



15 AMENITY (RESERVES)

15.1 EPA Objective

The EPA's objective for amenity is to ensure that impacts to amenity are reduced to as low as practicable (EPA, 2015a).

15.2 Existing Environment

15.2.1 Dick Perry Reserve

Dick Perry Reserve is located within Gnangara Park, west of Ellenbrook, and managed by DPAW (Figure 15.1). A recreational node directly east of Centre Way and north of Gnangara Road was identified as part of the Concept Plan for Gnangara Park (CALM et al., undated). The initial Concept Plan for the primary recreational node of Dick Perry Reserve was developed in 1999, after the Gnangara Park concept was approved by Cabinet in 1996 as part of the WA Government's strategy to address increasing salinisation and eutrophication of water resources.

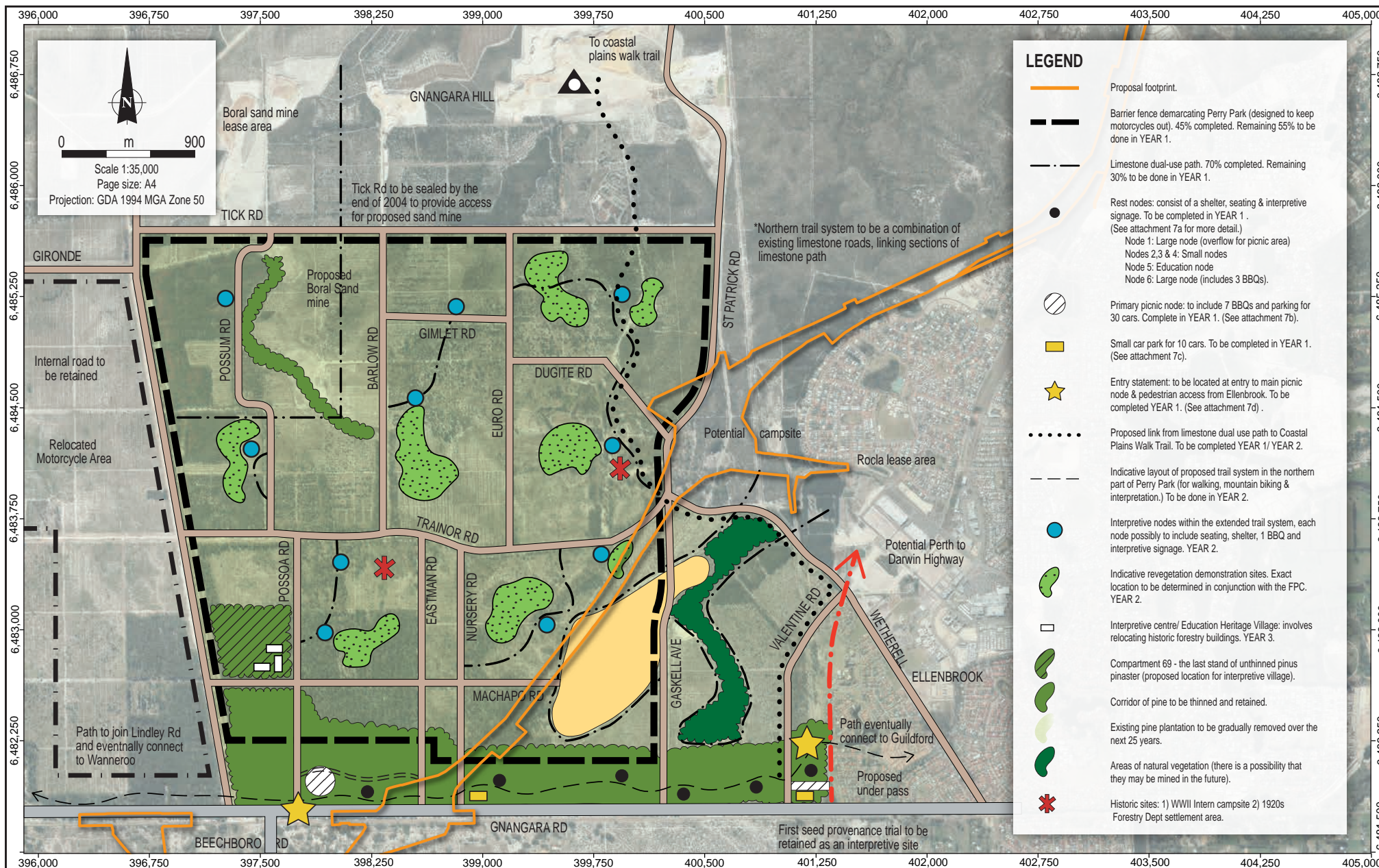
A Recreation Master Plan for Dick Perry Reserve was developed in 2004 with a range of strategies for recreation development and activities (CALM, 2004). This included:

- Rest nodes consisting of a shelter, seating and interpretive signage.
- A primary picnic node with BBQs and parking area.
- Smaller car parks.
- Walking trails.
- Interpretive nodes within the trail system.
- Indicative revegetation demonstration sites.
- An interpretive centre and Education Heritage Village, which involves relocating historic forestry buildings.

A number of existing and historic mining leases issued by Department of Mines and Petroleum (DMP) exist within the Gnangara Park area and the Concept Plan recognises these leases. A revegetated sand mining area is located in the southeastern corner of the reserve, while a Native Vegetation Clearing Permit was issued to Rocla Quarries on 31 December 2014 (CPS 6362/1) for a portion of land in the northwest of the reserve.

The area is currently used for pine plantations and these are managed by the FPC. The plantations are currently being harvested and will not be replanted. Harvesting of a portion of pines in the area earmarked for the development of Dick Perry Reserve has occurred since the proposal development commenced in 2014 and no revegetation has occurred.

Since the development of the Recreation Master Plan, a barrier fence has been erected around the reserve, a limestone walk trail (unpaved) developed, and a picnic node established to the west of Ellenbrook (outside of the reserve).



LEGEND

- Proposal footprint.
- Barrier fence demarcating Perry Park (designed to keep motorcycles out). 45% completed. Remaining 55% to be done in YEAR 1.
- Limestone dual-use path. 70% completed. Remaining 30% to be done in YEAR 1.
- Rest nodes: consist of a shelter, seating & interpretive signage. To be completed in YEAR 1. (See attachment 7a for more detail.)
 - Node 1: Large node (overflow for picnic area)
 - Nodes 2,3 & 4: Small nodes
 - Node 5: Education node
 - Node 6: Large node (includes 3 BBQs).
- Primary picnic node: to include 7 BBQs and parking for 30 cars. Complete in YEAR 1. (See attachment 7b).
- Small car park for 10 cars. To be completed in YEAR 1. (See attachment 7c).
- Entry statement: to be located at entry to main picnic node & pedestrian access from Ellenbrook. To be completed YEAR 1. (See attachment 7d).
- Proposed link from limestone dual use path to Coastal Plains Walk Trail. To be completed YEAR 1/ YEAR 2.
- Indicative layout of proposed trail system in the northern part of Perry Park (for walking, mountain biking & interpretation.) To be done in YEAR 2.
- Interpretive nodes within the extended trail system, each node possibly to include seating, shelter, 1 BBQ and interpretive signage. YEAR 2.
- Indicative revegetation demonstration sites. Exact location to be determined in conjunction with the FPC. YEAR 2.
- Interpretive centre/ Education Heritage Village: involves relocating historic forestry buildings. YEAR 3.
- Compartment 69 - the last stand of unthinned pinus pinaster (proposed location for interpretive village).
- Corridor of pine to be thinned and retained.
- Existing pine plantation to be gradually removed over the next 25 years.
- Areas of natural vegetation (there is a possibility that they may be mined in the future).
- Historic sites: 1) WWII Intern campsite 2) 1920s Forestry Dept settlement area.

Source: Imagery from Google Earth.
Note: Recreated from CALM, 2004 (indicative only)



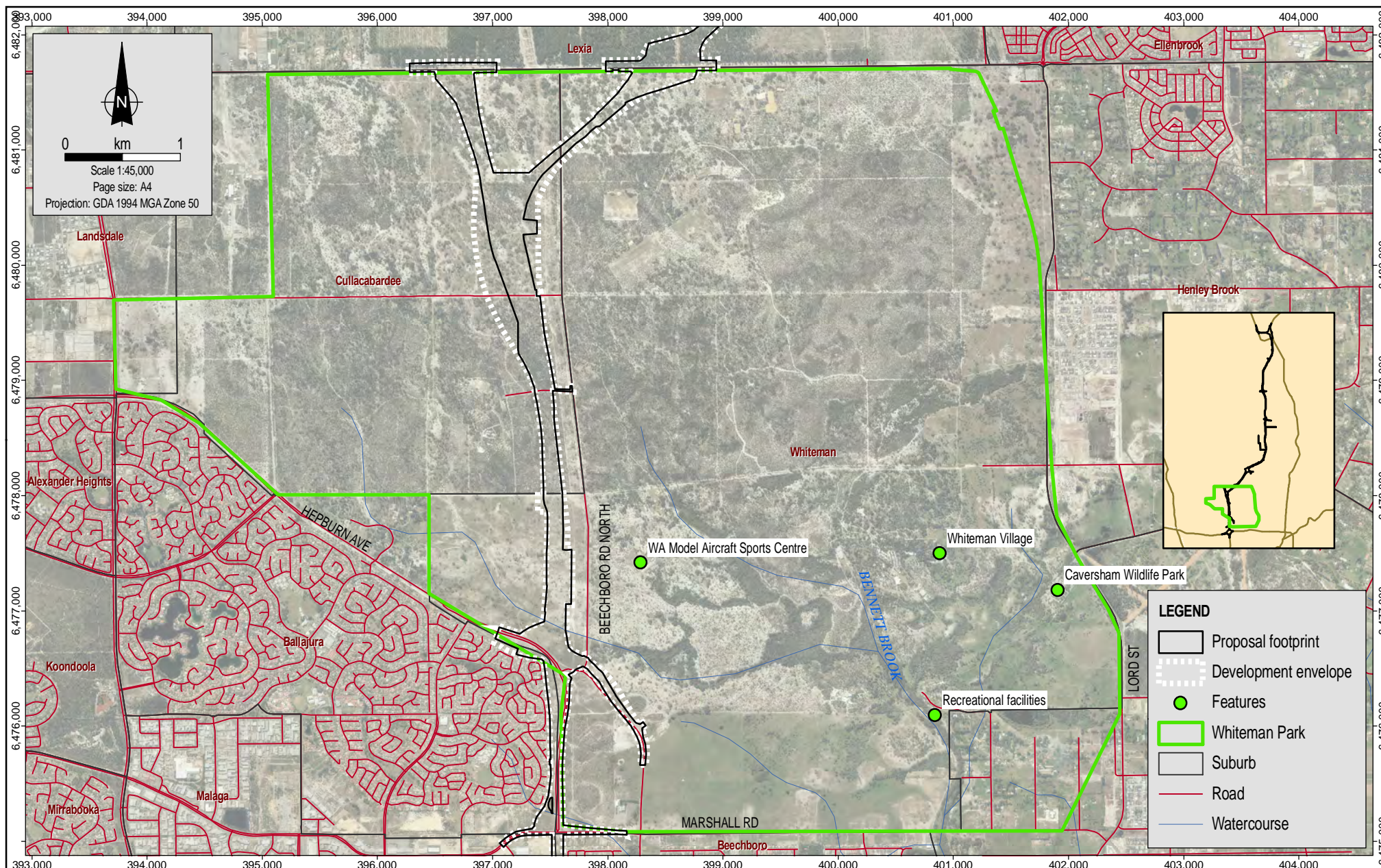
15.2.2 Whiteman Park

Whiteman Park, an area of approximately 4,000 ha, is bordered by Gngangara Road in the north, Lord Street in the east, Marshall Road in the south, and Hepburn Avenue in the southwest. Beechboro Road North runs in a north-south direction through the park and the proposal would be located parallel and to the west of this road (Figure 15.2) (Whiteman Park, 2015).

Whiteman Park was established in 1978 when the State government purchased land from a variety of private owners. The DOP is currently tasked with the operational management of the park on behalf of the WAPC. Whiteman Park is reserved for parks and recreation in the MRS, creating a space for the community whilst also providing protection to the Gngangara Mound, which supplies a large proportion of Perth's drinking water.

Facilities in the park include:

- Three bush walking trails, including Werillyiup, Goo Loorto and Wununga.
- Walking and cycling paths.
- Sports facilities, including a cricket oval, basketball and tennis courts.
- Dog park.
- Water playground.
- Orienteering courses.
- Picnic and BBQ areas.
- Playgrounds.
- Caversham Wildlife Park.
- Children's Forest.
- Woodland Reserve.
- Motor Museum of WA.
- Tractor Museum of WA.
- Revolutions Transport Museum.
- Train and tram rides.
- Speciality shops.



Source & Notes:
 Whiteman Park boundaries and facilities digitised from
 Whiteman Park, 2015 (indicative only).
 Suburbs from ABS (2011).
 Aerial imagery from Landgate (August 2014).

NorthLinkWA

coffey

Date:
18.06.2015
 MXD:
4483AA_03_GIS097_2
 File Name:
4483AA_03_F15.2_GIS

Main Roads WA
 Public Environmental Review
 Perth-Darwin National Highway

Whiteman Park

Figure No:
15.2



15.2.3 Conservation Areas

The proposal intersects the following conservation areas (Figure 15.3):

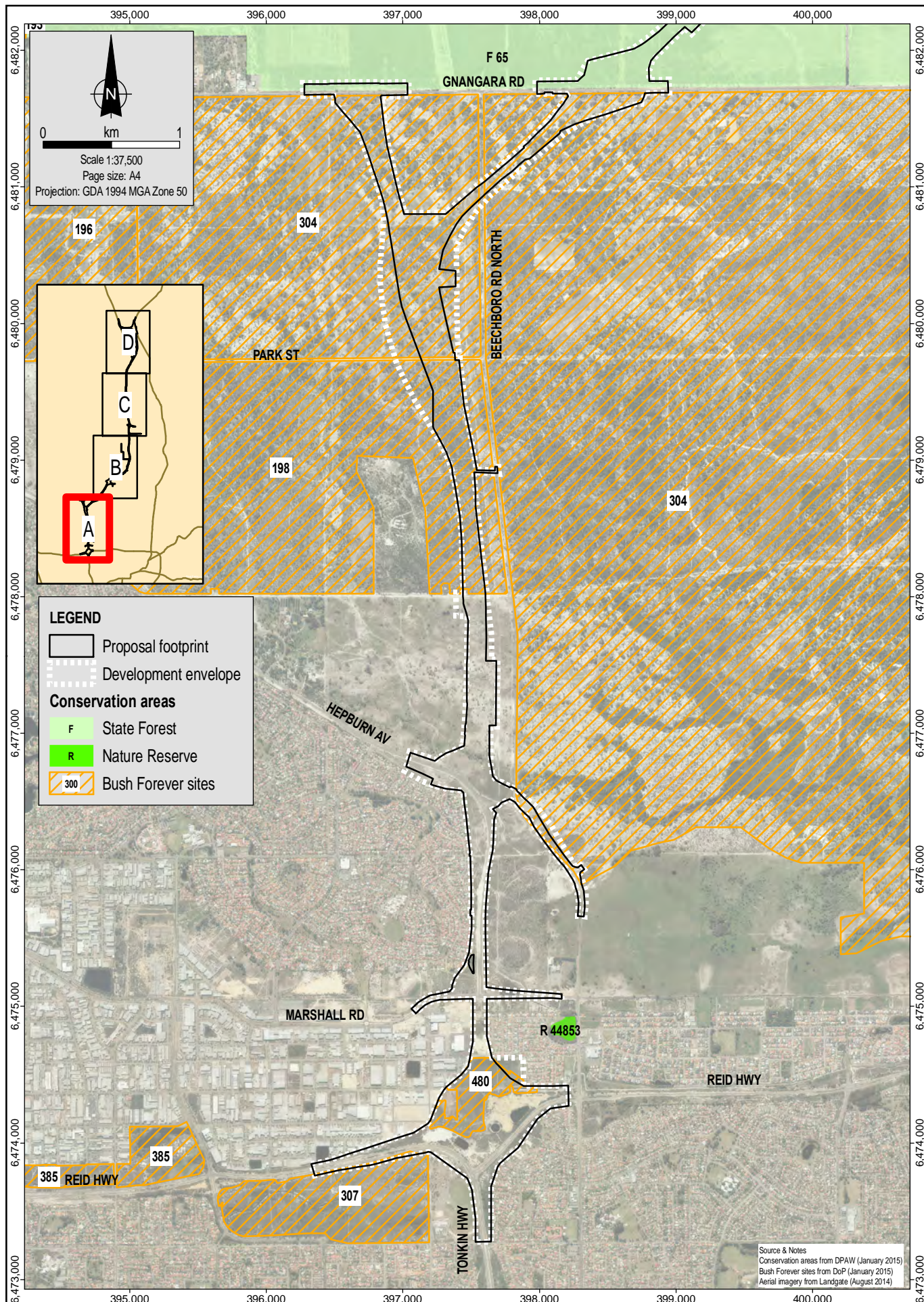
- Class A Nature Reserve 46919 (unnamed).
- Class A Nature Reserve 46920 (unnamed).
- Gnangara–Moore River State Forest No. 65.
- Nine Bush Forever sites, including sites 97, 100, 192, 198, 300, 304, 307, 399 and 480.

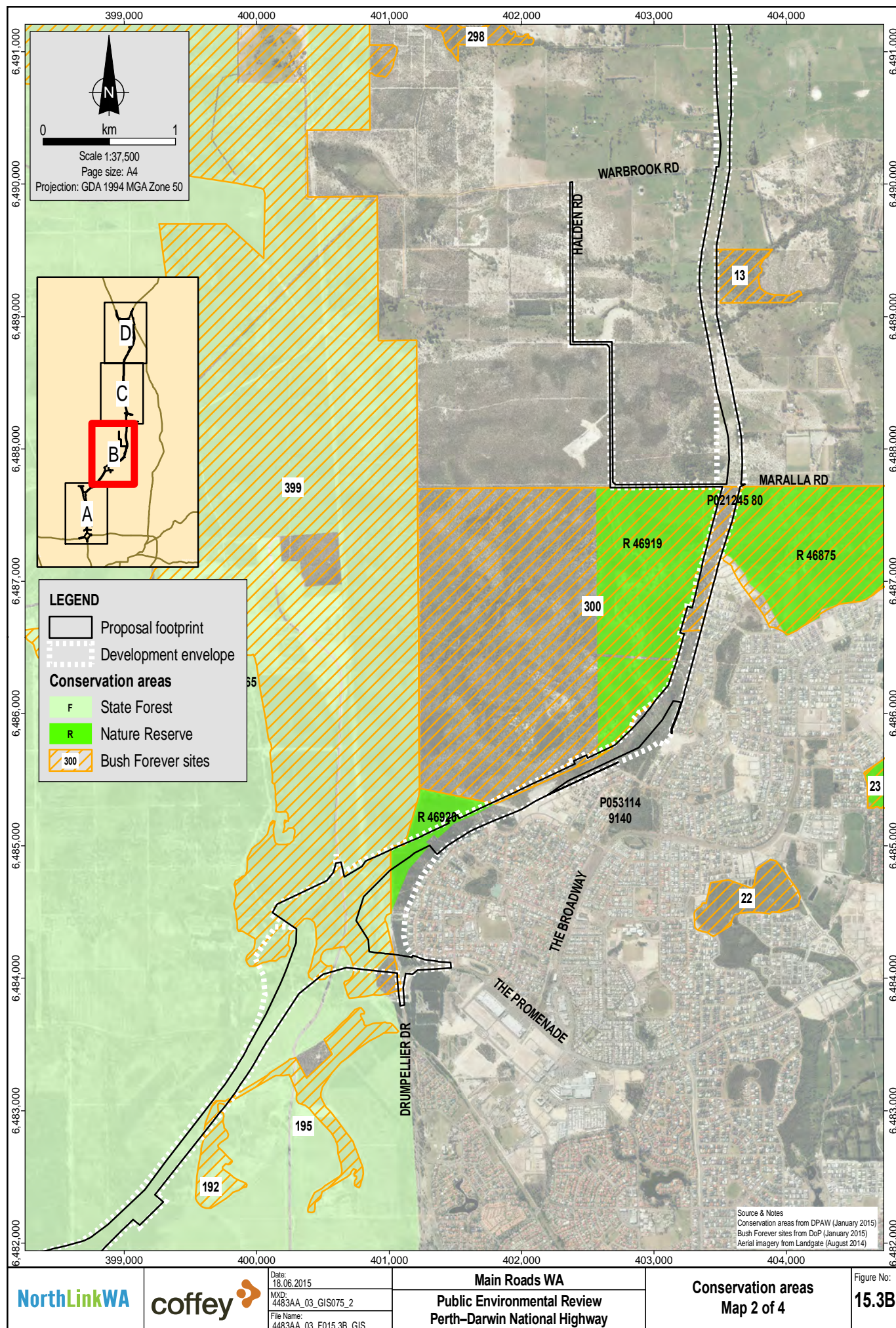
Class A Nature Reserves are areas of Crown land in WA that have been afforded the highest classification of protection and are usually created for a specific purpose. Both Class A Nature Reserves 46919 and 46920 are reserved for the purpose of conservation of flora and fauna.

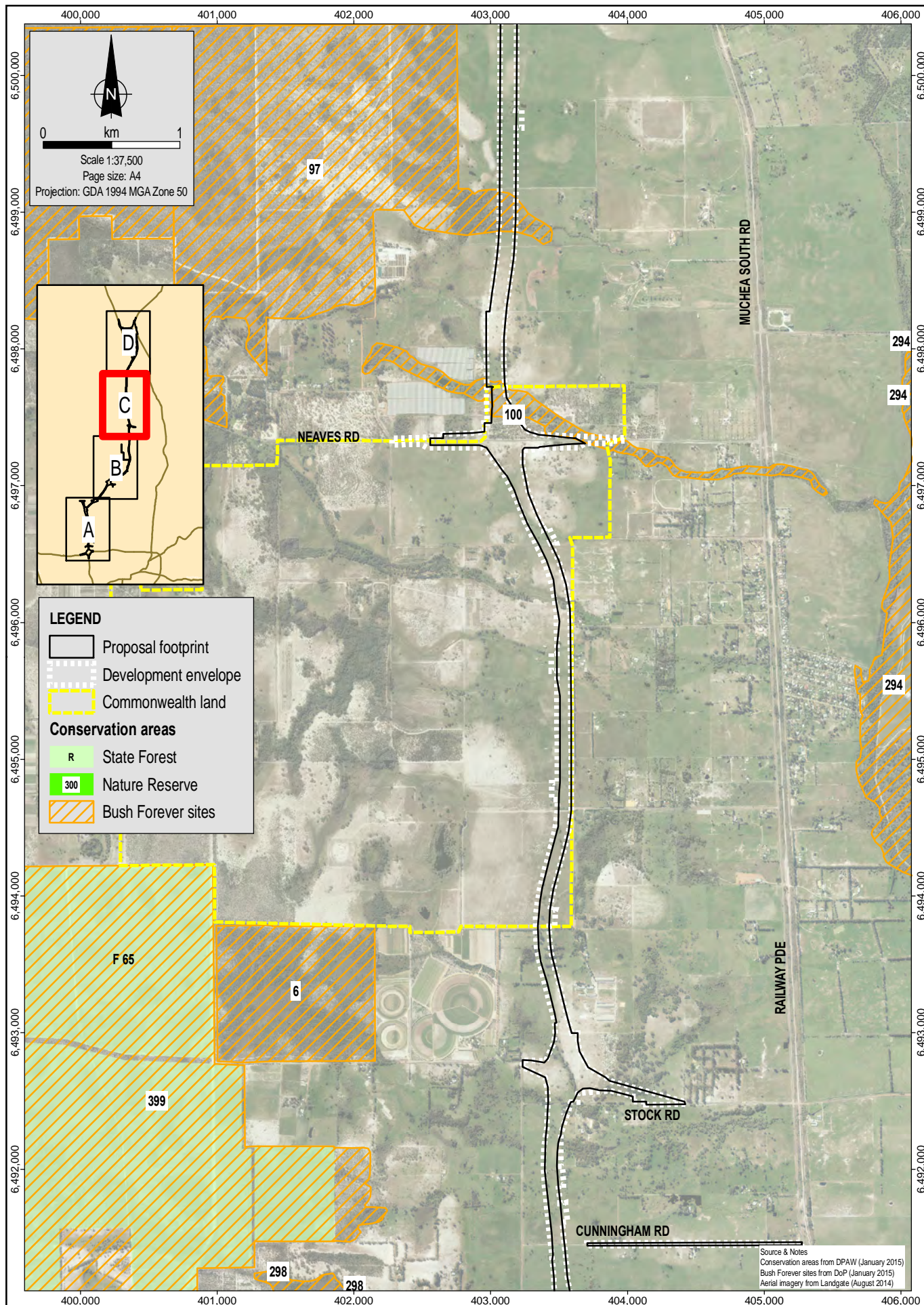
State Forest is an area of Crown land set aside for uses including timber production, conservation and recreation. This includes Crown land reserved as State Forest and used to grow non-native plantation species, as is the case for the Gnangara–Moore River State Forest, which is largely managed by the FPC as a non-native pine plantation for the purpose of timber production.

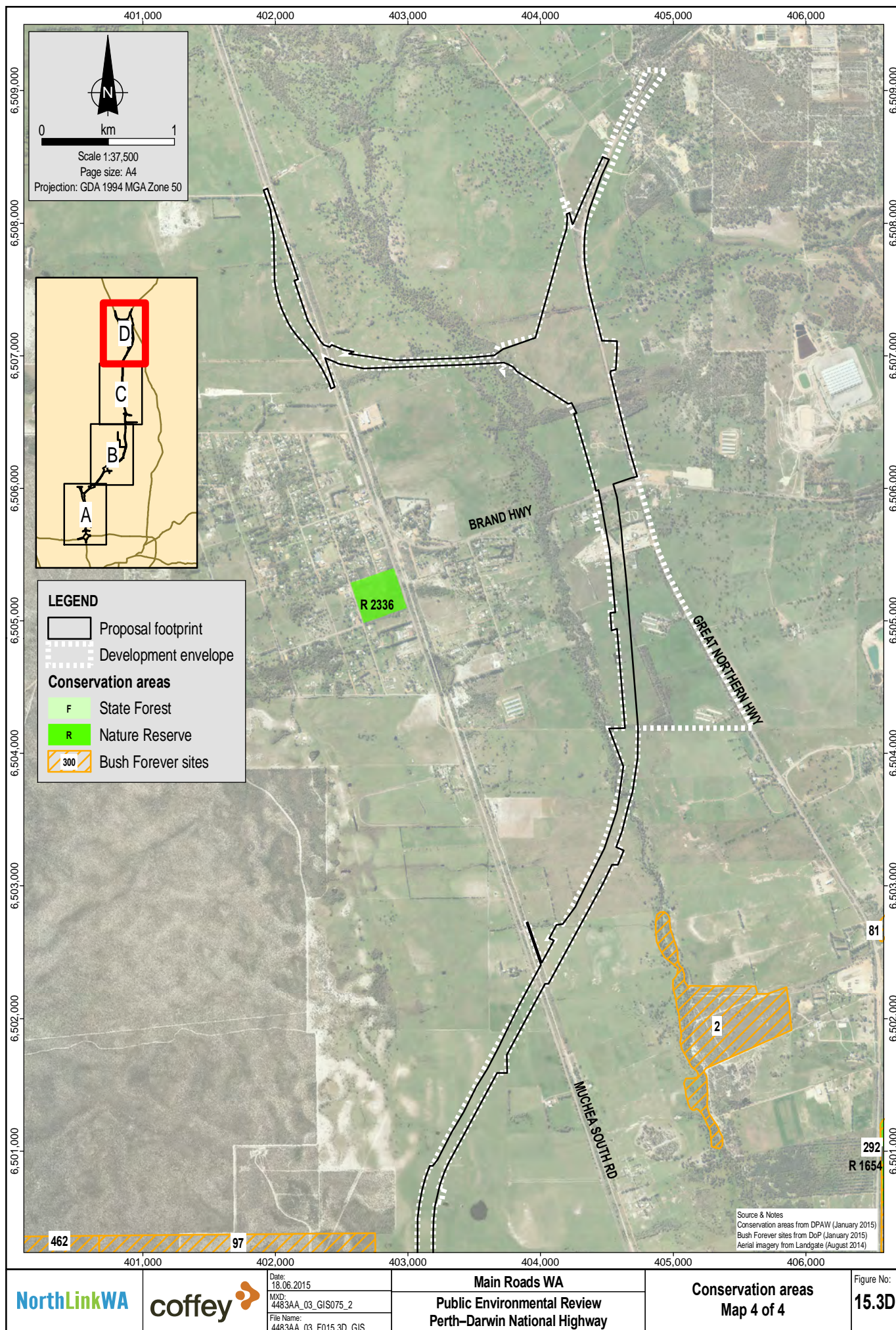
Bush Forever is a strategic plan for the conservation of bushland on the SCP portion of the PMR, designed to identify, protect and manage regionally significant bushland in order to achieve a sustainable balance between conservation and development in the PMR (Government of Western Australia, 2000b). Bush Forever identifies 51,200 ha of regionally significant bushland for protection within the SCP of the PMR, nearly two thirds of which is already protected. Bush Forever sites were selected based on their conservation value and to ensure representation of regional ecosystems and habitats, and play a central role in the conservation of Perth's biodiversity (Government of Western Australia, 2000b).

Bush Forever sites are not formally protected unless they have been vested as some form of conservation estate (e.g. Nature Reserve).











15.3 Potential Impacts

15.3.1 Dick Perry Reserve

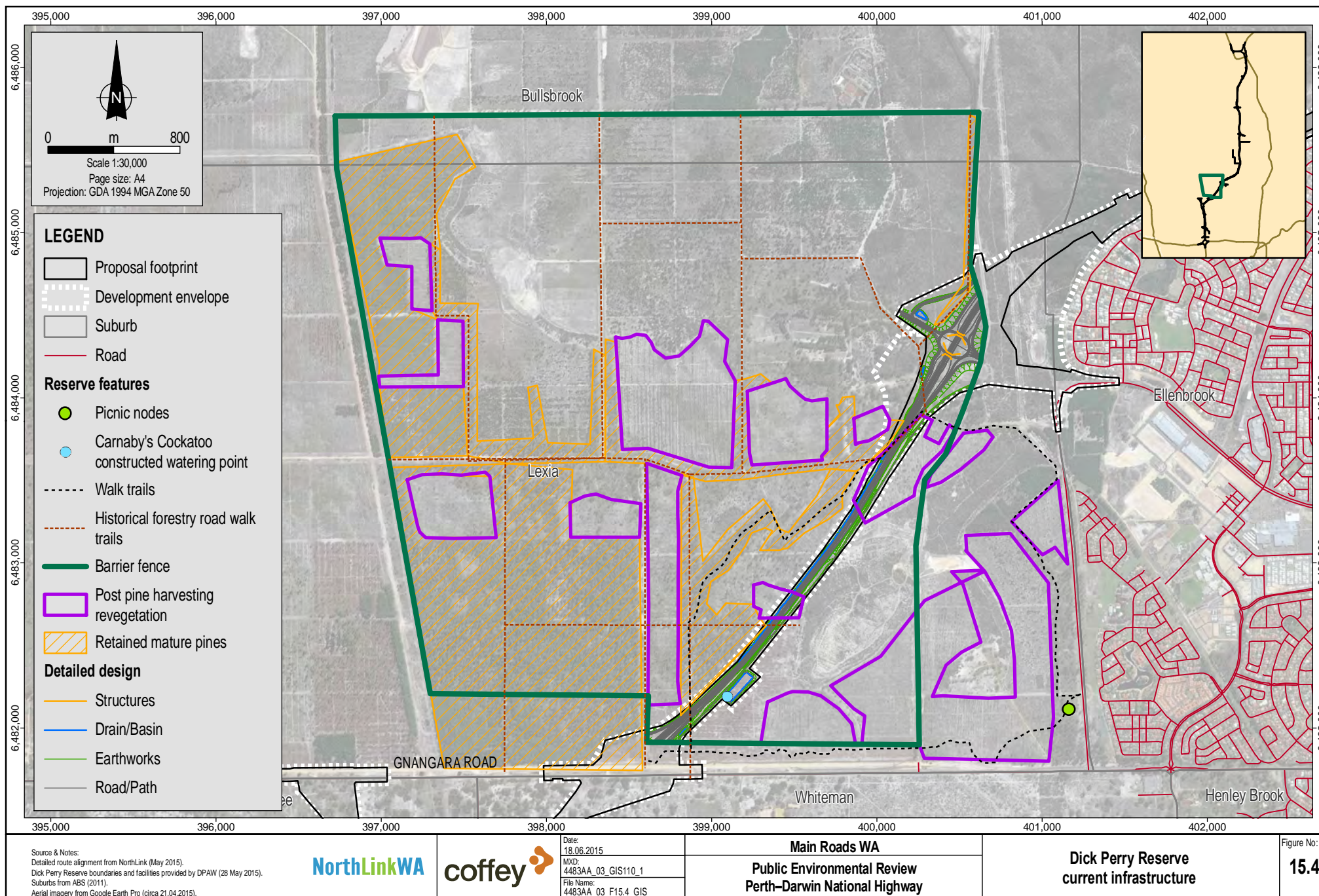
The proposal footprint crosses the southeastern part of the proposed reserve, with an interchange located at Gngara Road (southern boundary of the proposed reserve) and another interchange located along the eastern boundary of the proposed reserve (see Figure 15.1 and Figure 15.4).

The proposal will result in the following impacts on Dick Perry Reserve:

- Severing the northern and southern section of the limestone trail.
- Removal of a dam constructed near the southern boundary of the reserve, which serves as a watering source for cockatoos.
- Clearing of revegetated mining lease area.
- Severing a proposed north-south limestone dual use path planned to link the area to the Coastal Plains Walking Trail.
- Impact on the former site of the Gngara Forestry Headquarters (European heritage site – see Chapter 14). A review of Landgate historic aerial imagery suggested that the structures at this site were demolished between 1985 and 1995.

The corridor of pine trees that was earmarked to be retained along Gngara Road in the Recreation Master Plan has since been removed as part of the harvesting of the pine trees by FPC and as such has already impacted on the proposed future use of this area.

Construction of the proposal, as well as mining activities in the northwestern part of the reserve, will result in a significant reduction in the size of the proposed reserve and its potential to be utilised as recreational open space by the community.



Source & Notes:
 Detailed route alignment from NorthLink (May 2015).
 Dick Perry Reserve boundaries and facilities provided by DPAW (28 May 2015).
 Suburbs from ABS (2011).
 Aerial imagery from Google Earth Pro (circa 21.04.2015).

NorthLinkWA

coffey

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Main Roads WA
 Public Environmental Review
 Perth-Darwin National Highway

Dick Perry Reserve
 current infrastructure

Figure No:
 15.4

15.3.2 Whiteman Park

15.3.2.1 Construction Phase Impacts

Impacts on Whiteman Park during the construction phase of the proposal largely relate to native vegetation clearing, habitat fragmentation and potential fauna mortalities. These are discussed in detail in Chapters 8 and 9.

15.3.2.2 Operation Phase Impacts

The main impacts during the operation phase of the proposal relate to habitat fragmentation and fauna mortalities from fauna/vehicle interactions. These are discussed in detail in Sections 9.4.1 and 9.4.2.

Where the alignment intersects Beechboro Road North (south of Gngangara Road), traffic access to Whiteman Park will be severed through a cul-de-sac on Beechboro Road North. As the alignment is located to the west of Beechboro Road North, none of the facilities currently accessed by the community will be impacted by the proposal.

15.3.3 Conservation Areas

As discussed in Section 15.2.3 the proposal intersects Gngangara–Moore River State Forest No. 65, two Class A Nature Reserves (46919 and 46920). As the proposal is not consistent with the current purpose of the reserved land, a proposal to excise areas from each reserve is being submitted to Parliament under Section 45(4) of the *Land Administration Act 1997*. The area proposed to be excised is based on the proposal's development envelope and includes approximately (see Figure 15.3):

- 0.3 ha of Class A Nature Reserve 46919.
- 7.4 ha of Class A Nature Reserve 46920.
- 106 ha of Gngangara–Moore River State Forest No. 65.

However, as indicated on Figure 15.3, not all land proposed to be excised will be impacted by the proposal footprint. Table 15.1 distinguishes the loss of conservation estate and the actual impact of the proposal footprint on conservation values (i.e. intact native vegetation, Black Cockatoo habitat and Priority listed flora or ecological communities) within areas of conservation estate.

Table 15.1 Impacts to Conservation estate


Conservation estate	Area of conservation estate ¹	Area of native vegetation	Area of Black Cockatoo habitat	Priority listed flora or area of PEC
Class A Nature Reserve 46919	0.3 ha	0.25 ha	0.2 ha Moderate value habitat	<ul style="list-style-type: none">• 0.2 ha of SCP21c (P3)
Class A Nature Reserve 46920	7.4 ha	0.14 ha	0.2 ha Moderate value habitat	<ul style="list-style-type: none">• 1 individual of <i>Hypolaena robusta</i> (P4)• 0.1 ha of SCP22 (P3)• 0.6 ha of SCP21c (P3)
Gngangara–Moore River State Forest No. 65	106.0 ha	30.8 ha	2.5 ha of High value habitat and 28.0 ha of Moderate value habitat	<ul style="list-style-type: none">• 9.2 ha of Banksia dominated woodlands on the SCP (P3)• 20.7 ha of SCP21c (P3)• 2.6 ha of SCP24 (P3)

1. Based on the State Forest and Nature Reserve excision areas.

In addition, as discussed in Section 8.4.3, the proposal will result in the loss of 128.5 ha of intact native vegetation across nine Bush Forever sites (97, 100, 192, 198, 300, 304, 307, 399 and 480). However, 31.5 ha of this also occurs within and is formally protected by Gngangara–Moore River State Forest and Class A Nature Reserve 46919. Table 15.2 summarises the loss of conservation values (i.e. intact native vegetation, Black Cockatoo habitat and Priority listed flora or ecological communities) within Bush Forever sites.

Table 15.2 Impacts to Bush Forever sites

Bush Forever Site	Area of intact native vegetation	Area of Black Cockatoo habitat	Number of Priority listed flora	Area of Priority Ecological Community
97	3.3 ha	1.5 ha of High value habitat	–	–
100	0.2 ha	1.9 ha of High value habitat	–	–
192	1.3 ha	–	–	<ul style="list-style-type: none"> 1.3 ha of SCP24 (P3)
198	30.7 ha	15.8 ha of High value habitat and 15.3 ha of Moderate value habitat	<ul style="list-style-type: none"> 3 individuals of <i>Millotia tenuifolia</i> var. <i>laevis</i> (P2) 1 individual of <i>Hypolaena robusta</i> (P4) 1 individual of <i>Anigozanthos humilis</i> subsp. <i>chrysanthus</i> (P4) 	<ul style="list-style-type: none"> 3.8 ha of SCP20a (En) 10.6 ha of Banksia dominated woodlands on the SCP (P3) 9.0 ha of SCP21c (P3) 7.5 ha of SCP23b (P3)
300	16.9 ha	1.3 ha of High value habitat and 15.4 ha of Moderate value habitat	–	<ul style="list-style-type: none"> 4.3 ha of Banksia dominated woodlands on the SCP (P3) 10.5 ha of SCP21c (P3) 1.9 ha of SCP23b (P3)
304	29.7 ha	71.1 ha of High value habitat	–	<ul style="list-style-type: none"> 12.0 ha of Banksia dominated woodlands on the SCP (P3) 1.0 ha of SCP23b (P3)
307	1.0 ha	1.0 ha of Moderate value habitat	–	–
399	29.6 ha	2.5 ha of High value habitat and 27.9 ha of Moderate value habitat	–	<ul style="list-style-type: none"> 10.6 ha of Banksia dominated woodlands on the SCP (P3) 19.5 ha of SCP21c (P3) 0.7 ha of SCP24 (P3)
480	15.9 ha	1.6 ha of High value habitat	<ul style="list-style-type: none"> 1 individual <i>Meeboldina decipiens</i> subsp. <i>decipiens</i> ms (P3) 	<ul style="list-style-type: none"> 0.9 ha of Banksia dominated woodlands on the SCP (P3) 4.5 ha of SCP24 (P3)



Impacts to the specific environmental values (i.e. flora and vegetation, fauna and habitats, and wetlands) within each of these conservation areas are addressed separately in Sections 8.5, 9.5, 10.5 and 16.1.

15.4 Mitigation and Management

15.4.1 Dick Perry Reserve

Management measures to address the continued use and viability of the reserve have been addressed through the design of the proposal and include:

- Re-establishment of a barrier fence along the western side of the proposal to ensure access to the reserve is controlled. Gates for access for fire management activities will be established at regular intervals as agreed with DPAW.
- Linking of walk trails with PSP at the interchanges on Gngangara Road and at Ellenbrook to ensure continuity of the trails.

Planning for facilities in the Dick Perry Reserve is at an early stage although funds have been invested into this area over recent years. Construction of the proposal is likely to require DPAW to amend the Master Plan for Dick Perry Reserve and Gngangara Park. Amendment of this Master Plan falls outside of the scope of the proposal.

15.4.2 Whiteman Park

Management measures to address habitat fragmentation have been incorporated in the UPDC of the proposal. These are discussed in more detail in Section 9.5.1.

To ensure safe exit in the event of fire, a vehicle underpass will be provided further south at the crossing of Baal Street. Additionally, an access road parallel to the alignment will be constructed in this vicinity to provide access for the Cullacabardee community.

15.4.3 Conservation Areas

Mitigation measures relevant to the specific environmental values (i.e. flora and vegetation, fauna and habitats, and wetlands) impacted within each of these conservation areas are provided in Sections 8.5, 9.5, 10.5 and 16.1. The loss of conservation estate and Bush Forever sites cannot be avoided; however, the area to be excised through the State excision process has been minimised as far as practicable, whilst ensuring a suitably sized development envelope to accommodate a safe and efficient highway in these areas.

15.5 Residual Impacts


15.5.1 Dick Perry Reserve

It is expected that the proposal will result in impacts to the southeastern and eastern parts of Dick Perry Reserve. The implementation of the management and mitigation measures discussed in Section 15.4.1 will reduce impacts to Dick Perry Reserve amenity to the maximum extent practicable and so it is anticipated that this proposal will meet the EPA's objective.

A summary of the proposal's residual impacts on the amenity of Dick Perry Reserve following implementation of mitigation and management measures is provided in Table 15.3.

15.5.2 Whiteman Park

It is expected that the proposal will result in minimal residual impacts to the amenity of Whiteman Park following the implementation of the management and mitigation measures. Measures to mitigate habitat



fragmentation and access issues will reduce amenity impacts to Whiteman Park to the extent practicable and so it is anticipated that this proposal will meet the EPA's objective.

A summary of the proposals residual impacts on the amenity of Whiteman Park following the implementation of mitigation and management measures is provided in Table 15.3.

15.5.3 Conservation Areas

The impact to specific environmental values in each of these conservation areas (i.e. flora and vegetation, fauna and habitats, and wetlands) is provided separately in Chapters 8, 9, 10 and 16.

The loss of 114 ha of conservation estate (including approximately 8 ha of Class A Nature Reserve and 106 ha of State Forest) and 128.5 ha of Bush Forever cannot be avoided; however, the area to be excised through the State excision process has been minimised as much as practical, and so is likely to meet the EPA's objective, even before consideration of proposed offsets (see Chapter 17).

A summary of the proposal's residual impacts on the amenity of Dick Perry Reserve following implementation of mitigation and management measures is provided in Table 15.3.

Table 15.3 Summary of residual impacts on amenity to Dick Perry Reserve and Whiteman Park

Aspect	Predicted impacts	Management and mitigation	Residual impacts
Construction and clearing activities required for the proposal	Reduction in the size of Dick Perry Reserve and the potential to be utilised as recreational open space by the community.	<ul style="list-style-type: none"> Construction of the proposal is likely to require changes to the Master Plan to accommodate the relocation or redesign of planned infrastructure. Re-establishment of a barrier fence along the western side of the proposal to ensure access to the reserve is controlled. Gates for access for fire management activities will be established at regular intervals as agreed with DPAW. Linking of walk trails with PSP at the interchanges on Gngara Road and at Ellenbrook to ensure continuity of the trails. 	Reduced amenity of the proposed Dick Perry Reserve and its utilisation as open space.
	Native vegetation clearance, habitat fragmentation and potential fauna mortalities along Whiteman Park.	<ul style="list-style-type: none"> Management measures to address habitat fragmentation have been incorporated in the UPDC of the proposal. These are discussed in more detail in Section 9.5.1. The use of fauna spotters and a translocation program to reduce risk of fauna mortalities. 	Minor and localised impacts on fauna populations.
	Loss of conservation areas.	<ul style="list-style-type: none"> Minimise the State Forest and Nature Reserve excision area, and area of Bush Forever as much as practical. Implementation of mitigation measures relevant to the specific environmental values (i.e. flora and vegetation, fauna and habitats, and wetlands) detailed in Sections 8.5, 9.5, 10.5 and 16.1. 	Loss of 114 ha of conservation estate.
Road traffic using proposal	Habitat fragmentation and fauna mortalities from fauna/vehicle interactions in the vicinity of Whiteman Park.	<ul style="list-style-type: none"> Implementation of a vehicle underpass south at crossing of Baal Street. Additionally, an access road parallel to the alignment will be constructed in this vicinity to provide access to the Cullacabardee community. Implementation of fauna underpasses on or adjacent to Whiteman Park to facilitate fauna movement and maintain ecological connectivity. 	Fragmentation of fauna habitats will increase due to the proposal. However, the inclusion of fauna underpasses allows the maintenance of ecological connectivity to the greatest practicable extent.



16 MATTERS PROTECTED UNDER THE EPBC ACT

16.1 Matters of National Environmental Significance

The Commonwealth EPBC Act provides a legal framework to protect and manage MNES, including:

- World heritage properties.
- National heritage places.
- Wetlands of international importance (often called 'Ramsar' wetlands after the international treaty under which such wetlands are listed).
- Listed threatened species and ecological communities.
- Migratory species protected under international agreements.
- Commonwealth marine areas.
- The Great Barrier Reef Marine Park.
- Nuclear actions (including uranium mining).
- A water resource, in relation to coal seam gas development and large coal mining development.

In addition, the Act allows for the following matters to be protected:

- The environment, where actions proposed are on, or will affect, Commonwealth land.
- The environment, where Commonwealth agencies are proposing to take an action.

The proposal has the potential to have a significant impact on the following matters (see Appendix B):

- Listed threatened species and communities (sections 18 and 18A of the Act).
- Migratory species (sections 20 and 20A of the Act).
- Commonwealth land (sections 26 and 27A of the Act).


16.2 Listed Threatened Flora Species and Communities

A search of the Protected Matters Search Tool (PMST) and review of the flora and vegetation survey conducted by Coffey (2015a) (Appendix C), indicated that 26 conservation significant flora species protected under the EPBC Act may be present within a 10 km radius of the proposed proposal footprint. This includes the Grand Spider Orchid (*Caladenia huegelii*), Curved-leaf Grevillea (*Grevillea curviloba* subsp. *curviloba*), Narrow curved-leaf Grevillea (*Grevillea curviloba* subsp. *incurva*), Muchea Bell (*Darwinia foetida*) and Grass Wattle (*Acacia anomala*), which were listed in the ESD (EPA, 2014a).


EPBC listed threatened flora species potentially occurring in the proposal footprint according to DPAW databases are listed in Table 16.1. The likelihood of EPBC Act listed flora occurring in the proposal footprint has been assessed based on habitat preference and the nearest known localities to the proposal footprint.

Table 16.1 EPBC Act listed flora potentially occurring in the proposal footprint


Species	Common name	EPBC Status	Likelihood of occurrence	Nearest known location (km)	Comment
<i>Acacia anomala</i>	Grass Wattle, Chittering Grass Wattle	Vulnerable	Unlikely	0.04 ¹	Known to occur on lateritic soils which do not occur within the proposal footprint.
<i>Andersonia gracilis</i>	Slender Andersonia	Endangered	Unlikely	16	Known to occur north of Perth in the Northern Sandplains with outlier populations south of Perth. Preferred habitat of Heath of <i>Banksia telmatiaea</i> , which does not occur within the Proposal footprint.
<i>Anigozanthos viridis</i> subsp. <i>terraspectans</i>	Dwarf Green Kangaroo Paw	Vulnerable	Unlikely	>50	Known to occur in the Northern Sandplains. Vegetation association is Heath of <i>Banksia telmatiaea</i> , which does not occur within the Proposal footprint.
<i>Caladenia huegelii</i>	King Spider-orchid, Grand Spider-orchid, Rusty Spider-orchid	Endangered	Likely	0.1	Known to occur within 100 m of the proposal footprint. Preferred habitat available. Recorded in the flora study area during flora and vegetation survey (Appendix C).
<i>Calytrix breviseta</i> subsp. <i>breviseta</i>	Swamp Starflower	Endangered	Unlikely	7.3	Only known from several restricted sites south of Perth in swampy flats.
<i>Centrolepis caespitosa</i>	—	Endangered	Unlikely	3.9	Nearest known localities are south of Perth. Preferred habitat not present within the proposal footprint.
<i>Chamelaucium</i> sp. Gingin (N.G. Marchant 6)	Gingin Wax	Endangered	Unlikely	9.2	Known to occur north of Muchea with restricted distribution. Preferred habitat not present within the proposal footprint.
<i>Conospermum densiflorum</i> subsp. <i>unicephalum</i>	One-headed Smokebush	Endangered	Unlikely	>50	Known to occur in the northern extent of the Jarrah Forest, north of Bindoon.



Species	Common name	EPBC Status	Likelihood of occurrence	Nearest known location (km)	Comment
<i>Darwinia foetida</i>	Muchea Bell	Critically Endangered	Likely	0.3	Known to occur within 250 m of the proposal footprint, in the Bullsbrook and Muchea area, with preferred habitat present. Recorded in the flora study area during flora and vegetation survey (Appendix C).
<i>Diuris micrantha</i>	Dwarf Bee-orchid	Vulnerable	Unlikely	38	Known to occur to the south of Perth. Preferred habitat not present within the proposal footprint.
<i>Diuris purdiei</i>	Purdie's Donkey-orchid	Endangered	Unlikely	14.5	Known to occur in winter-wet swamps south of Perth. Preferred habitat not present within the proposal footprint.
<i>Drakaea elastica</i>	Glossy-leaved Hammer-orchid, Praying Virgin	Endangered	Unlikely	7	Known to occur south of Perth, with one outlier near Dandaragan. Preferred habitat not present within the proposal footprint.
<i>Drakaea micrantha</i>	Dwarf Hammer-orchid	Vulnerable	Unlikely	25.3	Known to occur in the southern suburbs of Perth and along the southwest coast.
<i>Eleocharis keigheryi</i>	Keighery's Eleocharis	Vulnerable	Possible	1.9	Preferred habitat not present within the proposal footprint but in land adjacent to the proposal footprint.
<i>Eucalyptus balanites</i>	Cadda Road Mallee, Cadda Mallee	Endangered	Unlikely	4.7	Known to occur in the Armadale area and north of Perth near Badgingarra.
<i>Eucalyptus leprophloia</i>	Scaly Butt Mallee, Scaly-butt Mallee	Endangered	Unlikely	>135	Known to occur well north of Perth in the Northern Sandplains. Preferred habitat not present within the proposal footprint.
<i>Grevillea althoferorum</i> subsp. <i>fragilis</i>	—	Endangered	Possible	4.2	Known to occur in close proximity to the proposal footprint. The preferred habitat is present within the proposal footprint.
<i>Grevillea corrugata</i>	—	Endangered	Unlikely	12.3	Preferred habitat (gravelly loam) and associated vegetation is not present within the proposal footprint.



Species	Common name	EPBC Status	Likelihood of occurrence	Nearest known location (km)	Comment
<i>Grevillea curviloba</i> subsp. <i>curviloba</i>	Curved-leaf Grevillea	Endangered	Likely	0.04	Known to occur within 100 m of the proposal footprint with preferred habitat present.
<i>Grevillea curviloba</i> subsp. <i>incurva</i>	Narrow Curved-leaf Grevillea	Endangered	Likely	0.02	Known to occur within 100 m of the proposal footprint with preferred habitat present. Recorded in the flora study area during flora and vegetation survey (Appendix C).
<i>Lepidosperma rostratum</i>	Beaked Lepidosperma	Endangered	Unlikely	16.6	Known to occur south of Perth. Preferred habitat not present within the proposal footprint.
<i>Macarthuria keigheryi</i>	Keighery's Macarthuria	Endangered	Unlikely	6.7	Known to occur north of the proposal footprint, and a population south of Perth, preferred habitat present.
<i>Thelymitra dedmaniarum</i>	—	Endangered	Unlikely	10.3	Preferred habitat (granite) not present within the proposal footprint.
<i>Thelymitra stellata</i>	Star Sun-orchid	Endangered	Possible	2.8	Preferred habitat (lateritic loam) is not present within the proposal footprint.
<i>Trithuria occidentalis</i>	Swan Hydatella	Endangered	Possible	1.9	Preferred habitat (winter-wet brown- grey claypans) not present within the proposal footprint



The desktop assessment did not identify any Threatened flora listed by the Commonwealth as occurring within the proposal footprint. Upon review of the known locations and habitat preferences for each Threatened flora:

- Four are considered 'Likely' to occur (*Caladenia huegelii*, *Darwinia foetida*, *Grevillea curviloba* subsp. *curviloba* and *Grevillea curviloba* subsp. *incurva*).
- Four are considered 'Possible' to occur (*Eleocharis keigheryi*, *Grevillea althoferorum* subsp. *fragilis*, *Thelymitra stellata* and *Trithuria occidentalis*).
- Seventeen are considered 'Unlikely' to occur (see Table 16.1).

As detailed in Section 8.2.3, three Commonwealth listed Threatened flora, *Caladenia huegelii*, *Darwinia foetida* and *Grevillea curviloba* subsp. *incurva*, were recorded within the flora study area. Of the remaining species considered likely (*Grevillea curviloba* subsp. *curviloba*) and possible (*Eleocharis keigheryi*, *Grevillea althoferorum* subsp. *fragilis*, *Thelymitra stellata* and *Trithuria occidentalis*) to occur within the proposal footprint, no individuals or populations were recorded during flora and vegetation surveys undertaken in 2012 (GHD, 2013a), 2013 (360 Environmental, 2014c) and 2014 (Coffey, 2015a).

The surveys were undertaken in spring, the optimal time to record the majority of the Commonwealth listed Threatened flora species. Additional targeted surveys within the proposal footprint were undertaken in November 2014 to identify the presence of late flowering Threatened flora species (for example *Calytrix breviseta* subsp. *breviseta*).

Caladenia huegelii, or Grand Spider Orchid, was recorded from one location in the Ellenbrook region. It is located in- between the Ellenbrook Estate and the proposal footprint and occurs within 20 m of a proposed noise wall. The habitat surrounding this known location is considered to be critical habitat (DEC, 2009).


The critical habitat for the Grand Spider Orchid has been mapped across the flora study area and the proposal footprint. In total, 228.3 ha of potential critical habitat occur within the flora study area, while 39.2 ha of this occur within the proposal footprint (see Figure 8.1). This equates to 17.2% of the total mapped area of potential critical habitat for the Grand Spider Orchid located within the flora study area.

Grevillea curviloba subsp. *incurva* was recorded from one location in association with previously known locations (DPAW, 2014a). No new or previously known populations of *Grevillea curviloba* subsp. *incurva* were recorded in the proposal footprint. The closest record was located 10 m from the proposal footprint boundary. The vegetation surrounding this location along the verge of Brand Highway and within the rail reserve is considered to be critical habitat (Phillimore and English, 2000), although it is in a degraded condition. The extent of critical habitat for *Grevillea curviloba* subsp. *incurva* within the proposal footprint is 2.0 ha (see Figure 8.1).

Darwinia foetida was located in association with previously known locations (DPAW, 2014a). No new population or individuals were recorded from the proposal footprint. The population was located 250 m from the proposal footprint North of Neaves Road. There is no continuous vegetation between the population of *Darwinia foetida* and the proposal footprint (Figure 8.1).

16.2.1 Potential Impacts and Management Measures

As discussed in Section 8.4.5, there are no direct impacts to the Grand Spider Orchid. Indirect impacts will be managed through the retention of a vegetated buffer no less than 50 m wide, where appropriate and available. The individual recorded from the flora study area is located approximately 20 m west of Ellenbrook and so the area of buffer will be reduced 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 suburb are present and



ongoing while the plant has been present. The project will increase the protection of the plant to the east with the construction of a noise wall along the boundaries of the properties abutting the project.

Surveys of the buffer area will be completed prior and during the construction phase to monitor the known location and the health of the surrounding vegetation within the buffer. The buffer to the east is reduced due to existing urban development. A management and monitoring program will be included within the EMP to ensure that the condition and structural integrity of the vegetated buffer is maintained.

Vegetation surveys undertaken in spring 2015 will assist in defining the extent of critical habitat for the Grand Spider Orchid. In addition, the description of critical habitat for the Grand Spider Orchid detailed in the recovery plan (DEC, 2009) will assist in defining the extent of critical habitat with regards to important populations and habitat. This will be based on known populations/individuals and surrounding similar habitat.

Darwinia foetida (Mucnea Bell) is known to occur greater than 250 m to the west of the Neaves Road separation and will not have direct impacts from the proposal footprint. The known location was searched, with the population located and considered to be in good condition. The vegetation surrounding the population was in good to degraded condition with introduced grasses prevalent. 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*. This population occurs on the edge of a Multiple Use Wetland and is surrounded by agriculture and industry; it is unlikely that there will be any indirect impacts to *Darwinia foetida*. The direction of ground water flow near the population of *Darwinia foetida* is from west to east (Golder, 2015), with the proposal located to the east of this population. It is unlikely that there will be any impact to *Darwinia foetida* from alteration in hydrology.

The proposal is not considered to have any direct impacts on Mucnea Bell, while indirect impacts are considered to be negligible and will be managed through the development and implementation of the EMP. Indirect impacts to which the proposal may contribute include groundwater abstraction resulting in a lowering of the groundwater and the introduction or spread of dieback and significant environmental weeds. Mucnea Bell occurs on swampy, seasonally wet habitats, so the lowering of the groundwater may impact on the habitat supporting the population.

The design of the proposal will ensure that there are no direct impacts and the indirect impacts, if present and measurable, will be managed through the implementation of the EMP. The groundwater abstraction required for the project will be undertaken in such a manner that there is no measurable reduction in groundwater associated with the population of Mucnea Bell. The population is located upstream of the project, with all flows moving in a south-easterly direction. Therefore, impacts associated with pooling and contamination of surface water as a result of the project will not influence the population. In addition, the construction of retention basins will assist in separating pollutants from the surface water of the proposed highway.

Grevillea curviloba subsp. *incurva* (or Narrow Curved-leaf Grevillea) was recorded from three locations within the Brand Highway road reserve at Mucnea. The locations are consistent with previously known records (Coffey, 2015a). No new additional individuals or populations were recorded during flora and vegetation surveys of the proposal footprint.

The three locations, and other known locations of the Narrow Curved-leaf Grevillea, do not occur within the proposal footprint. The locations along the Brand Highway road reserve are within 10 m of the proposal footprint; however, the proposal will cross over Brand Highway at this point and includes a bridge structure system to ensure adequate clearance over the railway line. The design will ensure that a separation distance of at least 10 m to individual plants is maintained where possible. The bridge structure will also allow continuity of the remnant vegetation located along the Brand Highway road reserve.

Critical habitat for the Narrow Curved-leaf Grevillea includes areas of known occupancy and corridors of vegetation that link populations (Phillimore and English, 2000). The remnant vegetation on the road and rail reserve along Brand Highway is considered critical habitat as it links the Muchea population to populations located to the south on Muchea Road South. The connectivity of the populations needs to be maintained to ensure sufficient movement of genetic material as per the requirements in the Narrow Curved-leaf Grevillea (*Grevillea curviloba* subsp. *incurva*) Interim Recovery Plan (Phillimore and English, 2000).

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.

The Narrow Curved-leaf Grevillea occurs in association with winter-wet heaths and is reliant on high soil moisture during the winter and early spring months. The bridge structure located in association with Brand Highway and the known locations of the Narrow Curved-leaf Grevillea will ensure the current altered hydrology (which is constrained by the presence of the highway and the railway) will be maintained.

The significance of any potential direct and indirect impacts to the three Threatened flora has been assessed based on the significant impact criteria (DOTE, 2013) and is detailed in Table 16.2.

Table 16.2 Significant impact criteria for flora

Species	Significant impact criteria	Proposal relevance	Significant impact?
<i>Caladenia huegelii</i>	Lead to a long-term decrease in the size of a population.	The proposal will not directly impact on any known populations	No
	Reduce the area of occupancy of the species.	The proposal is unlikely to reduce the area of occupancy for <i>Caladenia huegelii</i> .	No
	Fragment an existing population into two or more populations.	The proposal will not fragment a population into two.	No
	Adversely affect habitat critical to the survival of a species.	The proposal will impact on 39.2 ha of native vegetation that is potential critical habitat. The extent of critical habitat will be redefined following vegetation surveys in spring 2015. It is anticipated that the extent of critical habitat will reduce due to the habitat specificity of the species.	Potential
	Disrupt the breeding cycle of a population.	A vegetated buffer will be maintained around known populations, ensuring the native pollinators are able to persist in the area.	No
	Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline.	The proposal is unlikely to modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that <i>Caladenia huegelii</i> is likely to decline. Although 39.2 ha of intact critical habitat are present within the proposal footprint, this is considered to be an over-estimation. Refinement of the vegetation as habitat in spring 2015 will further refine the extent of critical habitat within the proposal footprint.	No

Species	Significant impact criteria	Proposal relevance	Significant impact?
	Result in invasive species that are harmful to a critically endangered or endangered species becoming established in the endangered or critically endangered species' habitat.	The proposal has the potential to introduce invasive weeds which may potentially degrade critical habitat supporting the known populations. The EMP will manage the introduction and/or spread of invasive weeds.	No
	Introduce disease that may cause the species to decline.	The EMP for the proposal will manage the risk of introduction or spread of diseases (i.e. <i>Phytophthora</i> Dieback).	No
	Interfere with the recovery of the species.	The proposal will not interfere with the recovery of <i>Caladenia huegelii</i> .	No
<i>Darwinia foetida</i>	Lead to a long-term decrease in the size of a population.	The proposal will not directly impact on any known populations	No
	Reduce the area of occupancy of the species.	The proposal is unlikely to reduce the area of occupancy for <i>Darwinia foetida</i> .	No
	Fragment an existing population into two or more populations.	The proposal will not fragment a population into two.	No
	Adversely affect habitat critical to the survival of a species.	Critical habitat has not been identified for <i>Darwinia foetida</i> . 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 <i>Darwinia foetida</i> .	No
	Disrupt the breeding cycle of a population.	Areas of known occupancy will not be directly impacts, and therefore the breeding cycle of a population will not be disrupted. The nearest known population is greater than 250 m from the proposal.	No
	Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline.	The proposal is unlikely to modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that <i>Darwinia foetida</i> is likely to decline.	No
	Result in invasive species that are harmful to a critically endangered or endangered species becoming established in the endangered or critically endangered species' habitat.	The proposal will not introduce new invasive species to the area of known occupancy due to the distance between the proposal footprint and the known population. The known population is already impacted by the presence of introduced species.	No
	Introduce disease that may cause the species to decline.	The EMP for the proposal will manage the risk of introduction or spread of diseases (i.e. <i>Phytophthora</i> Dieback).	No
	Interfere with the recovery of the species.	The proposal will not interfere with the recovery of <i>Darwinia foetida</i> .	No

Species	Significant impact criteria	Proposal relevance	Significant impact?
<i>Grevillea curviloba</i> subsp. <i>incurva</i>	Lead to a long-term decrease in the size of a population.	The proposal is not expected to impact directly on a known population. A population is located within 10 m of the proposal footprint; however, the EMP and design of the proposal will ensure the population is not directly impacted. A separation distance of 10 m will be maintained, where possible. A bridge structure will ensure there is minimal direct impact to native vegetation near the known populations.	No
	Reduce the area of occupancy of the species.	The proposal is unlikely to reduce the area of occupancy for <i>Grevillea curviloba</i> subsp. <i>incurva</i> .	No
	Fragment an existing population into two or more populations.	The design will ensure a connection between subpopulations is maintained across the proposal footprint. A bridge structure will maintain continuity in a north-south direction.	No
	Adversely affect habitat critical to the survival of a species.	The proposal will impact on 2.0 ha of degraded native vegetation that is considered to be critical habitat. This is only considered to be minor and the proposal will ensure a connection is maintained across the proposal footprint with the construction of bridge structures.	No
	Disrupt the breeding cycle of a population.	A vegetated buffer will be maintained around known populations, while a separation distance of 10 m will be maintained, where possible, between the known population and the proposal.	No
	Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline.	The proposal is unlikely to modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that <i>Grevillea curviloba</i> subsp. <i>incurva</i> is likely to decline.	No
	Result in invasive species that are harmful to a critically endangered or endangered species becoming established in the endangered or critically endangered species' habitat.	The proposal has the potential to introduce invasive weeds that may potentially degrade critical habitat supporting the known populations. It was noted that the habitat supporting the population is highly degraded with a high density and diversity of introduced species. The EMP will manage the introduction and/or spread of invasive weeds.	Potential
	Introduce disease that may cause the species to decline.	The EMP for the proposal will manage the risk of introduction or spread of diseases (i.e. <i>Phytophthora</i> Dieback).	No
	Interfere with the recovery of the species.	The proposal will not interfere with the recovery of <i>Grevillea curviloba</i> subsp. <i>incurva</i> .	No



16.2.2 Residual Impacts

A summary of the management measures and residual impacts detailed for the Grand Spider Orchid and Narrow Curved-leaf Grevillea are provided in Table 16.3. Based on the significant impact criteria (Table 16.2), the proposal may have a significant impact on the Grand Spider Orchid by the clearing of 39 ha of potential critical habitat. The proposal is not likely to have a significant impact on the Muchea Bell or the Narrow Curved-leaf Grevillea.


Management measures within the EMP will ensure that there is no direct impact on individuals within 10 m of the road and that no sub-populations of Narrow Curved-leaf Grevillea are fragmented.

The management measures are consistent with MRWA policies and procedures and are aligned with current industry practice. The effectiveness of the management measures in mitigating the residual impact on the Grand Spider Orchid and the Narrow Curved-leaf Grevillea will be dependent on the successful implementation of the EMP during the construction phase of the project by the relevant contractor appointed by MRWA.

The predicted success of these management measures are expected to substantially reduce impacts of the proposal on MNES.

Table 16.3 Summary of residual impacts to Threatened flora following implementation of management and mitigation measures

Species and EPBC Act conservation status	Existing environment	Management measures	Residual impacts
<p>Grand Spider Orchid (<i>Caladenia huegelii</i>)</p> <p>Endangered</p>	<p>One individual was recorded within approximately 20 m of the proposal footprint. Previous records of this species are known to occur within 100 m of the proposal footprint (Coffey, 2015a).</p> <p>Approximately 228 ha of critical habitat occur within the flora study area. The extent of critical habitat is considered to be an over-estimation.</p>	<ul style="list-style-type: none"> • A vegetated buffer will be maintained around the known locations of threatened flora. The buffer will be a minimum of 50 m where possible. • Vegetation to be retained as a buffer for the Threatened flora will be clearly demarcated. • Preparation and implementation of an EMP and monitoring program prior to construction to ensure impacts to Threatened flora and their vegetated buffers are being appropriately managed. • If clearing occurs within the buffer, the impacted vegetation will be immediately rehabilitated and revegetated. • Additional targeted surveys will be undertaken prior to vegetation clearing to clearly define population boundaries and to identify any additional populations within and adjacent to the proposal footprint, to inform the final design and construction. • If populations of Grand Spider Orchid are identified as occurring within the proposal footprint, the merits of translocation will be researched. If feasible, the plants will be translocated to adjacent populations. • Habitat surveys will occur in spring 2015 to further define the extent of critical habitat within the proposal footprint. 	<p>Approximately 39 ha of potential critical habitat will be impacted within the proposal footprint.</p>



Species and EPBC Act conservation status	Existing environment	Management measures	Residual impacts
<p>Narrow Curved-leaf Grevillea (<i>Grevillea curviloba</i> subsp. <i>incurva</i>)</p> <p>Endangered</p>	<p><i>Grevillea curviloba</i> subsp. <i>incurva</i> was recorded at previously known locations. No new populations or individuals were recorded from the proposal footprint. The known locations are within 10 m of the proposal footprint (Coffey, 2015a).</p> <p>The vegetation located along the Brand Highway verge and the rail reserve is considered to be critical habitat for <i>Grevillea curviloba</i> subsp. <i>incurva</i> (Phillimore and English, 2000).</p>	<ul style="list-style-type: none"> • A vegetated buffer will be maintained around the known locations of threatened flora. The buffer will be a minimum of 10 m. • Vegetation to be retained as a buffer for the Threatened flora will be clearly demarcated. • Vegetation located along the Brand Highway road reserve will be maintained during final design of the proposal with the aid of a bridge structure. The construction of a bridge will ensure continuity in the habitat along Brand Highway • Preparation and implementation of an EMP and monitoring program prior to construction to ensure impacts to Threatened flora and their vegetated buffers are being appropriately managed. • If clearing occurs within the buffer, the impacted vegetation will be immediately rehabilitated and revegetated. • Additional targeted surveys will be undertaken prior to vegetation clearing to clearly define population boundaries and to identify any additional populations within and adjacent to the proposal footprint, to inform the final design and construction. 	<p>Connectivity between known populations may be interrupted depending on the design of the Brand Highway cross over.</p>



16.3 Listed Threatened Ecological Communities

A search of the PMST and review of the flora and vegetation survey conducted (Coffey, 2015a) indicated that seven TECs listed under the EPBC Act may be located within five kilometres of the proposal in both the Muchea and Ellenbrook sections:

- Assemblages of plants and invertebrate animals of tumulus (organic mound) springs of the Swan Coastal Plain (Mound Springs SCP) – Endangered.
- Claypans of the Swan Coastal Plain – Critically Endangered.
- *Corymbia calophylla* – *Kingia australis* woodlands on heavy soils of the Swan Coastal Plain – Endangered.
- *Corymbia calophylla* – *Xanthorrhoea preissii* woodlands and shrublands of the Swan Coastal Plain – Endangered.
- Shrublands and woodlands of the eastern Swan Coastal Plain – Endangered.
- Shrublands and Woodlands on Muchea Limestone of the Swan Coastal Plain – Endangered.
- Subtropical and Temperate Coastal Saltmarsh – Vulnerable.

A series of tumulus springs were known to occur adjacent to the proposal footprint (Attachment 4 in GHD, 2008a). During the alignment definition (2003–2005) the alignment was designed to avoid direct impact on the springs (GHD, 2013b). The former Department of Environment and Conservation (now DPAW) required that detailed assessments be undertaken to justify the location of the proposal within the catchment of the TEC and determine how the potential impacts would be managed. To ensure that there would be no impacts to the hydrology of the TEC (given that the proposal is located within the catchment of the TEC), the proposal was re-aligned to the east of the TEC.

A detailed Level 2 flora and vegetation survey of the study area (Section 8.1), conducted in 2014 (Coffey, 2015a), included a statistical multivariate analysis of floristic data collected from the proposal footprint. The survey also reviewed previous studies to identify if any TECs have previously been recorded within the proposal footprint. The results of the statistical analysis and review of available information indicated that one TEC, Claypans of the SCP, occurs within the flora study area. The TEC was mapped in association with remnant native vegetation on clay based soils north of Muchea, adjacent to the Great Northern Highway.

The TEC Mound Springs SCP occurs within the flora study area near Gaston Road. In addition to the Claypans SCP and the Mound Springs SCP, the buffers of additional Mound Springs SCP sites and Shrublands and Woodlands on Muchea Limestone of the Swan Coastal Plain (Muchea Limestone SCP) sites occur across the proposal footprint in several locations. Although the proposal footprint occurs within portions of the TEC buffers, the impact on the TECs as a result of the construction and operation of the proposal is considered to be negligible. The minimum distance between the Muchea Limestone SCP and the proposal footprint is 1.5 km, and generally incorporates residential housing and cleared paddocks (Figure 8.4).

The proposal footprint is located down gradient of the known Mound Springs SCP TEC locations, except for one location in Ellenbrook. The buffer surrounding the Mound Spring SCP TEC in Ellenbrook incorporates the residential housing; as such, the construction and operation of the proposal will not impact on the location of the TEC in Ellenbrook.

The proposal will not impact on the Mound Springs SCP and the Muchea Limestone SCP as a result of the buffers occurring in association with the proposal footprint.



16.3.1 Potential Impacts and Management Measures

No TECs listed by the Commonwealth under the EPBC Act are known to occur within the proposal footprint. The impacts are considered to be negligible due to the distance between the TEC and the proposal footprint and the current land uses (i.e. residential housing, cleared paddocks) between the TECs and the proposal footprint.

The Mound Springs SCP TEC will not be directly impacted, and the potential indirect impacts associated with hydrological changes can be readily managed during the construction and operation phases of the proposal. The management measures associated with indirect impacts to the Mound Springs SCP TEC is discussed in Sections 8.5 and 10.5.

As discussed in Section 8.4.4, the proposal footprint will not directly impact on the TEC Claypans of the SCP. Existing earthworks of man-made dams located within the mapped TEC and the current Great Northern Highway may potentially be indirectly impacting the hydrology of the TEC.

The Claypans of the SCP TEC is dependent on the wetlands filling and drying at appropriate times of the year. Groundwater abstraction for construction purposes may lower the groundwater table, which may reduce the amount of wetland 'filling', reducing the biodiversity of the wetlands. Alterations to groundwater levels are expected to be localised, minimal and on a short-term basis (see Section 10.4.9).

To mitigate the potential impact of groundwater alteration on the Claypans of the SCP TEC, an investigation into dewatering and water abstraction requirements will be undertaken to understand the extent and scale of impacts on the groundwater and the TEC. The groundwater abstraction is not anticipated to adversely impact the groundwater levels that influence the TEC. In addition, surface water flows will be maintained during the construction and operation phase of the proposal.

16.3.2 Residual Impacts


A summary of the management measures and residual impacts detailed for Commonwealth TECs Claypans of the SCP and Mound Springs SCP are provided in Table 16.4, and are addressed in Section 10.4.9. Based on the significant impact criteria for critically endangered and endangered TECs (DOTE, 2013), the proposal will not have a significant impact on either the Mound Springs SCP TEC or the Claypans of the SCP TEC.

The management measures are consistent with MRWA policies and procedures and are aligned with current industry practice. The effectiveness of the management measures in mitigating the residual impact on the two TECs will be dependent on the successful implementation of the EMP during the construction phase of the project by the relevant contractor appointed by MRWA.

It is predicted that the impacts to these TECs will be fully mitigated.

Table 16.4 Summary of residual impacts to Threatened Ecological Communities following implementation of management and mitigation measures

TEC and conservation rating	Existing environment	Management measures	Residual impacts
Claypans of the SCP Critically Endangered (Commonwealth TEC)	9.8 ha in size and ranged in condition from very good to degraded. Dependent on the wetlands filling and drying at appropriate times of the year.	<ul style="list-style-type: none"> • Disturbance will be restricted to the proposal footprint. • The Commonwealth TEC Claypans of the SCP will be avoided. • Groundwater abstraction will not adversely impact the groundwater levels that influence the TEC. • An investigation into dewatering and water abstraction requirements will be undertaken to understand the extent and scale of impacts on the groundwater and the TEC. • Preparation and implementation of an EMP and monitoring program prior to construction to ensure there are no indirect impacts to the functionality of the TEC. 	Nil.
Mound Springs SCP Endangered (Commonwealth TEC) and Critically Endangered (State TEC)	1.5 ha occurs in the flora study area. The habitat of this community is characterised by the continuous discharge of groundwater in raised areas of peat. The peat and immediate surrounds provide a stable, permanently moist series of microhabitats. The design of the proposal ensured the proposal footprint was located down gradient from the local catchment for the Mound Springs SCP TEC.	<ul style="list-style-type: none"> • Project disturbance will be restricted to the proposal footprint. • The Commonwealth TEC Mound Springs SCP will be avoided. • Groundwater abstraction will not adversely impact the groundwater levels that influence the TEC. • Preparation and implementation of an EMP and monitoring program prior to construction to ensure there are no indirect impacts to the functionality of the TEC. 	Nil.



TEC and conservation rating	Existing environment	Management measures	Residual impacts
<p>Shrublands and Woodlands on Muchea Limestone of the SCP</p> <p>Endangered (Commonwealth TEC)</p>	<p>The buffers of two locations occur across the proposal footprint.</p> <p>Although the proposal footprint occurs in association with portions of the TEC buffers, the impact on the TECs as a result of the construction and operation of the proposal is considered to be negligible.</p> <p>The Muchea Limestone SCP and the proposal footprint is 1.5 km, and is predominately residential housing and cleared paddocks.</p> <p>The proposal will not impact on the Muchea Limestone SCP as a result of the buffers occurring in association with the proposal footprint.</p>	<ul style="list-style-type: none"> • Project disturbance will be restricted to the proposal footprint. • The Commonwealth TEC Muchea Limestone on the SCP will be avoided. • Groundwater abstraction will not adversely impact the groundwater levels that influence the TEC. • Preparation and implementation of an EMP and monitoring program prior to construction to ensure there are no indirect impacts to the functionality of the TEC. 	<p>Nil.</p>



16.4 Threatened and Migratory Fauna Species

Threatened fauna under the EPBC Act are classified according to the following categories: Extinct, Extinct in the Wild, Critically Endangered, Endangered or Vulnerable. Species can also be classified as migratory under the EPBC Act if they are listed under international conventions and/or agreements to which Australia is party to e.g., Bonn Convention, CAMBA or JAMBA.

A review of database searches (DOTE, 2014f; DPAW, 2014c, d) indicated that 41 conservation significant fauna species protected under the EPBC Act potentially occur within a 10 km radius of the proposal footprint. Of the 41 species identified as potentially occurring in the proposal footprint, two species were recorded during the fauna survey: Carnaby's Cockatoo (*Calyptorhynchus latirostris*) and Forest Red-tailed Black Cockatoo (*Calyptorhynchus banksii naso*). Three species were classified as likely to occur: Great Egret (*Ardea alba*), Cattle Egret (*Ardea ibis*) and Rainbow Bee-eater (*Merops ornatus*) (Coffey, 2015b) (Appendix G). As the proposal footprint does not contain suitable habitat, is not in the current distribution or does not contain recent records for the other 36 species, they were not assessed (aside from the Western Swamp Tortoise in Section 16.4.2). Further information on the species not considered likely to occur in the proposal footprint is contained in Appendix G.

16.4.1 Potential Impacts to Black Cockatoos and Migratory Fauna

The proposal is not expected to result in a significant impact on the majority of threatened or migratory fauna except for the Carnaby's Cockatoo and the Forest Red-tailed Black Cockatoo. The significant impact criteria for each of these species are summarised in Table 16.5.

16.4.2 Potential Impacts to the Western Swamp Tortoise

The Western Swamp Tortoise is classified as highly unlikely to occur in the proposal footprint as it currently occurs in only four known locations outside the proposal footprint. In addition, the proposal footprint lacks the ephemeral swamps over clay-based soils this species requires (Coffey, 2015b) (see Appendix G). However, due to the close proximity of the proposal footprint to sensitive habitat (Twin Swamps Nature Reserve and Ellen Brook Nature Reserve) and the conservation significance of this species, an analysis on the potential impact to these habitats from road runoff and pollutants was undertaken.

The Western Swamp Tortoise is listed as Critically Endangered under the EPBC Act and Schedule 1 under the WC Act. Its current distribution occurs at four locations, namely Ellen Brook Nature Reserve, Twin Swamps Nature Reserve, Moore River Nature Reserve and Mogumber Nature Reserve. The populations at the two latter locations are maintained by translocated individuals (DOTE, 2014g). Current populations at each reserve include 30 individuals at Ellen Brook Nature Reserve, six individuals at Twin Swamps Nature Reserve and approximately 26 individuals at Mogumber Nature Reserve (based upon 2004 data). The release of captive bred individuals to Moore River Nature Reserve commenced in 2007 (DOTE, 2014g; Burbidge et al., 2010). The significant impact criteria for the Western Swamp Tortoise are summarised in Table 16.6.

The wetlands within Twin Swamps Nature Reserve fill with water in response to the first winter rains from direct rainfall and surface runoff. The wetlands are also fed by groundwater, part of which is thought to be due to groundwater flow from the Darling Scarp in the east (EPA, 2006c). Surface water flows from the proposal towards the east and before the reserve split to the south and north of Twin Swamps Nature Reserve, therefore, there is no direct flow path from the proposal area into the swamps (Appendix J). Furthermore, given the expected sandy nature of the surrounding soils and the separation distance between the swamps and the proposal, groundwater levels at the swamps will not be impacted by the construction of the road embankment (see Appendix J).


Table 16.5 Significant impact criteria for fauna

Species and conservation status	Significant impact criteria	Proposal relevance	Significant impact
Carnaby's Cockatoo (Endangered) Forest Red-tailed Black Cockatoo (Vulnerable)	Will the proposal lead to a long-term decrease in the size of a population/important population of a species?	The proposal is unlikely to result in a long-term decrease in the size of the population for either species. The loss of habitat from the proposal represents approximately 0.04% of the bioregional habitat available for the Carnaby's Cockatoo and approximately 0.03% of the bioregional habitat available for the Forest Red-tailed Black Cockatoo (474,000 ha of Black Cockatoo habitat on the SCP) (Johnston, 2013).	No
	Will the proposal reduce the area of occupancy of this species/an important population?	The proposal is not expected to reduce the area of occupancy for each species (Carnaby's Cockatoo 10,000 km ² and Forest Red-tailed Black Cockatoo 20,000 km ²) (Garnett et al., 2011).	No
	Will the proposal fragment an existing population/ important population into two or more populations?	Both species are nomadic within their range and have strong dispersal capabilities. The proposal will not fragment the population of either species.	No
	Will the proposal adversely affect habitat critical to the survival of a species?	The proposal will clear vegetation that provides food resources and roosting sites in the non-breeding season for the Carnaby's Cockatoo. The proposal will clear Marri and Jarrah Woodland in an area of the southwest of WA that receives more than 600 mm of annual average rainfall. Under the critical habitat criteria in the recovery plan for each species both of these actions constitute a significant impact (DPAW, 2013a; Chapman, 2007).	Yes
	Will the proposal disrupt the breeding cycle of a population/important population?	The proposal footprint does not occur within the current breeding range of either species.	No
	Will the proposal modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline?	Although the proposal will clear quality habitat for both species, the extent of loss in a bioregional context is small (between 0.03% and 0.04%). As such, neither species is expected to decline due to the proposal.	No
	Will the proposal result in invasive species that are harmful to an endangered/vulnerable species becoming established in the endangered/vulnerable species' habitat?	The proposal footprint will not introduce an invasive species that may be harmful to either species.	No

Species and conservation status	Significant impact criteria	Proposal relevance	Significant impact
	Will the proposal introduce disease that may cause the species to decline?	The residual impacts of <i>Phytophthora</i> Dieback from the proposal are considered to be low with the implementation of an EMP. Any residual impacts are not likely to cause a decline to either species.	No
	Will the proposal interfere substantially with the recovery of the species?	Although the proposal will clear critical habitat for both species the extent of loss in a bioregional context is small (between 0.03% and 0.04%). As such, the recovery of either is not expected to be interfered with.	No
Great Egret, Cattle Egret and Rainbow Bee-eater (all Migratory)	Will the proposal substantially modify (including by fragmenting, altering fire regimes, altering nutrient cycles or altering hydrological cycles), destroy or isolate an area of important habitat for a migratory species?	<p>The proposal footprint does not contain habitat classified as important for this relatively common and widespread species, as it does not:</p> <ul style="list-style-type: none"> • Support an ecologically significant proportion of this species. • Contain habitat critical to a lifecycle stage. • Occur at the limit of this species range. • Occur within an area where this species is declining. 	No
	Will the proposal result in an invasive species that is harmful to the migratory species becoming established in an area of important habitat for the migratory species?	The proposal footprint will not introduce an invasive species that may be harmful to migratory species.	No
	Will the proposal seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of a migratory species?	<p>The Great Egret occurs throughout Australia with Western Australian populations occurring across the greater part of the state, except the arid eastern interior (Johnstone and Storr, 1998).</p> <p>The Cattle Egret occurs in the wetter parts of WA, and also in Northern and Eastern Australia, New Zealand and Southeast Asia (Johnstone and Storr, 1998).</p> <p>The Rainbow Bee-eater is one of the most widespread bird species in Australia (Barrett et al., 2003).</p> <p>As such, the proposal footprint does not support a significant proportion of the population of these species.</p>	No

Table 16.6 Significant impact criteria for the Western Swamp Tortoise

Species and conservation status	Significant impact criteria	Proposal relevance	Significant impact
Western Swamp Tortoise (Critically Endangered)	Will the proposal lead to a long-term decrease in the size of a population of the species?	Impacts to the Twin Swamps and Ellen Brook Nature Reserves will not create a long-term decrease in the size of the population of this species.	No
	Will the proposal reduce the area of occupancy of this species?	The proposal, at its closest point, comes within 2.6 km of Twin Swamps Nature Reserve and 4.8 km of Ellen Brook Nature Reserve. The proposal will not reduce the area of occupancy for this species.	No
	Will the proposal fragment an existing population into two or more populations?	The proposal, at its closest point, comes within 2.6 km of Twin Swamps Nature Reserve and 4.8 km of Ellen Brook Nature Reserve. The proposal will not fragment these already isolated populations.	No
	Will the proposal adversely affect habitat critical to the survival this species?	Surface water and groundwater drainage into Twin Swamps or Ellen Brook Nature Reserve will not be disrupted by the proposal.	No
	Will the proposal disrupt the breeding cycle of a population?	The proposal, at its closest point, comes within 2.6 km of Twin Swamps Nature Reserve and 4.8 km of Ellen Brook Nature Reserve. The proposal will not disrupt the breeding cycle of those populations.	No
	Will the proposal modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline?	Impacts from the proposal are upon habitats unsuitable for this species to inhabit. As such, the species is not expected to decline due to the proposal.	No
	Will the proposal result in invasive species that are harmful to a critically endangered species becoming established in the critically endangered species' habitat?	The proposal footprint will not introduce an invasive species that may be harmful to this species.	No
	Will the proposal introduce disease that may cause the species to decline?	The residual impacts of <i>Phytophthora</i> Dieback from the proposal are considered to be low with the implementation of an EMP. Due to the distance from the proposal any residual impacts are not likely to impact into Twin Swamps or Ellen Brook Nature Reserve.	No
	Will the proposal interfere substantially with the recovery of the species?	The proposal at its closest point comes within 2.6 km of Twin Swamps Nature Reserve and 4.8 km of Ellen Brook Nature Reserve. The proposal will not interfere with the recovery of this species.	No



The swamps within Ellen Brook Nature Reserve are fed by rainfall and surface water runoff from immediately adjoining properties. The proposal crosses Ellen Brook approximately 10 km upstream from Ellen Brook Nature Reserve. While Ellen Brook flows through the nature reserve, it is not known to interact with the swamps, nor is groundwater anticipated to feed these swamps as they are perched on a less permeable (more clayey) base (EPA, 2006c). Ellen Brook swamp is not expected to be impacted by changes to groundwater levels or flows as it is perched on a less permeable clay base and is not fed by groundwater (EPA, 2006c).

Based on the information in this section, the proposal is not expected to impact the Western Swamp Tortoise or its critical habitat at Twin Swamps Nature Reserve or Ellen Brook Nature Reserve. Impacts are considered to be fully mitigated and no effects are predicted.

16.4.3 Residual Impacts


A summary of management measures and residual impacts for the threatened/migratory fauna recorded or likely to occur in the proposal footprint is provided in Table 16.7. For more details on the impacts and mitigation/management measures refer to Section 9.5. All mitigation measures listed were considered through the application of the management hierarchy (Government of Western Australia, 2014) and based on current best practice methods. The EMP will be finalised prior to construction and implemented by the relevant contactor appointed by MRWA. Offset commitments will meet the requirements of the WA Environmental Offset Guidelines (Government of Western Australia, 2014).

Based on the significant impact criteria for Migratory species and the Western Swamp Tortoise, the proposal will not have a significant impact these species. Impacts from the proposal on both Black Cockatoo species are considered a significant impact based upon the Significant Impact Guidelines 1.1 (DOTE, 2013).

Table 16.7 Summary of residual impacts to Threatened and Migratory fauna following implementation of management and mitigation measures

Species and EPBC Act conservation status	Existing environment	Management measures	Residual impacts	Percentage of habitat loss at a local ¹ and regional ² scale
<p>Carnaby's Black Cockatoo (<i>Calyptorhynchus latirostris</i>) Endangered</p>	<p>There have been numerous records of this species occurring in the vicinity of the proposal footprint. This species was recorded foraging along Reid Highway and Cullacabardee Bushland during the survey (Coffey, 2015b).</p>	<ul style="list-style-type: none"> • Avoidance of vegetated areas in design (49.6 ha) and keep clearing to a minimum during construction. • Reduce design footprint to minimise impact on suitable breeding trees (68 trees avoided) and foraging habitat. • Offsetting of lost habitat. • Landscaping design to avoid foraging species planted on road verge. • Implementation of management measures in the EMP. 	<ul style="list-style-type: none"> • Loss of suitable habitat: <ul style="list-style-type: none"> – 201.8 ha foraging habitat. – 58.6 ha roosting habitat. – 120.1 ha breeding habitat. – 763 potential breeding trees. • Increased occurrence of vehicle collision. • Habitat degradation. 	<ul style="list-style-type: none"> • Foraging habitat: <ul style="list-style-type: none"> – 2.6% at a local scale. – 1% at a regional scale. – 0.04% at a bioregional scale³.

Species and EPBC Act conservation status	Existing environment	Management measures	Residual impacts	Percentage of habitat loss at a local ¹ and regional ² scale
Forest Red-tailed Black Cockatoo <i>(Calyptorhynchus Banksia naso)</i> Vulnerable	This species has previously been recorded in the vicinity of the proposal footprint. The Forest Red-tailed Black Cockatoo was recorded foraging in the Banksia Woodland in the Maralla Road Bushland during the survey (Coffey, 2015b).	<ul style="list-style-type: none"> Avoidance of vegetated areas in design (49.6 ha) and keeping clearing to a minimum during construction. Reduction of design footprint to lessen impact on suitable breeding trees (68 trees avoided) and foraging habitat. Offsetting of habitat loss. Landscaping design to avoid foraging species planted on road verge. Implementation of management measures in the EMP. 	<ul style="list-style-type: none"> Loss of suitable habitat: <ul style="list-style-type: none"> 120.1 ha foraging habitat. 58.6 ha roosting habitat. 120.1 ha breeding habitat. 763 potential breeding trees. Increased occurrence of vehicle collision. Habitat degradation. 	<ul style="list-style-type: none"> Foraging habitat: <ul style="list-style-type: none"> 1.6% at a local scale. 0.6% at a regional scale. 0.03% at a bioregional scale³.
Great Egret <i>(Ardea alba)</i> Migratory	<p>The Great Egret has been previously recorded at Lightning Swamp, Whiteman Park, Bennett Brook, Waltham Reserve and Malaga Regional Open Space, which are all directly adjacent to the proposal footprint.</p> <p>The Wetlands of the proposal footprint provide suitable habitat for this species (Coffey, 2015b).</p> <p>No important habitat for this species occurs within the proposal footprint..</p> <p>An ecologically significant proportion of the population of this species will not occur within the proposal footprint.</p>	<ul style="list-style-type: none"> Implementation of management measures contained in the EMP. 	<ul style="list-style-type: none"> No significant impact Habitat degradation and habitat loss (15.5 ha). Due to the widespread occurrence of this species and extent of its preferred habitats, impacts are expected to be negligible. 	Cannot be calculated ⁴ .



Species and EPBC Act conservation status	Existing environment	Management measures	Residual impacts	Percentage of habitat loss at a local ¹ and regional ² scale
Cattle Egret (<i>Ardea ibis</i>) Migratory	<p>Records of this species exist from the Lake Joondalup area, which is approximately 10 km west of the proposal footprint. The Wetland and Paddock habitat types provide suitable habitat for this species. A Cattle Egret was recorded foraging in pastures adjacent to the proposal footprint during the survey (Coffey, 2015b).</p> <p>No important habitat for this species occurs within the proposal footprint.</p> <p>An ecologically significant proportion of the population of this species will not occur within the proposal footprint.</p>	<ul style="list-style-type: none"> Implementation of management measures contained in the EMP. 	<ul style="list-style-type: none"> No significant impact Habitat degradation and habitat loss (271.3 ha). Due to the widespread occurrence of this species and extent of its preferred habitats, impacts are expected to be negligible. 	Cannot be calculated ⁴ .
Rainbow Bee-eater (<i>Merops ornatus</i>) Migratory	<p>This species has been previously recorded in the vicinity of the proposal footprint. All natural fauna habitats and the Modified Vegetation secondary habitat provide suitable habitat for this species (Coffey, 2015b).</p> <p>No important habitat for this species occurs within the proposal footprint..</p> <p>An ecologically significant proportion of the population of this species will not occur within the proposal footprint.</p>	<ul style="list-style-type: none"> Avoidance of vegetated areas in design and keeping clearing to a minimum during construction. Implementation of management measures contained in the EMP. 	<ul style="list-style-type: none"> No significant impact Habitat degradation and habitat loss (367.5 ha). Due to the widespread and common occurrence of this species and extent of its preferred habitats, impacts are expected to be negligible. 	<ul style="list-style-type: none"> 4.8% at a local scale. 1.8% at a regional scale.

1. Local scale represents the extent of all Bush Forever sites within 1 km of the proposal footprint.

2. Regional scale represents the extent of all Bush Forever sites within 10 km of the proposal footprint.

3. Bioregional scale represents the amount of Black Cockatoo habitat on the SCP.

4. Cannot be calculated due to the lack of information pertaining to the local or regional scale of the specific habitat requirements of that species.



16.5 Commonwealth Land

A 4.05 km section of the proposal alignment crosses Commonwealth land to the south of Neaves Road (Figure 16.1). This land is controlled and operated by the DOD and comprises 1,094 ha, with approximately 46.4 ha being impacted by the proposal.

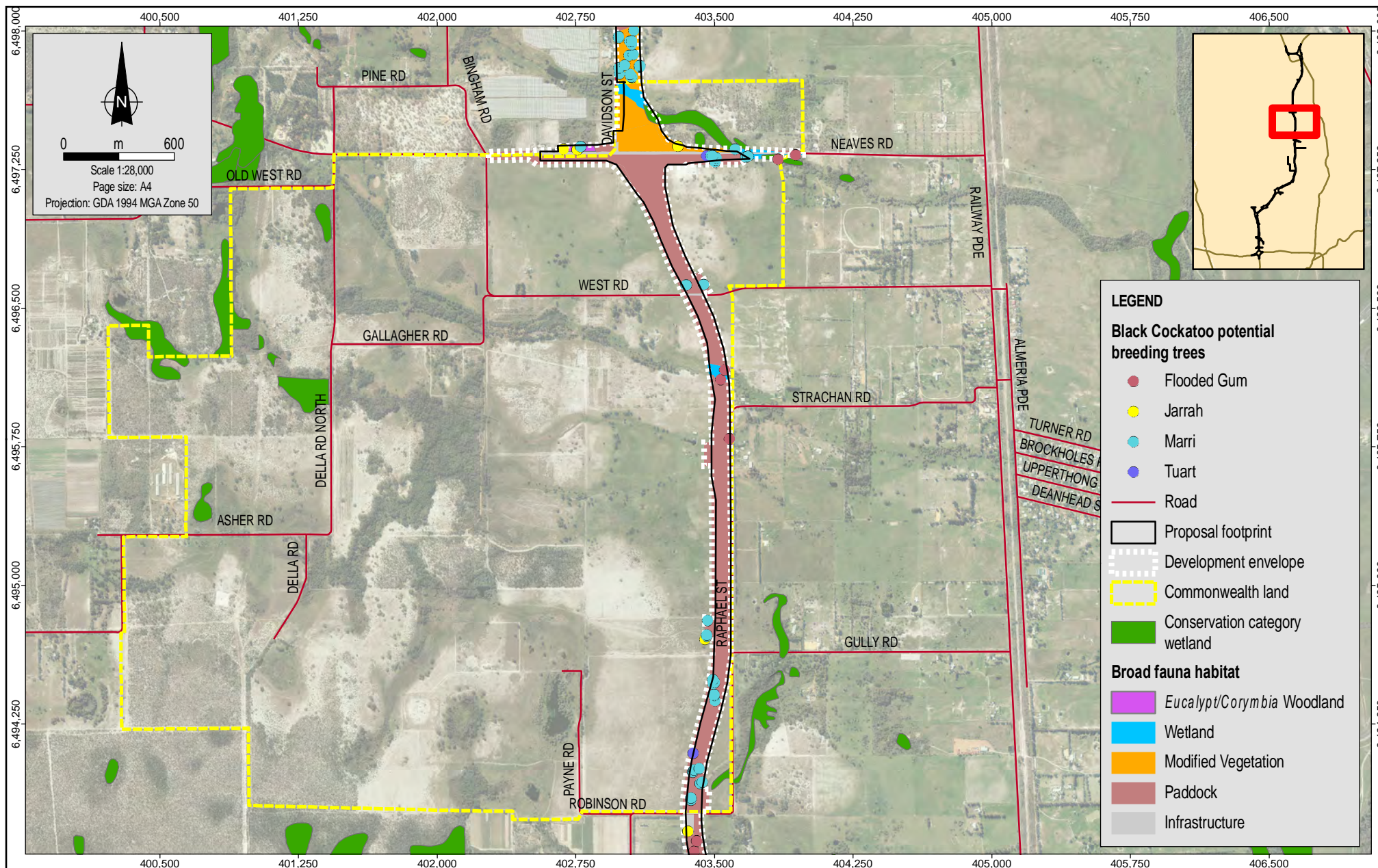
During 2004 and as part of a route selection study, an initial alignment was developed based on known constraints at that time. During the consultation phase in October 2004 a number of alignment issues were raised by the community and other stakeholders that required further investigation. At the time, the DOD requested that an alignment further to the east be considered in order to reduce severance to their estate (WAPC, 2012).

The resulting alignment is along the eastern boundary of the DOD land, to the west of Raphael Road, and is now gazetted in the Perth MRS. In the southeastern corner of the property the proposal turns slightly to the west in the vicinity of Robinson Road to avoid a CCW located in this area. In the northeastern corner of the DOD land, the alignment turns slightly westward to reduce impact on water bores and another CCW (MRWA, 2009).

At the planning stage, the DOD did not agree with the proposed alignment deviations at the southeastern and northeastern corners of their estate as described above. DOD's current position is that it does not agree with the alignment in the vicinity of Neaves Road and suggests that the alignment be straightened to reduce severance of DOD land. However, the proposal has not been amended to incorporate this request as it would result in a greater impact to CCWs in the vicinity of Neaves Road. In addition, the proposed alignment was subject to public consultation as part of the MRS amendment process and was subsequently gazetted in the MRS. Acquisition of adjacent private properties is progressing on the basis of the alignment in the MRS.

The key factors impacted by the proposal on Commonwealth land include:

- Conservation Category Wetlands.
- Fauna habitat.



Source & Notes
 Black cockatoo trees and broad fauna habitat from Coffey (October 2014).
 Conservation category wetlands from DPAW (January 2015).
 Cadastre from MRWA (August 2014).
 Aerial imagery from Landgate (August 2014).

NorthLinkWA

coffey

Date:
18.06.2015
 MXD:
4483AA_03_GIS032_2
 File Name:
4483AA_03_F16.1_GIS

Main Roads WA
 Public Environmental Review
 Perth-Darwin National Highway

Commonwealth land
 and associated ecological values

Figure No:
16.1

16.5.1 Flora and Vegetation Values

The Commonwealth land between Neaves Road and Raphael Road consists of largely cleared paddocks with remnant paddock trees of Flooded Gum (*Eucalyptus rudis* subsp. *rudis*) and Marri (*Corymbia calophylla*) and highly disturbed drainage lines dominated by native trees and Kikuyu grass (**Cenchrus clandestinus*). In addition, significant environmental weeds, including Blackberry (**Rubus laudatus*) and Arum Lily (**Zantedeschia aethiopica*) were recorded within the minor drainage lines. The paddocks were considered completely degraded (Coffey, 2015a).

The extent of the mapped vegetation associations within the Commonwealth land is provided in Table 16.8. The values for the extent within the proposal footprint are detailed in Section 8.4.1.1.

Table 16.8 Vegetation association extent within Commonwealth land

Vegetation association	Description	Extent within Commonwealth land		Vegetation condition
		(ha)	(%)	
CcEr ³	Open paddocks with remnant <i>Corymbia calophylla</i> and <i>Eucalyptus rudis</i> subsp. <i>Rudis</i> over pasture species (introduced) dominated by <i>*Cenchrus clandestinus</i> .	36.5	78.6	Completely degraded
Cl	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).	3.8	8.2	Completely degraded
Er ⁸	<i>Eucalyptus rudis</i> subsp. <i>Rudis</i> , <i>Corymbia calophylla</i> sparse mid woodland over <i>Melaleuca preissiana</i> and <i>Melaleuca raphiophylla</i> isolated clumps of low trees over <i>*Holcus lanatus</i> and <i>*Cenchrus clandestinus</i> closed mid grassland.	0.7	1.5	Degraded to completely degraded
Mp ⁷	<i>Melaleuca preissiana</i> sparse to open low woodland over <i>*Zantedeschia aethiopica</i> sparse tall herbland over <i>*Cenchrus clandestinus</i> and <i>*Holcus lanatus</i> sparse mid grassland.	0.1	0.2	Good to degraded
MpMr	<i>Melaleuca preissiana</i> and <i>Melaleuca raphiophylla</i> low (open) woodland over <i>*Zantedeschia aethiopica</i> and <i>*Typha orientalis</i> open mid herbland.	1.1	2.4	Good to degraded
R	<i>Corymbia calophylla</i> , <i>Eucalyptus camaldulensis</i> and <i>Eucalyptus todtiana</i> low woodland over <i>Calothamnus quadrifidus</i> and <i>Banksia nivea</i> sparse mid shrubland over <i>*Bromus diandrus</i> and <i>*Ehrharta calycina</i> sparse mid grassland over <i>*Ursinia anthemoides</i> and <i>*Hypochaeris glabra</i> sparse low herbland (Revegetation-site).	4.2	9.1	Completely degraded to degraded
Total	—	46.4	100	—

The vegetation south of Neaves Road does not constitute native vegetation and, as a result, the proposal through this section of the Commonwealth land will not require the clearing of native vegetation (see Section 8.4.1.1).

The Commonwealth land located in the proposal footprint on the northern side of Neaves Road consists of rehabilitated land and highly modified vegetation along Bingham Creek. Bingham Creek is dominated by

planted exotics (deciduous trees) and weeds, including Bulrush (**Typha orientalis*) and Arum Lily. The vegetation was considered to be in a good to completely degraded condition (Coffey, 2015a).

The rehabilitated portion of the property included Marri, River Red Gum (*Eucalyptus camaldulensis*) and Prickly Bark (*Eucalyptus tottiana*) (Coffey, 2015a). Although Marri and Prickly Bark occur naturally within the region, the specimens within the property are considered to be planted. The River Red Gum was planted.

The vegetation within the Commonwealth land is not considered to be significant and does not represent any Commonwealth or State listed ecological communities. In addition, no Commonwealth or State listed Threatened flora occur within the proposal footprint on Commonwealth land (Coffey, 2015a). A summary of the appropriate management measures and residual impacts to flora is provided in Table 16.9 (at the end of this chapter). All mitigation measures listed were considered through the application of the management hierarchy (Government of Western Australia, 2014) and based on current best practice methods.

16.5.2 Conservation Category Wetlands

A total of 0.4 ha of CCW 8773 and 0.02 ha of CCW 8909 occur within the proposal footprint and will be directly impacted by the proposal (Section 10.2.2 and Table 16.10). This impact is considered to be minor given the scale of the impact (only 12.3% and 5% respectively of the CCW mapped extent) and the degraded condition of these wetlands. A summary of the management measures and residual impacts to CCWs is provided in Table 16.9. All mitigation measures listed were considered through the application of the management hierarchy (EPA, 2014b) and based on current best practice methods.


Table 16.10 Commonwealth land wetland impacts

Wetland Unique Feature Identifier (UFI)	Category	Extent of wetland (ha)	Extent of proposal footprint on Commonwealth land	
			(ha)	(%)
8773	CCW	3.2	0.40	12.5
15732	MUW	13,744.4	30.22	0.2
8909	CCW	0.4	0.02	5.0

16.5.2.1 Wetlands at Southern End of Commonwealth Land

The geomorphic wetland located at the southern end of the Commonwealth land was classified as a CCW. It is located on both the eastern and western side of Raphael Road, having previously been split as a result of the construction of this road, and is connected via a culvert under Raphael Road (GHD, 2008b). The wetland consists of three sections with separate unique feature identifiers (UFIs), 8914, 8915 and 8916. The northern portion (UFI 8915 and UFI 8916) has been classified as resource enhancement palusplain, with the southern section as CCW.

The area is typical palusplain with a shallow depth to groundwater that is prevalent in the area. On the western side, the ground surface has intersected the natural groundwater level and has become a point of groundwater discharge. The wetland is, therefore, an expression of local groundwater levels and intersects the upper most part of the superficial aquifer. It was noted that there are other discharge points in the area in the form of various small creeks running in an easterly direction. The source of this groundwater discharge is likely to be from the Gngara Mound located to the west of the site (GHD, 2008b).



The site has previously been cleared and was highly degraded with few native species, including Marri and shrubs located in the paddocks adjacent to the wetland. Some native species remained within the wetland, but the majority of it was dominated by introduced grasses and herbs, including Narrowleaf Lupin (*Lupinus angustifolium*) and Yellow Serradella (*Ornithopus compressus*). The wetland condition ranged from Degraded to Completely Degraded (GHD, 2008b).

Although the wetland is degraded and has low conservation value, it was considered an important source of groundwater discharge that feeds the higher conservation value wetland to the east of Raphael Road. At the time, the DEC did not support an alignment that crosses the wetland and the alignment at this point was shifted slightly west to avoid the CCW (MRWA, 2009).

The DOD has acknowledged the outcomes of the 2008 survey and the decision regarding the alignment, but did not support the position due to the degraded nature of the CCW (MRWA, 2009).

16.5.2.2 Wetlands at Northern End of Commonwealth Land

The wetlands at the northern end of Commonwealth land at Neaves Road were surveyed during September 2014 (Coffey, 2014) and included a survey of plant communities, flora taxa and wetland values. The wetland vegetation is currently mapped as a combination of MUW and CCW. Five relevés and one mapping point were sampled within the wetlands and vegetation located within Lot 800 Neaves Road.

The current alignment of the proposal, in the Neaves Road region, will have a lower environmental impact on the wetlands within Lot 800 than the alignment further to the east preferred by DOD, which will impact significantly on the Conservation Category Wetland. In addition, the wetland is located within Bush Forever Site 100 (Neaves Road Creek, Bullsbrook). The construction of the proposal will divide the Bush Forever Site, however, the current alignment traverses a section of the Bush Forever Site that is completely degraded and would require lower levels of native vegetation clearing. If the proposal footprint was to move to the east, significantly more native vegetation clearing would be required, in addition to the impacts on the CCW.

The vegetation located in association with the MUW mapping is considered to be in a completely degraded condition, while the native vegetation in association with the CCW is considered to be in degraded condition.

Although there is scope for regeneration of vegetation in degraded condition, intensive management would be required over an extended period to rehabilitate the wetlands to a state approaching good condition. The upper stratum of the vegetation structure is present, thus reducing the scope for the rehabilitation of the upper stratum. An intensive weed eradication program and the revegetation of the middle and lower stratum would be required to manage the degraded understorey of the wetland.


The wetlands within Lot 800 are located within the Keysbrook Suite of wetlands. Several other wetlands within the Keysbrook Suite are located within and adjacent to the proposal footprint. The wetlands within Lot 800 may represent good examples of the Keysbrook Suite.

According to mapping and information obtained from DPAW (2013), approximately 1.5% of the original extent of wetlands in the Keysbrook consanguineous suite still supports a high level of values, attributes and functions and is, therefore, mapped as CCW.

The current alignment has a lower impact on the CCW and allows for the retention and revegetation of the CCW in Lot 800.

16.5.3 Fauna Habitat

The majority of Commonwealth land within the proposal footprint occurs on secondary fauna habitat classified as Paddock (36.7 ha) (Lots 1677, 1478, 5, 1, 2, 3, 4, 1729 and 1690). This habitat is characterised by sporadic Eucalypts/Corymbias such as *Eucalyptus rudis*, *Eucalyptus m16-29arginata* and *Corymbia*



calophylla, over pastures. As the original vegetation structure of this habitat has been disrupted, it does not support the full fauna assemblage although it does provide limited habitat for some species. The Paddock habitat is of low habitat value and is classified as being in a completely degraded condition (Coffey, 2015b).

Lot 800 contains secondary fauna habitat classified as Modified Vegetation (6.4 ha). The original vegetation structure of this habitat has been disrupted and it does not support the full fauna assemblage, although it does provide limited habitat for some species. The vegetation on this Lot is rehabilitated vegetation and consists of *Corymbia calophylla*, *Eucalyptus camaldulensis* and *Eucalyptus tottiana* low woodland over *Calothamnus quadrifidus* and *Banksia nivea* shrubland over sparse grassland and low herbland. This habitat is of low value and is classified as being in degraded condition (Coffey, 2015b).

Lots 800, 1478 and 5 contain approximately 1.9 ha of Wetland habitat. The vegetation of this habitat is characterised by *Eucalyptus rudis* and *Melaleuca preissiana* woodland over mixed shrubs over sedges and rushes with surface water expression. The Wetland habitat in Lots 800 and 1478 corresponds to a small lake and the Wetland habitat in Lot 5 is an ephemeral creek. These water bodies provide habitat to some aquatic species, but not for fauna that require deep lakes or large wetland habitats such as rivers, swamps and large lakes. This habitat does not contain the shallow margins that migratory wading birds prefer as foraging habitat. This habitat does, however, contain stands of suitable sized trees which are classified as breeding habitat for Black cockatoos. The Wetland habitat provides moderate habitat value and is classified as being in completely degraded to degraded condition on Lot 5 and good to degraded condition on Lots 800 and 1478 (Coffey, 2015b).

The remaining 1.5 ha of Commonwealth land is classified as cleared/infrastructure and does not provide any fauna value.

A total of 26 trees with a DBH of over 500 mm were recorded on Commonwealth land. Trees with a DBH of 500 mm or above are classified as providing breeding habitat for Black Cockatoos. The Wetland habitat contains stands of suitably sized trees and is classified as potential breeding habitat for Black Cockatoos (1.9 ha). As the Paddock and Modified Vegetation habitats contain sporadic Eucalypt/Corymbia trees rather than stands, the individual suitably sized trees were recorded in the total number of suitable breeding trees rather than the total area of breeding habitat.

None of the fauna habitats present on Commonwealth land are considered more significant than similar habitats in the local vicinity of the proposal footprint. Due to the vast majority of Commonwealth land occurring on the secondary habitat of Paddocks, impacts to the fauna values from the proposal are limited to habitat loss (Wetland habitat and potential Black Cockatoo habitat). No critical habitat exists on the Commonwealth land for conservation significant fauna other than the Black Cockatoos. A summary of impacts and mitigation measures for each Lot on Commonwealth land is provided in Table 16.11 and Figure 16.1 and residual impacts are provided in Table 16.9. All mitigation measures listed were considered through the application of the management hierarchy (Government of Western Australia, 2014) and based on current best practice methods.

Table 16.11 Fauna impacts on Commonwealth lands

Lot No.	Habitat	Management measures	Potential impacts
800	Wetland Modified Vegetation	Implementation of an environmental management plan to limit spread of weeds, dieback, rubbish and vehicle tracks. Installation of two drainage culverts to maintain hydrological flow. Reduction of design footprint.	<ul style="list-style-type: none">• 1.1 ha of Wetland cleared.• One potential breeding tree.
1677	Paddock	Implementation of an environmental management plan to limit spread of weeds, dieback, rubbish and vehicle tracks.	No expected impact due to the lack of fauna habitat.
1478	Paddock	Implementation of an environmental management plan to limit spread of weeds, dieback, rubbish and vehicle tracks.	<ul style="list-style-type: none">• 0.02 ha of Wetland cleared.• Eight potential breeding trees.
5	Wetland Paddock	Implementation of an environmental management plan to limit spread of weeds, dieback, rubbish and vehicle tracks. Installation of a drainage culvert to maintain hydrological flow.	<ul style="list-style-type: none">• 0.7 ha of Wetland cleared.• Two potential breeding trees.
1	Paddock	Implementation of an environmental management plan to limit spread of weeds, dieback, rubbish and vehicle tracks.	One potential breeding tree.
2	Paddock	Implementation of an environmental management plan to limit spread of weeds, dieback, rubbish and vehicle tracks.	No expected impact due to the lack of fauna habitat.
3	Paddock	Implementation of an environmental management plan to limit spread of weeds, dieback, rubbish and vehicle tracks.	No expected impact due to the lack of fauna habitat.
4	Paddock	Implementation of an environmental management plan to limit spread of weeds, dieback, rubbish and vehicle tracks.	No expected impact due to the lack of fauna habitat.
1729	Paddock	Implementation of an environmental management plan to limit spread of weeds, dieback, rubbish and vehicle tracks.	Six potential breeding trees.
1690	Paddock	Implementation of an environmental management plan to limit spread of weeds, dieback, rubbish and vehicle tracks.	Eight potential breeding trees.

Table 16.9 Summary of residual impacts to ecological values on Commonwealth land following implementation of management and mitigation measures


Aspect	Existing environment	Management measures	Residual impacts
Vegetation associations (CcEr ³ , Cl, Er ⁸ Mp ⁷ , MpMr and R)	1.2 ha of native vegetation (Mp ⁷ and MpMr) in extent in the proposal footprint on Commonwealth land. 45.2 ha of degraded to completely degraded of vegetation and infrastructure in the proposal footprint on Commonwealth land.	<ul style="list-style-type: none"> An EMP will be prepared and implemented, including management and monitoring of intact native vegetation. Disturbance will be restricted to the proposal footprint. 	<ul style="list-style-type: none"> Loss of 1.2 ha of native vegetation in degraded or better condition.
CCW and MUW	0.4 ha of CCW 8773, 0.02 ha of CCW 8909 and 30.22 of MUW 15732 in the proposal footprint on Commonwealth land.	<ul style="list-style-type: none"> Disturbance will be restricted to the proposal footprint. Finalisation of design will endeavour to avoid and minimise impacts to CCW and REWs within the proposal footprint. Where any areas of CCW and REW can be retained these will be identified within a detailed infrastructure plan prior to construction. A wetland management and monitoring plan will be prepared and implemented. 	<ul style="list-style-type: none"> Loss of 0.42 ha of CCW wetlands. Loss of 30.22 of MUW wetlands.
Black Cockatoo habitat and fauna habitat	26 potential breeding trees for Black Cockatoos. Approximately 1.9 ha of Wetland habitat.	<ul style="list-style-type: none"> An EMP will be implemented. During construction use boundary fencing or flagging will be used. Black Cockatoo habitat will be offset. 	<ul style="list-style-type: none"> Loss of 26 potential breeding trees for Black Cockatoos. Loss of approximately 1.9 ha of Wetland habitat.

16.6 Other Information Required by the Environment Protection and Biodiversity Conservation Regulations 2000

The Environment Protection and Biodiversity Conservation Regulations 2000 require a Public Environment Report prepared under the EPBC Act to provide certain information that has not otherwise been discussed elsewhere in this PER. This information is tabulated in Table 16.12.

Table 16.12 Other information required by Schedule 4 of the Environment Protection and Biodiversity Conservation Regulations 2000

Regulation ¹	Requirement ¹	Proponent response
4.01(e)	The name of the agency responsible for endorsing or approving each mitigation measure or monitoring program.	<p>The DPAW are responsible for the endorsing or approving of all mitigation measures and monitoring programs relating to protected fauna and flora.</p> <p>The EPA is responsible for compliance with conditions that prescribe monitoring and mitigation measures as part of an approval under the EP Act.</p> <p>The DOW is responsible for the water licencing and monitoring of compliance with conditions.</p>
4.01 (f)	A consolidated list of mitigation measures proposed to be undertaken to prevent, minimise or compensate for the relevant impacts of the action, including mitigation measures proposed to be taken by State governments, local governments or the proponent.	A consolidated list of mitigation measures has been included in the Executive Summary of the PER. It is not anticipated that any mitigation measures will be undertaken by state or local governments (other than MRWA), but they will instead be the responsibility of the proponent (MRWA) or their appointed contractor.
5.01(a)(ii)	How the scheme provides for the prevention, minimisation and management of any relevant impacts.	The schemes referred to in Table 5.2 do not provide for direct management of impacts and therefore the EMP is the primary reference document for the management of environmental impacts. All efforts have been made to include all applicable management measures that will be implemented by the relevant construction contractor.
6.01(a)	Details of any proceedings under a Commonwealth, State or Territory law for the protection of the environment or the conservation and sustainable use of natural resources against the person proposing to take the action.	MRWA is not aware of any proceedings under Commonwealth, State or Territory law for the protection of the environment or the conservation and sustainable use of natural resources against the Department.
6.01(b)	Details of any proceedings under a Commonwealth, State or Territory law for the protection of the environment or the conservation and sustainable use of natural resources against, for an action for which a person has applied for a permit, the person making the application.	MRWA is not aware of any proceedings under Commonwealth, State or Territory law for the protection of the environment or the conservation and sustainable use of natural resources in relation to any permits.



Regulation ¹	Requirement ¹	Proponent response
6.01(c)	If the person proposing to take the action is a corporation — details of the corporation's environmental policy and planning framework.	Regulation 6.01(c) is not applicable as the person taking the action, the Commissioner of Main Roads Western Australia, is not a corporation.

1. Cross-reference to the Environment Protection and Biodiversity Conservation Regulations 2000.