partial curfew unlike other Australian airports where there is a full curfew. Numerous arguments have been advanced against the imposition of a full curfew at Perth and it would appear that this will only be avoided if present noise abatement procedures are modified and stringently enforced to minimise noise and not costs.

Noise from ground running and engine testing are also the subject of many complaints and the Department of Aviation should investigate

methods of reducing noise by the construction of noise attenuation mounds, baffles and deflectors.

RECOMMENDATIONS

The Department believes that a number of additional safeguards can be employed by the Department of Aviation to minimise noise.

1. The DoA should consider the installation of noise attenuation mounds, particularly along the south-western edge of the airport, to minimise noise to residences which are very close at this point. This will become even more important when the new taxi-way is constructed closer to the airport margin at this location.

2. Engine testing should be confined to a specific area and noise deflectors should be installed to minimise interference to near-airport residents. The DoA should examine the possibility of prohibiting all engine testing during normal curfew hours (11 p.m. - 6 a.m.) and preferably until 7 a.m.

3. Noise abatement procedures should be redrafted so that the minimisation of noise is the prime objective. Procedures to save fuel costs should not in any way compromise the prime objective.

4. Because of the shortcomings in the NEF system as a predictor of noise annoyance (described in the text) :

   4.1 Studies should be carried out to more accurately describe and predict noise annoyance.

   4.2 Noise standards considered tolerable in other places within and outside Australia should not be imposed on Perth.

4.3 Decisions need to be made, by Perth communities as to the levels of noise (noise standards) which are acceptable. Night flights need to be taken into account.

4.4 The current practice of using the NEF system as a land use planning tool contains deficiencies. A more appropriate system should be investigated and adopted.

5. The application of a curfew at Perth Airport should remain as one of the options for future planning.

6. The Department of Aviation in conjunction with the State Department of Conservation and Environment should monitor noise exposure levels in various locations. The study should be designed to verify the NEI/NEF and should take account of seasonal factors and trends. Monitoring should identify single "noisy" aircraft that are not conforming to the theoretical noise output for that type of aircraft.

7. Wetland areas should be examined for rare or endangered species before earthworks are commenced.

8. A management plan, broadly following recommendation M52 in the System 6 Green Book, should be devised in consultation with DCE.

PERTH AIRPORT

1. INTRODUCTION

1.1 Airport History

Construction of Perth Airport began in 1942. It was used by the military until it was handed over to civilian authorities after the Second World War. At that time the airport consisted of two 839 m runways, associated hangers and ancilliary buildings.

In the late 1940s, the construction of a north-south runway and extensions to existing runways were carried out. The airport began handling international traffic in 1952. Further developments took place in the 1960s including extension of the north-south runway to a length of 3,144 m. In the 1970s further development of the domestic and international facilities was completed. After 1971 the Federal Government progressively acquired further land at Newburn (approximately 1,700 acres) on the basis that it was expected that a parallel runway and extensions to existing domestic and international facilities would be needed.

1.2 Background to the Proposal

A joint Commonwealth/State Advisory Committee composed of representatives of Commonwealth, State and local Government authorities (Table 1) was set up in 1973 to resolve planning issues relating to existing and future airport developments. The Terms of Reference for this Committee included the examination of alternative airport sites and making recommendations on nearby land use zoning. In 1980, the Advisory Committee published its report and recommended, amongst other things, that ... "Perth Airport be retained and further developed as the sole primary airport for the Perth region and that the Perth Airport Master Plan be published as soon as practicable. This master plan should be based on a detailed analysis of options and their impact on the environment and land use."

In accordance with this recommendation the Department of Aviation* designed four possible development strategies and

TABLE 1.

MEMBERSHIP OF COMMONWEALTH/STATE ADVISORY COMMITTEE ON W.A's AIRPORT NEEDS

CHAIRMAN Mr. J. W. E. Huggett, Dept. of Transport

MEMBERSHIP

Commonwealth Government
Department of Transport

Department of Housing and Construction

Department of Science and the Environment (formerly Department of Environment, Housing and Community Development)

Department of Administrative Services

Department of Defence

Western Australia Governments

Department of Conservation and Environment

Main Roads Department

Town Planning Department

Office of Director-General of Transport

Department of Industrial Development

Local Government Authorities

Perth City Council

Belmont City Council

in September, 1981, established the Perth Airport Master Plan State and Local Government Working Group. The Terms of Reference of this group were restricted to examining the four development strategies advanced by the Department of Aviation which reserved the right to have the final say on the recommended preferred strategy for development, irrespective of the findings of the Working Group. A Provisional Master Plan has now been prepared by the Department of Aviation which outlines the four development strategies and expresses that Department's preference for Strategy 1.

The initial Commonwealth/State Advisory Committee also recommended the establishment of a W.A. Airfields Committee; this committee has never been formed.

1.3 Preparation of Draft EIS

Following two meetings of the Perth Airport Master Plan State and Local Government Working Group, at which the Department of Aviation indicated that an Environmental Impact Statement on the four development strategies for Perth Airport would not be prepared, the Department of Conservation and Environment (DCE) wrote to the Commonwealth Department of Home Affairs and Environment (DHAE) in December, 1981, advising that in accordance with the Commonwealth Environmental Protection Act Administrative Procedures, an Environmental Impact Statement (EIS) for any significant or major alteration (including extensions to existing runways) to the Perth Airport was required and should be prepared. The Department further indicated its concern that the 'Master Plan' planning technique did not guarantee public participation or the inclusion of all issues believed to be appropriate.

In January, 1982, the City of Belmont referred the matter of the development of Perth Airport to the Environmental Protection Authority (EPA) under Section 56(1) of the Environmental Protection Act. The Authority advised that the airport lies on Commonwealth land and is therefore outside the jurisdiction of the State; the EPA could not therefore direct the preparation of an Environmental Review and Management Programme (ERMP): however, the Commonwealth Minister

for Home Affairs and Environment may direct that an EIS be prepared under Commonwealth Legislation.

Although the airport is located on Commonwealth land which is outside the jurisdiction of State legislation, many airport related activities produce effects which are external to the airport, such as noise and pollution. These impacts occur over non-Commonwealth land and may be the concern of State Authorities.

In January, 1982, the Commonwealth Department of Aviation wrote to the Department of Conservation and Environment and indicated that a Notice of Intention for the Master Plan for Perth Airport was being prepared in accordance with the Commonwealth's Environmental Administrative Procedures. The Department also advised that it was expected that the provisional Airport Master Plan would form a draft EIS. The Commonwealth Minister for Home Affairs and Environment advised in March, 1982, that he had directed that an Environmental Impact Statement be prepared and that the assessment was to be undertaken in accordance with existing arrangements concerning co-operation between the Commonwealth and Western Australia in environmental assessment of such proposals. Following the above events, the Department of Conservation and Environment provided comment on the guidelines for the Draft EIS, the draft provisional Master Plan/draft EIS, and arrangements for the display, distribution and advertising of the EIS.

The report entitled "Perth Airport Provisional Master Plan incorporating a Draft Environmental Impact Statement" was released for public comment for a period of six weeks from 21 June, 1982. The receiving date for submission was, in practice, extended considerably beyond this date. The document contained the Draft EIS as an appendix to the Master Plan, a format that is far from ideal in a document for public perusal (see Section 4.1).

2. EXISTING ENVIRONMENT

2.1 General

Perth Airport is situated on the Swan Coastal Plain on superficial deposits consisting of unconsolidated or partly lithified sediments, mainly poorly sorted quartz sands of the Bassendean Dunes which are Holocene in age. The complex contains swamps and seasonal wetlands in areas where clays or peaty podzols form a suitable basal seal. Shallow groundwater occurs within the Bassendean sands and is an important water resource exploited by the water supply authorities and local residents.

2.2 Climate and Meteorology

The climate of the region is warm to cool temperate. Average temperatures range between a daily mean minimum of 17.6°C to a daily mean maximum of 29.4°C in January and a daily mean minimum of 8.9°C to a daily mean maximum of 17.2°C in July.

Rainfall is reliable, averaging 875 mm per annum, mostly falling in winter.

Perth is Australia's windiest city, experiencing westerly gales in winter and strong afternoon sea breezes in summer. Both the annual mean windspeed of 15.5 km/hr and the maximum gust of 155 km/hr exceed the equivalent values of most other cities. A strong easterly wind predominates in the region of the airport on summer mornings. Other significant meteorological phenomena include the development of mists and fogs, low cloud base, inversion layers and wind-shear effects, all caused by the proximity of the Darling Scarp.

These factors all have an influence on airport usage, the dispersal of pollutants and the extent to which aircraft noise is perceived in nearby communities.

2.3 Biological Environment

No special biological studies were carried out by the Department of Aviation and the brief description given in the report has been compiled largely from the general information given in the Atlas of Natural Resources Darling System Western Australia, 1980.

This report was compiled to give a broad brush view as a backup to the System 6 Study and report. It was never intended that it should be a substitute for sound biological investigation of specific areas.

2.3.1 Flora and Wetlands

According to the draft EIS the vegetation associated Bassendean Dune system consists mainly of relatively flat, grey sands which carry a low scrub cover with Banksia species dominant.

The airport site and surrounding land has been extensively modified by human activity in the pursuit of agriculture and urbanisation. Grazing by stock has resulted in the loss of woodland understorey and dune-stabilising ground cover. Some areas within the airport boundaries have been allowed to regenerate and now approximate to a 'natural' state.

The System 6 green book described the remaining natural vegetation at the airport and made several recommendations specific to the airport site. These recommendations are aimed at ensuring that uncleared sections of vegetation are retained and that growth and regeneration of local indigenous flora is encouraged by means of a suitable management plan for the area.

The most significant biological features within the airport site are three wetlands. The largest of these is a perennial swamp lying in the north-eastern corner adjacent to a banksia/ sheoak woodland and is approximately 1500 m long and 250 m wide at its widest point. The swamp drains west via a constructed drain into the Swan River. Parts of the margins of this wetland have been grazed by stock but the fringing vegetation of large paperbarks (Melaleuca rhaphiophylla) and

robin redbreast bush (M. lateritia) are well established. This area is of considerable interest in its present form.

A second swamp lies at the southern end of the north-south runway but this has been extensively altered as a habitat and is of low botanical interest.

The third wetland is an area of seasonally wet low heathland which is very rich in terms of plant species. The vegetation is similar to that of the Kenwick Swamp, which is the subject of a System 6 recommendation M69). If it is possible to offer this area a measure of protection, an opportunity exists to conserve a rich wildflower area.

2.3.2 Fauna

According to the draft EIS, the most significant fauna which could be affected by the airport is the western swamp (short-necked) tortoise (Pseudomydura umbrina). It is known to occur in two swamp areas to the north of the airport, the Ellen Brook and Twin Swamps wildlife sanctuaries. The tortoises are present in very low numbers and have only been found recently in these two areas, to date, consequently there is considerable concern over the continued survival of the species.

Short-necked tortoise were found in the airport swamp some 12 years ago and it is thought unlikely that these swamps are still a suitable habitat.

2.4 Human Environment

From the 1981 census, it is known that approximately 200,000 people live within a 10 km radius of Perth Airport. National Acoustic Laboratory data indicate that at least 10% of these people are moderately to severely affected by aircraft noise at Perth Airport.

It is expected that the number of persons living within this 10 km radius will increase as a result of the occupation of land already zoned for residential development.

2.4.1 Surrounding Land Uses

Land zonings immediately adjoining the airport site are :

- residential to the west of the airport (Redcliffe, Belmont, and Cloverdale).
- industrial to the south (Kewdale, Welshpool).
- to the east, the zonings are residential (Maida Vale and Forrestfield), and rural, with rural zoning predominating.
- to the north (South Guildford, Guildford, Hazelmere, and Bassendean) a mixture of residential, rural and parks and recreation.

Further out from the airport site, but within 6 km, the land use changes from industrial to residential to the south with no significant changes in zoning to the west. Further north (Swan Valley) rural areas predominate and to the north-east are the residential areas of Midland and Midvale. To the east are the residential areas of Kalamunda and Gooseberry Hill.

2.4.2 Road Systems

Figure 1 shows the existing road system. The present access to the airport is from the Great Eastern Highway via Brearley Avenue (4 lanes) and Fauntleroy Avenue (2 lanes). Prior to joining the Great Eastern Highway, both these avenues pass through residential areas. Traffic with origins and/or destinations to the south of the airport utilise local roads such as Stanton Road and Second Street.

The Metropolitan Region plan indicates that the future Beechboro-Gosnells freeway will be along the southern edge of the airport site and that the future Redcliffe-Bushmead highway will skirt the northern perimeter.

3. THE PROPOSAL

3.1 Alternatives Considered

The Provisional Master Plan and Draft EIS considers four alternatives (termed strategies). The 'do nothing' option has not been considered, neither has the relocation of the whole airport complex been addressed. Both these should have been considered in the Draft EIS.

The essential elements of the four strategies for development are given in Table 2 and Figures 2 - 5.

Certain elements of the Master Plan are common to all the strategies, for example, all the strategies allow for extensions to the existing runways, irrespective of whether or not the parallel runway is constructed. Although the Provisional Master Plan is a long term planning document, the inclusion of an element (proposal) in the Master Plan does not mean that it will necessarily be constructed; however, the likelihood of construction taking place, given the need, is high. In addition, the existence of the Master Plan ensures that development is more likely to take place in accordance with the design shown in the plan.

As all the strategies show extensions to the runways this essentially means that acceptance of any of the four strategies, as presented, will allow for runway extensions in the future.

In addition to the four strategies, the Provisional Master Plan provides a plan for the ultimate development of the airport site. The essential elements of this possible development are shown in Table 2 and Figure 6.

3.2 Proponent's Preferred Strategy

The Department of Aviation has chosen Strategy 1 as the preferred option for the development of Perth Airport. This choice has been made principally on the basis of short-term cost advantages, even though the Draft EIS acknowledges that this option is not the most environmentally acceptable.

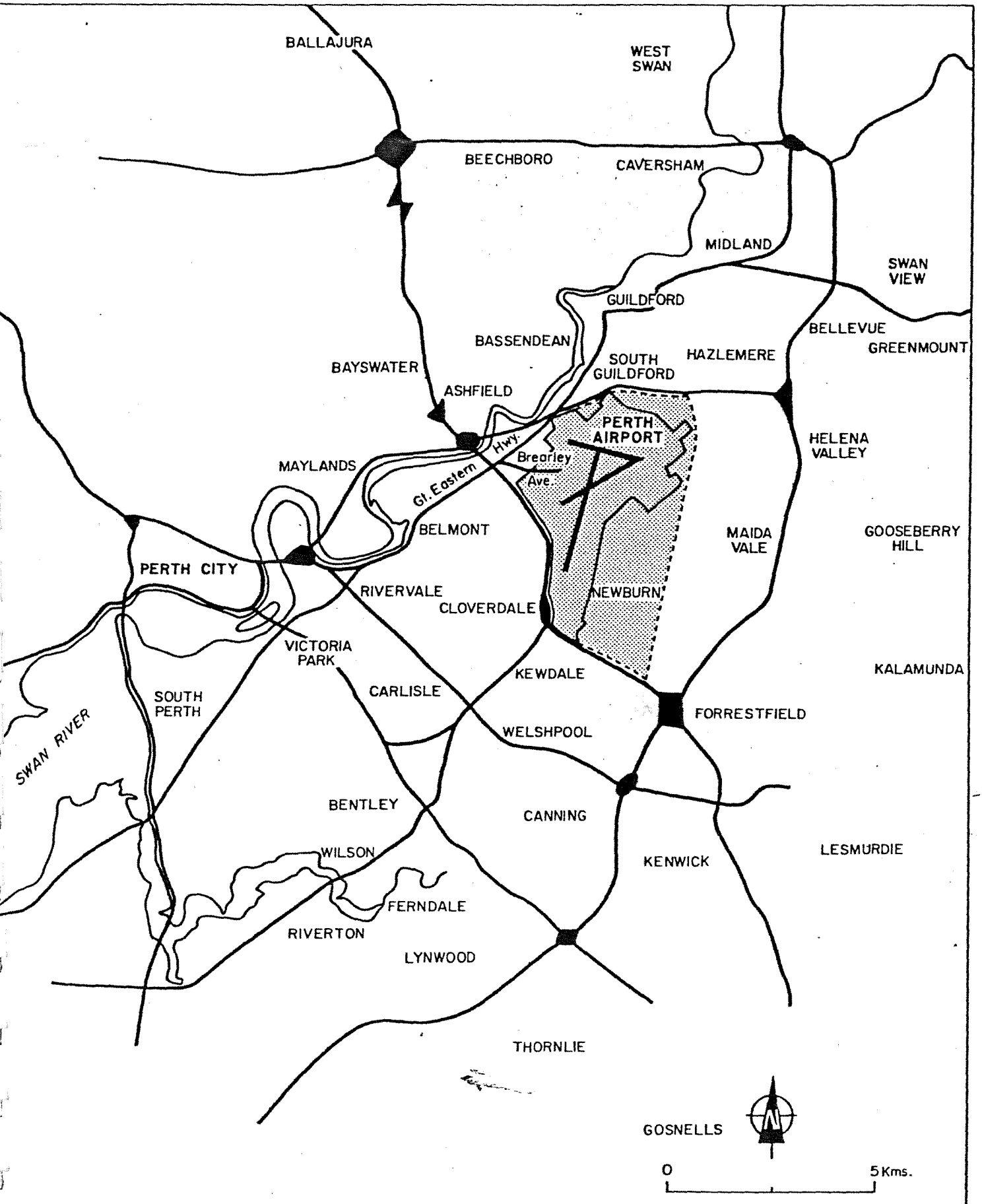


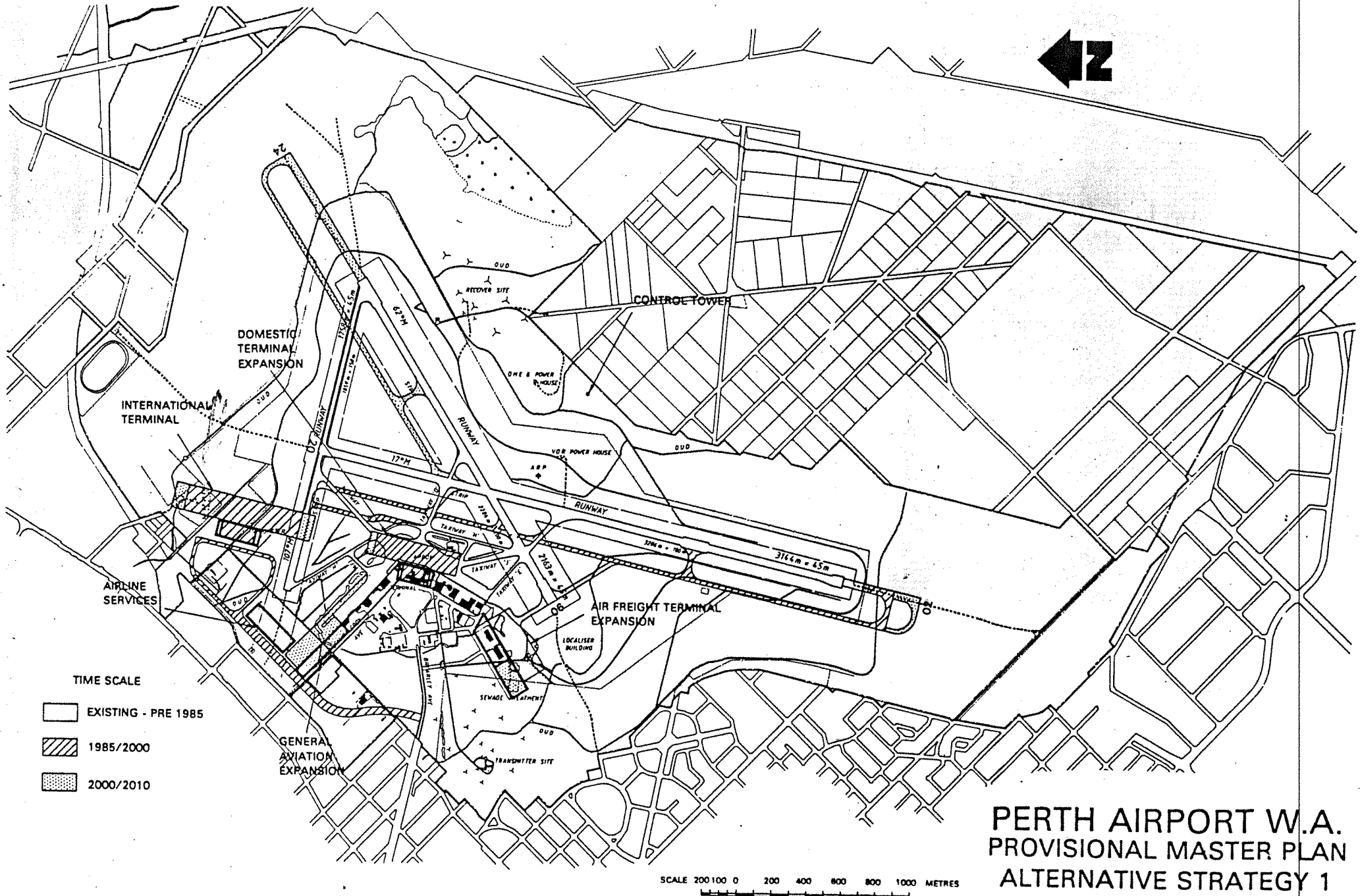
FIGURE I. SUBURBS NEAR PERTH AIRPORT SHOWING EXISTING ROAD SYSTEM

TABLE 2 : ESSENTIAL ELEMENTS OF THE FOUR DEVELOPMENT STRATEGIES

Element	Strategy			
	1	2	3	4
up to 2,000. New international complex north of existing terminal	X		X	
Terminal wholly linked to existing access roads	X		X	
Existing Terminal and aprons developed for domestic services	X	X	X	X
17^{O}m runway to be extended	X	X	X	X
Control tower located in south-eastern sector	X	X		
New international terminal east of main runway design for capacity of airport		X		X
Access to terminal by new road to Hardy Road		X		X
Internal access road between existing and planned terminal areas		X		X
A parallel taxiway to be constructed on eastern side of main runway		X		
Construction of a 3,600 m parallel runway east of 17^{O}m runway plus full length parallel taxiway			X	X
Control tower in between parallel runways (slightly different location in strategy 4)			X	X
period 2,000 - 2010				
Incremental expansion of International and domestic terminals	X		X	
17^{O}m runway extended to 3,600 m	X	X	X	X
62^{O}m runway extended to 3,000 m	X	X	X	X
Domestic expansion accommodated in new complex east of main runway		X		X
Incremental expansion of International terminal		X		X

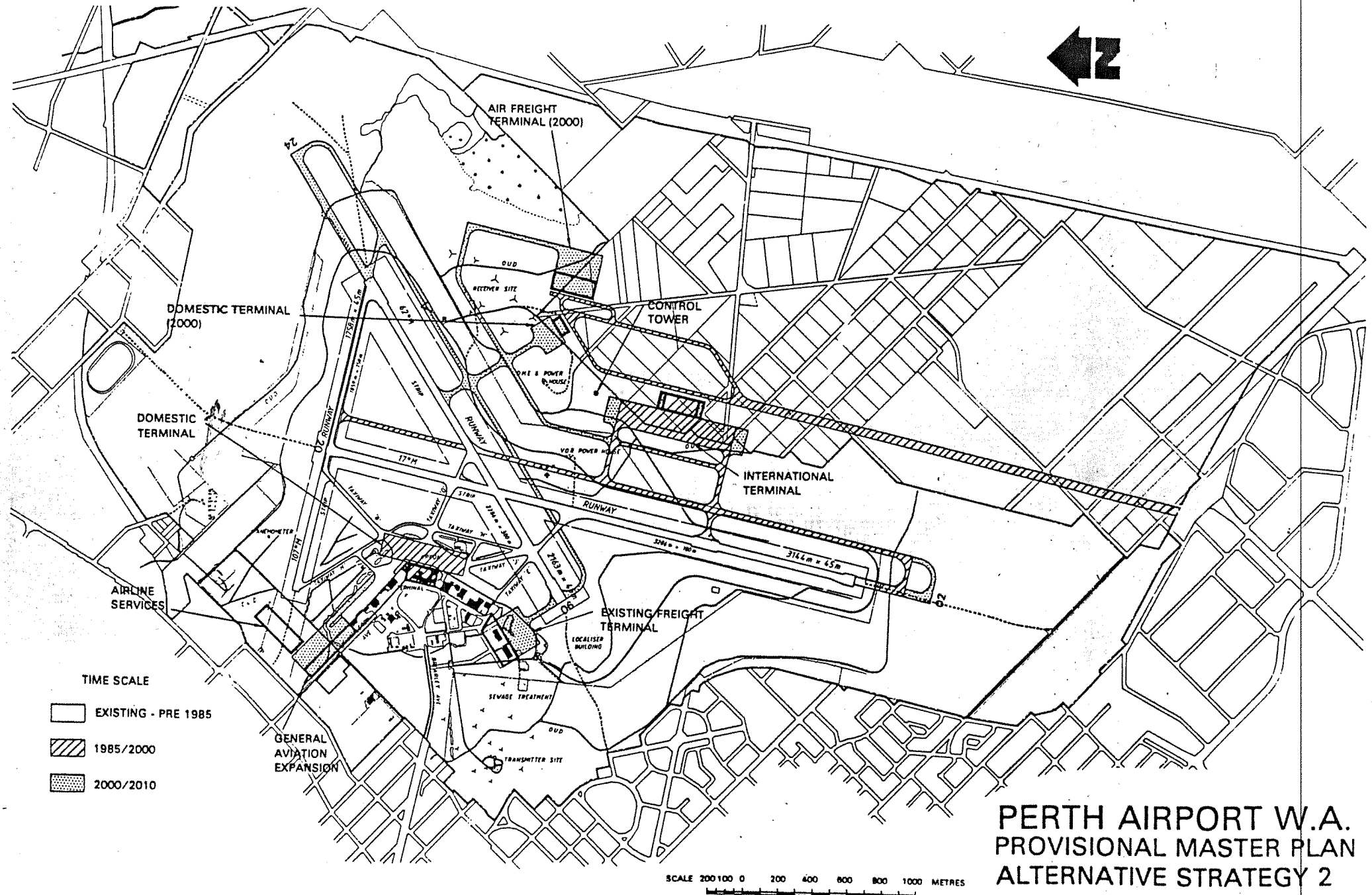
The ultimate Plan for Perth airport resembles option 4 plus the following additional features :

- further extension of parallel runways to 3,800 m.
- 67^{O}m runway further extended to 3,000 m.
- closure of 107^{O}m runway.
- Development of more taxiways and aprons.



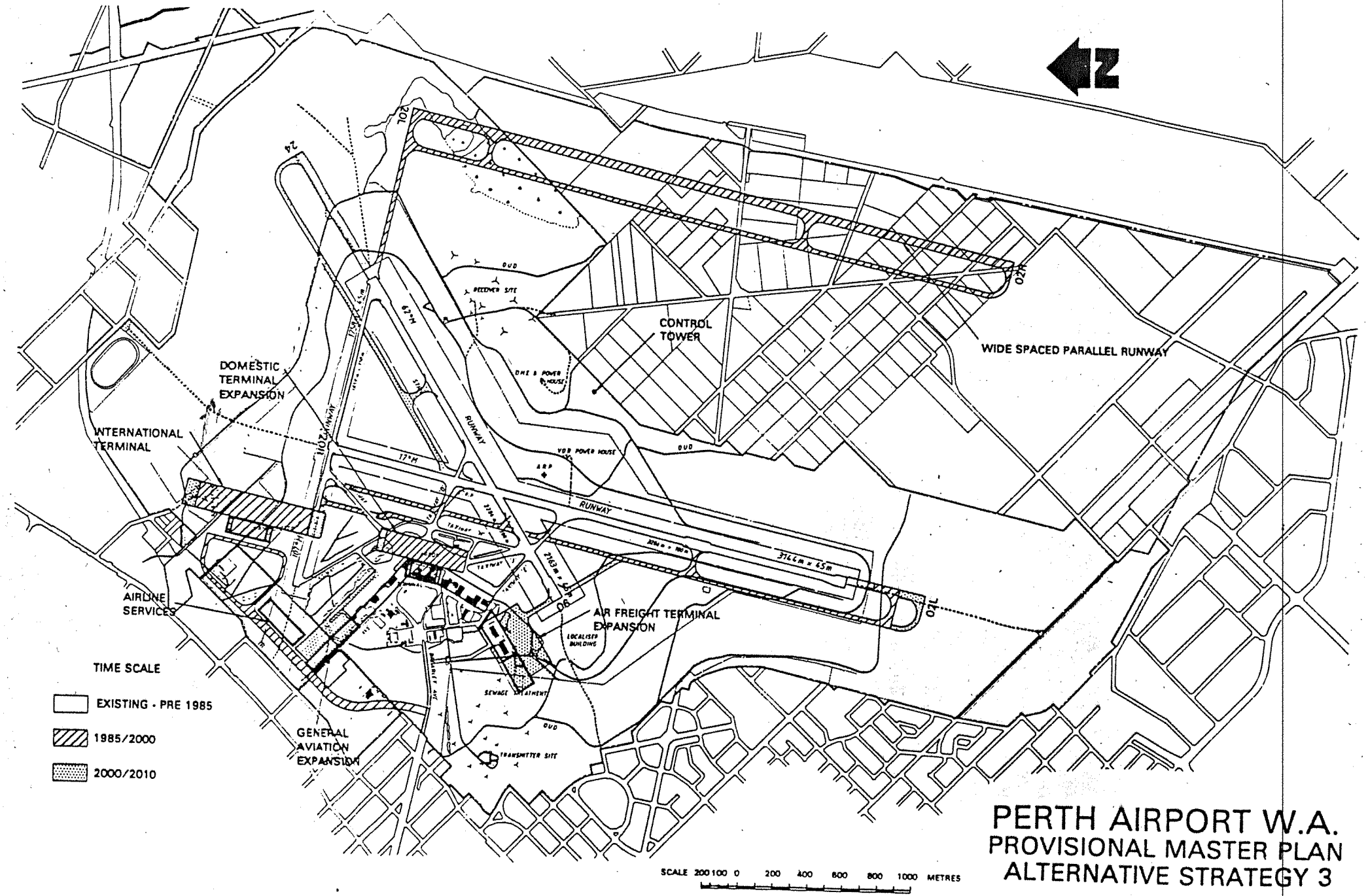
PERTH AIRPORT W.A.
PROVISIONAL MASTER PLAN
ALTERNATIVE STRATEGY 1

Figure 2.



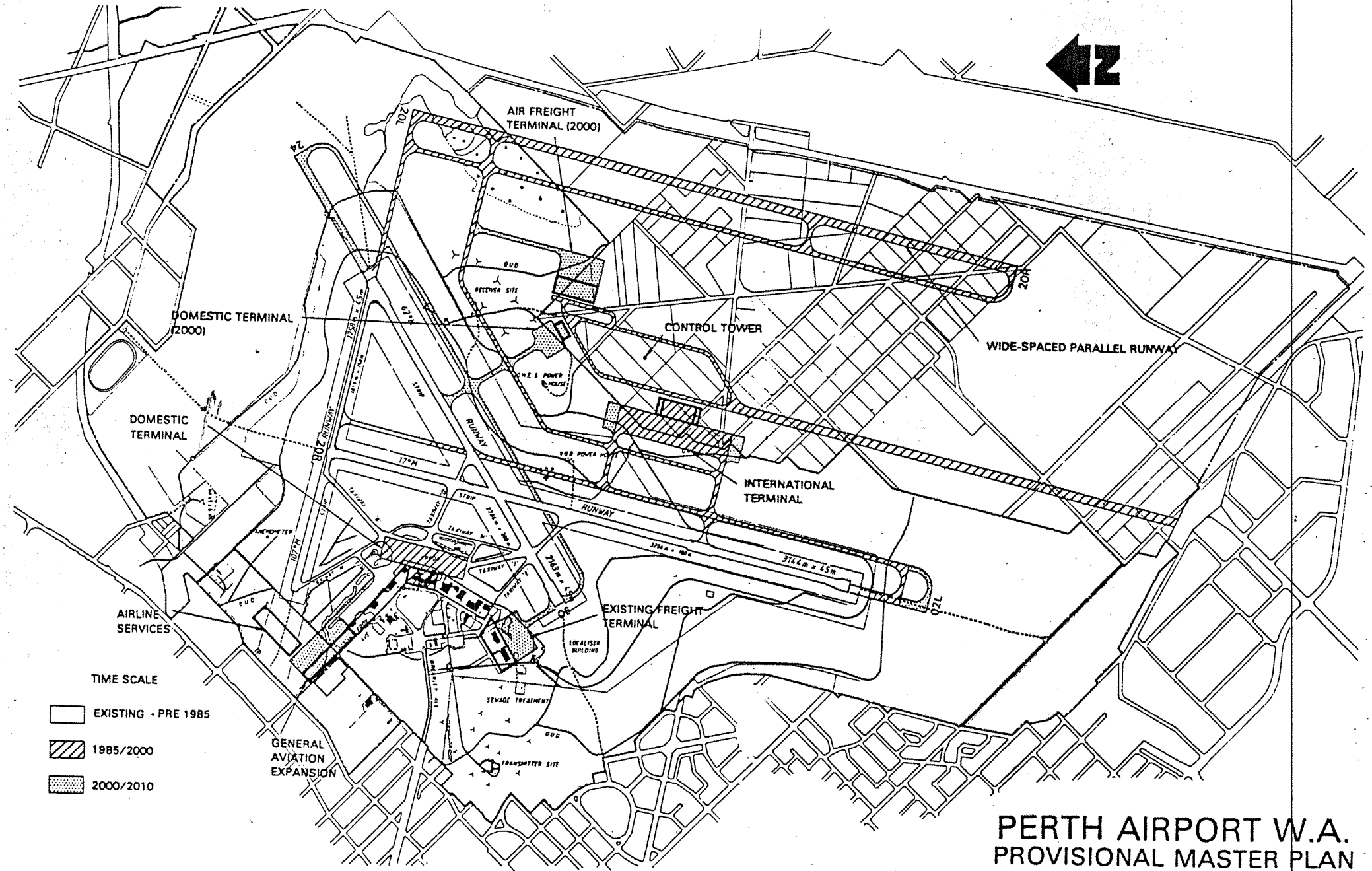
PERTH AIRPORT W.A.
PROVISIONAL MASTER PLAN
ALTERNATIVE STRATEGY 2

Figure 3.



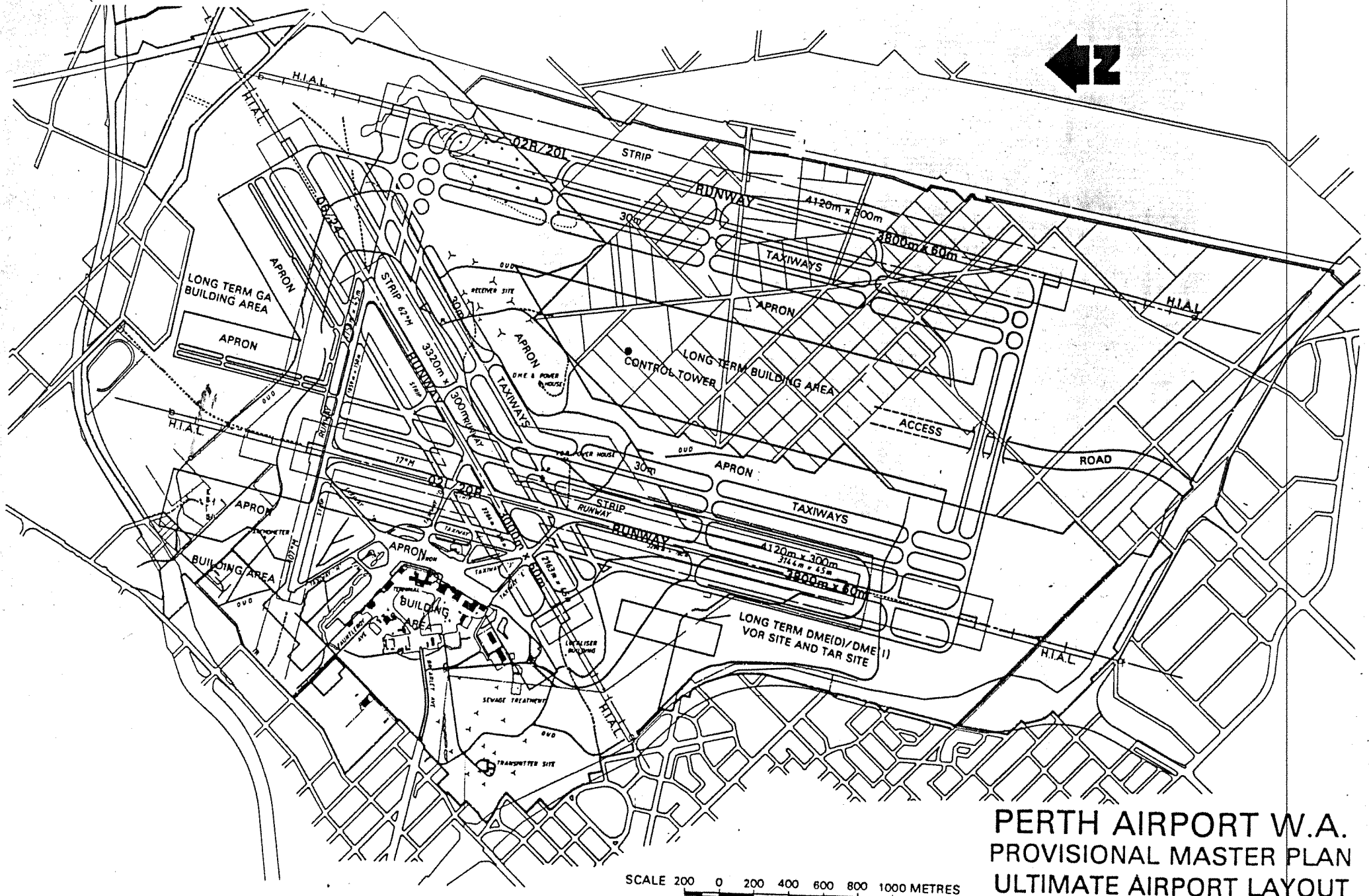
PERTH AIRPORT W.A.
PROVISIONAL MASTER PLAN
ALTERNATIVE STRATEGY 3

Figure 4.



PERTH AIRPORT W.A.
PROVISIONAL MASTER PLAN
ALTERNATIVE STRATEGY 4

Figure 5



PERTH AIRPORT W.A.
PROVISIONAL MASTER PLAN
ULTIMATE AIRPORT LAYOUT

Figure 6

4. ENVIRONMENTAL ASSESSMENT

4.1 Public Interest

The Provisional Master Plan and Draft EIS has attracted an abundance of public comment and a level of interest rarely seen in this State for any development proposal.

A total of 294 individual public, Local Government, State Government and Commonwealth Government submissions were received. Many of these were very detailed and most were several pages long.

A total of 1,000 signatures on petitions addressing the Master Plan were also received, not including the petitions sent separately to local authorities and politicians.

Several local authorities pursued a rigorous publicity campaign for some weeks via the local press. This undoubtedly was responsible for generating much of the public interest.

Local authorities have also embarked on their own noise annoyance assessments utilising the services of consultants. In addition they have acquired noise measuring devices so that they can monitor aircraft noise within their own municipalities and to give them sufficient data to be able to authoritatively question the Department of Aviation findings and NEF predictions.

4.2 Adequacy of Draft EIS and Environmental Assessment Procedures followed

The Master Planning process, followed by the Department of Aviation, is shown in Figure 7. The inclusion of the preparation of a Draft Environmental Impact Statement by DoA at level 5 of the master planning process (see Figure 7) is a major shortcoming in the process as the document should have been prepared much earlier so that it would have addressed the environmental impacts of all reasonable alternatives, including the 'do nothing' option. Instead, a decision on the strategy most favoured by DoA has been made and subsequent to that, the Draft EIS has been prepared. It consequently

FIGURE 7

MASTER PLANNING PROCESS (according to Dept. of Aviation)

LEVEL		
1.	IDENTIFY MAJOR PLANNING ISSUES	
2.	DEFINE ALTERNATIVE STRATEGIES	
3.	EVALUATE ALTERNATIVES . Capital Costs . Operating Costs . Social and Environmental costs	State and Local Government Working Group.
4.	SELECT STRATEGY (Decision)	Community Views Local Gov't views. State Gov't views
5.	PREPARE PROVISIONAL MASTER PLAN AND DRAFT EIS	Comments on Provisional Master Plan & Draft EIS . industry . governments . community . others.
6.	PREPARE FINAL MASTER PLAN AND EIS	
7.	IMPLEMENT DEVELOPMENT	
8.	REVIEW MASTER PLAN	

focusses mainly on the environmental considerations of the favoured strategy and does not consider the 'do nothing' option or any other option that may have a reduced environmental impact nor does it consider the option of relocating the airport. It accepts the findings of the Commonwealth/State Advisory Committee on W.A's Airport Needs. Public input to the decision-making process of this Committee was not sought.

The matter of the development of Perth Airport could have been the subject of a two stage Draft Environmental Impact Statement. Public input could have been sought on the site for Perth's main airport at stage 1 and on the preferred strategy for development at stage 2 (Figure 8).

The DCE has never been in favour of the Draft EIS being incorporated as part of the Master Plan document, believing that it should more appropriately have been prepared as an independent document in its own right, containing the essential information from the Master Plan, but at the same time devoid of all the unnecessary detail which served to make the report unnecessarily complex and confusing, particularly to the public.

All attempts made by DCE and by the Department of Home Affairs and Environment to have the Department of Aviation produce a proper, separate Environmental Impact Statement were unsuccessful.

The DCE was given an advance copy of the draft report, for comment, before the report was printed. It was of some concern to the Department that the document supplied did not conform to the guidelines issues to the Department of Aviation by DH&E and compiled in consultation with DCE. In its present form, DCE did not believe it to be a suitable document for release for public comment. A number of specific criticisms were made, some of which are detailed below. In spite of this advice, the published copy was released relatively unchanged.

FIGURE 8

PREFERRED AIRPORT PLANNING & ENVIRONMENTAL ASSESSMENT PROCESS

ACTUAL

TIME TAKEN	PLANNING	ENVIRONMENTAL	INPUTS
Oct. 1973	Set up C'wealth/State Advisory Committee on WA's Airport Requirements		
	Select Options for Location	Initial Draft EIS considers site for Airport (3 months)	. State Gov't . Local Gov't . Public . C'wealth Gov . Industry
Dec. 1979	DECISIONS . to form WA Airfields Committee. . Perth should remain the prime airport. . A Master Plan should be produced as soon as possible.		
Sept. 1981	MASTER PLANNING PROCESS		
	Identify Major Planning Issues		State & Local Gov't Working Group
	Define alternative strategies, including 'do nothing'.		
	Evaluate alternatives . capital costs . operating costs . environmental & social costs	Stage 2 Draft EIS - 3 month public review period	. State Gov't . Local Gov't . Public . C'wealth Gov't . Industry
	Select Strategy		
June, 1981	Prepare Provisional Master Plan		Comments. . State Gov't . Local Gov't . Public
	Prepare final Master Plan	Final EIS	. C'wealth Gov . Industry
	Implement Development	Public Review	
	Review Master Plan		

- the Draft EIS was an afterthought to the main document. It should have been self-contained as it is not reasonable to expect the public to wade through 166 pages of complex information to understand the Draft EIS.

- the report is confusing and difficult to follow. It is often difficult to locate figures referred to because of the format of the report. Table numbers are confusing because they are presented below the tabulated information rather than above it. In addition no list of tables is included in the contents.

- Department of Aviation was advised to include a 'summary' at the beginning of the document (there had been no contents or summary in the advance report). In spite of this, the summary is not included until page ix and follows the distribution list which, if needed at all, should have been an Appendix.

- the report freely interchanges the terms NEF and NEC and yet only maps showing NEI and NEC are incorporated. Nowhere is the relationship between NEI, NEC and NEF adequately explained.

- there are no conclusions made, except the nomination of the preferred strategy.

- there is no glossary, in spite of the fact that the report contains many technical terms and abbreviations.

- the fact that the reader is expected to make frequent reference to the Master Plan document for information to supplement the draft EIS implies that the DoA intended that the complete document constituted the Draft EIS, in which case the Draft EIS should have preceded the Master Plan and the title should have been changed. It is not a normal situation, when reading an Appendix, to have to refer to the main text of the report. The purpose of an Appendix is to provide extra detail in support of a text, the presentation of which in the text

would interrupt the reader's understanding. The Master Plan is, in fact, an Appendix to the Draft EIS and should have been presented that way.

- the report discusses runway positions by referring to them as 02/20, 06/24 and 11/29. The reference figure for runway locations is Figure 4.1 and yet this does not contain the above reference numbers, instead referring to 107°M, 17°M and 62°M only. The public was expected to understand this with no explanation.

- details of present approach and departure paths have not been included.

- there is an implied definition of a 'noise-affected house' being a house located within the 25 NEF. The inference is made that if any houses were to be insulated, it would be those within the 25 NEF or greater. This suggests that if the parameters for deciding the NEF are changed, as seems likely, so that the existing 25 NEF becomes 20 NEF then, immediately, there is an apparent reduction in the number of noise affected residences.

- the DoA uses proxy cost of insulating houses as a means of costing noise nuisance and yet accepts no responsibility for actually insulating houses.

- the description of the biological environment is inadequate and the reference to moving short-necked tortoises to other habitats is indicative of the poor level of understanding of ecosystems.

- the Draft EIS considers the selected strategy with only minor references to impact from the other alternatives. A Draft EIS is supposed to consider the impacts of all the alternatives including the 'do nothing' option. In this case the strategy of relocating the airport should also have been discussed as an option.

Two additional criticisms need to be made. The first relates to the length of the public review period which is considered to have been far too brief. A minimum review period of three months should be required for documents of this complexity, particularly for such major issues. A number of local authorities indicated in their submissions that a six weeks review period is insufficient to allow officers to examine a report and make a submission to Council, as most Councils only meet in full once per month.

The second criticism relates to the timing of the review period. Initial planning had been for the Provisional Master Plan and Draft EIS to be produced and made available for public review early enough in 1982 for the comments to have been submitted prior to the Parliamentary Works Committee hearings on the siting of the new control tower held over from 1981. Decisions on the Final Master Plan strategy should have been made prior to this hearing as the site and cost of the control tower vary with the four strategies. Because the Provisional Master Plan was delayed, the Parliamentary Works Committee hearings on the control tower have in fact pre-dated the decisions on the Final Master Plan. Furthermore, the timing was such that many authorities would not have had sufficient time to adequately consider the Provisional Master Plan/Draft EIS document prior to the hearings.

4.3 The Need for the Development

Transport development in Western Australia has been greatly influenced by the size of the State and climatic conditions. As a consequence the only region with adequate road and rail links is the south-western corner and air services play an important part in the State's transport system.

Future developments will increase both internal and external transport requirements and air transport facilities will need to be increased or used more efficiently to cope with the increased air traffic.

The need for the development can be considered from the Aviation aspect and from the passenger aspect.

4.3.1 Aviation Activity at Perth Airport

The information on aviation activity given by the Department of Aviation is summarised below for Perth Airport. In terms of noise impact, it is the total number of aircraft movements rather than total passengers which is important.

TABLE 3 - SUMMARY OF AVIATION ACTIVITY, 1960 AND 1979

Type of Aircraft Movements	No. of aircraft 1960	No. of Aircraft 1979	Average Annual Growth rate
Domestic aircraft	6,615	13,013	3.6%
International aircraft	614	3,309	9.3%
Commuter aircraft	5,509 (in 1972)	8,062 (in 1980)	4.7%
General Aviation (aerial work & charter categories)	17,000 (in 1972)	40,081 (in 1979)	13.0%

The method for deriving forecast future aviation movements is based on a number of assumptions.

- an attempt is made to predict the likely number of passenger movements.

- assumptions are then made on likely aircraft types and passenger load factors for the various routes over the time period.

- the ratio of transit flights to terminating/originating flights affects the number and pattern of movements.

From Department of Aviation's data in the master plan the total predicted aircraft movements are shown in Table

TABLE 4 - FORECAST NUMBER OF AIRCRAFT MOVEMENTS PER ANNUM

Type of Aircraft Movement	1985	1990	1995	2000	2005	2010
International*	4270	5000	5730	6100	6660	7130
Interstate**	5840	5900	6230	6390	6580	6880
Intrastate+	7880	8420	8990	9520	10330	11020
Commuter†	8780	9100	9500	9500	9670	9780
Other Aviation	51100	54000	56200	58100	59700	61100
TOTALS	78870	82840	86680	89610	92940	95910

* International aircraft movements from Master Plan Table No. 5.12.

** Interstate aircraft movements from Master Plan table No. 5.14.

\+ Intrastate aircraft movements from Master Plan table No. 5.16.

† Commuter aircraft movements from Master Plan table No. 5.17.

'Other Aviation' includes heavy and light general aviation, military, helicopter and non-scheduled airline aviation.

The Department of Aviation forecasts for International passengers and movements have been criticised by Qantas. The Qantas forecasts of total passengers are greater than the DoA estimates because they include non-revenue and domestic on-carriage passengers on International services. The comparative figures are shown in Table 5. Qantas also differs on forecasts of aircraft movements as transitting services between Eastern Australia and Asia/Europe will be replaced by an increasing number of services terminating at Perth. (see Table 5).

TABLE 5 COMPARISON OF DEPT. OF AVIATION AND QANTAS PREDICTIONS

Year	D of A Forecast -Revenue Pass'gr.	Qantas forecast total pass'grs.	D of A Inter-nat'l move'ts	Qantas Interr move't
1980	325,000	344,000	-	-
1985	407,000	582,000	4,270	3,980
1990	524,000	706,000	5,000	4,680
1995	641,000	830,000	5,730	5,430
2000	758,000	1,005,000	6,100	6,000
2005	876,000	1,077,000	6,660	7,000
2010	993,000	1,202,000	7,130	8,000

Disagreement with DoA forecasts has also been expressed in the submission made by the Civil Air Operations Officers Association of Australia (C.A.O.O.A.A.). The Association points out that the 1985 busy day forecast made by Department of Aviation is already being exceeded at Perth. This suggests a considerable underestimate by DoA in the forecast figures.

At times the existing facilities at Perth Airport appear to be inadequate for the number of daily aircraft movements. These inadequacies include :

- inadequate facilities for air traffic control which may ultimately affect safety.

- insufficient taxi-ing facilities so that the 02/20 runway (North-South runway) isunder-used for take-offs and landings as it is used as a taxi-way. This also necessitates leaving greater distance between aircraft when approaching the airport, to allow time for a landing aircraft to taxi out of the way of the following one.

- insufficient apron space for parking aircraft, necessitating the use of valuable taxi-ways for short term parking of aircraft at peak periods.

- inadequate arrangements and provision of runways : most of the larger aircraft will not land on the 06/24 runway because of its marginal length.

- Large commercial jets may be kept waiting while small charter aircraft make their landing.

- the 02/20 runway is the only runway in W.A. equipped with an Instrument Landing System and is therefore the only runway that can be used for certain aspects of Pilot training as laid down by Department of Aviation. This is an additional burden on the use of this runway.

- lack of space and facilities for servicing of aircraft for activities such as refueling, provisioning, cargo and baggage handling.

- cramped terminal space for personnel in provision of adequate security, baggage and cargo receiving and meals preparation (inflight).

Conclusions

The forecasts for aircraft movements given by Department of Aviation, appear to be open to question. The Department argues that a parallel runway will not be needed for operational reasons until after the planning scale of the project, however, if its forecasts are underestimated to the degree suggested in the submission by Qantas, then the parallel runway would be required much sooner and its provision now would be a very short term noise abatement measure. If their figures are on the high side, then improvements are possible via more efficient use of existing facilities.

4.3.2 Passenger Aspects of Perth Airport

For many travellers Perth Airport provides their first glimpse of Australia and is the point of immigration. First impressions tend to be long lasting and there is considerable concern that at the end of a long International flight, the long queues and waiting, at Perth, do not create a favourable impression. Some of the problem areas which cause inconvenience to passengers include :

- inadequate immigration, quarantine and customs facilities. This may be because the space allotted for these tasks is not large enough or it may be because not enough officers are rostered on to the task.

- excessive delay in baggage handling so that people have to wait long periods to obtain their luggage. This, in turn, causes delays in processing by customs authorities.

- inadequate transit facilities. The transit lounge/ departure lounge is barely large enough to cope with a single 747B. At times, transit facilities for several aircraft may be required and many people have to stand for long periods. At these times refreshments and toilet facilities in this area are not adequate.

- car parking room is inadequate at peak times because of bunched arrivals and departures. Free carparking should be provided on production of air ticket for cars depositing or collecting passengers.

- the waiting area on the ground floor is not adequate to cope with peak times and refreshment facilities are insufficient at these times.

- at times the airlines are not represented at the airport and the public cannot have their enquiries

4.4 Aircraft Noise

4.4.1 Factors influencing the impact of Aircraft Noise.

The impact of aircraft noise is dependent upon many factors which affect the generation, propagation, and characteristics of noise. Some of the factors that influence the impact of aircraft noise in the vicinity of airports include :

- the quality of sound, e.g. pitch, intensity, duration,
- type and rating of aircraft engines,
- type of aircraft,
- ground running and engine testing,
- noise abatement procedures,
- flight paths,
- runway usage and lengths
- meteorological conditions,
- aircraft scheduling,
- frequency of aircraft movements
- night flights,
- curfews,
- unscheduled and military aircraft movements,
- total load of aircraft at takeoff,
- safety considerations.

4.4.1.1 Response of individuals to Aircraft Noise

The reaction of an individual to aircraft noise is subjective and dictated to a large degree by the personality of the individual. The degree of reaction on exposure to noise will be influenced by the mood of the individual which is itself determined by a person's response to stresses throughout the day, at home at work or while travelling.

According to a study carried out by the National Acoustic Laboratory in 1979, to investigate the nature of subjective reaction to aircraft noise, some 74% of respondents recorded negative feelings about noise. The words most frequently used to describe these negative feelings were : annoyed (or annoying), sad (or not happy), nervous (or nervy), irritated (or irritable), cranky, angry, upset, frustrated, nuisance, frightened, mad, dislike, aggravated, wild, terrified, worried, hassled, disturbed, depressed, bad, tension, hectic. The most frequently endorsed word was annoyed, followed by irritated, upset, disturbed, bothered, and nervous.

Derivatives of the word annoyance are therefore the most appropriate terms to describe subjective reactions to aircraft noise. To determine annoyance often a social survey method of investigation is used. These surveys can give an indication of how strong and widespread the feelings of annoyance to aircraft noise are. Vibrations resulting from aircraft noise can elicit feelings of fear in some people and the above study found that the words:concerned, afraid, startled, frightened, nervous, worried and scared were used to describe fear reactions.

Various physical, social and psychologival effects have been identified as a result of aircraft noise. Effects of aircraft noise include :

- interference with TV and radio reception;
- interference with conversation;
- interference with use of the telephone;
- severe hearing difficulties in people using hearing aids;
- aggravation of existing medical problems such as Tinnitus (ringing in the ears) and stress-related illnesses;
- damage to houses from vibration;
- disturbed sleep;
- can produce or increase stress, makes people impatient and angry;
- psychological effects such as fear of aircraft crashing;
- alteration or interference with life style (particularly in Perth where there is an emphasis on outdoor living);
- possible loss of trade in establishments such as restaurants, under flight paths;
- physiological effects including disturbed concentration or reading ability.
- perceived decrease in property value.

Some of these effects might be regarded by some people as being trivial. For instance, TV and radio reception can be impaired directly by the close physical proximity of aircraft and secondly by noise from such aircraft interfering with a person's ability to hearing the transmission. However, if the disturbance occurs frequently enough, then the degree of annoyance can become considerable.

4.4.2 Statistical Indices for Measurement of Noise Exposure.

As mentioned above, reaction to noise is complex, depending upon the characteristics of the sound, the type of activities disturbed and the attitude and quality of life of an individual. The complexity of these subjective responses makes an accurate assessment of individual annoyance for exposure to given noise very different. However, general predictions are made from community groups on a statistical basis.

Indices used to estimate exposure to aircraft noise are usually based on a measure which tries to approximate subjective response to the noise of individual aircraft and a method for taking into account of the number and variety of aircraft operations. The most frequently used index in Australia is the Noise Exposure Forecast (NEF). A general definition of the NEF and two related indices is provided below.

4.4.2.1 Noise Exposure Forecast (NEF).

The NEF is a computation which provides estimation of predicted average daily*noise exposure (in dB(A)) caused by the operation of aircraft at and around airports. The NEF takes into account :

- the magnitude and duration of aircraft noise as determined by aircraft type, weight, and flight path. The noise levels are calculated using the Effective Perceived Noise Level (EPNL)** for each aircraft type.

- the distribution of noise energy or loudness, over the spectrum of audible frequencies.

- the forecast frequency of aircraft movements on various flight paths.

- the average daily distribution of aircraft movements by day and by night (not an actual or typical day).

---

* An average day in a specified year, that is based on the average number of aircraft movements, aircraft mix, and flight path designations over a year on a daily basis.

** Based on a complex calculation and measurement of individual aircraft noise levels it is also used in the noise certification of new aircraft.

It is worth noting that :

. the NEF is an 'equal energy' index. It is a measure of total amount of noise energy arriving at a given point per day, independent of whether it comes from a few loud aircraft or many quieter aircraft. Peak level indices on the other hand take account only of the loudest aircraft heard.

. the standard NEF calculation currently used in Australia incorporates weighting for exposure to aircraft noise experienced between the hours of 10 p.m. and 7 a.m. This weighting assumes that an aircraft movement during these hours is equivalent to 17 movements during the day time. There is no weighting for the evening hours of 7 p.m. to 10 p.m. This weighting is an attempt to improve the NEF system as a predictor of community response to aircraft noise.

. for practical reasons, noise from aircraft which are at the airport itself is not included in the NEF calculations in Australia. Hence noise generated by ground running is excluded from the NEF calculations.

. the NEF formula is such that the NEF increases as the logarithm of the number of operations increases. This means a 10 fold increase in aircraft movements would increase NEF contours by 10 dB whilst a doubling of movements would increase the NEF by about 3 dB.

. Since NEF calculations are based on the operations of an average day, extreme variations in procedures cannot be represented, in particular, aircraft are assumed to take off and land on fixed flight paths. Variations to these due to meteorological conditions and pay-loads may lead to significant alteration to the NEF calculation for any particular site.

4.4.2.2 Noise Exposure Index (NEI)

The NEI is the exposure to aircraft noise (calculated the same way as NEF) based on the actual aircraft movements for a given year, thus NEI contours can be compared with NEF predictions made in previous years to gauge the accuracy of the forecast noi: from actual airport operations. However, this index, like the NI assumes fixed flight paths and therefore, is subject to the same inherent limitations as the NEF.

4.4.2.3 Noise Exposure Concept (NEC)

This is a NEF contour plan for a given year in the future based on certain assumptions in relation to aircraft types, frequency of aircraft movements, and runway length and orientation. If an assumption is varied, a new NEC is produced. It should be noted that particularly in the scientific literature the term NEF is often used interchangeably with both the NEI and the NEC.

4.4.3 Studies of Aircraft Noise at Perth Airport.

Three major studies of the impact of aircraft noise in the vicinity of Perth Airport have been undertaken over the past three years. The National Acoustic Laboratories (NAL) published a report in 1982 (Hede and Bullen, 1982) on a major study of aircraft noise at 5 major airports in Australia including Perth. This study was the first comprehensive work of its kind undertaken in Australia.

The Department of Conservation and Environment is at present involved in work aimed at ascertaining the effectsof aircraft noise in an assessment of the relationship between noise exposure annoyance. As with the NAL study, this exercise has included a social survey to gauge community response to aircraft noise but in addition incorporates a noise monitoring programme designed to determine the actual noise environment more accurately.

The City of Canning commissioned Consultants in 1981 to investigat community reaction of aircraft noise outside the 25 NEF contour. The community reaction to aircraft noise was investigated by means of a social survey. Other investigations that have been carried out by local government authorities are as follows :

Survey of 650 householders on aircraft noise and provisional master plan ..	Bassendean Town Council.
Sound measurements of aircraft noise	Belmont City Council.
Collation of noise reduction methods and their cost within the 25 NEF ..	Belmont City Council.
Noise survey using the Ldn index ..	City of Canning.

A brief description of the three major studies and their results are given below.

4.4.3.1 Review of National Acoustic Laboratory Study

The primary goals of this study were to :

a. investigate the effects that aircraft noise has on residential communities around Australian airports.
b. Evaluate a range of indices (including NEF) used to establish aircraft noise exposure.

In Perth the NAL study consisted of a social survey of more than 600 residents within the main noise impact area, as determined by the 25 NEF contour. Noise levels were also measured for two weeks at each of four sites to check the accuracy of standard EPNL values which are based on the noise certification trials for each aircraft type and on the nominal flight paths designated for the airport.

Based on the responses given to many questions in the social survey a measure of reaction to aircraft noise was developed. From the reaction scale (see below) it was possible to determine those individuals that were "moderately affected" and those "seriously affected" by aircraft noise.

0	None
1	
2	a little
3	
4	
5	Moderate
6	
7	
8	A lot
9	

The physiological changes that noise can trigger include cardiovascular, endocrine and neurological functions. Many noise experts believe that man's tolerance to noise is quite high, while others maintain that the distressing effects of noise, either those above or together with other stress factors, can overwhelm man's capability for healthy adjustment, with resultant physical or mental ailments (Borskis, 1071). The effects of noise on persons whose health is already impaired are likely to be greater than on people enjoying normal health. "Impaired health" in this context will include people with cardiovascular, gastro-intestinal disorders and chronic neurological disorders (Cohen, 1971) as well as children and others with asthma and related diseases.

Many of the submissions received were from individuals who indicated that they believed that aircraft noise at Perth Airport aggravates some existing physical problem in themselves or in a member of their household. These people are unlikely to be relieved of their discomfort, whether real or imagined, other than by some perceived reduction in aircraft noise at Perth Airport.

A number of public submissions described the individual's response to aircraft noise and expressed concern over aggravation of health problems, for example, asthma and other allergic conditions, heart problems, tinnitus. People with poor hearing were frustrated by having their hearing further impaired.

People who are ill need conditions which ensure freedom from disturbance and which allow sleep at all times of the day and night. Hospitals and rest homes should not be sited under flight paths (Aust. Parlt. 1970).

Some observations made by this study were :

. approximately 4600 residents are seriously affected by aircraft noise around Perth Airport.

. Only a small proportion of the variation of individuals' response to aircraft noise can be explained by the amount of noise present. In other words, there are personality or psychological characteristics of the individual which control or modify the way in which noise affects individuals. These may include negative attitudes to the airport such as fear that the aircraft will crash in the area, and variations in sensitivity of individuals to noise in general.

. The NEF system used in Australia is one of the best indicators of noise annoyance and is superior to "peak level" indices. The correlation between NEF and annoyance as judged from the social survey is improved if :

a. the weighting for night flights is reduced from 17 to 2 day time flights.

b. a weighting is introduced so that an aircraft flight between the evening hours of 7-10 pm is made equivalent to 4 day time flights.

These modifications have the effect of reducing NEF values around Perth Airport by about 5-10 dB(A).

. The NAL study recommends that runway noise should not be included in the NEF calculations because runway noise is far less "effective" on residents than noise with the same total energy from aircraft flying over their residences.

. The study recommended that the 20 NEF contour be plotted on maps showing aircraft noise exposure around airports. The 20 NEF was loosely defined as an excessive amount of noise based on the dose/response relationships derived from the study." With the revision suggested, the area lying within this contour was marginally less than that lying within the existing 25 NEF contour.

- Even if there were no residential areas within the revised 20 NEF, aircraft noise problems would not be eliminated. Many people living outside the 20 NEF contour are adversely affected by noise exposure levels of less than 20 NEF. For example about 5% are seriously affected at the 15 NEF level and others at even lower levels.

- Calculated values of noise exposure correlated very poorly with individual reaction to noise. However, the average response for individuals in a region of similar exposure produces a better correlation with noise exposure.

The NAL Study is certainly the most definitive study undertaken in Australia to assess community reaction to aircraft noise. However, there are some questions as to the applicability or interpretation of results owing to the methodology adopted and the manner in which the study was carried out. For example :

- given that community values and airport operations differ markedly between the cities studied, the application of psychological data derived over all cities to one particular city or community is necessarily limited.
- more specifically 62% of respondents were from areas close to the curfewed airports of Sydney and Adelaide. Consequently it is not surprising that the most annoyance apparently occurred between the hours of 7 - 10 p.m. just prior to the curfew. Therefore, it is likely that the annoyance caused by the late night and early morning flights in Perth could be masked by the larger Sydney and Adelaide samples.

- The study was designed upon the NEF system and consequently sampling was confined to stated NEF zones. Therefore, there is a possibility of bias towards the NEF index.

- The social survey was predominantly conducted within the 25 NEF and little attempt was made to assess annoyance at low values of NEF.

4.4.3.2 DCE Airport Noise Pilot Study

In 1981-82, the Department of Conservation and Environment undertook a preliminary study of community noise levels and related annoyance in the immediate vicinity of Perth Airport. A sound level measurement programme and a social survey were designed to :

- Ascertain the effects of aircraft noise in the area,
- Investigate the relationship between measured sound levels and annoyance,
- Compare a range of noise annoyance parameters with the standard NEF parameter.

Community reaction to aircraft noise was investigated by means of a social survey conducted in a large area around the airport. More than 300 households were surveyed in the area covering the Shires of Bayswater and Bassendean and the Cities of Belmont and Canning as well as large portions of the Shires of Kalamunda and Swan, Town of Gosnells and the City of Perth.

The study area was divided into four approximately equal portions with a control sample taken well away from the airport at Ballajura. The number of interviews conducted in each of these regions was proportional to the population density and the questionnaires administered in a random fashion within each zone covering areas both within and outside the NEF 25 contour.

An attempt was made to quantify the degree of annoyance by aircraft noise by use of a 7 point annoyance scale (see below) ranging from 'not at all' to 'a great deal.' The scale permitted a simple grouping of annoyance into defined categories and provided quantitative scores which could be correlated with measured noise levels.

1. not at all
2. very little
3. a small amount
4. a fair amount
5. quite a bit
6. a lot
7. a great deal.

A limited physical noise measurement programme was conducted for the study around the Perth Airport. Twelve sites were monitored over a twenty four hour period. A number of noise parameters were determined from these data, including :

- 24 hour L_{eq} (equivalent continuous sound level pressure)
- L_{dn} ('day-night' L_{eq}, with a 10 dB(A) penalty between the hours of 2200 and 0700)
- L_{10} (the level exceeded for 10% of the time)
- L_{50} (the level exceeded for 50% of the time)
- L_{90} (the level exceeded for 90% of the time).

A theoretical L_{dn} was also calculated based on a published relationship between L_{dn} and NEF contours.

It was clearly recognised that, owing to their short-term nature, the physical noise measurements would be of limited value as indicators of the existing noise environment at the monitoring sites. Monitoring for much longer periods would more accurately reflect the annual noise impact.

Conclusions drawn from this study were :

- The social survey indicated that aircraft noise exerted a serious adverse effect on the quality of life of about 10% of the population residing in the study area. The primary effects of aircraft noise included disturbance to sleep, interruption of radio and television programmes and conversation and a perceived decrease in property value.
- The correlation between individual noise annoyance (as measured in the social survey) and the standard NEF parameter was very poor. As a consequence, the NEF contours cannot be said to accurately reflect noise annoyance experienced by the community. Mean annoyance (clustered data) for areas experiencing similar exposure showed a better correlation with NEF

. Limited noise monitoring has suggested that the NEF contours at Perth may not be a good indicator of the existing noise environment on the ground. This could be due to a number of factors such as flight path variations, poor specification of the "average day" used to calculate NEF or simply a lack of representative measurements.

If these preliminary conclusions are substantiated by further long-term monitoring presently being undertaken by the Department, they will have an important bearing on planning for Perth Airport and would suggest that similar studies may need to be carried out at each Australian airport to establish the local values.

4.4.3.3 City of Canning Study of Community Reaction to Aircraft Noise

The social survey carried out involved the evaluation of 300 responses from persons who lived outside the 25 NEF contour. The area to be surveyed was divided up into 31 zones and the number of interviews carried out in each zone was proportional to the residents in each zone.

In assessing the degree of annoyance from aircraft noise a scale of 1 - 10 was constructed as follows :

0	None
1	
2	
3	
4	
5	Moderate
6	
7	
8	
9	
10	Very much.

Some results of the survey indicated that :

. 16.3% of those interviewed indicated a level of annoyance at or greater than that to be expected from the annoyance scale.

. 27% of respondents indicated that relaxing, watching TV and sleeping were disturbed by aircraft noise.

. 59% would not like to see flight paths restricted to a smaller proportion of the metropolitan area.

4.4.4 Limitations of the NEF index

From the studies described above, it can be quite clearly concluded that the NEF index is a very poor indicator of aircraft noise annoyance to individuals. This may stem from a number of weaknesses in the calculation of the index, some of which would include :

. assumptions are made of rigid linear flight paths when in reality, standard flight paths vary according to air temperature load and are not lines but may be considered as bands or distorted cones. If the NEF index is to more closely represent noise exposure on the ground, calculations should be performed on the basis of actual flight paths.

. the calculation is based on what is perceived to be an average day's operations over the year. It is not a worst case situation, it is not sensitive to seasonal or weekly fluctuations in aircraft movements or flight paths.

. The calculation does not include ground running of jet engines which may be a problem to those living near the airport.

Furthermore, from studies mentioned in this report, NEF has been found to correlate poorly with measured noise levels under flight paths and has not been found to be a good indicator of the number of people adversely affected by aircraft noise. Consequently, the index should not be used in estimating the cost of compensation or sound insulation as a result of an airport development proposal. The NEF index may have a useful role in determining the relative qualitative impact on different airport planning options, but it cannot be used to currently estimate the absolute noise impact of such proposals. However, it is questionable as to how useful a comparison would be of various airport planning strategies on the basis of the NEF index.

Unless the NEF index can be improved markedly as a predictor of aircraft annoyance, its use as a major tool for town planning purposes is doubtful and very limited.

Even if NEF was an accurate measure of annoyance it still remains a value judgement as to what level of NEF should be acceptable.

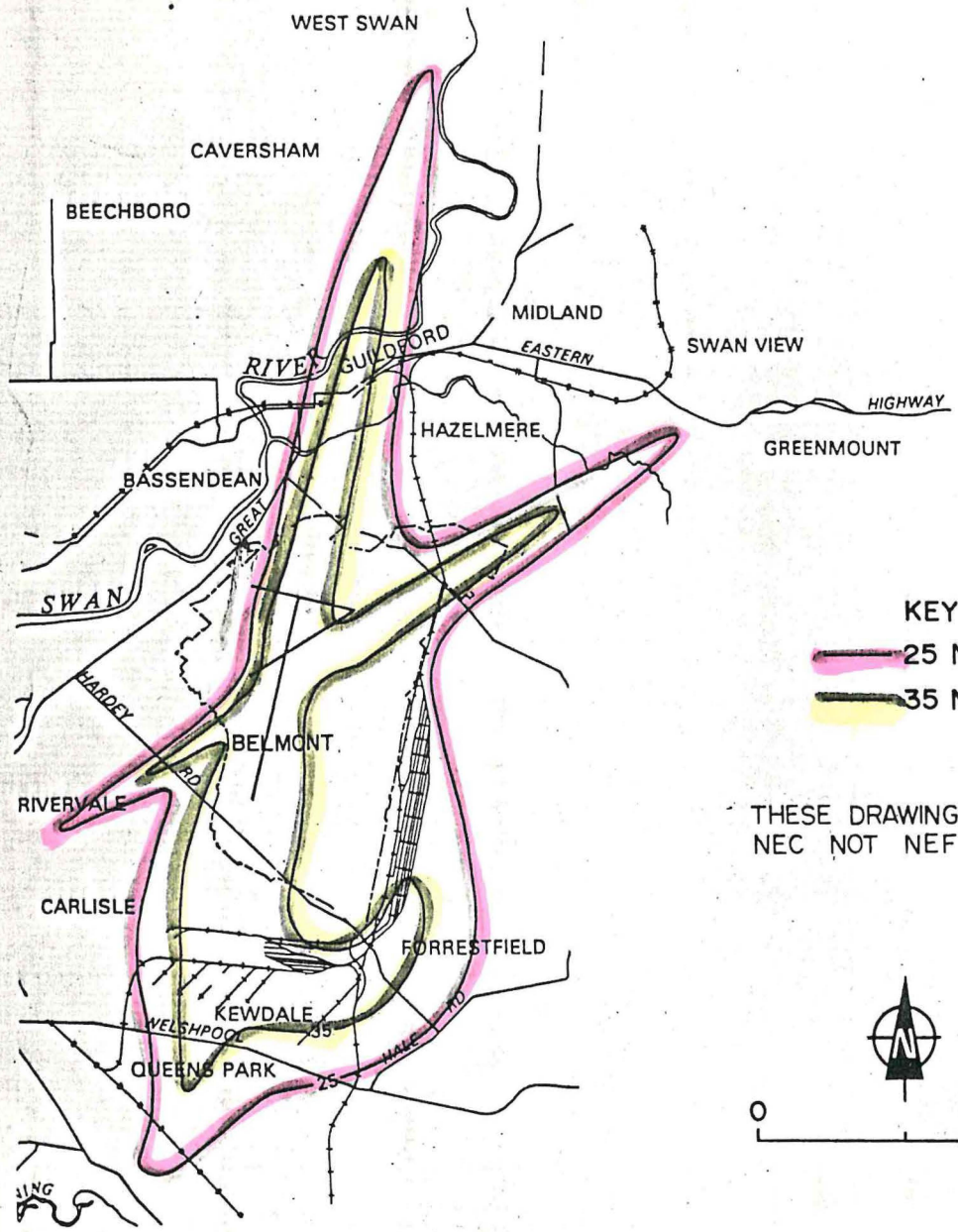
4.5 Impact of Aircraft Noise on Human Environment

4.5.1 Description of Impact of the Alternatives

All the proposed development strategies will have continuing or increased noise problems for near airport residents. Noise is the prime impact, it is largely external to the airport site proper and its sources are aircraft and airport-generated road traffic. The latter will be discussed in Section 4.6

Predictions of noise are presented on Figures B.2 - B.5 inclusive of the Draft EIS (Figs. 9 to 12 in this report) which illustrate the Noise Exposure Concepts for the years 1985 and 2000. It is unfortunate that these key figures contain a number of errors or misleading information, namely :

PERTH AIRPORT PROVISIONAL MASTER PLAN NOISE EXPOSURE CONCEPTS.



KEY

25 NEC

35 NEC

THESE DRAWINGS SHOW NEC NOT NEF

N

0 5 Kms

FIGURE 9. 1985 EXISTING RUNWAY SYSTEM STRATEGIES 1+2.

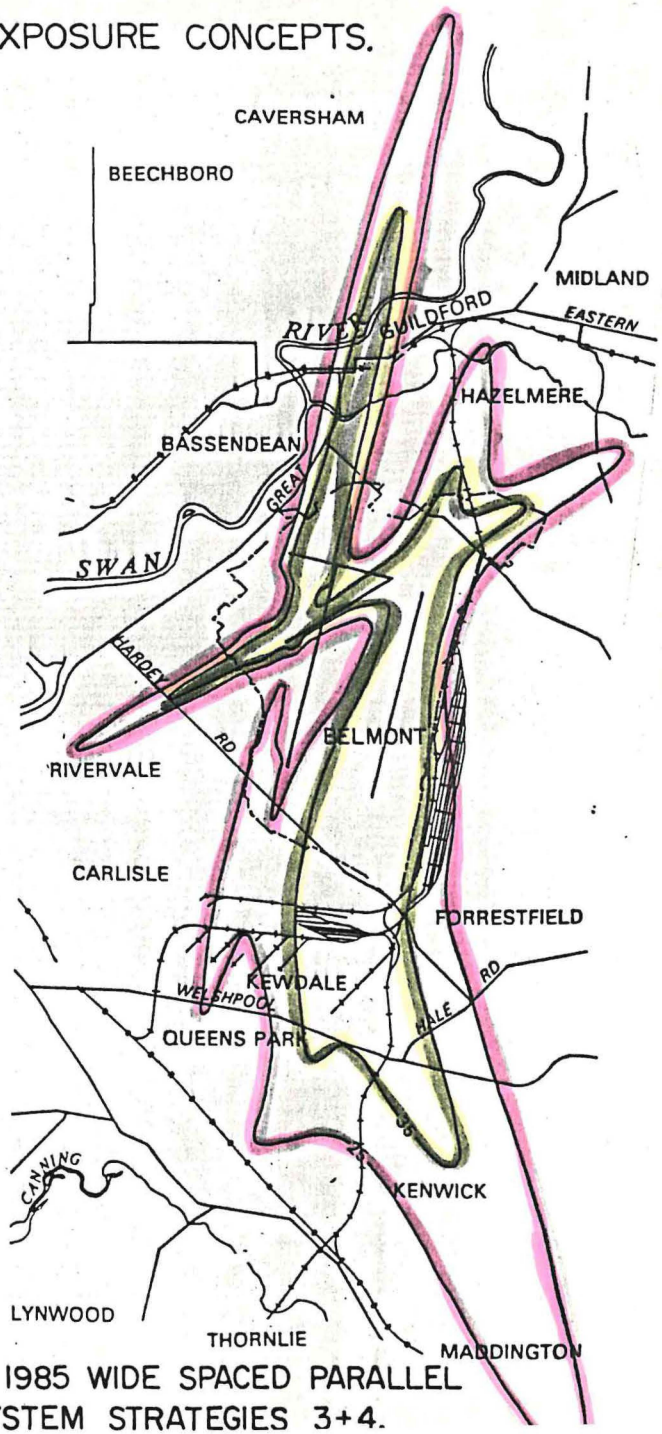


FIGURE 10. 1985 WIDE SPACED PARALLEL RUNWAY SYSTEM STRATEGIES 3+4.

PERTH AIRPORT PROVISIONAL MASTER PLAN NOISE EXPOSURE CONCEPTS.

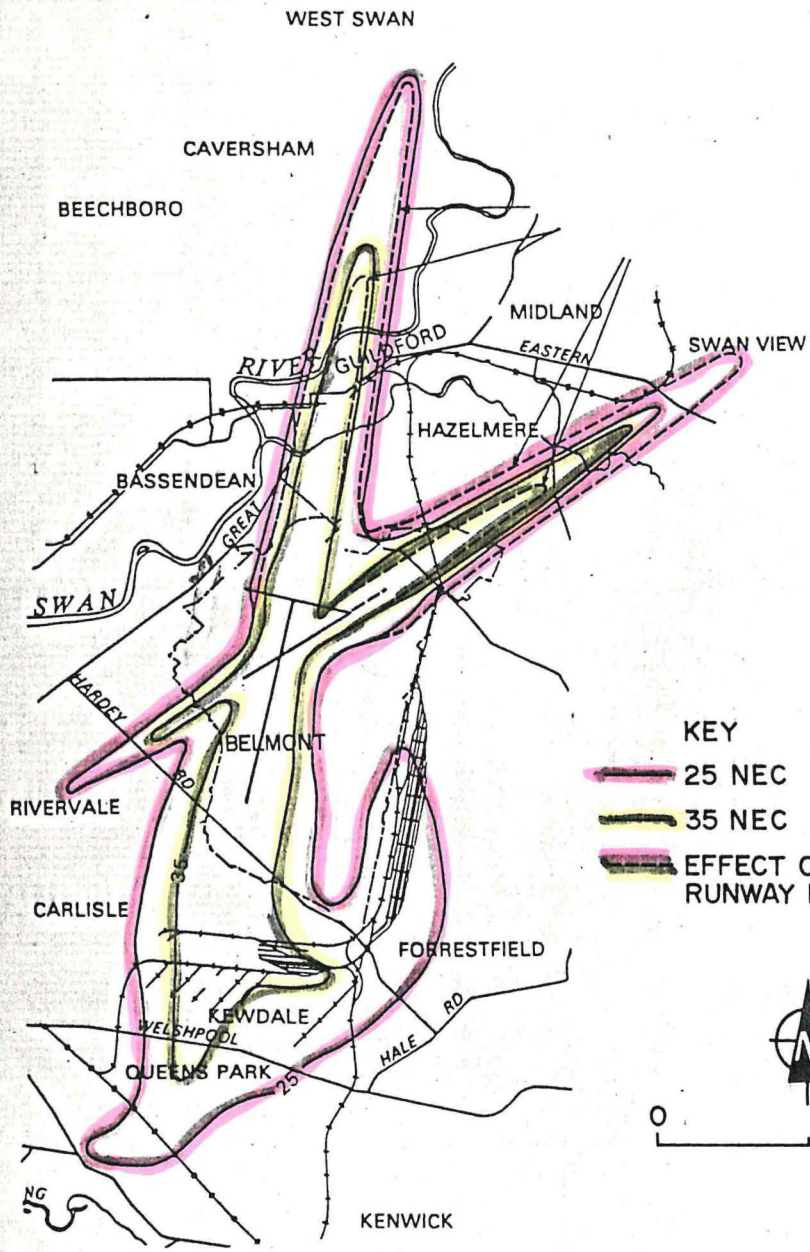


FIGURE 11. 2000 EXISTING RUNWAY SYSTEM STRATEGIES 1+2.

KEY

25 NEC

35 NEC

EFFECT OF 06/24 CROSS RUNWAY EXTENSIONS.

N

0 5 Kms

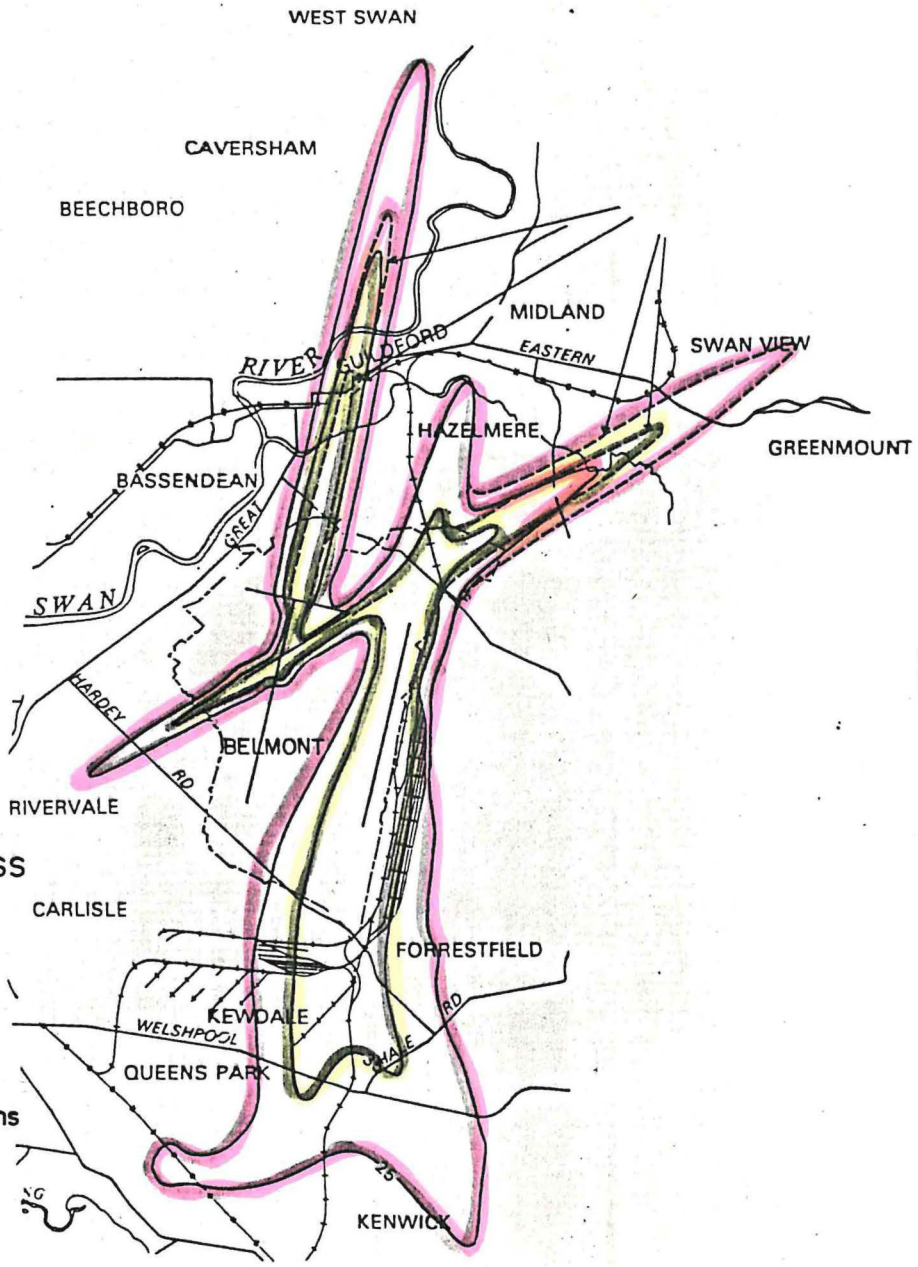


FIGURE 12. 2000 WIDE SPACED PARALLEL RUNWAY SYSTEM.

a. the drawings illustrate Noise Exposure Concepts and state clearly that the drawings are not of Noise Exposure Forecasts. This is misleading and serves to confuse the reader as the Department of Aviation itself uses the terms NEC and NEF interchangeably - and furthermore all text references are to NEF and yet the only figures presented illustrate NEC.

b. The information on Figures B.2 and B.3 of the Draft EIS (Figures 9 and 10 in this report), according to the Note on those figures, show NECS for the year 1990 and yet the title states that this is the situation for the year 1985.

c. Figures B.4 and B.5 of the Draft EIS (Figures 11 and 12 in this report) similarly indicate in the Note that the data are as predicted for 1990 and yet show the year 2000 in the title.

d. On Figure B.4 (Figure 11) the NEC values appear to have been reversed with the larger, outer contour being recorded as 35 and the inner as 25. This kind of elementary mistake should not occur in a document of this nature.

e. Data presented in tables in Figure B.5 (Figure 12) appear to be inconsistent with the diagrams. These errors raise doubts as to the validity of the information presented, and the means of illustrating it.

Unfortunately, the only way in which the impact of the alternatives can be compared is to accept the Department of Aviation's figures as a basis and then to modify this or question it on the basis of information gathered from other sources. The Department of Aviation's forecasts of aircraft movements are thought to be unreliable by other aviation bodies who point out that the 1985 predictions are already being exceeded at Perth. In addition, the shortcomings of the NEF/NEC system (discussed elsewhere in this report) make any predictions

The alternative strategies for the development of Perth airport which have been identified from public submissions and the draft EIS are :

- do nothing

- develop according to one of the four strategies advanced by the Department of Aviation, namely :
  - existing runway configuration, runway extensions, new terminal to north.
  - existing runways as above with central terminal.
  - wide spaced parallel runway with northern terminal.
  - wide spaced parallel runway with central terminal.
  - develop according to the strategy advanced by the City of Belmont - a modified Strategy 4.
  - relocate Perth Airport totally.

Any of these options could involve either :

- no change to operational noise abatement procedures or curfew.

- impose a curfew and enforce strict operation of noise abatement procedures and/or modify noise abatement procedures to put greater emphasis on noise annoyance and less on costs to operators.

4.5.1.1 Do nothing Option

The impact of this option would be progressive increase in aircraft noise resulting from the forecast increase in aircraft movements, offset to some degree by the introduction of quieter aircraft. In this scenario, areas already experiencing noise nuisance with today's aircraft on the current runway configuration and usage are likely to experience a greater level of noise nuisance. The introduction of quieter aircraft types will cause some reduction in noise but whether an overall increase or decrease in noise would be the result is difficult to predict.

Similarly noise from road traffic would increase and the inconvenience of more and more traffic attempting to bypass congested areas by travelling along residential streets in Belmont/Redcliffe would become aggravated.

Inconvenience to international passengers because of already inadequate international terminal facilities would be increased, as the number of passengers increased.

4.5.1.2 Strategy 1

Again, this option would result in progressive increase in aircraft noise from forecast increase in traffic. As the option allows for extensions to both the 02/20 and 06/24 runways some people presently not severely noise affected will be exposed to greater noise levels. This is particularly significant for the 06/24 extensions.

The construction of a new international terminal to the north of the existing domestic facility would alleviate problems presently experienced by travellers. This location would, however, result in aggravated road traffic problems on the existing airport access and corresponding increased traffic noise and decreased safety in the adjacent residential streets.

4.5.1.3 Strategy 2

The aircraft noise effects for this strategy would be the same as for Strategy 1. The benefit to passengers using the International terminal would be the same with some slight inconvenience perhaps being incurred by people joining or leaving intra-Australian flights as they would have to transfer terminals.

There would be great benefits from improved access, reduced traffic congestion and reduced traffic flow via residential streets with corresponding reductions in traffic noise and improved road safety for residents.

4.5.1.4 Strategy 3

The construction of a parallel runway should transfer noise from takeoffs from residential to largely industrial areas, but only if landings are restricted to the 02/20 west runway and take-offs are restricted to the 02/20 east runway. If this is not rigidly adhered to, then the overall noise impact of the parallel runway could be greater than the existing impact, in terms of total number of residences affected by noise to some degree. This does not necessarily mean that there will be more houses lying within the 25 NEC but acknowledges that people living within the 25 NEC will still be considerably affected by noise and that people living outside the 25 NEC may become more noise affected.

In addition, extensions to the 06/24 runway, to permit more landings from the north-east, would expose the residential areas of Greenmount and Swanview not presently exposed to the noise problem, to increasing noise levels. A reduction in noise levels to the north of the 02/20 runway may result, but as the area affected is largely rural the significance of this reduction may not be as great as it first appears. Any reduction in noise level on the 02/20 north area would be dependent upon changed operations encouraging 747B aircraft to land on 06/24 as a regular rather than occasional event.

The parallel runway would necessitate greater taxi-ing distances for aircraft joining or leaving the runway. This would result in increased noise.

Benefits to international travellers would be increased and road traffic problems would remain as described for Strategy 1.

4.5.1.5 Strategy 4

The aircraft noise aspects would be as discussed in Strategy 3.

Benefits to international travellers and road traffic impacts would be as discussed for Strategy 2.

4.5.1.6 Modified Strategy 4 (City of Belmont)

This strategy is different from Strategy 4 in that :

- there are no extensions to existing runways (including 06/24).
- there is substantial reduction in aircraft taxiways.
- the control tower is located close to or on the international terminal building.
- alteration in eastern flight path.

The details of this option are given in the Belmont Council submission.

The aircraft noise impacts in terms of total residences would be less than in Strategy 4 because there would be no further extensions to either the 02/20 or 06/24 runways. The present NEC predictions for the areas to the north of 02/20 and north-east of 06/24 would remain as they are now, as long as the strict use of the parallel runways is enforced. The takeoff noise pattern would be improved, because take-offs would be largely over industrial areas from the 02/20 east runway. Not extending the 06/24 runway would largely preclude takeoffs to the south-west from this runway, particularly for the larger jets.

A further reduction in total noise would result from the reduction in taxi-way lengths.

Benefit to the travelling public, and surface access considerations would be as in Strategy 4.

4.5.1.7 Ultimate Development

The Department of Aviation's design for the possible ultimate development of the airport site is shown in Figure 6. This provides the planning framework for the formulation of the four strategies, as short-term development at the site may take account of possible long term requirements when runways, buildings and taxiways are located. The critical airport planning elements are :

- the runway system.

. the taxiway and apron system.
. building area size and location.

The runway developments allowed for in the ultimate plan are detailed below, a taxiway system of dual parallel taxiways would also be required.

a. 02/20 runway(s)

. southerly extension to 3800 m within a runway strip length of 4120 m. This gives a runway some 200 m longer than in Strategy 4. Present length of this runway is 3144 m.

. 100 m stopways and 200 m clearways at each end of the runway to give take-off distance (TOD) of 4000 m and accelerate stop distance available (ASDA) of 3900 m in both directions.

. category 11 instrument approach.

. provision of an identical parallel runway to the east.

b. 06/24 runway

. north-easterly extension from the present 2163 m to 3000 m within a runway strip of length 3320 m (same as in Strategies 1 to 4).

. 100 m stopways.

. 60 m clearance at both ends to give TODA of 3060 m and ASDA of 3100 m in both directions.

. category 11 instrument approach.

c. 11/29 runway

- initial displacement of the 11 threshold.
- decrease in take-off distance available on 29
- ultimate closure of the runway.

The Department of Aviation has not included a NEC diagram for the ultimate layout, however, the extra length on the 02/20 runways would result in an extension of the NEC to the north on 02/20 west and an extension to the south on 02/20 east. If the runways are used in reverse so that landings are allowed on 02/20 east and takeoffs on 02/20 west, additional spikes would appear in the NEC.

4.5.1.8 Relocation

Relocation of the whole airport operations to a location outside the metropolitan area would obviously minimise the noise impact. Aircraft could also be routed to avoid traversing the metropolitan area.

Although the cost of this exercise would be very great indeed, closure of the present airport and the availability of this land for commercial or residential development would recoup a large measure of the cost. A total of some 1469 hectares of land is involved.

4.5.1.9 Discussion

The clearest means of alleviating the noise problem is to relocate the airport. A number of local authorities have resolved to pursue relocation of the airport by the end of the present planning frame (Year 2010).

The Department of Aviation's figures for severely noise-affected residences lying within the 25 NEF are low when compared with the figures given by local authorities for residences within the 25 NEF (see Table 6). In addition, it should be remembered that some people outside the 25 NEF will be at least as annoyed by aircraft noise as those

within the 25 NEF, also that some within the 25 NEF will be relatively unaffected, because of differing individual response to noise.

Table 6 - Comparison of numbers of noise affected residences i.e. within 25 NEF zone.

	D of A figures	City of Canning
1979 existing runway	5,600	
1982 existing runway		8,710
1985 existing runway	3,525	
1985 parallel runway	2,300	2,118
2000 existing runway	3,275	
2000 parallel runway	2,225	

The Department of Aviation contends that considerable noise reduction will result from the use of quieter aircraft in the future and although this is open to doubt it uses this as an argument against the construction of the parallel runway. It defines the "need" for the parallel runway in terms of the difference between the estimated drop in numbers of noise-affected residences resulting from introduction of quieter aircraft and from parallel runway.

i.e. Saving from parallel runway − Saving from quieter aircraft = "need" for runway

or numerically

3,475 − 2325 = 1150 residences.

However, it also points out that the provision of the parallel runway would add approximately 1300 houses which would become subjected to noise exposure within the 25 NEF. These 1300 houses are presently relatively unaffected by aircraft noise if the 25 NEF is accepted as the cutoff.

From a total noise viewpoint, the rating for the options from the lowest to highest noise impact is :

1.	relocate airport;)	on condition that noise abatement procedures and/ or curfews are modified and stringently applied.
2.	modified Strategy 4)	
3.	Strategy 4 and 2)	
4.	Strategy 1 and 3)	

The provision of a parallel runway may result in increased noise for many people and its desirability or otherwise will be determined by whether society believes that a few people should suffer extremely high noise levels or that many people should suffer a lower noise level. The amount of noise produced will be the same, the question is

whether it is more desirable to concentrate it over a small area or to spread it out. This is a decision for the community to make.

The use of the NEC contour to define noise-affected areas has questionable validity. It may have some use as a rough means of assessing relative numbers of residences to be affected by the different planning options, but it is incorrect to take it as a representation of what is occurring now. NEC/NEF provides an estimate of what might occur, it is therefore not correct to extrapolate this to attempt to derive now a value of nuisance.

4.5.2 Physiological Effects of Noise

The Australian Academy of Science (June, 1976) has stated that :

"Except for noise-induced hearing loss due to damage to the hearing organs, there is no known noise-induced disease. However, noise produces well-recognised physiological changes in the endocrine, cardio-vascular and auditory systems in addition to its effects on sleep.

If these physiological changes become extreme, noise becomes a health hazard. Until enough research has been accomplished to prove that noise-induced physiological alterations are harmless, then it must be considered that noise may have possible detrimental effects on human health, particularly on people who may be ill." (p 12).

In addition to direct physiological response to noise, humans can show a reaction to noise in a psychological sense, e.g. by showing fear, annoyance, anger or pleasure, which may in turn alter the physiological state.

The physiological changes that noise can trigger include cardiovascular, endocrine and neurological functions. Many noise experts believe that man's tolerance to noise is quite high, while others maintain that the distressing effects of noise, either those above or together with other stress factors, can overwhelm man's capability for healthy adjustment, with resultant physical or mental ailments (Borskis, 1071). The effects of noise on persons whose health is already impaired are likely to be greater than on people enjoying normal health. "Impaired health" in this context will include people with cardiovascular, gastro-intestinal disorders and chronic neurological disorders (Cohen, 1971) as well as children and others with asthma and related diseases.

Many of the submissions received were from individuals who indicated that they believed that aircraft noise at Perth Airport aggravates some existing physical problem in themselves or in a member of their household. These people are unlikely to be relieved of their discomfort, whether real or imagined, other than by some perceived reduction in aircraft noise at Perth Airport.

A number of public submissions described the individual's response to aircraft noise and expressed concern over aggravation of health problems, for example, asthma and other allergic conditions, heart problems, tinnitus. People with poor hearing were frustrated by having their hearing further impaired.

People who are ill need conditions which ensure freedom from disturbance and which allow sleep at all times of the day and night. Hospitals and rest homes should not be sited under flight paths (Aust. Parlt. 1970).

Aircraft noise interferes with speech and this is a major contributing factor in problems of aircraft annoyance. Speech interference affects face-to-face conversations, telephone use, or radio and TV listening. The significance of the interference is particularly high in public buildings such as schools, offices and churches where speech and listening activities are a vital ongoing function (Cohen, 1971).

In the document the Department of Aviation states that "there is little available data on the physiological effects of noise ..." (p 150). In fact a considerable amount of research has been carried out in this area, and although much of it pertains to industrial noise in the workplace, it is, nevertheless, relevant in a description of the effects of noise. The Department of Aviation's treatment of this area is grossly inadequate, amounting to six lines of text in a report 224 pages long.

4.5.3 Psychological Effects of Noise

A number of investigations have been carried out in an attempt to determine whether noise at a level not injurious to hearing has chronic effects on the mental and physical well-being of individuals. Noise is an environmental stressor because of its continuity and unavoidability, and it therefore demands continual adaptation.

Noises that may be annoying but are controllable are generally non-stressing in the long term whereas noises that are ever-present or ever-recurring and are unpredictable and/or uncontrollable by the individual, are likely to cause long-term general stress (Australian Academy of Science, 1976).

Aircraft noise itself falls within the latter definition and people who live beneath the approach and take-off paths of large airports obviously are exposed to noise of potential stressfulness. In addition to the stress caused by the actual noise of an aircraft and the additional distress this may cause as a result of disrupted sleep patterns, aircraft noise frequently has an added stress effect resulting from an individual's fear of aerial attack or fear of aircraft crash. Some people, on hearing loud aircraft noise, rush outdoors

to check that the plane is still safely in the air.

A number of public submissions expressed concern over the stress of living close to the airport, both from aircraft noise and from road access noise, and referred to nervous conditions, jumpiness, disrupted sleep and fear of aircraft crashing. The fact that many people respond to excessive and/or loud noises with feelings of frustration or anger can in itself be stressful.

The Department of Aviation has stated in the report that the psychological effects include interference with sleep or rest, annoyance, interference with performance of work; interference with any form of communications based on any of the previous points. They fail to consider that normal conversation in social discourse, use of telephone and interference to television and radio audio are also affected adversely by aircraft noise. The aspect of fear of aircraft crashing and/or fear of invasion by aircraft is not addressed.

The Department of Aviation's treatment of the psychological effects of noise is perfunctory.

4.5.4 Historic Buildings

The Town of Guildford is situated about three kilometres to the north of the airport. The town has important historical links with the growth of the Swan District and a number of buildings in Guildford have been classified by the National Trust or recognised by the Australian Heritage Commission and entered in the Register of the National Estate.

The town lies at the intersection of Great Eastern Highway and Guildford Road and experiences a large traffic volume with consequent noise and vibration problems, the latter resulting in structural damage particularly along traffic routes. Because the town also lies on the approach path to the 02/20 runway it experiences very high noise levels, particularly from landing aircraft flying low over the town. High noise levels

from these jets also produce vibration which may cause or aggravate damage to historic and other buildings.

The amenity of the town is in any case affected by the excessive aircraft noise and the visual effect of heavy traffic and aircraft are intrusions on the old town landscape.

4.5.5 Cost Benefit Analysis

According to Segal and Clark (1981) "cost-benefit analysis involves a logical approach to problem solving and contains five basic steps :

a. Objectives -
Specify carefully the main objectives of the project (proposed legislation or policy).

b. Specification of effects -
Ascertain and list the effects, or areas of impact of the project.

c. Quantification of effects -
Measure, in physical terms, the effects of the project. It is critical that when specifying and measuring the effects of the project and valuing the costs and benefits that all the assumptions underlying the analysis be made explicit.

d. Valuation methods -
Develop methods for assigning monetory values to these effects, recognising that an effect may be perceived as beneficial by some groups of the community while at the same time it may be perceived adversely by other groups. It is also important to remember that the upper limit for the value of an effect is the least cost alternative means of achieving that effect.

e. Comparison of values -
Sum and compare the values of effects. Determine the net benefit (or net effect) of the project. Present the results of the research.

The method of analysis and presentation should allow the effect of different sets of assumptions on the project result to be identified.

Economic Evaluation

An economic evaluation should properly include all the steps of the cost-benefit methodology outlined above. Effects on the environment constitute one of the effects of a project that must be identified, measured in physical terms and valued. A complete economic evaluation should, it is clear, incorporate an environmental impact statement.

An economic evaluation is quite different from an accounting or financial feasibility statement. The latter normally includes only market transactions, while the former must include non-market impacts as well, of which environmental effects may be a major component. Economics is a discipline concerned with allocating scarce resources, including environmental resources, so as to maximise total welfare.

Although the problems of assigning monetary values to environmental impacts may seem to be insurmountable, there has been an increasing trend to place a monetary value of all parameters simply because money is seen by some to be the only medium for summarising and comparing the diverse effects of a project. A side benefit of having to carry out a monetary evaluation is that the evaluation problem has to be fully understood and the decision-making process becomes exposed.

In their paper, Segal and Clark classify the various valuation techniques into three broad classes, namely :

"a. Revealed preference in proxy markets - the value of environmental damage may be inferred from observed market behaviour in a related market.

b. Cost-based values - estimates of the costs of avoiding environmental damage can provide useful information to the decision maker even though they generally do not provide a direct measure of the value of environmental effects.

c. Survey - this third class of techniques involves the direct assessment of the value of environmental damage through personal surveys."

The use of differential property values to indicate the value of environmental damage from noise falls within (a) above.

4.5.5.1 Use of Differential Property Prices to Value Noise Nuisance

In theory, the basis for valuing localised pollution using differential property prices is straightforward. Pollution (whether from industrial sources or noise from aircraft) is seen as disadvantageous, therefore the demand for properties subject to low levels of pollution will be higher than for equivalent properties in areas where the pollution is greater. This translates into higher prices for the properties in low pollution areas and the price differential becomes a means of quantifying the value to the individual of avoiding the pollution. In their submission, the Shire of Belmont referred to the depressed house prices being experienced in Redcliffe (see City of Belmont submission).

Unfortunately the way in which any calculated differential can be applied as a measure of the social cost of pollution is questionable. In addition, there are a number of difficulties implicit in the method itself, these are :

. There are costs of moving, and perceived and real restrictions on choice of residence, which means that demand and prices will not be an exact reflection of real value.

This is particularly relevant in the case of Perth Airport as many of the residents living within the 25 NEF have been living there since the 1950s, many are elderly and would find it difficult to relocate socially, many are financially disadvantaged and would find it impossible to relocate financially. This inability to move cannot therefore be taken to indicate that noise is not sufficiently annoying to the householders to justify a "willingness to pay" to avoid the noise.

. Individuals, particularly before they purchase, may not accurately perceive the impact of noise nuisance or air pollution and will not take proper account of them in their purchase decision.

This is a problem as the level of noise nuisance experienced by potential purchasers from aircraft noise will depend very much on the time of day that they inspect a property and it is possible that potential purchasers may be totally unaware that there is an airport close by, as the noise is intermittent and may not be a problem while they are in the vicinity.

. It may be difficult to obtain satisfactory data on house prices.

. It may be difficult to isolate the effect of the pollution (noise nuisance, etc) from the many other determinants of house prices, for example, proximity to facilities such as shops and schools, road noise, proximity to river or beach. In addition it can be difficult to quantify a value for "background pollution" such as road noise. In the case of airport extensions it can be difficult to know whether existing aircraft noise should be considered as "background" against which one costs any increased level of noise, or whether the noise should be considered as existing plus new for cost analysis purposes. Obviously, if noise is to be introduced to areas previously not noise affected, the situation is more straightforward.

. In order to use this technique the pollution must be of a type that can be measured in physical terms in a manner where :

. It is likely that there is a non-linear relationship between physical levels of pollution and perceived dis-benefit, the precise nature of which will always be difficult to establish, as evidenced by the difficulties experienced in trying to derive a relationship between aircraft noise, which can be physically measured, and the annoyance that that level of noise causes.

- The differences in house prices measured from this method are capitalised values, i.e. the values that would be expected to be realised at sale now. The value of the pollution is therefore also a capitalised value and there will be difficulties in attempting to translate this into an annual value if this is required, particularly as the annual values will be subject to short term rises and falls in the market.

- Where the pollution represents a significant change to the ambient environment (for example from establishment of a new airport) a more complex approach is required which takes into account the incremental changes across the extent of the impact area.

- The above problems may be by-passed and the process apparently simplified by asking experts for their opinions on the effect of noise on property values.

The technique is most useful when :

- the pollution can be easily measured in physical terms.

- the pollution, as measured, is what is generally perceived.

Although noise nuisance generally satisfies these conditions in that the noise from individual aircraft can be measured, the use of the NEF as a predictor of noise affected areas "dilutes" the measured value by means of averaging and weightings (see Section 4.4.2.1) so that the predicted noise level will bear no relation to what can actually be measured, on a noise per aircraft basis, or actually perceived by the individual.

4.5.5.2 Department of Aviation's Approach to Cost-Benefit Analysis for Noise

The Master Planning process involved a cost-benefit evaluation of the four development strategies advanced in the Provisional Master Plan. The DoA believes that the benefits to be experienced from the four strategies are the same, i.e. improved

International terminal facilities, new air and ground traffic control equipment, alterations to runways to suit operational requirements, and that the analysis in fact becomes a straight cost analysis. This attitude reflects a fundamental error in the methodology : it fails to take into account, adequately, the differing environmental benefits of the four strategies, in terms of noise.

Because the DoA regards the provision of the parallel runway before 2000 purely as a noise abatement measure, the cost of constructing this for operational purposes is not included in the pre 2000 timetable.

Costs taken into account by the Department of Aviation were :

. capital costs of construction and purchase of equipment to operate the facilities (i.e. runways, control tower, terminal buildings, aprons, internal access roads).

. operating costs borne by the airport management and airport users (i.e. industries, the public, airport employees and from activities such as taxi-ing, refuelling, servicing aircraft, landing fees).

. some environmental and social costs.

Department of Aviation believes that not all costs are quantifiable in monetary terms, in particular the social and environmental costs. It has ignored these costs and on the basis of calculated estimated capital costs and operating costs with a minor component for estimated noise cost, the Department favours Strategy 1.

The DoA estimates that the cost of construction of a parallel runway by 1985, for noise abatement purposes, would imply an annual noise annoyance cost in excess of $1,600 per household in the 25 - 30 NEF zone and $2,300 per household in the 30 + NEF zone.

The DoA approach is that the true dollar value of aircraft noise can really only be represented by the concept of "willingness to pay." The assumption is made that if a person does not move away from a noise affected area, then they are not disturbed by noise. This fails to take into account the economic and other circumstances of the individuals.

A survey was carried out by Morgan for Sydney (Kingsford Smith) Airport called "A Model for Costing the Effect of Aircraft Noise," which concluded that there is no universally acceptable formula for accurately determining the value of depreciation of property due to aircraft noise pollution. In fact the accuracy of noise costs suggested in the report is $\pm$100% - an unacceptably high margin of error.

In a paper entitled "A Value for Aircraft Noise Nuisance?" supplied by the Department of Aviation, R. Allison concludes "Quite clearly there is no simple and universally applicable technique for accurately assessing the cost of aircraft noise, nor is there any one particular approach that emerges as being manifastly superior."

4.5.5.3 Cost of Insulating Homes

Various Local Government authorities have suggested that the DoA should have to compensate noise affected people by insulating their homes, and that the cost of installing an adequate level of sound insulation is therefore a proxy noise cost. The DoA does not consider that they are under any obligation in this respect, however, they did include a costing of noise insulation merely to permit comparison with other costs.

Their costs are based on :

- initial capital expenditure of $10,000 per house within the 25 NEF, for insulation and airconditioning.

- annual operating cost of $300 per house from 1985 - 2010.

A total additional cost of $21.8 million is derived by DoA which differs markedly from the figure derived by the Noise Subgroup of the Perth Airport Master Plan State and Local Government Working Group.

The Noise Subgroup study was based on a typical house plan of 100 sq. metres and costing for noise insulation and ventilation was calculated for five different types of construction for each of the three NEI zones, namely 25 - 30; 30 - 35 and 35 - 40+. The 100 sq. m. figure was selected so that State Housing Commission homes with floor areas in the order of 75 - 100 sq. m. would also be included.

Where possible, the specification for noise insulation was taken from Australian Standard 2021 - 1977. An exception was the specification required for doors, where to achieve a sound reduction of up to 44dB(A) in some areas, it was necessary to specify two solid core doors to each opening, purpose made double frames and gaskets to each door.

Estimates for noise insulation costs for a 1000 sq. foot home in America for 1970 are tabulated below :

Construction	Noise Reduction 5-10PNdB	10-15PNdB	15-20PNdB
Light exterior walls (wood, metal stresses or composition	$318 to $1,003	$1,957 to $2,935	$4,892 to $5,504
Average cost	$660	$2,400	$5,200
Average air-conditioning costs	$1,250	$1,250	$1,250
TOTAL	$1,910	$3,650	$6,450

These are average costs for a 1,000 sq. ft. American home in 1970 prices in American dollars. With an increase cost factor of 235% to compare with Australian dollars December, 1981 the values become :

	Noise Reduction 5-10PNdB	10-15PNdB	15-20PNdB
Comparable Australian value	$6,790	$12,220	$21,600

The nearest equivalent costs estimated in Australian dollars are for noise affected homes in the City of Canning and are :

$7,024	$9,974	$18,576

The total cost of insulating homes within the 25 NEF contour is calculated to be $89,783,000. This estimate excludes completely the noise affected homes defined by the social survey but situated outside the 25 NEF (in excess of 60,000 homes).

4.5.5.4 Emissions Charge Approach to Noise Abatement

Several countries are experimenting with noise emission charges which mainly fall within the "user pays" principle. The most usual way is for passengers to be levied, the money collected from the levy is then used to mitigate noise affected residences and businesses. This method still allows aircraft to be noisy and/or not take adequate noise abatement measures, it also still depends on the accurate delineation of noise zones to define noise-affected residences.

At Manchester Airport in the U.K. up to a 20% rebate on landing charges is given to aircraft having confirmed noise emission standards of an acceptable level. This rebate would go some way towards offsetting the additional fuel costs that can be generated by adherence to stringent noise abatement procedures.

In Germany noise abatement measures and compensation to people living in noise zones operates at many airports. Aircraft which exceed an acceptable noise level are charged a levy which is paid to home owners.

4.5.5.5 Surface Access Costs

An attempt has been made by the Department of Aviation to quantify the costs of traffic access to the airport for the existing Brearley Avenue access with the two terminal locations in options 1 and 3 and for the Beechboro - Gosnells Highway access for the two terminal locations in options 2 and 4. There are additional costs associated with access within the airport complex. Several submissions dispute the Department's figures which have been based largely on vehicle running costs.

The allocation of monetary values to travel costs is complex as it should take into account actual vehicle running costs, and the value of the individual's time taken to complete the trip. Another complication is the fact that not all trips to or from the airport will be single purpose access trips but may be miltipurpose, in which case the cost of the small extra distance to the airport is only an incremental cost.

4.5.5.6 Conclusions

Some attempt at costing the social and environmental costs involved in the airport redevelopment is essential. The figures derived by Department of Aviation are deficient and as a result, relatively meaningless. It would have been more valuable if they had derived a range of figures showing estimated maximum and estimated minimum costs, rather than opting to express the minimum as though it is a realistic value.

It should also be kept in mind that the NEF may not be a sound basis for computation of compensation and sound insulation.

4.6 Surface Access

Aspects of surface access that have been considered relate to the adequacy of existing and planned road links to cater for forecast increases in airport-generated traffic and the effect of noise, road safety and congestion of airport-generated traffic on adjacent urban areas.

Many of the public submissions addressed the issues of traffic safety, particularly with reference to school children crossing roads, traffic noise and congestion.

The Draft EIS contains a description of :

- the existing and planned road/public transport system in the vicinity of the airport for each airport development strategy;

- figures for the forecasts of traffic entering/leaving the airport over the study period, including the split of traffic between domestic and international terminals;

- derivation of total airport and non-airport traffic and its assignment to existing/planned road/public transport systems to identify access constraint;

- assessment of adequacy of airport access and noise impacts for each airport development strategy.

Strategies 1 and 3 retain the existing access via Brearley Avenue as the prime access, with an additional internal access road from Brearley Avenue to the new International terminal complex to the north of the domestic terminal area.

Strategies 2 and 4 retain the Brearley Avenue access for domestic and general aviation activities and require a new access from the external road system (Beechboro-Gosnells CAH) to the centrally located international, domestic and freight terminals.

4.7 Air Pollution

The exhaust from turbine-engined aircraft contains a number of recognised pollutants in small quantities and large amounts of substances not regarded as air pollutants, namely nitrogen, oxygen and water. The pollutants are:

- particulate matter, for example smoke
- carbon monoxide resulting from the incomplete combustion of carbonaceous fuels
- photochemical oxidants or smog, resulting from the exposure of reactive organic compounds such as hydrocarbons, and nitrogen oxides are exposed to bright sunlight during periods of poor dispersion
- total hydrocarbons which includes products of combustion and unburned fuel
- nitrogen oxides such as nitric oxide (NO) and nitrogen dioxide (NO_2) which are formed during all atmospheric combustion processes in a spontaneous chemical reaction.

The total amount of all these pollutants in the exhaust gases does not exceed 700 ppm.

The Australian Environment Council (1981) has recently attempted to quantify the total emission of air pollutants in capital city airsheds. Comparison with the annual emissions for Perth Airport (for 1976) indicate that aircraft operations are not a significant contributor to air pollution in the Perth region as a whole.

Aircraft engines are designed for optimum efficiency off the ground, hence the levels of some pollutants

e.g. carbon monoxide and total hydrocarbons, will be greatest while aircraft are idling or taxi-ing. It is during these activities that the smell of aviation fuel is most noticeable.

From the draft EIS it appears that air pollutiin is not a problem in terms of the proportion of pollutants contributed to the Perth airshed from aviation activities.

4.8 Impact on Biological Environment

4.8.1 Flora and Wetlands

The amount of impact on flora and wetlands is dependent on the strategy selected for the development.

The location of the new International terminal and associated facilities to the north will have little impact as the locations are already cleared and support a dominant lovegrass pasture. Location of the new International terminal in the centre of the airport will affect the wetland to the south-east.

The runway systems shown in strategies 1 and 3 are already constructed, there would therefore be no further impact on native vegetation.

If the parallel runway option is exercised as in Strategies 2 and 3 virtually all the wetlands on the airport site would be levelled and lost, together with their fringing vegetation.

The Department of Aviation does not believe that the local loss of vegetation is regionally significant as all the associations identified on the site are regionally common. In addition they do not regard the wetland areas as having any special significance as similar examples occur to the north and south.

The Department of Aviation has stated its intention to carry out a detailed botanical survey to verify the range of species at the airport and that this survey will be carried out prior to any development which may affect the natural areas.

4.8.2 Vineyards

Although the vineyard area is to the north of the airport and the site is not affected directly by the proposed development, there is a possibility that engine emissions could have a detrimental effect.

4.8.3 Fauna

As in the case of the flora, the degree of impact on fauna will be determined by which strategy is adopted. Strategies 1 and 3 will have little additional impact. Strategies 2 and 4 will result in the removal of virtually all of the remaining natural habitat on the airport site, including the loss of the wetland fauna. The Department of Aviation recognises that there is some possibility of the existence of the short-necked tortoise (Pseudomydura umbrina) in the wetlands and states that they will carry out a survey to determine this. This study should have been carried out prior to preparation of the draft EIS so that the facts about the possible presence of the short-necked tortoise could have been incorporated. The Department's stated intention to relocate any specimens, if found, is considered to be impactical as it underestimates the amount of stress this is likely to cause and ignores population dynamics. In addition, if the short-necked tortoises are present in this swamp, then the importance of this must not be underestimated as presently they are thought to be confined to only two sites in Upper Swan. Obviously the occurrence of a second totally separate population some distance away should greatly improve the animals' chances of survival, as the risk of their being exterminated in a fire or other such disaster at both locations is therefore less likely.

4.8.4 Summary

Neither the Flora nor Fauna have been adequately described in the draft EIS. Although the Department of Aviation has made an undertaking to carry out a full botanical survey of one of the wetland areas and a study to determine the presence of the short-necked tortoise, it must be pointed

out that these studies should have been carried out prior to preparation of the draft EIS. The possible occurrence of these animals at a second site would be very significant and greatly increase their chances of survival. The importance of this wetland area cannot be fully determined until the necessary studies have been carried out.

Such studies should be carried out at the earliest possible date and results submitted to the DCE and Department of Home Affairs and Environment.

4.8.5 Effects on Groundwater Resources

Although a number of potential pollutants are generated by airport activities, namely hydrocarbons, detergents, solvents and faecal and other liquid wastes, the Department of Aviation believes that it is taking the necessary steps to prevent ground and surface water pollution.

This programme appears to be reasonable and it is likely that no significant impact on groundwater will occur.

4.8.6 Bird Hazard

A fundamental conflict exists between aircraft movements and bird roosting or feeding grounds at airports. The wetland area at the north-east side of the airport site provides significant habitats for many bird species.

If the parallel runway is constructed, the wetland area will be destroyed and the bird hazard problem will be removed.

If works include only extensions to existing runways, then according to the Department of Aviation, some elimination of wetland areas may still be required, to minimise bird hazard.

4.9 Environmental Management

4.9.1 Curfew

Several Australian airports have an operational curfew between the hours of 11 p.m. and 6 a.m. This enables residents near these airports to have the opportunity to have an undisturbed night's sleep. Most major overseas airports also operate on curfew and arrivals and departures at Perth Airport are scheduled to accommodate curfews at other airports both interstate and international.

A limited curfew operates at Perth Airport. Non-noise certificated Australian registered jet aircraft are not permitted to operate at Perth Airport between 11 p.m. and 6 a.m. The imposition of this curfew on non-noise certificated aircraft was made known to the airlines in 1977, and it took effect on 1 January, 1981. The policy was established as a measure to encourage airlines to replace noisy types of aircraft with the modern, noise-certificated types. Department of Aviation believes that the policy has been effective in achieving that objective. Under international agreements established by the International Civil Aviation Organisation, similar restrictions cannot be placed on foreign registered non-noise certificated jet aircraft before 1 January, 1988.

The following jet aircraft are therefore allowed to use Perth Airport throughout the 24 hour period :

1. noise certificated Australian registered jet aircraft;

2. non-noise certificated foreign registered jet aircraft until 1988.

These two categories cover the bulk of passenger aircraft using Perth Airport.

The Department of Aviation, in approving the scheduling of regular night flights, takes into account a number of factors and generally does not approve the operation of unscheduled movements of heavy jet aircraft in the night hours unless extenuating circumstances exist. The factors which have led to the Department of Aviation scheduling night flights at Perth Airport are :

a. ensuring the provision of an adequate and regular service, consistent with the needs of the travelling public;

b. fleet capacity limitations;

c. economic utilisation of the available aircraft;

d. the need to schedule arrivals from Perth, and departures to Perth, outside curfew hours at Adelaide and Sydney Airports.

These criteria do not take into account the comfort of the near-airport residents and it is apparent from the above that Perth residents are being subjected to night flying and are suffering inconvenience, for the benefit of other cities.

A number of submissions from local government and individual submissions from the public have indicated that, unless a development strategy is adopted which reduces noise nuisance in the short term then pressure for a full curfew at Perth Airport will increase.

The Department of Aviation has argued that imposition of a full curfew at Perth would mean the curtailment of a number of flights into Perth, as many scheduled flights come via Perth so that they can adhere to curfews in eastern Australia and Asia.

4.9.2 Ground Running and Training Flights

Ground running, for example from engine testing, and training flights are both noisy activities which are not taken into account either in the derivation of the Noise Exposure Forecasts for Perth Airport or in the limitations of the curfew.

Department of Aviation says in the draft EIS that there are strict limitations on training flight operations at Perth Airport. Training flights are permitted :

Monday to Saturday	7 a.m. - 9 p.m. (local time)
Sundays	12 noon - 9 p.m.

Certain types of training and runway approaches are permitted only for pilot re-licensing purposes and some additional limitations/concessions apply to FK28 training.

Ground running appears to be allowed at most times. The restrictions on ground running are summarised in Table 7 and detailed in Appendix 1. As ground running is a source of considerable annoyance to near airport residents and is not taken into account in the derivation of NEF, this situation is unacceptable. A complete ban on ground running at least between the normal curfew hours of 11 p.m. and 6 a.m. should be introduced and enforced. This period ideally should be extended to after 8 a.m., particularly at weekends. The same restrictions should apply to training flights.

In addition, in assessing noise exposure at airports, noise from ground running, taxi-ing and training flights should be incorporated in the NEF system, particularly for residences close to the airport. Noise levels from these activities should also be measured for incorporation in the derivation of the NEI.

TABLE 7 SUMMARY OF PERMITTED GROUND RUNNING TIMES, CONDITIONS AND PURPOSE AT PERTH AIRPORT

TIME IN HOURS - WEEKDAYS AND SATURDAYS

TYPE OF ENGINE	00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24	Purpose
All ground running	excluded except as below	
Turbine powered	10 mins per operator	a, b, c.
Turbine powered	10 mins/operator low or idle power, in specified areas	a, b, c.
Piston engines	5 mins in specified areas	d.
Aircraft-max takeoff wght < 53000 kg	permission of ATC required (sunrise) — no conditions except at idle speed (sunset) — permission of ATC required	c.
Turbo-jet aircraft	permissable (except 2100 Sat - 0600 Mon. unless approved by Airport Director) i.e. whole period is permissable	e.
Piston engines	as above	e.
SUNDAYS, CHRISTMAS DAY & GOOD FRIDAY		
Aircraft engines - aircraft takeoff weight <53000kg.	at idle speed, with permission of ATC	a, b, c, d, e.
All aircraft engines	10 mins/operator at greater than idle power	a, b, c, d, e.

KEY : ____ length of permitted time
ATC - Air Traffic Controller
a - planned maintenance
b - fault correction
c - compass swinging
d - unscheduled maintenance
e - testing

4.9.3 Noise Abatement Procedures

The Noise Abatement Procedures which can be employed at Perth Airport are detailed in Appendix 1 . There is no doubt that these procedures, if rigidly enforced to minimise noise rather than cost, would result in significant reductions in the general level of noise nuisance in Perth. In practical terms, this would mean that flight paths and runway usage would be selected to minimise noise, not costs, and would be more strictly enforce Although fewer people in number would be severely noise affected these people may be exposed to greater levels of noise. Other people, presently moderately or slightly affected by noise could experience a corresponding reduction in noise.

Noise Abatement Procedures include -

(a) use of preferred runways

(b) use of preferred flight paths

(c) provision of noise abatement climb procedures for departing turbo-jet aircraft

(d) the restriction of aircraft training flights to specified hours

(e) a curfew restriction on all Australian registered turbo-jet aircraft which fail to meet the specified noise abatement criteria.

This list contains no mention of restrictions on ground running, which causes considerable noise and it includes in (d) and (e) reference to activities mean that, in reality, little restriction at all is imposed.

A number of submissions from Local Authorities and individuals complain about 'straying aircraft'. These are aircraft which are not adhering to normal departure or arrival paths and therefore appear to be straying. As the whole Perth metropolitan region is effectively covered by defined paths the Department of Aviation can argue, technically, that these aircraft are not in fact 'straying' but are merely making use of other, allowable approaches.

There is some evidence that aircraft may, at times take short-cuts and move straight to a finals approach position instead of homing in on a beacon first. This manoevre undoubtedly saves some fuel and therefore cost. The strict application of noise abatement measures would enforce a penalty cost on the respective airlines if flying strictly to noise abatement procedures involve a slightly greater flying distance.

On page 207 of the Draft EIS the Department of Aviation states -

"Aircraft subject to noise abatement procedures will be directed in a manner that will avoid sensitive areas."

This could be interpreted to mean that aircraft not bound by the procedures, in particular the curfew aspect (which may be a great many aircraft) will not have to be directed in accordance with the statement. In addition small propellor driven aircraft and helicopters (general aviation) can be very annoying and do not appear to be covered by the procedures.

Noise abatement procedures are developed on the basis of balancing the cost of fuel or aircraft operation against the noise annoyance produced by aircraft. It is possible and indeed may be advisable to construct or

devise a different set of procedures that place greater emphasis on reducing noise annoyance while still saving costs to operators of aircraft. Such procedures could even address curfews.

Given the above-mentioned weaknesses, inadequacies and high level of annoyance now occurring, a re-evaluation of the present procedures would seem to be in order.

4.9.4 Vegetation and Wildlife

The Department of Aviation has made an undertaking in the Draft EIS to take account of areas important from a conservation perspective in their management of the airport, where doing so is consistent with safe and economic operations. They point out that the wetlands may require modifications as the conservation of habitat suitable for bird species which are hazardous to aircraft operations is inconsistent with safe operations.

It is most important that before any action in this area is contemplated, the full significance of the wetland areas, particularly with respect to the short-necked tortoise, should be established. In addition the flora survey of the south-eastern wetland should be carried out.

The area around the north-eastern wetland has been partly exposed to grazing by cattle and horses. Continuation of some light grazing activity in this area is probably desirable as a means of reducing fire risk from grasses.

An alternative means of control of the love-grass at the airport site may need to be found as the grass is encouraged by the burning off practice presently being imposed as a means of control.

5. CONCLUSIONS

5.1 The Draft EIS document is deficient in a number of areas. It is poor editorially and lacks information in a number of areas but particularly on the physical and psychological effects of noise.

5.2 The report is inadequate in its examination of the suitability of the NEF system as an index of noise annoyance.

5.3 The method employed by DoA to estimate the number of noise-affected residences for their cost-benefit analysis is inaccurate, relying as it does on a straight noise count from aerial photographs. This did not take account of multiple dwelling units such as duplexes, triplexes and home units which were taken into account in the local authority determinations.

5.4 The DCE believes that the NEF system is poor and of little use as a long-use planning tool. Part of this deficiency is because the NEF as placed on a map is not a solid line enabling a person to determine that noise levels on one side will be acceptable and on the other side will be unacceptable. Some authorities have stated that the margin of error this introduces into the NEF system is as high as $\pm$ 5 NEF. The DoA has used the NEF as though there is no margin of error.

5.5 The DCE noise study, to date, shows a poor correlation between noise annoyance and NEF. This would also argue against the use of the NEF system as a land-use planning tool.

5.6 The DoA has not taken method of house construction into account in its noise investigations as presented in the draft EIS. House construction has a large influence on the level of noise experienced, as brick houses attenuate noise from passing aircraft better than weatherboard constructed houses. The latter are correspondingly much more expensive to insulate against noise.

RECOMMENDATIONS

The Department believes that a number of additional safeguards can be employed by the Department of Aviation to minimise noise.

1. The DoA should consider the installation of noise attenuation mounds, particularly along the south-western edge of the airport, to minimise noise to residences which are very close at this point. This will become even more important when the new taxi-way is constructed closer to the airport margin at this location.

2. Engine testing should be confined to a specific area and noise deflectors should be installed to minimise interference to near-airport residents. The DoA should examine the possibility of prohibiting all engine testing during normal curfew hours (11 p.m. - 6 a.m.) and preferably until 7 a.m.

3. Noise abatement procedures should be redrafted so that the minimisation of noise is the prime objective. Procedures to save fuel costs should not in any way compromise the prime objective.

4. Because of the shortcomings in the NEF system as a predictor of noise annoyance (described in the text) :

   4.1 Studies should be carried out to more accurately describe and predict noise annoyance.

   4.2 Noise standards considered tolerable in other places within and outside Australia should not be imposed on Perth.

   4.3 Decisions need to be made, by Perth communities as to the levels of noise (noise standards) which are acceptable. Night flights need to be taken into account.

   4.4 The current practice of using the NEF system as a land use planning tool contains deficiencies. A more appropriate system should be investigated and adopted.

5. The application of a curfew at Perth Airport should remain as one of the options for future planning.

6. The Department of Aviation in conjunction with the State Department of Conservation and Environment should monitor noise exposure levels in various locations. The study should be designed to verify the NEI/NEF and should take account of seasonal factors and trends. Monitoring should identify single "noisy" aircraft that are not conforming to the theoretical noise output for that type of aircraft.

7. Wetland areas should be examined for rare or endangered species before earthworks are commenced.

8. A management plan, broadly following recommendation M52 in the System 6 Green Book, should be devised in consultation with DCE.

REFERENCES

Australian Academy of Science, 1976, Report of a Committee on the Problem of Noise. 101pp.

Borsky, P.N., 1971, Noise as Perceived by the Community. in Conference on Aircraft and the Environment, Washington D.C Feb 8-10, 1971, p.11-20.

Brisbane Airport Environmental Study Committee, 1977, Brisbane Airport Development Project Environmental Study, Volumes Australian Government Publishing Service.

Cohen, A., 1971, Airport Noise, Sonic Booms and Public Health: in Conference on Aircraft and the Environment, Washington D.(Feb 8-10, 1971, p. 42-55.

Commonwealth Department of Aviation, 1982, Perth Airport Provisional Master Plan incorporating a Draft Environmenta Impact Statement: Australian Government Publishing Service Canberra, 224pp.

Commonwealth Department of Home Affairs and Environment/EPA of Victoria, 1981, Costs and Benefits of Environment Protection: Australian Government Publishing Service, 1981 285pp.

Hede, A., Bullen, R., and Rose, J.A., 1979, A Social Study of the nature of subjective reaction to aircraft noise: National Acoustic Laboratory Report No. 79, Australian Government Publishing Service, 1979, 29pp.

Hede, A., and Bullen, R., 1982, Aircraft Noise in Australia: a surve of community reaction. Australian Government Publishing Service for National Acoustic Laboratory, Canberra, 236pp.

Parliament of the Commonwealth of Australia, 1970, Report from the House of Representatives Select Committee on Aircraft Noise, October, 1970: Parliamentary Paper No. 236, 96pp.

Segal, L., and Clark, N., 1981, Techniques for placing monetary values on Environmental Damage: in Costs and Benefits of Environmental Protection (ibid).

GLOSSARY

dB decibel, the unit of sound level measurement

dB(A) decibel value on the 'A' scale, a weighted dB scale derived to take account of the fact that the human ear is more sensitive to some sound frequencies than to others.

EPNL Effective Perceived Noise Level. Derived using very complex methods for determining frequency spectrum characteristics.

ILS Instrument Landing Systems

L_{eq} equivalent continuous sound level pressure

L_{dn} 'day-night' L_{eq} with a 10dB(A) penalty between the hours of 2200 and 0700

L_{10} the level exceeded for 10% of that time

L_{50} the level exceeded for 50% of that time

L_{90} the level exceeded for 90% of that time

NAL National Acoustic Laboratory

NEC Noise Exposure Concept (see p. 41)

NEF Noise Exposure Forecast (see p. 39)

NEI Noise Exposure Index (see p. 41)

SID Standard Instrument Departure path

APPENDIX 1

DETAILS OF NOISE ABATEMENT PROCEDURES AND GROUND RUNNING CONDITIONS AT PERTH AIRPORT

Extract from Department of Aviation Aeronautical Information Publication - Terminal Area Procedures, September, 1982 :

NOISE ABATEMENT PROCEDURES

1. APPLICATION

1.1 Noise Abatement procedures have been produced for locations which have noise sensitive areas, and shall normally apply to all jet aircraft and other aircraft having an MTOW exceeding 5,700 kg. (12,500 lb).

1.2 In applying noise abatement procedures, ATC will nominate a preferred runway appropriate to the operation, and aircraft will be required to conform with the resultant traffic pattern. Noise abatement will not be a determining factor in runway nomination under the following circumstances :

a. in conditions of low cloud, thunderstorms and/or poor visibility;

b. for runway conditions that are completely dry :

i. when the crosswind component, including gusts, exceeds 15 knots;

ii. when the downwind component, including gusts, exceeds 5 knots;

c. for runway conditions that are not completely dry :

i. when the crosswind component, including gusts, exceeds 10 knots;

ii. when there is any downwind component, including gusts;

d. when wind shear has been reported;

e. when, in the opinion of the pilot in command, safety would be prejudiced by runway conditions or any other operational consideration.

1.3 Preferred flight paths for arriving and departing aircraft are depicted for particular locations and for departing aircraft they may be in the form of a Standard Instrument Departure. The requirement to follow these flight paths shall be subject to a specific ATC clearance or instruction.

1.4 The requirement to follow a preferred flight path for the purpose of noise abatement may be varied by ATC for operational reasons, e.g. weather, traffic complexity.

1.5 On the runways listed at para 1.6 below, departing turbojet aircraft subject to noise abatement procedures will, unless required to do otherwise in accordance with a SID or specific ATC instruction :

a. climb straight ahead with take-off engine power maintained to a height above aerodrome level of :

i. 800 feet for domestic aircraft;

ii. 1500 feet for international aircraft;

b. maintain a speed range of V2 + 10 knots minimum to V2 + 20 knots maximum - or body angle limit speed - to a height above the aerodrome of :

i. 2500 feet for domestic aircraft;

ii. 3000 feet for international aircraft.

1.6 Noise abatement climb procedures are required for operations by jet aircraft from the following locations and runways :

Adelaide	:	Runway 05, 12, 30.
Brisbane	:	Runway 22.
Cairns	:	Runway 15.
Launceston	:	Runway 32.
Melbourne	:	Runway 09, 16.
Perth	:	Runway 20, 24.
Sydney	:	Runway 07, 25, 16, 34.

NOTE : This does not preclude the application of these procedures to other locations and runways.

1.7 Arriving aircraft subject to noise abatement procedures will be directed in a manner that will avoid noise sensitive areas, and approaches will be planned to preferred runways. Pilots are not to make approaches to land below the visual or electronic glide paths for the runway in use.

2. CURFEWS

2.1 The curfew prohibits specified categories of aircraft from operating at selected airports during specified times for the purpose of reducing annoyance to persons living near flight paths during the sensitive sleeping hours. It is an integral part of the Government's noise abatement policy. The conditions of the curfew are listed below.

2.2 Turbo-jet aircraft shall not operate at Adelaide, Avalon, Brisbane, Essendon and Sydney airports during curfew hours. Additionally, effective 1 January, 1981, Australian registered turbo-jet aircraft shall not operate at Melbourne or Perth airports during curfew hours unless they are of a type which is noise certificated under the applicable standards specified in I.C.A.O. Annex 16.

The curfew hours are published in this document as part of the noise abatement procedures for the individual airports.

2.2.1 An aircraft bound for a curfewed airport shall depart only if the estimated time of arrival will be at, or before, the start of the curfew, however, if the aircraft is subsequently delayed en-route by unforecast headwinds, thunderstorms, operational conditions, traffic, etc. it may continue and land.

2.2.2 An aircraft shall not depart from a curfewed airport unless air traffic control has been advised that the aircraft doors are closed, or the aircraft has requested a push back or taxi clearance at, or before, the start of the curfew.

2.2.3 The curfew does not apply to an aircraft when operational safety is involved or when it is engaged upon a flight for urgent medical, flood or fire relief purposes, to an evacuation flight undertaken to save some person from grave or imminent danger or to an in-flight medical emergency.

2.2.4 Except for Essendon, all curfewed airports may be nominated and used as planned or unplanned alternatives. However, an aircraft diverting to a curfewed airport may not land during the curfew if it has sufficient fuel to hold until the end of the curfew. Once it has landed at a curfewed airport, a diverted aircraft shall not depart again during the curfew.

2.3 Dispensation from the conditions of the curfew require the approval of the Minister for Transport. The Minister may, at his discretion, approve operations in the following situations :

a. when exceptional passenger hardship is involved;

b. for humanitarian reasons;

c. for delayed flights by visiting Heads of State;

d. when the aircraft involved is assessed by the Department of Transport as a "low noise" aircraft.

In these circumstances operators of turbo-jet aircraft requesting dispensation from conditions of the curfew should make application, with supporting evidence, in sufficient time before the start of the curfew to allow consideration to be given to the request. The names and telephone numbers of officers to whom requests for dispensation should be submitted in the first instance, are held at each operational control centre.

NOISE ABATEMENT PROCEDURES

PERTH

1. PREFERRED RUNWAYS

1.1 Landing — Equal 1 - Runways 24 and 20
2 - Runway 02
3 - Runway 06

Take-off — 1 - Runway 20
Equal 2 - Runway 02 and 06
3 - Runway 24.

2. PREFERRED FLIGHT PATHS

2.1 Arriving Aircraft

a. Landing Runway 24

From the east - 30 NM to Parkerville Locator for straight-in approach.

b. Landing Runway 20

From the east - 30 NM via Parkerville Locator to intercept final approach at 6 NM.

From the west and north-west - 30 NM to intercept final approach at 6 NM.

c. Landing Runway 02

From the east - 30 NM to intercept final approach at 5 NM.

From the west and north-west - via Perth NDB to intercept final approach at 5 NM.

NOTE : Radar vectoring, when available, is provided.

2.2 Departing Aircraft

All runways - IFR category aircraft will be instructed by ATC to track via Standard Instrument Departure procedures.

3. TRAINING FLIGHTS

See AIP/ERS-SAP.

4. CURFEW

4.1 Effective 1 January, 1981, Australian registered turbo-jet aircraft shall not operate at Perth Airport between 1500 and 2200 GMT unless they are of a type which is noise certificated under the applicable standards specified in ICAO Annex 16, or the conditions laid down in TMA-4-2, sub-section 2 apply.

GROUND RUNNING CONDITIONS AT PERTH AIRPORT

1. ground running of aircraft engines within the airport is prohibited between 2100 hours on any day and 0500 hours the following day except as specifically provided for by sub-paragraphs (a) to (c).

a. engines of turbine-powered aircraft may be ground run during the above period for purposes of planned maintenance, fault correction and compass swinging for a period in the case of each operator not exceeding 10 minutes between 2100 hours and 2300 hours

(i) in the text pad adjacent to taxiway H5 or taxiway E2 (for aircraft having a maximum take-off weight not exceeding 5,700 kg)

(ii) in the test pad adjacent to taxiway E2 or taxiway H5 observing a heading of between 180 degrees and 320 degrees (for aircraft with a maximum take-off weight of greater than 5700 kg and less than 32,000kg).

(iii) on taxiway B2 between the apron and the 11/29 runway or on a taxiway allocated by Air Traffic Control (for aircraft with a maximum take-off weight of over 32,000 kg) - blast to be away from terminal area (Trial position : 11/29 runway, 500 m east of centreline of 02/20 runway).

b. Aircraft engines of turbine-powered aircraft may be ground run for the purposes of planned maintenance, fault correction or compass swinging at low or idle power for not more than 10 minutes in the case of each operation, between 2300 hours and 0500 hours in the areas specified in sub-paragraph (2).

c. engines of piston-engined aircraft may be ground run if required by an operational exigency (unscheduled maintenance) for not more than 5 minutes between 2300 hours and 0500 hours in specified areas.

2. Engines of aircraft with a maximum take-off weight not exceeding 53,000 kg may be ground run at not more than

idle speed for the purpose of compass swinging at any time, except between sunset and sunrise on any day and on Sunday, Christmas Day and Good Friday unless with the permission of Air Traffic Control.

3. Turbo-jet aircraft may be ground run for the purpose of testing in the Hawker de Havilland engine test cell at any time except between 2100 hours Saturday and 0600 on the following Monday, unless with the approval of the Airport Director.

4. Piston engines may be ground run for the purposes of testing in a test track at the concrete test pad adjacent to taxiway H at any time except between 2100 hours local time on Saturday and 0600 on the following Monday, unless with the approval of the Airport Director.

5. Aircraft engines may be ground run on Sundays, Christmas Day and Good Friday between 0500 and 2300 hours for a period not exceeding 10 minutes per operator on each day at greater than idle power.