

### 8.2.10 Vegetation Condition

The condition of the vegetation located at each sampling site and additional locations throughout the flora study area was assessed according to the vegetation condition rating scale developed by Keighery (1994). Vegetation that is in degraded or better condition is considered to be intact vegetation. The condition of the vegetation is consistent with the size, connectivity and structure of the vegetation along the flora study area. For example, the fragmented vegetation located in the north of the flora study area is in degraded or worse condition due to historical clearing and grazing pressures, while in the Whitman Park, Cullacabardee and Ellenbrook areas, vegetation consists of relatively large, fairly contiguous areas, and is in good or better condition.

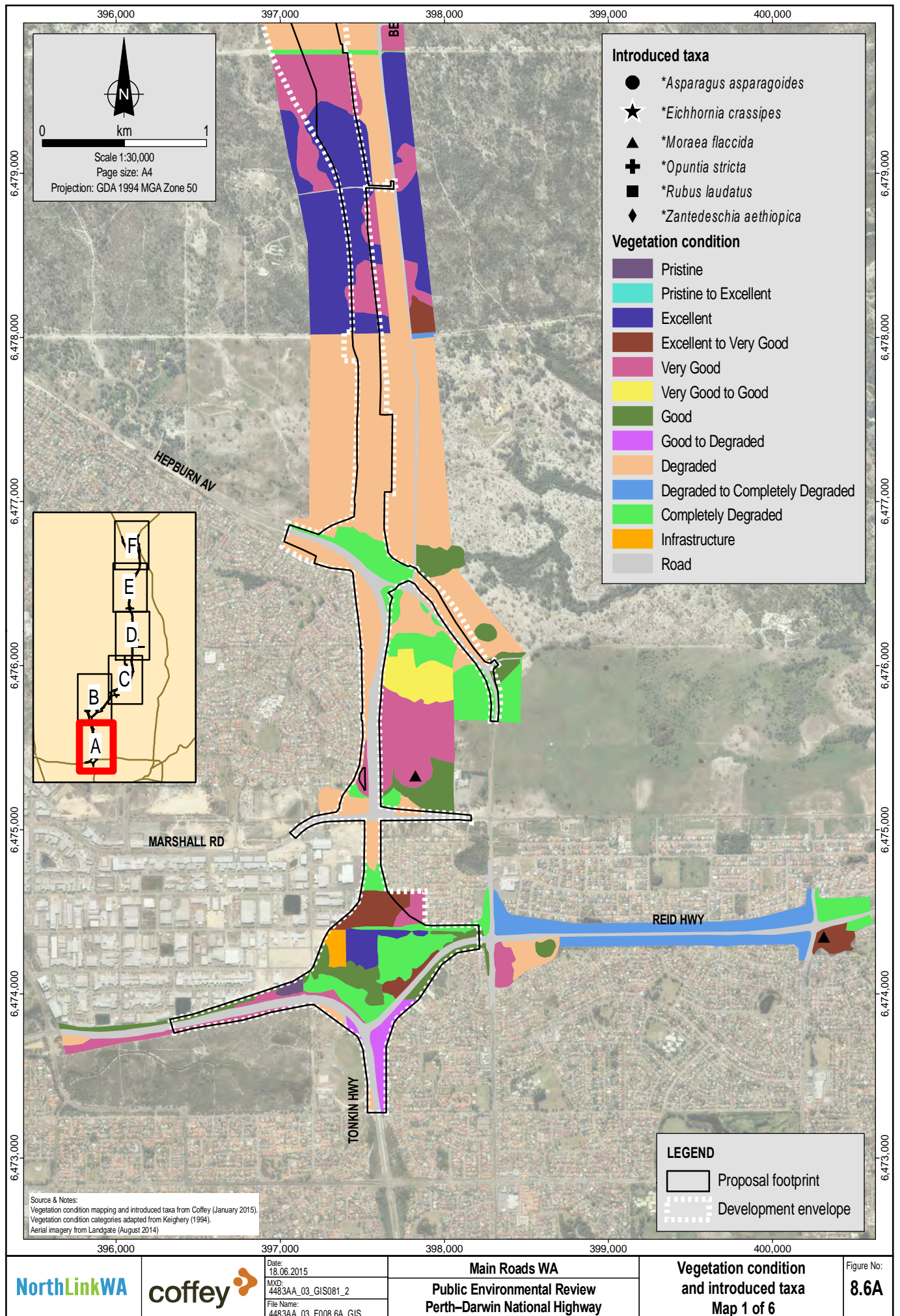
The vegetation north of Maralla Road through the palusplain zone was considered to be highly variable with large portions considered completely degraded or cleared. There were isolated pockets of vegetation considered to be in good or better condition. The vegetation south of Maralla Road was variable; however, the majority of the vegetation was considered to be in good or better condition with isolated pockets of vegetation that was considered degraded or worse and included isolated cleared areas. Isolated pockets of pristine vegetation were identified in the flora study area in the location of Ellenbrook.

The vegetation condition of the flora study area is presented in Table 8.7 and illustrated in Figure 8.6.

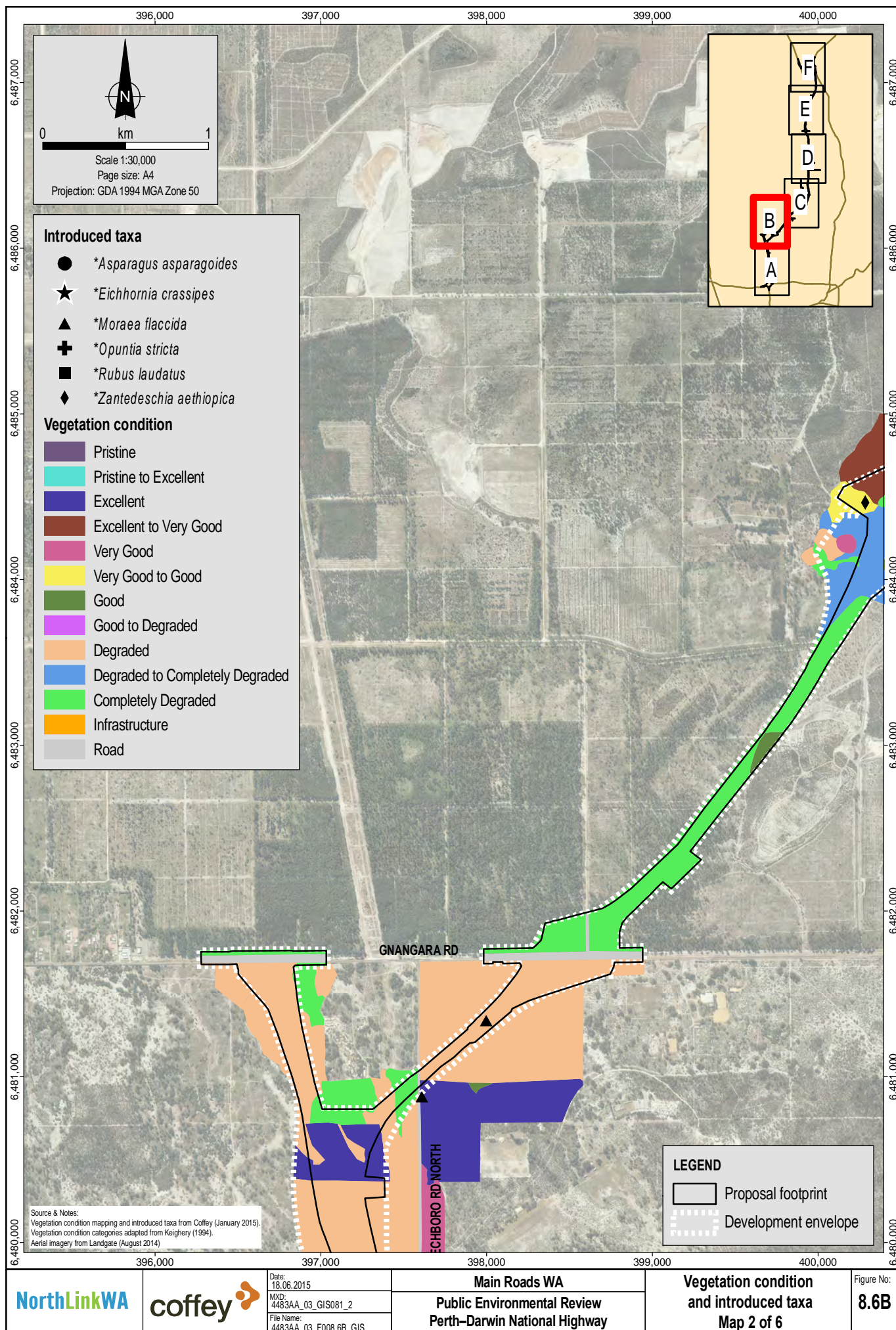
**Table 8.7 Vegetation condition rating in the flora study area**

Condition rating	Extent in flora study area	
	(ha)	(%)
Pristine	9.3	0.3
Pristine to Excellent	36.4	1.2
Excellent	226.7	7.5
Excellent to Very Good	51.2	1.7
Very Good	175.7	5.8
Very Good to Good	35.4	1.2
Good	51.0	1.7
Good to Degraded	23.4	0.8
Degraded	530.1	17.5
Degraded to Completely Degraded	138.1	4.6
Completely Degraded	1,627.9	53.8
Cleared and Infrastructure/Roads etc.	122.4	4.0
<b>Total</b>	<b>3,027.8</b>	<b>100.0</b>

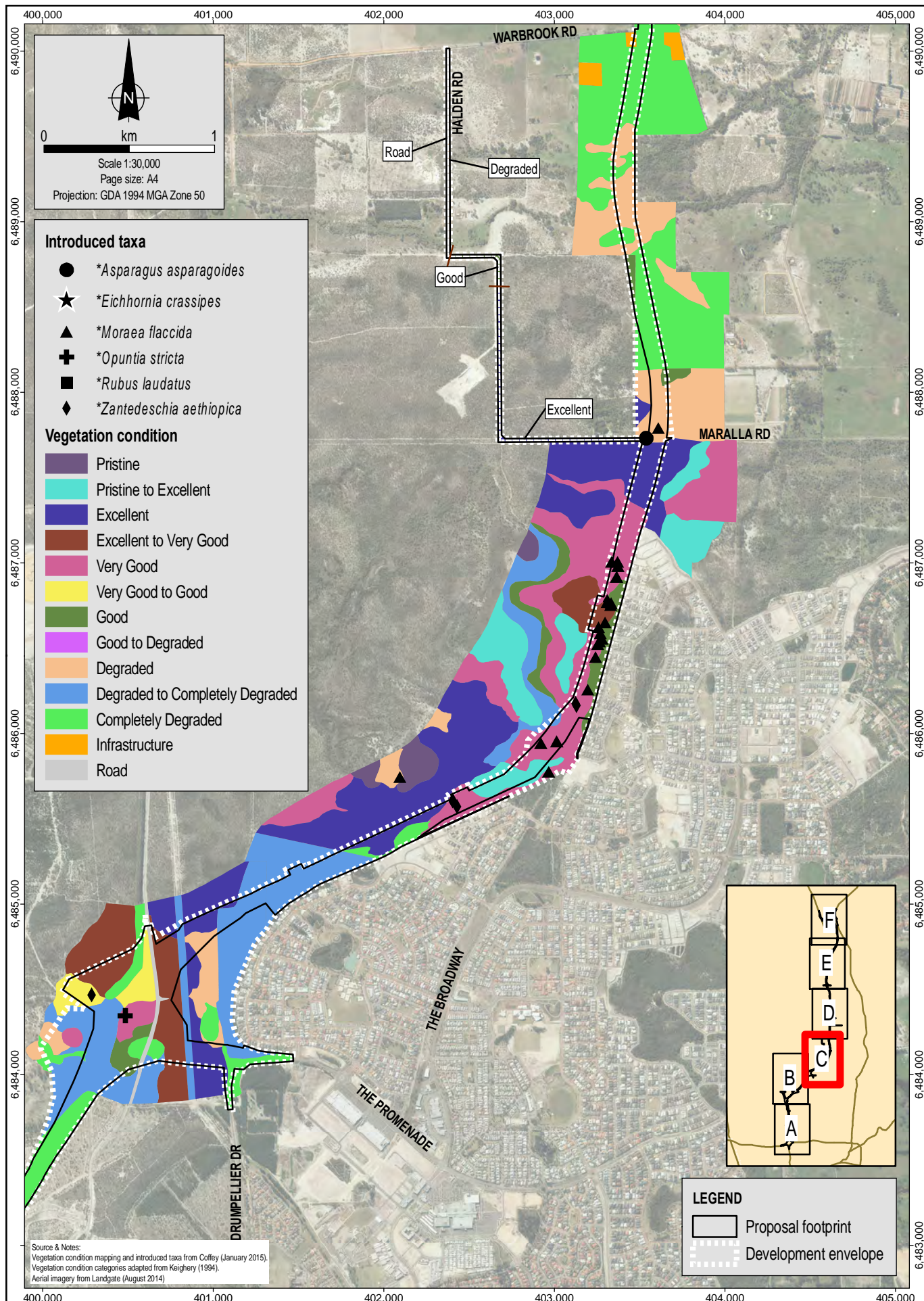
Source: Coffey (2015a) (Appendix C).



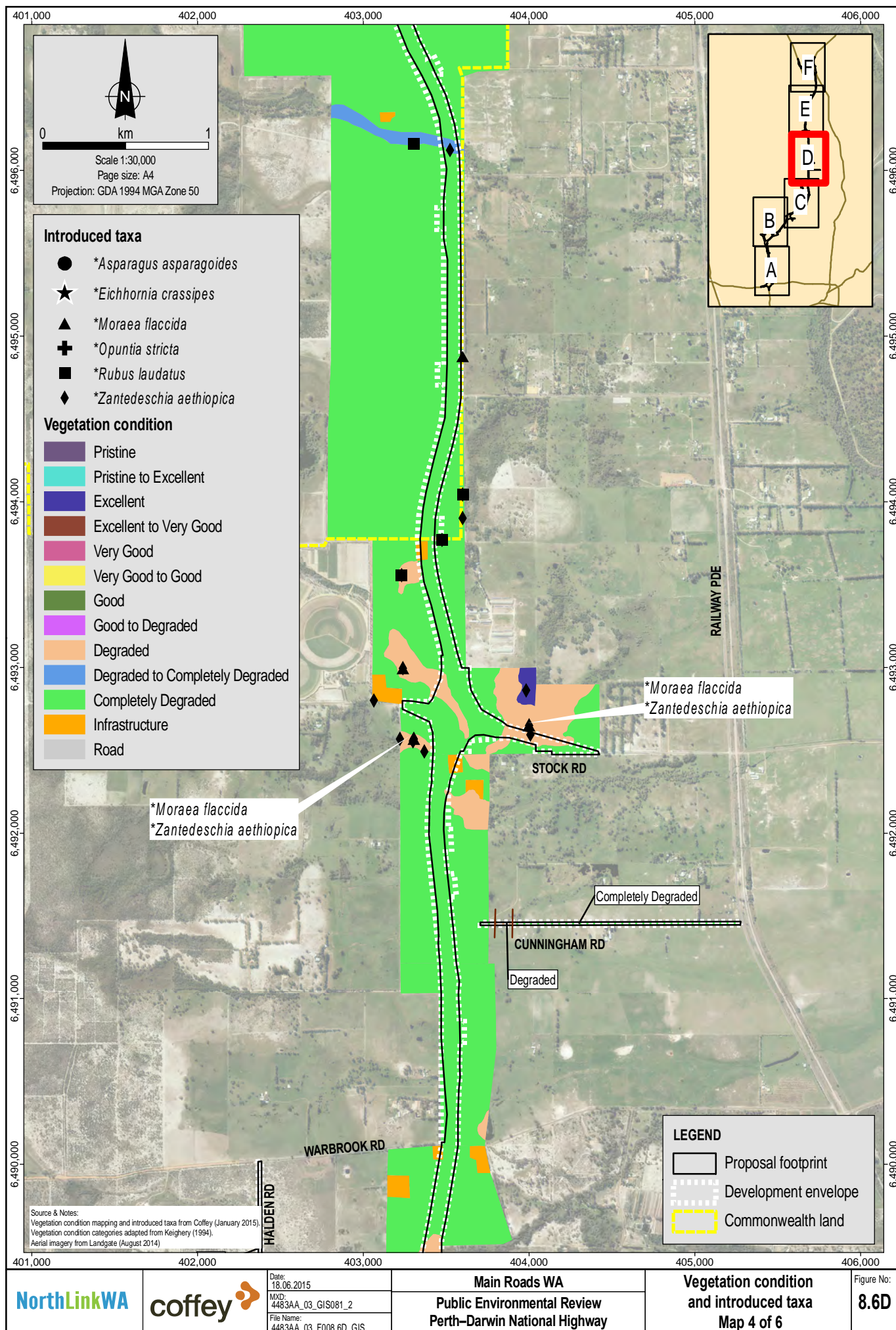




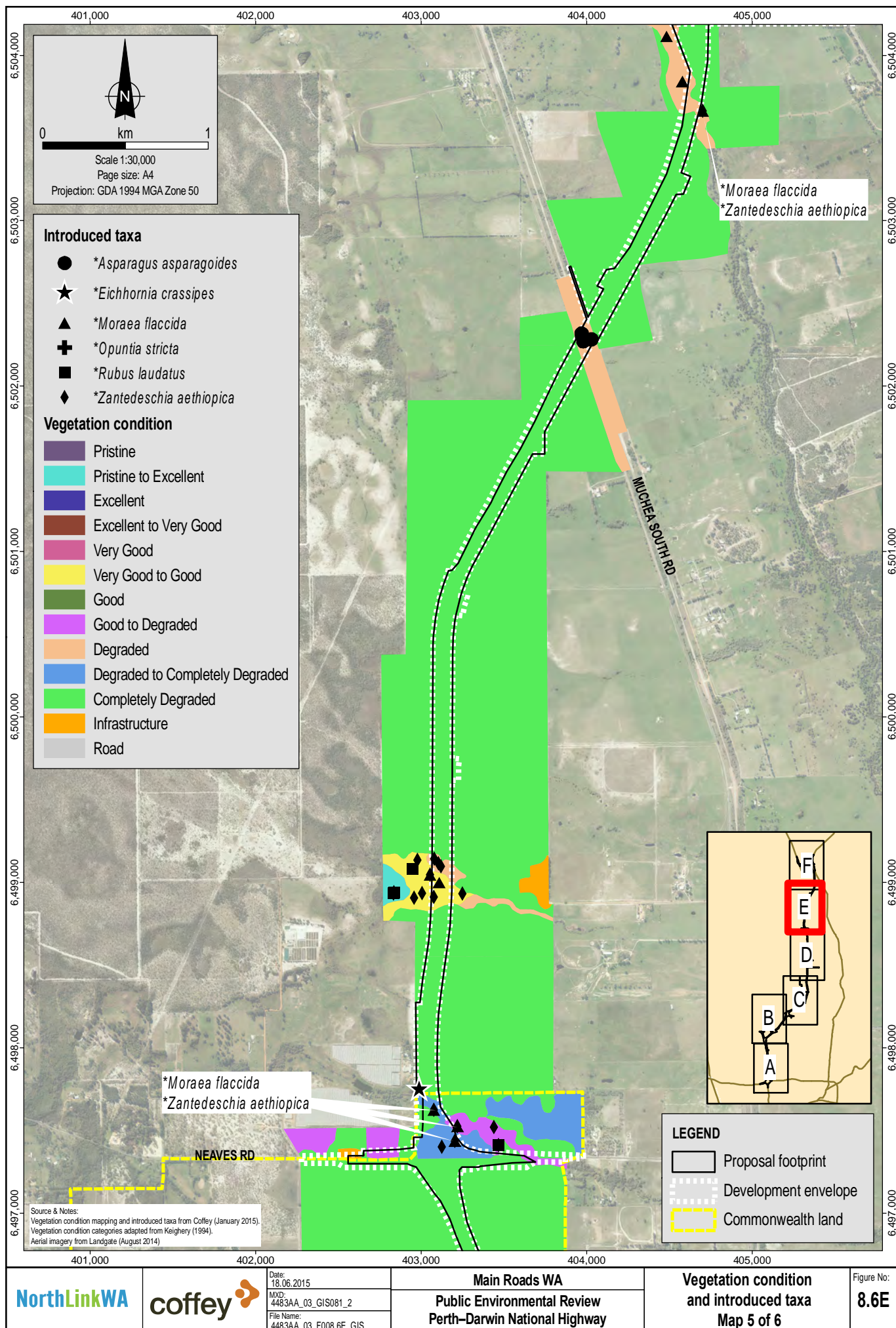




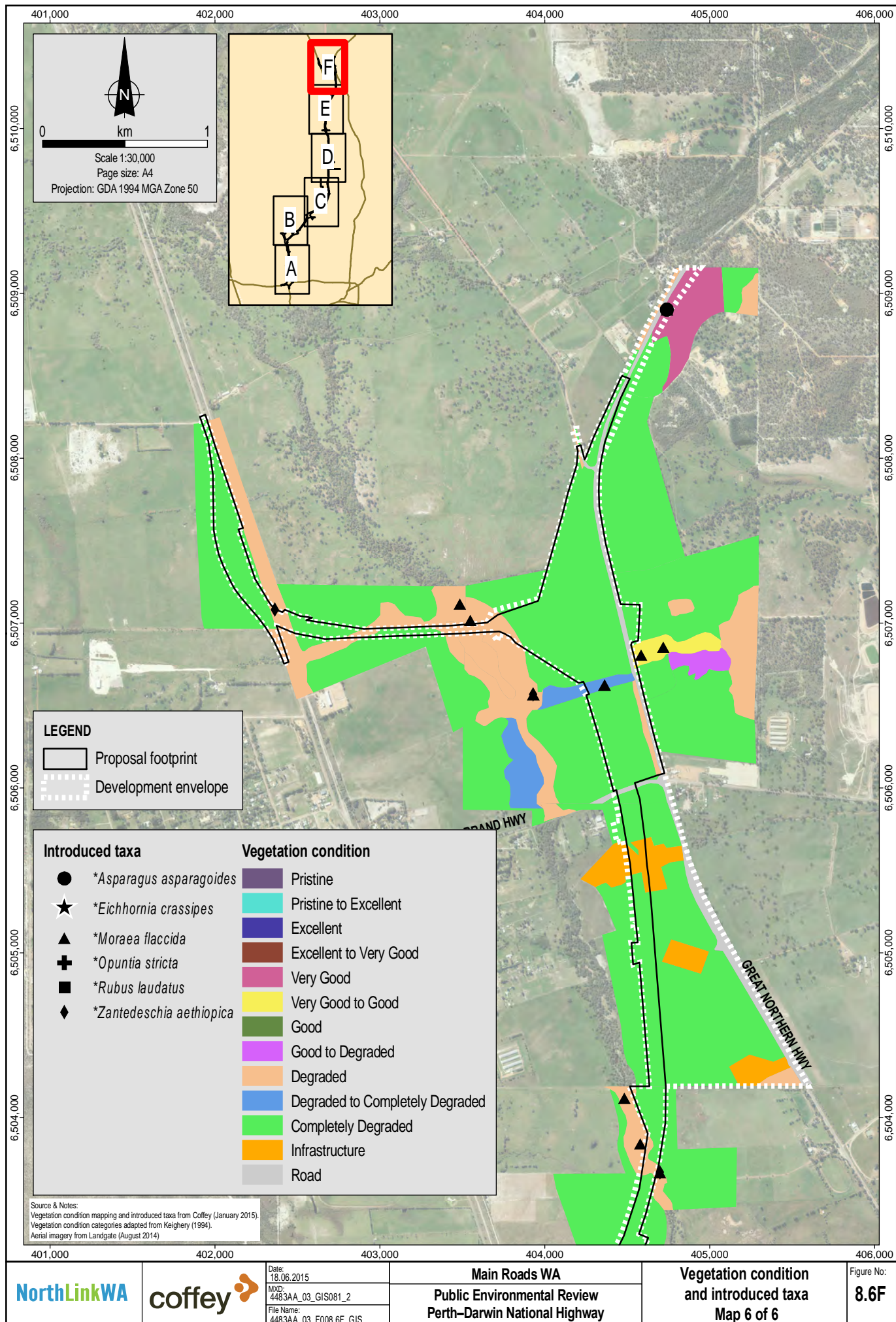












### 8.2.11 Groundwater Dependent Ecosystems

Groundwater dependent ecosystems (GDEs) are ecosystems that require access to groundwater to meet all or some of their water requirements in order to maintain communities of plants and animals, the ecological processes they support and the ecosystem services they provide (Richardson et al., 2011).

The vegetation associations recorded from the geomorphic wetlands (see Figure 8.2) and Ellen Brook are considered to be GDEs due to the presence of groundwater or surface water dependent flora. As such, there is approximately 361.5 ha of GDEs (geomorphic wetlands supporting intact native vegetation) within the flora study area, of which 49.6 ha is located within the proposal footprint (Figure 8.7).

Species recorded from the flora study area (Coffey, 2015a) that are considered to be either groundwater dependent or maintained by surface water runoff are listed in Table 8.8 (360 Environmental, 2014b; Syrinx, 2011).

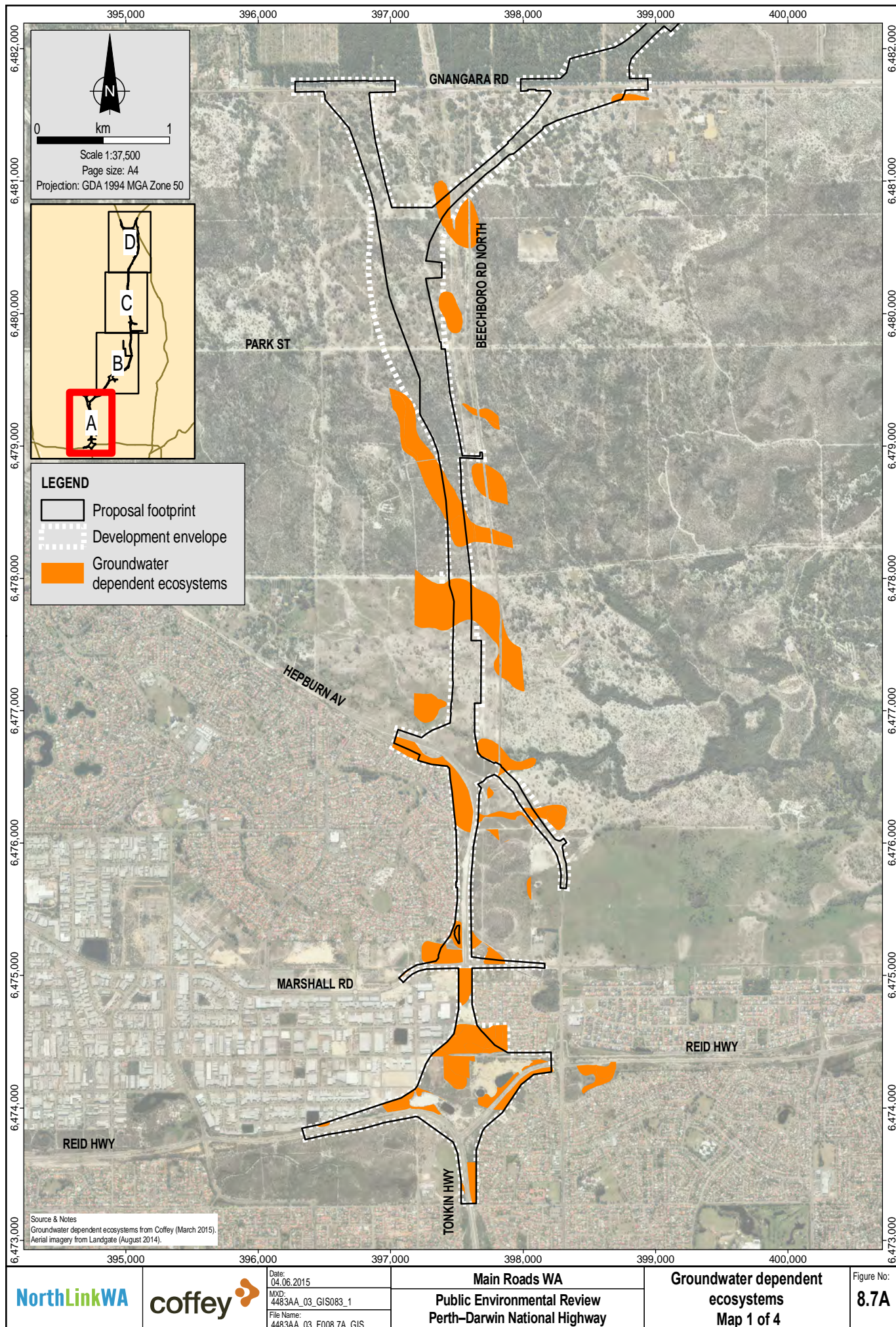
*Banksia ilicifolia* has been shown to display the greatest susceptibility and lowest net recovery to groundwater abstraction (Groom et al., 2000), while plants with shallow roots (i.e. sumpland sedges) are dependent on moisture in the vadose zone. Stratigraphic changes which affect the vadose zone will impact on the health and survival of these species (e.g. *Hypocalymma angustifolium*) (360 Environmental, 2014b).

**Table 8.8 Groundwater dependent flora**

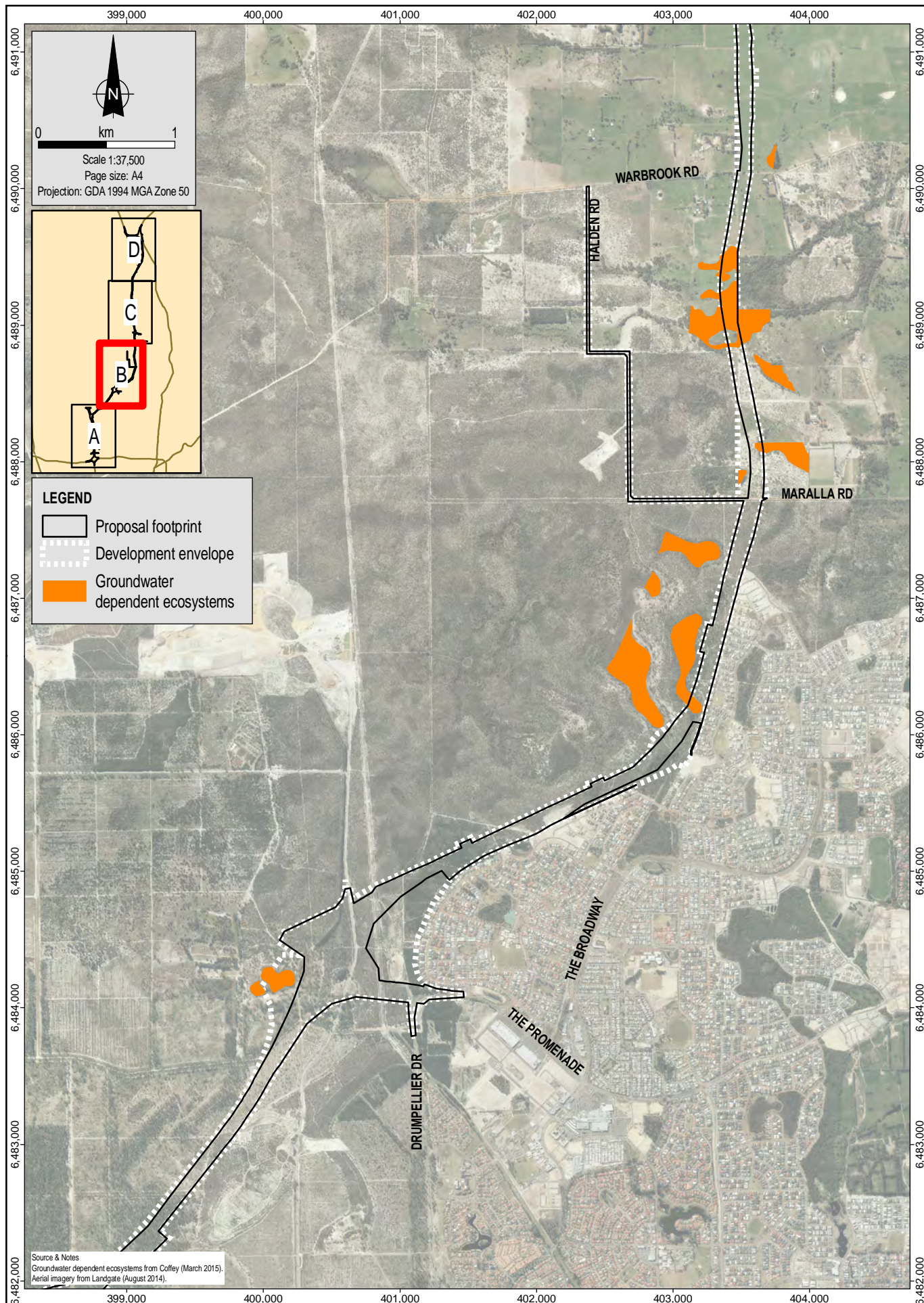
Taxa	Hydrological classification
<i>Astartea scoparia</i>	Subsurface – perched
<i>Banksia ilicifolia</i>	Groundwater dependent (obligate)
<i>Banksia littoralis</i>	Groundwater dependent (obligate)
<i>Baumea articulata</i>	Groundwater or surface water (obligate)
<i>Baumea juncea</i>	Groundwater or surface water (obligate)
<i>Corymbia calophylla</i>	Groundwater dependent (facultative)
<i>Eucalyptus rudis</i>	Groundwater dependent (obligate)
<i>Eucalyptus tottiana</i>	Groundwater dependent (facultative)
<i>Hypocalymma angustifolium</i>	Vadose (saturated) zone
<i>Meeboldina scariosa</i>	Groundwater or surface water (obligate)
<i>Melaleuca lateritia</i>	Groundwater dependent (obligate)
<i>Melaleuca preissiana</i>	Groundwater dependent (obligate)
<i>Melaleuca raphiophylla</i>	Groundwater dependent (obligate)
<i>Melaleuca teretifolia</i>	Groundwater dependent (obligate)
<i>Scholtzia involucreata</i>	Vadose (saturated) zone
<i>Stirlingia latifolia</i>	Vadose (saturated) zone
<i>Taxandria linearifolia</i>	Groundwater dependent (obligate)

Sources: 360 Environmental (2014b) and Syrinx (2011).







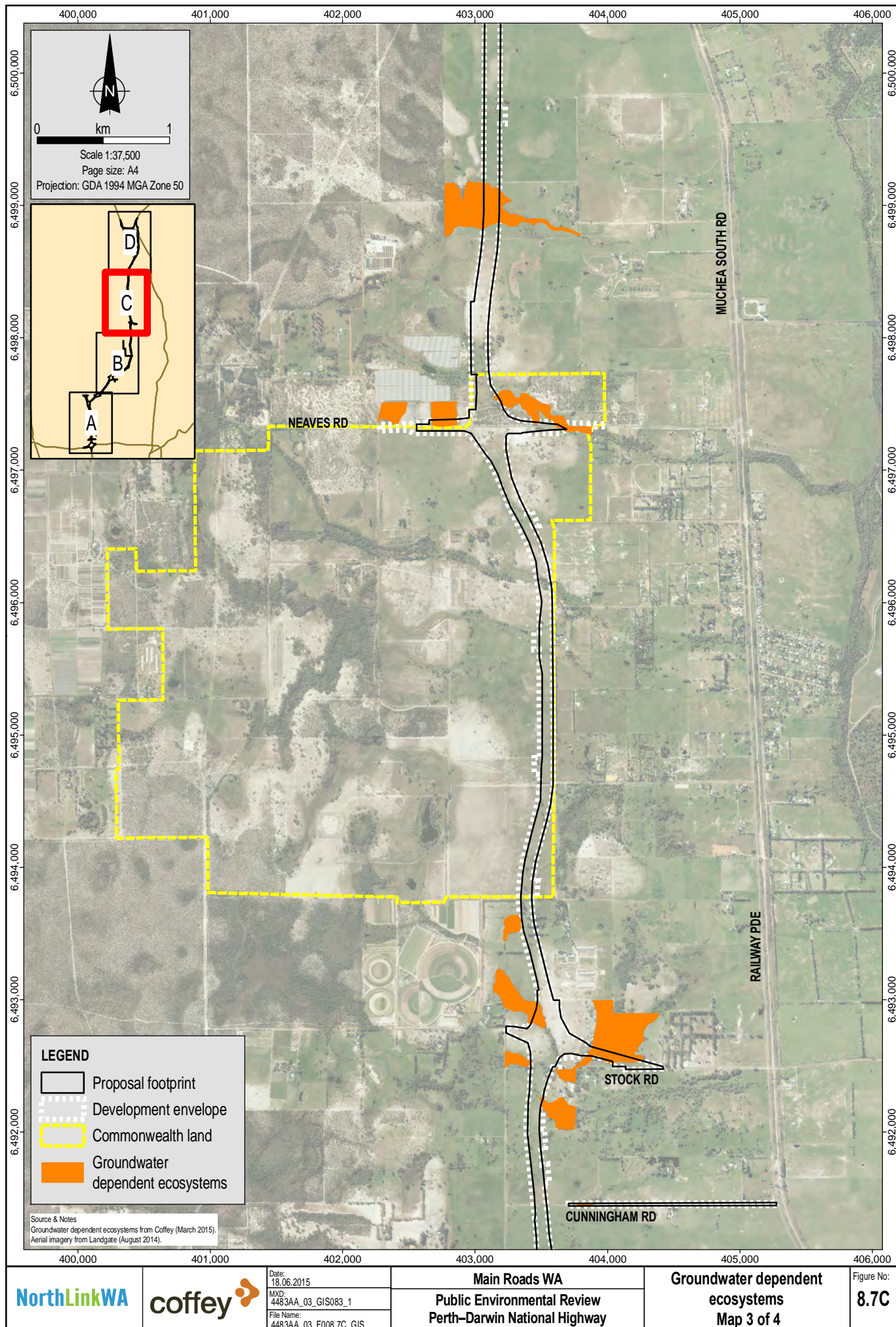


# LEGEND

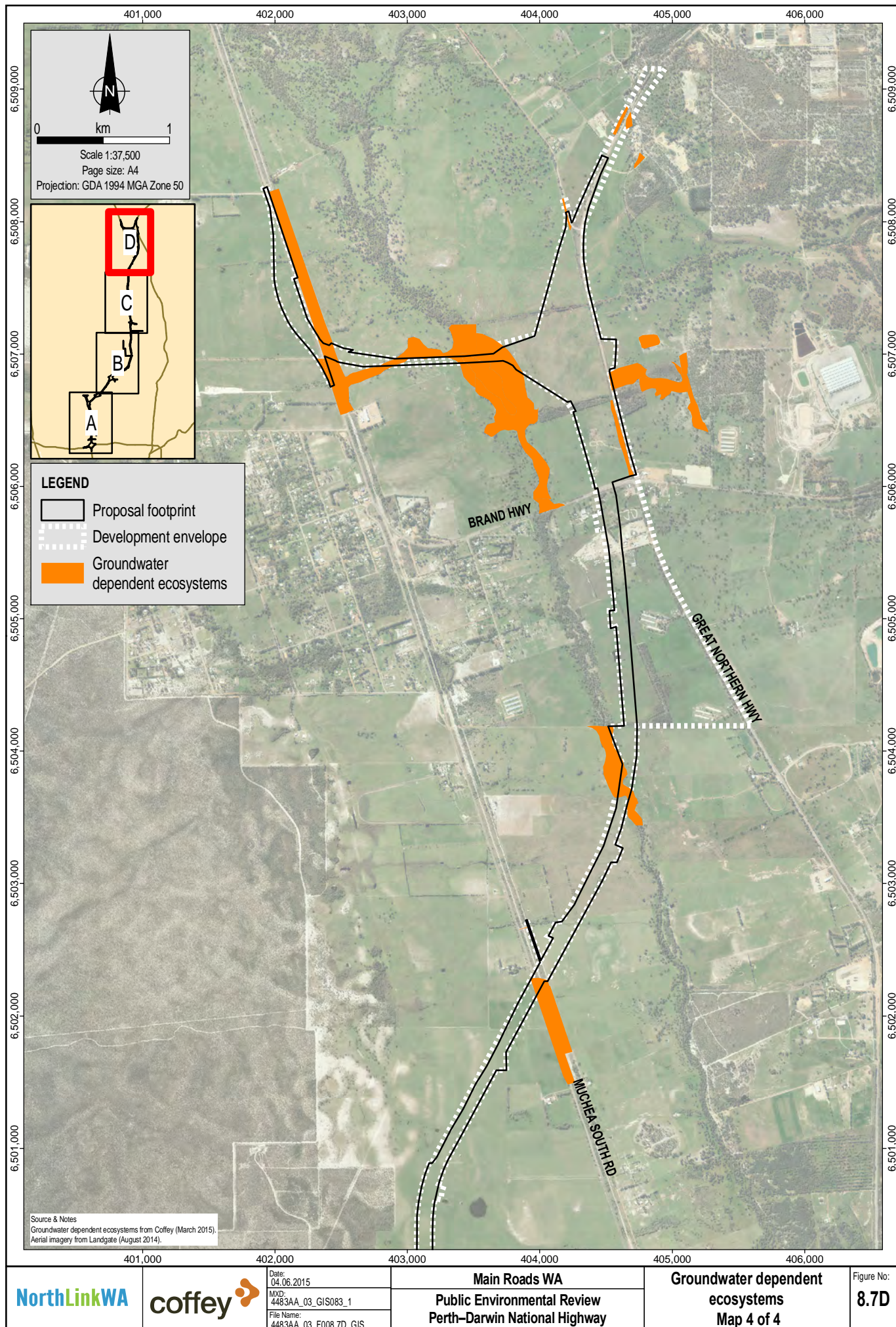
- Proposal footprint
- Development envelope
- Groundwater dependent ecosystems

Source & Notes  
 Groundwater dependent ecosystems from Coffey (March 2015).  
 Aerial imagery from Landgate (August 2014).











### 8.2.12 Bush Forever Sites

The Bush Forever Strategy aim was to protect, where achievable, a target of at least 10% of each of the original 26 vegetation complexes of the SCP portion of the Perth Metropolitan Region (PMR) (Government of Western Australia, 2000b). There are now 290 Bush Forever Sites making up approximately 51,200 ha of regionally significant bushland.

There are 14 Bush Forever sites located within or adjacent (within 1 km) to the proposal (Figure 8.5). Nine of these sites are located within the proposal footprint, and five are located within 1 km of the proposal footprint:


- Within the proposal footprint:
  - Site 97: Kirby Road Bushland, Bullsbrook.
  - Site 100: Neaves Road Creek, Bullsbrook.
  - Site 192: Wetherell Road Bushland, Lexia/Ellenbrook.
  - Site 198: Beechboro Road Bushland, Cullacabardee/Ballajura.
  - Site 300: Maralla Road Bushland, Ellenbrook/Upper Swan.
  - Site 304: Whiteman Park, Whiteman/West Swan.
  - Site 307: Lightning Swamp and Adjacent Bushland, Noranda.
  - Site 399: Melaleuca Park and Adjacent Bushland, Bullsbrook/Lexia.
  - Site 480: Victoria Road Bushland, Malaga/Beechboro.
- Adjacent (within 1 km) to the proposal footprint:
  - Site 2: North East Ellen Brook Bushland, Bullsbrook.
  - Site 6: Cooper Road Water Reserve and Adjacent Bushland, Bullsbrook.
  - Site 13: Sawpit Road Bushland, Bullsbrook.
  - Site 195: Wetherell Road Bushland, Lexia/Ellenbrook.
  - Site 385: Reid Highway Bushland, Mirrabooka/Malaga.

### 8.2.13 Introduced Flora

A total of 99 introduced taxa were recorded from the flora study area (Coffey, 2015a). Of the 99 taxa recorded, four were considered to be Weeds of National Significance (WONS) and an additional two taxa were declared pests under Section 22 of the *Biosecurity and Agricultural Management Act 2007* (BAM Act). Water Hyacinth (*\*Eichhornia crassipes*) is prohibited under Section 12 of the BAM Act:

- *\*Asparagus asparagoides* (Bridal Creeper) – WONS and declared pest.
- *\*Eichhornia crassipes* (Water Hyacinth) – WONS and prohibited.
- *\*Moraea flaccida* (One-leaf Cape Tulip) – declared pest.
- *\*Opuntia stricta* (Prickly Pear) – WONS and declared pest.
- *\*Rubus laudatus* (Blackberry) – WONS and declared pest.
- *\*Zantedeschia aethiopica* (Arum Lily) – declared pest.





The WONS and declared pests were recorded from numerous locations throughout the proposal footprint (see Figure 8.6). An additional 11 weeds were ranked as high priority for eradication or control within the DPAW (2013c) weed prioritisation process (Appendix C).

#### **8.2.14 *Phytophthora* Dieback**

*Phytophthora* Dieback (Dieback) is a soil borne pathogen with a range of hosts in the southwest of WA. Dieback predominantly occurs in members of the Proteaceae (Banksia), Ericaceae (heath), Myrtaceae (myrtle), Xanthorrhoeaceae (grass tree) and Fabaceae (pea) plant families. While some plant species are resistant, others are susceptible to the disease caused by the pathogen resulting in chlorosis, dieback and usually death (Wills and Keighery, 1994).

Dieback is listed as a Priority 1 threat<sup>1</sup> by the EPA and a Key Threatening Process under the EPBC Act. It is considered to be the third greatest threat to biodiversity in WA after salinity and climate change (EPA, 2007).

A Dieback assessment was undertaken within and adjacent to the proposal footprint (Terratree, 2014). The methods and approach undertaken are detailed further in Appendix D.

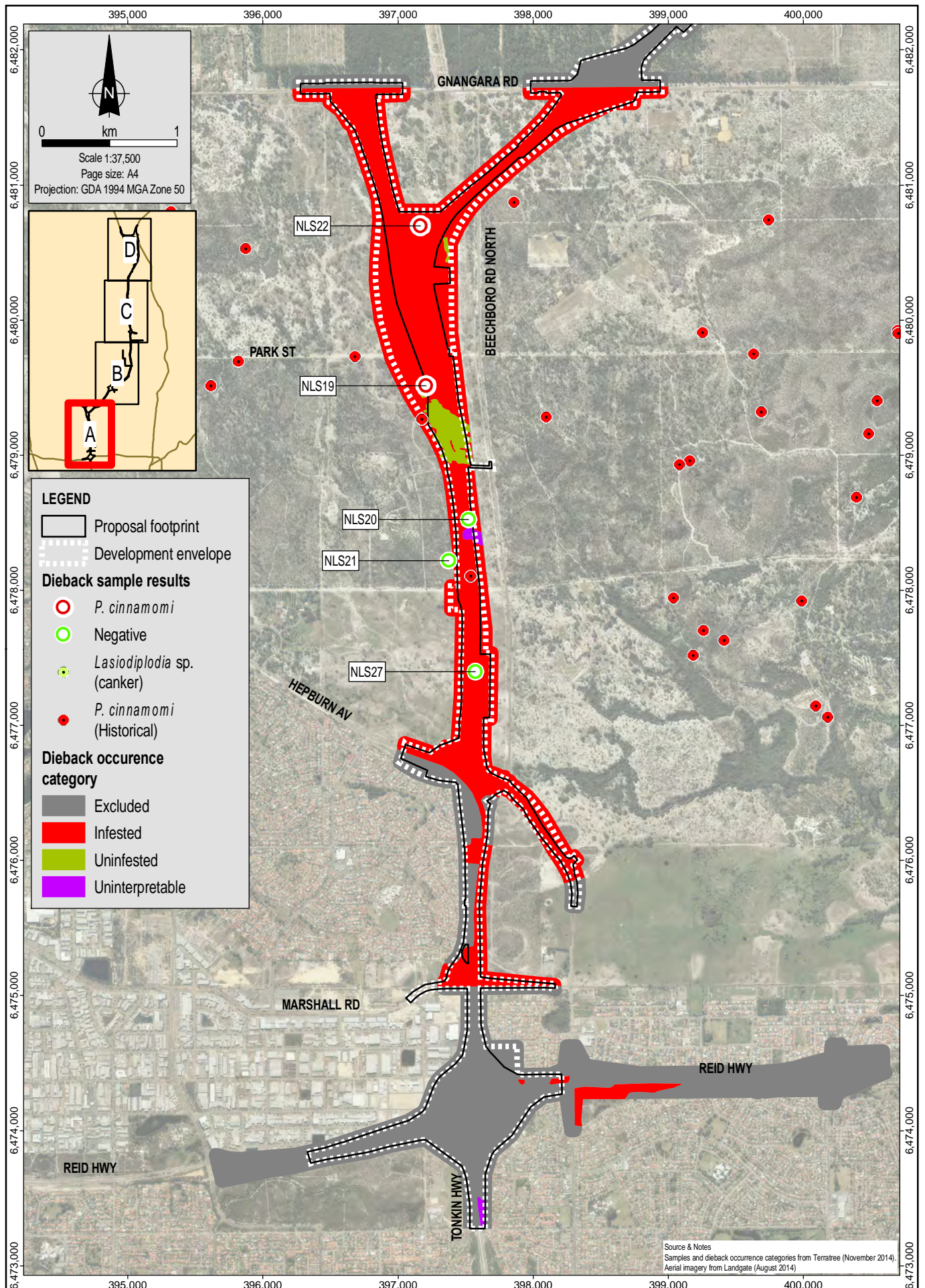
In total 725.3 ha was assessed with 67.56% of the area determined to be excluded (unmappable) from the Dieback assessment, 25.78% infested, 4.15% uninfested and 2.51% uninterpretable (Figure 8.8).

The majority of the proposal footprint and surrounding area was considered to be excluded due to the lack of native vegetation in good or better condition with sufficient disease indicator species to sample. The mappable areas of the proposal footprint were a mosaic of mainly infested and uninfested vegetation. While there were some areas of protectable uninfested vegetation within the proposal footprint, adjacent areas in the Ellenbrook area between Maralla Road and Gngangara Road were of more importance due to the longer term viability of keeping the area dieback free and protectable.

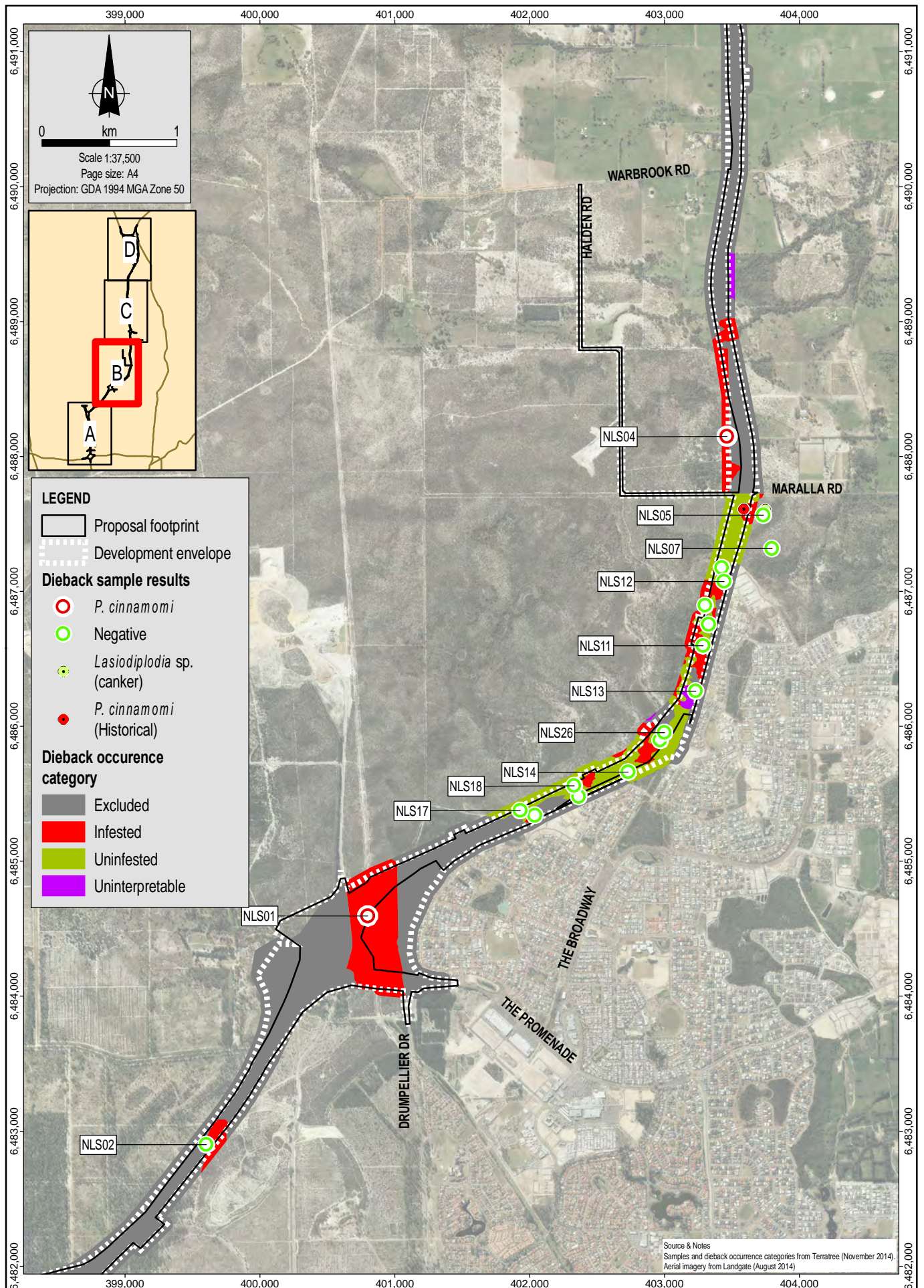
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<sup>1</sup> A Priority 1 threat represents a top environmental issue identified by the EPA during the State of the Environment reporting (EPA, 2007).

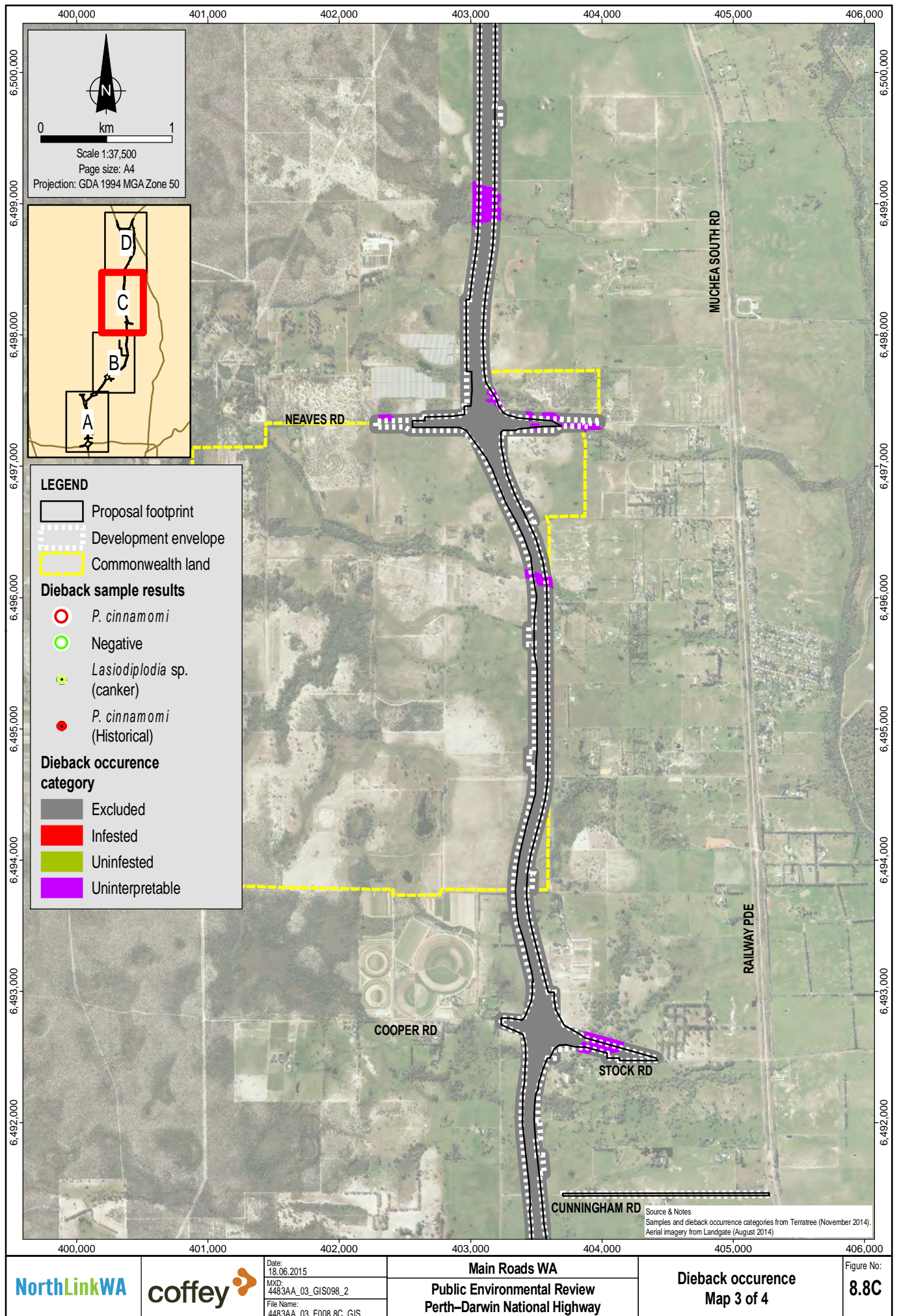




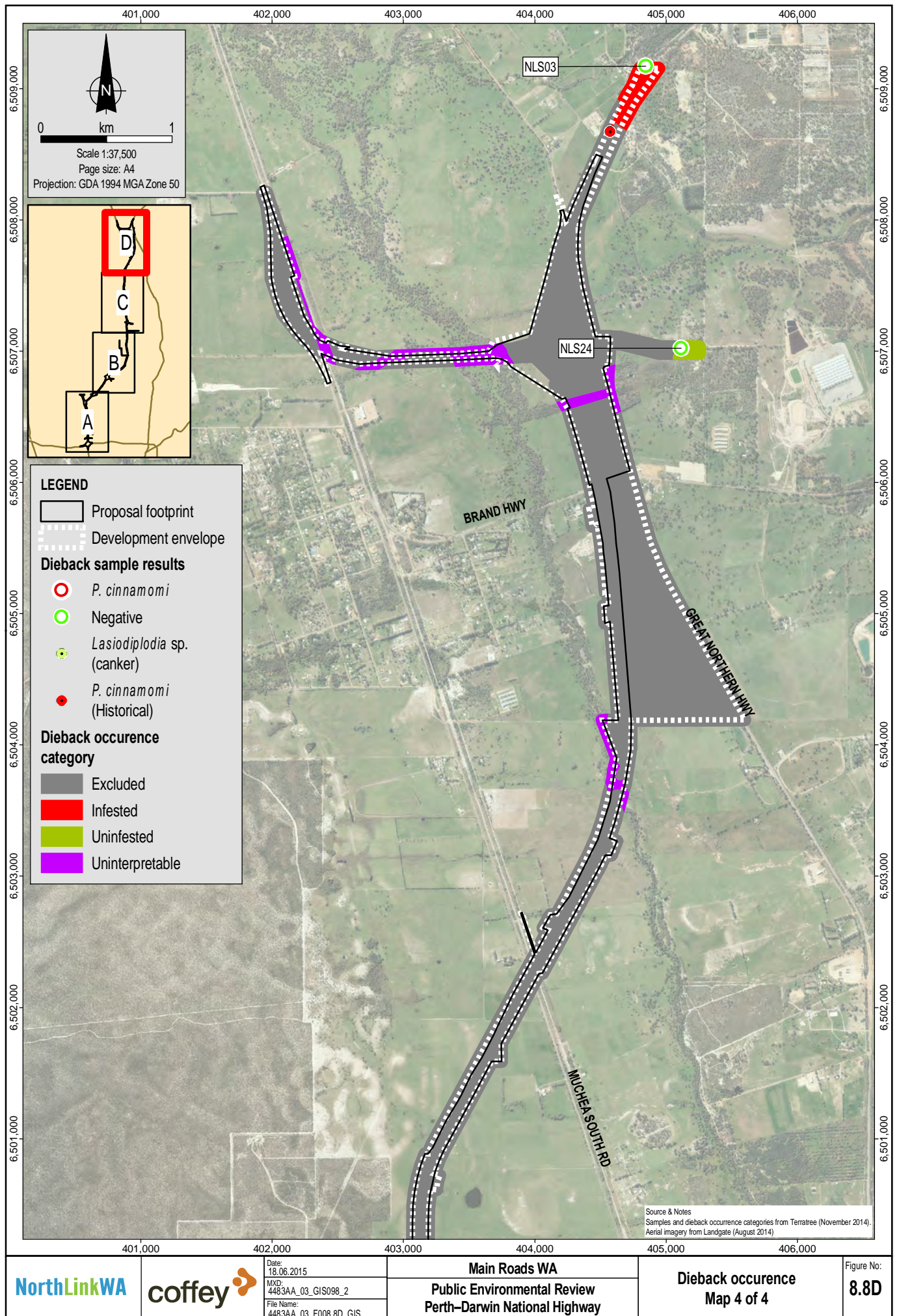
















### 8.3 Potential Impacts

The implementation of the proposal will have both temporary and permanent impacts to flora and vegetation. The potential impacts to flora and vegetation include:

- Construction phase impacts:
  - Permanent loss of native vegetation.
  - Permanent loss of GDEs.
  - Permanent loss of native vegetation within Bush Forever sites.
  - Permanent loss of TECs and PECs.
  - Permanent loss of Threatened and Priority flora.
  - Introduction and Spread of introduced weeds.
  - Introduction and Spread of *Phytophthora* Dieback.
  - Fragmentation of native vegetation.
- Operation phase impacts:
  - Spread of introduced weeds.
  - Spread of *Phytophthora* Dieback.
  - Vegetation degradation from uncontrolled access to remnant vegetation.
  - Changes to the fire regime.

### 8.4 Assessment of Potential Impacts

#### 8.4.1 Permanent Loss of Native Vegetation

The proposal footprint supports a range of vegetation associations in varying degrees of condition. Nearly 80% of the vegetation is in a degraded or worse condition, including areas considered to be cleared (for example infrastructure, agriculture and industry). The remaining 20% of the vegetation is considered to be in good or better condition. Table 8.9 provides the area of impact for each vegetation condition rating within the proposal footprint.

The design of the proposal ensured that as much of the very good and better condition vegetation will be avoided. The design ensured that impacts to vegetation in degraded or worse condition (approximately 78.6% or 585.8 ha) were preferred over vegetation in good to degraded or better condition (approximately 21.4% or 159.7 ha).



**Table 8.9 Clearing impacts by vegetation condition rating**

Condition rating	Extent within the development envelope (ha)	Extent to be cleared in the proposal footprint (ha)	Proportion to be retained (%) <sup>1</sup>
Pristine	1.2	1.2	0.0
Pristine to Excellent	4.6	3.6	21.7
Excellent	63.6	53.2	16.4
Excellent to Very Good	25.4	23.3	8.3
Very Good	58.2	39.3	32.5
Very Good to Good	9.2	8.8	4.3
Good	24.3	23.5	3.3
Good to Degraded	7.6	6.7	11.8
Degraded	175.7	134.1	23.7
Degraded to Completely Degraded	56.9	34.8	38.8
Completely Degraded	464.1	359.9	22.5
Cleared (Infrastructure, industry etc.)	81.3	56.9	30.3
<b>Total (ha)</b>	<b>972.0<sup>3</sup></b>	<b>745.3</b>	<b>23.4</b>

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

1. Extent retained inside development envelope but outside proposal footprint.

#### 8.4.1.1 Loss of Vegetation Associations

The extent of disturbance within each vegetation association recorded from the proposal footprint is detailed in Table 8.10. The vegetation associations Cc<sup>1</sup>, CcMpMr, ErCo, MpAl, Xp<sup>2</sup>, CcEr<sup>3</sup>, Pr, Pp, R, Rehab, FormerSettlement and all variants of CI have not been included in Table 8.10 as they represent cleared areas or areas highly altered not representing intact native vegetation. Parts of vegetation associations in Table 8.10 that are in degraded to completely degraded condition (or poorer) are further excluded from the area of intact native vegetation to be cleared from each vegetation association. Vegetation associations Bl, BlMp, Cc<sup>6</sup>, CcEm<sup>1</sup>, Co, Ep, Er<sup>3</sup>, Er<sup>4</sup>, Er<sup>5</sup>, ErMrMc, Mp<sup>1</sup>, Mp<sup>9</sup>, Mp<sup>10</sup>, MpBl and PeAsMtMl all occur in the study area but not in the development envelope and are therefore not considered in Table 8.10.

The impact on the vegetation associations was avoided or minimised during the design process for the proposal. This included the avoidance of vegetation associations Bl, BlMp, Cc<sup>6</sup>, CcEm<sup>1</sup>, Co, Em<sup>2</sup>, Ep, Er<sup>2</sup>, Er<sup>3</sup>, Er<sup>4</sup>, Er<sup>5</sup>, ErMrMc, Mp<sup>1</sup>, Mp<sup>9</sup>, MpBl and PeAsMtMl. Impact on the remaining vegetation associations was minimised where possible. The proposal will involve the clearing of the entire extent of three vegetation associations from the study area (see Table 8.10).



**Table 8.10 Clearing impact on vegetation associations**

<b>Vegetation association</b>	<b>Extent in study area (ha)</b>	<b>Extent of intact native vegetation to be cleared within proposal footprint</b>	<b>Extent remaining within flora study area (%)</b>
As	3.4	1.9	44.1
AsMIEvCI	5.4	5.3	1.9
Ba	3.7	3.5	5.4
BaBm <sup>1</sup>	41.7	11.2	73.1
BaBm <sup>2</sup>	147.6	26.2	82.2
BaBm <sup>3</sup>	41.9	25.8	38.4
BaBmMp	7.5	6.9	8.0
Cc/Mp	15.8	0.4	97.5
Cc <sup>2</sup>	7.6	1.6	78.9
Cc <sup>3</sup>	3.7	2.9	21.6
Cc <sup>4</sup>	13.4	1.4	89.6
Cc <sup>5</sup>	45.1	22.9	49.2
Cc <sup>7</sup>	4.9	2.5	49.0
CcEm <sup>2</sup>	92.5	27.1	70.7
CcEr <sup>1</sup>	9.3	2.2	76.3
CcEr <sup>2</sup>	20.6	2.9	85.9
CcMp	1	0.9	10.0
Em <sup>1</sup>	7.6	3.6	52.6
Em <sup>2</sup>	30.4	–	0.0
EpRi	0.9	0.8	11.1
Er <sup>1</sup>	8.3	1.7	79.5
Er <sup>2</sup>	4.8	–	0.0
Er <sup>6</sup>	51.8	5.2	90.0
Er <sup>7</sup>	4.4	<0.1	0.0
Er <sup>8</sup>	6.2	–	0.0
ErMp	11.7	5.8	50.4
Et <sup>1</sup>	13.8	3.1	77.5
Et <sup>2</sup>	81.9	23.7	71.1
Et <sup>3</sup>	20.5	4.8	76.6
Mp <sup>2</sup>	8.5	0.1	98.8
Mp <sup>3</sup>	5.3	0.4	92.5



Vegetation association	Extent in study area (ha)	Extent of intact native vegetation to be cleared within proposal footprint	Extent remaining within flora study area (%)
Mp <sup>4</sup>	12.5	0.8	93.6
Mp <sup>5</sup>	1.4	–	0.0
Mp <sup>6</sup>	2.7	1.3	51.9
Mp <sup>7</sup>	3.1	0.1	96.8
Mp <sup>8</sup>	9.4	5.1	45.7
MpCc	1.3	0.3	76.9
MpMr	7.1	1.3	81.7
Xp <sup>1</sup>	8.4	1.2	85.7
<b>Total</b>	<b>–</b>	<b>205.0</b>	<b>–</b>

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

Note: Vegetation associations Cc<sup>1</sup>, CcMpMr, ErCo, MpAl, Xp<sup>2</sup>, CcEr<sup>3</sup>, Pr, Pp, R, Rehab, Former Settlement and all variants of CI represent cleared areas or areas highly altered not representing intact native vegetation and have been excluded from this list.

#### 8.4.1.2 Loss of Vegetation Complexes

The five vegetation complexes occurring within the proposal footprint are all above the 10% target set by the EPA and Bush Forever Strategy, while two are above the 30% threshold set by ANZECC (Table 8.11). The proposal will not result in any vegetation complex crossing a threshold into a more threatened category; that is, the proposal will not cause any vegetation complex to drop below 30%, or below 10%.

**Table 8.11 Impacts on vegetation complexes at a regional level**

Vegetation complex	Pre-European extent (ha) <sup>1</sup>	2013 extent remaining (ha) <sup>1</sup>	Extent to be cleared within proposal footprint (ha) <sup>2</sup>	Pre-European extent remaining following development of the proposal (ha)
Bassendean Complex-Central and South	87,392	24,206 (27.70%)	61.76	24,144 (27.63%)
Bassendean Complex-North Transition	17,640	16,126 (91.42%)	10.18	16,116 (91.36%)
Bassendean Complex-North	74,133	53,518 (72.19%)	69.65	53,448 (72.10%)
Southern River	57,171	11,255 (19.69%)	44.50	11,170 (19.61%)
Yanga	26,176	4,645 (17.75%)	18.94	4,626 (17.67%)

1. Pre-European extents from WALGA (2013).

2. Only considers the 205.0 ha of intact native vegetation within the proposal footprint (see Table 8.10).

#### 8.4.2 Permanent Loss of Groundwater Dependent Ecosystems

Geomorphic wetlands (i.e. Conservation Category, Resource Enhancement and Multiple Use) occur across 349 ha of the proposal footprint (see Section 10.2.3). GDEs are intact native vegetation within geomorphic wetlands. The proposal will result in the permanent loss of 49.6 ha of GDEs, which is considered to



represent 20.9% of the mapped GDEs within the flora study area. In addition to the direct clearing of GDEs, the proposal may alter the surface and groundwater hydrology during the construction phase of the proposal. This may result in changes in composition and structure of adjacent GDEs through a change in the groundwater table or alterations to the natural surface or sub-surface water flow.

The construction of culverts and the raising of the road profile may impact on adjacent vegetation including GDEs with the creation of ‘water shadows’ down-flow and ponding of surface water. The shadowing and ponding of surface water is considered an issue for surface water dependent vegetation (e.g. *Hypocalymma angustifolium*). The design and construction of culverts will ensure that ponding and ‘shadowing’ are mitigated. The impacts to hydrology and wetlands within the proposal footprint are discussed in Section 10.6.

#### 8.4.3 Permanent Loss of Native Vegetation within Bush Forever Sites


The proposal footprint overlaps nine Bush Forever sites (see Figure 8.5) and will impact on 128.5 ha of intact native vegetation (Table 8.12). The proposal may introduce or spread dieback and/or weeds into the Bush Forever sites.

**Table 8.12 Clearing impacts on Bush Forever Sites**

Site Identification	Extent of Bush Forever site (ha)	Extent to be cleared within proposal footprint (ha) <sup>1</sup>	Extent remaining (%)
Site 97: Kirby Road Bushland, Bullsbrook	447	3.3	99.3
Site 100: Neaves Road Creek, Bullsbrook	34.4	0.2	99.4
Site 192: Wetherell Road Bushland, Lexia/Ellenbrook	43.6	1.3	97.0
Site 198: Beechboro Road Bushland, Cullacabardee/Ballajura	483.9	30.7	93.7
Site 300: Maralla Road Bushland, Ellenbrook/Upper Swan	660.3	16.9	97.4
Site 304: Whiteman Park, Whiteman/West Swan	2,801.40	29.7	98.9
Site 307: Lightning Swamp and Adjacent Bushland, Noranda	74.9	1	98.7
Site 399: Melaleuca Park and Adjacent Bushland, Bullsbrook/Lexia	4,261.40	29.6	99.3
Site 480: Victoria Road Bushland, Malaga/Beechboro	18.9	15.9	15.9
<b>Total</b>	<b>8,841.5</b>	<b>128.5</b>	<b>98.1</b>

1. Considers intact native vegetation in all mapped vegetation associations.





The proposal traverses nine Bush Forever sites resulting in the fragmentation of intact native vegetation. The proposal has a significant impact on Bush Forever site 480, with only 15.9% of the site remaining at the intersection of the Tonkin and Reid highways. The proposal is constrained in this area with residential areas abutting the road reserve leaving few opportunities for avoidance of clearing of vegetation.

The separation of Bush Forever sites 198, 300, 304 and 399 is not considered to be a significant impact due to the size of the sites and the presence of large, relatively contiguous vegetation adjacent to the proposal footprint.

The proposal footprint is located along the edge of sites 192 and 307, with 1.3 ha of rehabilitated vegetation in site 192 proposed to be cleared, and 1.0 ha of roadside vegetation at site 307. The clearing of native vegetation within these Bush Forever sites 192 and 307 is not considered to significantly impact the values of the site.

Site 100 is surrounded by infrastructure and open paddocks, and the proposal footprint will dissect this site. The impact to site 97 is 3.3 ha or 0.7%. The proposal footprint will separate a small section (4.3 ha) from the remaining site. The potential impacts on native vegetation within the proposal footprint include intact native vegetation within the Bush Forever sites partially located in the proposal footprint. The impacts on native vegetation are detailed in Section 8.4.1.

In addition to the impacts associated with clearing of native vegetation within the Bush Forever sites, impacts on wetlands and GDEs within the Bush Forever sites are likely and these are considered in Section 8.4.2.

#### **8.4.4 Permanent Removal of Threatened and Priority Ecological Communities**

The proposal will impact known locations of TECs and PECs recorded in the proposal footprint. The design of the proposal footprint will ensure that there are no direct impacts to the Mound Springs SCP or the Claypans of the SCP.

The extent of each TEC and PEC within the flora study area, the development envelope and the proposal footprint has been determined (see Figure 8.4). The extent of TECs and PECs mapped from the flora study (Appendix C) does not include buffers, once these new occurrences are incorporated into the DPAW database, buffers will be determined. The design of the proposal ensured that the extent of the Claypans of the SCP within the development envelope will not be impacted.

The proposal will involve the permanent removal of parts of two TECs (SCP02 and SCP20a) and five PECs (SCP21c, SCP23b, SCP22, *Banksia* dominated woodlands on the Swan Coastal Plain and SCP24) from the proposal footprint. The clearing impacts on the TECs and PECs recorded from the study area are presented in Table 8.13.

The development envelope traverses the buffers of six locations of the TEC Mound Springs SCP and of two locations of the TEC Muchea Limestone. The proposal is not considered to impact these locations as they are located more than 1 km from the development envelope, except in the case of the location of Mound Springs SCP near Gaston Road, which is discussed in further detail below.

The development envelope that intersects the buffers of the TECs (namely the Muchea Limestone and Mound Springs SCP TECs) is generally associated with open, cleared paddocks (north of Maralla Road) and housing associated with the Ellenbrook suburb. Where the buffers intersect the development envelope, native vegetation is sparse or highly modified (for example, north of Maralla Road). The proposal is not considered to increase the impact on the TECs due to the existing level of disturbance within the buffers.

The TEC Mound Springs SCP at Gaston Road is located upslope of the proposal footprint so indirect impacts associated with groundwater and hydrology influences will not occur. During the planning study of the proposal footprint, the proposal was located to the east of the TEC to protect the groundwater quality,



which is fed from the west, north and south of the TEC. Indirect impacts to the TEC may occur if there is an impediment to surface water movement from the TEC; however, the design and construction of culverts will ensure surface water is able to move unimpeded across the landscape to the east (GHD, 2008a) (Appendix E). Impacts to this TEC are further discussed in Section 10.4.8.

Indirect impacts to the Claypans of the SCP are addressed in Section 10.4.9.

**Table 8.13 Direct impacts to TECs and PECs**

Ecological Community	Conservation rating	Extent within the flora study area (ha)	Extent within the development envelope (ha)	Extent within the proposal footprint (ha) <sup>1</sup>
Claypans of the SCP ( <i>Casuarina obesa</i> association or Claypans with dense shrublands of <i>Melaleuca lateritia</i> over herbs – State PEC P1)	Critically Endangered (Commonwealth TEC) State PEC P1	9.8	0.0	0.0
Mound Springs SCP	Endangered (Commonwealth TEC) and Critically Endangered (State TEC)	1.5	0.0	0.0
SCP02	Endangered (State TEC)	1.4	1.1	0.4
SCP20a	Endangered (State TEC)	12.3	4.3	4.0
SCP21c	Priority 3 (State PEC)	178.0	78.0	64.0
SCP22	Priority 2 (State PEC)	3.4	0.3	0.1
SCP23b	Priority 3 (State PEC)	57.5	14.2	11.6
SCP24	Priority 3 (State PEC)	8.1	8.1	7.8
<i>Banksia</i> dominated woodlands on the Swan Coastal Plain	Priority 3 (State PEC)	488.1	174.8	62.0


1. Considers all vegetation in all mapped vegetation associations.

SCP02 (Endangered, State TEC) is known from nine occurrences with a total extent of 40.9 ha. The 2014 survey (Coffey, 2015a) recorded a potential new occurrence, which comprises 1.36 ha in size. The new occurrence has tentatively been identified as the TEC based on the results and review of the multivariate statistical analysis. Following the precautionary principle, the site is considered to be the TEC SCP02 until further assessments can be completed to determine its affinity. The proposal will involve the clearing of 0.4 ha of the SCP02 TEC.

SCP20a (Endangered, State TEC) is known from 57 occurrences and is 436 ha in extent. The 2014 survey recorded three new occurrences of the TEC, which are approximately 12.3 ha in extent. The extent of impact from the proposal footprint is approximately 4.0 ha.

SCP21c (Priority 3, State PEC) is known from 54 occurrences; however, the extent of 43 of these occurrences has not been mapped. Subsequently the current mapped extent of 310.5 ha for 11 occurrences is an under-representation of the known extent. The proposal will impact 64.0 ha of SCP21c, which is 13.1% of the known mapped extent of this PEC. SCP21c is known from 54 occurrences; however





only 11 of these have been mapped. Including surveys conducted for this study, SCP21c currently has a known mapped extent of 488.5 ha. This figure is an underrepresentation of the extent of this PEC.

SCP22 (Priority 2, State PEC) is known from approximately 45 occurrences, while the 2014 survey recorded one additional occurrence totalling 3.4 ha. The data on the extent of the previously known occurrences is not available, therefore, the overall impact is difficult to assess. The PEC SCP22 occurs across 0.1 ha of the proposal footprint and as such the proposal is not considered to have a significant impact on the PEC.

SCP23b (Priority 3, State PEC) is known from one occurrence with limited data available (DPAW, 2015) on the occurrence. The 2014 flora survey identified five new occurrences in addition to the previously known occurrence. However, as the data for the extent of the previously known occurrence is not available, the overall impact cannot be assessed. The extent of SCP23b within the flora study area was 57.5 ha, of which approximately 11.6 ha or 20.2% is located within the proposal footprint.

The proposal will impact 7.76 ha of SCP24 (Priority 3, State PEC), which is 0.76% of the known mapped extent. SCP24 is known from 33 occurrences representing 1,008 ha; however, only 16 of these have been mapped. As such the total extent of SCP24 is an underrepresentation of the extent of this PEC.

The number of occurrences and extent of the *Banksia* dominated woodlands of the Swan Coastal Plain (Priority 3, State PEC) is not currently known. The extent and final PEC description is awaiting approval from DOTE. The extent of the PEC mapped within the proposal footprint has been determined based on the presence of the two dominant *Banksia* species, *Banksia attenuata* and *Banksia menziesii*. The extent of the PEC within the development envelope is 174.8 ha, while the project will impact on 62.0 ha of the total 488.1 ha extent mapped within the flora study area. Approximately 12.7% of the mapped extent of the PEC will be impacted within the proposal footprint. The extent of the 'Banksia woodland of the Swan Coastal Plain' PEC does not include areas of Banksia woodland where other PEC or TEC are situated.

The condition of the extent of the TECs and PECs impacted by the proposal is provided in Table 8.14. The condition of the seven TECs or PECs to be impacted by the proposal ranged from Completely Degraded to Pristine/Excellent. Half of SCP02 is in very good condition but the remaining 0.2 ha appears to be in a degraded state or cleared. The proposal footprint will impact a total of 4.0 ha of SCP20a, the majority of which is in Excellent condition.

The majority of SCP21c to be impacted is in Good or better condition. A total of 7.69 ha of SCP24 occur in the study area, the majority of this vegetation is in Good condition. The proposal footprint will impact 10.9 ha of native vegetation of PEC SCP23b, the majority of which is in Excellent condition.

Approximately half of the Banksia dominated woodland on the Swan Coastal Plain to be impacted ranges from Very Good to Excellent condition, 12.2 ha is in degraded or worse condition. Only a small proportion is in Pristine to Excellent condition.

**Table 8.14 Condition of impacted TECs and PECs**

Vegetation condition	TECs		PECs				
	SCP02	SCP20a	SCP21c	SCP22	SCP23b	SCP24	Banksia SCP
Pristine to Excellent	–	–	3.4	–	–	–	0.2
Excellent	–	3.01	6.9	0.1	10.1	0.3	27.1
Excellent to Very Good	–	–	11.2	–	–	–	5.3
Very Good	0.2	0.8	23.9	–	0.8	–	9.5
Very Good to Good	–	–	5.3	–	–	0.7	<0.01
Good	–	–	8.0	–	–	6.4	4.5
Good to Degraded	–	–	–	–	–	–	3.2
Degraded	–	0.1	0.01	–	0.3	–	9.4
Degraded to Completely Degraded	–	–	4.0	–	<0.01	–	0.6
Completely Degraded	–	–	1.0	–	–	0.2	1.1
Cleared	0.2	–	0.3	–	0.5	0.2	1.2

#### 8.4.5 Permanent Removal of Threatened and Priority Listed Flora

The clearing of intact native vegetation within the proposal footprint will not directly impact the two Threatened flora species (*Caladenia huegelii* and *Grevillea curviloba* subsp. *incurva*) recorded or the known location of Threatened *Darwinia foetida* which is located 250 m to the west of the proposal footprint near the proposed Neaves Road grade separation. The clearing for the proposal footprint will impact six of the eight priority flora recorded. Details of their extents and impacts are quantified in Table 8.15.


The known location of the threatened *Caladenia huegelii* (Grand Spider Orchid) is not within the proposal footprint. The individual recorded within the development envelope is approximately 60 m from the proposal footprint. Critical habitat for the survival of this species is the current known occupancy and areas of similar habitat surrounding known populations (DEC, 2009). The location, including surrounding similar habitat, is considered to be critical habitat (see Figure 8.1). The critical habitat for *Caladenia huegelii* within the proposal footprint is 39.2 ha or 17.2% of the flora study area.

Indirect impacts to *Caladenia huegelii* may include the introduction and proliferation of introduced weeds and dieback and activities that may indirectly impact the lifecycle of the species including impacts on the symbiotic mycorrhizal fungus or the lifecycle and movement of thynnid wasps required for pollination.

A minimum buffer of 50 m will apply between the proposal footprint and the threatened plant (Appendix C). The buffer will ensure the ecological processes occurring within the bushland are maintained and the necessary processes for the threatened plant (for example, habitat for native pollinators, maintenance of hydrological regimes) are maintained. The *Caladenia huegelii* is located within a portion of native bushland (in excess of 8.5 ha) that will be retained, ensuring the condition of the buffer and plant are maintained.

The individual recorded from the flora study area is located approximately 20 m west of Ellenbrook. The area outside of the development envelope does not provide for a larger buffer to the east of the individual due to the existing disturbed areas and the housing development. The distance between the plant and the Ellenbrook suburb to the east is not considered to be an issue because the impacts associated with the





suburban area are present and ongoing. The project will increase the protection of the plant to the east with the construction of a noise wall along the boundary of the properties abutting the project. The species survives in remnant bushland areas such as along Roe Highway Stage 7 and the bushland on the eastern side of the Murdoch railway station car park.

The records of *Grevillea curviloba* subsp. *incurva* were located in association with previously known locations (DPAW, 2014a). No new populations or individuals were recorded from the proposal footprint. The proposal will not directly disturb any known populations; however, individuals are within 10 m of the proposal footprint. The population is persisting in the degraded vegetation between the existing rail line and road. The proposal will impact 2.0 ha of degraded vegetation that is considered to be critical habitat. The degraded vegetation located along the Brand Highway verge and the rail reserve (see Figure 8.1) is considered to be critical habitat to *Grevillea curviloba* subsp. *incurva* (Phillimore and English, 2000) due to the known area of occupancy and the link the Brand Highway verge and rail reserve provides between known populations along Brand Highway and Muchea Road South. The construction of the proposal has potential for indirect impacts to *Grevillea curviloba* subsp. *incurva* due to the proximity of the road; however, impacts due to shadowing, smothering, hydrology or introduction/spread of dieback are unlikely from this proposal.

*Darwinia foetida* was located in association with previously known locations (DPAW, 2014a). No new populations or individuals were recorded from the proposal footprint. The population was located 250 m from the proposal footprint northwest of Neaves Road. There is no contiguous vegetation between the population of *Darwinia foetida* and the proposal footprint (see Figure 8.1). Critical habitat has not been identified for *Darwinia foetida*. However, as no populations or intact native vegetation within 200 m of the populations will be impacted, the project is not considered to impact on critical habitat for *Darwinia foetida*.

Six of the eight priority listed flora (*Millotia tenuifolia* var. *laevis* (P2), *Poranthera moorokatta* (P2), *Meeboldina decipiens* subsp. *decipiens* ms (P3), *Cyathochaeta teretifolia* (P3), *Anigozanthos humilis* subsp. *chrysanthus* (P4) and *Hypolaena robusta* (P4)) are located within the proposal footprint.

The impact to *Anigozanthos humilis* subsp. *chrysanthus*, *Hypolaena robusta* and *Poranthera moorokatta* as a result of the proposal is considered to be minor. The proportion of known individuals to be impacted in the proposal footprint represents 0.15%, 0.10% and 0.04%, respectively.

The number of known populations and individuals of *Poranthera moorokatta* is considered to be low, as it is believed to be regularly misidentified in the field. It is likely that the impact of the proposal on the number of populations is minor and the priority taxon is more widespread in intact remnant native vegetation in the Ellenbrook region.

The impact to the known populations of *Millotia tenuifolia* var. *laevis* is considered to be potentially significant. *Millotia tenuifolia* var. *laevis* is a cryptic species with a wide distribution and it has not previously been recorded on the SCP. The identification of individuals in the flora study area represents the most western occurrence of this species (Figure 8.9). Previous records did not indicate the number of individuals recorded and so a conservative approach has been taken in that each record was treated as one individual. As such, this is considered the maximum potential impact. The proposal will impact on 18.8% of all known individuals and nearly 50% of the known individuals located in the flora study area, which represent a significant population as it is the first population to be recorded on the SCP.

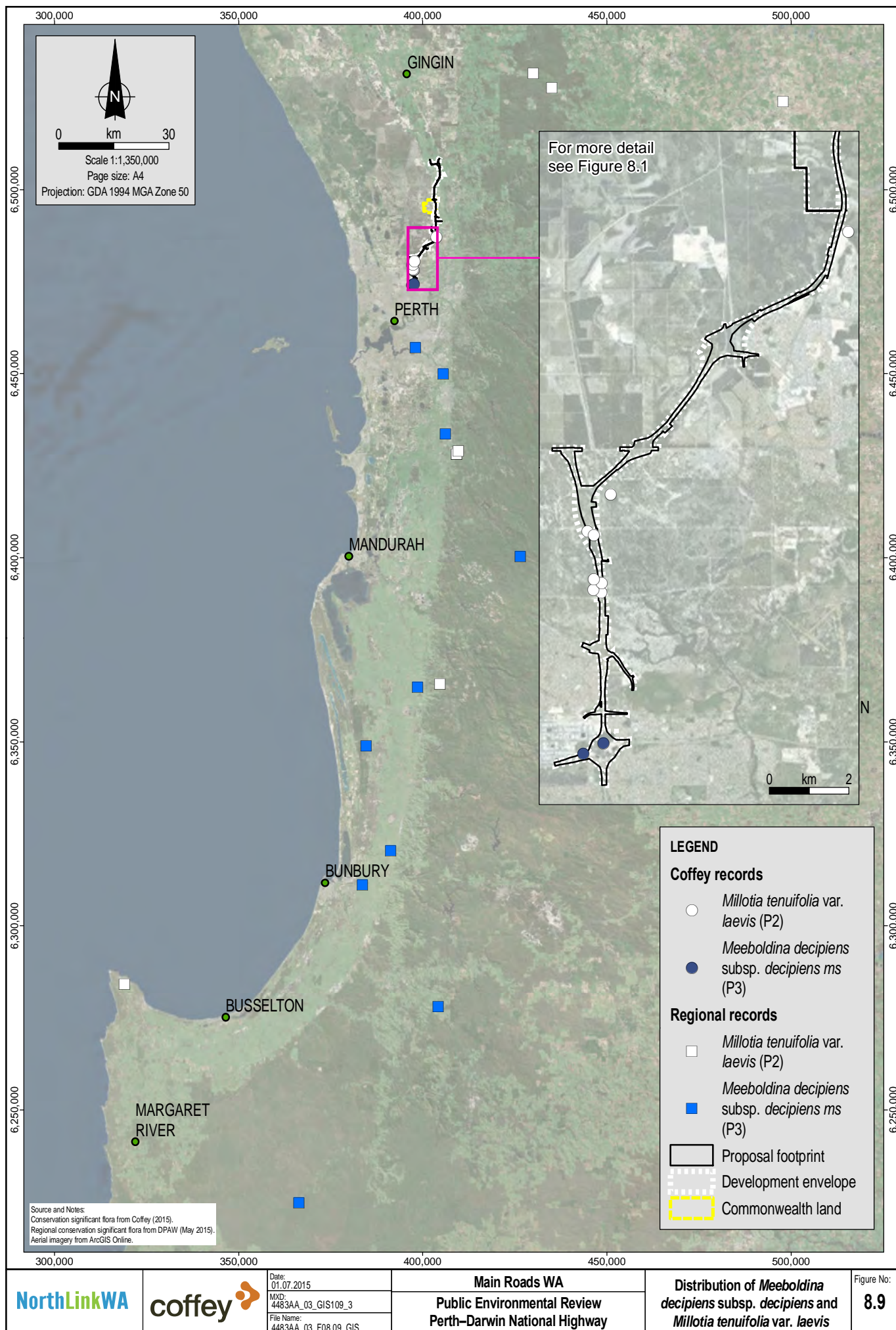
*Meeboldina decipiens* subsp. *decipiens* ms has a wide distribution but the population size is unknown. Two individuals are known from one recorded population, while the other nine population records did not specify the number of individuals. In the assessment of the impact of the project on the species, a conservative approach has been taken in that each record was treated as one individual (see Figure 8.9). As such, this is considered to be the maximum potential impact on this Priority taxon.


**Table 8.15 Local and regional impacts on threatened and priority flora**

Species	Conservation status	Total number of known populations <sup>1</sup>	Number of populations known within the study area	Number of populations to be impacted within the proposal footprint	Proportion of populations to be impacted (%)	Total minimum number of known Individuals	Number of individuals within study area	Number of known individuals to be impacted within the proposal footprint	Proportion of known individuals to be impacted (%)
<i>Caladenia huegelii</i>	T	19	1	–	–	355	1	–	0.00
<i>Grevillea curviloba</i> subsp. <i>Incurva</i>	T	24	3	–	–	682	137	–	0.00
<i>Millotia tenuifolia</i> var. <i>laevis</i>	P2	12	4	2	16.7	16	7	3	18.8
<i>Poranthera moorokatta</i>	P2	4	2	1	25.0	2,508	7	1	0.04
<i>Meeboldina decipiens</i> subsp. <i>decipiens</i> ms	P3	12	2	2	16.7	22	11	11	50.0
<i>Cyathochaeta teretifolia</i> <sup>1</sup>	P3	30	2	–	–	1,375	30	–	–
<i>Anigozanthos humilis</i> subsp. <i>chrysanthus</i>	P4	18	2	1	5.6	1,334	4	2	0.15
<i>Hypolaena robusta</i>	P4	30	3	3	10.0	17,742	25	17	0.1
<i>Ornduffia submersa</i>	P4	43	1	–	–	10,297	1	–	0.00
<i>Stylidium striatum</i>	P4	24	1	–	–	2,965	1	–	0.00

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







*Meeboldina decipiens* subsp. *decipiens* ms were recorded from two locations in wetland habitat within the proposed Tonkin Highway and Reid Highway interchange. The two locations will be directly impacted by the proposal. These locations represent the most northerly recorded extent of this taxon and are therefore considered to be significant. The proposal will result in a 50% reduction in known individuals.

The remaining priority listed flora, *Ornduffia submersa* (P4) and *Stylidium striatum* (P4) are located outside the proposal footprint and will not be directly impacted.

An historical record of *Cyathochaeta teretifolia* (P3) was known to occur in the proposal footprint from a quadrat established and sampled for the project. The quadrat was revisited in 2014 and no individuals were recorded within the quadrat or adjacent to the quadrat. As such, the priority taxon is not considered to occur within the proposal footprint and there is no direct impact on *Cyathochaeta teretifolia*.

#### **8.4.6 Spread of Introduced Weeds**

The construction and operation phase of the proposal has the potential to result in the introduction and spread of existing introduced weeds. Remnant native bushland within the PMR is resilient to most non-invasive weeds; however, the presence of significant environmental weeds is of more concern due to the invasiveness of these weeds. Significant weeds are considered to be WONS, declared pests under Section 22 of the BAM Act and Prohibited weeds under Section 12 of the BAM Act.

During construction and maintenance activities, weeds and their seeds or vegetative material can be transported to, and within the proposal footprint through the incorrect implementation of a weed hygiene management plan. Seeds and vegetative material can be located in mud and soil attached to the undercarriage of vehicles that require appropriate cleaning and inspection prior to moving within the proposal footprint.

The boundary between the proposal footprint and the native vegetation located adjacent to the proposal footprint poses the greatest risk of weed invasion. The edges are subjected to greater levels of light, water and disturbance which allow weeds to establish and slowly out-compete native flora.

In addition to the edges, areas of high traffic and movement by vehicles, equipment and construction workers also pose a higher risk to weed invasion, with inappropriate weed hygiene measures. Once weeds are established they can be difficult to remove due to their invasiveness, competitiveness and ability to spread across the landscape. The presence of significant weeds directly impacts the integrity of intact native vegetation and can increase the likelihood of additional impacts, including fires, vegetation degradation, vermin and economic returns.


#### **8.4.7 Spread of *Phytophthora* Dieback**

*Phytophthora* Dieback can degrade and alter the structure of susceptible native vegetation. More than 25% of the proposal footprint is infested, and only a small area of 4.15% is considered uninfested and protectable. The current infestations (see Figure 8.8) and any additional infestations have the potential to cause significant degradation to the native vegetation, altering the structure, composition and density of the vegetation. The impact of Dieback can also severely degrade significant fauna habitat, especially Black Cockatoo feeding habitat (*Banksia* woodlands).

Dieback is spread through the movement of water and soil within the landscape via wet soil adhering to vehicle tyres/tracks and earthmoving equipment. The management of Dieback is important to ensure it does not spread into adjacent uninfested areas and protectable areas.

The movement of soil, mulch and material into and within the proposal footprint has the potential to introduce and move Dieback throughout the proposal footprint and into adjacent native vegetation. This is particularly pertinent when machinery and vehicles have been operating within Dieback infested areas without appropriate management. It is also pertinent for movement within the proposal footprint across





Dieback category boundaries. The impacts from physical disturbance to native vegetation adjacent to the proposal are considered to be low and manageable.

#### **8.4.8 Fragmentation of Native Vegetation**

The proposal footprint consists of areas of contiguous vegetation and non-contiguous vegetation. The construction and operation of the proposal has the potential to further fragment the vegetation present within the proposal footprint.

Six regional ecological linkage networks traverse the proposal footprint (see Section 8.2.9). Three (Gaston Road Bullsbrook, Raphael Road Bullsbrook and Reid Highway) of the six regional linkage networks are already highly fragmented and rely on roadside vegetation and remnant vegetation along drainage corridors to connect regionally significant bushland. The remaining three (Maralla Road Nature Reserve, Rocla mining lease area, Cullacabardee) regional linkage networks consist of large contiguous blocks of vegetation in close proximity to each other with minor fragmentation as a result of roads and developments.

The construction phase of the proposal will temporarily impede the three fragmented regional linkage networks due to vegetation clearing and the construction of the proposal. It is expected at the completion of the construction that the remaining linkages will be maintained by the revegetation and rehabilitation of the roadside vegetation (see Chapter 12).

The operation of the highway will continue to provide an impediment to the linkage network even with the successful revegetation of the roadside vegetation (see Chapter 12).


The construction phase of the proposal is considered to have a moderate impact on fragmentation within the remaining three regional linkage networks (i.e. Maralla Road Nature Reserve, Rocla mining lease area and Cullacabardee), which include large contiguous areas of native vegetation. The proposal will provide a 100 to 250 m wide impediment in key areas located at Maralla Road, Rocla mining lease area and the intact native vegetation at Cullacabardee.

The regional linkage network along Maralla Road and Cullacabardee is considered to be important for the movement of vertebrate fauna and the movement of genetic material for flora and fauna. The impact of the proposal on fauna is discussed in Chapter 9.

#### **8.4.9 Edge Effects from Introduced Weeds and Refuse**

Edge effects are identifiable as any difference in environment between the edge and the interior of a particular patch of vegetation. These edges can be referred to as ecotones where an overlap occurs between two vegetation communities. Edges are zones of overlap and interaction between different habitats or vegetation associations and their constituent elements (i.e. flora, fauna, hydrology, soils) (Beer and Fox, 1997). Two edges are created by a clearing, the natural edge and the cleared edge. Edges are expected to be created as a result of the proposal. The edges will occur between the proposal footprint and the native vegetation located adjacent to the proposal footprint.

Edges and their effects may be natural or be human induced with new edges readily created by roads, vegetation clearing, forestry and other developments (van Etten, 2014). The distance the effect spreads from the edge can be highly variable and depends on many factors such as vulnerability of edge ecosystem, degree of change in land use, intensity of this use and chance events (Murchia, 1995). Edge effects have two particular and measurable properties: (i) the distance of which the effect occurs, or at least is detectable, from the edge of the vegetation/habitat into the interior, and (ii) the degree to which the edge environment differs from the interior of the vegetation/habitat (van Etten, 2014). The scope of these edge effects widens not only to include changes to the environment adjacent to the proposal footprint, but to



include restriction on the movement for fauna, gene flow and water imposed by roads (van Etten, 2014). The restrictions on fauna and water are discussed in Chapters 9 and 10, respectively.

The impacts of edge effects on native vegetation include the physical disturbance of vegetation at the edge, the introduction of pathogens and weeds, and changes to vegetation composition. The impacts of edge effects resulting from the construction of the proposal are also detailed in Chapters 9 and 10. Edge effects are considered to be greatest where the proposal is adjacent to native vegetation. Generally, this occurs south of Maralla Road in Bullsbrook, while native vegetation is sporadic north of Maralla Road.

The native vegetation adjacent to the proposal may potentially be impacted during the construction phase due to vehicle accidents, dumping of refuse, uncontrolled third party access into adjacent vegetation, dieback and weed incursion and fire. The impacts of fire during the construction and operation phase are discussed in Section 8.4.11, while the impacts of weeds and dieback are discussed in Sections 8.4.6 and 8.4.7, respectively.

#### **8.4.10 Uncontrolled Access**

Uncontrolled access is currently contributing to the degradation of native vegetation at Maralla Road Nature Reserve, the Lexia wetlands, State Forest, Cullacabardee and the Reid Highway and Tonkin Highway interchange.

Household refuse, significant environmental weeds (i.e. declared pests listed under the BAM Act), vegetation degradation through off-road activity and Dieback have all been attributable to the uncontrolled access.

#### **8.4.11 Fires**

Native vegetation on the SCP has adapted to deal with wildfires as part of the natural ecology. Altered fire regimes (including arson, poorly managed burn-offs) can lead to the degradation of vegetation by lowering recruitment of native species, alterations to structure and an increase in weed occurrence and density.

The division of vegetation and vegetation to housing (such as that in Ellenbrook) that the proposal will create will increase the ease of access for emergency services to respond to fires. The proposal will also provide a fire break between intact native vegetation, for example, between Cullacabardee and Whiteman Park.

Fires may increase within and adjacent to the proposal footprint as a result of the construction of the proposal from incorrect disposal of cigarette butts, poor handling and storage of flammable fuels and from 'hot works' activities (for example, welding sparks igniting dry grass). However these risks are readily managed during construction and are unlikely to result in additional fires.

### **8.5 Management Measures**

The mitigation hierarchy (Government of Western Australia, 2014) has been employed throughout the road planning and design phase and this assessment to ensure that:

- The locally and regionally significant vegetation located within the proposal footprint has been avoided as much as possible through the design process and specifically avoids the Mound Springs SCP and Claypans of the SCP TECs (see Chapter 4).
- Clearing is minimised to as low as practicable, i.e. the alignment and width of the development envelope has been reviewed to identify a proposal footprint that minimises clearing in very good to pristine condition vegetation and reduces the clearing of TECs and PECs.
- Where possible, vegetation will be rehabilitated. Details of rehabilitation are discussed in Chapter 12.



- Offsetting the significant residual impacts through an offset strategy (see Chapter 17).

To ensure the impact is reduced to as low as reasonably practicable, outcome-based commitments have been developed for the construction and operation aspects of the proposal. The mitigation hierarchy (Government of Western Australia, 2014) (avoid, minimise and rehabilitate/restore and offset – see Chapter 17) has been applied during proposal design and in the development of appropriate mitigation and management strategies and offsets.

As discussed throughout this chapter, the following significant flora and vegetation values have been avoided:

- Mound Springs SCP TEC at Gaston Road.
- Claypans of the SCP TEC adjacent to the existing Great Northern Highway.
- *Caladenia huegelii*, *Grevillea curviloba* subsp. *incurva* and *Darwinia foetida* threatened flora locations.
- *Cyathochaeta teretifolia* (P3), *Ornduffia submersa* (P4) and *Stylidium striatum* (P4) priority flora locations.
- The alignment of the proposal was also relocated to the west of Bush Forever Site 13 (west of Sawpit Road, Bullsbrook) to avoid any direct impact to the site, including the Conservation Category Wetland (UFI 8926) within the Bush Forever site.

To ensure that impacts to remaining flora and vegetation values present within and in close proximity to the proposal footprint are minimised and that the relevant EPA objectives can be met, MRWA commits to the following outcomes:


- A maximum of 205.0 ha of native vegetation will be cleared.
- A maximum of 49.6 ha of GDEs will be cleared.
- A maximum of 128.5 ha of intact native vegetation within Bush Forever sites will be cleared.
- A maximum of 4.4 ha of State listed TECs (SCP02 and SCP20a) will be cleared.
- A maximum of 145.5 ha of State listed PECs (SCP21c, SCP22, SCP23b, SCP24 and Banksia on the Swan Coastal Plain) will be cleared.

While various management measures are proposed in this PER to achieve these desired outcomes, alternative management strategies may arise with further design, investigations and project planning. MRWA is committed to achieving the environmental outcomes through appropriate management measures that are relevant to specific conditions on-site and which may vary from those described in this document.

This approach is consistent with the Environmental Assessment Guideline for Recommending Environmental Conditions (EPA, 2013a).

MRWA's commitment to the environmental outcomes may be achieved through the implementation of the following management measures:


- Additional targeted surveys for Threatened and Priority listed flora will be undertaken prior to vegetation clearing to clearly define population boundaries, and to identify any additional populations within and adjacent to the proposal.
- Additional targeted surveys of the known populations of *Millotia tenuifolia* var. *laevis* and *Meeboldina decipiens* subsp. *decipiens* ms to clearly define populations and known individuals. The



survey results will be provided to the EPA as part of the response to submissions process to inform the EPA's assessment of the proposal.

- Progressive clearing and revegetation will occur through the life of the construction phase of the proposal.
- Delineation of an approved clearing boundary.
- Preparation and implementation of an EMP (Appendix F) to limit risk of fire, the introduction and/or spread of weeds and/or dieback and litter to protect ecosystems that supports Threatened and Priority taxa. This EMP will include a monitoring program to monitor the condition of environmentally significant vegetation along the edge of the proposal footprint (i.e. TECs, PECs and threatened flora buffers) for any indirect impacts, including significant environmental weed incursions (i.e. WONS and declared pests) and refuse.
- Develop a detailed infrastructure plan for each stage of the development prior to construction to ensure the proposal is designed within the approved development boundary ('proposal footprint') and identifies areas of native vegetation to be retained.
- Design and installation of culverts to reduce shadowing and ponding.
- Threatened and Priority listed flora and ecological communities will be demarcated outside of the proposal footprint.
- Preparation and implementation of a weed and dieback hygiene management plan including:
  - A risk assessment of potential sources and activities.
  - The identification of 'protectable' areas adjacent to the proposal footprint.
  - Requirements for hygiene washdown locations that consider risk in the surrounding landscape.
  - A program to monitor and report on compliance and corrective actions where non-compliance has occurred.
  - Quarterly auditing of washdown sites to identify weed incursions.
  - Regular walk-overs at strategic locations along the proposal footprint (i.e. in association with native vegetation) to identify and ameliorate weed incursions.
  - An auditable hygiene inspection form will be prepared to detail inspection results at the hygiene locations.
- Educational and induction material will be provided about the significant flora and ecological communities to contractors working on the construction to reduce the risk of accidental clearing.
- Revegetation will occur at the earliest opportunity within designated revegetation areas and corridors to maintain ecological linkages.
- A fence will be installed along environmentally sensitive areas to reduce the risk of unauthorised or uncontrolled access impacting on the sensitive features. Environmentally sensitive areas will include, but not limited to conservation estate, Bush Forever sites, Cullacabardee, Whiteman Park, Lexia wetlands, Dick Perry Reserve and locations of Threatened and Priority listed flora and ecological communities.
- No movement of plant (construction) or vehicles outside of the designated clearing line during construction.





In addition to the above management measures, MRWA has committed to undertaking additional vegetation surveys and analysis of the vegetation inferred to be consistent with the TEC SCP02 to determine if the vegetation is consistent with the TEC SCP02. The surveys and analysis will occur in spring 2015 with the analysis and FCT determination available shortly after the survey completion. The survey design will be prepared in consultation with DPAW. The survey results will be provided to the EPA as part of the response to submissions process to inform the EPA's assessment of the proposal.

The State listed TEC SCP20a occurs in three locations within and adjacent to the project. One location on the corner of Reid Highway and Beechboro Road North is outside the development envelope and will not be impacted by the proposal. The indirect impacts of the project on locations the TEC adjacent to the impacted areas in Whiteman Park will be managed in accordance with standard MRWA policies and procedures regarding sensitive environments on MRWA assets.

## 8.6 Residual Environmental Outcome

The proposal will result in the clearing of native vegetation that supports TECs, PECs, GDEs, Priority Listed flora and is located within Bush Forever sites. In consideration of the proposal's outcome-based commitments, it is expected that the proposal will be managed so that only the following minor residual impacts are anticipated:


- Minor and permanent loss of State listed TECs.
- Minor and permanent loss of State listed PECs.
- Permanent loss of native vegetation within nine Bush Forever sites.

The proposal will involve the clearing of 205.0 ha of intact native vegetation. The impact on the intact native vegetation is not considered to be significant because:

- The clearing for the proposal will not reduce the extent of the vegetation complexes to levels below 10% for constrained areas.
- Excluding three associations (AsMIEvCI, Ba and EpRi), the remaining vegetation associations recorded in the proposal footprint are represented within the broader flora study area.
- Although the proposal footprint is considered to represent high biological diversity, the biological diversity is indicative of the linear extent of the proposal extending over two landforms (Pinjarra Plain and Bassendean Dunes) and numerous geomorphic wetland types (sumplands, damplands and palusplains).
- The clearing associated with TECs will be offset.
- The offset strategy has considered the impacts of the proposal, and the impacts to TECs, PECs and Bush Forever sites have been sufficiently offset within the offset proposal.

The design of the proposal footprint has ensured that no Threatened flora will be directly impacted as a result of the proposal. The proposal may have a significant effect on critical habitat for the Grand Spider Orchid and an offset has been proposed (see Section 17.6). The proposal is not likely to have a significant effect on the Narrow Curved-leaf Grevillea as it currently exists in the road reserve where indirect impacts of dieback, erosion and weeds are readily managed. With the appropriate mitigation measures for Threatened flora the proposal is likely to meet the EPA's objectives.

Of the eight Priority Listed flora identified within the flora study area, the proposal will avoid three of them, while the impact to another three Priority taxa is considered to be minor with less than 1% of the known individuals impacted. The impact on the remaining two Priority taxa, *Meeboldina decipiens* subsp. *decipiens*



and *Millotia tenuifolia* var. *laevis*, will be managed through the successful implementation of the EMP. As such, the proposal is not likely to have a significant effect on Priority flora and is likely to meet the EPA's objectives

The impacts to flora and vegetation can be managed to meet the EPA's objective and the proposal's environmental outcomes (as outlined in Section 8.1) and are not considered to have a significant effect. The direct loss of State listed TECs, PECs and intact native vegetation within Bush Forever sites is likely to have a significant effect. However, with the appropriate mitigation measures and offsets the proposal is likely to meet the EPA's objectives. An offset proposal for these impacts is provided in Chapter 17.

A summary of the proposal's residual impact on the flora and vegetation values following the implementation of management and mitigation is provided in the following Table 8.16.



**Table 8.16 Summary of residual impacts to flora and vegetation following implementation of management and mitigation measures**

Aspect	Predicted impact	Management and mitigation	Residual impact
Permanent loss of native vegetation and GDEs	<ul style="list-style-type: none"> <li>Loss of native vegetation in good or better condition.</li> <li>Loss of native vegetation in the local context.</li> <li>Loss of GDEs.</li> <li>Reduction in vegetation complexes.</li> <li>Direct loss of intact native vegetation in Bush Forever sites.</li> </ul>	<ul style="list-style-type: none"> <li>Disturbance will be restricted to the proposal footprint.</li> <li>Delineation of proposal footprint.</li> <li>Staged clearing and revegetation (where applicable) in accordance with infrastructure plan.</li> <li>Design and implementation of culverts in line with drainage strategy to maintain GDEs adjacent to the proposal footprint.</li> <li>Preparation and implementation of an EMP, including management and monitoring of intact native vegetation.</li> </ul>	<ul style="list-style-type: none"> <li>Loss of 205.0 ha of native vegetation in degraded or better condition.</li> <li>Loss of 49.6 ha of native vegetation consistent with GDEs.</li> <li>Loss of 128.5 ha within Bush Forever sites.</li> </ul>
Permanent loss of threatened and priority ecological communities	<ul style="list-style-type: none"> <li>Direct loss (i.e. clearing) of Commonwealth TECs.</li> <li>Direct loss (i.e. clearing) of State TECs and PECs.</li> </ul>	<ul style="list-style-type: none"> <li>Disturbance will be restricted to the proposal footprint.</li> <li>The Commonwealth TECs, Mound Springs SCP and Claypans of the SCP will be avoided.</li> <li>Finalisation of design will endeavour to avoid and minimise the impacts to State TECs and PECs within the proposal footprint.</li> <li>TECs and PECs to be retained will be demarcated within and adjacent to the proposal footprint.</li> <li>Preparation and implementation of an EMP, including management and monitoring of TECs, PECs and vegetated buffers.</li> </ul>	<ul style="list-style-type: none"> <li>Loss of 4.4 ha of two State TECs: <ul style="list-style-type: none"> <li>SCP02: 0.4 ha.</li> <li>SCP20a: 4.0 ha.</li> </ul> </li> <li>Loss of 145.5 ha of five State PECs: <ul style="list-style-type: none"> <li>SCP21c: 64.0 ha.</li> <li>SCP22: 0.1 ha.</li> <li>SCP23b: 11.6 ha.</li> <li>SCP24: 7.8 ha.</li> <li>Banksia Woodland on the Swan Coastal Plain: 62.0 ha.</li> </ul> </li> </ul>

Aspect	Predicted impact	Management and mitigation	Residual impact
Permanent loss of threatened and priority listed flora	<ul style="list-style-type: none"> <li>• Direct loss (i.e. clearing) of Threatened flora.</li> <li>• Direct loss (i.e. clearing) of critical habitat for Threatened flora.</li> <li>• Direct loss (i.e. clearing) of Priority flora.</li> <li>• Direct loss (i.e. clearing) and/or degradation of vegetated buffers.</li> </ul>	<ul style="list-style-type: none"> <li>• Design of proposal footprint will avoid Threatened flora.</li> <li>• Design of proposal footprint will avoid populations of <i>Cyathochaeta teretifolia</i> (P3), <i>Ornduffia submersa</i> (P4) and <i>Stylidium striatum</i> (P4).</li> <li>• Additional targeted surveys for <i>Millotia tenuifolia</i> var. <i>laevis</i> and <i>Meeboldina decipiens</i> subsp. <i>decipiens</i> ms within the Ellenbrook and Tonkin and Reid Highway intersections to clearly define populations and known individuals adjacent to the proposal footprint. The survey results will be provided to the EPA as part of the response to submissions process to inform the EPA's assessment of the proposal.</li> <li>• Vegetated buffers will be managed and monitored.</li> <li>• Demarcation of Threatened and Priority flora adjacent to the proposal footprint.</li> <li>• Preparation and implementation of an EMP, including management and monitoring of Threatened and Priority flora including vegetated buffers.</li> </ul>	<ul style="list-style-type: none"> <li>• Loss of 39.2 ha and 2.0 ha of Critical habitat for <i>Caladenia huegelii</i> and <i>Grevillea curviloba</i> subsp. <i>incurva</i>, respectively.</li> <li>• Minor loss (&lt;1% of known individuals) of three Priority taxa: <ul style="list-style-type: none"> <li>– <i>Anigozanthos humilis</i> subsp. <i>chrysanthus</i> (P4): 0.15%.</li> <li>– <i>Hypolaena robusta</i> (P4): 0.10%.</li> <li>– <i>Poranthera moorokatta</i> (P2): 0.04%.</li> </ul> </li> <li>• High loss (known individuals) of two Priority taxa: <ul style="list-style-type: none"> <li>– <i>Millotia tenuifolia</i> var. <i>laevis</i>: 18.8%.</li> <li>– <i>Meeboldina decipiens</i> subsp. <i>decipiens</i> ms: 50%.</li> </ul> </li> </ul>
Vegetation degradation through introduction and spread of dieback and weeds	<ul style="list-style-type: none"> <li>• Introduction and spread dieback.</li> <li>• Introduction and spread of environmentally significant weeds (WONS and declared plants and prohibited plants).</li> </ul>	<ul style="list-style-type: none"> <li>• Development and implementation of a weed and dieback management plan.</li> <li>• Monitoring of vegetation retained adjacent to proposal footprint.</li> <li>• There will be no plant and vehicle movement outside of designated clearing line during construction.</li> </ul>	Edge effects will occur between the clearing line and areas of native bushland over time during operation. It is unlikely that, with proper management, significant edge effects will extend further than 10 m from the edge of the clearing line.



Aspect	Predicted impact	Management and mitigation	Residual impact
Fragmentation of native vegetation	<ul style="list-style-type: none"> <li>Permanent interruption of ecological linkage networks.</li> </ul>	<ul style="list-style-type: none"> <li>Project disturbance will be restricted to the proposal footprint.</li> <li>Delineation of proposal footprint.</li> <li>Staged clearing and revegetation (where applicable) in accordance with infrastructure plan.</li> <li>Revegetation of proposal footprint will occur in accordance with landscape management plan.</li> <li>Preparation and implementation of an EMP, including management and monitoring of intact native vegetation.</li> </ul>	<ul style="list-style-type: none"> <li>Three fragmented ecological linkage networks (Gaston Road Bullsbrook, Raphael Road Bullsbrook and Reid Highway) will be further fragmented.</li> <li>Three large, mostly contiguous ecological linkage networks (Maralla Road Nature Reserve, Rocla mining lease area and Cullacabardee) will be fragmented.</li> </ul>
Increase in uncontrolled access	<ul style="list-style-type: none"> <li>Dumping of household and construction refuse.</li> <li>Introduction and spread of dieback.</li> <li>Introduction and spread of significant environmental weeds.</li> <li>Vegetation degradation.</li> </ul>	<ul style="list-style-type: none"> <li>No plant and vehicle movement outside of designated clearing line during construction.</li> <li>Installation of permanent fence along environmentally sensitive areas.</li> <li>Access points and the PSP will be located away from extant native vegetation, where possible. If this is unavoidable, then the access points and paths will be designed to minimise the risk of uncontrolled access into significant native vegetation (i.e. Maralla Nature Reserve).</li> <li>Preparation and implementation of an EMP, including management on uncontrolled access and construction refuse.</li> </ul>	<p>Nil.</p> <p>Edge effects.</p>
Increase in wildfires	<ul style="list-style-type: none"> <li>Vegetation degradation through fires associated with the construction of the proposal.</li> </ul>	<ul style="list-style-type: none"> <li>Risk of wildfire managed in accordance with DFES and MRWA policies and guidelines.</li> <li>Preparation and implementation of an EMP, including guidance in regards to 'hot works' and storing and handling of flammable materials.</li> </ul>	<p>Nil.</p>