Reconnaissance Flora, Vegetation and Tree Assessment

Part Mandurah Road Reserve between Fifty Road and Safety Bay Road

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Executive Summary

City of Rockingham engaged Emerge Associates to conduct a reconnaissance flora, vegetation and tree assessment to provide information on the flora and vegetation values within a section of Mandurah Road between Office Road and Dixon Road in East Rockingham (referred to herein as the 'site').

As part of the assessment a desktop review of relevant background information was completed and a field survey was undertaken on 15 June 2022. During the field survey an assessment was made on the type, condition and values of vegetation across the site.

Outcomes of the survey include the following:

- Native vegetation is present across 2.37 ha of the site in varying levels of condition.
- Non-native vegetation and sealed areas occur across more than half of the site (4.53 ha).
- A total of 35 native and 43 non-native (weed) species were recorded in the site.
- No threatened or priority flora species were recorded within the site.
- One species threatened flora species, *Caladenia huegelii*, may occur within plant community **EgBa**. *C. huegelii* is listed as endangered under the EPBC Act and the BC Act. Further survey during the main flowering period (September to October) would be required to confirm presence or absence of this species within the site.
- The vegetation within the site was classified into the following eight plant communities that are present in 'good', 'degraded' and 'completely degraded' condition:
- **AfMrLl** comprises a canopy of *Melaleuca rhaphiophylla* and *Agonis flexuosa* over a sedgeland and scattered herbs and weeds.
- **Ba** comprises groups of *Banksia attenuata* trees over non-native pasture grasses and weeds.
- **Eg** comprises a canopy of *Eucalyptus gomphocephala* over native shrubland over non-native pasture grasses and weeds.
- **EgBa** comprises a canopy of *Eucalyptus gomphocephala* and Banksia attenuata over a diverse native understorey and some pasture grasses and weeds.
- **EgBl** comprises scattered *Eucalyptus gomphocephala* and *Banksia littoralis* trees over isolated native shrubs and sedges and weeds.
- **Jf** comprises a shrubland of *Jacksonia furcellata* over scattered natives and pasture grasses and weeds
- The **EgBA**, **EgBl** and **Eg** plant communities contain tuart trees and extend over 3.10 ha within the site. Tuart trees can indicate that vegetation represents the tuart *(Eucalyptus gomphocephala)* woodlands and forests of the Swan Coastal Plain TEC/PEC. Further survey within and adjacent to the site would be required to confirm if this TEC/PEC occurs within the site and to identify its full extent.
- The **Ba** and **Eg** plant communities contain slender banksia trees and extend over 1.42 ha within the site. Slender banksia trees can indicate that vegetation represents the banksia woodlands of the Swan Coastal Plain TEC/PEC. Further survey within and adjacent to the site would be required to confirm if this TEC/PEC occurs within the site and to identify its full extent.
- Vegetation within the site may provide habitat for conservation significant fauna, particularly threatened species of black cockatoo.

- Fifty-two trees were recorded in the site, comprising 42 habitat trees and 10 other trees. The 42 habitat trees consisted of 11 with potentially suitable hollow(s) and 31 with no suitable hollow(s). The habitat trees with potentially suitable hollow(s) may provide breeding habitat for black cockatoos but an internal hollow inspection would be required to confirm whether the hollows are in fact suitable and whether they are being used by black cockatoos for breeding.

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Abbreviation Tables

Table A1: Abbreviations – Organisations

Organisations	
EPA	Environmental Protection Authority
DBCA	Department of Biodiversity, Conservation and Attractions
DWER	Department of Water and Environmental Regulation
WALGA	Western Australia Local Government Association

Table A2: Abbreviations – General terms

General terms	
FCT	Floristic community type
IBRA	Interim Biogeographic Regionalisation of Australia
NVIS	National Vegetation Inventory System (ESCAVI 2003)
P1	Priority 1
P2	Priority 2
P3	Priority 3
P4	Priority 4
P5	Priority 5
PEC	Priority ecological community
T	Threatened
TEC	Threatened ecological communities
UFI	Unique feature identifier

Table A3: Abbreviations – Legislation

Legislation	
BAM Act	*Biosecurity and Agriculture Management Act 2007*
EP Act	*Environmental Protection Act 1986*
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999*
BC Act	*Biodiversity Conservation Act 2016*

Table A4: Abbreviations – Units of measurement

Units of measurement	
cm	Centimetre
ha	Hectare
m AHD	m in relation to the Australian height datum
mm	Millimetre

1 Introduction

1.1 Project background

Emerge Associates (Emerge) were engaged by the City of Rockingham to characterise the flora and vegetation values within part of the road reserve along Mandurah Road between Fifty Road and Safety Bay Road on the border of Baldivis, Cooloongup and Waikiki (referred to herein as the 'site'). The site is located approximately 40 kilometres (km) south-west of the Perth Central Business District within the City of Rockingham.

The site is approximately 6.9 hectares (ha) in size and is bounded by bushland to the west and east and the continuation of Mandurah Road to the north and south. The location and extent of the site is shown in **Figure 1**.

1.2 Purpose and scope of work

The scope of work was specifically to undertake a flora and vegetation assessment within the site to the standard required of a reconnaissance survey with reference to the Environmental Protection Authority's (EPA's) technical guidance (EPA 2016), as well as an assessment of trees potentially impacted as part of proposed development within the site.

As part of this scope of work, the following tasks were undertaken:

- Desktop review of relevant background information pertaining to the site and surrounds, including database searches for threatened flora species and ecological communities.
- A field survey to record a comprehensive list of flora species and assess vegetation type and condition and tree locations.
- Mapping of plant communities, vegetation condition and conservation significant flora and vegetation and trees.
- Identification of potential habitat for conservation significant flora and vegetation and an assessment of likelihood of occurrence.
- Documentation of the desktop assessment, methodology, field survey and results into a report.

2 Environmental Context

2.1 Climate

Climate influences the types of vegetation that grow in a region and the life cycles of the flora present. Therefore, it is critical for a flora and vegetation survey to respond appropriately to climatic conditions to ensure that surveys are conducted during times when flora species are easiest to detect and identify.

The south-west of Western Australia experiences a Mediterranean climate of hot dry summers and cool wet winters. In Mediterranean type climates some flora species will typically spend part of their lifecycle as either underground storage organs or as seed. This is an adaptation to unfavourable environmental conditions such as excessive heat and drought that occur over the summer period. These species, known as 'geophytes' or 'annuals', tend to re-emerge during winter when favourable conditions return and are most visible during spring, which is the flowering period for a majority of plant species. Therefore, spring is the optimal time to complete flora and vegetation surveys in the south-west of WA.

An average of 610.4 millimetres (mm) of rainfall is recorded annually from the Garden Island HSF weather station (no. 009256), which is the closest weather station, located approximately 15 km north-east of the site. The majority of this rainfall is received between the months of May and September. Mean maximum temperatures at the Garden Island HSF weather station range from 17.9°C in July to 28.3°C in February, while mean minimum temperatures range from 11.2°C in August to 19.4°C in February (BoM 2022).

A total of 162.8 mm of rain was recorded during April and May 2022 prior to the survey which is higher than the combined long-term average of 113.2 mm for the same months (BoM 2022). Since the survey was undertaken outside of the main flowering period (spring), the amount of rainfall was not considered to affect the survey outcomes.

2.2 Geomorphology and soils

Landform and soils influence vegetation types at regional and local scales. The site occurs on the Swan Coastal Plain, which is the geomorphic unit that characterises much of the Perth metropolitan area. The Swan Coastal Plain is approximately 500 km long and 20 to 30 km wide and is roughly bound by the Indian Ocean to the west and the Darling Scarp to the east. Broadly the Swan Coastal Plain consists of two sedimentary belts of different origin. Its eastern side comprises the Pinjarra Plain which formed from the deposition of alluvial material washed down from the Darling Scarp, while its western side comprises three dune systems that run roughly parallel to the Indian Ocean coastline (Seddon 2004). These dune systems, referred to as Quindalup, Spearwood and Bassendean associations, represent a succession of coastal deposition that has occurred since the late Quaternary period (approximately two million years ago) (Kendrick *et al.* 1991) and, as a result, they contain soils at different stages of leaching and formation.

Examination of broad scale soil mapping places the site within the Cottesloe association (Churchward and McArthur 1980). The Cottesloe association comprises shallow yellow brown sands and exposed limestone and McArthur 1980). The soil types mapped within the site are shown in **Figure 2**.

Fine scale soil landscape mapping by DPIRD (2018) shows four units as occurring within the site, as described in **Table 1** and shown in **Figure 2**.

Table 1: Soil landscape mapping units within the site (DPIRD 2018)

Soil landscape unit	Location within site	Description
Vasse V4a Phase	Western portion of the site	Intermediate level terrace fringing lakes. The deep calcareous soils comprise black loams overlying brown to grey silty clay and muddy sands at depth.
Spearwood S1b Phase	Eastern portion of the site	Dune ridges with deep siliceous yellow brown sands or pale sands with yellow-brown subsoil and slopes up to 15%.
Spearwood S2a Phase	Northern and southern portions of the site	Lower slopes (1-5%) of dune ridge with moderately deep to deep siliceous yellow-brown sands or pale sands with yellow-brown subsoils and minor limestone outcrop.

The site is not known to contain any restricted landforms or unique geological features.

2.3 Topography

The elevation of the site ranges from three m in relation to the Australian height datum (mAHD) on the western site of the site to eight mAHD on the eastern side of the site (DoW 2008) (**Figure 2**).

2.4 Hydrology and wetlands

Wetlands are areas of seasonally, intermittently or permanently waterlogged land such as poorly drained soils, ponds, billabongs, lakes, swamps, tidal flats, estuaries, rivers and their tributaries (Wetlands Advisory Committee 1977). Wetlands can be recognised by the presence of vegetation associated with waterlogging or the presence of hydric soils such as peat, peaty sand or carbonate mud (Hill *et al.* 1996).

Wetlands of national or international significance may be afforded special protection under Commonwealth or international agreements. The following lists of important wetlands were checked as part of this assessment:

- *Ramsar List of Wetlands of International Importance* (DBCA 2017)
- *A Directory of Important Wetlands in Australia* (DBCA 2018)

No Ramsar or listed 'important wetlands' are located within or near the site.

Examination of the Department of Water and Environmental Regulation (DWER) hydrography dataset (DWER 2018) shows that part of an 'area subject to inundation' is mapped in the central-western portion of the site.

The Department of Biodiversity, Conservation and Attractions (DBCA) has developed the *Geomorphic Wetlands of the Swan Coastal Plain* dataset (DBCA 2021a). This dataset maps geomorphic wetland

features and classifies them based on their landform shape and water permanence. Each feature is assigned to one of three management categories which guides land use and conservation.

A review of the *Geomorphic Wetlands, Swan Coastal Plain* dataset indicated that no wetland features occur within the site (DBCA 2021a). A conservation category wetland is mapped adjacent to the western portion of the site (UFI 6385). This wetland feature is classified as a lake. The location of UFI 6385 and other geomorphic wetlands mapped in the wider area of the site are shown in **Figure 2**.

2.5 Regional vegetation

Native vegetation is described and mapped at different scales in order to illustrate patterns in its distribution. At a continental scale the *Interim Biogeographic Regionalisation of Australia* (IBRA) divides Australia into floristic subregions (Environment Australia 2000).

The site is contained within the Swan Coastal Plain IBRA region and within the 'SWA02' or Perth subregion. The Perth subregion is characterised by mainly banksia low woodland on leached sands with melaleuca swamps where ill-drained; and woodland of *Eucalyptus gomphocephala* (tuart), *E. marginata* (jarrah) and *Corymbia calophylla* (marri) on less leached soils (Beard 1990). This subregion is recognised as a biodiversity hotspot and contains a wide variety of endemic flora and vegetation types.

Variations in native vegetation can be further classified based on regional vegetation mapping. Heddle *et al.* (1980) mapping shows the site as comprising the 'Cottesloe central and south complex', which is described as a 'mosaic of woodland of *Eucalyptus gomphocephala* and open forest of *Eucalyptus gomphocephala*, *Eucalyptus marginata*, *Corymbia calophylla* closed heath on the limestone outcrops'.

The Cottesloe central and south complex was determined to have 32.16% of its pre-European extent remaining on the Swan Coastal Plain, of which 10.01% is protected for conservation purposes (Government of Western Australia 2019).

2.6 Historical land use

Review of historical images available from 1953 onwards shows that the majority of the site was cleared of native vegetation prior to 1953 as part of the Mandurah Road construction (WALIA 2022).

2.7 Conservation significant values

2.7.1 Threatened and priority flora

Certain flora taxa that are considered to be rare or under threat warrant special protection under Commonwealth and/or State legislation. At a Commonwealth level, flora taxa may be listed as 'threatened' under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). Threatened flora species listed under the EPBC Act are assigned a conservation status according to attributes such as population size and geographic distribution. Any action likely to have a significant impact on a taxon listed under the EPBC Act requires Ministerial approval.

In Western Australia flora species may also be classed as 'threatened' under *the Biodiversity Conservation Act 2016* (BC Act). Similarly, it is an offence to 'take' or 'disturb' threatened flora listed under the BC Act without Ministerial approval.

Flora species that do not currently meet the criteria for listing as threatened but are potentially rare or threatened may be added to the DBCA's *Priority Flora List*. These species are classified into 'priority' levels based on threat. Whilst priority species are not under direct statutory protection, they are considered during State approval processes.

Further information on threatened and priority species and their categories is provided in **Appendix A**. An assessment of the likelihood of occurrence of threatened and priority flora within the site was undertaken (refer to **Sections 3.1.1** and **4.2.1**).

2.7.2 Threatened and priority ecological communities

An ecological community is a naturally occurring group of native plants, animals and other organisms that are interacting in a unique habitat. An ecological community's structure, composition and distribution are influenced by environmental factors such as soil type, position in the landscape, altitude, climate and water availability (DAWE 2021a). 'Threatened ecological communities' (TECs) are ecological communities that are recognised as rare or under threat and therefore warrant special protection.

Selected TECs are afforded statutory protection at a Commonwealth level under the EPBC Act. Similar to flora species, TECs listed under the EPBC Act are assigned a conservation status. Any action likely to have a significant impact on a community listed under the EPBC Act requires Ministerial approval.

TECs are also listed within Western Australia under the BC Act and the BC Regulations. Their significance is also acknowledged through other state environmental approval processes such as 'environmental impact assessment' pursuant to Part IV of *the Environmental Protection Act 1986* (EP Act) and the *Environmental Protection* (Clearing of Native Vegetation) *Regulations 2004*.

An ecological community that is under consideration for listing as a TEC in Western Australia but does not yet meet survey criteria or has not been adequately defined may be listed as a 'priority ecological community' (PEC). Listing as a PEC is similarly considered during State approval processes.

Further information on categories of TECs and PECs is provided in **Appendix A**. An assessment of the likelihood of occurrence of threatened and priority flora within the site was undertaken (refer to **Sections 3.1.1** and **4.3.1**).

2.8 Weeds and pests

The term 'weed' can refer to any plant that requires some form of action to reduce its effect on the economy, the environment, human health and amenity. Many non-native flora species and some native species are considered to be weeds. The likelihood of weeds occurring is higher in areas disturbed areas, especially areas that have been agricultural or urban landuse.

A particularly invasive or detrimental weed species may be listed as a 'declared pest' pursuant to *Western Australia's Biosecurity and Agriculture Management Act 2007* (BAM Act), indicating that it warrants special management to limit its spread.

The Commonwealth government has further compiled a list of 32 *Weeds of National Significance* (WoNS) (DAWE 2021b). Whilst the WoNS list is non-statutory, many WoNS are also listed under the BAM Act. Further information on weeds and declared pests is provided in **Appendix A**.

2.9 Bush Forever

The Government of Western Australia's *Bush Forever* policy is a strategic plan for conserving regionally significant bushland within the Swan Coastal Plain portion of the Perth Metropolitan Region. The objective of *Bush Forever* is to protect comprehensive representations of all original ecological communities by targeting a minimum of 10% of each vegetation complex for protection (Government of WA 2000a). *Bush Forever* sites are representative of regional ecosystems and habitat and have a key role in the conservation of Perth's biodiversity. Flora considered to be 'significant', irrespective of Commonwealth and state conservation significance status, are listed in *Bush Forever* documentation.

Bush Forever site 356 (Lake Cooloongup, Lake Walyungup and adjacent bushland, Hillman to Port Kennedy) lies immediately adjacent to the western and eastern portions of the site and a small portion of the site is mapped as comprising part of this *Bush Forever* site. Multiple significant flora species were recorded within this site: *Trachymene coerulea*, *Trachymene pilosa*, *Sonchus hydrophilus*, *Atriplex suberecta*, *Linum marginale*, *Acacia pulchella* var. *goadbyi*, *Eremophila glabra* subsp. *albicans*, *Jacksonia furcellata* (floriferous shrub form) and *Kennedia coccinea*. The reasons these species were considered significant include range extensions, unique forms, and rare or at-risk species (Government of WA 2000).

The location of the of Bush Forever sites near the site are shown in **Figure 3**.

2.10 DBCA managed or legislated land

DBCA has tenure of or interests in numerous areas of land across the state for a range of purposes. Tenure categories include national parks, nature reserves, conservation parks, marine parks, marine nature reserves, marine management areas, section 5(1)(g) reserves, state forest and timber reserves. These areas are mapped within the *Legislated Lands and Waters* (DBCA 2021c) and *Lands of Interest* (DBCA 2021b) datasets. The *Legislated Lands and Waters* (DBCA 2021c) dataset includes lands subject to the following legislation; the *Conservation and Land Management Act 1984* (CALM Act 1984), *Swan and Canning Rivers Management Act 2006* (SCRM Act) and lands identified under the *Land Administration Act 1997* (LA Act). The *Lands of Interest* (DBCA 2021b) dataset includes all other lands of which DBCA is recognised as the manager but is not vested under any act. These lands comprise of crown land and freehold land which DBCA has been acknowledged by the Department of Lands as the responsible agency.

A small portion along the eastern boundary of the site is mapped as being part of crown freehold land under *CALM Act 1984 Section 8a* (No. 2211/799) (DBCA 2021c) as shown in **Figure 3**.

2.11 Ecological linkages

Ecological linkages are linear landscape elements that allow the movement of fauna, flora and genetic material between areas of remnant habitat. This exchange of genetic material between vegetation remnants improves the viability of those remnants by allowing greater access to breeding partners and food sources, refuge from disturbances such as fire and maintenance of genetic diversity of plant communities and populations. Ecological linkages are ideally continuous or near-continuous as the more fractured a linkage is, the less ease flora and fauna have in moving within the corridor (Alan Tingay and Associates 1998).

The Perth Biodiversity Project, supported by the Western Australia Local Government Association (WALGA), have identified and mapped regional ecological linkages within the Perth Metropolitan Region (WALGA and PBP 2004).

The southern portion of the site is mapped as forming part of regional ecological linkage No. 78 as shown in **Figure 3**. This linkage extends towards the eastern and western portion of the site, where it connects to linkages No. 74 and 76.

Review of aerial imagery indicates that the portion of the site mapped as regional ecological linkage No. 78 comprises predominantly sealed road or grassland with scattered trees and shrubs.

2.12 Previous surveys

No previous flora and vegetation surveys are known to have been undertaken over the site.

3 Methods

3.1 Flora and vegetation

3.1.1 Database searches

A search was conducted for threatened and priority flora that may occur or have been recorded within a 10 km radius of the site using the *Protected Matters Search Tool* (DAWE 2022), *NatureMap* (DBCA 2022) and DBCA's threatened and priority flora database (reference no. 12-0522FL).

A search was also conducted for TECs and PECs that may occur or have been recorded within a 10 km radius of the site using the *Protected Matters Search Tool* (DAWE 2022), the *weed and native flora dataset* (Keighery *et al.* 2012) and DBCA's threatened and priority ecological communities' database (reference no. 10_0522EC).

Prior to undertaking the field survey, information on the habitat preferences of threatened and priority flora species and communities identified from database searches was reviewed. This was compared to existing environmental information available for the site, such as geomorphology, soils, regional vegetation and historic land use, to identify species and communities for which habitat may occur in the site.

3.1.2 Field survey

Two botanists from Emerge visited the site on 15 June 2022 to conduct the flora, vegetation and tree field survey[1].

The site was traversed on foot and the composition and condition of vegetation was recorded. Photographs were taken throughout the field visit to show particular site conditions. Flora species not native to Western Australia are denoted by an asterisk ('*') in text and raw data.

Plant specimens collected during the field survey were dried, pressed and named in accordance with requirements of the Western Australian Herbarium (2022). Identification of specimens occurred through comparison with named material and through the use of taxonomic keys.

3.1.2.1 Sampling

Detailed sampling of vegetation using quadrats and/or relevés was not undertaken due to level of survey and the disturbed condition of vegetation in the site. Plant taxa were systematically recorded as the ecologists traversed the site.

3.1.2.2 Targeted searches

The suitability of habitat within the site for conservation significant flora and communities identified in the desktop assessment was assessed (refer **Section 3.1.1**). Areas of suitable habitat were traversed along transects and searched for conservation significant species, as required.

[1] Appropriate traffic management was in place in accordance with City of Rockingham requirements.

3.1.2.3 Vegetation condition

Vegetation condition was assigned at each sample and changes in vegetation condition were also noted and mapped across the site. The condition of the vegetation was assessed using the Keighery (1994) scale (**Table 2**). For vegetation in the site containing *Banksia* spp., the condition scale provided in the conservation advice for the 'banksia woodlands of the Swan Coastal Plain TEC' (DoEE 2016a) was applied in addition to the Keighery scale, as shown in **Table 2**.

Table 2: Vegetation condition scale applied during the field assessment

Condition category	Definition (Keighery 1994)	Indicator (DoEE 2016a)	
		Typical native vegetation composition	Typical weed cover
Pristine	Pristine or nearly so, no obvious signs of disturbance.	Native plant species diversity fully retained or almost so	Zero or close to
Excellent	Vegetation structure intact, disturbance affecting individual species and weeds are non-aggressive species.	High native plant species diversity	Less than 10%
Very good	Vegetation structure altered obvious signs of disturbance. For example, disturbance to vegetation structure caused by repeated fires, the presence of some more aggressive weeds, dieback, logging and grazing.	Moderate native plant species diversity	5-20%
Good	Vegetation structure significantly altered by very obvious signs of multiple disturbances. Retains basic vegetation structure or ability to regenerate it. For example, disturbance to vegetation structure caused by very frequent fires, the presence of some very aggressive weeds at high density, partial clearing, dieback and grazing.	Low native plant species diversity	5-50%
Degraded	Basic vegetation structure severely impacted by disturbance. Scope for regeneration but not to a state approaching good condition without intensive management. For example, disturbance to vegetation structure caused by very frequent fires, the presence of very aggressive weeds, partial clearing, dieback and grazing.	Very low native plant species diversity	20-70%
Completely degraded	The structure of the vegetation is no longer intact and the area is completely or almost completely without native species. These areas are often described as 'parkland cleared' with the flora comprising weed or crop species with isolated native trees or shrubs.	Very low to no native species diversity	Greater than 70%

3.1.2.4 Trees

Transects were traversed across the site and 'habitat trees' and 'other trees' were recorded. Habitat trees were defined as native eucalypt that is typically known to support black cockatoo[2] breeding

[2] Refers to three species of black cockatoo listed under the EPBC Act and BC Act: *Zanda latirostris* (Carnaby's black cockatoo), *Zanda baudinii* (Baudin's black cockatoo) and *Calyptorhynchus banksii naso* (forest red-tailed black cockatoo).

such as marri, jarrah, blackbutt, tuart or flooded gum with a DBH ≥50 centimetres (cm). Other trees were defined as non-habitat trees with a diameter at breast height of ≥15 cm.

Habitat trees and other trees were individually identified and the attributes outlined in **Table 3** were recorded. Where high numbers of other trees occurred within close proximity of each other, or where access was not possible, trees were mapped as vegetation polygons rather than individual points.

Table 3: Attributes recorded for each habitat tree and other tree in the site

Attribute	Description
GPS location	The location was recorded using a handheld GPS unit
Tree species	Species and common name were identified
Diameter at breast height (DBH) (cm)	DBH was measured at breast height (1.3 m) using a diameter tape
Hollows potentially suitable for breeding by a black cockatoo	Number of hollows potentially suitable for breeding by a black cockatoo recorded (assessed from ground level only)

To be suitable for use as breeding habitat by black cockatoos it was considered a hollow must:

- have an entrance opening of at least 10 cm but preferably 20-30 cm (Saunders *et al.* 1982; Groom 2010; Johnstone *et al.* 2013)
- be located at least 3 m from the ground (Saunders 1979b; Johnstone and Storr 1998; Groom 2010; Saunders 2014)
- be located in a trunk or branch that is generally large enough to contain a hollow that has a floor diameter of at least 40 cm and depth of 50-200 cm such that it could house an adult black cockatoo and nestlings (Saunders 1979a; Johnstone and Storr 1998; Saunders 2014; DPaW 2015)
- have vertical or near vertical orientation (Johnstone and Kirkby 2008; Johnstone *et al.* 2013).

Each habitat tree was assigned to a category listed in **Table 4**. Note that suitability of hollows for black cockatoos was assessed from ground level only.

Table 4: Habitat tree categories

Category	Specifications
Nest	The tree contains a hollow used by black cockatoos for breeding as confirmed by records of black cockatoos, their eggs or fledglings or other evidence of recent nesting activity by black cockatoos.
Suitable hollow(s) with signs of use	The tree contains one or more hollows that are suitable for use by black cockatoos as breeding habitat as confirmed by internal hollow inspection^ and potential evidence of use by black cockatoos such as feathers, chew marks or nest material has been recorded within a hollow.
Suitable hollow(s)	The tree contains one or more hollows that are suitable for use by black cockatoos as breeding habitat as confirmed by internal hollow inspection^.
Potentially suitable hollow(s)	The tree contains or is suspected to contain one or more hollows that have the potential to be suitable for use by black cockatoos when either viewed from the ground or following an internal hollow inspection that was inconclusive^.

Table 4: Habitat tree categories (continued)

Category	Specifications
No suitable hollow(s)	The tree does not contain hollow(s) that have the potential to be suitable for use by black cockatoos when viewed from the ground or contains hollows that were determined to be unsuitable for use by black cockatoos by internal inspection^.

^Hollow determined to be suitable for use as breeding habitat by black cockatoos as listed above in **Section 3.1.2.4**.

3.2 Mapping and analysis

3.2.1 Conservation significant flora and communities

Based on the database searches and information recorded during the field survey, an assessment of the likelihood of occurrence of threatened and priority flora species and communities within the site was undertaken using the categories outlined in **Table 5**.

Table 5: Likelihood of occurrence assessment categories and definitions

Likelihood	Definition
Recorded	The species was recorded during the current field survey.
Likely	The site contains suitable habitat for the species and it is likely the species may occur based on presence of a recent historical record within or close to the site.
Possible	The site contains suitable habitat for the species but there is no other information to suggest that the species may occur within or close to the site.
Unlikely	The site does not contain suitable habitat for the species or the site contains suitable habitat for the species within which thorough targeted searches were completed and conclusion has been made that the species is unlikely to be present.

3.2.2 Plant community identification and description

The plant communities within the site were identified from the sample data collected during the field survey. The vegetation was described according to the dominant species present using the structural formation descriptions of the *National Vegetation Inventory System* (NVIS) (NVIS Technical Working Group 2017). The identified plant communities were mapped on aerial photography from notes taken in the field and boundaries were interpreted from aerial photography. Vegetation condition was mapped on aerial photography based on notes recorded during the field survey to define areas with differing condition.

3.2.3 Floristic community type assignment

No floristic community type (FCT) analysis was completed due to the high level of disturbance and timing of the survey (outside of spring). Furthermore, the majority of the vegetation within the site is likely too disturbed to currently represent an FCT.

3.2.4 Threatened and priority ecological communities

Areas of native vegetation potentially representing a TEC or PEC were assessed against key diagnostic characteristics and, if available, size and/or vegetation condition thresholds.

3.2.5 Trees

Habitat trees and other trees were mapped on aerial imagery using data recorded during the field survey. A complete summary of the recorded attributes of habitat trees and other trees was compiled in a tabular format.

3.3 Survey limitations

It is important to note the specific constraints imposed on surveys and the degree to which these may have limited survey outcomes. An evaluation of the survey methodology against standard constraints outlined in the EPA document *Technical Guidance – Flora and Vegetation Surveys for Environmental Impact Assessment* (EPA 2016) is provided in **Table 6**.

Table 6: Evaluation of survey methodology against standard constraints outlined in EPA (2016)

Constraint	Degree of limitation	Details
Availability of contextual information	No limitation	The broad scale contextual information described in **Section 2** is adequate to place the site and vegetation in context.
Experience level of personnel	No limitation	This flora and vegetation assessment was undertaken by qualified botanists with two and four years of botanical experience in Western Australia. Technical review was undertaken by a senior environmental consultant/botanist with 11 years' botanical experience in Western Australia.
Suitability of timing	No limitation	The survey was conducted in June and thus outside of the main flowering season. The site has been subject to historical disturbance but there is still the possibility that annual and geophytic threatened and priority species may occur and would not have been detectable at the time of survey. The survey timing was acceptable for a reconnaissance level survey.
Temporal coverage	No limitation	Comprehensive flora and vegetation assessments can require multiple visits, at different times of year, and over a period of a number of years, to enable observation of all species present. The site was only surveyed once, and the survey was undertaken outside of the spring main flowering period. Further survey within vegetation mapped as being in 'good' condition may be required during the main flowering period, for FCT analysis and to confirm presence/absence of threatened flora species. However, one visit was considered sufficient for a reconnaissance level survey.
Spatial coverage and access	No limitation	Site coverage was comprehensive (track logged).
	No limitation	All parts of the site could be accessed.
Sampling intensity	No limitation	The site was traversed comprehensively and a total of 30 species were recorded. No formal sampling was undertaken or considered necessary due to the disturbed condition of the site and level of survey. Opportunistic records of flora, plant communities and vegetation condition were sufficient to accurately characterise the vegetation within the site.

Table 6: Evaluation of survey methodology against standard constraints outlined in EPA (2016) (continued)

Constraint	Degree of limitation	Details
Sampling intensity	No limitation	Survey effort was limited to the vegetation within the site. However, in order to determine whether the 'tuart (*Eucalyptus gomphocephala*) woodlands and forests of the Swan Coastal Plain' TEC/PEC and 'banksia woodlands of the Swan Coastal Plain' TEC/PEC occurs within the site and to determine their full extent, further survey n within and adjacent to the site is required. The survey effort was acceptable for a reconnaissance level.
Influence of disturbance	Minor limitation	Time since fire is greater than 69 years as interpreted from aerial imagery and therefore short-lived species more common after fire may not have been visible.
	No limitation	Historical ground disturbance was evident in parts of the site and some native vegetation in the site is regrowth with minimal non-native species present. The disturbance history of the site was considered when undertaking field sampling.
Adequacy of resources	No limitation	All resources required to perform the survey were available.

4 Results

4.1 General site conditions

The site slopes from the east to the west, with the highest point in the south-eastern portion. The western portion of road reserve primarily consists of bare ground and non-native vegetation with occasional native trees, whilst the eastern portion of road reserve primarily consists of comprises native vegetation with small areas of non-native vegetation and bare ground. The central portion of the site comprises sealed road surface.

4.2 Flora

4.2.1 Desktop assessment

The database search results identified a total of 15 threatened and 15 priority flora species occurring or potentially occurring within a 10 km radius of the site. Information on these species including their habitat preferences and flowering period is provided in **Appendix B**.

Based on background information available for the site, suitable habitat was considered to potentially occur within the site for two threatened flora species and 14 priority flora species as shown in **Table 7**.

Table 7: Conservation significant flora species considered to have potential to occur in the site based on known habitat preferences

Species	Level of significance		Life strategy	Habitat	Flowering period
	State	EPBC Act			
Caladenia huegelii	CR	EN	PG	Grey or brown sand, clay loam.	Sept-Oct
Synaphea sp. Serpentine (G.R. Brand 103)	CR	CR	P	Seasonally damp areas, loam - sand.	Sep-Oct
Acacia benthamii	P2	-	P	Sand, typically on limestone breakaways	Aug-Sept
Acacia lasiocarpa var. *bracteolata* long peduncle variant (G.J. Keighery 5026)	P1	-	P	Grey or black sand over clay. Swampy areas, winter wet lowlands.	May or Aug
Acacia sp. Binningup (G. Cockerton et al. WB 37784*)*	P1	-	P	Woodland and shrubland on sand, often in degraded areas	Aug
Boronia juncea subsp. *juncea*	P1	-	P	Sand in low scrub.	Apr
Lachnagrostis nesomytica subsp. *paralia*	P1	-	A/P	Calcareous sands. Coastal dunes and swales.	Unknown
Austrostipa mundula	P3	-	P	Grey sand over limestone.	Sept-Nov

Table 7: Conservation significant flora species considered to have potential to occur in the site based on known habitat preferences (continued)

Species	Level of significance		Life strategy	Habitat	Flowering period
	State	EPBC Act			
Beyeria cinerea subsp. *cinerea*	P3	-	P	Sand, limestone.	May-Oct
Cyathochaeta teretifolia	P3	-	P	Grey sand, sandy clay in swamps and creek edges.	Oct-Jan
Dillwynia dillwynioides	P3	-	P	Winter wet depressions on sandy soils	Aug - Dec
Jacksonia gracillima	P3	-	P	Sand, often adjacent to winter wet areas	Sep-Dec
Pimelea calcicola	P3	-	P	Sand, limestone on coastal ridges.	Sep-Nov
Sphaerolobium calcicola	P3	-	P	White-grey-brown sand, sandy clay over limestone, black peaty sandy clay. Tall dunes, winter-wet flats, interdunal swamps, low-lying areas.	Jun or Sep-Nov
Dodonaea hackettiana	P4	-	P	Sand, outcropping limestone.	Jul-Oct
Jacksonia sericea	P4	-	P	Calcareous and sandy soils on Swan Coastal Plain	Dec-Feb

CR=critically endangered, EN=endangered, VU=vulnerable, P1-P4=Priority 1-Priority 4, P=perennial, PG=perennial geophyte.

4.2.2 Species inventory

A total of 35 native and 43 non-native (weed) species were recorded within the site during the field survey, representing 38 families and 67 genera. The families containing the most native taxa were Fabaceae (eight native taxa and one weed taxa) and Proteaceae (six native taxa and one planted taxa). The most common genus was *Lomandra* and *Banksia* with three taxa each.

A complete species list is provided in **Appendix C.**

4.2.3 Threatened and priority flora

No occurrences of threatened or priority flora species were recorded within the site.

The majority of the threatened and priority flora species identified in the desktop assessment are not considered to occur in the site due to lack of suitable habitat and/or because they were not recorded during the field survey.

The survey was unable to confirm the presence or absence of one threatened flora species, *Caladenia huegelii* (endangered under the EPBC Act and the BC Act). Suitable habitat for this species occurs within plant community **EgBa** (refer **Section 4.3.2**).

4.2.4 Locally and regionally significant flora

One species listed as a significant in Bush Forever documentation for the Quindalup dunes was recorded within the site: *Agonis flexuosa*. A record of this species in within the vicinity of the site significant as populations of *Agonis flexuosa* would be considered disjunct from their known geographic range (Government of WA 2000).

4.2.5 Declared pests

No declared pests pursuant to the BAM Act or weeds of national significance were recorded within the site.

4.3 Vegetation

4.3.1 Desktop assessment

The database search results identified 16 TECs and 10 PECs occurring or potentially occurring within a 10 km radius of the site. Information on these communities is provided in **Appendix D**.

Based geomorphology, soils and regional vegetation patterns, four TECs and three PECs were considered to have potential to occur in the site:

- 'Sedgelands in Holocene dune swales of the southern Swan Coastal Plain' TEC which is listed as endangered under the EPBC Act and critically endangered in WA
- 'Woodlands over sedgelands in Holocene dune swales of the southern Swan Coastal Plain' TEC which is listed as endangered under the EPBC Act and critically endangered in WA.
- 'Tuart (*Eucalyptus gomphocephala*) woodlands and forests of the Swan Coastal Plain TEC/PEC' which is listed as 'critically endangered' under the EPBC Act and P3 in WA.
- 'Banksia woodlands of the Swan Coastal Plain' TEC/PEC which is listed as 'endangered' under the EPBC Act and P3 in WA.
- 'Northern Spearwood shrublands and woodlands' which is listed as P3 in WA.

4.3.2 Plant communities

Eight plant communities were identified within the site. Plant community **AfMrLl** occurs as a small patch in the northern portion of the site and extends over 0.13 ha. Plant communities **Ba**, **EgBl** and **Jf** occur as multiple small patches scattered throughout the site. Plan community **EgBa** occurs as two patches in the central-eastern portion of the site and extend over 0.24 ha. Plant community **Eg** occurs predominantly along the eastern portion of the site as two linear patches and scattered smaller patches, extending over 1.78 ha. The remainder of the site comprises **non-native** vegetation (2.76 ha) and **road** (1.77 ha).

A description and the area of each plant community is provided in **Table 8** and representative photographs of each are provided in **Plate 1** to **Plate 7**. The location of each plant community is shown in **Figure 5**.

Table 8: Description and extent of plant communities identified within the site

Plant community	Description	Area (ha)
AfMrLl	Open forest *Melaleuca rhaphiophylla* and *Agonis flexuosa* over closed sedgeland *Lepidosperma longitudinale* (or absent) over scattered *Centella asiatica* and/or closed non-native grass and pasture weeds (**Plate 1**).	0.13
Ba	Small groups of *Banksia attenuata* trees over non-native grassland and pasture weeds and occasional native species (**Plate 2**).	0.05
Eg	Closed forest to isolated trees *Eucalyptus gomphocephala* over open shrubland *Jacksonia furcellata* and/or *Hakea prostrata* or *Grevillea vestita* (or absent) over non-native grassland and pasture weeds and occasional native species (**Plate 3**).	1.78
EgBa	Woodland *Eucalyptus gomphocephala*, *Banksia attenuata* and occasional *Eucalyptus marginata* and *Allocasuarina fraseriana* over sparse shrubland *Jacksonia furcellata* over shrubland *Macrozamia fraseri* and *Hibbertia hypericoides* over sparse to open forbland *Lepidosperma* spp., *Lomandra* spp., *Corynotheca micrantha*, *Conostylis aculeata* and *Hovea trisperma*, **Ehrharta* sp. and pasture weeds (**Plate 4**)	0.24
EgBl	Scattered *Eucalyptus gomphocephala* and *Banksia littoralis* over isolated *Macrozamia fraseri*, *Gahnia trifida* and/or *Ficinia nodosa* over non-native grassland and pasture weeds or bare ground (**Plate 5**)	0.10
Jf	Shrubland *Jacksonia furcellata* over non-native grassland and pasture weeds and occasional native species (**Plate 6**).	0.07
Non-native	Heavily disturbed areas comprising predominantly non-native grassland and forbland with occasional native shrubs and forbs and planted vegetation (**Plate 7**).	2.76
Road	Sealed area associated with Mandurah Road, other roads and driveways (**Plate 7**).	1.77

*Plate 1: Plant community **AfMrLl** in good condition*

*Plate 2: Plant community **Ba** in degraded condition*

*Plate 3: Plant community **Eg** in degraded condition*

*Plate 4: Plant community **EgBa** in good condition*

*Plate 5: Plant community **EgBl** in 'degraded' condition*

*Plate 6: Plant community **Jf** in degraded condition*

Plate 7: Non-native vegetation in 'completely degraded' condition (right side) and road (left side)

4.3.3 Vegetation condition

The majority of the site has been subject to a high level of historic disturbance. Plant communities **AfMrLl**, **Ba**, **EgBl**, **Eg, Jf** and **EgAr** were mapped as being in 'degraded' condition as the vegetation

structure has been severely impacted, with low native species cover and diversity and high cover of non-native species.

The most intact native vegetation was located in the central-eastern portion of the site within plant community **EgBa** and a small portion of plant community **AfMrLl**. This vegetation was mapped as being in 'good' condition as it retains basic vegetation structure expected of a woodland/forest community but with low native species diversity and obvious signs of disturbance evident, including some aggressive weeds at moderate cover.

Non-native vegetation was mapped as being in 'completely degraded' condition as this vegetation is dominated by non-native/weed species. No vegetation condition was assigned to the **road**.

The extent of vegetation by condition category is detailed in **Table 9** and shown in **Figure 5**.

Table 9: Extent of vegetation condition categories within the site

Condition category (Keighery 1994)	Size (ha)
Pristine	0
Excellent	0
Very good	0
Good	0.26
Degraded	2.11
Completely degraded	2.76
Not applicable (road)	1.77

4.3.4 Threatened and priority ecological communities

The following TEC/PECs are considered to potentially occur within the site:

- 'Tuart (*Eucalyptus gomphocephala*) woodlands and forests of the Swan Coastal Plain' TEC/PEC (tuart TEC/PEC)
- 'Banksia woodlands of the Swan Coastal Plain' TEC/PEC (banksia woodland TEC/PEC).
- 'Northern Spearwood shrublands and woodlands' PEC.

The likelihood of occurrence of TECs and PECs are provided in **Appendix C**.

No other TECs or PECs occur within the site.

4.3.4.1 Tuart TEC/PEC

Plant communities **EgBa**, **EgBl** and **Eg** contain tuart trees and so may represent the tuart TEC/PEC. The extent of the potential TEC/PEC within the site is shown in **Figure 6**. Further targeted survey work would be required to confirm whether the TEC/PEC occurs within the site and to determine its full extent within the site. Plant communities **EgBa**, **EgBl** and **Eg**, in conjunction with tuart vegetation adjacent to the site, was assessed against the tuart TEC/PEC criteria, as outlined **Table 10**.

DBCA's *Priority Ecological Community* list indicates that the description, area and condition thresholds that apply to the Commonwealth-listed TEC of the same name also apply to the State

listed 'tuart (*Eucalyptus gomphocephala*) woodlands and forests of the Swan Coastal Plain' PEC (DBCA 2020). Therefore, some or all of the **EgBa**, **EgBl** and **Eg** vegetation in the site may also potentially represent the PEC.

Table 10: Assessment of site conditions against the tuart (Eucalyptus gomphocephala) woodlands and forests of the Swan Coastal Plain TEC criteria (adopted from (DoEE 2019))

Criteria	Requirements for meeting criteria	Site implications
1. Must meet key diagnostic characteristics	• Located in appropriate bioregion and landform. • At least 2 living established *E. gomphocephala* trees with DBH≥ 15cm present in canopy layer and with <60 m between the outer edges of canopies^ • Vegetation structure is a woodland, forest, open forest, open woodland, or mallee (various forms).	• Site is located in appropriate bioregion and landform. • The **EgBa**, **EgBl,** and **Eg** vegetation either contains more than two living established *E. gomphocephala* (tuart) trees with DBH≥ 15cm in the canopy layer and with <60 m between the outer edges of canopies AND/OR is located or likely located within the 30 m buffer of tuart tree canopy adjacent to the site. • **EgBa**, **EgBl,** and **Eg** vegetation comprises open forest to open woodland structure.
2. Must meet size threshold	• A patch must be larger than 0.5 ha[#]	• Some of the patches of **EgBa** and **Eg** vegetation form a contiguous patch of tuart vegetation that is above 0.5 ha in size and meet this criterion. • Some of the patches of **EgBl** vegetation and the scattered patches of **Eg** vegetation are less than 0.5 ha in size. Calculation of patch size using the TEC method has not been undertaken and so this criterion cannot be confirmed. Also, these patches of vegetation are likely connected to additional areas of tuart vegetation adjacent to the site, which would contribute to patch size. Further survey of the vegetation adjacent to the site would be required to confirm this.
3. Must meet condition thresholds	• Patches >5 ha: no condition threshold • Patches ≥0.5 – <2 ha: 'very high' or 'high' condition† • Patches ≥2 – ≤5 ha: 'very high', 'high' or 'moderate' condition†	• The patch size of **EgBa**, **EgBl,** and **Eg** vegetation in the site is unknown (refer criterion 2) and so condition thresholds cannot be applied. • Further survey would be required in spring to determine condition category of patches (if present).
4. Must incorporate surrounding context	• Breaks (e.g. tracks, cleared areas) < 30 m do not separate vegetation into separate patches • The site should be thoroughly sampled in the appropriate season. • Survey timing should be appropriate. • Surrounding environment should be considered (e.g. connectivity, conservation values, fauna habitat)	• Further survey work of the tuart vegetation adjacent to the site is required to determine whether the **EgBa**, **EgBl,** and **Eg** vegetation is part of a larger patch. • The survey timing was appropriate to determine that tuart trees occur within the **EgBa**, **EgBl,** and **Eg** vegetation. Additional survey in vegetation adjacent to the site during spring may be required to determine vegetation condition.

Table 10: Assessment of site conditions against the tuart (Eucalyptus gomphocephala) woodlands and forests of the Swan Coastal Plain TEC criteria (adopted from (DoEE 2019)) (continued)

Criteria	Requirements for meeting criteria	Site implications
Result	The site supports 3.10 ha of potential tuart (*Eucalyptus gomphocephala*) woodlands and forests of the Swan Coastal Plain TEC/PEC (defined as vegetation containing tuart trees/**EgBA**, **EgBl** and **Eg** plant communities). Further survey work would be required to determine whether this TEC/PEC occurs within the site and the full extent of the TEC/PEC.	

^Includes dead trees. Where species of dead tree is unclear it is assumed to be *E. gomphocephala* if its canopy is within 60 m of an identified *E. gomphocephala tree*. #Note that a patch comprises a 30 m buffer around the canopy of each *E. gomphocephala* canopy tree, may extend beyond a lot boundary and may include areas of bare ground, waterbodies and hardscape. †Using the condition scale provided in (DoEE 2019).

4.3.4.2 Banksia woodland TEC/PEC

Plant communities **EgBa** and **Ba**, and parts of **Eg**, have potential to represent the banksia woodland TEC/PEC. As outlined in **Table 11**, patches of this vegetation do not individually satisfy criteria to be considered the banksia woodland TEC due to their small patch size and/or degraded condition. However, additional areas of banksia vegetation occur adjacent to the site which may comprise a patch of the TEC which includes the **EgBa**, **Ba** and **Eg** vegetation.

DBCA's *Priority Ecological Community* list indicates that the description, area and condition thresholds that apply to the Commonwealth-listed TEC of the same name also apply to the State listed 'banksia woodlands of the Swan Coastal Plain' PEC (DBCA 2020). Therefore, some or all of the **EgBa**, **Ba**, and **Eg** vegetation in the site may also represent the PEC.

Table 11: Criteria for determining presence of Banksia Woodlands of the Swan Coastal Plain TEC adapted from DoEE (2016a)

Criteria	Requirements for meeting criteria	Site implications
1. Must meet key diagnostic characteristics	A variety of factors relating to: • Location • Soils • Structure • Composition	• Site meets location and soils criteria. • The **EgBa**, **Ba** and part of the **Eg** vegetation includes the key diagnostic feature of a tree layer of *Banksia attenuata* (slender banksia). • Slender banksia trees are scattered within the **Eg** vegetation. • The **EgBa**, **Ba** and part of the **Eg** vegetation meet structure and composition criterion.
2. Must meet condition thresholds	• A patch should at least meet the 'good' condition category (see **Table 2**)	• The two patches of **EgBa** vegetation are present in 'good' condition, which meets this criterion. • The **Ba** and **Eg** vegetation is in 'degraded' condition and does not independently meet this criterion. • The conservation advice indicates that a single patch may include areas of variable condition, meaning parts of the **Ba** and **Eg** vegetation in 'degraded' condition may still be considered the banksia woodland TEC if it is part of a larger patch of TEC.

Table 12: Criteria for determining presence of Banksia Woodlands of the Swan Coastal Plain TEC adapted from DoEE (2016a) (continued)

Criteria	Requirements for meeting criteria	Site implications
3. Must meet minimum patch size	Minimum size of patch: • Pristine=no minimum size • Excellent=0.5 ha • Very Good=1 ha • Good=2 ha	• As outlined in Criterion 2, most of the **EgBa**, **Ba** and **Eg** vegetation does not independently meet the condition thresholds but may meet the threshold dependent on adjacent vegetation. • The two patches of **EgBa** vegetation in 'good' condition are less than 2 ha and so do not independently meet this criterion. However, they may be part of a larger patch of TEC outside of the site.
4. Must incorporate surrounding context	• Breaks (e.g. tracks) < 30 m do not separate vegetation into separate patches • Buffer zones may apply (20-50 m recommended from patch edge) • The site should be thoroughly sampled (2 surveys in same spring). • Survey timing should be appropriate. • Surrounding environment should be considered (e.g. connectivity, conservation values, fauna habitat)	• Small scale tracks (<30 m wide) exist within the patches. • Land surrounding the patches is a combination of native vegetation on the eastern side and road on the western side. • This survey was conducted in June (outside of the main flowering season). For a reconnaissance level survey, the survey timing is appropriate. Subsequent survey in spring may be required to confirm whether the **EgBa** and part of the **Ba** and **Eg** vegetation in the site represents the banksia woodland TEC/PEC. • Native vegetation which contains banksia trees occurs adjacent to the eastern boundary of the site and may represent the TEC. The vegetation within the site may be contiguous and form part of a larger patch.
Result	The site supports 1.42 ha of vegetation which may represent the banksia woodland of the Swan Coastal Plain TEC/PEC. This vegetation is associated with the of **EgBa** and parts of the **Ba** and **Eg** plant communities. Further survey of the vegetation adjacent to the site in spring is required to confirm this.	

4.3.4.3 Northern Spearwood shrublands and woodlands PEC

It is possible that the **EgBa** vegetation also represents the 'northern Spearwood shrublands and woodlands' PEC (SCP24) as it contains some characteristic species of this PEC, such as tuart. Two patches of **EgBa** vegetation in 'good' condition', totalling 0.24 ha, occur in the site and may represent this PEC.

This PEC is synonymous with FCT24 and so detailed sampling in spring and floristic community type (FCT) analysis would be required to confirm whether the **EgBa** vegetation represents this PEC.

4.3.5 Locally and regionally significant vegetation

Mature eucalypt trees (diameter at breast height ≥50 cm) are present in the site, as outlined in **Section 4.4**. These trees have the potential to provide foraging, roosting and nesting habitat for threatened species of black cockatoo, along with other ecological services. Other plants within the

site may also provide foraging habitat to species of black cockatoo, including *Banksia* spp., *Jacksonia furcellata* and *Xanthorrhoea preissii*.

4.4 Trees

A total of 52 trees were recorded within the site, comprising 42 habitat trees and 10 other trees.

The 42 habitat trees consisted of 11 with potentially suitable hollow(s) and 31 without suitable hollow(s).

The 10 other trees consisted of native species slender banksia, tuart, Eucalyptus marginata (jarrah) and *Melaleuca rhaphiophylla* (swamp paperbark) and non-native **Eucalyptus* sp.

A summary of the habitat trees recorded within the site is provided in **Table 13** and an inventory in **Appendix E.** The locations of the trees are as shown in **Figure 7**.

Table 13: Habitat trees recorded within the site

Category	No. trees
Habitat tree - potentially suitable hollow(s)	11
Habitat tree - no suitable hollow(s)	31
Other tree	10

5 Discussion

5.1 Threatened and priority flora

No threatened or priority flora species were recorded within the site but the reconnaissance survey was undertaken outside of the flowering period of most conservation significant species with potential to occur within the site as listed in **Table 7**.

Nonetheless, targeted searches were undertaken throughout suitable habitat in the site. Larger perennial species such as *Acacia benthamii, Acacia* sp. Binningup (G. Cockerton et al. WB 37784), *Beyeria cinerea* subsp. *cinerea*, *Boronia juncea* subsp. *juncea*, *Dodonaea hackettiana*, *Jacksonia sericea*, *Pimelea calcicola* and *Sphaerolobium calcicola* would be visible throughout the year. Given that no unidentified specimens which have potential to comprise conservation significant species such as the above species were collected, the survey effort is considered sufficient to confirm the absence of these species.

The survey was not undertaken when the one perennial geophyte species listed in **Table 7**, *Caladenia huegelii*, would be visible. The **EgBa** vegetation represents suitable habitat for *C. huegelii*. Further survey in the **EgBa** vegetation during the main flowering period (September to October) would be required to confirm its presence or absence within the site.

5.2 Vegetation condition

The vegetation within the site showed obvious signs of long-term historical disturbance and clearly met the Keighery (1994) descriptions for good, degraded and completely degraded categories.

5.3 Threatened and priority ecological communities

5.3.1 Tuart TEC/PEC

Plant communities **EgBa** and **Eg** contain tuart trees. Whilst tuarts are a diagnostic feature of the tuart (*Eucalyptus gomphocephala*) woodlands and forests of the Swan Coastal Plain TEC/PEC, detailed assessment against the criteria outlined in the (DoEE 2019) conservation advice is required to determine if the TEC/PEC occurs. This includes identifying a patch of the ecological community, which consists of identifying groups of at least two tuart trees with a DBH ≥ 15cm, mapping the canopy boundary and applying a 30 m buffer. Following this, size and condition thresholds can be applied.

Due to the presence of many tuart trees with DBH ≥ 15cm within the **EgBa** and **Eg** vegetation, and tuart trees noted adjacent to the site that may be part of the same patch, it is likely that most of the potential TEC/PEC shown in **Figure 6** meets the criteria to represent the TEC/PEC. Furthermore, the TEC extent within the site may be larger than the **EgBa** and **Eg** vegetation due to the 30 m buffer.

Further survey work of the **EgBa** and **Eg** vegetation within the site, and vegetation adjacent to the site, would be required to determine whether the TEC/PEC occurs and to confirm its full extent within the site.

5.3.2 Banksia woodland TEC/PEC

Similarly, the **EgBa**, **Ba** communities, and part of the **Eg** plant community, support slender banksia trees. These trees are diagnostic of the banksia woodlands TEC/PEC but these plant communities do not independently meet criteria for representing the banksia woodlands TEC/PEC as they do not meet minimum size and/or condition thresholds.

Banksia woodland vegetation occurs adjacent to the east of the site and is likely to represent the TEC/PEC. It is possible that all or part of the **EgBa**, **Ba** and **Eg** plant communities are contiguous with a larger patch of banksia woodland TEC/PEC outside of the site.

Banksia trees are scattered within the **Eg** plant community and so only part of this vegetation may represent the banksia woodland TEC/PEC. The area currently shown as potential banksia woodland TEC/PEC in **Figure 6** is likely an overestimation of its actual extent.

Further survey in spring within the site and adjacent vegetation would be required to confirm whether the banksia woodland TEC/PEC occurs in the site and to determine its full extend within the site.

5.3.3 Northern Spearwood shrublands and woodlands PEC

There is no detailed conservation advice for the 'northern Spearwood shrublands and woodlands' PEC. Rather, the PEC is identified through floristic analysis, being synonymous with FCT24. Floristic analysis was not undertaken during the current survey but the **EgBa** vegetation contains species that are diagnostic of FCT24. There are no specific condition thresholds for PECs but 'good' condition is generally considered a minimum to represent a PEC. The **EgBa** vegetation occurs in good condition and so it was considered appropriate to consider that this vegetation may represent the PEC.

Detailed sampling in spring and FCT analysis would be required to confirm whether this PEC occurs within the site.

5.4 Locally and regionally significant flora and vegetation

Flora and vegetation may be significant irrespective of protection under policy or legislation. One reason that flora or vegetation within the site may be significant is that the vegetation has value as habitat for threatened or priority fauna species. In particular, the **EgBa** and **Eg** vegetation contains mature trees that have the potential to provide nesting (further discussed in **Section 5.5** below), foraging and/or roosting values for black cockatoos listed as threatened under the EPBC Act and BC Act.

5.5 Trees

As some of the habitat trees recorded within the site contain hollows that are potentially suitable for use by black cockatoos for breeding, the site may provide breeding habitat for black cockatoos. However, hollows were assessed from ground level only based on hollow location and trunk size. An internal hollow inspection would be required to confirm whether the internal dimensions of potentially suitable hollows are suitable for breeding by black cockatoos. The habitat trees without suitable hollow(s) have the potential to form suitable hollows in the future but it will likely take many

decades for hollows to form that are large enough to be suitable for use by black cockatoos for breeding.

The precise boundary of the site was sometimes difficult to interpret during the survey due to lack of physical markers and spatial error associated with handheld GPS receivers. Where habitat trees and other trees were close to the boundary these were recorded as being located within the site and so the number of trees recorded may be an overestimation. The north-eastern portion of the site could not be accessed during the field survey and so trees were mapped as vegetation polygons rather than individual points. No habitat trees occurred within this inaccessible area.

Specialist survey pick up of trees and demarcation of the site boundary would be required to determine the number of habitat trees and other trees that are actually located within the site.

6 Conclusions

The site is highly disturbed and modified, with approximately 4.53 ha of the site containing 'completely degraded', predominantly non-native vegetation or cleared areas such as roads. The remaining 2.37 ha of the site comprises native vegetation that is present in 'good' and 'degraded' condition.

No threatened or priority flora species were recorded within the site. One threatened flora species, *Caladenia huegelii*, may occur within plant community **EgBa**. *C. huegelii* is listed as endangered under the EPBC Act and the BC Act. Further survey during the main flowering period (September to October) would be required to confirm presence or absence of this species within the site.

The **EgBA**, **EgBl** and **Eg** plant communities contain tuart trees and extend over 3.10 ha within the site. Tuart trees can indicate that vegetation represents the tuart *(Eucalyptus gomphocephala)* woodlands and forests of the Swan Coastal Plain TEC/PEC. Further survey within and adjacent to the site would be required to confirm if this TEC/PEC occurs within the site and to identify its full extent.

The **Ba** and **Eg** plant communities contain slender banksia trees and extend over 1.42 ha within the site. Slender banksia trees can indicate that vegetation represents the banksia woodlands of the Swan Coastal Plain TEC/PEC. Further survey within and adjacent to the site would be required to confirm if this TEC/PEC occurs within the site and to identify its full extent.

Vegetation within the site may provide habitat for conservation significant fauna, particularly threatened species of black cockatoo.

Fifty-two trees were recorded in the site, comprising 42 habitat trees and 10 other trees. The 42 habitat trees consisted of 11 with potentially suitable hollow(s) and 31 with no suitable hollow(s). The habitat trees with potentially suitable hollow(s) may provide breeding habitat for black cockatoos but an internal hollow inspection would be required to confirm whether the hollows are in fact suitable and whether they are being used by black cockatoos for breeding.

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7.2 Online references

The online resources that have been utilised in the preparation of this report are referenced in **Section 7.1**, with access date information provided in **Table R 1**.

Table R 1 Access dates for online references

Reference	Date accessed	Website or dataset name
BoM (2022)	4 July 2022	Climate Data Online
DAWE (2021a)	10 May 2022	Threatened Ecological Communities
DAWE (2021b)	04 July 2022	Weeds of National Significance (WoNS)
DAWE (2022)	10 May 2022	Protected Matters Search Tool
WALIA (2022)	28 June 2022	Landgate Map Viewer
Western Australian Herbarium (2022)	4 July 2022	Florabase

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Figures

Figure 1: Site Location

Project:	Reconnaissance Flora, Vegetation and Tree Assessment - Part Mandurah Road Reserve between Fifty Road and Safety Bay Road
Client:	City of Rockingham

Plan Number: EP22-039(01)--F08

Drawn:	GAR
Date:	24/06/2022
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GDA 1994 MGA Zone 50

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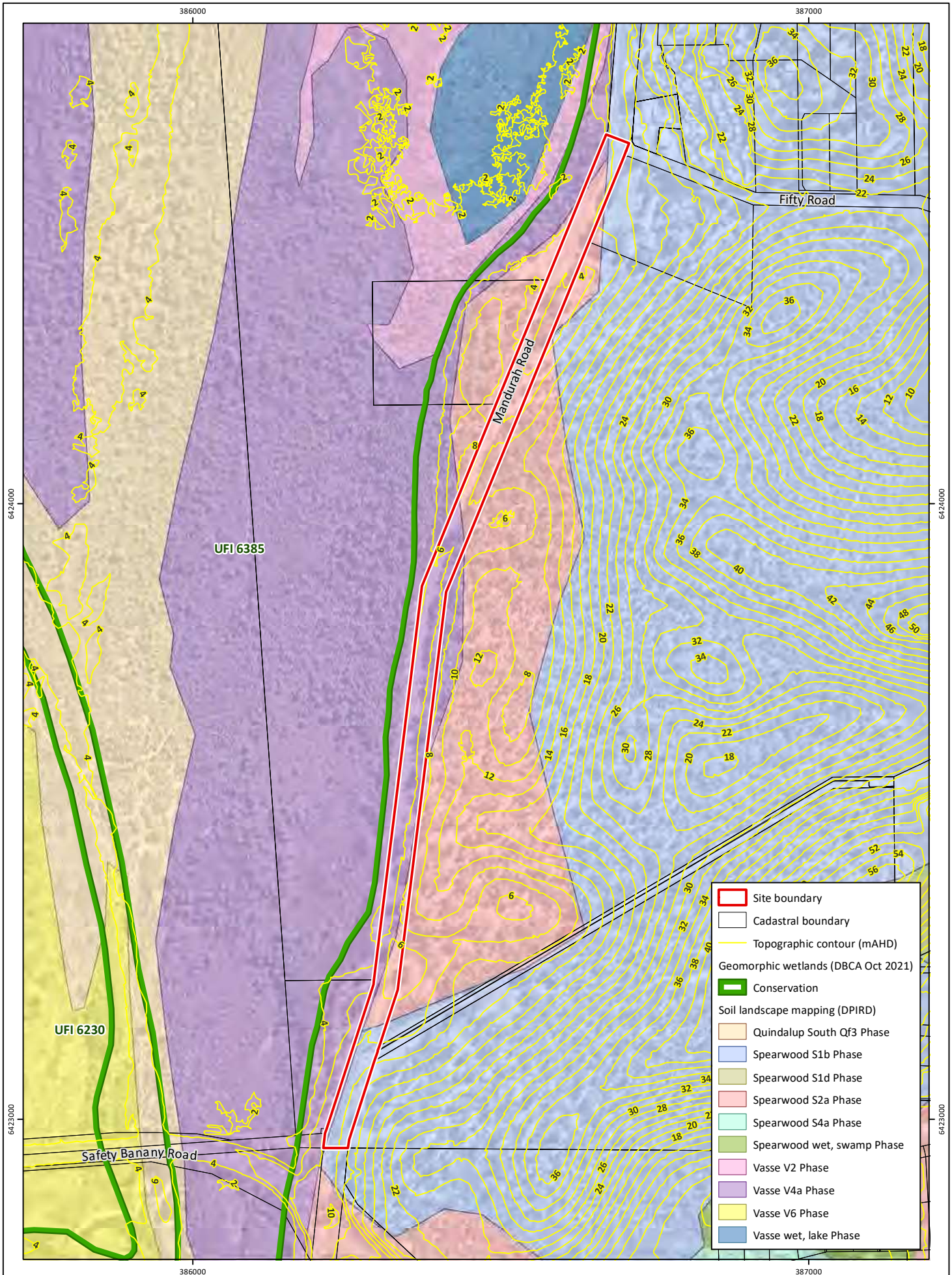

Figure 2: **Soils, Topography and Hydrology**

Project: Reconnaissance Flora, Vegetation and Tree Assessment - Part Mandurah Road Reserve between Fifty Road and Safety Bay Road

Client: City of Rockingham

Plan Number: EP22-039(01)--F09

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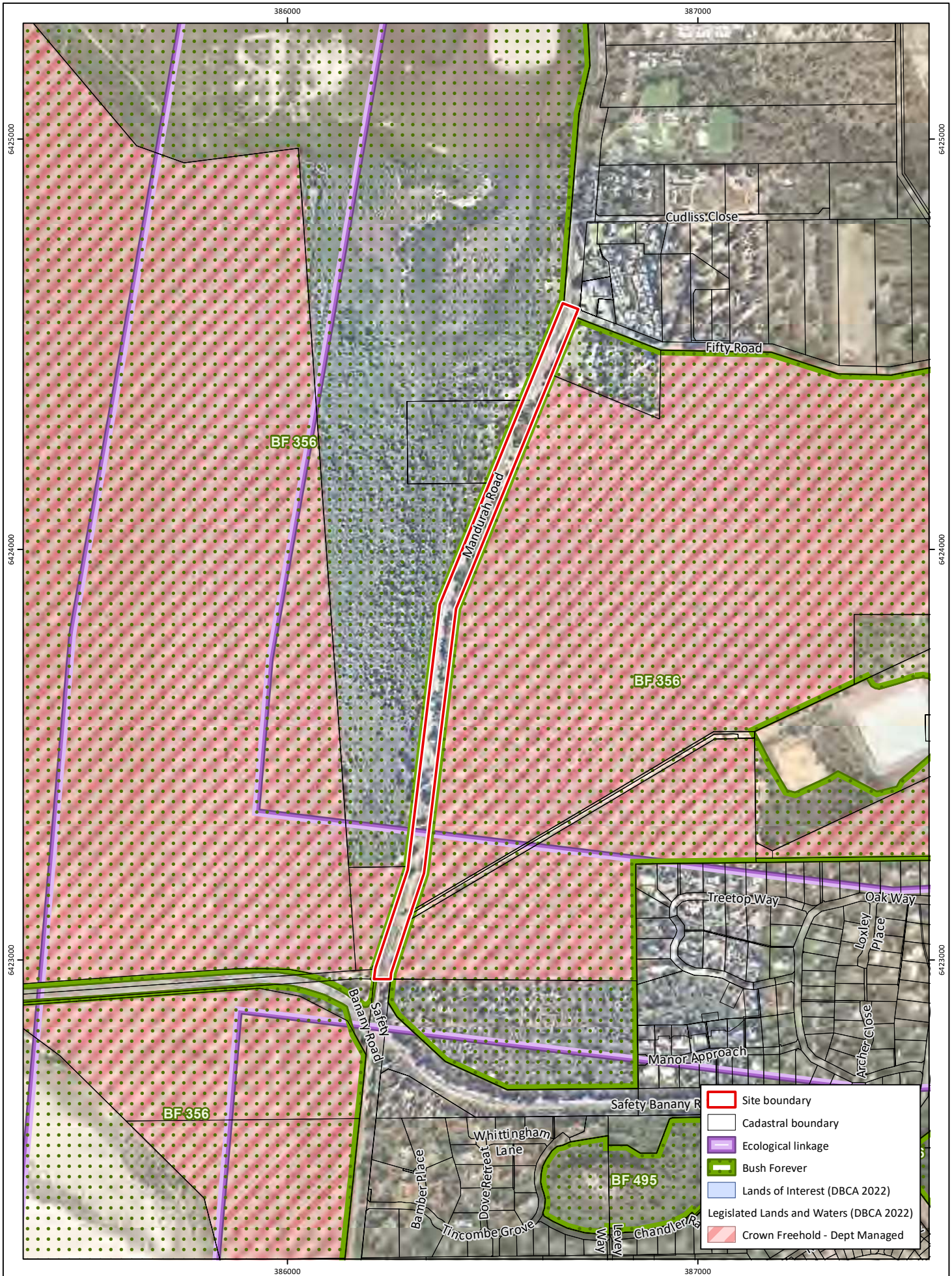

Figure 3: Environmental Features

Project:	Reconnaissance Flora, Vegetation and Tree Assessment - Part Mandurah Road Reserve between Fifty Road and Safety Bay Road
Client:	City of Rockingham

Plan Number: EP22-039(01)--F10

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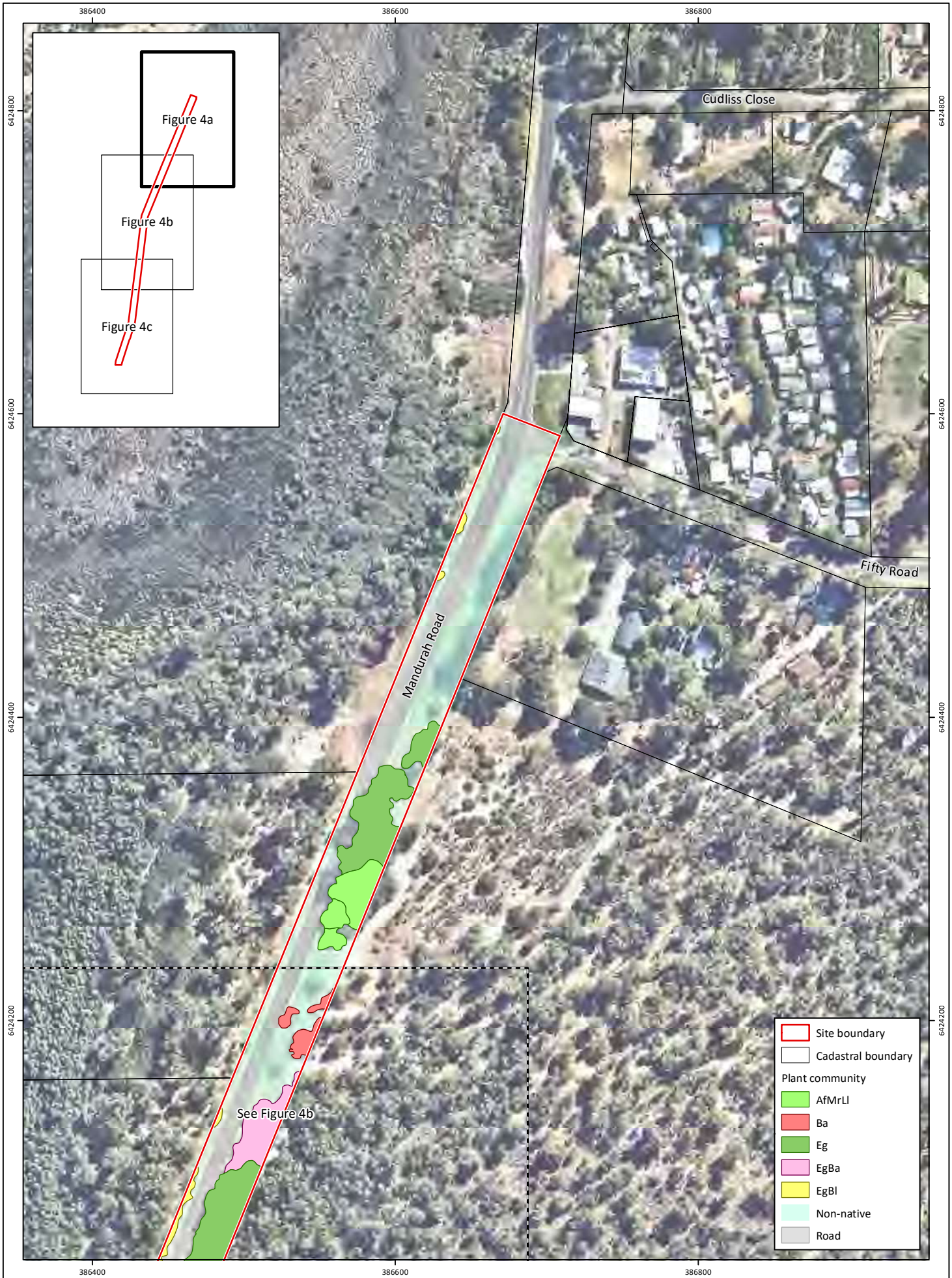

Figure 4a: Plant Communities

Project:	Reconnaissance Flora, Vegetation and Tree Assessment - Part Mandurah Road Reserve between Fifty Road and Safety Bay Road
Client:	City of Rockingham

Plan Number:
EP22-039(01)--F11

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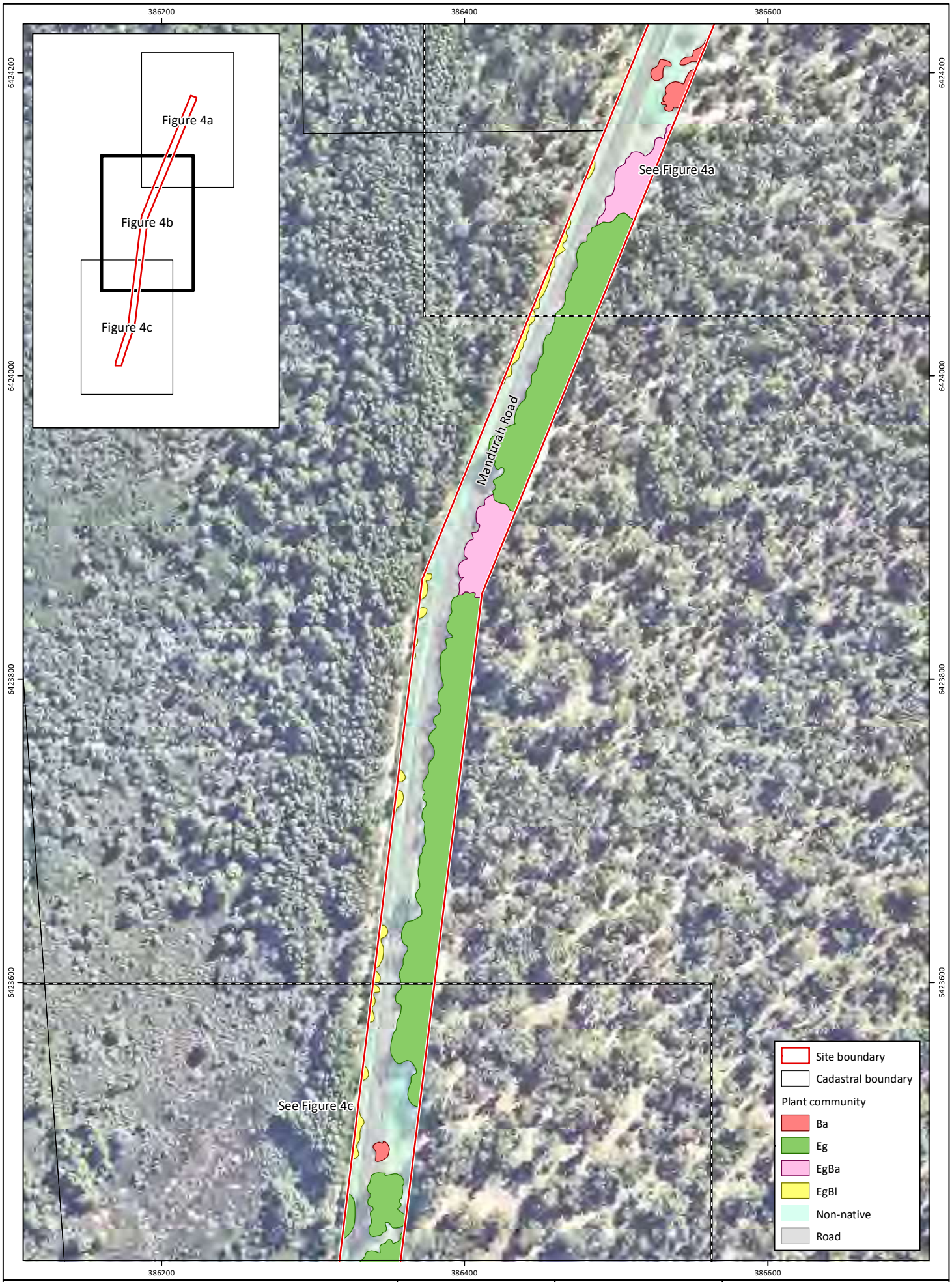

Figure 4b: Plant Communities

Project:	Reconnaissance Flora, Vegetation and Tree Assessment - Part Mandurah Road Reserve between Fifty Road and Safety Bay Road
Client:	City of Rockingham

Plan Number:
EP22-039(01)--F11

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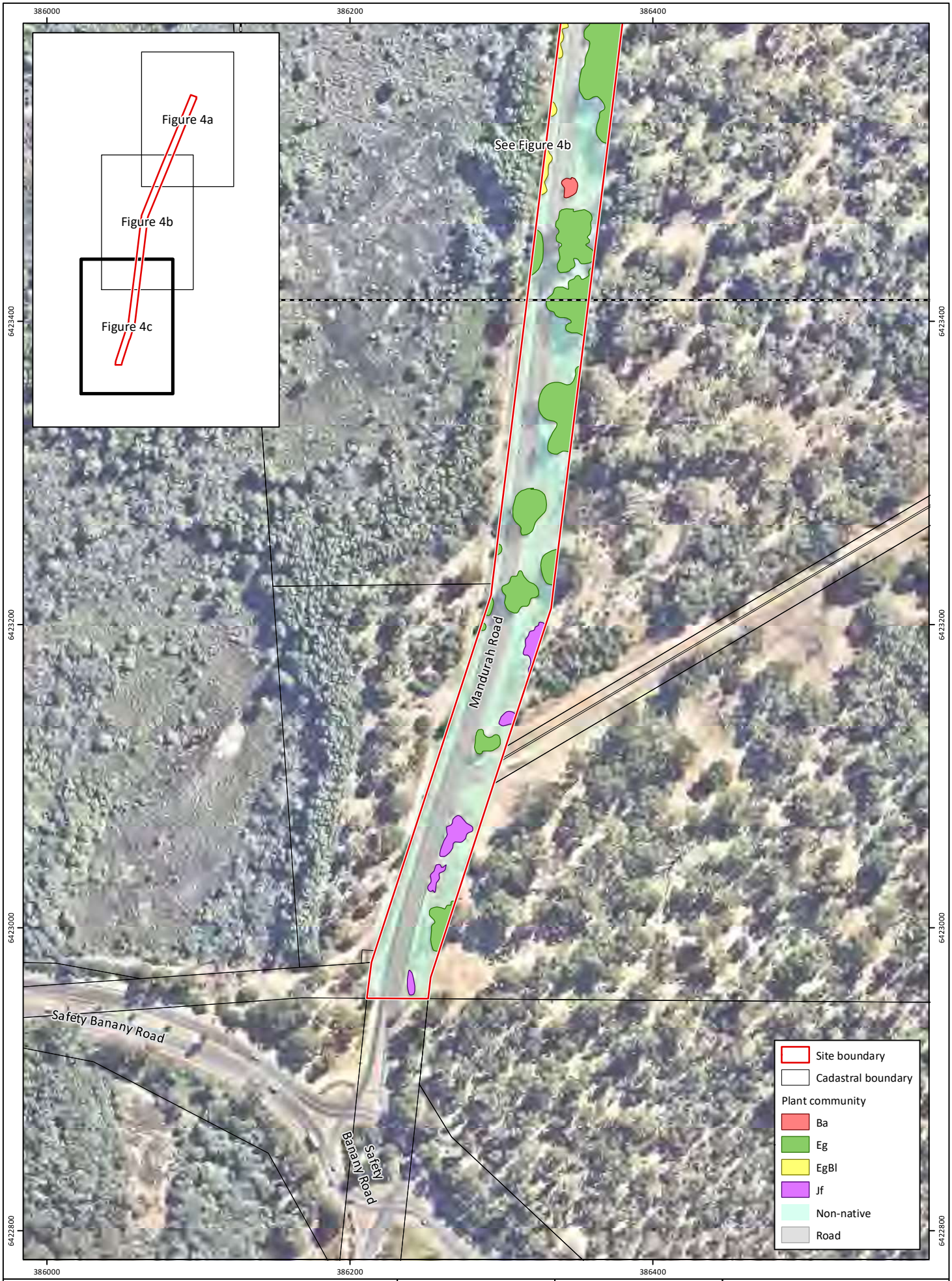

Figure 4c: Plant Communities

Project:	Reconnaissance Flora, Vegetation and Tree Assessment - Part Mandurah Road Reserve between Fifty Road and Safety Bay Road
Client:	City of Rockingham

Plan Number: EP22-039(01)--F11

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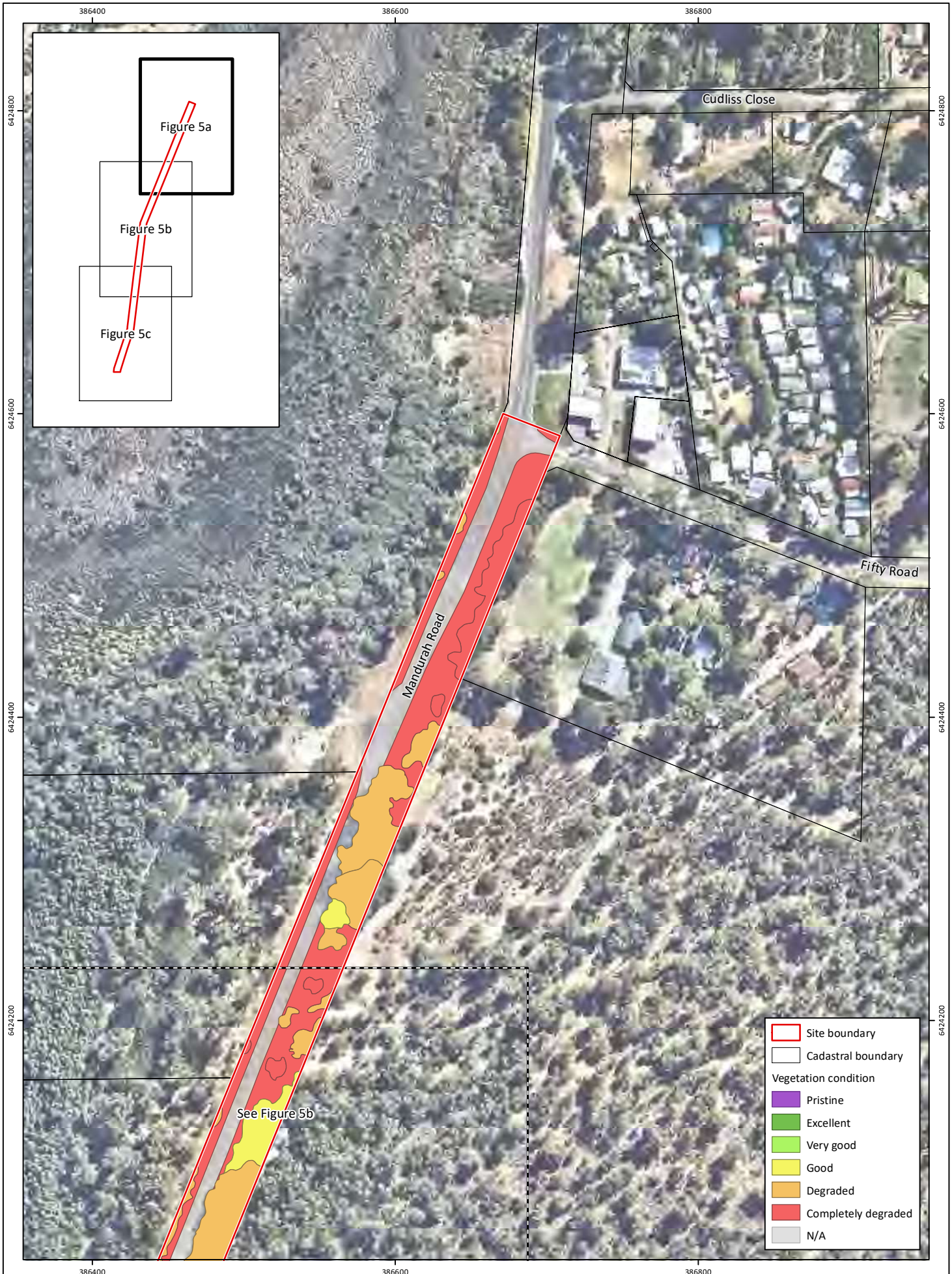

Figure 5a: Vegetation Condition

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Client:	City of Rockingham

Plan Number: EP22-039(01)--F12

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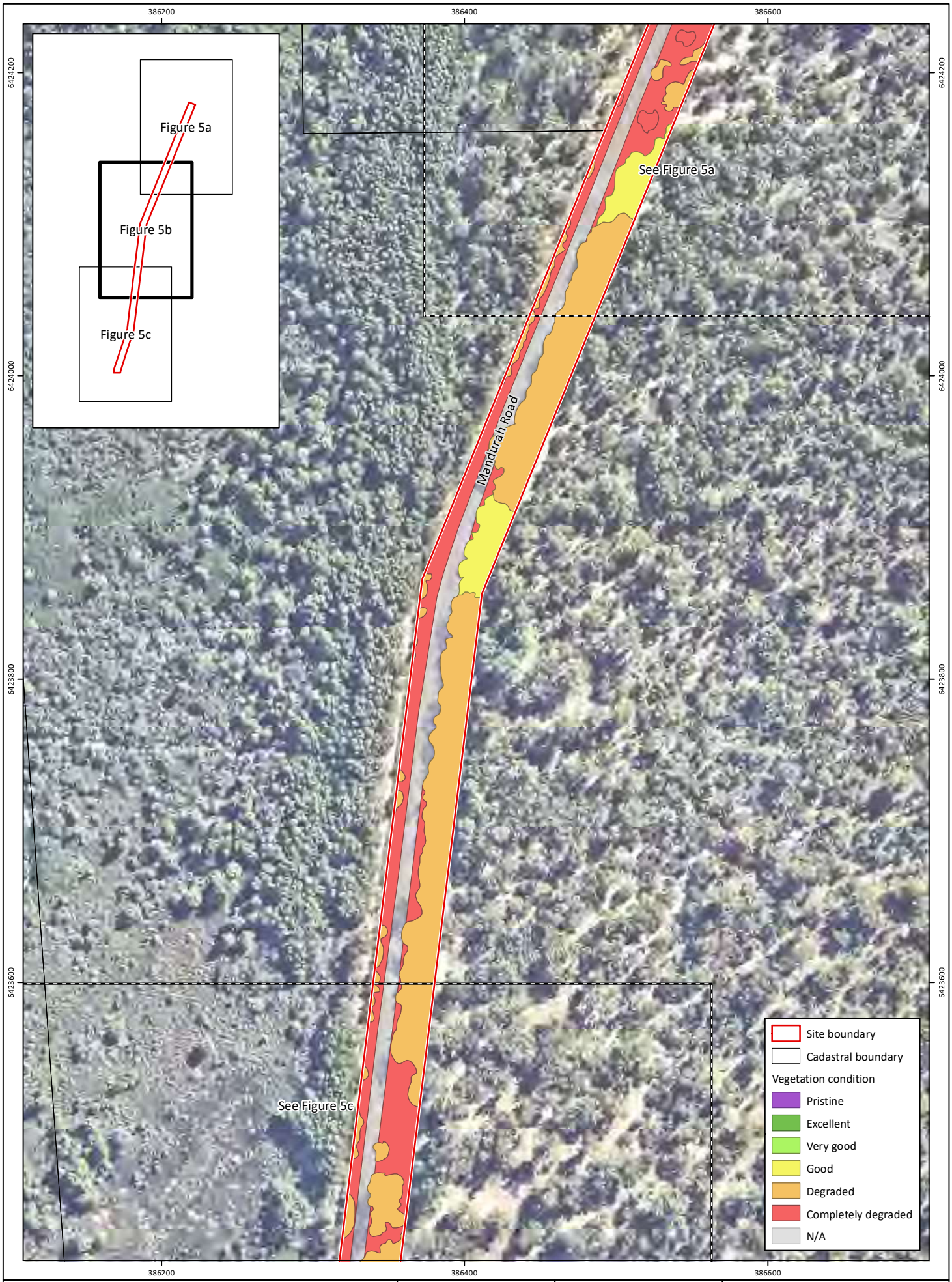

Figure 5b: Vegetation Condition

Project:	Reconnaissance Flora, Vegetation and Tree Assessment - Part Mandurah Road Reserve between Fifty Road and Safety Bay Road
Client:	City of Rockingham

Plan Number: **EP22-039(01)--F12**

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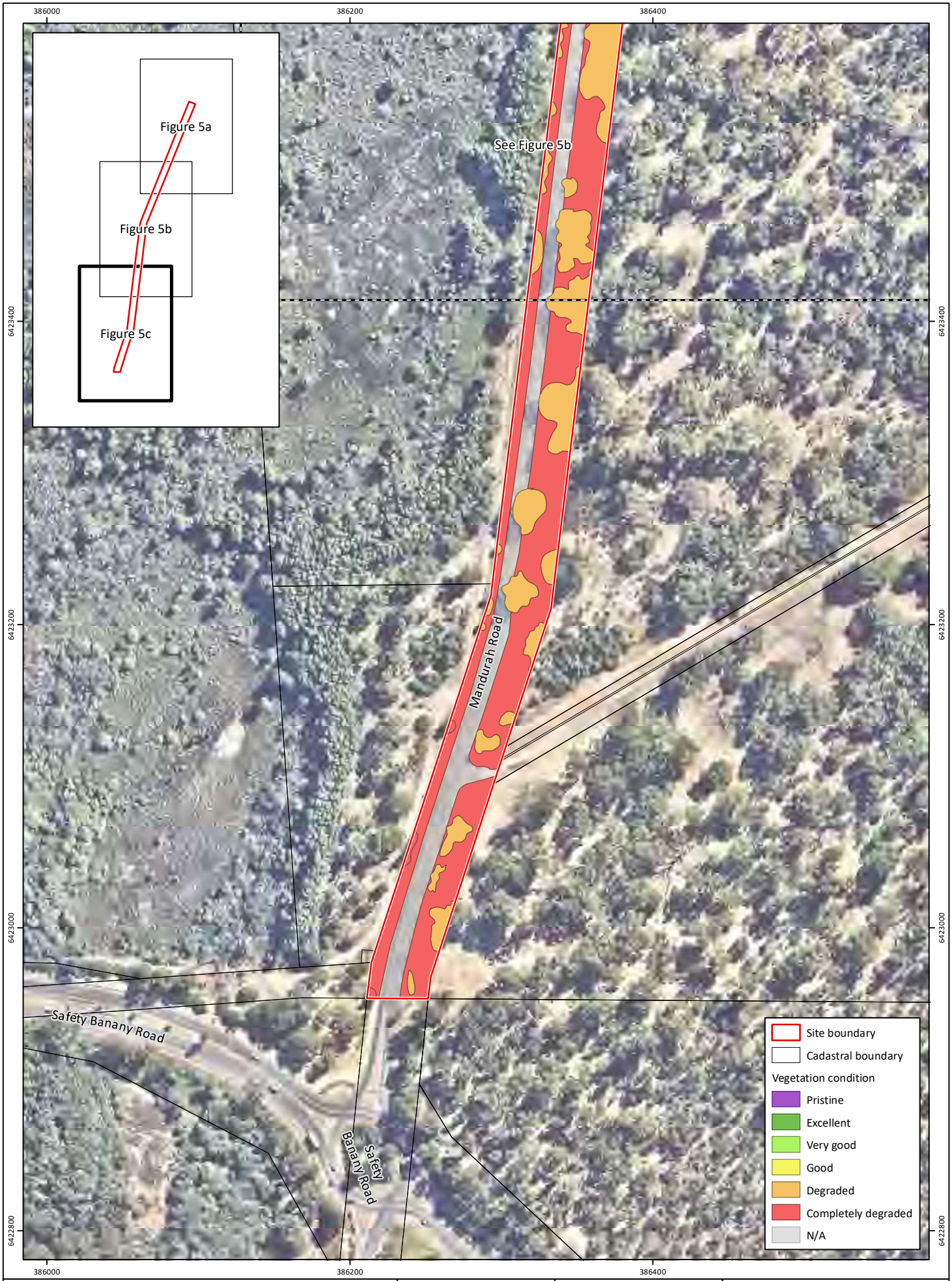

Figure 5c: Vegetation Condition

Project:	Reconnaissance Flora, Vegetation and Tree Assessment - Part Mandurah Road Reserve between Fifty Road and Safety Bay Road
Client:	City of Rockingham

Plan Number:
EP22-039(01)--F12

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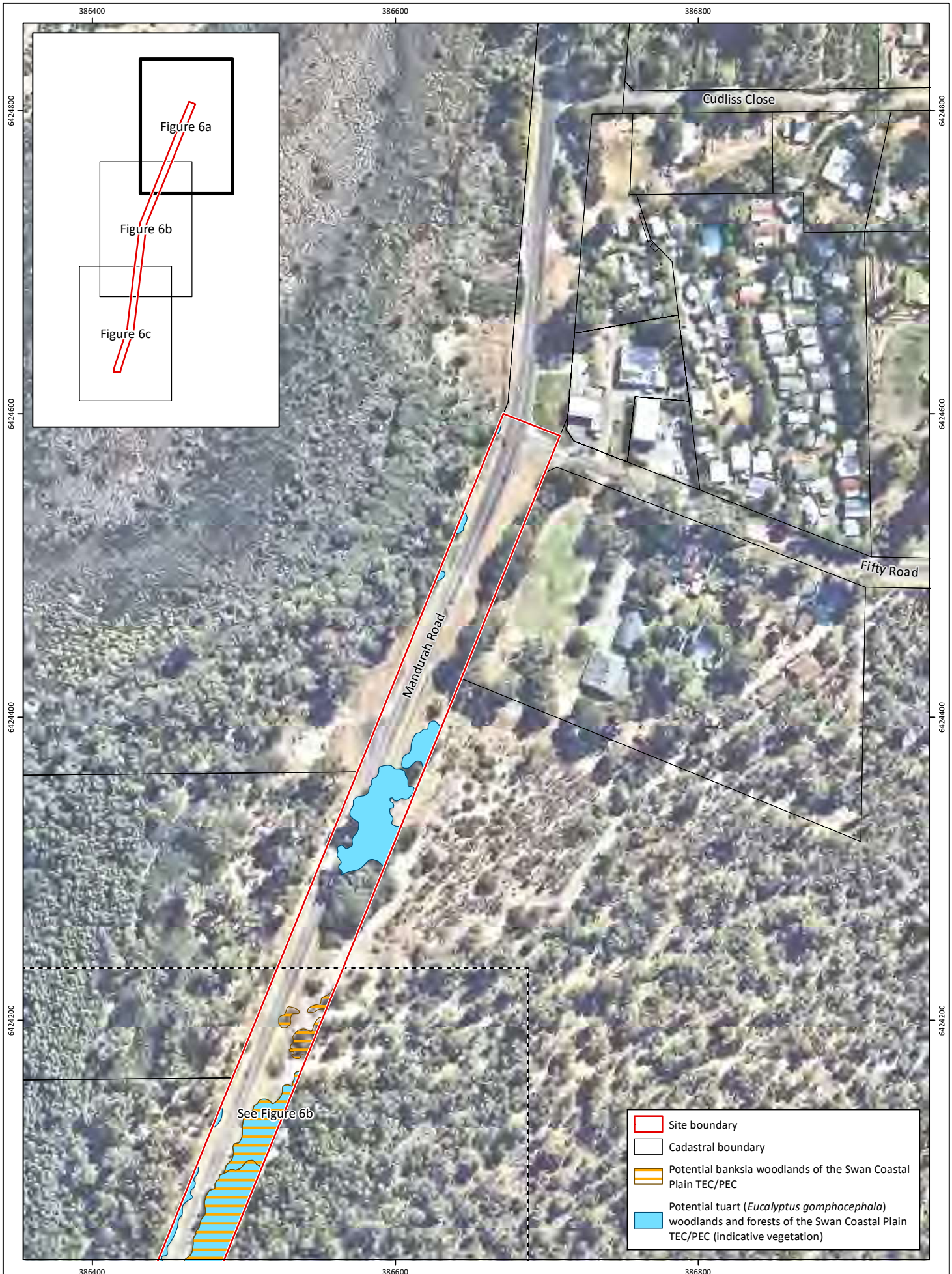

Figure 6a: Threatened and Priority Ecological Communities

Project: Reconnaissance Flora, Vegetation and Tree Assessment - Part Mandurah Road Reserve between Fifty Road and Safety Bay Road

Client: City of Rockingham

Plan Number: EP22-039(01)--F13A

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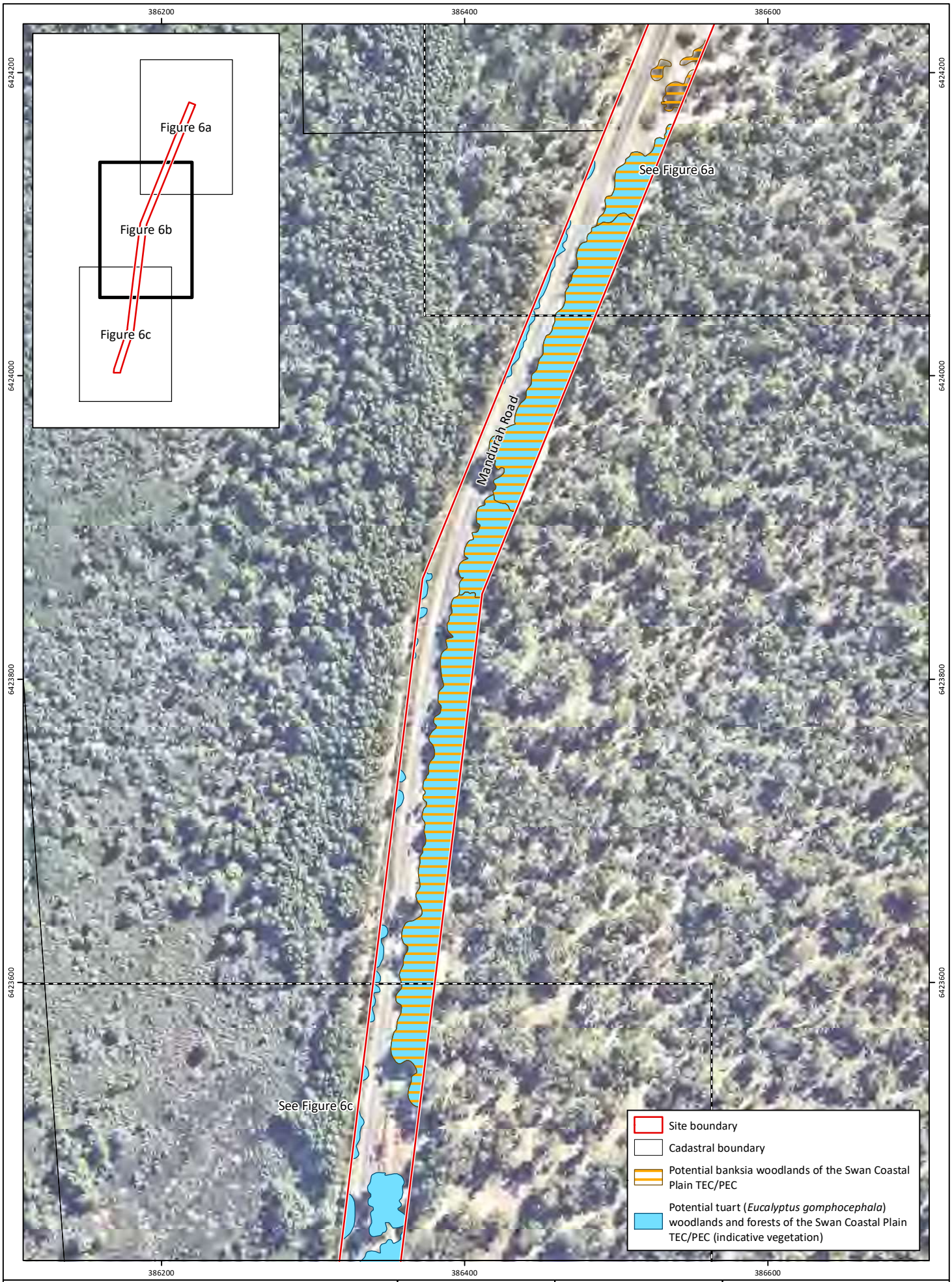

Figure 6b: Threatened and Priority Ecological Communities

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Client:	City of Rockingham

Plan Number: EP22-039(01)--F13A

Drawn:	GAR
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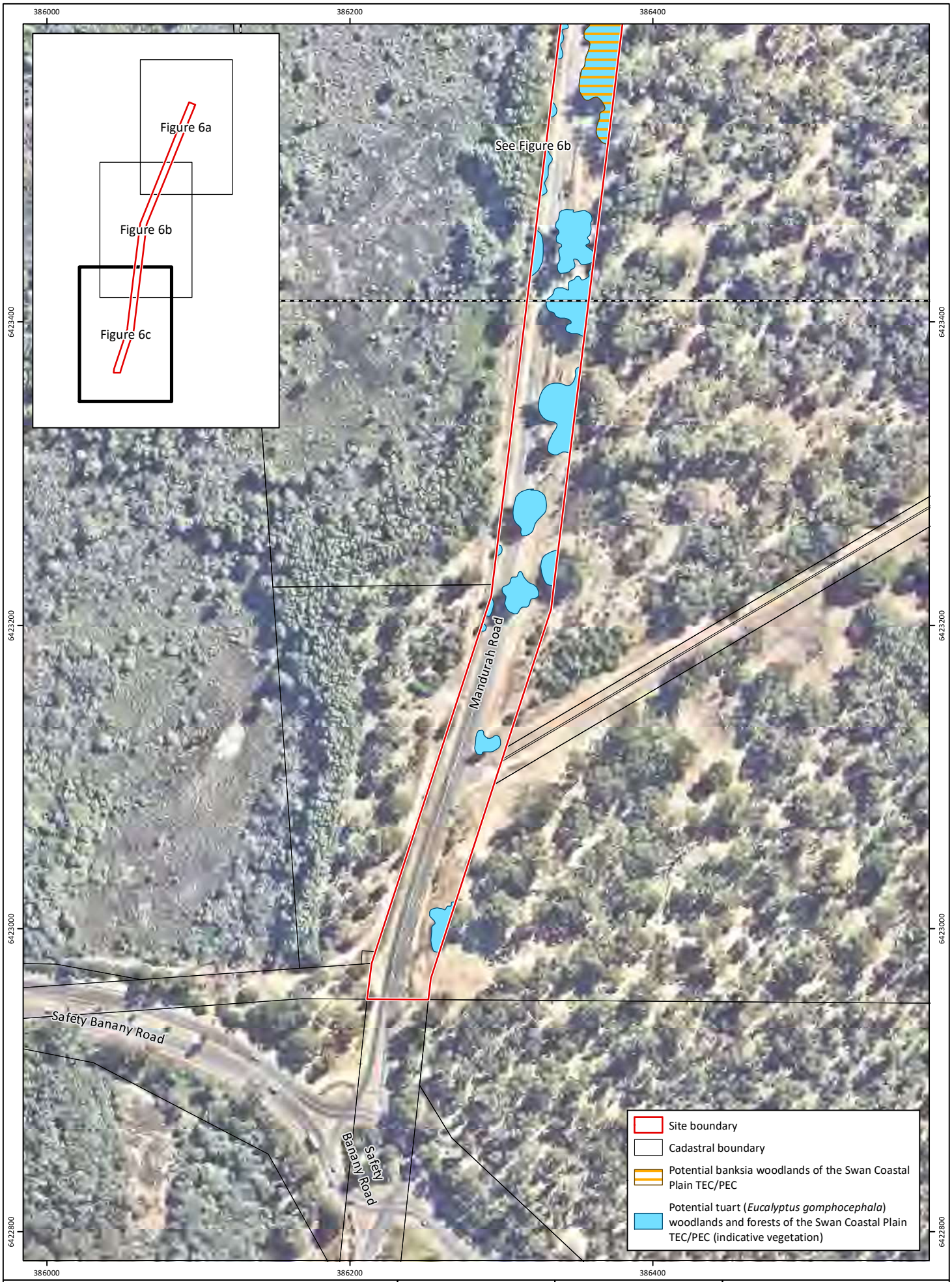

Figure 6c: Threatened and Priority Ecological Communities

Project:	Reconnaissance Flora, Vegetation and Tree Assessment - Part Mandurah Road Reserve between Fifty Road and Safety Bay Road
Client:	City of Rockingham

Plan Number: EP22-039(01)--F13A

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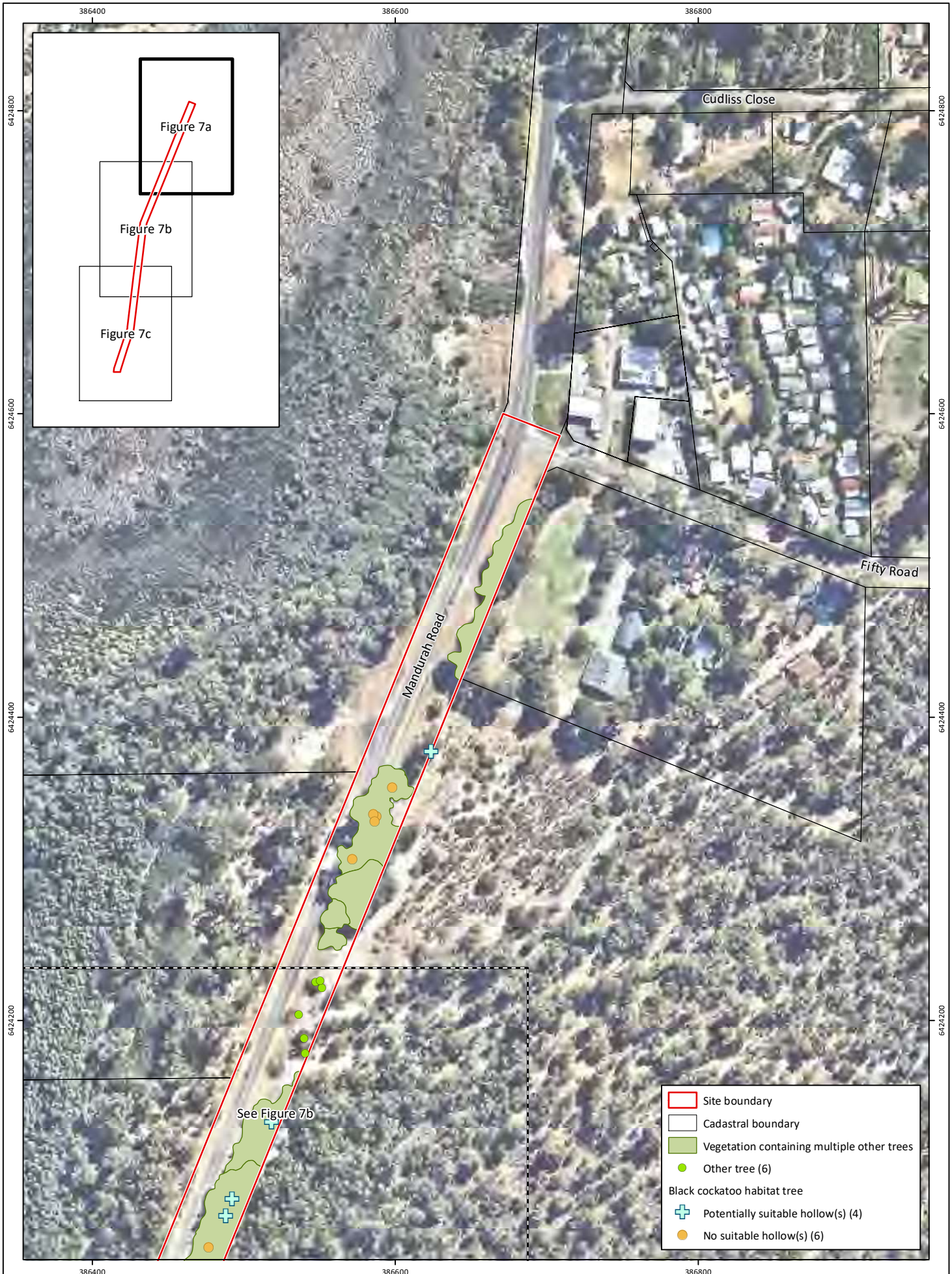

Figure 7a: Trees

Project:	Reconnaissance Flora, Vegetation and Tree Assessment - Part Mandurah Road Reserve between Fifty Road and Safety Bay Road
Client:	City of Rockingham

Plan Number: EP22-039(01)--F14

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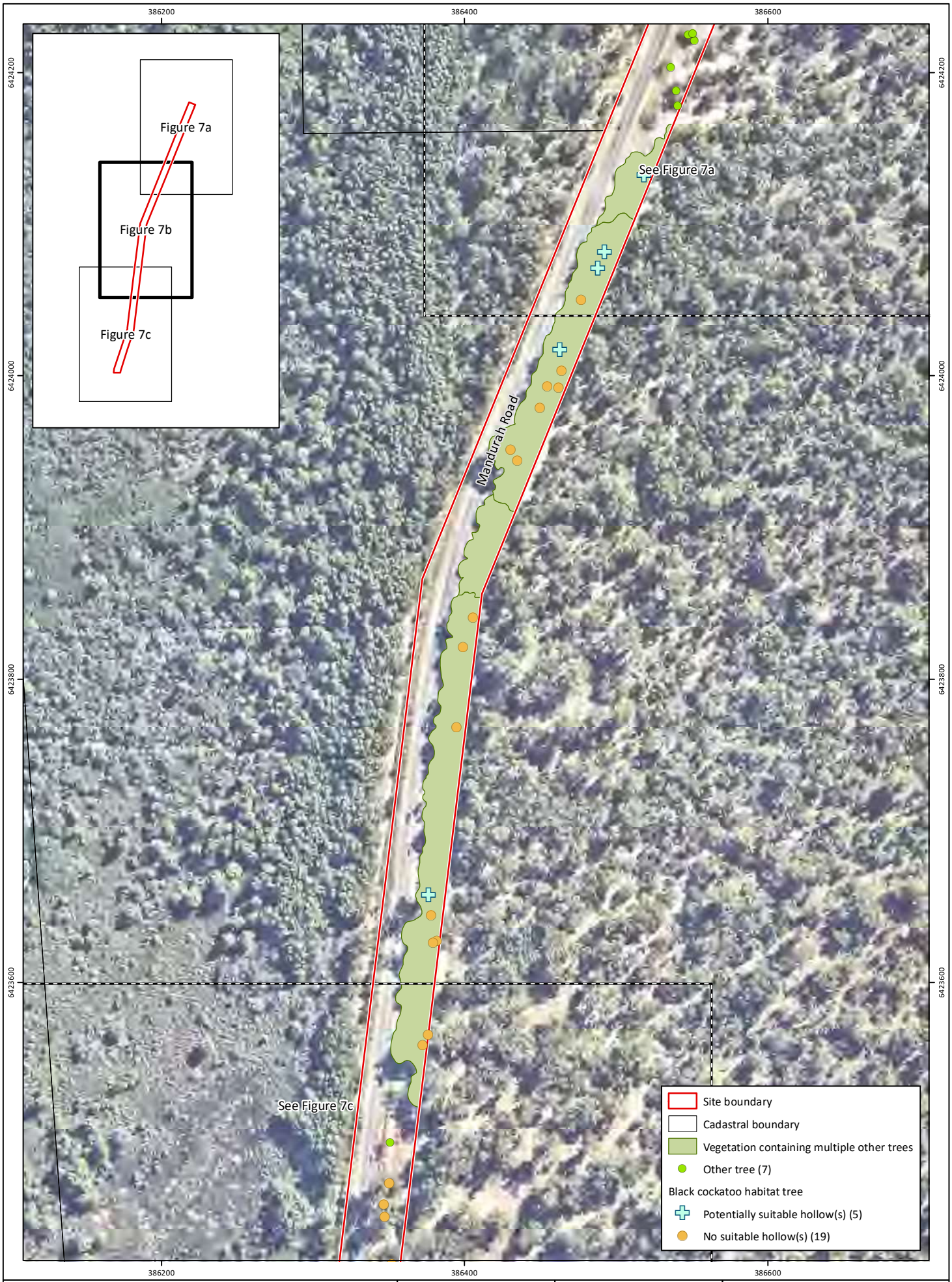

Figure 7b: Trees

Project:	Reconnaissance Flora, Vegetation and Tree Assessment - Part Mandurah Road Reserve between Fifty Road and Safety Bay Road
Client:	City of Rockingham

Plan Number: EP22-039(01)--F14

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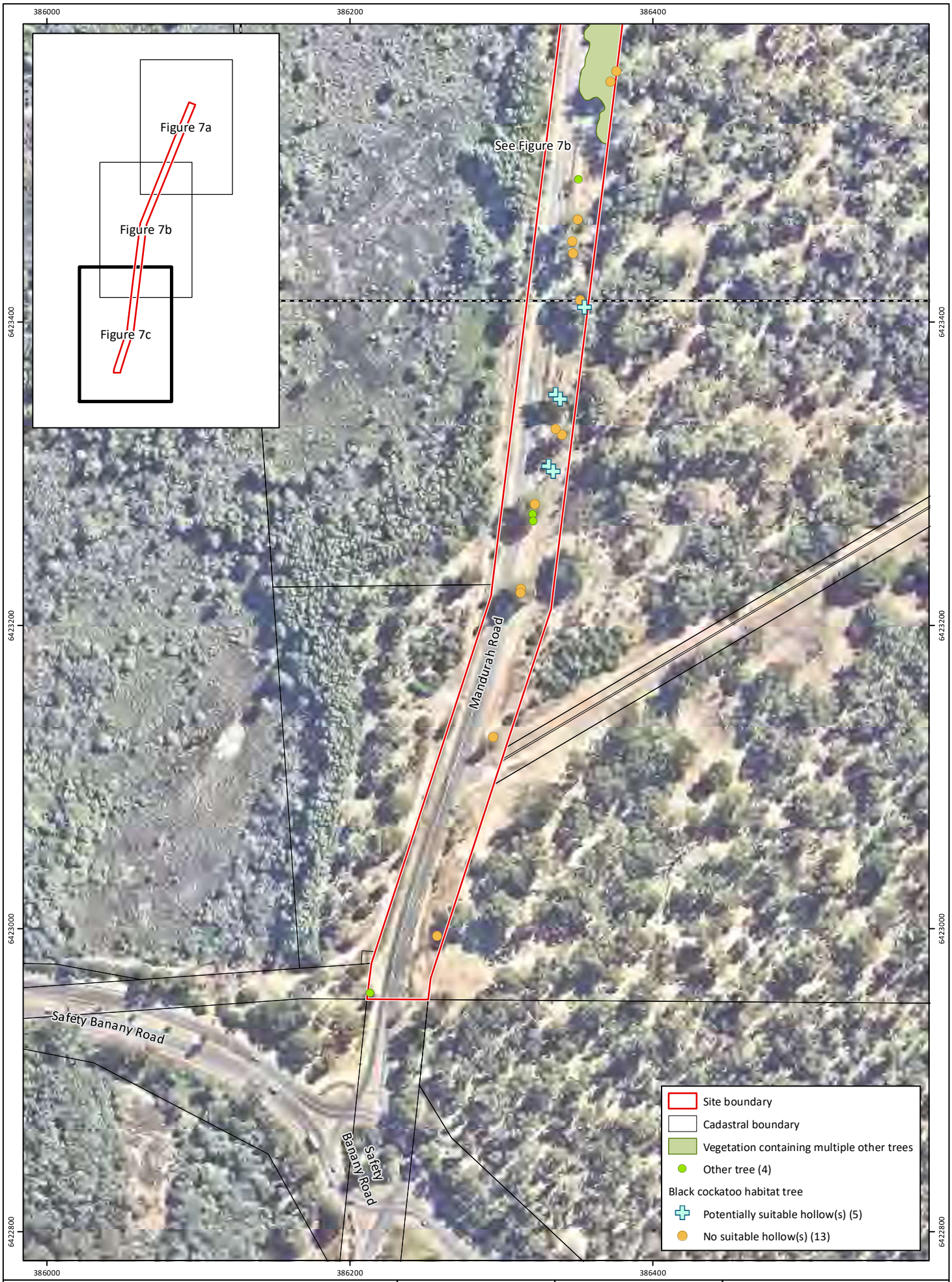

Figure 7c: Trees

Project:	Reconnaissance Flora, Vegetation and Tree Assessment - Part Mandurah Road Reserve between Fifty Road and Safety Bay Road
Client:	City of Rockingham

Plan Number: EP22-039(01)--F14

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GDA 1994 MGA Zone 50

Appendix A

Additional Information

Conservation Significant Flora and Vegetation

Threatened and priority flora

Flora species considered rare or under threat warrant special protection under Commonwealth and/or State legislation. At the Commonwealth level, flora species can be listed under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). Flora species considered 'threatened' pursuant to Schedule 1 of the EPBC Act are assigned categories according to their conservation status, as outlined in **Table 1**.

In Western Australia, plant taxa may be classed as 'threatened' under the *Biodiversity Conservation Act 2016* (BC Act) which is enforced by Department of Biodiversity Conservation and Attractions (DBCA). Threatened flora species are listed under sections 19(1) and 26(2) of the BC Act. It is an offence to 'take' or disturb threatened flora without Ministerial approval. Section 5(1)1 of the Act defines to take as including "… to gather, pluck, cut, pull up, destroy, dig up, remove, harvest or damage flora by any means" or to cause or permit the same to be done. The definition of threatened flora under the BC Act is provided in **Table 1**.

Section 43 of the BC Act requires that an occurrence of a threatened species or threatened ecological community is reported to DBCA where the occurrence has been identified as part of field work completed:

- as part of an assessment under Part IV of the *Environmental Protection Act 1986*; or
- in relation to an application for a clearing permit under the *Environmental Protection Act 1986* section 51E(1)(d).

Penalties apply to individuals and organisations that fail to provide accurate reports of threatened species or communities.

The *Biodiversity Conservation Regulations 2018* (BC Regulations 2018) came into effect on January 1 2019. The BC Regulations include provisions for licencing, charges, penalties and other provisions associated with the BC Act.

Flora species that may be threatened or near threatened but lack sufficient information to be listed under the BC Act may be added to the DBCA's *Priority Flora List* (DBCA 2018c). Priority flora species are considered during State approval processes. Priority flora categories and definitions are listed in **Table 1**.

Table 1: Definitions of conservation significant flora species pursuant to the EPBC Act and BC Act and on DBCA's Priority Flora List (DBCA 2018c)

Conservation code	Description
EX†	Threatened Flora – Presumed Extinct Taxa which have not been collected, or otherwise verified, over the past 50 years despite thorough searching, or of which all known wild populations have been destroyed more recently, and have been gazetted as such.
T^†	Threatened Flora – Extant Taxa which are declared to be likely to become extinct or is rare, or otherwise in need of special protection.
CR^	Threatened Flora – Critically Endangered Taxa which are considered to be facing an extremely high risk of extinction in the wild.
EN^	Threatened Flora – Endangered Taxa which are considered to be facing a very high risk of extinction in the wild.
VU^	Threatened Flora – Vulnerable Taxa which are considered to be facing a high risk of extinction in the wild.
P1	Priority One – Poorly Known Taxa which are known from one or a few (generally <5) populations which are under threat, either due to small population size, or being on lands under immediate threat e.g. road verges, urban areas, farmland, active mineral leases etc., or the plants are under threat, e.g. from disease, grazing by feral animals etc. May include taxa with threatened populations on protected lands. Such taxa are under consideration for declaration as 'rare flora', but are in urgent need of further survey.
P2	Priority Two – Poorly Known Taxa which are known from one or a few (generally <5) populations, at least some of which are not believed to be under immediate threat (i.e. not currently endangered). Such taxa are under consideration for declaration as 'rare flora', but urgently need further survey.
P3	Priority Three – Poorly Known Taxa which are known from several populations, and the taxa are not believed to be under immediate threat (i.e. not currently endangered), either due to the number of known populations (generally >5), or known populations being large, and either widespread or protected. Such taxa are under consideration for declaration as 'rare flora' but needs further survey.
P4	Priority Four – Rare Taxa which are considered to have been adequately surveyed and which, whilst being rare (in Australia), are not currently threatened by any identifiable factors. These taxa require monitoring every 5-10 years.

^pursuant to the EPBC Act, †pursuant to the BC Act, on DBCA's *Priority Flora List*

Threatened and priority ecological communities

'Threatened ecological communities' (TECs) are recognised as ecological communities that are rare or under threat and therefore warrant special protection. Selected TECs are afforded statutory protection at a Commonwealth level under section 181 of the EPBC Act. TECs nominated for listing under the EPBC Act are considered by the Threatened Species Scientific Committee and a final decision is made by the Commonwealth Minister for the Environment. Once listed under the EPBC Act, communities are categorised as either 'critically endangered', 'endangered' or 'vulnerable' as defined in **Table 2**. Any action likely to have a significant impact on a community listed under the EPBC Act requires approval from the Minister for the Environment.

Within Western Australia TECs are determined by the Western Australian Threatened Ecological Communities Scientific Advisory Committee (WATECSAC) and endorsed by the State Minister for the Environment. The WATECSAC is an independent group comprised of representatives from organisations including tertiary institutions, the Western Australian Museum and DBCA. The TECs endorsed by the State Minister are published by DBCA (DBCA 2018b).

TECs are assigned to one of the categories outlined in **Table 2** according to their status (in relation to the level of threat). TECs are afforded direct statutory protection at a State level under the BC Act and BC Regulations. Ecological communities are listed under Section 27(1) and 33 of the BC Act. Their significance is also acknowledged through other state environmental approval processes such as 'environmental impact assessment' pursuant to Part IV of the *Environmental Protection Act 1986* (EP Act) and the *Environmental Protection (Clearing of Native Vegetation) Regulations 2004*.

Table 2: Categories of threatened ecological communities (English and Blyth 1997; DEC 2009)

Conservation code	Description
PD	Presumably Totally Destroyed An ecological community that has been adequately searched for but for which no representative occurrences have been located.
CE	Critically Endangered An ecological community that has been adequately surveyed and is found to be facing an extremely high risk of total destruction in the immediate future.
E	Endangered An ecological community that has been adequately surveyed and is not critically endangered but is facing a very high risk of total destruction in the near future.
V	Vulnerable An ecological community that has been adequately surveyed and is not critically endangered or endangered but is facing a high risk of total destruction or significant modification in the medium to long-term future.

An ecological community that is under consideration for listing as a TEC, but does not yet meet survey criteria or has not been adequately defined may be listed as a 'priority ecological community' (PEC). PECs are categorised as priority category 1, 2 or 3 as described in **Table 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'. These ecological communities require regular monitoring. Conservation dependent ecological communities are placed in 'priority 5' (DEC 2013). Listed PECs are published by DBCA (DBCA 2017b).

Table 3: Categories of priority ecological communities (DEC 2013)

Priority code	Description
P1	Priority One: Poorly known ecological communities Ecological communities that are known from very few occurrences with a very restricted distribution (generally ≤5 occurrences or a total area of ≤ 100ha). Occurrences are believed to be under threat either due to limited extent, or being on lands under immediate threat (e.g. within agricultural or pastoral lands, urban areas, active mineral leases) or for which current threats exist. May include communities with occurrences on protected lands. Communities may be included if they are comparatively well-known from one or more localities but do not meet adequacy of survey requirements, and/or are not well defined, and appear to be under immediate threat from known threatening processes across their range.
P2	Priority Two: Poorly known ecological communities Communities that are known from few occurrences with a restricted distribution (generally ≤10 occurrences or a total area of ≤200ha). At least some occurrences are not believed to be under immediate threat (within approximately 10 years) of destruction or degradation. Communities may be included if they are comparatively well known from one or more localities but do not meet adequacy of survey requirements, and/or are not well defined, and appear to be under threat from known threatening processes.
P3	Priority Three: Poorly known ecological communities (i) Communities that are known from several to many occurrences, a significant number or area of which are not under threat of habitat destruction or degradation or: (ii) communities known from a few widespread occurrences, which are either large or with significant remaining areas of habitat in which other occurrences may occur, much of it not under imminent threat (within approximately 10 years), or; (iii) communities made up of large, and/or widespread occurrences, that may or may not be represented in the reserve system, but are under threat of modification across much of their range from processes such as grazing by domestic and/or feral stock, inappropriate fire regimes, clearing, hydrological change etc. Communities may be included if they are comparatively well known from several localities but do not meet adequacy of survey requirements and/or are not well defined, and known threatening processes exist that could affect them.
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. These communities require regular monitoring. (i) Rare. Ecological communities known from few occurrences 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 communities are usually represented on conservation lands. (ii) Near Threatened. Ecological communities that are considered to have been adequately surveyed and that do not qualify for Conservation Dependent, but that are close to qualifying for a higher threat category. (iii) Ecological communities that have been removed from the list of threatened communities during the past five years.
P5	Priority Five: Conservation Dependent ecological communities Ecological communities that are not threatened but are subject to a specific conservation program, the cessation of which would result in the community becoming threatened within five years.

Weeds

A number of legislative and policy documents exist in relation to weed management at state and national levels. The *Biosecurity and Agriculture Management Act 2007* (BAM Act) is the principle legislation guiding weed management in Western Australia and lists declared pest species. At a national level, the Australian government has compiled a list of 32 Weeds of National Significance (WoNS) (DoEE 2018), of which many are also listed under the BAM Act.

Declared Pests

Part 2.3.23 of the BAM Act requires a person must not; "*a) keep, breed or cultivate the declared pest; b) keep, breed or cultivate an animal, plant or other thing that is infected or infested with the declared pest; c) release into the environment the declared pest, or an animal, plant or other thing that is infected or infested with the declared pest; or d) intentionally infect or infest, or expose to infection or infestation, a plant, animal or other thing with a declared pest*".

Under the BAM Act, all declared pests are assigned a legal status, as described in **Table 7**. Species assigned to the 'declared pest, prohibited - s12' category are placed in one of three control categories, as described in **Table 8**.

The *Biosecurity and Agriculture Management Regulations 2013* specify keeping categories for species assigned to the 'declared pest - s22(2)' category, which relate to the purposes of which species can be kept, as well as the entities that can keep them. The categories are described in **Table 9**.

The Western Australian Organism List (WAOL) provides the status of organisms which have been categorised under the BAM Act (DPIRD 2020).

Table 4: Legal status of declared pest species listed under the BAM Act (DPIRD 2020)

Category	Description
Declared Pest Prohibited - s12	May only be imported and kept subject to permits. Permit conditions applicable to some species may only be appropriate or available to research organisations or similarly secure institutions.
Declared Pest s22(2)	Must satisfy any applicable import requirements when imported, and may be subject to an import permit if they are potential carriers of high-risk organisms. They may also be subject to control and keeping requirements once within Western Australia

Table 5: Control categories of declared pest species listed under the BAM Act (DPIRD 2020)

Category	Description
C1	Exclusion Not established in Western Australia and control measures are to be taken, including border checks, in order to prevent them entering and establishing in the State.
C2	Eradication Present in Western Australia in low enough numbers or in sufficiently limited areas that their eradication is still a possibility.
C3	Management Established in Western Australia but it is feasible, or desirable, to manage them in order to limit their

Category	Description
	damage. Control measures can prevent a C3 pest from increasing in population size or density or moving from an area in which it is established into an area which currently is free of that pest.

Table 6: Keeping categories of declared pest species listed under the BAM Act (DPIRD 2020)

Category	Description
Prohibited	Can only be kept under a permit for public display and education purposes, and/or genuine scientific research, by entities approved by the state authority.
Exempt	No permit or conditions are required for keeping.
Restricted	Organisms which, relative to other species, have a low risk of becoming a problem for the environment, primary industry or public safety and can be kept under a permit by private individuals.

Wetland Habitat

Geomorphic wetland types

On the Swan Coastal Plain DBCA (2017a) have used the geomorphic wetland classification system developed by Semeniuk (1987) and Semeniuk and Semeniuk (1995) to classify wetlands based on the landform shape and water permanence (hydro-period) as outlined in **Table 10**.

Table 7: Geomorphic Wetlands of the Swan Coastal Plain classification categories (DBCA 2017a)

Level of inundation	Geomorphology			
	Basin	Flat	Channel	Slope
Permanently inundated	Lake	-	River	-
Seasonally inundated	Sumpland	Floodplain	Creek	-
Seasonally waterlogged	Dampland	Palusplain	-	Paluslope

Wetland management categories

DBCA maintains the *Geomorphic Wetland of the Swan Coastal Plain* dataset (DBCA 2018a), which also categorises individual wetlands into specific management categories as described in **Table 11**.

Table 8: Geomorphic Wetlands of the Swan Coastal Plain classification categories (DBCA 2017a)

Management category	Description of wetland	Management objectives
Conservation (CCW)	Support high levels of attributes	Preserve wetland attributes and functions through reservation in national parks, crown reserves and state owned land. Protection provided under environmental protection policies.
Resource enhancement (REW)	Partly modified but still supporting substantial functions and attributes	Restore wetland through maintenance and enhancement of wetland functions and attributes. Protection via crown reserves, state or local government owned land, environmental protection policies and sustainable management on private properties.
Multiple use (MUW)	Few wetland attributes but still provide important hydrological functions	Use, development and management considered in the context of water, town and environmental planning through land care.

The management categories of wetland features are determined based on hydrological, biological and human use features. The DBCA document *A methodology for the evaluation of specific wetland types on the Swan Coastal Plain, Western Australia* (DBCA 2017a) details the methodology by which wetlands on the Swan Coastal Plain are assigned management categories based on a two tiered evaluation system, with preliminary and secondary evaluation stages. The preliminary evaluation aims to identify any features of conservation significance that would immediately place the wetland within the CCW management category. Examples of these significant features include presence on significant wetland lists, presence of TECs or PECs (Priority 1 and 2), presence of threatened flora and

over 90% of vegetation in good or better condition based on the Keighery (1994) scale. If such environmental values are identified the wetland would be categorised as CCW without further evaluation.

Should the preliminary evaluation indicate that no such features occur, the secondary evaluation and site assessment are then applied. In the secondary evaluation, an appropriate management category is determined through the assessment of a range of environmental attributes, functions and values.

Wetland reclassification

DBCA have a protocol for proposing changes to the wetland boundaries and management categories of the existing geomorphic wetland dataset (DEC 2007). The procedure involves a wetland desktop evaluation and site assessment which culminates in a recommended management category. Relevant information should be obtained in the optimal season for vegetation condition and water levels, which is usually spring (DEC 2007). In the case of larger wetlands that have undergone a degree of disturbance, a separate management category may be assigned to parts of the wetland in order to reflect the current values.

References

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Appendix B

Conservation Significant Flora Species and likelihood of Occurrence Assessment

Conservation Significant Flora Likelihood of Occurrence
Part Mandurah Road Reserve between Fifty Road and Safety Bay Road

Species name	Level of significance		Life strategy	Habitat	Flowering period	Likelihood of occurrence
	WA	EPBC Act				
Caladenia huegelii	CR	EN	PG	Well-drained, deep sandy soils in lush undergrowth in a variety of moisture levels.	Sep-early Nov	Possible
Drakaea elastica	CR	EN	PG	Bare patches of sand within otherwise dense vegetation in low-lying areas alongside winter-wet swamps. Typically in banksia woodland or thickets of Kunzea glabrescens.	late Sep-Oct/Nov, survey Jul-Aug	Unlikely
Synaphea sp. Serpentine (G.R. Brand 103)	CR	CR	P	Seasonally damp areas, loam - sand.	Sep-Oct	Unlikely
Eucalyptus x balanites	CR	EN	P	Light coloured sandy soils over laterite. Habitat consists of gently sloping heathlands; open mallee woodland over shrubland (Population 2) or heathland with emergent mallees (population 1)	Oct - Feb	Unlikely
Synaphea sp. Fairbridge Farm (D. Papenfus 696)	CR	CR	P	Low woodland on grey, clayey sand with lateritic pebbles (Pinjarra Plain) near winter wet flats.	Sep-Nov	Unlikely
Diuris purdiei	EN	EN	PG	Sand to sandy clay soils in areas subject to winter inundation.	late September to mid-October	Unlikely
Drakaea micrantha	EN	VU	PG	Open sandy patches often adjacent to winter-wet swamps.	Sept- early Oct	Unlikely
Synaphea sp. Pinjarra Plain (A.S. George 17182)	EN	CR	P	White grey clayey sand on edges of seasonally inundated low lying areas.	Sep-Oct	Unlikely
Andersonia gracilis	VU	EN	P	Seasonally damp, black sandy clay flats near or on the margins of swamps.	Sep-Nov	Unlikely
Diuris drummondii	VU	VU	PG	In low-lying depressions in peaty and sandy clay swamps.	Nov-Jan	Unlikely
Diuris micrantha	VU	VU	PG	Dark grey-black sandy clay-loam in winter wet depressions or swamps. Often in shallow standing water.	Aug/Sep-early Oct	Unlikely
Eleocharis keigheryi	VU	VU	P	Clay or sandy loam in freshwater creeks and transient waterbodies such as seasonally wet clay pans.	Aug-Dec	Unlikely
Acacia lasiocarpa var. bracteolata long peduncle variant (G.J. Keighery 5026)	P1	-	P	Grey or black sand over clay. Swampy areas, winter wet lowlands.	May or Aug	Unlikely

Species name	Level of significance		Life strategy	Habitat	Flowering period	Likelihood of occurrence
	WA	EPBC Act				
Acacia sp. Binningup (G. Cockerton et al. WB 37784)	P1	-	P	Woodland and shrubland on sand, often in degraded areas	Aug	Unlikely
Boronia juncea subsp. *juncea*	P1	-	P	Sand in low scrub.	Apr	Unlikely
Lachnagrostis nesomytica subsp. *paralia*	P1	-	A/P	Calcareous sands. Coastal dunes and swales.	Unknown	Unlikely
Acacia benthamii	P2	-	P	Sand, typically on limestone breakaways	Aug-Sept	Unlikely
Thelymitra variegata	P2	-	P	Sandy clay, sand, laterite.	Jun-Sep	Unlikely
Netrostylis sp. Chandala (G.J. Keighery 17055)	P2	-	P	Peaty soils on edges of swamps.	Feb, July	Unlikely
Austrostipa mundula	P3	-	P	Grey sand over limestone.	Sept-Nov	Unlikely
Beyeria cinerea subsp. *cinerea*	P3	-	P	Sand, limestone.	May-Oct	Unlikely
Cyathochaeta teretifolia	P3	-	P	Grey sand, sandy clay in swamps and creek edges.	Oct-Jan	Unlikely
Dillwynia dillwynioides	P3	-	P	Winter wet depressions on sandy soils	Aug - Dec	Unlikely
Jacksonia gracillima	P3	-	P	Sand, often adjacent to winter wet areas	Sep-Dec	Unlikely
Pimelea calcicola	P3	-	P	Sand, limestone on coastal ridges.	Sep-Nov	Unlikely
Sphaerolobium calcicola	P3	-	P	White-grey-brown sand, sandy clay over limestone, black peaty sandy clay. Tall dunes, winter-wet flats, interdunal swamps, low-lying areas.	Jun or Sep-Nov	Unlikely
Calandrinia oraria	P3	-	A/P	Coastal dunes, in low heath, sand over limestone.	Aug-Oct	Unlikely
Schoenus capillifolius	P3	-	A	Brown mud in claypans.	Oct-Nov	Unlikely
Stylidium paludicola	P3	-	P	Peaty sand over clay. Winter wet habitats. Marri and Melaleuca woodland, Melaleuca shrubland	Oct-Dec	Unlikely
Dodonaea hackettiana	P4	-	P	Sand, outcropping limestone.	Jul-Oct	Unlikely
Jacksonia sericea	P4	-	P	Calcareous and sandy soils on Swan Coastal Plain	Dec-Feb	Unlikely
Aponogeton hexatepalus	P4	-	P	Mud. Freshwater: ponds, rivers, claypans.	Jul-Oct	Unlikely
Stylidium ireneae	P4	-	P	Sandy loam in valleys near creeklines.	Oct-Dec	Unlikely
Stylidium longitubum	P4	-	A	Sandy clay, clay. Seasonal wetlands.	Oct-Dec	Unlikely

Note: T=threatened, CE=critically endangered, E=endangered, V=vulnerable, P1=Priority 1, P2=Priority 2, P3=Priority 3, P4=Priority 4, P=perennial, PG=perennial geophyte, A=annual. Species considered to potentially occur within the site are shaded green

Appendix C

Species List

Family	Status	Species
Agapanthaceae		
	*	*?Agapanthus praecox*
Agapanthaceae		
	*	*Carpobrotus edulis*
	*	*Tetragonia decumbens*
Alliaceae		
	*	*Allium sp.*
Apiaceae		
		Centella asiatica
Apocynaceae		
	*	*?Nerium oleander*
Asparagaceae		
		Acanthocarpus preissii
	*	*Agave americana*
		Lomandra caespitosa
		Lomandra micrantha subsp. micrantha
		Lomandra preissii
Asteraceae		
	*	*Arctotheca calendula*
	*	*Cirsium vulgare*
	*	*Erigeron bonariensis*
	*	*Erigeron sp.*
	*	*Sonchus oleraceus*
	*	*Ursinia anthemoides*
Caprifoliaceae		
	*	*Sixalix atropurpurea*
Casuarinaceae		
		Allocasuarina fraseriana
Chenopodiaceae		
		?*Rhagodia baccata*
Colchicaceae		
		Burchardia congesta
Cyperaceae		
		Ficinia nodosa
		Gahnia trifida
		Lepidosperma calcicola
		Lepidosperma longitudinale
Dilleniaceae		
		Hibbertia hypericoides
Droseraceae		
		Drosera ?pallida
Ericaceae		
		Styphelia propinqua
Euphorbiaceae		
	*	*Euphorbia sp.*
Fabaceae		
		Acacia pulchella subsp. glaberrima
		Acacia rostellifera

		Acacia saligna
		Gompholobium tomentosum
		Hardenbergia comptoniana
		Hovea trisperma
		Jacksonia furcellata
		Kennedia prostrata
	*	*Lupinus sp.*
Geraniaceae		
	*	*Pelargonium capitatum*
Haemodoraceae		
		Conostylis aculeata
Hemerocallidaceae		
		Corynotheca micrantha
		Dianella revoluta
Iridaceae		
	*	*?Freesia alba x leichtlinii*
	*	*Gladiolus caryophyllaceous*
	*	*Romulea rosea*
Malvaceae		
		Malva parviflora
Meliaceae		
	*	*Melia azedarach*
Moraceae		
	*	*Ficus carica*
Myrtaceae		
		Agonis flexuosa
	*	*Eucalyptus camaldulensis*
		Eucalyptus gomphocephala
		Melaleuca raphiophylla
Orchidaceae		
		Caladenia ?marginata
		Caladenia sp.
Oxalidaceae		
	*	*Oxalis pes-caprae*
Plantaginaceae		
	*	*Plantago lanceolata*
Poaceae		
	*	*Bambusa sp.*
	*	*Cenchrus ?setaceus*
	*	*Cynodon dactylon*
	*	*Ehrharta sp.*
	*	*Eragrostis curvula*
	*	*Hyparrhenia hirta*
	*	*Paspalum distichum*
	*	*Stenotaphrum secundatum*
Polygonaceae		
		?Muehlenbeckia adpressa

Proteaceae		
		Banksia attenuata
		Banksia grandis
		Banksia littoralis
	Pl, +	*Grevillea olivacea*
		Grevillea vestita
		Hakea prostrata
Restionaceae		
		Desmocladus ?flexuosus
Rhamnaceae		
		Spyridium globulosum
Rubiaceae		
		Opercularia hispidula
Solanaceae		
	*	*Solanum nigrum*
Verbenaceae		
	*	*Phyla nodiflora var. nodiflora*
Xanthorrhoeaceae		
		Xanthorrhoea preissii
Zamiaceae		
		Macrozamia fraseri

*=non-native, DP=declared pest Pl=planted, +=species listed as priority 4 but planted in this area and therefore not considered conservation significant.

Appendix D

Conservation Significant Communities and Likelihood of Occurrence Assessment

Conservation Significant Communities Likelihood of Occurrence
Part Mandurah Road Reserve between Fifty Road and Safety Bay Road

Code	Community name	TEC/ PEC	Level of significance		Likelihood of occurrence
			State	EPBC Act	
SCP3a	*Corymbia calophylla - Kingia australis* woodlands on heavy soils of the Swan Coastal Plain	TEC	CR	EN	Unlikely
SCP3c	*Corymbia calophylla - Xanthorrhoea preissii* woodlands and shrublands of the Swan Coastal Plain (floristic community type 3c as originally described in in Gibson et al. (1994))	TEC	CR	EN	Unlikely
SCP09	Dense shrublands on clay flats (floristic community type 9 as originally described in Gibson et al. (1994))	TEC	CR	CR	Unlikely
SCP08	Herb rich shrublands in clay pans (floristic community type 8 as originally described in Gibson et al. (1994))	TEC	VU	CR	Unlikely
-	Clay Pans of the Swan Coastal Plain	TEC	-	CR	Unlikely
SCP19a	Sedgelands in Holocene dune swales of the southern Swan Coastal Plain	TEC	CR	EN	Unlikely
SCP19b	Woodlands over sedgelands in Holocene dune swales of the southern Swan Coastal Plain	TEC	CR	EN	Unlikely
Mound Springs SCP	Communities of Tumulus Springs (Organic Mound Springs, Swan Coastal Plain)	TEC	CR	EN	Unlikely
Tuart woodlands	Tuart (*Eucalyptus gomphocephala*) woodlands and forests of the Swan Coastal Plain	TEC/ PEC	P3	CR	Likely
Banksia WL SCP	Banksia Woodlands of the Swan Coastal Plain ecological community	TEC/ PEC	P3	EN	Possible
SCP22	*Banksia ilicifolia* woodlands	TEC/ PEC	P3	EN	Unlikely
SCP21c	Low lying *Banksia attenuata* woodlands or shrublands	TEC/ PEC	P3	EN	Unlikely
SCP26a	*Melaleuca huegelii - Melaleuca systena* shrublands on limestone ridges (floristic community type 26a as originally described in Gibson et al. (1994))	TEC	EN	-	Unlikely
Richmond-microbial	Thrombolite (microbial) community of coastal freshwater lakes of the Swan Coastal Plain (Lake Richmond)	TEC	CR	EN	Unlikely
Coastal Saltmarsh	Subtropical and Temperate Coastal Saltmarsh	TEC/ PEC	P3	VU	Unlikely
SCP30a	*Callitris preissii* (or *Melaleuca lanceolata*) forests and woodlands, Swan Coastal Plain (floristic community type 30a as originally described in Gibson et al. (1994))	TEC	VU	-	Unlikely
Walyungup Microbial	Microbial community of a coastal saline lake (Lake Walyungup)	PEC	P1	-	Unlikely
SCP24	Northern Spearwood shrublands and woodlands	PEC	P3	-	Possible
SCP25	Southern *Eucalyptus gomphocephala - Agonis flexuosa* woodlands	PEC	P3	-	Unlikely
SCP29a	Coastal shrublands on shallow sands	PEC	P3	-	Unlikely
SCP29b	Acacia shrublands on taller dunes	PEC	P3	-	Unlikely

Note: TEC=threatened ecological community, PEC=priority ecological community, CR=critically endangered, EN=endangered, VU=vulnerable, P1=Priority 1, P3=priority 3. Communities that were recorded, or are considered to potentially occur within the site are shaded green

Appendix E

Tree Data

Tree Inventory

Part Mandurah Road Reserve between Fifty Road and Safety Bay Road

Tag No.	Easting	Northing	DBH (cm)	Species	Category	Notes
-	386623.55	6424377.09	191	Eucalyptus gomphocephala	Black cockatoo habitat tree	Potentially suitable hollow/s
-	386476.87	6424049.91	61	Eucalyptus gomphocephala	Black cockatoo habitat tree	No suitable hollow/s
-	386462.74	6424016.94	113	Eucalyptus gomphocephala	Black cockatoo habitat tree	Potentially suitable hollow/s
-	386454.63	6423993.01	90	Eucalyptus gomphocephala	Black cockatoo habitat tree	No suitable hollow/s
-	386434.75	6423944	81	Eucalyptus gomphocephala	Black cockatoo habitat tree	No suitable hollow/s
-	386399.04	6423821.2	104	Eucalyptus gomphocephala	Black cockatoo habitat tree	No suitable hollow/s
-	386376.21	6423657.4	194	Eucalyptus gomphocephala	Black cockatoo habitat tree	Potentially suitable hollow/s
-	386377.96	6423644.34	89	Eucalyptus gomphocephala	Black cockatoo habitat tree	No suitable hollow/s
-	386354.81	6423409.69	118	Eucalyptus gomphocephala	Black cockatoo habitat tree	Potentially suitable hollow/s
-	386322.09	6423280.05	87	Eucalyptus gomphocephala	Black cockatoo habitat tree	No suitable hollow/s
-	386312.93	6423224.17	63	Eucalyptus gomphocephala	Black cockatoo habitat tree	No suitable hollow/s
-	386312.78	6423221.4	84	Eucalyptus gomphocephala	Black cockatoo habitat tree	No suitable hollow/s
-	386352.12	6423414.1	54	Eucalyptus gomphocephala	Black cockatoo habitat tree	No suitable hollow/s
-	386339.94	6423325.7	161	Eucalyptus gomphocephala	Black cockatoo habitat tree	No suitable hollow/s
-	386598.11	6424353.74	96	Eucalyptus gomphocephala	Black cockatoo habitat tree	No suitable hollow/s
-	386587.69	6424334.55	81	Eucalyptus gomphocephala	Black cockatoo habitat tree	No suitable hollow/s
-	386585.69	6424336.08	54	Eucalyptus gomphocephala	Black cockatoo habitat tree	No suitable hollow/s
-	386586.59	6424331.1	79	Eucalyptus gomphocephala	Black cockatoo habitat tree	No suitable hollow/s
-	386571.71	6424306.32	72	Eucalyptus gomphocephala	Black cockatoo habitat tree	No suitable hollow/s
-	386518.31	6424132.43	166	Eucalyptus gomphocephala	Black cockatoo habitat tree	Potentially suitable hollow/s
-	386462.17	6423992.1	73	Eucalyptus gomphocephala	Black cockatoo habitat tree	No suitable hollow/s
-	386430.43	6423951.27	130	Eucalyptus gomphocephala	Black cockatoo habitat tree	No suitable hollow/s
-	386405.69	6423840.56	102	Eucalyptus gomphocephala	Black cockatoo habitat tree	No suitable hollow/s
-	386394.64	6423768.15	93	Eucalyptus gomphocephala	Black cockatoo habitat tree	No suitable hollow/s
-	386381.64	6423627.3	105	Eucalyptus gomphocephala	Black cockatoo habitat tree	No suitable hollow/s
-	386379.2	6423626.17	92	Eucalyptus gomphocephala	Black cockatoo habitat tree	No suitable hollow/s
-	386372.24	6423558.57	109	Eucalyptus gomphocephala	Black cockatoo habitat tree	No suitable hollow/s
-	386375.97	6423565.45	127	Eucalyptus gomphocephala	Black cockatoo habitat tree	No suitable hollow/s
-	386350.39	6423467.52	149	Eucalyptus gomphocephala	Black cockatoo habitat tree	No suitable hollow/s
-	386347.35	6423445.2	117	Eucalyptus gomphocephala	Black cockatoo habitat tree	No suitable hollow/s
-	386335.88	6423351.94	100	Eucalyptus gomphocephala	Black cockatoo habitat tree	Potentially suitable hollow/s

Tree Inventory

Part Mandurah Road Reserve between Fifty Road and Safety Bay Road

Tag No.	Easting	Northing	DBH (cm)	Species	Category	Notes
-	386335.85	6423329.54	100	Eucalyptus gomphocephala	Black cockatoo habitat tree	No suitable hollow/s
-	386294.64	6423126.29	144	Eucalyptus gomphocephala	Black cockatoo habitat tree	No suitable hollow/s
-	386338.73	6423349.09	136	Eucalyptus gomphocephala	Black cockatoo habitat tree	Potentially suitable hollow/s
-	386463.93	6424003.42	56	Eucalyptus marginata	Black cockatoo habitat tree	No suitable hollow/s
-	386449.61	6423978.98	86	Eucalyptus marginata	Black cockatoo habitat tree	No suitable hollow/s
-	386346.88	6423453.29	58	Stag	Black cockatoo habitat tree	No suitable hollow/s
-	386257.81	6422995.15	64	Stag	Black cockatoo habitat tree	No suitable hollow/s
-	386492.23	6424081.91	118	Stag	Black cockatoo habitat tree	Potentially suitable hollow/s
-	386488.02	6424071	135	Stag	Black cockatoo habitat tree	Potentially suitable hollow/s
-	386331.14	6423304.65	50	Stag	Black cockatoo habitat tree	Potentially suitable hollow/s
-	386334.09	6423301.36	161	Stag	Black cockatoo habitat tree	Potentially suitable hollow/s
-	386350.94	6423494.24	35-<50	Banksia attenuata	Tree	-
-	386536.15	6424203.81	15-35	Banksia attenuata	Tree	-
-	386540.58	6424178.13	15-35	Banksia attenuata	Tree	-
-	386320.57	6423273.27	35-<50	Eucalyptus gomphocephala	Tree	-
-	386320.89	6423268.83	15-35	Eucalyptus gomphocephala	Tree	-
-	386539.62	6424188.1	15-35	Eucalyptus marginata	Tree	-
-	386213.54	6422957.73	15-35	Eucalyptus sp.	Tree	-
-	386547.49	6424225.33	15-35	Melaleuca rhaphiophylla	Tree	-
-	386551.58	6424221.28	15-35	Melaleuca rhaphiophylla	Tree	-
-	386550.58	6424226.14	15-35	Melaleuca rhaphiophylla	Tree	-