FORRESTFIELD-AIRPORT LINK (WITHIN THE PERTH AIRPORT ESTATE)

FINAL MAJOR DEVELOPMENT PLAN

NOVEMBER 2015

Delivered by Public Transport Authority

Forrestfield-Airport Link
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CONTENTS

EXECUTIVE SUMMARY

- This Major Development Plan (MDP) outlines the case for the construction of required infrastructure for the Forrestfield-Airport Link project proposed to be located within the Perth Airport estate. This MDP is presented in accordance with the requirements for Major Development Plans prescribed under the *Airports Act 1996* (the Act).
- The Forrestfield-Airport Link project is an 8.5 kilometre extension of the Perth rail network from Bayswater to Forrestfield, of which 3.8 kilometres is located within the Perth Airport lease area. The project is funded and will be delivered by the State Government. The State Government considers that the link will form an integral component of Perth's long term public transport network in meeting existing and future public transport demand. The proposed rail will provide improved connectivity between the eastern suburbs, Perth Airport and the Perth Central Business District, as well as providing a viable alternative to car travel between these destinations. Works for the proposed Forrestfield-Airport Link project are expected to commence in October 2016, and are expected to be completed late 2020, subject to funding and all relevant approvals.
- Much of the works associated with the Forrestfield-Airport Link project occur outside the Perth Airport estate. The MDP addresses those parts of the Forrestfield-Airport Link that occur within the estate, and those works which meet the triggers for an MDP. This MDP includes the following elements:
  - twin-bored tunnels and rail infrastructure required to operate the train service,
  - construction of a new below-ground Airport Central Station, with pedestrian linkages to existing and future terminals,
  - emergency egress shaft,
  - several cross-passages, both airside and landside, and
  - two options for potential stockpile locations required for the storage and treatment of material extracted from the ground during tunnelling and construction of the Airport Central Station.
- The Act requires that Perth Airport produces a Master Plan to guide future strategic development and use on the airport estate. The Perth Airport Master Plan 2014 identified the future surface access plan for Perth Airport, including the future rail alignment. The Forrestfield-Airport Link project is consistent with the Perth Airport Master Plan 2014, as approved by the Minister for Infrastructure and Regional Development (DoIRD) on 9 January 2015.
- With respect to environmental considerations, the *Environmental Protection and Biodiversity Act 1999* (EPBC Act) is the Commonwealth Government's central piece of environmental legislation. It provides a legal framework to protect and manage nationally and internationally important flora, fauna, ecological communities and heritage places, defined in the EPBC Act as matters of national environmental significance. In consultation with the Department of Environment (DoE), it was determined that potential environmental impacts on the airport estate will be considered via the Act's MDP process. Accordingly, an assessment of the nine matters of national environmental significance to which the EPBC Act applies has been undertaken as part of this MDP, and it is not considered that the Forrestfield-Airport Link will have any significant environmental impact on the estate.
- Perth Airport, in partnership with the Public Transport Authority (PTA), has engaged in an extensive consultation process that includes State and local Government authorities, Airservices Australia, the Civil Aviation Safety Authority (CASA) and sub tenants on the estate directly impacted by the works. This consultation will continue throughout the design and construction of the project.
- The MDP was released for a 30 business day consultation period between 11 August 2015 and 22 September 2015. Comments received during this time were considered during the development of the MDP that was submitted to the Minister for Infrastructure and Regional Development for consideration.
- The Commonwealth Minister for Infrastructure and Regional Development approved the MDP on 30 November 2015.
- This MDP fulfils the requirements under the Act.

1. INTRODUCTION

In 2014, the State Government announced that a new rail link would be constructed from Bayswater to Forrestfield via the Perth Airport estate, now referred to as the Forrestfield-Airport Link project. The State Government outlined that the Forrestfield-Airport Link will form an integral component of Perth's long term public transport network in meeting existing and future public transport demand. The proposed rail line will provide improved connectivity between the eastern suburbs, Perth Airport and the Perth Central Business District, as well as providing a viable alternative to traditional car travel between these destinations.

The Forrestfield-Airport Link is an 8.5 kilometre extension of the Perth rail network from Bayswater to Forrestfield, of which 3.8 kilometres is located within Perth Airport lease area as shown in Figure 1.1. The rail line will be constructed underground within two tunnels. The alignment traverses State and Commonwealth land and generally follows Tonkin Highway and Brearley Avenue before crossing Perth Airport and surfacing to the east in Forrestfield.

The Forrestfield-Airport Link infrastructure will comprise twin-bored tunnels, with cross-tunnel passages, emergency escape shafts and three stations (two underground).

The Forrestfield-Airport Link project will provide three new stations as summarised below:

- Airport West Station – located outside the western boundary of the airport estate within the Brearley Avenue road reserve on State land in the locality of Redcliffe. This station will have below ground platforms with the station access at the surface similar to the Esplanade Station in Perth,
- Airport Central Station - located near the current International Terminal (T1) on Commonwealth land. This station will be underground similar to the Perth Underground Station in Perth. This station is also referred to as the Consolidated Airport Station in Public Transport Authority (PTA) material,
- Forrestfield Station - located adjacent to Dundas Road in High Wycombe on State land. This station will be at the existing ground level.

While the Forrestfield-Airport Link proposes three new stations, only one is located on the airport estate, the Airport Central Station. The remaining stations will be located in the locality of Redcliffe within the City of Belmont, and in the locality of High Wycombe within the Shire of Kalamunda. Further information with respect to the Forrestfield-Airport Link project can be obtained directly from the PTA through their website at www.forrestfieldairportlink.wa.gov.au.

The Act requires that Perth Airport must seek approval, via a MDP for any new rail lines that will be constructed on or within the Perth Airport estate. Those elements of the Forrestfield-Airport Link project that will be constructed within the Perth Airport estate are therefore covered in this MDP for approval under the Act.

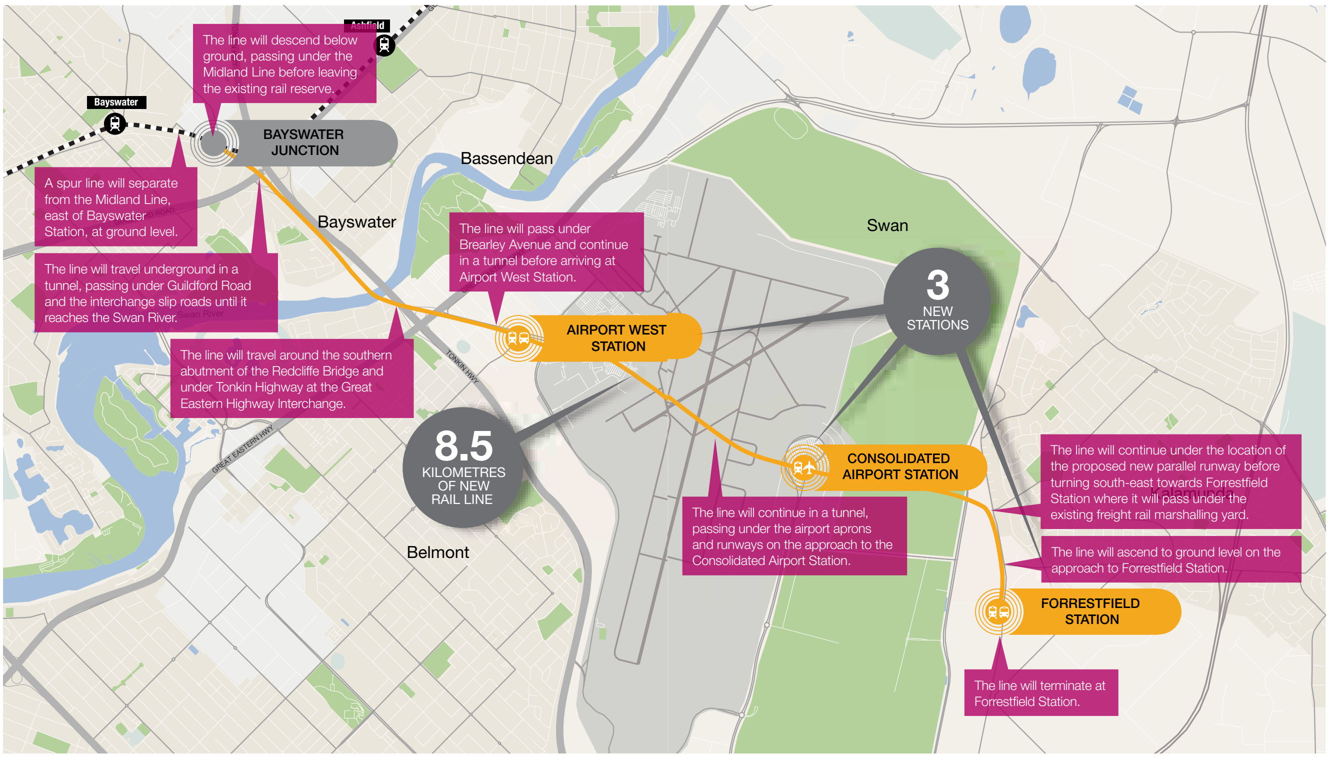


Figure 1.1 Forrestfield-Airport Link project boundary
Source: PTA

1.1. Proposed Development under this Major Development Plan

The majority of the development required for the Forrestfield-Airport Link project will occur outside the Perth Airport estate. Figure 1.2, 1.3 and Appendix B show the approval boundary within the Perth Airport estate.

The proposed development under this MDP incorporates the following elements:

- twin-bored tunnels traversing the airport estate from the western boundary, under the main runway (03L/21R) and the cross runway (06/24) through to the Airport Central Precinct and then passing under the proposed location of new runway (03R/21L) before exiting the estate at the eastern boundary,*
- rail infrastructure required to operate the train service,
- construction of a new Airport Central Station below ground, with pedestrian linkages to existing and future terminals,
- emergency egress shaft, which will connect the tunnels to the ground level for emergency egress and maintenance access,
- several cross-passages, providing an underground link between the twin-bored tunnels, to be located both airside and landside, and
- two options for potential stockpile locations required for the storage and treatment of material extracted from the ground during tunnelling and construction of the Airport Central Station.

**Although the MDP shows a rail alignment for the tunnelling, during the detailed design the alignment may shift within the approvals boundary. The tunnel corridor is typically 120 metres wide, based on an offset of 60 metres either side of the tunnel alignment centreline. Any changes to the alignment will not alter the location of the Airport Central Station.*

A reference design has been developed for the Forrestfield-Airport Link project. The reference design provides:

- a high level of certainty of the rail corridor footprint below ground,
- a concept plan and footprint for the Airport Central Station, and
- details of the footprint and land required to accommodate the emergency egress shaft structure.

Similarly, two proposed stockpile locations on the estate have been determined pursuant to investigations associated with construction staging and methods.

A detail design will be prepared once a construction contract has been awarded. The detailed design may alter slightly from the reference design; however the detailed design will be consistent with the approved MDP and consider all boundaries and impacts, as outlined in this MDP.

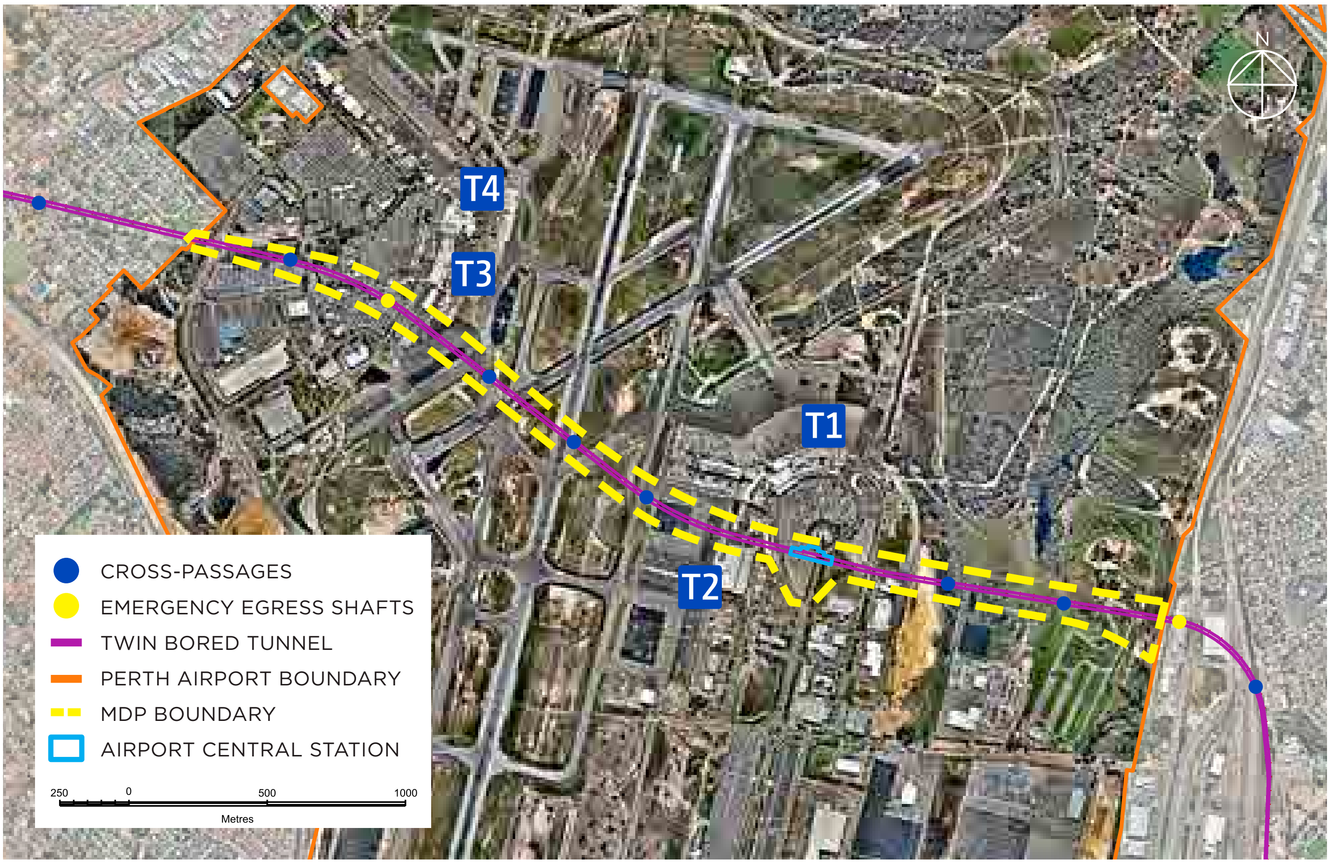


Figure 1.2 Project boundaries for components on the Perth Airport estate
Source: PTA

Figure 1.3 Project boundaries for potential stockpile locations
Source: Perth Airport

1.2. Ownership of Perth Airport

In 1997, the operation and management of Perth Airport was transferred from the Commonwealth of Australia to Westralia Airports Corporation (WAC) under a 50-year lease with a 49-year option for extension. In 2011, WAC changed its trading name to Perth Airport Pty Ltd. Although the day-to-day management of Australian capital city airports was privatised in the 1990s, the Commonwealth Government continues to play an important regulatory and oversight role through the Act and associated regulations. This statutory regime ensures that the public interest is protected. Perth Airport is operated by Perth Airport Pty Ltd, a wholly-owned subsidiary of Perth Airport Development Group Pty Ltd (PADG). The shareholders of PADG, as at October 2015, are shown in Table 1.1.

The proposed Forrestfield-Airport Link project is to be delivered by the State Government. To enable construction and operations of the infrastructure into the future, there will be commercial negotiations between the State Government and Perth Airport to provide appropriate tenure arrangements for the placement of the required infrastructure through either a sub-lease or licence. This sub-lease or licence will be in accordance with provisions under the Perth Airport lease with the Commonwealth and the Act, and will be consistent with the Perth Airport Master Plan 2014. Although the project will be delivered by the State Government, under the lease and the Act, Perth Airport must seek approval, as the proponent, for any construction on the estate that meets the trigger of an MDP, even when the project is being constructed and funded by a third party such as the State Government.

Shareholder	Percentage ownership
Utilities of Australia Pty Ltd ATF Utilities Trust of Australia (UTA)	38.3 per cent
The Northern Trust Company (TNTC) in its capacity as custodian for Future Fund Investment Company No.3 Pty Ltd (FFIC3), a wholly owned subsidiary of The Future Board of Guardians (FFBG)	29.7 per cent
Utilities of Australia Pty Ltd ATF Perth Airport Property Fund (PAPF)	17.3 per cent
The Private Capital Group Pty Ltd as trustee of The Infrastructure Fund	4.3 per cent
AustralianSuper Pty Ltd	5.0 per cent
Citicorp Nominees Pty Ltd as custodian for Commonwealth Bank Officers Superannuation Corporation Pty Ltd as trustee for Commonwealth Bank Group Super	3.2 per cent
Sunsuper Pty Ltd	2.2 per cent

Table 1.1 Perth Airport ownership
Source: Perth Airport

1.3. Requirements of a Major Development Plan

Section 89 (1) (k) of the Act requires that an MDP be prepared for the construction of new railway or new rail handling facility, where:

- the construction significantly increases the capacity of the airport to handle movements of passengers, freight or aircraft, and
- the cost of construction exceeds $20 million.

The proposed Forrestfield-Airport Link therefore meets the requirement for an MDP to be submitted for approval by the Commonwealth Minister for Infrastructure and Regional Development prior to construction commencing.

The required contents of an MDP are set out in Section 91 of the Act and include:

- the objectives of the proposed development,
- an assessment of the extent to which the future needs of civil aviation users of the airport and other users of the airport will be met by the development,
- a detailed outline of the proposed development,
- whether or not the proposed development is consistent with the airport's lease from the Commonwealth,
- whether or not the proposed development is consistent with the final master plan,
- if the proposed development could affect flight paths and noise exposure levels at the airport and the extent of relevant consultation with airlines and local government,
- the effect the proposed development will have on traffic flows at the airport and surrounding the airport, employment levels at the airport and the local and regional economy and community, including how the proposed development fits within the local planning schemes for commercial and retail developments in the adjacent area, and
- an assessment of environmental impacts and the plans for dealing with any such impacts.

The contents of an MDP, as prescribed under Section 91, are addressed in this MDP document as outlined in Appendix A.

Section 92 of the Act requires that prior to the MDP being published for public comment the proposed document must be drawn to the attention of:

- the Minister of the State in which the airport is situated, with responsibility for town planning or use of land,
- the authority of that State with responsibility for town planning or use of land, and
- each Local Government body with responsibility for an area surrounding the airport.

Section 92 also outlines the requirement for the MDP to be made available for public comment prior to submitting it to the Minister for consideration.

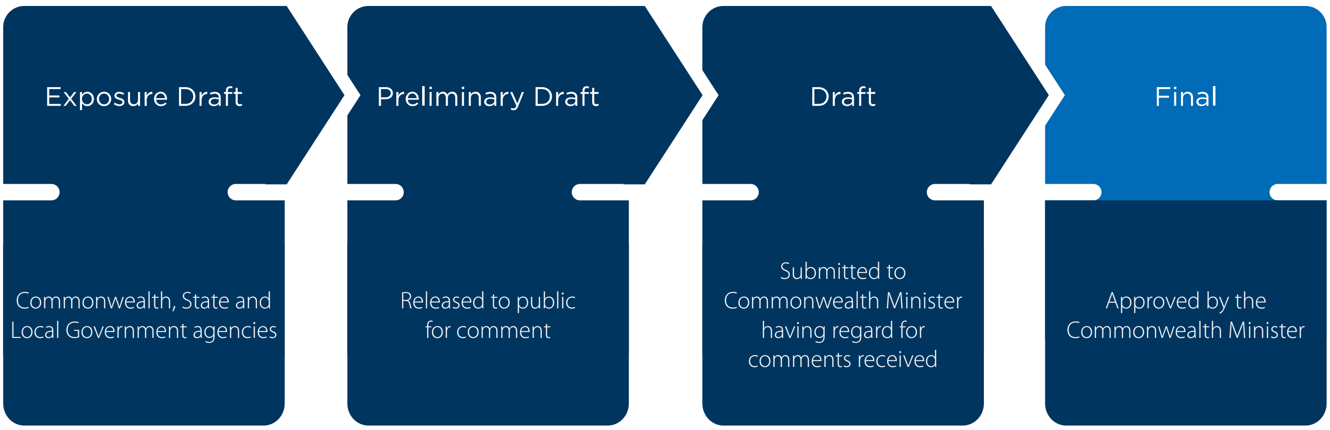


Figure 1.4 Major Development Plan process

2. PLANNING CONTEXT

2.1. Perth Airport Lease

Perth Airport Pty Ltd is the lessee of the 155 lots of land that make up the estate. The lease with the Commonwealth of Australia was executed on 1 July 1997. The term of the lease is for a period of 50 years, with an option for a further 49 years, exercisable by the lessee. An essential term of the lease is that the lessee must comply with all legislation relating to the airport site, including the Act.

The lease also outlines that the lessee has obligations to develop the site and that the site must be operated as an airport site. In doing so the airport should have regard to:

- the actual and anticipated future growth in, and pattern of, traffic demand for the airport site;
- the quality standards reasonably expected of such an airport in Australia; and
- good business practice.

Section 91(1) (ca) of the Act requires that a major development is consistent with the airport lease. A sub-lease and/or licence agreement (where applicable) will be developed with the State Government to enable rail infrastructure to be developed and operated on the airport land and, subsequently, for land on which the new station will be constructed consistent with the lease.

The sub-lease and/or licence will cover an agreed subterranean corridor through the estate as well as land at surface level for the Airport Central Station and emergency egress shaft.

This subterranean corridor is different than the approvals boundary as outline in Section 1.1 and shown in Appendix B. The approvals boundary covers an area for approval purposes only which allows slight flexibility in the alignment definition and delivery of all works.

As part of the sub-lease and/or licence and associated development deed as of right development loading and works over the tunnels, station and adjoining areas will be agreed between PTA and Perth Airport. Where proposed works exceed the agreed loading levels, the development deed will outline the process for PTA to access impacts. This will ensure that Perth Airport is not limited in the development of the airport estate in accordance with the lease.

The proposal for the Forrestfield-Airport Link as outlined in this MDP document is consistent with the Perth Airport lease.

2.1.1. Impact to Perth Airport sub-leases

The Forrestfield-Airport Link may impact a number of sub-leases and tenancies across the estate. Access and/or temporary relocation of activities may be required in some locations. Tenants continue to have the right to quiet enjoyment within their existing sub-lease framework and therefore this access and/or temporary relocation of activities will be subject to direct negotiation between PTA and the sub-lessee in conjunction with Perth Airport in accordance with tenants existing and future sub-leases.

Activities associated with the construction of the Forrestfield-Airport Link which may result in some impact to sub-leases include:

- site establishment and the construction of Airport Central Station,
- permanent infrastructure to support the Airport Central Station, including the location of pedestrian connections,
- construction of the emergency egress shaft, and
- ground stabilisation works associated with the construction of cross-passages, where they are proposed to be located landside.

2.2. Perth Airport Master Plan 2014

Under Section 70 (1) of the Act, each airport is required to produce a final master plan. The final master plan is one that has been submitted to the Minister as a draft master plan and approved. Prior to submitting a draft master plan to the Minister, the airport is required to take into account public comments. Subsequent developments at the airport must be consistent with the final master plan. Section 70 of the Act states that the purposes of a final master plan for an airport are to:

- establish the strategic direction for efficient and economic development at the airport over the planning period of the plan,
- provide for the development of additional uses of the airport site,
- indicate to the public the intended uses of the airport site,
- reduce potential conflicts between uses of the airport site, and to ensure that the uses of the airport site are compatible with the areas surrounding the airport,
- ensure that all operations at the airport are undertaken in accordance with relevant environmental legislation and standards,
- establish a framework for assessing compliance at the airport with relevant environmental legislation and standards, and
- promote the continual improvement of environmental management at the airport.

The Perth Airport Master Plan 2014, which includes an Environment Strategy and Ground Transport Plan, was approved by the Commonwealth Minister for Infrastructure and Regional Development, the Hon Warren Truss on 9 January 2015 and is available at www.perthairport.com.au.

Section 91(1A) (b) of the Act requires that an MDP is consistent with the final Master Plan for the airport.

2.2.1. Perth Airport Land Use Plan

Section 3 of the Master Plan 2014 outlines the Perth Airport Land Use Plan. Perth Airport is comprised of 2,105 hectares of land and, under the Land Use Plan, is divided into five land use precincts, akin to suburbs. These include:

- Airport Central,
- Airport West,
- Airport North,
- Airport South, and
- Airfield.

Within the five precincts, there are four different zonings in place which dictate the desired land uses for each of the defined areas, in a similar fashion to the way Local Town Planning Schemes manage land use planning for Local Government areas. The four zones overlayed across the estate comprise of Airfield, Commercial, Airport Services, and Terminal and have an applicable 'Land Use Table' to detail the desired land uses within the zone.

The Forrestfield-Airport Link project traverses beneath the Airport West, Airfield and Airport Central precincts and has surface level infrastructure landside in the Airport West and Airport Central precincts as shown in Figure 2.1.

2.2.1.1. Tunnels

The proposed tunnels and cross-passages are located below ground on the estate, however traverse through the Airport West, Airport South and Airport Central precincts, as well as all four zoning classifications under the Master Plan 2014. The development aligns with the intent of the precincts, and meets with the intent of the zoning land use tables as 'utilities and infrastructure'.

The proposed tunnels are aligned with the Master Plan 2014 land use plan both in terms of intent and desired design outcome.

2.2.1.2. Airport Central Station and emergency egress shaft structure

The proposed Airport Central Station is located within the Airport Central Precinct. The intent of the precinct under the provisions of the Master Plan 2014 is to provide integrated passenger terminal and associated ground transport and commercial facilities that meet the changing needs of airlines and other companies providing services in the precinct, and of the travelling public. The proposed Forrestfield-Airport link project is consistent with the Master Plan 2014 as it makes provision for the location of a station in the core of the Airport Central Precinct, providing connectivity to the existing Terminal 1 (T1) and Terminal 2 (T2) forecourts and ultimately to the proposed New Terminal (referred to in Section 4.5.3.3 of the Master Plan 2014) forecourt and arrivals hall. Planning for the Airport Central Precinct has demonstrated that integrating the rail station into both the existing and future terminal and forecourt areas is an important component in ensuring both an effective ground transport system and a high quality passenger and visitor experience.

Similarly, the emergency egress shaft located within the Airport West Precinct is consistent with the intent of the precinct to provide a range of aviation support facilities and associated ground transport as well as complimentary non-aviation commercial developments, comprising infrastructure contributing to the ground transport network.

Both the station and the emergency egress sites are located within the 'Airport Services' zoning across the estate and the proposed structures can be defined as 'utilities and infrastructure' under the applicable land use table of the Master Plan 2014. The development aligns with the intent of the zoning in providing ground transport facilities and services for efficient access to the airport.

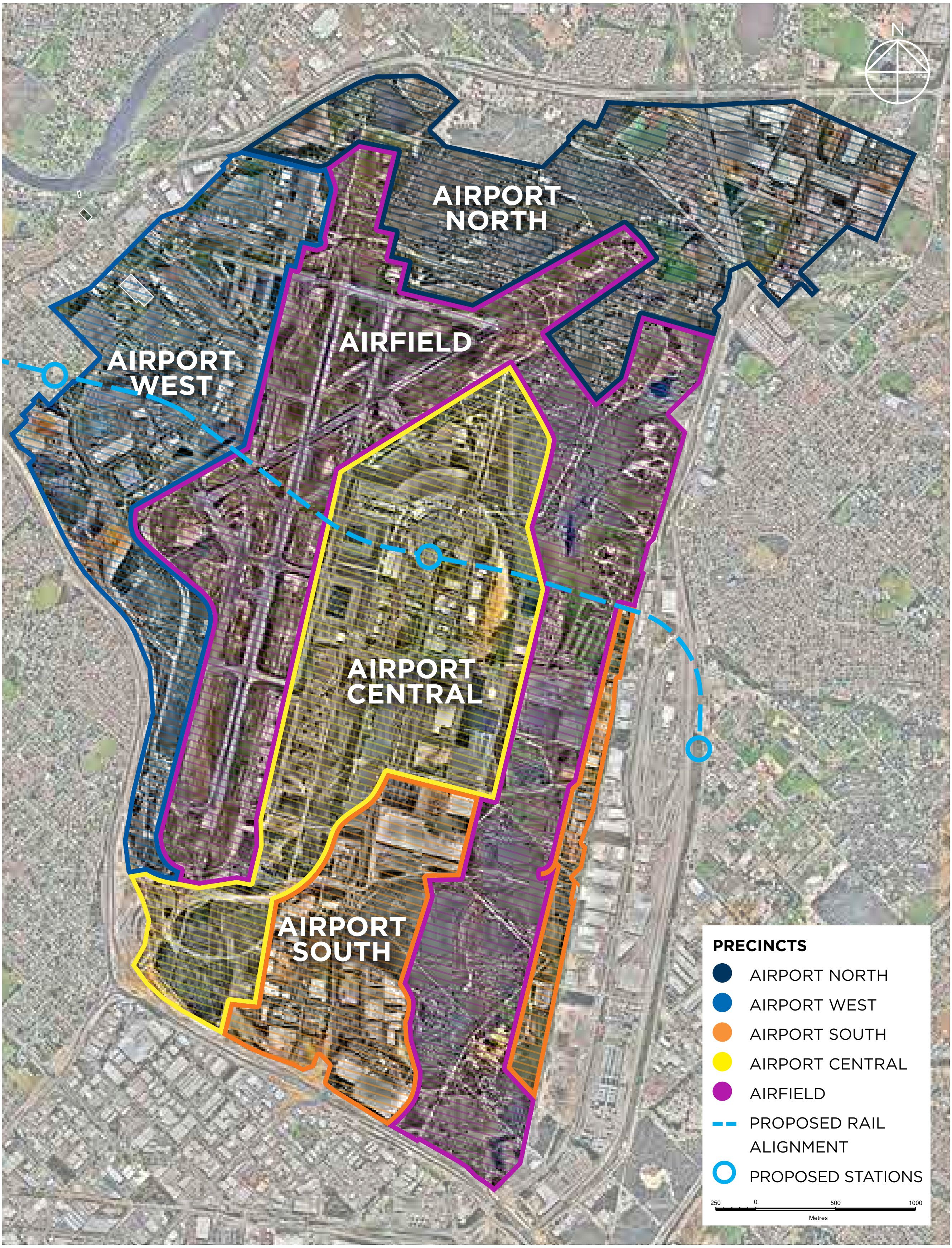


Figure 2.1 Perth Airport precincts and zones
Source: Perth Airport Master Plan 2014

2.2.2. Ground Transport Plan

Section 6 of the Master Plan 2014 outlines the vision for ground transport at Perth Airport, including rail.

The principle behind the ground access plan outlined in the Master Plan 2014 is to largely separate passenger vehicle traffic accessing the terminals within Airport Central from commercial vehicle traffic accessing industrial developments.

The Forrestfield-Airport Link assists with this objective, offering an alternative mode of access for staff and passengers into the Airport Central Precinct, and through the pedestrian linkages to terminals, minimises conflict of these users with other transport modes.

Section 6.4.2 of the Master Plan 2014 outlines the proposed route and stations, and states:

6.4.2 Proposed Routes and Stations

Perth Airport and the State Government are working to finalise the route and the preferred locations for rail stations to be developed on the Commonwealth land controlled by Perth Airport.

6.4.2.1 Proposed Routes

In August 2014, the State Government approved the alignment and timing of the proposed Forrestfield- Airport Link project. The principle of the routes is to provide a rail service connecting the Bayswater Station to a new station at Forrestfield via Perth Airport. The State Government have advised construction will start in 2016 with completion expected in 2020.

6.4.2.2 Proposed Stations

The State Government is investigating a series of stations on the proposed route. These include:

- Airport West / Redcliffe,
- Airport Central, and
- Forrestfield.

The State Government is assessing the feasibility of a rail station in the Airport West Precinct (on airport land) or the Redcliffe area (on State controlled land). The off airport solution is currently the preferred option. A station in this area would include a public transport interchange (providing links to local bus services) and as such would focus on general metropolitan commuter passenger demand. The station would also serve the current T3 and T4 aviation needs and the general Airport West business park users.

The station is proposed to be located in the core of the Airport Central Precinct and provide connectivity to the existing T1 and T2 terminal forecourts and ultimately to the New Terminal forecourt. Planning for Airport Central has demonstrated that integrating the rail station into the terminal and forecourt areas is an important component in ensuring both an effective ground transport system and a high-quality passenger and visitor experience.

The rail link will provide an alternative to the current car-based access to the airport. Perth Airport will work with the PTA to improve services to the airport and to seamlessly link the stations with the surrounding facilities. This will ensure that a high quality pedestrian experience is created for transitioning between the rail stations and the terminals. Should the Airport West Station be constructed, the associated bus interchange will significantly improve the catchment for public transport serving the area.

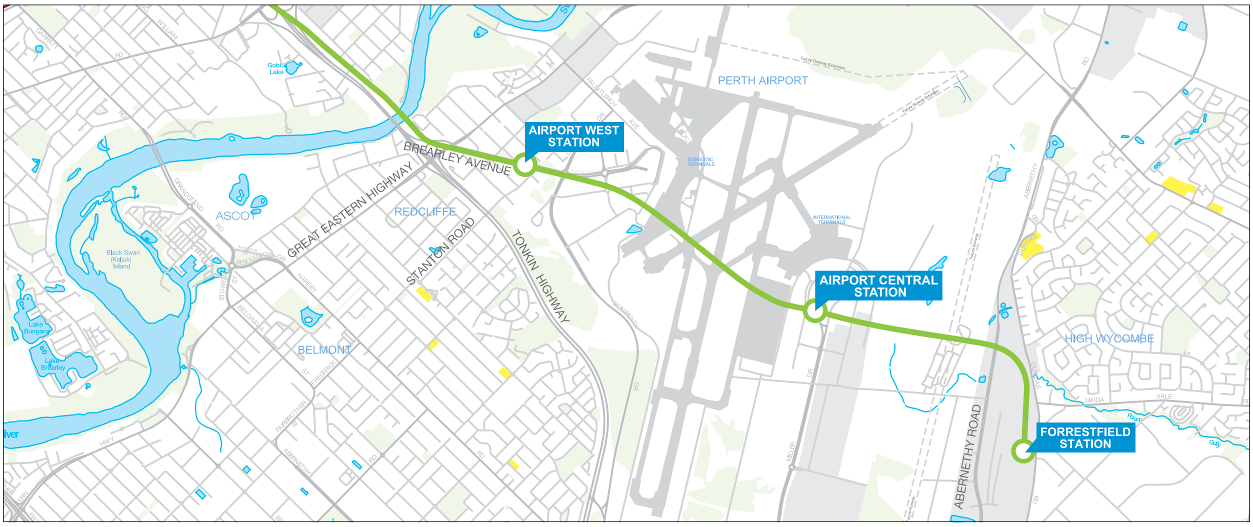


Figure 6.5 Proposed corridor of Forrestfield-Airport Link
Source: PTA

Section 6.4.2 Perth Airport Master Plan 2014

Following the publication of the Master Plan 2014, the State Government has worked with the community and key stakeholders to formalise the proposed route for the alignment of the Forrestfield-Airport Link. The outcome of this work has resulted in a finalised route which incorporates one station within the airport estate, to be located within the Airport Central Precinct, and two additional stations off the estate in Redcliffe and Forrestfield, located to the west and east of the estate boundaries respectively. The alignment and station locations have been selected on the basis of surrounding existing and future land uses, and available pedestrian catchments to support patronage and accessibility to the line.

The proposed development is aligned with the Master Plan 2014 and the Ground Transport Plan as it works to provide an alternative mode of transport to and from the airport.

2.3. Consistency with State and local planning schemes

While State Government planning laws do not apply to the Perth Airport lease area, the Act and subsidiary regulations require that the Master Plan 2014, where possible, describes proposals for land use planning and zoning in a format consistent with that used by the State or Territory in which the airport is located. The Land Use Plan presented in Section 3 of the Master Plan 2014 was prepared taking into account, and is consistent with, the State Planning Framework, which identifies Perth Airport as a 'Specialised Centre' as described in Section 2.4.4 of the Master Plan 2014.

With regard to local government planning, Perth Airport is located primarily within the City of Belmont; however sections of the Perth Airport estate are also within the City of Swan and the Shire of Kalamunda as shown in Figure 2.2. In order to provide compatible land uses and develop appropriate surface access arrangements, Perth Airport ensures that planning for the airport estate has due regard to the planning frameworks of adjoining local authorities. To achieve this outcome, Perth Airport works with the neighbouring Local Government agencies through the Perth Airport Planning Coordination Forum, and Forrestfield-Airport Link specific planning and design working groups.

The construction of the Forrestfield-Airport Link on the Perth Airport estate complements the existing and future land uses in the area surrounding the estate, and is consistent with the respective surrounding State and Local Government land use zones. The Metropolitan Region Scheme (MRS) is prepared and administered by the Western Australian Planning Commission (WAPC) as the principle planning scheme for the Perth metropolitan region, providing generalised broad-scale land uses and sets out regional reserves. Local Planning Schemes are then developed by the local authorities to provide the next tier of detail, in line with the State provisions. Although outside of the MDP process and not within the scope of Perth Airport's development objectives, the Forrestfield-Airport Link project may contribute towards generating future land uses (external to the estate) to assist in achieving the activity centre objectives of the State Government provided for in the MRS, local schemes and policy, contributing transport infrastructure to the benefit of the wider community.

2.3.1. Strategic Western Australian transport and planning policy overview

The State Government has developed a number of strategies and policies to guide the future development of Perth. Directions 2031 and Beyond: Metropolitan Planning Beyond the Horizon (Directions 2031) and the Public Transport Plan for Perth in 2031 (Draft) provide the foundations and directions for the development of land and transport infrastructure in the metropolitan Perth and Peel regions.

2.3.1.1. Directions 2031

Directions 2031 is the State Government's high-level spatial framework and strategic plan that establishes a vision for future growth in the metropolitan Perth and Peel regions. It provides a framework for the detailed planning and delivery of housing, infrastructure and services necessary to accommodate various growth scenarios.

Directions 2031:

- discusses the population forecasts provided by the Australian Bureau of Statistics and within the WAPC's Western Australia Tomorrow (2005) – the plan indicates that by 2031 the population is projected to have reached 2.2 million, largely due to overseas immigration (this figure has been adjusted to 2.6 million),
- identifies the 'connected city' model as the preferred medium-density future growth scenario for the metropolitan Perth and Peel regions – which suggests that the population of Perth will reach 3.5 million around 2050 (this is currently considered the most likely medium to long-term outcome), and
- investigates scenarios for planning for a city of 3.5 million people – providing an indication of how the planning system could spatially accommodate the housing and land supply needs of a city with that population.

Connecting Perth Airport and the public transport system is a key element in Directions 2031. An emphasis is placed on consolidating development around existing and future public transport infrastructure and around strategic centres and areas of future urban development. These major employment centres and destinations (Strategic Metropolitan Centres in red, Specialised Centres including the Perth Airport estate) are shown in Figure 2.3.

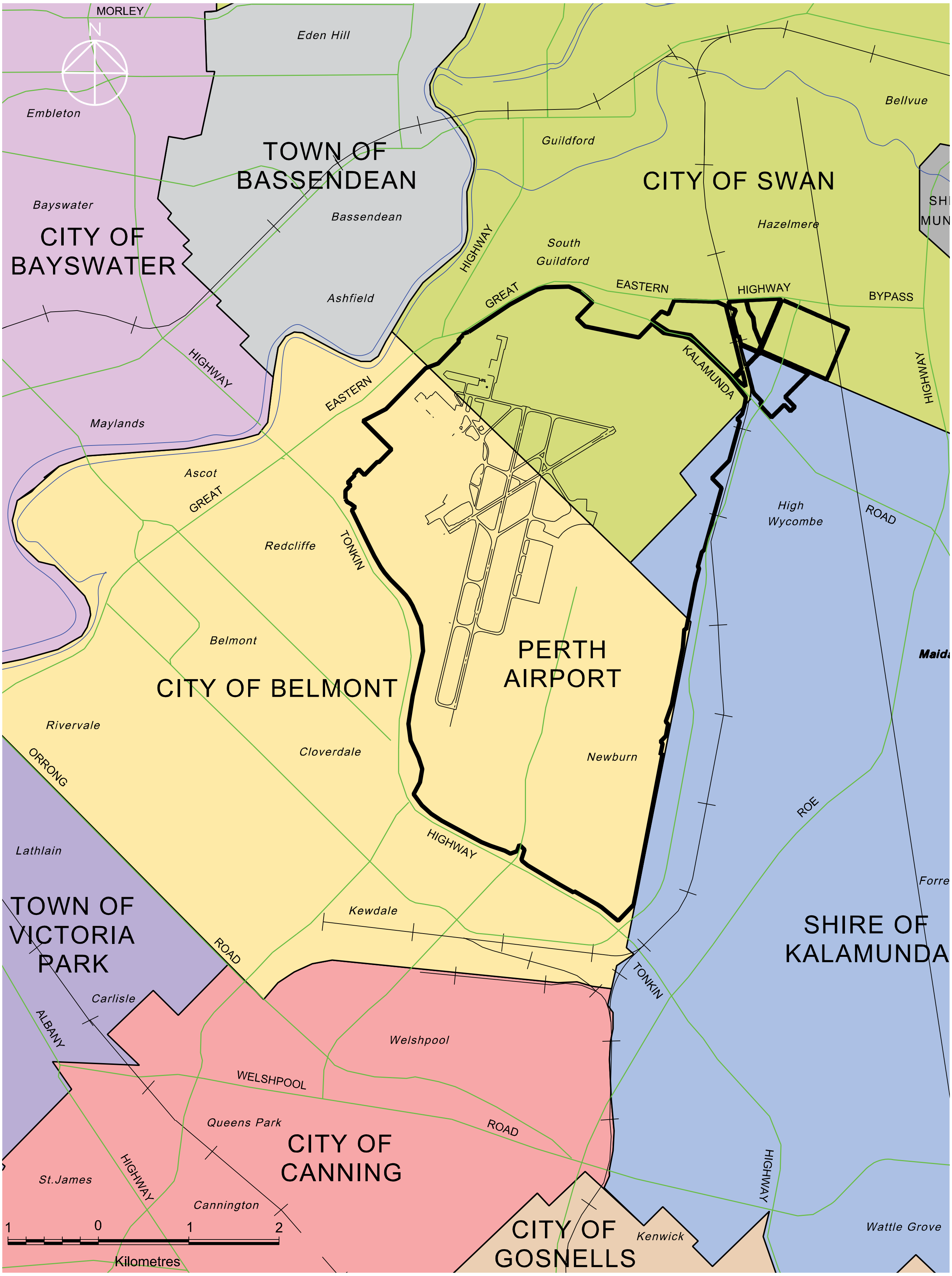


Figure 2.2 Location of Perth Airport

Source: State Department of Local Government

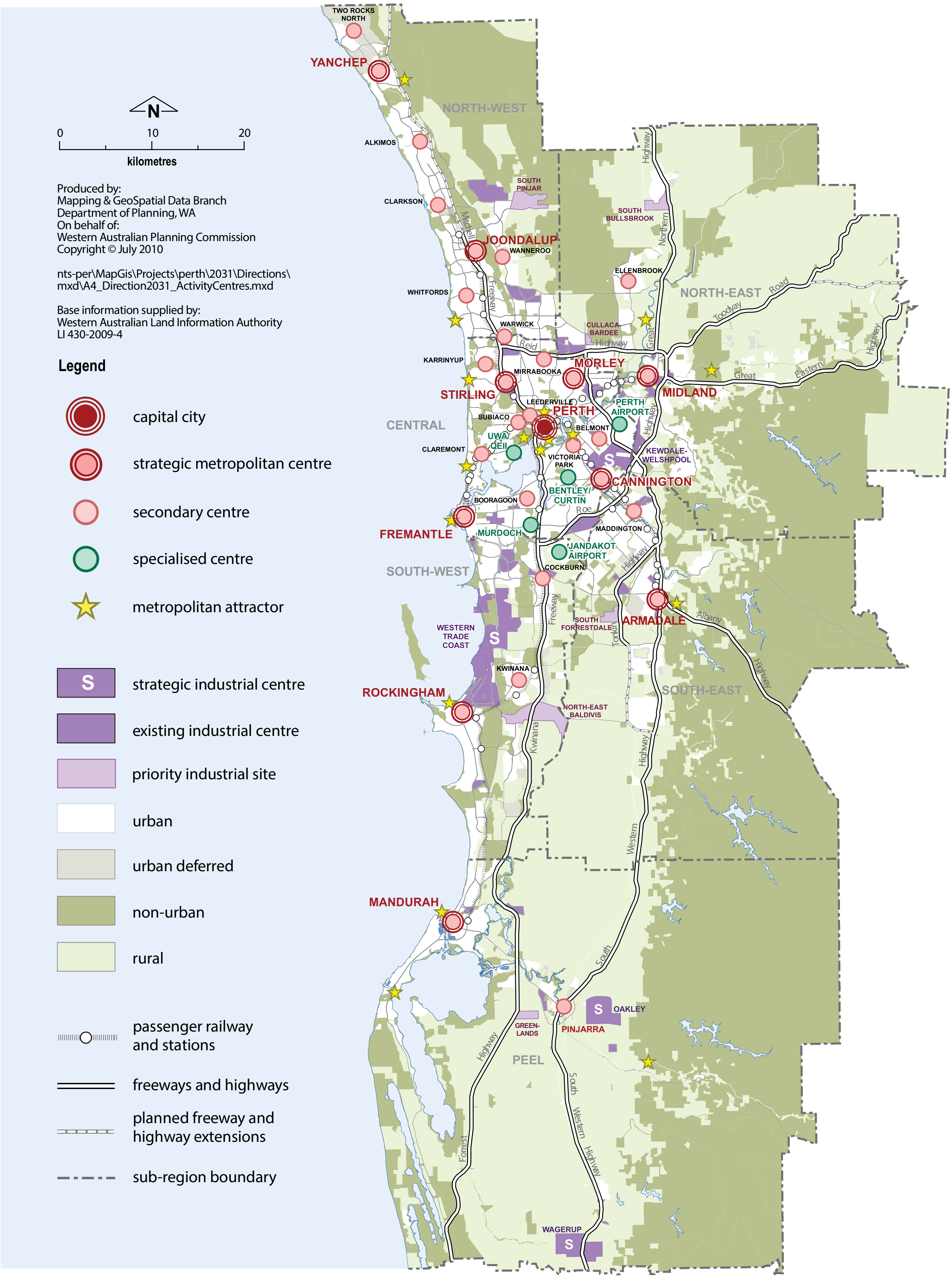


Figure 2.3 Perth and Peel regions: strategic centres and areas of future urban development

Source: Directions 2031 and Beyond: Metropolitan Planning Beyond the Horizon, Department of Planning & Western Australia Planning Commission, August 2010, p.34.

2.3.1.2. Public transport for Perth in 2031 (Draft)

Public Transport for Perth in 2031 (Draft) identifies the public transport network which will be required by 2031 to support Perth's growing population and the links to and between strategic centres. It points out that current public transport infrastructure will not be able to cope with projected population growth and that provision of improved public transport is a key enabler for meeting the population and land use targets of Directions 2031. Future preferred types of public transport services (modes) and priorities for infrastructure investment across the network are highlighted. One of those priorities includes the construction of an extension of the suburban rail system from Bayswater Station on the Midland Line to Perth Airport.

The State Government planning for a city with an estimated population of 3.5 million by 2050, considers an ultimate integrated public transport network that includes railways, light rail, priority bus corridors and ferry services. Together these modes form a network which will provide a greatly improved level of access to, and connectivity between, strategic centres and central Perth.

2.3.2. Consistency with local planning schemes

The Forrestfield-Airport Link also affects land to the east of the estate in Forrestfield and also to the west of the airport estate in Redcliffe, located within the local government areas of the Shire of Kalamunda and the City of Belmont respectively. While the elements of the project located within these adjacent local government areas do not form part of this approval, the following information is provided as context.

The Forrestfield-Airport Link, as outlined in this MDP, is consistent with the long term State and Local Planning objectives for the localities adjacent to the airport estate affected by the project. It provides key transport infrastructure to connect the eastern foothills region to the Perth CBD as well as opportunities for land use changes and access towards a well serviced urban village in Redcliffe.

2.3.2.1. City of Belmont

Within the City of Belmont, the Forrestfield-Airport Link will result in the location of tunnels and a semi-below ground station located within the Development Area 6 area of Redcliffe. Local Planning Policy 14 'Development Area 6 Vision' was adopted by the City of Belmont at its meeting on 17 December 2013 and is currently under review as a result of the Forrestfield-Airport Link project, which provides additional opportunities for future land use and access arrangements to support a transit orientated village concept.

The PTA have worked closely with Perth Airport, the City of Belmont, State Department of Planning and other State Government departments including Main Roads WA and Transperth to ensure the design of the station, traffic and access arrangements and associated infrastructure in Redcliffe will be effectively integrated with the surrounding locality – including the airport estate, and provide long term development opportunities for additional commercial and high density residential land uses to meet with State and local planning objectives. Further information about this project can be found on the City of Belmont's website at www.belmont.wa.gov.au.

2.3.2.2. Shire of Kalamunda

Within the Shire of Kalamunda, the Forrestfield-Airport Link will result in primarily above ground rail infrastructure, and the location of an above ground train station in High Wycombe – to be known as the Forrestfield station. Prior to the consideration of the Forrestfield-Airport Link project, the precinct has primarily been zoned for light industrial land uses, which is now under review with the preparation of the 'Forrestfield-North District Structure Plan', which is currently being considered by the Shire of Kalamunda and the WAPC for adoption.

The Forrestfield-North area provides an opportunity to meet growing population needs and provide employment options in an accessible and relatively central location that maximises the benefits of its proximity to established residential areas, employment hubs and existing key transport infrastructure including Roe Highway. The construction of the Forrestfield-Airport Link will provide the eastern foothill areas of Perth with direct public transport connections between the area and the Perth CBD, creating opportunities for increased employment generation within the Forrestfield District Centre and Transit Orientated Development precinct around the new train station itself.

The PTA has worked closely with the Shire of Kalamunda, State Department of Planning, and other State Government departments to ensure that the design of the station and associated infrastructure within the Forrestfield Station precinct is effectively integrated with the surrounding locality, and maximises the future opportunities for the development of a well-connected and vibrant District Centre that has the ability to service the wider eastern foothill region of Perth also.

It is noted that residential development within the Forrestfield-North area will need to take into account the impact of aircraft noise, and ensure that appropriate notification and noise amelioration measures are implemented.

3. DEVELOPMENT OBJECTIVE

3.1. Project objectives

Perth Airport's vision is to, 'operate an outstanding airport business providing great customer service.' This vision guides the overarching corporate objectives for the management of Perth Airport.

The corporate objectives are:

- ensuring our facilities and services are safe and secure for all,
- helping our airline and other business partners develop their businesses,
- meeting the needs of our customers,
- conducting our business in a commercially astute manner,
- providing our employees with satisfying employment,
- conducting operations in an ecologically sustainable manner,
- identifying and managing risk,
- facilitating travel, trade and industry in Western Australia, and
- ensuring we are a responsible and caring corporate citizen.

Taking into account these corporate objectives, Perth Airport has development objectives which underpin the overall development plans of the airport estate. The proposed Forrestfield-Airport Link project meets the following development objectives for Perth Airport:

- deliver aviation services that airlines, members of the public and business enterprises need,
- bring land not required for long-term aviation services into productive use to support economic development and employment creation in Western Australia,
- ensure all facilities are safe and secure for all people who use them or live in the vicinity of the airport, and
- ensure that the airport's development and operation minimises adverse impact on surrounding communities and the environment.

In addition to Perth Airport's objectives, the State Government is committed to delivering an integrated and affordable transport system for the eastern suburbs of Perth. The Forrestfield-Airport Link will be designed and operated with the customer at the centre of its design philosophy. The primary objectives for the Forrestfield-Airport Link are:

- to improve the liveability, connectivity and amenity for current and future residents of the eastern suburbs,
- to design and construct a project that will be sensitive to and promote environmental, economic and social sustainable outcomes,
- to provide an accessible, reliable and safe public transport system,
- to assist in alleviating congestion and improve productivity and capacity of the existing transport network, and
- to provide value-for-money outcomes in service and infrastructure delivery.

3.2. Project rationale

The State Government propose that the Forrestfield-Airport Link will deliver significant benefits to the Western Australian economy and to the communities along the route, and facilitate a more balanced and sustainable metropolitan transport system.

The key to the success of the new rail line is the route it will take. To determine that route, the State Government considered population growth patterns, projected demand, economic and infrastructure plans and stimulus potential. A detailed assessment process determined the most appropriate station locations, the catchments that will be served, the most efficient way to connect those catchments to the Perth CBD, and the capacity for future extension. Route planning and, importantly, the construction methodology for the Forrestfield-Airport Link was also guided by the key environmental and heritage values identified by the PTA.

3.2.1. Project rationale within the Airport Estate

To meet the growing demand for air travel, in 2008 Perth Airport released its 'Vision for the Future' which described that, through a staged major redevelopment, all commercial air services would be consolidated to new facilities around the site of the existing International Terminal (T1) in the Airport Central Precinct. Perth Airport has fully committed to the first stage of the consolidation plan with its privately funded $1 billion capital investment program. All projects in this first stage of redevelopment are either now completed or under construction. Perth Airport anticipates the final stage of consolidation of all commercial air services will occur early 2020's, when new facilities are constructed in Airport Central for Qantas Airways Group operations. This will result in the majority of passengers accessing air services from the single location.

The location of the Airport Central Station provides for a fully integrated rail service for the ultimate location of all commercial air service passengers by being central to the current and future terminals.

The Perth Airport estate lies geographically central to the start and finish of the Forrestfield-Airport Link alignment, and the cost of an alternative route to deviate around the periphery of the estate is prohibitive and unsustainable to the project as a whole. With respect to the nature of construction, various options were explored by the State Government before finalising the approach to use bored tunnels. This decision reflects the necessity to avoid any interference with vital aviation infrastructure within the airport estate, and reduces the need to occupy valuable surface land on the estate with rail infrastructure. This ensures the safeguarding of this land for future aviation related development within the Airport Central and Airfield precincts, and non-aviation commercial development within the Airport West and Airport South precincts.

3.3. Civil aviation users benefit

The proposed development of a rail link and the construction of a station in Airport Central will provide passengers and staff with access to a rail line as an alternative to the current car based access to the airport. While surface access projects such as the Gateway WA project and Perth Airport's construction of the new Airport Drive are delivering solutions to improve the access of both freight and passengers, alternative modes of transport benefit the movement network as a whole. At present, public transport servicing Perth Airport is limited. T3 and T4 are currently serviced by a public bus service that connects Perth Airport to the CBD. The proposed construction of the Forrestfield-Airport Link will provide additional improvements to the transport network that will assist in providing an alternative to car based access to the airport. Further information with respect to ground transport is incorporated within Section 5.1.

3.4. Tourism benefit

Perth Airport is the only airport in the Perth metropolitan area to offer both domestic and international services, making it the major gateway to and from Western Australia. Perth Airport contributes to economic development by being the conduit for the transport of many goods and services to and from the State, as well as providing transport for workers to support resource industry operations.

The rail service to Perth Airport will enhance the economic benefits that the airport provides by providing greater access for business and tourism visitors to Strategic Metropolitan Centres including Perth.

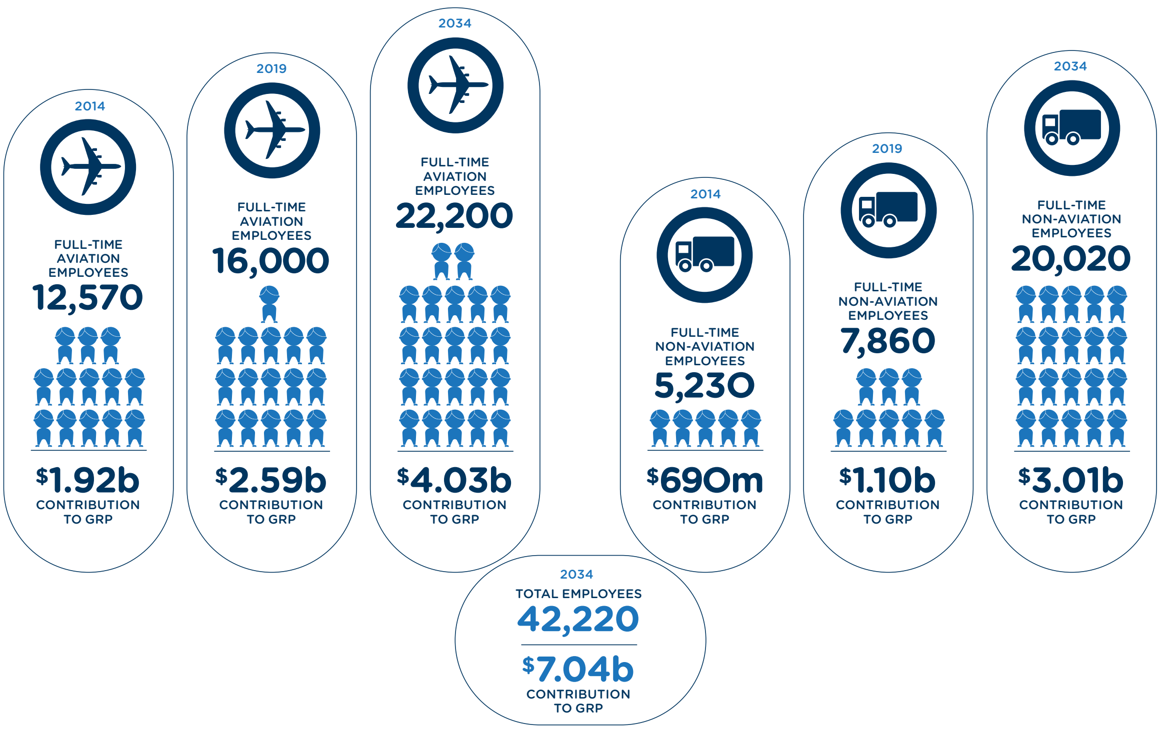
For example, this will be particularly beneficial to those businesses (including hotels) in the Perth City Link area – providing 'door to door' access from office to airport in around 20 minutes.

Tourism will also benefit from the provision of a rail service to Perth Airport. In the Tourism Council WA's Destination Perth: Developing Perth's Visitor Economy, released March 2014, the airport rail link, surrounding road improvements and finalisation of the new terminal infrastructure at Perth Airport were identified as a priority for achieving tourism targets.

3.5. Economic and employment benefit

The assessment of both the employment and economic impacts of the proposed Forrestfield-Airport Link and associated infrastructure on the estate is difficult to quantify given that the development is required by the State Government in order to fulfil wider metropolitan area objectives.

The Forrestfield-Airport Link is expected to deliver significant benefits to the community, with the link providing a travel alternative to bus and private vehicle, and reduced transit times between the Perth CBD, Perth Airport and the eastern foothills. These benefits to travel choice and time, as well as vehicle operating cost savings and reduced environmental impacts associated with an alternative to the private car, all contribute positively to the ability of the community to make choices in their travel modes.



The total State Government investment planned for the Forrestfield-Airport Link project is approximately $2 billion (escalated), and provides funds for:

- the project works (in the order of $1.2 billion to $1.4 billion (escalated) to be undertaken by the awarded contractor, including the construction of the rail, tunnels, stations, and associated infrastructure for the operation of the Forrestfield-Airport Link, and
- associated expenses including the acquisition of land and early works that are to be separately undertaken by the PTA, together with PTA project costs.

The Forrestfield-Airport Link project does not directly alter the economic benefit of Perth Airport at a regional level; rather it allows the airport to continue to support the significant growth in the State economy. Perth Airport will continue to manage increased passenger numbers that will facilitate growth in the State and result in assisting with the realisation of billions of dollars of economic benefit to the State and the Commonwealth.

Perth Airport is a major centre of employment in the Perth metropolitan region, and currently employs (directly and indirectly) an estimated 12,570 aviation-related full time employees who contribute $1.92 billion to the gross regional product (GRP). The number of non-aviation related full time employees is estimated at 5,230, and they add approximately $690 million to the GRP. Perth Airport's direct contribution of economic activity to the Western Australian economy is about 0.6 per cent of gross state product (GSP). The construction of the Forrestfield-Airport Link will support the economic contribution of Perth Airport to Western Australia's economy and will assist in enabling the airport to achieve its desired function under State policy as a key 'Specialised' activity centre within the Perth Metropolitan Region.

Statistics are inconclusive on the direct employment benefit as a result of the Forrestfield-Airport Link; however, the potential for employment creation in the local civil construction industry is estimated to incorporate an additional construction workforce of 2,000 people, over a four and a half year period. Aside from construction related employment, it is unlikely that the proposed development will create significant ongoing employment on the airport estate.

3.6. Other benefits

In addition to providing strategically-located stations and improving transport access to the airport, and the communities of Redcliffe and Forrestfield, the Forrestfield-Airport Link will also create a number of indirect benefits including:

- creating additional rail capacity on the Midland Line in the inner suburbs of Perth, where demand is expected to exceed current supply in the near future,
- connecting an increased number of regional bus services to Perth Airport, providing access from over 200 regional towns,
- encouraging access to strategic centres to promote local tourism activity,
- boosting employment, residential and economic growth by promoting new and existing centres, and
- minimising the impact of the airport as a physical divide in the area, improving social equity and quality of life for Perth's community.

4. DESCRIPTION OF THE DEVELOPMENT

4.1. Forrestfield-Airport Link project

The Forrestfield-Airport Link Project Definition Plan, available from www.forrestfieldairportlink.wa.gov.au, was developed by the PTA and was endorsed by State Cabinet of Western Australia in August 2014. The document sets out the vision for the overall development both on and off the Perth Airport estate. The Project Definition Plan incorporates the overall vision for the link which will incorporate:

- an 8.5 kilometre rail extension from the Midland Line east of Bayswater to Forrestfield via Perth Airport,
- three new stations – Airport West, Forrestfield (both with associated park and ride and bus transfer facilities) and Airport Central Station,
- pedestrian walkways linking Airport Central Station to the existing and future terminals,
- series of cross-passages and emergency egress shafts to allow for safe egress from tunnels in the event of emergencies and maintenance activities, and
- expanded and new bus feeder services.

The majority of development required for the Forrestfield-Airport Link will occur outside the airport estate. The proposed developments which are on the estate and subject to approval under an MDP are explained in further detail below.

4.2. Development on the Perth Airport estate

As outlined in Section 1, the proposed development on the airport estate includes:

- twin-bored tunnels traversing the airport estate from the western boundary, under the main runway (03L/21R) and the cross runway (06/24) through to the Airport Central precinct and then passing under the proposed location of new runway (03R/21L) before exiting the estate at the eastern boundary,*
- rail infrastructure required to operate the train service,
- construction of a new Airport Central Station below ground, with pedestrian linkages to existing and future terminals,
- emergency egress shaft, which will connect the tunnels to the ground level for emergency egress and intervention as well as maintenance access,
- several cross-passages, providing an underground link between the twin bored tunnels, to be located both airside and landside, and
- two options for potential stockpile locations required for the storage and treatment of material extracted from the ground during tunnelling and construction of the Airport Central Station.

**Although the MDP shows a rail alignment for the tunnelling, during the detailed design the alignment may shift within a corridor. The tunnel corridor is typically 120 metres wide, based on an offset of 60 metres either side of the tunnel alignment centreline. Any changes to the alignment will not alter the location of the Airport Central Station.*

The Forrestfield-Airport Link project traverses beneath the Airport West, Airfield and Airport Central precincts and has surface level infrastructure landside in the Airport West and Airport Central precincts.

A reference design has been developed for the Forrestfield-Airport Link project and provides:

- a high level of certainty of the rail corridor footprint below the ground,
- a concept plan and footprint for the Airport Central Station, and
- details of the footprint and land required to accommodate the emergency egress shaft structure.

Similarly, two proposed stockpile locations on the estate have been determined pursuant to investigations associated with construction and methods.

A detailed design will be prepared once a construction contract has been awarded. The detail of design may alter slightly from the reference design; however the detailed design will be consistent with the approved MDP and will consider all boundaries and impacts, as outlined in this MDP.

4.3. Design considerations

On the airport estate, four primary factors have been considered in the reference design of the Forrestfield-Airport Link infrastructure with regards to potential issues requiring careful consideration and risk mitigation measures:

- existing ground conditions,
- environmental and heritage value,
- proximity of infrastructure to Perth Airport's critical infrastructure and the Air Traffic Control Tower (ATC), and
- future infrastructure and development on the airport estate.

A number of extensive risk analysis studies related to ground conditions that will be encountered beneath and within the estate have been undertaken to better understand the settlement and ground movement tolerances and any implications to critical infrastructure. These are summarised in the following table.

Primary Factors	Considerations	Mitigation Measures
Existing ground conditions	Geological conditions, high water table, soil type, tunnel running beneath existing and future proposed runways could result in possible issues as a result of settlement	Detailed geotechnical and hydrogeological site investigation, ground movement impact report, ground conditions and risk studies, runway baseline studies
Environmental value	Acid sulfate soils, groundwater table, floristic communities and associations, construction spoil, contaminated sites and fauna	Flora, vegetation and fauna assessments, contaminated sites investigations, groundwater, dewatering and acid sulfate soils assessments, noise and vibration, spoil reuse study report
Heritage value	Listed and suspected heritage values	Ethnographic and archaeological heritage studies
Proximity to Perth Airport's critical infrastructure	Station and pedestrian link within close proximity to the ATC, excavation close to critical communication cables and ducts, tunnel running under runways and taxiways	Foundation systems report, ATC baseline monitoring, ground movement impact reporting
Future infrastructure and development	Alignment and key infrastructure have been designed to accommodate any airport future development and located in areas to minimise sterilisation of airport land	

Table 4.1 Design considerations

4.4. Development infrastructure

The following description is provided for the key infrastructure elements of the Forrestfield-Airport Link project located within the airport estate. This is provided with reference to:

- tunnels and rail infrastructure,
- Airport Central Station,
- emergency egress shaft,
- cross-passages, and
- potential stockpile sites.

4.4.1. Tunnels and rail infrastructure

The Forrestfield-Airport Link will comprise of twin-bored tunnels each with an internal diameter of approximately 6.2 metres. The tunnels, in most areas, will be approximately 12 metres deep or more below ground surface when under the airport estate. The twin tunnels will be spaced approximately seven metres apart and connected laterally by cross-passages and vertically to the surface by the Airport Central Station and/or an emergency egress shaft. The tunnels will cover a total distance of 3.8 kilometres across the estate and will remove approximately 300,000 in situ cubic metres of soil (from tunnelling).

Although the MDP shows a rail alignment for tunnelling, during the detailed design the alignment may shift within a corridor. The tunnel corridor is typically 120 meters wide, based on an offset of 60 meters either side of the tunnel alignment centreline, as shown in Appendix B – MDP Boundary Drawings.

Tunnel Boring Machines (TBMs) are commonly used to construct road and railway tunnels where access to the surface is not possible; such is the case for certain areas within the airport estate. The alignment enters the estate from the east and traverses under critical airfield infrastructure, therefore alternative construction methods which require construction from the surface are not feasible.

Tunnel boring will be undertaken using two TBMs designed for the ground conditions present. A TBM comprises a heavy steel cylinder with a rotating cutting head at one end. The cylinder, or shield, prevents the collapse of the soils and protects the machine operators. Behind the cutting head and within the cylinder, reinforced concrete ring segments are installed. As the machine moves forward, the pre-cast concrete ring segments are moved into position mechanically from the back of the cylinder and secured, thus forming the tunnel. The lining of the tunnels will be watertight, reinforced concrete and capable of supporting the ground above as well as any loading that is applied to the ground surface such as aircraft taxiing, landing or taking off and building development, with certain controls in place. The tunnel is then used to convey excavated soil back to the start of the tunnel in Forrestfield. The process is continuous except for times when the machine is halted for maintenance to take place. TBM maintenance stoppages are to be avoided under critical airfield infrastructure areas (runways, taxiways and aprons).

Figure 4.1 Example of a tunnel boring machine
Source: Mass Rapid Transit (MRT) Malaysia

In comparison to the 'cut and cover' method of tunnelling, bored tunnelling will have minimal impact on existing operations within the airport estate, both long term and during construction, and enables the safeguarding of development opportunities identified in the Master Plan 2014. As part of the sub-lease and/or licence and associated development deed as of right development loading and works over the tunnels, station and adjoining areas will be agreed between PTA and Perth Airport. Where proposed works exceed the agreed loading levels the development deed will outline the process for PTA to assess impacts. This will ensure that Perth Airport is not limited in the development of the airport estate in accordance with the lease.

Additionally, bored tunnelling alleviates issues such as dewatering management, noise and dust management and tenant and public disruption along the alignment that could occur when using other construction methods.

4.4.1.1. Rail infrastructure

The tunnels will contain the tracks, power, drainage, signalling, safety and communications infrastructure required to operate the train service. This will be designed to meet the standards required in the *Western Australian Rail Safety Act 2010* and integrate with the existing Perth to Midland rail line.

Figure 4.2 Proposed Airport Central Station relative to current and future terminal locations
Source: Perth Airport

4.4.2. Airport Central Station

The proposed Airport Central Station will be located underground, adjacent to T1 and T2 and approximately 50 metres south of the existing ATC tower. The station is centrally located for convenient passenger access to each of the current and future Domestic and International Terminals (refer to Figure 4.2). The proposed location of the station below ground level allows for a streamlined and integrated passenger experience while ensuring the flexibility to construct other services around the station to meet the needs of the travelling public.

The majority of the station structure will be below ground, with emergency access and ventilation buildings at the surface and minimal service vehicle parking adjacent to the station structure. The station will be designed to accommodate six-car train sets with a 150 metre long platform. The station concourse level will be approximately eight metres below ground surface level, with platforms at approximately 15 metres below ground level. It is proposed that passengers arriving will use a combination of lifts, stairs and escalators to link up to pedestrian connections to the terminals.

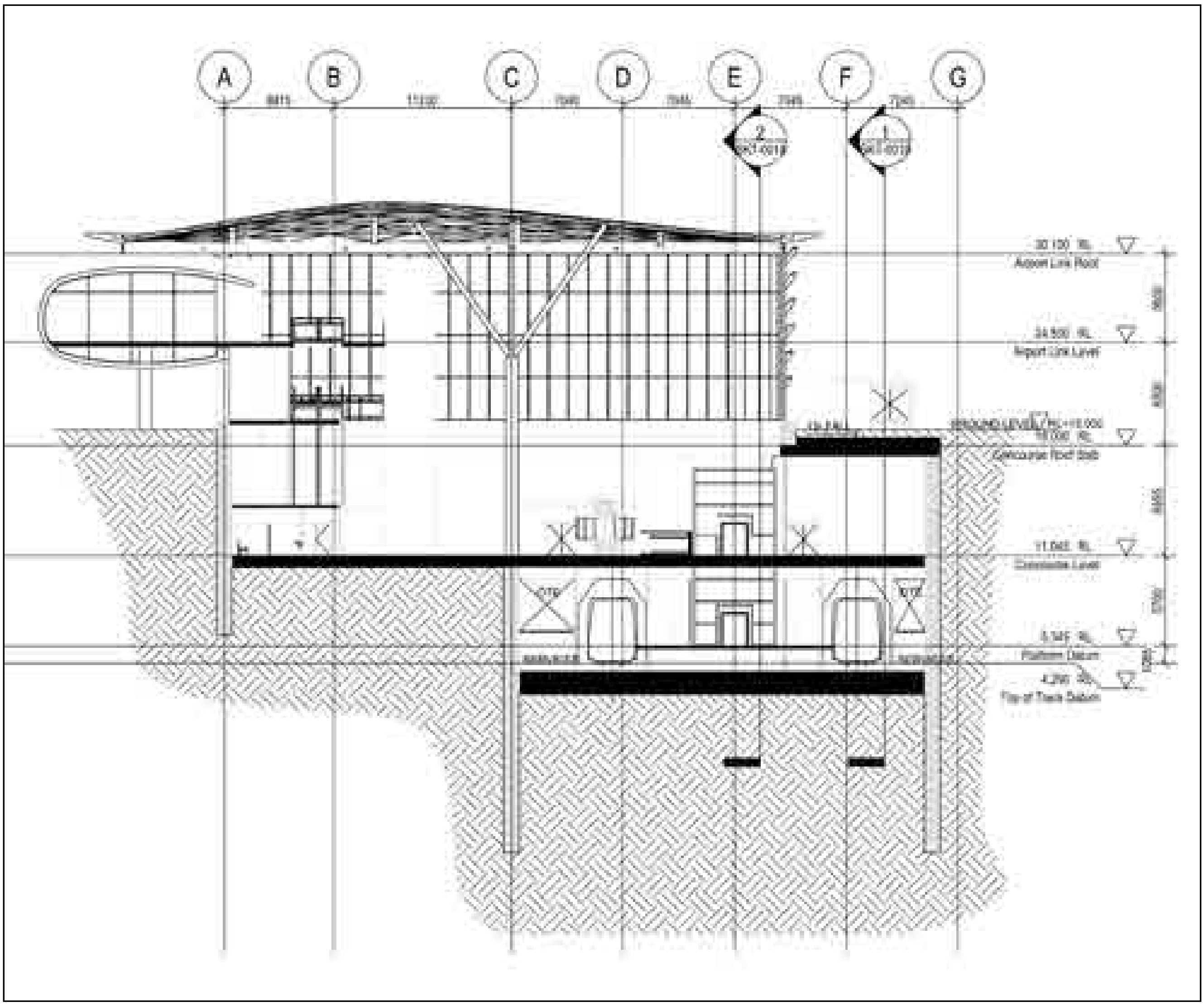


Figure 4.3 Concept cross section of Airport Central Station
Source: PTA

4.4.2.1. Pedestrian linkages / walkways from station to terminals

To ensure a streamlined and integrated passenger experience walkways will provide access from the station to T1 and T2. Provision will also be made to allow for future extensions to directly service T2 and the proposed new terminal. Figure 4.4 shows the proposed first stage of works.

The walkways will ensure that the rail station is integrated with the terminals and forecourt areas ensuring both an effective ground transport system and a high-quality passenger and visitor experience.

The walkway location and configuration was determined by considering current terminals and road layout as well as any future infrastructure that may be provided in the area (including future car parking, terminals etc.) while also ensuring the safety and security of the ATC tower.

The final design of the pedestrian walkways, including the location and configuration, will be subject to discussions with Airservices to ensure that blast threats, jamming of radio services and breach of Airservices' facilities has been considered and mitigated.

It is intended that the walkways will be enclosed above ground air conditioned structures approximately 10 metres wide with

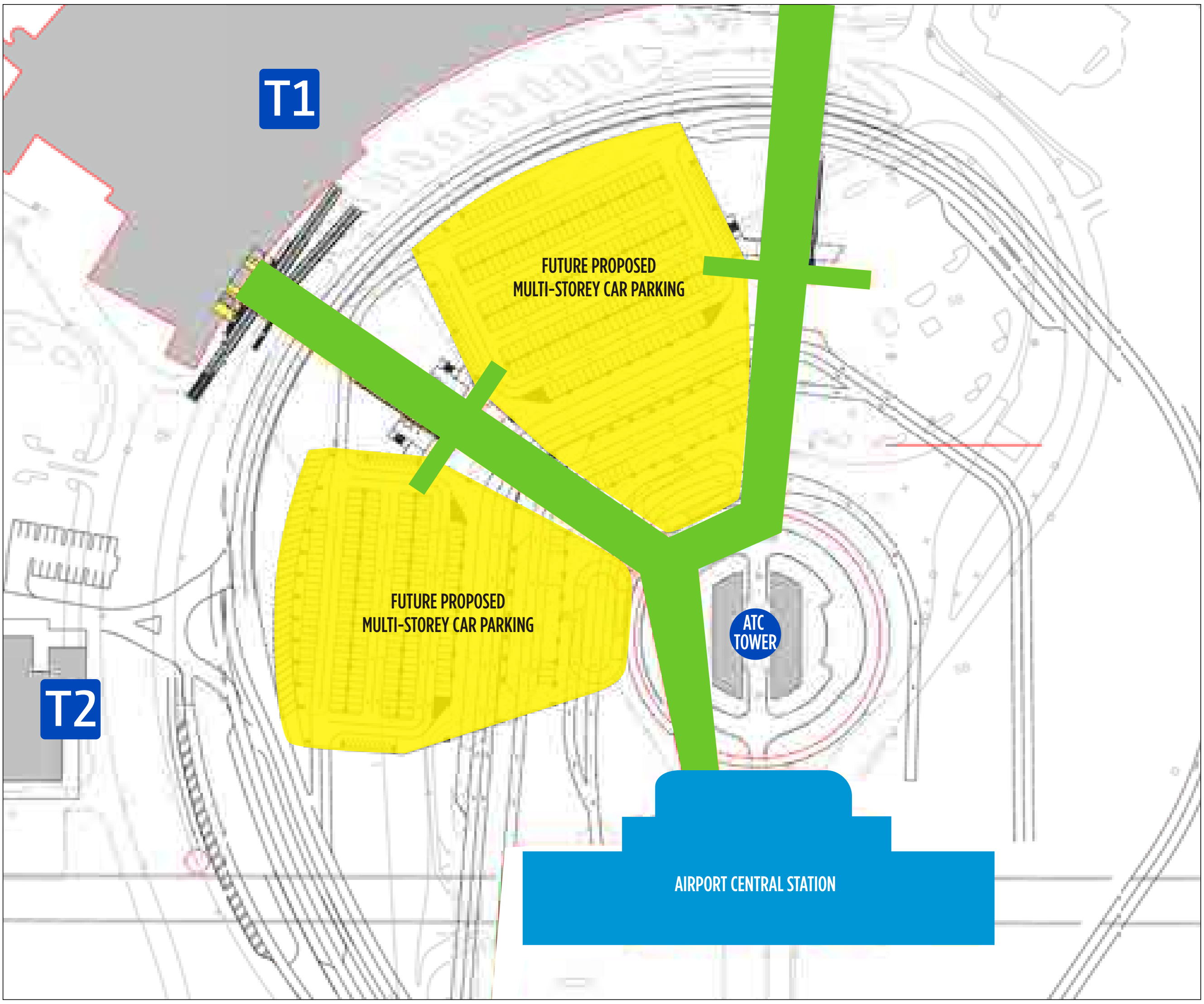


Figure 4.4 Concept location of pedestrian elevated walkways
Source: Perth Airport

passenger information displays, airport wayfinding signage and other technologies to ensure passengers receive a high level of service and a welcoming passenger experience when transitioning between the airport and the station.

The width of the internal walkway will be designed to allow for travelators, buggy movements and walking passengers. Buggy turnaround and trolley management will need to be provided prior to entering the station zone.

Artist impressions of the pedestrian walkways are shown in Figure 4.5 and 4.6.

4.4.2.2. Airport Central Station construction methodology

It is anticipated that tunnelling on the airport estate will commence via TBMs from the east, arriving at the Airport Central Station box, and then moving west across the estate beneath existing airfield infrastructure. Therefore, it will be necessary for the station box at Airport Central to be constructed prior to the arrival of the TBMs. The TBMs will be 'pushed' through and out of the excavated station box before travelling west underground across the remainder of the estate.

The construction is likely to be undertaken by building diaphragm walls, which are described as deep and narrow trenches cut into the ground, retained open by filling with bentonite slurry. This is then displaced as the trench is filled with concrete to form the side walls of the underground structure.

The construction of the Airport Central Station box will require dewatering and disposal of ground water. Management for ground water is outlined in Section 6 and it is anticipated that the majority of abstracted groundwater will be reinjected into the aquifer to maintain ground water levels in the area. Options for the disposal of surplus groundwater include:

- recycling, for example using the water for dust control,
- irrigation of vegetated land,
- disposal off site,
- discharge into appropriate nearby water courses, and/or
- discharge into the sewer system.

Ground water disposal will be addressed in the Acid Sulfate Soils and Dewatering Management Plan (ASSDMP), as part of the Construction Environmental Management Plan (CEMP), prior to works commencing on site.

Figure 4.6 Pedestrian walkway – internal perspective
Source: PTA

Figure 4.5 Pedestrian walkway – external perspective
Source: PTA

The nominal size of the station box at Airport Central is approximately 150 metres long x 50 metres wide x 25 metres deep.

The construction of the station will require a designated site. The provision of this site has been assessed and developed to ensure that there is minimal impact to the operations at T1 and accessibility for passengers. This area has been defined in Figure 4.7.

The relocation of services, including telecommunications near the Airport Central Station will also be required, which can be managed without any unnecessary disruption to the airport. In relation to the relocation of Airservices optical and copper fibre, Perth Airport and PTA will ensure ongoing consultation.

The construction of the station box will produce around 80,000 cubic metres of spoil which will be treated and stockpiled either onsite or offsite at a site determined by the PTA and the contractor.

The excavation and removal of the spoil will be undertaken using a work methodology so as to not materially impact operations and access to the T1 precinct car parking and forecourt. This will be ensured through extensive traffic management which confirms no adverse impact to airport operations and as required, the application of engineered solutions such as conveyor systems, slurry pipes or similar to transport the material. Any proposed stockpiles on the airport estate will require Perth Airport Consent and a Works Permit to be issued by the Airport Building Controller (ABC), and this process will involve input from the ABC as well as the development of an acceptable Traffic Management Plan.

In addition to standard Airport Approvals, the structural design of the Airport Central Station box will be subject to an independent design verification process, in accordance with the contractual arrangements for the project construction.

As the site is located within an active terminal precinct, construction noise and dust management procedures will be required to be submitted by the contractor for Perth Airport assessment and approval. The site will be adequately secured with standard hoarding providing a safety barrier between the construction site and airport passengers.

4.4.3. Emergency egress shaft

Along the alignment of the tunnel, emergency egress shafts are required to allow a response to fire and life safety events within the tunnels and connects the tunnels to the ground level to provide emergency escape in the event of an incident. The information provided within this section relates solely to the one emergency egress shaft that will be located on the airport estate.

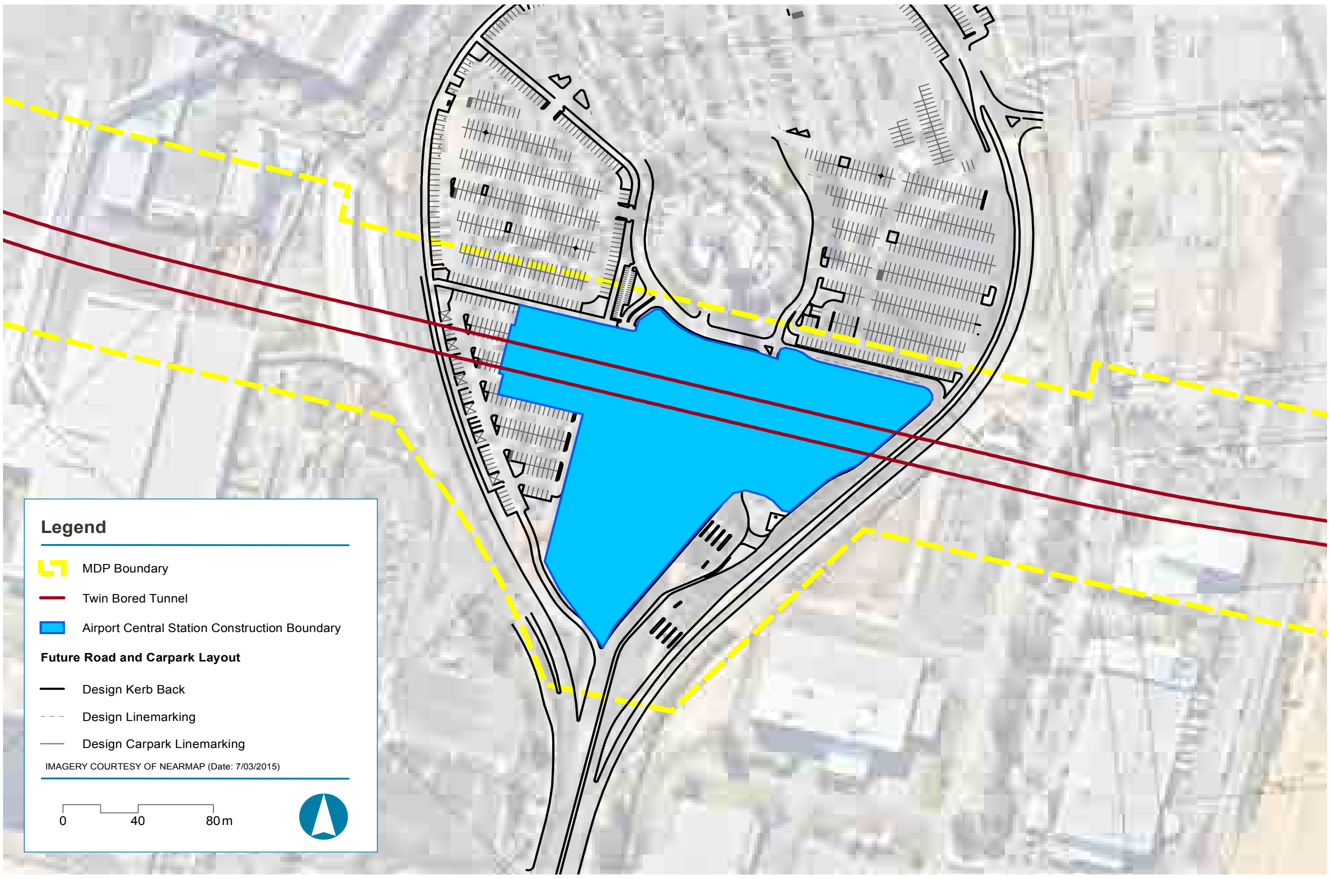


Figure 4.7 Airport Central Station – construction site boundary
Source: PTA

In general, the locations of emergency egress shafts are determined by the distance to adjacent tunnel cross-passages on either side of the egress shaft that meets fire and life safety engineering requirements for safe tunnel egress of people in the event of a fire or other emergency incident. They are required to meet the requirements of the State Department of Fire and Emergency Services (DFES) to safely and effectively intervene if such an event occurred.

One emergency egress shaft is required to service the rail alignment within the boundaries of the airport estate. The proposed location is adjacent to T3 within the existing staff carpark opposite the car rental facilities as shown in Figure 4.8.

Following extensive consultation with DFES and the Aviation Rescue Fire Fighting (ARFF), the final location of the emergency egress shaft may vary from the reference design location subject to the final cross-passage and egress shaft distance requirements agreed between the contractor, ARFF and DFES and approved by the ABC. However, it is anticipated that the final location will remain within the existing staff carpark area and will remain landside.

The emergency egress shaft consists of an above-ground building within a fenced compound area and a subsurface shaft down to tunnel level that is integrated with a cross-passage between the twin tunnels. The shaft includes stairs and a lift that is compliant with the Building Code of Australia, capable of transporting people who require assistance. The depth of the proposed emergency egress shaft located on the airport estate is approximately 20 metres from the existing ground level.

It is proposed that there will be a building that houses the staircase for emergency entrance and exit into the tunnel, equipment plant rooms and a fire control room. The surface building footprint above the emergency egress shaft will be approximately 345 square metres in size. In addition, there will be provision for an asphalt hardstand area for parking of emergency and maintenance vehicles within a secured compound of approximately 960 square metres.

For safe egress of passengers in the event of an emergency or incident within the tunnels, a designated pathway with pavement from the staircase to the egress gate will be clearly defined where evacuees will disperse once they exit the egress gate. An indicative layout of the area around the emergency egress shaft is displayed in Figure 4.9. The final design and location of the emergency egress provided is also subject to the assessment and approval of the Airport Building Controller (ABC) with regard to compliance with the National Construction Code.

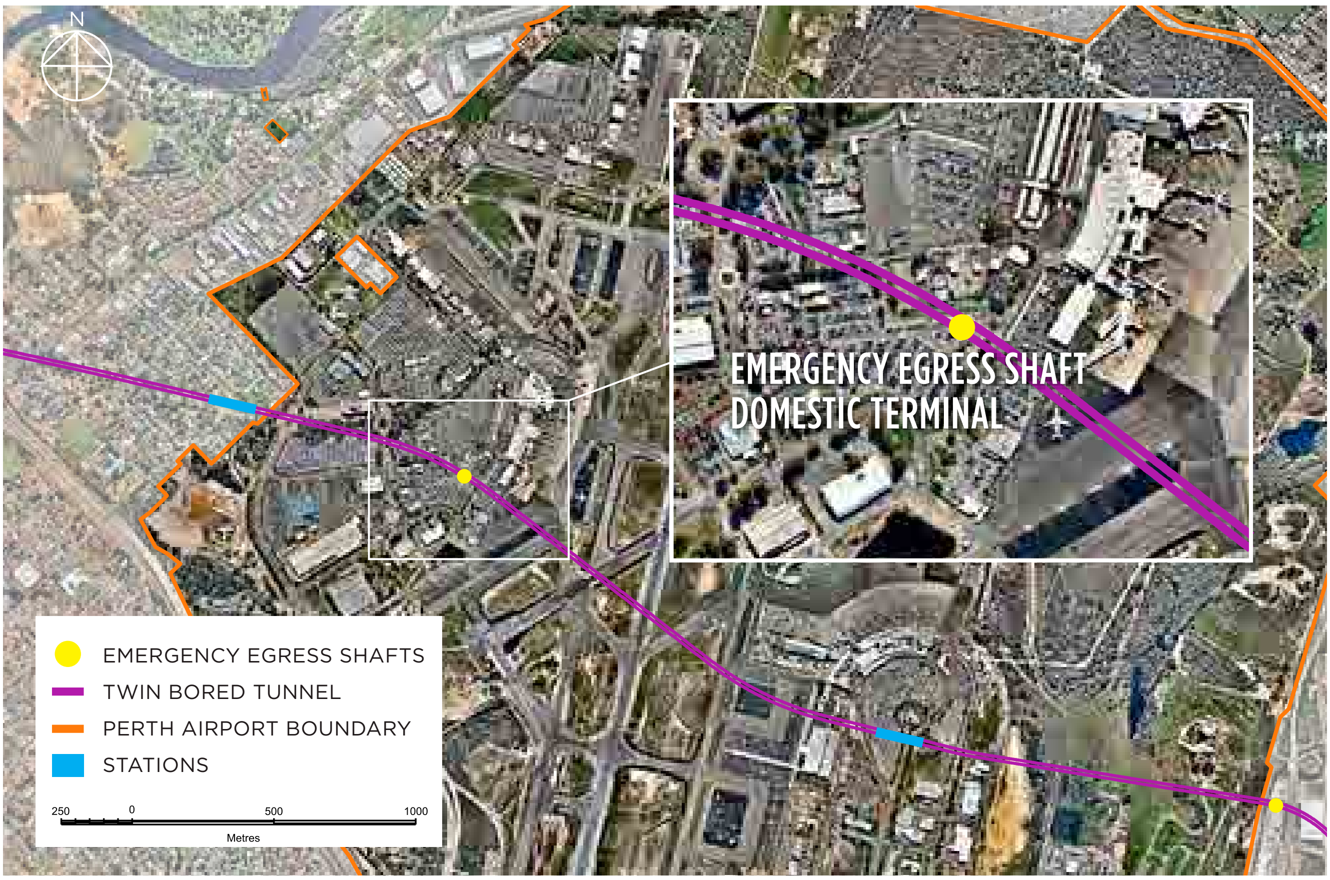


Figure 4.8 Emergency egress shaft location on the airport estate
Source: PTA

It is anticipated that the emergency egress shaft will be constructed similar to the proposed construction method for the Airport Central Station box. Excavation will be carried out from the surface down to the tunnels either using a caisson shaft sinking method or by diaphragm walls.

Ground treatment and preparation of the site around the emergency egress shaft will need to be completed prior to the arrival of the TBMs, however the construction of the shaft can occur any time after the TBMs have passed.

4.4.4. Cross-passages

Cross-passages provide a connection between the tunnels in the event of an emergency, allowing commuters to move to safety through the cross-passage to the next tunnel and walk to the nearest surface exit point at a station or egress shaft. A number of cross-passages are required across the alignment traversing the airport estate in order to allow emergency response to fire and life safety events within the tunnels.

The locations of cross-passages are defined by:

- distance to stations,
- distance between cross-passages, and
- surface infrastructure.

From a fire and life safety perspective, the distance between cross-passages needs to meet the requirements for safe tunnel egress of people in the event of a fire or other emergency incident as well as meet the requirements of the DFES to safely and effectively intervene in such an event.

The reference design suggests that six stand-alone cross-passages are required on the airport estate (landside and airside). There will also be a further connection between the tunnels integrated into the emergency egress shaft shown in Figure 4.9.

The cross-passages will be formed by excavating a passage between the two tunnels after they are constructed. To safely construct the cross-passages in geology other than the Osborne Formation rock strata, the ground must be improved prior to the excavation between the two tunnels commencing. Where the cross passages are located landside, ground improvement will involve using specialised equipment operated from the ground surface, such as jet grouting or deep soil mixing. Only the soil which surrounds the tunnels is improved thus creating a stabilised block of soil at the depth of the tunnels. Plan area of approximately 50 square metres will need to be stabilised for each of the landside cross-passages. This method of ground stabilisation is not applicable to cross-passages which are located airside.

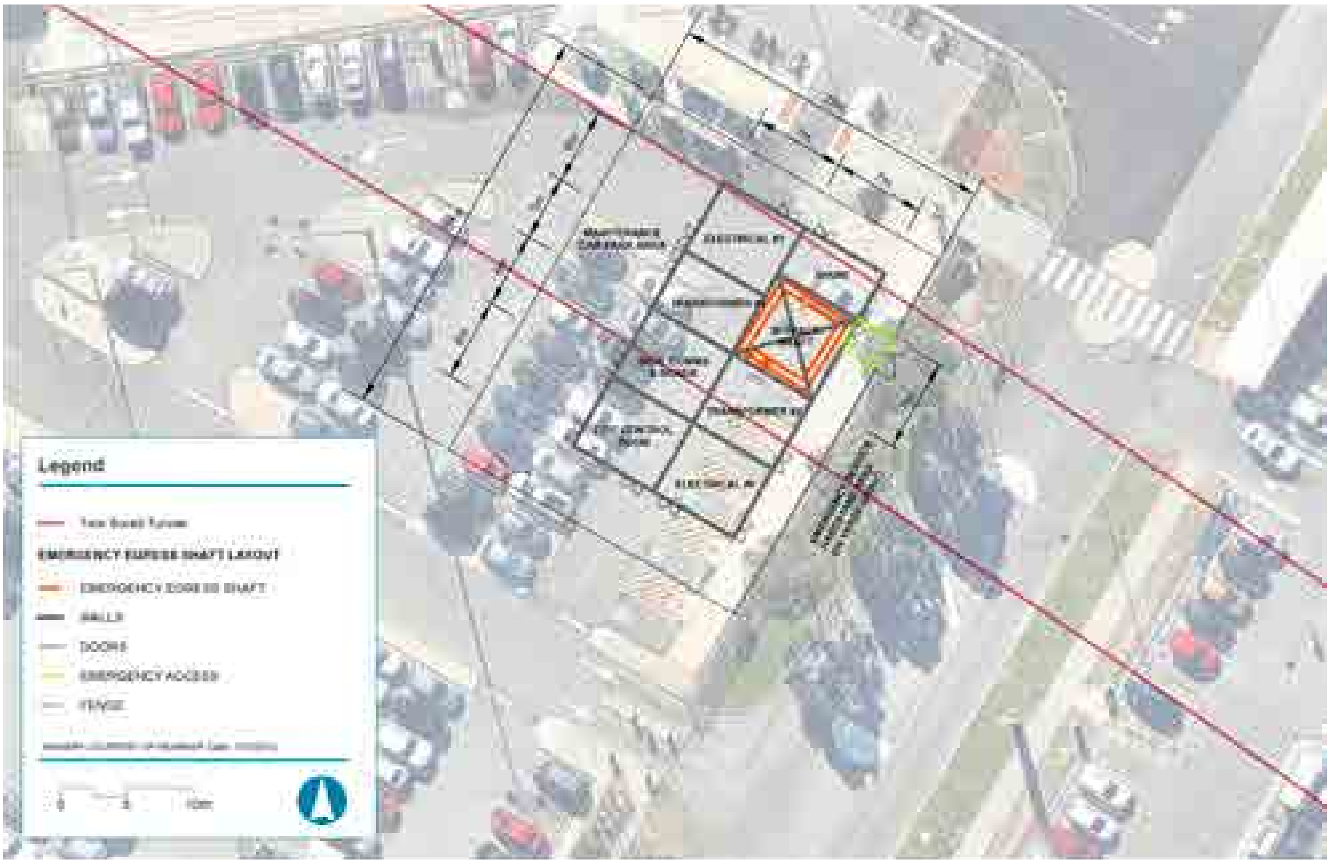


Figure 4.9 Indicative layout of emergency egress shaft including above ground permanent structures
Source: PTA

For cross-passages located airside, ground surface access will be restricted and hence it is proposed that the ground around these passages be treated via ground freezing from within the tunnels or similar methodology. There will be no intrusion from the ground surface airside as all activities will be undertaken from within the tunnels. After the completion of ground improvement, excavation from one tunnel to the other can commence along with shot-creting of a permanent lining to support the cross-passages.

There is potential for the final location of the cross-passages to vary from the reference design location subject to the final requirements negotiated between the contractor, DFES, ARFF and the ABC. In the event that cross-passage locations change or if additional ones are required, the impact of construction of these cross-passages will not alter from above. The location of the airside cross-passages will be restricted from being positioned beneath the airport runways and taxiways.

4.4.5. Stockpile location sites

Spoil, as a result of excavation on the airport estate, may need to be transported to a site suitable for treatment and storage.

As highlighted in Section 4.4.2.2, the construction of the station box will produce around 80,000 cubic metres of spoil which will be treated and stockpiled either onsite or offsite at a site determined by the PTA and the contractor.

The excavated spoil from Airport Central Station site will be transported either by road, subject to a traffic management plan which confirms no adverse impact to airport operations, or via an engineered solution such as a conveyor belt, slurry pipe or similar system to a location on the airport estate for treatment prior to disposal or stockpiling, or be transported by road to a site off the airport estate.

It is anticipated that the relatively small amount of spoil from the excavation of the emergency egress shaft will be transported in trucks either to the identified stockpile locations on the airport estate, or locations off the estate.

Two possible locations for the treatment and/or stockpiling of spoil on the estate have been identified within this MDP, as shown in Figure 4.12. The use of the stockpile sites is dependent on the final construction methodology applied by the contractor and on investigations of spoil material properties resulting from construction staging and methods. Therefore one, both or neither of the stockpile locations may be used partially or in their entirety. Also any future planning requirements from Perth Airport may also impact the ability to use the sites. Other sites on the airport estate may be considered and negotiated between the contractor, PTA

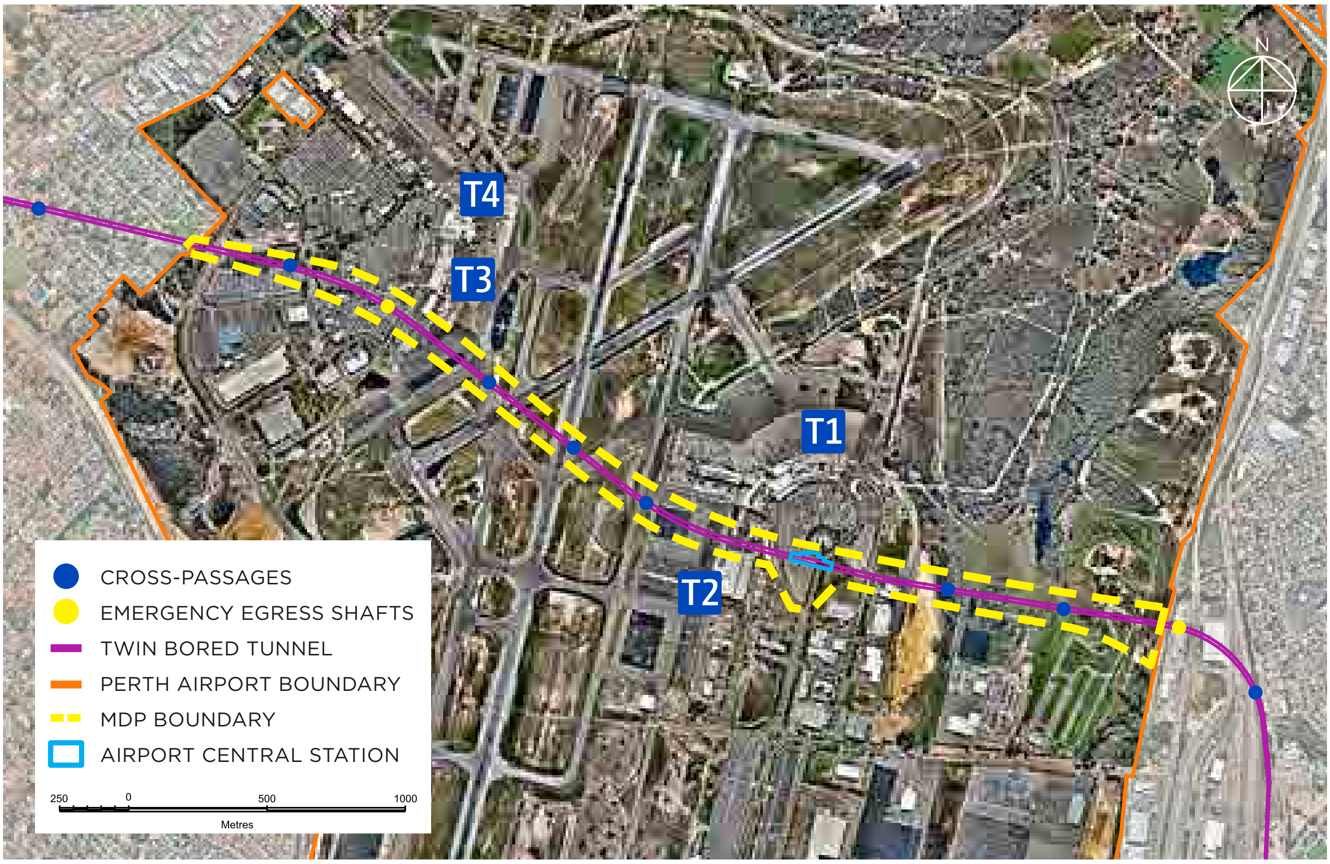


Figure 4.10 Cross-passage locations
Source: PTA

and Perth Airport. However any additional or replacement sites must not have a significant environmental impact.

The first of the identified stockpile locations is to the north of Grogan Road and to the east of all current terminals within Airport Central. At its closest and most direct point, the site is located approximately 380 metres from the Airport Central Station construction site. The area comprises just over 21 hectares of land, with the majority of the area already disturbed and cleared. The site is located within the Airfield Precinct and the proposed use of the land for the storage and/or treatment of spoil is consistent with the intent of the Master Plan 2014.

The second identified stockpile location is adjacent to the eastern boundary of the estate along Abernethy Road, also to the east of all current terminals within Airport Central. At its closest and most direct point, the site is approximately one kilometre from the Airport Central construction site. The area comprises just over 25 hectares of land, with the majority of the identified area already disturbed or cleared, and remaining vegetation in a completely degraded condition. The site is located within the Airfield Precinct and the proposed use of the land for the storage and/or treatment of spoil is consistent with the intent of the Master Plan 2014.

To prevent any negative impacts on Munday Swamp, a 50 metre setback will be required from Munday Swamp to the adjacent stockpile site.

Both sites are suitable given road transportation can occur via Horrie Miller Drive and Grogan Road, thus limiting the potential of traffic conflict between large construction vehicles and passenger vehicles accessing the terminal area via the new Airport Drive once Gateway WA is completed in 2016.

The contractor will be required to submit a Construction Traffic Management Plan detailing construction traffic access and management within the airport estate to avoid impact on general airport traffic.

Where planned impacts are deemed to be adverse on Perth Airport operations the application of engineered solutions such as conveyer systems, slurry pipes or similar will be applied.

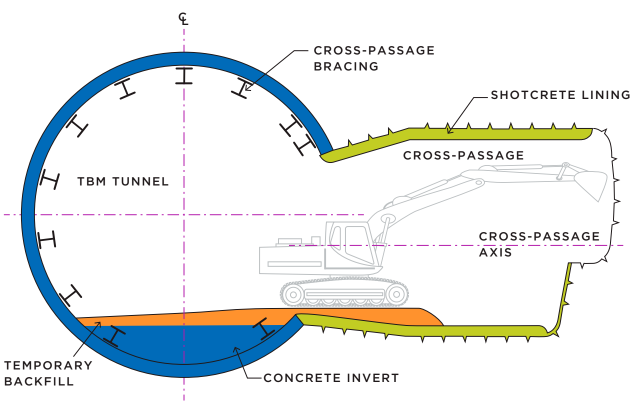


Figure 4.11 Cross-passage excavation
Source: PTA

All soil excavated by the TBMs for the tunnel construction will be transported within the tunnels themselves to the Forrestfield Station precinct, off airport estate land, for treatment and stockpiling prior to reuse or disposal. Construction works on site will generate soil material which is likely to be Potential Acid Sulphate Soil (PASS) and will require treatment prior to transporting to a suitable stockpile location (Refer to Section 6).

4.5. Construction activities

Construction of the Forrestfield-Airport Link project is expected to commence in October 2016, subject to funding and approvals, and is expected to be completed by October 2020. Construction within the airport estate is expected to commence in late 2016.

Construction of the Forrestfield-Airport Link project will involve works at both surface level and underground within the airport estate. All works on the airport estate will be completed in accordance with the timeframes outlined in Section 94 of the Act.

It is proposed that construction of the underground twin-bored tunnel structure will commence at Forrestfield and finish at Bayswater, facilitating connection to the existing Midland Line between Bayswater and Ashfield Stations. Fit-out of the tunnel, including rail infrastructure and all related services, will follow once the tunnel boring machines have been removed.

In parallel with these works, construction activity will take place at surface level including excavation, dewatering, ground stabilisation, building structure and fit-out. These activities will be necessary for the construction of Airport Central Station, the emergency egress shaft within the Airport West Precinct and aspects of the various cross-passages.

Timing of these surface level works will largely be driven by the tunnel boring program. For example, the Airport Central Station structural box must be completed prior to the tunnel boring machines reaching it, to provide a safe environment to receive and inspect the machines before they continue with tunnel boring. In addition, any ground stabilisation works from surface level will be required prior to the tunnel boring machines reaching each location in order to minimise ground settlement and facilitate construction works.

4.6. Operation activities

The rail has been designed to operate independently to the airport and will be operated by PTA. Risks to aviation activities during the ongoing operation of the rail and how these will be mitigated is provided in Section 7.

Figure 4.12 Proposed stockpile locations
Source: Perth Airport

5. TRAFFIC

5.1. Ground transport planning

The proposed development of a rail link and the construction of a station in Airport Central will provide passengers and staff with access to a rail line as an alternative to the current car based access to the airport. As highlighted in the Master Plan 2014, the success of the airport depends on being accessible, and both passengers and freight having the ability to move freely to and from their off-airport destinations and origins. While surface access projects such as the Gateway WA project and Perth Airport's construction of the new Airport Drive are delivering solutions to improve the access of both freight and passengers to the estate and terminals by vehicle, choice of alternative modes of transport benefit the movement network as a whole.

Perth Airport recognises that easy to use transport services are an important feature of the overall airport and travel experience, and as a consequence continues to progress ongoing improvements and upgrades to the transport network, including:

- expanding and improving car parking to provide more than 19,000 car parking bays,
- redevelopment of the T1 forecourt road network to improve efficiencies,
- support to Main Roads WA in the delivery of the Gateway WA project, which is expected to transform future road access to Perth Airport, and
- construction of the new Airport Drive to supplement the Gateway WA project and ensure safety and separation of passengers from freight transport using Horrie Miller Drive.

At present, public transport servicing Perth Airport is limited. T3 and T4 are currently serviced by a public bus service that connects Perth Airport to the CBD. The proposed construction of the Forrestfield-Airport Link will provide additional improvements to the transport network that will assist in providing an alternative to car based access to the airport.

Growth in air passenger traffic through Perth Airport has increased at around 9.5 per cent annually over the last decade, while in the four year period between 2008 and 2013, passenger growth increased from 9.9 million to 13.7 million, which is an increase of 38 per cent. Looking into the future, annual total passengers numbers are forecasts to grow from 13.66 million in 2013 to 28.45 million in 2034 (based on a central scenario). Based on a high scenario passenger growth rate, total annual passengers are forecast to grow from 13.66 million in 2013 to 32.83 million in 2034, as shown below in Figure 5.1.

The anticipated projected growth in the number of passenger passing through the Airport Central will result in significant increases in vehicle numbers entering the precinct. As highlighted in the Master Plan 2014, aviation related traffic in Airport Central is projected to increase from 13,500 vehicles

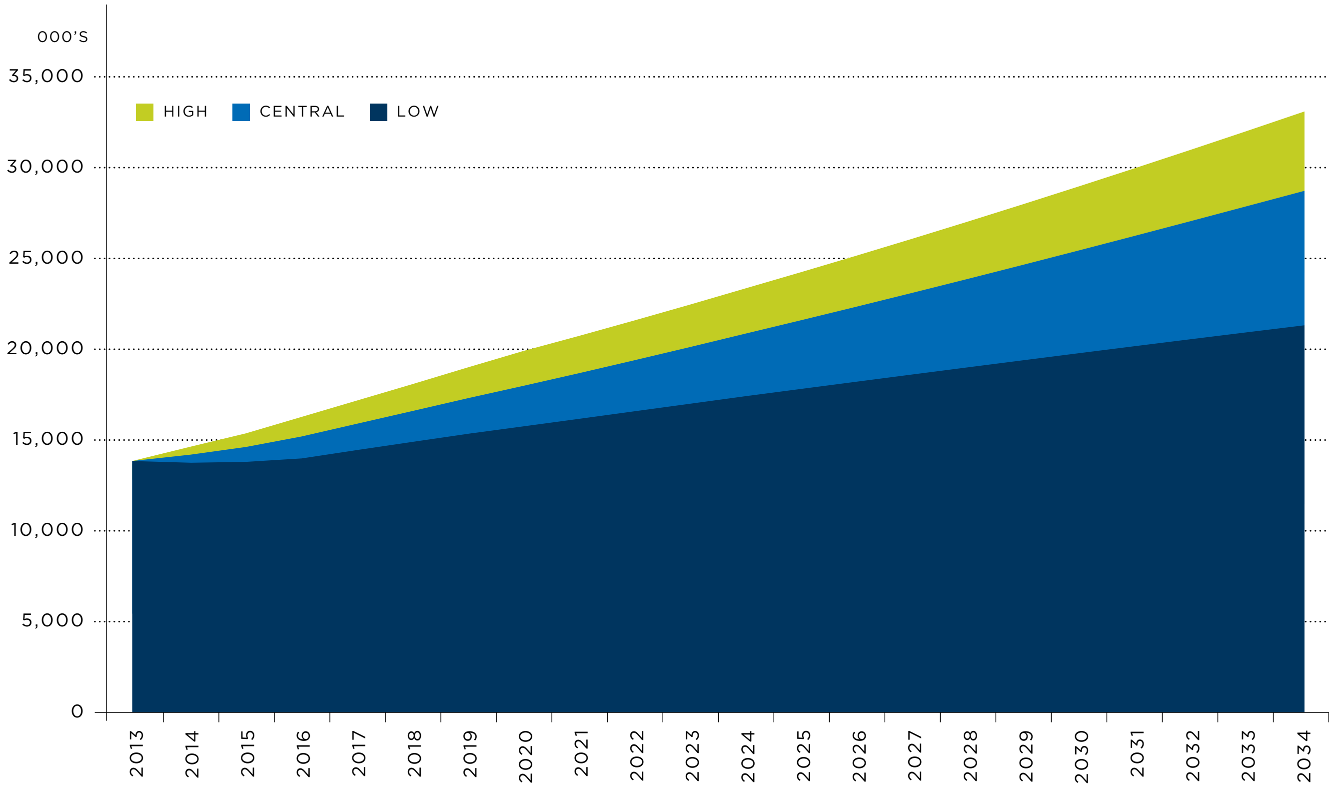


Figure 5.1 Perth Airport total passenger forecasts
Source: Perth Airport Master Plan 2014

per day in 2011 to 69,000 vehicles per day in 2021 and to 91,000 vehicles per day by 2031, as shown in Table 5.1. This will occur in a number of stages as consolidation of commercial air services to Airport Central is completed, including:

- commencement of operations from the T1 Domestic Pier and International Departures Expansion project (currently under construction), which will see Virgin Australia's domestic operations relocate to Airport Central, and
- the final stage of consolidation completed with the relocation of Qantas Airways Group domestic operations to Airport Central.

With the consolidation of commercial air services to Airport Central, it can also be expected that patronage of the Forrestfield-Airport Link from Airport Central Station will continue to increase. The rail link will provide an alternative to the current car-based access to the airport, with an anticipated mode share of approximately ten percent by 2034 as shown in Figure 5.2.

Year	Million Passengers Per Annum (MPH)	Aviation-Related Vehicle Traffic (Vehicles Per Day)
2011	3	13,500
2015	6.5	27,500
2021	18	69,000
2031	26	91,000

Table 5.1 Aviation related vehicle traffic using Airport Central
Source: Perth Airport Master Plan 2014

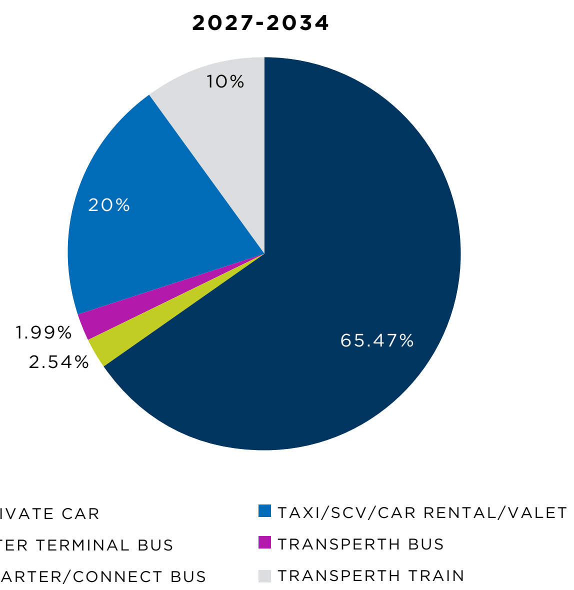


Figure 5.2 Projected passenger travel modes to and from Perth Airport 2027 - 2034
Source: Perth Airport Master Plan 2014

5.2. Road modelling

The State Government is responsible for assessing the impact to the road network of the Forrestfield-Airport Link project. The wider road impacts of the Forrestfield-Airport Link project do not form part of the MDP however details regarding the modelling that the State Government have completed are provide for context.

The State Government has prepared a traffic model of the wider Forrestfield-Airport Link area. The model is generally bounded by the Great Eastern, Tonkin and Roe Highways, and includes the internal roads within Perth Airport, as shown in Figure 5.3.

A 2014 base model year was built, which included:

- collection of traffic counts, travel times, signal data, and site observations,
- building of the model road network,
- development of the traffic demands based on data from Main Roads WA, and
- calibration and validation of the model for the AM and PM periods.

Traffic demand profiles were developed from the survey and were subsequently used in the model. The profiles are displayed as percentage peak factor of the peak hour. As shown in Figure 5.4, the AM profile is relatively consistent with a peak period between 7:30am to 8:30am. The PM traffic demand profile, shown in Figure 5.5 is also relatively consistent up until 17:30, with a peak period between 16:30 to 17:30. These recorded survey profiles align with on-site observations.

Traffic movement for three separate years were then modelled -

- 2017 for the construction phase,
- 2021 for the station operating, and
- 2031 as the ultimate development year.

Year 2031 is the latest timeframe for Main Roads WA road planning model and it is assumed for modelling purposes that all the proposed development in the Development Area 6 (DA6) area and the Forrestfield North District Structure Plan area has been completed, although in reality this is more likely to have a 2050 timeline.

Key points of the model are:

- traffic demands based on Main Roads WA forecasting data using updated land use information, including the current Master Plan 2014,
- includes State Government network changes such as Gateway WA and Brearley Avenue closing,
- testing of the proposed construction staging,
- testing of the performance of the road network when all stations are operational, and
- testing of the Great Eastern Highway corridor design, e.g. turn bay lengths.

Figure 5.3 Perth Airport external and internal road network
Source: Perth Airport Master Plan 2014 (updated road layout August 2015)

The traffic model shows that the proposed changes to the road networks and the proposed changes to land use function well in 2017 and 2021, as summarised below.

- 2017 Construction Year - traffic patterns at Airport Central are relatively similar between the two peak periods, however the evening period does exhibit slightly higher volumes. With the construction of the Airport Central Station, the movement of vehicles across the exit of the Airport Central Station bulb, controlled using manned stop/go priority, does not cause any noticeable delay to vehicles leaving either the paid parking or drop off/ pick up area. Generally there is no delay in either the morning or evening period in this area.
- 2021 Opening Year - whilst there is a moderate increase in passenger travel and therefore vehicle trips in 2021, the Airport Central network performs well. There are no signs of possible network failures given the large level of infrastructure changes in place as a result of Gateway WA.

The modelling has shown that the developments proposed as part of this MDP do not alter the road network within or outside the estate.

5.3. Construction

The construction of the underground station at Airport Central will generate vehicle traffic. Construction traffic will include spoil removal trucks, concrete delivery, reinforcement delivery and final fit-out trucks. All these vehicles will be 'as of right' vehicles, which are 19 metres or less in length and less than 42.5 tonnes gross weight, and able to operate on the public road network. The worst case scenario is that the excavation of the station box would see spoil transported via trucks to the stockpile locations. This could require in excess of approximately 100 truck movements per day for a duration of approximately 50 days to remove the spoil (based upon 20 tonnes 8 wheel rigid spoil trucks). However if this was to occur, a Traffic Management Plan would need to confirm no adverse impacts (including environmental and visual) to airport operation. The Plan would need to be approved by Perth Airport.

The main access to T1 and T2, is via the recently opened Airport Drive. It is envisaged that all construction traffic will access the site via Abernethy Road, Grogan Road and Horrie Miller Drive to reduce conflict with the terminal traffic (Refer to Figure 5.3 for the current internal road layout). Heavy vehicles will not be permitted on Airport Drive. Some minor intersection works may be required at the Grogan/Affleck Road intersection to accommodate the additional traffic. A Construction Management Plan will be prepared prior to commencement of any works on site. In addition, a Traffic Management Plan will be prepared by the contractor as part of the Airport Building Control Works Permits which will manage the traffic interfaces of both construction and general airport traffic. The Traffic Management Plan will be prepared by an Main Roads WA accredited person and will be submitted to Perth Airport for approval.

It should be noted that there will also be certain 'exceptional' vehicle deliveries. An example of this includes crawler cranes which will require careful planning and liaison with Perth Airport operational staff to facilitate their delivery to site in the safest possible manner. Where these vehicles are oversized, appropriate permits will be obtained by the contractor.

With respect to emergency response and management during the construction phase of the project, an Emergency Management Plan will be prepared by the contractor and approved by Perth Airport prior to commencement of works on site. This will ensure priority access to emergency vehicles in the event that an aviation security incident and/or emergency incident should occur.

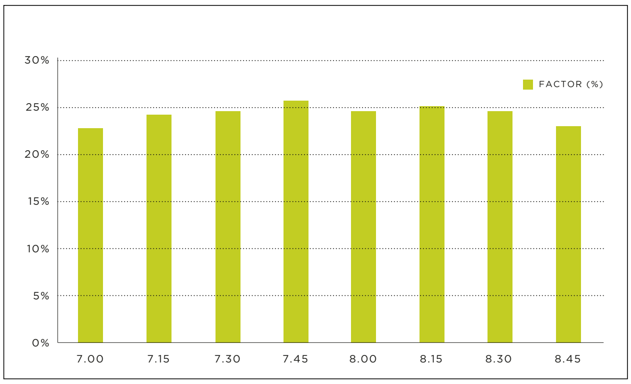


Figure 5.4 AM traffic profile

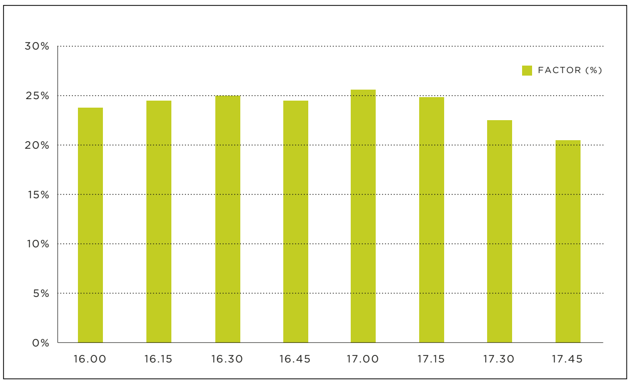


Figure 5.5 PM traffic profile

5.3.1. Spoil removal

The removal of spoil will be required at two points through the construction process for works on the airport estate. These are:

- excavation of the site to accommodate the Airport Central Station box within the Airport Central precinct, and
- excavation of the site to accommodate the emergency egress shaft within the Airport West precinct.

Options for spoil removal and disposal have been carefully considered in terms of opportunities to minimise conflict between passenger and construction traffic. Traffic modelling shows that the impact of construction traffic is manageable through active traffic management.

The excavation and removal of the spoil will be undertaken using a work methodology so as to not materially impact operations and access to the T1 precinct car parking and forecourt. This will be ensured through extensive traffic management which confirms no adverse impact to airport operations and as required, the application of engineered solutions such as conveyor systems, slurry pipes or similar to transport the material. Any proposed stockpiles on the airport estate will require Perth Airport Consent and a Works Permit to be issued by the Airport Building Controller (ABC), and this process will involve input from the ABC as well as the development of an acceptable Traffic Management Plan.

With regards to the excavation and subsequent removal of spoil required in order to excavate the site for the emergency egress shaft, there will be considerably less spoil created through these works than the Airport Central Station. Traffic conflict and congestion can be minimised through careful management, such as the timing for removal coinciding with off peak terminal traffic times, and appropriate onsite traffic management to ensure appropriate priority is given to passengers and workers within the precinct.

5.3.2. Other construction activity

It is likely that there will be other construction activity within Airport Central that may coincide with the station box construction. The worst case scenario is that another project may be under construction which may generate a large number of concrete truck movements, along with other associated construction traffic movements. In this scenario, there is an option to remove spoil from the Airport Central Station to an area east of the current international precinct using an overhead conveyor or slurry pipe or similar method from the station construction site to the proposed spoil area. This arrangement has the potential to remove approximately 100 vehicles from entry and egress to the Airport Central precinct during the construction period of the station.

Prior to any works commencing associated with the Forrestfield-Airport Link Project, the contractor is required to prepare a Transport Management Plan, carry out road safety audits and implement traffic management measures, as required.

5.3.3. Traffic generated by construction employees

It is proposed that no construction staff personal vehicles will have access to the construction site during the working day. Operative personnel vehicles will be parked remotely and transport provided to ferry personnel to site.

5.4. Operations

5.4.1. Train replacement service

In the unlikely event that trains are temporarily unable to run on the Forrestfield-Airport Link, a train replacement service will be provided. The Forrestfield-Airport Link runs independently of the Midland Line, allowing train replacement services to run from Forrestfield Station to Bayswater Station.

Buses will replace the trains allowing pick up and/or set down at Forrestfield Station, Airport Central Station, Airport West Station, and Bayswater Station. From Bayswater Station, passengers can continue their journey on the train. PTA will use the bus stand within Airport Central, which services the Perth Airport car park buses, tour buses and shuttle buses.

It is anticipated that the buses will access T1 and T2 via Horrie Miller Drive and pick up and/or set down at Airport Central Station, then travel along Airport Drive and Tonkin Highway to Dunreath Drive to access Airport West from the extension of Central Avenue. The buses then come back out onto Dunreath Drive to exit onto Tonkin Highway towards the Bayswater Station.

5.4.2. Pedestrian and cyclists

There will be no pedestrian or cyclist access to the Airport Central Station at ground level. Access will be via vertical transport connected to the station and terminals.

There will be no provision for cyclists at the Airport Central Station as it is unlikely that passengers will cycle to the station. Facilities will be provided at Forrestfield and Airport West stations.

5.4.3. Private vehicles

There will be no car parking or set down and pick up provided at Airport Central Station, hence deterring the use of private vehicles at Airport Central Station.

6. ENVIRONMENTAL IMPACTS

6.1. Environment and heritage considerations

A review of the environmental impacts associated with the construction and operation of the Forrestfield-Airport Link project on the airport estate was completed. The key concerns identified were:

- legislative environment,
- influence of climate conditions,
- geology and soil conditions, including Acid Sulfate Soils,
- groundwater levels,
- surface hydrology,
- contaminated sites and impact of dewatering,
- vegetation and flora,
- potential impact to Threatened Ecological Communities (TEC's),
- potential impact to rare flora,
- prevention of the spread of dieback,
- fauna, with focus on Black-Cockatoo and Rainbow Bee-eater habitat, and
- impact on known heritage sites.

The environmental values are based on data attained by site investigations and information obtained over the short and long term. On the basis of the information available, the conservation values of the proposed project area are described and defined by Commonwealth and State legislation, policy and guidance. A whole of estate context on relative values, representation and conservation is also provided for those environmental values proposed to be impacted by the development.

Should details of the project change, including stockpile locations, an assessment of environmental impacts will be undertaken on new project areas prior to works commencing.

6.1.1. Legislative context

The Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act) is the Commonwealth Government's central piece of environmental legislation. It provides a legal framework to protect and manage nationally and internationally important flora, fauna, ecological communities and heritage places, defined in the EPBC Act as matters of national environmental significance.

The nine matters of national environmental significance to which the EPBC Act applies are:

- listed threatened species and communities,
- listed migratory species,
- Ramsar wetlands of international importance,
- Commonwealth marine environment,
- world heritage properties,
- national heritage places,
- the Great Barrier Reef Marine Park,
- nuclear actions, and
- a water resource, in relation to coal seam gas development and large coal mining development.

In addition, the EPBC Act confers jurisdiction over actions that have a significant impact on the environment where the actions affect, or are taken on, Commonwealth land or are carried out by a Commonwealth agency (even if that significant impact is not on one of the nine matters of 'national environmental significance'). Collectively these are termed Protected Matters.

The EPBC Act is triggered where an action is likely to have a significant impact on Protected Matter. A significant impact as defined by the EPBC Act is an impact which is 'important, notable, or of consequence, having regard to its context or intensity'. Significance impact guidelines assist in the determination of whether an action is significant for a Protected Matter. For some species, referral guidelines have been developed, providing specific advice on when an action should be referred for assessment.

The *Airports Act 1996* (the Act) outlines that environmental impacts on the Perth Airport are considered via the Act's MDP process.

There are three different ways in which the environmental elements of a MDP can be assessed:

- Department of Environment (DoE) assessment under Section 160 of the EPBC Act,
- DoE accreditation of Department of Infrastructure and Regional Development (DoIRD) assessment process or of DoIRD's as an assessment body, or
- DoE accredit DoIRD's assessment but the MDP is still referred to them for comment once submitted to the Commonwealth Minister of Infrastructure and Regional Development.

A combined assessment under the Act and EPBC Act can be undertaken, with two processes available:

- DoE accreditation of DoIRD's assessment process or of DoIRD as an assessment body, or
- DoE assessment under Section 160 of EPBC Act and advice provided to Minister for Infrastructure and Regional Development.

Where the number and complexity of environmental impacts of a proposed major development is low and locally confined, and can be predicted with a high degree of confidence, the Environment Minister will accredit the MDP process under the Act for the purpose of the EPBC assessment. This means that the Final MDP is not subject to separate assessment requirements under the EPBC Act. Instead, in preparing advice for the Commonwealth Environment Minister to provide to the Commonwealth Minister for Infrastructure and Regional Development, DoE will draw on the outcome of the assessment by DoIRD of the Final MDP after it has been submitted by the airport.

Referral guidelines were released by the [then] Commonwealth Department of Sustainability, Environment, Water, Population and Communities (DSEWPC), now the Commonwealth Department of Environment (DoE), for three Black Cockatoo species in 2012. Based on these guidelines, the project does not represent a significant impact and does not require referral under the EPBC Act.

In consultation with DoIRD and DoE, it has been determined that it is likely that this MDP will not have a significant impact on the environment. Perth Airport submits that through this MDP, it has fulfilled its statutory obligations in accordance with the EPBC Act.

The project areas outside the Perth Airport estate were referred directly to the DoE (Reference number: 7399) and the State Environmental Protection Authority (EPA) (Assessment number: 2048). The proposed action outside the Perth Airport estate will be assessed by the EPA under a bilateral agreement with the Commonwealth. This assessment does not form part of this MDP.

6.1.1.1. Other legislative considerations

The commitments made as part of this MDP are enforceable under the relevant legislation including the:

- *Airports Act 1996*, and
- Airports (Environmental Protection) Regulations 1997 (EPR).

This MDP is also consistent with developments and commitments outlined in Section 9 (Environment Strategy) of the Master Plan 2014.

In addition, the Airport Environment Officer (AEO), who is employed by DoIRD and is independent to Perth Airport, is located onsite to monitor, report and take preventative action against any environmental impacts or pollutants.

6.1.2. Climate

Climatic conditions assist in understanding the environment of the project area as well as influence the development of construction management measures.

The Perth region has a Mediterranean climate, experiencing hot, dry summers and mild, wet winters. The annual average rainfall is 770 millimetres, with most of the rain falling between May and September, with mean daily minimum temperatures ranging between 8.0°C and 17.9°C. From December to March the climate is typically dry and hot with mean daily maximum temperatures ranging between 29°C and 31.9°C. Historical annual averages from the Bureau of Meteorology station located at Perth Airport are summarised in Figure 6.1.

Winds and the seasonality of rainfall in the Perth region is a factor that influences stormwater, dust control and sediment, and erosion control management strategies. The Perth region experiences strong westerly winds or gales in winter and strong easterly winds and south-westerly sea breezes in summer.

6.1.3. Geology and soils

The airport estate, including the project area, is situated at the base of the Darling Escarpment and is underlain by superficial formations of Quaternary age comprising of Swamp deposits, sands and clays.

The area upon which the airport estate was developed consisted of low, gently undulating dunes interspersed with swamps and damplands. A large proportion of the damplands, wetlands and creeks naturally present have either been drained, infilled or modified by construction of drainage control structures.

Ground conditions within the project area comprise Bassendean Sand overlaying Guildford Formation, overlaying Gnangara Sand, overlying Ascot Formation, overlaying Osborne Formation. These units are described below:

- the Bassendean Sand is a superficial unit exposed at the ground surface over the majority of the proposed alignment. It generally comprises a well sorted, fine to medium grained, loose to dense sand. This unit is believed to have complex

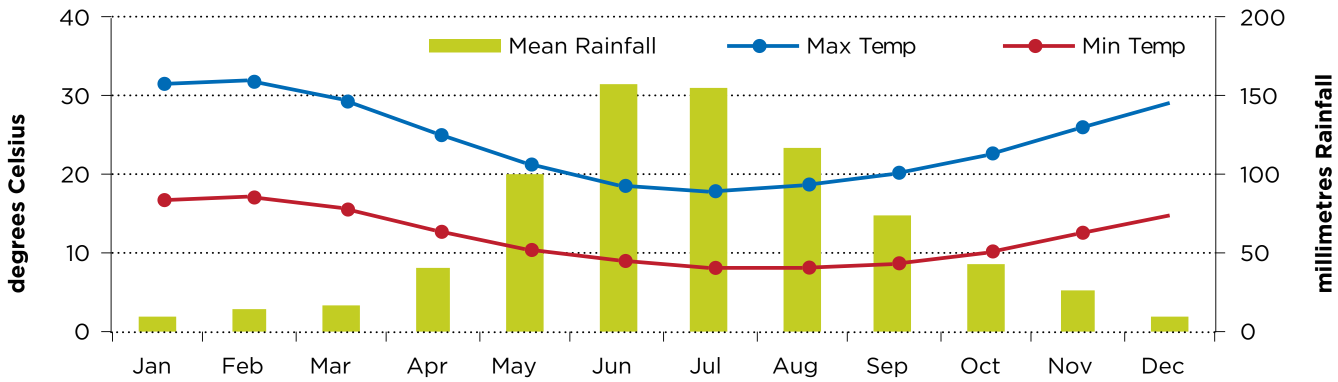


Figure 6.1 Perth Airport historical weather averages
Source: Bureau of Meteorology

origin including shallow-water sandy fluvial as well as wind-blown processes. It often also contains a weakly to moderately well cemented sand layer referred to as 'coffee rock'. Along the alignment this unit varies between approximately two to ten metres in thickness. It is thickest beneath the main runway (03L/21R) and thins west toward the Swan River and east toward the escarpment,

- the Guildford Formation comprises interbedded sand, silt and clays of varying stiffness ranging from medium dense to very dense and stiff to hard. Along the alignment the predominant grain size in this unit is sand. Unlike the Bassendean Sand, this unit often contains a significant proportion of fines within the sand,
- distribution of the Gnangara Sand appears to largely mirror the occurrence of the underlying Ascot Formation beneath the airport estate. It is a relatively thin unit, generally less than five metres thick and more often about two metres thick. The contact between the Gnangara Sand and the Ascot Formation is often associated with a significant decrease in density and may contain loose to very loose 'running' sand,
- the Ascot Formation comprises carbonate-rich sediments thought to be deposited in a near shore marine environment along a progressively receding shoreline. The unit has undergone alteration since initial deposition. Initially, carbonate cementation occurred, but the cemented material appears to have been subsequently leached, forming voids and cavities, and it is inferred that there has been some infilling of voids and cavities with carbonate sand. Relatively continuous layers of calcarenite rock and/or calcarenite cobbles and boulders up to two metres thick have been interpreted to be present in this unit under the airport estate. However, cemented layers appear to be more common east of the Air Traffic Control Tower and near the eastern termination of the Ascot Formation beneath the RAC driver training area,
- the Osborne Formation in the project area includes the Mirrabooka Member and the Kardinya Shale Member. The Kardinya Shale Member is extremely low to medium strength rock and is sand dominated to the west (sandstone) and fines dominated to the east (mudstone and siltstone). The Mirrabooka Member is largely a medium to coarse, dense to very dense sand and clayey sand, which is expected to have significantly higher permeability than the Kardinya Shale Member.

6.1.3.1. Acid Sulfate Soils

Acid Sulfate Soils are naturally occurring soils containing iron sulfide minerals (notably pyrite) formed under saturated anoxic conditions. In an undisturbed state below the water table, these soils are benign and non-acidic. However, if the soils are exposed to the atmosphere through activities such as drainage, excavation or dewatering, the sulfides may react with oxygen to form sulfuric acid.

Acid Sulfate Soils can be present in the form of:

- Potential Acid Sulfate Soils (PASS) – Soil that contains unoxidised iron sulphides. When exposed to oxygen through drainage or disturbance these soils produce sulphuric acid,
- Actual Acid Sulfate Soils (AASS) – PASS that has been exposed to oxygen and water and has generated acidity.

An assessment of the State Department of Environment Regulation's (DER) Acid Sulfate Soils mapping indicates that the risk of Acid Sulfate Soils occurring on the airport estate ranges from 'no risk of Acid Sulfate Soils occurring within three metres of the natural soil surface' to a 'high to moderate risk of Acid Sulfate Soils beyond three metres of the natural soil surface'.

Localised areas of soil and groundwater contamination may be present within the route corridor and its immediate surrounds. If present, contaminated soil is most likely to be encountered at shallow depths during excavation of the underground structures. Tunnel spoil material is unlikely to be contaminated due to the depth of the tunnels. Contaminated groundwater may be abstracted or mobilised by dewatering activities.

The majority of the tunnel spoil and material excavated to construct the underground structures is likely to be Acid Sulfate Soils. Disturbance of Acid Sulfate Soils can result in the release of sulphuric acid and heavy metals which have the potential to pollute groundwater, water courses and wetlands. Dewatering activities also have the potential to disturb Acid Sulfate Soils.

6.1.4. Groundwater

The airport estate is located on the Swan Coastal Plain, is relatively flat, and is near the base of the Darling Scarp, extending to within 500 metres of the Swan River. Groundwater beneath the estate sits at a shallow depth (surface to four metres below ground level) as an unconfined water table within the highly permeable sands of the Bassendean Dunes and as a semi-confined aquifer in the Guildford Formation. Groundwater flows in north-westerly direction across the airport estate.

All materials overlying the Osborne Formation are considered to be part of the Superficial Aquifer. The presence of 'coffee rock' in the Bassendean sand may result in perched groundwater conditions in local areas above the coffee rock layer.

Groundwater levels across the project area range from 9.8 metres Australian Height Datum (AHD) to 17.3 metres AHD (1.2 to 2.3 metres below ground level). Perth Airport monitoring bore locations are shown on Figure 6.2.

Groundwater quality monitoring has been occurring on the estate since 2000. The closest monitoring bores to the project area are MB8-s, MB10-s, MW19-s, and MB5-s. Analytes monitored in these bores as required under the EPR include: arsenic (As);

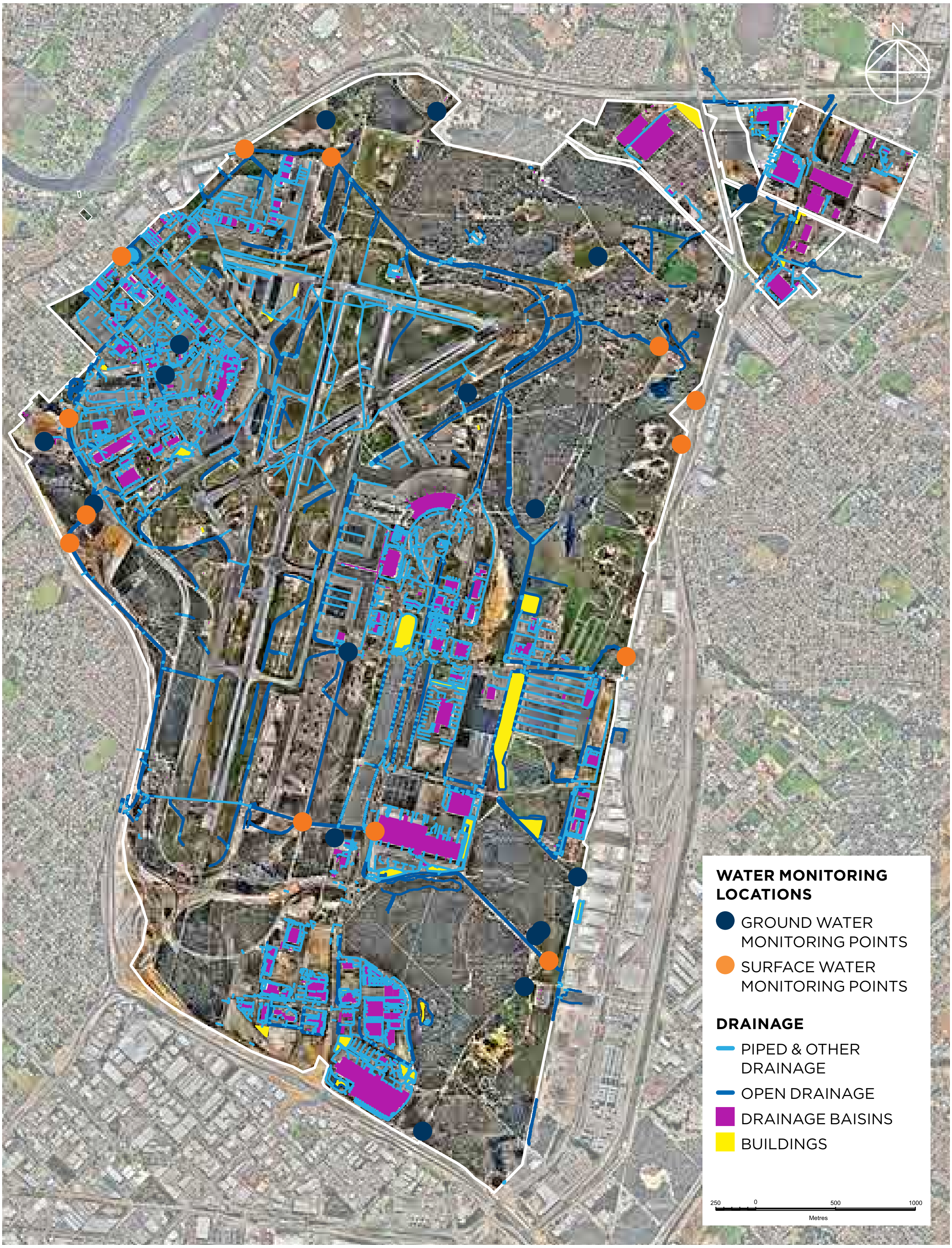


Figure 6.2 Groundwater and surface water monitoring sites
Source: Perth Airport Pty Ltd

cadmium (Cd); copper (Cu); chromium (Cr); lead (Pb); mercury (Hg); nickel (Ni); zinc (Zn); total nitrogen (TN); total phosphorous (TP); Total Petroleum Hydrocarbons (C_{6-9}, C_{10-14}, C_{15-28}, and C_{29-36}). In addition, general water quality parameters such as pH and Electrical Conductivity (EC) are monitored.

The analytes, total nitrogen, total phosphorous, zinc and lead are regularly outside the monitoring criteria defined in Schedule 2 of the EPR and detailed in Table 6.1. However the results for these analytes are a reflection of the natural environment of the airport estate which has acidic soils (pH and zinc) and also hydrogeologically connected to the Poison Gully system from the east, which is high in nutrients (ammoniacal nitrogen, total nitrogen and phosphorous). Historically the wetlands on the estate have resulted in the nutrient levels leaving the estate being significantly lower than what enters the estate resulting in increased protection to the Swan River from the impacts of eutrophication.

Most recent monitoring results from these three bores are presented in Table 6.1. Acceptance criteria are defined as limits for fresh water as defined by Schedule 2 of the EPR.

Results of monitoring in these bores are fairly typical of water quality across the estate (with the exception of areas that have been impacted by localised pollution). Nutrient levels are elevated in the groundwater entering the estate and the nutrient values in the water exiting the estate are also generally elevated to similar levels. High nutrient levels are attributed to up-gradient land uses, particularly the historical and ongoing use of septic systems for sewerage disposal.

Similarly, levels of zinc are elevated in groundwater across the estate. The source of this is considered to be natural soil conditions, with zinc being present in the soils of the Darling Scarp, which is located immediately to the east and up-gradient of the estate.

Elevated lead in MB 8-s is thought to be associated with known underground storage tank contamination.

Due to the limited amount of clearing involved (limited to stockpile areas and potential clearing for landside cross-passage stabilisation), the proposed development is not expected to impact the groundwater values or the hydrological regimes.

Analyte	Acceptance Criteria	Units	MB 8-s	MB 10-s	MW 19-s
			June 2015	June 2015	June 2015
As	0.050	mg/L	0.04	0.002	0.002
Cd	0.0002	mg/L	<0.0001	<0.0001	<0.0001
Cu	0.002	mg/L	<0.001	<0.001	0.001
Cr	0.010	mg/L	<0.001	0.002	<0.001
Pb	0.001	mg/L	**0.011**	<0.001	<0.001
Hg	0.0001	mg/L	<0.0001	<0.0001	<0.0001
Ni	0.015	mg/L	0.009	0.003	0.002
Zn	0.005	mg/L	<0.005	<0.005	0.007
TN	0.1	mg/L	**5.2**	**1.3**	**1.9**
TP	0.01	mg/L	**0.59**	**0.72**	**0.23**
TPH C_{6-9}	0.15	mg/L	1.3	<0.02	<0.02
TPH C_{10-14}	0.6	mg/L	3.4	<0.02	<0.02
TPH C_{15-28}	0.6	mg/L	<0.04	<0.04	<0.04
TPH C_{29-36}	0.6	mg/L	<0.04	<0.04	<0.04

Table 6.1 Recent monitoring results (MB8-s, MB10-s, MW19-s)
Source: Perth Airport

6.1.5. Surface hydrology

The key hydrological features within the airport estate are:

- Munday Swamp in the north east corner of the estate, and
- the drainage network within the airport estate (Northern Main Drain (NMD) and Southern Main Drain (SMD)).

Surface water flows through the airport estate via two main drains; the NMD and the SMD. These drains generally flow east to west and have been constructed as extensions and modifications to naturally-occurring watercourses. The NMD receives surface flow from Poison Gully (located to the east of the airport estate) and Munday Swamp. Both drains discharge into the Swan River.

The Perth Airport Master Drainage Strategy incorporating the '*Living Stream*' provides for the management of hydrological values on the estate in anticipation of the ultimate development articulated by the Master Plan 2014. The Master Drainage Strategy is an integrated ground and surface water management approach providing opportunities for infiltration of surface water to groundwater, flood management and water quality improvements.

Munday Swamp is a freshwater wetland in the north east corner of the airport estate. It is fed by both groundwater and surface water and is listed on the Commonwealth Directory of Important Wetlands in Australia. To prevent any negative impacts on Munday Swamp, a 50 metre setback will be required from Munday Swamp to the adjacent stockpile site.

There are no Ramsar wetlands located within the project area.

6.1.6. Contaminated sites

A Preliminary Site Investigation (PSI) undertaken by GHD, in accordance with the State Department of Environment Regulation (DER) guidelines, identified known contaminated sites and localised potential sources of contamination along the length of the proposed alignment (GHD, 2013). The PSI has been reviewed and endorsed by an approved auditor under the *Western Australian Contaminated Sites Act* 2003, the DER and the Department of Health (DoH). The auditor is also an approved assessor under the EPRs. The potential sources of contamination located on the estate within or adjacent to the project area are outlined in Table 6.2.

6.1.6.1. Dewatering

Temporary lowering of the groundwater table will be required to construct the underground structures (excluding tunnels). Dewatering activities have the potential to mobilise existing groundwater contamination, expose Acid Sulfate Soils and cause a decline in vegetation and wetland health and function. Importantly, no dewatering is required for the bored tunnel sections of the route.

A Preliminary Dewatering Assessment was commissioned by the State Government and undertaken by Golder Associates (2014) to model the extent of groundwater level drawdown at each of the underground structures. The results indicate that by reinjecting abstracted groundwater and using diaphragm walls to build the underground structures, potential environmental impacts will be manageable. The results also indicate that environmental impacts to Munday Swamp are unlikely to be significant.

Should there be evidence or a determination that potential for mobilisation of existing contamination from the BP JOSF site or the Former Shell Service station as a result of these works exists, then appropriate mitigation measures will be developed.

Site ID	Potential Contamination	Location
BP Joint Operations Storage Facility (JOSF) site	Soil and groundwater contamination (Hydrocarbons, MTBE, lead)	Airport West Precinct on the western boundary of the airport Not within an area which will be excavated from the surface. North of the tunnels
Former Shell Service Station	Soil and groundwater contamination (Hydrocarbons, MTBE, lead)	Airport West Precinct on the western boundary of the airport Not within an area which will be excavated from the surface. North of the tunnels
Ansett	Potential soil and groundwater contamination (Hydrocarbons, MTBE, lead)	Airport West Precinct on the western boundary of the airport Not within an area which will be excavated from the surface. South of the tunnels
Fuel line	Potential soil and groundwater contamination (Hydrocarbons, MTBE)	Airport West Precinct on the western boundary of the airport Not within an area which will be excavated from the surface. Directly above the tunnels
Hire car services area	Potential soil and groundwater contamination (Hydrocarbons, MTBE, lead)	Airport West Precinct on the western boundary of the airport Not within an area which will be excavated from the surface. South of the tunnels

Table 6.2 Contamination sites and potential sources of contamination of the airport estate

6.1.7. Vegetation and flora

Numerous comprehensive flora and vegetation surveys have been undertaken across the airport estate dating back to 1994. The most recent botanical surveys undertaken included:

- Mattiske Consulting (2011) *Flora and Vegetation Survey of Precinct 3 Perth Airport*. Unpublished report prepared for Westralia Airports Corporation, Perth, WA,
- Bamford (2012) *Perth Airport Black-Cockatoo Habitat Study*. Unpublished report prepared for Perth Airport Pty. Ltd, Perth, WA,
- Bamford (2013) *Perth Airport Black-Cockatoo Habitat Survey*. Unpublished report prepared for Perth Airport Pty. Ltd, Perth, WA,
- Ecologia Environment (2013) *Perth Airport Flora and Vegetation Survey*. Unpublished report prepared for Perth Airport Pty Ltd,
- Bamford (2014) *Fauna Surveys of the Perth Airport Bushland 2008 and 2014*. Unpublished report prepared for Perth Airport Pty. Ltd, Perth, WA,
- Mattiske Consulting (2014) *Review of Macarthuria keigheryi on Perth Airport Areas*. Unpublished report prepared for Perth Airport Pty. Ltd, Perth, WA, and
- Biologic (2015). *Perth Airport Targeted Fauna and Flora Survey*. Unpublished report prepared for Perth Airport Pty. Ltd, Perth, WA.

The catalogue of vegetation surveys undertaken on the estate provides a high level of confidence in the vegetation information and this information has guided Perth Airport's environmental management efforts.

The construction of the tunnel and the Airport Central Station will not impact vegetation or flora and therefore the vegetation and flora environmental assessment in this section has only considered the areas where surface impacts will occur, for example the potential stockpile locations (Refer to Figure 6.3. Further detail regarding the potential stockpile locations is provided in Section 4.4.5). Information that relates to outside the stockpile locations has been included to provide context.

6.1.7.1. Bioregion

The airport estate is located within the Swan Coastal Plain Interim Biogeographic Regionalisation of Australia (IBRA) Region and Swan Coastal Plain 2 Subregion. This subregion is a low lying coastal plain covered with woodlands dominated by Banksia and Tuart on sandy soils, Casuarina obesa on outwash plains and paperbark in swampy areas.

Figure 6.3 Aerial of potential stockpile locations
Source: Nearmaps June 2015

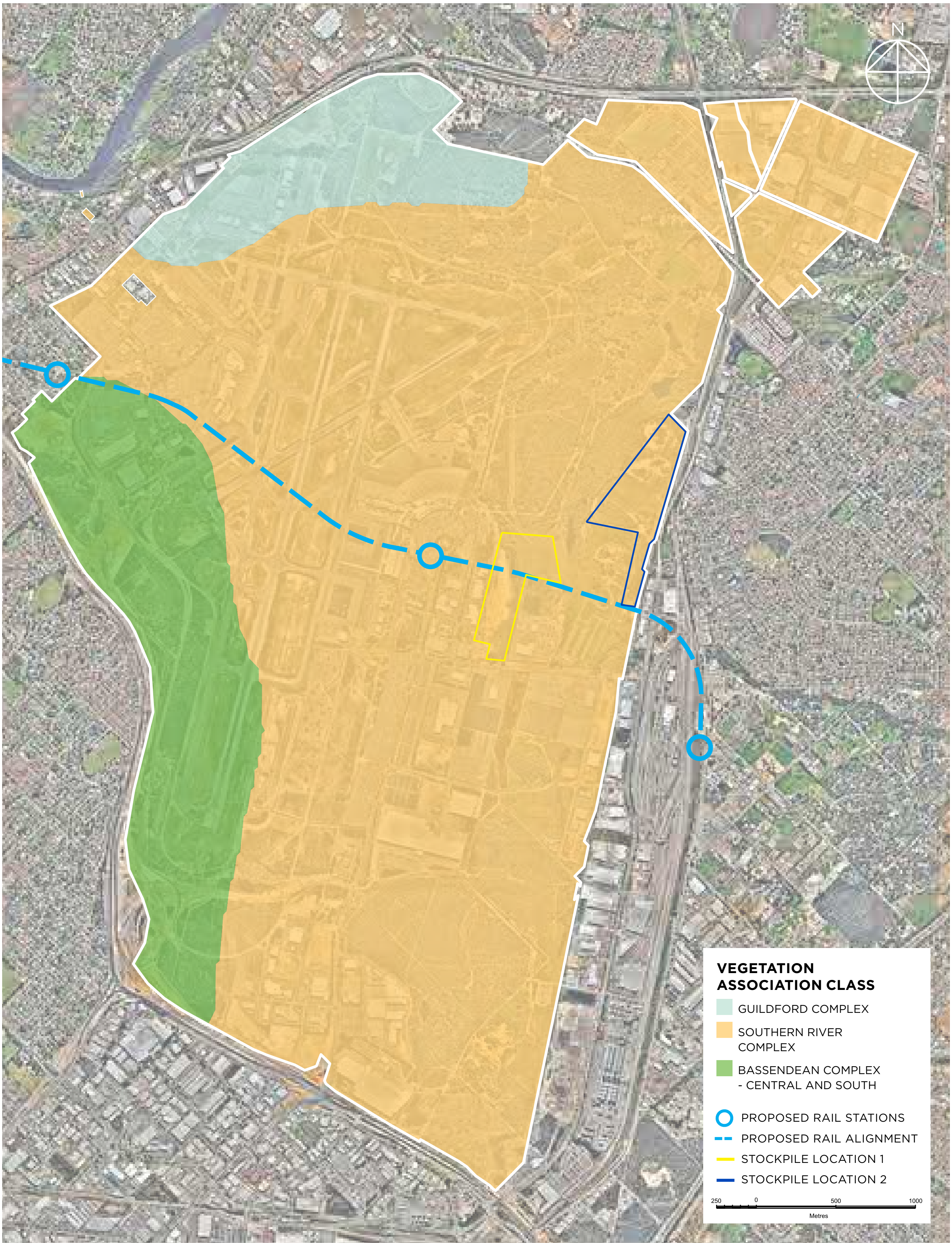


Figure 6.4 Vegetation complex/type plan
Source: Perth Airport Pty Ltd

6.1.7.2. Vegetation complexes

Vegetation complexes present within the estate as mapped by Heddle (E. M. Heddle, 1980) include:

- Southern River Complex,
- Bassendean Complex – central and south, and
- Guildford Complex.

The stockpile locations are located within the Bassendean Complex – central and south (refer to Figure 6.4).

6.1.7.3. Vegetation community types

A total of eight vegetation community types have been mapped on the estate. The majority of vegetation within the project areas has previously been cleared and comprises degraded pasture, buildings or infrastructure. Some of the vegetation types have also been cleared for infrastructure since the vegetation surveys were completed. Vegetation community types that are within the stockpile areas are outlined in Table 6.3. Those areas mapped as cleared have been removed from the data shown in Table 6.3.

6.1.7.4. Vegetation condition

Vegetation condition within the estate was assessed in 2007 (Mattiske Consulting, 2008) and 2012 (Ecologia Environment, 2013) in accordance with the Keighery Scale (1994), Table 6.4.

The majority of the vegetation within the stockpile area is 'completely degraded' or has been previously cleared. The remaining vegetation within the stockpile areas ranges from 'good' to 'completely degraded' and outlined in Table 6.5 and Figure 6.5.

6.1.7.5. Vegetation significance

The majority of the stockpile area is cleared of vegetation. The small amount of vegetation impacted by the proposed stockpile areas is comprised of vegetation communities that are well represented on the airport estate, and within the State of Western Australia. The clearing of 5.37 hectares of primarily degraded vegetation is therefore not considered by Perth Airport to be environmentally significant.

Vegetation Code	Vegetation Type	Project Area Footprint (hectares)		
		Stockpile Site 1 Qantas Freight Side	Stockpile Site 2 Abernethy Road Side	Combined
I1	Low Forest to Low Woodland of *Eucalyptus marginata, Banksia attenuata* and *Banksia menziesii* with occasional *Allocasuarina fraseriana* over *Acacia pulchella, Patersonia occidentalis* and *Dasypogon bromeliifolius*	0.57	0	0.57
I2	Low Woodland of Banksia *attenuata* and *Allocasuarina fraseriana* over *Jacksonia sternbergiana, Bossiaea eriocarpa, Eremaea puciflora* and *Adenanthos cygnorum* over low herbs, *cacia pulchella, Patersonia occidentalis* and *Dasypogon bromeliifolius*	0.38	0	0.38
J1	Woodland of *Corymbia calophylla, Melaleuca preissiana, Banksia spp*. and occasional *Adenanthos cygnorum* over *Xanthorrhoea preissii, Hypocalymma angustifolium* and *Jacksonia sternbergiana* over low herbs and shrubs	0.29	1.89	2.18
J2	Woodland of *Corymbia calophylla* over *Kingia australis* and *Xanthorrhoea preissii* over low shrubs and herbs	1.33	0	1.33
K1	Woodland of *Melaleuca rhaphiophylla Eucalyptus rudis Melaleuca preissiana* with *Banksia ilicifolia* over *Lyginia barbata, Xanthorrhoea preissii, Hypocalymma angustifolium, Dasypogon bromeliifolius, Pericalymma ellipticum var. ellipticum* and Asta	0.91	0	0.91
SUB TOTAL	**Vegetation to be cleared**	**3.48**	**1.89**	**5.37**
TOTAL	**Including cleared and completely degraded land**	**21**	**25.8**	**46.8**

Table 6.3 Vegetation types within project areas

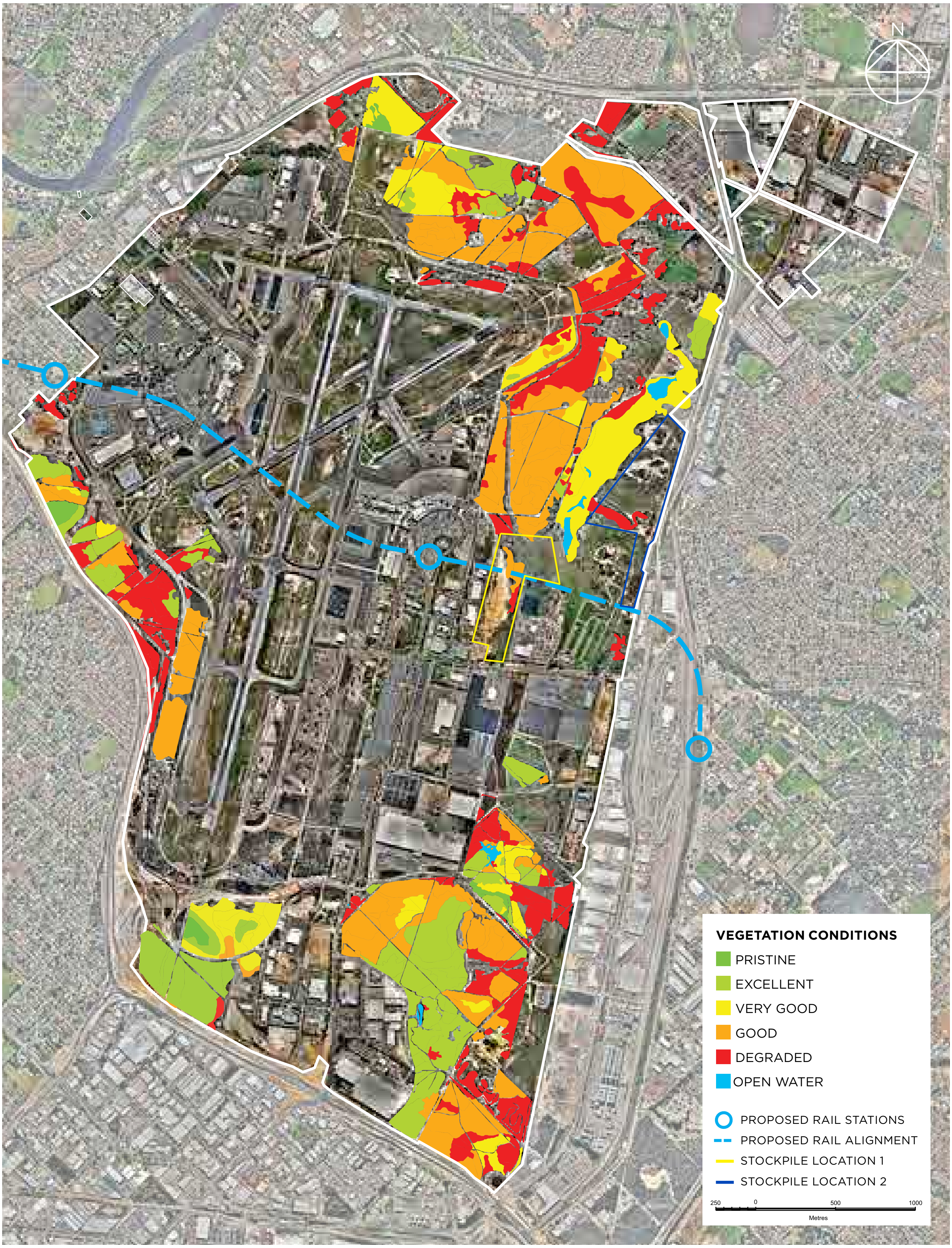


Figure 6.5 Vegetation condition plan from surveys conducted 2007 and 2012
Source: Perth Airport

Condition Description	Explanation
Pristine	Pristine or nearly so, no obvious signs of disturbance
Excellent	Vegetation structure intact, disturbance affecting individual species and weeds are non-aggressive species
Very Good	Vegetation structure altered, obvious signs of disturbance. Disturbance to vegetation structure covers repeated fire, aggressive weeds, dieback, logging and grazing
Good	Vegetation structure significantly altered by very obvious signs of multiple disturbances. Retains basic vegetation structure or ability to regenerate it. Disturbance to vegetation structure covers frequent fires, aggressive weeds at high density, partial clearing, dieback and grazing
Degraded	Basic vegetation structure severely impacted by disturbance. Scope for regeneration but not to a state approaching good condition without intensive management. Disturbance to vegetation structure includes frequent fires, presence of very aggressive weeds, partial clearing, dieback and grazing
Completely Degraded	The structure of the vegetation is no longer intact and the area is completely or almost completely without native species. These areas often described as 'parkland cleared' with the flora comprising weed or crop species with isolated native trees or shrubs

Table 6.4 Vegetation condition rating scale from Keighery (1994)

Vegetation Condition	Project Area Footprint (ha)		
	Stockpile Site 1 Qantas Freight Side	Stockpile Site 2 Abernethy Road Side	Combined
Pristine	0	0	0
Excellent	0	0	0
Very Good	0	0	0
Good	2.28	0	2.28
Degraded	0.91	1.89	2.8
Completely Degraded	0.29	0	0.29
TOTAL	**3.48**	**1.89**	**5.37**

Table 6.5 Vegetation condition on the Perth Airport estate

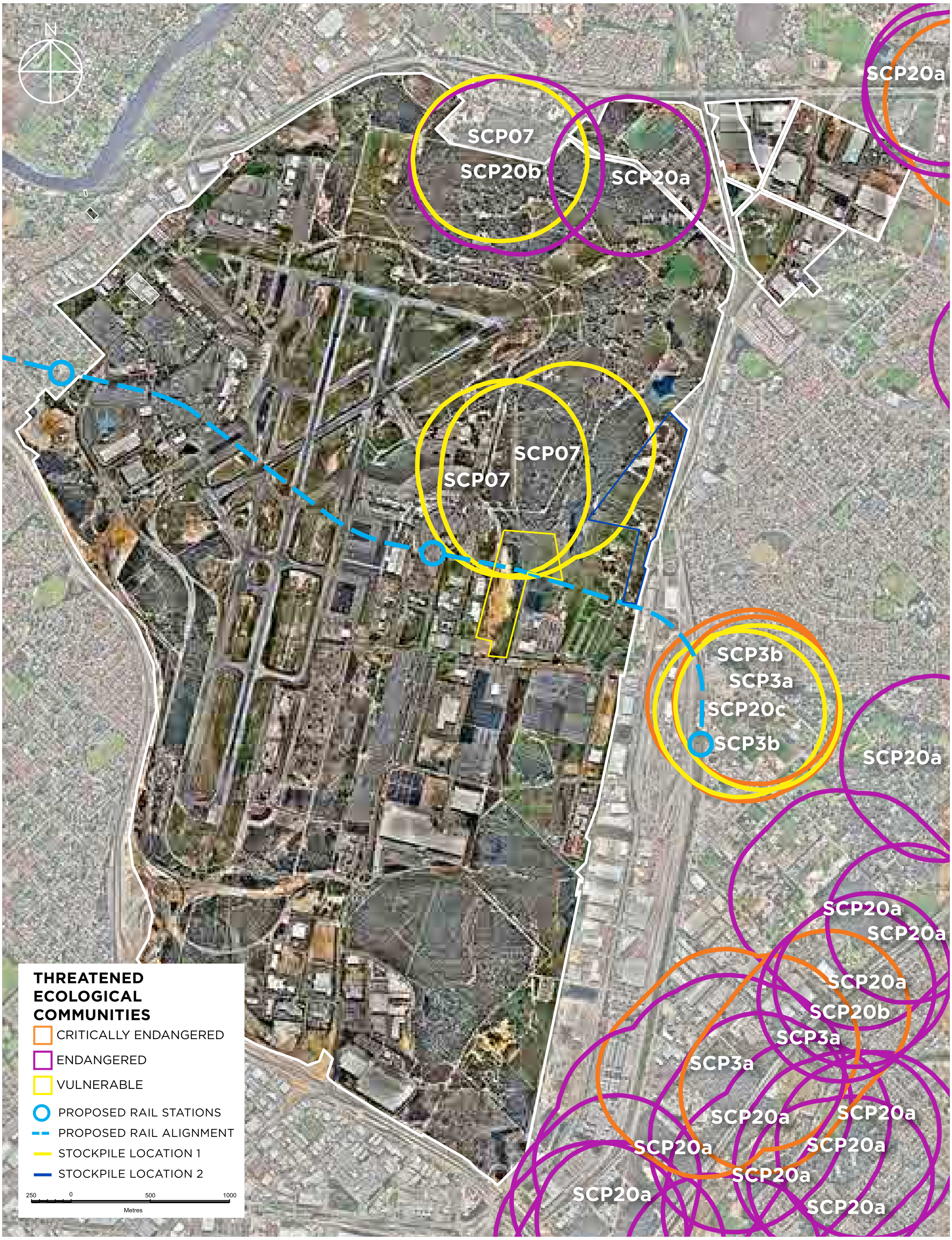


Figure 6.6 Threatened Ecological Communities (TEC)
Source: Perth Airport Pty Ltd

6.1.7.6. Rare flora

No threatened flora species listed under the EPBC Act occur within the stockpile areas.

A desktop assessment was undertaken to determine those flora species potentially occurring along the alignment which are protected under the EPBC Act. None of these species potentially present were identified within the stockpile area. In addition, as the vegetation condition is mostly degraded there is a low likelihood of these species occurring.

6.1.7.7. Introduced flora

The majority of the stockpile area is degraded and highly disturbed, featuring mainly airport infrastructure and other cleared areas. Although a large number of exotic species were identified along the alignment during surveys, no species listed as Weeds of National Significance (WONS) were identified along the alignment or in the proposed stockpile locations.

6.1.7.8. Threatened Ecological Communities

No '*Threatened Ecological Communities*' have been identified within the stockpile areas as shown in Figure 6.6 .

6.1.8. Dieback

Phytophthora dieback disease is caused by the pathogen Phytophthora cinnamomi and presents a major threat to biodiversity in south-western Western Australia. Dieback has been previously found to occur on some areas of the airport estate. No assessment for the presence of dieback has been undertaken within the project area as vegetated areas are classified degraded and dieback risk is considered low.

6.1.9. Fauna

The construction of the tunnel and the Airport Central Station will not impact fauna and therefore the fauna assessment in this section has only considered the areas where surface impacts will occur, for example the potential stockpile locations (Further detail regarding the potential stockpile locations is provided in Section 4.4.5). Information that relates to outside the stockpile locations has been included to provide context.

The vegetation that exists within the proposed stockpile areas may have the potential to provide habitat for a variety of fauna species. A protected matters search has indicated the potential for 23 listed species or species habitat and 17 migratory species or species habitat to occur on the airport estate.

Numerous vertebrate and invertebrate fauna surveys have been undertaken on the estate over the past 20 years, with the most recent ones including:

- Bamford Consulting Ecologists (2010). *Graceful Sun Moth (Synemon gratiosa) Survey*, Unpublished report prepared for Westralia Airports Corporation, Perth, WA,
- Bamford Consulting Ecologists (2012). *Perth Airport Black Cockatoo Habitat Survey*, Unpublished report prepared for Perth Airport Pty. Ltd, Perth, WA,
- Australasian Ecological Services (2012). *Graceful Sun Moth Survey*, Unpublished report prepared for Perth Airport Pty. Ltd, Perth, WA
- Bamford (2013) *Perth Airport Black-Cockatoo Habitat Survey*. Unpublished report prepared for Perth Airport Pty. Ltd, Perth, WA, and
- Bamford (2014) *Fauna Surveys of the Perth Airport Bushland 2008 and 2014*. Unpublished report prepared for Perth Airport Pty. Ltd, Perth, WA.

The Commonwealth listed species that have been identified as being present on the airport estate are listed in Table 6.6. This section will only discuss fauna of conservation significance that have been identified on the airport estate or are considered likely to be of particular interest to regulatory authorities.

The only potential fauna habitat occurring within the proposed stockpile areas comprises a small area of medium quality potential Black Cockatoo habitat (1.6 hectares).

Name	Status	Type of Presence
Calyptorhynchus banksii naso (Forest Red-tailed Black-Cockatoo, Karrak)	Vulnerable	Species or species habitat may occur within area
Calyptorhynchus baudinii (Baudin's Black-Cockatoo, Long-billed Black-Cockatoo)	Vulnerable	Roosting known to occur within area
Calyptorhynchus latirostris (Carnaby's Black-Cockatoo, Short-billed Black-Cockatoo)	Endangered	Breeding likely to occur within area
Apus pacificus (Fork-tailed Swift)	Migratory	Species or species habitat likely to occur within area
Merops ornatus (Rainbow Bee-eater)	Migratory	Species or species habitat may occur within area
Ardea ibis (Cattle Egret)	Migratory	Species or species habitat likely to occur within area

Table 6.6 Environment Protection and Biodiversity Conservation Act listed species previously recorded on the estate
Source: Perth Airport

6.1.9.1. Black Cockatoo

The airport estate lies in a region where Carnaby's Black-Cockatoo (*Calyptorhynchus latirostris*) are common, the Forest Red-tailed Black-Cockatoo (*Calyptorhynchus banksii naso*) often overflies and therefore only occurs rarely and Baudin's Black-Cockatoo (*Calyptorhynchus baudinii*) occurs probably only as a vagrant. Black Cockatoos are classified as 'Endangered' while Baudin's and Forest Red-tailed Black Cockatoos are listed as 'Vulnerable' under the EPBC Act.

Extensive and regular investigations into Black Cockatoo habitat are conducted on the airport estate. The quality of potential habitat is classified as low, medium or high, with medium and high value habitat considered during impact assessments.

Medium value Black-Cockatoo habitat on the airport estate is defined as: Contains some Black-Cockatoo habitat plants which are clumped together but cover less than half the area.

High value Black-Cockatoo habitat on the airport estate is defined as: *Contains large numbers of plants* (majority of individuals) likely to provide Black-Cockatoos with foraging and/or nesting opportunities, in particular Banksia spp. and Marri.

Perth Airport considers the impacts from this project to Black-Cockatoo habitat as not significant to the survival of the species. The amount of potential habitat that will be impacted is relatively minor (1.6 hectares), with the majority of the project area already being cleared, developed, or degraded.

Should details of the project change, including stockpile locations, an assessment of environmental impacts will be undertaken on new project areas prior to works commencing.

6.1.9.2. Rainbow Bee-eater

The Rainbow Bee-eater is found throughout mainland Australia, as well as eastern Indonesia, New Guinea and, rarely, on the Solomon Islands. In Australia their distribution is widespread with the exception of desert areas, or overly cool areas such as Tasmania.

In more southern locations such as the south-west of Western Australia (Perth Airport), these birds can be found in summer months, but will migrate north to New Guinea or Indonesia as the weather cools down.

The Rainbow Bee-eater has been recorded as a regular visitor to the airport estate, nesting at one known location for the past three years, arriving September or October. The known nest location is not within the proposed stockpile area.

6.1.10. Heritage

6.1.10.1. European heritage

A search of the Australian Heritage database has revealed no built form places of heritage significance exist within or near the project area.

6.1.10.2. Natural heritage

A search of the Australian Heritage database identified that the following Commonwealth Heritage listed places occur on the airport estate:

- Forrestfield Bushland, Horrie Miller Drive, Newburn via Perth Airport, and
- Munday Swamp, Kalamunda Road, Perth Airport.

Both of these sites are classified as '*Indicative places*' on the Commonwealth Heritage list, meaning that data in relation to both of these potential sites has been provided to or obtained by the Heritage Division and has been entered into the database. However, a formal nomination has not been made and the Australian Heritage Council has not received the data for assessment. The data in an indicative place does not necessarily represent the views of the Australian Heritage Council or the Commonwealth Minister of Environment.

Forrestfield Bushland is located on the south-eastern side of Horrie Miller Drive, outside the vicinity of the project area. The Munday Swamp site is situated in the north-eastern section of the estate, immediately north of the project area. No direct impacts to Munday Swamp will occur as a result of the project. Studies have been done which consider indirect impacts (such as

Site ID	Site Name	Status	Site Type
3888	Munday Swamp: Poison Gully	Registered Site	Artefacts/scatter
3719	Munday Swamp	Registered Site	Ceremonial, mythological, artefacts/scatter
25023	Poison Gully Creek	Registered Site	Birthplace, water source
4408	Newburn: Bingham Street	Registered Site	Artefacts/scatter
3935	Airport: Zante Road A-D	Registered Site	Artefacts/scatter
3872	Airport: Leghorn Road	Registered Site	Artefacts/scatter

Table 6.7 Registered Aboriginal heritage sites within the project

drawdown from dewatering), showing that no indirect impacts are expected. Should any impacts be considered likely during works, Section 18 approvals will be sought under the *Aboriginal Heritage Act 1972* (AHA) prior to works.

Perth Airport recognises the special association that Aboriginal people have with the land. There are a number of sites located on the estate which are known to have particular significance.

Six Aboriginal sites defined under the AHA are present within the project stockpile area. These sites are detailed in Table 6.7.

Perth Airport will undertake all relevant applications under Section 18 of the AHA prior to undertaking any works that have the potential to impact registered Aboriginal Heritage sites. In addition, Perth Airport will continue to liaise with key Aboriginal stakeholders prior to and during works.

6.2. Management and mitigation

Management and mitigation actions to reduce the potential environmental impacts of the Forrestfield-Airport Link project are described in this section.

Additional investigations will be undertaken and management strategies developed as the details of the proposed development are finalised.

The ABC manages many aspects of the construction phase through the Airports (Building Control) Regulations. Consequently, all construction activities will be subject to a Construction Environmental Management Plan (CEMP) designed to limit environmental impacts to the minimum necessary for development. The CEMP will be developed and implemented by the contractor and provided to Perth Airport for assessment and approval. (See Section 8) The CEMP process will be supplemented with the Perth Airport consent review and approval, and the ABC Building Permit process. The CEMP will describe the management strategies that will be applied to minimise potential environmental impacts.

The CEMP will define such matters as:

(a) Environmental Policy

(b) Planning
   - i. Aspects and impacts
   - ii. Legal and other requirements
   - iii. Timing of construction activities
   - iv. Environmental and heritage risk assessment

(c) Implementation and Operation
   - i. Roles and responsibilities
   - ii. Competence, training and awareness (including inductions)
   - iii. Environmental management of sub-contractors
   - iv. Project communication (internal and external)
   - v. Documentation
   - vi. Control of documents
   - vii. Detailed maps of proposed construction zones, including:
     - a. Project Works and Temporary Works
     - b. Exclusion zones (e.g. high conservation areas, Aboriginal heritage sites)

(d) Environmental Management Operational Controls including:
   - a. Ground disturbance management (including Vegetation clearing and flora management)
   - b. Weed management (including hygiene management program to minimise the spread of weeds and dieback)
   - c. Aboriginal heritage management (including the extent of excavation requiring Aboriginal monitors)
   - d. Soils management (including stockpiles, topsoil, contaminated land and spoil management)
   - e. Acid Sulfate Soils Management
   - f. Air quality management (including monitoring and dust suppression).
   - g. Construction noise and vibration management
   - h. Hazardous materials and hydrocarbon management
   - i. Waste management
   - j. Water management (including groundwater and storm water management measures, prevention of offsite discharges and management of surface water to ensure contaminated run off from the construction site does not leave the site)
   - k. Fauna management
   - l. Site access and travel routes for construction traffic
   - m. Light emissions management
   - n. Demobilisation and rehabilitation management
   - o. Greenhouse emissions management

(e) Emergency Preparedness and Response

(f) Checking
   - i. Monitoring and measurement (including project environmental reporting and National Greenhouse and Energy Reporting)
   - ii. Environmental incident management
   - iii. Non-conformance and corrective actions
   - iv. Control of environmental records
   - v. Environmental audits and inspections
   - vi. Management review

A number of more detailed environmental management sub plans will form part of the CEMP, namely:

- Acid Sulfate Soils and Dewatering Management Plan (ASSDMP),
- Spoil and Contamination Management Plan (SCMP), and
- Construction Noise and Vibration Management Plan (CNVMP).

These plans will be developed to effectively manage the key environmental considerations throughout delivery of the project. All environmental management plans will be prepared by the contractor and first provided to Perth Airport for assessment and approval and then to the AEO for review prior to any works.

Specific management and mitigation actions to reduce the potential impacts (as outlined in Section 6.1) are described below.

6.2.1. Climate conditions

As discussed in Section 6.1.2 the winds and the seasonality of rainfall in the Perth region is a factor that influences stormwater, dust control and sediment, and erosion control management strategies. The impacts of seasonal conditions will be addressed in the CEMP.

6.2.2. Acid Sulfate Soils

A detailed Acid Sulfate Soils investigation in accordance with the DER guidelines will be undertaken prior to any disturbance of existing contamination and Acid Sulfate Soils.

An Acid Sulfate Soils and Dewatering Management Plan (ASSDMP) will be prepared and implemented by the contractor prior to any excavation and/or dewatering activities being undertaken in the project area which could directly or indirectly disturb Acid Sulfate Soils. Any excavation or dewatering which could directly or indirectly disturb Acid Sulfate Soils will then be managed in accordance with the ASSDMP to ensure that any disturbance of Acid Sulfate Soils does not result in adverse impacts to the surrounding environment.

The ASSDMP will also detail how the excavated soil and abstracted groundwater will be treated and managed to ensure that there are no detrimental impacts to the environment.

6.2.3. Groundwater and surface water

Drainage design will be developed prior to the commencement of any works, to ensure adequate management of surface water flows in the area is maintained. The drainage design will be in line with the Master Drainage Strategy and will ensure an integrated ground and surface water management approach providing opportunities for infiltration of surface water to groundwater, flood management and water quality improvements.

The linkages between Munday Swamp and Poison Creek Gully will be assessed and maintained should Stockpile 2 location be utilised during works. Should Stockpile 2 be utilised during works, there is potential for surface soil weight to have a marginal effect on flow lines immediately beneath the ground surface.

The CEMP will outline the management of ground and surface water, including mitigation of impacts at Munday Swamp.

Water and sediment management methodologies during construction will also be defined in the CEMP. Sediment controls will be provided where required, to ensure that construction activities do not result in an increase in suspended solids in the drainage network.

Ground water disposal will be addressed in the ASSDMP, as part of the CEMP, prior to works commencing on site. It is anticipated that the majority of abstracted groundwater will be reinjected into the aquifer to maintain ground water levels in the area.

To minimise impacts on groundwater levels, environment and nearby bore users it is anticipated that groundwater abstraction bores would be constructed within the area of excavation to remove groundwater and that groundwater recharge bores will be constructed surrounding the area of excavation to return abstracted groundwater back into the aquifer.

Depending on the design and construct methodology the anticipated extraction volumes (peak initial rate) could be up to 55 litres per second at Airport Central Station.

Alternate options for the disposal of the surplus groundwater include:

- recycling, for example using the water for dust control,
- irrigation of vegetated land,
- disposal off site,
- discharge into appropriate nearby water courses, and/or
- discharge into the sewer system.

6.2.4. Contaminated sites

Further investigation will be undertaken to assess how the dewatering activities may disturb existing contamination and Acid Sulfate Soils and as mentioned in Section 6.2.2 an ASSDMP will be prepared prior to any work that have the potential to directly or indirectly impact any contamination or Acid Sulfate Soils.

A Spoil and Contamination Management Plan (SCMP) will be prepared and implemented by the contractor prior to any excavation and/or dewatering activities being undertaken in the project area.

Prior to any excavation or dewatering being undertaken on an area which has been identified as contaminated, a thorough contaminated sites investigation will be commissioned in accordance with relevant government agency guidelines. Any subsequent excavation and/or dewatering activities to be undertaken on the site will be subject to appropriate management measures contained within the SCMP.

6.2.5. Vegetation and flora

Perth Airport operates a policy whereby species that can be readily translocated are moved prior to clearing. If any *Xanthorrhoea preissii and Macrozamia sp*. are present in the clearing of the proposed stockpile areas they will be removed and translocated to another part of the airport estate.

The CEMP will include management measures to ensure that no impact to vegetation occurs outside the project area.

6.2.6. Dieback

An assessment will be undertaken prior to the commencement of works and the CEMP will include measures to prevent the spread of dieback either to or from the project area via vehicle and other plant movements.

6.2.7. Fauna

In accordance with Perth Airport policy, prior to clearing vegetation, fauna will be trapped and relocated, either on or off the estate. Species such as Southern Brown Bandicoots are easily trapped and respond well to translocation.

6.2.8. Heritage

As Munday Swamp is located in close proximity to the project area, the CEMP, ASSDMP and SCMP must ensure that the management of the proposed stockpile location mitigates any potential impacts.

6.2.9. Other Matters

6.2.9.1. Air quality

Construction activities for the Forrestfield-Airport Link project have the potential to impact upon air quality through dust generation and emissions. The CEMP will outline methods to manage dust generation and emissions during construction.

If the proposed stockpiles locations are required, upon completion of construction activities Perth Airport will become responsible for management of the stockpiles within the estate, including the management of dust generation and emissions.

6.2.9.2. Spoil management

Methods to manage soil reuse, disposal, treatment and handling (including spoil, contaminated soil and topsoil) will be specified in the SCMP.

6.2.9.3. Noise and vibration

Construction and operation of the Forrestfield-Airport Link has the potential to affect the amenity of airport employees and customers, and cause damage to existing buildings and structures through increased levels of noise and vibration.

The noise and vibration impacts associated with construction are likely to be temporary and intermittent in nature. Construction noise will comply with the EPRs in order to minimise the impact to the amenity of the community.

Project specific vibration limits will be developed and monitored during construction to minimise the risk of damage to existing buildings and structures. Building condition surveys will be undertaken to establish a baseline to evaluate any complaints regarding damage to buildings during construction. Control measures will be incorporated into a Construction Noise and Vibration Management Plan (CNVMP).

Project specific compliance criteria for operational noise and vibration are being developed in conjunction with the key airport stakeholders, including Airservices, to minimise impacts to airport employees and customers and existing buildings and structures. Features such as the use of resilient rail fasteners have been incorporated into the concept design to minimise potential impacts.

An operational noise and vibration monitoring program will be implemented following construction to ensure that train operations meet the criteria set for the project. A monitoring and complaints procedure for construction and operations will also be implemented.

6.3. Operational Environmental Management Plan

The PTA will also need to prepare and provide to Perth Airport, for approval, an Operational Environmental Management Plan (OEMP). The OEMP must outline;

(a) Environment Policy
(b) Introduction
  i. Operation Description
  ii. Objective
  iii. Legal and Other Requirement
(c) Management Framework
  i. Roles and Responsibilities
  ii. Induction, Training, Awareness and Competency
(d) Environmental Commitments
(e) Environmental Setting
  i. Physical and Ecological Environment
  ii. Social Environment
(f) Environmental Assessment
  i. Environmental Risk Assessment
  ii. Potentially Significant Environmental Risks
  iii. Environmental Management Measures
  iv. Environmental Performance Objectives
(g) Document and Records Management
(h) Incident and Complaint Management (Guidance Document)
(i) Corrective and Preventative Action
(j) Environmental Inspection and Audit
(k) Environmental Monitoring
(l) Maintenance Management System
(m) Emergency Response
(n) Environmental Reporting
(o) References

Appendix A – Register of Legal and Other Requirements

Appendix B – Environmental Risk Register

Appendix C – Listing of Management System Documentation which Relates to Environmental Management

Appendix D – Environmental Inspection Checklist(s)

6.4. Monitoring program

To determine the effectiveness of the controls for both construction and operation, it is essential that the implementation of the management and mitigation measures identified in the CEMP and OEMP are monitored. Perth Airport will implement a monitoring program for the Forrestfield-Airport Link project. This monitoring will be sufficient to allow for an assessment of the potential environmental impacts of the proposed developments.

6.5. Reporting

An annual report in relation to the monitoring of the proposed development will be prepared by Perth Airport. This document will contain the results of any monitoring conducted including a review and suggested alteration to management based on the results. As part of its annual environmental report, Perth Airport will ensure that this information is passed on to the Commonwealth Government in sufficient detail to allow for the impact of development activities on Perth Airport to be assessed.

6.5.1. Incident reporting

Environmental incidents include events that directly or indirectly cause environmental impacts or harm, as well as events involving non-compliance with project procedures and 'near-miss' events which may or may not have resulted in an environmental impact.

The CEMP will outline the specific incident reporting procedures that will be adopted for the Forrestfield-Airport Link project.

6.6. Risk management

A project specific construction environmental risk assessment is required and will be developed by the contractor to identify environmental risks applicable to the project. The contractor's project specific construction environmental risk assessment will be approved by Perth Airport prior to project mobilisation. The project specific construction environmental risk assessment will inform the development of the CEMP.

7. RELATIONSHIP TO AVIATION ACTIVITY

An extensive study of the risks associated with the construction and operation of the Forrestfield-Airport Link project has been completed. Particular reference has been made to the risks associated with excavation beneath and within close proximity to airport infrastructure.

A detailed qualitative project risk register has been developed with particular emphasis on the variability of the geological conditions beneath the airport and the possible impact that this may have on construction works and third parties. In developing this risk register, practical limits for settlement and movement of critical elements of infrastructure have been established. Development of the risk register involved workshops with PTA representatives. Similar risk workshops have been held in Canberra with Airservices and Civil Aviation Safety Authority (CASA) representatives.

The key concerns identified from these workshops include:

- interruption to continuity of business,
- damage to critical infrastructure e.g. ATC tower, fuel lines, pavements, communication cables, services and utilities,
- disruption to operational services and communications with aircraft,
- loss of access and mobility around the estate,
- delayed or no early warning of departures from expected performance, and
- construction non-compliance with standard industry best practice.

In developing the reference design and the project documentation, the PTA has consulted widely with a number of specialist consultants, manufacturers and suppliers including procurement of the following services and advice:

- geotechnical studies performed by GHD Pty. Ltd and Golder Associates,
- specialist numerical modelling on ground movements carried out by Golder's Hong Kong office,
- fire life safety studies carried out by Stephen Grubits and Associates from their Sydney office,
- specialist advice regarding tunnelling methodology provided by Tunnel Consult Ltd United Kingdom based staff,
- specialist advice regarding Tunnel Boring Machine design and configuration provided by Herrenknecht, a renowned German TBM manufacturer, and
- specialist studies of potential impact of tunnelling induced ground movement on aircraft runway operations conducted by United States based APR Consultants.

As a result of this collaboration, the PTA is confident that the contract technical specifications for the Forrestfield-Airport Link project specify best modern construction practices and equipment that will minimise risk to the lowest practicable levels.

7.1. Discussion on key risks for airport operations

Over sixty geotechnical risks and construction hazards where construction could affect airport operations have been identified.

The key risks identified include:

- excessive ground movement beyond acceptable levels,
- sinkhole formation at ground surface,
- cross-passage construction,
- differential settlement at runway 06 Precision Approach Path Indicators (PAPI),
- damage to buildings, structures, infrastructure and services,
- main bearing failure of TBM,
- differential settlement of ATC tower,
- ground movements due to bulk excavations,
- excessive drawdown due to dewatering of deep excavations,
- electromagnetic interference, and
- site access security and its potential impact on airport security.

Where the risks identified have a high probability of occurrence and/or where the consequences of such an occurrence would be severe, mitigation, monitoring and action plans will be developed to mitigate these risks.

7.1.1. Tunnelling under airside infrastructure

As outlined in Section 1, the Forrestfield-Airport Link will traverse the airport estate and go under the main runway (03L/21R), the cross runway (06/24) and the proposed location of the new runway (03R/21L). To ensure continued operations at Perth Airport, an extensive study of international cases where tunnels have been driven beneath airport runways was completed. From the 18 projects, five with the most comparable methods of construction, tunnel size and depth of cover were further studied with regard to the settlement criteria specified and the magnitude of the settlement that actually resulted. The results are outlined in Table 7.1.

From the case histories studied, it was considered that the most comparable was the Zurich Kloten Airport where twin tunnels of a similar size were driven beneath the runways using slurry shields with similar depths of cover. At Zurich, a maximum settlement criterion of 15 millimetres was established for tunnel excavation beneath the airport runways, taxiways, aprons and terminal buildings. In practice, the observed settlement was less than five millimetres.

Much larger tunnels were also excavated beneath the runways at Sydney Airport (10.7 metre excavated diameter) and Diabolo Airport in Belgium (8.3 metre excavated diameter) using slurry shields. Even though those machines had considerably larger face areas than the machines proposed for the Forrestfield-

Airport Link project, in both instances the resulting settlements beneath the runways were less than five millimetres.

From the 18 case studies reviewed, there were no instances identified where the tunnelling operations had an adverse impact on airport operations.

Similar size rail tunnels (6.9 metres external diameter) were constructed in 2005-2006 in the Perth CBD as part of the New Metro Rail Project. Those tunnels were constructed using Earth Pressure Balance (EPB) type tunnel boring machines principally through the Guildford Formation.

The tunnels were built with close separation (2.8 metre apart), with shallow cover (4.2 metres) and on very tight horizontal curves (130 metres radius) beneath five busy passenger rail lines in the Perth Rail Yard area and beneath city streets and buildings. Those conditions are significantly more onerous than the conditions at the airport in terms of ground movement control.

The resultant settlements in the shallow cover Perth Rail Yard section of the project did not exceed 10 millimetres and heave did not exceed 15 millimetres. No damage to property was recorded and the tunnelling works had no impact on train operations.

PTA engaged independent experts to complete a preliminary assessment of the potential impact of tunnelling induced ground movement on aircraft operations by surveying pavement elevation profiles and conducting computer simulation models of aircraft runway operations and straightedge analyses. That study concluded that 15 millimetres of ground movement results in very little change in aircraft response during runway operations. Further, the study concluded that the upper limit of acceptable ground movements with regards to aircraft operations is at least 30 millimetres. Even higher amounts of ground movement were concluded to be acceptable, depending on the bump/dip ground movement profile resulting from the combined effect of both tunnel drives.

Following consultation with airport consultants, Airservices, CASA, review of the Manual of Standards (MOS) Part 139, and the aircraft runway operations study described above, it has been deemed that heave or settlement beneath the airport runways should not exceed 15 millimetres. This follows previous international precedence. There is an expectation that, given close control of the excavation methodology, the actual settlements experienced will be considerably less.

The following ground movement criteria are proposed for airside infrastructure:

- settlement or heave beneath the runways, taxiways and aprons due to construction activities shall not exceed 15 millimetres,
- settlement or heave beneath the runways, taxiways and aprons due to construction activities shall not result in additional excessive ponding or standing water on the runways affecting serviceability, and
- compliance with any of the requirements described in MOS Part 139 – Aerodromes,

If Perth Airport determines that a runway becomes unserviceable due to construction activities, the runway will be closed immediately and immediate remedial action will be undertaken to return the runway to an operational condition.

Project Name	Sydney Airport	**Zurich Kloten Airport**	London Heathrow	Minneapolis St Paul International	Diabolo, Belgium
Tunnel Configuration	Single	**Twin**	Single	Twin	Twin
TBM Type	Slurry	**Slurry**	EPB	EPB	Slurry
Excavated Diameter	10.7m	**6.3m**	9.2m	6.5m	8.3m
Min/Max cover Above crown	0.5 to 2D	**0.3 to 2D**	0.5 to 1.5D	1.2D to 2.2D	0.5D to 2D
Performance criteria	Criteria was 6mm @ 0.2% face loss	**Criteria max 15mm under runways and terminals**	Criteria max 15mm heave or settlement (VL 0.35%)	Unavailable	Criteria max 15mm
Settlement measured	Achieved <3mm under runway	**Achieved <5mm**	Full length achieved <5mm for 63% and <10mm for 89% of route	Achieved near zero settlement under pavements and structures	Contractual max 05.% VL achieved Achieved <5mm under runway

Table 7.1 International airports-summary of settlement criteria and results achieved
Source: PTA

7.1.2. Excessive ground movement beyond acceptable levels due to tunnelling

Ground movements around a tunnelling shield can occur through three main areas, as follows:

- Ground losses into the face of the machine,
- Ground movement around the shield body, and/or
- Ground movement behind the shield tail skin.

Mitigation measures for minimising ground movements around tunnelling shields are discussed in the following two sub-sections.

7.1.2.1. Ground losses into the face of the machine

Within the airport airside area, the reference design vertical tunnel alignment has generally been set below the potentially loose Gnangara Sand and will be excavated primarily through the Ascot Formation, which is characterised as medium dense to very dense carbonate sandy gravel, gravelly sand and fine to medium grained and fine to coarse grained sand. The Ascot Formation is also expected to contain hard bands of calcarenite rock material with the possibility of encountering hard conglomerate cobbles or boulders near the contact between the Ascot Formation and the underlying Osborne Formation.

Accordingly, the bored tunnels will require the machines to be operated in slurry mode while beneath the airport estate. Further, to deal with cemented or rock material, the TBMs will be required to be equipped with a combination of cutting tools appropriate for the geological conditions and a boulder rock crusher. Slurry mode operation is the most suitable excavation mode for coarse materials. This equipment specification is best able to deal with the predicted mixed face conditions with minimum ground loss.

Provided the excavation face is correctly stabilised by the slurry pressure during excavation, ground loss into the face of the TBM is small.

7.1.2.2. Ground losses around the shield body and behind the shield tail skin

In order to steer the machine around the tighter horizontal curves on the alignment, it is necessary for the gauge cutters to be set slightly larger than the shield diameter. It is also necessary for the shield body to be slightly tapered over its length with the shield diameter reducing towards the rear.

The TBM shields must be articulated and in order to minimise possible ground losses around the shield body, are required to be provided with grout injection ports equally spaced around the shield skin.

The shield body must be larger than the external diameter of the segmental lining; hence, there is a risk that the surrounding ground will move into the annular void behind the shield tail skin as the TBM advances. In order to minimise these movements, the TBMs are appropriately equipped to continuously inject a two part fluid grout into this void as the machine advances.

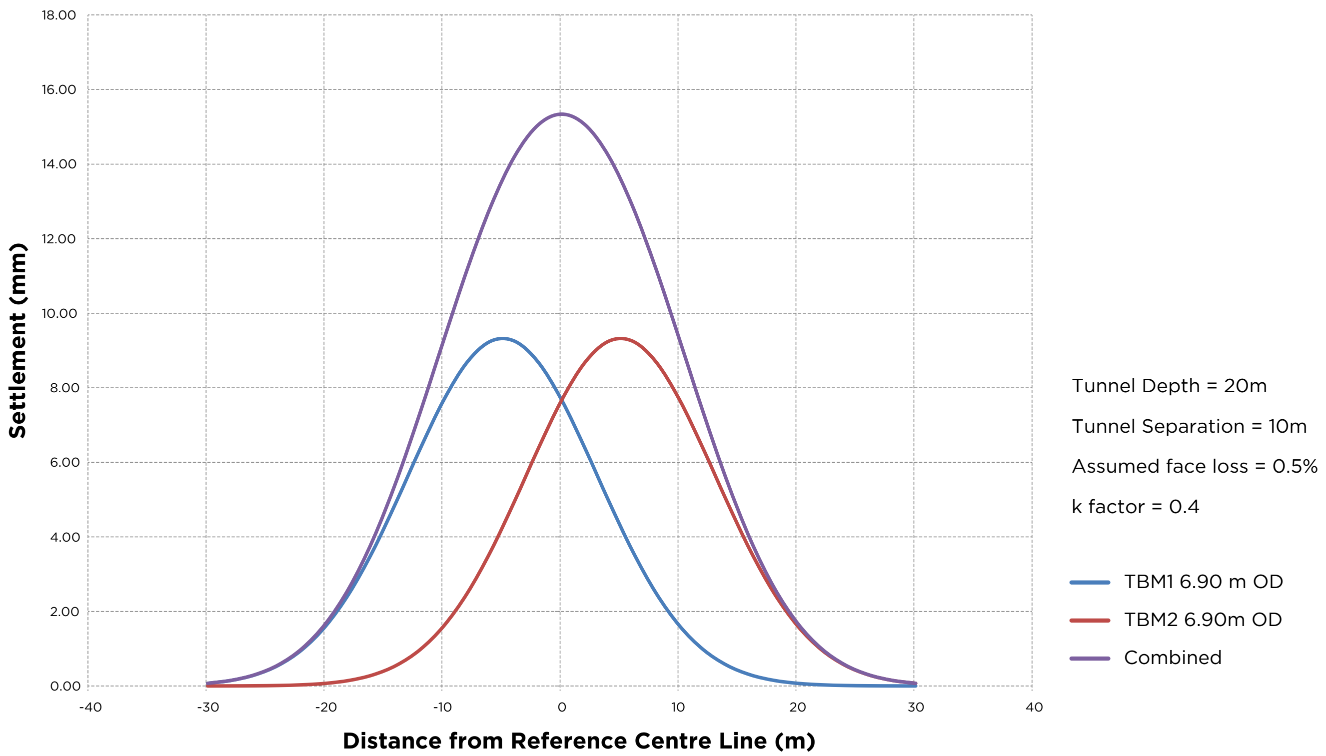


Figure 7.1 Greenfield settlement profiles at runway level
Source: PTA

The combined ground losses around the shield body and into the tail void result in small radial ground movements into the excavation and are reflected as a shallow settlement trough at the ground surface.

As illustrated in Figure 7.1, even at the maximum expected face loss percentage of 0.5 per cent, surface settlements associated with the bored tunnelling works are expected to remain below the specified level of 15 millimetres distributed across a settlement trough width of typically at least 60 metres for the twin bored tunnel alignment. This distribution of predicted maximum ground deformation translates to a differential ground surface settlement of approximately 1:1000.

Note that 'green field' predictions of this form are normally regarded as upper bound (conservative) values for the purposes of planning and design.

7.1.2.3. Sinkhole formation at ground surface

TBM operations are not entirely failsafe and there is a history of localised sinkholes developing above tunnel boring machines; particularly Earth Pressure Balance (EPB) machines.

Analysis of such sinkhole development indicates that they typically occur in coarse soils below the water table where the applied face pressure falls below the ambient hydrostatic pressure allowing quicksand type flowing ground conditions to develop. Water flowing into the cutterhead transports the soil particles and leads to a narrow chimney type piping failure. This piping chimney can rapidly migrate to the surface and create a sinkhole.

It is anticipated that most tunnelling in the airport estate will take place within the Ascot Formation. This is a high permeability material comprising predominantly sand, gravel, cemented layers and boulders. Slurry type rather than EPB type TBMs are considered to be more suitable for such ground conditions. Correctly operated, the probability of a sinkhole developing using a slurry type TBM is assessed as very low. Conversely, the risk of sinkhole development using an EPB type TBM is higher and could not be eliminated.

Accordingly the use of a slurry machine in sands and gravels beneath the airport infrastructure represents the 'As Low As Reasonably Practicable' (ALARP) construction methodology and the use of this type of equipment will be mandated.

7.1.3. Cross-passage construction in proximity to runways and taxiways

In order to provide safe means of egress from the tunnels in the event of an emergency it is necessary to provide escape shafts to the surface, and cross-passages between the tunnels at intervals along the tunnel length.

Ground treatment to facilitate cross-passage construction below airside areas must be by ground freezing or similar construction methods to avoid the requirement for construction equipment (other than instrumentation) at the surface.

Ground freezing will effectively treat all soil and rock types. The freeze body will create an impermeable annulus of frozen ground around the excavation that will isolate it from the surrounding hydrostatic regime and allow the excavation to proceed safely in a free air unpressurised environment, see Figure 7.2.

The frozen soil mass has strength properties similar to weak rock and can be structurally designed to temporarily support the external ground and water loads until a structural support system, such as shotcrete, is progressively installed. Specialist laboratory tests are being conducted to facilitate this design.

The structural integrity of the frozen soil mass can be monitored by thermocouples placed within the frozen soil mass and by carefully monitoring the water pressure changes within the excavation.

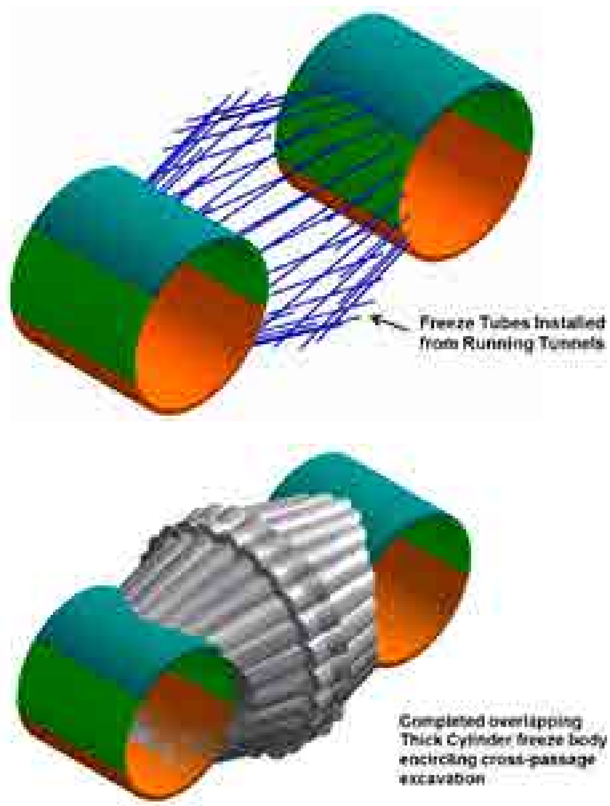


Figure 7.2 Typical overlapping ground freezing pattern for cross-passage construction
Source: PTA

Given careful control and monitoring of the following parameters, the effectiveness of the ground freezing works can be formally quality assured through measures such as:

- laboratory testing of frozen soil samples - permits strength, creep and heave characteristics to be assessed,
- structural analysis of the freeze body – ice is strong in compression, but weak in bending or tension. Compression members such as thick cylinder, dome, arch or cone profiles, formed within the freeze body provide appropriate patterns,
- survey alignment of freeze tubes – add tubes if there is excessive deviation from the design alignments,
- temperature measurement of the freeze body by thermocouples - provides information on freeze development and provides data to check design assumptions,
- monitoring of refrigerant supply and return temperatures and flow rates – detects any anomalies, and
- monitoring of water pressure within the freeze body – provides evidence that the freeze body has closed and that the excavation is isolated from the external aquifer.

7.1.4. Differential settlement of the runway 06 Precision Approach Path Indicator

The Precision Approach Path Indicator (PAPI) systems for runways 03, 21 and 24 are located outside the zone of influence of the Forrestfield-Airport Link project tunnelling works; however, the runway 06 PAPI lies within the zone of influence. As illustrated in Figure 7.3, the 06 PAPI light boxes are located between 7.3 metres and 17.2 metres from the centreline of the westbound tunnel.

The PAPI comprises a system of four narrow beam lights each inclined at slight angles either side of the correct approach slope angle as illustrated in Figure 7.4.

For the projected maximum 15 millimetres settlement profile indicated in Figure 7.5, it can be seen that the maximum predicted change of slope is approximately 1:1000 or an angular distortion of approximately 3.5 minutes of arc at a distance in plan of 10 metres from the planned project centreline.

The 06 PAPI lights will be monitored for settlement and biaxial tilt if the 06 PAPI lies within the zone of influence of the Forrestfield-Airport Link project tunnelling works, or if the lights lie within a minimum of 50 metres either side of the project centreline.

Appropriate trigger and allowable levels for settlement and tilt of the 06 PAPI will be established in conjunction with Perth Airport. If a trigger value is exceeded, Perth Airport will be immediately notified. If an allowable level is exceeded for any of the 06 PAPI footings, Perth Airport will be immediately notified and will arrange for calibration and readjustment as necessary.

7.1.5. Damage to buildings, structures, infrastructure and services

Prior to construction commencing limits for damage to buildings, structures, infrastructure and services ('assets') with particular reference to both airside and landside property will be established.

The criteria for building damage assessment criteria follows the requirements of AS2870-2011: Residential Slabs and Footings; which follows the work of Burland et.al. (1977) and Boscardin

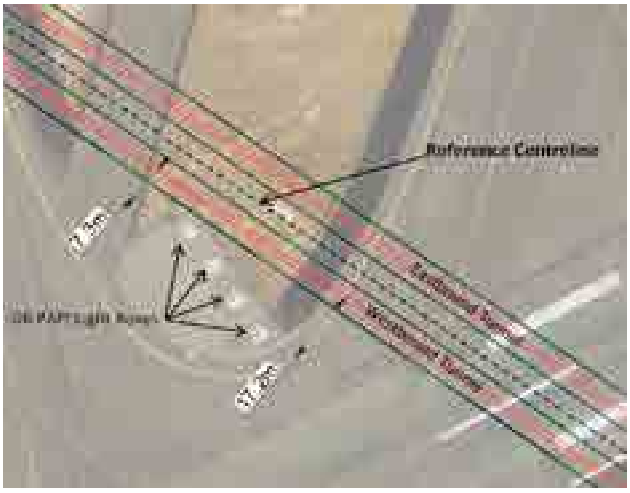


Figure 7.3 Location plan of 06 PAPI light boxes
Source: PTA

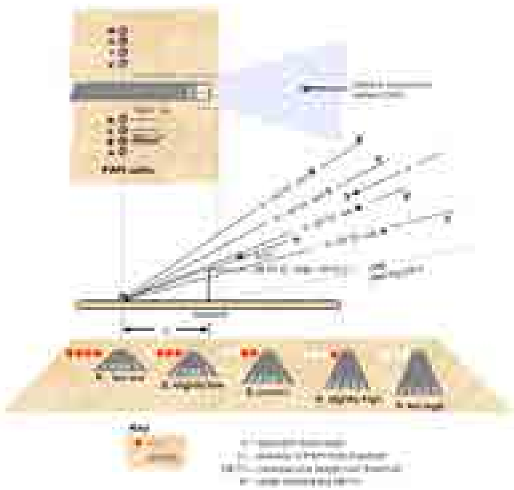


Figure 7.4 Arrangement of the PAPI system and resultant display
Source: Manual of Standards Part 139 – Aerodromes

and Cording (1989) and is summarised in Table 7.2. Damage to buildings and structures is limited to 'slight'. At this level, damage remains cosmetic, is non-structural and easily repaired.

The Table 7.2 criteria are related to tensile strain experienced by the structure due to ground movement resulting from tunnel excavation.

In Figure 7.6, it can be seen that the maximum predicted tensile strain remains less than 0.05 per cent, and from Table 7.2 that the damage assessment is Risk Category 0, 'negligible'. The limiting tensile strain value for the Forrestfield-Airport Link which corresponds with the 'slight' classification is 0.15 per cent.

However, in applying the Table 7.2 criteria it should be appreciated that the database of buildings studied by the abovementioned authors were predominantly brick structures supported on shallow strip, raft or pad foundations. While these criteria are considered appropriate for the residential structures that fall within the zone of influence of the tunnelling works on other sections of the alignment, they may be of limited application to the steel framed structures present within the airport estate.

For framed structures supported on local pad or shallow pile foundations at each column base, it is considered that the damage criteria should also be judged against differential settlement measured as angular distortion. Accordingly, for the Forrestfield-Airport Link project, the damage criteria have been extended to incorporate the work of Rankine (1988), which is also presented in Table 7.2.

For steel frame buildings with diagonal bracing elements, construction activities within the airport estate will require that the damage criteria are lowered by at least one category i.e. damage should be limited to 'very slight' with a maximum differential ground settlement of 1:500. Reference to Figure 7.6 and Table 7.2 indicates that this criterion is met for all the assumed tunnelling conditions. For framed structures with critical elements such as hangers with large roller doors that may jam, damage must be limited to 'very slight'.

Vertical settlement in itself will not cause building damage if the building settles uniformly. However it is a parameter that can easily be monitored and act as a trigger for a more rigorous inspection and monitoring regime. Absolute limits on settlement may however be required with regard to operational conditions for fork lift trucks within certain airport buildings.

The above criteria are principally directed towards ground losses caused by tunnelling or bulk excavation within deep excavations such as shafts and stations. With regard to damage caused by dewatering, the settlement trough created is generally very wide and flat with little angular distortion or horizontal tensile strain. Consequently, dewatering settlement is likely to result in settlements to the shallow founded structures on the airport estate which would be classified as 'negligible' damage when using the Table 7.2 criteria.

With regards to pavements, including roads and airport pavements (excluding runway strips) within the airport estate, the criteria set out in Table 7.3 apply. Construction associated with the Forrestfield-Airport Link must limit damage to Category R.

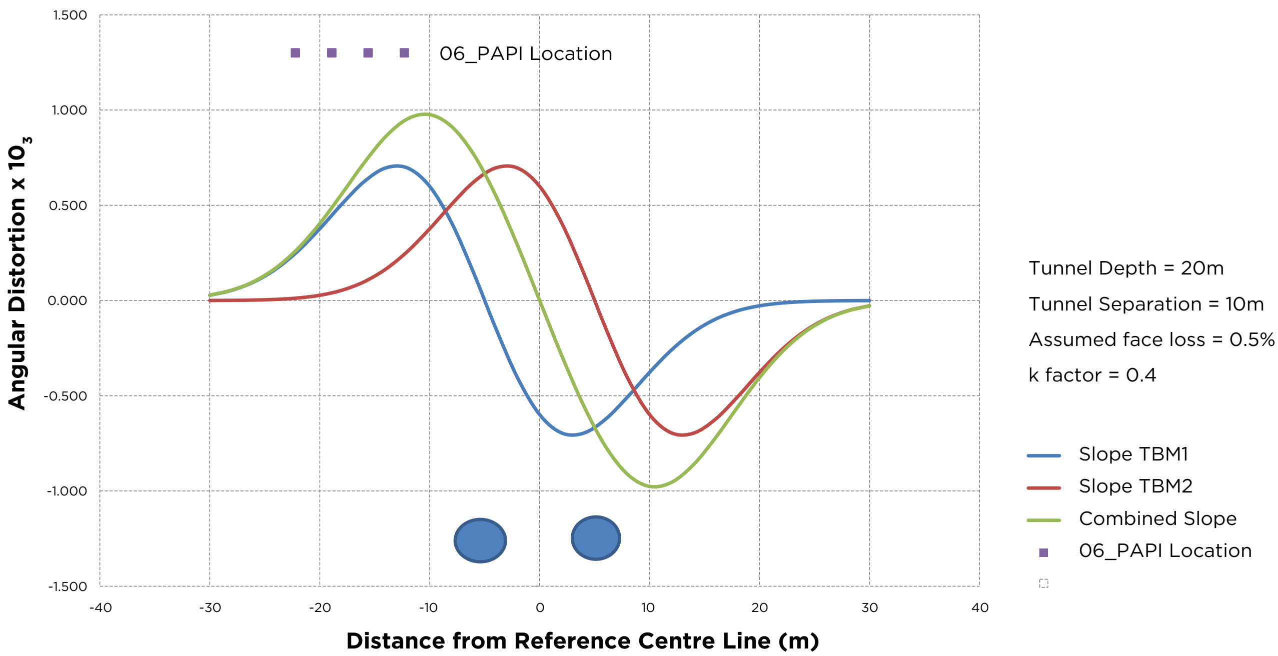


Figure 7.5 Projected angular distortion for maximum 15 millimetre settlement profile
Source: PTA

Similarly with regard to utilities within the airport estate the criteria set out in Table 7.4 apply.

Construction associated with the Forrestfield-Airport Link must limit damage to Category U-I, except where asbestos cement or vitreous clay pipes are located within the monitoring or assessment zone, for which the maximum induced slip or strain criteria for gas pipes, steel and iron pipes in Table 7.4 must apply, and damage must be limited to Category R.

A major utilities survey has been completed around the airport estate. In construction areas, existing drawings, site investigations and where necessary, potholing, were used to check and identify the presence, type and location of additional services. The resulting 3D database of services will be used and later verified prior to undertaking site works during the project.

The use of AS2870 and other codes/references has been successfully used on previous TBM projects (eg: tunnelling past Bankwest Tower on St. Georges Terrace – 52 storey building). Also the above strategies on management of ground movement impacts are typical of bored tunnel projects through sensitive built-up areas such as Perth Airport and have been shown to result in safe outcomes on many projects.

Building damage classification After Burland et al, 1977, and Boscardin and Cording, 1989					Approximately equivalent ground settlement and slopes (after Rankin 1988)	
1 Risk Cat	2 Description of degree of damage	3 Description of typical and likely forms of repair for typical masonry buildings	4 Approx. crack width (mm)	5 Max. tensile strain %	6 Max. slope of ground	7 Max. settlement of building (mm)
0	Negligible	Hairline cracks		Less than 0.05		
1	Very slight	Fine cracks easily treated during normal redecoration. Perhaps isolated slight fracture in building. Cracks in exterior visible upon close inspection	0.1 to 1.0	0.05 to 0.075	Less than 1:500	Less than 10
2	Slight	Cracks easily filled. Redecoration probably required. Several slight fractures inside building. Exterior cracks visible; some repainting may be required for weather-tightness. Doors may stick slightly	1 to 5	0.075 to 0.15	1:500 to 1:200	10 to 50
3	Moderate	Cracks may require cutting out and can be patched by a mason. Recurrent cracks can be masked by suitable linings. Brick pointing and possible replacement of a small amount of exterior brickwork may be required. Doors and windows sticking. Utility services may be interrupted. Weather tightness often impaired	5 to 15 or a number if cracks greater than 3	0.15 to 1:50	1:200 to 1:50	50 to 75
4	Severe	Extensive repair involving removal and replacement of walls especially over door and windows required. Window and door frames distorted. Floor slopes noticeably. Walls lean or bulge noticeably. Some loss of bearing in beams. Utility services disrupted	15 to 25 but also depends on number of cracks	Greater than 0.3	1:200 to 1:50	Greater than 75
5	Very severe	Major repair required involving partial or complete reconstruction. Beams lose bearing; walls lean badly and required shoring. Windows broken by distortion. Danger of instability	Usually greater than 25 but depends on number of cracks		Greater than 1:50	Greater than 75

Table 7.2 Building damage assessment criteria for structures
Source: PTA

7.1.6. Main Bearing Failure

There have been a number of high profile international problematic tunnel projects, where, in order to make repairs to the TBM's main bearing seals and/or the main bearing itself, it proved necessary to sink a shaft from ground surface to recover either the complete shield, or the cutterhead and main bearing assembly.

All TBMs are designed with a system of seals designed to protect the ingress of dirt and grit into the main bearing. Commonly it is the failure (or imminent failure) of these seals that leads to such drastic repair procedures being necessary.

In order to mitigate this risk, the TBMs to be used on the Forrestfield-Airport Link project will require:

- that the TBM main bearings are protected by a sealing system comprising a series of labyrinths and multiple lip seals,
- the design of the seals shall allow for the expected wear for a working life of 10,000 working hours and allow sufficient redundancy and at least one series of seals shall be considered to become unserviceable during any tunnel drive section,
- the design shall provide for exchanging both inner and outer sealing systems from within the tunnel should failure of the seals occur,
- the sealing system shall have facilities to monitor its performance. Where grease is used for lubrication, cooling and support of the seals, a means of adequate sampling must be provided. In the case where oil is used to lubricate, cool and support the seals, a circuit to filter, cool and sample the oil must be incorporated. The lubrication circuit for the bearing raceways and gear drives shall be provided with a facility for monitoring lubricant contamination, with alarms alerting the operator and above ground monitoring station,
- the main bearing shall be a heavy duty assembly having a rating of not less than 10,000 hours B10 life. (Note the B10 life is used to express the minimum lifetime of ninety percent of a given batch of bearings operating within speed and loading tolerances), and
- in the event of the need for replacement, the main bearing shall be removable rearward from the front bulkhead with a minimum of disturbance to the other components, hence in the very unlikely extreme situation that the mitigation measures noted above did not prevent failure of the TBM seals or main bearing within the airside area, in the final measure, repairs can be effected from within the tunnel.

These provisions, although they will add complexity to the design of the TBMs, are considered viable within the 6.9 metre diameter machines proposed for the Forrestfield-Airport Link project.

7.1.7. Differential settlement of Air Traffic Control tower

The ATC tower, pictured in Figure 7.7, is situated approximately 50 metres north of the excavation for the Airport Central Station.

The station will be constructed within diaphragm walls and all of these walls must extend a minimum distance of three metres into the underlying Osborne Formation (i.e. including for the wall closest to the ATC tower). At the location of the Airport Central Station the upper surface of the Osborne Formation is formed of the sand dominated Mirrabooka Member.

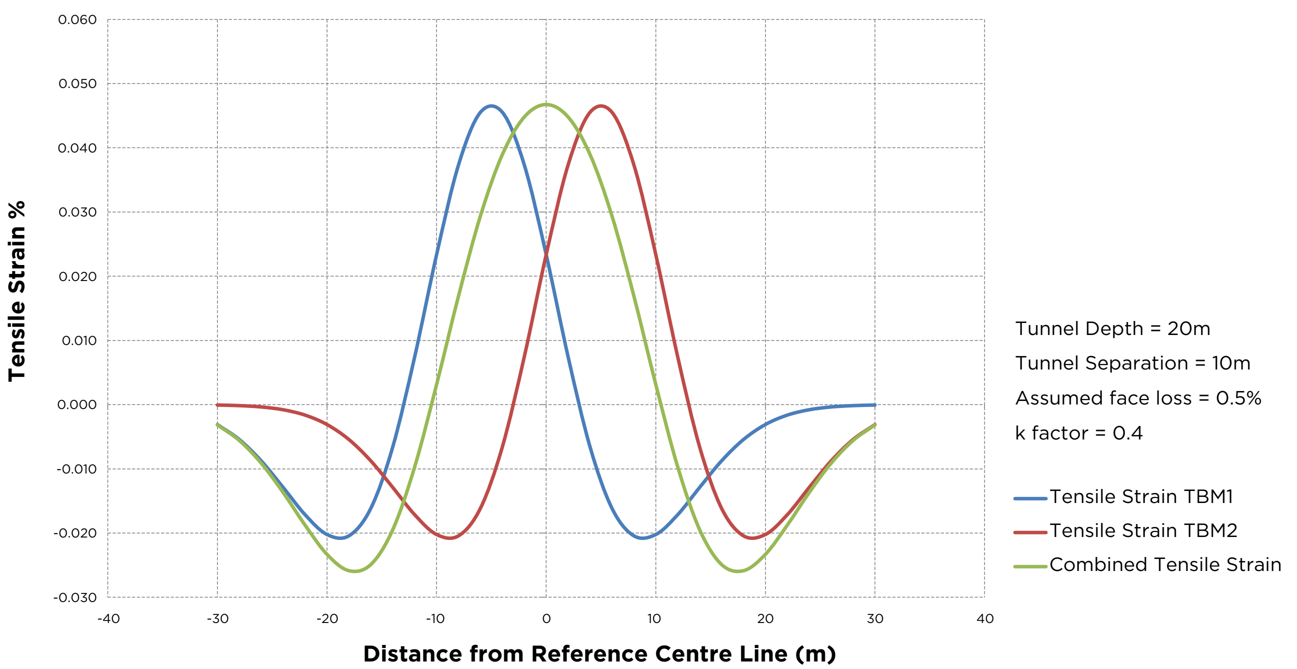


Figure 7.6 Predicted tensile strain
Source: PTA

Category	Max. Slope and settlement Induced	Maximum induced slip (mm) or strain (mm/m)		Description of Potential Damage
R	<1/500 Settlement 10mm	Road pavements: mm/m	5	Negligible effects, superficial Damage unlikely
		Kerbs & foot paths: mm/m	5	
R	1/500 to 1/150 Settlement 15mm	Road pavements: mm/m	10	Possible superficial damage, which is unlikely to have significant effect to the structure
		Kerbs & foot paths: mm/m	10	
R	1/150 to 1/50 Settlement 25mm	Road pavements: mm/m	20	Expected superficial damage to structures, possible structural damage to structures
		Kerbs & foot paths: mm/m	20	
R	>1/50 Settlement 50mm	Road pavements: mm/m	30	Expected structural damage to structure
		Kerbs & foot paths: mm/m	30	

Table 7.3 Damage criteria for road pavements, kerbs and footpaths
Source: PTA

Category of damage	Max. Slope Induced	Maximum slip (mm) or strain (mm/m)		Description of Potential Damage
U-0	<1/500	Concrete pipe/culvert	10mm	Negligible effect, superficial Damage unlikely
		Water Steel & iron	10mm	
		Cable in PVC duet	2mm/m	
		Cable buried in the ground	1mm/m	
		Gas pipes PVC	5mm	
		Gas pipes, steel & iron	5mm	
U-I	1/500 to 1/150	Concrete pipe/culvert	15mm	Possible superficial damage, which is unlikely to have significant effect to the structure or function of the utility
		Cable in PVC duet	4mm/m	
		Cable buried in the ground	2mm/m	
		Gas pipes PVC	10mm	
	1/500 to 1/250	Water Steel and iron	15mm	
		Gas Steel and iron	10mm	
U-II	1/150 to 1/50	Concrete pipe/culvert	25mm	Expected superficial damage to structures, possible structural damage to structures possible damage to rigid utilities
		Cable in PVC duet	6mm/m	
		Cable buried in the ground	6mm/m	
		Gas pipes PVC	20mm	
		Water Steel and iron	25mm	
		Gas Steel and iron	15mm	
U-III	>150	Concrete pipe/culvert	30mm	Expected structural damage to structure and function of utility
		Cable in PVC duet	8mm/m	
		Cable buried in the ground	4mm/m	
		Gas pipes PVC	25mm	
	>1/130	Water Steel and iron	30mm	
		Gas Steel and iron	20mm	

Table 7.4 Damage criteria for utilities
Source: PTA

Ground movements outside the footprint of the Airport Central Station excavation can be due to a combination of the following effects:

- stress relaxation caused by bulk excavation, and
- stress changes due to the effects of dewatering.

These movements are discussed in more detail below.

The ATC tower is founded within the Guildford Formation, on an approximately 19 metre diameter, 2.5 metre thick circular raft foundation. At its closest point the shallow (eight metres deep) excavation to concourse level is approximately 50 metres from the edge of the ATC tower raft foundation. The nominally 19 metre deep station box excavation is approximately 70 metres from the edge of the ATC tower raft foundation (see Figure 7.8).

Based upon case history studies on ground movements due to bulk excavations retained by diaphragm walls, geotechnical engineering researchers have published guidelines on the typical extent/zone of influence of ground movements as a function of bulk excavation depth.

Figure 7.7 Air Traffic Control tower

These guidelines suggest that ground surface settlement tends to cease at a distance of around twice the excavation depth behind the retaining wall.

As indicated in Figure 7.8, the nearest diaphragm wall is located approximately 50 metres away from the edge of the ATC tower footing, which suggests that the ATC tower foundation is outside the zone of influence for the station box excavation.

In addition to the guidelines indicated above, preliminary finite element modelling of the station box excavation has been undertaken by PTA's consultant. These preliminary analyses predict maximum ground slope beneath the control tower footing in the building damage category of "negligible", as defined in Table 7.2.

Design, verification and monitoring of all works and impacts on the control tower and other property are prescribed with escalating trigger alarms, action plans, etc to be agreed by the contractor and Airservices.

Preliminary assessment by PTA's consultant for a top-down Airport Central Station construction indicates tilt of the tower due to station box excavation and dewatering may range from 1:8800 to 1:47,500 depending on workmanship and other assumptions. (ie: <10 millimetres movement at the top of the tower). Maximum allowable movement is 1:1500 (ie: <50 millimetres at the top of the tower) to be achieved by the design and construction activities.

In order to control piping and base heave of the station box excavations, all diaphragm walls and other deep foundation at Airport Central Station and emergency egress shaft are extended to have a minimum of three metre embedment into the underlying Osborne Formation. This will ensure that the

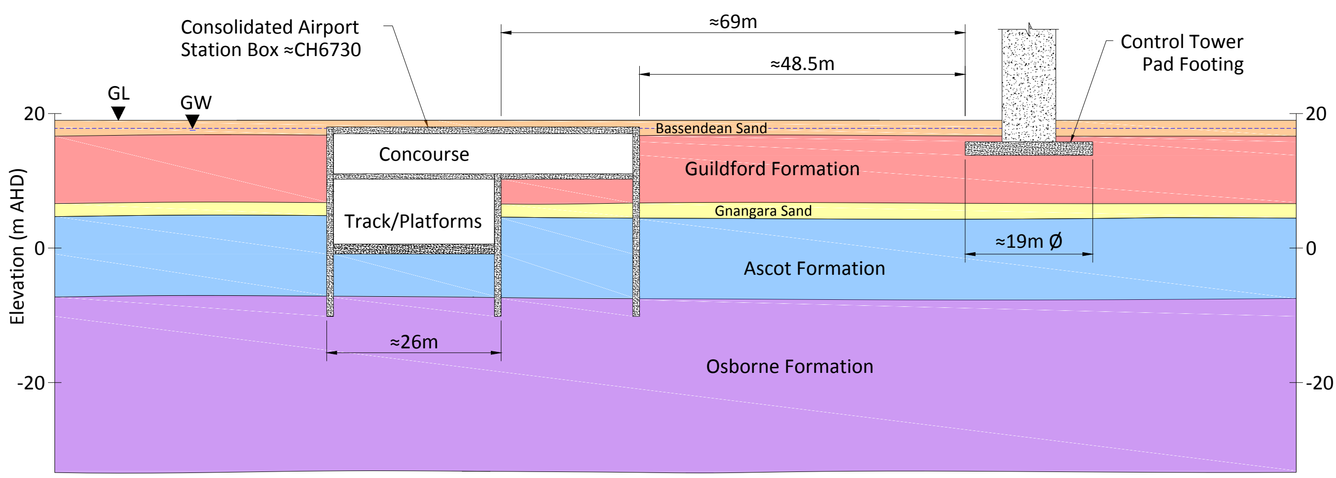


Figure 7.8 Cross section through the Airport Central Station and the Air Traffic Control tower

excavation is cut-off from the permeable Bassendean Sand, Guildford, Gnangara Sand and Ascot formations. Extension of the diaphragm walls in this manner will have the effect of increasing the drainage path and hence reducing the volume of water required to be pumped.

At the Airport Central Station, an approximately 15 metre thick unit of the Mirrabooka Member is present at the upper surface of the Osborne Formation. This member comprises medium to coarse grained, dense to very dense, sand, silty sand and clayey sand. Although it is generally of lower permeability than the overlying strata, permeable sand bodies are likely to be present within the Mirrabooka Member. Hence it is unlikely to form a fully effective cut-off. For this reason an extensive system of recharge wells surrounding the Airport Central Station excavation is envisaged to protect critical elements of airport infrastructure such as the ATC tower.

Pre and post construction condition surveys will be used by independent consultants (unless otherwise triggered by stakeholder complaints during construction) to ascertain any damage incurred by the works, and the contractor is bound to repair all/any of the damage and/or provide compensations.

Through ongoing consultation with Airservices, PTA and Perth Airport will ensure the risks to the structural integrity of the ATC tower and facilities mounted on or within the tower are addressed and mitigation measures implemented.

7.1.8. Recognition of natural seasonal ground movements

The available piezometer data from the site investigation program indicates that the groundwater table within the airport estate is typically two to three metres below ground surface and is subject to seasonal variations of up to about one metre per year.

The underlying Guildford Formation is prone to seasonal shrink and swell movements. As a result, the airport infrastructure is not static and some areas are subject to seasonal movements and ongoing settlement.

In order to understand the extent of such movement, a study of satellite data 'InSAR' has been commissioned. The most recent satellite data acquired over the approximately two year period October 2012 – September 2014 indicates that:

- within both current runways and various taxiways, the aircraft wheel tracks have sunk in the order of 2.5 millimetres to five millimetres per year during the period, and
- settlements up to 15 millimetres per year have been observed in taxilane 'Tango' leading to the T1 apron area (outside the Forrestfield- Airport Link project zone of influence) during the period.

In order to mitigate the effects of dewatering during construction, the Forrestfield-Airport Link project will, amongst other things, ensure that:

- the groundwater recharge system is designed to ensure that groundwater levels in all aquifers within 500 metres of the dewatering/recharge activity must not be elevated or lowered by more than one metre during construction when compared to locally recorded seasonal highs/lows in that aquifer (except locally, adjacent to extraction wells and diaphragm walls, provided there are no detrimental consequences such as flooding, excessive settlement, excessive load resulting in damage or excessive displacement, adverse acid sulfate soils reactions or additional environmental impact),
- within excavations, aim to limit the drawdown to within one metre of the base of that excavation, and
- all dewatering and recharge wells are fully developed prior to commissioning the dewatering system.
- the groundwater system design must be verified by an Independent Geotechnical and Hydrogeological Design Verifier.

Given these provisions, ground movements during construction should be of the same order as those previously observed due to seasonal variations and operational traffic.

7.1.9. Electromagnetic Interference

It is recognised that, Perth Airport and Airservices operate various types of radio frequency (RF) equipment, for both air-to-air and ground-to-air communications. This equipment is safety critical. Accordingly, the operation of electrical equipment which can cause electromagnetic interference (EMI), or the use of radio transmitting equipment on a similar frequency to Perth Airport and Airservices must be prevented.

Therefore the contractor must liaise and agree with Perth Airport and Airservices before installing any instruments that may generate such interference.

During construction, it is anticipated that the contractor will install a system of radio communications and Closed Circuit TV (CCTV) within the tunnels and tunnel entrances respectively to allow control of the temporary narrow gauge rail system or rubber tyred vehicles required to transport men and materials between the Forrestfield worksite and the TBMs. Survey parties may wish to use short range walkie-talkie type radios to communicate between groups.

It is also anticipated that various instruments and data loggers related to the works will use a combination of wired, WiFi, Bluetooth, and 3G or 4G type mobile phone systems to report readings to the base station. The radio frequencies and power of these devices will need to be agreed by Perth Airport and Airservices. In this regard, approval has recently been obtained from Airservices concerning instrumentation of the ATC tower currently being conducted by the PTA and transmission of monitoring data from the tower by 3G or 4G.

During operations, the principal source of potential EMI will be the 25 kilovolt overhead traction power equipment for trains. In order to ensure the rollingstock that will be utilised for the Forrestfield-Airport Link project does not have an impact on aviation operations, it is a requirement that the contractor must evaluate the electromagnetic environment on the airport estate to ensure that the electrified railway does not interfere with any aviation navigational and control systems.

In addition, a specialist EMI consultant has been engaged to assess potential electromagnetic interference on aviation operations due to electromagnetic emissions caused by trains when they begin operating on the Forrestfield-Airport Link project.

An electromagnetic field assessment was undertaken to predict likely electromagnetic noise emissions from electric-powered rollingstock and the results compared with existing electromagnetic noise levels measured at selected locations within the airport, including the ATC tower. The assessment concluded that 'there is extremely low, if any, risk of electromagnetic interference to airport navigation and communication facilities due to the operation of the Forrestfield-Airport Link.'

After the Forrestfield-Airport Link project has commenced services, the electromagnetic frequency spectrum at selected airport locations will be remeasured.

7.1.10. Access security

Access security within a construction worksite is a key element of any contractor's health and safety plan. It is critical to ensure that only trained and authorised operatives are admitted to high risk areas such as the tunnelling and underground station work sites, particularly airside underground. It is also important to ensure that an accurate log of personnel within the tunnel and station worksites is maintained at all times.

Access to the tunnel worksites must include a graded security solution divided into four levels of security; with access into each level being controlled by security gates and access controlled doors. Access to the administrative office and workers showers and changing room areas is controlled by a secured main entrance to the site. Access from this area to the main works area of the tunnels where segments and grout trains etc. are prepared is controlled by a second security gate and turnstile(s).

Security area Level 3 must include a secured and lockable store provided to contain any valuable materials that are vital to the operation and security of the facility. Access to Level 3 must only be accorded to all who have a need to access security area Level 3 and/or security area Level 4. The store is suggested in this location so that goods cleared can be stored and accessed from the Level 4 area minimising the interaction between Level 4 and Level 2.

Access into long tunnels such as the Forrestfield-Airport Link for both workmen and materials is security Level 4, obtained via a narrow gauge rail system or rubber tyred vehicles. Workman rider cars are used to transport the operatives between the worksite and the TBM. The operation of the narrow gauge rail system is controlled by a control room within the main worksite that is linked by radio and CCTV to the Loco drivers. Personnel access into the tunnels (Level 4) from the main worksite (Level 2) is generally controlled by a security gate within this control room.

Each security gate typically comprises a full height bi-directional access controlled pedestrian turnstile controlled by a security guard or electronic entry system, monitored by CCTV cameras to record all movements. As a minimum, operatives must present at the turnstiles their authorised Project ID card with the correct point authorisation to gain access into, or egress from, each secure area. Visitors to the tunnels are generally confined to small parties and must attend a safety induction prior to entering the tunnels. They must swipe a visitors pass and must be accompanied by a representative of the contractor or PTA at all times.

For the construction of the Airport Central Station box, the contractor will be required to construct a temporary commercial security fence around the worksite and exercise similar levels of worksite sub-division and access control at entry and exit points to the site. For operational reasons of demarcation of labour, it is likely that the contractor will maintain a temporary barrier between the tunnel and station works. For this reason it is anticipated that only emergency access will be available to or from the tunnels via the station boxes, once the tunnel construction has reached the station box.

Where the contractor's staff are required to access ground level airside areas, such as for the installation and maintenance of monitoring instrumentation, the particular staff will be subject to Perth Airport safety briefings, Australian Security Identity Card (ASIC) regulations and access protocols and accompanied by a Perth Airport representative or Airside Works Safety Officer as required.

The ABC and AEO will have escorted access to the construction activities as required, of which they will be required to comply with the contractor's security access and safety procedures.

No above ground infrastructure will be required airside, and therefore there are no security requirements for access airside during construction.

7.2. Risk management strategies

As highlighted previously, an extensive risk assessment for the Forrestfield-Airport Link project with particular reference to the problems associated with construction in close proximity to and beneath Perth Airport and Airservices infrastructure has been carried out.

These assessments have been used to develop risk management strategies for the project. Where considered necessary, the project documentation specifies the use of ALARP construction procedures identified in the risk analysis. High risk construction methodology that may put Perth Airport and Airservices infrastructure in jeopardy is precluded. The principal elements of the risk management requirements and measures for the project are summarised below.

The principal risk mitigation measure is the adoption of a Systematic Risk Management Plan. This has resulted in the following specification:

- specification of the TBM type, TBM mode of operation and temporal separation of TBM excavations of the two tunnels beneath the airport estate - the TBM design is prescribed to handle the wide range of soil and rock types expected along the route as a result of extensive geotechnical investigations,
- Specification of ground control features on the shield including:
  - articulated shield,
  - injection ports around shield body,
  - continuous injection of grout into tail void,
  - main bearing sealing system to contain multiple lips and labyrinths,
  - facility to exchange inner and outer main bearing seals from within the tunnel,
  - monitor performance of sealing system and lubricants,
  - minimum rating and lifetime for bearing, and
  - ability to remove the main bearing from within the tunnel in the event of replacement.
- ground freezing or similar methodology for cross-passage construction near runways and taxiways (eg. airside) ,
- maximum differential movement at runway 06 PAPI,
- maximum tensile strain limits for services and buildings,
- diaphragm walls for all deep excavations from the surface,
- recharge wells at the Airport Central Station excavation,
- agreement on radio frequency use prior to construction,
- assessment of electromagnetic field changes, and
- personal identification system for entry to contractor sites underground airside.

7.2.1. Systematic ground movement management strategy

The contractor will adopt a systematic approach to damage assessment and control of ground movements. The following outline procedures are envisaged:

- the first stage is to assess the zone of influence of the works and estimate likely ground movements associated with the tunnelling, deep station excavations, egress shafts, cross-passages and the associated dewatering works. For all infrastructure and buildings that fall within the assessed zone of influence detailed monitoring plans are required to be developed. In this regard, based on the reference design studies, the PTA has prepared predefined minimum instrumentation and monitoring zones. The contractor will be required to adopt this strategy and augment to suit his chosen work methods.
- the contractor will be required to prepare pre-construction condition surveys. Based upon these surveys the contractor will be required to identify any infrastructure that is particularly vulnerable and assess construction impacts on property. Where the anticipated ground movements exceed the allowable level of impact, the contractor will be required to provide protective works to reduce impacts to acceptable levels.
- the contractor will be required to establish alert levels for all instruments and action plans to be implemented in the event that any alert level is exceeded. The contractor is also required to carry out post-condition surveys in the event of alleged damage to property and undertake any repairs required or provide compensation to re-establish the infrastructure to its pre-construction condition.

Comprehensive detection and reporting mechanisms for excessive ground movement and damage to services will be implemented, both during tunnelling and longer term. No long term ground movements are expected after excavations and dewatering is complete. Perth Airport operational staff will continue to monitor report and manage the airfield environment in accordance with Perth Airport Aerodrome Manual.

7.3. Instrumentation and monitoring

7.3.1. General

Maintaining normal operations and continuity of business of Perth Airport during Forrestfield-Airport Link construction is a critical priority. A key element to achieving this objective is the installation of instrumentation and monitoring equipment and the development of action plans that can:

- detect movements of critical property on a near real time basis,
- provide early warning of departures from expected performance,
- raise alarms before movements exceed critical levels,

- prevent damage to critical property e.g. runways, ATC tower, taxiways, and
- allow the Forrestfield-Airport Link contractor and Perth Airport to implement contingency measures as necessary.

Implicit in the development of action plans is the establishment of direct lines of communication between the Forrestfield-Airport Link contractor and Perth Airport. There will also be direct line of communication between the contractor and the ABC. Noticeably, surface access to Perth Airport estate (both airside and landside) will be necessary to install and maintain appropriate levels of instrumentation.

7.3.2. Hierarchy of Perth Airport infrastructure

For the purposes of ground movement monitoring, the PTA has designated Perth Airport assets and infrastructure into two categories.

Critical property: will be monitored continuously on a near real time basis while the asset remains within the zone of influence of the Forrestfield-Airport Link works. Critical property within the airport estate includes:

- the ATC tower, including services essential for the functioning of the tower, i.e. power lines and optic fibre cables,
- all airside paved areas within the zone of influence of the project works as determined by the project specifications or a minimum of fifty metres either side of the project centreline, whichever is the widest,
- all airside infrastructure including, but not limited to, navigational aids.

Other property: includes all property in the zone of influence of the Forrestfield-Airport Link that is not critical property.

7.3.3. Minimum monitoring requirements

Minimum requirements for the design, selection, installation, monitoring and reporting of instrumentation for monitoring movements, stresses, strains, piezometric pressures and vibrations due to earthworks, excavations and tunnelling have been defined by PTA. The instrumentation requirements specified to the contractor are PTA's minimum requirements and may be expanded by the contractor's Geotechnical Manager where considered necessary. Runway closures as negotiated with Perth Airport may be required to facilitate installation, commissioning and maintenance of monitoring equipment.

The contractor will be required to appoint a Monitoring Manager and prepare an Instrumentation and Monitoring Plan (IMP) detailing the types and locations of all installations. The IMP will be submitted to CASA and Airservices for their information and acceptance. The IMP must also be verified by the Independent Geotechnical and Hydrogeological Design Verifier.

In order to establish a reliable set of base readings, at least 30 days of continuous verified reliable data must be collected from all of the relevant instrumentation before construction activity can commence in an area.

7.3.4. Instrumented TBM check section

In order to demonstrate that ground movement being achieved by the TBMs is less than the specified levels, a 100 metre section of the bored tunnel alignment will be required to be heavily instrumented and monitored prior to the tunnel excavation reaching the airside area. As far as possible, the check section should comprise similar ground conditions to those expected airside beneath the runways. To this end, a potential tunnelling check section east of the Qantas Catering workshop is shown in Figure 7.9. At this point the TBMs are expected to be operating within a full face section of Ascot Formation that is considered representative of the material that will be encountered beneath the airport runways and taxiways.

The instrumentation for this section is required to comprise a pattern of monitoring arrays.

Performance reports for the passage of each TBM through the check section must be prepared by the contractor, including any recommendations for improvement of operational procedures where performance is unsatisfactory. The performance reports must be verified by the Independent Geotechnical and Hydrogeological Design Verifier, accepted by PTA, with no objection received from Perth Airport prior to re-launch of each TBM from the Airport Central Station box into the airside area.

Figure 7.9 Location plan for the instrument TBM check section

7.3.5. Monitoring requirements for runway and critical pavements

The contractor will be responsible for monitoring surface ground movements of airside pavements, which includes runways, taxiways and aprons within the zone of influence of construction activities. Monitoring of the critical property defined in Section 7.3.2 of this report will be on a near real time basis.

In addition to other monitoring obligations, surface movement of the runways must be monitored by the contractor over an area extending for 50 metres either side of the project centreline and over the entire paved runway width of 75 metres (including inner and outer shoulders). Surface level measurements accurate to two millimetres must be taken on a grid pattern with increased density near the tunnel alignments with a minimum of a hundred points per runway crossing.

Final details of an appropriate monitoring system to meet PTA's minimum requirements will be determined by the contractor in liaison with Perth Airport and PTA.

Video surveillance will also be used to allow quick reference to current surface conditions, with a minimum of two cameras required to ensure full, uninterrupted coverage of the relevant airside areas. If located on the airfield, the camera mountings will be required to be frangible and compliant with Obstacle Limitation Surfaces (OLS) requirements. Footage obtained from the cameras will be made available live online via a password-protected internet web page accessible to key members of the contractor's team, PTA and Perth Airport, with recordings retained for a minimum prescribed period of 60 days to allow for retrospective viewing.

Additional instrumentation and monitoring may also be proposed by the contractor. Perth Airport will be consulted during the development of the IMP with regard to instrumentation systems and the possibility of installing instruments concurrently with scheduled airfield maintenance works.

7.3.6. Air Traffic Control tower

A pre-contract study of the ATC tower movements over a one year period has been awarded and installation of instruments and monitoring commenced in July 2015. The monitoring includes two biaxial tiltmeters installed on level eight of the tower, one biaxial tiltmeter installed on the roof of the tower, a GPS receiver with integrated triaxial accelerometer attached to the roof of the tower, along with precise levelling of a series of pins installed at the tower base and collection of weather data. A total station will also be used to monitor two prisms installed on the roof for quality control checks.

The contractor will be required to monitor the ATC tower to the same (or superior) standard before, during and after excavation and construction of the Airport Central Station box, and passage of both TBMs, in addition to providing for near real time monitoring of movement of the tower base. All monitoring data will be available to PTA, Perth Airport and Airservices.

Any significant difference in measurements obtained between the pre-contract period and those measured during construction will be immediately brought to the attention of PTA, Perth Airport and Airservices via automatic alarms. Any permanent tilt of the ATC tower exceeding 1:1,500 induced by construction activities will be corrected by the contractor.

7.3.7. Runway 06 Precision Approach Path Indicators

The tunnel alignment runs close to the PAPI for runway 06. The 06 PAPI, which comprises four elements, will be monitored for settlement and biaxial tilt in near real time. The instrumentation and monitoring procedures for the 06 PAPI lights are discussed in detail in Section 7.1.4.

7.4. Contingency measures

7.4.1. Standby plant at critical phases of project

During periods that the tunnel boring machines are operating beneath critical elements of Perth Airport infrastructure as defined in Section 7.3.2, the contractor is required to maintain suitable construction plant on standby in the event that the ground movement criteria set out in Section 7.1.5 are exceeded.

The standby plant must be capable of effecting suitable repairs to the runway and taxiway pavements and of being mobilised to the site within four hours of Perth Airport's formal notification that the infrastructure has become unserviceable.

In practice, the instrumentation and monitoring proposed will provide early warning of any ground movement trends and that an exceedance of the settlement criteria is pending. Re-profiling of the runway to maintain it within operational limits should therefore be possible on a planned emergency maintenance basis with minimum disruption to operations.

7.5. Other issues as identified under the Airports Act

7.5.1. Aircraft noise exposure levels

The Act requires that an MDP identifies whether the proposed development will affect noise exposure levels and the airport's plan for managing aircraft noise within the area. The proposed Forrestfield-Airport Link project will have no impact on aircraft noise exposure levels.

Australian Standard 2021:2015 provides guidelines for determining the acceptability of aircraft noise intrusion in buildings within Australian Noise Exposure Forecast (ANEF) contours of a given aerodrome, the level of noise reduction measures to be taken and the types of attenuation measures that should be put in place based on the classification of the building.

The Airport Central Station is located within the 20 to 25 ANEF contour. The elements of the station that are above ground are deemed to be commercial buildings. This is in line with the classification of other buildings on the airport estate such as terminals. Given this classification the Airport Central Station does not require any additional noise amelioration measures beyond the requirements of the Building Code of Australia in order to comply with AS2021:2015.

7.5.2. Effect of flight paths

The Act requires an MDP to outline if a development could affect flight paths at the airport. The Forrestfield-Airport Link will not affect any flight paths.

7.5.3. Airspace requirements

Protection of airspace required for Perth Airport's current and future needs is essential to provide a safe, predictable environment for the arrivals and departures of aircraft using Perth Airport in all weather conditions.

The Airports (Protection of Airspace) Regulations 1996 prescribe airspace around the airports for protection from activities that could pose a hazard to air navigation.

Prescribed airspace comprises the airspace above the lower of two sets of defined invisible surfaces above the ground known as the Obstacle Limitation Surfaces (OLS) and Procedures for Air Navigation Services - Aircraft Operations (PANS-OPS) surfaces.

Perth Airport guidelines on building design and height restriction have been considered when planning the location and height of the proposed development. The majority of the works will be underground. The location and size of any stockpiles will consider

Figure 7.10 Forrestfield-Airport Link project Obstacle Limitation Surfaces

the impact to current and future aircraft operations including impacts to protected airspace.

Figure 7.10 shows the OLS for the project area and Figure 7.11 the PANS-OPS for the project area. Monitoring equipment airside and any structures above ground will be managed and assessed in accordance with the Airport (Protection of Airspace) Regulations 1996 and Civil Aviation Regulations 1994, which includes the requirements for any controlled activities that impinge upon prescribed airspace to be referred to Airservices' and CASA.

7.5.3.1. Cranes during construction

During the construction of the Forrestfield-Airport Link, cranes will need to be operated. The construction phase will therefore require the implementation of the prescribed airspace processes, as it is likely that cranes may impact the OLS in the vicinity of Airport Central Station.

The Forrestfield-Airport Link Project will follow the 'Process Application' under the Airports (Protection of Airspace) Regulations 1996 Guidelines for Operations of Federal Airports as published by the DoIRD.

7.5.3.2. Air/exhaust vents

It is necessary to consider the risks of any activities that could cause the emission of steam, smoke, dust or other particulate matter with the potential to affect the ability of aircraft to operate in the prescribed airspace in accordance with Visual Flight Rules (VFR).

Two ventilation shafts will be required at either end of the Airport Central Station. The station shafts will act as both intakes and discharges. When acting as a discharge, the shaft exit velocity will be less than 4.3 metres per second, which is below CASA's assessment criteria at a height of approximately four metres above the surrounding ground level. The air is likely to be discharged horizontally, but is dependent upon final design.

The stacks are expected to be only used in an emergency and during maintenance testing, and occasionally during summer if there are high train frequencies. This will occur when there is a need to control the build-up of temperatures in the stations and tunnels. The temperature of discharge is expected to be no more than five to 10 degrees above ambient. Fogging at stacks generally occurs when warm moist air is discharged at times of low ambient temperatures and coincident high relative humidity. The most usual source of such plumes is the discharge from a cooling tower. There are no cooling towers associated with the Forrestfield-Airport Link network.

A visible plume can be expected if there is an emergency in the station or tunnel network that involves a fire. This is a low probability event, and in such circumstances, a decision to discharge at Airport Central Station depends upon a number of

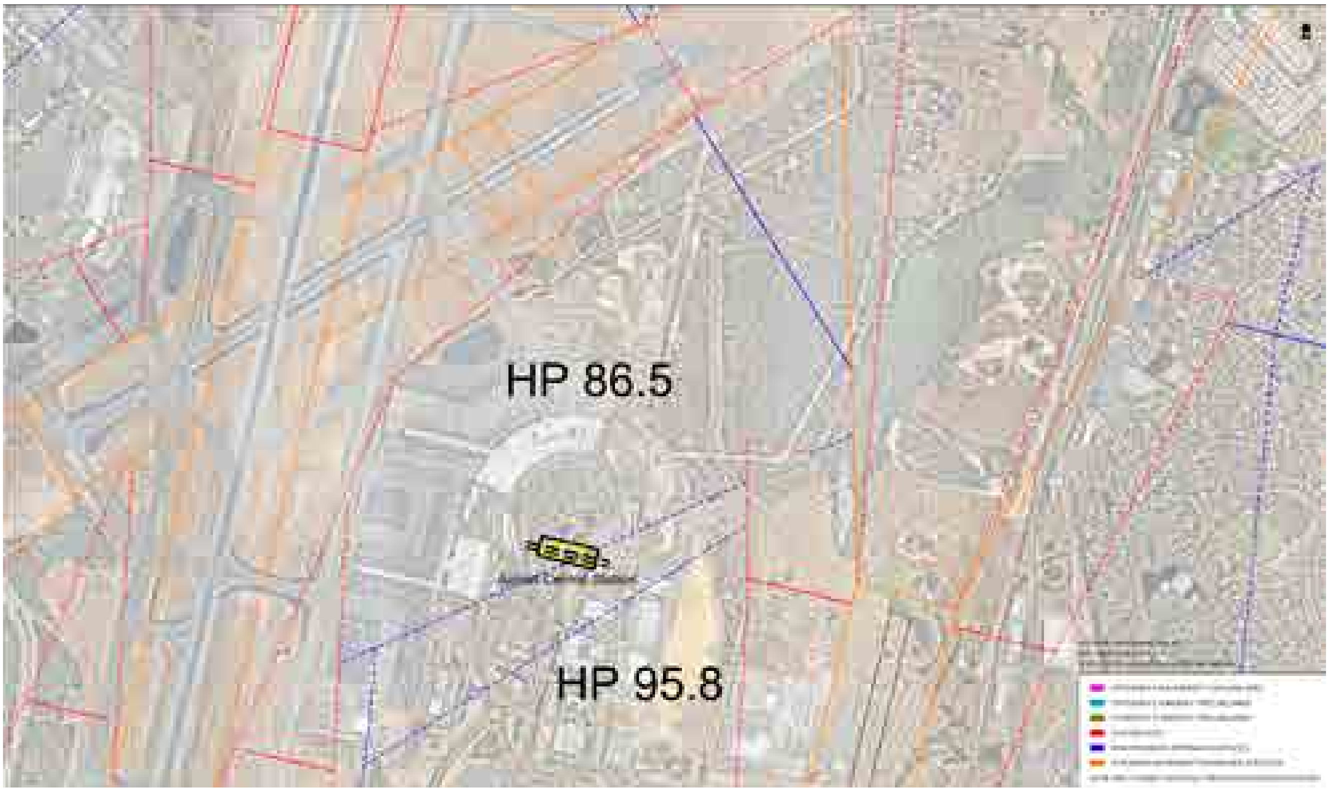


Figure 7.11 Forrestfield-Airport Link project Procedures for Air Navigation Services-Aircraft Operations Surfaces

factors which reduce the probability further given that in many cases there will be the option to extract from the Airport West Station, or one of the tunnel portals depending upon the nature of the incident. The plume from the unlikely occurrence of fire will be comparable to a plume from a building fire within the airport estate, or from a car on fire in one of the carparks.

There will be other minor building related air exhaust grilles and similar on the façade of the stations, but these will have relatively low air quantities with discharge velocities below 4.3 metres per second.

Tunnel ventilation shafts have been limited to locations associated with the Airport Central Station and within the emergency egress shaft area.

7.5.4. Air Traffic Control tower line of sight

A review of the ATC tower height in relation to the proposed development has been undertaken. It has been concluded that the proposed development will not compromise the line of sight of the ATC tower to the aircraft movement areas as demonstrated in Figure 7.12.

7.5.5. Protection of Communication, Navigational and Surveillance infrastructure (CNS)

There are a number of radio navigational aids and communication installations that provide guidance to aircraft and are operated by Airservices, including Distance Measuring Equipment (DME), VHF omnidirectional range radio (VOR), Non-Directional Beacon (NDB) and Instrument Landing System (ILS) (glide path and localiser). These systems rely on the transmission of radio waves that must be protected from any structure or obstacles that could cause signal refraction or interference.

A noise and vibration assessment was undertaken which included detailed modelling to predict the levels of noise and vibration likely to be received at vibration sensitive assets operated by Airservices during construction and operation of the project.

To ensure that any movement of CNS sites is minimal and that there is no adverse impact to continuous operation of ATC services, a report will be provided to Airservices for endorsement of acceptable levels of vibration and ground movement.

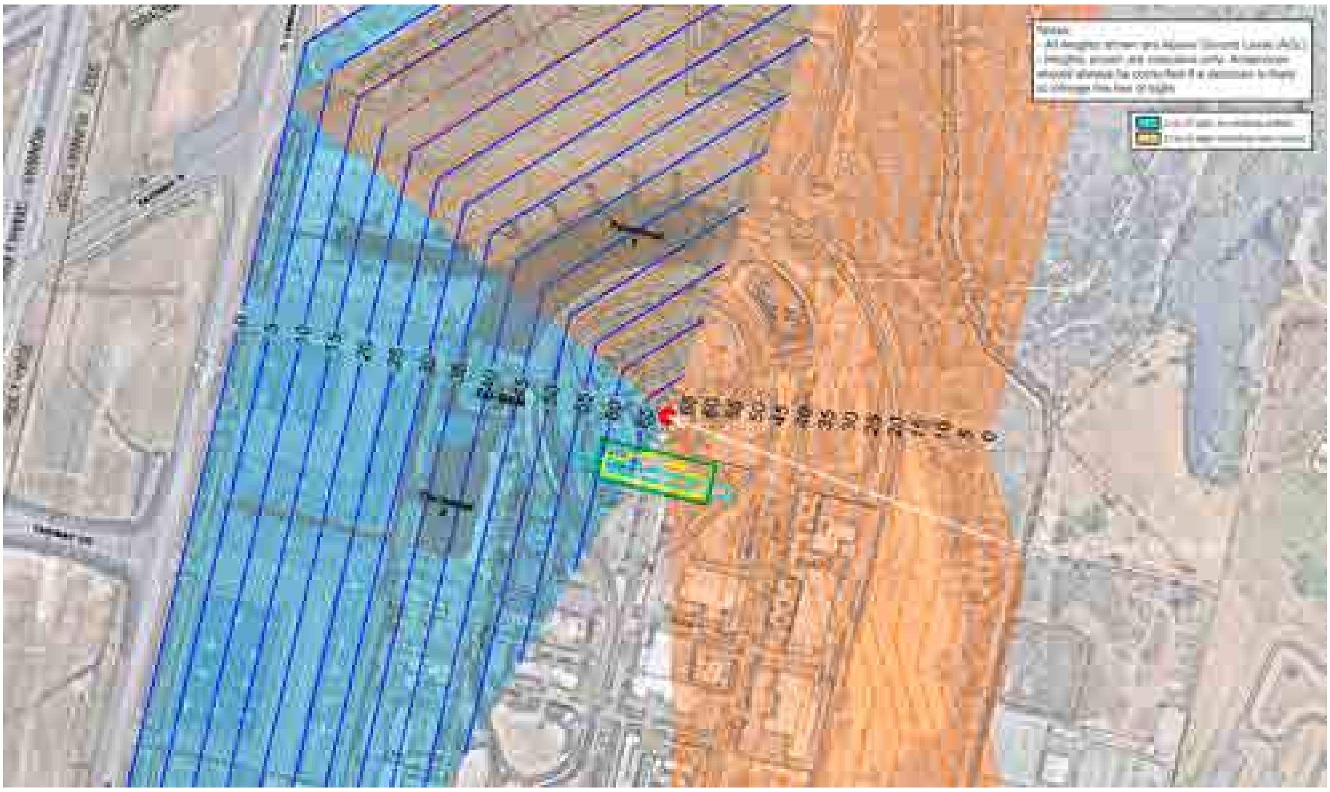


Figure 7.12 Forrestfield-Airport Link ATC tower line of site

The navigational aids clearances were taken into consideration as part of the assessment in this MDP. Perth Airport will continue to engage with Airservices during the detailed design phase of this project to ensure there is no negative impact on the navigational equipment used.

The stockpiling site 1 passes directly beneath the Airservices Perth ATC tower- Kalamunda radio link. As a result, the use of machinery and stockpiling of soil in this area has the potential to impact on Airservices communications facilities. Any activities planned for this zone are to be submitted to Airservices for technical engineering assessment prior to commencement to ensure the service is not impacted as a result of the work.

7.5.6. Bird and animal hazard management

Perth Airport is required to monitor and control the presence of birds on, or in the vicinity of, the airport in accordance with CASA regulations. Perth Airport maintains a vigilant Bird and Animal Hazard Management System to remove and reduce potential high-risk bird species.

In regards to noise and vibration impacts of tunnelling and construction on local bird and animal behaviour, an acoustic and vibration specialist determined that:

- Impacts during construction, if any, are likely to be highly localised in space, intermittent in nature and not for more than a few days at a time.
- During train operation within tunnels, the frequency and level of noise radiated by vibrating ground is well below typical published bird hearing thresholds.
- In the event rail vibration levels were perceptible to birds, it would not be as sudden or widespread as other stimuli in the area such as freight train horns and aircraft movements, and would be of very short duration.

7.5.7. Security and emergency management

Perth Airport and PTA have facilitated several Security and Emergency Management workshops with Commonwealth and State governing bodies including the DFES, the Australian Federal Police (AFP), Aviation and Rescue and Fire Fighting Services (ARFF) and Security department and other emergency services.

The agreed outcomes of these workshops are for the contractor to develop a Security Management Plan and an Emergency Management Plan for construction and operational phases of the Forrestfield-Airport Link project. The contractor must also undertake a Threat and Vulnerability Risk Assessment (TVRA) of the security issues that will apply to the construction of the project. The Security Management Plan, Emergency Management Plan and TVRA undertaken by the contractor will be in accordance with the following:

- Intergovernmental Agreement on Surface Transport Security, 2005,
- National Surface Transport Security Strategy, 2013,
- AS/NZ 4360:2004,
- National Code of Practice for CCTV Systems for the Mass Passenger Transport Sector for Counter-Terrorism,
- Perth Airport's Security and Emergency Management requirements, and
- AS 4825, NFPA 130 and best practice.

The Construction Emergency Management Plan shall cover (as a minimum):

- how an emergency event during construction will be managed,
- details of emergency management policies to be adopted,
- details of emergency response plans and evacuation procedures by emergency incident type and how they will be implemented,
- emergency response governance arrangements including details of the relationships to relevant authorities for the management of emergencies,
- the emergency response chain of command including organisational details, responsibilities, reporting requirements and contact details for nominated representatives,

- the contractor's emergency response organisation structure that shows responsibility for the management of sub-contractors, visitors, deliveries, couriers, heavy haulage drivers and vehicles,
- interfaces with the security management plan,
- access to emergency egress shafts and station tunnel entries from outside (i.e. key over-ride, key storage, key management and access to keys to temporary and/or permanent doors, hatches, vents/grilles, etc.),
- tunnel evacuation,
- tracking of all vehicles and persons entering and leaving the tunnel including the provision of card readers and CCTV at all entry/exits in order to maintain a site wide emergency muster register,
- traffic management of emergency and non-emergency vehicles, and
- details of emergency response drills and exercises including frequency.

The Operational Emergency Management Plan shall cover (as a minimum):

- security incidents including:
  - bomb threat,
  - suspicious articles/substances,
  - chemical biological radiological, and
  - individual threat (i.e. active shooter/siege hijack hostage).
- general emergencies including:
  - earthquake,
  - environmental emergency,
  - pandemic influenza, and
  - severe weather.
- fire emergencies including:
  - fire within Airport Central Station,
  - fire within a railcar,
  - fire within the tunnel, and
  - fire within station precincts.
- rail emergencies including:
  - rail emergencies on the Midland Line or Forrestfield Line, and
  - fatalities on the Midland Line or Forrestfield Line.

Both the Construction and the Operational Emergency Management Plan developed by the contractor will describe how an emergency event during the construction and operation of the Forrestfield-Airport Link project will be managed, including details of the roles and responsibilities of the PTA, DFES, the AFP, ARFFS and other emergency services, and describes the egress routes and DFES personal access points.

The TVRA and Security Management Plan will identify all possible security risks or threats that apply to the Forrestfield-Airport Link project, including security mitigation measures which will be included within the contractor's security solution for the project. The risk assessment undertaken will place emphasis on high risk areas of the project such as:

- the implications of the construction of the tunnel in particular beneath Perth Airport's critical infrastructure including runways, taxiways and aprons,
- the construction of Airport Central Station adjacent to T1, T2 and the ATC tower, and
- the construction of the emergency egress shaft within the Airport West Precinct and cross-passages located airside.

The Security (incorporating the Threat and Vulnerability Risk Assessment) and Emergency Management Plans will require endorsement from Perth Airport and the Commonwealth governing bodies including ARFFs and Airservices where relevant. The Aerodrome Emergency Plan will be updated to reflect the Forrestfield-Airport Link and any endorsed changes.

7.6. Impacts during operation of the rail network

The biggest risks to aviation activities are during the construction of the project, however the operations of the rail have also been carefully considered. The rail has been designed to operate independently to the airport.

To minimise impacts to airport operations including employees and customers, existing buildings and structures, project specific compliance criteria for operational noise and vibration are being developed in conjunction with the key airport stakeholders including Airservices. A noise and vibration assessment has been undertaken which included identification of sensitive receptors within the airport and detailed modelling to predict the levels of operational noise and vibration likely to be received at the identified receptors.

Following this assessment, features such as the use of resilient rail fasteners have been incorporated into the concept design to minimise potential impacts.

An operational noise and vibration monitoring program will be implemented following construction to ensure that train operations meet the criteria set for the project. A monitoring and reporting procedure for operations will also be implemented.

To cover management arrangements for response to emergencies during the operations of the rail through the airport estate, the project also requires the Perth Airport Emergency Management Plan to be revised.

7.7. Consultation on risks and mitigation measures

Perth Airport is committed to effective engagement and consultation with stakeholders that are impacted by the development of the Forrestfield-Airport Link. Perth Airport will continue to work with Airservices to ensure that their assets and infrastructure are not detrimentally impacted, including by the location of stockpiles. Airservices will be consulted and provided the opportunity to review and assess the final design and construction methodology developed by the contractor to ensure the ongoing safety, integrity and operation of their systems and facilities throughout construction and operation of the Forrestfield-Airport Link. The design of the Forrestfield-Airport Link will meet all CASA and Airservices requirements.

In addition, the PTA has embedded a process within their contract documents that enable an independent design verification process to occur. The contractor is required to provide to PTA an Independent Design Verifier (across a number of specialised technical disciplines, including geotechnical and structural) who is independent of the contractor and experienced in the design and construction of large engineering and tunnel projects. The Design Verifier must verify key elements of the design at concept and detailed stages to ensure an appropriate level of professional skill and care has been undertaken and to ensure compliance with the PTA specifications. In addition at final design stage they must verify the design is appropriate for construction.

PTA will work with Airservices and Perth Airport to share the contractor's design solutions and the various stages of independent design verification reports and certificates to ensure that all stakeholders are adequately engaged with the final design solution. In the event that this process does not adequately resolve Airservices concerns, Airservices may consider engaging a further third party design reviewer and agree cost recovery with the PTA.

8. CONSULTATION

8.1 Community and stakeholder consultation

Perth Airport is committed to effective consultation with all stakeholders. Through the preparation of this MDP, Perth Airport, in conjunction with the PTA, has undertaken consultation with Airservices, CASA and adjoining local authorities with respect to the detailed elements of the project form and design and in arriving at mutually agreeable outcomes.

During the preparation of the Forrestfield-Airport Link MDP, Perth Airport has undertaken formal consultation with stakeholders in line with the requirements of the Act.

The following stakeholders were consulted during the preparation of the MDP:

- Civil Aviation Safety Authority,
- Airservices,
- WA Department of Planning,
- WA Department of Transport,
- Main Roads WA,
- WA Department of Environment and Regulations,
- WA Department of Parks and Wildlife,
- WA Department of Fire and Emergency Services,
- City of Swan,
- City of Belmont,
- Shire of Kalamunda,
- Sub-lessors on the Airport estate directly affected by the project,
- Members of the Perth Airport Planning Coordination Forum,
- Perth Airport Community Forum,
- Perth Airport's Municipalities Group,
- Aviation Rescue Fire Fighting,
- Airport Building Controller,
- Commonwealth Department of Environment,
- Australian Federal Police,
- Perth Airport Aboriginal Partnership Group, and
- Perth Airport Section 18 Aboriginal Consultation Group.

As the proposal is in accordance with the approved Master Plan 2014 and considerable detail was provided on the rail project, a shortened public consultation period of 30 days was approved by the Commonwealth Minister for Infrastructure and Regional Development on 8 July 2015.

In accordance with the Act, the Preliminary Final MDP was publicly advertised for a period of 30 business days to enable comments from stakeholders and the public. The MDP was released for public comment from 11 August 2015 to 22 September 2015.

Comments received during the public comment period were used to develop the Draft MDP which was submitted to the Commonwealth Minister for consideration.

The Commonwealth Minister for Infrastructure and Regional Development approved the MDP on 30 November 2015.

8.2 Perth Airport consent and ABC approval

Following approval of the MDP, in accordance with Division 5 of the Act, Perth Airport will seek approval from the ABC for the proposed activity via a permit application as outlined in Figure 8.1. The activity is to be consistent with the approved MDP.

The contractor must lodge design documentation for building activity to Perth Airport and ABC following the process indicated in Figure 8.1

Airport Land Approval Process

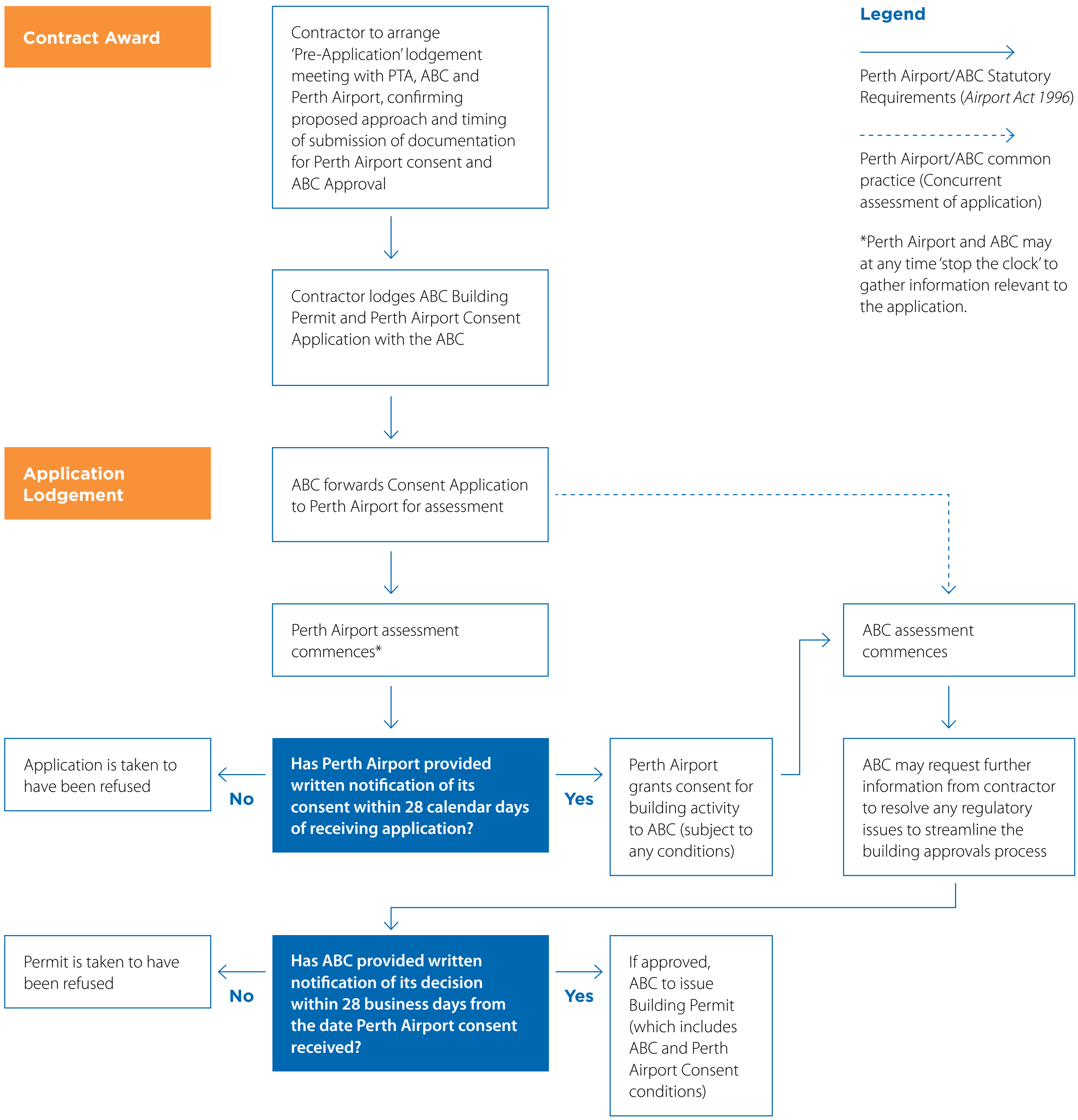


Figure 8.1 Perth Airport consent and ABC approvals process

9. CONCLUSION

The proposed Forrestfield-Airport Link will meet the State Government's objectives of moving towards more sustainable transport alternatives for passengers and employees of Perth Airport while also expanding the Perth urban rail system. The proposed development will also assist Perth Airport in meeting the predicted doubling of growth in passenger movements from 13.66 million in 2013 to 28.45 million in 2034.

Perth Airport believes that any risk to third party infrastructure on the estate due to the construction and operation of the Forrestfield-Airport Link through the airport can be mitigated. Perth Airport and PTA are committed to ongoing and transparent consultation with key stakeholders as the design and construction of the tunnels and the Airport Central Station progresses.

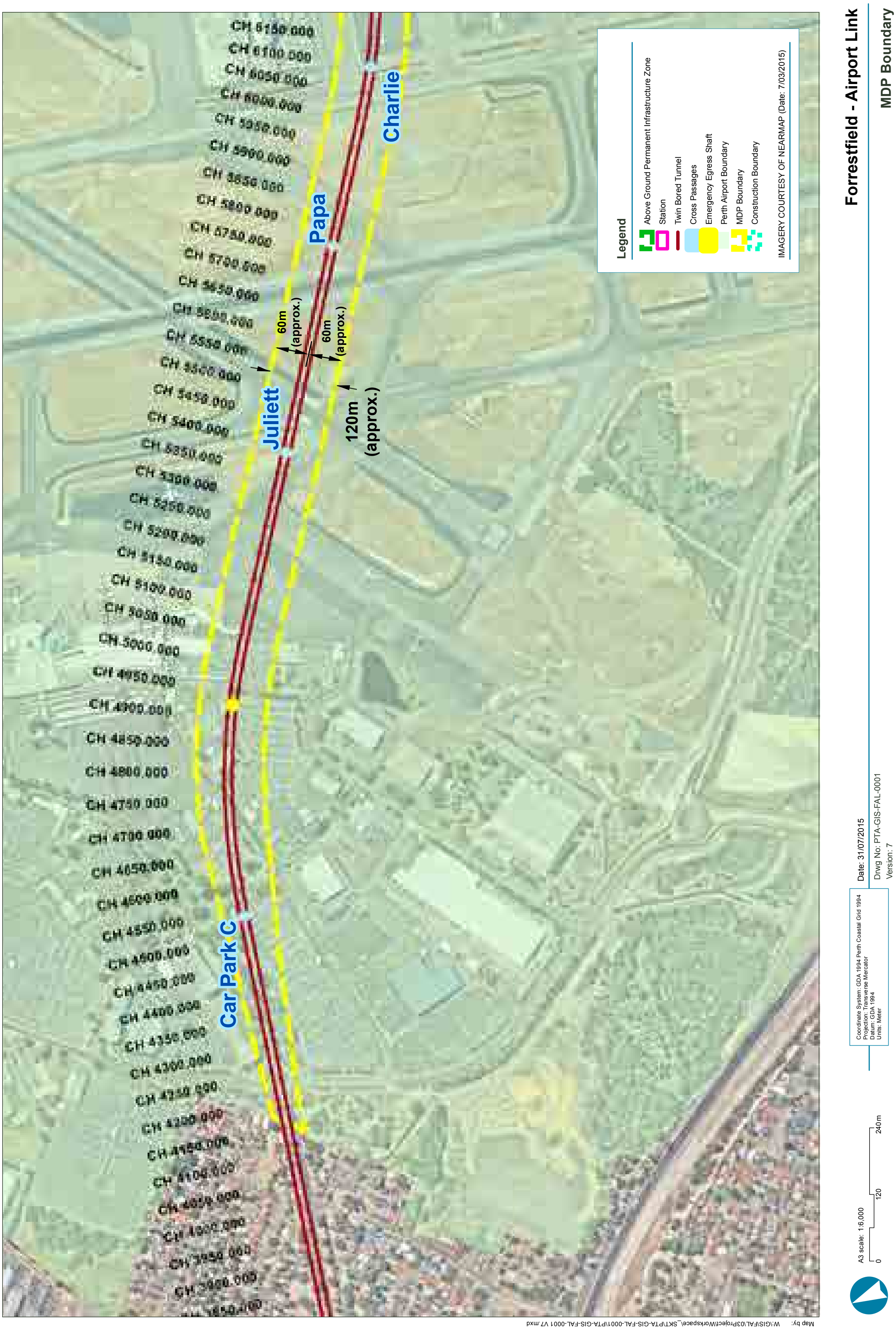
This MDP has been prepared to meet the requirements as prescribed in the Act. Perth Airport submits that, through this MDP, it has fulfilled its statutory obligations.

APPENDIX

Appendix A - Consistency with the *Airports Act 1996*

(1) A major development plan, or a draft of such a plan, must set out: (a) the airport-lessee company's objectives for the development; and	Section 3
(b) the airport-lessee company's assessment of the extent to which the future needs of civil aviation users of the airport, and other users of the airport, will be met by the development; and	Sections 2 and 3
(c) a detailed outline of the development; and	Section 4
(ca) whether or not the development is consistent with the airport lease for the airport; and	Section 2
(d) if a final master plan for the airport is in force—whether or not the development is consistent with the final master plan; and	Section 2
(e) if the development could affect noise exposure levels at the airport—the effect that the development would be likely to have on those levels; and	Section 7
(ea) if the development could affect flight paths at the airport—the effect that the development would be likely to have on those flight paths; and	Section 7
(f) the airport-lessee company's plans, developed following consultations with the airlines that use the airport, local government bodies in the vicinity of the airport and—if the airport is a joint user airport—the Department of Defence, for managing aircraft noise intrusion in areas forecast to be subject to exposure above the significant ANEF levels; and	N/A
(g) an outline of the approvals that the airport-lessee company, or any other person, has sought, is seeking or proposes to seek under Division 5 or Part 12 in respect of elements of the development; and	Section 8
(ga) the likely effect of the proposed development that are set out in the major development plan, or the draft of the major development plan, on (i) Traffic flows at the airport and surrounding the airport; and	Section 5
(ii) Employment levels at the airport; and	Section 3
(iii) The local and regional economy and community, including an analysis of how the proposed developments fit within the local planning scheme for commercial and retail development in the adjacent area; and	Section 2
(h) the airport-lessee company's assessment of the environmental impacts that might reasonably be expected to be associated with the development; and	Section 6
(j) the airport-lessee company's plans for dealing with the environmental impacts mentioned in paragraph (h) (including plans for ameliorating or preventing environmental impacts); and	Section 6
(k) if the plan relates to a sensitive development – the exceptional circumstances that the airport-lessee company claims will justify the development of the sensitive development at the airport; and	N/A
(4) In specifying a particular objective or proposal covered by paragraph (1)(a) or (c), a major development plan, or a draft of such a plan, must address (a) the extent (if any) of consistency with planning schemes in force under a law of the State or Territory in which the airport is located; and (b) if the major development plan is not consistent with those planning schemes – the justification for the inconsistencies.	Section 2
(6) In developing plans referred to in paragraph (l)(f), an airport-lessee company must have regard to Australian Standard AS2021–1994 ('Acoustics—Aircraft noise intrusion—Building siting and construction') as in force or existing at that time.	Section 7

Appendix B – Forrestfield-Airport Link MDP project boundary



Map by: W:\GIS\FAL\03Project\Workspace_SKT\PTA-GIS-FAL-0001\PTA-GIS-FAL-0001 V7.mxd

A3 scale: 1:6,000

0 120 240m

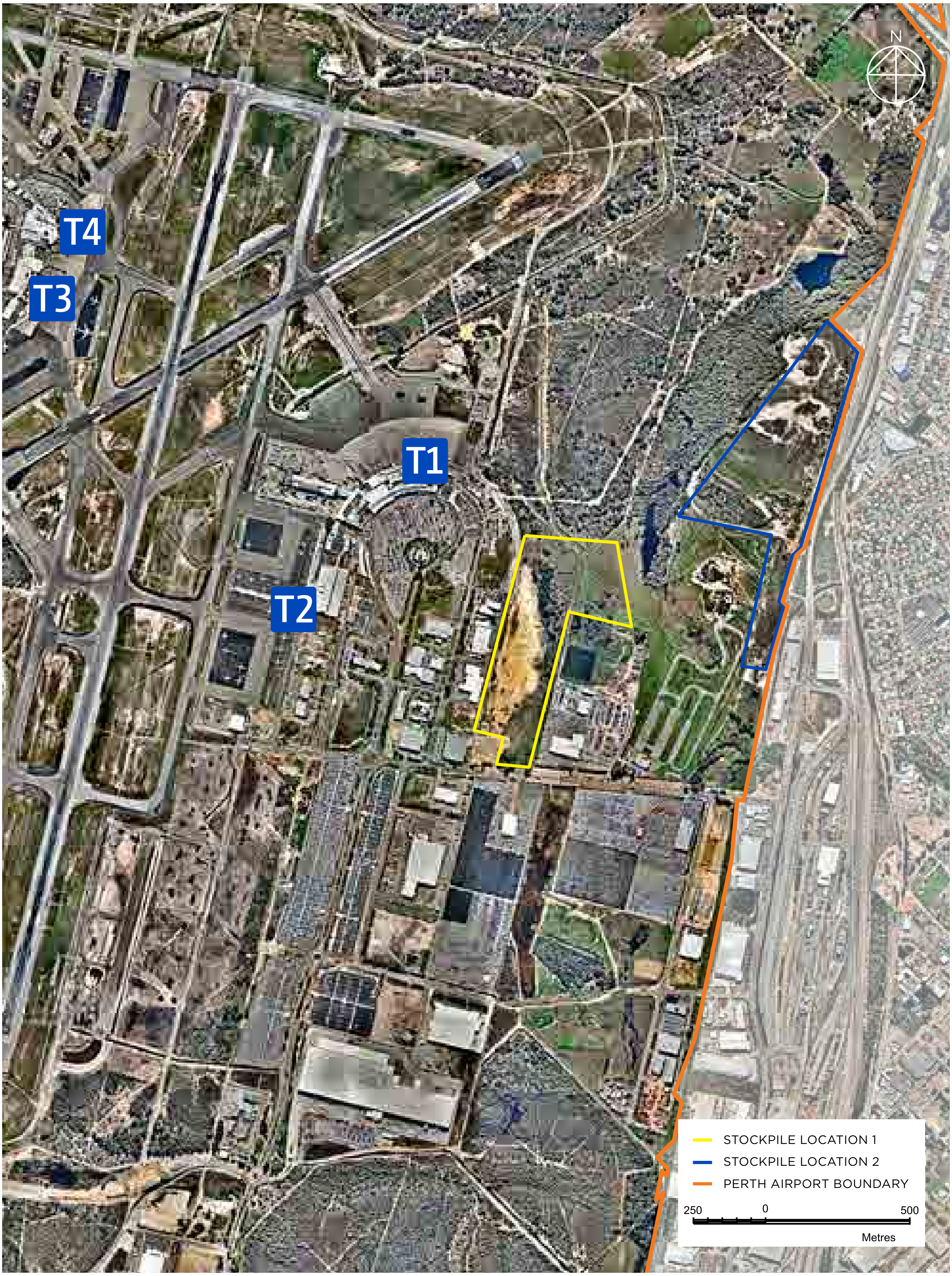
Coordinate System: GDA 1994 Perth Coastal Grid 1994
Projection: Transverse Mercator
Datum: GDA 1994
Units: Meter

Date: 31/07/2015

Drwg No: PTA-GIS-FAL-0001
Version: 7

Forrestfield - Airport Link

MDP Boundary



T4
T3
T1
T2
N
STOCKPILE LOCATION 1
STOCKPILE LOCATION 2
PERTH AIRPORT BOUNDARY
250
0
500
Metres

LIST OF FIGURES

LIST OF TABLES


PERTH CBD
BAYSWATER JUNCTION
AIRPORT WEST
AIRPORT CENTRAL STATION
FORRESTFIELD STATION

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