Main Roads Western Australia
17-Oct-2014

Tonkin Hwy and Welshpool Road East

Preliminary Environmental Impact Assessment

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Preliminary Environmental Impact Assessment

Client: Main Roads Western Australia

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Executive Summary

Tonkin Highway is a major arterial highway in the Perth Metropolitan Area. It links the south east corridor of Perth with the north east and north west corridors of the metropolitan area. It services the Kewdale industrial area and the Perth airport. It is a strategic freight, tourist and inter town route. Welshpool Road East is a major arterial road intersecting Tonkin Highway in Wattle Grove.

Main Roads Western Australia (MRWA) is developing a project to construct a grade separated interchange at the intersection of Tonkin Highway and Welshpool Road East in Wattle Grove (the "project"). Grade separation at this location is necessary to reduce potential vehicular conflict and improve traffic times, congestion and both vehicle and pedestrian safety.

AECOM Australia Pty Ltd was commissioned by Main Roads WA to conduct a Preliminary Impact Assessment (PEIA) for the Project. A desktop review of the environmental conditions of the project and assessment of potential impacts has been conducted for each environmental factor.

The Project is considered to be **at variance** with one principle, **likely to be at variance** with three principles, **may be at variance** with two principles and **not likely to be at variance** with four principles. The principles that the project is at variance or likely to be at variance with are:

Principle c - Native vegetation should not be cleared if it includes, or is necessary for the continued existence of rare flora.

Principle e - Native vegetation should not be cleared if it is significant as a remnant of native vegetation in an area that has been extensively cleared.

Principle f - native vegetation should not be cleared if it is growing in, or in association with, an environment associated with a watercourse or wetland.

Principle h - Native vegetation should not be cleared if it is likely to have an impact on the environmental values of any adjacent or nearby conservation area.

A number of environmental and/or social factors for further consideration have been identified through this PEIA. These factors are:

- Vegetation and Flora
    - Potential for Threatened flora
    - Commonwealth listed Threatened Ecological Communities
    - Under represented vegetation complex
- Threatened fauna
- Surface Water and Wetlands
- Environmentally Sensitive Areas (ESAs) and Nature Reserves
- Acid Sulfate Soils
- Aboriginal Heritage
- Noise and Vibration

There are two Bush Forever Sites (387 and 320) located within or adjacent to the Project Area. Greater Brixton Street Wetlands (Bush Forever Site 387) is known to contain Threatened flora and four TECs including Floristic community type 10a – *Shrublands on dry clay flats*. Hartfield Park Bushland (Bush Forever Site 320) consists of 73.6 ha of remnant bushland and has been reported to contain Endangered Threatened Ecological Community *Banksia attenuata woodlands over species rich dense shrublands* (SCP20a).

One Threatened Ecological Communities (TEC) SCP 10a - *Shrublands on dry clay flats* a State listed Endangered community and a Commonwealth listed Critically Endangered community occurs within the Project Area.

Clearing of native vegetation will be required for project construction. The amount to be cleared is yet to be determined, however all project work occurs within the road reserve boundary of the Metropolitan Regional Scheme. State Planning Policy 2.8 seeks to protect regionally significant bushland except where a proposal is within existing reserves for regional or local roads (WAPC, 2010).

The Project is likely to have a significant impact on the *Environment Protection and Biodiversity Conservation Act, 1999* (EPBC Act) and *Wildlife Conservation Act, 1950* (WC Act) listed three black cockatoo species and *Conospermum undulatum* and *Banksia mimica.*

Eight Geomorphic Wetlands occur within the Project Area. This consists of five Conservation Category Wetlands (CCW), one Resource Enhancement Wetland and two Multiple Use Wetlands. The disturbance of a CCW through construction activities has the potential to further degrade the wetland and damage habitat vital to the survival of flora and fauna species. Clearing of vegetation within the CCW will be required for project construction.

The Vegetation Health Services branch of the Department of Parks and Wildlife have identified the presence of *Phytophthora* at three locations directly north of the Project Area on the western side of Tonkin Highway. Dieback hygiene management actions are required during construction to prevent the introduction or spread of dieback or other pathogens.

The central portion of the Project Area, to the north of Welshpool Road East, has a high to moderate risk of ASS occurring within 3 m of the natural ground level. Any soil or sediment disturbance of equal to or greater than 100 m^3 in areas classed as high to moderate risk of ASS will also require further investigation (DEC, 2009).

Three local government municipal Heritage inventory (MHI) listed sites occur in close proximity to the Project Area. There are no State Heritage registered places in close proximity to the Project Area.

There are five Registered Aboriginal Heritage sites and three other Aboriginal Heritage places within the vicinity of the Project Area. The Project Area traverses four Aboriginal Heritage sites (3773, 3631, 4341 and 22673). A Section 18 Notice form may be required. Further consultation with DAA is required as disturbance of these four Aboriginal Heritage sites may result as a result of construction activities.

Construction activities that occur outside of work hours 07:00 to 19:00 will be required to comply with the requirements of Regulation 13(6) of the Environmental Protection (Noise) regulations 1997 for construction noise. If out of hours work is required, the Department of Environment Regulation (DER) will be required to review and approve a detailed Construction Noise and Vibration Management Plan (CNVMP) that complies with Regulation 13(6) of the Environmental Protection (Noise) Regulations 1997.

Referral under the *Environmental Protection Act, 1986* is likely to be required, unless further environmental studies show that the impact of the Project will not be significant.

Referral under the EPBC Act is likely to be required, unless further studies show that the impact of the Project on EPBC listed species is not likely to be significant.

The following recommendations are made in order to complete the environmental assessment and approval process for the Project:

- Conduct further environmental studies to determine the significance of potential environmental impacts including:
    - a Level 2 flora and vegetation survey to quantify vegetation communities and native vegetation to be cleared within the entire Project Area
    - a black cockatoo habitat assessment
    - a traffic noise impact assessment to predicted noise levels at the affected residential dwellings adjacent to the intersection against nominated noise criteria.

- Depending on outcome of surveys, refer project to the EPA to determine if formal assessment is required.
- Depending on outcome of surveys, refer project to the Commonwealth Minister for the Environment for a decision on whether an assessment is required pursuant to the EPBC Act.
- Consult with DAA to determine if further surveys are required for Aboriginal Heritage.
- Develop an Wetland and Vegetation Management Plan that addresses the management of:
    - flora and Vegetation
    - dieback and weeds
    - groundwater licencing
    - noise and vibration
    - dust
    - hazardous materials and emergency response.
- Develop and implement a site hygiene plan for Dieback and Weeds.

1.0 Introduction

1.1 Background

Tonkin Highway is a major arterial highway in the Perth Metropolitan Area. It links the south east corridor of Perth with the north east and north west corridors of the metropolitan area. It services the Kewdale industrial area and the Perth airport. It is a strategic freight, tourist and inter town route. Welshpool Road East is a major arterial road intersecting Tonkin Highway in Wattle Grove. The intersection of Tonkin Highway and Welshpool Road East is currently an at grade signalised intersection.

Main Roads Western Australia (MRWA) is developing a project to construct a grade separated interchange at the intersection of Tonkin Highway and Welshpool Road East in Wattle Grove (the "project"). Grade separation at this location is necessary to reduce potential vehicular conflict and improve traffic times, congestion and both vehicle and pedestrian safety.

MRWA requires a Preliminary Impact Assessment (PEIA) for the Tonkin Highway and Welshpool Road East intersection. The PEIA will be used to assist in the approvals process and will assist in identifying the scope for additional field investigations. The report will also provide the basis for discussion with the environmental agencies regarding the need to refer the proposal for statutory approval.

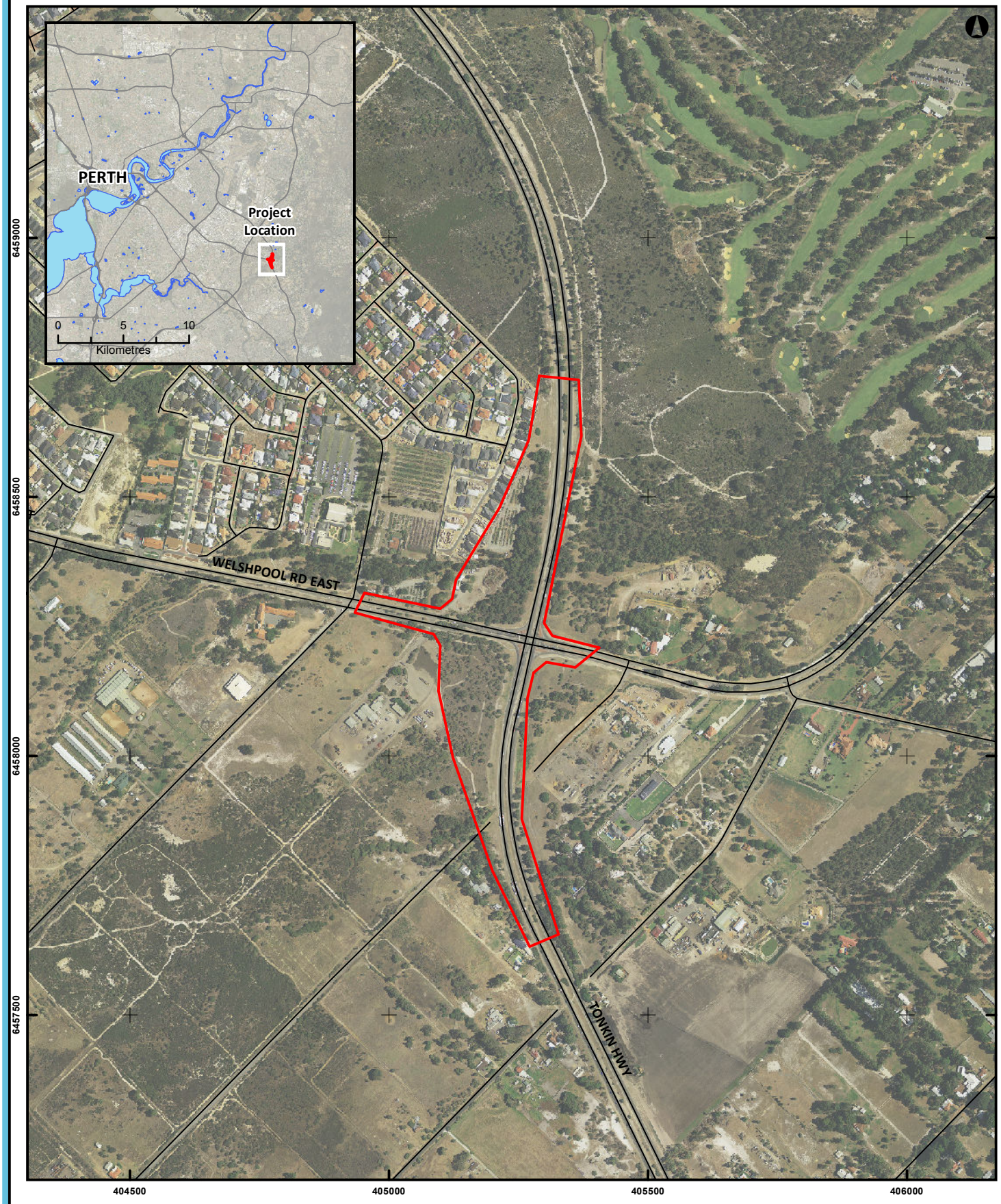
1.2 Project Location

The Tonkin Hwy and Welshpool Road East intersection is located within the Shire of Kalamunda approximately 12 km south east of the Perth CBD (Figure 1).

1.3 Scope of Report

AECOM has undertaken a PEIA of the proposed project. The PEIA included:

- a site inspection
- identification and review of any existing relevant environmental reports
- an initial assessment to determine the key environmental aspects for the road proposal
- assessment of the project against the *Environmental Protection Act's* 10 Clearing Principles (Schedule 5)
- assessment of all environmental aspects likely to require referral of the project in order to provide advice on whether the project should be referred to the Environmental Protection Authority (EPA)
- assessment of all matters of National Environmental Significance to determine whether the project is likely to require referral to the Commonwealth Department of the Environment (DotE) under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) and provide advice as to whether the project should be referred
- consultation with relevant government agencies as required
- a list of the clearances required under other legislative provisions
- a concise report on the findings.



Project Area

Tonkin Hwy and Welshpool Rd East PEIA

Figure 1

Coordinate System: GDA 1994 MGA Zone 50

0 50 100 150 200

Metres

1:10,000 (A4)

LEGEND

Project Area

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1.4 Legal Framework

This PEIA considers the key legislation governing the protection and management of Western Australia's environment and heritage (Table 1).

Table 1 Relevant legislation and potential clearance requirements

Legislation	Purpose	Requirement
Western Australia		
Wildlife Conservation Act 1950	Provides for the conservation and protection of Western Australia's wildlife.	License to take protected flora and fauna, consent to take rare or endangered flora.
Aboriginal Heritage Act 1972	Preservation of places and objects customarily used by the original inhabitants of Australia.	Consent to disturb Aboriginal sites.
Environmental Protection Act 1986	Preventing, controlling and abating environmental harm and conserving, preserving, protecting, enhancing and managing the environment.	Key environmental assessment and approvals legislation in WA.
Conservation and Land Management Act 1984	Provides for the use, protection and management of certain public lands and waters and the establishment of responsible authorities.	License/permit to undertake activities impacting on DER and DPaW managed properties and compliance with management plans
Heritage of Western Australia Act 1990	Conservation of places having significance to Western Australia's cultural heritage.	Permit to disturb damage or demolish Heritage sites.
Rights in Water and Irrigation Act 1914	Provides for regulation, management, use and protection of water resources and irrigation schemes.	Rights and licenses to take water; permit to obstruct or interfere with a watercourse or wetland including its bed or banks.
Contaminated Sites Act 2003	Identification, recording, management and remediation of contaminated sites.	Ensure that development complies with site classification and any restrictions that may apply.
Biosecurity and Agriculture Management Act	Provides for the management, control and prevention of certain plants and animals, declaration of pest species and for the protection of agriculture and related resources generally	Control of weeds declared under the act (Declared Plants)
Commonwealth of Australia		
Environment Protection and Biodiversity Conservation Act 1999	Provides for the protection of the environment and the conservation of biodiversity	Key Commonwealth legislation for environmental protection and conservation. Approval under this Act is required for activities likely to have a significant impact on any matter of national environmental significance.

2.0 Methodology

A desktop review of the environmental values of the Project Area and assessment of potential impacts has been conducted for each environmental factor. Information was sourced from available databases and Geographic Information System (GIS) datasets (Table 2).

A site inspection was conducted on 5th August 2014 by qualified environmental practitioners. The purpose of the site inspection was a reconnaissance to confirm the results of the desktop assessment and identify other environmental issues in the Project Area that had not been identified in the desktop assessment. Vegetation condition and type was noted, but not mapped or formally surveyed.

The Department of Parks and Wildlife (DPaW) database searches were conducted with a 5 km buffer around the Project Area.

The desktop review was used to conduct a preliminary assessment against the Ten Clearing Principles. Note that this is a preliminary assessment and has not been conducted in accordance with the MRWA clearing assessment report template.

Table 2 Desktop information sources

Source	Information Platform
Department of Environment Regulation (DER)	- Contaminated Sites Database - Acid Sulfate Soils and Acidic Landscapes
Department of Parks and Wildlife (DPaW)	- Threatened and Priority Flora Database - Threatened and Priority Fauna Database - Threatened and Priority Ecological Communities Database - WA Herbarium Database - Geomorphic Wetlands of the Swan Coastal Plain
Native Title Tribunal	- Register of Native Title Claims
Department of Aboriginal Affairs (DAA)	- Aboriginal Heritage Inquiry System (AHIS)
Department of the Environment (DotE)	- EPBC Act Protected Matters Search Tool
Department of Water (DoW)	- Hydrogeological Atlas - Groundwater Atlas - Surface Water Proclamation Areas - Groundwater Proclamation Areas
Shire of Kalamunda	- Local Planning Scheme – No 3 - Municipal Heritage Inventory
Heritage Council of Western Australia (HCWA)	- Places Database (inHerit)
Australian Heritage Council	- Australian Heritage Database
Landgate	- Shared Land Information Platform (SLIP)

3.0 Existing Environment

3.1 Vegetation

3.1.1 Vegetation Complexes

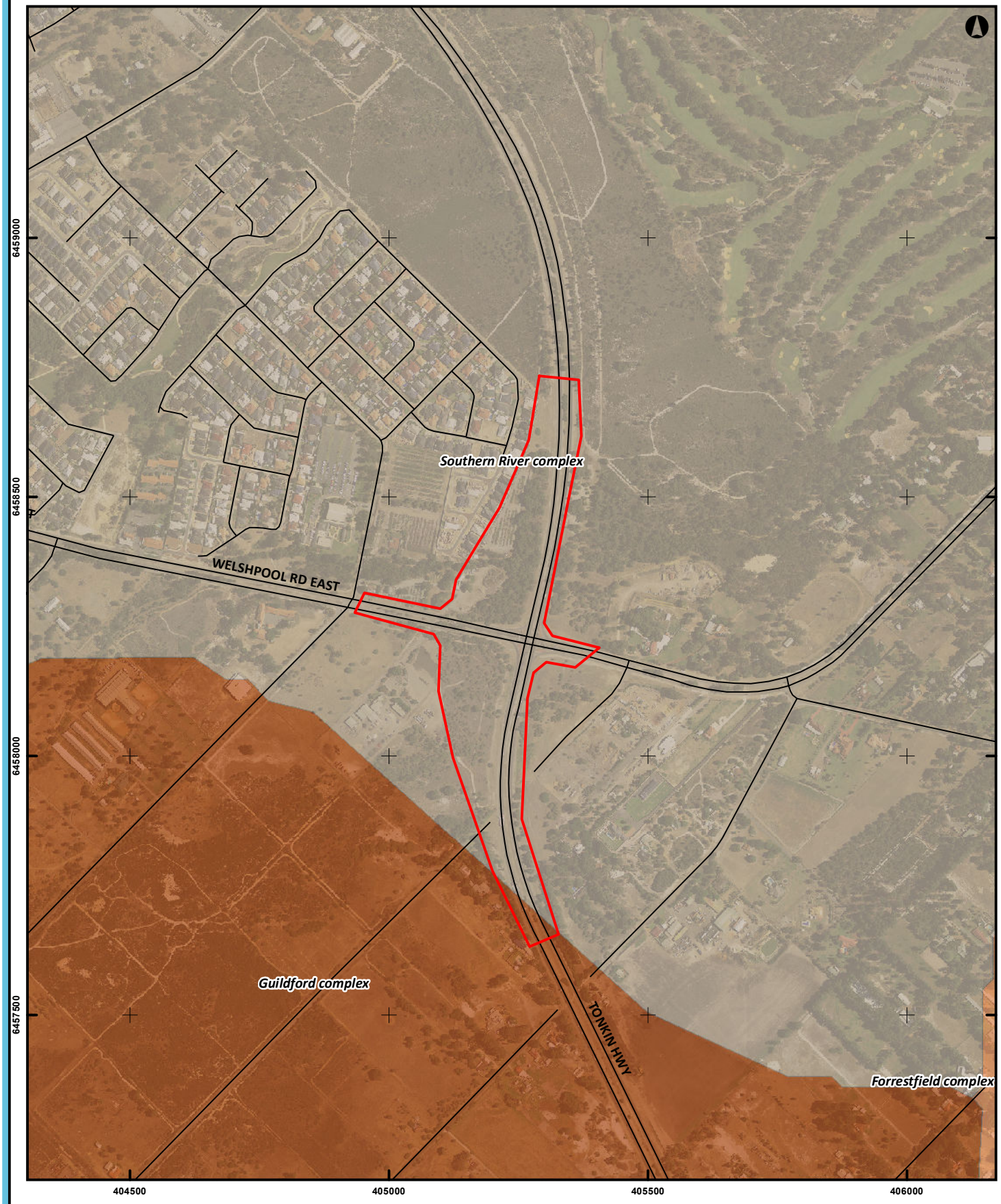
The Project Area (approximately 15ha) is located on the Swan Coastal Plain and has been broadly characterised by Beard (1990) as medium woodland of Jarrah (*Eucalyptus marginata*), Marri (*Corymbia calophylla*) and Wandoo (*Eucalyptus wandoo*). Vegetation complexes within the Project Area have been defined by Heddle *et al.* (1980) and are based on vegetation in association with landforms and underlying geology. The majority of native vegetation occurring within the Project Area forms part of the Southern River Complex and a small southern portion forms part of the Guildford Complex (Heddle *et al.*, 1980) (Figure 2). The remaining extent of the Southern River Complex exceeds the minimum 10% target for the retention of vegetation complexes in constrained areas on the Swan Coastal Plain (EPA, 2000); however Guildford Complex only has 5.9% of the original extent remaining on the Swan Coastal Plain (Table 3).

Table 3 Extent of vegetation complexes on Swan Coastal Plain (Local Biodiversity Program, 2013)

Vegetation Complex	Original Area in Swan Coastal Plain (ha)	Remaining Area (ha)	Percentage Remaining (%)
Guildford Complex	92,281.4	5,412.8	5.9
Southern River Complex	57,171.5	11,255.0	19.7

Approximately 5ha of remnant vegetation remains in the Project Area and broadly consists of three vegetation types. This includes: Jarrah and Marri Woodland over introduced grass, *Eucalyptus / Allocasuarina / Melaleuca* Shrubland over introduced weeds and *Melaleuca rhaphiophylla* Shrubland over introduced weeds. The eastern side of Tonkin highway is devoid of remnant vegetation and only consists of isolated *Melaleuca* spp. and *Allocasuarina* spp. over introduced weeds.

Vegetation condition was not specifically mapped during the site inspection however it was noted that there was a high level of introduced species throughout the entire Project Area with no native vegetation understorey.



Vegetation Complexes

Tonkin Hwy and Welshpool Rd East PEIA

Figure 2

Coordinate System: GDA 1994 MGA Zone 50

0 50 100 150 200

Metres

1:10,000 (A4)

LEGEND

- Project Area

Heddle Vegetation Complexes

- Forrestfield complex
- Guildford complex
- Southern River complex

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3.1.2 Threatened and Priority Ecological Communities

One Threatened Ecological Community (TEC) occurs within the Project Area. SCP 10a - *Shrublands on dry clay flats* is listed as an Endangered community by the state and Critically Endangered community by the Commonwealth. Four TECs have been identified to occur within 5 km of the Project Area (Table 4).

No Priority Ecological Communities are known to occur within close proximity to the Project Area.

Table 4 Threatened Ecological Communities within 5 km of the Project Area

Description	Commonwealth Conservation status	State Conservation Status	Distance to Project Area
SCP10a - Shrublands on dry clay flats	Critically Endangered	Endangered	TEC or TEC buffer occurs within the Project Area
SCP3b - *Corymbia calophylla - Eucalyptus marginata* woodlands on sandy clay soils of the southern Swan Coastal Plain		Vulnerable	1.2 km
SCP20a - *Banksia attenuata* woodland over species rich dense scrublands		Endangered	1.1 km
SCP20c - Shrublands and woodlands of the eastern side of the Swan Coastal Plain	Endangered	Critically Endangered	1.2 km

3.2 Flora

3.2.1 Threatened and Priority Flora

A desktop study identified a total of 60 Threatened or Priority Flora species known to occur in the vicinity of the Project Area. This comprised of 21 species listed under the EPBC Act, 21 species listed under the *Wildlife Conservation Act 1950* and five Priority 1, six Priority 2, 19 Priority 3 and nine Priority 4 species (Appendix A). One threatened species, *Conospermum undulatum* (Vulnerable) has been recorded within 50 m of the Project Area, on the eastern side of Tonkin Highway. Part of the Project Area intersects the Greater Brixton Street Wetland (Bush Forever Site 387) and Hartfield Park Bushland (Bush Forever Site 320). Both Bush Forever sites are known to contain numerous Threatened and Priority Flora (GOW, 2000b) including *Conospermum undulatum*.

Several threatened and priority flora species have been recorded within 200 m of the Project Area and it is likely that the Project Area will contain a number of these species including:

- *Conospermum undulatum* (Vulnerable)
- *Banksia mimica* (EPBC Act – Endangered; WC Act - Threatened (Vulnerable))
- *Grevillea thelemanniana* subsp. *thelemanniana* (Priority 2).

3.2.2 Dieback

Dieback is a plant disease caused by *Phytophthora cinnamomi* which causes root rot in susceptible plants. The Vegetation Health Services (VHS) Branch of DPaW, have identified the presence of *Phytophthora* in the vicinity of the Project Area (DEC, 2006). There are three known records of dieback occurring directly north of the Project Area on the western side of Tonkin Highway.

Dieback hygiene management actions are required during construction to prevent the introduction or spread of dieback and other pathogens.

3.2.3 Weeds

Introduced (weed) species dominate the vegetation of the Project Area. Vegetation within the project area broadly consists of vegetation types comprising a dominant tree species such as *Eucalyptus* or *Melaleuca* over introduced weeds and grasses. Weed species are prolific within the Project Area and large patches of Watsonia (*Watsonia meriana*) dominate the understorey. Vegetation condition was not specifically mapped during the site inspection however it was noted that there was a high level of introduced species throughout the entire Project Area with no native vegetation understorey.

Weed species identified during the site inspection included: Date Palm (*Phoenix dactylifera*), Indian Coral Tree *(Erythrina variegata),* Coastal Teatree *(Leptospermum laevigatum)* and *Watsonia* spp.

3.3 Fauna

3.3.1 Threatened and Priority Fauna

A total of 27 Threatened, Terrestrial Migratory and Priority fauna species were identified through database searches as potentially occurring within the Project Area (Appendix B). Of these species, six are considered likely to occur, one may occur and 20 are considered unlikely to occur. The species considered likely to occur are listed below:

- Forest Red-tailed Cockatoo - *Calyptohynchus banksii* subsp. *naso* (Vulnerable(EPBC Act) & Schedule 1 (WC Act)).
- Baudin's Cockatoo - *Calyptorhynchus baudinii* (Vulnerable (EPBC Act) & Schedule 1 (WC Act)).
- Carnaby's Cockatoo - *Calyptorhynchus latirostris* (Endangered (EPBC Act) & Schedule 1 (WC Act)).
- Rainbow Bee-eater - *Merops ornatus* (Migratory (EPBC Act) & Schedule 3 (WC Act)).
- Eastern Great Egret - *Ardea modesta* (Migratory (EPBC Act) & Schedule 3 (WC Act)).
- Southern Brown Bandicoot or Quenda - *Isoodon obsesulus* subsp. *fusciventer* (Priority 5 DPaW Ranking).

The Common Greenshank may fly over the Project Area and is known to frequent terrestrial wetlands. This species is known to occur in the Welshpool area.

The remaining species were considered unlikely to occur within the Project Area:

- due to lack of suitable species habitat within the Project Area
- as they are only known to occur within the vicinity from historic records
- as they are considered to be migratory or marine species that commonly frequent coastal habitats.

3.3.2 Fauna Habitat

The Project Area is considered to contain habitat for a number of threatened and priority fauna species. There is foraging and potential roosting and breeding habitat for the three black cockatoo species (Carnaby's Cockatoo, Forest Red-tailed Cockatoo and Baudin's Cockatoo). It is also likely that the Project Area contains habitat for Quenda and the Rainbow Bee-eater.

The seasonal movements of black cockatoos means they require large areas of habitat for breeding, night roosting and foraging, as well as connectivity between these habitats to assist their movement through the landscape (DSEWPaC, 2012). The Project Area lies within known foraging area for Baudin's Cockatoos (DSEWPaC, 2012) which primarily consists of *Eucalyptus* woodlands and forest and proteaceous woodland and heaths. During the breeding season they primarily feed on native vegetation, particularly Marri.

Carnaby's Cockatoo is moderately common in pairs, small flocks, occasionally larger flocks and very rarely larger aggregations (Johnstone *et al.*, 2010). Carnaby's Cockatoos are known to utilise Jarrah, Marri and larger Tuart Forests (predominantly on the Swan Coastal Plain) for both foraging and nesting habitat. The Project Area contains Jarrah and Marri woodland over introduced grass which may be suitable as cockatoo nesting and foraging habitat. Numerous trees with the potential to form suitable hollows (>500mm DBH) were observed within the road reserve.

Quenda are likely to use some areas within the Project Area, as they have been recorded to occur near Welshpool, High Wycombe and Forrestfield. Quenda utilise a variety of habitat types including forests, woodlands, heaths and shrub communities. Preferred habitat usually consists of a combination of sandy soils and dense healthy vegetation (Van Dyck & Strahan, 2008) however they are known to occur within degraded road reserves.

The Rainbow Bee-eater is a common species which occupies numerous habitats including open woodlands with sandy loamy soil, sand ridges, sandpits, riverbanks, road cuttings, beaches, dunes, cliffs, mangroves and rainforests. It is possible that this species will occupy open woodland areas within the survey area. This species is not restricted for nesting habitat in the Perth region, as they build nesting tunnels in sandy slopes in a variety of areas, including disturbed sites.

3.4 Surface Water and Wetlands

3.4.1 Catchments

The Project Area is located within the South West Division, Swan Coastal Basin Hydrographic Catchment (DoW 2012).

3.4.2 Surface Water

There are no surface water features in the Project Area (Figure 3).

The Project Area is not within a surface water proclamation area under the *Rights in Water and Irrigation Act 1914*.

3.4.3 Wetlands

Eight Geomorphic Wetlands occur within the Project Area (Table 5). These include five Conservation Category Wetlands (CCW), one Resource Enhancement Wetland and two Multiple Use Wetlands. CCW's are relatively undisturbed wetlands that retain high ecological values. Approximately 20% of the wetlands remaining in the Swan Coastal Plain are considered to be CCW (DPaW, 2014). The disturbance of a CCW through construction activities has the potential to further degrade the wetland and damage habitat vital to flora and fauna species. Resource Enhancement Wetlands are considered to have been partly modified but still support substantial functions and attributes (EPA, 2008). Management priorities for Resource Enhancement Wetlands are to restore the wetland through maintenance and enhancement of functions and attributes by sustainable management. Multiple Use Wetlands are considered to have few attributes which still provide important wetland functions (EPA, 2008). In the case of Multiple Use Wetlands, reasonable measures are to be taken to retain the wetland's hydrological function and, where possible, other wetland functions (EPA, 2008).

Table 5 Wetlands within the Project Area

Wetland Name	UFI	Classification	Category
Unknown	8025	Palusplain	Conservation
Unknown	8028	Sumpland	Conservation
Unknown	8030	Palusplain	Multiple Use
Unknown	13619	Palusplain	Multiple Use
Unknown	14962	Palusplain	Conservation
Unknown	15020	Palusplain	Conservation
Unknown	15021	Palusplain	Conservation
Unknown	15257	Palusplain	Resource Enhancement

3.4.4 EPP SCP Lakes

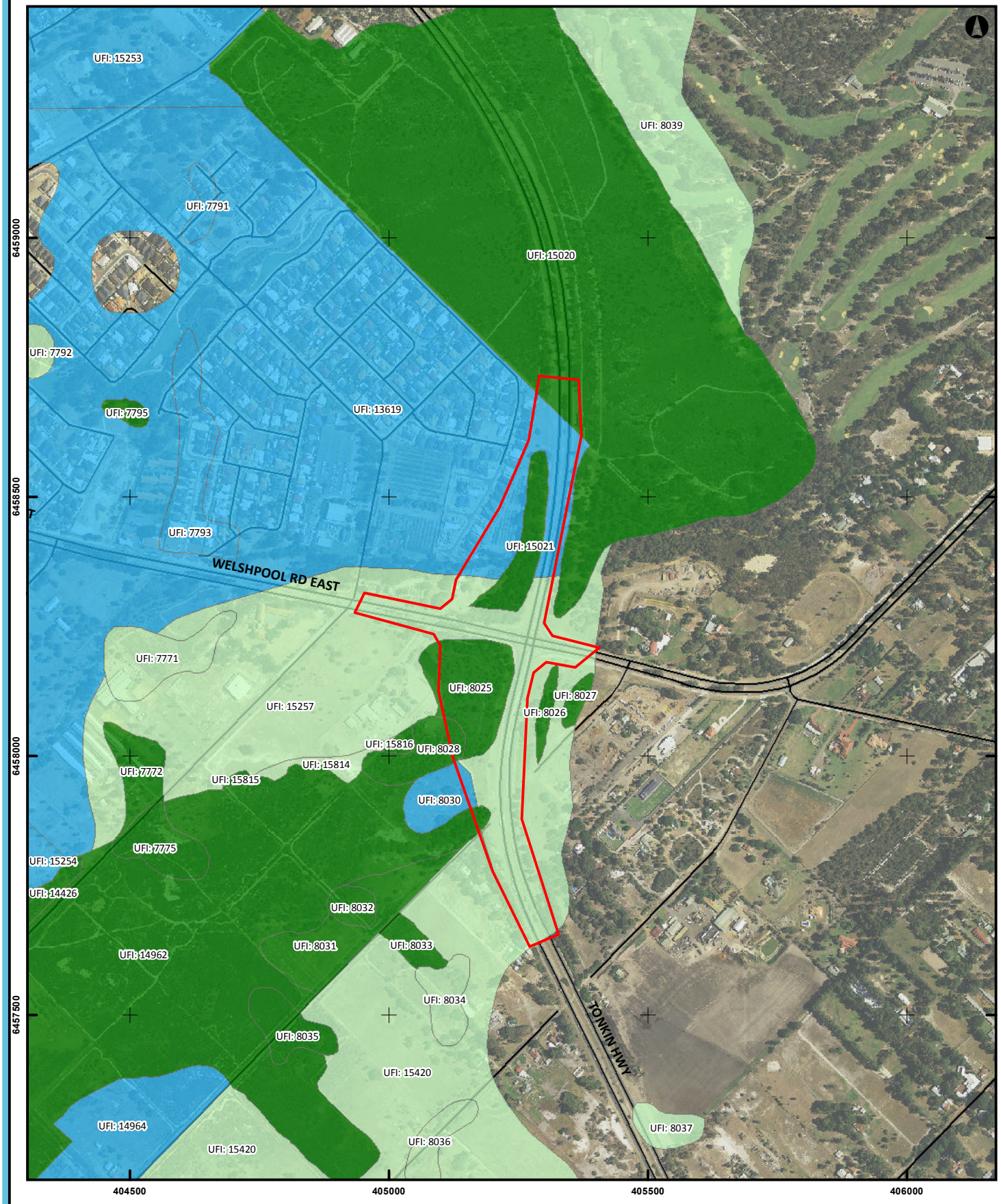
The *Environmental Protection Swan Coastal Plain Lakes Policy 1992* (EPP SCP Lakes) was developed for the protection of the environmental values of lakes on the Swan Coastal Plain. The policy recognises the significant conservation values of lakes, in particular for flora and fauna species, and the need to protect them from infringing development. Lakes having a surface area of 1000 m^2 or more of standing water at 1 December 1991 within the policy area on the Swan Coastal Plain were classified as EPP SCP Lakes.

There are no EPP SCP Lakes within the Project Area. The closest EPP SCP Lake occurs approximately 2.5 km north west of the Project Area and will not be impacted as a result of Project works.

3.4.5 Public Drinking Water Source Areas

Public Drinking Water Source Areas (PDWSA) are declared for management and protection of water sources used for public drinking water supply (DoE, 2005). PDWSAs are proclaimed under the *Metropolitan Water Supply, Sewerage and Drainage Act 1909* and include underground water pollution control areas, water reserves and catchment areas.

There are no Public Drinking Water Source Areas (PDWSAs) located within the Project Area. The nearest PDWSA is the Bickley Brook Catchment Area, 4.4 km south east of the Project Area.



Surface Water, Wetlands and PDWSAs

Tonkin Hwy and Welshpool Rd East PEIA

Figure 3

Coordinate System: GDA 1994 MGA Zone 50

0 50 100 150 200

Metres

1:10,000 (A4)

LEGEND

- Project Area

Geomorphic Wetlands

- Conservation
- Resource Enhancement
- Multiple Use
- Not Assessed
- Not Applicable

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3.5 Groundwater

Three layers of aquifer occur beneath the Project Area. The unconfined or superficial aquifer is the topmost layer, and is most usually accessed for groundwater abstraction. Beneath the superficial aquifer lies the semi-confined Leederville aquifer. Below the Leederville aquifer lies the confined Yarragadee North aquifer.

The superficial aquifer receives direct recharge from groundwater infiltration and surface water. There is limited interaction between the various aquifers, in terms of water exchange. Both the Yarragadee and the Leederville aquifer receive direct recharge where these formations outcrop (not within the Project Area). Groundwater movement and recharge is very slow in these confined aquifers. Some water in the Yarragadee is believed to be up to 50,000 years old.

Depth to groundwater is approximately 9.5 m below ground level throughout the Project Area (DoW, 2012). Groundwater levels are fairly constant across the Project Area at around 11 to 12 m Australian Height Datum (AHD). The depth of the bottom superficial aquifer in the Project Area is approximately 21 m below ground level (DoW, 2012).

Dewatering and abstraction of groundwater may reduce the quantity of groundwater available for other human uses and groundwater dependant ecosystems including wetlands. Groundwater dependant ecosystems require access to groundwater to meet all or some of their water requirements to maintain their ecological processes. Dewatering and abstraction of groundwater may result in a drawdown cone and artificially lower the groundwater levels, resulting in less water being available at the root zone of plant species within the GDE. It is highly unlikely that Groundwater dependant vegetation are equipped to tolerate drastic modifications to the local groundwater regime (Bacon, *et al.*, 1993; Dye, 1996; White *et al.*, 1996).

The Project Area is located within a groundwater proclamation area. In proclaimed areas, under the *Rights in Water and Irrigation Act 1914*, it is illegal to take water from a watercourse or groundwater aquifer without a licence.

3.6 Environmentally Sensitive Areas

3.6.1 Environmentally Sensitive Areas

Environmentally Sensitive Areas (ESAs) are areas that have been identified for their environmental significance as outlined in the Western Australian *Environmental Protection (Environmentally Sensitive Areas) Notice 2005*, which was gazetted on 8 April 2005. ESAs are gazetted due to supporting environmental values of State or Commonwealth importance and include:

- Declared World Heritage properties
- areas included on the National Heritage List
- defined wetlands and associated buffers
- vegetation within 50 m of rare flora
- TECs.

Exemptions from the clearing regulations under Regulation 5 of the *Environmental Protection (Clearing of Native Vegetation) Regulations 2004* do not apply within ESAs.

The majority of the Project Area falls within an ESA with the exception of two small areas located at the southern end of the Project Area and north of Welshpool Road East (Figure 4). This ESA is associated with Bush Forever Site 387, 320 and TEC 10a – *Shrublands on dry clay flats*.

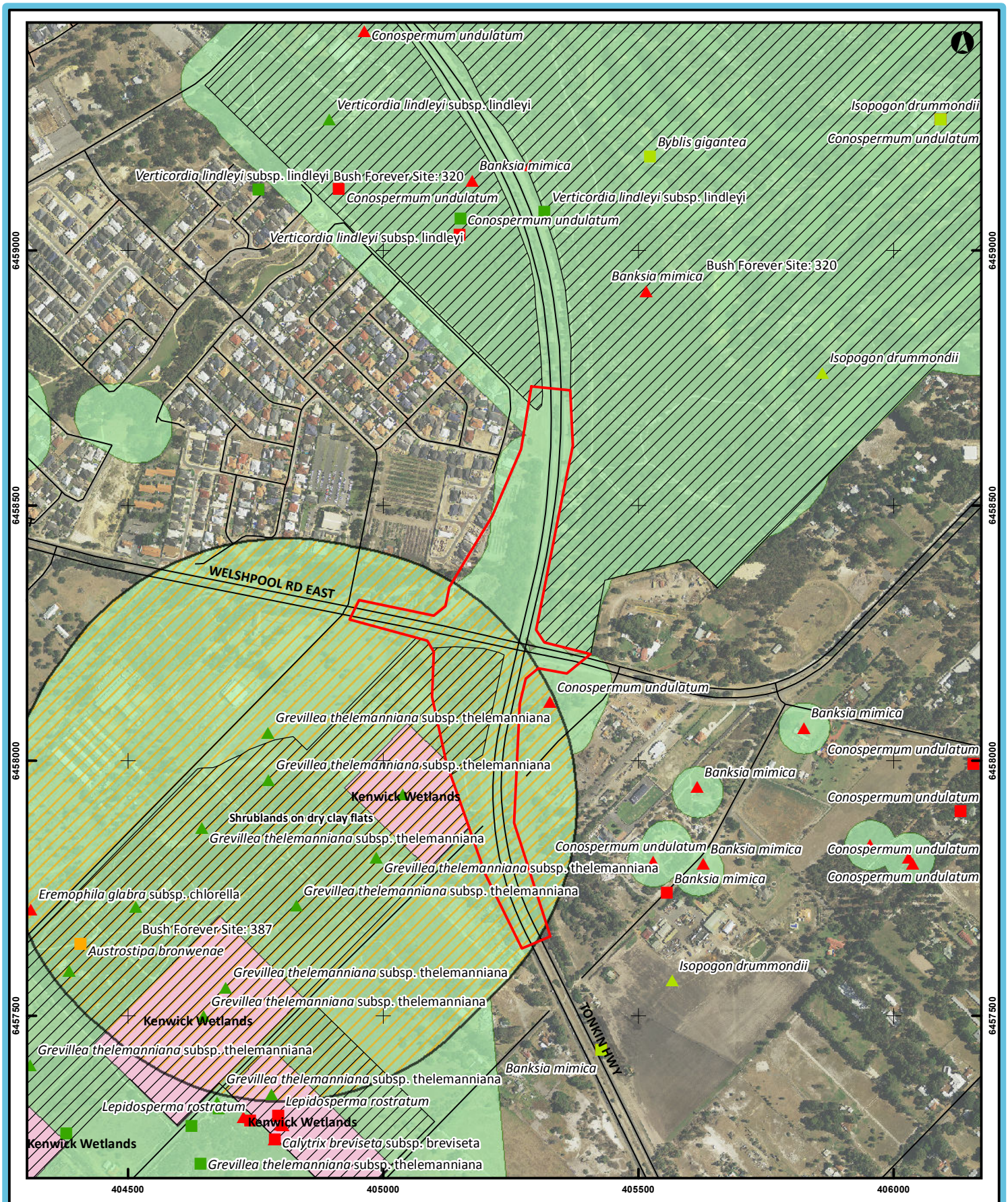
3.6.2 Bush Forever Sites

State Planning Policy 2.8: *Bushland Policy for the Perth Metropolitan Region* recognises the protection and management of significant bushland areas such as Bush Forever in the planning process, as well as integrating environmental, social and economic considerations (WAPC, 2010). Bush Forever identifies regionally significant bushland to be retained and protected wherever possible. It is one of the most significant conservation initiatives undertaken in Western Australia. There are two Bush Forever Sites (387 and 320) located within or adjacent to the Project Area.

Greater Brixton Street Wetlands (Bush Forever Site 387) is 126.7 ha in size and has been reported to contain over 555 native taxa including numerous Threatened flora (Figure 4). This Bush Forever site is known to contain four TECs including Floristic community type 10a – *Shrublands on dry clay flats*.

Hartfield Park Bushland (Bush Forever Site 320) consists of 73.6 ha of remnant bushland and has been reported to contain Endangered Threatened Ecological Community *Banksia attenuata woodlands over species rich dense shrublands* (SCP20a).

State Planning Policy 2.8 seeks to protect regionally significant bushland except where a proposal is within existing reserves for regional or local roads (WAPC, 2010). The policy does not prevent development or clearing within regionally significant bushland where a proposal or decision is consistent with existing approved uses or existing planning / environmental commitments or approvals such as upgrades to the road transport network within the existing MRS road reserve (WAPC, 2010).



Environmentally Sensitive Areas, Bush Forever and Nature Reserves

Tonkin Hwy and Welshpool Rd East PEIA

Figure 4

Coordinate System: GDA 1994 MGA Zone 50

0 50 100 150 200

Metres

1:10,000 (A4)

LEGEND

- Project Area
- Bush Forever Sites
- Environmentally Sensitive Areas
- Nature Reserve

TEC/PEC

- Critically Endangered
- Endangered
- Vulnerable

	DPaW TPFL	WAHerb Records
	T	T
	1	1
	3	2
	4	3
		4

AECOM

3.7 Geology, Landforms and Soils

The surface geology of the Project Area is mainly from the Guildford Formation, with some Bassendean Sand. The Guildford Formation is derived from alluvial and estuarine sediment and consists of alluvial sand and clay with shallow marine and estuarine lenses and local basal conglomerates (Geological Survey of Western Australia, 1970). The Bassendean Sand is derived from aeolian sand and coastal sediment and is described as basal conglomerate overlain by dune quartz sand with heavy mineral concentrations (Geological Survey of Western, Australia 1970).

3.7.1 Soils

The Project Area consists of soil type Cb38. This soil type is described as sandy dunes with intervening sandy and clayey swamp flats; chief soils are leached sands (Uc2.33) and (Uc2.21), sometimes with a clay horizon on the dunes and sandy swamps (Geological Survey of Western Australia, 1970).

3.7.2 Acid Sulfate Soils

Acid Sulfate Soils (ASS) are naturally occurring soils, sediments and peats that contain iron sulphides, predominately in the form of pyrite materials. These soils are most commonly found in low-lying land bordering the coast or estuarine and saline wetlands and freshwater groundwater dependant wetlands throughout Western Australia (DEC, 2009).

The central portion of the Project Area, to the north of Welshpool Road East, has a high to moderate risk of ASS occurring within 3 m of the natural ground level (Figure 5). Any soil or sediment disturbance of equal to or greater than 100 m^3 in areas classed as high to moderate risk of ASS will also require further investigation (DEC, 2009).

The remainder of the Project Area has a moderate to low risk of ASS occurring within 3 m of natural ground level. Soil or sediment disturbance equal to or greater than 100 m^3 involving excavation below the natural watertable or lowering of the water table (temporarily or permanently) in areas classed as moderate to low risk of ASS occurrence will require an ASS investigation (DEC, 2009).

3.8 Contaminated Sites

The DER *Contaminated Sites Database* presents information on known contaminated sites that have been classified by DER as ‘contaminated – restricted use’; ‘contaminated – remediation required’ and ‘contaminated for restricted use’. The *Contaminated Sites Database* does not provide details of all contamination classifications. Information on all recorded sites is available for a fee by contacting DER in writing to access the Reported Sites Register.

A search of the *Contaminated Sites Database* indicates that there are no registered contaminated sites within the Project Area.

The nearest known contaminated site is located approximately 200m to the west of the Project Area. This area has been classified as ‘*contaminated – remediation required*’ due to the presence of hydrocarbon contamination in soils and groundwater. The DER has reported that the hydrocarbon plume extends off-site in a south-westerly direction. Based on the anticipated plume direction and distance from the Project Area, this contaminated site is considered unlikely to impact the Project Area.

Acid Sulfate Soil Risk and Contaminated Sites

Tonkin Hwy and Welshpool Rd East PEIA

Figure 5

Coordinate System: GDA 1994 MGA Zone 50

0 50 100 150 200

Metres

1:10,000 (A4)

LEGEND

- Project Area
- Acid Sulfate Soil Risk
  - High to moderate risk
  - Moderate to low risk
- Contaminated Sites
  - Contaminated - remediation required
  - Contaminated - restricted use
  - Remediated for restricted use

AECOM

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3.9 Heritage

3.9.1 Commonwealth Heritage

There are no Commonwealth Heritage Places within 1km of the Project Area. It should be noted that the Register of National Estate was closed in 2007 and is now a non-statutory list, with all references to it in the EPBC Act were removed in 2012. Places of national heritage importance which are protected under the EPBC Act are now listed under the National Heritage List.

3.9.2 Non-Indigenous Heritage

Three local government municipal heritage inventory (MHI) listed sites occur in close proximity to the Project Area. The closest, Wattle Grove Primary School occurs directly adjacent to the Project Area at the intersection of Welshpool Road East and Brook Street (Figure 6). There are no State Heritage registered places in close proximity to the Project Area. A summary of those Heritage sites within close proximity to the Project Area is presented in Table 6.

Table 6 Heritage sites listed on the Shire of Kalamunda Municipal Inventory within 1.5 km of the Project Area

Shire of Kalamunda Site Number	Name	Listing	Other Place Names	Location	Distance from Project Area (m)
185	Wattle Grove Primary school	Municipal Heritage Inventory		639 Welshpool Road East, Wattle Grove	50m
186	Taylor's home	Municipal Heritage Inventory	Rothwood	782 Welshpool Road East, Wattle Grove	750m
187	Archer's home and Poultry farm	Municipal Heritage Inventory		790 Welshpool Road East, Wattle Grove	800m

Wattle Grove Primary School was built in 1940 and is of significance as it is indicative of the growth of Wattle Grove post World War II (Shire of Kalamunda, 2014a). During 1940s the building consisted of a single building including a verandah with additional construction taking place during 1952, 1959 and 1990. The school is of significance for its demonstration of the change in the school facilities from 1940 to 2011 and has social value for many of the community who have attended the school since 1940 (Shire of Kalamunda, 2014a).

3.9.3 Aboriginal Heritage

In Western Australia, the *Aboriginal Heritage Act 1972* (AHA) protects Aboriginal sites defined under Section 5 of the Act. It is an offence under Section 17 of the Act to excavate, destroy or damage a site unless the person is acting with the authorisation of the Registrar under Section 16, or the consent of the Minister under Section 18 of the AHA.

Known Aboriginal sites are classified as 'Registered' when they have been assessed as meeting the definition of Section 5 of the AHA. These sites are fully protected by law and any disturbance of the actual site will usually require Section 18 consent to disturb the site. Registered sites are listed and mapped on the Department of Aboriginal Affairs (DAA) Aboriginal Sites Register. DAA can examine the actual extent of the closed site and advise if an impact is likely. In the case of Open sites, the actual spatial extent of the site can be provided by DAA on request.

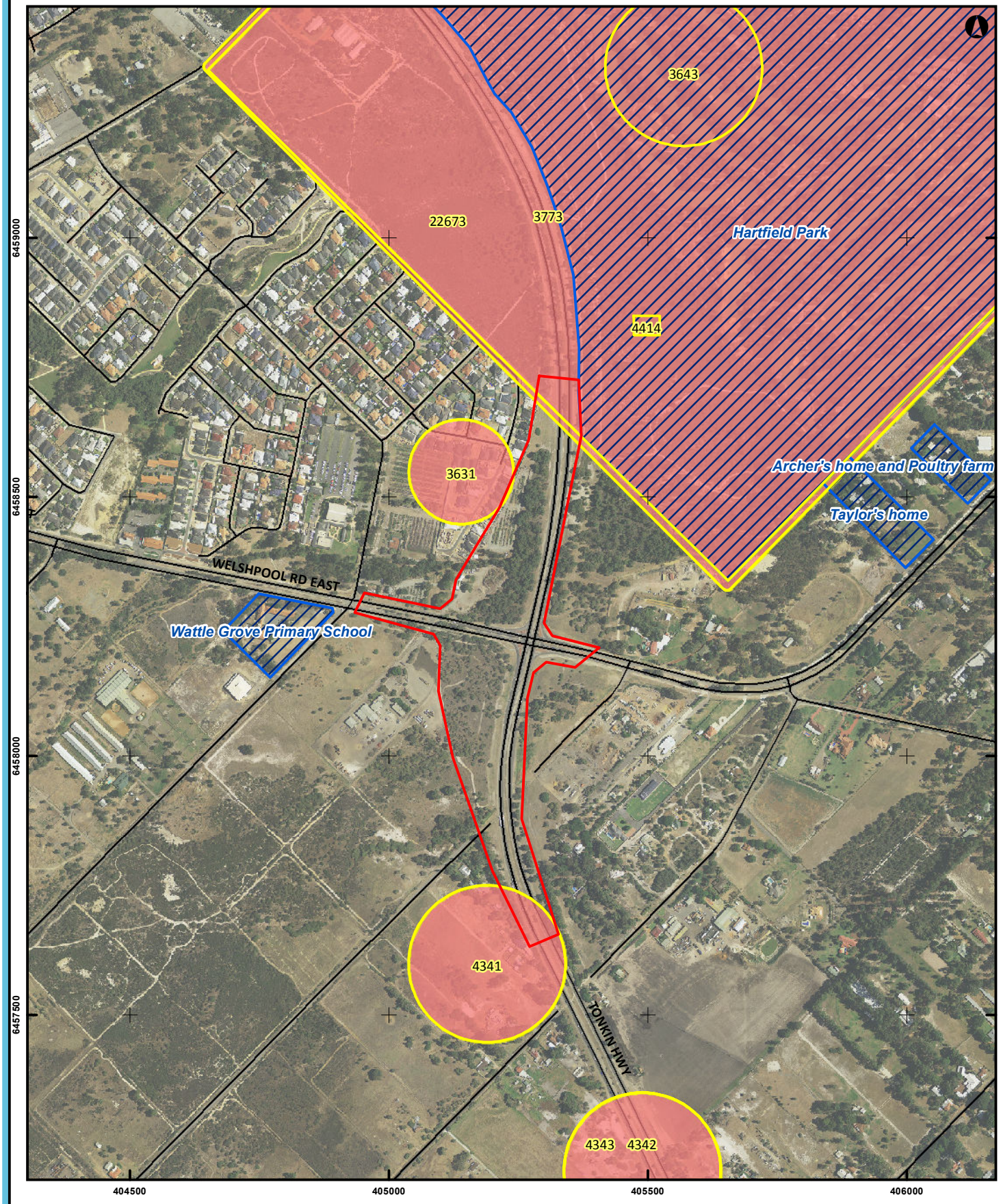
'Other Heritage Places' covers sites that have been assessed by the Aboriginal Cultural Material Committee (ACMC) as not meeting the definition of a site under Section 5 of the AHA, or sites awaiting final determination by the ACMC. Other Heritage Places are places that have not been assessed by the ACMC, or may be awaiting a final decision on the place status, or the ACMC may have determined that there is insufficient information to make a determination. Places that have been assessed and have been determined by the ACMC as not meeting the requirements of Section 5 of the AHA are classified as stored data. The information is retained on the DAA Aboriginal Sites Register for reference, but these Other Heritage Places are not protected by the AHA.

It should be noted that an Aboriginal Heritage site is protected, even if it is not listed on the DAA Aboriginal Sites Register. Any new Aboriginal Heritage site discovered in the course of the Project should be considered to be protected under the AHA, until it has been determined otherwise.

There are five Registered Aboriginal Heritage sites and three other Aboriginal Heritage places within the vicinity of the Project Area (Table 7) (Figure 6). The Project Area traverses four Aboriginal Heritage sites (3773, 3631, 4341 and 22673).

Table 7 Aboriginal Heritage Sites recorded in the vicinity of the Project Area (DAA, 2014)

Site Id	Site Name	Status	Site Type
Aboriginal Heritage Site			
3631	Yule Brook A & B	Registered Site	Artefacts / Scatter
3773	Welshpool Reserve	Registered Site	
4414	Forrestfield Scarred Tree	Registered Site	Modified Tree
4342	Brentwood Road, Quarry	Registered Site	Artefacts / Scatter, Quarry
4343	Brentwood Road, Swamp	Registered Site	Artefacts / Scatter
Other Aboriginal Heritage Places			
3643	Hartfield Road	Lodged	Artefacts / Scatter
4341	Brentwood Road NW	Lodged	Artefacts / Scatter
22673	Maamba Reserve	Lodged	Historical



Heritage Sites within close proximity to the Project Area

Tonkin Hwy and Welshpool Rd East PEIA

Figure 6

Coordinate System: GDA 1994 MGA Zone 50

0 50 100 150 200 250

Metres

1:10,000 (A4)

LEGEND

- Project Area
- Aboriginal Heritage
- Non Indigenous Heritage

AECOM

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3.10 Noise and Vibration

3.10.1 Construction Noise

Construction noise can cause temporary adverse impacts on nearby residential receivers. Whilst the impacts are temporary, construction noise can have a nuisance effect, and in more severe cases, an impact on human health. Major causes of impacts from construction noise are:

- extremely loud, repetitive noise, such as piling at any time of the day
- out of hours works, particularly night works
- pre-start noise (e.g. vehicles starting up, pre-start meetings, workers gathering), particularly when the site office or compound is close to residential receivers
- noisy plant (especially where other quieter plant is available)
- reversing beepers (particularly at night).

Construction activities that occur outside of the work hours of 07:00 to19:00 will be required to comply with the requirements of Regulation 13(6) of the *Environmental Protection (Noise) Regulations 1997* (Noise Regulations) for construction noise.

3.10.2 Vibration

Vibration from construction works may cause impacts on humans and buildings. Humans can experience discomfort from vibration, so construction vibration may have a temporary nuisance effect on nearby residents. Vibration has the potential to cause structural damage to nearby buildings, especially where the ground particle velocity exceeds 5 mm/s.

3.10.3 Traffic Noise

Excessive traffic noise has the potential to adversely impact human health and amenity. Long term exposure to high levels of noise may cause health, learning and development problems (WAPC, 2009). An individual's tolerance to noise can vary depending on the time of day and type of noise, and tolerances vary between individuals.

For the upgrade of an existing road, State Planning Policy (SPP) 5.4 states that practicable noise management and mitigation measures should be considered in accordance with the possible measures and what is reasonable and practicable, having regard to:

- the existing transport noise levels
- the likely changes in noise emissions resulting from the proposal; and
- the nature and scale of the works and the potential for noise amelioration.

There are several nearby noise sensitive receivers. The nearest residential property is adjacent to the Project Area boundary in the north west of the Project Area.

3.11 Air Quality

Perth, like most urban areas of Australia, occasionally suffers poor air quality, including photochemical smog in summer and particle haze during winter (DER, 2014a). The two main causes of air pollution in Perth are vehicle emissions and smoke (DEP, 1996). Air pollutants are measured by DER at eight sites throughout the Perth metropolitan area. The National Environmental Protection Measure (NEPM) sets standards for the allowable concentration of carbon monoxide (CO), nitrogen dioxide (NO_2), photochemical oxidants (measured as ozone) (O_3), sulphur dioxide (SO_2), lead (Pb) and inhalable particles (particulate matter as PM_{10} and $PM_{2.5}$) in ambient air. Lead is no longer monitored as it poses little risk in ambient air since the abolition of leaded petrol.

The closest DER air quality monitoring site to the Project Area is at Caversham, approximately 16 km to the north of the Project Area. The Caversham monitoring station is located in a region of low population density and is therefore not considered a performance monitoring station. Ambient air quality monitored at Caversham is generally within the National Environmental Protection Measure (NEPM) Ambient Air Quality standards. Ambient air quality in 2013 exceeded the NEPM on two days for Ozone and PM_{10} (DER, 2014b). These exceedances were due to smoke haze or inland events.

It is unlikely that the project will have a significant adverse impact on ambient air quality. It is expected that the project will marginally improve ambient air quality, through reducing traffic congestion. Any increases in traffic volume are anticipated to have a minor adverse impact on ambient air quality, but will not result in air quality deteriorating to the point that it exceeds the NEPM standards.

Regional ambient air quality meets the NEPM standards for all criteria other than for $PM_{2.5}$. Other than for particulate matter, it is unlikely that the NEPM standards for air quality will be exceeded in foreseeable future. Where particulate matter exceeds the NEPM, it is usually caused by dust storms or smoke from bushfires or residential woodfires and is not due to vehicle emissions.

No management actions are required for impacts on ambient air quality.

3.11.1 Dust

Dust is comprised of particles suspended in the atmosphere and is classified on the basis of particle size. Dust size classifications include total suspended particulates (TSP), which consists of particulate matter less than 50 micrometres (µm), particulate matter less than 10 µm (PM_{10}) and particulate matter less than 2.5 µm ($PM_{2.5}$) in diameter.

Dust during construction has the potential to cause nuisance impacts on nearby residential, commercial and industrial land uses. It may also constitute a safety hazard to road and rail traffic. High concentration levels of dust may impact upon human health.

3.12 Salinity

Groundwater salinity within the Project Area is brackish with a total dissolved salt content of 1500 to 3000mg/L (DoW, 2012).

3.13 Adjacent Land Use

Land use adjacent to the Project Area consists of conservation reserves, residential housing and recreation areas. Numerous new residential buildings occur on the north side of Welshpool Road East, whilst the south side is predominantly conservation reserve.

3.14 Visual Amenity

The Project may potentially have an impact on visual amenity within the Project Area and surrounds, as the proposed construction of the grade separated interchange will change the visual and landscape amenity of the area. Visual intrusion impacts occur when a Project allows a new intrusive view from a public area into an otherwise private area of a residential property. Visual intrusion impacts are likely to occur due to the close proximity to existing residential development north of Welshpool Road East.

3.15 Public Safety and Risk

The Project aspects which have the potential to impact upon public safety include construction activities and traffic.

Access to the construction site and the movement of traffic through and around the Project Area during construction both have the potential to cause injury or death to the public if not managed properly. The proposed Project may impact on public safety during construction and operation phases. During construction, access to the work site and the interface between the Project site and public roads represent the greatest risk. During operations, public access and general road traffic on the highway represent the highest risk to public safety.

Preventing public access and establishing suitable traffic management procedures during construction will reduce the risk to public safety.

3.16 Hazardous Substances

The storage and use of chemicals, including fuel, within the Project Area has the potential to adversely impact the quality of groundwater, surface water and soils through spills and leaks. Appropriate construction management procedures and an emergency response procedure will reduce the risk of spills and their impact. Storage of chemicals and refuelling should not occur in or adjacent to wetlands and bunding should be used for the storage of all liquids except rainwater.

4.0 Matters of National Environmental Significance

4.1 Summary of Potential Matters of NES

A search utilising the Department of the Environment Protected Matters Search Tool was conducted to identify any factors of environmental significant Protected under the EPBC Act (Appendix C). The results of the report are presented in Table 8. The significance of impacts on Matters of National Environmental Significance has been assessed in accordance with DotE's Matters of National Environmental Significance: Significant Impact Guidelines 1.1 and other relevant guidance (DotE, 2013b).

Table 8 Summary of MNES that may occur in the Project Area

Matters of NES	Number Potentially Occurring	Significance of Impact
World Heritage Properties	0	No impact
National Heritage Places	0	No impact
Wetlands of International Significance (Ramsar)	0	No impact
Nuclear Actions	0	No impact
Great Barrier Reef Marine Park	0	No impact
Commonwealth Marine Areas	0	No impact
Threatened Ecological Communities	1	Potential impact on TEC SCP 10a – *Shrublands on dry clay flats*. This TEC or TEC buffer occur within the Project Area
Threatened Species	18 Threatened flora identified through EPBC search. 21 Threatened flora identified through EPBC and DPaW database search 8 Threatened fauna species identified through EPBC search. 11 Threatened fauna identified through EPBC and DPaW Database search	Potential impact on six Threatened flora including - *Conospermum undulatum* – recorded within 50m of Project Area - *Calytrix breviseta* subsp *breviseta* - *Lepidosperma rostratum* - *Diuris purdiei* - *Banksia mimica* - *Eleocharis keigheryi* Potential impact on three Threatened fauna species including: - Forest Red-tailed Cockatoo (Vulnerable EPBC Act) - Baudin's Cockatoo (Vulnerable EPBC Act) - Carnaby's Cockatoo (Endangered EPBC Act)
Migratory Species	6	No impact The Project is not anticipated to have significant impact upon important habitat of any EPBC Act listed migratory species. It is not considered likely that there will be a significant impact on migratory species as a result of the Project.

Matters of NES	Number Potentially Occurring	Significance of Impact
Protection of water resources from coal seam gas development and large coal mining development	0	No impact
Other Matters Protected under the EPBC Act		
Commonwealth Lands	0	No impact
Commonwealth Heritage Places	0	No impact
Listed Marine Species	7	No impact. Project is entirely on-shore and will not impact upon marine species.
Whales and other Cetaceans	0	No impact.
Critical Habitats	0	No impact
Commonwealth Reserves Marine	0	No impact
Commonwealth Reserves Terrestrial	0	No impact

4.2 Threatened Species

The EPBC Protected Matters Search identified 26 threatened species listed under the EPBC Act that may occur in the Project Area. This consisted of 18 Threatened flora and eight Threatened fauna species. A combined EPBC Protected Matters Search and DPaW database search identified a total of 32 EPBC listed Threatened species consisting of 21 flora species and 11 fauna species.

4.2.1 Threatened Flora

A combined total of 21 EPBC listed Threatened flora species were identified as potentially occurring within the Project Area. One Threatened flora species (*Conospermum undulatum),* listed as Vulnerable under both the EPBC and the WC Act, is located approximately 50 m from the Project Area. This species is known to occur within Bush Forever Site 387 and 320.

Based on current distribution, preferred habitat types and degraded nature of the road reserve, it is considered that six flora species may occur and 15 are unlikely to occur within the Project Area (Table 9).

Table 9 Potential EPBC listed Threatened flora species occurring within the Project Area

Species	Commonwealth Conservation Status	WA Conservation Status	Flowering Period	Preferred Habitat	Likelihood of occurrence
Synaphea sp. Fairbridge Farm (D Papenfus 696)	Critically Endangered	Threatened - Critically Endangered	October	Sandy with lateritic pebbles, near winter wet flats in low woodland with weedy grasses.	Unlikely to occur – no known records occurring near Project Area
Ptilotus pyramidatus	Critically Endangered	Threatened - Critically Endangered	October	Scrub. Growing under *Melaleuca lateriflora* subsp. *acutifolia*. Grey-white sandy clay	Unlikely to occur – no suitable habitat present within Project Area
Darwinia foetida	Critically Endangered	Threatened – Endangered	October to November	Low plain with dry grey sand	Unlikely to occur – all known records from Muchea area
Calytrix breviseta subsp *breviseta*	Endangered	Threatened - Critically Endangered	October to November	Sandy clay, Swampy flats	May occur – recorded within Bush Forever Site 387
Eucalyptus x balanites	Endangered	Threatened - Critically Endangered	October to December or January to February	Sandy soils with lateritic gravel	Unlikely to occur – No suitable habitat present within Project Area
Thelymitra dedmaniarum	Endangered	Threatened - Critically Endangered	November January	Granite	Unlikely to occur – No suitable habitat present within Project Area
Caladenia huegelii	Endangered	Threatened – Critically Endangered	September to October	Grey or brown sand, clay loam	Unlikely to occur – no suitable habitat present within Project Area

Species	Commonwealth Conservation Status	WA Conservation Status	Flowering Period	Preferred Habitat	Likelihood of occurrence
Drakaea elastica	Endangered	Threatened – Critically Endangered	October to November	White or grey sand. Low lying situations adjoining winter wet swamps	Unlikely to occur – no suitable habitat present within Project Area
Grevillea curviloba subsp. *incurva*	Endangered	Threatened - Endangered	August to September	Sand, sandy loam, Winter wet heath	Unlikely to occur – no suitable habitat present within Project Area
Lepidosperma rostratum	Endangered	Threatened - Endangered		Peaty sand, clay	May occur – recorded within Bush Forever Site 387
Macarthuria keigheryi	Endangered	Threatened - Endangered	September to December or February to March	White or grey sand	Unlikely to occur – no suitable habitat present within Project Area
Diuris purdiei	Endangered	Threatened – Endangered	September to October	Grey-black sand. Winter wet swamps	May occur – suitable habitat present within Project Area
Thelymitra stellata	Endangered	Threatened – Endangered	October to November	Sand, gravel, lateritic loam	Unlikely to occur – no suitable habitat present within Project Area
Banksia mimica	Endangered	Threatened - Vulnerable	December or January to February	White or grey sand over laterite, sandy loam Woodland heath with Banksia, Melaleuca and Dasypogon.	May occur – recorded within 300m of Project Area
Chamelaucium sp. Gingin (NG Marchant 6)	Endangered	Threatened - Vulnerable	October to December	White/grey sand	Unlikely to occur – known records from Muchea area
Andersonia gracilis	Endangered	Threatened – Vulnerable	September to November	White/grey sand, sandy clay, gravelly loam. Winter-wet areas near swamps	Unlikely to occur – all known records from Cataby area
Centrolepis caespitosa	Endangered	Priority 4	October to December	White sand, clay, salt flats and wet areas.	Unlikely to occur – No suitable habitat present within Project Area
Drakaea micrantha	Vulnerable	Threatened - Endangered	September to October	White grey sand	Unlikely to occur – No suitable habitat present within Project Area

Species	Commonwealth Conservation Status	WA Conservation Status	Flowering Period	Preferred Habitat	Likelihood of occurrence
Conospermum undulatum	Vulnerable	Threatened - Vulnerable	May to October	Grey or yellow - orange clayey sand	May occur – recorded approximately 50m of the Project Area
Diuris micrantha	Vulnerable	Threatened - Vulnerable	September to October	Brown loamy clay. Winter wet swamps in shallow water	Unlikely to occur – No suitable habitat present within Project Area
Eleocharis keigheryi	Vulnerable	Threatened - Vulnerable	August to November	Clay sandy loam. Emergent in freshwater creeks and clayplans	May occur – suitable habitat present within Project Area

4.2.2 Threatened Fauna

A combined total of 11 Threatened fauna species were identified through the EPBC Protected Matters search and DPaW database search. Based on preferred fauna habitat and previous records it was determined that three Threatened fauna species are likely to occur within the Project Area and eight are unlikely to occur within the Project Area (Table 10). The species considered likely to occur are:

- Forest Red-tailed Cockatoo (Vulnerable).
- Baudin's Cockatoo (Vulnerable).
- Carnaby's Cockatoo (Endangered).

These species were not observed during the site inspection however have been previously recorded to occur within Jarrah and Marri Forest within close proximity to the Project Area. Numerous trees with the potential to form suitable hollows (>500mm DBH) were observed within the road reserve, which may provide suitable nesting habitat for the three black cockatoo species. The Project Area lies within known foraging area for the three black cockatoo species (DSEWPaC, 2012) which primarily consists of *Eucalyptus* woodlands and forest and proteaceous woodland and heaths. The Jarrah and Marri woodland within the Project Area may also provide suitable foraging habitat for these species.

A significant impact is an impact which is important, notable or of consequence, having regards to its context or intensity. The determination of a significant impact depends upon the sensitivity, value, and quality of the environment which is impacted and upon the intensity, duration, magnitude and geographic extent of the impacts (DotE, 2013b).

The Project is considered likely to have a significant impact upon the three black cockatoo species as it may adversely affect habitat critical to the survival of the species (DotE, 2013b). Habitats critical to the survival of a species includes areas that are used for foraging, breeding, roosting and dispersal.

Table 10 Potential Threatened fauna species occurring within the Project Area

Species	Vernacular	Legislation		Habitat	Likelihood
		EPBC Act Conservation status	WC Act / Priority Rank		
BIRD					
Calyptorhynchus latirostris	Carnaby's Cockatoo	Endangered	Threatened - Endangered	Carnaby's Cockatoo is a postnuptial nomad and typically moves west soon after breeding. The species nests in hollows of smooth-barked eucalypts, particularly Salmon Gum (*Eucalyptus salmonophloia)* and Wandoo (*E. Wandoo)* but is not limited to these eucalypts. Diet consists of an array of Proteaceous and Eucalypt species prevalent on the Swan Coastal Plain. Foraging habitat, including *Banksia* woodlands, is considered to be habitat critical to the survival of the species (Johnstone *et al,* 2010).	Likely to occur - This species have been previously recorded within close proximity to the Project Area.
Rostratula australis	Australian Painted Snipe	Endangered, Marine, Migratory (CAMBA))	Threatened - Endangered	The Australian Painted Snipe is usually found in shallow inland wetlands, either freshwater or brackish, that are either permanently or temporarily filled. It is a cryptic bird that is hard to see and often water's edge and on mudflats, taking invertebrates, such as insects and worms, and seeds .recorded. It nests on the ground amongst tall reed-like vegetation near water, and feeds near the overlooked. Usually only single birds are seen, though larger groups of up to 30 have been	Unlikely to Occur - No suitable habitat present in Project Area.
Cacatua pastinator subsp. *pastinator*	Muirs Corella	Vulnerable	Schedule 4 – Other specially protected fauna	Muirs Corella is confined to the extreme south west of Western Australia (Schodde and Mason, 1997). Its habitat is severely fragmented with much of the original habitat lost due to clearing, processes associated with dieback and degradation (Chapman *et al*. 2005; Garnett and Crowley 2000; Mawson and Johnstone 1997; Mawson and Long, 1994).	Unlikely to occur - Not recorded along the Swan River since 1900. Most recent historic record occurs from 1835.

Species	Vernacular	Legislation		Habitat	Likelihood
		EPBC Act Conservation status	WC Act / Priority Rank		
Calyptorhynchus baudinii	Baudin's Cockatoo	Vulnerable	Threatened - Endangered	Habitat critical to the survival of this species includes forests of Karri (*E. diversicolor*), Jarrah (E. *marginata*) and Marri (*C. calophylla*); in areas of 600 mm average rainfall per year. Individuals typically move north through the Perth region from March to May and south through the Perth region from August to October. This species ranges north to Gidgegannup and Hoddy Well and west to the Eastern Strip of the Swan Coastal Plain including West Midland in the north, heading south through Armadale, Byford and continues south and towards the coast until Lake Clifton where it continues to hug the coastline to east of Albany (Johnstone *et al,* 2010).	Likely to occur - The species has been previously recorded near Gooseberry Hill during 2003.
Calyptohynchus banksii subsp. *naso*	Forest Red-tailed Cockatoo	Vulnerable	Threatened - Vulnerable	Requires tree hollows to nest and breed, occurs in forests of Karri (*E. diversicolor*), Jarrah (*E*. *marginata*) and Marri (*Corymbia calophylla*), with flocks moving out onto the Swan Coastal Plain in search of food from exotic trees such as White Cedar (Johnstone *et al*, 2010). Foraging habitat for the species consists of Jarrah and Marri woodlands and forest throughout its range.	Likely to occur - The species has been previously recorded near Kenwick and High Wycombe during 2012.
Leipoa ocellata	Malleefowl	Vulnerable	Threatened - Vulnerable	This species mainly occurs within the southern arid and semiarid zones of Western Australia. Mallefowl commonly occurs within scrubs and thickets of mallee Eucalyptus spp., Melaleuca lanceolata and Acacia linophylla, also other dense litter forming shrublands.	Unlikely to Occur - No suitable habitat present in Project Area.
INSECT					
Leioproctus douglasiellus	bee	Critically Endangered	Threatened - Endangered	Insufficient information	Unlikely to occur – Not previously recorded within the vicinity of the Project Area

Species	Vernacular	Legislation		Habitat	Likelihood
		EPBC Act Conservation status	WC Act / Priority Rank		
MAMMAL					
Bettongia penicillata subsp. *ogilbyi*	Woylie	Endangered	Threatened - Critically Endangered	*Gastrolobium* thickets provide refuge for Woylies against introduced predators. *Gastrolobium* thickets provide the woylie with refuge from introduced predators, partly because of the ability to physically hide in the bushes but also the local reduction in predator numbers caused by secondary poison present within *Gastrolobium* species.	Unlikely to occur - No suitable habitat present within the Project Area
Dasyurus geoffroii	Chuditch	Vulnerable	Threatened - Vulnerable	Following European settlement the range of this species contracted dramatically, from much of the continent to a small area in the south west. It currently only occurs in areas dominated by sclerophyll forest or drier woodland, heath and mallee shrubland (Van Dyck & Strahan, 2008). The majority of records are found in the contiguous Jarrah forests of the south west of Western Australia (DotE, 2013a). Recent records exist within the Gnangara pine forest and Walyunga National Park.	Unlikely to occur - Due to degraded nature of vegetation
Pseudocheirus occidentalis	Western Ringtail Possum	Vulnerable	Threatened - Vulnerable	The Western Ringtail Possum has a patchy distribution in predominantly two areas: near Bunbury to Leeuwin-Naturaliste National Park (with a small translocated population near Dawesville); and near Albany. Populations on the Swan Coastal Plain are associated with stands of myrtaceous trees (usually Peppermint Tree (*Agonis flexuosa*)) growing near swamps, water courses or floodplains, and at topographic low points which provide cooler often more fertile conditions	Unlikely to Occur - Closest known record is from 1958 in Midland.
Setonix brachyurus	Quokka	Vulnerable	Threatened - Vulnerable	The Quokka prefers early seral (young) vegetation stages that have been burned within the previous ten years. The quokka currently inhabits dense low vegetation that provides refuge from predation by owls, foxes and cats.	Unlikely to occur - No suitable habitat present within the Project Area

4.3 Migratory Species

Six migratory bird species protected under the EPBC Act potentially occur within the Project Area. Of these, only the Rainbow Bee-eater (Migratory EPBC Act & Schedule 3 WC Act) and Eastern Great Egret (Migratory EPBC Act & Schedule 3 WC Act) are considered likely to occur within the Project Area. Eastern Great Egret (Migratory EPBC Act & Schedule 3 WC Act) was previously observed to overfly the High Wycombe area and is likely to overfly to project area. Suitable Rainbow Bee-eater habitat may be present within the project area.

For an action to have a significant impact upon a Listed Migratory Species, there must be a real chance or possibility that it will:

- substantially modify, destroy or isolate an area of important habitat for a migratory species
- result in the establishment of an invasive species that is harmful to the migratory species in an area of important habitat for the migratory species
- seriously disrupting the life cycle of a significant proportion of a migratory species.

As the project will not impact upon an area of important habitat, result in the establishment of an invasive species into an important habitat or disrupt any part of the life cycle of any EPBC Act listed migratory species, there will be no significant impact to EPBC Act migratory species from the project (DotE, 2013b).

4.4 Marine Species

Seven marine species protected under the EPBC Act were identified to potentially occur within the Project Area. All of these species prefer coastal and marine environmental. Therefore, it is considered unlikely that these species will occur as the Project Area is approximately 23km from the coast.

5.0 Clearing of Native Vegetation

In assessing whether the project is likely to have a significant impact on the environment, the project was assessed against the ten clearing principles (EP Act 1986, Schedule 5). This assessment is based on a desktop assessment and a brief site inspection of the Project Area, rather than the actual design footprint. A clearing assessment for the clearing of native vegetation is summarised in Table 11. The Project is considered to be **at variance** with one principle, **likely to be at variance** with three principles, **may be at variance** with two principles and **not likely to be at variance** with four principles.

Table 11 Assessment against Ten clearing principles

Clearing Principle	Rationale	Likelihood of Variance
a) Native vegetation should not be cleared if it comprises a high level of biological diversity	EPBC Protected Matters and DPaW database searches identified a total of 60 Threatened or Priority Flora species were identified to potentially occur within the vicinity of the Project Area. This comprised of 21 species listed under the EPBC Act, 21 species listed under the WC Act, five Priority 1, six Priority 2, 19 Priority 3 and nine Priority 4 species (Appendix A). One of these species, *Conospermum undulatum* listed as Vulnerable under both the EPBC and the WC Act, is known to occur approximately 50m of the Project Area, however there are no known records within the Project Area. The Project Area traverses two Bush Forever Sites; the Greater Brixton Street Wetlands (Bush Forever Site 387) and Hartfield Park Bushland (Bush Forever Site 320). Both are known to contain numerous Threatened and Priority Flora and Commonwealth and State listed TECs. During the site inspection three broad vegetation types were observed. This includes: Jarrah and Marri Woodland over introduced grass, *Eucalyptus* / *Allocasuarina* / *Melaleuca* Shrubland over introduced weeds and *Melaleuca rhaphiophylla* Shrubland over introduced weeds. The eastern side of Tonkin highway is devoid of remnant vegetation and only consists of isolated *Melaleuca* spp. and *Allocasuarina* spp. over introduced weeds. The Project Area was observed to be heavily infested with weeds and was largely devoid of remnant vegetation understorey. The clearing of native vegetation is not likely to be at variance with this Principle.	Not Likely to be at variance

Clearing Principle	Rationale	Likelihood of Variance
b) Native vegetation should not be cleared if it comprises the whole or a part of, or is necessary for the maintenance of, a significant habitat for fauna indigenous to Western Australia	A total of 27 Threatened, Terrestrial Migratory and Priority fauna species were identified through EPBC Protected Matters search and DPaW database searches to potentially occur within the Project Area (Appendix B). Of these species, six are considered likely to occur, one may occur and 20 are considered unlikely to occur. The species considered likely to occur are listed below: - Forest Red-tailed Cockatoo (Vulnerable (EPBC Act) & Schedule 1 (WC Act)) - Baudin's Cockatoo (Vulnerable(EPBC Act) & Schedule 1 (WC Act)) - Carnaby's Cockatoo (Endangered (EPBC Act) & Schedule 1 (WC Act)) - Rainbow Bee-eater (Migratory (EPBC Act) & Schedule 3 (WC Act)) - Eastern Great Egret (Migratory EPBC Act & Schedule 3 WC Act) - Southern Brown Bandicoot or Quenda (Priority 5 DPaW Ranking) Numerous trees with the potential to form suitable hollows (>500mm DBH) were observed within the road reserve, which may provide suitable nesting habitat for the three black cockatoo species. The Project Area lies within known foraging area for the three black cockatoo species (DSEWPaC, 2012) which primarily consists of *Eucalyptus* woodlands and forest and proteaceous woodland and heaths. The Jarrah and Marri woodland within the Project Area may also provide suitable foraging habitat for these species. The three black cockatoos have been previously recorded within Jarrah and Marri Forest near High Wycombe and are likely to frequent the Project Area. Some cockatoo foraging habitat of greater than 1 ha will be cleared as a result of the project. This is considered to be significant as it may adversely affect habitat critical to the survival of the species. Remnant vegetation in the adjoining Greater Brixton Street Wetlands is likely to provide suitable foraging area. Quenda are likely to use some areas within the Project Area, as they have been recorded to occur near Welshpool, High Wycombe and Forrestfield. Quenda utilise a variety of habitat types including forests, woodlands, heaths and shrub communities and are known to occur within degraded road reserves. The clearing of native vegetation may be at variance with this Principle.	May be at variance

Clearing Principle	Rationale	Likelihood of Variance
c) Native vegetation should not be cleared if it includes, or is necessary for the continued existence of rare flora	Desktop searches of the DPaW Threatened and Priority Flora Databases and the *Environment Protection and Biodiversity Conservation Act, 1999* Protected Matters Search Tool for the Project Area identified 21 species listed under the EPBC Act and 21 species listed under the WC Act to occur within close proximity of the Project Area. No Threatened or Priority Flora are known to occur within the Project Area. Several threatened and priority flora species have been recorded within 200 m of the Project Area and it is likely that the Project Area will contain a number of these species including: - *Conospermum undulatum* (Vulnerable) - *Banksia mimica* (EPBC Act – Endangered; WC Act - Threatened (Vulnerable) - *Grevillea thelemanniana* subsp*. thelemanniana (Priority 2)* The clearing of native vegetation within the Project Area is likely to be at variance with this Principle.	Likely to be at variance
d) Native vegetation should not be cleared if it comprises whole or a part of, or is necessary for the maintenance of a Threatened Ecological Community	Database searches identified two Commonwealth listed and four State listed Threatened Ecological Communities to occur within 5km of the Project Area. These are: - Commonwealth Critically Endangered and WA Endangered TEC - SCP10a - Shrublands on dry clay flats - Commonwealth Endangered and WA Critically Endangered TEC - SCP20c - Shrublands and woodlands of the eastern side of the Swan Coastal Plain - WA Critically Endangered TEC - SCP3b *Corymbia calophylla - Eucalyptus marginata* woodlands on sandy clay soils of the southern Swan Coastal Plain - WA Endangered TEC - SCP20a - *Banksia attenuata* woodland over species rich dense scrublands One TEC or TEC buffer occurs within the Project Area. SCP10a occurs on the western side of Tonkin Highway. A detailed flora assessment is recommended to be conducted to definitively determine the presence or absence of any of these known TECs within the Project Area. Clearing of native vegetation may be at variance with this principle.	May be at variance

Clearing Principle	Rationale	Likelihood of Variance
e) Native vegetation should not be cleared if it is significant as a remnant of native vegetation in an area that has been extensively cleared	The *National Objectives and Targets for Biodiversity Conservation 2001 – 2005* (Commonwealth of Australia, 2001) recognise that the retention of 30% or more of the pre-clearing extent of each ecological community is necessary if Australia's biodiversity is to be protected. This level is in keeping with the *EPA Position Statement No 2 on Environmental Protection of Native Vegetation in Western Australia* (EPA, 2000). The objective is also to protect at least 30% of the original extent of each vegetation complex in unconstrained areas and 10% in constrained areas (i.e. Urban Zoned regions). Vegetation complexes within the project area, as defined by Heddle *et al.* (1980), are based on vegetation in association with landforms and underlying geology. The majority of native vegetation occurring within the Project Area forms part of the Southern River Complex and a small southern portion forms part of the Guildford Complex (Heddle *et al.*, 1980) (Figure 2). The remaining extent of the Southern River Complex exceeds the minimum 10% target for the retention of vegetation complexes in constrained areas on the Swan Coastal Plain (EPA, 2000), however Guildford Complex only has 5.9% of the original extent remaining on the Swan Coastal Plain (Table 3). The clearing of native vegetation may be at variance with this Principle.	At variance
f) Native vegetation should not be cleared if it is growing in, or in association with, an environment associated with a watercourse or wetland	Seven Geomorphic wetlands have been identified to occur within the Project Area traverse. This consists of four CCW, one Resource Enhancement Wetland and two Multiple Use Wetlands. The disturbance of a CCW through construction activities has the potential to further degrade the wetland and damage habitat vital to flora and fauna species. Clearing of native vegetation in association with all seven wetlands will occur. The clearing of native vegetation is likely to be at variance with this Principle.	Likely to be at variance

Clearing Principle	Rationale	Likelihood of Variance
g) Native vegetation should not be cleared if the clearing of the vegetation is likely to cause appreciable land degradation	The Project Area is located within the Perth Metropolitan Area and occurs directly adjacent to remnant vegetation and residential development. The Project Area occurs along a major transport route and as a result has previously been subject to disturbance. With the current proportion of remnant vegetation remaining directly adjacent to the Project Area, the proportion of vegetation required to be cleared for project works is not considered likely to cause appreciable land degradation. Drainage structures will be designed to limit erosion. The clearing of native vegetation within the Project Area is unlikely to result in appreciable land degradation. The SLIP database indicates that the Project Area has a Moderate to Low risk of Acid Sulfate Soil occurrence. Sulfides react with oxygen to form sulphuric acid which could potentially kill vegetation, leach into groundwater or kill aquatic organisms. The potential for ASS within the Project Area may lead to a decline in environmental values. Construction work and excavation within the Project Area is considered unlikely to cause any impacts associated with ASS. It is not anticipated that ASS will cause appreciable land degradation. The clearing of native vegetation is not likely to be at variance with this Principle.	Not likely to be at variance
h) Native vegetation should not be cleared if it is likely to have an impact on the environmental values of any adjacent or nearby conservation area	Bush Forever identifies areas for protection of regionally significant bushland and associated wetlands (GOW, 2000a & 2000b) and focuses on the Swan Coastal Plain portion of the Perth Metropolitan region. Listings of Bush Forever sites take into consideration regional attributes, land forms, soils, vegetation, wetlands and threatened ecological communities (Shire of Kalamunda, 2014b). The Project Area traverses two Bush Forever sites. The Greater Brixton Street Wetland (Bush Forever Site 387) which encompasses 126.7ha of bushland. It has been previously reported to contain Floristic Community Type SCP 10a- *Shrublands on dry clay flats* (Gibson *et. al,* 1994), a Commonwealth listed Critically Endangered TEC and a State listed Endangered TEC. This bushland is part of a regionally significant fragmented bushland and wetland linkage. Hartfield Park Bushland (Bush Forever Site 320) encompasses 73.6ha of Bushland. It has been previously reported to contain Floristic Community Type SCP20a - *Banksia attenuata* woodland over species rich dense scrublands (Gibson *et. al,* 1994), a State listed Endangered TEC. This bushland is part of a regionally significant fragmented bushland and wetland linkage The clearing of native vegetation is likely to be at variance with this Principle.	Likely to be at variance

Clearing Principle	Rationale	Likelihood of Variance
i) Native vegetation should not be cleared if the clearing of the vegetation is likely to cause deterioration in the quality of surface or ground water	Clearing has the potential to impact on the quality of surface water or groundwater where vegetation associated with surface water features (i.e. riparian and wetland vegetation) or groundwater (wetland and groundwater dependent vegetation) is cleared. The Project Area does not fall within a Public Drinking Water Supply Catchment. The clearing of native vegetation is not likely to be at variance with this Principle.	Not Likely to be at variance
j) Native vegetation should not be cleared if the clearing of the vegetation is likely to cause or exacerbate the incidence or intensity of flooding	Given that the majority of the Project Area will be utilised for road infrastructure, it is considered unlikely that the clearing of vegetation for the proposed Project will cause or exacerbate the incidence and intensity of flooding, if suitable drainage is incorporated into the road design. The clearing of native vegetation is not likely to be at variance with the Principle.	Not likely to be at variance

6.0 Aspects and Impacts

The environmental aspects, impacts and suggested management measures for Project have been summarised in Table 12, and are based on the desktop assessment.

Table 12 Environmental Aspects and Impacts for the Project

Aspect	Impact	Management Actions
Vegetation – associations, representativeness and clearing	- The amount of native vegetation to be cleared is yet to be determined, approximately 5 ha of remnant vegetation remains within the Project Area - Assessment against the ten clearing principles concludes that the clearing of native vegetation is at variance, is likely to be at variance or may be at variance with five of the ten clearing principles - Under represented vegetation complex, (Guildford Complex) has only 5.9% of the original extent remaining on the Swan Coastal Plain. This vegetation complex may be cleared as a result of project works.	- Level 2 flora and vegetation surveys are recommended for the entire Project Area to quantify flora values. - Consultation with DPaW regarding clearing of underrepresented vegetation complex and vegetation within TEC buffer - Prepare a Wetland and Vegetation Management Plan - Ensure design minimises clearing of native vegetation as far as practicable - Obtain suitable clearing permit prior to clearing
Vegetation – threatened and priority species and communities	- *Conospermum undulatum* listed as Vulnerable under both the EPBC and the WC Act is known to occur approximately 50m east of the Project Area. This species has not been previously recorded within the Project Area - Four TECs have been identified to occur within 5 km of the Project Area. One of these or its buffer SCP 10a – *Shrublands on dry clay flat*s has been identified to occur in the Project Area.	- Targeted Flora surveys are recommended to identify all threatened and Priority flora occurring within the Project Area - Flora and vegetation surveys are recommended for the entire Project Area to determine presence or absence of TECs. - Permit to take Threatened flora will be required if threatened flora will be impacted - Obtain suitable clearing permit prior to clearing - Consultation with stakeholders
Vegetation – dieback and other diseases or pathogens	- Potential to introduce or spread of Dieback into Greater Brixton Street Wetlands and Hartfield Park Bushland.	- Conduct a dieback assessment - Develop and implement a site hygiene plan
Vegetation – weeds	- Potential to further introduce and spread of weeds into adjacent areas	- Develop and implement a site hygiene plan - Identify and dispose of weedy topsoil during construction - Conduct weed control on rehabilitated areas post-construction to prevent colonisation of weeds

Aspect	Impact	Management Actions
Fauna	- It is likely that the clearing of any remnant habitat patch of greater than 1ha is likely to have a significant impact upon the three black cockatoo species as it will adversely affect habitat critical to the survival of the species	- Conduct a fauna habitat assessment to quantify extent of black cockatoo habitat - Referral under the EPBC Act may be required depending on information gathered from detailed flora and fauna surveys
Fire	- On-site ignition sources, could result in increased fire frequency/intensity that may favour the establishment of weeds and prevent the regeneration of native vegetation, particularly fire-sensitive species	- Implement appropriate procedures during construction to minimise the risk of fire
Surface Water and Wetlands	- Potential for pollutants from construction to spill directly into Conservation Category Wetland. - Clearing and loss of Conservation Category Wetland	- Prepare a Wetland and Vegetation Management Plan - Minimise clearing of wetland vegetation
Groundwater	- The storage and use of chemicals, including fuel, within the Project Area has the potential to adversely impact groundwater quality through spills and leaks - Abstraction and dewatering may impact the availability of groundwater to the environment (groundwater dependent ecosystems) and for human use	- Manage spills and hazardous substances during construction - Obtain appropriate licence to abstract groundwater if dewatering is required
Environmentally Sensitive Areas	- The proposed Project has the potential to impact upon ESAs	- Prepare a Wetland and Vegetation Management Plan
Bush Forever Sites and Reserves	- Direct clearing as a result of the project will occur within Greater Brixton Street Wetlands (Bush Forever Site 387) and Hartfield Park Bushland (Bush Forever Site 320). These bushlands are part of a regionally significant fragmented bushland and wetland linkage. - There is a general presumption against clearing within a Bush Forever site, except where the proposal is consistent with existing planning commitments – in this case the Project is consistent with the Metropolitan Region Scheme (MRS) planning. The Project Area is within the planned MRS Primary Regional Road zoning.	- Consult with relevant stakeholders (WAPC, DPaW, non-government organisations) - Ensure that the Project remains within the MRS Primary Regional Road boundary - Prepare a Wetland and Vegetation Management Plan
Acid Sulfate Soils	- Potential to disturb soils with a High to Moderate risk of ASS	- Conduct an ASS investigation in accordance with DER guidance - Develop an Acid Sulfate Soils Management Plan
Contaminated Sites	- No impact	- None required
Heritage – non-indigenous	- No impact	- None required

Aspect	Impact	Management Actions
Aboriginal Heritage	- The Project Area traverses four Aboriginal Heritage sites (3773,3631,4341 and 22673).	- Consult with DAA to determine if the Project will impact any Aboriginal Heritage sites in accordance with the Aboriginal Cultural Heritage Protocol - Further surveys may be required following consultation with DAA -
Noise and Vibration	- Nearest noise and vibration sensitive receivers are a number of residential properties on the north west boundary of the Project Area - Construction noise impacts on sensitive receptors - Vibration from construction works may cause impacts on humans and buildings. - Road traffic noise may adversely impact nearby noise sensitive receivers	- Develop a CNVMP in accordance with the noise regulations and submit to DER and LGA for approval prior to the commencement of construction - Conduct road traffic noise assessment to determine the impact of road noise on noise sensitive receivers - Noise walls or other noise mitigation is likely to be required to address noise impacts on nearby noise sensitive receivers
Air Quality and Dust	- Dust during construction may have an adverse impact on amenity	- Develop a dust management plan for construction
Adjacent Land Uses	- Residential dwellings on the north side of Welshpool Road East - Project will impact upon adjacent Bush Forever Site	- Liaise with appropriate stakeholders including local government and residents - Prepare appropriate Management Plans to mitigate impacts to Greater Brixton Street Wetlands and Hartfield Park
Visual Amenity	- May be visual intrusion impacts to local residents. - Construction of a grade separated interchange will change the visual amenity of the area	- Incorporate suitable screening and noise walls into project design. - Consider conducting a visual impact assessment to address the impacts of visual intrusion on nearby residents and minimise the overall visual impact of the interchange
Hazardous Substances	- The storage and use of chemicals, including fuel, within the Project Area has the potential to adversely impact groundwater and surface water quality through spills and leaks	- Develop a management plan for hazardous materials and spill response - Storage of chemicals and refuelling should not occur in or adjacent to wetlands and bunding should be used for the storage of all liquids except rainwater

Aspect	Impact	Management Actions
Matters of National Environmental Significance	- Presence of one Commonwealth listed TEC within the Project Area - EPBC listed threatened black cockatoo species are likely to utilise habitat in the Project Area. It is likely that the clearing of any remnant habitat patch of greater than 1ha is likely to have a significant impact upon the three black cockatoo species as it will adversely affect habitat critical to the survival of the species - The Vulnerable *Conospermum undulatum* is known to occur within 50 m of the Project Area and may occur within the Project Area - A number of other EPBC listed threatened flora species are known to occur in the vicinity of the Project Area and may occur within the Project Area	- Conduct fauna habitat assessment to determine extent of black cockatoo habitat within the Project Area - Conduct a Targeted flora survey to determine if *Conospermum undulatum* or any other EPBC listed species is present - Liaise with DotE prior to any potential referral - Referral under the EPBC Act may be required depending on information gathered from detailed fauna surveys

7.0 Approvals

7.1 EPA Referral

Referral under the EP Act is likely to be required, unless further environmental studies show that the impact of the Project will not be significant when considered against the design footprint.

Section 38 (Part IV) of the EP Act provides that any person may refer a significant proposal (one that is likely to have a significant effect on the environment) to the EPA. The EP Act also states that where the environmental impact of a proposal can be adequately assessed and managed through other legislative mechanisms the proposal is unlikely to require formal environmental impact assessment.

A number of significant environmental impacts are likely to occur as a result of project work. This includes:

- Direct impact to Greater Brixton Street Wetlands (Bush Forever Site 387) and Hartfield Park Bushland (Bush Forever Site 320).
- Loss of CCW.
- Clearing of under-represented vegetation communities.
- presence of black cockatoo foraging habitat and potential nesting habitat.
- Potential of noise impacts to local residents living directly adjacent to the project.

Without further studies, due to the number of potentially significant environmental impacts identified in this PEIA, a referral to the EPA is recommended as there is currently insufficient information to determine whether the potential impacts of this Project will be significant.

It is recommended that Main Roads consults with the Office of the EPA prior to any referral. Further flora and vegetation, fauna and noise studies are required to more effectively quantify the potential significant impacts of this Project.

7.2 EPBC Referral

Referral under the EPBC Act is likely to be required, unless further studies show that the impact of the Project will not be significant of EPBC listed species.

An action that will have or is likely to have a significant impact on MNES must be referred to the Commonwealth Minister for the Environment for a decision on whether assessment is required pursuant to the EPBC Act.

The Project may have a significant impact upon:

- The three black cockatoo species as it will adversely affect habitat critical to the survival of the species (DotE, 2013b).
- *Conospermum undulatum* as the species is likely to occur within the Project Area.

7.3 Clearing Permit

If the Project is not formally assessed by the EPA under Part IV of the EP Act, a Part V Native Vegetation Clearing Permit will be required. Main Roads Purpose Permit (CPS 818/11) may be used to conduct the clearing, subject to the conditions of the permit. Additional stakeholder consultation is required under CPS 818/11, and as the clearing is at variance with some clearing principles, the following will be required:

- Preliminary Clearing Impact Assessment (PCIA) or a Clearing Impact Assessment (CIA)
- Vegetation Management Plan (VMP)
- Offset Plan.

7.4 Aboriginal Heritage

A Section 18 Notice form may be required. Further consultation with DAA is required as the Project Area traverses four registered Aboriginal Heritage sites. An archaeological and ethnographic survey may be required.

7.5 Non-Indigenous Heritage

No Non Indigenous Heritage places will be directly impacted as a result of project works.

7.6 Groundwater Licence

A licence under the *Rights in Water and Irrigation Act 1914* is required if groundwater is to be abstracted for use during construction or if dewatering of any ground excavations is required.

8.0 Conclusions and Recommendations

8.1 Conclusions

The Project Area traverses part of Greater Brixton Street Wetlands (Bush Forever Site 387) and Hartfield Park Bushland (Bush Forever Site 320). Greater Brixton Street Wetlands consists of 126.7 and has been reported to contain over 555 native taxa including numerous Threatened flora. This site is known to contain four TECs including Floristic Community Type SCP10a – *Shrublands on dry clay flats.*

Hartfield Park Bushland encompasses 73.6ha of Bushland and is considered to contain a high level of biodiversity. It has been previously reported to contain Floristic Community Type SCP20a - *Banksia attenuata* woodland over species rich dense scrublands (Gibson *et. al*, 1994), a state listed Endangered TEC. Both sites form part of a regionally significant fragmented bushland and wetland linkage.

Clearing of vegetation within the Project Area has the potential to have an impact on a number of environmental aspects. Suitable management measures will be required to mitigate the impact identified in this PEIA. These impacts include:

- Threatened flora – Desktop assessment identified the presence of *Conospermum undulatum* approximately 50m east of the Project Area
- Threatened fauna – Site inspection identified potential black cockatoo nesting and foraging habitat
- Threatened Ecological Communities – Community SCP 10a occurs within the Project Area. Community SCP 20a has previously been recorded within Hartfield Park
- Surface Water and Wetlands – The Project Area traverses five Conservation Category Wetland
- Groundwater - The storage and use of chemicals, including fuel, groundwater quality through spills and leaks
- ESAs and Conservation Reserves – The Project Area traverses ESAs and Bush Forever Sites 387 and 320
- Dieback – known presence of Dieback adjacent to the Project Area on the west side of Tonkin Highway
- Aboriginal heritage – Project Area traverses four Aboriginal heritage sites.

The Project is likely to have a significant impact upon the following aspect protected under the EPBC Act:

- Threatened fauna species:
    - Carnaby's Cockatoo
    - Baudin's Cockatoo
    - Forest Red-tailed Cockatoo
- Threatened flora species *Conospermum undulatum* and *Banksia mimica*
- Threatened Ecological Communities.

8.2 Recommendations

The following recommendations are made in order to complete the environmental assessment and approval process for the Project:

- Conduct further environmental studies to determine the significance of potential environmental impacts including:
    - a Level 2 flora and vegetation survey to quantify vegetation communities and native vegetation to be cleared within the entire Project Area
    - a black cockatoo habitat assessment
    - a traffic noise impact assessment to predicted noise levels at the affected residential dwellings adjacent to the intersection against nominated noise criteria.

- Depending on outcome of surveys, refer project to the EPA to determine if formal assessment is required.
- Depending on outcome of surveys, refer project to the Commonwealth Minister for the Environment for a decision on whether an assessment is required pursuant to the EPBC Act.
- Consult with DAA to determine if further surveys are required for Aboriginal Heritage.
- Develop an Wetland and Vegetation Management Plan that addresses the management of:
    - flora and Vegetation
    - dieback and weeds
    - groundwater licencing
    - noise and vibration
    - dust
    - hazardous materials and emergency response.
- Develop and implement a site hygiene plan for Dieback and Weeds.

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Appendix A

Threatened and Priority Flora identified through database searches

Appendix A Threatened and Priority Flora identified through database searches

Species	Commonwealth Conservation Status	WA Conservation Status	Flowering Period	Preferred Habitat	Likelihood of occurrence
Synaphea sp. Fairbridge Farm (D Papenfus 696)	Critically Endangered	Threatened - Critically Endangered	October	Sandy with lateritic pebbles, near winter wet flats in low woodland with weedy grasses.	Unlikely to occur – no known records occurring near Project Area
Ptilotus pyramidatus	Critically Endangered	Threatened - Critically Endangered	October	Scrub. Growing under *Melaleuca lateriflora* subsp. *acutifolia*. Grey-white sandy clay	Unlikely to occur – no suitable habitat present within Project Area
Darwinia foetida	Critically Endangered	Threatened – Endangered	October to November	Low plain with dry grey sand	Unlikely to occur – all known records from Muchea area
Calytrix breviseta subsp *breviseta*	Endangered	Threatened - Critically Endangered	October to November	Sandy clay, Swampy flats	May occur – recorded within Bush Forever Site 387
Eucalyptus x balanites	Endangered	Threatened - Critically Endangered	October to December or January to February	Sandy soils with lateritic gravel	Unlikely to occur – No suitable habitat present within Project Area
Thelymitra dedmaniarum	Endangered	Threatened - Critically Endangered	November January	Granite	Unlikely to occur – No suitable habitat present within Project Area
Caladenia huegelii	Endangered	Threatened – Critically Endangered	September to October	Grey or brown sand, clay loam	Unlikely to occur – no suitable habitat present within Project Area
Drakaea elastica	Endangered	Threatened – Critically Endangered	October to November	White or grey sand. Low lying situations adjoining winter wet swamps	Unlikely to occur – no suitable habitat present within Project Area
Grevillea curviloba subsp. *incurva*	Endangered	Threatened - Endangered	August to September	Sand, sandy loam, Winter wet heath	Unlikely to occur – no suitable habitat present within Project Area
Lepidosperma rostratum	Endangered	Threatened - Endangered		Peaty sand, clay	May occur – recorded within Bush Forever Site 387

Species	Commonwealth Conservation Status	WA Conservation Status	Flowering Period	Preferred Habitat	Likelihood of occurrence
Macarthuria keigheryi	Endangered	Threatened - Endangered	September to December or February to March	White or grey sand	Unlikely to occur – no suitable habitat present within Project Area
Diuris purdiei	Endangered	Threatened – Endangered	September to October	Grey-black sand. Winter wet swamps	May occur – suitable habitat present within Project Area
Thelymitra stellata	Endangered	Threatened – Endangered	October to November	Sand, gravel, lateritic loam	Unlikely to occur – no suitable habitat present within Project Area
Banksia mimica	Endangered	Threatened - Vulnerable	December or January to February	White or grey sand over laterite, sandy loam Woodland heath with Banksia, Melaleuca and Dasypogon.	May occur – recorded within 300m of Project Area
Chamelaucium sp. Gingin (NG Marchant 6)	Endangered	Threatened - Vulnerable	October to December	White/grey sand	Unlikely to occur – known records from Muchea area
Andersonia gracilis	Endangered	Threatened – Vulnerable	September to November	White/grey sand, sandy clay, gravelly loam. Winter-wet areas near swamps	Unlikely to occur – all known records from Cataby area
Centrolepis caespitosa	Endangered	Priority 4	October to December	White sand, clay, salt flats and wet areas.	Unlikely to occur – No suitable habitat present within Project Area
Drakaea micrantha	Vulnerable	Threatened - Endangered	September to October	White grey sand	Unlikely to occur – No suitable habitat present within Project Area
Conospermum undulatum	Vulnerable	Threatened - Vulnerable	May to October	Grey or yellow - orange clayey sand	May occur – recorded approximately 50m of the Project Area
Diuris micrantha	Vulnerable	Threatened - Vulnerable	September to October	Brown loamy clay. Winter wet swamps in shallow water	Unlikely to occur – No suitable habitat present within Project Area

Species	Commonwealth Conservation Status	WA Conservation Status	Flowering Period	Preferred Habitat	Likelihood of occurrence
Eleocharis keigheryi	Vulnerable	Threatened - Vulnerable	August to November	Clay sandy loam. Emergent in freshwater creeks and clayplans	Unlikely to occur – No suitable habitat present within Project Area
Eremophila glabra subsp. *chlorella*		Threatened - Critically Endangered	July to November	Sandy clay. Winter-wet depressions.	Unlikely to occur – No suitable habitat present within Project Area
Austrostipa bronwenae		Priority 1	September	Wetland. Seasonally waterlogged muddy sand.	May occur – recorded from Kenwick area
Hydrocotyle striata		Priority 1	October	Herb. Clay. Springs.	Unlikely to occur – No suitable habitat present within Project Area
Schoenus pennisetis		Priority 1	August to September	Grey or peaty sand, sandy clay.	May occur – suitable habitat present within Project Area
Senecio gilbertii		Priority 1	September to November	Peaty sand. Swamps, slopes	May occur – suitable habitat present within Project Area
Thelymitra magnifica		Priority 1	September to October	Stony ridges	Unlikely to occur – No suitable habitat present within Project Area
Andersonia sp. Blepharifolia (F. & J. Hort 1919) PN		Priority 2	September to November	Jarrah forest.	Unlikely to occur – No suitable habitat present within Project Area
Comesperma rhadinocarpum		Priority 2	October to November	Sandy soils.	Unlikely to occur – No suitable habitat present within Project Area
Grevillea thelemanniana subsp. *thelemanniana*		Priority 2	June to September	Edge of seasonal clay based open depression. Moist grey brown sandy loam over clay.	May occur – recorded 100m west of Project Area
Lepyrodia curvescens		Priority 2	September to November	Sand, laterite. Seasonally inundated swampland.	May occur – suitable habitat present within Project Area

Species	Commonwealth Conservation Status	WA Conservation Status	Flowering Period	Preferred Habitat	Likelihood of occurrence
Melaleuca viminalis		Priority 2	November to December	Drain. Brown sandy clay over clay.	May occur – suitable habitat present within Project Area
Schoenus loliaceus		Priority 2	August to November	Sandy soils. Winter-wet depressions	Unlikely to occur – No suitable habitat present within Project Area
Acacia horridula		Priority 3	May to August	Gravelly soils over granite, sand. Rocky hillsides.	Unlikely to occur – No suitable habitat present within Project Area
Asteridea gracilis		Priority 3	September to December	Sand, clay, gravelly soils.	Unlikely to occur – No suitable habitat present within Project Area
Baeckea sp. Perth Region (R.J. Cranfield 444)		Priority 3	January to March	Orange sand, brown loam, white sandy clay. Low flats, winter-wet swamps, railway reserves.	May occur – suitable habitat present within Project Area
Banksia pteridifolia subsp. *vernalis*		Priority 3	September to October	White/grey sand over laterite.	Unlikely to occur – No suitable habitat present within Project Area
Byblis gigantea		Priority 3	September to December or January	Sandy soil often swampy. Sandy-peat swamps. Seasonally wet areas.	May occur – recorded in Bush Forever Site 387
Eryngium pinnatifidum subsp. *Palustre* (G.J. Keighery 13459) PN		Priority 3	September to November	Alluvial flat, under water. Grey sand over clay.	May occur – suitable habitat present within Project Area
Eryngium sp. Subdecumbens (G.J. Keighery 5390) PN		Priority 3	September	Open claypan, winter wet, claypan. Grey-white clay over clay.	May occur – suitable habitat present within Project Area
Grevillea manglesii subsp. *dissectifolia*		Priority 3	January or March to April or June to November	Gravelly loam, sandy loam on granite, clay. Roadsides, granite outcrops.	May occur – suitable habitat present within Project Area
Haemodorum loratum		Priority 3	November	Grey or yellow sand, gravel.	May occur – suitable habitat present within Project Area

Species	Commonwealth Conservation Status	WA Conservation Status	Flowering Period	Preferred Habitat	Likelihood of occurrence
Isopogon drummondii		Priority 3	February to June	White, grey or yellow sand, often over laterite.	May occur – recorded within Bush Forever site 320
Jacksonia gracillima		Priority 3	October to November	Banksia woodland. winter-wet swamp; pale grey sand.	Unlikely to occur – no suitable habitat present within Project Area
Meionectes tenuifolia		Priority 3	October to December	Granite flats, shallow soil at margins, inundated among moss beds.	Unlikely to occur – no suitable habitat present within Project Area
Pithocarpa corymbulosa		Priority 3	January to April	Gravelly or sandy loam. Amongst granite outcrops	Unlikely to occur – No suitable habitat present within Project Area
Schoenus benthamii		Priority 3	October to November	White, grey sand, sandy clay. Winter-wet flats, swamps.	May occur – suitable habitat present within Project Area
Schoenus capillifolius		Priority 3	October to November	Brown mud. Claypans.	May occur – suitable habitat present within Project Area
Schoenus griffinianus		Priority 3	September to October	White sand.	May occur – suitable habitat present within Project Area
Schoenus sp. Waroona (G.J. Keigheryi 12235)		Priority 3	October to November	Clay or sandy clay. Winter-wet flats.	May occur – suitable habitat present within Project Area
Tetratheca sp. Granite (S. Patrick SP1224)		Priority 3	May to November	Clay, moist, clayey sand. Granite boulders.	Unlikely to occur – No suitable habitat present within Project Area
Thysanotus anceps		Priority 3	October to December	Lateritic gravel. Open Jarrah and Marri woodland.	May occur – suitable habitat present within Project Area
Boronia tenuis		Priority 4	August to November	Laterite, stony soils, granite.	Unlikely to occur – No suitable habitat present within Project Area

Species	Commonwealth Conservation Status	WA Conservation Status	Flowering Period	Preferred Habitat	Likelihood of occurrence
Drosera occidentalis subsp. *occidentalis*		Priority 4	November to December	Sandy and clayey soils. Swamps and wet depressions.	May occur – suitable habitat present within Project Area
Grevillea pimeleoides		Priority 4	July to November	Jarrah Forest.	May occur – suitable habitat present within Project Area
Lasiopetalum bracteatum		Priority 4	August to November	Sandy clay, clay, lateritic gravel. Along drainage lines, creeks, gullies, granite outcrops.	Unlikely to occur – no suitable habitat present within Project Area
Ornduffia submersa		Priority 4	September to October	Wet black sand.	Unlikely to occur – no suitable habitat present within Project Area
Stylidium striatum		Priority 4	October to November	Brown clay loam over laterite. Hill slopes. Jarrah/Marri forest. Wandoo woodland.	Unlikely to occur – no suitable habitat present within Project Area
Tripterococcus paniculatus		Priority 4	October to November	Grey, black or peaty sand. Winter wet flats.	May occur – suitable habitat present within Project Area
Verticordia lindleyi subsp. *lindleyi*		Priority 4	May or November to December or January	Sand, Sandy Clay. Winter wet depressions.	Likely to occur – known to occur within Bush Forever Site 320

Appendix B

Threatened and Priority Fauna identified through database searches

Appendix B Threatened and Priority Fauna identified through database searches

Species	Vernacular	Legislation		Habitat	Likelihood
		EPBC Act Conservation status	WC Act / Priority Rank		
BIRD					
Calyptorhynchus latirostris	Carnaby's Cockatoo	Endangered	Threatened - Endangered	Carnaby's Cockatoo is a postnuptial nomad and typically moves west soon after breeding. The species nests in hollows of smooth-barked eucalypts, particularly Salmon Gum (*Eucalyptus salmonophloia)* and Wandoo (*E. Wandoo)* but is not limited to these eucalypts. Diet consists of an array of Proteaceous and Eucalypt species prevalent on the Swan Coastal Plain. Foraging habitat, including *Banksia* woodlands, is considered to be habitat critical to the survival of the species (Johnstone *et al,* 2010).	Likely to occur - This species have been previously recorded within close proximity to the Project Area.
Rostratula australis	Australian Painted Snipe	Endangered, Marine, Migratory (CAMBA))	Threatened - Endangered	The Australian Painted Snipe is usually found in shallow inland wetlands, either freshwater or brackish, that are either permanently or temporarily filled. It is a cryptic bird that is hard to see and often water's edge and on mudflats, taking invertebrates, such as insects and worms, and seeds recorded. It nests on the ground amongst tall reed-like vegetation near water, and feeds near the overlooked. Usually only single birds are seen, though larger groups of up to 30 have been	Unlikely to Occur - No suitable habitat present in Project Area.
Cacatua pastinator subsp. *pastinator*	Muirs Corella	Vulnerable	Schedule 4 – other specially protected fauna	Muirs Corella is confined to the extreme south west of Western Australia (Schodde and Mason, 1997). Its habitat is severely fragmented with much of the original habitat lost due to clearing, processes associated with dieback and degradation (Chapman et al. 2005; Garnett and Crowley 2000; Mawson and Johnstone 1997; Mawson and Long, 1994).	Unlikely to occur - Not recorded along the Swan River since 1900. Most recent historic record occurs from 1835.

Species	Vernacular	Legislation		Habitat	Likelihood
		EPBC Act Conservation status	WC Act / Priority Rank		
Calyptorhynchus baudinii	Baudin's Cockatoo	Vulnerable	Threatened - Endangered	Habitat critical to the survival of this species includes forests of Karri (*E. diversicolor*), Jarrah (E. *marginata*) and Marri (*C. calophylla*), in areas of 600 mm average rainfall per year. Individuals typically move north through the Perth region from March to May and south through the Perth region from August to October. This species ranges north to Gidgegannup and Hoddy Well and west to the Eastern Strip of the Swan Coastal Plain including West Midland in the north, heading south through Armadale, Byford and continues south and towards the coast until Lake Clifton where it continues to hug the coastline to east of Albany (Johnstone *et al,* 2010).	Likely to occur - The species has been previously recorded near Gooseberry Hill during 2003.
Calyptohynchus banksii subsp. *naso*	Forest Red-tailed Cockatoo	Vulnerable	Threatened - Vulnerable	Requires tree hollows to nest and breed, occurs in forests of Karri (*E. diversicolor*), Jarrah (*E. marginata*) and Marri (*Corymbia calophylla*), with flocks moving out onto the Swan Coastal Plain in search of food from exotic trees such as White Cedar (Johnstone *et al*, 2010). Foraging habitat for the species consists of Jarrah and Marri woodlands and forest throughout its range.	Likely to occur - The species has been previously recorded near Kenwick and High Wycombe during 2012.
Leipoa ocellata	Malleefowl	Vulnerable	Threatened - Vulnerable	This species mainly occurs within the southern arid and semiarid zones of Western Australia. Mallefowl commonly occurs within scrubs and thickets of mallee *Eucalyptus* spp., *Melaleuca lanceolata* and *Acacia linophylla*, also other dense litter forming shrublands.	Unlikely to Occur - No suitable habitat present in Project Area.
Actitis hypoleucos	Common Sandpiper	Marine, Migratory (Bonn, CAMBA, JAMBA, ROKAMBA)	Schedule 3 – Migratory bird protected under International Agreement	This species utilises a wide range of coastal wetlands and some inland wetlands, with varying levels of salinity. The common sandpiper has been recorded in estuaries and deltas of streams as well as on banks farther upstream, around lakes, pools, billabongs and reservoirs. The species generally forage in shallow water and on bare soft mud at the edges of wetlands.	Unlikely to Occur - No suitable habitat present in Project Area.

Species	Vernacular	Legislation		Habitat	Likelihood
		EPBC Act Conservation status	WC Act / Priority Rank		
Tringa nebularia	Common Greenshank	Marine, Migratory (Bonn, CAMBA, JAMBA, ROKAMBA)	Schedule 3 – Migratory bird protected under International Agreement	The Common Greenshank is found in a wide variety of inland wetlands and sheltered coastal habitats of varying salinity. This species uses both permanent and ephemeral terrestrial wetlands, including swamps, lakes, dams, rivers, creeks, billabongs, waterholes and inundated flooplains, claypans and saltflats.	May overfly the area - Suitable habitat occurs within close proximity to Project Area
Haliaeetus leucogaster	White bellied Sea Eagle	Marine, Migratory (CAMBA)	Schedule 3 – Migratory bird protected under International Agreement	The White-bellied Sea-Eagle is a large raptor that is widespread throughout coastal Australia. The White Bellied Sea-Eagle occupies a wide range of habitats, usually in close proximity to a large body of water (including the ocean). Breeding usually occurs in tall open woodlands overlooking bodies of water (DotE, 2013a).	Unlikely to occur - Commonly coastal marine species
Ardea ibis	Cattle Egret	Marine, Migratory (CAMBA, JAMBA)	Schedule 3 – Migratory bird protected under International Agreement	The Cattle Egret is a small egret weighing only 390g and standing 70 cm tall. The heaviest distribution of this species in WA is in the north east, and into the Northern Territory. In the non-breeding season, it can be found throughout most of Australia (DotE, 2013a).	Unlikely to occur - closest known record from Caversham area during 2001
Ardea modesta	Eastern Great Egret	Marine, Migratory (CAMBA, JAMBA)	Schedule 3 – Migratory bird protected under International Agreement	The Eastern Great Egret is a large bird (~100 cm, 1 kg) with white plumage and black or yellow bill. The species occurs individually or in small groups when foraging, but roosts in large flocks. Non-breeding individuals have been recorded throughout Australia. Almost all breeding colonies are located in the Top End of the Northern Territory (DotE, 2013a). Non breeding individuals have been recorded across much of the Australian continent (DotE, 2013a).	Likely to occur - numerous previous records within close proximity to Project Area from Welshpool and High Wycombe Area.

Species	Vernacular	Legislation		Habitat	Likelihood
		EPBC Act Conservation status	WC Act / Priority Rank		
Merops ornatus	Rainbow Bee-eater	Marine, Migratory (JAMBA)	Schedule 3 – Migratory bird protected under International Agreement	The Rainbow Bee-eater is a common species which occupies numerous habitats including open woodlands with sandy loamy soil, sand ridges, sandpits, riverbanks, road cuttings, beaches, dunes, cliffs, mangroves and rainforests. It is possible that this species will occupy open woodland areas within the survey area. The Rainbow Bee-eater avoids heavy forest that would hinder the pursuit of its insect prey (Morcombe, 2003).	Likely to occur - Suitable habitat may occur within the Project Area.
Falco peregrinus	Peregrin Falcon		Schedule 4 – Other specially protected fauna	The peregrine falcon is found on every continent and major island group except Antarctica and New Zealand. They occur throughout Australia however are absent for treeless and waterless deserts and dense forest.	Unlikely to occur - No suitable habitat present within the Project Area
INSECT					
Leioproctus douglasiellus	bee	Critically Endangered	Threatened - Endangered	Insufficient information	Unlikely to occur - Other bee species known from one historic collection from Kenwick area in 1981
Austromerope poultoni	scorpionfly		Priority 2	The scorpionfly is endemic to Western Australia and is found in a variety of habitats, including woodland, Jarrah Forest and sand plain vegetation.	Unlikely to occur - Previous records from Boddington area
Leioproctus bilobatus	bee		Priority 2	Insufficient information	Unlikely to occur - Historic collection from Kenwick area in 1981
MAMMAL					
Bettongia penicillata subsp. *ogilbyi*	Woylie	Endangered	Threatened - Critically Endangered	Gastrolobium thickets provide refuge for Woylies against introduced predators. Gastrolobium thickets provide the woylie with refuge from introduced predators, partly because of the ability to physically hide in the bushes but also the local reduction in predator numbers caused by secondary poison present within Gastrolobium species.	Unlikely to occur - No suitable habitat present within the Project Area

Species	Vernacular	Legislation		Habitat	Likelihood
		EPBC Act Conservation status	WC Act / Priority Rank		
Dasyurus geoffroii	Chuditch	Vulnerable	Threatened - Vulnerable	Following European settlement the range of this species contracted dramatically, from much of the continent to a small area in the south west. It currently only occurs in areas dominated by sclerophyll forest or drier woodland, heath and mallee shrubland (Van Dyck & Strahan, 2008). The majority of records are found in the contiguous Jarrah forests of the south west of Western Australia (DotE, 2013a). Recent records exist within the Gnangara pine forest and Walyunga National Park.	Unlikely to occur - Due to degraded nature of vegetation
Pseudocheirus occidentalis	Western Ringtail Possum	Vulnerable	Threatened - Vulnerable	The Western Ringtail Possum has a patchy distribution in predominantly two areas: near Bunbury to Leeuwin-Naturaliste National Park (with a small translocated population near Dawesville); and near Albany. Populations on the Swan Coastal Plain are associated with stands of myrtaceous trees (usually Peppermint Tree (Agonis flexuosa)) growing near swamps, water courses or floodplains, and at topographic low points which provide cooler often more fertile conditions	Unlikely to Occur - Closest known record is from 1958 in Midland.
Setonix brachyurus	Quokka	Vulnerable	Threatened - Vulnerable	The Quokka prefers early seral (young) vegetation stages that have been burned within the previous ten years. The quokka currently inhabits dense low vegetation that provides refuge from predation by owls, foxes and cats.	Unlikely to occur - No suitable habitat present within the Project Area
Phascogale tapoatafa subsp. tapoatafa	Southern Brush-tailed Phascogale, Wambenger		Threatened - Vulnerable	This species occurs in dry sclerophyll forests and open woodlands that contains hollow bearing trees.	Unlikely to occur - Know from historic collections
Hydromys chrysogaster	Water-rat		Priority 4	This species lives in burrows on the banks of rivers, lakes and estuaries and feeds on aquatic insects, fish, crustaceans, mussels, snails, frogs, birds eggs and water birds.	Unlikely to occur - No suitable habitat present within the Project Area

Species	Vernacular	Legislation		Habitat	Likelihood
		EPBC Act Conservation status	WC Act / Priority Rank		
Isoodon obsesulus subsp. *fusciventer*	Southern Brown Bandicoot or Quenda		Priority 5	The Quenda or Southern Brown Bandicoot exists only in a fragmented distribution to its former range in southern south western and eastern Australia. It is found in forest, woodland, heath and shrub communities in these regions. Preferred habitat usually consists of a combination of sandy soils and dense heathy vegetation (Van Dyck & Strahan, 2008).	Likely to occur – has been recorded from several locations within close proximity to Project Area near High Wycombe and Forrestfield
Macropus irma	Western Brush Wallaby		Priority 4	This species is found in the southwest coastal region of Western Australia from Kalbarri all the way down to Cape Arid, particularly centralized near the Swan River.	Unlikely to occur - Historic collection from Forrestfield area in 1963
REPTILE					
Neelaps calonotos	Black-striped Snake		Priority 3	The Black-striped Snake is typically found in sand plain habitat in association with Banksia species, having a very limited distribution exclusive to the Swan Coastal Plain. This taxon is particularly difficult to locate, and is infrequently collected during biological surveys on the Swan Coastal Plain.	Unlikely to occur - Due to previous disturbance.
Ctenotus delli	Dell's Ctenotus, Darling Range Heath Ctenotus		Priority 4	This species is only found in a small portion of the Darling Range in small heath patches and dense schrub understorey. May be present regionally but scarce.	Unlikely to occur - due to degraded nature of vegetation
Morelia spilota subsp. *imbricata*	Carpet Python		Schedule 4 – Other specially protected fauna	The carpet python grows to a length of 2.3m from snout to vent. It occurs is coastal areas, woodland, heathland and semiarid areas often in woodlands of Eucalyptus and Banksia or amongst grasses or low growing shrubs.	Unlikely to occur - due to degraded nature of vegetation

Appendix C

EBPC Act Protected Matters Report

Australian Government
Department of the Environment

EPBC Act Protected Matters Report

This report provides general guidance on matters of national environmental significance and other matters protected by the EPBC Act in the area you have selected.

Information on the coverage of this report and qualifications on data supporting this report are contained in the caveat at the end of the report.

Information is available about Environment Assessments and the EPBC Act including significance guidelines, forms and application process details.

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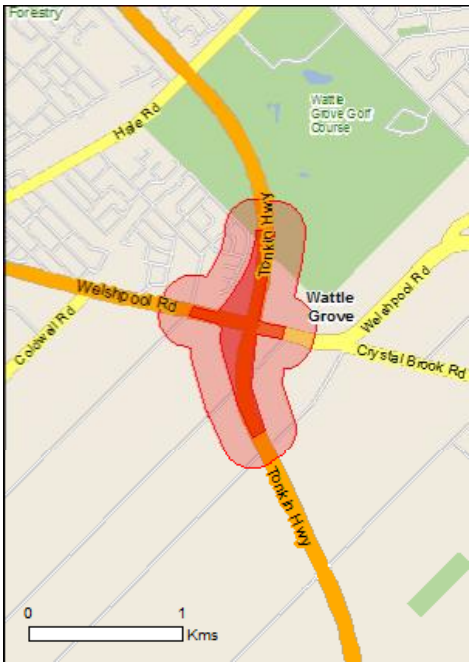

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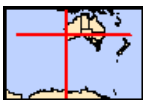

Summary

Matters of National Environmental Significance

This part of the report summarises the matters of national environmental significance that may occur in, or may relate to, the area you nominated. Further information is available in the detail part of the report, which can be accessed by scrolling or following the links below. If you are proposing to undertake an activity that may have a significant impact on one or more matters of national environmental significance then you should consider the Administrative Guidelines on Significance.

World Heritage Properties:	None
National Heritage Places:	None
Wetlands of International Importance:	None
Great Barrier Reef Marine Park:	None
Commonwealth Marine Areas:	None
Listed Threatened Ecological Communities:	1
Listed Threatened Species:	26
Listed Migratory Species:	6

Other Matters Protected by the EPBC Act

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the environment anywhere.

The EPBC Act protects the environment on Commonwealth land, the environment from the actions taken on Commonwealth land, and the environment from actions taken by Commonwealth agencies. As heritage values of a place are part of the 'environment', these aspects of the EPBC Act protect the Commonwealth Heritage values of a Commonwealth Heritage place and the heritage values of a place on the Register of the National Estate.

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the environment anywhere.

A permit may be required for activities in or on a Commonwealth area that may affect a member of a listed threatened species or ecological community, a member of a listed migratory species, whales and other cetaceans, or a member of a listed marine species.

Commonwealth Land:	None
Commonwealth Heritage Places:	None
Listed Marine Species:	7
Whales and Other Cetaceans:	None
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Commonwealth Reserves Marine	None

Extra Information

This part of the report provides information that may also be relevant to the area you have nominated.

Place on the RNE:	1
State and Territory Reserves:	1
Regional Forest Agreements:	None
Invasive Species:	39
Nationally Important Wetlands:	1
Key Ecological Features (Marine)	None

Details

Matters of National Environmental Significance

Listed Threatened Ecological Communities [Resource Information]

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Name	Status	Type of Presence
Corymbia calophylla - Kingia australis woodlands on heavy soils of the Swan Coastal Plain	Endangered	Community known to occur within area

Listed Threatened Species [Resource Information]

Name	Status	Type of Presence
Birds		
Calyptorhynchus banksii naso Forest Red-tailed Black-Cockatoo [67034]	Vulnerable	Species or species habitat may occur within area
Calyptorhynchus baudinii Baudin's Black-Cockatoo, Long-billed Black-Cockatoo [769]	Vulnerable	Roosting known to occur within area
Calyptorhynchus latirostris Carnaby's Black-Cockatoo, Short-billed Black-Cockatoo [59523]	Endangered	Breeding likely to occur within area
Leipoa ocellata Malleefowl [934]	Vulnerable	Species or species habitat may occur within area
Rostratula australis Australian Painted Snipe [77037]	Endangered	Species or species habitat may occur within area
Mammals		
Dasyurus geoffroii Chuditch, Western Quoll [330]	Vulnerable	Species or species habitat known to occur within area
Pseudocheirus occidentalis Western Ringtail Possum, Ngwayir [25911]	Vulnerable	Species or species habitat may occur within area
Setonix brachyurus Quokka [229]	Vulnerable	Species or species habitat may occur within

Name	Status	Type of Presence
		area
Plants		
Andersonia gracilis Slender Andersonia [14470]	Endangered	Species or species habitat may occur within area
Banksia mimica Summer Honeypot [82765]	Endangered	Species or species habitat likely to occur within area
Caladenia huegelii King Spider-orchid, Grand Spider-orchid, Rusty Spider-orchid [7309]	Endangered	Species or species habitat likely to occur within area
Calytrix breviseta subsp. breviseta Swamp Starflower [23879]	Endangered	Species or species habitat likely to occur within area
Centrolepis caespitosa [6393]	Endangered	Species or species habitat likely to occur within area
Chamelaucium sp. Gingin (N.G.Marchant 6) Gingin Wax [64649]	Endangered	Species or species habitat may occur within area
Conospermum undulatum Wavy-leaved Smokebush [24435]	Vulnerable	Species or species habitat likely to occur within area
Darwinia foetida Muchea Bell [83190]	Critically Endangered	Species or species habitat likely to occur within area
Diuris micrantha Dwarf Bee-orchid [55082]	Vulnerable	Species or species habitat may occur within area
Diuris purdiei Purdie's Donkey-orchid [12950]	Endangered	Species or species habitat likely to occur within area
Drakaea elastica Glossy-leafed Hammer-orchid, Praying Virgin [16753]	Endangered	Species or species habitat likely to occur within area
Drakaea micrantha Dwarf Hammer-orchid [56755]	Vulnerable	Species or species habitat may occur within area
Eleocharis keigheryi Keighery's Eleocharis [64893]	Vulnerable	Species or species habitat likely to occur within area
Grevillea curviloba subsp. incurva Narrow curved-leaf Grevillea [64909]	Endangered	Species or species habitat may occur within area
Lepidosperma rostratum Beaked Lepidosperma [14152]	Endangered	Species or species habitat likely to occur within area
Synaphea sp. Fairbridge Farm (D.Papenfus 696) Selena's Synaphea [82881]	Critically Endangered	Species or species habitat may occur within area
Thelymitra manginii K.Dixon & Batty ms. [67443]	Endangered	Species or species habitat may occur within area
Thelymitra stellata Star Sun-orchid [7060]	Endangered	Species or species habitat likely to occur

Name	Status	Type of Presence within area

Listed Migratory Species		[Resource Information]
* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.		
Name	Threatened	Type of Presence
Migratory Marine Birds		
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Migratory Terrestrial Species		
Haliaeetus leucogaster White-bellied Sea-Eagle [943]		Species or species habitat likely to occur within area
Merops ornatus Rainbow Bee-eater [670]		Species or species habitat may occur within area
Migratory Wetlands Species		
Ardea alba Great Egret, White Egret [59541]		Species or species habitat likely to occur within area
Ardea ibis Cattle Egret [59542]		Species or species habitat likely to occur within area
Rostratula benghalensis (sensu lato) Painted Snipe [889]	Endangered*	Species or species habitat may occur within area

Other Matters Protected by the EPBC Act

Listed Marine Species		[Resource Information]
* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.		
Name	Threatened	Type of Presence
Birds		
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Ardea alba Great Egret, White Egret [59541]		Species or species habitat likely to occur within area
Ardea ibis Cattle Egret [59542]		Species or species habitat likely to occur within area
Haliaeetus leucogaster White-bellied Sea-Eagle [943]		Species or species habitat likely to occur within area
Merops ornatus Rainbow Bee-eater [670]		Species or species habitat may occur within area
Pandion haliaetus Osprey [952]		Species or species habitat may occur within area
Rostratula benghalensis (sensu lato) Painted Snipe [889]	Endangered*	Species or species habitat may occur within area

Extra Information

Places on the RNE [Resource Information]

Note that not all Indigenous sites may be listed.

Name	State	Status
Indigenous		
Forrestfield Scarred Tree	WA	Registered

State and Territory Reserves [Resource Information]

Name	State
Kenwick Wetlands	WA

Invasive Species [Resource Information]

Weeds reported here are the 20 species of national significance (WoNS), along with other introduced plants that are considered by the States and Territories to pose a particularly significant threat to biodiversity. The following feral animals are reported: Goat, Red Fox, Cat, Rabbit, Pig, Water Buffalo and Cane Toad. Maps from Landscape Health Project, National Land and Water Resouces Audit, 2001.

Name	Status	Type of Presence
Birds		
Acridotheres tristis Common Myna, Indian Myna [387]		Species or species habitat likely to occur within area
Anas platyrhynchos Mallard [974]		Species or species habitat likely to occur within area
Carduelis carduelis European Goldfinch [403]		Species or species habitat likely to occur within area
Columba livia Rock Pigeon, Rock Dove, Domestic Pigeon [803]		Species or species habitat likely to occur within area
Passer domesticus House Sparrow [405]		Species or species habitat likely to occur within area
Passer montanus Eurasian Tree Sparrow [406]		Species or species habitat likely to occur within area
Streptopelia chinensis Spotted Turtle-Dove [780]		Species or species habitat likely to occur within area
Streptopelia senegalensis Laughing Turtle-dove, Laughing Dove [781]		Species or species habitat likely to occur within area

Name	Status	Type of Presence
Sturnus vulgaris Common Starling [389]		Species or species habitat likely to occur within area
Turdus merula Common Blackbird, Eurasian Blackbird [596]		Species or species habitat likely to occur within area
Mammals		
Bos taurus Domestic Cattle [16]		Species or species habitat likely to occur within area
Canis lupus familiaris Domestic Dog [82654]		Species or species habitat likely to occur within area
Capra hircus Goat [2]		Species or species habitat likely to occur within area
Felis catus Cat, House Cat, Domestic Cat [19]		Species or species habitat likely to occur within area
Funambulus pennantii Northern Palm Squirrel, Five-striped Palm Squirrel [129]		Species or species habitat likely to occur within area
Mus musculus House Mouse [120]		Species or species habitat likely to occur within area
Oryctolagus cuniculus Rabbit, European Rabbit [128]		Species or species habitat likely to occur within area
Rattus norvegicus Brown Rat, Norway Rat [83]		Species or species habitat likely to occur within area
Rattus rattus Black Rat, Ship Rat [84]		Species or species habitat likely to occur within area
Sus scrofa Pig [6]		Species or species habitat likely to occur within area
Vulpes vulpes Red Fox, Fox [18]		Species or species habitat likely to occur within area
Plants		
Anredera cordifolia Madeira Vine, Jalap, Lamb's-tail, Mignonette Vine, Anredera, Gulf Madeiravine, Heartleaf Madeiravine, Potato Vine [2643]		Species or species habitat likely to occur within area
Asparagus asparagoides Bridal Creeper, Bridal Veil Creeper, Smilax, Florist's Smilax, Smilax Asparagus [22473]		Species or species habitat likely to occur within area
Brachiaria mutica Para Grass [5879]		Species or species habitat may occur within area
Cenchrus ciliaris Buffel-grass, Black Buffel-grass [20213]		Species or species habitat may occur within area
Chrysanthemoides monilifera Bitou Bush, Boneseed [18983]		Species or species habitat may occur within

Name	Status	Type of Presence
		area
Chrysanthemoides monilifera subsp. monilifera Boneseed [16905]		Species or species habitat likely to occur within area
Genista linifolia Flax-leaved Broom, Mediterranean Broom, Flax Broom [2800]		Species or species habitat likely to occur within area
Genista monspessulana Montpellier Broom, Cape Broom, Canary Broom, Common Broom, French Broom, Soft Broom [20126]		Species or species habitat likely to occur within area
Genista sp. X Genista monspessulana Broom [67538]		Species or species habitat may occur within area
Lantana camara Lantana, Common Lantana, Kamara Lantana, Large-leaf Lantana, Pink Flowered Lantana, Red Flowered Lantana, Red-Flowered Sage, White Sage, Wild Sage [10892]		Species or species habitat likely to occur within area
Lycium ferocissimum African Boxthorn, Boxthorn [19235]		Species or species habitat likely to occur within area
Olea europaea Olive, Common Olive [9160]		Species or species habitat may occur within area
Pinus radiata Radiata Pine Monterey Pine, Insignis Pine, Wilding Pine [20780]		Species or species habitat may occur within area
Rubus fruticosus aggregate Blackberry, European Blackberry [68406]		Species or species habitat likely to occur within area
Salix spp. except S.babylonica, S.x calodendron & S.x reichardtii Willows except Weeping Willow, Pussy Willow and Sterile Pussy Willow [68497]		Species or species habitat likely to occur within area
Salvinia molesta Salvinia, Giant Salvinia, Aquarium Watermoss, Kariba Weed [13665]		Species or species habitat likely to occur within area
Tamarix aphylla Athel Pine, Athel Tree, Tamarisk, Athel Tamarisk, Athel Tamarix, Desert Tamarisk, Flowering Cypress, Salt Cedar [16018]		Species or species habitat likely to occur within area
Reptiles		
Hemidactylus frenatus Asian House Gecko [1708]		Species or species habitat likely to occur within area

Nationally Important Wetlands [Resource Information]

Name	State
Brixton Street Swamps	WA

Coordinates

-32.003412 115.997257,-32.00352 115.998349,-32.004628 115.998203,-32.00787 115.997403,
-32.008028 115.997803,-32.008226 115.998963,-32.008788 115.998778,-32.008549
115.997393,-32.008714 115.997247,-32.010319 115.997071,-32.01122 115.997022,
-32.013312 115.997803,-32.013759 115.9971,-32.012014 115.996135,-32.009343 115.995228,
-32.008791 115.995169,-32.008259 115.995228,-32.008069 115.994974,-32.00768
115.993384,-32.007167 115.993699,-32.007523 115.995043,-32.006762 115.995725,
-32.005902 115.996388,-32.005075 115.996886,-32.003867 115.997257,-32.003412
115.997257

Caveat

The information presented in this report has been provided by a range of data sources as acknowledged at the end of the report.

This report is designed to assist in identifying the locations of places which may be relevant in determining obligations under the Environment Protection and Biodiversity Conservation Act 1999. It holds mapped locations of World Heritage and Register of National Estate properties, Wetlands of International Importance, Commonwealth and State/Territory reserves, listed threatened, migratory and marine species and listed threatened ecological communities. Mapping of Commonwealth land is not complete at this stage. Maps have been collated from a range of sources at various resolutions.

Not all species listed under the EPBC Act have been mapped (see below) and therefore a report is a general guide only. Where available data supports mapping, the type of presence that can be determined from the data is indicated in general terms. People using this information in making a referral may need to consider the qualifications below and may need to seek and consider other information sources.

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

For species where the distributions are well known, maps are digitised from sources such as recovery plans and detailed habitat studies. Where appropriate, core breeding, foraging and roosting areas are indicated under 'type of presence'. For species whose distributions are less well known, point locations are collated from government wildlife authorities, museums, and non-government organisations; bioclimatic distribution models are generated and these validated by experts. In some cases, the distribution maps are based solely on expert knowledge.

Only selected species covered by the following provisions of the EPBC Act have been mapped:

- migratory and
- marine

The following species and ecological communities have not been mapped and do not appear in reports produced from this database:

- threatened species listed as extinct or considered as vagrants
- some species and ecological communities that have only recently been listed
- some terrestrial species that overfly the Commonwealth marine area
- migratory species that are very widespread, vagrant, or only occur in small numbers

The following groups have been mapped, but may not cover the complete distribution of the species:

- non-threatened seabirds which have only been mapped for recorded breeding sites
- seals which have only been mapped for breeding sites near the Australian continent

Such breeding sites may be important for the protection of the Commonwealth Marine environment.

Acknowledgements

This database has been compiled from a range of data sources. The department acknowledges the following custodians who have contributed valuable data and advice:

-Department of Environment, Climate Change and Water, New South Wales
-Department of Sustainability and Environment, Victoria
-Department of Primary Industries, Parks, Water and Environment, Tasmania
-Department of Environment and Natural Resources, South Australia
-Parks and Wildlife Service NT, NT Dept of Natural Resources, Environment and the Arts
-Environmental and Resource Management, Queensland
-Department of Environment and Conservation, Western Australia
-Department of the Environment, Climate Change, Energy and Water
-Birds Australia
-Australian Bird and Bat Banding Scheme
-Australian National Wildlife Collection
-Natural history museums of Australia
-Museum Victoria
-Australian Museum
-SA Museum
-Queensland Museum
-Online Zoological Collections of Australian Museums
-Queensland Herbarium
-National Herbarium of NSW
-Royal Botanic Gardens and National Herbarium of Victoria
-Tasmanian Herbarium
-State Herbarium of South Australia
-Northern Territory Herbarium
-Western Australian Herbarium
-Australian National Herbarium, Atherton and Canberra
-University of New England
-Ocean Biogeographic Information System
-Australian Government, Department of Defence
-State Forests of NSW
-Geoscience Australia
-CSIRO
-Other groups and individuals

The Department is extremely grateful to the many organisations and individuals who provided expert advice and information on numerous draft distributions.

Please feel free to provide feedback via the Contact Us page.

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