Murdoch Drive / South St Intersection EIA EMP
Main Roads Western Australia
8 May 2012
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Murdoch Drive and South Street Intersection Upgrade

Environmental Impact Assessment and Environmental Management Plan

Murdoch Drive and South Street Intersection Upgrade

Environmental Impact Assessment and Environmental Management Plan

Prepared for

Main Roads Western Australia

Prepared by

AECOM Australia Pty Ltd
3 Forrest Place, Perth WA 6000, GPO Box B59, Perth WA 6849, Australia
T +61 8 6208 0000 F +61 8 6208 0999 www.aecom.com
ABN 20 093 846 925

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Quality Information

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A	11-Apr-2012	Internal review	Jorgen Schouten Technical Director	
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Executive Summary

Main Roads Western Australia (Main Roads) intends to upgrade the intersection of Murdoch Drive and South Street to accommodate future traffic volumes arising from planned development within the Murdoch Activity Centre, in particular the opening of Fiona Stanley Hospital in 2014.

The project comprises modification of the intersection by widening the pavement to accommodate additional and longer turning lanes and vehicle queuing capacity. The major parameter governing the design of the intersection upgrade is the predicted increase in vehicles turning right from Murdoch Drive northbound onto South Street eastbound. This movement provides the quickest access to Kwinana Freeway for vehicles leaving Fiona Stanley Hospital.

The project area and construction footprint have been considered in terms of their ecological functions and environmental values and the requirement for either preservation or management of those values. Particular consideration has been given to Quenda Wetland in terms of the requirement for environmental management as a consequence of the project.

With appropriate management including stormwater treatment, weed management and rehabilitation of degraded areas with local species it is expected that the project will enhance the integrity, ecological functions and environmental values of the Quenda Wetland.

AECOM concludes that the project will have minimal effects on the environment. Some sections of the project area and its surrounds naturally include locations where a range of species and habitats of environmental significance occur. AECOM concludes that the project is unlikely to have a significant impact on these areas.

The proximity of the project area to a conservation category wetland triggers the requirement for formal referral to the Western Australian Environmental Protection Authority consistent with section 38 of the *Environmental Protection Act 1986*. AECOM concludes, however, that the findings of this EIA EMP should enable the project to be Assessed on Proponent Information (API) should the EPA determine that the project requires formal assessment.

AECOM concludes that the project has a low risk of significant impact to black-cockatoos. The limited presence of suitable habitat for black-cockatoos protected under the *Environment Protection and Biodiversity Conservation Act 1999* indicates that the project is not a controlled action and therefore does not require referral to the Commonwealth Minister for Environment. Main Roads may wish to refer the matter to the Commonwealth in the event that legal certainty is required.

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1.0 Introduction and background

This Environmental Impact Assessment and Environmental Management Plan (EIA EMP) has been prepared by AECOM Australia (AECOM) for the proposed upgrade by Main Roads Western Australia (Main Roads) of the intersection of Murdoch Drive and South Street, Murdoch (the project). Several studies have been undertaken to provide sufficient detail for the assessment of impacts on the environment:

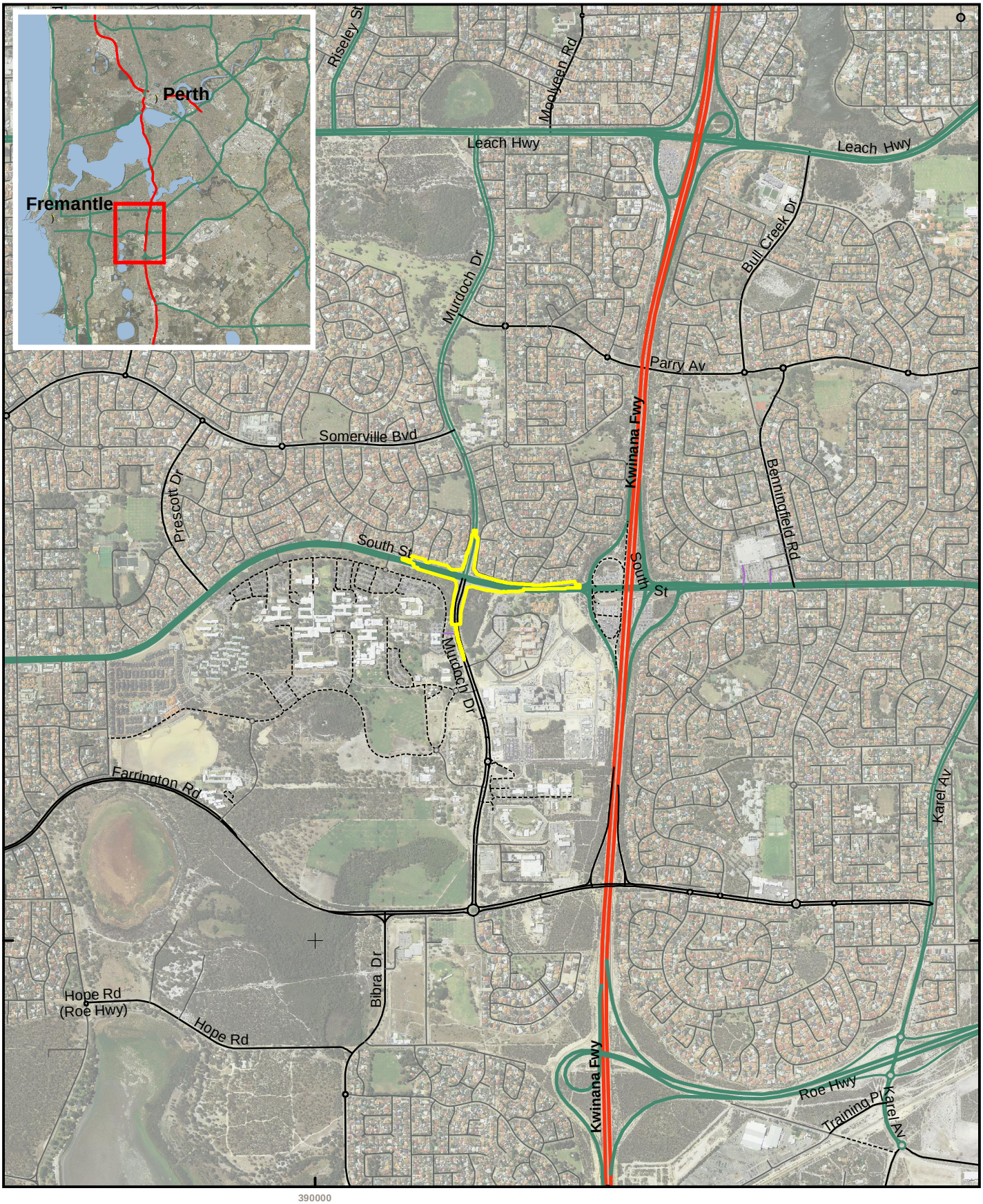
- AECOM 2012. Quenda Wetland Assessment.
- AECOM, 2010. Kwinana Freeway Third Lane: Flora and Fauna Survey.
- AECOM, 2011. Noise Measurement and Prediction 2031.
- Hohnen, J.L. 2009. A Desktop Aboriginal Heritage Survey of the Kwinana Freeway 3rd Lane Project: Leach Highway to Roe Highway and South Street Intersection, Western Australia.
- Harris, J. and Hohnen, J. 2011. Report of an Archaeological Survey for a Section 18 Application at Corner of South Street and Murdoch Drive, Murdoch.
- Goode, B., Chown, R., and J. Harris 2011. Report of an Aboriginal Heritage Survey of the Proposed Intersection Upgrade at South Street and Murdoch Drive, Murdoch, Western Australia.

1.1 Project description

The project comprises modification of the intersection by widening the pavement to accommodate additional and longer turning lanes and vehicle queuing capacity. The major parameter governing the design of the intersection upgrade is the predicted increase in vehicles turning right from Murdoch Drive northbound onto South Street eastbound. A summary of the key aspects of the project is provided in Table 1.

Table 1 Key project characteristics

Component	Description
Geometry	- double-right turn for traffic from South Street westbound to Murdoch Drive northbound - double-right turn from South Street eastbound to Murdoch Drive southbound - maintenance of two lanes in each direction for Murdoch Drive and three lanes in each direction for South Street - three northbound lanes on Murdoch Drive on the southern approach to the intersection; the third lane feeds the right-turn lanes - widening of the approach on South Street eastbound to Kwinana Freeway northbound on-ramp; left lane on South Street will be a dedicated left turn.
Drainage	- some flows go into drainage sump on NW corner, overflow is designed to go into Quenda wetland - flow into Quenda wetland via existing Gross Pollutant Trap and drainage swale as well as sheet flow from Murdoch Drive intercepted by swales adjacent to wetland
Services	- relocation of overhead and underground services including power, water, sewage and telecommunications
Lighting	- lighting uses existing poles in situ where possible, otherwise these poles are relocated. - lighting for Shared Use Paths designed in accordance with AS/NZS 1185.3.1 2005 which includes intensity and upward waste light limitations
Pedestrian and Cycleway Facilities	- a 2.5m wide Shared Use Path is provided on all approaches to the intersection – these tie in with the existing Share Use Path - on-road cycle ways are provided on both sides of Murdoch Drive south of the intersection.
Other	- an amenity wall (2.4 m high) will be constructed on the northern side of South Street adjacent to residential areas - limestone block retaining walls will be provided adjacent to Quenda Wetland to reduce impact on the wetland



Location Map

Murdoch Drive / South Street EIA EMP

Figure 1

Coordinate System: GDA 1994 MGA Zone 50

0 200 400 600 800

Metres

1:25,000 (A4)

LEGEND

- Project Area
- Freeway
- Highway
- Main Road
- Connector Road
- Local Road
- Private Road
- Restricted Access

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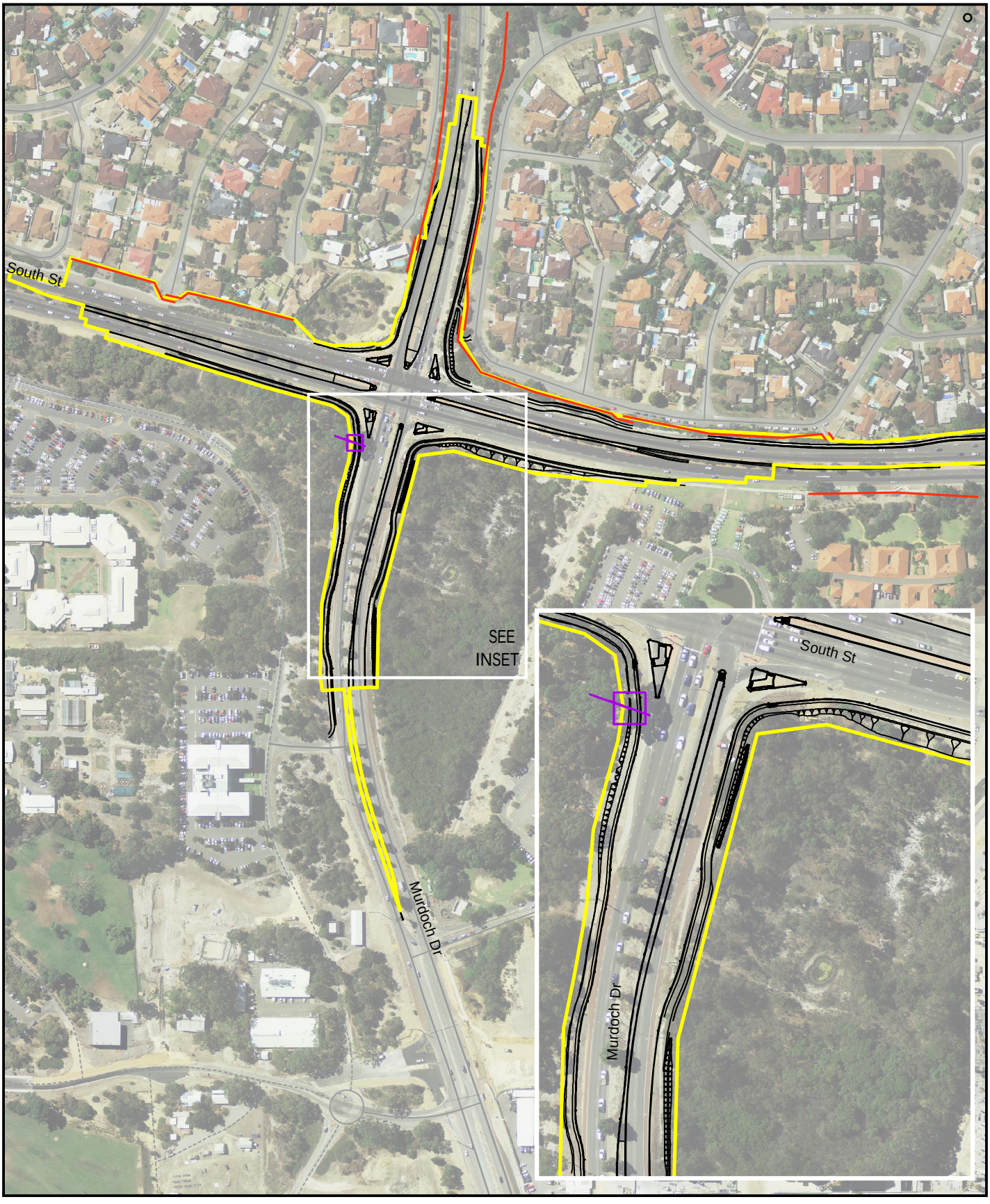

Project Area and Intersection Design

Murdoch Drive / South Street EIA EMP

Figure 2

Coordinate System: GDA 1994 MGA Zone 50

0 40 80 120

Metres

1:4,000 (A4)

LEGEND

- Project Area
- Road Design
- Amenity Wall
- Power pole relocation

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1.2 Project justification

Planning for the Murdoch Activity Centre (MAC) identifies it as one of the largest activity centres in the metropolitan area (WAPC, 2009). The new Fiona Stanley Hospital, combined with existing institutions including the St John of God Hospital, the Challenger Institute of Technology and Murdoch University will produce one of the largest concentrations of employment (about 35,000 jobs) outside of the Perth Central Business District.

Development of the Murdoch Activity Centre (MAC), which includes the Fiona Stanley Hospital (FSH), will cause an increase in the number of vehicles using the intersection of Murdoch Drive and South Street (the intersection). The intersection's level of service is rated E, which is well below Main Roads' standards. The intersection's level of service is predicted to fall to a rating of F as a result of the development of the MAC.

The proposed extension of Roe Highway, to the south of the intersection, is expected to improve access to the MAC; however the funding and timing for delivery of the Roe Highway extension remain uncertain. Without the construction of the Roe Highway extension, access to the MAC will remain constrained. Consequently, there is no way to improve the intersection's level of service without increasing its capacity. The upgrade of the intersection is required to coincide with the opening of the Fiona Stanley Hospital in 2014.

1.3 Project alternatives

Construction of the Roe Highway extension would alleviate some of the forecast increase in traffic volume arising from the development of the MAC.

An evaluation of four intersection configurations was undertaken to identify the optimum configuration that provides acceptable levels of service until at least 2021. The intersection configurations comprised two at-grade configurations and two grade-separated configurations:

- Conventional Signalised (CS) intersection, both with and without pedestrian grade separation
- Displaced Right Turn (DRT) intersection
- Centre Turn Overpass (CTO) interchange
- Centre Overpass (CO) interchange

The configurations were evaluated against sustainability criteria and the CS intersection was selected by Main Roads as the preferred option.

1.4 Legal framework

This EIA EMP considers the key legislation governing the protection and management of Western Australia's environment and heritage (Table 2). The key approvals requirements for the project derive from the *Environmental Protection Act 1986* and the *Aboriginal Heritage Act 1972*.

Table 2 Relevant legislation and potential approval 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.	Approval to undertake an assessed proposal. Permit to clear native vegetation.
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 DEC 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.
Metropolitan Water Supply Sewage and Drainage Act 1909	Provides for the establishment and control of the Metropolitan Water, Sewerage and Drainage Area.	Authorisation to impact upon watercourse within water reserves and catchment areas.
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.
Commonwealth of Australia		
Environment Protection and Biodiversity Conservation Act 1999	Provides for the protection of the environment and the conservation of biodiversity	Approval required for activities likely to have a significant impact on any matter of national environmental significance.

1.5 Timing and staging

Pre-construction activities such as the relocation of services are expected to commence in June 2012, to be followed by construction of the new intersection in December 2012. The construction is expected to take 12-18 months and will not be staged.

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2.0 Existing environment and potential impacts

AECOM completed a desktop review of the environmental conditions of the project area and screening of impacts for a range of environmental factors. The screening process identified those environmental factors that will clearly not be subject to adverse effects as a result of the project. This enabled the assessment to focus on the key environmental factors – flora, fauna, surface water, groundwater, wetlands, noise, air quality and heritage.

An aspect-factor-impact assessment model was applied that involved the identification, assessment and evaluation of project aspects and their potential impacts on the key environmental factors relevant to the project area and its surrounds.

Project aspects were identified by considering each step in the process of project development, from site investigation through construction and operation of the additional lanes and other associated road works. These are:

- ground disturbance and vegetation clearing
- earthworks
- relocation of services
- installation of culverts and drains
- construction of formations (for example, batters and retaining walls)
- operation of construction machinery
- vehicle movement.

The impact of the various project aspects on the environmental factors were assessed with reference to the EPA's objectives. Information for the assessment was sourced from publically available databases together with site assessments of flora, fauna and Aboriginal heritage undertaken by AECOM during 2010 and 2011. Numerous site investigations were undertaken during this time. The flora and fauna assessment included a spring field survey undertaken in accordance with the EPA's Guidance Statement No. 51 (2004). The field survey was conducted by AECOM botanists experienced in identifying and surveying the flora of the Swan Coastal Plain Reference photographs were taken and observations noted with respect to adjacent land use, topography, drainage, and potentially sensitive environmental receptors (AECOM 2012).

2.1 Vegetation and flora

2.1.1 Regional vegetation associations and complexes

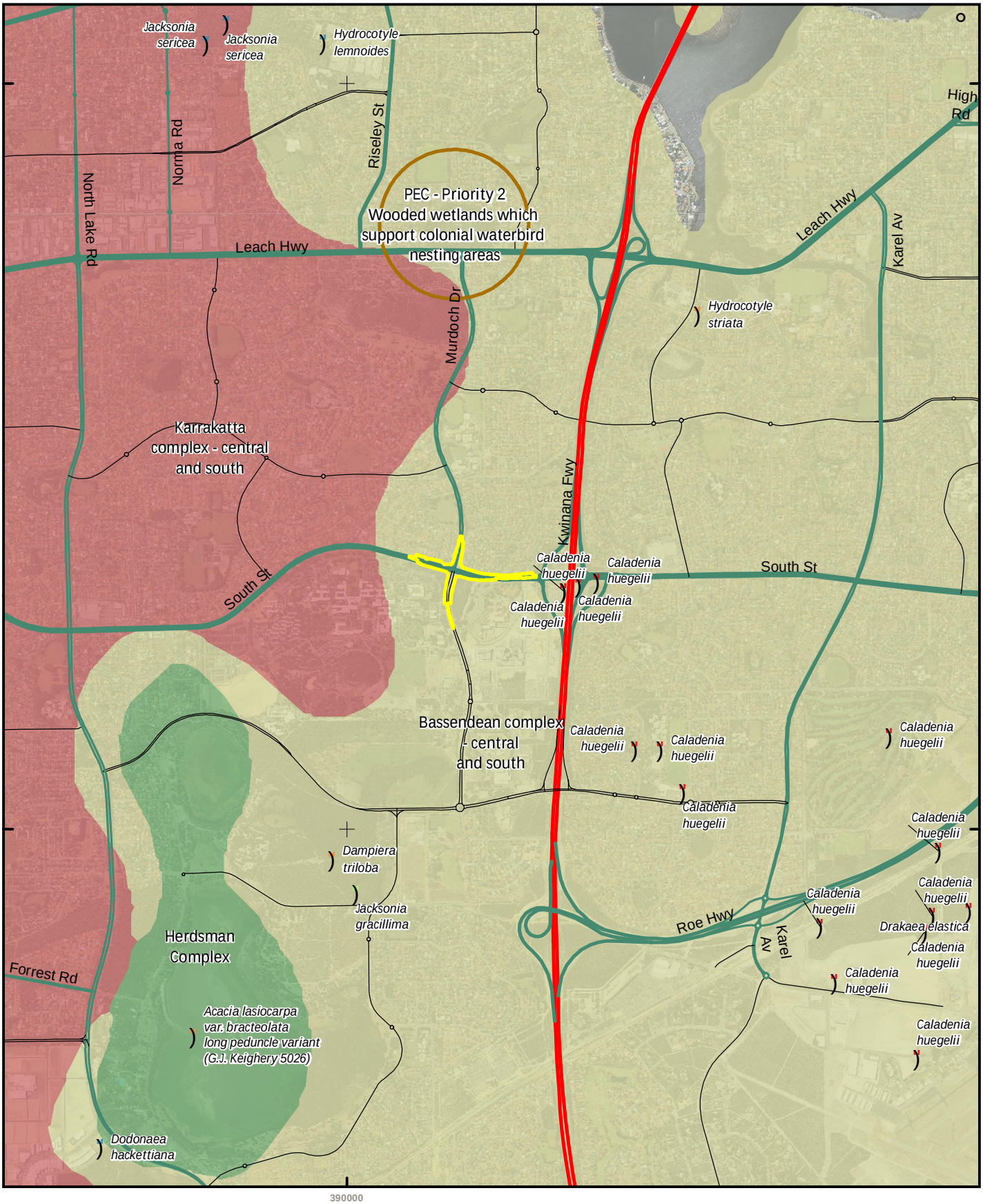
The project area is located on the Swan Coastal Plain within the Drummond Botanical Subdistrict (Beard 1990). This sub-district is typically characterised by low *Banksia* Woodlands with *Melaleuca* swamps and woodlands of Tuart (*Eucalyptus gomphocephala*), Jarrah (*Eucalyptus marginata*) and Marri (*Corymbia calophylla*).

Broad vegetation complexes have been defined by Heddle et al., (1980) based on vegetation in association with landforms and underlying geology (Figure 3). The project area is mapped as Bassendean Complex Central and South and is described by Heddle et al (1980) as follows:

> Woodland of *Eucalyptus marginata – Corymbia calophylla* with well defined second storey of *Calytrix fraseriana* and *Banksia grandis* on the deeper soils and a closed scrub on the moister sites. The understorey species reflect similarities with the adjacent vegetation complexes.

The vegetation of the project area has also previously been broadly mapped according to rainfall variations and landform/soil properties by Beard (1979) as vegetation type e2Mb cbLi (Medium very sparse woodland: Jarrah with low woodland; *Banksia* and *Casuarina*.

Approximately 200 metres west of the project area, the vegetation is described as a medium woodland of Tuart and Jarrah (e2, 4Mi) (Beard 1979). Heddle et al (1980) have mapped this vegetation as 'Karrakatta Complex Central and South' which is described as a predominantly open forest of *Eucalyptus gomphocephala, Eucalyptus marginata* and *Corymbia calophylla* and woodland of *E. marginata* and *Banksia* species.



Vegetation Complexes and Threatened and Priority Flora of the Project Area

Murdoch Drive / South Street EIA EMP

Figure 3

Coordinate System: GDA 1994 MGA Zone 50

0 250 500 750 1,000

Metres

1:35,000 (A4)

LEGEND

- Project Area
- Priority Ecological Community

Vegetation Complexes

- Bassendean complex - central and south
- Herdsman Complex
- Karrakatta complex - central and south

DEC & WA Herbarium Database Records

- Threatened
- Priority 1
- Priority 3
- Priority 4

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2.1.2 Threatened and priority ecological communities

There are no Threatened Ecological Communities (TECs) and three Priority Ecological Communities (PECs) in the vicinity of the project area (AECOM 2012) (Figure 3). The PECs are:

- Wooded Wetlands which support colonial waterbird nesting areas (P2) (Figure 3)
- *Banksia illicifolia* Woodlands (SCP22)(P2)
- Low lying *Banksia attenuata* woodland or shrublands (SCP21c) (P3).

The SCP22 and SCP21c PECs are inferred occurrences and only confidential point data exists for their location. The P2 PEC 'Wooded wetlands which support colonial waterbird nesting areas', refers to Booragoon Lake which is located approximately 1.9 kilometres north of the study area.

None of the vegetation communities recorded are equivalent to Western Australian Threatened Ecological Communities (TEC) or Priority Ecological Communities as listed by DEC (AECOM 2012). Similarly, none of the vegetation units within the project area are equivalent to Commonwealth TECs as listed under the EPBC Act (AECOM 2012).

2.1.3 Threatened and priority flora

There are 18 Threatened and Priority Flora species having the potential to occur within the project area, of which 7 species are listed as threatened under both the WC Act and the EPBC Act. The remaining 11 species are listed as priority species under the WC Act with the exception of *Centrolepis caespitose,* which is also listed as endangered under the EPBC Act. These species are described in Table 3 and their locations are shown in Figure 3. AECOM's desktop assessment of specimen records, preferred habitat and soil types indicates that only four of the species listed in Table 3 are likely to occur given the environmental conditions of the project area:

- *Acacia lasiocarpa* var. *bracteolata* long peduncle variant (G.J. Keighery 5026) (P1)
- *Dampiera triloba* (P1)
- *Jacksonia gracillima* (P3)
- *Tripterococcus paniculatus* (P4).

No threatened flora species were recorded within the project area during the field survey; the Priority 4 species *Eucalyptus caesia* was recorded within planted vegetation unit P2 and does not occur naturally on the Swan Coastal Plain.

Table 3 Threatened and priority flora of the project area and surrounds

Species	Conservation Status		Habitat	Flowering Period	Likelihood of Occurrence in Study Area
	EPBC Act	WC Act			
Caladenia huegelii Grand Spider Orchid	EN	T (CR)	Grey or brown sand, clay loam	September to October	**Unlikely to Occur.** The study area does not support suitable habitat for this species.
Darwinia foetida Muchea Bell	EN	T (CR)	Grey white sand on swampy, seasonally wet sites	October to November	**Unlikely to Occur.** There are no records of this species from the vicinity of the study area. All currently known populations occur in the Muchea area approximately 70 kilometres north of Perth.
Drakaea elastica Glossy Leaved Hammer Orchid	EN	T (CR)	White or grey sand. Low-lying situations adjoining winter-wet swamps	October to November	**Unlikely to Occur.** There are no records of this species occurring in the vicinity of the study area

Species	Conservation Status		Habitat	Flowering Period	Likelihood of Occurrence in Study Area
	EPBC Act	WC Act			
Synaphea sp. Fairbridge Farm (D. Papenfus 696)	CR	T (CR)	Sandy with lateritic pebbles. Near winter-wet flats, in low woodland with weedy grasses	October	**Unlikely to Occur.** There are no records of this species occurring in the vicinity of the study area.
Drakaea micrantha Dwarf Hammer Orchid	VU	T (EN)	White-grey sand	September to October	**Unlikely to Occur.** There are no records of this species occurring in the vicinity of the study area.
Lepidosperma rostratum Beaked Lepidosperma	EN	T (EN)	Peaty sand, clay		**Unlikely to Occur.** There are no records of this species from the vicinity of the study area. All currently known populations occur east of Perth in heavy clay soils which differ significantly from the habitat within the study area
Andersonia gracilis Slender Andersonia	EN	T (VU)	White/grey sand, sandy clay, gravelly loam, winter wet areas near swamps	September to November	**Unlikely to Occur.** There are no records of this species from the vicinity of the study area. It is currently only known from Badgingarra, Dandaragan and Kenwick, on seasonally damp black clay flats, often in duplex soils. Habitat within the study area is unlikely to be suitable.
Acacia lasiocarpa var. *bracteolata* long peduncle variant (G.J. Keighery 5026)	None	P1	Grey or black sand over clay. Swampy areas, winter wet lowlands	May or August	**May Occur.** There is a record of this species from nearby Bibra Lake, habitat appears to be suitable, however no population of this species is currently known from Quenda Wetland.
Dampiera triloba	None	P1	Sandy rises, peaty sand over clay	August to December	**May Occur**. There is a large population of this species at nearby North Lake.
Hydrocotyle striata	None	P1	Clay, springs	Unknown	**Unlikely to Occur.** There are no recent records of this species from the vicinity of the study area, habitat unlikely to be suitable.
Angianthus micropodioides	None	P3	Saline sandy soils. River edges, saline depressions, claypans	November to December or January to February	**Unlikely to Occur.** There are no records of this species occurring in the vicinity of the study area. Habitat is unlikely to be suitable.
Jacksonia gracillima	None	P3	Winter wet flats, grey sands	Unknown	**May Occur.** There are records of this species from nearby wetlands. Habitat is suitable, however has not been previously recorded from the study area.

Species	Conservation Status		Habitat	Flowering Period	Likelihood of Occurrence in Study Area
	EPBC Act	WC Act			
Phlebocarya pilosissima subsp. *pilosissima*	None	P3	White or grey sand, lateritic gravel	August to October	**Unlikely to Occur.** There are no recent records of this species occurring in the vicinity of the study area. Habitat is unlikely to be suitable.
Centrolepis caespitosa Matted Centrolepis	EN	P4	White sand, clay, salt flats, wet areas	October to December	**Unlikely to Occur.** There are no records of this species from the vicinity of the study area. All currently known populations occur well south of the study area.
Dodonaea hackettiana Hackett's Hopbush	None	P4	Sand. Outcropping limestone	July to October	**Unlikely to Occur**. Habitat of the study area is unlikely to be suitable.
Hydrocotyle lemnoides Aquatic Pennywort	None	P4	Swamps	August to October	**Unlikely to Occur**. There are no records of this species from the vicinity of the study area. Habitat unlikely to be suitable as all records occur in swamps on heavy clay/duplex soils.
Jacksonia sericea Waldjumi	None	P4	Calcareous & sandy soils	December or January to February	**Unlikely to Occur.** There are no records of this species from the vicinity of the study area. Habitat unlikely to be suitable.
Tripterococcus paniculatus	None	P4	Grey, black or peaty sand. Winter-wet flats	October to November	**May Occur.** There are records from 1999 and 1990 of this species occurring in Willetton and Canning Vale. Suitable habitat may occur in the study area.

Acacia lasiocarpa var. *bracteolata* (long peduncle variant), *Jacksonia gracillima* would have been flowering (or may have just finished flowering) and would have been easily visible at the time of the survey. *Dampiera triloba* has a distinctive carpeting habit and bright blue to mauve flowers that would have been highly visible at the time of the survey if present. *Tripterococcus paniculatus* was unlikely to have been flowering at the time of the survey; however it would most likely have been in bud and therefore able to be readily identified. Based on this information and the fact that no observations were recorded in the field, it is unlikely that any of these species occur in the project area.

2.1.4 Vegetation units and condition

There are 5 vegetation units within the project area, including two planted units, one rehabilitated unit and 2 remnant vegetation units (AECOM 2012). The remnant vegetation units comprise a *Eucalyptus/Melaleuca* Woodland and a *Eucalyptus* Woodland. The distribution and condition of these vegetation units is shown in Figure 4 and Figure 5, respectively. A description of the species composition of these units is provided in Table 4.

Table 4 Vegetation units of the project area

Vegetation Unit	Type	Site Number/s	Description
P1	Planted Vegetation in Stormwater detention basin	1, 2a, 3	Revegetated areas comprising of a scattered Low Open Woodland of *Eucalyptus camaldulensis* over *Melaleuca* sp., *Melaleuca preissiana*, #*Grevillea ?olivacea* and #*Grevillea leucopteris* over introduced species including **Ehrharta longiflora*, **E. calycina, *Lolium rigidum* and **Fumaria capreolata* in grey sand associated with stormwater detention basin and surrounding batters.
P2	Planted Vegetation along roadside	13	Revegetated roadside areas comprising of but not limited to non-locally native species such as #*Corymbia ficifolia*, #*Eucalyptus erythrocorys*, *Allocasuarina fraseriana*, #*Eucalyptus platypus*, #*Melaleuca nesophila* and #*Eucalyptus* x *tetragona*, *Grevillea bipinnatifida,* #*Callistemon phoeniceus*, and #*Acacia iteaphylla* over weed species or lawns.
ErMpAlSc	Eucalyptus/ Melaleuca Woodland	2b, 4, 5, 10, 11	Low Open Woodland of *Melaleuca preissiana* and *Banksia littoralis* with emergent *Eucalyptus rudis* over scattered tall shrubs of *Kunzea glabrescens* over an Open Shrubland of *Astartea leptophylla* with *Adenanthos cygnorum* becoming more dominant on disturbed edges over an Open Sedgeland of *Schoenus caespititius, Tetraria capillaris* and *Baumea* sp. on grey sand.
ErMrXp	Eucalyptus Woodland	na	Low Woodland of *Eucalyptus rudis* over a Shrubland of *Macrozamia riedlei* and *Banksia grandis* over **Cynodon dactylon ,* associated with planted roadside.
R1	Rehabilitated Woodland	na	Low Open Woodland of *Eucalyptus conferruminata, Eucalyptus erythrocorys* and *Eucalyptus platypus* with scattered *Corymbia calophylla* and *Eucalyptus marginata* over a Tall Open Shrubland of *Melaleuca nesophila, *Acacia iteaphylla, Jacksonia furcellata* and *Callistemon phoeniceus* with scattered *Callitris preissii* and occasional thickets of **Leptospermum laevigatum* over introduced grasses dominated by **Cynodon dactylon, *Ehrharta calycina* and **Eragrostis curvula* on brown sand

2.1.5 Weeds

A total of 56 introduced plant species were recorded within the project area including Quenda wetland. Of these, 48 are Environmental Weeds (DEC, 1999) and one is a Declared Plant (**Asparagus asparagoides*). This plant was recorded from two vegetation units within the study area (ErMpAlSc and KgAlXpDbTc) and has a high ecological impact. Nearly half of environmental weeds have a high ecological impact (DEC, 1999) (Table 5). The unnamed sumpland (UFI 6511) in the north-west corner of the study area supports the majority of these weed species.

Quenda Wetland (UFI6512) is vulnerable to the invasion of introduced species due to a number of factors including its small size (large edge to area ratio), the entry of storm water into the wetland and potential pedestrian traffic due to its urban location. Despite this, many parts of the site remain relatively weed free.

The relative absence of weeds within Quenda Wetland is most likely due to the thick covering of sedges in some areas and dense stands of *Kunzea glabrescens* that shade out potential invasive species that have become established at the disturbed edges, and preventing pedestrian access.

The most significant invasion of weed species has occurred on the edge adjacent to South Street where a recent fire has reduced the cover of sedges.

Vegetation Units of the Project Area

Murdoch Drive / South Street EIA EMP

Figure 4

Coordinate System: GDA 1994 MGA Zone 50

0 50 100 150

Metres

1:4,000 (A4)

LEGEND

Vegetation Units

- ErMrXp
- R1
- AlCEl
- ErMpAlSc
- KgAlXpDbTc
- MpC
- P1
- P2
- WB

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Vegetation Condition

Murdoch Drive / South Street EIA EMP

Figure 5

Coordinate System: GDA 1994 MGA Zone 50

0 50 100 150

Metres

1:4,000 (A4)

LEGEND

Vegetation Condition

- Completely Degraded
- Degraded - Completley Degraded
- Degraded
- Good
- Very Good
- Excellent

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Table 5 High impact environmental weeds within the project area (DEC 2011d)

Species	Notes	Vegetation Communities Recorded In
Arctotheca calendula Cape Weed	Colonises bare soil and disturbed areas, is likely to impact on soil moisture and nutrient availability, however does not seem to compete well in natural undisturbed ecosystems. Seedbank persistence of up to eight years.	P1,P2, R1 ErMpAlSc
Asparagus asparagoides (DP) Bridal Creeper	Extremely invasive, smothers vegetation, forms monocultures, increases risk of fire during summer die off phase. Seedbank persistence of two to three years.	ErMpAlSc, KgAlXpDbTc
Asphodelus fistulosus	A weed of alkaline sandy or gravelly well drained soils in winter rainfall areas. Capable of growing and spreading rapidly.	P1, ErMpAlSc, KgAlXpDbTc
Brassica tournefortii Mediterranean Turnip	Aggressive weed of disturbed ground, roadside and cultivation.	P1, P2, R1
Bromus diandrus Great Brome	Highly competitive for water, nutrients and space. Produces prolific seed, seedbank persistence is short from days up to 2 years.	P1
Cynodon dactylon Couch	Inhabits open sites subject to frequent disturbance. Documented as allelopathic, that is reduced germination of other species. Survives most fire, re-shoots from rhizomes, seedbank persists for 3 to 4 years.	ErMpAlSc, KgAlXpDbTc ErMrXp
Ehrharta calycina Perennial Veldt Grass	Commonly invades disturbed ecosystems, but is also capable of invading undisturbed ecosystems. Sets prolific seed, resulting in high seedbank densities (which can last from days to five years) and germinates earlier than most native species leading to early domination. Thought to be capable of altering nutrient cycles.	P1, P2, R1 KgAlXpDbTc ErMrXp
Ehrharta longiflora Annual Veldt Grass	Increases in cover by mass germination of soil stored seed. Seedbank persistence is 1 + years.	P1, P2, R1 KgAlXpDbTc
Euphorbia peplus Petty Spurge	Colonises degraded and disturbed sites. Seeds dispersed by ants.	ErMpAlSc, KgAlXpDbTc
Euphorbia terracina Geraldton Carnation Weed	Once established is able to invade relatively undisturbed vegetation. Has alleolopathic properties. Forms dense thickets and out-competes native species. Has rapid growth and prolific seed production in first season, seedbank persistence 3-5 years.	P1, R1, ErMpAlSc, KgAlXpDbTc
Ferraria crispa Black Flag	Each year plants produce new corms that are added to a column of dormant corms produced in previous years. There can be 15-20 corms in a single column.	P1
Freesia alba x leichtlinii	Perennial Herb occurs on grey white sand, lateritic soils or sandy clay.	P1
Fumaria capreolata Whiteflower Fumitory	Colonises degraded sites. Can be difficult to control due to strongly persistent soil seedbank (seeds persist for up to 20 years)	P1, ErMpAlSc
Gladiolus caryophyllaceus	Fire can bring corms out of dormancy and stimulate prolific flowering. Seedling recruitment in the seasons following fire can be very high.	ErMpXp, R1
Hypochaeris glabra Smooth Catsear	Common weeds of lawns, horticultural areas, roadsides and bushland throughout the south west (Hussey *et al.* 2007).	P1, P2, R1ErMpAlSc
Lagurus ovatus Hare's Tail Grass	Widespread on sandy soils. Can lead to decline in native plant species cover and diversity. Seedbank persistence 2-3 years.	ErMpAlSc, MpC, R1
Leptospermum laevigatum	Adult plants are killed by fire however seed is released from woody fruits and germinates prolifically in post fire conditions.	R1
Lotus angustissimus Narrowleaf Trefoil	Slender annual or perennial herb. Weed of river edges, plains, pasture, road verges, disturbed and cultivated areas.	P1

Species	Notes	Vegetation Communities Recorded In
Lupinus cosentinii Blue Lupin	A widespread and serious weed of roadsides, woodlands and heaths from Carnarvon to Esperance (Hussey *et al.* 2007).	P1
Oxalis pes-caprae Soursob	Prefers disturbed sites, reproduces by bulbs, rarely setting seed.	ErMpAlSc, KgAlXpDbTc
Pelargonium capitatum Rose Pelargonium	Major weed of Banksia woodland and coastal heathland, facilitated by frequent disturbance such as fire. Tail like spiral attached to seed allows movement by attachment to animals and humans. Seedbank persistence 2+ years.	P1, ErMpAlSc, R1
Pennisetum clandestinum Kikuyu Grass	Grows rapidly forming dense mats. A serious weed of bushland areas, in particular riparian areas. Known to release allelopathic substances to inhibit other species. Reproduction is by rhizomes and stolons, rarely sets seed.	P1, P2, ErMpAlSc, KgAlXpDbTc, AlCEl
Typha orientalis	Native to eastern Australia. Eradication is difficult due to prolific seed production and extensive rhizomatous roots.	WB

2.1.6 Dieback

Visual inspection of vegetation health (particularly susceptible families such as *Myrtaceae* and *Proteaceae)* during the spring 2009 field assessments did not identify any areas of *Phytophthora cinnamomi* (dieback) infestation.

2.1.7 Impact assessment

The EPA's objective for this factor is to maintain the abundance, diversity, geographic distribution and productivity of flora at species and ecosystem levels through the avoidance or management of adverse impacts and improvement of knowledge.

The project's impact with respect to this factor is limited to clearing of vegetation and the spread of weeds, as there are no threatened or priority flora and fauna species that occur within the project area. The project will result in clearing of about 0.23 ha of native vegetation as well as 1.1 ha of planted and/or rehabilitated areas. The area of planted vegetation to be cleared may be reduced depending on the method of construction of the proposed amenity walls.

None of the vegetation within the project area is locally significant. With respect to its regional significance EPA Position statement No.2 lays out a series of constraints which relate to biodiversity. One of them is to protect at least 30% of the original extent of vegetation complexes in unconstrained areas and 10% in constrained areas (i.e. urban zoned regions). The project area is considered a constrained area due to its urban zoning; therefore the 10% protection target applies.

Vegetation association 1001 identified by Shepherd et al (2002) within the study area meets the 10% target, with approximately 27.6% of its original extent remaining. However, Technical Report 249 (Shepherd et al, 2002) which outlines vegetation extent, type and status in Western Australia is almost 10 years old and in the past 10 years there would have been some changes to these figures due to the further development and expansion of the Perth metropolitan area. However, at present there is no updated estimate of vegetation extent so this reference is still used.

A large portion of the project area lies within a mapped ESA as it is within the boundaries and buffers of two mapped wetlands. Remnant vegetation communities within these areas, specifically ErMpAlSc and ErMrXp, may be considered to be significant within the region. Vegetation units P1, P2 and R1 do not represent the original vegetation types of the area, and as such, these vegetation units are not considered to be regionally significant, despite falling within the ESA. Further assessment of the impact of the project on this ESA is provided in Section 0.

With regard to weeds, ground disturbance during construction has the potential to distribute weeds throughout the project area. The impact of weed distribution will be greatest in the vicinity of Quenda Wetland. Quenda Wetland is vulnerable to weed invasion due its small size (large edge to area ratio), the entry of stormwater into the wetland and potential pedestrian traffic due to its urban location. Efforts to keep weed populations under control, including hand weeding, have been made as part of ongoing management of the wetland by the City of Melville.

The implementation of appropriate weed management strategies, including hygiene procedures for vehicles, machinery and topsoil will assist in minimising the spread of weeds.

An assessment of the project against the native vegetation clearing principles in Schedule 5 of the *Environmental Protection Act 1986* is presented in Appendix A.

2.2 Fauna and habitat

2.2.1 Species occurrence

There are 20 species of protected fauna having the potential to occur within the project area. Database search results and analysis are provided in Table 6 . Due to the proximity of the project area to the Swan and Canning Rivers, several large wetlands and the coast, the EPBC Protected Matters Search identified several marine species as well as the potential occurrence of migratory marine and wetland birds. Migratory birds may be occasional visitors to the project area but it is unlikely to provide significant habitat for them.

Based on specimen records and preferred habitat, the following species are likely to occur in the project area:

- Forest Red-tailed Black Cockatoo (*Calyptorhynchus banksii naso*) – Vulnerable (EPBC Act) and Threatened (WC Act)
- Carnaby's Cockatoo (Calyptorhynchus latirostris) – Endangered (EPBC Act) and Threatened (WC Act)
- Quenda (*Isoodon obesulus* subsp. *fusciventer*) – Priority Five
- Rainbow Bee-eater (*Merops ornatus*) – Migratory (EPBC Act)
- Perth Lined Lerista (*Lerista lineata*) – Priority Three.
- Native Bee (*Leioproctus contrarius*) – Priority Three
- Graceful Sun Moth (*Synemon gratiosa*) – Endangered (EPBC Act) and Threatened (WC Act)
- Cricket (*Throscodectes xiphos*) – Priority One.

Two species of conservation significance occur within Quenda Wetland, based on the field survey undertaken by AECOM in 2011. An Oblong Turtle was observed in the basin within the wetland. This species is not listed under Commonwealth or State legislation but it is listed by the International Union for the Conservation of Nature (IUCN) as 'Near Threatened'. Quenda also occur in the study area, although the species was not directly observed during the field survey. Runnels within dense sedges and conical diggings indicate recent Quenda activity in the study area.

No other species were observed during the field survey.

The Graceful Sun-moth is unlikely to occur in the project area as the host plants for this species, *Lomandra hermaphrodita* (or *Lomandra maritima* in areas closer to the coast) were not recorded during the field survey.

The Rainbow Bee-eater is a common species throughout Australia that constructs nesting tunnels within the banks of soft sandy substrate. There were no Rainbow Bee-eater nests observed during the field assessment and only very limited areas suitable for the construction of the nest tunnels were located.

Lerista lineata has been recorded from the surrounding area including adjacent sites such as the Fiona Stanley Hospital. It is unlikely that the project area provides suitable habitat for this species although some habitat may occur in the more sandy fringes of the wetland vegetation.

The remaining species of significant fauna identified by the database searches are unlikely to occur in the study area. This is due to unsuitable habitat and lack of recent records in the area due to urban development and marginalisation of habitat

Table 6 Records of threatened and priority fauna in the vicinity of the project area (DEC 2011, DSEWPaC 2011)

Species	Conservation Status		Habitat	Likelihood of Occurrence in Study Area
	EPBC Act	WC Act		
Botaurus poiciloptilus Australasian Bittern	Endangered	T Endangered	Inhabits shallow, vegetated freshwater or brackish swamps, favouring those dominated by sedges, rushes and/or reeds.	**Unlikely to occur.** The small wetland basin associated with the Quenda Wetland site is unlikely to provide suitable habitat for this species. There have been very few confirmed records of this species on the Swan Coastal Plain since 1992 (Garnett et al, 2011).
Calyptorhynchus banksii naso Forest Red-tailed Black Cockatoo	Vulnerable	T Vulnerable	Requires tree hollows to nest and breed, occurs in forests of Karri (*Eucalyptus 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 (*Melia azedarach*) (Johnstone et al. 2010)	**Likely to be an occasional visitor**. This species has been frequently recorded in nearby woodlands that support its primary food species. Although Quenda wetland is unlikely to comprise suitable feeding and foraging or nesting habitat this species is likely to pass through the area in search of suitable foraging sites which occur nearby.
Calyptorhynchus baudinii Baudin's Black Cockatoo	Vulnerable	T Endangered	Breeds in spring/summer in the southern forests, nesting in tree hollows (primarily Marri).	**Unlikely to Occur**. This species is generally not known from the study area and surrounding region (DSEWPaC, 2011).
Calyptorhynchus latirostris Carnaby's Black Cockatoo	Endangered	T Endangered	Forages in woodland and kwongan heath dominated by proteaceous species. Nests in hollows in large eucalypts, primarily Salmon Gum (*Eucalyptus salmonophloia*) and Wandoo (*E. wandoo*).	**Likely to Occur**. There are many records of this species from the search area. Quenda wetland is likely to provide suitable foraging habitat, but unlikely to provide suitable nesting habitat.
Charadrius rubricollis Hooded Plover	Marine	Priority 4	Inhabits ocean beaches, particularly wide beaches with large amounts of seaweed and creek mouths or inlet entrances, also inhabits inland lakes.	**Unlikely to Occur**. The study area does not provide suitable habitat for this species.
Dasyurus geoffroii Chuditch, Western Quoll	Vulnerable	T Vulnerable	Forests of Eucalyptus marginata, drier woodlands and mallee shrublands.	**Unlikely to Occur.** There have been no recent observations of Chuditch in the study area and surrounds; as vegetation in the area is small in area and very fragmented, this species is unlikely to occur.

Species	Conservation Status		Habitat	Likelihood of Occurrence in Study Area
	EPBC Act	WC Act		
Falco peregrinus Peregrine Falcon	None	S	Mainly occurs along coastal cliffs, rivers and ranges and around wooded watercourses. utilises ledges, cliff faces and the large hollows and broken spouts of trees for nesting	**Unlikely to Occur.** The study area is unlikely to provide suitable habitat for this species.
Isoodon obesulus subsp. *fusciventer* Southern Brown Bandicoot	None	Priority 5	Dense understorey vegetation, particularly around swamps and along watercourses.	**Likely to Occur.** The study area provides suitable habitat for this species and it is known from the area.
Leioproctus contrarius Native Bee	None	Priority 3	Dependent on the flowers of Goodeniaceae, possibly Lechenaultia stenosepala	**Unlikely to Occur**. A poorly known species recorded from the area in 1978. It is unlikely to occur as suitable food species were not recorded from the project area.
Lerista lineata Perth Lined Lerista	None	Priority 3	Banksia woodland, sandy coastal heath and shrubland. This species has a preference for areas supporting a low percentage of clay and does not occur in areas of heavier waterlogged soils, such as in damplands and swamp areas	**May Occur.** *Lerista lineata* has been recorded from the general area and adjacent sites, it is likely that the wetland area does not provide ideal habitat for this species, however it may occur in the more sandy fringes of the wetland vegetation.
Macropus irma Western Brush Wallaby	None	Priority 4	Forest and woodland supporting a dense shrub layer.	**Unlikely to Occur.** Although this species has been recorded recently in nearby Jandakot, it is unlikely to occur in the study area as it is likely to be too small and fragmented to support this species.
Myrmecobius fasciatus Numbat	Vulnerable	T Vulnerable	Woodland and shrubland, shelters in hollow logs, tree hollows and burrows	**Unlikely to Occur.** The study area is outside of the currently known range of this species.
Neelaps calonotos Black-striped Snake	None	Priority 3	Occurs on dunes and sand-plains vegetated with heaths or *Eucalyptus /Banksia* woodlands.	**Unlikely to Occur.** There are no recent records of this species occurring in the area that was searched.

Species	Conservation Status		Habitat	Likelihood of Occurrence in Study Area
	EPBC Act	WC Act		
Numenius madagascariensis Eastern Curlew	Marine, Migratory	Priority 4	Non-breeding birds occur around coastal Australia. Habitat for non breeding birds includes estuaries, mangroves, salt marshes and intertidal flats.	**Unlikely to Occur**. The study area does not provide suitable habitat for this species.
Phascogale calura Red-tailed Phascogale	Endangered	T Endangered	*Allocasuarina* woodland with hollow bearing eucalypts such as *Eucalyptus wandoo*	**Unlikely to Occur.** The study area is considered to be outside of the currently known range of this species and does not provide suitable habitat.
Setonix brachyurus Quokka	Vulnerable	T Vulnerable	Densely vegetated coastal heaths, swamps and riverine habitats.	**Unlikely to Occur.** Historically, the quokka would have been likely to occur in the study area, however habitat fragmentation and predation have decreased its habitat range on the mainland by at least 50%
Synemon gratiosa Graceful Sun Moth	Endangered	T Endangered	Coastal heathland on the Quindalup dunes where the preferred host plant *Lomandra maritima* occurs and Banksia woodland on Spearwood and Bassendean dunes where the preferred host plant *Lomandra hermaphrodita* occurs.	**Unlikely to Occur.** There are known populations of this species at nearby sites, however it is unlikely to occur at the quenda wetlands due to a lack of suitable host plants.
Throscodectes xiphos Cricket	None	Priority 1	Described from a specimen collected in Banksia woodland in Jandakot on the Bassendean complex.	**May Occur.** A poorly known species, specific habitat requirements are not known, therefore its presence cannot be ruled out as the original collection falls within the search area.
Haliaeetus leucogaster White-bellied Sea Eagle	Migratory	None	Coastal habitats and terrestrial wetlands in tropical and temperate Australia. Generally coastal lowlands with large areas of open water.	**Unlikely to Occur.** The study area does not provide suitable habitat for this species.
Merops ornatus Rainbow Bee-eater	Migratory	None	Occurs in a range of habitats across Australia, particularly open country of woodland, open forest, semi arid scrub, grasslands, clearings in heavier forest and farmlands. Requires soft sandy substrate for nest tunnel construction.	**Likely to Occu**r. A common bird that occurs throughout Australia, the Rainbow bee-eater is likely to be a visitor to the study area, with some potential nesting areas in the vicinity of the wetland.

2.2.2 Fauna habitat

Fauna habitat within the project area is comprised of Eucalyptus Woodland, Melaleuca Woodland over Sparse Sedges and planted vegetation.

Neither of the habitat types within the project area provide suitable habitat for Quenda. The Eucalyptus Woodland habitat does not suit Quenda due to its fragmented nature and lack of suitable vegetation. The Melaleuca Woodland over Sparse Sedges habitat type has been affected by disturbance from fire, stormwater run-off and edge effects. Growth of sedges is quite sparse and thus does not provide suitable cover for Quenda. There is potential for this area to regenerate to provide suitable understorey cover for Quenda and there are extensive rehabilitation efforts currently being undertaken in this area.

The project area contains foraging habitat for black-cockatoos in the form of planted vegetation as well as several larger trees that have the potential to provide roosting and/or future nesting habitat as defined in DSEWPaC's (2011) draft black-cockatoo referral guidelines (Figure 6). Details of these potential habitat trees within the project area are provided in Table 7. None of these trees contain hollows; however *E. Gomphocephala* may be of significance in terms of their potential to develop nesting hollows in the figure (DSEWPaC 2011). While they also have potential to be utilised for both feeding and roosting, their proximity to the road suggests that utilisation in this manner would be limited.

Banksia menziesii occurs within the Eucalyptus Woodland habitat type and offers limited foraging potential for black-cockatoos. Due to the isolation and proximity to road infrastructure, *Calyptorhynchus* spp will likely favour more extensive *Banksia* woodlands located nearby.

Table 7 Potential habitat trees for black-cockatoos within the project area

Species	Potential Use	Attributes
Eucalyptus rudis	Roosting	No visible hollows DBH = 600mm
Acacia sp.	Foraging	Not significant
Acacia sp.	Foraging	Not significant, outside of project area
Eucalyptus gomphocephala	Foraging, Nesting and Roosting	No visible hollows DBH = 900mm
Banksia menziesii	Foraging	Feeding and foraging plant
Eucalyptus gomphocephala	Foraging, Nesting and Roosting	No visible hollows DBH = 800mm

2.2.3 Impact assessment

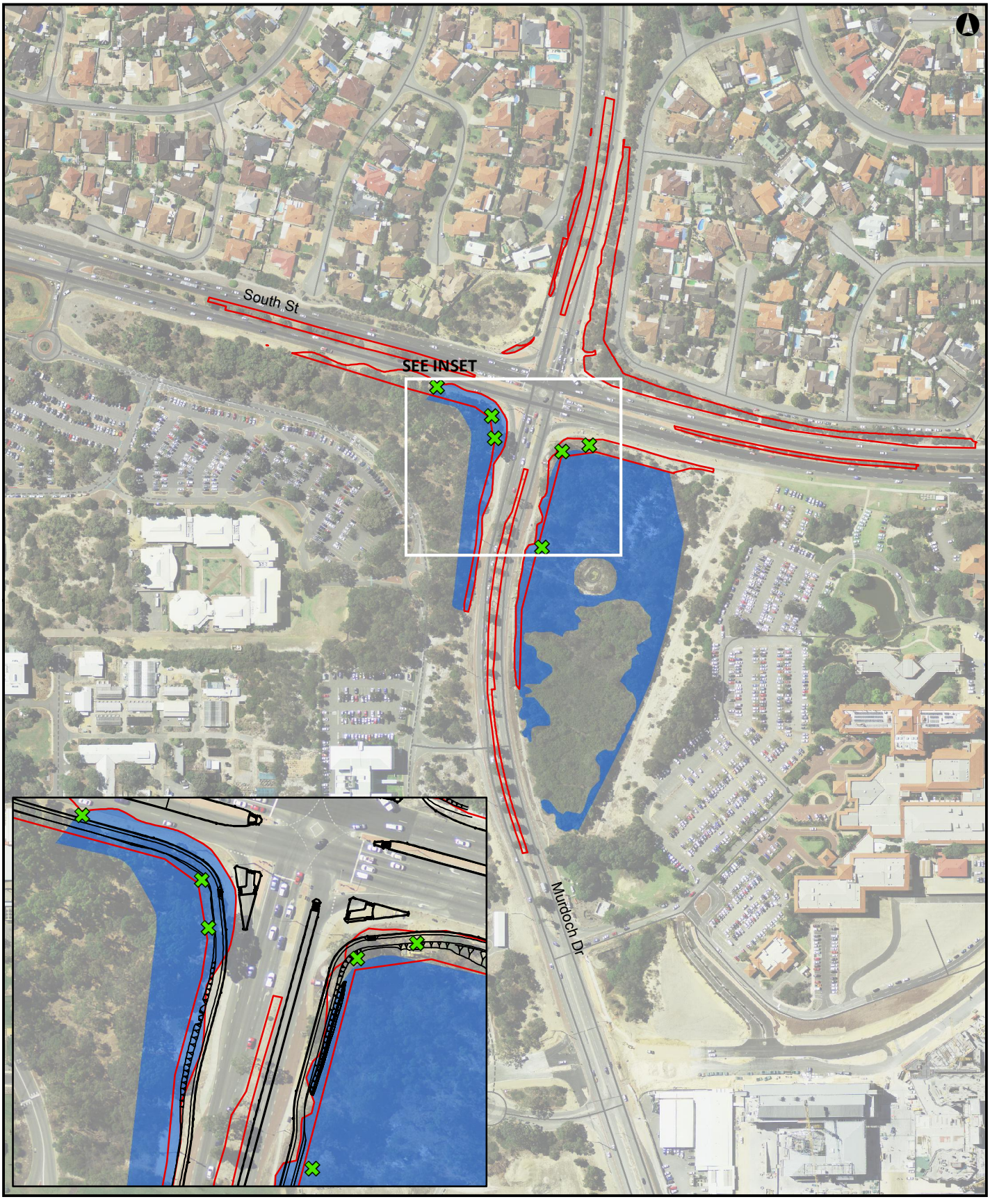
The EPA's objective for this factor is to maintain the abundance, diversity, geographic distribution and productivity of fauna at species and ecosystem levels through the avoidance or management of adverse impacts and improvement in knowledge.

Quenda and Oblong Turtles are not expected to be significantly affected by the project as habitat for these species is located deeper within the wetland environment, well away from the edge of the construction footprint. The intersection design has minimised the need for encroachment into the wetland area as much as possible.

Light spill during periods of night-time construction has the potential to impact fauna; however this impact is not expected to be significant provided appropriate management procedures are implemented to ensure lights are directed away from habitat areas.

The project's impact on fauna is therefore largely confined to clearing of habitat for black-cockatoos. An assessment of whether the project has the potential to significantly impact this listed species or its habitat has been undertaken using the Principal Significant Impact Guidelines 1.1: Matters of National Environmental Significance (DEH, 2006).

The assessment is presented in Table 8 with areas to be cleared shown in Figure 7. Based on the assessment criteria AECOM concludes that the project is unlikely to have a significant impact on black-cockatoos.



Potential Black-cockatoo Habitat

Murdoch Drive / South Street EIA EMP

Figure 6

Coordinate System: GDA 1994 MGA Zone 50

0 50 100 150

Metres

1:4,000 (A4)

LEGEND

- Project Footprint
- Potential Black-cockatoo Habitat Trees
- Black-cockatoo foraging habitat (ErMpAlSc, ErMrXp)

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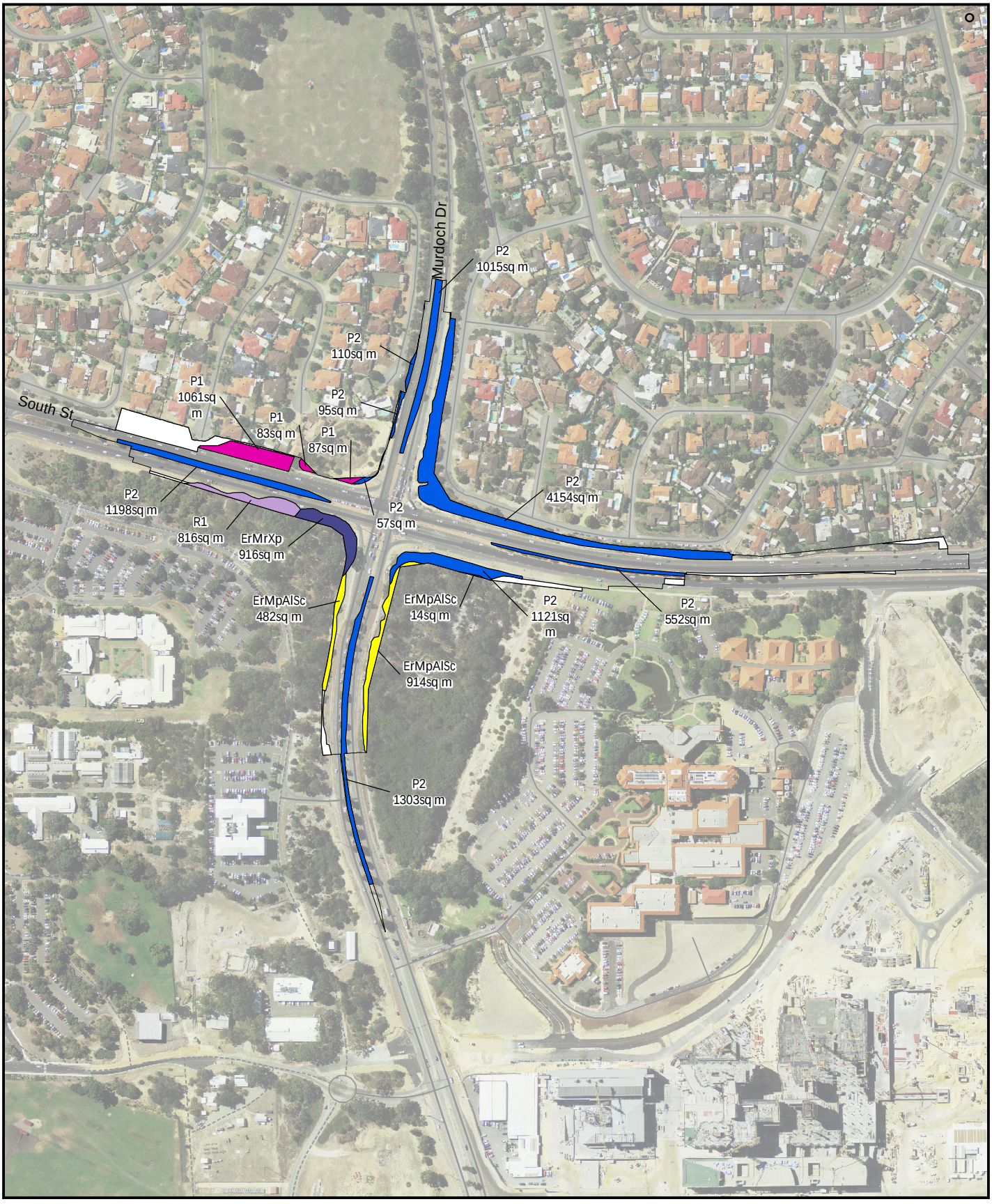
Table 8 Assessment for black cockatoo species

Significance Criteria	Assessment
Lead to a long-term decrease in the size of the population	The extent of clearing is small and is not expected to lead to a long-term decrease in the size of the population of any species of black-cockatoo.
Reduce the area of occupancy of the species	The extent of clearing is small and the vegetation is fragmented. Black-cockatoos are only occasional visitors to the project area and there is no evidence that the project will cause a reduction in the area of occupancy by black-cockatoos.
Fragment an existing population into two or more populations	The clearing will not fragment habitat to the extent that it would represent a barrier to the movement of black cockatoos.
Adversely affect habitat critical to the survival of a species	The habitat for these species within the project area is unlikely to be critical to the survival of black-cockatoos.
Disrupt the breeding cycle of a population	There are no hollows within the habitat trees identified in the project area; accordingly the project will not disrupt the breeding cycle of any population of black cockatoos. Although the project area provides some foraging habitat, clearing of this habitat is unlikely to disrupt any black-cockatoos that may be breeding in the area as there are other food sources available.
Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	The project area contains a relatively small area of foraging habitat together with limited potential roosting and future breeding habitat for black cockatoos (5 trees in total, two of which may provide hollows in the future). The majority of the foraging habitat within the project area comprises planted vegetation in generally poor condition. The extent of clearing is limited and is unlikely to lead to a long-term decrease in the size of a population (or important population) of any species of black cockatoo. Planted vegetation comprises the majority of habitat within the project area and it is generally in poor condition. The project is in proximity to larger areas of Banksia woodland that are likely to be more favourable foraging habitat. There is no evidence that clearing of vegetation for this project will modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline.
Result in invasive species that are harmful to critically endangered, endangered or vulnerable species becoming established or their habitat	The project is not expected to result in an invasive species that is harmful to black-cockatoos or their habitat.
Introduce disease that may cause the species to decline	The project is not expected to introduce disease affecting habitat to the extent that black-cockatoo species would decline. A large portion of the project area is unmappable with respect to *P. cinnamomi*, as it contains areas that are disturbed to the extent that mapping is not possible. With appropriate management there is a low risk of introducing *P. cinnamomi* to black-cockatoo habitat as a result of the project.
Interfere with the recovery of the species	The area of vegetation that will be cleared is small and confined to a limited area. This vegetation is not expected to be critical for the recovery of black-cockatoos.



Clearing by Vegetation Unit

Murdoch Drive / South Street EIA EMP

Figure 7

Coordinate System: GDA 1994 MGA Zone 50

0 50 100 150

Metres

1:5,000 (A4)

LEGEND

- Project Area
- Vegetation Units within Project Area
  - ErMrXp
  - R1
  - ErMpAlSc
  - P1
  - P2
  - NO MAPPING

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2.3 Surface water and drainage

There are no surface water bodies within the project area. There are two wetlands adjacent to the project area; namely Quenda wetland south east of the project area) and an un-named wetland north west of the project area). Quenda Wetland contains a small permanent water body and seasonal wetland. The attributes, values and conservation status of these wetlands are discussed in further detail in Section 2.4, together with an assessment of the project's impact on these attributes and values.

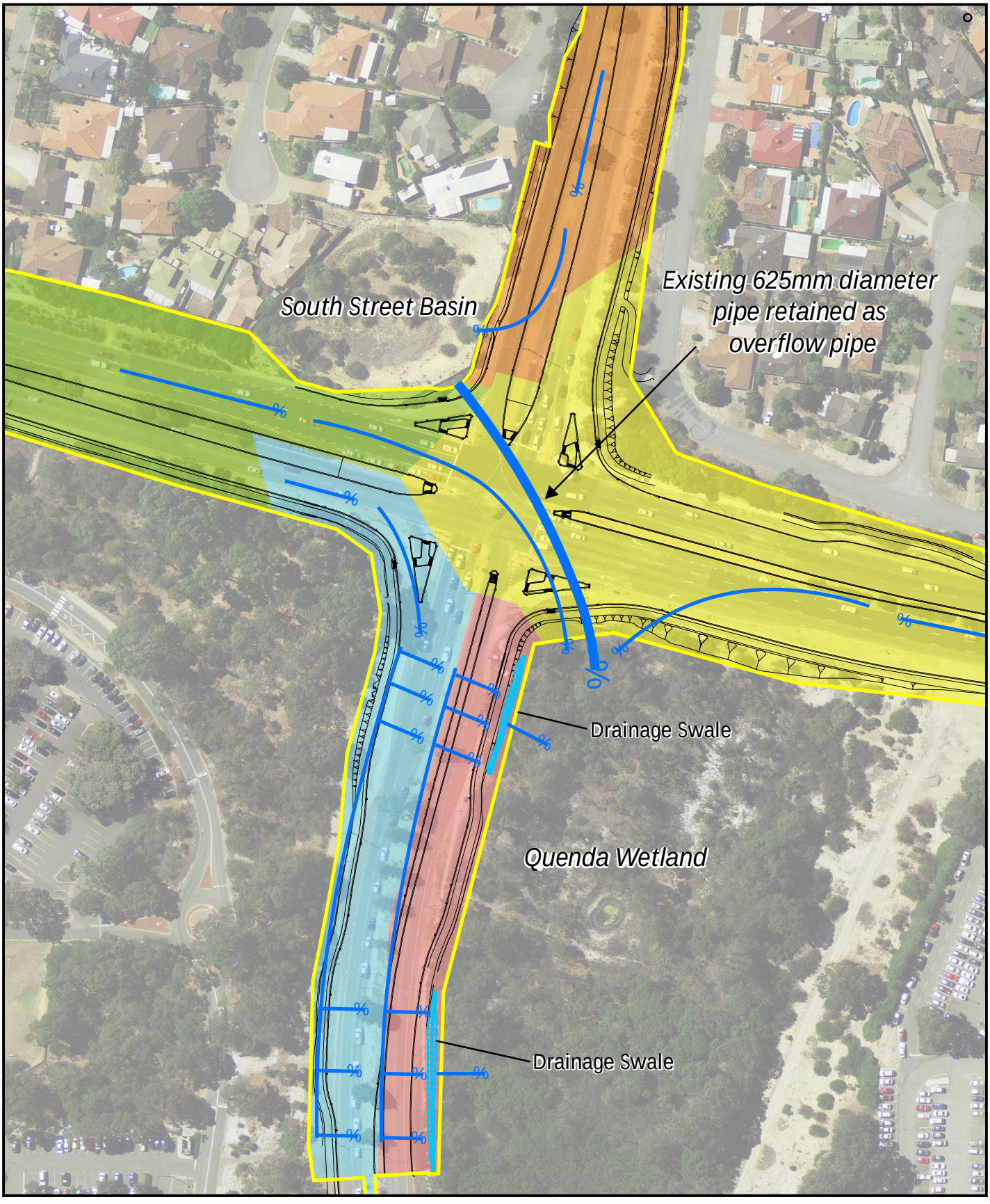
Surface water flow within the project area has been extensively modified as a result of construction of the intersection in its current form and installation of a piped drainage network to convey water flow. Stormwater is collected from both South Street and Murdoch Drive and conveyed to Quenda Wetland via a combined outfall located on the south-east corner of the intersection and another outfall located south of the intersection.

In addition to Quenda Wetland, there are two infiltration basins that collect surface water runoff via a piped drainage network from residential areas to the north of the intersection. The Murdoch Drive basin is located to the north of the intersection beyond the project area. The South Street basin is located on the north-west corner of the intersection. The basins are connected by a piped drainage system.

The proposed drainage network for the intersection upgrade is described in Table 9 and shown in Figure 8 . The impact of the modified drainage network upon Quenda Wetland in terms of water quantity and quality are discussed in Section 2.4

Table 9 Proposed drainage network

Component	Outflow	Description
Murdoch Drive North	South Street Basin	A new drainage network is to be constructed along the west side of Murdoch Drive to the north of South Street. This drainage system will collect surface water runoff from this area and discharge to the existing South Street basin. Part of the existing pipe network will be retained to accommodate overflow from the South Street Basin back into Quenda Wetland for major storm events.
Murdoch Drive South 1 (southbound lanes)	Quenda Wetland	ACO kerb drain is to be constructed as part of the road kerb along the eastern edge of Murdoch Drive South from the end of South Street East turn pocket to the end of the road widening. The ACO kerb drain collects surface water runoff and discharges via pipes located at 20m intervals into the shallow swales to be constructed at the edge of the Quenda Wetland.
Murdoch Drive South 2 (northbound lanes)	Quenda Wetland	A new drainage network is to be constructed adjacent to the northbound median on Murdoch Drive South. This drainage network will cross the southbound lanes of Murdoch Drive South and discharge via the existing outfall to Quenda Wetland (which will be upgraded).
South Street West	Quenda Wetland	Surface water runoff along this section of South Street will be discharged directly into the existing 625mm diameter pipe to be retained as an overflow for South Street basin and will ultimately discharge via the existing outfall to the Quenda Wetland.
South Street East	Quenda Wetland	Surface water runoff will be collected via new drainage networks and will connect with the existing 625mm diameter overflow pipe from the South Street Basin and ultimately discharge into Quenda Wetland.



Drainage Network

Murdoch Drive / South Street EIA EMP

Figure 8

Coordinate System: GDA 1994 MGA Zone 50

0 20 40 60

Metres

1:1,750 (A4)

LEGEND

- Project Area
- Design
- Murdoch Dr Swales
- % Direction of Outflow
- Murdoch Drive North - *outflow to South St basin*
- South St West - *outflow to Quenda wetland*
- South St East - *outflow to Quenda wetland*
- Murdoch Dr South (east) - *outflow to swales and Quenda wetland*
- Murdoch Dr South (west) - *outflow to Quenda wetland*

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2.4 Wetlands

The project area intersects two wetlands and their buffers that are located on opposite corners of the intersection, namely Quenda Wetland (UFI6512) on the southeast corner and an un-named wetland (UFI6511) on the northwest corner (Figure 9). Quenda Wetland is classified as a sumpland (seasonally inundated basin) while the un-named wetland is classified as a lake (permanently inundated basin) (Hill et al, 1996).

Although both wetlands are Conservation Category wetlands, wetland UFI 6511 functions as a constructed stormwater infiltration basin servicing runoff from adjacent residential development. This wetland has been highly modified by past and present land use and no longer meets the criteria for evaluation as a Conservation Category wetland; it is more appropriately evaluated as a Multiple Use wetland (AECOM 2012). Accordingly, no further assessment of this wetland is given in this report.

An assessment of Quenda Wetland and its immediate surrounds was undertaken by AECOM during 2011/12. The key findings are summarised in the sections below and reported in detail in AECOM (2012).

2.4.1 Hydrology

Quenda Wetland is an example of a lentic wetland (still water) that receives water from both surface water and groundwater flows. The permanent water body within Quenda Wetlands has been artificially deepened; however the adjacent wetland area still reflects the natural expression of the water table.

Groundwater flow is generally to the north-west, which means that groundwater passes beneath the Fiona Stanley Hospital site and St John of God Hospital before it reaches Quenda Wetland. A series of stormwater containment units beneath the carpark at St John of God Hospital intercept runoff from the carpark and other cleared areas.

The catchment area for Quenda Wetland is relatively small and limited to land immediately adjacent to the lake and sumpland. Surface water flows from the project area enter the wetland via a Gross Pollutant Trap and offline oil storage tank on the south-east corner of the intersection and through a natural outfall further south along Murdoch Drive. There are other entry points for surface water flows closer to St John of God hospital.

Water levels in Quenda Wetland fluctuate seasonally; between winter 2011 and summer 2012 the shoreline receded by about two metres.

2.4.2 Functions and values

Quenda Wetland includes a permanent lake and seasonal wetland lying within the same dunal depression that forms the Beeliar Wetland System. Quenda Wetland is a good example of a functioning wetland that performs nutrient cycling, removal of nutrients, pollutants and sediment as well as storing rain and flood waters.

The Beeliar Wetlands are an intrinsic part of the hydrology of the Swan Coastal Plain and are recognised as being significant for their ecological, hydrological, social and economic values. The ecosystem values of Quenda Wetland appear limited when compared to wetlands elsewhere as it does not provide habitat for threatened communities or species, nor international migratory bird species. It does provide habitat for several Priority species including some foraging habitat for black-cockatoos.

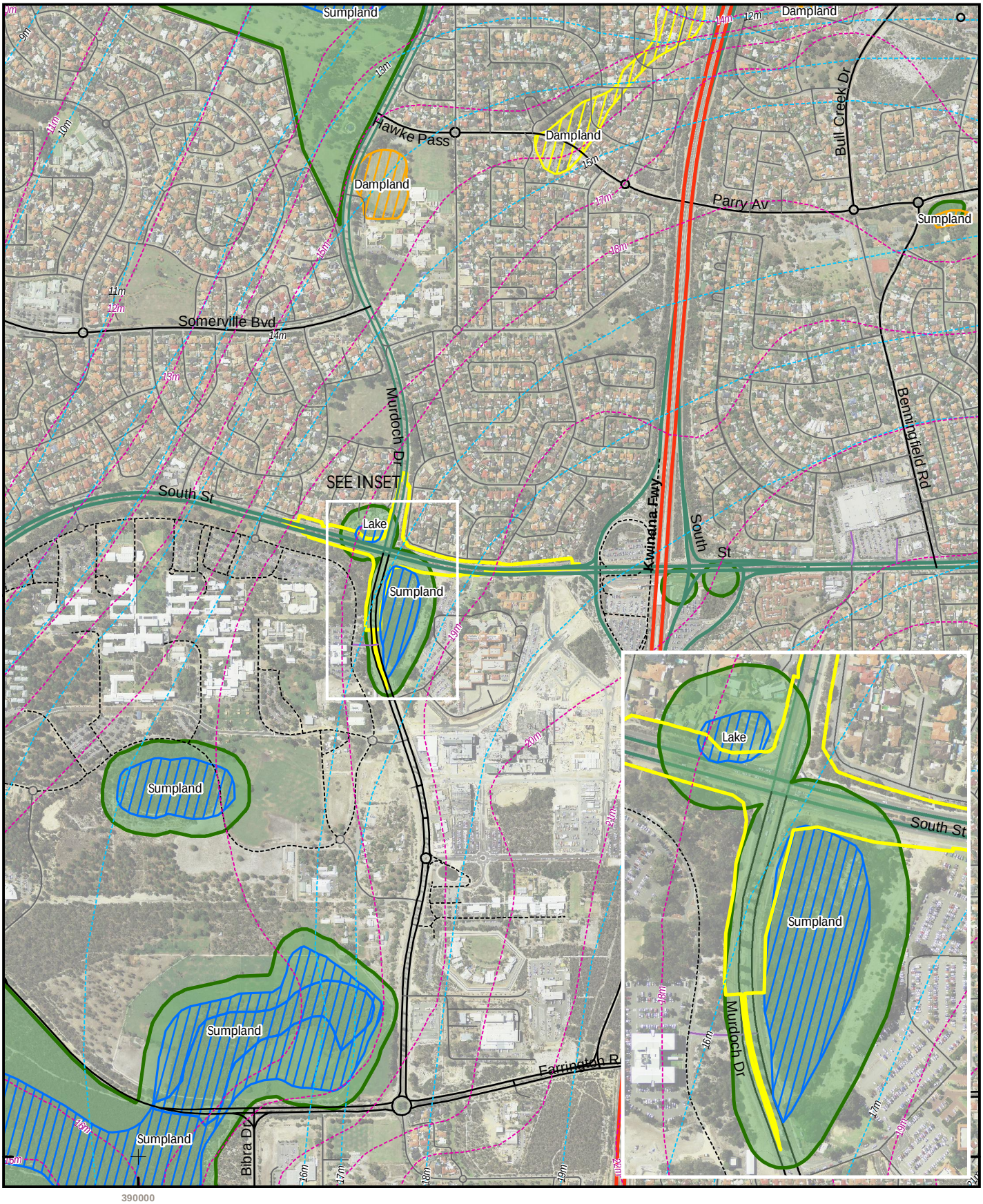
Quenda Wetland exhibits ongoing biological productivity despite the extensive land use modification that has occurred around it since European settlement. Evidence of this biological productivity can be seen following the fire in early 2010 that burnt out much of the northern portion of the wetland. Since that time, recovery has been rapid. Given that 2010 marked the end of lengthy dry period for Perth this recovery suggests that the wetland is resilient.

In addition to its biological productivity, Quenda Wetland also provides human use values such as cultural and spiritual value for indigenous people, landscape amenity as well as a study site for educational purposes.

2.4.3 Water and sediment quality

Water and sediment quality within Quenda Wetland is characteristic of wetlands in high urbanised surroundings.

Water within the wetland contains elevated levels of metals, with significant exceedances of the guideline levels occurring for aluminium, copper, iron, zinc and the nutrients NOx and ammonia (AECOM 2012). Petroleum hydrocarbons such as diesel, kerosene and/or heavy oils are also present in both the permanent water body and in stormwater runoff (AECOM 2012).



Wetlands, Environmentally Sensitive Areas and Groundwater Contours

Murdoch Drive / South Street EIA EMP

Figure 9

Coordinate System: GDA 1994 MGA Zone 50

0 100 200 300 400 500

Metres

1:15,000 (A4)

LEGEND

- Project Area
- Environmentally Sensitive Areas

Geomorphic Wetlands

- Conservation
- Multiple Use
- Resource Enhancement

- Groundwater Contours, May 2003 Superficial Aquifers
- Groundwater Contours, Historical Maximum

AECOM

Sediment within the wetland contains elevated levels of aluminium, iron, total Kjeldahl nitrogen, total organic carbon as well as petroleum hydrocarbons in the form of diesel, kerosene and/or heavy oils. There were no exceedances above guideline levels for these contaminants.

2.4.4 Impact assessment

The EPA's objective for wetlands is to maintain their integrity, ecological functions and environmental values.

About 0.09 ha of Eucalyptus/Melaleuca Woodland adjacent to Murdoch Drive and 0.11 ha of planted vegetation adjacent to South Street will be cleared from within the wetland reserve. These areas will be replanted following construction of the drainage swales adjacent to Murdoch Drive and the repositioning of the drainage outfall in the south-east corner of the intersection. Accordingly, the small area of vegetation to be cleared is not expected to adversely affect the integrity, ecological functions and environmental values of the wetland.

The similarity of contaminants found in stormwater from the outfall on the south-east corner of the intersection and the permanent water body within the wetland indicates a high level of connectivity between the two. A new head wall and outfall riprap protection was completed in 2010 to reduce erosion from stormwater flow from this outfall. However, the area is eroding and there is little vegetation to slow the flow of storm water, reduce erosion and strip contaminants from the stormwater.

The project is expected to improve water quality within the wetland by managing runoff from constructed impervious areas in landscaped drainage swales on the edge of the wetland reserve. Surface water flows from the project area will enter the wetland via the two existing outfalls and the drainage swales to be constructed adjacent to Murdoch Drive. The outfall in the south-east corner of the intersection will be upgraded by installing a planted swale designed to reduce erosion and allow vegetation to slow the velocity of stormwater as well as stripping contaminants.

In terms of water quantity, the project requires a water storage volume of 5,887 m^3 for a rainfall event with an Average Recurrence Interval of 20 years. The design results in a 22% increase in the impervious area contributing to Quenda Wetland and 45% reduction in the pervious area. This represents a total increase of 375 m^2 of catchment area for the wetland. Surface water flow into the wetland is therefore expected to be similar to the pre-development annual discharge volume.

Based on the above the project is not expected to have an adverse impact on the biological productivity of the wetland. The quality of water entering the permanent lake within Quenda Wetland will be improved through the construction of drainage swales planted with appropriate vegetation. Rehabilitation of cleared areas and road-side batters with wetland species, including targeted weed management, is expected to improve currently degraded areas and enhance the function of these areas for fauna habitat.

2.5 Groundwater

There are three aquifers beneath the project area, in order of depth:

- The unconfined superficial aquifer of the Swan Coastal Plain, which consists of Quaternary and Tertiary sediments (e.g. quartz sands)
- The confined Lower Leederville aquifer, which extends north to Ledge Point and south to Augusta. It is a shallow artesian aquifer used for public water supply in the Perth metropolitan area
- The confined Yarragadee North aquifer, which is the largest aquifer in the Perth basin reaching 3,000 m thick and extending from north of Dongara to the Serpentine area.

Recharge to the superficial aquifer occurs through direct vertical infiltration of rainfall at which point groundwater primarily flows laterally through the aquifer.

Groundwater flow is generally to the west-northwest (DoE, 2004), with salinity ranging from fresh to marginal at 500-1000 mg/L TDS (DoE 2004; DoW 2012).

The project will not have an adverse impact on groundwater as earthworks are not being undertaken at depth. Accordingly, no further assessment of this factor is considered necessary.

2.6 Geology, landform and soils

The project area is located within the Perth sub-region of the Swan Coastal Plain biogeographic region, which is composed of colluvial and aeolian sands representing three phases of Quaternary marine sand dune development including a complex series of seasonal freshwater wetlands, alluvial river flats, coastal limestones and several offshore islands.

The project area is located within one landform and soil unit; namely the Bassendean dunes (Churchward and McArthur 1980). Bassendean dunes are characterised as pale grey, white, medium grained moderately sorted quartz sand with little or no calcium carbonate content. Bassendean dunes tend to be acidic, highly leached and nutrient poor. They are thought to be about 800,000 years old (Bolland 1999)

On a finer scale the Geological Survey of Western Australia (1986) identifies the project area as traversing two different soil types as presented below in Table 10.

Table 10 Soils Units within the Study Area (Geological Survey of Western Australia, 1986).

Soil Code	Description
S7	Sand – pale yellowish brown, medium to coarse grained sub-angular quartz, trace of feldspar, moderately sorted of residual origin
S8	Sand – very light grey at surface, yellow at depth, fine to medium grained, sub-rounded quartz, moderately well sorted, of eolian origin

The topography of the project area can be described as gently undulating; however it has been significantly modified by the construction of the South Street and Murdoch Drive intersections.

2.6.1 Acid sulfate soils

Acid Sulphate Soils (ASS) are naturally occurring soils, sediments and peats which contain sulphides, most commonly in the form of pyrite materials most commonly found in low-lying land bordering coastal, estuarine, saline wetlands, and freshwater groundwater dependent systems. In an anoxic state, these materials do not pose significant environmental risk, however, disturbance and exposure to oxygen has the potential to cause adverse environment impacts (DEC 2009a).

The majority of the project area is classified as having a moderate to low risk (Class 2) of acid sulphate soils (ASS) occurring within three metres of natural ground level that could be disturbed by road construction activities (DoE, 2004).

A Preliminary ASS Investigation was conducted (AECOM 2012) to assess the presence or absence of ASS in areas that may be disturbed by proposed road widening development activities. This comprised a programme of preliminary soil sampling and data collection to ascertain the possible presence of ASS or PASS in the project area.

The results of the field testing and subsequent testing of selected samples from the locations investigated, indicated that the soil samples analysed had a net acidy below the DEC recommended guidelines and do not require a management plan (AECOM 2012).

Whilst depth to water generally decreases from south to north, it is typically greater than three metres at the project area. As excavation will not be expected to occur below the natural watertable, there will be no significant impact caused by exposure of ASS in this area as a result of surface-based construction.

2.7 Contamination

There are no known contaminated sites either within or immediately adjacent to the project area, based on a search of the DEC Contaminated Sites Register. The nearest registered contaminated site 2.5 kilometres north east of the project area and has been partially remediated. The predominantly residential and institutional use of land adjacent to the project area suggests that the potential for unknown contaminated sites is low.

Contamination of surface and groundwater via stormwater run-off is addressed in Section 2.4.3.

2.8 Reserves and conservation areas

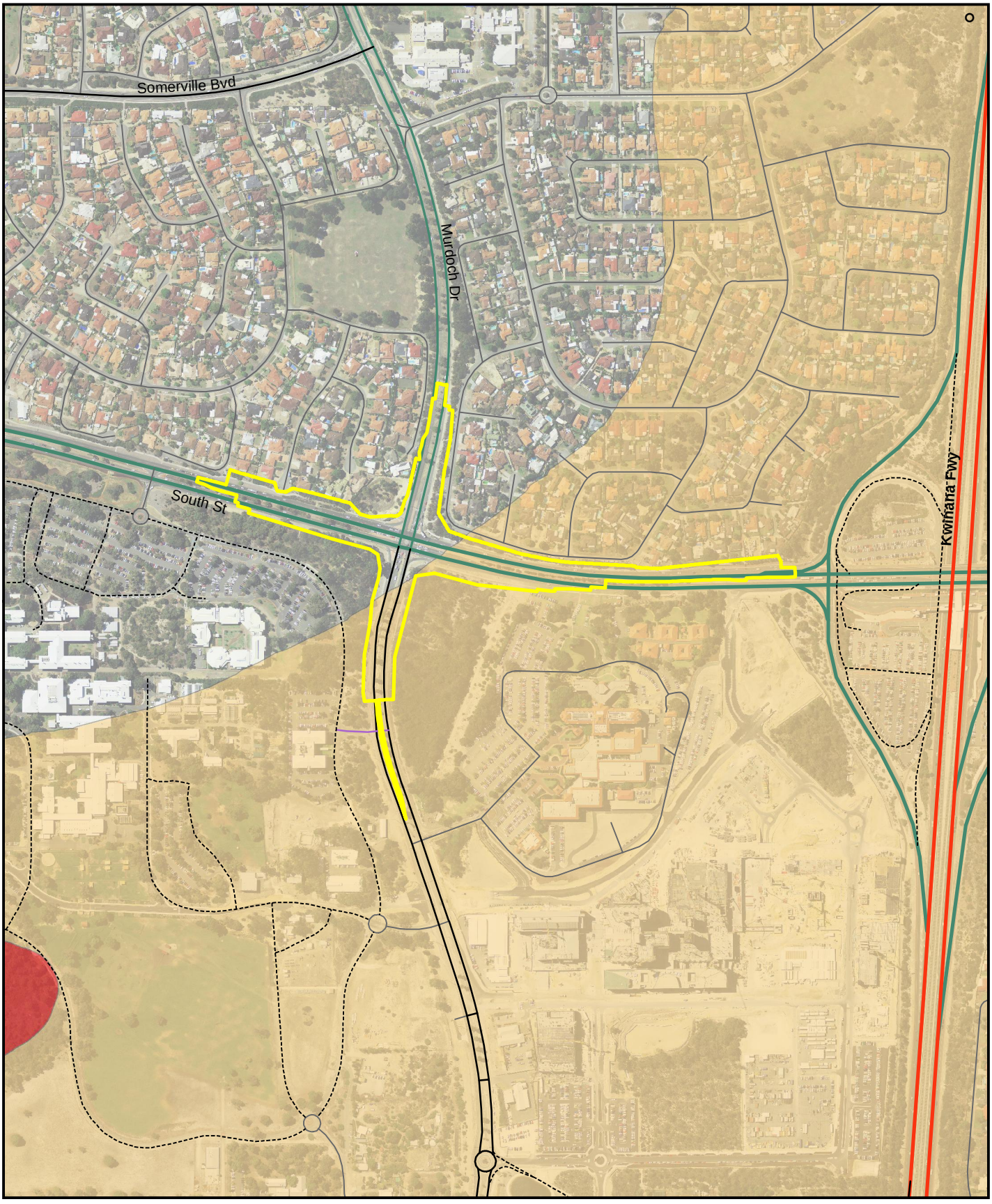
Other than Quenda Wetland reserve, there are no reserves for conservation and/or recreation purposes within the project area (Figure 11). Beeliar Regional Park and two related Bush Forever Sites are located within 2 km of the project area. These reserves are separated from the project area by roads and residential areas and will therefore not be impacted by the upgrade. Potential impacts to Quenda Wetland Reserve are discussed in Section 0.

2.9 Climate

Perth experiences a Mediterranean climate of hot, dry summers and cool to mild, wet winters. The city has an annual mean maximum temperature of 24°C and an annual mean minimum temperature of about 12.7°C. In 2009 Perth's annual mean maximum temperature was 25°C, the second warmest on record since the 25.2°C recorded in 1978. The city's long-term average annual rainfall is 854 mm and 2009 was the tenth driest year on record (608 mm) since the 466 mm recorded in 2006. The majority of Perth's rainfall (80%) occurs between May and September (BoM, 2010a).

Average annual wind frequency analysis for the Bureau of Meteorology's Perth Metro site indicates calm conditions are experienced a relatively low 2 percent of the time, with a predominate easterly flow during the morning with wind speed generally less than 20 km/h (BoM, 2010b). In contrast, calm conditions are rarely experienced during the afternoon (less than 0.5 %), with a predominant south-westerly flow that is generally between 10 and 30 km/h (BoM, 2010c).

This project will not have a significant impact on climate despite a small increase in $C0_2$ emissions as a result of vegetation clearing and operation of construction machinery. Improved traffic flow and reduced vehicle idling times following completion of the project are expected to reduce $C0_2$ emissions once operational. The project will not adversely affect the local climate of the Perth region.



Acid Sulphate Soil Risk

Murdoch Drive / South Street EIA EMP

Figure 10

Coordinate System: GDA 1994 MGA Zone 50

0 50 100 150 200 250

Metres

1:7,500 (A4)

LEGEND

Project Area

Acid Sulphate Soil Risk

High to moderate risk

Moderate to low risk

AECOM

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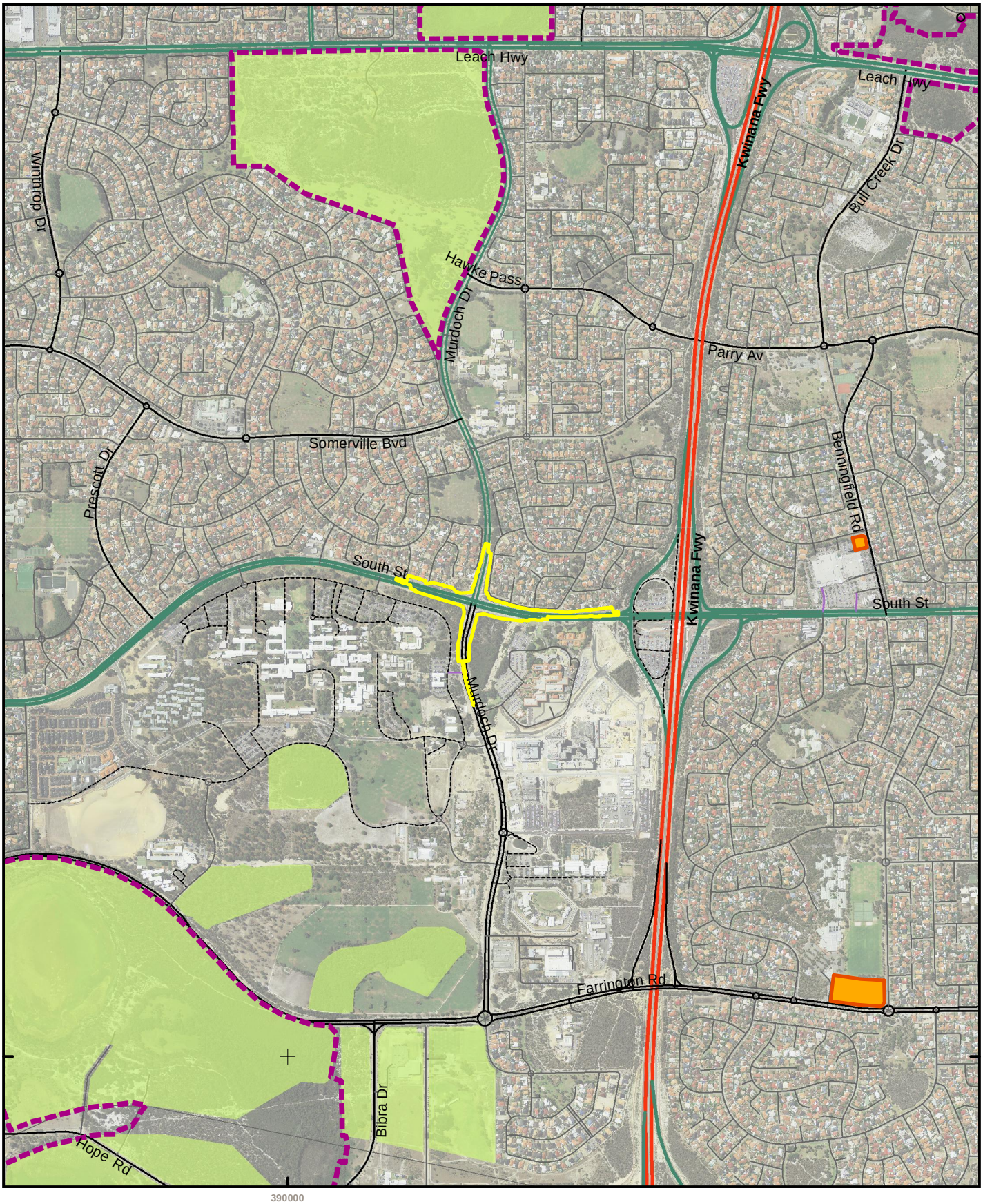

Reserves and Contaminated Sites

Murdoch Drive / South Street EIA EMP

Figure 11

Coordinate System: GDA 1994 MGA Zone 50

0 100 200 300 400 500

Metres

1:20,000 (A4)

LEGEND

- Project Area
- Contaminated Sites
- Bush Forever Sites
- Regional Park

AECOM

Last Modified 11/04/2012 at 01:31 PM by joneskd4

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2.10 Air quality

The Perth Air Quality Management Plan (DEP, 2000) reports Perth as being on the threshold on having an air quality problem, with levels of photochemical smog during summer regularly exceeding the relevant guidelines whilst in winter a smoke haze frequently hangs over the city. These episodes of unacceptable air quality are perpetuated by weather conditions that prevent air pollutants from dispersing rapidly. In general though, Perth air quality is of a high standard compared to other Australian and international cities (EPA, 2007).

The two main causes of air pollution in Perth are vehicle emissions and smoke (DEP, 1996). Air pollutants are measured at ten sites throughout the Perth metropolitan area although the extent of pollution monitoring varies in response to community health concerns, research studies and investigations, or regulatory requirements. The main air pollutants are carbon monoxide, nitrogen dioxide, photochemical oxidants (measured as ozone), sulphur dioxide, lead and inhalable particles (particulate matter).

Between 2001 – 2010 daily peak 1-hour emission concentrations of nitrogen dioxide, particulates and sulphur dioxide had generally increased, while emissions for carbon monoxide and ozone decreased (DEC 2011e).

2.10.1 Impact assessment

The EPA's objective for air quality is to ensure that emissions do not adversely affect environmental values or the health, welfare and amenity of people and land uses by meeting statutory requirements and acceptable standards.

Inhalable particles (particulate matter) and photochemical smog are associated with increases in respiratory illnesses. This is of particular concern to asthmatics, children and the elderly. Photochemical smog also irritates membranes in the eyes and can detrimentally affect the health of native vegetation.

A temporary increase in inhalable particles in the form of dust is likely to occur during construction. Dust emissions will be associated with activities such as ground disturbance, vegetation clearing, and movement of machinery together with wind erosion of exposed dry soil. Inhalable particles from exhaust fumes may also increase slightly as a result of construction machinery operating on site and traffic delays during construction.

A minor local increase in photochemical smog is likely as a result of traffic congestion and operation of construction machinery; however this increase is not expected to adversely affect environmental values or the health, welfare and amenity of people and adjacent land uses. The project area already receives air pollution from vehicle emissions and numerous other sources across the Perth metropolitan area.

Local businesses and residents adjacent to the South Street and Murdoch Drive intersection may experience airborne dust during construction of the intersection upgrade, and road users may also be affected if suitable management measures are not implemented during construction. Adverse effects from dust emissions will be minimised through the implementation of the strategies and actions outlined in the Environmental Management Plan.

It is expected that air quality will be similar to that currently experienced once construction is complete, primarily as a result of stabilised ground surfaces and improved traffic flow.

2.11 Noise and vibration

An acoustic assessment was conducted to evaluate the measured and predicted noise environment surrounding the project area. In addition, the assessment investigated amenity wall configurations aimed at reducing noise emissions. The detailed assessment is provided in AECOM (2011) and is summarised below.

Ambient noise monitoring was carried out at three representative locations along the project corridor. All noise loggers were deployed on site for a minimum of one week in order to obtain valid noise data for at least five week days. Summaries of daily $L_{A10,18hr}$, $L_{Aeq,16hr}$, $L_{Aeq,8hr}$ and $L_{Aeq,24hr}$ noise indicators for each location are presented in Table 11.

Noise monitoring results show the mean difference between daytime $L_{Aeq,16hr}$ and night time $L_{Aeq,8hr}$ levels of 7.0 dB(A), with the differences at all individual locations being greater than 5 dB(A). The results also show the average difference between daytime $L_{A10,18hr}$ and $L_{Aeq,16hr}$ descriptors at the three monitoring locations is 2.1 dB(A).

Table 11 Environmental noise emission summary

Location Reference		Existing Noise Exposure Levels – dB(A)				Difference between L_{eq16hr} and L_{eq8hr}
Location	Date	$L_{Aeq,16h}$	$L_{Aeq,8h}$	$L_{Aeq,24h}$	$L_{A10,18h}$	
Location 1: 6 Crampton Elbow	23-Aug-10	62.1	56.3	60.9	64.3	6.1
	24-Aug-10	63.5	56.0	62.1	65.2	
	25-Aug-10	62.9	56.6	61.6	64.9	
	26-Aug-10	62.9	56.8	61.6	65.0	
	27-Aug-10	62.3	57.5	61.2	64.7	
	Period Average	**62.7**	**56.6**	**61.5**	**64.8**	
Location 2: 14 Urbahns Crescent	23-Aug-10	58.7	49.2	57.1	60.3	8.1
	24-Aug-10	57.4	49.9	56.0	59.0	
	25-Aug-10	57.9	49.3	56.4	59.4	
	27-Aug-10	58.1	50.7	56.7	60.2	
	02-Sep-10	57.8	50.1	56.4	59.8	
	Period Average	**58.0**	**49.8**	**56.5**	**59.7**	
Location 3: 38 Urbahns Crescent	02-Nov-09	63.5	56.9	62.2	66.0	6.7
	03-Nov-09	63.0	56.5	61.7	65.8	
	04-Nov-09	63.2	56.3	61.9	65.8	
	10-Nov-09	63.8	56.2	62.4	66.1	
	11-Nov-09	63.1	56.8	61.8	65.8	
	Period Average	**63.3**	**56.6**	**62.0**	**65.9**	

2.11.1 Impact assessment

The EPA's objective for this factor is to protect the amenity of nearby residents from noise impacts resulting from activities associated with the proposal by ensuring noise levels meet statutory requirements and acceptable standards.

Noise measurement results were used to calibrate the existing road traffic noise model and predict existing noise emissions within the project area. The calibrated noise model was used to predict the future noise environment for build and no-build scenarios in the design year (2031).

The predictions were used to assess noise impacts associated with the proposed upgrade. The results of assessment are summarised in Table 12 for the cases without additional mitigation measures implemented at site.

Table 12 Summary of predicted daytime (L_{eq}) noise levels for each modelled scenario

Modelled Scenario	Number of Receivers			Daytime L_{eq}, dB(A)	
	Total	> 60 dB(A)	> 65 dB(A)	Average	Maximum
2010 Existing	211	10	0	51.3	63.6
2016 No Build	211	10	0	51.3	63.7
2016 Build	211	12	0	51.5	63.7
2031 No Build	211	10	0	51.3	63.7
2031 Build	211	16	0	51.9	64.4

Predicted noise impacts have been assessed against the *WA State Planning Policy 5.4* noise criteria for existing roads. For the purpose of this assessment, existing and future transport noise levels have been benchmarked against the noise limit criteria that would be applicable to new roads.

Modelling results indicate 10 noise-sensitive receivers are predicted to exceed 60 dB(A) in 2031 if the proposed upgrade doesn't go ahead. The number of exceeding receivers remains the same as in the existing scenario. The number of receivers exceeding 60 dB(A) in 2031 is predicted to increase from 10 to 16 due to the proposed project. Relative changes in the future noise environment due to the proposed project are shown in Table 13.

Table 13 Summary of changes in daytime (Leq) noise levels between the modelled scenarios

Scenario	Number of Receivers			Changes in L_{eq}, dB(A)	
	Total	Increasing by 0-1 dB(A)	Increasing by > 1 dB(A)	Average Increase	Largest Increase
2031 No Build to 2031 ID Build	211	196	9	0.5	1.6

Noise predictions indicate a negligible average increase of less than 1 dB(A) due to the proposed upgrade, with only three receivers predicted to increase by 2 dB(A), where the increase may be perceptible. The future noise levels however, are predicted to exceed 60 dB(A) at the majority of receivers fronting the upgraded roads.

Although no mitigation measures are considered necessary due to the negligible increase in predicted noise levels, amenity walls are proposed with the aim of achieving 60 dB(A) or less at all noise sensitive receivers adjacent to the road upgrades (refer Section 3.2.8).

2.12 Heritage

A number of Aboriginal heritage surveys and consultations have been conducted for the project area in accordance with the requirements of the West Australian *Aboriginal Heritage Act 1972* (AH Act) (Goode. The archival research involved an examination of the Department of Indigenous Affairs (DIA) sites register, a review of relevant site files, and a review of unpublished Aboriginal heritage reports relating to the project area.

Non-indigenous heritage values were assessed through searches of Commonwealth, State and Local Government heritage databases, registers and inventories. State heritage places were provided as GIS data by the Department of Planning, from data extracted from the Heritage Council Sites of WA database. Municipal heritage inventories were sourced the City of Melville.

2.12.1 Aboriginal heritage

Two previously recorded Aboriginal heritage sites have been recorded either within or adjacent to the project area (Figure 12). These sites are:

- Site ID 3397 'Murdoch Drive Camp' (Interim register)
- Site ID 3630 'Murdoch University' (Permanent register)

Site ID 3397 'Murdoch Drive Camp' is a camp and water source at an adjacent wetland on the east side of Murdoch Drive, 150 m south of the intersection of South Street and Murdoch Drive. The site has 'interim' status on the register due to insufficient information being available to establish the significance of the site under the AH Act. As a result of consultations with members of the Independent Aboriginal Environmental Group, Bibbulmun Consultative Group, Ballaruks Peoples Native Title Claim Group, and Single Noongar Claim (Area 1) WC03/6 Native Title Claimants Group, the existence of ethnographic Site ID 3397 'Murdoch Drive Camp' was confirmed and no new ethnographic sites were recorded in the project area.

Site ID 3630 'Murdoch University' is an artefact scatter with a DIA extent that overlies a section of South Street immediately west of the intersection of South Street and Murdoch Drive. The original description of the artefact scatter locates the site more precisely as an area about 122 m in length and 43 m in width on the southern side of South Street on the verge between South Street and Murdoch University about 160 m west of the intersection with Murdoch Drive. The eastern end of the site is 3.3 m from South Street.

Aboriginal Heritage Sites

Murdoch Drive / South Street EIA EMP

Figure 12

Coordinate System: GDA 1994 MGA Zone 50

0 50 100 150 200 250

Metres

1:7,500 (A4)

LEGEND

- Project Area
- Aboriginal Heritage Sites

AECOM

2.12.2 European heritage

There are no place of Commonwealth, State or local heritage significance within or adjacent to the project area DSEWPaC 2012; State Heritage Office 2012, City of Melville 2012.

2.12.3 Impact assessment

The EPA's objective for this factor is to ensure that changes to the biophysical environment do not adversely affect historical and cultural associations and comply with relevant heritage legislation. The project's potential impact on Aboriginal heritage is discussed in further detail below.

Widening of South Street adjacent to Site ID 3630 is not expected to directly affect the site provided works are contained within the project area

Widening of South Street and Murdoch Drive adjacent to Site ID 3397 will directly affect the site and therefore requires consent from the Minister for Indigenous Affairs. As such, there is the potential for the project to impact previously unrecorded artefact sites, particularly during preliminary works such as ground clearing and vegetation removal; however it is acknowledged that the likelihood of any significant artefacts being uncovered is low.

Main Roads is currently progressing an application to the Registrar of Aboriginal Sites under section 18 of the AH Act for consent to use the land required for the proposed intersection upgrade. The application covers registered sites ID 3397 'Murdoch Drive Camp' and any subsurface material within the designated project area.

2.13 Visual amenity

The visual amenity of the project area was observed and during the site visit and evaluated with reference to a range of key viewpoints. These view points are located adjacent to residential premises on the north-east and north-west corner of the intersection.

As viewed from these key viewpoints, the intersection is screened completely by planted vegetation on the north-eastern corner and by a large brick wall on the north-western corner. South Street and Murdoch Drive are major roads that traverse an extensively modified urban landscape comprising residential and institutional land uses.

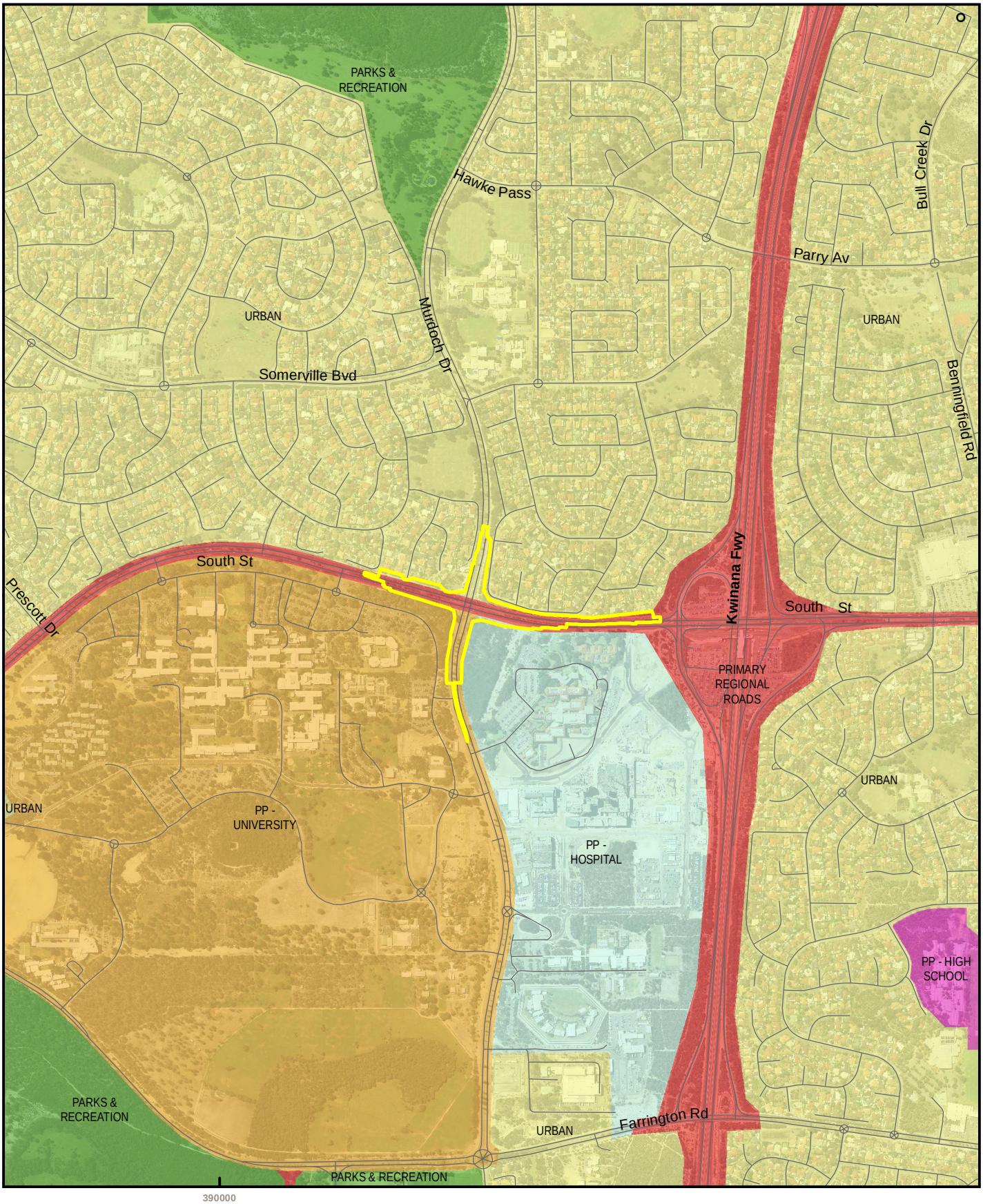
Amenity walls will be constructed and these have the potential to affect the visual amenity for residential areas on the north-eastern corner of the intersection. Depending on the placement of these walls and the method of construction it may be possible to retain some of the planted vegetation on the northern side of the amenity wall.

The changes to the visual landscape of the intersection are shown in Appendix B. These changes are not expected to have a significant impact.

Light spill during periods of night-time construction has the potential to impact adjacent residential areas. Light spill will need to be managed to ensure flood lights are directed away from residential areas.

2.14 Land use

Land use adjacent to the project area comprises residential dwellings, institutional uses, public open space and wetlands (Figure 13). Planning for the Murdoch Activity Centre in the vicinity of the project area identifies a range of future uses. These uses include health services, high density residential uses for short-term and permanent accommodation together with civic, retail, commercial and entertainment uses (WAPC, 2007). The project will have little impact on adjacent land-use, except for the small area of Crown Land to be acquired on each corner of the intersection to accommodate the upgrade.



Land Use

Murdoch Drive / South Street EIA EMP

Figure 13

Coordinate System: GDA 1994 MGA Zone 50

0 100 200 300 400 500

Metres

1:15,000 (A4)

LEGEND

- Project Area
- Metropolitan Regional Scheme
- Land Use
  - Urban
  - Primary Regional Roads
  - Parks and Recreation
  - High School
  - Hospital
  - University

AECOM

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3.0 Environmental management plan

This Environmental Management Plan (EMP) describes the management strategies required to reduce the risk of adverse environmental impacts occurring during construction and operation of the intersection upgrade. It also provides an approach to sustainability, monitoring, auditing and commitments, a summary of actions to be undertaken together with a stakeholder consultation and communications plan. Mitigation and management measures are summarised in Table X for each of the identified environmental factors.

3.1 Approach to sustainability

MRWA is committed to constructing the proposed project in a way that is consistent with the broad sustainability principles relating to environmental protection, social advancement and economic prosperity through its sustainability policy, which outlines six areas of focus (MRWA, 2009):

1) leadership and corporate policy
2) education and awareness
3) business processes
4) partnerships
5) sustainability projects
6) performance tracking and reporting.

A major goal of this policy is to create a culture of sustainability within MRWA with sustainability becoming an integral part of each project from inception to completion. It is a process to be conducted in unison with the environmental assessment process as it relates to the use of raw materials, energy and labour. In addition, it relates to the potential issues of tracking air emissions, managing solid waste and handling potential releases of hazardous materials. The process of integrating sustainability into the assessment process is continuing to gain momentum with regulatory agencies such as the EPA.

The EPA's Position Statement No. 6, *Towards Sustainability*, sets out an approach to integrating sustainability into the environmental assessment process. The position statement defines sustainability and encourages Western Australia to advance towards a more sustainable future by integrating environmental, social and economic elements in order to maintain current levels of natural and community resources; as well as integrating efficient development methodologies into the fabric of municipal and regulatory procedure. Although specific to Western Australia, the Position Statement draws on the similarities of global issues such as the inevitable increase in human population and subsequent effects on biological habitat and ecosystems; as well as the interference with nitrogen, phosphorus, and carbon cycles (EPA, 2004).

3.2 Environmental management measures

3.2.1 Vegetation and flora

During construction activities, the construction contractors are directly responsible for minimising the effects on adjacent vegetation and topsoil by implementing the following practices prior to construction:

- minimise clearing in areas of better quality, native vegetation, particularly vegetation community
- areas to be cleared will be clearly marked and contractors will be instructed not to clear vegetation outside these areas
- reduce the area of impact by only clearing the minimum area necessary; this applies to the construction of the amenity walls as well as retaining walls and batters adjacent to Quenda Wetland
- retain existing native flora species where possible, including isolated trees and shrubs that provide foraging habitat for black-cockatoos
- all weedy topsoil and vegetation will be disposed of and not re-used in landscaping revegetation
- all native vegetation will be chipped and stockpiled for later rehabilitation purposes; where larger trees are removed consideration should be given to recycling timber for landscape improvement works e.g. benches, fencing

- mulch and woodchip stockpiles will be stored away from drainage areas, particularly adjacent to Quenda Wetland
- land outside the project area will not be disturbed
- rehabilitation and landscaping will be planned for adjacent areas post construction.

3.2.2 Weeds

In addition to relevant measures described in Section 3.2.1 for controlling the spread of weeds, the following management practices will be implemented:

- prior to clearing for service relocation, weeds will be encouraged to grow and sprayed prior to setting seed
- all weed infested areas will be marked prior to clearing
- carry out required control of Declared Weeds throughout the project area, according to guidelines of the WA Department of Agriculture and Food
- all construction machinery brought to site will be washed and inspected within a contained area for any weeds and seeds remaining
- wash material will be disposed of as deep fill or in a suitable landfill
- weedy topsoil will not be re-used on site
- weed maintenance of roadside vegetation in accordance with Handbook of Environmental Practice for Road Construction and Maintenance Works (DEC 2005).

3.2.3 Dieback

To prevent the introduction of dieback to the project area the following management practices will be implemented during construction:

- ensure no dieback affected road building materials, mulches or fill are bought into the project area
- clean earth-moving machinery of soil and vegetation prior to entering and leaving the project area
- avoid movement of soil in wet conditions
- restrict movement of machines and other vehicles to the limits of the areas to be cleared.

3.2.4 Revegetation

Revegetation of surplus cleared land within the project area will be undertaken on completion of construction, or when no longer required, whichever is sooner. The following practices will be implemented:

- a Landscaping Plan will be prepared prior to construction, that will include feature planting along the Murdoch Drive and South Street to enhance the visual landscape
- a Revegetation Plan that specifies local native species will be prepared to inform rehabilitation activities for Quenda Wetland that will be disturbed during the works
- rehabilitation will be via either local native seed species, local native tube stock, or a combination of both
- where possible, revegetation with local provenance species is recommended
- rehabilitated areas will be monitored and maintained for three years following completion of the works.

3.2.5 Fire Management

The construction contractor will ensure that appropriate fire prevention measures are taken to protect the surrounding areas from fire, including the following:

- all machinery to have spark arrestors fitted to the exhaust system
- all vehicles and plant to be fitted with fire extinguishers
- water tankers, equipment and personnel trained to fight fires in the work areas will be provided
- all hot works will be undertaken in accordance with standard safety procedures
- workers will extinguish and report fires occurring within the project area.

3.2.6 Fauna

Management measures for reducing impacts on native vegetation will also reduce the risk of impacts to native fauna; however the following specific measures will also be implemented:

- consult with DEC regarding the potential impacts to Quenda Wetland and strategies for minimisation and management of impacts, plus contingencies if appropriate
- avoid or minimise clearing of vegetation associated with the Quenda Wetland
- minimise impacts on areas of vegetation where conservation significant fauna have may occur
- no pets, traps or firearms to be allowed within the project area
- venomous snakes and other fauna should not be killed unless as a last resort, and then should only be done by a trained professional.

3.2.7 Wetlands and surface water

Potential impacts on surface water and wetlands within and adjacent to the project area will be reduced through implementation of the following measures:

- prior to commencement of construction, temporary site drainage aimed at containing sediment and other contaminants within the project area will be considered
- clearing and construction activities should be timed to minimise the risk of environmental harm
- vegetation removal and soil disturbance will be minimised; this is particularly important for works adjacent to Quenda Wetland involving the construction of the bus stop, retaining walls and drainage swales
- existing natural drainage paths and drainage channels along the road will not be unnecessarily blocked or restricted during construction
- drainage sumps will be regularly inspected for sediment and other contaminants, particularly following periods of rainfall
- vehicle and equipment wash down areas will be located away from environmentally sensitive areas, in particular Quenda Wetland
- hazardous substances will be used and stored appropriately
- liquid and solid wastes will be disposed of appropriately
- the construction area should be fenced and following construction fencing and paths will be installed to limit access to Quenda Wetland
- drainage facilities will be upgraded to enhance quality of water entering Quenda Wetland
- degraded and/or eroded portions of the wetland and its buffer will be repaired
- disturbed areas will be stabilised soon after work is complete.

3.2.8 Noise and Vibration

A Construction Noise Management Plan that fulfils the requirements of the DEC, Noise Regulations, the City of Melville and the City of Cockburn will be prepared by the construction contractor prior to the commencement of construction. Construction noise levels will be managed through implementation of the following measures:

- effectively communicate any need to undertake out of hours work to the community
- install noise barriers at the earliest feasible opportunity
- for work that will be undertaken on a Sunday or Public Holiday:
    - the builder must submit to the chief executive officer (CEO) a noise management plan at least seven days before the work starts, and the plan must be approved by the CEO. The noise management plan must include details of:
        - need for the work to be done out of hours
        - types of activity which could be noisy

    - predictions of noise levels
    - control measures for noise and vibration
    - monitoring of noise and vibration
    - complaint response
  - the builder must advise all nearby occupants of the work to be done at least 24 hours before it commences
  - the builder must show that it was reasonably necessary for the work to be done out of hours
- ensure compliance with all applicable statutory requirements
- require alternatives to audible reversing alarms where practicable
- limit construction activity to normal business hours as practicable
- maximise separation between noisy activities and adjacent residential areas, particularly for piling operations
- implement an effective complaint procedure
- In accordance with Regulation 13 of the *Environmental Protection (Noise) Regulations 1997*, assigned noise levels do not apply to construction sites where construction is carried out between the hours 7.00am and 7.00pm (excluding Sundays and Public Holidays). Work carried out during these hours:
  - must be carried out in compliance with control of noise practices set out in Section 6 of AS 2436-1981 *Guide to Noise Control on Construction, Maintenance and Demolition Sites*
  - must utilise the quietest equipment reasonably available
  - may require implementation of a noise management plan as directed by the CEO of DEC.
- Work that will be undertaken on a Sunday or Public Holiday will be subject to the following:
  - the work must be carried out in accordance with Section 6 of AS 2436-1981
  - the equipment used must be the quietest reasonably available

Construction vibration impacts will be managed by:

- undertaking pre-construction property inspections
- establish appropriate criteria and monitoring vibration during compaction and piling operations
- maximise separation between vibration inducing activities and adjacent residential areas, particularly for piling operations
- adopt construction techniques that will minimise vibration impacts within nearby residential areas, particularly for compaction and piling operations
- monitor ground vibrations when compaction and piling operations are being undertaken within proximity to buildings.

Operation noise levels can be managed through the installation of suitable amenity walls. Prior to design and construction of these walls, consultation will be undertaken with affected residents.

3.2.9 Acid Sulfate Soils

Although ASS and PASS are not likely to be present within three metres of natural ground level, the following measures will be applied during construction:

- during excavation, field observations will be made of the soil profile to detect the presence of ASS
- workforce induction will include instructions on identifying ASS including:
  - wet, grey or dark coloured soils
  - a hydrogen sulphide (rotten egg) smell
- where ASS are apparent, the site will be investigated in accordance with the *Identification and Investigation of Acid Sulphate Soils and Acidic Landscape* (DEC, 2009)

- where ASS are apparent, management of ASS will include the preparation and implementation of an ASS Management Plan to provide for the ongoing management and monitoring of the effects of disturbance of ASS through the entire construction or operation period of the project and describe the construction schedules and environmental management procedures.

3.2.10 Air quality

Dust suppression will be most critical during the construction phase of the project where high winds coincide with vegetation clearing, earthworks and other ground disturbance. The following dust management procedures will be applied during construction activities:

- a Dust Management Plan will be prepared in accordance with DEC guidelines prior to the commencement of construction
- inform the adjoining community about planned activities that might cause significant dust
- clear vegetation only when necessary to avoid unnecessary exposure of soil
- treat areas due for soil stabilisation as soon as practicable
- water tankers to be available to dampen exposed surfaces within construction and laydown areas, particularly during ground disturbing activities
- adequate signage of works in progress to be posted in visible areas
- dust generating activities to be minimised during days with high winds
- respond to complaints by nearby residents, businesses and institutions rapidly
- plant and machinery will be the best available and will be required to be maintained in an appropriate working order to minimise emissions
- visual monitoring of excessive dust to be conducted during ground disturbance and construction vehicle activities
- application of water, road sweeping and signage for suitable speed limits to be incorporated during vehicle movement.

3.2.11 Contamination and waste

The following management measures in addition to relevant measures described in Section 3.2.1and Section 3.2.7 will be implemented to reduce the risk of contamination incidents and their potential impacts:

- bulk fuel and hazardous material storage areas will be bunded and managed in compliance with applicable Australian Standards
- regular vehicle servicing will be undertaken at designated areas, at least 100 m away from watercourses
- adequate fire suppressant equipment, spill trays and spill response equipment will be available near fuel storage or refuelling areas
- any spills will be reported
- on discovery of pre-existing ground contamination (such as a strong smell is noticed during excavation or other earthworks), work will stop, management will be notified and specialist advice will be sought on a course of action
- identify waste products from road activities and dispose of controlled waste in an approved and certified facility
- construction waste and other rubbish will be contained in bins with lids and removed regularly.

3.2.12 Heritage

Construction contractors are responsible for working within the boundaries of the s18 consent notices that authorise disturbance to Aboriginal Heritage Site ID 3397 (Murdoch Drive Camp) for the purpose of pre-construction and construction activities. The following specific measures will be implemented:

- ensure workers are aware of the sites and the requirement to protect them
- mark sites for protection where appropriate

- modify construction and maintenance actions to ensure protection of sites
- if any human skeletal material is uncovered, work will cease within 25 metres of the material and it will be reported to the Police
- if any artefacts or material of apparent Aboriginal origin is discovered, work will cease within 25 metres of the material and the Project Manager will contact a qualified archaeologist to investigate the item(s) and take the appropriate actions (i.e. contact DIA).

3.3 Visual amenity

Soil stockpiles, dust and presence of machinery during construction phase will be a temporary source of visual impact. To minimise the project's visual impact on the landscape during construction, the following practices will be implemented:

- a Rehabilitation and Landscaping Plan will be prepared and implemented as early as practicable

Construction

- stockpiles and other materials will be stored in designated areas and be kept in a neat and tidy state at all times
- appropriate dust control measures will be applied as per Section 3.2.9
- the duration of ground disturbing activities will be limited as far as practicable.

Although the project is not expected to adversely affect the visual landscape, a visual fly-through and community outreach will be conducted to minimise potential negative effects of the proposed project. The visual fly-through and outreach will focus on lighting, aesthetics of noise walls and proposed landscaping. Mitigation of the effects of light spill and other post-construction effects will be achieved by implementing the following measures:

- consultation with affected land users
- design of aesthetically pleasing noise walls
- design lighting to comply with Australian Standard 4283 Control of the Obtrusive Effects of Outdoor Lighting
- use of cut-off lights designed to direct light onto the road and minimise off-target glare and light spill where appropriate
- selection of revegetation species of a height and density for post-construction landscaping that reduces light spill onto neighbouring properties.

3.4 Communication plan

Main Roads will take a proactive approach to communication that will engage key stakeholders and establish constructive working relationships through the major project phases of detailed design, pre-construction, construction and post-construction.

This communication plan provides the overall framework for the management of community and stakeholder relations for the project. It allows for accurate and timely information to be provided to stakeholders concerning the project's objectives, scope and design and construction activities. Key stakeholder and community groups for the project include:

- Friends of Quenda Wetland
- adjacent businesses, residents and landowners
- road users
- Nyungar people
- project personnel
- utility providers
- City of Melville
- Department of Environment and Conservation

- Environmental Protection Authority
- Department of Indigenous Affairs
- Department of Water
- Department of Agriculture and Food. and
- Public Transport Authority

Key impacts and issues affecting the stakeholders are as follows:

- fauna
- Indigenous heritage
- noise
- air quality
- vibration
- traffic management, and
- public safety.

Stakeholder issues and impacts will become apparent in different ways as the project evolves; therefore it is important that communication activities are planned and carefully tailored to each particular issue, stakeholder group and phase of the project. It is also important that opportunities to provide feedback and raise queries and complaints are provided. Communication tools available to Main Roads include: Meetings,

- site visits
- public notices
- site signage
- media releases
- phone line (MRWA call centre or establishment of project specific 1800 line)
- project email address
- letterbox drop, and
- information sheets.

3.5 Environmental management

3.5.1 Induction and training

Construction personnel will be made aware of the issues and actions in this Environmental Management Plan and be trained in how to undertake works in an environmentally sensitive manner. Emergency training in relation to fires, chemical spills or other risks will be carried out early in the construction phase.

3.5.2 Management of environmental incidents

The process for management of environmental incidents will be in accordance with MRWA's corporate procedure: *Environmental Incident Reporting and Investigation* (2006). Definitions of environmental incident categories are listed in Table 14, and required incident notification is listed in Table 15.

Table 14 Environmental incident categories (MRWA, 2006)

Incident Category	Definition	Examples
MINOR ENVIRONMENTAL INCIDENT	- Where the environmental impact is limited and is confined within the work site. Environmental impacts are readily addressed through clean up or changes to work practices. - Breach of project or contract EMP. NB: Minor incidents that have a high frequency of recurrence are indicative of underlying issues associated with work practices. This in turn increases the potential for these minor incidents developing into significant incidents.	- Uncontained hydrocarbon spillage <200 L. - Dust suppression spray failure without causing off site impact.
SIGNIFICANT ENVIRONMENTAL INCIDENT	- Incident involving off site environmental impacts that requires significant resources to address. - Non-compliance with statutory requirements or environmental criteria requiring reporting to authorities.	- Clearing outside of approved area (<100m^2). - Over spray of herbicides damaging nearby crops or native vegetation. - Dust monitoring results exceed statutory criteria. - Failure to submit compliance report to DEC within the timeframe.
	- Non-conformance with Contractor's EMP occurring within the work site where the environmental impact is significant and has the potential for an offsite environmental impact.	- Uncontained hydrocarbon spillage >200 L. - Dust suppression spray failure causing actual off-site impact. - Unauthorised clearing of rare flora.
MAJOR ENVIRONMENTAL INCIDENT	- Any on site or off-site environmental incident resulting in significant long term environmental harm - An incident resulting in prosecution under environmental laws.	- Unauthorised clearing of a large area (>100 m^2). - Actual pollution of waterways (eg. by on-site or off-site fuel spills). - Land disturbance resulting in damage to public infrastructure (power line or water pipes) which impact on a group of people.

Table 15 Environmental incidents – notification (MRWA, 2006)

Incident Category	Personnel to be Notified by Whom	Timing of Notification
MINOR	- Observer(s) notifies the relevant Supervisor	- By the end of the working day.
SIGNIFICANT	- Observer(s) notifies the relevant Supervisor - Contractor's Supervisor notifies the Contractor's Representative and Contract Manager - Contract Manager/Main Roads' Supervisor notifies Manager Environment and DEC if the incident is a non-compliance with statutory requirements or has resulted in pollution or environmental harm.	- Upon completion of remediation actions - Upon completion of initial incident assessment. - Upon completion of initial incident assessment.
MAJOR	- Observer(s) notifies the relevant Supervisor. - Contractor's Supervisor notifies Contractor's Representative and Contract Manager. - Contract Manager/Main Roads' Supervisor notifies DEC, Manager Environment and relevant Executive Directors.	- Immediately. - Immediately. - Upon completion of initial incident assessment and/or site emergency response procedure.

3.6 Monitoring and auditing

The following actions will be undertaken to ensure that management requirements are being implemented and are meeting their objectives:

- an incidents and complaints register will be maintained during construction activities
- a documented monitoring and auditing schedule will be developed and implemented, and
- weekly inspections of construction areas be conducted in accordance with specific checklists and a record of inspections will be maintained.

Project monitoring requirements are summarised in Table 16.

Table 16 Project monitoring requirements

Factor	Monitoring Activity	Timing	Trigger	Response
Air Quality	Visual dust observations	Daily	Excessive dust plumes observed Dust is affecting visibility	Apply dust suppression or stop work.
	Weekly vehicle checklists	Weekly	Unacceptable exhaust quality	Service vehicle or remove from service.
	Complaints register	Ongoing	Complaints received	Address complaints.
Acid Sulphate Soils	Visual soil observations	During excavations	Wet grey or dark soils; hydrogen sulphide smell	Obtain laboratory report.
	Lab Testing	Upon encountering suspect material	Lab results confirm ASS presence	Develop and implement ASS Management Plan.
Flora and vegetation	Clearing surveys	Following clearing	Clearing undertaken beyond approved extents	Repeat induction. Review procedures.
	Vehicle inspections	Upon arrival at site	Seed and organic material present	Vehicle wash down.
	Topsoil stockpile inspections	Monthly	Weeds emerging from topsoil	Spray with weed control.
	Limit movement of plants, seed and all parts of Declared Weeds as proscribed by DAF. Dispose of all contaminated soil.	During clearing and earthworks	Plants, seeds and parts present in soil moved within the site and not disposed of	Dispose of all weedy matter that may contain Bridal Creeper, Cootamundra Wattle, Flinders Range Wattle and Golden Wattle.
	Composition and density assessments	Annually	Poor establishment compared with pre determined criteria	Undertake further rehabilitation.
	Vehicle inspections	On arrival at site	No spark arrestors or fire extinguishers fitted	Have spark arrestors and fire extinguishers fitted or remove from service.
	Incident register	Monthly	Unacceptable number of fires recorded	Repeat induction
Fauna	Visual observation of native fauna	During clearing and earthworks	Presence of native fauna	Remove and relocate fauna.
Surface Water	Visual inspection of storm water drains and sediment traps	Following rainfall	Build up of sediment observed	Clean out sediment traps Review site drainage.
Groundwater	Depth to groundwater	Monthly	Pre-determined drawdown level reached	Reduce or cease consumption.
	Volumes abstracted	Monthly	Exceedance of volume specified by Licence condition	Reduce or cease consumption.

Factor	Monitoring Activity	Timing	Trigger	Response
Contamination	Vehicle inspections	Daily	Leaky hoses, engines	Service vehicle or remove from service.
	Vehicle servicing	Per owner manuals	Poor vehicle / machinery performance	Remove from service.
	Visual inspection of stormwater drains and oil water separators	Following incident	Contaminating substances observed	Clean our stormwater drains and oil water separators.
Aboriginal heritage	Aboriginal Monitor(s)	During excavations	Potential Archaeological material uncovered Human remains uncovered	Stop work and seek specialist advice Contact police
	Workforce visual observations	During excavations	Uncovering of potential archaeological material Uncovering of human remains.	Stop work and seek specialist advice Contact police
Noise and vibration	Noise monitoring	Weekly	Exceedance of acceptable levels	Change activity, review methods or stop work
	Vibration monitoring	Weekly	Exceedance of acceptable levels	Change activity, review methods or stop work
	Complaints register	Ongoing	Complaints received	Address complaint

3.7 Summary of environmental commitments

Table 17 provides a summary of the environmental management measures that will be committed to by MRWA, as outlined in the preceding sections.

Table 17 Summary of Environmental Commitments

Aspect	Objective	Management	Timing	Responsibility	Advice
Air quality and dust	To minimise potential impacts from dust and particulate emissions	- Clear vegetation only when necessary - Treat areas due to soil stabilisation as soon as practicable - Water tankers to be available to dampen exposed surfaces within construction and laydown areas, particularly during ground disturbing activities - Adequate signage of works in progress to be posted in visible areas - Dust generating activities to be minimised during days with high winds - Inform the adjoining community about planned activities that might cause significant dust; and respond to complaints by nearby residents, businesses and institutions rapidly - Plant and machinery will be the best available and will be required to be maintained in an appropriate working order to minimise emissions - Visual monitoring of excessive dust to be conducted during ground disturbance and construction vehicle activities; and - Application of water, road sweeping and signage for suitable speed limits to be incorporated during vehicle movement.	During Construction	Construction Contractor	Department of Environment and Conservation
Acid Sulphate Soils	To minimise potential for disturbance of ASS and contain acidic leachate if disturbed	- During excavation, field observations will be made of the soil profile to detect the presence of ASS - Workforce induction will include instructions on identifying ASS including: • Wet, grey or dark coloured soils, and • A hydrogen sulphide (rotten egg) smell; - Where appropriate ASS are apparent, the site will be investigated in accordance with the *Identification and Investigation of Acid Sulphate Soils and Acidic Landscape* (DEC, 2009); and - Management of any ASS will include the preparation and implementation of an ASS Management Plan to provide for the ongoing management and monitoring of the effects of disturbance of ASS through the entire construction or operation period of the project and describe the construction schedules and environmental management procedures.	During Construction	Construction Contractor	Department of Environment and Conservation

Aspect	Objective	Management	Timing	Responsibility	Advice
Flora and vegetation	To minimise and manage the impact of the project on native vegetation	- Reduce the area of impact by only clearing the minimum area necessary - Minimise clearing in areas of better quality, remnant native vegetation, particularly vegetation community ErMpAlSc - Retain existing native flora species where possible, including isolated trees and shrubs - Areas to be cleared will be clearly marked	Pre-construction	Construction Manager	Department of Environment and Conservation
		- All weedy topsoil and vegetation will be disposed of and not re-used in landscaping revegetation - All native vegetation will be chipped and stockpiled for later rehabilitation purposes - Mulch and woodchip stockpiles will be stored away from drainage areas - Land outside the project area will not be disturbed; and	Construction		
		- Rehabilitation and landscaping will be planned for adjacent areas	Post construction		
	To minimise and manage the spread of weeds as a result of the project	- Prior to clearing, weeds will be encouraged to grow and sprayed prior to setting seed - Carry out required control of the Declared Weeds according to guidelines of the WA Department of Agriculture and Food, throughout the project area - All weed infested areas will be marked prior to clearing - All construction machinery brought to site will be washed and inspected for any weeds and seeds remaining within a contained area - Wash material will be disposed of as deep fill or in a suitable landfill	Pre-construction	Construction Manager	Department of Environment and Conservation Department of Food and Agriculture
		- Weedy topsoil will not be re-used on site.	Construction		
	To improve the ecological values of the road reserve through appropriate revegetation	- A Landscaping Plan will be prepared prior to construction, that will include feature planting along the Murdoch Drive and South Street to enhance the visual landscape; - A Revegetation Plan that specifies local native species will be prepared to inform rehabilitation activities for areas of the intersection that will be disturbed during the works	Pre-construction	Construction Manager	Department of Environment and Conservation

Aspect	Objective	Management	Timing	Responsibility	Advice
		- Rehabilitation will be via either local native seed species, local native tube stock, or a combination of both; - Where possible, revegetation with local provenance species is recommended, and - Rehabilitation will be monitored and maintained for three years following completion of the works.	Post construction		
	To minimise the risk of fire	- All machinery to have spark arrestors fitted to the exhaust system - All vehicles and plant to be fitted with fire extinguishers - Water tankers, equipment and personnel trained to fight fires in the work areas will be provided - All hot works will be undertaken in accordance with standard safety procedures; and - Workers will extinguish and report fires occurring within the project area.	Construction	Construction Manager	Fire and Emergency Services Authority Department of Environment and Conservation
Fauna	To minimise and manage the impact of the project on native fauna	- Avoid or minimise clearing of vegetation associated with the Quenda Wetland - Consult with DEC regarding the potential impacts of the Quenda Wetland and strategies for minimisation and management of impacts, plus contingencies if appropriate - Minimise impacts on areas of vegetation where significant fauna have been recorded or may potentially occur	Pre-construction	Construction Manager	Department of Environment and Conservation City of Melville
		- No pets, traps or firearms to be allowed within the project area; and - Venomous snakes and other fauna should not be killed unless as a last resort, and then should only be done by a trained professional.	Construction		
Surface water	To maintain existing drainage patterns and minimise the potential for contaminants such as sediment and hydrocarbons from	- Undertake site drainage assessment to inform detailed design - Prior to commencement of construction, temporary site drainage aimed at containing sediment within the project area will be considered	Pre-construction	Design Manager Construction Manager	Department of Water

Aspect	Objective	Management	Timing	Responsibility	Advice
	reaching natural drainage systems drainage	- Vegetation removal and soil disturbance will be minimised - Disturbed areas will be stabilised soon after work is complete - Existing natural drainage paths and drainage channels along the road will not be unnecessarily blocked or restricted during construction - Drainage sumps will be regularly inspected for sediment and other contaminants, particularly following periods of rainfall - Vehicle and equipment wash down areas will be located away from environmentally sensitive areas - Hazardous substances will be used and stored appropriately; and - Liquid and solid wastes will be disposed of appropriately.	Construction		
Groundwater	To maintain ground water quality so that existing and potential environmental values, including ecosystem maintenance, are protected	- All spills will be contained immediately and removed within 24 hours to minimise the potential for contaminants reaching the water table; and	Construction	Construction Manager	Department of Water
Contamination and waste	To maintain the quality of the soil, surface water and groundwater	- Bulk fuel and hazardous material storage areas will be bunded and managed in compliance with applicable Australian Standards - Regular vehicle servicing will be undertaken at designated areas, at least 100 m away from watercourses - Adequate fire suppressant equipment, spill trays and spill response equipment will be available near fuel storage or refuelling areas - Any spills will be reported - On discovery of pre-existing ground contamination (such as a strong smell is noticed during excavation or other earthworks), work will stop, management will be notified and specialist advice will be sought on a course of action - Identify waste products from road activities and dispose of controlled waste in an approved and certified facility; and - Construction waste and other rubbish will be contained in bins with lids and removed regularly.	Construction	MRWA Construction Manager	Department of Environment and Conservation
Aboriginal Heritage	To avoid interfering with Aboriginal heritage sites as much as practicable	- Ensure workers are aware of the sites and the requirement to protect them - Mark sites for protection where appropriate	Pre-construction	Construction Manager	Department of Indigenous Affairs

Aspect	Objective	Management	Timing	Responsibility	Advice
		- Modify construction and maintenance actions to ensure protection of sites - If any human skeletal material is uncovered, work will cease within 25 metres of the material and it will be reported to the Police - If any artefacts or material of apparent Aboriginal origin is discovered, work will cease within 25 metres of the material and the Project Manager will contact a qualified archaeologist to investigate the item(s) and take the appropriate actions (i.e. contact DIA); and - Appropriate management of any liquid spills and stormwater runoff to ensure proposed works and drainage do not adversely affect identified sites or any wetland or water body including creeks, springs, swamps and soaks that may be present in the area.	Construction		South West Aboriginal Land and Sea Council
Noise and Vibration - Construction	To minimise the potential impacts of noise and vibration during construction	- Install noise barriers, if required, at the earliest feasible opportunity; and - Implement an effective complaint procedure - Undertake pre-construction property inspections	Pre-construction	Construction Manager	Department of Environment and Conservation AS 2436-1981
		- Ensure compliance with all applicable statutory requirements - Require alternatives to audible reversing alarms where practicable - Limit construction activity to normal business hours as practicable - Effectively communicate any need to undertake out of hours work to the community - Maximise separation between noisy activities and adjacent residential areas, particularly for piling operations - Establishing appropriate criteria and monitoring vibration during compaction and piling operations - Maximise separation between vibration inducing activities and adjacent residential areas, particularly for piling operations - Adopt construction techniques that will minimise vibration impacts within nearby residential areas, particularly for compaction and piling operations; and - Monitor ground vibrations when compaction and piling operations are being undertaken within proximity to buildings.	Construction		

Aspect	Objective	Management	Timing	Responsibility	Advice
Noise and Vibration – Traffic Operations	To minimise the potential impacts of noise and vibration during traffic operation	- Design and install amenity walls, where appropriate, to provide for increased residential amenity.	Pre-construction	Design Manager	AS 2436-1981
Visual Amenity	To ensure that the visual amenity of the area is not significantly affected by implementation of the proposal.	- A Rehabilitation and Landscaping Plan will be prepared and implemented as early as practicable - Consultation with affected land users - Design of aesthetically pleasing noise walls - Selection of revegetation species of a height and density for post-construction landscaping that reduces light spill onto neighbouring properties; and - Design lighting to comply with Australian Standard 4283 *Control of the Obtrusive Effects of Outdoor Lighting*.	Pre-construction	Construction Manager Design Manager	Department of Environment and Conservation Department of Planning
		- Stockpiles and other materials will be stored in designated areas and be kept in a neat and tidy state at all times - Appropriate dust control measures will be applied as per Section 3.2.10 - The duration of ground disturbing activities will be limited as far as practicable - Use of cut-off lights designed to direct light onto the road and minimise off-target glare and light spill where appropriate	Construction		

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4.0 Advice and recommendations

The natural environment of the project area has been extensively modified from its original state as a result of previous land use and, more recently, the construction of the intersection of Murdoch Drive and South Street. This modification includes clearing of native vegetation as well as filling of a portion of the historic wetland environment to provide the necessary elevation for the intersection pavement.

As a result, the wetland has been split into two separate areas, the smaller of which occurs on the north-west corner of the intersection and has been converted into a drainage sump for the adjacent residential subdivision. Notwithstanding the extensive environmental modification that has occurred within the project area, native vegetation within parts of the adjacent wetland is in very good condition and the wetland is a good example of a biologically productive wetland ecosystem.

4.1 Approvals

4.1.1 Environment Protection and Biodiversity Conservation Act 1999

An action that will have or is likely to have a significant impact on matters of national environmental significance must be referred to the Commonwealth Minister for Environment. The following Commonwealth listed threatened species have the potential to occur in the project area:

- Carnaby's Black-Cockatoo
- Forest red-tailed Black-Cockatoo

Native vegetation within the project area provides only limited foraging and potential future breeding habitat for Carnaby's Black-Cockatoo and the Red-tailed Black Cockatoo. None of the habitat trees have hollows. AECOM concludes that the project is unlikely to have a significant impact on these two species of black-cockatoos, on the basis that the project area is already heavily developed and that loss of quality habitat is minimal. Clearing of potential foraging habitat will not exceed one hectare.

For the reasons outlined above the project is not a controlled action and therefore does not require referral to the Commonwealth. Main Roads may wish to refer the matter to the Commonwealth in the event that legal certainty is required.

4.1.2 Environmental Protection Act 1986

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.

Where the environmental impact of a proposal can be adequately assessed and managed through other legislative mechanisms, such as Part V of the EP Act, the proposal is unlikely to require formal environmental impact assessment.

AECOM anticipates that the EPA is unlikely to assess the project because it will not have a significant environmental impact. Notwithstanding this, AECOM recommends that the project is referred to the EPA on the basis that Quenda Wetland is recognised as being of high conservation significance.

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Appendix A

MRWA Native Vegetation Clearing Assessment Report

Appendix A MRWA Native Vegetation Clearing Assessment Report

MRWA Vegetation Clearing Impact Assessment Report

This guideline has been prepared to assist MRWA in addressing condition 7 "Assessment of Clearing Impacts" under Clearing Permit CPS 818.

1. AREA UNDER ASSESSMENT DETAILS

Proponent details

Proponent's name:	**MRWA**	
Contacts:	Name:	Yaqoob Siddiqui
	Phone:	08 9323 4219
	Fax:	08 9323 4309
	Email:	yaqoob.siddiqui@mainroads.wa.gov.au

Property details

Property:	Murdoch Drive and South Street intersection
Colloquial name:	

Area under assessment

Clearing Area (ha)	No. Trees	Method of Clearing	For the purpose of:	Site Plan Attached
<1 ha	<10	Mechanical	Road widening and service relocation	☐ Yes ☑ No

Avoidance/Minimise clearing

How have the clearing impacts been minimised?

The majority of clearing will occur within previously cleared or planted areas. Clearing within areas of native vegetation has been reduced to the maximum extent possible within the design constraints.

2. BACKGROUND

Existing environment and information

The project area contains extensive planted areas, cleared areas together with a small area of native vegetation that occurs on the south-west corner of the intersection and adjacent to Quenda Wetland. Remnant vegetation generally comprises Eucalyptus Woodland and Eucalyptus/Melaleuca Woodland,

The condition of vegetation in the road reserve is mostly completely degraded, with a large percentage comprising roads, pathways and cleared areas. Remnant native vegetation covers the remainder of the road reserve and has been assigned condition ratings ranging from 'Degraded' to 'Very Good'.

Site Visit Undertaken	☑ Yes ☐ No	**Fauna / Flora Survey Undertaken**	☑ Yes ☐ No
Site Report Attached	☑ Yes ☐ No	**Fauna / Flora Survey Report Attached**	☑ Yes ☐ No
Site Photos Attached	☑ Yes ☐ No	**Other Relevant References Attached**	☑ Yes ☐No

Vegetation Complex	Clearing Description	Vegetation Condition	Comment
Bassendean Complex Central and South	Clearing of vegetation adjacent to existing pavement	Very good to completely degraded	Nil

3. ASSESSMENT OF APPLICATION AGAINST CLEARING PRINCIPLES

(a) Native vegetation should not be cleared if it comprises a high level of biological diversity.

Comments

Proposal is unlikely to be at variance to this Principle

The native vegetation within the project area does not comprise a high level of diversity. There are five vegetation units described for the project area, and the majority of the vegetation is planted. The vegetation units of the project area are described below.

Vegetation Unit	Type	Site Number/s	Description
P1	Planted Vegetation in Stormwater detention basin	1, 2a, 3	Revegetated areas comprising of a scattered Low Open Woodland of *Eucalyptus camaldulensis* over *Melaleuca* sp., *Melaleuca preissiana*, #*Grevillea ?olivacea* and #*Grevillea leucopteris* over introduced species including **Ehrharta longiflora*, **E. calycina*, **Lolium rigidum* and **Fumaria capreolata* in grey sand associated with stormwater detention basin and surrounding batters.
P2	Planted Vegetation along roadside	13	Revegetated roadside areas comprising of but not limited to non-locally native species such as #*Corymbia ficifolia*, #*Eucalyptus erythrocorys*, *Allocasuarina fraseriana*, #*Eucalyptus platypus*, #*Melaleuca nesophila* and #*Eucalyptus* x *tetragona*, *Grevillea bipinnatifida*, #*Callistemon phoeniceus*, and #*Acacia iteaphylla* over weed species or lawns.
ErMpAlSc	Eucalyptus/ Melaleuca Woodland	2b, 4, 5, 10, 11	Low Open Woodland of *Melaleuca preissiana* and *Banksia littoralis* with emergent *Eucalyptus rudis* over scattered tall shrubs of *Kunzea glabrescens* over an Open Shrubland of *Astartea leptophylla* with *Adenanthos cygnorum* becoming more dominant on disturbed edges over an Open Sedgleand of *Schoenus caespititius, Tetraria capillaris* and *Baumea* sp. on grey sand.
ErMrXp	Eucalyptus Woodland	na	Low Woodland of *Eucalyptus rudis* over a Shrubland of *Macrozamia riedlei* and *Banksia grandis* over **Cynodon dactylon ,* associated with planted roadside.
R1	Rehabilitated Woodland	na	Low Open Woodland of *Eucalyptus conferruminata, Eucalyptus erythrocorys* and *Eucalyptus platypus* with scattered *Corymbia calophylla* and *Eucalyptus marginata* over a Tall Open Shrubland of *Melaleuca nesophila, *Acacia iteaphylla, Jacksonia furcellata* and *Callistemon phoeniceus* with scattered *Callitris preissii* and occasional thickets of **Leptospermum laevigatum* over introduced grasses dominated by **Cynodon dactylon, *Ehrharta calycina* and **Eragrostis curvula* on brown sand

Original native vegetation representation of less than 5% of the total project area assessed has been considered to define limited representation in the local context. None of the vegetation untis within the project area are considered locally significant due to limited representation in the local context.

The entire project area falls within a mapped ESA due to being with the boundaries and buffers of CC wetlands. As such, all remnant vegetation communities within the project area (ErMpAlSc, ErMrXp) may be considered to be significant within the region. Vegetation units P1, P2 and R1 do not represent the original vegetation types of the area, and as such, these vegetation units are not considered to be regionally significant, despite falling within an ESA.

A total of 182species from 119 genera and 41 families were recorded within the Quenda Wetland study area during the September 2011 field assessment. The total includes 102 (56%) locally

endemic species, 24 (13.2 %) non-locally endemic species and 56 (30.8%) introduced (exotic) or naturalised weed species.

The floristic assessment did not identify the occurrence of PECs in the study area. The species composition of the intact vegetation communities recorded within the study area was analysed and compared to the Gibson et al (1994) dataset and from this Floristic Community Types (FCTs) have been inferred

The proposal is unlikely to be at variance to this principle; clearing will result in the loss of less than one hectare of vegetation that does not contain high level of biological diversity.

Methodology AECOM 2012a
DEC Threatened and Priority Ecological Communities database.

(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.

Comments

Proposal is unlikely to be at variance to this Principle

Based on a desktop assessment of specimen records and preferred habitat, the following species are may occur in the study area:

- Forest Red-tailed Black Cockatoo (*Calyptorhynchus banksii naso*) – Vulnerable (EPBC Act) and Threatened (WC Act)
- Carnaby's Cockatoo (*Calyptorhynchus latirostris*) – Endangered (EPBC Act) and Threatened (WC Act)
- Quenda (*Isoodon obesulus* subsp. *fusciventer*) – Priority Five
- Rainbow Bee-eater (*Merops ornatus*) – Migratory (EPBC Act)
- Perth Lined Lerista (*Lerista lineata*) – Priority Three
- Native Bee (*Leioproctus contrarius*) – Priority Three
- Graceful Sun Moth (*Synemon gratiosa*) – Endangered (EPBC Act) and Threatened (WC Act)
- Cricket (*Throscodectes xiphos*) – Priority One

Two species of conservation significance occur within Quenda Wetland, based on the field survey undertaken by AECOM in 2011. An Oblong Turtle was observed in the basin within the wetland. This species is not listed under Commonwealth or State legislation but it is listed by the International Union for the Conservation of Nature (IUCN) as 'Near Threatened'. Quenda also occur in the area, although the species was not directly observed during the field survey. Runnels within dense sedges and conical diggings indicate recent Quenda activity in the area.

Quenda Wetlands contains a wetland basin and surrounding vegetation that provides habitat for fauna. Clearing as a result of the proposal is to occur on the previously disturbed edges of the vegetation surrounding the wetland reserve. Vegetation within the project area does not represent important fauna habitat.

No other species were observed during the field survey.

The Graceful Sun-moth is unlikely to occur in the project area as the host plants for this species, *Lomandra hermaphrodita* (or *Lomandra maritima* in areas closer to the coast) were not recorded during the field survey.

The Rainbow Bee-eater is a common species throughout Australia that constructs nesting tunnels within the banks of soft sandy substrate. There were no Rainbow Bee-eater nests observed during the field assessment and only very limited areas suitable for the construction of the nest tunnels were located.

Lerista lineata has been recorded from the surrounding area including adjacent sites such as the Fiona Stanley Hospital. It is unlikely that the project area provides suitable habitat for this species although some habitat may occur in the more sandy fringes of the wetland vegetation.

The remaining species of significant fauna identified by the database searches are unlikely to occur in the study area. This is due to unsuitable habitat and lack of recent records in the area due to urban development and marginalisation of habitat.

Fauna habitat within the project area is comprised of Eucalyptus Woodland, Melaleuca Woodland over Sparse Sedges and planted vegetation.

Neither of the habitat types within the project area provide suitable habitat for Quenda. The Eucalyptus Woodland habitat does not suit Quenda due to its fragmented nature and lack of suitable vegetation. The Melaleuca Woodland over Sparse Sedges habitat type has been affected by disturbance from fire, stormwater run-off and edge effects. Growth of sedges is quite sparse and thus does not provide suitable cover for Quenda. There is potential for this area to regenerate to provide suitable understorey cover for Quenda and there are extensive rehabilitation efforts currently being undertaken in this area.

The project area contains foraging habitat for black-cockatoos in the form of planted vegetation and larger trees that have the potential to provide roosting and/or future nesting habitat. A total of six potential black-cockatoo habitat and foraging trees occur within the project area. Of these trees the *E. Gomphocephala* may be of significance due to their potential to develop nesting hollows in the figure (DSEWPaC 2011). They also have potential to be utilised for both feeding and roosting.

Banksia menziesii occurs within the Eucalyptus Woodland habitat type and offers limited foraging potential for black-cockatoos. Due to the isolation and proximity to road infrastructure, *Calyptorhynchus* spp will likely favour more extensive Banksia woodlands located nearby.

The proposal is unlikely to be at variance to this principle as the project area does not contain significant fauna habitat.

Methodology AECOM 2012a

The Quenda Wetlands Assessment assessment identified the likelihood of threatened and priority fauna species occurring in the project area based on the provision of suitable habitat. It included field surveys and a desktop assessment of relevant literature and DEC and DSEWPaC database searches.

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

Comments **Proposal is unlikely to be at variance to this Principle**

No species listed as Declared Rare Flora or Threatened (T or X) under the WC Act or as Threatened under the EPBC Act were recorded from within the project area.

Based on desktop assessment of specimen records and preferred habitat, it has been determined that threatened flora species do not have the potential to occur within the project area. The DEC database search did not identify previously recorded rare flora within the project area.

Based on the information above, clearing as a result of the proposal is unlikely to be at variance to this principle.

Methodology DEC Threatened (Declared Rare) Flora Database;
Western Australian Herbarium records; and
DEC Declared Rare Flora and Priority Flora List; and
DEPBC Act Protected Matters search tool

The likelihood of occurence of threatened species was assessed based on the DEC's known distribution and preferred habitat.

(d) Native vegetation should not be cleared if it comprises the whole or a part of, or is necessary for the maintenance of a threatened ecological community.

Comments **Proposal is unlikely to be at variance to this Principle**

There are no threatened ecological communities in or adjacent to the project area. The degraded condition of the remnant vegetation in the project area indicates that the occurrence of good quality TEC vegetation is highly unlikely.

Methodology AECOM 2012a
DEC Threatened and Priority Ecological Communities database

(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.

Comments

Proposal is unlikely to be at variance to this Principle

EPA's Position statement No.2 lays out a series of constraints which relate to biodiversity. One of them is to protect at least 30% of the original extent of vegetation complexes in unconstrained areas and 10% in constrained areas (i.e. urban zoned regions). The project area is considered a constrained area due to its urban zoning; therefore the 10% protection target applies.

Vegetation complex Bassendean Central and South (Heddle et al, 1980) meets the 10% target with 24% of its original extent remaining.

In addition to this, the table below shows Beard (1979) vegetation associations, current extent and extent remaining sub-divided into IBRA Region, sub-region and Local Government Authority (LGA) with all meeting the 10% minimum retention target.

Extent Category		Extent of Vegetation Association 1001
Statewide	Pre-European Extent	57,410.23
	Current Extent	14,111.96
	% Remaining	24.58%
IBRA Region (SWA)	Pre-European Extent	57,410.23
	Current Extent	14,111.96
	% Remaining	24.58%
IBRA Sub-region (SWA2)	Pre-European Extent	57,410.23
	Current Extent	14,111.96
	% Remaining	24.58%
LGA – City of Melville	Pre-European Extent	1,503.56
	Current Extent	166.39
	% Remaining	11.07%

Methodology

AECOM 2012a

Beard (1981) vegeation mapping was used to determine the vegeation associations of the project area. These assocociations were referenced against the Department of Agriculture and Foods CAR Reserve Analysis spreadsheet to determine the percent remaing of each associaition within the state, IBRA bioregion and City of Melville Local Governement Authority.

(f) Native vegetation should not be cleared if it is growing in, or in association with, an environment associated with a watercourse or wetland.

Comments

Proposal is at variance to this Principle

A large portion of the project area lies within a mapped ESA as it is within the boundary and buffer of a Conservation Category wetland.

Based on the current design of the intersection upgrade, about 0.09 ha of Eucalyptus/Melaleuca Woodland adjacent to Murdoch Drive and 0.11 ha of planted vegetation adjacent to South Street will be cleared from within the wetland reserve.

These areas will be replanted following construction of the drainage swales adjacent to Murdoch Drive and the repositioning of the drainage outfall in the south-east corner of the intersection. Accordingly, the small area of vegetation to be cleared is not expected to adversely affect the integrity, ecological functions and environmental values of the wetland.

Methodology

AECOM 2012b

Geomorphic Wetlands of the Swan Coastal Plain dataset (adapted from Hill et al. 1996).

(g) Native vegetation should not be cleared if the clearing of the vegetation is likely to cause appreciable land degradation.

Comments **Proposal is unlikely to be at variance to this Principle**

The project area is located within a highly modified, urban landscape. The majority of the construction footprint comprises planted vegetation. The relatively small extent of native vegetation to be cleared will not cause appreciable land degradation.

Clearing will occur in areas that are already degraded in order to minimise the impact to better quality vegetation. It is anticipated that various rehabilitation and weed control activities will be carried out to improve the quality of the vegetation in areas beyond the construction footprint, as may be required.

Methodology AECOM 2012b

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

Comments **Proposal is unlikely to be at variance to this Principle**

Other than Quenda Wetland reserve, there are no reserves for conservation and/or recreation purposes within the project area (Figure 11). Beeliar Regional Park and two related Bush Forever Sites are located within 2 km of the project area. These reserves are separated from the project area by roads and residential areas and will therefore not be impacted by the upgrade.

Methodology AECOM 2012b
DEC managed lands dataset
Bush Forever

(i) Native vegetation should not be cleared if the clearing of the vegetation is likely to cause deterioration in the quality of surface or underground water.

Comments **Proposal is unlikely to be at variance to this Principle**

Clearing for the proposal is located along the existing earth batters at the edges of South Street and Murdoch Drive. Deterioration in the quality of surface or underground water is not expected to occur. The quality of water entering the permanent lake within Quenda Wetland will be improved through the construction of drainage swales planted with appropriate vegetation. Groundwater is not expected to be impacted during clearing activities.

The small amount of disturbed wetland vegetation to be cleared is unlikely to have significant effects on groundwater and the surface water basins of the two Conservation Category wetlands.

Methodology AECOM 2012b

(j) Native vegetation should not be cleared if clearing the vegetation is likely to cause, or exacerbate, the incidence or intensity of flooding.

Comments **Proposal is unlikely to be at variance to this Principle**

The total area of native vegetation to be cleared this proposal is relatively small, particularly with reference to areas associated with surface water and/or wetlands.

Road drainage systems will be installed and/or modified to address the increased amount of stormwater run-off. Appropriate management of stormwater quantity and quality will be incorporated into this design to reduce the risk of flooding.

The clearing of vegetation is therefore unlikely cause or exacerbate the incidence or intensity of flooding. Drainage systems will be designed and constructed to appropriately collect and redistribute road drainage. Appropriate management of stormwater quality will be incorporated into this design.

For the reasons outlined above the project is unlikely to be at variance to this principle.

Methodology AECOM 2012b

Planning instrument, Native Title, RIWI Act Licence, EP Act Licence, Works Approval, Previous EPA decision or other matter.

Comments Potential dewatering licence under Section 26C of the RIWI Act, if total dewatering is expected to be greater than 25 000 kilolitres.

Methodology Department of Water: http://www.water.wa.gov.au/Business+with+water/Water+licensing/Water+licensing+frequently+asked+questions/FAQ+2+Applying+for+different+types+of+licenses/default.aspx#6

4. ASSESSOR'S RECOMMENDATIONS

List of Principles seriously at variance, at variance or maybe at variance	Recommendation
Principle (f) – at variance	Construction Environmental Management Plan

5. REFERENCES

AECOM 2012a. Quenda Wetland Assessment. Unpublished report prepared for Main Roads Western Australia. In Preparation.

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OFFICER PREPARING REPORT

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Tram Vu
Environmental Scientist

1 May 2012

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Appendix B

Landscape Plan

Appendix B Landscape Plan

INTERSECTION DETAIL PLAN

N

0 10 20 30 40 50 100m

AECOM

LEVEL 7, 3 FORREST PLACE, PERTH, WA 6000 **T** 08 6208 0000 **F** 08 6208 9999

DRAWING NUMBER
L-AG-01

MARCH 2012

MURDOCH DRIVE AND SOUTH STREET INTERSECTION UPGRADE

INTERSECTION DETAIL PLAN