8 FLORA AND VEGETATION

8.1 EPA Objectives

The EPA's objective in respect of flora and vegetation (EPA, 2015a) is to maintain representation, diversity, viability and ecological function at the species, population and community level.

8.2 Existing Environment

A detailed flora and vegetation survey was conducted in 2014 (Coffey, 2015a) (Appendix C) and built on previous survey work (GHD, 2013b; 360 Environmental 2014a). These surveys were undertaken as follows:

- GHD (2013b) – three days in September 2012.
- 360 Environmental (2014a) – nine days between 15 September and 26 November 2014.
- Coffey (2015a) – ten days in September 2014 and three days in November 2014.

The survey completed by Coffey (2015a) covered an area of approximately 3,074 ha (the 'flora study area'); which is approximately four times larger than the proposal footprint (746 ha) to provide a broader floristic context. The flora study area followed the alignment of the proposal footprint and extended to approximately 500 m from the edge of the proposal footprint in several locations south of Maralla Road. North of Maralla Road, the flora study area extended to the boundaries of the properties that the proposal footprint traverses. The flora study area was limited to properties where access was granted.

8.2.1 Flora

The 2014 spring flora and vegetation survey identified a total of 456 vascular flora species from 73 families and 234 genera. This included 357 native taxa (approximately 78% of the total) and 99 introduced taxa (Coffey, 2015a). The total number of vascular taxa recorded from the three main surveys along the proposal footprint is 485 native taxa and 149 introduced taxa. This is considered to represent a high diversity of flora on the SCP and is higher than comparable surveys in the proximity of the proposal footprint (Coffey, 2015a).

The families with the highest representation were Myrtaceae, Fabaceae, Orchidaceae, Cyperaceae, Poaceae and Asteraceae (Coffey, 2015a).

8.2.2 Conservation Significant Flora of the Region

A desktop search of Department of Parks and Wildlife (DPAW) and DOTE databases and previous biological surveys for significant taxa (Threatened and Priority Listed) occurring within and in proximity to the proposal footprint was used in association with the field studies in determining the likelihood of significant taxa occurring within the proposal footprint.

The desktop search identified 25 Threatened and 45 Priority listed (two Priority 1, nine Priority 2, 21 Priority 3 and 13 Priority 4) taxa as occurring within and in proximity to the proposal footprint (Figure 8.1 and Table 8.1).

8.2.3 Conservation Significant Flora

Three Threatened and eight Priority listed flora recorded from the flora study area (see Figure 8.1), are listed under the WC Act, the EPBC Act or protected by DPAW (Coffey, 2015a). The Threatened and Priority listed flora recorded from the flora study area include:

- *Caladenia huegelii* (CR – State and EN – Commonwealth).
- *Darwinia foetida* (EN – State and CR – Commonwealth).
- *Grevillea curviloba* subsp. *incurva* (EN – State and Commonwealth).
- *Millotia tenuifolia* var. *laevis* (P2).
- *Poranthera moorokatta* (P2).
- *Cyathochaeta teretifolia* (P3).
- *Meeboldina decipiens* subsp. *decipiens* ms (P3).
- *Anigozanthos humilis* subsp. *chrysanthus* (P4).
- *Hypolaena robusta* (P4).
- *Ornduffia submersa* (P4).
- *Stylidium striatum* (P4).

Table 8.1 Threatened and priority listed flora occurring in proximity to the proposal footprint

Taxon	Conservation code			Generalised description of known locations	Flowering period	Closest record (km)	Likelihood of occurrence in the proposal footprint[2]
	EPBC Act	WC Act[1]	DPAW				
Acacia anomala	VU	VU	–	Lateritic soils. Slopes.	Aug to Sep	0.04	Unlikely
Acacia benthamii	–	–	2	Sand. Typically on limestone breakaways.	Aug to Sep	1.2	Unlikely
Acacia drummondii subsp. *affinis*	–	–	3	Lateritic gravelly soils.	Jul to Aug	1.3	Unlikely
Acacia oncinophylla subsp. *oncinophylla*	–	–	3	Granitic soils.	Aug to Oct	6.1	Unlikely
Acacia ridleyana	–	–	3	Grey or yellow/brown sand, gravelly clay, granitic loam.	Aug to Dec	5.3	Unlikely
Adenanthos cygnorum subsp. *chamaephyton*	–	–	3	Grey sand, lateritic gravel.	Jul or Sep to Dec or Jan	0.8	Unlikely
Andersonia gracilis	EN	VU	–	Heath associated with *Banksia telmatiaea* on sandplains, sandy clay, gravelly loam. Winter-wet areas, near swamps	Sep to Nov	16	Unlikely
Anigozanthos humilis subsp. *chrysanthus*	–	–	4	Grey or yellow sand.	Jul to Oct	5.6	Unlikely
Anigozanthos viridis subsp. *terraspectans*	VU	VU	–	Low heath associated with *Banksia telmatiaea* on sandplains, clay loam. Winter-wet depressions.	Aug to Sep	>50	Unlikely
Caladenia huegelii	EN	CR	–	Grey or brown sand, clay loam.	Sep to Oct	0.03	Likely
Calectasia sp. Pinjar (C. Tauss 557)	–	–	1	Deep grey quartz soils. Gentle slopes, above damplands.	Oct to Nov	2.3	Unlikely
Calytrix breviseta subsp. *breviseta*	EN	CR	–	Sandy clay. Swampy flats.	Oct to Nov	7.3	Unlikely

Taxon	Conservation code			Generalised description of known locations	Flowering period	Closest record (km)	Likelihood of occurrence in the proposal footprint[2]
	EPBC Act	WC Act[1]	DPAW				
Centrolepis caespitosa	EN	–	4	Brown, orange or grey clay. Salt flats, wet areas.	Oct to Dec	3.9	Possible
Chamaescilla gibsonii	–	–	3	Clay to sandy clay. Winter-wet flats, shallow water-filled claypans.	Sep	0.6	Possible
Chamelaucium sp. Gingin (N.G. Marchant 6)	EN	VU	–	Yellow undulating sand, red- brown gravel supporting open low woodland over open scrub.	May and Oct to Feb	9.2	Unlikely
Conospermum densiflorum subsp. *unicephalatum*	EN	EN	–	Heath with brown clay soils. Low-lying areas. Loam, loam-clay over laterite. Laterite	Sep to Nov	>50	Unlikely
Conospermum undulatum	VU	VU	–	Swamps with grey or yellow-orange clayey sand, peaty sand over clay	May to Oct	0.7	Possible
Cyanicula ixioides subsp. *ixioides*	–	–	4	Laterite, gravel.	Aug to Oct	3.8	Unlikely
Cyathochaeta teretifolia	–	–	3	Grey sand, sandy clay. Swamps, creek edges.	Jan	0	Present
Darwinia foetida	CR	EN	–	Grey-white sand on swampy, seasonally wet sites.	Oct to Nov	0.3	Likely
Darwinia pimelioides	–	–	4	Loam, sandy Loam. Granite outcrops.	Sep to Oct	4.8	Possible
Diuris micrantha	VU	VU	–	Herblands with brown loamy clay. Winter-wet swamps, in shallow water.	Sep to Oct	38	Unlikely
Diuris purdiei	EN	EN	–	Grey-black sand, moist. Winter-wet swamps.	Sep to Oct	14.5	Unlikely
Drakaea elastica	EN	CR	–	*Kunzea glabrescens* thickets with white or grey sand. Low-lying situations adjoining winter-wet swamps.	Oct to Nov	7	Unlikely

Taxon	Conservation code			Generalised description of known locations	Flowering period	Closest record (km)	Likelihood of occurrence in the proposal footprint[2]
	EPBC Act	WC Act[1]	DPAW				
Drakaea micrantha	VU	EN	–	Jarrah forest with white-grey sand.	Sep to Oct	25.3	Unlikely
Drosera occidentalis subsp. *occidentalis*	–	–	4	Sandy & clayey soils. Swamps & wet depressions.	Nov to Dec	0.04	Likely
Eleocharis keigheryi	VU	VU	–	Clay, sandy loam. Emergent in freshwater: creeks, claypans.	Aug to Nov	1.9	Possible
Eryngium pinnatifidum subsp. Palustre (G.J. Keighery 13459) PN	–	–	3	Winter-wet flats. Brown sandy loam.	Nov	0	Present
Eucalyptus x *balanites*	EN	CR	–	Sandy soils with lateritic gravel.	Oct to Dec or Jan to Feb	4.7	Unlikely
Eucalyptus leprophloia	EN	EN	–	White or grey sand over laterite. Valley slopes.	Aug to Oct	>135	Unlikely
Grevillea althoferorum subsp. *fragilis*	EN	CR	–	Crests, pale brown loamy sand or grey sand over yellow sands.	Aug to Nov	4.2	Possible
Grevillea corrugata	EN	VU	–	Woodlands associated with Wandoo on gravelly lateritic loam. Brown – red loam, clay-loam over Laterite/granite.	?Aug to Sep	12.3	Unlikely
Grevillea curviloba subsp. *curviloba*	EN	CR	–	Grey sand. Winter-wet heath.	Oct	0.04	Likely
Grevillea curviloba subsp. *incurva*	EN	EN	–	Roadsides associated with *Acacia saligna* on sand, sandy loam. Winter-wet heath.	Aug to Sep	0.02	Likely
Guichenotia tuberculata	–	–	3	Sand clay over laterite, sand.	Aug to Oct	0.04	Possible
Haemodorum loratum	–	–	3	Grey or yellow sand, gravel.	Nov	1.9	Possible

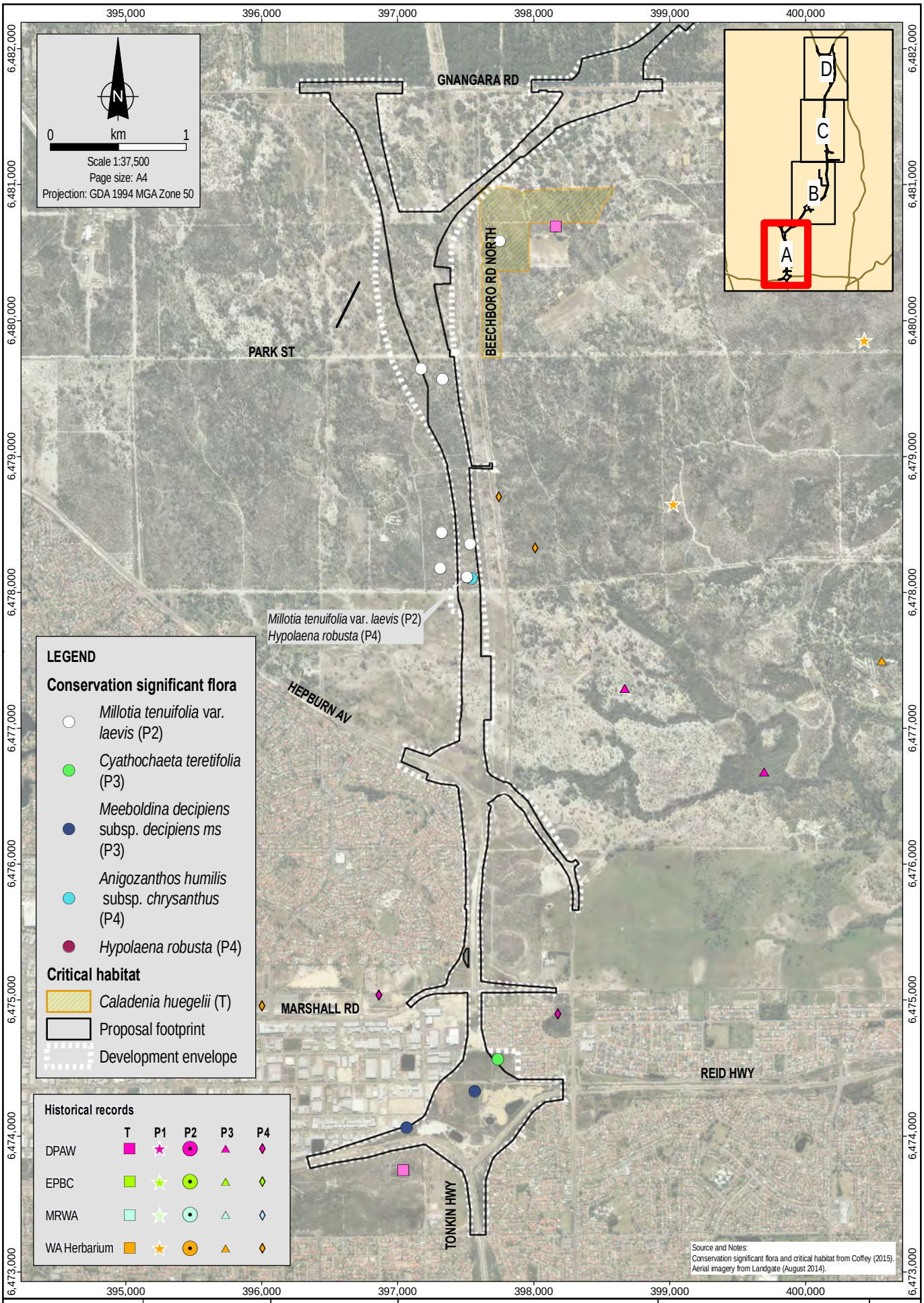
Taxon	Conservation code			Generalised description of known locations	Flowering period	Closest record (km)	Likelihood of occurrence in the proposal footprint[2]
	EPBC Act	WC Act[1]	DPAW				
Hibbertia helianthemoides	–	–	4	Clayey sand over sandstone or loam over quartzite. Hills and scree slopes.	Jul or Sep to Oct	7.4	Unlikely
Hydrocotyle lemnoides	–	–	4	Swamps.	Aug to Oct	0.04	Likely
Hypolaena robusta	–	–	4	White sand. Sandplains.	Sep to Oct	0	Present
Isopogon drummondii	–	–	3	White, grey or yellow sand, often over laterite.	Feb to Jun	5.3	Unlikely
Jacksonia sericea	–	–	4	Calcareous & sandy soils.	Usually Dec or Jan to Feb	0.4	Possible
Lepidosperma rostratum	EN	EN	–	Sedgeland on clay. Seasonal clay based open depression.	May to Jun	16.6	Unlikely
Leucopogon squarrosus subsp. *trigynus*	–	–	2	White, grey sand.	Jun	3.9	Possible
Macarthuria keigheryi	EN	EN	–	White or grey sand. Associated with Banksia woodlands.	Sep to Dec or Feb to Mar	6.7	Unlikely
Meionectes tenuifolia	–	–	3	Granite flats, shallow soil at margins, inundated. Grey clay.	Sep to Dec	2.1	Possible
Oxymyrrhine coronata	–	–	4	Yellow sand-clay-gravel over laterite.	Dec	9.9	Unlikely
Persoonia rudis	–	–	3	White, grey or yellow sand, often over laterite.	Sep to Dec or Jan	3.6	Possible
Phlebocarya pilosissima subsp. *pilosissima*	–	–	3	White or grey sand, lateritic gravel.	Aug to Oct	0.13	Possible
Platysace ramosissima	–	–	3	Sandy soils.	Oct to Nov	0.7	Likely

Taxon	Conservation code			Generalised description of known locations	Flowering period	Closest record (km)	Likelihood of occurrence in the proposal footprint[2]
	EPBC Act	WC Act[1]	DPAW				
Poranthera moorokatta	–	–	2	White silica sand in open spaces between shrubs.	Sep to Oct	1	Likely
Schoenus capillifolius	–	–	3	Brown mud. Claypans.	Oct to Nov	3.4	Possible
Schoenus griffinianus	–	–	3	White sand.	Sep to Oct	6.9	Unlikely
Schoenus sp. Bullsbrook (J.J. Alford 915)	–	–	2	Grey peaty sand. Low-lying flats.	Oct	3.2	Possible
Schoenus sp. Waroona (G.J. Keighery 12235)	–	–	3	Clay or sandy clay. Winter-wet flats.	Oct to Nov	4	Possible
Stachystemon sp. Keysbrook (R. Archer 17/11/99)	–	–	1	Grey sand.	Oct	1.5	Possible
Stenanthemum sublineare	–	–	2	Littered white sand. Coastal plain.	Oct to Dec	7.8	Unlikely
Stylidium aceratum	–	–	2	Sandy soils. Swamp heathland.	Oct to Nov	3.2	Possible
Stylidium longitubum	–	–	3	Sandy clay, clay. Seasonal wetlands.	Oct to Dec	1.3	Possible
Stylidium paludicola	–	–	3	Peaty sand over clay. Winter wet habitats. Marri and Melaleuca woodland, Melaleuca shrubland.	Oct to Dec	1.2	Possible
Stylidium squamellosum	–	–	2	Brown to red-brown clay loam. Winter-wet habitats and depressions, open woodland, shrubland.	Oct to Nov	1.3	Possible
Stylidium trudgenii	–	–	3	Grey sand, dark grey to black sandy peat. Margins of winter-wet swamps, depressions.	Nov to Jan	0.8	Likely
Synaphea grandis	–	–	4	Laterite.	Oct to Nov	2	Possible

Taxon	Conservation code			Generalised description of known locations	Flowering period	Closest record (km)	Likelihood of occurrence in the proposal footprint[2]
	EPBC Act	WC Act[1]	DPAW				
Tetraria sp. Chandala (G.J. Keighery 17055)	–	–	2	Mound spring, black peat over clay & humic sand.	Jul to Feb	4.8	Possible
Thelymitra dedmaniarum	EN	CR	–	Granite.	Nov to Dec or Jan	10.3	Unlikely
Thelymitra stellata	EN	EN		Sand, gravel, lateritic loam.	Oct to Nov	2.8	Possible
Thysanotus glaucus	–	–	4	White, grey or yellow sand, sandy gravel.	Oct to Dec or Jan to Mar	6.9	Unlikely
Trichocline sp. Treeton (B.J. Keighery & N. Gibson 564)	–	–	2	Sand over limestone, sandy clay over ironstone. Seasonally wet flats.	Dec to Jan	1.6	Possible
Trithuria occidentalis	EN	CR	–	Edge of shallow, winter-wet brown- grey claypans in very open shrubland of *Melaleuca lateritia*.	Oct to Nov	1.9	Possible
Verticordia lindleyi subsp. *lindleyi*	–	–	4	Sand, sandy clay. Winter-wet depressions.	May or Nov to Dec or Jan	0.2	Likely
Verticordia serrata var. *linearis*	–	–	3	White sand, gravel. Open woodland.	Sep to Oct	0.04	Likely

Source: Coffey (2015a) (Appendix C).

1. *Wildlife Conservation Act 1950*.
2. 'Present' = occurring within the proposal footprint based on surveys.
   'Likely' = suitable habitat present and records within 1 km from the proposal footprint.
   'Possible' = suitable habitat present, but records within 1 km to 5 km from the proposal footprint.
   'Unlikely' = a lack of suitable habitat, and/or there are no records closer than 5 km from the proposal footprint.



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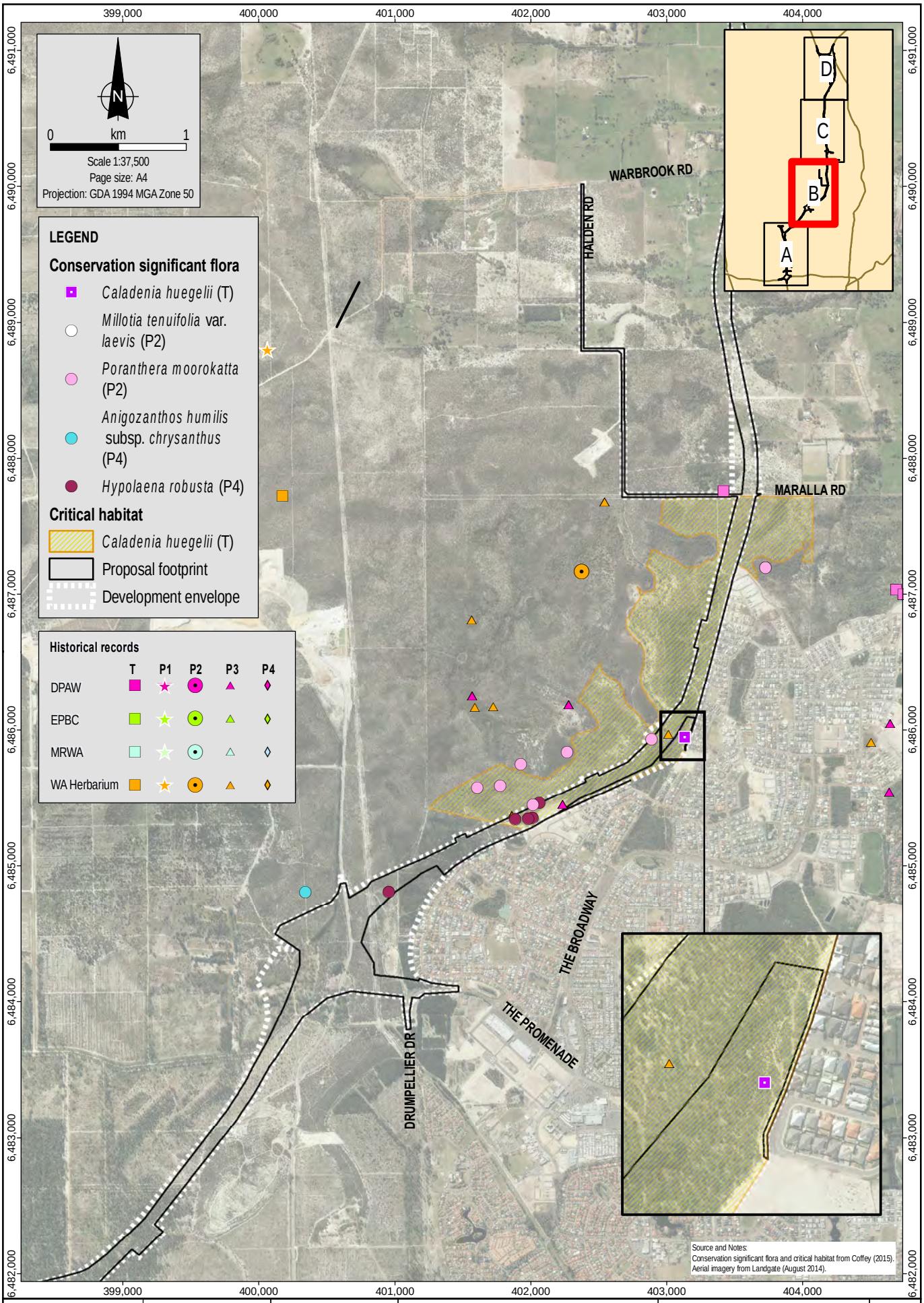
Conservation significant flora
Map 1 of 4

Figure No:
8.1A



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Conservation significant flora
Map 2 of 4

Figure No:
8.1B

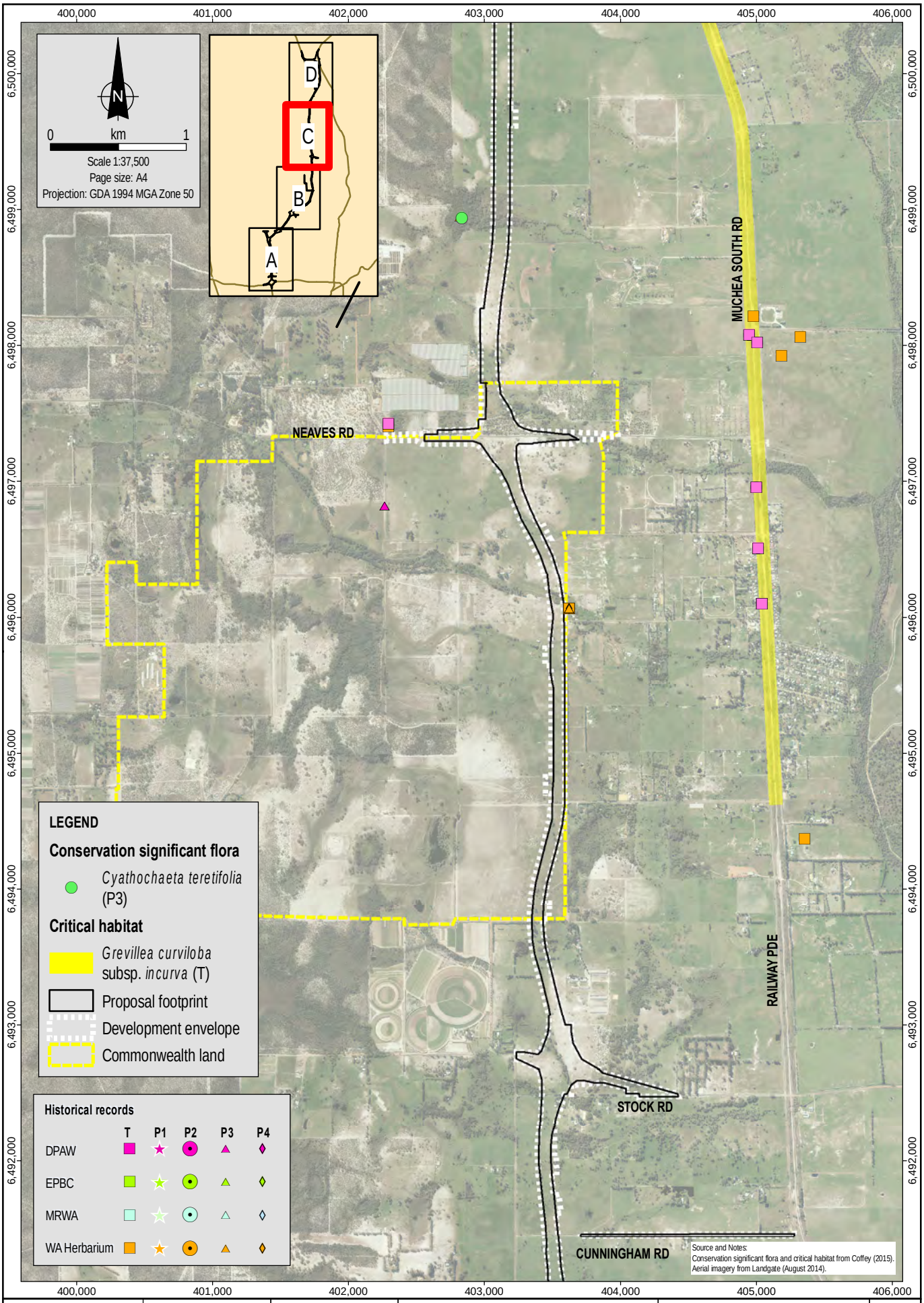

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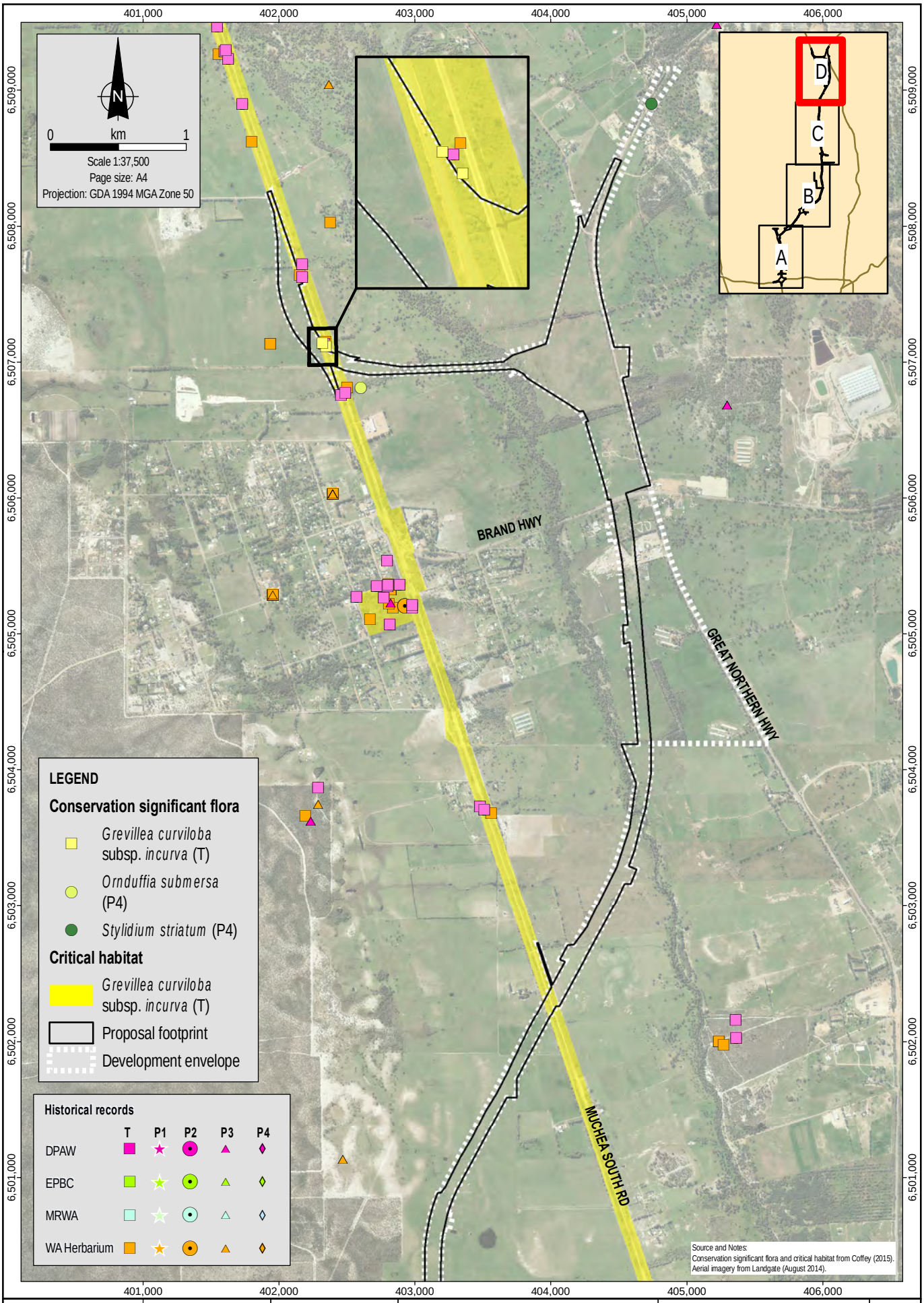
Figure No:
8.1C



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Conservation significant flora
Map 4 of 4

Figure No:
8.1D

8.2.4 Broad Vegetation Communities of the Region

The proposal footprint is located within the Drummond Botanical Subdistrict of the SCP subregion which is mainly comprised of Banksia low woodlands on leached sands with Melaleuca swamps on ill-drained sites with woodland of Tuart, Jarrah and Marri on less leached sands (Beard, 1990).

The Interim Biogeographic Regionalisation for Australia (IBRA) divides Australia into 89 bioregions based on major biological and geographical or geological attributes (Thackway and Cresswell, 1995). The flora study area is located within the Perth IBRA subregion (SWA02) of the Swan Coastal Plain IBRA bioregion (SWA).

The SWA IBRA bioregion is a low-lying coastal plain, mainly covered with woodlands. It is dominated by Banksia (*Banksia* spp.) or Tuart (*Eucalyptus gomphocephala*) on sandy soils with *Casuarina obesa* on outwash plains, and paperbark (*Melaleuca* spp.) in swampy areas. In the east, the plain rises to duricrusted Mesozoic sediments dominated by Jarrah (*E. marginata*) woodland (Mitchell et al., 2002).

The Perth IBRA subregion is composed of colluvial and aeolian sands, alluvial river flats and coastal limestone. Heaths and/or Tuart woodlands occur on limestone with Banksia and Jarrah-Banksia woodlands on the Quaternary marine dunes, while Marri (*Corymbia calophylla*) exist on colluvials and alluvials. The Perth IBRA subregion also includes a complex series of seasonal wetlands (adapted from Mitchell et al., 2002).

The SWA IBRA bioregion is not considered to be a bioregion with less than 10% protection (DOTE, 2014b). Both the SWA IBRA bioregion and the Perth IBRA subregion have between 10 and 15% of their current area protected within International Union for the Conservation of Nature (IUCN) Class I-IV Reserves (i.e. National Parks, Nature Reserves).

Five vegetation complexes occur across the proposal footprint (Heddle et al, 1980). The five vegetation complexes that occur and the extent remaining on the SCP are detailed in Table 8.2.

Table 8.2 Native vegetation extent remaining on the Swan Coastal Plain

Vegetation complex	Pre-European extent (ha)[1]	2013 extent (ha)[1]	Pre-European extent remaining (%)[1]	Formal protection[2] (ha)	Pre-European extent within formal protection (%)[1]
Bassendean Complex-Central and South	87,392	24,206	27.70	2,244	2.57
Bassendean Complex-North Transition	17,640	16,126	91.42	11,318	64.16
Bassendean Complex-North	74,133	53,518	72.19	26,442	35.67
Southern River Complex	57,172	11,255	19.69	1,234	2.16
Yanga Complex	26,176	4,645	17.75	530	2.02

1. Pre-European extents from WALGA (2013).
2. WALGA (2013) states "formal protection includes DPAW conservation estates, Bush Forever on DPAW managed lands and Bush Forever in Regional Parks".

The National Objectives and Targets for Biodiversity Conservation 2001-2005 recognises that retention of 30% or more of the pre-clearing extent of each vegetation complex is necessary if Australia's biological diversity is to be protected (Environment Australia, 2001). In addition to the 30% retention target, the EPA has adopted a 10% level of pre-clearing extent as representing 'endangered' (EPA, 2000). The SWA IBRA

bioregion is considered a constrained area (Government of Western Australia, 2000b) and as such the retention target for the vegetation complexes on the SCP is 10%.

The Bassendean-North Transition and Bassendean-North vegetation complexes currently have greater than 30% of their pre-European extent remaining on the SCP (WALGA, 2013). The pre-European extent remaining on the SCP for the remaining three vegetation complexes are above the level of 10% (WALGA, 2013) for it to be classified as endangered (EPA, 2000).

Of the five vegetation complexes occurring within the proposal footprint, only the Bassendean-North Transition and Bassendean-North vegetation complexes have greater than 30% of their pre-European extent remaining on the SCP in formal protection. The remaining three vegetation complexes have less than 10% of their pre-European extent remaining on the SCP in formal protection.

8.2.5 Vegetation Associations

The vegetation recorded from the flora study area can be grouped into eight broad floristic formations (excluding cleared and built up areas):

- *Astartea* tall shrubland to open tall shrubland.
- *Banksia* sparse low woodland.
- *Cenchrus* grassland.
- *Corymbia* sparse mid woodland.
- *Eucalyptus* sparse mid woodland.
- *Melaleuca* open low woodland.
- *Pinus* mid woodland.
- *Xanthorrhoea* open tall shrubland.

Upon further refinement of the broad floristic formations, and with the aid of statistical analysis, review of aerial imagery and information available on the soils and landforms, the eight broad floristic formations were differentiated into 60 vegetation associations. A further six mapping units have been delineated from the flora study area. These included highly modified areas ($CcEr^3$, Pp, Rehab, R, and Former Settlements) and cleared areas (Cl) which include infrastructure and industry/development.

The 60 vegetation associations and six mapping units are described in Table 8.3 and mapped on Figure 8.2. The floristic information collected from the sampling sites located within the flora study area is provided in Appendix C.

Table 8.3 Vegetation associations

Unit code	Broad floristic formation and site preference	Vegetation association descriptions	Extent in flora study area (ha)
As	*Astartea* tall shrubland to open tall shrubland Floodplain/Dampland	*Astartea scoparia*, *Kunzea glabrescens* tall shrubland to tall open shrubland over **Holcus lanatus, *Bromus diandrus* and **Vulpia bromoides* low grassland over **Romulea rosea, *Hypochaeris glabra* and **Lotus subbiflorus* open to isolated low herbs.	3.4 (0.1%)
AsMlEvCl	*Astartea* tall shrubland to open tall shrubland Dampland	*Astartea scoparia, Melaleuca lateritia, Eutaxia virgata* closed mid shrubland over *Lepidosperma striatum* and *Lepidosperma longitudinale* sparse tall sedgeland with occasional *Meeboldina* spp. and *Hypolaena exsulca* sparse tall rushland.	5.4 (0.2%)
Ba	*Banksia* sparse low woodland Flat plain	*Banksia attenuata* sparse low woodland and *Eucalyptus todtiana* isolated low mallee trees over *Melaleuca seriata, Eremaea pauciflora* var. *pauciflora* and *Xanthorrhoea preissii* sparse low shrubland over *Phlebocarya ciliata* open low herbland.	3.7 (0.1%)
BaBm[1]	*Banksia* sparse low woodland Dune slopes and crests	*Banksia attenuata* and *Banksia menziesii* low woodland to sparse low woodland over *Eremaea pauciflora* var. *pauciflora, Hibbertia hypericoides, Hibbertia subvaginata* sparse low shrubland over *Patersonia occidentalis* subsp. *occidentalis* sparse low herbland.	41.7 (1.4%)
BaBm[2]	*Banksia* sparse low woodland Dune slopes and crests	*Banksia attenuata* and *Banksia menziesii* low woodland to sparse low woodland over *Calytrix fraseri* (Ellenbrook Form), *Verticordia nitens* and *Beaufortia elegans* sparse mid shrubland over *Alexgeorgea nitens* and *Desmocladus flexuosus* sparse low rushland.	147.6 (4.9%)
BaBm[3]	*Banksia* sparse low woodland Flat plain to lower dune slopes	*Banksia attenuata, Banksia menziesii* low woodland over *Eremaea pauciflora* var. *pauciflora, Scholtzia* aff. *involucrata, Hibbertia hypericoides* open to sparse low shrubland over *Patersonia occidentalis* subsp. *occidentalis* sparse mid herbland.	41.9 (1.4%)
BaBmMp	*Banksia* sparse low woodland Flat, dampland	*Banksia attenuata, Banksia menziesii* and *Melaleuca preissiana* sparse low woodland over *Adenanthos cygnorum* subsp. *cygnorum, Regelia inops* and *Banksia ilicifolia* sparse tall shrubland over *Verticordia nitens* and *Astroloma xerophyllum* isolated mid shrubs.	7.5 (0.2%)
Bl	*Banksia* sparse low woodland Dampland	*Banksia littoralis* sparse low woodland over *Hypocalymma angustifolium* and *Pericalymma crassipes* closed mid shrubland over *Meeboldina scariosa* sparse tall rushland.	4.8 (0.2%)

Unit code	Broad floristic formation and site preference	Vegetation association descriptions	Extent in flora study area (ha)
BlMp	*Melaleuca* open low woodland Low depression, dampland	*Banksia littoralis* and *Melaleuca preissiana* sparse low woodland over *Astartea scoparia*, *Pericalymma crassipes* and *Kunzea glabrescens* closed mid shrubland to mid shrubland over *Schoenus caespititius* open tall sedgeland.	8.2 (0.3%)
Cc/Mp	*Corymbia* sparse mid woodland Dampland	*Corymbia calophylla* and/or *Melaleuca preissiana* mid woodland over *Banksia littoralis* sparse low woodland over *Xanthorrhoea preissii* and *Taxandria linearifolia* open to sparse tall shrubland.	15.8 (0.5%)
Cc[1]	*Corymbia* sparse mid woodland	*Corymbia calophylla* isolated clumps of mid trees with occasional *Eucalyptus marginata* subsp. *thalassica* mid trees over *Xanthorrhoea preissii* sparse mid shrubland over **Ehrharta calycina* and **Briza maxima* sparse low grassland.	263.2 (8.7%)
Cc[2]	*Corymbia* sparse mid woodland Dampland	*Corymbia calophylla* isolated mid trees over *Melaleuca preissiana* isolated low trees over *Xanthorrhoea preissii* sparse mid shrubland.	7.6 (0.3%)
Cc[3]	*Corymbia* sparse mid woodland Dune slope	*Corymbia calophylla* mid woodland over *Banksia attenuata* and *Banksia ilicifolia* sparse low woodland over *Xanthorrhoea preissii* and *Macrozamia fraseri* sparse tall shrubland.	3.7 (0.1%)
Cc[4]	*Corymbia* sparse mid woodland Dampland	*Corymbia calophylla* mid woodland over *Melaleuca preissiana* low woodland to sparse low woodland over *Dielsia stenostachya* closed mid rushland.	13.4 (0.4%)
Cc[5]	*Corymbia* sparse mid woodland Flat plain	*Corymbia calophylla* mid woodland over *Xanthorrhoea preissii* and *Jacksonia furcellata* sparse tall shrubland over *Dasypogon bromeliifolius*, *Patersonia occidentalis* subsp. *occidentalis*, **Ursinia anthemoides* low herbland.	45.1 (1.5%)
Cc[6]	*Corymbia* sparse mid woodland Flat plain	*Corymbia calophylla* sparse mid woodland over *Banksia menziesii, Banksia attenuata* and *Nuytsia floribunda* sparse low woodland over *Xanthorrhoea preissii* sparse tall shrubland.	16.9 (0.6%)
Cc[7]	*Corymbia* sparse mid woodland Plain on edge of dampland	*Corymbia calophylla* sparse mid woodland over *Banksia menziesii, Banksia attenuata* and occasional *Banksia ilicifolia* low woodland to sparse low woodland over *Hibbertia subvaginata* and *Petrophile linearis* sparse low shrubland.	4.9 (0.2%)

Unit code	Broad floristic formation and site preference	Vegetation association descriptions	Extent in flora study area (ha)
CcEm[1]	*Corymbia* sparse mid woodland Depression to low slopes	*Corymbia calophylla* and *Eucalyptus marginata* subsp. *thalassica* isolated clumps of mid trees over *Banksia attenuata, Banksia menziesii* and *Banksia ilicifolia* low woodland to sparse low woodland over *Xanthorrhoea brunonis* mid shrubland to open mid shrubland.	3.9 (0.1%)
CcEm[2]	*Corymbia* sparse mid woodland Flat plain, gently sloping	*Corymbia calophylla* and *Eucalyptus marginata* subsp. *thalassica* mid woodland to sparse mid woodland over *Xanthorrhoea preissii*, *Calytrix fraseri* (Ellenbrook Form), *Verticordia nitens* sparse mid shrubland over *Hibbertia hypericoides, Eremaea pauciflora* var. *pauciflora, Scholtzia* aff. *involucrata* open to sparse low shrubland.	92.5 (3.1%)
CcEr[1]	*Corymbia* sparse mid woodland	*Corymbia calophylla* and *Eucalyptus rudis* subsp. *rudis* isolated mid trees over *Astartea scoparia* and *Taxandria linearifolia* tall shrubland over **Cenchrus clandestinus* and **Holcus lanatus* closed low grassland.	9.3 (0.3%)
CcEr[2]	*Corymbia* sparse mid woodland	*Corymbia calophylla* and *Eucalyptus rudis* subsp. *rudis* isolated clumps of low trees over *Jacksonia furcellata* sparse tall shrubland over **Ehrharta calycina, *Bromus diandrus* and **Ehrharta longiflora* closed mid grassland.	20.6 (0.7%)
CcMp	*Corymbia* sparse mid woodland Relatively flat, on edge of depression	*Corymbia calophylla* and *Melaleuca preissiana* sparse mid woodland over *Banksia attenuata* and *Banksia ilicifolia* sparse low woodland over *Kunzea glabrescens* open tall shrubland.	1.0 (0.1%)
CcMpMr	*Corymbia* sparse mid woodland Road and rail verge (Brand Highway)	*Corymbia calophylla* isolated clumps of mid trees over *Melaleuca preissiana* and *Melaleuca rhaphiophylla* isolated clumps of low trees over grassland dominated by introduced grasses.	11.1 (0.4%)
Co	*Melaleuca* open low woodland Palusplain	*Casuarina obesa* isolated low trees over *Melaleuca concreta* open tall shrubland over *Lepidosperma longitudinale, Juncus pallidus, Schoenus caespititius* open mid sedgeland.	5.2 (0.2%)
Em[1]	*Eucalyptus* sparse mid woodland Flat plain	*Eucalyptus marginata* subsp. *thalassica* isolated mid trees over *Melaleuca preissiana* and occasional *Banksia attenuata* and *Banksia ilicifolia* low woodland over *Xanthorrhoea preissii*, *Hypocalymma angustifolium* and *Astroloma xerophyllum* open to sparse mid shrubland.	7.6 (0.2%)

Unit code	Broad floristic formation and site preference	Vegetation association descriptions	Extent in flora study area (ha)
Em[2]	*Eucalyptus* sparse mid woodland Low hill	*Eucalyptus marginata* subsp. *thalassica* sparse mid woodland over *Banksia menziesii* low woodland over *Xanthorrhoea preissii* sparse tall shrubland.	30.4 (1.0%)
Ep	*Banksia* sparse low woodland Flat plain	*Banksia* spp. sparse low woodland over *Eremaea pauciflora* subsp. *pauciflora Melaleuca striata, Beaufortia elegans* low shrubland over *Patersonia occidentalis, Dasypogon bromeliifolius*, sparse herbland.	4.8 (0.2%)
EpRi	*Banksia* sparse low woodland Dune slope	*Banksia* spp. sparse low woodland over *Eremaea pauciflora, Calytrix flavescens* and *Regelia inops* sparse low shrubland over *Patersonia occidentalis, Dasypogon bromeliifolius* and *Podotheca gnaphalioides* sparse herbland.	0.9 (0.1%)
Er[1]	*Eucalyptus* sparse mid woodland Palusplain	*Eucalyptus rudis* subsp. *rudis* and occasional *Corymbia calophylla* sparse mid woodland over *Astartea scoparia*, *Kunzea glabrescens* and *Aotus gracillima* open tall shrubland over *Desmocladus flexuosus* and *Dielsia stenostachya* isolated low rushes.	8.3 (0.3%)
Er[2]	*Eucalyptus* sparse mid woodland Dampland/Palusplain	*Eucalyptus rudis* subsp. *rudis* isolated mid trees over *Astartea scoparia, Melaleuca teretifolia* and *Melaleuca lateritia* closed tall shrubland to open tall shrubland over *Lepidosperma longitudinale* and *Schoenus caespititius* sparse mid sedgeland.	4.8 (0.2%)
Er[3]	*Eucalyptus* sparse mid woodland Dampland	*Eucalyptus rudis* subsp. *rudis* isolated mid trees over *Melaleuca preissiana, Banksia littoralis* and occasional *Melaleuca rhaphiophylla* sparse low woodland over *Astartea scoparia, Melaleuca teretifolia* and *Hypocalymma angustifolium* closed tall shrubland to tall shrubland.	12.8 (0.4%)
Er[4]	*Eucalyptus* sparse mid woodland Floodplain	*Eucalyptus rudis* subsp. *rudis* open mid forest over *Hardenbergia comptoniana* open tall shrubland over *Pteridium esculentum* subsp. *esculentum* tall herbland.	3.5 (0.1%)
Er[5]	*Eucalyptus* sparse mid woodland Creekline/floodplain	*Eucalyptus rudis* subsp. *rudis* sparse mid woodland over *Melaleuca preissiana* and *Melaleuca rhaphiophylla* low woodland over **Zantedeschia aethiopica* and **Rorippa nasturtium-aquaticum* open mid herbland.	0.9 (0.1%)

Unit code	Broad floristic formation and site preference	Vegetation association descriptions	Extent in flora study area (ha)
Er[6]	*Eucalyptus* sparse mid woodland Creekline/floodplain	*Eucalyptus rudis* subsp. rudis sparse mid woodland over *Melaleuca rhaphiophylla* sparse low woodland over **Lolium rigidum, *Ehrharta longiflora* and **Cenchrus clandestinus* low grassland.	51.8 (1.7%)
Er[7]	*Eucalyptus* sparse mid woodland Creekline/floodplain	*Eucalyptus rudis* subsp. *rudis* sparse mid woodland over **Zantedeschia aethiopica* tall herbland over low grassland (dominated by introduced species).	4.4 (0.1%)
Er[8]	*Eucalyptus* sparse mid woodland Creekline/floodplain	*Eucalyptus rudis* subsp. *rudis*, *Corymbia calophylla* sparse mid woodland over *Melaleuca preissiana* and *Melaleuca rhaphiophylla* isolated clumps of low trees over **Holcus lanatus* and **Cenchrus clandestinus* closed mid grassland.	5.5 (0.2%)
ErCo	*Eucalyptus* sparse mid woodland Floodplain	*Eucalyptus rudis* subsp. *rudis, Casuarina obesa* and *Melaleuca* sp. open low forest over **Ehrharta longiflora, *Ehrharta calycina* and **Lolium rigidum* low grassland over **Lotus subbiflorus* and **Moraea flaccida* sparse low herbland.	4.7 (0.2%)
ErMp	*Eucalyptus* sparse mid woodland Sumpland	*Eucalyptus rudis* subsp. *rudis* and *Melaleuca preissiana* sparse mid woodland over **Acacia longifolia* subsp. *longifolia* closed tall shrubland over *Astartea scoparia* sparse mid shrubland.	11.7 (0.4%)
ErMrMc	*Eucalyptus* sparse mid woodland Floodplain	*Eucalyptus rudis* subsp. *rudis, Melaleuca rhaphiophylla* and *Melaleuca concreta* open low forest over **Moraea flaccida* sparse mid herbland over **Lolium rigidum, *Ehrharta longiflora* and **Cynodon dactylon* mid grassland.	2.3 (0.1%)
Et[1]	*Eucalyptus* sparse mid woodland Dune rise	*Eucalyptus todtiana* isolated mid mallee trees over *Banksia attenuata, Banksia menziesii* and *Nuytsia floribunda* sparse low woodland over *Allocasuarina humilis, Jacksonia floribunda* and *Stirlingia latifolia* sparse mid shrubland.	13.8 (0.5%)

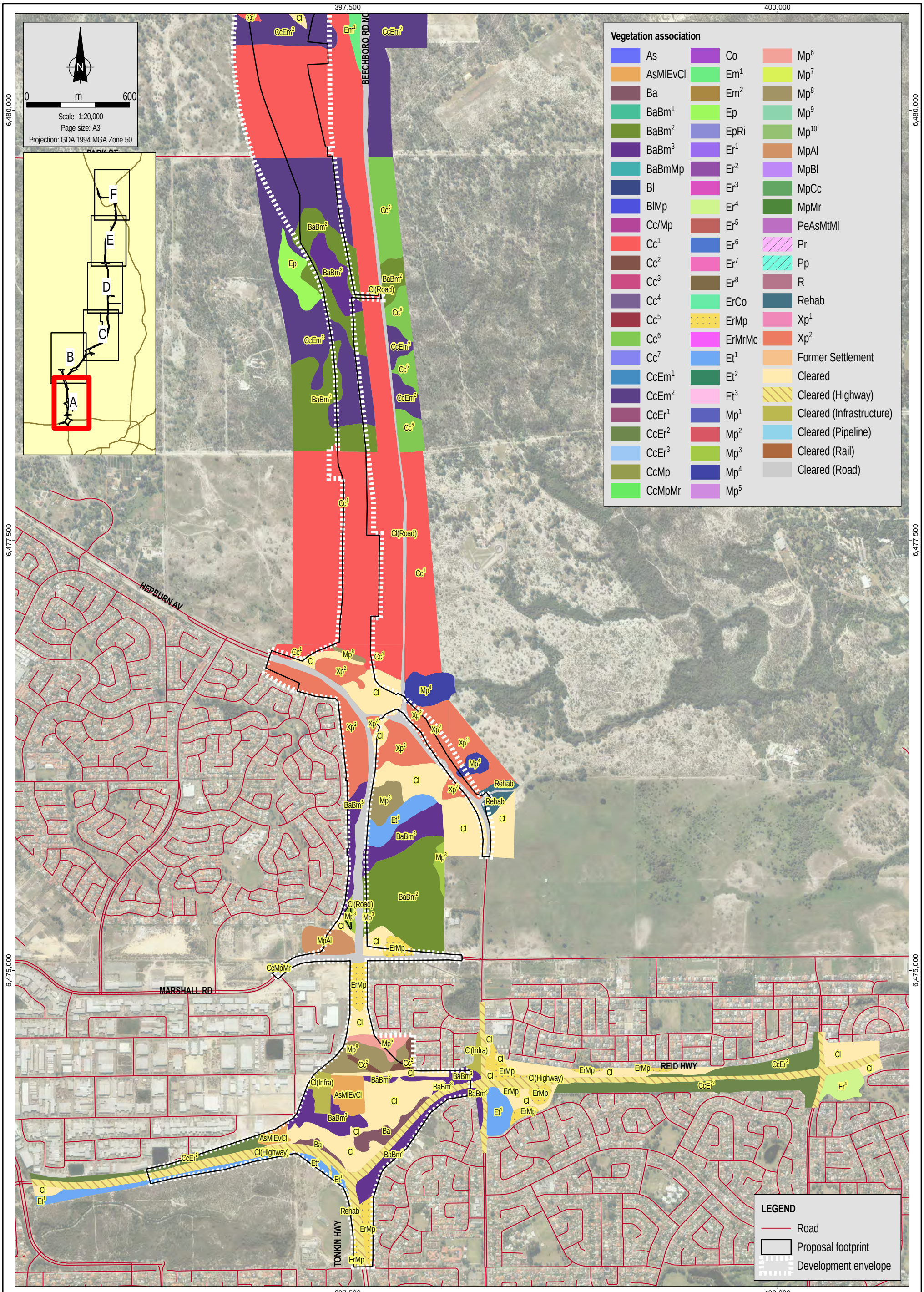
Unit code	Broad floristic formation and site preference	Vegetation association descriptions	Extent in flora study area (ha)
Et[2]	*Eucalyptus* sparse mid woodland Dune slopes, crests and flats	*Eucalyptus todtiana* isolated mid mallee trees over *Banksia attenuata, Banksia menziesii* and *Nuytsia floribunda* sparse low woodland over *Verticordia nitens, Beaufortia elegans*, *Jacksonia floribunda* sparse mid shrubland.	81.9 (2.7%)
Et[3]	*Eucalyptus* sparse mid woodland Dune rise	*Eucalyptus todtiana* sparse mid mallee trees over *Banksia attenuata, Banksia menziesii* and *Banksia ilicifolia* sparse low woodland over *Adenanthos cygnorum* subsp. *cygnorum* and *Jacksonia furcellata* sparse tall shrubland.	20.5 (0.7%)
Mp[1]	*Melaleuca* open low woodland Mound spring	*Melaleuca preissiana* closed low forest over *Histiopteris incisa* and *Pteridium esculentum* subsp. *esculentum* sparse tall herbland over *Cyathochaeta teretifolia* open mid sedgeland.	1.5 (0.1%)
Mp[2]	*Melaleuca* open low woodland Transitional dampland/dryland	*Melaleuca preissiana* isolated mid trees over *Banksia attenuata, Banksia menziesii* and occasional *Banksia ilicifolia* sparse low woodland over *Xanthorrhoea preissii, Adenanthos cygnorum* subsp. *cygnorum* and *Hypocalymma angustifolium* mid shrubland.	8.5 (0.3%)
Mp[3]	*Melaleuca* open low woodland Dampland	*Melaleuca preissiana* low woodland over *Astartea scoparia, Taxandria linearifolia* and *Aotus gracillima* open tall shrubland over *Cyathochaeta avenacea* and *Juncus pallidus* open tall sedgeland.	5.3 (0.2%)
Mp[4]	*Melaleuca* open low woodland Dampland/depression	*Melaleuca preissiana* mid woodland over *Banksia littoralis* sparse low woodland over *Lepidosperma striatum* and *Lepidosperma longitudinale* closed tall sedgeland.	12.5 (0.4%)
Mp[5]	*Melaleuca* open low woodland Depression	*Melaleuca preissiana* low open woodland over *Astartea scoparia, Eutaxia virgata* and *Hypocalymma angustifolium* open low shrubland over *Cyathochaeta avenacea* and *Lepyrodia glauca* open low sedgeland.	1.4 (0.1%)
Mp[6]	*Melaleuca* open low woodland Dampland	*Melaleuca preissiana* sparse low woodland over *Pericalymma crassipes, Hypocalymma angustifolium* and *Xanthorrhoea preissii* open tall shrubland over *Lepidosperma striatum* and *Lepidosperma longitudinale* tall sedgeland.	2.7 (0.1%)
Mp[7]	*Melaleuca* open low woodland	*Melaleuca preissiana* sparse to open low woodland over **Zantedeschia aethiopica* sparse tall herbland over **Cenchrus clandestinus* and **Holcus lanatus* sparse mid grassland.	3.0 (0.1%)

Unit code	Broad floristic formation and site preference	Vegetation association descriptions	Extent in flora study area (ha)
Mp[8]	*Melaleuca* open low woodland	*Melaleuca preissiana* sparse to open low woodland over *Xanthorrhoea preissii* sparse mid shrubland over *Lepidosperma longitudinale* sparse mid sedgeland.	9.4 (0.3%)
Mp[9]	*Melaleuca* open low woodland Dampland	*Melaleuca preissiana* sparse to open low woodland over *Xanthorrhoea preissii* tall shrubland over *Astartea scoparia* and *Taxandria linearifolia* sparse mid shrubland.	0.9 (0.1%)
Mp[10]	*Melaleuca* open low woodland Dampland	*Melaleuca preissiana* open low woodland to forest over *Juncus kraussii* subsp. *australiensis* sparse mid sedgeland over **Cynodon dactylon* open low grassland.	4.6 (0.2%)
MpAl	*Melaleuca* open low woodland	*Melaleuca preissiana* and **Acacia longifolia* subsp. *longifolia* sparse low woodland over *Xanthorrhoea preissii* sparse mid shrubland over **Bromus diandrus, *Ehrharta calycina* and *Avena barbata* tall grassland.	4.3 (0.1%)
MpBl	*Melaleuca* open low woodland Dampland	*Melaleuca preissiana* and *Banksia littoralis* open low woodland to forest over *Melaleuca lateritia* and *Melaleuca teretifolia* sparse mid shrubland over *Schoenus caespititius* sparse mid sedgeland.	5.4 (0.2%)
MpCc	*Melaleuca* open low woodland Wetland slope, depression	*Melaleuca preissiana* and *Corymbia calophylla* sparse mid woodland over *Astartea scoparia* and *Hypocalymma angustifolium* open mid shrubland.	1.3 (0.1%)
MpMr	*Melaleuca* open low woodland	*Melaleuca preissiana* and *Melaleuca rhaphiophylla* low (open) woodland over **Zantedeschia aethiopica* and **Typha orientalis* open mid herbland.	6.0 (0.2%)
PeAsMtMl	*Astartea* tall shrubland to open tall shrubland Dampland	*Pericalymma ellipticum* var. *floridum, Astartea scoparia* and *Melaleuca teretifolia* tall shrubland.	8.4 (0.3%)
Pr	*Eucalyptus* sparse mid woodland Dune crest	**Pinus radiata* sparse low woodland over *Eucalyptus todtiana* isolated mid mallee trees over *Adenanthos cygnorum* subsp. *cygnorum* and *Macrozamia fraseri* sparse tall shrubland.	8.6 (0.3%)
Xp[1]	*Xanthorrhoea* open tall shrubland	*Xanthorrhoea preissii* tall open shrubland over **Ehrharta calycina* sparse mid grassland.	8.4 (0.3%)

Unit code	Broad floristic formation and site preference	Vegetation association descriptions	Extent in flora study area (ha)
Xp[2]	*Xanthorrhoea* open tall shrubland	*Xanthorrhoea preissii* sparse mid shrubland to open tall shrubland.	35.3 (1.2%)
Other mapping units			
CcEr[3]	*Corymbia* sparse mid woodland	Open paddocks with remnant *Corymbia calophylla* and *Eucalyptus rudis* subsp. *rudis* over pasture species (introduced) dominated by **Cenchrus clandestinus.*	629.1 (20.8%)
Cl	N/A	Cleared areas, consisting of paddocks, infrastructure corridors (i.e. Roads and Highways), building envelopes (i.e. residential housing, industry etc.) and the former Ellenbrook settlement (within Rocla mine tenement). Includes mapping units Cleared (Highway), Cleared (Infrastructure), Cleared (Pipeline), Cleared (Road), Cleared (Rail) and Former Settlement.	1,105.3 (36.5%)
Pp	*Pinus* mid woodland	**Pinus pinaster* plantation.	74.6 (2.5%)
R	*Corymbia* sparse mid woodland	*Corymbia calophylla, Eucalyptus camaldulensis* and *Eucalyptus todtiana* low woodland over *Calothamnus quadrifidus* and *Banksia nivea* sparse mid shrubland over **Bromus diandrus* and **Ehrharta calycina* sparse mid grassland over **Ursinia anthemoides* and **Hypochaeris glabra* sparse low herbland (Revegetation site).	31.7 (1.0%)
Rehab	N/A	Rehabilitation sites associated with Rocla mine site and other sites of rehabilitation, including road sides.	11.2 (0.4%)

Source: Coffey (2015a) (Appendix C).

* Introduced (weed) species.



Source & Notes
Vegetation association mapping from Coffey (January 2015)
Aerial imagery from Landgate (August 2014)

NorthLinkWA

coffey

Date: 04.06.2015
MXT: 4483AA_03_GIS060_3
File Name: 4483AA_03_F008.2A_GIS

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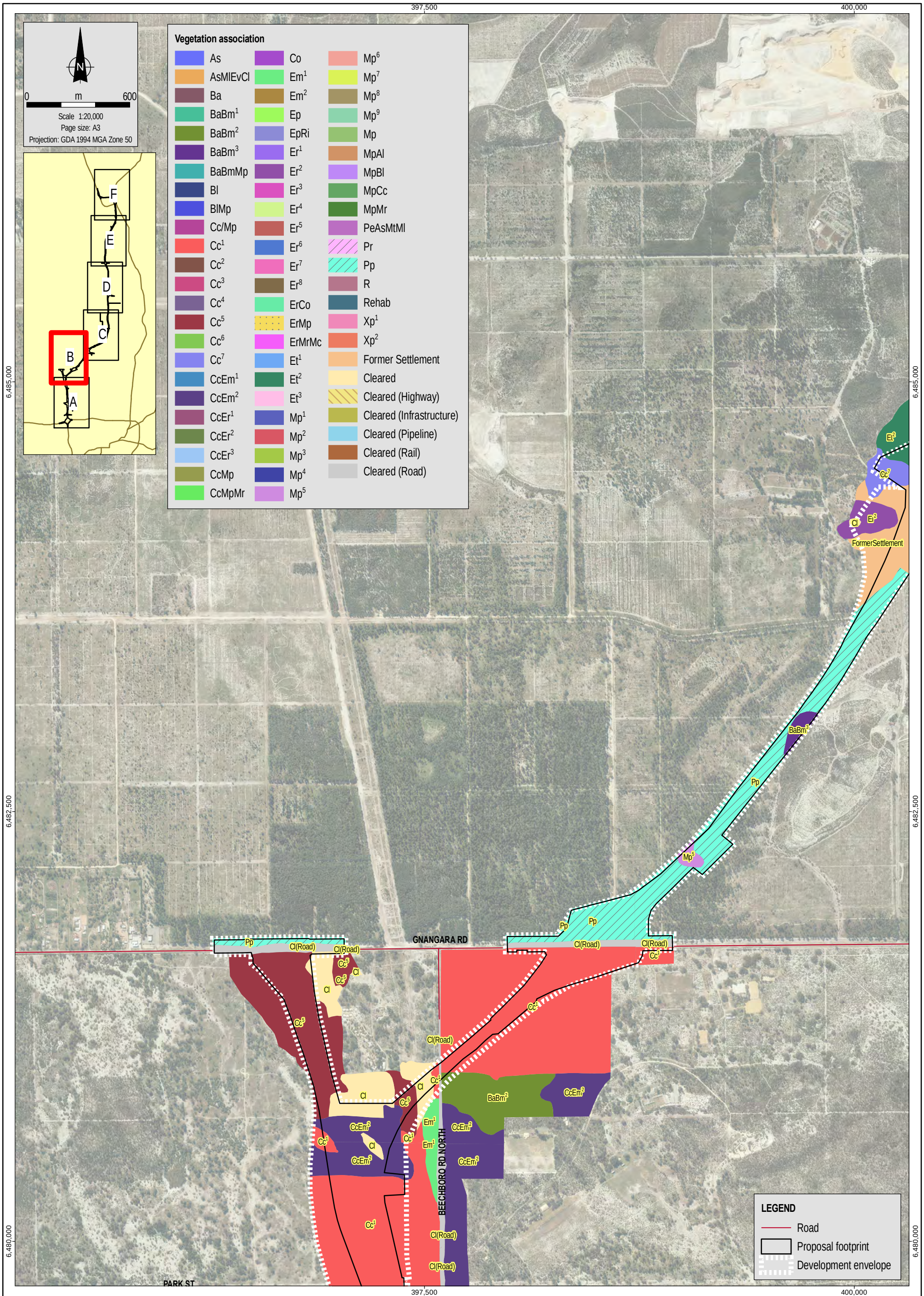
Figure No: 8.2A



Source & Notes
Vegetation association mapping from Coffey (January 2015)
Aerial imagery from Landgate (August 2014)

NorthLinkWA

coffey

Date: 04.06.2015
MXT: 4483AA_03_GIS060_3
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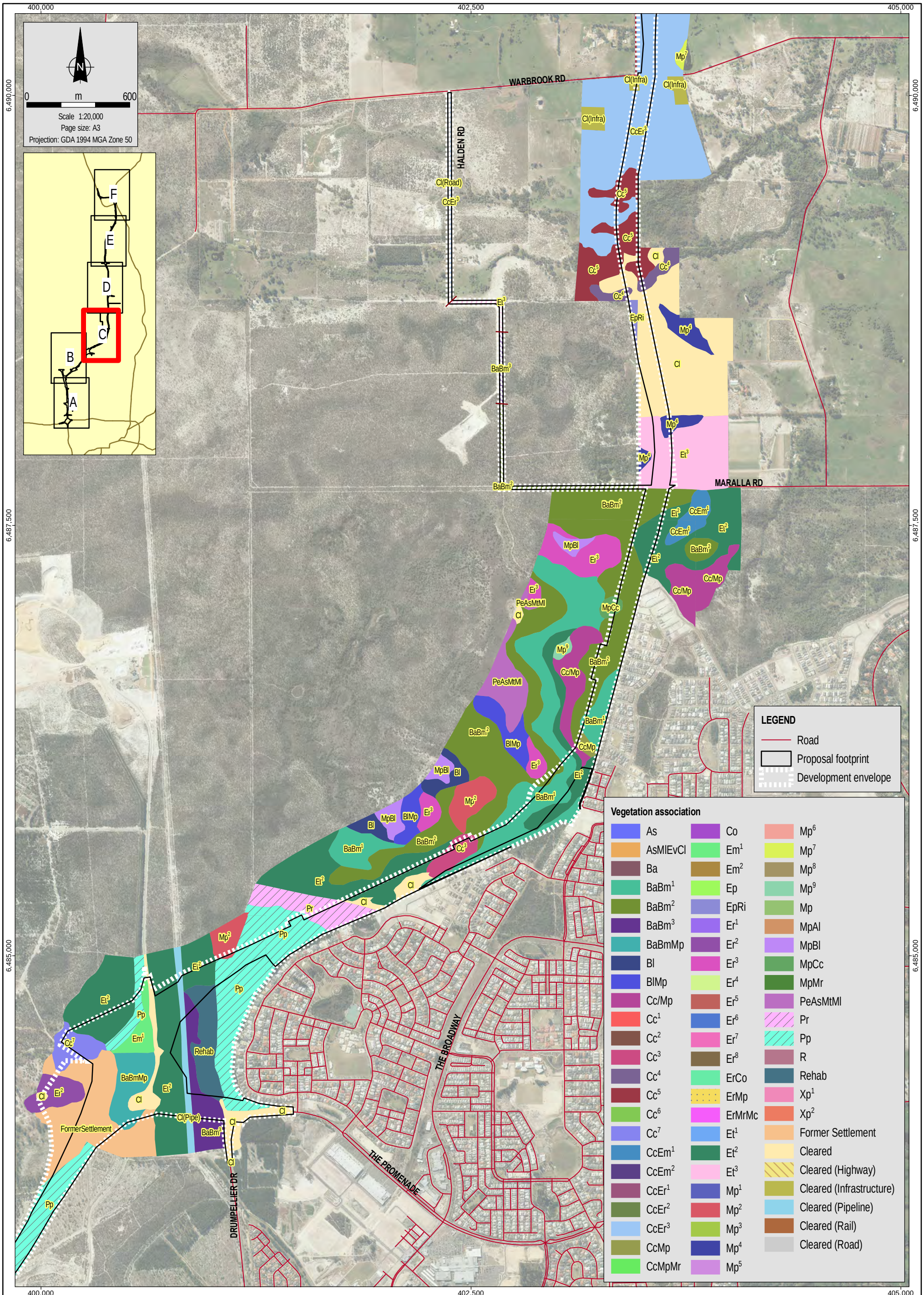
Figure No: 8.2B



Source & Notes
Vegetation association mapping from Coffey (January 2015)
Aerial imagery from Landgate (August 2014)

NorthLinkWA

coffey

Date: 04.06.2015
MXT: 4483AA_03_GIS060_3
File Name: 4483AA_03_F008.2C_GIS

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Figure No: 8.2C