Metropolitan Road Improvement Alliance

Clearing Permit Amendment Supporting Document

Armadale Road Upgrade – Tapper Road to Anstey Road

1 February 2018

Document Number
W81020-REP-EN-0701

REVISION RECORDING

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1 INTRODUCTION

1.1 Project Description

Main Roads Western Australia (Main Roads) is proposing to upgrade 7 km of Armadale Road between Tapper Road and Anstey Road in Forrestdale. Main Roads is upgrading this section of road to increase traffic capacities to better service the increasing growth and development in the area.

The project traverses the municipal areas of the City of Cockburn and the City of Armadale. The Project will consist of the construction of a four-lane dual carriageway between Anstey Road and Tapper Road. The road will include dedicated turning lanes, intersection improvements and a shared path for cyclists and pedestrians at the following roads:

- Nicholson Road, Forrestdale
- Wright Road, Piara Waters
- Ghostgum Avenue, Banjup
- Liddelow Road, Banjup
- Rossiter Avenue, Piara Waters.

Existing lighting and drainage will also be upgraded and some services relocated. The Project construction is anticipated to commence in the first half of 2018 in the area outlined in this amendment. The works will be undertaken by the Metropolitan Road Improvement Alliance (MRIA), which consists of CPB Contractors, Georgiou, WA Limestone, GHD, AECOM and BG&E, in partnership with Main Roads.

1.2 Purpose of this document

The clearing permit application (CPS 7623/1) was approved on the 24th October 2017 to clear 12.4 ha of native vegetation within and outside the current road reserve for the purpose of widening Armadale Road.

The recent modification made to the proposed design of Armadale Road has resulted in a larger Development Envelope, on this basis additional clearing is required. A total of 14.86 ha of native vegetation clearing will be required, resulting in an additional 2.46 ha of native vegetation clearing, above the previous approval.

The purpose of this document is to provide supporting information to amend the existing Clearing Permit, (CPS 7623/1) for the Project described above, and to present the results of the recent biological assessment (MRIA 2017) against the ten clearing principles as outlined in the (then) Department of Environment Regulation (DER) Guide to Assessment: Clearing of Native Vegetation under the *Environmental Protection Act 1986* (EP Act). This report identifies the potential environmental impacts associated with the Project based on the best available data. This NVCP amendment application will be submitted to the Department of Water and Environmental Regulation (DWER) for assessment.

1.3 Project Location and Footprint

The Project is located within the suburbs of Atwell and Banjup in the City of Cockburn, and Piara Waters and Forrestdale in the City of Armadale. Areas surveyed to date encompasses roadside native and non-native vegetation along Armadale Road from east of Tapper Road to Anstey Road.

The location of the Project in relation to the Perth Metropolitan region and surrounds is presented in the location Figure 1.

The original Clearing Permit application was based on a preliminary project design with the native vegetation within the footprint of that design approved for clearing. Due to changes in the design, the footprint has increased, as has the required clearing area. This is depicted in Figure 2. From herein, when referred to, the 'Development Envelope' refers to the updated area shown in red in Figure 2, unless otherwise explicitly stated.

The proposed additional Clearing Area of native vegetation as defined under the EP Act 1986 is 2.46 ha. The total clearing area of native vegetation for the entire project increases to 14.86 ha, in an overall Development Area of 68.38 ha. Herein, unless otherwise stated, the 'Clearing Area' refers to the additional clearing required to accommodate the recent design changes, as shown in dark blue in Figure 2.

2 ASSESSMENT METHODOLOGY

A summary of investigations undertaken to date is summarised below. The relevant information from each of these reports has been used to prepare this document, namely to determine the impacts as a result of the additional clearing (Clearing Area).

2.1 Desktop assessment

A desktop study, undertaken as part of the biological assessment conducted by Astron (2015) provided background information on the flora and vegetation of the Project based on the original Development Envelope. Database searches of the Australian Government EPBC Act Protected Matters Search Tool and Department of Parks and Wildlife (DPaW) Threatened and Priority Ecological Communities Database was undertaken as part of the biological assessment to identify potential Threatened Ecological Communities (TECs) or Priority Ecological Communities (PECs) that may be present in the Development Envelope.

Results of this assessment are detailed in Appendix 1 of Strategen 2017, which was submitted previously to DWER as part of the original clearing permit application.

A further desktop study was undertaken by MRIA in 2017 to gather background information and determine the appropriate level of survey. Sources used to inform the desktop study included government database search results and other publicly available sources and biological surveys undertaken in the local area, including:

- WA Herbarium database
- Protected Matters Search Tool (Appendix 1)
- Naturemap (Appendix 1)
- Armadale Road Duplication Biological Assessment (Astron, 2015)
- Armadale Road Duplication Environmental Impact Assessment (Strategen, 2017)
- Armadale Road to North Lake Road Bridge (MRIA, 2017a)
- Karel Avenue Upgrade (MRIA, 2017b)
- Kwinana Freeway Widening (MRIA, 2017c).

The search results were reviewed to assess the potential presence of conservation significant environmental values (Figure 3 and Figure 4) and are discussed further in Section 3.

2.2 Flora Vegetation and Fauna Surveys

2.2.1 Original Development Envelope

The investigations summarised in this section were undertaken as the preliminary design was developed. Each investigation had a defined survey area, and are not necessarily consistent. For the precise survey areas, please see the investigations within the appendices.

2.2.1.1 Level 2 Vegetation and Flora Survey and Level 1 Fauna Survey 2015

Astron conducted a Level 2 vegetation and flora survey, and a Level 1 fauna survey in 2015 for the original Development Envelope. The surveys assessed key flora, fauna, soil, groundwater and surface water values and potential sensitivity to impact within a 50 m buffer of the existing road and along a 400 m length of all side roads.

Key findings across the study area of the original Development Envelope include:

- three vegetation associations identified within the survey area
- twenty-seven introduced (weed) species identified within the survey area
- one conservation significant fauna species identified in the survey area; Forest Red-tailed Black Cockatoo
- limited foraging habitat present for Black Cockatoo species
- no potential breeding or roosting trees for Black Cockatoo species identified within the survey area.

The report concluded that targeted flora surveys are required for select flora species, several wetlands within and adjacent to the original Development Envelope should be surveyed and an ASS investigation is required pending the amount of excavation and dewatering required for the construction works.

Results of this assessment can be found in Appendix 1 of Strategen 2017.

2.2.1.2 Targeted Survey and Black Cockatoo Habitat Assessment 2016

A supplementary vegetation survey was completed in 2016 by Strategen, this report detailed the results of a Level 1 flora and vegetation survey (to supplement the Level 2 survey undertaken by Astron), a targeted survey for *Drakaea elastica* and a Black Cockatoo habitat assessment.

The EIA (Strategen 2017) outlined the following findings:

- four vegetation associations were identified within this survey area (including the reclassified Astron vegetation); however the majority of the survey area is cleared or planted with exotic species
- no individuals of the rare orchid species *Drakaea elastica* were located within the *Kunzea glabrescens* tall shrublands targeted as part of this survey
- approximately 4.85 ha of moderate quality foraging habitat for Carnaby Black Cockatoo was identified within the additional survey area. No significant trees for Black Cockatoos were recorded during the survey, although potentially significant trees may be present within private property.

The area surveyed in this assessment includes the additional proposed Clearing Area that is the subject of this application. Results of this assessment can be found in Appendix 2 of Strategen 2017.

2.2.1.3 Level 1 Vegetation Survey 2017

Strategen undertook an additional Level 1 vegetation survey on 5 April 2017 to assess the Vegetation associations present in areas of the original clearing permit application area, but outside areas of the previous study summarised in section 2.2.1.1. The vegetation survey also validated the findings of a number of areas Strategen (2017) identified as Banksia Woodland. Results of this assessment can be found in Strategen 2017.

2.2.2 Additional Clearing Area

2.2.2.1 Detailed Flora and Vegetation Assessment 2017

MRIA completed a detailed flora and vegetation assessment to determine the environmental value of native vegetation present in the Clearing Area and its surrounds. The methodology for this assessment included the establishment of permanent quadrats. In particular, the presence of the Banksia Woodland of the Swan Coastal Plain (Banksia Woodland) TEC, and potential for PECs and conservation significant flora species, warranted a detailed field survey. This survey also validated the findings of vegetation condition and types from earlier studies where present within the Clearing Area.

A targeted survey was undertaken for *C. huegelii* in Banksia woodland vegetation within the survey area.

Key outcomes of the survey:

- Three locations mapped containing Banksia Woodland TEC.
- Bush Forever Site 344 is within the survey area mapped as between Good and Degraded condition.
- No Threatened or Priority species were recorded in the detailed flora and vegetation assessment survey area.
- One individual *C. huegelii* was recorded within the targeted flora survey area, however this is outside the proposed additional Clearing Area.
- Twenty-three introduced species were recorded from the survey area. Of these one species is listed as Declared Pests, namely Arum Lily (**Zantedeschia aethiopica*).

Results of this assessment can be found in Appendix 2.

2.2.2.2 Targeted Black Cockatoo Survey 2017

A targeted Black Cockatoo survey was conducted by MRIA to identify potential breeding, roosting and foraging habitat for the two threatened Black Cockatoo species that are likely to occur in the additional proposed Clearing Area, as well as that surrounding it.

- Only one tree contained potential hollows, though these were assessed as not being suitable for use by breeding Black Cockatoos.
- Potential roosting trees were searched for and assessed during the field survey and no confirmed roosting sites were identified.
- The area surveyed contains foraging habitat for Carnaby's and Red-tail Cockatoos.

Throughout this assessment, 'native' vegetation included both that as defined in the EP Act, and planted native species. Therefore the latter have been excluded in this document based on the vegetation condition assessment undertaken in Appendix 2.

Results of this assessment can be found in Appendix 3.

3 EXISTING ENVIRONMENT

3.1 Conservation areas

A total of six Bush Forever sites occur within the vicinity of the Development Envelope (Figure 3), of which two intersect the Clearing Area. A total of 0.60 ha of Bush Forever will be cleared as follows:

Table 1 Bush Forever within Clearing Area

Bush Forever Site	Site number	Clearing Area (ha)
Gibbs Road Swamp Bushland, Banjup/Forrestdale	344	0.03
Fraser Road Bushland, Banjup	390	0.57

3.2 Wetlands

The Project area does not intersect any wetlands on the List of Wetlands of International Importance under the Convention on Wetlands (Ramsar), (Strategen 2017). However, Forrestdale Lake, approximately 250 m south of the eastern end of the survey area, is listed as a Ramsar site, together with Thomsons Lake, number 481 (Australian site number 35) (DotEE 2018).

The Clearing Area only intersects two Geomorphic Wetlands, both of which are classified as Resource Enhancement. 0.02 ha of vegetation is proposed to be cleared within wetland UFI 7215, which is in a laydown area for the existing Water Corporation facility. 0.15 ha of native vegetation within wetland UFI 15297 is proposed to be cleared. This vegetation has been classified as 'Degraded'. The surrounding Geomorphic Wetlands in relation to the project are displayed in Figure 3.

3.3 Broad vegetation mapping

There are 53 IBRA subregions in Western Australia, of which, the Development Envelope occurs within the Swan Coastal Plain IBRA region, comprising an area of approximately 1,501,221 ha (Mitchell et al, 2002); of pre-European vegetation, of which approximately 579,161 ha is currently remaining, comprising 38.6% (as presented in Table 2).

The Swan Coastal Plain IBRA region is dominated largely by Banksia or Tuart on sandy soils, *Casuarina obesa* on outwash plains and paperbark in swampy areas (Mitchell et al, 2002). The Swan Coastal Plain rises to duricrusted Mesozoic sediments dominated by Jarrah woodland in the east (Mitchell et al, 2002). Vegetation and soil associations typically include, heath and/or Tuart woodlands on limestone, Banksia and Jarrah-Banksia woodlands on Quaternary marine dunes, Marri on colluvial and alluvial soils (Mitchell et al, 2002). The sub-region exhibits a Mediterranean climate with rainfall ranging between 600 and 1,000 mm annually (Mitchell et al, 2002).

The City of Cockburn and the City of Armadale have a total of 28.02% and 77.05% of the pre-European vegetation remaining, comprising approximately 4,138 ha and 43,002 ha respectively.

The Development Envelope occurs within the South-west Botanical Province which has been subject to extensive biological survey at both the regional and local scale. Key Western Australian regional mapping undertaken includes Beard (1981) and Heddle et al (1980).

Table 2 includes a summary of broad-scale vegetation mapping and current percentage remaining of each association.

Table 2 Broad-scale vegetation mapping

Broad Scale Mapping	Association	Pre-European (ha)	Current extent (ha)	% remaining	% remaining in DPAW reserves
	Swan Coastal Plain	1 501 221.93	579 161.92	38.58	10.19
Local Government Authority	City of Cockburn	14765	4138.40	24.02	13.06
	City of Armadale	55 812	43 002.54	77.05	10.44
Heddle Vegetation Complex (2013 extent)	Bassendean complex – Central and South	87 392.73	24 206.24	27.70	0.79
	Southern River Complex	57 171.55	11 254.99	19.69	1.31
Beard vegetation mapping (1981)	Medium very sparse woodland; jarrah, with low woodland; Banksia and Casuarina (1001)	57 410.23	12 879.81	22.43	2.80
	Medium woodland; jarrah, marri and wandoo (968)	296 715.07	95 731.63	32.26	1.17

3.4 Site vegetation types and condition

3.4.1 Vegetation Type

Six vegetation types were recorded, mapped and described in the Clearing Area. This includes three native and two degraded vegetation types (Figure 5). Vegetation types include:

- Two Banksia Woodlands, BaHhBm and BaBm
- One wetland, MpKgLs
- Two considerably degraded communities, Kg and Trees

Banksia Woodlands BaHhBm was identified as significant during the first field survey and therefore represented by three permanent quadrats. This community represents FCT23a Central *B. attenuata – B. menziesii* Woodlands and the Banksia Woodlands TEC listed as Endangered under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) and Priority 3 by the Department of Biodiversity, Conservation and Attractions (DBCA). This community was mostly in Very Good condition. A total of 1.37 ha of this community will be cleared.

Banksia Woodland BaBm was mapped at one location (north west of the intersection of Warton Road and Nicholson Road) supporting Degraded native vegetation with significant weed invasion from the edges. The recent construction of a limestone track and fencing has led to further degradation of this vegetation type within the application area. Historical aerial imagery and species present indicates potential natural drainage attributes of this area. It is likely that the patch used to represent an ecotone of wetland fringing vegetation associated with the wetland south of Armadale Road, and the upland Banksia Woodland. Due to the Degraded nature of the site, it is not considered significant. A total of 0.04 ha is in the Clearing Area.

The wetland unit MpKgLs occurs at two wetlands. Both locations were historically cleared and significantly burnt in the past. Vegetation within these patches represent regrowth from approximately 1995 which has resulted in dense colonising species such as *Kunzea glabrescens* and weeds (**Ehrharta calycina*). Vegetation at this site is approximately 22 years old and is not considered significant. A total of 0.52 ha will be cleared.

0.32 ha of *Kunzea glabrescens* tall open scrub is inside the Clearing Area. This vegetation type was Degraded and is not considered significant.

Trees over paddock were also identified in the Clearing Area.

A summary of the vegetation units impacted by the Clearing Area is summarised in the table below.

Table 3 Vegetation Units Impacts

Vegetation Unit	Clearing Area (ha)
BaHhBm	1.372
BaBm	0.039
MpKgLs	0.516
Mp	0.003
Kg	0.317
Trees over paddock	0.216
Total	2.46*

* Rounded to the nearest two decimal place

The Clearing Area was determined based on the Vegetation Type mapping within the footprint of the Development Envelope which was not considered as part of the original Clearing Permit application.

Vegetation types, their descriptions and mapping codes, survey effort, extent, species richness and photographs are presented in the Detailed Flora and Vegetation Assessment 2017 (Appendix 2).

3.4.2 Vegetation Condition

Vegetation condition ranged from Completely Degraded to Very Good. Vegetation condition was predominantly a result of historical clearing for urban development (residential, roads, light industrial). The impact of this disturbance includes edge effects from weeds, rubbish, and erosion. A summary of the vegetation condition impacted by the Clearing Area is detailed in the table below and displayed in Figure 6.

Table 4 Vegetation Condition Impacts

Vegetation Condition	Clearing Area (ha)
Completely Degraded	0.216
Degraded	1.057
Good	0.378
Good to Very Good	0.003

Vegetation Condition	Clearing Area (ha)
Very Good	0.809
Total	2.46*

* Rounded to the nearest two decimal place

Vegetation condition, descriptions, survey effort, extent and photographs are presented in the Detailed Flora and Vegetation Assessment 2017 (Appendix 2).

3.5 Threatened / priority ecological communities

3.5.1 Desktop Assessment

Two Threatened Ecological Communities (TECs) were mapped as occurring within the Clearing Area including the Banksia Woodlands of the Swan Coastal Plain (Banksia Woodlands), and the Claypans of the Swan Coastal Plain (Claypans). These communities are defined further below.

The desktop study results show the Banksia Woodlands of the Swan Coastal Plain TEC (Banksia Woodlands TEC) has been mapped within the survey area. The mapping of the Banksia Woodland TEC is based on the Commonwealth's 'likely to occur' areas and incorporates broad-scale mapping of areas most likely to contain the TEC. The desktop results are therefore an indicative distribution.

The Banksia Woodlands TEC was listed under the EPBC Act as Endangered on 16 September 2016. The community incorporates woodland of Banksia species with scattered Eucalypts and other tree species over a species rich mix of sclerophyllous shrubs, graminoids, and forbs. The community shows high endemism and considerable local variation in species composition across its range. It is restricted to the southwest of WA on the Swan Coastal Plain. It occurs mainly on deep Bassendean and Spearwood sands or occasionally on Quindalup sands.

The Banksia Woodlands TEC relates to three Threatened communities at the State-level and eight Priority Ecological Communities (PECs). Two of these PECs were identified in the desktop study as likely to occur and one was mapped as present.

The Claypans TEC, considered Critically Endangered under the EPBC Act, is mapped over the eastern edge of the survey area east of Anstey Road. Two state listed TECs are associated with this federal Claypans TEC; Herb Rich Shrublands in Clay Pans (Vulnerable) and Dry Clay Flats (Endangered). Both of theses TECs were considered unlikely to occur in the desktop assessment. The Claypans TEC is associated with native vegetation within and adjacent to Forrestdale Lake Nature Reserve and Bush Forever Site 345. The TECs and PECs descriptions, their relationship to EPBC Act-listed communities, conservation status and likelihood of occurrence assessment is presented in the Detailed Flora and Vegetation Assessment (Appendix 2 - Table 10 and mapped in Figure 4).

3.5.2 Field Survey Results

During the Detailed Flora and Vegetation Assessment one TEC listed as Endangered under the EPBC Act was recorded in the survey area. A comprehensive assessment for determining the presence of the Banksia Woodlands of the Swan Coastal Plain TEC (Banksia Woodlands) was applied to three patches of Banksia Woodland:

- Patch 1 Jandakot Regional Park
- Patch 2 Rose Shanks Reserve (southeast corner)

- Patch 3 Bush Forever Site 344 northern boundary.

At a State level, the three patches are considered a Priority 3 ecological community "Banksia Dominated Woodlands of the Swan Coastal Plain IBRA Region".

The total extent of Banksia Woodland Endangered TEC and Priority 3 PEC within the survey area is 1.06 ha, (Figure 7). The detailed Banksia Woodland TEC assessment for the three patches is provided in Appendix 2.

3.6 Conservation significant flora

3.6.1 Desktop assessment

A comprehensive desktop assessment of conservation significant flora and an evaluation of their occurrence likelihood has been completed, based on database searches and previous biological surveys undertaken in the vicinity of the Threatened and Priority flora species, which have been historically recorded in the vicinity of the survey area, this is presented in Appendix 2 (Table 11). The only threatened species under the WC Act and EPBC Act determined likely to occur within the Clearing Area was the *C. huegelii.* Seven priority flora species were also determined as likely to occur.

3.6.2 Field Survey Results

A targeted survey was undertaken for *C. huegelii* in Banksia woodland vegetation within the Clearing Area and surrounds. Prior to commencing the survey, known populations of *C. huegelii* were checked for flowering. This included a large population in bushland east of the project area; south east of Jandakot Road and Ghostgum Avenue in Jandakot and a smaller population east of Roe Highway and north of Brookfield Rail in Jandakot. When at least 60% of the populations were observed in flower the targeted survey was undertaken. Checks of known populations were undertaken on the following dates:

- 7 September – Jandakot Airport 'Industrial Park' population (DBCA population 56); leaves present near markers and population not flowering
- 13 September – Jandakot Airport 'Industrial Park' population (DBCA population 56); leaves present near markers, flower stalk present on one plant and population not flowering
- 19 September – Jandakot Airport 'Industrial Park' population (DBCA population 56); leaves present near markers, flower stalk present on one plant and population not flowering. Fraser Road population (DBCA population 42) mostly in flower (>80%). Survey was commenced.

No Threatened or Priority species were recorded in the Clearing Area during Spring 2017 (Appendix 2). One individual *C. huegelii* was found outside the Clearing Area near Ghostgum Avenue (Figure 8).

3.7 Weeds

Twenty-three introduced species were recorded from the survey area, which includes the Clearing Area. Of these, one species is listed as a Declared Pest, namely Arum Lily (**Zantedeschia aethiopica*). Declared Pests are listed under the *Biosecurity and Agricultural Management Act 2007* (BAM Act). Pursuant to the BAM Act, these species are subject to restrictions on movement or sale and landholders are obliged to carry out control measures to prevent their spread. The management of this weed, as well as others not listed as Declared Pests, will be incorporated within site management procedures.

3.8 Fauna

3.8.1 Fauna habitat

Three broad fauna habitat were identified within the Clearing Area (Figure 9) during the MRIA 2017 survey (Appendix 3), these comprised:

- Wetlands and Riparian Vegetation (0.52 ha) – this predominantly includes varied density Paperbark and other riparian vegetation
- Woodland (1.69 ha) - this habitat varies from moderate canopy cover, good quality Banksia, Sheoak and Jarrah woodland, to very open and degraded woodlands which contain occasional small trees and minimal groundcover
- Isolated Trees over Paddock – (0.22 ha) – this generally comprises cleared areas with scattered large mature native or introduced trees

The remaining footprint within the Development Envelope not previously considered as part of the original clearing permit application consists of planted vegetation and predominately cleared areas.

Fauna habitat condition varies considerably throughout the Clearing Area. Intact vegetation communities were generally considered to be in Good condition, while areas which had been cleared, partially cleared or were adjacent to cleared areas were generally in Degraded condition.

3.8.2 Conservation significant fauna

3.8.2.1 Desktop assessment

Threatened fauna species identified in Strategen (2017) that have been recorded in proximity to the Clearing Area comprise:

Invertebrates:

- Bee *(Leioproctus contrarius*) (Priority 3)

Vertebrates:

- Great Egret (*Ardea modesta*) (Migratory)
- Red-necked Stint *(Calidris ruficollis)* (Migratory)
- Rainbow Bee-eater (*Merops ornatus*) (Migratory)
- Glossy Ibis (*Plegadis falcinellus*) (Migratory)
- Carnaby's Cockatoo (*Calyptorhynchus latirostris*) (Threatened)
- Forest Red-tailed Black Cockatoo (*Calyptorhynchus banksii* subsp. *Naso*) (Threatened)
- Quenda (*Isoodon obesulus* subsp. *Fusciventer*) (Priority 4)
- Perth Lined Skink (*Lerista lineata* (Priority 3)
- Numbat (*Myrmecobius fasciatus*) (Threatened).

Six of the identified species are likely to occur within the Clearing Area, as defined in Table 5 Conservation Significant Fauna Species Likely to Occur within the Clearing Area.

Table 5 Conservation Significant Fauna Species Likely to Occur within the Clearing Area

Species	Common Name	Conservation Code		Ecology
		Commonwealth	State	
Ardea modesta	Great Egret	Migratory	IA	The Great Egret occupies a wide variety of wet habitats including freshwater wetlands, dams, flooded pastures, estuarine mudflats, mangroves and reefs (Morcombe, 2003). The species is also known to visit shallows of rivers, sewage ponds and irrigation areas (Pizzey & Knight, 2007).
Calyptorhynchus banksii naso	Forest Red-tailed Black Cockatoo	Vulnerable	VU	The Forest Red-tailed Black Cockatoo requires tree hollows of Karri (*Eucalyptus diversicolor*), Jarrah (*E. marginata*) and Marri (*Corymbia calophylla*) forests to nest and breed. Flocks move out onto the Swan Coastal Plain in search of food from exotic trees such as the White Cedar (Johnstone *et al.*, 2010). The foraging habitat for the species consists of Jarrah and Marri woodlands and forest within its range.
Calyptorhynchus latirostris	Carnaby's Cockatoo	Endangered	EN	Carnaby's Cockatoo is a postnuptial nomad and typically moves west soon after breeding. The species nests in hollows of smooth-barked eucalypts, particularly Salmon Gum (*Eucalyptus salmonophloia*) and Wandoo (*E. Wandoo*) but is not limited to these eucalypts. Diet consists of an array of Proteaceous and *Eucalyptus* species prevalent on the Swan Coastal Plain. Foraging habitat, including *Banksia* woodlands, is considered to be habitat critical to the survival of the species (Johnstone *et al.,* 2010).
Isoodon obesulus fusciventer	Quenda	-	P4	The Quenda or Southern Brown Bandicoot exists only in a fragmented distribution to its former range in southern south western and eastern Australia. It is found in forest, woodland, heath and shrub communities in these regions. Preferred habitat usually consists of a combination of sandy soils and dense heathy vegetation (Van Dyck & Strahan, 2008).
Lerista lineata	Perth Lined Skink	-	P3	The Perth Lined Lerista is an underground dwelling skink, sheltering in leaf litter and upper layers of loose soil. It is typically found at the bases of shrubs, spoil heaps and stick ant nests (Bush *et al,* 2010). The species inhabits sandy soils supporting Eucalypt/*Banksia* woodland, coastal heath and low shrubland (Bush *et al,* 2010; Wilson and Swan, 2010).
Merops ornatus	Rainbow Bee-eater	Marine	IA	The Rainbow Bee-eater is a common species which occupies numerous habitats including open woodlands with sandy loamy soil, sand ridges, sandpits, riverbanks, road cuttings, beaches, dunes, cliffs, mangroves and rainforests. It is possible that this species will occupy open and disturbed areas within the Survey Area. The Rainbow Bee-eater avoids heavy forest that would hinder the pursuit of its insect prey (Morcombe, 2003).

Migratory species such as the Great Egret (*Ardea modesta*), Red-necked Stint (*Calidris ruficollis*), Rainbow Bee-eater (*Merops ornatus*) and Glossy Ibis (*Plegadis falcinellus*) are likely to be occasional visitors to the area, particularly wetland and riparian vegetation.

Quenda (*Isoodon obesulus* subsp. *Fusciventer*) (Priority 4) are considered likely to occur. Isolated trees over paddock are considered to have limited habitat value to this species. The Clearing Area has 2.21 ha of habitat suitable for Quenda.

3.8.2.2 Field Survey Results – Black Cockatoo

The results from the targeted Black Cockatoo Survey are summarised below, and displayed in Figure 10 and Figure 11. The detailed assessment is provided in Appendix 3.

Breeding Habitat

The Black Cockatoo breeding habitat assessment focussed on quantifying potential breeding trees (DBH >500 mm DBH and *E. wandoo* DBH >300 mm) and breeding trees (trees containing potentially suitable hollows) within the Clearing Area. There are two native eucalypts with a DBH > 500mm within the Clearing Area, neither of these had hollows.

Roosting Habitat

Carnaby's Cockatoo typically roosts in or near riparian environments or near other permanent water sources. The Forest Red-Tailed Black Cockatoo prefers the edges of forests for roosting (DotEE, 2017). Potential roosting trees were searched for and assessed during the field survey and no confirmed roosting sites were identified.

Foraging Habitat

The quality of foraging habitat not only reflects the availability of food sources, but also the proximity to reliable water sources, connectivity to other suitable habitat, presence of potential breeding trees, and proximity to confirmed roost and breeding sites (amongst others). These parameters were utilised by the DotEE to produce a draft quality of foraging habitat scoring system (DotEE 2017). This scoring system was utilised to assess potential foraging habitat for each Black Cockatoo species. A total of 2.08 ha of Black Cockatoo foraging habitat is present within the Clearing Area.

4 ASSESSMENT AGAINST THE 10 CLEARING PRINCIPLES

The proposed clearing activities have been assessed against the ten clearing principles as defined in DWER's Guide to Assessment: Clearing of Native Vegetation under the *Environmental Protection Act 1986*, taking into account the current extent and condition of the native vegetation on the site. This assessment is presented in Table 6.

Table 6 Assessment against the 10 Clearing Principles

Background	Source/Tools for Assessment	Conclusion
Principle (a) - Native vegetation should not be cleared if it comprises a high level of biological diversity.		
A detailed flora and vegetation survey was conducted of the Clearing Area (MRIA, 2017d). The Clearing Area is characterised by numerous slivers and small patches restricted to the edge of the road reserve along Armadale Road comprising 2.46 ha of vegetation. Vegetation communities included 1.41 ha of Banksia Woodlands (types BaBm and BaHhBm), 0.52 ha of Wetland that has been historically cleared (type MpKgLs), 0.53 ha of significantly degraded/altered vegetation. A comprehensive assessment against the key diagnostic criteria outlined in the Conservation Advice was undertaken, confirming that both Banksia Woodland vegetation types are representative of the Endangered Banksia Woodlands of the Swan Coastal Plain TEC. A total of 1.06 ha of this TEC will be directly impacted as a result of the proposal. Vegetation condition was mapped mostly as Degraded (43%), followed by Very Good (33%).	*Technical Guide Flora and Vegetation Assessment – EPA, 2016a* *Armadale Road Upgrade Detailed Flora and Vegetation Assessment, 2016* *Armadale Rd Duplication EIA, Strategen 2017* *Banksia Woodlands Conservation*	***The proposal is likely to be at variance with this clearing principle***

Background	Source/Tools for Assessment	Conclusion
The majority of vegetation within the Clearing Area has been degraded as a result of historical clearing, edge effects, erosion and weed invasion. No Threatened or Priority flora species were recorded within the Clearing Area in the spring survey. One individual *Caladenia huegelii* has been identified in the vicinity of the Project but is more than 100 m outside the Clearing Area. 0.60 ha of native vegetation within the Clearing Area is within Bush Forever, including 0.03 ha within Site 344 and 0.57 ha within Site 390. Based on the information presented above, there are isolated patches within the Clearing Area that contain a high level of biodiversity, particularly in areas that represent the edge of a larger area of remnant native vegetation that act as a buffer to protect areas of high biodiversity. However they are small, and surrounded by degraded/cleared land. Therefore, the proposed clearing may be at variance with this Principle.	*Advice (TSSC, 2016)*	
Principle (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		
The desktop survey of the project area identified five fauna species likely to occur, including: • Great Egret (*Ardea modestra*) – listed as Migratory under the EPBC Act and International Agreements under the WC Act • Carnaby's Cockatoo (*Calyptorhynchus latirostris*) – listed as Endangered under the EPBC Act and under the WC Act • Forest Red-tailed Black Cockatoo (*Calyptorhynchus banksii naso*) – listed as Endangered under the EPBC Act and under the WC Act • Quenda (*Isoodon obesulus fusciventer*) – listed on the DBCA Priority fauna list • Perth Lined Skink (*Lerista lineata*) – listed on the DBCA Priority fauna list • Rainbow Bee-eater (*Merops ornatus*) – listed as Marine under the EPBC Act and International Agreements under the WC Act. The Clearing Area includes breeding and foraging habitat for Carnaby's Black Cockatoo and Forest Red-tailed Black Cockatoo. Two potential breeding trees were identified, neither contained hollows. A total of 2.08 ha of foraging habitat for Carnaby's Cockatoo is in the Clearing Area, including 1.37 ha considered 'Quality' or 'High' represented by Banksia Woodlands. Carnaby's Cockatoo foraging evidence was recorded twice within the Clearing Area. The Clearing Area contains 1.47 ha of suitable foraging habitat for the Forest Red-tailed Black Cockatoo, with 0.88 ha of 'Quality' or 'High' foraging habitat available. This is represented by Banksia Woodlands habitat. An additional 0.59 ha of lower quality	*Armadale Rd Duplication EIA, Strategen 2017* *Technical Guide – Fauna Surveys, EPA 2016b* *Referral Guidelines for Threatened Black Cockatoo Species – DoEE 2012*	***The proposal is at variance with this clearing principle***

Background	Source/Tools for Assessment	Conclusion
foraging habitat was recorded, representing isolated slivers of Woodland and Isolated Trees. The condition and quality of the habitat and the presence of potential breeding trees, means that the clearing is at variance with this Principle.		
Principle (c) - Native vegetation should not be cleared if it includes or is necessary for the continued existence of, rare flora.		
No species listed as Declared Rare Flora or Threatened (T or X) under the WC Act or Threatened under the EPBC Act were recorded from within the Clearing Area. A known population of the Threatened *Caladenia huegelii* has been recorded within 300 m of the proposed Clearing Area. Population #42 occurs within Jandakot Regional Park, extending south along Ghostgum Avenue to Armadale Road. One individual population was recorded within 50 m of Ghostgum Road in Banksia woodland on grey deep sandy soils. This is more than 100 m from the Clearing Area. The wider area of Banksia Woodland supports hundreds of plants (DEC 2009). Habitat critical to the survival of this species includes the area of current occupancy of important populations and areas of similar habitat surrounding important populations (DEC 2009). The Clearing Area includes 0.3 ha of Banksia woodland located within 300 m of the known population. This woodland comprises a narrow linear corridor of degraded remnant vegetation nested between a cleared extraction area and Armadale Road. It is unlikely that this patch would qualify as habitat critical to the survival of the species due to its size and the surrounding land uses which result in degradation and edge effects. Based on the above information, no clearing of habitat considered critical habitat for the survival of *C. huegelii* will be cleared for the Project.	*Armadale Road Upgrade Detailed Flora and Vegetation Assessment, 2016* *Armadale Rd Duplication EIA, Strategen 2017* *Caladenia huegelii Recovery Plan, DEC 2009*	***The proposal is not likely to be at variance with this clearing principle***
Principle (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.		
The flora and vegetation assessment identified the Banksia Woodland of the SCP TEC to occur within the survey area. This TEC is also representative of state PEC "Banksia Dominated Woodlands of the Swan Coastal Plain IBRA Region". The TEC is represented by vegetation types BaHhBm and BaBm. A total of 1.06 ha of this TEC will be cleared.	*Armadale Road Upgrade Detailed Flora and Vegetation Assessment, 2016* *Armadale Rd Duplication EIA, Strategen 2017*	***The proposal is at variance with this clearing principle***
Principle (e) - Native vegetation should not be cleared if it is significant as a remnant of native vegetation in an area that has been significantly cleared.		
The National Objectives and Targets for Biodiversity Conservation 2001-2005 (Commonwealth of Australia, 2001)	*Armadale Road Upgrade Detailed Flora and*	***The proposal is unlikely to be at***

Background	Source/Tools for Assessment	Conclusion
recognises that the retention of 30% or more of the pre-clearing extent of each ecological community is necessary if Australia's biodiversity is to be protected. However on the Swan Coastal Plain this threshold has been reduced to 10% of each vegetation complex is aspired to be retained (Mitchell et al, 2002). Heddle *et al.* (1980) mapped two vegetation complexes including Bassendean Complex – Central and South, and the Southern River Complex. According to Perth at 3.5 million (Government of WA, 2015) there is currently 26.1% of the Bassendean Complex remaining and 18.4 % of the Southern River Complex remaining. Native vegetation within the Clearing Area is restricted to roadsides and cleared land. The degradation of vegetation from current impacts have reduced the value of these areas which are therefore unlikely to be considered 'significant remnant native vegetation'. Based on the above, the proposed clearing is unlikely to be at variance with this Principle.	*Vegetation Assessment, 2016* *Perth and Peel Green Growth Plan, Government of WA 2015* *Swan Coastal Plain 2 (SWA2 – Swan Coastal subregion)' in CALM 2002. Bioregional Summary of the 2002 Biodiversity Audit for Western Australia.*	***variance with this clearing principle***
Principle (f) - Native vegetation should not be cleared if it is growing in, or in association with, an environment associated with a watercourse or a wetland		
The Clearing Area intersects with several Conservation, Resource Enhancement and Multiple Use wetlands. One wetland vegetation type was mapped within the Clearing Area, representing two wetlands. Both wetlands have been historically cleared before 1995. Vegetation within these wetlands is regrowth approximately 22 years old, which has resulted in dense colonising species such as *Kunzea glabrescens* and weeds (**Ehrharta calycina*). The Clearing Area includes 0.52 ha of wetland vegetation, mapped as Good to Degraded. The proposed clearing is at variance with this principle.	*Armadale Road Upgrade Detailed Flora and Vegetation Assessment, 2016*	***The proposal is at variance with this clearing principle***
Principle (g) Native vegetation should not be cleared if the clearing of the vegetation is likely to cause appreciable land degradation.		
According to the Department of Primary Industry and Regional Development Natural Resource Map, the project is in an area with variable risk of wind erosion and low risk of water erosion (DPIRD 2017). The Clearing Area is 2.46 ha, including 1.27 ha of Degraded and Completely Degraded vegetation. The Clearing Area is restricted to along the existing roadside, which will be widened and have adequate drainage features installed to prevent scouring and erosion. Therefore, additional clearing along Armadale Road is unlikely to cause appreciable land degradation.	*Armadale Road Upgrade Detailed Flora and Vegetation Assessment, 2016*	***The proposal is unlikely to be at variance with this clearing principle***
Principle (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.		

Background	Source/Tools for Assessment	Conclusion
The Clearing Area intersects 0.60 ha of Bush Forever Sites including Site 344 (0.03 ha) and Site 390 (0.57 ha). This vegetation has been mapped as Good to Completely Degraded with the majority mapped as Very Good. One patch of Banksia woodland within the Clearing Area represents Site 390. This patch reflects the Banksia Woodland TEC, and is considered in Very Good condition. The proposed clearing is likely to be at variance with this principle.	*Armadale Road Upgrade Detailed Flora and Vegetation Assessment, 2016*	***The proposal is likely to be at variance with this clearing principle***
Principle (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.		
The Clearing Area intersects with the Jandakot Underground Water Pollution Control Area including a Priority 1 water catchment reservation and a Priority 2 rural-water protection zone. As part of the Jandakot Groundwater Protection policy (WAPC 2017), native vegetation around wetlands should be protected and enhanced for any new development. Wetland vegetation, mapped as MpKgLs, within the Clearing Area extends for 0.52 ha and is in Good to Degraded condition. The vegetation type is restricted to immediately south of Armadale Road, west of Liddelow Road. The existing Armadale Road includes drainage structures and engineered water management strategies to avoid impacts on the quality of surface and groundwater. The additional clearing of 2.46 ha of native vegetation in close proximity to the existing road is unlikely to cause or exacerbate impacts. Drainage features will be included in project design to prevent degradation to surface and underground water resources. For these reasons, the project is unlikely to be at variance with this principle.	*Armadale Rd Duplication EIA, Strategen 2017* *Jandakot Groundwater Protection Policy* WAPC, 2017	***The proposal is unlikely to be at variance with this clearing principle***
Principle (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.		
According to the Department of Primary Industry and Regional Development Natural Resource Map, the project is in an area with high flooding risk due to poorly draining soils (DPIRD 2017). The project is restricted to vegetation within and directly adjacent to the existing Armadale Road. It is unlikely that clearing of 2.46 ha of varying condition vegetation would exacerbate the incidence or intensity of flooding. Flood risk will be managed by drainage structures and stormwater management measures as part of the project design.	*Armadale Rd Duplication EIA, Strategen 2017*	***The proposal is unlikely to be at variance with this clearing principle***

5 OFFSET PROPOSAL

The offsets offered for this Clearing Permit amendment will be provided in alignment with that agreed for the original permit. Funds of $173,720 will be provided, intended to purchase 17.2 ha of Black Cockatoo habitat and Banksia Woodland TEC to offset an original clearing area of 4.85 ha of Black Cockatoo habitat and Banksia Woodland TEC.

The additional clearing area includes 2.08 ha of Black Cockatoo habitat. Within this Black Cockatoo habitat, 1.06 ha is also Banksia Woodland TEC occurs. In line with the approach above, it is proposed to offset this clearing of 2.08 ha with an area of 7.37 ha, and at a cost of $74,436.

6 SUMMARY OF ASSESSMENT AND CONCLUSION

Field and desktop assessments of the environmental values were undertaken for the additional clearing required. A total of 2.46 ha of native vegetation clearing will be needed, as shown in Figure 2. Of this, 2.08 ha of Black Cockatoo foraging habitat and 1.06 ha of the Banksia Woodlands of the Swan Coastal Plain TEC will be removed. An offset of $74,436 is proposed for the purchase of 7.37 ha of native vegetation with comparable environmental values as the Clearing Area.

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FIGURES

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APPROVED BY A Elkington
LAST MODIFIED 31 JAN 2018

Metropolitan Road Improvement Alliance

N

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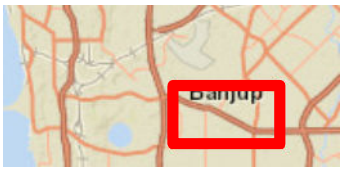

Locality Map

ARMADALE ROAD UPGRADE DUAL CARRIAGEWAY – TAPPER ROAD TO ANSTEY ROAD

Main Roads Western Australia

Figure 1

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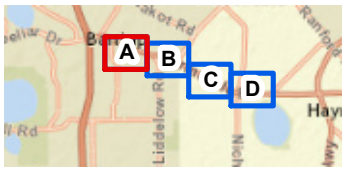

Clearing Permit Approval Boundaries

ARMADALE ROAD UPGRADE DUAL CARRIAGEWAY – TAPPER ROAD TO ANSTEY ROAD

Main Roads Western Australia

Figure 2A

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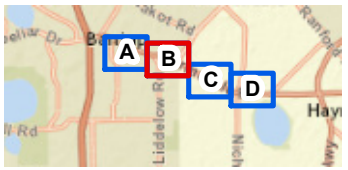

Clearing Permit Approval Boundaries

ARMADALE ROAD UPGRADE DUAL CARRIAGEWAY – TAPPER ROAD TO ANSTEY ROAD

Main Roads Western Australia

Figure 2B

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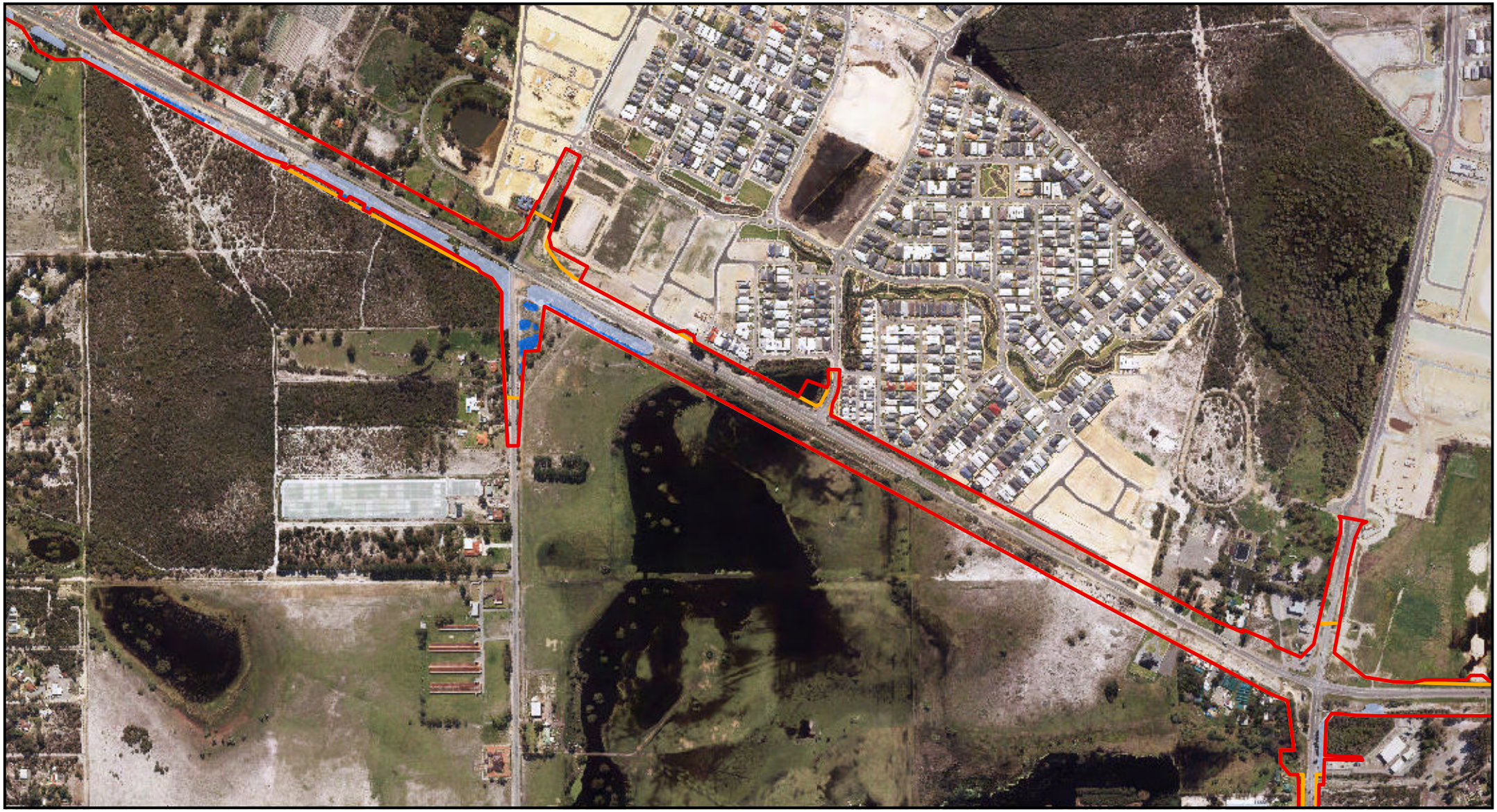

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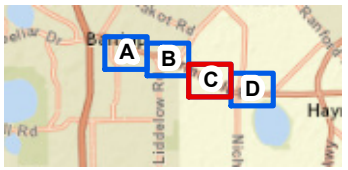

Clearing Permit Approval Boundaries

ARMADALE ROAD UPGRADE DUAL CARRIAGEWAY – TAPPER ROAD TO ANSTEY ROAD

Main Roads Western Australia

Figure 2C

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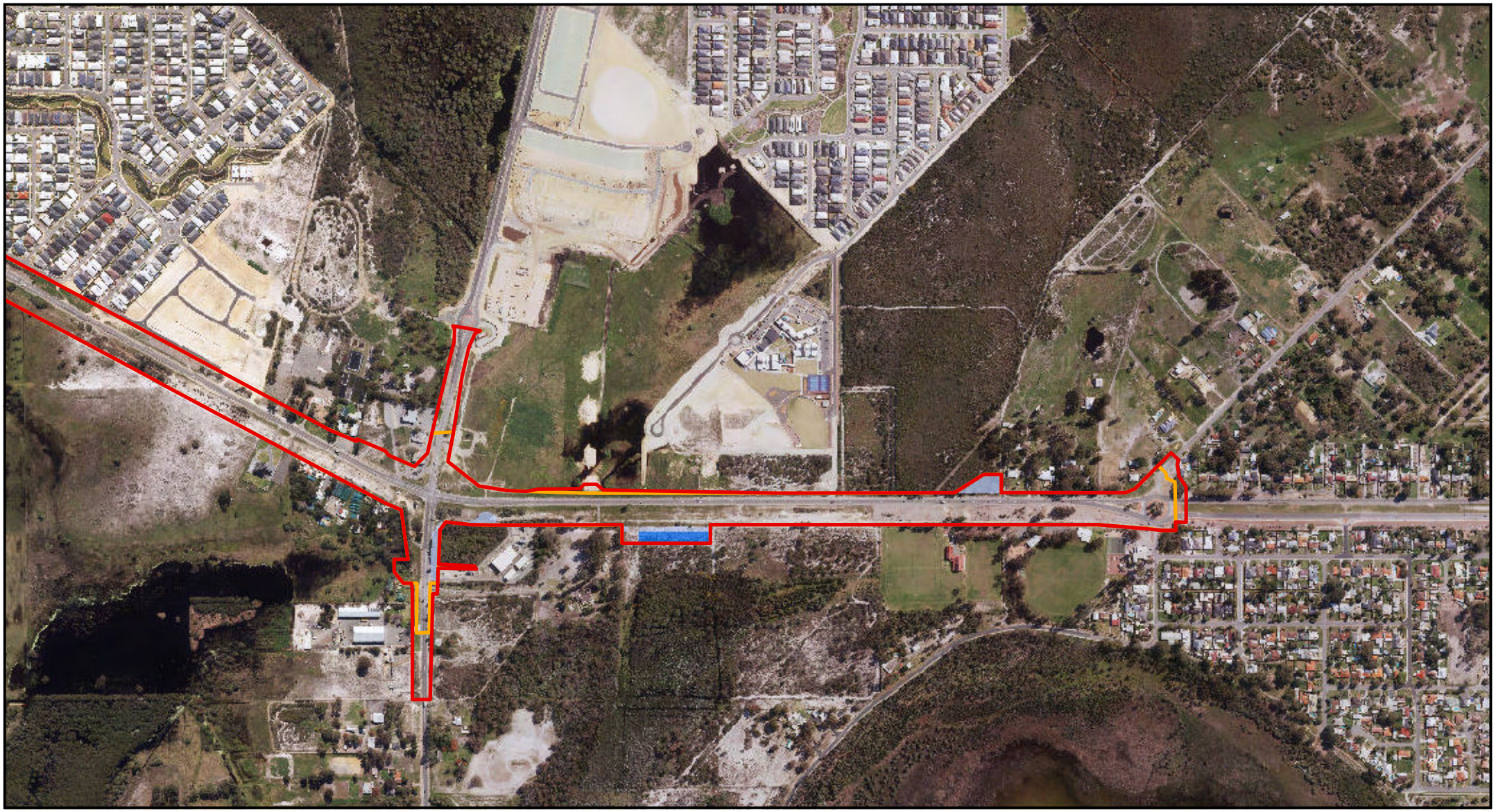

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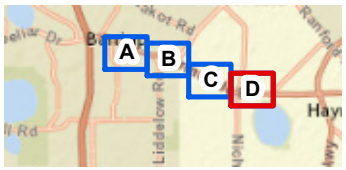

Clearing Permit Approval Boundaries

ARMADALE ROAD UPGRADE DUAL CARRIAGEWAY – TAPPER ROAD TO ANSTEY ROAD

Main Roads Western Australia

Figure 2D

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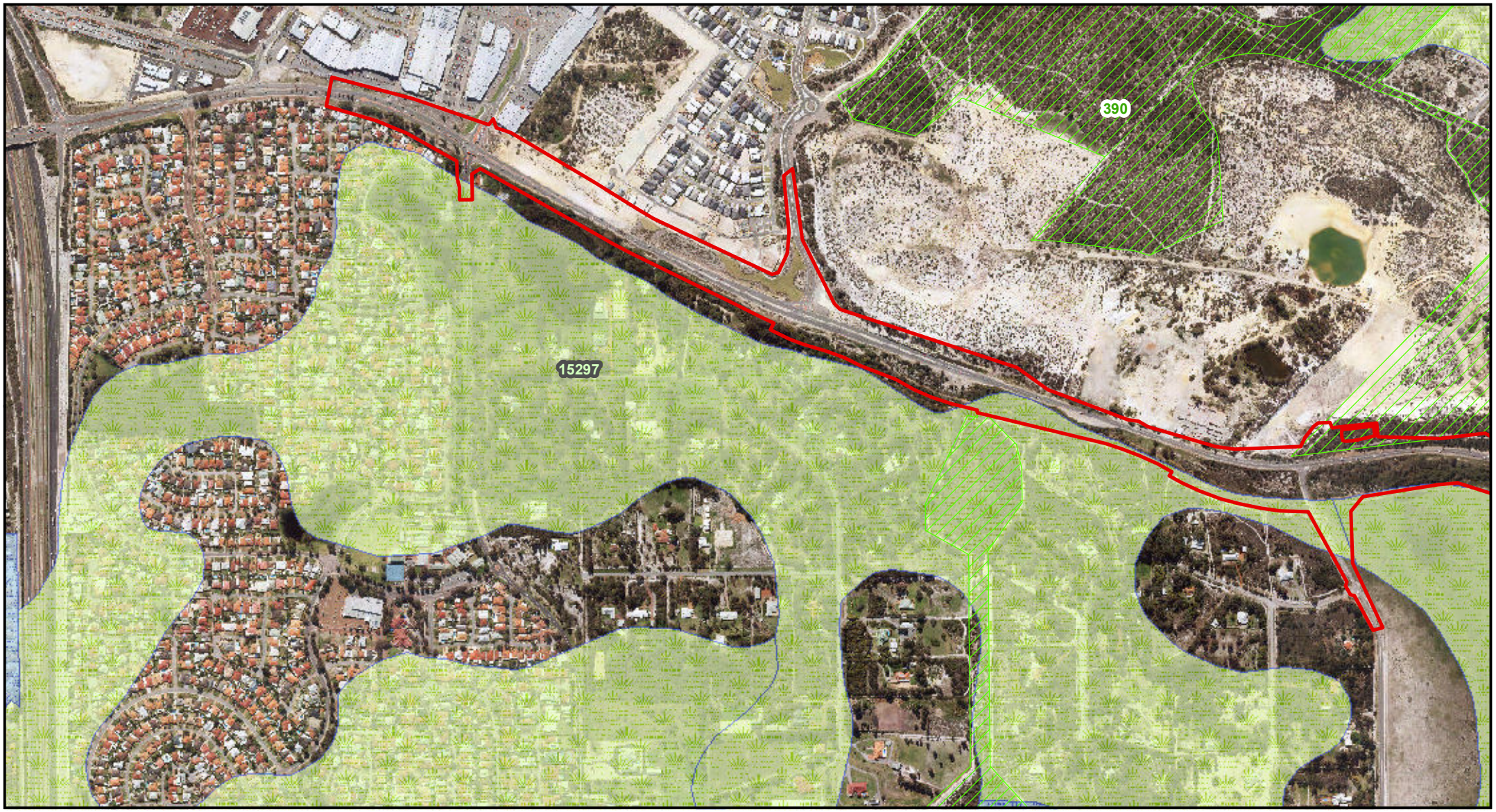

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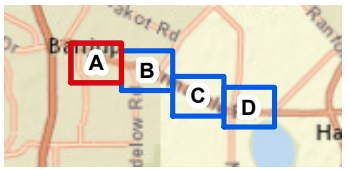
- Bush Forever

Wetlands

- Multiple Use
- Resource Enhancement



Desktop Wetlands and Bushforever

ARMADALE ROAD UPGRADE DUAL CARRIAGEWAY – TAPPER ROAD TO ANSTEY ROAD

Main Roads Western Australia

Figure 3A

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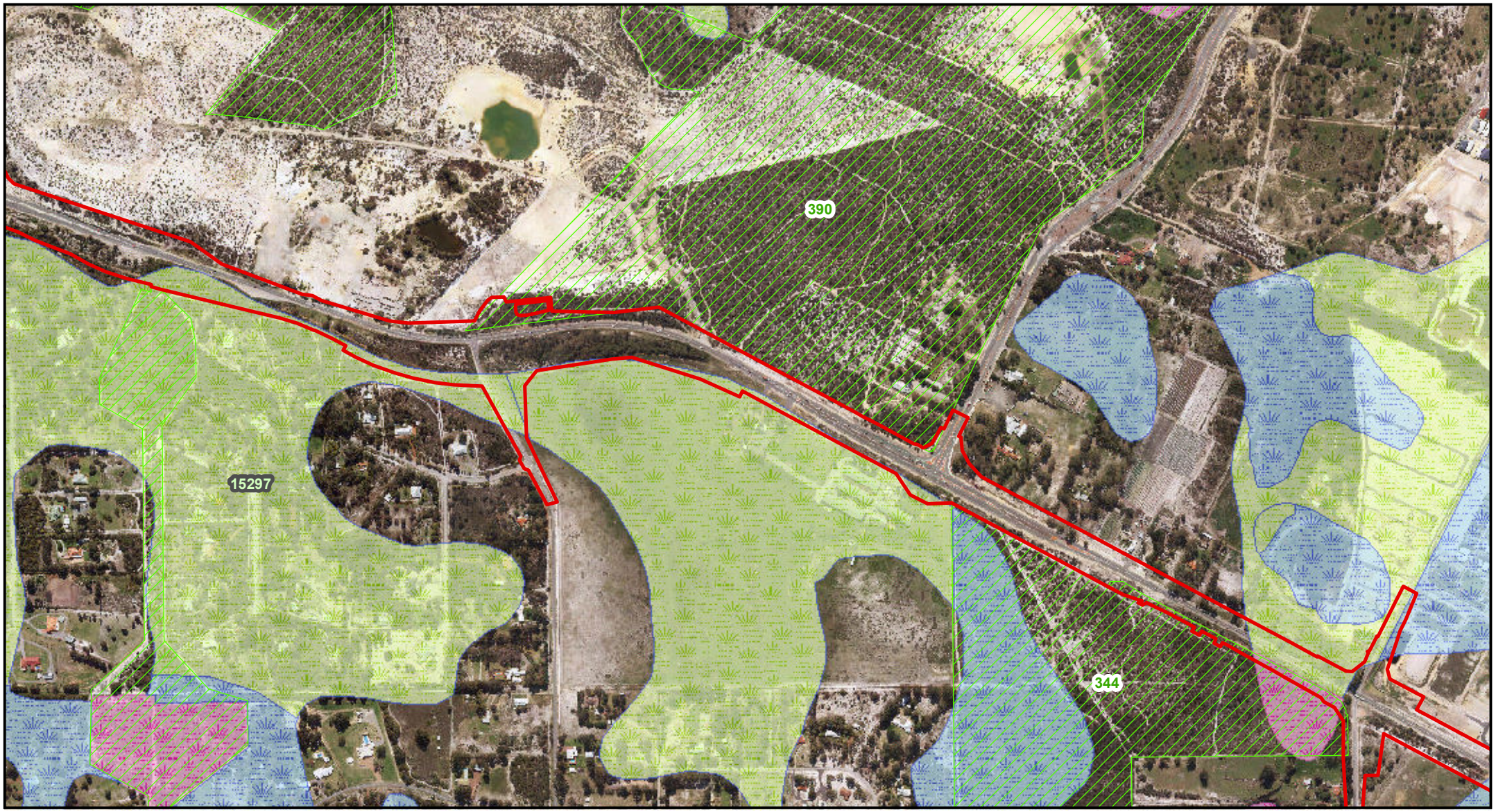

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Wetlands

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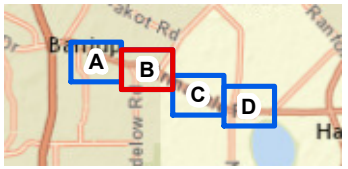

Desktop Wetlands and Bushforever

ARMADALE ROAD UPGRADE DUAL CARRIAGEWAY – TAPPER ROAD TO ANSTEY ROAD

Main Roads Western Australia

Figure 3B

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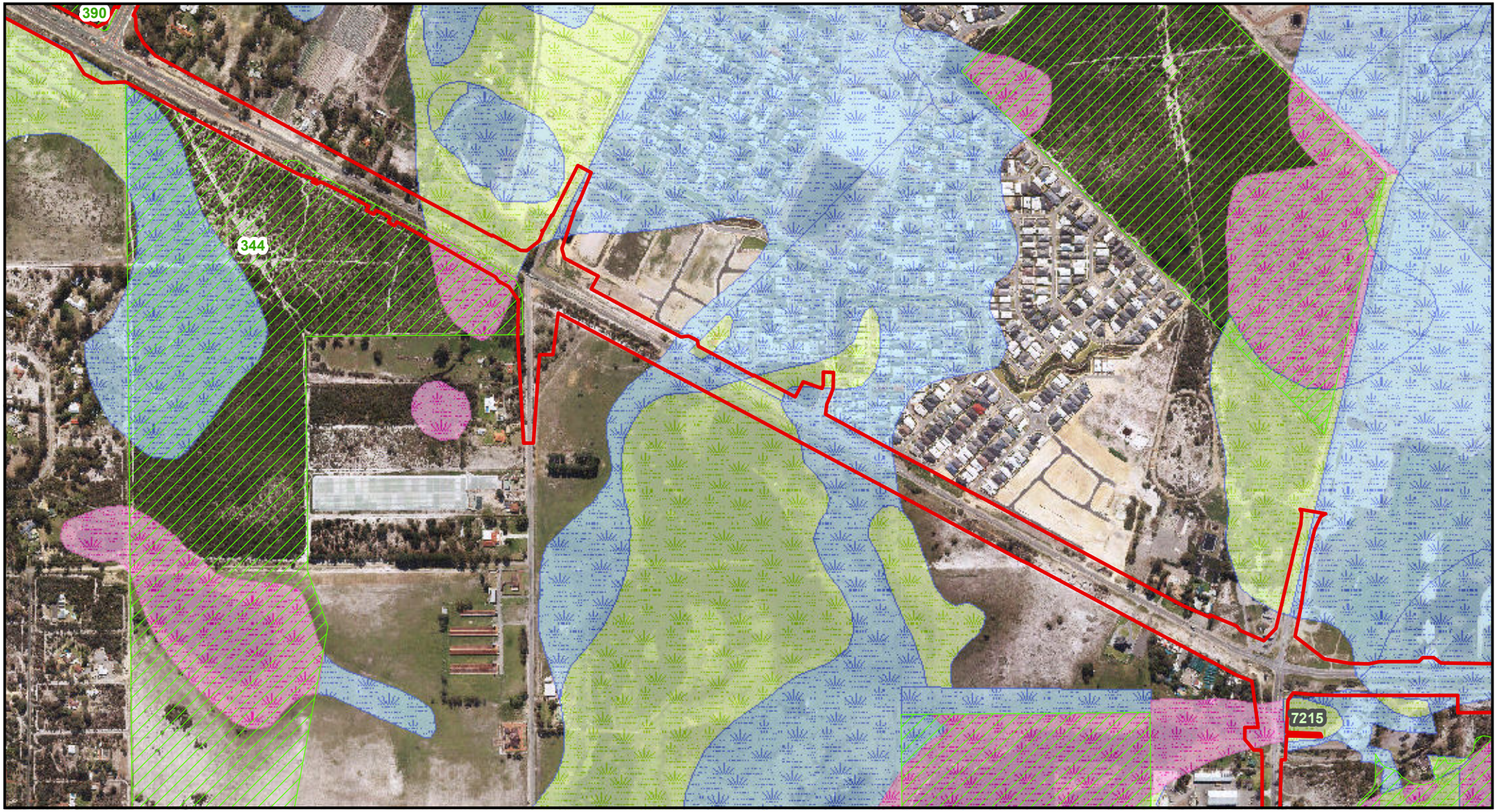

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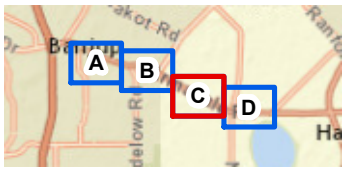
Wetlands

- Conservation
- Multiple Use
- Resource Enhancement



Desktop Wetlands and Bushforever

ARMADALE ROAD UPGRADE DUAL CARRIAGEWAY – TAPPER ROAD TO ANSTEY ROAD

Main Roads Western Australia

Figure 3C

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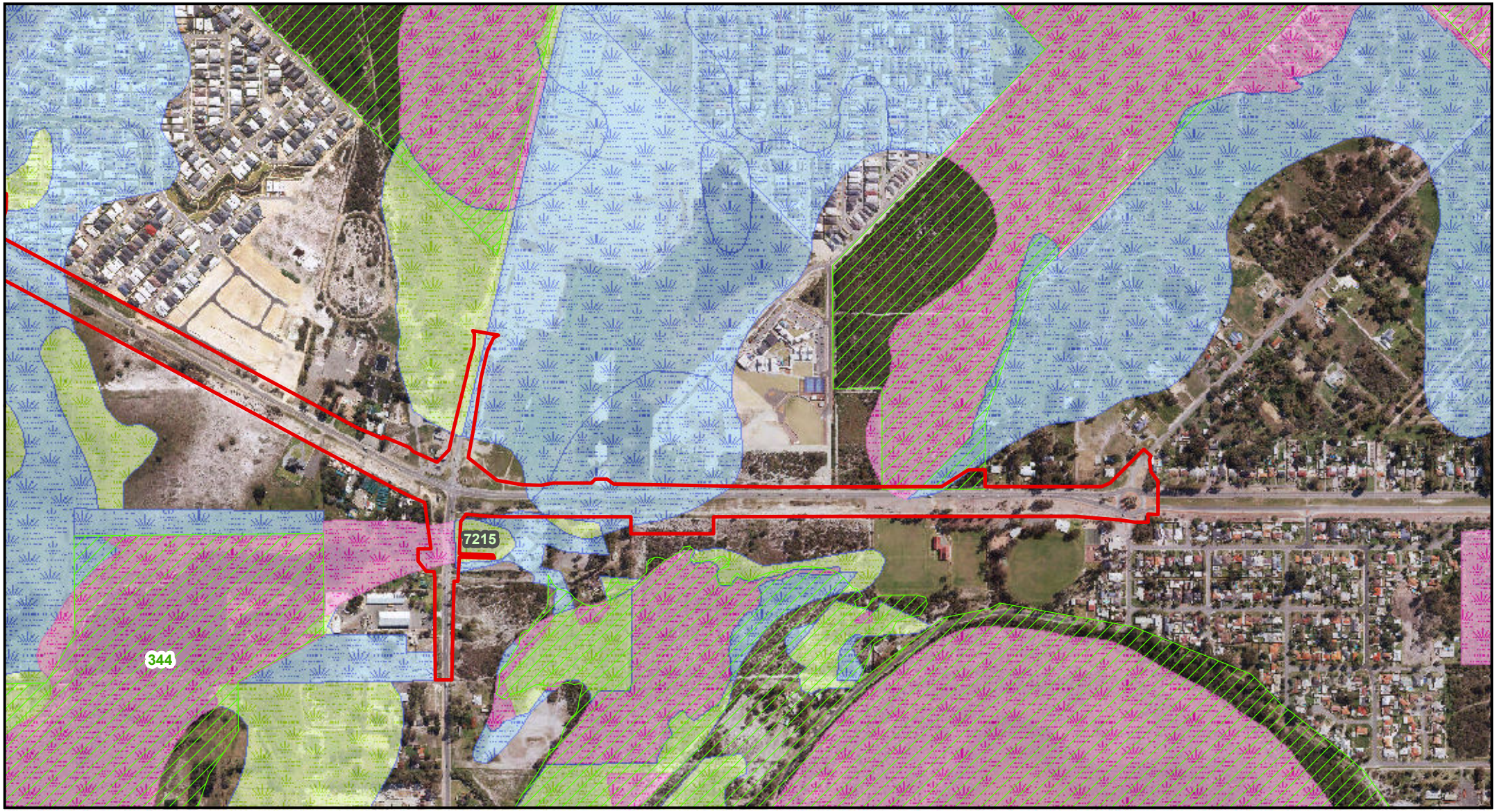

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LEGEND

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Wetlands

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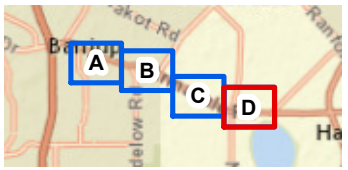
- Resource Enhancement



Desktop Wetlands and Bushforever

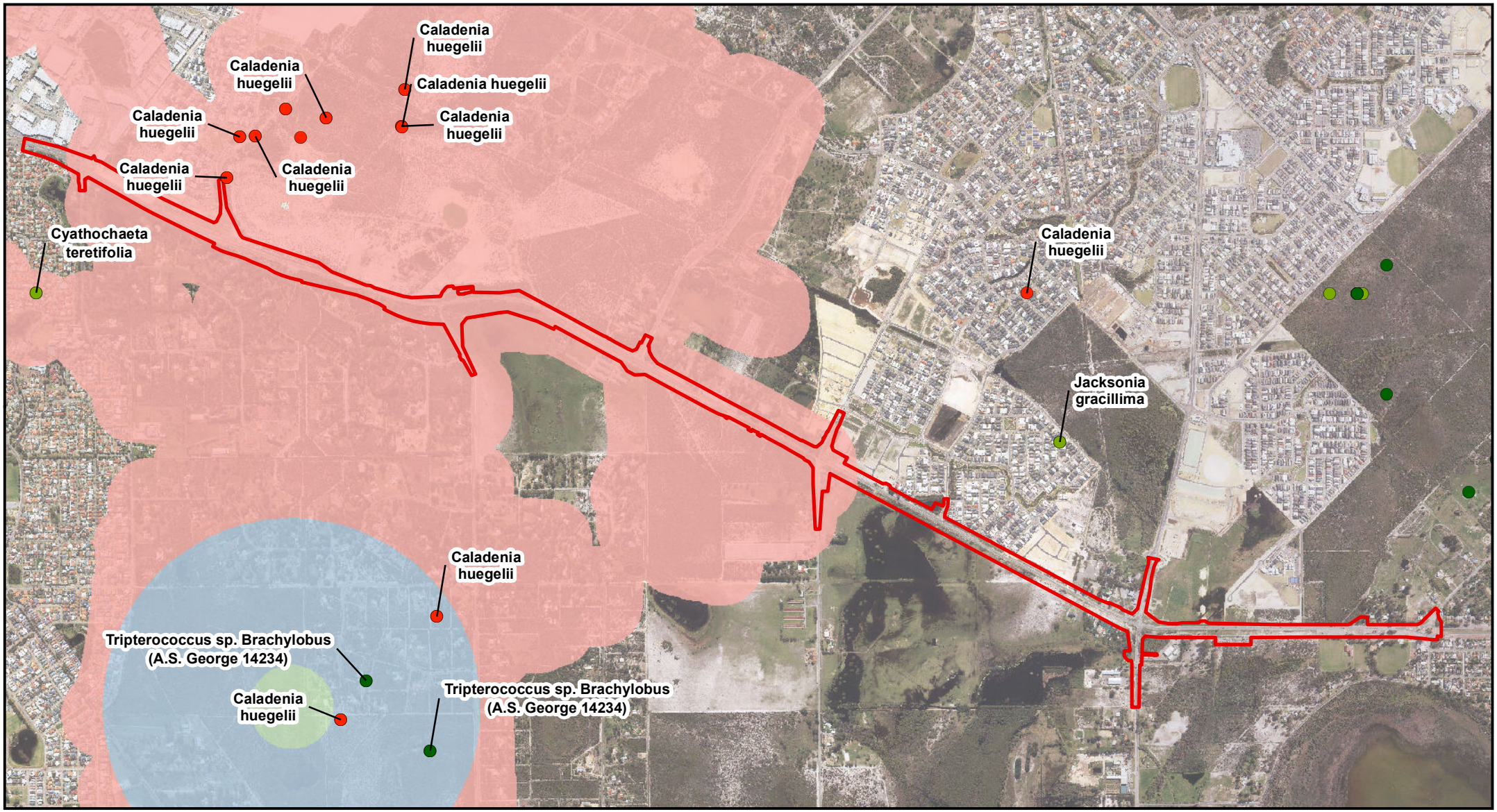
ARMADALE ROAD UPGRADE DUAL CARRIAGEWAY – TAPPER ROAD TO ANSTEY ROAD

Main Roads Western Australia

Figure 3D

Map Document: K:\ED Engineering & Design\ED66 GIS\07_Armadale Road Duplication\02_MXDs\06_ClearingPermitAmendment\Fig3_Desktop Wetlands and Bushforever.mxd (dfotheri)

A4 size



PROJECT ID 60550185.0
CREATED BY DGF
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LAST MODIFIED 31 JAN 2018

Metropolitan Road Improvement Alliance

N

DATUM GDA 1994, PROJECTION PERTH COASTAL GRID 1994

0 140 280 420 560
metres

1:25,000 when printed at A4

LEGEND

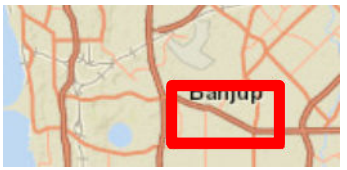
Development Envelope

Desktop Threatened and Priority Flora

- T
- 1
- 2
- 3
- 4

TEC PEC

- Banksia Dominated Woodlands of the Swan Coastal Plain IBRA Region
- Banksia ilicifolia woodlands
- Low lying Banksia attenuata woodlands or shrublands



Desktop Threatened Flora and Threatened Ecological Communitieis

ARMADALE ROAD UPGRADE DUAL CARRIAGEWAY – TAPPER ROAD TO ANSTEY ROAD

Main Roads Western Australia

Figure 4

Map Document: K:\ED Engineering & Design\ED66 GIS\07_Armadale Road Duplication\02_MXDs\06_ClearingPermitAmendment\Fig4_Desktop TEC and Rare flora.mxd (dfotheri)

A4 size

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N

DATUM GDA 1994, PROJECTION PERTH COASTAL GRID 1994

0 50 100 150 200
metres

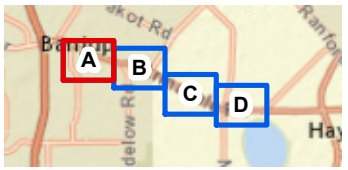
1:10,000 when printed at A4

LEGEND

- Development Envelope
- Clearing Permit Application Area

Vegetation Community

- BaBm
- BaHhBm
- MpKgLs



Vegetation Units within Additional Clearing Area

ARMADALE ROAD UPGRADE DUAL CARRIAGEWAY – TAPPER ROAD TO ANSTEY ROAD

Main Roads Western Australia

Figure 5A

Map Document: K:\ED Engineering & Design\ED66 GIS\07_Armadale Road Duplication\02_MXDs\06_ClearingPermitAmendment\Fig5_VegTypes.mxd (dfotheri)

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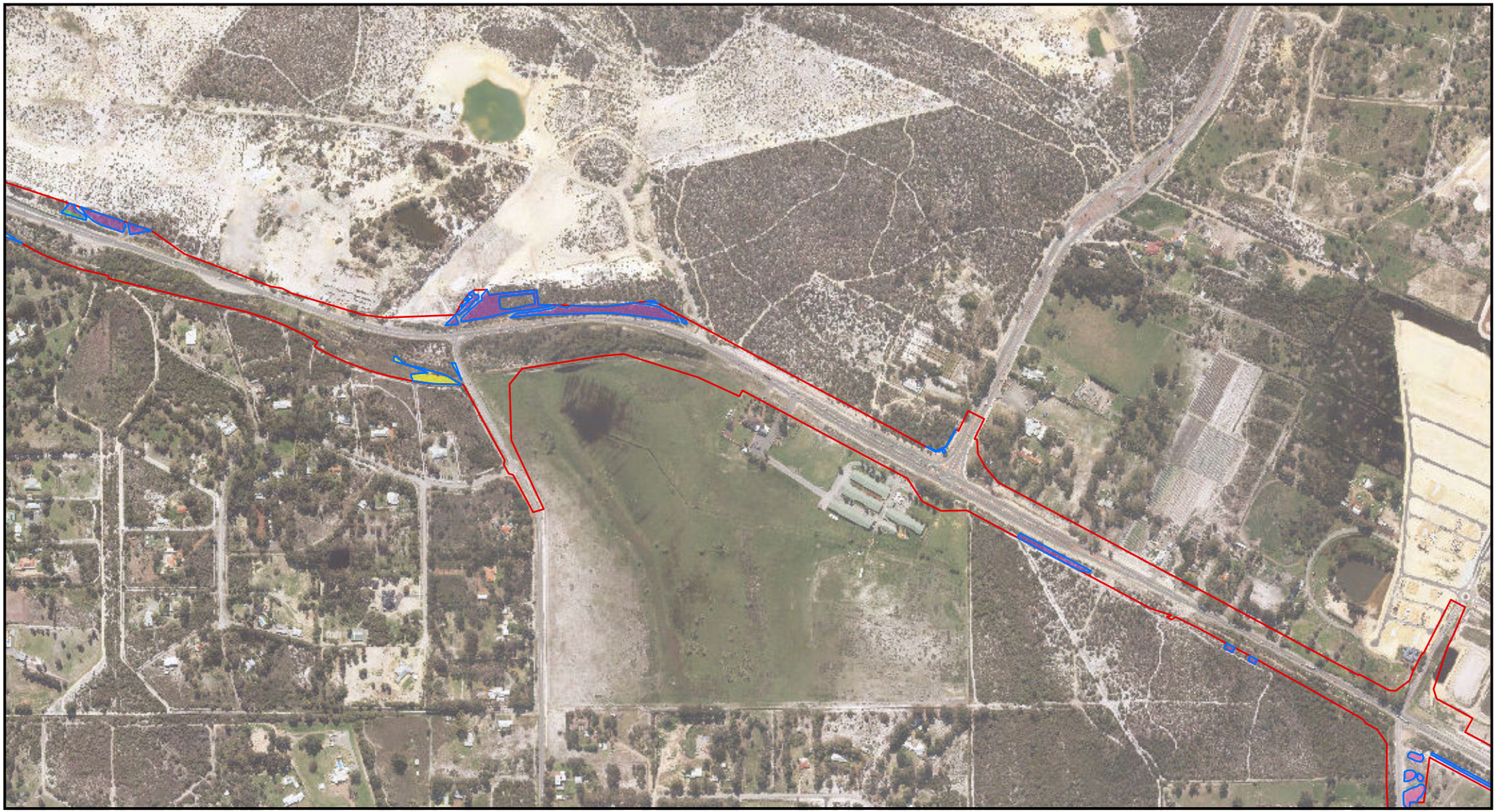

PROJECT ID 60550185.0
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N

DATUM GDA 1994, PROJECTION PERTH COASTAL GRID 1994

0 50 100 150 200
metres

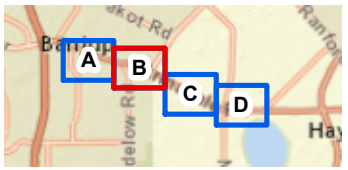
1:10,000 when printed at A4

LEGEND

- Development Envelope
- Clearing Permit Application Area

Vegetation Community

- BaBm
- BaHhBm
- MpKgLs
- Trees Over Paddock



Vegetation Units within Additional Clearing Area

ARMADALE ROAD UPGRADE DUAL CARRIAGEWAY – TAPPER ROAD TO ANSTEY ROAD

Main Roads Western Australia

Figure 5B

Map Document: K:\ED Engineering & Design\ED66 GIS\07_Armadale Road Duplication\02_MXDs\06_ClearingPermitAmendment\Fig5_VegTypes.mxd (dfotheri)

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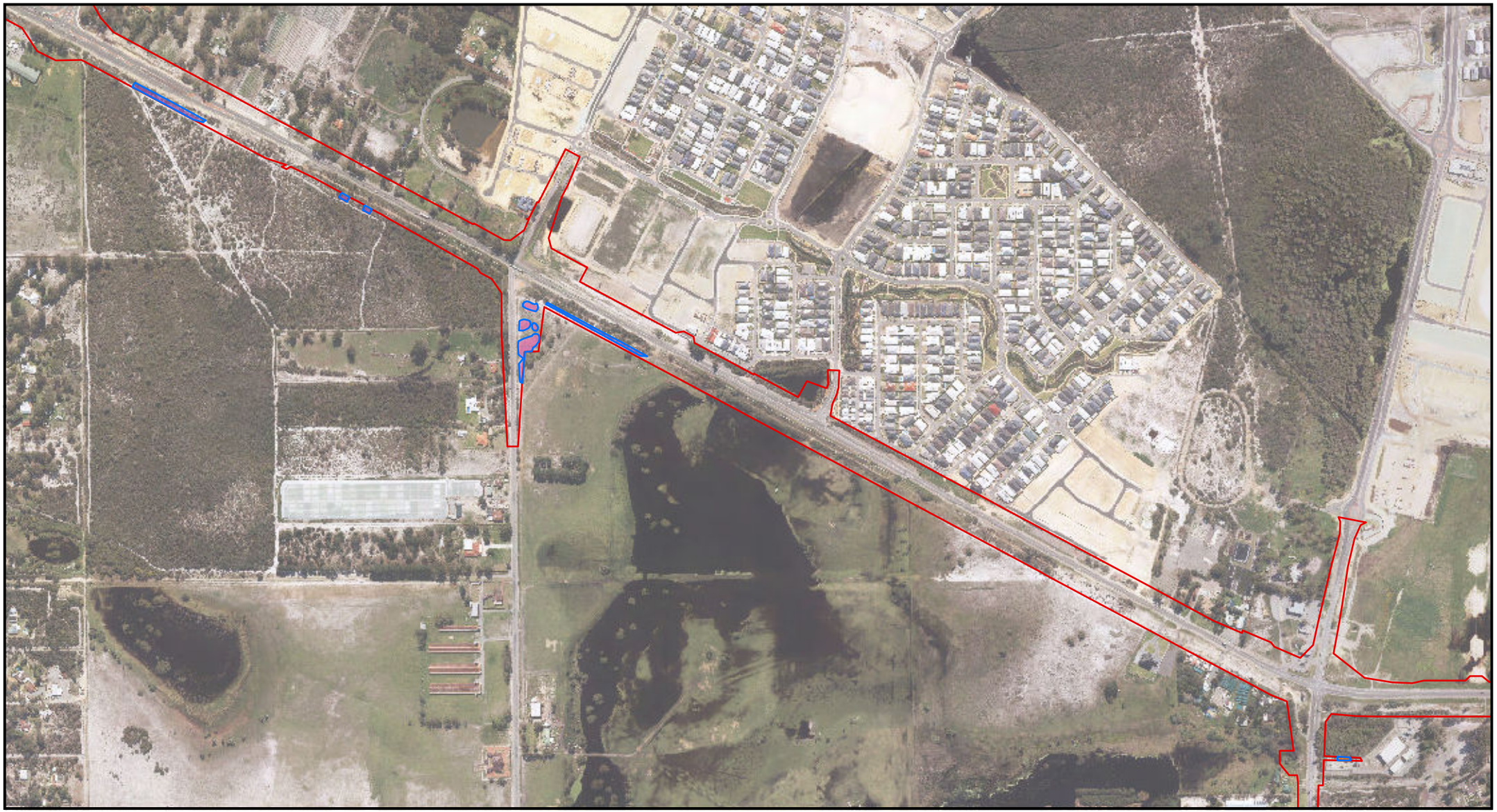

PROJECT ID 60550185.0
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DATUM GDA 1994, PROJECTION PERTH COASTAL GRID 1994

0 50 100 150 200
metres

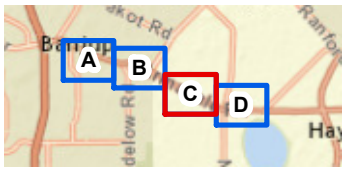
1:10,000 when printed at A4

LEGEND

- Development Envelope
- Clearing Permit Application Area

Vegetation Community

- BaBm
- BaHhBm
- Kg
- Trees Over Paddock



Vegetation Units within Additional Clearing Area

ARMADALE ROAD UPGRADE DUAL CARRIAGEWAY – TAPPER ROAD TO ANSTEY ROAD

Main Roads Western Australia

Figure 5C

Map Document: K:\ED Engineering & Design\ED66 GIS\07_Armadale Road Duplication\02_MXDs\06_ClearingPermitAmendment\Fig5_VegTypes.mxd (dfotheri)

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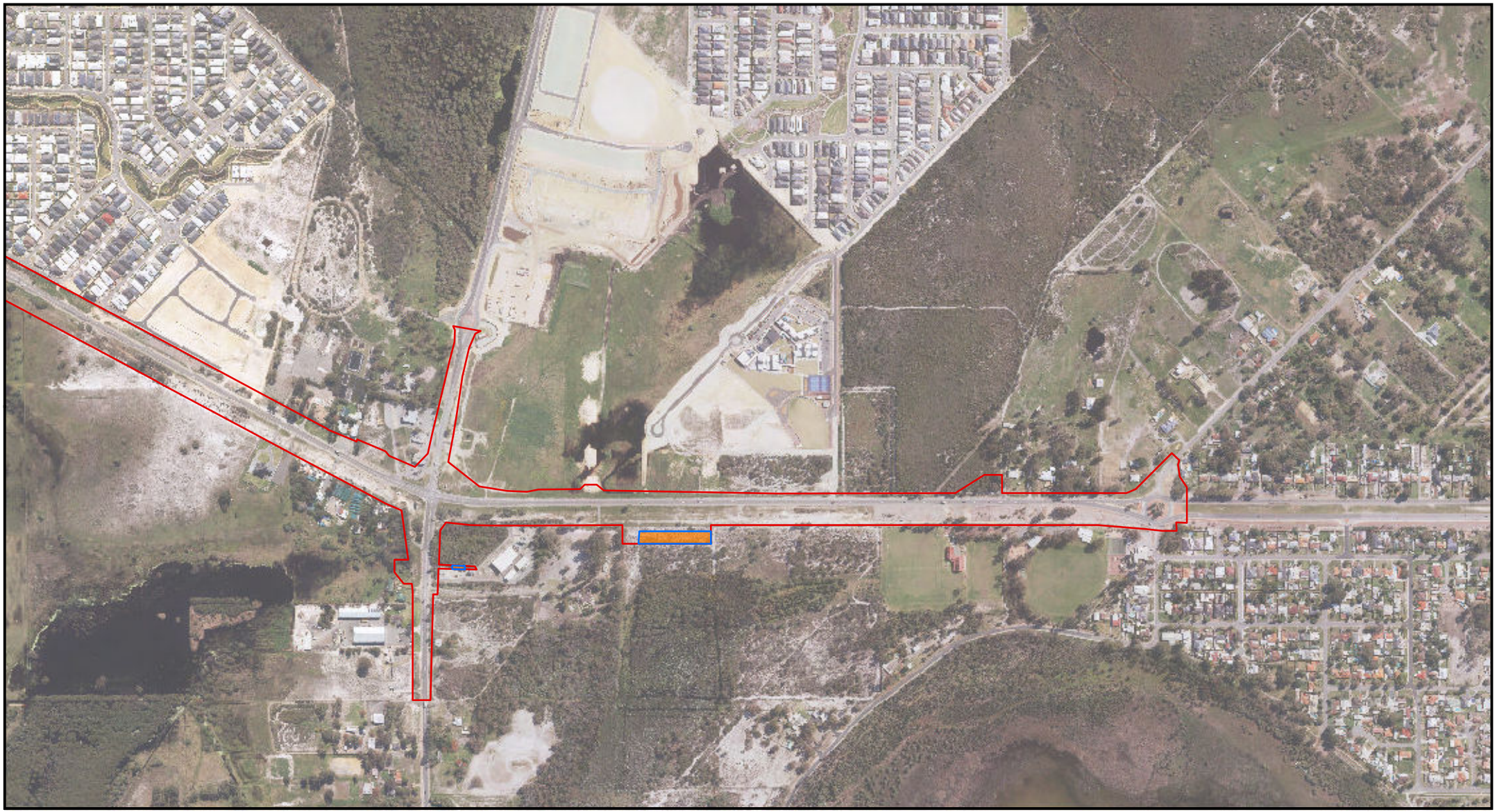

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DATUM GDA 1994, PROJECTION PERTH COASTAL GRID 1994

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metres

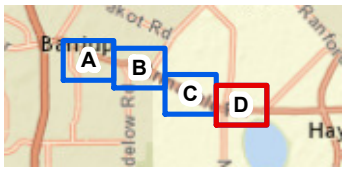
1:10,000 when printed at A4

LEGEND

Development Envelope
Clearing Permit Application Area

Vegetation Community

Kg



Vegetation Units within Additional Clearing Area

ARMADALE ROAD UPGRADE DUAL CARRIAGEWAY – TAPPER ROAD TO ANSTEY ROAD

Main Roads Western Australia

Figure 5D

Map Document: K:\ED Engineering & Design\ED66 GIS\07_Armadale Road Duplication\02_MXDs\06_ClearingPermitAmendment\Fig5_VegTypes.mxd (dfotheri)

A4 size

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DATUM GDA 1994, PROJECTION PERTH COASTAL GRID 1994

0 50 100 150 200
metres

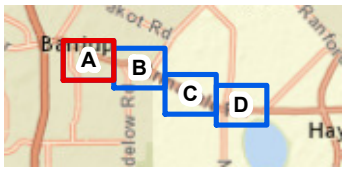
1:10,000 when printed at A4

LEGEND

- Clearing Permit Application Area
- Development Envelope

Vegetation Condition

- Very Good
- Good
- Degraded
- Completely Degraded



Vegetation Condition within Additional Clearing Permit Area

ARMADALE ROAD UPGRADE DUAL CARRIAGEWAY – TAPPER ROAD TO ANSTEY ROAD

Main Roads Western Australia

Figure 6A

Map Document: K:\ED Engineering & Design\ED66 GIS\07_Armadale Road Duplication\02_MXDs\06_ClearingPermitAmendment\Fig6_VegCondition.mxd (dfotheri)

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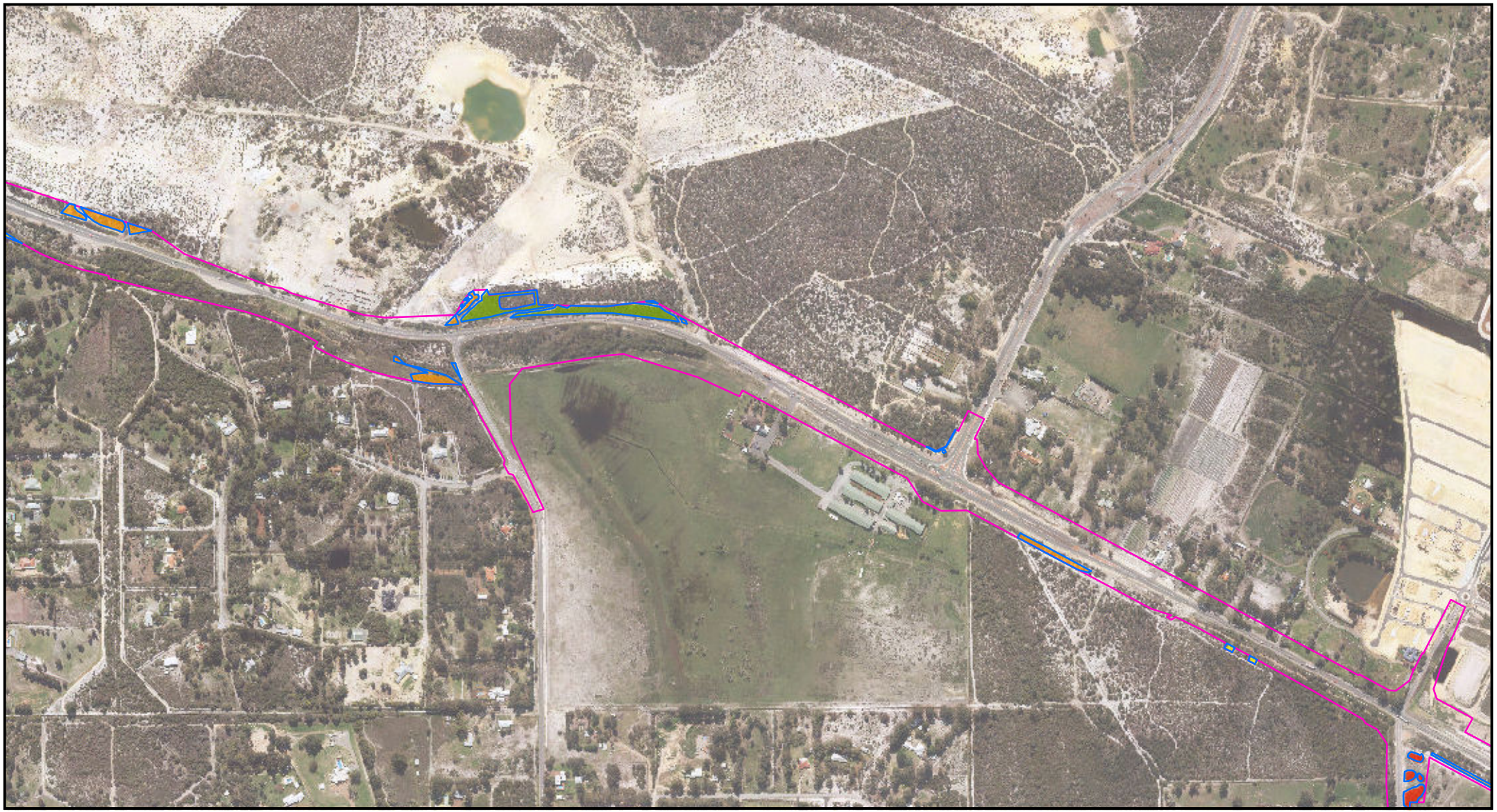

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Metropolitan Road Improvement Alliance

N

DATUM GDA 1994, PROJECTION PERTH COASTAL GRID 1994

0 50 100 150 200
metres

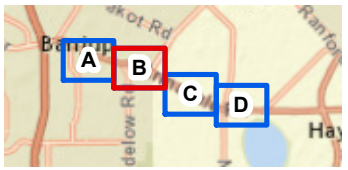
1:10,000 when printed at A4

LEGEND

- Clearing Permit Application Area
- Development Envelope

Vegetation Condition

- Very Good
- Good
- Degraded
- Completely Degraded



Vegetation Condition within Additional Clearing Permit Area

ARMADALE ROAD UPGRADE DUAL CARRIAGEWAY – TAPPER ROAD TO ANSTEY ROAD

Main Roads Western Australia

Figure 6B

Map Document: K:\ED Engineering & Design\ED66 GIS\07_Armadale Road Duplication\02_MXDs\06_ClearingPermitAmendment\Fig6_VegCondition.mxd (dfotheri)

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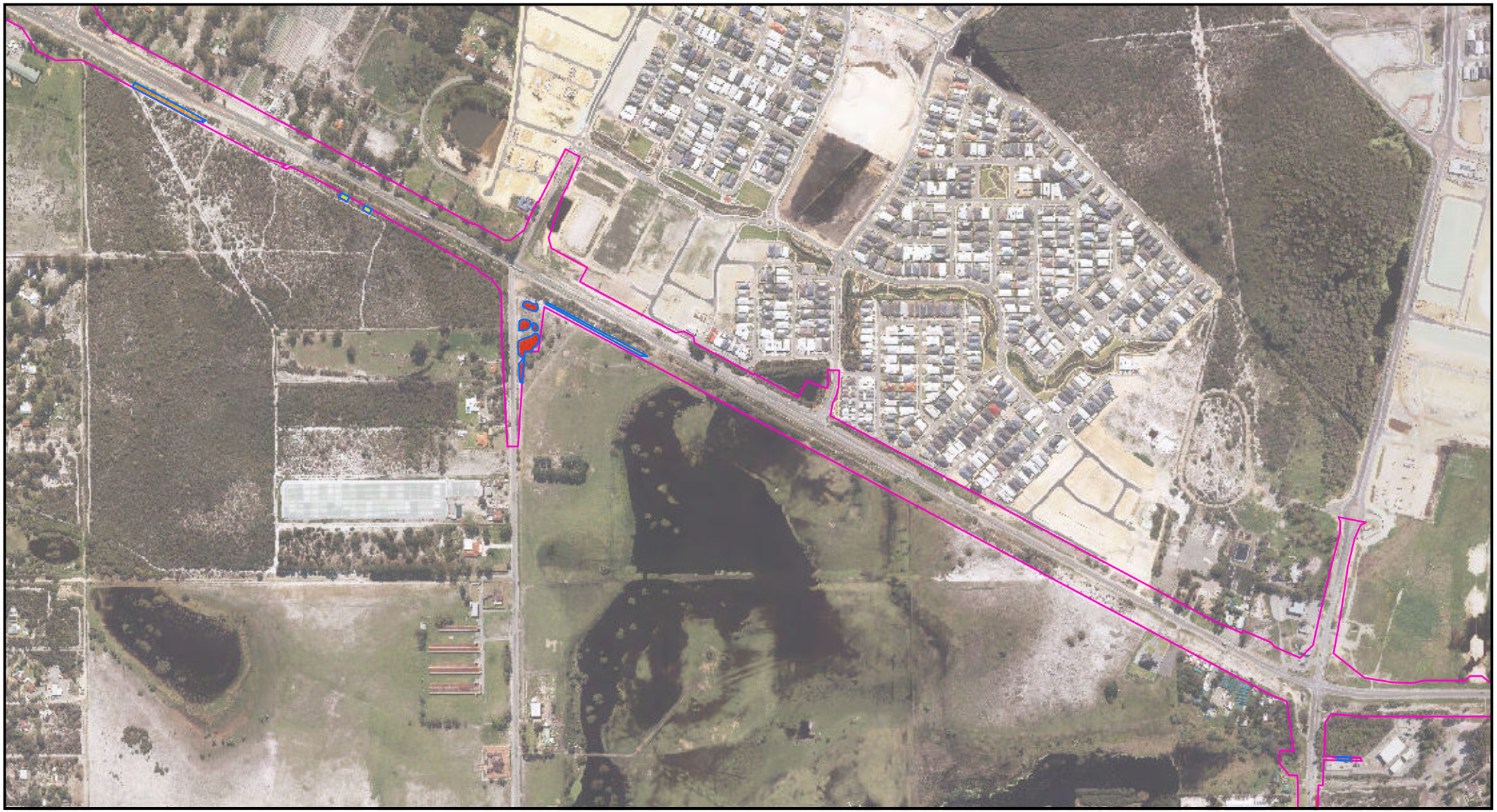

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DATUM GDA 1994, PROJECTION PERTH COASTAL GRID 1994

0 50 100 150 200
metres

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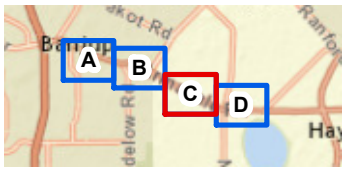
LEGEND

- Clearing Permit Application Area
- Development Envelope

Vegetation Condition

- Good
- Degraded
- Completely Degraded



Vegetation Condition within Additional Clearing Permit Area

ARMADALE ROAD UPGRADE DUAL CARRIAGEWAY – TAPPER ROAD TO ANSTEY ROAD

Main Roads Western Australia

Figure 6C

Map Document: K:\ED Engineering & Design\ED66 GIS\07_Armadale Road Duplication\02_MXDs\06_ClearingPermitAmendment\Fig6_VegCondition.mxd (dfotheri)

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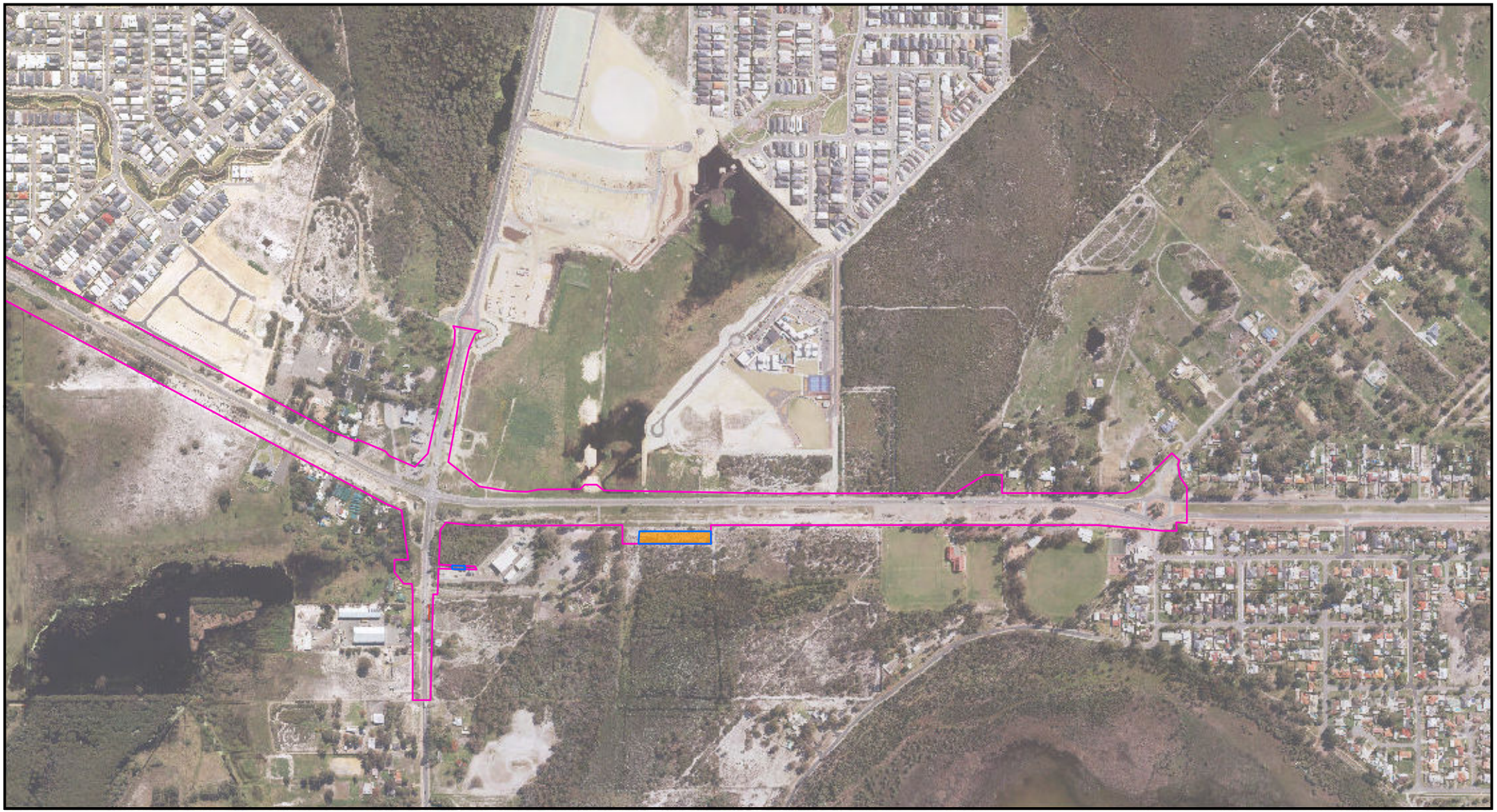

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DATUM GDA 1994, PROJECTION PERTH COASTAL GRID 1994

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metres

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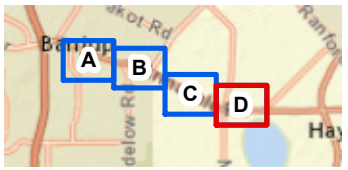
LEGEND

- Clearing Permit Application Area
- Development Envelope

Vegetation Condition

- Degraded
- Completely Degraded



Vegetation Condition within Additional Clearing Permit Area

ARMADALE ROAD UPGRADE DUAL CARRIAGEWAY – TAPPER ROAD TO ANSTEY ROAD

Main Roads Western Australia

Figure 6D

Map Document: K:\ED Engineering & Design\ED66 GIS\07_Armadale Road Duplication\02_MXDs\06_ClearingPermitAmendment\Fig6_VegCondition.mxd (dfotheri)

A4 size

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DATUM GDA 1994, PROJECTION PERTH COASTAL GRID 1994

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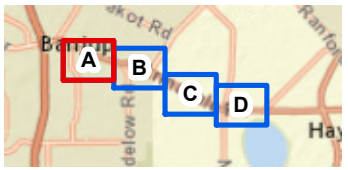
metres

1:10,000 when printed at A4

LEGEND

- Clearing Permit Application Area
- Development Envelope
- Banksia Woodlands of the Swan Coastal Plain (Endangered)



Conservation Significant Communities within Additional Clearing Area

ARMADALE ROAD UPGRADE DUAL CARRIAGEWAY – TAPPER ROAD TO ANSTEY ROAD

Main Roads Western Australia

Figure 7A

Map Document: K:\ED Engineering & Design\ED66 GIS\07_Armadale Road Duplication\02_MXDs\06_ClearingPermitAmendment\Fig7_ConservationSignificantCommunities.mxd (dfotheri)

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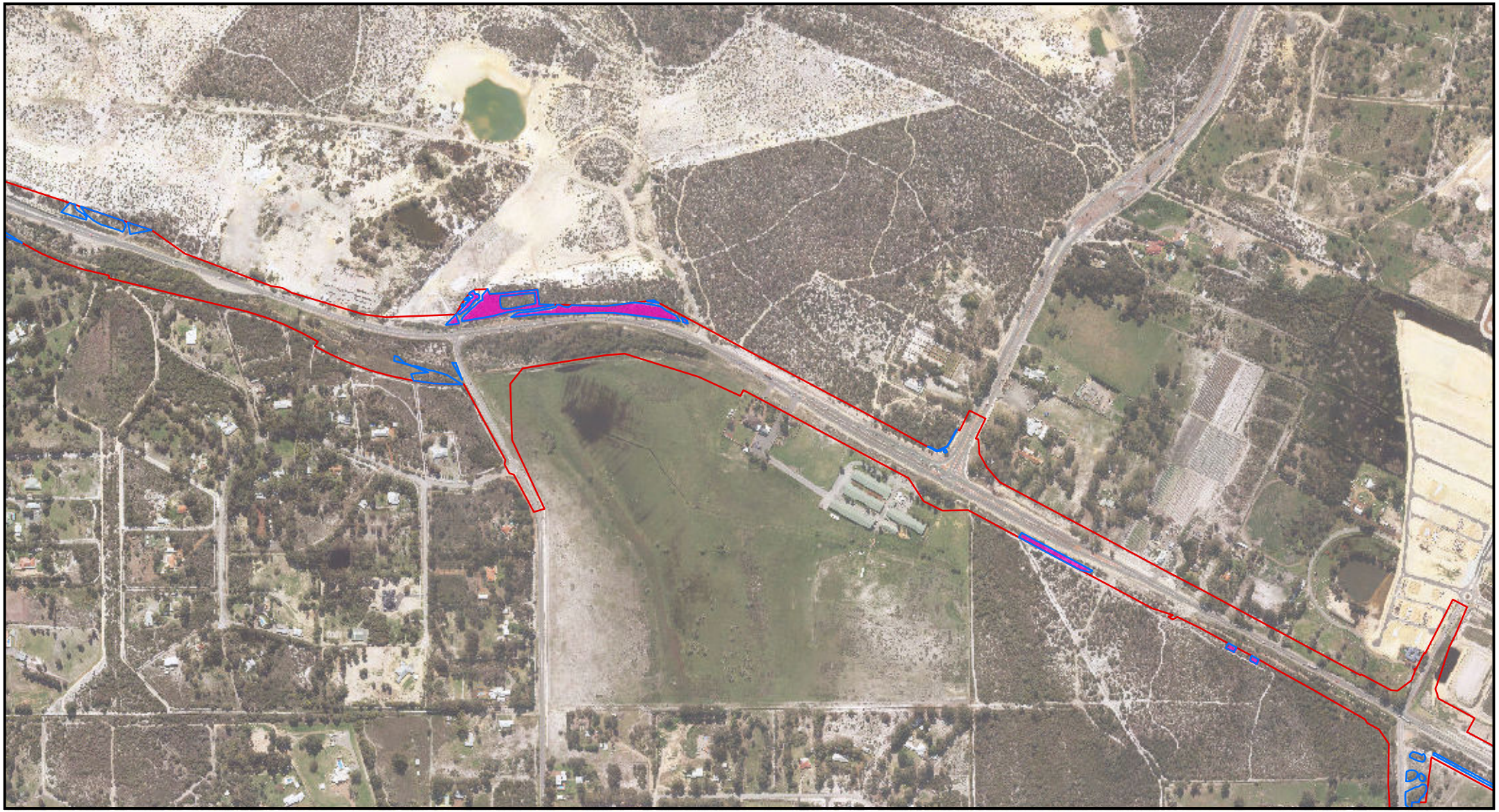

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Metropolitan Road Improvement Alliance

N

DATUM GDA 1994, PROJECTION PERTH COASTAL GRID 1994

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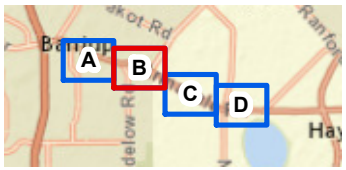
1:10,000 when printed at A4

LEGEND

- Clearing Permit Application Area
- Development Envelope
- Banksia Woodlands of the Swan Coastal Plain (Endangered)



Conservation Significant Communities within Additional Clearing Area

ARMADALE ROAD UPGRADE DUAL CARRIAGEWAY – TAPPER ROAD TO ANSTEY ROAD

Main Roads Western Australia

Figure 7B

Map Document: K:\ED Engineering & Design\ED66 GIS\07_Armadale Road Duplication\02_MXDs\06_ClearingPermitAmendment\Fig7_ConservationSignificantCommunities.mxd (dfotheri)

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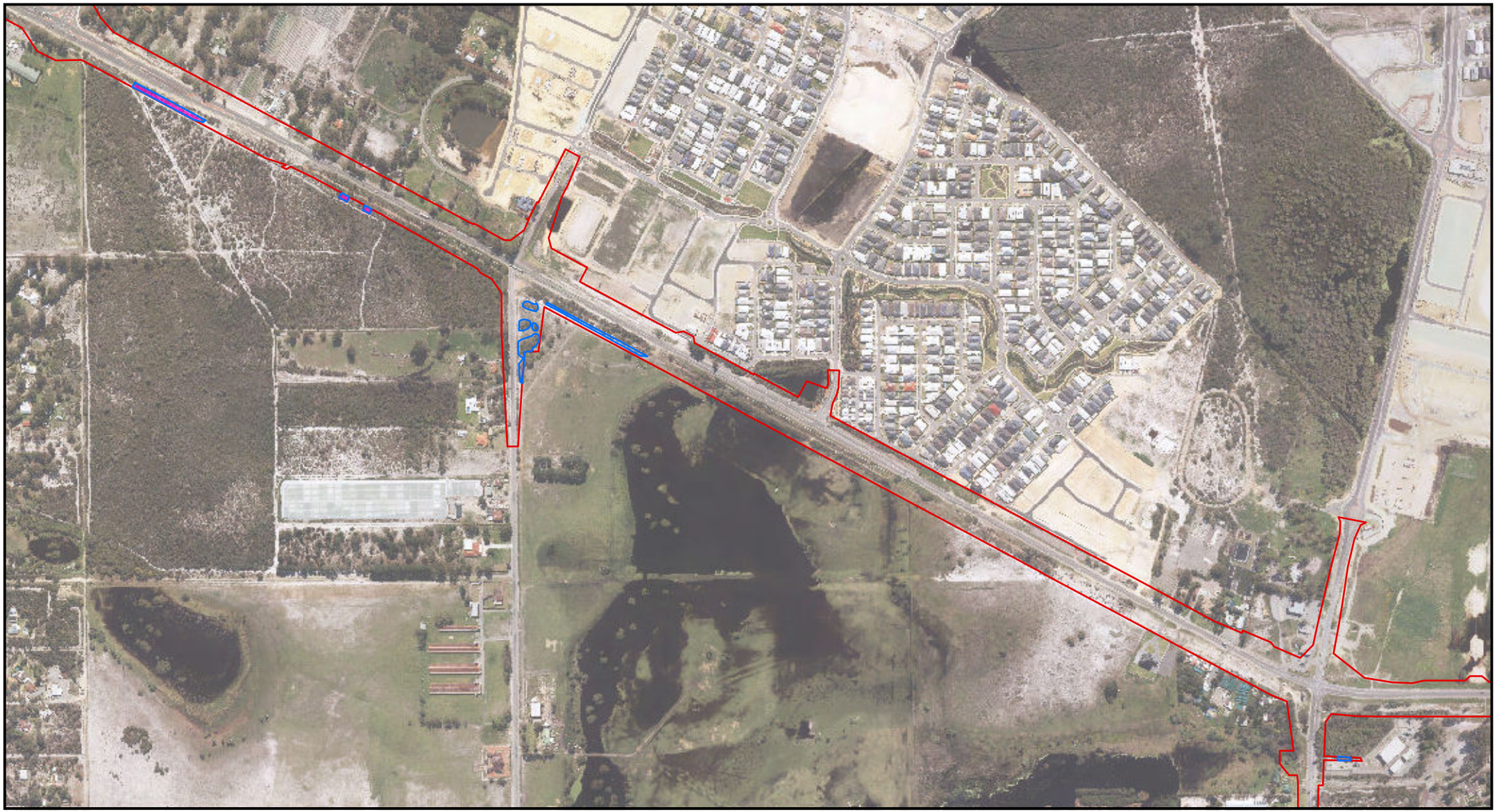

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DATUM GDA 1994, PROJECTION PERTH COASTAL GRID 1994

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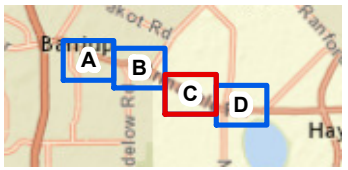
1:10,000 when printed at A4

LEGEND

- Clearing Permit Application Area
- Development Envelope
- Banksia Woodlands of the Swan Coastal Plain (Endangered)



Conservation Significant Communities within Additional Clearing Area

ARMADALE ROAD UPGRADE DUAL CARRIAGEWAY – TAPPER ROAD TO ANSTEY ROAD

Main Roads Western Australia

Figure 7C

Map Document: K:\ED Engineering & Design\ED66 GIS\07_Armadale Road Duplication\02_MXDs\06_ClearingPermitAmendment\Fig7_ConservationSignificantCommunities.mxd (dfotheri)

A4 size

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Metropolitan Road Improvement Alliance

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DATUM GDA 1994, PROJECTION PERTH COASTAL GRID 1994

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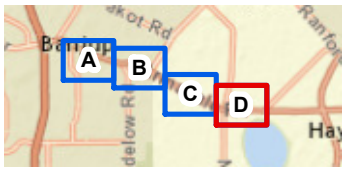

Conservation Significant Communities within Additional Clearing Area

ARMADALE ROAD UPGRADE DUAL CARRIAGEWAY – TAPPER ROAD TO ANSTEY ROAD

Main Roads Western Australia

Figure 7D

Map Document: K:\ED Engineering & Design\ED66 GIS\07_Armadale Road Duplication\02_MXDs\06_ClearingPermitAmendment\Fig7_ConservationSignificantCommunities.mxd (dfotheri)

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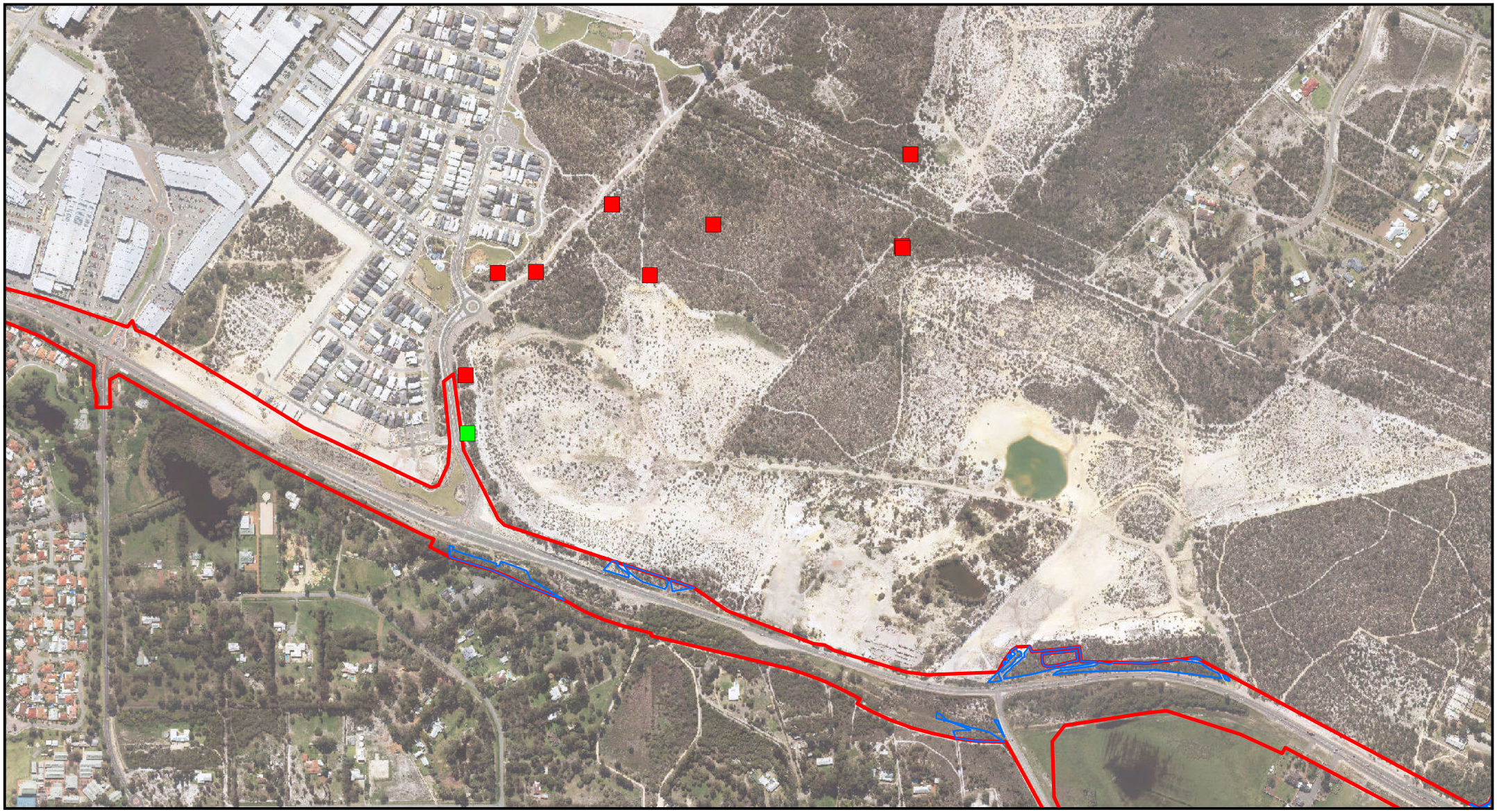

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Metropolitan Road Improvement Alliance

N

DATUM GDA 1994, PROJECTION PERTH COASTAL GRID 1994

0 50 100 150 200
metres

1:10,000 when printed at A4

LEGEND

- Clearing Permit Application Area
- Development Envelope
- Desktop Threatened *Caladenia huegelii*
- Field Survey *Caladeniahuegelii*

Caladenia huegleii in proximity to the Project

ARMADALE ROAD UPGRADE DUAL CARRIAGEWAY – TAPPER ROAD TO ANSTEY ROAD

Main Roads Western Australia

Figure 8

Map Document: K:\ED Engineering & Design\ED66 GIS\07_Armadale Road Duplication\02_MXDs\06_ClearingPermitAmendment\Fig8_ThreatenedFlora.mxd (dfotheri)

A4 size

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N

DATUM GDA 1994, PROJECTION PERTH COASTAL GRID 1994

0 50 100 150 200
metres

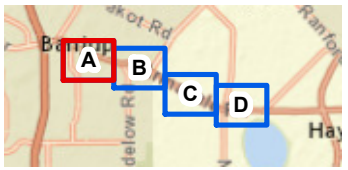
1:10,000 when printed at A4

LEGEND

- Clearing Permit Application Area
- Development Envelope

Fauna Habitat

- Wetlands and Riparian Vegetation
- Woodland



Fauna Habitat within Additional Clearing Permit Area

ARMADALE ROAD UPGRADE DUAL CARRIAGEWAY – TAPPER ROAD TO ANSTEY ROAD

Main Roads Western Australia

Figure 9A

Map Document: K:\ED Engineering & Design\ED66 GIS\07_Armadale Road Duplication\02_MXDs\06_ClearingPermitAmendment\Fig9_FaunaHabitats.mxd (dfotheri)

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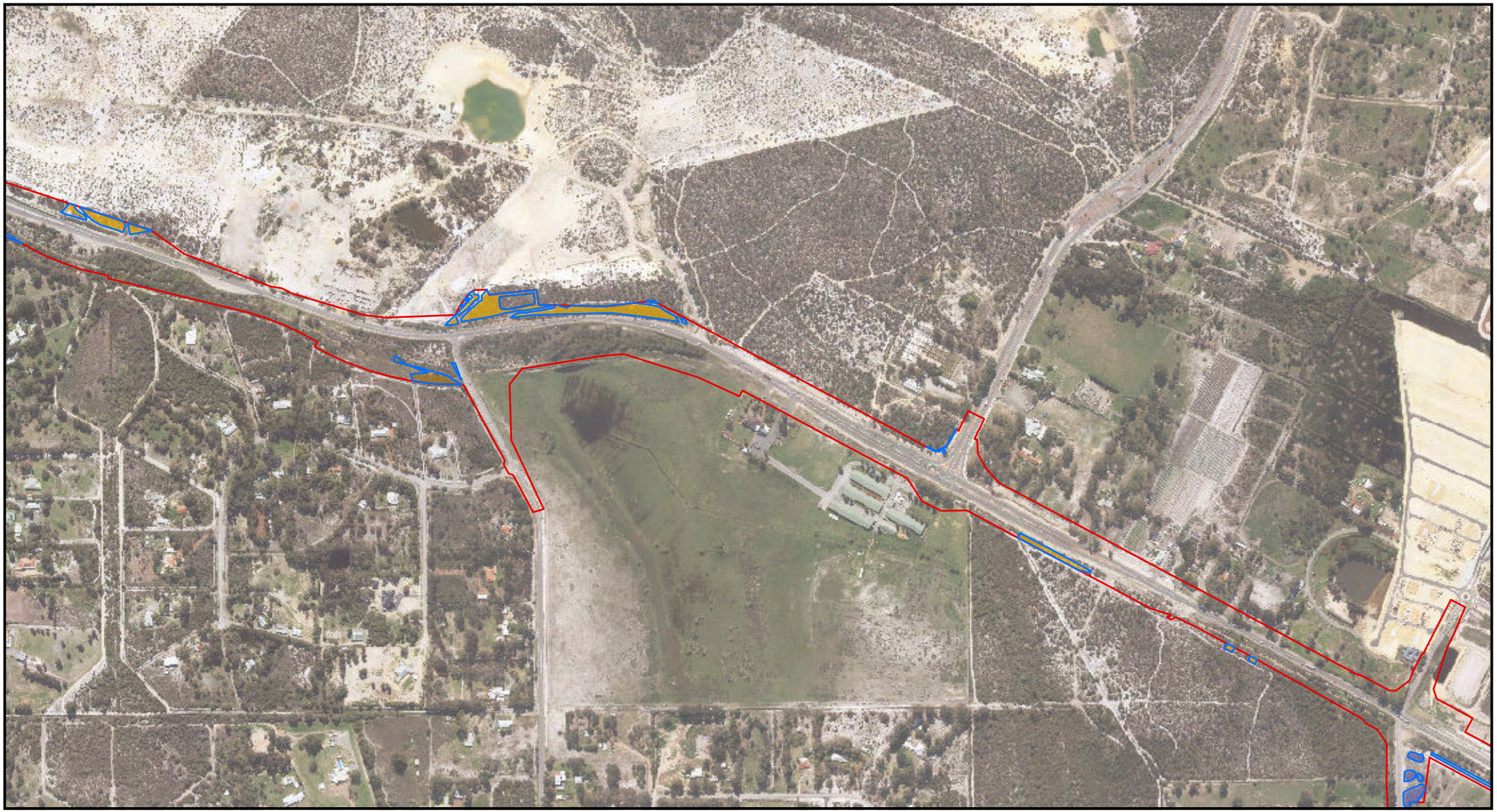

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Metropolitan Road Improvement Alliance

N

DATUM GDA 1994, PROJECTION PERTH COASTAL GRID 1994

0 50 100 150 200
metres

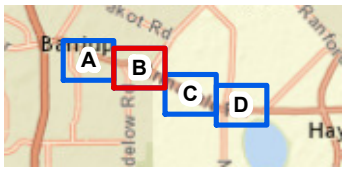
1:10,000 when printed at A4

LEGEND

- Clearing Permit Application Area
- Development Envelope

Fauna Habitat

- Isolated Trees
- Wetlands and Riparian Vegetation
- Woodland



Fauna Habitat within Additional Clearing Permit Area

ARMADALE ROAD UPGRADE DUAL CARRIAGEWAY – TAPPER ROAD TO ANSTEY ROAD

Main Roads Western Australia

Figure 9B

Map Document: K:\ED Engineering & Design\ED66 GIS\07_Armadale Road Duplication\02_MXDs\06_ClearingPermitAmendment\Fig9_FaunaHabitats.mxd (dfotheri)

A4 size

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LAST MODIFIED 31 JAN 2018

Metropolitan Road Improvement Alliance

N

DATUM GDA 1994, PROJECTION PERTH COASTAL GRID 1994

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metres

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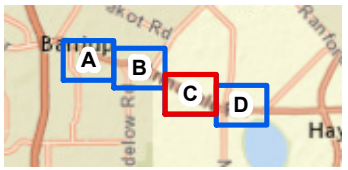
LEGEND

- Clearing Permit Application Area
- Development Envelope

Fauna Habitat

- Isolated Trees
- Woodland



Fauna Habitat within Additional Clearing Permit Area

ARMADALE ROAD UPGRADE DUAL CARRIAGEWAY – TAPPER ROAD TO ANSTEY ROAD

Main Roads Western Australia

Figure 9C

Map Document: K:\ED Engineering & Design\ED66 GIS\07_Armadale Road Duplication\02_MXDs\06_ClearingPermitAmendment\Fig9_FaunaHabitats.mxd (dfotheri)

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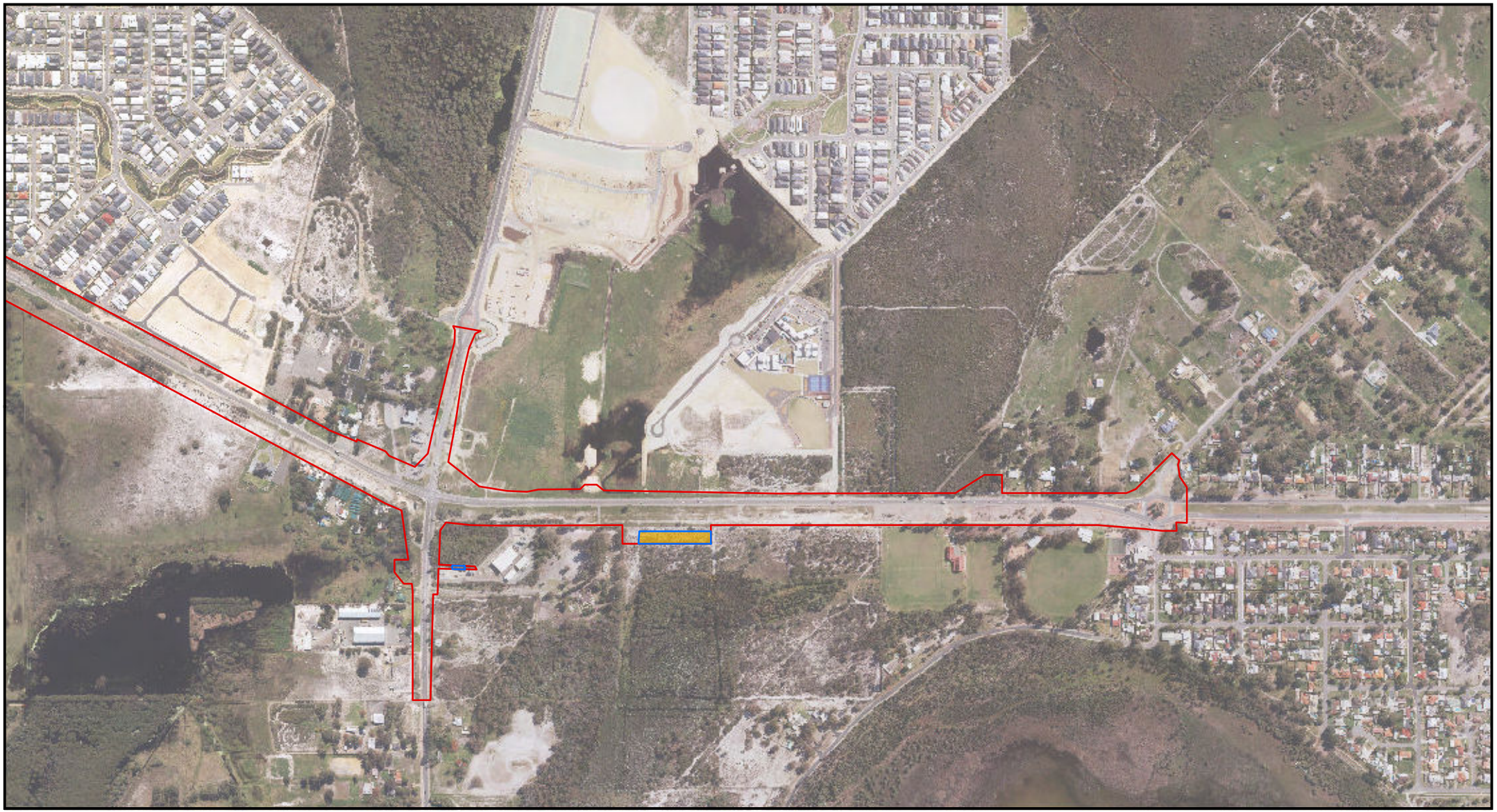

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metres

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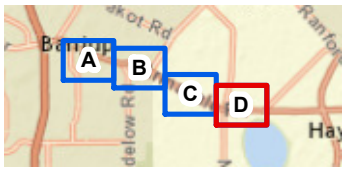
LEGEND

Clearing Permit Application Area
Development Envelope

Fauna Habitat

Woodland



Fauna Habitat within Additional Clearing Permit Area

ARMADALE ROAD UPGRADE DUAL CARRIAGEWAY – TAPPER ROAD TO ANSTEY ROAD

Main Roads Western Australia

Figure 9D

Map Document: K:\ED Engineering & Design\ED66 GIS\07_Armadale Road Duplication\02_MXDs\06_ClearingPermitAmendment\Fig9_FaunaHabitats.mxd (dfotheri)

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Metropolitan Road Improvement Alliance

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DATUM GDA 1994, PROJECTION PERTH COASTAL GRID 1994

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metres

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LEGEND

- Clearing Permit Application Area
- Development Envelope

Foraging Evidence

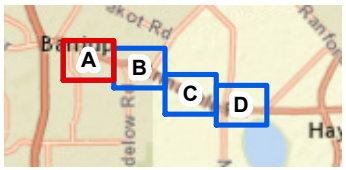
- Carnaby's Cockatoo

Black Cockatoo Breeding Trees

- Stag

Carnaby's Cockatoo Foraging Quality

- Low Quality
- High Quality
- Very High Quality



Carnaby's Black Cockatoo Foraging Habitat within Additional Clearing Permit Area

ARMADALE ROAD UPGRADE DUAL CARRIAGEWAY – TAPPER ROAD TO ANSTEY ROAD

Main Roads Western Australia

Figure 10A

Map Document: K:\ED Engineering & Design\ED66 GIS\07_Armadale Road Duplication\02_MXDs\06_ClearingPermitAmendment\Fig10_CarnabyForagingHabitat.mxd (dfotheri)

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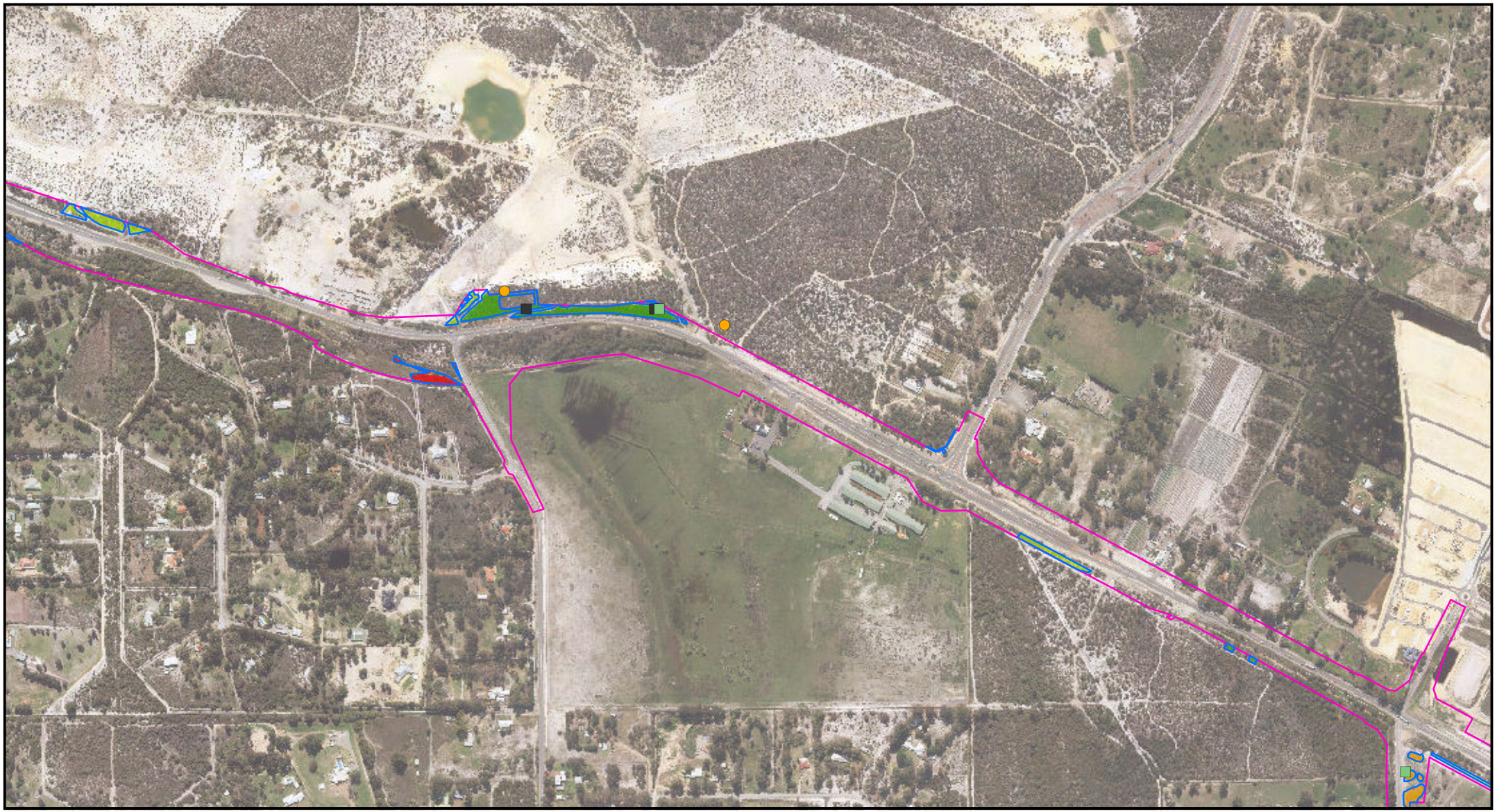

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DATUM GDA 1994, PROJECTION PERTH COASTAL GRID 1994

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1:10,000 when printed at A4

LEGEND

- Clearing Permit Application
- Development Envelope

Foraging Evidence

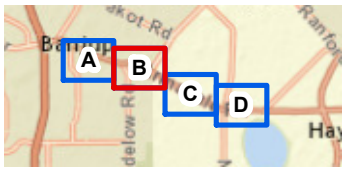
- Carnaby's Cockatoo

Black Cockatoo Breeding Trees

- Potential Breeding Trees
- Stag

Carnaby's Cockatoo Foraging Quality

- Low Quality
- Quality
- High Quality
- Very High Quality



Carnaby's Black Cockatoo Foraging Habitat within Additional Clearing Permit Area

ARMADALE ROAD UPGRADE DUAL CARRIAGEWAY – TAPPER ROAD TO ANSTEY ROAD

Main Roads Western Australia

Figure 10B

Map Document: K:\ED Engineering & Design\ED66 GIS\07_Armadale Road Duplication\02_MXDs\06_ClearingPermitAmendment\Fig10_CarnabyForagingHabitat.mxd (dfotheri)

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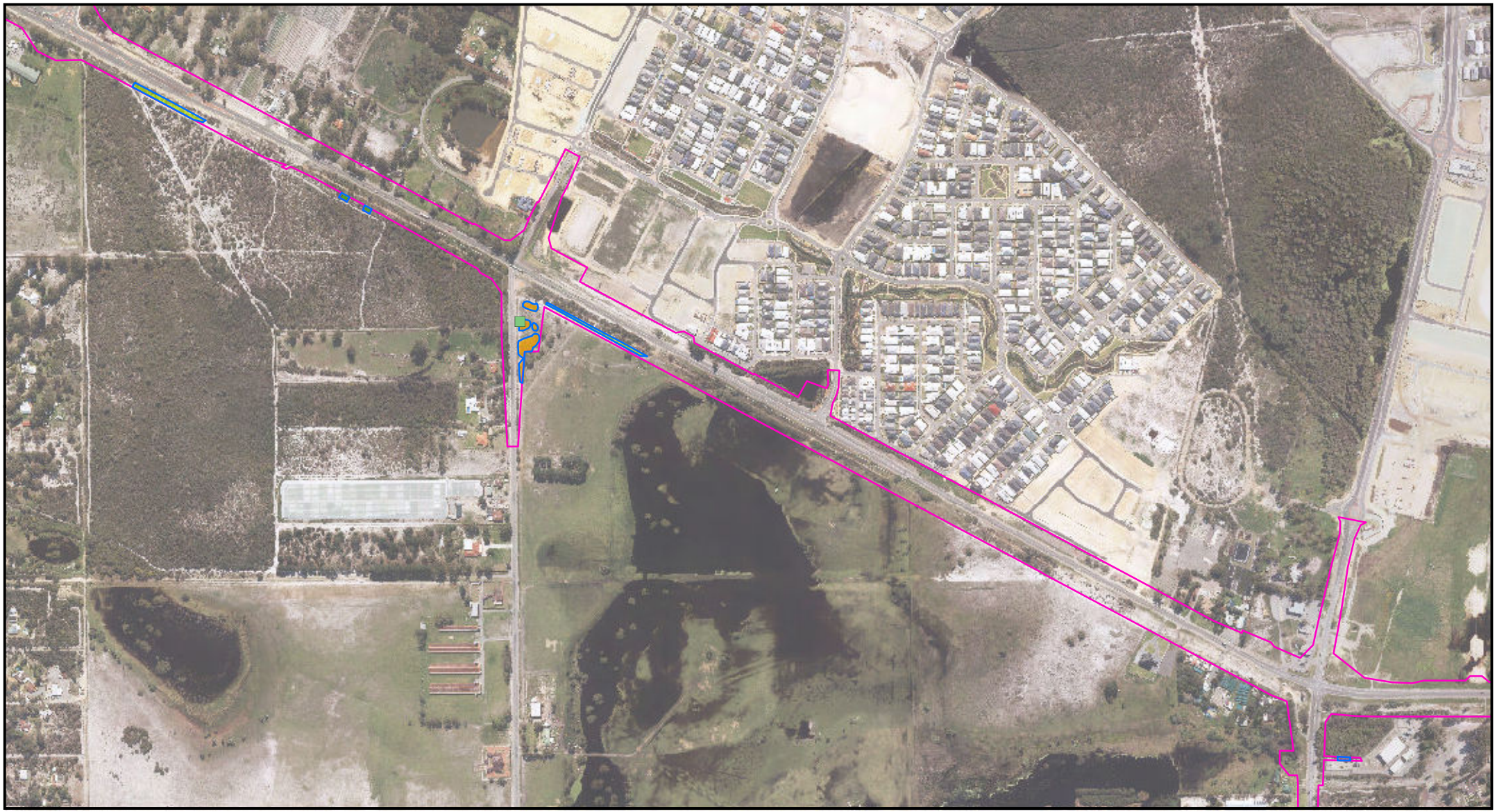

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LEGEND

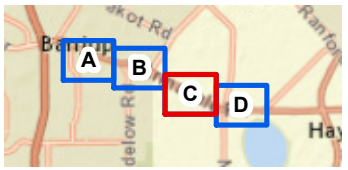
- Clearing Permit Application
- Development Envelope

Black Cockatoo Breeding Trees

- Potential Breeding Trees

Carnaby's Cockatoo Foraging Quality

- Quality
- High Quality
- Very High Quality



Carnaby's Black Cockatoo Foraging Habitat within Additional Clearing Permit Area

ARMADALE ROAD UPGRADE DUAL CARRIAGEWAY – TAPPER ROAD TO ANSTEY ROAD

Main Roads Western Australia

Figure 10C

Map Document: K:\ED Engineering & Design\ED66 GIS\07_Armadale Road Duplication\02_MXDs\06_ClearingPermitAmendment\Fig10_CarnabyForagingHabitat.mxd (dfotheri)

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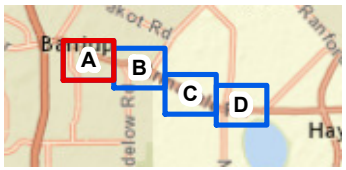
LEGEND

- Clearing Permit Application
- Development Envelope

Black Cockatoo Breeding

- Stag

- Quality
- Very High Quality



Forest Red-tailed Black Cockatoo Foraging Quality within Additional Clearing Permit Area

ARMADALE ROAD UPGRADE DUAL CARRIAGEWAY – TAPPER ROAD TO ANSTEY ROAD

Main Roads Western Australia

Figure 11A

Map Document: K:\ED Engineering & Design\ED66 GIS\07_Armadale Road Duplication\02_MXDs\06_ClearingPermitAmendment\Fig11_FRTForagingHabitat.mxd (dfotheri)

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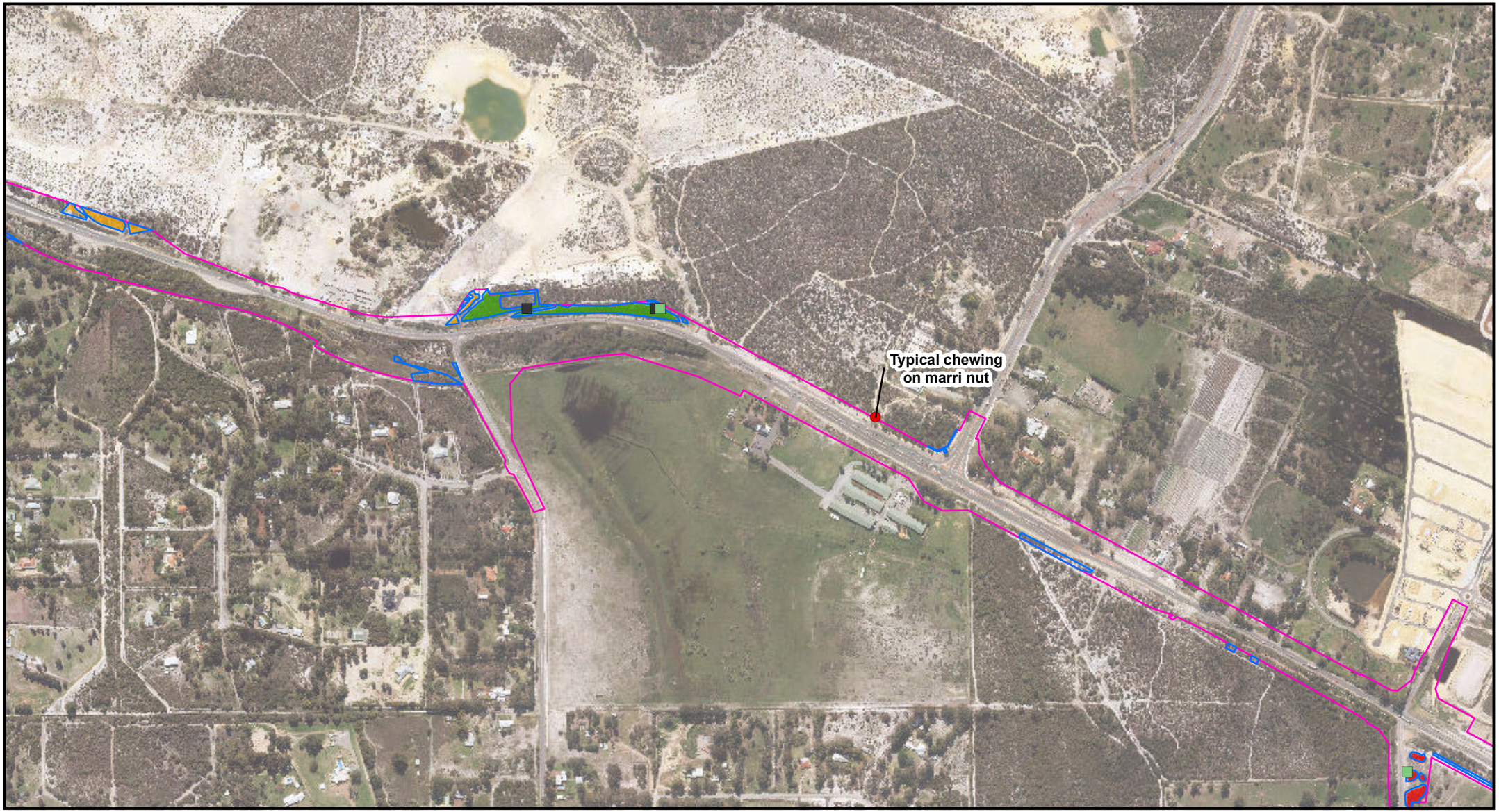

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DATUM GDA 1994, PROJECTION PERTH COASTAL GRID 1994

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metres

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LEGEND

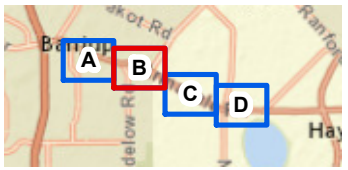
- Clearing Permit Application
- Development Envelope

Foraging Evidence

- Forest Red-tailed Black

Black Cockatoo Breeding

- Potential Breeding
- Stag
- Low Quality
- Quality
- Very High Quality



Forest Red-tailed Black Cockatoo Foraging Quality within Additional Clearing Permit Area

ARMADALE ROAD UPGRADE DUAL CARRIAGEWAY – TAPPER ROAD TO ANSTEY ROAD

Main Roads Western Australia

Figure 11B

Map Document: K:\ED Engineering & Design\ED66 GIS\07_Armadale Road Duplication\02_MXDs\06_ClearingPermitAmendment\Fig11_FRTForagingHabitat.mxd (dfotheri)

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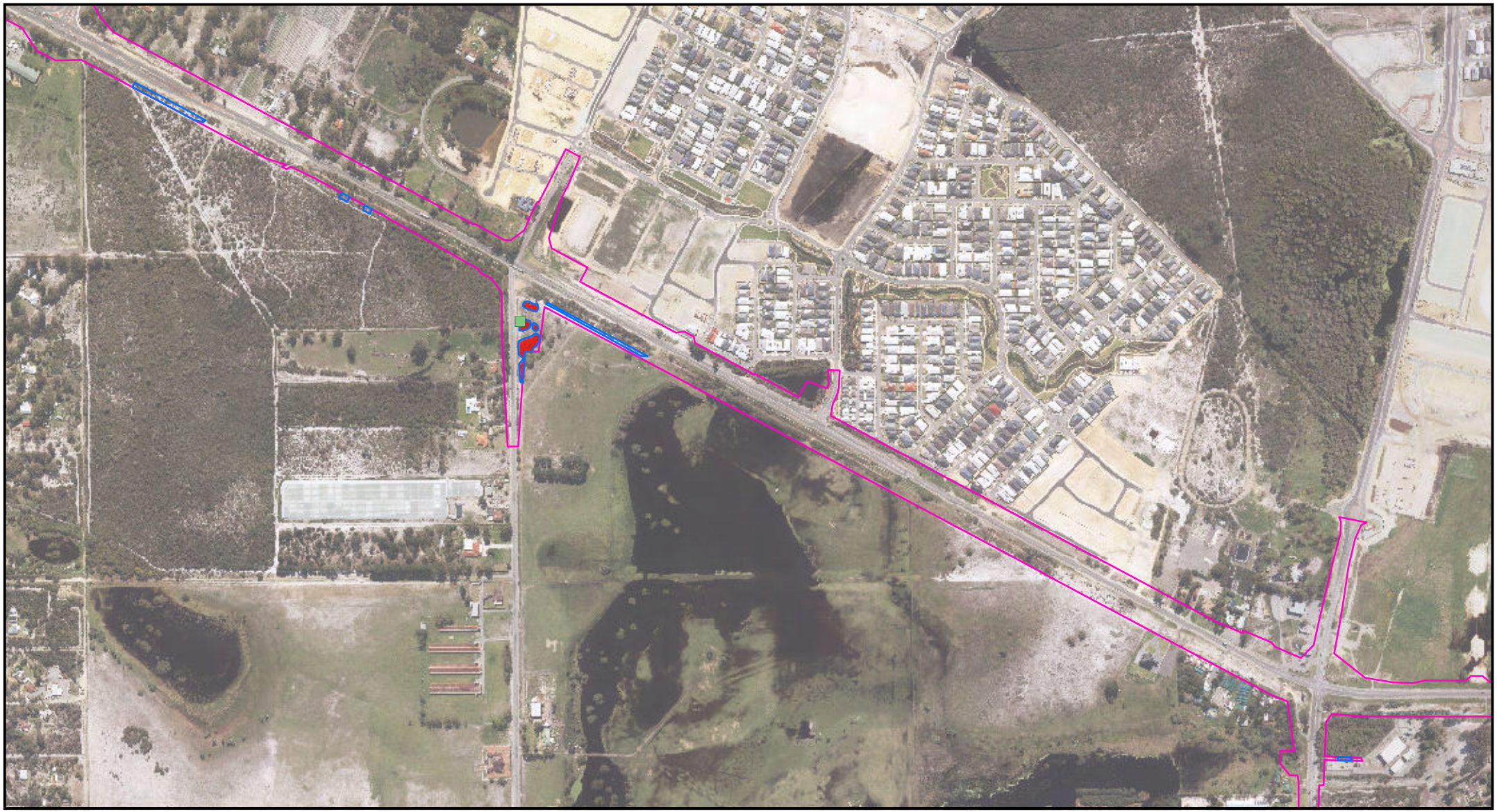

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DATUM GDA 1994, PROJECTION PERTH COASTAL GRID 1994

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metres

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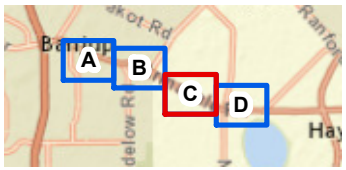
LEGEND

- Clearing Permit Application
- Development
- Low Quality

Black Cockatoo Breeding

- Potential Breeding



Forest Red-tailed Black Cockatoo Foraging Quality within Additional Clearing Permit Area

ARMADALE ROAD UPGRADE DUAL CARRIAGEWAY – TAPPER ROAD TO ANSTEY ROAD

Main Roads Western Australia

Figure 11C

Map Document: K:\ED Engineering & Design\ED66 GIS\07_Armadale Road Duplication\02_MXDs\06_ClearingPermitAmendment\Fig11_FRTForagingHabitat.mxd (dfotheri)

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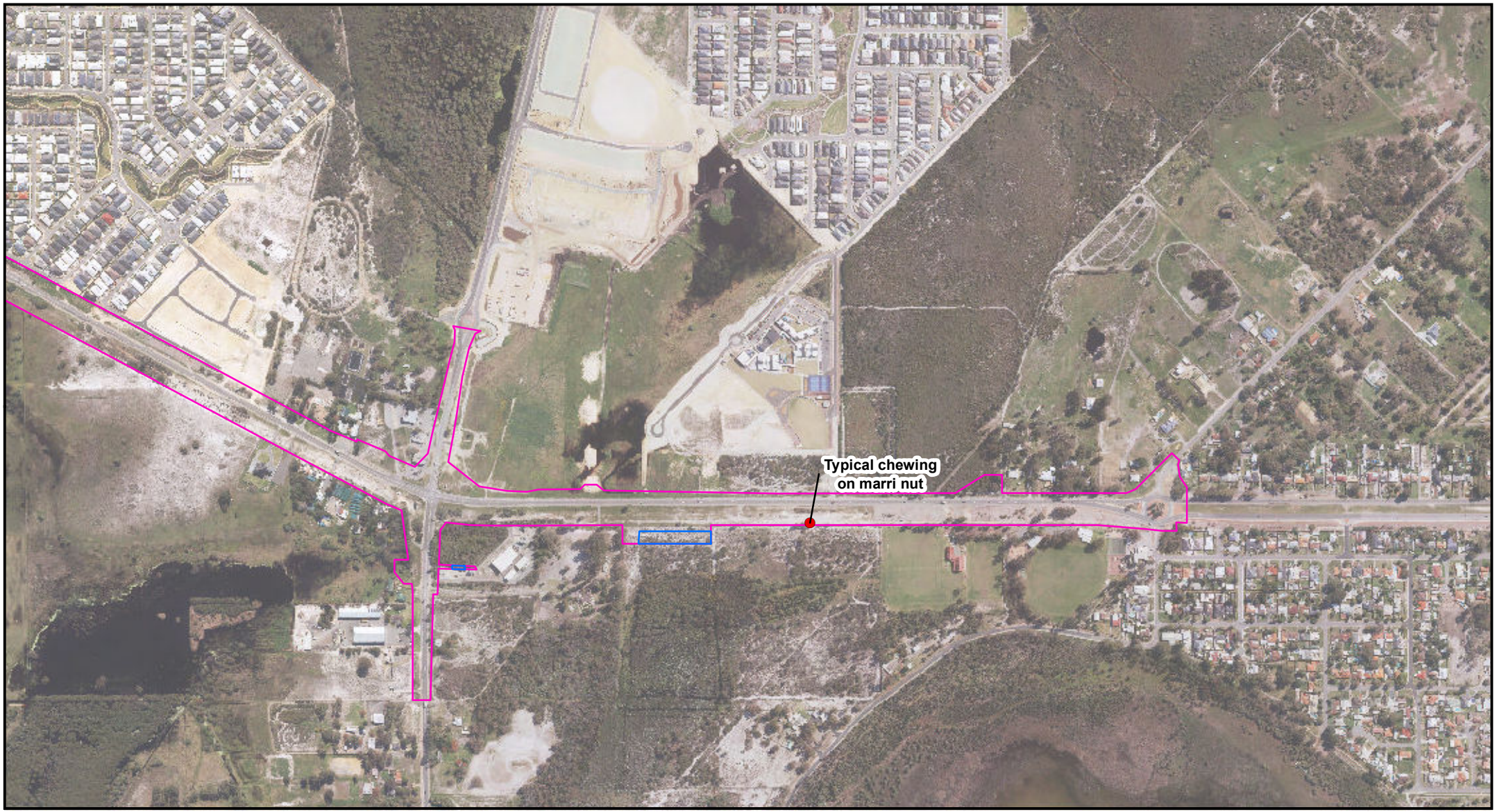

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DATUM GDA 1994, PROJECTION PERTH COASTAL GRID 1994

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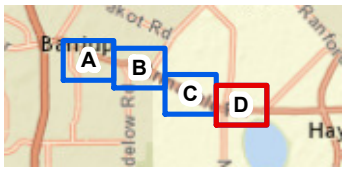
LEGEND

Clearing Permit Application Area

Development Envelope

Foraging Evidence

Forest Red-tailed Black Cockatoo



Forest Red-tailed Black Cockatoo Foraging Quality within Additional Clearing Permit Area

ARMADALE ROAD UPGRADE DUAL CARRIAGEWAY – TAPPER ROAD TO ANSTEY ROAD

Main Roads Western Australia

Figure 11D

Map Document: K:\ED Engineering & Design\ED66 GIS\07_Armadale Road Duplication\02_MXDs\06_ClearingPermitAmendment\Fig11_FRTForagingHabitat.mxd (dfotheri)

A4 size

APPENDIX 1 DESKTOP SEARCHES

NatureMap
Mapping Western Australia's biodiversity

NatureMap Species Report

Created By Guest user on 11/01/2018

Kingdom Animalia
Current Names Only Yes
Core Datasets Only Yes
Method 'By Circle'
Centre 115° 53' 49" E,32° 08' 10" S
Buffer 5km
Group By Species Group

Species Group	Species	Records
Amphibian	9	93
Bird	170	27844
Invertebrate	21	52
Mammal	11	228
Reptile	36	287
TOTAL	**247**	**28504**

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
Amphibian					
1.	25398	*Crinia georgiana (Quacking Frog)*			
2.	25399	*Crinia glauerti (Clicking Frog)*			
3.	25400	*Crinia insignifera (Squelching Froglet)*			
4.	25410	*Heleioporus eyrei (Moaning Frog)*			
5.	25415	*Limnodynastes dorsalis (Western Banjo Frog)*			
6.	25378	*Litoria adelaidensis (Slender Tree Frog)*			
7.	25388	*Litoria moorei (Motorbike Frog)*			
8.	25420	*Myobatrachus gouldii (Turtle Frog)*			
9.	25433	*Pseudophryne guentheri (Crawling Toadlet)*			
Bird					
10.	24260	*Acanthiza apicalis (Broad-tailed Thornbill, Inland Thornbill)*			
11.	24261	*Acanthiza chrysorrhoa (Yellow-rumped Thornbill)*			
12.	24262	*Acanthiza inornata (Western Thornbill)*			
13.	24560	*Acanthorhynchus superciliosus (Western Spinebill)*			
14.	25535	*Accipiter cirrocephalus (Collared Sparrowhawk)*			
15.	25536	*Accipiter fasciatus (Brown Goshawk)*			
16.	25755	*Acrocephalus australis (Australian Reed Warbler)*			
17.	24310	*Anas castanea (Chestnut Teal)*			
18.	24312	*Anas gracilis (Grey Teal)*			
19.	24315	*Anas rhynchotis (Australasian Shoveler)*			
20.	24316	*Anas superciliosa (Pacific Black Duck)*			
21.	47414	*Anhinga novaehollandiae (Australasian Darter)*			
22.		*Anser anser*			
23.	24561	*Anthochaera carunculata (Red Wattlebird)*			
24.	24562	*Anthochaera lunulata (Western Little Wattlebird)*			
25.	25554	*Apus pacificus (Fork-tailed Swift, Pacific Swift)*		IA	
26.	24285	*Aquila audax (Wedge-tailed Eagle)*			
27.	24337	*Ardea garzetta subsp. nigripes (Little Egret)*			
28.	25558	*Ardea ibis (Cattle Egret)*		IA	
29.	41324	*Ardea modesta (great egret, white egret)*		IA	
30.	24340	*Ardea novaehollandiae (White-faced Heron)*			
31.	24341	*Ardea pacifica (White-necked Heron)*			
32.	25736	*Arenaria interpres (Ruddy Turnstone)*		IA	
33.	25566	*Artamus cinereus (Black-faced Woodswallow)*			
34.	24352	*Artamus cinereus subsp. melanops (Black-faced Woodswallow)*			
35.	24353	*Artamus cyanopterus (Dusky Woodswallow)*			
36.	24318	*Aythya australis (Hardhead)*			
37.		*Barnardius zonarius*			
38.	24319	*Biziura lobata (Musk Duck)*			
39.	24345	*Botaurus poiciloptilus (Australasian Bittern)*		T	

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
40.	25713	*Cacatua galerita (Sulphur-crested Cockatoo)*			
41.	25714	*Cacatua pastinator (Western Long-billed Corella)*			
42.	25716	*Cacatua sanguinea (Little Corella)*			
43.	24729	*Cacatua tenuirostris (Eastern Long-billed Corella)*	Y		
44.	25598	*Cacomantis flabelliformis (Fan-tailed Cuckoo)*			
45.	42307	*Cacomantis pallidus (Pallid Cuckoo)*			
46.	24779	*Calidris acuminata (Sharp-tailed Sandpiper)*		IA	
47.	24784	*Calidris ferruginea (Curlew Sandpiper)*		T	
48.	24786	*Calidris melanotos (Pectoral Sandpiper)*		IA	
49.	24788	*Calidris ruficollis (Red-necked Stint)*		IA	
50.	24789	*Calidris subminuta (Long-toed Stint)*		IA	
51.	25717	*Calyptorhynchus banksii (Red-tailed Black-Cockatoo)*			
52.	24731	*Calyptorhynchus banksii subsp. naso (Forest Red-tailed Black-Cockatoo)*		T	
53.	24734	*Calyptorhynchus latirostris (Carnaby's Cockatoo (short-billed black-cockatoo), Carnaby's Cockatoo)*		T	
54.	48400	*Calyptorhynchus sp. (white-tailed black cockatoo)*		T	
55.	25575	*Charadrius leschenaultii (Greater Sand Plover)*		IA	
56.	24377	*Charadrius ruficapillus (Red-capped Plover)*			
57.	24321	*Chenonetta jubata (Australian Wood Duck, Wood Duck)*			
58.		*Chroicocephalus novaehollandiae*			
59.	24288	*Circus approximans (Swamp Harrier)*			
60.	24289	*Circus assimilis (Spotted Harrier)*			
61.	24774	*Cladorhynchus leucocephalus (Banded Stilt)*			
62.	25675	*Colluricincla harmonica (Grey Shrike-thrush)*			
63.	24399	*Columba livia (Domestic Pigeon)*	Y		
64.	25568	*Coracina novaehollandiae (Black-faced Cuckoo-shrike)*			
65.	25592	*Corvus coronoides (Australian Raven)*			
66.	24671	*Coturnix pectoralis (Stubble Quail)*			
67.	25701	*Coturnix ypsilophora (Brown Quail)*			
68.	24673	*Coturnix ypsilophora subsp. australis (Brown Quail)*			
69.	25595	*Cracticus tibicen (Australian Magpie)*			
70.	25596	*Cracticus torquatus (Grey Butcherbird)*			
71.	24322	*Cygnus atratus (Black Swan)*			
72.	30901	*Dacelo novaeguineae (Laughing Kookaburra)*	Y		
73.	25673	*Daphoenositta chrysoptera (Varied Sittella)*			
74.	25607	*Dicaeum hirundinaceum (Mistletoebird)*			
75.		*Egretta garzetta*			
76.		*Egretta novaehollandiae*			
77.		*Elanus axillaris*			
78.	47937	*Elseyornis melanops (Black-fronted Dotterel)*			
79.		*Eolophus roseicapillus*			
80.	24567	*Epthianura albifrons (White-fronted Chat)*			
81.	24379	*Erythrogonys cinctus (Red-kneed Dotterel)*			
82.	24368	*Eurostopodus argus (Spotted Nightjar)*			
83.	25621	*Falco berigora (Brown Falcon)*			
84.	25622	*Falco cenchroides (Australian Kestrel, Nankeen Kestrel)*			
85.	25623	*Falco longipennis (Australian Hobby)*			
86.	25624	*Falco peregrinus (Peregrine Falcon)*		S	
87.	25727	*Fulica atra (Eurasian Coot)*			
88.	24761	*Fulica atra subsp. australis (Eurasian Coot)*			
89.	25729	*Gallinula tenebrosa (Dusky Moorhen)*			
90.	24763	*Gallinula tenebrosa subsp. tenebrosa (Dusky Moorhen)*			
91.	25730	*Gallirallus philippensis (Buff-banded Rail)*			
92.	47954	*Gelochelidon nilotica (Gull-billed Tern)*		IA	
93.	25530	*Gerygone fusca (Western Gerygone)*			
94.	47962	*Glyciphila melanops (Tawny-crowned Honeyeater)*			
95.	24443	*Grallina cyanoleuca (Magpie-lark)*			
96.	24293	*Haliaeetus leucogaster (White-bellied Sea-Eagle)*			
97.	24295	*Haliastur sphenurus (Whistling Kite)*			
98.	47965	*Hieraaetus morphnoides (Little Eagle)*			
99.	25734	*Himantopus himantopus (Black-winged Stilt)*			
100.	24491	*Hirundo neoxena (Welcome Swallow)*			
101.	47975	*Ixobrychus dubius (Australian Little Bittern)*		P4	
102.	24511	*Larus novaehollandiae subsp. novaehollandiae (Silver Gull)*			
103.	25661	*Lichmera indistincta (Brown Honeyeater)*			
104.	25741	*Limosa limosa (Black-tailed Godwit)*		IA	
105.		*Lophoictinia isura*			
106.	24326	*Malacorhynchus membranaceus (Pink-eared Duck)*			
107.	25654	*Malurus splendens (Splendid Fairy-wren)*			
108.	24583	*Manorina flavigula (Yellow-throated Miner)*			

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
109.	25758	*Megalurus gramineus (Little Grassbird)*			
110.	47997	*Melanodryas cucullata (Hooded Robin)*			
111.	25663	*Melithreptus brevirostris (Brown-headed Honeyeater)*			
112.	24587	*Melithreptus chloropsis (Western White-naped Honeyeater)*			
113.	24598	*Merops ornatus (Rainbow Bee-eater)*		IA	
114.		*Microcarbo melanoleucos*			
115.	25542	*Milvus migrans (Black Kite)*			
116.	25610	*Myiagra inquieta (Restless Flycatcher)*			
117.	24738	*Neophema elegans (Elegant Parrot)*			
118.	25564	*Nycticorax caledonicus (Rufous Night Heron)*			
119.	24742	*Nymphicus hollandicus (Cockatiel)*			
120.	24407	*Ocyphaps lophotes (Crested Pigeon)*			
121.	24328	*Oxyura australis (Blue-billed Duck)*		P4	
122.	25680	*Pachycephala rufiventris (Rufous Whistler)*			
123.		*Pandion cristatus*			
124.	25543	*Pandion haliaetus (Osprey)*		IA	
125.	25681	*Pardalotus punctatus (Spotted Pardalote)*			
126.	25682	*Pardalotus striatus (Striated Pardalote)*			
127.	24648	*Pelecanus conspicillatus (Australian Pelican)*			
128.	48060	*Petrochelidon ariel (Fairy Martin)*			
129.	48061	*Petrochelidon nigricans (Tree Martin)*			
130.	48066	*Petroica boodang (Scarlet Robin)*			
131.	24659	*Petroica goodenovii (Red-capped Robin)*			
132.	25697	*Phalacrocorax carbo (Great Cormorant)*			
133.	25698	*Phalacrocorax melanoleucos (Little Pied Cormorant)*			
134.	24667	*Phalacrocorax sulcirostris (Little Black Cormorant)*			
135.	25699	*Phalacrocorax varius (Pied Cormorant)*			
136.	24409	*Phaps chalcoptera (Common Bronzewing)*			
137.	25587	*Phaps elegans (Brush Bronzewing)*			
138.	48071	*Phylidonyris niger (White-cheeked Honeyeater)*			
139.	24596	*Phylidonyris novaehollandiae (New Holland Honeyeater)*			
140.	24841	*Platalea flavipes (Yellow-billed Spoonbill)*			
141.	25720	*Platycercus icterotis (Western Rosella)*			
142.	24843	*Plegadis falcinellus (Glossy Ibis)*		IA	
143.	24382	*Pluvialis fulva (Pacific Golden Plover)*		IA	
144.	24383	*Pluvialis squatarola (Grey Plover)*		IA	
145.	25703	*Podargus strigoides (Tawny Frogmouth)*			
146.	25704	*Podiceps cristatus (Great Crested Grebe)*			
147.	24681	*Poliocephalus poliocephalus (Hoary-headed Grebe)*			
148.	25722	*Polytelis anthopeplus (Regent Parrot)*			
149.	25731	*Porphyrio porphyrio (Purple Swamphen)*			
150.	24767	*Porphyrio porphyrio subsp. bellus (Purple Swamphen)*			
151.	24769	*Porzana fluminea (Australian Spotted Crake)*			
152.	25732	*Porzana pusilla (Baillon's Crake)*			
153.	24771	*Porzana tabuensis (Spotless Crake)*			
154.	48085	*Psittacula krameri (Indian Ringnecked Parrot, Rose-ringed Parakeet)*	Y		
155.		*Purpureicephalus spurius*			
156.	24776	*Recurvirostra novaehollandiae (Red-necked Avocet)*			
157.	48096	*Rhipidura albiscapa (Grey Fantail)*			
158.	25614	*Rhipidura leucophrys (Willie Wagtail)*			
159.	25534	*Sericornis frontalis (White-browed Scrubwren)*			
160.	30948	*Smicrornis brevirostris (Weebill)*			
161.	24516	*Stercorarius longicaudus (long-tailed jaeger, long-tailed skua)*		IA	
162.	24329	*Stictonetta naevosa (Freckled Duck)*			
163.	25597	*Strepera versicolor (Grey Currawong)*			
164.	25589	*Streptopelia chinensis (Spotted Turtle-Dove)*	Y		
165.	25590	*Streptopelia senegalensis (Laughing Turtle-Dove)*	Y		
166.	30950	*Streptopelia senegalensis subsp. senegalensis (Laughing Turtle-Dove)*	Y		
167.	25705	*Tachybaptus novaehollandiae (Australasian Grebe, Black-throated Grebe)*			
168.	24682	*Tachybaptus novaehollandiae subsp. novaehollandiae (Australasian Grebe, Black-throated Grebe)*			
169.	24331	*Tadorna tadornoides (Australian Shelduck, Mountain Duck)*			
170.	24845	*Threskiornis spinicollis (Straw-necked Ibis)*			
171.	25549	*Todiramphus sanctus (Sacred Kingfisher)*			
172.	48141	*Tribonyx ventralis (Black-tailed Native-hen)*			
173.	25723	*Trichoglossus haematodus (Rainbow Lorikeet)*			
174.	24806	*Tringa glareola (Wood Sandpiper)*		IA	
175.	24808	*Tringa nebularia (Common Greenshank, greenshank)*		IA	
176.	24809	*Tringa stagnatilis (Marsh Sandpiper, little greenshank)*		IA	
177.	48147	*Turnix varius (Painted Button-quail)*			

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
178.	24386	*Vanellus tricolor (Banded Lapwing)*			
179.	25765	*Zosterops lateralis (Grey-breasted White-eye, Silvereye)*			
Invertebrate					
180.		*Aname mainae*			
181.		*Aname tepperi*			
182.	33939	*Cherax cainii (Marron)*			
183.		*Cherax destructor*			
184.		*Cherax preissii*			
185.		*Cherax quinquecarinatus*			
186.		*Cherax sp.*			
187.		*Cormocephalus aurantiipes*			
188.		*Dingosa serrata*			
189.		*Eodelena convexa*			
190.		*Isopeda leishmanni*			
191.		*Lampona cylindrata*			
192.		*Latrodectus hasseltii*			
193.	33982	*Leioproctus contrarius (short-tongued bee)*		P3	
194.		*Lycosa gilberta*			
195.		*Missulena granulosa*			
196.		*Mituliodon tarantulinus*			
197.	33984	*Neopasiphae simplicior (short-tongued bee)*		T	
198.	33992	*Synemon gratiosa (Graceful Sunmoth)*		P4	
199.	33994	*Throscodectes xiphos (cricket)*		P1	Y
200.		*Urodacus novaehollandiae*			
Mammal					
201.	24215	*Hydromys chrysogaster (Water-rat, Rakali)*		P4	
202.	25478	*Isoodon obesulus (Southern Brown Bandicoot)*		P4	
203.	24153	*Isoodon obesulus subsp. fusciventer (Quenda, Southern Brown Bandicoot)*		P4	
204.	24132	*Macropus fuliginosus (Western Grey Kangaroo)*			
205.	24133	*Macropus irma (Western Brush Wallaby)*		P4	
206.	24223	*Mus musculus (House Mouse)*	Y		
207.	24146	*Myrmecobius fasciatus (Numbat, Walpurti)*		T	
208.	24245	*Rattus rattus (Black Rat)*	Y		
209.	24167	*Tarsipes rostratus (Honey Possum, Noolbenger)*			
210.	24158	*Trichosurus vulpecula subsp. vulpecula (Common Brushtail Possum)*			
211.	24040	*Vulpes vulpes (Red Fox)*	Y		
Reptile					
212.	42368	*Acritoscincus trilineatus (Western Three-lined Skink)*			
213.	44629	*Anilios australis*			
214.	24991	*Aprasia repens (Sand-plain Worm-lizard)*			
215.	42381	*Brachyurophis semifasciatus (Southern Shovel-nosed Snake)*			
216.	43380	*Chelodina colliei (South-western Snake-necked Turtle)*			
217.	24980	*Christinus marmoratus (Marbled Gecko)*			
218.	30893	*Cryptoblepharus buchananii*			
219.	30899	*Ctenophorus adelaidensis (Southern Heath Dragon, Western Heath Dragon)*			
220.	25027	*Ctenotus australis*			
221.	25040	*Ctenotus gemmula (Jewelled South-west Ctenotus (Swan Coastal Plain pop P3), skink)*			
222.	25766	*Delma fraseri (Fraser's Legless Lizard)*			
223.	24999	*Delma grayii*			
224.	25296	*Demansia psammophis subsp. reticulata (Yellow-faced Whipsnake)*			
225.	25100	*Egernia napoleonis*			
226.	25250	*Elapognathus coronatus (Crowned Snake)*			
227.	24959	*Gehyra variegata*			
228.	25119	*Hemiergis quadrilineata*			
229.	25131	*Lerista distinguenda*			
230.	25133	*Lerista elegans*			
231.	25147	*Lerista lineata (Perth Slider, Lined Skink)*		P3	
232.	25005	*Lialis burtonis*			
233.	25184	*Menetia greyii*			
234.	25192	*Morethia obscura*			
235.	25252	*Notechis scutatus (Tiger Snake)*			
236.	25253	*Parasuta gouldii*			
237.	25007	*Pletholax gracilis subsp. gracilis (Keeled Legless Lizard)*			
238.	25510	*Pogona minor (Dwarf Bearded Dragon)*			
239.	25511	*Pseudonaja affinis (Dugite)*			
240.	25259	*Pseudonaja affinis subsp. affinis (Dugite)*			
241.	25008	*Pygopus lepidopodus (Common Scaly Foot)*			
242.	25203	*Tiliqua occipitalis (Western Bluetongue)*			

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
243.	25519	*Tiliqua rugosa*			
244.	25204	*Tiliqua rugosa subsp. aspera*			
245.	25207	*Tiliqua rugosa subsp. rugosa*			
246.	25218	*Varanus gouldii (Bungarra or Sand Monitor)*			
247.	25225	*Varanus rosenbergi (Heath Monitor)*			

Conservation Codes
T - Rare or likely to become extinct
X - Presumed extinct
IA - Protected under international agreement
S - Other specially protected fauna
1 - Priority 1
2 - Priority 2
3 - Priority 3
4 - Priority 4
5 - Priority 5

[1] For NatureMap's purposes, species flagged as endemic are those whose records are wholely contained within the search area. Note that only those records complying with the search criterion are included in the calculation. For example, if you limit records to those from a specific datasource, only records from that datasource are used to determine if a species is restricted to the query area.

NatureMap
Mapping Western Australia's biodiversity

NatureMap Species Report

Created By Guest user on 11/01/2018

Kingdom Plantae
Current Names Only Yes
Core Datasets Only Yes
Method 'By Circle'
Centre 115° 53' 49" E,32° 08' 10" S
Buffer 5km
Group By Family

Family	Species	Records
Aizoaceae	2	11
Amaranthaceae	1	1
Anarthriaceae	3	38
Apiaceae	5	33
Apocynaceae	1	1
Araceae	1	2
Araliaceae	2	54
Asparagaceae	31	289
Asteraceae	38	226
Boraginaceae	1	1
Byblidaceae	1	1
Campanulaceae	6	51
Caryophyllaceae	5	11
Casuarinaceae	2	9
Celastraceae	1	2
Centrolepidaceae	5	15
Chenopodiaceae	4	5
Colchicaceae	1	48
Commelinaceae	1	3
Crassulaceae	2	31
Cupressaceae	1	1
Cyperaceae	29	108
Dasypogonaceae	2	43
Dilleniaceae	8	66
Droseraceae	10	58
Elaeocarpaceae	1	2
Elatinaceae	1	1
Ericaceae	12	83
Euphorbiaceae	2	5
Fabaceae	37	208
Gentianaceae	1	2
Geraniaceae	2	3
Goodeniaceae	5	38
Haemodoraceae	15	156
Haloragaceae	3	21
Hemerocallidaceae	10	65
Iridaceae	8	119
Juncaceae	5	7
Juncaginaceae	1	1
Lamiaceae	4	6
Lauraceae	1	1
Loganiaceae	1	11
Loranthaceae	1	17
Lythraceae	1	1
Macarthuriaceae	2	9
Marchantiaceae	1	1
Menyanthaceae	1	3
Montiaceae	3	19
Moraceae	1	1
Myrtaceae	35	163
Onagraceae	4	5
Orchidaceae	44	164
Orobanchaceae	1	3
Papaveraceae	1	1
Philydraceae	1	1
Phyllanthaceae	3	8
Phytolaccaceae	1	2
Poaceae	32	200
Polygalaceae	2	9
Polygonaceae	1	1
Primulaceae	1	10
Proteaceae	18	171
Restionaceae	9	64
Rhamnaceae	1	1
Rosaceae	1	1
Rubiaceae	2	10
Rutaceae	4	39
Salviniaceae	2	2
Santalaceae	1	1
Solanaceae	2	2
Stylidiaceae	19	100
Tamaricaceae	1	2
Thymelaeaceae	2	2
Tropaeolaceae	1	1
Typhaceae	1	2

Xanthorrhoeaceae	3	29
Zamiaceae	2	16
Zygophyllaceae	1	1
TOTAL	**478**	**2899**

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
Aizoaceae					
1.	2794	*Carpobrotus aequilaterus (Angular Pigface)*	Y		
2.	2795	*Carpobrotus edulis (Hottentot Fig)*	Y		
Amaranthaceae					
3.	2718	*Ptilotus drummondii (Narrowleaf Mulla Mulla)*			
Anarthriaceae					
4.	1097	*Lyginia barbata*			
5.		*Lyginia barbata/imberbis*			
6.	18049	*Lyginia imberbis*			
Apiaceae					
7.	6214	*Centella asiatica*			
8.	6222	*Homalosciadium homalocarpum*			
9.	6253	*Platysace filiformis*			
10.	6263	*Schoenolaena juncea*			
11.	6289	*Xanthosia huegelii*			
Apocynaceae					
12.	6587	*Gomphocarpus fruticosus (Narrowleaf Cottonbush)*	Y		
Araceae					
13.	1049	*Zantedeschia aethiopica (Arum Lily)*	Y		
Araliaceae					
14.	6223	*Hydrocotyle alata*			
15.	6280	*Trachymene pilosa (Native Parsnip)*			
Asparagaceae					
16.	8779	*Asparagus asparagoides (Bridal Creeper)*	Y		
17.	1307	*Laxmannia ramosa (Branching Lily)*			
18.	11911	*Laxmannia ramosa subsp. ramosa*			
19.	11464	*Laxmannia sessiliflora subsp. australis*			
20.	1309	*Laxmannia squarrosa*			
21.		*Lomandra ?caespitosa*			
22.		*Lomandra ?hermaphrodita*			Y
23.		*Lomandra ?nigricans*			Y
24.		*Lomandra ?suaveolens*			Y
25.	1223	*Lomandra caespitosa (Tufted Mat Rush)*			
26.		*Lomandra caespitosa/suaveolens*			Y
27.	1228	*Lomandra hermaphrodita*			
28.	1232	*Lomandra micrantha (Small-flower Mat-rush)*			
29.	1234	*Lomandra nigricans*			
30.	1239	*Lomandra preissii*			
31.	1243	*Lomandra sericea (Silky Mat Rush)*			
32.		*Lomandra sp.*			
33.	1246	*Lomandra suaveolens*			
34.	1312	*Sowerbaea laxiflora (Purple Tassels)*			
35.		*Thysanotus ?arbuscula*			Y
36.		*Thysanotus ?tenellus*			Y
37.		*Thysanotus ?thyrsoideus*			Y
38.	1318	*Thysanotus arbuscula*			
39.	1338	*Thysanotus manglesianus (Fringed Lily)*			
40.		*Thysanotus manglesianus/patersonii complex*			
41.	1339	*Thysanotus multiflorus (Many-flowered Fringe Lily)*			
42.	1343	*Thysanotus patersonii*			
43.		*Thysanotus sp.*			
44.	1351	*Thysanotus sparteus*			
45.	1354	*Thysanotus tenellus*			
46.	1358	*Thysanotus triandrus*			
Asteraceae					
47.	7833	*Angianthus preissianus*			
48.	7838	*Arctotheca calendula (Cape Weed, African Marigold)*	Y		
49.	7851	*Asteridea pulverulenta (Common Bristle Daisy)*			
50.	7867	*Brachyscome bellidioides*			
51.	7878	*Brachyscome iberidifolia*			
52.	7937	*Cirsium vulgare (Spear Thistle, Scotch Thistle)*	Y		
53.	7939	*Conyza bonariensis (Flaxleaf Fleabane)*	Y		
54.	7941	*Conyza parva*	Y		

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
55.	20074	*Conyza sumatrensis*	Y		
56.	7945	*Cotula coronopifolia (Waterbuttons)*	Y		
57.	12624	*Gnephosis angianthoides*			
58.	12741	*Hyalosperma cotula*			
59.	8086	*Hypochaeris glabra (Smooth Catsear)*	Y		
60.	9352	*Hypochaeris radicata (Flat Weed, Cats-ear)*	Y		
61.	8095	*Lactuca saligna (Wild Lettuce, Willow-leaf Lettuce)*	Y		
62.	8096	*Lactuca serriola (Prickly Lettuce)*	Y		
63.	18585	*Lagenophora huegelii*			
64.	44490	*Leontodon rhagadioloides*	Y		
65.	8099	*Leontodon saxatilis (Hairy Hawkbit)*	Y		
66.	8106	*Millotia tenuifolia (Soft Millotia)*			
67.		*Podotheca ?gnaphalioides*			
68.	8182	*Podotheca angustifolia (Sticky Longheads)*			
69.	8183	*Podotheca chrysantha (Yellow Podotheca)*			
70.	8184	*Podotheca gnaphalioides (Golden Long-heads)*			
71.		*Podotheca sp.*			
72.	8195	*Quinetia urvillei*			
73.	13300	*Rhodanthe citrina*			
74.	25878	*Senecio condylus*			
75.	8203	*Senecio diaschides*			
76.	25884	*Senecio pinnatifolius var. latilobus*			
77.	8225	*Siloxerus humifusus (Procumbent Siloxerus)*			
78.		*Siloxerus humifusus/filifolius*			
79.	8230	*Sonchus asper (Rough Sowthistle)*	Y		
80.	8231	*Sonchus oleraceus (Common Sowthistle)*	Y		
81.	25902	*Symphyotrichum squamatum (Bushy Starwort)*	Y		
82.	8254	*Urospermum picroides (False Hawkbit)*	Y		
83.	8255	*Ursinia anthemoides (Ursinia)*	Y		
84.	38388	*Ursinia anthemoides subsp. anthemoides*	Y		
Boraginaceae					
85.	6710	*Heliotropium europaeum (Common Heliotrope)*	Y		
Byblidaceae					
86.	3178	*Byblis gigantea (Rainbow Plant)*		P3	
Campanulaceae					
87.	9289	*Lobelia anceps (Angled Lobelia)*			
88.	7408	*Lobelia tenuior (Slender Lobelia)*			
89.		*Wahlenbergia ?preissii*			Y
90.	7384	*Wahlenbergia capensis (Cape Bluebell)*	Y		
91.	7389	*Wahlenbergia preissii*			
92.		*Wahlenbergia sp.*			
Caryophyllaceae					
93.	2889	*Cerastium glomeratum (Mouse Ear Chickweed)*	Y		
94.	16693	*Minuartia mediterranea*	Y		
95.	19825	*Petrorhagia dubia*	Y		
96.	2905	*Polycarpon tetraphyllum (Fourleaf Allseed)*	Y		
97.	2909	*Silene gallica (French Catchfly)*	Y		
Casuarinaceae					
98.	1728	*Allocasuarina fraseriana (Sheoak, Kondil)*			
99.	1732	*Allocasuarina humilis (Dwarf Sheoak)*			
Celastraceae					
100.	44444	*Tripterococcus sp. Brachylobus (A.S. George 14234)*		P4	
Centrolepidaceae					
101.	1117	*Aphelia cyperoides*			
102.	1121	*Centrolepis aristata (Pointed Centrolepis)*			
103.	1125	*Centrolepis drummondiana*			
104.	1131	*Centrolepis inconspicua*			
105.	1134	*Centrolepis polygyna (Wiry Centrolepis)*			
Chenopodiaceae					
106.	2471	*Atriplex prostrata (Hastate Orache)*	Y		
107.	2490	*Chenopodium glaucum (Glaucous Goosefoot)*	Y		
108.	2501	*Dysphania glomulifera*			
109.	11368	*Dysphania glomulifera subsp. glomulifera*			
Colchicaceae					
110.	12770	*Burchardia congesta*			

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
Commelinaceae					
111.	1162	*Cartonema philydroides*			
Crassulaceae					
112.	3137	*Crassula colorata (Dense Stonecrop)*			
113.	11709	*Crassula colorata var. acuminata*			
Cupressaceae					
114.	36600	*Callitris pyramidalis (Swamp Cypress)*			
Cyperaceae					
115.	741	*Baumea articulata (Jointed Rush)*			
116.	744	*Baumea laxa*			
117.	749	*Bolboschoenus caldwellii (Marsh Club-rush)*			
118.	16245	*Cyathochaeta teretifolia*		P3	
119.	822	*Eleocharis acuta (Common Spikerush)*			
120.	835	*Evandra pauciflora*			
121.	20200	*Isolepis cernua var. setiformis*			
122.	917	*Isolepis marginata (Coarse Club-rush)*			
123.	921	*Isolepis producta*			
124.	924	*Isolepis stellata (Star Club-rush)*			
125.	925	*Lepidosperma angustatum*			
126.	937	*Lepidosperma longitudinale (Pithy Sword-sedge)*			
127.	41649	*Lepidosperma rigidulum*			
128.		*Lepidosperma sp.*			
129.		*Lepidosperma sp. terete*			
130.	945	*Lepidosperma squamatum*			
131.	953	*Mesomelaena graciliceps*			
132.	973	*Schoenus asperocarpus (Poison Sedge)*			
133.	979	*Schoenus caespititius*			
134.	982	*Schoenus clandestinus*			
135.	984	*Schoenus curvifolius*			
136.	986	*Schoenus efoliatus*			
137.	992	*Schoenus grandiflorus (Large Flowered Bogrush)*			
138.	1008	*Schoenus pennisetis*		P3	
139.	1011	*Schoenus rigens*			
140.	1017	*Schoenus subbulbosus*			
141.	1018	*Schoenus subfascicularis*			
142.	16251	*Schoenus subflavus subsp. long leaves (K.L. Wilson 2865)*			
143.	1038	*Tricostularia neesii*			
Dasypogonaceae					
144.	19309	*Calectasia narragara*			
145.	1218	*Dasypogon bromeliifolius (Pineapple Bush)*			
Dilleniaceae					
146.	19778	*Hibbertia glomerata subsp. darlingensis*			
147.	5134	*Hibbertia huegelii*			
148.		*Hibbertia huegelii complex*			
149.	5135	*Hibbertia hypericoides (Yellow Buttercups)*			
150.	5162	*Hibbertia racemosa (Stalked Guinea Flower)*			
151.	43280	*Hibbertia sericosepala*			
152.	5173	*Hibbertia subvaginata*			
153.	5176	*Hibbertia vaginata*			
Droseraceae					
154.	3095	*Drosera erythrorhiza (Red Ink Sundew)*			
155.	13217	*Drosera erythrorhiza subsp. erythrorhiza*			
156.	3106	*Drosera macrantha (Bridal Rainbow)*			
157.	11853	*Drosera menziesii subsp. menziesii*			
158.	13216	*Drosera menziesii subsp. penicillaris*			
159.	13191	*Drosera occidentalis subsp. occidentalis*		P4	
160.	3118	*Drosera pallida (Pale Rainbow)*			
161.	8911	*Drosera rosulata*			
162.		*Drosera sp. "climbing"*			
163.	3131	*Drosera stolonifera (Leafy Sundew)*			
Elaeocarpaceae					
164.	4524	*Platytheca galioides*			
Elatinaceae					
165.	5187	*Elatine gratioloides (Waterwort)*			
Ericaceae					
166.	6339	*Astroloma xerophyllum*			

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
167.	6341	*Brachyloma preissii (Globe Heath)*			
168.	6348	*Conostephium pendulum (Pearl Flower)*			
169.	6349	*Conostephium preissii*			
170.	13527	*Croninia kingiana*			
171.	6374	*Leucopogon conostephioides*			
172.	6425	*Leucopogon oxycedrus*			
173.	6434	*Leucopogon polymorphus*			
174.	40803	*Leucopogon squarrosus subsp. squarrosus*			
175.	6451	*Leucopogon tenuis*			
176.	6456	*Lysinema ciliatum (Curry Flower)*			
177.	6458	*Lysinema elegans*			
Euphorbiaceae					
178.	4648	*Euphorbia terracina (Geraldton Carnation Weed)*	Y		
179.	4666	*Monotaxis occidentalis*			
Fabaceae					
180.	3374	*Acacia huegelii*			
181.	17861	*Acacia longifolia*	Y		
182.	3502	*Acacia pulchella (Prickly Moses)*			
183.	30032	*Acacia saligna subsp. saligna*			
184.	3557	*Acacia stenoptera (Narrow Winged Wattle)*			
185.	3581	*Acacia trigonophylla*			
186.	3602	*Acacia willdenowiana (Grass Wattle)*			
187.	3686	*Aotus cordifolia*			
188.	3692	*Aotus procumbens*			
189.	3710	*Bossiaea eriocarpa (Common Brown Pea)*			
190.	18156	*Chamaecytisus palmensis (Tagasaste)*	Y		
191.	3845	*Daviesia triflora*			
192.	3872	*Euchilopsis linearis (Swamp Pea)*			
193.	3880	*Eutaxia virgata*			
194.	20475	*Gastrolobium capitatum*			
195.	20483	*Gastrolobium linearifolium*			
196.	3957	*Gompholobium tomentosum (Hairy Yellow Pea)*			
197.	3968	*Hovea trisperma (Common Hovea)*			
198.	12859	*Hovea trisperma var. trisperma*			
199.	4012	*Jacksonia furcellata (Grey Stinkwood)*			
200.	20462	*Jacksonia gracillima*		P3	
201.	4027	*Jacksonia sericea (Waldjumi)*		P4	
202.	4029	*Jacksonia sternbergiana (Stinkwood, Kapur)*			
203.	4044	*Kennedia prostrata (Scarlet Runner)*			
204.	4052	*Latrobea tenella*			
205.	4059	*Lotus angustissimus (Narrowleaf Trefoil)*	Y		
206.	8564	*Lotus subbiflorus*	Y		
207.	4065	*Lupinus angustifolius (Narrowleaf Lupin)*	Y		
208.	4079	*Medicago polymorpha (Burr Medic)*	Y		
209.	4085	*Melilotus indicus*	Y		
210.	4141	*Phyllota gracilis*			
211.	4177	*Pultenaea ochreata*			
212.	4181	*Pultenaea reticulata*			
213.	17145	*Trifolium angustifolium var. angustifolium*	Y		
214.	14738	*Trifolium resupinatum var. resupinatum*	Y		
215.		*Trifolium sp.*			
216.	11474	*Vicia sativa subsp. nigra*	Y		
Gentianaceae					
217.	6542	*Centaurium tenuiflorum*	Y		
Geraniaceae					
218.	4343	*Pelargonium capitatum (Rose Pelargonium)*	Y		
219.	4346	*Pelargonium littorale*			
Goodeniaceae					
220.	7451	*Dampiera lavandulacea*			
221.	7454	*Dampiera linearis (Common Dampiera)*			
222.	19286	*Goodenia pulchella subsp. Coastal Plain A (M. Hislop 634)*			
223.	7574	*Lechenaultia floribunda (Free-flowering Leschenaultia)*			
224.	7619	*Scaevola lanceolata (Long-leaved Scaevola)*			
Haemodoraceae					
225.	1409	*Anigozanthos humilis (Catspaw)*			
226.	1411	*Anigozanthos manglesii (Mangles Kangaroo Paw, Kurulbrang)*			
227.		*Anigozanthos sp.*			

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
228.	1417	*Blancoa canescens (Winter Bell)*			
229.	1418	*Conostylis aculeata (Prickly Conostylis)*			
230.	11826	*Conostylis aculeata subsp. aculeata*			
231.	11695	*Conostylis festucacea subsp. festucacea*			
232.	1436	*Conostylis juncea*			
233.	1454	*Conostylis setigera (Bristly Cottonhead)*			
234.		*Haemodorum ?spicatum*			Y
235.		*Haemodorum sp.*			
236.	1475	*Haemodorum spicatum (Mardja)*			
237.	1478	*Phlebocarya ciliata*			
238.	1479	*Phlebocarya filifolia*			
239.	1481	*Tribonanthes australis*			
Haloragaceae					
240.	6160	*Gonocarpus paniculatus*			
241.	6161	*Gonocarpus pithyoides*			
242.	34676	*Meionectes brownii (Swamp Raspwort)*			
Hemerocallidaceae					
243.	1264	*Arnocrinum preissii*			
244.	1276	*Caesia micrantha (Pale Grass Lily)*			
245.	1277	*Caesia occidentalis*			
246.		*Caesia sp.*			
247.	1285	*Corynotheca micrantha (Sand Lily)*			
248.	1259	*Dianella revoluta (Blueberry Lily)*			
249.	1293	*Hensmania turbinata*			
250.	1260	*Stypandra glauca (Blind Grass)*			
251.	1361	*Tricoryne elatior (Yellow Autumn Lily)*			
252.	1363	*Tricoryne tenella*			
Iridaceae					
253.	18392	*Freesia alba x leichtlinii*	Y		
254.	1520	*Gladiolus caryophyllaceus (Wild Gladiolus)*	Y		
255.	19179	*Moraea flaccida (One-leaf Cape Tulip)*	Y		
256.	1550	*Patersonia occidentalis (Purple Flag, Koma)*			
257.	14485	*Romulea flava var. minor*	Y		
258.	1556	*Romulea rosea (Guildford Grass)*	Y		
259.	14924	*Romulea rosea var. communis*	Y		
260.	1558	*Sparaxis bulbifera*	Y		
Juncaceae					
261.	1178	*Juncus bufonius (Toad Rush)*	Y		
262.	1180	*Juncus capitatus (Capitate Rush)*	Y		
263.	1186	*Juncus microcephalus*	Y		
264.	1188	*Juncus pallidus (Pale Rush)*			
265.	1190	*Juncus planifolius (Broadleaf Rush)*			
Juncaginaceae					
266.	40660	*Cycnogeton huegelii*			
Lamiaceae					
267.		*Hemiandra ?pungens*			Y
268.	6839	*Hemiandra pungens (Snakebush)*			
269.	38320	*Hemiandra sp. Jurien (B.J. Conn & M.E. Tozer BJC 3885)*			
270.	6777	*Lachnostachys albicans*			
Lauraceae					
271.	2957	*Cassytha racemosa (Dodder Laurel)*			
Loganiaceae					
272.	16177	*Phyllangium paradoxum*			
Loranthaceae					
273.	2401	*Nuytsia floribunda (Christmas Tree, Mudja)*			
Lythraceae					
274.	5281	*Lythrum hyssopifolia (Lesser Loosestrife)*	Y		
Macarthuriaceae					
275.	2838	*Macarthuria apetala*			
276.	2839	*Macarthuria australis*			
Marchantiaceae					
277.		*Marchantia berteroana*			
Menyanthaceae					
278.	36200	*Ornduffia submersa*			

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
				P4	
Montiaceae					
279.	2848	*Calandrinia corrigioloides (Strap Purslane)*			
280.	2854	*Calandrinia granulifera (Pygmy Purslane)*			
281.	16365	*Calandrinia sp. Kenwick (G.J. Keighery 10905)*			
Moraceae					
282.	1747	*Ficus carica (Common Fig)*	Y		
Myrtaceae					
283.	20350	*Astartea affinis (West-coast Astartea)*			
284.	20283	*Astartea scoparia (Common Astartea)*			
285.	5393	*Beaufortia squarrosa (Sand Beaufortia, Sand Bottlebrush, Puno)*			
286.	5411	*Calothamnus hirsutus*			
287.	5415	*Calothamnus lateralis*			
288.		*Calytrix ?flavescens*			Y
289.	5439	*Calytrix angulata (Yellow Starflower)*			
290.	5458	*Calytrix flavescens (Summer Starflower)*			
291.	5460	*Calytrix fraseri (Pink Summer Calytrix)*			
292.		*Calytrix leschenaultii/fraseri*			Y
293.	5508	*Darwinia citriodora (Lemon-scented Darwinia)*			
294.	13950	*Eremaea asterocarpa subsp. asterocarpa*			
295.	5541	*Eremaea pauciflora*			
296.	5763	*Eucalyptus rudis (Flooded Gum, Kulurda)*			
297.		*Eucalyptus sp.*			
298.	5790	*Eucalyptus todtiana (Coastal Blackbutt)*			
299.	5817	*Hypocalymma angustifolium (White Myrtle, Kudjid)*			
300.	15498	*Kunzea glabrescens (Spearwood)*			
301.	5835	*Kunzea micrantha*			
302.	37580	*Melaleuca acutifolia*			
303.	5900	*Melaleuca cuticularis (Saltwater Paperbark)*			
304.	13273	*Melaleuca incana subsp. incana*			
305.	5926	*Melaleuca lateritia (Robin Redbreast Bush)*			
306.	5959	*Melaleuca rhaphiophylla (Swamp Paperbark)*			
307.	5964	*Melaleuca seriata*			
308.	5978	*Melaleuca teretifolia (Banbar)*			
309.	5980	*Melaleuca thymoides*			
310.	5987	*Melaleuca viminea (Mohan)*			
311.	6006	*Pericalymma ellipticum (Swamp Teatree)*			
312.	16477	*Pericalymma ellipticum var. ellipticum*			
313.	6012	*Regelia ciliata*			
314.	6014	*Regelia inops*			
315.	6033	*Scholtzia involucrata (Spiked Scholtzia)*			
316.	15432	*Verticordia densiflora var. densiflora*			
317.	14714	*Verticordia lindleyi subsp. lindleyi*		P4	
Onagraceae					
318.	6133	*Epilobium hirtigerum (Hairy Willow Herb)*			
319.	14293	*Oenothera indecora subsp. bonariensis*	Y		
320.	16347	*Oenothera laciniata*	Y		
321.	6140	*Oenothera mollissima*	Y		
Orchidaceae					
322.	15330	*Caladenia arenicola*			
323.	1592	*Caladenia flava (Cowslip Orchid)*			
324.	15348	*Caladenia flava subsp. flava*			
325.	1596	*Caladenia huegelii (Grand Spider Orchid)*		T	
326.	1599	*Caladenia latifolia (Pink Fairy Orchid)*			
327.	15361	*Caladenia longicauda subsp. calcigena*			
328.	15503	*Caladenia paludosa*			
329.	15398	*Caladenia xantha*			
330.	10916	*Cyrtostylis huegelii*			
331.	10942	*Cyrtostylis tenuissima*			
332.	19649	*Disa bracteata*	Y		
333.		*Diuris corymbosa/magnifica*			
334.	1637	*Diuris purdiei (Purdie's Donkey Orchid)*		T	
335.	13635	*Drakaea micrantha*		T	
336.	1643	*Elythranthera brunonis (Purple Enamel Orchid)*			
337.	1645	*Epiblema grandiflorum (Babe-in-a-cradle)*			
338.	1646	*Eriochilus dilatatus (White Bunny Orchid)*			
339.	15410	*Eriochilus dilatatus subsp. dilatatus*			
340.	15412	*Eriochilus dilatatus subsp. multiflorus*			

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
341.	15414	*Eriochilus helonomos*			
342.	15415	*Eriochilus scaber subsp. scaber*			
343.	1653	*Leporella fimbriata (Hare Orchid)*			
344.	10954	*Microtis media (Tall Mignonette Orchid)*			
345.	15419	*Microtis media subsp. media*			
346.		*Orchidaceae sp.*			Y
347.	1670	*Prasophyllum drummondii (Swamp Leek Orchid)*			
348.	1673	*Prasophyllum gibbosum (Humped Leek Orchid)*			
349.	1674	*Prasophyllum giganteum (Bronze Leek Orchid)*			
350.	1676	*Prasophyllum hians (Yawning Leek Orchid)*			
351.	1680	*Prasophyllum parvifolium (Autumn Leek Orchid)*			
352.	1681	*Prasophyllum regium (King Leek Orchid)*			
353.	17267	*Pterostylis brevisepala*			
354.	44723	*Pterostylis glebosa*			
355.		*Pterostylis nana "short sepal"*			
356.	1693	*Pterostylis recurva (Jug Orchid)*			
357.	12217	*Pterostylis sanguinea*			
358.	18648	*Pterostylis sp. cauline leaves (N. Gibson & M.N. Lyons 1490)*			
359.	18655	*Pterostylis sp. crinkled leaf (G.J. Keighery 13426)*			
360.	1698	*Pterostylis vittata (Banded Greenhood)*			
361.	16367	*Pyrorchis nigricans (Red beaks, Elephants ears)*			
362.	11143	*Thelymitra graminea*			
363.		*Thelymitra sp.*			
364.	1716	*Thelymitra tigrina (Tiger Orchid)*			
365.	20731	*Thelymitra vulgaris*			
Orobanchaceae					
366.	7090	*Parentucellia viscosa (Sticky Bartsia)*	Y		
Papaveraceae					
367.	2969	*Fumaria capreolata (Whiteflower Fumitory)*	Y		
Philydraceae					
368.	14306	*Philydrella pygmaea subsp. pygmaea*			
Phyllanthaceae					
369.	4691	*Poranthera microphylla (Small Poranthera)*			
370.		*Poranthera microphylla/moorokatta*			
371.	42022	*Poranthera moorokatta*		P2	
Phytolaccaceae					
372.	2793	*Phytolacca octandra (Red Ink Plant)*	Y		
Poaceae					
373.		*Aira caryophyllea/cupaniana group*			
374.	187	*Aira praecox (Early Hairgrass)*	Y		
375.	20184	*Amphipogon laguroides subsp. laguroides*			
376.	199	*Amphipogon strictus (Greybeard Grass)*			
377.	200	*Amphipogon turbinatus*			
378.	207	*Aristida contorta (Bunched Kerosene Grass)*			
379.	17234	*Austrostipa compressa*			
380.	17240	*Austrostipa flavescens*			
381.	17245	*Austrostipa mollis*			
382.	233	*Avena barbata (Bearded Oat)*	Y		
383.	244	*Briza maxima (Blowfly Grass)*	Y		
384.	245	*Briza minor (Shivery Grass)*	Y		
385.	11105	*Echinochloa crus-galli*	Y		
386.	347	*Ehrharta calycina (Perennial Veldt Grass)*	Y		
387.	349	*Ehrharta longiflora (Annual Veldt Grass)*	Y		
388.		*Eragrostis sp.*			
389.	17043	*Glyceria declinata*	Y		
390.	444	*Holcus lanatus (Yorkshire Fog)*	Y		
391.	20019	*Lachnagrostis filiformis*			
392.	19955	*Lachnagrostis plebeia*			
393.	467	*Lagurus ovatus (Hare's Tail Grass)*	Y		
394.	478	*Lolium rigidum (Wimmera Ryegrass)*	Y		
395.		*Lolium sp. (annual)*			
396.	485	*Microlaena stipoides (Weeping Grass)*			
397.	492	*Neurachne alopecuroidea (Foxtail Mulga Grass)*			
398.	527	*Paspalum dilatatum*	Y		
399.	582	*Polypogon monspeliensis (Annual Beardgrass)*	Y		
400.	583	*Polypogon tenellus*			
401.	40426	*Rytidosperma occidentale*			

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
402.		*Unknown Annual Grasses*			
403.	722	*Vulpia bromoides (Squirrel Tail Fescue)*	Y		
404.		*Vulpia sp.*			
Polygalaceae					
405.	4550	*Comesperma calymega (Blue-spike Milkwort)*			
406.	4554	*Comesperma flavum*			
Polygonaceae					
407.	11052	*Persicaria prostrata*			
Primulaceae					
408.	36375	*Lysimachia arvensis (Pimpernel)*	Y		
Proteaceae					
409.	1775	*Adenanthos cygnorum (Common Woollybush)*			
410.	1791	*Adenanthos obovatus (Basket Flower)*			
411.	1800	*Banksia attenuata (Slender Banksia, Piara)*			
412.	32580	*Banksia dallanneyi var. dallanneyi*			
413.	1822	*Banksia ilicifolia (Holly-leaved Banksia)*			
414.	1834	*Banksia menziesii (Firewood Banksia)*			
415.	1852	*Banksia telmatiaea (Swamp Fox Banksia)*			
416.	1858	*Conospermum amoenum (Blue Smokebush)*			
417.	19628	*Grevillea bipinnatifida subsp. bipinnatifida*			
418.	2032	*Grevillea leucopteris (White Plume Grevillea)*			
419.		*Grevillea robusta*			Y
420.	2197	*Hakea prostrata (Harsh Hakea)*			
421.	2216	*Hakea varia (Variable-leaved Hakea)*			
422.	2273	*Persoonia saccata (Snottygobble)*			
423.	20391	*Petrophile juncifolia*			
424.	2299	*Petrophile linearis (Pixie Mops)*			
425.	2308	*Petrophile seminuda*			
426.	2316	*Stirlingia latifolia (Blueboy)*			
Restionaceae					
427.	17685	*Chaetanthus aristatus*			
428.	17692	*Cytogonidium leptocarpoides*			
429.	15831	*Desmocladus castaneus*			
430.	16595	*Desmocladus flexuosus*			
431.	17838	*Dielsia stenostachya*			
432.	1070	*Hypolaena exsulca*			
433.	17841	*Hypolaena pubescens*			
434.	19833	*Leptocarpus laxus*			
435.	46382	*Leptocarpus roycei*			
Rhamnaceae					
436.	4822	*Rhamnus alaternus (Buckthorn)*	Y		
Rosaceae					
437.	18301	*Eriobotrya japonica*	Y		
Rubiaceae					
438.	7323	*Galium murale (Small Goosegrass)*	Y		
439.	18255	*Opercularia vaginata (Dog Weed)*			
Rutaceae					
440.	16636	*Boronia crenulata subsp. viminea*			
441.	4417	*Boronia dichotoma*			
442.	11381	*Boronia ramosa subsp. anethifolia*			
443.	18529	*Philotheca spicata (Pepper and Salt)*			
Salviniaceae					
444.	17737	*Azolla pinnata*			
445.	42902	*Azolla rubra*			
Santalaceae					
446.	2344	*Leptomeria empetriformis*			
Solanaceae					
447.	7020	*Solanum linnaeanum (Apple of Sodom)*	Y		
448.	7022	*Solanum nigrum (Black Berry Nightshade)*	Y		
Stylidiaceae					
449.		*Levenhookia pusilla/stipitata*			
450.	7677	*Levenhookia stipitata (Common Stylewort)*			
451.	25831	*Stylidium araeophyllum (Stilt Walker)*			
452.		*Stylidium araeophyllum/neurophyllum*			

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
453.	7693	*Stylidium brunonianum (Pink Fountain Triggerplant)*			
454.	7696	*Stylidium calcaratum (Book Triggerplant)*			
455.	7699	*Stylidium carnosum (Fleshy-leaved Triggerplant)*			
456.	7717	*Stylidium divaricatum (Daddy-long-legs)*			
457.	7734	*Stylidium guttatum (Dotted Triggerplant)*			
458.	7756	*Stylidium longitubum (Jumping Jacks)*		P4	
459.	25829	*Stylidium neurophyllum (Coastal Plain Triggerplant)*			
460.	25800	*Stylidium paludicola*		P3	
461.	7774	*Stylidium piliferum (Common Butterfly Triggerplant)*			
462.	7777	*Stylidium preissii (Lizard Triggerplant)*			
463.	7785	*Stylidium repens (Matted Triggerplant)*			
464.	7790	*Stylidium roseoalatum (Pink-wing Triggerplant)*			
465.	25806	*Stylidium scariosum*			
466.	7798	*Stylidium schoenoides (Cow Kicks)*			
467.	7806	*Stylidium utricularioides (Pink Fan Triggerplant)*			
Tamaricaceae					
468.	37360	*Tamarix ramosissima*	Y		
Thymelaeaceae					
469.	11404	*Pimelea imbricata var. major*			
470.	5252	*Pimelea lanata*			
Tropaeolaceae					
471.	4360	*Tropaeolum majus (Garden Nasturtium)*	Y		
Typhaceae					
472.	98	*Typha domingensis (Bulrush, Djandjid)*			
Xanthorrhoeaceae					
473.	1280	*Chamaescilla corymbosa (Blue Squill)*			
474.	1251	*Xanthorrhoea brunonis*			
475.	1256	*Xanthorrhoea preissii (Grass tree, Palga)*			
Zamiaceae					
476.	18119	*Macrozamia fraseri*			
477.	85	*Macrozamia riedlei (Zamia, Djiridji)*			
Zygophyllaceae					
478.	4383	*Tribulus terrestris (Caltrop)*	Y		

Conservation Codes
T - Rare or likely to become extinct
X - Presumed extinct
IA - Protected under international agreement
S - Other specially protected fauna
1 - Priority 1
2 - Priority 2
3 - Priority 3
4 - Priority 4
5 - Priority 5

[1] For NatureMap's purposes, species flagged as endemic are those whose records are wholely contained within the search area. Note that only those records complying with the search criterion are included in the calculation. For example, if you limit records to those from a specific datasource, only records from that datasource are used to determine if a species is restricted to the query area.

Australian Government
Department of the Environment and Energy

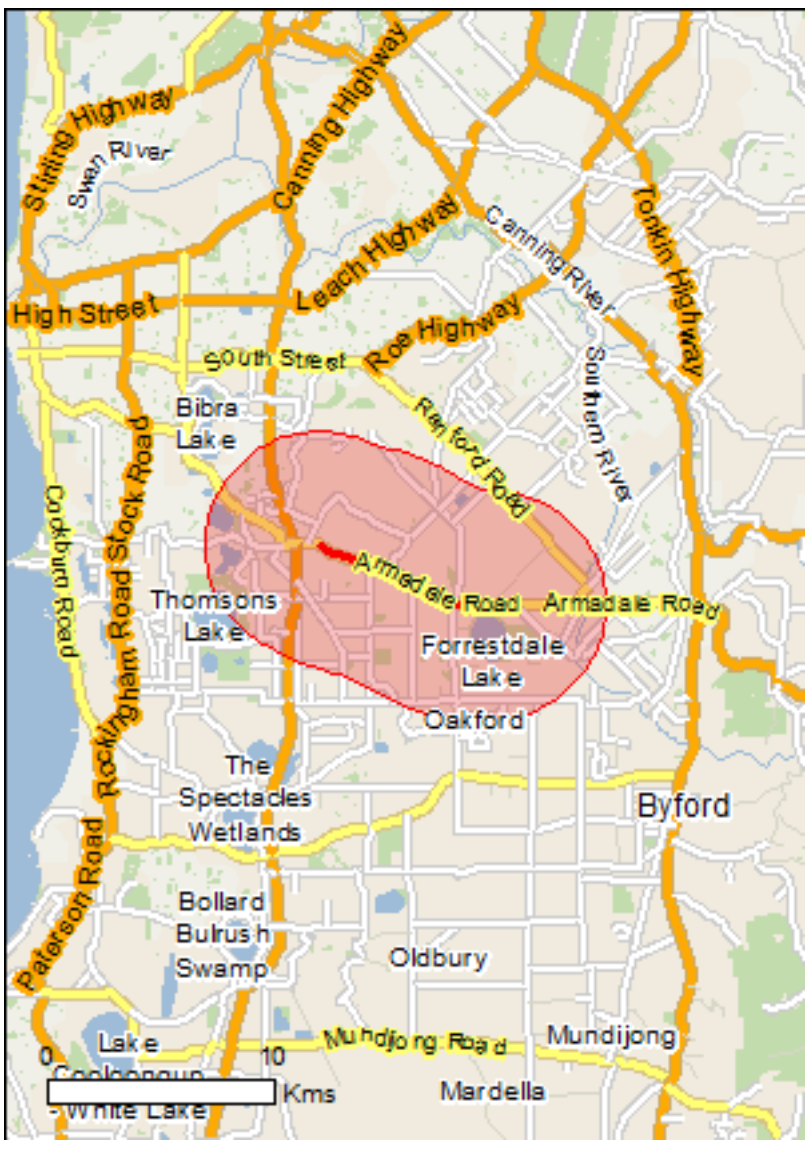
EPBC Act Protected Matters Report

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

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

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

Report created: 05/01/18 12:54:10



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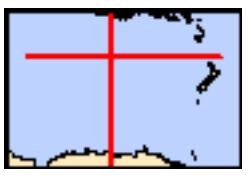
Coordinates
Buffer: 5.0Km



Summary

Matters of National Environmental Significance

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

World Heritage Properties:	None
National Heritage Places:	None
Wetlands of International Importance:	2
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	None
Listed Threatened Ecological Communities:	2
Listed Threatened Species:	28
Listed Migratory Species:	20

Other Matters Protected by the EPBC Act

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

The EPBC Act protects the environment on Commonwealth land, the environment from the actions taken on Commonwealth land, and the environment from actions taken by Commonwealth agencies. As heritage values of a place are part of the 'environment', these aspects of the EPBC Act protect the Commonwealth Heritage values of a Commonwealth Heritage place. Information on the new heritage laws can be found at http://www.environment.gov.au/heritage

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

Commonwealth Land:	1
Commonwealth Heritage Places:	None
Listed Marine Species:	29
Whales and Other Cetaceans:	None
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Commonwealth Reserves Marine:	None

Extra Information

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

State and Territory Reserves:	7
Regional Forest Agreements:	None
Invasive Species:	44
Nationally Important Wetlands:	3
Key Ecological Features (Marine)	None

Details

Matters of National Environmental Significance

Wetlands of International Importance (Ramsar) [Resource Information]

Name	Proximity
Forrestdale and thomsons lakes	Within Ramsar site
Peel-yalgorup system	40 - 50km upstream

Listed Threatened Ecological Communities [Resource Information]

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

Name	Status	Type of Presence
Banksia Woodlands of the Swan Coastal Plain ecological community	Endangered	Community likely to occur within area
Clay Pans of the Swan Coastal Plain	Critically Endangered	Community likely to occur within area

Listed Threatened Species [Resource Information]

Name	Status	Type of Presence
Birds		
Botaurus poiciloptilus Australasian Bittern [1001]	Endangered	Species or species habitat known to occur within area
Calidris canutus Red Knot, Knot [855]	Endangered	Species or species habitat likely to occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat known to occur within area
Calyptorhynchus banksii naso Forest Red-tailed Black-Cockatoo, Karrak [67034]	Vulnerable	Species or species habitat known to occur within area
Calyptorhynchus baudinii Baudin's Cockatoo, Long-billed Black-Cockatoo [769]	Vulnerable	Roosting known to occur within area
Calyptorhynchus latirostris Carnaby's Cockatoo, Short-billed Black-Cockatoo [59523]	Endangered	Species or species habitat known to occur within area
Leipoa ocellata Malleefowl [934]	Vulnerable	Species or species habitat likely to occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat likely to occur within area
Rostratula australis Australian Painted Snipe [77037]	Endangered	Species or species habitat may occur within area
Insects		

Name	Status	Type of Presence
[Leioproctus douglasiellus](#) a short-tongued bee [66756]	Critically Endangered	Species or species habitat known to occur within area
[Neopasiphae simplicior](#) A native bee [66821]	Critically Endangered	Species or species habitat likely to occur within area
Mammals		
[Bettongia penicillata](#) Brush-tailed Bettong, Woylie [213]	Endangered	Species or species habitat may occur within area
[Dasyurus geoffroii](#) Chuditch, Western Quoll [330]	Vulnerable	Species or species habitat likely to occur within area
[Pseudocheirus occidentalis](#) Western Ringtail Possum, Ngwayir, Womp, Woder, Ngoor, Ngoolangit [25911]	Vulnerable	Species or species habitat likely to occur within area
[Setonix brachyurus](#) Quokka [229]	Vulnerable	Species or species habitat may occur within area
Plants		
[Andersonia gracilis](#) Slender Andersonia [14470]	Endangered	Species or species habitat may occur within area
[Caladenia huegelii](#) King Spider-orchid, Grand Spider-orchid, Rusty Spider-orchid [7309]	Endangered	Species or species habitat known to occur within area
[Diuris micrantha](#) Dwarf Bee-orchid [55082]	Vulnerable	Species or species habitat known to occur within area
[Diuris purdiei](#) Purdie's Donkey-orchid [12950]	Endangered	Species or species habitat known to occur within area
[Drakaea elastica](#) Glossy-leafed Hammer Orchid, Glossy-leaved Hammer Orchid, Warty Hammer Orchid [16753]	Endangered	Species or species habitat known to occur within area
[Drakaea micrantha](#) Dwarf Hammer-orchid [56755]	Vulnerable	Species or species habitat known to occur within area
[Eleocharis keigheryi](#) Keighery's Eleocharis [64893]	Vulnerable	Species or species habitat may occur within area
[Eucalyptus x balanites](#) Cadda Road Mallee, Cadda Mallee [87816]	Endangered	Species or species habitat likely to occur within area
[Grevillea curviloba subsp. incurva](#) Narrow curved-leaf Grevillea [64909]	Endangered	Species or species habitat may occur within area
[Lepidosperma rostratum](#) Beaked Lepidosperma [14152]	Endangered	Species or species habitat likely to occur within area
[Synaphea sp. Fairbridge Farm (D. Papenfus 696)](#) Selena's Synaphea [82881]	Critically Endangered	Species or species habitat likely to occur within area
[Thelymitra dedmaniarum](#) Cinnamon Sun Orchid [65105]	Endangered	Species or species habitat may occur within

Name	Status	Type of Presence
		area
Thelymitra stellata		
Star Sun-orchid [7060]	Endangered	Species or species habitat likely to occur within area

Listed Migratory Species [Resource Information]

* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

Name	Threatened	Type of Presence
Migratory Marine Birds		
Apus pacificus		
Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Migratory Terrestrial Species		
Motacilla cinerea		
Grey Wagtail [642]		Species or species habitat may occur within area
Migratory Wetlands Species		
Actitis hypoleucos		
Common Sandpiper [59309]		Species or species habitat known to occur within area
Calidris acuminata		
Sharp-tailed Sandpiper [874]		Roosting known to occur within area
Calidris canutus		
Red Knot, Knot [855]	Endangered	Species or species habitat likely to occur within area
Calidris ferruginea		
Curlew Sandpiper [856]	Critically Endangered	Species or species habitat known to occur within area
Calidris melanotos		
Pectoral Sandpiper [858]		Species or species habitat known to occur within area
Calidris ruficollis		
Red-necked Stint [860]		Roosting known to occur within area
Calidris subminuta		
Long-toed Stint [861]		Roosting known to occur within area
Charadrius dubius		
Little Ringed Plover [896]		Roosting known to occur within area
Gallinago megala		
Swinhoe's Snipe [864]		Roosting likely to occur within area
Gallinago stenura		
Pin-tailed Snipe [841]		Roosting likely to occur within area
Limosa limosa		
Black-tailed Godwit [845]		Roosting known to occur within area
Numenius madagascariensis		
Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat likely to occur within area
Numenius minutus		
Little Curlew, Little Whimbrel [848]		Roosting likely to occur within area
Pandion haliaetus		
Osprey [952]		Species or species habitat known to occur within area
Philomachus pugnax		
Ruff (Reeve) [850]		Roosting known to occur within area

Name	Threatened	Type of Presence
Tringa glareola		
Wood Sandpiper [829]		Roosting known to occur within area
Tringa nebularia		
Common Greenshank, Greenshank [832]		Species or species habitat known to occur within area
Tringa stagnatilis		
Marsh Sandpiper, Little Greenshank [833]		Roosting known to occur within area

Other Matters Protected by the EPBC Act

Commonwealth Land [Resource Information]

The Commonwealth area listed below may indicate the presence of Commonwealth land in this vicinity. Due to the unreliability of the data source, all proposals should be checked as to whether it impacts on a Commonwealth area, before making a definitive decision. Contact the State or Territory government land department for further information.

Name
Commonwealth Land -

Listed Marine Species [Resource Information]

* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

Name	Threatened	Type of Presence
Birds		
Actitis hypoleucos		
Common Sandpiper [59309]		Species or species habitat known to occur within area
Apus pacificus		
Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Ardea alba		
Great Egret, White Egret [59541]		Breeding known to occur within area
Ardea ibis		
Cattle Egret [59542]		Species or species habitat may occur within area
Calidris acuminata		
Sharp-tailed Sandpiper [874]		Roosting known to occur within area
Calidris canutus		
Red Knot, Knot [855]	Endangered	Species or species habitat likely to occur within area
Calidris ferruginea		
Curlew Sandpiper [856]	Critically Endangered	Species or species habitat known to occur within area
Calidris melanotos		
Pectoral Sandpiper [858]		Species or species habitat known to occur within area
Calidris ruficollis		
Red-necked Stint [860]		Roosting known to occur within area

Name	Threatened	Type of Presence
Calidris subminuta Long-toed Stint [861]		Roosting known to occur within area
Charadrius dubius Little Ringed Plover [896]		Roosting known to occur within area
Charadrius ruficapillus Red-capped Plover [881]		Roosting known to occur within area
Gallinago megala Swinhoe's Snipe [864]		Roosting likely to occur within area
Gallinago stenura Pin-tailed Snipe [841]		Roosting likely to occur within area
Haliaeetus leucogaster White-bellied Sea-Eagle [943]		Species or species habitat known to occur within area
Himantopus himantopus Black-winged Stilt [870]		Roosting known to occur within area
Limosa limosa Black-tailed Godwit [845]		Roosting known to occur within area
Merops ornatus Rainbow Bee-eater [670]		Species or species habitat may occur within area
Motacilla cinerea Grey Wagtail [642]		Species or species habitat may occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat likely to occur within area
Numenius minutus Little Curlew, Little Whimbrel [848]		Roosting likely to occur within area
Pandion haliaetus Osprey [952]		Species or species habitat known to occur within area
Philomachus pugnax Ruff (Reeve) [850]		Roosting known to occur within area
Recurvirostra novaehollandiae Red-necked Avocet [871]		Roosting known to occur within area
Rostratula benghalensis (sensu lato) Painted Snipe [889]	Endangered*	Species or species habitat may occur within area
Thinornis rubricollis Hooded Plover [59510]		Species or species habitat known to occur within area
Tringa glareola Wood Sandpiper [829]		Roosting known to occur within area
Tringa nebularia Common Greenshank, Greenshank [832]		Species or species habitat known to occur within area
Tringa stagnatilis Marsh Sandpiper, Little Greenshank [833]		Roosting known to occur within area

Extra Information

State and Territory Reserves [Resource Information]

Name	State
Balannup Lake	WA
Forrestdale Lake	WA
Gibbs Road	WA
Harry Waring Marsupial Reserve	WA
Piara	WA
Thomsons Lake	WA
Unnamed WA49561	WA

Invasive Species [Resource Information]

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

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

Name	Status	Type of Presence
Sturnus vulgaris Common Starling [389]		Species or species habitat likely to occur within area
Turdus merula Common Blackbird, Eurasian Blackbird [596]		Species or species habitat likely to occur within area
Mammals		
Bos taurus Domestic Cattle [16]		Species or species habitat likely to occur within area
Canis lupus familiaris Domestic Dog [82654]		Species or species habitat likely to occur within area
Felis catus Cat, House Cat, Domestic Cat [19]		Species or species habitat likely to occur within area
Funambulus pennantii Northern Palm Squirrel, Five-striped Palm Squirrel [129]		Species or species habitat likely to occur within area
Mus musculus House Mouse [120]		Species or species habitat likely to occur within area
Oryctolagus cuniculus Rabbit, European Rabbit [128]		Species or species habitat likely to occur within area
Rattus norvegicus Brown Rat, Norway Rat [83]		Species or species habitat likely to occur within area
Rattus rattus Black Rat, Ship Rat [84]		Species or species habitat likely to occur within area
Vulpes vulpes Red Fox, Fox [18]		Species or species habitat likely to occur within area
Plants		
Anredera cordifolia Madeira Vine, Jalap, Lamb's-tail, Mignonette Vine, Anredera, Gulf Madeiravine, Heartleaf Madeiravine, Potato Vine [2643]		Species or species habitat likely to occur within area
Asparagus aethiopicus Asparagus Fern, Ground Asparagus, Basket Fern, Sprengi's Fern, Bushy Asparagus, Emerald Asparagus [62425]		Species or species habitat likely to occur within area
Asparagus asparagoides Bridal Creeper, Bridal Veil Creeper, Smilax, Florist's Smilax, Smilax Asparagus [22473]		Species or species habitat likely to occur within area
Asparagus plumosus Climbing Asparagus-fern [48993]		Species or species habitat likely to occur within area
Brachiaria mutica Para Grass [5879]		Species or species habitat may occur within area
Cenchrus ciliaris Buffel-grass, Black Buffel-grass [20213]		Species or species habitat may occur within area
Chrysanthemoides monilifera Bitou Bush, Boneseed [18983]		Species or species habitat may occur within

Name	Status	Type of Presence
		area
Chrysanthemoides monilifera subsp. monilifera Boneseed [16905]		Species or species habitat likely to occur within area
Genista linifolia Flax-leaved Broom, Mediterranean Broom, Flax Broom [2800]		Species or species habitat likely to occur within area
Genista monspessulana Montpellier Broom, Cape Broom, Canary Broom, Common Broom, French Broom, Soft Broom [20126]		Species or species habitat likely to occur within area
Genista sp. X Genista monspessulana Broom [67538]		Species or species habitat may occur within area
Lantana camara Lantana, Common Lantana, Kamara Lantana, Large-leaf Lantana, Pink Flowered Lantana, Red Flowered Lantana, Red-Flowered Sage, White Sage, Wild Sage [10892]		Species or species habitat likely to occur within area
Lycium ferocissimum African Boxthorn, Boxthorn [19235]		Species or species habitat likely to occur within area
Olea europaea Olive, Common Olive [9160]		Species or species habitat may occur within area
Opuntia spp. Prickly Pears [82753]		Species or species habitat likely to occur within area
Pinus radiata Radiata Pine Monterey Pine, Insignis Pine, Wilding Pine [20780]		Species or species habitat may occur within area
Protasparagus densiflorus Asparagus Fern, Plume Asparagus [5015]		Species or species habitat likely to occur within area
Protasparagus plumosus Climbing Asparagus-fern, Ferny Asparagus [11747]		Species or species habitat likely to occur within area
Rubus fruticosus aggregate Blackberry, European Blackberry [68406]		Species or species habitat likely to occur within area
Sagittaria platyphylla Delta Arrowhead, Arrowhead, Slender Arrowhead [68483]		Species or species habitat likely to occur within area
Salix spp. except S.babylonica, S.x calodendron & S.x reichardtii Willows except Weeping Willow, Pussy Willow and Sterile Pussy Willow [68497]		Species or species habitat likely to occur within area
Salvinia molesta Salvinia, Giant Salvinia, Aquarium Watermoss, Kariba Weed [13665]		Species or species habitat likely to occur within area
Solanum elaeagnifolium Silver Nightshade, Silver-leaved Nightshade, White Horse Nettle, Silver-leaf Nightshade, Tomato Weed, White Nightshade, Bull-nettle, Prairie-berry, Satansbos, Silver-leaf Bitter-apple, Silverleaf-nettle, Trompillo [12323]		Species or species habitat likely to occur within area
Tamarix aphylla Athel Pine, Athel Tree, Tamarisk, Athel Tamarisk, Athel Tamarix, Desert Tamarisk, Flowering Cypress, Salt Cedar [16018]		Species or species habitat likely to occur within area
Reptiles		

Name	Status	Type of Presence
Hemidactylus frenatus Asian House Gecko [1708]		Species or species habitat likely to occur within area

Nationally Important Wetlands [Resource Information]

Name	State
Forrestdale Lake	WA
Gibbs Road Swamp System	WA
Thomsons Lake	WA

Caveat

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

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

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

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

Threatened, migratory and marine species distributions have been derived through a variety of methods. Where distributions are well known and if time permits, maps are derived using either thematic spatial data (i.e. vegetation, soils, geology, elevation, aspect, terrain, etc) together with point locations and described habitat; or environmental modelling (MAXENT or BIOCLIM habitat modelling) using point locations and environmental data layers.

Where very little information is available for species or large number of maps are required in a short time-frame, maps are derived either from 0.04 or 0.02 decimal degree cells; by an automated process using polygon capture techniques (static two kilometre grid cells, alpha-hull and convex hull); or captured manually or by using topographic features (national park boundaries, islands, etc). In the early stages of the distribution mapping process (1999-early 2000s) distributions were defined by degree blocks, 100K or 250K map sheets to rapidly create distribution maps. More reliable distribution mapping methods are used to update these distributions as time permits.

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

- migratory and
- marine

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

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

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

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

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

Coordinates

-32.127998 115.869108,-32.129615 115.872648,-32.131033 115.87606,-32.132069 115.879772,-32.133359 115.884279,-32.133777 115.885781,-32.133704 115.887497,-32.133504 115.889471,-32.133559 115.890952,-32.135521 115.895673,-32.140027 115.9052,-32.147585 115.922366,-32.147803 115.936957

Acknowledgements

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

-Office of Environment and Heritage, New South Wales
-Department of Environment and Primary Industries, Victoria
-Department of Primary Industries, Parks, Water and Environment, Tasmania
-Department of Environment, Water and Natural Resources, South Australia
-Department of Land and Resource Management, Northern Territory
-Department of Environmental and Heritage Protection, Queensland
-Department of Parks and Wildlife, Western Australia
-Environment and Planning Directorate, ACT
-Birdlife Australia
-Australian Bird and Bat Banding Scheme
-Australian National Wildlife Collection
-Natural history museums of Australia
-Museum Victoria
-Australian Museum
-South Australian Museum
-Queensland Museum
-Online Zoological Collections of Australian Museums
-Queensland Herbarium
-National Herbarium of NSW
-Royal Botanic Gardens and National Herbarium of Victoria
-Tasmanian Herbarium
-State Herbarium of South Australia
-Northern Territory Herbarium
-Western Australian Herbarium
-Australian National Herbarium, Canberra
-University of New England
-Ocean Biogeographic Information System
-Australian Government, Department of Defence
Forestry Corporation, NSW
-Geoscience Australia
-CSIRO
-Australian Tropical Herbarium, Cairns
-eBird Australia
-Australian Government – Australian Antarctic Data Centre
-Museum and Art Gallery of the Northern Territory
-Australian Government National Environmental Science Program
-Australian Institute of Marine Science
-Reef Life Survey Australia
-American Museum of Natural History
-Queen Victoria Museum and Art Gallery, Inveresk, Tasmania
-Tasmanian Museum and Art Gallery, Hobart, Tasmania
-Other groups and individuals

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

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

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APPENDIX 2 DETAILED FLORA AND VEGETATION ASSESSMENT

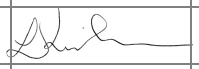
Metropolitan Road Improvement Alliance

Detailed Flora and Vegetation Assessment

Armadale Road Upgrade – Tapper Road to Anstey Road

Doc Number: W81020-REP-EN-0502

Document Approval

Rev.	Date	Prepared by	Reviewed by	Recommended by	Approved by	Remarks
A	19/12/17	F d Wit	L Kirchner	A Elkington	J Redelinghuys	
Signature:						
B	21/12/2017	F d Wit	L Kirchner	A Elkington	J Redelinghuys	
Signature:						
Signature:						
Signature:						

REVISION RECORDING

Rev	Date	By	Description of Revision	Approved
A	19/12/17	F d Wit	Internal review	
B	21/12/17	F d Wit	Draft submission to MRIA	

EXECUTIVE SUMMARY

Main Roads Western Australia required a detailed flora and vegetation assessment for the Armadale Road Upgrade – Tapper Road to Anstey Road. The survey area included isolated patches along Armadale Road which had not been included in the existing approvals process for the road upgrade.

The detailed flora and vegetation assessment included a desktop assessment, field surveys including floristic sampling and targeted searches, and data analysis. A field survey was undertaken on 25 August, 2017 (Survey 1) at which time three permanent quadrats were established and floristic data collected from these and three relevés. Only native vegetation in Good or better condition was represented by quadrat data. Survey 2 was undertaken on 29 September, 2017 at which time all quadrats and some relevés were visited and all flora species were recorded. Survey 3 was undertaken on 26 and 27 September walking transects within suitable habitat for the Threatened orchid *Caladenia huegelii*.

The Project dataset was reconciled with the Swan Coastal Plain (Keighery *et al.,* 2012) dataset to infer the Floristic Community Type. The three quadrats showed a 51-53% similarity to FCT23a Central *Banksia attenuata-B. menziesii* Woodlands. This community represents the Banksia Woodlands of the Swan Coastal Plain Threatened Ecological Community listed as Endangered under the *Environment Protection and Biodiversity and Conservation Act 1999* and is listed as Priority 3 by the State. The presence of the Banksia Woodlands TEC was further supported by applying the key diagnostic criteria, minimum size and condition thresholds.

The TEC was recorded at three distinct locations including Jandakot Regional Park, Rose Shanks Reserve, and Bush Forever Site 344. The TEC extends for 1.6 ha within the survey area, where it represents roadside vegetation at the edge of protected areas of native vegetation.

A *Caladenia huegelii* orchid was recorded at one location along Ghostgum Avenue. This individual is part of a known population listed by DBCA as population #42. No other Threatened or Priority flora species were recorded.

The survey area was characterised by isolated slivers and small patches of varying condition. Because of this the data collected from within these patches may not represent the floristic values of the larger area of remnant native vegetation that the patch is associated with.

INTRODUCTION

1.1 Background

Main Roads Western Australia (Main Roads) is proposing to duplicate approximately 7 km of Armadale Road, between Tapper Road in Atwell and Anstey Road in Forrestdale (the Project). The Project will involve the duplication of Armadale Road between Tapper Road and Anstey Road, improvement/upgrade of various intersections, and associated works including lighting, service relocations and drainage. The Project construction is anticipated to commence in late 2017.

As part of the Project, the following upgrades and/or improvements to a number of intersections along Armadale Road and within the Project area are proposed, including:

- Tapper Road/Verde Drive, Atwell
- Fraser Road, Banjup
- Liddelow Road, Banjup
- Wright Road, Piara Waters
- Rossiter Avenue, Piara Waters
- Nicholson Road, Forrestdale.

The duplication and improvement of Armadale Road will assist in relieving the congestion along the existing corridor which currently experiences breakdown flow in the peak periods.

1.2 Location

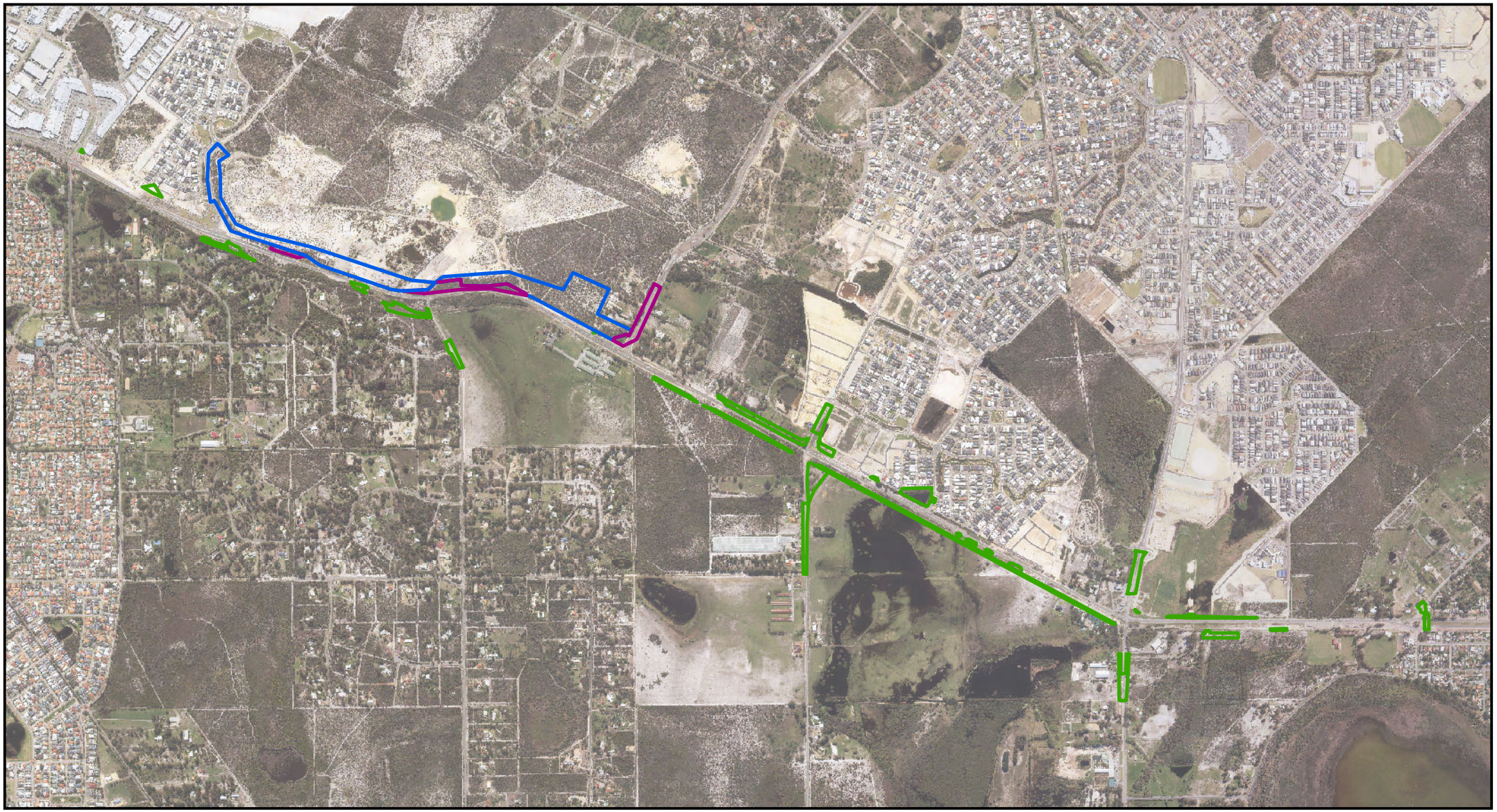
The Project is located within the suburbs of Atwell and Banjup in the City of Cockburn and Piara Waters and Forrestdale in the City of Armadale. The survey area encompasses roadside native and non-native vegetation along Armadale Road from east of Tapper Road to Anstey Road. The survey area includes an area that was subject to the detailed flora and vegetation assessment, and an area that was subject to targeted *Caladenia huegelii* surveys. The survey areas are presented in Figure 1.

1.3 Objectives

The objective of the detailed flora and vegetation assessment was to determine the environmental value of native vegetation present in the survey area. The specific objectives of the flora and vegetation assessment were to:

- complete a desktop assessment
- undertake a field survey incorporating two ‘scoring events’ and targeted Threatened flora searches
- assess significance of vegetation by inferring the Floristic Community Type
- map vegetation units and vegetation condition.

This report presents a description of the flora and vegetation values of the survey area including existing environment, methods, field survey and data analysis results, figures and supporting detailed appendices.



PROJECT ID 60550185.0
CREATED BY DGF
APPROVED BY FdeWit
LAST MODIFIED 14 DEC 2017

Metropolitan Road Improvement Alliance

N

DATUM GDA 1994, PROJECTION PERTH COASTAL GRID 1994

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metres

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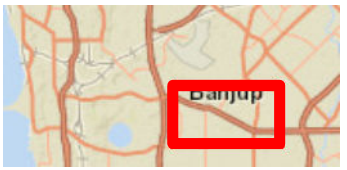
LEGEND

Survey Area

Caladenia huegelii Targeted Survey

Detailed Flora and Vegetation Assessment

Detailed and Targeted Surveys



Survey Area

ARMADALE ROAD UPGRADE DUAL CARRIAGEWAY – TAPPER ROAD TO ANSTEY ROAD

Main Roads Western Australia

Figure

1

Map Document: G:\Client_Data\MRIA\07_Armadale Road Duplication\02_MXDs\03_FaunaFlora\Fig1_SurveyArea.mxd (fotheringhamd)

A4 size

2 LEGISLATIVE FRAMEWORK

2.1 EPBC Act

2.1.1 Matters of National Environmental Significance

The *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) is the main piece of Federal legislation protecting biodiversity in Australia. All Matters of National Environmental Significance (MNES) are listed under the EPBC Act. These include:

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

If an action is likely to have a significant impact on a MNES this action must be referred to the Minister for the Environment for a decision on whether assessment and approval is required under the EPBC Act.

2.1.2 Flora and fauna

Species at risk of extinction are recognised at a Commonwealth level and are categorised in one of six categories as outlined in Table 1.

Table 1 Categories of Species Listed under Schedule 179 of the EPBC Act (Commonwealth)

Conservation	Code Category
Ex	Extinct Taxa
ExW	Extinct in the Wild
CE	Critically Endangered
E	Endangered
V	Vulnerable
CD	Conservation Dependent
OS	Other specially protected fauna

2.1.3 Vegetation Communities

Communities can be classified as Threatened Ecological Communities (TECs) under the EPBC Act. The EPBC Act protects Australia's ecological communities by providing for:

- identification and listing of ecological communities as threatened
- development of conservation advice and recovery plans for listed ecological communities
- recognition of key threatening processes
- reduction of the impact of these processes through threat abatement plans.

Categories of federally listed TECs are described in Table 2.

Table 2 Categories of TECs that are listed under the EPBC Act

Code	Category
CE	Critically Endangered If, at that time, it is facing an extremely high risk of extinction in the wild in the immediate future.
E	Endangered If, at that time, it is not critically endangered and is facing a very high risk of extinction in the wild in the near future.
V	Vulnerable If, at that time, it is not critically endangered or endangered, and is facing a high risk of extinction in the wild in the medium-term future.

2.2 Western Australian legislation

2.2.1 Flora

Threatened flora are plants which have been assessed as being at risk of extinction (DEC 2012). Under the *Wildlife Conservation Act* 1950 (WC Act), the Minister for the Environment may declare species of flora to be protected if they are considered to be in danger of extinction, rare or otherwise in need of special protection (WAH 1998-).
Plants and animals that are considered Threatened and need to be specially protected because they are under identifiable threat of extinction are listed under the WC Act. These categories are defined in Table 3.

Table 3 Conservation codes for WA flora listed under the Wildlife Conservation Act 1950 updated November 2015

Code	Category
CR	Critically endangered species / Schedule 1
EN	Endangered species / Schedule 2
VU	Vulnerable species / Schedule 3
EX	Presumed extinct species / Schedule 4
IA	Migratory birds protected under an international agreement (fauna only) / Schedule 5
CD	Special conservation (fauna only) / Schedule 6
OS	Special protection for reasons other than those already mentioned (fauna only) / Schedule 7

Species that have not yet been adequately surveyed to warrant being listed under the WC Act, or are otherwise data deficient, are added to a Priority Lists under Priorities 1, 2 or 3 by the State Minister for Environment. Species that are adequately known, are rare but not threatened, or meet criteria for near threatened, or that have been recently removed from the threatened species list for other than taxonomic reasons, are placed in Priority 4. Categories and definitions of Priority Flora and Fauna species are provided in Table 4.

Table 4 Conservation codes for WA flora and fauna as listed by DPaW and endorsed by the Minister for Environment

Conservation Code	Category
Priority One	Poorly Known Species
Priority Two	Poorly Known Species
Priority Three	Poorly Known Species
Priority Four	Rare, Near Threatened and other species in need of monitoring

2.2.2 Vegetation Communities

Threatened Ecological Communities (TECs) are naturally occurring biological assemblages that occur in a particular type of habitat and that may be subject to processes that threaten to destroy or significantly modify the assemblage across its range. TECs are listed by both state and commonwealth legislation.

Vegetation communities in Western Australia are described as TECs if they have been endorsed by the Western Australian Minister for Environment following recommendations made by the Threatened Species Scientific Committee. Categories of TECs are defined in Table 5.

Department of Biodiversity, Conservation and Attractions (DBCA) maintains a database of state listed TECs which is available for online searches via their website. Possible TECs that do not meet survey criteria or are not adequately defined are listed as Priority Ecological Communities (PECs) under Priorities 1, 2 and 3. Ecological communities that are adequately known and are rare but not threatened, or meet criteria for Near Threatened, or that have been recently removed from the threatened list, are placed in Priority 4. Conservation dependent communities are classified as Priority 5. PECs are endorsed by the Minister for Environment are categories are described in Table 6.

DBCA requires that all Priority and Threatened ecological communities are considered during environmental impact assessments and clearing permit applications.
There is currently no formal protection afforded to TECs or PECs listed at the state level.

Table 5 Conservation codes for State listed Ecological Communities

Conservation Code	Category
PD	Presumed Totally Destroyed
CR	Critically Endangered
EN	Endangered
VU	Vulnerable

Table 6 Categories for Priority Ecological Communities

Code	Category
P1	Priority One: poorly-known ecological communities
P2	Priority Two: poorly-known ecological communities
P3	Priority Three: poorly known ecological communities
P4	Priority Four: ecological communities that are adequately known, rare but not threatened or meet criteria for Near Threatened, or that have been recently removed from the threatened list.
P5	Priority Five: communities that are not threatened but subject to a specific conservation program.

3 METHODS

3.1 Desktop

A desktop study was undertaken to gather background information and determine the appropriate level of survey. Sources used to inform the desktop study included government database search results (provided by Main Roads, March 2017) and other publicly available sources and biological surveys undertaken in the local area, including:

- WA Herbarium database
- Protected Matters Search Tool (co-ordinates: -31.126865^{o} 115.864931^{o} with a 5km buffer)
- Naturemap (same co-ordinates as above) (DBCA, 2017)
- Armadale Road Duplication Biological Assessment (Astron, 2015)
- Armadale Road Duplication Environmental Impact Assessment (Strategen, 2017)
- Armadale Road to North Lake Road Bridge (AECOM, 2017a)
- Karel Avenue Upgrade (AECOM, 2017b)
- Kwinana Freeway Widening (AECOM, 2017c).

The search results were reviewed to assess the potential presence of conservation significant environmental values. All conservation significant matters including flora, fauna and communities were reviewed and a likelihood of occurrence was completed based on the categories outlined in Table 7.
Following the desktop study, it was determined that a detailed flora and vegetation assessment, including the establishment of permanent quadrats was required. In particular, the presence of the Banksia Woodland of the Swan Coastal Plain TEC, and potential for PECs and conservation significant flora species, warranted a detailed field survey.

Table 7 Categories of likelihood of occurrence for species and communities

Likelihood	Flora	Communities
Likely to occur	Habitat is present in the survey area and the species has been recorded in close proximity to the survey area	Known occurrences of the community in close proximity to the survey area. Vegetation looks the same within the known occurrence and survey area based on aerial imagery. Geographic location is similar to the survey area
May occur	Habitat may be present and/or the species has been recorded in close proximity to the survey area	Known occurrence of the community in the local area, and/or vegetation looks the same within known occurrence and survey area based on aerial imagery. Geographic location is similar to the survey area
Unlikely to occur	No suitable habitat is present and the species has not been recorded in close proximity to the survey area	Known occurrence of the community in close proximity to the survey area however geographic location does not occur in survey area

3.2 Flora Survey

The detailed flora and vegetation assessment included undertaking two field surveys in different seasons, and collecting data from permanent quadrats and relevés in areas of remnant native vegetation. The first field survey was undertaken by Floora de Wit (flora collection permit SL011912) and Lyn van Gorp (flora collection permit SL011913) on 25 August, 2017.

Floora de Wit has 10 years' experience undertaking flora and vegetation assessments on the Swan Coastal Plain. Floora completed a Bachelor of Science in Environmental Biology (Environmental Restoration) and completed a Postgraduate Diploma in Environmental Management and Impact Assessment.

Lyn van Gorp has more than 7 years' experience in environmental management and impact assessment, and 3 years' of technical botanical experience. Lyn completed a Bachelor of Environmental Science (Natural Resource Science).

Follow-up surveys were undertaken on 29 September by Floora de Wit.
Three permanent quadrats, three relevés and six observation points were completed during the field surveys. All attempts were made to select quadrat locations that were not positioned in a boundary or transition zone. However due to the small patches of native vegetation, and considerable disturbance that has affected these patches, this was not always possible.

Quadrats followed DBCA's Standard Operating Procedure (SOP) No. 6.1 - Establishing Vegetation Quadrats (DEC, 2009a). Quadrats were 10x10 metres (m) defined by a measuring tape and all four corners permanently marked with jarrah pegs. Data collected from quadrats included the presence of plant species, their cover abundance, structural composition of vegetation, physical environment, and presence/absence of disturbance. Each sample point location was given a unique site number, and the following parameters recorded:

- date
- location using hand-held GPS (accuracy of 5 m)
- sample site type (quadrat/relevé and size)
- photograph (northwest corner)
- soil details (type, colour, moisture)
- landform
- vegetation condition using the Keighery (1994) scale and description of disturbance
- fire history
- comprehensive species list
    - estimated height
    - estimated percentage cover (for trees both percentage within quadrat and within community was recorded to enable better description of vegetation community).

3.3 Targeted Orchid Survey

A targeted survey was undertaken for *C. huegelii* in Banksia woodland vegetation within the survey area. Prior to commencing the survey, known populations of *Caladenia huegelii* were checked for flowering. This included a large population in bushland east of the project area; south east of Jandakot Road and Ghostgum Avenue in Jandakot and a smaller population east of Roe Highway and north of Brookfield Rail in Jandakot. When at least 60% of the populations were observed in flower the targeted survey was undertaken. Checks of known populations were undertaken on the following dates:

- 7 September – Jandakot Airport 'Industrial Park' population (DBCA population 56); leaves present near markers and population not flowering
- 13 September – Jandakot Airport 'Industrial Park' population (DBCA population 56); leaves present near markers, flower stalk present on one plant and population not flowering
- 19 September – Jandakot Airport 'Industrial Park' population (DBCA population 56); leaves present near markers, flower stalk present on one plant and population not flowering. Fraser Road population (DBCA population 42) mostly in flower (>80%) (Plate 1). Survey was commenced.

The survey was undertaken on 26 and 27 September by Senior Botanist Catherine Krens (flora collecting licence SL011901) and Environmental Scientists Danielle Sullivan. Parallel survey transects were walked at 5 to 15 m apart within suitable habitat. Survey transects were logged on handheld Garmin Differential GPS units to demonstrate survey effort (see Figure 2).

All *Caladenia* species similar in appearance to *Caladenia huegelii* were recorded. Orchid texts (Hoffman & Brown, 2011 and Liddelow, 2015) and reference images taken of known populations were used to determine any potential *Caladenia huegelii* individuals. The following information was recorded for each potential *Caladenia huegelii* population:

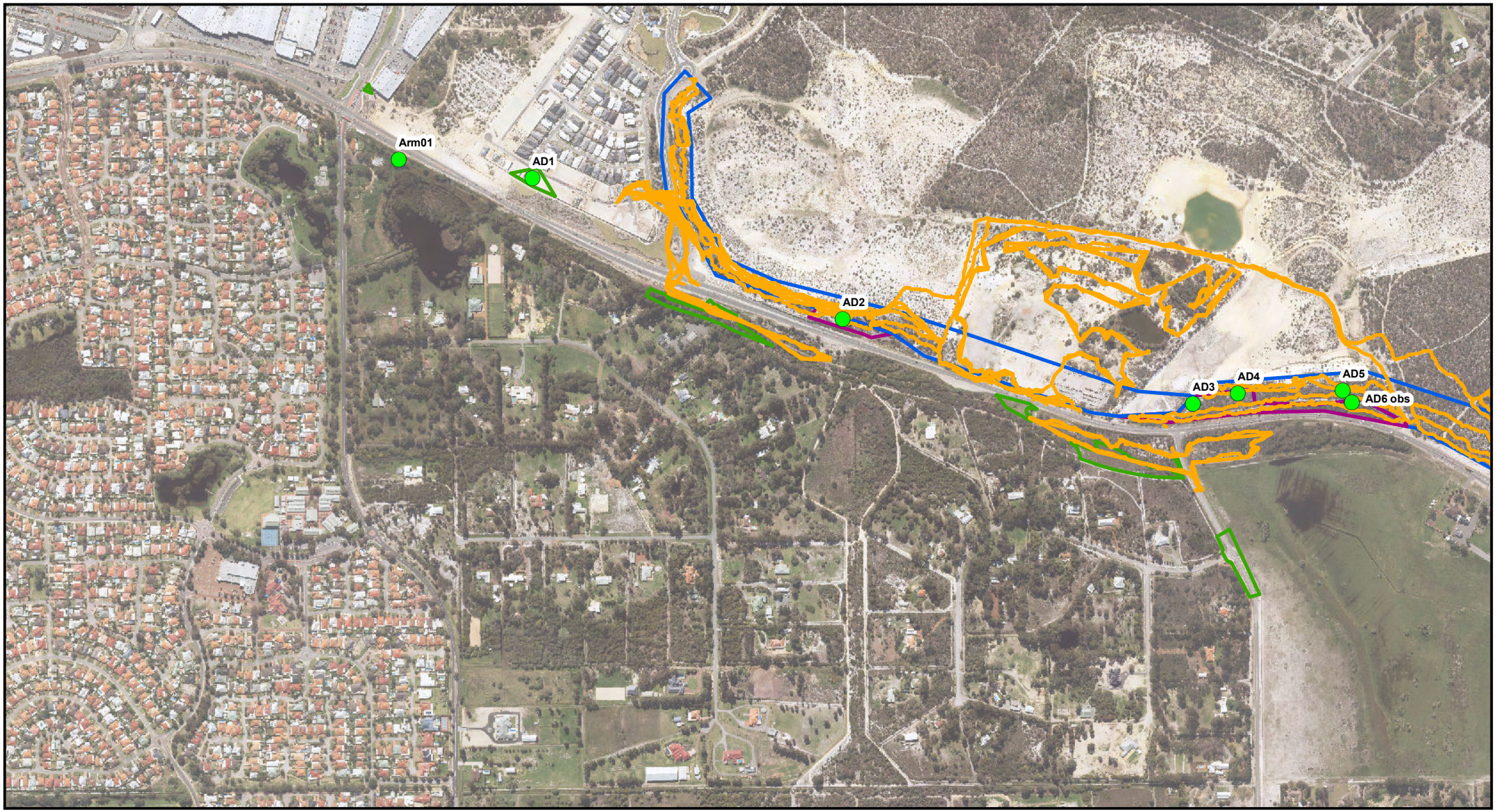
- Waypoint of each population
- Number of individual plants within 1m
- Photograph of each individual plant within the population.

Plate 1 *Caladenia huegelii* in flower at Fraser Road population (DBCA population 42)

Targeted surveys followed methods prescribed in the Draft Orchid Survey Guidelines (Commonwealth of Australia, 2013). Factors to improve the detectability of orchids were considered and are addressed in Table 8. The identification of orchids encountered was based on their key morphological features defined by Jones (2006) and Brown *et al.* (2013).

Table 8 Factors considered to improve detectability of *Caladenia huegelii*

Factor	Comments
Use of appropriate personnel	The survey was led by Catherine Krens a senior botanist with over 10 years' experience in planning and conducting targeted flora surveys including surveys for *Caladenia huegelii* within the Swan Coastal Plain region. Catherine's experience in undertaking *Caladenia huegelii* surveys increased the potential for detection and reduced the chance of recording false 'negatives' and 'positives'.
Determining the optimal timing of survey	The optimal time for survey is from late September to October. Known populations were checked weekly for flowering from early September (7 to 19 September) and the Survey was undertaken on 26 and 27 September.
Characterisation of the study area	Preliminary mapping undertaken following first quadrat-scoring field survey. Banksia woodlands were mapped and identified as requiring targeted surveys.
Establishing a sample design	Transects of 5-10 m spacings were walked at a slow pace to search for the orchid.
Applying sufficient survey effort	GPS track logs were obtained to verify survey effort. All *Caladenia* Spider Orchids were photographed and their identification confirmed by Andrew Brown (DBCA).



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CREATED BY DGF
APPROVED BY FdeWit
LAST MODIFIED 18 DEC 2017

Metropolitan Road Improvement Alliance

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LEGEND

Flora Quadrats

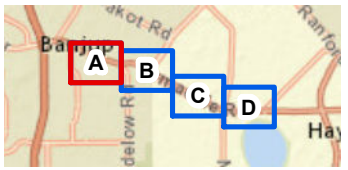
Survey Effort Track Log

Survey Area

Caladenia huegelii Targeted Survey

Detailed Flora and Vegetation Assessment

Detailed and Targeted Surveys



Caladenia huegelii survey effort

ARMADALE ROAD UPGRADE DUAL CARRIAGEWAY – TAPPER ROAD TO ANSTEY ROAD

Main Roads Western Australia

Figure 2A

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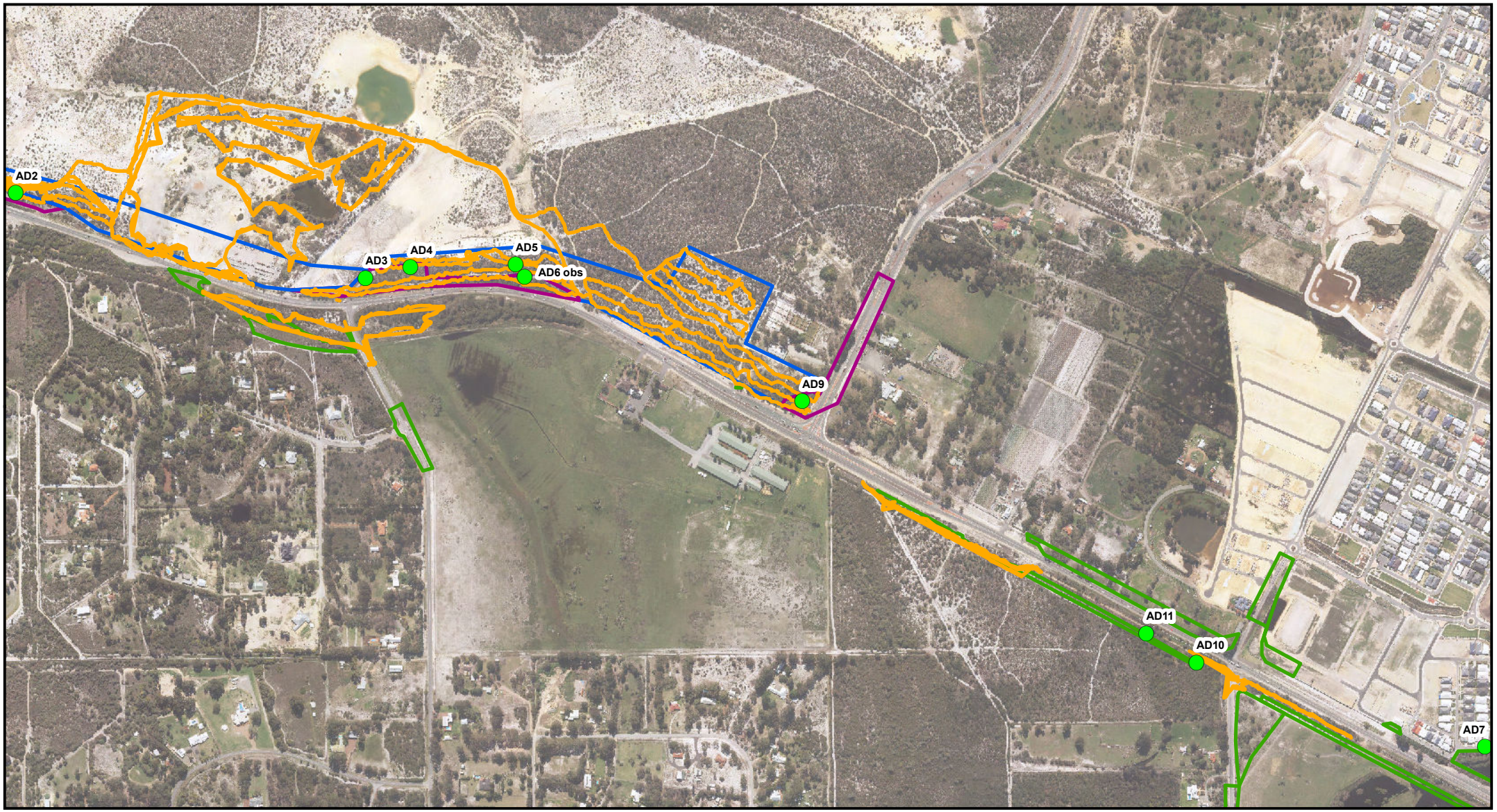

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LEGEND

Flora Quadrats

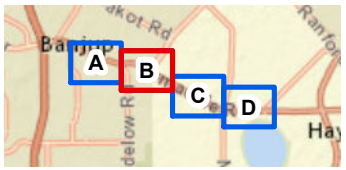
Survey Effort Track Log

Survey Area

Caladenia huegelii Targeted Survey

Detailed Flora and Vegetation Assessment

Detailed and Targeted Surveys



Caladenia huegelii survey effort

ARMADALE ROAD UPGRADE DUAL CARRIAGEWAY – TAPPER ROAD TO ANSTEY ROAD

Main Roads Western Australia

Figure 2B

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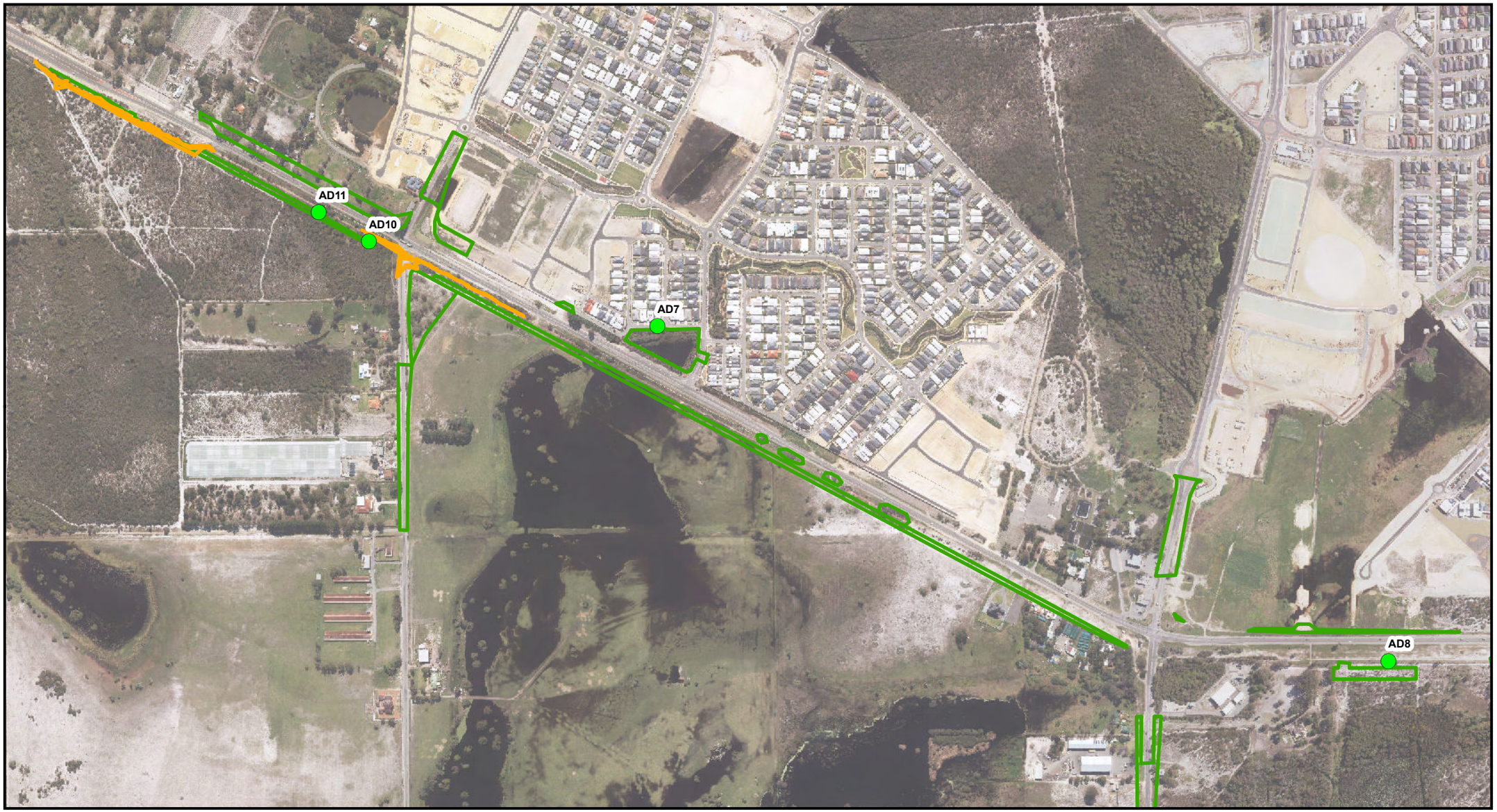

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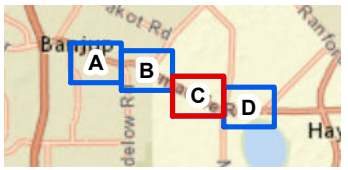
LEGEND

Flora Quadrats

Survey Effort Track Log

Survey Area

Detailed Flora and Vegetation Assessment



Caladenia huegelii survey effort

ARMADALE ROAD UPGRADE DUAL CARRIAGEWAY – TAPPER ROAD TO ANSTEY ROAD

Main Roads Western Australia

Figure 2C

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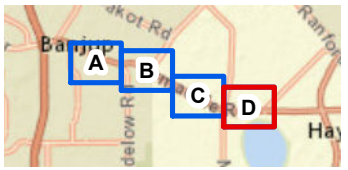
LEGEND

Flora Quadrats

Survey Area

Detailed Flora and Vegetation Assessment



Data sources: NearMap 2017. Sources: Esri, HERE, DeLorme, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), MapmyIndia, NGCC, © OpenStreetMap contributors, and the GIS User Community

Base Data: (c) Based on information provided by and with the permission of the Western Australian Land Information Authority trading as Landgate (2010).

Caladenia huegelii survey effort

ARMADALE ROAD UPGRADE DUAL CARRIAGEWAY – TAPPER ROAD TO ANSTEY ROAD

Main Roads Western Australia

Figure 2D

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3.4 Vegetation classification, data analysis and mapping

Vegetation mapping was undertaken following the first field survey. This allowed for additional quadrats and relevés to be completed during the second survey where gaps in representation were identified. Units that were degraded or representing rehabilitation and/or planted vegetation were not represented in relevés or quadrats. These were mapped as observations recorded on field maps.

Mapping was undertaken using Arc GIS 10.4 and aerial imagery taken August 2017. Historical aerial imagery was used to assess historical clearing footprints. The National Vegetation Information System (NVIS) (ESCAVI, 2003) classification system was used to map and describe the vegetation types at a Level VI sub-association scale. This includes the dominant growth form, height, cover and up to five species for all strata and a mapping code.

Vegetation types were defined by analysing floristic data using cluster dendrograms and similarity indices. Quadrat species lists were imported in statistical program PC Ord and cluster analysis undertaken using Ward's distance measure, nearest neighbour, and Bray-Curtis similarity indices. Presence absence and scaled percentage foliage cover (Braun-Blanquet scale) was considered. The analysis results identified quadrats that had the highest similarity to one another, indicating they are likely to represent the same vegetation type.

The comprehensive Keighery *et al.,* (2012) southern Swan Coastal Plain dataset (SCP dataset) was used to determine the Floristic Community Types (FCT) of each quadrat/vegetation type. A mapping exercise was used to identify SCP quadrats that were within 40 km of the survey area. This included 539 quadrats representing 53 FCTs. The sub-set was reconciled with the Project quadrat data and reviewed for compatibility. Nomenclature of flora species followed the WA Plant Census, current at the time the analysis was undertaken. The combined dataset was imported in PC Ord. The Bray-Curtis similarity index was used to identify the most similar SCP quadrats, and their associated FCT.

Additional quadrat and desktop information such as geology, soils, landscape and historical disturbance was considered to determine the final FCT, including descriptions provided in the Gibson *et al.* (1994) reference material and Bush Forever (Government of WA, 2000). Inferred FCT results presented in this report identifies the most similar SCP dataset quadrats relevant for each Project quadrat, the similarity of these quadrats (represented as percentage) and what FCT they represent.

Patches of native vegetation that may represent the Banksia Woodlands TEC were assessed using methods outlined in the Banksia Woodlands Conservation Advice (TSSC, 2016). The document provides detailed descriptive methods for determining the presence of the TEC, and are therefore not comprehensively provided here. In summary, the identification of the TEC comprises four steps:

- Step 1: use key diagnostic characteristics to determine if TEC is present, informed by the quadrat data, FCT analysis results and vegetation type mapping
- Step 2: determine condition of patch
- Step 3: determine size of patch and consider minimum size threshold
- Step 4: consider context of a patch that may affect the outcome

The assessment methods implemented and comprehensive results are provided in **Appendix B**.

Vegetation condition was mapped using the Keighery (1994) vegetation condition scale, informed by quadrat data, survey observations, and weed infestations recorded.

3.5 Limitations

Limitations are inherent with any biological assessment. The limitations associated with the biological assessment are outlined in Table 9, as specified in EPA (2016) Flora Survey Technical Guide. The limitation assessment scale ranges from “not”, “minor”, “moderate”, “significant”.

Table 9 Limitations of the assessment

Limitation	Flora and vegetation assessment
Availability of contextual information on the region	**Not a limitation.** Sufficient resources for the Swan Coastal Plain were available to provide contextual information including Beard (1981), Heddle *et al*. (1980) vegetation mapping, Perth @ 3.5 million (Government of WA, 2015) and the Gibson *et al.* (1994) and Keighery *et al.* (2012) swan coastal plain datasets. Contextual information was also obtained from other Main Roads projects including Armadale Duplication Survey (Astron 2015), Karel Avenue (AECOM, 2017a), Armadale Road to North Lake Road Bridge (2017b) and Kwinana Freeway Widening (AECOM, 2017c).
Competency/experience of consultant conducting survey	**Not a limitation.** The flora and vegetation assessment was led by Floora de Wit who has more than 10 years’ experience conducting surveys of similar scope. Advice from Val English and Andrew Brown was sought where necessary to discuss the significant Banksia TEC and threatened orchids.
Proportion of flora/fauna identified, recorded and/or collected (based on sampling, timing and intensity)	**Not a limitation.** Floristic data was collected from three permanent quadrats, two relevés and multiple observation points. The degraded condition of vegetation from historical clearing and edge effects, and the considerable extent of rehabilitated areas led to the inclusion of more observation points than quadrats.
Completeness (was relevant area fully surveyed)	**Not a limitation**. All native vegetation was visited and data collected from quadrats or relevés. The targeted orchid survey was undertaken in all areas of suitable habitat. No additional work is required.
Remoteness and/or access problems	**Not a limitation.** All areas of native and planted vegetation were accessible on foot.
Timing, weather, season, cycle	**Minor limitation.** The first field survey was undertaken on 25 August 2017 followed by the second scoring event on 29 September 2017. Not much time had lapsed between the two surveys which may have impacted on the inclusion of particular flowering species that are present later in the season. The impact of altered rainfall patterns in 2017 (significant summer rain, late winter rains) on flowering species, in particular annual species and flowering periods of perennial species is uncertain.
Disturbances (e.g. fire flood, accidental human intervention) which affected results of the survey	**Not a limitation.** Disturbance such as clearing has affected the majority of the survey area and/or boundary of the survey area. This is an indication of the condition of vegetation as present and is not considered to impact on the survey results.

4 EXISTING ENVIRONMENT

4.1 Climate

The Armadale duplication project is located in Perth which experiences a Mediterranean climate. A Mediterranean climate is characterised by warm to hot dry summers and mild to cool wet winters. The Mediterranean climate in Australia is a result of the Indian Ocean High, a high pressure cell that shifts towards the poles in summer and the equator in winter, playing a major role in the formation of the deserts of Western Australia, and the Mediterranean climate of southwest and south-central Australia. Precipitation occurs during winter months, with the possibility of some summer storms.

Rainfall data was obtained from the Jandakot Aero weather station (no. 9172). The climate data in the 12 months preceding the survey shows a fluctuating rainfall pattern (Figure 2) including significant summer rain, a delayed winter rain season and warmer winter months. The first field survey was undertaken in mid-August, following reasonable July rainfall. However the late arrival of rain may have impacted on the presence of herb species in particular. The second field survey was undertaken at the ideal survey season following three months of higher than average rainfall. The impact of the variation in rainfall patterns in 2017 on the presence of flora species is unknown.

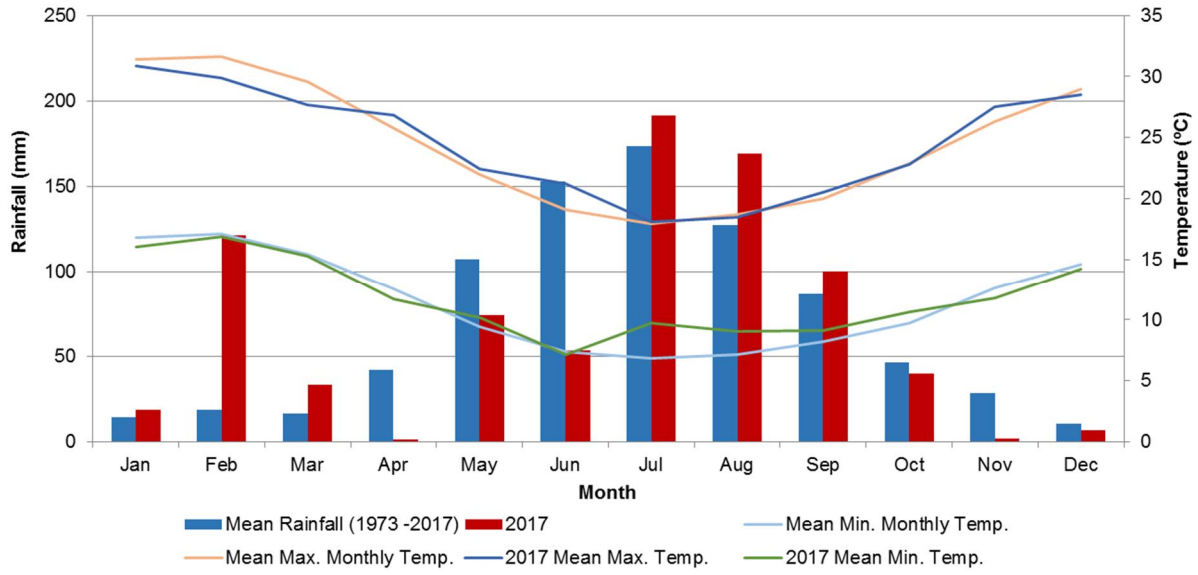


Figure 3 Climate data obtained from the closest comprehensive weather station, Jandakot Aero (009172).

4.2 IBRA Region

The Swan Coastal Plain bioregion, described in CALM (2002), includes Perth and the outer suburbs (excluding the Hills suburbs). The Swan Coastal Plain consists of the Dandaragan Plateau and the Perth Coastal Plain and is comprised of a narrow belt less than 30km wide of Aeolian, alluvial and colluvial deposits of Holocene or Pleistocene age (Gibson et al 1994). A complex series of seasonal fresh water wetlands, alluvial river flats, coastal limestone and several offshore islands are included in the bioregion. Younger sandy areas and limestone are dominated by heath and/or tuart woodlands, while Banksia and jarrah-Banksia woodlands are found on the older dune systems. The outwash plains at the foot of the Darling Escarpment were once dominated by Casuarina obesa-marri woodlands and Melaleuca shrublands. Extensive clearing has occurred on the Swan Coastal Plain for urban and agricultural development. The region is divided into the Dandaragan Plateau and the Swan Coastal Plain subregions.

The Swan Coastal Plain subregion, described by Mitchell et al. (2002), is a low-lying coastal plain covered with woodlands dominated by Banksia or Tuart on sandy soils, *Casuarina obesa* on outwash plains, and paperbark in swampy areas. The area includes a complex series of seasonal wetlands and includes Rottnest, Carnac and Garden Islands. Land use is predominantly cultivation, Conservation, urban and rural residential. The area contains a number of rare features including Holocene dunes and wetlands and a large number of rare and threatened species and ecological communities.

4.3 Vegetation

Beard (1981) mapped the vegetation on the Swan Coastal Plain. The survey area intersects with the Beard vegetation association 1001, described as 'Medium very sparse woodland; Jarrah, with low woodland; *Banksia* & *Casuarina*' (Beard, 1981).

The survey area west of Warton Road occurs in the Bassendean Complex central and south vegetation complex under the Heddle *et al.* (1980) classification system. The project area east of Warton Road to Anstey Road is largely found in the Southern River Complex. Vegetation within the Southern River Complex is defined as comprising of open woodland of *Corymbia calophylla – E. marginata – Banksia* spp. with fringing woodland of *E. rudis – M. rhaphiophylla* along creek beds.

The Bassendean Complex is described as vegetation ranging from woodland of *Eucalyptus marginata – Allocasuarina fraseriana - Banksia* spp. to low woodland of *Melaleuca* spp. and sedgelands on the moister sites.

4.4 Soils and geology

The survey area is located on Bassendean Sands, a basal conglomerate overlain by dune quartz sand with heavy mineral concentrations (Geological Survey of WA & Geoscience Australia, 2008). Two soil types are mapped in the survey area including Cb38 grading east to west into Cb39. Cb38 includes sandy dunes with intervening sandy and clayey swamp flats. Chief soils are leached sands sometimes with a clay D horizon below 5 feet on the dunes, and sandy swamps. Cb39 includes subdued dune-swale terrain with chief soils including leached sands. Soil was observed onsite to be largely grey, dry sand.

5 DESKTOP RESULTS

5.1 Threatened and Priority Ecological Communities

Two Threatened Ecological Communities (TECs) were mapped as occurring within the survey area including the Banksia Woodlands of the Swan Coastal Plain (Banksia Woodlands), and the Claypans of the Swan Coastal Plain (Claypans). These communities are defined further below.

The desktop study results show the Banksia Woodlands of the Swan Coastal Plain TEC (Banksia Woodlands TEC) has been mapped within the survey area. The mapping of the Banksia Woodland TEC is based on the Commonwealth's 'likely to occur' areas and incorporates broad-scale mapping of areas most likely to contain the TEC. The desktop results are therefore an indicative distribution.

The Banksia Woodlands TEC was listed under the EPBC Act as Endangered on 16 September 2016. The community incorporates woodland of *Banksia* species with scattered Eucalypts and other tree species over a species rich mix of sclerophyllous shrubs, graminoids, and forbs. The community shows high endemism and considerable local variation in species composition across its range. It is restricted to the southwest of WA on the Swan Coastal Plain. It occurs mainly on deep Bassendean and Spearwood sands or occasionally on Quindalup sands.

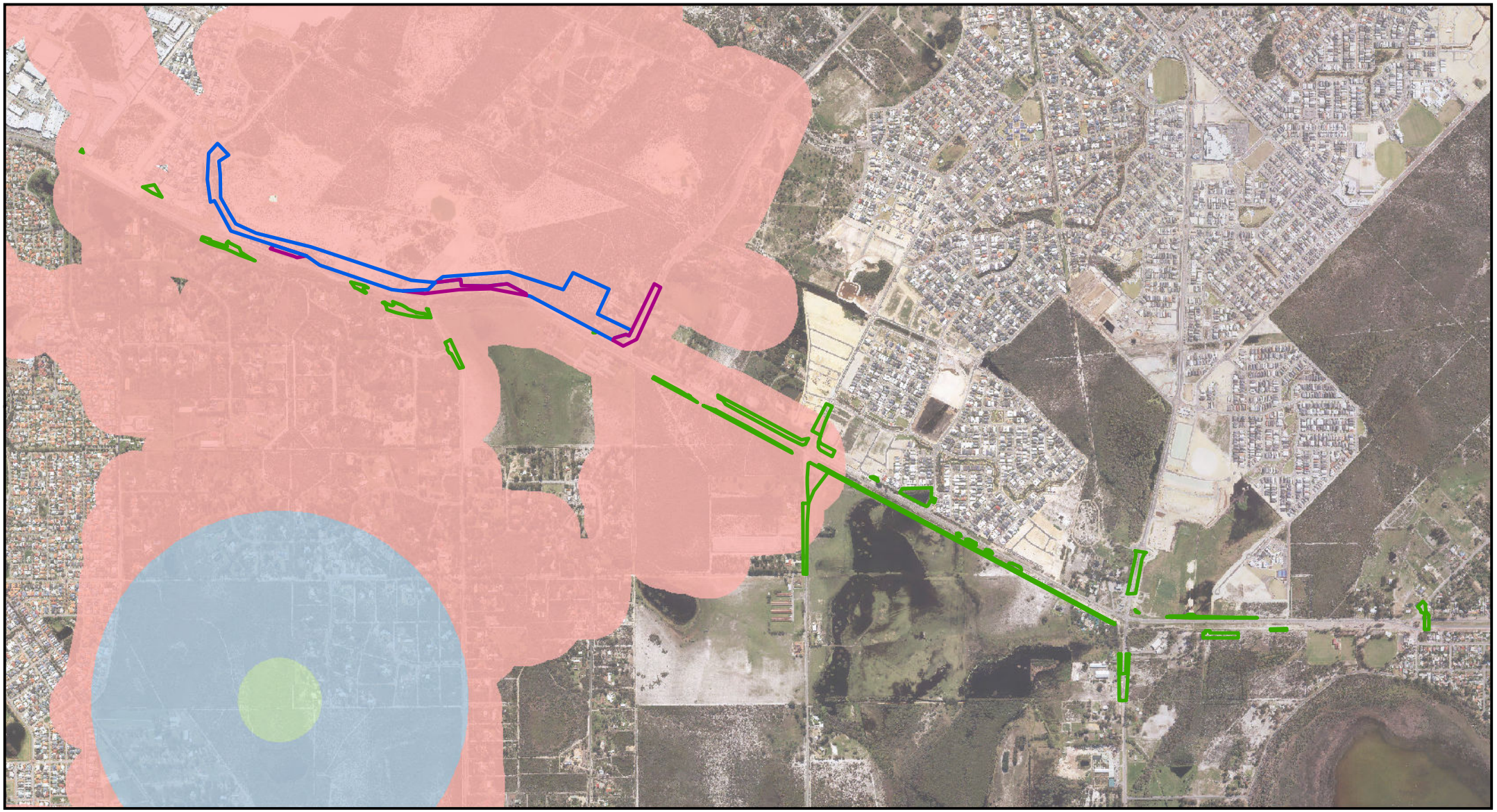
The Banksia Woodlands TEC relates to three Threatened communities at the State-level and eight Priority Ecological Communities (PECs). Four of these PECs were identified in the desktop study.

The Claypans TEC, considered Critically Endangered under the EPBC Act, is mapped over the eastern edge of the survey area east of Anstey Road. The TEC at this location represents the Herb Rich Shrublands in Clay Pans listed as Vulnerable under the WC Act. The TEC is associated with native vegetation within and adjacent to Forrestdale Lake Nature Reserve and Bush Forever Site 345. The other TEC associated with the EPBC Act-listed TEC is Shrublands on Dry Clay Flats, listed as Endangerd under the WC Act. This community encompasses native vegetation within Bush Forever Site 345 and overlaps with the Herb Rich Shrublands in Clay Pans TEC.

The TECs and PECs descriptions, their relationship to EPBC Act-listed communities, conservation status and likelihood of occurrence assessment is presented in Table 10 and mapped in Figure 4.

Table 10 Threatened and Priority Ecological Communities that may or are likely to be present in the survey area

Community Description	Cons. Status	Likelihood of occurrence
Banksia Woodlands of the Swan Coastal Plain TEC Distinctive upper sclerophyllous layer of low trees dominated or co-dominated by one or more Banksia species. Emergent tree layer may be present including Eucalyptus and/or Allocasuarina. Understorey of high biodiversity.:	EPBC Act: E	Mapped in survey area
Wooded wetlands which support colonial waterbird nesting areas Includes Chandala, Booragoon Lake, unnamed wetland near Pinjarra, McCarleys Swamp.	State: P2	Unlikely
Banksia Dominated Woodlands of the Swan Coastal Plain IBRA Region Canopy is most commonly dominated or co-dominated by *Banksia attenuata* and/or *B. menziesii*. Other Banksia species that can dominate in the community are *B. prionotes or B.ilicifolia*. It typically occurs on well drained, low nutrient soils on sandplain landforms.	State: P3	Mapped in survey area
Low-lying *Banksia attenuata* woodlands or shrublands (FCT21c) Occurs sporadically between Gingin and Bunbury. Occupies low lying wetter sites and is variously dominated by *Melaleuca preissiana*, *Banksia attenuata, B. menziesii*, *Regelia ciliata, Eucalyptus marginata* or *Corymbia calophylla*. Structurally, this community type may be either a woodland or occasionally shrubland.	State: P3	Likely
***Banksia ilicifolia* woodlands (FCT22)** Low lying sites generally consisting of *Banksia ilicifolia – B. attenuata* woodlands, but *Melaleuca preissiana* woodlands and scrubs are also recorded. Occurs on Bassendean and Spearwood systems in the central Swan Coastal Plain north of Rockingham. Typically has very open understorey, and sites are likely to be seasonally waterlogged.	State: P2	Likely
Claypans of the Swan Coastal Plain Occurs where clay soils form an impermeable layer close to the landscape surface, and wetlands that rely solely on rainfall to fill then dry to impervious pans in summer. Community generally occurs as a shrubland over a ground layer of geophytes, herbs and sedges (TSSC, 2012).	EPBC Act: CR	Unlikely
Herb Rich Shrublands in Clay pans (FCT8) Dominated by *Viminaria juncea, Melaleuca viminea, M. lateritia* or *M. uncinata* and occasionally *E. wandoo.* Aquatic annuals are common.	WC Act: VU	Unlikely
Shrublands on Dry Clay Flats (FCT10a) Thin skeletal soils or rapidly drying clay flats. Includes aquatic annuals and geophytes (eg. *Schoenus natans, Crassula natans, Eryngiuym pinnatifidum, Wurmbea dioica*).	WC Act: EN	Unlikely



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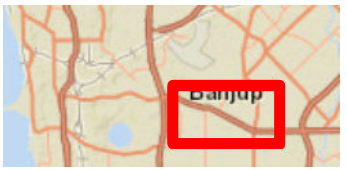
LEGEND

Survey Area

- *Caladenia huegelii* Targeted Survey
- Detailed Flora and Vegetation Assessment
- Detailed and Targeted Surveys

TEC PEC (All Endangered)

- Banksia Dominated Woodlands of the Swan Coastal Plain IBRA Region
- Banksia ilicifolia woodlands
- Low lying Banksia attenuata woodlands or shrublands



Desktop Threatened and Priority Ecological Communities

ARMADALE ROAD UPGRADE DUAL CARRIAGEWAY – TAPPER ROAD TO ANSTEY ROAD

Main Roads Western Australia

Figure 4

Map Document: G:\Client_Data\MRIA\07_Armadale Road Duplication\02_MXDs\03_FaunaFlora\Fig5_DesktopThreatenedFlora.mxd (fotheringhamd)

A4 size

5.2 Threatened and Priority flora

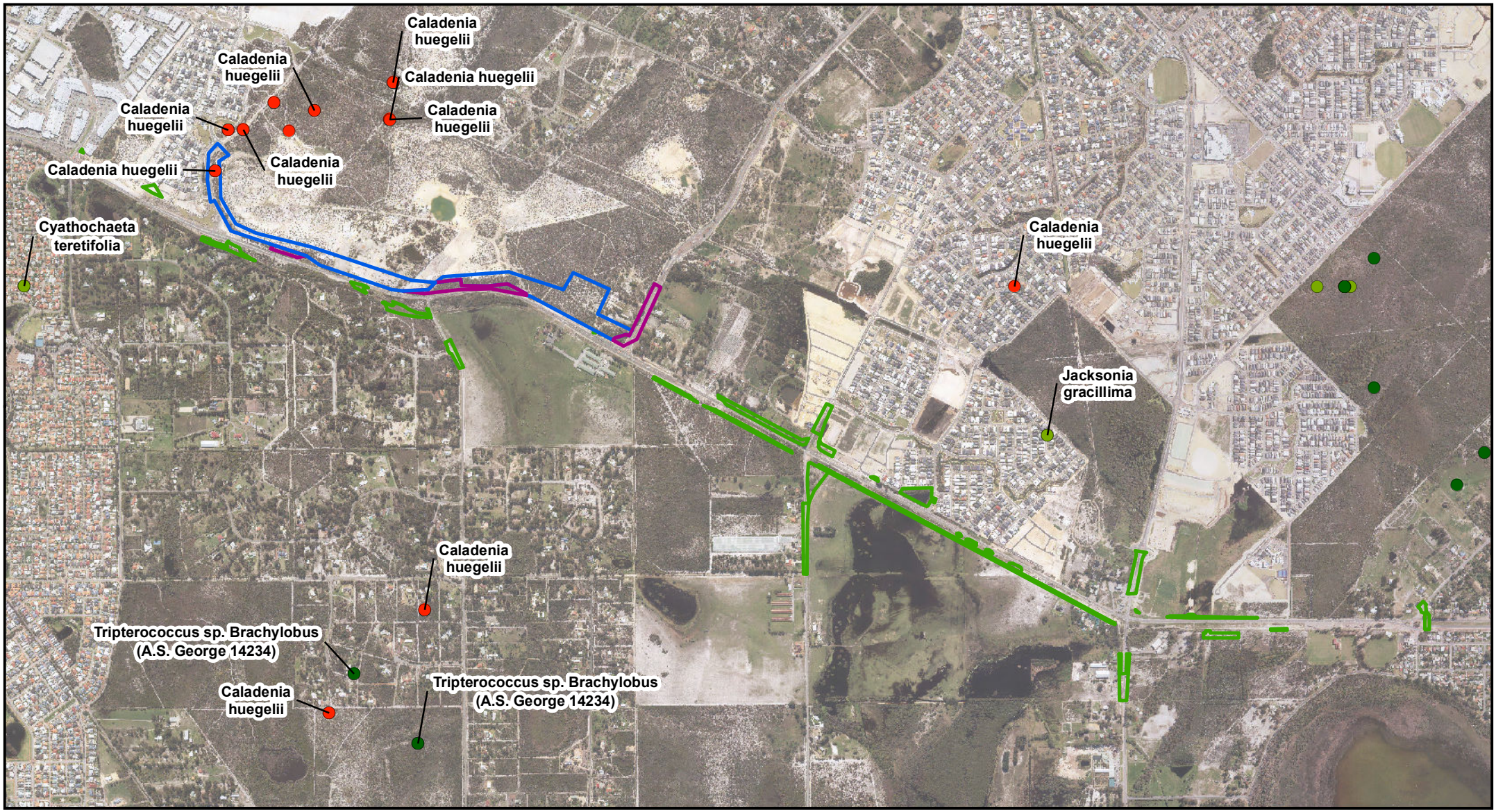
Thirty-six Threatened and Priority species were identified as potentially occurring within the survey areas, including seven mushrooms and 29 flora species. Of these, eleven are listed under the EPBC Act and WC Act, and one species is listed solely under the WC Act. The likelihood assessment considered presence of suitable habitat, and proximity of known records. Habitat within the survey area includes Banksia Woodland, Wetlands and associated fringing vegetation, and disturbed regrowth and planted patches.

The likelihood assessment identified eight species that are considered likely to occur. These species included one EPBC Act-listed species *Caladenia huegelii* which prefers deep sandy soils with Banksia and/or Jarrah Woodlands. The other seven Priority species were associated with sandy soils and/or winter-wet flats and wetlands. Eleven species may occur, including three EPBC Act-listed species associated with clay soils and wetlands. Ten species are considered unlikely to occur and seven species are mushrooms of which we have no information to inform the assessment.

Species likely to occur are outlined in Table 11, with a comprehensive list provided in **Appendix A** and mapped in Figure 5.

Table 11 Threatened and Priority flora species that may or are likely to occur within the projects areas

Taxon	Cons, Code		Habitat
	WC Act / DBCA	EPBC Act	
Caladenia huegelii	CR	E	Deep sandy soils in *Banksia-Eucalyptus marginata* woodlands.
Cyathochaeta teretifolia	P3		Grey sand, sandy clay. Swamps, creek edges.
Dampiera triloba	P3		Sandy rises, peaty sand over clay.
Dodonaea hackettiana	P4		Sand. Outcropping limestone.
Jacksonia sericea	P4		Calcereous and sandy soils. Recorded in *Banksia* and *Melaleuca preissiana* woodland.
Styphelia filifolia	P3		Several records in close proximity. Recorded in Banksia woodland and low forest.
Phlebocarya pilosissima subsp. Pilosissima	P3		White or grey sand, lateritic gravel.
Synaphea sp. Fairbridge Farm (D. Papenfus 696)	CR		Near winter-wet flats in low woodland with weedy grasses.
Amanita carneiphylla	P3		Deeply rooting in sandy soil, solitary or in small scattered groups.



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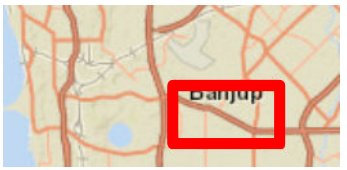
LEGEND

Survey Area

- *Caladenia huegelii* Targeted Survey
- Detailed Flora and Vegetation Assessment
- Detailed and Targeted Surveys

Desktop Threatened and Priority Flora

- T
- 2
- 3
- 4



Desktop Threatened and Priority Flora

ARMADALE ROAD UPGRADE DUAL CARRIAGEWAY – TAPPER ROAD TO ANSTEY ROAD

Main Roads Western Australia

Figure 5

Map Document: G:\Client_Data\MRIA\07_Armadale Road Duplication\02_MXDs\03_FaunaFlora\Fig5_DesktopThreatenedFlora.mxd (fotheringhamd)

A4 size

6 FIELD SURVEY RESULTS

6.1 Threatened communities

One TEC listed as Endangered under the EPBC Act was recorded in the survey area. A comprehensive assessment for determining the presence of the Banksia Woodlands of the Swan Coastal Plain TEC (Banksia Woodlands) was applied to three patches of Banksia Woodland:

- Patch 1 Jandakot Regional Park
- Patch 2 Rose Shanks Reserve (southeast corner)
- Patch 3 Bush Forever Site 344 northern boundary.

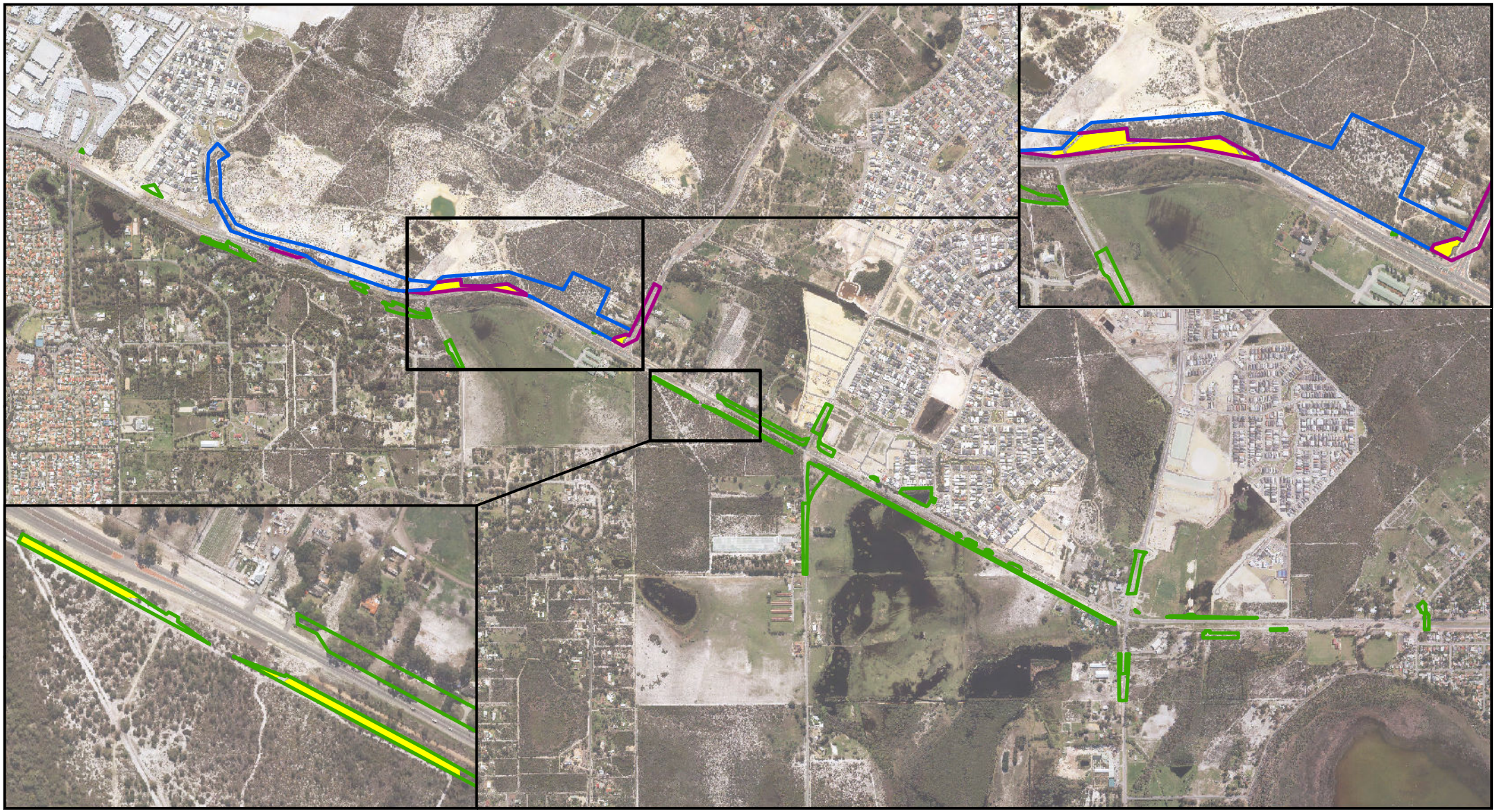
Patch 1 met all the key diagnostic criteria, size and condition requirements. This patch represents Very Good Banksia Woodland, mapped as BaHhBm, and is considered of high conservation value. The Banksia Woodland TEC assessment was supported by an assessment against the key diagnostic criteria, application of the minimum condition and size thresholds, and the inferred FCT analysis. All quadrats within the patch represent FCT23a Central *B. attenuata-B. menziesii* Woodlands (see Section 6.2) which is recognised as part of the Banksia Woodland TEC.

Patch 2 Rose Shanks Reserve was assessed taking into account the adjacent native vegetation rather than the small area within the survey area. The inclusion of Rose Shanks Reserve this patch met all key diagnostic criteria, size and condition requirements. The patch is mapped as BaBm and mapped as Good condition. Conservation value is considered low due to poor condition and low diversity.

Patch 3 Bush Forever Site 344 is represented by several slivers within the survey area. These slivers are mapped as BaHhBm and vary in condition between Good and Degraded. This patch was assessed taking into account the adjacent native vegetation as per the Conservation Advice (TSSC, 2016). These slivers therefore also met key diagnostic criteria for the TEC. However, as with patch 2, the conservation value is considered low given the degradation of vegetation and isolation from adjacent vegetation by fence.

At a State level, the three patches are considered a Priority 3 ecological community. The total extent of Banksia Woodland of the SCP Endangered TEC and Priority 3 PEC within the survey area is 1.6 ha, mapped in Figure 6. The detailed Banksia Woodland TEC assessment for the three patches is provided in **Appendix B**.

Plate 2 Banksia Woodland of the Swan Coastal Plain (Endangered TEC)



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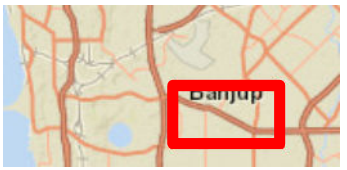
LEGEND

Survey Area

- *Caladenia huegelii* Targeted Survey
- Detailed Flora and Vegetation Assessment
- Detailed and Targeted Surveys

Threatened and Priority Ecological Communities

- Banksia Woodlands of the Swan Coastal Plain



Conservation Significant Communities

ARMADALE ROAD UPGRADE DUAL CARRIAGEWAY – TAPPER ROAD TO ANSTEY ROAD

Main Roads Western Australia

Figure 6

Map Document: G:\Client_Data\MRIA\07_Armadale Road Duplication\02_MXDs\03_FaunaFlora\Fig6_ConservationSignificantCommunities.mxd (fotheringhamd)

A4 size

6.2 Inferred FCT

The three quadrats completed for the survey are situated on the Bassendean – Central and South vegetation complex as mapped by Heddle (1980). This was taken into account when considering the final inferred FCT.

All three quadrats showed the highest similarity to SCP quadrats in FCT23a (see Table 12). Similarities varied between 51%-53%. The similarity between the project quadrats and SCP quadrats are directly correlated to survey effort. Scoring quadrats over multiple seasons and years would account for the variation in species presence.

For AD3 and AD5, the three SCP quadrats with highest similarities represent FCT23a. It can therefore be said with reasonable confidence that vegetation unit BaHhBm represents FCT23a Central *B. attenuata-B. menziesii* woodlands.

Table 12 Inferred FCT for Quadrats completed in the survey area. Includes vegetation condition, highest similarity, a review and the final inferred FCT

Quadrat Details	Condition	Quadrat (FCT; % similarity)	Review of Result	Final FCT
AD3	Very Good	53% (perth04; 23a) 51% (perth08; 23a) 50% (jand08; 23a)	FCT23a is a good fit.	FCT23a Central *B. attenuata-B. menziesii* woodlands
AD4	Excellent	55% (gosn12; 23a) 52% (ELE17, 23b) 52% (ELE28; 23b) 52% (perth06; 23a) 52% (WHITE-1; 23a)	FCT23a is a good fit.	FCT23a Central *B. attenuata-B. menziesii* woodlands
AD5	Very Good	51% (ELE17; 23a) 51% (ELE28; 23a) 51% (Cresw01; 23a)	FCT23a is a good fit.	FCT23a Central *B. attenuata-B. menziesii* woodlands

6.3 Vegetation types

Six vegetation types were recorded, mapped and described in the survey area. This includes three native and three degraded or non-native vegetation types. Vegetation types include:

- Two Banksia Woodlands, BaHhBm and BaBm
- One wetland, MpKgLs
- Two considerably degraded communities, Kg and Trees
- One planted (non-native).

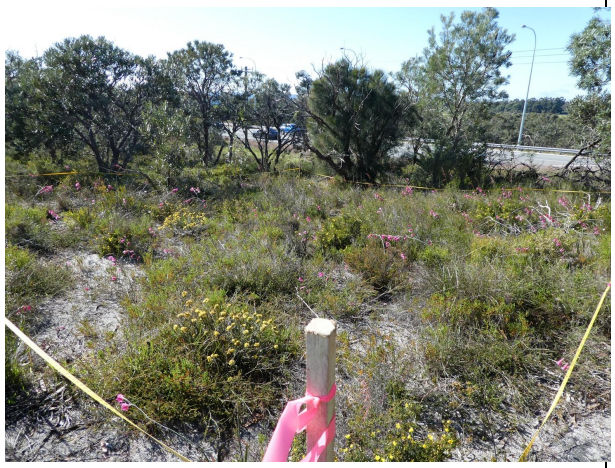
Banksia Woodlands BaHhBm was identified as significant during the first field survey and therefore represented by three permanent quadrats. This community represents FCT23a Central *B. attenuata-B. menziesii* Woodlands and the Banksia Woodlands TEC listed as Endangered under the EPBC Act and Priority 3 by DBCA. This community was mostly in Very Good condition.

Banksia Woodland BaBm was mapped at one location supporting degraded native vegetation with significant weed invasion from the edges. The construction of a limestone track and good quality fencing has led to further degradation of this vegetation type. Historical aerial imagery and species present indicates potential natural drainage attributes of this area. It is likely that the patch used to represent an ecotone of wetland fringing vegetation associated with the wetland south of Armadale Road, and the upland Banksia Woodland.

The wetland unit MpKgLs occurs at two wetlands. Both locations were historically cleared and significantly burnt in the past. Vegetation within these patches represent regrowth from approximately 1995 which has resulted in dense colonising species such as *Kunzea glabrescens* and weeds (**Ehrharta calycina*).

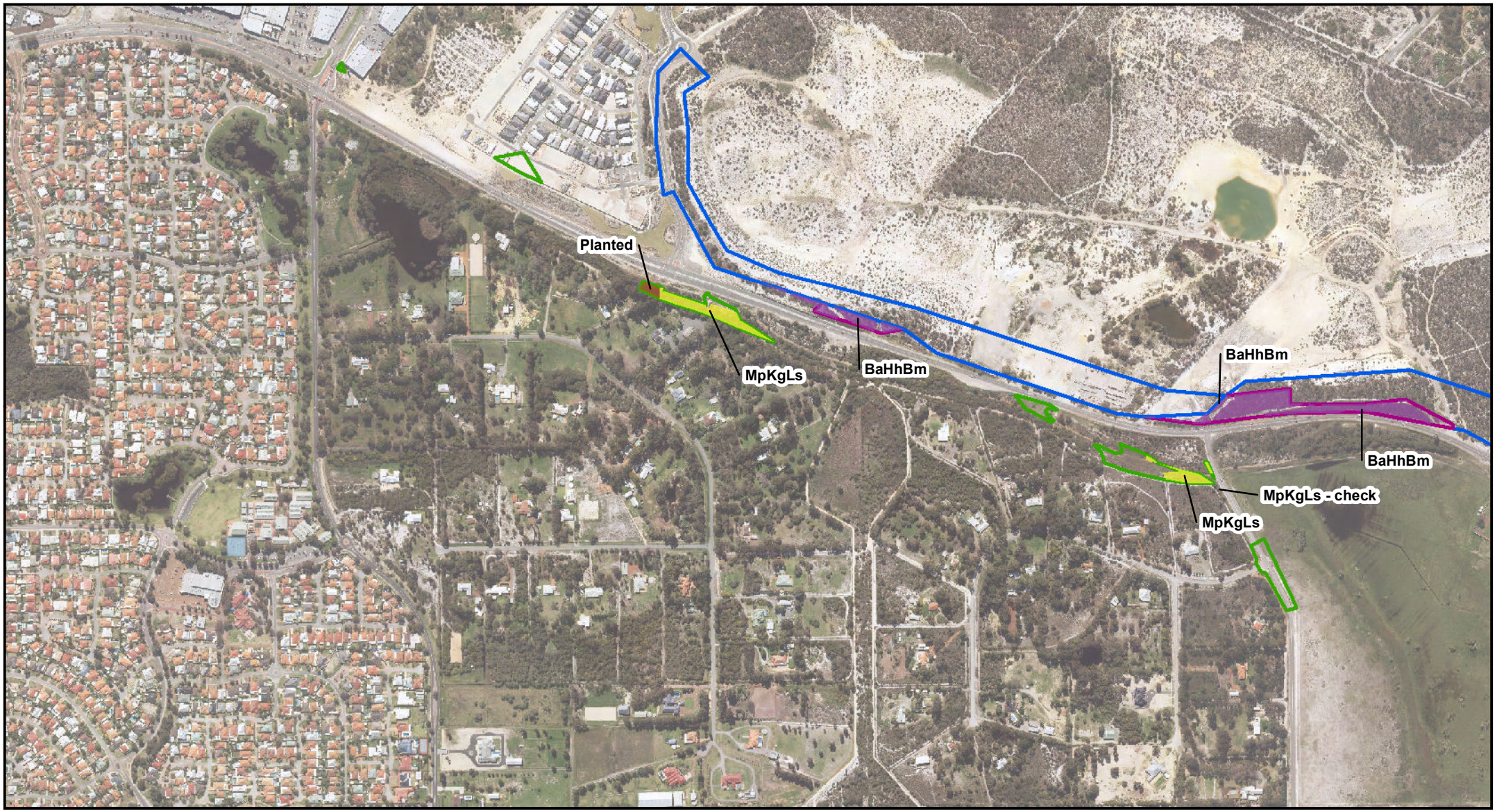
Vegetation types, their descriptions and mapping codes, survey effort, extent, species richness and photograph are presented in Table 13 and mapped in Figure 7.

Table 13 Vegetation types recorded in the survey area

Description	Details	Photograph
BaHhBm *Banksia attenuata, Banksia menziesii,* and *Allocasuarina fraseriana* low woodland over *Hibbertia hypericoides, Scholtzia involucrata, Stirlingia latifolia*, *Allocasuarina humilis* and *Acacia pulchella* var. *glaberrima* mid heath shrub with **Briza maxima*,, **Ehrharta calycina, Amphipogon turbinatus* and **Aira caryophyllea* low sparse grassland over **Ursinia anthemoides, Conostylis aurea, Lechenaultia biloba, Chamaescilla corymbosa* var. *corymbosa* and **Gladiolus caryophyllaceus* low herbland. Regionally significant, represents Banksia Woodland TEC.	Survey effort: three permanent quadrats (AD3, 4, 5) and two observation points (AD2 & 6). Species richness: 65 native and 13 weed species. Area: 1.79 ha Condition: Degraded to Very Good	
BaBm *Banksia attenuata, Banksia menziesii* and *Banksia ilicifolia* low woodland (with *Eucalyptus marginata* scattered trees) over *Xanthorrhoea preissii* and *Macrozamia riedlei* open shrubland over *Dasypogon bromeliifolius* and *Phlebocarya ciliata* or *Desmocladus flexuosus* open herbland to closed herbland. Extrapolation from Astron (2015) supported by observation point. Within the survey area it represents Degraded to Good vegetation in a low-lying area. Regionally significant as representative of Banksia Woodland TEC (Endangered) and part of Jandakot Regional Park (Rose Shanks Reserve).	Survey effort: one relevé (AD9) from this survey and three relevés from Astron (2015) Area: 0.18 ha Condition: Degraded	

Description	Details	Photograph
MpKgLs *Melaleuca preissiana* low open forest over *Kunzea glabrescens* and *Jacksonia furcellata* tall shrubland over **Ehrharta calycina* and **Briza maxima* low grassland with *Melaleuca huegelii, Acacia pulchella* var. *glaberrima* and *Xanthorrhoea preissii* mid sparse shrubland over *Lepidosperma scabrum* low open sedgeland. Understorey density and species vary depending on surface to groundwater table level and proximity to edge of community. This community is closely aligned with **Mp *Melaleuca preissiana* damplands** from Astron (2015). Community has been historically cleared (1985), subsequent natural revegetation was significantly burnt in 1995.	Survey effort: two relevés from this survey, four relevés from Astron (2015). Area: 0.65 ha	
Planted Private gardens, roadside planted trees.	Area: 2.38 ha	

Description	Details	Photograph
Kg – *Kunzea glabrescens* tall shrubland *Kunzea glabrescens* tall open scrub to closed tall scrub over *Dasypogon bromeliifolius* or *Phlebocarya ciliata* low open shrubland. Aligns with Kg from Astron (2015).	Survey effort: one observation point from this survey, two relevés from Astron (2015) Area: 0.32 ha	
Trees Mixed native trees in paddock.	Survey effort: one observation point Area: 0.91 ha	No photograph taken



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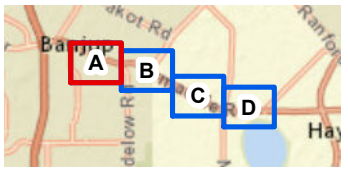
LEGEND

Survey Area
- *Caladenia huegelii* Targeted Survey
- Detailed Flora and Vegetation Assessment
- Detailed and Targeted Surveys

Vegetation Community
- BaHhBm
- MpKgLs
- Planted



Vegetation Units

ARMADALE ROAD UPGRADE DUAL CARRIAGEWAY – TAPPER ROAD TO ANSTEY ROAD

Main Roads Western Australia

Figure 7A

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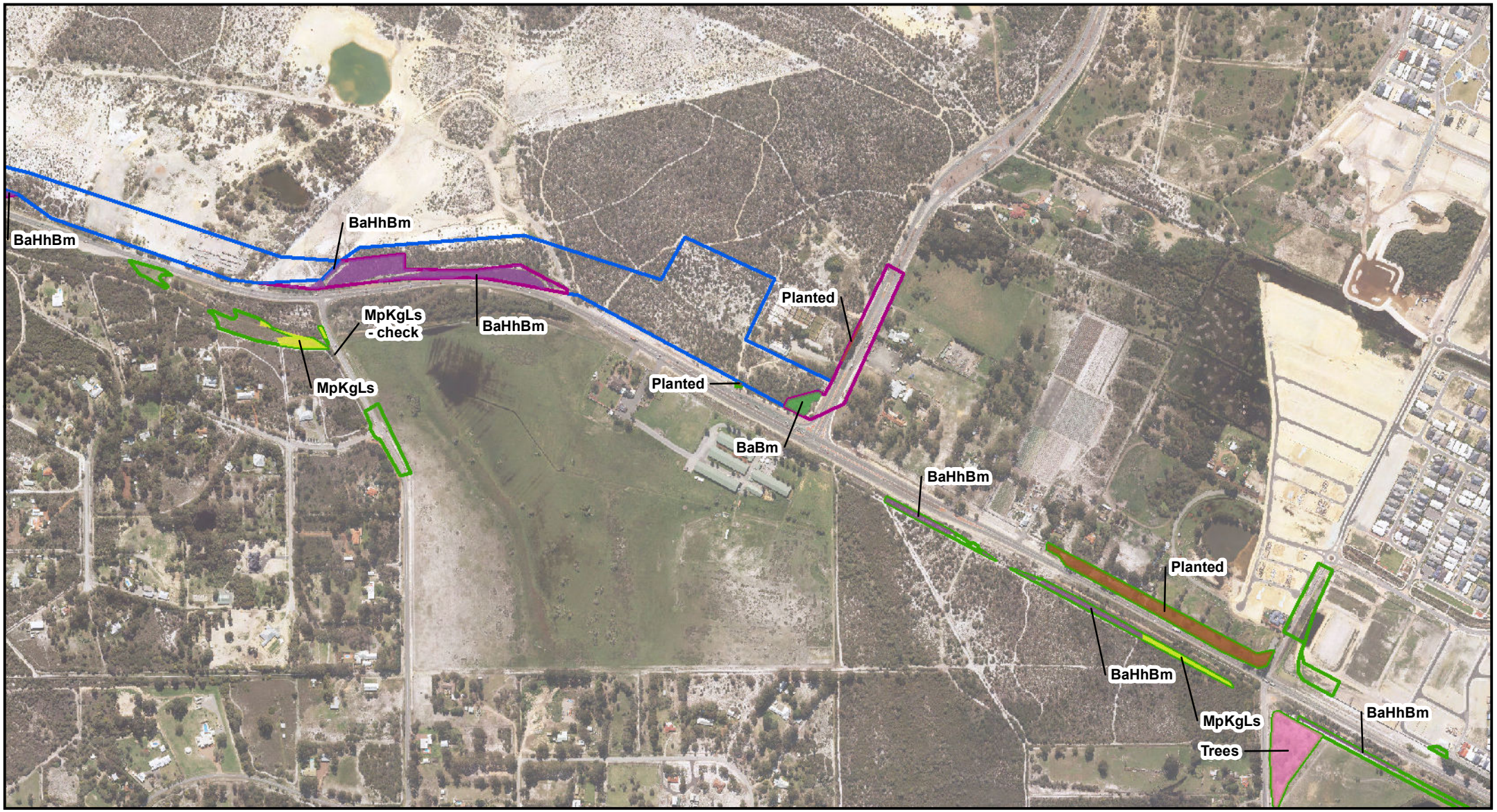

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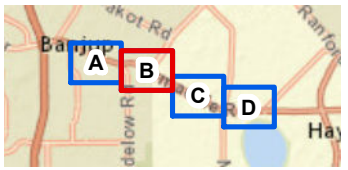
LEGEND

Survey Area

- *Caladenia huegelii* Targeted Survey
- Detailed Flora and Vegetation Assessment
- Detailed and Targeted Surveys

Vegetation Community

- BaBm
- BaHhBm
- MpKgLs
- Planted
- Trees



Vegetation Units

ARMADALE ROAD UPGRADE DUAL CARRIAGEWAY – TAPPER ROAD TO ANSTEY ROAD

Main Roads Western Australia

Figure 7B

Map Document: \\auper1gis01\geo\Client_Data\MRIA\07_Armadale Road Duplication\02_MXDs\03_FaunaFlora\Fig7_VegTypes.mxd (fotheringhamd)

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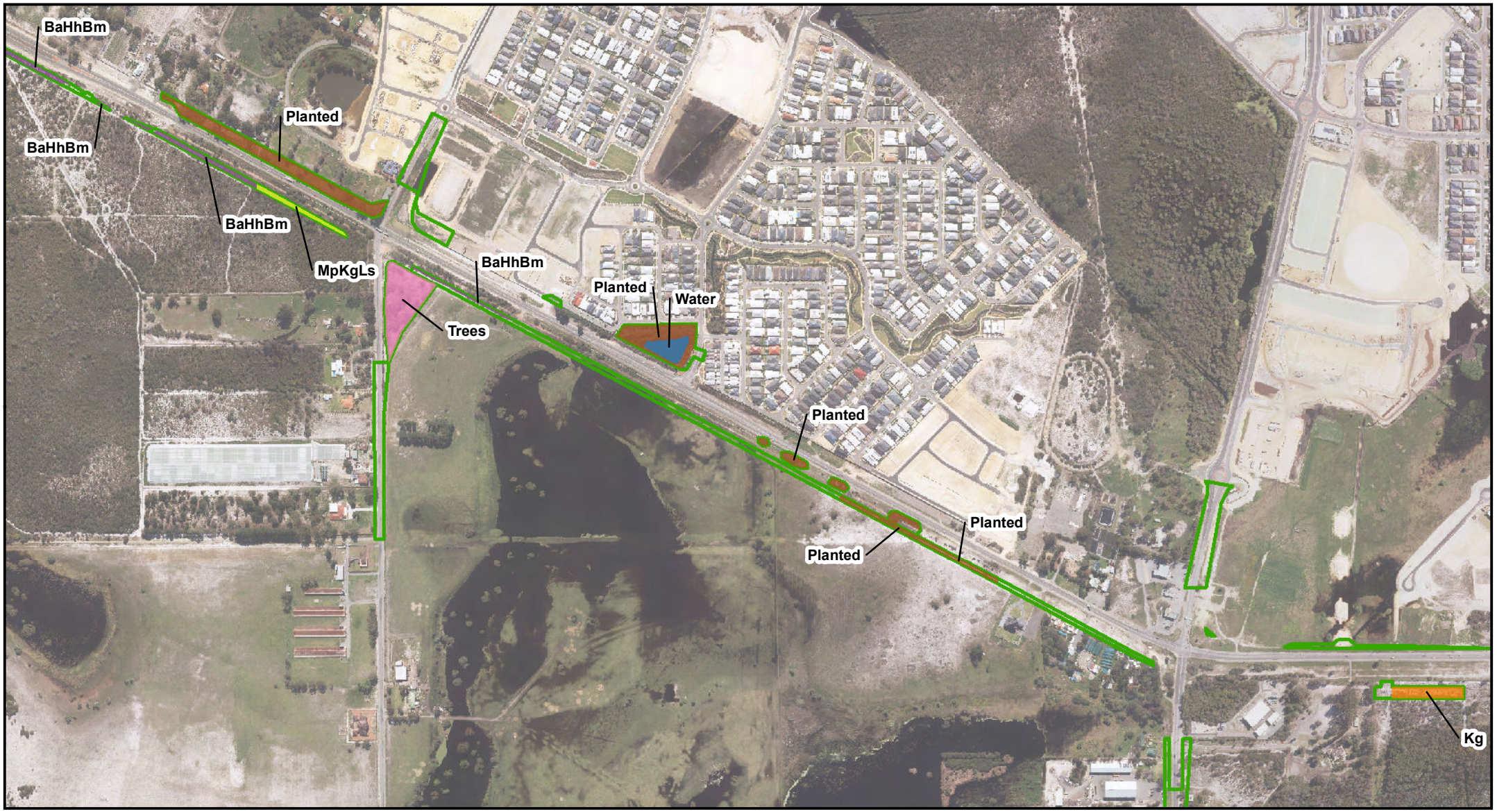

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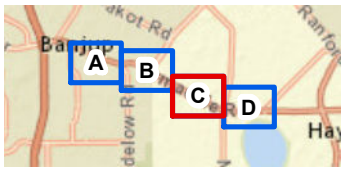
LEGEND

Survey Area

- *Caladenia huegelii* Targeted Survey
- Detailed Flora and Vegetation Assessment
- Detailed and Targeted Surveys

Vegetation Community

- BaHhBm
- Kg
- MpKgLs
- Planted
- Trees
- Water



Vegetation Units

ARMADALE ROAD UPGRADE DUAL CARRIAGEWAY – TAPPER ROAD TO ANSTEY ROAD

Main Roads Western Australia

Figure 7C

Map Document: \\auper1gis01\geo\Client_Data\MRIA\07_Armadale Road Duplication\02_MXDs\03_FaunaFlora\Fig7_VegTypes.mxd (fotheringhamd)

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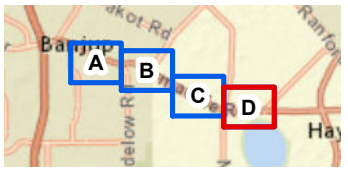
LEGEND

Survey Area
- *Caladenia huegelii* Targeted Survey
- Detailed Flora and Vegetation Assessment
- Detailed and Targeted Surveys

Vegetation Community
- Kg
- Planted



Vegetation Units

ARMADALE ROAD UPGRADE DUAL CARRIAGEWAY – TAPPER ROAD TO ANSTEY ROAD

Main Roads Western Australia

Figure 7D

Map Document: \\auper1gis01\geo\Client_Data\MRIA\07_Armadale Road Duplication\02_MXDs\03_FaunaFlora\Fig7_VegTypes.mxd (fotheringhamd)

A4 size

6.4 Vegetation condition

Vegetation condition ranged between Completely Degraded to Very Good. Vegetation condition was predominantly a result of historical clearing for urban development (residential, roads, light industrial). The impact of this disturbance includes edge effects from weeds, rubbish, and erosion. The extent of the various vegetation condition categories mapped for the Project are presented in Table 14 and mapped in **Figure 8**.

Table 14 Vegetation condition mapped in the survey areas

Condition scale	Area (ha)
Very Good	0.97
Good	1.29
Degraded	1.20
Completely Degraded	5.95
Cleared	4.37

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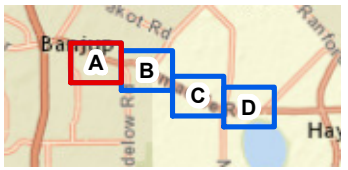
LEGEND

Survey Area

- *Caladenia huegelii* Targeted Survey
- Detailed Flora and Vegetation Assessment
- Detailed and Targeted Surveys

Vegetation Condition

- Very Good
- Good
- Degraded
- Completely Degraded



Vegetation Condition

ARMADALE ROAD UPGRADE DUAL CARRIAGEWAY – TAPPER ROAD TO ANSTEY ROAD

Main Roads Western Australia

Figure 8A

Map Document: G:\Client_Data\MRIA\07_Armadale Road Duplication\02_MXDs\03_FaunaFlora\Fig8_VegCondition.mxd (fotheringhamd)

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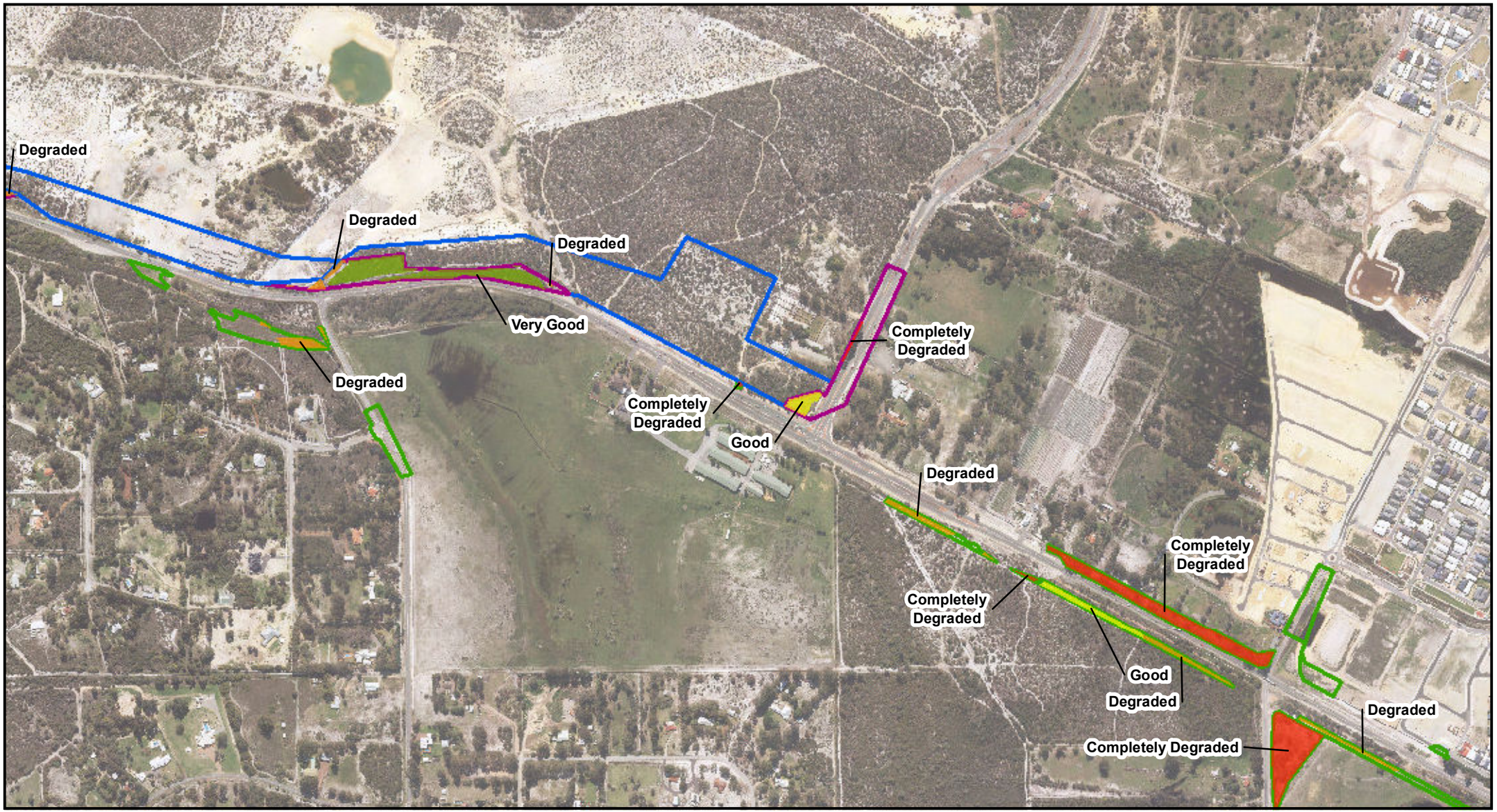

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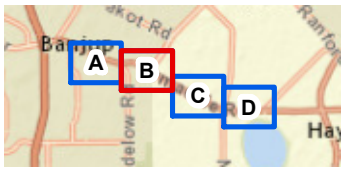
LEGEND

Survey Area

- *Caladenia huegelii* Targeted Survey
- Detailed Flora and Vegetation Assessment
- Detailed and Targeted Surveys

Vegetation Condition

- Very Good
- Good
- Degraded
- Completely Degraded



Vegetation Condition

ARMADALE ROAD UPGRADE DUAL CARRIAGEWAY – TAPPER ROAD TO ANSTEY ROAD

Main Roads Western Australia

Figure 8B

Map Document: G:\Client_Data\MRIA\07_Armadale Road Duplication\02_MXDs\03_FaunaFlora\Fig8_VegCondition.mxd (fotheringhamd)

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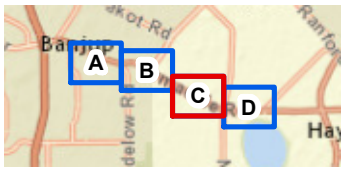
LEGEND

Survey Area
- *Caladenia huegelii* Targeted Survey
- Detailed Flora and Vegetation Assessment
- Detailed and Targeted Surveys

Vegetation Condition
- Water
- Good
- Degraded
- Completely Degraded



Vegetation Condition

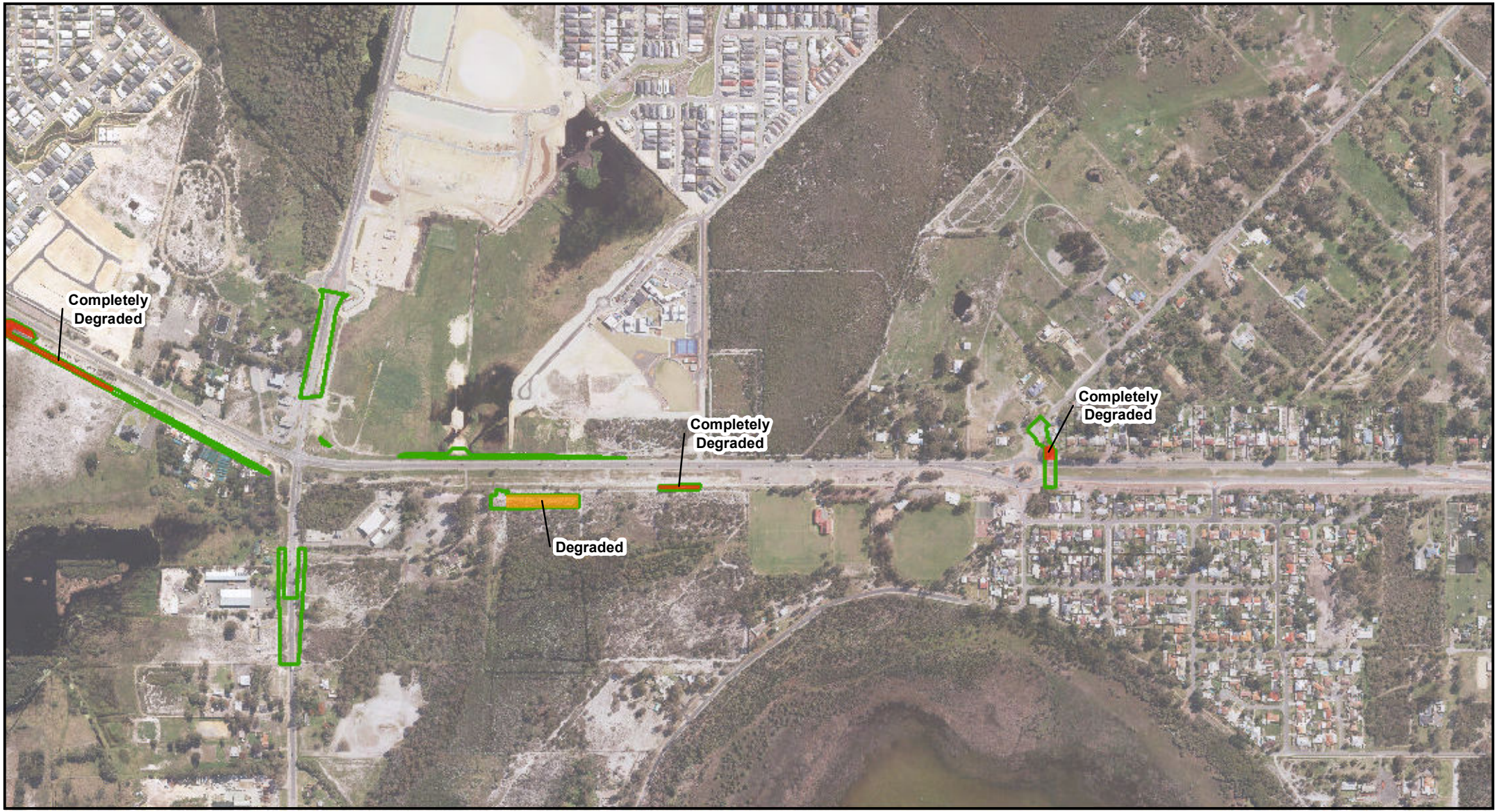
ARMADALE ROAD UPGRADE DUAL CARRIAGEWAY – TAPPER ROAD TO ANSTEY ROAD

Main Roads Western Australia

Figure 8C

Map Document: G:\Client_Data\MRIA\07_Armadale Road Duplication\02_MXDs\03_FaunaFlora\Fig8_VegCondition.mxd (fotheringhamd)

A4 size



PROJECT ID 60550185.0
CREATED BY DGF
APPROVED BY FdeWit
LAST MODIFIED 14 DEC 2017

Metropolitan Road Improvement Alliance

N

DATUM GDA 1994, PROJECTION PERTH COASTAL GRID 1994

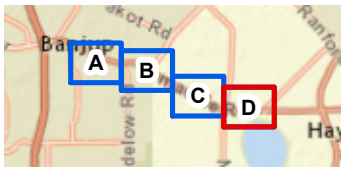
0 50 100 150 200
metres

1:10,000 when printed at A4

LEGEND

Survey Area
- *Caladenia huegelii* Targeted Survey
- Detailed Flora and Vegetation Assessment
- Detailed and Targeted Surveys

Vegetation Condition
- Degraded
- Completely Degraded



Vegetation Condition

ARMADALE ROAD UPGRADE DUAL CARRIAGEWAY – TAPPER ROAD TO ANSTEY ROAD

Main Roads Western Australia

Figure 8D

Map Document: G:\Client_Data\MRIA\07_Armadale Road Duplication\02_MXDs\03_FaunaFlora\Fig8_VegCondition.mxd (fotheringhamd)

A4 size

6.5 Flora

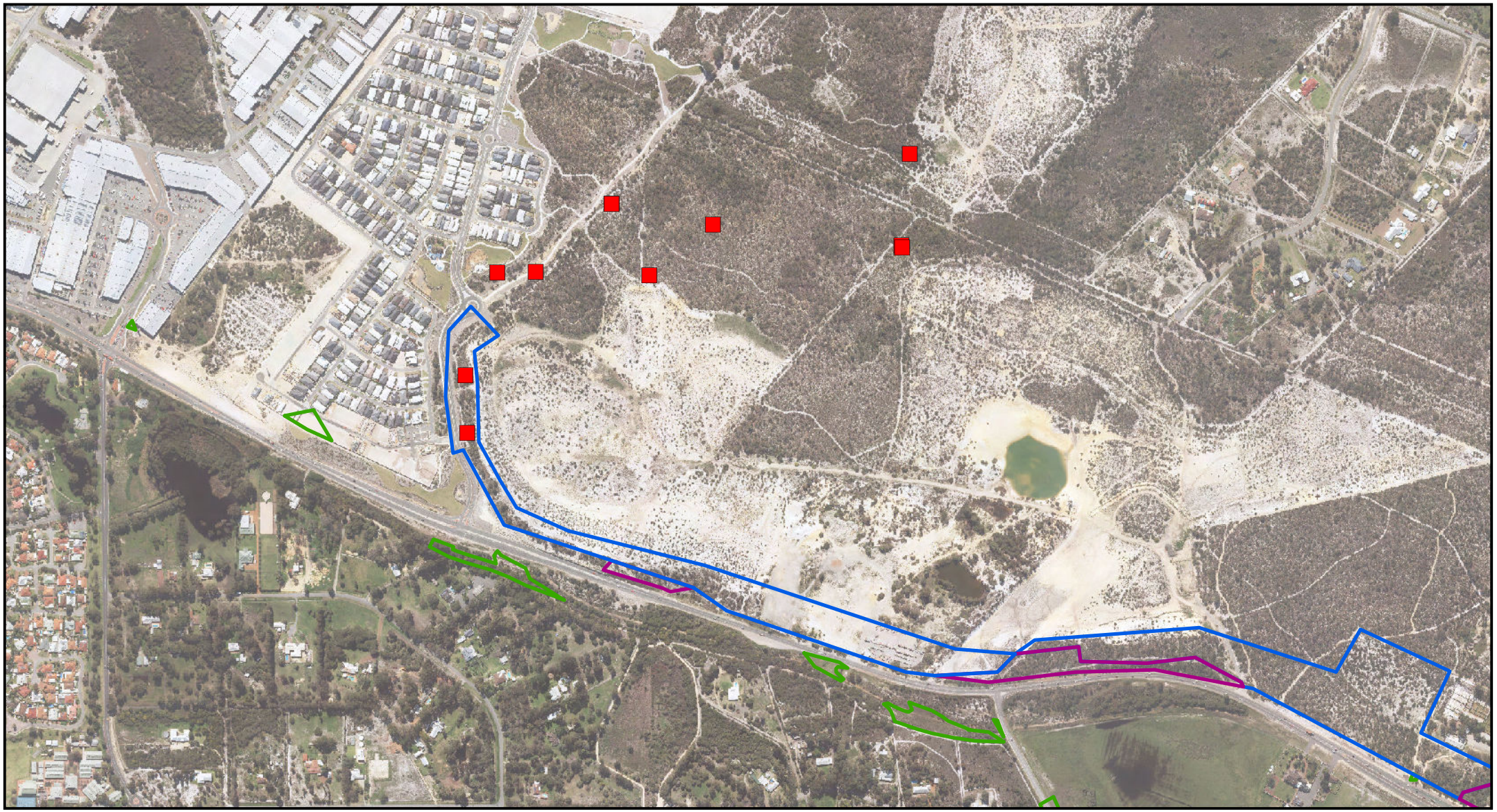
6.5.1 Threatened and Priority Flora

No Threatened or Priority species were recorded in the detailed flora and vegetation assessment survey area.

One *Caladenia huegelii* individual was recorded within the targeted flora survey area. This individual is not within the detailed flora and vegetation assessment area. The individual was recorded along Ghostgum Road and Fraser Road. It represents the existing known DBCA population #42 located at Fraser Road Bushland Site No. 390. Population 42 is detailed in the Recovery Plan (DEC, 2009b) as occurring on private property which was identified as significant and protected as Bush Forever Site 390. The wider area of Banksia Woodland supports hundreds of plants (DEC, 2009b).

During the targeted survey one individual was recorded along Ghostgum Avenue (Plate 3, Figure 9). This record is 100m from a known DBCA record as part of population #42. The individual was recorded on deep grey sands in Banksia Woodland.

Plate 3 *Caladenia huegelii* recorded during the survey



PROJECT ID 60550185.0
CREATED BY DGF
APPROVED BY FdeWit
LAST MODIFIED 18 DEC 2017

Metropolitan Road Improvement Alliance

N

DATUM GDA 1994, PROJECTION PERTH COASTAL GRID 1994

0 50 100 150 200
metres

1:10,000 when printed at A4

LEGEND

Threatened *Caladenia huegelii*

Survey Area

Caladenia huegelii Targeted Survey
Detailed Flora and Vegetation Assessment
Detailed and Targeted Surveys

Threatened Flora Locations

ARMADALE ROAD UPGRADE DUAL CARRIAGEWAY – TAPPER ROAD TO ANSTEY ROAD

Main Roads Western Australia

Figure 9

Map Document: \\auper1gis01\geo\Client_Data\MRIA\07_Armadale Road Duplication\02_MXDs\03_FaunaFlora\Fig9_ThreatenedFlora.mxd (fotheringhamd)

A4 size

6.5.2 Inventory of Flora Species

A total of 104 species from 78 genera and 42 families were recorded within the survey area. The total includes 131 (80%) locally native species and 35 (20%) introduced (exotic) or naturalised weed species.

Families with the highest native species representation are Myrtaceae (12 species), Proteaceae and Asparagaceae (seven species each). The full list of vascular flora species recorded and representative units in which they occur in are presented in **Appendix C**. Qualitative data recorded from individual quadrats is presented in **Appendix D**.

6.5.3 Weed Species

Twenty-three introduced species were recorded from the survey area. Of these one species is listed as Declared Pests, namely Arum Lily (**Zantedeschia aethiopica*). Declared Pests are listed under the *Biosecurity and Agricultural Management Act 2007* (BAM Act). Pursuant to the BAM Act, these species are subject to restrictions on movement or sale and landholders are obliged to carry out control measures to prevent their spread.

7 CONCLUSION

A detailed flora and vegetation assessment and targeted Threatened orchid survey was undertaken for the Armadale Road Upgrade Project. The assessment included a desktop study, detailed flora and vegetation survey including scoring permanent quadrats on two occasions and targeted orchid survey, and FCT analysis. Six vegetation types were described and mapped including two Banksia Woodlands (BaHhBm and BaBm), one wetland (MpKgLs), two degraded communities (Kg and Trees) and one planted community.

The Banksia Woodlands of the Swan Coastal Plain was mapped at three locations, represented by BaHhBm and BaBm, extending for 1.6 ha within the survey area. These locations also represent the Priority 3 Banksia Dominated Woodlands of the Swan Coastal Plain.

The Threatened orchid *Caladenia huegelii* was recorded at one location along Ghostgum Avenue. This individual is part of DBC-listed population #42. The identification of this species was confirmed by orchid specialist Andrew Brown.

The survey was successfully completed with no significant limitations identified. No additional work is recommended at this time.

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Appendix A: Flora Desktop Results

Appendix A Armadale Road Duplication Flora Desktop Results

The table below shows all Threatened and Priority flora species that have been historically recorded in the vicinity of the survey area and an assessment of their occurrence likelihood.

Table 1 Comprehensive desktop results based on database searches and previous biological surveys undertaken in the vicinity

Taxon	State	Federal	Habitat	Flowering	Count	Likelihood
Acacia lasiocarpa var. *bracteolata* long peduncle variant (G.J. Keighery 5026)	P1		Grey or black sand over clay. Swampy areas, winter wet lowlands.	May-Aug	1957	May
Andersonia gracilis	V	E	Known from Badgingarra, Dandaragan and Kenwick. Grows on seasonally damp, black sandy clay flats near or on margins of swamps among low open heath vegetation with species such as *Calothamnus hirsutus, Verticordia densiflora* and *Kunzea recurve* over sedges.	Sep-Nov	NA	Unlikely
Angianthus micropodioides	P3		Saline sandy soils. River edges, saline depressions, claypans.	Nov-Dec, Jan-Feb	1988	May
Byblis gigantea	P3		Sandy-peat swamps. Seasonally wet areas.	Sep-Jan	1991	May
Caladenia huegelii	CR	E	Deep sandy soils in *Banksia-Eucalyptus marginata* woodlands.	Sep-Oct	2014	Likely
Cyathochaeta teretifolia	P3		Grey sand, sandy clay. Swamps, creek edges.	Unknown	2008	Likely
Dampiera triloba	P3		Sandy rises, peaty sand over clay.	Aug-Dec	2015	Likely
Diuris micrantha	VU	V	Known from seven populations east of Kwinana south towards the Frankland area. Grows on dark grey to blackish sandy clay-loam substrates in winter wet depressions or swamps (TSSC, 2008b).	Aug-early Oct	NA	Unlikely
Diuris purdiei	EN	E	Under dense shrubs in seasonally-wet swamps and drainage lines. Grey black sand. Records from one population near Nicholson Road.	Sep-Oct	1990	May

Taxon	State	Federal	Habitat	Flowering	Count	Likelihood
Dodonaea hackettiana	P4		Sand. Outcropping limestone.	Jul-Oct	2005	Likely
Drakaea elastica	R	E	Grows in sandy soil in *Banksia* woodlands and tall shrublands, usually dominated by *Kunzea* thickets. White or grey sand, low-lying situations adjoining winter-wet swamps.	Oct-Nov	2005	May
Drakaea micrantha	EN	V	Grows in open sandy patches where competition has been removed. Occurs in infertile grey sands in Banksia, Jarrah, and Common Sheoak woodland or forest and is often found under thickets of Spearwood (*Kunzea ericifolia*).	Sep-Oct	1988	Unlikely
Eleocharis keigheryi	V	V	Known from north of Eneabba to Qualeup. Grows in small clumps on clay or sandy loam and is often emergent in freshwater creeks and claypans.	Aug-Nov/Dec	NA	Unlikely
Eucalyptus x balanites	CR	E	Found on light coloured sandy soils over laterite (DEC, 2004). Habitat consists of gently sloping heathlands; open mallee woodland over shrubland (Population 2) or heathland with emergent mallees (Population 1) (DEC, 2004).	Oct-Feb	NA	Unlikely
Grevillea curviloba subsp. *incurva*		E	Recorded between Muchea and Badgingarra where it gorws in open heath in winter-wet areas on sand over limestone or over ironstone at sites with a high water table (TSSC, 2016).	Sep-Oct	NA	Unlikely
Hydrocotyle striata	P1		Clay. Springs.	Unknown	1970	Unlikely
Jacksonia gracillima	P3		Associated with edges of swamp on sandy soils.	Unknown	2011	May
Jacksonia sericea	P4		Calcereous and sandy soils. Recorded in *Banksia* and *Melaleuca preissiana* woodland.	Dec-Feb	2015	Likely
Lepidosperma rostratum	E	E	Associated with Marsh Banksia (*Banksia telmatiaea*) and *Calothamnus hirsutus*. Grows in sandy soils among low heath in winter-wet swamps.	Jun-Aug	NA	May
Styphelia filifolia	P3		Several records in close proximity. Recorded in Banksia woodland and low forest.	Unknown	2002	Likely
Microtis quadrata	P4		Sandy clay swamps, black peaty soil.	Unknown	1960	Unlikely
Phlebocarya	P3		White or grey sand, lateritic gravel.	Aug-Oct	1978	Likely

Taxon	State	Federal	Habitat	Flowering	Count	Likelihood
pilosissima subsp. *Pilosissima*						
Pimelea calcicola	P3		Sand. Coastal limestone ridges.	Sep-Nov	1999	May
Stylidium longitubum	P4		Sandy clay, clay. Seasonal wetlands.	Oct-Dec	1973	May
Stylidium paludicola	P3		Peaty sand over clay. Winter wet habitats. Marri and Melaleuca woodland and shrublands	Oct-Dec	1999	Unlikely
Synaphea sp. Fairbridge Farm (D. Papenfus 696)	CR		Near winter-wet flats in low woodland with weedy grasses.	Oct	2004	Likely
Thelymitra dedmaniarum	CR	E	Grows in *Eucalyptus wandoo* and *E. accedens* woodlands on red-brown sandy-loam soil associated with dolerite and granite outcrops.	Oct-Dec/Jan	NA	Unlikely
Thelymitra variegata	P2		Sandy clay, sand, laterite.	Jun-Sep	1959	May
Tripterococcus sp. Brachylobus (A.S. George 14234)	P4		Historically recorded winter wet flats with peaty to clay sand amongst low heath.	Unknown	1999	May
Amanita carneiphylla	P3		Deeply rooting in sandy soil, solitary or in small scattered groups.	Unknown	2016	Likely
Amanita drummondii	P3		No information.	Unknown	2015	Unknown
Amanita fibrillopes	P3		No information.	Unknown	2014	Unknown
Amanita griseibrunnea	P2		No information.	Unknown	1995	Unknown
Amanita quenda	P1		No information.	Unknown	2016	Unknown
Amanita wadjukiorum	P3		No information.	Unknown	2015	Unknown
Amanita wadulawitu	P2		No information.	Unknown	2008	Unknown

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Appendix B: Banksia Woodlands of the Swan Coastal Plain Criteria

Appendix B Banksia Woodlands of the Swan Coastal Plain Criteria

1.0 Introduction

The Banksia Woodlands of the Swan Coastal Plain community (Banksia Woodlands) was listed under the Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act) as Endangered on 16 September 2016. The Banksia Woodlands incorporates woodland of Banksia species with scattered Eucalypts and other tree species over a species rich mix of sclerophyllous shrubs, graminoids, and forbs. The community shows high endemism and considerable local variation in species composition across its range. It is restricted to the southwest of WA on the Swan Coastal Plain. It occurs mainly on deep Bassendean and Spearwood sands or occasionally on Quindalup sands. Banksia Woodlands relate to three Threatened communities at the State-level and eight Priority Ecological Communities (PECs).

2.0 Methods

The Threatened Species Scientific Committee (TSSC) developed a comprehensive conservation advice document (2016) which provides a detailed description, methods for identifying the community, current threats, research priorities and conservation actions required. Identifying this community is described in detail using four steps:

- Step 1: use key diagnostic characteristics to determine if TEC is present
- Step 2: determine condition of patch, see Section 1.3
- Step 3: consider if patch meets minimum size threshold using spatial data and aerial imagery to define the boundary of patches, see Section 1.4
- Step 4: surrounding context of a patch must be taken into account when considering factors that add to the importance of a patch that meets the condition thresholds.

The key diagnostic characteristics summarise the main features that characterise the Banksia Woodland (presented in results tables, Section 2.0). The condition categories are applied to identify the varying quality of patches, usually as a result of degradation, and ensure that patches of high quality are considered a Matter of National Significance (MNES). The condition of the patch is informed by species richness of quadrat data compared to available datasets, most notably the Gibson *et al.* (1994) and Keighery *et al.* (2012) Swan Coastal Plain datasets, and weed cover. The condition of the patch and size thresholds are then used to determine whether the quality of the patch is suitable to meet MNES standards.

A detailed flora and vegetation field survey was undertaken for the Project following methods outlined in the Flora Survey Technical Guide (EPA, 2016). Three permanent quadrats were established and scored on 21 June, 2017 by Senior Botanist Floora de Wit and Environmental Scientist Lyn van Gorp. Quadrats were scored again on 2 September, 2017 by Floora de Wit. Approximately 45 minutes was spent at each quadrat. Floristic data collected from quadrats was analysed and used to inform the Banksia TEC Assessment.

Detailed methods used for this Project is presented in Section 3 of the main Report.

2.1 Condition assessment

Determining the condition of Banksia Woodlands TEC vegetation is informed by quadrat data and species richness compared to a regional dataset (where available). The results of the condition assessment may vary slightly in scale compared to the vegetation condition mapping undertaken as part of the flora and vegetation assessment. In particular, patches are represented by quadrats located in vegetation in the best condition. Degradation of edges of patches are not mapped separately.

The condition of vegetation of each patch needs to be determined in accordance with the following:

- The condition assessment of a patch should be centred on the area of highest native floristic diversity and/or cover of the patch.
- Timing of surveys and recent disturbance should be taken into account
- Surrounding context of a patch should be considered
- Certain vegetation components of Banksia Woodlands community merit consideration as critical elements to protect. Three components are recognised as threatened in their own right i.e. Priority Ecological Communities
- A relevant expert may be useful to help identify the ecological community and its condition.
- Vegetation must be in 'Good' or better condition in accordance with Table 1.

Table 1 Condition Table

Keighery (1994) Vegetation Condition Scale	Indicative Condition Thresholds	
	Typical Native Vegetation Composition	Typical Weed Cover
Pristine No obvious signs of disturbance	Native plant species diversity fully retained or almost so[1]	Zero or almost no weed cover/abundance
Excellent Vegetation structure intact, disturbance only affecting individual species, weeds are non-aggressive species.	High native plant species diversity[1]	Less than 10%
Very Good Vegetation structure altered, obvious signs of disturbance (e.g. repeated fires, dieback, logging, grazing). Aggressive weeds present.	Moderate native plant species diversity[1]	5 – 20%
Good Vegetation structure altered but retains basic vegetation structure or ability to regenerate it. Obvious signs of disturbance (from partial clearing, dieback, logging, grazing). Presence of very aggressive weeds.	Low native plant species diversity[1]	5 – 50%
Degraded Basic vegetation structure severely impacted by disturbance. Requires intensive management. Disturbance evident such as partial clearing, dieback, logging and grazing. Presence of very aggressive weeds at high density.	Very low native plant species diversity[1]	20 – 70%
Completely Degraded Vegetation structure is no longer intact and the area	Very low to no native species diversity[1]	Greater than 70%

Keighery (1994) Vegetation Condition Scale	Indicative Condition Thresholds	
is completely or almost completely without native flora. Equivalent to 'Parkland Cleared'.		

1. relative to expected natural range of diversity for that vegetation unit e.g. Floristic Community Type where comparative data exists.

2.2 Patch size thresholds

Minimum patch size thresholds vary according to the vegetation condition, including:

- Pristine – no minimum patch size
- Excellent – 0.5 ha or 5,000 m^2 (50 x 100 m)
- Very Good – 1 ha or 10,000 m^2 (100 x 100 m)
- Good – 2 ha or 20,000 m^2 (200 x 100 m)'

2.3 Patch context

Contextual information for each patch that may affect the outcome of the TEC assessment should be considered. The Conservation Advice (TSSC, 2016) details a number of contextual factors, the most relevant for this Project include:

- Land use history and landscape position of patch including position relative to surrounding vegetation
- Patch size, variation in condition, and functionality. Tracks, breaks and gaps within a patch that are less than 30 m and do not significantly alter the overall functionality of the ecological community are considered part of the same patch.
- Variation in canopy cover, quality or condition of vegetation across a patch should not be considered evidence of multiple patches
- A minimum buffer zone of 20-50 m is recommended for all patches of Banksia Woodlands TEC. Buffer zones ideally comprise a contiguous area immediately adjacent to a patch of the ecological community. Larger buffer zones should be considered for patches of particularly high conservation value, or if patches are down slope of drainage lines or a source of nutrient enrichment, or groundwater drawdown.
- Restored vegetation is not excluded provided it meets the key diagnostic criteria, condition threshold and patch size.
- Identify limitations that may have affected the TEC assessment outcome, including survey effort, sample size, seasonality, historical disturbance, etc.
- Surrounding environment, landscape context and other significance considerations including biodiversity (areas with high diversity and low disturbance provide greater value), and habitat corridors/linkages.

3.0 TEC Assessment Results

3.1 Patch 1 Jandakot Regional Park

Patch 1 is located north of Armadale Road between Midland Brick and the Fremantle Pistol Club in City of Cockburn. The patch has met all the criteria and is in Very Good condition. It **is therefore considered** to represent the Banksia Woodland TEC.

The patch resembles remnant native vegetation and supports a high species diversity. Conservation significance is considered high for these reasons, and its size.

Location	Armadale Road (north) between Midland Brick and the Fremantle Pistol Club in City of Cockburn
Key diagnostic characteristics	Meets all diagnostic characteristics
Condition	Very Good. 8.5-13% weed foliage cover. Mostly low impact weeds such as **Ursinia anthemoides* and **Gladiolus caryophyllaceus*. Also includes **Briza maxima* and **Ehrharta calycina* on edges. 35-43 species/quadrat, represents approximately 50-60% of inferred FCT species richness.
Patch size	Within survey area the patch extends 1.25 ha. Incorporating adjacent vegetation, patch extends approximately 67.8 ha.
Additional features	Provides linkage to native vegetation south of Armadale Road. Provides buffer and reduces erosion for adjacent cleared area that exposes soft sand.
Land use history	Unknown
Any variations in patch	Minor variation in condition as a result of weed invasion and tracks.
Buffer zone present	Present of 20% of sides (east).
Sampling protocol	Three quadrats sampled 25 August and 29 September, 2017 by Senior Botanist Floora de Wit. Approximately 45 minutes spent at each quadrat.
Disturbance history	Represents remnant native vegetation.
Surrounding environment	Ongoing clearing in surrounding area from Midland Brick. Improvements and widening of Armadale Road. Four-wheel drive track used recreationally.

Key diagnostic characteristics	Response
Location and physical environment	
Patch on Swan Coastal Plain or adjacent lower parts of the Darling and Whicher escarpments that lie within the Jarrah Forest bioregion to the immediate east and south of the Swan Coastal Plain.	Swan Coastal Plain
Soils and landform	
Typically occurs on: deep Bassendean, Spearwood sands, occasionally on Quindalup sands, sandy colluvium and Aeolian sands of the Ridge Hill Shelf, Whicher Scarp and Dandaragan Plateau. Sometimes on transitional substrates, sandflats.	Bassendean Sands
Structure: The structure of the ecological community is a low woodland to forest with the following features:	
Distinctive upper sclerophyllous layer of low trees typically dominated or co-dominated by one or more of the *Banksia* species identified below. Highly species-rich understorey that consists of a layer of sclerophyllous shrubs of various heights and a herbaceous ground layer of cord rushes, sedges and perennial and ephemeral forbs that sometimes includes grasses.	Tree stratum dominated by *B. attenuata* and *B. menziesii.* Understorey includes 23 sclerophyllous shrubs (30% foliage cover), two sedges (0.1%), two rushes (2.5-7%), 41 herbs (7-20%) and five grasses (5-12%).
Composition	
Canopy is most commonly dominated or co-dominated by *Banksia attenuata* and/or *Banksia menziesii.* Other *Banksia* species that dominate in some examples are *B. prionotes* or *B. ilicifolia*. Must include at least one of the following diagnostic species: • Banksia attenuata • Banksia menziesii • Banksia prionotes • Banksia ilicifolia Emergent tree layer often includes *Corymbia calophylla, E. marginata,* or less commonly *E. gomphocephala*. Other trees of a medium height may be present and may be co-dominant with the Banksia species across a patch, include *E. todtiana, Nuytsia floribunda, Allocasuarina fraseriana, Callitris arenaria*, *Callitris pyramidalis* and *Xylomelum occidentale*.	Canopy dominated by Banksia (10-30%) with some *Allocasuarina fraseriana* (1%) and occasional *E. marginata* and *Nuytsia floribunda*.
Contra-indicators	
Patches clearly dominated by *Banksia littoralis* are not part of the TEC	No
Patches clearly dominated by *Banksia burdettii* are not the TEC	No

FCT20c – Eastern shrublands and woodlands, corresponds with a separate EPBC ecological community listing, Shrublands and Woodlands of the eastern Swan Coastal Plain. Occurrences of this FCT should be considered under that separate listing.	No

3.2 Patch 2 Rose Shanks Reserve Corner

Patch 2 within the survey area is isolated to a corner of Warton Road and Armadale Road southwest of the Cockburn-Fremantle Pistol Club. This patch was mapped by Astron (201) as BaBm which was confirmed during the field survey.

The condition of this patch is mapped as Good, with low native species richness and considerable weed foliage cover, particularly following rain. The patch has met the criteria and **is therefore considered** the Banksia Woodland TEC, however the significance of this patch is questionable given its low diversity. It may provide some local hydrological functions, and has limited value as a habitat corridor connecting Rose Shanks Reserve to native vegetation south of Armadale Road (Jandakot Regional Park).

Location	Corner Warton Road and Armadale Road (northwest). Part of Rose Shanks Reserve, mapped as a regional park.
Key diagnostic characteristics	Yes, met all key diagnostic criteria.
Condition	Good, 10-17% weed foliage, 21 native species.
Patch size	Within the survey area, patch is 0.17 ha, however it should be considered a buffer to the larger Rose Shanks Reserve, approximately 33 ha.
Additional features	Buffer to existing reserve. Has minor drainage functions. Part of Bush Forever Site 390 Fraser Road Bushland.
Land use history	Unknown.
Any variations in patch	Appears to resemble minor drainage properties. Condition varies between Degraded and Good.
Buffer zone present	Buffer zone present for approximately 20% of patch.
Sampling protocol	Represented by two relevés including R7 (Astron, 2015) and ArmDup9 each subject to one recording event.
Disturbance history	Clearing for limestone tracks and fencing.
Surrounding environment	Roads, the Cockburn-Fremantle Gun Club and nature reserve.

Key diagnostic characteristics	Response
Location and physical environment	
Patch on Swan Coastal Plain or adjacent lower parts of the Darling and Whicher escarpments that lie within the Jarrah Forest bioregion to the immediate east and south of the Swan Coastal Plain.	Swan Coastal Plain
Soils and landform	
Typically occurs on: deep Bassendean, Spearwood sands, occasionally on Quindalup sands, sandy colluvium and Aeolian sands of the Ridge Hill Shelf, Whicher Scarp and Dandaragan Plateau. Sometimes on transitional substrates, sandflats.	Bassendean Sands
Structure: The structure of the ecological community is a low woodland to forest with the following features:	
Distinctive upper sclerophyllous layer of low trees typically dominated or co-dominated by one or more of the *Banksia* species identified below. Highly species-rich understorey that consists of a layer of sclerophyllous shrubs of various heights and a herbaceous ground layer of cord rushes, sedges and perennial and ephemeral forbs that sometimes includes grasses.	Tree stratum dominated by *B. attenuata* and *B. menziesii.* Understorey includes 7 sclerophyllous shrubs (5-15% foliage cover), one sedge (3%), one rush (0.5%) and five herbs (90%).
Composition	
Canopy is most commonly dominated or co-dominated by *Banksia attenuata* and/or *Banksia menziesii.* Other *Banksia* species that dominate in some examples are *B. prionotes* or *B. ilicifolia*. Must include at least one of the following diagnostic species: • Banksia attenuata • Banksia menziesii • Banksia prionotes • Banksia ilicifolia Emergent tree layer often includes *Corymbia calophylla, E. marginata,* or less commonly *E. gomphocephala*. Other trees of a medium height may be present and may be co-dominant with the Banksia species across a patch, include *E. todtiana, Nuytsia floribunda, Allocasuarina fraseriana, Callitris arenaria*, *Callitris pyramidalis* and *Xylomelum occidentale*.	Canopy dominated by Banksia (10-35%) with some *Allocasuarina fraseriana* (1%) and *E. todtiana* (15%) and *Nuytsia floribunda* (1%).
Contra-indicators	
Patches clearly dominated by *Banksia littoralis* are not part of the TEC	No
Patches clearly dominated by *Banksia burdettii* are not the TEC	No

FCT20c – Eastern shrublands and woodlands, corresponds with a separate EPBC ecological community listing, Shrublands and Woodlands of the eastern Swan Coastal Plain. Occurrences of this FCT should be considered under that separate listing.	No

3.3 Patch 3 Bush Forever Site 344

Patch 3 represents three slivers of roadside vegetation along Armadale Road. They represent the northern boundary of Bush Forever Site 344. The slivers represent revegetated Banksia woodland, with aerial imagery from 1995 showing them as cleared for a wide access track.

They are likely to meet the key diagnostic features based on observation points. Applying the precautionary principle, these patches **are considered to** represent the Banksia Woodland TEC. Conservation significance of this roadside vegetation is likely to be low given historical clearing, degraded condition, and isolation from remnant bushland by fence.

Location	Armadale Road, City of Armadale (south side) between Warton Road and Tailor Road.
Key diagnostic characteristics	Likely to meet key diagnostic criteria.
Condition	Taking into account adjacent Regional Park, condition is likely to be Very Good.
Patch size	42.1 ha total, of this 0.38 ha is within the survey area.
Additional features	Part of Bush Forever Site 344 Dennis DeYoung Reserve and Gibbs Road Swamp Bushland. Value of patch within survey area is questionable as it represents regrowth of Banksia woodland since 1995. It suffers from weed invasion and edge effects. Could be considered a buffer for adjacent bushland.
Land use history	Historically cleared for wide access track/fence.
Any variations in patch	Condition varies between Good to Degraded (within survey area). Rest of bushland south is likely to be in Very Good to Excellent condition.
Buffer zone present	The patch represents the buffer for the larger area of remnant native vegetation.
Sampling protocol	Observation points only.
Disturbance history	Cleared, regrowth commenced approximately 1995.
Surrounding environment	Roadside (50%) and Bush Forever Site 344 and Jandakot Regional Park.

Appendix C: Flora Species List

Appendix C Species by Family and Community Matrix, Armadale Rd Upgrade Project 2017

Note * denotes weed species, DP denotes Declared Pest listed under the BAM Act

Family	*	Taxon	Community				
			BaHhMp	BaXpEc	BmEpEc	EmAcOp	MpAsHr
Aizoaceae							
	*	*Carpobrotus edulis*		X			
Anarthriaceae							
		Lyginia barbata	X		X		
Araceae							
	*DP	*Zantedeschia aethiopica*		X	X	X	X
Araliaceae							
		Trachymene pilosa			X		
Asparagaceae							
	*DP	*Asparagus asparagoides*		X	X		X
		Laxmannia squarrosa			X		
		Lomandra caespitosa			X		
		Lomandra hermaphrodita			X		
		Lomandra micrantha			X		
		Lomandra nigricans			X		
		Lomandra preissii		X	X		
Asteraceae							
	*	*Arctotheca calendula*	X		X		
	*	*Conyza bonariensis*	X				
	*	*Hypochaeris glabra*			X		X
	*	*Sonchus oleraceus?*			X		
	*	*Ursinia anthemoides*			X		
Cactaceae							
	*DP	*Opuntia stricta*			X		
Casuarinaceae							
		Allocasuarina humilis	X		X		
Colchicaceae							
		Burchardia congesta	X		X		
Crassulaceae							
		Crassula colorata var. *colorata*			X		
Cyperaceae							
		Cyperus congestus					X
		Lepidosperma gladiatum					X
		Lepidosperma leptostachuym	X				
		Lepidosperma squamatum			X		
		Mesomelaena pseudostygia	X				
		Schoenus clandenstinus	X				
		Schoenus curvifolius			X		
		Schoenus laevigatus			X		
Dasypogonaceae							
		Dasypogon bromeliifolius	X	X	X		X
Dennstaedtiaceae							
		Pteridium esculentum				X	
Dillenaceae							
		Hibbertia huegelii	X				
		Hibbertia hypericoides	X		X		
		Hibbertia subvaginata			X		
Droseraceae							
		Drosera erythrorhiza subsp. *erythrorhiza*			X		
		Drosera pallida	X		X		
Ericaceae							
		Astroloma sp.			X		
		Conostephium pendulum			X		
Euphorbiaceae							
	*	*Euphorbia terracina*			X		
Fabaceae							
	*	*Acacia longifolia* subsp. *longifolia*		X	X		X
		Acacia pulchella var. glaberrima	X		X		X
	*	*Acacia* sp. Planted					X
		Bossiaea eriocarpa	X	X	X		
		Daviesia divaricata subsp. *divaricata*	X				
		Daviesia nudiflora	X				
		Daviesia triflora	X		X		
		Gastrolobium capitatum			X		
		Gompholobium tomentosum	X		X		X
		Hardenbergia comptoniana	X				
		Hovea pungens			X		
		Hovea trisperma	X		X		
		Jacksonia furcellata			X		
Geraniaceae							
	*	*Pelargonium capitatum*	X				X
Goodeniaceae							

Family	*	Taxon	Community				
			BaHhMp	BaXpEc	BmEpEc	EmAcOp	MpAsHr
		Dampiera linearis		X	X		
		Scaevola canescens	X				
Haemodoraceae							
		Anigozanthos humilis subsp. *humilis*			X		
		Anigozanthos manglesii subsp. *manglesii*			X		
		Conostylis aurea			X		
		Conostylis juncea			X		
		Conostylis setigera subsp. *setigera*		X			
		Conostylis setosa	X				
		Haemodorum laxum			X		
Hemerocallidaceae							
		Arnocrinum preissii			X		
		Caesia micrantha		X			
		Dianella revoluta			X		
Iridaceae							
	*	*Gladiolus caryophyllaceus*	X	X	X		X
		Patersonia occidentalis	X		X		
	*	*Romulea rosea*					X
	*	*Watsonia meriana?*				X	
Lauraceae							
		Cassytha ?glabella forma racemosa					X
Loranthaceae							
		Nuytsia floribunda			X		X
Montiaceae							
		Calandrinia glandulifera			X		
Myrtaceae							
		Agonis flexuosa				X	
		Astartea scoparia					X
		Calytrix flavescens			X		
		Calytrix sp.	X				
		Eremaea pauciflora	X	X	X		
		Eucalyptus marginata subsp. *marginata*	X	X		X	
		Eucalyptus todtiana			X		
		Hypocalymma robustum	X		X		X
		Kunzea glabrescens		X	X		X
		Leptospermum spinescens			X		
		Melaleuca preissiana					X
		Scholtzia involucrata	X		X		
Oleaceae							
		Olea europaea	X				
Orchidaceae							
		Caladenia flava subsp. *flava*			X		X
		Diuris corymbosa		X	X		
		Pterostylis sanguineus	X		X		X
		Pterostylis sp.					X
Oxalidaceae							
	*	*Oxalis pes-caprae*				X	
Papaveraceae							
	*	*Fumaria capreolata*	X	X	X	X	X
Pittosporaceae							
		Billardiera ?fusiformis	X				
Poaceae							
		Amphipogon turbinatus	X				
	*	*Avena barbata*	X		X		
	*	*Briza maxima*	X		X		X
	*	*Ehrharta calycina*	X		X		
		Poacea sp.					X
Polygalaceae							
		Comesperma confertum			X		
Primulaceae							
	*	*Lysimachia arvensis*	X				
Proteaceae							
		Adenanthos cygnorum subsp. cygnorum	X		X	X	
		Adenanthos obovatus		X			
		Banksia attenuata	X		X		
		Banksia ilicifolia		X			
		Banksia littoralis					
		Banksia menziesii	X		X		
		Banksia sp. Dead		X			
		Petrophile linearis	X		X		
		Stirlingia latifolia	X		X		
Restionaceae							
		Desmocladus fasciculatus			X		
		Desmocladus flexuosus	X		X		
		Dielsia stenostachya					X
		Hypolaena exsulca			X		
Rhamnaceae							

Family	*	Taxon	Community				
			BaHhMp	BaXpEc	BmEpEc	EmAcOp	MpAsHr
Rubiaceae		*Spyridium globulosum*	X				
Rutaceae		*Opercularia vaginata*	X				
Solanaceae		*Philotheca spicata*			X		
	*DP	*Solanum linnaeanum*			X		
	*	*Solanum nigrum*	X		X		
Stylidiaceae		*Stylidium repens*			X		
Xanthorrhoeaceae		*Xanthorrhoea preissii*	X	X	X		X
Zamiaceae		*Macrozamia riedlei*	X		X		

Appendix D: Quadrat Data

Appendix D Armadale Duplication Quadrat Data

Observation ArmDup1	**Location:**	**Date:** 25/8/2017
Topography:	**Soils:**	**Colour:**
Vegetation description: Planted, Australian and local natives		
TEC: None		
Condition: Completely Degraded		
Additional notes:		

*	Taxon	Height cm	Foliage %	Comments

Note: * depicts an introduced (weed) species

Observation ArmDup2	Location:	Date: 25/8/2017
Topography:	**Soils:**	**Colour:**
Vegetation description: Degraded Banksia woodland		
TEC: None		
Condition: Degraded		
Additional notes:		

*	Taxon	Height cm	Foliage %	Comments

Note: * depicts an introduced (weed) species

Quadrat ArmDup3	**Location:**	**Survey Date 1:** 25/8/2017	**Survey Date 2:**
Topography: Upper Slope	**Soils:** Sand, dry	**Colour:** Grey	
Vegetation description: Banksia woodland			
TEC: Banksia woodland of the SCP			
Condition: Very Good, weeds			
Additional notes:			

*	Taxon	Height cm	Foliage %	Comments

Note: * depicts an introduced (weed) species

Quadrat ArmDup4	**Location:**	**Survey Date 1:** 25/8/2017	**Survey Date 2:**
Topography: Undulating	**Soils:** Sand, dry	**Colour:** Grey	
Vegetation description: Banksia woodland			
TEC: Banksia woodland of the SCP			
Condition: Excellent, weeds			
Additional notes:			

*	Taxon	Height cm	Foliage %	Comments

Note: * depicts an introduced (weed) species

Quadrat ArmDup5	**Location:**	**Survey Date 1:** 25/8/2017	**Survey Date 2:**
Topography: Undulating	**Soils:** Sand, dry	**Colour:** Grey	
Vegetation description: Banksia woodland			
TEC: Banksia woodland of the SCP			
Condition: Excellent, weeds			
Additional notes:			

*	Taxon	Height cm	Foliage %	Comments

Note: * depicts an introduced (weed) species

Observation ArmDup6	**Location:**	**Date:** 25/8/2017
Topography:	**Soils:**	**Colour:**
Vegetation description: Banksia woodland		
TEC: Banksia woodland of the SCP		
Condition: Good, weeds, tracks		
Additional notes:		

*	Taxon	Height cm	Foliage %	Comments

Note: * depicts an introduced (weed) species

Observation ArmDup7	Location:	Date: 25/8/2017
Topography:	**Soils:**	**Colour:**
Vegetation description: Planted species with M. rhaphiophylla, Juncus, Baumea. Man-made		
TEC: None		
Condition: Completely Degraded		
Additional notes:		

*	Taxon	Height cm	Foliage %	Comments

Note: * depicts an introduced (weed) species

Observation ArmDup8	Location:	Date: 25/8/2017
Topography:	**Soils:**	**Colour:**
Vegetation description: Kunzea glabrescens, Jacksonia furcellata over weeds		
TEC: None		
Condition: Completely Degraded		
Additional notes:		

*	Taxon	Height cm	Foliage %	Comments

Note: * depicts an introduced (weed) species

Observation ArmDup9	**Location:**	**Date:** 26/9/2017
Topography: Flat	**Soils:** Sand	**Colour:** White
Vegetation description: Banksia woodland		
TEC: None		
Condition: Good - Degraded		
Additional notes: Extensive weeds; relevé done from edge.		

*	Taxon	Height cm	Foliage %	Comments

Note: * depicts an introduced (weed) species

Observation ArmDup10	**Location:**	**Date:** 25/8/2017
Topography: Wetland	**Soils:** Sand	**Colour:**
Vegetation description: Melaleuca preissiana & Kunzea glabrescens over weeds		
TEC: None		
Condition: Completely Degraded		
Additional notes:		

*	Taxon	Height cm	Foliage %	Comments

Note: * depicts an introduced (weed) species

Observation ArmDup11	Location:	Date: 25/8/2017
Topography: Wetland	**Soils:** Sand	**Colour:** White
Vegetation description: Melaleuca preissiana over weeds		
TEC: None		
Condition: Completely Degraded		
Additional notes:		

*	Taxon	Height cm	Foliage %	Comments

Note: * depicts an introduced (weed) species

APPENDIX 3 TARGETED BLACK COCKATOO SURVEY

Metropolitan Road Improvement Alliance

Targeted Black Cockatoo Survey

Armadale Road Upgrade – Tapper Road to Anstey Road

Doc Number
W81020-REP-EN-0704

REVISION RECORDING

Rev	Date	By	Description of Revision	Approved
A	22/01/2018	J Leigh M Jensen	Draft for Main Roads Review	AE
B	30/01/2018	J Leigh M Jenson	Final for Main Roads Review	AE
0	1/02/2018	J Leigh M Jenson	Final	AE

EXECUTIVE SUMMARY

The duplication and improvement of Armadale Road will assist in relieving the congestion along the existing corridor which currently experiences breakdown flow in the peak periods. The activity will include the duplication of Armadale Road between Tapper Road and Anstey Road, improvement/upgrade of various intersections, and associated works including lighting, service relocations and drainage. The Project construction is anticipated to commence in early 2018.

The Project is located within the suburbs of Atwell and Banjup in the City of Cockburn and Piara Waters and Forrestdale in the City of Armadale. The area surveyed extends beyond this and is referred to in this report as the "Survey Area". The Project may require clearing of vegetation and a targeted Black Cockatoo survey was undertaken over the Survey Area. The field survey was undertaken by Ecologist Jared Leigh between 12th and 13th September 2017 and by Ecologist Claudia Perry on 13th October 2017. The targeted Black Cockatoo survey included assessing all potential breeding and roosting trees, and conducting 13 foraging habitat assessments within the Survey Area. Observations of Black Cockatoos and their foraging evidence were also recorded opportunistically.

The Survey Area contains a total of five native trees and two stags defined as potential Black Cockatoo breeding habitat trees. None of these trees contained hollows that were potentially suitable for use by breeding Black Cockatoos. The Survey Area contains minimal Very High and High Quality foraging habitat for the Forest Red-tailed Black Cockatoo (*Calyptorhynchus banksii naso*) and Carnaby's Black Cockatoo (*Calyptorhynchus latirostris*). Much of the Survey Area (7.03 ha, approximately 60%) is cleared and comprises hardstand areas such as roads, or bare ground and cleared paddocks with minimal vegetation. The Survey Area does contain some introduced and native Eucalypts and *Banksia* / *Allocasuarina* woodland, which provide common food items for Black Cockatoos.

1 INTRODUCTION

1.1 Background

Main Roads Western Australia (Main Roads) is proposing to duplicate approximately 7 km of Armadale Road, between Tapper Road in Atwell and Anstey Road in Forrestdale (the Project). The Project will involve the duplication of Armadale Road between Tapper Road and Anstey Road, improvement/upgrade of various intersections, and associated works including lighting, service relocations and drainage. The Project construction is anticipated to commence in early 2018.
As part of the Project, the following upgrades and/or improvements to a number of intersections along Armadale Road and within the Project area are proposed, including:

- Tapper Road/Verde Drive, Atwell;
- Fraser Road, Banjup;
- Liddelow Road, Banjup;
- Wright Road, Piara Waters;
- Rossiter Avenue, Piara Waters; and
- Nicholson Road, Forrestdale.

The duplication and improvement of Armadale Road will assist in relieving the congestion along the existing corridor which currently experiences breakdown flow in the peak periods.

The Project may require clearing of vegetation and fauna habitat. Ecological investigations are being undertaken to characterise the environmental values of the Survey Area. This report details the Black Cockatoo habitat component of these investigations.

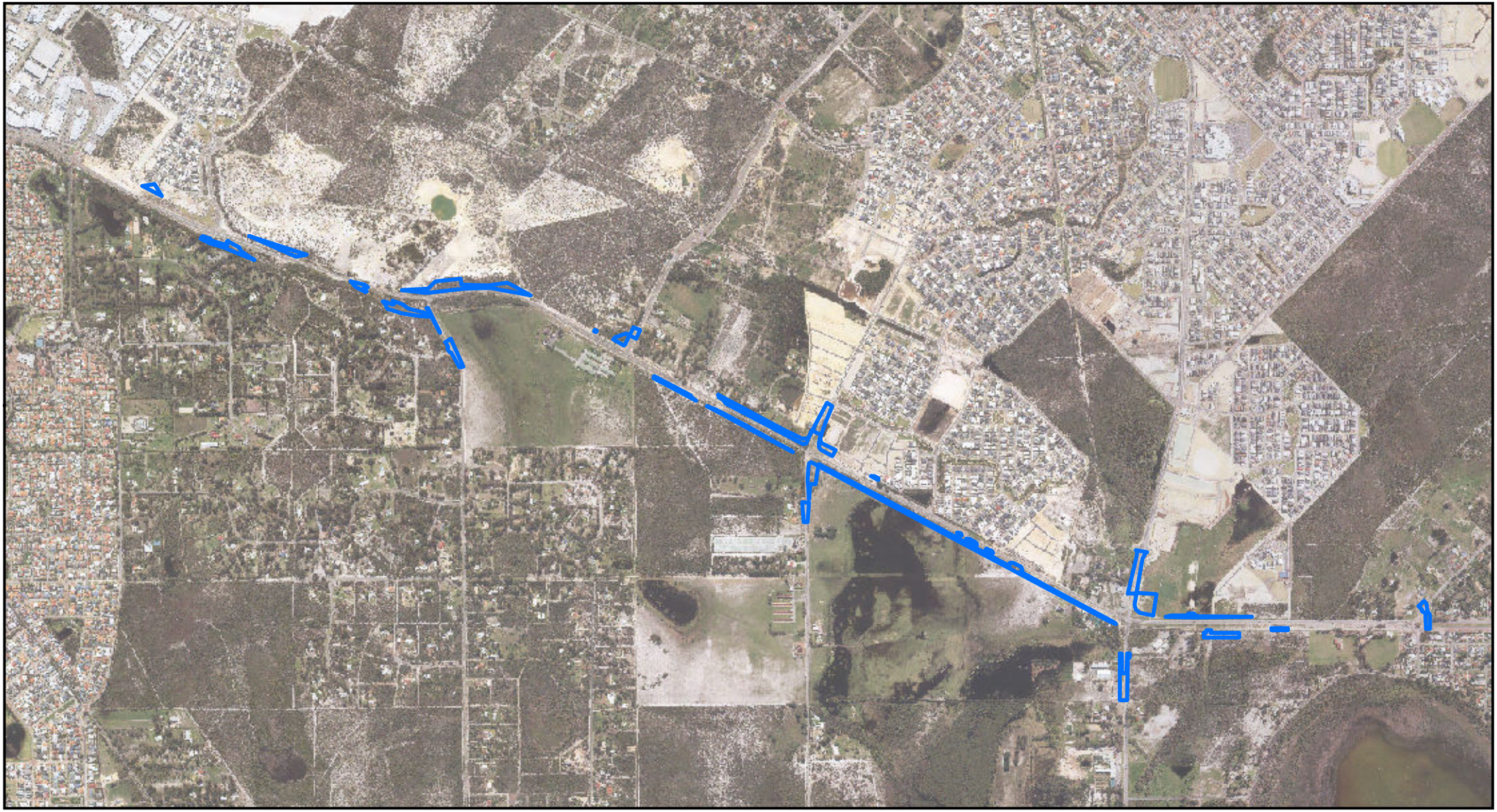
1.2 Location

The Project is located within the suburbs of Atwell and Banjup in the City of Cockburn and Piara Waters and Forrestdale in the City of Armadale. The location of the Survey Area, as part of the overall Project area, is presented in Figure 1.

1.3 Objectives

The objective of this survey is to assess the significance of the Survey Area to Black Cockatoo species. The specific objectives of the survey were to assess the extent and quality of Black Cockatoo foraging, roosting and breeding habitat throughout the Survey Area.

This technical document describes the existing environment, methodology, results and preliminary discussion.



PROJECT ID 60550185.0
CREATED BY DGF
APPROVED BY FdeWit
LAST MODIFIED 23 JAN 2018

Metropolitan Road Improvement Alliance

N

DATUM GDA 1994, PROJECTION PERTH COASTAL GRID 1994

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metres

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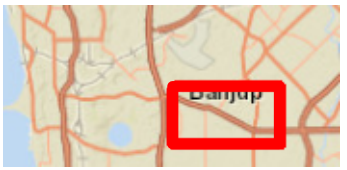
LEGEND

Survey Area

Survey Area



Survey Area

ARMADALE ROAD UPGRADE DUAL CARRIAGEWAY – TAPPER ROAD TO ANSTEY ROAD

Main Roads Western Australia

Figure

1

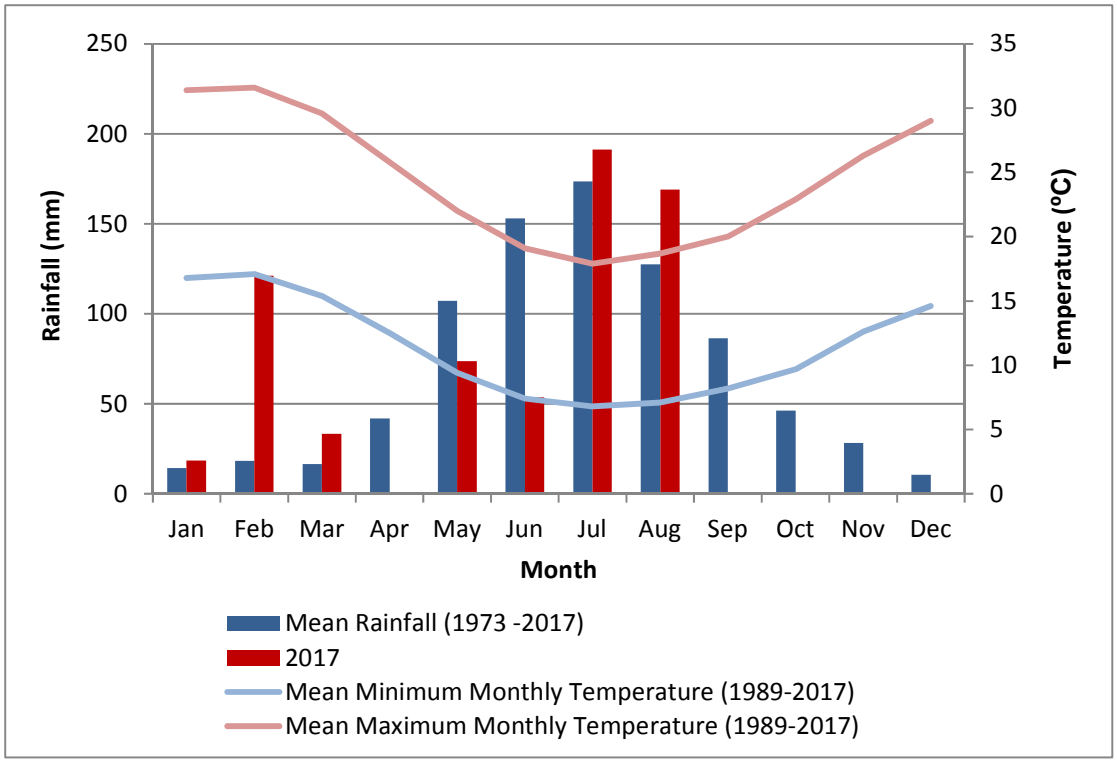
Map Document: K:\ED Engineering & Design\ED66 GIS\07_Armadale Road Duplication\02_MXDs\04_Fauna\Fig1_SurveyArea.mxd (dfotheri)

A4 size

2 EXISTING ENVIRONMENT

2.1 Climate

The Project is located in Perth which experiences a Mediterranean climate. A Mediterranean climate is characterised by warm to hot dry summers and mild to cool wet winters. The Mediterranean climate in Australia is a result of the Indian Ocean High, a high pressure cell that shifts towards the poles in summer and the equator in winter, playing a major role in the formation of the deserts of Western Australia, and the Mediterranean climate of southwest and south-central Australia. Precipitation occurs during winter months, with the possibility of some summer storms.



Graph 1 Climate data obtained from the closest comprehensive weather station, Jandakot Aero (009172).

2.2 IBRA Region

There are 89 recognised Interim Biogeographical Regionalisation of Australia (IBRA) regions across Australia that have been defined based on climate, geology, landforms and characteristic vegetation and fauna. IBRA is the National Reserve System's planning framework which assists in identifying reservation targets and setting priorities to meet these targets (Australian Government, 2013). Western Australia supports 53 IBRA subregions and the project area lies within the Swan Coastal Plain (SCP) IBRA region.

The SCP is comprised of a narrow 30 km wide belt of aeolian, alluvial and colluvial deposits of Holocene or Pleistocene age (Gibson *et al.,* 1994). The Plain is bound by the Indian Ocean and the Yilgarn block, uplifting of which has caused the Darling Scarp on the east side of the Plain. The Perth subregion is found on colluvial and aeolian sands, alluvial river flats and coastal limestone and includes a complex series of seasonal wetlands (Mitchell *et al.*, 2002). The subregion is 1,138,648 ha in size.

2.3 Vegetation

Beard (1981) mapped the vegetation on the Swan Coastal Plain. The Survey Area intersects with the Beard vegetation association 1001, described as 'Medium very sparse woodland; Jarrah, with low woodland; *Banksia* & *Casuarina*' (Beard, 1981).

The Survey Area west of Warton Road occurs in the Bassendean Complex central and south vegetation complex under the Heddle *et al.* (1980) classification system. The Survey Area east of Warton Road to Anstey Road is largely found in the Southern River Complex. Vegetation within the Southern River Complex is defined as comprising of open woodland of *E. calophylla – E. marginata – Banksia* spp. with fringing woodland of *E. rudis – M. rhaphiophylla* along creek beds.

The Bassendean Complex is described as vegetation ranging from woodland of *Eucalyptus marginata – Allocasuarina fraseriana - Banksia* spp. to low woodland of *Melaleuca* spp. and sedgelands on the moister sites.

2.4 Soils and Geology

The Survey Area is located on Bassendean Sands, a basal conglomerate overlain by dune quartz sand with heavy mineral concentrations (Geological Survey of WA & Geoscience Australia, 2008). Soil was observed onsite to be largely grey, dry sand

3 LEGISLATIVE FRAMEWORK

3.1 Overview

Table 1 summarises the key legislation governing the protection and management of Western Australia's conservation significant fauna species. These are further discussed below.

Table 1 Relevant Legislation, Regulations and Guidance

Legislation, Regulations and Guidance	Purpose
Commonwealth of Australia	
Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act)	Provides for the protection of the environment and the conservation of biodiversity.
EPBC Act Referral Guidelines for Three Threatened Black Cockatoo Species (2012).	These guidelines are intended to assist proponents in determining whether an action needs to be referred to the Australian Government. Definitions of habitat are provided as are criteria used to judge significant impact for these black Cockatoo species.
Revised Draft Referral Guideline for Three Threatened Black Cockatoo Species (2017).	This guideline outlines important information and requirements for proponents, particularly on habitat quality, survey expectations, standards for mitigating impacts and significant impacts.
Western Australia	
Wildlife Conservation Act 1950 (WC Act)	Provides for the conservation and protection of Western Australia's wildlife.
Environmental Protection Act 1986 (EP Act)	Preventing, controlling and abating environmental harm and conserving, preserving, protecting, enhancing and managing the environment.
Biosecurity and Agriculture Management Act 2007 (BAM Act)	Provides for the management, control and prevention of certain plants and animals, and for the protection of agriculture and related resources generally.
EPA Technical Guidance – Terrestrial Fauna Surveys, 2016	Provides guidance on the standard of survey required to assist in collecting the appropriate data for decision-making associated with the protection of Western Australia's terrestrial fauna.
EPA Technical Guidance – Sampling Methods for Terrestrial Vertebrate Fauna, 2016	Provides advice on fauna sampling techniques and methodologies for different regions of the State and the analysis, interpretation and reporting requirements for EIA.

3.2 Commonwealth – EPBC Act

The *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) is the main piece of Federal legislation protecting biodiversity in Australia. All matters of national environmental significance (MNES) are listed under the EPBC Act. These include:

- Listed threatened species and ecological communities;
- Migratory species protected under international agreements;
- Ramsar wetlands of international importance;
- The Commonwealth marine environment;
- World Heritage properties;
- National Heritage places;
- Great Barrier Reef Marine Park;
- A water resource, in relation to coal seam gas development and large coal mining development; and
- Nuclear actions.

If an action is likely to have a significant impact on a MNES this action must be referred to the Minister for the Environment for a decision on whether assessment and approval is required under the EPBC Act.

Species at risk of extinction are recognised at a Commonwealth level and are categorised in one of six categories as outlined in Table 2.

Table 2 Categories of Species Listed under Schedule 179 of the EPBC Act

Conservation	Code Category
Ex	**Extinct** Taxa which at a particular time if, at that time, there is no reasonable doubt that the last member of the species has died.
ExW	**Extinct in the Wild** Taxa which is known only to survive in cultivation, in captivity or as a naturalised population well outside its past range; or it has not been recorded in its known and/or expected habitat, at appropriate seasons, anywhere in its past range, despite exhaustive surveys over a time frame appropriate to its life cycle and form.
CE	**Critically Endangered** Taxa which at a particular time if, at that time, it is facing an extremely high risk of extinction in the wild in the immediate future, as determined in accordance with the prescribed criteria.
E	**Endangered** Taxa which is not critically endangered and it is facing a very high risk of extinction in the wild in the immediate or near future, as determined in accordance with the prescribed criteria.
V	**Vulnerable** Taxa which is not critically endangered or endangered and is facing a high risk of extinction in the wild in the medium-term future, as determined in accordance with the prescribed criteria.

Conservation	Code Category
CD	**Conservation Dependent** Taxa which at a particular time if, at that time; a) the species is the focus of a specific conservation program the cessation of which would result in the species becoming vulnerable, endangered or critically endangered b) the following subparagraphs are satisfied: i. the species is a species of fish ii. the species is the focus of a plan of management that provides for management actions necessary to stop the decline of, and support the recovery of, the species so that its chances of long term survival in nature are maximised iii. the plan of management is in force under a law of the Commonwealth or of a State or Territory cessation of the plan of management would adversely affect the conservation status of the species.

3.3 Western Australia

3.3.1 *Wildlife Conservation Act 1950*

Fauna that are considered Threatened and need to be specially protected because they are under identifiable threat of extinction are listed under the WC Act. These categories are defined in Table 3.

Table 3 Conservation Codes for Fauna Listed under the *Wildlife Conservation Act 1950*

Code	Category
CR	**Critically endangered species** Threatened species considered to be facing an extremely high risk of extinction in the wild. Published as Specially Protected under the Wildlife Conservation Act 1950, in Schedule 1 of the Wildlife Conservation (Specially Protected Fauna) Notice for Threatened Fauna and Wildlife Conservation (Rare Flora) Notice for Threatened Flora.
EN	**Endangered species** Threatened species considered to be facing a very high risk of extinction in the wild. Published as Specially Protected under the Wildlife Conservation Act 1950, in Schedule 2 of the Wildlife Conservation (Specially Protected Fauna) Notice for Threatened Fauna and Wildlife Conservation (Rare Flora) Notice for Threatened Flora
VU	**Vulnerable species** Threatened species considered to be facing a high risk of extinction in the wild. Published as Specially Protected under the Wildlife Conservation Act 1950, in Schedule 3 of the Wildlife Conservation (Specially Protected Fauna) Notice for Threatened Fauna and Wildlife Conservation (Rare Flora) Notice for Threatened Flora.
EX	**Presumed extinct species** Species which have been adequately searched for and there is no reasonable doubt that the last individual has died. Published as Specially Protected under the Wildlife Conservation Act 1950, in Schedule 4 of the Wildlife Conservation (Specially Protected Fauna) Notice for Presumed Extinct Fauna and Wildlife Conservation (Rare Flora) Notice for Presumed Extinct Flora.
IA	**Migratory birds protected under an international agreement** Birds that are subject to an agreement between the government of Australia and the governments of Japan (JAMBA), China (CAMBA) and The Republic of Korea (ROKAMBA), and the Bonn Convention, relating to the protection of migratory birds. Published as Specially Protected under the Wildlife Conservation Act 1950, in Schedule 5 of the Wildlife Conservation (Specially Protected Fauna) Notice.
CD	**Special conservation**

Code	Category
OS	**Special protection for reasons other than those already mentioned (fauna only)**

Species that have not yet been adequately surveyed to warrant being listed under the WA Act are added to a Priority List by the State Minister for Environment. Categories and definitions of Priority flora and fauna species are provided in **Error! Not a valid bookmark self-reference.**.

Table 4 Conservation Codes for Fauna Endorsed by the Minister for Environment

Conservation Code	Category
Priority One	**Poorly Known Species** Species that are known from one or a few collections or sight records (generally less than five), all on lands not managed for conservation, e.g. agricultural or pastoral lands, urban areas, Shire, Westrail and Main Roads WA road, gravel and soil reserves, and active mineral leases and under threat of habitat destruction or degradation. Species may be included if they are comparatively well known from one or more localities but do not meet adequacy of survey requirements and appear to be under immediate threat from known threatening processes.
Priority Two	**Poorly Known Species** Species that are known from one or a few collections or sight records, some of which are on lands not under imminent threat of habitat destruction or degradation, e.g. national parks, conservation parks, nature reserves, State forest, vacant Crown land, water reserves, etc. Species may be included if they are comparatively well known from one or more localities but do not meet adequacy of survey requirements and appear to be under threat from known threatening processes.
Priority Three	**Poorly Known Species** Species that are known from collections or sight records from several localities not under imminent threat, or from few but widespread localities with either large population size or significant remaining areas of apparently suitable habitat, much of it not under imminent threat. Species may be included if they are comparatively well known from several localities but do not meet adequacy of survey requirements and known threatening processes exist that could affect them.

Conservation Code	Category
Priority Four	**Rare, Near Threatened and other species in need of monitoring** a) Rare. Species that are considered to have been adequately surveyed, or for which sufficient knowledge is available, and that are considered not currently threatened or in need of special protection, but could be if present circumstances change. These species are usually represented on conservation lands. b) Near Threatened. Species that are considered to have been adequately surveyed and that do not qualify for Conservation Dependent, but that are close to qualifying for Vulnerable. c) Species that have been removed from the list of threatened species during the past five years for reasons other than taxonomy.
Priority Five	**Conservation Dependent species**

3.3.2 *Biosecurity and Agriculture Management Act 2007*

Biosecurity is the management of the risk of animal and plant pests and diseases entering, emerging, establishing or spreading in WA to protect the economy, environment and community. Biosecurity is managed under the BAM Act which came into effect 1 May 2013. Exotic animals and plants can become an invasive species if they can establish in new areas where local conditions are favourable for their growth.

4 METHODOLOGY

4.1 Field Surveys

4.1.1 Targeted Black Cockatoo Survey

A targeted Black Cockatoo survey was conducted to identify potential breeding, roosting and foraging habitat for the two threatened Black Cockatoo species that are likely to occur in the Survey Area. These are Carnaby's Black Cockatoo (*Calyptorhynchus latirostris* [Endangered under the EPBC Act and under the WC Act]), and the Forest Red-tailed Black Cockatoo (*Calyptorhynchus banksii* subsp. *naso* [Vulnerable under the EPBC Act and under the WC Act]). Refer to Section 5.1 for further information on these species.

The surveys were conducted in accordance with DSEWPaC (2012) and the draft DoEE (2017) Referral Guidelines. The field survey was conducted by Jared Leigh, 15 years' experience in fauna survey programs, including multiple Black Cockatoo surveys.

4.1.1.1 Breeding Habitat

The Black Cockatoo breeding habitat assessment focussed on quantifying potential breeding trees (Diameter at Breast Height (DBH) >500 mm DBH and *E. wandoo* DBH >300 mm) and breeding trees (trees containing potentially suitable hollows) within the Survey Area. Table 5 defines breeding habitat and identifies those trees that Black Cockatoos will utilise as breeding trees, according to DoEE (2017). The following information was collected for all potential breeding trees with a DBH >500 mm (*Eucalyptus wandoo* >300 mm):

- Location;
- Fire scarring present;
- Tree species;
- DBH;
- Height;
- Number of hollows; and
- Number of potentially suitable hollows.

Photographs were also taken of each tree.

Table 5 Potential Breeding Habitat for Black Cockatoo Species

Habitat	Carnaby's Black Cockatoo	Forest Red-tailed Black Cockatoo
Specific breeding habitat	Generally in woodland or forest, but also breeds in partially cleared woodland or forest, including isolated trees. Nest in hollows in live or dead trees of *Eucalyptus salmonophloia, E. wandoo, E. gomphocephala*, *E. marginata*, *E. rudis*, *E. loxophleba* subsp. *loxophleba, E. accedens, E. diversicolor* and *Corymbia calophylla*.	Generally in woodland or forest, but may also breed in partially cleared woodland or forest, including isolated trees. Nest in hollows in live or dead trees of *Corymbia calophylla, Eucalyptus diversicolor, E. wandoo, E. megacarpa*, *E. patens*, *E. gomphocephala* and *E. marginata*.
Definition of breeding habitat	'Breeding habitat' is defined in these referral guidelines as trees of species known to support breeding (as specified in the row above for each species of Black Cockatoo, taken from Table 1 of DSEWPaC 2012) within the range of the species which either have a suitable nest hollow OR are of a suitable DBH to develop a nest hollow. For most tree species, suitable DBH is 500 mm. Note that *E. wandoo* is DBH >300 mm.	

Source: DSEWPaC (2012).

4.1.1.2 Roosting Habitat

Table 6 defines the suitable trees that the three Western Australian Black Cockatoo species may utilise as roosting trees. Both white-tailed Black Cockatoo species roost in or near riparian environments or near other permanent water sources. The Forest Red-tailed Black Cockatoo prefers the edges of forests for roosting (DSEWPaC, 2012). Potential roosting trees were searched for and assessed during the field survey.

Table 6 Suitable Roosting Trees for Carnaby's Cockatoo and the Forest Red-tailed Black Cockatoo

Carnaby's Black Cockatoo	Forest Red-Tailed Black Cockatoo
Any tall trees may provide suitable roosting, but particularly Flat-topped Yate (*Eucalyptus occidentalis*), Salmon Gum (*E. salmonophloia*), Wandoo (*E. wandoo*), Marri (*Corymbia calophylla*), Karri (*E. diversicolor*), Blackbutt (*E. patens*), Tuart (*E. gomphocephala*), introduced eucalypts and introduced pines.	Any tall trees may provide suitable roosting, but particularly tall Jarrah (*Eucalyptus marginata*), Marri (*Corymbia calophylla*), Blackbutt (*E. patens*), Tuart (*E. gomphocephala*) and introduced eucalypt trees or large trees on the edges of forests.

Source: DSEWPaC (2012).

4.1.1.3 Foraging Habitat

The common food items that Black Cockatoo species forage upon are presented in Table 7. The quality of foraging habitat not only reflects the availability of food sources, but also the proximity to reliable water sources, connectivity to other suitable habitat, presence of potential breeding trees, and proximity to confirmed roost and breeding sites (amongst others). These parameters were utilised by the DoEE (2017) to produce a draft foraging habitat assessment tool (Table 6 and Table 7). This scoring system was utilised to assess potential foraging habitat for each Black Cockatoo species. Thirteen assessments were completed across the Survey Area (refer to Appendix A and B).

Table 5 Foraging and Common Food Items for the Black Cockatoo Species

Carnaby's Black Cockatoo	Forest Red-tailed Black Cockatoo
Native shrubland, kwongan heathland and woodland on seeds, flowers and nectar of native proteaceous plant species (*Banksia* sp., *Hakea* sp., *Dryandra* sp., and *Grevillea* sp.), as well as *Callistemon* sp. and Marri. Also seeds of introduced species including *Pinus* sp., *Erodium* sp., wild radish, canola, almonds and pecan nuts; insects and insect larvae; occasionally flesh and juice of apples and persimmons.	Primarily seeds of Jarrah and Marri in woodlands and forest, and edges of Karri forests, including Wandoo and Blackbutt. Forages on *Eucalyptus caesia, E. erythrocorys, Allocasuarina* cones, fruits of snottygobble (*Persoonia longifolia*) and Mountain Marri (*Corymbia haematoxylon).* Also some introduced eucalypts such as River Red Gum (*E. camaldulensis*) and Flooded or Rose Gum (*E. grandis*). On the Swan Coastal Plain, often feeds on introduced Cape Lilac (*Melia azedarach*).

Source: DoEE (2017).

The scoring tool is used by initially defining the quality of the overall habitat present (i.e. Very High Quality, High Quality, Quality and Low Quality) and then adding or subtracting points from this depending on the ecological values of the habitat (i.e. proximity to water, proximity to a known roost site, evidence of foraging material etc.). This determines an overall quantitative rating. These scores were then used as representative scores for that unit. Table 7 define the levels of foraging habitat quality used during the assessment.

Table 6 Black Cockatoo Foraging Assessment Scoring

Score	Foraging Quality
1 – 3	Low Quality
4 – 6	Quality
7 – 8	High Quality
9 – 10	Very High Quality

Table 7 Quality of Foraging Habitat Assessment Tool for the Threatened Black Cockatoo Species

Score	Carnaby's Black Cockatoo	Forest Red-tailed Black Cockatoo
≥10 Very High Quality	Quality foraging habitat that is being managed for Black Cockatoos, including successful rehabilitation, and/or has some level of protection from clearing, and / or is Quality habitat described below with attributes contributing to meet a score of 10 or greater	Quality foraging habitat that is being managed for Black Cockatoos, including successful rehabilitation, and/or has some level of protection from clearing, and / or is Quality habitat described below with attributes contributing to meet a score of 10 or greater
7 High Quality	Native shrubland, kwongan heathland and woodland dominated by proteaceous plant species (e.g. *Banksia* sp., *Hakea* sp. and *Grevillea* sp.) as well as eucalypt (not mallee) woodland and forest that is dominated by foraging species. Does not include orchards, canola, or areas under a RFA	Jarrah and Marri woodlands and forest, and edges of Karri forests, including Wandoo and Blackbutt, within the range of the subspecies. Does not include areas under a RFA
5 Quality	Pine plantation or introduced eucalypts	Introduced eucalypts as well as the introduced Cape lilac (*Melia acedarach*)
1 Low Quality	Individual foraging plants or small stand of foraging plants (≤2 ha)	Individual foraging plants or small stand of foraging plants (≤2 ha)
Additions: Context adjustor – attributes improving habitat quality		
+3	Is within the Swan Coastal Plain	Jarrah and/or Marri shows good recruitment (i.e. evidence of young trees)
+3	Contains trees known to be used for breeding and/or with suitable nest hollows	Contains trees known to be used for breeding and/or with suitable nest hollows
+2	Primarily comprises Marri	Primarily contains Marri and/or Jarrah
+2	Contains trees with potential to be used for breeding (DBH ≥500 mm or ≥300 mm for Salmon Gum and Wandoo	
+1	Known to be a large or key roosting site	
Subtractions: Context adjustor – attributes reducing habitat quality		
-2	No other foraging habitat within 6 km	
-1	Is >12km from known roosting site	
-2	Does not contain evidence of foraging by species	
-1	Is >12 km from known breeding location	
-1	Is >2 km from watering point	
-1	Disease present (e.g. *Phytophthora cinnamomi* or Marri canker)	

Source: DoEE (2017)

4.2 Survey Limitations

Limitations of the Black Cockatoo surveys are discussed in Table 8.

Table 8 Limitations of the Black Cockatoo Surveys

Limitation	Black Cockatoo Survey
Competency/experience of consultant conducting survey	**Nil** Jared is an ecologist with over 15 years' experience in the environmental industry who has conducted fauna surveys in a range of bioregions within Western Australia. Claudia is an ecologist with over four years' experience in the environmental industry, who has undertaken Black Cockatoo surveys in the metropolitan area.
Scope (i.e. what life forms were sampled)	**Minor** All areas of potential foraging habitat were inspected and every potential breeding tree within the Survey Area was assessed for suitability. Due to size of some trees, vision of the entire tree was not always possible when looking for hollows, and in this case the precautionary principle was utilised.
Proportion of fauna identified, recorded and/or collected (based on sampling, timing and intensity)	**Nil** Carnaby's Cockatoo and Forest Red-tailed Black Cockatoo were both recorded through either direct sighting or indirect evidence.
Sources of information	**Minor** DBCA database, Naturemap, EPBC Act PMST, DoEE (2017) and DSEWPaC (2012) were utilised to inform the Black Cockatoo survey.
Completion (is further work needed)	**Nil** The objectives of the targeted Black Cockatoo survey were met and no further work is required.
Timing, weather, season, cycle	**Nil** Forest Red-tailed Black Cockatoo has been recorded on the Swan Coastal Plain during the survey period. Carnaby's Black Cockatoo are often seen in late spring to mid-winter on the Swan Coastal Plain.
Disturbances (e.g. fire flood, accidental human intervention) which affected results of the survey	**Nil** The Targeted Black Cockatoo survey was not disrupted or impacted.
Intensity (was the intensity adequate)	**Nil** The Survey Area was assessed over a three day period which enabled sufficient time to assess each vegetation community and potential breeding habitat tree.
Resources (degree of expertise available in animal identification)	**Nil** The resources (time, equipment and expertise) were sufficient for a Black Cockatoo survey. Jared is an ecologist with over 15 years' environmental industry experience. Similarly Claudia has over 4 years' in the environmental industry.
Remoteness and/or access problems	**Nil** The majority of the Survey Area was traversed on-ground and was accessible. Private land was not entered and has been marked as such.
Availability of contextual information on the region	**Nil** Sufficient contextual information is available on the Swan Coastal Plain.

5 RESULTS AND DISCUSSION

5.1 Black Cockatoo Ecology

5.1.1 Carnaby's Black Cockatoo

Carnaby's Black Cockatoo is endemic to the southwest of Western Australia, extending from the Murchison River to Esperance, and inland to Coorow, Kellerberrin and Lake Cronin. This Black Cockatoo has a white patch on its cheek, white bands on its tail, and a strong curved bill. Carnaby's Black Cockatoo feeds on seeds, nuts and flowers of a variety of native and exotic plants. Feed plants include the various proteaceous species (e.g. *Banksia*, *Grevillea* and *Hakea*), *Corymbia calophylla* (Marri), *Eucalyptus* (e.g. Jarrah [*Eucalyptus marginata*]), and seeds from the cones of Pine trees (*Pinus* sp.).

Carnaby's Black Cockatoo displays strong pair bonds and nest in the hollows of live or dead mature eucalypts including Salmon Gum (*Eucalyptus salmonophloia*), York *Gum (E. loxophleba* subsp*. loxophleba)*, Flooded Gum (*E. rudis*), Karri (*E. diversicolor*), Marri (*Corymbia calophylla*), Wandoo (*E. wandoo*) and Tuart (*E. gomphocephala* [DSEWPaC, 2012]). Nest hollows generally range from 2.5-12 m above ground, size of entrance from 23-30 cm and depth of hollows from 1-2.5 m (Johnstone and Storr,1998). The species appears to be expanding its current breeding range westward and south into the Jarrah-Marri forests of the Darling Range and into the Tuart forests of the SCP (Johnstone *et al.*, 2010). After breeding, Carnaby's Black Cockatoo disperse to the higher rainfall coastal areas of the south-west of Western Australia to feed in late December to July. Breeding has been recorded from early July to mid-December.

Foraging evidence from the Carnaby's Black Cockatoo was recorded twice within the Survey Area (refer to Section 5.2.1 for further details).

5.1.2 Forest Red-tailed Black Cockatoo

The Forest Red-tailed Black Cockatoo is endemic to the south-west humid and semi-humid zones of Western Australia, where it inhabits dense Jarrah, Karri and Marri forests which receive more than 600 mm average annual rainfall (DSEWPaC, 2012). It has a pair of black central tail feathers and a bright red, orange or yellow barring on the tail.

This species predominantly feeds in eucalypt forests, preferring Marri (*Corymbia calophylla*) and Jarrah (*Eucalyptus marginata*) seeds, but also feeding on Blackbutt (*E. patens*), Albany Blackbutt (*Eucalyptus staeri*), Karri (*E. diversicolor*), Sheoak (*Allocasuarina fraseriana*) and Snottygobble (*Persoonia longifolia*) (Johnstone, 2016 pers. comm.). Forest Red-tailed Black Cockatoo are monogamous and pairs nest in tree hollows from 6.5–33 m above ground. Most nests are in very large and very old, mature Marri (Johnstone, Kirkby and Sarti, 2013), though they will nest in other eucalypts such as Tuart (Johnstone, 2016 pers. comm.).

Foraging evidence from the Forest Red-tailed Black Cockatoo was recorded twice within the Survey Area (refer to Section 5.2.2 for further details).

5.2 Foraging Habitat

5.2.1 Carnaby's Black Cockatoo

The Survey Area contains a total of 4.25 ha of foraging habitat for Carnaby's Black Cockatoo. Much of the Survey Area has been cleared, and the highest quality foraging habitats are the good quality Banksia Woodlands that contain potential breeding trees. Foraging habitat is presented spatially in Figure 2 and the total approximate foraging quality areas are presented in Table 11. Foraging Assessments are presented in Appendix A.

Carnaby's Cockatoo foraging evidence was recorded twice within or directly adjacent the Survey Area (Table 12).

Table 11 Carnaby's Black Cockatoo Foraging Habitat Areas

Foraging Quality	Areas (ha)
Low Quality (1-3)	0.67
Quality (4-6)	0.58
High Quality (7-8)	1.64
Very High Quality (>8)	1.36
Total	**4.25**

Table 12 Carnaby's Black Cockatoo Foraging Evidence

ID	Lat	Long	Record Type	Comments	Photo
194	-32.1337	115.8925	Carnaby's Cockatoo Foraging Evidence	Typical grub removal from cone	
188	-32.1331	115.8881	Carnaby's Cockatoo Foraging Evidence	Typical grub removal from *Banksia infructescence*	

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DATUM GDA 1994, PROJECTION PERTH COASTAL GRID 1994

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LEGEND

- Survey Area

Foraging Evidence

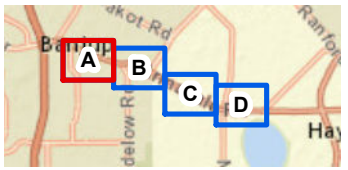
- Carnaby's Cockatoo

Black Cockatoo Breeding Trees

- Potential Breeding Tree
- Stag

Carnaby's Cockatoo Foraging Quality

- Low Quality
- High Quality
- Very High Quality



Carnaby's Cockatoo Foraging Quality

ARMADALE ROAD UPGRADE DUAL CARRIAGEWAY – TAPPER ROAD TO ANSTEY ROAD

Main Roads Western Australia

Figure 2A

Map Document: G:\Client_Data\MRIA\07_Armadale Road Duplication\02_MXDs\04_Fauna\Fig2_CarnabyForagingHabitat.mxd (fotheringhamd)

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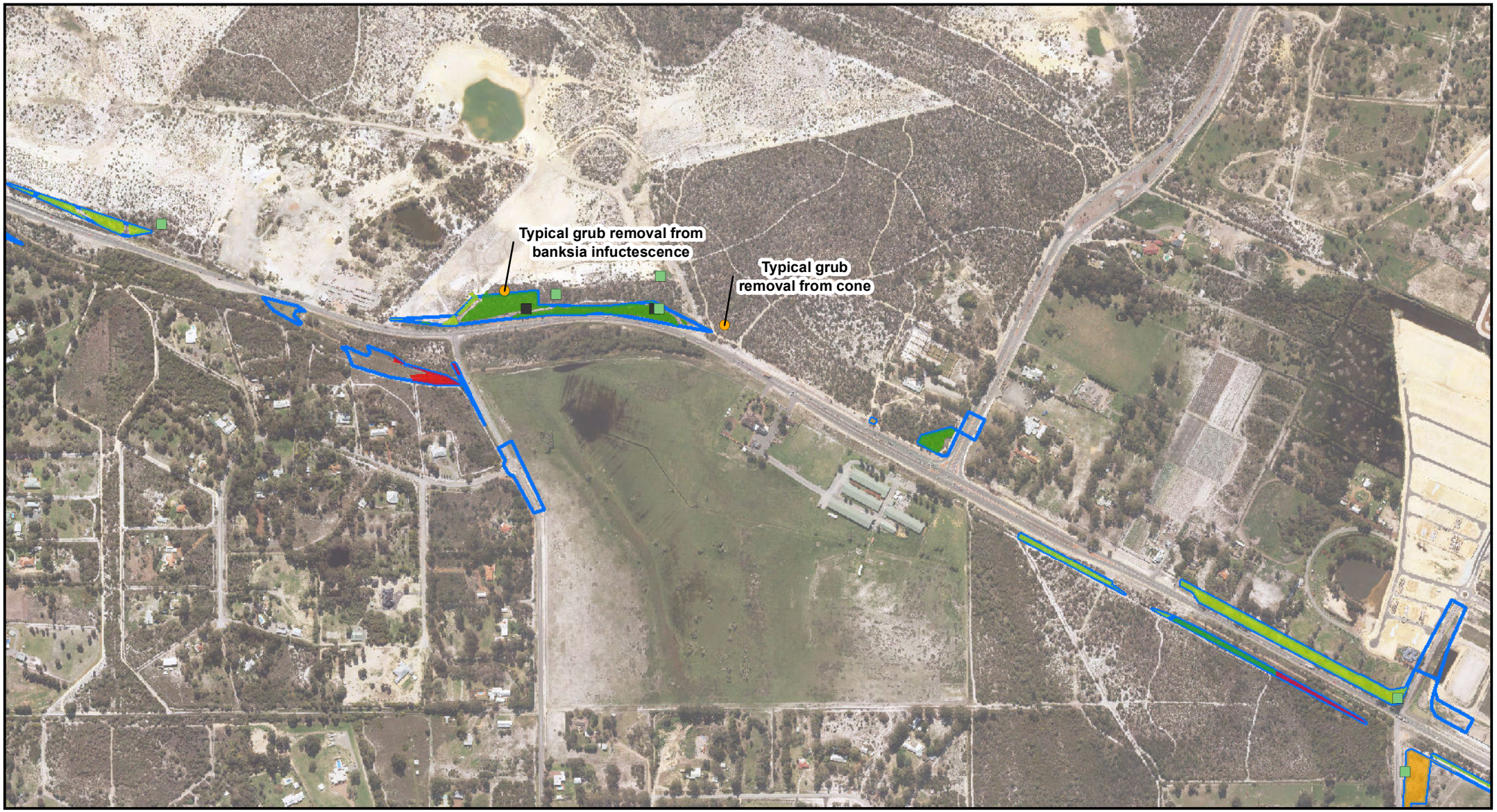

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LEGEND

- Survey Area

Foraging Evidence

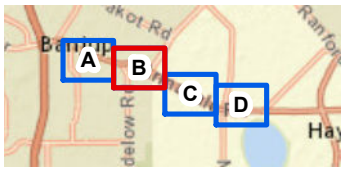
- Carnaby's Cockatoo

Black Cockatoo Breeding Trees

- Potential Breeding Tree
- Stag

Carnaby's Cockatoo Foraging Quality

- Low Quality
- Quality
- High Quality
- Very High Quality



Carnaby's Cockatoo Foraging Quality

ARMADALE ROAD UPGRADE DUAL CARRIAGEWAY – TAPPER ROAD TO ANSTEY ROAD

Main Roads Western Australia

Figure 2B

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LEGEND

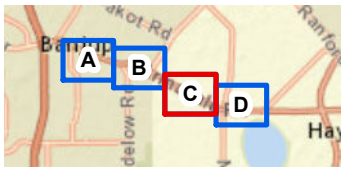
Survey Area

Black Cockatoo Breeding Trees

Potential Breeding Tree

Carnaby's Cockatoo Foraging Quality

Low Quality
Quality
High Quality
Very High Quality



Carnaby's Cockatoo Foraging Quality

ARMADALE ROAD UPGRADE DUAL CARRIAGEWAY – TAPPER ROAD TO ANSTEY ROAD

Main Roads Western Australia

Figure 2C

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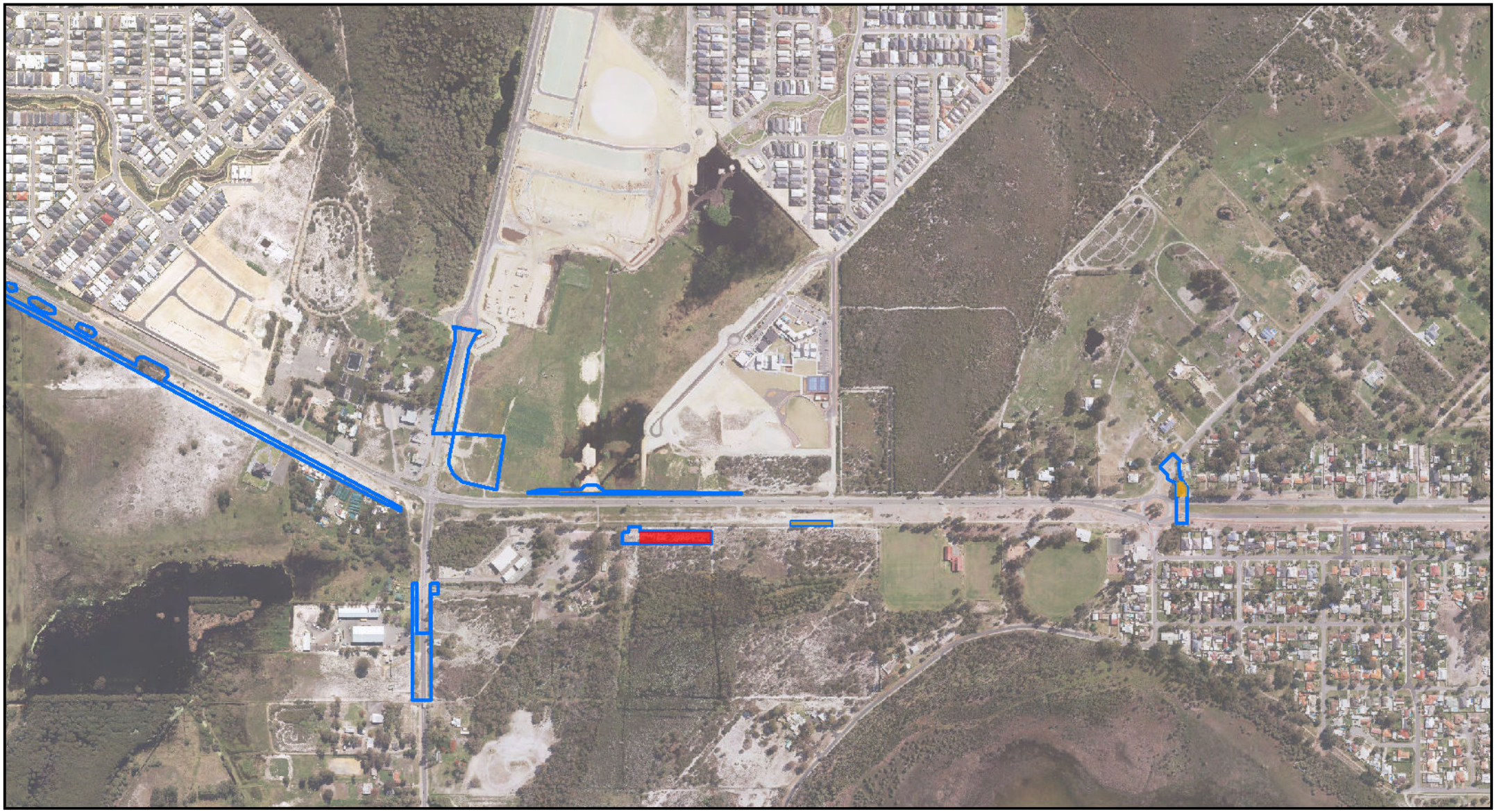

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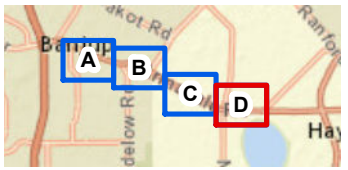
LEGEND

Survey Area

Carnaby's Cockatoo Foraging Quality

Low Quality

Quality



Carnaby's Cockatoo Foraging Quality

ARMADALE ROAD UPGRADE DUAL CARRIAGEWAY – TAPPER ROAD TO ANSTEY ROAD

Main Roads Western Australia

Figure 2D

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5.2.2 Forest Red-tailed Black Cockatoo

The Survey Area contains a total of 2.39 ha of foraging habitat for the Forest Red-tailed Black Cockatoo. The highest quality foraging habitats are the good quality woodlands which contain significant numbers of Jarrah, Sheoak and potential breeding trees. Foraging habitat is presented spatially in Figure 3 and total approximate areas are presented in Table 13. Foraging Assessments are presented in Appendix B.

Forest Red-tailed Black Cockatoo foraging evidence was recorded twice within or directly adjacent the Survey Area (Table 14).

Table 13 Forest Red-tailed Black Cockatoo Foraging Habitat Areas

Foraging Quality	Areas (ha)
Low Quality (1-3)	0.06
Quality (4-6)	1.28
High Quality (7-8)	0.06
Very High Quality (>8)	0.99
Total	**2.39**

Table 14 Forest Red-tailed Black Cockatoo Foraging Evidence

ID	Lat	Long	Record Type	Comments	Photo
197	-32.1481	115.93	Forest Red-tailed Black Cockatoo Foraging Evidence	Typical chewing on marri nut	

191	-32.1352	115.8955	Forest Red-tailed Black Cockatoo Foraging Evidence	Typical chewing on marri nut	

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LEGEND

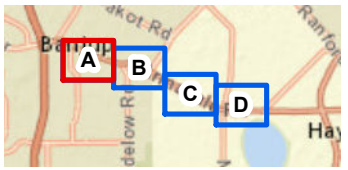
- Survey Area

Black Cockatoo Breeding Trees

- Potential Breeding Trees
- Stag

Forest Red-tailed Black Cockatoo Foraging Quality

- Quality
- Very High Quality



Forest Red-tailed Black Cockatoo Foraging Quality

ARMADALE ROAD UPGRADE DUAL CARRIAGEWAY – TAPPER ROAD TO ANSTEY ROAD

Main Roads Western Australia

Figure 3A

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DATUM GDA 1994, PROJECTION PERTH COASTAL GRID 1994

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LEGEND

Survey Area

Foraging Evidence

Forest Red-tailed Black Cockatoo

Black Cockatoo Breeding Trees

Potential Breeding Trees

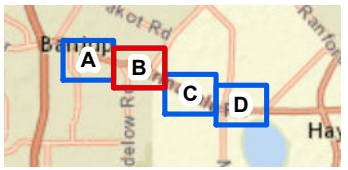
Stag

Forest Red-tailed Black Cockatoo Foraging Quality

Low Quality

Quality

Very High Quality



Forest Red-tailed Black Cockatoo Foraging Quality

ARMADALE ROAD UPGRADE DUAL CARRIAGEWAY – TAPPER ROAD TO ANSTEY ROAD

Main Roads Western Australia

Figure 3B

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PROJECT ID	60550185.0
CREATED BY	DGF
APPROVED BY	FdeWit
LAST MODIFIED	22 JAN 2018

Metropolitan Road Improvement Alliance

N

DATUM GDA 1994, PROJECTION PERTH COASTAL GRID 1994

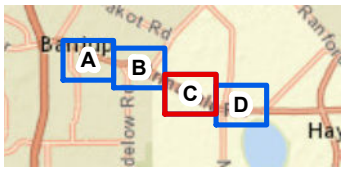
0 50 100 150 200

metres

1:10,000 when printed at A4

LEGEND

- Survey Area
- **Black Cockatoo Breeding Trees**
  - Potential Breeding Trees
- **Forest Red-tailed Black Cockatoo Foraging Quality**
  - Low Quality
  - Quality



Forest Red-tailed Black Cockatoo Foraging Quality

ARMADALE ROAD UPGRADE DUAL CARRIAGEWAY – TAPPER ROAD TO ANSTEY ROAD

Main Roads Western Australia

Figure 3C

Map Document: G:\Client_Data\MRIA\07_Armadale Road Duplication\02_MXDs\04_Fauna\Fig3_FRTForagingHabitat.mxd (fotheringhamd)

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Metropolitan Road Improvement Alliance

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DATUM GDA 1994, PROJECTION PERTH COASTAL GRID 1994

0 50 100 150 200
metres

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LEGEND

Survey Area

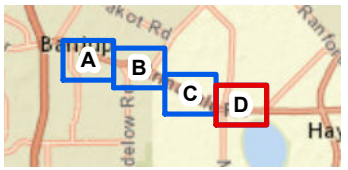
Foraging Evidence

Forest Red-tailed Black Cockatoo

Forest Red-tailed Black Cockatoo Foraging Quality

Low Quality

High Quality



Forest Red-tailed Black Cockatoo Foraging Quality

ARMADALE ROAD UPGRADE DUAL CARRIAGEWAY – TAPPER ROAD TO ANSTEY ROAD

Main Roads Western Australia

Figure

3D

Map Document: G:\Client_Data\MRIA\07_Armadale Road Duplication\02_MXDs\04_Fauna\Fig3_FRTForagingHabitat.mxd (fotheringhamd)

A4 size

5.3 Breeding Habitat

The Survey Area contains a total of five native trees and two stags defined as potential Black Cockatoo breeding habitat trees (DSEWPaC, 2012). These details are presented in Table 15. Only one of these trees contained potential hollows (two), although these were assessed as not being suitable for use by breeding Black Cockatoos. Please note, whilst these species are native to the area, they may not meet the definition of 'native' under the *Environmental Protection Act 1986* and associated regulations. This should be cross referenced with flora and vegetation assessment information.

Table 9 Potential Black Cockatoo Breeding Habitat Trees Recorded in and Directly Adjacent the Survey Area

ID	Lat	Long	Species	Tree Height (m)	DBH (cm)	No. of Potential Hollows	No. of Potentially Suitable Hollows
950	-32.1401	115906097	*Eucalyptus rudis* (Flooded Gum)	15	120	0	
932	-32.1334	115.891179	*Eucalyptus marginata* (Jarrah)	10	70	0	
935	-32.1334	115.891087	Stag	14	150	2	0
920	-32.1334	115.888489	Stag	12	120	0	
0	-32.1413	115.906251	*Eucalyptus marginate* (Jarrah)	8	85	0	

5.4 Roosting Habitat

Carnaby's Black Cockatoo typically roosts in the tallest trees in the landscape in or near riparian environments or near other permanent water sources. The Forest Red-tailed Black Cockatoo prefers the edges of forests for roosting (DSEWPaC, 2012). Evidence of roosting usually involves large amounts of bird scat beneath a large, mature tree, with a significant amount of broken branches on the ground. Potential roosting sites were searched for throughout the Survey Area during the field survey and no confirmed Black Cockatoo roosting sites were identified.

6 CONCLUSION

In summary, the significant Black Cockatoo values of the Survey Area include:

- The presence of five native trees and two stags defined as potential Black Cockatoo breeding habitat trees, although none of these trees contained hollows that were potentially suitable for use by breeding Black Cockatoos.
- No roosting sites were identified within the Survey Area.
- Minimal Very High and High Quality foraging habitat for the Forest Red-tailed Black Cockatoo (*Calyptorhynchus banksii naso*) and Carnaby's Black Cockatoo (*Calyptorhynchus latirostris*) (see numbers below). The Survey Area contains some introduced and native Eucalypts and Banksia / Allocasuarina woodland, which provide common food items for Black Cockatoos. Much of the Survey Area (7.03 ha, approximately 60%) is cleared and comprises hardstand areas such as roads, or bare ground and cleared paddocks with minimal vegetation.
- Areas of foraging habitat for Carnaby's Black Cockatoo comprise 1.25 ha of Low Quality/Quality and 3.00 ha of High Quality/Very High Quality vegetation.
- Areas of foraging habitat for Forest Red-tailed Black Cockatoo comprise 1.34 ha of Low Quality/Quality and 1.05 ha of High Quality/Very High Quality vegetation.

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Appendix A Carnaby's Cockatoo Foraging Habitat Assessments

ID	Initial Quality	Is within the Swan Coastal Plain (+3)	Contains trees known to be used for breeding and / or with suitable nest hollows (+3)	Primarily comprises Marri (+2)	Contains trees with potential to be used for breeding (DBH ≥500 mm or ≥300 mm for Salmon Gum and Wandoo (+2)	Known to be a large or key roosting site (+1)	Does not contain evidence of foraging by species (-2)	No other foraging habitat within 6 km (-2)	Is >12 km from known breeding location (-1)	Is >12km from known roosting site (-1)	Is >2 km from a watering point (-1)	Disease present (-1)	Final Score	General Comments
S149	1	3	0	0	2	0	-2	0	0	0	0	0	**4**	Less than 2 ha area of large mature breeding tree potential introduced eucalypts. No foraging evidence.
S98	1	3	3	0	2	0	-2	0	0	0	0	0	**7**	Strip of degraded woodland with scattered Banksia, Jarrah and Sheoak. Contains breeding and potential breeding trees. No foraging evidence recorded.
S110	7	3	0	0	2	0	0	0	0	0	0	0	**12**	Good quality Banskia, Jarrah and Sheoak woodland on the SCP, containing foraging evidence and potential breeding trees.
UID58	1	3	0	0	0	0	-2	0	0	0	0	0	**2**	Minimal foraging species in small patch on SCP. No foraging evidence or breeding trees.
S119	1	3	0	2	2	0	-2	0	0	0	0	0	**6**	Small patch of mature Marri on the SCP with potential breeding trees. No foraging evidence.
S116	7	3	0	0	2	0	-2	0	0	0	0	0	**10**	Good quality Banksia woodland on the SCP, containing potential breeding trees, no foraging evidence.
S146	1	3	0	0	0	0	-2	0	0	0	0	0	**2**	Low quality riparian type habitat on SCP with occassional scattered foraging species (e.g. grasstree). No breeding or potential breeding trees.

ID	Initial Quality	Is within the Swan Coastal Plain (+3)	Contains trees known to be used for breeding and / or with suitable nest hollows (+3)	Primarily comprises Marri (+2)	Contains trees with potential to be used for breeding (DBH ≥500 mm or ≥300 mm for Salmon Gum and Wandoo (+2)	Known to be a large or key roosting site (+1)	Does not contain evidence of foraging by species (-2)	No other foraging habitat within 6 km (-2)	Is >12 km from known breeding location (-1)	Is >12km from known roosting site (-1)	Is >2 km from a watering point (-1)	Disease present (-1)	Final Score	General Comments
S125	5	3	0	0	2	0	-2	0	0	0	0	0	**8**	Area >2ha on SCP with occassional introduced mature eucalypt of breeding potential size. No foraging evidence.
S143	1	3	0	0	0	0	-2	0	0	0	0	0	**2**	Areas with occassional, scattered foraging species (generally proteaceous). On SCP, with no breeding trees or clear foraging evidence.
S140	1	3	0	0	2	0	0	0	0	0	0	0	**6**	Predominantly cleared area on SCP with scattered eucalypts, Banksia and Sheoak. Area not accessed at this stage and Precautionary Principle utilised for breeding trees and foraging evidence.
S137	1	3	0	2	2	0	-2	0	0	0	0	0	**6**	Small planted strip of Marri on SCP, with breeding potential. No foraging evidence.
S134	1	3	0	0	2	0	-2	0	0	0	0	0	**4**	Area on SCP with a few indiviudal foraging species (introduced eucalypts, bottlebrush), with breeding potenital. No Foraging evidence.
UID14	1	3	0	0	0	0	-2	0	0	0	0	0	**2**	Degraded woodland with scattered Banksia, and Sheoak. Contains no breeding or potential breeding trees. No foraging evidence recorded.

Appendix B Forest Red-tailed Black Cockatoo Foraging Habitat Assessments

ID	Initial Quality	Jarrah and/or Marri shows good recruitment (i.e. evidence of young trees)	Contains trees known to be used for breeding and / or with suitable nest hollows	Primarily contains Marri and/or Jarrah	Contains trees with potential to be used for breeding (DBH ≥500 mm or ≥300 mm for Salmon Gum and Wandoo	Known to be a large or key roosting site	No other foraging habitat within 6 km (-2)	Is >12km from known roosting site (-1)	Does not contain evidence of foraging by species (-2)	Is >12 km from known breeding location (-1)	Is >2 km from watering point (-1)	Disease present (-1)	Final Score	General Comments
S149	1	0	0	0	2	0	0	0	-2	0	0	0	**1**	Less than 2 ha area of large mature breeding tree potential introduced eucalypts. No foraging evidence.
S98	1	0	3	0	2	0	0	0	-2	0	0	0	**4**	Strip of degraded woodland with scattered Jarrah and Sheoak. Contains breeding and potential breeding trees. No foraging evidence recorded.
S110	7	3	0	0	2	0	0	0	-2	0	0	0	**10**	Good quality Woodland with significant numbers of Jarrah (showing good recruitment) and Sheoak. On the SCP and containing foraging evidence and potential breeding trees.
UID58	0												**0**	No foraging species
S119	1	0	0	2	2	0	0	0	0	0	0	0	**5**	Small patch of mature Marri with no recruitment, Presence of potential breeding

ID	Initial Quality	Jarrah and/or Marri shows good recruitment (i.e. evidence of young trees)	Contains trees known to be used for breeding and / or with suitable nest hollows	Primarily contains Marri and/or Jarrah	Contains trees with potential to be used for breeding (DBH ≥500 mm or ≥300 mm for Salmon Gum and Wandoo	Known to be a large or key roosting site	No other foraging habitat within 6 km (-2)	Is >12km from known roosting site (-1)	Does not contain evidence of foraging by species (-2)	Is >12 km from known breeding location (-1)	Is >2 km from watering point (-1)	Disease present (-1)	Final Score	General Comments
														trees and foraging evidence.
S116	0												**0**	Banksia woodland with minimal foraging species
S146	1	0	0	0	0	0	0	0	-2	0	0	0	**-1**	Minimal foraging species (rare Sheoak)
S125	5	0	0	0	2	0	0	0	-2	0	0	0	**5**	Area >2ha on SCP with occasional introduced mature eucalypt of breeding potential size. No foraging evidence.
S143	0												**0**	No foraging species
S140	1	0	0	0	2	0	0	0	0	0	0	0	**3**	Predominantly cleared area on SCP with scattered eucalypts, Banksia and Sheoak. Area not accessed at this stage and Precautionary Principle utilised for breeding trees and foraging evidence.
S137	1	3	0	2	2	0	0	0	0	0	0	0	**8**	Small planted strip of Marri on SCP, with breeding potential and foraging evidence.

ID	Initial Quality	Jarrah and/or Marri shows good recruitment (i.e. evidence of young trees)	Contains trees known to be used for breeding and / or with suitable nest hollows	Primarily contains Marri and/or Jarrah	Contains trees with potential to be used for breeding (DBH ≥500 mm or ≥300 mm for Salmon Gum and Wandoo	Known to be a large or key roosting site	No other foraging habitat within 6 km (-2)	Is >12km from known roosting site (-1)	Does not contain evidence of foraging by species (-2)	Is >12 km from known breeding location (-1)	Is >2 km from watering point (-1)	Disease present (-1)	Final Score	General Comments
S134	1	0	0	0	2	0	0	0	-2	0	0	0	**1**	Area on SCP with a few introduced eucalypts of breeding potential. No foraging evidence.
UID14	1	0	0	0	0	0	0	0	-2	0	0	0	**-1**	Degraded woodland with scattered Banksia, and Sheoak. Contains no breeding or potential breeding trees. No foraging evidence recorded.