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Flinders Island Aerodrome

New Runway Siting Study Report

Flinders Council

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Document prepared by:

Aurecon Australasia Pty Ltd

ABN 54 005 139 873

Aurecon Centre
Level 8, 850 Collins Street
Docklands VIC 3008

PO Box 23061
Docklands VIC 8012
Australia

T +61 3 9975 3000
F +61 3 9975 3444
E melbourne@aurecongroup.com
W aurecongroup.com

In conjunction with:

Airport Survey Consultants Pty Ltd

ABN

PO Box 306
Chirnside Park VIC 3116
Australia

T +61 3 5962 4440
F +61 3 5962 4440
E paul@airportsurveys.com.au
W airportsurveys.com

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Author signature	SRO	Approver signature	MDG
Name	Simon Oakley	Name	Matt Glenn
Title	Associate – Airports	Title	Technical Director – Airports

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Executive Summary

The existing 14/32 Runway at Flinders Island Aerodrome is currently exhibiting signs of distress under the existing aircraft traffic loading, with a range of pavement defects occurring. Consequently, the requirement for regular preventative pavement maintenance to ensure the runway is safe and serviceable for aircraft operations has resulted in disruptions to aircraft operations (during the preventative pavement maintenance works) and is an ongoing cost for Flinders Council.

The *Flinders Island Airport Master Plan 2012* states that the construction of a new runway was identified as an opportunity to address the weaknesses within the existing runways, where those weaknesses were identified as:

- Runway orientation not ideal (prevailing wind direction from the west / south-west);
- Runway obstacles (hills/mountains to the north, east and south);
- Length of the 05/23 Runway only 1070m; and
- Existing runway pavement strength only Pavement Classification Number (PCN) 7.

The *Flinders Island Airport Master Plan 2012* recommended that in relation to a new runway, the existing runway and taxiway pavements be upgraded and that the requirement for upgrade be reviewed again in 5 years times as part of the Master Plan review.

In May 2012, Aurecon Australasia Pty Ltd (Aurecon) was commissioned by Flinders Council to undertake Falling Weight Deflectometer (FWD) testing and a Geotechnical Investigation for the 14/32 Runway, 05/23 Runway, Taxiway A and the RPT Apron at Flinders Island Aerodrome.

Subsequent to the FWD testing and Geotechnical Investigation, an *Existing Pavement Strength Analysis Report (Revision 1)* dated 2 October 2012 was prepared by Aurecon detailing the existing pavement composition and strength, pavement material characteristics and pavement upgrade recommendations.

It is noted in the *Existing Pavement Strength Analysis Report*, that the existing 14/32 Runway pavement strength is inadequate for existing aircraft traffic loads. The existing 14/32 Runway pavement strength is therefore also a limiting factor in attracting operators of larger aircraft to Flinders Island Aerodrome, which results in a potential loss of economic growth.

The *Existing Pavement Strength Analysis Report* identified that the lowest risk option (in terms of allowing a range of aircraft at particular weights and tyre pressures, minimising the disruption to existing aircraft operations, reducing the requirement for preventative pavement maintenance and maintaining safe and serviceable pavements) into the long term (greater than 20 years) was to investigate, plan, design and construct a new runway, west of the existing 14/32 Runway and reconstruct the existing Taxiway A and the RPT Apron pavements.

Maintaining the operation of the 14/32 Runway into the medium to long term (greater than 10 years) at Flinders Island Aerodrome presents a range of risks to Flinders Council, including the following:

1. The existing pavement strength of the 14/32 Runway and 05/23 Runway will not support aircraft larger than 7,500kg;
2. Ongoing pavement failures on the existing 14/32 Runway will continue and are likely to increase in frequency, requiring regular preventative pavement maintenance to ensure the runway is safe and serviceable;

3. Ongoing costs (with likelihood to increase) associated with the regular preventative pavement maintenance of the existing 14/32 Runway;
4. High likelihood of disruption to existing aerodrome operations during ongoing regular preventative pavement maintenance activities on the 14/32 Runway;
5. Lack of flexibility to cater for changes to the existing aircraft fleet which currently service Flinders Island;
6. Restrict the ability to cater for a range of current or future aircraft or operators, which impacts destination reach, passenger and freight capacity, and economic growth; and
7. Poor provision for future increase in airside capacity and development.

Due to the likely extended disruption to existing aircraft operations during construction, it is not considered appropriate to reconstruct or overlay the existing 14/32 Runway, Taxiway and RPT Apron pavements at Flinders Island Aerodrome to improve pavement strength. In order for these works to occur, it is anticipated that the 14/32 Runway would be closed to aircraft operations for a minimum of 6 months.

Aurecon was commissioned by Flinders Council to undertake a New Runway Siting Study Report in June 2014, which is a desk top study that includes preliminary layout design, a bulk earthworks estimate and indicative budget cost estimates for a potential new runway, as well as an assessment of the airspace and potential runway length and orientation (alignment) to cater for aircraft of up to Code 3C.

It is recommended that should a potential new Code 3C, instrument non-precision approach runway (11/29 Runway) be constructed (Traffic Scenario C, Option 1), that the location and orientation (alignment) detailed herein be adopted, based on consideration of the range of existing preliminary information and data available, and other key criteria detailed in **Section 3**.

A range of potential runway locations and orientations (alignments) were investigated in the option optimisation process which resulted in two preferred options. The majority of potential options were not investigated in detail due to the resulting encroachment of existing topography with the approach and departure paths.

The runway orientation option of providing a potential new runway on the same alignment as the existing 14/32 Runway, offset 93m to the west, and converting the existing 14/32 Runway into a parallel Code C taxiway was also investigated. This option was not investigated in detail due to the following:

a. The predominant winds do not favour the existing 14/32 Runway alignment;
b. The environmental impact was much more significant;
c. The extent of land acquisition was much more significant;
d. The extent of bulk earthworks was much more significant; and
e. The existing 14/32 Runway pavement strength would still need to be upgraded in order to serve as a taxiway.

The indicative budget costs for construction of a potential new 11/29 Runway range between $19.6M to $20.5M.

A potential new 11/29 Runway would provide Flinders Island with a future proofed asset which would provide no significant restrictions to a range of aircraft and operators travelling between Flinders Island and southern Australian capital cities and regional centres. A potential new 11/29 Runway would therefore provide greater passenger and freight capacity and contribute significantly to economic growth on Flinders Island.

The option of maintaining existing conditions into the future is a realistic possibility in the short to medium term with a comprehensive regular pavement monitoring and pavement maintenance regime to ensure that there are no aircraft safety issues and the 14/32 Runway is not rendered unserviceable.

However the extent of preventative maintenance, capital expenditure and the medium to long term effect of pavement overload damage is difficult to quantify. Based on the extent of recent in-situ stabilised patching works that were undertaken on the 14/32 Runway (March/April 2015), combined with the observed existing condition of the base course material and wearing course, it is considered that any preventative pavement maintenance regime implemented in order to maintain a safe and serviceable pavement would need to be extensive and diligently maintained.

Under a preventative pavement maintenance regime, the worst case scenario would be that the 14/32 Runway would be rendered unserviceable for aircraft operations (based on a visual inspection) and the 14/32 Runway would need to be closed for a period of time.

In this circumstance, Flinders Council would need to react quickly to undertake whatever maintenance work is necessary for the 14/32 Runway to be operational again, at whatever cost during an unknown timeframe.

For such a regime to be functional and effective, Flinders Council need to understand and accept the risks, ensure maintenance budgets are flexible, ensure maintenance staff are well equipped and have adequate materials, and ensure that stakeholders (such as Sharp Airlines, Royal Flying Doctor Service, community etc.) are informed of the potential risks (i.e. delays to services) and why the regime is necessary.

1 Introduction

1.1 Background

The existing 14/32 Runway at Flinders Island Aerodrome is currently exhibiting signs of distress under the existing aircraft traffic loading, with a range of pavement defects occurring. Consequently, the requirement for regular preventative pavement maintenance to ensure the runway is safe and serviceable for aircraft operations has resulted in disruptions to aircraft operations (during the preventative pavement maintenance works) and is an ongoing cost for Flinders Council.

The *Flinders Island Airport Master Plan 2012* states that the construction of a new runway was identified as an opportunity to address the weaknesses within the existing runways, where those weaknesses were identified as:

- Runway orientation not ideal (prevailing wind direction from the west / south-west);
- Runway obstacles (hills/mountains to the north, east and south);
- Length of the 05/23 Runway only 1070m; and
- Existing runway pavement strength only Pavement Classification Number (PCN) 7.

The *Flinders Island Airport Master Plan 2012* recommended that in relation to a new runway, the existing runway and taxiway pavements be upgraded and that the requirement for upgrade be reviewed again in 5 years times as part of the Master Plan review.

In May 2012, Aurecon was commissioned by Flinders Council to undertake FWD testing and a Geotechnical Investigation for the 14/32 Runway, 05/23 Runway, Taxiway A and the RPT Apron at Flinders Island Aerodrome.

Subsequent to the FWD testing and Geotechnical Investigation, an *Existing Pavement Strength Analysis Report (Revision 1)* dated 2 October 2012 was prepared by Aurecon detailing the existing pavement composition and strength, pavement material characteristics and pavement upgrade recommendations.

It is noted in the *Existing Pavement Strength Analysis Report*, that the existing 14/32 Runway pavement strength is inadequate for existing aircraft traffic loads. The existing 14/32 Runway pavement strength is therefore also a limiting factor in attracting operators of larger aircraft to Flinders Island Aerodrome, which results in a potential loss of economic growth.

The *Existing Pavement Strength Analysis Report* identified that the lowest risk option (in terms of allowing a range of aircraft at particular weights and tyre pressures, minimising the disruption to existing aircraft operations, reducing the requirement for preventative pavement maintenance and maintaining safe and serviceable pavements) into the long term (greater than 20 years) was to investigate, plan, design and construct a new Runway, west of the existing 14/32 Runway and reconstruct the existing Taxiway A and the RPT Apron pavements.

Aurecon was commissioned by Flinders Council to undertake a New Runway Siting Study Report in June 2014, which is a desk top study that includes preliminary layout design, a bulk earthworks estimate and indicative budget cost estimates for a potential new runway, as well as an assessment of the airspace and potential runway length and orientation (alignment) to cater for aircraft of up to Code 3C.

1.2 Flinders Island Airport Master Plan 2012

The *Flinders Island Airport Master Plan 2012* states that the construction of a new runway was identified as an opportunity to address the weaknesses within the existing runways, where those weaknesses were identified as:

- Runway orientation not ideal (prevailing wind direction from the west / south-west);
- Runway obstacles (hills/mountains to the north, east and south);
- Length of the 05/23 Runway only 1070m; and
- Existing runway pavement strength only Pavement Classification Number (PCN) 7.

It was concluded within the *Flinders Island Airport Master Plan 2012* that a new runway could not be justified in the life of the Master Plan (20 years) for the following reasons:

- Construction cost (indicative costs are in the order of $9-$18 million);
- Land acquisition costs to construct to the north-west;
- Potential impact on low density residential area to the south-east of the airport; and
- The existing runways are operationally suitable for the current and the 20 year forecast aircraft movements, with reconstruction requirements to improve the pavement strength.

The *Flinders Island Airport Master Plan 2012* recommended that in relation to a new runway, the existing runway and taxiway pavements be upgraded and that the requirement for upgrade be reviewed again in 5 years times as part of the Master Plan review.

Since that time, the existing 14/32 Runway at Flinders Island Aerodrome is currently exhibiting signs of distress under the existing aircraft traffic loading, with a range of pavement defects occurring. Consequently, the requirement for regular preventative pavement maintenance to ensure the runway is safe and serviceable for aircraft operations has resulted in disruptions to aircraft operations (during the preventative pavement maintenance works) and is an ongoing cost for Flinders Council.

Due to the likely extended disruption to existing aircraft operations during construction, it is not considered appropriate to reconstruct or overlay the existing 14/32 Runway, Taxiway and RPT Apron pavements at Flinders Island Aerodrome to improve pavement strength. In order for these works to occur, it is anticipated that the 14/32 Runway would be closed to aircraft operations for a minimum of 6 months.

1.3 Project Drivers

The New Runway Siting Study Report is necessary due to the following:

1. The existing pavement strength of the 14/32 Runway and 05/23 Runway will not support aircraft larger than 7,500kg;
2. Ongoing pavement failures on the existing 14/32 Runway under existing aircraft traffic will continue and are likely to increase in frequency, requiring regular preventative pavement maintenance to ensure the runway is safe and serviceable;
3. Ongoing costs (with likelihood to increase) associated with the regular preventative pavement maintenance of the existing 14/32 Runway;
4. High likelihood of disruption to existing aerodrome operations during ongoing regular preventative pavement maintenance activities on the 14/32 Runway;

5. Inability for the existing 14/32 Runway pavement to be upgraded in strength without extended disruption to existing aircraft operations during construction (it is anticipated that the 14/32 Runway would be closed to aircraft operations for a minimum of 6 months), and the existing 05/23 Runway can only be used as an alternative during daylight hours and when weather conditions permit;
6. The existing pavement strength of the 14/32 Runway provides a lack of flexibility to cater for changes to the existing aircraft fleet which currently service Flinders Island; and
7. The existing pavement strength of the 14/32 Runway restricts the ability to cater for a range of current or future aircraft or operators, which impacts destination reach, passenger and freight capacity, and economic growth.

1.4 Scope

The objectives of this New Runway Siting Study Report are to:

a. Provide Flinders Council with general information on the appropriateness of the existing Flinders Island Aerodrome site (including access, aerodrome operations, geotechnical and environmental) to accommodate the potential new runway;
b. Provide Flinders Council with runway length and orientation (alignment) requirements for a range of aircraft travelling from Australia interstate capital cities and regional centres to Flinders Island Aerodrome;
c. Provide Flinders Council with an overall preliminary plan layout for the potential new runway, based on Code 3C aircraft operations (medium to long term);
d. Provide Flinders Council with the basic airspace management requirements (i.e. flight paths) for the potential new runway location and orientation including the provision of information on critical planning issues such as natural or manmade obstacles;
e. Provide Flinders Council with information on the anticipated noise impact of the potential new runway on Whitemark and nearby residential properties for the anticipated aircraft traffic;
f. Review the potential new runway alignment and ascertain if it meets general aerodrome safety requirements, including those related to the prevailing winds, topography (Obstacle Limitation Surface), airspace management, aircraft performance, aircraft weights and environmental conditions;
g. Provide Flinders Council with preliminary earthwork quantities and indicative engineering budget estimates for the construction of the potential new runway (+/- 30% accuracy); and
h. Provide Flinders Council with an indicative construction program.

1.5 Report Structure

The New Runway Siting Study Report is structured as follows:

- **Section 1 – Introduction**
- **Section 2 – Basis for Planning**

  This section provides background information regarding the legislation and rules by which the planning, construction and maintenance of physical infrastructure at aerodromes is governed in Australia to provide context regarding the information presented within the New Runway Siting Study Report.

- **Section 3 – Aerodrome Site Selection and Runway Orientation**

  This section provides existing site information and data and provides details of the major criteria considered when completing the options optimisation in order to determine the runways physical characteristics and the resulting preferred runway options (alignment and orientation).

- **Section 4 – Aerodrome Infrastructure Requirements**

  This section provides details of the potential runways physical characteristics (i.e. concept pavement design options) as well as the anticipated airside infrastructure required to support the potential new runway.

- **Section 5 – Concept Design Options**

  This section provides a summary of the advantages and disadvantages of the potential new runways physical characteristics based on a range of aircraft traffic scenarios.

- **Section 6 – Semi-Quantitative Multi-Criteria Assessment**

  This section provides a summary the semi-quantitative multi-criteria assessment (non-financial) in order to positively prioritise the opportunities and options.

- **Section 7 – Indicative Budget Cost Estimates**

  This section provides a summary of the indicative budget costs for the potential new runway options, including assumptions and exclusions.

- **Section 8 – Indicative Construction Program**

  This section provides a summary of typical project delivery methods and an indicative project program for the potential new runway development.

- **Section 9 – Conclusions and Recommendations**

1.6 References

The following references have been used in undertaking this New Runway Siting Study Report.

1. Civil Aviation Safety Authority (CASA)
   "Manual of Standards (MOS) Part 139 – Aerodromes"
   Version 1.12 – November 2015

2. CASA – Civil Aviation Order (CAO)
   CAO 20.7.1B – Aeroplane Weight and Performance Limitations – Specified Aeroplanes above 5,700kg – All Operations (Turbine and Piston Engined)
   10 June 2005

3. CASA – Civil Aviation Advisory Publications (CAAPs) – various

4. CASA – Advisory Circulars (ACs) – various

5. International Civil Aviation Organisation (ICAO)
   Annex 14 to the Convention on International Aviation
   Volume I - "Aerodrome Design and Operations"
   Fourth Edition, July 2004 (including Amendments 7, 8 and 9)
   Aerodrome Design Manual Part 1 – Runways
   Aerodrome Design Manual Part 2 – Taxiways, Aprons and Holding Bays
   Aerodrome Design Manual Part 3 – Pavements
   Aerodrome Design Manual Part 4 – Visual Aids

Aerodrome Design Manual Part 5 – Electrical Systems
Airport Services Manual Part 9 – Airport Maintenance Practices
Aerodrome Planning Manual Part 1 – Master Planning

6. International Air Transport Association (IATA)
"Airport Development Reference Manual"
9th Edition, January 2004

7. Federal Aviation Administration (FAA)
Advisory Circulars – various

8. Relevant Australian Standards

9. Australian Airport Association (AAA)
"Australia's Regional Airports – Facts, Myths & Challenges"
November 2012

10. Aurecon Australia Pty Ltd
"Flinders Island Aerodrome – Existing Pavement Strength Analysis"
Revision 1, 2 October 2012

11. Mineral Resources Tasmania – Department of State Growth
Geology of Northeast Tasmania — Reference AGD 66/AMG Zone 55
www.mrt.tas.gov.au
May 2015

12. Tasmanian Government – Department of Primary Industries, Parks, Water and Environment
www.thelist.tas.gov.au
May 2015

13. Kneebush Planning Pty Ltd in association with Airports Plus Pty Ltd
"Flinders Island Airport Master Plan 2012"
Version 4.0, 2 May 2012

2 Basis for Planning

2.1 Regulatory Requirements

The Civil Aviation Safety Authority (CASA) has been established by the Commonwealth Government and, through powers vested by the Civil Aviation Act 1988, made responsible for the safety regulation of civil aviation in Australia and of Australian registered aircraft operating overseas.

CASA administers the Civil Aviation Act 1988 through the Civil Aviation Safety Regulations (CASRs) and the Manual of Standards (MOS) – the CASRs establishing the broader regulatory framework and the MOS setting out the specifications or standards that CASA deems should be uniformly applied to ensure the "safety of air navigation".

CASA has developed, or is in the process of developing, parts of the MOS which have specific application to the design and operation of aerodromes, the airworthiness and operation of aircraft, the design of airspace and the provision of air traffic control services.

The relevant CASRs and parts of the MOS, whether formally adopted or made available by CASA as a consultation draft, have been considered in this study. Where a CASR or part of the MOS is in draft form the current legislation and standards are found in various documents including the Civil Aviation Regulations, Civil Aviation Orders and the Aeronautical Information Publication. These have been cross checked as necessary to ensure compliance with both current and possible future regulatory requirements.

One of the major aspects of the CASRs and MOS is to ensure that:

1. Aerodromes are planned, constructed and operated in a manner that minimises risk to aircraft operations; and
2. Aerodrome infrastructure is adequately planned, constructed and maintained to preserve the operational capability of the aerodrome.

2.2 Planning Criteria

The planning criteria for aerodrome development may be categorised into a three-tiered structure as follows:

- International standards and recommended practices (International Civil Aviation Organisation [ICAO]);
- National standards and advisory publications (CASA); and
- Local standards and practices.

The international standards and recommended practices are formalised in Annex 14 to the Convention on International Civil Aviation adopted by the ICAO under the provisions of the Convention. In addition, ICAO publishes a number of Aerodrome Design Manuals and Airport Services Manuals.

National standards and advisory publications are published by the Australian CASA which administers the Civil Aviation Act 1988 through the CASRs and the MOS.

The Manual of Standards Part 139 – Aerodromes (MOS Part 139) is a CASA policy manual, made in pursuant to CASR Part 139. CASR Part 139 sets out the regulatory regime of aerodromes used by aeroplanes conducting Regular Public Transport (RPT) operations. The regulatory regime provides for aerodromes to be certified or registered.

MOS Part 139 sets out the standards and operating procedures for certified and registered aerodromes, as well as for other aerodromes used for RPT operations.

2.3 Aerodrome Reference Code

The planning and design of various aerodrome facilities is controlled by mandatory standards based on the selected Aerodrome Reference Code for each particular aerodrome. The intent of the Aerodrome Reference Code is to provide a simple method for inter-relating the numerous specifications concerning the characteristics of aerodromes so as to provide a series of aerodrome facilities that are suitable for the aeroplanes that are intended to operate at the aerodrome.

The code is composed of two elements that are related to the aeroplanes performance characteristics and dimensions. Element 1 is a number based on the aeroplanes reference field length. Element 2 is a letter based on the aeroplane wing span and outer main gear wheel span.

For taxiway and apron works, the various geometric standards are controlled by Code Element 2. The code letter for Element 2 is determined from **Table 1**, Column 3, by selecting the code letter which corresponds to the greatest wing span, or the greatest outer main gear wheel span, whichever gives the more demanding code letter of the aeroplanes for which the facility is intended. For instance, if code letter C corresponds to the aeroplanes with the greatest wing span and code letter D corresponds to the aeroplanes with the greatest outer main gear wheel span, the code letter selected would be “D”.

The Aerodrome Reference Codes for various aircraft are shown in **Table 1**.

Table 1 | Aerodrome Reference Codes (Source: MOS Part 139)

Code Element 1		Code Element 2		
Code Number	**Aeroplane Reference Field Length**	**Code Letter**	**Wing Span**	**Outer Main Gear Wheel Span [(a)]**
(1)	**(2)**	**(3)**	**(4)**	**(5)**
1	Less than 800 m	A	Up to but not including 15 m	Up to but not including 4.5 m
2	800 m up to but not including 1,200 m	B	15m up to but not including 24 m	4.5 m up to but not including 6 m
3	1,200 m up to but not including 1,800 m	C	24 m up to but not including 36 m	6 m up to but not including 9 m
4	1,800 m and over	D	36 m up to but not including 52 m	9 m up to but not including 14 m
		E	52 m up to but not including 65 m	9 m up to but not including 14 m
		F	65 m up to but not including 80 m	14 m up to but not including 16 m
(a) Distance between the outside edges of the main gear wheels.				

2.4 Standard for Flinders Island Aerodrome

The existing 14/32 Runway currently accommodates aircraft of up to and including Aerodrome Reference **Code 3C**.

The appropriate planning standard (Aerodrome Reference Code) for the potential new runway is **Code 3C** to accommodate the anticipated medium to long term aircraft operations (Refer to **Section 3.3.3** for further details), which is consistent with the recommendations of the *Flinders Island Airport Master Plan 2012*.

Table 2 provides relevant information on the forecast design aircraft applicable to Flinders Island Aerodrome.

Table 2 | Aircraft Identification Guide

Designator	Code	ARFL (m)	Wingspan (m)	Length (m)	OMGWS (m)	MTOW (kg)	Approx. Passengers
BE20	1B	<1,200	16.6	13.4	5.23	5,670	8
ATR 42-200	2C	1,010	24.6	22.7	4.9	16,150	42
DHC8-200/300	2C	1,122	27.4	25.7	8.5	18,642	45
Metro 23	3B	1,341	17.4	18.1	5.4	7,484	19
SF340	3C	1,220	21.4	19.7	7.5	12,370	38
ATR 72-500	3C	1,333	27.05	27.17	4.1	22,800	64
F50	3C	1,760	29.0	25.2	8.0	20,820	45
DHC8-400*	3D*	1,354	28.4	32.8	9.6	29,000	78

***Bombardier Dash 8-400 (DHC8-400 or DHC8D) is theoretically a Code 3D aircraft however, there is a CASA ruling that states that it may be classified as **Code 3C** for planning and design purposes

2.5 Geometric Design Criteria

Table 3 indicates the geometric design requirements for Code 3C Runways.

Table 3 | Code 3C Runway Design Standards (Source: MOS Part 139)

Facility	Item	Code 3C Requirements
Runway	Runway Width	30m
	Longitudinal Slope (overall)	1% max
	Longitudinal Slope (any portion)	1.5% max
	Longitudinal Slope Change	1.5% max
	Rate of Change of Longitudinal Slope	0.2% per 30m
	Runway Sight Distance	3m to 3m over half runway length 3m to ground over 600m
	Transverse Slope	1.0% min 1.5% preferred 2.0% max
Runway Shoulders	Shoulder Width	N/A
	Transverse Slope	2.5% max (down)
Runway Strip	Runway Strip Length	60m beyond Runway End
	Graded Runway Strip Width	90m
	Runway Strip Width	150m
	Longitudinal Slope	1.75% max
	Longitudinal Slope Change	2% max

Facility	Item	Code 3C Requirements
Runway End Safety Area (RESA)	Transverse Slope	2.5% max (can be 5% in first 3m adjacent to the runway shoulder)
	Length	60m min 90-240m recommended
	Width	60m (twice runway width)
	Longitudinal Slope	5% max (down) Below Approach or Take-off Surface (up)
	Transverse Slope	5% max (up or down)

2.6 Runway Classification Criteria

Runways are classified as non-instrument (also known as visual or circling approach) or instrument runways.

Instrument runways are further classified as non-precision or precision.

A non-precision instrument runway is served by visual aids and a radio aid providing at least directional guidance adequate for a straight in approach with a published minimum descent altitude, also known as a landing minima for a particular radio aid or combination of radio aids.

A precision approach runway is a runway served by an Instrument Landing System (ILS) with minima significantly lower than for a non-precision runway.

The appropriate runway classification for the potential new runway, to accommodate the anticipated medium to long term Code 3C aircraft operations, is as an instrument, non-precision approach runway.

The instrument, non-precision approach runway classification is appropriate for the potential new runway as the existing visual aids and a radio aid for the 14/32 Runway could be removed and relocated, and the installation and operation of an ILS by AirServices Australia is not likely to be justified based on current and projected future aircraft traffic, and the resulting low risk to aircraft safety.

3 Aerodrome Site Selection and Runway Orientation

3.1 General

There are no mandatory procedures for the establishment of a new runway at an existing aerodrome, nor for the establishment of a new runway at a new aerodrome site.

A number of mandatory standards, physical constraints and sound planning practices however impact where a potential new runway should be established including the following major criteria:

1. Physical land space required;
2. Physical airspace required;
3. Meteorological conditions;
4. Topography;
5. Geology;
6. Environmental and heritage impact;
7. Land acquisition;
8. Access to population centres;
9. Access to emergency services; and
10. Disruption to existing aerodrome operations.

The potential new runway orientation has been established in conjunction with the following considerations:

a. Ultimate Aerodrome Reference Code 3C (medium to long term) for an instrument, Code 3 non-precision approach runway;
b. Consideration of the existing metrological information in the area of the potential new runway;
c. Consideration of the surrounding topography and feature and level survey information in the area of the potential new runway;
d. Consideration of the future airspace management in the area of the potential new runway;
e. Consideration of the appropriateness of the potential new runway to accommodate the future forecast traffic of Flinders Island Aerodrome (including access);
f. Consideration of the local Land Use Planning Regulations and Environmental Controls and the appropriateness of the potential new runway; and
g. Consideration that the site, orientation and length of the potential new runway meets general aerodrome safety requirements, including those related to the prevailing winds, average temperatures, topography (Obstacle Limitation Surface (OLS) and elevation), airspace management, aircraft performance, aircraft weights and environmental conditions.

Section 3.2 to **Section 4.3** provide the technical details of the relevant New Runway Siting Study Report inputs, and **Section 5** and **Section 6** provide details of the concept pavement design options and multi-criteria assessment.

3.2 Site Information and Data

3.2.1 Meteorological Information and Data

The historical meteorology information and data used for this New Runway Siting Study Report is from the Flinders Island Aerodrome Weather Station. The details for the Flinders Island Aerodrome Weather Station are presented in **Table 4**.

Table 4 | Bureau of Meteorology Weather Station Details for Flinders Island Aerodrome (Source: Bureau of Meteorology Website)

Station Name	Station Number	Station Opened	Latitude	Longitude	Elevation
Flinders Island Aerodrome	099005	1942	- 40.09°	148.00°	9m

3.2.2 Wind Data

At Flinders Island, winds are generally from the west. The wind direction as a percentage of total observations according to wind speed for Flinders Island are shown in **Figure 1** and **Figure 2**, respectively and provided in more detail in **Table 5**.

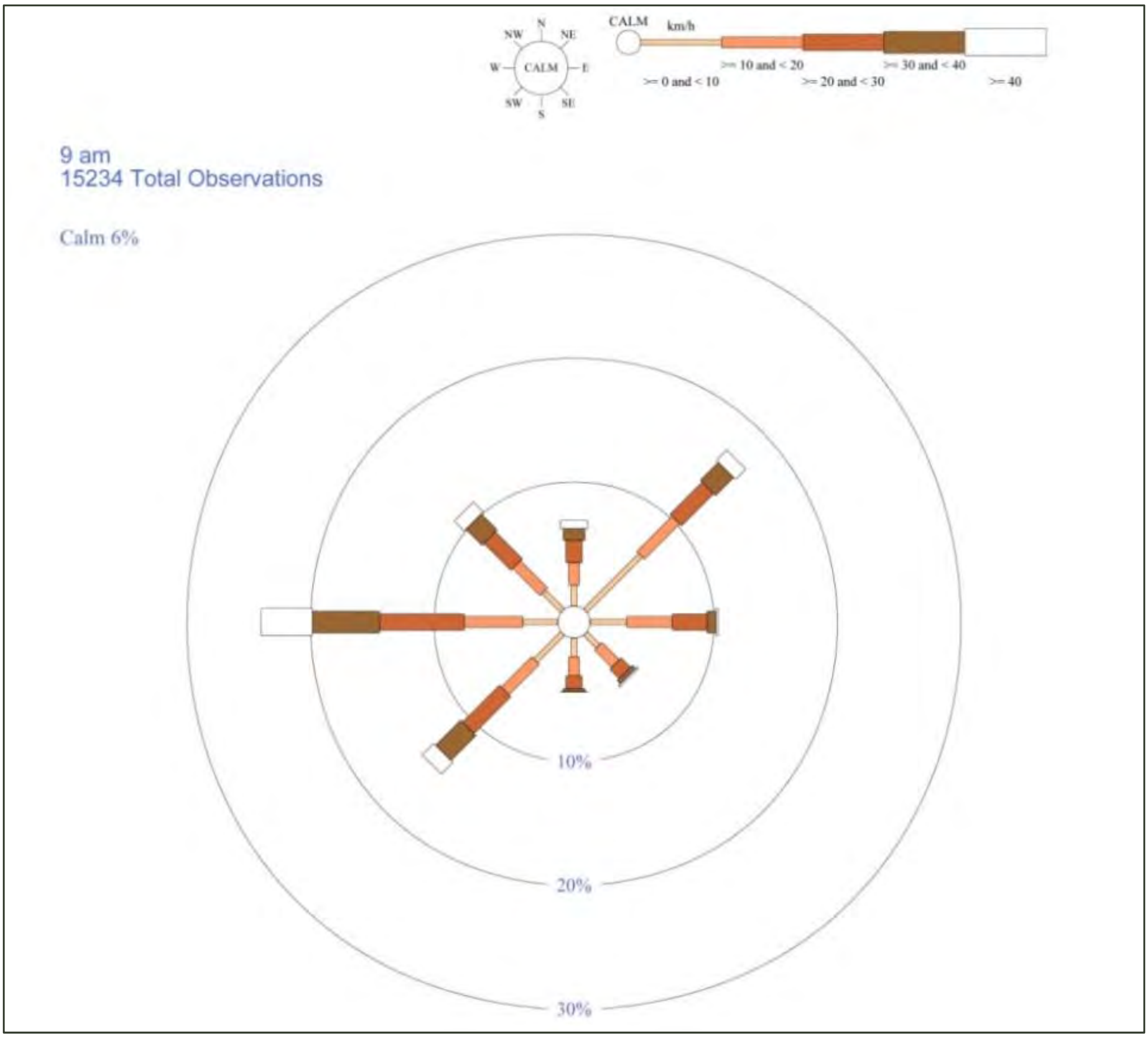

Figure 1 | Wind Direction Versus Wind Speed in km/h for Flinders Island (Jan 1962 to Sep 2010 at 09:00 hours) (Source: Bureau of Meteorology Website – Weather Station 099005)

Figure 2 | Wind Direction Versus Wind Speed in km/h for Flinders Island (Jan 1962 to Sep 2010 at 15:00 hours) (Source: Bureau of Meteorology Website – Weather Station 099005)

Table 5 | Flinders Island Aerodrome Wind Direction as a Percentage of Total Observations According to Wind Speed (Since 1962) (Source: Bureau of Meteorology 2014– Weather Station 099005)

Station Name	Number of Observations	Time	Calm	Speed Range	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Total	Mean
Flinders Island Aerodrome	17580	09:00	6	1-10km/h	1%	1%	4%	2%	1%	1%	1%	*	1%	1%	2%	1%	1%	1%	1%	1%	**21%**	**1.31**
Flinders Island Aerodrome	17580	09:00	6	11-20km/h	1%	1%	3%	2%	2%	2%	1%	1%	1%	1%	2%	2%	3%	2%	2%	1%	**25%**	**1.56**
Flinders Island Aerodrome	17580	09:00	6	21-30km/h	1%	1%	2%	2%	2%	1%	1%	*	1%	1%	2%	3%	4%	2%	2%	1%	**25%**	**1.56**
Flinders Island Aerodrome	17580	09:00	6	>30km/h	1%	2%	2%	1%	*	*	*	*	*	*	2%	5%	6%	2%	2%	*	**24%**	**1.50**
Total					**3%**	**6%**	**11%**	**7%**	**5%**	**5%**	**2%**	**1%**	**2%**	**2%**	**8%**	**12%**	**14%**	**7%**	**6%**	**3%**		
Station Name	**Number of Observations**	**Time**	**Calm**	**Speed Range**	**N**	**NNE**	**NE**	**ENE**	**E**	**ESE**	**SE**	**SSE**	**S**	**SSW**	**SW**	**WSW**	**W**	**WNW**	**NW**	**NNW**	**Total**	**Mean**
Flinders Island Aerodrome	15592	15:00	2	1-10km/h	*	*	**1%**	*	*	*	*	*	1%	2%	3%	2%	1%	1%	*	*	**13%**	**0.81**
Flinders Island Aerodrome	15592	15:00	2	11-20km/h	1%	1%	2%	1%	1%	2%	1%	*	1%	2%	4%	4%	4%	2%	1%	1%	**26%**	**1.63**
Flinders Island Aerodrome	15592	15:00	2	21-30km/h	1%	2%	2%	2%	2%	1%	1%	*	*	*	2%	4%	5%	3%	2%	*	**28%**	**1.75**
Flinders Island Aerodrome	15592	15:00	2	>30km/h	*	2%	2%	1%	1%	1%	*	*	*	*	1%	6%	11%	4%	2%	*	**31%**	**1.94**
Total					**2%**	**6%**	**7%**	**4%**	**4%**	**4%**	**2%**	**1%**	**2%**	**4%**	**10%**	**14%**	**22%**	**10%**	**5%**	**1%**		

* Indicates the range occurred but with a frequency less than 0.5%

From **Table 5**, it is observed that at 09:00 hours at Flinders Island, the wind predominately comes from the west-south west and west approximately 26% of the time, and the wind speed at 09:00 hours is between 10km/h to 30km/h approximately 50% of the time. Calm conditions have been observed 6% of the time. The westerly wind component (SW, WSW, W, WNW and NW– range between 225° to 335°) accounts for approximately 50% of the total wind direction at 09:00 hours. The extended range of the north westerly and south easterly wind components (N, NNW, NW, WNW, W, S, SSE, SE, ESE and E – range of 270° to 360° and 90° to 180°) account for approximately 48% of the total wind direction at 09:00 hours

From **Table 5** it is observed that at 15:00 hours at Flinders Island, the wind predominately comes from the west south-west and west approximately 36% of the time, and the wind speed at 15:00 hours is between 10km/h to 30km/h approximately 54% of the time. The westerly wind component (SW, WSW, W, WNW and NW– range between 225° to 335°) accounts for approximately 61% of the total wind direction at 15:00 hours. The extended range of the north westerly and south easterly wind components (N, NNW, NW, WNW, W, S, SSE, SE, ESE and E – range of 270° to 360° and 90° to 180°) account for approximately 53% of the total wind direction at 15:00 hours.

Through analysis of the wind direction as a percentage of total observations according to wind speed for Flinders Island, the preferred alignment of the potential runway for Flinders Island Aerodrome is within the range east north-east (67.5°)/west south-west (247.5°), east (90°)/west (270°) and east south-east (112.5°)/west north-west (292.5°). This corresponds to a runway designation for the potential new runway of 07/25, 08/26, 09/27, 10/28 or 11/29.

ICAO Annex 14 states that the runway should be orientated such that it may be used by the aircraft it is intending to serve 95% of the time, considering that for a runway which is intending to serve aircraft with an Aeroplane Reference Field Length (ARFL) >1,500m in length, it would not be useable for winds >37km/h (20kt). As illustrated in **Table 5**, the wind in any direction >30km/h occurs approximately 28% of the time (on average).

For aircraft with an AFRL<1,500m, the runway would not be useable for winds >24 km/h (13kt). As illustrated in **Table 5**, the wind in any direction >21km/h occurs approximately 27% of the time (on average). Therefore, for smaller aircraft and turbo prop aircraft, the preferred orientation is in the east-west direction in order to maximise the centreline component of the prevailing wind during take-off and landing (to minimise the roll effect).

3.2.3 Temperature and Rainfall Data

The mean maximum and minimum temperatures and mean rainfall data for Flinders Island are shown in **Figure 3** and **Figure 4**, respectively.

At Flinders Island, the warmest months are from December to March, with an average maximum temperature above 20°C.

Flinders Island experiences maximum mean rainfall in May to August, with the period from January to March receiving the lowest mean rainfall.

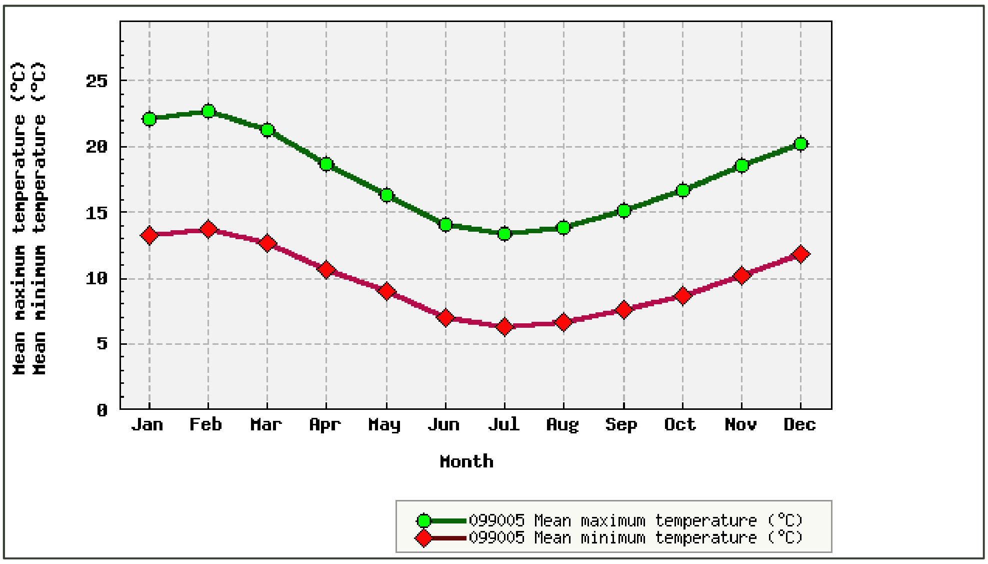

Figure 3 | Mean Minimum and Maximum Temperature Data for Flinders Island Aerodrome (since 1962) (Source: Bureau of Meteorology Website – Weather Station 099005)

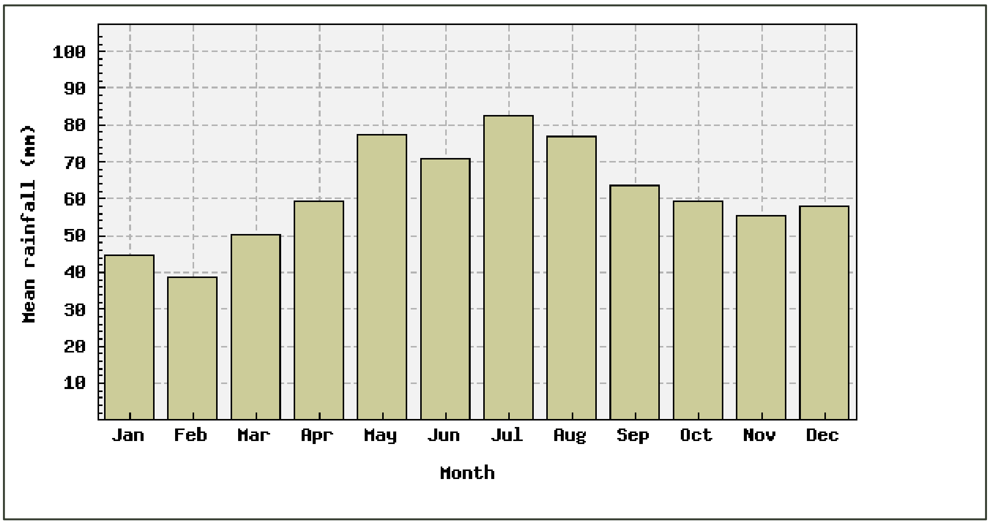

Figure 4 | Mean Rainfall for Flinders Island Aerodrome (since 1962) (Source: Bureau of Meteorology Website – Weather Station 099005)

3.2.4 Geotechnical Information and Data

Limited existing geotechnical information and data is available for the potential new runway location. As a result, two sources of geotechnical information have been assessed for the purpose of this New Runway Siting Study Report.

The existing geology of the site is critical for establishing the likely natural subgrade material properties, which in turn impacts pavement design and associated construction costs.

Historical Geological Information

Based on historical geological information which is publically available (Mineral Resources Tasmania – Department of State Growth – Geology of Northeast Tasmania — Reference AGD66/AMG Zone 55 – www.mrt.tas.gov.au), it is observed that the natural subgrade in the area had a range of tertiary sediments which were generally non-marine sequences of gravels, sands, silts, clays and regolith, with the presence of basalt and related volcaniclastic rocks nearby.

It was likely that the tertiary sediment subgrades were poorly compacted due to the coastal environment and the presence of water nearby in Bass Straight.

For the purposes of engineering, subgrade soils are identified and classified according to field observations (and later laboratory tested engineering properties) as part of the Unified Soil Classification System (USCS), which enables the likely engineering properties and behaviours of soil materials to be generally predicted at a basic level.

From the historical geological information sourced, it was predicted that the natural subgrade is likely to range from a coarse sand (SP), sandy clay/clayey sand (SM to SC) material to a low plasticity clay (ML to CL).

Historically, soils classified as SP generally have a California Bearing Ratio (CBR) range of between 10% to 30%, and soils classified as CL generally have a CBR range of 2% to 10%.

Geotechnical Investigation

A geotechnical investigation was conducted in June 2012 by Tasman Geotechnics of the existing 14/32 Runway, 05/23 Runway, Taxiway A and RPT Apron areas.

The details of the 2012 investigation by Tasman Geotechnics is contained in the Aurecon report titled *Existing Pavement Strength Analysis* (*Revision 1)* dated 2 October 2012 (refer to **Appendix E**).

Results from the Geotechnical Investigation concluded that the subgrade material below the existing 14/32 Runway was predominantly sand with thin layers of clay material, overlying a clayey sand or sandy clay (SM to SC).

The representative subgrade CBR values for the 14/32 Runway were between 5% and 9%, which relates to a subgrade category C, meaning it is generally lower than the published subgrade category of B (AirServices Australia – EnRoute Supplement Australia (ERSA)). CBR values for subgrade category B are between 9% and 13%.

Due to the variable existing subgrade strength identified through the results of the FWD and geotechnical testing, it is strongly recommended that a detailed geotechnical site investigation be undertaken in the potential new runway pavement areas prior to any detailed design, bulk earthworks or pavement construction taking place.

The results of this investigation will provide more certainty in the design subgrade CBR that should be adopted, which may result in a more economical pavement design and potential cost saving for Flinders Council. It is also critical that ground water and natural subgrade properties be fully determined to minimise the design, construction and long term performance risks for the pavement.

For the purpose of this New Runway Siting Study Report, a design subgrade CBR of 5% has been adopted.

3.2.5 Feature and Level Survey Information and Data

Detailed feature and level survey information and data are not available for the potential new runway site. However, data from Mapinfo has been sourced for the purposes of this New Runway Siting Study Report.

The horizontal datum for the aerial survey information is Geodetic Datum Australia (GDA94) and the vertical datum is Australian Height Datum (AHD), with the corresponding map projection Zone 55 (Map Grid of Australia).

The limit of accuracy of the aerial survey is horizontal to within 0.500m and Reduced Levels (vertical) to within 0.200m.

The reference elevation for the potential new runway has been approximated as 5.9m, based on the vertical contours provided in the aerial survey.

3.2.6 Land Use Planning

The existing Flinders Island Aerodrome is located wholly within the Public Purpose Zone with land to the north and west within the Residential Zone, as shown on **Figure 1** in **Appendix C**.

The foreshore area is covered by an Environmental Management Recreation Zone following Pats River to the east. Areas of dense Allocasuarina Verticillata forest surround the existing 14/32 Runway particularly to the north-west.

Removal of the Allocasuarina Verticillata forest will potentially trigger the requirement for planning approval or permit prior to works commencing.

Flinders Island Aerodrome is also located adjacent to the Arthurs Bay Conservation Area along the coastline with a Shoreline Waterbody Flinders Special Area overlay along the coast, as illustrated on **Figure 2** in **Appendix C**.

These areas will require attention in the planning/permit stage to ensure construction works will have no adverse effects.

Planning Scheme Zone amendments may be necessary to accommodate the potential new runway. As any amendments to the Planning Scheme Zone will occur in the future, it is not possible to definitely determine whether an amendment will be necessary or not as the Planning Scheme may change over time.

3.2.7 Environmental Information

Limited recent studies exist on the ecology of the area of the potential new runway however an Environmental Protection and Biodiversity Conservation (EPBC) Act Protected Matters Report revealed that there are 40 Listed Threatened Species and 39 Listed Migratory Species within a 10km radius.

No known studies exist regarding aboriginal cultural heritage.

In order to mitigate the environmental risks associated with the development of the potential new runway, studies may be required including flora and fauna, noise, soil hydrology and aboriginal cultural heritage. It is recommended that Flinders Council consult with relevant government authorities such as the Department of State Growth, the Department of Primary Industries, Parks, Water and Environment (DPIPWE) and the Environmental Protection Authority (EPA) of Tasmania in order to determine the likely requirements that will need to be satisfied prior to commencing with detailed design or construction.

Additional studies may be required as determined by the relevant government authorities, subject to the outcomes of the initial studies.

It should also be noted that the removal of native vegetation in the area may also trigger the requirement for planning approval or permit prior to works commencing as noted in **Clause 3.2.6**.

3.2.8 Airspace Information and Data

Adequate airspace will be required to enable aircraft to approach, circle, descend, land, and take-off on the potential new runway.

The existing airspace associated with Flinders Island Aerodrome is surrounded by high terrain to the north and east. Consequently, circling east of the existing 14/32 Runway is currently not permitted.

3.2.9 Engineering Services Supply Information and Data

Flinders Island Aerodrome is adequately provided by engineering services which have capacity to accommodate the potential new runway.

Currently all engineering services (communications, electrical and water supply) at Flinders Island Aerodrome, with the exception of waste water, are provided from Whitemark.

3.2.10 Access to Flinders Island Aerodrome

Currently the Flinders Island community has good access by road to Flinders Island Aerodrome, with Whitemark approximately 4.5km by road (6 minute driving time).

The existing Flinders Island Aerodrome site is adequately positioned for rapid emergency response (i.e. in the event of an emergency at the aerodrome requiring Police, Ambulance, Tasmania Fire Service and/or State Emergency Service) and medical evacuation by air (i.e. patient transfer from Whitemark).

3.3 Preliminary Runway Siting and Orientation Assessment

3.3.1 Preliminary Runway Location (Siting)

The preliminary potential new runway location has been determined based on an assessment of the following:

a. The potential location provides suitable access (road infrastructure and travel time) to Whitemark;

b. Maximising access for the community and emergency services based on the population catchment. To achieve this the potential new runway should be within (the existing Flinders Island Aerodrome boundary) or adjacent to the existing Flinders Island Aerodrome site considering the existing sites proximity to Whitemark;

c. Maximising the use of the existing land within the existing Flinders Island Aerodrome boundary, which is zoned Public Purpose in the existing Planning Scheme Zone for the purpose of aerodrome activities, which also includes the existing Buffer Attenuation Area Planning Scheme Overlay;

d. Minimising the extent of the works area necessary for the potential new runway on a greenfield site (which reduces environmental impact – i.e. vegetation removal, earthwork extent, coastline impact and other flora and fauna impact);

e. Minimising the extent of bulk earthworks by selecting a potential new runway location which is in a coastal plain area with only small topographical variation and no major topographical obstacles or natural watercourses;

f. Maximising the ability to develop other aviation related infrastructure at Flinders Island Aerodrome in the future, based on the development of potential new facilities or leveraging development from existing facilities (landside and airside), including the use of existing engineering services (communications, electrical and water supply);

g. Integrating the potential new runway with the existing 05/23 Runway to ensure safe aerodrome operations; and

h. Minimising the impact on the existing airspace management system.

3.3.2 Preliminary Runway Orientation

The preliminary potential new runway alignment (orientation) of 11/29 has been determined based on the following:

a. Known obstacles surrounding Flinders Island Aerodrome as detailed in **Table 6** and shown on **Figure 5** in **Appendix C** which affect the existing airspace associated with Flinders Island Aerodrome;

Table 6 | Flinders Island Aerodrome Known Obstacles

Obstacle No.	Description	Location Relative to Flinders Island Aerodrome
1	Mount Strzelecki	South South-East
2	Pillingers Peak	South East
3	Mount Leventhorpe (and Darling Range)	North East
4	Brougham Sugarloaf Conservation Area	North
5	Old Wind Turbine	South East
6	Old Tower	South East
7	New Wind Turbine	South East
8	Proposed Wind Turbine	South East

b. The constraint of the high terrain to the north and east of Flinders Island Aerodrome which prevents circling of aircraft to the east on approach and departure to Flinders Island Aerodrome;

c. Wind rose information from the Bureau of Meteorology for Flinders Island which indicates that winds are predominately from a westerly direction, resulting in a preferred runway designation of 09/27;

d. The 11/29 designation is not preferred for aircraft with an ARFL<1,500m (small jet aircraft and turbo-prop aircraft) and in some instances where the cross wind speeds are greater than 24km/hr, smaller aircraft will not be able to operate, however this circumstance is alleviated by the ability for aircraft to operate on the existing 05/23 Runway in such conditions; and

e. Minimising the impact of aircraft noise on Whitemark.

Table 7 and **Table 8** provide the details for two options investigated in detail for the potential new runway (1,900m) position and orientation.

Table 7 | Alignment Option 1 – Flinders Island Aerodrome Runway Position and Orientation (1,900m in Length)

General	
Geodetic Datum	GDA94
Calculation type	Ellipsoid
Magnetic Variation	13.836°E
Magnetic variation date	1 April 2015
11 Runway Strip End Position	
ID	11_1
Latitude	-40°05'02.8668"
Longitude	147°58'28.2798"
29 Runway Strip End Position	
ID	29_1
Latitude	-40°05'35.4976"
Longitude	147°59'42.2110"
Finishing Position	
Forward true bearing	119°53'25"
Forward magnetic bearing	106 °03'16"
Rounded forward magnetic bearing	011 °
Reverse true bearing	299 °52'38"
Reverse magnetic bearing	286 °04'12"
Rounded reverse magnetic bearing	029 °
Distance between positions	2019.998m

Table 8 | Alignment Option 2 – Flinders Island Aerodrome Runway Position and Orientation (1,900m in Length)

General	
Geodetic Datum	GDA94
Calculation type	Ellipsoid
Magnetic Variation	13.836°E
Magnetic variation date	1 April 2015
11 Runway Strip End Position	
ID	11_2
Latitude	-40°04'57.4998"
Longitude	147°58'32.7880"
29 Runway Strip End Position	
ID	29_2
Latitude	-40°05'35.8320"
Longitude	147°59'41.9248"
Finishing Position	
Forward true bearing	125°49'48"
Forward magnetic bearing	111 °59'38"
Rounded forward magnetic bearing	011 °
Reverse true bearing	305 °49'04"
Reverse magnetic bearing	291 °58'55"
Rounded reverse magnetic bearing	029 °
Distance between positions	2019.998m

Based on an assessment of the RNAV (GNSS) non-precision instrument approach procedures aligned with the potential new 11/29 Runway orientation, the coordinates for Alignment Option 1 provides the preferred 11/29 Runway orientation. Refer to **Section 3.3.5** for further details.

Other runway orientation options (variations beyond Option 1 and Option 2 rotated clockwise and anti-clockwise) were investigated, however these were not investigated in detail due to the resulting encroachment of existing topography with the approach and departure paths.

The runway orientation option of providing a potential new runway on the same alignment as the existing 14/32 Runway, offset 93m to the west, and converting the existing 14/32 Runway into a parallel Code C taxiway was also investigated. This option was not investigated in detail due to the following:

a. The predominant winds do not favour the existing 14/32 Runway alignment;

b. The environmental impact was much more significant;

c. The extent of land acquisition was much more significant;

d. The extent of bulk earthworks was much more significant; and

e. The existing 14/32 Runway pavement strength would still need to be upgraded in order to serve as a taxiway.

3.3.3 Forecast Traffic Assessment

Ideally for this type of study, Flinders Council would provide the forecast frequency of aircraft types and origin and destination of the various flights anticipated for the potential new runway based on forecasted demand. This information is not currently available and has therefore been estimated, for the purposes of this New Runway Siting Study Report.

The forecast frequency of aircraft types forms the basis for pavement thickness design and runway length assessment. The aircraft origin and destinations also form the basis of the runway length assessment.

It is noted that the *Flinders Island Airport Master Plan 2012* does not address in detail the forecast frequency of aircraft types and origin and destination of the various flights anticipated into the future.

The following assumptions have therefore been made for the purpose of this New Runway Siting Study Report in order to estimate the potential aircraft types and potential forecast aircraft traffic:

- Consideration of aircraft currently in operation in Australia and the Asia Pacific region;
- Consideration of aircraft that may potentially operate from major southern capital cities and regional centres in Australia to Flinders Island Aerodrome;
- Consideration of maximum payload (passengers and freight) for potential aircraft; and
- Aircraft potentially departing from their origin at Maximum Take-Off Weight (MTOW) and landing at their destination at Maximum Landing Weight (MLW).

The approximate distance from Flinders Island Aerodrome to the major southern capital cities and regional centres in Australia are provided in **Table 9**.

Table 9 | Approximate Distance from Flinders Island Aerodrome to Australian Capital Cities and Regional Centres

City/Regional Centre	Approximate Distance to Flinders Island
Devonport	180km
Launceston	180km
Hobart	310km
Melbourne (Essendon)	380km
Melbourne	390km
Canberra	550km
Sydney	750km
Adelaide (Parafield)	1,020 km

Figure 5 | Illustration of Approximate Distance from the Potential Future New Flinders Island Aerodrome Runway to Australian Capital Cities and Potential Major Regional Centres

The potential aircraft mix and the approximate range of each aircraft is provided in **Table 10**.

Table 10 | Approximate Aircraft Range for Potential Aircraft Mix

Designator	Code	ARFL (m)	Aircraft Range (km)	MTOW (kg)	Approx. Passengers
BE20	1B	<1,200	3,255	5,670	8
ATR 42-200	**2C**	**1,010**	**2,100**	**16,150**	**42**
DHC8-200/300	**2C**	**1,122**	**1,540**	**18,642**	**45**
Metro 23	3B	1,341	1,100	7,484	19
SF340	**3C**	**1,220**	**1,490**	**12,370**	**38**
ATR 72-500	**3C**	**1,333**	**2,100**	**22,800**	**64**
F50	**3C**	**1,760**	**1,500**	**20,820**	**45**
DHC8-400	**3C**	**1,354**	**2.500**	**29,000**	**78**

From the potential aircraft mix provided in **Table 10**, it has been estimated from existing operators' aircraft fleets and current trends in the aviation industry, that the aircraft types emboldened provide the most economical alternatives (considering operating costs, payload potential and aircraft performance/range) for potential aircraft operators to service Flinders Island Aerodrome into the future. In essence, this is a time series forecast which extrapolates the current trends of aviation activity in Australia and assumes that those factors that currently determine the business model for aircraft operators, will continue into the future.

It is noted that the *Flinders Island Airport Master Plan 2012* predicts that aircraft movements are not likely to exceed 6,000 movements per year for at least 20 years, where a movement is defined as a landing and a take-off.

For the purposes of this New Runway Siting Study Report, the predicted ultimate aircraft traffic for Flinders Island Aerodrome has been forecast with consideration of the forecast peak passenger demand for 2015 and then extrapolated to 2025 and 2035 (primarily to assist in establishing the potential traffic for the 20 year design life of the flexible pavements and beyond).

It is proposed to adopt the following design aircraft traffic scenarios, detailed in **Table 11**, for the development of the concept pavement thickness design.

It should be noted that the BE20, ATR 42-200 and F50 aircraft have been omitted from Traffic Scenario C provided in **Table 11** for the development of pavement thickness design due to their comparable MTOW when compared to the other aircraft in the traffic scenario mix with the same Aerodrome Reference Code, however there is a reduced likelihood of frequent operations of these aircraft.

Similarly, the King Air 200 aircraft has been removed from Scenarios B and C, as the other aircraft listed are more critical in terms of pavement thickness design.

Table 11 | Aircraft Traffic Scenarios (20 years)

Traffic Scenario Number	Aircraft	Coverages (Landing and Take-Off)
Traffic Scenario A	Metro 23	87,600
	BE20	87,600
Traffic Scenario B	Metro 23	116,800
	SAAB 340	43,800
Traffic Scenario C	Metro 23	175,200
	SAAB 340	87,600
	DHC-8-300	43,800

3.3.4 Preliminary Aerodrome Runway Length Assessment

Overview

The length of the potential new runway is dependent on three main factors, as follows:

- The CASA applied regulations for particular categories of aircraft;
- The environmental conditions at the proposed site (i.e. temperature, surface wind, surface wind direction, runway gradient, altitude and runway condition); and
- The aircrafts performance (i.e. the range of operating weights and conditions that the aircraft is certified to perform in for the aircrafts range).

The runway length required is invariably based on the assumption that the aircraft sustains an engine failure at a critical moment in the take-off run and subsequently either aborts the take-off ('Accelerate-Stop') or continues ('Accelerate-Go') depending on whether the failure occurs before or after the critical decision speed (V_1) is achieved.

The US Federal Aviation Regulations (FAR) used in aircraft manufacturer's Airport Planning Manuals define take-off field length the most limiting of the following:

- Distance to reach a height 35ft above the runway with all engines operating;

- Distance to reach a height 35ft above the runway with all but one engine out; and
- Accelerate stop distance.

Runway Length Assessment Inputs

Generally aircraft manufacturer's aircraft performance data is referenced at standard conditions (ambient conditions at sea level, dry, and no wind and at International Standard Atmosphere (ISA) 15°C) for ease of comparison. The aircraft manufacturer established aircraft performance data through trials, which eventually lead to certification of the aircraft.

For the purposes of this New Runway Siting Study Report, the aircraft manufacturers aircraft performance charts have been analysed to determine the most performance critical aircraft based on the following critical (worst case) conditions:

- Take-off weight of the aircraft (varies – Runway Limited Weight considered);
- Engine type and thrust of the aircraft (varies);
- Maximum payload (passengers plus baggage and freight) for the aircraft (varies);
- Aircraft operator will adopt the optimum take-off flap setting for the local weather conditions and no other aircraft system which may inhibit aircraft performance will be activated during landing or take-off;
- Intended range or flight sector length of 1,020km (refer to **Table 9**);
- Wind strength of up to 24km/h and from a westerly direction (refer to **Section 3.2.2**);
- Elevation of the aerodrome of 9m (atmospheric pressure) (refer to **Section 3.2.1**);
- Temperature at the aerodrome of 25°C (ISA +10°C) (refer to **Section 3.2.3**);
- Runway gradient range between 0% and maximum 2%;
- No significant obstacles within or beyond the take-off (departure) splay;
- In the case of a continued take-off following engine failure, the aircraft would be allowed to continue to climb on the runway alignment to a specified height above the aerodrome elevation; and
- Runway pavement wearing course type is sprayed seal for Code 3C aircraft and in good condition (assumed both wet and dry pavement surface). A wet runway is assumed to have less than 3mm of standing water.

Runway Length Assessment Summary

Based on the above variable inputs (worst case), the critical Code 3C aircraft is the F50 which theoretically requires a 1,900m minimum runway length for take-off at MTOW. Therefore, providing factors of safety to account for worse case individual aircraft operating procedures and performance, a minimum runway length for Code 3C of 1,950m to 2,000m may be necessary. However for the purposes of this New Runway Siting Study Report a potential runway length of 1900m is considered adequate.

It should be noted that the actual aircraft performance will vary according to the individual operators aircraft specification (i.e. depending on engine type, associated performance ratings and structural limit options etc.) as well as the aircraft operators procedures (i.e. prescribed take-off speed ratios etc.). Hence, the minimum runway length of 1,900m for the critical aircraft is provided for planning purposes only. Accordingly, actual runway length requirements should be confirmed with the likely operators of particular aircraft into Flinders Island Aerodrome prior to detailed design and construction.

The critical (worst case) conditions assumed for the runway length assessment (high temperatures, wet runway condition, large aircraft weights etc.) are likely to occur infrequently. Therefore, in such instances aircraft operators may reduce their payloads or vary their operating procedures to safely operate on a less than optimal runway length, for a particular aircraft, as required.

The runway lengths above are considered to be the Take-off Run Available (TORA), which is defined as the length of runway available for the ground run of an aircraft taking off, not including the clearway, stopway or Runway End Safety Area (RESA). For the purpose of this New Runway Siting Study Report, the Landing Distance Available (LDA), which is defined as the length of runway available for the ground run of a landing aircraft, not including the clearway, stopway or RESA is considered to equal the TORA. The Accelerate –Stop Distance Available (ASDA) is defined as the length of the take-off runway available plus the length of any stopway, however for this New Runway Siting Study Report it is considered equal to the TORA and LDA.

A 90m RESA is required at either end of the potential new runway, based on the requirements of MOS Part 139.

3.3.5 Preliminary Airspace Management Assessment

Overview

As part of the potential new runway siting and orientation work, Aurecon and Airport Survey Consultants have liaised with IDS Australasia (on behalf of Flinders Council) to establish and validate the airspace management system requirements including consideration of the existing system.

A copy of the IDS Australasia Report titled *Feasibility Report for Flinders Island RNAV GNSS Procedures* is contained in **Appendix B**.

RNAV (GNSS) non-precision instrument approach procedures aligned with the potential new 11/29 Runway orientation (Option 1) are viable for the existing Flinders Island Aerodrome site and are considered more appropriate than the potential new runway alignment investigated as Option 2.

The minimum altitude for the RNAV approach for the 11 Runway End is at 450 feet above ground level.

The minimum altitude for the RNAV approach for the 29 Runway End, with the proposed new wind turbine, is 900 feet above ground level. Without the proposed new wind turbine the minimum altitude is 890 feet above ground level.

As part of the preliminary airspace review, a general plan of the area showing typical flight paths has been provided for the potential new 11/29 Runway.

A summary of the approvals process is also contained within the IDS Australasia Report.

It is anticipated that should the detailed design of the potential new runway proceed, the next phase of the airspace management process (considered outside the scope of this New Runway Siting Study Report) would be that an Airspace Change Proposal (ACP) would be lodged with CASA to formalise the agreed airspace changes. A flight validation date is then set, the procedures are validated and then lodged with AirServices Australia for promulgation in the form of Departure and Approach Procedures (DAP) (which includes charts).

As part of these DAP charts, the OLSs must be established identifying any obstacles which penetrate these surfaces in accordance with current standards and regulations.

3.3.6 Preliminary Obstacle Limitation Surface (OLS) Assessment

Overview

The basis of the preliminary OLS assessment is to define a volume of airspace that should be kept obstacle free in order to minimise the danger to aircraft operations during an entirely visual approach or during the final visual segment of an instrument approach procedure. The surfaces are of a permanent nature and comprise the reference datum that defines the surface and anything above the surface as a hazard. Any obstacles identified should be reported to CASA so that they can determine if they are "hazardous" and therefore need to be marked and/or lit to ensure safe operation. The OLS standards are based on the runway code and classifications (i.e. size of the critical design aircraft) and whether or not they are utilised for instrument approach procedures.

During detailed design of the potential new runway, OLS charts (in conjunction with the Aeronautical Charts) will be required to be produced and approved by the relevant authorities prior to construction.

A concept OLS plan is provided on **Figure 5** in **Appendix B**.

3.3.7 Preliminary Aircraft Noise Assessment

Overview

In proximity to aerodromes, aircraft noise is the most readily identifiable single impact source. The potential impact to residents in the area of the aerodrome has been investigated by undertaking a general review of noise exposure, using typical noise charts and general noise exposure data from aircraft manufacturers' published information, in order to assess the likely impact on these areas and highlight any critical issues.

The following factors are important in assessing the extent of intrusion and disturbance which are created by aircraft noise:

- The perceived loudness of the noise;
- The duration of time in which the noise is present;
- Whether the noise occurs in the day time or night time, and
- The number of noise events which occur in any period of time.

In addition to the complex factors that affect the generation of aircraft noise, the assessment of its impact must also be based on general community reaction since social surveys have found a wide divergence in noise acceptance of individuals.

Determination of Aircraft Noise

There are a number of methods available for the determination of aircraft noise, with the most common being peak level indices and equal energy indices.

Peak Level Indices (dBA)

The impact of an individual noise event may be represented by reference to its maximum level (dBA max). The dBA (decibel A-weighted) unit has gained universal acceptance for the measurement of environmental or background noise due to its good correlation with subjective human reactions and simplicity of use. It is used to determine peak noise levels and may be defined as a logarithmic unit used to express the magnitude of a change in level of sound intensity.

Equal-energy Indices (ANEF System)

Equal-energy indices are based on the principle that a loud noise occurring only a few times in a day produces a similar response to a moderate noise occurring many times, if the total noise energy from both types of exposure is similar. Research by the National Acoustic Laboratories (NAL) suggests that such indices provided are a higher correlation with community reaction than indices based on peak noise levels.

In Australia, aircraft noise has for some years been measured by reference to a specific equal-energy index known as the Australian Noise Exposure Forecast (ANEF) system.

Single Event Contours

This New Runway Siting Study Report is not based on the ANEF System, but is rather based on a single event contour. It does not consider the total spectrum of aircraft types, frequency of operation and whether day time or night time. A single event contour is a line joining points of equal noise level of a single aircraft either taking-off or landing or both. It is essentially used to compare the noise footprint of one aircraft with another.

In this case, the noise contours are based on a straight-in approach and landing, and take-off and straight-out departure.

There are three fundamental metrics for the measurement of aircraft noise.

The first family of metrics is related to the A-weighted sound level, denoted by the symbol LA. A-weighted sound levels de-emphasize the low and high frequency portions of the spectrum. This weighting provides a good approximation of the response of the human ear, and correlates well with the average person’s judgement of the relative loudness of a noise event.

The second family of metrics is related to the C-weighted sound level, denoted by the symbol LC. C-weighted sound levels retain the low frequency portions of the spectrum. This weighting is intended to provide a means of simulating human perception of the loudness of sounds above 90 dB.

The third group of metrics is related to the tone-corrected perceived noise level, denoted by the symbol LPNT. Tone corrected perceived noise levels are used to estimate perceived noise from broadband sound sources, such as aircraft, which contain pure tones or other major irregularities in their frequency spectra.

Basis of Study

For this New Runway Siting Study Report, the A-weighted maximum sound level (LAMAX) measure has been used, as it provides good approximation of the response of the human ear, and correlates well with the average person’s judgement of the relative loudness of a noise event at its maximum potential level.

This method does not consider the duration of the noise, the time at which the noise occurs, and the community reaction to the noise. It merely provides a comparative measure of the noise emitted by the aircraft (i.e. the relative noise effect of aircraft, as the values presented may not represent actual measurable noise levels).

Figure 6 in **Appendix C** indicates the area of land around the Flinders Island Aerodrome site which will be exposed to aircraft noise and is produced for the consideration of aerodrome planning and development. Since the contours have no official status, they cannot be officially used for land-use planning purposes until they are converted into an ANEF.

Therefore, the data within **Figure 6** presented has not been verified and is provided in good faith for information purposes only. The data provided has been derived from FAAs *Integrated Noise Model (INM) Version 7.0c* using standard, non-verified inputs contained within *INM V7.0c* including typical engine noise data, and typical landing and take-off profiles.

Aurecon does not take any responsibility or liability for the accuracy or completeness of the information presented which is derived from the *INM V7.0c* software.

During detailed design of the potential new runway, an ANEF will be required to be produced and approved by the relevant authorities prior to construction.

Study Results

Figure 6 in **Appendix C** shows the relative A-weighted maximum sound level for Metro 23, SAAB 340 and DHC8D aircraft landing and taking-off from both the 11 Runway End and the 29 Runway End (combined), as generated by the *INM V7.0c* software.

The preliminary noise exposure concepts indicate that aircraft noise levels to residents in the vicinity of Flinders Island Aerodrome are, in general, likely to be acceptable in accordance with *AS 2021-2000 Acoustics – Aircraft noise intrusion – Building siting and construction*, with the exception of buildings around Bluff Road and Boyes Road. In this area noise levels are likely to exceed 80dB. Therefore depending on the number of flights per day, these buildings may require noise abatement measures.

There may also be other localised instances in the vicinity of the aerodrome where residential buildings may require noise abatement measures.

4 Aerodrome Infrastructure Requirements

4.1 General

Commentary on the specific requirements for detailed design and construction of airside and landside facilities and infrastructure is not considered within the scope of the New Runway Siting Study Report. It is therefore assumed that the detailed design and construction of all airside and landside facilities and infrastructure within this section of the New Runway Siting Study Report will be undertaken in accordance with all current regulatory requirements and industry standards.

It is assumed that should Traffic Scenario A be adopted as the Traffic Scenario for future planning purposes, Flinders Council will retain and operate the existing 14/32 Runway and not proceed with the potential new runway as it is not required.

For Traffic Scenario B and C the potential new runway and associated infrastructure shall satisfy the following general requirements:

a. Provide an instrument, Aerodrome Reference Code 3C, non-precision approach runway;
b. Enable the design aircraft mix to operate between Flinders Island and any southern mainland capital city or regional centre without significant operational restrictions;
c. Consolidate and improve the ability of GA, charter (including but not limited to F50 aircraft) and emergency aircraft to operate between Flinders Island, Tasmania and Victoria and other regional aerodromes, without significant operational restrictions;
d. Consolidate and improve the ability of freight aircraft to operate between Flinders Island and any southern mainland capital city or regional centre without significant operational restrictions;
e. Satisfy the requirements of a certified aerodrome under the Australian regulatory requirements;
f. Provide safe, functional, efficient, high quality and fit for purpose aerodrome airside infrastructure;
g. Provide aerodrome airside infrastructure which is economical to operate and maintain over their lifecycle;
h. Provide aerodrome airside infrastructure which is able to be constructed (constructability); and
i. Provide aerodrome airside infrastructure which is environmentally efficient and sustainable.

Considering the potential increase in aircraft capacity, and therefore passenger and freight capacity the potential new runway is likely to require a staged development of landside infrastructure (new or upgraded) in order to provide the required level of service to the community. The staged development will need to address, as a minimum, the following general requirements:

a. Enable the efficient and functional transfer and processing of passengers, baggage and freight to and from airside;
b. Enable the efficient and functional circulation and parking (short and long term) of a range of vehicles landside;
c. Accommodate aerodrome emergency procedure requirements;
d. Maximise the use of the aerodrome site in an economical and effective way, reserving space for future airside and landside facility and infrastructure expansion;
e. Achieve a balanced aerodrome layout whereby each element of the aerodrome has a potential capacity commensurate with the capacity of each other element;

f. Permitting the progressive development of aerodrome facilities to meet the demand with minimum dislocation to existing facilities and operations;

g. Retaining as far as practicable, flexibility and options for development to meet unforeseen demand or changed circumstances in foreseen demand;

h. Achieving as far as practicable, compatibility with the surrounding community and development; and

i. Recognising the potential for urban encroachment or airspace encroachment and providing appropriate protection measures.

4.2 Airside Infrastructure Requirements

4.2.1 Runway Dimensions and Standards

For comparison purposes, **Table 12** identifies the minimum runway dimensions and standards required to cater for Traffic Scenario B and C identified in **Section 3.3.3**.

Table 12 | Comparison of Runway Dimensions and Standards for Traffic Scenario B and C

Traffic Scenario	Runway Code	Runway Length	Runway Width	Runway Shoulders	Overall Runway Strip	Graded Portion of Runway Strip
Traffic Scenario B	3C	1600m to1900m	30m	Not Applicable	150m	90m
Traffic Scenario C	3C	1900m	30m	Not Applicable	150m	90m

4.2.2 Movement Area Pavements

Movement area pavements are defined as those pavements which are airside and used by aircraft.

Considering Flinders Council currently has no data on the predicted ultimate aircraft traffic for the potential new runway, it is proposed to adopt the aircraft traffic scenarios as outlined in **Section 3.3.3** for the purpose of pavement thickness design and indicative budget cost estimating.

The preliminary pavement composition design detailed will take into account cost, practicality and the minimisation of construction time.

Aurecon uses a combination of internally developed software and commercially developed software for pavement design. The internally developed programs for flexible and concrete pavements are based on the US Army Corps of Engineers (USACE) procedures as implemented by the Australian Department of Housing and Construction. For pavements comprising thick asphalt or bound layers, use is made of the APSDS (Airport Pavement Structural Design System) software.

Based on a 20 year functional design life, the pavement thickness and composition to cater for a range of aircraft traffic scenarios with aircraft arriving at MLW and departing at MTOW has been determined for a range of design subgrade CBR values (since site specific geotechnical information is not currently available). The range of design subgrade CBRs have been determined based on the Geotechnical Information and Data detailed in **Section 3.2.4**.

Table 13 illustrates the preliminary pavement thickness requirements for a range of subgrade CBR values to support the aircraft types and frequencies detailed in Traffic Scenarios B and C.

Table 13 | Preliminary Movement Area Pavement Thickness Requirements (mm)

Traffic Scenario	Design Subgrade CBR (%)			
	5	**6**	**8**	**10**
Traffic Scenario B	440	410	300	275
Traffic Scenario C	530	500	440	390

4.2.3 New Wearing Course

A comparison of the advantages and disadvantages between adopting a two coat bituminous spray seal and an asphalt wearing course is provided in **Table 14**.

Table 14 | Advantages and Disadvantages of a Two Coat Bituminous Spray Seal Compared to an Asphalt Wearing Course

Two Coat Bituminous Spray Seal		Asphalt	
Advantages	**Disadvantages**	**Advantages**	**Disadvantages**
Estimated cost range $\$20/m^2$ to $\$45/m^2$	Increased potential for FOD generation	Decreased potential for FOD generation	Estimated cost range $\$70/m^2$ to $\$130/m^2$
	Only suitable for aircraft <10,000kg	Suitable for aircraft >10,000kg	Anticipated functional life 10-15 years
	Anticipated functional life 10-12 years	Lower ongoing maintenance costs	
	Higher ongoing maintenance costs		

It has been assumed that the wearing course for the potential new runway pavement will be a two coat (likely 10mm/7mm) bituminous spray seal in the short to medium term, due to the cost difference when compared to asphalt. The difference in cost may be attributed to labour, plant and equipment transportation and the lack of high quality construction materials currently available on Flinders Island.

Considering the likely frequency of use, lower wheel loads and lower tyre pressures of the probable smaller aircraft in the short to medium term, an aerodrome specific two coat bituminous spray seal is appropriate. It is recommended in the medium to long term that if aircraft greater than 10,000kg MTOW are proposed to regularly utilise Flinders Island Aerodrome that consideration be given to an asphalt wearing course as the potential aircraft safety risk and pavement maintenance is minimised.

For an aerodrome bituminous spray seal, it is noted that high quality materials, workmanship and construction techniques are required for the duration of the works to ensure an adequate wearing course is achieved (well compacted, tight surface texture with minimal loose aggregate). The level of construction and material quality generally accepted for a rural road will not be adequate for the movement area wearing courses at the aerodrome. It is recommended that an aerodrome specific bituminous spray seal design be undertaken prior to tender and construction. It is also recommended that Contractors with suitable aerodrome construction experience be sought for such work, as well as ensuring that construction is closely monitored by suitably qualified Engineers.

It is noted that for many local government owned and operated aerodromes around Australia it is common practice for local governments to incorporate the cyclical re-sealing of the aerodrome movement area pavements into the overall road asset maintenance program in order to achieve capital expenditure reductions.

4.2.4 New Pavement Composition

A 20 year functional design life and an assumed design subgrade CBR 5% has been adopted for the pavement compositions identified in **Table 15** for indicative budget cost estimating purposes (refer also to **Figure 7** in **Appendix C**).

Table 15 | Pavement Composition based on Assumed Subgrade 5%

Option	Pavement Composition
Traffic Scenario B	Two coat bituminous seal
	Prime Coat
	100mm Class A crushed rock base course
	125mm Class A crushed rock base course
	200mm Cement treated crushed rock
	Subgrade CBR 5%
Traffic Scenario C	Two coat bituminous seal
	Prime Coat
	150mm Class A crushed rock base course
	150mm Class A crushed rock base course
	200mm Cement treated crushed rock
	Subgrade CBR 5%

Through recent investigations into potential sources of crushed rock on Flinders Island, it has been concluded that there are no suitable quarries or potential sources of Class A or Class B crushed rock which would satisfy the higher quality material properties which are necessary for the construction of the base course layer within the potential new runway pavement. This is also applicable to the 10mm and 7mm aggregate which would be required for the construction of the bituminous spray seal wearing course. These aggregate materials would need to be sourced from Tasmania or Victoria.

Should local rock be quarried and crushed on Flinders Island in the short to medium term, there is potential to use this material in the lower portion of the sub-base course layer or cement treated crushed rock layer. It is recommended that an assessment of locally sourced aggregate material, and the risks associated with this material based on its engineering properties be undertaken during the detailed design phase in order to assess the viability of its use.

Refer to **Section 3.2.4** regarding the existing geotechnical information and the assumed subgrade CBR 5%.

4.2.5 Aeronautical Ground Lighting

It is suggested that the following visual aids provided by Aeronautical Ground Lighting (AGL) will be required to support the anticipated Code 3C aircraft operations:

a. Runway lighting system (3 stage medium intensity Pilot Activated Lighting (PAL) system) comprising;
   - Runway edge lights;
   - Runway turning area edge lights;
   - Runway threshold lights; and

Runway end lights.

b. Precision Approach Path Indicator (PAPI) System (potential); and

c. Obstacle lighting (potential).

Refer to **Figure 8** in **Appendix C** for a typical AGL detail.

It is assumed that all visual aids will be serviced by a pit and conduit (including duct banks) system with power supplied from a central distribution source with specific lighting equipment housed in an Aerodrome Lighting Equipment Room (ALER).

Determination of any necessary power upgrade requirements have not be assessed in detail as this determination will be dependent on a detailed review as to whether Mains Isolating Transformers (MITs) or Constant Current Regulators (CCRs) are documented during detailed design (which is dependent on the type of AGL fittings and other equipment specified to be installed), however no major power supply upgrades are anticipated to be necessary for the new AGL system.

4.2.6 Visual Aids

It is suggested that the following visual aids will be required to support Code 3C aircraft operations:

a. Runway line marking;

b. Gable markers;

c. Ground signal area;

d. Wind Direction Indicator (illuminated); and

e. Movement Area Guidance Signs (MAGS).

4.3 Environmentally Sustainable Design

It is suggested that an environmentally sustainable approach to detailed design be applied for airside infrastructure where practicable and economical, or specifically required by Flinders Council.

During the process of detailed design it is recommended that the following is considered as a minimum:

a. Efficient use of energy (including low energy products and materials);

b. Reuse of existing natural materials (where practical and economical);

c. Avoid disruption of local flora and fauna (where practical);

d. Avoid disturbance of culturally sensitive areas;

e. Minimal disruption to the surrounding community through noise and dust creation; and

f. Maximisation of locally available material usage to minimise haulage.

Environmentally Sustainable Design measures incorporated into the design are anticipated to potentially include:

a. Recovery of stone material for reuse in erosion protection works; and

b. Use of local quarry material in pavement sub-base.

5 Concept Design Options

5.1 Concept Design Options Summary

The potential new runway layout options are illustrated in **Figure 3** and **4** of **Appendix C**.

Table 16 below summarises the advantages and disadvantages of adopting Traffic Scenario A, B or C for either Option 1 or Option 2.

A semi-quantitative multi-criteria assessment (non-financial) of Option 1, Option 2 and Option 3 (existing conditions) has also been undertaken and is detailed separately in **Section 6**.

Table 16 | Summary of Concept Design Options

Option	Advantages	Disadvantages
Traffic Scenario A	▪ Existing 14/32 Runway would be maintained ▪ Existing 14/32 Runway is a compliant 1600m long x 30m wide Code 3C Runway ▪ Potential new 11/29 Runway would not be constructed ▪ Low environmental impact ▪ Lowest capital cost option	▪ Suitable for aircraft up to 7,500kg only ▪ Existing aircraft traffic is causing ongoing pavement failures on the existing 14/32 Runway which require regular preventative pavement maintenance ▪ Ongoing existing 14/32 Runway regular preventative pavement maintenance costs ▪ Potential high disruption to existing aerodrome operations during ongoing regular preventative pavement maintenance activities on the 14/32 Runway ▪ Existing 14/32 Runway pavement strength restricts the size and type of aircraft that may operate, which is therefore limiting destinations, operators, passenger and freight capacity (potential economic impact) ▪ Existing 14/32 Runway pavement length restricts the size and type of aircraft that may operate, which is therefore limiting destinations, operators, passenger and freight capacity (potential economic impact) ▪ Utilising the existing 14/32 Runway at Flinders Island Aerodrome results in a lack of flexibility to cater for any changes to the existing aircraft fleet which currently serves Flinders Island. ▪ Poor provision for future increase in airside capacity and development
Traffic Scenario B	▪ Fully compliant (pending official CASA approval regarding minor approach surface infringements) 1900m long x 30m wide Code 3C Runway (partially future proofed asset)	▪ Medium capital cost option ▪ Potential medium disruption to existing aerodrome operations during construction

Option	Advantages	Disadvantages
	■ Eliminate the need for regular preventative pavement maintenance on the existing 14/32 Runway ■ Suitable for aircraft up to 13,500kg and larger aircraft under a pavement concession ■ Good flexibility to cater for a range of different aircraft and operators ■ 11/29 Runway pavement strength will not significantly restrict the size and type of aircraft that may operate, which therefore provides increased destination potential, passenger and freight capacity (which in turn has economic growth potential) ■ 11/29 Runway pavement length will not significantly restrict the size and type of aircraft that may operate, which therefore provides increased destination potential, passenger and freight capacity (which in turn has economic growth potential) ■ Good provision for future increase in airside capacity and development	■ Medium environmental impact
Traffic Scenario C	■ Fully compliant (pending official CASA approval regarding minor approach surface infringements) 1900m long x 30m wide Code 3C Runway (future proofed asset) ■ Eliminate the need for regular preventative pavement maintenance on the existing 14/32 Runway ■ Suitable for aircraft up to 19,000kg and larger aircraft under pavement concession ■ Good flexibility to cater for a range of different aircraft and operators ■ 11/29 Runway pavement strength will not significantly restrict the size and type of aircraft that may operate, which therefore provides increased destination potential, passenger and freight capacity (which in turn has economic growth potential) ■ 11/29 Runway pavement length will not significantly restrict the size and type of aircraft that may operate, which therefore provides increased destination potential, passenger and freight capacity (which in turn has economic growth potential) ■ Good provision for future increase in airside capacity and development	■ Highest capital cost option ■ Potential medium disruption to existing aerodrome operations during construction ■ Medium environmental impact ■ Potential for excess operational capacity which may never be utilised (however low likelihood)

6 Semi-Quantitative Multi-Criteria Assessment

6.1 Semi-Quantitative Criteria

The semi-quantitative multi-criteria assessment (non-financial) of Option 1, Option 2 and Option 3 (existing conditions) has been undertaken based on the semi-quantitative criteria identified in **Table 17** below in order to positively prioritise the opportunities.

Table 17 | Semi-Quantitative Criteria

Level	Descriptor	Description
1	■ Insignificant	Low impact, preferred solution
2	■ Minor	Minor impact, lower preference solution
3	■ Moderate	Moderate impact, lower preference solution
4	■ Major	Major impact, lowest preference solution

6.2 Semi-Quantitative Multi-Criteria Assessment Summary

The semi-quantitative multi-criteria assessment (non-financial) of Option 1, Option 2 and Option 3 (existing conditions) is provided in **Table 18** below.

Items highlighted in grey are considered critical criteria which may render the option unviable.

Table 18 | Semi-Quantitative Multi-Criteria Assessment for Option 1, Option 2 and Option 3 (existing conditions)

Assessment Criteria	Option 1	Option 2	Option 3 (existing conditions)
1.Physical land space required	▪ 3 – Moderate	▪ 3 – Moderate	▪ 1 – Insignificant
2.Physical airspace required	▪ 1 – Insignificant	▪ 1 – Insignificant	▪ 1 – Insignificant
3.Metrological conditions	▪ 1 – Insignificant	▪ 1 – Insignificant	▪ 2 – Minor
4.Topography	▪ 2 – Minor	▪ 4 – Major	▪ 1 – Insignificant
5.Geology	▪ 2 – Minor	▪ 2 – Minor	▪ 1 – Insignificant
6.Environmental and heritage impact	▪ 3 – Moderate	▪ 2 – Minor	▪ 1 – Insignificant
7.Land acquisition	▪ 3 – Moderate	▪ 2 – Minor	▪ 1 – Insignificant
8.Access to population centres	▪ 1 – Insignificant	▪ 1 – Insignificant	▪ 1 – Insignificant
9.Access to emergency services	▪ 1 – Insignificant	▪ 1 – Insignificant	▪ 1 – Insignificant
10.Potential disruption to existing aerodrome operations during construction	▪ 3 – Moderate	▪ 3 – Moderate	▪ 1 – Insignificant
11.Aircraft type/fleet flexibility	▪ 1 – Insignificant	▪ 1 – Insignificant	▪ 4 – Major
12.Potential disruption to existing aerodrome operations in the future	▪ 1 – Insignificant	▪ 1 – Insignificant	▪ 4 – Major
13.Potential economic impact in the future	▪ 1 – Insignificant	▪ 1 – Insignificant	▪ 3 – Moderate
14.Traffic Scenario A (Pavement Strength)	▪ 1 – Insignificant	▪ 1 – Insignificant	▪ 3 – Moderate
15.Traffic Scenario B (Pavement Strength)	▪ 1 – Insignificant	▪ 1 – Insignificant	▪ 4 – Major
16.Traffic Scenario C (Pavement Strength)	▪ 1 – Insignificant	▪ 1 – Insignificant	▪ 4 – Major
Total	**25**	**26**	**33**

Based on the 16 criteria assessment, Option 1 is ranked as the preferred option, followed by Option 2 and Option 3.

Option 2 and Option 3 also have critical criteria which may render these options unviable.

The option of maintaining existing conditions into the future is a realistic possibility in the short to medium term with a comprehensive regular pavement monitoring and pavement maintenance regime to ensure that there are no aircraft safety issues and the 14/32 Runway is not rendered unserviceable.

However the extent of preventative maintenance, capital expenditure and the medium to long term effect of pavement overload damage is difficult to quantify. Based on the extent of recent in-situ stabilised patching works that were undertaken on the 14/32 Runway (March/April 2015), combined with the observed existing condition of the base course material and wearing course, it is considered that any preventative pavement maintenance regime implemented in order to maintain a safe and serviceable pavement would need to be extensive and diligently maintained.

Under a preventative pavement maintenance regime, the worst case scenario would be that the 14/32 Runway would be rendered unserviceable for aircraft operations (based on a visual inspection) and the 14/32 Runway would need to be closed for a period of time.

In this circumstance, Flinders Council would need to react quickly to undertake whatever maintenance work is necessary for the 14/32 Runway to be operational again, at whatever cost during an unknown timeframe.

For such a regime to be functional and effective, Flinders Council need to understand and accept the risks, ensure maintenance budgets are flexible, ensure maintenance staff are well equipped and have adequate materials, and ensure that stakeholders (such as Sharp Airlines, Royal Flying Doctor Service, community etc.) are informed of the potential risks (i.e. delays to services) and why the regime is necessary.

7 Indicative Budget Costs

7.1 Basis for Costing

Indicative budget costs for providing a potential new runway for Code 3C aircraft operations as detailed in this New Runway Siting Study Report are summarised below and detailed in **Appendix D**. All costs exclude GST, allowances for other fees, other Flinders Council costs and contingencies.

Aurecon considers indicative budget costs to be a first cost indication (at current prices at the date stated). They are provided to Flinders Council based on an outline estimate of Flinders Council's needs; prepared by reference to feasibility sketches or assessed without sketches (in some instances) and based on Aurecon's knowledge of costs for similar projects. They have been prepared without the benefit of detailed design and without detailed consideration of survey, geometry, drainage, existing/proposed services or other local information. An indicative budget cost is intended only as a guide for a pre-feasibility and planning purposes, it is not an estimate and may not be quoted as such. Indicative budget costs are prepared using broad cost parameters (e.g. earthworks and pavements on a cost per square metre basis).

Since Aurecon has no control over the cost of labour, materials, equipment or services furnished by others, or over Contractor's methods of determining prices, or over competitive bidding or market conditions, any opinion or indicative costs by Aurecon is made on the basis of our experience and represents Aurecon's judgement as experienced and qualified professional Engineers. Aurecon cannot and does not, however, guarantee that proposals, bids or actual construction costs will not vary from our indicative budget costs.

7.2 Indicative Budget Costs

Table 19 and **Table 20** provides a summary of indicative budget costs for new runway pavement construction for Traffic Scenario B and C as described in **Section 4.2** based on the assumed representative subgrade CBR value of 5% described in **Section 3.2.4**.

Table 19 | Indicative Budget Costs –Traffic Scenario B

Option	Item	Cost ($M)
Traffic Scenario B	Preliminaries	$1.7
	Clearing and Grubbing of Site	$0.3
	11/29 Runway Pavement Construction	$14.8
	Line Marking	$0.2
	Aeronautical Ground Lighting	$0.9
	Stormwater Drainage	$0.6
	Provisional Sums	$1.1
	Total	**$19.6**

Table 20 | Indicative Budget Costs –Traffic Scenario C

Option	Item	Cost
Traffic Scenario C	Preliminaries	$1.7
	Clearing and Grubbing of Site	$0.3
	11/29 Runway Pavement Construction	$15.7
	Line Marking	$0.2
	Aeronautical Ground Lighting	$0.9
	Stormwater Drainage	$0.6
	Provisional Sums	$1.1
	Total	**$20.5**

It is difficult to undertake a comprehensive comparison of the concept pavement design and the associated indicative budget costs detailed herein with similar aerodromes in Australia, as no two aerodrome sites are identical.

Items such as the procurement and transportation of stormwater drainage materials are comparable to other regional and remote sites on mainland Australia.

However, based on recent project experience, due to Flinders Island's remoteness, the cost of aggregate material procurement and transportation is significantly more than in mainland Australia or Tasmania. The cost of aggregate materials are typically greater than two times the standard market rates in Tasmania (primarily due to transportation by sea), and this is the single largest project cost item which is inflated due to the order of magnitude in quantity.

Refer to **Section 4.2.4** for details regarding the aggregate quality typically required for aerodrome pavement construction and discussion regarding the use of locally sourced materials.

The indicative budget costs are based on construction costs and include an estimation of:

- Preliminaries such as Contractor site establishment and disestablishment, Contractor site administration, Contractor QA and environmental management, maintenance of site access roads, surveying and supply of As-Built drawings;
- Pavement excavation and earthworks and subgrade preparation including cartage, compaction and proof rolling;
- Pavement construction (based on bituminous sprayed seal surfacing, base course, sub-base course and cement treated crushed rock material where applicable);
- Pavement base course construction from imported material only;
- Pavement sub-base course construction from imported and local sourced materials;
- Select fill material for subgrade replacement from local sourced materials;
- Elevated edge lights and SIT pits including new concrete bases;
- Primary and secondary conduit system (with cables and pits) for the AGL;
- Illuminated wind direction indicator;
- Gable markers;

- Line marking;
- Stormwater drainage (no allowance for sub-surface drainage); and
- Provisional items estimate such as treatment of existing pavement, subgrade replacement and topsoiling of disturbed areas.

The indicative budget costs specifically exclude an estimation of:

- Costs associated with excavation and earthworks to achieve compliant design longitudinal and transverse gradients (vertical geometry);
- Importing select fill material for subgrade replacement from a remote site;
- Disposal of cut material from site which may not be suitable for use as general fill in flanks;
- Costs associated with delays as a result of weather during construction;
- Costs associated with new infrastructure and services (including buildings, roads, electrical, communications, sewerage, water, gas and fuel facilities);
- Costs associated with upgrades to existing infrastructure and services (including buildings, roads, electrical, communications, sewerage, water, gas and fuel facilities);
- Costs associated with future pavement, drainage, lighting or infrastructure expansion;
- Costs associated with any aerodrome fencing and security control;
- Costs associated with any restrictions to aerodrome operations during construction;
- Costs associated with any aircraft operational matters including:
  - Take-off and approach tracks;
  - GPS approaches;
  - Noise and noise abatement procedures;
  - Navigational aids (with the exception of line marking);
  - Obstacle Limitation Surfaces;
- Costs associated with the potential development or redevelopment of airside areas into the future; and
- Costs associated with any additional statutory, regulatory, planning or environmental requirements associated with the potential new runway pavement construction. CASA or environmental requirements associated with the concept layout options.

7.3 Accuracy of Indicative Budget Costs

The accuracy of the indicative budget costs is considered to be of the order of 30% too high to 30% too low.

The accuracy is governed by the limitations identified in **Section 7.1**.

7.4 Potential Project Cost Savings

The following have been identified as potential cost savings for Flinders Council:

a. Sourcing suitable aggregate from a local quarry where possible for lower sub-base or subgrade replacement – estimated potential saving of $1M to $2M;

b. Refining the assumed aircraft traffic and/or establishing the site specific geotechnical conditions which may potentially reduce the overall pavement thickness required – estimated potential saving of $0.5M to $1M;
c. Completing the vegetation removal, bulk earthworks and other discrete construction elements as a separable portion with the use of local Contractors and equipment – estimated potential saving of $0.3M to $0.7M;
d. Completing the majority of AGL works with Flinders Council Resources – estimated potential saving of $0.2M to $0.45M;
e. Completing the majority of stormwater works with Flinders Council Resources – estimated potential saving of $0.1M to $0.2M;
f. Completing the line marking with Flinders Council Resources – estimated potential saving of $0.05M to $0.07M; and
g. Flinders Council provides Principal Supplied Items to the Contractor (i.e. light fittings, pipes, pits etc) – estimated potential saving of $0.5M to $2M.

8 Indicative Construction Program

8.1 Pre-Construction Activities

It is envisaged that there will be a need for a range pre-construction activities to take place prior to the commencement of any works on site. Some of the necessary pre-commencement activities may include:

- Liaising with Government to determine funding opportunities;
- Undertaking necessary studies, investigations and detailed design to assist with Government and authority approvals, as well as funding applications;
- Community and stakeholder consultation;
- Government and authority approval process;
- Liaison with CASA and AirServices Australia;
- Liaison with likely aircraft operators;
- Tendering the Works;
- Material procurement, such as aggregates for pavement construction and long lead time items such aerodrome lighting cabling and navigational aids;
- Site establishment; and
- Bulk earthworks.

Due to the statutory nature of many of these tasks, it is envisaged that a minimum period of 24 to 30 months will be required from project inception to awarding the tender, subject to funding approval.

8.2 Project Delivery Method

A contracting and execution strategy that meets operational, budget, quality and program requirements of Flinders Council needs to be developed.

There are a number of possible delivery strategies that influence the time, cost and quality of project outcomes. There are obviously many variables, combinations and influencing factors but in short, a Design and Construct (D&C) approach is likely to produce overall time advantages, Early Contractor Involvement (ECI) is likely to have an influence on cost and a conventional (traditional) approach (design, tender and construct) is likely to have the greatest influence on construction quality.

Combinations, such as a conventional approach with some ECI can be adopted to leverage the cost (and possibly the program), benefits that ECI has to offer.

8.3 Indicative Construction Program

The following programs have been prepared based on a conventional delivery method and are provided as a guide only. The timeframes provided are based on a single Contractor working normal daylight hours and with no allowance for an accelerated program. The actual timeframes will be influenced by a number of variables including the Contractors resources, number of work fronts, experience, material availability and weather delays.

Consideration should also be given to the need for a 9-12 month design, tender and award period prior to the commencement of works. Similarly after construction is complete, a time allowance will need to be allowed for testing, commissioning and certification prior to the potential new runway being suitable for operation.

An accelerated program involving multiple contracts and/or multiple work fronts undertaken concurrently and/or under extended working hours (e.g. 2 shifts per day for 7 days per week) could be developed to expedite the delivery of the project, however this would attract additional costs and is likely to have a detrimental impact on quality and is therefore not recommended.

It is estimated that construction of a potential new 1900m long, 30m wide runway will take between 10-16 months.

9 Conclusions and Recommendations

The existing 14/32 Runway at Flinders Island Aerodrome is currently exhibiting signs of distress under the existing aircraft traffic loading, with a range of pavement defects occurring. Consequently, the requirement for regular preventative pavement maintenance to ensure the runway is safe and serviceable for aircraft operations has resulted in disruptions to aircraft operations (during the preventative pavement maintenance works) and is a significant ongoing cost for Flinders Council.

Maintaining the operation of the 14/32 Runway into the medium to long term (greater than 10 years) at Flinders Island Aerodrome presents a range of risks to Flinders Council, including the following:

1. The existing pavement strength of the 14/32 Runway and 05/23 Runway will not support aircraft larger than 7,500kg;
2. Ongoing pavement failures on the existing 14/32 Runway will continue and are likely to increase in frequency, requiring regular preventative pavement maintenance to ensure the runway is safe and serviceable;
3. Ongoing costs (with likelihood to increase) associated with the regular preventative pavement maintenance of the existing 14/32 Runway;
4. High likelihood of disruption to existing aerodrome operations during ongoing regular preventative pavement maintenance activities on the 14/32 Runway;
5. Lack of flexibility to cater for changes to the existing aircraft fleet which currently service Flinders Island;
6. Restrict the ability to cater for a range of current or future aircraft or operators, which impacts destination reach, passenger and freight capacity, and economic growth; and
7. Poor provision for future increase in airside capacity and development.

Due to the likely extended disruption to existing aircraft operations during construction, it is not considered appropriate to reconstruct or overlay the existing 14/32 Runway, Taxiway and RPT Apron pavements at Flinders Island Aerodrome to improve pavement strength. In order for these works to occur, it is anticipated that the 14/32 Runway would be closed to aircraft operations for a minimum of 6 months.

The lowest risk option (in terms of allowing a range of aircraft at particular weights and tyre pressures, minimising the disruption to existing aircraft operations, reducing the requirement for preventative pavement maintenance and maintaining safe and serviceable pavements) into the long term (greater than 20 years) is to investigate, plan, design and construct a potential new runway, west of the existing 14/32 Runway and reconstruct the existing Taxiway A and the RPT Apron pavements.

It is recommended that should a potential new Code 3C, instrument non-precision approach runway (11/29 Runway) be constructed (Traffic Scenario C, Option 1), that the location and orientation (alignment) detailed herein be adopted, based on consideration of the range of existing preliminary information and data available, and other key criteria detailed in **Section 3**.

A range of potential runway locations and orientations (alignments) were investigated in the option optimisation process which resulted in two preferred options. The majority of potential options were not investigated in detail due to the resulting encroachment of existing topography with the approach and departure paths.

The runway orientation option of providing a potential new runway on the same alignment as the existing 14/32 Runway, offset 93m to the west, and converting the existing 14/32 Runway into a parallel Code C taxiway was also investigated. This option was not investigated in detail due to the following:

a. The predominant winds do not favour the existing 14/32 Runway alignment;
b. The environmental impact was much more significant;
c. The extent of land acquisition was much more significant;
d. The extent of bulk earthworks was much more significant; and
e. The existing 14/32 Runway pavement strength would still need to be upgraded in order to serve as a taxiway.

A potential new 11/29 Runway would provide Flinders Island with a future proofed asset which would provide no significant restrictions to a range of aircraft and operators travelling between Flinders Island and southern Australian capital cities and regional centres. A potential new 11/29 Runway would therefore provide greater passenger and freight capacity and contribute significantly to economic growth on Flinders Island.

The option of maintaining existing conditions into the future is a realistic possibility in the short to medium term with a comprehensive regular pavement monitoring and pavement maintenance regime to ensure that there are no aircraft safety issues and the 14/32 Runway is not rendered unserviceable.

However the extent of preventative maintenance, capital expenditure and the medium to long term effect of pavement overload damage is difficult to quantify. Based on the extent of recent in-situ stabilised patching works that were undertaken on the 14/32 Runway (March/April 2015), combined with the observed existing condition of the base course material and wearing course, it is considered that any preventative pavement maintenance regime implemented in order to maintain a safe and serviceable pavement would need to be extensive and diligently maintained.

Under a preventative pavement maintenance regime, the worst case scenario would be that the 14/32 Runway would be rendered unserviceable for aircraft operations (based on a visual inspection) and the 14/32 Runway would need to be closed for a period of time.

In this circumstance, Flinders Council would need to react quickly to undertake whatever maintenance work is necessary for the 14/32 Runway to be operational again, at whatever cost during an unknown timeframe.

For such a regime to be functional and effective, Flinders Council need to understand and accept the risks, ensure maintenance budgets are flexible, ensure maintenance staff are well equipped and have adequate materials, and ensure that stakeholders (such as Sharp Airlines, Royal Flying Doctor Service, community etc.) are informed of the potential risks (i.e. delays to services) and why the regime is necessary.

Although not considered within the scope of this New Runway Siting Study Report, it is important to note the following when considering the economic viability of the potential new 11/29 Runway:

- In a recent report published by the Australian Airports Association (AAA) in 2012, it was estimated that as many as 50% of Australia's regional aerodromes/airports may be operating at a loss each year;
- It is estimated by Aurecon that the majority of small to medium aerodromes in Australia with less than 1,700 RPT aircraft movements and/or 60,000 passenger movements per year operate at a financial loss. However they are considered by their owners and operators (typically local government) to be a public asset which provides a service to the community;

- The major source of revenue from small to medium aerodromes in Australia is typically from passenger and landing charges;
- Small aerodromes typically transition to medium aerodromes through diversifying their revenue base and reducing their dependence on passenger and landing charges. This can best be accomplished through a greater focus on attracting aviation and aviation support industries, land development and growth of complementary businesses. This however, is dependent on population catchment and demand.

Considering the current and projected population of Flinders Island over the next 20 years, the primary objective in developing Flinders Island Aerodrome should be to provide the best aerodrome facilities, the best airline services, the best commercial and industrial opportunities and the best recreational amenity at a reasonable cost that is acceptable to Flinders Council and the Flinders Island community.

The key to the future of Flinders Island Aerodrome is therefore founded upon:

- Timely upgrading of airside and landside infrastructure to provide operational flexibility to accommodate a range of aircraft and operators into the future;
- Maintaining and improving a public asset which can adequately support airlines, business, emergency services, agriculture, recreational activities and therefore the Flinders Island community into the future; and
- Maintaining and improving a public asset which is a facilitator for economic growth.

Generally, in order to determine future investment at Flinders Island Aerodrome and assess the viability of a potential new 11/29 Runway, the current and projected population would be assessed in conjunction with indicative cash flows over the 20 year duration. This information would then be modelled using Cost Benefit Analysis (CBA).

The CBA is based on the premise that the value of a project is the Net Present Value (NPV) of its future cash flows, both in terms of costs and revenue that can be directly attributed to the project.

The CBA requires forecasting of the projects cash flows over a time period reflecting the effective life of the asset, analysis of these future cash flows and the application of an appropriate discount rate to align with the cost of capital.

Although the potential new 11/29 Runway has a significant amount of construction works in the medium term (indicatively as early as 2020), any CBA would need to provide for a 20 year assessment period post construction that corresponds to the effective useful life of the potential new 11/29 Runway (prior to the need for routine maintenance works).

A positive NPV and a Benefit Cost Ratio (BCR) greater than one indicate that the project is commercially justified under the set of assumptions adopted in the CBA modelling.

For Flinders Island Aerodrome in the short to medium term, the primary aerodrome revenue item is Passenger Head Charges, which is directly attributed to passenger movements through the aerodrome and Aircraft Landing Charges at the aerodrome.

Based on previous experience with similar projects, it is probable that the NPV will be negative and the BCR will be less than one for the potential new 11/29 Runway project, to what degree will depend greatly on the assumptions made during the analysis.

It is therefore important that the CBA modelling results are considered as a component within the process of evaluating the benefits of such a project. Accordingly, the project should be considered alongside the major community (social), environmental, planning and budgetary considerations.

Regional aerodromes such as Flinders Island Aerodrome play a critical role in serving their community and the Australian economy more broadly. However the broad economic impacts are typically difficult to quantify and may potentially only be recognised over a long period of time.

For example, the 2012 AAA report noted that in 2011, regional and remote aerodromes in Australia value added approximately $77M from aerodrome related activities from their precincts, with approximately $42M in wages and costs yielding a gross operating surplus of approximately $35M. This is only one component of the economic profile for regional and remote aerodromes; however it illustrates how important they are as a community asset.

Appendices

Appendix A
Glossary of Terms and Abbreviations

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Glossary of Terms and Abbreviations

Term	Definition
ACN	Aircraft Classification Number
ACP	Airspace Change Proposal
AGL	Aeronautical Ground Lighting
ALER	Airport Lighting Equipment Room
ANEC	Australian Noise Exposure Contours
ANEF	Australian Noise Exposure Forecast
ARC	Aerodrome Reference Code
ARFL	Aeroplane Reference Field Length
ASDA	Accelerate Stop Distance Available
ATC	Air Traffic Control
CBR	California Bearing Ratio
CASA	Civil Aviation Safety Authority
CASR	Civil Aviation Safety Regulation
CCR	Constant Current Regulator
DAP	Departure and Approach Procedures
DME	Distance Measuring Equipment
ERSA	Enroute Supplement Australia
FAR	Federal Aviation Regulations
GA	General Aviation (*GA operations include non-scheduled airlines, charter, private flying, pilot training, aircraft testing, ferrying and aerial work).*
GPS	Global Positioning System
GNSS	Global Navigation Satellite System
IATA	International Air Transport Association
ICAO	International Civil Aviation Organisation
ISA	International Standard Atmosphere

Term	Definition
LDA	Landing Distance Avaliable
MAGS	Movement Area Guidance Sign
MIT	Mains Isolating Transformer
MLW	Maximum Landing Weight
MOS Part 139	Manual of Standards Part 139 – Aerodromes (CASA)
MTOW	Maximum Take-Off Weight
NAL	National Acoustics Laboratories
NDB	Non-Directional Beacon
NOTAM	Notice to Airmen
OLS	Obstacle Limitation Surface
PAL	Pilot Activated Lighting
PAPI	Precision Approach Path Indicator
PCN	Pavement Classification Number
RESA	Runway End Safety Area
RNAV	Area Navigation
RPT	Regular Public Transport
TODA	Take Off Distance Available
TORA	Take Off Run Available

Appendix B
IDS Australasia Report

FEASIBILITY REPORT FOR FLINDERS ISLAND RNAV GNSS PROCEDURES

The following document has been prepared for Flinders Island (YFLI) for the purpose of a feasibility study (Desktop review) for the implementation of two Area Navigation (RNAV) Global Navigation Satellite System (GNSS) approach. The information contained has taken into account all factors in accordance with CASR MOS PART 173, with the exception of environmental, flight validation and publication of the procedures.

IDS Australasia Pty Ltd
Unit 5, 3-5 Hinkler Court, Brendale, Queensland, Australia, 4500
Phone + 61 732 055 524
Fax +61 732 055 536
ABN 45 131 835 562
www.idscorporation.com/au

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1. OVERVIEW

Flinders Island is located in Bass Strait and sits to the north east of the Tasmanian mainland. Flinders Island aerodrome (YFLI) is located on the coastal plain on the western side of the island.

The existing runway arrangement consists of the primary runway aligned 14/32 and a cross runway, 05/23 intersecting at the southern end of the main runway.

The terrain in the vicinity of the aerodrome is to the east and to the north of the runway complex has presented some challenges in achieving useful landing minima. Mount Strzelecki is the highest peak on the island being some 780 metres high and on bearing 148° T and 7.6nm (15km) from the Flinders Island (YFLI) Aerodrome reference Point (ARP). The terrain surrounding the peak has had no impact on the proposed RWY 30 RNAV approach however, obstacles and terrain closer to the aerodrome have had a significant impact.

The existing approaches to YFLI consist of the RNAV GNSS approach and the Non Directional Beacon (NDB) approach to RWY 05. The minima on these approaches are relatively high due to the final inbound tracks tracking east towards high terrain.

Note: results provided in this Feasibility Report are based on data supplied by the client. The actual results achieved may change after procedure design and flight validation should additional obstacles be observed. The proposed wind turbine generator (WTG) is the controlling obstacle for the RWY 29 approach however, without the generator; the minima would only be reduced by ten feet.

Note: the heights in the tables below are in feet above ground level (AGL).

2. FEASIBILITY OF PROPOSED INSTRUMENT APPROACHES

This report was compiled to determine the feasibility of Instrument Approaches to each end of a proposed re-alignment of the current runway. These proposed approaches would be termed RNAV GNSS approaches as they are based on aircraft utilising global navigation satellite systems (GNSS).

From the supplied Eastings and Northings data, the alignment of proposal 1 resulted in the following runway bearings: 119° 53’ 25.24” and 299° 52’ 37.63”. This alignment results in magnetic runway bearings of 11/29.

All instrument approaches are designed around criteria set out in the International Civil Aviation Organisation (ICAO) Document 8168 and also to the Manual of Standards (MOS) 173 promulgated by the Australian Civil Aviation Safety Authority (CASA).

Approaches based on satellite-based positioning systems have a nominal aircraft track that is runway aligned or within up to ± 15°. This type of procedure allows for reduced pilot workload as the aircraft is tracking for a straight-in approach rather than a turning procedure using ground based navigation approaches such as NDB/VOR. (Refer to FLI NDB approach)

The protection areas associated with GNSS approaches are smaller in comparison than ground based navigation aid approaches. This is advantageous as there are a reduced numbers of obstacles and terrain peaks to be considered in the assessment.

All GNSS approaches in Australia are designed around a standard ‘Y’ bar arrangement which has three initial waypoints (where the procedure is commenced) followed by intermediate and final waypoints (Refer to diagram attached to this report).The final waypoint/fix (FAF) is generally positioned 5nm (9km) from the runway threshold. At the threshold is a missed approach waypoint (MAPt) which the aircraft must overfly in the event the procedure cannot be continued due to weather or other constraints.

3. FEASIBILITY RWY 11 RNAV.

From the supplied Eastings and Northings data, the alignment of proposal 1 resulted in the following runway bearings: 119° 53' 25.24" and 299° 52' 37.63". This alignment is considered 11/29. A design was constructed for a straight approach to RWY 11 using a standard 'Y' bar arrangement with three initial approach waypoints and a turning missed approach to an altitude A turning missed approach to the right is necessary in this instance to avoid the high terrain to the south east of the aerodrome. The turning missed approach procedure returns the aircraft back to one of the initial waypoints.

In the final approach for RWY 11, the Final Approach Fix (FAF) was placed at 4 nm from the threshold (THR). The minimum altitude for this approach was determined as follows:

Obstacle Clearance Height (OCH) (*from procedure construction*)	**307 (310) feet AGL**
Vegetation Allowance	**100 feet** (required as per MOS 173 – 8.1.5.1 (c)
Chart Error	**33 feet** (required as per MOS 173 – 8.1.5.1 (a) (i)
No TAF Service	**N/A**
Minimum Descent Altitude (MDA) with AWIS	**443 (450) feet** *
Minimum Descent Altitude without AWIS	**550 feet AGL**

*The AIP states that where an accurate QNH source is available, the published minima may be reduced by 100 feet. ***AIP ENR 1.5 para 5.3.2***

4. FEASIBILITY FOR RWY 29 RNAV

A number of proposed designs for this approach were considered complying with the standard 'Y' bar arrangement. Due to Mt. Strzelecki and the surrounding terrain, it was decided to have only two initial approach waypoints.

The third initial waypoint would have been located in proximity with this high terrain substantially raising the initial approach altitude.

Due to obstacles and terrain between the final approach fix and the RWY 29 threshold, it was decided to construct the procedure with a 3.5° approach slope. The high terrain on the islands' south posed no significant issues as the initial approach fixes were over relatively low terrain.

The obstacles and terrain that impacted on the procedure are all located within three nautical miles of the RWY 30 threshold. The intended proposed design had a straight-in approach but the protection area included terrain points/peaks immediately to the north east of the aerodrome. A design incorporating an 8° off-set approach was used with a step-down fix 2.25nm/4.16km from the 29 threshold. This fix allows an aircraft fly over obstacles prior to descent and generally allows a lower minimum altitude.

With all instrument procedures, it is optimal to have 3° or 5% approach slope. Under ICAO criteria, the minimum and maximum approach slopes are 2.5° and 3.5° respectively. In order to minimise time spent on this procedure, it was decided to design the procedure using a 3.5° slope so as to immediately avoid any obstacles/terrain peaks below the aircraft nominal track. However, due to terrain within the protection areas, terrain points were still picked up during the assessment. The proposed design for this feasibility was a 3.5° approach slope with the final approach track being off-set by 8° from the proposed runway alignment. The missed approach procedure was also off-set to the left of the runway heading in order to avoid the terrain to the east of the aerodrome.

One of the obstacles is the proposed wind turbine generator (WTG) that was noted in the RWY 11 procedure. Although this has not been constructed, it was entered as part of the evaluation. The controlling obstacle for this procedure is the existing WTG located 3.74nm/6.92km and bearing 131.47 from the RWY 29 threshold. For the approach to this runway, the FAF was placed at 7NM from the runway threshold (THR). The minimum altitude for this approach was determined as follows:

The minimum OCH/MDH for RWY 29 was calculated as follows:

Obstacle Clearance Height (OCH) (*from procedure construction)*	**752.76 (760)feet AGL**
Vegetation allowance	**100 feet** (as per MOS 173)
Chart Error	**33 feet** (as per MOS 173)
No TAF Service	**N/A**
Minimum Descent Altitude (MDA)with WTG Minimum Descent Altitude (MDA)no WTG	**893 (900) feet AGL (with AWIS)*** **883 (890) feet AGL (with AWIS)***
AWIS not available	**Add 100 feet to above figures***

5. WEATHER STATION

MOS 173 8.1.5.1 (b) (ii) imposes an altitude penalty of +150 feet where a Terminal Area Forecast (TAF) service is not provided on a 24 hour basis. Flinders Island is a Category D (Weather forecast purposes) aerodrome and has a TAF service issued.

(AIP GEN 3.5 para 3.4.3.). Flinders Island aerodrome also has an AWIS facility available on a VHF frequency and a landline phone number and therefore 100 feet may be subtracted from the published MDA provided that current weather information is available at the time.

6. CIRCLING

The circling areas for both RWY 11 and RWY 29 are restricted to the south and east of the runway complex due to the high terrain to the north-west of the aerodrome.

The Category A & B circling controlling obstacle is a terrain high point located 2.81 nm/5.21 km and bearing 121.2° T from the ARP. The circling MDA for Category Cat A/B aircraft is 850 feet.

The Category C circling controlling obstacle is terrain located 4.32 nm/8km and bearing 111.48°T from the ARP. The circling MDA for Cat C aircraft is 1470 feet (same as the current published RWY 05 RNAV Approach).

7. ALTERNATE AERODROME REQUIREMENTS

Alternate aerodrome requirements are based on the appropriate circling minima for the aircraft performance category. Alternate aerodrome requirements are based on the appropriate circling minima for the aircraft performance category. For Category C aircraft, the cloud base requiring alternate fuel would be 1968 feet AGL.

8. MINIMUM SECTOR ALTITUDE (MSA).

The 25nm and 10nm minimum sector altitude (MSA) centred on the ARP has a controlling obstacle (terrain) located on bearing 151.52° T and a distance of 7.58nm/14.05km. The calculated MSA, using the Geoscience terrain model, for 25nm and 10 nm is 3800 feet.

9. POTENTIAL IMPACT ON EXISTING PROCEDURES

If runway 05 runway at Flinders Island is removed then the existing RNAV-Z for the RWY 05 procedure would be withdrawn. If the proposed re-alignment proceeds, then all existing procedures would remain. The NDB-A approach is a circling approach only and is not aligned with a specific runway and will remain.

The GNSS arrival procedure is to circling minima only and would remain irrespective of any re-alignment. There is no specific impact the proposed procedures would have on existing approaches.

10. SUMMARY

The instrument procedures requested for the proposed re-alignment are for an anticipated runway direction of 11 and 29. The minimum altitude for the RNAV approach for runway 11 came in at 450 feet AGL (above ground level).

The minimum altitude for the RNAV approach for runway 29 (with the proposed wind turbine generator WTG) was 900 feet AGL and without the WTG was 890 feet AGL.

Should re-alignment and a subsequent request for the approaches proceed, then evaluation and obstacle assessment would be completed with revised data for runway threshold co-ordinates and elevations. A revised known obstacle list would also be required to complete the assessment.

The PANS-OPS surfaces, which include the VSS, are assessed at the time of design. Any obstacles that are known to penetrate the VSS should be noted and if possible removed. The OLS survey is carried out by the aerodrome operator/management and supplied to the design organisation with all the relevant data for procedure construction.

11. Approval Process

Once the designs have been completed, a design report is compiled. This report outlines all aspects of the design(s) including waypoint co-ordinates, design methodology, information referencing climatic conditions, magnetic variation, airspace considerations and draft instrument approach plates.

The Civil Aviation Safety Authority (CASA) is advised at an early stage in the design process so that a flight validation date can be arranged. Once the procedures(s) have been validated, they are entered into the AIRAC cycle and will subsequently be entered into Airservices DAP suite. The entry of the procedure(s) into the DAP suite will generally take up to three months however, after the validation has been processed, the procedure can be entered into the Supplementary list and is still a valid and flyable procedure.

The environmental report can be completed by IDS and is required prior to flight validation. It assesses noise footprints of the largest aircraft type to be operated into the airport as well as other environmental issues.

Lindsay Walsh

IDS Procedure Designer

GLOSSARY OF TERMS

Aerodrome Reference Point (ARP)	A point on the aerodrome that designated the geographical position of the runway complex.
Alternate Aerodrome	An aerodrome used for planning purposes to which an aircraft may proceed when it becomes inadvisable to proceed to or land at the aerodrome of intended landing.
Area Navigation (RNAV)	A method of navigation which permits aircraft operation on any desired flight path within the coverage of the station-referenced navigation aids or within the limits of the capability of self-contained aids, or a combination of these.
Circling Approach	An extension of an instrument approach procedure which provides for visual circling of the aerodrome prior to landing.
Final Approach Segment	That segment of an instrument approach procedure in which alignment and descent for landing are accomplished.
Final Approach Segment	That segment of an instrument approach procedure in which alignment and descent for landing are accomplished.
Final Approach Track	The flight track in the final approach segment that is normally aligned with the runway centre line.
Global Navigation Satellite System	A worldwide position and time determination system that includes one or more satellite constellations, aircraft receivers and system integrity monitoring, augmented as necessary to support the required navigation performance for the intended operation.
Instrument Approach Procedure	A series of predetermined manoeuvres by reference to flight and navigation instruments with specified protection from obstacles from the initial approach fix to a point at which a landing can be completed and if a landing is not completed , to a position at which holding or en-route obstacle clearance criteria apply.
Minimum Sector Altitude	The lowest altitude which may be used which will provide a minimum clearance of 300m (1000 ft) above all objects located in an area within a sector of a circle of 25nm/46km centred on either the aerodrome ARP or ground based navigation aid.
Missed Approach Procedure	The procedure to be followed if the instrument approach cannot be continued.

Minimum Descent Altitude (MDA)	A specified altitude in a non-precision approach or circling approach below which descent must not be made without the required visual reference.
Precision Approach	An approach which incorporates lateral and descent guidance to a landing runway.
Protection Area	An area either side of the nominal flight path in which obstacles are assessed against criteria outlined in ICAO Doc 8168.
Non-Precision Approach	An approach which provides lateral guidance only to a landing runway.
Visual Segment Surface (VSS)	A surface which extends from 60m prior to the runway threshold equal to the runway strip width and then splaying 15% on either side of the extended runway centreline and terminating at a height where the surface reaches obstacle clearance altitude (OCH). The slope of the surface is 1.12° less than the published approach procedure angle.
Waypoint	A specified geographical location used to define an area navigation (RNAV) route or the flight path of an aircraft employing area navigation.

APPENDIX A

EXAMPLE STANDARD Y-BAR RNAV APPROACH

This is an example of a standard 'Y' bar arrangement for RNAV approach procedures. There are three initial approach fixes (IAF) followed by a 5nm leg to the intermediate fix (IF). This then is a straight approach (aligned with the runway where possible) of another 5nm to the final approach fix (FAF) and another 5nm to the runway threshold. The missed approach point (MAPt) is generally at the threshold. The missed approach procedure is generally straight providing that surrounding terrain presents no issues and takes the aircraft to either a holding fix or to altitude.

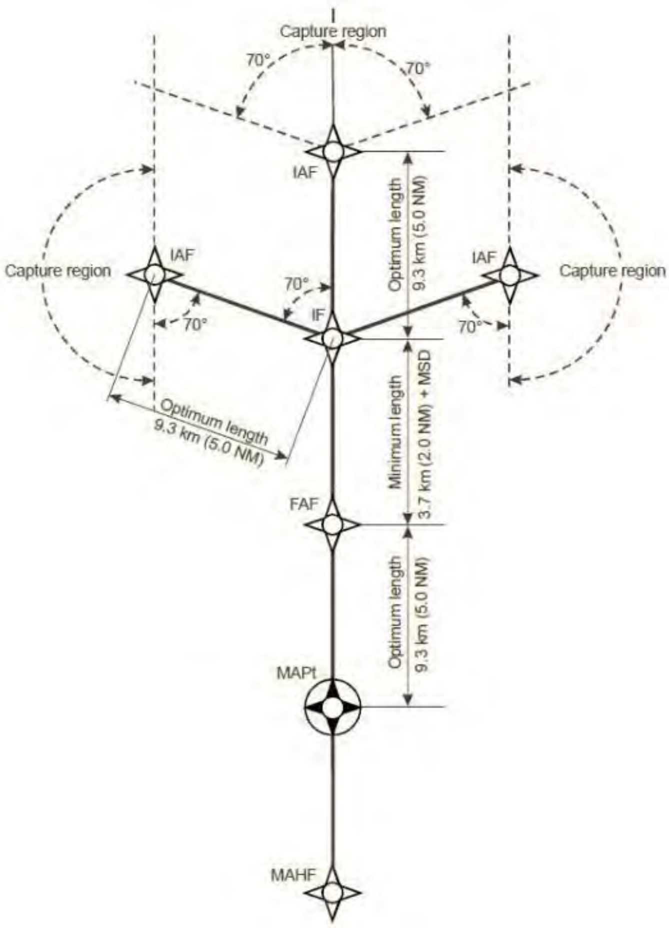


Figure 1 STANDARD Y-BAR RNAV APPROACH

APPENDIX B

RNAV GNSSS RWY 11

This procedure has three initial approach waypoints called fixes (IAF). All three proceed to the intermediate and then to final and runway threshold. The missed approach procedure turns right and returns the aircraft to initial approach fix (IAF) - A .

Figure 2 RNAV GNSS RWY 11

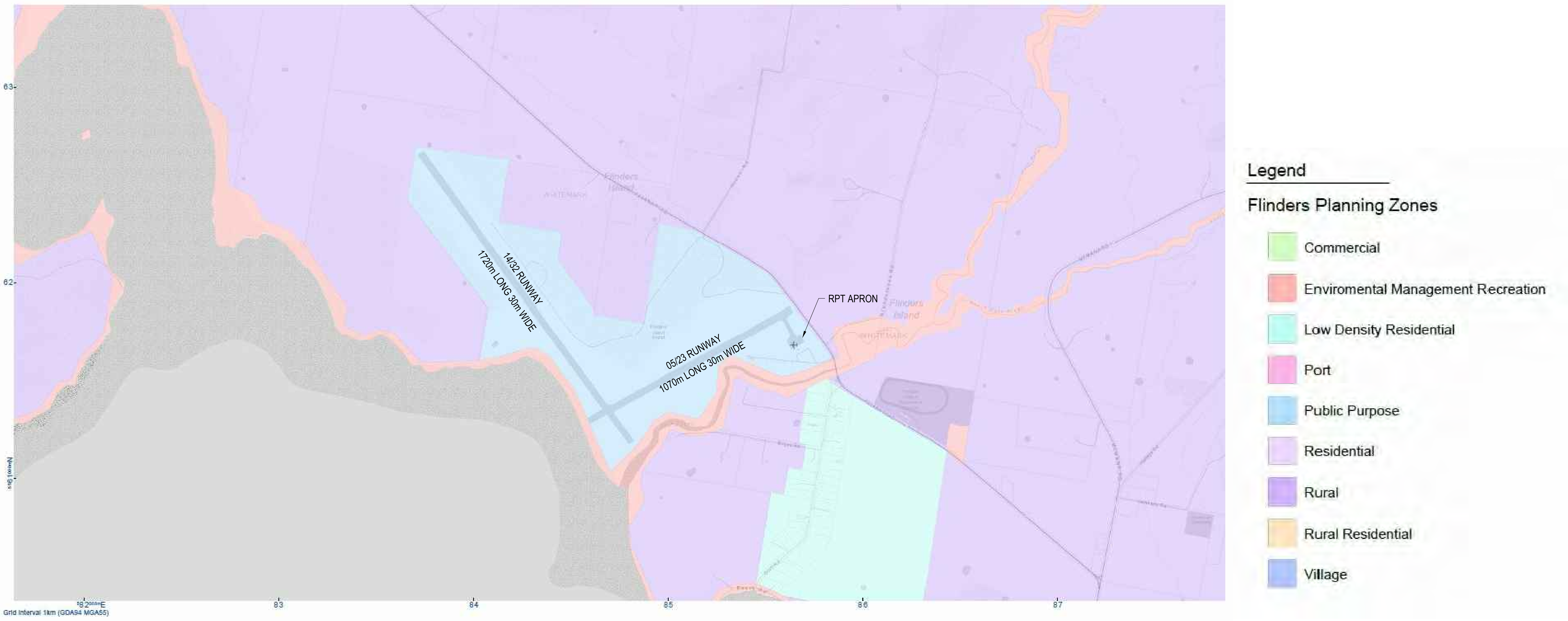
APPENDIX C

RNAV GNSSS RWY 29

This procedure has two initial approach fixes (IAF) proceeding to an intermediate then final. The final approach track is off-set by 8° to the runway centreline for obstacle avoidance. The missed approach procedure turns left and takes the aircraft back to a safe altitude (MSA) over water.

Figure 3 RNAV GNSS RWY 29

Appendix C
Figures



SOURCE: www.thelist.tas.gov.au

NOT TO SCALE

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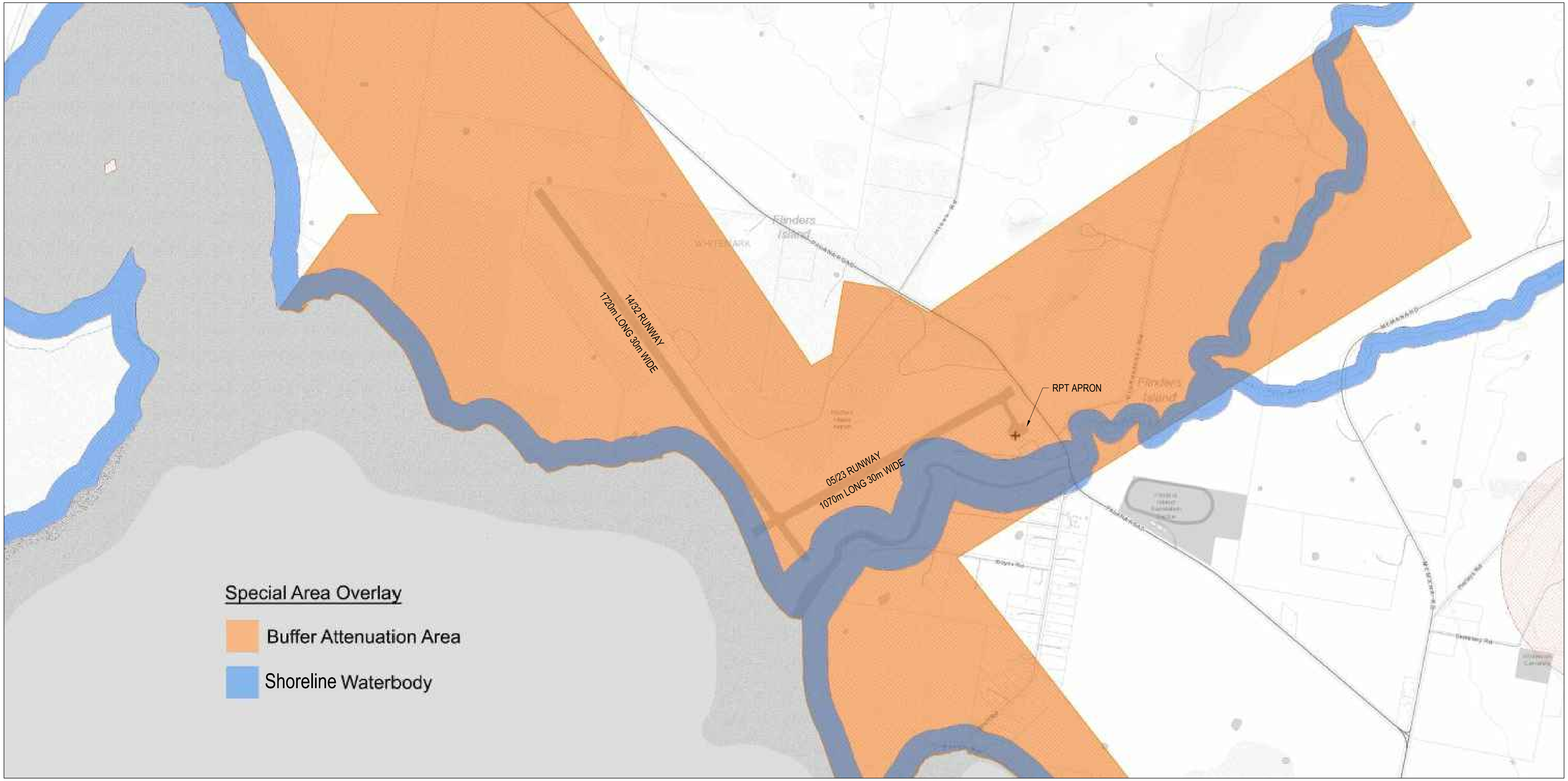
229779.010

Existing Planning Scheme Zones

FIGURE 1



SOURCE: www.thelist.tas.gov.au

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Existing Planning Scheme Overlays

FIGURE 2

Notes

1. EXTENT OF NEW LIGHTING CABLE/CONDUIT AND PIT SYSTEM NOT SHOWN FOR CLARITY.
2. EXTENT OF NEW STORM WATER DRAINAGE INFRASTRUCTURE NOT SHOWN FOR CLARITY.
3. EXTENT OF EARTHWORKS AND TREE CLEARING NOT SHOWN.

Legend

- NEW PAVEMENT CONSTRUCTION WITH BITUMINOUS SPRAY SEAL (APPROX. 68,300m²) AND LINE MARKING
- NEW ELEVATED RUNWAY EDGE LIGHTS (WHITE)
- NEW INSET RUNWAY EDGE LIGHTS (WHITE)
- NEW ELEVATED RUNWAY TURN NODE LIGHTS (BLUE)
- NEW ELEVATED THRESHOLD LIGHTS (GREEN)
- NEW INSET OR ELEVATED RUNWAY THRESHOLD/END LIGHTS (GREEN/RED)
- NEW RUNWAY GABLE MARKERS
- NEW FENCE

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Concept New Runway - Option 1

FIGURE 3

Notes

1. EXTENT OF NEW LIGHTING CABLE/CONDUIT AND PIT SYSTEM NOT SHOWN FOR CLARITY.
2. EXTENT OF NEW STORM WATER DRAINAGE INFRASTRUCTURE NOT SHOWN FOR CLARITY.
3. EXTENT OF EARTHWORKS AND TREE CLEARING NOT SHOWN.

Legend

- NEW PAVEMENT CONSTRUCTION WITH BITUMINOUS SPRAY SEAL (APPROX. 68,300m²) AND LINE MARKING
- NEW ELEVATED RUNWAY EDGE LIGHTS (WHITE)
- NEW INSET RUNWAY EDGE LIGHTS (WHITE)
- NEW ELEVATED RUNWAY TURN NODE LIGHTS (BLUE)
- NEW ELEVATED THRESHOLD LIGHTS (GREEN)
- NEW INSET OR ELEVATED RUNWAY THRESHOLD/END LIGHTS (GREEN/RED)
- NEW RUNWAY GABLE MARKERS
- NEW FENCE

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Concept New Runway - Option 2

FIGURE 4

aurecon

AIRPORT SURVEY CONSULTANTS

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Concept Aerodrome Obstacle Limitation Surface Plan - Option 1

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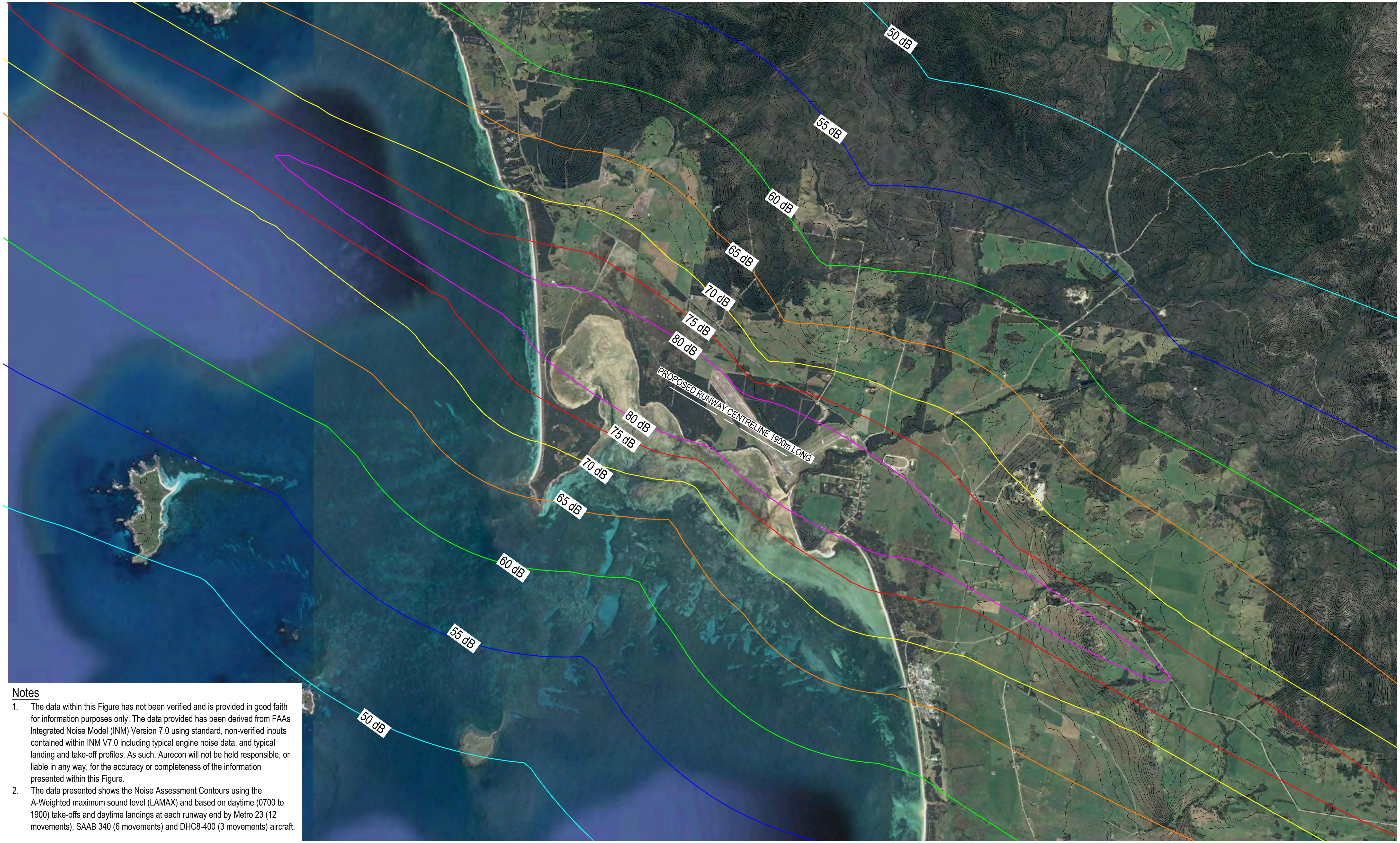
FIGURE 5



Notes
1. The data within this Figure has not been verified and is provided in good faith for information purposes only. The data provided has been derived from FAAs Integrated Noise Model (INM) Version 7.0 using standard, non-verified inputs contained within INM V7.0 including typical engine noise data, and typical landing and take-off profiles. As such, Aurecon will not be held responsible, or liable in any way, for the accuracy or completeness of the information presented within this Figure.
2. The data presented shows the Noise Assessment Contours using the A-Weighted maximum sound level (LAMAX) and based on daytime (0700 to 1900) take-offs and daytime landings at each runway end by Metro 23 (12 movements), SAAB 340 (6 movements) and DHC8-400 (3 movements) aircraft.

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Flinders Council - Flinders Island Aerodrome

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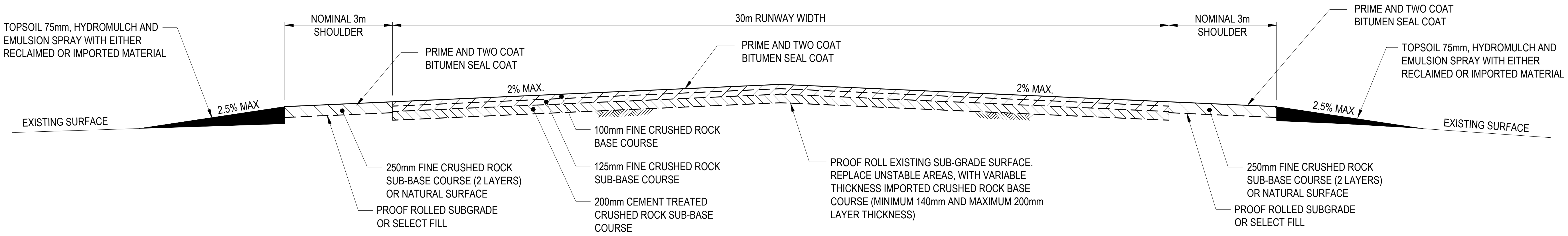
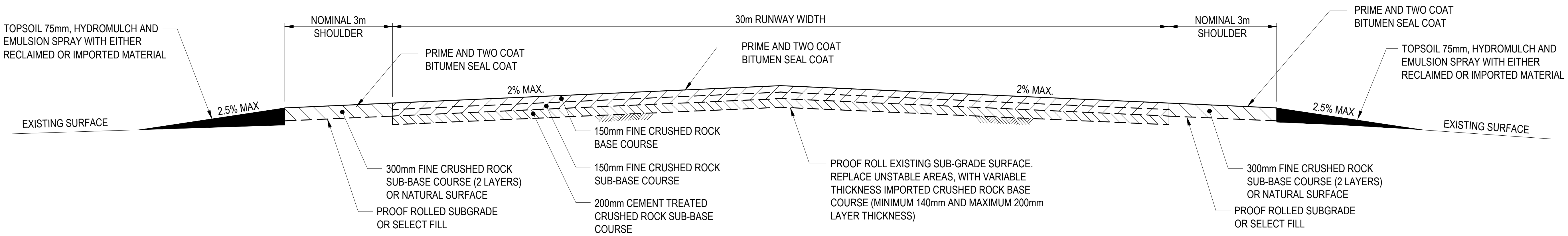
Noise Assessment Contours for Metro 23, SAAB 340 and DHC-8-400 Combined

Runway 11/29 End Approach and Departure

FIGURE 6



TYPICAL RUNWAY CROSS SECTION - TRAFFIC SCENARIO B
N.T.S.



TYPICAL RUNWAY CROSS SECTION - TRAFFIC SCENARIO C
N.T.S.

NOTES

1. PAVEMENT THICKNESSES SHOWN ARE BASED ON THE FOLLOWING:

   TRAFFIC SCENARIO B

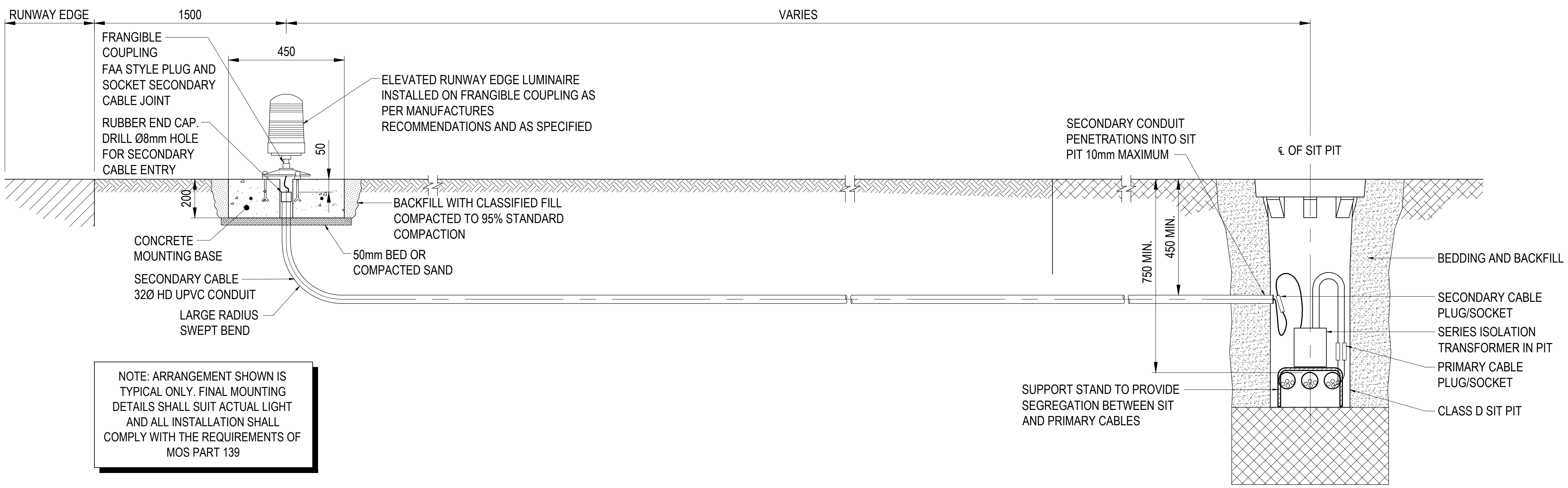
METRO 23	8 ARRIVALS PER DAY AT MAXIMUM LANDING WEIGHT (7.5 tonnes)
METRO 23	8 DEPARTURES PER DAY AT MAXIMUM TAKE-OFF WEIGHT (7.5 tonnes)
SAAB 340	3 ARRIVALS PER DAY AT MAXIMUM LANDING WEIGHT (12.9 tonnes)
SAAB 340	3 DEPARTURES PER DAY AT MAXIMUM TAKE-OFF WEIGHT (13.2 tonnes)

2. TRAFFIC SCENARIO C

METRO 23	12 ARRIVALS PER DAY AT MAXIMUM LANDING WEIGHT (7.5 tonnes)
METRO 23	12 DEPARTURES PER DAY AT MAXIMUM TAKE-OFF WEIGHT (7.5 tonnes)
SAAB 340	6 ARRIVALS PER DAY AT MAXIMUM LANDING WEIGHT (12.9 tonnes)
SAAB 340	6 DEPARTURES PER DAY AT MAXIMUM TAKE-OFF WEIGHT (13.2 tonnes)
DHC-8-300	3 ARRIVALS PER DAY AT MAXIMUM LANDING WEIGHT (18.7 tonnes)
DHC-8-300	3 DEPARTURES PER DAY AT MAXIMUM TAKE-OFF WEIGHT (18.7 tonnes)

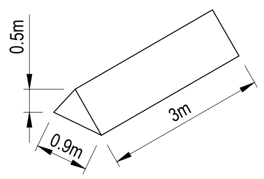
   ASSUMED SUBGRADE CBR OF 5%

   THE CONTRACTOR IS TO UNDERTAKE SUB-GRADE CBR TESTING AS DIRECTED AND TO THE APPROVAL OF THE PRINCIPAL TO CONFIRM THAT THE EXISTING SUB-GRADE CBR IS 5% OR GREATER.



INSTALLATION OF "ELEVATED" RUNWAY EDGE LIGHT AND TRANSFORMER PIT TYPICAL ARRANGEMENT

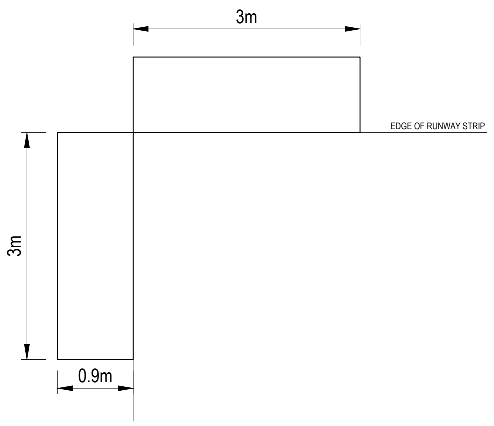
N.T.S.



1. THE STRIP GABLE MARKERS ARE NOT TO SCALE.
2. SPACING OF GABLE MARKERS NOT TO EXCEED 180.0 METRES.
3. TWO GABLE MARKERS TO BE PLACED AT ALL CHANGES OF DIRECTION OF STRIP.
4. ALL MARKERS ARE TO BE PAINTED WHITE.
5. ALL BOUNDARY MARKERS TO BE CONSTRUCTED OF LIGHT FRANGIBLE MATERIAL WHICH WOULD NOT CAUSE DAMAGE TO AIRCRAFT. SUGGESTED MATERIALS ARE MALTHOID RUBBER, CFC AND FIBRE GLASS.
6. GABLE MARKERS TO BE FIXED BY GROUND PEGS OR SUITABLE EQUIVALENT.

RUNWAY STRIP MARKERS (GABLE TYPE)

N.T.S.



POSITION OF CORNER GABLE MARKERS

N.T.S.

Appendix D
Indicative Budget Costs

Flinders Island Aerodrome - New Runway Siting Study Report
Potential Future New Runway Construction
Indicative Budget Costs (Scenario B)

Appendix D

Item	Description	Unit	Quantity	Rate	Amount
	Section A - Preliminaries				
A1	Site Establishment including mobilisation of plant, materials and equipment, transportation by ferry, establishment of site offices and amenities, security fencing and site clearing	Item	1	$ 750,000.00	$ 750,000.00
A2	Site Disestablishment including demobilisation of plant, materials and equipment, transportation by ferry, disestablishment of site offices and amenities, security fencing and site cleanup	Item	1	$ 600,000.00	$ 600,000.00
A3	Prepartion and maintenance of Project Quality Plan	Item	1	$ 7,500.00	$ 7,500.00
A4	Preparation and maintenance of Safety Plan	Item	1	$ 7,500.00	$ 7,500.00
A5	Preparation and maintenance of Site Environmental Management Plan	Item	1	$ 7,500.00	$ 7,500.00
A6	Preparation and maintenance of Program	Item	1	$ 7,500.00	$ 7,500.00
A7	Submission of asphalt mix design and materials test results	Item	1	$ 15,000.00	$ 15,000.00
A8	Paving Trial - supply, deliver and place 2 coat seal (7/10mm nominal size) (PROVISIONAL QUANTITY)	Item	1	$ 20,000.00	$ 20,000.00
A9	Hire of portable floodlighting system	Item	1	$ 75,000.00	$ 75,000.00
A10	Survey/setting out of Works	Item	1	$ 80,000.00	$ 80,000.00
A11	Maintenance of haul roads	Item	1	$ 25,000.00	$ 25,000.00
A12	Provision of "As Constructed" drawings	Item	1	$ 15,000.00	$ 15,000.00
A13	Provision of Security Guard (and amenities) at each airside entry gate during each work period and at other times entry to the site is required	Item	1	$ 55,000.00	$ 55,000.00
A14	Ongoing overheads and other costs not included elsewhere in the Schedule (to be identified separately if valued over $1000)	Item	1	$ 30,000.00	$ 30,000.00
	Sub-Total Section A				$ 1,695,000.00
	Section B – Site Clearing and Grubbing				
B1	Clearing and removal of vegetation from site above the existing surface	m^2	110,000	$ 2.00	$ 220,000.00
B2	Grubbing and removal of vegetation beneath the existing surface to the depth of excavation	m^2	110,000	$ 0.75	$ 82,500.00
	Sub-Total Section B				$ 302,500.00
	Section C – New Code 3C Runway Construction				
	Runway Earthworks and Subgrade Preparation				
C1	Demolish existing pavement and cart to stockpile onsite as directed and to the approval of the Superintendent	m^2	4,000	$ 15.00	$ 60,000.00
C2	Strip and remove 100mm topsoil (paved areas), stockpile onsite or offsite as directed and to the approval of the Superintendent	m^2	57,000	$ 5.00	$ 285,000.00
C3	Excavate to design subgrade levels and cut to fill (including grading)	m^3	30,000	$ 20.00	$ 600,000.00
C4	Excavate to design subgrade levels and cart to stockpile onsite or offsite as directed and to the approval of the Superintendent	m^3	5,000	$ 20.00	$ 100,000.00
C5	Proof roll and compact at subgrade level (paved areas)	m^2	57,000	$ 7.50	$ 427,500.00
	Runway High Strength Flexible Pavement Construction				
C6	Supply, deliver and place 200mm cement treated fine crushed rock sub base course	m^2	57,000	$ 90.00	$ 5,130,000.00
C7	Supply, deliver and place 150 mm fine crushed rock sub base course	m^2	57,000	$ 56.00	$ 3,192,000.00
C8	Supply, deliver and place 100 mm fine crushed rock base course	m^2	57,000	$ 40.00	$ 2,280,000.00
C9	Supply, deliver and place prime coat	m^2	57,000	$ 2.50	$ 142,500.00
C10	Supply, deliver and place 2 coat seal (7/10mm nominal size)	m^2	57,000	$ 22.00	$ 1,254,000.00
	Grassing (PROVISIONAL QUANTITY)				
C11	(ii) Remove topsoil from stockpile on site or import material and spread to minimum 75mm depth and grade to match finished surface level or grade existing surface to match finished surface level	m^2	115,000	$ 10.00	$ 1,150,000.00
C12	(iii) Supply, deliver and spray hydromulch and emulsion	m^2	35,000	$ 5.00	$ 175,000.00
	Sub-Total Section C				$ 14,796,000.00

Item	Description	Unit	Quantity	Rate	Amount
	Section D - Line Marking				
	Survey, setout and place new line marking in accordance with MOS Part 139 (2 coats) comprising:				
	Runway Line Marking				
D1	(i) Runway centreline (white; 30m mark; 450mm wide)	m	960	$ 12.00	$ 11,520.00
D2	(ii) Runway edge/side-stripe (white; continuous; 450mm wide)	m	3500	$ 12.00	$ 42,000.00
D3	(iii) Runway end (white; continuous; 1200mm wide)	m	60	$ 20.00	$ 1,200.00
D4	(iv) Runway threshold 'piano key' (white; 1 x 30m mark; 1500mm wide)	no.	12	$ 1,500.00	$ 18,000.00
D5	(v) Runway aiming point (white; 45m mark; 9000mm wide)	no.	4	$ 10,000.00	$ 40,000.00
D6	(vi) Runway touchdown zone (white; 30m mark; 3000mm wide)	no.	12	$ 2,000.00	$ 24,000.00
D7	(vii) Runway designation (white)	no.	4	$ 1,500.00	$ 6,000.00
D8	Runway Reference Chainage Markings	no.	190	$ 10.00	$ 1,900.00
	Sub-Total Section D				$ 144,620.00
	Section E - Aeronautical Ground Lighting				
E1	Supply and install new concrete light bases	No.	90	$ 500.00	$ 45,000.00
E2	Supply and install new inset Runway edge light fittings (white)	No.	2	$ 1,450.00	$ 2,900.00
E3	Supply and install new elevated Runway edge light fittings (white)	No.	62	$ 1,450.00	$ 89,900.00
E4	Supply and install new elevated Runway turn node light fittings (blue)	No.	10	$ 1,450.00	$ 14,500.00
E5	Supply and install new elevated Runway threshold light fittings (green)	No.	4	$ 1,450.00	$ 5,800.00
E6	Supply and install new elevated Runway/end threshold light fittings (green/red)	No.	12	$ 1,450.00	$ 17,400.00
E7	Supply and install new SITs and SIT pits	No.	90	$ 2,200.00	$ 198,000.00
E8	Supply and install new concrete duct pits (including excavation, bedding and backfill)	No.	4	$ 5,500.00	$ 22,000.00
E9	Supply and install Duct Bank complete with conduits	m	180	$ 300.00	$ 54,000.00
E10	Supply and install new 63mm dia orange conduit (including trenching, bedding and backfill and connection to existing circuits)	m	5,000	$ 12.00	$ 60,000.00
E11	Supply and install new Primary Cable 6 mmsq 7/1.04 Stranded 5000 Volts insulated	m	10,000	$ 30.00	$ 300,000.00
E12	Supply and install new 32mm dia secondary condui (including trenching, bedding and backfill)	m	3,150	$ 8.00	$ 25,200.00
E13	Supply and install new 'Secondary Cable 2.5 mmsq 50/0.25 Stranded 50 Volts insulated	m	3,150	$ 15.00	$ 47,250.00
	Sub-Total Section E				$ 881,950.00
	Section F – Stormwater Drainage				
F1	Supply and install new 600mm dia. RCP RRJ; Pipe Class 4 - including earthworks, trenching, backfill and hydromulch	m	400	$ 500.00	$ 200,000.00
F2	Supply and install new square concrete drainage pit (including excavation, bedding and backfill) nominally 900mm length x 900mm width, complete with Class G grated inlet and steps, and additional pit risers as required; Junction Pit	No.	10	$ 20,000.00	$ 200,000.00
F3	Cut new OUD along each side of runway and cart material to stockpile onsite or offsite as directed and to the approval of the Superintendent	m^3	16,800	$ 10.00	$ 168,000.00
	Sub-Total Section F				$ 568,000.00
	Section G – Provisional Quantities and Sums				
	Disruption of Works by Principal as defined in Special Conditions of Contract				
G1	(i) Notification prior to work shift of denial of access to work area (PROVISIONAL QUANTITY)	Work Shift	2	$ 30,000.00	$ 60,000.00
G2	(ii) Delay to commencement of a work shift (PROVISIONAL QUANTITY)	Hours	3	$ 10,000.00	$ 30,000.00
G3	(iii) Suspension of work during a work shift (PROVISIONAL QUANTITY)	Hours	3	$ 10,000.00	$ 30,000.00
G4	Supply, deliver and place 75mm topsoil, hydromulch and spray bituminous emulsion to disturbed areas (PROVISIONAL QUANTITY)	m^2	1,000	$ 12.50	$ 12,500.00
G5	Removal and replacement of unsuitable subgrade material to 300 mm below subgrade level with select fill as directed and to the approval of the Superintendent (PROVISIONAL QUANTITY)	m^2	10,000	$ 100.00	$ 1,000,000.00
	Sub-Total Section G				$ 1,132,500.00

Flinders Island Aerodrome - New Runway Siting Study Report
Potential Future New Runway Construction
Indicative Budget Costs (Scenario B)

Appendix D

Item	Description	Unit	Quantity	Rate	Amount
				SUMMARY	
				Sub-Total Section A	$ 1,695,000.00
				Sub-Total Section B	$ 302,500.00
				Sub-Total Section C	$ 14,796,000.00
				Sub-Total Section D	$ 144,620.00
				Sub-Total Section E	$ 881,950.00
				Sub-Total Section F	$ 568,000.00
				Sub-Total Section G	$ 1,132,500.00
				Total Sections A, B, C, D, E, F and G	$ 19,520,570.00
				GST	$1,952,057.00
				Total including GST	$ 21,472,627.00

Note 1 Indicative budget costs for providing a potential future new runway for Code 3C aircraft operations as detailed in this New Runway Siting Study Report are summarised above. All costs exclude allowances for other fees, other Flinders Council costs and contingencies.

Note 2 Aurecon considers indicative budget costs to be a first cost indication (at current prices at the date stated). They are provided to Flinders Council based on an outline estimate of Flinders Council's needs; prepared by reference to feasibility sketches or assessed without sketches (in some instances) and based on Aurecon's knowledge of costs for similar projects. They have been prepared without the benefit of detailed design and without detailed consideration of survey, geometry, drainage, existing/proposed services or other local information. An indicative budget cost is intended only as a guide for a pre-feasibility and planning purposes, it is not an estimate and may not be quoted as such. Indicative budget costs are prepared using broad cost parameters (e.g. earthworks and pavements on a cost per square metre basis).

Note 3 Since Aurecon has no control over the cost of labour, materials, equipment or services furnished by others, or over Contractor's methods of determining prices, or over competitive bidding or market conditions, any opinion or indicative costs by Aurecon is made on the basis of our experience and represents Aurecon's judgement as experienced and qualified professional engineers. Aurecon cannot and does not, however, guarantee that proposals, bids or actual construction costs will not vary from our indicative budget costs.

Note 4 The accuracy of the indicative budget costs is considered to be of the order of 30% too high to 30% too low.

Flinders Island Aerodrome - New Runway Siting Study Report
Potential Future New Runway Construction
Indicative Budget Costs (Scenario C)

Appendix D

Item	Description	Unit	Quantity	Rate	Amount
	Section A - Preliminaries				
A1	Site Establishment including mobilisation of plant, materials and equipment, transportation by ferry, establishment of site offices and amenities, security fencing and site clearing	Item	1	$ 750,000.00	$ 750,000.00
A2	Site Disestablishment including demobilisation of plant, materials and equipment, transportation by ferry, disestablishment of site offices and amenities, security fencing and site cleanup	Item	1	$ 600,000.00	$ 600,000.00
A3	Prepartion and maintenance of Project Quality Plan	Item	1	$ 7,500.00	$ 7,500.00
A4	Preparation and maintenance of Safety Plan	Item	1	$ 7,500.00	$ 7,500.00
A5	Preparation and maintenance of Site Environmental Management Plan	Item	1	$ 7,500.00	$ 7,500.00
A6	Preparation and maintenance of Program	Item	1	$ 7,500.00	$ 7,500.00
A7	Submission of asphalt mix design and materials test results	Item	1	$ 15,000.00	$ 15,000.00
A8	Paving Trial - supply, deliver and place 2 coat seal (7/10mm nominal size) (PROVISIONAL QUANTITY)	Item	1	$ 20,000.00	$ 20,000.00
A9	Hire of portable floodlighting system	Item	1	$ 75,000.00	$ 75,000.00
A10	Survey/setting out of Works	Item	1	$ 80,000.00	$ 80,000.00
A11	Maintenance of haul roads	Item	1	$ 25,000.00	$ 25,000.00
A12	Provision of "As Constructed" drawings	Item	1	$ 15,000.00	$ 15,000.00
A13	Provision of Security Guard (and amenities) at each airside entry gate during each work period and at other times entry to the site is required	Item	1	$ 55,000.00	$ 55,000.00
A14	Ongoing overheads and other costs not included elsewhere in the Schedule (to be identified separately if valued over $1000)	Item	1	$ 30,000.00	$ 30,000.00
	Sub-Total Section A				$ 1,695,000.00
	Section B – Site Clearing and Grubbing				
B1	Clearing and removal of vegetation from site above the existing surface	m^2	110,000	$ 2.00	$ 220,000.00
B2	Grubbing and removal of vegetation beneath the existing surface to the depth of excavation	m^2	110,000	$ 0.75	$ 82,500.00
	Sub-Total Section B				$ 302,500.00
	Section C – New Code 3C Runway Construction				
	Runway Earthworks and Subgrade Preparation				
C1	Demolish existing pavement excluding shoulders and cart to stockpile onsite as directed and to the approval of the Superintendent	m^2	4,000	$ 15.00	$ 60,000.00
C2	Strip and remove 100mm topsoil (paved areas), clear and grub organic material, and cart to stockpile onsite or offsite as directed and to the approval of the Superintendent	m^2	57,000	$ 5.00	$ 285,000.00
C3	Excavate to design subgrade levels and cut to fill	m^3	30,000	$ 20.00	$ 600,000.00
C4	Excavate to design subgrade levels and cart to stockpile onsite or offsite as directed and to the approval of the Superintendent	m^3	5,000	$ 20.00	$ 100,000.00
C5	Proof roll and compact at subgrade level (paved areas)	m^2	57,000	$ 7.50	$ 427,500.00
	Runway High Strength Flexible Pavement Construction				
C6	Supply, deliver and place 200mm cement treated fine crushed rock sub base course	m^2	57,000	$ 90.00	$ 5,130,000.00
C7	Supply, deliver and place 150 mm fine crushed rock sub base course	m^2	57,000	$ 56.00	$ 3,192,000.00
C8	Supply, deliver and place 150 mm fine crushed rock base course	m^2	57,000	$ 56.00	$ 3,192,000.00
C9	Supply, deliver and place prime coat	m^2	57,000	$ 2.50	$ 142,500.00
C10	Supply, deliver and place 2 coat seal (7/10mm nominal size)	m^2	57,000	$ 22.00	$ 1,254,000.00
C11	Grassing (PROVISIONAL QUANTITY) (ii) Remove topsoil from stockpile on site or import material and spread to minimum 75mm depth and grade to match finished surface level or grade existing surface to match finished surface level	m^2	115,000	$ 10.00	$ 1,150,000.00
C12	(iii) Supply, deliver and spray hydromulch and emulsion	m^2	35,000	$ 5.00	$ 175,000.00
	Sub-Total Section C				$ 15,708,000.00

Flinders Island Aerodrome - New Runway Siting Study Report
Potential Future New Runway Construction
Indicative Budget Costs (Scenario C)

Appendix D

Item	Description	Unit	Quantity	Rate	Amount
	Section D - Line Marking				
	Survey, setout and place new line marking in accordance with MOS Part 139 (2 coats) comprising:				
	Runway Line Marking				
D1	(i) Runway centreline (white; 30m mark; 450mm wide)	m	960	$ 12.00	$ 11,520.00
D2	(ii) Runway edge/side-stripe (white; continuous; 450mm wide)	m	3500	$ 12.00	$ 42,000.00
D3	(iii) Runway end (white; continuous; 1200mm wide)	m	60	$ 20.00	$ 1,200.00
D4	(iv) Runway threshold 'piano key' (white; 1 x 30m mark; 1500mm wide)	no.	12	$ 1,500.00	$ 18,000.00
D5	(v) Runway aiming point (white; 45m mark; 9000mm wide)	no.	4	$ 10,000.00	$ 40,000.00
D6	(vi) Runway touchdown zone (white; 30m mark; 3000mm wide)	no.	12	$ 2,000.00	$ 24,000.00
D7	(vii) Runway designation (white)	no.	4	$ 1,500.00	$ 6,000.00
D8	Runway Reference Chainage Markings	no.	190	$ 10.00	$ 1,900.00
	Sub-Total Section C				$ 144,620.00
	Section D - Aeronautical Ground Lighting				
D1	Supply and install new concrete light bases	No.	90	$ 500.00	$ 45,000.00
D2	Supply and install new inset Runway edge light fittings (white)	No.	2	$ 1,450.00	$ 2,900.00
D3	Supply and install new elevated Runway edge light fittings (white)	No.	62	$ 1,450.00	$ 89,900.00
D4	Supply and install new elevated Runway turn node light fittings (blue)	No.	10	$ 1,450.00	$ 14,500.00
D5	Supply and install new elevated Runway threshold light fittings (green)	No.	4	$ 1,450.00	$ 5,800.00
D6	Supply and install new elevated Runway/end threshold light fittings (green/red)	No.	12	$ 1,450.00	$ 17,400.00
D7	Supply and install new SITs and SIT pits	No.	90	$ 2,200.00	$ 198,000.00
D8	Supply and install new concrete duct pits (including excavation, bedding and backfill)	No.	4	$ 5,500.00	$ 22,000.00
D9	Supply and install Duct Bank complete with conduits	m	180	$ 300.00	$ 54,000.00
D10	Supply and install new 63mm dia orange conduit (including trenching, bedding and backfill and connection to existing circuits)	m	5,000	$ 12.00	$ 60,000.00
D11	Supply and install new Primary Cable 6 mmsq 7/1.04 Stranded 5000 Volts insulated	m	10,000	$ 30.00	$ 300,000.00
D12	Supply and install new 32mm dia secondary condui (including trenching, bedding and backfill)	m	3,150	$ 8.00	$ 25,200.00
D13	Supply and install new 'Secondary Cable 2.5 mmsq 50/0.25 Stranded 50 Volts insulated	m	3,150	$ 15.00	$ 47,250.00
	Sub-Total Section D				$ 881,950.00
	Section E – Stormwater Drainage				
E1	Supply and install new 600mm dia. RCP RRJ; Pipe Class 4 - including earthworks, trenching, backfill and hydromulch	m	400	$ 500.00	$ 200,000.00
E2	Supply and install new square concrete drainage pit (including excavation, bedding and backfill) nominally 900mm length x 900mm width, complete with Class G grated inlet and steps, and additional pit risers as required; Junction Pit	No.	10	$ 20,000.00	$ 200,000.00
E3	Cut new OUD along each side of runway and cart material to stockpile onsite or offsite as directed and to the approval of the Superintendent	m^3	16,800	$ 10.00	$ 168,000.00
	Sub-Total Section E				$ 568,000.00
	Section F – Provisional Quantities and Sums				
	Disruption of Works by Principal as defined in Special Conditions of Contract				
F1	(i) Notification prior to work shift of denial of access to work area (PROVISIONAL QUANTITY)	Work Shift	2	$ 30,000.00	$ 60,000.00
F2	(ii) Delay to commencement of a work shift (PROVISIONAL QUANTITY)	Hours	3	$ 10,000.00	$ 30,000.00
F3	(iii) Suspension of work during a work shift (PROVISIONAL QUANTITY)	Hours	3	$ 10,000.00	$ 30,000.00
F4	Supply, deliver and place 75mm topsoil, hydromulch and spray bituminous emulsion to disturbed areas (PROVISIONAL QUANTITY)	m^2	1,000	$ 12.50	$ 12,500.00
F5	Removal and replacement of unsuitable subgrade material to 300 mm below subgrade level with select fill as directed and to the approval of the Superintendent (PROVISIONAL QUANTITY)	m^2	10,000	$ 100.00	$ 1,000,000.00
	Sub-Total Section F				$ 1,132,500.00

Flinders Island Aerodrome - New Runway Siting Study Report
Potential Future New Runway Construction
Indicative Budget Costs (Scenario C)

Appendix D

Item	Description	Unit	Quantity	Rate	Amount
				SUMMARY	
				Sub-Total Section A	$ 1,695,000.00
				Sub-Total Section B	$ 302,500.00
				Sub-Total Section C	$ 15,708,000.00
				Sub-Total Section D	$ 144,620.00
				Sub-Total Section E	$ 881,950.00
				Sub-Total Section F	$ 568,000.00
				Sub-Total Section G	$ 1,132,500.00
				Total Sections A, B, C, D, E, F and G	$ 20,432,570.00
				GST	$2,043,257.00
				Total including GST	$ 22,475,827.00

Note 1 Indicative budget costs for providing a potential future new runway for Code 3C aircraft operations as detailed in this New Runway Siting Study Report are summarised above. All costs exclude allowances for other fees, other Flinders Council costs and contingencies.

Note 2 Aurecon considers indicative budget costs to be a first cost indication (at current prices at the date stated). They are provided to Flinders Council based on an outline estimate of Flinders Council's needs; prepared by reference to feasibility sketches or assessed without sketches (in some instances) and based on Aurecon's knowledge of costs for similar projects. They have been prepared without the benefit of detailed design and without detailed consideration of survey, geometry, drainage, existing/proposed services or other local information. An indicative budget cost is intended only as a guide for a pre-feasibility and planning purposes, it is not an estimate and may not be quoted as such. Indicative budget costs are prepared using broad cost parameters (e.g. earthworks and pavements on a cost per square metre basis).

Note 3 Since Aurecon has no control over the cost of labour, materials, equipment or services furnished by others, or over Contractor's methods of determining prices, or over competitive bidding or market conditions, any opinion or indicative costs by Aurecon is made on the basis of our experience and represents Aurecon's judgement as experienced and qualified professional engineers. Aurecon cannot and does not, however, guarantee that proposals, bids or actual construction costs will not vary from our indicative budget costs.

Note 4 The accuracy of the indicative budget costs is considered to be of the order of 30% too high to 30% too low.

Appendix E
Existing Pavement Strength Analysis

Project: Flinders Island Aerodrome

Existing Pavement Strength Analysis

Reference: 229779.002

Prepared for: Flinders Council

Revision: 1

2 October 2012

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Document prepared by:

Aurecon Australia Pty Ltd
ABN 54 005 139 873
Level 12, 60 Albert Road
South Melbourne VIC 3205
PO Box 321
South Melbourne VIC 3205
Australia

T +61 3 8683 1333
F +61 3 8683 1444
E melbourne@aurecongroup.com
W aurecongroup.com

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Author Signature	IP	Approver Signature	MDG
Name	Ivan Phung	Name	Matt Glenn
Title	Senior Pavement Engineer	Title	Technical Director

Contents

Appendices

1. Introduction

1.1 Background

Aurecon was commissioned by Flinders Council on 25 May 2012 to undertake an analysis of Falling Weight Deflectometer (FWD) test results for the 14/32 Runway, 05/23 Runway, Taxiway A and the RPT Apron at Flinders Island Aerodrome. A plan of the aerodrome layout is shown in **Figure 1**, contained in **Appendix A**.

The objective of the study was to analyse the FWD test data and provide an assessment of the existing pavement strength, and to establish the theoretical Pavement Classification Number (PCN) for the pavements tested.

To allow the PCN assessment to proceed, Falling Weight Deflectometer (FWD) and a geotechnical investigation (comprising fieldwork and laboratory testing) was undertaken to provide information on the existing pavement composition and strength and pavement material characteristics.

Fugro PMS was engaged by Aurecon, on behalf of Flinders Council, to undertake the FWD testing. The testing was undertaken over three day work shifts on 13, 14 and 15 June 2012.

The FWD test is non-destructive and operates by lifting and dropping an adjustable weight onto a set of springs mounted on a circular loading plate of 150 mm radius. A load cell measures the dynamic load applied to the pavement during each test, and nine geophones (seismic velocity transducers) accurately measure the pavement deflection at various distances up to 1500 mm from the load.

By analysing the measured deflection values, representative strength values for the subgrade can be established.

Tasman Geotechnics was engaged by Aurecon, on behalf of Flinders Council, to undertake a geotechnical investigation to provide information on the existing pavement composition, layer thicknesses, material properties and subgrade strength. The geotechnical investigation was undertaken over three days between 5 and 7 June 2012.

With knowledge of the pavement material and subgrade stiffnesses from the analysis of the FWD test results, and the pavement material thicknesses from the boreholes, the strength of the subgrade and pavement layers was determined. Areas of common strength have been grouped, and the study also identified areas of pavement with substantially different or weaker strength.

This report provides:

- Details of the geotechnical investigation undertaken in June 2012;
- Details of the FWD testing undertaken in June 2012;
- An assessment of the subgrade strength based on the results of the FWD testing and geotechnical investigation;
- An assessment of the existing pavement strength and theoretical Pavement Classification Number (PCN); and
- Concept pavement strength upgrade options with indicative budget cost estimates.

1.2 References

a) International Civil Aviation Organisation (ICAO)
"Aerodrome Design Manual Part 3 - Pavements"
2nd Edition, 1983

b) Austroads
"Austroads Guide to Pavement Technology Part 2 – Pavement Structural Design"
February 2012

2. Geotechnical Investigation

2.1 Field and Laboratory Test Results

Tasman Geotechnics was engaged to undertake a geotechnical investigation (comprising fieldwork and laboratory testing) to provide information on the existing pavement composition, layer thicknesses, material properties and subgrade strength. The geotechnical investigation field and laboratory test report is included in **Appendix B**.

A summary of borehole locations and pavement thicknesses is presented in **Table 2-1** and a summary of field and laboratory test results is presented in **Table 2-2**.

Table 2-1: Summary of Borehole Locations and Pavement Thicknesses

Area	Borehole No.	Approximate Chainage (m)	Approximate Offset from Centreline (m)	Base Course Thicknesses (mm)
14/32 Runway	1	45	7.2 Left	150
	2	215	7.3 Right	500
	3	430	4.2 Left	600
	4	645	9.8 Right	350
	5	860	4.8 Left	100
	6	1075	7.8 Right	400
	7	1290	8.3 Left	550
	8	1505	4.5 Right	250
	9	1675	0.7 Right	350
05/23 Runway	10	15	7.1 Right	550
	11	265	6.3 Left	350
	12	535	5.1 Right	450
	13	805	9.3 Left	350
	14	1010	6.5 Right	350
	15	1120	10.7 Left	150
Taxiway A	16	40	5.9 Left	250
	17	105	Centreline	150
RPT Apron	18	135	7.0 Right	150
	19	150	5.0 Right	250
	20	150	25.7 Left	350
	21	140	34.1 Right	200
	22	155	17.0 Left	150
	23	165	5.0 Left	200

Notes: 1) The chainage system for the RPT Apron is a continuation from Taxiway A.
2) Chainages are shown in Figure 2.

Table 2-2: Summary of Field and Laboratory Test Results

Area	Borehole No.	Pavement Layer	USCS	Moisture Content (%)		Soaked CBR (%)	Atterberg Limits			PSD (%)		
				OMC	In-Situ		LL	PL	PI	Gravel	Sands	Fines
14/32 Runway	3	Base Course	SM	-	5.9	-	-	-	-	35	50	15
	4		SM	-	5.2	-	-	-	-	28	53	19
	7		SM	-	6.2	-	-	-	-	30	51	19
	2	Subgrade	SP	-	-	-	-	-	-	95		5
	6		SM	-	-	-	-	-	-	73		27
05/23 Runway	10	Base Course	SP	-	8.5	-	-	-	-	32	68	0
	12		SM	-	4.9	-	-	-	-	32	49	19
	10	Subgrade	SC	-	-	-	-	-	-	1	52	47
	12		SM	8.8	6.3	30	NP	NP	-	7	75	18
	15		SC	15.5	14.8	3	28	15	13	6	48	46
RPT Apron	21	Base Course	SM	-	-	-	-	-	-	25	58	17
	20	Subgrade	SC	16.2	15.1	3.5	50	21	29	5	49	46
	21		CH	20.5	20.4	4	60	25	35	7	29	64

Note: USCS denotes Unified Soil Classification System

A total of 23 boreholes were undertaken on the 14/32 Runway, 05/23 Runway, Taxiway A and RPT Apron. Based on the geotechnical investigation, the existing pavement comprised an asphalt layer overlying a base course layer over existing subgrade. No sub-base layers were identified during the borehole investigation.

It is assumed that the asphalt layer identified during the geotechnical investigation is in fact a multiple coat sprayed seal or sprayed seal treatment as there are no records indicating that an asphalt overlay has been previously constructed.

The base course layer thicknesses ranges from 100mm to 550mm and is predominantly silty gravelly sand with subrounded gravel and non-plastic fines. The particle size distribution (PSD) indicates that the base course material is finer than what would be typically expected for an aerodrome pavement base course material and is more comparable to a sub-base course material that is normally used in aerodrome pavements.

Tasman Geotechnics has also compared the PSD for the base course material with the (Tasmanian) Department of Infrastructure, Energy and Resources (DIER) specifications for base and sub-base course materials used in road pavements and concluded that the base course material is also comparable to a sub-base course material.

However, it is not uncommon for regional aerodromes to use sub-base course material in lieu of better quality base course material due to material availability (remoteness) and budget constraints, given that regional aerodromes do not normally receive the heavier RPT aircraft that typically operate at Australian capital city airports.

The subgrade material encountered in the boreholes can be broadly divided into two zones. The first zone generally applies to the 14/32 Runway between the 14 Runway End and the intersection with the 05/23 Runway. In this zone, the subgrade was found to be predominantly sand that extends to at least 1m below the runway surface level and contains thin layers of clay material. No Soaked CBR tests were performed on the subgrade samples from this zone.

In the second zone, which generally applies to the remainder of the 14/32 Runway, 05/23 Runway, Taxiway A and RPT Apron, the subgrade was found to comprise of sand that extends to less than 1m below the runway surface level, which is underlain by clayey sand or sandy clay.

Soaked CBR tests were performed on the sandy clay or clayey sand subgrade samples from boreholes BH 15, BH 20 and BH 21 and the soaked CBR values were between 3% and 4%. The soaked CBR value of the single gravelly sand subgrade sample from borehole BH 12 was 30%. The presence of gravel in the subgrade sample, combined with the confining effects of the mould during the soaked CBR tests, is likely to have contributed to the relatively higher soaked CBR value in this instance.

3. Falling Weight Deflectometer (FWD) Testing

3.1 FWD Equipment

The FWD test system is non-destructive and operates by lifting and dropping an adjustable weight onto a set of springs mounted on a circular loading plate of 150 mm radius. The resulting dynamic, single impulse load of up to 240 kN is applied over a duration of 25-30 milliseconds, corresponding to the effect of a moving aircraft wheel load. A load cell measures the dynamic load applied to the pavement during each test, and nine geophones (seismic velocity transducers) accurately measure the pavement deflection at various distances up to 1500 mm from the load.

Each test can be completed in less than two minutes, and extensive coverage of the pavements at an aerodrome can be completed within a single day.

The ability of the FWD to provide a non-destructive pavement testing method that is quick, accurate and reliable has been demonstrated in other projects undertaken by Aurecon in the past.

3.2 FWD Test Results

The FWD testing was undertaken by Fugro PMS. The testing was undertaken over three day work shifts on 13, 14 and 15 June 2012. The testing program was organised to cover the areas shown in **Table 3-1**.

Table 3-1: Summary of FWD Testing Program

Area	Chainage (m)	Offsets (m)	Datum
14/32 Runway	-70 to 1760	CL ± 3.75 ± 7.5	Ch 0 m corresponds to the 14 Runway End Threshold and chainages increase towards the south to the 32 Runway End.
05/23 Runway	-50 to 1140	CL ± 3.75 ± 7.5	Ch 0 m corresponds to the 05 Runway End Threshold and chainages increase towards the east to the 23 Runway End.
Taxiway A	0 - 100	CL ± 2 ± 4 ± 6 ± 8	Ch 0 m corresponds to the intersection of the centrelines of the taxiway and the 05/23 Runway, and chainages increase to the south towards the RPT Apron. Taxiway widens at the intersection with the 05/23 Runway and FWD testing was carried across the full width.
RPT Apron	100 – 170	-30 to 40	Ch 100 m corresponds approximately to where Taxiway A interfaces with the RPT Apron.

Note: The chainages for the RPT Apron is a continuation from Taxiway A.

In order to eliminate the effect of load variations, and to permit comparison between pavements tested at different loads, the measured deflections have been standardised by converting the measured deflections into unit deflections (i.e. the deflection in mm divided by the contact pressure in MPa).

The FWD deflections measured from the testing on the 14/32 Runway, 05/23 Runway, Taxiway A and RPT Apron are shown in **Appendices C, D, E and F**, respectively.

The unit deflections derived from the FWD test results for the 14/32 Runway, 05/23 Runway, Taxiway A and RPT Apron are shown in **Appendices G, H, I and J**, respectively.

The unit deflections for the 14/32 Runway, 05/23 Runway, Taxiway A and RPT Apron are also shown on **Figures 3, 4, 5 and 6,** respectively, contained in **Appendix A**.

4. Subgrade Strength Assessment

4.1 Method of Analysis

Two techniques are available for determining theoretical pavement and subgrade strengths from the FWD deflection test results.

The first technique involves a deflection bowl fitting computer program to determine the stiffness of each pavement layer. The procedure used is based on an elastic layered pavement model comprising up to five layers, each of which is assumed to be homogeneous, isotropic and characterised by an elastic modulus (stiffness), Poisson's ratio, and thickness (see **Figure 7** in **Appendix A**). Using this model, pavement responses such as stresses, strains and elastic deflections can be predicted for a given load. A computer program is used to determine, by successive iterations, the combination of pavement layer and subgrade stiffnesses that produce the closest deflected pavement shape to that measured.

The deflection bowl fitting procedure commences with the lowest layer (the subgrade). At some distance remote from the loaded area and dependent on the pavement layer stiffnesses and thicknesses, the surface deflection is due only to the elastic compression of the lowest layer. This is because the layers above it are outside the zone of influence created by the load which, for this purpose, is assumed to be a truncated cone. Consequently, the stiffness of the lowest layer can be estimated from the deflections measured at the appropriate outer gauge (see **Figure 8 (a)** in **Appendix A**). Similarly, the deflections at distances closer to the loading plate are only dependent on the pavement layers within their zone of influence, and this procedure can be used, at least conceptually, to determine the stiffnesses of each of the pavement layers (see **Figure 8 (b)** in **Appendix A**).

Using these initial estimates of pavement layer stiffnesses, the iterative bowl-fitting procedure adjusts the layer stiffnesses until the predicted deflections match the measured deflections within the desired level of accuracy.

The second technique assumes a non-linear stress-strain relationship for the subgrade. The elastic modulus is not constant and is assumed to be stress dependent in accordance with the relationship:

$$E_s = C * (\sigma' / \sigma)^n$$

Where: E_s is the subgrade modulus

C is a positive constant

σ' is the major principal stress

σ is the reference stress

n is a negative constant (commonly in the range –0.25 to –0.5).

In this study, the second technique has been used to establish representative modulus values from the measured deflections as it is considered to provide more reliable results.

The FWD test results were analysed to provide estimates of the subgrade strengths at each test location. The results were tabulated and categorised into sections of common subgrade strengths. Abnormalities in test results such as extremely low or high deflections and/or where the deflections did not decrease with increasing distance from the central loading plate have been omitted from the analysis.

For each of the areas identified as exhibiting similar behaviour, the mean and standard deviation were computed. The representative subgrade modulus value for each area was calculated as the mean minus one standard deviation, which represents the 15th percentile. By implication, 15% of the tests (assumed to represent 15% of the pavement area tested) have strength values below this level.

The CBR for each area was derived using the empirical, but widely accepted relationship:

$$CBR (\%) = k * E_s (MPa)$$

where k is a constant within the range 0.08 - 0.20 (taken in this case as 0.10).

The strength of an unbound granular pavement has little effect on pavement deflections (provided it comprises well-compacted, high strength materials), since the majority of the elastic deflection occurs in the lower (weaker) layers. Conversely, it is difficult to derive accurate modulus values for these layers from the analysis of deflection test results.

For this pavement strength assessment, it has been assumed that the subgrade is always the weakest layer controlling the load-carrying capacity. However, areas of low base course strength that may provide poor pavement performance have also been identified in the following sections.

4.2 14/32 Runway

4.2.1 Subgrade Strength

The structural capacity of a pavement typically varies throughout the test length. For pavement strength assessment, it is usually necessary to divide the test length into sub-sections that display similar characteristics in terms of the deflections and pavement details.

Wherever possible, the test length has been divided into subsections based on Austroads Guide to Pavement Technology: Part 5 which recommends that sub-sections should exceed 100 m in length and is considered homogeneous if the deflection values have a coefficient of variation CV (i.e standard deviation divided by mean) of 25% or less.

The theoretical subgrade strength values for all test locations on the 14/32 Runway ranged between CBR 5% and 16%. A summary of the sections and the inferred CBR values are shown in **Table 4-1**.

Table 4-1: Summary of Results – 14/32 Runway

Section No.	Chainage (m)	Mean Unit Deflection (mm/MPa) at Geophone									Inferred CBR			
		0 mm	200 mm	300 mm	450 mm	600 Mm	750 mm	900 mm	1200 mm	1500 mm	Mean	Std Dev	CV (%)	Rep Value
1	0 – 120	2.446	1.231	0.729	0.436	0.304	0.223	0.176	0.109	0.077	6.5	0.7	10.6	6
2	120 – 300	2.116	1.128	0.714	0.454	0.324	0.241	0.190	0.121	0.086	7.2	0.8	11.1	6
3	300 – 500 1090 – 1400	1.842	0.953	0.606	0.382	0.271	0.200	0.159	0.105	0.076	8.4	1.3	15.3	7
4	500 – 830 1500 – 1600	1.456	0.753	0.488	0.318	0.232	0.175	0.141	0.096	0.071	10.3	1.7	16.9	9
5	830 – 980 1400 – 1500	1.748	0.914	0.565	0.353	0.248	0.184	0.147	0.098	0.075	9.2	2.5	27.2	7
6	980 – 1090	2.391	1.258	0.747	0.423	0.280	0.197	0.152	0.088	0.054	6.0	0.9	14.3	5
7	1600 – 1740	2.162	1.162	0.657	0.306	0.170	0.117	0.097	0.070	0.057	7.1	1.4	19.4	6
8	RESA -70 – 0 1740 – 1760	3.098	1.601	0.859	0.455	0.280	0.180	0.129	0.084	0.073	5.4	1.2	22.2	4

4.2.2 Base Course Strength

The base course appears to be of lower strength than would normally be expected for an aerodrome pavement in the following areas:

- At Chainage 890 m – Offset 7.5L;
- Between Chainage 990 m and Chainage 1060 m;
- At Chainage 1320 m – Offset 3.75R;
- At Chainage 1410 m – Offset 7.5R;
- Between Chainage 1610 m and Chainage 1630 m; and
- Between Chainage 1670 m and Chainage 1720 m.

The pavements in these locations need to be monitored for evidence of distress under traffic.

4.3 05/23 Runway

4.3.1 Subgrade Strength

The theoretical subgrade strength values for all test locations on 05/23 Runway ranged between 4% and 21%. A summary of the sections and the representative CBR values are shown in **Table 4-2**.

Table 4-2: Summary of Results – 05/23 Runway

Section No.	Chainage (m)	Mean Unit Deflection (mm/MPa) at Geophone									Inferred CBR			
		0 mm	200 mm	300 mm	450 mm	600 Mm	750 mm	900 mm	1200 mm	1500 mm	Mean	Std Dev	CV (%)	Rep Value
1	0 – 35	1.784	0.890	0.505	0.278	0.177	0.123	0.097	0.109	0.070	8.8	1.0	11.8	8
2	70 – 280	1.325	0.669	0.396	0.231	0.154	0.111	0.088	0.062	0.049	12.1	1.9	16.0	10
3	280 – 860	1.154	0.555	0.335	0.209	0.147	0.111	0.091	0.065	0.051	15.3	2.1	14.0	13
4	860 – 950	0.996	0.483	0.297	0.186	0.134	0.101	0.083	0.059	0.046	16.7	2.2	13.3	15
5	950 – 1110	1.623	0.767	0.433	0.229	0.145	0.101	0.080	0.056	0.045	10.7	2.1	19.6	9
6	-50 – 0 1110 – 1140	2.347	1.109	0.569	0.275	0.159	0.110	0.089	0.060	0.057	7.1	1.7	23.4	5

Note: Section between Chainage 35 m and 70 m is covered in Section 7 of 14/32 Runway (Refer to Table 4-1)

4.3.2 Base Course Strength

The base course appears to be of lower strength than would normally be expected for an aerodrome pavement in the following areas:

- At Chainage 170 m – Offset 7.5L;
- At Chainage 960 m – Offset 3.75L; and
- At Chainage 1070 m – Centreline.

The pavements in these locations need to be monitored for evidence of distress under traffic.

4.4 Taxiway A

4.4.1 Subgrade Strength

The theoretical subgrade strength values for all test locations on Taxiway A ranged between 4% and 15%. A summary of the sections and the representative CBR values are shown in

Table 4-3.

Table 4-3: Summary of Results – Taxiway A

Section No.	Chainage (m)	Mean Unit Deflection (mm/MPa) at Geophone									Inferred CBR			
		0 mm	200 mm	300 mm	450 mm	600 Mm	750 mm	900 mm	1200 mm	1500 mm	Mean	Std Dev	CV (%)	Rep Value
1	0 – 105	2.047	1.105	0.623	0.312	0.186	0.127	0.102	0.076	0.061	7.6	2.1	27.4	5

4.4.2 Base Course Strength

The base course appears to be of lower strength than would normally be expected for an aerodrome pavement in the following areas:

- At Chainage 16 m – Offsets 20R and 24R;
- At Chainage 20 m – Offset 10L;
- At Chainage 30 m – Offsets 6L and 10R;
- At Chainage 35 m – Offset 8R;
- At Chainage 40 m – Offset 6R;
- At Chainage 45 m – Offset 4R and 8R;
- At Chainage 50 m – Offset 6R;
- At Chainage 60 m – Offset 6R;
- Between Chainage 75 m and Chainage 85 m; and
- At Chainage 95 m – Offset 4R.

The pavements in these locations need to be monitored for evidence of distress under traffic.

4.5 RPT Apron

4.5.1 Subgrade Strength

The theoretical subgrade strength values for all test locations on the RPT Apron ranged between 3% and 18%. A summary of the sections and the representative CBR values are shown in **Table 4-4**.

Table 4-4: Summary of Results – RPT Apron

Section No.	Chainage (m)	Mean Unit Deflection (mm/MPa) at Geophone									Inferred CBR			
		0 mm	200 mm	300 mm	450 mm	600 Mm	750 mm	900 mm	1200 mm	1500 mm	Mean	Std Dev	CV (%)	Rep Value
1	105 – 120 135 – 175 (Offset 5L to east apron edge)	1.382	0.620	0.336	0.182	0.120	0.089	0.073	0.053	0.042	13.0	2.4	18.6	11
2	120 – 130 130 – 165 (Offset 5L to west apron edge)	1.815	0.817	0.404	0.200	0.131	0.096	0.079	0.056	0.045	9.7	1.8	18.3	8
3	130 – 135 (Offset 5L to east apron edge) 165 – 175 (Offset 5L to west apron edge)	3.255	1.564	0.716	0.274	0.142	0.099	0.081	0.060	0.046	5.3	1.4	26.5	4

4.5.2 Base Course Strength

The base course appears to be of lower strength than would normally be expected for an aerodrome pavement in the following area:

- At Chainage 135 m – Offsets 10L to 30L and Offset 40R;
- At Chainage 145 m – Offset 40R;
- At Chainage 150 m – Offset 40R;
- At Chainage 155 m – Offset 40R;
- At Chainage 160 m – Offset 40R; and
- At Chainage 170 m – Offsets 5L to 30R.

The pavement in this location needs to be monitored for evidence of distress under traffic.

5. Pavement Strength Assessment

5.1 ACN-PCN Method

5.1.1 Basis

The International Civil Aviation Organisation (ICAO) Air Navigation Commission approved a recommendation of the Eighth Air Navigation Conference in 1974 that called for the development of a single internationally accepted method of reporting airport pavement strength. A Study Group subsequently examined various methods and, through its work, the Aircraft Classification Number-Pavement Classification Number (ACN-PCN) method was proposed as an amendment to ICAO Annex 14: "International Standards and Recommended Practices for Aerodromes".

The two terms used in the system are defined as follows:

Aircraft Classification Number (ACN) is a number expressing the relative effect of an aircraft on a pavement for a specified standard subgrade strength.

Pavement Classification Number (PCN) is a number expressing the bearing strength of a pavement for unrestricted operations.

The ACN-PCN method reports pavement strengths on a continuous scale from zero, but with no upper limit, and the same scale is used to measure the load ratings of both aircraft and pavements.

Any aircraft having an ACN equal to or less than the reported PCN can operate on the pavement in question at unrestricted frequency, subject to any tyre pressure limitations.

The theoretical PCN for any pavement can be mathematically derived from the US Army Corps of Engineers CBR design procedure, using the following expression:

$$T = \sqrt{\frac{DSWL}{C1.CBR} - \frac{DSWL}{C2.P}}$$

where: T is the pavement thickness
DSWL is the design single wheel load (at a tyre pressure, P, of 1.25MPa)
CBR is the California Bearing Ratio of the subgrade
C1 and C2 are numerical constants.

For T in cm, and DSWL in kg, the appropriate constants are:

C1 = 0.5695 and C2 = 32.035.

By transposition, the design single wheel load for a pavement whose thickness and subgrade strength are known is given by:

$$DSWL = \frac{T^2 (C1.CBR.C2.P)}{C2.P - C1.CBR}$$

$$= \frac{22.805T^2.CBR}{(40.044 - 0.5695\ CBR)}$$

By definition, the PCN is assigned a value equal to twice the derived single wheel load (expressed in tonnes). The factor of two is used only to achieve a suitable scale so that the system can be used with reasonable accuracy.

Thus, the theoretically derived PCNs for each of the pavements evaluated in this report have been determined using the following expression:

PCN rating = 2 DSWL/1000

$$= 0.002 \times \frac{22.805\ T^2\ CBR}{(40.044 - 0.5695\ CBR)}$$

where: T is the thickness of pavement above the critical layer (cm); and
CBR is the representative CBR value determined from the analysis of the HWD test results.

The ACN-PCN method is intended only for the reporting of pavement strength data, typically in the Aeronautical Information Publication (AIP) or in ERSA. It is not intended that the method be used for the design or evaluation of pavements. Whilst various rules of thumb are available for determining pavement overload concessions using the ACN to PCN ratio, it is not suited for this purpose since it cannot take into account the cumulative effect of such overloads.

5.1.2 Reporting Method

The standard method for reporting the assigned pavement strength classification of a pavement is:

PCN V/W/X/Y/Z

where: V is the assigned PCN value
W is the pavement type (F for flexible or R for rigid)
X is the subgrade strength category (A, B, C, or D)
Y is the maximum allowable tyre pressure (in kPa)
Z is the method by which the pavement strength has been evaluated (T for Technical or U for Experience).

For flexible pavements, four standard subgrade strength categories are used and these are defined as follows:

- Category A: High Strength CBR > 13%
- Category B: Medium Strength CBR 8 - 13%
- Category C: Low Strength CBR 4 - 8 %
- Category D: Ultra-low Strength CBR < 4%

5.1.3 Currently Published PCN Rating

The current version of EnRoute Supplement Australia (ERSA) dated 23 August 2012, shows the strength rating of the 14/32 Runway and 05/23 Runway as PCN 7/F/B/610/T Sealed. This rating is interpreted as follows:

Pavement Classification Number (PCN)	= 7
Pavement Type	= F = Flexible Pavement
Subgrade Strength	= B = Medium Strength
Maximum Tyre Pressure	= 610 kPa
Method of Evaluation	= T = Technical

No strength ratings were published for Taxiway A or the RPT Apron.

5.1.4 Use of the ACN-PCN Method

A paper entitled “Aircraft Pavement Strength Classification – The ICAO ACN-PCN Method” was presented by Bruce Rodway at the International Airport Engineering Course, Canberra, in 2003.

This paper clearly identifies that:

- The ACN-PCN method is a reporting system only and cannot be used for pavement design.

- The selection of an appropriate PCN is a business decision by the airport owner, and should not be linked to the theoretical PCN of the pavement computed from knowledge of the pavement thickness and subgrade support.
- The method cannot quantify the relative damaging effect of:
  - different aircraft types;
  - the same aircraft at different loads; or
  - different frequencies of operation.

The ACN-PCN system is the means by which **airport owners and operators regulate the use of their pavements** having regard to pavement strength and maintenance strategies in relation to revenue from landing fees. The owners are free to design the pavements by any method they choose, and are also free to assign a load rating of their choice which is published as a PCN, a subgrade strength category, and an upper tyre pressure limit. The aircraft manufacturers provide their customers, the aircraft operators, with aircraft load data. This is in the form of ACNs for all possible aircraft operating weights.

If the aircraft's ACN at its intended operating weight is less than the PCN of the runway, it is able to operate at unrestricted frequency. If the ACN is greater than the PCN, however, access is at the discretion of the airport owners. They may allow unrestricted operations at the requested operating weight, or may restrict the frequency of operations. These permits to operate at ACNs that are higher than the PCN are called pavement concessions. The owners may require that the aircraft operate at a lower load, thereby reducing the aircraft's ACN to an acceptable number. The owners can take into account any likely additional maintenance cost or reduced pavement life (i.e. reduced time between asphalt overlays) that might result from so-called 'overload' operations and balance these and other factors against the extra revenue obtained through landing charges.

ACNs must be calculated using a **fixed** technical method and they are intended to indicate the relative pavement damaging effect of each aircraft. The ACN of an aircraft is determined based on its weight and wheel layout, and the subgrade strength. The airport owner has no say in what the ACN of an aircraft is. It is a technical fact. By contrast, the PCN functions as a pavement management tool, and its selection is largely a business decision. Airport operators have considerable scope in rating their pavements. They take into account the thickness and strength of their pavements together with the observed performance of their pavements under aircraft of known ACNs if such information is available. But they also have regard to the size and numbers of aircraft they wish to attract to their airport, and take into account the amount they are prepared to spend to maintain the pavements. They can, for example raise the PCN of their runway to allow unrestricted access of a new heavier aircraft if they wish, and consciously accept the fact that their pavement maintenance bill may increase as a result of the heavier aircraft's use of the runway.

5.1.5 Aerodrome Pavement Composition Requirements

As discussed in **Section 5.1.1** the theoretical PCN for any pavement can be mathematically derived from the USACE CBR design procedure.

The design procedure still in use in Australia for flexible airport pavements is based on the former Australian Department of Housing and Construction method. This method is based on the USACE procedures developed over many years and supported by test track verification.

The CBR method for aircraft flexible pavement design was developed by the USACE during World War II and greatly refined in subsequent years. The system and its derivatives are probably still the most widely accepted methods for the design of pavements for aircraft. The method was adopted (with slight modification) by the Commonwealth Department of Works which assumed responsibility for the design of all government owned airport pavements in Australia after the war.

Without going into a high level of technical detail, the CBR design system essentially comprises three components.

1. The Thickness Requirement

The design method assumes that the pavement comprises various layers, starting with the natural soil at the site (termed the subgrade), and progressing upwards generally with each layer stronger than the underlying one. Each layer, including the subgrade, is rated in terms of its load supporting strength according to a test known as the California Bearing Ratio (CBR). The computations that are undertaken provide the thickness of stronger material required over a layer of a given CBR for it to be able to support an aircraft wheel of a given magnitude. Thus a pavement structure can be designed with each layer being checked to ensure that it is protected by sufficient cover of stronger materials above it.

The amount of cover provided is increased or decreased according to a defined procedure depending on whether the number of effective repetitions of the aircraft load is greater than or less than the standard number assumed in the computations.

If more than one aircraft type is involved, or if the same aircraft type operates at a range of loads, the cumulative effects also need to be considered.

2. The Materials Quality Requirement

In assessing the strength (CBR) of the materials to be used in the various layers above the subgrade in the pavement, the USACE in its Technical Manual TM-824-2 “Flexible Airfield Pavements”, warns against reliance on the results of laboratory CBR tests because “experience has shown that laboratory CBR tests on gravelly materials have tended to give CBR values higher than those obtained in the field”. The USACE consequently placed an upper limiting value on the CBR to be used for design purposes for materials within the pavement layers depending on the properties of the materials. These properties can be determined by simple laboratory tests, namely the amount of the material that will pass through certain key sieve sizes, and the plastic properties as measured by the Plasticity Index (PI), which together indicate the amount and nature of the clay minerals in the material.

3. The Density Requirement

The strength and stability of a pavement layer is generally improved by increasing its density. This is usually achieved during construction by subjecting the layer to numerous passes of a heavy roller to pack the individual soil and rock particles as closely together and to achieve the highest density as is possible.

Aircraft wheels can have the same effect as a roller and could possibly further pack the particles together and cause depressions or other unevenness in the surface if a high level of compaction is not achieved throughout the pavement depth in the initial construction. In order to minimise this possibility, the USACE design system specifies densities to be achieved at various depths within the pavement structure for aircraft loads of different magnitudes.

The combined effect of adherence to all three of the above can be summarised as follows:

- The **Thickness Requirement** ensures that the load transmitted from aircraft wheels to the subgrade is reduced to a value such that any progressive deformation in the subgrade will be very gradual by providing overlying stronger layers of appropriate thickness.

- The **Materials Quality Requirement** ensures that each layer of pavement material above the subgrade is stronger than the layer below so that the weakest link in the total pavement structure is the subgrade, which is the layer furthest from the aircraft wheels.

- The **Density Requirement** ensures that little, if any, further compaction occurs in any of the pavement layers above the subgrade as a result of aircraft wheel loads.

A properly designed and constructed pavement will therefore deteriorate very gradually as a result of the subgrade slowly but progressively deforming under repeated loads. Little, if any, deformation will occur within the highly compacted layers above the subgrade. As a consequence, over a long period of time the pavement could be expected to develop shallow broad depressions in the wheel tracks. Its riding quality may gradually deteriorate, and puddles of water may remain in the depressions for some time after rainfall.

In this condition the pavement is still structurally sound and can be brought to an "as new" condition by placing a variable thickness layer of asphalt on the surface, or resheeting with gravel and resealing to restore the riding quality and ensure that the surface sheds water effectively.

Pavements with bituminous surfaces normally require resurfacing within a period of say 10-15 years as a result of ageing of the surface. It is common for a pavement to be designed for a life of about this value so that correction of the riding quality and surface drainage can be undertaken at the same time as the cyclic resurfacing.

5.1.6 14/32 Runway, 05/23 Runway, Taxiway A, and RPT Apron Pavement Strength

The structure of flexible pavements generally comprises a range of materials from asphalt and crushed rock to stabilised materials and natural subgrade.

In order to evaluate the theoretical bearing strength of a pavement structure, accurate information on the material layer thickness and material characteristics within the pavement structure is required. Material equivalency factors are used to determine the equivalent thickness that is required by alternative materials to achieve the same structural bearing strength.

The material equivalency factors that have been adopted to determine existing pavement thicknesses are presented in **Table 5-1**.

Table 5-1: Adopted Material Equivalency Factors

Pavement Material	Material Equivalency Factors		
	Adopted	ICAO Range	FAA Range
Asphalt to crushed rock (for thickness > 100mm only)	1.3	1.5 to 2	1.2 to 1.6
Stablised crushed rock (base) to crushed rock (base) (for thickness > 100mm only)	1.5	1.5 to 2	1.2 to 1.6
Stablised crushed rock (subbase) to crushed rock (subbase) (for thickness > 100mm only)	1.5	1.5 to 2	1.6 to 2.3
Portland cement concrete to crushed rock (base) (for thickness >100mm only)	2	2 to 3	-
Crushed rock base to uncrushed gravel	0.5	1	0.2 to 0.8

Table 5-2 shows a summary of the representative pavement thicknesses and subgrade strengths adopted for the 14/32 Runway, 05/23 Runway, Taxiway A and RPT Apron together with the theoretical PCN ratings.

The representative pavement thicknesses were obtained from the boreholes undertaken as part of the geotechnical investigation. Sprayed seal surfaces do not provide any contribution to the pavement structural strength and is not considered as part of the representative pavement thicknesses.

On sections where no boreholes were undertaken, representative pavement thicknesses from other sections which displayed similar deflections have been adopted.

Table 5-2: Theoretical PCN Ratings – 14/32 Runway, 05/23 Runway, Taxiway A and RPT Apron

Area	Section	Chainages (m)	Representative Pavement Thickness (mm)	Representative Subgrade CBR (%)	Theoretical PCN	Subgrade Strength Category
14/32 Runway	1	0 – 120	150	6	2	C
	2	120 – 300	500	6	19	C
	3	300 – 500 1090 – 1400	580	7	30	C
	4	500 – 830 1500 – 1600	350	9	6	B
	5	830 – 980 1400 – 1500	180	7	3	C
	6	980 – 1090	400	5	10	C
	7	1600 – 1740	350	6	9	C
	8	RESA -70 – 0 1740 – 1760	150	4	1	C
05/23 Runway	1	0 – 35	550	8	31	B
	2	70 – 280	350	10	16	B
	3	280 – 860	400	13	29	B
	4	860 – 950	400	15	35	A
	5	950 – 1110	350	9	14	B
	6	RESA -50 – 0	150	5	1	C

Area	Section	Chainages (m)	Representative Pavement Thickness (mm)	Representative Subgrade CBR (%)	Theoretical PCN	Subgrade Strength Category
		1110 – 1140				
Taxiway A	1	0 – 105	200	5	2	C
RPT Apron	1	105 – 120 135 – 175 (Offset 5L to east apron edge)	350	11	18	B
	2	120 – 130 130 – 165 (Offset 5L to west apron edge)	200	8	4	C
	3	130 – 135 (Offset 5L to east apron edge) 165 – 175 (Offset 5L to west apron edge)	200	4	2	C
Current PCN For 14/32 and 05/23 Runways					**7**	**B**

Based on the geotechnical laboratory test results and the relatively high FWD unit deflections, the actual theoretical PCN is considered to be less than the value stated in Table 5-2 due to the base/sub-base course potentially not satisfying the Material Quality Requirement and Material Density Requirement as identified in Section 5.1.5. If the Material Quality Requirement and Material Density Requirement are not satisfied, the theoretical load bearing capacity of the pavement would be reduced and therefore the theoretical PCN would be reduced also.

Considering the base/sub-base materials potential poor quality and potential poor density it is suggested that a material equivalency factor of 0.6 be applied to achieve a more realistic total equivalent pavement thickness (i.e. equivalent pavement thickness x 0.6). A summary of reduced theoretical PCNs is provided in **Table 5-3**.

Table 5-3: Theoretical PCN Ratings – 14/32 Runway, 05/23 Runway, Taxiway A and RPT Apron Using Material Equivalency of 0.6

Area	Section	Chainages (m)	Representative Pavement Thickness (mm)	Representative Subgrade CBR (%)	Theoretical PCN	Subgrade Strength Category	General Allowable MTOW Range (kg) (Note 1)
14/32 Runway	1	0 – 120	90	6	1	C	**Aircraft < 5,700 kg**
	2	120 – 300	300	6	7	C	Aircraft < 10,000 kg
	3	300 – 500 1090 – 1400	350	7	11	C	Aircraft < 10,000 kg
	4	500 – 830 1500 – 1600	210	9	5	B	**Aircraft < 5,700 kg**
	5	830 – 980 1400 – 1500	110	7	1	C	**Aircraft < 5,700 kg**
	6	980 – 1090	240	5	4	C	**Aircraft < 5,700 kg**
	7	1600 – 1740	210	6	3	C	**Aircraft < 5,700 kg**
	8	RESA -70 – 0 1740 – 1760	90	4	1	C	**Aircraft < 5,700 kg**
05/23 Runway	1	0 – 35	330	8	11	B	Aircraft < 10,000 kg
	2	70 – 280	210	10	6	B	Aircraft < 10,000 kg
	3	280 – 860	240	13	10	B	Aircraft < 10,000 kg
	4	860 – 950	240	15	13	A	Aircraft < 15,000 kg
	5	950 – 1110	210	9	5	B	**Aircraft < 5,700 kg**
	6	RESA	90	5	1	C	**Aircraft < 5,700 kg**

Area	Section	Chainages (m)	Representative Pavement Thickness (mm)	Representative Subgrade CBR (%)	Theoretical PCN	Subgrade Strength Category	General Allowable MTOW Range (kg) (Note 1)
		-50 – 0 1110 – 1140					
Taxiway A	1	0 – 105	120	5	1	C	**Aircraft < 5,700 kg**
RPT Apron	1	105 – 120 135 – 175 (Offset 5L to east apron edge)	210	11	7	B	Aircraft < 10,000 kg
	2	120 – 130 130 – 165 (Offset 5L to west apron edge)	120	8	1	C	**Aircraft < 5,700 kg**
	3	130 – 135 (Offset 5L to east apron edge) 165 – 175 (Offset 5L to west apron edge)	120	4	1	C	**Aircraft < 5,700 kg**
Current PCN For 14/32 and 05/23 Runways					**7**	**B**	

Notes:
1. General Allowable MTOW Range based on the weights of aircraft that correspond to ACN's that are equal to the given theoretical PCN. This is not definitive for all aircraft within the weight range identified and is only provided for the purpose of comparison. For individual aircraft a detailed analysis should be undertaken based on the ACN-PCN system.

6. Pavement Strengthening Requirements

6.1 Aircraft Traffic Scenarios

The following scenarios have been adopted as representative of the potential future aircraft traffic at Flinders Island Aerodrome.

Traffic Scenario A

Metro 23	6 arrivals per day at Maximum Landing Weight (7.5 tonnes)
Metro 23	6 departures per day at Maximum Take-off Weight (7.5 tonnes)
King Air 200	6 arrivals per day at Maximum Landing Weight (5.7 tonnes)
King Air 200	6 departures per day at Maximum Take-off Weight (5.7 tonnes)

Traffic Scenario B

Metro 23	8 arrivals per day at Maximum Landing Weight (7.5 tonnes)
Metro 23	8 departures per day at Maximum Take-off Weight (7.5 tonnes)
SAAB 340	3 arrivals per day at Maximum Landing Weight (12.9 tonnes)
SAAB 340	3 departures per day at Maximum Take-off Weight (13.2 tonnes)

Traffic Scenario C

Metro 23	12 arrivals per day at Maximum Landing Weight (7.5 tonnes)
Metro 23	12 departures per day at Maximum Take-off Weight (7.5 tonnes)
SAAB 340	6 arrivals per day at Maximum Landing Weight (12.9 tonnes)
SAAB 340	6 departures per day at Maximum Take-off Weight (13.2 tonnes)
DHC-8-300	3 arrivals per day at Maximum Landing Weight (18.7 tonnes)
DHC-8-300	3 departures per day at Maximum Take-off Weight (18.7 tonnes)

Note that in Traffic Scenario B and C, aircraft smaller than a Metro 23 will not influence the pavement thickness design due to their relatively small loads when compared to the other larger aircraft being considered. Accordingly, aircraft such as the King Air 200 have been removed from Traffic Scenarios A and B.

These scenarios have been adopted to determine the pavement upgrade requirements for a 20 year functional design life.

6.2 Wearing Course Options

It has been assumed that the wearing course for any reconstructed or granular overlaid pavement will be a two coat (likely 10mm/7mm) bitumen seal in the short to medium term due to the cost difference between asphalt and a two coat bitumen seal, which may be attributed to labour, plant and equipment transportation and the lack of high quality construction materials currently available on Flinders Island. Considering the likely frequency of use, lower wheel loads and lower tyre pressures of the probable smaller aircraft in the short to medium term, an aerodrome specific two coat bitumen seal is appropriate. It is recommended in the medium to long term that if aircraft greater than 10,000kg MTOW are proposed to utilise Flinders Island Aerodrome that consideration be given to an asphalt wearing course as the potential aircraft safety risk and pavement maintenance is minimised with an asphalt wearing course as opposed to a two coat bitumen seal.

For an aerodrome bituminous seal coat it is noted that high quality materials, workmanship and construction techniques are required for the duration of the works to ensure an adequate wearing course is achieved (well compacted, tight surface texture with minimal loose aggregate). The level of construction and material quality generally accepted for a rural road will not be adequate for the movement area wearing courses at the aerodrome. It is recommended that an aerodrome specific bituminous seal coat design be undertaken prior to tender and construction. It is also recommended that Contractors with suitable aerodrome construction experience be sought for such work, as well as ensuring that construction is closely monitored by suitably qualified engineers.

It is noted that for many local government owned and operated Aerodromes around Australia it is common practice for local governments to incorporate the cyclical re-sealing of the aerodrome movement areas pavements into the overall road asset maintenance program in order to achieve capital expenditure reductions.

6.3 Concept Pavement Upgrade Design Options

Two concept pavement upgrade design options were considered as follows;

- Pavement reconstruction; and
- Pavement overlay with granular material (crushed rock) and a bituminous spray seal surfacing.

The pavement reconstruction option involves excavation and removal of the existing pavement material to the required depth to allow new cement treated crushed rock material sub-base course and new granular crushed rock base course material to be placed followed by a prime coat and bituminous sprayed seal surfacing. The main objective of this option is to ensure pavement material and construction quality and to maintain the existing finish surface levels and profile as much as possible in order to minimise the amount of work that is required on the shoulders and adjacent grassed flank areas to achieve grade compliance.

The pavement granular overlay option involves maintaining the existing pavement structure, proof rolling the existing surface, overlaying the existing pavement with new granular crushed rock base course material followed by a prime coat and bituminous sprayed seal surfacing. The objective of this option is to retain the existing pavement material as a substrate for the pavement strengthening overlay. This option will increase the total pavement thickness over the existing subgrade which will reduce the horizontal strain on the subgrade, subsequently minimising the total new granular crushed rock base course material overlay thickness required to increase the existing pavement strength.

However, with an increase in finished surface level, additional crushed rock base course material would be required on the shoulders to match the overlay surface levels and additional fill material would also be required on the adjacent grassed flanks to achieve drainage and grade compliance. The elevated edge lights and SIT pits also may have to be lifted if additional fill material is required on the flanks. This option does not provide assurance in the overall strength of the pavement due to the potential variability in the quality of the underlying pavement materials and the underlying pavement construction techniques.

The selection of the most appropriate form of construction will need to be determined based on an assessment of the cost, existing surface grade and shape (including compliance with MOS Part 139), quality of material available, quality of construction equipment available, finished pavement quality and maintaining safe aircraft operations at the aerodrome. The existing pavement surface grading and drainage compliance has the potential to be a governing factor in which construction method is selected. A detailed geometric assessment of the existing surface shape can only be determined once the runways, taxiways and RPT Apron are surveyed over a grid (normally 10m longitudinally and 3.75m transversely). This is normally undertaken prior to the concept or preliminary design phase.

Table 6-1 to **Table 6-3** illustrates the pavement thickness requirements for a range of subgrade CBR values to support the aircraft types and frequencies detailed in Traffic Scenarios A, B and C. A design life of 20 years has been adopted for both pavement upgrade options. The pavement design thicknesses are considered preliminary only and do not take into consideration the individual representative pavement thickness and subgrade CBR values for each section of the 14/32 Runway, 05/23 Runway, Taxiway A and RPT Apron.

For the pavement granular overlay option, the average existing pavement thicknesses for the 14/32 Runway, 05/23 Runway, Taxiway A and RPT Apron are based on the representative pavement thicknesses shown in **Table 5-2** for comparison purposes. The adopted average existing pavement thicknesses are presented in **Table 6-1** to **Table 6-3.**

Based on the representative existing pavement thicknesses and the representative subgrade CBR values for the sections shown in **Table 5-2,** the existing pavement thicknesses of the 14/32 Runway and 05/23 Runway are generally adequate to cater for Traffic Scenarios A and B, with the exception of Sections 1 and 5 on the 14/32 Runway. Due to a combination of relatively low subgrade CBR values and small existing pavement thicknesses, pavement strengthening would be required in Sections 1 and 5.

For Traffic Scenario C, majority of the sections on the 14/32 Runway would require pavement strengthening. The existing pavement thickness of the 05/23 Runway is generally adequate to accommodate the aircraft types and frequency for Traffic Scenario C for the range of subgrade CBR values presented.

Pavement strengthening is required for Taxiway A and RPT Apron for Traffic Scenarios A, B and C.

Table 6-1: Pavement Thickness Requirements – Traffic Scenario A

Area	Average Existing Pavement Thickness (mm)	Option 1 – Pavement Reconstruction				Option 2 – Granular Overlay			
		Design Subgrade CBR (%)				Design Subgrade CBR (%)			
		5%	6%	8%	10%	5%	6%	8%	10%
14/32 Runway	400	N/R	N/R	N/R	N/R	N/R	N/R	N/R	N/R
05/23 Runway	380	N/R	N/R	N/R	N/R	N/R	N/R	N/R	N/R
Taxiway A	200	110mm Class A CR 150mm CTCR	100mm Class A CR 140mm CTCR	100mm Class A CR 100mm CTCR	75mm Class A CR 100mm CTCR	180mm Class A CR	140mm Class A CR	75mm Class A CR*	75mm Class A CR*
RPT Apron	250	140mm Class A CR 140mm CTCR	130mm Class A CR 130mm CTCR	90mm Class A CR 100mm CTCR	N/R	160mm Class A CR	120mm Class A CR	75mm Class A CR*	N/R

Note: N/R denotes pavement strengthening not required; CR denotes Crushed Rock; CTCR denotes Cement Treated Crushed Rock

Table 6-2: Pavement Thickness Requirements – Traffic Scenario B

Area	Average Existing Pavement Thickness (mm)	Option 1 – Pavement Reconstruction				Option 2 – Granular Overlay			
		Design Subgrade CBR (%)				Design Subgrade CBR (%)			
		5%	6%	8%	10%	5%	6%	8%	10%
14/32 Runway	400	75mm Class A CR 100mm CTCR	N/R	N/R	N/R	75mm Class A CR*	N/R	N/R	N/R
05/23 Runway	380	75mm Class A CR 100mm CTCR	N/R	N/R	N/R	75mm Class A CR*	N/R	N/R	N/R
Taxiway A	200	140mm Class A CR 150mm CTCR	120mm Class A CR 140mm CTCR	110mm Class A CR 110mm CTCR	100mm Class A CR 100mm CTCR	120mm Class A CR 120mm Class B CR	180mm Class A CR	75mm Class A CR*	75mm Class A CR*
RPT Apron	250	140mm Class A CR 150mm CTCR	130mm Class A CR 140mm CTCR	100mm Class A CR 100mm CTCR	75mm Class A CR 100mm CTCR	190mm Class A CR	140mm Class A CR	75mm Class A CR*	75mm Class A CR*

Note: N/R denotes pavement strengthening not required; CR denotes Crushed Rock; CTCR denotes Cement Treated Crushed Rock

Table 6-3: Pavement Thickness Requirements – Traffic Scenario C

Area	Average Existing Pavement Thickness (mm)	Option 1 – Pavement Reconstruction				Option 2 – Granular Overlay			
		Design Subgrade CBR (%)				Design Subgrade CBR (%)			
		5%	6%	8%	10%	5%	6%	8%	10%
14/32 Runway	400	120mm Class A CR 150mm CTCR	75mm Class A CR 100mm CTCR	NR	NR	100mm Class A CR	75mm Class A CR*	NR	NR
05/23 Runway	380	110mm Class A CR 180mm CTCR	90mm Class A CR 110mm CTCR	75mm Class A CR 100mm CTCR	NR	120mm Class A CR	75mm Class A CR*	75mm Class A CR*	NR
Taxiway A	200	170mm Class A CR 180mm CTCR	150mm Class A CR 170mm CTCR	130mm Class A CR 140mm CTCR	120mm Class A CR 120mm CTCR	160mm Class A CR 170mm Class B CR	130mm Class A CR 130mm Class B CR	170mm Class A CR	120mm Class A CR
RPT Apron	250	170mm Class A CR 180mm CTCR	160mm Class A CR 170mm CTCR	140mm Class A CR 150mm CTCR	130mm Class A CR 130mm CTCR	140mm Class A CR 150mm Class B CR	110mm Class A CR 120mm Class B CR	130mm Class A CR	90mm Class A CR

Note: N/R denotes pavement strengthening not required; CR denotes Crushed Rock; CTCR denotes Cement Treated Crushed Rock

6.4 Indicative Budget Costs

6.4.1 Basis for Costing

Indicative budget costs for providing existing pavement upgrades for aircraft operations as detailed in this report are summarised below. All costs exclude GST, allowances for other fees, other Flinders Council costs and contingencies.

Aurecon's considers indicative budget costs to be a first cost indication (at current prices at the date stated). They are provided to Flinders Council based on an outline estimate of Flinders Council's needs; prepared by reference to feasibility sketches or assessed without sketches (in some instances) and based on Aurecon's knowledge of costs for similar projects. They have been prepared without the benefit of detailed design and without detailed consideration of survey, geometry, drainage, existing/proposed services or other local information. An indicative cost is intended only as a guide for a pre-feasibility and planning purposes, it is not an estimate and may not be quoted as such. Indicative budget costs are prepared using broad cost parameters (eg. earthworks and pavements on a cost per square metre basis).

Since Aurecon has no control over the cost of labour, materials, equipment or services furnished by others, or over Contractor's methods of determining prices, or over competitive bidding or market conditions, any opinion or indicative costs by Aurecon is made on the basis of our experience and represents Aurecon's judgement as experienced and qualified professional engineers. Aurecon cannot and does not, however, guarantee that proposals, bids or actual construction costs will not vary from our budgets and estimates.

6.4.2 Indicative Budget Cost Breakdown

Table 6-4 to **Table 6-6** provide a summary of indicative budget costs for both pavement strengthening options for each traffic scenario as described in **Section 6.1** and **Section 6.2** based on the following average representative subgrade CBR values for the movement areas described in **Section 5.1.6**.

- 14/32 Runway – CBR 7%;
- 05/23 Runway – CBR 12%;
- Taxiway A – CBR 5%; and
- RPT Apron – CBR 8%.

Table 6-4: Indicative Budget Cost – Traffic Scenario A

Option	Item	Cost ($M)
Option 1 – Pavement Reconstruction	Preliminaries	$0.10
	Demolition and removal of existing pavement	$0.15
	Taxiway A pavement reconstruction	$0.15
	RPT Apron pavement reconstruction	$0.27
	Line Marking	$0.01
	Stormwater Drainage	$0.04
	Provisional Sums	$0.05
	Total	**$0.8**
Option 2 – Pavement Overlay	Preliminaries	$0.08
	Taxiway A pavement overlay	$0.15
	RPT Apron pavement overlay	$0.15
	Aeronautical Ground Lighting	$0.02
	Line Marking	$0.01
	Stormwater Drainage	$0.04
	Provisional Sums	$0.05
	Total	**$0.5**

Table 6-5: Indicative Budget Cost – Traffic Scenario B

Option	Item	Cost
Option 1 – Pavement Reconstruction	Preliminaries	$0.10
	Demolition and removal of existing pavement	$0.16
	Taxiway A pavement reconstruction	$0.16
	RPT Apron pavement reconstruction	$0.27
	Line Marking	$0.01
	Stormwater Drainage	$0.04
	Provisional Sums	$0.05
	Total	**$0.8**
Option 2 – Pavement Overlay	Preliminaries	$0.08
	Taxiway A pavement overlay	$0.20
	RPT Apron pavement overlay	$0.16
	Aeronautical Ground Lighting	$0.02
	Line Marking	$0.01
	Stormwater Drainage	$0.04
	Provisional Sums	$0.05
	Total	**$0.6**

Table 6-6: Indicative Budget Cost – Traffic Scenario C

Option	Item	Cost
Option 1 – Pavement Reconstruction	Preliminaries	$0.40
	Demolition and removal of existing pavement	$1.30
	14/32 Runway pavement construction	$3.20
	Taxiway A pavement reconstruction	$0.16
	RPT Apron pavement reconstruction	$0.31
	Aeronautical Ground Lighting	$0.05
	Line Marking	$0.06
	Stormwater Drainage	$0.30
	Provisional Sums	$0.30
	Total	**$6.1**
Option 2 – Pavement Overlay	Preliminaries	$0.40
	14/32 Runway pavement overlay	$2.45
	Taxiway A pavement overlay	$0.19
	RPT Apron pavement overlay	$0.18
	Aeronautical Ground Lighting	$0.08
	Line Marking	$0.06
	Stormwater Drainage	$0.30
	Provisional Sums	$0.45
	Total	**$4.2**

The indicative budget costs are based on construction costs and include an estimation of:

- Preliminaries such as Contractor site establishment and disestablishment, Contractor site administration, Contractor QA and environmental management, maintenance of site access roads, surveying and supply of As-Built drawings;
- Pavement excavation and earthworks and subgrade preparation including cartage and compaction and proof rolling;
- Pavement construction (based on bituminous sprayed seal surfacing, base course, sub-base course and cement treated crushed rock material where applicable);
- Pavement construction from locally sourced material only;
- Select fill material for subgrade replacement from local sourced materials only;
- Lifting of elevated edge lights and SIT pits including new concrete bases;
- Line marking;
- Stormwater drainage (no allowance for sub-surface drainage); and
- Provisional items estimate such as treatment of existing pavement, subgrade replacement and topsoiling of disturbed areas.

The indicative budget costs specifically exclude an estimation of:

- Sprayed seal treatment on areas where pavement strengthening is not required;
- Costs associated with excavation and earthworks to achieve compliant design longitudinal and transverse gradients (vertical geometry);
- Importing select fill material for subgrade replacement from a remote site;
- Disposal of cut material from site which may not be suitable for use as general fill in flanks;
- Costs associated with delays as a result of weather during construction;
- Costs associated with new infrastructure and services (including buildings, roads, electrical, communications, sewerage, water, gas and fuel facilities);
- Costs associated with upgrades to existing infrastructure and services (including buildings, roads, electrical, communications, sewerage, water, gas and fuel facilities);
- Costs associated with future pavement, drainage, lighting or infrastructure expansion;
- Costs associated with any aerodrome fencing and security control;
- Costs associated with any restrictions to airfield operations during construction;
- Costs associated with any aircraft operational matters including:
  - Take-off and approach tracks;
  - GPS approaches;
  - Noise and noise abatement procedures;
  - Navigational aids (with the exception of line marking)
  - Obstacle Limitation Surfaces;
- Costs associated with the potential development or redevelopment of airside areas into the future; and
- Costs associated with any additional statutory, regulatory, planning or environmental requirements associated with the pavement strengthening options.

6.4.3 Accuracy of Indicative Budget Costs

The accuracy of the indicative budget cost estimates is considered to be of the order of 30% too high to 30% too low.

The accuracy is governed by the limitations identified in **Section 6.4.1**.

6.4.4 Potential Project Cost Savings

Once a preferred option is adopted by Flinders Council for further development to tender design, there is potential for overall project cost savings related to the following:

- Adopting a combination of both pavement strengthening options to achieve a more economical pavement strengthening design;
- Flinders Council sources suitable aggregate from a local quarry (compared to importing material from Tasmania);

- The assumed aircraft traffic is refined (potentially reducing the pavement thickness); and
- Flinders Council may complete earthworks and other construction elements at rates cheaper than market rates.

7. Conclusions and Recommendations

7.1 General

Based on the geotechnical investigation results provided by Tasman Geotechnics and the FWD test data provided by Fugro PMS, the subgrade strength of the existing 14/32 Runway, 05/23 Runway, Taxiway A and RPT Apron at Flinders Aerodrome were assessed.

The existing pavement comprises sprayed seal surface overlying a base course layer with thicknesses ranging from 100 mm to 550 mm over the existing subgrade. No sub-base layers were identified during the borehole investigation.

The laboratory test results indicate that the base course material does not typically satisfy the material characteristics anticipated for aerodrome pavement base course materials and is more comparable to sub-base course material. However, it is not uncommon for regional aerodromes to use sub-base course material in lieu of better quality base course material due to material availability (remoteness) and budget constraints, given that regional aerodromes do not normally receive the heavier RPT aircraft that typically operate at Australian capital city airports.

The subgrade material was predominantly sand with thin layers of clay material, overlying a clayey sand or sandy clay. The theoretical subgrade CBR values obtained from the FWD test analysis were between 3% and 21% which is comparable to the values obtained from the soaked CBR tests performed during the geotechnical investigation (CBR values in the range of 3% to 30%).

Based on Austroads publication 'Guide to Pavement Technology: Part 2 – Pavement Structural Design', the presumptive CBR values for sand subgrade are generally between 10 to 18%. The presence of clay in the subgrade material is likely to have contributed to the lower CBR values whilst the presence of gravel in the subgrade material, combined with the confining effects of the mould during the soaked CBR tests, is likely to have contributed to the higher soaked CBR test values.

The representative subgrade CBR values for the 14/32 Runway were between 5% and 9%, which relates to a subgrade category C, meaning it is generally lower than the published subgrade category of B. CBR values for subgrade category B are between 9% and 13%.

Based on the above, consideration should be given to lowering the published subgrade category from B to C for the 14/32 Runway.

Based on the representative subgrade CBRs and representative pavement thicknesses obtained from the FWD and geotechnical investigations, the theoretical PCN ratings for the existing pavements excluding the Runway Safety End Areas (RESA) that are lower than the 14/32 Runway and 05/23 Runway published PCN rating of 7/F/B/610/T, are as follows:

	Theoretical PCN Rating
• 14/32 Runway, Section 1	1/F/C/610/T
• 14/32 Runway, Section 4	5/F/B/610/T
• 14/32 Runway, Section 5	1/F/C/610/T
• 14/32 Runway, Section 6	4/F/C/610/T
• 14/32 Runway, Section 7	3/F/C/610/T
• 05/23 Runway, Section 2	6/F/C/610/T
• 05/23 Runway, Section 5	5/F/C/610/T
• Taxiway A, Section 1	1/F/C/610/T
• RPT Apron, Section 2	1/F/C/610/T
• RPT Apron, Section 3	1/F/C/780/T

If the ACN's of the aircraft that are currently operating at Flinders Aerodrome are significantly higher than the theoretical PCN ratings shown in **Table 5-3**, it is recommended that these sections of pavement are closely monitored for evidence of distress under traffic. Where appropriate routine pavement maintenance or pavement reconstruction should be undertaken to reduce or eliminate potential safety risks to aircraft operations.

Three traffic scenarios were considered in the concept pavement strengthening design. Scenario A is based on the aircraft mix that currently operates at Flinders Island Aerodrome. Scenarios B and C are medium to long term scenarios that include heavier Code 3C aircraft such as the SAAB 340 and/or the DHC-8-300.

Two concept pavement strengthening options were investigated, the first option is pavement reconstruction and the second option is a granular overlay of the existing pavement.

The pavement reconstruction option involves excavation and removal of the existing pavement material to the required depth to allow new cement treated crushed rock material sub-base course and new granular crushed rock base course material to be placed followed by a prime coat and bituminous sprayed seal surfacing. The main objective of this option is to ensure pavement material and construction quality and to maintain the existing finish surface levels and profile as much as possible in order to minimise the amount of work that is required on the shoulders and adjacent grassed flank areas to achieve grade compliance.

The pavement granular overlay option involves maintaining the existing pavement structure, proof rolling the existing surface, overlaying the existing pavement with new granular crushed rock base course material followed by a prime coat and bituminous sprayed seal surfacing. The objective of this option is to retain the existing pavement material as a substrate for the pavement strengthening overlay. This option will increase the total pavement thickness over the existing subgrade which will reduce the horizontal strain on the subgrade, subsequently minimising the total new granular crushed rock base course material overlay thickness required to increase the existing pavement strength.

However, with an increase in finished surface level, additional crushed rock base course material would be required on the shoulders to match the overlay surface levels and additional fill material would also be required on the adjacent grassed flanks to achieve drainage and grade compliance. The elevated edge lights and SIT pits also may have to be lifted if additional fill material is required on the flanks. This option does not provide assurance in the overall strength of the pavement due to the potential variability in the quality of the underlying pavement materials and the underlying pavement construction techniques.

The majority of the 14/32 Runway does not require pavement strengthening to cater for Traffic Scenarios A and B, whilst the majority of the sections would require pavement strengthening to accommodate Traffic Scenario C.

The 05/23 Runway does not generally require any pavement strengthening for Traffic Scenarios A, B and C.

Taxiway A and the RPT Apron require pavement strengthening for all traffic scenarios.

The indicative budget costs indicate that the difference in cost between Traffic Scenarios A and B is marginal. The pavement strengthening cost to cater for Traffic Scenario C is significantly higher, due to the required pavement strengthening of the 14/32 Runway which was not required for Traffic Scenarios A and B.

The selection of the most appropriate form of construction will need to be determined based on an assessment of the cost, existing surface grade and shape (including compliance with MOS Part 139), quality of material available, quality of construction equipment available, finished pavement quality and maintaining safe aircraft operations at the aerodrome. The existing pavement surface grading and drainage compliance has the potential to be a governing factor in which construction method is selected. A detailed geometric assessment of the existing surface shape can only be determined once the runways, taxiways and RPT Apron are surveyed over a grid (normally 10m longitudinally and 3.75m transversely). This is normally undertaken prior to the concept or preliminary design phase.

It has been assumed that the wearing course for any reconstructed or granular overlaid pavement will be a two coat (likely 10mm/7mm) bitumen seal in the short to medium term due to the cost difference between asphalt and a two coat bitumen seal, which may be attributed to labour, plant and equipment transportation and the lack of high quality construction materials currently available on Flinders Island. Considering the likely frequency of use, lower wheel loads and lower tyre pressures of the probable smaller aircraft in the short to medium term, an aerodrome specific two coat bitumen seal is appropriate. It is recommended in the medium to long term that if aircraft greater than 10,000kg MTOW are proposed to utilise Flinders Island Aerodrome that consideration be given to an asphalt wearing course as the potential aircraft safety risk and pavement maintenance is minimised with an asphalt wearing course as opposed to a two coat bitumen seal.

For an aerodrome bituminous seal coat it is noted that high quality materials, workmanship and construction techniques are required for the duration of the works to ensure an adequate wearing course is achieved (well compacted, tight surface texture with minimal loose aggregate). The level of construction and material quality generally accepted for a rural road will not be adequate for the movement area wearing courses at the aerodrome. It is recommended that an aerodrome specific bituminous seal coat design be undertaken prior to tender and construction. It is also recommended that Contractors with suitable aerodrome construction experience be sought for such work, as well as ensuring that construction is closely monitored by suitably qualified engineers.

It is noted that for many local government owned and operated Aerodromes around Australia it is common practice for local governments to incorporate the cyclical re-sealing of the aerodrome movement areas pavements into the overall road asset maintenance program in order to achieve capital expenditure reductions.

7.2 Pavement Upgrade Recommendations

It is difficult to provide a definitive pavement upgrade recommendation for the movement areas at Flinders Island Aerodrome considering the following

- The variable existing subgrade strength;
- The potential variable quality of existing pavement materials;
- The potential variable quality of construction techniques previously employed to construct the existing pavements;
- The unknown future aircraft types and frequency of operations in the medium (5 to 20 years) to long term (20 years and beyond);
- The commercial considerations of Flinders Council's expenditure on pavement maintenance compared to pavement upgrade (plant and equipment, materials and labour) in order to maintain safe movement areas.

In the short term (less than 5 years) it is recommended that if the ACN's of the aircraft that are currently operating at Flinders Aerodrome are significantly higher than the theoretical PCN ratings shown in **Table 5-3**, issue pavement concessions (where required and appropriate) and ensure these sections of pavement are closely monitored for evidence of distress under traffic. Where appropriate routine pavement maintenance or pavement reconstruction (in localised areas) should be undertaken to reduce or eliminate potential safety risks to aircraft operations.

In the medium term (less than 20 years) the low risk option recommended is to monitor the ACN's of the aircraft that propose to operate at Flinders Aerodrome to establish if they are significantly higher than the theoretical PCN ratings shown in **Table 5-3**, issue pavement concessions (where required and appropriate) and ensure these sections of pavement are closely monitored for evidence of distress under traffic. Where appropriate routine pavement maintenance or pavement reconstruction (in localised areas) should continue to be undertaken to reduce or eliminate potential safety risks to aircraft operations. Cyclical pavement maintenance should also continue (i.e. a bituminous spray seal should be constructed as required every 10-15 years). This medium term recommendation is dependent on the current aircraft traffic remaining unchanged. If the aircraft traffic does change or is foreseen to change in the medium term, and the potential aircraft operating are larger and/or more frequent, this is considered the trigger point for the long term recommendation process to commence.

It is recommended that detailed planning and pavement engineering advice be sought for routine pavement maintenance, localised pavement reconstruction as well as cyclical pavement maintenance to ensure that the maintenance activities are targeted, of the highest quality possible and do not result in the creation of a situation where the repair works give rise to further pavement issues.

Furthermore, maintenance activities such as wearing course construction (bituminous spray seal) and pavement reconstruction should be undertaken, as previously discussed using skilled labour, suitably sized equipment and high quality materials with a high level of quality control, including being technically specified and monitored by a suitably qualified engineer to ensure an adequate wearing course is achieved (well compacted, tight surface texture with minimal loose aggregate).

In the long term (greater than 20 years) the lowest risk option recommended is adopt Traffic Scenario C and investigate, plan, design and construct a new Runway (orientation likely to be 10/28) west of the existing 14/32 Runway connecting to the 14/32 Runway and reconstruct Taxiway A and RPT Apron pavements at Flinders Island Aerodrome (lowest disruption to existing aircraft operations).

Due to the potential extended disruption to existing aircraft operations during construction it is not considered appropriate to reconstruct or overlay the existing 14/32 Runway, Taxiway and RPT Apron pavements at Flinders Island Aerodrome.