12.5. INFRASTRUCTURE

12.5.1. East Kimberley Regional Airport - Runway Extension Prefeasibility Study

DATE:	30 August 2016
AUTHOR:	Paul Bawden, East Kimberley Regional Airport Manager
RESPONSIBLE OFFICER:	David Klye, Director Infrastructure
FILE NO:	TT.04.08
DISCLOSURE OF INTERESTS:	Nil

VOTING REQUIREMENT

Simple Majority

OFFICER'S RECOMMENDATION

That Council:

1. **Requests the CEO, or their delegate to include the appropriate revisions required to the Business Case and Prefeasibility Study dated August 2016 to incorporate the provision of lighting to Taxiway B including the associated financial implications.**

2. **Endorses the Business Case and Prefeasibility Study dated August 2016 and therefore the extension of East Kimberley Regional Airport Runway 12/30 project in accordance with the recommended Option 4 contained in this Study subject to Part 1 of this resolution being finalised, noting in particular that Option 4 contains the following:**

7.1 Preliminary runway length and pavement works

Based on the runway extension options assessment and preliminary pavement designs the following tables outlines the recommended runway extension length, airfield lighting upgrades, and associated taxiway and apron pavement upgrades to enable operations of the design aircraft into and out of Kununurra Airport.

Table 11 Runway extension profile recommendation (Option 4)

Runway Extension	Comment
Western end extension	540 m pavement extension
Eastern end extension	61 m pavement extension
Total New 12/30 Runway Length	**2430 m**
Runway width	**30 m**
Runway shoulders	**3 m each side**
Runway strip width	**300 m (150 m without land acquisition)**
Taxiway width	**15 m**

3. **Provides an in-principle commitment of $1 million from the Airport Reserve and requests the CEO, or their delegate to pursue external funding opportunities with other levels of government and the private sector.**

4. **Request the CEO to initiate discussions with the landholders of Lot 876 on Plan 28266 and Lot 1 on Plan 41419 for the acquisition of the required land to the north east and north west of the Airport Runway that will improve operations.**

Cr A Petherick left the Council Chambers at 6:41pm and returned at 6:41pm.

COUNCIL DECISION

Minute No: 11470

Moved: Cr K Wright
Seconded: Cr B Robinson

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Carried 8/1
For: Cr J Parker, Cr K Wright, Cr S Rushby, Cr A Petherick, Cr E Bolto, Cr B Robinson, Cr N Perry, Cr S Cooke
Against: Cr D Spackman

PURPOSE

The purpose of this report is to present the outcomes of the East Kimberley Regional Airport (EKRA) Runway Extension Prefeasibility Study that has investigated extending the current runway to accommodate larger aircraft with a greater range of direct flights. The work has also addressed the needs for associated pavement strengthening to Taxiways and Regular Public Transport (RPT) Apron. This report also seeks Council support to progress the project.

NATURE OF COUNCIL'S ROLE IN THE MATTER

Provider - provide physical infrastructure and essential services

BACKGROUND/ PREVIOUS CONSIDERATIONS BY COUNCIL

The adopted Airport Master Plan (Rehbein Consulting 2013) identifies the further development of the Runway (12/30) to support operations to all domestic destinations for

RPT services and the possibility of destinations in south-east Asia. Options include the extension of the existing runway and a new parallel runway to the north.

The Council at its Meeting of 23 June 2015 resolved to note the Chief Executive Officer's intention to appoint GHD Consulting Engineers to:

- Investigate the ground soil conditions for the proposed runway extension and associated taxiways and passenger terminal apron at the Airport to determine their structural adequacy to accommodate B737 and A320 aircraft;
- Prepare a Business Case to support grant opportunities including an application to a future round of the National Stronger Regions Fund.

A briefing was provided to Councillors regarding the Draft Prefeasibility Study on 12 July 2016 that included a presentation from Michael Ryan of GHD (the Shire's Consultant). The issues raised during the session included gaining views of both major airlines; extent of extension at the eastern end of the runway; weight limitations; runway configurations at comparable regional airports; cost estimates for differing scale of runway works; international capital costs; illuminating Taxiway B; and maintenance costs. These matters are addressed in the "Comments" section of the Report, with the Consultants correspondence comprising Attachment 5.

STATUTORY IMPLICATIONS

The design and construction of the runway extension, taxiways and apron will need to comply with the provisions of Civil Aviation Safety Authority (CASA) Manual of Standards (MOS) Part 139 - Aerodrome Design Standards.

POLICY IMPLICATIONS

There are no significant policy implications however there would be a need during implementation to comply with a range of procurement and safety matters.

FINANCIAL IMPLICATIONS

The construction and related costs are detailed later in this Report and amount to some $20.5m. It is recognised that implementation of the project will require significant external financial support, most likely through grants from other levels of government.

A decision on the Prefeasibility Study does not in itself raise any financial liabilities for the Shire but can provide the basis through the Project Business Plan to pursue funding opportunities.

On the basis of Council support for the project it is proposed that the Council provide an in-principle commitment of $1m from the Airport Reserve as a local contribution towards gaining grant funding. This in-principle commitment will aid the Shire's application for grant funding, however any expenditure of these funds would be subject to gaining the appropriate level of grant funding in the first instance.

STRATEGIC IMPLICATIONS

Strategic Community Plan 2012-2022

Goal 2: Greater returns from regional investment to ensure sustainable provision of appropriate physical and social infrastructure

Objective 2.2: Maintenance of economic diversity and greater community returns from investment in the region

Strategy 2.2.8:Support and advocate for further development of the East Kimberley Regional Airport to attract more aircraft and greater competition

Objective 2.3: Assets are appropriate for their intended purpose and factor in whole of life costing and maintenance

Strategy 2.3.2 : Plan, design and budget for sustainable infrastructure

RISK IMPLICATIONS

Risk: Inability to deliver levels of service expected by the community.
Control: Develop agreed standards of service and communicate with the community

Risk: Failure to comply with legislative requirements leading to damage of reputation and/or financial loss.
Control: Increased accountability to the Audit (Finance and Risk) Committee

Risk: Non compliance with procurement policy and procedures resulting in financial and/or reputation loss.
Control: Procurement policy and procedures.

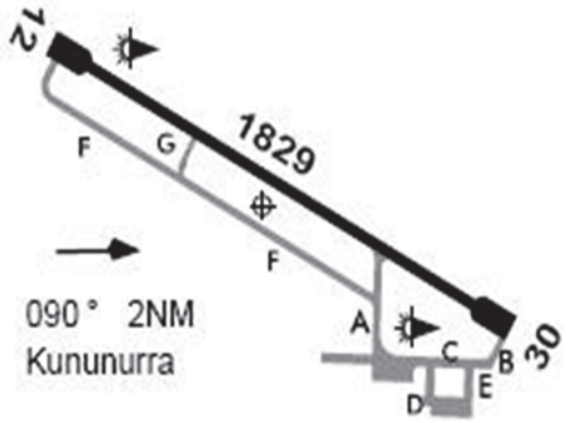
COMMUNITY ENGAGEMENT

No formal community engagement is required however, during the Prefeasibility work there has been liaison with key aviation stakeholders. Wider community engagement is anticipated as the project investigations progress.

COMMENTS

INTRODUCTION
The EKRA includes sealed Runway 12/30 that is 1,829m long by 30m wide within a 150m wide graded strip. The runway is suitable for non-precision instrument approach by aircraft up to and including Code 3C (i.e. Fokker 100 with 100 passengers).

The runway is serviced by multiple taxiways (A-C can accommodate aircraft of over 5,700kg while D-G are restricted to aircraft below this weight). There is a Regular Public Transport (RPT) Apron together with a General Aviation (GA) Apron to the west and east. Charter and private aircraft are operated from a number of hangars located at the Airport.



The Council has supported investigations to upgrade the Airport to accommodate Code 4C operations (design aircraft comprising Boeing B737 and Airbus A320 that can each carry 170 passengers). This also has the potential through increased fuel capacity, to provide for direct flights to all domestic airports in Australia together with key destinations in south-east Asia.

A significant opportunity has been provided through the Civil Aviation Advisory Publication 235A-10 of November 2014. This allows for a narrower minimum runway width of 30m (compared to 45m) for Code 4C aeroplanes that provide regular public transport and charter services with a minimum take-off weight greater than 5,700kg and subject to certification by the operators.

The investigations for the proposed runway extension have been undertaken across three areas comprising:

- Prefeasibility Report (Minor updates following briefing);
- Pavement Investigation Reports;
- Business Case Report (Minor updates following briefing).

A copy of the above documents (together with recent Memo from GHD) comprise Attachments 1-5.

PREFEASIBILITY REPORT (Attachment 1):

Runway Options: Four options were investigated to determine the ultimate runway extension length achievable for the existing Runway 12/30 alignment. The work addressed physical constraints, obstacle limitation surfaces, drainage and land tenure together with compliance to CASA Manual of Standards (MOS) Part 139 - Aerodromes Design Standards. The principal constraints are:

- Extension at west end - Ord River including riparian zone and drainage together with former borrow pit (extraction area);
- Extension at east end - Ord River irrigation channel (500m from current Runway 30 threshold) and Victoria Highway (to south) together with height restrictions to buildings north-east of aerodrome boundary;
- Crown Land outside Shire ownership to north of current runway (western end) and to north east corner (private ownership).

The proposal is to achieve the maximum feasible runway extensions of 540m at the western end and 61m at eastern end. This would provide for a runway length of 2,430m which is considered sufficient for the operation of B737 and A320 jet aircraft servicing all domestic and key airports in south-east Asia (e.g. Singapore, Jakarta and Kuala Lumpur) without the need for a refueling stop. This range is illustrated in the following graphic.

Range existing Fokker 100 (red) vs proposed Boeing 737-800 (blue)

Following the briefing with elected members, investigations have been undertaken on the potential to achieve an increased extension of the runway at the eastern end (based on an additional interval of 60m) including a reassessment of the obstacle limitations. This was on assumption that the buildings located at the north eastern corner are removed and the Shire will seek to achieve a 300m wide runway strip at some point in the future.

The investigations concluded that a further extension of 60m would result in aircraft having approach and take-off slopes that would result in unacceptable restrictions on vehicles using Victoria Highway (below 4m), light poles on Highway Bridge and some larger vegetation on the eastern side of the drainage channel. If a lesser extension interval than 60m were pursued it would necessitate the relocation of all existing lights on the runway to maintain an equal spacing.

A review of the weight limitations for aircraft has also been undertaken since the briefing. As an example the take-off performance of B737s is dependent on numerous factors including engine type/rating; wet or dry runway; wind; runway gradient; temperature; flap setting; operational take-off weight; airport elevation; and runway surface. While acknowledging that take-off performance will be different on every occasion the “B737 Airplane Characteristics for Airport Planning” document indicates that with a proposed length of 2,430m the runway will provide near unrestricted weight limitations for take-off for most situations.

Upgrades/provision of other infrastructure: To accommodate aircraft on the extended runway there will be a need to also upgrade or provide the following additional infrastructure:

- Taxiways A-C will need to be upgraded (pavement details in following section) for aircraft travelling between the Terminal and the runway (while they would continue to backtrack using the runway if landing from/taking-off to the east).
- RPT Apron layout to be upgraded to accommodate a second Code 4C aircraft.
- Lighting upgrade comprising:
    - Replacement/extension of existing runway edge lighting;
    - Relocation of the western illuminated wind indicator (IWI);
    - Replacement of the T-Visual Approach Slope Indicator System (AT-TVASIS) for the longer runway with a Precision Approach Path Indicator (PAPI) system due to improved maintenance and running costs;
    - Terrain lighting masts (with solar powered hazard lights) erected to additional high points in the vicinity of the airport.

To accommodate International flights (passenger/freight) there is also a need to address the following:

- Provision of a Runway End Safety Area (RESA) of 240m at each end of the runway as recommended under the MOS rather than the current 90m RESA (If required this could impact on some of the runway extension);
- Aerodrome Rescue and Fire Fighting Service (ARFFS) with the current Manual of Standards requiring for a B737-800 passenger aircraft a two vehicle facility. However in December 2015 a regulatory policy review consultation paper nominated in the future that rather than a hard trigger that a risk based approach be adopted;
- Air Traffic Control (ATC) together with Customs and Border Control facilities;
- Expansion of the Terminal Building that could be in the order of 40% of current building foot-print.

The construction/operational costs of these facilities has not been scoped at this stage.

Construction efficiencies: To achieve construction efficiencies while meeting the operational needs of the design aircraft the following are proposed:

- Runway to be 30m wide (as existing) based on airline operators certifying the aircraft capabilities to operate safely. This is a common practice for the design aircraft at regional airports (details in the two following sections);
- Taxiways A-C to be retained at 15m (rather than 18m) wide which can accommodate the design aircraft;
- Continue to use Taxiways D-G and GA Apron only for aircraft below 5,700kg;
- Retaining the extended runway within the current 150m wide strip. The runway strip can ultimately be extended to 300m in width through land acquisitions (that are costed into the project) but do not need to delay the proposed works.

Advice from Airlines on narrow runway: The two major national airlines that operate aircraft that could utilise the extended runway have been contacted for advice on the narrow runway design.

QANTAS has provided its support as follows:
“We have the AFM narrow runway appendix to support operations to runways less than 45m on our fleet of 737-800. This complies with the guidelines contained in the subject CAAP. Based on this approval, we already operate to a number of 30m runways, whether they are used as planned destinations or alternatives. The only benefit to widening the runway would

be a small increase to the crosswind capability (40kt in lieu of 33), though this would be unlikely to be of significance at Kununurra."

Virgin have similarly advised that:
"For the 737-700/800W, Virgin has no technical objection to keeping the runway at 30m wide. Virgin currently operates to 30m wide runways with the B737.
There are operational restrictions to narrow runways (defined, for the 737, as widths less than 45m and no less than 30m), which are summarised below:

- The ground control speed (VMCG) may change due to the maximum 20 foot deviation from runway centreline (this may or may not affect the MTOW and other take-off speeds).
- Nose gear steering must be operative.
- Runway centreline shall be clearly visible.
- Brakes must be operative.
- Thrust reversers operative.
- Yaw damper operative.
- (More restrictive) Crosswind limitations are not exceeded.

As we already operate to 30m wide runways these restrictions are not new to the Virgin operation. While 45m wide runways are operationally preferred, Virgin can operate to Kununurra without any "new restrictions."

It should be noted that Air North's current aircraft fleet only requires a 30m wide runway e.g. E170.

Comparison to runways at other regional airports: The following Table provides a comparison of the runway configuration for the design aircraft (B737 and A320) at EKRA (as proposed) and examples of similar regional airports raised at the briefing.

Airport	Narrow Runway	Runway Width	Runway Strip Width	Runway Length	RESA*
EKRA (Proposed)	Yes	30m	150m (Then to 300m)	2,430m	90m
Ayers Rock	Yes	30m	150m	2,599m	90m
Ballina	Yes	30m	150m	1,900m	90m
Broome	No	45m	150m	2,458m	90m
Karratha	No	45m	300m	2,280m	90m
Newman	Yes	30m	150m	2,072m	90m

*Runway End Safety Area

PAVEMENT INVESTIGATIONS (Attachments 2 and 3)
The Pavement Investigation Report (document dated June 2016 Attachment 2) has been undertaken to identify the construction standard for the runway extension and adequacy of

current runway, taxiways and apron utilised by RPT aircraft. This reflects the need for pavements to accommodate the increased wheel loadings of the larger aircraft.

Recent surfacing works at the Airport have included the current runway being overlaid with an asphalt coat in July 2015; Taxiways A-C cement stabilised and a double coat seal in 2010; and RPT apron resealed in 2004 and 2014.

This investigation included:

- Review of 2015 asphalt overlay of current runway that has been found to have successfully strengthened the pavement;
- Visual inspection and assessment of Taxiways A-C and RPT Apron concluding they are generally in good condition with minor defects and are functional for current aircraft;
- Excavation of trial pits within the runway extension area and adjoining Taxiways A-C that through laboratory testing identified a sandy clay subgrade with expansive properties. Previous reports have identified more reactive clays west of Taxiway A;
- Heavy Weight Deflectometer (HWD) testing of RPT Apron and Taxiways A-C which showed the pavements to be relatively stiff with localised softening around edges of the Apron.

Scenarios of air traffic loadings were estimated over the next twenty years to support the design of the runway extension and upgrading of Taxiway/Apron pavements.

The proposed pavement works to be progressed through detailed design provide for:

- RPT Apron pavement being provided with a 60mm asphalt overlay;
- Taxiways A-C to be over laid with 260mm of cement modified crushed rock, 15mm of waterproofing/prime and a 60mm asphalt surface;
- Runway extension to have a similar layered pavement to current runway with a total depth of 1,275mm. Where fill is required at the western end in particular there will be a need to provide significant compacted base material.

It needs to be recognised that the extended runway will add to the Airport's long term asset and maintenance responsibilities that are detailed in the following section.

Further geotechnical investigation and soil testing is proposed as part of the detailed design.

While not part of this project the investigations also considered Taxiways D-G and the general aviation (GA) Apron (document dated May 2016 Attachment 3). The testing indicates a need for maintenance works in the coming years to ensure an adequate pavement for the current aircraft (under 5,700 tonnes).

BUSINESS CASE REPORT (Attachment 4)
The Business Case Report (document dated August 2016) for the runway extension and associated works recognises the economic and social benefits to the region of the proposal.

The need to upgrade the airport to accommodate the increased size and capability of aircraft has been identified in a range of recent reports including Our North, Our Future: White Paper

on Developing Northern Australia (Australian Government) and 2036 and Beyond: a regional blueprint for the Kimberley (Kimberley Development Commission).

The key criteria that support the project are based around:

- Contribution to regional growth: There is significant growth associated with the tourism, agriculture, aquaculture and in the longer term mining sectors. Each industry is inhibited by the cost to access markets, barriers to employing people and undertaking business;

- Isolation of the region: Remoteness is a significant constraint in accessing many medical, social and commercial services together with family and other networks. Access is limited to road and aviation with the closest centre with a population over 10,000 people being Darwin located 800km away by road and return cost of up to $800 by air.

  This situation is compounded by the closure of roads for periods during the wet season and potential for natural disasters linking to cyclones and bushfire. An extended runway can better service both the community in Kununurra and those in more isolated localities.
  It is noted that through consultation in developing the 2012-2022 Strategic Community Plan the number one priority for residents was “Cheaper flights in and out of town”;

- Addressing disadvantage: The Australian Bureau of Statistics Socio-economic Index ranks the East Kimberley within the top 20% of most disadvantaged regions within Australia. There are particular challenges for Indigenous Australians, while the regional cost of living in Kununurra is higher than those nationally.

BUDGET AND FUNDING
Capital costs: An indicative cost estimate has been prepared (exclusive of GST) totalling $17.5m for construction and $18.6m with the inclusion of land purchases. The assumptions in preparing these figures include a contingency of 30% and all pavement fill being sourced locally, but does not currently have a time based escalation.

The following Table provides comparative construction cost estimates for the proposed and two other designs that have been raised:

Proposed Construction	**Cost (millions)***
Current Runway 30m wide, together with an extension of 601m length at 30m wide (excludes land acquisition)	$17.5m
Current Runway 30m wide, together with an extension of 601m length at 45m wide (excludes land acquisition)	$20.2m

Current Runway widened to 45m wide, together with an extension of 601m length at 45m wide (excludes land acquisition). The widening of the current runway would necessitate the closure of the Airport for an extended period (as occurred at Broome when Derby was used). Alternatively a new parallel runway to the north would need to be constructed at a significantly increased cost.	$23.5m+

*Exclusive of GST

During the briefing a proposal was also raised for the lighting of Taxiway B (see location diagram earlier in this report). On the basis of installing elevated Taxiway edge and hold point lighting the cost is estimated at $150,000 (exclusive of GST) and could be added to the project with revisions to the supporting reports (resulting in total cost with land and excluding GST of $18.95m).

It is recognised that the Shire is not in a position to fund the capital expenditure but will be expected to accept responsibility for implementation and longer term asset management. The proposed funding model is based on:

- Federal National Stronger Regions Fund (NSRF) - Grants up to $10m have been available under previous funding rounds. Prior to making a submission however an applicant needs to source a contribution (outside Federal Government bodies), which due to Kununurra's 'remote' regional status would be $1 for each $3 sought.

  There is also potential for Federal funding to be available through the new Northern Australia initiative although details have not been released.
- State Royalties for Regions Fund (RfR) - The WA Government has recently refocused its allocations to projects that generate greater economic development potential, whereby this project would be clearly aligned.

  Other State funding opportunities are:

  - Regional Airport Development Scheme that has been established to improve regional airport infrastructure. Runway development, including the extension of an existing runway, is listed as an eligible project. However over the 2017-19 funding round a maximum of $3.88m will be available across the State and a 1:1 matching contribution from the applicant organisation is normally expected;
  - Regional Growth Centres with Kununurra's status as a group two town likely to provide access to funds for priority projects;

- Shire - A contribution from the Shire's own resources would likely assist grant applications to other levels of Government.

Obtaining major grants is becoming progressively more difficult and as such there will be a need to focus on lobbying and the preparation of quality applications. It is suggested that the Shire (if including the land purchases) make an in-principle commitment of $1m and then

seek $8.9m through State sources, in particular RfR that can be used to leverage $8.9m through NSRF. This could take a year or more to achieve.

Maintenance costs: There is a need to appreciate that the extended runway will generate additional maintenance costs. With a proposed asphalt wearing surface there will be reduced work compared to a bitumen seal surface - as has been experienced following the 2015 asphalt overlay of the existing runway.

Additional maintenance costs will include:

- Repainting of additional line markings around three year intervals;
- Asphalt resurfacing and grooving of additional runway length in 15-20 years;
- Mowing/slashing of grass in additional runway strip area;
- Filling of gilgai holes within additional runway strip area;
- Maintenance of additional light fittings (minimal).

In proportionate terms this is likely to be an increase of about 25% on the costs of maintaining the current runway.

PROJECT TIMEFRAME:

Recognising the challenges to achieve the extended runway project the following provides an indicative timeframe. This timeframe will be further refined as additional information is obtained.

August 2016:	Council's in-principle commitment to the project and endorsement of the Prefeasibility Study.
September 2016 - February 2017:	Seek to obtain State funding of at least $2m.
March 2017 - August 2017	Secure remaining $6.9m from State sources.
April 2017:	Submit funding application for $8.9m under NSRF utilising $1:$3 local funding comprising $2m from State and $1m from Shire (assuming that Round 4 follows the same calendar dates as Rounds 1-3).
July 2017	Outcome of NSRF funding announced (assuming that Round 4 follows the same dates as Rounds 1-3).
September 2017 - February 2018:	Undertake Detailed Engineering Design.

March 2018 - July 2018	Undertake Tendering and other procurement steps.
August 2018 - May 2019:	Construction (managed around wet season).
August 2019	Reconciliation of NSRF based on dates in previous funding rounds

SUMMARY AND CONCLUSIONS

The Prefeasibility Study has identified that the current East Kimberley Regional Airport runway can be extended by 601m to provide a total length of 2,430m. With some minor land acquisitions the runway strip can be widened to 300m although this does not need to occur immediately.

This configuration is capable of accommodating B737 and A320 aircraft with a capacity of 170 passengers, close to twice that of current jets and they would be able to directly service all domestic and key south-east Asian destinations.

To best manage the costs a number of construction efficiencies are proposed, in particular the adoption of a “narrow runway” design of 30m that is supported by the two major national airlines (Qantas and Virgin) and is utilised at other regional airports. The alternate provision of a 45m wide runway would result in significantly higher costs including the temporary closure of the airport during construction or the more expensive option of a new parallel runway.

Associated works include upgrading the pavements of Taxiways A-C at the current width of 15m. Some minor works would also be needed to the RPT Apron. While not referenced in the reports, lighting of the short Taxiway B is recommended to support improved access to the Terminal area.

The proposed approach would minimise long-term maintenance costs.

At a construction cost of $18.8m a funding strategy is recommended to Council based on a $1m Shire in-principle commitment to a contribution from the Airport Reserve and grants totalling $8.9m from each of the Federal and State Governments. With long term uncertainties over the availability of current grants an ambitious program is nominated to achieve the upgrade by May 2019.

ATTACHMENTS - Item 12.5.1

The following documents are attached:

Attachment 1: East Kimberley Regional Airport Runway 12/30 Extension - Prefeasibility Study August 2016

Attachment 2: East Kimberley Regional Airport Runway Extension Prefeasibility Study - Preliminary Pavement Investigation and Design June 2016

Attachment 3: East Kimberley Regional Airport Runway Extension Prefeasibility Study - Pavement Condition Assessment May 2016

Attachment 4: East Kimberley Regional Airport Runway 12/30 Extension - Business Case August 2016

Attachment 5: Memo from GHD - Responding to matters raised at briefing - 9 August 2016

Shire of Wyndham East Kimberley

East Kimberley Regional Airport
Runway 12/30 Extension
Prefeasibility Study

August 2016

Executive summary

This report summarises the prefeasibility study for a runway extension and pavement upgrade at Kununurra Airport to a Code 4C aerodrome for the Shire of Wyndham East Kimberley (SWEK). The design aircraft for the prefeasibility study is the Boeing 737-800 and Airbus A320-200 aircraft. The extension of the runway was identified in the 2013 East Kimberley Regional Airport Master Plan.

The current airport is rated for aircraft up to Code 3C and includes a 1,829 m long by 30 m wide runway within a 150 m wide graded runway strip.

New CASA regulations specified in CAAP 235A-1(0) for the minimum runway width for aeroplanes engaged in regular public transport and charter operations with a maximum take-off weight greater than 5700 kg will enable B737 and A320 aircraft to operate in and out of Kununurra Airport on the existing 30 m wide runway. GHD recommends the SWEK adopt the narrow runways supplement for the runway development.

GHD wrote to airline operators (Qantas and Virgin) to seek their feedback on the proposal. Both companies responded that they do not have any concerns with the proposal to maintain a 30m wide runway at Kununurra Airport. It is also noted that the B737-800 and A320-200 aircraft are operated regularly by Qantas and Virgin into other airports within Australia which only have 30 m wide runways, such as Newman Airport (WA), Ballina Airport (NSW) and Ayers Rock Airport (NT).

Four options have been investigated to determine the ultimate runway extension length achievable for the existing Runway 12/30 alignment. The physical constraints, obstacle limitation surfaces, drainage and land tenure have been considered in this assessment and comply with CASA Manual of Standards (MOS) Part 139 – Aerodromes design standards. The overall runway extension length available is 601 m providing an ultimate Runway 12/30 length of 2,430 m. This ultimate length will provide greater operational useability for aircraft.

GHD undertook a pavement investigation for the proposed runway extension of Runway 12/30 and to evaluate the capability of the existing Taxiways A, B and C and RPT apron with regards to the future aircraft traffic and design aircraft. The extended runway will require 60 mm asphalt mix on 150 mm crushed rock base, on 250 mm cement modified subbase, on 700 mm river shingle on 100 mm sand to carry the loading of the design aircraft. This pavement thickness is the same as the existing runway pavement.

For Taxiways A, B and C strengthening is required which would consist of a 260 mm of cement modified base placed on the existing pavement with a 60 mm asphalt surfacing. The existing RPT apron pavement will only require a 60 mm asphalt overlay for strengthening and shape correction.

The runway lighting needs to be extended along with replacement of the existing runway edge light fittings and replacing the AT-TVASIS approach guidance system with a PAPI system. The wind indicator is required to be relocated at the western end of the runway.

The indicative preliminary cost estimate to complete the Runway 12/30 extension and pavement upgrade based on the engineering completed for the prefeasibility study is in the order of $20.5 million (incl. GST). This includes an additional allowance of $1.3 million for land acquisition. A number of qualifications are associated with the cost estimate.

During the concept design stage, a number of reasonably foreseeable hazards were identified and a Safety in Design risk assessment was undertaken. The process considered issues affecting the design, construction, commissioning, operation, and maintenance of the

aerodrome. The design has been modified as far as reasonably practicable to eliminate inherent design and aerodrome operational risk.

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Appendices

Abbreviations

Abbreviation	Description
A320	Airbus A320-200 aircraft
AC	Asphaltic Concrete
ACN	Aircraft Classification Number
AFMS	Aeroplane Flight Manual Supplement
ARRB	Australian Road Research Board Group Ltd
AS	Australian Standards
AT-TVASIS	T-Visual Approach Slope Indicating System
B737	Boeing 737-800 aircraft
CAAP	Civil Aviation Advisory Publication
CASA MOS 139	Civil Aviation Safety Authority Manual of Standards Part 139 Aerodromes
CBR	California Bearing Ratio
CCR	Constant Current Regulator
ERSA	En Route Supplement Australia
F100	Fokker 100 aircraft
GA	General Aviation
GHD	GHD Pty Ltd
HWD	Heavy Weight Deflectometer
ICAO	International Civil Aviation Organization
IWI	Illuminated Wind Indicator
Kununurra Airport	East Kimberley Regional Airport
MIT	Mains Isolating Transformer
NATA	National Association of Testing Authorities
OEI	One Engine Inoperative
OEM	Original Equipment Manufacturer
OLS	Obstacle Limitation Surfaces
OUD	Open Unlined Drain
PAPI	Precision Approach Path Indicator
PCN	Pavement Classification Number
PSI	Pounds per Square Inch
RESA	Runway End Safety Area
RAV	Restricted Access Vehicles
RPT	Regular Public Transport
SiD	Safety in Design
SWEK	Shire of Wyndham East Kimberley
T	Technical Evaluation
TODA	The take-off distance available

1. Introduction

1.1 Background

GHD Pty Ltd (GHD) was engaged by the Shire of Wyndham East Kimberley (SWEK) in August 2015 to undertake the Prefeasibility Study on extending the existing runway and complete a full pavement strength evaluation of the Regular Public Transport (RPT) apron and Taxiways A, B, and C at the East Kimberley Regional Airport (Kununurra Airport) in Kununurra. Figure 1 indicates the location of each of the taxiways.

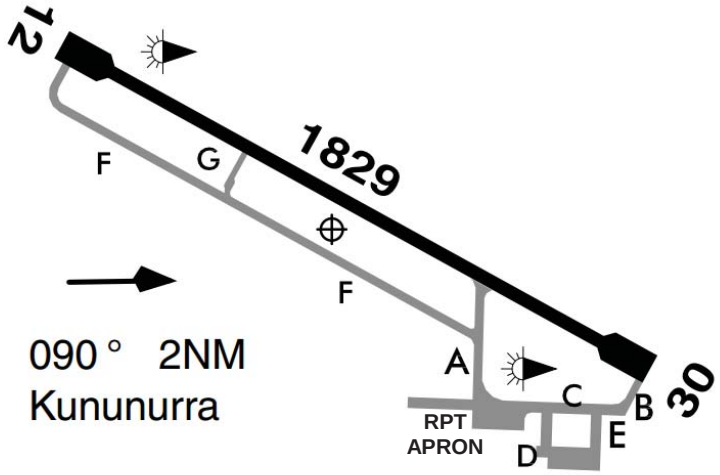

Figure 1 Aerodrome Layout

The upgrade to the aerodrome will enable airlines to operate large aircraft, the Boeing 737-800 and Airbus A320-200 for regular public transport. Consideration has also been given for general aviation aircraft that regularly service the aerodrome.

This Prefeasibility Study report details the concepts and options available for the runway extension and upgrade of taxiways and RPT apron pavements. The options presented will enable the operation of B737 and A320 aircraft at Kununurra Airport.

Confirmation on some aspects of the design is required by the SWEK to progress the feasibility of the design options to detailed design.

1.2 Purpose of this Report

The purpose of this report is to document the concept and options analysis, and detail the Prefeasibility design undertaken for the runway extensions to enable B737 and A320 operations into and out of Kununurra Airport.

Pavement designs are detailed following the preliminary geotechnical investigation carried out in August 2015. The geotechnical and pavement investigation and analysis of the existing pavement capacity is discussed in this report and provides recommendations on the strengthening and upgrade works to the runway, taxiways A-C and RPT apron pavement areas. The Preliminary Pavement Investigation and Design report is issued separately.

Investigation on the runway extension length and geometric options available for the aerodrome to enable larger aircraft operations is detailed in this report. The runway extensions options are considered following an assessment of land tenure and obstacle limitation surfaces (OLS), and a recommended option is presented in this report.

A preliminary indicative cost estimate for the preferred option is also detailed in this report.

1.3 Scope of Work

The scope of work for the prefeasibility and preliminary aerodrome design comprises the following:

- Airport location and airside design considerations;
- Geometric and runway extension layout options;
- Preliminary pavement designs for the runway extension, Taxiways A, B and C and the RPT apron;
- Recommended option;
- Preliminary indicative cost estimate for the recommended option.

1.4 Limitations

This report has been prepared by GHD for the Shire of Wyndham East Kimberley and may only be used and relied on by the Shire of Wyndham East Kimberley for the purpose agreed between GHD and the Shire of Wyndham East Kimberley as set out in section 1.2 of this report.

GHD otherwise disclaims responsibility to any person other than the Shire of Wyndham East Kimberley arising in connection with this report. GHD also excludes implied warranties and conditions, to the extent legally permissible.

The services undertaken by GHD in connection with preparing this report were limited to those specifically detailed in the report and are subject to the scope limitations set out in the report.

The opinions, conclusions and any recommendations in this report are based on conditions encountered and information reviewed at the date of preparation of the report. GHD has no responsibility or obligation to update this report to account for events or changes occurring subsequent to the date that the report was prepared.

The opinions, conclusions and recommendations in this report are based on assumptions made by GHD described in this report. GHD disclaims liability arising from any of the assumptions being incorrect.

GHD has prepared the preliminary cost estimate set out in section 8 of this report ("Cost Estimates") using information reasonably available to the GHD employee(s) who prepared this report and based on assumptions and judgments made by GHD.

The Cost Estimate prepared for the purpose of this report is a preliminary indicative estimate only. Actual prices, costs and other variables may be different to those used to prepare the Cost Estimate and may change. Unless as otherwise specified in this report, no detailed quotation has been obtained for actions identified in this report. GHD does not represent, warrant or guarantee that the works can or will be undertaken at a cost which is the same or less than the Cost Estimate. Notwithstanding the conservatism of the level of confidence selected at this Prefeasibility level, there remains a chance that the cost will be greater than the estimate, and any funding would not be adequate. The confidence level considered to be most appropriate for prefeasibility purposes vary depending on the conservatism of the user and the nature of the project. The Shire of Wyndham East Kimberley should therefore select appropriate confidence levels to suit their particular risk profile.

2. Current Airport and Master Plan

2.1 East Kimberley Regional Airport

Runway 12/30 is 1,829 m long by 30 m wide within a 150 m wide graded runway strip. The runway is suitable for non-precision instrument approach operations by aircraft up to and including Code 3C. The runway is serviced by multiple taxiways, and includes a RPT apron and general aviation (GA) apron. Charter and private aircraft also operate out of the airport with a number of hangars located on the airport.

SWEK intend to upgrade the airport to accommodate Code 4C operations by extending the runway which will support larger sized aircraft and thus increase the range of destinations that the airport can support.

2.2 Master Plan

The runway extension and upgrade option is detailed in the 2013 Kununurra Airport Masterplan (developed by Rehbein Airport Consulting, 11 January 2013), of which GHD has reviewed and considered in developing the runway extension options.

The 2013 Master Plan outlines concept runway extension options for the runway upgrade in order to accommodate operations of B737 and A320 aircraft. Option 1 of the Master Plan entails a runway extension along the existing runway alignment at the west end, for a final runway length of 2,350 m with a width of 45 m. Option 2 of the Master PLan proposes a new 2,500 m by 45 m wide runway on a new alignment to the north of the existing Runway 12/30.

With the introduction of the CASA narrow runway supplement in November 2014, a runway width of 45 m is not required for the operations of some Code 4C aircraft and a 30 m wide runway will be sufficient for the operation of the design aircraft. Therefore, GHD has progressed the masterplan Option 1 but with a 30 m wide runway pavement.

GHD has excluded Taxiways D - G from the prefeasibility study to limit costs, as it is more cost effective for Code C aircraft to continue backtracking on the runway.

2.3 Runway Useability: Narrow Runways

New regulations specified in CAAP 235A-1(0) in November 2014 for the minimum runway width for aeroplanes engaged in regular public transport and charter operations with a maximum take-off weight greater than 5700 kg will enable B737 and A320 aircraft to operate in and out of Kununurra Airport on the existing 30m wide runway.

The airline operators are required to certify the aircraft capabilities to operate safely on narrow runways under the regulations. Under the changes, aeroplanes now need to be assessed by the original equipment manufacturer or by flight test of the aeroplane to determine their capability to operate on the narrow runway. The aeroplanes are then be issued an approved Aeroplane Flight Manual narrow runway supplement (AFMS).

It noted that the B737-800 and A320-200 aircraft are operated regularly by Qantas and Virgin into other airports within Australia which only have 30 m wide runways, such as Newman Airport (WA), Ballina Airport (NSW) and Ayers Rock Airport (NT).

The runway shall conform to the following performances for the design aircraft in order to achieve a narrow runway supplement:

"The runway width must be adequate to safely contain an aeroplane during take-off and landing by flight crews of average skill, using procedures which can be consistently

repeated in service. The runway width must be sufficient, at the crosswind limit, to prevent any aeroplane damage or subsequent malfunction, and any landing gear wheel from leaving the runway surface under the approved operating conditions after a sudden failure of the critical engine during take-off, or during a one engine inoperative (OEI) approach and landing. The take-off and landing technique shall be that recommended by the OEM and shall prevent any part of the aeroplane contacting the runway surface except for the landing gear i.e. engine nacelles, tail skids and flap trailing edges".

The CAAP is applicable to Kununurra Airport and provides an opportunity to support larger sized aircraft without requiring widening of the existing runway, assuming a runway extension project is undertaken for the existing 12/30 runway. GHD recommends the SWEK adopt the narrow runways supplement for the runway development for the significant cost savings achieved by retaining the existing runway width.

2.4 Airline response to Narrow Runway operations

GHD wrote to the two major airline operators (Qantas and Virgin Australia) to seek their feedback on the proposal to maintain a 30m wide runway.

2.4.1 Qantas Airways

GHD received a response from Captain Alex Passerini (Chief Technical Pilot, Qantas Flight Operations) which states:

"*We have the AFM narrow runway appendix to support operations to runways less than 45m on our fleet of 737-800s. This complies with the guidelines contained in the subject CAAP. Based on this approval, we already operate to a number of 30m runways, whether they are used as planned destinations or alternates. The only benefit to widening the runway would be a small increase to the crosswind capability (40 kt in lieu of 33), though this would be unlikely to be of significance at Kununurra."*

2.4.2 Virgin Australia

Rachael Barnes (Aircraft Performance Lead, Virgin Australia) responded to GHD as follows:

"For the 737-700/800W, Virgin have no technical objection to keeping the runway at 30m wide.

Virgin currently operates to 30m wide runways with the B737.

There are operational restrictions to narrow runways (defined, for the 737, as widths less than 45m and no less than 30m), which are summarised below.

- *The ground control speed (VMCG) may change due to the maximum 20 foot deviation from runway centreline (this may or may not affect the MTOW and other takeoff speeds).*
- *Nose gear steering must be operative.*
- *Runway centreline shall be clearly visible.*
- *Brakes must be operative.*
- *Thrust reversers operative.*
- *Yaw damper operative.*
- *(More restrictive) Crosswind limitations are not exceeded.*

As we already operate to 30m wide runways, these restrictions are not new to the Virgin operation. While 45m wide runways are operationally preferred, Virgin can operate to Kununurra without any "new" restrictions."

3. Aerodrome Standards

3.1 Design criteria

The following sections outline the minimum design criteria that the extension options must adhere to in order to accommodate the design aircraft.

3.2 Codes and standards

Airport engineering design shall comply with the following Codes and Standards:

- CASA Manual of Standards (MOS) Part 139 – Aerodromes
- ICAO Annex 14 – Aerodromes
- Civil Aviation Advisory Publication (CAAP) 235A-1(0)

Relevant current Australian Standards (AS) shall apply to all earthworks, asphalt surfacing, lighting installations, etc. for the runway extension works.

The constructed runway extension, RPT apron and taxiway upgrades is to meet all requirements for certification by CASA.

3.3 Design aircraft

SWEK has specified the aerodrome upgrade to cater for B737 and A320 operations. The design criteria will adopt the CASA MOS Part 139 Code 4C criteria with the exception of the runway width that shall operate under the narrow runway CAAP 235A-1(0).

Typical 4C aircraft that may frequent the aerodrome following the upgrade are shown in Table 1.

Table 1 4C Future aircraft capacity and operators in/out of Kununurra Airport

Aircraft	Passenger Numbers	Operators
Boeing 737-800	170	Virgin Australia Regional Airlines Qantas
Airbus A320-200	170	Virgin Australia Regional Airlines Jetstar Airways

3.4 Runway classification

The runway is classified as a Non-Precision Instrument Runway.

3.5 Aerodrome physical dimensions

The aerodrome is to comply with Reference Code 4C design requirements as set out in CASA Manual of Standards Part 139 – Aerodromes (MOS 139) and ICAO Annex 14 – Aerodromes.

The relevant design criteria for Code 4C aircraft are provided in Table 2 and have been followed in developing the design options for the runway extension design.

Table 2 Design Criteria for Code 3C and Code 4C aircraft

Description	Code 3C	Code 4C
Runway		
Runway Pavement Width	30 m	45 m[Note 1]
Shoulder Width	Not required but recommended	Not required but recommended
Runway Strip		
Runway Strip Width	150 m	300 m
Width of Graded Portion of Runway Strip	90 m	150 m
Flyover Area Width (each side)	30 m	75 m
Runway End Safety Area		
Length	90 m [Note 2]	90 m [Note 2]
Width	60 m	60 m
Taxiway		
Taxiway Pavement Width	15 m	18 m [Note 3]
Shoulder Width	3.5 m	3.5 m
Taxiway Strip		
Taxiway Strip Width	52 m	52 m
Taxiway Graded Area Width	25 m	25 m

Notes

[1] The existing runway width of 30m shall be retained with 4C aircraft operating on the runway under the narrow runway supplement CAAP 235A-1(0). This supplement is used for the design of the runway width. Further information is detailed in Section 2.3.

[2] Additional length of Runway End Safety Area (RESA) should be provided if the aerodrome is classified or operates international flights (passenger or freight) in accordance with ICAO recommendations. The total length of RESA recommended is 240m. The length of the runway would need to be reduced at each end to incorporate a 240m RESA

[3] The taxiway width may be reduced to 15m for Code C taxiways that are only intended to serve aircraft with a wheelbase of less than 18m, such as the B737 and A320.

3.6 Obstacle Limitation Surfaces

Based on the design aircraft code and runway classification, the following Obstacle Limitation Surfaces are applicable for the runway upgrade at Kununurra Airport:

- Conical surface;
- Inner horizontal surface;
- Approach surface;
- Transitional surface, and
- Take-off climb surface.

The OLS dimensions required for Code 3 and Code 4 runways are provided in Table 3 below.

Table 3 OLS Dimensions

Characteristic	Code 3	Code 4
Approach Surface		
Length of inner edge	150 m	300 m[Note 1]
Distance from threshold	60 m	60 m
Divergence each side	15%	15%
First section length	3,000 m	3,000 m
Slope	3.33%	2%
Second section length	3,600 m	3,600 m
Slope	2.5%	2.50%
Horizontal section length	8,400 m	8,400 m
Total length	15,000 m	15,000 m
Take-Off Climb Surface		
Length of inner edge	180 m	180 m
Distance from runway end	60 m	60 m
Rate of divergence each side	12.5%	12.50%
Final width	1,800 m	1,800 m
Slope	2%	2%
Overall length	15,000 m	15,000 m
Inner Horizontal Surface		
Height	45 m	45 m
Radius	4,000 m	4,000 m
Transitional Surface		
Slope	14.30%	14.30%
Conical Surface		
Slope	5%	5%
Height	75 m	100 m

Note

[1] 150 m if only used by aeroplanes requiring 30 m wide runway.

The above table is presented graphically in the following tables, representing the OLS clearances.

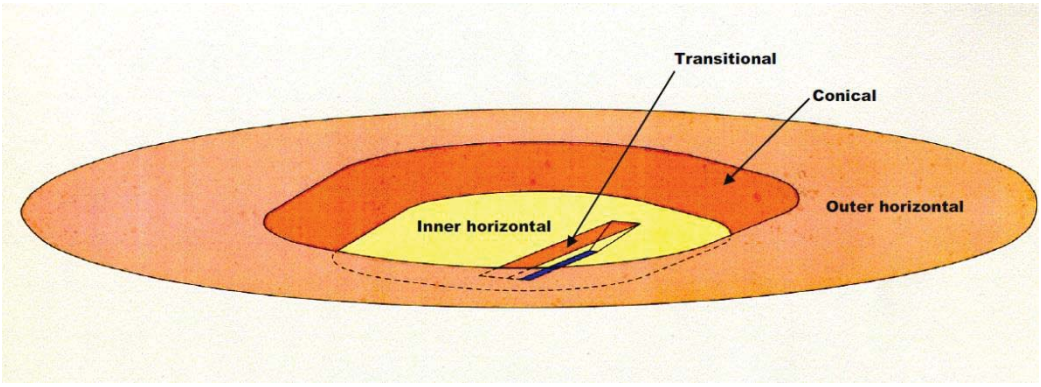

Figure 2 Relationship of outer horizontal, conical, inner horizontal and transitional surfaces (MOS Part 139)

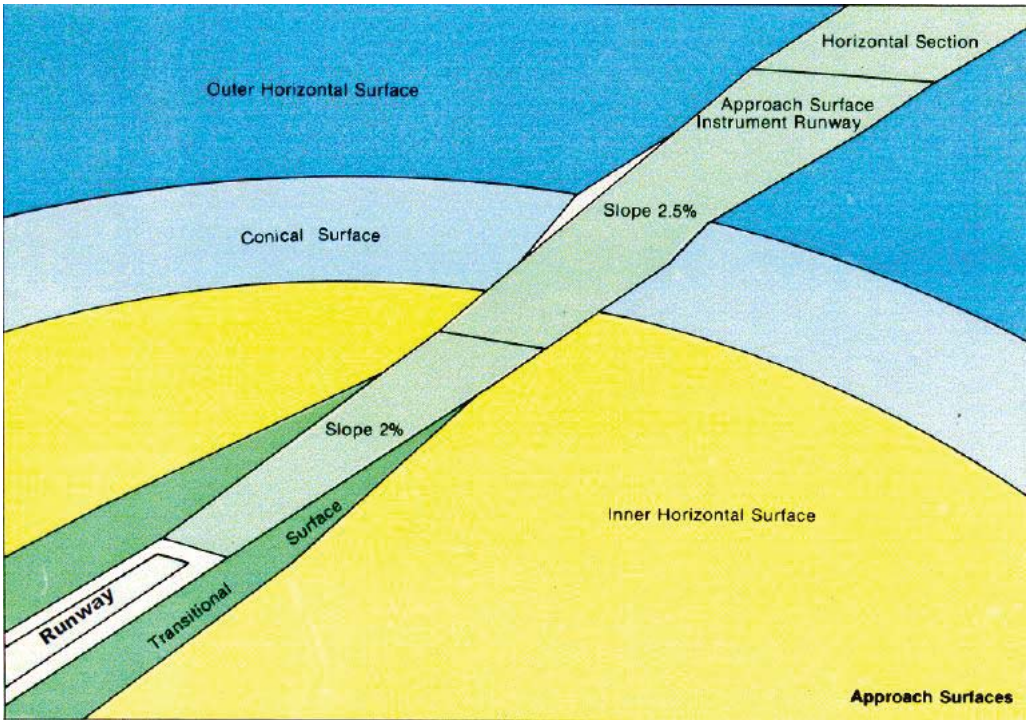

Figure 3 Approach surface for an instrument approach runway (MOS Part 139)

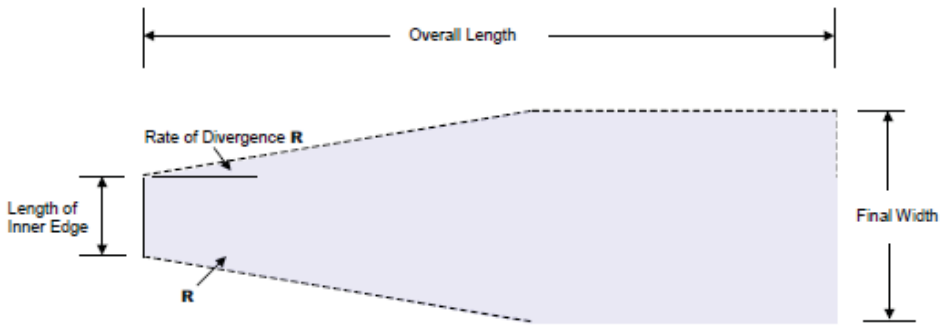

Figure 4 Plan view of take-off climb surface (MOS Part 139)

3.6.1 OLS terrain constraints

During the concept and options analysis the OLS was considered for terrain and infrastructure penetrations of surrounding terrain. A draft OLS plan is shown on drawing No. 61-32392-C006 within Appendix C for the recommended runway extension.

The airport is located on a river plain region adjacent to the Ord River at the west end and close to the Kununurra town centre at the east end. There are a number of high terrain in the area to the east, south east, and west of the aerodrome. The current ERSA entry details for Kununurra Airport notes there are three terrain penetrations to the east and west of the runway.

The ERSA notes right hand circuits only for runway 30.

In the current ERSA (May 2016) the takeoff gradient on Runway 30 is published at 1.21% and for Runway 12 it is 2.12%.

For the upgrade to a Code 4 classification, there is additional terrain points that penetrate the Code 4 OLS. These points will require a level survey to confirm the levels and may be required to be suitably lit with masts for the critical penetrations. The draft OLS drawing issued in the preliminary design drawings indicates these locations and an allowance for solar power hazard lights has been made in the construction cost estimate.

The existing RPT apron parking bays are clear of the transitional OLS surface for the tail heights of the design aircraft.

3.6.2 OLS land title constraints

The 2013 Masterplan identified two areas of land which should be acquired as part of the long-term airport strategy – a section on the north-west side of the extended runway and another section adjacent to the eastern end of the extended runway.

A fully compliant Code 4C aerodrome requires a 300m wide runway strip which at the north-western end of the runway would coincide with the airport boundary. As a result, the Illuminated Wind Indicator would need to be relocated outside the associated OLS transitional clearance surface, which would place it outside the airport boundary – requiring land acquisition.

If the existing 150 m wide runway strip is retained instead of a 300 m wide runway strip there is likely to be a minor increase in the minimum descent altitude for the design B737 and A320 aircraft on instrument approaches. Therefore, whilst the existing airport landholding is sufficient to facilitate the proposed runway extension with a 150m wide runway strip; the purchase of additional unallocated crown land to the north-west will allow the relocation of the IWI and the widening of the runway strip to 300m which will improve operations by B737-800 and A320-200 aircraft.

At the east end of the Runway 30, the OLS considerations for the private property close to the aerodrome were considered in the pre-feasibility stage. The private property adjacent to the aerodrome boundary will not need to be purchased for this extension option, however severe height limitations will need to be placed on buildings and other obstacles within the property in close proximity to the runway end. The existing building height within the property will need to be confirmed during detailed design and if the height restrictions cannot be met then consideration shall be given to purchasing the property or not widening the strip to 300 m.

An allowance for the acquisition of land areas identified in the Master Plan has been provided within the overall project cost – refer to the Business Case Report for further details.

4. Airside Design

4.1 Design intent

The design intent is to extend the runway and strengthen existing pavements to allow the operation of B737 and A320 aircraft into and out of the aerodrome. This study has investigated the opportunity for a runway extension at both the west and east ends of the existing runway. The design intent for the extension during the prefeasibility stage is to determine the extent viable for the runway extensions and consider all elements of the design, including physical constraints through constructability. The following sections outline the design considerations.

4.2 Runway orientation

The alignment of the runway is constrained by the surrounding terrain, the Ord River and associated irrigation schemes, the flood level boundary and the Victoria Highway. The existing runway with a bearing of 120˚/300˚ has been retained. The runway vectors are Runway 12 and Runway 30. This conforms with the approved airport Master Plan.

4.3 Physical constraints for the runway extension

There are a number of physical constraints that will influence the length available for a runway extension at both the west and east ends. Their impact on the extension options are further detailed in Section 5.

For an extension at the west end the major constraints are outlined below and highlighted in Figure 5.

- The Ord River: restrictions included the riparian zone and drainage considerations for the local catchment area. The open unlined drains on the outside of the runway strip will be extended and aligned in order to provide suitable drainage runoff and protection to any future runway extensions in this area. The Ord River is approximately 1,200 m to the west from the current Runway 12 threshold.
- There is also a significant old borrow pit approximately 640 m in length from the existing runway threshold. This is a major constraint given the volume of fill that is required to provide a suitable surface for runway pavement and associated runway strip and RESA areas.

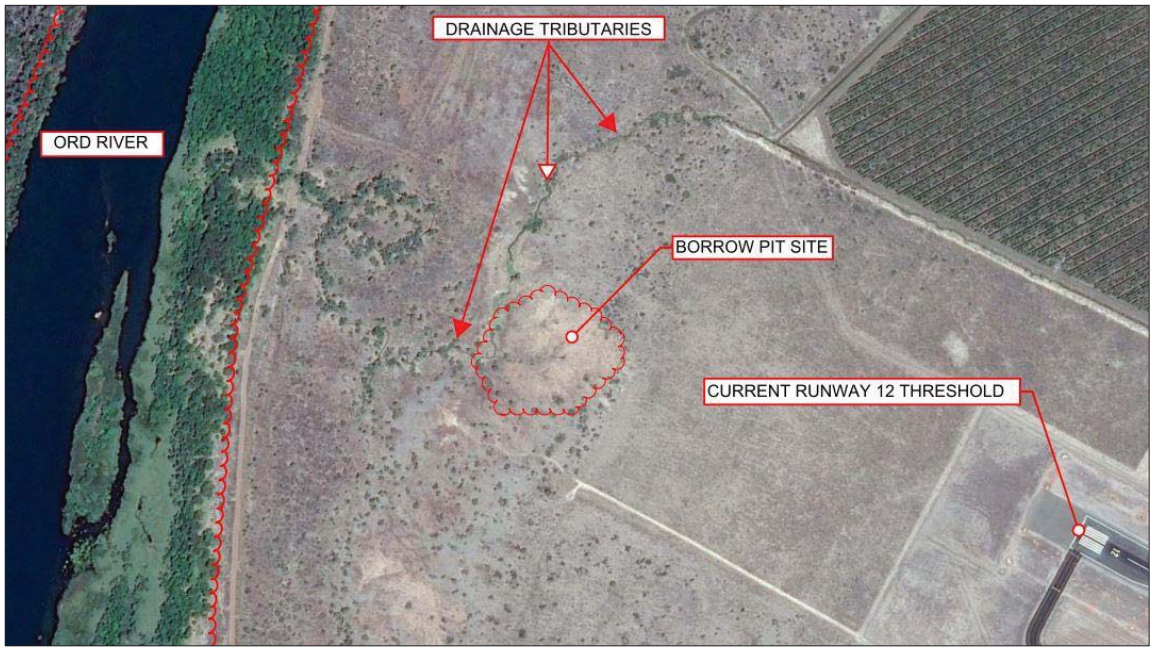

Figure 5 Western end extension constraints

For an extension at the east end the major constraints are outlined below and highlighted in Figure 6.

Figure 6 Eastern end extension constraints

- Ord River irrigation channel: The channel is approximately 500 m to the east of Runway 30 threshold.
- Victoria Highway: Victoria Highway is aligned to the south of the aerodrome and overpasses the Ord River irrigation channel listed above. For the OLS take-off critical clearance, the highway must be offset at least 250 m from the runway end for a RAV

Category 1 truck height of 4.6 m. This restriction has determined the length available for the runway extension.

- The private property lot to the north-east of the aerodrome boundary. Access to this property is via an unsealed road on the eastern end of the aerodrome boundary. There will be height restrictions enforced for buildings on this property with a runway extension. Refer to Section 3.6.2 for further details.
- The open unlined drain is required to be realigned for a runway extension. Refer to design drawing 61-32392-C002 (included in Appendix C) for the realignment.

4.4 Runway length

The site investigation and survey extents have been undertaken to explore the options for runway extension options at both the east and west ends. The length of runway must be adequate to meet the operational requirements of the aeroplanes for which the runway is intended. The runway length may be extended up to maximum of 540 m at the western end. At the eastern end there is minimal opportunity for a runway extension, with a maximum of 61 m extension, due to the physical constraints of the existing aerodrome boundary and adjacent private property. The runway extension options are discussed in Section 5.

The take-off distance available (TODA), defined as the distance available for an aeroplane for completion of its ground run, lift-off and initial climb to 35 ft. for the existing runway is detailed in the ERSA. For Runway 12 at 1.6% the TODA is 1,704 m with an obstacle listed at 5,590 m distance and for 1.9% take-off gradient the TODA is 1,822 m distance. The TODA will be revised and updated in the ERSA if an extension at the east end is undertaken and the take-off gradients will be increased to clear the obstacle.

In regards to temperatures, the Bureau of Meteorology records show that the mean maximum monthly temperatures for October to January recorded is 38.8˚C. During the detailed design phase of the project, the consultation with the airlines on maximum take-off weights and the required runway length for the aircraft shall be undertaken.

The proposed maximum runway length of 2,430 m is the maximum possible length achievable on the site and is considered to be sufficient for operations by B737 and A320 jet aircraft. The length is sufficient for aircraft arrivals and departures from interstate airports and some airports within South East Asia. Flights to other destinations would require refuelling stops. The figure below shows the increased range of the larger B737-800 aircraft compared to the existing Fokker 100.

Should international flights (passenger or freight) operate from the airport, the relevant standards – MOS Part 139 and ICAO Annex 14, recommend that additional length of RESA (240 m for Code 3 & 4 runways) be provided at each end of the runway. The Master Plan only allowed for 90m length RESA. Should a 240m RESA be required, the available runway length would need to reduce accordingly.

It is important to note that additional infrastructure would be required before the aerodrome could operate international flights such as a permanent Aerodrome Rescue and Fire Fighting Service (ARFFS) and ATC (Air Traffic Control) plus Customs & Border Control in the terminal.

Figure 7 Range of existing Fokker 100 (red) vs proposed Boeing 737-800 (blue)

4.5 Runway layout

The existing runway layout and runway strip dimensions shall be retained in the runway extension design. At both runway thresholds, a section of 50 m wide pavement will be adopted to provide suitable area for aircraft to undertake 180 degree turns to either line up for departure or back track following landings. This width is adequate for B737/A320 aircraft which can turn within 50m.

The runway layout for all options is shown on drawing No. 61-32392-C002 (Appendix C).

4.6 Runway longitudinal profiles

The runway longitudinal profiles for the runway extension are to comply with all CASA standards. A uniform slope for at least 300 m will be provided at the runway extension end.

The preliminary runway longitudinal profile for the runway extension options is shown on drawing No. 61-32392-C003 (Appendix C).

4.7 Taxiways and RPT apron – layout

The existing taxiway and RPT apron layout shall be retained. The taxiway and RPT apron layout and resurfacing extents for Taxiways A-C are shown on drawing 61-32392-C005 (Appendix C). No works are proposed for Taxiways D-G or the GA Apron as these will remain accessible for aircraft below 5,700kg.

Allowance has been made for the design Code C aircraft (737 and A320) to backtrack on the runway and only utilise Taxiways A-C for access between the runway and the apron.

4.8 Stormwater runoff and drainage

A number of drainage options were investigated to accommodate the surface runoff from the extended runway pavements, runway strip and RESA areas for the aerodrome.

For all aircraft pavements the minimum grades detailed in MOS 139 have been met to ensure adequate water runoff is achieved. The extension of the runway at the east end will require the fill of a 6 m wide OUD and removal of the existing 450 mm diameter culvert as the proposed extension RESA is designed to overlay this area. The runoff from this catchment will be directed to the existing swale drain that outflows to the irrigation channel to the east of the aerodrome.

During detailed design an assessment on the sizing of the drains for the catchment areas will need to be undertaken and modelling of flows to investigate if rock protection is required at outlets and/or transitions with the existing drainage channels.

4.9 Airfield lighting

4.9.1 Airfield Lighting Upgrade

For this prefeasibility study an allowance has been made to replace the existing runway edge lighting during the runway extension works. The light spacing's have been set out to comply with CASA MOS 139 standards and is shown on layout drawing No. 61-32392-E007 (Appendix C). Upgrades to the MIT/CCR have been included in the indicative fee estimate to supply the new runway edge lights.

4.9.2 Runway edge light fittings

The currently installed Artcraft runway edge light fittings are considered MOS Part 139 compliant (based on the assessment of the age/condition of the fittings in the Annual Electrical Inspection 2014 report). There is no information in the 2014 Annual Electrical Inspection Report that suggests the runway edge light fittings are in a poor or unacceptable condition. The 2015 annual inspection has not been reviewed - this document may provide up to date information on the condition of the lighting.

4.9.3 Illuminated wind indicator (IWI)

The IWI will require relocation to suit the revised threshold location for the runway extension at the western end. It is assumed that the existing IWI complies with the latest MOS Part 139 requirements and will not need to be replaced. An allowance has been made within the construction cost estimate for relocation. The IWI adjacent to the apron will remain in its current position.

4.9.4 AT-TVASIS

An AT-TVASIS system is currently installed for both runway vectors (port side only) as approach guidance for pilots. The AT-TVASIS system for each vector consists of 10 x light units. It is recommended an allowance is made for replacement of the existing AT-TVASIS system with a PAPI system, therefore preventing the need to relocate 10 x light units. The PAPI system has improved maintenance and running costs due to the reduced number of PAPI boxes (4) compared to the AT-TVASIS boxes (10) per runway vector. Further development of the approach guidance system design will be undertaken during detailed design once the desired system is selected.

4.10 Airside access track and boundary fence

The airside access track alignment at both east and west ends will be relocated to accommodate the extensions. The revised alignment is shown on the aerodrome extension layout plans. The design of the new access road is a 3.5 m wide unsealed access track suitable for a two wheel drive vehicle to match the existing.

The boundary fence alignment is also revised to border the extended runway strip and RESA perimeter and is offset to comply with the OLS restrictions. It is understood that the fence is being progressive replaced to ensure it is adequate for restricting wildlife access. The offset of the aerodrome safety crash gates is included in the design of the new fence alignment, with the provision for crash gates included beyond both runway ends.

5. Upgrade Extension Options

5.1 Runway extensions

In reviewing Options 1 and 2 from the 2013 Master Plan (discussed in Section 2.2) the proposed Master Plan Option 1 (extend runway at the west end by 520 m) runway extension along the existing runway alignment beyond the west end is the recommend and adopted option. GHD has undertaken further investigation as part of this study to determine the maximum runway pavement extension that is achievable at the west end. In addition, GHD has also investigated the opportunity to extend the runway at the east end by 61 m to increase the overall runway length further.

The following section outlines the four options analysed by GHD in developing the runway extension concepts with key considerations for each option listed in the following table.

The runway extension prefeasibility study drawings, included in Appendix C, show the runway extension design layout options and longitudinal grades and include the updated airfield lighting layout details.

Table 4 Runway extension Option 1

Option 1	
Summary	• Extend runway at west end by 480 m • Runway width remains at 30 m and 50 m for the runway end turning node. • Longitudinal grade at 0.5% for 300 m before vertical curve across chainage 820 – 950 and matching to the existing runway pavement grade. • Minimises earthworks required for cut and fill of runway strip and pavements by matching extended strip to existing ground surface and following grade as close as possible for RESA and runway strip end. • Borrow pit area avoided
Runway Extension Summary	
Western end extension	480 m pavement extension (refer Figure 8)
Eastern end extension	0 m
Total Runway Length	**2309 m**

Table 5 Runway extension Option 2

Option 2	
Summary	• Extend runway at west end by 540 m • Runway width remains at 30 m and 50 m for the runway end turning node. • Longitudinal grade at 0.5% for 400 m before vertical curve across chainage 860 – 980 before matching to the existing runway pavement and geometric grade. • Earthworks required for fill for runway strip and boxout for extension pavements. Significant earthworks required to fill RESA and to batter to existing ground level. • Fence and access road aligned outside of RESA and runway strip boundary offset for minimum OLS clearance. • Earthworks required to fill natural drainage channel at the end of RESA. • General fill required for this option to retain the ground levels where material was previously excavated or eroded. • Drainage assessment for suitable return period will need to be carried out during detailed design to assess extents of high water levels of Ord River and/or flooding extents
Runway Extension Summary	
Western end extension	540 m pavement extension (refer Figure 9)
Eastern end extension	0 m
Total Runway Length	**2369 m**

Table 6 Runway extension Option 3

Option 3	
Summary	• Extend runway at west end by 480 m • Extend runway at east end by 61 m • Runway width remains at 30 m and 50 m for the runway end turning node. **For west end extension:** • Longitudinal grade at 0.5% for 300 m before vertical curve across chainage 820 – 950 and matching to the existing runway pavement grade.

	• Minimises earthworks required for cut and fill of runway strip and pavements by matching extended strip to existing ground surface and following grade as close as possible for RESA and runway strip end. • Borrow pit area avoided **For east end extension:** • As the extension is 61 m, the runway width will remain at 50 m to provide adequate turning area for aircraft backtracking for Runway 30 take-off. • Regrade existing swale drain running to align with open unlined drain (OUD) for catchment to the south of the runway strip. Grade runway strip and RESA to ensure drainage paths match with existing swales. • Remove 450 mm diameter pipe culvert for the swale drain aligned north/south as this swale will be filled for RESA • During detail design drainage catchment assessments will be confirmed for the runway end area to ensure the existing OUD can accommodate flows. Review for the capacity of the outlet swales and recommendation for outlet protection will be determined. • Height limitations for the private property adjacent to the runway on the eastern side are set based on the OLS levels. Building heights in the take-off OLS are restricted to less than 3.0 m, and 10.0 m for the transitional surface. As the property borders both OLS this restriction will need to be clearly understood by both the Airport Owner and the property holder. • For Taxiway B the design for the fillet pavement at the intersection with the runway will be required, and additional taxiway lights for the edge lighting will be required.
Runway Extension Summary	
Western end extension	480 m pavement extension (refer Figure 8)
Eastern end extension	61 m pavement extension (refer Figure 10)
Total Runway Length	**2370 m**

Table 7 Runway extension Option 4

Option 4	
Summary	**For west end extension:** • Extend runway by 540 m at the western end of the runway. • Runway width remains at 30 m and 50 m for the runway end turning node. • The same constraints as listed in Option 2 **For east end extension:** • Extend runway pavement by 61 m • The same constraints as listed in Option 3
Runway Extension Summary	
Western end extension	540 m pavement extension (refer Figure 9)
Eastern end extension	61 m pavement extension (refer Figure 10)
Total Runway Length	**2430 m**

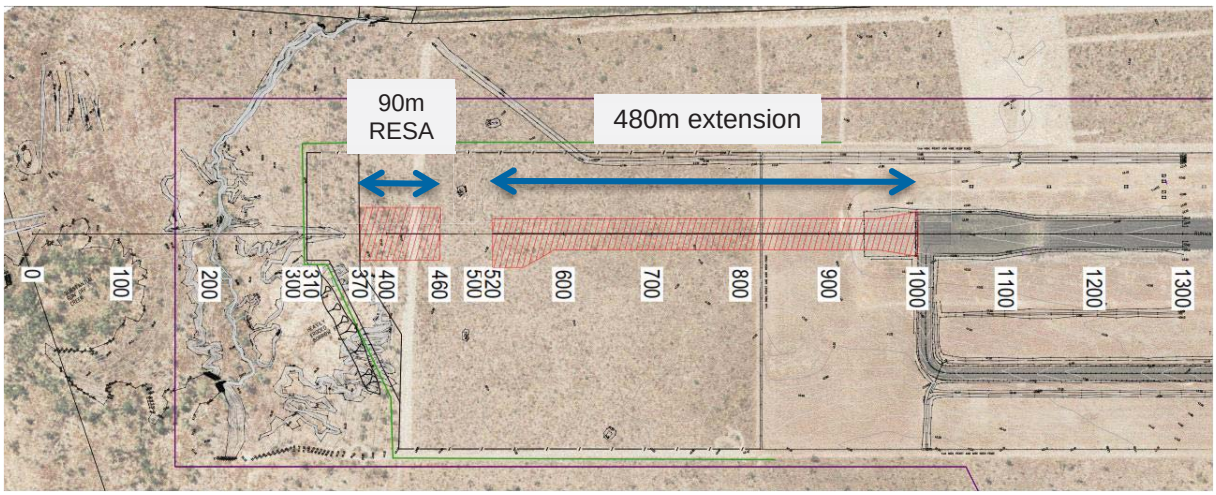

Figure 8 West extension – Option 1 & 3

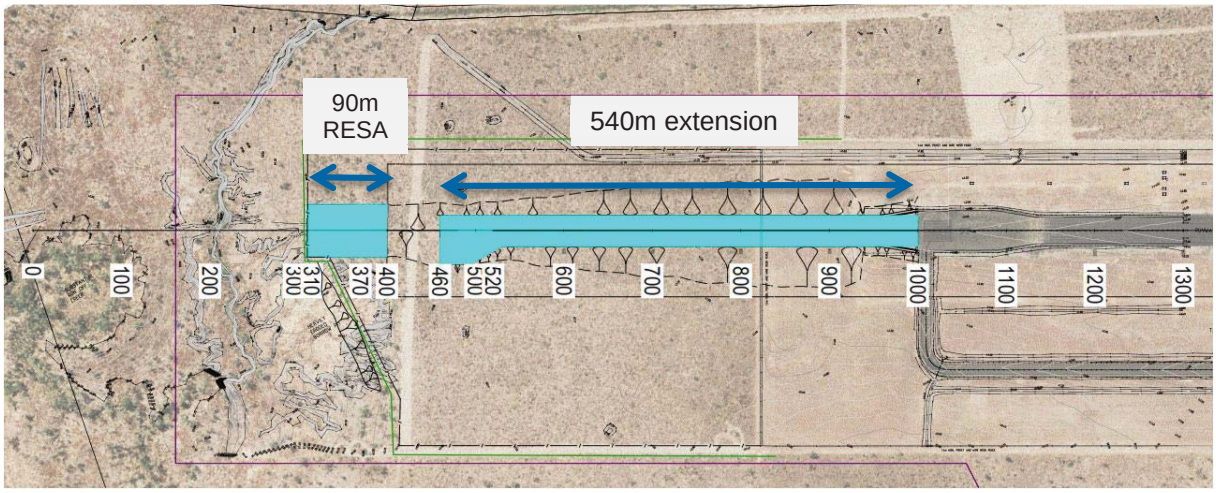

Figure 9 West extension – Option 2 & 4

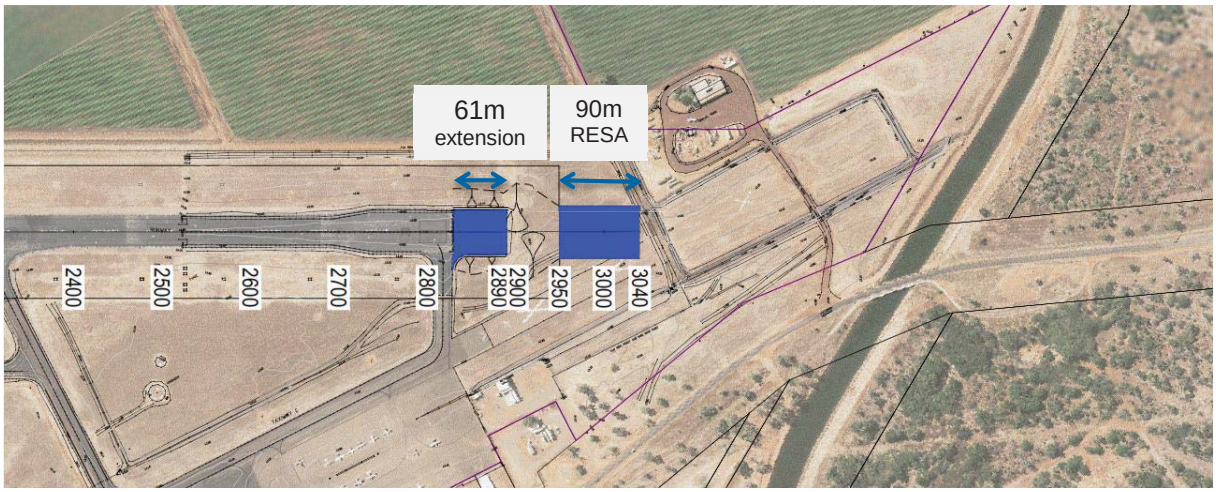

Figure 10 East extension – Option 3 & 4

Table 8 Runway extension Options 1-4 summary

Option	New Runway 12/30 Length
Option 1	2,309 m
Option 2	2,369 m
Option 3	2,370 m
Option 4	2,430 m

5.2 Taxiways A, B and C

Taxiways A, B and C confirm to MOS 139 design criteria's for minimum taxiway widths and no change is proposed to the layout or alignment of these taxiways. The runway extension options presented above do not impact on the existing taxiways layouts. Pavement strengthening will be required to accommodate the larger aircraft which is discussed in the following section.

5.3 RPT apron

The current RPT apron accommodates three Code 3C aircraft. Two bays accommodate the Fokker 100 or a similar sized aircraft with the remaining bay suitable to accommodate the Embraer E170 or a similar sized aircraft. For aircraft such as the B737 and A320, the RPT apron can accommodate one aircraft of this size or similar, while the remaining two bays are occupied by Code 3C aircraft, such as the Fokker 100 or Embraer E170. The Master Plan details the potential apron expansion/s that could be required to accommodate additional Code 4 aircraft on the RPT apron during the high traffic scenarios. During detailed design confirmation from SWEK on the number of Code 4C parking bays required during the upgrade works will determine the adequacy of the existing parking layout, and confirm the operations for power in/power out manoeuvres by B737 and A320 aircraft. The tail heights of the B737 and A320 aircraft do not penetrate the OLS transitional surface at the existing parking locations on the RPT apron.

6. Aircraft Pavement Design

6.1 Background

GHD has undertaken a pavement investigation for the proposed runway extension of Runway 12/30 and provided an evaluation of the capability of the existing Taxiways A, B and C and RPT apron with regards to the future aircraft traffic. As noted in Section 2.2, GHD has excluded Taxiway D - G from the prefeasibility study to limit costs, as it is more cost effective for Code C aircraft to continue backtracking on the runway. Refer to the Preliminary Pavement Investigation and Design Report for full details.

The current runway pavement is performing adequately under the current loading and was recently overlayed with 60 mm of asphalt and grooved as part of the pavement strengthening program. The proposed typical pavement cross-sections for the runway extension pavement and Taxiways A, B and C are shown on drawing 61-32392-C004 (Appendix C).. The proposed pavement design is similar to the existing pavements and therefore no strengthening of the existing runway is required.

6.2 Pavement strength evaluation

GHD carried out pavement strength evaluation in 2014 prior to the asphalt overlay and excavated three pits in the existing runway. GHD reported the runway pavement consists of the following average thickness:

Runway Pavement (total thickness 1710 mm)

- 20 mm of multiple chip seal; on
- 180 mm of base and subbase; on
- 1,300 mm of selected fill materials; on
- 230 mm of sand blanket; on
- subgrade.

6.3 Surfacing history and strengthening records

Previous investigations show that separate basecourse and sub-base layers on the existing aircraft pavements were difficult to distinguish and were recorded as one layer.

The runway was overlaid with a nominal 60 mm thickness of polymer modified AC14 asphalt in July 2015.

The maintenance records which were provided from East Kimberley Regional Airport (2014) show that in 2010 the subgrade and basecourse of Taxiways A, B and C were cement stabilised (7.5 m on each side of the centreline) to a total depth of 600 mm, sealed with a 10 mm and 7 mm double coat sprayed seal followed by a sand seal.

According to the maintenance records, the RPT apron was resealed in 2004 (aggregate size was not specified) and resealed again in 2014.

The current runway 12/30 pavement configuration including the recent asphalt overlay can be rated as follows:

PCN 51 / F / C / 1410 (205 PSI) / T

As listed in MOS 139 the pavement classification number (PCN) reported indicates that an aircraft with an aircraft classification number (ACN) equal to or less than the reported PCN can

operate on the pavement subject to any limitation on the tyre pressure, or aircraft all-up weight for specified aircraft types.

6.4 Site investigation

6.4.1 Pavement visual inspection

A site investigation was carried out between the 8th and 9th of August 2015 under the direction and supervision of a Senior Pavement Engineer from GHD. The works carried out comprised of the following:

- A visual inspection and assessment of the existing pavements on Taxiways A, B and C and the RPT Apron;
- Three trial pits were excavated to determine the existing pavement profiles on Taxiways A, B and C; and
- Four trial pits were excavated to provide an indication of ground conditions for the proposed runway extension.

6.4.2 Trial pits and laboratory testing

Guerinoni and Son Plant Hire were engaged by GHD to excavate a total of seven trial pits using a 7t tracked excavator. The pits comprised:

- Three through the existing pavement profile on Taxiways A, B and C;
- Three along the centreline of the potential western extension; and
- One at the potential eastern extension.

Representative samples of the soils encountered in the test pits were submitted for laboratory testing. Laboratory testing was conducted by Mining and Civil Geotest Pty Ltd; a National Association of Testing Authorities (NATA) accredited soil testing laboratory in Jandakot, Perth.

The test pit investigation from the pavement edge of Taxiways A, B and C revealed multiple spray seals a granular pavement comprising blended river gravel base and river shingle general fill on clayey subgrade.

The test pits in the runway extension areas identified very stiff, SANDY CLAY subgrade which has expansive properties. A soaked subgrade CBR 4% was adopted for the runway extension areas, Taxiway A, B & C and CBR 10% for the RPT apron.

6.4.3 HWD Testing – Taxiways and RPT Apron

Non-destructive Heavy Weight Deflectometer (HWD) testing was undertaken by ARRB Consultants on the 1st and 2nd of August 2015. The HWD testing was performed on the existing RPT apron and Taxiways A, B and C.

The HWD results show the taxiway and apron pavements to be relatively stiff over the majority of the pavements with localised softening around the edges of the RPT apron.

6.5 Future air traffic loading for pavement design

Three traffic scenarios are considered for the traffic modelling for the aerodrome based on assumed design aircraft as described below in Table 9. This data was used for the proposed runway extension structural pavement design and taxiway and RPT apron pavement strengthening designs.

Table 9 Predicted Air Traffic loading (20 Years)

Scenarios	Aircraft Type	Design Period	
		2017 to 2021-22 (% of Aircraft)	2022 to 2036-37 (% of Aircraft)
1	B737-800	10	40
	A320-200	10	40
	F100	80	20
2	B737-800	10	90
	A320-200	0	0
	F100	90	10
3	B737-800	100	100
	A320-200	0	0
	F100	0	0

6.5.1 Air traffic distribution

The geometry and wind direction effect on the alignment of the runway influence the likely air traffic loading on the pavement. It is estimated that 60% of the aircraft take off from Runway 12. In order to access the hold point, aircraft need to enter the runway from the taxiways, travel the length of the runway and turn around at the end. As a consequence the aircraft loading on the pavement is increased to double the coverage if taking off on Runway 12.

6.5.2 Taxiways and RPT apron traffic

The majority of the aircraft will use Taxiway A and part of Taxiway C to access the parking bays on the RPT apron. The alternative route is along Taxiway B and part of Taxiway C. It is assumed that 90% of aircraft will utilise Taxiways A and C (partial) while the alternative, Taxiway B, will only be used by 10% of the aircraft. For simplicity, the entire Taxiway C has been designed for the section which is subject to 90% aircraft loading.

It is assumed that all aircraft will use the RPT apron.

6.6 Taxiways and Apron Strengthening

Based on the HWD survey, back calculated stiffness and pavement design analysis, the existing RPT apron and taxiway pavements require strengthening for the future design aircraft loadings.

6.6.1 RPT apron pavement

The RPT apron pavement has adequate pavement structure and a 60 mm asphalt overlay is recommended.

6.6.2 Taxiway pavement

The predicted traffic on the taxiways varies due to environmental constraints. For ease of construction and planning it is proposed that a single pavement design thickness is adopted for all of the pavements. It is recommended that 260 mm of cement modified crushed rock base material is placed on the existing pavement followed by a prime coat then water proofing chip seal and a 60 mm asphalt surfacing.

6.7 Runway Extension

The runway extension pavement proposed is similar to the existing pavement, except for the provision of a cement modified subbase to ensure that it is more rut resistant. The runway extension pavement preliminary design is detailed in Table 10.

The runway extension pavement preliminary design is detailed in Table 10.

Table 10 Preliminary Runway Extension Pavement Design

Thickness	Proposed Pavement layer profile (mm)
60 mm	Continuously graded polymer modified AC14 asphalt
10 mm + 5 mm	Water proofing chip seal on prime
150 mm	High quality fine crushed rock base
250 mm	Cement modified subbase
700 mm	River shingle or select granular fill
100 mm	Sand
Insitu	Subgrade CBR 4%

The proposed runway extension pavement should be able to carry the indicated loading for the next 20 years with nominal routine maintenance with the proposed materials and thickness.

The current investigation report laboratory CBR values of between 3% and 13%. Given natural variation of the material, a lower band design CBR value of 4% was adopted for the pavement design. As a result, it was not considered necessary for any further contingency in the prefeasibility construction cost estimate. Further geotechnical investigation and soil testing of the existing pavement is recommended for the feasibility and detail design stages to confirm the subgrade CBR.

Refer to drawing No. 61-32392-C004 within Appendix C for recommended pavement details.

7. Recommendations

7.1 Preliminary runway length and pavement works

Based on the runway extension options assessment and preliminary pavement designs the following tables outlines the recommended runway extension length, airfield lighting upgrades, and associated taxiway and apron pavement upgrades to enable operations of the design aircraft into and out of Kununurra Airport.

Table 11 Runway extension profile recommendation (Option 4)

Runway Extension	Comment
Western end extension	540 m pavement extension
Eastern end extension	61 m pavement extension
Total New 12/30 Runway Length	**2430 m**
Runway width	**30 m**
Runway shoulders	**3 m each side**
Runway strip width	**300 m (150 m without land acquisition)**
Taxiway width	**15 m**

Table 12 Airfield lighting upgrade recommendations

Airfield Lighting Upgrades	Comment
Runway edge lighting	Remove existing lights and replace and install new edge lights for total runway length
PAPI	Upgrading the existing AT-TVASIS system to a PAPI system
IWI	Relocate western end IWI to the new runway 12 threshold

Table 13 Runway extension pavement recommendation

Thickness	Proposed Pavement layer profile (mm)
60 mm	Continuously graded polymer modified AC14 asphalt
10 mm + 5 mm	Water proofing chip seal on prime
150 mm	High quality fine crushed rock base
250 mm	Cement modified subbase
700 mm	River shingle or select granular fill
100 mm	Sand

Table 14 Apron and taxiways pavement recommendation

Thickness	Proposed Pavement layer profile (mm)
Taxiways A, B and C	
60 mm	Continuously graded polymer modified AC14 asphalt
10 mm + 5 mm	Water proofing chip seal on prime
260 mm	Cement modified base is placed on the existing pavement
RPT Apron	
60 mm	Continuously graded polymer modified AC14 asphalt

7.2 Additional investigations for detailed design

The following additional information, among others, shall be investigated and confirmed in consultation with SWEK during the detailed design phase:

- Confirm the building heights on the private property at the east end of the runway.
- Confirm the terrain heights at locations that penetrate the OLS surfaces.
- Confirm the drainage catchment areas for the runway extension at the east and west end and undertake a channel sizing assessment for the proposed OUDs.
- Undertake further consultation with airlines to confirm operations of the B373 and A320 aircraft on the extended runway and for operations under the CAAP 235A-1(0).
- Confirm the existing runway edge light conditions and associated equipment and confirm the capacity of MITs to adequately supply the airfield lighting upgrade. Confirm the inclusion of the PAPI guidance system.
- Confirm the parking layout for the RPT apron to accommodate multiple Code 4C aircraft.
- Further geotechnical investigations to confirm subgrade strength, existing pavements and potential borrow pits. Refer to Section 10.5 of the Preliminary Pavement Investigation and Design Report for full details.

8. Construction Cost Estimates

8.1 Indicative cost estimates

An indicative construction cost estimate has been developed for the runway extension recommended Option 4 and is included in Appendix A.

The construction cost estimate is based on the preliminary design option recommended in Section 7 and will be further revised during the detailed design phase of the project. Elements of the design that have significant cost implications may be revised in the detailed design phase and this will result in an overall cost increase.

The rates applied in the indicative construction cost estimate are taken from similar jet aerodrome project in recent years that involved earthworks operations, pavement rehabilitation, airfield lighting installations and general civil works. These rates will change over the course of the Project.

Note that the construction cost included in Appendix A does not account for any land acquisition costs that should be included in the project's overall funding requirements. This land is not required to facilitate safe use of the A320-200 and B737-800 aircraft, however the Shire should commence acquisition of the land to improve operability of the airport. Refer to the Business Case Report for details of the land acquisition costs.

The following assumptions have been made in developing the indicative construction cost estimate:

a. An overall contingency of 30% has been applied to the construction cost estimate. This is considered appropriate for this level of study.

b. A total runway pavement extension of 601 m (Option 4) has been costed, with the pavement layer thickness and asphalt overlay material as outlined in Section 6.

c. All runway pavement fill material will be sourced and imported from suitable local borrow pit/s.

d. Replacement of the existing runway edge lights and associated pit and duct, and two single sided PAPIs have been included in the indicative construction cost estimate.

e. Inclusive of engineering design and tender preparation fees.

f. Inclusive of contract administration, project management and supervision fees by SWEK.

g. Additional geotechnical investigation at a cost of $50,000 has been included.

9. Safety in Design

Safety in design (SiD) is an ongoing process throughout the life of the project. During the concept design stage, GHD identified a number of reasonably foreseeable hazards during a SiD risk assessment. The process considered design issues affecting the design, construction, commissioning, operation, and maintenance of the aerodrome. The design has been modified as far as reasonably practicable to eliminate inherent design and aerodrome operational risk. In considering the SiD for the construction of the aerodrome, the nature of the construction works and the risks associated with these are considered to be within the capability of a competent and experienced contractor.

The SiD summary is included in Appendix B

10. Concept Drawings

The following table lists the drawings included in the Runway Extension Prefeasibility Study Drawings. The drawing set it included in Appendix C.

Table 15 Drawing List for Kununurra Runway Extension Feasibility Design

Document No.	Title
61-32392-G001	LOCALITY PLAN AND DRAWING INDEX
61-32392-C002	RUNWAY EXTENSION OPTIONS PLAN
61-32392-C003	RUNWAY EXTENSION WEST & EAST END PLAN & LONGITUDINAL SECTION
61-32392-C004	RUNWAY & TAXIWAY PAVEMENT DETAILS
61-32392-C005	TAXIWAY AND APRON RESURFACING PLAN
61-32392-C006	RUNWAY EXTENSION – OBSTACLE LIMITATION SURFACES PLAN
61-32392-E007	RUNWAY EXTENSION – AIRFIELD LIGHTING SETOUT

Appendices

Appendix A – Preliminary Construction Cost Estimate

Kununurra Airport Runway 12/30 Extension - Prefeasibility Study **61-3239203**
Option 4 Extend runway pavements by 601m and upgrade Taxiway A, B and C and RPT Apron
EARTHWORKS, AIRCRAFT PAVEMENTS, DRAINAGE & ELECTRICAL WORKS **Recommended Option#** **4**
G:\61\3239202\Cost Estimates\[MR EDIT OPTION 4 Costings for REPORT.xls]Development Estimate

ITEM	DESCRIPTION		AMOUNT
1-	**GENERAL / PRELIMINARIES**		2,700,000
2-	**CLEARING, EARTHWORKS & DUST CONTROL**		1,600,000
3-	**AIRCRAFT PAVEMENTS**		5,600,000
4-	**DRAINAGE**		100,000
5-	**ELECTRICAL WORKS**		1,600,000
6-	**OTHER**		750,000
7-	**CONTINGENCY**		3,700,000
	SUBTOTAL of CONSTRUCTION COSTS - Excl. GST:		**16,050,000**
	D - ENGINEERING FEES		
D - 1	**Planning Fees** *(Not Applicable)*		0
D - 2	**Engineering Fees**		0
D - *2.1*	*Design & Tender Preparation Fees*	3.5% of Construction =	561,750
D - *2.2*	*Contract Administration by Shire*	4.0% of Construction =	642,000
D - *2.3*	*Technical Support*		50,000
D - *2.4*	*Other Fees / variations*		
D - *2.41*	*Geotechnical Investigation*		50,000
D - *2.5*	*Project Management Fees by Shire*		100,000
	SUBTOTAL for : D - ENGINEERING FEES		1,403,750
	SUBTOTAL of Sections A, B, C & D - Excl. GST:		**1,403,750**
	GRAND TOTAL (with construction costs) **- Excl. GST:**		**17,453,750**
	Add GST		**1,745,375**
	TOTAL DEVELOPMENT COST (Incl. GST):		**19,199,125**

Job Manager:
(Sign & print name under) RUSSELL CLAYTON

Project Director:
(Sign & print name under) MICHAEL RYAN

Assumptions:

Disclaimer: GHD has prepared this cost estimate using information available to GHD and where required, based on assumptions made by GHD. Prices and quantities in the cost estimate may change. GHD does not represent, warrant or guarantee that the project can be completed for the cost estimates prepared by GHD. Cost estimate to be read in conjunction with Runway 12/30 Extension Prefeasibility Study Report. Qualifications and assumptions to this cost estimate are detailed in Section 8.

Note: The above development cost estimate is not valid unless checked, signed and approved by both the Job Manager and Project Director.

CLIENT: Shire of Wyndham East Kimberley

PROJECT: KUNUNURRA AIRPORT RUNWAY EXTENSION
OPTION 4 - Recommended Option

Ref No: 613239203
REVISION: B

REV:	BY:	DATE:	CHD:	APP:	DESCRIPTION:
B	RS	13/11/2015	MR	MR	Issued for Prefeasibility Study Preliminary Design

This MTO has been prepared at the request of SWEK to assist in the estimation of cost for the runway extension at Kununurra Airport, based on design drawings prepared by GHD. GHD has exercised due care consistent with the intended level of accuracy in preparation of this MTO and no warranty should be implied as to the accuracy of estimates. This MTO calls up items and quantities considered to have a material impact on the preliminary cost estimate. No allowances have been made for wastage, connections and fixing, variability in subsoil conditions, etc.

Item No.		Item Description	Unit	Quantity	Rate ($)	Value ($)
1.0		**PRELIMINARIES**				
1-	1	Mobilisation (People and sub-contractors from Perth, incld flights, accommodation for project duration, car hire for project)	Item	1	$1,743,000.00	1,743,000.00
1-	2	Mobilisation (Plant and equipment from Kununurra)	Item	1	$134,000.00	134,000.00
1-	3	Establishment of laydown, staging areas and site offices, amenities, lunchrooms and services	Item	1	$107,000.00	107,000.00
1-	4	Insurances	Item	1	129,000.00	129,000.00
1-	5	Site inductions, meetings, etc	Item	1	$40,000.00	40,000.00
1-	6	Safety Management Plan (SMP)	Item	1	$10,000.00	10,000.00
1-	7	Environmental Management Plan (EMP)	Item	1	$10,000.00	10,000.00
1-	8	Traffic Management Plan (TMP) and Traffic Control	Item	1	$25,000.00	25,000.00
1-	9	Method of Works Plans (MOWP)	Item	1	$20,000.00	20,000.00
1-	10	Establishment of site testing laboratory	Item	1	$20,000.00	20,000.00
1-	11	Survey control and set out	Item	1	$172,000.00	172,000.00
1-	12	QA plan	Item	1	$10,000.00	10,000.00
1-	13	On site Laboratory and Testing	Item	1	$100,000.00	100,000.00
1-	14	Contractor Supervision	Item	1	$140,000.00	140,000.00
1-	15	Clean up and demobilisation (including plant and personnel)	Item	1	$40,000.00	40,000.00
		Subtotal				**$ 2,700,000**
2.0		**EARTHWORKS**				
2-	1	Borrow pit establishment, management and rehabilitation	Item	1	$15,000.00	15,000.00
2-	2	Site clearing, grubbing, stockpiling or mulching of vegetation of works areas and carting to borrow pit offsite	Ha	15	$700.00	10,500.00
2-	3	Strip topsoil 150 mm deep and stockpile within 1km of aerodrome	bcm	11,500	$3.00	34,500.00
2-	4	Importing, placement, compaction, trimming and grading well graded granular fill material or river shingle for runway general fill material	ccm	17,900	$30.00	537,000.00
2-	5	Importing, placement, compaction, trimming and grading of general fill material for runway strip to tie into runway pavement and RESA fill material	ccm	18,000	$35.00	630,000.00
2-	6	Runway cut to fill material including placement, compaction, trimming and grading of material for runway strip to tie into runway pavement and RESA fill material	ccm	4,800	$10.00	48,000.00
2-	7	Runway earthworks general cut to spoil and dispose material off site	bcm	4,000	$20.00	80,000.00
2-	8	Runway importing of 100mm sand for pavement base layer	m^2	24,500	$10.00	245,000.00
2-	9	Rock excavation (provisional item)	m^3		$85.00	0.00
		Subtotal				**$ 1,600,000**

3.0		**AIRCRAFT PAVEMENTS**				
3a-		***RUNWAY EXTENSION***				
3a-	1	Prepare runway Subgrade	m^2	24,400	$5.00	122,000.00
3a-	2	Supply, place and compact 250 mm Cement Modified Subbase for all associated runway pavement areas (excluding shoulders)	m^2	20,600	$10.00	206,000.00
3a-	3	Supply, place and compact 150 mm Basecourse in runway pavements (including shoulders)	m^2	24,300	$10.00	243,000.00
3a-	4	Primer seal	m^2	24,200	$6.00	145,200.00
3a-	5	10mm + 5mm Water proofing chip seal on runway pavements (including shoulders)	m^2	24,200	$9.00	217,800.00
3a-	6	Supply and lay 60 mm Asphalt in runway pavement areas including tack coat and ramping (including shoulders)	m^3	1,452	$920.00	1,335,840.00
3a-	7	Runway Grooving across full length and full width of the runway extension and 30m wide on the turning node	m^2	18,030	$10.00	180,300.00
3a-	8	Supply, place and compact prime and seal, 150 mm gravel pavement for Runway 12 and 30 blast area	m^2	3,600	$15.00	54,000.00
3b-		***TAXIWAY A, B AND C AND RPT APRON***				
3b-	9	Rip and dispose of existing taxiway areas for resurfacing	m^2	24,600	$8.00	196,800.00
3b-	10	Supply, place and compact 260 mm Basecourse in Taxiway A, B and C pavements	m^2	24,600	$20.00	492,000.00
3b-	11	10mm + 5mm Water proofing chip seal on taxiway and apron pavements (including shoulders)	m^2	32,100	$9.00	288,900.00
3b-	12	Primer seal	m^2	32,100	$6.00	192,600.00
3b-	13	Supply and lay 60 mm Asphalt in taxiway pavement areas including tack coat and ramping	m^3	1,600	$920.00	1,472,000.00
3b-	14	Supply and lay 60 mm Asphalt in RPT apron pavement areas, including tack coat	m^3	450	$920.00	414,000.00
3b-	15	Fuel Resistant Surface Treatment on aircraft parking bays	m^2	3,000	$13.00	39,000.00
		Subtotal				**$ 5,600,000**
4.0		**DRAINAGE**				
4-	1	Construction of open unlined drains	m	1,200	$25.00	30,000.00
4-	2	Remove and store of 450 dia culvert including associated headwalls at runway end 30	Item	1	$400.00	400.00
4-	3	450mm dia. RRJ RCP class 2	m	10	$300.00	3,000.00
4-	4	450 dia headwalls	Item	4	$1,400.00	5,600.00
4-	5	Provisional items	Item	1	$60,000.00	60,000.00
		Subtotal				**$ 99,000**
5.0		**ELECTRICAL WORKS**				
5-	1	Supply and Install pit and duct system with cabling for all airside electrical works	m	5,200	$160.00	832,000.00
5-	2	Supply and install Elevated Runway Edge lighting	No.	80	$4,000.00	320,000.00
5-	3	Supply and install inset Bidirectional Runway Threshold/End lighting	No.	16	$6,000.00	96,000.00
5-	4	Supply and install turning node lights	No.	5	$3,500.00	17,500.00
5-	5	Supply and install single sided PAPI including footings	No.	2	$60,000.00	120,000.00
5-	6	Labelling, aiming, testing and commissioning of airfield lighting and apron floodlighting systems	Item	1	$25,000.00	25,000.00
5-	7	Supply and install control cubicle	Item	1	$110,000.00	110,000.00
5-	8	Flight test and commissioning	Item	1	$30,000.00	30,000.00
5-	9	Decommissioning and removal of AT-TVASIS and concrete pads, and make good for compliance with graded runway strip	/block	10	$4,500.00	45,000.00
5-	10	Removal of existing elevated runway edge lighting	Item	62	$60.00	3,720.00
		Subtotal				**$ 1,600,000**

6.0		**OTHER**				
6-	1	Pavement line marking on runway	Item	1	$75,000.00	75,000.00
6-	2	Stock Proof and Perimeter Chain Link Fencing	m	1,500	$160.00	240,000.00
6-	3	Crash gates	no.	2	$4,000.00	8,000.00
6-	4	Signage	Item			0.00
6-	5	Gable markers	no.	6	$1,000.00	6,000.00
6-	6	White cone markers	no.		$300.00	0.00
6-	7	Update Departure and Approach Procedures	Item	1	$150,000.00	150,000.00
6-	8	Update Aerodrome Manual to incorporate aerodrome works	Item	1	$50,000.00	50,000.00
6-	9	Lighting of terrain for Obstacle Limitation Surface restrictions and loppings where required for OLS works	Item	1	$60,000.00	60,000.00
6-	10	Relocate IWI including concrete footings	Item	1	$15,000.00	15,000.00
6-	11	Remove existing chain link fence	m	450	$20.00	9,000.00
6-	12	Aerodrome access road preparation of subgrade including compaction	m^2	8,000	$4.00	32,000.00
6-	13	Aerodrome access road supply, place, compact natural gravel basecourse 250mm thick	m^2	8,000	$10.00	80,000.00
6-	14	As-constructed survey and drawings	Item	1	$25,000.00	25,000.00
		Subtotal				**$ 750,000**
7.0		**CONTINGENCY**				
7-	1	30% Contingency	30%	of	$12,349,000.00	3,704,000.00
		Subtotal				**$ 3,704,000**
					Cost (Exc GST)	$ 16,053,000
					GST	$ 1,605,300
					Total Cost	**$ 17,658,300**

Appendix B - Safety in Design

Prefeasibility Study: Kununurra Airport Extension and Pavement Upgrade
Safety in Design Assessment

Notes: *Designs with significant quantities of dangerous goods may require detailed risk assessments under Dangerous Goods or Major Hazard legislation
* Most industrial processes will require an industry specific assessment, e.g. HAZOP and/or Quantitative Risk Assessment for facilities that have chemical or high-pressure processes under Dangerous Goods or Major Hazard legislation.

Design Life Cycle:	Investigation and Design	Setup, Construction and Commissioning	Operation	Maintenance	Disposal	**Date:**	4/11/2015	**Revision No:** A
Job Name:	Kununurra Airport Extension and Pavements Upgrade	**Job No:**	613239202	**Client**	SWEK	**Design:**	Concept Design and Options Analysis	
People involved in Risk Assessment:	Michael Ryan, Richard Stevenson							

Risk ID	Design Ref	Design Life Cycle Stage (Select from Drop Down Box)	Event Description	Risk/Impacts (What could go wrong and what might happen as a result)	Existing Control Measures	Initial Risk Rating C	L	RR	Potential Control Measures (Consider Hierarchy of Control - Elimination, Substitution, Isolation, Engineering Controls, Administrative Controls, PPE)	Responsibility	By When	Decision / Status	Residual Risk Rating C	L	RR	Comments
1.01	Construction buildings (amenities, accommodation, workshops, storage)	Setup, Construction and Commissioning	Inappropriate Emergency Escape Routes in construction/operational phase. Personnel unable to escape in emergencies, aircraft unable to be manoeuvred in emergency situation	Injury to personnel - burns etc, Aircraft damage		E	2	Significant	Contractors SMP, marking of access routes (Contractor's TMP)	SWEK	Mobilisation of construction equipment	Confirmed by SWEK	E	1	Moderate	
1.02	Removal of existing pavement material (e.g. milling)	Setup, Construction and Commissioning	Risk to personnel in milling process, increased risk of FOD leading to damage to aircraft	Aircraft damage, injury to personnel, plant damage		B	3	Low	Monitor pavements for damage, abrasion and exacerbated wear from truck and heavy plant usage	Contractor	During construction phase	Confirmed by SWEK	B	3	Low	
1.03	Construction plant	Setup, Construction and Commissioning	Construction Plant noise/vibration, Personnel working close to vibrating/loud construction machinery	Vibration, Hearing damage to personnel		C	2	Low	PPE, Contractor's SMP, exclusion zones, noise limitations, mufflers	Contractor	During construction phase	Confirmed by SWEK	C	1	Low	
1.04	Construction plant	Setup, Construction and Commissioning	Construction Vehicles (access, traffic management, road conditions, load and dimensions), Speed of construction plant/vehicles	Injury to personnel		C	4	Moderate	Provide adequate drainage for runoff including crossfall, relief culverts, tables drains as necessary	GHD	During Detailed Design	Include in Detailed Design	C	1	Low	
1.05	Aerodrome Pavements	Setup, Construction and Commissioning	Delays in procurement of material during construction	Project delays and increased costs		D	3	Significant	1. Identify suitable borrow pit material locations in early development stage of project. 2. Utilise local materials through modifying/blending to meet requirements to avoid importing. 3. Appropriate contractor management for procurement of material.	1. Confirmed by SWEK or during detailed geotechnical investigation 2. GHD 3. SWEK	During Detailed Design	Sirius to manage	D	2	Moderate	
1.06	Runway Extension	Operation	Rain / natural creek flows	Altered cross flow of runoff water impacting on flora		D	3	Significant	No high velocity water flows expected due to general terrain Existing water courses to be controlled by diversion drains.	GHD	During Detailed Design	GHD to provide adequate drainage	D	2	Moderate	
1.07	Aerodrome Pavements	Setup, Construction and Commissioning	Flora and fauna permits not obtained early in schedule	Restricted access to borrow pits resulting in delays		D	3	Significant	Permits to be obtained prior to construction works	SWEK	Prior to construction	SWEK to manage	D	1	Moderate	
1.08	Aerodrome Pavements	Maintenance	Inadequate sealing of pavement surface due to poor construction methodology	Excessive maintenance repair frequency over life of mine		B	4	Low	QA Measures during Construction	SWEK	Construction	SWEK to manage	B	2	Negligible	
1.09	Aerodrome	Maintenance	Rain water runoff pooling on the road runway	Pooling water may weaken road pavement requiring road repairs, etc Runway not operational due to repair work		C	4	Moderate	Provide adequate drainage for runoff including appropriate crossfall, relief culverts, tables drains as necessary	GHD	During Detailed Design	Include in Detailed Design	C	1	Low	
1.10	Aerodrome	Investigation and Design	Inadequate pavement design due to insufficient Geotech information	To progress to detailed design without appropriate geotechnical information may result with an inadequate pavement design		C	4	Moderate	Complete adequate Geotech investigation and incorporate results into detailed design	GHD/SWEK	During Detailed Design		C	1	Low	

Risk ID	Design Ref	Design Life Cycle Stage (Select from Drop Down Box)	Event Description	Risk/Impacts What could go wrong and what might happen as a result	Existing Control Measures	Initial Risk Rating C	L	RR	Potential Control Measures (Consider Hierarchy of Control - Elimination, Substitution, Isolation, Engineering Controls, Administrative Controls, PPE)	Responsibility	By When	Decision / Status	Residual Risk Rating C	L	RR	Comments
1.11	Aerodrome	Operation	Aircraft damage/incident during landing and take off due to birds strike and/or vegetation growth over height in flight path	Aircraft incident, fatalities plane breakdown on the ground		D	3	Significant	1. Clearing diagram at Runway end 12 developed and to include bird management. 2. Bird attracting areas at Runway end 12 (Ord River) monitored if continually present. 3. All planned clearing activities to be documented and provided to client for relevant approvals.	GHD/SWEK	During Detailed Design	Include in Detailed Design	D	2	Moderate	
1.12	Aerodrome	Operation	Hydrocarbons (oils and fuel) leaking from planes parked on apron impacting on surface	Plane incident, facilities		C	3	Moderate	Fuel resistance Surface Treatment to be used to protect the apron parking bay	GHD/SWEK	Detailed design/maintenance during operation	Include in Detailed Design	C	2	Low	
1.13	Aerodrome	Operation	Unrestricted larger animal movements near aerodrome	Plane incident, facilities		C	3	Moderate	1. Runway fenced is reinstated to preclude large animals from aerodrome 2. Large animals are more likely to be observed by pilots. 3. Runway to be checked prior to arrival of plane	GHD/SWEK	Detailed design/maintenance during operation	GHD to include appropriate fencing in detailed design.	C	2	Low	
1.14	Aerodrome	Operation	Obstacle issues in and around flight path due to unknown clearances between aircraft and various ground installations	Aeroplane flight implications		C	3	Moderate	Confirm OLS terrain clearances and objects during concept design	GHD	Concept Design and Options Analysis	GHD to incorporate OLS clearances in design.	C	2	Low	
1.15	Aerodrome	Setup, Construction and Commissioning	Stockpiling top soil stripping and vegetation clearing debris	Stockpiling areas not being defined prior to construction		B	3	Low	Include cleared material stockpile in the clearing diagram plan.	GHD/SWEK	Detailed Design	Stockpiling/laydown areas to be defined on detailed design drawings	A	1	Negligible	
1.16	Aerodrome	Setup, Construction and Commissioning	Construction laydown area			B	3	Low	Identify construction lay down area and mark on clearing plan.	GHD/SWEK	Detailed Design	Stockpiling/laydown areas to be defined on detailed design drawings	A	1	Negligible	
1.17	Aerodrome	Setup, Construction and Commissioning	NOTAM issued for Kun Airport	Pilots are not updated on the aerodrome closure and attempt to land aircraft on runway during construction		D	3	Significant	Ensure NOTAM is issued and filed with CASA	SWEK	Detailed Design	Responsibility of SWEK	D	1	Moderate	
1.18	Aerodrome	Setup, Construction and Commissioning	RFDS required emergency access to runway	Potential incident with construction crew working at Runway end 12 with forced landing of aircraft		E	3	Extreme	Ensure NOTAM is current. Contractor to develop appropriate Safety Management Plan to address forced landing during the runway works	SWEK/Contractor	Setup		E	2	Significant	
1.19	Aerodrome	Setup, Construction and Commissioning	Delay in certification processes for operation of aerodrome	Delay in aerodrome operations		C	3	Moderate	Early commencement of certification process (Regular dialogue with CASA to update them on progress of runway extension).	GHD/SWEK	Detailed Design	Include in Detailed Design	C	2	Low	

Appendix C – Runway Extension Prefeasibility Study Drawings

SHIRE OF WYNDHAM EAST KIMBERLEY

EAST KIMBERLEY REGIONAL AIRPORT

RUNWAY 12/30 EXTENSION PREFEASIBILITY STUDY

RUNWAY PLAN
SCALE 1:10,000

DRAWING INDEX	
DRAWING NUMBER	DRAWING TITLE
GENERAL	
61-32392-G001	LOCALITY PLAN AND DRAWING INDEX
CIVIL	
61-32392-C002	RUNWAY EXTENSION - OPTIONS PLAN
61-32392-C003	RUNWAY EXTENSION - WEST & EAST END EXTENSION PLAN & LONGITUDINAL SECTION
61-32392-C004	RUNWAY & TAXIWAY PAVEMENT DETAILS
61-32392-C005	TAXIWAY & APRON RESURFACING PLAN
61-32392-C006	RUNWAY EXTENSION - OBSTACLE LIMITATION SURFACES PLAN
ELECTRICAL	
61-32392-E007	RUNWAY EXTENSION - AIRFIELD LIGHTING - SETOUT

PRELIMINARY

No	Revision	Note: * Indicates signatures on original issue of drawing or last revision of drawing	Drawn	Job Manager	Project Director	Date
A	ISSUED FOR PRELIMINARY CONCEPT DESIGN		AR			25/11/15

N

0 100 200 300 400 500m
SCALE 1:10,000 AT ORIGINAL SIZE

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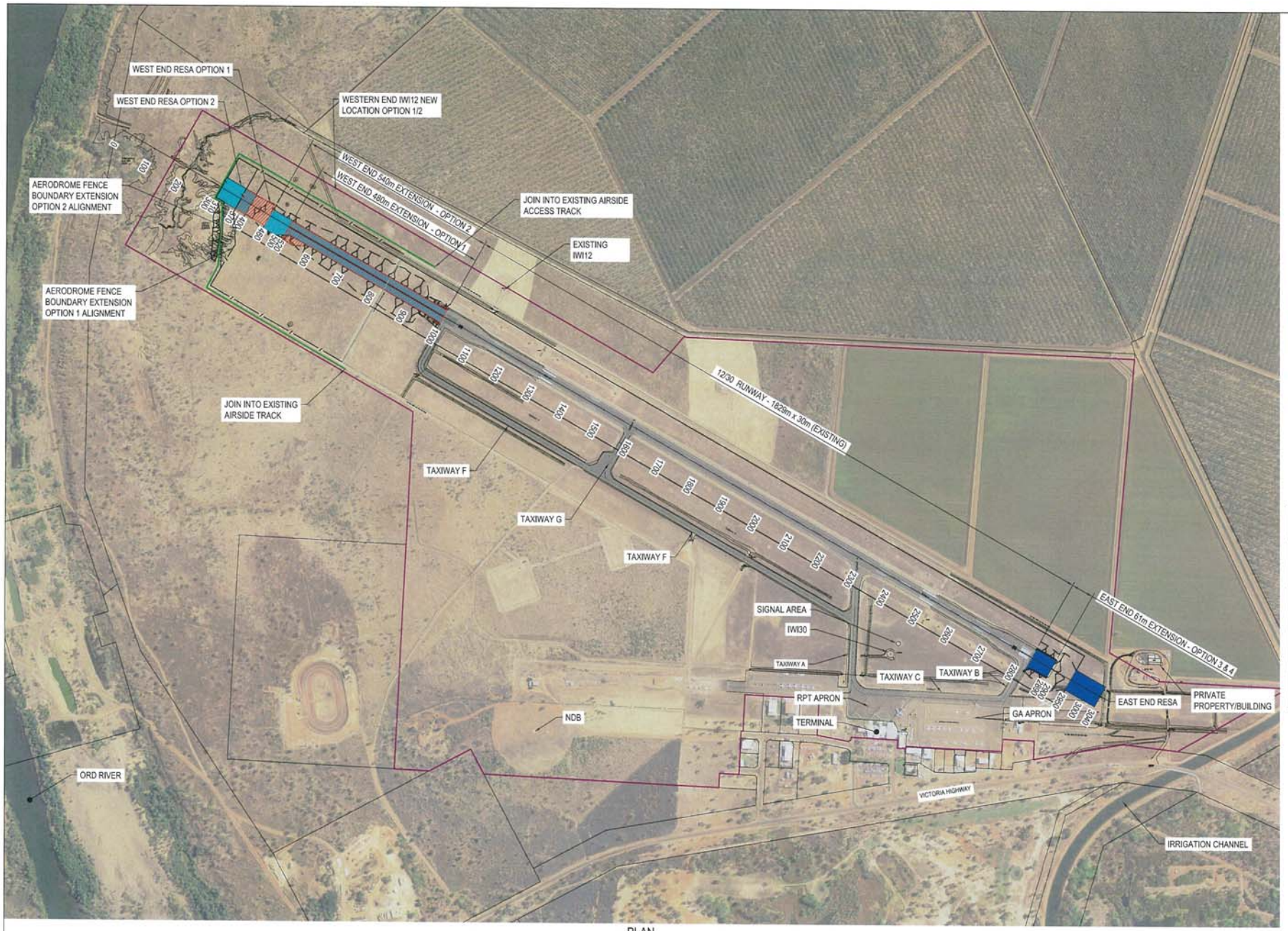
Drawn	A. ROBINSON	Designer	R. STEVENSON
Drafting Check		Design Check	
Approved (Project Director)			
Date			
Scale	AS SHOWN	This Drawing must not be used for Construction unless signed as Approved	

Client: SHIRE OF WYNDHAM EAST KIMBERLEY
Project: RUNWAY EXTENSION PREFEASABILITY STUDY
Title: LOCALITY PLAN AND DRAWING INDEX

Original Size: A1
Drawing No: 61-32392-G001
Rev: A

Plot Date: 24 November 2015, 10:11 AM Plotted by: Anne Robinson
Cad File No: \\ghdnet.internal\ghd\AU\Perth\Projects\61\32392\CAD\Drawings\61-32392-G-001.dwg



PLAN
SCALE 1:5000

NOTES

1. ALL DIMENSIONS IN METRES (m) OTHERWISE NOTED
2. HEIGHT DATUM A.H.D
3. HORIZONTAL DATUM CO-ORDINATES KUN94.
4. SURVEY PROVIDED BY MNG.

SETOUT CO-ORDINATES		
SETOUT POINTS	EASTING	NORTHING
CH 460	44356.163	255622.670
CH 520	44408.305	255592.985
CH 1000	44825.454	255355.526
CH 2829	46414.925	254450.703
CH 2890	46467.946	254420.475

LEGEND

- 2500 — CHAINAGE
- WEST END EXTENSION - OPTION 1 RUNWAY EXTENDED BY 480m
- WEST END EXTENSION - OPTION 2 RUNWAY EXTENDED BY 540m
- EAST END EXTENSION - OPTION 3 & 4 RUNWAY EXTENDED BY 61m
- AERODROME CADASTRAL BOUNDARY
- CADASTRAL BOUNDARY
- AIRSIDE ACCESS ROAD
- EXISTING AERODROME FENCE BOUNDARY
- NEW AERODROME FENCE BOUNDARY
- NDB — NON DIRECTIONAL BEACON
- RESA — RUNWAY END SAFETY AREA

RUNWAY EXTENSION OPTIONS SUMMARY		
OPTION 1	RUNWAY 12 EXTENSION	480 m
	RUNWAY 30 EXTENSION	0 m
	TOTAL RUNWAY LENGTH	2309 m
OPTION 2	RUNWAY 12 EXTENSION	540m
	RUNWAY 30 EXTENSION	0m
	TOTAL RUNWAY LENGTH	2369 m
OPTION 3	RUNWAY 12 EXTENSION	480 m
	RUNWAY 30 EXTENSION	61 m
	TOTAL RUNWAY LENGTH	2370 m
OPTION 4	RUNWAY 12 EXTENSION	540m
	RUNWAY 30 EXTENSION	61m
	TOTAL RUNWAY LENGTH	2430 m

PRELIMINARY

No	Revision	Drawn	Job Manager	Project Director	Date
A	ISSUED FOR PRELIMINARY CONCEPT DESIGN	AR		MR	25/11/15

Note: * Indicates signatures on original issue of drawing or last revision of drawing.

N

0 50 100 150 200 250m
SCALE 1:5000 AT ORIGINAL SIZE

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Approved (Project Director)			
Date			
Scale	AS SHOWN	This Drawing must not be used for Construction unless signed as Approved	

Client: SHIRE OF WYNDHAM EAST KIMBERLEY
Project: RUNWAY EXTENSION PREFEASABILITY STUDY
Title: RUNWAY EXTENSION - OPTIONS PLAN

Original Size: A1
Drawing No: 61-32392-C002
Rev: A

Plot Date: 24 November 2015 - 11:35 AM Plotted by: Anne Robinson
Cad File No: \\ghdnet.intamal\ghd\AU\Perth\Projects\61\32392\02\CAD\Drawings\61-32392-C002.dwg

NOTES

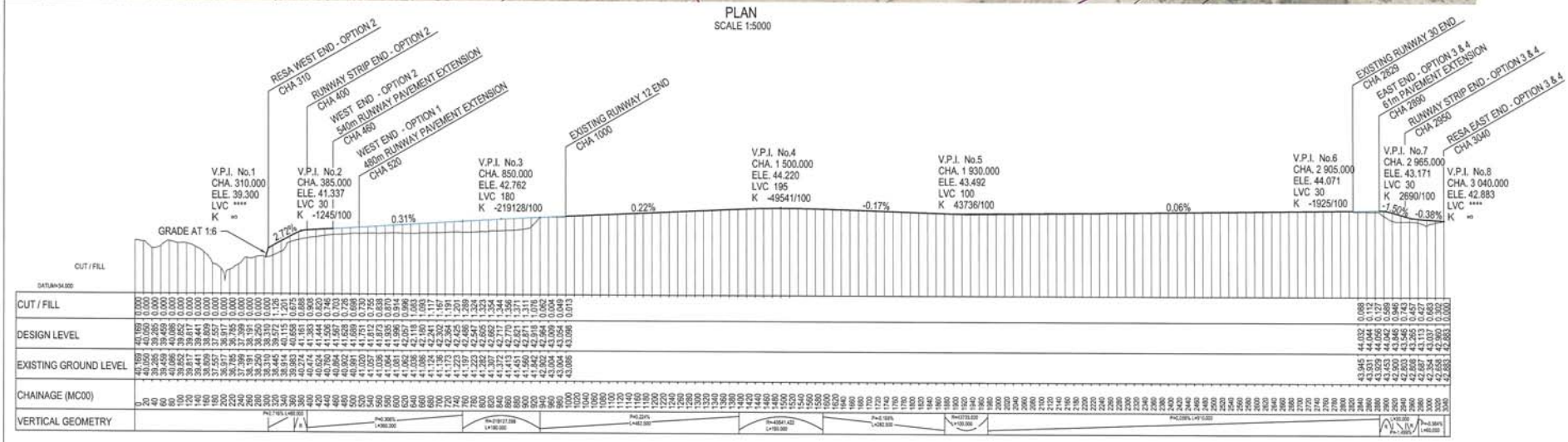
1. ALL DIMENSIONS IN METRES (m) OTHERWISE NOTED
2. HEIGHT DATUM A.H.D
3. HORIZONTAL DATUM CO-ORDINATES KUN94.
4. SURVEY PROVIDED BY MNG.

SETOUT CO-ORDINATES		
SETOUT POINTS	EASTING	NORTHING
CH 460	44356.163	255622.670
CH 520	44408.305	255592.985
CH 1000	44825.454	255355.526
CH 2829	46414.925	254450.703
CH 2890	46467.946	254420.475

LEGEND

- 2500 CHAINAGE
- WEST END EXTENSION - OPTION 1 RUNWAY EXTENDED BY 480m
- WEST END EXTENSION - OPTION 2 RUNWAY EXTENDED BY 540m
- EAST END EXTENSION - OPTION 3 & 4 RUNWAY EXTENDED BY 61m
- AERODROME CADASTRAL BOUNDARY
- CADASTRAL BOUNDARY
- AIRSIDE ACCESS ROAD
- EXISTING AERODROME FENCE BOUNDARY
- NEW AERODROME FENCE BOUNDARY
- NDB NON DIRECTIONAL BEACON
- RESA RUNWAY END SAFETY AREA

PLAN
SCALE 1:5000



LONGITUDINAL SECTION FOR RUNWAY EXTENSION OPTIONS
SCALE 1:5000 HIGH / VERTICAL 1:250

PRELIMINARY

No	Revision	Note: * indicates signatures on original issue of drawing or last revision of drawing	Drawn	Job Manager	Project Director	Date
A	ISSUED FOR PRELIMINARY CONCEPT DESIGN	AR	DRC	MR		25/01/15

SCALE 1:5000 AT ORIGINAL SIZE (0 50 100 150 200 250m)
SCALE 1:250 AT ORIGINAL SIZE (0 2.5 5 7.5 10 12.5m)

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Approved (Project Director)			
Date			
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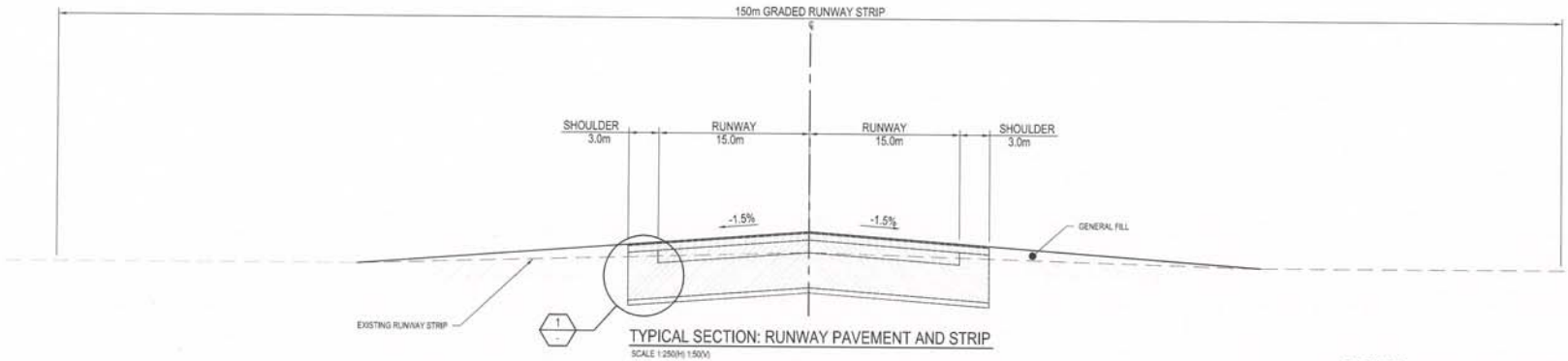
Client: SHIRE OF WYNDHAM EAST KIMBERLEY
Project: RUNWAY EXTENSION PREFEASABILITY STUDY
Title: RUNWAY EXTENSION - WEST & EAST END EXTENSION PLAN & LONGITUDINAL SECTION

Original Size: A1 Drawing No: 61-32392-C003 Rev: A

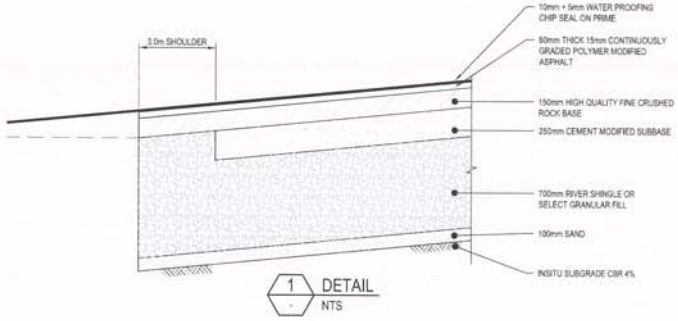
Plot Date: 26 January 2015 - 11:12 AM - Plotted by: James Dickson
Cad File No: \\ghdnet.internal\ghd\AU\Perth\Projects\61\32392\CADD\Drawings\61-32392-C003.dwg

NOTES

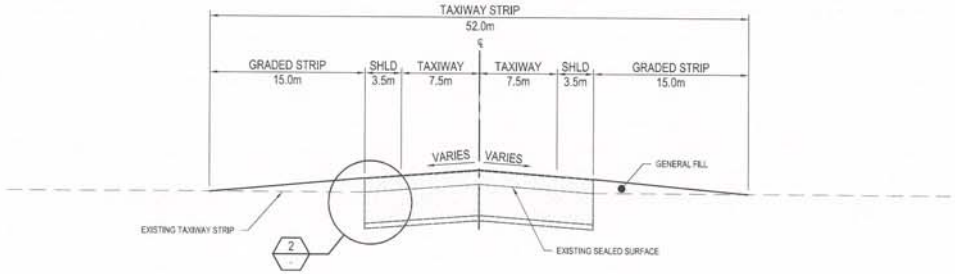
1. DIMENSIONS ARE IN METRES UNLESS OTHERWISE SPECIFIED.
2. 150mm OF TOPSOIL IS TO BE STRIPPED OVER FULL EXTENT OF EARTHWORKS.



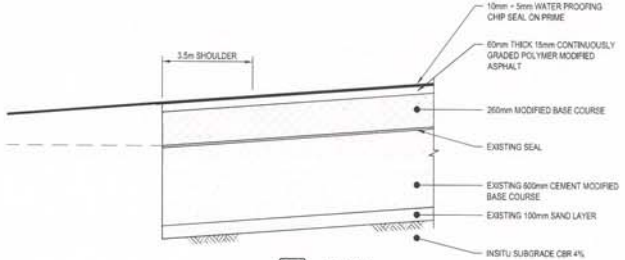
TYPICAL SECTION: RUNWAY PAVEMENT AND STRIP
SCALE 1:250(H) 1:50(V)



1 DETAIL NTS



TYPICAL SECTION: TAXIWAYS 'A', 'B' AND 'C' PAVEMENT AND STRIP
SCALE 1:250(H) 1:50(V)



2 DETAIL NTS

PRELIMINARY

No	Revision	Drawn	Job Manager	Project Director	Date
B	RE-ISSUED FOR PRELIMINARY CONCEPT DESIGN	AR	RAC	MR	21/6/16
A	ISSUED FOR PRELIMINARY CONCEPT DESIGN	AR	RAC	MR	25/11/15

Note: * indicates signatures on original issue of drawing or last revision of drawing

VERTICAL 1:50 AT ORIGINAL SIZE
HORIZONTAL 1:250 AT ORIGINAL SIZE
0 0.5 1 1.5 2 2.5m
0 2.5 5 7.5 10 12.5m

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Drafting Check		Design Check	
Approved (Project Director)		Date	
Scale	AS SHOWN	This Drawing must not be used for Construction unless signed as Approved	

Client: SHIRE OF WYNDHAM EAST KIMBERLEY
Project: RUNWAY EXTENSION PREFEASABILITY STUDY
Title: RUNWAY & TAXIWAY PAVEMENT DETAILS

Original Size: A1
Drawing No: 61-32392-C004
Rev: B

Plot Date: 9 June 2016 - 8:14 AM Plotted by: Elizabeth Siddons
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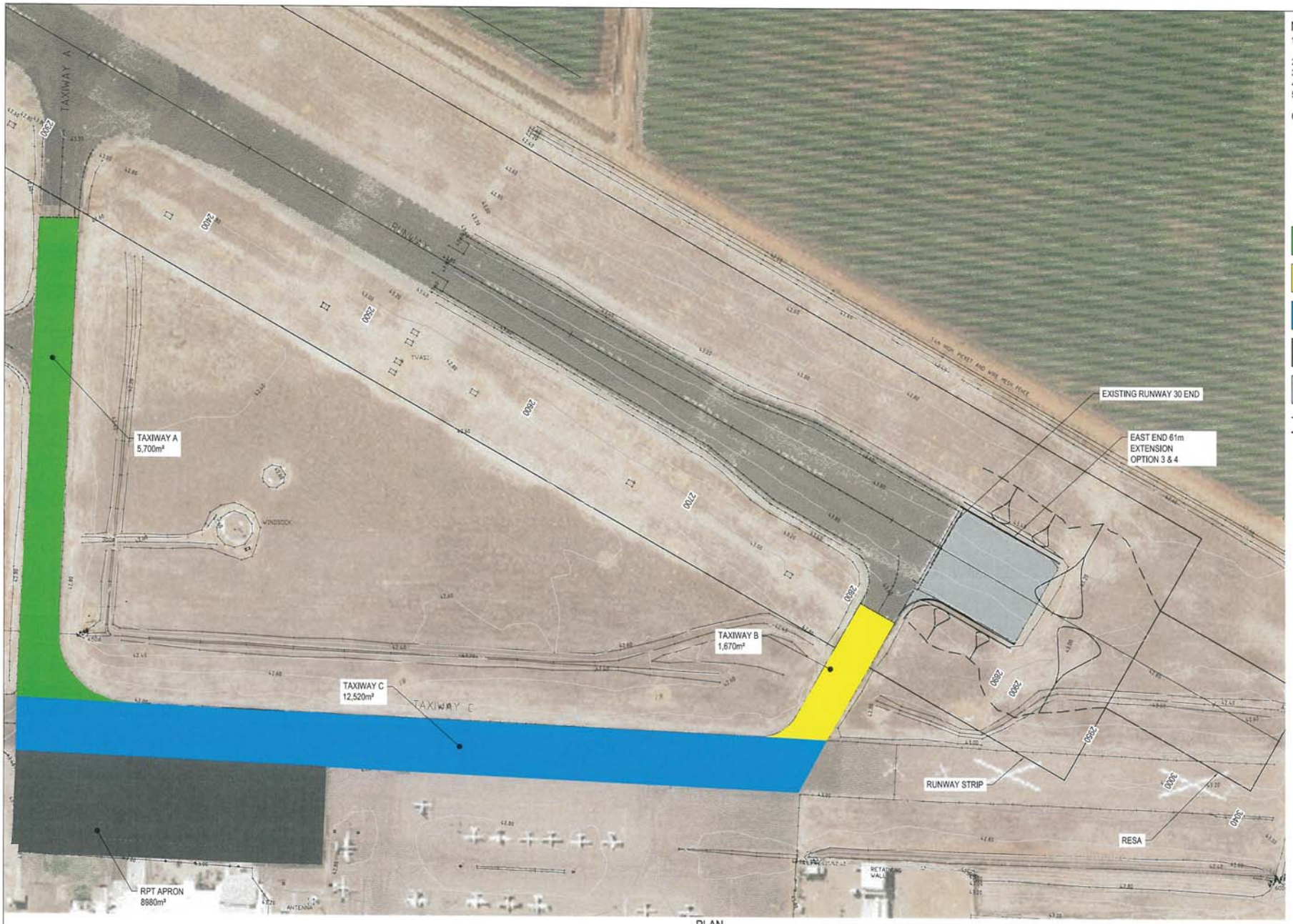

NOTES

1. ALL DIMENSIONS IN METRES (m) OTHERWISE NOTED
2. HEIGHT DATUM A.H.D
3. HORIZONTAL DATUM CO-ORDINATES KUN94.
4. SURVEY PROVIDED BY MNG.
5. REFER TO DRG 61-32392-C-004 FOR TYPICAL PAVEMENT CROSS SECTIONS.
6. PAVEMENT RECONSTRUCTION, INSITU STABILISATION OF EXISTING PAVEMENT WITH CEMENT MODIFIED BASECOURSE DEPTH OF 260mm, WITH 10mm + 5mm WATERPROOFING CHIPSEAL ON PRIME WITH 60mm THICK 15mm CONTINUOUSLY GRADED POLYMER MODIFIED ASPHALT.

LEGEND

- 2500 CHAINAGE
- TAXIWAY A RESURFACING EXTENT REFER NOTE 6.
- TAXIWAY B RESURFACING EXTENT REFER NOTE 6.
- TAXIWAY C RESURFACING EXTENT REFER NOTE 6.
- RPT APRON RESURFACING EXTENT 60mm CONTINUOUSLY GRADED POLYMER MODIFIED AC14 ASPHALT
- EAST END 61m EXTENSION OPTION 3 & 4
- EDGE OF RUNWAY STRIP
- EDGE OF 2015 ASPHALT RUNWAY RESEAL EXTENT
- 42.80 EXISTING CONTOUR

PLAN
SCALE 1:1000

PRELIMINARY

No	Revision	Drawn	Job Manager	Project Director	Date
A	ISSUED FOR PRELIMINARY CONCEPT DESIGN	AR			24/11/15

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N

0 10 20 30 40 50m
SCALE 1:1000 AT ORIGINAL SIZE

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Drafting Check		Design Check
Approved (Project Director)		
Date		
Scale AS SHOWN		This Drawing must not be used for Construction unless signed as Approved

Client: SHIRE OF WYNDHAM EAST KIMBERLEY
Project: EAST KIMBERLEY REGIONAL AIRPORT
Title: TAXIWAY AND APRON RESURFACING PLAN

Original Size: A1
Drawing No: 61-32392-C005
Rev: A

Plot Date: 24 November 2015 - 11:21 AM Plotted by: Aaron Robinson
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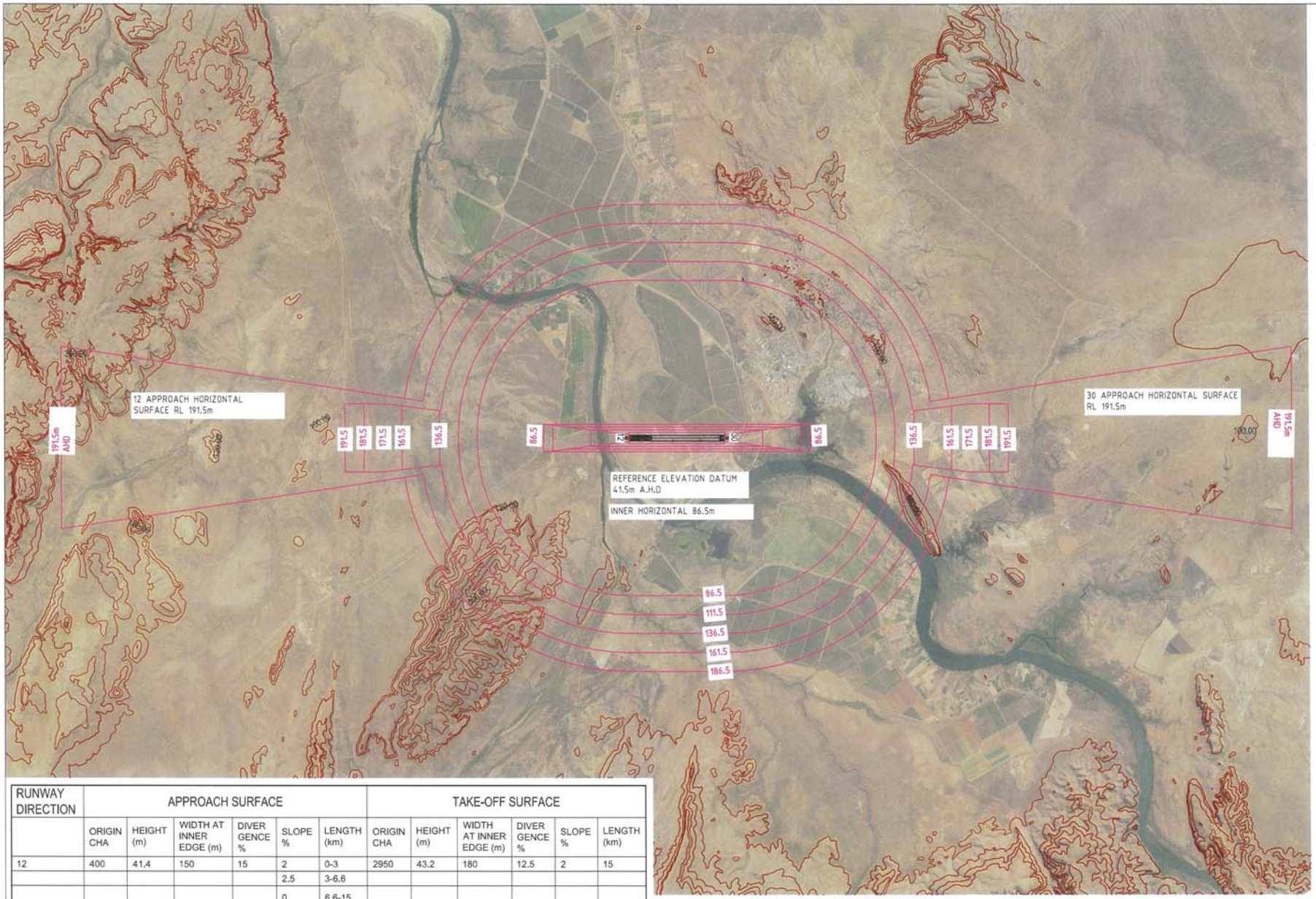

NOTES

1. ALL DIMENSIONS IN METRES (m) OTHERWISE NOTED
2. HEIGHT DATUM A.H.D
3. HORIZONTAL DATUM CO-ORDINATES KUN94.
4. GROUND CONTOURS BY LANDGATE.
5. CONTOURS ARE IN 20m INTERVALS.

LEGEND

12 — RUNWAY 12 THRESHOLD

—180.00— GROUND CONTOUR

RUNWAY DIRECTION	APPROACH SURFACE						TAKE-OFF SURFACE					
	ORIGIN CHA	HEIGHT (m)	WIDTH AT INNER EDGE (m)	DIVER GENCE %	SLOPE %	LENGTH (km)	ORIGIN CHA	HEIGHT (m)	WIDTH AT INNER EDGE (m)	DIVER GENCE %	SLOPE %	LENGTH (km)
12	400	41.4	150	15	2	0-3	2950	43.2	180	12.5	2	15
					2.5	3-6.6						
					0	6.6-15						
30	2950	43.2	150	15	2	0-3	400	41.4	180	12.5	2	15
					2.5	3-6.6						
					0	6.6-15						

OBSTACLE LIMITATION SURFACE PLAN

SCALE 1:50000

PRELIMINARY

No	Revision	Note: * Indicates signatures on original issue of drawing or last revision of drawing	Drawn	Job Manager	Project Director	Date
A	ISSUED FOR PRELIMINARY CONCEPT DESIGN		AR			25/11/15

0 500 1000 1500 2000 2500m

SCALE 1:50,000 AT ORIGINAL SIZE

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Drafting Check		Design Check	
Approved (Project Director)		Date	
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Client: SHIRE OF WYNDHAM EAST KIMBERLEY

Project: RUNWAY EXTENSION PREFEASABILITY STUDY

Title: OBSTACLE LIMITATION SURFACES PLAN

Original Size: A1 | Drawing No: 61-32392-C006 | Rev: A

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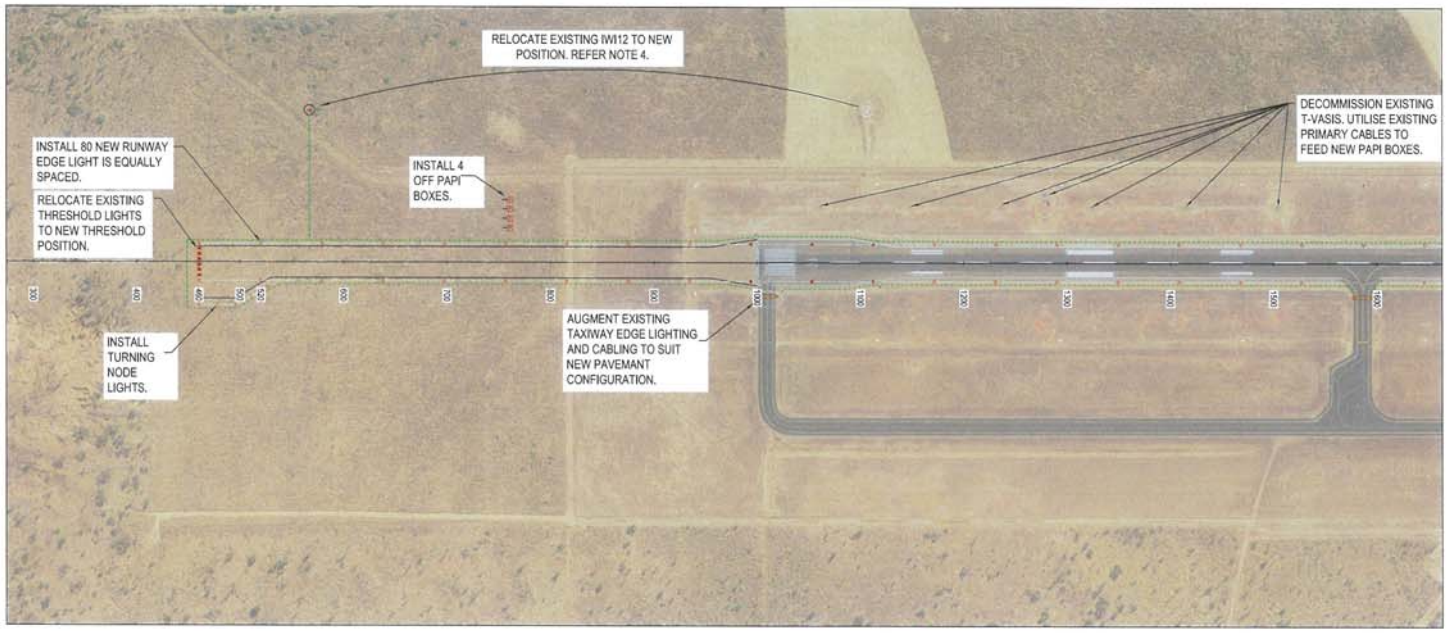

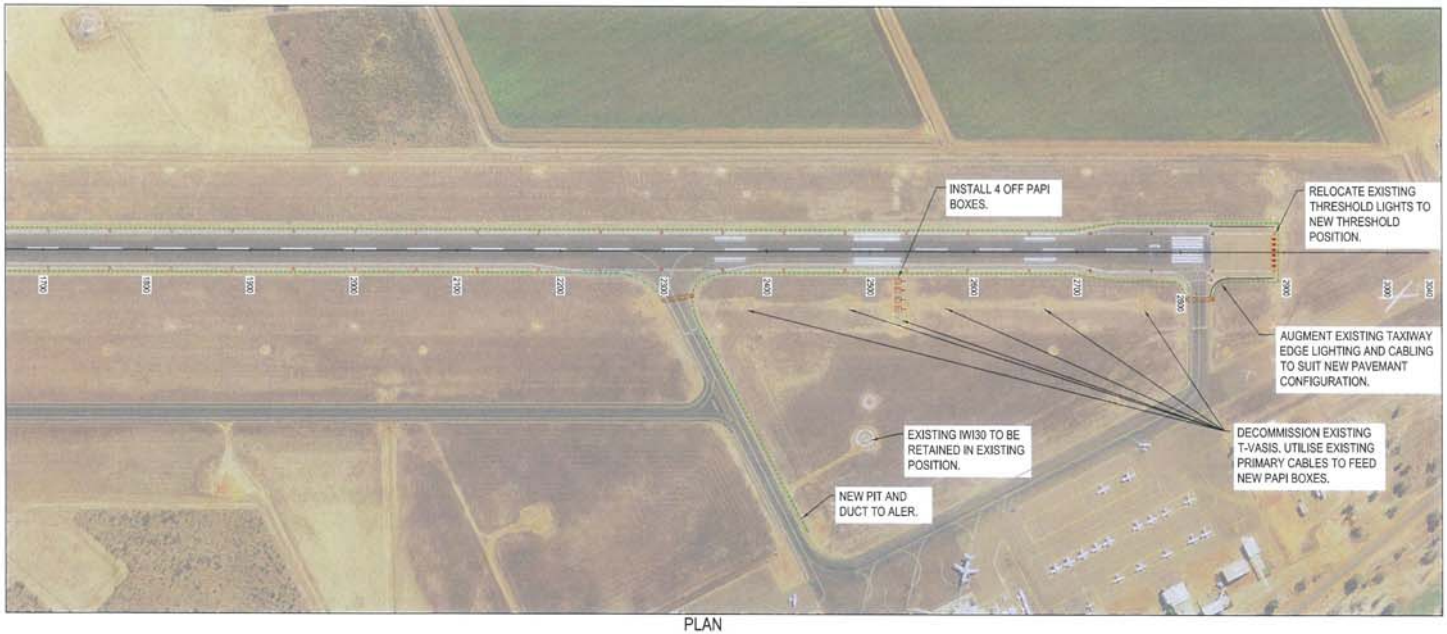

PLAN
SCALE 1:2500

NOTES:

1. SURVEY PROVIDED BY MNG.
2. CAPACITY AND CONDITION OF EXISTING UNDER PAVEMENT DUCT CROSSINGS TO BE CONFIRMED.
3. ALER LOCATION AND CABLE ROUTE TO ALER TO BE CONFIRMED.
4. COMPLIANCE OF EXISTING IWI's NOT CONFIRMED. NEW IWI REQUIRED WHERE EXISTING DOES NOT COMPLY WITH CURRENT STANDARDS AND TO BE RELOCATED.
5. ANTICIPATED (MINIMUM) AGL CONTROL SYSTEM WORKS TO INCLUDE:
   - UP-SIZING OF EXISTING MIT/CCR.
   - CONTROL LOGIC MODIFICATION ASSOCIATED WITH PAPI.
   - IWI SUPPLY/CONTROL TO BE CONFIRMED.
6. OPTION TO AUGMENT SUPPLY ARRANGEMENTS TO PROVIDE INTERLEAVED RUNWAY CIRCUIT FOR REDUNDANCY.

LEGEND:

- PRECISION APPROACH PATH INDICATOR (PAPI) BOXES.
- OMNI-DIRECTIONAL LIGHT.
- INSET OMNI-DIRECTIONAL LIGHT.
- INSET BI-DIRECTIONAL SYMMETRICAL LIGHT..
- ILLUMINATED WIND INDICATOR.
- NEW AGL PIT AND DUCT SYSTEM, CABLING AND SITs
- 30 RUNWAY DESIGNATION
- UNDER PAVEMENT DUCT CROSSING

PRELIMINARY

No	Revision	Drawn	Job Manager	Project Director	Date
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Approved (Project Director)			
Date			
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Project: RUNWAY EXTENSION PREFEASABILITY STUDY
Title: RUNWAY EXTENSION - AIRFIELD LIGHTING - SETOUT

Original Size: A1
Drawing No: 61-32392-E007
Rev: A

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Document Status

Rev No.	Author	Reviewer		Approved for Issue		
		Name	Signature	Name	Signature	Date
0	R Stevenson	M Ryan	*M. Ryan*	M Ryan	*M Ryan*	*24/11/2015*
1	L Huxtable	M Ryan	*M Ryan*	M Ryan	*M Ryan*	*13/05/2016*
2	L Huxtable	M Ryan	*M Ryan*	M Ryan	*M Ryan*	*03/06/2016*
3	L Huxtable	M Ryan	*M Ryan*	M Ryan	*M Ryan*	*04/07/2016*
4	L Huxtable	M Ryan	*M Ryan*	M Ryan	*M Ryan*	*09/08/2016*
5	L Huxtable	M Ryan		M Ryan		

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Shire of Wyndham East Kimberley

East Kimberley Regional Airport

Runway Extension Prefeasibility Study

Preliminary Pavement Investigation and Design

June 2016

Executive summary

This report summarises the pavement investigation carried out for the proposed runway extension of Runway 12/30 at the Kununurra Airport and provides an evaluation of the capability of the existing taxiways A, B, C and RPT apron with regards to the future aircraft traffic (mainly B737-800 and A320-200). An evaluation of the runway was presented under cover of GHD report dated 11 September 2015 which indicated the asphalt overlay had improved the strength of the runway.

Soil samples were taken from subgrade depth of the proposed runway extension areas and also from the edge of existing pavements of taxiways A, B and C to evaluate the subgrade soil characteristics and CBR value.

The pavement strength evaluation of the taxiways A, B, C and RPT apron comprised of visual inspection and Heavy Weight Deflectometer (HWD) testing and evaluation.

The outcome of the visual evaluation suggests that the taxiways A, B, C and RPT apron are generally in a good condition with some minor defects. The surface is considered functional for current aircraft use.

The proposed structural pavement thickness of the runway extension is provided. This thickness is adequate to provide cover over a weak subgrade and minimise the effects of the expansive subgrade to the pavement surface and also satisfy PCN rating for the future design aircraft.

The test pit investigation from the pavement edge of taxiways A, B and C revealed multiple spray seals, a granular pavement comprising blended river gravel base and river shingle general fill on clayey subgrade.

The test pits in the runway extension areas identified very stiff, SANDY CLAY subgrade which has expansive properties locally known as “Black Clay”. A soaked subgrade CBR 4% was adopted for the runway extension areas and Taxiway A, B and C and CBR 10% was adopted for the RPT apron.

The HWD results show the taxiway and apron pavements to be relatively stiff over the majority of the pavements with localised softening around the edges of the RPT apron.

Three future traffic scenarios described in Section 5 of this report were used for the proposed runway extension structural pavement design and taxiway A, B, C and RPT apron pavement strengthening designs.

Based on the HWD survey, back calculated stiffness and pavement design analysis, the existing RPT apron and taxiway pavements require strengthening for the future design aircraft loadings:

- RPT apron: 60 mm asphalt AC14 mm overlay (allowing 20 mm for shape correction);
- Taxiway A, B and C pavements: 60 mm AC 14 mm overlay on 260 mm of cement modified base.

The proposed runway extension pavement should be able to carry the indicated loading for the next 20 years with minimum routine maintenance with the following proposed materials and thickness:

- 60 mm grooved PMB 14 mm asphalt mix; on
- 150 mm water proofing sealed prime fine crushed rock base; on
- 250 mm cement modified subbase; on

- 700 mm river shingle or select fill; on
- 100 mm sand; on
- Subgrade CBR 4%.

Further geotechnical investigation and soil testing of the existing pavements taxiway A, B, C and RPT apron and the runway proposed extension areas should be undertaken as part of the detailed design stage to confirm the design subgrade and existing pavement structure.

At the time of the investigation HWD testing was also carried out on Taxiways D, E, F, G and the GA aprons. An analysis of this testing is not discussed in this Runway Extension Prefeasibility Report.

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Appendices

1. Introduction

1.1 General

The Shire of Wyndham East Kimberley (SWEK) intend to upgrade the East Kimberley Regional Airport (Kununurra Airport) to accommodate Code 4C (B737 and A320) aircraft. The proposed upgrade entails extending the existing Runway 12/30 by 601 m and strengthening the existing Taxiways A to C and RPT apron to accommodate the increased wheel loads of larger aircraft.

GHD was engaged by SWEK in August 2015 to carry out the prefeasibility study for the runway extension and investigate pavement strengthening options for the Regular Passenger Transport (RPT) apron and Taxiways A to C.

The 2013 Kununurra Airport Masterplan (developed by Rehbein Airport Consulting) allows for extending Taxiway F from Taxiway A to Taxiway B, and strengthening Taxiways F (partial only) and G. GHD has excluded Taxiway F and G from the prefeasibility study to limit costs, as it is more cost effective for Code C aircraft to continue to backtracking on the runway.

Figure 1-1 indicates the location of each of the taxiways.

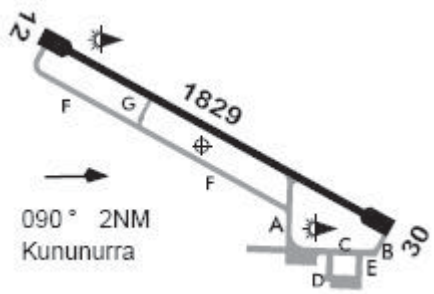

Figure 1-1: Locality Plan

The purpose of the prefeasibility investigation is to establish the subgrade characteristics of the proposed runway extension area, assess the overall condition of the existing pavement structures (RPT apron and Taxiways A to C) and provide strengthening options for the future design aircraft (B737-800 and A320-200) for the RPT apron and Taxiways A to C.

1.2 Purpose of this Report

The purpose of the Runway Extension Prefeasibility Study Report is to document the pavement investigation and findings.

The following aspects will be addressed:

- Evaluate the overall condition of the existing RPT apron and taxiway A to C pavement structures;
- Determine the existing makeup of the RPT apron and Taxiway A to C pavements including:
  - Pavement thickness;
  - Basecourse properties;
  - Subgrade properties; and
  - Pavement strength.
- Characterise the strength of the existing Code C pavements including the RPT apron and Taxiway A to C;

- Determine the soil profile of the proposed extension area;
- Determine the expected air traffic for a twenty (20) year pavement design life. 20 years design life is the accepted norm for new regional airfield pavements;
- Determine the feasibility of various pavement designs.

1.3 Scope of Work

The following scope of work was undertaken:

- Pavement condition inspection of the RPT apron and Taxiway A to C to identify any visual signs of defects;
- Excavation of three test pits to determine the pavement profile of the RPT apron and taxiway pavements (A, B and C);
- Excavation of four test pits from each end of the existing runway, with one beyond the east and three beyond the west end, to establish the quality of the in-situ material for the proposed runway extension (TP1-East, TP2-West, TP3-West, TP4-West);
- Laboratory testing of selected soil and pavement samples including California Bearing Ratio (CBR), maximum modified dry density / optimum moisture content (MMDD), atterberg limits and particle size distribution (PSD);
- Heavy Weight Deflectometer (HWD) testing on the Taxiways A to C and the RPT apron;
- HWD testing of Taxiway D to G and the GA Aprons was carried out during the investigation. An analysis of this testing is not discussed in this Runway Extension Prefeasibility Report.
- Code C structural pavement design of the proposed runway extension;
- Code C structural pavement design of the RPT apron and Taxiway A to C for pavement strengthening.

1.4 Limitations

This report has been prepared by GHD for the Shire of Wyndham East Kimberley and may only be used and relied on by the Shire of Wyndham East Kimberley for the purpose agreed between GHD and the Shire of Wyndham East Kimberley as set out in section 1.2 of this report

GHD otherwise disclaims responsibility to any person other than the Shire of Wyndham East Kimberley arising in connection with this report. GHD also excludes implied warranties and conditions, to the extent legally permissible.

The services undertaken by GHD in connection with preparing this report were limited to those specifically detailed in the report and are subject to the scope limitations set out in the report.

The opinions, conclusions and any recommendations in this report are based on conditions encountered and information reviewed at the date of preparation of the report. GHD has no responsibility or obligation to update this report to account for events or changes occurring subsequent to the date that the report was prepared.

The opinions, conclusions and recommendations in this report are based on assumptions made by GHD described in this report. GHD disclaims liability arising from any of the assumptions being incorrect.

GHD has prepared this report on the basis of information provided by Shire of Wyndham East Kimberley and others who provided information to GHD (including Government authorities), which GHD has not independently verified or checked beyond the agreed scope of work. GHD

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The opinions, conclusions and any recommendations in this report are based on information obtained from, and testing undertaken at or in connection with, specific sample points. Site conditions at other parts of the site may be different from the site conditions found at the specific sample points.

Investigations undertaken in respect of this report are constrained by the particular site conditions, such as the location of buildings, services and vegetation. As a result, not all relevant site features and conditions may have been identified in this report.

Site conditions (including the presence of hazardous substances and/or site contamination) may change after the date of this Report. GHD does not accept responsibility arising from, or in connection with, any change to the site conditions. GHD is also not responsible for updating this report if the site conditions change.

2. Background information

2.1 Pavement Testing Report, Airport Consulting and Construction Australia, 1987

In February 1987, Airport Consulting and Construction Australia (ACCA) Pty Ltd was commissioned by the Shire of Wyndham-East Kimberley to undertake a pavement investigation at the Kununurra Airport. The purpose of this investigation was to assess the suitability of the runway and apron pavements for both the current and future aircraft traffic at that time, and to determine whether any pavement rehabilitation works would be required on the existing pavements in June 1987.

2.1.1 As Constructed

According to the information presented in the ACCA report, the original construction of runway and RPT apron pavement in 1969 comprised the following:

Runway 12/30 Pavement (total thickness 1050 mm)

- 10 mm/5 mm two coat bituminous chip seal; on
- 150 mm basecourse (Ord River shingle blended with red soil); on
- 150 mm sub-base (Ord River shingle); on
- 600 mm minimum select fill (Ord River shingle); on
- 150 mm sand blanket; on
- Prepared subgrade.

RPT Apron Pavement (total thickness 750 mm)

- 10 mm/5 mm two coat bituminous chip seal; on
- 150 mm basecourse (Ord River shingle blended with red soil); on
- 150 mm sub-base (Ord River shingle); on
- 300 mm minimum select fill (Ord River shingle); on
- 150 mm sand blanket; on
- Prepared subgrade.

2.1.2 Pavement Investigation

The ACCA investigation of March 1987 comprised the excavation of three test pits in the runway and one in the apron area.

Laboratory testing of the subgrade from one runway test pit and one RPT apron test pit was carried out by ACCA.

The laboratory soaked CBR's for the two samples was reported as:

- Runway subgrade CBR 2%;
- RPT apron subgrade CBR 8%.

The pavement profile on the runway was reported as follows:

Runway Pavement (total thickness 1400 mm)

- Three bituminous chip seals; on
- 130 – 250 mm base/sub-base; on
- 950 – 1130 mm select fill; on
- 110 – 160 mm sand blanket; on
- Subgrade CBR 4%.

RPT Pavement (total thickness 790 mm)

- Three bituminous chip seals; on
- 470 mm base/sub-base; on
- 250 mm select fill; on
- 70 mm sand blanket; on
- Subgrade CBR 15%.

2.2 Runway 12/30 Pavement Strength Evaluation Report, GHD, 2014

GHD carried out pavement strength evaluation in 2014 and excavated three pits in the existing runway.

Laboratory testing was carried out on three subgrade samples below the existing pavement.

The laboratory soaked CBR's was reported as:

- Runway subgrade CBR 4% and 6%; and
- Swell of 2% to 4%.

GHD reported the runway pavement consists of the following average thickness.

Runway Pavement (total thickness 1710 mm)

- 20 mm of multiple chip seal; on
- 180 mm of base and subbase; on
- 1,300 mm of selected fill materials; on
- 230 mm of sand blanket; on
- Subgrade.

2.3 Report on Preliminary Gilgai Investigation, GHD, 2014

A previous investigation carried out by GHD in 2014, Report on Preliminary Gilgai Investigation identified that the subgrade consists of moderately to highly reactive clays west of Taxiway A. The same report indicated that clay to the east of Taxiway A has low to medium reactivity.

Runway 12/30 Pavement Strength Evaluation Report (GHD, 2014) identified that the subgrade west of Taxiway A is poor with soaked CBR's ranging between 2% and 4%. The runway extension zone laboratory testing found CBR's of between 3% and 6%.

2.4 East Kimberley Regional Airport Runway 12/30 Strength Evaluation, GHD, 2015

An evaluation of Runway 12/30 was carried out by GHD in September 2015 which indicated the asphalt overlay had improved the strength of the runway.

The report dated 11 September 2015 states that the current Runway 12/30 pavement configuration including the recent asphalt overlay can be rated as follows.

PCN 51 / F / C / 1410 (205PSI) / T.

2.5 Surfacing History and Strengthening Records

The previous investigations show that the separate basecourse and sub-base layers were difficult to distinguish and were recorded as one layer.

The runway was overlaid with a variable thickness of levelling course AC10 asphalt and a nominal 60 mm thickness of polymer modified AC14 asphalt in July 2015.

The maintenance records which were provided from East Kimberley Regional Airport (2014) show that in 2010 the subgrade and basecourse of the Taxiways A, B and C were cement stabilised (7.5 m on each side of the centreline) to a total depth of 600 mm sealed with a 10 mm and 7 mm double coat sprayed seal followed by a sand seal.

According to the maintenance records, the RPT apron was resealed in 2004 (aggregate size was not specified) and resealed again in 2014 (6 mm aggregate size).

3. Site Investigation

3.1 General

The site investigation consisted of three stages:

- HWD testing was carried out to allow for condition assessment of the existing pavements on Taxiway A to C and RPT Apron;
- A visual inspection and assessment of the existing pavements to be strengthened; Taxiways A, B and C and the RPT Apron;
- Excavation of three test pits to determine the existing pavement profiles of the pavements to be strengthened; Taxiways A, B and C; and
- Excavation of four test pits to provide an indication of ground conditions for the proposed runway extension.

3.2 Pavement Visual Inspection

On the 8th of August 2015 a visual inspection was undertaken by a Senior Pavement Engineer from GHD on Taxiways A, B and C and the RPT apron where accessible.

3.2.1 Taxiway A

The pavement surfacing of Taxiway A comprises a multiple chip seal and has been resealed within the taxiway edge line marking. The latest seal appeared to comprise a 10 mm / 7 mm double coat spray seal with sand seal and was considered to be in good condition, with the only defect noted being flushing along the outer wheel paths either side of the centre line. No cracking or obvious rutting was observed.

3.2.2 Taxiway B

The pavement surfacing of Taxiway B comprises a multiple chip seal, similar to that observed on Taxiway A. During the visual inspection no obvious signs that Taxiway B had been resealed were observed. The condition of the pavement surfacing is similar to that on Taxiway A with flushing in the wheel paths and no obvious signs of cracking or rutting.

3.2.3 Taxiway C and RPT apron

The pavement surfacing on Taxiway C and the main apron comprises a multiple chip seal similar to that observed on Taxiway A. The condition of the pavement surfacing along Taxiway C is better than that observed on Taxiways A and B with minimal signs of flushing. The main apron is flushed along wheel paths with some signs of movement in the seal at major turning points. No obvious signs that the apron had a fuel resistant treatment were noted at the time of the inspection.

3.3 Trial Pits

The trial pit investigation was carried out on the 8th and 9th of August 2015 under the direction and supervision of a Senior Pavement Engineer from GHD in accordance with a project specific JSEA.

Guerinoni and Son Plant Hire were engaged by GHD to excavate a total of seven trial pits using a 7t tracked excavator. Refer to Appendix A for the location of the trial pits. The pits comprised:

- Three through the existing pavement profile on Taxiways A, B and C;

- Three along the centreline of the potential western extension; and
- One at the potential eastern extension.

Trial pits at Taxiways A, B and C were positioned on the outer edge of the double edge lines and excavated to a maximum depth of 900 mm below the existing surface. Upon completion the pits were backfilled with preconditioned natural gravel basecourse and sealed with emulsion and a 30 mm to 40 mm thick layer of cold mix asphalt.

One test pit was excavated in the proposed extension zone at the east end of the runway (TP1, 100 m past end of the runway) and three test pits were excavated in the proposed extension zone at the west end of the runway (TP2, TP3 and TP4, 100 m, 200 m and 300 m from the existing runway end respectively).

Test pits for the potential runway extension were excavated to a maximum depth of 1.2 m below the existing surface and backfilled with the excavated spoil. Subgrade materials from the western end of the runway were similar therefore only TP2 and TP4 material were selected for testing. The trial pit profiles are presented in Appendix B (Trial Pit Profiles).

3.4 HWD Testing

Non-destructive Heavy Weight Deflectometer (HWD) testing was undertaken by ARRB Consultants on the 1st and 2nd of August 2015. The HWD testing was performed on the existing RPT apron, GA Aprons and Taxiways A to G.

The HWD testing carried out on the RPT Apron and Taxiway A to C is discussed in this Runway Extension Prefeasibility Report.

HWD testing on the taxiways was performed on the centreline and at a 5 m offset each side of the taxiway centreline at 10 m intervals over the full length. HWD testing on the aprons was carried out on a 10 m grid.

Testing was performed with a target load of 100 kN being applied to the pavement, representing a contact stress of approximately 1400 kPa on the pavement, which closely resembles the tyre pressures of B737-800 and A320 aircraft.

4. Laboratory Testing

Representative samples of the soils encountered in the test pits were submitted for laboratory testing. Laboratory testing was conducted by Mining and Civil Geotest Pty Ltd; a National Association of Testing Authorities (NATA) accredited soil testing laboratory in Jandakot, Perth. The laboratory test results are summarised in Table 4-1 and the laboratory test certificates are presented in Appendix C.

Table 4-1 - Summary of laboratory test results

Test ID	Layer Type	Particle Size Distribution			Atterberg Limits %			MMDD (t/m^3)	OMC (%)	Soaked CBR (%)	Swell (%)
		% Fines (<0.075 mm)	% Sand	% Gravel (>2.36 mm)	LL (%)	PI (%)	LS (%)				
TA-PV	Pavement	3	31	66	SIC	NP	0	2.203	6.3	140[2]	0
TA-SG	Subgrade	67	25	8	37	20	9	1.997	10.9	4.5[1]	5
TB-PV	Pavement	-	-	-	-	-	-	2.095	7.6	110[2]	0
TB-SG	Subgrade	62	38	0	42	27	9	1.865	14.0	9[1]	1.5
TC-PV	Pavement	10	35	55	SIC	NP	NP	2.270	5.0	200[2]	0
TC-SG	Subgrade	-	-	-	-	-	-	2.010	10.4	12[1]	1.5
TP-01	Subgrade (0.4-0.6 m)	59	35	6	37	24	10.5	1.915	13.3	13[1]	1
TP-02	Subgrade (0.4-0.6 m)	80	19	1	59	42	13.5	1.825	14.2	3[1]	9.5
TP-04	Subgrade (0.3-0.5 m)	77	23	0	60	43	19	1.745	17.8	6[1]	4

[1] 10 Day soaked CBR

[2] 4 Day soaked CBR

5. Air Traffic Forecasts

5.1 General

Rehbin Airport Consulting prepared a Masterplan for the East Kimberley Regional Airport in 2013. According to the masterplan by 2021-22 the numbers of passengers is estimated to be approximately 274,000 according to the high growth scenario. These passengers will be serviced by approximately 2,600 RPT aircraft movements per annum (primarily Embraer 170 and Fokker 100 supplemented by larger aircraft).

By 2036-37, the high growth scenario estimates that passenger numbers will increase to approximately 577,000 passengers with approximately 5,100 annual RPT movements. These passengers will primarily be serviced by larger aircraft (A320-200 and B737-800) supplemented by smaller aircraft (E170 and F100).

The number of passengers was used to calculate the anticipated number of each aircraft type. The expected growth rate varies from 2017 to 2021-22(11%) and 2022 to 2036-37 (5.1%). It was assumed that 80% of the seats on each aircraft will be occupied per flight but it is understood occupancy reduces outside of peak tourism months, potentially leading to an overestimate of passengers.

Three aircraft distribution scenarios were considered for the runway, taxiways and RPT apron traffic. The B737-800, A320-200 and F100 aircraft are assumed to operate regularly in the future of the airport. The cumulative number of each aircraft movement is calculated from 2017 to 2037 (20 year life).

In terms of pavement design an aircraft landing has a low fuel load and has minimal impact on accumulative pavement damage. Given the remoteness of the airport, departing aircraft will carry a fuel load commensurate with the destination airport. The aircraft loaded with fuel, cargo and passengers add to the accumulate pavement damage.

It is assumed that the aircraft will refuel at Kununurra airport, therefore the number of take-offs of loaded aircraft only is considered for the traffic calculation. The annual average traffic that was used for analysis is the cumulative take-off (20 year period) divided by 20.

The predominant wind directions for the airport according to the Bureau of Meteorology Australia is East, South East and North. Therefore a flight direction ratio of 60% on Runway 12 and 40% for Runway 30 for landing & take-off was adopted.

Summaries of the aircraft distribution scenarios are shown in Table 5-1, Table 5-2 and Table 5-3. The detail of the traffic calculations are provided in Appendix D.

5.2 Future Air Traffic Loading

Three traffic scenarios are considered for the traffic modelling for the airfield based on assumed Code C design aircraft as described below in Table 5-1.

For each scenario the distribution of the three aircraft likely to use the runway was analysed to allow modelling of the possible aircraft pavement loadings. As an example Scenario 1 assumes 80% F100, 10% A320-200 and 10% B737-800 in the design period 2017 to 2022.

Table 5-1 – Predicted Air Traffic loading (20 Years)

Scenarios	Aircraft Type	Design Period	
		2017 to 2021-22 (% of Aircraft)	2022 to2036-37 (% of Aircraft)
1	B737-800	10	40
	A320-200	10	40
	F100	80	20
2	B737-800	10	90
	A320-200	0	0
	F100	90	10
3	B737-800	100	100
	A320-200	0	0
	F100	0	0

5.3 Air Traffic Distribution

The geometry and wind direction of the runway influence the likely air traffic loading on the pavement. It is estimated that 60% of the aircraft take off from Runway 12. In order to access the hold point, aircraft need to enter the runway from either Taxiway A or C and travel the length of the runway and turn around at the end. As a consequence the aircraft loading on the pavement is increased for the double coverage if taking off on Runway 12. We have allowed for 60% of the airplanes to require two passes on the runway before take-off. The summary of cumulative and average passes of each aircraft on the runway is shown in Table 5-2.

Table 5-2 - Runway Air Traffic Loading

Scenarios	Aircraft Type	Cumulative Numbers of passes (2017-2037)	Annual Average passes*
1	B737-800	15,580	779
	A320-200	15,264	763
	F100	17,216	861
2	B737-800	27,508	756
	A320-200	0	0
	F100	15,129	1,375
3	B737-800	35,175	1,759
	A320-200	0	0
	F100	0	0

*Number of times loaded aeroplane traverses the runway

5.4 Taxiways and Apron Traffic

The majority of the aircraft will use Taxiways A and part of Taxiway C to access the parking bays on the RPT apron. It is assumed that 90% of aircraft will utilise Taxiway A and C (partial) while Taxiway B will only be used by 10% of the aircraft. For simplicity Taxiway C has been designed for the section which undergoes 90% aircraft loading.

It is assumed that all aircraft will use the RPT apron.

The summary of cumulative and average passes of each aircraft on Taxiways A to C and RPT aprons is shown in Table 5-3.

Table 5-3 – Air traffic loading on Aviation Pavements

Scenarios	Aircraft Type	Cumulative Numbers and Average of passes (2017-2037)				
		Average / Cumulative	Taxiway A	Taxiway B	Taxiway C	RPT Apron
1	B737-800	A*	438	44	438	487
		C*	8,764	974	8764	9,737
	A320-200	A	429	43	429	477
		C	8,586	954	8,586	9,540
	F100	A	484	48	484	538
		C	9,684	1,076	9,684	10,760
2	B737-800	A	774	77	774	860
		C	15,473	1,719	15,473	17,193
	A320-200	A	0	0	0	0
		C	0	0	0	0
	F100	A	425	43	425	473
		C	8,510	946	8,510	9,456
3	B737-800	A	989	99	989	1,099
		C	19,786	2,1980	19,786	21,984

Scenarios	Aircraft Type	Cumulative Numbers and Average of passes (2017-2037)				
		Average / Cumulative	Taxiway A	Taxiway B	Taxiway C	RPT Apron
	A320-200	A	0	0	0	0
		C	0	0	0	0
	F100	A	0	0	0	0
		C	0	0	0	0

A*=Average

C*=Cumulative

6. Geotechnical Evaluation

6.1 Evaluation of Existing Materials

6.1.1 Evaluation of Existing Taxiways A to C

Pavement and subgrade samples were taken from the shoulder of the existing main taxiways (one sample from Taxiways A, B and C respectively).

As the central taxiway strips (15 m wide) were cement modified in 2010 to a depth of 600 mm the following results relate to the taxiway shoulders which remain as the original unmodified pavement subgrade and base course.

Subgrade

Atterberg and particle size distribution (PSD) testing carried out on two subgrade samples (TA and TB) indicated medium plasticity sandy clay. The grading for TA produced 67% fines, 25% sand and 8% gravel while the grading for TB produced 62% fines and 38% sand. The plasticity index and liquid limit of TA was 20% and 37% respectively while the plasticity index and liquid limit of TB was 27% and 42% respectively.

The TA subgrade is categorised as low expansive soil and TB subgrade as moderate expansive soil (moderate expansive soils have PI of 25 to 45 and LL% of 50 to 70) in accordance with Austroads Guide To Pavement Technology Part 4: Pavement Materials and AS 1726-1993. Expansive subgrade soils (black clay) experience large volumetric increases with an increase in moisture content and large reductions in volume with a reduction in moisture content. These fluctuations in volume cause swell and shrinkage movements in soils which cause damage to pavements constructed on them.

CBR testing was carried out on subgrade samples TA, TB and TC. 10 day soaked CBR testing was carried out, as the soaking period of 10 days provided a more accurate representation of the swell potential of the soil. The CBR results for Taxiways A, B and C subgrades (compacted to 95% maximum modified density ratio) are summarised in Table 6-1.

During detailed design careful consideration needs to be given to maintaining the expansive clay moisture contents at the long term equilibrium moisture. This should ensure the clay does not shrink or swell excessively after construction.

Table 6-1 – 10 Days Soaked Subgrade CBR Values for Taxiway areas

Test ID	MMDD (t/m^3)	OMC (%)	10 Days Soaked CBR (%)	Swell (%)
TA	1.997	10.9	4.5	5
TB	1.865	14.0	9	1.5
TC	2.010	10.4	12	1.5

Moisture and Swelling Properties

The optimum moisture content (OMC) of TA, TB and TC are 10.9%, 14% and 10.4%. The OMC of the previous samples from the runway subgrade was 14% to 16.5%. A CBR swell of 1.5% to 5% was measured on a re-compacted sample (moisture content increased from OMC to saturation during soaking). As there is evidence of the subgrade drying out below OMC during the dry season, there is a strong likelihood of the material having an even larger swell potential. It is highly likely that some subgrade soil swelling activity occurs during seasonal moisture changes under the pavement but the deep layer of pavement prevents reflective cracks or noticeable movement of the pavement surface.

Pavement Materials (Basecourse)

Atterberg and particle size distribution (PSD) testing was carried out on two basecourse samples (TA and TC). The testing indicates that the basecourse material is a sandy gravel. The grading for TA produced 3% fines, 31% sand and 66% gravel while the grading for TC produced 10% fines, 35% sand and 55% gravel. Atterberg testing of both samples indicated that the fines were non plastic.

CBR testing was carried out on pavement samples TA, TB and TC. 4 day soaked CBR testing of the base produced results of 140% (TA), 110% (TB) and 200% (TC) as summarised in Table 6-2.

Table 6-2 – Summary of basecourse test results

Test ID	MMDD (t/m^3)	OMC (%)	4 Days Soaked CBR (%)	Swell (%)
TA	2.203	6.3	140	0
TB	2.095	7.6	110	0
TC	2.270	5.0	200	0

Due to the heavy loading experienced on aircraft pavements a minimum CBR requirement of 100% soaked CBR for basecourse material is normally specified. Therefore the existing pavement material has high bearing ratio and could perform well under the current aircraft loading and proposed landings.

6.1.2 Runway Extension Zone

Subgrade

Atterberg and particle size distribution (PSD) testing of three samples (TP1, TP2 and TP4) indicates medium to high plasticity sandy clay. The grading ranges from 59% to 77% fines and gravel content from 0 to 6%. Atterberg testing show the plasticity index ranges from 24% to 43% while the liquid limit ranges from 37% to 60%. The PI results from the current investigation are higher than the results obtained in the ACCA investigation from RTP apron (24%).

In accordance with Austroad Guide To Pavement Technology Part 4: Pavement Materials TP1 subgrade is classified as having low expansive nature while TP2 and TP4 materials are classified as moderate expansive nature. Visually the material is quite different from the “black clay” but further testing during detailed design should confirm this.

The subgrade materials of the runway extension zone were also tested for 10 days soaked CBR testing and the results of tests are shown in Table 6-3.

Table 6-3 – 10 Days Soaked subgrade CBR Values for the Runway Extension zone

Test ID	MMDD (t/m^3)	OMC (%)	10 Days Soaked CBR (%)	Swell (%)
TP1 (East)	1.915	13.3	13	1
TP2 (West)	1.825	14.2	3	9.5
TP4 (West)	1.745	17.8	6	4

Moisture and swelling properties

The optimum moisture content (OMC) of TP1, TP2 and TP4 are 13.3%, 14.2% and 17.8% as shown in Table 6-3. The previous ACCA investigation reported that the subgrade OMC for the runway ranged from 14% to 16.5%.

The CBR swell for the three samples tested (TP1, TP2, and TP4) ranged from 1% to 9.5%. It is likely that subgrade soil swelling will occur under the pavement, therefore the proposed pavement needs to be of sufficient thickness to minimise the impact. The proposed runway thickness is 1,250 mm which equals the existing runway pavement thickness.

6.2 Design Subgrade

6.2.1 Taxiway A, B and C

The current investigation reported laboratory CBR values of between 4.5% and 13%.

The subgrade falls within the classification of a low strength subgrade (CBR4 to CBR8). Given natural variation of the material a low band CBR of 4% is recommended for pavement analysis and design.

6.2.2 RPT Apron

The ACCA report indicates that the RPT apron subgrade CBR value is 15% while the HWD investigation indicated that the subgrade CBR was in the order of 10%.

To be conservative a design subgrade CBR of 10% was adopted

6.2.3 Runway Extension

The current investigation reported laboratory CBR values of between 3% and 13%. A design CBR of 4% was adopted for the runway pavement design in ACCA (1987) and GHD reports (2014).

A soaked subgrade CBR value of 4% has been adopted for the proposed runway extension areas.

Further investigation of the runway extension areas during detailed design will be required to assure the adopted subgrade CBR value is appropriate.

7. Current Pavement Profiles

7.1 Taxiway A to C

The pavement profile for Taxiways A, B, and C were determined from the trial pit log and a design subgrade CBR was determined from the 10 day soaked subgrade test results detailed in Section 6.2.1.

The trial pit profiles are presented in Appendix B and photos are presented in Appendix E.

Table 7-1 – Summary of Taxiways A, B and C Pavement Profile

Layer	Thickness (mm)	Description
Surfacing	-	Seal
Basecourse/Subbase (Min CBR 80%)	600	Cemented modified base/subbase (blended river gravel)
Sand Layer	100	Sand blanket
Subgrade (Min CBR 4%)	-	-

Total Pavement thickness 700 mm

7.2 RPT Apron

The pavement thickness and design subgrade CBR of the RPT apron was determined from the previous ACCA report and HWD testing as detailed in Section 6.2.2.

The existing pavement thickness of the RPT apron is taken as 750 mm based on the single trial pit recorded in the ACCA report.

Table 7-2 – Summary of RPT Apron Pavement Profile

Layer	Thickness	Description
Surfacing	-	Seal
Basecourse (CBR 80%)	150	Blended river gravel base
Subbase (CBR 50%)	450	Blended river gravel subbase
Fill (Min CBR 15%)	150	River shingle on sand blanket
Subgrade (Min CBR 10%)	-	-

Total pavement thickness 750 mm

8. Apron & Taxiway Analysis & Design

8.1 Design Profile

8.1.1 Design CBR Subgrade

A design subgrade CBR 4% was adopted for Taxiways A to C.

A design subgrade CBR 10% was adopted for the RPT Apron.

8.2 Existing Pavement Condition Assessment

Analysis of the HWD testing data from the RPT Apron and Taxiway A to C was carried out using the Evaluation of Layer Moduli and Overlay Design (ELMOD) 5.0 software.

The data has been used to back calculate the stiffness properties of the pavement layers and to rate the PCN of the existing pavements.

8.2.1 Deflection under load (D_0)

Pavement deflections (D_0) were assessed with regards to the benchmarking criteria for maximum deflection. The benchmark criteria adopted for a contact drop stress of 1415kPa (100kN FWD drop weight) is given in Table 8-1.

Pavement condition is classified as either, *Sound, Warning or Severe*. Typically *Sound* implies the parameter being measured is within the acceptable limits, *Warning* indicates that the parameter is not ideal and some actions may need to be taken in the future to address this and *Severe* suggests that immediate action is required, otherwise rapid deterioration is likely to occur.

Table 8-1 - Benchmark criteria for HWD Maximum Deflection

Structural Condition Rating	Max. Deflection D_0 (um)
Sound	<1250
Warning	1250 to 1875
Severe	>1875

RPT Apron Deflection

In a general sense the RPT pavement appears to be reasonably stiff in terms of deflection with the majority of the deflections recorded in the sound range with deflections less than 1250um.

HWD deflections of up to 2000um were recorded along the edge of the RPT pavement. The high deflections are thought to be due to moisture ingress into the pavement materials and subgrade along the edges, leading to softening and weakening of the material.

Taxiway A, B and C Deflection

The taxiway deflection values are in the sound zone (<1250$_u$m), suggesting that the pavements are stiff and appear to be performing satisfactorily under the current aircraft loading. The pavement is relatively thin and has low deflections for the loading. The low deflections are attributed to the cement modification of the base and subbase which may be at risk of damage due to fatigue cracking if not adequately protected before the increased aircraft load by the B737 and A320 is applied.

The deflection plots for the RPT apron and taxiways A to C are shown in Appendix F.

8.3 Pavement Layer Stiffness

Pavement layer stiffness was determined by back calculation for the individual deflection bowls at each drop point using ELMOD software and the design profile in Table 7-1 for Taxiway A, B and C and Table 7-2 for the RPT Apron.

Through an iterative process the software determines the moduli for the defined layers so that the measured in-field deflection bowl matches the calculated bowl. The moduli that achieved the best fit are then used to model the pavement at that point. The back calculated moduli were found to be high for all pavements.

Taxiway A, B and C Pavement

The adopted pavement moduli values for Taxiways A, B and C are shown in Table 8-2.

Table 8-2 - Summary of Back Calculated Moduli from HWD Analysis for Taxiways

Layers	Taxiway	Adopted Value (MPa)
Base	A	500
Subgrade		60
Base	B	500
Subgrade		60
Base	C	500
Subgrade		60

The results of the HWD back analysis typically gave higher moduli for each layer than those adopted. A modulus of 500 MPa is recommended for the cement modified base as it is likely to fatigue crack and deteriorate quite rapidly under the action of the increased loading and revert back to a cracked phase or granular layer. The modulus of the subgrade is assumed to be 60 MPa and this correlates with the soaked CBR.

The design moduli were used in the Airport Pavement Design System (APSDS) analysis for the pavement strengthening design.

Additional evaluation of the cement modified sections of the taxiways is recommended to determine the strength and quality of the material.

RPT Apron Pavement

The adopted pavement moduli values for the RPT apron are shown in Table 8-3.

Table 8-3 - Back Calculated Moduli from HWD Analysis for the RPT apron

Layers	Apron	Adopted Value (MPa)
Base	RPT	300
Subbase		250
Select fill		150
Subgrade		100

The following moduli are recommended for further pavement design; base course (300 MPa), subbase (250 MPa), select fill (150 MPa) and 100 MPa for the subgrade. The design moduli were used in the Airport Pavement Design System (APSDS) analysis for the pavement strengthening design.

During detailed design mitigation strategies to minimise the impact of water ingress on the apron shoulders, such as improving drainage or extending the seal, should be investigated.

8.4 Pavement Overlay Thickness Design

The structural capacities of the existing pavements were assessed using APSDS 5.0, mechanistic pavement design software specifically designed for aircraft pavement design and COMFAA 3.0, a Federal Aviation Administration software recommended to determine the airport runway, taxiway and apron pavement thickness.

A sensitivity analysis of the subgrade strength was undertaken to determine the range of pavement thicknesses that may be required on the project.

This analysis was undertaken due to the uncertainty of the subgrade CBR for the taxiways and RPT apron.

8.4.1 COMFAA Analysis

COMFAA was used to check the existing aircraft pavement thicknesses against the assumed CBR values. There is good correlation between the current pavement design and the analyses.

Taxiway Pavement

The existing Taxiways A, B and C are performing well for the current design aircraft (F100). Back calculation from COMFAA shows that the existing 600 mm pavement requires subgrade CBR of 6% for an F100 aircraft load. Therefore further analysis was carried out using COMFAA on the required pavement thickness for various subgrade CBRs for both the existing aircraft (F100) and future aircraft (B737-800). The results of this analysis are shown in Table 8-4. The details of the COMFAA analysis are shown in Appendix G to this report.

Table 8-4 –Pavement Thickness for various CBR values for Design Aircraft

Design Aircrafts	CBR4	CBR6	CBR10	CBR15
F100	780	610	430	330
B737-800	1020	790	560	430

RPT Apron

A 780 mm pavement is required to meet the existing F100 loading on a CBR4 subgrade. The ACCA report indicates that the existing thickness of the RPT apron meets this requirement.

More analysis on pavement thickness and the subgrade CBR value for F100 and B737-800 (assuming 1000 annual average passes) design aircraft was carried out using COMFAA and the results are presented in Appendix G to this report.

8.4.2 Pavement strengthening analysis

APSDS was used to determine the pavement strengthening requirements for Taxiways A to C and the RPT apron to enable the pavements to accommodate the increased traffic loading. The pavement profiles as described in Table 7-1 and Table 7-2 and the aircraft loading scenarios as described in Table 5-3 were used to model the pavement thickness requirements.

RPT Apron

The pavement thickness requirements for all three scenarios suggest that a 40 mm asphalt overlay is required to enable the apron to carry the additional aircraft loading.

The proposed pavement thickness for the three traffic scenarios is summarised in Table 8-5.

Table 8-5 - RPT Apron proposed/new works pavement strengthening

	Layer	Existing Thickness (mm)	Proposed Scenario 1 (mm)	Proposed Scenario 2 (mm)	Proposed Scenario 3 (mm)
New works	Asphalt	-	40	40	40
Existing	Spray seal	-	-	-	-
	Basecourse (CBR 80%)	150	150	150	150
	Subbase (CBR 50%)	150	450	450	450
	Select Fill (CBR 15%)	450	150	150	150
	Subgrade (CBR 10%)	-	-		-
Total Thickness		750	790	790	790

Typically taxiway and aprons receive 40 mm nominal thickness overlay, however for estimating purposes it is recommended that a 60 mm asphalt overlay is allowed, the additional 20 mm should be allowed to accommodate shape, level and fall corrections.

It should be noted that further investigation is required of the pavement and subgrade of the RPT apron to confirm the assumed properties for the pavement and subgrade materials are consistent over the entire apron. This work should be carried out as part of the detailed design phase of the project.

The APSDS calculations are shown in Appendix H.

Taxiways A, B and C

The existing pavement thickness of Taxiways A, B and C is assumed to consist of:

- Multiple chip seal;
- 600 mm cement modified basecourse;
- 100 mm select fill;
- Subgrade CBR 4%.

Taxiways A and C

The analysis based on the three traffic loading scenarios indicates that Taxiways A and C require thickening with 230 mm to 260 mm of cement modified base and a 60 mm asphalt surfacing with a waterproofing seal.

It is recommended that the 260 mm cement modified base is selected and the material placed in two separate layers. The results of APSDS analysis are shown in Appendix G to this report.

Taxiway B

The traffic loading on Taxiway B is lighter than Taxiways A and C. As a consequence the design pavement thickness is less. Whilst in theory there are some potential savings in a reduced pavement thickness, it does create problems with level tie in and potentially understrength pavements if the aircraft movements change. It is recommended that the pavement thickness for Taxiway B is built to the same standard as the other two taxiways.

The summary of the taxiways pavement strengthening for the three future traffic Scenarios are shown in Table 8-6 and Table 8-7.

Table 8-6 – Taxiways A and C proposed/new works pavement strengthening

	Layer	Existing Thickness (mm)	Proposed Scenario 1 (mm)	Proposed Scenario 2 (mm)	Proposed Scenario 3 (mm)
New works	Asphalt	-	60	60	60
	Spray seal	-	-	-	-
	Cement modified base	-	230	250	260
Existing	Cement modified base	600	600	600	600
	Sand Layer	100	100	100	100
	Subgrade (CBR 4%)	-	-	-	-
Total Thickness		700	990	1010	1020

Table 8-7 – Taxiway B proposed pavement strengthening

	Layer	Existing Thickness (mm)	Proposed Scenario 1 (mm)	Proposed Scenario 2 (mm)	Proposed Scenario 3 (mm)
New works	Asphalt	-	60	60	60
	Spray seal	-	-	-	-
	Cement modified base	-	120	140	150
Existing	Cement modified base	600	600	600	600
	Sand Layer	100	100	100	100
	Subgrade (CBR 4%)	-	-	-	-
Total Thickness		700	880	900	940
Recommended construction thickness		-	990	1010	1020

Recommendation

It is recommended that taxiway A to C pavements are constructed to a total thickness of 1020 mm.

8.5 Taxiway A to C and RPT Apron PCN

The methodology published in CASA Advisory Circular AC 139-25 (0), using COMFAA software, was followed to rate the strength of the RPT apron and the taxiway pavements. The results of COMFAA analysis are included in Appendix H to this report. According to AC 139-25(0), each aerodrome pavement needs to be evaluated individually to determine its rating based on the pavement design, construction, type and frequency of traffic and present condition.

The runway structural strength classification is currently published in En Route Supplement Australia (ERSA) as:

PCN 40 / F / C / 1200 (174PSI) / T.

The current Runway 12/30 pavement configuration including the recent asphalt overlay can be rated as follows.

PCN 51 / F / C / 1410 (205PSI) / T.

The results of COMFAA and ELMOD analysis of the taxiway pavements indicate the existing pavements (600 mm pavement thickness and CBR value of 4%) have a PCN value less than the ACN. Under normal conditions an aircraft can only use the airport pavement if its ACN is equal to or less than the PCN.

Since the pavement is performing well under traffic from the current design aircraft (F100) we believe the subgrade CBR could be higher than 4% (around 6-7%).

The PCN rating for Taxiways A, B and C was based on a total pavement thickness of 600 mm and design subgrade CBR of 4%. In accordance with MOS Part 139 (version 1 12 Nov 2014) when the subgrade CBR is in the range of 4% ≤ CBR ≤ 8% the subgrade strength is categorised as LOW STRENGTH. Based on this a Code Designation of C for flexible pavements was used for the taxiway pavements strength rating.

The PCN rating for the RPT Apron was based on a total pavement thickness of 750 mm and a design subgrade CBR of 10%. In accordance with MOS Part 139 the subgrade CBR is categorised as MEDIUM STRENGTH. Based on this a Code Designation of B for flexible pavements was used for the RPT apron pavement strength rating.

The existing ACN-PCN rating is provided in Appendix H and the PCN rating of each pavement for various subgrade CBR values are given in Table 8-8.

Further investigation of the existing pavement is required during detailed design to confirm the subgrade CBR to verify the PCN rating.

Table 8-8 –PCN rating of Taxiways A, B and C and RPT Apron for F100 Design Aircraft (COMFAA) for varying design CBR

Pavement Section	Design CBR (%)	Pavement Thickness (mm)	Pavement Classification Number (PCN) F100 Design Aircraft
Taxiways A, B and C	4	600	16 / F /C / 980 (142 PSI)
	6	600	27 / F /C / 980 (142 PSI)
	7	600	33 / F /C / 980 (142 PSI)
RPT Apron	4	750	26 / F /C / 980 (142 PSI)
	6	750	42/ F /C / 980 (142 PSI)
	10	750	75 / F /B / 1410 (205 PSI)

9. Runway Extension Pavement

9.1 Design Profile

9.1.1 Design CBR Subgrade

A design subgrade CBR 4% was adopted for the runway extension.

9.1.2 Pavement Design

The analysis for the three traffic scenarios shows that the maximum pavement thickness required for Code 4C runway is 1,260 mm. The proposed pavement layer configuration is summarised below in Table 9-1 and closely replicates the existing pavement. The current runway received a grooved 60 mm overlay to improve structural strength and a durable surfacing. The surfacing is expected to last 10 to 15 years under current and expected loading, before milling and a new overlay is required.

A cement stabilised subbase layer has been included as it should provide excellent support to the fine crushed rock base and help reduce the risk of rutting under the heavier aircraft.

This pavement satisfies the PCN rating of 51 for future design aircraft and the select fill will reduce the effect of the poor subgrade on the pavement performance.

Table 9-1 – Proposed Runway Extension Pavement Profile

Thickness	Proposed Pavement layer profile(mm)
60 mm	14 mm continuously graded polymer modified asphalt, grooved
10 mm + 5 mm	Water proofing chip seal on prime
150 mm	High quality fine crushed rock base
250 mm	Cement modified subbase
700 mm	River shingle or select granular fill
100 mm	Sand
Insitu	Subgrade CBR 4%

10. Conclusions

10.1 Existing Pavements

The pavement surfacing on Taxiway C and the RPT apron comprises a chip seal similar to that observed on Taxiway A. Taxiway C pavement surfacing is in better condition than that observed on either Taxiways A and B with minimal signs of flushing. The central 15 m of Taxiways A, B and C were cemented modified in 2010 to a depth 600 mm.

The RPT apron is flushed along the wheel paths with some signs of movement in the seal at major turning points. It was noted that there were no obvious signs of a fuel resistant treatment on the apron at the time of the inspection. The application of the 60 mm asphalt overlay on the flush seal followed by a fuel resistant treatment should address the flushing.

The trial pit investigation of the taxiway pavements (outer edge of the double line) revealed a deep granular pavement comprising multiple spray seals, granular pavement overlying a medium to high plastic sandy clay subgrade with expansive properties.

Based on the laboratory testing results and back calculation moduli calculations, design subgrade CBR values of 4% were adopted for the runway extension and taxiways and 10% for the RPT apron.

The HWD survey indicated that the existing Taxiway A to C and RPT apron pavements are quite stiff and performing well. The maximum deflection (D0) (except the edge of the RPT apron pavement) was in the sound zone and the existing pavements appear to have sufficient strength for the current aircraft types.

10.2 Pavement strengthening

Three traffic scenarios were considered for the future design aircraft traffic. The pavement analysis indicated that there is a small difference in the required pavement thickness for the three scenarios and the thickest pavement have been adopted for the business case study and Prefeasibility Study preliminary design.

10.2.1 RPT Apron Pavement

The RPT apron pavement appears to have adequate pavement structure and a 60 mm asphalt overlay is recommended.

Mitigation strategies to limit the impact of water ingress on the shoulders should be investigated during detailed design.

10.2.2 Taxiway A, B and C Pavement

The predicted traffic on the taxiways varies due to environmental constraints. For ease of construction and planning it is proposed that a single pavement design thickness is adopted for all of the pavements. It is recommended that 260 mm of cement modified base is placed on the existing pavement followed by a prime, waterproofing seal and a 60 mm asphalt surfacing.

10.3 Current Runway

The current runway pavement is performing adequately under the current loading and was recently overlayed with 60 mm of asphalt and grooved as part of the pavement strengthening program. The existing runway has performed well over the years with minimal maintenance required. It has exhibited some rutting which was attended to during the asphalt overlay project.

The overlay should have a life expectancy of 10 to 15 years, after which it will require the grooved surface of the asphalt to be milled off, defects (if any, repaired) and a new overlay applied, followed by grooving.

10.4 Runway Extension

The runway extension pavement proposed is similar to the existing pavement, except for the provision of a cement modified subbase to ensure that it is more rut resistant. The runway extension pavement preliminary design is detailed in Table 10-1.

Table 10-1 - Preliminary Runway Extension Pavement Design

Thickness	Proposed Pavement layer profile (mm)
60 mm	14 mm continuously graded polymer modified asphalt, grooved
10 mm + 5 mm	Water proofing chip seal on prime
150 mm	High quality fine crushed rock base
250 mm	Cement modified subbase
700 mm	River shingle or select granular fill
100 mm	Sand
Insitu	Subgrade CBR 4%

10.5 Recommendations

The current level of investigation was conducted according to the Shire brief and is considered adequate for the preliminary planning stage and the preparation of costings for funding. It is recommended that during detailed design of the works, a geotechnical and borrow pit investigation is planned and initiated to better understand:

- The runway extension subgrade strength;
- The pavement configuration in the taxiways and RPT apron;
- The potential borrow sources for general fill, selected subgrade, subbase and fine crushed rock base.

The investigation should include:

- The excavation of further, closely spaced trial pits along the runway extension centreline;
- Coring of the taxiway and RPT apron pavements;
- Location and testing of potential on and off site borrow pits for fill and subgrade;
- Location of commercial sources of subbase and base;
- Preliminary stabilisation design of potential subbase / base sources.

The investigation is likely to take up to two months to complete, including fieldwork, routine laboratory testing and taking into account curing time of up to 28 days is required for cement stabilisation design laboratory testing.

11. References

1. Standards Australia , AS 1726, Geotechnical site investigations 1993
2. Shire of Wyndham East Kimberley , Kununurra Airport, Pavement Testing Engineering Report, Airport Consulting and Construction Australia Pty Ltd (ACCA) , April 1987
3. Austroads Guide To Pavement Technology Part 4: Pavement Materials (2007)
4. East Kimberley Regional Airport Master Plan for Shire of Wyndham East Kimberley, Rehbein Airport Consulting, January 2013
5. Shire of Wyndham East Kimberley, East Kimberley Regional Airport, Runway 12/30 Pavement Strength Evaluation Report, Final Report, GHD , February 2014

Appendices

Appendix A – Locality and Site plan

Locality Plan

Site Plan

Appendix B – Trial Pit Profiles

Pavement Trial Pit Profiles

Test ID	Depth range	Layer	Description
Taxiway A (TA)	0 – 50mm	Surfacing	• Surfacing comprises multiple layers of sprayed seals. • Lower seal comprises river gravels up to 20mm. • Upper seal appears to be a reseal and comprises a 10/7 double seal with sand seal.
	50mm – 650mm	Basecourse / Sub-Base	• Basecourse / Sub-base pavement layers comprise red brown, non plastic river sand / gravel blend with no signs of crushed particles; • Upper portion is generally finer gravels with larger cobbles up to 150mm concentrated in the lower sub-base layer.
	650mm – 750mm	Select Sand / Filter Layer	• Select layer comprises brown, non plastic, medium to coarse grained river sand
	750mm – 900mm	Subgrade	• Red brown sandy silt/clay, medium to high plasticity, firm to stiff consistency.
Taxiway B (TB)	0 – 50mm	Surfacing	• Surfacing comprises multiple layers of sprayed seals. • Lower seal comprises river gravels up to 20mm. • Upper seal comprises a 10/7 double seal with sand seal.
	50mm – 450mm	Basecourse / Sub-Base	• Basecourse / Sub-base pavement layers comprise red brown, non plastic river sand / gravel blend with no signs of crushed particles; • Upper portion is generally finer gravels with larger cobbles up to 150mm concentrated in the lower sub-base layer.
	450mm – 650mm	Select Sand / Filter Layer	• Select layer comprises brown, non plastic, medium to coarse grained river sand
	650mm – 900mm	Subgrade	• Red brown sandy silt/clay, medium to high plasticity, firm to stiff consistency.
Taxiway C (TC)	0 – 40mm	Surfacing	• Surfacing comprises multiple layers of sprayed seals. • Lower seal comprises river gravels up to 20mm. • Upper seal appears to be a reseal and comprises a 10/7 double seal with sand seal.
	40mm – 290mm	Basecourse	• Basecourse is manufactured and comprises a brown blend of non plastic, fine to medium

Test ID	Depth range	Layer	Description
			grained river sand and fine to medium (<19mm) angular gravel.
	290mm – 540mm	Sub-Base	• Highly cemented natural river gravel and sand blend with an anticipated UCS value in excess of 5 MPa
	540mm – 900mm	Subgrade	• Red brown sandy silt/clay, medium to high plasticity, firm to stiff consistency.

Proposed Runway Extension Profiles

Test ID	Depth range	Layer	Description
TP1 (Eastern extension)	0 – 150 mm	Topsoil	• Topsoil comprises brown, gravelly silt/clay with roots, high plasticity, gravels are medium to coarse, sub-rounded to rounded. Density is loose.
	150mm – 400mm	Subgrade	• Red brown, gravelly clay/silt, high plasticity, gravels are medium to coarse, rounded with cobbles to 150mm. Density is loose to medium
	400mm – 1200mm	Subgrade	• Brown sandy silt/clay, high plasticity, sand is fine to medium grained. Density is medium becoming dense with depth.
TP2 (Western extension)	0 – 100mm	Topsoil	• Dark brown to black silty clay, high plasticity, with roots. Consitency is soft.
	100mm – 1100mm	Kununurra Black Clay	• Dark brown to black, silty clay, high plasticity with deep fissures throughout. Consistency is soft.
TP3 (Western extension)	0 – 100mm	Topsoil	• Dark brown to black silty clay, high plasticity, with roots. Consistency is soft.
	100mm – 1100mm	Kununurra Black Clay	• Dark brown to black, silty clay, high plasticity with deep fissures throughout. Consistency is soft, Signs of increasing moisture with depth (as the locations approach the

Test ID	Depth range	Layer	Description
			creek)
TP4 (Western extension)	0 – 100mm	Topsoil	• Dark brown to black silty clay, high plasticity, with roots. Consistency is soft.
	100mm – 1100mm	Kununurra Black Clay	• Dark brown to black, silty clay, high plasticity with deep fissures throughout. Consistency is soft, Signs of increasing moisture with depth (as the locations approach the creek).

Appendix C – Laboratory Certificates

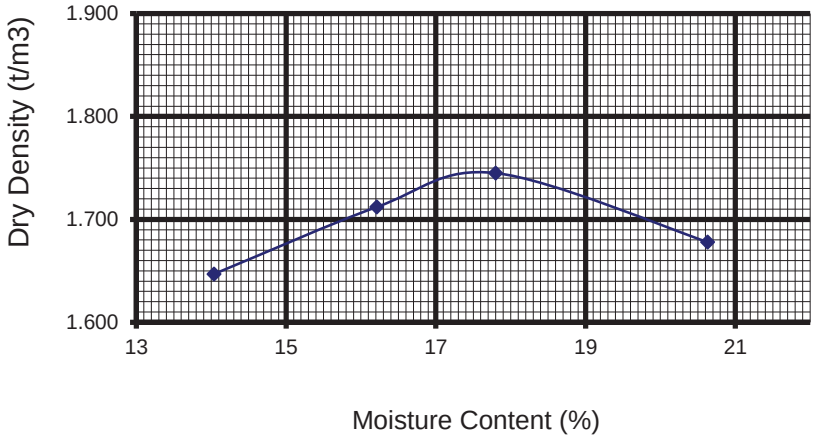
Mining & Civil
Geotest Pty Ltd
Unit 1/1 Pusey Road, JANDAKOT WA 6164
Ph (08) 9414 8022
Fax (08)9414 8011
Email matt@mcgeotest.com.au

Modified Maximum Dry Density (AS 1289.5.2.1) & California Bearing Ratio (AS 1289.6.1.1) Test Report

Certificate No:	60054-P15/5948	**Client:**	GHD Pty Ltd (61/32392)
Sample No:	P15/5948	**Location:**	Kununurra
Project:	Kununurra Airport Runway Extension	**Date of issue:**	7 September 2015
Sample :	Test Pit 4, 0.3 - 0.5 (Subgrade)	**Job No:**	60054

Maximum Dry Density t/m^3:	1.745	**Conditions at Test**	
Optimum Moisture Content %:	17.8	Soaking Period (Days)	10
Desired Conditions: %MDD / %OMC	95/100	Surcharge (kg)	11.25
Compactive Effort		Entire Moisture Content %	24.8
Mass of hammer kg	4.9	Entire Moisture Ratio %	139.5
Number of layers	5	Top 30mm Moisture Content %	31.6
Number of blows/layer	20	Top 30mm Moisture Ratio %	177.5
Conditions after Compaction		Swell %	4.0
Dry Density t/m^3	1.661	C.B.R. at 2.5 mm Penetration %	6
Moisture Content %	17.6	**Conditions after Soaking**	
Density Ratio %	95.0	Dry Density t/m^3	1.595
Moisture Ratio %	98.5	Moisture Content %	24.4
Soaked / Unsoaked	Soaked	Dry Density Ratio %	91.5
		Moisture Ratio %	137.5

Comments: Tested as received



Client Address: GHD House, Adelaide Tce Perth

ASMDD-CBR May 2009

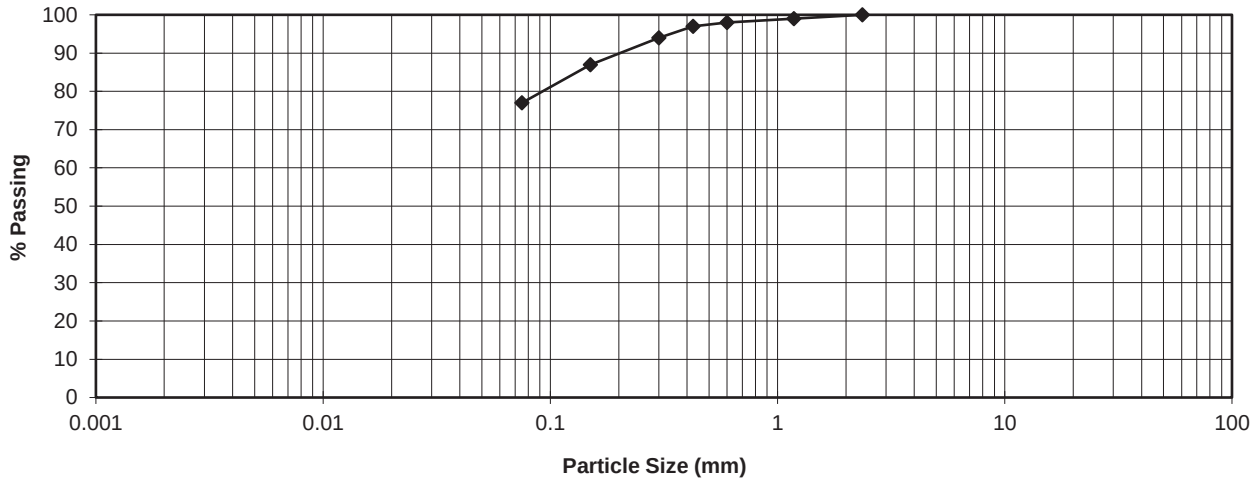
Approved Signature Matthew van Herk

Particle Size Distribution & Plasticity Index tests

Mining & Civil
Geotest Pty Ltd
unit1/1 Pusey Road, Jandakot, WA 6164
Ph (08) 9414 8022 Fax (08) 9414 8011
Email: matt@mcgeotest.com.au

Job No:	60054
Report No:	60054-P15/5948
Sample No:	P15/5948
Issue Date:	3 September 2015

Client:	GHD Pty Ltd 61/32392	Borehole/Test Pit:	Test Pit 4
Project:	Kununurra Airport Runway Extension	Names/Codes:	0.3 - 0.5m (Subgrade)
Location:	Kununurra	Type of Material:	CH



SIEVE ANALYSIS AS 1289.3.6.1

Sieve Size (mm)	% Passing
75.0	
37.5	
19.0	
9.5	
4.75	
2.36	100
1.18	99
0.600	98
0.425	97
0.300	94
0.150	87
0.075	77

Plasticity index tests
AS 1289

Liquid limit 3.1.1	60	%
Plastic limit 3.2.1	17	%
Plasticity index 3.3.1	43	%
Linear shrinkage 3.4.1	19.0	%
Cracked	☑	
Curled	☑	

Client Address: GHD House, Adelaide Terrace, Perth

Sampling Procedure: Tested as received

NATA WORLD RECOGNISED ACCREDITATION

Approved signature

Matthew van Herk

AS PSDPI May 2009

Mining & Civil
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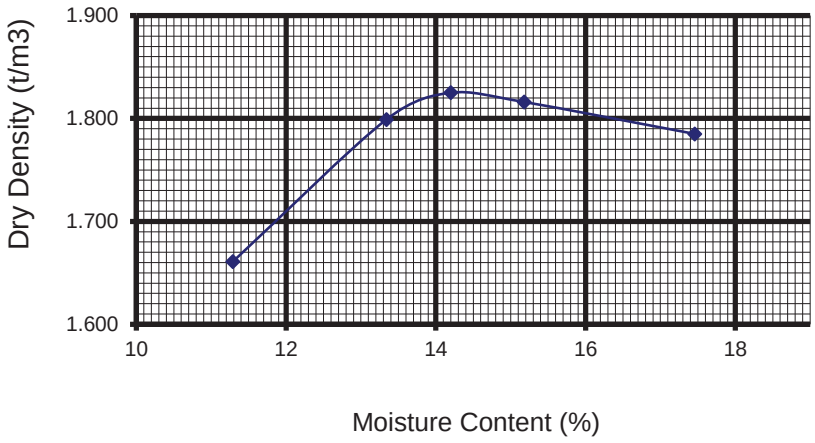
Modified Maximum Dry Density (AS 1289.5.2.1) & California Bearing Ratio (AS 1289.6.1.1) Test Report

Certificate No:	60054-P15/5947	**Client:**	GHD Pty Ltd (61/32392)
Sample No:	P15/5947	**Location:**	Kununurra
Project:	Kununurra Airport Runway Extension	**Date of issue:**	7 September 2015
Sample :	Test Pit 2, 0.4 - 0.6 (Subgrade)	**Job No:**	60054

Maximum Dry Density t/m^3:	1.825	**Conditions at Test**	
Optimum Moisture Content %:	14.2	Soaking Period (Days)	10
Desired Conditions: %MDD / %OMC	95/100	Surcharge (kg)	11.25
Compactive Effort		Entire Moisture Content %	25.7
Mass of hammer kg	4.9	Entire Moisture Ratio %	181.0
Number of layers	5	Top 30mm Moisture Content %	32.7
Number of blows/layer	20	Top 30mm Moisture Ratio %	230.0
Conditions after Compaction		Swell %	9.5
Dry Density t/m^3	1.737	C.B.R. at 2.5 mm Penetration %	3.0
Moisture Content %	14.2	**Conditions after Soaking**	
Density Ratio %	95.0	Dry Density t/m^3	1.589
Moisture Ratio %	100.0	Moisture Content %	25.8
Soaked / Unsoaked	Soaked	Dry Density Ratio %	87.0
		Moisture Ratio %	182.0

Comments: Tested as received



Client Address: GHD House, Adelaide Tce Perth

ASMDD-CBR May 2009

Approved Signature Matthew van Herk

Particle Size Distribution & Plasticity Index tests

Mining & Civil
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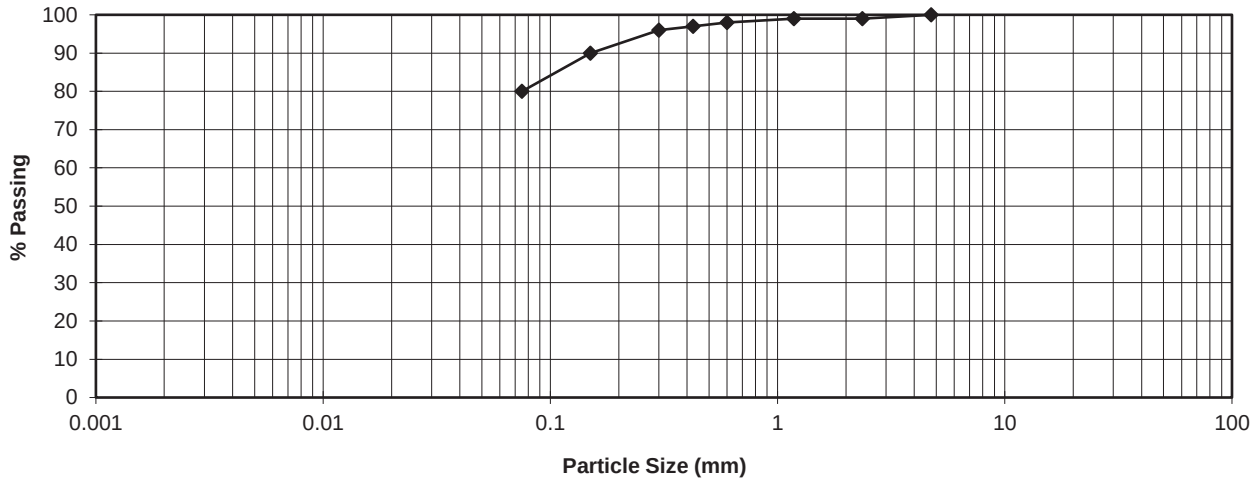
Job No:	60054
Report No:	60054-P15/5947
Sample No:	P15/5947
Issue Date:	3 September 2015

Client:	GHD Pty Ltd 61/32392	Borehole/Test Pit:	Test Pit 2
Project:	Kununurra Airport Runway Extension	Names/Codes:	0.4 - 0.6m (Subgrade)
Location:	Kununurra	Type of Material:	CH



SIEVE ANALYSIS AS 1289.3.6.1

Sieve Size (mm)	% Passing
75.0	
37.5	
19.0	
9.5	
4.75	100
2.36	99
1.18	99
0.600	98
0.425	97
0.300	96
0.150	90
0.075	80

Plasticity index tests
AS 1289

Liquid limit 3.1.1	59	%
Plastic limit 3.2.1	17	%
Plasticity index 3.3.1	42	%
Linear shrinkage 3.4.1	13.5	%
Cracked	☑	
Curled	☑	

Client Address: GHD House, Adelaide Terrace, Perth

Sampling Procedure: Tested as received

NATA WORLD RECOGNISED ACCREDITATION

Approved signature

Matthew van Herk
AS PSDPI May 2009

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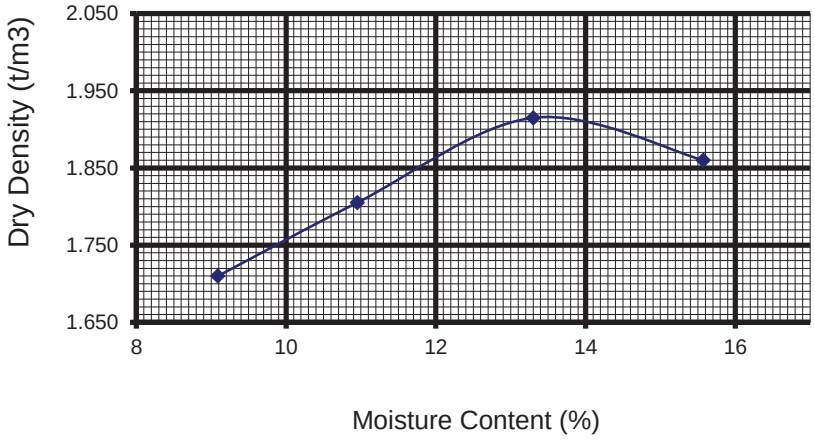
Modified Maximum Dry Density (AS 1289.5.2.1) & California Bearing Ratio (AS 1289.6.1.1) Test Report

Certificate No:	60054-P15/5946	**Client:**	GHD Pty Ltd (61/32392)
Sample No:	P15/5946	**Location:**	Kununurra
Project:	Kununurra Airport Runway Extension	**Date of issue:**	7 September 2015
Sample :	Test Pit 1, 0.4 - 0.6 (Subgrade)	**Job No:**	60054

Maximum Dry Density t/m^3:	1.915	**Conditions at Test**	
Optimum Moisture Content %:	13.3	Soaking Period (Days)	10
Desired Conditions: %MDD / %OMC	95/100	Surcharge (kg)	11.25
Compactive Effort		Entire Moisture Content %	17.7
Mass of hammer kg	4.9	Entire Moisture Ratio %	133.5
Number of layers	5	Top 30mm Moisture Content %	19.9
Number of blows/layer	18	Top 30mm Moisture Ratio %	150.0
Conditions after Compaction		Swell %	1.0
Dry Density t/m^3	1.818	C.B.R. at 2.5 mm Penetration %	13
Moisture Content %	13.7	**Conditions after Soaking**	
Density Ratio %	95.0	Dry Density t/m^3	1.799
Moisture Ratio %	103.0	Moisture Content %	18.4
Soaked / Unsoaked	Soaked	Dry Density Ratio %	94.0
		Moisture Ratio %	138.5

Comments: Tested as received



Client Address: GHD House, Adelaide Tce Perth

ASMDD-CBR May 2009

Approved Signature Matthew van Herk

Particle Size Distribution & Plasticity Index tests

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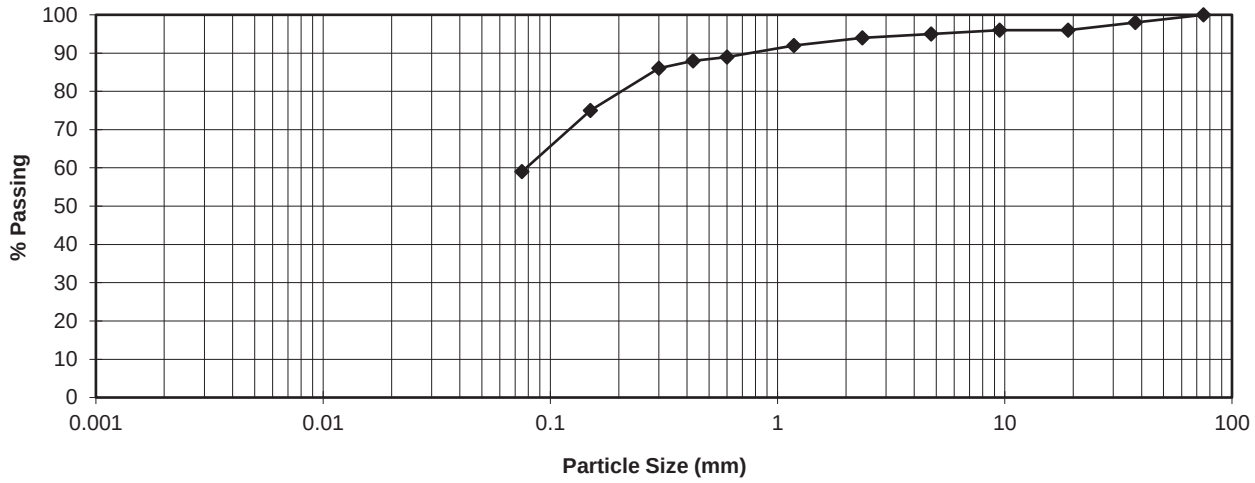
Job No:	60054
Report No:	60054-P15/5946
Sample No:	P15/5946
Issue Date:	3 September 2015

Client:	GHD Pty Ltd 61/32392	Borehole/Test Pit:	Test Pit 1
Project:	Kununurra Airport Runway Extension	Names/Codes:	0.4 - 0.6m (Subgrade)
Location:	Kununurra	Type of Material:	CL-ML



SIEVE ANALYSIS AS 1289.3.6.1

Sieve Size (mm)	% Passing
75.0	100
37.5	98
19.0	96
9.5	96
4.75	95
2.36	94
1.18	92
0.600	89
0.425	88
0.300	86
0.150	75
0.075	59

Plasticity index tests
AS 1289

Liquid limit 3.1.1	37	%
Plastic limit 3.2.1	13	%
Plasticity index 3.3.1	24	%
Linear shrinkage 3.4.1	10.5	%
Cracked	☐	
Curled	☑	

Client Address: GHD House, Adelaide Terrace, Perth

Sampling Procedure: Tested as received

NATA WORLD RECOGNISED ACCREDITATION

Approved signature

Matthew van Herk
AS PSDPI May 2009

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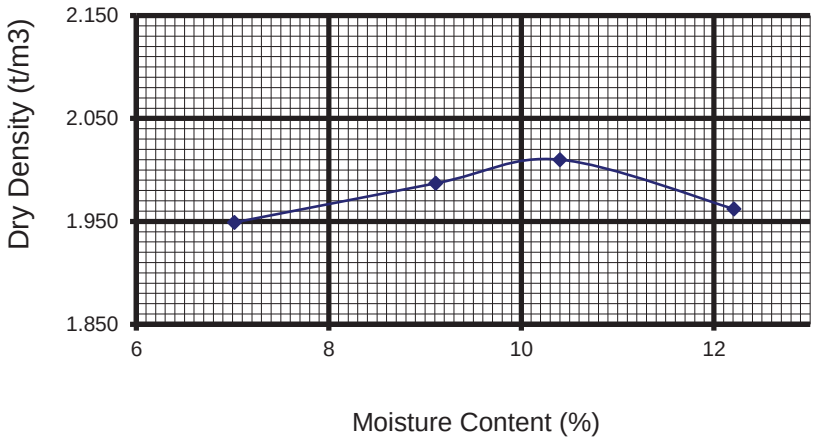
Modified Maximum Dry Density (AS 1289.5.2.1) & California Bearing Ratio (AS 1289.6.1.1) Test Report

Certificate No:	60054-P15/5945	**Client:**	GHD Pty Ltd (61/32392)
Sample No:	P15/5945	**Location:**	Kununurra
Project:	Kununurra Airport Runway Extension	**Date of issue:**	7 September 2015
Sample :	Test Pit C, TC-SG (Subgrade)	**Job No:**	60054

Maximum Dry Density t/m^3:	2.010	**Conditions at Test**	
Optimum Moisture Content %:	10.4	Soaking Period (Days)	10
Desired Conditions: %MDD / %OMC	95/100	Surcharge (kg)	11.25
Compactive Effort		Entire Moisture Content %	14.7
Mass of hammer kg	4.9	Entire Moisture Ratio %	141.5
Number of layers	5	Top 30mm Moisture Content %	16.4
Number of blows/layer	22	Top 30mm Moisture Ratio %	158.0
Conditions after Compaction		Swell %	1.5
Dry Density t/m^3	1.914	C.B.R. at 2.5 mm Penetration %	12
Moisture Content %	10.3	**Conditions after Soaking**	
Density Ratio %	100.0	Dry Density t/m^3	1.885
Moisture Ratio %	99.0	Moisture Content %	15.1
Soaked / Unsoaked	Soaked	Dry Density Ratio %	94.0
		Moisture Ratio %	145.5

Comments: Tested as received



Client Address: GHD House, Adelaide Tce Perth

ASMDD-CBR May 2009

Approved Signature Matthew van Herk

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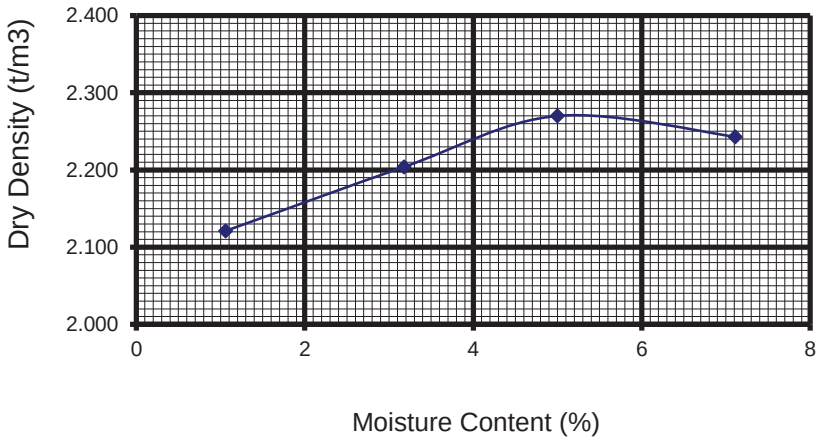
Modified Maximum Dry Density (AS 1289.5.2.1) & California Bearing Ratio (AS 1289.6.1.1) Test Report

Certificate No:	60054-P15/5944	**Client:**	GHD Pty Ltd (61/32392)
Sample No:	P15/5944	**Location:**	Kununurra
Project:	Kununurra Airport Runway Extension	**Date of issue:**	3 September 2015
Sample :	Test Pit C, TC-PV	**Job No:**	60054

Maximum Dry Density t/m^3:	2.270	**Conditions at Test**	
Optimum Moisture Content %:	5.0	Soaking Period (Days)	4
Desired Conditions: %MDD / %OMC	100/100	Surcharge (kg)	4.5
Compactive Effort		Entire Moisture Content %	5.8
Mass of hammer kg	4.9	Entire Moisture Ratio %	115.5
Number of layers	5	Top 30mm Moisture Content %	5.9
Number of blows/layer	30	Top 30mm Moisture Ratio %	119.0
Conditions after Compaction		Swell %	0.0
Dry Density t/m^3	2.275	C.B.R. at 5.0 mm Penetration %	200
Moisture Content %	4.8	**Conditions after Soaking**	
Density Ratio %	100.0	Dry Density t/m^3	2.275
Moisture Ratio %	96.0	Moisture Content %	6.1
Soaked / Unsoaked	Soaked	Dry Density Ratio %	100.0
		Moisture Ratio %	122.5

Comments: Tested as received



Client Address: GHD House, Adelaide Tce Perth

ASMDD-CBR May 2009

Approved Signature Matthew van Herk

Particle Size Distribution & Plasticity Index tests

Mining & Civil
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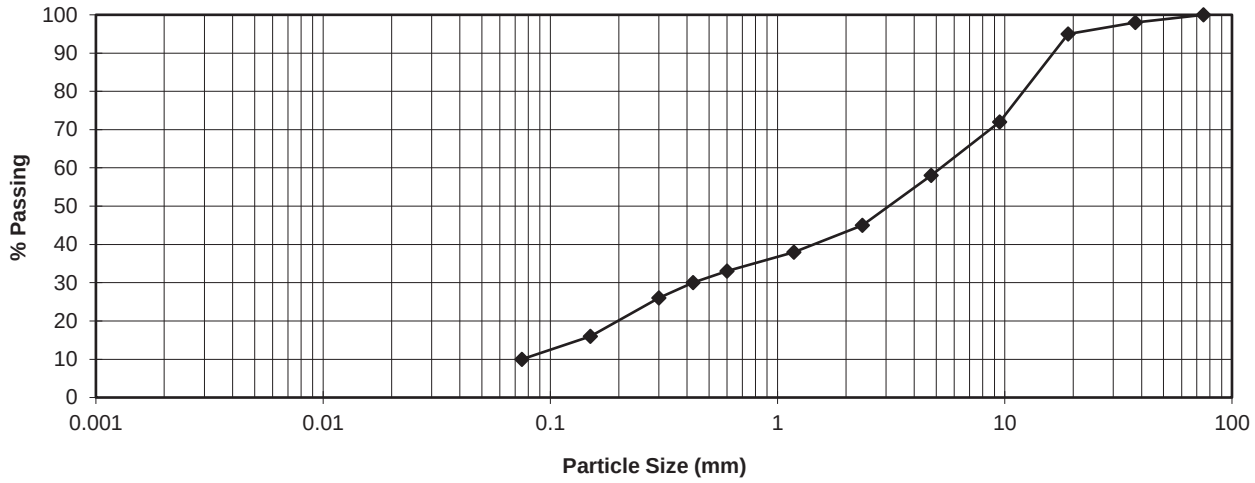
Email: matt@mcgeotest.com.au

Job No:	60054
Report No:	60054-P15/5944
Sample No:	P15/5944
Issue Date:	3 September 2015

Client:	GHD Pty Ltd 61/32392	Borehole/Test Pit:	Test Pit C
Project:	Kununurra Airport Runway Extension	Names/Codes:	TC-PV
Location:	Kununurra	Type of Material:	GW-GP



SIEVE ANALYSIS AS 1289.3.6.1

Sieve Size (mm)	% Passing
75.0	100
37.5	98
19.0	95
9.5	72
4.75	58
2.36	45
1.18	38
0.600	33
0.425	30
0.300	26
0.150	16
0.075	10

Plasticity index tests
AS 1289

Liquid limit 3.1.1	SIC	%
Plastic limit 3.2.1	NP	%
Plasticity index 3.3.1	NP	%
Linear shrinkage 3.4.1	*0.0	%

Cracked ☐

Curled ☐

SIC = Slipped in cup
NP = Non plastic
***Non standard test as liquid limit was not determined.**

Client Address: GHD House, Adelaide Terrace, Perth

Sampling Procedure: Tested as received

Approved signature

Matthew van Herk

AS PSDPI May 2009

Mining & Civil
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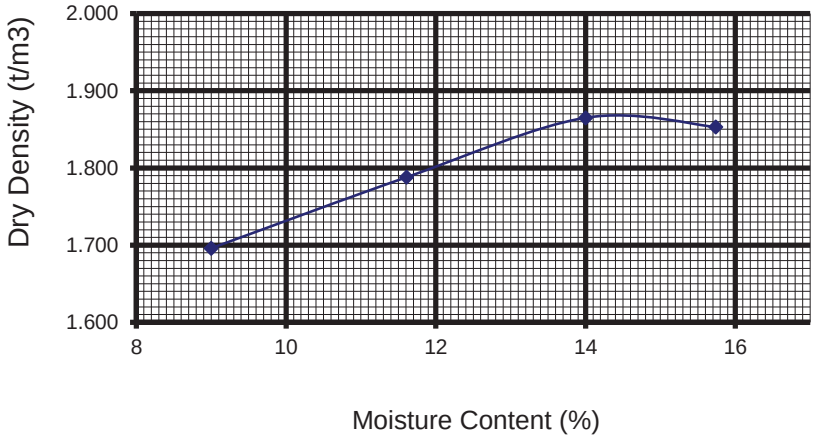
Modified Maximum Dry Density (AS 1289.5.2.1) & California Bearing Ratio (AS 1289.6.1.1) Test Report

Certificate No:	60054-P15/5943	**Client:**	GHD Pty Ltd (61/32392)
Sample No:	P15/5943	**Location:**	Kununurra
Project:	Kununurra Airport Runway Extension	**Date of issue:**	7 September 2015
Sample :	Test Pit B, TB-SG (Subgrade)	**Job No:**	60054

Maximum Dry Density t/m^3:	1.865	**Conditions at Test**	
Optimum Moisture Content %:	14.0	Soaking Period (Days)	10
Desired Conditions: %MDD / %OMC	95/100	Surcharge (kg)	11.25
Compactive Effort		Entire Moisture Content %	19.4
Mass of hammer kg	4.9	Entire Moisture Ratio %	138.5
Number of layers	5	Top 30mm Moisture Content %	21.7
Number of blows/layer	22	Top 30mm Moisture Ratio %	155.5
Conditions after Compaction		Swell %	1.5
Dry Density t/m^3	1.772	C.B.R. at 2.5 mm Penetration %	9
Moisture Content %	14.2	**Conditions after Soaking**	
Density Ratio %	100.0	Dry Density t/m^3	1.743
Moisture Ratio %	101.5	Moisture Content %	20.3
Soaked / Unsoaked	Soaked	Dry Density Ratio %	93.5
		Moisture Ratio %	145.0

Comments: Tested as received



Client Address: GHD House, Adelaide Tce Perth

ASMDD-CBR May 2009

Approved Signature Matthew van Herk

Particle Size Distribution & Plasticity Index tests

Mining & Civil

Geotest Pty Ltd

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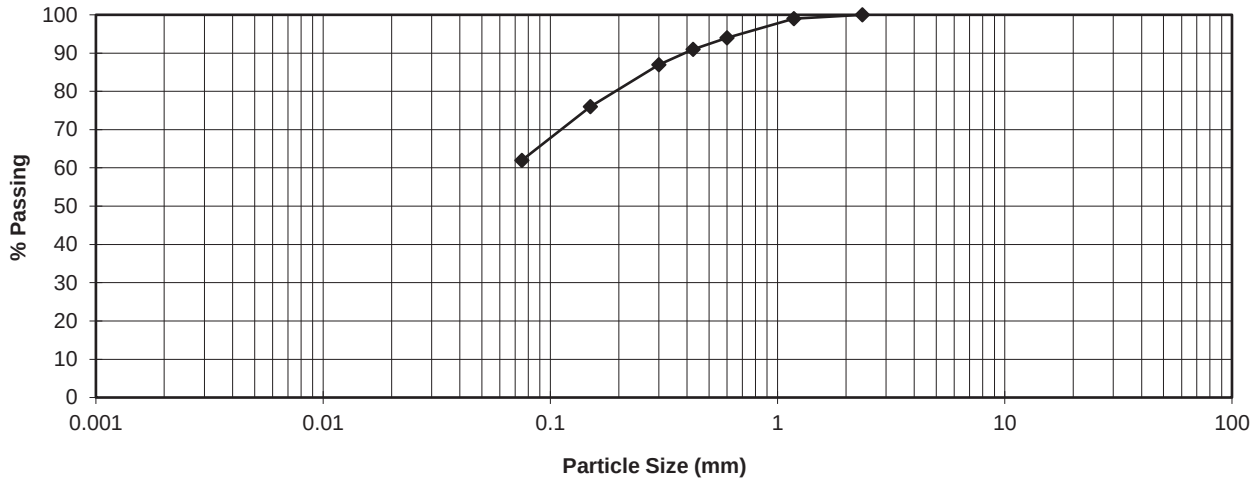
Job No:	60054
Report No:	60054-P15/5943
Sample No:	P15/5943
Issue Date:	3 September 2015

Client:	GHD Pty Ltd 61/32392	Borehole/Test Pit:	Test Pit B
Project:	Kununurra Airport Runway Extension	Names/Codes:	TB-SG
Location:	Kununurra	Type of Material:	CL-ML



SIEVE ANALYSIS AS 1289.3.6.1

Sieve Size (mm)	% Passing
75.0	
37.5	
19.0	
9.5	
4.75	
2.36	100
1.18	99
0.600	94
0.425	91
0.300	87
0.150	76
0.075	62

Plasticity index tests

AS 1289

Liquid limit 3.1.1	42	%
Plastic limit 3.2.1	15	%
Plasticity index 3.3.1	27	%
Linear shrinkage 3.4.1	9.0	%

Cracked ☐

Curled ☑

Client Address: GHD House, Adelaide Terrace, Perth

Sampling Procedure: Tested as received

NATA WORLD RECOGNISED ACCREDITATION

Approved signature

Matthew van Herk

AS PSDPI May 2009

Mining & Civil
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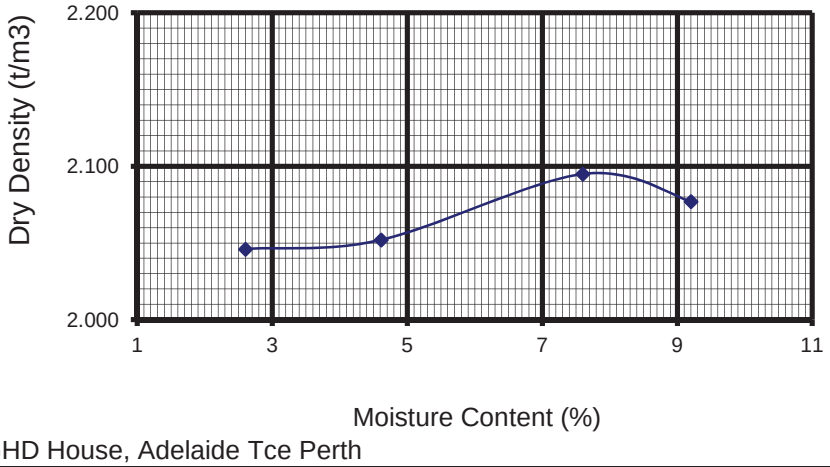
Modified Maximum Dry Density (AS 1289.5.2.1) & California Bearing Ratio (AS 1289.6.1.1) Test Report

Certificate No:	60054-P15/5942	**Client:**	GHD Pty Ltd (61/32392)
Sample No:	P15/5942	**Location:**	Kununurra
Project:	Kununurra Airport Runway Extension	**Date of issue:**	3 September 2015
Sample :	Test Pit B, TB-PV	**Job No:**	60054

Maximum Dry Density t/m^3:	2.095	**Conditions at Test**	
Optimum Moisture Content %:	7.6	Soaking Period (Days)	4
Desired Conditions: %MDD / %OMC	100/100	Surcharge (kg)	4.5
Compactive Effort		Entire Moisture Content %	7.9
Mass of hammer kg	4.9	Entire Moisture Ratio %	103.5
Number of layers	5	Top 30mm Moisture Content %	7.9
Number of blows/layer	35	Top 30mm Moisture Ratio %	103.5
Conditions after Compaction		Swell %	0.0
Dry Density t/m^3	2.097	C.B.R. at 5.0 mm Penetration %	110
Moisture Content %	7.5	**Conditions after Soaking**	
Density Ratio %	100.0	Dry Density t/m^3	2.097
Moisture Ratio %	98.5	Moisture Content %	9.0
Soaked / Unsoaked	Soaked	Dry Density Ratio %	100.0
		Moisture Ratio %	118.0

Comments: Tested as received



Client Address: GHD House, Adelaide Tce Perth

ASMDD-CBR May 2009

Approved Signature Matthew van Herk

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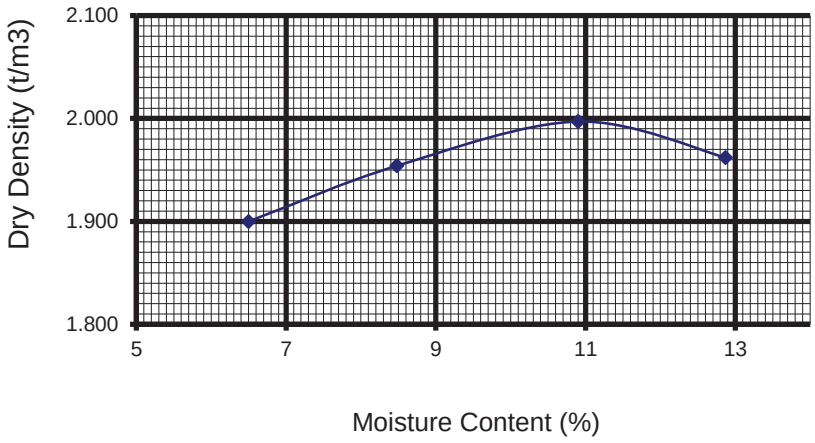
Modified Maximum Dry Density (AS 1289.5.2.1) & California Bearing Ratio (AS 1289.6.1.1) Test Report

Certificate No:	60054-P15/5941	**Client:**	GHD Pty Ltd (61/32392)
Sample No:	P15/5941	**Location:**	Kununurra
Project:	Kununurra Airport Runway Extension	**Date of issue:**	7 September 2015
Sample :	Test Pit A, TA-SG (Subgrade)	**Job No:**	60054

Maximum Dry Density t/m^3:	1.997	**Conditions at Test**	
Optimum Moisture Content %:	10.9	Soaking Period (Days)	10
Desired Conditions: %MDD / %OMC	95/100	Surcharge (kg)	11.25
Compactive Effort		Entire Moisture Content %	17.4
Mass of hammer kg	4.9	Entire Moisture Ratio %	160.0
Number of layers	5	Top 30mm Moisture Content %	23.8
Number of blows/layer	25	Top 30mm Moisture Ratio %	218.5
Conditions after Compaction		Swell %	5.0
Dry Density t/m^3	1.897	C.B.R. at 2.5 mm Penetration %	4.5
Moisture Content %	10.8	**Conditions after Soaking**	
Density Ratio %	100.0	Dry Density t/m^3	1.803
Moisture Ratio %	99.0	Moisture Content %	18.9
Soaked / Unsoaked	Soaked	Dry Density Ratio %	90.5
		Moisture Ratio %	173.5

Comments: Tested as received



Client Address: GHD House, Adelaide Tce Perth

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Particle Size Distribution & Plasticity Index tests

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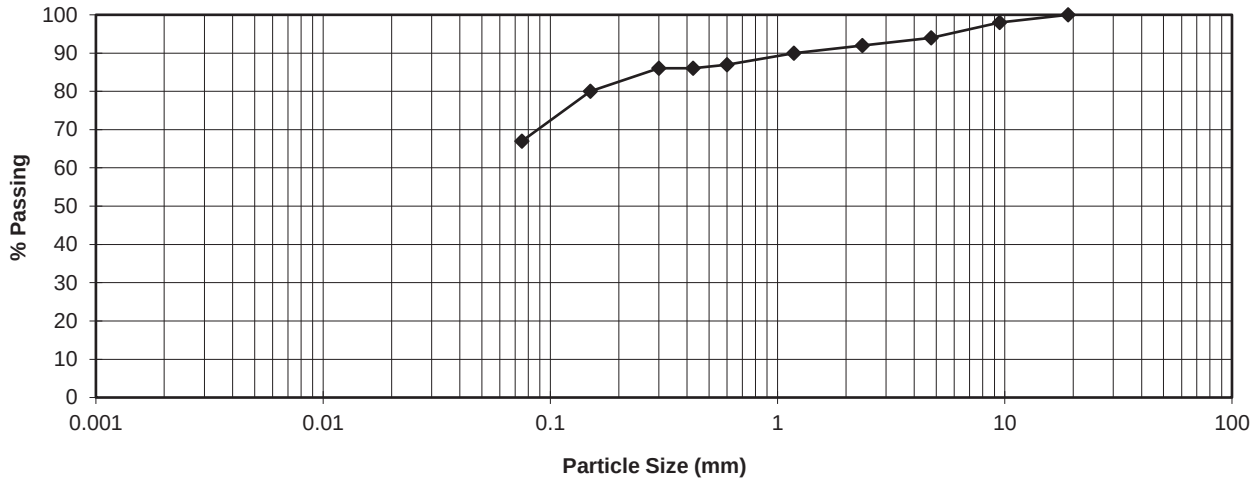
Job No:	60054
Report No:	60054-P15/5941
Sample No:	P15/5941
Issue Date:	3 September 2015

Client:	GHD Pty Ltd 61/32392	Borehole/Test Pit:	Test Pit A
Project:	Kununurra Airport Runway Extension	Names/Codes:	TA-SG
Location:	Kununurra	Type of Material:	CL-ML



SIEVE ANALYSIS AS 1289.3.6.1

Sieve Size (mm)	% Passing
75.0	
37.5	
19.0	100
9.5	98
4.75	94
2.36	92
1.18	90
0.600	87
0.425	86
0.300	86
0.150	80
0.075	67

Plasticity index tests
AS 1289

Liquid limit 3.1.1	37	%
Plastic limit 3.2.1	17	%
Plasticity index 3.3.1	20	%
Linear shrinkage 3.4.1	9.0	%

Cracked ☐

Curled ☑

Client Address: GHD House, Adelaide Terrace, Perth

Sampling Procedure: Tested as received

NATA WORLD RECOGNISED ACCREDITATION

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Matthew van Herk

AS PSDPI May 2009

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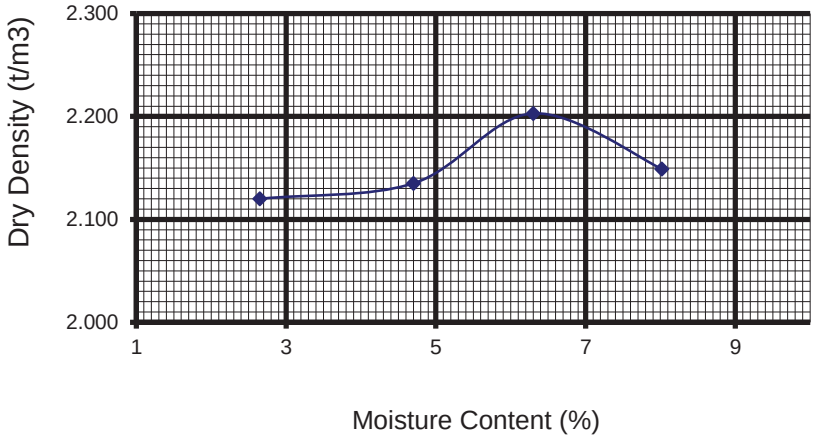
Modified Maximum Dry Density (AS 1289.5.2.1) & California Bearing Ratio (AS 1289.6.1.1) Test Report

Certificate No:	60054-P15/5940	**Client:**	GHD Pty Ltd (61/32392)
Sample No:	P15/5940	**Location:**	Kununurra
Project:	Kununurra Airport Runway Extension	**Date of issue:**	3 September 2015
Sample :	Test Pit A, TA-PV	**Job No:**	60054

Maximum Dry Density t/m^3:	2.203	**Conditions at Test**	
Optimum Moisture Content %:	6.3	Soaking Period (Days)	4
Desired Conditions: %MDD / %OMC	100/100	Surcharge (kg)	4.5
Compactive Effort		Entire Moisture Content %	6.3
Mass of hammer kg	4.9	Entire Moisture Ratio %	100.0
Number of layers	5	Top 30mm Moisture Content %	6.5
Number of blows/layer	30	Top 30mm Moisture Ratio %	103.0
Conditions after Compaction		Swell %	0.0
Dry Density t/m^3	2.204	C.B.R. at 5.0 mm Penetration %	140
Moisture Content %	6.3	**Conditions after Soaking**	
Density Ratio %	100.0	Dry Density t/m^3	2.204
Moisture Ratio %	99.5	Moisture Content %	7.3
Soaked / Unsoaked	Soaked	Dry Density Ratio %	100.0
		Moisture Ratio %	116.5

Comments: Tested as received



Client Address: GHD House, Adelaide Tce Perth

ASMDD-CBR May 2009

Approved Signature Matthew van Herk

Particle Size Distribution & Plasticity Index tests

Mining & Civil
Geotest Pty Ltd
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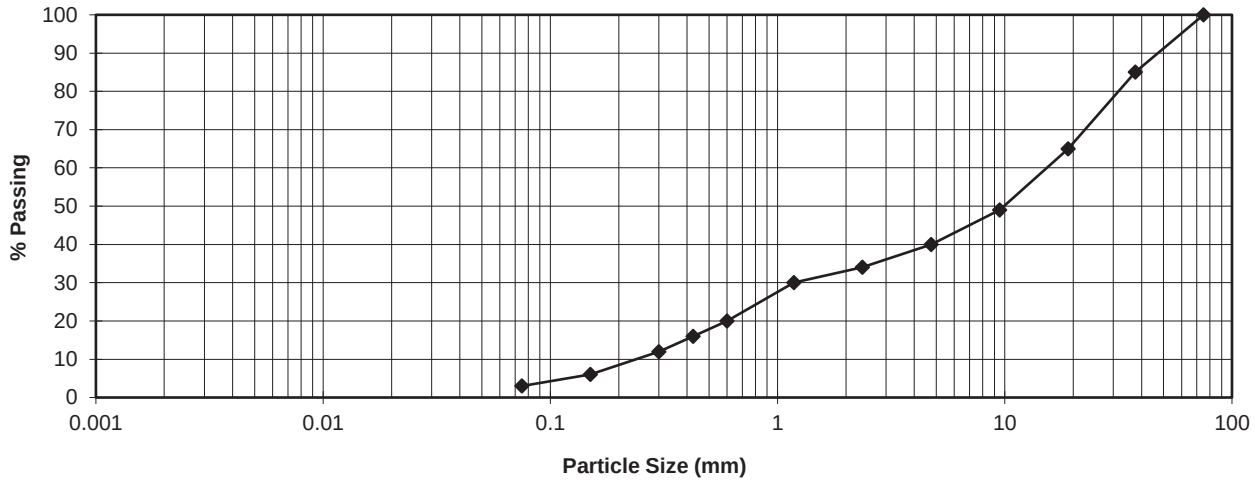
Job No:	60054
Report No:	60054-P15/5940
Sample No:	P15/5940
Issue Date:	3 September 2015

Client:	GHD Pty Ltd 61/32392	Borehole/Test Pit:	Test Pit A
Project:	Kununurra Airport Runway Extension	Names/Codes:	TA-PV
Location:	Kununurra	Type of Material:	GW-GP



SIEVE ANALYSIS AS 1289.3.6.1

Sieve Size (mm)	% Passing
75.0	100
37.5	85
19.0	65
9.5	49
4.75	40
2.36	34
1.18	30
0.600	20
0.425	16
0.300	12
0.150	6
0.075	3

Plasticity index tests
AS 1289

Liquid limit 3.1.1	SIC	%
Plastic limit 3.2.1	NP	%
Plasticity index 3.3.1	NP	%
Linear shrinkage 3.4.1	*0.0	%

Cracked ☐

Curled ☐

SIC = Slipped in cup
NP = Non plastic
***Non standard test as liquid limit was not determined.**

Client Address: GHD House, Adelaide Terrace, Perth

Sampling Procedure: Tested as received

NATA WORLD RECOGNISED ACCREDITATION

Approved signature

Matthew van Herk

AS PSDPI May 2009

Appendix D – Traffic Calculation

Scenarios 1, 2 and 3

2021-22(11%GR) 2022-2023 to 2036-37(5.1%GR)

Scenario 1 **(10%B737/10%A320/80%FK-40%B737/40% A320/20%FK)**

			CU movements	B737-800	A320-200	F100	E170
			SEATS	168	170	100	76
				10	10	80	0
				80% occupied	80% occupied	80% occupied	80% occupied
				134	136	80	61
1	2015	146524	146524	109	86	1172	0
2	16	162642	309166	121	96	1301	0
3	2017	180532	489698	134	106	1444	0
4	18	200391	690089	149	118	1603	0
5	19	222434	912522	166	131	1779	0
6	20	246901	1159424	184	145	1975	0
7	21	274061	1433484	204	161	2192	0
	Growth rate decreases from 11% to 5.1%			40	40	20	0
8	22	288038	1721522	857	847	576	0
9	23	302728	2024250	901	890	605	0
10	24	318167	2342417	947	936	636	0
11	25	334393	2676810	995	984	669	0
12	26	351447	3028257	1046	1034	703	0
13	27	369371	3397628	1099	1086	739	0
14	28	388209	3785837	1155	1142	776	0
15	29	408008	4193845	1214	1200	816	0
16	30	428816	4622661	1276	1261	858	0
17	31	450686	5073347	1341	1326	901	0
18	32	473671	5547017	1410	1393	947	0
19	33	497828	6044845	1482	1464	996	0
20	34	523217	6568063	1557	1539	1046	0
21	35	549901	7117964	1637	1617	1100	0
22	2036	577946	7695910	1720	1700	1156	0

		B737-800	A320-200	F100
	average till 2022	167	132	1799
	ave rage till 2036-7	1243	1228	835
	Average for COMFAA and ELMOD	705	680	1317
Runway	TOTAL Cumulative flights no	19475	19080	21519
	total takeoffs	9737	9540	10760
	60% takeoff RWY 12	5842	5724	6456
	40% take-offs RWY 30	3895	3816	4304
	10% take off(taxiway B)	974	954	1076
	90% TAKE OFF (Taxiway A,C and Apron)	8764	8586	9684
	CUMULATIVE passess	**15580**	**15264**	**17216**
	P/TC(obtain fuel)	1	1	1
	Total Average passes	**779**	**763**	**861**

TAXIWAY	% Taxiway passes	B737-800	A320-200	F100
A	90	438	429	484
B	10	44	43	48
C	90	438	429	484
APRON RPT	100	487	477	538

2021-22(11%GR) 2022-2023 to 2036-37(5.1%GR)

Scenario 2 **(10%B737/90%FK-90%B737/10%FK)**

			CU movements	B737-800	A320-200	F100	E170
				168	170	100	76
				10	0	90	0
				80% occupied	80% occupied	0% occupi	30% occupied
				134	136	80	61
1	2015	146524	146524	109	0	1648	0
2	16	162642	309166	121	0	1830	0
3	2017	180532	489698	134	0	2031	0
4	18	200391	690089	149	0	2254	0
5	19	222434	912522	166	0	2502	0
6	20	246901	1159424	184	0	2778	0
7	21	274061	1433484	204	0	3083	0
	Growth rate decreases from 11% to 5.1%			90	0	10	0
8	22	288038	1721522	1543	0	288	0
9	23	302728	2024250	1622	0	303	0
10	24	318167	2342417	1704	0	318	0
11	25	334393	2676810	1791	0	334	0
12	26	351447	3028257	1883	0	351	0
13	27	369371	3397628	1979	0	369	0
14	28	388209	3785837	2080	0	388	0
15	29	408008	4193845	2186	0	408	0
16	30	428816	4622661	2297	0	429	0
17	31	450686	5073347	2414	0	451	0
18	32	473671	5547017	2538	0	474	0
19	33	497828	6044845	2667	0	498	0
20	34	523217	6568063	2803	0	523	0
21	35	549901	7117964	2946	0	550	0
22	2036	577946	7695910	3096	0	578	0

Runway

	B737-800	A320-200	F100
average till 2022	167	0	2530
ave rage till 2036-7	2237	0	417
Average for COMFAA and ELMOD	1202	0	1474
TOTAL Cumulative flights no	34385	0	18911
total takeoffs	17193	0	9456
60% takeoff RWY 12	10316	0	5673
40% take-offs RWY 30	6877	0	3782
10% take off(taxiway B)	1719	0	946
90% TAKE OFF (Taxiway A,C and Apron)	15473	0	8510
CUMULATIVE passess	**27508**	**0**	**15129**
P/TC(obtain fuel)	1	1	1
Total Average passes	**1375**	**0**	**756**

TAXIWAY	% Taxiway passes	B737-800	A320-200	F100
A	90	774	0	425
B	10	77	0	43
C	90	774	0	425
APRON RPT	100	860	0	473

2021-22(11%GR) 2022-2023 to 2036-37(5.1%GR)

Scenario 3 **(100%B737/0%FK-100%B737/0%FK)**

			CU movements	B737-800	A320-200	F100	E170	
				168	170	100	76	SEATS
				100	0	0	0	%
				80% occupied	80% occupied	80% occupied	80% occupied	
				134	136	80	61	
1	2015	146524	146524	872	0	0	0	
2	16	162642	309166	968	0	0	0	
3	2017	180532	489698	1075	0	0	0	
4	18	200391	690089	1193	0	0	0	
5	19	222434	912522	1324	0	0	0	
6	20	246901	1159424	1470	0	0	0	
7	21	274061	1433484	1631	0	0	0	
	Growth rate decreases from 11% to 5.1%			100	0	0	0	
8	22	288038	1721522	1715	0	0	0	
9	23	302728	2024250	1802	0	0	0	
10	24	318167	2342417	1894	0	0	0	
11	25	334393	2676810	1990	0	0	0	
12	26	351447	3028257	2092	0	0	0	
13	27	369371	3397628	2199	0	0	0	
14	28	388209	3785837	2311	0	0	0	
15	29	408008	4193845	2429	0	0	0	
16	30	428816	4622661	2552	0	0	0	
17	31	450686	5073347	2683	0	0	0	
18	32	473671	5547017	2819	0	0	0	
19	33	497828	6044845	2963	0	0	0	
20	34	523217	6568063	3114	0	0	0	
21	35	549901	7117964	3273	0	0	0	
22	2036	577946	7695910	3440	0	0	0	

Runway

	B737-800	A320-200	F100
average till 2022	1338	0	0
ave rage till 2036-7	2485	0	0
Average for COMFAA and ELMOD	1912	0	0
TOTAL Cumulative flights no	43969	0	0
total takeoffs	21984	0	0
60% takeoff RWY 12	13191	0	0
40% take-offs RWY 30	8794	0	0
10% take off(taxiway B)	2198	0	0
90% TAKE OFF (Taxiway A,C and Apron)	19786	0	0
CUMULATIVE passess	**35175**	**0**	**0**
P/TC(obtain fuel)	1	1	1
Total Average passes	**1759**	**0**	**0**

TAXIWAY	% Taxiway passes	B737-800	A320-200	F100
A	90	989	0	0
B	10	99	0	0
C	90	989	0	0
APRON RPT	100	1099	0	0

Appendix E – Site Investigation Photos

Location	Taxiway A
Description	Spray sealed surface with occasional signs of flushing

Location	Taxiway B
Description	Facing north west, tie in of asphalt

Location	Taxiway B
Description	Facin7g south west towards light aircraft parking bays

Location	Taxiway C
Description	Facing south west, signs of flushing in wheel paths

Location	Taxiway A
Description	Pavement pit profile, seal on natural gravel base and sub-base on sand

Location	Taxiway A
Description	Pavement pit profile, seal on natural gravel base and sub-base on sand

Location	Taxiway B
Description	Material excavated from basecourse and sub-base layers

Location	Taxiway B
Description	Pavement pit profile showing underlying sand layer

Location	Taxiway C
Description	Pavement pit showing highly cemented sub-base layer

Location	Taxiway C
Description	Excavated basecourse material, signs of manufacturing

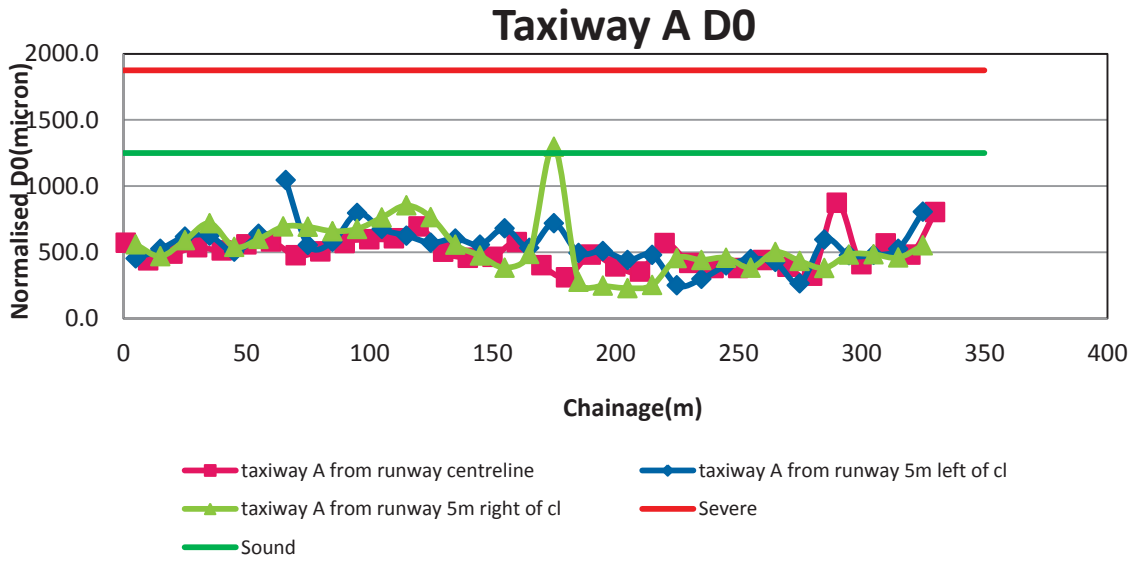
Location	Test Pit 1 (eastern end of runway)
Description	Excavated test pit wall

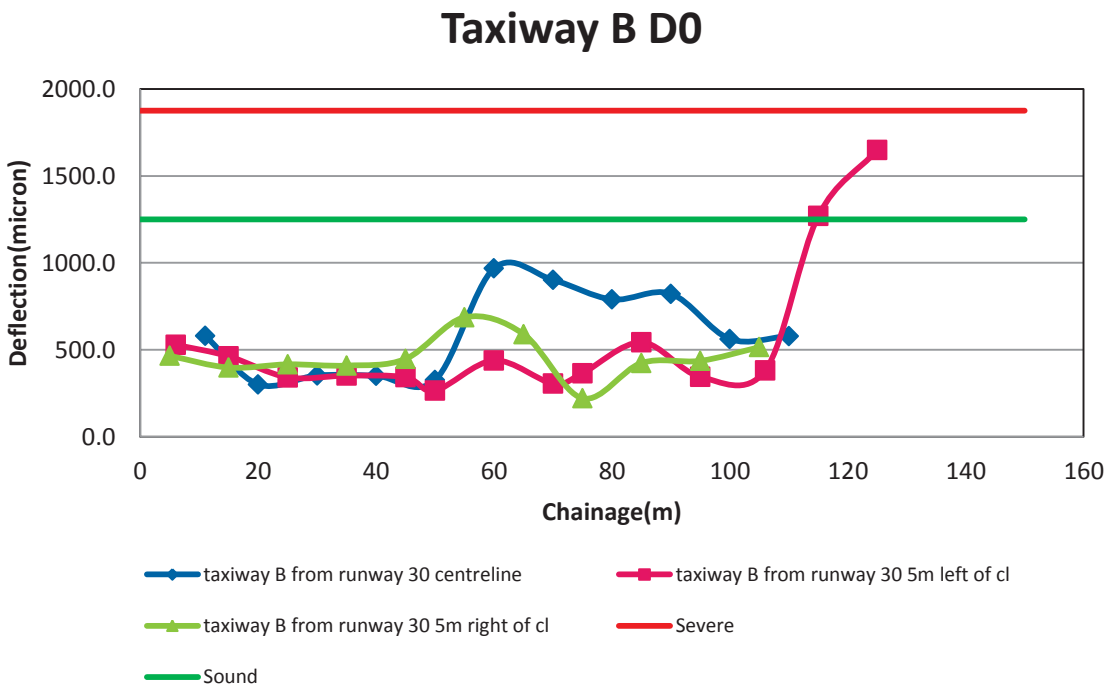
Location	Test Pit 2
Description	Excavated test pit showing black clay throughout

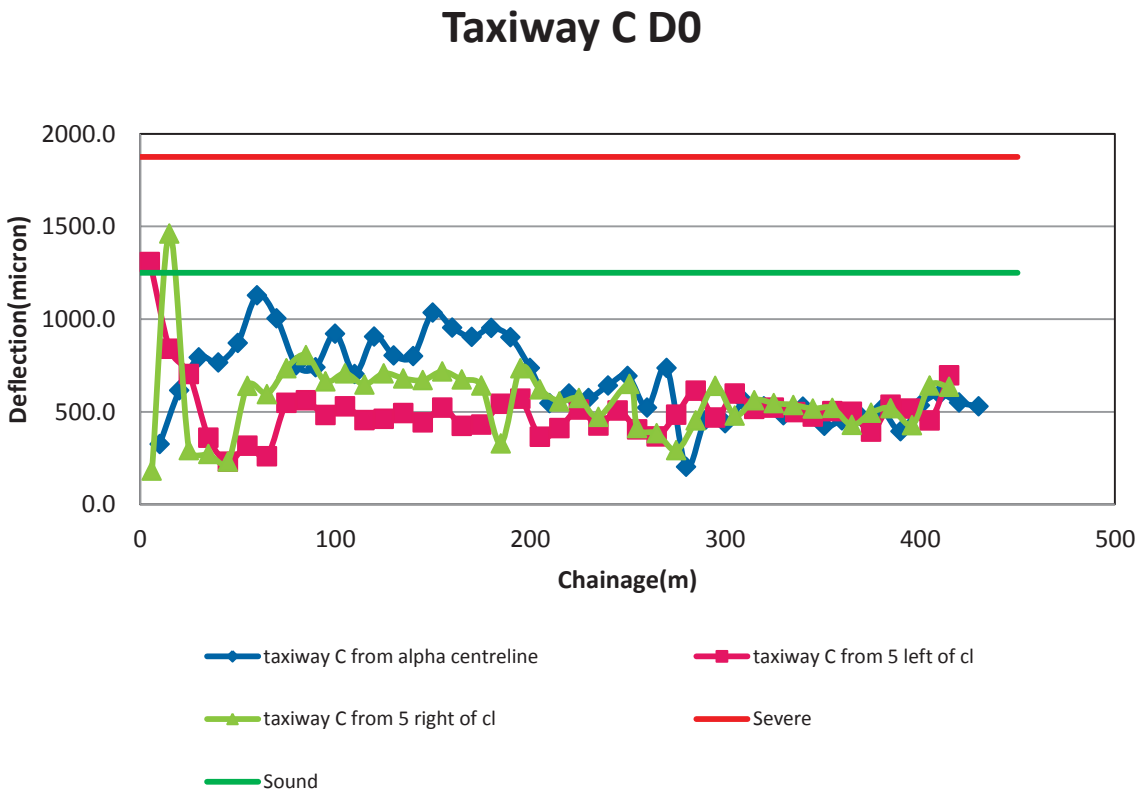
Location	Test Pit 3
Description	Excavated material from test pit, black clay throughout

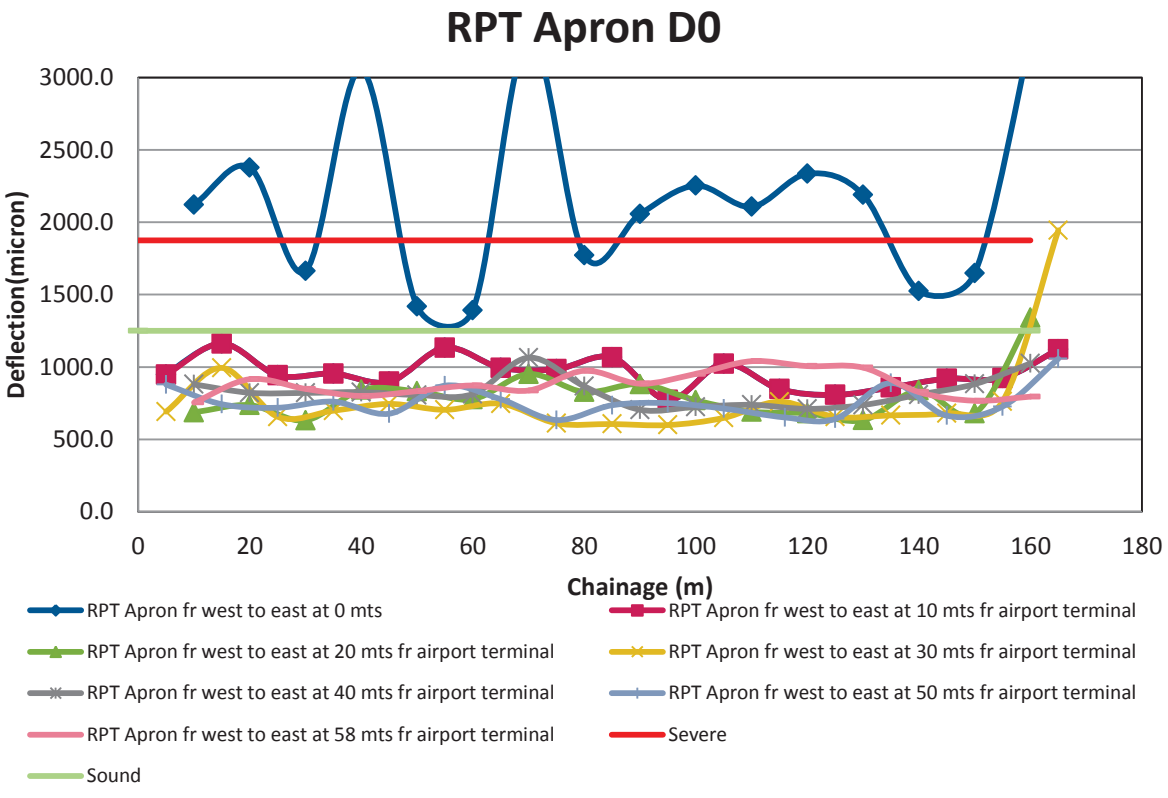
Location	Test Pit 4
Description	Excavated test pit showing black clay throughout

Appendix F – Deflection Plots






Taxiway C D0
2000.0
1500.0
1000.0
500.0
0.0
Deflection(micron)
0
100
200
300
400
500
Chainage(m)
taxiway C from alpha centreline
taxiway C from 5 left of cl
taxiway C from 5 right of cl
Severe
Sound

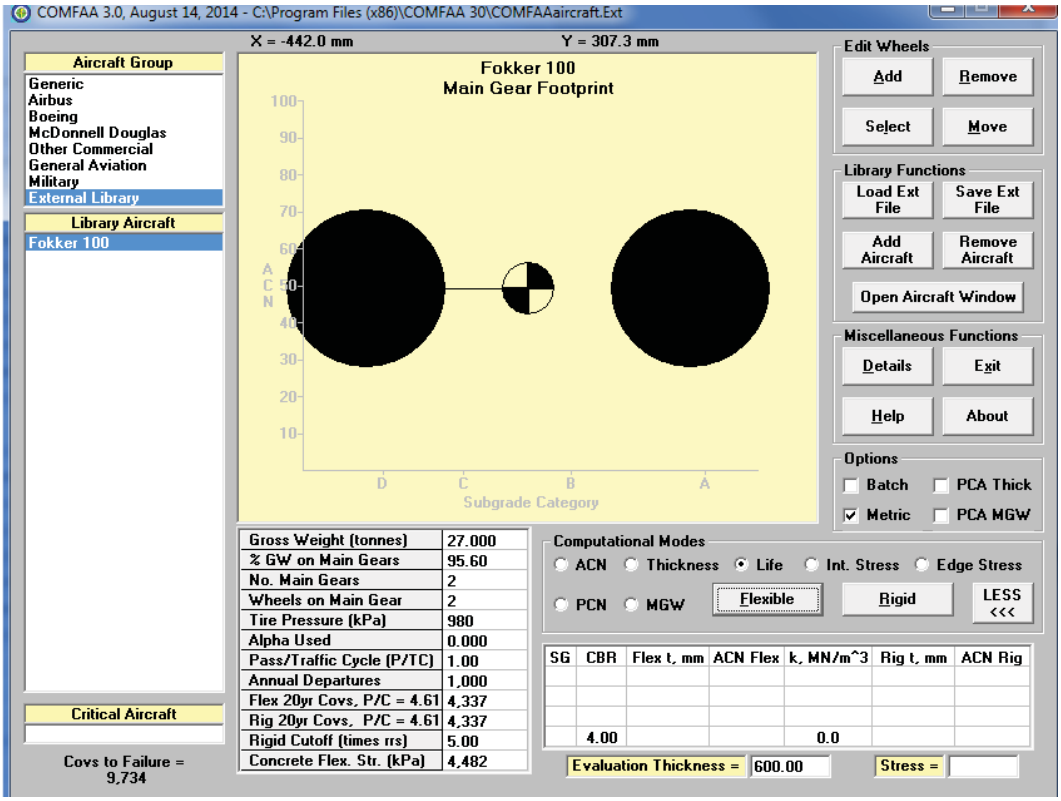

RPT Apron D0
3000.0
2500.0
2000.0
1500.0
1000.0
500.0
0.0
Deflection(micron)
0
20
40
60
80
100
120
140
160
180
Chainage (m)
RPT Apron fr west to east at 0 mts
RPT Apron fr west to east at 10 mts fr airport terminal
RPT Apron fr west to east at 20 mts fr airport terminal
RPT Apron fr west to east at 30 mts fr airport terminal
RPT Apron fr west to east at 40 mts fr airport terminal
RPT Apron fr west to east at 50 mts fr airport terminal
RPT Apron fr west to east at 58 mts fr airport terminal
Severe
Sound

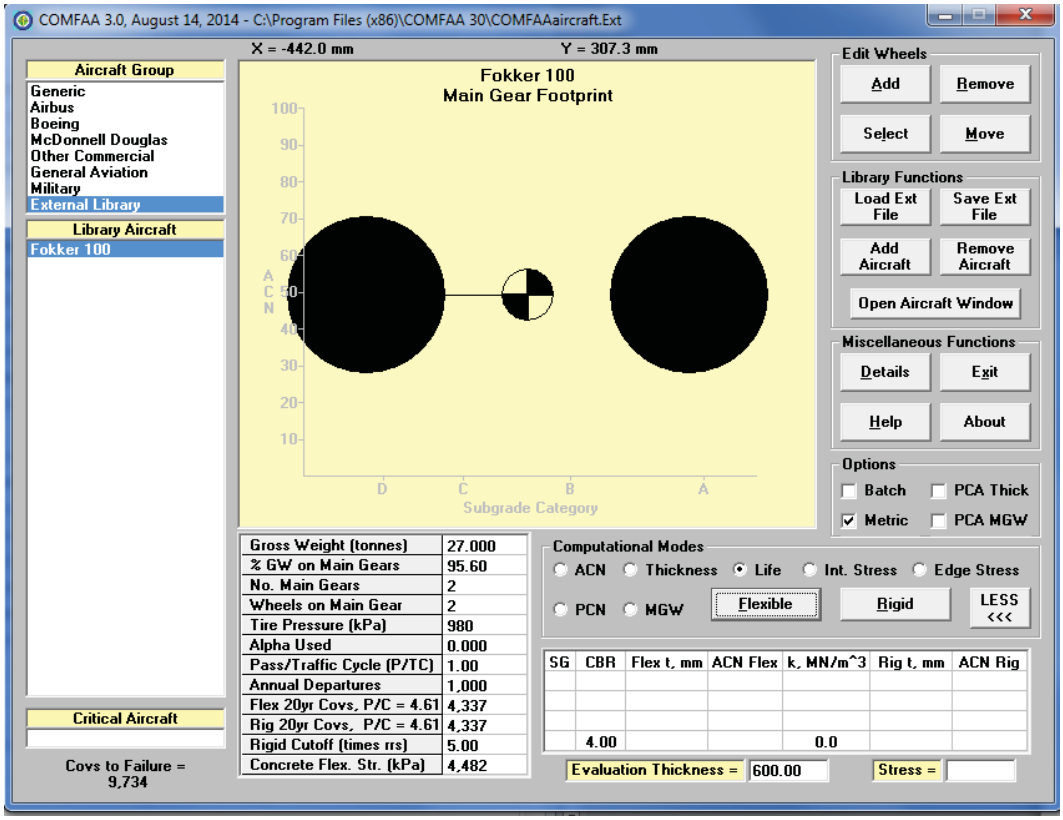
Benchmark criteria for a contact drop stress of 1415kPa (100kN FWD drop weight) (Dr Emile Horak and Dr Stephen Emery Using FWD readings to conduct structural benchmarking of airport pavement structures)

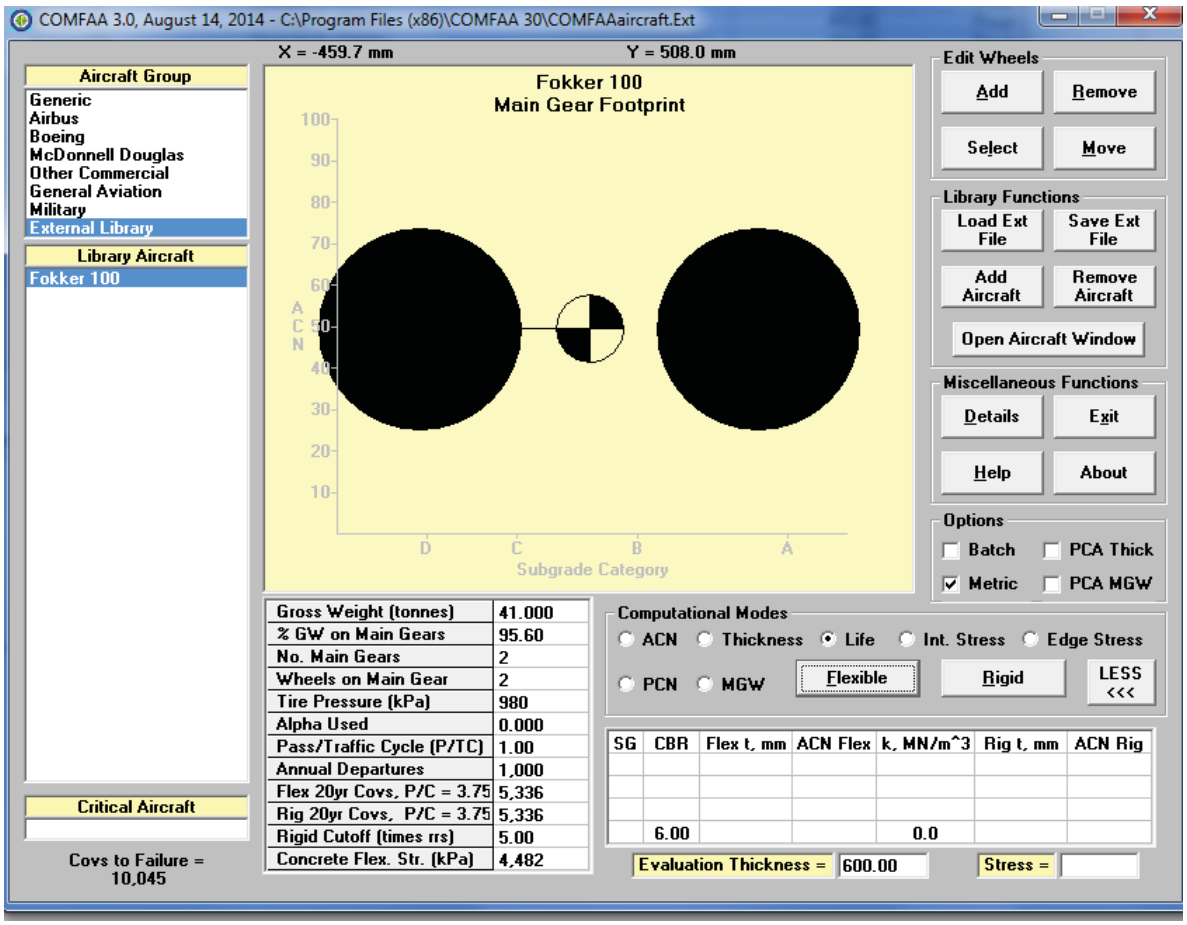
Structural Condition Rating	Max Deflection (micrometer)	BLI	MLI	LLI
Sound	<1250	<500	<250	<125
Warning	1250 to 1875	500 to 1000	250 to 500	125 to 250
Severe	>1875	>1000	>500	>250

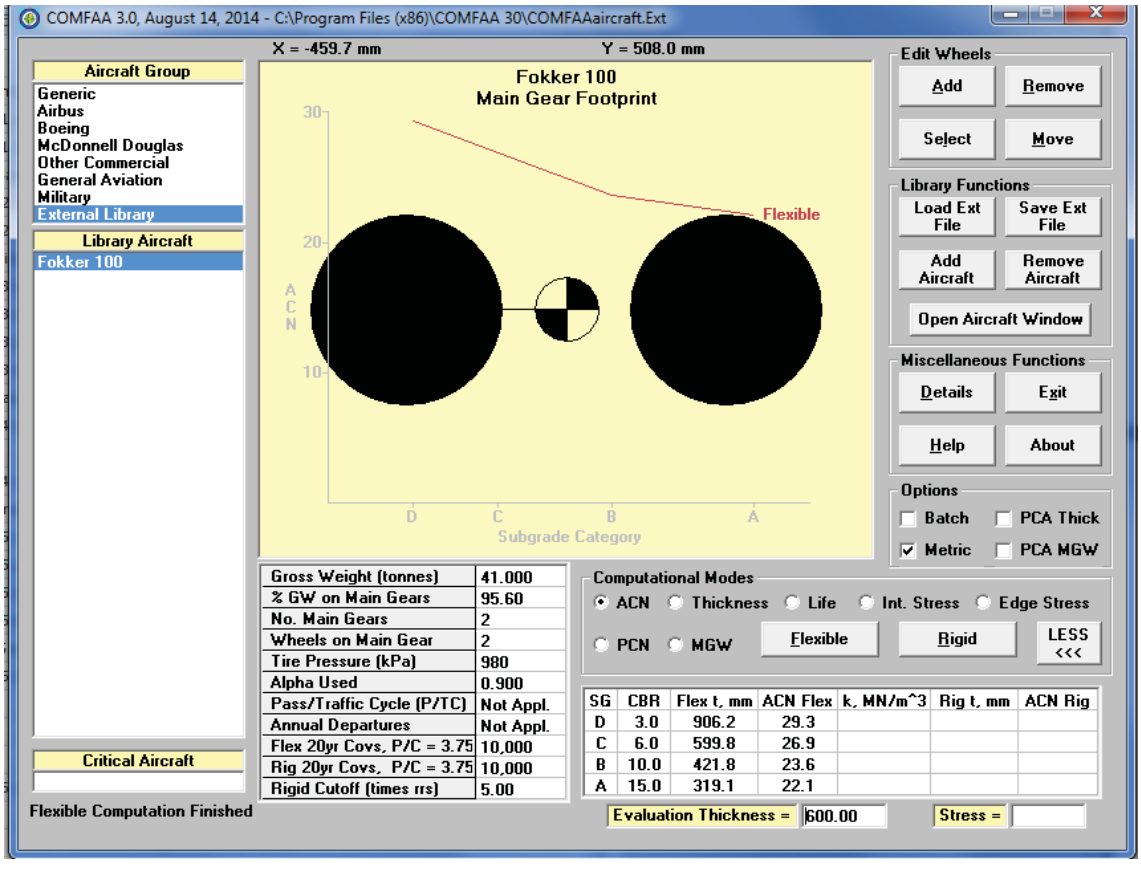
Appendix G - APSDS and COMFAA Pavement Design

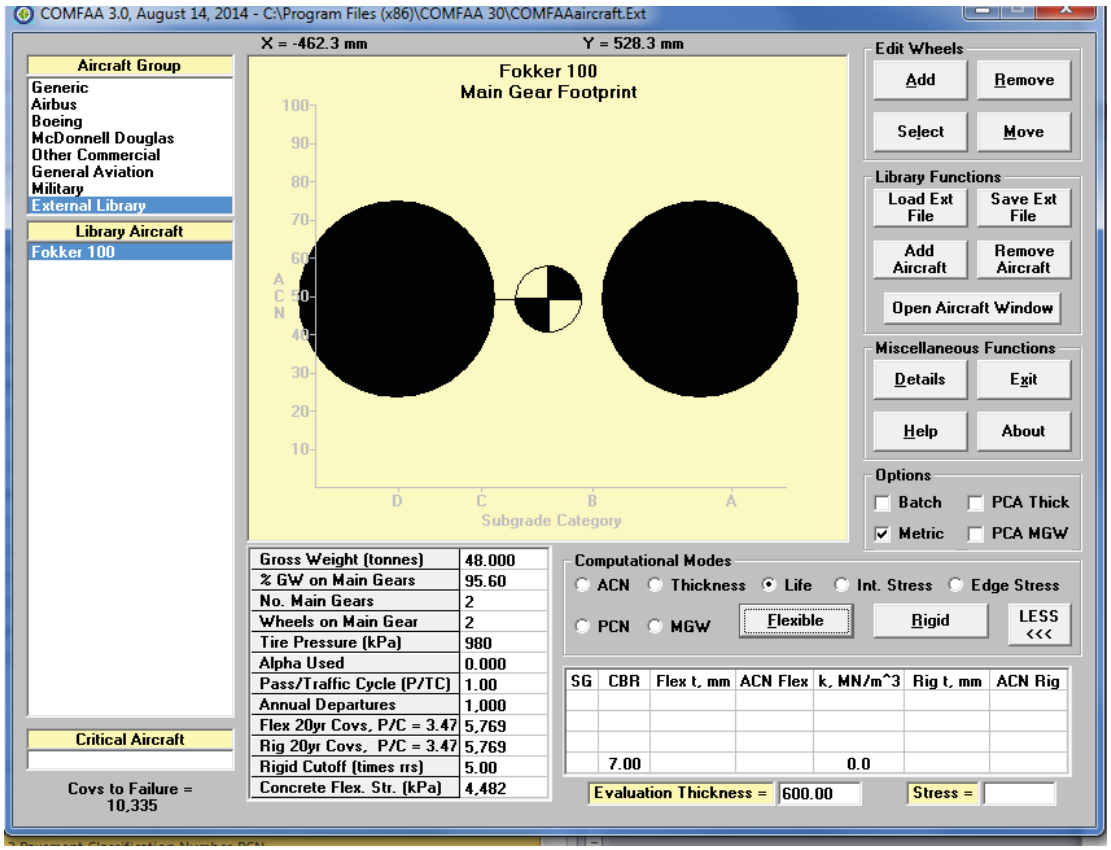
EXISTING PCN TAXIWAYS A,B AND C

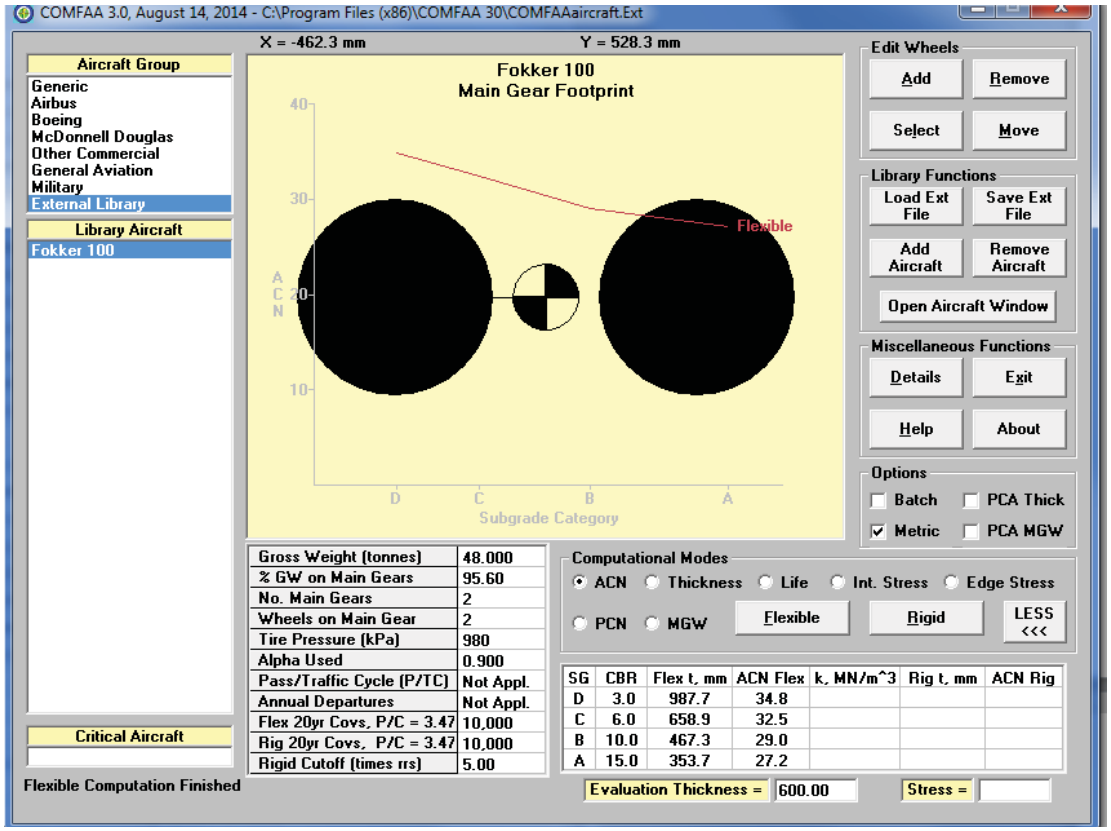


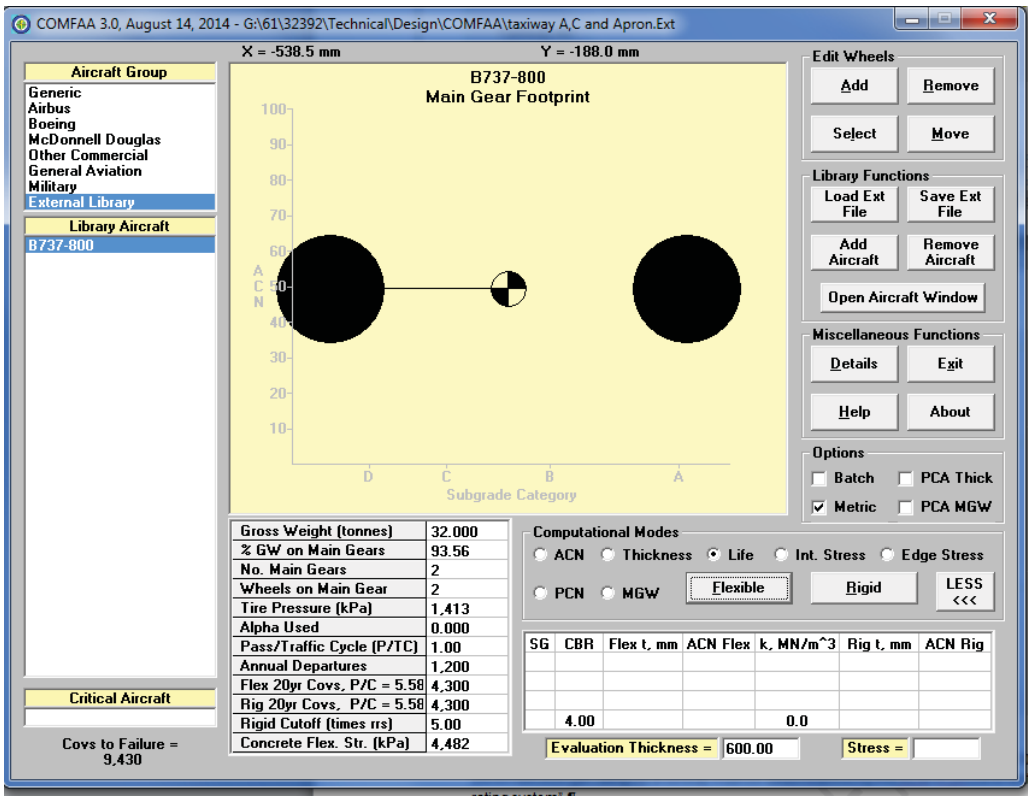


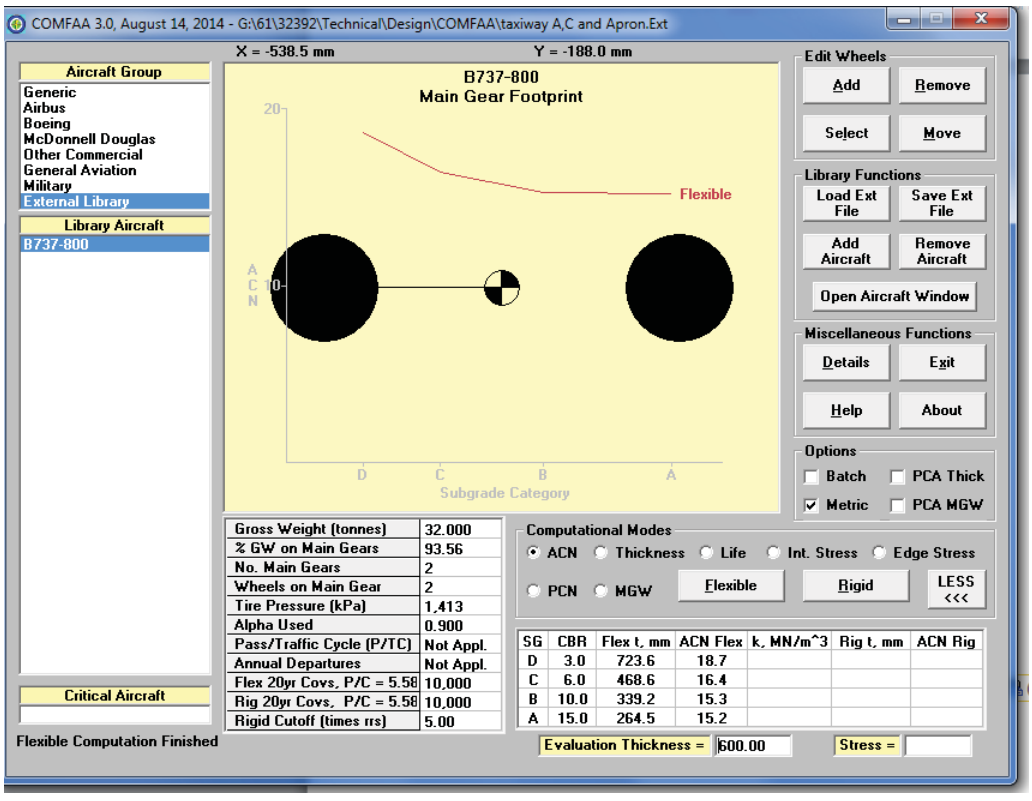

COMFAA 3.0, August 14, 2014 - C:\Program Files (x86)\COMFAA 30\COMFAAaircraft.Ext
X = -459.7 mm
Y = 508.0 mm
Aircraft Group
Generic
Airbus
Boeing
McDonnell Douglas
Other Commercial
General Aviation
Military
External Library
Library Aircraft
Fokker 100
Critical Aircraft
Covs to Failure = 10,045
Fokker 100
Main Gear Footprint
ACN
Subgrade Category
Edit Wheels
Add
Remove
Select
Move
Library Functions
Load Ext File
Save Ext File
Add Aircraft
Remove Aircraft
Open Aircraft Window
Miscellaneous Functions
Details
Exit
Help
About
Options
Batch
PCA Thick
Metric
PCA MGW
Gross Weight (tonnes) 41.000
% GW on Main Gears 95.60
No. Main Gears 2
Wheels on Main Gear 2
Tire Pressure (kPa) 980
Alpha Used 0.000
Pass/Traffic Cycle (P/TC) 1.00
Annual Departures 1,000
Flex 20yr Covs, P/C = 3.75 5,336
Rig 20yr Covs, P/C = 3.75 5,336
Rigid Cutoff (times rrs) 5.00
Concrete Flex. Str. (kPa) 4,482
Computational Modes
ACN
Thickness
Life
Int. Stress
Edge Stress
PCN
MGW
Flexible
Rigid
LESS <<<
SG CBR Flex t, mm ACN Flex k, MN/m^3 Rig t, mm ACN Rig
6.00 0.0
Evaluation Thickness = 600.00
Stress =


COMFAA 3.0, August 14, 2014 - C:\Program Files (x86)\COMFAA 30\COMFAAaircraft.Ext
X = -459.7 mm
Y = 508.0 mm
Aircraft Group
Generic
Airbus
Boeing
McDonnell Douglas
Other Commercial
General Aviation
Military
External Library
Library Aircraft
Fokker 100
Critical Aircraft
Flexible Computation Finished
Fokker 100
Main Gear Footprint
Flexible
ACN
Subgrade Category
Edit Wheels
Add
Remove
Select
Move
Library Functions
Load Ext File
Save Ext File
Add Aircraft
Remove Aircraft
Open Aircraft Window
Miscellaneous Functions
Details
Exit
Help
About
Options
Batch
PCA Thick
Metric
PCA MGW
Gross Weight (tonnes) 41.000
% GW on Main Gears 95.60
No. Main Gears 2
Wheels on Main Gear 2
Tire Pressure (kPa) 980
Alpha Used 0.900
Pass/Traffic Cycle (P/TC) Not Appl.
Annual Departures Not Appl.
Flex 20yr Covs, P/C = 3.75 10,000
Rig 20yr Covs, P/C = 3.75 10,000
Rigid Cutoff (times rrs) 5.00
Computational Modes
ACN
Thickness
Life
Int. Stress
Edge Stress
PCN
MGW
Flexible
Rigid
LESS <<<
SG CBR Flex t, mm ACN Flex k, MN/m^3 Rig t, mm ACN Rig
D 3.0 906.2 29.3
C 6.0 599.8 26.9
B 10.0 421.8 23.6
A 15.0 319.1 22.1
Evaluation Thickness = 600.00
Stress =

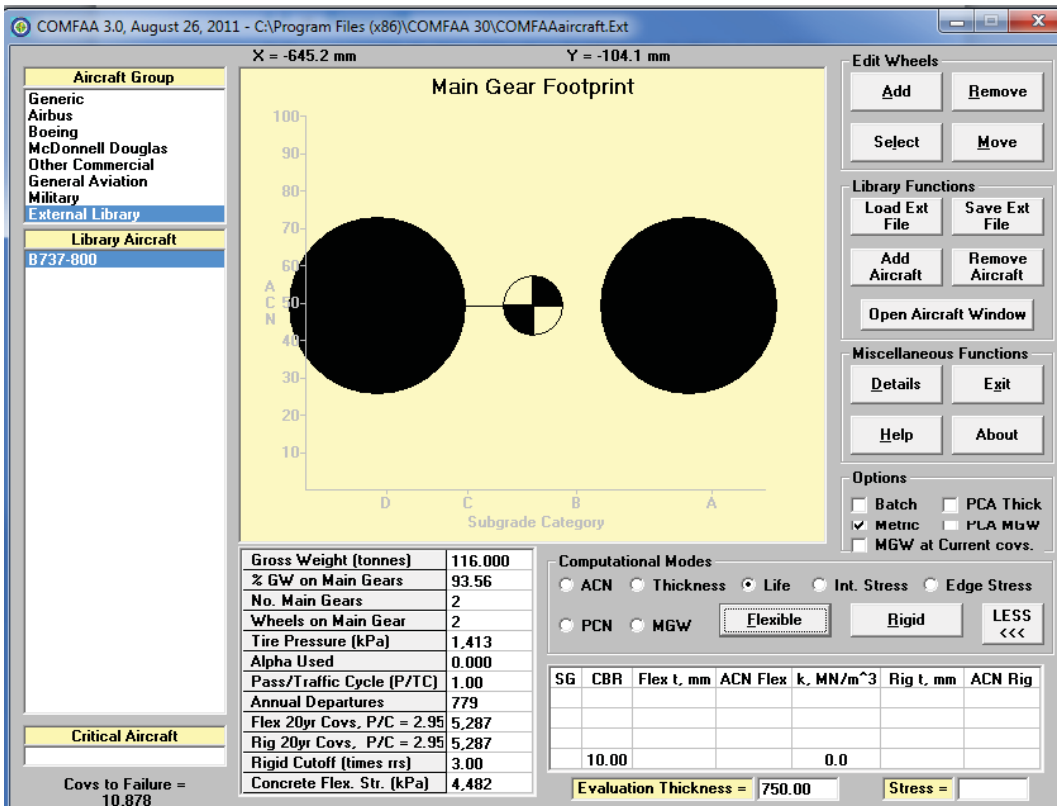

COMFAA 3.0, August 14, 2014 - C:\Program Files (x86)\COMFAA 30\COMFAAaircraft.Ext
X = -462.3 mm
Y = 528.3 mm
Aircraft Group
Generic
Airbus
Boeing
McDonnell Douglas
Other Commercial
General Aviation
Military
External Library
Library Aircraft
Fokker 100
Critical Aircraft
Covs to Failure = 10,335
Fokker 100
Main Gear Footprint
ACN
Subgrade Category
Edit Wheels
Add
Remove
Select
Move
Library Functions
Load Ext File
Save Ext File
Add Aircraft
Remove Aircraft
Open Aircraft Window
Miscellaneous Functions
Details
Exit
Help
About
Options
Batch
PCA Thick
Metric
PCA MGW
Gross Weight (tonnes) 48.000
% GW on Main Gears 95.60
No. Main Gears 2
Wheels on Main Gear 2
Tire Pressure (kPa) 980
Alpha Used 0.000
Pass/Traffic Cycle (P/TC) 1.00
Annual Departures 1,000
Flex 20yr Covs, P/C = 3.47 5,769
Rig 20yr Covs, P/C = 3.47 5,769
Rigid Cutoff (times rrs) 5.00
Concrete Flex. Str. (kPa) 4,482
Computational Modes
ACN
Thickness
Life
Int. Stress
Edge Stress
PCN
MGW
Flexible
Rigid
LESS <<<
SG CBR Flex t, mm ACN Flex k, MN/m^3 Rig t, mm ACN Rig
7.00 0.0
Evaluation Thickness = 600.00
Stress =

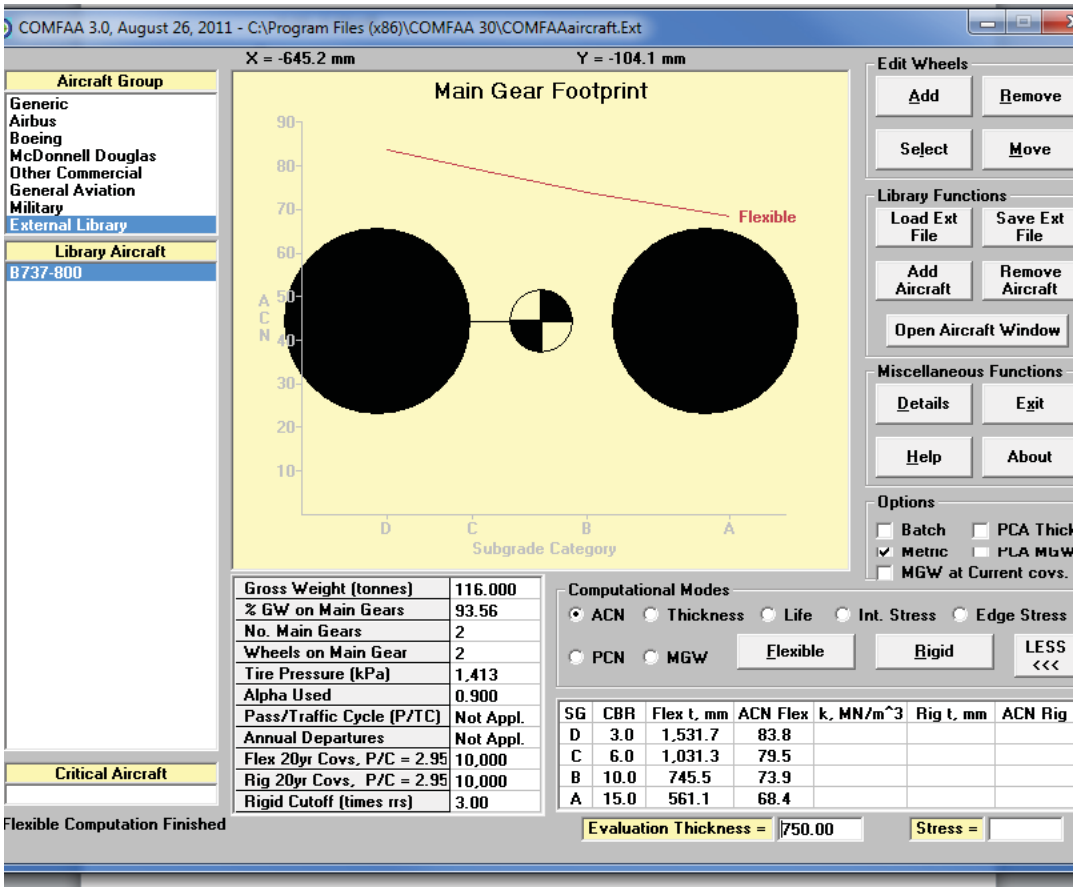

COMFAA 3.0, August 14, 2014 - C:\Program Files (x86)\COMFAA 30\COMFAAaircraft.Ext
X = -462.3 mm
Y = 528.3 mm
Aircraft Group
Generic
Airbus
Boeing
McDonnell Douglas
Other Commercial
General Aviation
Military
External Library
Library Aircraft
Fokker 100
Critical Aircraft
Flexible Computation Finished
Fokker 100
Main Gear Footprint
Flexible
ACN
Subgrade Category
Edit Wheels
Add
Remove
Select
Move
Library Functions
Load Ext File
Save Ext File
Add Aircraft
Remove Aircraft
Open Aircraft Window
Miscellaneous Functions
Details
Exit
Help
About
Options
Batch
PCA Thick
Metric
PCA MGW
Gross Weight (tonnes) 48.000
% GW on Main Gears 95.60
No. Main Gears 2
Wheels on Main Gear 2
Tire Pressure (kPa) 980
Alpha Used 0.900
Pass/Traffic Cycle (P/TC) Not Appl.
Annual Departures Not Appl.
Flex 20yr Covs, P/C = 3.47 10,000
Rig 20yr Covs, P/C = 3.47 10,000
Rigid Cutoff (times rrs) 5.00
Computational Modes
ACN
Thickness
Life
Int. Stress
Edge Stress
PCN
MGW
Flexible
Rigid
LESS <<<
SG CBR Flex t, mm ACN Flex k, MN/m^3 Rig t, mm ACN Rig
D 3.0 987.7 34.8
C 6.0 658.9 32.5
B 10.0 467.3 29.0
A 15.0 353.7 27.2
Evaluation Thickness = 600.00
Stress =

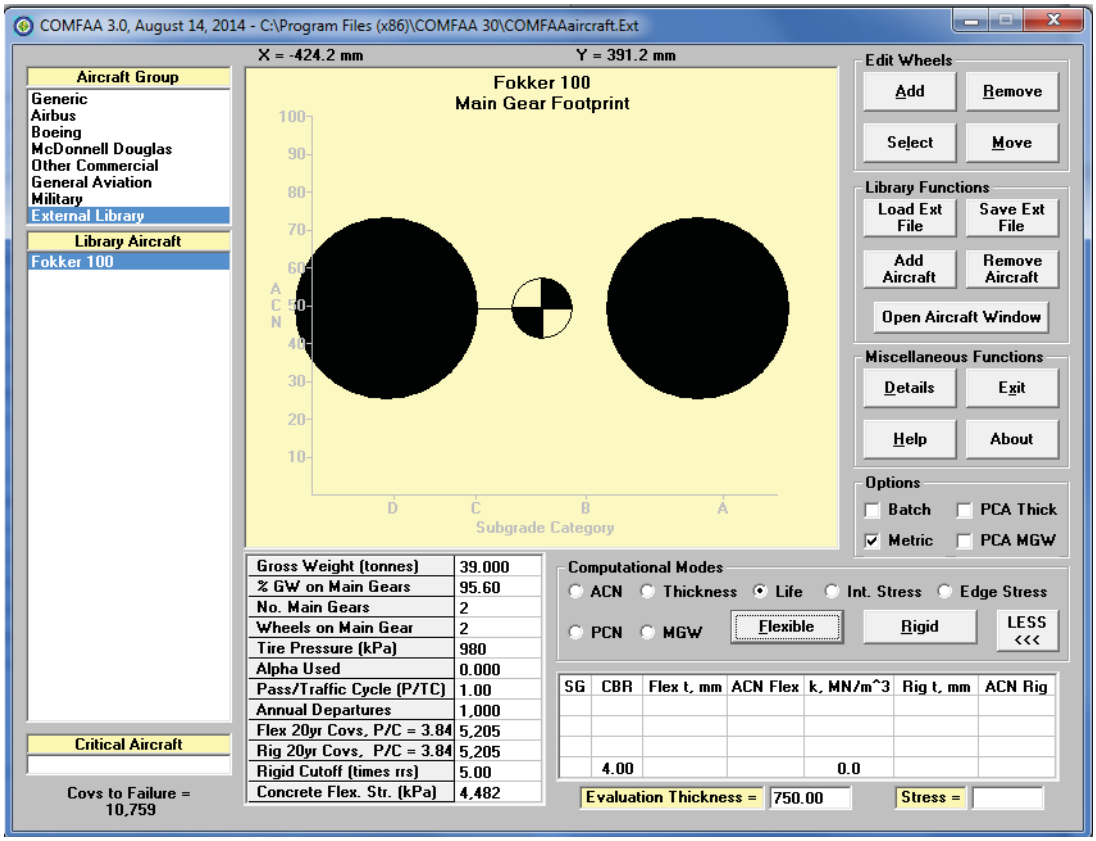

COMFAA 3.0, August 14, 2014 - G:\61\32392\Technical\Design\COMFAA\taxiway A,C and Apron.Ext
X = -538.5 mm
Y = -188.0 mm
Aircraft Group
Generic
Airbus
Boeing
McDonnell Douglas
Other Commercial
General Aviation
Military
External Library
Library Aircraft
B737-800
B737-800
Main Gear Footprint
ACN
Subgrade Category
Edit Wheels
Add
Remove
Select
Move
Library Functions
Load Ext File
Save Ext File
Add Aircraft
Remove Aircraft
Open Aircraft Window
Miscellaneous Functions
Details
Exit
Help
About
Options
Batch
PCA Thick
Metric
PCA MGW
Gross Weight (tonnes) 32.000
% GW on Main Gears 93.56
No. Main Gears 2
Wheels on Main Gear 2
Tire Pressure (kPa) 1,413
Alpha Used 0.000
Pass/Traffic Cycle (P/TC) 1.00
Annual Departures 1,200
Flex 20yr Covs, P/C = 5.58 4,300
Rig 20yr Covs, P/C = 5.58 4,300
Rigid Cutoff (times rrs) 5.00
Concrete Flex. Str. (kPa) 4,482
Computational Modes
ACN
Thickness
Life
Int. Stress
Edge Stress
PCN
MGW
Flexible
Rigid
LESS <<<
SG CBR Flex t, mm ACN Flex k, MN/m^3 Rig t, mm ACN Rig
4.00 0.0
Evaluation Thickness = 600.00
Stress =
Critical Aircraft
Covs to Failure = 9,430

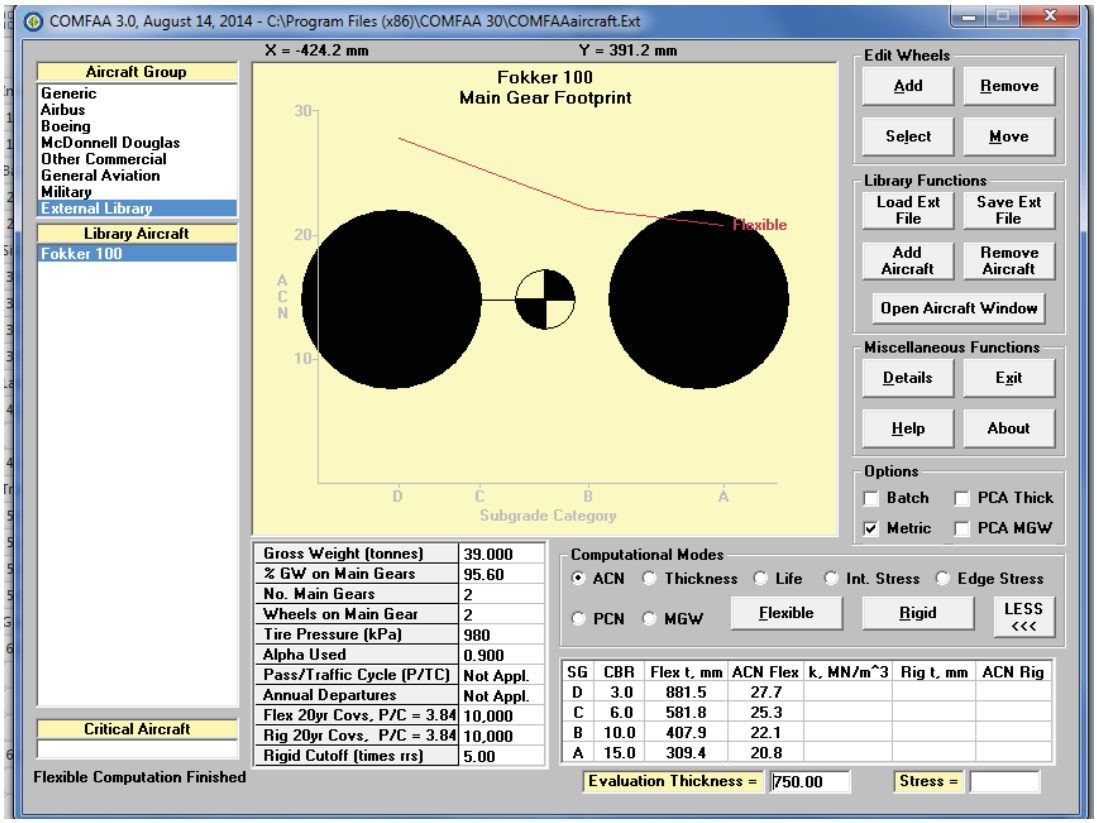

COMFAA 3.0, August 14, 2014 - G:\61\32392\Technical\Design\COMFAA\taxiway A,C and Apron.Ext
X = -538.5 mm
Y = -188.0 mm
Aircraft Group
Generic
Airbus
Boeing
McDonnell Douglas
Other Commercial
General Aviation
Military
External Library
Library Aircraft
B737-800
B737-800
Main Gear Footprint
Flexible
ACN
Subgrade Category
Edit Wheels
Add
Remove
Select
Move
Library Functions
Load Ext File
Save Ext File
Add Aircraft
Remove Aircraft
Open Aircraft Window
Miscellaneous Functions
Details
Exit
Help
About
Options
Batch
PCA Thick
Metric
PCA MGW
Gross Weight (tonnes) 32.000
% GW on Main Gears 93.56
No. Main Gears 2
Wheels on Main Gear 2
Tire Pressure (kPa) 1,413
Alpha Used 0.900
Pass/Traffic Cycle (P/TC) Not Appl.
Annual Departures Not Appl.
Flex 20yr Covs, P/C = 5.58 10,000
Rig 20yr Covs, P/C = 5.58 10,000
Rigid Cutoff (times rrs) 5.00
Computational Modes
ACN
Thickness
Life
Int. Stress
Edge Stress
PCN
MGW
Flexible
Rigid
LESS <<<
SG CBR Flex t, mm ACN Flex k, MN/m^3 Rig t, mm ACN Rig
D 3.0 723.6 18.7
C 6.0 468.6 16.4
B 10.0 339.2 15.3
A 15.0 264.5 15.2
Evaluation Thickness = 600.00
Stress =
Critical Aircraft
Flexible Computation Finished

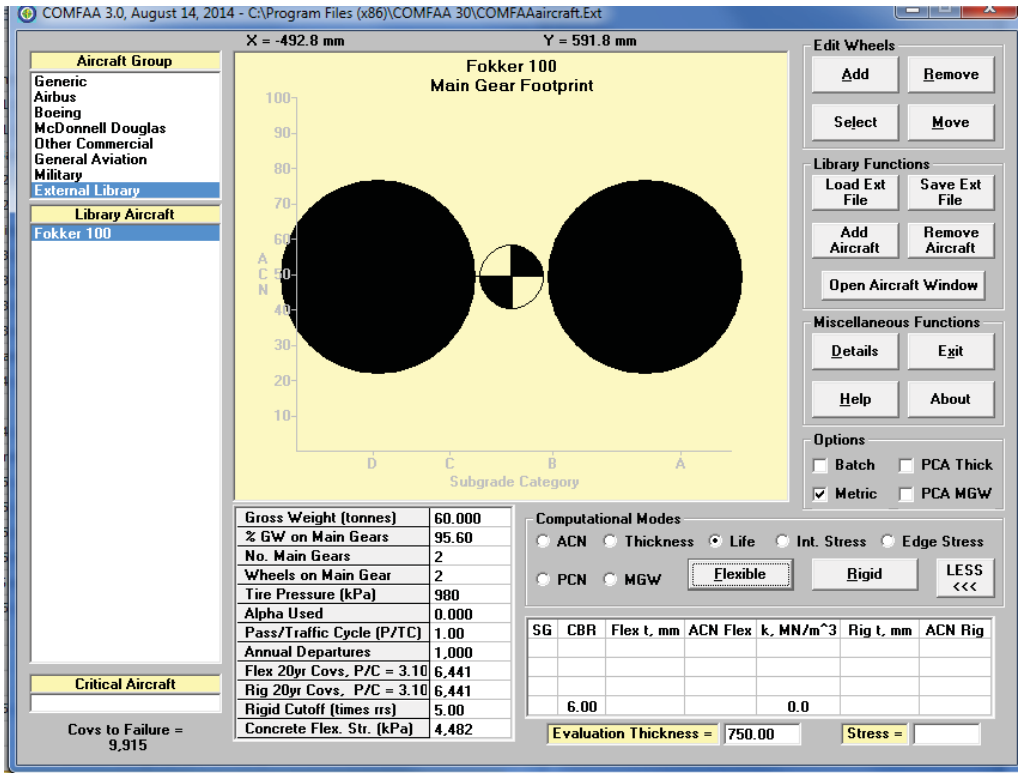
EXISTING PCN - RPT Apron

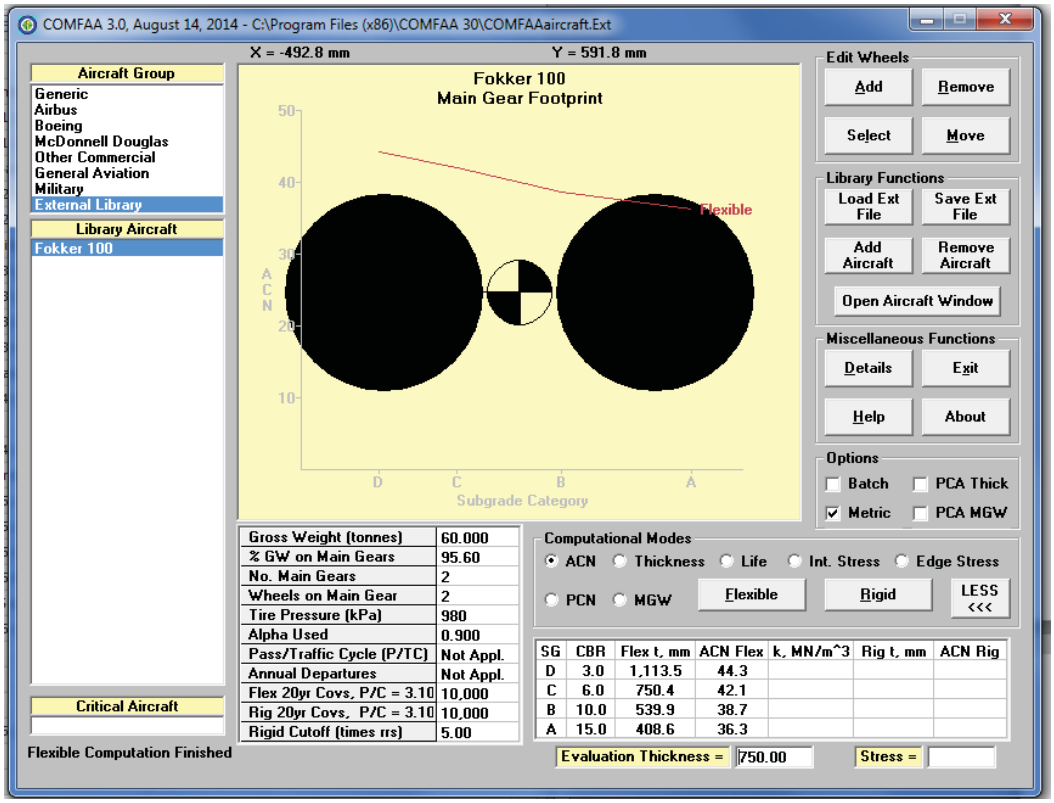


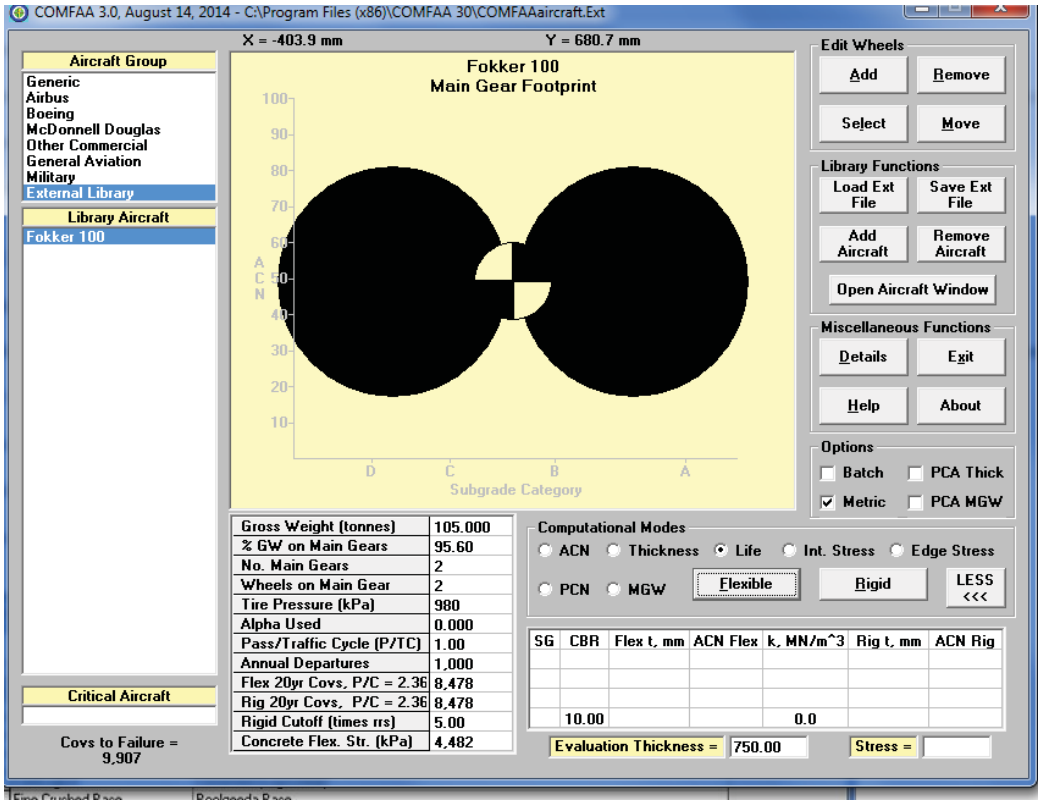


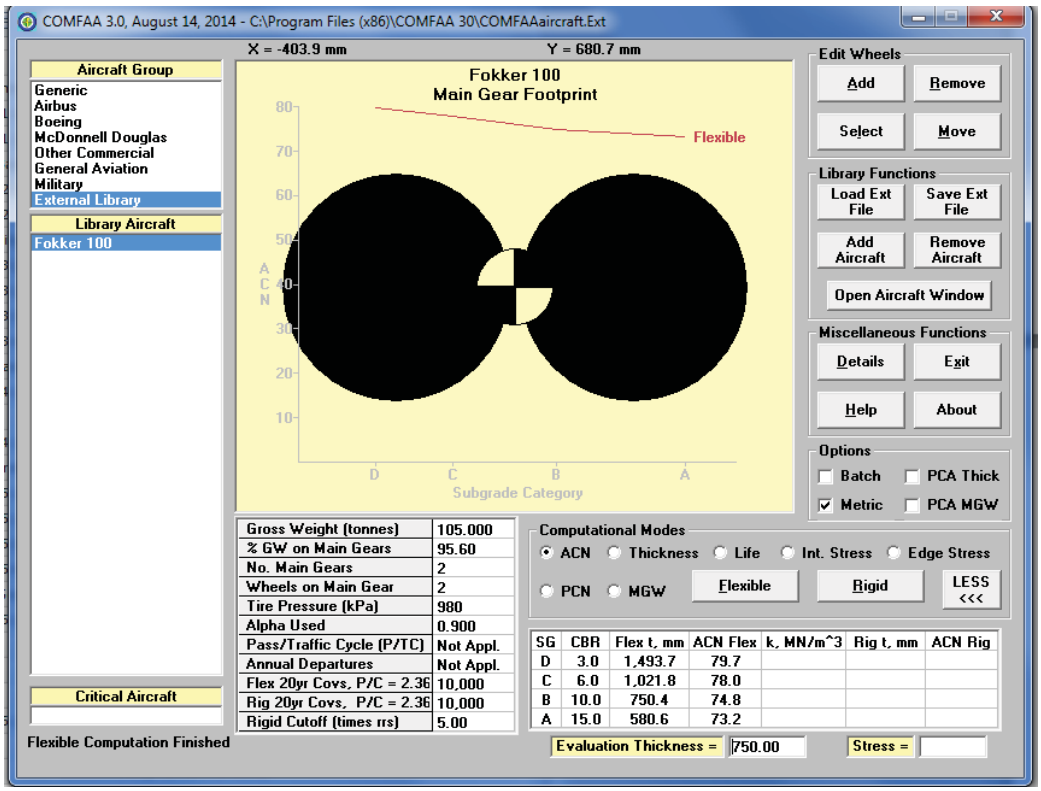

COMFAA 3.0, August 14, 2014 - C:\Program Files (x86)\COMFAA 30\COMFAAaircraft.Ext
X = -424.2 mm
Y = 391.2 mm
Aircraft Group
Generic
Airbus
Boeing
McDonnell Douglas
Other Commercial
General Aviation
Military
External Library
Library Aircraft
Fokker 100
Critical Aircraft
Covs to Failure = 10,759
Fokker 100
Main Gear Footprint
ACN
Subgrade Category
Edit Wheels
Add
Remove
Select
Move
Library Functions
Load Ext File
Save Ext File
Add Aircraft
Remove Aircraft
Open Aircraft Window
Miscellaneous Functions
Details
Exit
Help
About
Options
Batch
PCA Thick
Metric
PCA MGW
Gross Weight (tonnes) 39.000
% GW on Main Gears 95.60
No. Main Gears 2
Wheels on Main Gear 2
Tire Pressure (kPa) 980
Alpha Used 0.000
Pass/Traffic Cycle (P/TC) 1.00
Annual Departures 1,000
Flex 20yr Covs, P/C = 3.84 5,205
Rig 20yr Covs, P/C = 3.84 5,205
Rigid Cutoff (times rrs) 5.00
Concrete Flex. Str. (kPa) 4,482
Computational Modes
ACN
Thickness
Life
Int. Stress
Edge Stress
PCN
MGW
Flexible
Rigid
LESS <<<
SG CBR Flex t, mm ACN Flex k, MN/m^3 Rig t, mm ACN Rig
4.00 0.0
Evaluation Thickness = 750.00
Stress =


COMFAA 3.0, August 14, 2014 - C:\Program Files (x86)\COMFAA 30\COMFAAaircraft.Ext
X = -424.2 mm
Y = 391.2 mm
Aircraft Group
Generic
Airbus
Boeing
McDonnell Douglas
Other Commercial
General Aviation
Military
External Library
Library Aircraft
Fokker 100
Critical Aircraft
Flexible Computation Finished
Fokker 100
Main Gear Footprint
Flexible
ACN
Subgrade Category
Edit Wheels
Add
Remove
Select
Move
Library Functions
Load Ext File
Save Ext File
Add Aircraft
Remove Aircraft
Open Aircraft Window
Miscellaneous Functions
Details
Exit
Help
About
Options
Batch
PCA Thick
Metric
PCA MGW
Gross Weight (tonnes) 39.000
% GW on Main Gears 95.60
No. Main Gears 2
Wheels on Main Gear 2
Tire Pressure (kPa) 980
Alpha Used 0.900
Pass/Traffic Cycle (P/TC) Not Appl.
Annual Departures Not Appl.
Flex 20yr Covs, P/C = 3.84 10,000
Rig 20yr Covs, P/C = 3.84 10,000
Rigid Cutoff (times rrs) 5.00
Computational Modes
ACN
Thickness
Life
Int. Stress
Edge Stress
PCN
MGW
Flexible
Rigid
LESS <<<
SG CBR Flex t, mm ACN Flex k, MN/m^3 Rig t, mm ACN Rig
D 3.0 881.5 27.7
C 6.0 581.8 25.3
B 10.0 407.9 22.1
A 15.0 309.4 20.8
Evaluation Thickness = 750.00
Stress =

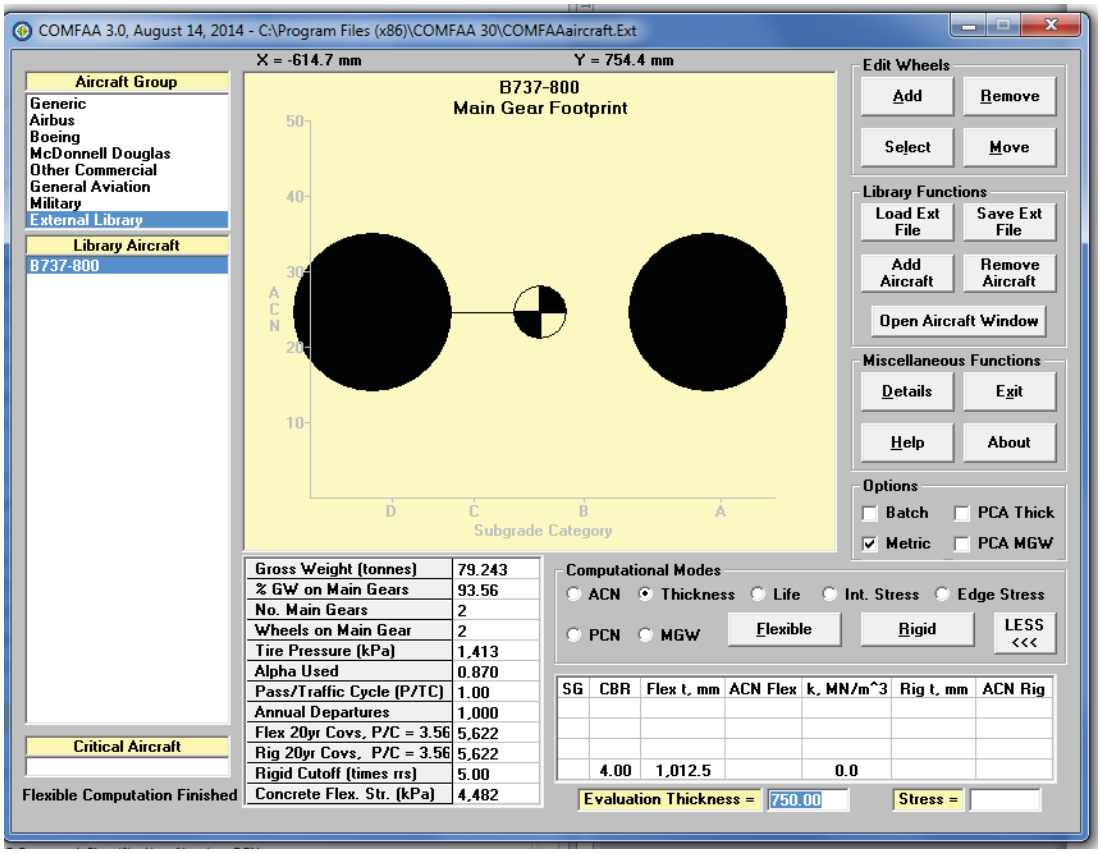

COMFAA 3.0, August 14, 2014 - C:\Program Files (x86)\COMFAA 30\COMFAAaircraft.Ext
X = -492.8 mm
Y = 591.8 mm
Aircraft Group
Generic
Airbus
Boeing
McDonnell Douglas
Other Commercial
General Aviation
Military
External Library
Library Aircraft
Fokker 100
Critical Aircraft
Covs to Failure = 9,915
Fokker 100
Main Gear Footprint
ACN
Subgrade Category
Edit Wheels
Add
Remove
Select
Move
Library Functions
Load Ext File
Save Ext File
Add Aircraft
Remove Aircraft
Open Aircraft Window
Miscellaneous Functions
Details
Exit
Help
About
Options
Batch
PCA Thick
Metric
PCA MGW
Gross Weight (tonnes) 60.000
% GW on Main Gears 95.60
No. Main Gears 2
Wheels on Main Gear 2
Tire Pressure (kPa) 980
Alpha Used 0.000
Pass/Traffic Cycle (P/TC) 1.00
Annual Departures 1,000
Flex 20yr Covs, P/C = 3.10 6,441
Rig 20yr Covs, P/C = 3.10 6,441
Rigid Cutoff (times rrs) 5.00
Concrete Flex. Str. (kPa) 4,482
Computational Modes
ACN
Thickness
Life
Int. Stress
Edge Stress
PCN
MGW
Flexible
Rigid
LESS <<<
SG CBR Flex t, mm ACN Flex k, MN/m^3 Rig t, mm ACN Rig
6.00 0.0
Evaluation Thickness = 750.00
Stress =

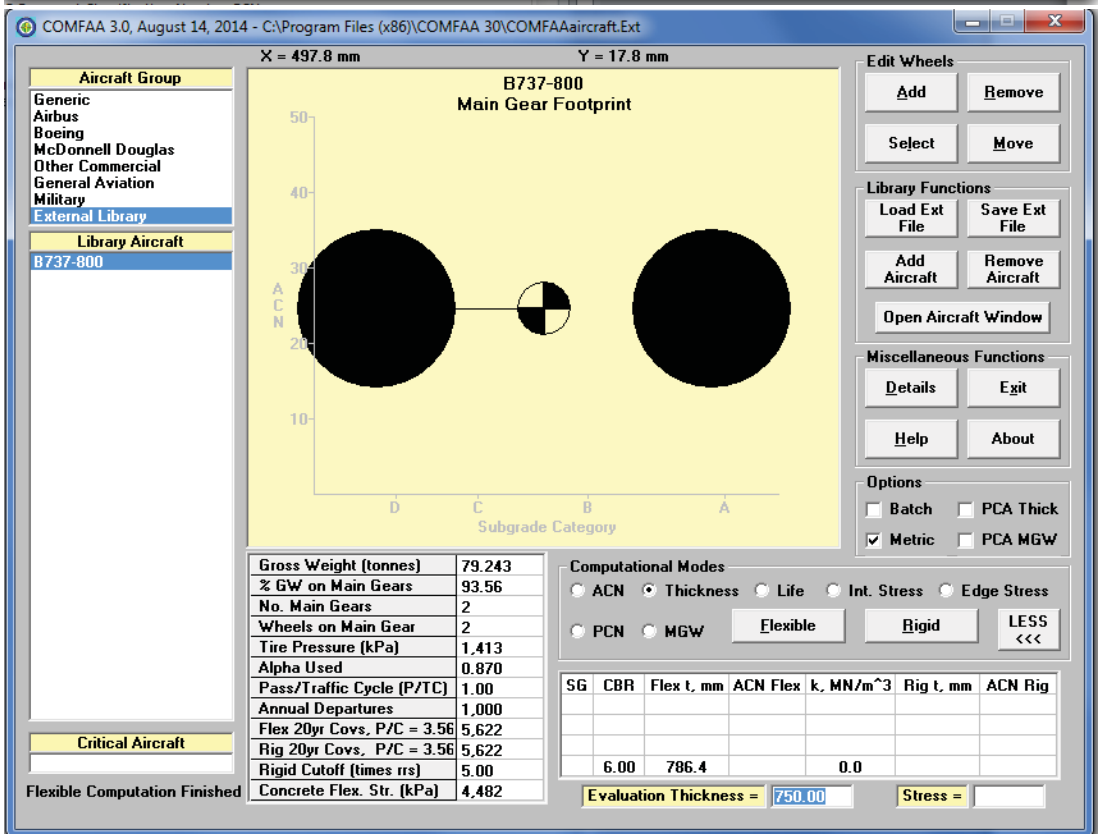

COMFAA 3.0, August 14, 2014 - C:\Program Files (x86)\COMFAA 30\COMFAAaircraft.Ext
X = -492.8 mm
Y = 591.8 mm
Aircraft Group
Generic
Airbus
Boeing
McDonnell Douglas
Other Commercial
General Aviation
Military
External Library
Library Aircraft
Fokker 100
Critical Aircraft
Flexible Computation Finished
Fokker 100
Main Gear Footprint
Flexible
ACN
Subgrade Category
Edit Wheels
Add
Remove
Select
Move
Library Functions
Load Ext File
Save Ext File
Add Aircraft
Remove Aircraft
Open Aircraft Window
Miscellaneous Functions
Details
Exit
Help
About
Options
Batch
PCA Thick
Metric
PCA MGW
Gross Weight (tonnes) 60.000
% GW on Main Gears 95.60
No. Main Gears 2
Wheels on Main Gear 2
Tire Pressure (kPa) 980
Alpha Used 0.900
Pass/Traffic Cycle (P/TC) Not Appl.
Annual Departures Not Appl.
Flex 20yr Covs, P/C = 3.10 10,000
Rig 20yr Covs, P/C = 3.10 10,000
Rigid Cutoff (times rrs) 5.00
Computational Modes
ACN
Thickness
Life
Int. Stress
Edge Stress
PCN
MGW
Flexible
Rigid
LESS <<<
SG CBR Flex t, mm ACN Flex k, MN/m^3 Rig t, mm ACN Rig
D 3.0 1,113.5 44.3
C 6.0 750.4 42.1
B 10.0 539.9 38.7
A 15.0 408.6 36.3
Evaluation Thickness = 750.00
Stress =

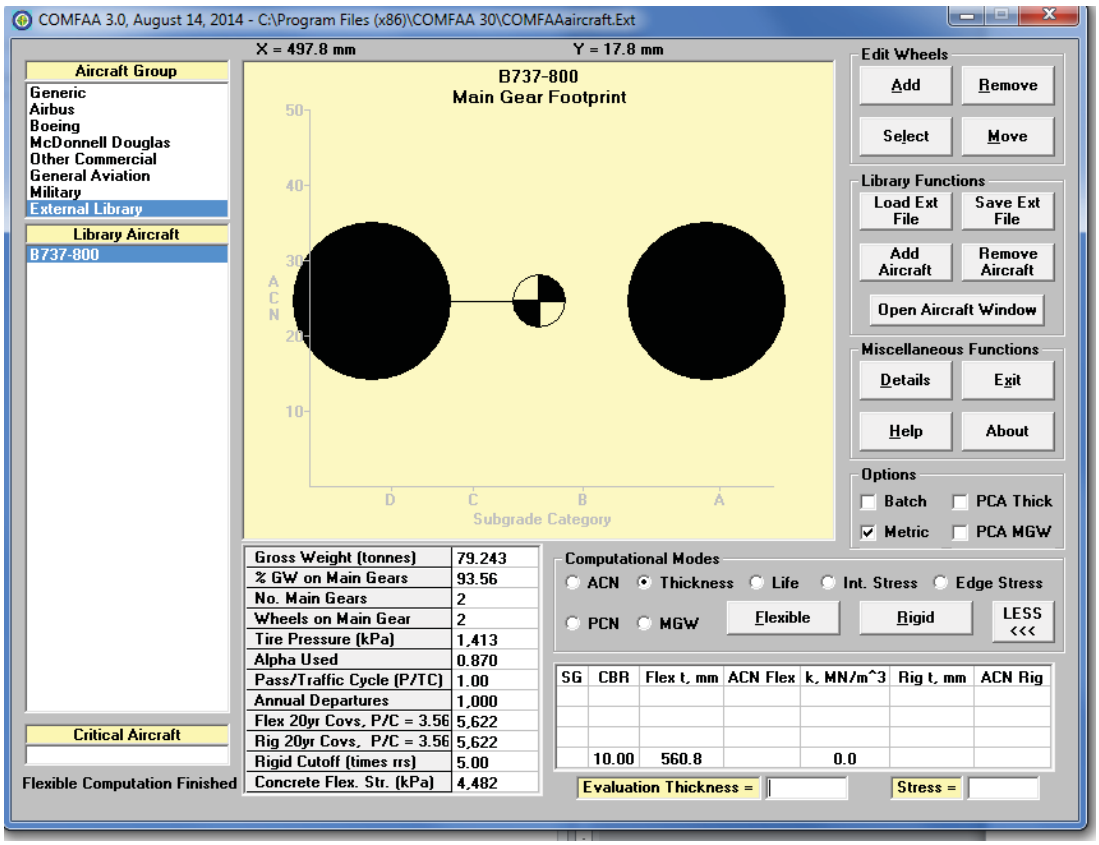

COMFAA 3.0, August 14, 2014 - C:\Program Files (x86)\COMFAA 30\COMFAAaircraft.Ext
X = -403.9 mm
Y = 680.7 mm
Aircraft Group
Generic
Airbus
Boeing
McDonnell Douglas
Other Commercial
General Aviation
Military
External Library
Library Aircraft
Fokker 100
Critical Aircraft
Covs to Failure = 9,907
Fokker 100
Main Gear Footprint
ACN
Subgrade Category
Edit Wheels
Add
Remove
Select
Move
Library Functions
Load Ext File
Save Ext File
Add Aircraft
Remove Aircraft
Open Aircraft Window
Miscellaneous Functions
Details
Exit
Help
About
Options
Batch
PCA Thick
Metric
PCA MGW
Gross Weight (tonnes) 105.000
% GW on Main Gears 95.60
No. Main Gears 2
Wheels on Main Gear 2
Tire Pressure (kPa) 980
Alpha Used 0.000
Pass/Traffic Cycle (P/TC) 1.00
Annual Departures 1,000
Flex 20yr Covs, P/C = 2.36 8,478
Rig 20yr Covs, P/C = 2.36 8,478
Rigid Cutoff (times rrs) 5.00
Concrete Flex. Str. (kPa) 4,482
Computational Modes
ACN
Thickness
Life
Int. Stress
Edge Stress
PCN
MGW
Flexible
Rigid
LESS <<<
SG CBR Flex t, mm ACN Flex k, MN/m^3 Rig t, mm ACN Rig
10.00 0.0
Evaluation Thickness = 750.00
Stress =

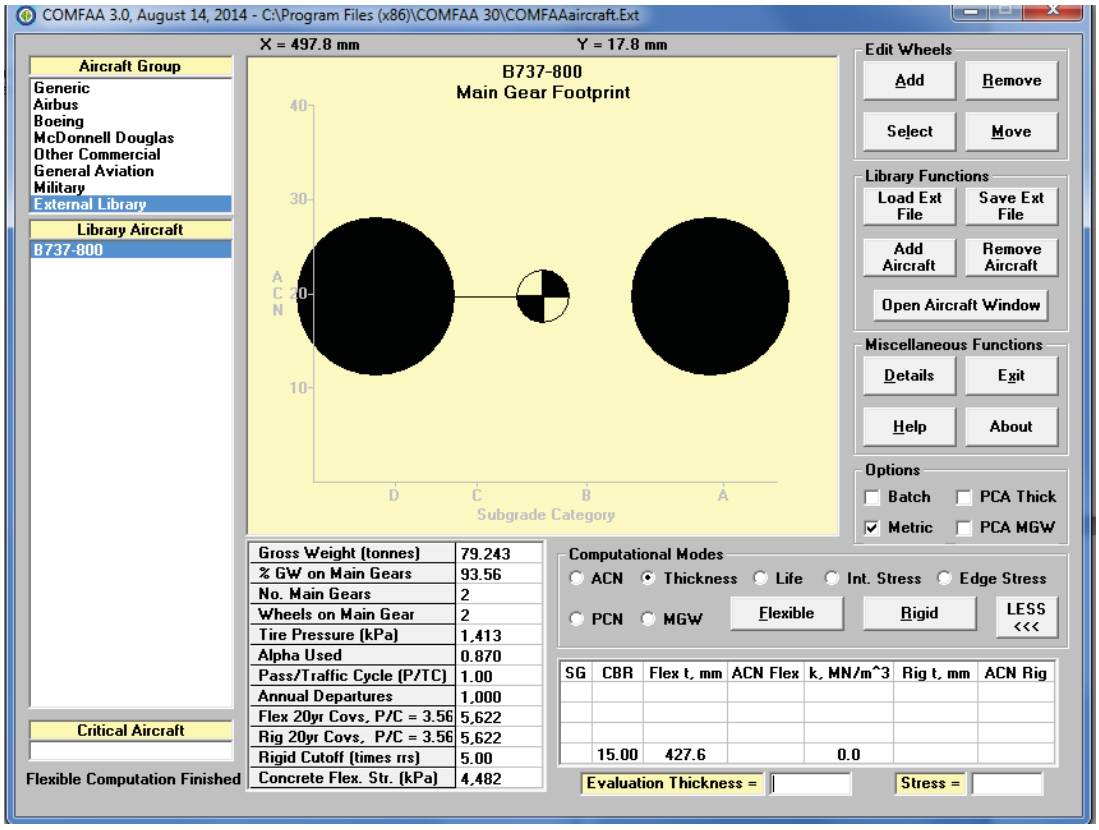

COMFAA 3.0, August 14, 2014 - C:\Program Files (x86)\COMFAA 30\COMFAAaircraft.Ext
X = -403.9 mm
Y = 680.7 mm
Aircraft Group
Generic
Airbus
Boeing
McDonnell Douglas
Other Commercial
General Aviation
Military
External Library
Library Aircraft
Fokker 100
Critical Aircraft
Flexible Computation Finished
Fokker 100
Main Gear Footprint
Flexible
ACN
Subgrade Category
Edit Wheels
Add
Remove
Select
Move
Library Functions
Load Ext File
Save Ext File
Add Aircraft
Remove Aircraft
Open Aircraft Window
Miscellaneous Functions
Details
Exit
Help
About
Options
Batch
PCA Thick
Metric
PCA MGW
Gross Weight (tonnes) 105.000
% GW on Main Gears 95.60
No. Main Gears 2
Wheels on Main Gear 2
Tire Pressure (kPa) 980
Alpha Used 0.900
Pass/Traffic Cycle (P/TC) Not Appl.
Annual Departures Not Appl.
Flex 20yr Covs, P/C = 2.36 10,000
Rig 20yr Covs, P/C = 2.36 10,000
Rigid Cutoff (times rrs) 5.00
Computational Modes
ACN
Thickness
Life
Int. Stress
Edge Stress
PCN
MGW
Flexible
Rigid
LESS <<<
SG CBR Flex t, mm ACN Flex k, MN/m^3 Rig t, mm ACN Rig
D 3.0 1,493.7 79.7
C 6.0 1,021.8 78.0
B 10.0 750.4 74.8
A 15.0 580.6 73.2
Evaluation Thickness = 750.00
Stress =

RUNWAY EXTENSION PAVEMENT THICKNESS






COMFAA 3.0, August 14, 2014 - C:\Program Files (x86)\COMFAA 30\COMFAAaircraft.Ext
X = 497.8 mm
Y = 17.8 mm
Aircraft Group
Generic
Airbus
Boeing
McDonnell Douglas
Other Commercial
General Aviation
Military
External Library
Library Aircraft
B737-800
Critical Aircraft
Flexible Computation Finished
B737-800
Main Gear Footprint
ACN
Subgrade Category
Edit Wheels
Add
Remove
Select
Move
Library Functions
Load Ext File
Save Ext File
Add Aircraft
Remove Aircraft
Open Aircraft Window
Miscellaneous Functions
Details
Exit
Help
About
Options
Batch
PCA Thick
Metric
PCA MGW
Gross Weight (tonnes) 79.243
% GW on Main Gears 93.56
No. Main Gears 2
Wheels on Main Gear 2
Tire Pressure (kPa) 1,413
Alpha Used 0.870
Pass/Traffic Cycle (P/TC) 1.00
Annual Departures 1,000
Flex 20yr Covs, P/C = 3.56 5,622
Rig 20yr Covs, P/C = 3.56 5,622
Rigid Cutoff (times rrs) 5.00
Concrete Flex. Str. (kPa) 4,482
Computational Modes
ACN
Thickness
Life
Int. Stress
Edge Stress
PCN
MGW
Flexible
Rigid
LESS <<<
SG CBR Flex t, mm ACN Flex k, MN/m^3 Rig t, mm ACN Rig
10.00 560.8 0.0
Evaluation Thickness =
Stress =


COMFAA 3.0, August 14, 2014 - C:\Program Files (x86)\COMFAA 30\COMFAAaircraft.Ext
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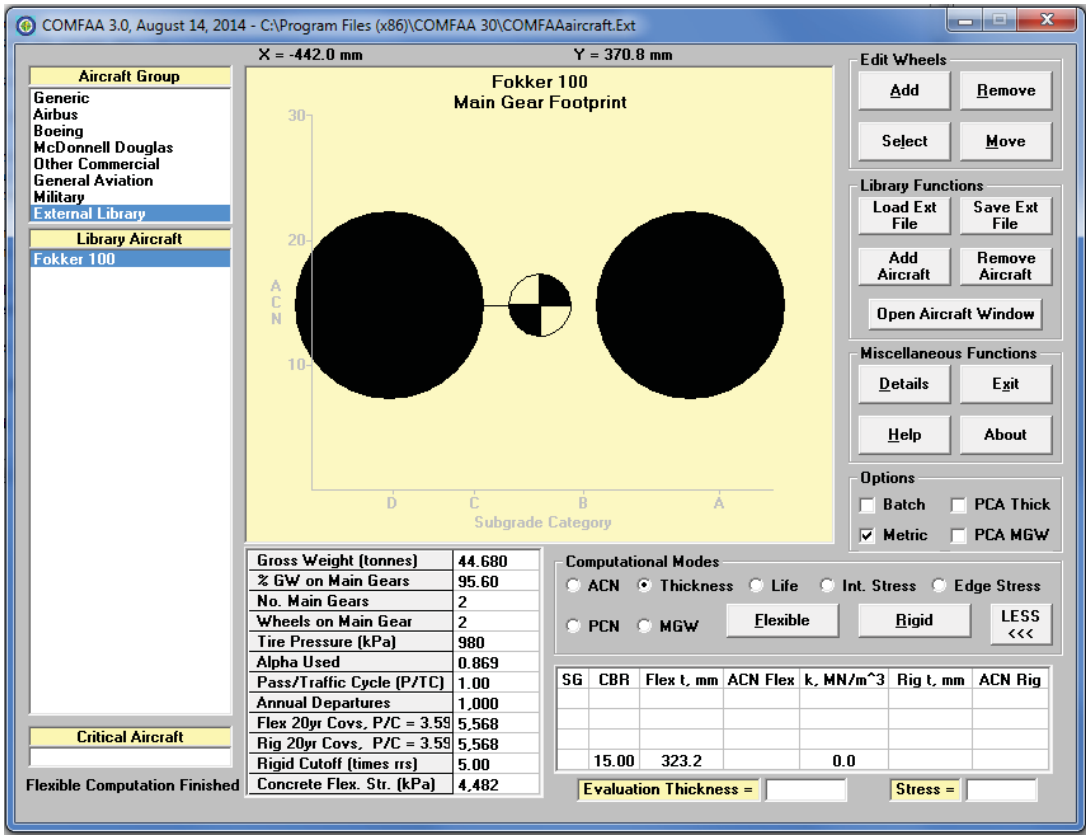
Y = 17.8 mm
Aircraft Group
Generic
Airbus
Boeing
McDonnell Douglas
Other Commercial
General Aviation
Military
External Library
Library Aircraft
B737-800
Critical Aircraft
Flexible Computation Finished
B737-800
Main Gear Footprint
ACN
Subgrade Category
Edit Wheels
Add
Remove
Select
Move
Library Functions
Load Ext File
Save Ext File
Add Aircraft
Remove Aircraft
Open Aircraft Window
Miscellaneous Functions
Details
Exit
Help
About
Options
Batch
PCA Thick
Metric
PCA MGW
Gross Weight (tonnes) 79.243
% GW on Main Gears 93.56
No. Main Gears 2
Wheels on Main Gear 2
Tire Pressure (kPa) 1,413
Alpha Used 0.870
Pass/Traffic Cycle (P/TC) 1.00
Annual Departures 1,000
Flex 20yr Covs, P/C = 3.56 5,622
Rig 20yr Covs, P/C = 3.56 5,622
Rigid Cutoff (times rrs) 5.00
Concrete Flex. Str. (kPa) 4,482
Computational Modes
ACN
Thickness
Life
Int. Stress
Edge Stress
PCN
MGW
Flexible
Rigid
LESS <<<
SG CBR Flex t, mm ACN Flex k, MN/m^3 Rig t, mm ACN Rig
15.00 427.6 0.0
Evaluation Thickness =
Stress =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Airbus
Boeing
McDonnell Douglas
Other Commercial
General Aviation
Military
External Library
Library Aircraft
Fokker 100
Critical Aircraft
Flexible Computation Finished
Fokker 100
Main Gear Footprint
ACN
30
20
10
D
C
B
A
Subgrade Category
Edit Wheels
Add
Remove
Select
Move
Library Functions
Load Ext File
Save Ext File
Add Aircraft
Remove Aircraft
Open Aircraft Window
Miscellaneous Functions
Details
Exit
Help
About
Options
Batch
PCA Thick
Metric
PCA MGW
Gross Weight (tonnes) 44.680
% GW on Main Gears 95.60
No. Main Gears 2
Wheels on Main Gear 2
Tire Pressure (kPa) 980
Alpha Used 0.869
Pass/Traffic Cycle (P/TC) 1.00
Annual Departures 1,000
Flex 20yr Covs, P/C = 3.59 5,568
Rig 20yr Covs, P/C = 3.59 5,568
Rigid Cutoff (times rrs) 5.00
Concrete Flex. Str. (kPa) 4,482
Computational Modes
ACN
Thickness
Life
Int. Stress
Edge Stress
PCN
MGW
Flexible
Rigid
LESS <<<
SG CBR Flex t, mm ACN Flex k, MN/m^3 Rig t, mm ACN Rig
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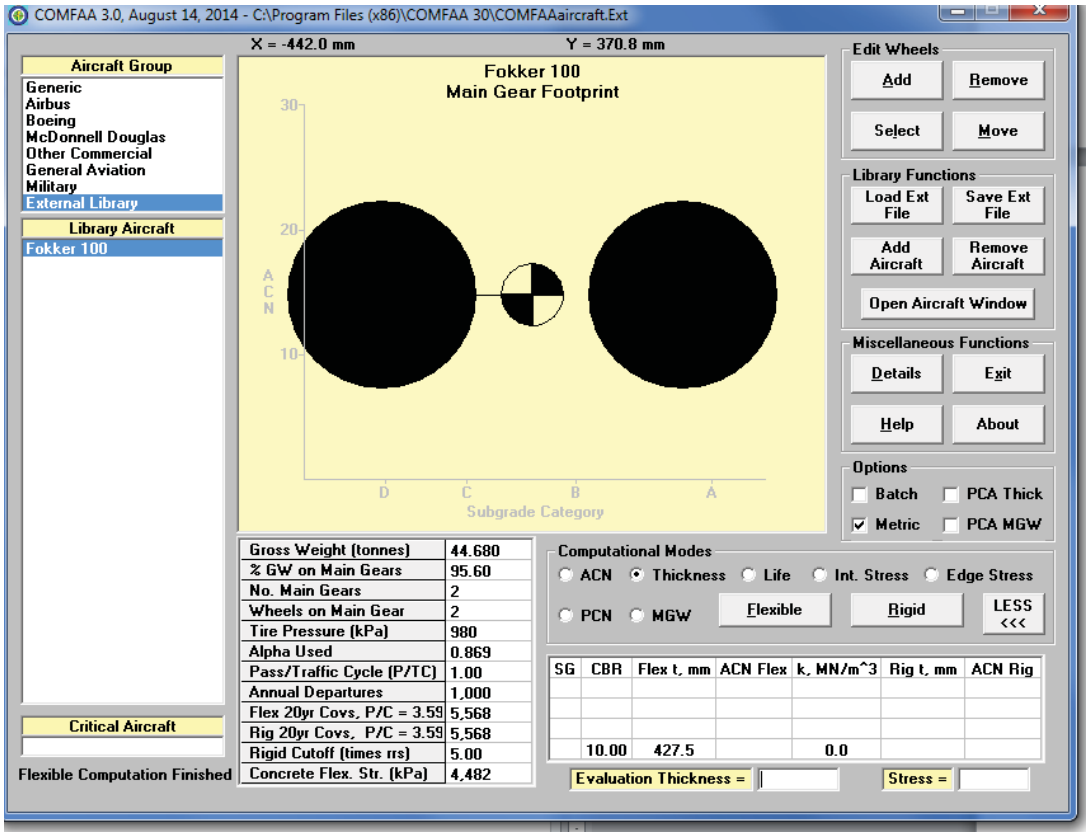
Evaluation Thickness =
Stress =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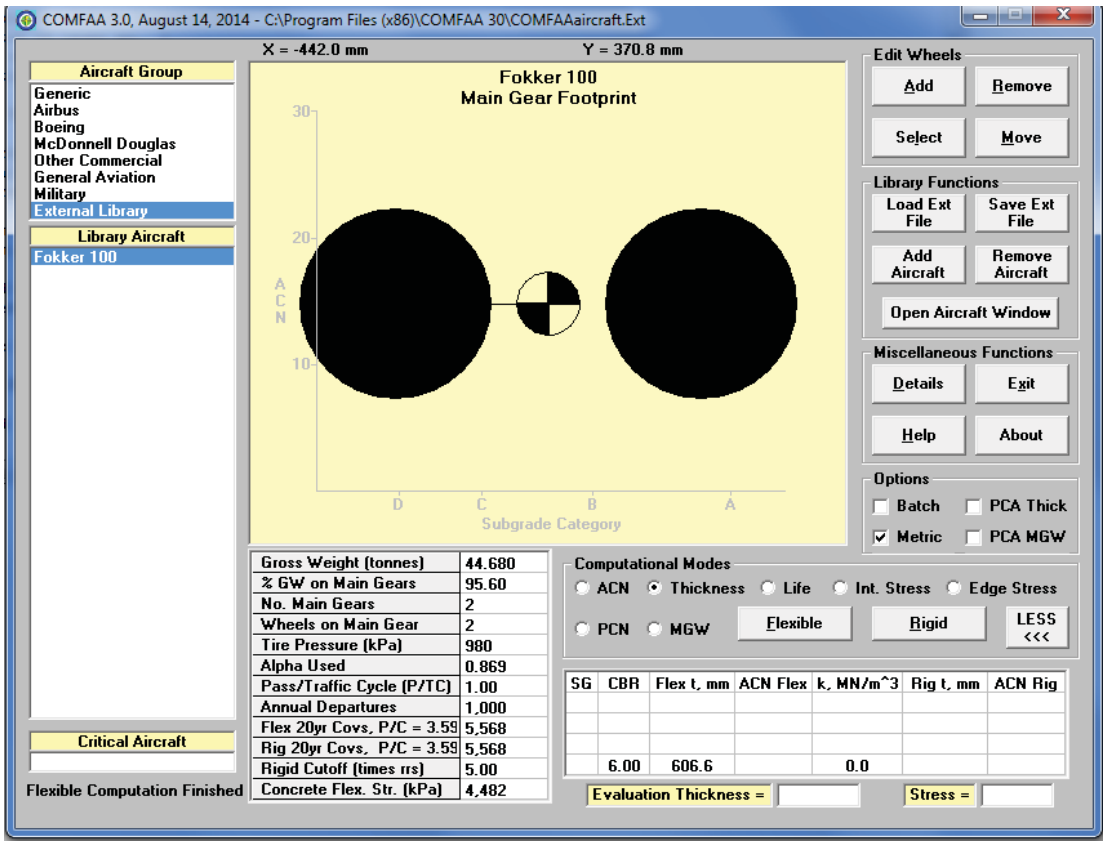
X = -442.0 mm
Y = 370.8 mm
Aircraft Group
Generic
Airbus
Boeing
McDonnell Douglas
Other Commercial
General Aviation
Military
External Library
Library Aircraft
Fokker 100
Critical Aircraft
Flexible Computation Finished
Fokker 100
Main Gear Footprint
ACN
30
20
10
D
C
B
A
Subgrade Category
Edit Wheels
Add
Remove
Select
Move
Library Functions
Load Ext File
Save Ext File
Add Aircraft
Remove Aircraft
Open Aircraft Window
Miscellaneous Functions
Details
Exit
Help
About
Options
Batch
PCA Thick
Metric
PCA MGW
Gross Weight (tonnes) 44.680
% GW on Main Gears 95.60
No. Main Gears 2
Wheels on Main Gear 2
Tire Pressure (kPa) 980
Alpha Used 0.869
Pass/Traffic Cycle (P/TC) 1.00
Annual Departures 1,000
Flex 20yr Covs, P/C = 3.59 5,568
Rig 20yr Covs, P/C = 3.59 5,568
Rigid Cutoff (times rrs) 5.00
Concrete Flex. Str. (kPa) 4,482
Computational Modes
ACN
Thickness
Life
Int. Stress
Edge Stress
PCN
MGW
Flexible
Rigid
LESS <<<
SG CBR Flex t, mm ACN Flex k, MN/m^3 Rig t, mm ACN Rig
10.00 427.5 0.0
Evaluation Thickness =
Stress =


COMFAA 3.0, August 14, 2014 - C:\Program Files (x86)\COMFAA 30\COMFAAaircraft.Ext
X = -442.0 mm
Y = 370.8 mm
Aircraft Group
Generic
Airbus
Boeing
McDonnell Douglas
Other Commercial
General Aviation
Military
External Library
Library Aircraft
Fokker 100
Critical Aircraft
Flexible Computation Finished
Fokker 100
Main Gear Footprint
ACN
30
20
10
D
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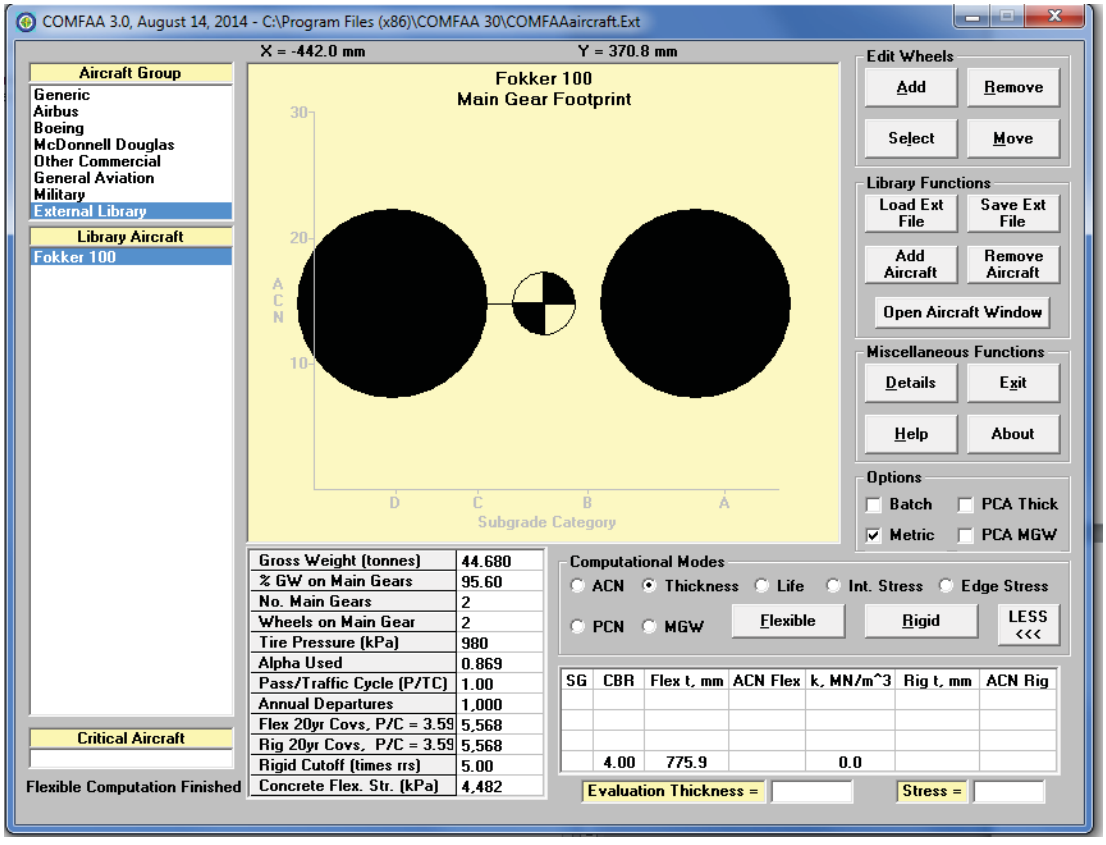
B
A
Subgrade Category
Edit Wheels
Add
Remove
Select
Move
Library Functions
Load Ext File
Save Ext File
Add Aircraft
Remove Aircraft
Open Aircraft Window
Miscellaneous Functions
Details
Exit
Help
About
Options
Batch
PCA Thick
Metric
PCA MGW
Gross Weight (tonnes) 44.680
% GW on Main Gears 95.60
No. Main Gears 2
Wheels on Main Gear 2
Tire Pressure (kPa) 980
Alpha Used 0.869
Pass/Traffic Cycle (P/TC) 1.00
Annual Departures 1,000
Flex 20yr Covs, P/C = 3.59 5,568
Rig 20yr Covs, P/C = 3.59 5,568
Rigid Cutoff (times rrs) 5.00
Concrete Flex. Str. (kPa) 4,482
Computational Modes
ACN
Thickness
Life
Int. Stress
Edge Stress
PCN
MGW
Flexible
Rigid
LESS <<<
SG CBR Flex t, mm ACN Flex k, MN/m^3 Rig t, mm ACN Rig
6.00 606.6 0.0
Evaluation Thickness =
Stress =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X = -442.0 mm
Y = 370.8 mm
Aircraft Group
Generic
Airbus
Boeing
McDonnell Douglas
Other Commercial
General Aviation
Military
External Library
Library Aircraft
Fokker 100
Critical Aircraft
Flexible Computation Finished
Fokker 100
Main Gear Footprint
ACN
30
20
10
D
C
B
A
Subgrade Category
Edit Wheels
Add
Remove
Select
Move
Library Functions
Load Ext File
Save Ext File
Add Aircraft
Remove Aircraft
Open Aircraft Window
Miscellaneous Functions
Details
Exit
Help
About
Options
Batch
PCA Thick
Metric
PCA MGW
Gross Weight (tonnes) 44.680
% GW on Main Gears 95.60
No. Main Gears 2
Wheels on Main Gear 2
Tire Pressure (kPa) 980
Alpha Used 0.869
Pass/Traffic Cycle (P/TC) 1.00
Annual Departures 1,000
Flex 20yr Covs, P/C = 3.59 5,568
Rig 20yr Covs, P/C = 3.59 5,568
Rigid Cutoff (times rrs) 5.00
Concrete Flex. Str. (kPa) 4,482
Computational Modes
ACN
Thickness
Life
Int. Stress
Edge Stress
PCN
MGW
Flexible
Rigid
LESS <<<
SG CBR Flex t, mm ACN Flex k, MN/m^3 Rig t, mm ACN Rig
4.00 775.9 0.0
Evaluation Thickness =
Stress =

Appendix H – APSDS Calculations

APSDS Version 5.0h (15 January 2015)

y-coordinate for results (Y): 0

Locations for Damage Calculations:
   Bottom of layer no. 1
   Top of layer no. 5
Job Title: APRON B737-800, A320-200 AND F100

Damage Factor Calculation

Standard Deviation of Wander: 200
Interval between result points along X-axis (XWDEL): 100
Upper range for approximation of statistics (XWMAX): 600

Minimum x-coordinate for results (XMIN): 0
Maximum x-coordinate for results (XMAX): 2950

Assumed number of damage pulses per movement:
   Reservoir Method

Traffic Spectrum Details:

   ID: KUNU APRON SC1 Title: APRON B737-800, AC320-200 AND F100

Load No.	Load ID	Movements
1	A320-200	9.54E+03
2	B737-800	9.74E+03
3	F100	1.08E+04

N.B. Full details of Load Groups will be provided in a future release.

Details of Layered System:

   ID: Kununurra APRON SC1 Title: Kununurra APRON SC1

Layer No.	Lower i/face	Material ID	Isotropy	Modulus (or Ev)	P.Ratio (or vvh)	F	Eh	vh
1	rough	Asph1000	Iso.	1.00E+03	0.40			
2	rough	Gran-300	Aniso.	3.00E+02	0.35	2.22E+02	1.50E+02	0.35
3	rough	Gran-250	Aniso.	2.50E+02	0.35	1.85E+02	1.25E+02	0.35
4	rough	Gran-150	Aniso.	1.50E+02	0.35	1.11E+02	7.50E+01	0.35
5	rough	cbr10 - dependent	Iso.	1.00E+02	0.40			

   Performance Relationships:

Layer No.	Location	Performance ID	Component	Perform. Constant	Perform. Exponent	Traffic Multiplier
1	bottom	Asph1000	ETH	0.005695	5.000	1.000
5	top	Calibr_2010	EZZ	0.000000	0.000	1.000

   Reliability Factors: Not Used.

Results:

Layer No.	Thickness	Material ID	Load ID	Gross Weight	Critical Strain	CDF
1	30.00	Asph1000	Total			1.15E-04
			A320-200	77.00	-1.92E-04	5.04E-05
			B737-800	78.00	-1.65E-04	3.91E-05
			F100	42.00	-1.54E-04	3.63E-05
2	150.00	Gran-300			n/a	n/a
3	450.00	Gran-250			n/a	n/a
4	150.00	Gran-150			n/a	n/a
5	0.00	cbr10 - dependent	Total			4.86E-02
			A320-200	77.00	1.15E-03	4.36E-03
			B737-800	78.00	1.21E-03	4.75E-02
			F100	42.00	8.70E-04	6.23E-04

APSDS Version 5.0h (15 January 2015)

y-coordinate for results (Y): 0

Locations for Damage Calculations:
   Bottom of layer no. 1
   Top of layer no. 3
Job Title: TAXI B B737-800

Damage Factor Calculation

Standard Deviation of Wander: 773
Interval between result points along X-axis (XWDEL): 100
Upper range for approximation of statistics (XWMAX): 2100.1

Minimum x-coordinate for results (XMIN): 0
Maximum x-coordinate for results (XMAX): 2950

Assumed number of damage pulses per movement:
   Reservoir Method

Traffic Spectrum Details:

   ID: KUNU TX B SC 3 Title: TAX B B737-800

Load No.	Load ID	Movements
1	B737-800	2.20E+03

N.B. Full details of Load Groups will be provided in a future release.

Details of Layered System:

   ID: Kununurra TX B SC3 Title: TAX B B737-800

Layer No.	Lower i/face	Material ID	Isotropy	Modulus (or Ev)	P.Ratio (or vvh)	F	Eh	vh
1	rough	Asph1000	Iso.	1.00E+03	0.40			
2	rough	Cem500A	Aniso.	5.00E+02	0.35	3.70E+02	2.50E+02	0.35
3	rough	cbr4 - dependent	Iso.	4.00E+01	0.40			

   Performance Relationships:

Layer No.	Location	Performance ID	Component	Perform. Constant	Perform. Exponent	Traffic Multiplier
1	bottom	Asph1000	ETH	0.005695	5.000	1.000
3	top	Calibr_2010	EZZ	0.000000	0.000	1.000

   Reliability Factors: Not Used.

Results:

Layer No.	Thickness	Material ID	Load ID	Gross Weight	Critical Strain	CDF
1	50.00	Asph1000	Total			2.69E-07
			B737-800	78.00	-7.51E-05	2.69E-07
2	750.00	Cem500A			n/a	n/a
3	0.00	cbr4 - dependent	Total			8.50E-01
			B737-800	78.00	1.55E-03	8.50E-01

APSDS Version 5.0h (15 January 2015)

y-coordinate for results (Y): 0

Locations for Damage Calculations:
   Bottom of layer no. 1
   Top of layer no. 3
Job Title: B737-800 AND F100

Damage Factor Calculation

Standard Deviation of Wander: 773
Interval between result points along X-axis (XWDEL): 100
Upper range for approximation of statistics (XWMAX): 2100.1

Minimum x-coordinate for results (XMIN): 0
Maximum x-coordinate for results (XMAX): 2950

Assumed number of damage pulses per movement:
   Reservoir Method

Traffic Spectrum Details:

   ID: KUNU TX B SC 2 Title: TAX B B737-800 AND F100

Load No.	Load ID	Movements
1	B737-800	1.72E+03
2	F100	9.46E+02

N.B. Full details of Load Groups will be provided in a future release.

Details of Layered System:

   ID: Kununurra TX B SC2 Title: TAX B B737-800 AND F100

Layer No.	Lower i/face	Material ID	Isotropy	Modulus (or Ev)	P.Ratio (or vvh)	F	Eh	vh
1	rough	Asph1000	Iso.	1.00E+03	0.40			
2	rough	Cem500A	Aniso.	5.00E+02	0.35	3.70E+02	2.50E+02	0.35
3	rough	cbr4 - dependent	Iso.	4.00E+01	0.40			

   Performance Relationships:

Layer No.	Location	Performance ID	Component	Perform. Constant	Perform. Exponent	Traffic Multiplier
1	bottom	Asph1000	ETH	0.005695	5.000	1.000
3	top	Calibr_2010	EZZ	0.000000	0.000	1.000

   Reliability Factors: Not Used.

Results:

Layer No.	Thickness	Material ID	Load ID	Gross Weight	Critical Strain	CDF
1	50.00	Asph1000	Total			3.00E-07
			B737-800	78.00	-7.31E-05	2.25E-07
			F100	42.00	-1.17E-04	1.93E-07
2	740.00	Cem500A			n/a	n/a
3	0.00	cbr4 - dependent	Total			8.19E-01
			B737-800	78.00	1.58E-03	8.17E-01
			F100	42.00	1.06E-03	1.80E-03

APSDS Version 5.0h (15 January 2015)

y-coordinate for results (Y): 0

Locations for Damage Calculations:
   Bottom of layer no. 1
   Top of layer no. 3
Job Title: KUNUNURRA TAX B SC1

Damage Factor Calculation

Standard Deviation of Wander: 773
Interval between result points along X-axis (XWDEL): 100
Upper range for approximation of statistics (XWMAX): 2100.1

Minimum x-coordinate for results (XMIN): 0
Maximum x-coordinate for results (XMAX): 2950

Assumed number of damage pulses per movement:
   Reservoir Method

Traffic Spectrum Details:

   ID: KUNU TAX B SC 1 Title: B737-800, A320-200 AND F100

Load No.	Load ID	Movements
1	A320-200	9.54E+02
2	B737-800	9.74E+02
3	F100	1.08E+03

N.B. Full details of Load Groups will be provided in a future release.

Details of Layered System:

   ID: Kununurra TX B SC1 Title: B737-800, A3200-200 AND F100

Layer No.	Lower i/face	Material ID	Isotropy	Modulus (or Ev)	P.Ratio (or vvh)	F	Eh	vh
1	rough	Asph1000	Iso.	1.00E+03	0.40			
2	rough	Cem500A	Aniso.	5.00E+02	0.35	3.70E+02	2.50E+02	0.35
3	rough	cbr4 - dependent	Iso.	4.00E+01	0.40			

   Performance Relationships:

Layer No.	Location	Performance ID	Component	Perform. Constant	Perform. Exponent	Traffic Multiplier
1	bottom	Asph1000	ETH	0.005695	5.000	1.000
3	top	Calibr_2010	EZZ	0.000000	0.000	1.000

   Reliability Factors: Not Used.

Results:

Layer No.	Thickness	Material ID	Load ID	Gross Weight	Critical Strain	CDF
1	50.00	Asph1000	Total			6.03E-07
			A320-200	77.00	-1.32E-04	3.59E-07
			B737-800	78.00	-7.27E-05	1.45E-07
			F100	42.00	-1.14E-04	1.94E-07
2	720.00	Cem500A			n/a	n/a
3	0.00	cbr4 - dependent	Total			8.78E-01
			A320-200	77.00	1.55E-03	2.40E-01
			B737-800	78.00	1.63E-03	7.04E-01
			F100	42.00	1.10E-03	3.27E-03

APSDS Version 5.0h (15 January 2015)

y-coordinate for results (Y): 0

Locations for Damage Calculations:
   Bottom of layer no. 1
   Top of layer no. 3
Job Title: B737-800 ONLY

Damage Factor Calculation

Standard Deviation of Wander: 773
Interval between result points along X-axis (XWDEL): 100
Upper range for approximation of statistics (XWMAX): 2100.1

Minimum x-coordinate for results (XMIN): 0
Maximum x-coordinate for results (XMAX): 2950

Assumed number of damage pulses per movement:
   Reservoir Method

Traffic Spectrum Details:

   ID: KUNU TX A SC 3 Title: B737-800 ONLY

Load No.	Load ID	Movements
1	B737-800	1.98E+04

N.B. Full details of Load Groups will be provided in a future release.

Details of Layered System:

   ID: Kununurra TX A SC3 Title: B737-800 ONLY

Layer No.	Lower i/face	Material ID	Isotropy	Modulus (or Ev)	P.Ratio (or vvh)	F	Eh	vh
1	rough	Asph1000	Iso.	1.00E+03	0.40			
2	rough	Cem500A	Aniso.	5.00E+02	0.35	3.70E+02	2.50E+02	0.35
3	rough	cbr4 - dependent	Iso.	4.00E+01	0.40			

   Performance Relationships:

Layer No.	Location	Performance ID	Component	Perform. Constant	Perform. Exponent	Traffic Multiplier
1	bottom	Asph1000	ETH	0.005695	5.000	1.000
3	top	Calibr_2010	EZZ	0.000000	0.000	1.000

   Reliability Factors: Not Used.

Results:

Layer No.	Thickness	Material ID	Load ID	Gross Weight	Critical Strain	CDF
1	50.00	Asph1000	Total			4.05E-06
			B737-800	78.00	-9.63E-05	4.05E-06
2	860.00	Cem500A			n/a	n/a
3	0.00	cbr4 - dependent	Total			8.96E-01
			B737-800	78.00	1.32E-03	8.96E-01

APSDS Version 5.0h (15 January 2015)

y-coordinate for results (Y): 0

Locations for Damage Calculations:
   Bottom of layer no. 1
   Top of layer no. 3
Job Title: KUNUNURRA TAX A SC2

Damage Factor Calculation

Standard Deviation of Wander: 773
Interval between result points along X-axis (XWDEL): 100
Upper range for approximation of statistics (XWMAX): 2100.1

Minimum x-coordinate for results (XMIN): 0
Maximum x-coordinate for results (XMAX): 2950

Assumed number of damage pulses per movement:
   Reservoir Method

Traffic Spectrum Details:

   ID: KUNU TX A SC 2 Title: B737-800 AND F100

Load No.	Load ID	Movements
1	B737-800	1.55E+04
2	F100	8.51E+03

N.B. Full details of Load Groups will be provided in a future release.

Details of Layered System:

   ID: Kununurra TX A SC2 Title: B737-800 AND F100

Layer No.	Lower i/face	Material ID	Isotropy	Modulus (or Ev)	P.Ratio (or vvh)	F	Eh	vh
1	rough	Asph1000	Iso.	1.00E+03	0.40			
2	rough	Cem500A	Aniso.	5.00E+02	0.35	3.70E+02	2.50E+02	0.35
3	rough	cbr4 - dependent	Iso.	4.00E+01	0.40			

   Performance Relationships:

Layer No.	Location	Performance ID	Component	Perform. Constant	Perform. Exponent	Traffic Multiplier
1	bottom	Asph1000	ETH	0.005695	5.000	1.000
3	top	Calibr_2010	EZZ	0.000000	0.000	1.000

   Reliability Factors: Not Used.

Results:

Layer No.	Thickness	Material ID	Load ID	Gross Weight	Critical Strain	CDF
1	50.00	Asph1000	Total			6.08E-06
			B737-800	78.00	-9.45E-05	2.89E-06
			F100	42.00	-1.30E-04	3.23E-06
2	850.00	Cem500A			n/a	n/a
3	0.00	cbr4 - dependent	Total			8.46E-01
			B737-800	78.00	1.33E-03	8.45E-01
			F100	42.00	8.72E-04	1.40E-03

APSDS Version 5.0h (15 January 2015)

y-coordinate for results (Y): 0

Locations for Damage Calculations:
   Bottom of layer no. 1
   Top of layer no. 3
Job Title: KUNUNURRA TAXI A SC1

Damage Factor Calculation

Standard Deviation of Wander: 773
Interval between result points along X-axis (XWDEL): 100
Upper range for approximation of statistics (XWMAX): 2100.1

Minimum x-coordinate for results (XMIN): 0
Maximum x-coordinate for results (XMAX): 2950

Assumed number of damage pulses per movement:
   Reservoir Method

Traffic Spectrum Details:

   ID: KUNU TX A SC 1 Title: KUNU TX A SC 1

Load No.	Load ID	Movements
1	A320-200	8.59E+03
2	B737-800	8.76E+03
3	F100	9.68E+03

N.B. Full details of Load Groups will be provided in a future release.

Details of Layered System:

   ID: Kununurra TX A SC1 Title: Kununurra TX A SC1

Layer No.	Lower i/face	Material ID	Isotropy	Modulus (or Ev)	P.Ratio (or vvh)	F	Eh	vh
1	rough	Asph1000	Iso.	1.00E+03	0.40			
2	rough	Cem500A	Aniso.	5.00E+02	0.35	3.70E+02	2.50E+02	0.35
3	rough	cbr4 - dependent	Iso.	4.00E+01	0.40			

   Performance Relationships:

Layer No.	Location	Performance ID	Component	Perform. Constant	Perform. Exponent	Traffic Multiplier
1	bottom	Asph1000	ETH	0.005695	5.000	1.000
3	top	Calibr_2010	EZZ	0.000000	0.000	1.000

   Reliability Factors: Not Used.

Results:

Layer No.	Thickness	Material ID	Load ID	Gross Weight	Critical Strain	CDF
1	50.00	Asph1000	Total			9.63E-06
			A320-200	77.00	-1.46E-04	5.15E-06
			B737-800	78.00	-9.07E-05	1.36E-06
			F100	42.00	-1.28E-04	3.31E-06
2	830.00	Cem500A			n/a	n/a
3	0.00	cbr4 - dependent	Total			8.67E-01
			A320-200	77.00	1.29E-03	2.38E-01
			B737-800	78.00	1.37E-03	6.98E-01
			F100	42.00	9.03E-04	2.45E-03

APSDS Version 5.0h (15 January 2015)

y-coordinate for results (Y): 0

Locations for Damage Calculations:
   Bottom of layer no. 1
   Top of layer no. 5
Job Title: KUNUNURRA RW SC 3

Damage Factor Calculation

Standard Deviation of Wander: 773
Interval between result points along X-axis (XWDEL): 100
Upper range for approximation of statistics (XWMAX): 2100.1

Minimum x-coordinate for results (XMIN): 0
Maximum x-coordinate for results (XMAX): 2950

Assumed number of damage pulses per movement:
   Reservoir Method

Traffic Spectrum Details:

   ID: KUNU RW SC 3 Title: KUNU RW SC 3

Load No.	Load ID	Movements
1	B737-800	2.20E+04

N.B. Full details of Load Groups will be provided in a future release.

Details of Layered System:

   ID: Kununurra SC 3 OP1 Title: Kununurra SC3 OP1

Layer No.	Lower i/face	Material ID	Isotropy	Modulus (or Ev)	P.Ratio (or vvh)	F	Eh	vh
1	rough	Asph1000	Iso.	1.00E+03	0.40			
2	rough	BBBase	Aniso.	7.00E+02	0.35	5.20E+02	3.50E+02	0.35
3	rough	Gran-250	Aniso.	2.50E+02	0.35	1.85E+02	1.25E+02	0.35
4	rough	Gran-150	Aniso.	1.50E+02	0.35	1.11E+02	7.50E+01	0.35
5	rough	cbr4 - dependent	Iso.	4.00E+01	0.40			

   Performance Relationships:

Layer No.	Location	Performance ID	Component	Perform. Constant	Perform. Exponent	Traffic Multiplier
1	bottom	Asph1000	ETH	0.005695	5.000	1.000
5	top	Calibr_2010	EZZ	0.000000	0.000	1.000

   Reliability Factors: Not Used.

Results:

Layer No.	Thickness	Material ID	Load ID	Gross Weight	Critical Strain	CDF
1	50.00	Asph1000	Total			1.44E-07
			B737-800	78.00	-3.64E-05	1.44E-07
2	150.00	BBBase			n/a	n/a
3	250.00	Gran-250			n/a	n/a
4	800.00	Gran-150			n/a	n/a
5	0.00	cbr4 - dependent	Total			5.17E-01
			B737-800	78.00	1.27E-03	5.17E-01

APSDS Version 5.0h (15 January 2015)

y-coordinate for results (Y): 0

Locations for Damage Calculations:
   Bottom of layer no. 1
   Top of layer no. 5
Job Title: KUNUNURRA RUNWAY SC 2

Damage Factor Calculation

Standard Deviation of Wander: 773
Interval between result points along X-axis (XWDEL): 100
Upper range for approximation of statistics (XWMAX): 2100.1

Minimum x-coordinate for results (XMIN): 0
Maximum x-coordinate for results (XMAX): 2950

Assumed number of damage pulses per movement:
   Reservoir Method

Traffic Spectrum Details:

   ID: KUNU RW SC 2 Title: KUNU RW SC 2

Load No.	Load ID	Movements
1	B737-800	1.72E+04
2	F100	9.46E+03

N.B. Full details of Load Groups will be provided in a future release.

Details of Layered System:

   ID: Kununurra SC 2 0P1 Title: Kununurra SC2 OP1

Layer No.	Lower i/face	Material ID	Isotropy	Modulus (or Ev)	P.Ratio (or vvh)	F	Eh	vh
1	rough	Asph1000	Iso.	1.00E+03	0.40			
2	rough	BBBase	Aniso.	7.00E+02	0.35	5.20E+02	3.50E+02	0.35
3	rough	Gran-250	Aniso.	2.50E+02	0.35	1.85E+02	1.25E+02	0.35
4	rough	Gran-150	Aniso.	1.50E+02	0.35	1.11E+02	7.50E+01	0.35
5	rough	cbr4 - dependent	Iso.	4.00E+01	0.40			

   Performance Relationships:

Layer No.	Location	Performance ID	Component	Perform. Constant	Perform. Exponent	Traffic Multiplier
1	bottom	Asph1000	ETH	0.005695	5.000	1.000
5	top	Calibr_2010	EZZ	0.000000	0.000	1.000

   Reliability Factors: Not Used.

Results:

Layer No.	Thickness	Material ID	Load ID	Gross Weight	Critical Strain	CDF
1	50.00	Asph1000	Total			1.16E-07
			B737-800	78.00	-3.64E-05	1.13E-07
			F100	42.00	-3.27E-05	3.72E-09
2	150.00	BBBase			n/a	n/a
3	250.00	Gran-250			n/a	n/a
4	800.00	Gran-150			n/a	n/a
5	0.00	cbr4 - dependent	Total			4.04E-01
			B737-800	78.00	1.27E-03	4.04E-01
			F100	42.00	7.70E-04	3.68E-04

APSDS Version 5.0h (15 January 2015)

y-coordinate for results (Y): 0

Locations for Damage Calculations:
   Bottom of layer no. 1
   Top of layer no. 5
Job Title: APRON B737-800

Damage Factor Calculation

Standard Deviation of Wander: 200
Interval between result points along X-axis (XWDEL): 100
Upper range for approximation of statistics (XWMAX): 600

Minimum x-coordinate for results (XMIN): 0
Maximum x-coordinate for results (XMAX): 2950

Assumed number of damage pulses per movement:
   Reservoir Method

Traffic Spectrum Details:

   ID: KUNU APRON SC 3 Title: APRON B737-800

Load No.	Load ID	Movements
1	B737-800	2.20E+04

N.B. Full details of Load Groups will be provided in a future release.

Details of Layered System:

   ID: Kununurra APRON SC3 Title: APRON B737-800

Layer No.	Lower i/face	Material ID	Isotropy	Modulus (or Ev)	P.Ratio (or vvh)	F	Eh	vh
1	rough	Asph1000	Iso.	1.00E+03	0.40			
2	rough	Gran-300	Aniso.	3.00E+02	0.35	2.22E+02	1.50E+02	0.35
3	rough	Gran-250	Aniso.	2.50E+02	0.35	1.85E+02	1.25E+02	0.35
4	rough	Gran-150	Aniso.	1.50E+02	0.35	1.11E+02	7.50E+01	0.35
5	rough	cbr10 - dependent	Iso.	1.00E+02	0.40			

   Performance Relationships:

Layer No.	Location	Performance ID	Component	Perform. Constant	Perform. Exponent	Traffic Multiplier
1	bottom	Asph1000	ETH	0.005695	5.000	1.000
5	top	Calibr_2010	EZZ	0.000000	0.000	1.000

   Reliability Factors: Not Used.

Results:

Layer No.	Thickness	Material ID	Load ID	Gross Weight	Critical Strain	CDF
1	30.00	Asph1000	Total			8.84E-05
			B737-800	78.00	-1.65E-04	8.84E-05
2	150.00	Gran-300			n/a	n/a
3	450.00	Gran-250			n/a	n/a
4	150.00	Gran-150			n/a	n/a
5	0.00	cbr10 - dependent	Total			1.07E-01
			B737-800	78.00	1.21E-03	1.07E-01

APSDS Version 5.0h (15 January 2015)

y-coordinate for results (Y): 0

Locations for Damage Calculations:
   Bottom of layer no. 1
   Top of layer no. 5
Job Title: APRON B737-800 AND F100

Damage Factor Calculation

Standard Deviation of Wander: 200
Interval between result points along X-axis (XWDEL): 100
Upper range for approximation of statistics (XWMAX): 600

Minimum x-coordinate for results (XMIN): 0
Maximum x-coordinate for results (XMAX): 2950

Assumed number of damage pulses per movement:
   Reservoir Method

Traffic Spectrum Details:

   ID: KUNU APRON SC2 Title: APRON B737-800 AND F100

Load No.	Load ID	Movements
1	B737-800	1.72E+04
2	F100	9.46E+03

N.B. Full details of Load Groups will be provided in a future release.

Details of Layered System:

   ID: Kununurra APRON SC2 Title: B737-800,F100

Layer No.	Lower i/face	Material ID	Isotropy	Modulus (or Ev)	P.Ratio (or vvh)	F	Eh	vh
1	rough	Asph1000	Iso.	1.00E+03	0.40			
2	rough	Gran-300	Aniso.	3.00E+02	0.35	2.22E+02	1.50E+02	0.35
3	rough	Gran-250	Aniso.	2.50E+02	0.35	1.85E+02	1.25E+02	0.35
4	rough	Gran-150	Aniso.	1.50E+02	0.35	1.11E+02	7.50E+01	0.35
5	rough	cbr10 - dependent	Iso.	1.00E+02	0.40			

   Performance Relationships:

Layer No.	Location	Performance ID	Component	Perform. Constant	Perform. Exponent	Traffic Multiplier
1	bottom	Asph1000	ETH	0.005695	5.000	1.000
5	top	Calibr_2010	EZZ	0.000000	0.000	1.000

   Reliability Factors: Not Used.

Results:

Layer No.	Thickness	Material ID	Load ID	Gross Weight	Critical Strain	CDF
1	30.00	Asph1000	Total			1.01E-04
			B737-800	78.00	-1.65E-04	6.91E-05
			F100	42.00	-1.54E-04	3.19E-05
2	150.00	Gran-300			n/a	n/a
3	450.00	Gran-250			n/a	n/a
4	150.00	Gran-150			n/a	n/a
5	0.00	cbr10 - dependent	Total			8.44E-02
			B737-800	78.00	1.21E-03	8.39E-02
			F100	42.00	8.70E-04	5.47E-04

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Document Status

Rev No.	Author	Reviewer		Approved for Issue		
		Name	Signature	Name	Signature	Date
0	S Karami C Hugo	R. Clayton	*R Clayton*	M. Ryan	*M Ryan*	*12.11.2015*
1	C. Maekivi	R. Clayton	*R Clayton*	M. Ryan	*M Ryan*	*7.4.2016*
2	C. Maekivi	R. Clayton	*R. Clayton*	M. Ryan	*M Ryan*	*13.5.2016*
3	C. Maekivi	R. Clayton	*R. Clayton*	M. Ryan	*M Ryan*	*26.05.2016*
4	C. Maekivi	R. Clayton		M. Ryan		16/6/2016

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Shire of Wyndham East Kimberley

East Kimberley Regional Airport

Runway Extension Prefeasibility Study

Pavement Condition Assessment

May 2016

Executive summary

This report summarises the pavement condition assessment carried out concurrently with the Runway 12/30 Extension prefeasibility study at the Kununurra Airport and provides an evaluation of the pavement strength of the taxiways A to G, GA Aprons and RPT apron based on Heavy Weight Deflectometer (HWD).

The HWD survey indicated that the existing Taxiway A to C and RPT apron pavements are quite stiff and performing well. The maximum deflection (D0) (except the edge of the RPT apron pavement) was in the sound zone and the existing pavements appear to have sufficient strength for the current aircraft types.

The HWD survey indicated that the GA Apron East and West and Taxiway E are only suitable for light aircraft, reporting in the warning to severe zone with the application of the HWD.

The HWD survey for Taxiway D typically reported deflections in the sound zone indicating that the pavement is stiff and performing adequately under current aircraft loading.

The HWD survey for Taxiway F and G reported deflections in excess of 3 mm (severe deflection) indicating that Taxiway F and G are in poor condition and are currently only suitable for light aircraft.

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Appendices

1. Introduction

1.1 General

The Shire of Wyndham East Kimberley (SWEK) intend to upgrade the East Kimberley Regional Airport (Kununurra Airport) to accommodate Code 4C (B737 and A320) aircraft. The proposed upgrade entails extending the existing Runway 12/30 by 601 m and strengthening the existing Taxiways A to C and RPT apron to accommodate the increased wheel loads of larger aircraft.

GHD was engaged by SWEK in August 2015 to carry out the prefeasibility study for the runway extension and investigate pavement strengthening options for the Regular Passenger Transport (RPT) apron and Taxiways A to C. The results of this investigation are included in the Preliminary Pavement Investigation and Design Report.

In addition SWEK requested that the existing condition of pavements utilised by light aircraft (Taxiways D to G, GA Apron East and West) was assessed with the HWD.

This report summarises the findings of the HWD assessment.

Figure 1-1 indicates the location of each of the taxiways.

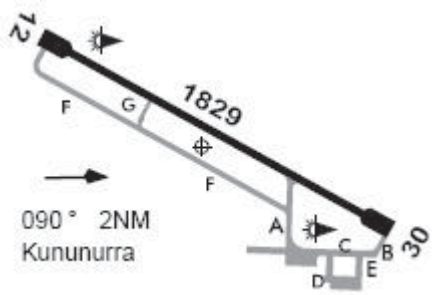

Figure 1-1: Locality Plan

1.2 Purpose of this Report

The purpose of the Pavement Condition Assessment Report is to document the HWD survey and provide an evaluation on the overall condition of the existing RPT apron, GA Aprons and Taxiway A to G pavement structures based on the HWD survey.

1.3 Scope of work

The scope of work for the Pavement Condition Assessment Report comprises the following:

- Heavy Weight Deflectometer (HWD) testing on the Taxiways A to G, GA Aprons and the RPT apron;
- Existing pavement condition assessment analysis based on HWD survey results.

1.4 Limitations

This report has been prepared by GHD for the Shire of Wyndham East Kimberley and may only be used and relied on by the Shire of Wyndham East Kimberley for the purpose agreed between GHD and the Shire of Wyndham East Kimberley as set out in section 1.2 of this report

GHD otherwise disclaims responsibility to any person other than the Shire of Wyndham East Kimberley arising in connection with this report. GHD also excludes implied warranties and conditions, to the extent legally permissible.

The services undertaken by GHD in connection with preparing this report were limited to those specifically detailed in the report and are subject to the scope limitations set out in the report.

The opinions, conclusions and any recommendations in this report are based on conditions encountered and information reviewed at the date of preparation of the report. GHD has no responsibility or obligation to update this report to account for events or changes occurring subsequent to the date that the report was prepared.

The opinions, conclusions and recommendations in this report are based on assumptions made by GHD described in this report. GHD disclaims liability arising from any of the assumptions being incorrect.

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The opinions, conclusions and any recommendations in this report are based on information obtained from, and testing undertaken at or in connection with, specific sample points. Site conditions at other parts of the site may be different from the site conditions found at the specific sample points.

Investigations undertaken in respect of this report are constrained by the particular site conditions, such as the location of buildings, services and vegetation. As a result, not all relevant site features and conditions may have been identified in this report.

Site conditions (including the presence of hazardous substances and/or site contamination) may change after the date of this Report. GHD does not accept responsibility arising from, or in connection with, any change to the site conditions. GHD is also not responsible for updating this report if the site conditions change.

2. Background information

2.1 Pavement Testing Report, Airport Consulting and Construction Australia, 1987

In February 1987, Airport Consulting and Construction Australia (ACCA) Pty Ltd was commissioned by the Shire of Wyndham-East Kimberley to undertake a pavement investigation at the Kununurra Airport. The purpose of this investigation was to assess the suitability of the runway and apron pavements for both the current and future aircraft traffic at that time, and to determine whether any pavement rehabilitation works would be required on the existing pavements in June 1987.

2.1.1 As Constructed

According to the information presented in the ACCA report, the original construction of runway and RPT apron pavement in 1969 comprised the following:

Runway 12/30 Pavement (total thickness 1050 mm)

- 10 mm/5 mm two coat bituminous chip seal; on
- 150 mm basecourse (Ord River shingle blended with red soil); on
- 150 mm sub-base (Ord River shingle); on
- 600 mm minimum select fill (Ord River shingle); on
- 150 mm sand blanket; on
- Prepared subgrade.

RPT Apron Pavement (total thickness 750 mm)

- 10 mm/5 mm two coat bituminous chip seal; on
- 150 mm basecourse (Ord River shingle blended with red soil); on
- 150 mm sub-base (Ord River shingle); on
- 300 mm minimum select fill (Ord River shingle); on
- 150 mm sand blanket; on
- Prepared subgrade.

2.1.2 Pavement Investigation

The ACCA investigation of March 1987 comprised the excavation of three test pits in the runway and one in the apron area.

Laboratory testing of the subgrade from one runway test pit and one RPT apron test pit was carried out by ACCA.

The laboratory soaked CBR's for the two samples was reported as:

- Runway subgrade CBR 2%;
- RPT apron subgrade CBR 8%.

The pavement profile on the runway was reported as follows:

Runway Pavement (total thickness 1400 mm)

- Three bituminous chip seals; on
- 130 – 250 mm base/sub-base; on
- 950 – 1130 mm select fill; on
- 110 – 160 mm sand blanket; on
- Subgrade CBR 4%.

RPT Pavement (total thickness 790 mm)

- Three bituminous chip seals; on
- 470 mm base/sub-base; on
- 250 mm select fill; on
- 70 mm sand blanket; on
- Subgrade CBR 15%.

2.2 Runway 12/30 Pavement Strength Evaluation Report, GHD, 2014

GHD carried out pavement strength evaluation in 2014 and excavated three pits in the existing runway.

Laboratory testing was carried out on three subgrade samples below the existing pavement.

The laboratory soaked CBR's was reported as:

- Runway subgrade CBR 4% and 6%; and
- Swell of 2% to 4%.

GHD reported the runway pavement consists of the following average thickness.

Runway Pavement (total thickness 1710 mm)

- 20 mm of multiple chip seal; on
- 180 mm of base and subbase; on
- 1,300 mm of selected fill materials; on
- 230 mm of sand blanket; on
- Subgrade.

2.3 Report on Preliminary Gilgai Investigation, GHD, 2014

A previous investigation carried out by GHD in 2014, Report on Preliminary Gilgai Investigation identified that the subgrade consists of moderately to highly reactive clays west of Taxiway A. The same report indicated that clay to the east of Taxiway A has low to medium reactivity.

Runway 12/30 Pavement Strength Evaluation Report (GHD, 2014) identified that the subgrade west of Taxiway A is poor with soaked CBR's ranging between 2% and 4%. The runway extension zone laboratory testing found CBR's of between 3% and 6%.

2.4 East Kimberley Regional Airport Runway 12/30 Strength Evaluation, GHD, 2015

An evaluation of Runway 12/30 was carried out by GHD in September 2015 which indicated the asphalt overlay had improved the strength of the runway.

The report dated 11 September 2015 states that the current Runway 12/30 pavement configuration including the recent asphalt overlay can be rated as follows.

PCN 51 / F / C / 1410 (205PSI) / T.

2.5 Surfacing History and Strengthening Records

The previous investigations show that the separate basecourse and sub-base layers were difficult to distinguish and were recorded as one layer.

The runway was overlaid with a variable thickness of levelling course AC10 asphalt and a nominal 60 mm thickness of polymer modified AC14 asphalt in July 2015.

The maintenance records which were provided from East Kimberley Regional Airport (2014) show that in 2010 the subgrade and basecourse of the Taxiways A, B and C were cement stabilised (7.5 m on each side of the centreline) to a total depth of 600 mm sealed with a 10 mm and 7 mm double coat sprayed seal followed by a sand seal.

According to the maintenance records, the RPT apron was resealed in 2004 (aggregate size was not specified) and resealed again in 2014 (6 mm aggregate size).

3. Site Investigation

3.1 HWD Testing

Non-destructive Heavy Weight Deflectometer (HWD) testing was undertaken by ARRB Consultants on the 1st and 2nd of August 2015. The HWD testing was performed on the existing RPT apron, GA Aprons and Taxiways A to G.

HWD testing on the taxiways was performed on the centreline and at a 5 m offset each side of the taxiway centreline at 10 m intervals over the full length. HWD testing on the aprons was carried out on a 10 m grid.

Testing was performed with a target load of 100 kN being applied to the pavement, representing a contact stress of approximately 1400 kPa on the pavement, which closely resembles the tyre pressures of B737-800 and A320 aircraft.

4. Existing Pavement Condition Assessment

4.1 Deflection under load (D_0)

Pavement deflections (D_0) were assessed with regards to the benchmarking criteria for maximum deflection. The benchmark criteria adopted for a contact drop stress of 1415kPa (100kN FWD drop weight) is given in Table 4-1.

Pavement condition is classified as either, *Sound, Warning or Severe*. Typically *Sound* implies the parameter being measured is within the acceptable limits, *Waring* indicates that the parameter is not ideal and some actions may need to be taken in the future to address this and *Severe* suggests that immediate action is required, otherwise rapid deterioration is likely to occur.

Table 4-1 - Benchmark criteria for HWD Maximum Deflection

Structural Condition Rating	Max. Deflection D_0 (um)
Sound	<1250
Warning	1250 to 1875
Severe	>1875

4.2 RPT Apron Deflection

In a general sense the RPT pavement appears to be reasonably stiff in terms of deflection with the majority of the deflections recorded in the sound range with deflections less than 1250um.

HWD deflections of up to 2000um were recorded along the edge of the RPT pavement. The high deflections are thought to be due to moisture ingress into the pavement materials and subgrade along the edges, leading to softening and weakening of the material.

4.3 West GA Apron Deflection

The apron deflection values are in the warning to severe zone, with deflections typically between 1250 and 3000 $_u$m), suggesting that the pavement is not suitable for the loads applied by the HWD. West GA Apron is currently only used by aircraft lighter that 5700 kg and is not suitable for use by larger aircraft without significant strengthening.

4.4 East GA Apron Deflection

The apron deflection values for different HWD test strings typically range between 1000 $_u$m and 3000 $_u$m which reflects the upper sound to severe zone, suggesting that the majority of the pavement is not suitable for the loads applied by the HWD. East GA Apron is currently only used by aircraft lighter that 5700 kg and is not suitable for use by larger aircraft without significant strengthening.

4.5 Taxiway A, B and C Deflection

The taxiway deflection values are in the sound zone (<1250$_u$m), suggesting that the pavements are stiff and appear to be performing satisfactorily under the current aircraft loading. The pavement is relatively thin and has low deflections for the loading. The low deflections are attributed to the cement modification of the base and subbase which may be at risk of damage

due to fatigue cracking if not adequately protected before the increased aircraft load by the B737 and A320 is applied.

The deflection plots for the RPT apron and taxiways A to C are shown in Appendix B.

4.6 Taxiway D Deflection

The taxiway deflection values are typically in the sound zone (<1250$_u$m), suggesting that the pavement is stiff and appears to be performing satisfactorily under the current aircraft loading. The pavement has low deflections for the loading.

4.7 Taxiway E Deflection

The taxiway deflection values are in the warning zone (1250$_u$m to 1875$_u$m), suggesting that the pavement is not adequate for the loads applied by the HWD. As Taxiway E is used by aircraft lighter than 5700 kg it is likely satisfactorily under the current aircraft loading.

4.8 Taxiway F and G Deflection

The taxiway deflection values are in the severe zone (>1875 $_u$m) with deflections in excess of 3 mm, suggesting that the pavements are not suitable for the loads applied by the HWD. Taxiways F and G are currently only used by aircraft lighter that 5700 kg. Taxiway F and G are not suitable for Code C aircraft.

5. Conclusions

The HWD survey indicated that the existing Taxiway A to C and RPT apron pavements are quite stiff and performing well. The maximum deflection (D0) (except the edge of the RPT apron pavement) was in the sound zone and the existing pavements appear to have sufficient strength for the current aircraft types.

The HWD survey indicated that the GA Apron East and West and Taxiway E are only suitable for light aircraft, reporting in the warning to severe zone with the application of the HWD.

The HWD survey for Taxiway D typically reported deflections in the sound zone indicating that the pavement is stiff and performing adequately under current aircraft loading.

The HWD survey for Taxiway F and G reported deflections in excess of 3 mm (severe deflection) indicating that Taxiway F and G are in poor condition and are currently only suitable for light aircraft.

6. References

1. Standards Australia , AS 1726, Geotechnical site investigations 1993
2. Shire of Wyndham East Kimberley , Kununurra Airport, Pavement Testing Engineering Report, Airport Consulting and Construction Australia Pty Ltd (ACCA) , April 1987
3. Austroads Guide To Pavement Technology Part 4: Pavement Materials (2007)
4. East Kimberley Regional Airport Master Plan for Shire of Wyndham East Kimberley, Rehbein Airport Consulting, January 2013
5. Shire of Wyndham East Kimberley, East Kimberley Regional Airport, Runway 12/30 Pavement Strength Evaluation Report, Final Report, GHD , February 2014

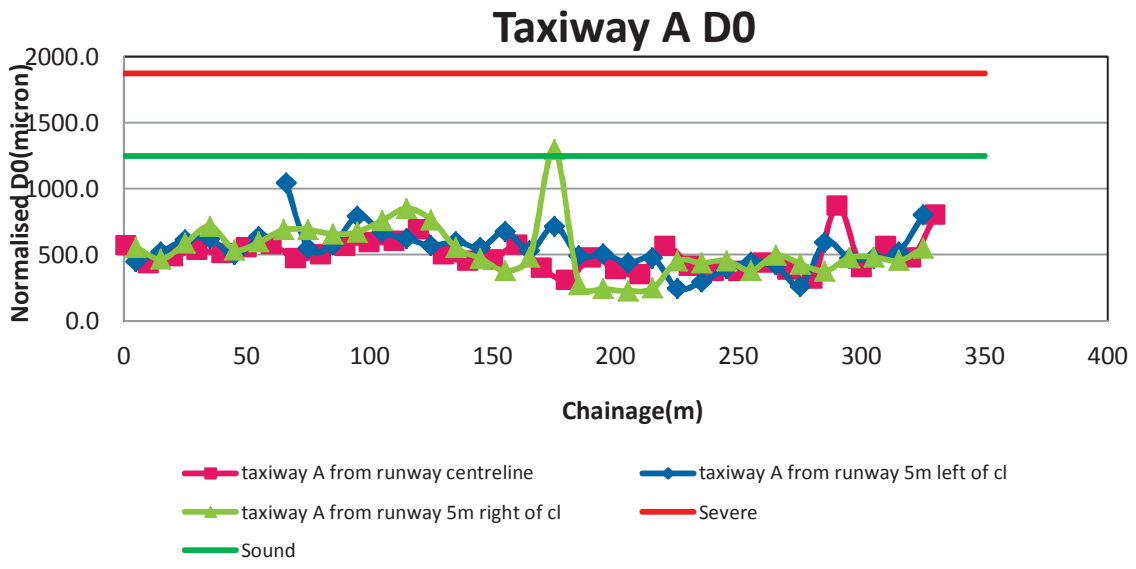
Appendices

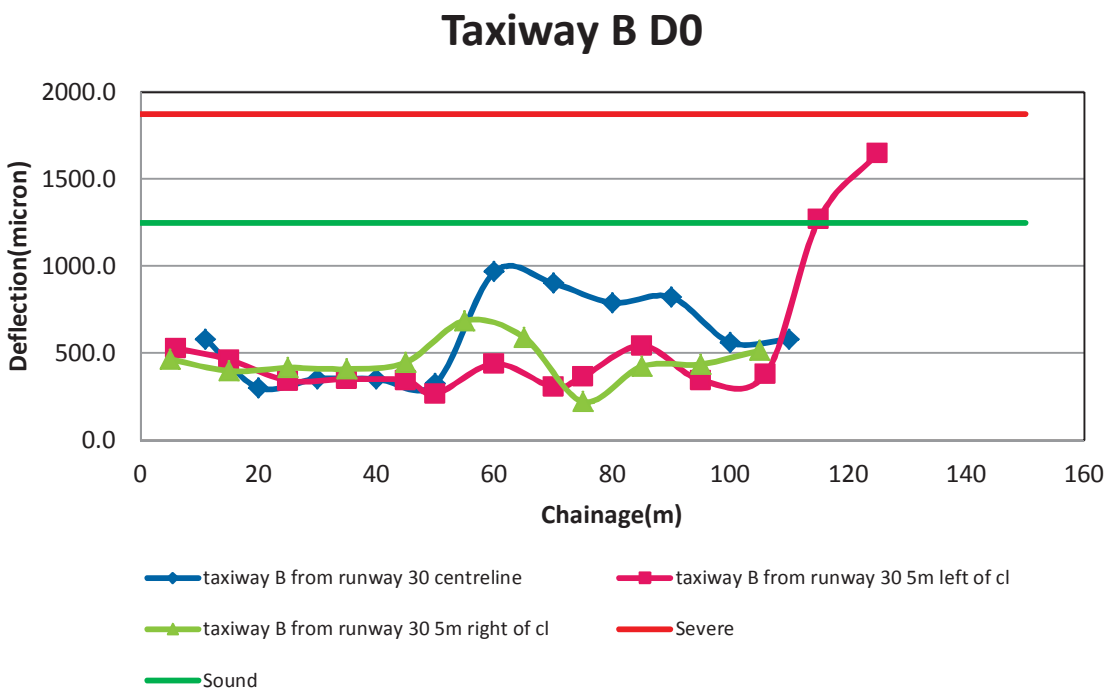
Appendix A – Locality and Site plan

Locality Plan

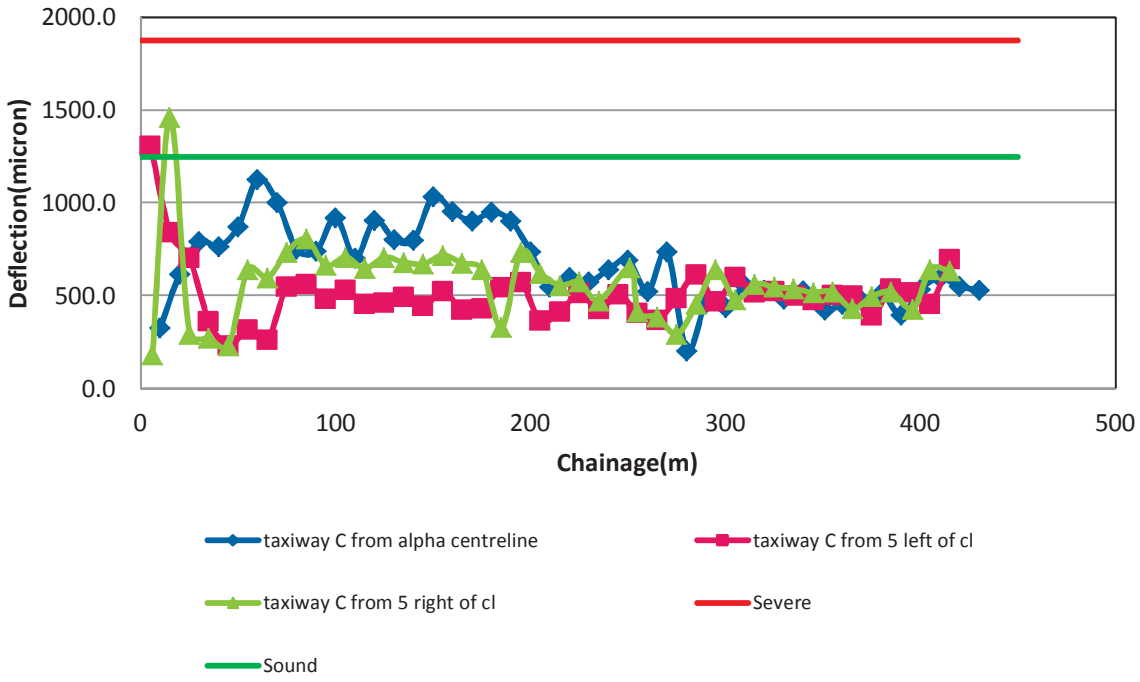
Site Plan

Appendix B – Deflection Plots

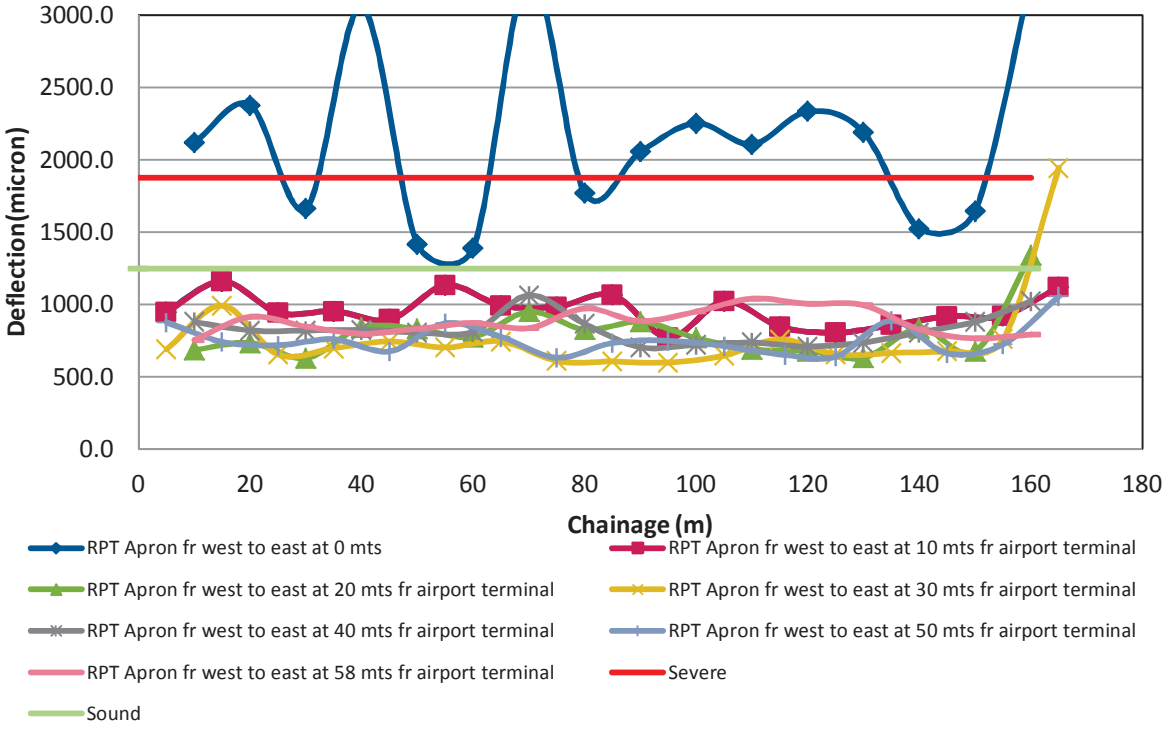




Taxiway C D0



RPT Apron D0



Benchmark criteria for a contact drop stress of 1415kPa (100kN FWD drop weight) (Dr Emile Horak and Dr Stephen Emery Using FWD readings to conduct structural benchmarking of airport pavement structures)

Structural Condition Rating	Max Deflection (micrometer)	BLI	MLI	LLI
Sound	<1250	<500	<250	<125
Warning	1250 to 1875	500 to 1000	250 to 500	125 to 250
Severe	>1875	>1000	>500	>250

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Document Status

Rev No.	Author	Reviewer		Approved for Issue		
		Name	Signature	Name	Signature	Date
0	C. Maekivi	R. Clayton	PP C.ITAEKIVI	M. Ryan	M Ryan	26/5/2016

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Shire of Wyndham East Kimberley

East Kimberley Regional Airport Runway 12/30 Extension

Business Case

August 2016

Executive summary

GHD was commissioned by the Shire of Wyndham East Kimberley (SWEK) in July 2015 to prepare a business case to upgrade the runway capability to accommodate B737-800 and A320-200 aircraft operation at the East Kimberley Regional Airport (EKRA).

The economic objectives for the Kimberley region are reliant on affordable access to the major population centres on the Australian eastern seaboard. The use of these larger aircraft with longer range capabilities will facilitate greater economic development in the region, particularly for perishable produce supply to major cities. The tourism and resources industries will be significantly enhanced by direct flights. The potential to access South-East Asian markets is an obvious opportunity adjunct to Australian markets.

This business case highlights the need and opportunities for a runway extension, outlines and investigates a number of options to address this need, and provides a recommendation that forms the basis for a funding application under the Federal National Stronger Regions Fund and the State Royalties for Regions Fund.

The need to upgrade the airport to accommodate the increased size and capability of aircraft has been recognised in multiple Federal and State Government reports, including *The Green Paper on Developing Northern Australia* (Australian Government)*, 2036 and beyond: a regional blueprint for the Kimberley* (Kimberley Development Commission), *Our North, Our Future: White Paper on Developing Northern Australia* (Australian Government 2015)

The upgrade is also consistent with the 2013 East Kimberley Regional Airport Master Plan prepared by Rehbein Aviation Consulting which provides a two staged development plan, Stage 1 being for the period 2021-22 and Stage 2 for the period 2036-37. Both stages include aviation and non-aviation upgrades.

Stage 1 relies on a runway capably of Code 4 servicing larger longer range aircraft, A320's or B737's. The non-aviation requirements include an upgrade to the main passenger terminal which was recently completed.

A number of runway capability options have been considered in this Business Case, and the preferred option is an extension of the existing runway length to 2,430 metres, together with associated improvements to taxiways and approach systems and minor land acquisition at an estimated cost of $20.5 million (incl GST).

The Shire of Wyndham East Kimberley is not in a position to fund the capital expenditure needed for this critical enabling infrastructure improvement, but has the ability and accepts responsibility for implementation and asset management of the airport.

It is proposed that applications for funding be sought on the funding basis:

- National Stronger Regions Fund - $10 million (maximum available)
- Royalties for Regions Fund - $9.5 million
- Shire of Wyndham – East Kimberley - $1 million from reserve account

In support of the National Stronger Regions Fund application criteria, this Executive Summary is aligned to the application criteria.

In support of the Royalties for Regions application the format of the body of the report is aligned with the application template.

The increased airport rating to accommodate Code 4 is essential to the future growth of Kununurra and the East Kimberley region.

NATIONAL STRONGER REGIONS FUND

Criterion 1: Contribution to Economic Growth in the Region

Kununurra, in the Shire of Wyndham East Kimberly, is a relatively isolated township and region that is undergoing significant economic growth associated with tourism, agriculture, aquaculture and mining.

Access to the region and township is limited to road and aviation with the only significant airport being the East Kimberley Regional Airport in Kununurra. The closest centre with a population over 10,000 people is Darwin, which is located 800 km away by road and costs up to $800 for airfares.

Each industry is currently inhibited by the cost to access markets in the major population centres on the eastern seaboard of Australia. The runway length limits the aircraft type and size that can utilise the airport. Critically these aircraft have limited range and are unable to reach the markets in Melbourne, Sydney and Brisbane.

The extension of the runway is acknowledged in a number of reports as being vital to sustaining economic growth in the region and facilitating access to Southeast Asia. *The Green Paper on Developing Northern Australia* (Australian Government), *2036 and beyond: a regional blueprint for the Kimberley* (Kimberley Development Commission), *Our North, Our Future: White Paper on Developing Northern Australia* (Australian Government 2015) all refer to the need for improved transport infrastructure in the northern regions of Australia and the East Kimberley Regional Airport at Kununurra is specifically mentioned.

Criterion 2: Addressing Disadvantage in the Region

The local community of Kununurra continually suffers disadvantage due to remoteness and the cost to obtain specialist and in many cases general social and commercial services due to the cost of service delivery to the region. This business case highlights the common cause to be difficulty in obtaining reasonable cost aviation services.

The Australian Bureau of Statistics Socio-economic Index ranks the East Kimberley region within the top 20% of most disadvantaged regions within Australia. The local employment opportunities, particularly for Indigenous Australians, are poor and the cost of living very high. Local employment opportunities are desperately needed in the region in key areas.

Through consultation undertaken by the Shire in developing the 2012-2022 Strategic Community Plan, the number one priority for East Kimberley residents was “Cheaper flights in and out of town”.

The region faces a number of unique challenges:

- The airport serves as a lifeline for the community, which is often isolated during the wet season for periods.
- A number of medical services are not available in Kununurra, with residents having to fly to Darwin for even minor medical check-ups. As an example, a resident simply wanting to see an optometrist would have to fly to Darwin or Broome.
- The town has a transient population.

Criterion 3: Increasing Investment and Establishing Partnerships in the Region

Ord River Irrigation Scheme in Kununurra is pivotal in Australia's developing food bowl which continues to attract investment from both Federal and State Governments, Australian companies and overseas entities. There have been many barriers to successful agri-business in the Ord, some of which can be addressed by increased affordable aviation access.

In 2013 and 2014, Australia concluded Free Trade Agreements with China, Japan and the Republic of Korea. Over three quarters of exports from Western Australia, Northern Territory and Queensland are to these markets. These countries are the source of significant and growing investment flows that contribute to the development of northern Australia.

Free Trade Agreements will help northern Australia capitalise on its existing strengths and natural advantages. High tariffs on beef are being progressively cut, wheat and wheat gluten market access is being eased, and tariffs on mangoes, macadamia nuts, prawns and many other horticultural and seafood products produced in the region are being progressively eliminated.

These Free Trade Agreements will promote further capital flows from these Asian economies to join the already significant investment in the region with flow on effects for employment and regional communities.

Aviation accessibility is critical to facilitating investment activities, construction and development activities and ongoing operations of the broad range of opportunities offered by the East Kimberley region.

Criterion 4: Project and Applicant Viability and Sustainability

Project Viability:

The East Kimberley Regional Airport is owned by the Shire of Wyndham East Kimberley which currently covers the operational and asset management costs. The Shire has demonstrated its ability to competently manage the airport, which currently has RPT services to Perth, Darwin and Broome with over 90,000 passengers annually. The airport is the base for 4 significant charter operators with specialist services like the Royal Flying Doctor Service also operating from the EKRA.

Increased tourism visitations through the airport are recognised as a significant opportunity to increase financial viability and this is dependent upon the cost of airfares and the development of further tourism infrastructure. The local aviation operators of tourism related helicopter, sea plane and general charter aircraft rely heavily on tourism activity.

The economic activity associated with the Ord River Scheme continues to grow steadily, but not as rapidly as potentially possible, as fresh fruit and vegetables become an in demand product through South East Asia and to southern Australian states.

Applicant Sustainability:

The Applicant is Shire of Wyndham East Kimberley which is committed to the ongoing expansion and improvement at the East Kimberley Regional Airport as evidenced in its strategic Corporate Business Plan 2012 – 2016.

Extracts from the Shire Budget 2015-16 for the combined East Kimberley Regional Airport and Wyndham Airport (majority of income/expenditure is associated with the former), comprises:

- Income of $3.975,703
- Operational Expenditure of $3,707,479 with some funds transferred for depreciation.
- Capital Expenditure of $4,200,784 which includes grant funding (majority has been utilized for Runway Asphalt Overlay)

The current Airport Reserve, principally established to ensure long term asset renewal obligations are met, is estimated to have an End of Year (2015/16) Closing Balance of $4.4m.

The Shire completed an overlay of the current runway in September 2015, and has plans to and upgrade the carpark using internal funds at a cost of $250,000 and replace the fuel depot.

The Shire is also responsible for running the Wyndham Airport. Utilising capital reserves, the Shire has undertaken to reseal most of the runway, taxiways and aprons in 2016.

While the Shire is financially sustainable, it is unable to provide the capital funding required to provide the capital investment in critical infrastructure required to unlock the region's economic potential from such a small local population base.

The Shire's debt to revenue ratio is shown below:

Year	Revenue	Debt (Loans)	Ratio
2014/15 Actual	27,875,588	7,117,661	0.255
2015/16	20,966,113	6,163,214	0.294

(For LGA's debt to revenue is a more applicable indicator of financial sustainability)

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Appendices

This report: has been prepared by GHD for the Shire of Wyndham East Kimberley and *may only be used and relied on by the Shire of Wyndham East Kimberley for the purpose agreed between GHD and the Shire of Wyndham East Kimberley as set out in the Executive Summary of this report.*

GHD otherwise disclaims responsibility to any person other than the Shire of Wyndham East Kimberley arising in connection with this report. GHD also excludes implied warranties and conditions, to the extent legally permissible.

The services undertaken by GHD in connection with preparing this report were limited to those specifically detailed in the report and are subject to the scope limitations set out in the report.

The opinions, conclusions and any recommendations in this report are based on conditions encountered and information reviewed at the date of preparation of the report. GHD has no responsibility or obligation to update this report to account for events or changes occurring subsequent to the date that the report was prepared.

The opinions, conclusions and any recommendations in this report are based on assumptions made by GHD described throughout this report. GHD disclaims liability arising from any of the assumptions being incorrect.

GHD has prepared this report on the basis of information provided by the Shire of Wyndham East Kimberley and others who provided information to GHD (including Government authorities)], which GHD has not independently verified or checked beyond the agreed scope of work. GHD does not accept liability in connection with such unverified information, including errors and omissions in the report which were caused by errors or omissions in that information.

GHD has prepared the preliminary cost estimates in the report ("East Kimberley Regional Airport Runway 12/30 Extension Pre-feasibility Study") using information reasonably available to the GHD employee(s) who prepared this report; and based on assumptions and judgments made by GHD and other assumptions.

The Cost Estimate has been prepared for the purpose of providing a basis for comparative options analysis and global project funding application and must not be used for any other purpose.

The Cost Estimate is a preliminary estimate only. Actual prices, costs and other variables may be different to those used to prepare the Cost Estimate and may change. Unless as otherwise specified in this report, no detailed quotation has been obtained for actions identified in this report. GHD does not represent, warrant or guarantee that the runway extension works can or will be undertaken at a cost which is the same or less than the Cost Estimate.

Where estimates of potential costs are provided with an indicated level of confidence, notwithstanding the conservatism of the level of confidence selected as the planning level, there remains a chance that the cost will be greater than the planning estimate, and any funding would not be adequate. The confidence level considered to be most appropriate for planning purposes will vary depending on the conservatism of the user and the nature of the project. The user should therefore select appropriate confidence levels to suit their particular risk profile.

1. Project Scope and Evaluation

1.1 Project Outcome

The extension of the East Kimberley Regional Airport runway will open the airport to larger aircraft, resulting in cheaper flights to and from the region for business, visitors and local residents. Improving access to the region through larger aircraft will assist in:

- Fostering a profitable business environment by lowering the costs of doing business in the region;
- Increasing job creation directly and indirectly;
- Increasing competition in the aviation business driving down costs to residents, regional employees and tourists; and
- Retaining a population that feels isolated and needs to travel for health or family related reasons.

Larger aircraft will open up opportunities to leverage the Region's proximity to the South East Asian markets for:

- Increasing trade links
- Maximising regional opportunities for the expanding agriculture industry
- Developing adventure, nature and cultural based tourism

The project will increase the airport capability to allow the operation of B737-800 (170 passengers) and A320-200 (170 passengers) providing a substantial increase in the range and passenger capacity over the currently operated Fokker 100 (100 passengers) and the Embraer 170 (78 passengers).

Most importantly larger aircraft will have a longer range and able to access the major cities on the eastern seaboard of Australia and into key South East Asian markets.

1.2 Project Description

The Kununurra Airport Runway Extension involves lengthening the runway to 2,430 m (currently 1,829 m) using the current alignment and utilising the recently resurfaced runway pavement. Pavement strengthening is required for Taxiways A, B and C, and the regular public transport apron (RPT). A new approach guidance system will be installed.

1.3 Project Need

1.3.1 Objectives

Shire of Wyndham East Kimberley identified several specific drivers for the runway extension project, including the need to:

- Provide reliable aviation access for long-term sustainability of the region;
- Cater for current and future growth;
- Increase affordability of access to the region;
- Facilitate additional aviation business and commercial development whilst still maintaining long-term control of airport land; and
- Protect land for aviation growth and expansion.

2. Background

2.1 Kimberley Region and the Shire of Wyndham East Kimberley

The Kimberley is Western Australia's most northern region, recognised for its abundant natural resources and largely undeveloped area. The region comprises four local government areas: the shires of Broome, Derby-West Kimberley, Halls Creek and Wyndham East Kimberley and has a population of nearly 40,000.

Kununurra is the largest town within the Shire of Wyndham East Kimberley, and was established to service the Ord River Irrigation Scheme.

Long-term sustainable growth will be achieved by the development of permanent employment in the region. The region has a diverse economy, including mining, agricultural production, tourism, construction and retail trade. The Kimberley is well positioned to capitalise on its proximity to the South East Asian markets, by increasing trade links, developing irrigated agricultural land, maximising regional benefits from servicing the mining industry and developing adventure, nature and cultural based tourism (Kimberley Development Commission, 2014).

2.2 East Kimberley Regional Airport

The East Kimberley Regional Airport is owned and operated by the Shire of Wyndham East Kimberley. RPT services to and from the airport are operated by Air-North and Virgin Australia.

The East Kimberley Regional Airport is located approximately four kilometres (by road) west of the centre of Kununurra town centre. The airport is located on an area of land of approximately 275 hectares. Of this, Shire of Wyndham East Kimberley owns 261.5 hectares and the remainder is held on a freehold or lease basis by other parties. The airport land is bordered to the south by the Victoria Highway reserve and a golf course. The remainder of the surrounding land is generally used for agricultural purposes, some of this is privately owned and some is held by the State of Western Australia. The Ord River borders the airport to the south and west.

Access to the airport is via the Victoria Highway from Kununurra town centre to the east and other local centres, including Wyndham, to the west.

East Kimberley Regional Airport has a single sealed runway. Runway 12/30 is 1,829 metres long and 30 metres wide and sits within a 150 metre wide graded strip. The runway is therefore suitable for non-precision instrument approach operations by aircraft up to Code 3C.

The passenger terminal has recently been redeveloped. The terminal is now a modern, high quality structure with a total footprint of approximately 2,000 m2 excluding external waiting areas. East Kimberley Regional Airport has a Non-Directional Beacon (NDB) and a VHF Omni-Directional Range/Distance Equipment Measuring (VOR/DME). Jet A-1 and AVGAS facilities are also accommodated.

The Shire of Wyndham East Kimberley manages two airports, the East Kimberley Regional Airport (Kununurra Airport) and the Wyndham Airport.

2.2.1 Local Airport Traffic

An analysis of passenger numbers undertaken by Rehbein Airport Consulting in 2013 found that passenger numbers had grown from 37,000 in 2002/03 to nearly 87,000 passengers in 2010/11, with an average Compound Annual Growth Rate (CAGR) of 11.2% over the period.

Analysis of the Bureau of Infrastructure, Transport and Regional Economics (BITRE) airport traffic data from 1985 to 2014 indicates "Total Passenger Movements" at East Kimberley

Regional Airport experienced significant changes, peaking in 1994 (131,111), bottoming in 2002 (35,917) and peaking again in 2012 (92,203).

“Total Aircraft Movements” have been consistent from 1985 to 2014 at an average of 2,350 (excluding a 3 year peak of approximately 3,900 from 1994 to 1996).

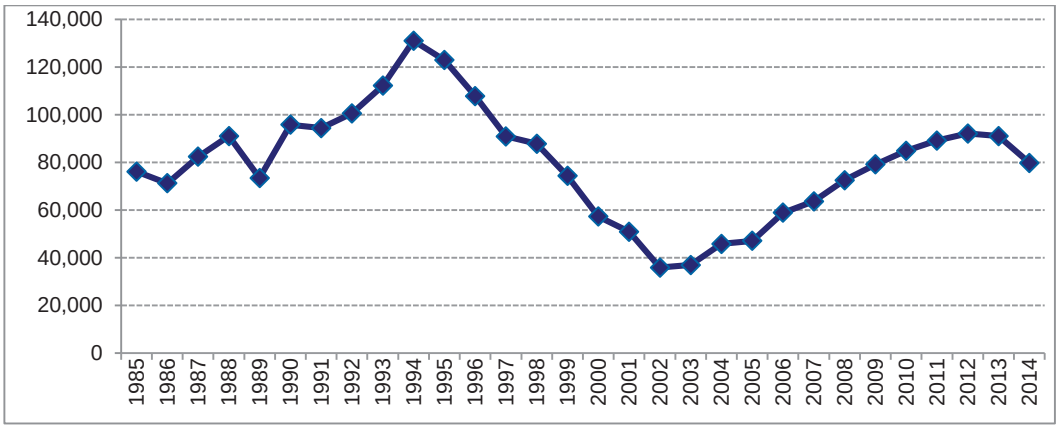

Figure 1: East Kimberley Regional Airport - Passenger Movement History

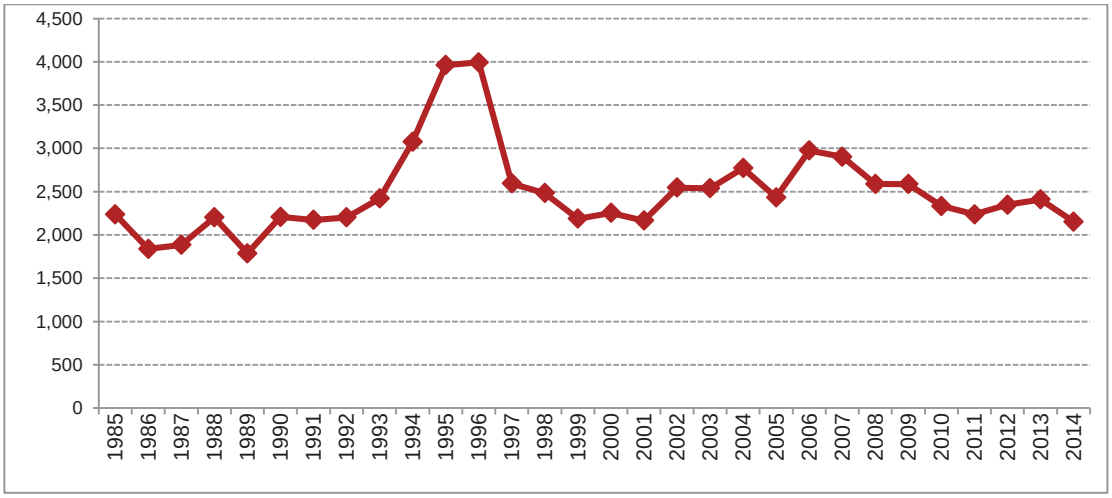

Figure 2: East Kimberley Regional Airport Aircraft Movements History

The current Australian and Western Australian policies and strategies for the Ord River Expansion Project and tourism promotions will create new demand for aviation services at the East Kimberley Regional Airport and it is anticipated that passenger movements will grow significantly.

2.2.2 East Kimberley Regional Airport – Terminal Building Upgrade

The $8.7 million East Kimberley Regional Airport terminal building project was constructed by SWEK with joint funding from the East Kimberley Development Package - $5 million, the Regional Airports Development Scheme $2.2 million and $1.5 million of the Shire's funding.

The terminal building provides a gateway to the communities of Kununurra, Halls Creek, Wyndham, Warmun and Kalumburu in the East Kimberley.

The new terminal building is now of an appropriate standard to service larger aircraft. The Airport Masterplan indicates that the current terminal is sufficient for the foreseeable future (Section 5.4.1, Rehbein 2013).

3. Policy and Strategic Framework

The need for an upgrade in airport infrastructure has been highlighted in a number of recent reports. This section outlines the regional drivers and opportunities necessitating the runway extension, and follows with the master planning integration work that has been undertaken in determining the optimal airport upgrade configuration.

3.1 Regional Development

3.1.1 Green Paper on Developing Northern Australia

The Kimberley Zone of Western Australian Local Government Association's submission to the Green Paper on Developing Northern Australia in 2014 highlights the cost of air travel as a major barrier for investment in the region:

> *The cost of inter-regional air travel is exorbitant compared to travel along the east coast. The costs are prohibitive for both business and private travel, impacting on the tourism market, impacting families with the higher costs to travel, and impacting all in the region due to the higher costs of business.*
>
> *Airports are at capacity, and incapable of taking larger planes and more carriers, thus market competition is haltered and the ability for major investment in the region such as large scale mineral and gas developments may be stiffened in the future if these facilities are incapable of accommodating the demand.*
>
> *The extension of the Regional East Kimberley Airport as identified and supported by Infrastructure Australia will enable significant expansion of the tourist and freight export markets servicing the Ord development.*

3.1.2 2036 and beyond: a regional blueprint for the Kimberley

The 2014 draft for public comment version notes that enablers of cross-sectoral growth and development in infrastructure includes a progressive need to develop airports to support increased domestic and international passenger and airfreight transport.

There is a highlighted priority for:

- **Agriculture and food:** develop and upgrade airports, ports and roads to facilitate export of value-added agricultural product.
- **Rangeland industries:** upgrade port and airport facilities to enhance live export and value-added production.

3.1.3 Our North, Our Future: White Paper on Developing Northern Australia

The 2015 White Paper identifies the need to unlock the north's full potential by addressing the challenges to development:

- Making it easier to use natural assets, in close consultation with, and the support of Indigenous communities
- Providing a more welcoming investment environment
- Investing in infrastructure to lower business and household costs
- Reducing barriers to employing people
- Improving governance

It highlights the key role regional airports play in providing access to the North and includes $39.6 million to upgrade airstrips and subsidise air services in remote Australia in its Action Plan. It also outlines a number of initiatives which have or are currently being undertaken in the region, which will necessitate a runway upgrade:

- $40 million Water for Food programme to support the expansion of irrigated agriculture in the East Kimberley
- $81.5 million Kimberley Science and Conservation Strategy
- $322 million Ord-East Kimberley Expansion Project to increase the size of the Ord River Irrigation Area

3.1.4 Regional Defence and Security

The 2015 White Paper also highlights northern Australia as a gateway for our defence and security cooperation into the Indo-Pacific region and supports Australia's ability to protect and sustain forces into the region for surveillance, humanitarian assistance and disaster relief. Kununurra airport is a key point between Broome and Darwin (1,166 kms apart) critical to rapid deployment of security, defence and disaster relief operations.

3.2 Kimberley Regional Planning and Infrastructure Framework

The 2014 draft Western Australian Planning Commission and Department of Planning document notes that the "region's transport infrastructure will continue to play a crucial role in facilitating economic growth by providing connections to State, interstate and overseas markets" (Western Australian Planning Commission, 2014). One of the four key aviation projects listed is the construction of a new runway at Kununurra Airport (or extension).

3.3 Shire of Wyndham East Kimberley Business Plans

The Corporate Business Plan addresses all of Shire of Wyndham East Kimberley's operations – including services, assets (capital works and ongoing operating) and projects. It also identifies how the Shire of Wyndham East Kimberley's operations link to the Strategic Community Plan through strategies and outcomes. The Strategic Community Plan is a high-level plan that identifies the Shire's and the community's vision for its region for the next 10 years.

The Shire of Wyndham East Kimberley identified the potential to extend the runway at the East Kimberley Regional Airport as a key opportunity through the development of the Corporate Business Plan and Strategic Community Plan. The purpose of this opportunity is to increase competition between aviation companies by allowing more aircraft access and hence reducing airfares. Within the Corporate Business Plan, the Shire of Wyndham East Kimberley outlined an objective to "implement the East Kimberley Regional Airport Master Plan" which is discussed in the next section.

4. Regional Business Need

Long-term sustainable growth will be achieved by the development of permanent employment in the region through private investment. The region has a diverse economy, including agriculture/aquaculture, tourism, mining and construction and retail trade. Each of these industry sectors relies heavily on both road and aviation transport.

The cost of air-freight and airfares in the East Kimberley is an additional impediment to the impost of travel duration and represents a significant economic impact on future business growth of the region.

The industries that will benefit from lower cost accessibility are detailed in the following sections.

4.1 Agriculture/Aquaculture

4.1.1 Ord River Irrigation Scheme

Kununurra has become a major focus of both the Australian and Western Australian Government's as a strategic food bowl for the future based on the Ord River irrigation system.

The Western Australian Government began investing in Ord River infrastructure to release land for irrigated agriculture in the 1960's.

In 2010 Stage 1 of the Ord River Irrigation Expansion Project built essential infrastructure to enable the release of an additional 13,400ha of land for irrigated agriculture. This comprised:

- Extending the main irrigation channel by 40 kilometres;
- Building 41 kilometres of new roads;
- Excavating 86 kilometres of drainage channels; and
- Building flood levees.

Contractors completed these infrastructure works late in 2013.

The aim of the project and the concurrent $195 million East Kimberley Development Package is to realise the full potential of available resources in the East Kimberley and contribute to the social amenity of the region.

Under Stage 2 the Ord Development Agreement, Kimberley Agricultural Investment has committed to the development of 7,400ha of the Goomig (Weaber Plain) farm area with an option to develop a further 6,000ha of Knox Plain land with the aim of developing a sugar industry in the region.

Figure 3: Ord River Irrigation Expansion Project - DRD

The Ord Development Agreement can be seen as a staged investment process with significant milestones over the next four years that will lead to a 50 year lease with a 25 year option for renewal. Private sector investment under the Development Agreement is estimated to be $200 million.

Over the next four years, the state expects the private sector to:

- Create on-farm infrastructure;
- Develop and crop the Goomig Farm Area; and
- Commence construction of roads and irrigation infrastructure for the Knox Plain land.

The Federal Government has expressed plans to further increase the irrigation capacity in the Ord region by raising the Lake Argyle dam wall by several meters.

4.1.2 Future land release

Further expansion of the Ord River Irrigation Scheme will see the development of Ord West Bank and Mantinea lands comprised of an estimated additional 5,000ha of land.

There are a number of land areas that are currently being investigated for potential future land release. These include Carlton Hill (approximately 6,000ha) and Cockatoo Sands (4,000ha potentially up to 30,000ha).

The strategic nature of the Ord River Irrigation Scheme will see continued growth and development in the Kununurra area, with associated demand for greater access and transport infrastructure. Much of the capital investment in the Ord is from overseas and the cost of aviation transport is an additional impediment.

4.1.3 Seafarms Prawn Farming – Project Sea Dragon

Seafarms has applied to the National Stronger Regions Fund to progress Project Sea Dragon, which if achieved will be the largest aquaculture project ever undertaken in Australia, with the capacity to produce over 100,000 tonnes of Black Tiger prawns a year for export. Seafarms is seeking approval to begin the first 1,000 ha of production ponds, expanding to 10,000 ha.

At capacity, the project will employ approximately 1,500 people, of which 500 are expected to be based in Kununurra.

The facility is located to the east of Kununurra.

4.2 Tourism

The East Kimberley region has a strong tourism industry and Kununurra forms a gateway and base for accessing the region. The region exhibits a range of tourist attractions and activities which are growing as part of an active local tourism market.

The local natural landscape attracts tourists to features including Lake Argyle, Purnululu National Park and Mitchell River National Park, among several other national parks in the area. Scenic aerial tours around the area, including many over the Bungle Bungles within Purnululu National Park, are operated from East Kimberley Regional Airport. The region is also a popular location for barramundi fishing and the local diamond industry provides an attraction for tourists. The region boasts a number of remote stations that offer unique accommodation, many of which provide luxury accommodation that attract high end tourists. The popular El Questro Wilderness Park is located close to Kununurra.

Much of the tourism activity within the area occurs during the dry season, with fewer tourists during the quieter wet season. There is a desire within Shire of Wyndham East Kimberley to increase tourism numbers during the wet season in the future.

Total visitor nights in Western Australia overall are forecast to have a compound annual growth rate of approximately 2.7% to 2022 (Tourism Research Australia, 2013). No specific forecast data is available for the East Kimberley itself, however, anecdotal evidence suggests that there is a large untapped tourism market within the region and tourism is therefore expected to grow at a higher rate than that forecast for the rest of the state.

The tourism industry is cost sensitive and airfares are a key destination determinant that can benefit from larger aircraft.

4.3 Resources

Mining provides a significant contribution to the economy in the region and is a major business sector seeking affordable air travel costs and a stable local workforce.

The longer runway capable of accommodating Code 4C aircraft will provide more seats per flight arrival. With an increasing number of mining and construction projects in the region, there will be a corresponding growth in the number and size of shift changes at the local mines and construction sites. To achieve flexibility as the demand for concurrent travel occurs, only larger aircraft will be able to ensure seat availability for other travellers.

There are several resources projects of note within the Kununurra area.

4.3.1 Argyle Diamonds

The Argyle Diamond mine operated by Rio Tinto is located 110 kilometres south of Kununurra. The Argyle open pit mine was commissioned in 1985 and operates 24 hours per day, 365 days per year. In 2005, the construction of an underground diamond mine at Argyle commenced, however in 2009 its development was slowed as a result of global market conditions (Rio Tinto, 2010). In 2013 the underground mine was completed and the ramp-up to full operation of the underground mine occurred in 2015.

4.3.2 Sorby Hills Lead-Silver Project

The Sorby Hills Lead-Silver Project, operated by KBL Mining Limited, is located approximately 50 kilometres by road from Kununurra. It has completed the pre-feasibility study stage and the $80 million project was given State Government approval in April 2014. The site is currently at the bankable feasibility study stage and will be seeking project financing in the near future (KBL Mining Ltd, 2015). Once the mine has secured financing it is expected to create up to 500 jobs

during the construction period. Post-construction, the mine will be operated by 80 to 100 personnel for a potential lifespan of 6 to 10 years (Dupe, 2015).

4.3.3 Manbarrum Zinc-Silver Project

TNG operates the Manbarrum project to the east of Sorby Hills over the border in the Northern Territory. The Manbarrum project covers a combined area of 407 square kilometres and includes licences to explore and prospect. The drilling programs enabled TNG to determine that the deposits contain zinc, lead and/or silver. The exploration conducted by TNG has confirmed that the project has excellent economic potential (TNG Limited, n.d.).

4.3.4 Savannah Nickel Project

Panoramic Resources operates the Savannah Nickel Project located 240 kilometres south of Kununurra. This project comprises of underground mining and a processing plant. The Jinchuan Group of China has contracted to purchase the Savannah concentrate until April 2020 (Panoramic Resources Ltd, n.d.). With the world prices of nickel at less than 20% of the 2007 prices, this project has been placed on care and maintenance. There is optimism that it will restart and realise the huge growth potential into Savannah North when nickel prices recover.

4.4 Other Air Transport Needs

General Aviation aprons are located to the east and west of the RPT apron and are used by Kununurra based charter operators and the Royal Flying Doctor Service (RFDS).

4.4.1 Kununurra airport patient transfer facility

The $400,000 East Kimberley Regional Airport patient transfer facility project has been provided to increase accessibility to urgent medical services for the local community. The St Johns Ambulance Association operates the facility under a lease from SWEK.

4.4.2 Flood and other natural disasters

The airport serves as an important lifeline for the community which is exposed to a number of extreme weather conditions and natural disasters:

- Cyclone risk area
- Bushfire threats
- 6 month wet season

4.4.3 Regional services for isolated communities

The airport has a significant role in providing services to indigenous communities, many of which can’t be accessed by the road during the wet season, such as Kalumburu.

5. Key Deliverables

5.1 Design Criteria

To facilitate the safe operational access of Code 4C rated aircraft (Boeing 737-800 and Airbus A320-200) at the Kununurra Airport, a runway length of 2,430 m has been selected based on the suitable length of runway for the design aircraft (to be confirmed in the Feasibility Stage).

The following table summarises the design requirements for Code 4C facilities and shows the only major design upgrade required is the main runway length. See footnote 1 below for details of an alternative to increasing the width of the existing runway. This option, involving a 30m wide runway, is the preferred option and is commonly accepted at other regional airports in Australia, such as Newman Airport, Ballina Airport and Ayres Rock Airport.

There is no code requirement regarding the length of a runway, which is selected based on aircraft typology.

Table 1: Design Criteria for Code 4C

Description	Code 3C	Code 4C
Runway		
Runway Pavement Width	30 m	45 m[Note 1]
Shoulder Width	Not required but recommended	Not required but recommended
Runway Strip		
Runway Strip Width	150 m	300 m
Width of Graded Portion of Runway Strip	90 m	150 m
Flyover Area Width (each side)	30 m	75 m
Runway End Safety Area		
Length	90 m	90 m [Note 2]
Width	60 m	60 m
Taxiway		
Taxiway Pavement Width	15 m	18 m [Note 3]
Shoulder Width	3.5 m	3.5 m
Taxiway Strip		
Taxiway Strip Width	52 m	52 m
Taxiway Graded Area Width	25 m	25 m

Notes

[1] The existing runway width of 30m shall be retained with 4C aircraft operating on the runway under the narrow runway supplement CAAP 235A-1(0). This supplement is used for the design of the runway width.

[2] Additional length of Runway End Safety Area (RESA) should be provided if the aerodrome is classified or operates international flights and in accordance with ICAO. The length of the runway would need to be accordingly shortened to allow for additional RESA

[3] The taxiway width may be reduced to 15m for Code C taxiways that are only intended to serve aircraft with a wheelbase of less than 18m, such as the B737 and A320.

5.2 Accessing New Markets and Populations

By upgrading the rating of the East Kimberley Regional Airport to accommodate larger Code 4C aircraft, including dedicated freighters, it will be able to provide direct access to and from Australian eastern seaboard cities and key Southeast Asian markets. Supplying perishable produce to these major population centres is critical to the objectives of the Kimberley Blueprint 2036 and beyond and the Our North, Our Future White Paper on Developing Northern Australia.

Enhanced economic growth opportunities are possible for the local tourism industry from direct (single flight) access to Kununurra.

The proposed maximum runway length of 2,430 m is practical achievable on the site and is sufficient for operations by B737 and A320 jet aircraft. The length is also sufficient for aircraft arrivals and departures from all interstate airports and key airports within Southeast Asia. The figure below shows the increased range of the larger B737-800 aircraft compared to the existing Fokker 100.

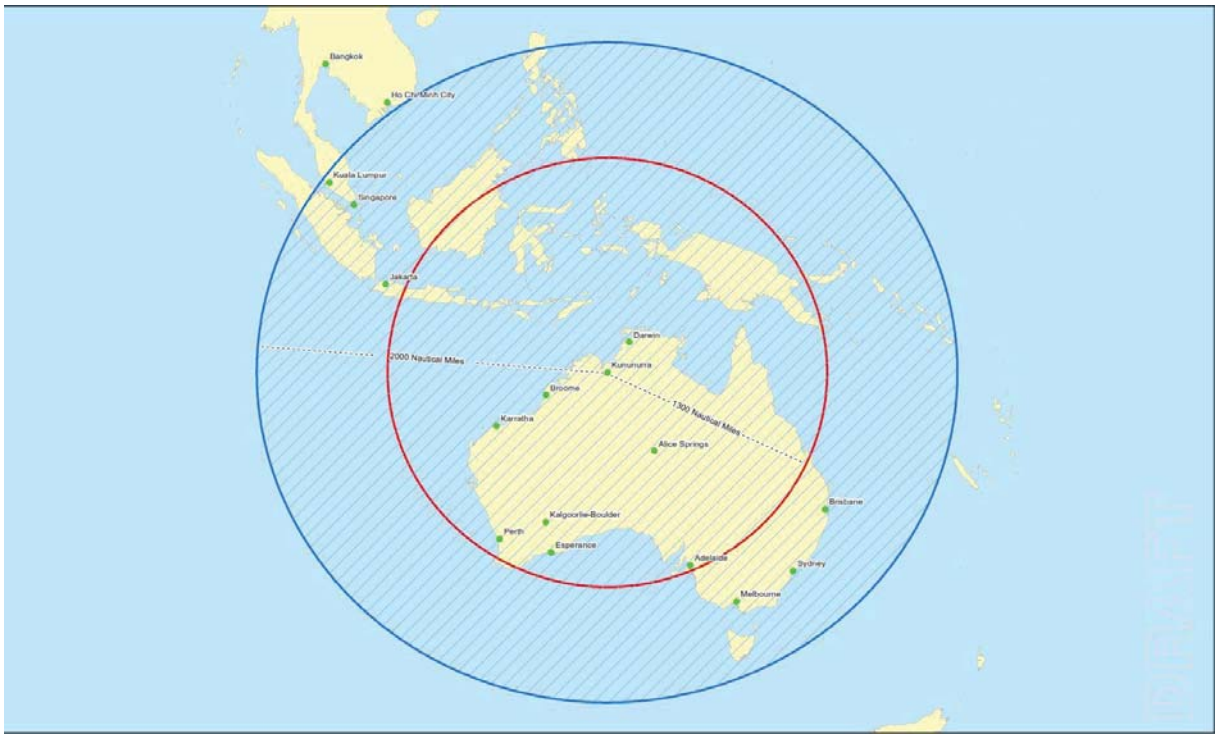

Figure 4: Range of existing Fokker 100 craft (red) vs proposed B737-800 craft (blue)

5.3 Providing improved access to regional/national services for the local community

Extending the runway will facilitate greater ease of access for the local community to services around the country without multiple flights, resulting in:

- Increased access to medical services
- Greater availability to personnel required for commercial services
- Improved access in and out of Kununurra for residents, family and the wider community

5.4 Key Deliverable Measures

The extension of the runway at East Kimberley Regional Airport is specifically targeted at:

- Fostering a profitable business environment by lowering the costs of doing business; and
- Increasing competition in the aviation business driving down costs to residents, regional employees and tourists.

Table 2: Key Deliverable Outcomes

	Outcomes	Performance Measures
1	Lower business costs	Lower comparative cost airfares
2	Increased aviation competition	Lower comparative cost airfares
3	Increased accessibility	More direct flight destinations

Table 3: Key Deliverable Outputs

	Outputs	Performance Measures
1	Larger aircraft utilised on RPT routes	Availability of seats post construction
2	Code 4C rated capable aircraft	CASA Certification

5.5 Stakeholder Engagement

A number of key stakeholder groups were identified during the development of the East Kimberley Regional Airport Master Plan and are aware of the intention to upgrade the runway to Code 4C. The Shire has facilitated ongoing dialogue and input from many stakeholders, who have expressed a strong interest and expectation to extend the runway.

GHD has made contact with key personnel from the following operators and companies in the region to solicit input to this report:

- Airnorth
- Aviair
- Broome Air Services
- Freshwater East Kimberley Apartments
- Helispirit
- Kimberley Air Tours
- Kimberley Development Commission
- Kingfisher Tours
- Shoal Air
- Top End Mustering

Key benefits recognised in association with undertaking the runway extension

- Operators recognise that there are significant economic and social opportunities which arise from direct-flight-access to Brisbane, Sydney and Melbourne.
    - Social benefits to local residents would include direct flights to the east coast of Australia, particularly for family and friends.
    - Economic benefits would include increased business related travel, increased accessibility for tourists, and reduced travel time to existing businesses by reducing the number of flights required to get to Kununurra.
    - Extending the runway would facilitate direct flights to a catchment of 10.5 million people (Brisbane – 2.1 million, Sydney – 4.3 million, Melbourne – 4.1 million), over and above Perth (1.8 million).
- An extension to the runway would facilitate larger aircraft which can export freight to key Australian capital cities.
- An extension to the runway would facilitate larger aircraft which can export freight to South East Asia.
- Current RPT providers will likely be reviewing their fleets in the future; an awareness of the intention to extend the runway will be useful in selecting larger more efficient aircraft.

Key concerns recognised in association with undertaking the runway extension

- Airlines are not currently operating at full capacity.
- EKRA management needs to review its revenue model to ensure it also caters to the needs of current local aviation operators, who will not directly benefit from a runway extension. Note that an alternate schedule of Landing Charges has recently been adopted by the Shire which sets lower charges for GA Fixed Wind and Rotary Wing aircraft.
- EKRA management is prioritising high profile projects like the runway extension over other works, such as upgrades to the parking lots and access roads.
- Aviation operators expressed concern in regards to how construction works would affect the regular operations of the runway (duration and frequency of any shut-down periods).
- Aviation operators expressed a desire to remain engaged throughout the runway extension project.

Airline operators

GHD also wrote to the major RPT airline operators to inform them of the intention to extend the runway and retain the 30 m width. It is noted that the B737-800 and A320-200 aircraft are operated regularly by airlines (Qantas and Virgin) into other airports within Australia which have 30 m wide runways, such as such as Newman Airport, Ballina Airport and Ayres Rock Airport.

GHD received a response from Qantas (Capt. Alex Passerini, Chief Technical Pilot, Qantas Flight Operations) which states

"*We have the AFM narrow runway appendix to support operations to runways less than 45m on our fleet of 737-800s. This complies with the guidelines contained in the subject CAAP. Based on this approval, we already operate to a number of 30m runways, whether they are used as planned destinations or alternates. The only benefit to widening the runway would be a small increase to the crosswind capability (40 kt in lieu of 33), though this would be unlikely to be of significance at Kununurra."*

The response from Virgin Australia (Rachael Barnes, Aircraft Performance Lead, Virgin Australia) was as follows:

"For the 737-700/800W, Virgin have no technical objection to keeping the runway at 30m wide.

Virgin currently operates to 30m wide runways with the B737.

There are operational restrictions to narrow runways (defined, for the 737, as widths less than 45m and no less than 30m), which are summarised below.

- *The ground control speed (VMCG) may change due to the maximum 20 foot deviation from runway centreline (this may or may not affect the MTOW and other takeoff speeds).*
- *Nose gear steering must be operative.*
- *Runway centreline shall be clearly visible.*
- *Brakes must be operative.*
- *Thrust reversers operative.*
- *Yaw damper operative.*
- *(More restrictive) Crosswind limitations are not exceeded.*

As we already operate to 30m wide runways, these restrictions are not new to the Virgin operation. While 45m wide runways are operationally preferred, Virgin can operate to Kununurra without any "new" restrictions."

6. Option Evaluation and Assessment

6.1 Assessment of options

To accommodate larger aircraft, a number of options were considered:

Table 4: Airport Upgrade Options

Option	Option Description
A	Extend existing runway to 2430 m and widen to 45 m (extend 601 m and widen)
B	Build a new runway 2430 m long and 45 m wide parallel to existing runway
C	Extend existing runway to 2430 m remains 30 m wide (extend 601 m only)*
D	Build a new runway 2430 m long and 30 m wide parallel to existing
E	Build a new airport in a new location to allow future greater runway lengthening
F	Do nothing

* Equivalent to Option 4 in the Pre-Feasibility Study

Each option has pro's and con's and these are addressed using a multi–criteria analysis of critical success factors. The criteria are:

- Accommodate Code 4C Aircraft
- Maximise use of existing infrastructure
- Construction cost

Each option was assessed against the critical success factors using rating systems as follows:

✗ Does not meet criteria
✓ Partly meets the criteria
✓✓ Meets the criteria
✓✓✓ Exceeds the criteria

Table 5: Airport Upgrade Options Analysis

Option	Description	Accommodate Code 4C Aircraft	Maximise use of existing infrastructure	Construction cost (GST Incl.)
A	Extend runway to 2430m x 45m	✓✓✓	✓✓	$25.9 m
B	Build new runway 2430m x 45m	✓✓✓	✓	$43.7 m
C	**Extend runway to 2430m x 30m**	✓✓	✓✓	**$19.2 m***
D	Build new runway 2430m x 30m	✓✓	✓	$35.2 m
E	New airport new site	✓✓✓	✗	$127.8 m
F	Do nothing	✗	✓✓	$0

* Construction costs only

6.2 Preferred option

The preferred option which meets all aviation and customer requirements and provides greatest value for money is Option C.

6.3 Project Budget

An indicative cost estimate has been developed for the runway extension recommended Option C. The following table outlines the order of magnitude project budget:

Item	Reference	Cost (incl. GST)
Construction Costs	Appendix A	$ 19,199,125
Land Acquisition Allowance	Section 6.3.1	$ 1,300,000
	Total Costs	$20,499,125.00

The rates applied in the indicative cost estimate are taken from similar aerodrome projects in recent years which involved earthworks operations, pavement works, airfield lighting installations and general civil works.

The following assumptions have been made in developing the indicative cost estimate:

- A contingency for 30% has been applied to the indicative construction cost.
- A total runway pavement extension of 601 m (Option C) has been costed, with the pavement layer thickness and asphalt overlay material as outlined in GHD Pre-Feasibility Study.
- All runway pavement fill material will be sourced and imported from suitable local borrow pit/s.
- Replacement of the existing runway edge lights and associated pit and duct, and two single sided PAPIs have been included in the indicative cost estimate.
- Inclusive of engineering design and tender preparation fees.
- Inclusive of contract administration, project management and supervision fees by Shire of Wyndham East Kimberley.
- Upgrade of taxiways A, B and C and RPT Apron
- Excludes escalation.

6.3.1 Land acquisition allowance

The 2013 Masterplan identified two areas of land which should be acquired as part of the long-term airport strategy. The existing airport landholding is sufficient to facilitate the proposed runway extension; however the purchase of additional crown land to the north-west and private land to the east will improve the fly-over area adjacent to the runway and reduce aircraft minimum approach descent altitudes. While this additional land is not a requirement to facilitate safe use by A320-200 and B737-800 aircraft, it would reduce the risk of damage to aircraft running off a runway, and provide flexibility to relocate instrumentation in the future.

The following table shows the lot areas and ownerships:

Table 6: Additional land required

Lot details	Land ownership	Part area to be acquired *(ha)
Lot 876 on plan 28266	Crown Land (to be vested)	18
Lot 1 on plan 41419	Freehold Land (to be acquired)	2
Total provision for land acquisition (including GST and contingency)		$1,300,000

Note:

Costs are indicative, based on the Unimproved Land Value Extract for Lot 1 on Plan 41419. Additional costs will be required to relocate existing structures on Lot 1 on Plan 414

***Area approximated from Rehbein Masterplan concept drawings.

****Approximate cost from Landgate Unimproved Land Value Extract, pro-rata.

6.4 Funding strategy

The strategic importance of the Ord River Irrigation System, resources industry and tourism makes this a project of national significance.

National Stronger Regions Fund

The National Stronger Regions Fund (NSRF) is the most applicable national funding source.

The NSRF guidelines stipulate a maximum grant level of $10 million. The next round of NSRF funding is yet to be announced. Round Three NSRF Programme Guidelines define Kununurra as a “Remote” region, which permits an applicant to apply for three dollars for every dollar provided outside of the NSRF program, up to the maximum grant level of $10 million.

Royalties for Regions

The Western Australian Government’s Royalties for Regions Fund is refocusing its allocations to projects that generate greater economic development potential and is the most applicable fund for the balance of the project cost. The maximum amount of funding generally available for any one project is $10 million.

RADS

The Regional Airports Development Scheme (RADS) is a Western Australian State Government grant program which was established to improve regional airport infrastructure. Runway development, including the extension of an existing runway, is listed as one of the eligible projects for RADS funding.

Proposed Funding Allocation

It is proposed that two funding sources be sought, one Federal Government the other State Government. It is proposed that the funding distribution be:

- National Stronger Regions Fund - $10 million (incl GST)
- Royalties for Regions Fund - $9.5 million (incl GST)
- Shire of Wyndham East Kimberley - $1 million from reserves

Should either of these funding sources be unavailable, RADS could provide another option, subject to the terms of the funding facility.

6.5 Project timeframe and key milestones

The formal funding process for the next phase of the National Stronger Regions Fund has not yet been announced, but previous applications for rounds have been annually in 2014, 2015 and 2016. It is anticipated the next round will be in 2017, subject to Federal Government policy.

Indicative Timeframe:

- Funding Application and Approval Period (from date of application) – 12 months
- Engineering Design – 6 months
- Tender Period (incl. award) – 6 months
- Construction – 8 months

Assuming the applications for the next round of National Stronger Regions Fund is in the first quarter of 2017, project completion would be August 2019.

6.6 Risk analysis – Key Issues

- FUNDING: Achieving funding alignment will be critical and needs to be managed as a project activity.
- CONSTRUCTION: Contractors are currently readily available and the market is very competitive at this point in time. Lengthy delays may incur increased costs if construction activity in Kununurra increases.
- LAND ACQUISITION: Some of the land identified for acquisition might be subject to Native Title Claims. As the acquisition of land is not required to facilitate safe use of A320-200 and B737-800 aircraft, it is not anticipated to be an impediment to the extension of the runway. The Shire should commence the acquisition of the land as part of a long term strategy for securing the future of the airport, and recognises that the land acquisition is likely to be a complex process.
- BENEFITS REALISATION: Lower passenger airfares are only likely to be achievable if larger aircraft are scheduled by the airlines in lieu of the current Fokker or Embraer

7. Implementation strategy

7.1 Project management and governance

The Shire of Wyndham East Kimberley will be the project sponsor and will engage appropriate consultants to prepare the detailed design, tender documentation, obtain approvals, administer the construction contracts and prepare the regulatory operational documentation for ongoing management of the airport.

The Shire will engage an appropriately experienced project manager to management the project and to prepare the necessary design consultants engagement contract and the civil construction contractor's tender documentation and risk manage the procurement process.

The project manager will ensure all funding obligations and reporting are delivered on a timely basis.

The Shire will form a Project Control Group, with appropriate stakeholder representation, to be accountable for the entire project. The Project Control Group chair will report directly to the Shire Chief Executive Officer.

7.2 Procurement strategy

The procurement strategy is based on the assumption that the major civil construction works will be a lump sum contract.

Consultants will be commissioned to provide a fully documented set of tender documents that allow competitive tenders on an equitable basis. This methodology also ensures the cost of the project can be monitored during the design phase and the allocation of risk can be appropriately allocated to the entity most able to manage the risk in a cost efficient manner.

7.3 Supporting documents

The principal support documents are:

- East Kimberley Regional Airport Runway 12/30 Extension – Prefeasibility Study – June 2016 - GHD
- East Kimberley Regional Airport Master Plan – Jan 2013 - Rehbein Airport Consulting

Also see Section 9 References for other contributory documents.

8. Recommendation of preferred option

The recommendations to achieve the project objectives are:

1. Adopt the extension-only option utilising the existing 30 m wide runway and extending to 2430 m total length.
2. Seek project funding from both the National Stronger Regions Fund (next round) and the Royalties for Regions Fund.
3. Upgrade the airport to Code 4C standard adopting the CAAP235A-1(0) approval Aeroplane Flight Manual (AFM) narrow runway supplement or specified AFM runway width limitation to land on narrow runways.
4. Upgrade Taxiway's A, B and C and RPT apron.
5. Acquire identified land reserves to support runway operation.

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Appendices

Appendix A – (Feasibility Construction Cost Estimates)

Kununurra Airport Runway 12/30 Extension - Prefeasibility Study **61-3239203**

Option 4 Extend runway pavements by 601m and upgrade Taxiway A, B and C and RPT Apron

EARTHWORKS, AIRCRAFT PAVEMENTS, DRAINAGE & ELECTRICAL WORKS **Recommended Option#** **4**

G:\61\3239202\Cost Estimates\[MR EDIT OPTION 4 Costings for REPORT.xls]Development Estimate

ITEM	DESCRIPTION		AMOUNT
1-	**GENERAL / PRELIMINARIES**		2,700,000
2-	**CLEARING, EARTHWORKS & DUST CONTROL**		1,600,000
3-	**AIRCRAFT PAVEMENTS**		5,600,000
4-	**DRAINAGE**		100,000
5-	**ELECTRICAL WORKS**		1,600,000
6-	**OTHER**		750,000
7-	**CONTINGENCY**		3,700,000
	SUBTOTAL of CONSTRUCTION COSTS - Excl. GST:		**16,050,000**
D -	**ENGINEERING FEES**		
D -	**1 Planning Fees** *(Not Applicable)*		0
D -	**2 Engineering Fees**		0
D -	*2.1 Design & Tender Preparation Fees*	3.5% of Construction =	561,750
D -	*2.2 Contract Administration by Shire*	4.0% of Construction =	642,000
D -	*2.3 Technical Support*		50,000
D -	*2.4 Other Fees / variations*		
D -	*2.41 Geotechnical Investigation*		50,000
D -	*2.5 Project Management Fees by Shire*		100,000
	SUBTOTAL for : D - ENGINEERING FEES		1,403,750
	SUBTOTAL of Sections A, B, C & D - Excl. GST:		**1,403,750**
	GRAND TOTAL (with construction costs) **- Excl. GST:**		**17,453,750**
	Add GST		**1,745,375**
	TOTAL DEVELOPMENT COST (Incl. GST):		**19,199,125**

Job Manager: .....

(Sign & print name under)

Project Director: .....

(Sign & print name under)

Assumptions:

Disclaimer: GHD has prepared this cost estimate using information available to GHD and where required, based on assumptions made by GHD. Prices and quantities in the cost estimate may change. GHD does not represent, warrant or guarantee that the project can be completed for the cost estimates prepared by GHD. Cost estimate to be read in conjunction with Runway 12/30 Extension Prefeasibility Study Report. Qualifications and assumptions to this cost estimate are detailed in Section 8.

Note: The above development cost estimate is not valid unless checked, signed and approved by both the Job Manager and Project Director.

G:\61\32392\WP\

Document Status

Revision	Author	Reviewer		Approved for Issue		
		Name	Signature	Name	Signature	Date
0	B Meyer	P Tilley	*P Tilley*	P Tilley	*P Tilley*	03/12/15
1	B Meyer	P Tilley	*P Tilley*	P Tilley	*P Tilley*	28/06/16
2	B Meyer	P Tilley	*P Tilley*	P Tilley	*P Tilley*	09/08/16
3	B Meyer	P Tilley	*P Tilley*	M Ryan	*M Ryan*	15/08/16
4	B Meyer	P Tilley	PP	M Ryan		25/08/16

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Memorandum

09 August 2016

To	Paul Bawden (Shire of Wyndham East Kimberley)		
Copy to			
From	Michael Ryan	Tel	6222 8521
Subject	Response to letter dated 14 July 2016	Job no.	61/32392

We provide the following advice on the matters raised in your letter dated 14 July 2016.

1 Virgin Australia & Air North

1.1 Virgin Australia

Virgin currently operate the following fleet of aircraft:

Table 1

Aircraft Type	Number of Aircraft	Reference Code
B737-800	73	4C
B737-700	2	3C
A320-200	2	4C
E190	17	3C
F100	14	3C

Source: Virgin website

GHD contacted Virgin to seek their feedback on operating Code 4C aircraft into Kununurra airport with a 30m wide runway.

The advice we received from Rachael Barnes, Aircraft Performance Lead, Virgin Australia is:

> *"For the 737-700/800W, Virgin have no technical objection to keeping the runway at 30m wide.*
>
> *Virgin currently operates to 30m wide runways with the B737.*
>
> *There are operational restrictions to narrow runways (defined, for the 737, as widths less than 45m and no less than 30m), which are summarised below.*
>
> - *The ground control speed (VMCG) may change due to the maximum 20 foot deviation from runway centreline (this may or may not affect the MTOW and other takeoff speeds).*
> - *Nose gear steering must be operative.*
> - *Runway centreline shall be clearly visible.*

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- *Brakes must be operative.*
- *Thrust reversers operative.*
- *Yaw damper operative.*
- *(More restrictive) Crosswind limitations are not exceeded.*

As we already operate to 30m wide runways, these restrictions are not new to the Virgin operation. While 45m wide runways are operationally preferred, Virgin can operate to Kununurra without any "new" restrictions."

1.2 Air North

Air North currently operate the following fleet of aircraft:

Table 2

Aircraft Type	Number of Aircraft	Reference Code
E170	4	3C
EMB 120	5	3C
Metro 23	3	3C

Source: Air North website

The E170 jet only requires a 30m wide runway.

2 Weight limitations

The Kununurra Airport Master Plan notes on Page 53 that a new runway length of 2,500m will accommodate unrestricted operations by 150-160 jet aircraft such as the Boeing 737-800 and Airbus A320-200 to all domestic destinations as well as to destinations within south-east Asia including Singapore, Kuala Lumpur and Denpasar. Some destinations in southern China may also be within reach however, some limitations on payload may need to be applied.

The yearly average high temperature in Kununurra is 35.1^{o}C. The elevation at the airport is 145 feet above sea level.

The take-off performance of the B737-800 is dependent on numerous factors including:

- Engine type and rating
- Wet or dry runway
- Wind
- Runway gradient
- Temperature
- Flap setting

- Operational Take-off weight
- Airport elevation
- Runway surface (grooving improves take-off performance)

To take-off performance will be different on every occasion and is determined by the pilot inputting all of the above into the aircraft performance manual prior to each departure.

The B737 Airplane Characteristics for Airport Planning document indicates that the recommended runway length of 2,430m will provide near unrestricted weight restrictions for take-off for the most situations.

3 Further extension of the eastern end

The most significant constraint on extending the runway at the eastern end is Victoria Highway and the existing buildings located at the north eastern corner of the airport boundary. The open unlined drains east of the existing runway threshold are considered minor constraints as they can be relatively easily realigned.

We have re-assessed the obstacle limitation heights on the eastern end of the runway on the basis that the Shire will now acquire and demolish the existing buildings located at the north eastern corner of the airport boundary.

The table below indicates the maximum height of vehicles that will be able to travel on Victoria Highway before they become a transient object that will impinge on the obstacle limitation surfaces. A transient object of 4 m is the maximum height before it is considered an unacceptable restriction on the approach and take-off slopes.

Table 3 Obstacle Height Limits for Victoria Highway

	Current		**61m extension (pre-feasibility design)**		**120m extension**	
Runway Width & Runway Strip Width	Approach slope	Take-off slope	Approach slope	Take-off slope	Approach slope	Take-off slope
30 m wide runway (150 m strip)	7 m	6 m	6 m	5 m	5 m	4 m
30 m or 45 m wide runway (300 m strip)	5 m	6 m	4 m	5 m	3 m	4 m

In addition to the vehicles travelling on the highway there are a number of other existing objects that will intrude into the obstacle limitation surface for a runway extended beyond the prefeasibility design of 60m.

These include the light poles on the Victoria Highway bridge, and some larger vegetation on the east side of the drainage channel.

Therefore, based on the results of the assessment outlined in Table and the assumption that the Shire will wish to pursue a 300 m wide runway strip at some point in the future, it is not considered feasible for further extension of the runway beyond the 61m extension already determined in the Prefeasibility Study.

(Runway extension intervals of 60m suit the spacing of the lights on RWY 12/30. A shorter spacing would necessitate the relocation of all existing lights on the runway to maintain an equal spacing between lights.)

4 Broome and Karratha Airports

The physical characteristics of Broome and Karratha Airports are outlined in Table below. Both of these aerodromes are Code 4C and regularly have B737 aircraft operating from them.

Table 4 Comparative airports

Airport	Runway Width	Runway Strip Width	Runway Length	RESA
Broome International Airport	45m	150m	2,548m	90m
Karratha Airport	45m	300m	2,280m	90m

The 2013 Master Plan for Karratha Airport states:

> *The current runway length of 2,280 metres is considered to be sufficient to accommodate operations by existing aircraft including the B737-800 to Perth, Brisbane, Sydney, Melbourne and some destinations in Southeast Asia, such as Singapore and Indonesia. It is also considered sufficient to support the operation of larger aircraft on these routes such as the B767-300 and A330-300. However, in order to reach more northerly destinations in Southeast Asia and China, such as Bangkok, Hong Kong and Shanghai, a runway extension to 2,500 metres would likely be required to support these operations by a B737-800/A320 and larger aircraft.*

The 2008 Master Plan for Broome Airport states:

> *The runway geometry is suited for aircraft operations to ICAO Code D/E. RESAs of 90m are provided.*
>
> *The runway has a displaced threshold at each end, which is high strength pavement, and is available for takeoffs. The declared runway lengths are 2458m for a 10 takeoff, and 2368m for a 28 takeoff (with an additional 90m available to RPT operators).*
>
> *The runway was extended to the present length and strengthened to allow Boeing 737-800 aircraft to carry maximum passengers from Broome to Sydney or Melbourne.*

5 Comparative Cost estimates

Table below outlines comparative construction cost estimates of the additional configurations outlined in your letter.

Table 5 Comparative Cost Estimates

Current runway retained at 30m wide, together with an extension of 601m length at 30m wide	$19.2 M
Current runway retained at 30m wide, together with an extension of 601m length at 45m wide	$22.2 M
Current runway widened to 45m wide, together with an extension of 601m length at 45m wide	$25.9 M
Any additional length	N/A

The above cost estimates are inclusive of GST

6 Taxiway B illumination

The additional cost to provide elevated taxiway edge and hold point lighting to Taxiway B is estimated to be in the order of $165,000 (GST Inclusive).

7 Maintenance Costs

The asphalt wearing surface to be provided on the runway extension will require less maintenance than on a bitumen seal runway surface. The airport maintenance staff will be experiencing this following the recent asphalt overlay on the existing runway.

Additional maintenance costs will include the following:

- Repainting of additional line markings at say 3 year intervals
- Asphalt resurfacing and grooving of additional runway length in 15-20 years
- Mowing/slashing of grass in additional runway strip area
- Filling of gilgai holes within additional runway strip area
- Maintenance on additional light fixtures (although expected to be minimal)

The additional maintenance costs would be about 25% of the costs that the airport spend on maintaining the existing runway (not the total airside maintenance costs).

8 International Capital costs

Terminal Building

The 2013 Kununurra Airport Master Plan states:

The frequent operation of an international service may also require significant expansion to the terminal with the development of a dedicated international departure lounge with areas to accommodate the requirements for customs, immigration and quarantine.

The required area for the expansion of the terminal building was not identified in the Master Plan. The expansion required could be in the order of 40% of the current building footprint. The cost of the recent new terminal building can be used by the Shire to identify an "order of magnitude" cost for the international operations.

Aerodrome Rescue and Fire Fighting Services

MOS Part 139H—Standards Applicable to the Provision of Aerodrome Rescue and Fire Fighting Services requires that a Level 1 ARFFS is required at:

an aerodrome from or to which an international passenger air service operates

Based on the design B737-800 aircraft, the minimum number of ARFFS Vehicles to achieve adequate protection for Level 1 at Kununurra Airport is two.

The location of a Rescue and Fire Fighting Facility was identified in the 2013 Master Plan (Proposed Development Plan Stage 2).

MOS Part 139H does not address any requirement to provide ARFFS for freight flights.

The provision of an ARFFS is generally provided by Air Services Australia when deemed necessary.

In response to the Aviation Safety Regulation Review, the Australian Government asked the Department of Infrastructure and Regional Development to provide policy advice on a range of potential improvements to the efficiency and clarity of Aviation Rescue and Fire Fighting Service (ARFFS) requirements including the use of risk assessments.

On 18 December 2015, the Department released a regulatory policy review consultation paper that considered future arrangements in relation to the provision of ARFFS at Australian airports. The paper nominated the following:

Unlike the current arrangements, where the receipt of scheduled international air services acts as a hard trigger for the provision of ARFFS, undertaking a risk review would provide flexibility to potentially determine that at certain locations (for example those with low passenger numbers and very few international movements) an ARFFS is not required.

If the ARFFS Regulatory Policy Review is adopted, then an ARFFS may not be required at Kununurra Airport for infrequent international passenger services.

Regards

Michael Ryan
Principal Civil/Airport Engineer

12.5.2. Funeral Fee Waiver Request

DATE:	30 August 2016
AUTHOR:	Vlad Adamek, Manager Operations
RESPONSIBLE OFFICER:	David Klye, Director Operations
FILE NO:	PH.05.2
DISCLOSURE OF INTERESTS:	Nil

VOTING REQUIREMENT

Simple Majority

OFFICER'S RECOMMENDATION

That Council, in accordance with section 6.12 of the *Local Government Act 1995*, waive the surcharge for weekend interment of $1,004 (GST inclusive) for an upcoming burial in Wyndham.

COUNCIL DECISION

Minute No: 11471

Moved: Cr K Wright
Seconded: Cr N Perry

That Council, in accordance with section 6.12 of the *Local Government Act 1995*, waive the surcharge for weekend interment of $1,004 (GST inclusive) for an upcoming burial in Wyndham.

Carried 9/0

PURPOSE

To seek a Council decision to waive the surcharge for weekend interment for a weekend burial.

NATURE OF COUNCIL'S ROLE IN THE MATTER

Provider - provide physical infrastructure and essential services

BACKGROUND/ PREVIOUS CONSIDERATIONS BY COUNCIL/ COMMITTEE

In March 2016, Council resolved the following:

COUNCIL DECISION

Minute No: 11300

Moved: Cr B Robinson
Seconded: Cr S Cooke

That Council pursuant to section 53 of the Cemeteries Act 1986 adopts the fees and charges for the Seven Mile Cemetery, Nine Mile Cemetery, Afghan Cemetery, Pioneer Cemetery, Gully Cemetery, Kununurra Cemetery, and other cemetery associated fees as specified in Attachment 1.

Carried 7/0

The associated fees from the Shire's Fees and Charges Schedule relevant to this item, inclusive of GST, are:

1. On application for an order for burial the following fees shall be payable:	
(a) For sinking grave 1.83m deep (Adult)	$1,318.20
(d) Surcharge for weekend interments	$1,004.00

Reference: Page 17 of the 2016/17 Shire of Wyndham East Kimberley Fees and Charges

STATUTORY IMPLICATIONS

Local Government Act 1995, Section 6.12(1)(b) and (c) applies to this item

6.12. Power to defer, grant discounts, waive or write off debts

(1) Subject to subsection (2) and any other written law, a local government may —

(a) when adopting the annual budget, grant a discount or other incentive for the early payment of any amount of money; or*
(b) waive or grant concessions in relation to any amount of money; or
(c) write off any amount of money,
which is owed to the local government.

** Absolute majority required.*

(2) Subsection (1)(a) and (b) do not apply to an amount of money owing in respect of rates and service charges.

(3) The grant of a concession under subsection (1)(b) may be subject to any conditions determined by the local government.

(4) Regulations may prescribe circumstances in which a local government is not to exercise a power under subsection (1) or regulate the exercise of that power.

POLICY IMPLICATIONS

Delegation 11 - Write, Grant Concessions or Write off Debts applies to this item. However, the amount requested is in excess of this delegation and it is not considered to be an exceptional circumstance.

FINANCIAL IMPLICATIONS

The Shire will forgo income of $1,004 (GST inclusive) for a weekend burial.

STRATEGIC IMPLICATIONS

Strategic Community Plan 2012-2022

Goal 2: Greater returns from regional investment to ensure sustainable provision of appropriate physical and social infrastructure

Objective 2.4: Access to appropriate health, family and community services

Strategy 2.4.2 : Ensure community compliance with Environmental Health regulations

RISK IMPLICATIONS

Risk: Inability to deliver levels of service expected by the community.

Control: Current budget and service levels.

Risk: Death or injury of an employee(s) resulting in substantial claim(s) from unsafe work practices.

Control: Implementation of OS&H policy and procedures.

COMMUNITY ENGAGEMENT

No community engagement is required, however the application has been requested by Derby Funeral Services, therefore the outcome will be provided to them after Council has considered their request.

COMMENTS

The Shire has received a written request from Derby Funeral Services dated 9 August 2016, requesting a fee waiver for a burial on the weekend of 27 August (last Saturday), which is provided as Attachment 1.

The Funeral Company has requested that the Shire dig the appropriate sized hole during normal business hours and has offered to undertake the refilling process with the family. This is a reasonably common practice for indigenous families, with Shire staff often only being required to check the site upon completion. As the family is offering to fill the grave

themselves, they are seeking a waiver of the surcharge for weekend interment fee for this burial.

The usual practice for grave digging is for the Shire staff dig the allocated space on the day prior to the funeral, in case difficult soil (eg.Rock) is encountered. The grave is then covered with timber until the appointed time for the interment.
The Chief Executive is not delegated to waive fees in excess of $500.00 and only if there are exceptional circumstances in any case. As a result this request is presented to Council for consideration.

ATTACHMENTS - Item 12.5.2

Confidential Attachment 1 - Letter from Derby Funeral Services dated 9 August 2016.

13. MOTIONS OF WHICH PREVIOUS NOTICE HAS BEEN GIVEN

Nil

14. QUESTIONS BY MEMBERS OF WHICH DUE NOTICE HAS BEEN GIVEN

Nil

15. URGENT BUSINESS APPROVED BY THE PERSON PRESIDING OR BY DECISION

15.1 SHOW CAUSE NOTICE - COUNCIL SUSPENSION

DATE:	30 August 2016
AUTHOR:	Lisa Hannagan, Senior Governance and Risk Officer
RESPONSIBLE OFFICER:	Louise Gee, Acting Chief Executive Officer
FILE NO:	CM.05.3
DISCLOSURE OF INTERESTS:	Nil

VOTING REQUIREMENT

Simple Majority

OFFICER'S RECOMMENDATION

That Council:

1. ***Receives the Show Cause Notice [Section 8.15B(1)] Local Government Act 1995 and provides a response within 21 days; and***
2. ***Determines a suitable response to the Minister's intention to make an Order under Section 8.15C(2) of the Local Government Act.***

Cr Robinson moved the recommendation with an amendment to dot point two with the inclusion of "Will determine by resolution" at the beginning of dot point two to replace the word "Determines". Cr Perry seconded the recommendation with the amendment.

Cr K Wright foreshadows a motion – that Council write to the Minister seeking clarification of several dot points and upon receipt of his response hold a Special Council Meeting to respond.

Cr S Cooke moves that the motion be put. Motion lapsed due to no seconder.

Cr Spackman moved an amendment to include a new dot point three “to seek clarification from the Minister in relation to specific matters raised in the Show Cause Notice before Council makes is in a position to formally respond”. The mover and the seconder of the recommendation did not accept Cr Spackman’s amendment. Cr Rushby seconded Cr Spackman’s amendment.

COUNCIL DECISION

Minute No: 11472

Moved: Cr D Spackman
Seconded: Cr S Rushby

That the motion be amended to include a dot point three “Seek clarification from the Minister in relation to specific matters raised in the Show Cause Notice before Council is in a position to formally respond”.

Carried 6/3
For: Cr J Parker, Cr K Wright, Cr D Spackman, Cr E Bolto, Cr A Petherick, Cr S Rushby
Against: Cr N Perry, Cr B Robinson, Cr S Cooke

COUNCIL DECISION

Minute No: 11473

Moved: Cr B Robinson
Seconded: Cr N Perry

That Council:

1. **Receives the Show Cause Notice [Section 8.15B(1)] Local Government Act 1995 and provides a response within 21 days; and**
2. **Will determine by resolution a suitable response to the Minister’s intention to make an Order under Section 8.15C(2) of the Local Government Act; and**
3. **Seek clarification from the Minister in relation to specific matters raised in the Show Cause Notice before Council is in a position to formally respond.**

Carried 9/0

PURPOSE

The purpose of this item is for Councillors to consider correspondence addressed to the Shire President from the Hon. Tony Simpson MLA Minister for Local Government, which was received on Friday 26 August 2016.

The correspondence included a Show Cause Notice in accordance with Section 8.15B of the *Local Government Act 1995* (Attachment 1)

At point 7, of the Show Cause Notice, the Minister advised of his intention to suspend the Council of the Shire of Wyndham East Kimberley.

At point 8, of the Show Cause Notice, the Minister advised of his intention to require all members of the Council to undertake training, of a kind approved by the Director General, during the suspension period.

NATURE OF COUNCIL'S ROLE IN THE MATTER

Leader - plan and provide direction through policy and practices

BACKGROUND/ PREVIOUS CONSIDERATIONS BY COUNCIL/ COMMITTEE

The Minister for Local Government; Community Services; Seniors and Volunteering; Youth issued the Shire of Wyndham East Kimberley a previous Show Cause Notice in May 2016. That Show Cause Notice required Councillors and Senior Officers to undertake mediation.

Graham Castledine of Castledine Gregory Law and Mediation was appointed by the Minister, by Order published in the Government Gazette on 17 June 2016, to undertake the mediation. The mediation program commenced on 12 July 2016.

The Department of Local Government was advised by Mr. Castledine on 2 August 2016, that "based on actions to date, I have formed the view that there is insufficient commitment to either the process proposed, or the desired outcomes". This has led him to believe there is no reasonable prospect of success with the mediation program and hence his recommendation to the Department that mediation be terminated.

The Minister accepted Mr Castledine's recommendation to terminate mediation.

The Council is required to prepare and submit a response to the Show Cause Notice by 21 September 2016.

STATUTORY IMPLICATIONS

8.15. Minister can take action to ensure that recommendations are put into effect

(1) The Minister may, if he or she thinks fit —

(a) after receiving the local government's advice; or
(b) after the time allowed by or under section 8.14(3) runs out, if no advice has been received by then, order the local government, or any of its council members or employees, to give effect to any one or more of the recommendations in the report in a manner and within a time ordered by the Minister.

(2) If the Minister's order under subsection (1) is not complied with according to

its terms the Minister may, by order, suspend the council of the local government.

8.15A. Local government may have to meet inquiry costs

If —

(a) an authorised person makes findings adverse to a local government, or to its council or any member, or to any of its employees; or

(b) an inquiry by an authorised person was instituted at the request of a local government,

the Minister may order the local government to pay all or part of the costs of the inquiry and the local government is to comply with that order.

[Section 8.15A inserted by No. 64 of 1998 s. 43.]

Division 2A — Council may be peremptorily suspended or required to undertake remedial action

[Heading inserted by No. 2 of 2012 s. 22.]

8.15B. Notice that council may be peremptorily suspended or required to undertake remedial action

(1) Before the Minister makes an order under section 8.15C(2), the Minister is to give a notice (a show cause notice) in writing to the local government of the intention to do one or both of the following —

(a) suspend the council of the local government;

(b) require the council, or one or more of the members of the council, to undertake such remedial action as is specified in the notice.

(2) Within 21 days of receiving a show cause notice, or such longer period as the Minister allows, the local government is to give the Minister a written response to the notice.

[Section 8.15B inserted by No. 2 of 2012 s. 22.]

8.15C. Minister may order that council be peremptorily suspended or required to undertake remedial action.

(1) This section applies if the Minister thinks that —

(a) the seriousness or duration of a suspected failure of the council of a local government to ensure that the local government performs its functions properly; or

(b) such other factors as the Minister considers relevant, make it inappropriate for the council to act, or to continue to act, without intervention under this section, as the governing body of the local government, whether or not there has been an inquiry under Division 1.

(2) The Minister may —

(a) after receiving the local government's response under section 8.15B(2); or
(b) after the time allowed by or under section 8.15B(2) runs out, if no response has been received by then, by order, do one or more of the following —
(c) suspend the council;
(d) require the council, or one or more of the members of the council, to undertake such remedial action as is specified in the order.

(3) An order under this section suspending a council ceases to have effect when —

(a) an Inquiry Panel is appointed to conduct an inquiry and make a report about the local government; or
(b) the council is reinstated by the Minister under section 8.28(3); or
(c) the period of 6 months from when the order was made ends, whichever happens soonest.

[Section 8.15C inserted by No. 2 of 2012 s. 22.]

POLICY IMPLICATIONS

Nil

FINANCIAL IMPLICATIONS

At this stage, future budget implications are unknown.

STRATEGIC IMPLICATIONS

Strategic Community Plan 2012-2022

Goal 1: Strong leadership and governance that underpins a more strategic approach to community engagement, regional development and organisational sustainability

Objective 1.4: Business innovation, efficiency and improved services

Strategy 1.4.1 : Ensure legislative compliance and follow best practice principles in planning and service delivery

RISK IMPLICATIONS

Failure to comply with legislative requirements leading to damage of reputation and/or financial loss.

COMMUNITY ENGAGEMENT

No community engagement is required.

COMMENTS

The Show Cause Notice clearly notes, at point 5, that the mediation program “has failed to bring an end to the conflict between members of the Council”.

During the period of a Council suspension, elected members are still elected members, but they are not permitted to undertake any functions or duties of an elected member.

Local Government (Rules of Conduct) Regulations 2007 and the *Shire of Wyndham East Kimberley Code of Conduct for Council Members, Committee Members and Employees* will continue to apply to elected members and any current enquiries for Minor or Serious Breach complaints will progress during this period.

ATTACHMENTS – Item 15.1

Attachment 1 - Show Cause Notice

SHOW CAUSE NOTICE [Section 8.15B]
Local Government Act 1995

To: The Shire of Wyndham-East Kimberley

Attention: Cr Jane Parker, Shire President

This Show Cause Notice is given pursuant to Section 8.15B of the *Local Government Act 1995*.

1. Based on the high level of ongoing complaints and concerns relating to the Shire, including complaints made since the publication of the *Local Government (Wyndham-East Kimberley – Requirement for Council to Undertake Remedial Action) Order 2016* (**Order**), I have formed the view that the local government of the Shire is unable to properly perform the functions set out in the *Local Government Act 1995* in relation to providing for the good governance of persons in the district.

2. I am satisfied that an analysis of the complaints and concerns identifies *inter alia:*
   A. credible evidence of significant ongoing conflicts between members of the Council to an extent that the levels of communication necessary for good decision making processes have been compromised;
   B. ongoing complaints alleging bullying and harassment of staff and councillors;
   C. allegations of denigrating comments by councillors;
   D. continuing allegations of failing to declare interests and/or failing to vote;
   E. alleged interference by councillors and, in some instances, acquaintances of councillors, in the administration and Chief Executive Officer functions; and
   F. ongoing and systemic compliance and governance issues.

3. I am satisfied that the behaviour demonstrated by the councillors is bringing the Shire into disrepute.

4. I am also satisfied that the Council lacks the present capacity to properly address these matters, based on the ongoing complaints, including complaints made since the publication of the Order.

5. Furthermore, I am satisfied that the programme of mediation commenced in accordance with the Order has failed to resolve these matters and, in particular, has failed to bring an end to the conflict between members of the Council. In light of the failure of the programme of mediation, I am satisfied that there is no realistic prospect that the Council will be able to address these matters in the future.

6. Accordingly, I am satisfied that the matters referred to in this notice provide significant evidence of a serious and ongoing failure of the Council to ensure that the Shire properly acquits its functions, rendering it inappropriate, without further intervention, for the Council to act as the local government's governing body.

7. I therefore give notice of my intention to suspend the Council of the Shire of Wyndham-East Kimberley.

8. I also give notice of my intention to require all members of the Council to undertake training, of a kind approved by the Director General, during the suspension period.

9. The Council has until Wednesday, 21 September 2016 to provide a written response to my office.

10. This notice should be presented to Council at the first opportunity to enable the preparation and submission of a response by the Shire by Wednesday, 21 September 2016.

HON TONY SIMPSON MLA
MINISTER FOR LOCAL GOVERNMENT; COMMUNITY SERVICES; SENIORS AND VOLUNTEERING; YOUTH

COUNCIL DECISION

Minute No: 11474

Moved: Cr B Robinson
Seconded: Cr N Perry

That Council moves behind closed doors.

Carried 9/0

Council moved behind closed doors at 7:20pm.

Cr N Perry left Chambers at 7:20pm and returned to Chambers at 7:22pm

16. MATTERS BEHIND CLOSED DOORS

16.1. REQUEST TO WAIVER INTEREST AND PENALTIES ON ASSESSMENT NUMBER A2574

DATE:	30 August 2016
AUTHOR:	Veronica Gulland, Senior Rates Officer
RESPONSIBLE OFFICER:	Natalie Te Pohe, Director Corporate Services
FILE NO:	A2574
DISCLOSURE OF INTERESTS:	Nil

This item is to be considered behind closed doors as per the *Local Government Act 1995*:

5.23. Meetings generally open to public

(2) If a meeting is being held by a council or by a committee referred to in subsection (1)(b), the council or committee may close to members of the public the meeting, or part of the meeting, if the meeting or the part of the meeting deals with any of the following —

(a) a matter affecting an employee or employees; and

(b) the personal affairs of any person; and

(c) a contract entered into, or which may be entered into, by the local government and which relates to a matter to be discussed at the meeting; and

(d) legal advice obtained, or which may be obtained, by the local government and which relates to a matter to be discussed at the meeting; and

(e) a matter that if disclosed, would reveal —

(i) a trade secret; or

(ii) information that has a commercial value to a person; or
(iii) information about the business, professional, commercial or financial affairs of a person, where the trade secret or information is held by, or is about, a person other than the local government; and

(f) a matter that if disclosed, could be reasonably expected to —
(i) impair the effectiveness of any lawful method or procedure for preventing, detecting, investigating or dealing with any contravention or possible contravention of the law; or
(ii) endanger the security of the local government's property; or
(iii) prejudice the maintenance or enforcement of a lawful measure for protecting public safety; and

(g) information which is the subject of a direction given under section 23(1a) of the Parliamentary Commissioner Act 1971; and

(h) such other matters as may be prescribed.

(3) A decision to close a meeting or part of a meeting and the reason for the decision are to be recorded in the minutes of the meeting.

VOTING REQUIREMENT

Simple Majority

OFFICER'S RECOMMENDATION

That Council advise the CEO to respond to the property holders of Assessment Number A2574 advising them that interest and penalties will continue to accrue until payment is made in full.

COUNCIL DECISION

Minute No: 11475

Moved: Cr B Robinson
Seconded: Cr D Spackman

That Council advise the CEO to respond to the property holders of Assessment Number A2574 advising them that interest and penalties will continue to accrue until payment is made in full.

Carried 9/0

PURPOSE

For Council to consider a request to waiver the future interest and penalties on Assessment A2574.

COUNCIL DECISION

Minute No: 11476

Moved: Cr B Robinson
Seconded: Cr D Spackman

That Council move out from behind closed doors.

Carried 9/0

Council moved out from behind closed doors at 7:23pm.

Members of the public were invited back into the Council Chambers.

The resolution and voting results of the item considered behind closed doors was read out to the members of the public by the Shire President.

17. CLOSURE

The Shire President declared the meeting closed at 7.24pm