Ellenbrook Bus Rapid Transit

Environmental Impact Assessment and Environmental Management Plan

Main Roads Western Australia

15 June 2016

Revision: C

Reference: 247607 - 037

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Executive Summary

The Ellenbrook Bus Rapid Transit (EBRT) project will provide a dedicated public transport route, connecting the Ellenbrook town centre to Reid Highway in the south. The project will involve the construction of approximately 10km of busway, grade separations at road crossings by either underpass or overpass, upgrades of all existing intersections and three bus stations with Park and Ride facilities.

Major environmental and heritage factors for the project include groundwater, surface water, flora and vegetation, terrestrial fauna and Aboriginal heritage.

Groundwater dewatering may be required to enable construction of underpasses. This will result in localised lowering of the groundwater table, which may impact vegetation health and water supply in nearby bores. Groundwater abstraction and dewatering licences will be obtained prior to commencement of dewatering and a Groundwater Dewatering Management Plan will be developed and implemented by the construction contractor to minimise potential for adverse impacts on vegetation health and neighbouring bore users.

The project footprint intersects Priority 2 and Priority 3 Public Drinking Water Source Areas (PDWSA). The project has the potential to contribute increased contamination through surface water runoff to the PDWSAs. Water Sensitive Urban Design (WSUD) Principles will be employed in the design of the road and drainage to minimise potential impacts to groundwater quality.

The project will intersect a number of surface water features. There is potential for changes to surface water runoff which will be managed through WSUD including infiltration in-situ.

The project footprint covers a total area of 56.8ha within the 185.2ha study area. Within the project footprint, there is a total area of 21.1ha remnant native vegetation, of which only 2.1ha is in Good to Very Good condition. The area has previously been subject to extensive clearing and disturbance and the majority of vegetation is degraded. There will be no impact to threatened flora or Threatened Ecological Communities. There will be no significant impact to flora and vegetation.

The project footprint contains mature Marri and Marri/Melaleuca woodland which provides foraging habitat for three species of black cockatoo and potential breeding habitat for Forest Red-tailed Black Cockatoo and Carnaby's Black Cockatoo. There will also be some loss of habitat for Rainbow Bee-eater, Quenda and Western Brush Wallaby. Given the degraded nature of remnant vegetation available within the project footprint, the project is unlikely to significantly reduce populations of fauna. A number of management measures will be implemented to minimise impacts to fauna including site walkover by fauna specialist prior to clearing to ensure no active nests will be disturbed.

A number of registered Aboriginal heritage sites are intersected by the project footprint. There is a high risk the project will disturb these sites. An ethnographic and archaeological study will be undertaken and where required, consent will be sought under Section 18 of the *Aboriginal Heritage Act 1972*.

Minor environmental factors for the project include acid sulphate soils, dieback and visual amenity; however these factors are readily manageable and no adverse residual impacts are anticipated.

A comprehensive Environmental Management Plan (Appendix A) will be implemented to minimise potential impacts to major and minor environmental factors as a result of the project proceeding.

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1 Introduction

1.1 Project purpose and background

The Ellenbrook Bus Rapid Transit (EBRT) project will provide a dedicated public transport route, connecting the Ellenbrook town centre to Reid Highway in the south. The project will involve the construction of approximately 10km of busway, grade separations at road crossings by either underpass or overpass, upgrades of all existing intersections and three bus stations with Park and Ride facilities. The EBRT is intended to improve public transport connections to Midland, Bassendean and Morley. Journey times for other vehicle users will be reduced through the construction of new Lord Street. This will provide two new sections of road and improve access to intersections at Marshall Road and Gnangara Road.

Structure plans are currently in place for expanded residential development east of Lord Street within the next five to 10 years. These developments are likely to contribute further traffic volumes along Lord Street.

The purpose of this Environmental Impact Assessment and Environmental Management Plan (EIA and EMP) is to assess the potential impacts of the project in order to fulfil environmental assessment and approvals processes, to identify potential management measures that may be required to minimise or mitigate residual impacts and to determine whether further assessments are required.

1.2 Project location

The proposed EBRT route extends south from The Parkway at Ellenbrook Town Centre, to Marshall Road in the City of Swan (Figure 1). It is located predominantly within the existing 'Public Purpose – Special Use (Transit)' and 'Primary Regional Roads' reservations in the Metropolitan Region Scheme (MRS) (AECOM 2016). The total extent of the study area is 185.2ha and the project footprint for the concept design covers an area of 56.8ha (Figure 2).

The project location is shown below.

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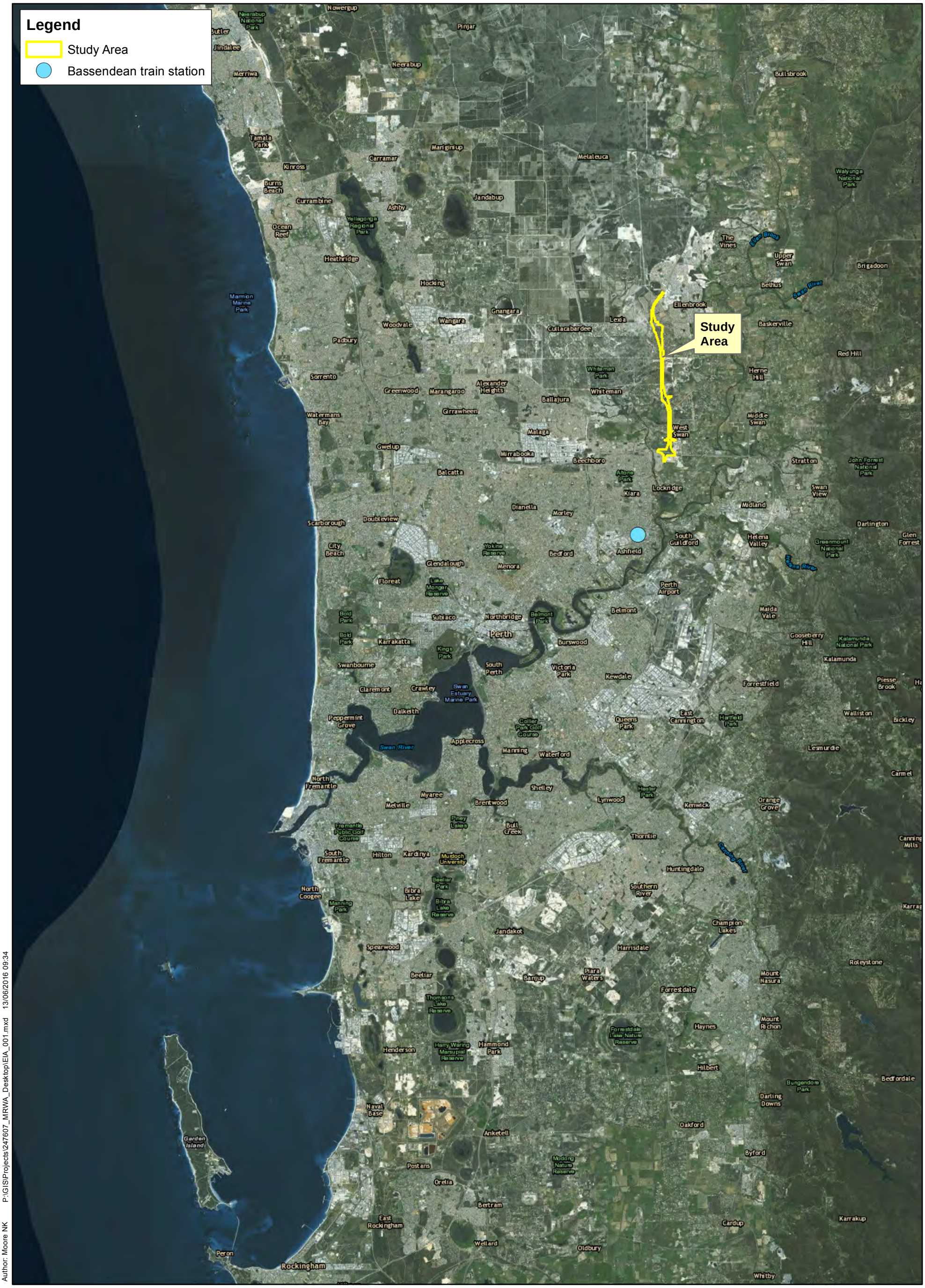

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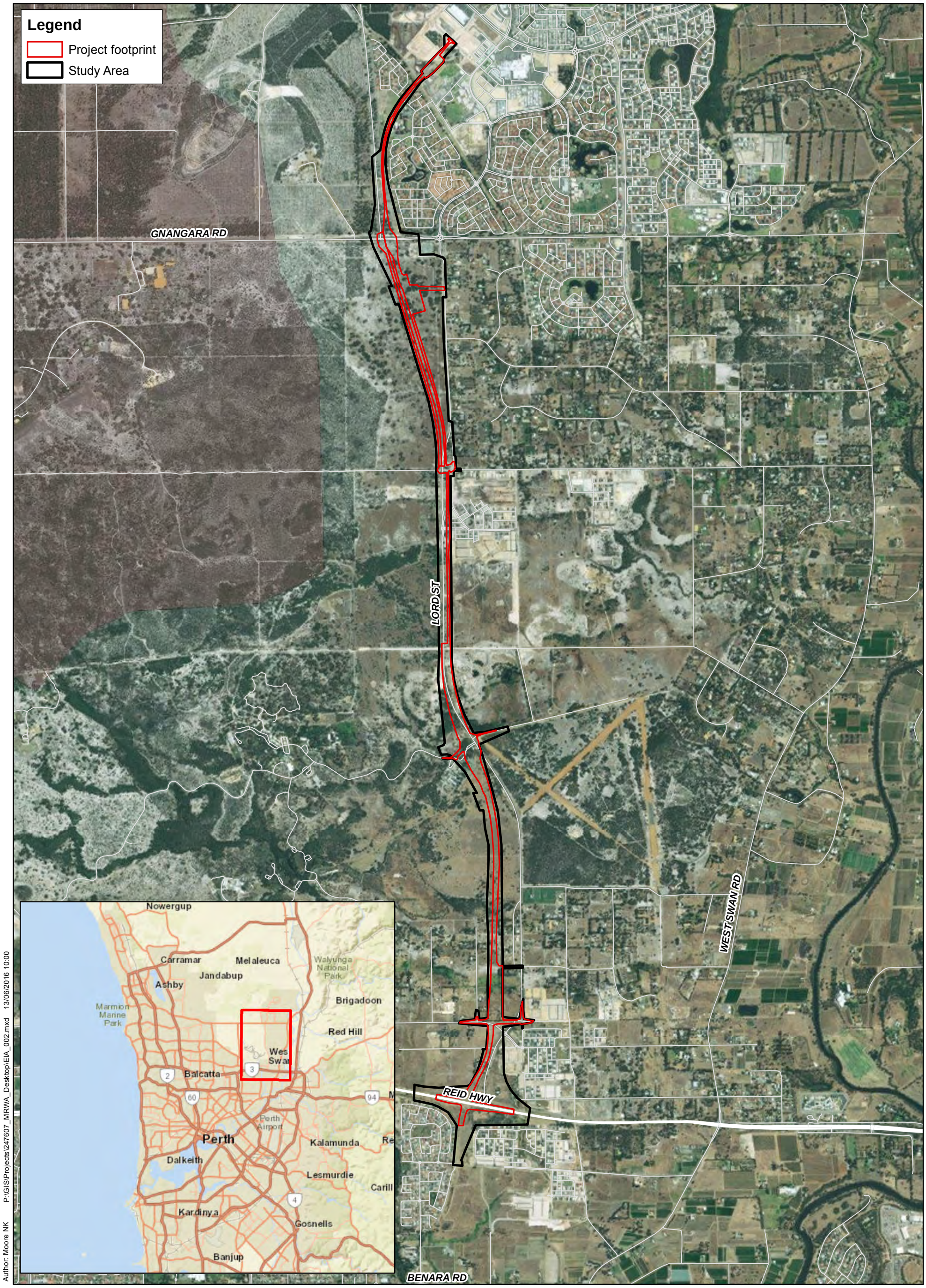
Coordinate System: GDA 1994 MGA Zone 50

MRWA Ellenbrook Bus Rapid Transit EIA and EMP

Figure 1: Project Location



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MRWA Ellenbrook Bus Rapid Transit EIA and EMP

Figure 2: Project footprint and study area

2 Environmental Impact Assessment and Environmental Management Plan

2.1 Project scope

A preliminary desktop review of existing information, including a recent biological survey by AECOM (2016) and consultation with Main Roads has been undertaken to identify the key environmental factors for the project.

These are likely to include:

- Groundwater
- Surface water/drainage
- Flora and vegetation
- Terrestrial fauna
- Aboriginal heritage

Minor aspects include:

- Acid sulphate soils
- Air quality and dust
- Contaminated sites
- Dieback
- Hazardous substances
- Heritage (non-Indigenous)
- Land tenure
- Noise and vibration
- Visual amenity
- Reserves/conservation areas

A review of the existing environment and an assessment of likely impacts for each of these aspects is provided below.

2.2 Environmental impact assessment of key aspects

2.2.1 Groundwater

2.2.1.1 EPA Objective for groundwater

The EPA objectives relevant to groundwater are provided below.

Table 1 EPA factors and objectives relevant to groundwater

Factor	Objective
Hydrological processes	*To maintain the hydrological regimes of groundwater and surface water so that existing and potential uses, including ecosystem maintenance, are protected*
Inland Waters Environmental Quality	*To maintain the quality of groundwater and surface water, sediment and biota so that the environmental values, both ecological and social, are protected.*

The following water quality protection notes are applicable to both the construction and operational phase of the EBRT:

- Risk Assessment of public drinking water source areas (WQPN no. 77) (DoE 2005a)
- Land use compatibility in public drinking water source areas (WQPN no.25) (DoE 2004a)
- Vegetation buffers to sensitive water resources (WQPN no.06) (DoW 2006a)
- Roads near sensitive water resources (WQPN no. 44) (DoW 2006b)

2.2.1.2 Existing information on groundwater

The project footprint will partially transect Priority 2 (P2) and Priority 3 (P3) Source Protection Areas (SPA) of the Gnangara Underground Water Pollution Control Area (UWPCA) (Water Corporation 2007).

P2 classification areas are managed to ensure that there is no increased risk of water source contamination or pollution and these areas include established low-risk land development (DoE 2004a). P3 classification areas are defined to manage the risk of pollution to the water source from catchment activities (DoE 2004a).

A search of Perth Groundwater Atlas identifies depth to groundwater along the alignment as ranging from 12.5m at the Parkway in the north to 0m at the intersection of Lord Street and Youle-Dean Road. Groundwater is predominantly at a depth of 2m to 4m.

An assessment of groundwater in the vicinity of the project footprint will be conducted. The results of this investigation will help to inform the design of grade separations and to manage impacts from any potential dewatering activities.

2.2.1.3 Assessment of potential impacts to groundwater

Three park and ride facilities will be established providing an approximate total of 300 parking bays. One of these proposed parking areas is location within the P2 Public Drinking Water Source Areas (PDWSA). Carparks are not a compatible land use within a P2 PdWSA, except where there are conditions on the management of the carpark.

The road alignment does not cross any wellhead protection zones.

Potential impacts to groundwater from the proposal include contamination from vehicle hydrocarbon leaks. The nature of vehicle derived contamination is diffuse and temporary, and unlikely to cause

significant water quality impacts to groundwater in the vicinity of the project footprint. Further discussion on the potential of hydrocarbon contamination is included in Sections 2.2.2 and 2.3.6.

The project design includes grade separations at major intersections. These will be constructed as either underpasses or overpasses. In the event that underpasses are the preferred final design, dewatering will be required to lower the groundwater table in the vicinity of the underpasses. Ongoing maintenance dewatering may also be required to preserve the structural integrity of the underpasses.

Groundwater dewatering may result in changes in surface water levels and adverse impacts to vegetation within the cone of depression. It may also result in a lowering of standing water and of groundwater levels in local bores.

If groundwater drawdown coincides with the presence of acid sulphate soils, it may result in the exposure of iron sulphide in soil to oxygen, creating acidic conditions which in turn may release toxic metals into the groundwater.

2.2.1.4 Proposed management measures for groundwater

In the event that the final design identifies underpasses as grade separations, groundwater abstraction and dewatering licences will be obtained prior to commencement of dewatering. A Groundwater Dewatering Management Plan will be developed and implemented by the construction contractor, to minimise and manage impacts to groundwater and will include infiltration or injection of dewatering effluent.

Management measures related to hydrocarbon impacts are provided in Sections 2.2.2 and 2.3.5.

2.2.2 Surface water/drainage

2.2.2.1 EPA Objective for surface water and other guidance

The EPA objectives relevant to surface water and drainage are provided below.

Table 2 EPA factors and objectives relevant to surface water and drainage

Factor	Objective
Hydrological processes	*To maintain the hydrological regimes of groundwater and surface water so that existing and potential uses, including ecosystem maintenance, are protected*
Inland Waters Environmental Quality	*To maintain the quality of groundwater and surface water, sediment and biota so that the environmental values, both ecological and social, are protected.*

2.2.2.2 Existing information on surface water

Major surface water features within and in close proximity to the project footprint include:

- Bennett Brook – approximately 300 m west of the project footprint;
- St Leonards Creek – approximately 800 m east of the project footprint;
- Henley Brook – approximately 3.3 km east of the project footprint; and
- Ellen Brook – approximately 4 km east of the project footprint.

A desktop search using WA Atlas for wetlands within and adjacent to the project footprint identified a number of wetlands. The footprint intersects three Multiple Use wetlands and one Resource Enhancement wetland. These are depicted in Figure 3 and identified in Table 3 below.

Table 3 Wetlands intersected by the project footprint

UFI	Conservation category	Description	Extent (ha) within project footprint	Extent (ha) vegetated wetland within footprint
8678	Resource Enhancement	Sumpland, seasonally inundated basin	0.8	0.5
8720	Multiple Use	Palusplain, flat, seasonally waterlogged	0.3	0.05
8806	Resource Enhancement	Palusplain, flat, seasonally waterlogged	0.3	0.05
13396	Multiple Use	Palusplain, flat, seasonally waterlogged	16.4	8.6
15511	Multiple Use	Palusplain, flat, seasonally waterlogged	13.6	1.5

A total of 1.1ha of Resource Enhancement wetland is within the project footprint, of which 0.5ha supports remnant vegetation. A further 30.3ha of Multiple Use wetland is within the footprint, of which 10.2ha supports remnant vegetation.

The project footprint contains both Bassendean Sands and Southern River Soils (DCE 1980) with isolated areas of peaty clay swamp deposits (Davidson 1995). The project footprint can be characterised as an interdunal area with gently undulating sandy crests and wetlands/damplands formed in the valleys (NorthLink 2015a). The existing Gnangara Road, is unkerbed with runoff sheeting to the adjacent verges to infiltrate (NorthLink 2015a).

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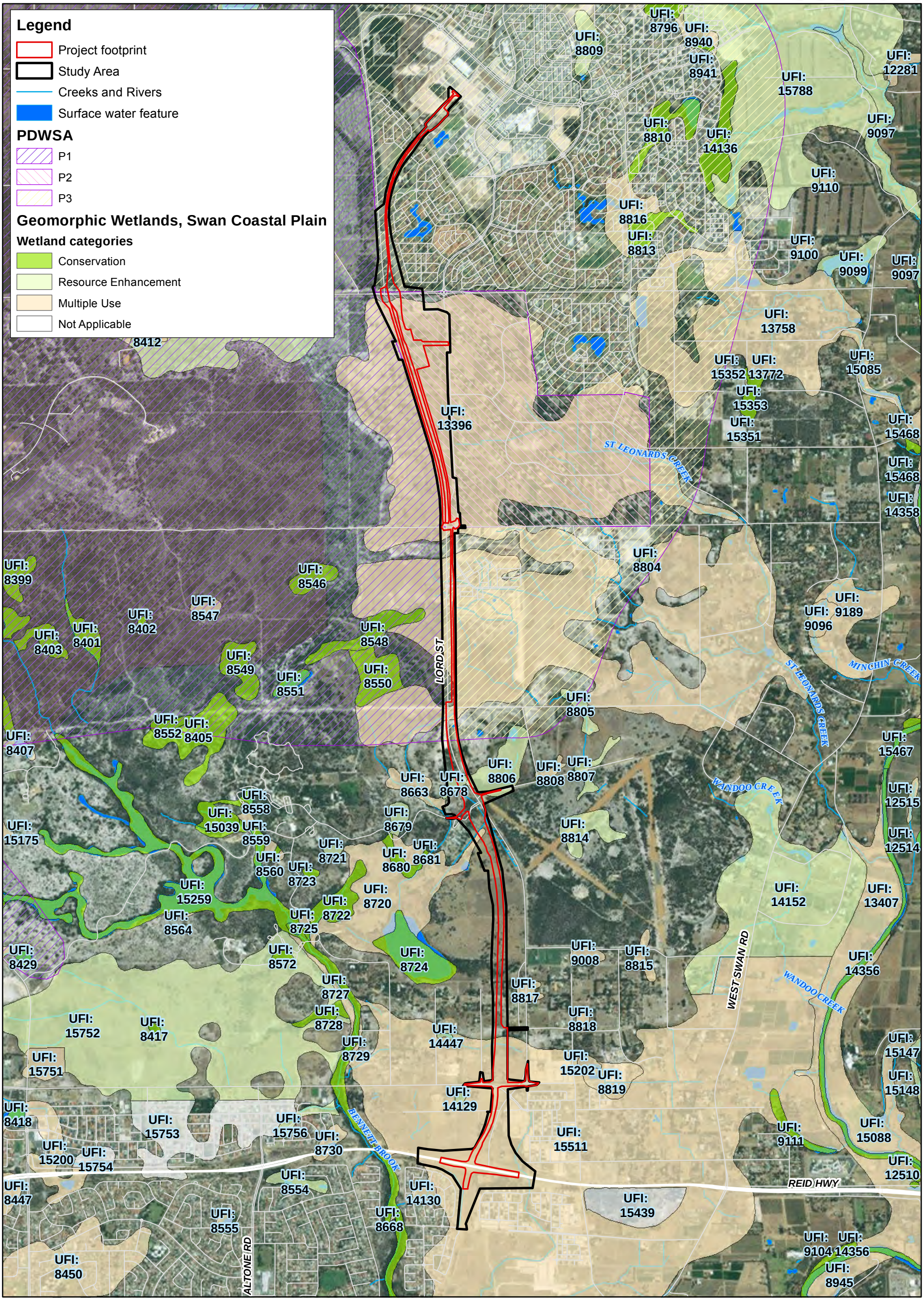

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Coordinate System: GDA 1994 MGA Zone 50

MRWA Ellenbrook Bus Rapid Transit EIA and EMP

Figure 3: Surface water features and PDWSA Protection Zones

2.2.2.3 Assessment of potential impacts to surface water

The construction of the project will intersect surface drainage flows in some areas and result in the disturbance to three Multiple Use wetlands and two Resource Enhancement wetlands as identified in Table 3 above. After the application of management measures, the disturbance of 0.5ha of vegetated Resource Enhancement Wetland and 10.2ha of vegetated Multiple Use wetland is not expected to significantly impact the hydrological processes of the surrounding areas, given the extent of wetland area remaining outside of the project footprint.

There are no major creek or river crossings within the EBRT footprint; however, some minor tributaries and drainage lines will be traversed.

Potential impacts to surface water and drainage relate to the maintenance of existing surface water flows and surface water quality and include:

Construction impacts

- Altered water quality associated with silt deposition, increased turbidity and accidental spills and releases
- Potential water quality impacts to sensitive water systems (i.e. Gnangara UWPCA and sensitive wetlands)
- Interruption/obstruction to existing surface water flows
- Changes to local surface water hydrology including altered surface water runoff volumes from vegetation clearing
- Excess runoff/ponding which could lead to localised soil erosion and flood risk respectively
- Development of new areas of water logging.

These impacts are manageable and only a potential risk during the construction phase and are therefore not considered to be significant.

Operational impacts

- Altered surface water runoff volumes from road surface;
- Altered water quality associated with road runoff and accidental spills and releases (contamination of surface water); and
- Changes to water levels of 'downstream' wetlands and water courses.

The main operational impact will be drainage and run off from the proposed car park to the south-east of the Gnangara Road intersection in the P2 water source area. This runoff will potentially carry contaminants and could result in larger volumes of runoff due to the non-porous surfaces of the parking bays. Management measures detailed in Section 2.2.2.4 will minimise impacts to surface water flows in this area.

2.2.2.4 Proposed management measures for surface water

The project design will employ water sensitive urban design (WSUD) principles, in particular infiltration of runoff in-situ, to ensure that surface water regimes are maintained. Where possible, existing natural drainage paths and networks such as contours and the natural stormwater system will be used to capture excess runoff and mitigate flooding. Existing drainage channels will not be unnecessarily blocked or restricted and any material that is found to block drainage will be removed.

Where it is not possible to utilise existing natural drainage features, artificial ones will be created; such as pipes, culverts and engineered swales. WSUD options will be implemented as a first preference, including infiltration systems, grassed/vegetated swales and buffer strips and bioretention/biofilter

systems. Existing natural vegetation will be incorporated into the design to promote filtering and slow run-off.

Infiltration systems are effective at removing coarse sediment, rubbish and total suspended solids. However, they are less effective at removing nutrients from runoff due to the low phosphorous retention index of most naturally occurring sandy soils in Western Australia (NorthLink 2015b). The nutrient removal efficiency can be increased by soil amendment.

Swales are grassed or vegetated broad, shallow channels used to capture runoff, promote infiltration and remove water-borne sediments (DoW 2011a). Swales remove coarse and medium, suspended solids and trace metals (NorthLink 2015b) from runoff waters. Buffer strips are vegetated areas that reduce sediment loads from water flowing through them. Buffer strips and swales may be used in conjunction, as required (DoW 2011a).

A bioretention system is an excavated basin or trench that is filled with porous media and planted with vegetation (DoW 2011b). Bioretention systems remove fine sediment, trace metals, nutrients, bacteria and organics. They are generally considered to be more effective than vegetated swales.

Minimising disturbance to soil, vegetation and preventing compacting of soil surfaces, in addition to stabilising disturbed areas as soon as possible, will help minimise impacts to surface flows and drainage.

The above management options are considered to be Best Management Practices as presented in the Department of Water (DoW) Stormwater Management Manual for WA (DoW 2004).

Drainage design will follow the principles of Northlink (2015b) which utilises 'at source' infiltration as the key management measure, through maximising the use of 'kerb-less pavements', table drains and swales. This drainage strategy will be consistent with the drainage strategy prepared by MRWA and approved by the DoW for the Perth-Darwin Highway (NorthLink) Project (NorthLink 2015b). Ongoing consultation will be undertaken with DoW and Water Corporation in regard to drainage design and their requirements for the drainage strategy.

2.2.3 Flora and vegetation

2.2.3.1 EPA Objective for flora and vegetation

The EPA objective for flora and vegetation is identified below:

Table 4 EPA factor and objective for flora and vegetation.

Factor	Objective
Flora and vegetation	*To maintain representation, diversity, viability and ecological function at the species, population and community level.*

2.2.3.2 Existing information on flora and vegetation

A Level 1 biological survey was conducted by AECOM (2016) in a survey area which includes the majority of the project footprint. Changes to the concept design have resulted in additional areas included in the project footprint which have not been surveyed. These areas total 1.5ha. Aerial imagery indicates these areas are largely cleared, with limited remnant vegetation with little to no understorey. These areas coincide with the Southern River vegetation complex, characterised by Marri/Jarrah and Banksia woodland. The survey area extended from the Ellenbrook Town Centre to Marshall Road and includes three proposed park and ride sites located at Marshall Road, Youle-Dean Road and Gnangara Road. The survey area extended outside of the 'Public Purpose – Special Use (Transit)' and 'Primary Regional Roads' reservations.

The AECOM study included a desktop search of publicly accessible databases maintained by the Department of Parks and Wildlife (DPaW), using a 5 km buffer, and a review of previous studies, in addition to a field survey.

The desktop assessment identified six conservation significant flora species as potentially occurring within the study area, based on an assessment of preferred habitat and soil types compared to habitat and soil types available within the study area (AECOM 2016). These are identified in Table 5. Definitions of conservation categories are defined in Appendix B.

Table 5 Threatened and priority flora that may occur within the study area

Species	Conservation status (WA)	Preferred habitat
Poranthera moorokatta	Priority 2	Open banksia woodland on white silica sands or shallow dampland on mixed grey and white sand.
Cyathochaeta teretifolia	Priority 3	Grey sand, sandy clay. Swamps, creek edges.
Haemodorum loratum	Priority 3	Grey or yellow sand, gravel.
Stylidium trudgenii	Priority 3	Grey sand, dark grey to black sandy peat. Margins of winter wet swamps, depressions.
Hypolaena robusta	Priority 4	White sand. Sandplains.
Thysanotus glaucus	Priority 4	White, grey or yellow sand, sandy gravel.

The field survey was conducted over two days, on 22 and 29 October 2015 and was conducted in accordance with Environmental Protection Authority (EPA) Guidance Statement 51 (EPA 2004a).

The field survey identified a total of 129 vascular plant species from 43 families and 103 genera with the families Fabaceae, Myrtaceae and Poaceae, the most abundant. Of this total, 49 were weed species, including the four Declared Pests under the *Biosecurity and Agricultural Management Act 2007* (BAM Act). Two species were considered to have been planted outside of their usual range (AECOM 2016). No threatened or priority species were recorded within the survey area at the time of the field survey (AECOM 2016).

2.2.3.2.1 Vegetation communities

The desktop assessment identified three vegetation communities, as described by Heddle et al (1980) as occurring within the study area. These are the Bassendean Complex – North, Bassendean Complex – Central and South and Southern River Complex.

The extent of each of these in the project footprint, and remaining extent is given in Table 6.

Table 6 Extent and predicted impact to Heddle Vegetation Communities

Vegetation Complexes	Pre-European Extent (ha)	2015 extent (ha)	% remaining	Known extent to be cleared (ha)	Extent unsurveyed (ha)	Known % loss of 2015 extent	Predicted % remaining after project
Bassendean Complex - North	74 131	53 218	71%	0.0	0.5	0.0	71
Bassendean Complex – Central and South	87 416	22 846	26%	6.3	0.7	0.02	25.98
Southern River Complex	57 163	10 533	18%	9.2	0.3	0.08	17.92

Source: EPA 2015

The field survey identified a total of 17 communities including nine native vegetation communities, including six woodland types, and three wetland vegetation types. Six disturbed or non-native communities were identified, in addition to open water and cleared areas. Only 12 of the 17 communities occur within the project footprint. Figure 4 shows the distribution of the vegetation communities and their condition recorded within the project footprint. Table 7 presents the area each community occupies within the study area, its extent within the project footprint and how much of that extent is in good condition.

Of the 56.8ha within the project footprint, 9.9ha is Marri/*Melaleuca preissiana* mid open forest with Jarrah and *Banksia* sp. (CcXpBm and CcXpPe), representing 17% of the project footprint. One other woodland community dominated by Melaleuca (MpAsPp) covers an area of 0.5ha, representing less than 1% of the project footprint. A total of 29.5ha is cleared (AECOM 2016).

Table 7 Vegetation communities within the study area (AECOM 2016)

Vegetation community code	Vegetation description	Extent (ha) within study area	Extent (ha) within project footprint	Extent (ha) within project footprint ranked in Good to Very Good condition
Woodlands				
CcXpBm	*Corymbia calophylla* and *Melaleuca preissiana* mid open forest over *Xanthorrhoea preissii*, *Dasypogon bromeliifolius* and *Patersonia occidentalis* sparse shrubland over **Briza maxima*, *Alexgeorgea nitens*, **Ehrharta longiflora* low to mid mixed tussock grassland and sedgeland. *Eucalyptus marginata*, *Nuytsia floribunda*, *Allocasuarina* sp. and Banksia species are intermittent. In degraded versions of this community the understorey is dominated by grasses.	30.8	9.9	1.2
CcXpPe	*Corymbia calophylla*, *Melaleuca preissiana* and *Eucalyptus marginata* low to mid open forest over *Xanthorrhoea preissii* mid isolated shrubs over *Pteridium esculentum*, *Lepidosperma ?longitudinale* and Dasypogon bromeliifolius mid closed mixed fern and sedgeland.	0.2	0.05	0.05
ErCd	*Eucalyptus rudis* and *Melaleuca rhaphiophylla* low to mid woodland over **Cynodon dactylon*, *Marsilea drummondii* and **Avena barbata* low closed grassland	0.3	0.0	N/A
CcAsAb	*Corymbia calophylla*, *Melaleuca rhaphiophylla* and *Casuarina obesa* low woodland over *Acacia saligna*, *Hakea prostrata* and **Solanum nigrum* mid to high shrubland over **Avena barbata*, **Lolium rigidum* and **Ehrharta longiflora* closed grassland	2.0	0.0	N/A
MpAsPp	*Melaleuca preissiana*, *Melaleuca rhaphiophylla* and *Eucalyptus rudis* low to mid woodland with emergent *Corymbia calophylla* over *Acacia saligna*, **Lupinus angustifolius* and **Brassica* sp. low to high open shrubland over	1.7	0.50	0.0

Vegetation community code	Vegetation description	Extent (ha) within study area	Extent (ha) within project footprint	Extent (ha) within project footprint ranked in Good to Very Good condition
	**Pentameris pallida*, **Ehrharta longiflora* and **Vulpia myuros* low to high open grassland			
Wetlands				
MpXpCa	*Melaleuca preissiana* and *Melaleuca rhaphiophylla* low closed forest over *Xanthorrhoea preissii*, *Taxandria linearifolia* and *Aotus gracillima* high open shrubland over *Cyathochaeta avenacea*, *Dielsia stenostachya* and *Lepidosperma ?longitudinale* high sedgeland. In wetter areas, the understorey is dominated by sedges including *Baumea articulata*, *Ornduffia albiflora* and ?*Schoenoplectus pungens*	3.0	0.9	0.7
ErAbLl	*Eucalyptus rudis*, *Melaleuca preissiana* and *Melaleuca rhaphiophylla* mid closed forest over *Acacia blakelyi* and **Ficus carica* low open shrubland over *Lepidosperma ?longitudinale*, *Juncus pallidus* and **Zantedeschia aethiopica* high open sedgeland	0.1	0.0	N/A
MrAsCp	*Melaleuca rhaphiophylla* and *Eucalyptus rudis* low woodland over, *Acacia saligna* and *Viminaria juncea* low open shrubland over **Cyperus papyrus*, **Cyperus polystachyos* and **Holcus lanatus* high closed sedgeland	1.8	1.5	0.0
Disturbed vegetation				
Mp/Mr	Isolated *Melaleuca preissiana* and/or *Melaleuca rhaphiophylla* trees over common pasture weeds	8.2	2.8	0.0
Native Eucalypts over paddock	*Corymbia calophylla*, *Eucalyptus rudis*, *Eucalyptus marginata*, and/or *Eucalyptus patens* isolated trees over common pasture weeds	23.0	5.4 (106 trees)	0.0

Vegetation community code	Vegetation description	Extent (ha) within study area	Extent (ha) within project footprint	Extent (ha) within project footprint ranked in Good to Very Good condition
To	**Typha orientalis* tall closed rushland in artificial drainage infrastructure. Emergent *Acacia saligna* and Planted Eucalypts are present in places	0.2	0.0	N/A
Pine plantation	**Pinus pinaster* isolated trees over common pasture weeds	4.0	1.2	N/A
Landscaping	Planted vegetation comprising predominantly non-native species	6.0	1.7	N/A
Planted	Roadside planted common native rehabilitation species	2.4	1.8	N/A
Other				
Water	Inundated areas associated with wetlands	0.1	0.02	N/A
Cleared	Areas devoid of native vegetation including existing roads, tracks, infrastructure or cleared paddock areas comprising weeds.	91.7	29.5	N/A
Unsurveyed	Area not surveyed by current field survey.	9.7	1.5	N/A
Total (ha)		**185.2**	**56.8**	**2.1 plus 106 trees.**

Vegetation condition

Vegetation condition within the study area varied from 'Very Good' to 'Completely Degraded,' with the majority of vegetation being rated as 'Completely Degraded,' due to human use of the area and extensive weed invasion. A total of 2.1ha, out of the 56.8ha project footprint surveyed, was assessed as 'Good' to 'Very Good.' In addition, 106 trees with a Diameter at Breast Height (DBH) of 500mm or greater were recorded within a 5.4ha of cleared paddock that supports no understorey. While this area is rated as 'Completely Degraded,' the remnant trees may provide habitat to fauna (Section 2.2.4.3).

The areas of vegetation assessed as 'Good' to 'Very Good' include Marri/*Melaleuca preissiana* woodland (CcXpBm), Marri/*Melaleuca preissiana* and Jarrah woodland (CcXpPe); and *Melaleuca* and *Eucalyptus rudis* woodland (MpXpCa).

Definition of vegetation condition ratings are provided in Appendix C.

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Legend

- Project footprint
- Study Area

Vegetation Communities

- BaCePg
- CCXpBm
- CcXpBm
- Cleared
- Landscaping
- Native Eucalypts over paddock
- Pine Plantation

Vegetation Complexes

- Bassendean complex - central and south
- Bassendean complex north
- Bassendean complex- north - transition vegetation complex
- Southern River complex

A
B
C
D

HALPIN CIR
BARNFIELD DR
HALPIN CIR
GRANESSE DR
THE BROADWAY
FOSSIL LANE
INDEE LANE
IOWINA LANE
THUNDELARRA AV
COOLAMON BVD
KINCLAVEN LANE
SILENT GR
THE PROMENADE
BARQUE AV
COMSERV LOOP
BRICK LANE
LOCKE LANE
LOCKE LANE
WINDERIE CR
LOUISA GR
BRONTIE AV
MIA CT
THEDA LANE
KILLARA AV
NITA LANE
WANARRA CL
COMMERCIAL RD
CIVIC TCE
GALLERY LANE
MAIN ST
FLORAC CL
MIRIMAS CT
ST REMY LANE
VILLEFORT AV
VAUCLUSE CR
PLAZA TURN
THE PARKWAY
METRO TURN
TOME WAY
LIBRARY AV
SAN LORENZO BVD
TOULON LANE
COTTAGE CL
SCHOOL LANE
OVAL VSTA
RADIATA AV
SMOKE BUSH WAY
LATINA CR
VERDANT VSTA
SORRENTO TURN
TRIESTE AV
SANTONA BVD
VALINCO AV
BEAUFORTIA CR
ANGOPHORA AV
NAPOLI AV
PORTOFINO TURN
ROMA VSTA
GRANADA WAY
TORINO LANE
DRUMPELLIER DR
SANTORINI TURN
TRIGGER PLANT AV
TEA TREE LANE
SNOW WOOD AV
BRONZEWING AV
FRINGE LILY CR
STAR BUSH CR
WATTLEBIRD CR
PONTE VECCHIO BVD
WOODLAKE BVD
SUNRAY CIR
MILANO PDE
PISANO WALK
PALLADIO WALK
ARMANI WALK
FERRANTE AV
TARKINE LANE
PINEA TURN
PARROTBUSH CR
MONACO AV
PINASTER PDE
MILLSTREAM GR
SHERBROOKE RTT
TARANTO WAY
ROSSINI CIR
BELLINI AV
MIMOSA LANE
TANAMI CIR
SOLANUM CT
MARSALA WAY
FORESTVIEW BVD
MORTON AV
REGELIA TURN
JENOLAN LANE
KYEEMA WAY
HIBBERTIA PL
GNANGARA RD
PINE ST
WELARA CIR
BALUCHI WAY
BARRAMBIE WAY
LOSINO BVD
ANDREA DR
PETRANA PL
LORD ST
PINE ST

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Figure 4A : Vegetation Communities

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Legend

Project footprint

Study Area

Vegetation Communities

CcXpBm

Cleared

Landscaping

Mp/Mr

MpXpCa

Native Eucalypts over paddock

Planted

Vegetation Complexes

Bassendean complex - central and south

Southern River complex

A

B

C

D

HENLEY ST

ANDREA DR

HORSESHOE CCT

TOKARA AV

MARTINGALE AV

PINE ST

BROOKLANDS DR

LORD ST

DIANE PL

STARFLOWER PL

PARK ST

WHARTON PDE

LIVONIA ST

PARTRIDGE ST

HEATON RD

FAIRMOUNT BVD

BAISLEY LANE

HEISLER BVD

ARDWICK RD

SAVELLO PL

ASHBROOK LANE

CHARLTON WAY

STOVER LANE

PIEDMONT WAY

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Figure 4B : Vegetation Communities

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Legend

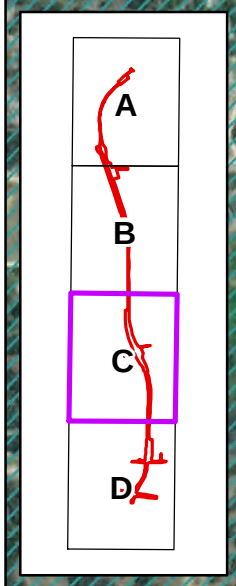
- Project footprint
- Study Area

Vegetation Communities

- CcXpBm
- CcXpPe
- Cleared
- ErAbLi
- Landscaping
- Mp/Mr
- MpAsPp
- MpXpCa
- Native Eucalypts over paddock
- Planted
- Water

Vegetation Complexes

- Southern River complex



WOOLLCOTT AV

PARTRIDGE ST

YOULE-DEAN RD

LORD ST

HARROW ST

REPTON ST

DULWICH ST

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Figure 4C : Vegetation Communities

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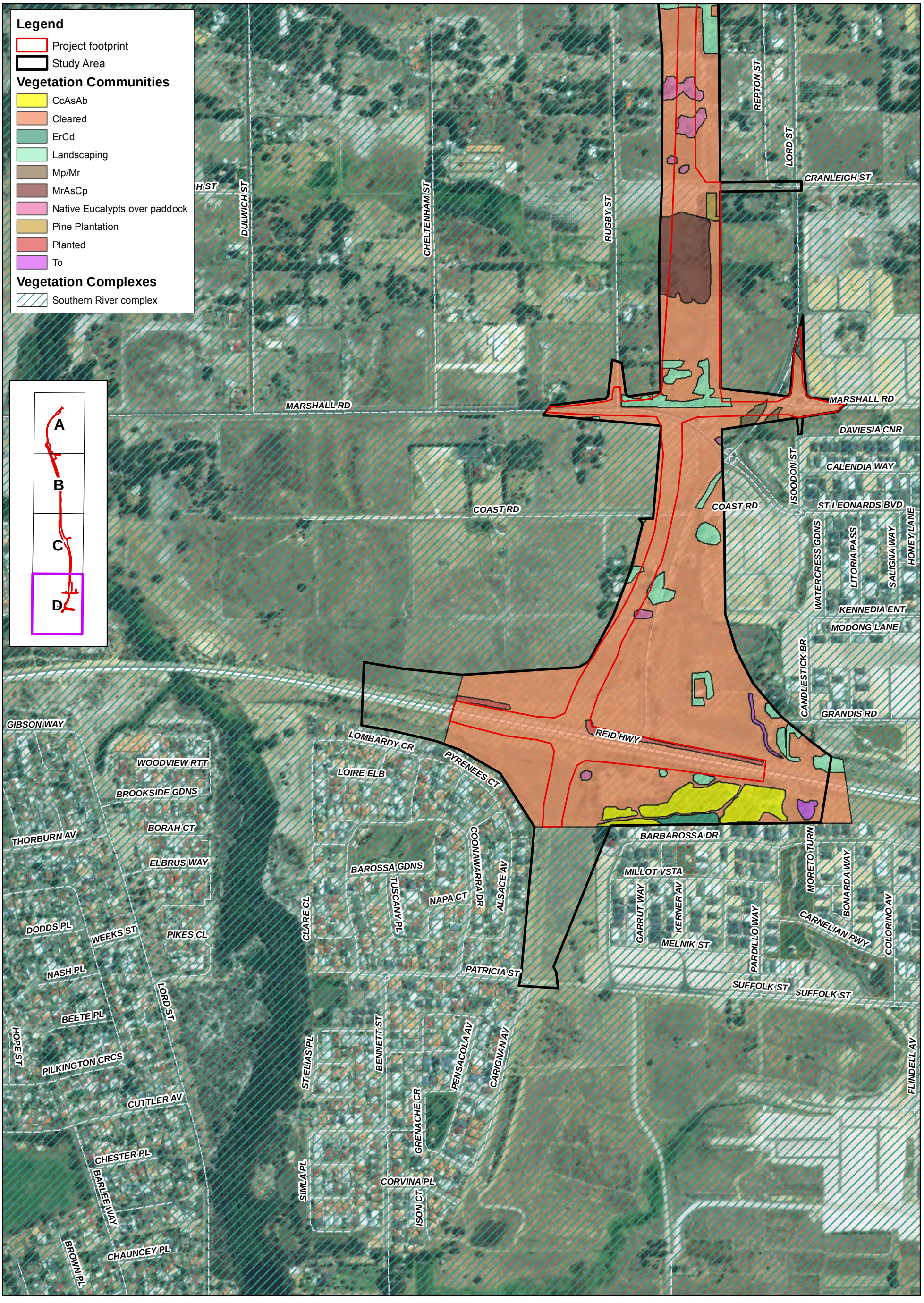

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Date: 13/06/2016 Version: 2 Job No: 247607

Coordinate System: GDA 1994 MGA Zone 50

MRWA Ellenbrook Bus Rapid Transit EIA and EMP

Figure 4D : Vegetation Communities

2.2.3.2.2 Threatened and Priority Ecological Communities

The desktop assessment identified two Threatened Ecological Communities (TEC) and one Priority Ecological Community (PEC) in close proximity to the study area. These are:

- Mound Springs SCP – Communities of Tumulus Springs (Organic Mound Springs, Swan Coastal Plain) – Critically Endangered
- Muchea Limestone – Shrublands and woodlands on Muchea limestone – Endangered
- SCP22 – *Banksia ilicifolia* woodlands and *Banksia attenuata* woodlands – Priority 3

A level 1 survey identified a TEC to the north east of the project footprint, with no TECs or PECs were identified in the study area during the field survey.

The area of land between the northern extent of the project footprint and the TEC has been developed for residential purposes.

These are depicted in Figures 4 and 5 of Appendix D.

2.2.3.3 Assessment of potential impacts to flora and vegetation

Clearing for the proposal will result in the removal of 21.1ha of remnant native vegetation. The remaining extent of the 56.8ha project footprint is cleared or introduced. 1.5ha remains unsurveyed; however this area appears to be largely cleared with limited remnant vegetation, coinciding with the Southern River vegetation complex.

The majority of native vegetation to be cleared is Marri/*Melaleuca preissiana* woodland, of which 2.1ha is considered to be in 'Good' to 'Very Good' condition (Table 7). This impact is not expected to be significant as these communities are not restricted and are well represented in conservation areas.

Vegetation clearing is predicted to result in the loss of 0.0% of Bassendean Complex North resulting in 71% of the pre-European extent remaining after the project. Bassendean Complex Central and South is already under-represented with a remaining extent of 26%. The project will result in additional loss of 0.02%, leaving 25.98% of the pre-European extent remaining. The Southern River Complex is also under-represented with current extent at 18%. Loss from the project will result in 0.08% loss, resulting approximately 17.92% of the Pre-European extent remaining after completion of the project.

There will be no impact to threatened or priority flora or ecological communities within proximity of the study area.

Impacts to flora and vegetation are unlikely to be significant given the extent of remnant native vegetation held within conservation areas and reserves.

Table 8 below provides an assessment of clearing against the ten clearing principles (DER 2016a).

Table 8 Assessment against ten clearing principles (DER 2016a)

Number	Clearing Principle	Status of variance	Justification
a)	**Native vegetation should not be cleared if it comprises a high level of biological diversity.**	Not at variance	The project footprint does not comprise vegetation of high biological diversity.
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.**	Not at variance	The project footprint does not comprise the whole or part of significant fauna habitat. While black cockatoos are known and likely to forage in the project footprint, the habitat is not likely to support a significant population, or breeding of these species.
c)	**Native vegetation should not be cleared if it includes, or is necessary for the continued existence of rare flora.**	Not at variance	There are no rare or priority flora within the surveyed portion of the project footprint
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.**	Not at variance	There are no TECs within the project footprint.
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.**	Not likely to be at variance.	The project footprint has been subject to substantial historical clearing. Three Heddle complexes occur within the footprint, two of which, Bassendean Complex Central and South, and Southern River both already underrepresented with only 26% and 18% remaining, respectively. The project will result in further loss of 0.02% and 0.08% loss respectively for these complexes from the 2015 extents.
f)	**Native vegetation should not be cleared if it is growing in, or in association with, an environment associated with a watercourse or wetland.**	Likely to be at variance.	The project footprint will intersect 0.5ha of vegetated Resource Enhancement Wetland and 10.2ha of vegetated Multiple Use wetland. Given the extent of the wetland outside of the project footprint, the vegetation

Number	Clearing Principle	Status of variance	Justification
			clearing is not expected to impact hydrological processes.
g)	**Native vegetation should not be cleared if the clearing of the vegetation is likely to cause appreciable land degradation.**	Not at variance	The project footprint, including the unsurveyed area, comprises predominantly already cleared land.
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.**	Not at variance.	The project will not impact on the environmental values of the adjacent Whiteman Park Bush Forever Site.
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.**	Not at variance	Clearing required for the project will not adversely affect groundwater or surface water quality.
j)	**Native vegetation should not be cleared if the clearing of the vegetation is likely to cause, or exacerbate, the incidence or intensity of flooding.**	Not at variance.	The project will not impact the incidence or intensity of flooding. Water sensitive urban design principles will be employed in the project design to ensure onsite infiltration of runoff.

2.2.3.4 Proposed management measures for flora and vegetation

The following management measure is recommended to manage impacts to flora and vegetation:

- During construction, clearing activities will be monitored to ensure they are restricted to within the project footprint which will be clearly marked.

2.2.4 Terrestrial fauna

2.2.4.1 EPA Objective for terrestrial fauna

The EPA objective for terrestrial fauna is identified below:

Table 9 EPA factor and objective for terrestrial fauna

Factor	Objective
Terrestrial Fauna	*To maintain representation, diversity, viability and ecological function at the species, population and assemblage level.*

2.2.4.2 Existing information on terrestrial fauna

A level 1 fauna survey was conducted in accordance with EPA Guidance Statement 56 (EPA 2004b) within a survey area which extends from the Ellenbrook Town Centre to Marshall Road and includes three proposed park and ride sites located at Marshall Road, Youle-Dean Road and Gnangara Road (AECOM 2016).

As indicated previously an area of 1.5ha of the project footprint remains unsurveyed; however aerial imagery indicates most of this area has been cleared and likely has very little fauna habitat value.

The survey included a desktop assessment of species and habitat likely to occur in the study area, comprising database searches using a 2km buffer and a review of previous studies. A field survey conducted on 22 and 29 October 2015 recorded direct and indirect fauna observations and potential fauna habitat. In addition, a targeted black cockatoo assessment (ground based) was undertaken, which identified direct observations, secondary evidence and potential habitat. Locations of sightings and habitat were recorded.

A total of 42 vertebrate fauna species were directly recorded during the field survey in the study area, including 33 birds, six mammals and three reptiles (AECOM 2016). A further five introduced fauna species were recorded including four declared pests. The complete list of fauna recorded in the AECOM survey is provided in Appendix D.

The desktop assessment and field survey identified six fauna species of conservation significance as recorded or likely to occur within the project footprint. These are identified in Table 10 below.

Table 10 Conservation significant species recorded or likely to occur within the study area (AECOM 2016)

Species	Conservation status WA	Conservation Status Australian Government	Habitat requirements and availability within project area	Recorded or likely to occur
Carnaby's Black Cockatoo *Calyptorhynchus latirostris*	Schedule 2 Endangered	Endangered	Uncleared or remnant eucalypt woodland including Salmon Gum, Wandoo and in shrubland or kwongan heath. Breeds in eucalypt woodland in large, tall, living or dead trees (DoE 2016a). Suitable foraging and potential breeding habitat occurs within study area.	Not recorded during October 2015 study. Likely to occur given availability of suitable habitat.
Forest Red-tailed *Black Cockatoo* *Calyptorhynchus banksia naso*	Schedule 3 Vulnerable	Vulnerable	Dense Jarrah, Karri and Marri forests receiving more than 600mm average annual rainfall. May occur in other forest and woodland types (DoE 2016b). Suitable foraging and potential breeding habitat	Recorded by direct observations and chewing evidence on Marri fruits.

Species	Conservation status WA	Conservation Status Australian Government	Habitat requirements and availability within project area	Recorded or likely to occur
			available within study area.	
Baudin's Black Cockatoo *Calyptorhynchus baudinii*	Schedule 2 Endangered	Vulnerable	Eucalypt woodland especially Jarrah, Marri and Karri. Breeding habitat occurs within far south west in areas with annual average rainfall above 750mm (DoE 2016c). Suitable foraging habitat occurs within study area.	Not recorded during October 2015 study (AECOM 2016). Previously recorded by Kinhill Engineers (1995) (cited in AECOM 2016). Likely to occur given availability of suitable foraging habitat.
Rainbow Bee-eater *(Merops ornatus)*	Schedule 5 Migratory bird under International Agreement	Migratory	Sandy banks near wetlands and sandy tracks in project area provide suitable habitat for nest construction.	Recorded by direct observations.
Western Brush Wallaby *Macropus irma*	P4 Rare, near threatened, or in need of monitoring	NA	Open forest or woodland, open seasonally-wet flats with low grasses and scrubby thickets (DEC 2012a)	Advice from Whiteman Park officers confirming presence within park (AECOM 2016). Likely to occur within study area.
Quenda *Isoodon obesulus* subsp. *fusciventer*	P4 Rare, near threatened, or in need of monitoring	NA	Dense scrub and understorey up to 1m of Eucalypt and Banksia woodlands, often associated with wetlands and vegetation (Bramwell 1998; DEC 2012b).	Advice from Whiteman Park officers (AECOM 2016) and numerous potential diggings observed within study area. Likely to occur.

The field survey also assessed fauna habitat values within the study area and identified eight fauna habitat types as described in Table 11 below. This table has been adapted from AECOM (2016).

Table 11 Habitat types and proposed extent of clearing within the study area and project footprint

Habitat	Extent within study area ha)	Extent within project footprint (ha)
Eucalypt/Marri woodland over introduced grasses	56.3	10.0ha plus 106 trees with DBH of 500mm or greater (5.4ha)
Melaleuca over introduced grasses	8.0	2.7
Melaleuca swampland	1.8	1.5
Melaleuca woodland	5.0	1.4
Pine plantation	4.0	1.2
Total fauna habitat	***75.1***	***22.1***
Planted/landscaping	8.4	3.6
Water	0.3	0.02
Cleared	91.7	29.5
Unsurveyed	9.7	1.5
Total	***185.2***	***56.8***

Identified fauna habitat totals 22.1ha. The majority of this habitat is Eucalypt/Marri woodland over introduced grasses, which may provide habitat to three species of black cockatoo, Rainbow Bee-eater and Quenda.

Only 2.1ha of the total extent of fauna habitat within the project footprint (22.1ha) is considered to be in 'Good' to 'Very Good' condition.

Figure 5 depicts fauna habitats and conservation significant fauna recordings in the project footprint.

2.2.4.3 Black cockatoo habitat assessment

A targeted black cockatoo habitat assessment was conducted (AECOM 2016) in accordance with the EPBC Act Referral guidelines for three threatened black cockatoo species (DSEWPaC 2012a). This identified a total of 10.0ha of potential foraging habitat including Marri/Melaleuca woodland for all three species of black cockatoo. A further 1.2ha of pine plantation provides a foraging source for Carnaby's Black Cockatoo and Baudin's Black Cockatoo (AECOM 2016); however, it is not utilised by Forest Red-tailed Black Cockatoo.

A total of 106 trees with DBH of 500mm or greater were identified within the project footprint. Three trees contain a hollow; however at the time of survey, one of these hollows was occupied by bees. Note that all three hollows had openings of 5cm or greater. The assessment did not include visual inspection of hollows, and as a result the depth of the hollows could not be measured.

No assessment of roosting sites was undertaken as part of the study.

Figure 6 depicts the location of potential black cockatoo breeding trees within the project footprint.

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Legend

- Project footprint
- Study Area

Fauna habitat mapping

- Banksia Woodland
- Cleared
- Eucalypt/Marri over introduced grasses
- Pine Plantation
- Planted Landscaping
- Planted/Landscaping

Significant Fauna

- Forest Red-tailed Black Cockatoo

DPaW Fauna Search Results

- Calyptorhynchus latirostris
- Isoodon obesulus fusciventer

A
B
C
D

HALPIN CIR
BARNFIELD DR
HALPIN CIR
GRANESSE DR
THE BROADWAY
FOSSIL LANE
INDEE LANE
IOWNA LANE
THUNDELARRA AV
COOLAMON BVD
KINCLAVEN LANE
THE PROMENADE
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VILLEFORT AV
VAUCLUSE CR
SAN LORENZO BVD
PLAZA TURN
THE PARKWAY
METRO TURN
TOME WAY
LIBRARY AV
COTTAGE CL
TOULON LANE
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VERDANT VSTA
SCHOOL LANE
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SORRENTO TURN
TRIESTE AV
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VALINCO AV
NAPOLI AV
PORTOFINO TURN
TORINO LANE
ROMA VSTA
GRANADA WAY
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MILANO PDE
PISANO WALK
PALLADIO WALK
ARMANI WALK
FERRANTE AV
MONACO AV
PINASTER PDE
MILLSTREAM GR
TARANTO WAY
ROSSINI CIR
BELLINI AV
MARSALA WAY
MIMOSA LANE
TANAMI CIR
JENOLAN LANE
MORTON AV
FORESTVIEW BVD
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ANDREA DR
PETRANA PL
PINE ST
BARRAMBIE WAY
LORD ST

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Figure 5A : Fauna habitat and conservation significant fauna

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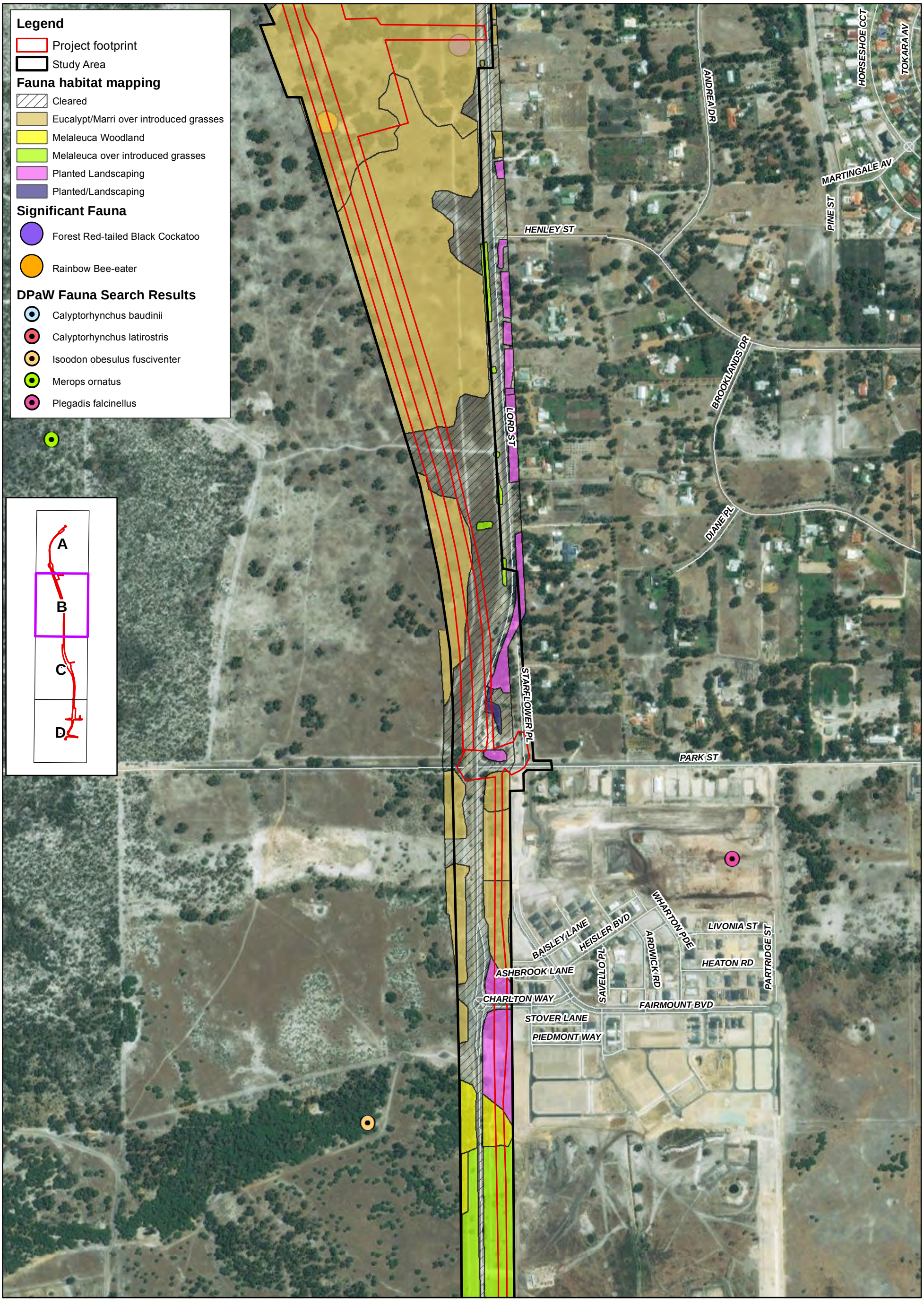

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Figure 5B : Fauna habitat and conservation significant fauna

aurecon

Legend

- Project footprint
- Study Area

Fauna habitat mapping

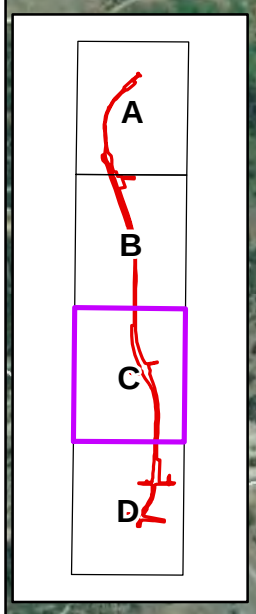
- Cleared
- Eucalypt/Marri over introduced grasses
- Melaleuca Woodland
- Melaleuca over introduced grasses
- Planted Landscaping
- Planted/Landscaping
- Swampland

Significant Fauna

- Forest Red-tailed Black Cockatoo

DPaW Fauna Search Results

- Calyptorhynchus latirostris
- Isoodon obesulus fusciventer



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DULWICH ST

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Date: 13/06/2016 Version: 2 Job No: 247607

Coordinate System: GDA 1994 MGA Zone 50

MRWA Ellenbrook Bus Rapid Transit EIA and EMP

Figure 5C : Fauna habitat and conservation significant fauna

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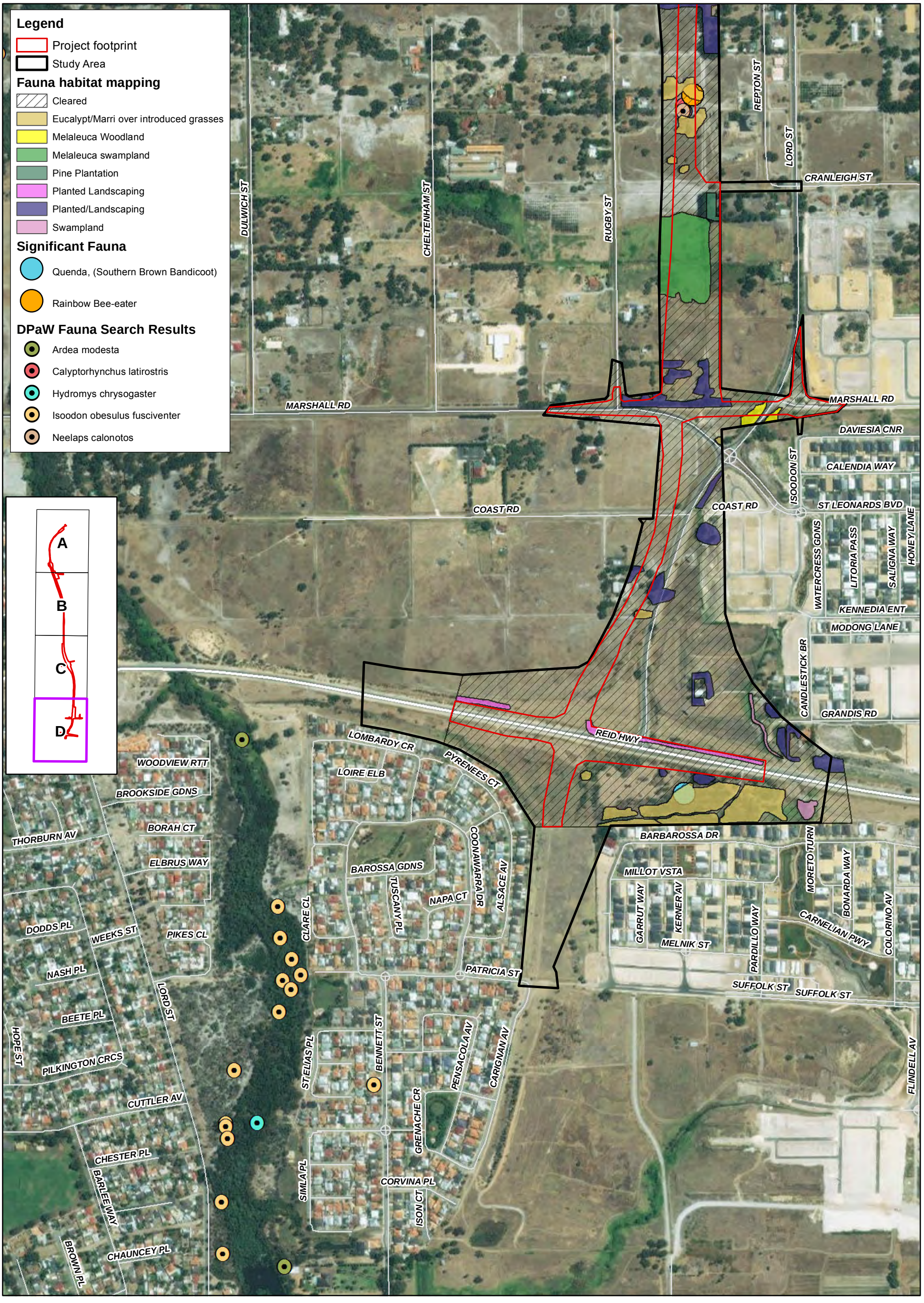

MRWA Ellenbrook Bus Rapid Transit EIA and EMP

Figure 5D : Fauna habitat and conservation significant fauna