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Department of Primary Industries and Regional Development

GOVERNMENT OF WESTERN AUSTRALIA

State Barrier Fence Esperance Extension

Public Environmental Review

Prepared for
Department of Primary Industries and Regional Development, Agriculture and Food Division
by Strategen

December 2017

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State Barrier Fence
Esperance Extension

Public Environmental Review

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Client: Department of Primary Industries and Regional Development, Agriculture and Food Division

Report Version	Revision No.	Purpose	Strategen author/reviewer	Submitted to Client	
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Preliminary Draft Report	A	For client review	D White, C Lehman/ L Adams	Electronic	19 Dec 2016
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Final Draft Report	1	To OEPA	D White / J Mitchell	Electronic	11 May 2017
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Final Report	**3**	**Issued for use: public review**	**J Mitchell**	**Electronic and hard copy**	**8 Dec 2017**

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Invitation

The Environmental Protection Authority (EPA) invites people to make a submission on this proposal. The environmental impact assessment process is designed to be transparent and accountable, and includes specific points for public involvement, including opportunities for public review of environmental review documents. In releasing this document for public comment, the EPA advises that no decisions have been made to allow this proposal to be implemented.

The Department of Primary Industries and Regional Development, Agriculture and Food Division (DPIRD on behalf of the agricultural and livestock industries in the southeast of WA proposes to extend the existing State Barrier Fence (the existing SBF) 660 km east from its current termination point near Ravensthorpe (the Proposal). The Proposal alignment will extend north around Salmon Gums and finish east of Esperance near Cape Arid National Park. The Proposal will involve the construction of a 660 km long and 1.35 m high barrier fence in the Shires of Ravensthorpe and Esperance to protect agricultural enterprises from the impact of wild dogs, emus and kangaroos coming from the rangelands and adjacent woodlands. The Proposal will result in a maximum clearing footprint of 816 ha, including 6 ha for the construction of water turnouts for erosion control. In accordance with the *Environmental Protection Act 1986*, a Public Environmental Review (PER) has been prepared that describes this proposal and its likely effects on the environment. The PER is available for a public review period of 4 weeks from 18 December 2017 closing on 29 January 2018.

Comments from government agencies and from the public will assist the EPA to prepare an assessment report in which it will make recommendations to government.

Where to get copies of this document

Printed and CD copies of this document may be obtained from:

Matt Stadler
Department of Primary Industries and Regional Development, Agriculture and Food Division
444 Albany Highway
ALBANY WA 6330
Telephone: (08) 9892 8446
Email: Matthew.Stadler@agric.wa.gov.au

Hard copies of the document cost $10 (including postage); CDs will be provided free of charge.

The PER may also be accessed through the Proponent's website at www.agric.wa.gov.au.

Why write a submission?

A submission is a way to provide information, express your opinion and put forward your suggested course of action – including any alternative approaches. It is useful if you indicate any suggestions you have to improve the Proposal.

All submissions received by the EPA will be acknowledged with electronic submissions being acknowledged electronically. The Proponent will be required to provide adequate responses to points raised in submissions. In preparing its assessment report for the Minister for Environment, the EPA will consider the information in submissions, the Proponent's responses and other relevant information. Submissions will be treated as public documents unless provided and received in confidence, subject to the requirements of the Freedom of Information Act 1992, and may be quoted in full or in part in the report.

Why not join a group?

If you prefer not to write your own comments, it may be worthwhile joining with a group or other groups interested in making a submission on similar issues. Joint submissions may help to reduce the workload for an individual or group, as well as increase the pool of ideas and information. If you form a small group (up to 10 people) please indicate all the names of the participants. If your group is larger, please indicate how many people your submission represents.

Developing a submission

You may agree or disagree with, or comment on, the general issues discussed in the PER or the specific proposals. It helps if you give reasons for your conclusions, supported by relevant data. You may make an important contribution by suggesting ways to make the proposal environmentally more acceptable.

When making comments on specific proposals in the PER:

- clearly state your point of view
- indicate the source of your information or argument if this is applicable
- suggest recommendations, safeguards or alternatives.

Points to keep in mind

By keeping the following points in mind, you will make it easier for your submission to be analysed:

- attempt to list points so that issues raised are clear. A summary of your submission is helpful
- refer each point to the appropriate section, chapter or recommendation in the PER document
- if you discuss different sections of the PER document, keep them distinct and separate, so there is no confusion as to which section you are considering
- attach any factual information you may wish to provide and give details of the source. Make sure your information is accurate.

Remember to include:

- your name
- address
- date
- whether you want your submission to be confidential.

The closing date for submissions is: 29 January 2018

The EPA prefers submissions to be made at: *https://consultation.epa.wa.gov.au*.

Alternatively, submissions can be:

- posted to: Chairman, Environmental Protection Authority, Locked Bag 10, EAST PERTH WA 6892; or
- delivered to the Environmental Protection Authority, Level 8, The Atrium, 168 St Georges Terrace, Perth.

If you have any questions on how to make a submission, please ring Environmental Protection Authority Services, Department of Water and Environmental Regulation (the DWER; formerly the Office of the Environmental Protection Authority) on 6145 0800.

Executive summary

Introduction

The Department of Primary Industries and Regional Development, Agriculture and Food Division (DPIRD, formerly Department of Agriculture and Food WA [DAFWA]), on behalf of the agricultural industries in the Shires of Ravensthorpe and Esperance, proposes to extend the existing State Barrier Fence (SBF) from its current termination point 25 km east of Ravensthorpe, north to Salmon Gums and ending east of Esperance near Cape Arid National Park [NP] in Western Australia (WA) (the Proposal; Figure ES 1). The Proposal aims to protect agricultural enterprises in the Shires of Ravensthorpe and Esperance from the socio-economic impacts associated with wild dogs limiting livestock enterprises; and damage to crops and pasture from emus and kangaroos in the agricultural region.

The Proposal involves the construction of a 660 km long and 1.35 m high barrier fence that is largely impermeable to wild dogs, emus and kangaroos (target fauna). The proposed barrier fence will have three unfenced gaps where the Proposal alignment intersects three major waterways, and a 3.2 km wide unfenced coastal corridor near Cape Arid NP. These gaps in the proposed barrier fence will maintain significant ecological corridors (Figure ES 2).

The Proposal alignment follows the boundary between agricultural land and Unallocated Crown Land (UCL) in the Great Western Woodlands, with a total of approximately 529 km of the Proposal alignment to be located on UCL and a further 131 km on private farming property (Figure ES 2).

Assessment process

The Proposal is currently being assessed under the Western Australian *Environmental Protection Act 1986* (EP Act). The Proposal was referred to the Environmental Protection Authority (EPA) under s.38 of the EP Act on 10 June 2016. The EPA determined a Public Environmental Review (PER) level of assessment (Assessment No. 2088) for the Proposal on 1 September 2016 with a 4 week public review period.

The Proposal was referred to the Department of the Environment and Energy (DEE) (formerly Department of the Environment [DotE]) under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) on 23 June 2016 (EPBC 2016/7722). The referral addressed the potential loss of foraging habitat for Carnaby's Black Cockatoo (*Calyptorhynchus latirostris*, Endangered), the risk of collision with the proposed barrier fence by Western Ground Parrot (*Pezoporus flaviventris*; Critically Endangered) and potential impacts to flora species *Conostylis lepidospermoides* (Endangered) and *Eucalyptus merrickiae* (Vulnerable). One hectare of previously cleared Proteaceae Dominated Kwongkan Shrublands Threatened Ecological Community (TEC) was also identified to be impacted in an existing firebreak. DEE determined that the Proposal was 'not a controlled action' on 4 August 2016.

Under the Environmental Impact Assessment (Part IV Divisions 1 and 2) Administrative Procedures 2012 (the Administrative Procedures), the EPA prepared an Environmental Scoping Document (ESD) identifying the preliminary key environmental factors to be addressed in the PER and the work required to inform the assessment of the environmental impact of the Proposal. A draft ESD was issued to DPIRD on 28 September 2016. The final ESD was provided to DPIRD on 27 October 2016 and identified the following preliminary key environmental factors:

- Flora and Vegetation
- Terrestrial Fauna
- Heritage
- Offsets.

Detailed biological surveys, including flora, fauna and dieback assessments, were undertaken by Ecoscape (2017a), Glevan (2015) and Great Southern Bio Logic (GS Bio Logic 2015). These assessments were required to provide baseline environmental data to be submitted by DPIRD to the EPA and DEE as a part of Proposal reviews and appraisal processes.

In the period between the referral of the Proposal in June 2016 and the submission of the draft PER in January 2017 the Proposal Development Envelope has increased by 2826 ha from 5313 ha to 8139 ha, and the maximum clearing footprint has decreased by 27 ha, from 843 ha to 816 ha. In a letter dated 28 February 2017 responding to the draft PER, the DWER recommended DPIRD submit a request to seek EPA consent to the proposed changes without a revised Proposal being referred under Part IV of the EPA Act pursuant to s 43A of the EP Act. On 29 May 2017, DPIRD received a Notice of decision to consent to the change to proposal during assessment from the EPA; this PER document includes the updated amendments.

Benefits of the Proposal

The Proposal has been developed in response to socio-economic impacts on industry and communities in the agricultural region resulting from the damage caused to crops and pasture by periodic emu 'migrations' and kangaroos, and the impact of wild dogs in limiting livestock enterprises.

It is estimated that the Proposal will allow landholders to increase current stocking rates by 10% for sheep in the area managed by the Southern Biosecurity Group (formerly Ravensthorpe Declared Species Group) (the existing SBF borders most of this region, with largely successful Licensed Pest Management Technicians [LPMT; Doggers] activities currently preventing most wild dogs from entering around the existing SBF) and by 40% in the area managed by the Esperance Biosecurity Association Inc. (Esperance Shire area). Positive feedback was also received during a grower survey undertaken by DPIRD in 2013, which sought comments on the effectiveness of the existing SBF. Farmers and growers in general outlined that upgrades to the integrity of existing SBF were effective in minimising damage from kangaroos, emus and wild dogs on farming operations.

The Proposal is expected to have a good return on investment (Benefit Cost Ratio calculated to be 6.6 and 4.8 in the Ravensthorpe and Esperance regions, respectively; Peterson & Cooke 2016) and will help assist to double the value of the agrifood sector by 2025 by minimising socio-economic impacts.

Other potential ecological benefits from the Proposal include:

- reduced threat of wild dog predation to native fauna
- access for fire fighting in previously uncleared vegetation
- non-lethal and long-term option to control the incursion of emus and kangaroos into the agricultural land from the vast area of adjacent woodlands and rangelands.

Integrated wild dog control (trapping, baiting and shooting) will still be required along the Proposal alignment to minimise dog movement and to reduce the passage of wild dogs through the unfenced river crossings, open coastal end point and previously uncleared areas along the Proposal alignment.

The consequences of not proceeding with the Proposal would be the continuing liability and financial loss associated with target fauna. The status quo for wild dog management (includes trapping, baiting and shooting wilds dogs) will also be maintained without the proposed barrier fence.

Description of Proposal

The Proposal is to construct an approximately 660 km long, 1.35 m high barrier fence. The Proposal would extend the existing SBF eastwards from its current termination 25 km east of Ravensthorpe, extending north around Salmon Gums and ending east of Esperance near Cape Arid NP in the Goldfields-Esperance Region of WA. The Proposal may take up to two years to construct following environmental and heritage approval.

To construct the proposed barrier fence, a maximum clearing footprint of 816 ha is required.

The width of the clearing footprint varies along the Proposal alignment based on the pre-existing condition of the environment. The Proposal alignment will be positioned within a 15–20 m wide clearing footprint corridor. Where the Proposal alignment is located within or adjacent to other disturbance (such as previously chained[1] firebreak areas) the width of the clearing footprint is 15 m. Where the Proposal alignment is located in undisturbed areas (such as previously uncleared vegetation) the clearing footprint width is 20 m wide.

Within the 15–20 m wide clearing footprint, a 6 m wide track of full clearing (grading) will be required to construct and enable ongoing maintenance of the proposed barrier fence. The remaining width of clearing footprint corridor (up to 14 m) will be chained and potentially mulched.

[1] Chaining involves two bulldozers pulling a heavy chain across vegetation to clear trees and woody vegetation.

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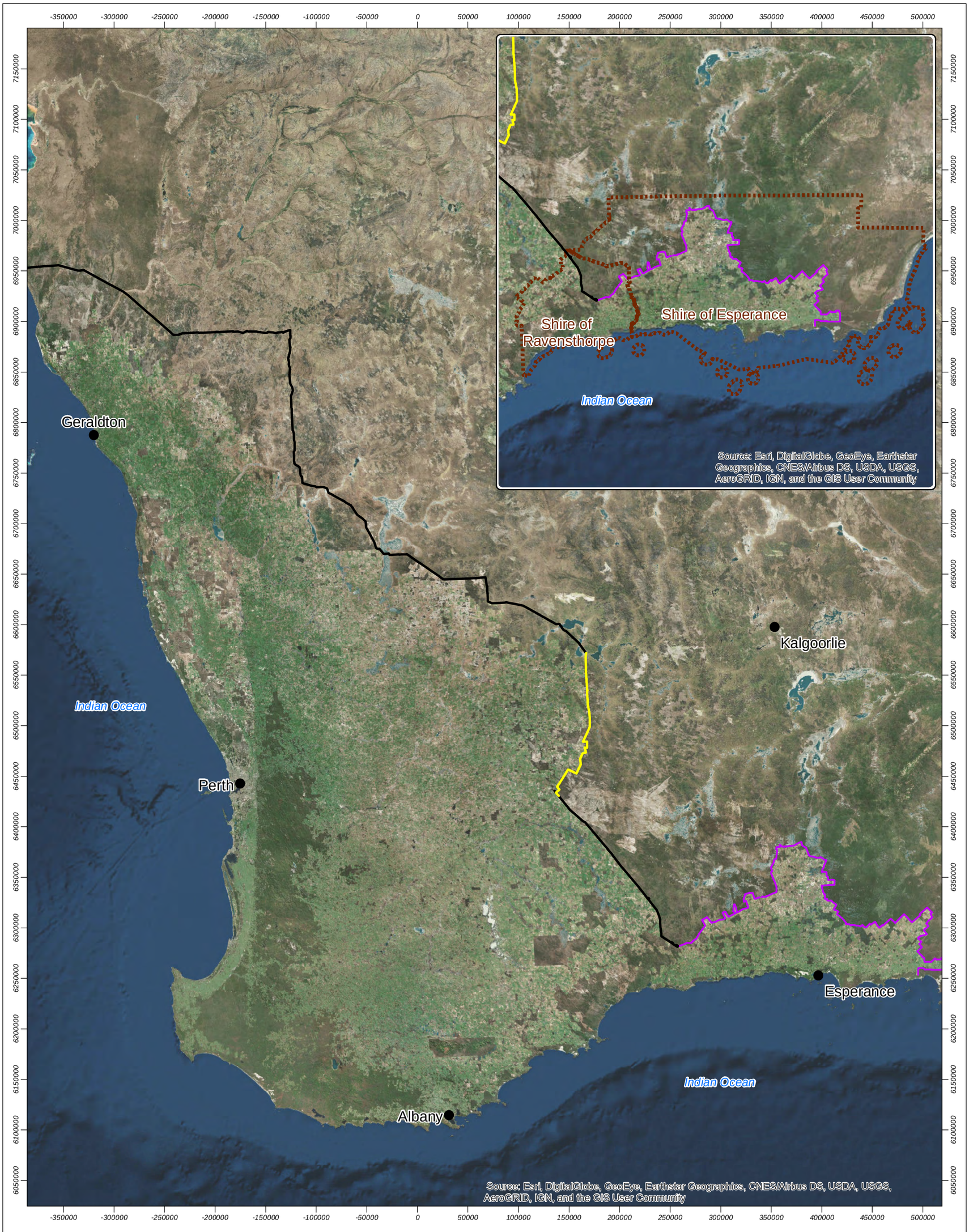


Figure ES1: Proposal location and existing SBF

Scale 1:3,440,000at A3

0 50 100 150 200 250 km

Coordinate System: GDA 1994 MGA Zone 51
Note that positional errors may occur in some areas
Date: 1/08/2017
Author: DWhite
Source: Aerial: ESRI approx. 2010; Data: Client 2016

Legend

- Major town
- Existing SBF
- Yilgarn Gap
- Proposal alignment



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Path: Q:\Consult\2016\DAF\DAF16515\ArcMap_documents\R001\DAF16515_01_R001_RevE_ES1.mxd

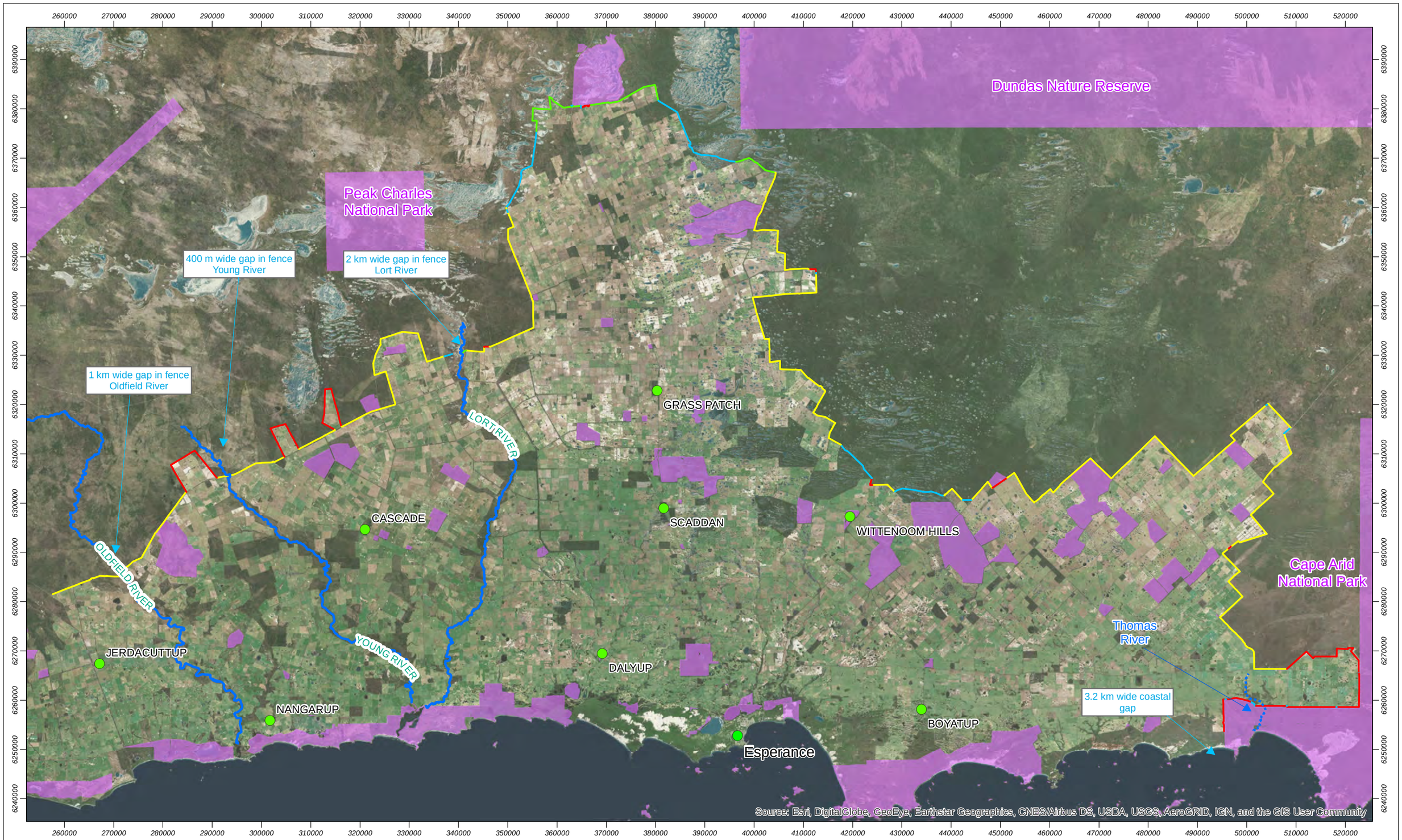


Figure ES2: Existing environment condition along the Proposal alignment

Scale 1:708,000 at A3

0 2 4 6 8 10 km

N

Legend

- Reserves
- Town
- Major watercourses
- Minor creekline
- **Proposal alignment existing environment conditions**
- Previously chained firebreak
- Existing track or graded firebreak
- Previously cleared freehold farmland
- Uncleared vegetation

Coordinate System: GDA 1994 MGA Zone 51
Note that positional errors may occur in some areas
Date: 1/08/2017
Author: DWhite
Source: Aerial: ESRI approx. 2010; Data: Client 2016; Reserves: DPaW: 2012.
Path: Q:\Consult\2016\DAF\DAF16515\ArcMap_documents\R001\DAF16515_01_R001_RevE_ES2.mxd

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Stakeholder consultation

DPIRD has consulted broadly in an open, transparent manner about the Proposal. DPIRD and the Esperance Extension Reference Group (EERG) have considered the various stakeholders' views on the Proposal and significantly altered the Proposal alignment in response to concerns raised and advice provided. This has resulted in a revised final Proposal alignment, fence structure design and clearing practice that minimises or avoids potential environmental impacts.

Key issues raised during consultation regarding the Proposal include the following:

- potential environmental, cultural and community impacts from the Proposal including:
  - inadequate knowledge about the flora species that may be impacted by the Proposal
  - potential risks to Western Ground Parrots from the removal of habitat and risk of collision/entrapment from the proposed barrier fence
  - habitat fragmentation and potential loss of ecological connectivity
- final Proposal alignment route, and fence design specifications (such as construction materials)
- potential increase in meso-predation on native fauna inside the barrier fence and along the proposed barrier fence corridor
- methods to improve engagement with conservation groups in the Proposal.

Other relevant consultation has been undertaken by the WA Wild Dog Action Group (WA WDAG), who met in July 2015 to determine the priorities to develop a new Western Australian Wild Dog Action Plan (the Action Plan) to coordinate and prioritise efforts to better address the impacts wild dogs have on livestock across WA. The clear message from the consultation process regarding the Action Plan was that wild dogs are having a severe impact on the ability of landholders to run livestock in the pastoral regions of WA, and that they are now moving into the agricultural areas of WA. This has significantly impacted landholders financially, emotionally and socially.

Government agencies were consulted during the preparation of the PER to ensure that all relevant issues were identified and addressed in the PER. The Draft PER was submitted to the Environmental Protection Authority Services, Department of Water and Environmental Regulation (the DWER; formerly the Office of the Environmental Protection Authority [OEPA]) in January 2017. The DWER reviewed the Draft PER and provided preliminary comments on the adequacy of the information presented. The Draft PER was then revised in accordance with agency comments following further discussion and clarification of issues with agencies.

Consultation with key stakeholders will continue throughout the assessment, approvals, construction and implementation stages of the Proposal (if Proposal approvals are obtained).

Flora and Vegetation

The ESD recognised the potential for Flora and Vegetation to be affected during construction and ongoing maintenance of the proposed barrier fence. The potential direct and indirect impacts relate to:

- clearing of native vegetation
- introduction and spread of weeds and dieback
- fragmentation of vegetation
- change in fauna aided seed dispersal.

To determine existing flora and vegetation values, a number of baseline flora and vegetation investigations were undertaken. The baseline data was then used to inform the final Proposal alignment route, as well as highlight any potential impacts from the Proposal on Flora and Vegetation. Results from baseline investigations were also used to inform an impact assessment that calculated flora and vegetation loss from the Proposal.

The predicted residual impacts to Flora and Vegetation include:

1. Disturbance of up to 816 ha of native vegetation with approximately:
    - 373.8 ha for re-chaining (if necessary) of previously chained areas
    - 248.6 ha of grading within chained areas, where the inner graded fire track will be used preferentially where possible
    - 146.0 ha of chaining within uncleared vegetation
    - 41.6 ha (5%) of permanent grading (for a 6 m wide access track) within uncleared vegetation
    - an estimated maximum 6.0 ha for water diversion turnouts for erosion control (total predicted residual impacts are not expected to significantly impact vegetation at a local or regional scale).
2. Disturbance of the following regional Vegetation Associations with less than 30% of their extent remaining in the maximum clearing footprint:
    - 28.1 ha of Vegetation Association 47
    - 64.2 ha of Vegetation Association 512
    - 3.6 ha of Vegetation Association 4801 with 1.2 ha of this clearing located in uncleared vegetation.
3. Disturbance of 655 m Proteaceae Dominated Kwongkan Shrubland TEC (0.87 ha) located within an existing and recently re-chained firebreak. The TEC comprising 0.87 ha will occur in areas to be re-chained and may re-grow; however, will be subject to future re-chaining events.
4. Fragmentation and localised edge effects along the 69.3 km of the Proposal alignment that is within uncleared vegetation.
5. Clearing of 36 species of Priority flora, with 11 Priority Flora species located within uncleared vegetation.
6. Clearing of up to 103 significant trees (trees with a diameter greater than 500 mm at breast height) in sections of the alignment north of the Salmon Gums township.

There will be no new clearing of records of Threatened Flora species (*Conostylis lepidospermoides*, *Anigozanthos bicolor* subsp. *minor, Eucalyptus merrickiae*, *Rhizanthella gardneri)*, which occur in the vicinity of the Proposal alignment. The clearing footprint will not significantly change the percentage remaining of any Vegetation Associations. Disturbance of 0.87 ha of Proteaceae Dominated Kwongkan Shrubland from the Proposal also represents no new impact as this disturbance is located within a previously chained area.

After the application of mitigation and management measures, the Proposal is expected to meet the EPA objective for Flora and Vegetation.

Terrestrial Fauna

The ESD recognised the potential for Terrestrial Fauna to be affected during construction and ongoing maintenance of the proposed barrier fence. The potential direct and indirect impacts relate to:

- collisions and entrapment of fauna with the proposed barrier fence
- removal of fauna habitat from vegetation clearing
- reduction in ecological connectivity
- prevention of dispersal and access to resources
- restriction of fauna movement during fires
- separation, isolation and changes of populations and faunal communities resulting in loss of genetic diversity
- changes to predator behaviour such as preferential predation along fence lines
- changes to feral animal abundance and distribution
- changes in anti-predator behaviour in prey species.

To determine existing fauna values, a number of baseline environmental investigations were undertaken. Results from baseline investigations were used to calculate fauna habitat loss from the Proposal.

The predicted residual impacts of the Proposal on Terrestrial Fauna include:

1. Disturbance of up to 816 ha of fauna habitat with approximately:
    - 373.8 ha for re-chaining (if necessary) of previously chained areas
    - 248.6 ha of grading within chained areas, where the inner graded fire track will be used preferentially where possible
    - 146.0 ha of chaining within uncleared vegetation
    - 41.6 ha (5%) of permanent grading (for a 6 m wide access track) within uncleared vegetation
    - 6.0 ha for water diversion turnouts for erosion control.
2. Low mortality of a low number of emus and kangaroos through entanglement in the proposed barrier fence.
3. Potential loss of up to 103 potential habitat trees within uncleared vegetation located in the Salmon Gum area.
4. Loss of connection of vegetation remnants inside the proposed barrier fence with areas outside the agricultural areas:
    - fifteen vegetation remnants were identified as potentially being isolated with three of these being less than 1500 ha in size, small enough to suffer population decline of Western Brush Wallabies due to genetic isolation; and one of these remnants having little connection with other remnants in the agricultural region.
5. Uncertain risk to the Critically Endangered Western Ground Parrot as the Proposal alignment is outside (approximately 2 km from) the known occurrence of the species.

After the application of mitigation and management measures, the Proposal is expected to meet the EPA objective for Terrestrial Fauna.

Heritage

The ESD recognised the potential for Heritage to be affected during construction and ongoing maintenance of the proposed barrier fence. The potential direct and indirect impacts relate to the loss or disturbance to heritage values from:

- physical disturbance of cultural sites and artefacts from the installation of the proposed barrier fence
- physical disturbance through the action of chaining to remove vegetation for the fire protection zone around the proposed barrier fence
- installation of a physical barrier preventing animal movement across the landscape and disrupting ecological connectivity
- installing the proposed barrier fence across the three river systems preventing movement of fauna and people resulting in a ‘broken songline’.

Two heritage survey reports prepared by Dr James Taylor (2015) and Applied Archaeology Australia (2015) were used to inform the potential for sensitive cultural material along the Proposal alignment. The results from the heritage survey reports were then used to inform the final Proposal alignment route.

The predicted residual impacts of the Proposal on Heritage include:

- ground disturbance potentially damaging buried artefacts within 18 cultural areas–in all cases, the disturbance will be within existing cleared farm land, vehicle tracks or previously chained areas (one cultural area only)
- ground disturbance within two Registered Heritage sites and two lodged heritage sites within previously disturbed areas
- the potential loss of cultural plants along the Proposal alignment from chaining activities (unable to be assessed through the confidentiality of the identified cultural plants)
- fauna deaths of emus and kangaroos that become entangled in the proposed barrier fence.

After the application of mitigation and management measures, the Proposal is expected to meet the EPA objective for Heritage.

Offsets

No significant residual impact on Flora and Vegetation, Terrestrial Fauna or Heritage was identified following the impact assessment undertaken in this PER. No offsets are proposed as part of this Proposal.

A summary of potential residual impacts, mitigation and assessment against the EPA objectives for key preliminary environmental factors (Flora and Vegetation, Terrestrial Fauna, Heritage and Offsets) is provided in Table ES 1.

Table ES 1: Summary of impacts, mitigation and assessment

Inherent Impact	Environmental Aspect	Mitigation actions to address residual impacts	Proposed regulatory mechanisms for ensuring mitigation	Outcome to demonstrate that Proposal meets EPA objective
Flora and Vegetation - To maintain representation, diversity, viability and ecological function at the species, population and community level.				
Context/key survey findings • eighty-nine vegetation types were identified within the Ecoscape (2017a) study area for the Proposal • vegetation condition ranged from Degraded to Pristine but was predominantly Very Good or better in condition • Vegetation Associations 512, 4801, 47 have 10–30% of their Pre-European extent remaining at various scales • 60 Priority Flora were recorded in the Ecoscape (2017a) study area, an additional Priority 3 taxon *Hibbertia hamata* was identified from the Merivale Rd (UCL) section by GS Biologic (2015) • twenty-six introduced flora (weed) species were recorded by Ecoscape (2017a), including three species which are Declared Pest species under the *Biosecurity and Agriculture Management 2007* (BAM Act). Impacts without mitigation • direct clearing of native vegetation during construction • the introduction and spread of weeds • the introduction and spread of *Phytophthora cinnamomi* • fragmentation of vegetation • change in fauna aided seed dispersal.	Clearing of native vegetation.	Avoidance: • altering 89.5% of the Proposal alignment length to utilise existing linear disturbance areas such as existing fire management breaks and already cleared areas within private property for farm boundary fences • Proposal alignment avoids instances of Threatened Flora in previously uncleared areas • Proposal alignment has unfenced areas associated with the three main river systems and coastal corridor to retain ecological connection with vegetation on both sides of the proposed barrier fence. Minimisation • minimising the width of the clearing footprint to 15–20 m • only bare earth clearing a width of 6 m and chaining the remaining 9–14 m disturbance width within the clearing footprint within previously disturbed areas • preparation and implementation of the following plans during construction and operation of the proposed barrier fence: 1. Construction Management Plan (CMP)–action items to include: • delineating the fence reserve boundary via pegging to provide accuracy to the limits of the allowable clearing lines • pre-clearing survey of unsurveyed areas to identify potential Declared Pests or Weeds of National Significance (WONS), and Threatened and Priority flora species prior to installation of the proposed barrier fence. 2. Phytophthora Dieback Management Plan (PDMP)–action items to include: • implementation of vehicle/soil hygiene measures. 3. Weed Hygiene Plan (WHP)–action items to include: • implementation of vehicle/soil hygiene measures. Residual impacts • disturbance of up to 816 ha of native vegetation with approximately 373.8 ha for re-chaining (if necessary) of previously chained areas, 248.6 ha of grading within chained areas, 146.0 ha of chaining within uncleared vegetation, 41.6 ha of permanent clearing within uncleared vegetation and 6 ha for water diversion turnouts (predicted residual impacts from water turn outs are presented in Table 9-14) • fragmentation and localised edge effects along the 69.3 km of the Proposal alignment that is within uncleared vegetation • loss of approximately 28.1 ha of Vegetation Association 47, 64.2 ha of Vegetation Association 512, and 3.6 ha of Vegetation Association 4801, of which only 1.2 ha of Vegetation Association 4801 required to be chained/graded is within uncleared vegetation (the remainder is within previously chained areas) • 655 m Proteaceae Dominated Kwongkan Shrubland TEC (0.87 ha) to be re-chained within an existing and recently re-chained firebreak • clearing of 36 species of Priority Flora, with only 11 of these species located in uncleared vegetation–the other 25 are located in previously disturbed areas and are resilient to ongoing disturbance from chaining.	Future Ministerial Statement under EP Act.	Following the application of mitigation measures outlined in Section 9.5, the Proposal is expected to result in the removal of up to 816 ha of native vegetation, with only 23.0% (187.6 ha) of the maximum clearing footprint being new disturbance (i.e. in previously uncleared areas). The Proposal can be managed to meet the EPA objective for Flora and Vegetation through the implementation of key mitigation strategies such as: 1. Minimising clearing of native vegetation by reducing the clearing footprint width. 2. Adjusting the Proposal alignment to avoid areas of conservation significance. 3. Positioning 89.5% the proposed barrier fence length in existing disturbance areas to minimise isolation of vegetation. 4. Where the Proposal alignment intersects uncleared vegetation, the Proposal alignment has been adjusted to avoid any records of Threatened Flora species. The Proposal will also be managed through the implementation of a CMP, PDMP and WHP to avoid or minimise impact on Flora and Vegetation. In addition, the future Ministerial Statement under the EP Act will also be used to manage the potential impacts to Flora and Vegetation from the Proposal. These mitigation strategies are expected to be effective in mitigating potential impacts to Flora and Vegetation. The 655 m (0.87 ha) of Proteaceae Dominated Kwongkan Shrubland TEC to be re-chained as part of the Proposal. The TEC may regrow, but will be subject to future rechaining events. The TEC is located within existing and recently re-chained firebreak and; therefore, located within a previously disturbed area. There is no loss of this TEC as part of this Proposal. There will also be no new clearing records of four Threatened Flora species (*Conostylis lepidospermoides*, *Anigozanthos bicolor* subsp. *Minor* (located in previously chained areas in the clearing footprint), *Eucalyptus merrickiae*, *Rhizanthella gardneri*) located within 100 m of the Proposal alignment. The loss of approximately 28.1 ha of Vegetation Association 47, 64.2 ha of Vegetation Association 512, and 3.6 ha of Vegetation Association 4801 is not expected to significantly change the percentage remaining of these Vegetation Associations in the region. The majority of the clearing required for these vegetation associations is within previously chained areas and; therefore, does not represent a new impact. Only 1.2 ha of Vegetation Association 4801 required to be chained/graded is within uncleared vegetation. The remaining and ongoing disturbance of these three Vegetation Associations will result from re-chaining not from grading. Total predicted residual impacts to the mapped extent of local vegetation types (which include water turnout diversions) are less than 20% and; therefore, no significant impacts to vegetation at a local or regional scale is expected from the Proposal. The Proposal will not result in significant residual impacts to any conservation significant flora species, vegetation community or ecosystems. No significant impact on the representation, diversity, viability and ecological function of vegetation and flora is anticipated at the species, population and assemblage level. No significant residual impacts are anticipated and offsets for Flora and Vegetation are; therefore, not required as part of this Proposal.
Terrestrial Fauna - To maintain representation, diversity, viability and ecological function at the species, population and assemblage level.				
Context/key survey findings • eight fauna habitats were identified across the Proposal alignment (Ecoscape 2017a) • habitat condition ranged from Very Good to Completely Degraded • three threatened species recorded within the vicinity of the Proposal alignment: i. Malleefowl (*Leipoa ocellata*) ii. Western Quoll or 'Chuditch' (*Dasyurus geoffroii*) iii. Carnaby's Black Cockatoo (*Calyptorhynchus latirostris*) • three Priority 4 species observed across the Proposal alignment, and one Migratory species • one species was identified to likely utilise the area within the Proposal alignment but were not observed:	Clearing of habitat and the physical barrier to fauna movement.	Avoidance • altering 89.5% of the Proposal alignment length to utilise existing linear disturbance areas such as existing fire management breaks and already cleared areas within private property for farm boundary fences • avoid or minimise impacts to habitat features of conservation significant habitat features (such as Malleefowl mounds and potential habitat trees) based on outcomes of searches • Proposal alignment has unfenced gaps associated with the three main river systems to maintain the identified ecological corridors in the region • Proposal alignment has been modified to reduce the number of bottlenecks/acute angles that emus may aggregate in. Minimisation • reducing the total clearing footprint to a 15–20 m width • the dimensions of the mesh used in constructing the proposed barrier fence will be wide enough to enable the majority of fauna to pass through	Future Ministerial Statement under EP Act.	Following the application of mitigation measures outlined in Section 10.5, the Proposal is expected to result in the removal of up to 816 ha of native vegetation, with only 23.0% (187.6 ha) of the clearing footprint located in uncleared vegetation. The Proposal can be managed to meet the EPA objective for Terrestrial Fauna through the implementation of key mitigation strategies including reducing the clearing footprint for the Proposal, avoidance of the use of electric or barbed wire fencing in Proposal design, and utilising existing disturbance areas along 89.5% of the length of the Proposal alignment, and adjusting the Proposal alignment to minimise isolation of fauna habitat. The number of fluorescent orange fence droppers will be doubled (two droppers 2.3 m apart between the star pickets which are 7 m apart) along approximately 115 km of Proposal alignment near the Western Ground Parrot habitat at the border of Cape Arid NP to mitigate risk of collision. The Proposal will also be managed through the implementation of a CMP and PPCMP to avoid or minimise impact on Terrestrial Fauna. In addition, the future Ministerial Statement under the EP Act will also be used to manage the potential impacts to Terrestrial Fauna from the Proposal. These mitigation strategies are expected to be effective in mitigating potential impacts to Terrestrial Fauna.

Inherent Impact	Environmental Aspect	Mitigation actions to address residual impacts	Proposed regulatory mechanisms for ensuring mitigation	Outcome to demonstrate that Proposal meets EPA objective
i. Red-tailed Phascogale (*Phascogale calura*) • four macro corridors likely to be used by fauna: i. Fitzgerald River NP to Cape Arid NP ii. Oldfield River iii. Young River Corridor iv. Lort River Corridor • the Western Ground Parrot occurs in the Cape Arid NP but its range is not intersected by the Proposal alignment. <u>Impacts without mitigation</u> • direct clearing of habitat during construction • fragmentation of habitat • fauna collisions with Proposal alignment resulting in entanglement and death • loss of genetic diversity • no significant impact on any conservation significant fauna.		• number of fluorescent orange fence droppers to be doubled (two droppers 2.3 m apart between the star pickets which are 7 m apart) along approximately 115 km of Proposal alignment near the Western Ground Parrot habitat at Cape Arid NP to mitigate risk of collision–an existing farm boundary fence will be replaced with a high visibility barrier fence for this section • no barbed or electrical wire to be used in constructing the propose barrier fence • use of high visibility fluorescent marker to reduce risk of fauna collisions with the proposed barrier fence • monitoring and prevention of public access • replacing existing farm boundary fences with a high visibility fence for 129.4 km • preparation and implementation of the following plans during construction and operation of the proposed barrier fence: 1. CMP–action items to include: • no clearing of native vegetation between August and November for sections of the Proposal alignment that is adjacent to Cape Arid NP to minimise impacts on breeding and juvenile birds • targeted searches for conservation significant fauna (such as Malleefowl mounds), including potential habitat trees and hollows, to be undertaken prior to clearing within any section of the Proposal alignment that has not been previously surveyed • any new mounds should also be readily detected during construction works and could be avoided • restriction of public access to the proposed barrier fence to minimise stress to animals • further contingency actions to be developed in consultation with DBCA and implemented in order to avoid or minimise impacts to significant fauna if identified during searches. 2. PPCMP–action items to include: • management actions that monitor feral animal abundance. 3. DPIRD Emu Mitigation Procedure to mitigate risk of emu migrations. <u>Residual impacts</u> • disturbance of up to 816 ha of native vegetation with approximately 373.8 ha for re-chaining (if necessary) of previously chained areas, 248.6 ha of grading within chained areas, 146.0 ha of chaining within uncleared vegetation, 41.6 ha of permanent clearing within uncleared vegetation and 6 ha for water diversion turnouts • mortality of a low number of emus and kangaroos through entanglement in the proposed fence • loss of connection of vegetation remnants inside the proposed barrier fence with areas outside the agricultural areas–fifteen vegetation remnants were identified as potentially being isolated with three of these being less than 1500 ha in size, small enough to suffer population decline of Western Brush Wallabies due to genetic isolation, and one of these having little internal connection with other remnants • loss of up to 103 potential habitat trees located in uncleared vegetation associated with the proposed alignment north of Salmon Gums township • uncertain risk to the Critically Endangered Western Ground Parrot as the Proposal alignment is outside (approximately 2 km from) the known occurrence of the species • local risk of increased predation along the 69.3 km of the Proposal alignment that does not follow existing disturbance areas.		The Proposal will not result in significant residual impacts to any conservation significant fauna species or the representation, diversity, viability and ecological function of fauna is anticipated at the species, population and assemblage level. No significant residual impacts or offsets are expected for Terrestrial Fauna.
Heritage – To ensure that historical and cultural associations, and natural heritage, are not adversely affected.				
<u>Context/key survey findings</u> • two surveys across the length of the Proposal alignment identified 37 cultural areas, 127 isolated finds, seven Registered Heritage Sites, and two lodged Heritage Sites intersecting with the Proposal alignment • thirty-seven cultural areas and the 127 isolated finds were mostly small stone artefact scatters • Proposal alignment avoids 19 of the cultural areas identified. <u>Impacts without mitigation</u> • loss or disturbance impacts to heritage values	Proposal construction and vehicle movements.	<u>Avoidance</u> • altering 89.5% of the proposed fence length to utilise existing linear disturbance areas such as existing fire management breaks and already cleared areas within private property • Proposal alignment re-aligns away from Registered Heritage Sites, or culturally significant areas where possible • Proposal alignment intersects with management boundary only and avoids locations of identified archaeological material	s 18 of the *Aboriginal Heritage Act 1972.*	Following the application of mitigation measures outlined in Section 11.5, the Proposal is expected to impact on 18 cultural areas and four Heritage Sites. The residual impacts are not significant as the Proposal alignment for all sites identified to be potentially impacted are located within previously disturbed areas. Chaining activities to reduce vegetation will not occur in identified cultural areas or Heritage Sites to remove any potential for impact on surface material. A total of 0.95 ha of uncleared bushland in Site 2396 will be cleared. The clearing in this Site is well away from its key archaeological/ethnographic feature. The Proposal alignment has been surveyed though this area by an archaeologist and Traditional Owners and no surface material was identified.

Inherent Impact	Environmental Aspect	Mitigation actions to address residual impacts	Proposed regulatory mechanisms for ensuring mitigation	Outcome to demonstrate that Proposal meets EPA objective
• physical disturbance of cultural sites and artefacts from the installation of the proposed barrier fence • physical disturbance through the action of chaining to remove vegetation for the fire protection zone • installation of a physical barrier preventing animal movement across the landscape and disrupting ecological connectivity • installing the proposed barrier fence across the rivers preventing movement of fauna and people resulting in a 'broken songline'.		• fence design has unfenced areas associated with the three main river systems and coastal corridor to retain ecological connection with vegetation on both sides of the proposed barrier fence. <u>Minimisation</u> • minimising the width of the clearing footprint to 15–20 m • use of high visibility fluorescent marker to reduce risk of fauna collisions with the proposed barrier fence <u>Residual impact</u> • ground disturbance potentially damaging buried artefacts within 18 cultural areas (or their management boundaries) and four Heritage Sites i. eight cultural areas will have the edge of their management boundary disturbed but only on existing cleared freehold land ii. three cultural areas will be disturbed on farm land (an already highly modified landscape) by replacing an existing fence iii. the management boundary of four cultural areas would be disturbed but on an existing firebreak iv. one Site will be disturbed within a previously chained area v. minor disturbance of two sites that identified artefact scatters • two Registered and two Lodged Aboriginal Heritage Sites may be impacted by the Proposal alignment located within previously disturbed areas • the potential loss of cultural plants along the Proposal alignment from chaining activities (unable to be assessed through the confidentiality of the identified cultural plants) • deaths of emus and kangaroos which become entangled in the proposed barrier fence.		Approval under s 18 of the *Aboriginal Heritage Act 1972* (AH Act) will be sought for any Registered Heritage Site that may be disturbed. If the s 18 applications are not supported or approved then the Proposal may be stopped at those sites by DPIRD and recommence after the site. No significant impact on heritage values is expected and; therefore, no offsets for Heritage are required.
Offsets - To counterbalance any significant residual environmental impacts or uncertainty through the application of offsets.				
No significant residual impact on vegetation and flora, fauna or heritage was identified following the impact assessment undertaken in this PER. No offsets are proposed as part of this Proposal.	Residual environmental impacts have been determined through the assessment in alignment with the WA Environmental Offsets guidelines.	Not applicable.	Not applicable.	Not applicable.

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Appendix 1 Environmental Scoping Document

Appendix 2 WA Wild Dog Action Group Consultation Report September 2015

Appendix 3 Supporting environmental studies:

- Department of Agriculture and Food Western Australia (DAFWA) 2016e, *Recommended General Erosion Mitigation Strategies for the State Barrier Fence Esperance Extension,* Government of Western Australia
- Department of Agriculture and Food Western Australia (DAFWA) 2016f, *Erosion assessment of the proposed extension of the State Barrier Fence in the Esperance Region,* Government of Western Australia
- Ecoscape 2016, *State Barrier Fence Esperance Extension Assessment of the Eucalypt Woodlands of the Western Wheatbelt Threatened Ecological Community,* letter from Stephen Kern (Ecoscape) to Mat Stadler (Department of Agriculture and Food Western Australia), Reference 10595-3640-16R, 19 February 2016
- Ecoscape 2017a, *State Barrier Fence Biological Surveys,* 9309-3087-13R Rev 2, report prepared for Department of Agriculture and Food Western Australia, March 2017
- Ecoscape 2017b, State Barrier Fence SRE Database Searches (WAM) Results and Interpretation, report prepared for Strategen, May 2017
- Everard, C & Bamford M 2016, *Risk assessment of the proposed extension to the State Barrier Fence on the Brush Wallaby*, M.J. & A.R. Bamford Consulting Ecologists, 13 May 2016
- GHD 2012, *Report for State Barrier Fence Esperance Extension Scoping Study,* report prepared by GHD Pty Ltd for Department of Agriculture and Food Western Australia, September 2012
- Glevan Consulting (Glevan) 2015, *AGR2013058 – State Barrier Fence Esperance Extension Phytophthora Dieback occurrence assessment – Version 2.0,* report prepared for Ecoscape Australia Pty Ltd
- Great Southern Bio Logic (GS Bio Logic) 2015, *Biological Surveys of the State Barrier Fence – Merivale Road Reserve Realignment – Cape Arid,* report prepared for Department of Agriculture and Food Western Australia, 28 September 2015
- GS Biologic (2017) *Assessment of significant trees along identified sections of the SBF near Salmon Gums,* letter report prepared for Department of Agriculture and Food, , reference: GSBL306-SBF sig tree assessment-V1, 24 July 2017
- Precision Technology Solutions (PTS) 2016, DAFWA Proposed Barrier Fence Survey Sections Erosion Hotspot Survey Report, Esperance, Western Australia

Appendix 4 Summary of vegetation types (Ecoscape 2017a)

Appendix 5 Weed Hygiene Plan

Appendix 6 Predator and Pest Control Management Plan

1. Introduction

1.1 Proposal overview

1.1.1 Location and description

The Department of Primary Industries and Regional Development, Agriculture and Food Division (DPIRD, formerly DAFWA[2]), on behalf of the agricultural industries in the Shires of Ravensthorpe and Esperance, propose to extend the existing State Barrier Fence (SBF) from its current termination point 25 km east of Ravensthorpe, north to Salmon Gums and ending east of Esperance near Cape Arid National Park [NP] in Western Australia (WA) (the Proposal; Figure 1-1). The Proposal aims to protect agricultural enterprises in the Shires of Ravensthorpe and Esperance from the socio-economic impacts resulting from wild dogs limiting livestock enterprises, and damage to crops and pasture from emus and kangaroos in the agricultural region.

The Proposal involves the construction of a 660 km long and 1.35 m high barrier fence that is largely impermeable to wild dogs, emus and kangaroos (target fauna). The proposed barrier fence will have three unfenced gaps where the Proposal alignment intersects three major waterways, and a 3.2 km wide unfenced coastal corridor near Cape Arid NP (Figure 1-2). These gaps in the proposed barrier fence will maintain significant ecological corridors.

The Proposal alignment follows the boundary between agricultural land and Unallocated Crown Land (UCL) in the Great Western Woodlands, with approximately 529 km of the Proposal alignment to be located on UCL and a further 131 km on private farming property (Figure 1-2, Table 4-2)[3].

The following terms are used throughout this document:

- Proposal alignment: the route chosen for the proposed barrier fence
- Development Envelope: the approximate 100 m wide corridor within which the proposed barrier fence would be constructed
    - note that in some areas, the Development Envelope varies in width to greater than 100 m to ensure previously disturbed areas, such as existing tracks and existing farm boundary fences, are within the Development Envelope - this allows for flexibility to install the proposed barrier fence in these areas if possible if on-ground constraints prevent the Proposal alignment from being positioned in its current location
- clearing footprint: the 15–20 m wide disturbance footprint that will be required to construct the proposed barrier fence including maintenance tracks and a previously chained[4] firebreak by Department of Biodiversity Conservation and Attractions[5] (DBCA) for fuel management.

1.1.2 Proposal alignment

The Proposal alignment is approximately 660 km long and terminates adjacent to the Cape Arid NP and leaves 3.2 km between the termination point of the Proposal and the coast. The initial option for the Proposal alignment considered by DPIRD was approximately 450 km long and did not accurately follow the boundary of the agricultural area thereby isolating large sections of the Great Western Woodlands (URS 2007).

[2] Now Department of Primary Industries and Regional Development (DPIRD). The former agency name has been retained for this PER as the change occurred during drafting of the final document.

[3] Proposal alignment kilometre lengths are current as of the time of preparation of this PER document.

[4] Chaining involves two bulldozers pulling a heavy chain across vegetation to clear trees and woody vegetation.

[5] Now Department of Biodiversity, Conservation and Attractions (DBCA). The former agency name has been retained for this PER as the change occurred during drafting of the final document.

The proposed barrier fence has unfenced gaps associated with the following watercourses that intersect the Proposal alignment (Figure 1-2):

- Oldfield River (approximately 1 km wide gap in the Proposal alignment)
- Young River (approximately 400 m wide gap in the Proposal alignment)
- Lort River (approximately 2 km wide gap in the Proposal alignment).

The Proposal alignment also intersects a minor creekline (Thomas River) located in the far southeast portion of the alignment, adjacent to Cape Arid NP (Figure 1-2).

The Thomas River crossing is located on freehold land in a highly disturbed area next to concrete culverts and adjacent to Merivale Road. An existing private farm boundary fence currently crosses Thomas River and no additional clearing is required for this area.

The current route for the Proposal alignment has been chosen to:

- minimise the overall clearing of native vegetation required
- avoid conservation significant flora and fauna habitat
- minimise disturbance to Aboriginal heritage and management boundary sites where possible
- provide protection to the full extent of the agricultural area
- avoid creating fauna traps/acute angles outside the proposed barrier fence (i.e. areas of vegetation with fence on three sides).

1.1.3 Development Envelope

The Proposal will be constructed within an approximate 8139 ha Development Envelope that represents the corridor within which the 816 ha clearing footprint will be located. The Development Envelope is up to approximately 100 m wide to enable some flexibility regarding the precise location of the Proposal alignment during construction. In some areas, the Development Envelope varies in width to greater than 100 m to ensure previously disturbed areas, such as existing tracks and existing farm boundary fences, are within the Development Envelope. This allows flexibility to install the proposed barrier fence on previously cleared areas if on-ground constraints prevent the Proposal alignment being placed in its current position, as well as reducing the native vegetation clearing footprint to produce a better environmental outcome.

In areas where environmental constraints have been identified (e.g. Aboriginal heritage sites, or conservation significant flora and fauna species) the Development Envelope is narrower to ensure avoidance of these areas and to protect these values.

Currently, the Proposal alignment allows for 129.4 km of the proposed barrier fence length to replace existing farm boundary fences on private farming property with an additional 1.5 km of fenceline proposed through uncleared areas on private property to avoid a salt lake and Aboriginal place. The extent of the Development Envelope has been expanded in locations where the Proposal alignment located in UCL has the potential to be located on adjacent private property. This allows flexibility for private farm land owners to request the Proposal alignment be placed onto their property without the Proposal being re-assessed. Allowing the Proposal alignment to be placed from UCL to private, cleared farm land boundaries results in less native vegetation being cleared and; therefore, produces a better environmental outcome. However, any changes from UCL to private properly in the Proposal alignment will undergo pre-clearing surveys and assessments, and will seek formal agreement between the landowner and DPIRD Director General before the proposed barrier fence is re-aligned onto private property.

1.1.4 Maximum clearing footprint

The Proposal requires a 15–20 m wide cleared area to construct the proposed barrier fence, maintenance tracks and chained firebreak within the Development Envelope. The maximum clearing footprint is 816 ha. Where possible, the clearing footprint will be located within previously cleared area such as existing tracks or firebreaks, or will replace existing private farm boundary fences (Figure 1-2). This 816 ha maximum clearing footprint includes 6 ha for the construction of water turnouts for erosion control.

The maximum clearing footprint is further described in Section 4.3 and includes:

- 146.0 ha (17.9%) chaining within uncleared vegetation
- 373.8 ha (45.8%) re-chaining of previously chained areas
- 41.6 ha (5.1%) of permanent grading (for a 6 m wide access track) within uncleared vegetation
- 248.6 ha (30.5%) grading (full clearing) within previously chained areas but utilising existing graded tracks where possible.

Water turnout locations (comprising a maximum 6 ha or approximately 0.7% of the maximum clearing footprint) will be determined during construction and will only be required where necessary based on the potential for erosion and the state of erosion on any existing tracks.

1.2 Existing State Barrier Fence

The Proposal will extend the existing SBF to the southeast portion of the agricultural region to provide the same level of protection and social and economic benefits that the rest of the agricultural land in WA receives from the existing SBF (Figure 1-1). The Proposal provides a physical barrier to restrict target fauna movement from the rangelands into the grain producing and livestock agricultural lands of the southeast land division in WA.

The first barrier fence (rabbit proof fence) in WA was constructed in 1901 to stop rabbits spreading from South Australia. The rabbit proof fence extended from the coast at Jerdacuttup, near Ravensthorpe, 1822 km to 80-Mile Beach north of Port Hedland. Several additional versions and variations to the original rabbit proof fence were constructed following the expansion of agriculture, to assist with the control of rabbit, emu and wild dog populations. While historical barrier fences were unsuccessful in preventing the spread of rabbits, the existing SBF has proved successful in limiting the impact of target fauna on agricultural enterprises.

The existing SBF currently runs for 1190 km starting north of Kalbarri on the coast at Zuytdorp Cliffs to 25 km east of Ravensthorpe. In late 2014, 170 km of new SBF was constructed to fill a 50-year gap in the existing SBF (the 'Yilgarn Gap') located between Southern Cross and Hyden (Figure 1-1).

1.3 Environmental assessment process

The Proposal is currently being assessed under the Western Australian *Environmental Protection Act 1986* (EP Act). The Proposal was referred to the Environmental Protection Authority (EPA) under s 38 of the EP Act on 10 June 2016. The EPA determined a Public Environmental Review (PER) level of assessment (Assessment No. 2088) for the Proposal on 1 September 2016 with a 4 week public review period. The PER process is summarised in (Figure 1-3).

The Proposal was referred to the Department of the Environment and Energy (DEE) (formerly Department of the Environment [DotE]) under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) on 23 June 2016 (EPBC 2016/7722). The referral addressed the potential loss of foraging habitat for Carnaby's Black Cockatoo (*Calyptorhynchus latirostris*, Endangered), the risk of collision with the proposed barrier fence by *Pezoporus flaviventris* (Western Ground Parrot; Critically Endangered) and potential impacts to Threatened Flora species *Conostylis lepidospermoides* (Endangered) and *Eucalyptus merrickiae* (Vulnerable), in locations that were recently cleared (chained) by DBCA for fire breaks as part of the Esperance emergency fire response of November 2015. One hectare of previously cleared Proteaceae Dominated Kwongkan Shrublands Threatened Ecological Community (TEC) was also identified to be potentially disturbed in an existing firebreak. DEE determined that the Proposal was 'not a controlled action' on 4 August 2016.

Under the *Environmental Impact Assessment (Part IV Divisions 1 and 2) Administrative Procedures 2012* (the Administrative Procedures; GoWA 2012), the EPA prepared an Environmental Scoping Document (ESD) identifying the preliminary key environmental factors to be addressed in the PER and the work required to inform the assessment of the environmental impact of the Proposal. A draft ESD was issued to DPIRD on 28 September 2016.

Detailed biological surveys, including flora, fauna and dieback assessments, were undertaken by Ecoscape (2017a; 2017b), Glevan (2015) and Great Southern Bio Logic (GS Bio Logic) (2015; 2017). These surveys were required to provide baseline environmental data to be submitted by DPIRD to the EPA and DEE as a part of Proposal reviews and appraisal processes.

The EPA prepared an ESD (included in Appendix 1) identifying the following preliminary key environmental factors required to be assessed in the PER document:

1. Flora and Vegetation.
2. Terrestrial Fauna.
3. Heritage.
4. Offsets.

The final ESD was provided to DPIRD on 27 October 2016 (Appendix 1).

In the period between the referral of the Proposal in June 2016 and the submission of the draft PER in January 2017 the Proposal Development Envelope has increased by 2866 ha from 5313 ha to 8139 ha, and the maximum clearing footprint has decreased by 27 ha, from 843 ha to 816 ha. In a letter dated 28 February 2017 responding to the draft PER, the DWER recommended DPIRD submit a request to seek EPA consent to the proposed changes without a revised proposal being referred under Part IV of the EP Act pursuant to s 43A of the EP Act. On 29 May 2017, DPIRD received a Notice of decision to consent to the change to proposal during assessment from the EPA; this PER document includes the updated amendments.

The change to the Proposal and rationale for the proposed change has been provided in Table 1-1.

Table 1-1: Proposed changes to the Proposal

Proposal component	Referral	Proposed change	Rationale for proposed change
Proposal alignment	660 km	No change	N/A.
Maximum clearing footprint	843 ha	816 ha	Following recent requests from the relevant adjacent landholder, a total of 19 km of the Proposal alignment previously located on Unallocated Crown Land (UCL) has been adjusted to replace existing farm boundary fences on private property. This means a 15 m wide clearing area required for this 19 km length of the Proposal alignment, comprising approximately 28 ha, is no longer required. Another four locations along the Proposal alignment require additional clearing of a total of up to approximately 1.0 ha that had not been previously identified in the referral, all associated with minor and narrow sections of roadside vegetation. Given the reduced overall clearing footprint and negligible extent of 'new' clearing, no significant adverse changes to the currently predicted outcomes for environmental factors (flora and vegetation, heritage and terrestrial fauna) were expected.

Proposal component	Referral	Proposed change	Rationale for proposed change
Development Envelope	5313 ha	8139 ha	An increase of 2826 ha is requested to allow improved flexibility in the final position of the alignment. The scale of the proposed additional area is due to the Development Envelope corridor being widened to more than 100 m in some areas along the alignment's 660 km length. The widening is intended to provide flexibility by encompassing existing tracks and other previously cleared areas. Only existing disturbed areas are proposed to be utilised in the event any unexpected on-ground constraints (e.g. geotechnical, environmental or heritage) are identified during pre-construction which render construction of any sections of the fence unviable at the currently mapped location. The change in width does not introduce any significant new risks or environmental factors not already addressed under the referral and scoping stages, as assessed in the PER.

1.4 The Proponent

The Proponent for the Proposal is DPIRD. DPIRD supports the economic development of the agriculture and food sector in WA and are acting on behalf of the agricultural and livestock industries in the southeast of WA for this Proposal.

Proponent details:

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Key contact:

Matt Stadler
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Department of Primary Industries and Regional Development, Agriculture and Food Division
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1.5 Purpose and scope of this document

The purpose of this document is to present an environmental review of the Proposal, including a detailed description of the key components, environmental impacts and proposed environmental management measures for the relevant environmental factors identified by the ESD (Appendix 1).

This PER describes the specific studies and investigations conducted by DPIRD in relation to the preliminary key environmental factors identified in the ESD, as well as those identified through consultation and screening processes. The objectives of the reviews and additional studies and investigations are to:

- ensure that the full environmental effects of the Proposal are properly understood
- inform mitigation and optimal management controls
- enable a reliable and knowledge-based environmental impact assessment to be conducted.

This document has been prepared in accordance with the EPA *Guidelines for Preparing a Public Environmental Review* (EPA 2016a) to fulfil the requirements of a PER document. This PER contains the following information:

- the proponent and a description of the Proposal (Section 1)
- key characteristics of the Proposal (Section 4)
- existing environment (Section 7)
- assessment of preliminary key environmental factors (Sections 9, 10, 11 and 12)
- environmental studies and survey effort (Section 8)

- environmental management (Section 13.1)
- stakeholder consultation (Section 6)
- conclusions (Section 13).

The appendices contain copies of relevant technical study reports referenced in this PER and Geographical Information System (GIS) data files. These can be found on a data CD/DVD-ROM inside the back cover of this report or on the disc containing the electronic version of this PER document.

The assessment of the potential significant impacts is summarised in Table 13-2, which includes the environmental objective for the key factors in accordance with *Environmental Assessment Guideline 8: Environment Principles, Factors and Objectives* (EAG8) (EPA 2015a). Since the referral of the Proposal, and the release of the ESD, the EPA has published revised instructions on administration procedures. After 13 December 2016, the EAG 8 guidelines have been superseded. However, consistent with EPA advice for this transitional period this PER has been prepared in accordance with the requirements set out in the ESD.

1.6 Identification of key factors and their significance

On the basis of the EPA *Environmental Assessment Guideline No. 8: Environmental Principles, Factors and Objectives* (2015a) the ESD (Appendix 1) identified the preliminary key environmental factors.

1. Flora and Vegetation.
2. Terrestrial Fauna.
3. Heritage.
4. Offsets.

Table 1-2 identifies environmental factors, objectives and associated potential impacts described in the ESD.

Potential impacts, mitigation and management measures and the proposed regulatory mechanisms for each preliminary key environmental factor, and their relevant environmental studies, are presented in Sections 9, 10, 11 and 12.

Table 1-2: Environmental factors, objectives and associated potential impacts outlined in the ESD

Environmental factor	EPA objective	Potential impacts
Flora and Vegetation	To maintain representation, diversity, viability and ecological function at the species, population and community level.	Direct clearing of flora and vegetation during construction. Indirect impacts on flora and vegetation from: • the introduction and spread of weeds • the introduction and spread of *Phytophthora cinnamomi* • fragmentation of vegetation • change in fauna aided seed dispersal.
Terrestrial Fauna	To maintain representation, diversity, viability and ecological function at the species, population and assemblage level.	Direct impacts to fauna through collisions and entrapment with the fence. Direct and indirect impacts to fauna through the clearing of fauna habitat. Direct and indirect impacts to fauna from fragmentation of habitat and a reduction in ecological connectivity. Indirect impacts to fauna may occur as a result of: • prevention of dispersal and access to resources • restriction of fauna movement during fires • separation, isolation and changes of populations and faunal communities resulting in loss of genetic diversity • changes to predator behaviour such as preferential predation along fence lines • changes to feral animal abundance and distribution • changes in anti-predator behaviour in prey species.
Heritage	To ensure that historical and cultural associations, and natural heritage, are not adversely affected.	Loss or disturbance impacts to heritage values.
Offsets	To counterbalance any significant residual environmental impacts or uncertainty through the application of offsets.	Potential residual environmental impact on conservation significant flora and fauna populations and habitat.

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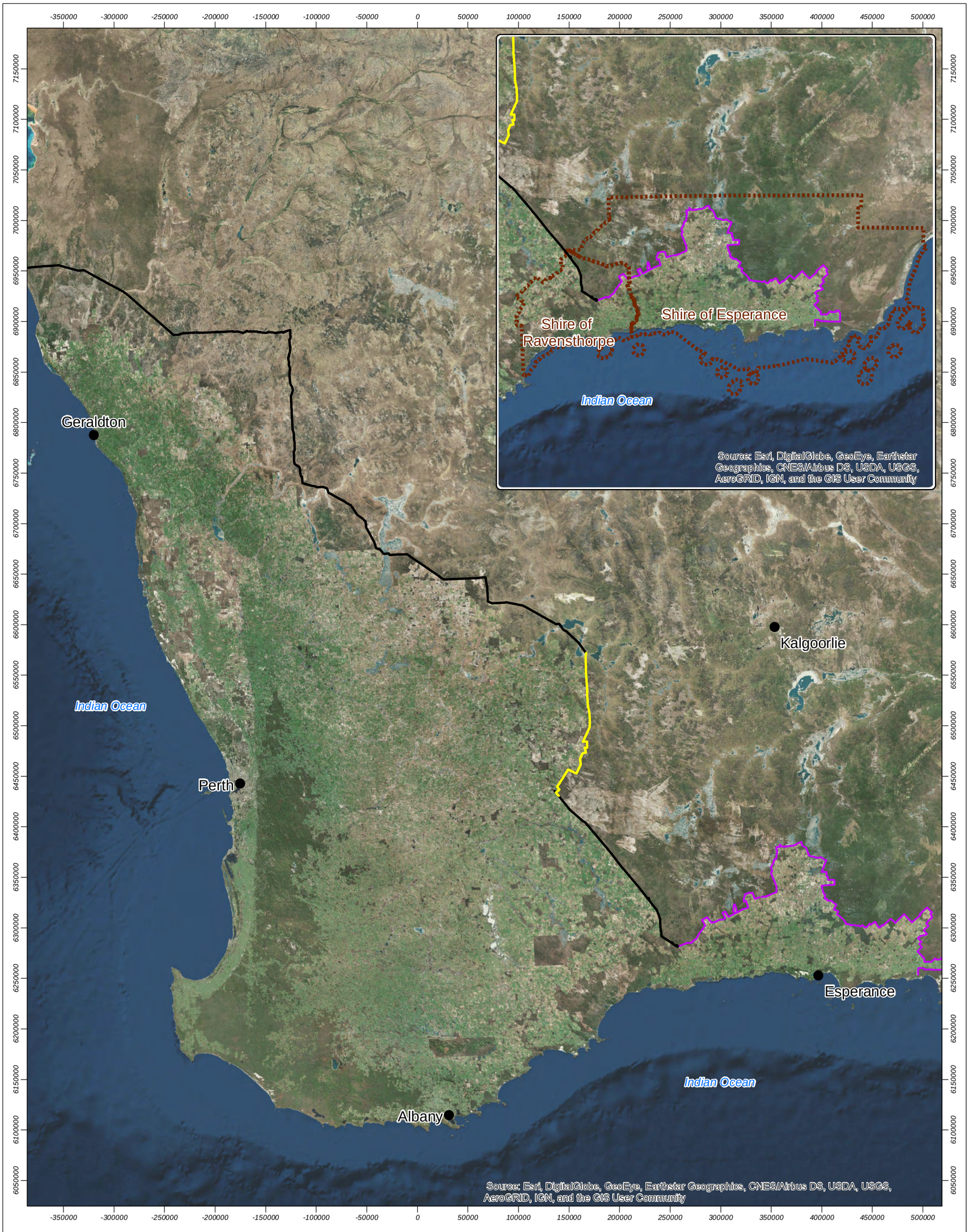


Figure 1-1: Proposal location and existing SBF

Scale 1:3,440,000at A3

0 50 100 150 200 250 km

Coordinate System: GDA 1994 MGA Zone 51
Note that positional errors may occur in some areas
Date: 1/08/2017
Author: DWhite
Source: Aerial: ESRI approx. 2010; Data: Client 2016

Legend

- Major town
- Existing SBF
- Yilgarn Gap
- Proposal alignment



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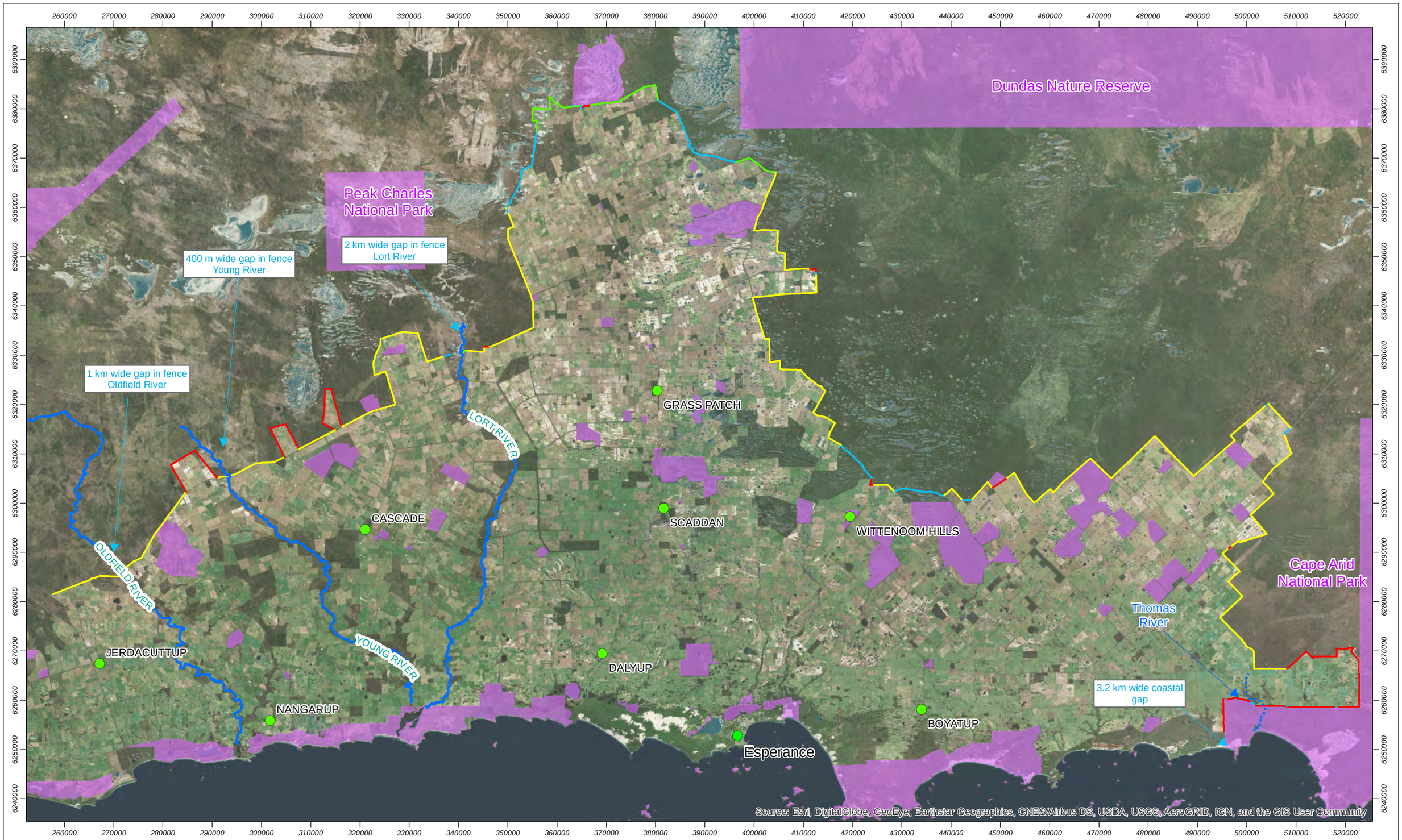


Figure 1-2: Existing environment condition along the Proposal alignment

Scale 1:708,000 at A3

km
0 2 4 6 8 10

Coordinate System: GDA 1994 MGA Zone 51
Note that positional errors may occur in some areas
Date: 1/08/2017
Author: DWhite
Source: Aerial: ESRI approx. 2010; Data: Client 2016; Reserves: DPaW: 2012.

Path: Q:\Consult\2016\DAF\DAF16515\ArcMap_documents\R001\DAF16515_01_R001_RevE_F001-2.mxd

Legend

- Reserves
- Town
- Major watercourses
- Minor creekline
- **Proposal alignment existing environment conditions**
- Previously chained firebreak
- Existing track or graded firebreak
- Previously cleared freehold farmland
- Uncleared vegetation

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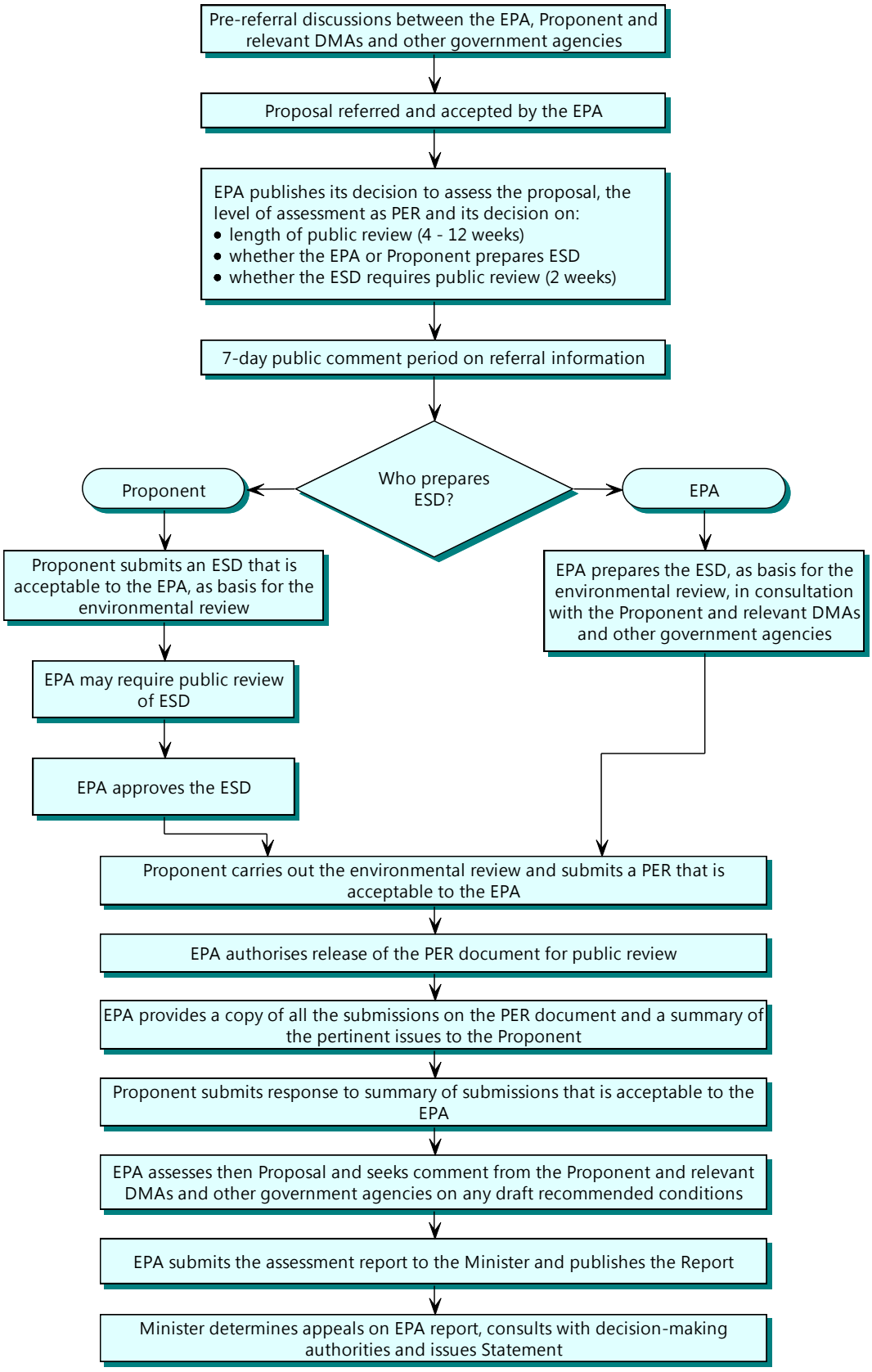


Figure 1-3: Public Environmental Review procedure

2. Benefits of Proposal

2.1 Requirements for the Proposal

The Proposal has been developed in response to socio-economic impacts on industry and communities in the agricultural region resulting from the damage caused to crops and pasture by periodic emu 'migrations' and kangaroos, and the impact of wild dogs on livestock enterprises. The Proposal aims to minimise socio-economic impacts (as detailed in Section 2.1.1 to Section 2.1.3) by providing a physical barrier along the boundary between agricultural land and UCL in the Great Western Woodlands to restrict the movement of target fauna from entering the agricultural region.

The Proposal integrates existing wild dog control practices implemented by Biosecurity Groups such as those referred to in the Western Australian Wild Dog Action Plan 2016–2021 (the Action Plan; WA WDAG 2016). The Action Plan identified completion of the existing SBF through the implementation of this Proposal as a high priority in the recommended actions (Appendix 2).

There will be no equivalent control of kangaroos and emus and populations of these species will continue to exist in the Esperance agricultural area as they do in the northern agricultural areas within the existing SBF.

2.1.1 Periodic emu 'migrations'

Emus move within their range according to climatic conditions. If sufficient food and water are present, emus will reside in one area. Where these resources are more variable, emus move as needed to find suitable conditions (Australian Museum 2016). These mass movement events have been referred to as emu 'migrations', where the birds are known to move hundreds of kilometres, sometimes at rates of 15 km to 25 km per day. These 'migrations' are not considered to be a natural occurrence, but are a consequence of the altered pastoral landscape with additional water sources enabling populations to build (Dr. Davies S [DBCA] 2016 pers. comm. no date). If large numbers of emus enter the agricultural region during these migrations they can cause significant damage by trampling crops and damaging fence infrastructure.

Migrations of large numbers of emus occur in WA when years of good rainfall lead to increases in the emu population. If those good rainfall years are followed by the failure of rains over consecutive seasons the emus mostly follow rain-bearing clouds and head southeast (i.e. not all into agricultural areas) seeking water sources and better environmental conditions. These emu 'migrations' occur on average every 7–11 years.

2.1.2 Kangaroo damage

The intrusion of kangaroos into agricultural land from UCL varies in intensity and duration with seasonal conditions and the availability of food and water on farms. Kangaroos have benefited from the improvement of pastures and the provision of year-round, reliable water supplies in the agricultural region. The damage caused by kangaroos throughout WA can be highly localised and very significant to individual primary producers. Kangaroos can cause damage to agricultural fences allowing livestock to move between paddocks and outside farming properties. Kangaroos also compete with domestic livestock for pasture and water; and graze and trample crops.

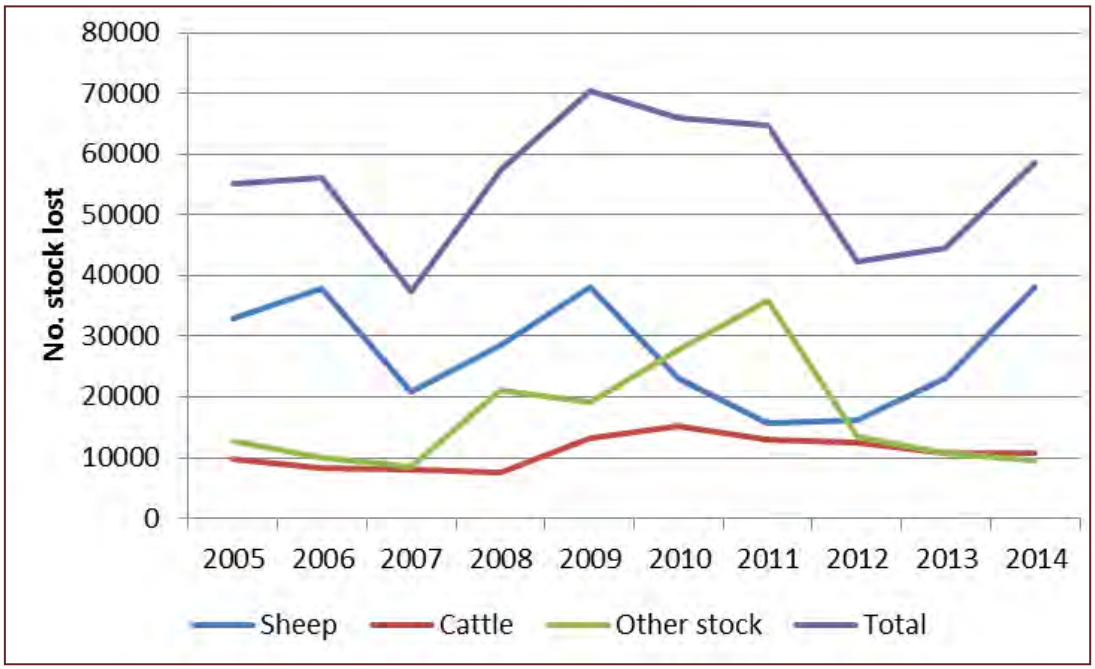
2.1.3 Wild dog impacts on livestock enterprises

The continuous risk that wild dogs pose for producers in the region deters many from investing or re-investing in livestock. Currently, there are 713 properties with sheep brands within 50 km of Proposal alignment. Many of these properties no longer run flocks of sheep, partially due to the risk of predation by wild dogs (DAFWA 2016a). For example, over a four month period in 2015, one property approximately 60 km east of Esperance lost 36 sheep and 40 were wounded by one wild dog in four separate attacks. Lambing rates on the property dropped 20% and the property owners were forced to relocate sheep off the property until the wild dog was destroyed approximately four months later. The owners reported additional costs in freight and time, and suffered significant emotional stress and anxiety from the attacks after dealing with mauled livestock (DAFWA 2016a).

Increasing pressure from wild dog predation has had a profound impact on stock production in some regions, and is recognised as a serious challenge for livestock producers from the Kimberley to Esperance as indicated in the Pastoral Lands Board (PLB) reports on stock losses (Figure 2-1; PLB [2015], as cited in the WA WDAG [2016]). The extent of the economic losses due to wild dog predation is difficult to quantify, particularly under the extensive rangeland grazing conditions in WA. The PBL annual returns from 2007 to 2014 show an increase in stock losses from $2.4 M to over $6.0 M across the WA Pastoral Region (WA WDAG 2016) (Figure 2-1).

In addition to direct impacts of predation, wild dogs can have indirect effects on stock including mismothering, injury and transmission of disease (the impact of diseases spread by wild dogs is difficult to quantify [WA WDAG 2016]).

Predation of livestock by wild dogs can have significant social impacts, causing considerable stress to individuals and communities affected by wild dogs. These impacts may include anxiety, sleep disruption and conflicts between community members (WA WDAG 2016). In addition, the total estimated damage caused by wild dogs in the Rangelands sheep industry was valued at $14 M annually (WA WDAG 2016). However, this cost does not include direct or indirect impacts to sheep in the agricultural region where approximately 87% of WA sheep occur.



Source: PLB Annual Returns as cited in WA WDAG (2016)

Figure 2-1: Reported stock lost to wild dogs across the rangelands of WA

2.2 Social and economic benefits

Barrier fences have been used extensively as a tool in mitigating human–wildlife conflict associated with predation of livestock (Treves & Karanth [2003] as cited in DAFWA [2016b]) and in conservation (Somers & Hayward 2011). For example, the Wild Dog Barrier Fence, and the Darling Downs Moreton Rabbit Fence maintained by the Queensland Government has been used to manage invasive pest species in Queensland since the 1880s (AEE 2015).

The existing SBF in WA has been demonstrated to be successful in limiting the impact of target fauna on agricultural enterprises. The WA sheep industry currently runs 14.2 million sheep which contribute a gross value of agricultural production (GVAP) of $992 M to the WA economy. This is 48% of WA's total livestock GVAP and comprises $410 M in meat and $582 M in wool. The impact of wild dogs on small livestock[6] enterprises was documented in 2007 in an independent Benefit-Cost Analysis report for the initial 450 km Proposal alignment (URS 2007). The impact of wild dogs on small livestock production in the WA agricultural region, where wild dogs occur, was estimated between $11–$18/ha (URS 2007).

The Proposal is estimated to allow landholders to increase current stocking rates by 10% for sheep in the area managed by the Southern Biosecurity Group (the existing SBF borders half of this region, with largely successful Licensed Pest Management Technicians [LPMT; Doggers] activities currently preventing most wild dogs from entering around the existing SBF) and by 40% in the area managed by the Northern Mallee (Esperance) Declared Species Group (WA WDAG 2016). The completion and modification of the existing SBF to prevent wild dogs entering agricultural areas could provide an annual benefit to agriculture of $4.4 M annually (URS 2007). Positive feedback was also received during a grower survey undertaken by DPIRD in 2013, which sought comments on the effectiveness of the existing SBF (DAFWA 2016c). Farmers and growers in general outlined that upgrades to the integrity of existing SBF were effective in minimising damage from kangaroos and wild dogs on farming operations.

The Proposal is expected to have a good return on investment and will help assist to double the value of the agrifood sector by 2025 by minimising socio-economic impacts (Peterson & Cooke 2016) outlined in Section 2.1. The WA Government announced $20 M over four years to implement key recommendations of the Action Plan including cell fencing grants, more LPMTs and the continuation of the existing SBF (this Proposal) to control wild dogs on the 14 November 2016 (GoWA 2016).

Inside the 1190 km long existing SBF, emus and kangaroos are still present. In the Esperance agricultural area, emu densities have been estimated to be less than 0.1/km^2 outside the Proposal alignment and approximately 0.3/km^2 in the agricultural areas (DAFWA 2016a). Kangaroos and emus and the ecological role they play will continue within the agricultural region.

Other potential ecological benefits from the Proposal include:

- reduced threat of wild dog predation to native fauna
- access for fire fighting in previously uncleared areas
- non-lethal and long-term option to control the incursion of emus and kangaroos into the agricultural land from the vast area of adjacent woodlands and rangelands.

Integrated wild dog control (trapping, baiting and shooting) will still be required along the Proposal alignment to minimise dog movement along the Proposal alignment and to reduce the passage of wild dogs through the unfenced river crossings and the open coastal end point (DAFWA 2016a). A Predator and Pest Control Plan (PPCMP) has been prepared for DPIRD to implement wild dog control at these locations, and previously uncleared areas.

[6] Small livestock refers to producers of small stock (e.g. sheep, goats).

2.3 Consequences of not proceeding

Small stock and wild dogs cannot co-exist. Sheep production is concentrated in the agricultural region. Profitability of sheep production (both wool and lamb meat) is increasing but so are wild dog impacts. Physical exclusion (fencing) provides a humane, effective method of control to one of the most significant risks to sheep production in WA. The consequences of not proceeding with the Proposal would be the continuing liability and financial loss, that the socio-economic impacts outlined in Section 2.1 will cause.

The status quo for wild dog management (includes trapping, baiting and shooting wilds dogs) will also be maintained.

3. Legal framework

3.1.1 Applicable legislation

Implementation of the Proposal will require compliance with Australian legislation and regulations as listed in Section 3.1.3 to Section 3.1.6. Further to these statutory requirements, a range of other guidelines, standards and policies are also relevant to the Proposal. The generic standards, policies and guidelines are listed in Section 3.1.1 to Section 3.1.6.

3.1.2 Western Australian legislation

Key Western Australian legislation relevant to the Proposal includes:

- *Aboriginal Heritage Act 1972* (AH Act)
- *Conservation and Land Management Act 1984*
- *Environmental Protection Act 1968* (EP Act)
- Environmental Protection Regulations 1987
- *Biosecurity and Agriculture Management Act 2007* (BAM Act)
- Biosecurity and Agriculture Management Regulations 2013
- *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act)
- *Land Administration Act 1997*
- *Wildlife Conservation Act 1950* (WC Act)[7].

The Western Australian BAM Act provides the authority for Regulations to be made for the erection and maintenance of barrier fences as a means of controlling animals that are Declared Pests. Emus, Wild dogs, Dingoes and Western Grey and Red Kangaroos are Declared Pests under the BAM Act due to their adverse effects on agricultural activities.

Regulations 46 to 51 of the Biosecurity and Agriculture Management Regulations 2013 authorise the Director General of DPIRD to erect, improve, alter, maintain, repair or renew a barrier fence and associated infrastructure on any land. A barrier fence is defined as a substantial fence under the control of the Director General which is used to impede the movement of animals that are Declared Pests. The barrier fence reserve is land reserved for the purpose of a barrier fence and for the protection and maintenance of the fence, vested with the WA Agriculture Authority. On private land, an agreement between the landholder and the DPIRD Director General would apply and the barrier fence would become the property of the State.

3.1.3 Western Australian standards, guidelines and policies

Assessment of the environmental impacts of the Proposal is based on various WA Position Statements and Guidance Statements. Standards, guidelines and policies related to specific environmental factors or individual aspects of the Proposal are listed and discussed in the individual sections relevant to the environmental factor being addressed. The documents generally considered relevant to assessment by the EPA are:

Environmental Assessment guidelines:

- Environmental Assessment Guidelines No. 1 (EAG1): *Environmental Assessment Guideline for Defining the Key Characteristics of a Proposal Environmental Protection Act 1986* (EPA 2012)
- Environmental Assessment Guidelines No. 6 (Revised, EAG6): *Timelines for Environmental Impact Assessment of Proposals* (EPA 2013a)
- Environmental Assessment Guidelines No. 8 (Revised, EAG8): *Environmental Assessment Guideline for Environmental principles, factors and objectives* (EPA 2015a)

[7] The WC Act will eventually be replaced by the *Biodiversity Conservation Act 2016*.

- Environmental Assessment Guidelines No. 9 (revised EAG9): *Environmental Assessment Guideline for Application of a significance framework in the environmental impact assessment process* (EPA 2015b)
- Environmental Assessment Guidelines No. 10 (EAG10): *Environmental Assessment Guideline for Scoping a Proposal* (EPA 2013b)
- Environmental Assessment Guidelines No. 17 (EAG17): Preparation of management plans under Part IV of the Environmental Protection Act 1986 (EPA 2015c).

EPA guidelines and position statements:

- EPA PER guidelines - *Guidelines for Preparing a Public Environmental Review* (EPA 2016a)
- EPA (2000) Position Statement No.2- *Environmental Protection of Native Vegetation in Western Australia*
- EPA (2002) Position Statement No. 3: *Terrestrial Biological Surveys as an Element of Biodiversity Protection*
- EPA (2004c) Position Statement No. 7: *Principles of Environmental Protection*
- EPA (2008) Guidance Statement No. 33: *Environmental Guidance for Planning and Development*
- EPA (2004a) Guidance Statement No. 51: *Terrestrial Flora and Vegetation Surveys for Environmental Impact Assessments in Western Australia*
- EPA (2003) Guidance Statement No. 55: *Implementing Best Practice in Proposals Submitted to the Environmental Impact Assessment Process*
- EPA (2004b) Guidance Statement No. 56: *Terrestrial Fauna Surveys for Environmental Impact Assessment in Western Australia*
- EPA and Department of Environment and Conservation (EPA & DEC 2010) *Technical Guide – Terrestrial Vertebrate Fauna Surveys for Environmental Impact Assessment.*

Since the referral of the Proposal, and the release of the ESD, the EPA has updated its policy and guideline documents and the *Environmental Impact Assessment (Part IV Divisions 1 and 2) Procedures Manual 2016* and *EPA Instructions on how to prepare Environmental Protection Act 1986 Part IV Management Plans* have replaced EAG 17. However, consistent with EPA advice for this transitional period this PER and associated management plans have been prepared in accordance with the requirements set out in the ESD.

State guidance

- Western Australian *Planning and Development Act 2005*
- Western Australian Planning Commission (WAPC) & Department of Planning (DoP) (2012) *State Planning Policy 2.5. Land use planning in rural areas*
- WAPC & DoP (2013) *State Planning Policy No. 2.6. State Coastal Planning Policy*
- DoP (2010) *Shire of Esperance Town Planning Scheme No. 23*
- DoP (2012) *Shire of Ravensthorpe Town Planning Scheme No. 5 (Updated to include Amd 23 gg 7/12/12).*

3.1.4 Decision Making Authorities

The relevant Decision Making Authorities (DMAs) in relation to the Proposal are:

- Department of Biodiversity, Conservation and Attractions (DBCA)
- Environmental Protection Authority (EPA)
- Shires of Ravensthorpe and Esperance
- Department of Planning, Lands and Heritage (DPLH) formerly Department of Aboriginal Affairs (DAA).

3.1.5 Australian Government Environmental Impact Assessment Process

While the States and territories have responsibility for environmental matters at a state and local level, the EPBC Act aims to focus the Australian Government interests on protecting Matters of National Environmental Significance (MNES). The EPBC Act requires an assessment as to whether a proposed action is likely to have a significant effect on a MNES.

The Proposal was referred to DEE under the EPBC Act (EPBC 2016/7722). The DEE determined that the Proposal was 'not a controlled action' on 4 August 2016.

3.1.6 Other Environmental Approvals

Approval under s 18 for disturbance to heritage sites under the AH Act.

4. Description of the Proposal

The key characteristics of the Proposal are provided in Table 4-1. The key characteristics have been described in accordance with *Environmental Assessment Guideline for Defining the Key Characteristics of a Proposal* (EAG1) (EPA 2012), which identifies how projects should be described under Part IV of the EP Act.

Table 4-1: Key Proposal characteristics

Summary of the Proposal

Proposal title	State Barrier Fence Esperance Extension
Proponents name	DPIRD.
Short description	The Proposal is to construct an approximately 660 km long, 1.35 m high barrier fence. The Proposal would extend the existing SBF eastwards from its current termination 25 km east of Ravensthorpe, extending north around Salmon Gums and ending east of Esperance near Cape Arid National Park in Goldfields-Esperance Region of Western Australia.

Physical elements

Element	Location	Proposed extent
Clearing and disturbance	Figure 1-2	Clearing and disturbance of up to 816 ha of native vegetation consisting of up to 188 ha (excluding 6 ha for water turnouts) of previously uncleared native vegetation within a Development Envelope comprising 8139 ha.

Operational elements

Element	Location	Proposed extent
Ongoing maintenance	Figure 1-2	Ongoing chaining of 188 ha in previously uncleared areas.

4.1 Project timing and staging

The Proposal may take up to two years to construct following environmental and heritage approval. No staging of implementation is proposed for the proposed barrier fence.

Materials to construct the proposed barrier fence are expected to have a lifespan of approximately 25 years with maintenance and replacement of materials occurring over this period as required.

4.2 Proposal tenure

The Proposal will be constructed under Regulation 47 of the Biosecurity and Agriculture Management Regulations 2013 by the DPIRD Director General and remain the property of the State. Where located on UCL, the Proposal is positioned within a 15–20 m wide clearing footprint (Barrier Fence Reserve) to be vested in the WA Agriculture Authority. Where the Proposal alignment is located on freehold land in agreement with the landholder and the DPIRD Director General, an existing farm boundary fence would be removed and replaced with the proposed barrier fence. The proposed barrier fence would then become the property of the State.

Responsibility for managing the Barrier Fence Reserve, including ongoing chaining is currently vested with the WA Agriculture Authority and will be implemented by DPIRD staff and contractors.

4.3 Proposal clearing footprint

The width of the clearing footprint varies along the Proposal alignment based on the pre-existing condition of the environment in which the proposed barrier fence will be located in. The Proposal alignment will be positioned within a 15–20 m wide clearing footprint corridor. Where the Proposal alignment is located adjacent to pre-existing disturbance (such as previously chained areas) the width of the clearing footprint is 15 m. Where the Proposal alignment is located in undisturbed areas (such as previously uncleared vegetation) the clearing footprint is 20 m wide. This excludes four short areas of previously uncleared areas adjacent to Merivale Rd where a 6 m wide clearing footprint is proposed.

Within the 15–20 m wide clearing footprint, a 6 m wide track of full clearing (grading) will be required to construct and enable ongoing the maintenance of the proposed barrier fence. The remaining width of clearing footprint corridor (up to 14 m) will be chained and potentially mulched.

There are four broad categories of pre-existing environmental conditions within the 15–20 m wide clearing footprint (Figure 1-2). These pre-existing environmental conditions are presented below:

1. **Uncleared vegetation:** A total of 69.3 km (10.5%) of the Proposal alignment will traverse through uncleared bushland predominantly in the north of the Proposal (Plate 1). This also includes a total of 1.5 km (0.2%) of vegetation in private property to avoid a salt lake and Aboriginal heritage site.

   A 20 m wide clearing footprint is required in these areas (full clearing of a 6 m wide track and 14 m of partial clearing [chaining], to ensure there is an appropriate firebreak adjacent to the proposed barrier fence, to stop large trees falling on the fence and to act as an animal visibility corridor).

   Four short areas of previously uncleared areas adjacent to Merivale Rd are proposed to be subject to a 6 m wide clearing footprint.

2. **Previously chained firebreak**: A total of 414.3 km (62.8%) of the Proposal alignment will be located in areas that have already been previously chained for fire management by DBCA or local Shires. These areas are depicted in Plate 2 and Plate 3. Ongoing buffer management/clearing of vegetation in these areas was undertaken in 2016 and will continue to occur to protect human life and property unrelated to this Proposal. These chained areas typically have between one and three existing graded tracks for fire vehicle access and to assist burning of knocked down vegetation.

   A 15 m wide clearing footprint (6 m to be graded or re-graded and 9 m of re-chaining if required) is required in these areas.

3. **Existing track or firebreak:** A total of 46.4 km (7.0%) of the Proposal alignment will utilise an existing 6 m wide track or graded firebreak (Plate 4).

   The clearing footprint in these areas will consist of up to 14 m of chaining adjacent to the existing track and potentially grading a 6 m wide corridor.

4. **Previously cleared areas:** A total of approximately 129.4 km (19.6%) of the Proposal alignment will be located on private property and will replace existing farm boundary fences. No clearing will be required but pruning of any overhanging branches or vegetation pushing through the existing farm boundary fence may be undertaken if necessary.

Ongoing chaining in the Barrier Fence Reserve will be required every 4–6 years, similar to existing DBCA fire management practices. Herbicide spraying may be necessary for woody re-growth along the 6 m wide graded access track. DPIRD is investigating the option of potentially mulching vegetation instead of herbicide use.

Proposal alignment details and location in existing environmental conditions is outlined in Table 4-2.

Table 4-2: Proposal alignment details

Existing condition along alignment	Tenure	Disturbance type	Total clearing width (m)	Length of alignment (km)	% of total length
Previously cleared	Private Property	No clearing	0	129.4	19.6
Previously chained firebreak	UCL	Re-chaining and grading if necessary	15	414.3	62.8
Existing track or firebreak	UCL	Previously chained areas	9	1.0	0.2
	UCL	New clearing	14	45.4	6.9
Uncleared vegetation	UCL	New clearing (area south of Salmon Gums)	15	27.8	4.2
	UCL	New clearing (area north of Salmon Gums)	20	39.5	6.0
	Private Property	New clearing (to avoid Aboriginal place & a deep salt lake)	20	1.5	0.2
Total				**659.4**	**100**

A breakdown of the clearing required for the Proposal is presented in Table 4-3. A total of 76.3% (622.4 ha) of the maximum clearing footprint for the Proposal will be located within previously disturbed (cleared or chained) areas and will require re-clearing (Table 4-3). This does not include the replacement of existing farm boundary fences within previously cleared areas on private property as no new disturbance footprint is required for these areas.

Table 4-3: Clearing required for the Proposal

Clearing footprint	Area (ha)	% of clearing footprint
Chaining within uncleared vegetation	146.0	17.9
Re-chaining (if necessary)	373.8	45.8
Grading (full clearing) within uncleared vegetation	41.6	5.1
Grading (full clearing) within previously chained areas	248.6	30.5
No clearing required along 129.4 km of Proposal alignment (private property)	0.0	0.0
Water turn outs	6.0	<1.0
Total	**816.0**	**100.0**

In addition to the clearing outlined in Table 4-3, a total of up to 6 ha over the total Proposal alignment will also be cleared for erosion control. Controls will involve the construction of water diversion turnouts (10 m long by 2.5 m wide), allowance has been made for these to be installed alternating every 200 m along the 6 m wide cleared track in areas susceptible to erosion. This will result in an additional maximum of 5.5 m x 2.5 m (13.75 m^2) of clearing every 200 m.

The actual extent of disturbance from water diversion turnouts is expected to be much less than indicated, as in practice locations will be determined during construction and will only be required where necessary based on the potential for erosion and the state of erosion on any existing tracks.



Plate 1: Uncleared vegetation (Salmon gum habitat that would require additional clearing)



Plate 2: DBCA vegetation chaining for the November 2015 Esperance fires



Plate 3: Typical chained fire break with modified vegetation next to agricultural land, along which the majority of the Proposal alignment will be located



Plate 4: Innermost fire track that will preferentially be re-graded for the proposed barrier fence track if possible

4.4 Proposal design and construction

The current Proposal alignment, barrier fence specifications and construction have been designed to mitigate potential impacts on flora and vegetation, terrestrial fauna and heritage values, including:

- increasing the visibility of the proposed barrier fence in a colour spectrum that is brighter to fauna thereby reducing the potential for fauna entanglements and collisions
- maintaining ecological corridors and dispersal of non-target fauna such as small mammals, invertebrates and reptiles by having four unfenced gaps in the Proposal alignment associated with Lort River, Young River, Oldfield River, and the coast; and having a netting mesh size large enough for many non-target species to traverse through.

Fence specifications for the Proposal are the same as that for the recently constructed 'Yilgarn Gap' barrier fence (constructed in 2013 and 2014) (Figure 1-1). The clearing footprint for the Proposal has been modified from the existing SBF practice of bulldozing and grading the entire 20 m wide area, to only bulldozing and grading a 6 m wide track. The remaining area adjacent to the track will be chained and potentially mulched (instead of bare earth cleared) to reduce erosion potential, maintain the seed bank, and to provide some ground habitat and cover for smaller animals while still acting as a firebreak and visibility corridor.

Fence design specifications for the Proposal are summarised below:

1. The Proposal will be constructed of ten line fabricated wire netting with a height of approximately 1.35 m. A single strand of 2.8 mm high tensile plain wire is on top of the fabricated netting.
2. No barbed wire or electrical wire to be used.
3. 1.8 m high star pickets will be placed every 7 m with a ground penetration of approximately 0.45 m.
4. The barrier fence netting mesh size is approximately 102 mm high by 152 mm wide at the base of the proposed barrier fence and increases to 152 mm by 152 mm at the top of the fence.
5. Galvanised 2.4 m drive-in angle strainers with 3.2 m struts are used. The strut base plates and ground anchors are at 300 m intervals with a maximum ground penetration of 0.90 m.
6. 1.3 m high visibility fluorescent orange droppers are attached to the fence 7 m apart.
7. Double the number of fluorescent orange fence droppers for approximately 115 km of the proposed barrier fence near (2 km from) known Western Ground Parrot habitat in Cape Arid National Park:
    - two florescent orange droppers would be installed in-between each 7 m solid star picket (about 2.3 m apart).
8. 400 mm lap wire extends from the base of the proposed barrier fence along the ground under tension to minimise the potential for target fauna to push or dig under the proposed barrier fence.
9. Access gates will be placed in line with the proposed barrier fence across minor access roads or at 10 km intervals if there are no existing access roads.
10. Stock grids of varying widths (generally 5–8 m depending on the road they cross) will be set in existing roads where needed.

5. Alternative alignment and target fauna control options

DPIRD and the agricultural industries in the Esperance region have considered alternative options for target fauna control over a long period of time. An independent Benefit-Cost Analysis report was conducted by URS (2007) for the initial 450 km Proposal alignment to compare the costs of alternative barrier fence designs and associated non-fence control measures against the benefits provided by reducing the impacts of damage caused by target fauna over a 25 year time period. A recent independent Benefit-Cost Analysis report (WA WDAG 2016) for a 670 km Proposal alignment provided an estimation of the cost effectiveness of various options for wild dog management in the pastoral and agricultural regions of WA. Based on the Benefit-Cost Analysis results from both reports, and alternative options for target fauna control long-term, DPIRD considers the best long-term, non-lethal, cost-effective option is to construct the proposed barrier fence to deflect the movement of target fauna and to mitigate socio-economic impacts from target fauna.

Section 5.1 and Section 5.2 identifies the alternative options considered by DPIRD for the Proposal.

5.1 "No barrier fence" option

Non-fence control measures were considered by DPIRD as an alternative to barrier fences to reduce agricultural impacts from target fauna. These measures offer varying degrees of effectiveness in controlling the impact of target fauna. Non-fence control measures demonstrated notable levels of control against wild dogs but were ineffective against large emu migrations (URS 2007).

Non-fence control measures include:

- maintaining current wild dog management practices such as trapping and baiting of wild dogs
- shooting of kangaroos
- individual farmers constructing their own fences
- maintaining current wild dog management practices
- use of livestock guardian dogs.

5.1.1 Culling/baiting for emu and kangaroo population control

Lethal options such as shooting and strychnine poisoning to control emu and kangaroo populations have been considered by DPIRD (DAFWA 2016a).

Historically emu mortalities during migrations along the existing SBF have been the result of past policies of culling and illegal culling. To legally shoot or poison emus a licence to take protected fauna causing damage to a property can be applied for by an affected property owner under Regulation 5 of the Wildlife Conservation Regulations 1970. However, emus can be extremely difficult to humanely shoot as they usually occur in large mobs, running at speed and will try and run through fences if being pursued (DAFWA 2016a). Strychnine is not preferred as poisoning requires emus to learn to feed on grain provided at certain locations before the grain is then laced with the poison. The process also requires a strychnine permit and training by DPIRD. Strychnine poisoning also poses a risk of non-target poisonings (DAFWA 2016a).

The non-fence option to control kangaroo populations is shooting. Under the WC Act an open season on Grey Kangaroos exists in the Shires of Ravensthorpe and Esperance. This means that Grey Kangaroos can be shot when they are causing damage to primary production or may be reasonably expected to cause damage to primary production (DAFWA 2016a).

Overall, the following constraints make culling/baiting for emu and kangaroo population control less desirable options:

- animal welfare considerations
- difficulty to humanely shoot emus
- poisoning impacts on non-target fauna
- obtaining permits and training to undertake culling/baiting action
- limited impact of shooting large mobs.

5.1.2 Wild dog control alternatives

Wild dogs have the potential to cause significant impact on small stock enterprises. Such impacts result in significant financial, social and environmental costs. The following options have been considered by DPIRD as alternatives for wild dog control.

Construction of private barrier fences

The construction of private barrier fences around properties would not stop movement of target fauna into the agricultural areas through areas of UCL, nature reserves and road reserves that extend into and between agricultural properties. Many land owners would need to fence multiple property boundaries and a very complex, much longer and less effective barrier fence 'network' would result.

This option would also require the cooperation of all landholders over the 660 km Proposal alignment distance to construct and then maintain multiple property boundary fences to a barrier fence standard. This option would become ineffective if a property was left vacant or a section of barrier fence was not maintained properly by a neighbouring property (DAFWA 2016a).

Culling/baiting and trapping

The continuous risk that wild dogs pose for small livestock enterprises in the region deters many farmers from investing or re-investing in small livestock and wild dog attacks on livestock in the region continue to occur (DAFWA 2016a).

Integrated wild dog control (trapping, baiting and shooting) will still be required if the proposed barrier fence is constructed but to a lesser extent to minimise dog movement along the Proposal alignment and to reduce the passage of wild dogs through the unfenced gaps associated with the river crossings and the 3.2 km open coastal end point. DPIRD is undertaking research programs to greater understand the behaviour and movement of wild dogs and the effect fencing has elsewhere in WA on wild dog populations. A PPCMP has been prepared for DPIRD to implement wild dog control at the unfenced gaps, and previously uncleared areas.

Use of livestock guardian dogs

Another option considered and trialled by landholders in the region to protect their livestock from predation is the use of livestock guardian dogs. Guardian dogs of various breeds have been shown to reduce the impact of wild dogs and foxes on producers at the property level if the dogs are correctly trained and managed (van Bommel 2010). However, this option on its own is not expected to be effective at managing wild dogs at a regional and landscape level.

Guardian dogs have been trialled in the Esperance region with limited success (DAFWA 2016a). There may be several interacting reasons why these trials have been unsuccessful, such as inadequate training or bonding with the stock or poor selection or training of guardian dogs. Farming in the southeast continues a trend towards larger property holdings with less staff. Many farmers consider the significant time and effort required to train and manage successful guardian dogs to be too onerous and the potential for failure too high. Moreover, guardian dogs will not stop kangaroo or emu damage to crops as when crops are in the ground, livestock are removed from the paddocks. The result is that this option has been available to farmers in the region for some time, but farmers have not adopted their use due to the complexities of use and unsatisfactory outcomes (DAFWA 2016a).

5.2 Proposal alignment options

Significant planning and biological studies have been undertaken to avoid or mitigate potential ecological impacts of the Proposal, including assessing alternative alignment options.

DPIRD compared four different alignment options to identify the expected primary environmental impacts of the Proposal and to help determine an optimum alignment (the least constrained option) to be taken into the approval process. The scoping study provided by GHD (2012) compared and assessed the four various alignment options to identify which option provided optimum target species control and minimal environmental and social impacts.

The alignment options considered by DPIRD and GHD (2012) were classified according to their distance from the border between agricultural lands and UCL:

- Option A–the outermost route which follows the shortest route across the UCL
- Option B–the median route between A and C
- Option C–the innermost route which follows the follows the boundary between the cleared private property and the UCL
- Option BC–where options B and C merge.

These alignment options from the scoping study are presented in Figure 5-1.

The selection of the "least constrained" alignment design involved consideration of the following aspects:

- biophysical constraints
- flora and fauna constraints:
  - gaps in significant flora records
  - fragmentation of native vegetation
  - vegetation condition
  - fauna habitat values
- dieback potential
- heritage
- planning.

The land area impacted, land tenure and possible land acquisition requirements including the need to acquire areas as offsets for environmental impacts was also considered to inform the final "least constrained" design of the alignment (GHD 2012).

The "least constrained" alignment was identified to follow Option C (the innermost route) wherever Option A (outer route) constraints were greater than or equal to those of the innermost route. The outermost route was chosen only when the limiting factors were less than those of the innermost option. In some sections, a slight alteration of the innermost option provided by DPIRD was chosen to avoid a constraint (Figure 5-1).

The least constrained alignment is generally within the UCL at the interface with the agricultural land. This means that the alignment is usually within areas of previously chained vegetation. These areas require minimal clearing of native vegetation and will largely avoid impacts on undisturbed vegetation along with the associated indirect impacts, such as the introduction of weed species and dieback and increases in erosion and soil degradation. The least constrained alignment option also reduced habitat fragmentation by avoiding transecting large tracts of native vegetation, which reduces impacts on wildlife corridor connectivity. Selection of an alignment that abuts the agricultural area also reduced the potential problem of isolating large areas of vegetation within the agricultural land. These areas could harbour wild dog populations and/or provide refuges for dogs that may cross the Proposal alignment.

5.2.1 Current Proposal alignment

An interdepartmental approach has been taken with DPIRD liaising with the Great Southern Region of DBCA to co-locate and maximise the use of the chaining/clearing associated with DBCA fuel management program. The current Proposal alignment has been modified and refined to:

- entirely avoid the Threatened underground orchid (*Rhizanthella gardneri)* habitat near the Oldfield River
- reduce isolation of large sections of Great Western Woodlands from vegetated patches to the south of the Proposal alignment
- maximise the use of previously chained firebreak areas, adjacent to private agricultural land:
  - existing cleared tracks will be used for the Proposal alignment wherever possible to avoid clearing duplication
- avoid clearing in any Class A reserves and Cape Arid NP
- realign onto private property to avoid impacts to approximately 7245m of 7900 m of Proteaceae Dominated Kwongkan Shrublands TEC:
  - the remaining 655 m TEC (0.87 ha) proposed to be cleared was re-chained recently for fire mitigation and is located within a previously disturbed area
- utilise private property for 129.4 km by replacing existing farm boundary fences with the proposed barrier fence to avoid high environmental or cultural concerns identified in previous investigations
- avoid heritage management areas that were mapped as buffers around cultural areas with artefact scatters, where possible
- avoid water courses (including salt lakes), landscape features and steep areas
- minimise the use of acute-angle corners where emu numbers could build up in a migration.



Source: GHD (2012)

Figure 5-1: Alternative Proposal alignment options assessed by GHD (2012)

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6. Stakeholder consultation

6.1 Stakeholder consultation undertaken to date for the Proposal

Significant consultation, planning and biological studies have been undertaken to avoid or mitigate potential ecological impacts of the Proposal and to involve stakeholders in developing the Proposal alignment.

DPIRD has consulted broadly in an open, transparent manner in relation to the Proposal. DPIRD and the Esperance Extension Reference Group (EERG) have considered the various stakeholders' views on the Proposal and significantly altered the Proposal alignment in response to concerns raised and advice provided (see Section 5). This has resulted in a revised final Proposal alignment, fence structure and clearing practice that minimises or avoids potential environmental impacts.

The stakeholder consultation undertaken for the Proposal is summarised in Table 6-1.

6.2 Other relevant consultation

Other relevant consultation has been undertaken by the WA Wild Dog Action Group (WA WDAG), which met over a 12-month period from July 2015 to determine the priorities to develop a new Western Australian Wild Dog Action Plan to coordinate and prioritise efforts to better address the impacts wild dogs have on livestock across WA (DAFWA 2016d).

In August and September 2015, a total of 66 people (comprising landholders, pastoralists, farmers, local government, Regional Biosecurity Group [RBG] representatives, Sporting Shooters Association, industry groups and WA government agency staff) were interviewed to provide their views, information and to contribute to the development of an agreed approach to the control of wild dogs in the Action Plan (DAFWA 2016d).

The clear message from the consultation process regarding the Action Plan (WA WDAG 2016) was that wild dogs are having a severe impact on the ability of landholders to run livestock in the pastoral regions of WA, and that they are now moving into the agricultural areas of WA (DAFWA 2016d). This has significantly affected landholders financially, emotionally and socially.

One of the key recommendations of the Action Plan was to extend the existing SBF to complete the Esperance extension project (i.e. this Proposal) in conjunction with other control measures. This recommendation will be implemented through this Proposal.

6.3 PER consultation

Government agencies were consulted during the preparation of the PER to ensure that all relevant issues were identified and addressed in the PER. The Draft PER was submitted to the DWER in January 2017. The DWER reviewed the Draft PER and provided preliminary comments on the adequacy of the information presented. The Draft PER was then revised in accordance with agency comments following further discussion and clarification of issues with agencies. Some of the agency comments related to:

- clarification on the direct and indirect impacts on Terrestrial Fauna and Flora and Vegetation
- additional detail to justify conclusions and impact assessment of the environmental factors identified
- further clarification on why offsets are not required for identified residual impacts for the Proposal
- requirements to undertake a Short-Range Endemic invertebrate survey in consultation with the WA Museum
- quantifying identified residual impacts for Flora and Vegetation and Terrestrial Fauna
- refining the Western Ground Parrot habitat mapping and defining existing environmental conditions
- update of a preliminary biological survey report to be consistent with DBCA mapping requirements.

The additional information and analysis requested by DWER has been included in the revised PER.

6.4 Ongoing consultation

Consultation with key stakeholders will continue throughout the assessment, approvals, construction and implementation stages of the Proposal.

Table 6-1: Summary of key stakeholder consultation undertaken for the Proposal

Stakeholder	Date	Form of consultation	Issues raised	Response to issues
• Northern Mallee Declared Species Group (NMDSG) • Shire Council Members • State and Federal Members of Parliament • Greg Mifsud (National Wild Dog Facilitator)	2010/2011	Proposal briefing and provision of newsletters.	Funding for the Proposal to include a specified Shire area rate to be applied to agricultural land.	No information was provided regarding response to issues raised.
Shire of Esperance	July 2011	Referendum.	Vote to support an approximate $2 million contribution towards the construction of the Proposal through raising a specified area rate on agricultural land.	Of the 1350 ballot papers distributed in the Shire of Esperance, 54% were returned with 67% in support of the Proposal.
Esperance Biosecurity Association Inc. – formerly the Northern Mallee Declared Species Group (NSDMG)	2011-2016	Provision of information and updates regarding the Proposal via the NMDSG website and local radio interviews.	Support for the State Barrier Fence Esperance Extension.	Not applicable.
Esperance Extension Reference Group (EERG) comprising: • DPIRD representatives • Southern Biosecurity Group, formerly the Ravensthorpe Declared Species Group; NMDSG • Shires of Esperance and Ravensthorpe • South Coast Natural Resource Management Inc. • Department of Lands • DBCA • Department of Premier and Cabinet • specialists in various field or representatives from regional groups	September 2011	Quarterly to six monthly internal meetings since 2011.	Provision of direction and advice on processes towards planning and construction of the Proposal including determining a final preferred alignment that minimises environmental, cultural or community impacts from the Proposal.	The final Proposal alignment was developed in response to concerns raised and advice provided by the EERG.
Department of Mines and Petroleum (DMP)	December 2011	Provision of proposal alignment and request for comments on route options.	The protection of mineral deposits from the proposal alignment and the consultation of mining tenement holders on the final Proposal alignment.	The Proposal alignment was altered to minimise the potential impact on known mineral resources.
Department of Conservation (DEC)	January 2012	Request for comments on the proposal alignment and the impact to matters concerning the DEC.	The DEC advises that the Proposal alignment causes little or no impact on the Cape Arid National Park boundary, and requests that the balance of the Cape Arid National Park which remains within the Proposal alignment development envelope be excised from DEC control. The DEC requests that unfettered access be granted along the Proposal alignment that serves as a common boundary for the provision of management activities.	Final Proposal alignment does not enter Cape Arid National Park. Final alignment preferentially uses inner most firebreak in chained area at request of DBCA.
• Shire of Esperance • Shire of Ravensthorpe • DEC, Albany • South Coast NRM • NMDSG • Regional Development and Lands	17 February 2012	Question forum.	Issues raised: • cost and resourcing of the Proposal • the distance of the Proposal alignment • potential for the requirement of external funding • environment and heritage concerns • fragmentation of vegetation • fauna impacts such as large emu migrations • fire access • coastal corridor • Western Woodlands • responsibility for ongoing maintenance • danger will be protracted nature of construction and the financial performance of farms in that period – support might wane • hard to see the wild dog issue in Esperance • land tenure • DPIRD needs to make sure they don't disempower the NMDSG • struggle for support from all farming communities and city • potential issues from environmental groups and how to address their concerns if the alignment runs through the National Park.	No information was provided in regarding a response to the issues raised.

Stakeholder	Date	Form of consultation	Issues raised	Response to issues
Great Western Woodlands Reference Group	6 March 2012	Workshop meeting.	Methods on how to integrate various conservation groups to improve engagement or consultation regarding the Proposal. Provision of information to enable an understanding of Proposal status and future planned stages.	Representatives of conservation interest groups advised DPIRD that they did not want to receive further briefings about the Proposal.
Conservation groups	6 March 2012	Workshop meeting.	Some of the questions raised in the workshop included the following: • necessity of the fence and whether the requirement for the Proposal was based on anecdotal evidence • any figures on dog numbers that have been used to determine the requirement for the Proposal • how many farmers support the Proposal in Esperance • risk of emu mortality • whether the old extension would be removed as it is now derelict • width of clearing required • maintenance of the track either side of the proposed barrier fence • amount of money being spent for the small amount of return. Overall issues raised are below: • cumulative 215 000 ha (+ 35 000 ha) continuous vegetation will be cut off, will in effect become remnant vegetation. Is there a way to ensure this is on the other side of the fence? • coastal fringe is where the best opportunities (i.e. biological diversity) for the Great Western Woodlands exist • some of the land is not as productive - can some farm land be excluded? • increase in meso-predation in rangelands – what assessment has there been for an increase in meso-predators (cats and foxes) with the removal of wild dogs and the primary predator? • economics for sheep are poor – how many sheep are involved? Not just brands but stock numbers? • scoping is about cost, efficiency, minimising environment, heritage and social impacts • is there evidence of the problem – quantification of the extent of the issue. How do we know if the fence delivers – who measures outcomes and performance – need to measure not just the benefits but the ecological impacts • maintenance of the asset – is there a plan? • any consideration given to offsetting impacts? • Native title – Esperance Nyungar claim covers cleared area and UCL as their strongest interest lie in the UCL. The fence vesting in DPIRD will extinguish native title rights – will need to negotiate over outcomes for extinguishment of rights/interests • expect a full assessment from EPA (PER) and Commonwealth which needs to include an assessment of the alternatives. Would prefer proponent to refer it as it would generate good faith • can you build part fences and still manage dog impact? • river crossings – how will they be built – diversions not river crossings are likely • emu plague/large numbers – what is the animal ethics or humane treatment required when emu's get stuck • dieback consideration – could be as much as 1/3 of the length of the proposed barrier fence is susceptible – will implement standard practices • it is expected that some of the fence will go through currently uncleared bush, however most will be located in previously disturbed vegetation.	DPIRD responses to the questions raised in the workshop are presented below: • the State Government has provided funding for the materials and approvals components of the 'Esperance Extension' which demonstrates its intent for the fence to go ahead • the information on dog numbers and impact was largely anecdotal (leading up to the proposal to build the fence – DPIRD has since obtained data on impacts from a recent survey of landholders) • the answer was that 67% of farmers that voted in the referendum held were willing to contribute to the cost of construction through a Special Area Rate in the Shire of Esperance • the removal of the obsolete barrier fences is not part of the current SBF project but would be raised as an issue • clearing width required is 10 m either side – 20 m in total • track is sprayed and the fence is maintained by doing repairs from either malicious damage, floods or other damage.
• Shire of Esperance • Shire of Ravensthorpe • Department of Environment and Conservation • Regional Development and Lands • SCRNM • GEDC • DPIRD	22 March 2012	Not provided.	• scepticism from urban community about priority of the proposed barrier fence, ongoing engagement of broader community essential, support might wane with ratepayers as well if fin performance of farm decreases • this is the 3rd most important issue for Ravensthorpe behind roads and health, there is broad community support • isolation of vegetation, possible impacts on fauna, fire access • weed incursion, dieback spread, woodland fragmentation, cut off reserves, potential flora and fauna issues, dunes- creep, wetlands and banksia (coastal alignment), Fires (don't see fence as a firebreak), open up access recreational 4WD users • lots of land parcels are impacted which makes process difficult, need for accuracy in how describe land parcels, advertisement for route needs to be precise, need to avoid Aboriginal sites in planning stage, will be govt reserve • community perception and impact on western woodlands, coastal corridors and tourism, access to coast, coastal and marine impact, access to maintenance tracks, dieback, need community consultation phase to scoping study to identify ways in which the issues can be overcome • more work needs to be done on alignment, can allow some species migration, biodiversity values/habitat value - how can it be calculated, is it possible to stick to cleared land, questions over validity of referendum, complexity of SH groups enormous, DSG's have to get their heads around the other SH's, management of relationships will make or break the project • fence might facilitate larger recreation use of those areas - east west movement of people of greatest concern, in broader community confusion over what the fence is for, naming and branding and key messaging, only one DEC ranger so managing impacts will be critical, planning process needs to be iterative • getting the funding - like a half commitment, size of the project - it's a big construction project	-

Stakeholder	Date	Form of consultation	Issues raised	Response to issues
			• salt country - composite plastic posts needed, specs for water crossings difficult as each is individual, high rainfall area may delay construction, need to reform State Barrier Advisory Committee to discuss how to fund it, South Australian model, current budget existing fence $420k half of what is needed, needs industry funding scheme, Emu traps better idea than going to coast.	
Goldfields Land and Sea Council	April 2012	Presentation of Proposal and request for traditional owner consultants for the region to be engaged.	Request for DPIRD to present project overview at a Working Group Meeting.	No information was provided in regarding a response to the issues raised.
Wagyl Kaip Working Party	21 June 2012	Presentation of project overview.	Request Aboriginal employment be given priority where possible. Heritage surveys be conducted over relevant land along the Proposal Alignment.	DPIRD has conducted heritage surveys of the Proposal alignment; additionally, employment opportunities were also raised in the anthropological survey of the Proposal Alignment, DPIRD indicated they agreed in principle to the issue and that consideration would be given to maximise the potential for Aboriginal employment subject to State Government procurement policies.
Great Western Woodlands Reference Group	2 August 2012	Presentation of results from GHD (2012) scoping study in Kalgoorlie.	The Proposal and the outcomes from the scoping study were presented.	No records are available regarding the response provided at that time.
NMDSG	17 September 2012	Public consultation.	NMDSG members consider the alignment should go along the North/South section on public lands. Discussion focussed on the alignment south of Parmango Road. This section is highly constrained with limited options for mitigation of issues. Options were presented to use existing chained areas, engage landholders in consultation to research use of private land. Discussion also on the endpoint including land tenure of the endpoint and geophysical constraints of the endpoint. Issues still to be resolved include • endpoint • ownership of the north south section of alignment • impacts presented by dieback not clarified • fence options where alignment intersects major waterways • management strategies for managing large scale emu migration events. A general agreement was reached that the North South alignment would be required along the property boundaries based on DEC opposition to cutting through existing remnant vegetation (cut- through option). The members from NMDSG consider that affected landholders will need to be consulted on the North South alignment and their views on the proposed end point. Following this, the landholder meetings captured the sentiment that the fence should go on public lands, and they wanted it managed the same way as the existing SBF, with landholders along the North-South section saying that they were prepared for the whole fence project to be disbanded if this wasn't accommodated.	No information was provided in regarding a response to the issues raised.
Industry meetings	22-24 October 2012	Industry meetings in Condingup, Ravensthorpe, Salmon Gums and Cascades.	The NMDSG committee identified the preferred route for the Proposal Alignment is the most direct. This would help reduce bottle necks in the Proposal Alignment. Preference for the rivers to have a suspension fence along them. The NMDSG does not support the use of private land for the Proposal Alignment. The fence should be constructed all the way to the coast and not have a gap along the coastline.	The Proposal Alignment has been altered to minimise the potential for wildlife bottlenecks to occur. The rivers have remained unfenced to allow ecological connectivity across the landscape and to maintain the integrity of the Aboriginal Heritage contained within them. DPIRD has decided to align the Proposal alignment as close as possible to farm fences and in some cases to alter the Proposal Alignment to occur on private land to minimise the impact to vegetation and Aboriginal Heritage values. DPIRD has agreed to decrease the coastline gap from 15 km to 3.2 km to provide greater protection for the agricultural properties along the coast.
Public consultation	2012-2016	Proposal updates made publically available on DPIRD website. Information on other Royalties for Regions funded components of the existing SBF upgrades completed in 2013 and 2014 have also been provided (i.e. lapwire upgrades to the existing SBF and the 170 km Yilgarn Gap construction project).	Provided for information only.	DPIRD has provided documents on the Proposal to stakeholders on request and assisted the Minister for Agriculture's Office with numerous requests for information on the Proposal or responses to concerns raised.

Stakeholder	Date	Form of consultation	Issues raised	Response to issues
Heritage consultation: • Goldfields Land and Sea Council Aboriginal representative body • Esperance Tjaltjraak Native Title Aboriginal Corporation • Ngadju Native Title holders	2012-2016	Consultation was undertaken to identify the relevant traditional owner groups and engage them to undertake heritage surveys and provide feedback on the Proposal. Comprehensive description of the proposed project and preferred alignment was provided to the Goldfields Land and Sea Council via the 'Activity Notice' process required under the Esperance Nyungar Government Standard Heritage Agreement.	The field surveys raised the following concerns: • preventing emus crossing the landscape • access to water (rivers) • employment • site monitors • rehabilitation • formal assessment of sites which cannot be avoided • diversion of the fence around identified cultural sites • fence should stay as close to farm fences as possible • Heritage Monitoring Plan.	Archaeological and ethnographic surveys were subsequently completed by the Esperance Nyungar and Ngadju Native Title holders on the proposed alignment in mid-late 2015. Reports and recommendations on the findings of the archaeological and ethnographic reports have been considered by DPIRD, the DAA and the EERG. Alterations have been made to the final alignment to minimise any impacts to Aboriginal places in consultation with the Department of Planning, Lands and Heritage and Traditional Owners. A response was provided by DPIRD to the concerns raised by the Esperance Tjaltraak Native Title Aboriginal Corporation after the survey in January 2016.
Esperance Nyungar Claim Group	28 February 2013	Meeting presentation.	No formal comments or issues raised in the presentation. Comment made by one attendee that people should consider not farming livestock and they should eat kangaroos and emus instead.	No information was provided regarding a response to the issues raised.
Southern Landholders	1 and 28 March 2013	Question and Answer forum and Proposal briefing.	1. Do I have to give up land to provide access for fence construction and maintenance? 2. Why do east- west alignment properties have their fence constructed and maintained where north-south alignment properties must construct their own barrier fence? 3. Will I have to maintain my section of the fence? Will there be money available for materials or labour required for maintenance and repairs? Do we have to use the same design as the SBF EE? 4. If I am not given the same protection as other landholders will I be expected to pay towards a rate that I don't get any benefit from? 5. What is the government going to do about the wild dogs/emus/kangaroos coming onto our properties from your government land if we don't get a fence? 6. What about the emu traps? Are these going to be used when there is an emu migration? How are you going to control the emus when they travel along the fence and come onto my property at the end of the fence? 7. Who is going to manage the weeds along the outside of the fence? If there is a track put in on the outside who will manage that? 8. For the East West section are there going to be gates allowing us to access the crown land?- we have picnic spots we like to go to. 9. If some landholders along the North/South do not take up the grant/funding for the private boundary fence upgrade, we might end up with a bigger problem than before with animal coming in through the gaps! What are you going to do about this? How are you going to ensure everyone maintains their bit of fence? 10. Will the Dogger be trapping and baiting along the track on the outside of the fence? How will we know if there is a trap set on the fence?? What will be done to protect my family/workers/working dog to protect them from traps/baits near my property boundary?	1. DPIRD proposes that landholders along the 'North South' alignment will be offered funds towards upgrading or replacing existing farm boundary fencing to the standard of the Esperance Extension SBF. As this will be a grant direct to each landholder, it will be their own responsibility to manage the construction and maintenance of this landholder owned property boundary fence. An agreement may be required as part of the funding that commits landholders to ongoing maintenance of their own boundary fence to emu and dog standard, with a specific standard being defined. 2. A DPIRD-commissioned scoping study has been completed as part of the southern extension of the State Barrier Fence (Esperance Extension). The goal of the study was to identify the 'least-constrained' alignment option, which was found to be at the interface of farm land with unallocated crown land along the 'East West' alignment. Lands further south to this were considered highly constrained on public lands. The same protection from emus, wild dogs and kangaroos can be offered to landholders who would like to take up the offer for boundary fence upgrades to the same specifications as the SBF. 3. For those landholders taking up the grant to upgrade boundary fences to SBF standard, the maintenance will be the responsibility of individual landholders. An agreement may be required as part of the funding that commits landholders to ongoing maintenance of their own boundary fence to emu and dog standard, with a specific standard being defined. 4. The SAR was based on the regional benefits and required landholders throughout the region to commit funds to the project as a whole, and was not levied on individual farmers receiving a direct benefit. However, there may be some review required of the SAR in light of the changes made to the alignment, as presented by the Shire of Esperance in the Referendum. 5. The Department of Agriculture and Food (DPIRD) takes an active role in supporting landholders in their responsibility to control wild dogs on their properties. Support is currently provided through Declared Species Groups (DSG's) in agricultural areas (NMDSG). The support provided to these organisations is intended to provide additional benefit to individual control efforts by adopting a community coordinated approach and by planning and undertaking operations across local or regional landscapes. The NMDSG receives such support from DPIRD and other key agencies, and we would encourage you to work with this group to participate in coordinated baiting programs. Other farm pests, such as emus, may be controlled through licences granted by the DEC, in smaller numbers. Where a significant emu migration event occurs (numbers in the thousands) DPIRD can be notified for further advice and support. 6. Where a significant emu migration event occurs (numbers in the thousands) DPIRD may choose to respond by assisting in humane control of emus, depending on the risks to infrastructure and agricultural lands. Each incident will be managed considering best practice pest animal control methods and animal welfare considerations. 7. The property boundary fence upgrade will not require additional maintenance tracks to be created on the outside of property boundaries as all boundary fence maintenance will be managed by the private landholder. Any weed management issues on UCL should be directed to DEC in the first instance, as is current practice. 8. There is no requirement for access gates to recreational areas to be provided from private properties. Any access to UCL or other reserves would be managed through existing management access tracks. Gates may be placed along the fence at strategic locations to allow access for maintenance and fire management activities, in negotiation with DEC or other Shire operational staff. These gate placements will be identified in the Project Implementation Plan, in partnership with these agencies. Any specific requests for gate placements should be directed to the Project Manager, Emily Lewis, for review in the Implementation Planning, which will be overseen by the Esperance Extension Reference Group. 9. For those landholders taking up the grant to upgrade boundary fences to SBF standard, the maintenance will be the responsibility of individual landholders. An agreement may be required as part of the funding that commits landholders to ongoing maintenance of their own boundary fence to emu and dog standard, with a specific standard being defined.

Stakeholder	Date	Form of consultation	Issues raised	Response to issues
				10. The operational procedures for Doggers are based on national standards and overseen by the NMDSG, who is provided funding for the Doggers. Any working dogs should be kept inside fences and out of reserves and UCL to protect from unintentional uptake of 1080 baits. Any trapping along private property fencing should be overseen by the NMDSG to ensure that Dogger and landholders are working cooperatively to manage these risks.
Goldfields Land and Sea Council/Ngadju Working Group Party	19 February 2014	Meeting.	No information provided on the concerns raised in the meeting.	No information was provided regarding a response to the issues raised.
Department of Planning, Lands and Heritage (DPLH)	27 March 2014	Teleconference.	Heritage survey requirements for the Proposal alignment. Issues/suggestions raised included: • wastage of public funds if the whole Proposal alignment was surveyed • DPIRD to consider the use of predictive modelling to identify potential heritage areas. Criteria to include waterways, availability of stone (breakaways), salt lakes, and level of impact • Identify potential ethnographic sites in addition to modelling outcomes • DAA available to advise and possibly undertake predictive modelling to inform scope of what is required for survey • DAA advised to initiate modelling first but also undertake consultation (with GLSC) – engagement is critical • DAA advice to liaise with DBCA with any changes to legislation • DAA offer to review Heritage Agreement.	• DPIRD to prepare an Aboriginal Consultation Plan • DPIRD to prepare a clear statement of what is intended and proposed consultation process – include in letter from DPIRD to DAA seeking advice on what Approvals are required under statute (including modelling results and identified potential ethnographic locations) • DPIRD to develop a Timeline for parallel processes and identify decision points, including at what stage to undertake the archaeological survey (especially in relation to confirmation of full funding).
Shire of Esperance	31 July 2013 and 2 August 2013	WA State Coastal Conference.	Discussions regarding: • Level 1 fauna and Level 2 flora reports • dieback surveys • weed management plans • erosion studies • cultural heritage surveys • fence construction design changes • alignment alterations onto private land. Significant alterations to the original scoping studies preferred (least constrained) alignment were recommended by the EERG.	DPIRD made changes to the preferred (least constrained) alignment to further minimise environmental and cultural impacts of the Proposal.
Various government and non-government stakeholders	June 2016	Public comments regarding the referral for the Proposal between 23 to 29 June 2016.	Issues raised by submissions included: • habitat fragmentation • alignment location through reserves and potentially national park with significant damage to vegetation • potential disturbance and damage to the biological richness and localised endemism within the vicinity of the Proposal • potential clearance of TECs and DRF and associated adverse impacts on regional significance • inadequate knowledge about the flora species that may be impacted by the Proposal.	These comments informed the EPA's preparation of the ESD (Appendix 1) and are addressed in this PER.
DBCA	29 November 2016	Teleconference to discuss the concerns raised by DBCA in their submission on the Proposal referral. Phone call to Threatened Species Branch to discuss the concerns regarding fauna aided seed dispersal.	Issues discussed included: • the potential risk to Western ground parrots were discussed in detail. Due to their very low numbers, even a low risk of collision was considered significant. The concern was regarding the potential for young dispersing birds which may come into contact with the fence. The proposed mitigation of high visibility fluorescent droppers was supported • potential for echidnas to become stuck. Although no specific evidence to suggest this risk, it has been identified due to the size of the animal and the potential to become stuck due to their quills • potential for effects on fauna aided seed dispersal by emus were identified in the eastern part of the Proposal alignment where there are no gaps. Follow up discussions with the Threatened Species Branch indicated that emus play a significant ecological role in the spread of Eremophila sp. and that passage through their gut may be important to trigger seed germination. No rare flora species in the agricultural area were identified that are likely to be affected • acknowledged that utilising the previously chained areas was supported.	The issues raised have informed the impact assessment outlined in the PER. Further advice regarding the potential for echidnas to become stuck was sought from Peter Mawson (Director of Animal Health and Research) at Perth Zoo. Peter Mawson provided the following advice: • echidnas can dig up to 3 m tunnels parallel to the surface and would have no trouble digging under the fence and lapwire • the gaps in the fence at the rivers will be utilised as preferred ecological corridors for echidnas • juvenile animals will likely pass through the 10x15 cm mesh size proposed • only a few individuals would need to cross the fence (in both directions) to maintain a healthy gene flow for the population that exists in the vicinity of the fence • entrapment of Echidnas due to their spines is only an issue if fences are electrified (no electrification planned for the Proposal). DPIRD staff who maintain the existing SBF have not reported ever finding an entrapped echidna over the last 15 years but have noted holes that could have been made by echidnas under the existing SBF.
DAA	8 December 2016	Meeting to discuss the scope of the heritage impact assessment.	Issues discussed included: • the cultural areas identified in the heritage surveys currently have no formal status as the Heritage Information Submission Form applications to have them recognised as sites under the AH Act have has not yet been made. DPIRD's planned avoidance of these areas where possible is supported • it was confirmed that heritage site disturbance that is prohibited under the AH Act without approval does not include any buffer zone provision. Therefore, the management areas outlined in the heritage surveys would have no formal status unless they were included in the listed heritage site.	Discussion informed the impact assessment of this factor.

Stakeholder	Date	Form of consultation	Issues raised	Response to issues
DAA	24 July 2013	Known Aboriginal Heritage and the State Barrier Fence Proposed Extension recommendations report.	1. DPIRD to avoid placing any fencing within the boundary of Protected Area 032 (DAA 2396 Reserve Stone Arrangement). Should this be an unavoidable requirement DPIRD should approach this Department to obtain specific and targeted advice relating to this particular. 2. DPIRD to take note that the majority of the proposed fence line is not addressed by Aboriginal heritage survey reports held by this Department. 3. DPIRD to take note of the predictive modelling for Aboriginal archaeological sites in the region as posited by Smith. As such, extra diligence should be undertaken when the fence line is installed over or close to granite outcrops, riverine systems and swampy country. 4. DPIRD to conduct its own Due Diligence Assessment of the Proposal acknowledging that the level of previous land disturbance along the fence changes. This should also factor in the exact activities which will be required to construct and maintain the Proposal alignment in order to ascertain the maximum level of disturbance which occurs as a result of the fence's installation. 5. DPIRD to consider re-contacting this Department for future advice relating to Aboriginal heritage and the SBF. Support could include the provision of more targeted advice as the Proposal evolves, advice on framing scope of works documents for heritage consultants (if DPIRD considers this necessary) and advice on obtaining approvals should this become an identified need.	-
Shire of Esperance	January 2013	Position statement of the Merivale Road section of the Proposal Alignment.	Following the release of the GHD (2012) scoping study, the following issues were raised: • fencing may reduce access to culverts and drainage offshoots • fencing may reduce the efficiency of the pipe culvert outfalls and drainage offshoots due to potential silting or blockage which can result in damage • the fencing may need to be frangible where fill batters or downward slopes exist, dependent upon clear zone requirements • fence may reduce access for heavy machinery to access cut batters or fill in the event of necessary maintenance. The Shire of Esperance does not agree to the installation of the proposed barrier fence along the Merivale Road. The Shire of Esperance preference is to install the proposed barrier fence within existing cleared farmland in a manner which will not affect overland drainage flows particularly during a 1 in 100 year flood event.	No records are available regarding the response provided at that time. However, the Proposal alignment has been modified onto private farm land near Merivale Road. Additional consultation undertaken by Project Manager with Shire Director and Manager of Asset Development.

7. Overview of existing environment

A number of field and desktop investigations have been conducted to identify the existing environmental values within the Development Envelope and the Esperance region. Details of field and desktop investigations have been provided in Section 8.

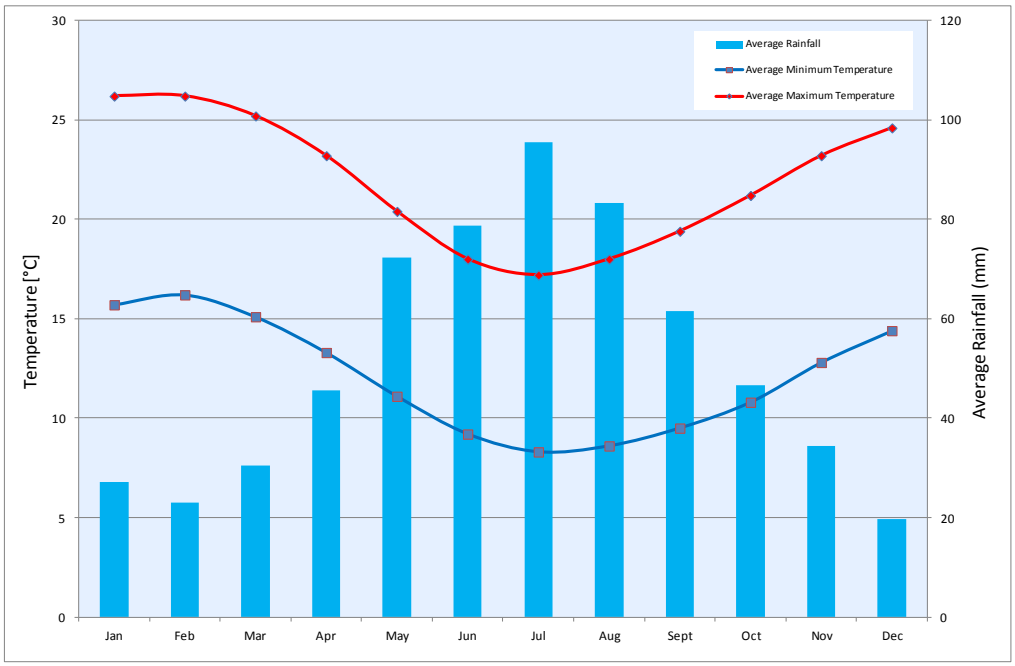
7.1 Physical characteristics

7.1.1 Climate

Esperance experiences a Mediterranean climate characterised by mild, wet winters and warm to hot, dry summers. The nearest Bureau of Meteorology (BoM) weather station to the Proposal is the Esperance Weather Station (station number 9789).

Average annual rainfall recorded (since 1969) at Esperance is 616.7 mm (BoM 2016). Rainfall may occur at any time of year; however most occurs in winter between June and August in association with cold fronts from the south-west. Highest temperatures occur from December to March with average monthly maximums ranging from 24.6°C in December to 26.2°C in February (BoM 2016). Lowest temperatures occur from June to September with average monthly minimums ranging from 8.3°C in July to 9.5°C in September (BoM 2016).

The monthly climate characteristics at Esperance are presented in Figure 7-1.



Monthly climate statistics data from BoM (2016)

Figure 7-1: Monthly climate statistics between 1969–2016 for Esperance, WA (Esperance Station No. 9789)

7.1.2 Geology, landform and soils

The Esperance subregion has variable relief, consisting of Quaternary coastal sandplains and dunes overlying Proterozoic gneiss and granite as well as Eocene and more recent coastal limestones (GS Bio Logic 2015).

7.1.3 Hydrology

Surface water

The Oldfield River (southwest of Cheadanup Nature Reserve [NR]), Young River (northeast of Cheadanup NR) and Lort River (west of Field Road) are the most significant drainage lines that intersect the Proposal alignment (Figure 1-2). These watercourses correspond with 'gaps' in the Proposal alignment which will not be fenced. There are also several unnamed, minor, ephemeral or seasonally inundated drainage lines that intersect the Proposal alignment, such as Thomas River (Figure 1-2).

The Proposal alignment is upstream from the Lake Gore and Lake Warden System RAMSAR wetlands. Both RAMSAR wetlands are close to the coast near Esperance and 67 km southeast and 46 km southwest (respectively) from the nearest point of the Proposal alignment. There are no significant drainage lines that discharge from the Proposal into either of these RAMSAR wetlands. Oldfield River discharges into Oldfield Estuary whilst the Young and Lort River discharge into Stokes Inlet (west of Lake Gore) (Ecoscape 2017a).

The Proposal alignment intersects extensive areas containing Salt Lake systems, particularly in the central portion. The salt lakes, with the exception of one location on the northwest of the Proposal alignment, have been avoided in the design of the Proposal alignment.

Groundwater

The western areas of the Esperance extension are located within the Kondinin-Ravensthorpe Groundwater area (GHD 2012). The construction and ongoing maintenance of the Proposal will not require the abstraction of groundwater or major ground disturbance. No impact from construction and maintenance of the Proposal on groundwater is expected.

7.2 Biological characteristics

7.2.1 Flora and Vegetation

Desktop and field environmental investigations undertaken from 2014 to 2016 for the Proposal have been used to inform Section 7.2.3.

Regional vegetation

The Western Australian Interim Biogeographic Regionalisation of Australia (IBRA) divides Australia into 85 bioregions based on biological and geographic/geological attributes (GHD 2012).

The Proposal alignment is located within five IBRA subregions. The location of where the Proposal alignment intersects these IBRA subregions, and IBRA subregion descriptions (Ecoscape 2017a; are detailed in Table 7-1.

Vegetation types within the Proposal area are diverse and include heath, coastal dune scrub, mallee, mallee-heath and granite heath (Comer et al. 2001).

Table 7-1: IBRA subregions intersecting Proposal alignment

IBRA subregion	Description	Proposal location	Source
Eastern Mallee MAL1	*The Eastern Mallee subregion comprises calcareous clays and loams as duplex soils that often contain sheet and modular kankar, outcrops of metamorphosed sandstone, and white and yellow sandplains and loamy plains with numerous saltpans (pan fields). Mallee on sandplains, samphire around small salt lakes, mallee and patches of woodland on clay, and scrub-heath on sandstone. Mallee with Boree (Melaleuca pauperiflora) on calcareous clay and loam. Climate is semi-arid (Dry) Warm Mediterranean and has 300-500 mm of annual rainfall during winter.*	Centre	Comer et al. (2002)
Western Mallee MAL2	*Western Mallee (MAL2) subregion has more relief than its eastern counterpart: main surface types comprise clays and silts underlain by kankar, exposed granite, sandplains and laterite pavements. Salt lake systems on a granite basement. Occluded drainage system. Mallee communities occur on a variety of surfaces;* Eucalyptus *woodlands occur mainly on fine-textured soils, with scrub-heath on sands and laterite. The climate is warm Mediterranean and annual rainfall is 250-500 mm. Total area of the subregion is 4 763 963 ha.*	Far west	Beecham & Danks (2001)
Esperance Plains Fitzgerald ESP1	*The ESP1 subregion has variable relief, comprising subdued relief on the sandplains of the coastal region, punctuated with metamorphosed granite and quartzite ranges both inland and on the coastal plain. It lies mainly on the Bremer Sedimentary Basin and the eastern and western sections of the ESP1 subregion within the Albany-Fraser Orogen of the Yilgarn Craton. It has extensive western plains over Eocene marine sediment basement with small areas of Gneiss outcropping. Archaean greenstones – sand sheets with varying levels of lateritisation with gravel soils also occurs. The region is dominated by duplex soils and deep and shallow sands on the plains and dissected areas and by shallow sandy soils on the mountain ranges.*	West	Comer et al. (2001a)
Esperance Plains Recherche ESP2	*ESP2 subregion has variable relief, comprising the Quaternary coastal sandplains and dunes overlying Proterozoic gneiss and granite as well as Eocene and more recent coastal limestones. Numerous granitic islands occur in the near shore area of this subregion. Vegetation comprises heath, coastal dune scrub, mallee, mallee-heath and granite heath. Vegetation types are diverse. The climate is Temperate Mediterranean, with 400-700 mm annual rainfall and total area is 1 606 517 ha.*	East	Comer et al. (2001b)
Eastern Goldfield COO3	*Coolgardie 3 lies on the Yilgarn Craton's 'Eastern Goldfields Terrains'. The relief is subdued and comprises of gently undulating plains interrupted in the west with low hills and ridges of Archaean greenstones and in the east by a horst of Proterozoic basic granulite. The underlying geology is of gneisses and granites eroded into a flat plane covered with tertiary soils and with scattered exposures of bedrock. Calcareous earths are the dominant soil group and cover much of the plains and greenstone areas. A series of large playa lakes in the western half are the remnants of an ancient major drainage line. The vegetation is of Mallees, Acacia thickets and shrub heaths on sandplains. Diverse Eucalyptus woodlands occur around salt lakes, on ranges, and in valleys. Salt lake support dwarf shrublands of samphire. Woodlands and Dodonaea shrubland occur on basic graninulites of the Fraser Range. The area is rich in endemic Acacias. The climate is Arid to Semi-arid with 200-300 mm of rainfall, sometimes in summer but usually in winter. The subregional area is 5, 102, 428 ha.*	North	Cowan (2001)

7.2.2 The Great Western Woodlands

The Great Western Woodlands is a continuous band of native vegetation that stretches north and east from the edge of the wheatbelt, covering almost 16 million hectares. The woodlands predominantly cover UCL, and most of the Proposal alignment fringes the edge of the woodlands.

The Great Western Woodlands is an internationally significant area of great biological richness. It is the largest remaining intact Mediterranean climate woodland on Earth (GHD 2012). The woodlands are still in excellent biological condition but are under increasing pressure from feral animals, weeds and bushfires. The conservation strategy for the Great Western Woodlands includes priorities for retaining the composition, structure and function of native ecosystems and to minimise clearing within the woodlands (DEC 2010).

The Great Western Woodlands is an ecologically significant area and impacts on the woodlands have been minimised where possible through alterations of the Proposal alignment.

7.2.3 Regional conservation values

Regional conservation values associated with the IBRA subregions are provided in Table 7-2.

Local conservation values for Flora and Vegetation, and Terrestrial Fauna are defined in Section 9 and Section 10.

Table 7-2: Summary of regional conservation values for IBRA subregions intersecting the Proposal alignment

IBRA subregions	Conservation values
Eastern Mallee MAL1	Key features include: • gypsum dunes at Lake Tay containing rare plants such as *Anigozanthos bicolor* subsp*. minor, Eremophila lactea, Myoporum turbinate* and *Ricinocarpos trichophorus* • rare birds such as Western Whipbird (*Psophodes nigrogularis oberon*), Western Ground Parrot (*Pezoporus wallicus*), Malleefowl (*Leipoa ocellata*), Cape Barren Goose (*Cereopsis novaehollandiae*), and Slender-billed Thornbill (*Acanthiza iredalei*) • rare mammal *Dasyurus geoffroii* • rare reptiles *Parasuta spectabilis bushi* locations • rare ecosystems including Mixed thicket complex of the Russell Range – includes dominants *Eucalyptus doratoxylon, Adenanthos oreophilus, Dampiera parvifolia, Monotoca oligarrhenoides*, Declared Rare Flora *Kennedia beckxiana*, and priority taxa *Leucopogon apiculatus* and *Chorizema nervosum.* (Source: Comer et al. [2002])
Western Mallee MAL2	Known special values in relation to landscape, ecosystem, species and genetic values include: • Critical Weight Range (CWR) mammals: 35–7 000 g weight range mammals threatened by fox predation such as Western Barred Bandicoot (*Perameles b. bougainville*) which is sub-regionally extinct • granite outcrops: important as seasonal resources and temporary refuge for fauna of surrounding habitats; Black-flanked Rock Wallaby and four species of reptiles are restricted to granite outcrops • Mallee Eucalypts and Melaleuca for Oil Production • gypsum dunes • Lake Bryde–East Lake Bryde, and Lake Cronin • Eucalypt Woodlands. (Source: Beecham & Danks [2001])
Esperance Plains Fitzgerald ESP1	Known special values in relation to landscape, ecosystem, species and genetic values include: • Near Shore Islands such as Bald Island, Doubtful Island, Red Islet, Glasse Island, Cheyne Island • rare ecosystems include Stirling Range Montane Thicket and Heath of the South-West Botanical Province • DRF includes: *Dryandra montana*, *Sphenotoma drummondii* and *Andersonia axilliflora*, other priority taxa are *Adenanthos filifolius*, *Calothamnus crassus* and *Andersonia echinocephala* • vegetation communities of the Ravensthorpe Range–*Eucalyptus argyphea* low forest on magnesite on ridgetops and upper slopes. Species include *Beyeria brevifolia*, *Eremophila latrobei*, *Lasiopetalum rosmarinifolium*, *Leucopogon carinatus*, *Melaleuca striata* and *Scaevola densifolia* • Thumb Peak/Mid Mount Barren Woolburup Hill Eucalyptus acies mallee heath–DRF includes *Coopernookia georgei*, *Daviesia obovata* and *Grevillea infundibularis*

IBRA subregions	Conservation values
	• Montane Mallee Thicket Community, including *Banksia brownii*, *B. solandri*, *Eucalyptus marginata* and *Kunzea montana* • Vulnerable and Specially Protected Fauna including the following birds: Noisy Scrub-bird (*Atrichornis clamosus*), Western Ground Parrot (*Pezoporus wallicus*), Western Bristlebird (*Dasyornis longirostris*), Western Whipbird (*Psophodes nigrogularis*), Malleefowl (*Leipoa ocellata*), Carnaby's Black Cockatoo (*Calyptorhynchus latirostris*), Little Bittern (*Ixobrychus minutus*), Australian Bustard (*Botaurus poiciloptilus*), Shy Heathwren (*Hylacola cauta*) and Rufous Fieldwren (*Calamanthus campestris*) • CWR mammals such as the Dibbler (*Parantechinus apicalis*), Heath Rat (*Pseudomys shortridgei*), Red-tailed Phascogale (*Phascogale calura*), Brush-tailed Phascogale (*Phascogale tapoatafa*), Southern Brown Bandicoot (*Isoodon obesulus*), Tammar Wallaby (*Macropus eugenii derbianus*), Western Brush Wallaby (*Notomacropus [Macropus] irma*), Water Rat (*Hydromys chrysogaster*) and Numbats (*Myrmecobius fasciatus*, which have been released into Stirling Range National Park) • reptiles such as *Lerista viduata* and Carpet Python (*Morelia spilota*) • rare invertebrates *Moggridgea* sp. S and *Rhytidid* sp. Undescribed. (Source: Comer et al. [2001a])
Esperance Plains Recherche ESP2	Known special values in relation to landscape, ecosystem, species and genetic values include: • the Recherché Archipelago, which incorporates 105 islands comprising 9720 ha or 97.2 square km in size, containing distinct land flora which incorporates representations of the nearby mainland flora plus species restricted to islands. Rare ecosystems include: • vegetation communities of *Eucalyptus megacornuta* on the Ravensthorpe Range (Bandalup Hill) - *Eucalyptus argyphea* low forest on magnesite on ridgetops and upper slopes; species include *Beyeria brevifolia*, *Eremophila latrobei*, *Lasiopetalum rosmarinifolium*, *Leucopogon carinatus*, *Melaleuca striata* and *Scaevola densifolia* • Pink Lake – Stromatolite Community Number 3 of Coastal Hypersaline Lakes. Dominant species are *Dunaliella salina* and *Microcoleus vaginatus*, with *Charadrius rubricollis* • Esperance Sandplain – Scrub heath on deep sand with Banksia and Lambertia, and Banksia scrub heath on sandplain. Includes the dominants *Banksia speciosa*, and *Lambertia inermis* and priority taxa *Andersonia macranthera*, *Comesperma acerosum*, *Dampiera sericantha* • Mixed thicket complex of the Russell Range – includes dominants *Eucalyptus doratoxylon*, *Adenanthos oreophilus*, *Dampiera parvifolia*, *Monotoca oligarrhenoides*, DRF *Kennedia beckxiana*, and priority taxa *Leucopogon apiculatus* and *Chorizema nervosum*. DRF include: *Lambertia echinata* subsp. *echinata*, *Eucalyptus insularis*, *Anigozanthos bicolor minor, Conostylis lepidospermoides, Eremophila denticulate denticulata, Eucalyptus merrickiae, Marianthus villosus.* Priority plants include: *Kunzea similis* (Bandalup Hill), which is currently under threat from mining. Vulnerable and Specially Protected Fauna: • Threatened birds e.g. Western Ground Parrot (*Pezoporus wallicus flaviventris*), Malleefowl (*Leipoa ocellata*), Recherche Cape Barren Goose (*Cereopsis novaehollandiae grisea*), Carnaby's Cockatoo (*Calyptorhynchus latirostris*), Peregrine Falcon (*Falco peregrinus*) and Australasian Bittern (*Botaurus poiciloptilus*) • Threatened mammals including the Chuditch (*Dasyurus geoffroii*), Red-tailed Phascogale (*Phascogale calura*), Black-footed Rock-wallaby (*Petrogale lateralis lateralis*), Recherche Blackfooted Rock-wallaby (*Petrogale lateralis hacketti*), Heath Rat (*Pseudomys shortridgei*) and Dibbler (*Parantechinus apicalis*) • Priority mammals such as Tammar wallaby (*Macropus eugenii derbianus*) • reptiles such as *Parasuta spectabilis bushi* (a form of the Mallee black-headed snake), the gecko *Phyllodactylus* sp. Cape Le Grand, and Carpet Python (*Morelia spilota imbricata*). (Source: Comer et al. [2001b])

IBRA subregions	Conservation values
Eastern Goldfield COO3	Known special values in relation to landscape, ecosystem, species and genetic values include: • Rowles Lagoon, Clear and Muddy Lakes • Plant assemblages of the Fraser Range Vegetation Complex • Plant assemblages of the Woodline Hills • Swan Lake. Plant and Community Special Values include • DRF include: *Gastrolobium graniticum, Pityrodia scabra, Daviesia microcarpa*, and *Eucalyptus platydisca*. Communities include arid zone eucalypt woodlands. Fauna Special Values include: • Vulnerable and specially protected fauna Malleefowl (*Leipoa ocellata*), Carpet Python (*Morelia spilota imbricata*), Peregrine Falcon (*Falco peregrinus*), Chuditch (*Dasyurus geoffroii*) and the Freckled Duck (*Stictonetta naevosa*). (Source: Cowan [2001])

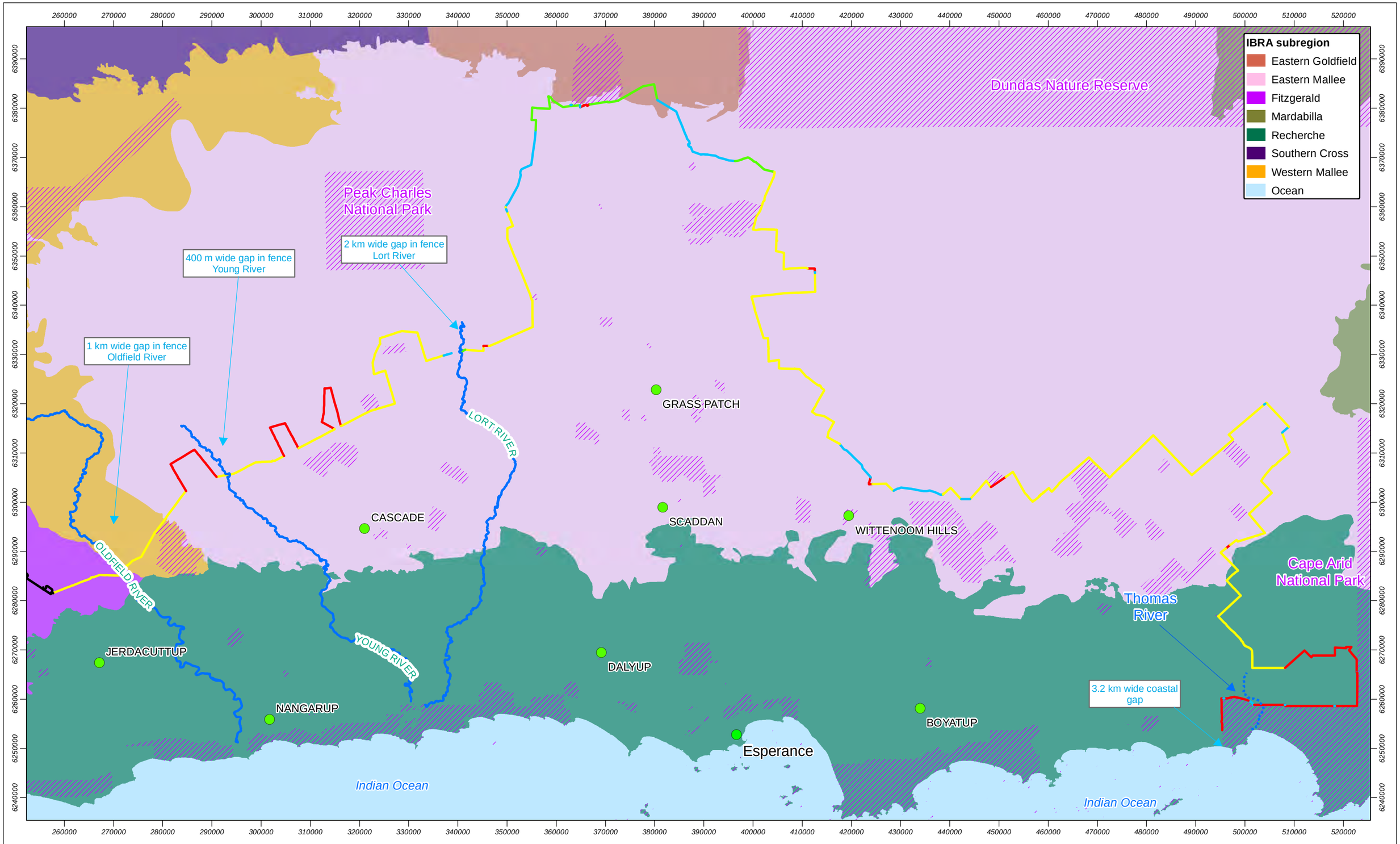


Figure 7-2: IBRA subregions

Scale 1:708,000 at A3

km
0 2 4 6 8 10

Coordinate System: GDA 1994 MGA Zone 51
Note that positional errors may occur in some areas
Date: 1/08/2017
Author: DWhite
Source: Aerial: ESRI approx. 2010; Data: Client 2016; Reserves: DPaW: 2012; IBRA subregions: DEWHA 2012.
Path: Q:\Consult\2016\DAF\DAF16515\ArcMap_documents\R001\DAF16515_01_R001_RevE_F007-2.mxd

Legend

- Town
- Reserves
- Existing SBF
- Major watercourses
- Minor creekline
- **Proposal alignment existing environment conditions**
- Previously chained firebreak
- Existing track or graded firebreak
- Previously cleared freehold farmland
- Uncleared vegetation

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7.3 Socio-economic characteristics

The towns of Ravensthorpe and Hopetoun are the major population and activity centres within the Shire of Ravensthorpe with mining, construction, farming (agriculture, forestry and fishing) and tourism the main employment sectors.

The township of Esperance within the Shire of Esperance is the main population hub and service centre for the surrounding region and is located on the coastline. Esperance holds the only port in the southeast of WA that is serviced by road and rail freight. The main employment sectors include agriculture, forestry, fishing, retail, health care and social assistance.

7.3.1 Land use

The dominant land tenure and uses within the eastern South Coast include:

- UCL and Crown reserves, including conservation reserves
- grazing: native pastures – leasehold and freehold
- grazing: improved pasture
- cultivation: dry land agriculture
- forestry plantation
- conservation
- mining leases.

7.3.2 Other tenure

A large portion of the Proposal alignment occurs along agricultural properties on freehold land. Further inland are conservation reserves and vacant crown land as UCL. The boundaries of several mining tenements occur along the Proposal alignment; however, the Proposal alignment does not intersect with any active mining operations (DAA 2016).

8. Environment studies and survey effort

Details of environmental studies and surveys undertaken are provided in Table 8-1. These supporting studies are included in Appendix 3. Environmental survey areas have been provided in Figure 8-1.

Table 8-1: Summary of environmental studies and surveys

Factor	Consultant	Survey/investigations name	Study area, type and timing	Study standard/guidance and limitations
Flora and Vegetation Heritage Terrestrial Fauna	GHD	Report for State Barrier Fence Extension Scoping Study (GHD 2012)	Flora and fauna field assessment covered 100 m wide area along the entire length of all proposed alignment options. Due to the large survey size, field surveys only assessed key sites within this 100 m wide corridor along the Proposal alignment. The heritage assessment was undertaken for a 200 m corridor (100 m either side of the centre line of the identified Proposal options). A Level 1 flora and fauna field investigation was conducted in May 2012. Desktop assessment of registered Aboriginal Heritage matters; and extent of Dieback and propensity for the spread of Dieback for various alignment options for the Proposal. Report completed September 2012.	The survey was consistent with a single season Level 1 flora and vegetation survey in accordance with EPA requirements for environmental surveying and reporting for flora and vegetation in WA as outlined in the following documents: • Guidance Statement No. 51–Terrestrial Flora and Vegetation Surveys for Environmental Impact Assessment in Western Australia, June 2004 • Position Statement No. 3–Terrestrial biological surveys as an element of biodiversity protection, March 2002. Single season Level 1 fauna survey was conducted in accordance with EPA Guidance Statement No. 56 (EPA 2004). Guidance requirements were met in regard to botanical and zoological surveys regarding: • experience of staff in floristic and habitat surveys • timing of the survey (in spring which is considered the optimal season condition for floristic surveys) • survey sampling design and intensity (which considered regional and area specific environmental attributes such as landform, habitat, vegetation structure, potential for DRF and other conservation significant biota)–these environmental attributes were determined through a desktop investigation (including aerial photographs) to assess a number of features which could influence the least constrained alignment option • consideration of results from previous environmental investigations such as the GHD (2012) reconnaissance survey –for example, key sites were selected on the basis of previous Beard (1973) vegetation mapping, geology and soils mapping, access and aerial photography. Targeted searches were conducted in locations likely to support conservation significant flora and significant environmental features likely to influence the Proposal alignment based on desktop and previous investigations. <u>Limitations:</u> • limited biological investigations available for the area • accuracy of online resources when conducting the desktop assessment, information was based on broad scale information sources • lack of access in certain areas to comprehensively assess the bio-physical landforms • single site survey between 22–29 May 2012 for the flora, vegetation and fauna survey resulted in only key species identified based on the desktop assessment, and some species may not have been detected based on their life span (e.g. annuals), differences in flowering times, climatic and stochastic events (such as fire), and species that are low in abundance

Factor	Consultant	Survey/investigations name	Study area, type and timing	Study standard/guidance and limitations
				• the survey was not conducted at the optimum time of year to record certain flora species, such as annuals, or to obtain the necessary flowering and fruiting material required to identify certain plants; however, there are recommendations in the report to suggest that further investigations are required in Spring to record plants not identified in the GHD (2012) field surveys. Scoping study provides a broad scale understanding of the main flora and fauna constraints along the various alignment options for the Proposal.
Flora and Vegetation Terrestrial Fauna	Ecoscape	State Barrier Fence Biological Surveys (Ecoscape 2017a)	Survey area comprises 6430 ha and is a100 m wide easement following the Proposal alignment (640 km length including an optional section). Desktop review and field surveys for Level 2 flora, Level 1 fauna and dieback. The Dieback assessment was conducted in 2014 by Glevan Consulting (Glevan 2015). Field surveys were undertaken on six survey periods between October–December 2013; and September–October 2014. Report completed July 2015.	The survey was consistent with a single season Level 2 flora and vegetation survey in accordance with EPA requirements for environmental surveying and reporting for flora and vegetation in WA as outlined in the following documents: • Guidance Statement No. 51–Terrestrial Flora and Vegetation Surveys for Environmental Impact Assessment in Western Australia, June 2004 • Position Statement No. 3–Terrestrial biological surveys as an element of biodiversity protection, March 2002. Dieback assessments were conducted to comply with: • Guidance Statement No. 56 (EPA 2004), and EPA & DEC 2010) Technical Guide–Terrestrial Vertebrate Fauna Surveys for Environmental Impact Assessment. Single season Level 1 fauna survey was conducted in accordance with EPA Guidance Statement No. 56 (EPA 2004). Guidance requirements were met in regard to botanical and zoological surveys regarding: • experience of staff in floristic and habitat surveys • timing of the survey (in spring which is considered the optimal season condition for floristic surveys) • survey sampling design and intensity (which considered regional and area specific environmental attributes such as landform, habitat, vegetation structure, potential for DRF and other conservation significant biota) • consideration of results from previous environmental investigations such as the GHD (2012) reconnaissance survey. Targeted searches were conducted in locations likely to support conservation significant flora based on desktop and previous investigations. <u>Limitations:</u> • a total of 860 flora taxa were identified from the survey area of which 33 (3.9%) could not be identified to species level due to lack of reproductive material • limited flora and vegetation surveys/reports available at the time that cover the vicinity of the survey area–few area-specific references were available for fauna, however there were adequate resources to identify fauna species • a few days of the field survey were 'rained out', making some areas temporarily inaccessible however no areas were left unsurveyed due to weather conditions • annual conditions were average or above based on rainfall records prior to the surveys–daily weather conditions varied from good to poor (rain and low temperatures) and may have resulted in low fauna activity and detection levels.

Factor	Consultant	Survey/investigations name	Study area, type and timing	Study standard/guidance and limitations
Flora and Vegetation	Ecoscape	State Barrier Fence Esperance Extension Assessment of the Eucalypt Woodlands of the Western Wheatbelt Threatened Ecological Community (Ecoscape 2016)	Desktop assessment of the Proposal alignment for potential extent of the TEC 'Eucalypt Woodlands of the Western Australian Wheatbelt'.	NA.
Terrestrial Fauna	M.J. & A.R. Bamford Consulting Ecologists	Risk assessment of the proposed extension to the State Barrier Fence on the Brush Wallaby (Everard & Bamford 2016)	Desktop risk assessment and based on scientific literature review of the Bush Wallaby to provide *"Advice on whether the reserves inside the fence could support viable populations, how much movement/genetic variation may be required to maintain viable populations, and any other information that will help the EPA determine the risk that the barrier fence poses to the Brush Wallaby"*. Desktop risk assessment related to potential for population fragmentation and changes in the abundance of predators and competitors due to the construction of the Proposal.	NA.

Factor	Consultant	Survey/investigations name	Study area, type and timing	Study standard/guidance and limitations
Flora and Vegetation Terrestrial Fauna	Great Southern Bio Logic (GS Bio Logic) Environmental Solutions	Biological Surveys of the State Barrier Fence – Merivale Road Reserve Realignment – Cape Arid (GS Bio Logic 2015)	Study area: 100 m wide corridor adjacent to Merivale Road located on the edge of a larger patch of remnant vegetation and close to Cape Arid National Park. Desktop review and field surveys for Level 1 flora and Level 1 fauna survey, and dieback assessment for an additional 1.63 km section of UCL previously not surveyed. Flora survey was conducted in September 2015, and the dieback assessment and fauna survey was conducted in August 2015. Report completed September 2015.	The surveys were consistent with a single season Level 1 flora and vegetation survey in accordance with EPA requirements for environmental surveying and reporting for flora and vegetation in WA as outlined in the following documents: • Guidance Statement No. 51–Terrestrial Flora and Vegetation Surveys for Environmental Impact Assessment in Western Australia, June 2004 • Position Statement No. 3–Terrestrial biological surveys as an element of biodiversity protection, March 2002 • Dieback assessments were conducted to comply with: ∗ *Phytophthora* dieback interpreter's manual for lands managed by the department (DPaW 2015). Single season Level 1 fauna survey was conducted in accordance with EPA Guidance Statement No. 56 (EPA 2004). Guidance requirements were met in regard to botanical and zoological surveys regarding: • experience of staff in floristic and habitat surveys • timing of the survey in spring to conduct the floristic survey which is considered the optimal season condition for floristic surveys) • survey sampling design and intensity (which considered regional and area specific environmental attributes such as landform, habitat, vegetation structure, potential for DRF and other conservation significant biota) • consideration of results from previous environmental investigations such as the GHD (2012) reconnaissance survey and Ecoscape (2017a) biological survey. The Dieback assessment adopted a comprehensive transect survey method defined in the Phytophthora dieback interpreter's manual (DPaW 2015) to provide high confidence disease distribution information and hygiene classification data, and was also undertaken by a registered disease interpreter, also consistent with the Phytophthora dieback interpreter's manual. Targeted searches were conducted in locations likely to support conservation significant flora based on desktop and previous investigations. <u>Limitations:</u> • fauna field surveys were conducted in winter–fauna, particularly reptiles are likely to be less active in the winter months which may adversely impact detectability • invertebrates and other short-range endemics were not considered in the site reconnaissance • single site visit and climate conditions likely to have some impact on the effectiveness of the survey • difficulty in determining if a hollow bearing tree is hollow without a physical inspection therefore it is possible that some hollows may have been overlooked, however, based on the vegetation present this is unlikely • limited flora and vegetation and fauna surveys/reports available at the time to reference in the desktop assessment • narrow width of the study area (100 m) may not have detected all species as some fauna may utilise the study area intermittently for foraging • a precautionary approach was adopted in order to determine the likely presence of species. If suitable habitat was present in the desktop assessment, it was determined that the species could occur in the area and was assumed to have potential to utilise habitat within the site.

Factor	Consultant	Survey/investigations name	Study area, type and timing	Study standard/guidance and limitations
Terrestrial Environmental Quality	DAFWA & Precision Technology Solutions Esperance WA (2016)	*Soil and Land Conservation Act 1945* reports- (1) desktop study (DAFWA 2016e); (2) subsequent field investigation (PTS 2016) and (3) final recommendations report DAFWA 2016f)	Research and field investigations undertaken on potential high-risk erosion areas of the alignment and mitigation strategies adopted to minimise erosion potential.	N/A.
Flora and Vegetation	Glevan Consulting	State Barrier Fence Extension. Phytophthora Dieback occurrence assessment (Glevan 2015)	Dieback assessment completed for the Proposal alignment. Assessment was conducted in June and September 2014.	N/A.
Flora and Vegetation	Ecoscape	State Barrier Fence Weed Hygiene Plan (Ecoscape 2017a)	Weed management plan prepared for contractors if Proposal is approved.	N/A.
Heritage	Applied Archaeology Australia (AAA)	Report of an Aboriginal Cultural Heritage Survey of the State Barrier Fence Proposed Extension, Esperance Shire, Western Australia (AAA 2015)	Comprehensive archaeological and ethnographic Aboriginal heritage surveys completed for the Esperance Nyungar and Ngadju Determined Native Title lands for the Proposal. Not publically available.	The survey was conducted in accordance with the Esperance Nyungar Government Standard Heritage Agreement, EPA requirements for heritage surveys and the DAA guidance for conducting heritage surveys, as outlined in the following documents: • EPA Guidance Statement No. 41–Assessment of Aboriginal Heritage (2004). Perth, Western Australia • Department of Aboriginal Affairs and Department of Premier and Cabinet. Aboriginal Heritage – Due Diligence Guidelines, Version 3.0 (2013). Perth, WA. Guidance requirements were met in regard to the assessment of heritage by: • the landscape where the activity was to take place was assessed • the heritage matters were assessed on their relationship to the environment in which they occurred • the relevant Aboriginal heritage issues were identified and minimised • the Aboriginal heritage inquiry system was searched • the relevant Aboriginal people were consulted • the survey reports are provided to the EPA for review and the key findings are identified in the PER. <u>Limitations:</u> 1. The survey report fails to clearly identify any Aboriginal sites that do or could meet s 5 of the AH Act, and instead identifies “cultural places” (or similar) with minimal detail. Accordingly, DPIRD undertakes to avoid and minimise activity in the cultural places where possible and feasible. This distinction means the sites identified have no formal protection under the AH Act. 2. The survey was only able to identify surface material; there were no detailed excavations performed or remote sensing technologies applied once material was discovered. As such, more significant material may remain buried beneath the surface but the limited ground disturbance involved in building the fence has a very low risk of impacting this material.

Factor	Consultant	Survey/investigations name	Study area, type and timing	Study standard/guidance and limitations
				3. Some of the information gathered within the report was done so verbally and relied on the accounts and recollections of participants. Consequently, some of the information provided is unverifiable.
Heritage	Dr James Taylor Consultant Anthropologist	Anthropological Heritage Survey Work Area Clearance, Ngadju People (WAD6020/1998) DAFWA State Barrier Fence Esperance Extension (Taylor 2015)	Ethnographic Aboriginal Heritage surveys completed for the Ngadju Determined Lands of the Proposal. Not publically available.	The survey was conducted in accordance with the EPA requirements for heritage surveys and the DAA guidance for conducting heritage surveys, as outlined in the following documents: • EPA Guidance Statement No. 41–Assessment of Aboriginal Heritage (2004). Perth, Western Australia • Department of Aboriginal Affairs and Department of Premier and Cabinet. Aboriginal Heritage – Due Diligence Guidelines, Version 3.0 (2013). Perth, Western Australia. Guidance requirements were met in regard to the assessment of heritage by: • the landscape where the activity was to take place was assessed • the heritage matters were assessed on their relationship to the environment in which they occurred • the relevant Aboriginal heritage issues were identified and minimised • the Aboriginal heritage inquiry system was searched • the relevant Aboriginal people were consulted • the survey reports are provided to the EPA for review and key findings are identified in the PER. Limitations: • some of the information gathered within the report was done verbally and relied on the accounts and recollections of participants. Consequently, some of the information provided is unverifiable.

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Figure 8-1: Environmental survey areas

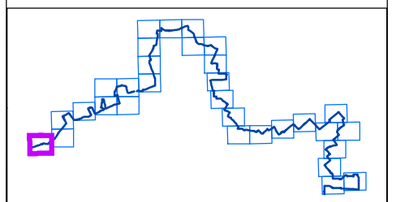


Legend

- Ecoscape (2015) study area
- Roads
- Major watercourses
- Parks and Wildlife Managed Lands and Waters

Proposal alignment existing environment conditions

- Previously chained firebreak



Scale 1:95,734 at A3

0 0.5 1 1.5 2 km

N

Coordinate System: GDA 1994 MGA Zone 51

Note that positional errors may occur in some areas

Date: 12/04/2017

Author: DWhite

Source: Aerial: ESRI approx. 2010; Inland waters: SLIP database, Landgate 2017

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Figure 8-1: Environmental survey areas

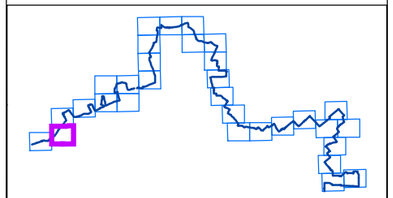


Legend

- Ecoscape (2015) study area
- Roads
- Major watercourses
- Parks and Wildlife Managed Lands and Waters

Proposal alignment existing environment conditions

- Previously chained firebreak
- Previously cleared freehold farmland



Scale 1:95,734 at A3

0 0.5 1 1.5 2 km

Coordinate System: GDA 1994 MGA Zone 51

Note that positional errors may occur in some areas

Date: 12/04/2017

Author: DWhite

Source: Aerial: ESRI approx. 2010; Inland waters: SLIP database, Landgate 2017

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Figure 8-1: Environmental survey areas

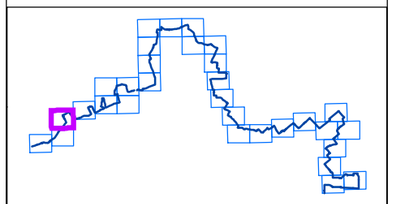


Legend

- Ecoscape (2015) study area
- Roads
- Major watercourses
- Parks and Wildlife Managed Lands and Waters

Proposal alignment existing environment conditions

- Previously chained firebreak
- Previously cleared freehold farmland



Scale 1:95,734 at A3

0 0.5 1 1.5 2 km

Coordinate System: GDA 1994 MGA Zone 51

Note that positional errors may occur in some areas

Date: 12/04/2017

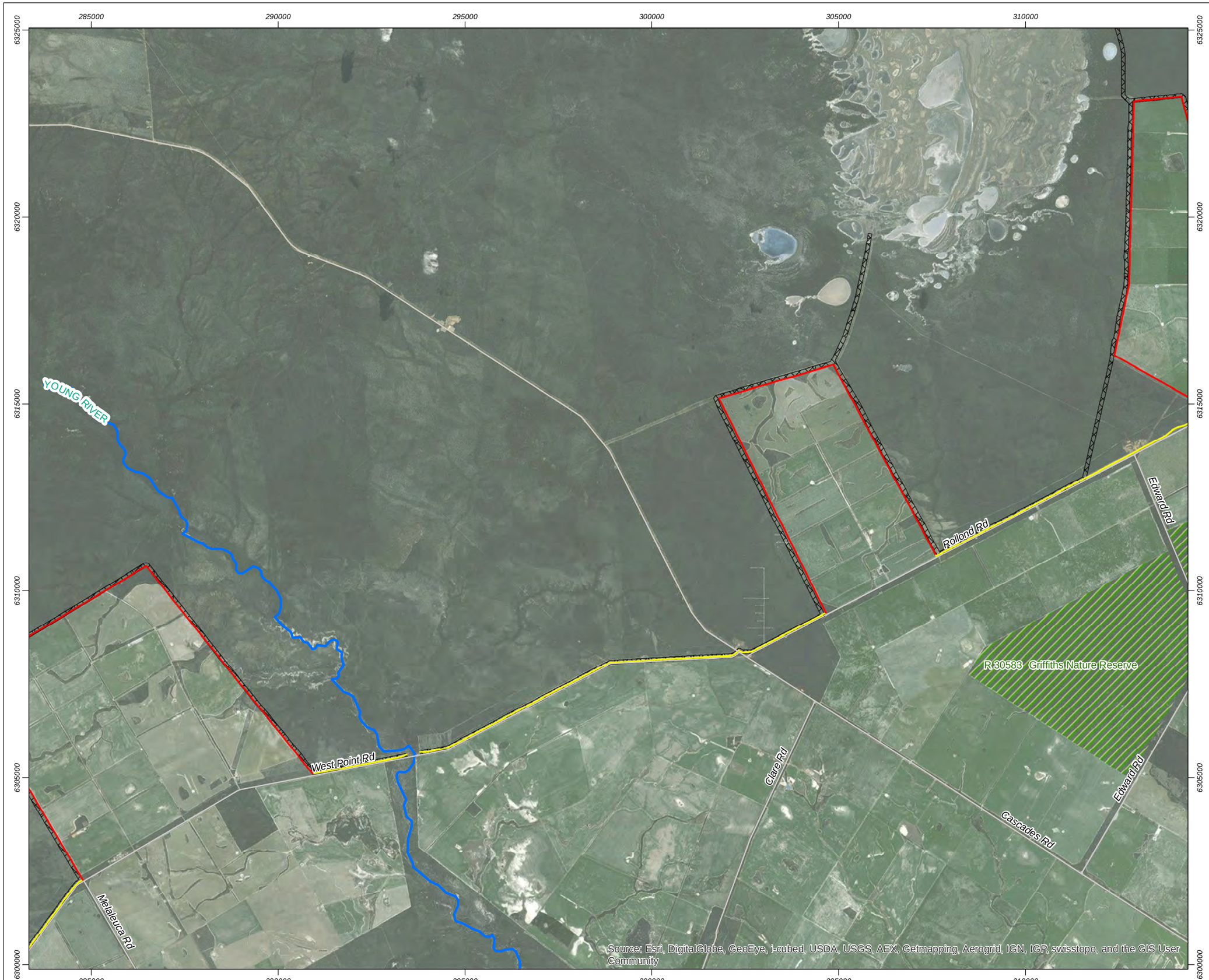
Author: DWhite

Source: Aerial: ESRI approx. 2010; Inland waters: SLIP database, Landgate 2017

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Figure 8-1: Environmental survey areas

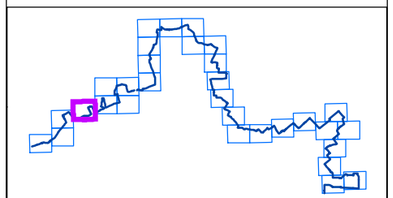


Legend

- Ecoscape (2015) study area
- Roads
- Major watercourses
- Parks and Wildlife Managed Lands and Waters

Proposal alignment existing environment conditions

- Previously chained firebreak
- Previously cleared freehold farmland



Scale 1:95,734 at A3

0 0.5 1 1.5 2 km

Coordinate System: GDA 1994 MGA Zone 51

Note that positional errors may occur in some areas

Date: 12/04/2017

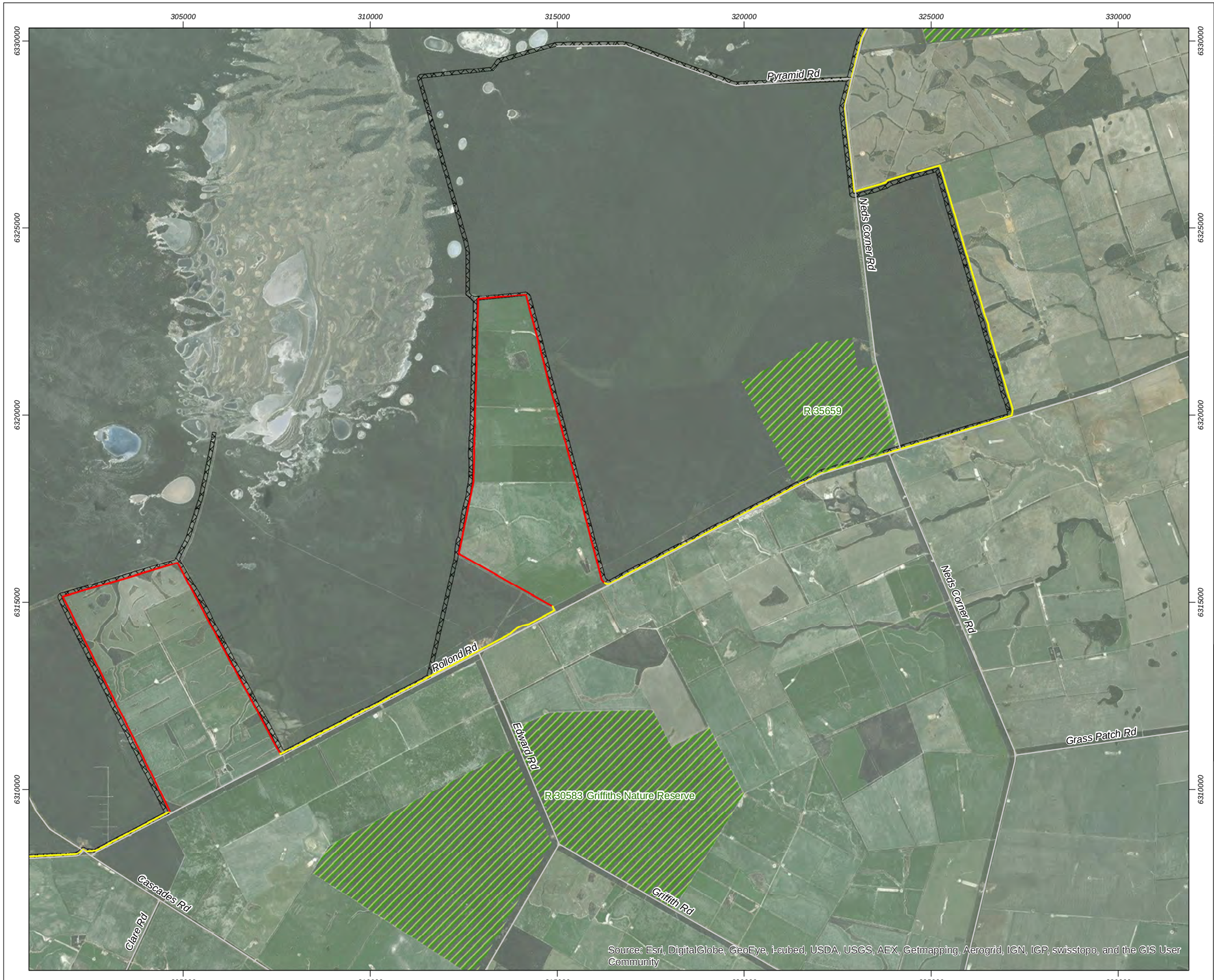
Author: DWhite

Source: Aerial: ESRI approx. 2010; Inland waters: SLIP database, Landgate 2017

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Figure 8-1: Environmental survey areas

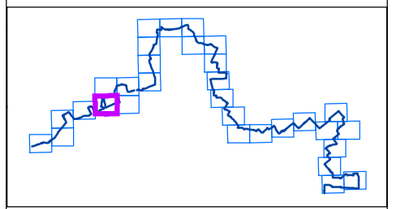


Legend

- Ecoscape (2015) study area
- Roads
- Parks and Wildlife Managed Lands and Waters

Proposal alignment existing environment conditions

- Previously chained firebreak
- Previously cleared freehold farmland



Scale 1:95,734 at A3

0 0.5 1 1.5 2 km

Coordinate System: GDA 1994 MGA Zone 51

Note that positional errors may occur in some areas

Date: 12/04/2017

Author: DWhite

Source: Aerial: ESRI approx. 2010; Inland waters: SLIP database, Landgate 2017

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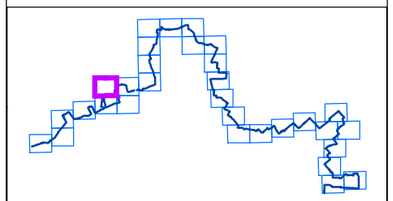


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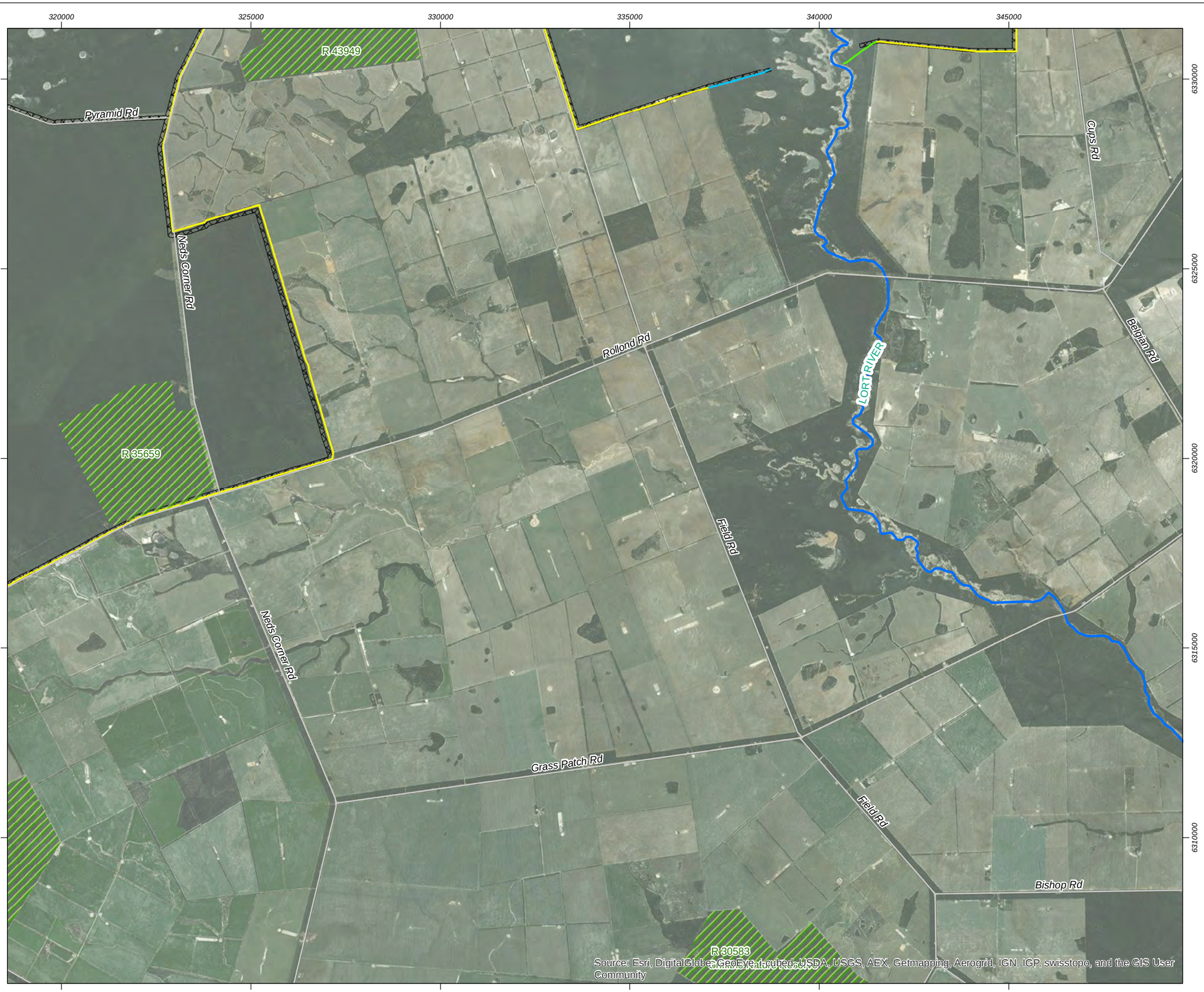
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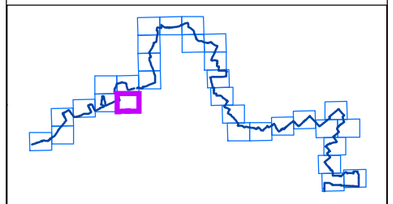


Legend

- Ecoscape (2015) study area
- Roads
- Major watercourses
- Parks and Wildlife Managed Lands and Waters

Proposal alignment existing environment conditions

- Previously chained firebreak
- Existing track or graded firebreak
- Uncleared vegetation



Scale 1:95,734 at A3

0 0.5 1 1.5 2 km

N

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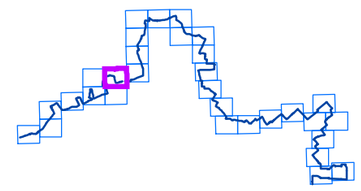


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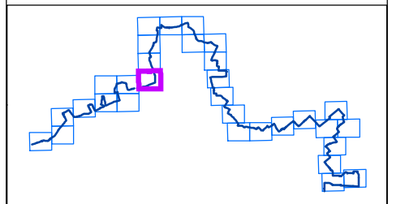


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Figure 8-1: Environmental survey areas

335000 340000 345000 350000 355000 360000 365000

6360000 6355000 6350000 6345000 6340000

Cups Rd
Ginlet Rd
Ainsworth Rd
Ginlet Rd
Hanson Rd
Ginlet Rd
Ginlet Rd
Salmon Gums West Rd
Donney Rd
Machen Rd
Old Kens Rd
Dundas Rd

Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

Legend

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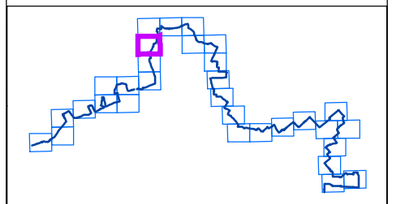


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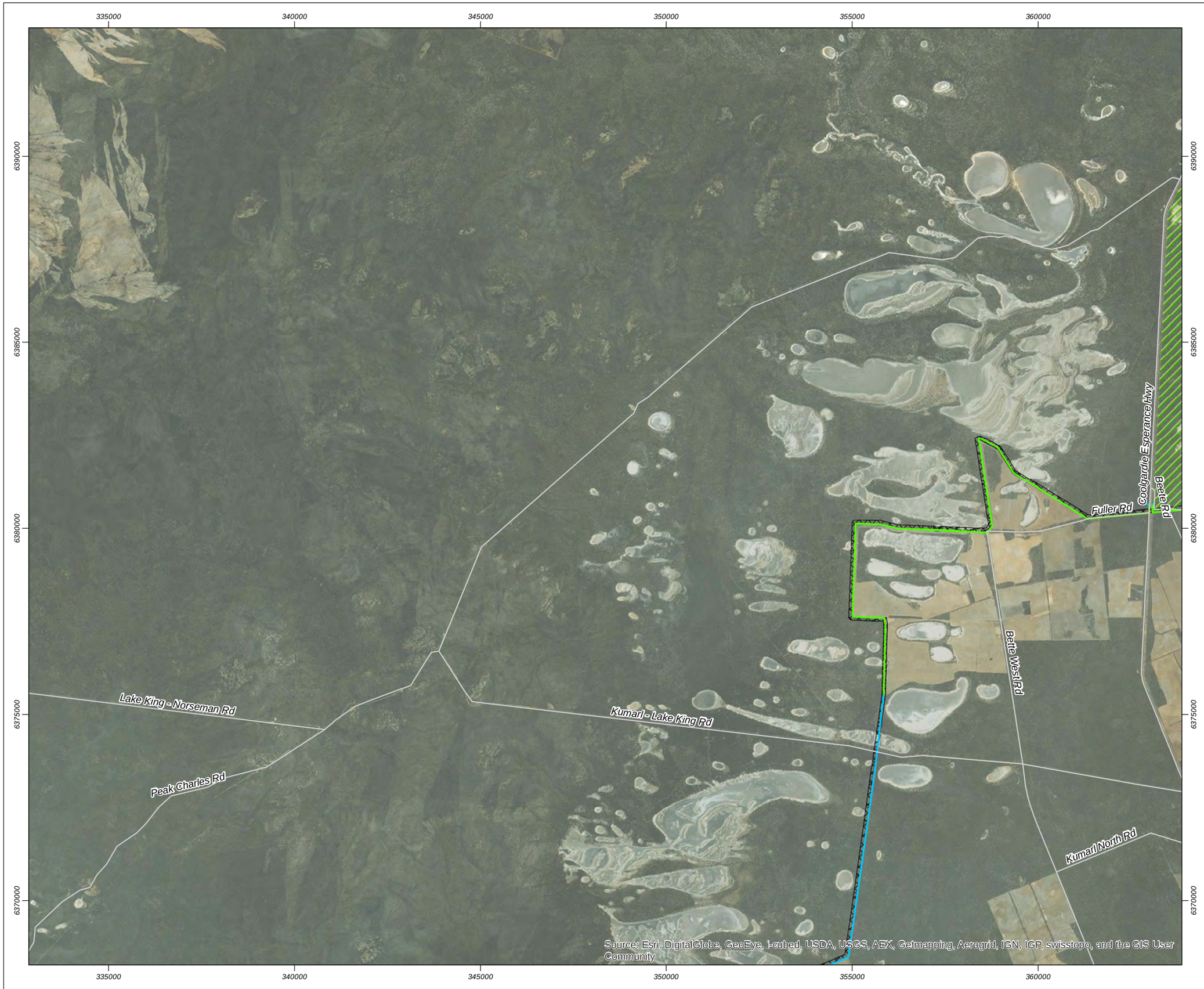
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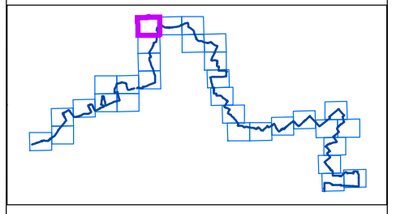


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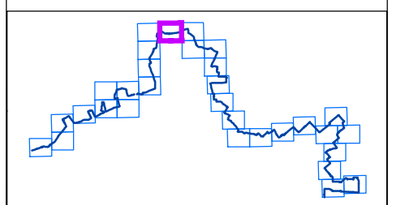


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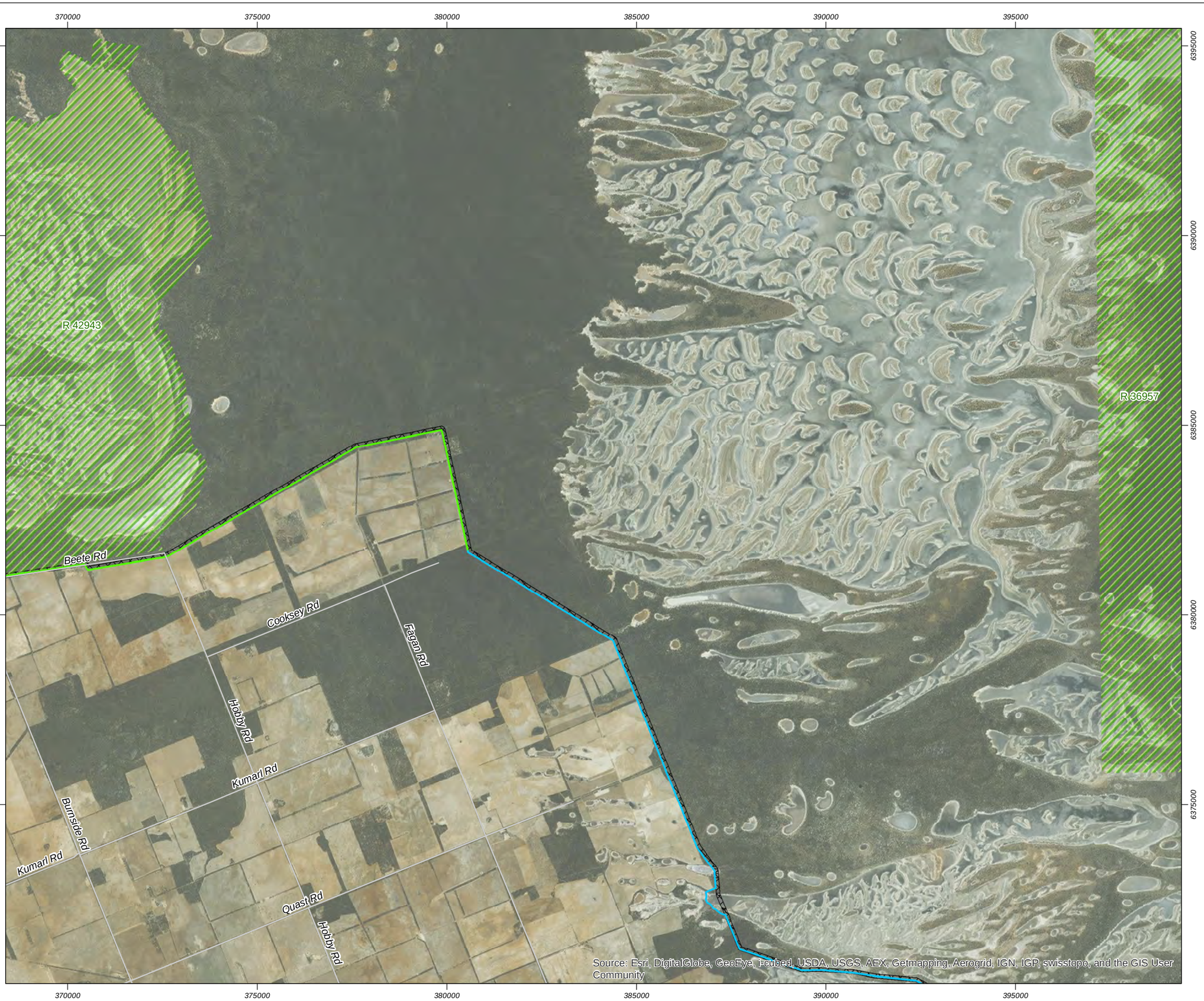
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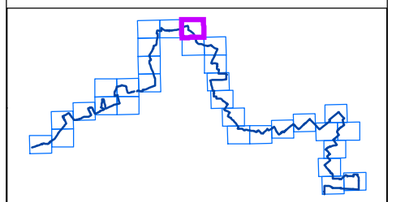


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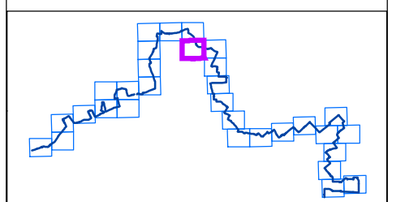


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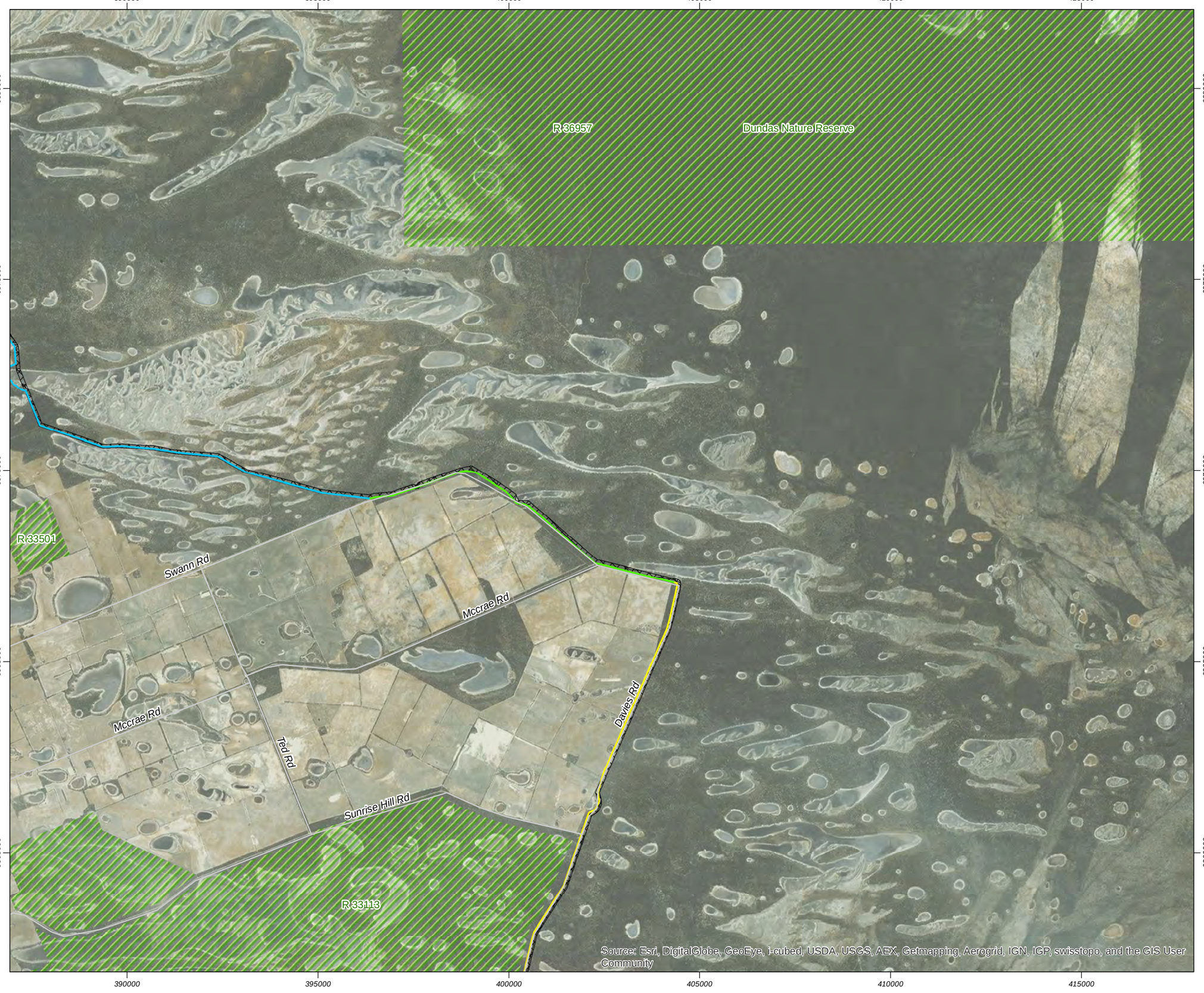
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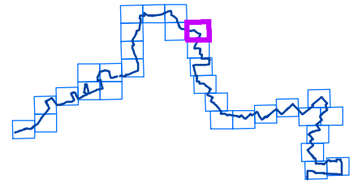


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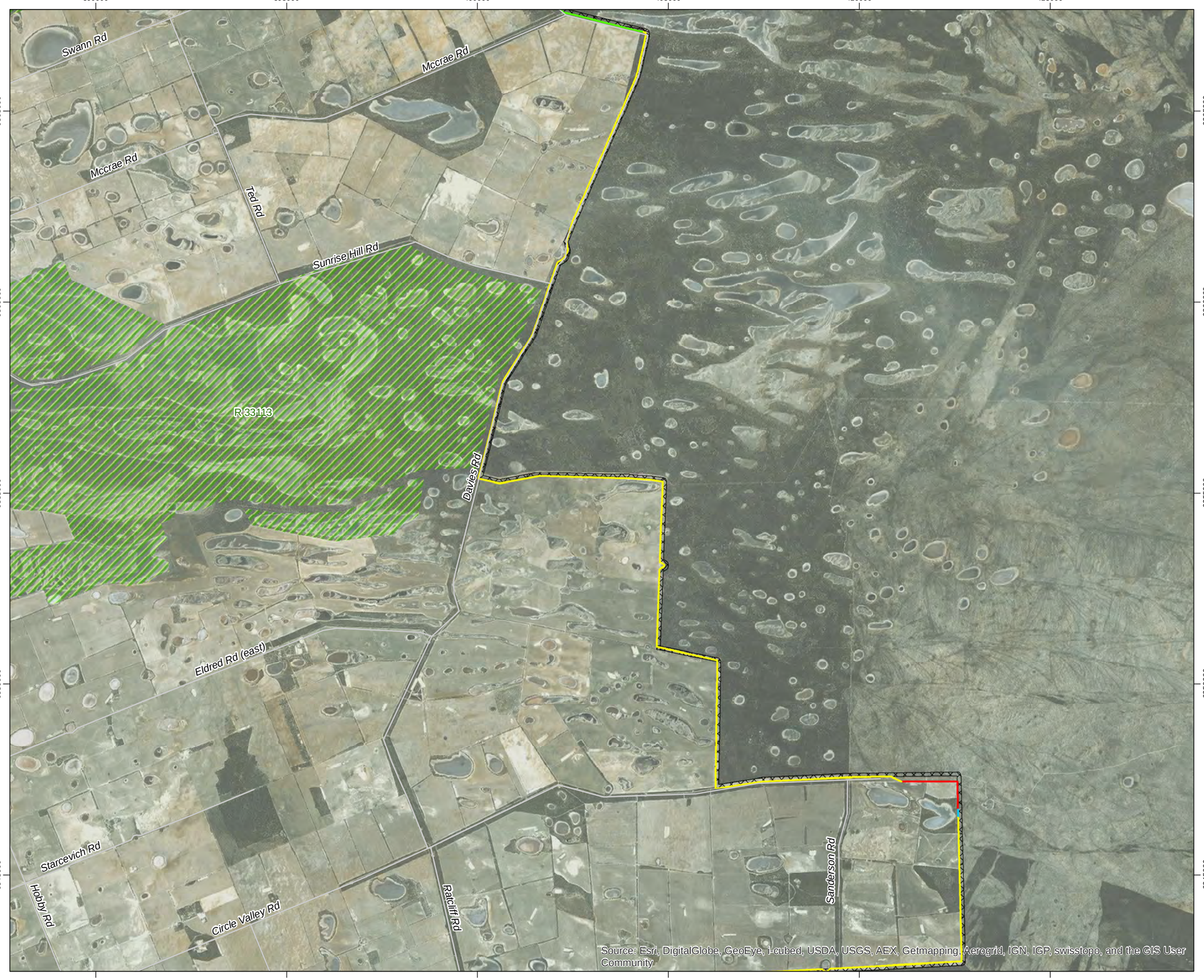
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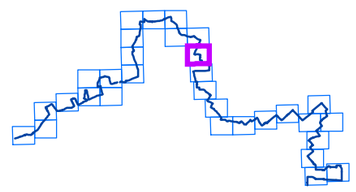


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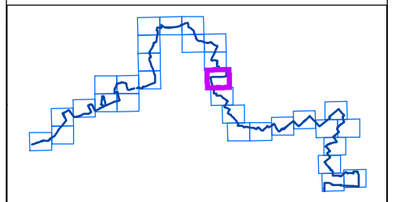


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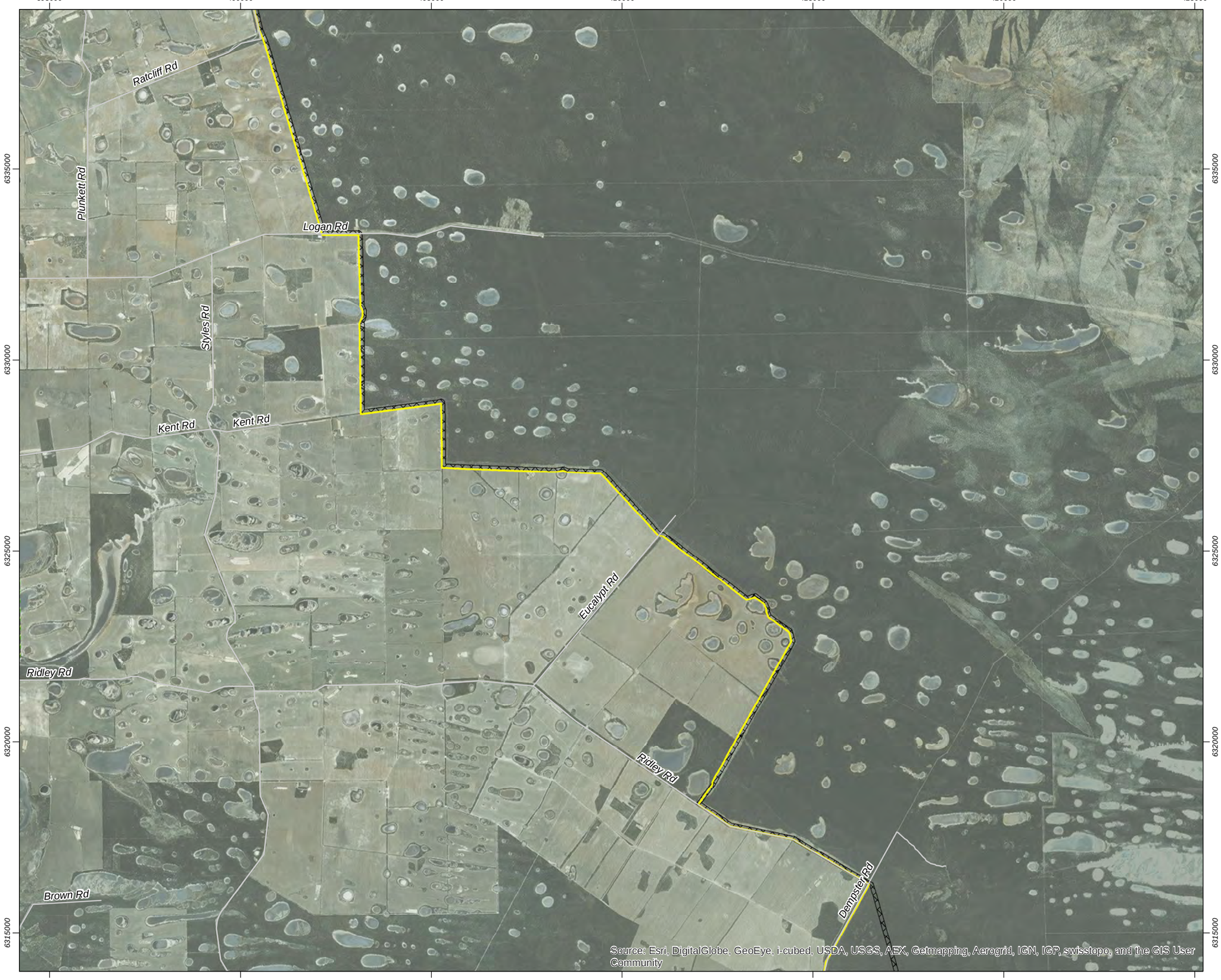
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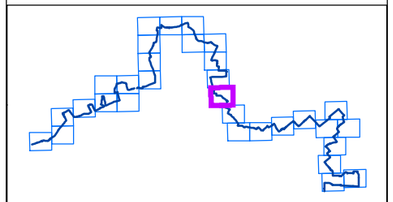


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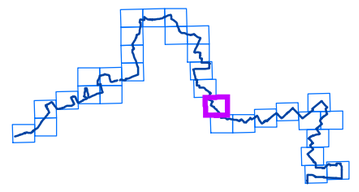
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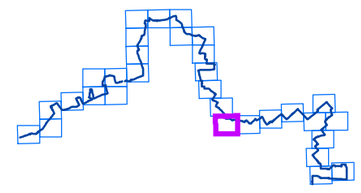


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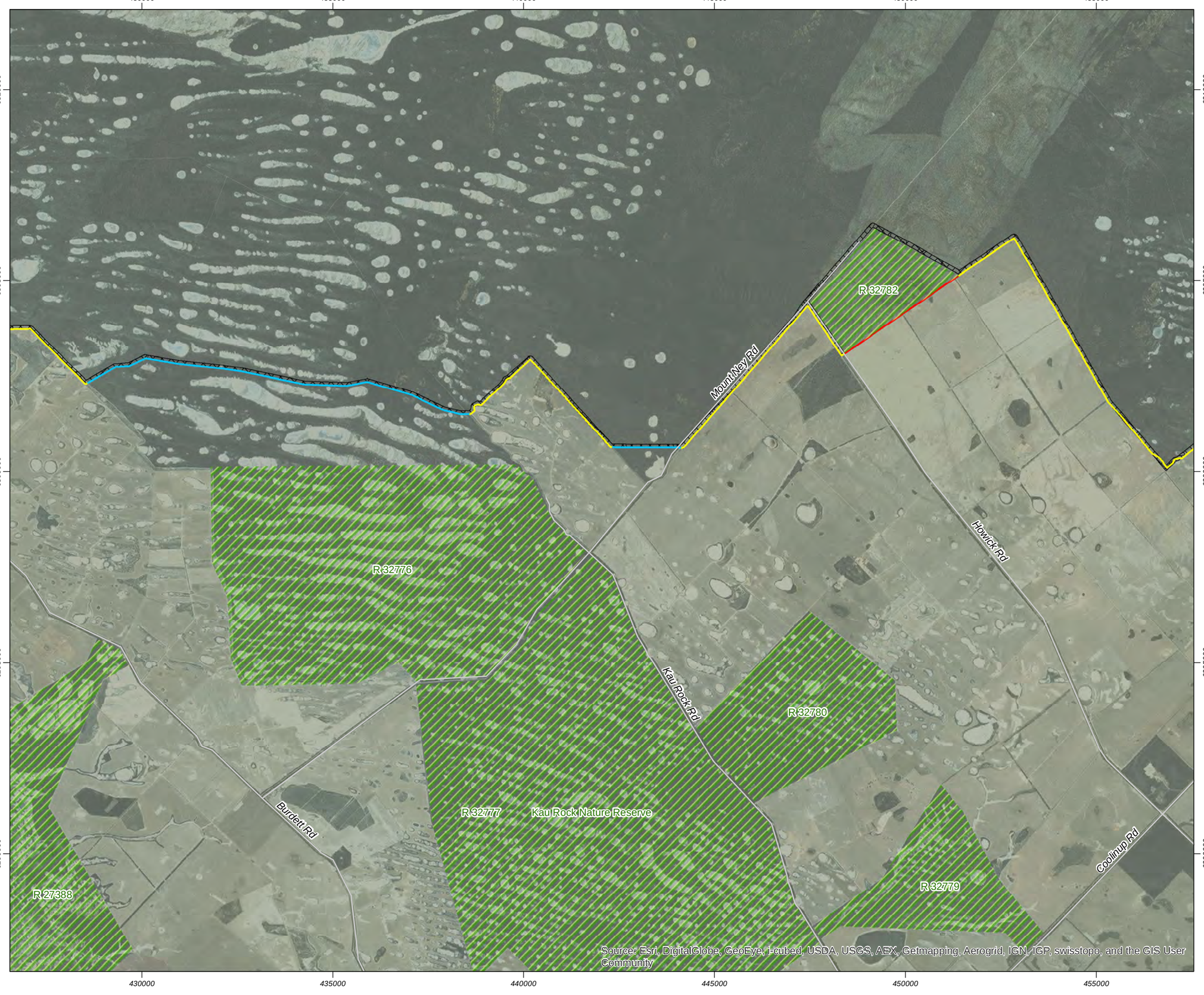
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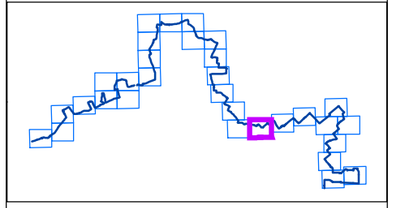


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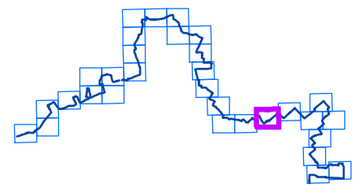


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Author: DWhite

Source: Aerial: ESRI approx. 2010; Inland waters: SLIP database, Landgate 2017

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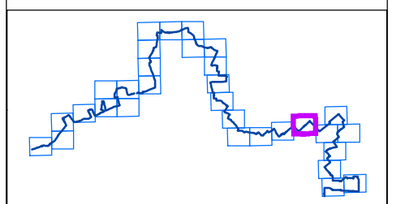
Figure 8-1: Environmental survey areas

Legend

- Ecoscape (2015) study area
- Roads
- Parks and Wildlife Managed Lands and Waters

Proposal alignment existing environment conditions

- Previously chained firebreak



Scale 1:95,734 at A3

0 0.5 1 1.5 2 km

N

Coordinate System: GDA 1994 MGA Zone 51

Note that positional errors may occur in some areas

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Figure 8-1: Environmental survey areas

480000 485000 490000 495000 500000 505000 510000

6315000 6310000 6305000 6300000 6295000

R 38545
Clyde Hill Nature Reserve

R 38334

R 38544
Niblick Nature Reserve

R 32131

Karl Berg Rd
Parmango Rd
Beaumont Rd
Shearer Rd
Muntz Rd

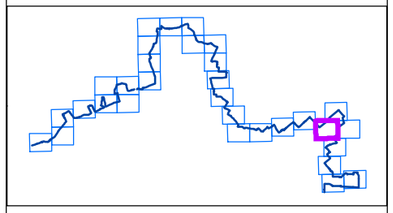
Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

Legend

- Ecoscape (2015) study area
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- Parks and Wildlife Managed Lands and Waters

Proposal alignment existing environment conditions

- Previously chained firebreak
- Uncleared vegetation



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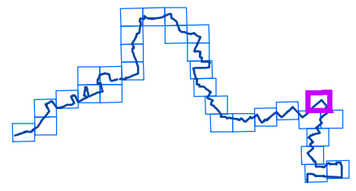


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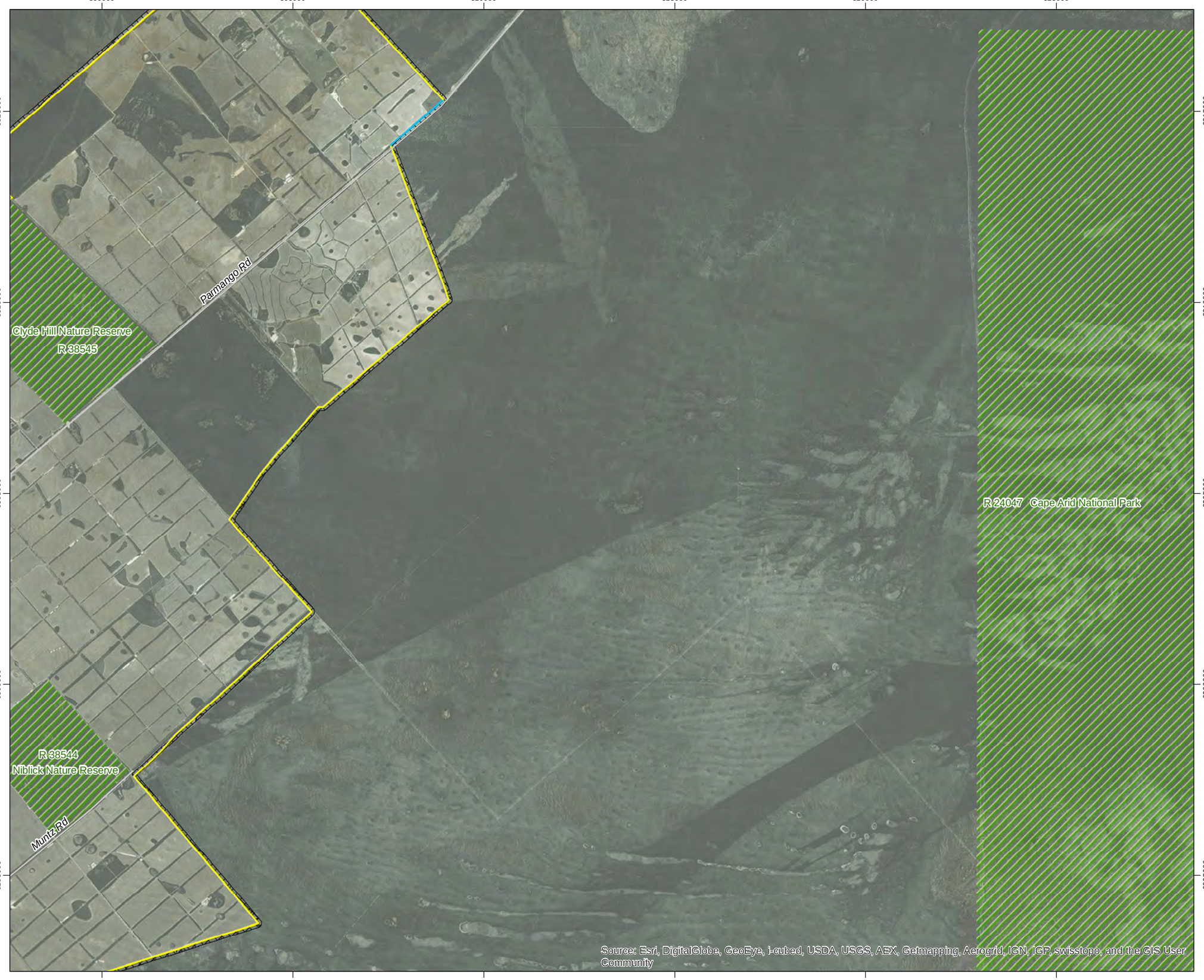
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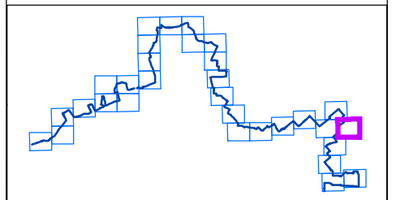


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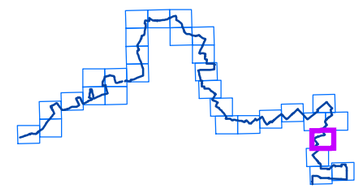
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Proposal alignment existing environment conditions

- Previously chained firebreak
- Previously cleared freehold farmland



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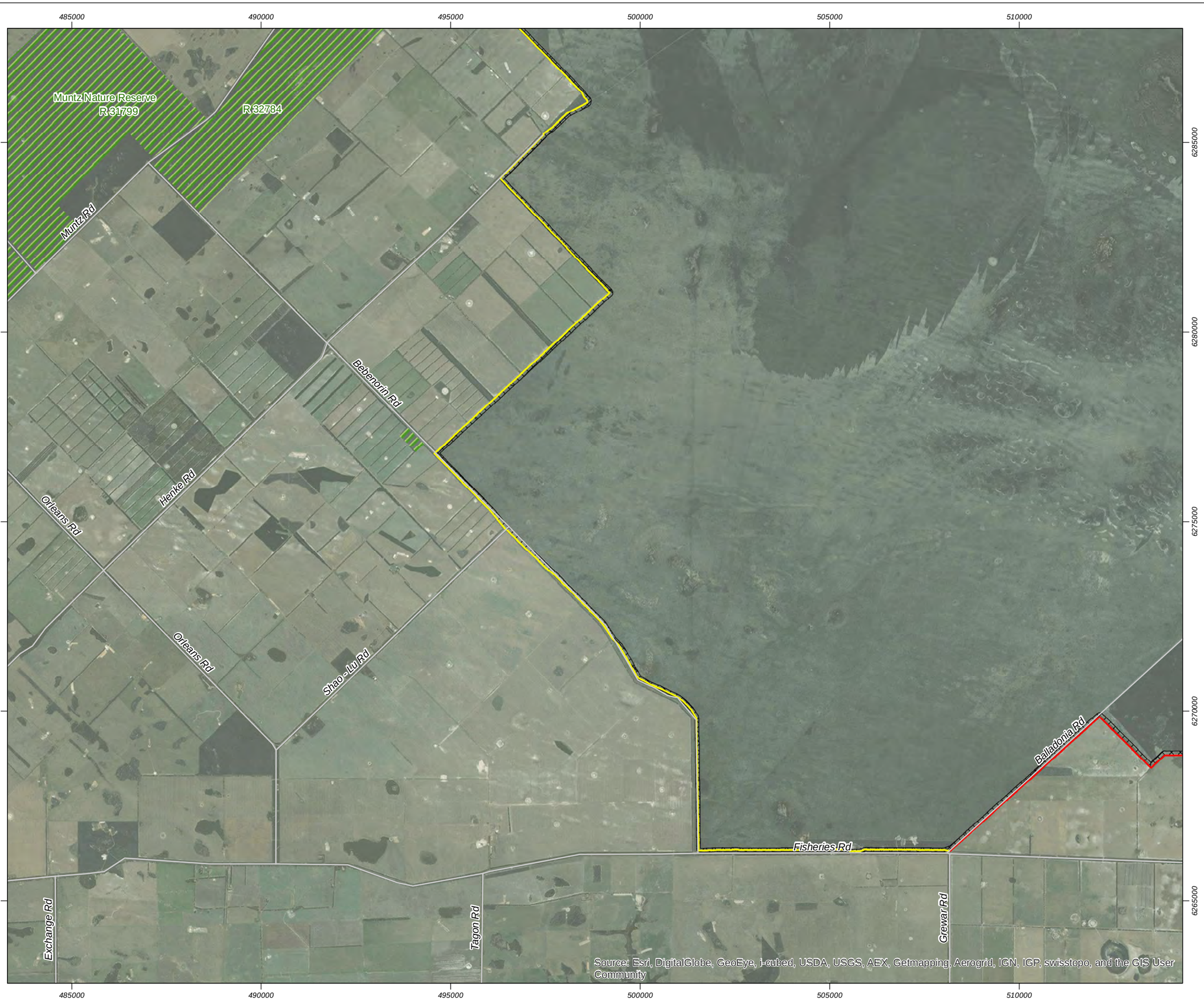


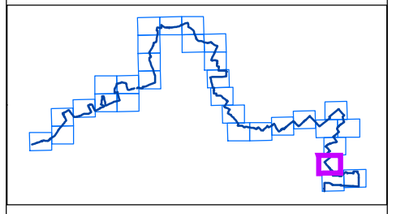
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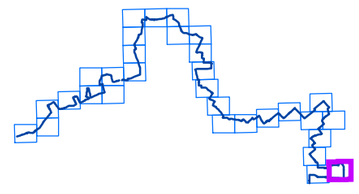


Legend

- Ecoscape (2015) study area
- Roads
- Parks and Wildlife Managed Lands and Waters

Proposal alignment existing environment conditions

- Previously chained firebreak
- Previously cleared freehold farmland
- Uncleared vegetation



Scale 1:95,734 at A3

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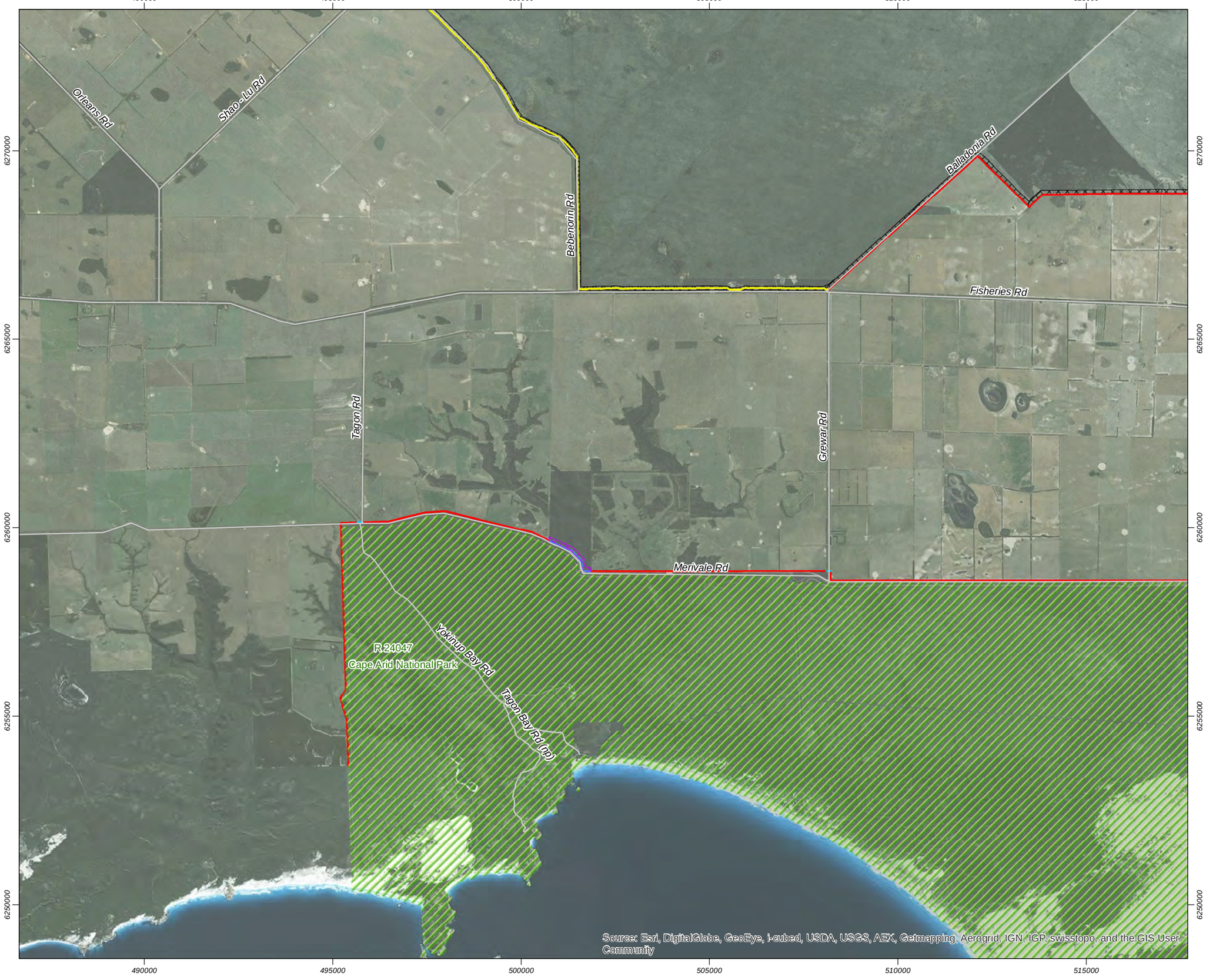
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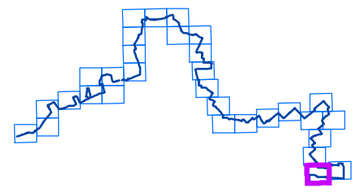


Legend

- Ecoscape (2015) study area
- Roads
- GS Bio Logic (2015) study area
- Parks and Wildlife Managed Lands and Waters

Proposal alignment existing environment conditions

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- Uncleared vegetation



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9. Flora and Vegetation

Potential impacts, mitigation and management measures, proposed regulatory mechanisms and relevant environmental studies for Flora and Vegetation are presented in the following sections. These sections will demonstrate that the Proposal will meet the EPA objective for Flora and Vegetation and fulfil the requirements of Required Work Items 1 to 5 outlined in the ESD.

9.1 Relevant environmental objectives, legislation, policies and guidelines

9.1.1 Environmental objectives

The EPA environmental objectives for Flora and Vegetation, as well as potential environmental aspects of the Proposal that may impact Flora and Vegetation are provided in Table 9-1.

Table 9-1: Key environmental factors, objectives and Proposal environmental aspects

Environmental factor	EPA objective	Proposal environmental aspect
Flora and vegetation	To maintain representation, diversity, viability and ecological function at the species, population and community level.	Clearing of native vegetation.

9.1.2 Requirements of the ESD

The ESD outlines the work required for the environmental impact assessment of key environmental factors for the PER. These requirements for Flora and Vegetation are presented in Table 9-2.

Table 9-2: Flora and Vegetation required work for the Proposal as per the ESD

Item	Requirement	Section in the PER
1	Conduct a Level 1 flora and vegetation survey within the proposal footprint to identify and characterise flora and vegetation in accordance with the requirements of Guidance Statement No. 51. The survey is to include areas that are likely to be directly or indirectly impacted as a result of the proposal. Targeted surveys are to be undertaken for conservation significant flora and communities and in areas adjacent to a conservation estate. *Note: If the proponent has already undertaken biological surveys at the referral stages, then the survey results are to be included in the PER, along with demonstration that they meet the "Required work" and relevant policies.*	Section 9.3
2	Describe the vegetation and conservation significant flora species present and likely to be present within the proposal area. Describe the significance of the vegetation and conservation significant flora species in a local and regional context.	Section 9.3 and Figure 9-1
3	Describe and assess the potential direct and indirect impacts that may result from both construction and ongoing maintenance of the proposal on conservation significant flora and vegetation. Identify the residual impacts after considering and applying the mitigation hierarchy.	Section 9.6
4	Describe proposed management, monitoring and mitigation methods to be implemented to ensure residual impacts (direct and indirect) are not greater than predicted.	Section 9.5
5	Demonstrate and document in the PER how the EPA's objective for this factor can be met.	Section 9.6

9.1.3 Legislation, policies and guidelines

Relevant EPA policy and guidelines outlined in the ESD and an explanation on how the Proposal meets EPA policy and guidelines are presented in Table 9-3.

A summary of how the Proposal meets the EPA's policies and guidelines is provided in Section 9.1.4 to Section 9.1.8.

Table 9-3: Relevant EPA policies and guidelines for Flora and Vegetation

Policy/guideline	Summary of policy/guideline	Requirements to address the policy/guideline
EPA Position Statement No. 2 (2000) *Environmental Protection of Native Vegetation in Western Australia.* Perth, Western Australia	Provides an overview of the EPA's position on the clearing of native vegetation in Western Australia with particular reference to clearing within the agricultural area. The Proposal borders the agricultural area of Western Australia. The clearing of native vegetation for the Proposal must be in accordance with the EPA's view on the clearing of native vegetation in Western Australia with particular reference to clearing within the agricultural area.	To meet Position Statement No. 2 DPIRD must demonstrate: • a comparison of all Proposal options to minimise impacts to flora and vegetation • the Proposal avoids species and community extinctions • that implementing the Proposal will not take a vegetation type below the "threshold level" of 30% • on-and off-site impacts can be managed.
EPA Position Statement No. 3 (2002) *Terrestrial Biological Surveys as an Element of Biodiversity Protection.* Perth, Western Australia	Outlines the principles which the EPA will use when assessing proposals which may impact on biodiversity values.	To meet Position Statement No. 3 the flora and vegetation assessments conducted for the Proposal must demonstrate: • that the quality of information and scope of field surveys meet standards, requirements and protocols as determined and published by the EPA • the IBRA are used as the largest unit for EIA decision-making in relation to the conservation of biodiversity • provide sufficient information to address both biodiversity conservation and ecological function values within the context of the Proposal • results are publicly available.
EPA Guidance Statement No. 51 (2004) *Terrestrial Flora and Vegetation Surveys for Environmental Impact Assessment in Western Australia.* Perth, Western Australia	Provides guidance and information on expected standards and protocols for terrestrial flora and vegetation surveys to environmental consultants and proponents.	To meet this guidance, flora and vegetation assessments undertaken for the Proposal must demonstrate: • appropriate scale of flora and vegetation survey appropriate for different areas • survey, analysis, interpretation and reporting undertaken for EIA is of a suitable quality and consistent methodology to enable the EPA to judge the impacts of the Proposal on flora and vegetation • that the environment, in particular significant flora and vegetation biodiversity values are identified and protected • ensure WA's knowledge base of flora and vegetation biodiversity and biogeography is developed and enhanced over time, (particularly at the local scale) to the benefit of future decision-making • survey data provided in the flora and vegetation assessment is capable of underpinning long-term observation and measurement for later compliance and audit purposes.
EPA Guidance Statement No. 33 (2008) *Environmental Guidance for Planning and Development.* Perth, Western Australia	Describes the processes the EPA may apply under the *Environmental Protection Act 1986* to land use planning and development in Western Australia, in particular the EIA process applied to schemes. Also provides information and advice on a range of environmental issues and their protection and management.	The Proposal involves the clearing of native vegetation. As a result, the Proposal must meet the EPA's broad principles in Chapter B2 (refer to Section 9.1.6) for the protection of native terrestrial vegetation in order to meet EPA's objective for Flora and Vegetation.

Policy/guideline	Summary of policy/guideline	Requirements to address the policy/guideline
EPA and Department of Parks and Wildlife (2015) *Technical Guide - Flora and Vegetation Surveys for Environmental Impact Assessment.* Perth, Western Australia	Provides information on adequate survey techniques and standards for the EPA's environmental factor of Flora and Vegetation. This technical guide defines data collection techniques and standards for EIA including survey preparation, design, data analysis and reporting.	To meet the requirements in this technical guide, flora and vegetation surveys must: • be led by botanists with over 5 years experience in systematic sampling and analysis methodologies, and has knowledge and experience in the ecology of the flora and vegetation of the region to be surveys • demonstrate an appropriate level of detail regarding survey preparation, design, data analysis as per the requirements outlined in this guide.

9.1.4 Position Statement No.2 (EPA 2000)

The Proposal meets the requirements of Position Statement No.2 as:

1. The Proposal protects biodiversity by ensuring protection and management of higher quality remnant native vegetation in the general area.
2. The clearing footprint (comprising 816 ha) has been minimised where possible and is located predominantly in previously chained/ or cleared areas. The Proposal also recognises the ecological values present within the Ravensthorpe and Esperance area and have identified mitigation measures to minimise impacts to biodiversity.
3. DPIRD has demonstrated that it has considered alternative options (Section 5) to evaluate the Proposal alignment to ensure the best possible protection of biodiversity at the species and ecosystem levels.
4. There are no known species or population of flora or fauna, association or community that will become extinct as a consequence of the Proposal. The risks to Threatened species are considered to be acceptable.
5. Gaps in the Proposal alignment for the Oldfield River (1 km), Young River (0.4 km) and Lort River (2 km), and a 3.2 km corridor to the coast provide ecological corridors.
6. The Proposal would not significantly compromise any vegetation type by taking it below the "threshold level" of 30% of the pre-clearing extent of the vegetation type. The clearing of vegetation within the three vegetation associations that have less than 30% remaining is small and would not significantly change the percentage of vegetation remaining.
7. The on-site and off-site impacts of the Proposal are identified and DPIRD can demonstrate that these impacts can be managed through the mitigation measures presented in Section 9.5.

9.1.5 Position Statement No.3 (EPA 2002):

The EPA requires that the quality of information and scope of field surveys meets the standards, requirements and protocols as determined and published by the EPA. An indicative guide to the level of investigation required for EIA related biological surveys is provided in this Statement.

The Proposal meets the indicative level of biological survey expected by the EPA in relation to the scale and nature of the impact and the sensitivity of the receiving environment. The Proposal is located within the Warren, Avon Wheatbelt, Geraldton Sandplains, Esperance Plains, Mallee, Swan (Largely Cleared) (WAGEMS) bioregion. The environmental studies undertaken for this Proposal fulfil the requirements of a terrestrial biological study at high scale and appropriate to the nature of impact. The high scale and nature of impact requirements include:

- desktop study
- reconnaissance survey
- comprehensive Level 2 flora survey
- Level 1 fauna survey.

These requirements have been addressed in the environmental studies outlined in Section 9.1.2.

The Proposal meets the requirements of Position Statement No.3 in the following ways:

1. Biodiversity values are protected as the Proposal is located in areas with a high degree of pre-existing modification (such as cleared agricultural land and chained fire breaks).
2. Terrestrial biological surveys conducted for the Proposal provide sufficient information that address the biodiversity conservation and ecological function values within the area affected by the Proposal. This information is provided in Table 8-1.
3. The terrestrial biological surveys are also publicly available and have been provided to DBCA to contribute to the bank of data available for WAGEMS, to aid the overall biodiversity understanding and assessment by facilitating transfer into State biological databases.
4. The Proposal has also taken careful evaluation to avoid, wherever practicable, serious or irreversible damage to the environment; and an assessment of the risk-weighted consequences of various options (Section 9.5).

9.1.6 Guidance Statement 33 (EPA 2008)

The Proposal meets broad principles for the protection of native terrestrial vegetation and flora outlined in Guidance Statement 33 as:

1. The Proposal minimises clearing of native vegetation.
2. The removal of native vegetation (where required) allows for the maintenance of biodiversity at sustainable levels.
3. Mitigation strategies outlined in Section 9.5 will help protect native vegetation and biodiversity values.
4. The potential impacts of land uses and development on significant native vegetation and flora are identified (direct, indirect and cumulative impacts) and managed with a view to meeting the overarching environmental objectives for the region.
5. The alteration of the Proposal alignment avoids clearing native vegetation (where possible) by locating development on cleared land in preference to areas of native vegetation.
6. No known species of native flora or fauna, or community or association will be extinct as a result of this Proposal.
7. No ecological communities occurring at 10% or less of the original extent in the region (considered to be critically endangered) has been identified to be significantly impacted by the Proposal.
8. Adequate survey work and assessment addressing vegetation and flora characteristics, values, issues, threats, functions, significance, overarching environmental objectives and appropriate management have been undertaken.
9. Mitigation measures will be implemented during construction and ongoing maintenance of the Proposal alignment (Section 9.5) to minimise adverse impacts on flora and vegetation with the objective of achieving no significant change to existing flora and vegetation values.

9.1.7 Guidance Statement 51 (EPA 2004)

The Proposal meets the requirements for terrestrial flora and vegetation surveys outlined in Guidance Statement 51 as:

1. Environmental studies for the Proposal demonstrate adequate provision of resources for the survey and documentation of the flora and vegetation. This includes the intensity of sampling (the number of sites, their spacing, and their area) is attuned to the complexity of the flora and vegetation of the Proposal.
2. Fieldwork collectively across the environmental studies covers multiple years and spans different seasons throughout the year; therefore, the majority of the plant species within the Proposal alignment could be identified based on flowering, fruiting and foliage visibility. As the Proposal is within the South-West Botanical Province, rainfall is mainly in winter, and environmental studies were conducted across multiple periods and adopted the 10 x 10 m quadrat size appropriate to undertake flora assessments in the South West Botanical Province.
3. Flora and vegetation surveys were coordinated and led by botanists who have had appropriate training, mentoring and experience in flora and vegetation survey.

4. The extent of vegetation surveys covers the Proposal alignment, including a 100 m buffer from the alignment and identifies conservation significant flora, and vegetation at a regional and sub-regional scale.
5. Sampling design and intensity has been informed by characteristics of existing landform, habitat, vegetation, potential for conservation significant flora to occur, results of reconnaissance investigations and preliminary sampling for the specific investigation.
6. Collections of conservation significant flora were vouchered at the WA Herbarium.
7. Information was collected for adjacent areas, including herbarium records and previous surveys.
8. Surveys are publically available and all survey data has been provided to DBCA.

9.1.8 Technical guide (EPA & DPaW 2015)

The environmental surveys meet the appropriate level of detail regarding survey preparation, design, data analysis and reporting outlined in this guide (Table 8-1).

9.2 Required work

Consistent with the requirements of the ESD (Required Work Item 1 for Flora and Vegetation) the following environmental studies have been undertaken for the Proposal to characterise the flora and vegetation values present within the Development Envelope:

- GHD (2012) *Report for State Barrier Fence Extension Scoping Study*
- GS Bio Logic (2015) *Biological Surveys of the State Barrier Fence – Merivale Road Reserve Realignment – Cape Arid*
- Ecoscape (2017a) *State Barrier Fence Biological Surveys*
- Ecoscape (2017b) *State Barrier Fence SRE Database Searches (WAM) Results and Interpretation*
- Ecoscape (2016) *State Barrier Fence Esperance Extension Assessment of the Eucalypt Woodlands of the Western Wheatbelt Threatened Ecological Community.*

The results of these environmental studies have been used to inform Sections 9.3 to characterise flora and vegetation values.

9.3 Findings from Level 1 & 2 flora surveys

GHD (2012) conducted a desktop and Level 1 flora assessment for various Proposal alignment options and outlined the possible flora and vegetation constraints for the construction of the Proposal. As a result, the Level 1 flora assessment conducted in the scoping study (GHD 2012) covers a wider area and provides a broad understanding of the flora and vegetation values presented within the general area of the Proposal alignment. Since the scoping study (GHD 2012), the Proposal alignment has been modified and refined to one single alignment as presented in Ecoscape (2017a) and GS Bio Logic (2015) flora assessments. This section describes local flora and vegetation values for the Proposal based on the revised Proposal alignment as described in the Ecoscape (2017a) and GS Bio Logic (2015) floristic surveys.

Ecoscape (2017a) undertook a single season Level 2 flora survey in 2015 which exceeds the requirement in the ESD for a Level 1 survey to be undertaken.

9.3.1 Flora and vegetation values and significance

Vegetation has been modified over most of the Proposal alignment due to chaining or clearing. This includes significant fuel management and fire break clearing by DBCA since the Ecoscape (2017a) and GS Bio Logic (2015) surveys were undertaken.

A total of 89 vegetation types were identified within the Ecoscape (2017a) study area. The Ecoscape (2017a) study area generally corresponds with the southern edge of the Great Western Woodlands. Vegetation types within the Proposal alignment are diverse and comprise of heath, coastal dune scrub, mallee-heath and granite heath. The distribution of local vegetation types is presented in Ecoscape (2017a) in Appendix 3. The vegetation types identified within the Ecoscape (2017a) Level 2 flora survey are presented in Table 9-4.

Vegetation condition ranged from Degraded to Pristine based on the Keighery (1994) Bushland Condition Scale, with 98% of assessment sites within the Ecoscape (2017a) study area classified as Very Good or better condition (Ecoscape 2017a).

Approximately 320 km of the Proposal alignment has been chained since the surveys by Ecoscape (2017a) in 2015 were undertaken for fuel management by DBCA. The Proposal alignment has been chosen to follow existing tracks or graded firebreaks to minimise native clearing where possible.

Table 9-4: Local vegetation types

Code	Vegetation description	Area (ha)	Proportion of Ecoscape (2017a) study area (%)
AcLd	*Allocasuarina campestris, Melaleuca uncinata* and *Acacia mimica* var. *angusta* mid shrubland over *Lepidosperma drummondii*, *Platysace effusa* and *Hibbertia gracilipes* low open sedgeland/ shrubland	36.69	0.58
AfCr	*Acacia fragilis, Grevillea plurijuga* and *Melaleuca pulchella* mid shrubland over *Cryptandra recurva* low sparse shrubland	9.13	0.14
AsAt	*Acacia singula, Calothamnus quadrifidus* and *Verticordia chrysantha* mid open shrubland over *Allocasuarina thuyoides*, *Melaleuca tuberculata* var. *macrophylla* and *Lepidosperma* sp. low open shrubland/ sedgeland	9.28	0.15
BaMs	*Banksia armata* var. *armata, Melaleuca striata* and *Grevillea baxteri* mid open shrubland over *Melaleuca scabra, Xanthorrhoea platyphylla* and *Lepidosperma* sp. low shrubland	4.55	0.07
BpBe	*Banksia pilostylis* and *Adenanthos cuneatus* mid open shrubland over *Beaufortia empetrifolia*, *Hypolaena humilis* and *Melaleuca scabra* low shrubland/ rushland	36.54	0.58
BsBeAl	*Banksia speciosa* and *Hakea obliqua* subsp. *obliqua* tall shrubland over *Beaufortia empetrifolia, Leucopogon crassifolius* and *Melaleuca striata* mid open shrubland over *Anarthria laevis, Banksia petiolaris* and *Stirlingia anethifolia* low open rushland/ shrubland	74.67	1.18
Cl	Cleared (completely degraded)	3.31	0.05
CqAp	*Calothamnus quadrifidus, Acacia assimilis subsp. atroviridis and Grevillea teretifolia mid open shrubland over Acacia pinguiculosa subsp. teretifolia, Cryptandra graniticola and Lepidosperma rigidulum low shrubland/ sedgeland*	3.34	0.05
DcTp	*Dodonaea ceratocarpa*, *Acacia triptycha* and *Thryptomene australis* subsp. *brachyandra* mid open shrubland over *Trachymene pilosa, *Hypochaeris glabra* and **Aira cupaniana* low open herbland/ grassland	2.24	0.04
Degraded	Degraded	44.94	0.71
DhCc	*Duboisia hopwoodii* and *Rhagodia preissii* mid sparse shrubland over *Commersonia craurophylla, Acacia glaucissima* and *Glischrocaryon aureum* low open shrubland/ herbland	15.29	0.24
EaCqLb	*Eucalyptus angulosa* mid open woodland over *Calothamnus quadrifidus* and *Banksia media* mid open shrubland over *Leucopogon breviflorus, Cyathostemon* aff. *tenuifolius* and *Schoenus subfascicularis* low open shrubland/ sedgeland	18.43	0.29
EcCc	*Eucalyptus conglobata* low open mallee woodland over *Commersonia craurophylla, Acacia glaucissima* and *Glischrocaryon aureum* low open shrubland/ herbland	55.39	0.87
EcPe	*Eucalyptus conglobata* mid mallee shrubland over *Pultenaea elachista, Grevillea plurijuga* and *Westringia rigida* low open shrubland	5.21	0.08
EdDiMa	*Eucalyptus dielsii, E. ?calycogona* and *E. uncinata* mid woodland/ mallee woodland over *Daviesia incrassata* subsp. *incrassata, Dodonaea stenozyga* and *Melaleuca teuthidoides* mid open shrubland over *Microcybe albiflora, Spyridium minutum* and *Westringia rigida* low sparse shrubland	5.38	0.08
EdMhLp	*Eucalyptus dissimulata* subsp. *dissimulata* and *E. scyphocalyx* mid mallee woodland over *Melaleuca hamata* and *Callitris preissii* mid open shrubland over *Leptomeria pachyclada*, *Coleanthera myrtoides* and *Conostephium drummondii* low open shrubland	18.23	0.29
EdMhVr	*Eucalyptus dolichorhyncha, E. perangusta* and *E. phaenophylla* subsp. *interjacens* low open mallee shrubland over *Melaleuca hamata, Aluta appressa* and *Calothamnus quadrifidus* mid shrubland over *Verticordia roei* subsp. *roei, V. chrysantha* and *Lepidosperma drummondii* low open shrubland/ sedgeland	46.29	0.73
EdMpLsp	*Eucalyptus dissimulata* subsp. *dissimulata* and *E. scyphocalyx* mid mallee woodland over *Melaleuca plumea, Melaleuca hamata* and *Melaleuca sapientes* mid shrubland over *Lepidosperma* sp. Bandalup Scabrid (N. Evelegh 10798), *Leucopogon* sp. Coujinup (M.A. Burgman 1085) and *Hibbertia* sp. low open sedgeland/ shrubland	20.91	0.33
EdMpOm	*Eucalyptus diptera, E. urna* and *E. eremophila* mid woodland over *Melaleuca pauperiflora, M. podiocarpa* and *M. linguiformis* mid open shrubland over *Olearia muelleri, Scaevola spinescens* and *Daviesia* sp. low sparse shrubland	140.05	2.21
EdMpRs	*Eucalyptus diptera* and *E. polita* low woodland over *Melaleuca pauperiflora* subsp. *pauperiflora* mid open shrubland over *Rhodanthe spicata* low open herbland	2.15	0.03

Code	Vegetation description	Area (ha)	Proportion of Ecoscape (2017a) study area (%)
EdMqMm	*Eucalyptus delicata, E. urna* and *E. salmonophloia* mid mallee woodland over *Melaleuca quadrifaria, M. teuthidoides* and *M. pauperiflora* tall open shrubland over *Microcybe multiflora* subsp. *multiflora, Daviesia benthamii* subsp. *acanthoclona* low isolated shrubs	191.01	3.01
EeAl	*Eucalyptus extrica, Grevillea baxteri* and *Hakea obliqua* subsp. *obliqua* low open mallee shrubland/ shrubland over *Anarthria laevis, Mesomelaena stygia* subsp. *stygia* and *Banksia repens* low sedgeland/ shrubland	103.01	1.62
EeDsDv	*Eucalyptus extensa, E. spreta* and *E. diptera* mid woodland over *Dodonaea stenozyga*, *Exocarpos aphyllus* and *Eremophila scoparia* mid open shrubland over *Pultenaea arida, Diocirea violacea* and *Halgania andromedifolia* low sparse shrubland	27.73	0.44
EeEsBi	*Eucalyptus eremophila, E. flocktoniae subsp. flocktoniae and E. phenax subsp. phenax mid mallee woodland over Exocarpos sparteus and Melaleuca cucullata mid open shrubland over Boronia inornata subsp. leptophylla, Spyridium cordatum and Pultenaea purpurea low open shrubland.*	8.09	0.13
EeGbMs	*Eucalyptus extrica* low sparse mallee shrubland *over Grevillea baxteri, Daviesia apiculata* and *Adenanthos cuneatus* mid open shrubland over *Mesomelaena stygia* subsp. *stygia, Beaufortia empetrifolia* and *Calothamnus gracilis* low sedgeland/ shrubland	152.75	2.41
EeMeLd	*Eucalyptus eremophila* mid open woodland over *Melaleuca exuvia, M. thyoides* and *Cyathostemon* cf. *ambiguus* tall open shrubland over *Lepidosperma drummondii, Darwinia* sp. Karonie (K. Newbey 8503) and *Microcybe multiflora* subsp. *baccharoides* low open sedgeland/ shrubland	17.11	0.27
EeMhHa	*Eucalyptus eremophila, E. pileata* and *E. scyphocalyx* mid open mallee shrubland over *Melaleuca hamata, Grevillea plurijuga* and *Dodonaea amblyophylla* mid open shrubland over *Halgania andromedifolia* and *Coopernookia strophiolata* low open shrubland	66.57	1.05
EeMlOm	*Eucalyptus eremophila, E. leptocalyx* and *E. valens* mid open woodland over *Melaleuca linguiformis, M. thyoides* and *Alyxia buxifolia* mid open shrubland over *Olearia muelleri, Scaevola spinescens* and *Waitzia suaveolens* var. *flava* low open shrubland/ herbland	210.36	3.32
EeMsGa	*Eucalyptus eremophila, E. flocktoniae* and *E. scyphocalyx* low woodland/ mallee woodland over *Melaleuca societatis, M. sapientes* and *M. teuthidoides* mid shrubland over *Gahnia ancistrophylla*, *Spyridium minutum* and *Comesperma spinosum* low open sedgeland/ shrubland	1471.12	23.21
EeMsGa/ ElMsAs	Mosaic, see separate descriptions	40.57	0.64
EeMsGa/ EoMpAs	Mosaic, see separate descriptions	26.62	0.42
EeMsWc	*Eucalyptus eremophila, E. kessellii* and *E. flocktoniae* mid mallee woodland over *Melaleuca sapientes, Daviesia benthamii* subsp. *acanthoclona* and *Melaleuca teuthidoides* mid shrubland over *Westringia cephalantha* var. *caterva, Coopernookia strophiolata* and *Olearia muelleri* low open shrubland	285.35	4.50
EePmHh	*Eucalyptus extrica, E. angulosa* and *E. leptocalyx* mid open mallee shrubland over P*hymatocarpus maxwellii, Beaufortia empetrifolia* and *Melaleuca pulchella* mid shrubland over *Hypolaena humilis, Acacia crispula* and *Anarthria laevis* low open rushland/ shrubland	106.47	1.68
EfEaHsp	*Eucalyptus flocktoniae* subsp. *flocktoniae, E. eremophila and E. pileata* mid woodland over *Exocarpos aphyllus, Melaleuca johnsonii* and *M. lateriflora* mid open shrubland over *Halgania* sp. Peak Eleanora (M.A. Burgman 3547 B), *Pultenaea ?arida* and *Pomaderris rotundifolia* low sparse shrubland	25.11	0.40
EfMcAc	*Eucalyptus flocktoniae, E. quadrans* and *E. extensa* mid mallee woodland over *Melaleuca cucullata*, *M. strobophylla* and *Dodonaea stenozyga* tall shrubland over *Acacia crassuloides, A. erinacea* and *Hakea commutata* low open shrubland	120.72	1.90
EfMmBi	*Eucalyptus flocktoniae* low open mallee shrubland over *Melaleuca marginata* mid open shrubland over *Boronia inornata* subsp. *inornata* and *Daviesia benthamii* subsp. *acanthoclona* low open shrubland	20.23	0.32
EfMpAc	*Eucalyptus flocktoniae* subsp. *flocktoniae, E. conglobata* and *E. leptocalyx* mid mallee woodland over *Melaleuca podiocarpa*, *M. pauperiflora* subsp. *pauperiflora* and *Daviesia bentham* subsp. *acanthoclona* mid open shrubland over *Acacia crassuloides, A. deficiens* and *Pomaderris rotundifolia* low sparse shrubland	24.36	0.38
EfMsDb	*Eucalyptus forrestiana, E. conglobata* and *E. flocktoniae* low woodland/ mallee woodland over *Melaleuca societatis, M. podiocarpa* and *M. bromelioides* mid shrubland over *Daviesia benthamii* subsp. *acanthoclona, Spyridium minutum* and *Boronia inornata* subsp. *leptophylla* low open shrubland	243.10	3.83
EgAs	*Eucalyptus grossa, Melaleuca uncinata* and *Calothamnus quadrifidus* subsp. *quadrifidus* mid shrubland over *Acacia sulcata* var. *platyphylla, Lepidosperma drummondii* and *Cryptandra minutifolia* subsp. *brevistyla* low open shrubland/ sedgeland	66.05	1.04

Code	Vegetation description	Area (ha)	Proportion of Ecoscape (2017a) study area (%)
EgAs/ EpBmMs	Mosaic, see separate descriptions	10.70	0.17
EgMqCc	*Eucalyptus gracilis, E. ovularis* and *E. spreta* mid woodland over *Melaleuca quadrifaria, M. teuthidoides* and *M. lanceolata* tall open shrubland over *Cratystylis conocephala, Atriplex vesicaria* and *Zygophyllum aurantiacum* low open shrubland	167.46	2.64
EgMtBi	*Eucalyptus gracilis* and *E.* sp. low open woodland over *Melaleuca teuthidoides* mid sparse shrubland over *Boronia inornata* subsp. *leptophylla, Westringia rigida* and *Acacia merrallii* low open shrubland	7.51	0.12
EiAiMe	*Eucalyptus incrassata* and *E. uncinata* tall mallee woodland over *Adenanthos ileticos, Banksia media* and *Phymatocarpus maxwellii* mid open shrubland over *Micromyrtus elobata* subsp. *scopula* and *Darwinia polycephala* low sparse shrubland	45.42	0.72
EiBsLd	*Eucalyptus incrassata, E. phaenophylla* subsp. *interjacens* and *E. uncinata* mid open mallee shrubland over *Beaufortia schaueri, Calothamnus quadrifidus* and *Gastrolobium nutans* mid shrubland over *Lepidosperma drummondii, Conostylis argentea* and *Schoenus brevisetis* low sedgeland/ herbland	12.59	0.20
EiMcGa	*Eucalyptus incrassata* and *E. phaenophylla* mid mallee shrubland over *Melaleuca calycina, M. societatis* and *M. johnsonii* mid open shrubland over *Gahnia ancistrophylla, Daviesia lancifolia* and *Gahnia aristata* low sparse sedgeland/ shrubland	43.18	0.68
EiMpAc	*Eucalyptus indurata, E. conglobata* and *E. flocktoniae* mid open mallee woodland over *Melaleuca pauperiflora* subsp. *pauperiflora, M. strobophylla* and *M. podiocarpa* mid open shrubland over *Acacia crassuloides, Daviesia benthamii* subsp. *acanthoclona* and *Microcybe multiflora* subsp. *multiflora* low open shrubland	29.03	0.46
EkBmPm	*Eucalyptus kessellii, E. pleurocarpa* and *E. pileata* mid open mallee shrubland over *Banksia media* mid sparse shrubland over *Phymatocarpus maxwellii, Melaleuca pulchella* and *Daviesia lancifolia* low shrubland	20.48	0.32
EkMtDb	*Eucalyptus kessellii, E. eremophila* and *E.* aff. *leptocalyx* mid open mallee woodland over *Melaleuca teuthidoides, M. sapientes* and *M. podiocarpa* tall open shrubland over *Daviesia benthamii* subsp. *acanthoclona, Boronia inornata* subsp. *leptophylla* and *Acacia glaucissima* low sparse shrubland	89.79	1.42
ElMbBi	*Eucalyptus luculenta* and *E. eremophila* low sparse mallee shrubland over *Melaleuca bromelioides* mid open shrubland over *Boronia inornata* subsp. *leptophylla* and *Microcybe multiflora* subsp. *baccharoides* low sparse shrubland	3.72	0.06
ElMsAs	*Eucalyptus luculenta, E. uncinata* and *E. eremophila* mid open mallee woodland over *Melaleuca societatis, Daviesia benthamii* subsp. *acanthoclona* and *Melaleuca hamata* mid open shrubland over *Acacia sorophylla, Pultenaea purpurea* and *Boronia inornata* subsp. *leptophylla* low sparse shrubland	180.81	2.85
ElMsDp	*Eucalyptus* aff. *leptocalyx* and *E. uncinata* mid woodland over *Melaleuca societatis* and *M. teuthidoides* tall open shrubland over *Darwinia polycephala, Cyathostemon* aff. *ambiguus* and *Baeckea crassifolia* low open shrubland	5.79	0.09
ElMsLg	*Eucalyptus leptocalyx* and *E. flocktoniae* mid mallee woodland over *Melaleuca societatis, M. hamata* and *M. undulata* tall open shrubland over *Lepidosperma gahnioides*, *Lepidosperma* sp. Bandalup Scabrid (N. Evelegh 10798) and *Gahnia ancistrophylla* low open sedgeland	49.77	0.79
ElMsLg/ ElPmGa	Mosaic, see separate descriptions	4.05	0.06
ElMsSm	*Eucalyptus leptocalyx, E. uncinata* and *E. varia* subsp. *varia* mid open mallee shrubland over *Melaleuca societatis* and *M. glaberrima* mid shrubland over *Spyridium mucronatum* subsp. *mucronatum, Boronia inornata* subsp. *leptophylla* and *Gahnia ancistrophylla* low open shrubland/ sedgeland	401.82	6.34
ElPmGa	*Eucalyptus leptocalyx, E. pleurocarpa* and *E. micranthera* mid open mallee shrubland over *Phymatocarpus maxwellii, Melaleuca pulchella* and *M. plumea* mid shrubland over *Gahnia ancistrophylla* and *Boronia crassifolia* low open sedgeland/ shrubland	72.50	1.14
ElPmGa/ EfMsDb	Mosaic, see separate descriptions	6.00	0.09
ElPmSm	*Eucalyptus leptocalyx* and *E. uncinata* and *E. angulosa* mid open mallee shrubland over *Phymatocarpus maxwellii, Melaleuca societatis* and *Banksia media* mid shrubland over *Spyridium mucronatum* subsp. *mucronatum, Microcybe pauciflora* subsp. *pauciflora* and *Conostephium drummondii* low open shrubland	61.63	0.97
EmMpCc	*Eucalyptus melanoxylon, E. dundasii* and *E. salmonophloia* mid woodland over *Melaleuca pauperiflora, M. quadrifaria* and *M. teuthidoides* tall sparse shrubland over *Cratystylis conocephala, Maireana* sp. and *Acacia merrallii* low open shrubland	176.94	2.79

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EoArTsp	*Eucalyptus occidentalis* mid woodland over *Acacia rostellifera* and *A. cyclops* mid open shrubland over *Tetraria* sp. Mt Madden (C.D. Turley 40 BP/ 897), *Neurachne alopecuroidea* and *Dodonaea caespitosa* low sedgeland/ grassland/ shrubland	1.45	0.02
EoEd	*Eucalyptus ovularis* and *E. platycorys* mid sparse mallee shrubland over *Eremophila dichroantha*, *E.* aff. *rugosa* and *Philotheca fitzgeraldii* low shrubland	41.29	0.65
EoMcBi	*Eucalyptus oleosa* subsp. *oleosa, E. conglobata* and *E. dielsii* mid mallee woodland over *Melaleuca cucullata, M. acuminata* subsp. *acuminata* and *M. podiocarpa* tall shrubland over *Boronia inornata* subsp. *leptophylla, Olearia muelleri* and *Acacia profusa* low sparse shrubland	43.68	0.69
EoMpAm	*Eucalyptus oleosa* subsp. *cylindroidea* mid mallee woodland over *Melaleuca pauperiflora* subsp. *pauperiflora* and *M. quadrifaria* mid shrubland over *Acacia merrallii* and *Daviesia* sp. low scattered shrubs	12.62	0.20
EoMpAs	*Eucalyptus oleosa* subsp. *cylindroidea* mid mallee woodland over *Melaleuca podiocarpa, M. teuthidoides* and *M. brevifolia* mid open shrubland over *Acacia sorophylla, Microcybe multiflora* subsp. *baccharoides* and *Boronia inornata* subsp. *leptophylla* low open shrubland	23.47	0.37
EoMpPa	*Eucalyptus oleosa* subsp. *cylindroidea, E. eremophila* and *E. diptera* mid open woodland/ mallee woodland over *Melaleuca pauperiflora, Alyxia buxifolia* and *Eremophila ionantha* mid sparse shrubland over *Pultenaea arida, Olearia muelleri* and *Austrostipa trichophylla* low sparse shrubland/ grassland	17.33	0.27
EoMpSf	*Eucalyptus occidentalis* mid woodland over *Melaleuca pulchella, M. calycina* and *Baeckea pachyphylla* mid shrubland over *Schoenus subfascicularis* low sparse sedgeland	7.47	0.12
EoMs	*Eucalyptus occidentalis* mid woodland over *Melaleuca strobophylla* and *Acacia diaphana* tall open shrubland	5.13	0.08
EoMtTc	*Eucalyptus obesa* and *E. pleurocarpa* mid open mallee shrubland over *Melaleuca tuberculata* var. *macrophylla, Beaufortia micrantha* var. *micrantha* and *Calothamnus gracilis* mid open shrubland over *Tricostularia compressa, Chordifex sphacelatus* and *Schoenus subfascicularis* low open sedgeland/ rushland	11.12	0.18
EoOm	*Eucalyptus olivina* mid open woodland over *Olearia muelleri, Lepidosperma drummondii* and *Gahnia ancistrophylla* low sparse shrubland/ sedgeland	2.45	.04
EpAh	*Eucalyptus pleurocarpa* and *E. tumida* mid sparse mallee shrubland over *Allocasuarina humilis, Melaleuca hamata* and *Banksia armata* var. *armata* low open shrubland	10.54	0.17
EpBmMs	*Eucalyptus pleurocarpa, E. phaenophylla* and *E. incrassata* mid open mallee shrubland over *Beaufortia micrantha* var. *micrantha, M. rigidifolia* and *M. hamata* mid open shrubland over *Mesomelaena stygia* subsp. *stygia, Lysinema pentapetalum* and *Lepidosperma* spp. low open sedgeland/ shrubland	168.18	2.65
EpEa	*Eucalyptus platypus* subsp. *platypus, E. flocktoniae* subsp. *flocktoniae* and *E. dielsii* low open woodland over *Exocarpos aphyllus, Gastrolobium musaceum* and *Daviesia argillacea* mid open shrubland	43.01	0.68
EpMhGa	*Eucalyptus phaenophylla, E. leptocalyx* and *E. uncinata* mid mallee woodland over *Melaleuca hamata, M. subfalcata* and *Exocarpos sparteus* mid sparse shrubland over *Gahnia ancistrophylla, Spyridium cordatum* and *Acacia ingrata* low sparse sedgeland/ shrubland	102.67	1.62
EqMpOm	*Eucalyptus quadrans* mid mallee woodland over *Melaleuca pauperiflora* subsp. *pauperiflora, M. acuminata* subsp. *A acuminata* and *Acacia amyctica* mid shrubland over *Olearia muelleri* low sparse shrubland	10.29	0.16
EsBpLt	*Eucalyptus sporadica* and *E. clivicola* mid mallee woodland/ woodland over *Baeckea pachyphylla, Melaleuca eurystoma* and *Melaleuca hamata* mid open shrubland over *Lepidosperma tuberculatum* and *Tetraria* sp. Mt Madden (C.D. Turley 40 BP/ 897) mid open sedgeland	4.14	0.07
EsGlWr	*Eucalyptus spreta* mid isolated trees over *Geijera linearifolia, Santalum acuminatum* and *Dodonaea viscosa* subsp. *angustissima* tall sparse shrubland over *Westringia rigida, Atriplex vesicaria* and *Austrostipa variabilis* low shrubland/ tussock grassland	33.54	0.53
EsMt	*Eucalyptus spreta* and *E. kumarlensis* low woodland over *Melaleuca thyoides, Cyathostemon* aff. *ambiguus* and *Spyridium mucronatum* subsp. *mucronatum* low shrubland	18.73	0.30
EspLp	*Eucalyptus* sp. Fraser Range (D. Nicolle 2157), *Exocarpos sparteus* and *Melaleuca hamata* low open mallee shrubland/ shrubland over *Leptomeria pachyclada, Phymatocarpus maxwellii* and *Dillwynia divaricata* low open shrubland	15.46	0.24
EspMhLsp	*Eucalyptus* sp. Fraser Range (D. Nicolle 2157) and *Allocasuarina huegeliana* mid low open mallee shrubland/ woodland over *Melaleuca hamata, Acacia patagiata and A. mutabilis* subsp. *angustifolia* mid open shrubland over *Lepidosperma* aff. *brunonianum* and *Lomandra micrantha* subsp. *teretifolia* low sparse sedgeland/ herbland	9.20	0.15

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EspPmCl	*Eucalyptus* sp. Fraser Range (D. Nicolle 2157) mid sparse mallee shrubland over *Phymatocarpus maxwellii, Adenanthos cuneatus* and *Acacia assimilis* subsp. *atroviridis* mid shrubland over *Calytrix leschenaultii, Lepidosperma carphoides* and *Chordifex sphacelatus* low sparse shrubland/ sedgeland/ rushland	2.67	0.04
EtMgLd	*Eucalyptus tetraptera* and *E. leptocalyx* mid sparse mallee shrubland over *Melaleuca glena, M. rigidifolia* and *M. glaberrima* mid shrubland over *Lepidosperma drummondii* and *Gahnia ancistrophylla* low sparse sedgeland	18.85	0.30
EtMs	*Eucalyptus transcontinentalis, E. urna* and *E. eremophila* low woodland over *Melaleuca sapientes, M. podiocarpa* and *M. eleuterostachya* low shrubland	29.56	0.47
EtMuGsp	*Eucalyptus tumida, E. uncinata* and *E. flocktoniae* mid sparse mallee shrubland over *Melaleuca undulata, M. societatis* and *Grevillea plurijuga* low open shrubland over *Gahnia* sp. Ravensthorpe (G.F. Craig 5005), *Acacia gonophylla* and *A. crassuloides* low sparse sedgeland/ shrubland	50.86	0.80
EuAcSs	*Eucalyptus uncinata* and *E. conglobata* mid mallee shrubland over *Acacia cyclops, A. nitidula* and *Dodonaea amblyophylla* mid open shrubland over *Schoenus subfascicularis*, *Gahnia* sp. and *Lepidosperma* sp. Mt Burdett (M.A. Burgman & C. Layman MAB 3287) low open sedgeland	6.59	0.10
EuGpBi	*Eucalyptus uncinata* and *E. leptocalyx* mid open mallee shrubland over *Grevillea plurijuga* subsp. *plurijuga, Melaleuca hamata* and *Melaleuca societatis* mid open shrubland over *Boronia inornata* subsp. *leptophylla*, *Pultenaea purpurea* and *Hibbertia psilocarpa* low open shrubland	44.75	0.71
EuMh	*Eucalyptus uncinata* and *E. phaenophylla* subsp. *interjacens* mid mallee woodland over *Melaleuca hamata, Acacia patagiata* and *A. assimilis* subsp. *assimilis* mid shrubland	5.00	0.08
EuMpRs	*Eucalyptus urna* and *E. valens* low open forest over *Melaleuca pauperiflora, M. brevifolia* and *M. sapientes* mid open shrubland over *Ricinocarpos stylosus* and *Daviesia* sp. low sparse shrubland	14.06	0.22
EuMtDl	*Eucalyptus uncinata* and *E. tumida* mid sparse mallee shrubland over *Melaleuca teuthidoides, M. rigidifolia* and *M. hamata* mid shrubland *over Daviesia lancifolia, Pultenaea elachista* and *Microcybe albiflora* low open shrubland	67.95	1.07
EuMtPe	*Eucalyptus uncinata, E. conglobata* and *E. indurata* mid open mallee woodland over *Melaleuca teuthidoides, Daviesia incrassata* subsp. *incrassata* and *Melaleuca calycina* mid open shrubland over *Pultenaea elachista, Spyridium minutum* low sparse shrubland	10.73	0.17
EvEaPf	*Eucalyptus valens* and *E. kumarlensis* low open forest over *Exocarpos aphyllus, Callitris preissii* and *Alyxia buxifolia* tall sparse shrubland over *Phebalium filifolium, Lepidosperma drummondii* and *Bertya virgata* low open shrubland	18.01	0.28
EvEaPf/ EtMs	Mosaic, see separate descriptions	27.20	0.43
HcBe	*Hakea cinerea, H. pandanicarpa* subsp. *pandanicarpa* and *Eucalyptus extrica* mid open shrubland/ mallee shrubland, over *Beaufortia empetrifolia, Leucopogon crassifolius* and *Melaleuca pulchella* low shrubland	159.41	2.51
MaTs	*Melaleuca acuminata* subsp. *acuminata, Melaleuca thyoides* and *Melaleuca lanceolata* tall shrubland over *Triodia scariosa, Bossiaea leptacantha* and *Westringia rigida* low open hummock grassland/ shrubland	25.74	0.41
MbAj	*Melaleuca brevifolia, M. subalaris* and *M. thyoides* mid open shrubland over *Austrostipa juncifolia* and *Tecticornia* spp. mid sparse grassland/ samphire shrubland	64.97	1.02
MhAj	*Melaleuca hamulosa* tall sparse shrubland over *Austrostipa juncifolia* and *Gahnia* sp. L (K.R. Newbey 7888) mid open tussock grassland/ sedgeland	1.54	0.02
MuTm	*Melaleuca uncinata, Thryptomene australis* subsp. *brachyandra* and *Acacia nitidula* mid shrubland over *Trymalium myrtillus* subsp. *myrtillus*, *Spartochloa scirpoidea* and *Platysace effusa* low shrubland/ tussock grassland	26.83	0.42
SL	Salt lake (no vegetation)	19.19	0.30
Tspp	*Tecticornia* spp. and *Maireana oppositifolia* low open samphire shrubland/ chenopod shrubland	16.36	0.26
Total		**6339.59**	**100**

9.3.2 Vegetation associations

Twenty vegetation associations have been mapped over the Ecoscape (2017a) study area, based on Shepherd et al. (2002). Regional Pre-European vegetation associations identified in the Ecoscape (2017a) study area have been presented in Table 9-5. The following three vegetation associations (highlighted in Table 9-5) have 10 to 30% of their pre-European extent remaining:

- vegetation association 512 (Shrublands; mallee scrub, *Eucalyptus eremophila* & Forrest's marlock [*E. Forrestiana*]) has 26.4% of its pre-European extent remaining within Western Australia, the Mallee IBRA region, the Eastern Mallee (MAL1) IBRA subregion and Shire of Esperance
- vegetation association 4801 (Shrublands; heath with scattered *Nuytsia floribunda* on sandplain) has 11.17% of its pre-European extent remaining within Western Australia and the Esperance Plains IBRA region
- the Recherche (ESP2) IBRA subregion and Shire of Esperance vegetation association 47 (Shrublands; tallerack mallee-heath) has 35.89% of its pre-European extent remaining but less than 30% remaining within the IBRA Recherche (ESP2) IBRA subregion.

Table 9-5: Pre-European vegetation associations

Vegetation system association No. (Pre-European)	Description (GWA 2016)	Extent (ha)	% Vegetation Association remaining (GWA 2016)
9	Medium woodland; coral gum (*Eucalyptus torquata*) & goldfields blackbutt (*E. le soufii)*	240 509.33	97.78
10	Medium woodland; red mallee group	145 676.38	98.96
47	Shrublands; tallerack mallee-heath	1 033 054.74	35.89
125	Bare areas; salt lakes	3 485 786.61	90.27
128	Bare areas; rock outcrops	329 836.19	87.54
482	Medium woodland; merrit & red mallee	1 628 465.00	99.04
486	Mosaic: Medium woodland; salmon gum & red mallee / Shrublands; mallee scrub *Eucalyptus eremophila*	436 130.35	58.69
512	Shrublands; mallee scrub, *Eucalyptus eremophila* & Forrest's marlock (*E. forrestiana*)	237 886.07	26.40
516	Shrublands; mallee scrub, black marlock	607 434.24	54.82
519	Shrublands; mallee scrub, *Eucalyptus eremophila*	2 333 413.96	61.71
552	Shrublands; *Casuarina acutivalvus* & *Calothamnus* (also *Melaleuca*) thicket on greenstone hills	33 908.72	93.40
924	Shrublands; mallee scrub, *Eucalyptus eremophila* & red mallee	107 607.70	56.47
925	Shrublands; mallee scrub, red mallee	5152.66	73.83
1047	Shrublands; *Eucalyptus incrassata* mallee-heath	220 297.22	84.96
1413	Shrublands; acacia, casuarina & melaleuca thicket	1 679 917.00	76.61
1516	Shrublands; mallee scrub, black marlock & Forrest's marlock	126 686.61	47.15
2048	Shrublands; scrub-heath in the Mallee Region	322 219.98	49.95
3106	Medium woodland; salmon gum & Dundas blackbutt	52 660.80	97.99
4048	Shrublands; scrub-heath in the Esperance Plains including Mt Ragged scrub-heath	50 400.59	59.71
4801	Shrublands; heath with scattered *Nuytsia floribunda* on sandplain	58 196.27	11.17

9.3.3 Threatened and Priority Ecological Communities

Proteaceae Dominated Kwongkan Shrublands

In January 2014, a community described as 'Proteaceae Dominated Kwongkan Shrublands of the Southeast Coastal Floristic Province of Western Australia' was endorsed by the Commonwealth Minister for the Environment for inclusion on the EPBC Act list of TECs as Endangered. Two vegetation types were considered by Ecoscape (2017a) as likely to match the description of the 'Proteaceae Dominated Kwongkan Shrublands' TEC. These local vegetation types are:

- BaMs (dominated by *Banksia armata*)
- BsBeAl (dominated by *Banksia speciosa*).

BsBeAl has been confirmed by DBCA as likely to represent the 'Proteaceae Dominated Kwongkan Shrublands' TEC based on its proteaceous cover of 30% or greater. The BaMs vegetation assessed currently contains less than 30% proteaceous cover, though it has been affected by previous disturbance including chaining and wildfire. It is considered possible by Ecoscape (2017a) that this vegetation type could exceed the 30% proteaceous cover threshold if undisturbed and; therefore, should be treated as the potential TEC as a precaution.

Vegetation considered as potentially representative of the 'Proteaceae Dominated Kwongkan Shrublands' TEC covers 79.22 ha (1.25%) of the Ecoscape (2017a) study area, extending for a total linear range of 8 km across five separate occurrences. All locations of the potential TEC occur towards the eastern end of the Ecoscape (2017a) study area. The locations of the BaMs and BsBeAl vegetation types are entirely adjacent to agricultural land and correspond with areas of the existing chained Park and Wildlife areas. Therefore, the vegetation has been subject to historical disturbance from chaining activities.

The Proposal alignment was realigned to previously cleared freehold farmland to also avoid impacts to approximately 7245 of 7900 m of Proteaceae Dominated Kwongkan Shrublands TEC. The remaining 655 m TEC comprises 0.87 ha within the proposed clearing footprint and was recently re-chained for fire mitigation by DBCA. This area will be re-chained as part of the Proposal and may regrow, but will be subject to future rechaining events.

There is no new loss of this TEC as part of this Proposal.

Eucalypt Woodlands of the Western Australian Wheatbelt

On 26 November 2015, another ecological community named 'Eucalypt Woodlands of the Western Australian Wheatbelt' was endorsed as a TEC under the Commonwealth EPBC Act. Following a review of the vegetation types present within the Ecoscape (2017a) study area it was concluded that none of the vegetation types recorded within the Proposal alignment, or within 5 km, were considered to represent the 'Eucalypt Woodlands of the Western Australian Wheatbelt' TEC (Ecoscape 2016).

9.3.4 Conservation significant flora

Since completion of the Ecoscape (2017a) report in 2015, the conservation status of three conservation flora species recorded during the field surveys or historically has changed. A summary of changes is provided below:

- *Daviesia newbeyi*, previously listed as Priority 2, is now listed as Priority 3 (DBCA)
- *Frankenia glomerata,* previously listed as Priority 3, is now listed as Priority 4 (DBCA)
- *Myoporum turbinatum,* previously listed as Threatened Flora, is now listed as Priority 4 (DBCA).

The following sections reflect the changes in conservation status for these flora species. Figure 9-1 demonstrates database search results and recorded priority flora species within 5 km of the Proposal alignment.

Strategen conducted a new database search in April 2017 for conservation significant flora within 5 km of the Proposal alignment due to the changes of conservation status of some priority flora species. A total of 20 Priority 1, 24 Priority 2, 41 Priority 3, 22 Priority 4 and nine Threatened species were identified within 5 km of the Proposal alignment (Figure 9-1). The new flora species that were identified in the April 2017 database search are presented in Table 9-6.

Table 9-6: Flora species not identified in Ecoscape (2017a) database search

WA conservation status	Flora species
Priority 1	*Astus duomilia*
	Brachyloma nguba
	Cyathostemon sp. Dowak (J.M. Fox 86/271)
	Cyathostemon sp. Esperance (A. Fairall 2431)
	Drosera grievei
	Eucalyptus dielsii x *platypus*
	Eucalyptus misella
	Eucalyptus sp. Esperance (M.E. French 1579)
	Eutaxia andocada
	Lepidosperma sp. Mt Chester (S. Kern et al. LCH 16596)
	Leucopogon rugulosus
	Melaleuca similis
	Pimelea pelinos
	Scaevola archeriana
Priority 2	*Astroloma* sp. Grass Patch (A.J.G. Wilson 110)
	Bentleya diminuta
	Caesia viscida
	Conostephium uncinatum
	Dampiera orchardii
	Eremophila calcicola
	Hydrocotyle sp. Decipiens (G.J. Keighery 463)
	Leucopogon corymbiformis
	Levenhookia pulcherrima
	Myriocephalus biflorus
	Olearia laciniifolia
	Paracaleana parvula
	Pimelea halophila
	Pterostylis zebrina
	Tricostularia sp. Lake King (A.M. Coates 2298)
Priority 3	*Acacia truculenta*
	Banksia lullfitzii
	Banksia xylothemelia
	Chorizema circinale
	Commersonia rotundifolia
	Cryptandra polyclada subsp. *polyclada*
	Dampiera sericantha

WA conservation status	Flora species
	Dampiera sp. Ravensthorpe (G.F. Craig 8277)
	Daviesia pauciflora
	Eucalyptus famelica
	Eucalyptus semiglobosa
	Eutaxia actinophylla
	Leucopogon apiculatus
	Leucopogon florulentus
	Mirbelia densiflora
	Pultenaea daena
	Sphaerolobium validum
	Stylidium pulviniforme
	Synaphea platyphylla
	Verticordia verticordina
Priority 4	*Allocasuarina hystricosa*
	Darwinia sp. Mt Burdett (N.G. Marchant 80/42)
	Eremophila racemosa
	Goodenia phillipsiae
	Grevillea fastigiata
	Kennedia beckxiana
	Melaleuca penicula
	Myoporum turbinatum
	Myriophyllum petraeum
	Prostanthera carrickiana
	Pultenaea calycina subsp. *proxena*
	Stachystemon vinosus
Threatened	*Acrotriche orbicularis*
	Eremophila denticulata subsp. *denticulata*
	Eremophila subteretifolia
	Hypocalymma sp. Cascade (R. Bruhn 20896)
	Myoporum velutinum
	Ricinocarpos trichophorus

The flora species that were identified in the April 2017 database search (presented in Table 9-6) were not identified in the Ecoscape (2017a) report and; therefore, are not expected to occur within the Development Envelope.

Threatened Flora species

Ecoscape (2017a) identified 860 vascular flora taxa within a 100 m buffer area of the Proposal alignment during the Level 2 flora survey. Four Threatened Flora species were found within the Ecoscape (2017a) study area:

- *Anigozanthos bicolor* subsp. *minor* (Endangered)
- *Conostylis lepidospermoides* (Endangered)
- *Eucalyptus merrickiae* (Vulnerable)
- *Rhizanthella gardneri* (Endangered).

Anigozanthos bicolor subsp. minor

Twenty-seven plants were recorded from a single, geographically restricted, previously unrecorded, population that extended for a length of approximately 200 m along the study area between Shao Lu Road and Fisheries Road, in the eastern portion of the Ecoscape (2017a) study area. Individuals were only observed to be growing on the old tracks associated with previously chained areas, indicating a preference for disturbed areas. The associated vegetation type (DcTp) was unique to this location and was not recorded elsewhere within the Ecoscape (2017a) study area. A search of the surrounding area in 2014 did not identify additional individuals outside of the Ecoscape (2017a) study area adjacent to the known population; however, this species typically requires a disturbance event to promote germination.

Conostylis lepidospermoides

A total of 47 records for this species was listed on NatureMap (Ecoscape 2017a), all located to the west or northwest of Esperance; a north-south and east-west range of approximately 120 km. There are currently approximately 30 populations of *Conostylis lepidospermoides* known outside the Ecoscape (2017a) study area.

The nine populations of *Conostylis lepidospermoides* were recorded intermittently between the westernmost end of the Ecoscape (2017a) study area and Young River, extending across a total linear range of approximately 56 km. There were estimated to be almost 3000 individual plants recorded within the study area (Ecoscape 2017a). There was one historic record of this species within the Ecoscape (2017a) study area; however, this population could not be located despite a targeted search, potentially due to inaccurate location coordinates (Ecoscape 2017a).

In 2014, searches were conducted to identify whether, and to what extent, populations occur outside of the Ecoscape (2017a) study area. It was apparent that flowering of *Conostylis lepidospermoides* in 2014 was not as prolific as 2013, making it more difficult to locate the species. Six of the nine populations were observed to extend well beyond the boundary of the study area. It is expected that the other three populations extend into adjacent areas considering the vegetation types supporting *Conostylis lepidospermoides* are not restricted to the Proposal area (Ecoscape 2017a).

Eucalyptus merrickiae

Eleven populations of *Eucalyptus merrickiae* were recorded intermittently over 56 km of the Ecoscape (2017a) study area alignment, none of which were previously known to occur. There were 412 individual plants estimated from all populations combined. Most populations were associated with, or in proximity to, salt lakes. All populations are located in sections that are adjacent to agricultural land and correspond with the existing low fuel chained DBCA buffer strip. Plants occurring within the buffer strip were observed to be successfully resprouting from lignotubers.

Rhizanthella gardneri

There are two records for this species from a single population along the study area alignment near the Oldfield River, recorded in 2004 (Ecoscape 2017a). This species grows underground and can only be located during its flowering period (May to July) when the flower bracts form a small opening at the soil surface, although this is often below the leaf litter layer (Ecoscape 2017a). Targeted searches for this species were conducted in both 2013 and 2014; however, all field surveys were conducted from September to November which is outside the recognised flowering period.

Rhizanthella gardneri was not recorded during the field survey. It can only be readily detected during its flowering period (May to July) and even during that period it is highly cryptic. The records are considered by Ecoscape to be reliable based on the location details, date of survey and presence of threatened flora road markers at the site (Ecoscape 2017a).

Priority Flora species

A total of 60 Priority Flora were recorded in the Ecoscape (2017a) and GS Bio Logic (2015) study area with 59 Priority Flora recorded in the Ecoscape (2017a) flora assessment and one Priority 3 species identified by GS Bio Logic (2015) (Figure 9-1).

Of the 60 Priority Flora, 36 species occur within the 816 ha clearing footprint and 11 of these species occur within previously uncleared vegetation. A summary of Priority Flora species and their location within the maximum clearing footprint is provided below and in Table 9-7:

- three Priority 1 species
- eight Priority 2 species
- seventeen Priority 3 species
- eight Priority 4 species.

The 11 Priority Flora species were located within uncleared vegetation and 25 species within previously disturbed (chained or graded) areas (Table 9-7). As shown in Table 9-7 most of the priority flora species were only recorded in disturbed areas, including all the Priority 1 species.

Only five species were predominantly recorded in uncleared vegetation:

- *Frankenia brachyphylla* (Priority 2) 100 of 100 in uncleared vegetation
- *Thysanotus brachyantherus* (Priority 2) 9 of 10 in uncleared vegetation
- *Bossiaea flexuosa* (Priority 3) 200 of 245 in uncleared vegetation
- *Hibbertia hamata* (Priority 3) 35 of 35 in uncleared vegetation
- *Micromyrtus elobata* subsp. *scopula* (Priority 3) in uncleared vegetation.

Species profiles of conservation significant flora are provided in Ecoscape (2017a) and GS Bio Logic (2015) (Appendix 3).

The Priority 3 taxon *Hibbertia hamata* was also identified from the Merivale Rd (UCL) section by GS Biologic (2015) (Figure 9-1). Two sub-populations comprising 35 individuals of *H. hamata* were identified along an existing telecommunications cable alignment (GS Bio Logic 2015) within the Development Envelope. No Declared Rare Flora were identified (GS Bio Logic 2015).

Table 9-7: Priority Flora species, number of individuals and location within existing disturbance conditions within the clearing footprint

Species	Existing disturbance condition			Total of individuals
	Chained	Graded	Uncleared	
Priority 1				
Boronia baeckeacea subsp. *patula*	15	-	-	15
Darwinia sp. Mt Ney (M.A. Burgman & S. McNee 1274)	401	-	-	401
Leucopogon sp. Bonnie Hill (K.R. Newbey 9831)	400	-	-	400
Priority 2				
Acacia nitidula	500	-	-	500
Aotus sp. Dundas (M.A. Burgman 2835)	85	45	100	230
Eucalyptus luculenta	1	-	-	1
Frankenia brachyphylla	-	-	100	100
Halgania sp. Peak Eleanora (M.A. Burgman 3547 B)	1930	-	-	1930
Melaleuca eximia	20	-	-	20
Persoonia spathulata	1	-	-	1
Thysanotus brachyantherus	1	-	9	10
Priority 3				
Acacia euthyphylla	129	-	-	129
Acacia glaucissima	3478	-	15	3493

Species	Existing disturbance condition			Total of individuals
	Chained	Graded	Uncleared	
Acacia singula	90	-	-	90
Bossiaea flexuosa	45	-	200	245
Comesperma calcicola	2	-	-	2
Cyathostemon sp. Salmon Gums (B. Archer 769)	67	540	335	942
Eremophila chamaephila	426	-	-	426
Eremophila compressa	57	-	-	57
Gonocarpus pycnostachyus	100	-	-	100
Goodenia laevis subsp. *laevis*	2470	40	-	2510
Hibbertia hamata	-	-	35	35
Isopogon alcicornis	2772	-	3	2775
Micromyrtus elobata subsp. *scopula*	2	-	550	552
Persoonia cymbifolia	1	-	-	1
Persoonia scabra	235	-	-	235
Pityrodia chrysocalyx	15	-	-	15
Pultenaea daena	129	-	-	129
Priority 4				
Adenanthos ileticos	133	-	-	133
Darwinia polycephala	687	-	100	787
Eremophila serpens	18	-	-	18
Eucalyptus dolichorhyncha	57	-	20	77
Grevillea aneura	124	-	-	124
Grevillea baxteri	464	-	-	464
Gyrostemon ditrigynus	454	-	-	454
Melaleuca fissurata	208	-	-	208
Total	**15 517**	**625**	**1467**	**17 609**

Data based on Ecoscape (2017a) and GS Bio Logic (2015) estimates. (-) indicates absence of species within existing disturbance condition.

9.3.5 Introduced flora species

Twenty six introduced flora (weed) species were recorded during the Level 2 flora survey (Ecoscape 2017a), including two[8] species which are Declared Pest plants under the BAM Act:

- *Asparagus asparagoides* (Bridal Creeper)– adjacent to Cape Arid NP
- *Onopordum acaulon* (Stemless Thistle) – north of Salmon Gums adjacent to Beete Road.

The two identified Declared Pests are recognised as Category Three (C3) in the BAM Act Western Australian Organism List (WAOL). Broadly, under the BAM Act and Regulations, C3 category organisms are those where eradication is not feasible but some form of management should be applied to alleviate its harmful impact, reduce its numbers or distribution or prevent or contain its spread in that area.

[8] Ecoscape (2017a) also identified *Carthamus lanatus* as a Declared Pest. This species has since been delisted under the BAM Act.

The biological surveys did not include the easternmost end of the Proposal alignment (south of Fisheries Road), where the Proposal alignment is located on freehold crop land near Cape Arid NP, or several minor sections which have since been modified to ensure existing fire tracks could be used for the Proposal alignment if possible. Therefore, there is no data available regarding the occurrence of Declared Pests in these sections of the Proposal alignment.

Agricultural lands with introduced pasture species occur close to the Proposal alignment; however, no introduced pasture species were identified in the study area during the GS Bio Logic (2015) investigation.

9.3.6 Range extensions, range edges and other significant features

The following species are considered by Ecoscape (2017a) to represent range extensions or range edges based on where they were recorded within the Ecoscape (2017a) study area, based on FloraBase (WAH 1998-2014) and NatureMap (Parks and Wildlife 2007) data. These species are presented in Table 9-8.

Table 9-8: Species expected to be range extensions

Species	Conservation status	Description (Ecoscape 2017a)
Acacia bartlei	Priority 3	**Current known range:** north of the Cascade locality to Kau Rock NR; a linear range of approximately 150 km. **Range extension:** a minor eastern range extension of approximately 10 km.
Acacia singula	Priority 3	**Current known range:** 44 records of this species listed on NatureMap, from Tarin Rock eastwards to north of Munglinup; an east-west range of approximately 200 km. **Range extension:** at the eastern extent of its known range.
*Austrostipa pycnostachya**		**Current known range:** 129 records from Dalwallinu in the north west, east of Koolyanobbing at its north-eastern extent to near Denmark in the south west to approximately 80 km east of Esperance. **Range extension:** at the easternmost extent of its known range.
Baeckea sp. fine-leaved (C.M. Lewis 517) (now *Ericomyrtus drummondii*)*		**Current known range:** 76 records listed on NatureMap, from north of Kondut south eastwards to Munglinup and west to near Kojonup. **Range extension:** a substantial eastern range extension of approximately 150 km.
*Bertya virgata**		**Current known range:** Nine records listed on NatureMap, located near Norseman on a range of approximately 150 km. **Range extension:** a southern range extension of approximately 50 km.
Boronia baeckeacea subsp. *patula*	Priority 1	**Current known range:** eight records listed on NatureMap, all northeast of Esperance over a range of approximately 60 km. **Range extension:** one of the recorded populations represents a northern range extension of approximately 50 km.
Conostephium marchantiorum	Priority 3	**Current known range:** 47 records of this species listed on NatureMap, located from the northwest to north of Esperance over an east-west range of approximately 80 km and north-south range of approximately 70 km. **Range extension:** a minor northern range extension of approximately 20 km.
Cryptandra minutifolia subsp. *brevistyla**		**Current known range:** 58 records distributed over a north-south range of approximately 300 km and east-west range of approximately 330 km from approximately 75 km east of Kalgoorlie south westwards to near Kulin to the northern edge of the Stirling Range to Esperance. **Range extension:** one of the records represents an eastern range extension of approximately 100 km.

Species	Conservation status	Description (Ecoscape 2017a)
Cyathostemon sp. Salmon Gums (B. Archer 769)	Priority 3	**Current known range:** 12 records of this taxon listed on NatureMap, to the north and northwest of Esperance over an east-west and north-south range of approximately 140 km. **Range extension:** one population represents a minor eastern range extension of approximately 20 km.
Darwinia polycephala	Priority 4	**Current known range:** 29 records listed on NatureMap, distributed between Grass Patch and Scaddan (approximately 25 km) and approximately 60 km eastwards, with an outlier population in Cape Arid NP, approximately 100 km further east. **Range extension:** a minor northern range extension of approximately 20 km.
*Eragrostis falcata**	NA	**Current known range:** 161 records listed on NatureMap with distribution throughout most of the State. **Range extension:** approximately 200 km from the nearest known record of the species, representing a south-eastern range extension.
*Eremophila gibbosa**	NA	**Current known range:** 37 records listed on NatureMap located over a range of approx. 400 km, from 50 km north of Koolyanobbing southeast to approximately 130 km northeast of Esperance. **Range extension:** a minor southern range extension of approximately 30 km.
Eremophila serpens	Priority 4	**Current known range:** 41 records listed on NatureMap, with a wide distribution from Skeleton Rock, south to the Fitzgerald River NP (approximately 225 km) and eastwards to near Beaumont NR, approximately 330 km. There is an outlier population near York, over 200 km to the west of the main species range. **Range extension:** a minor eastern range extension of approximately 35 km.
Goodenia laevis subsp. *laevis*	Priority 3	**Current known range:** 16 records of this taxon listed on NatureMap, with a north-south distribution from Norseman to Scaddan (approximately 140 km) and an east-west range of approximately 170 km. **Range extension:** a minor western range extension of approximately 20 km.
*Lepidosperma gahnioides**	NA	**Current known range:** 50 records of this taxon listed on NatureMap, mostly distributed over an east-west range of approximately 160 km from Corackeup east to Jerdacuttup and north to Lake King. One record is located approximately 20 km north of Kelleberrin. **Range extension:** the two populations recorded (near Mt Ney NR) represent an eastern range extension of approximately 180 km.
Hydrocotyle sp. Coraginaensis (K. Newbey 7747)	Priority 2	**Current known range:** three records listed on NatureMap, all to the north and northeast east of Esperance, across a range of approximately 200 km. **Range extension:** a southern range extension of approximately 50 km.
Hydrocotyle sp. Hexaptera (T. Erickson TEE 173)	Priority 1	**Current known range:** seven records listed on NatureMap, all from near Lake King. **Range extension:** a substantial eastern range extension of over 200 km.
Olearia picridifolia	NA	**Current known range:** most collections of this species are from the Nullarbor region. **Range extension:** a western range extension of approximately 40 km.

Species	Conservation status	Description (Ecoscape 2017a)
*Petrophile stricta**	NA	**Current known range:** 48 records listed on NatureMap, over an east-west range of approximately 430 km from Toodyay eastwards to west of Coolgardie and north-south range of approximately 200 km to near and east of Lake King. **Range extension:** a south-eastern range extension of approximately 70 km.
Pultenaea craigiana	Priority 3	**Current known range:** 31 records listed on NatureMap, all from near Ravensthorpe and Kundip, over a north-south range of less than 30 km and east-west range of less than 25 km. **Range extension:** an eastern range extension of approximately 30 km.
*Ricinocarpos stylosus**	NA	**Current known range:** 61 records listed on NatureMap, distributed over a north-south range of approximately 240 km from Coolgardie to Salmon Gums. **Range extension:** a minor southern range extension of approximately 30 km.
*Spergularia brevifolia**	NA	**Current known range:** 23 records listed on NatureMap, widely distributed in the South West Land Division from Yallabathara in the north west to Walpole in the south west to Balladonia in the east. **Range extension:** a rarely collected species, the population recorded (north of Salmon Gums) is approximately 140 km north of the closest population.
*Stenanthemum ?emarginatum**	NA	**Current known range:** 37 records listed on NatureMap, distributed over a wide range of approximately 1000 km from Shark Bay in the north west to near Denmark in the south west to approximately 40 km south west of Ravensthorpe at its south-eastern extent. **Range extension:** this sterile, poor quality specimen (if confirmed) would represent a range extension of over 200 km.
*Stylidium zeicolor**	NA	**Current known range:** 129 records listed on NatureMap, distributed in the Wheatbelt from Moora to Narembeen to Ravensthorpe to Kojonup. **Range extension:** an eastern range extension of approximately 70 km.
*Synaphea reticulata**	NA	**Current known range:** 50 records listed on NatureMap, distributed along the south coast and adjacent areas from approximately 30 km east of Esperance to approximately 30 km west of Denmark, and from near Kojonup to Lake Grace. **Range extension:** an eastern range extension of approximately 50 km.
Thysanotus brachyantherus	Priority 2	**Current known range:** 12 records of this species listed on NatureMap, distributed over a wide range from approximately 475 km north of Esperance (west of Menzies) to approximately 150 km east of Esperance (Cape Arid NP and northwards); a linear range of approximately 500 km. **Range extension:** one of the populations represents a southwest range extension of approximately 60 km.

*Current known range for these species not described in Ecoscape (2017a) – NatureMap review undertaken separately.

Species with local endemism or a restricted distribution are considered to be significant flora according to *Guidance Statement No. 51* (EPA 2004a). *Darwinia* sp. Mt Ney Virgate (A.S. George 15837); whilst not formally listed as Threatened or Priority Flora, has a very small known geographic extent with only nine collections from around Mt Ney and is; therefore, considered of potential significance (Ecoscape 2017a).

No significant range extensions were recorded in the Level 1 flora assessment undertaken by GS Bio Logic (2015); however, many taxa recorded are at the eastern edge of their range (GS Bio Logic 2015).

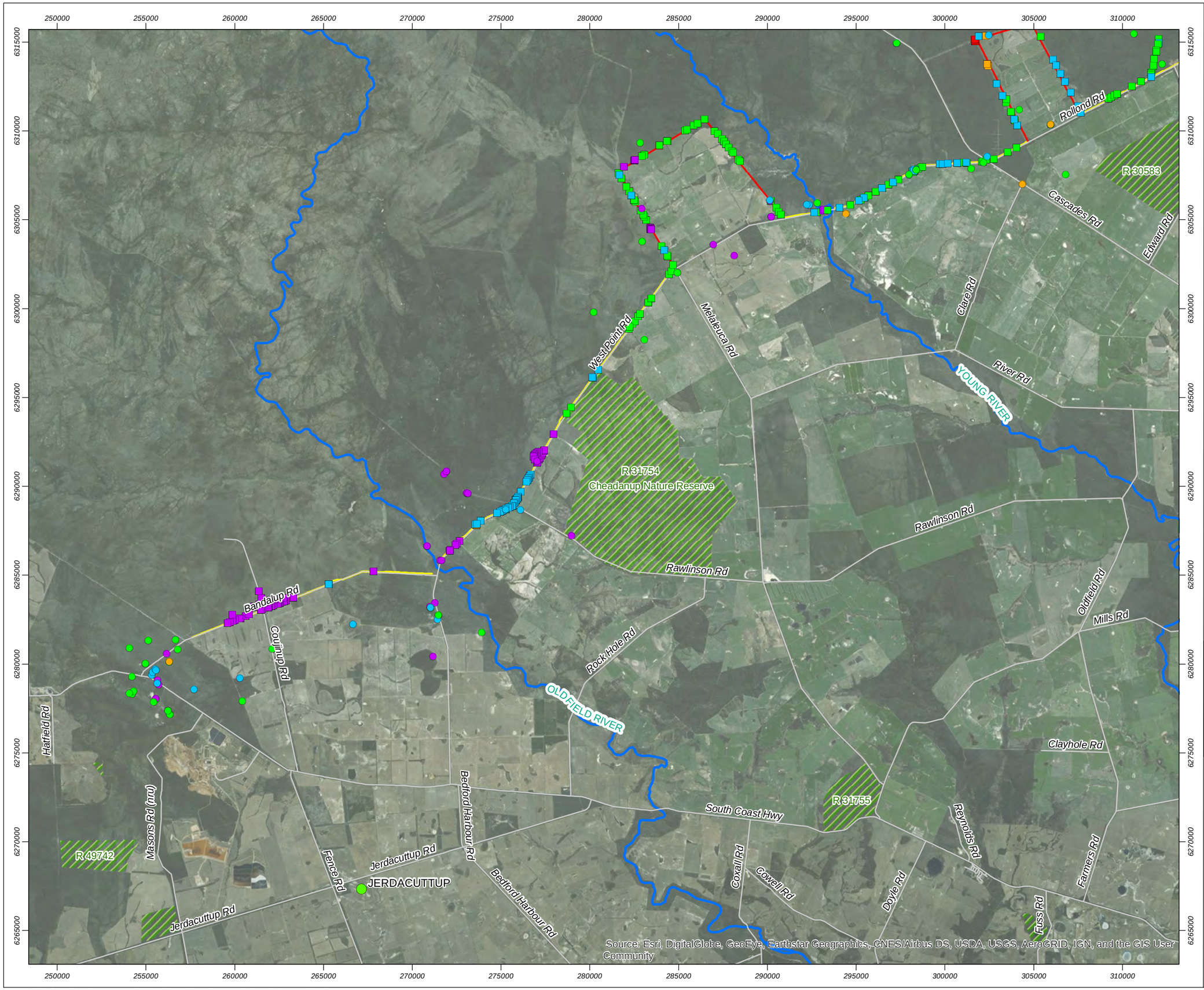
9.3.7 Presence of *Phytophthora* Dieback

The scoping study conducted by GHD (2012) identified possible risk of the spread of *Phytophthora* Dieback along the Proposal alignment from the clearing, construction and maintenance activities associated with the Proposal to currently uninfested areas. Glevan (2015) assessed the vegetation associated with the Proposal for the presence of *Phytophthora* Dieback. The majority of the area surveyed was categorised as Uninterpretable due to inadequate rainfall or an insufficient coverage of reliable indicator species. *Phytophthora* Dieback was not observed in the vegetation within or immediately adjacent to the Proposal alignment. Dieback was observed at locations in proximity to the Proposal alignment, including previously recorded infestations along South Coast Highway east of Ravensthorpe, and at sites in Cape Arid NP and Cape Le Grand NP (Glevan 2015). At each site, the disease was expressing in multiple deaths of *Xanthorrhoea platyphylla* and *Banksia speciosa*, with a reasonable pattern of deaths at each site (Glevan 2015).

An infestation of *Phytophthora rosacearum* was observed adjacent to Bandalup Road, near the intersection of Coujinup Road. The infestation appears restricted to a disused gravel extraction site. A significant infestation of *Phytophthora inundata* was identified toward the eastern end of the Proposal alignment and is having a significant impact on the susceptible vegetation. The infestation is adjacent to farmland and is spreading along the existing firebreak (Glevan 2015).

GS Bio Logic (2015) found *Phytophthora cinnamomi* present in the 1.6 km section of UCL surveyed along Merivale Road adjacent to Cape Arid NP.

Figure 9-1: Conservation significant flora field and database search results



Legend

Database Threatened and Priority Flora (WA Herbarium, Parks and Wildlife)

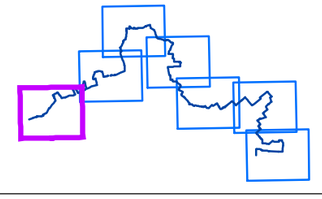
- Priority 1
- Priority 2
- Priority 3
- Priority 4
- Threatened; Rare or likely to become extinct (Schedule 1, WC Act)

Recorded Priority Flora (Ecoscape 2015)

- Priority 1
- Priority 2
- Priority 3
- Priority 4
- Rare or likely to become extinct (Schedule 1, WC Act)
- Roads
- Major watercourses
- Parks and Wildlife Managed Lands and Waters

Proposal alignment existing environment conditions

- Previously chained firebreak
- Previously cleared freehold farmland



Scale 1:200,000 at A3

0 1 2 3 4 km

Coordinate System: GDA 1994 MGA Zone 51

Note that positional errors may occur in some areas

Date: 1/08/2017

Author: DWhite

Source: Aerial: ESRI approx. 2010; Inland waters: SLIP database, Landgate 2017; Recorded Priority Flora: Ecoscape (2015) - updated 2017;
Flora database: Parks and Wildlife 2017, search radius 5 km.

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Figure 9-1: Conservation significant flora field and database search results



Legend

Database Threatened and Priority Flora (WA Herbarium, Parks and Wildlife)

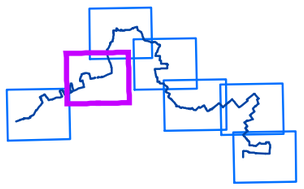
- Priority 1
- Priority 2
- Priority 3
- Priority 4

Recorded Priority Flora (Ecoscape 2015)

- Priority 1
- Priority 2
- Priority 3
- Priority 4
- Roads
- Major watercourses
- Parks and Wildlife Managed Lands and Waters

Proposal alignment existing environment conditions

- Previously chained firebreak
- Existing track or graded firebreak
- Previously cleared freehold farmland
- Uncleared vegetation



Scale 1:200,000 at A3

0 1 2 3 4 km

Coordinate System: GDA 1994 MGA Zone 51

Note that positional errors may occur in some areas

Date: 1/08/2017

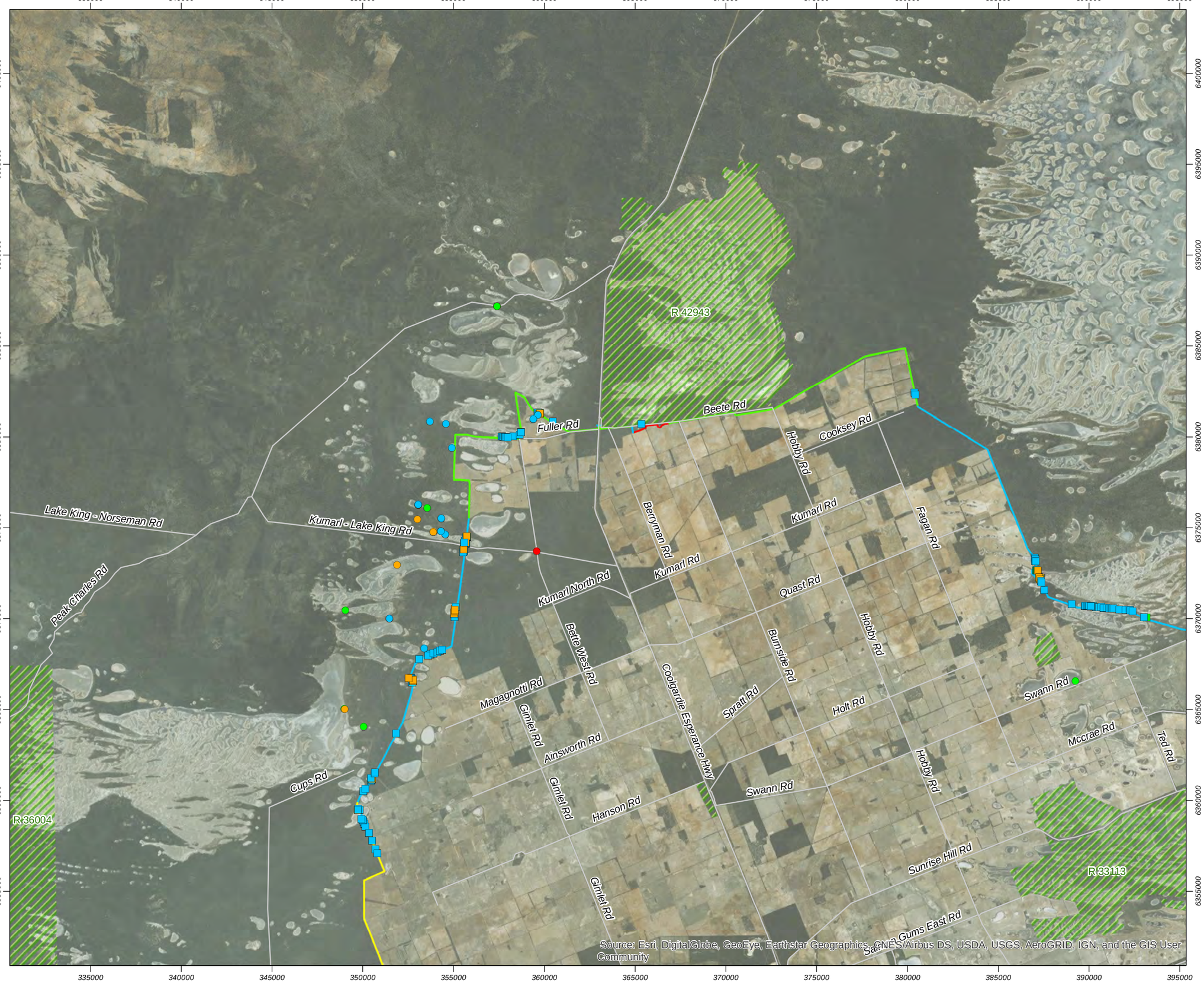
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Flora database: Parks and Wildlife 2017, search radius 5 km.

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Figure 9-1: Conservation significant flora field and database search results



Legend

Database Threatened and Priority Flora (WA Herbarium, Parks and Wildlife)

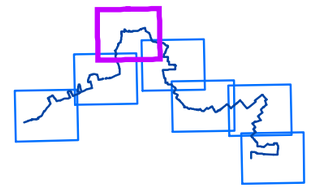
- Priority 1
- Priority 2
- Priority 3

Recorded Priority Flora (Ecoscape 2015)

- Priority 2
- Priority 3
- Priority 4
- Roads
- Parks and Wildlife Managed Lands and Waters

Proposal alignment existing environment conditions

- Previously chained firebreak
- Existing track or graded firebreak
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- Uncleared vegetation



Scale 1:200,000 at A3

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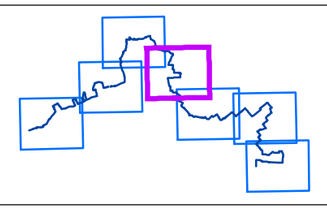
- Priority 4
- Threatened; Rare or likely to become extinct (Schedule 1, WC Act)

Recorded Priority Flora (Ecoscape 2015)

- Priority 1
- Priority 2
- Priority 3
- Priority 4
- Rare or likely to become extinct (Schedule 1, WC Act)
- Roads
- Parks and Wildlife Managed Lands and Waters

Proposal alignment existing environment conditions

- Previously chained firebreak
- Existing track or graded firebreak
- Previously cleared freehold farmland
- Uncleared vegetation



Scale 1:200,000 at A3

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Coordinate System: GDA 1994 MGA Zone 51

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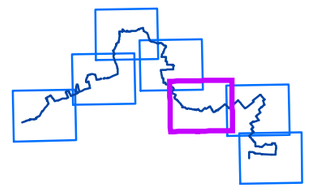
- Priority 1
- Priority 4
- Threatened; Rare or likely to become extinct (Schedule 1, WC Act)

Recorded Priority Flora (Ecoscape 2015)

- Priority 1
- Priority 2
- Priority 3
- Priority 4
- Roads
- Parks and Wildlife Managed Lands and Waters

Proposal alignment existing environment conditions

- Previously chained firebreak
- Previously cleared freehold farmland
- Uncleared vegetation



Scale 1:200,000 at A3

0 1 2 3 4 km

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Coordinate System: GDA 1994 MGA Zone 51

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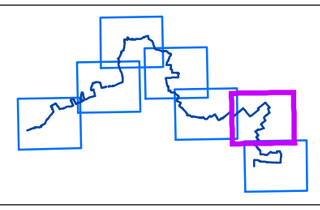
- Priority 1
- Priority 2
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- Priority 4
- Threatened; Rare or likely to become extinct (Schedule 1, WC Act)

Recorded Priority Flora (Ecoscape 2015)

- Priority 1
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Proposal alignment existing environment conditions

- Previously chained firebreak
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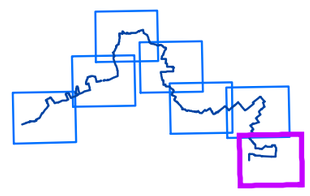
- Priority 2
- Priority 3
- Priority 4
- Threatened; Rare or likely to become extinct (Schedule 1, WC Act)

Recorded Priority Flora (Ecoscape 2015)

- Priority 2
- Priority 3
- Priority 4
- Rare or likely to become extinct (Schedule 1, WC Act)
- Roads
- Parks and Wildlife Managed Lands and Waters

Proposal alignment existing environment conditions

- Previously chained firebreak
- Previously cleared freehold farmland
- Uncleared vegetation



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Flora database: Parks and Wildlife 2017, search radius 5 km.

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9.4 Potential impacts

The ESD identifies the requirement to describe and assess potential impacts resulting from clearing of native vegetation as part of the Proposal on local and regional flora and vegetation. The ESD has identified the following potential impacts on the Flora and Vegetation environmental factor:

1. Direct clearing of native vegetation during construction.
2. Indirect impacts on flora and vegetation from:
    - the introduction and spread of weeds
    - the introduction and spread of *Phytophthora cinnamomi*
    - fragmentation of vegetation
    - change in fauna aided seed dispersal.

9.5 Application of the mitigation hierarchy

In accordance with the Administrative Procedures (GoWA 2012), consideration was given during the planning for the Proposal to avoid, minimise and rectify or rehabilitate the potential impacts identified in the ESD. These measures are summarised in Table 9-9. The planned mitigation measures are taken into account when predicting the residual impacts of the Proposal.

DPIRD has undertaken extensive consultation with stakeholders and been informed by consultant reports to develop a Proposal that minimises unintended impacts on flora and vegetation. Recommendations were developed by GS Bio Logic (2015) and Ecoscape (2017a), how these recommendations have been incorporated into the Proposal is outlined in Table 9-10.

Table 9-9: Application of the mitigation hierarchy to potential impacts on Flora and Vegetation

Potential impacts	Avoid	Minimise	Rectify/rehabilitate	Offset
Clearing of native vegetation	The requirement for clearing of native vegetation has been avoided along large sections of the Proposal alignment by following existing fire management breaks and already cleared areas within private property. The Proposal alignment has also been selected to entirely avoid the threatened underground orchid (*Rhizanthella gardneri*) habitat near the Oldfield River and to avoid clearing in any A Class Reserves and Cape Arid NP.	The clearing of vegetation has been minimised by reducing the total clearing footprint width to as low as possible (15–20 m width). Clearing activity within the 15–20 m wide clearing footprint has been modified from bulldozing and grading the entire 20 m wide area, to only bulldozing/grading a 6 m wide track. The 6 m wide track within the clearing footprint will be used for the construction and ongoing maintenance of the proposed barrier fence. The remaining area adjacent to the 6 m wide track (up to 14 m) will be chained and potentially mulched (instead of bare earth cleared) to minimise the potential for erosion, cultural heritage disturbance, as well as to maintain the seed bank and retain some ground habitat. A Construction Management Plan (CMP) will also be developed by the Proponent following approval of the Proposal. This will include key management actions such as: • accurately delineating the fence reserve boundary via pegging to provide accuracy to the limits of the allowable clearing lines • pre-clearing survey of unsurveyed areas along the Proposal alignment to identify potential Declared Pests or Weeds of National Significance, and threatened and priority flora species prior to installation of the proposed barrier fence • avoidance of priority areas containing conservation significant flora or vegetation during installation of water diversion turnouts. .	Not applicable	Not applicable
Introduction and spread of weeds	The Proposal alignment will largely be located within existing tracks and graded firebreaks, and previously chained areas where possible to avoid the spread of weeds into uncleared vegetation.	The Weed Hygiene Plan (WHP) presented in Appendix 5 will be implemented by DPIRD during construction and ongoing maintenance of the proposed barrier fence. Clearing and construction works contract terms will have requirements for strict adherence to the WHP. Key action items in the WHP include the implementation of vehicle hygiene measures to minimise soil transfer across the Proposal alignment.	Not applicable	Not applicable

Potential impacts	Avoid	Minimise	Rectify/rehabilitate	Offset
Introduction and spread of *Phytophthora cinnamomi*	Areas of *P. rosacearum* and *P. inundata* infestation were identified during the Glevan (2015) survey and *P. cinnamomi* was identified by GS Biologic (2015) in a 1.6 km section of UCL. These areas have been avoided where possible in the current design of the Proposal alignment.	A *Phytophthora* Dieback Management Plan (PDMP) will be prepared by DPIRD in consultation with DBCA and South Coast Natural Resource Management Inc. and will be implemented by DPIRD prior to any construction works commencing on site. Clearing and construction works contract terms will have requirements for strict adherence to the PDMP (e.g. clean on entry points). Compliance with the PDMP will be enforced by DPIRD construction supervisors.	Not applicable	Not applicable
Fragmentation of vegetation	The Proposal alignment has been modified to reduce isolation of large sections of the Great Western Woodlands compared to the original scoping studies preferred alignment (GHD 2012). The Proposal alignment has also been moved (in agreement with the landholders) onto private property for approximately 129.4 km where high environmental and cultural concerns were identified. This will be achieved in various sections by replacing existing farm boundary fences on freehold land with the proposed barrier fence. As a result, no new clearing would be undertaken. Additional clearing on freehold land has been restricted to 3 ha over 1.5 km to avoid a cultural place and deep salt lake.	The three main river systems in the west of the Proposal alignment and the coastal corridor to the southeast of the Proposal alignment will be unfenced to allow for the maintenance of these ecological corridors. The barrier fence specifications have been designed to minimise impacts to non-target fauna species. Small animals and birds will be able to pass through or over the proposed barrier fence retaining the ecological connection with vegetation on both sides of the Proposal alignment. The Proposal alignment has been developed to utilise existing linear infrastructure and firebreaks where possible. This has significantly reduced the fragmentation of vegetation by the Proposal. The width and type of clearing has also been minimised which reduces the overall clearing footprint and the level of vegetation fragmentation caused by the Proposal.	Not applicable	Not applicable
Change in fauna aided seed dispersal	The avoidance of this impact for large target species is not applicable as the prevention of access for wild dogs, emus and kangaroos from the rangelands and adjacent woodlands is the purpose of the Proposal. The gaps in the Proposal alignment associated with the three main river systems (Oldfield River, Lort River and Young River) and along the coast ensure that dispersal and access to resources can still occur along the key ecological corridors in the region.	The proposed barrier fence mesh dimensions will allow the majority of native fauna to pass through. The Proposal alignment utilises existing 'soft barriers' of firebreaks and replaces existing farm boundary fences for the majority of the route which minimises new effects of the Proposal. The ecological benefits from kangaroos and emus will be retained in the agricultural area. The proposed barrier fence would prevent periodic irruption of emu numbers into the agricultural area during migration years but would be unlikely to decrease numbers within the agricultural area during 'normal years'. There is no intent to remove these taxa from within the fenced area.	Not applicable	Not applicable

Table 9-10: Consultant recommendations regarding flora and vegetation management and incorporation into the Proposal

Recommendation	Proposed approach	Recommendation to be implemented by the Proponent
GS Bio Logic (2015) recommendations		
Construct the fence as close as possible to Merivale Road to minimise the depth of impact into the UCL and associated habitat.	The Proposal alignment along Merivale Road will replace existing farm boundary fences where possible to minimise the impact into the UCL and associated habitat. The Proposal alignment through this 1.6 km section of UCL is proposed approximately 10 m from Merivale Road near an existing disturbed area from a buried Telstra communications cable.	Yes
All clearing and construction activities should be performed in accordance with a project specific operational hygiene plan designed to mitigate the risk of spreading Phytophthora dieback.	A PDMP will be prepared and will be implemented by DPIRD during construction and ongoing maintenance of the proposed barrier fence.	Yes
Should fence construction occur 12 months or more from the date of the Phytophthora dieback field assessment (12 August 2015), disease boundaries will require a re-check survey to be completed before operational activities can be undertaken. Should fence construction occur 36 months or more from the date of the Phytophthora dieback field assessment then the entire study area will require a full re-survey due to the potential for disease movement and additional infestation.	Prior to construction, a PDMP will be prepared by DPIRD.	Yes
General controls and mitigation measures should be implemented through an Environmental Management Plan (EMP). The EMP would ensure roles and responsibilities are clearly defined, site audits are conducted and construction staff are inducted to the fauna habitat values of the site. *Phytophthora* dieback management and soil hygiene and fauna preclearance survey requirements. Appropriate reporting would also be addressed through the EMP in line with standard operating procedures.	A number of management plans will be in place to outline general controls and mitigation measures for the Proposal. Roles and responsibilities, and requirements for environmental inductions for construction staff will be defined in the environmental management plans following approval. Site audits and reporting requirements will be conducted and outlined as part of the future Ministerial Statement to be issued for the Proposal. *Phytophthora* dieback management and soil hygiene and fauna preclearance survey requirements will be outlined in the PPDMP and the CMP.	Yes
Final designs should quantify the amount of native vegetation required to be cleared and this should be assessed against any matters of National Environment Significance (e.g. Carnaby's Black Cockatoo foraging habitat.	The Proposal (including proposed clearing of Carnaby's Black Cockatoo foraging habitat) was referred to DEE under the EPBC Act and received a not a controlled action decision.	Yes

Recommendation	Proposed approach	Recommendation to be implemented by the Proponent
Ecoscape (2017a) recommendations		
Avoid or minimise impact to TEC vegetation.	Clearing has been minimised along the entire Proposal alignment. The Proposal alignment avoids TEC areas with the exception of approximately 655 m (0.87 ha) of Proteaceae Dominated Kwongkan Shrublands TEC which was recently re-chained for fire mitigation by DBCA. Only 0.87 ha of this TEC is located within the maximum clearing footprint and is proposed to be re-chained as part of the Proposal. The TEC is located in a previously chained area and; therefore, there is no new disturbance to this TEC.	Yes
Minimise impact to pre-European vegetation associations with less than 30% extent remaining.	Vegetation Associations 47, 512 and 4801 within the 15–20 m wide clearing footprint are mostly located in previously chained areas by DBCA. The only exception to this is the proposed clearing of 1.2 ha of Vegetation Association 4801 located within uncleared vegetation.	Yes
Avoid or minimise impact to Threatened Flora taxa.	The Proposal alignment avoids known records of threatened flora species located in uncleared vegetation. The Proposal alignment is also located in previously chained areas where possible to avoid impacts to threatened species.	Yes
Minimise impact to Priority Flora.	The Proposal alignment intersects records of Priority Flora in previously chained areas.	Partially The Proposal avoids most Priority flora. A total of 37 species may occur within the 15–20 m wide clearing footprint with only 11 Priority species occurring within uncleared vegetation
Develop and implement a weed hygiene plan.	A WHP has been developed (Appendix 5) and will be implemented by the Proponent during construction and ongoing maintenance of the Proposal.	Yes
General recommendations for minimising the overall impact to flora, vegetation and fauna, including: • utilise low fuel modified buffer strip instead of clearing undisturbed vegetation • placement of the fence as close as possible to the existing agricultural boundary • limiting unauthorised access to the fence.	All three mitigation measures recommended have been adopted in the Proposal.	Yes
Develop and implement dieback hygiene procedures.	A PDMP will be prepared and will be implemented by DPIRD during construction and ongoing maintenance of the Proposal.	Yes
Environmental inductions regarding wildlife interactions and waste disposal for all construction teams.	Environmental inductions will be included in the environmental management plans to be prepared for the Proposal following approval.	Yes

9.6 Assessment of predicted direct and indirect residual impacts

Sections 9.6.1 to 9.7 present an assessment of predicted direct and indirect residual impacts on Flora and Vegetation after the mitigation hierarchy has been applied (as described in Section 9.5).

9.6.1 Direct clearing of flora and vegetation during construction

The Proposal will result in the clearing or disturbance of up to 816 ha of vegetation. However, the Proposal has been designed to minimise clearing through:

- only requiring full vegetation clearing (grading) of a 6 m wide track within the 15 to 20 m wide clearing footprint:
  - the remaining clearing footprint width (up to 14 m wide) will be chained or potentially mulched
- adjusting the Proposal alignment to use previously cleared areas or existing cleared fire tracks where possible
- implementation of the following plans relating to direct clearing of vegetation:
  - Weed Hygiene Plan (WHP)
  - Construction Management Plan (CMP).

Following the implementation of mitigation measures outlined in Table 9-9, the residual disturbance impact will consist of:

Disturbance to previously disturbed vegetation:

- 373.8 ha (45.8%) of re-chaining within existing chained fire management buffers
- 248.6 ha (30.5%) of grading (full clearing) within existing chained fire management buffers.

Disturbance to uncleared vegetation:

- 146.0 ha (17.9%) of chaining within uncleared vegetation
- 41.6 ha (5.1%) of permanent grading (for a 6 m wide access track) within uncleared vegetation.

Clearing for water diversion:

- 6 ha (0.7%) of full clearing for water diversion turnouts (predicted impacts on local vegetation are presented in Table 9-14).

Most of the vegetation clearing required for the Proposal will occur within an existing, low fuel managed (previously chained) fire buffer between the agricultural land and woodlands. Total area for re-chaining (if necessary) will account for approximately 373.8 ha (or 45.8%) of the maximum clearing footprint (816 ha) for the Proposal (Table 4-3). This fire buffer will continue to be cleared for fire protection irrespective of the construction of the Proposal. In addition to the re-chaining, 248.6 ha of grading (full clearing) will also be required in previously chained areas for fire management.

Clearing within uncleared vegetation will be limited to approximately 188 ha (23% of total vegetation disturbance), predominantly near Salmon Gums in the northern section of the Proposal alignment. However, the majority (146.0 ha or 17.9%) of this will be chained and only 41.6 ha (5.1%) of the vegetation clearing is full clearing within uncleared vegetation.

To allow construction of water diversion turnouts along the alignment the disturbance of 6.0 ha allowed for; however, the location of turnouts will be determined during construction and as such it is not yet possible to identify whether these will occur in cleared or uncleared vegetation.

The Proposal alignment follows the edge of the agricultural area and is adjacent to almost 16 million hectares of uncleared vegetation in the Great Western Woodlands. The Great Western Woodlands includes approximately 69 000 ha of disturbance associated with linear infrastructure. Additional disturbance is associated with townships and mines. Due to the relatively small scale, and its location along the edge of the Great Western Woodlands and the largely already cleared agricultural areas, the overall effect of clearing of vegetation for the Proposal is not expected to be significant.

A total of 129.4 km of the Proposal alignment will replace existing farm boundary fences on freehold land and; therefore, no vegetation clearing will be required in these areas.

Threatened and Priority Ecological Communities

The Proposal has the potential to impact 0.87 ha of the Proteaceae Dominated Kwongkan Shrublands' TEC within the maximum clearing footprint. The location of this clearing is within previously chained areas for fire mitigation by DBCA. The removal of 0.87 ha represents no new loss of this TEC as part of this Proposal.

Vegetation associations

Two of the vegetation associations (512 and 4801) within the Proposal alignment have 10 to 30% of their pre-European extent remaining in WA and are considered overcleared by the EPA according to EPA Position Statement No.2 (EPA 2000). The total clearing of these vegetation associations is outlined in Table 9-11, and associated local vegetation types identified by Ecoscape (2017a). However, the majority of the clearing required for the vegetation associations are within previously chained areas and; therefore, does not represent a new impact. Only 1.2 ha of Vegetation Association 4801 required to be chained/graded is within uncleared vegetation (Table 9-11). This is not expected to be a significant residual impact as the removal of 1.2 ha will not significantly change the current extent of Vegetation Association 4801.

Vegetation associate 47 has 35.89% of its pre-European extent remaining but less than 30% remaining within the IBRA Recherche (ESP2) IBRA subregion and; therefore, expected to be regionally significant. Approximately 28.1 ha of this vegetation association will be cleared but all within previously chained areas and no significant residual impact on Vegetation Association 47 is expected.

Predicted impacts on vegetation system associations have been calculated based on pre-European vegetation associations (Shepherd et al. 2002) within the maximum clearing footprint (Table 9-11). Some minor sections of the maximum clearing footprint fall outside of the extent of vegetation mapping mapped by Ecoscape (2017a) which was based on an earlier (2013) version of the Development Envelope. Consequently the Ecoscape (2017a) local vegetation types listed in Table 9-11 are indicative only.

In addition to the disturbance described in Table 9-11, if all water diversion turnouts (comprising a maximum of 6 ha) were located within any of the vegetation association 47, 512 and 4801 with less than 30% of the original extent remaining (i.e. concentrated) there would be no significant change to predicted extent remaining.

Table 9-11: Pre-European and current extent of vegetation system associations

Vegetation system association no. (Pre-European)	Pre-European extent (ha)	Current extent - % Vegetation Association remaining (GWA 2016)	Impact within Proposal			Predicted % of Pre-European extent remaining after the Proposal	Corresponding Ecoscape (2017a) local vegetation type (in order of representation
			Chained (ha)	Graded (ha)	Uncleared (ha)		
9	240 509.33	97.78	-	6.9	6.0	97.78	EdMqMm, EeDsDv, EmMpCc, EoMpPa
10	145 676.38	98.96	4.5	-	-	98.96	EfMsDb
47	1 033 054.74	35.89	28.1	-	-	35.89	EpBmMs, EeMsGa, EiMcGa, EpMhGa, EoMpSf, EpEa, AsAt, EspPmCl, EdMhVr, CqAp
125	3 485 786.61	90.27	1.1	3.5	2.1	90.27	EgMqCc, MbAj, EdMqMm, SL, EvEaPf, Tspp
128	329 836.19	87.54	2.6	-	0.4	87.54	EeMsGa, EoMpAs, EpEa, MuTm, EpMhGa, ElMsSm, AcLd
482	1 628 465.00	99.04	41.2	0.9	2.6	99.04	EeMsGa, EtMs, EeMhHa, EgAs, EoMpAs, EfMcAc, EsMt, MuTm, EdMpLsp, EeMeLd, EeMsGa/EoMpAs
486	436 130.35	58.69	94.3	44.4	74.1	58.69	EdMpOm, EeMsGa, EdMqMm, EgMqCc, EeMlOm, EeMsWc, EmMpCc, EfMcAc, EsGlWr, EkMtDb, EcCc, EoEd, MbAj, EeMhHa, MaTs, EvEaPf, EuMpRs, DhCc, EfMmBi, Tspp, EdMhVr, EoMpPa, EpBmMs, EeMeLd, EcPe, EiAiMe, SL
512	237 886.07	26.40	64.2	-	-	26.40	EeMsGa, EpBmMs, EpMhGa, EiMpAc, EiBsLd, EgAs, EkBmPm, EfMcAc, AsAt, EpEa, EdMhVr, EuMh
516	607 434.24	54.82	137.5	-	3.8	54.82	ElMsSm, ElMsAs, EfMsDb, EuMtDl, EePmHh, EuGpBi, EeMsGa, ElMsLg, MbAj, EuMtPe, AcLd, EtMuGsp, ElPmGa, EgAs, ElPmSm, EdDiMa, ElMsLg/ElPmGa, MuTm, SL, EeAl, EoMs
519	2 333 413.96	61.71	156.6	-	2.8	61.71	EeMsGa, EeMsWc, ElMsAs, EpEa, EpMhGa, ElPmSm, EkMtDb, EiAiMe, ElMsSm, EfMsDb, EeMsGa/ElMsAs, EeMlOm, EpBmMs, EeMsGa/EoMpAs, EoMtTc, EkBmPm, EoMcBi, EoMpAs, EeEsBi, EiMcGa, EgMtBi, AcLd, AfCr, EdMhVr, EeMhHa, EsBpLt, ElMbBi, CqAp, MuTm, EoMs, EspPmCl, SL
552	33 908.72	93.40	2.9	-	-	93.40	No intersecting mapped vegetation types, outside survey extent. Vegetation types adjacent are EgAs, EeMsGa and EfMcAc
924	107 607.70	56.47	12.8	-	4.9	56.47	EeMsGa, EfMsDb, ElPmGa, ElPmGa/EfMsDb, ElMsDp, EeMlOm
925	5152.66	73.83	9.4	-	-	73.83	EeMsGa, EdMhVr, EpBmMs, EfMcAc, EgAs
1047	220 297.22	84.96	42.6	-	0.2	84.96	EeAl, EeGbMs, HcBe, EePmHh, EaCqLb, EuAcSs, BaMs, Cl, DcTp, BsBeAl
1413	1 679 917.00	76.61	5.6	-	-	76.61	ElMsSm, AcLd, EfMmBi, EuMtDl, EoEd, EuGpBi
1516	126 686.61	47.15	9.1	-	24.9	47.15	EeMlOm, EfMsDb, ElPmGa, MbAj, AcLd, EtMgLd, ElMsLg
2048	322 219.98	49.95	0.5	-	-	49.95	EpBmMs, EspMhLsp
3106	52 660.80	97.99		8.6	-	97.99	EmMpCc, EdMqMm. MbAj, EgMqCc
4048	50 400.59	59.71	7.1	-	-	59.71	EeGbMs
4801	58 196.27	11.17	2.4	-	1.2	11.17	EeGbMs, EoArTsp

Source: Adapted from Government of Western Australia (2016) *2016 Statewide Vegetation Statistics incorporating the CAR Reserve Analysis.*

Local vegetation types

To assess the potential impact from clearing on local vegetation within the clearing footprint, spatial data identifying local vegetation types from Ecoscape (2017a) was overlayed with the clearing footprint. However, a number of uncertainties have been identified to ascertain the impact of clearing activities on local vegetation. These uncertainties include:

- unsurveyed areas within the clearing footprint
- the allocation of 6 ha for water diversion turn outs.

As a result, assumptions have been made to quantify the maximum disturbance on local vegetation types within the clearing footprint. These assumptions are made below.

Unsurveyed areas

Areas within the clearing footprint not covered by extent of spatial data for local vegetation were identified as 'unsurveyed'. Unsurveyed areas comprise a total of 208.3 ha. Unsurveyed areas within the clearing footprint have occurred as the Proposal alignment has changed since the time of the vegetation mapping surveys undertaken by Ecoscape (2017a). However, the modifications have been undertaken to improve environmental and cultural outcomes by locating the Proposal alignment in previously disturbed areas where possible. For example, the Proposal alignment has changed from deviating around the northern border of Reserve 32782 on Mount Ney Road, which would require clearing of uncleared vegetation, to deviating the southern border of Reserve 32782 on Howick Road in previously chained areas, and will also replace an existing farm boundary fence (Figure 8-1). The extent of the vegetation mapping does not cover the clearing footprint on Howick Road or private crop land. This situation is repeated across the Proposal alignment. In other situations, the Proposal alignment is located immediately adjacent to cleared areas (not covered by vegetation mapping), or the unsurveyed areas within the clearing footprint are located within a few meters from the extent of the vegetation mapping. Unsurveyed areas are expected to be surveyed prior to any clearing activities occuring within the cleairng footprint. Surveys on private farm land (crop land and improved pastures) are not proposed where an existing farm fence is replaced by a barrier fence.

Clearing for water diversion turnouts

A total of up to 6 ha over the total length of the Proposal alignment will be cleared for erosion control. Controls will involve the construction of water diversion turnouts (up to 10 m long by 2.5 m wide). The actual extent of disturbance from water diversion turnouts is expected to be less than indicated, as locations will be determined during construction and will only be required where necessary based on the potential for erosion and the state of erosion on any existing tracks. Erosion control along sections of the proposed barrier fence located on private land will be the responsibility of the land owner.

Investigations undertaken by DPIRD identified areas expected to be most at risk from water erosion (DAFWA 2016e) and locations where existing erosion has been observed in the field. These areas that were identified were expected to require water diversion turnouts and are outlined in Table 9-12. The allowance has been made for these to be installed alternating every 200 m along the 6 m wide cleared track and every 70 m in high erosion risk areas.

High erosion risk areas where the Proposal alignment replaces existing farm boundary fences were excluded as erosion control will be the responsibility of the land owner. The number of turnouts at these locations have been increased to reflect the maximum potential extent of clearing, based on the DPIRD assessment.

Table 9-12 provides a summary of the estimated number of turnouts in the high erosion risk areas (shown in Figure 9-2 to Figure 9-5) and the maximum disturbance area for the erosion control structures. Table 9-13 uses the disturbance area calculated in Table 9-12 to estimate the maximum total impacts on local vegetation in high risk erosion areas.

Since the erosion assessment (DAFWA 2016e), the section length (comprising 7.1 km) of the Proposal alignment associated with W1 (Figure 9-3) has changed from being allocated on UCL to private property. As a result, the potential impact of 0.2 ha within W1 is not expected to occur along this section of the Proposal alignment; however, has been included in Table 9-12 and Table 9-13 to demonstrate the allocation of the estimated 6 ha for water diversions.

Table 9-12: Water diversion turnouts – estimated locations and approximate disturbance

Section	Location	Estimated section length (km)	Turnout spacing (m) requirement	Maximum number of water diversion turnouts	Maximum disturbance area (ha)#
High erosion risk area					
W0 (expanded)	0 (western end) – 17 km (Figure 9-2)	14.5*	70	210	0.30
W1	39 – 46.1 km (Figure 9-3)	7.1	70	71	0.20
W2	57.5 – 66.3 km (Figure 9-4)	8.4^	70	84	0.20
E2	475.8 – 490.1 km (Figure 9-5)	14.3	70	210	0.30
Low erosion risk area					
Remainder of UCL	Rest of the Proposal alignment	Approximately 493.4	Max. of one every 200 m	3100	5.00
Total				**3675**	**6.00**

*Includes Oldfield River gap (no clearing)
^Includes Young River gap (no clearing)
Note: Estimated 122.3 km of the Proposal alignment is located on private property (included W1 section length)

Table 9-13: Predicted impacts on local vegetation within identified high risk areas

Vegetation type	Risk area	Area allocated for water turn outs (ha)	Section of high risk area (km)	% within the risk area	Predicted impact (ha)	Total predicted impact (ha)
EeEsBi	W0 (expanded)	0.3	0.8	5.5%	0.02	0.02
EiMcGa	W0 (expanded)	0.3	4.4	30.9%	0.09	0.09
	W0 (expanded)	0.3	0.4	3.0%	0.01	
EoMpSf	W1	0.2	0.3	3.9%	0.01	0.02
	W0 (expanded)	0.3	2.5	17.4%	0.05	
	W1	0.2	2.6	34.2%	0.07	
EpBmMs	W2	0.2	0.9	10.1%	0.02	0.70
EpEa	W0 (expanded)	0.3	0.4	2.5%	0.01	0.01
EpMhGa	W0 (expanded)	0.3	5.8	40.7%	0.12	0.12
	W1	0.2	3.7	48.7%	0.10	
	W2	0.2	5.6	66.5%	0.13	
EeMsGa	E2	0.3	2.2	15.1%	0.05	0.28
EiBsLd	W1	0.2	1.0	13.2%	0.03	0.03

Vegetation type	Risk area	Area allocated for water turn outs (ha)	Section of high risk area (km)	% within the risk area	Predicted impact (ha)	Total predicted impact (ha)
AsAt	W2	0.2	0.9	11.0%	0.02	0.02
EdMhVr	W2	0.2	0.6	7.6%	0.02	0.02
EkBmPm	W2	0.2	0.4	4.8%	0.01	0.01
EdDiMa	E2	0.3	0.6	3.9%	0.01	0.01
EgAs	E2	0.3	0.2	1.6%	0.00	0.00
EsMsGa	E2	0.3	2.2	15.1%	0.05	0.05
EuGpBi	E2	0.3	4.5	31.4%	0.09	0.09
EuMtDl	E2	0.3	5.7	39.7%	0.12	0.12
EuMtPe	E2	0.3	1.1	7.4%	0.02	0.02
MbAj	E2	0.3	0.1	0.9%	0.00	0.00

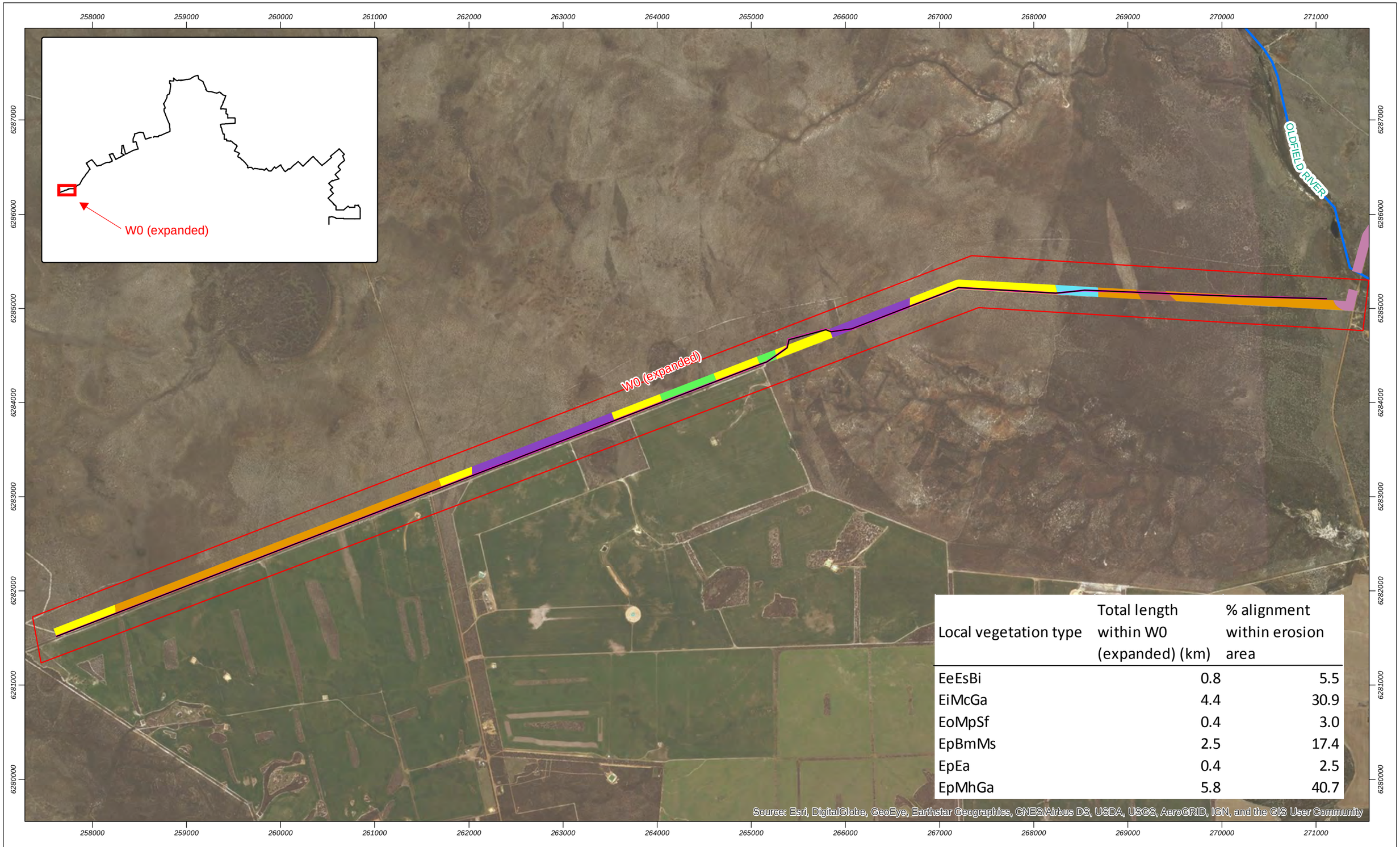
For the balance of the Proposal alignment, a total of 5 ha was assumed to be impacting on local vegetation. Predicted impacts from water diversion turn outs in high risk erosion areas are less than 1 ha, with the highest predicted impact of 0.70 ha in EpBmMs.

Impacts on local vegetation

A summary of total predicted impacts across all local vegetation types from water turn outs and direct clearing is provided Table 9-14.

There are no significant impacts expected on local vegetation types from the Proposal. Total predicted impacts are less than 20% of the 6339.6 ha of vegetation mapped along the Proposal alignment. The maximum clearing within any of the local vegetation types (EsGlWr) is 20% of its mapped extent along the Proposal alignment; however, this vegetation type is represented in Vegetation Association 486, which is well represented and has a total of approximately 58.7% of its pre-European extent remaining (Table 9-11).

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Local vegetation type	Total length within W0 (expanded) (km)	% alignment within erosion area
EeEsBi	0.8	5.5
EiMcGa	4.4	30.9
EoMpSf	0.4	3.0
EpBmMs	2.5	17.4
EpEa	0.4	2.5
EpMhGa	5.8	40.7

Figure 9-2: Maximum water turn out disturbance within W0 (expanded)

Scale 1:37,000 at A3

0 0.5 1 1.5 2 2.5 km

N

Legend

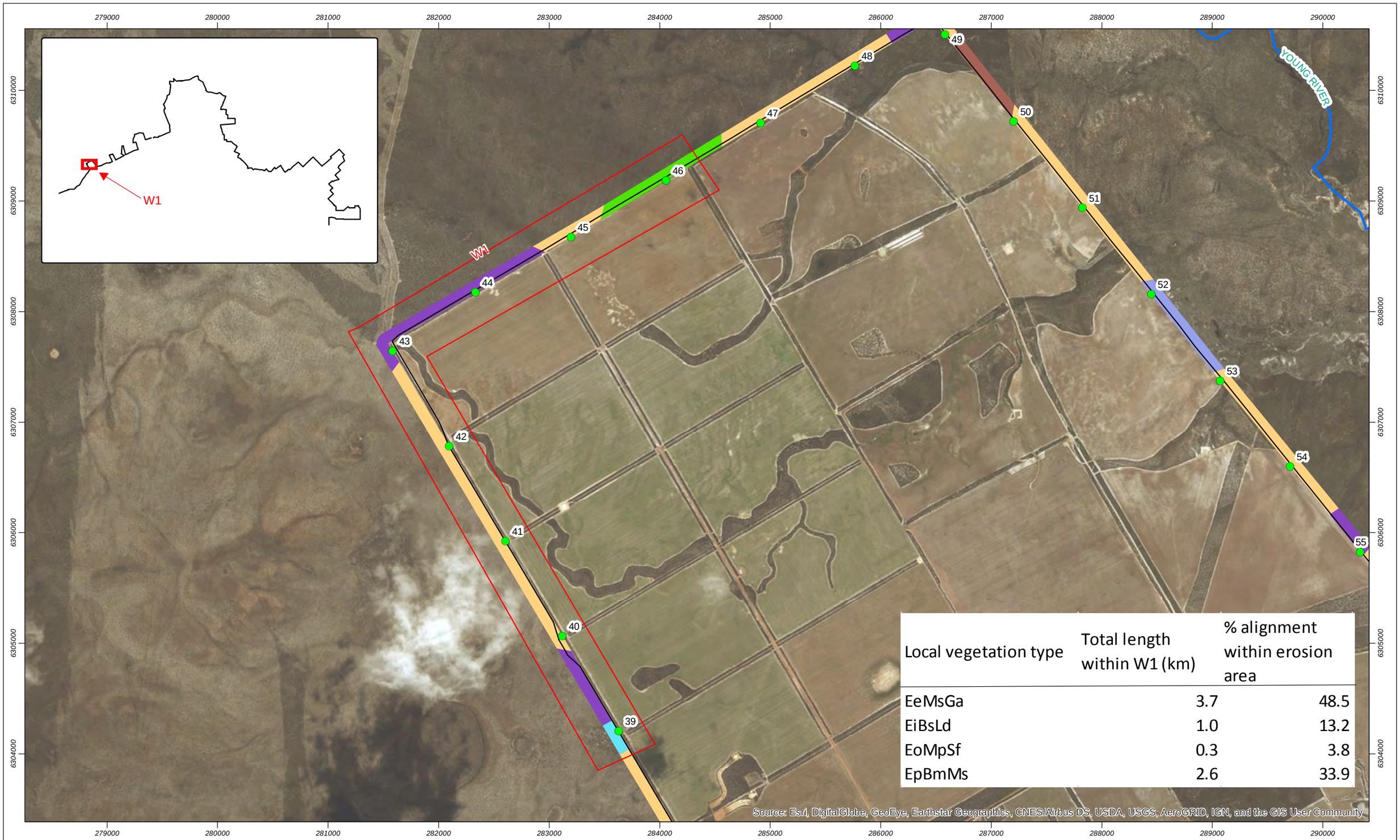
Major watercourses
Proposal alignment
Maximum clearing footprint

Vegetation type

EeEsBi
EiMcGa
EoMpSf
EpBmMs
EpEa
EpMhGa
EspMhLsp

Coordinate System: GDA 1994 MGA Zone 51
Note that positional errors may occur in some areas
Date: 18/07/2017
Author: DWhite
Source: Aerial: ESRI approx. 2010; Data: Client 2016; Reserves: DPaW: 2012.
Path: Q:\Consult\2016\DAF\DAF16515\ArcMap_documents\R001\DAF16515_01_R001_RevE_F009-2.mxd

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Local vegetation type	Total length within W1 (km)	% alignment within erosion area
EeMsGa	3.7	48.5
EiBsLd	1.0	13.2
EoMpSf	0.3	3.8
EpBmMs	2.6	33.9

Figure 9-3: Maximum water turn out disturbance within W1

Scale 1:31,510 at A3

0 0.5 1 1.5 2 2.5 km

Coordinate System: GDA 1994 MGA Zone 51
Note that positional errors may occur in some areas
Date: 18/07/2017
Author: DWhite
Source: Aerial: ESRI approx. 2010; Data: Client 2016; Reserves: DPaW: 2012.

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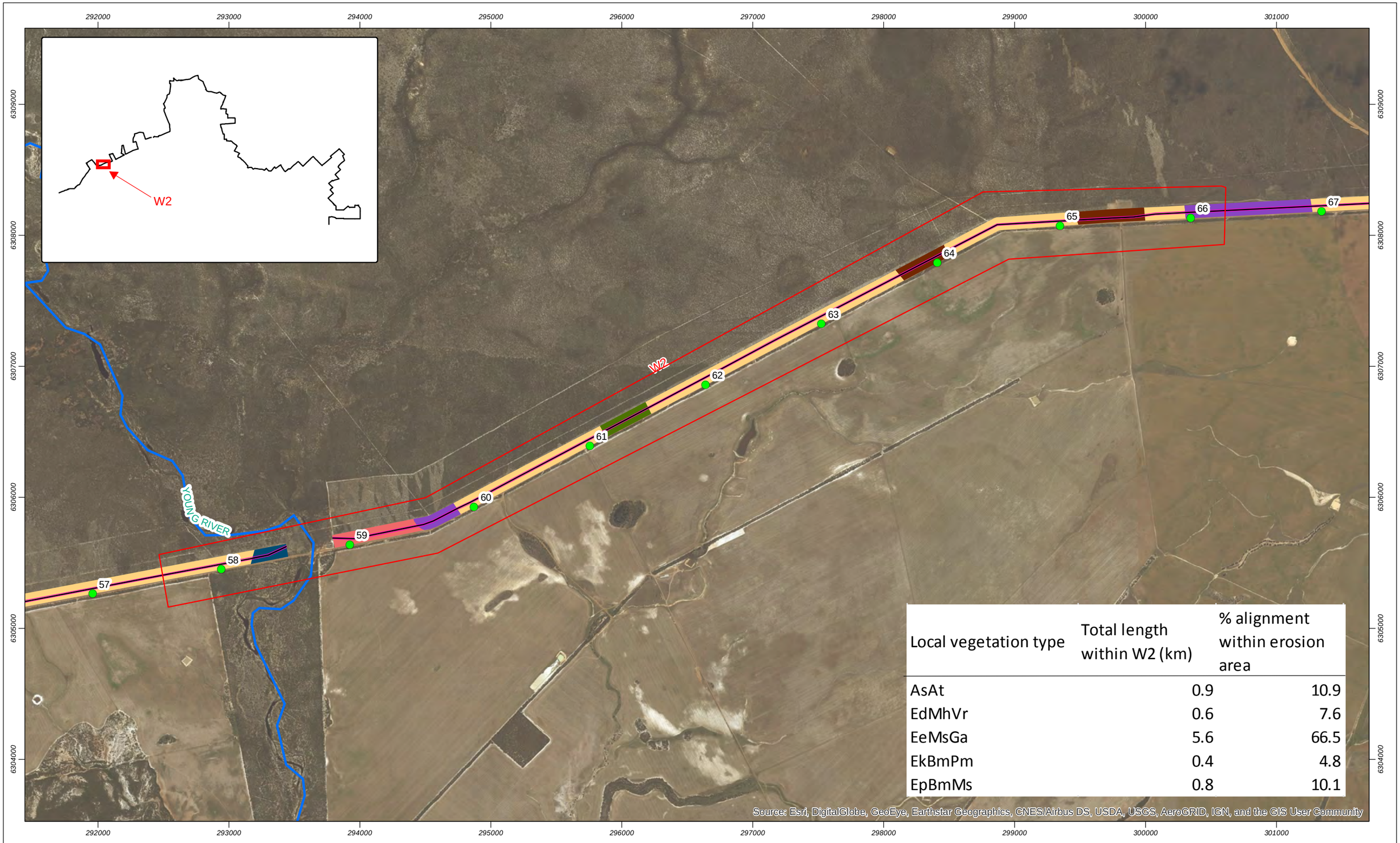
- Major watercourses
- Proposal alignment
- Distance divisions (km)

Vegetation type

- EeMsGa
- EiBsLd
- EkBmPm
- EoMpSf
- EpBmMs
- EpEa

Note: Potential vegetation impacts from water turnouts along the length of W1 are not expected as the Proposal alignment will replace private farm boundary fences.

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Local vegetation type	Total length within W2 (km)	% alignment within erosion area
AsAt	0.9	10.9
EdMhVr	0.6	7.6
EeMsGa	5.6	66.5
EkBmPm	0.4	4.8
EpBmMs	0.8	10.1

Figure 9-4: Maximum water turn out disturbance within W2

Scale 1:26,597 at A3

km
0 0.25 0.5 0.75 1 1.25

Coordinate System: GDA 1994 MGA Zone 51
Note that positional errors may occur in some areas
Date: 18/07/2017
Author: DWhite
Source: Aerial: ESRI approx. 2010; Data: Client 2016; Reserves: DPaW: 2012.

Legend

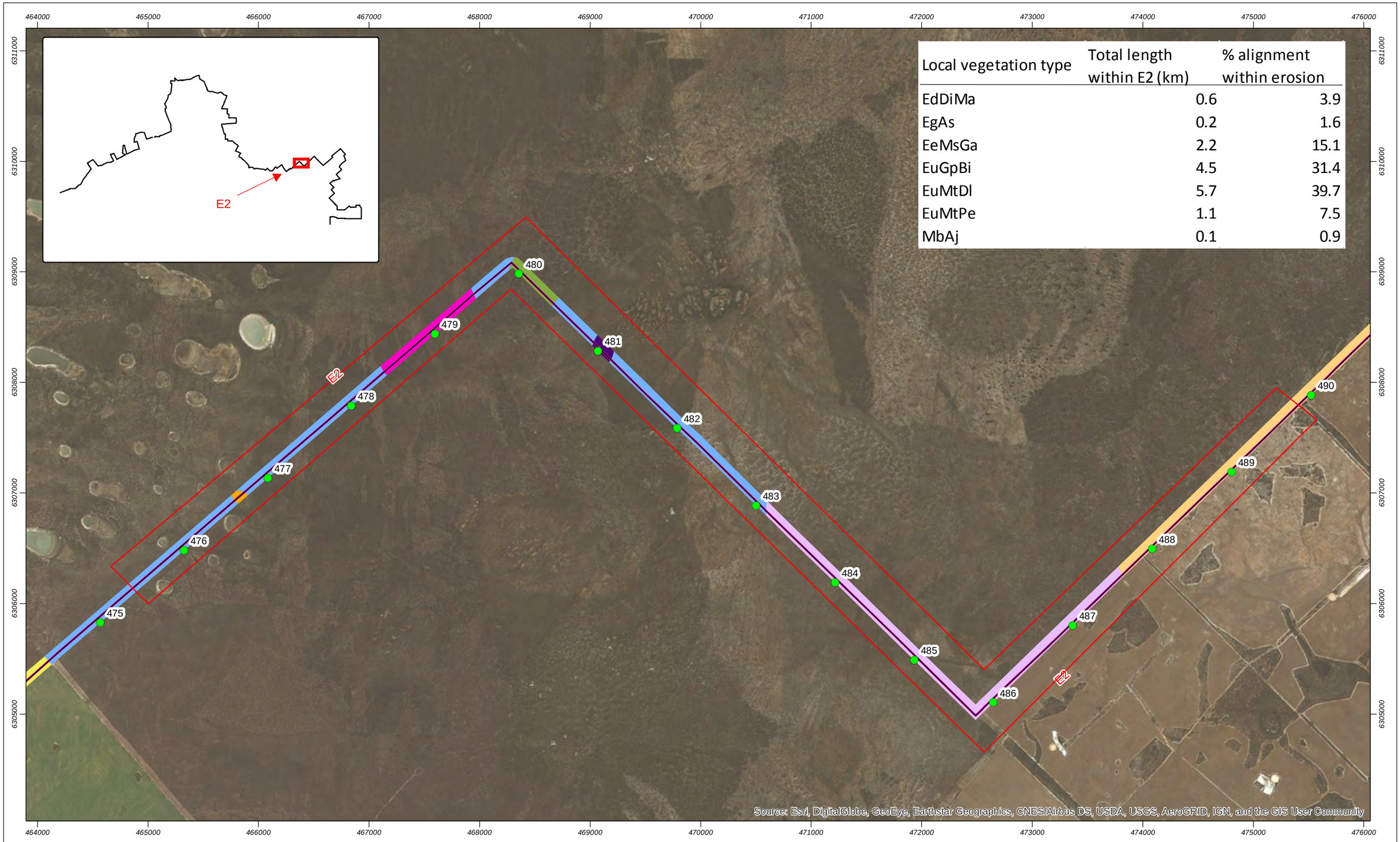
Major watercourses
Distance divisions (km)
Proposal alignment
Maximum clearing footprint

Vegetation type

AsAt
EdMhVr
EeMsGa
EkBmPm
EpBmMs
EspPmCl

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Local vegetation type	Total length within E2 (km)	% alignment within erosion
EdDiMa	0.6	3.9
EgAs	0.2	1.6
EeMsGa	2.2	15.1
EuGpBi	4.5	31.4
EuMtDl	5.7	39.7
EuMtPe	1.1	7.5
MbAj	0.1	0.9

Figure 9-5: Maximum water turn out disturbance within E2

Scale 1:31,510 at A3

0 0.25 0.5 0.75 1 1.25 km

Coordinate System: GDA 1994 MGA Zone 51
Note that positional errors may occur in some areas
Date: 18/07/2017
Author: DWhite
Source: Aerial: ESRI approx. 2010; Data: Client 2016; Reserves: DPaW: 2012.

Path: Q:\Consult\2016\DAF\DAF16515\ArcMap_documents\R001\DAF16515_01_R001_RevE_F009-5.mxd

Legend

- Distance divisions (km)
- Proposal alignment
- Maximum clearing footprint

Vegetation type

- EdDiMa
- EeMsGa
- EgAs
- ElMsSm
- EuGpBi
- EuMtDl
- EuMtPe
- MbAj

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Table 9-14: Predicted impacts on local vegetation

Local vegetation code	Total mapped area (ha)	% total mapped area	Predicted impact in high risk erosion areas from water diversions (ha)	Estimated water turnout impact area across the whole Proposal alignment (ha)	Disturbance within clearing footprint (ha)	Total impact area (ha)	Total predicted impact (%)
AcLd	36.69	0.6%	-	0.03	4.4	4.4	12.1%
AfCr	9.13	0.1%	-	0.01	0.9	0.9	9.7%
AsAt	9.28	0.1%	0.02	0.01	1.4	1.4	15.3%
BaMs	4.55	0.1%	-	0.00	0.6	0.6	13.5%
BpBe	36.54	0.6%	-	0.03	0.0	0.0	0.1%
BsBeAl	74.67	1.2%	-	0.06	0.3	0.3	0.4%
Cl	3.31	0.1%	-	0.00	0.5	0.5	14.3%
CqAp	3.34	0.1%	-	0.00	0.5	0.5	15.0%
DcTp	2.24	0.0%	-	0.00	0.3	0.3	13.8%
Degraded	44.94	0.7%	-	0.04	3.4	3.4	7.6%
DhCc	15.29	0.2%	-	0.01	1.6	1.6	10.8%
EaCqLb	18.43	0.3%	-	0.01	1.8	1.8	9.9%
EcCc	55.39	0.9%	-	0.04	4.9	4.9	8.9%
EcPe	5.21	0.1%	-	0.00	0.7	0.7	14.3%
EdDiMa	5.38	0.1%	0.01	0.00	0.8	0.8	15.1%
EdMhLp	18.23	0.3%	-	0.01	0.0	0.0	0.1%
EdMhVr	46.29	0.7%	0.02	0.04	6.2	6.3	13.6%
EdMpLsp	20.91	0.3%	-	0.02	0.5	0.5	2.6%
EdMpOm	140.05	2.2%	-	0.11	17.5	17.6	12.6%
EdMpRs	2.15	0.0%	-	0.00	0.0	0.0	0.1%
EdMqMm	191.01	3.0%	-	0.15	18.0	18.2	9.5%
EeAl	103.01	1.6%	-	0.08	15.4	15.5	15.1%
EeDsDv	27.73	0.4%	-	0.02	2.2	2.2	7.8%
EeEsBi	8.09	0.1%	-	0.01	1.2	1.2	15.1%
EeGbMs	152.75	2.4%	-	0.12	16.1	16.3	10.6%

Local vegetation code	Total mapped area (ha)	% total mapped area	Predicted impact in high risk erosion areas from water diversions (ha)	Estimated water turnout impact area across the whole Proposal alignment (ha)	Disturbance within clearing footprint (ha)	Total impact area (ha)	Total predicted impact (%)
EeMeLd	17.11	0.3%	-	0.01	1.1	1.1	6.6%
EeMhHa	66.57	1.1%	-	0.05	7.0	7.0	10.6%
EeMlOm	210.36	3.3%	-	0.17	26.9	27.0	12.8%
EeMsGa	1471.12	23.2%	0.28	1.16	121.9	123.3	8.4%
EeMsGa/ElMsAs	40.57	0.6%	-	0.03	3.1	3.1	7.7%
EeMsGa/EoMpAs	26.62	0.4%	-	0.02	1.9	2.0	7.4%
EeMsWc	285.35	4.5%	-	0.23	26.5	26.7	9.4%
EePmHh	106.47	1.7%	-	0.08	10.6	10.7	10.0%
EfEaHsp	25.11	0.4%	-	0.02	0.0	0.0	0.1%
EfMcAc	120.72	1.9%	-	0.10	9.6	9.7	8.1%
EfMmBi	20.23	0.3%	-	0.02	2.3	2.3	11.2%
EfMpAc	24.36	0.4%	-	0.02	0.0	0.0	0.1%
EfMsDb	243.1	3.8%	-	0.19	28.0	28.2	11.6%
EgAs	66.05	1.0%	0.00	0.05	4.7	4.7	7.2%
EgAs/EpBmMs	10.7	0.2%	-	0.01	0.0	0.0	0.1%
EgMqCc	167.46	2.6%	-	0.13	17.7	17.8	10.6%
EgMtBi	7.51	0.1%	-	0.01	1.1	1.1	15.0%
EiAiMe	45.42	0.7%	-	0.04	4.3	4.4	9.6%
EiBsLd	12.59	0.2%	0.03	0.01	0.0	0.0	0.3%
EiMcGa	43.18	0.7%	0.09	0.03	5.8	5.9	13.8%
EiMpAc	29.03	0.5%	-	0.02	3.3	3.3	11.5%
EkBmPm	20.48	0.3%	0.01	0.02	0.9	0.9	4.6%
EkMtDb	89.79	1.4%	-	0.07	10.2	10.2	11.4%
ElMbBi	3.72	0.1%	-	0.00	0.6	0.6	16.5%
ElMsAs	180.81	2.9%	-	0.14	25.4	25.5	14.1%

Local vegetation code	Total mapped area (ha)	% total mapped area	Predicted impact in high risk erosion areas from water diversions (ha)	Estimated water turnout impact area across the whole Proposal alignment (ha)	Disturbance within clearing footprint (ha)	Total impact area (ha)	Total predicted impact (%)
ElMsDp	5.79	0.1%	-	0.00	0.9	0.9	15.5%
ElMsLg	49.77	0.8%	-	0.04	6.7	6.7	13.5%
ElMsLg/ElPmGa	4.05	0.1%	-	0.00	0.5	0.5	13.4%
ElMsSm	401.82	6.3%	-	0.32	44.9	45.2	11.2%
ElPmGa	72.5	1.1%	-	0.06	11.0	11.1	15.3%
ElPmGa/EfMsDb	6	0.1%	-	0.00	0.9	0.9	15.2%
ElPmSm	61.63	1.0%	-	0.05	4.7	4.8	7.8%
EmMpCc	176.94	2.8%	-	0.14	13.1	13.2	7.5%
EoArTsp	1.45	0.0%	-	0.00	0.2	0.2	13.2%
EoEd	41.29	0.7%	-	0.03	4.5	4.6	11.0%
EoMcBi	43.68	0.7%	-	0.03	1.6	1.6	3.7%
EoMpAm	12.62	0.2%	-	0.01	0.0	0.0	0.1%
EoMpAs	23.47	0.4%	-	0.02	3.4	3.4	14.6%
EoMpPa	17.33	0.3%	-	0.01	2.3	2.3	13.4%
EoMpSf	7.47	0.1%	0.02	0.01	0.7	0.7	9.0%
EoMs	5.13	0.1%	-	0.00	0.3	0.3	5.0%
EoMtTc	11.12	0.2%	-	0.01	1.7	1.7	15.0%
EoOm	2.45	0.0%	-	0.00	0.0	0.0	0.1%
EpAh	10.54	0.2%	-	0.01	0.0	0.0	0.1%
EpBmMs	168.18	2.7%	0.70	0.13	17.9	18.7	11.1%
EpEa	43.01	0.7%	0.01	0.03	4.8	4.8	11.2%
EpMhGa	102.67	1.6%	0.12	0.08	12.4	12.6	12.3%
EqMpOm	10.29	0.2%	-	0.01	0.0	0.0	0.1%
EsBpLt	4.14	0.1%	-	0.00	0.6	0.6	15.1%
EsGlWr	33.54	0.5%	-	0.03	6.7	6.7	20.0%
EsMt	18.73	0.3%	-	0.01	0.8	0.8	4.5%
EspLp	15.46	0.2%	-	0.01	0.0	0.0	0.1%

Local vegetation code	Total mapped area (ha)	% total mapped area	Predicted impact in high risk erosion areas from water diversions (ha)	Estimated water turnout impact area across the whole Proposal alignment (ha)	Disturbance within clearing footprint (ha)	Total impact area (ha)	Total predicted impact (%)
EspMhLsp	9.2	0.1%	-	0.01	0.0	0.0	0.4%
EspPmCl	2.67	0.0%	-	0.00	0.4	0.4	15.4%
EtMgLd	18.85	0.3%	-	0.01	0.5	0.5	2.6%
EtMs	29.56	0.5%	-	0.02	3.6	3.7	12.4%
EtMuGsp	50.86	0.8%	-	0.04	1.4	1.5	2.9%
EuAcSs	6.59	0.1%	-	0.01	1.0	1.0	14.5%
EuGpBi	44.75	0.7%	0.09	0.04	6.7	6.9	15.3%
EuMh	5	0.1%	-	0.00	0.2	0.2	3.5%
EuMpRs	14.06	0.2%	-	0.01	1.7	1.7	12.1%
EuMtDl	67.95	1.1%	0.12	0.05	10.2	10.4	15.3%
EuMtPe	10.73	0.2%	0.02	0.01	1.6	1.6	15.3%
EvEaPf	18.01	0.3%	-	0.01	2.4	2.4	13.4%
EvEaPf/EtMs	27.2	0.4%	-	0.02	0.0	0.0	0.1%
HcBe	159.41	2.5%	-	0.13	5.2	5.3	3.3%
MaTs	25.74	0.4%	-	0.02	2.4	2.4	9.3%
MbAj	64.97	1.0%	0.00	0.05	7.8	7.9	12.1%
MhAj	1.54	0.0%	-	0.00	0.0	0.0	0.1%
MuTm	26.83	0.4%	-	0.02	1.7	1.7	6.3%
SL	19.19	0.3%	-	0.02	0.6	0.6	3.2%
Tspp	16.36	0.3%	-	0.01	1.6	1.6	9.8%
Unsurveyed areas						**208.3**	

Clearing of Threatened Flora species

Three Threatened Flora species were recorded within the vicinity of the Development Envelope by Ecoscape (2017a). *Rhizanthella gardneri* is also known to occur in the area based on recent records. The Proposal alignment has since been modified to avoid new clearing of Threatened Flora species where possible. Threatened Flora species were recorded within vegetation along the Proposal alignment that has since been chained for fire management. Disturbance to two of these species by DBCA (*Conostylis lepidospermoides* and *Eucalyptus merrickiae*) was approved under the WC Act and clearing within these areas is not considered by DPIRD to be a significant additional impact. The other species (*Anigozanthos bicolor* subsp. *minor*) can be avoided.

Outside of these chained areas, all known records of Threatened Flora species have been avoided in the Proposal alignment.

Conostylis lepidospermoides

Since the Ecoscape (2017a) surveys were completed, an 80 to 100 m wide area was chained in the same area as the Proposal alignment. DBCA, which is responsible for fire mitigation on UCL, applied for and were granted a permit to take an estimated 300 *Conostylis lepidospermoides* plants (CP 136-1516). The Proposal alignment and native vegetation clearing is in the same location as this cleared fire break area. This species was identified by Ecoscape (2017a) within previously chained areas and; therefore, no new impacts to these populations are expected.

The Proponents for the Ravensthorpe Nickel Mine identified an additional 2129 *Conostylis lepidospermoides* individuals (Woodman Environmental 2015) about 1 to 2 km from the Proposal alignment in a recent referral to the EPA to expand mining operations (EPBC 2016/7756). This indicates that *C. lepidospermoides* is significantly more abundant than previously known (670 plants recorded prior to the Ecoscape [2017a] survey). These survey results were submitted to the EPA in a recent referral by Ravensthorpe Nickel to build a conveyor belt.

Anigozanthos bicolor subsp. minor

The area near where this species is located was re-chained by DBCA during the November 2015 Esperance fires; however, disturbance to *Anigozanthos bicolor* subs. *minor* records were avoided by only chaining the inner 60 m strip of vegetation next to a private property farm boundary fence. The population is located outside of this inner 60 m fire break. DPIRD have avoided this species by realigning the Development Envelope within this existing cleared area next to private property. The records of the species outside the inner 60 m firebreak are approximately 60 m from the Development Envelope.

No disturbance or access to areas outside of the Development Envelope in this area will be permitted. This information will be included in a CMP to be prepared for the Proposal if approved.

Eucalyptus merrickiae

Since the Ecoscape (2017a) surveys were completed for this species, an 80 to 100 m wide area was chained by DBCA with a permit to take *Eucalyptus merrickiae* granted by the Minister for Environment (CP 95-1516). The Development Envelope is located in the same location as this cleared fire break area. Species were recorded in previously chained areas of the clearing footprint and; therefore, no new impacts on these populations are expected.

Rhizanthella gardneri

The population of *Rhizanthella gardneri* is located adjacent to a ‘gap’ in the Proposal alignment at the Oldfield River. DPIRD modified the Proposal alignment to ensure that the vegetation type associated with *Rhizanthella gardneri* (EspMhLsp) was avoided. No impact on this species is expected.

Priority Flora species

Sixty Priority Flora taxa were recorded within the Ecoscape (2017a) and GS Bio Logic (2015) study areas (Figure 9-1). Of the 60 Priority Flora species recorded 36 occur within the maximum clearing footprint of 816 ha. As described in Section 9.3.4 (and shown in Table 9-7), most of the species (25) occur within previously disturbed areas with 11 Priority Flora species recorded within uncleared vegetation. The 25 species recorded in the previously disturbed area (i.e. areas that have previously been chained or graded) indicates the potential for these species to be disturbance specialists; however, this is uncertain as there is a paucity of information available regarding any long term response to ongoing and regular disturbance for the relevant species. Table 9-15 presents the potential impacts on Priority Flora species. Most of the Priority Flora species are well represented in the Ecoscape (2017a) study area outside the maximum clearing and are also well represented in the populations outside the study area.

As described in Table 4-3, up to 373.8 ha of the maximum clearing footprint for the Proposal (816 ha) is rechaining of previously disturbed areas and as such represents a continuation of existing management. It is therefore expected that the 25 Priority Flora species that have been recorded in previously disturbed areas will continue to be present; however, as indicated this outcome remains uncertain due to the lack of information regarding the disturbance ecology of the relevant species. In addition to the 25 Priority Flora species that only occur in previous disturbed areas, six of the 11 recorded in uncleared vegetation were also recorded in previously disturbed areas. Therefore, With the continuation of existing management practices (i.e. chaining), the presences of the species are not expected to change and these species will not be significantly affected; however, this expectation is based on the assumption the relevant species will continue to respond to ongoing disturbance.

Hibbertia hamata was identified within the Development Envelope in uncleared bushland, which represents a previously unknown population of this taxon. According to existing records this species occurs in 16 populations over a narrow range of 61 km, often in the vicinity of granite (GS Bio Logic 2015). At least five populations are known from within 20 km of the Proposal. A paucity of floristic survey has been conducted in this region; therefore, the actual abundance of many priority flora is likely to be greater than existing records indicate (GS Bio Logic 2015). No recommendations were made to realign the proposed barrier fence to avoid *H. hamata* due to its location in existing site disturbances such as road and communication cable, and the potential spread of *Phytophthora* dieback which would be associated with a fence location away from the existing disturbances. In this instance, the occurrence of *H. hamata* in a site of minor disturbance and its abundance in the vicinity of the Proposal indicate the removal of approximately 35 individuals will not have a significant impact on the taxon.

Based on the assumptions above, the clearing of these Priority Flora species records within uncleared areas and previously disturbed areas is not expected to have a significant impact on Priority flora species.

Table 9-15: Priority Flora and key range extension species located within uncleared and disturbed areas of the clearing footprint

Species	No. individuals in Ecoscape (2015) study area	Individuals affected by Proposal in previously disturbed area		Individuals affected by Proposal in vegetated area		Populations			Summary
		Number	%	Number	%	Number of populations within clearing footprint	In Ecoscape (2015) study area	Total*	
Priority 1									
Boronia baeckeacea subsp. *patula*	447	15	3.40	0	0	1	7	12	Species well represented outside Proposal area and mainly recorded in previously disturbed areas. With continuation of existing management practices (i.e. chaining) presence of species unlikely to change. **Species will not be significantly affected.**
Darwinia sp. Mt Ney (M.A. Burgman & S. McNee 1274)	2222	401	18.00	0	0	5	9	16	Species well represented outside Proposal area and mainly recorded in previously disturbed areas. With continuation of existing management practices (i.e. chaining) presence of species unlikely to change. **Species will not be significantly affected.**
Leucopogon sp. Bonnie Hill (K.R. Newbey 9831)	1690	400	23.70	0	0		2	5	Species well represented outside Proposal area and mainly recorded in previously disturbed areas. With continuation of existing management practices (i.e. chaining) presence of species unlikely to change. **Species will not be significantly affected.**
Priority 2									
Acacia nitidula	6340	500	7.90	0	0	1	9	24	Species well represented outside Proposal area and mainly recorded in previously disturbed areas. With continuation of existing management practices (i.e. chaining) presence of species unlikely to change. **Species will not be significantly affected.**
Aotus sp. Dundas (M.A. Burgman 2835)	4532	130	2.90	100	2.21	5	22	34	Species well represented outside Proposal area and mainly recorded in previously disturbed areas. With continuation of existing management practices (i.e. chaining) presence of species unlikely to change. **Species will not be significantly affected.**
Eucalyptus luculenta	12	1	8.30	0	0	1	11	14	Species well represented outside Proposal area and mainly recorded in previously disturbed areas. With continuation of existing management practices (i.e. chaining) presence of species unlikely to change. **Species will not be significantly affected.**
Frankenia brachyphylla	400	0	0	100	25.00	1	3	6	Species well represented outside Proposal area. While species is restricted to vegetated areas, there are three additional populations identified in the area outside the study area. **Species will not be significantly affected.**

Species	No. individuals in Ecoscape (2015) study area	Individuals affected by Proposal in previously disturbed area		Individuals affected by Proposal in vegetated area		Populations			Summary
		Number	%	Number	%	Number of populations within clearing footprint	In Ecoscape (2015) study area	Total*	
Halgania sp. Peak Eleanora *(M.A. Burgman 3547 B)*	5921	1930	32.60	0	0	9	22	27	Species well represented outside Proposal area and mainly recorded in previously disturbed areas. With continuation of existing management practices (i.e. chaining) presence of species unlikely to change. **Species will not be significantly affected.**
Melaleuca eximia	20	20	100.00	0	0	1	1	8	While all 20 individuals recorded in the study are within the Proposal area, they are located in previously disturbed areas. With continuation of existing management practices (i.e. chaining) presence of species unlikely to change. In addition, disturbance will occur in only one of the eight populations identified in the area. **Species will not be significantly affected.**
Persoonia spathulata	36	1	2.80	0	0	1	8	11	Species well represented outside Proposal area and mainly recorded in previously disturbed areas. With continuation of existing management practices (i.e. chaining) presence of species unlikely to change. **Species will not be significantly affected.**
Thysanotus brachyantherus	15	1	6.67	9	60	2	3	12	While 10 of the 15 individuals recorded in the study are within the Proposal area, disturbance will occur in only three of the 12 populations identified in the area. **Species will not be significantly affected.**
Priority 3									
Acacia euthyphylla	907	129	14.20	0	0	3	8	29	Species well represented outside Proposal area and mainly recorded in previously disturbed areas. With continuation of existing management practices (i.e. chaining) presence of species unlikely to change. **Species will not be significantly affected.**
Acacia glaucissima	10835	3478	32.10	15	0.14	33	82	102	Species well represented outside Proposal area and mainly recorded in previously disturbed areas. With continuation of existing management practices (i.e. chaining) presence of species unlikely to change. **Species will not be significantly affected.**
Acacia singula	1271	90	7.10	0	0	1	3	17	Species well represented outside Proposal area and mainly recorded in previously disturbed areas. With continuation of existing management practices (i.e. chaining) presence of species unlikely to change. **Species will not be significantly affected.**
Bossiaea flexuosa	3494	45	1.30	200	5.72	3	11	30	Species well represented outside Proposal area. **Species will not be significantly affected.**

Species	No. individuals in Ecoscape (2015) study area	Individuals affected by Proposal in previously disturbed area		Individuals affected by Proposal in vegetated area		Populations			Summary
		Number	%	Number	%	Number of populations within clearing footprint	In Ecoscape (2015) study area	Total*	
Comesperma calcicola	102	2	2.00	0	0	1	9	17	Species well represented outside Proposal area and mainly recorded in previously disturbed areas. With continuation of existing management practices (i.e. chaining) presence of species unlikely to change. **Species will not be significantly affected.**
Cyathostemon sp. Salmon Gums (B. Archer 769)	4684	607	13.00	335	7.15	9	24	34	Species well represented outside Proposal area. **Species will not be significantly affected.**
Eremophila chamaephila	10258	426	4.20	0	0	4	11	24	Species well represented outside Proposal area and mainly recorded in previously disturbed areas. With continuation of existing management practices (i.e. chaining) presence of species unlikely to change. **Species will not be significantly affected.**
Eremophila compressa	1224	57	4.70	0	0	2	4	18	Species well represented outside Proposal area and mainly recorded in previously disturbed areas. With continuation of existing management practices (i.e. chaining) presence of species unlikely to change. **Species will not be significantly affected.**
Gonocarpus pycnostachyus	330	100	30.30	0	0	1	1	8	Species well represented outside Proposal area and mainly recorded in previously disturbed areas. With continuation of existing management practices (i.e. chaining) presence of species unlikely to change. In addition, disturbance will occur in only one of the eight populations identified in the area. **Species will not be significantly affected.**
Goodenia laevis subsp. *laevis*	12026	2510	20.90	0	0	16	58	73	Species well represented outside Proposal area and mainly recorded in previously disturbed areas. With continuation of existing management practices (i.e. chaining) presence of species unlikely to change. **Species will not be significantly affected.**

Species	No. individuals in Ecoscape (2015) study area	Individuals affected by Proposal in previously disturbed area		Individuals affected by Proposal in vegetated area		Populations			Summary
		Number	%	Number	%	Number of populations within clearing footprint	In Ecoscape (2015) study area	Total*	
Hibbertia hamata	35	0	0	35	100	0	2	7	Species was identified within the Development Envelope in uncleared bushland, which represents a previously unknown population of this taxon. According to existing records this species occurs in 16 populations over a narrow range of 61 km, often in the vicinity of granite (GS Bio Logic 2015). At least five populations are known from within 20 km of the Proposal. A paucity of floristic survey has been conducted in this region; therefore, the actual abundance of many priority flora is likely to be greater than existing records indicate (GS Bio Logic 2015). No recommendations were made to realign the proposed barrier fence to avoid *H. hamata* due to its location in existing site disturbances such as road and communication cable, and the potential spread of *Phytophthora* dieback which would be associated with a fence location away from the existing disturbances. In this instance, the occurrence of *H. hamata* in a site of minor disturbance and its abundance in the vicinity of the Proposal indicate the removal of approximately 35 individuals will not have a significant impact on the taxon. **Species will not be significantly affected.**
Isopogon alcicornis	31	0	0	3	9.68	1	6	20	Species well represented outside Proposal area. In addition, disturbance will occur in only six of the 20 populations identified in the area. **Species will not be significantly affected.**
Micromyrtus elobata subsp. *scopula*	18390	2772	15.10	550	2.99	16	44	52	Species well represented outside Proposal area and mainly recorded in previously disturbed areas. With continuation of existing management practices (i.e. chaining) presence of species unlikely to change. **Species will not be significantly affected.**
Persoonia cymbifolia	24	2	8.30	0	0	2	11	30	Species well represented outside Proposal area and mainly recorded in previously disturbed areas. With continuation of existing management practices (i.e. chaining) presence of species unlikely to change. **Species will not be significantly affected.**
Persoonia scabra	30	1	3.30	0	0	1	7	18	Species well represented outside Proposal area and mainly recorded in previously disturbed areas. With continuation of existing management practices (i.e. chaining) presence of species unlikely to change. **Species will not be significantly affected.**
Pityrodia chrysocalyx	4941	235	4.80	0	0	4	11	22	Species well represented outside Proposal area and mainly recorded in previously disturbed areas. With continuation of existing management practices (i.e. chaining) presence of species unlikely to change. **Species will not be significantly affected.**

Species	No. individuals in Ecoscape (2015) study area	Individuals affected by Proposal in previously disturbed area		Individuals affected by Proposal in vegetated area		Populations			Summary
		Number	%	Number	%	Number of populations within clearing footprint	In Ecoscape (2015) study area	Total*	
Pultenaea daena	561	15	2.70	0	0	1	2	15	Species well represented outside Proposal area and mainly recorded in previously disturbed areas. With continuation of existing management practices (i.e. chaining) presence of species unlikely to change. **Species will not be significantly affected.**
Priority 4									
Adenanthos ileticos	4588	133	2.90	0	0	7	15	48	Species well represented outside Proposal area and mainly recorded in previously disturbed areas. With continuation of existing management practices (i.e. chaining) presence of species unlikely to change. **Species will not be significantly affected.**
Darwinia polycephala	7240	0	0	100	1.38	9	18	39	Species well represented outside Proposal area. **Species will not be significantly affected**
Eremophila serpens	36	18	50.00	0	0	4	5	29	While 50% of individuals recorded in the study are within the Proposal area, they are located in previously disturbed areas. With continuation of existing management practices (i.e. chaining) presence of species unlikely to change. In addition, disturbance will occur in only five of the 29 populations identified in the area. **Species will not be significantly affected.**
Eucalyptus dolichorhyncha	435	57	13.10	20	4.6	4	10	33	Species well represented outside Proposal area. **Species will not be significantly affected**
Grevillea aneura	5702	124	2.20	0	0	8	22	49	Species well represented outside Proposal area and mainly recorded in previously disturbed areas. With continuation of existing management practices (i.e. chaining) presence of species unlikely to change. **Species will not be significantly affected.**
Grevillea baxteri	3932	464	11.80	0	0	6	22	51	Species well represented outside Proposal area and mainly recorded in previously disturbed areas. With continuation of existing management practices (i.e. chaining) presence of species unlikely to change. **Species will not be significantly affected.**
Gyrostemon ditrigynus	3195	454	14.20	0	0	7	19	38	Species well represented outside Proposal area and mainly recorded in previously disturbed areas. With continuation of existing management practices (i.e. chaining) presence of species unlikely to change. **Species will not be significantly affected.**

Species	No. individuals in Ecoscape (2015) study area	Individuals affected by Proposal in previously disturbed area		Individuals affected by Proposal in vegetated area		Populations			Summary
		Number	%	Number	%	Number of populations within clearing footprint	In Ecoscape (2015) study area	Total*	
Melaleuca fissurata	1605	208	13.00	0	0	8	20	46	Species well represented outside Proposal area and mainly recorded in previously disturbed areas. With continuation of existing management practices (i.e. chaining) presence of species unlikely to change. **Species will not be significantly affected.**

*Total populations – all known and mapped populations (Ecoscape [2017a] and NatureMap).

Range extensions, range edges and other significant features

Of the 26 species that have been identified as ranges extensions or at range edge in the studies undertaken for this Proposal seven have at least one population located within the potential disturbance footprint. All species are represented outside the Proposal area and no significant effect is expected to these flora. The species represented within the Proposal alignment include:

- *Acacia singula*
- *Boronia baeckeacea* subsp. *patula*
- *Cyathostemon* sp. Salmon Gums (B. Archer 769
- *Darwinia polycephala*
- *Eremophila serpens*
- *Goodenia laevis* subsp. *laevis*
- *Thysanotus brachyantherus*.

9.6.2 Indirect impacts

Introduction and spread of Phytophthora cinnamomi and introduced weeds

The identified areas of *P. rosacearum* infestations have been avoided as part of the design of the Proposal alignment. The Proposal alignment avoids the disused gravel extraction site (adjacent to Bandalup Road, near the intersection of Coujinup Road), and the proposed barrier fence has been modified at the eastern portion of the Proposal alignment to avoid the firebreak by replacing an existing farm boundary fence with a barrier fence. This includes avoidance of the 1.6 km section of UCL surveyed by GS Bio Logic (2015) along Merivale Road adjacent to Cape Arid NP.

A PDMP will be prepared and implemented by DPIRD during construction and ongoing maintenance of the proposed barrier fence. The PDMP will address:

- vehicle hygiene
- access and the timing of clearing to avoid high risk periods when the soil is wet.

The potential for the spread of weeds from the Proposal was also identified in the ESD (Appendix 1). The spread of weeds may have adverse impacts on the biodiversity values of the Great Western Woodlands, as well as the agricultural sector, including impacts of resource competition with native flora, prevention of seedling recruitment and alteration to geomorphological processes. A WHP has been prepared (Appendix 5) and will be implemented by DPIRD during construction and ongoing maintenance of the Proposal. The WHP addresses:

- awareness of Declared Pests and Weeds of National Significance
- vehicle hygiene procedures
- access and monitoring during construction and ongoing maintenance activities.

Fragmentation of vegetation

Fragmentation caused by linear clearing of vegetation can lead to the increased risk of 'edge effects' such as weed invasion, disease spread, fire, dust and erosion. The Great Western Woodlands are recognised internationally as the largest remaining area of intact Mediterranean climate woodland on Earth. The Great Western Woodlands is predominantly within UCL, but also includes significant areas of pastoral lease and conservation reserve.

Fragmentation of vegetation has been minimised through the use of existing tracks and graded firebreaks and the replacement of existing farm boundary fences for 590 km (or 89.5%) of the 660 km Proposal alignment. The remaining 69.3 km of the Proposal alignment is within uncleared vegetation and would cause local fragmentation effects in these areas. The potential for increased fire risk, weed invasion and disease spread will be managed through the prevention of public access without a permit and legitimate reason to travel the proposed barrier fence and the implementation of a PDMP and WHP.

The risk of erosion will be addressed through the construction of water diversion turnouts (similar to that used on roads) with an approximate allowance for a turnout to be installed every 200 m along sections of the Proposal alignment determined to be at risk of erosion. Erosion will also be monitored closely during fence inspections and managed to ensure the integrity of the proposed barrier fence and so that no indirect impacts on adjacent vegetation occur. The actual disturbance from water diversion turnouts is expected to be much less than the 6 ha allowed for, as in practice locations will be determined during construction and will only be required where necessary based on the potential for erosion and the state of erosion on any existing tracks.

The fragmentation effects on vegetation are expected to be highly localised and no significant residual impact is anticipated.

Change in fauna aided seed dispersal

Fauna aided seed dispersal can occur through the ingestion of seeds or from seeds attaching to the animal and being dispersed to other areas within the animal's range. Small animals can pass through the fence, and birds (other than emus) and bats can fly over the fence; as such, the role of these fauna species in aiding seed dispersal will be maintained.

Emus are known to play a role in the dispersal of larger seeds. The digestion of seeds from some species of *Eremophila* is even known to facilitate germination. There are also pre-existing densities of macropods and emus on both sides of the proposed barrier fence; therefore, emus and kangaroos will continue to move through the agricultural area on the inside of the proposed barrier fence so this ecological function of fauna aided seed dispersal will continue. The Proposal only prevents large numbers of emus in 'migration' events moving through the agricultural region. The retention of ecological corridors along the three river systems and along the coast will ensure that seeds continue to be dispersed from the rangelands into the agricultural area (and vice versa).

It is also noted that no Threatened species is reliant on this method of seed dispersal.

No significant residual impact is anticipated from the interruption of fauna aided seed dispersal.

9.7 Summary of predicted residual impacts

The predicted residual impacts of the Proposal include:

1. Disturbance of up to 816 ha of native vegetation with approximately:
    - 373.8 ha for re-chaining (if necessary) of previously chained areas
    - 248.6 ha of grading within chained areas, where the inner graded fire track will be used preferentially where possible
    - 146.0 ha of chaining within uncleared vegetation
    - 41.6 ha (5%) of permanent grading (for a 6 m wide access track) within uncleared vegetation
    - 6 ha for water diversion turnouts for erosion control (predicted residual impacts are not expected to significantly impact vegetation at a local or regional scale).
2. Disturbance of the following vegetation associations with less than 30% of their extent remaining:
    - 28.1 ha of Vegetation Association 47
    - 64.2 ha of Vegetation Association 512
    - 3.6 ha of Vegetation Association 4801 with 1.2 ha of this clearing located in uncleared vegetation.
3. Disturbance of 655 m Proteaceae Dominated Kwongkan Shrubland TEC (0.87 ha) (re-chaining proposed as part of the Proposal) within an existing and recently re-chained firebreak.
4. Fragmentation and localised edge effects along the 69.3 km of the Proposal alignment that is within uncleared vegetation.
5. Clearing of 36 species of Priority flora, with 11 Priority Flora species located within uncleared vegetation.

There will be no new clearing of records of Threatened flora species (*Conostylis lepidospermoides*, *Anigozanthos bicolor* subsp. *minor, Eucalyptus merrickiae*, *Rhizanthella gardneri)* which occur in the vicinity of the Proposal alignment, and the proposed clearing will not significantly change the percentage remaining of any Vegetation Associations. Disturbance of 0.87 ha of Proteaceae Dominated Kwongkan Shrubland also represents no new impact as this disturbance is located within a previously chained area.

The Proposal can be managed to meet the EPA objective for Flora and Vegetation as outlined in EPA EAG8 (2015a).

The key mitigation strategies to minimise clearing and fragmentation of native vegetation include:

- altering 89.5% of the proposed barrier fence length to utilise existing linear disturbance areas such as existing fire management breaks and already cleared areas within private property
- reducing the total clearing footprint to a 15–20 m width
- adjusting the Proposal alignment to:
  - allow for unfenced areas associated with three main river systems and coastal corridor to retain the ecological connection with vegetation on both sides of the proposed barrier fence
  - to avoid any records of threatened flora species in uncleared vegetation areas
- implementation of the following plans during construction and ongoing maintenance of the proposed barrier fence to manage direct and indirect impacts from the Proposal on Flora and Vegetation:
  - CMP–action items to include, but not limited to, delineating the fence reserve boundary via pegging to provide accuracy to the limits of the allowable clearing lines, and pre-clearing survey of unsurveyed areas to identify potential Declared Pests or Weeds of National Significance, and Threatened and Priority flora species prior to installation of the proposed barrier fence
  - WHP–action items to include implementation of vehicle hygiene measures
  - PDMP—action items to include implementation of vehicle/soil hygiene measures.

The proposed mitigation and management strategies are expected to be effective in minimising potential impacts. No significant impact on the representation, diversity, viability and ecological function of vegetation and flora is expected at the species, population and assemblage level following the implementation of mitigation and management strategies. The Proposal will not result in significant residual impacts to any conservation significant flora species vegetation community or ecosystems. As a result, no significant residual impacts are anticipated and offsets for Flora and Vegetation are not required.

Table 13-2 summarises the inherent potential environmental impacts (prior to mitigation), the mitigation measures as well as an assessment against EPA objectives.

10. Terrestrial Fauna

Potential impacts, mitigation and management measures, proposed regulatory mechanisms and relevant environmental studies for Terrestrial Fauna are presented in the Sections 10.1 to 10.7.5. These sections will demonstrate that the Proposal will meet the EPA objective for Terrestrial Fauna and fulfil the requirements of Required Work Items 6 to 11 outlined in the ESD.

10.1 Relevant environmental objectives, legislation, policies and guidelines

10.1.1 Environmental objectives

The EPA environmental objectives for Terrestrial Fauna, as well as potential environmental aspects of the Proposal that may impact this environmental factor are provided in Table 10-1.

Table 10-1: Key environmental factors, objectives and Proposal environmental aspects

Environmental factor	EPA objective	Proposal environmental aspect
Terrestrial Fauna	To maintain representation, diversity, viability and ecological function at the species, population and assemblage level.	Clearing of habitat and the physical barrier to fauna movement.

10.1.2 Requirements of the ESD

The ESD outlines the work required for the environmental impact assessment of key environmental factors for the PER. These requirements for Terrestrial Fauna are presented in Table 10-2.

Table 10-2: Terrestrial Fauna required work for the Proposal as per the ESD

Item	Requirement	Section in the PER
6	Conduct Level 1 terrestrial fauna surveys to identify and characterise terrestrial fauna, fauna habitat and habitat connectivity that may be impacted directly and indirectly by the implementation of the proposal in accordance with the requirements of Guidance Statements No. 56 and 20 and the EPA and DEC Technical Guide - *Terrestrial Vertebrate Fauna Surveys for Environmental Impact Assessment.* The Level 1 terrestrial fauna surveys should be used to inform the requirement for targeted surveys of conservation significant fauna. *Note: If the proponent has already undertaken biological surveys at the referral stages, then the survey results are to be included in the PER, along with demonstration that they meet the "Required work" and relevant policies.*	Section 10.3
7	Describe the values and significance of fauna, fauna habitat and habitat connectivity that maybe impacted directly and indirectly by implementation of the proposal and describe the significance of these values in a local and regional context.	Section 10.3.1
8	Provide a map illustrating the known recorded locations of conservation significant species in relation to the proposal.	Figure 10-1
9	Describe and assess the extent of direct and indirect impacts as a result of implementation of the proposal to terrestrial fauna taking into consideration cumulative impacts, the significance of fauna, fauna habitat, ecological connectivity and whether the isolated habitat has adequate carrying capacity. Identify the residual impacts after considering and applying the mitigation hierarchy.	Section 10.7
10	Discuss proposed management, monitoring and mitigation methods to be implemented to ensure residual impacts (direct and indirect) are not greater than predicted.	Section 10.5
11	Provide justification for the selection of the locations, total number and dimensions of gaps planned within the proposal to facilitate fauna movement. Include maps at an appropriate scale.	Section 10.6

Item	Requirement	Section in the PER
12	Describe the management measures for predator/pest control to be implemented as part of this proposal, and how this interacts with any other relevant predator/pest control programs in the vicinity of the proposal. An environmental management plan is to be submitted as part of the PER consistent with Environmental Assessment Guidelines 17 *Preparation of management plans under Part IV of the Environmental Protection Act 1986.*	Section 10.5 broadly describes the management measures. The Predator and Pest Control Management Plan is provided in Appendix 6
13	Demonstrate and document in the PER how the EPA's objective for this factor can be met.	Section 10.7.5

10.1.3 Legislation, policies and guidelines

Relevant EPA policy and guidelines outlined in the ESD (Appendix 1) and an explanation on how the Proposal meets EPA policy and guidelines are presented in Table 10-3.

A summary of how the Proposal meets the EPA's policies and guidelines is provided in Section 10.1.4 to 10.1.9.

Table 10-3: Relevant EPA policies and guidelines for Terrestrial Fauna

Policy/guideline	Summary of policy/guideline	Requirements to address the policy/guideline
EPA Position Statement No. 3 (2000) *Terrestrial Biological Surveys as an Element of Biodiversity Protection.* Perth, Western Australia	Outlines the principles which the EPA will use when assessing proposals which may impact on biodiversity values.	To meet Position Statement No. 3 the terrestrial fauna assessments conducted for the Proposal must demonstrate: • that the quality of information and scope of field surveys meet standards, requirements and protocols as determined and published by the EPA • the IBRA regions are used as the largest unit for EIA decision-making in relation to the conservation of biodiversity • provide sufficient information to address both biodiversity conservation and ecological function values within the context of the Proposal • results are publicly available.
EPA Guidance Statement No. 56 (2004) *Terrestrial Fauna Surveys for Environmental Impact Assessment in Western Australia.* Perth, Western Australia	To provide direction and information on general standards and protocols for terrestrial fauna surveys to environmental consultants and proponents engaged in EIA activities.	To meet Guidance Statement 56 terrestrial fauna surveys must demonstrate: • the scale of fauna and faunal assemblage survey appropriate for the Proposal area • the fauna and faunal assemblage survey, analysis, interpretation and reporting undertaken for EIA is of a suitable quality and of consistent methodology to enable the EPA to judge the impacts of proposals on fauna and faunal assemblages • the environment, in particular significant fauna and faunal assemblages, is identified and protected through best practice in the conduct and reporting of fauna and faunal assemblage surveys for EIA • Western Australia's knowledge base of fauna and faunal assemblages and biogeography are developed and enhanced over time at both the local and regional scale to the benefit of future decision making • survey data are capable of underpinning long-term observation and measurement for later compliance and audit purposes.

Policy/guideline	Summary of policy/guideline	Requirements to address the policy/guideline
EPA Guidance Statement No. 33 (2008) *Environmental Guidance for Planning and Development.* Perth, Western Australia	Describes the processes the EPA may apply under the *Environmental Protection Act 1986* to land use planning and development in Western Australia, in particular the EIA process applied to schemes. Also provides information and advice on a range of environmental issues and their protection and management.	The Proposal involves the clearing of native vegetation and therefore fauna habitat. As a result, the Proposal must meet the EPA's broad principles in Chapter B3 Native terrestrial fauna in order to meet EPA's objective for Terrestrial Fauna.
EPA Guidance Statement No. 20 (2009) *Sampling of Short Range Endemic Invertebrate Fauna for Environmental Impact Assessment in Western Australia.* Perth, Western Australia	Addresses the general standards and a common framework including risk-based assessment for the sampling and assessment of Short Range Endemic (SRE) invertebrate fauna for EIA in Western Australia. It also sets out the EPA's current expectations in respect of the quality and quantity of information derived from these surveys, and the consequent analysis, interpretation and reporting. The Guidance recognises and discusses limitations on current knowledge in respect to this fauna, and how this may affect the EPA's consideration of development proposals.	In order to meet Guidance Statement No.20 the Proposal must: • ensure the protection of key habitats for SRE species • maintain the distribution, abundance and productivity of populations of SRE taxa • ensure that the conservation status of SRE taxa is not adversely changed as a result of development proposals.
EPA and Department of Environment and Conservation (2010) *Technical Guide -Terrestrial Vertebrate Fauna Surveys for Environmental Impact Assessment.* Perth, Western Australia	Provides direction and information on general standards and protocols for terrestrial fauna surveys to environmental consultants and proponents engaged in EIA activities.	To meet the requirements in this technical guide terrestrial fauna surveys must: • demonstrate an appropriate level of detail regarding survey preparation, design, data analysis as per the requirements outlined in this guide • be undertaken in accordance with the recommended timing for vertebrate fauna assemblage surveys for the South-West Botanical Province/South-Western interzone.
EPA Environmental Assessment Guidelines No. 17 (2015) *Preparation of management plans under Part IV of the Environmental Protection Act 1986.* Perth, Western Australia	Provides guidance to proponents on the content of management plans under Part IV of the *Environmental Protection Act 1*986 (EP Act).	Relevant for the Predator and Pest Control Management Plan (PPCMP) (Appendix 6).
Other policy and guidance		
WA WDAG (2016) *Western Australian Wild Dog Action Plan 2016- 2021*	Principles of the WA Wild Dog Action Plan: 1. Targeted management. 2. Coordination. 3. Shared responsibility and accountability. 4. Co-investment. 5. Proactive management to reduce impact. 6. Research and monitoring. 7. Capacity development. 8. Communication.	The implementation of the Proposal is a recommendation of WA WDAG (2016).

10.1.4 Position Statement No. 3 (EPA 2000)

The EPA requires that the quality of information and scope of field surveys meets the standards, requirements and protocols as determined and published by the EPA. An indicative guide to the level of investigation required for EIA related biological surveys is provided in this Statement.

The Proposal meets the indicative level of biological survey expected by the EPA in relation to the scale and nature of the impact and the sensitivity of the receiving environment. The Proposal is located within the Warren, Avon Wheatbelt, Geraldton Sandplains, Esperance Plains, Mallee, Swan (Largely Cleared) (WAGEMS) bioregion. The environmental studies undertaken for this Proposal fulfil the requirements of a terrestrial biological study at low scale and nature of impact. The low scale and nature of impact requirements include:

- desktop study
- reconnaissance survey.

These requirements have been addressed in the environmental studies outlined in Section 8.

The Proposal meets the requirements of Position Statement No.3 in the following ways:

1. Biodiversity values are protected as the Proposal is located in areas with a high degree of pre-existing modification (such as cleared agricultural land and previously chained firebreaks).
2. Terrestrial biological surveys conducted for the Proposal provide sufficient information that address the biodiversity conservation and ecological function values within the area impacted for the construction of the Proposal. This information is provided in Table 8-1.
3. The terrestrial biological surveys are also publicly available to contribute to the bank of data available for WAGEMS, to aid the overall biodiversity understanding and assessment by facilitating transfer into State biological databases.
4. Planning of the Proposal has also been based on careful evaluation to avoid, wherever practicable, serious or irreversible damage to the environment; and an assessment of the risk-weighted consequences of various options (Section 9.5).

10.1.5 Guidance Statement 56 (EPA 2004)

The Proposal meets the requirements for terrestrial fauna surveys outlined in Guidance Statement 56 as:

1. The fauna assessment methodology was based on a Level 1 assessment as described in Appendix 2 of Guidance Statement 56. This is consistent with Required Work Item 6.
2. Environmental studies for the Proposal demonstrate adequate provision of resources for the survey and documentation of the fauna species and habitat. This includes the intensity of sampling (the number of sites, their spacing, and their area) is attuned to the complexity of the fauna assemblages that may be present within and surrounding the Proposal area.
3. Fieldwork collectively across the environmental studies cover multiple years (2012–2015), GS Bio Logic (2015) field survey for 1.63 km of UCL was conducted in winter, Ecoscape (2017a) field surveys for the Proposal alignment were conducted in spring and summer, and the GHD (2012) field study for multiple Proposal alignment options was conducted in autumn. This means fauna species such as reptiles (which are likely to be less active in winter) were able to be detected in fauna surveys conducted in warmer times of the year.
4. Terrestrial fauna surveys were coordinated and led by zoologists who have had training, mentoring and experience in terrestrial fauna surveys.
5. Fauna desktop and field surveys of the Proposal alignment identify conservation significant fauna at a regional and sub-regional scale; this includes a review of aerial photography together with identification of specific ecological attributes including habitat features and physical site characteristics including drainage and topography.
6. Sampling design and intensity has been informed by characteristics of existing landform, habitat, vegetation, potential for conservation significant fauna to occur, results of previous fauna surveys for the Proposal alignment.

7. Terrestrial fauna surveys identify limitations.
8. Surveys are publically available.

10.1.6 Guidance Statement No. 33 (EPA 2008)

The Proposal meets broad principles for the protection of native terrestrial fauna outlined in Guidance Statement 33 as.

1. The Proposal minimises clearing native vegetation where possible in order to protect and manage the Great Western Woodlands.
2. The Proposal design adopts an ecosystem and environmentally sound practices to minimise adverse impacts on target, and non-target fauna.
3. No known species of native fauna will be made extinct as a result of this Proposal.
4. Throughout the design of the Proposal, DPIRD have adopted an integrated and consultative approach to manage expectations of the Proposal.
5. adequate survey work and assessment addressing fauna characteristics, values, issues, threats, functions, significance, overarching environmental objectives and appropriate management have been undertaken.
6. Mitigation measures to be implemented during construction and ongoing maintenance of the Proposal (Section 10.5) minimise adverse impacts to terrestrial fauna with the objective of achieving no significant change in terrestrial fauna values.

10.1.7 EPA Guidance Statement No. 20 (2009)

No surveys have been conducted for Short Range Endemic (SRE) invertebrates.

Optimal timing for sampling SREs for the southwest is winter-early spring (May to October) based on the life history characteristics of the SREs present in this region. This includes the presence of adults for key SRE groups in the region such as millipedes and onychophorans and enhanced activity in otherwise cryptic groups such as *Bothriembryon* land snails and male mygalomorph spiders. Database searches conducted for the Proposal identified no SREs; therefore, reporting was based on the findings of desktop searches.

10.1.8 Technical Guide (EPA &DEC 2010)

The Proposal demonstrates that the environmental surveys meet the appropriate level of detail regarding survey preparation, design, data analysis and reporting outlined in this guide.

10.1.9 Western Australian Wild Dog Action Plan 2016-2021

The Action Plan is an industry driven plan that considers the economic, environmental and social impacts of wild dogs. The Action Plan coordinates the control of wild dogs by developing partnership arrangements between industry, Biosecurity Groups, Government and the community to deliver a sustained, whole-of-industry benefit. The Action Plan outlines how Biosecurity Groups will undertake ongoing control measures within and along the SBF to deliver the agricultural protection objectives.

The State Government announced funding to implement the key recommendations of the Action Plan in November 2016. Further, the Esperance Biosecurity Association Inc. and Southern Biosecurity Group Inc. covering the Shires of Esperance and Ravensthorpe were recognised under s 169 of the BAM Act by the Minister for Agriculture in early 2017. This provides funding security that the essential wild dog control programs along the proposed alignment will continue to be implemented.

10.2 Required work

Consistent with the requirements of the ESD (Required Work Item 6 for Terrestrial Fauna) the following environmental studies have been undertaken for the Proposal to characterise the terrestrial values present within the Development Envelope:

- GHD (2012) *Report for State Barrier Fence Extension Scoping Study*
- GS Bio Logic (2015) *Biological Surveys of the State Barrier Fence – Merivale Road Reserve Realignment – Cape Arid*
- Ecoscape (2017a) *State Barrier Fence Biological Surveys*
- Ecoscape (2017a) *State Barrier Fence Biological Surveys*
- Everard & Bamford (2016) *Risk assessment of the proposed extension to the State Barrier Fence on the Brush Wallaby.*

The results of these environmental studies have been used to inform Section 10.3 to characterise Terrestrial Fauna values.

10.3 Findings from Level 1 fauna surveys

10.3.1 Fauna habitat values and significance

Habitat has been modified over the majority of the Proposal alignment due to chaining or clearing of vegetation. This includes substantial fuel management (fire break and track clearing/grading) by DBCA since the Ecoscape (2017a) and GS Bio Logic (2015) surveys were undertaken. The chained, partially disturbed areas still provide ground cover and some level of habitat value as well as connectivity to the surrounding bushland. Habitat condition was considered good within the surveyed chained areas (though more unsuitable for some species than others) and very good within the remaining vegetated areas (Ecoscape 2017a). Graded areas including multiple fire tracks within the chained firebreaks are fully cleared.

Eight fauna habitat types were distinguished and mapped based on landscape and vegetation features relevant to the likelihood of occurrence of vertebrate fauna, including conservation significant fauna (Ecoscape 2017a). These fauna habitat types are outlined in Table 10-4 and depicted in Map 4 of Ecoscape 2017a, each habitat type is well represented, and each habitat type is expected to be also extensively represented in areas surrounding the Proposal.

Riparian areas tend to be important habitat for fauna due to relatively fertile soils and water availability. Creeklines and riparian areas have not been listed as a separate habitat type as most creeklines in the study areas are minor ephemeral drainages with vegetation similar to surrounding areas. The three rivers (Oldfield, Lort and Young rivers) that occur in the region are excluded from the Proposal alignment with gaps in the fence.

The Proposal alignment intersects Thomas River located in the far eastern portion of the alignment (Figure 1-2). The Thomas River fence crossing is located on freehold land in a highly disturbed area next to concrete culverts and adjacent to Merivale Road. An existing farm boundary fence crosses the river and no significant clearing or tree felling will occur in this area. Plate 5 and Plate 6 show the Thomas River and the disturbed nature of the proposed crossing area.

Table 10-4: Fauna habitat values and extent in the Ecoscape (2017a) study area

Type	Habitat description	Area (ha)	%	Habitat values
1 – Mallee Woodland	*Eucalyptus* Woodland over mixed shrubs	3247	51.2	High value for significant vertebrate fauna due to presence of sandy soil, abundant leaf litter, fallen logs and presence of hollows in standing and fallen trees.
2 – Mallee Shrubland	*Eucalyptus* Shrubland over mixed shrubs	1742	27.5	Soil and litter provide important habitat values, but logs and tree hollows are less abundant than in woodland. Dense (thicket) vegetation may provide important refuge for small and medium-sized vertebrates from introduced predators, particularly where *Gastrolobium* occurs (naturally containing fluoroacetate or 1080 poison).
3 – Shrubland	*Acacia* or other species mixed shrubland/herbland	129	2.0	Sandy soil, presence of litter and dense vegetation provide habitat values for some significant fauna species.
4 – Woodland	*Eucalyptus* sp. over shrubs/sedges	579	9.1	Relatively high habitat values due to presence of logs and tree hollows in addition to sandy soil and leaf litter.
5 – Banksia Shrubland	*Banksia* or Proteaceae sp.	116	1.8	Sandy soil, leaf litter and seasonally abundant food resources provide important habitat values, important foraging habitat for species that may depend on other nearby habitats for shelter or other resources.
6 – Salt Lake/Fringe	Samphire/chenopod shrubland or *Melaleuca* sp. shrubland	83	1.3	Used by resident terrestrial vertebrates, and potential foraging and shelter habitat for shorebirds that utilise inland salt lakes when conditions are temporarily suitable.
7 – Forest	Tall *Eucalyptus* sp. with mixed tall shrubs	376	5.9	Relatively high habitat values due to presence of logs and tree hollows in addition to sandy soil and leaf litter.
8 – Salt Lake	Open water or bare ground	19	0.3	Occasionally used by shorebirds when inundated.
Degraded / Cleared	Degraded areas and cleared areas	48	0.8	Little habitat value.



Plate 5: Thomas River crossing private land–existing farm fence is located approximately 20 m behind abandoned fence post seen in picture.



Plate 6: Thomas River culverts under Merivale Road

10.3.2 Conservation significant fauna

An assessment of the likely occurrence of conservation significant fauna species within the Development Envelope was prepared based on Level 1 fauna surveys. Specifically, the assessment involved reviewing:

- species recorded in field surveys (Table 10-5)
- species identified in database searches as occurring (Figure 10-1)
- presence of potential habitat (Table 10-6).

A summary of the ecology for all species recorded, likely to occur and potentially occurring within the Development Envelopment has been provided in Table 10-7.

Species recorded in field surveys

Nine conservation significant fauna species were recorded during fauna field assessments from 2012 to 2015. Since the field fauna assessments were conducted, the conservation status of three recorded conservation significant fauna species has been revised. These changes in conservation status for recorded conservation significant fauna by Ecoscape (2017a) are outlined below:

- Crested Bellbird (*Oreoica gutturalis)* and White-Browed Babbler (*Pomatostomus superciliosus ashbyi*), previously listed as Priority 4 under the WC Act, has since been delisted under the WC Act
- Quenda (*Isoodon obesulus fusciventer)* previously listed as a Priority 5 fauna species is currently listed as a Priority 4 fauna species under the WC Act.

Following the revision of conservation status of the aforementioned species, a total of seven conservation significant species have been recorded to occur within the Proposal area. These conservation significant fauna species are outlined in Table 10-5.

Table 10-5: Recorded conservation significant fauna species

Species	WC Act conservation status	EPBC Act conservation status	Field observations
Malleefowl *Leipoa ocellata*	Vulnerable under Schedule 3	Vulnerable	Observed mound and tracks within Mallee Woodland habitat Mound was observed outside the proposed barrier fence corridor, and the tracks were observed within the proposed barrier fence corridor (Ecoscape 2017a).
Carnaby's Black Cockatoo *Calyptorhynchus latirostris*	Endangered	Endangered	A lone male was observed 5 km west of the Proposal alignment (GS Bio Logic 2015). During the field survey, a large flock of Carnaby's Black Cockatoo was recorded roosting and feeding near Fisheries Rd in the east of the GHD (2012) study area.
Chuditch or Western Quoll *Dasyurus geoffroii*	Vulnerable under Schedule 3	Vulnerable	Potential tracks observed within Salt Lake/ Fringe habitat. Potential tracks observed outside proposed barrier fence corridor (Ecoscape 2017a).
Western Brush Wallaby *Notomacropus (Macropus) irma*	Priority 4	Not listed	Sightings of Western Brush Wallaby were observed in three locations in Mallee shrubland habitat located within the proposed barrier fence corridor (Ecoscape 2017a).
Western Rosella (inland sub-species) *Platycercus icterotis xanthogenys*	Priority 4	Not listed	Western Rosella call was heard in Mallee shrubland habitat within the proposed barrier fence corridor (Ecoscape 2017a).

Species	WC Act conservation status	EPBC Act conservation status	Field observations
Quenda *Isoodon obesulus fusciventer*	Priority 4	Not listed	Evidence of Quenda diggings were observed in five locations within Salt Lake/Fringe, Woodland, Mallee woodland and Shrubland habitat within the proposed barrier fence corridor (Ecoscape 2017a).
Rainbow Bee-eater *Merops ornatus*	Migratory under Schedule 5	Not listed	Numerous sightings, and evidence of the Rainbow Bee-eater was observed in Mallee woodland and Forest (not within the proposed barrier fence corridor), as well as Woodland, Salt Lake/fringe habitat (within the proposed barrier fence corridor) Evidence comprised of a burrow, calls and sightings (Ecoscape 2017a).

Definitions: **Threatened:** Threatened species considered to be facing a very high risk of extinction in the wild. Published as Specially Protected under the WC Act, in Schedule 2 of the Wildlife Conservation (Specially Protected Fauna) Notice for Threatened Fauna and Wildlife Conservation (Rare Flora) Notice for Threatened Flora (the Notice). **Vulnerable**: Threatened species considered to be facing a high risk of extinction in the wild. Published as Specially Protected in Schedule 3 of the Notice. **Priority 4:** rare, near threatened and other species in need of monitoring.

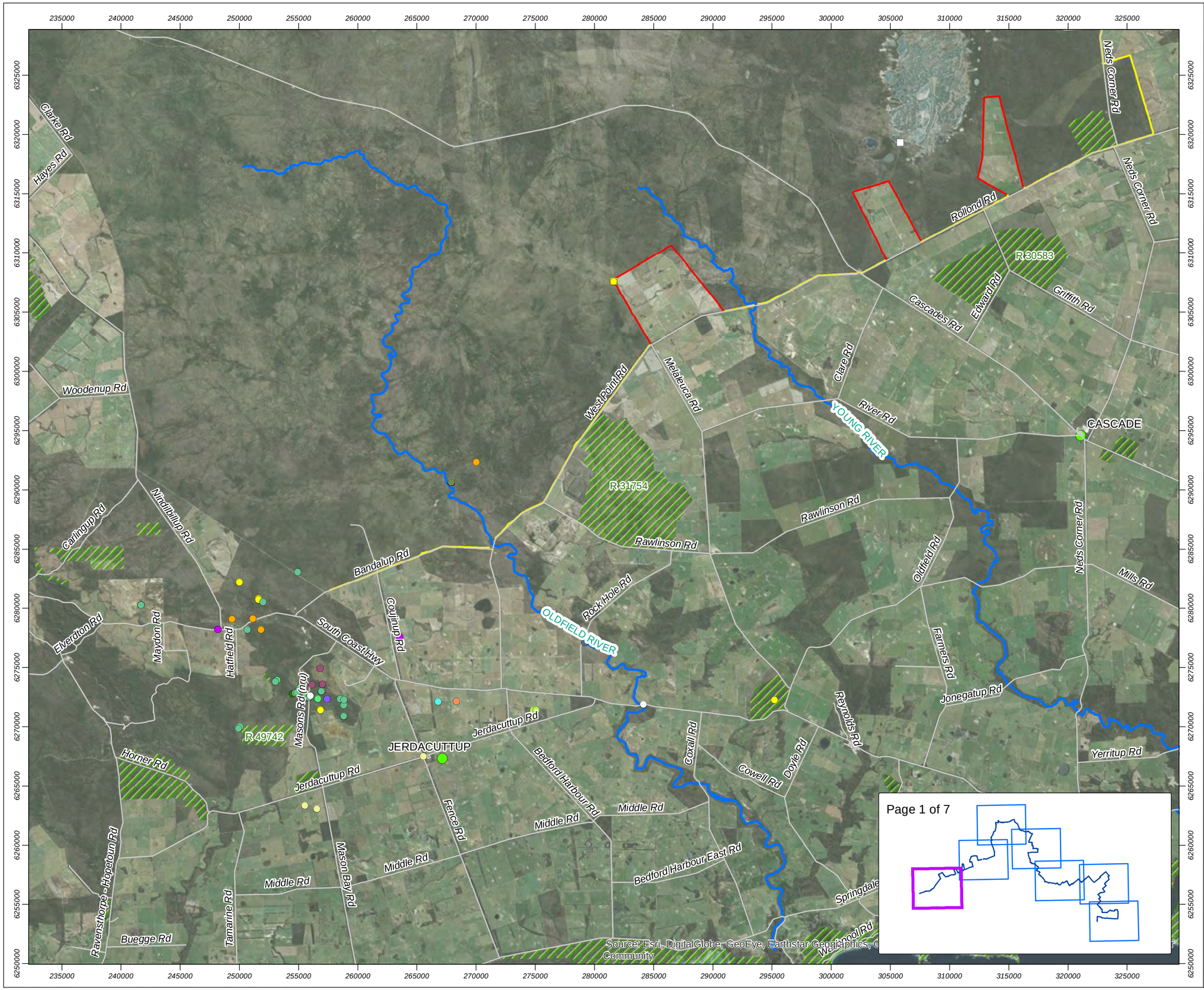
Conservation significant species identified in database searches

In total, 47 conservation significant species were identified in database searches as occurring in area surrounding the Proposal, including 10 mammals, two reptiles, 30 birds and six invertebrates. The recorded locations of conservation significant species are provided in Figure 10-1.

An assessment was undertaken for the potential occurrence of these conservation significant fauna based on the fauna habitat mapped by Ecoscape (2017a) within the Development Envelope (Table 10-6). Full species profiles of all conservation significant fauna species expected to occur is included in Ecoscape (2017a) (Appendix 3) and has been summarised in Table 10-7.

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Figure 10-1: Conservation significant fauna field and database search results



Legend

Species recorded from database searches

- *Ardea modesta*
- *Arenaria interpres*
- *Budginmaya eulae*
- *Calidris acuminata*
- *Calidris alba*
- *Calidris ferruginea*
- *Calidris ruficollis*
- *Calyptorhynchus baudinii*
- *Calyptorhynchus latirostris*
- *Dasyurus geoffroii*
- *Falco peregrinus*
- *Isoodon obesulus fusciventer*
- *Leipoa ocellata*
- *Limosa lapponica*
- *Macropus eugenii derbianus*
- *Macropus irma*
- *Merops ornatus*
- *Parantechinus apicalis*
- *Phascogale calura*
- *Pseudomys occidentalis*
- *Pseudomys shortridgei*
- *Psophodes nigrogularis oberon*
- *Thalassarche chlororhynchos*
- *Tringa nebularia*

Recorded fauna species

- *Macropus irma*
- *Merops ornatus*
- Roads
- Major watercourses
- Parks and Wildlife Managed Lands and Waters

Proposal alignment existing environment conditions

- Previously chained firebreak
- Previously cleared freehold farmland

Scale 1:300,000 at A3

0 1 2 3 4 km

N

Coordinate System: GDA 1994 MGA Zone 51

Note that positional errors may occur in some areas

Date: 26/07/2017

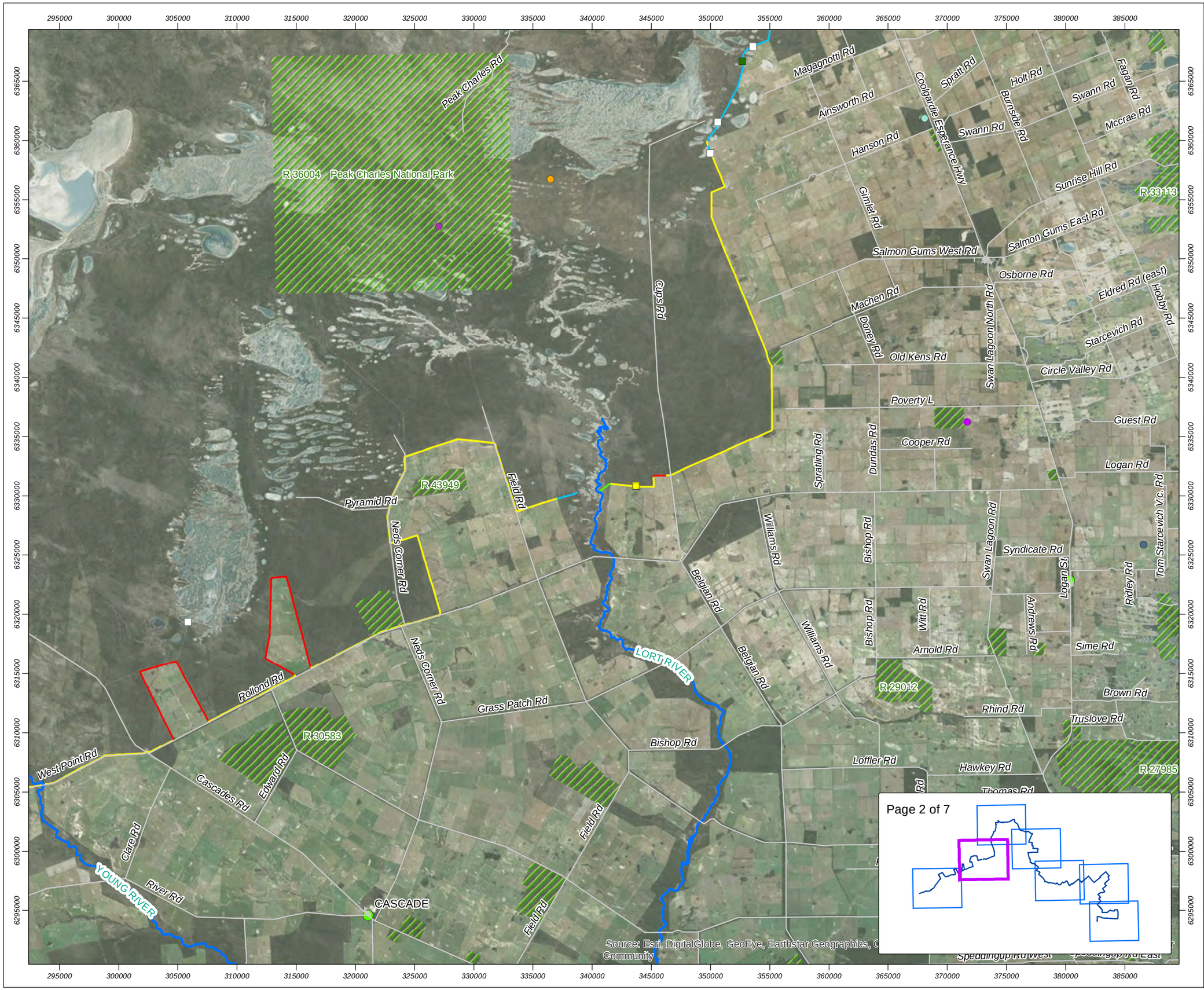
Author: DWhite

Source: Aerial: ESRI approx. 2010; Inland waters: SLIP database, Landgate 2017; Recorded Priority Fauna: Ecoscape (2015)- updated 2017; Fauna database: Parks and Wildlife 2017, search radius 20 km.

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Figure 10-1: Conservation significant fauna field and database search results



Legend

Species recorded from database searches

- *Calyptorhynchus latirostris*
- *Dasyurus geoffroii*
- *Falco peregrinus*
- *Leipoa ocellata*
- *Paroplocephalus atriceps*

Recorded fauna species

- *Isoodon obesulus*
- *Macropus irma*
- *Merops ornatus*
- Roads
- Major watercourses
- Parks and Wildlife Managed Lands and Waters

Proposal alignment existing environment conditions

- Previously chained firebreak
- Existing track or graded firebreak
- Previously cleared freehold farmland
- Uncleared vegetation

Scale 1:300,000 at A3

0 1 2 3 4 km

N

Coordinate System: GDA 1994 MGA Zone 51

Note that positional errors may occur in some areas

Date: 26/07/2017

Author: DWhite

Source: Aerial: ESRI approx. 2010; Inland waters: SLIP database, Landgate 2017; Recorded Priority Fauna: Ecoscape (2015)- updated 2017;
Fauna database: Parks and Wildlife 2017, search radius 20 km.

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Figure 10-1: Conservation significant fauna field and database search results



Legend

Species recorded from database searches

- *Calidris ferruginea*
- *Charadrius rubricollis*
- *Falco peregrinus*
- *Leipoa ocellata*
- *Macropus irma*
- *Merops ornatus*
- *Paroplocephalus atriceps*

Recorded fauna species

- *Dasyurus geoffroii*
- *Isoodon obesulus*
- *Leipoa ocellata*
- *Merops ornatus*
- Roads
- Parks and Wildlife Managed Lands and Waters

Proposal alignment existing environment conditions

- Previously chained firebreak
- Existing track or graded firebreak
- Previously cleared freehold farmland
- Uncleared vegetation

Scale 1:300,000 at A3

0 1 2 3 4 km

N

Coordinate System: GDA 1994 MGA Zone 51

Note that positional errors may occur in some areas

Date: 26/07/2017

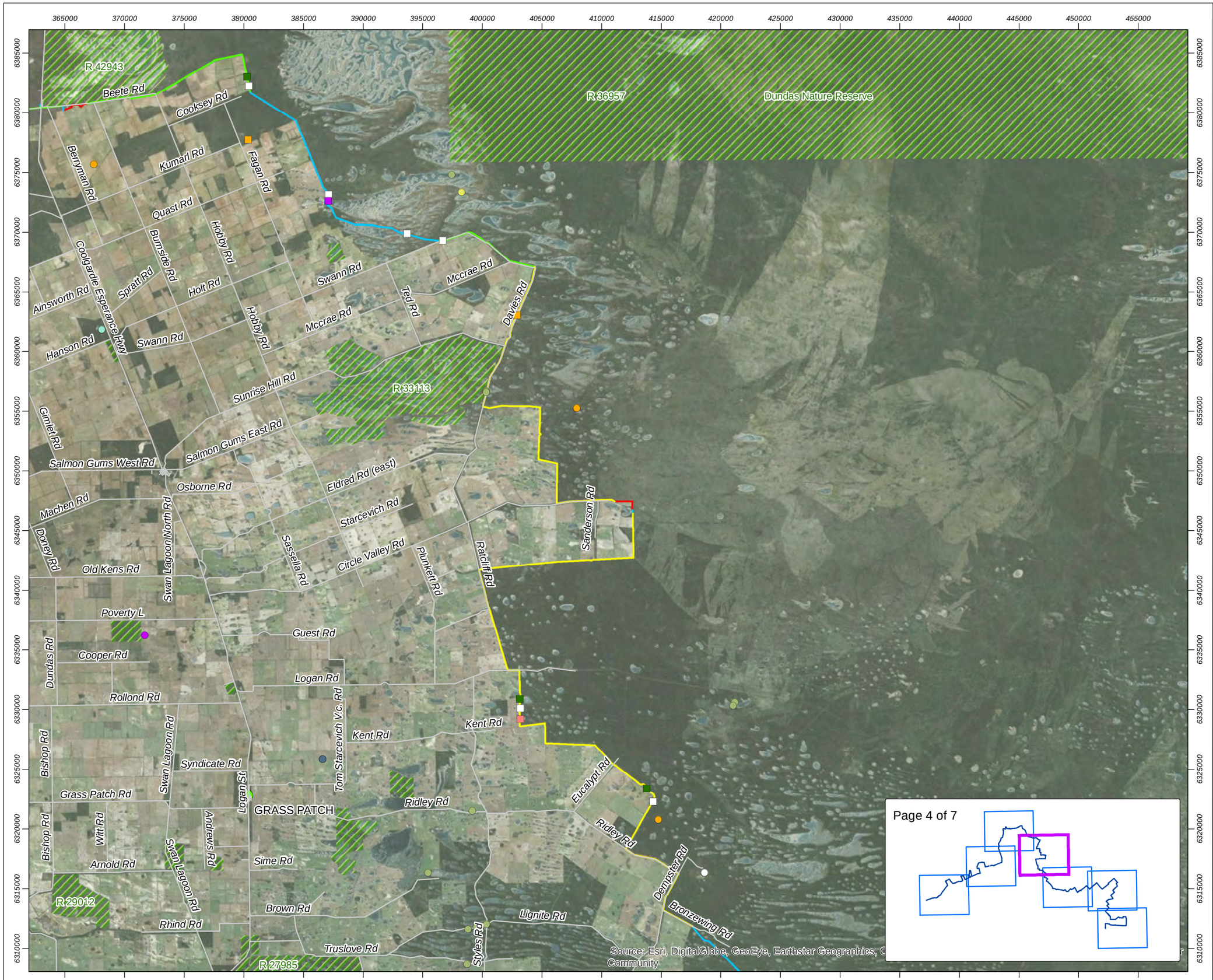
Author: DWhite

Source: Aerial: ESRI approx. 2010; Inland waters: SLIP database, Landgate 2017; Recorded Priority Fauna: Ecoscape (2015)- updated 2017;
Fauna database: Parks and Wildlife 2017, search radius 20 km.

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Figure 10-1: Conservation significant fauna field and database search results



Legend

Species recorded from database searches

- *Calidris ferruginea*
- *Calyptorhynchus latirostris*
- *Charadrius rubricollis*
- *Dasyurus geoffroii*
- *Falco peregrinus*
- *Leipoa ocellata*
- *Merops ornatus*

Recorded fauna species

- *Dasyurus geoffroii*
- *Isoodon obesulus*
- *Leipoa ocellata*
- *Merops ornatus*
- *Platycercus icterotis*
- Roads
- Parks and Wildlife Managed Lands and Waters

Proposal alignment existing environment conditions

- Previously chained firebreak
- Existing track or graded firebreak
- Previously cleared freehold farmland
- Uncleared vegetation

Scale 1:300,000 at A3

km
0 1 2 3 4

N

Coordinate System: GDA 1994 MGA Zone 51

Note that positional errors may occur in some areas

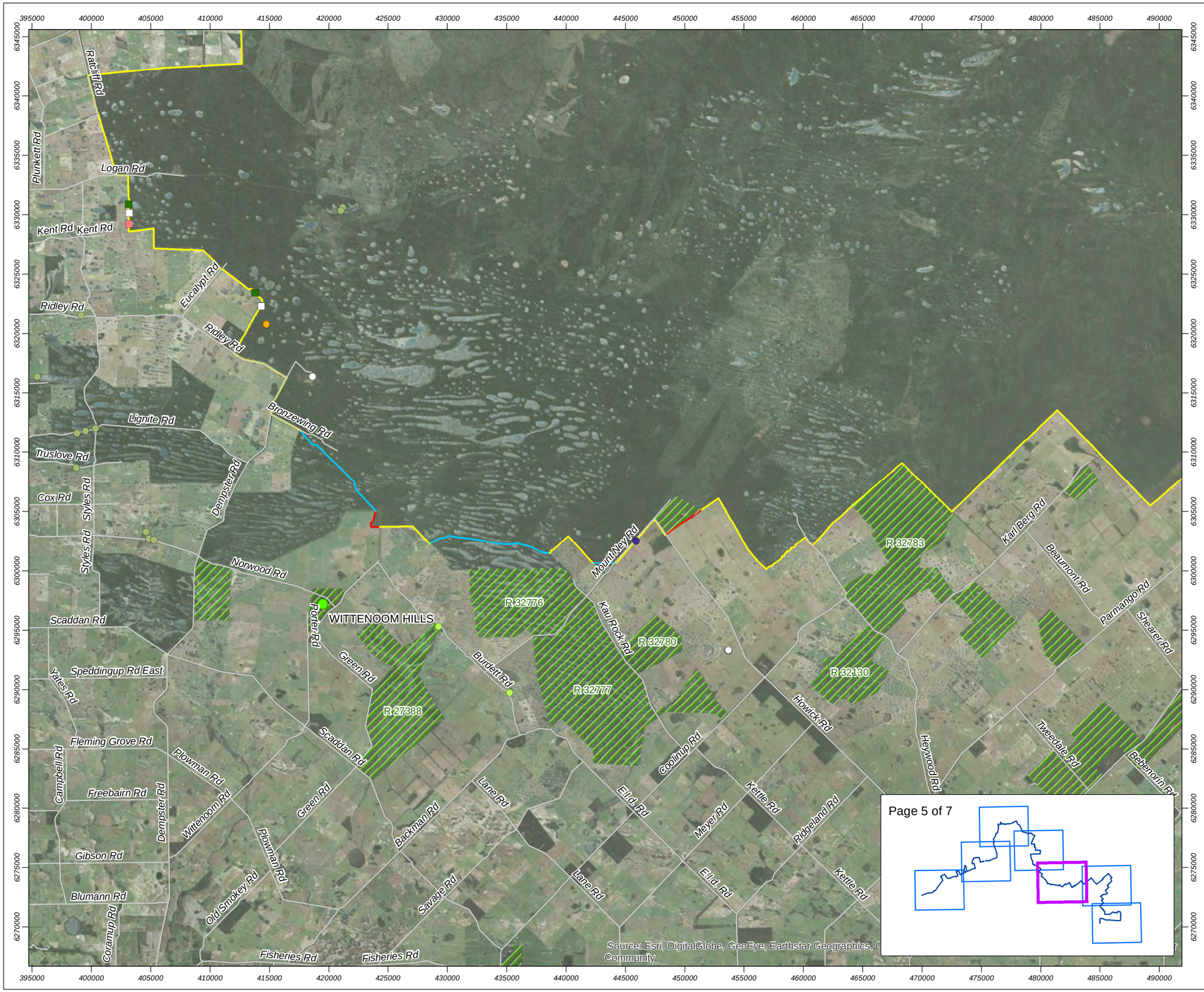
Date: 26/07/2017

Author: DWhite

Source: Aerial: ESRI approx. 2010; Inland waters: SLIP database, Landgate 2017; Recorded Priority Fauna: Ecoscape (2015)- updated 2017;
Fauna database: Parks and Wildlife 2017, search radius 20 km.

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Figure 10-1: Conservation significant fauna field and database search results



Legend

Species recorded from database searches

- *Apus pacificus*
- *Ardea ibis*
- *Ardea modesta*
- *Calidris ruficollis*
- *Calyptorhynchus baudinii*
- *Charadrius rubricollis*
- *Leipoa ocellata*
- *Merops ornatus*
- *Tringa nebularia*

Recorded fauna species

- *Isoodon obesulus*
- *Merops ornatus*
- *Platycercus icterotis*
- Roads
- Parks and Wildlife Managed Lands and Waters

Proposal alignment existing environment conditions

- Previously chained firebreak
- Previously cleared freehold farmland
- Uncleared vegetation

Scale 1:300,000 at A3

0 1 2 3 4 km

N

Coordinate System: GDA 1994 MGA Zone 51

Note that positional errors may occur in some areas

Date: 26/07/2017

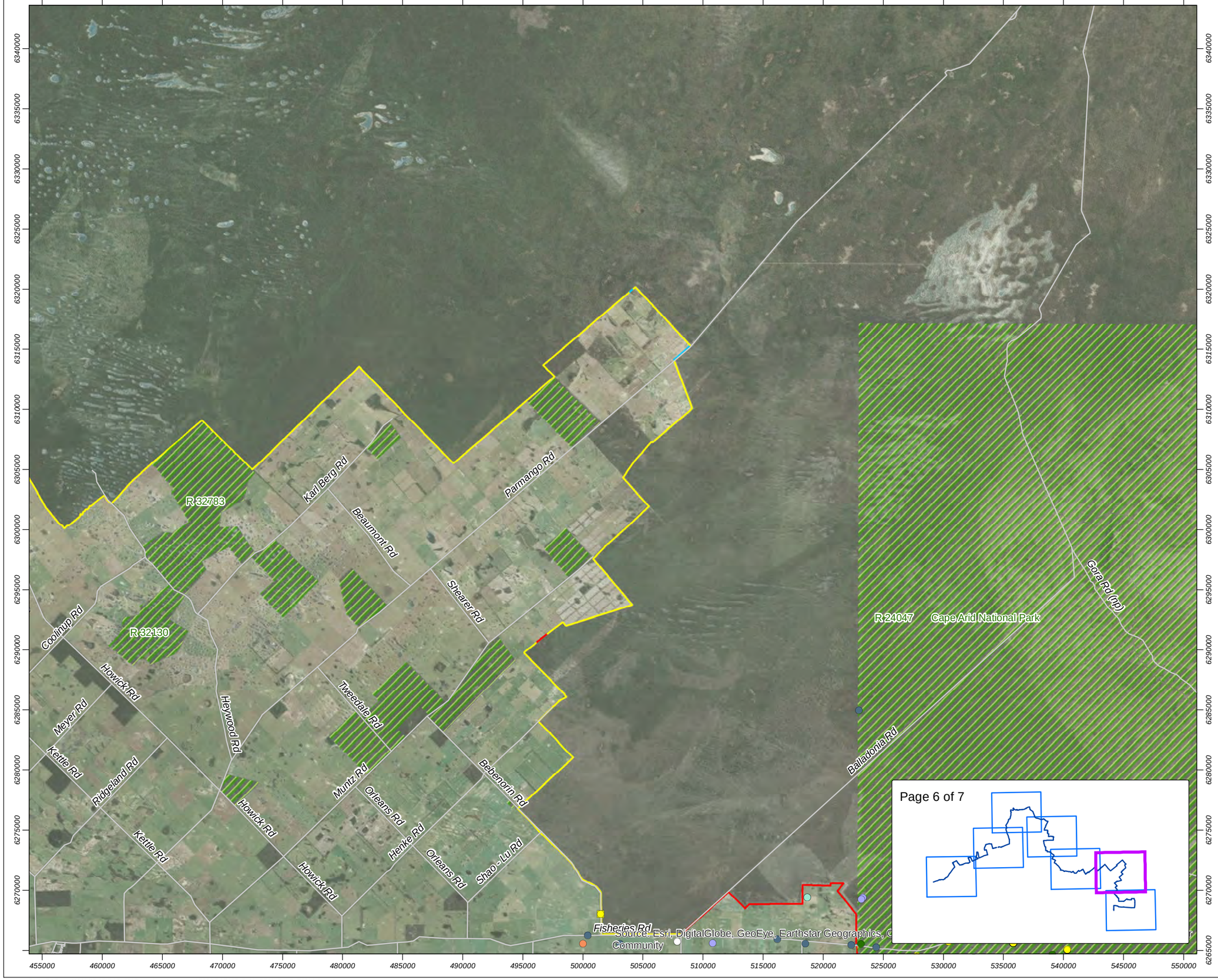
Author: DWhite

Source: Aerial: ESRI approx. 2010; Inland waters: SLIP database, Landgate 2017; Recorded Priority Fauna: Ecoscape (2015)- updated 2017;
Fauna database: Parks and Wildlife 2017, search radius 20 km.

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Figure 10-1: Conservation significant fauna field and database search results



Legend

Species recorded from database searches

- *Apus pacificus*
- *Ardea ibis*
- *Ardea modesta*
- *Calidris ruficollis*
- *Calyptorhynchus baudinii*
- *Calyptorhynchus latirostris*
- *Falco peregrinus*
- *Isoodon obesulus fusciventer*
- *Macropus eugenii derbianus*
- *Macropus irma*
- *Merops ornatus*
- *Pezoporus flaviventris*

Recorded fauna species

- *Macropus irma*
- Roads
- Parks and Wildlife Managed Lands and Waters

Proposal alignment existing environment conditions

- Previously chained firebreak
- Previously cleared freehold farmland
- Uncleared vegetation

Scale 1:300,000 at A3

0 1 2 3 4 km

N

Coordinate System: GDA 1994 MGA Zone 51

Note that positional errors may occur in some areas

Date: 26/07/2017

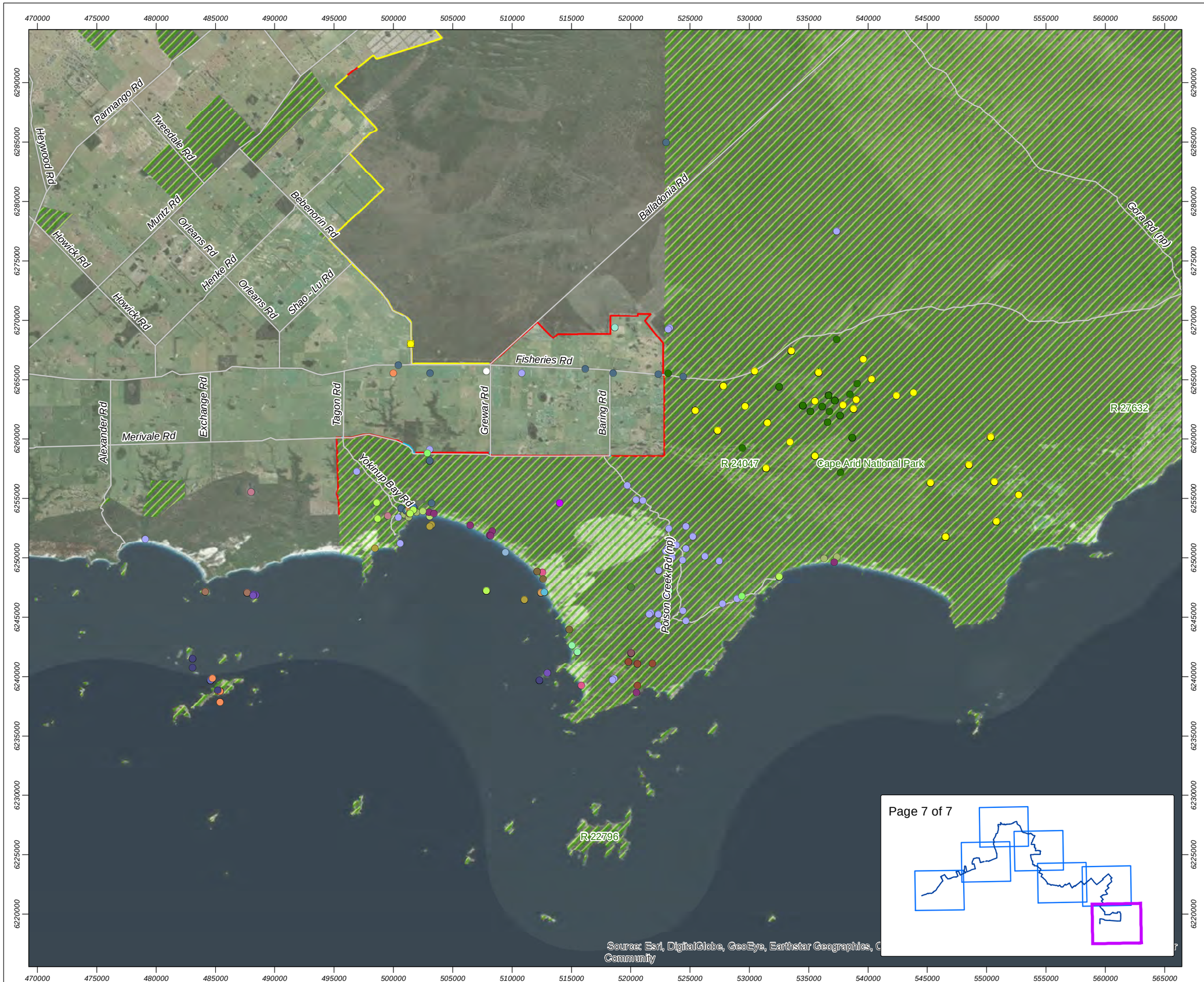
Author: DWhite

Source: Aerial: ESRI approx. 2010; Inland waters: SLIP database, Landgate 2017; Recorded Priority Fauna: Ecoscape (2015)- updated 2017;
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Figure 10-1: Conservation significant fauna field and database search results



Legend

Species recorded from database searches

- *Acanthophis antarcticus*
- *Apus pacificus*
- *Ardea modesta*
- *Arenaria interpres*
- *Atelomastix anancita*
- *Atelomastix melindae*
- *Atelomastix sarahae*
- *Botaurus poiciloptilus*
- *Calidris acuminata*
- *Calidris alba*
- *Calidris ruficollis*
- *Calidris tenuirostris*
- *Calyptorhynchus baudinii*
- *Calyptorhynchus latirostris*
- *Cereopsis novaehollandiae grisea*
- *Charadrius leschenaultii*
- *Charadrius rubricollis*
- *Cyliosoma sarahae*
- *Dasyurus geoffroii*
- *Eubalaena australis*
- *Falco hypoleucos*
- *Falco peregrinus*
- *Isoodon obesulus fusciventer*
- *Limosa lapponica*
- *Macropus eugenii derbianus*
- *Macropus irma*
- *Merops ornatus*
- *Neophoca cinerea*
- *Oxyura australis*
- *Pezoporus flaviventris*
- *Pluvialis fulva*
- *Pluvialis squatarola*
- *Puffinus carneipes (Ardenna carneipes)*
- *Puffinus tenuirostris (Ardenna tenuirostris)*
- *Thalassarche chrysostoma*
- *Tringa nebularia*

Recorded fauna species

- *Macropus irma*
- Roads
- Parks and Wildlife Managed Lands and Waters

Proposal alignment existing environment conditions

- Previously chained firebreak
- Previously cleared freehold farmland
- Uncleared vegetation

Scale 1:300,000 at A3

0 1 2 3 4 km

N

Coordinate System: GDA 1994 MGA Zone 51

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Source: Aerial: ESRI approx. 2010; Inland waters: SLIP database, Landgate 2017; Recorded Priority Fauna: Ecoscape (2015)- updated 2017;
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Species identified as potentially occurring based on habitat assessment

Table 10-6 provides an assessment undertaken by Ecoscape (2017a) of the likely occurrence of 64 conservation significant fauna within the Development Envelope of the Proposal. Table 10-6 uses the current DBCA Threatened and Priority Fauna List (DBCA 2017). The conservation statuses have been updated and delisted conservation significant fauna species removed as appropriate.

In addition to the seven species recorded in Level 1 surveys (as outlined in Table 10-5), a further 11 species were identified by Ecoscape (2017a) as 'likely to occur' and seven 'potentially occurring' within the Development Envelope. In total 26 species were identified to be occurring, likely to occur or potentially occurring. The species considered by Ecoscape (2017a) to likely to occur were predominately migratory bird species that may visit the area.

The assessment of potential and likely species was undertaken based on the habitat assessment, database records and a review of the ecology of the species provided by Ecoscape (2017a). A summary of the ecology for each of the occurring, likely and potential species is provided in Table 10-7.

Table 10-6: Assessment of potential occurrence and habitat of conservation significant fauna

Species	EPBC Act[#]	WC Act[#]	Occurrence	Habitat type*
Mammals				
Dasyurus geoffroii Chuditch or Western Quoll	VU	VU	Present -potential tracks observed (Ecoscape 2017a)	1,4,7
Parantechinus apicalis Dibbler	EN	EN	Out of range	-
Phascogale calura Red-tailed Phascogale	VU	CD	Likely – based on occurrence of potential habitat	1,2,3,4,5,7
Myrmecobius fasciatus Numbat, walpurti	VU	EN	Out of range	-
Isoodon obesulus fusciventer Quenda	Not listed	P4	Present - Evidence of diggings were observed (Ecoscape 2017a)	2,3,5,6,7
Notamacropus [Macropus] irma Brush Wallaby	Not listed	P4	Present – observed (Ecoscape 2017a)	1,2,3,4,7
Macropus eugenii derbianus Tammar Wallaby	Not listed	P4	Out of range	-
Nyctophilus major Greater Long-eared Bat	Not listed	P4	Potential	1,4,7
Pseudomys occidentalis Western Mouse	Not listed	P4	Potential	2,3
Pseudomys shortridgei Heath Mouse	EN	VU	Unlikely	-
Reptiles				
Christinus sp. Cape Le Grand Gecko	Not listed	P2	Out of range	-
Lerista viduata Ravensthorpe Range Slider	Not listed	P1	Out of range	-
Aspidites ramsayi Woma	Not listed	P1	Out of range	-
Acanthophis antarcticus Southern Death Adder	Not listed	P3	Likely	1,2,3,4,5

Species	EPBC Act[#]	WC Act[#]	Occurrence	Habitat type*
Parasuta spectabilis bushi Mallee Black-headed Snake	Not listed	P1	Out of range	-
Paroplocephalus atriceps Lake Cronin Snake	Not listed	P3	Potential (northwest part)	any
Birds				
Leipoa ocellata Malleefowl	VU	VU	Present – observed (Ecoscape 2017a)	1,2,3,4,5
Cereopsis novaehollandiae grisea Recherche Cape Barren Goose	VU	VU	Out of range	-
Apus pacificus Fork-tailed Swift	IA	IA	Likely visitor	Any
Botaurus poiciloptilus Australasian Bittern	EN	EN	Out of range	-
Ardea modesta Eastern Great Egret	Not listed	IA	Out of range	-
Ardea ibis Cattle Egret	Not listed	IA	Out of range	-
Plegadis falcinellus Glossy Ibis	Not listed	IA	Likely visitor	6,8
Falco peregrines Peregrine Falcon	Not listed	OS	Likely	any
Pluvialis fulva Pacific Golden Plover	Not listed	IA	Out of range	-
Pluvialis squatarola Grey Plover	Not listed	IA	Out of range	-
Charadrius mongolus Lesser Sand Plover	EN & IA	EN & IA	Out of range	-
Charadrius l. leschenaultia Greater Sand Plover	(VU & IA at species level)	VU (& IA at species level)	Out of range	-
Charadrius rubricollis Hooded Plover	Not listed	P4	Likely (winter)	6,8
Gallinago stenura Pin-tailed Snipe	IA	IA	Out of range	-
Gallinago megala Swinhoe's Snipe	IA	IA	Out of range	-
Limosa limosa Black-tailed Godwit	IA	IA	Out of range	-
Limosa lapponica Bar-tailed Godwit	IA (& CR or VU at subspecies level)	IA (& VU at subspecies level)	Out of range	-
Numenius minutes Little Curlew	IA	IA	Out of range	-
Numenius phaeopus Whimbrel	IA	IA	Out of range	-

Species	EPBC Act[#]	WC Act[#]	Occurrence	Habitat type*
Numenius madagascariensis Eastern Curlew	CR & IA	VU & IA	Out of range	-
Actitis hypoleucos Common Sandpiper	IA	IA	Potential visitor	6,8
Tringa brevipes Grey-tailed Tattler	IA	IA & P4	Out of range	-
Tringa nebularia Common Greenshank	IA	IA	Likely visitor	6,8
Tringa stagnatilis Marsh Sandpiper	IA	IA	Potential visitor	6,8
Tringa glareola Wood Sandpiper	IA	IA	Likely visitor	6,8
Arenaria interpres Ruddy Turnstone	IA	IA	Out of range	-
Calidris canutus Red Knot	EN & IA	IA (& VU at subspecies level)	Potential visitor	6,8
Calidris ruficollis Red-necked Stint	IA	IA	Likely visitor	6,8
Calidris acuminata Sharp-tailed Sandpiper	IA	IA	Likely visitor	6,8
Calidris ferruginea Curlew Sandpiper	CR & IA	VU & IA	Likely visitor	6,8
Calidris tenuirostris Great Knot	CR & IA	VU & IA	Out of range	-
Calidris alba Sanderling	IA	IA	Out of range	-
Calidris subminuta Long-toed Stint	IA	IA	Out of range	-
Calidris melanotos Pectoral Sandpiper	IA	IA	Out of range	-
Onychoprion anaethetus Bridled Tern	IA	IA	Out of range	-
Stema caspia (Hydroprogne caspia) Caspian Tern	IA	IA	Out of range	-
Calyptorhynchus latirostris Carnaby's Black-Cockatoo	EN	EN	Present – observed (Ecoscape 2017a)	1,2,3,4,5,7
Platycercus icterotis xanthogenys Western Rosella	Not listed	P4	Present – call heard (Ecoscape 2017a)	any
Pezoporus flaviventris Western Ground Parrot	CR	CR	Potential	2,3,5
Merops ornatus Rainbow Bee-eater	Not listed	IA	Present – observed (Ecoscape 2017a)	all
Dasyornis longirostris Western Bristlebird	VU	VU	Out of range	-

Species	EPBC Act[#]	WC Act[#]	Occurrence	Habitat type*
Psophodes nigrogularis Oberon Western Whipbird	Not listed	P4	Potential	1,2,4,5 (western part)
Invertebrates				
Budginmaya eulae Eula's Planthopper	Not listed	P1	Out of range	-
Hylaeus globuliferus (bee)	Not listed	P3	Out of range	-
Daphnia jollyi (water flea)	Not listed	P1	Unlikely	-
Atelomastix (6 spp.) (millipede)	Not listed	VU	Out of range	-
Cyliosoma sarahae (ex Epicyliosoma) (Sarah's pill millipede)	Not listed	VU	Out of range	-
Zephyrarchaea marki (assassin spider)	Not listed	VU	Out of range	-

Source: Ecoscape (2017a)

[#]EPBC Act/WC Act codes: CD: Conservation dependent fauna under Schedule 6 of the Wildlife Conservation [Specially Protected Fauna] Notice 2016) (the Notice); CR: Critically endangered species; EN (EPBC Act): Endangered species; EN (WC Act): Endangered fauna under Schedule 2 of Notice; A: Migratory birds protected under an international agreement; OS: Other specially protected fauna under Schedule 7 of the Notice; P3: Poorly-known species; P4: Rare, Near Threatened and other species in need of monitoring; VU (EPBC Act): Vulnerable species; VU (WC Act): Vulnerable fauna under Schedule 3 of the Notice.

*Habitat codes: As per Table 10-4.

Table 10-7: Summary of ecology of recorded, potential and likely conservation significant fauna species

Species	EPBC Act[#]	WC Act[#]	Occurrence	Ecology	Potential presence
Mammals					
Dasyurus geoffroii Chuditch or Western Quoll	VU	VU	Present	The Chuditch formerly occurred through most of mainland Australia, but is now known only from WA where it predominantly occurs in Jarrah (*Eucalyptus marginata*) forest in a roughly triangular area bounded by Moora in the north, Cape Arid to the east and Cape Leeuwin in the south. Occasional records are obtained from the Wheatbelt and Goldfields, where suitable habitat has been reduced to scattered fragments but it persists in very low numbers. The Chuditch is the largest carnivorous marsupial in WA (males up to 1.5 kg, females to one kilogram). Chuditch are short-lived (average lifespan two to three years) but highly mobile (individual movements of up to 180 km have been recorded) and utilise large home ranges (Ecoscape 2017a). Chuditch use horizontal hollow logs or earth burrows as dens or refuge, and visit a large number of such sites, averaging over a hundred annually, rather than spending long in any place. The species feeds mainly on large invertebrates, also reptiles, birds and small mammals. The main threats to the species are from cats and foxes.	There are numerous post-1990 records from the general vicinity of the Ecoscape (2017a) study area (DPaW 2007-2014), and Chuditch are likely to regularly utilise the wooded habitats of the Ecoscape (2017a) study area. Tracks recorded during the Level 1 fauna survey close to a woodland area near the eastern end of the Ecoscape (2017a) study area possibly represent this species.
Phascogale calura Red-tailed Phascogale	VU	CD	Likely	This species was formerly widespread in woodland habitats in inland south and central Australia (also with subfossil records in the north), but is now mainly restricted to remnants of mature Wandoo (*Eucalyptus Wandoo*) or Rock Oak (*Allocasuarina huegeliana*) woodland in the south of the WA Wheatbelt where the annual rainfall is 300–600 mm. It shows a preference for long unburnt habitat with a continuous canopy, as well as tree hollows (Ecoscape 2017a). Sparse records in the south-eastern Wheatbelt are associated with mallee and heath, indicating a broader range of habitats. The species is nocturnal, mostly solitary, shy and rarely seen. It is agile and forages on trees, especially rough-barked Eucalypts, dead branches and extensively on the ground. Mating occurs in a three week period in July after which all males die.	Desktop investigations conducted by Ecoscape (2017a) outlined two records of this species on the South Coast Hwy east of Ravensthorpe, both opportunistic finds of dead animals from 1997. These records were within 20 km of the western end of the proposed fence alignment, so that similar habitats and potential dispersal routes for this species are likely to exist in the western part of the Ecoscape (2017a) study area. Due to the lack of surveys conducted for this species in the Proposal area, it was assumed by Ecoscape (2017a) that this species is likely to be present where suitable habitat exists (including forest and woodland providing suitable tree hollows, and also mallee and shrubland if dense enough to provide shelter), and that it may be affected by any clearing that increases fragmentation.

Species	EPBC Act[#]	WC Act[#]	Occurrence	Ecology	Potential presence
Isoodon obesulus fusciventer Quenda	Not listed	P4	Present	Quenda are present through much of the southwest of WA, with more patchy distribution extending to the Great Western Woodlands and Recherche area. They prefer dense scrubby, often swampy, vegetation with dense cover up to one metre high, often feeding in adjacent forest and woodland that is burnt on a regular basis and in areas of pasture and cropland lying close to dense cover (Ecoscape 2017a). Quenda are mostly nocturnal, usually solitary, terrestrial and omnivorous, digging into the soil for invertebrates, fungi, edible plant parts and occasional small vertebrates. Breeding occurs at any season with a peak in spring, nesting in litter-covered depressions concealed under logs, shrubs or debris (Ecoscape 2017a).	Patches of suitable habitat occur in the study area, and the entire area lies within the less-densely-occupied part of the species range. Numerous signs of Quenda presence were observed during the field survey and the species is likely to be present wherever suitable habitat occurs, although their ability to utilise the habitat would be hampered by the presence of predators such as foxes, feral cats and domestic dogs.
Notamacropus [Macropus] irma Western Brush Wallaby	Not listed	P4	Present	The Western Brush Wallaby is endemic to the southwest of WA and occurs from North of Kalbarri to Cape Arid NP. It commonly occurs in dry sclerophyll forest, *Banksia* woodlands and shrublands, typically favouring dense low vegetation that provides dense cover. Western Brush Wallabies tend to rely more on moisture derived from plants than from free-water sources (Everard & Bamford 2016). Brush Wallabies are solitary, nocturnal but tending to be more active just after sunset and just before sunrise. Recently-burnt areas, at least up to two years post-fire, are favoured for foraging but are not essential, whereas access to dense vegetation for shelter is. Population studies in Whiteman Park have found that males have large home ranges, up to 9.9 ha in a night and 69.2 ha during a year. The male ranges appear to overlap with several females (up to 5.3 ha in a night and 32.5 ha during a year; Everard & Bamford 2016).	The Ecoscape (2017a) study area is in the easternmost part of the species current distribution, and is likely to be occupied wherever suitable habitat occurs. Three sightings occurred during Level 1 fauna survey, in mallee shrubland and mallee woodland.
Nyctophilus major Greater Long-eared Bat	Not listed	P4	Potential	Formerly treated as part of a widespread 'species' *Nyctophilus timoriensis* (Vespertilionidae), the taxonomy of this complex was resolved by Parnaby (2009) (as cited in Ecoscape 2017a) including separation of *N. major* and description of two subspecies. *Nyctophilus major* subsp. *major* occurs in the southwest of Western Australia (south from Perth and west from Albany), *N. major tor* is slightly smaller and occurs in lower rainfall areas to the north and east (as far as the Pilbara, and Eyre Peninsula SA), with a narrow zone of intergradation between the forms around the Dryandra Woodlands (Ecoscape 2017a). Occurrence of this species is expected to be more likely in inland (northern) parts of the Proposal area, and in or close to woodland or forest habitat containing hollow-bearing trees. *Nyctophilus* species are insectivorous bats that catch prey in flight or, in some species, by gleaning from surfaces (so that non-flying prey such as caterpillars may be eaten). Roosts and particularly	*N. m. major* does not extend east of Albany and *N. major tor* does not occur in coastal areas west of the Nullarbor, but precise distribution is unclear because few other sources have followed the revised taxonomy (Ecoscape 2017a). There are two records identified as *N. m. major* from close to Esperance (Ecoscape 2017a). This species is considered more likely to occur in inland (northern) parts of the Ecoscape (2017a) study area, and in or close to woodland or forest habitat containing hollow-bearing trees.

Species	EPBC Act[#]	WC Act[#]	Occurrence	Ecology	Potential presence
				breeding sites are usually in tree hollows, and thus in trees usually over a century old (Abbott & Whitford 2001). There have been few studies of species ecology subsequent to the 2009 taxonomic revision, and it is often unclear whether older results are applicable, but the relative uniformity of echolocation calls across Western Australian *Nyctophilus* (Bullen & McKenzie 2002) suggests relative uniformity of diet and foraging mode.	
Pseudomys occidentalis Western Mouse	Not listed	P4	Potential	The Western Mouse (Muridae) is now limited to isolated patches of remnant vegetation in the southern Wheatbelt and south coast of Western Australia (Ecoscape 2017a). Occupied sites have dense, long-unburnt low vegetation with overstorey of *Eucalyptus, Isopogon, Acacia, Casuarina* or *Melaleuca*, and the presence of Quandong (*Santalum acuminatum*) and sedges are considered important requirements (Van Dyck & Strahan 2008, as cited in Ecoscape 2017a). Most or all of the Proposal alignment is within the species range, so this species is likely to occur where suitable habitat is present. Quandongs and sedges occur within shrubland habitat types, and sites with long-unburnt low vegetation may be occupied by this species (Ecoscape 2017a). Nocturnal, sheltering in communal burrows, feeding on varied plant and invertebrate material but particularly kernels of Quandong nuts.	The Ecoscape (2017a) study area is predominately within the species range and; therefore, is likely to occur where suitable habitat is present. Quandongs and sedges occur within shrubland habitat types, and sites with long-unburnt low vegetation may be occupied by this species.
Reptiles					
Acanthophis antarcticus Southern Death Adder	Not listed	P3	Likely	This moderately large (to 75 cm), heavily built venomous snake (Elapidae) is locally confined to the Darling Range between Mt Helena and Jarrahdale. Found in Jarrah woodlands adjacent to granite outcrops and along densely vegetated creeks (Bush *et al*. 1995). The Darling Range population is isolated from those along the south coast east of Albany; there are relatively few records inland, but some up to about 50 km from the south coast; habitats in this part of the range have not been well described, but it seems more likely to be associated with heath rather than mallee or woodland habitats. Death Adders are relatively sedentary, feeding by ambush on vertebrate prey that is sometimes attracted by use of the modified tail as a lure. They rarely shelter under hard items of cover (rocks, logs) but mostly remain at least partly covered by leaf litter except when moving between sites.	Potentially suitable habitat occurs throughout the Ecoscape (2017a) study area and this snake should be considered reasonably likely to inhabit the Ecoscape (2017a) study area.

Species	EPBC Act[#]	WC Act[#]	Occurrence	Ecology	Potential presence
Paroplocephalus atriceps Lake Cronin Snake	Not listed	P3	Potential (northwest part)	Occurs in the semi-arid southern inland of WA, around Lake Cronin and Peak Eleanora. Habitat at the type locality is open eucalypt woodland on sandy loam (Storr 1980) near an ephemeral freshwater lake, other sites are associated with granite outcrop. This small venomous snake (total length up to 57 cm) is poorly known, but likely to be mainly nocturnal and a generalist feeder on lizards, frogs and probably small mammals. It is closely related to the eastern Australian species of *Hoplocephalus* (Broad-headed Snakes) and shares with them features of body form and scalation associated with climbing habits, and thus probably uses tree hollows and elevated rock crevices for shelter (Ehmann 1993; Keogh *et al*. 2000). Bites from this species are considered potentially dangerous to humans (Allen *et al*. 2013b).	This snake occurs within about 10 km to the northwest of the Ecoscape (2017a) study area at Peak Eleanora, but the study area does not overlap with the known range. As a result, this species may be potentially present in nearby sections of the Ecoscape (2017a) study area with similar landscapes of salt lakes and granite outcrops, regardless of vegetation.
Birds					
Leipoa ocellata Malleefowl	VU	VU	Present	Malleefowl are mostly located to the south and west of a line north of Carnarvon, to the Eyre Bird Observatory in the far southeast of WA. They occur in semi-arid and arid zones of temperate Australia, where they occupy shrublands and low woodlands that are dominated by mallee vegetation. Pairs occupy permanent territories, cooperating to build or repair a nesting mound of sand and leaf litter (typically 3–5 m in diameter and one metre high); after egg-laying, the male alone maintains the mound during incubation, attending it for 9-11 months each year. A sandy substrate with abundant leaf litter is necessary for mound construction. Active mounds are usually conspicuous structures that can be readily identified within line of sight. No nesting mounds occurred in the areas surveyed by Ecologic (2017a) and GS Bio Logic (2015). One inactive mound was observed about 4 km from the Proposal alignment.	An inactive mound was observed about 4 km from the proposed barrier fence, in a mallee remnant to the south. Current presence of the species in part of the Ecoscape (2017a) study area is indicated by a fresh track. While the presence of foxes and other feral predators reduces suitability of the habitat, this species is likely to be present at low density throughout the general area.

Species	EPBC Act[#]	WC Act[#]	Occurrence	Ecology	Potential presence
Apus pacificus Fork-tailed Swift	IA	IA	Likely visitor	In Australia, the Fork-tailed Swift mostly occurs over dry and open inland plains, but also over a wide variety of land and marine habitats. In Western Australia, it is considered uncommon to moderately common near the north- west, west and south- east coasts, common in the Kimberley and rare or scarce elsewhere (Johnstone & Storr 1998). Some birds have been sighted in Western Australia arriving from Indonesia between October–November. Flocks have been recorded near Broome on southward passage across the continent. In north and north-west Western Australia, most birds have departed by the end of April. A non-breeding visitor to all states and territories of Australia, this swift (Apodidae) feeds on flying insects and is almost exclusively aerial in habits, flying from less than 1 m to at least 300 m above ground and probably much higher (Simpson & Day 2004). Fork-tailed Swifts are nomadic and typically respond to broad- scale weather pattern changes. They are attracted to thunderstorms and cyclonic disturbances where they can be seen in flocks hawking insects from the storm fronts with numbers ranging from a few individuals to flocks of up to 2 000 birds.	There are a number of sighting records along the coast south of the Ecoscape (2017a) study area, and also further inland to the north. Fork-tailed Swifts were not observed during the Ecoscape (2017a) Level 1 fauna survey but the species is likely to seasonally visit the area to forage.
Plegadis falcinellus Glossy Ibis	Not listed	IA	Likely visitor	This bird has a nearly global distribution, and in Australia mostly occurs in eastern and north eastern areas, but also patchily in most of Western Australia. It usually occurs in freshwater marshes, floodplains and artificial wetlands, but also uses coastal wetlands including saltmarsh and estuary habitats (DoE 2014b). Migratory and nomadic, moving long distances to breed after good rainfall and to tropical areas in Autumn. Feeds predominantly on aquatic invertebrates and insects, but also small aquatic and terrestrial vertebrates, and seeds of aquatic plants. Roosts in trees or shrubs, usually close to water (DoE 2014b).	Most records are coastal and there are only sparse, scattered inland records in the south of WA, but this species is likely to be an occasional visitor.
Falco peregrinus Peregrine Falcon	Not listed	OS	Likely	This species is uncommon but wide-ranging throughout Australia, preferring areas with rocky ledges, cliffs, watercourses, open woodland or margins with cleared land. Ledges, cliff faces, large tree hollows and spouts, electricity pylons and similar structures, or abandoned nests of other raptors are used for nesting (Debus 2012). Feeds almost exclusively on birds (including pigeons, parrots and passerines) which are captured in flight, but rarely takes mammals (e.g. possums, rabbits), reptiles, fish or carrion (Debus 2012; Olsen *et al*. 2008). Eggshell thickness has returned to normal after the discontinuation of DDT use, but localised threats persist due to illegal persecution by pigeon-fanciers and taking of eggs and nestlings (Debus 2012).	Individual Peregrine Falcons are occasionally sighted throughout the region (DPaW 2007–2014) and individuals would use the general area as part of a large foraging range (Ecoscape 2017a). Most sightings are associated with cliffs or rocky hills. No suitable roosting or nesting habitat (cliffs, large trees, or stick nests built by other raptors) was recorded within the Ecoscape (2017a) study area, but this species may also use artificial structures such as microwave towers.

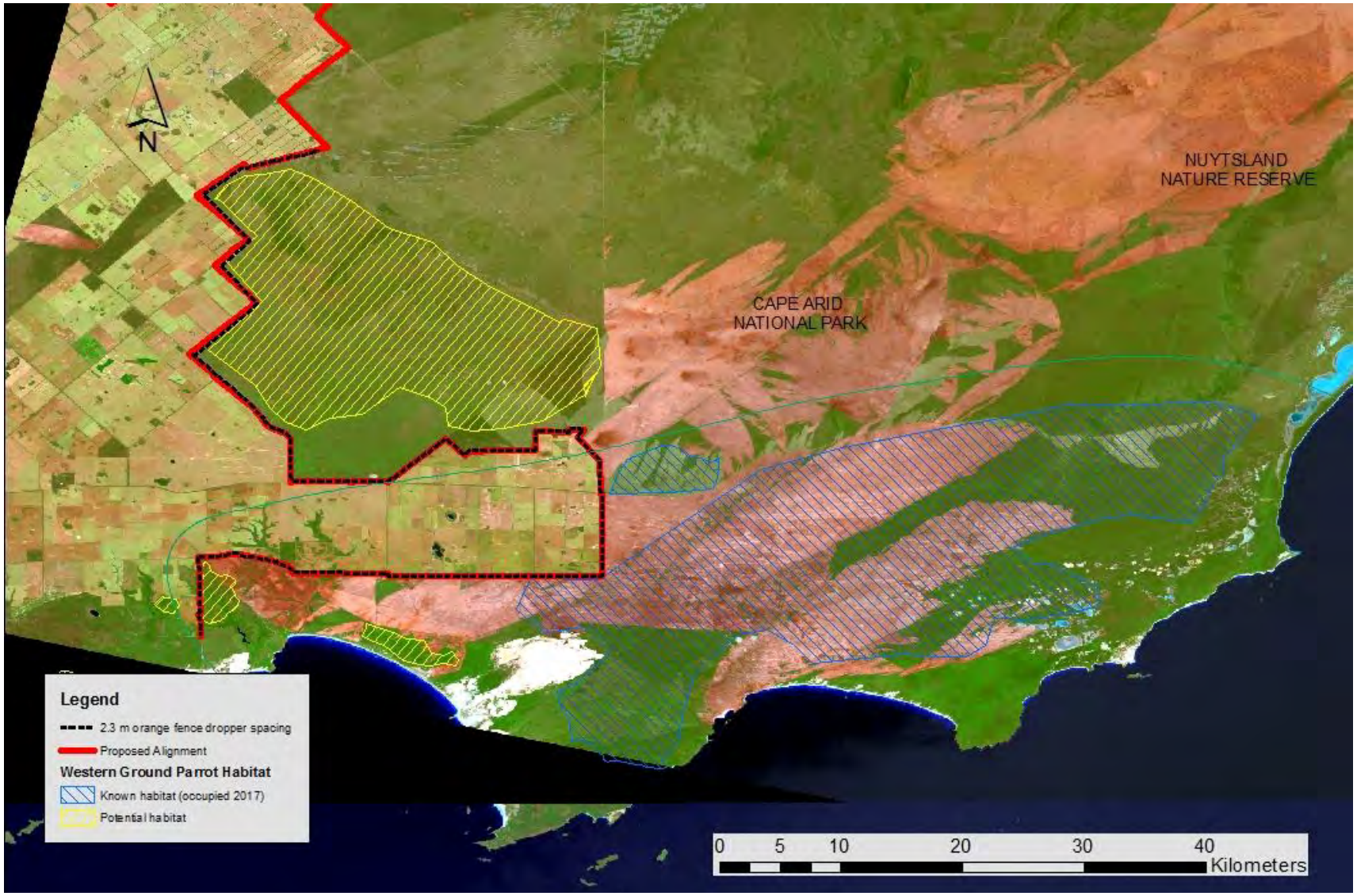
Species	EPBC Act[#]	WC Act[#]	Occurrence	Ecology	Potential presence
Charadrius rubricollis Hooded Plover	Not listed	P4	Likely (winter)	This medium-sized wader (Charadriidae) is a predominantly marine, non-migratory species endemic to Australia. It occurs on sandy beaches of all southern States, and the Western Australian population winters on inland salt-lakes up to 250 km from the coast (Birds Australia 2011). Feeds on small invertebrates along beaches and lakeshores. Threats include disturbance and disruption of breeding by recreational beachgoers, and possibly predation by foxes. The western subspecies *T. rubricollis tregellasi* is listed as 'in need of monitoring' but does not appear to be in decline (in contrast to the eastern Australian form).	There are numerous records from the general vicinity of the Ecoscape (2017a) study area, and this species is likely to use any salt lakes and their marginal vegetation during winter.
Actitis hypoleucos Common Sandpiper	IA	IA	Potential visitor	Each of these Wader or Shorebird species (Scolopacidae) breeds in the northern hemisphere (mostly Siberia) and migrates along the East Asian - Australasian Flyway (DoE 2014b). Each of the species listed in the tables has a broad distribution on the north, west and south coasts of Western Australia (beaches, saltmarshes etc), but many are also recorded from inland localities (ephemeral or permanent natural and artificial wetlands such as dams, sewage treatment works, floodplains, salt lakes etc). Species feed on small invertebrates picked out of mud or soil by pecking or probing, but some catch small fish in shallow water.	Some of these migratory species may be expected to occasionally use salt lakes and their margins throughout the Ecoscape (2017a) study area because they are typically in Australia during the northern winter, potentially suitable inland habitats will mostly be dry at such times due to the Mediterranean (winter wet/ summer dry) climate of southern WA.
Tringa nebularia Common Greenshank	IA	IA	Likely visitor		
Tringa stagnatilis Marsh Sandpiper	IA	IA	Potential visitor		
Tringa glareola Wood Sandpiper	IA	IA	Likely visitor		
Calidris canutus Red Knot	EN & IA	IA (& VU at subspecies level)	Potential visitor		
Calidris ruficollis Red-necked Stint	IA	IA	Likely visitor		
Calidris acuminata Sharp-tailed Sandpiper	IA	IA	Likely visitor		
Calidris ferruginea Curlew Sandpiper	CR & IA	VU & IA	Likely visitor		

Species	EPBC Act[#]	WC Act[#]	Occurrence	Ecology	Potential presence
Calyptorhynchus latirostris Carnaby's Black-Cockatoo	EN	EN	Present	Black cockatoos are long-lived, slow-breeding birds that display strong pair bonds. The species is suffering the effects of population decline and habitat loss. Carnaby's Black Cockatoo breed in hollows that are usually found in trees that are more than 200 years old and are generally known to breed throughout the southwest, to the west of Ravensthorpe in the higher rainfall areas (SEWPAC 2012). Roosting and breeding activity is likely to be limited to tall trees, which occur in coastal areas but not within the Development Envelope. Tree hollows are not expected to be used for breeding purposes by Carnaby's Black Cockatoo as the Proposal is located outside the known breeding range (Ecoscape 2017a). Habitat types 1, 2, 3, 4, 5 and 7 (Table 10-4) were assessed as potential foraging habitat for Carnaby's Black Cockatoo (Ecoscape 2017a). The condition of these habitats was typically Good (assessed using criteria similar to Keighery (1994) within the previously chained areas and Very Good within the remaining uncleared vegetation. However, due to the repeated chaining of vegetation, trees are typically immature with minimal fruit development. The value as foraging habitat within previously chained areas is expected to be low (Ecoscape 2017a). The Proposal may result in the clearing of approximately 2.8 ha of heath and closed scrub identified on Merivale Road from the GS Bio Logic (2015) assessment which contains numerous species of plants (e.g. *Banksia*) that are commonly used for foraging by black-cockatoos. A total of 6189 ha of low value potential foraging habitat for Carnaby's Black-Cockatoo was indicated by Ecoscape (2017a) to be within its study area. Note that the Ecoscape (2017a) study area does not completely cover the current maximum clearing footprint. However, the 6189 ha of potential foraging habitat mapped provides a good indicator of the extent of regional habitat.	There are some old *NatureMap* (DPaW 2007–2014) records from north of the Ecoscape (2017a) study area, but in recent decades it appears to be limited to less than 50 km from the coast in this far eastern part of the species range. Carnaby's Black Cockatoo is likely to forage in eucalypt forest, mallee and *Banksia* shrubland habitats where they occur near the eastern and western ends of the study area, but not in the central section which is further from the coast. Roosting and breeding activity is likely to be limited to tall trees, which occur in coastal areas but not within the Ecoscape (2017a) study area.
Platycercus icterotis xanthogenys Western Rosella	Not listed	P4	Present	The Western Rosella is the smallest species of Rosella and occupies eucalypt forests and woodlands in the southwest of WA. The species feeds on seeds of various trees (especially *Allocasuarina* spp.), shrubs, herbs and grasses (including pasture plants and weeds), and some insects collected opportunistically on food plants. Feeds on seeds of various trees (especially *Allocasuarina* spp.), shrubs, herbs and grasses (including pasture plants and weeds), and some insects collected opportunistically on food plants (Long 1984). Nests are built only in hollows of standing trees, and the minimum size of trees used was recorded as 325 mm and 478 mm DBH in two studies, with mean DBH of 696 mm (inferred age over 400 years) in the most commonly used species, *Eucalyptus wandoo* (Abbott & Whitford 2001; Mawson & Long 1994).	Not recorded east of Esperance, but expected to occur throughout the western and central part of the study area, and recorded based on calls during the field survey (Ecoscape 2017a).

Species	EPBC Act[#]	WC Act[#]	Occurrence	Ecology	Potential presence
Pezoporus flaviventris Western Ground Parrot	CR	CR	Potential	The Western Ground Parrot inhabits low, dry or swampy, near-coastal heathlands on sandplains and uplands in long unburnt (5–40 years), floristically diverse areas that receive 400 to 500 mm of rainfall annually (Ecoscape 2017a). The Western Ground Parrot occurs in coastal areas of the Cape Arid NP and Nuytsland Nature Reserve [NR] approximately 2 km southeast from Proposal alignment (Figure 10-2). This area is a designated Management Area for the species as outlined in the Great Southern Threatened Birds Recovery Plan (DBCA 2014) (GS Bio logic 2015) (Figure 10-3). This population is highly significant as it is currently known to occur in one other location in the Fitzgerald River NP; however, the status of the other population is uncertain. The total population estimate for the species was 110 birds in 2010 (GS Bio logic 2015). Surveys conducted in 2012 for the Western Ground Parrot did not locate individuals where they were present a few years before (GS Bio logic 2015). No recent population estimates could be identified for the Western Ground Parrot following the November 2015 Esperance fires. Western Ground Parrots were heard following a field survey by DBCA in Nuytsland NR following the fire (GS Bio logic 2015). Recent surveys also conducted by Friends of the Western Ground Parrot near Balladonia Road, approximately 40 km northeast from the Proposal alignment, and 20 km north of Cape Arid NP, found no evidence of permanent populations of Western Ground Parrots. The Western Ground Parrot is generally solitary and not known to establish territories (Ecoscape 2017a). The breeding season appears to be from July to December, although few nests have ever been observed. These parrots eat seeds, fruits and flowers and forage on the ground or in low shrubs. The birds fly between feeding and overnight roosting sites after sunset or before sunrise. Juvenile dispersal probably begins in late November extending through summer.	The western limit of the recorded distribution of this species coincides, within a few kilometres, with the eastern end of the Proposal alignment, so that there may be a small overlap, or none. It may be expected to occur in, or have potential to extend its range into, suitable habitat near the western end (Ecoscape 2017a). It is possible that juvenile birds could disperse in the area.
Merops ornatus Rainbow Bee-eater	Not listed	IA	Present	The Rainbow Bee-Eater is widespread throughout most of Australia, and does not depend on any particular habitat or vegetation type for feeding or breeding. Rainbow Bee-Eaters feed mainly on insects taken in flight (hawking), but also take prey from the ground and foliage (gleaning). Populations in southern Australia are migratory, and move north over winter to Indonesia, New Guinea and northern Australia (GS Bio Logic 2015). Populations then move south over summer and breeding in Australia between September and February. Nesting occurs in burrows dug in flat or slightly sloping ground, sandy banks or cuttings, and often at the margins of roads or tracks.	Rainbow Bee-eaters are common throughout the region and were sighted or identified from calls on numerous occasions during the Ecoscape (2017a) survey. Burrows interpreted as Bee-eater nests were observed at numerous sites in cleared sandy areas within the study area, including both apparently active nests and older unoccupied ones.

Species	EPBC Act[#]	WC Act[#]	Occurrence	Ecology	Potential presence
Psophodes nigrogularis Oberon Western Whipbird	Not listed	P4	Potential	The Western Whipbird (Eupetidae) comprises four recognised subspecies, sometimes considered to comprise two distinct species (DoE 2014b; Garnett & Crowley 2000; Schodde & Mason 1991). *Psophodes nigrogularis leucogaster* (Eyre Peninsula, Yorke Peninsula and Ninety Mile Plain, SA; Big Desert and Sunset Country, VIC) is 'VU' under *EPBC Act 1999*; *P. n. oberon* (Western Mallee subspecies, Stirling Range to Ravensthorpe WA) was delisted from 'VU' under the *EPBC Act 1999* in 2009 (now P4), and *P. n. lashmari* (Kangaroo Island, South Australia) is relatively secure and not federally listed. The Western Heath subspecies *P. n. nigrogularis* is smaller and greener than other forms including the parapatric *P. n. oberon* (Schodde & Mason 1991); it formerly occurred on both the west and south coasts of southwestern WA, but is now restricted to a small number of sites east of Albany, notably Two Peoples Bay and Mt Manypeaks (DoE 2014b; Smith 1991). *P. n oberon* occurs as scattered sub-populations in the southern wheatbelt and central south coast region, in open mallee eucalypt woodland with dense, tall shrub layer up to 1.5 m tall, dominated by taxa such as *Hakea, Lambertia, Dryandra* or *Banksia* (Gilfillan *et al*. 2009 and references therein). Like other *Psophodes*, this species is insectivorous, mainly active within dense low vegetation and rarely seen, but pairs are stable and sedentary after territory establishment, with a core range size of 0.018 ±0.003 km^2, and have a loud, repetitive and distinct territorial song (antiphonal duet) that can be used to localised and census individuals in the field (McGuire *et al*. 2011). Breeding occurs at five years, nests in dense heath adjacent to areas of thick shrubland (thicket). The main threat to most populations of the species is clearance of native vegetation, but protected populations in National Parks are more likely to be impacted by fire, through effects on vegetation structure (DoE 2014b; Smith 1991).	The eastern limit of the recorded distribution of this species coincides, within a few kilometres, with the western end of the Proposal alignment, so that there may be a small overlap, or none. It may be expected to occur in, or have potential to extend its range into, suitable habitat near the western end.

[#]EPBC Act/WC Act codes: CD: Conservation dependent fauna under Schedule 6 of the Wildlife Conservation [Specially Protected Fauna] Notice 2016) (the Notice); CR: Critically endangered species; EN (EPBC Act): Endangered species; EN (WC Act): Endangered fauna under Schedule 2 of Notice; A: Migratory birds protected under an international agreement; OS: Other specially protected fauna under Schedule 7 of the Notice; P3: Poorly-known species; P4: Rare, Near Threatened and other species in need of monitoring; VU (EPBC Act): Vulnerable species; VU (WC Act): Vulnerable fauna under Schedule 3 of the Notice.



Source: Department of Biodiversity, Conservation and Attractions (2017)

Figure 10-2: Western Ground Parrot habitat and proposed area for increased frequency of fence droppers

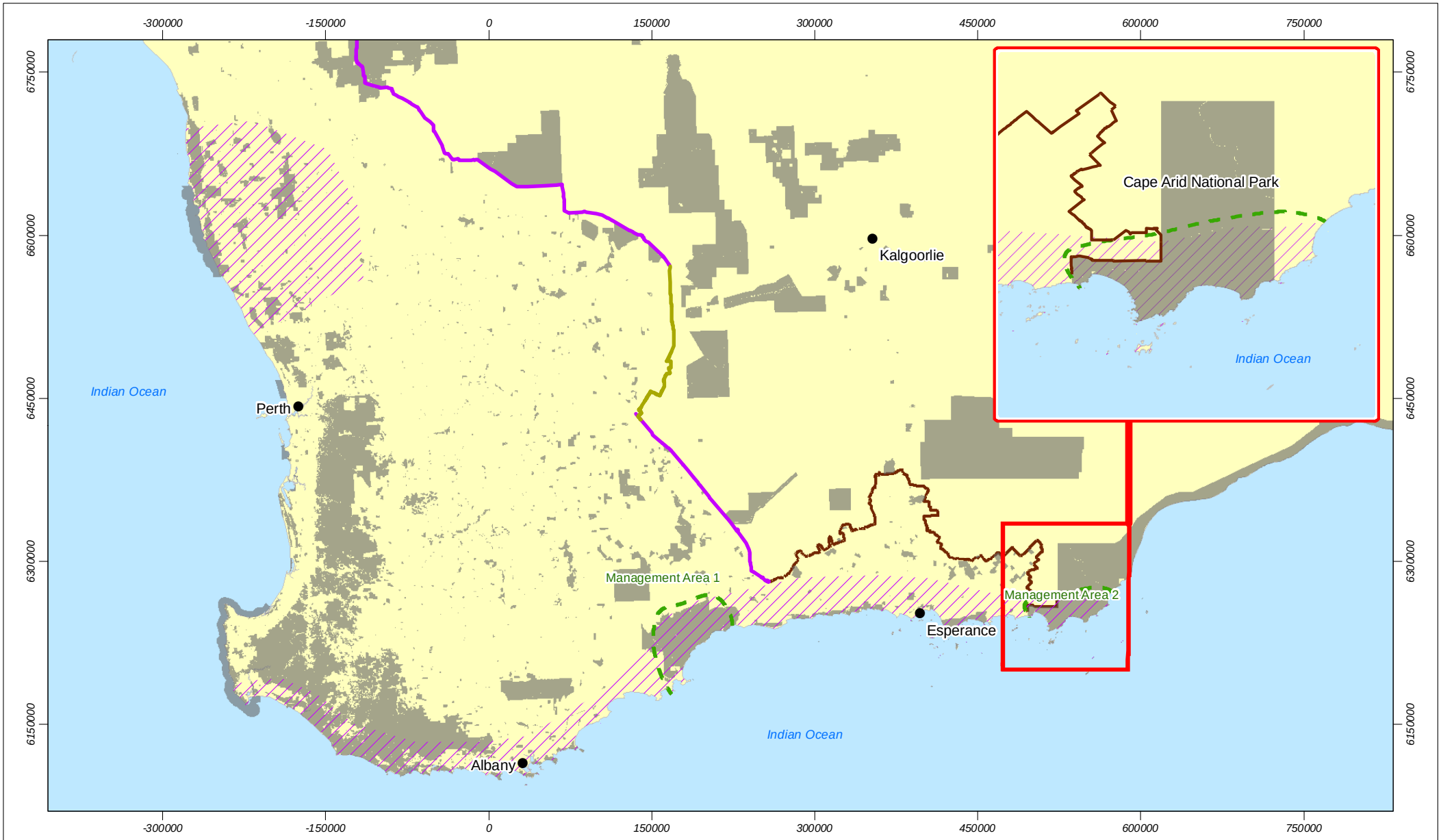


Figure 10-3: Past and current (post-2003) distribution of the Western Ground Parrot and management areas

Scale 1:4,765,000 at A4

0 50 100 150 200 250 km

Coordinate System: GDA 1994 MGA Zone 51
Note that positional errors may occur in some areas
Date: 1/08/2017
Author: DWhite
Source: Coastline: SLIP database; Landgate 2017; WGP distribution and Management areas: Parks and Wildlife 2017.

Legend

- Existing SBF
- Yilgarn Gap
- Town
- Management areas
- Western Ground Parrot (WGP) past distribution (post 2003)
- Reserves
- Proposal alignment
- Ocean

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Significant habitat trees

In recognition that the largest and oldest trees can have an important habitat function a targeted search for 'significant trees' (potential habitat trees) (DBH > 500 mm) was undertaken in an area of potential fauna habitat near Salmon Gums (Appendix 3).

A total of 103 potential habitat trees was identified to occur within a 20 m corridor of the Proposal alignment within the Development Envelope (GS Biologic 2017) (Table 10-8). The assessment was localised to the Salmon Gum section of the Proposal alignment (Figure 10-4) as previous flora and vegetation assessments recognised a greater potential for large trees and; therefore, potential fauna habitat, to occur along this area. Large trees were typically found to occur in clusters which often extended beyond the 20 m Proposal alignment corridor. Vegetation adjacent to the Proposal alignment corridor were consistent with that within the corridor and comprised of boundary tracks and fire breaks.

Approximately 39 km of the Proposal alignment within the section of the Proposal alignment north of Salmon Gums township will be adjacent to existing roads, use existing tracks or graded firebreaks where possible to limit new impacts. The balance of the Proposal alignment in this area is located within uncleared vegetation and comprises a total of 41 potential habitat trees (Table 10-8). Of the 41 potential habitat trees, 30 are located in forest fauna habitat, and 11 occur in Mallee woodland. These trees lie outside the known breeding range for Carnaby's Black-Cockatoo. These 41 potential habitat trees will be avoided where practical during the construction of the proposed barrier fence and will be subject to a pre-clearing survey for potential hollows prior to construction works.

The possible removal of 103 potential habitat trees is not expected to be significant at a local or regional scale as:

- large trees were typically found to occur in clusters which often extended beyond the 20 m corridor for the Proposal alignment
- 41 potential habitat trees identified within uncleared vegetation will be subject to a pre-clearing survey prior to construction for potential breeding hollows
- potential habitat trees lie outside the known breeding range for Carnaby's Black Cockatoo.

Table 10-8: Potential habitat trees (DBH > 500 mm) and associated fauna habitat

Potential habitat tree species	Fauna habitat			Total
	Forest	Mallee Woodland	Woodland	
Adjacent to existing road, utilising track or graded firebreak				
E. dundasii	38	3	5	46
E. melanoxylon	10	1	2	13
E. salmonophloia	2	1	0	3
Total	**50**	**5**	**7**	**62**
Uncleared vegetation				
E. dundasii	6	1	0	7
E. melanoxylon	24	10	0	34
Total	**30**	**11**	**0**	**41**
Grand total	**80**	**16**	**7**	**103**

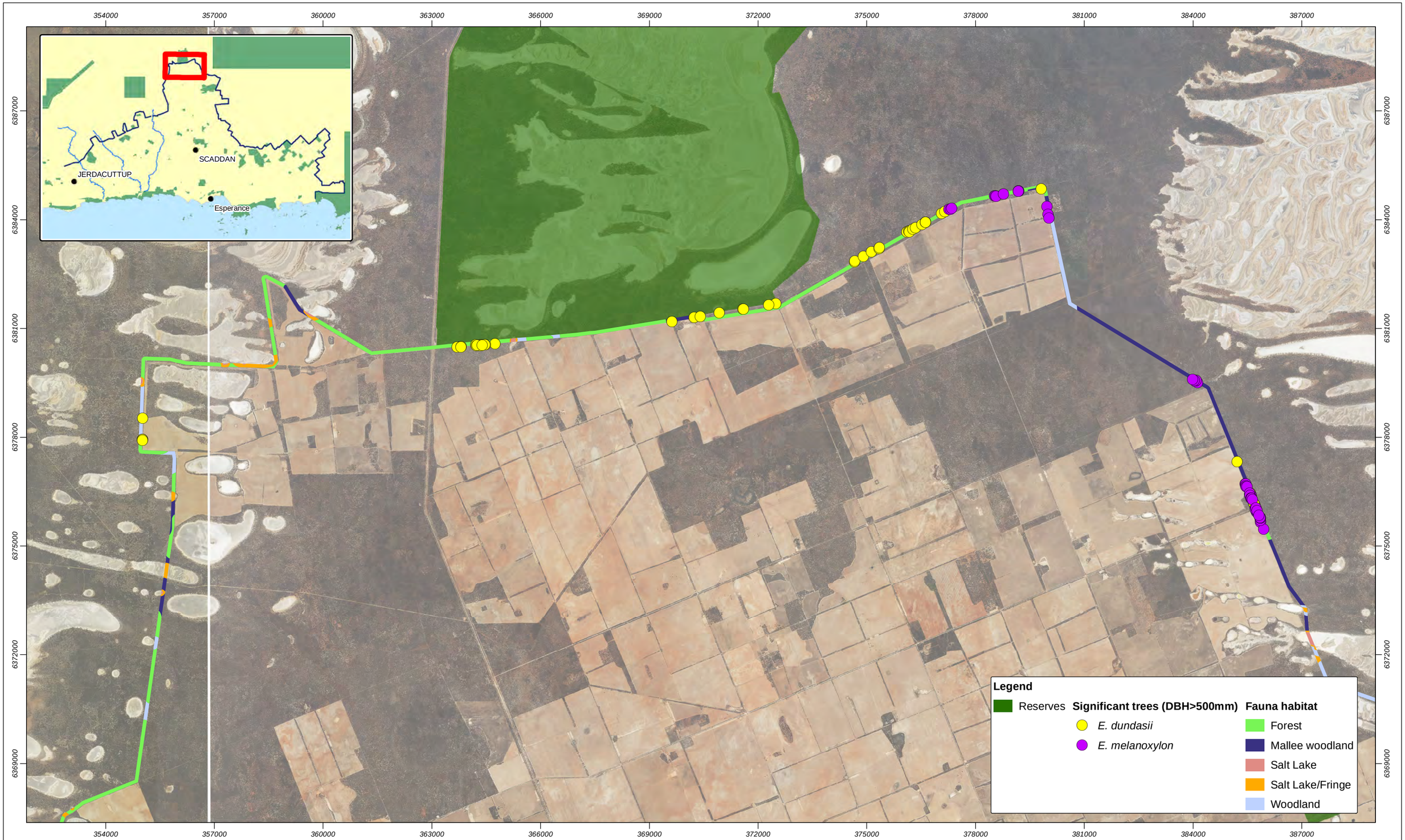


Figure 10-4: Location of significant trees in Salmon Gum area

Scale 1:96,436 at A3

0 2 4 6 8 10 km

N

Coordinate System: GDA 1994 MGA Zone 51
Note that positional errors may occur in some areas
Date: 1/08/2017
Author: DWhite
Source: Aerial: ESRI approx. 2010; Data: Client 2016; Reserves: DPaW: 2012; Significant trees: GS Biologic (2017); Fauna habitat: Ecoscape (2017a)
Path: Q:\Consult\2016\DAF\DAF16515\ArcMap_documents\R001\DAF16515_01_R001_RevE_F0010-4.mxd

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10.3.3 Requirement for targeted surveys

In accordance with the ESD, the Level 1 terrestrial fauna surveys were used to address the requirement for targeted surveys of conservation significant fauna. Table 10-6 provides an assessment of the likely occurrence of conservation significant fauna species as undertaken by Ecoscape (2017a). The assessment identified that in addition to the seven species were recorded in Level 1 surveys, 11 were identified as 'likely to occur' and seven 'potentially occurring'. In total 26 species were considered by Ecoscape (2017a) as 'present', 'likely to occur' or 'potentially occurring'. The species considered 'likely to occur' were predominately migratory bird species that may visit the area.

The assessment of 'likely' and 'potential' occurrence for each species is based on the ecology habitat preferences of the species and the potential habitat within the Proposal alignment.

The assessment applies the precautionary principle in assuming that the species identified as 'potential' and 'likely' are present. For the species that weren't recorded in Level 1 fauna surveys, but that have been identified as 'potentially occurring' and 'likely to occur' species are present, information regarding the ecology of these species has been used to assess the impact of the Proposal. On this basis of the available information of each species Ecoscape (2017a) recommended that no additional targeted surveys were required to understand the potential impacts to these species.

10.3.4 Other fauna values

A total of 405 species of vertebrates and eleven invertebrates were identified from a desktop assessment as potentially occurring within the Ecoscape (2017a) study area. This is expected to be an overestimate as online sources covered a wider geographic area.

Short-Beaked Echidna (Tachyglossus aculeatus)

The Short-Beaked Echidna is found throughout mainland Australia and offshore islands including Tasmania, and also south-eastern New Guinea. It is not restricted to any particular habitat or range of habitats, occurring from sea level to alpine areas, and from sandy deserts to rainforest, varying in abundance from sparse to common. Echidnas feed on ant and termite adults and brood extracted from nests with the long sticky tongue after excavation with powerful clawed forelimbs (Ecoscape 2017a).

The species is not listed as threatened or Priority by WA or the Commonwealth; however, stakeholder consultation has identified echidnas as a species of concern for entanglement in the proposed barrier fence.

Echidnas are known to be susceptible to entanglement (leading to injury or death) when attempting to pass under electrified wire fences (DAFWA 2016b). Electrical wires will not be used for the construction of the Proposal as they can cause mortality of smaller native species (e.g. some reptiles as well as echidnas) which can become entrapped against the 'live' wires (Long & Robley 2004 cited in DAFWA 2016b).

Invertebrates and Short Range Endemics

SRE fauna, which includes species of insects, arachnids, myriapods and crustaceans that have highly restricted distributions because of poor dispersal, slow growth, low fecundity or specific habitat preferences, are particularly vulnerable to extinction. Very little is known regarding the abundance or extent of many of these species within the South West of WA, or which species may be regarded as most critical for conservation (GS Bio Logic 2015).

Searches conducted in 2015 by Ecoscape (2017a) using the DBCA Naturemap and EPBC Projected Matters Search Tool did not identify any local records of invertebrates or SREs of conservation significance. Subsequent database searches for the threatened invertebrate species (under EPBC Act, WC Act and DBCA Priority) within a 100 km search area around the Proposal alignment was conducted by the Western Australian Museum (WAM) in April 2017 and were reported by Ecoscape (2017b) for:

- Arachnida & Myriapoda
- Crustacea
- Mollusca.

At the time of the database request the WAM was not able to provide an SRE filter on the results, resulting in the large number of species being assessed as potential SRE. The large number of species being classified as 'potential SREs' is due to the following reasons:

- limited public access to species information (e.g. unpublished reports, taxonomic statements)
- lack of taxonomist input on the likelihood of the species to represent an SRE
- all females and juveniles of species that cannot be identified to species level are required to be treated as 'potential SRE' under the precautionary principle
- low taxonomic resolution resulting from the lack of mature males and/or the fact that most morpho-species were collected from a single location and the distribution of the species is unknown[9]
- availability of literature relevant to SREs is relatively scarce.

A total of 158 species were identified as potential or confirmed SREs within the 100 km search area, and included species listed under the WC Act and by DBCA. These 158 species comprised of the following:

- 111 morpho-species of mygalomorph spiders
- nine species of pseudoscorpion
- 26 millipedes
- one soil centipede (geophilomorph)
- eight scorpions
- three molluscs (snails).

One mygalomorph spider was identified as likely SRE and one millipede was identified as confirmed SRE based on the precautionary principle (Ecoscape 2017b). In addition, two species of plant hopper (Flatidae) and one species of water flea are listed as Priority 1, one araneomorph spider and nine species of millipede are listed as Schedule 3 under the WC Act.

In addition to the WAM database investigations for the 100 km search area, two mygalomorph spiders (*Aname mainae* and *Chenistonia tepperi*), which are expected to have restricted distributions, and five species of Lycosidae Wolf Spiders were collected in a previous survey in 2004 by Biota for the Kundip and Trilogy Project, located approximately 27 km southeast of Ravensthorpe (Ecoscape 2017b). Despite rare records in the region for these species, there are not expected to be SREs (Ecoscape 2017b). A single snail of the genus Bothriembryon was also collected during a 2004 survey which was unknown at the time of the survey (Ecoscape 2017b). Generally, species belonging to this genus tend to have limited distributions and represent SREs (Ecoscape 2017b). None of the species recorded during the 2004 survey for the Kundip and Trilogy Project were assessed as potential SRE species (Ecoscape 2017b).

The WAM database search within 100 km of the Proposal alignment are presented in Appendix 3. A summary of all SRE species recorded in the area (within 100 km of the Proposal) is presented in Table 10-9.

[9] This is due to the fact that SREs are dominated by invertebrate species, which are historically understudied and in many cases lack formal descriptions.

Habitat assessment and further surveys

EPA (2016b) identifies that the specialised habitat characteristics of short-range endemics are associated with comprise vine thickets, boulder piles, isolated hills and other landforms, vegetated gullies and freshwater habitats. These specialised habitat types are not expected to be widespread along the Proposal alignment. Habitat areas where SRE may potentially occur are localised to the three main drainage lines (Oldfield River, Young River, and Lort River) and salt lake/fringes. These major drainage lines are not affected by the Proposal alignment due to gaps in the proposed barrier fence. For areas where salt lakes/fringes occur only a small proportion of habitat is expected to overlap the clearing footprint due to the narrow, linear nature of the disturbance. Avoiding saline and low-lying areas where possible also minimises corrosion of fence materials and the risk of bogging maintenance vehicles. The location, quantity and quality of fauna habitat types are presented in Table 10-4. The salt lake/fringes (comprising only 3% of the Ecoscape [2017a] study area) were identified to be used by resident terrestrial vertebrates, and potential foraging and shelter habitat for shorebirds that use inland salt lakes when conditions are temporarily suitable.

In addition to SRE habitat not occurring within the Proposal alignment, vegetation mapping along the Proposal alignment reflect geology, landform, soil type and hydrology, which are relevant factors to determine the distribution of SREs. Vegetation units present along the Proposal alignment are not restricted to the local area and; therefore, the distribution of SREs are not expected to be confined to the clearing footprint. Therefore, the potential occurrence of SRE is expected to be low.

Five key threatening processes have been identified by EPA (2016b) for SRE fauna:

- clearing of native vegetation (habitat removal)
- changes to fire regimes
- introduction and/or spread of weeds and soil pathogens
- fragmentation and subdivision of habitats
- changes to surface hydrology.

The main impact on invertebrates and SREs during construction of the Proposal alignment is the clearing of native vegetation due to:

- lack of mobility of individuals to move away from areas of impact
- removal of available fauna habitat.

Other key threatening processes such as changes to fire regimes, introduction and/or spread of weeds and soil pathogens, fragmentation and subdivision of habitats and changes to surface hydrology are not expected to significantly impact invertebrate or SRE fauna during the construction or operation phase of the Proposal due to the proposed mitigation measures to be implemented by the Proponent as outlined in Section 10.5.

On the basis that the potential for disturbance to SRE habitat is low, the risk of potential impacts to invertebrate or SRE fauna from the Proposal is also low. The main key threatening process identified for invertebrates and SRE fauna is the clearing of native vegetation. Some individuals may be impacted due to the lack of mobility to move away from the impact area during construction (Ecoscape 2017b); however, the Proposal will not adversely impact:

- key habitats for SRE species as these specialized habitats are not widespread within the clearing footprint; if they are present, only a small proportion of habitat is expected to overlap the clearing footprint due to the narrow, linear nature of the disturbance
- the distribution, abundance and productivity of populations of SRE as vegetation units and fauna habitat is not restricted to the local Esperance area, and the permeability of the proposed barrier fence is not expected to prevent distribution of invertebrates or SRE fauna
- the conservation status of SRE fauna due to the minor scale of clearing associated with a narrow, linear disturbance area for the proposed barrier fence.

On this basis, the impact to SREs are not considered further in this assessment.

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Table 10-9: SRE invertebrates recorded from the region/database searches

Family	SPECIES	Common Name	EPBC Act	WC/BC Act	DPaW	SRE status	PMST	WAM database search	Burbidge et al. 2004	WAM database	DPaW listing (South Coast)	Ravensthorpe (Biota 2004)	NatureMap record close by	Field survey (Ecoscape)
INSECTS														
Arthropoda														
Flatidae	*Budginmaya eulae*	Eula's Planthopper	-	-	P1						X		X	
	Hylaeus globuliferus	(Bee)	-	-	P3						X		X	
ARACHNIDS														
Arachnida														
Araneomorphae														
Archaeidae	*Zephyrarchaea marki*	Cape Le Grand assassin spider	-	S3	Vu						X		X	
Mygalomorphae														
Nemesiidae	`*Proshermacha*` *'MYG346'*					Potential SRE		X						
	`*Proshermacha*` `*MYG347*`					Potential SRE		X						
	`*Proshermacha*` *'MYG349'*					Potential SRE		X						
	`*Proshermacha*` *'MYG440'*					Potential SRE		X						
	`*Proshermacha*` *'MYG468'*					Potential SRE		X						
	`*Proshermacha*` *'MYG485'*					Potential SRE		X						
	`*Proshermacha*` *'MYG509'*					Potential SRE		X						
	`*Proshermacha*` 'sp.indet. (female)' & 'sp.indet. (juvenile)'					Potential SRE		X						
	Aname `*Barrett* sp. 1`					Potential SRE		X						
	Aname `*Barrett* sp. 2`					Potential SRE		X						
	Aname `*Biota sp. B*`					Potential SRE		X						
	Aname `*Biota sp. F*`					Potential SRE		X						
	Aname `*Biota sp. I*`					Potential SRE		X						
	Aname `*kwonkoides spp. group*`					Potential SRE		X						
	Aname `*Lake Exclamation sp. 1*`					Potential SRE		X						
	Aname `*MYG010*`					Potential SRE		X						
	Aname 'MYG181 (juvenile)`					Potential SRE		X						
	Aname `*MYG182*`					Potential SRE		X						
	Aname `*MYG212*					Potential SRE		X						
Nemesiidae	*Aname* `*MYG391*`					Potential SRE		X						
	Aname `*MYG398*`					Potential SRE		X						
	Aname `MYG399'					Potential SRE		X						
	Aname `*MYG461*`					Potential SRE		X						
	Aname `sp. 1 (red head)`					Potential SRE		X						
	Aname `sp. 2 (grey)`					Potential SRE		X						
	Aname `sp. indet. (female) & `sp. indet. (juvenile)`					Potential SRE		X						
	Aname `sp.`					Potential SRE		X						
	Chenistonia `*MYG344-DNA*`					Potential SRE		X						
	Chenistonia `*MYG348*`					Potential SRE		X						
	Chenistonia `*raggedensis*`					Potential SRE		X						
	Chenistonia `*sp. indet. (female)*` & `*sp. indet. (juvenile)*`					Potential SRE		X						
	Chenistonia cuspidata					Potential SRE		X						
	Kwonkan`*MYG060*`					Potential SRE		X						
	Kwonkan `*MYG096*`					Potential SRE		X						
Nemesiidae	*Kwonkan*`*MYG122*`					Potential SRE		X						
	Kwonkan `*MYG175*`					Potential SRE		X						
	Kwonkan `*MYG183*`					Potential SRE		X						
	Kwonkan `*MYG343*`					Potential SRE		X						
	Kwonkan silvestre					Potential SRE		X						

Family	SPECIES	Common Name	EPBC Act	WC/BC Act	DPaW	SRE status	PMST	WAM database search	Burbidge et al. 2004	WAM database	DPaW listing (South Coast)	Ravensthorpe (Biota 2004)	NatureMap record close by	Field survey (Ecoscape)
	Kwonkan `*sp.*					Potential SRE		X						
	Merredinia `*MYG454-DNA*`					Potential SRE		X						
	Merredinia `sp. indet. (female)`					Potential SRE		X						
Actinopodidae	*Missulena* `MYG041`					Potential SRE		X						
	Missulena `MYG042`					Potential SRE		X						
	Missulena `MYG051`					Potential SRE		X						
	Missulena `MYG289-DNA`					Potential SRE		X						
	Missulena `sp. B04`					Potential SRE		X						
	Missulena `sp. indet. (female)`					Potential SRE		X						
	Missulena pinguipes					Potential SRE		X						
Idiopidae	`Genus indet.` ‘sp/indet.(juvenile)’					Potential SRE		X						
	`*Eucanippe*` ‘Biota sp. B’					Potential SRE		X						
	`*Eucanippe*` ‘MYG072’					Potential SRE		X						
	Arbanitinae `Genus indet.` `sp. indet. (juvenile)`					Potential SRE		X						
	Aganippe `Biota sp. D`					Potential SRE		X						
	Aganippe `Biota sp. E`					Potential SRE		X						
	Aganippe `charlesi’					Potential SRE		X						
	Aganippe `esperance`					Potential SRE		X						
	Aganippe `longbottomi`					Potential SRE		X						
	Aganippe `MYG064 (female)` &`MYG064 (juvenile)`					Potential SRE		X						
	Aganippe `MYG065 (female)` & `MYG065 (juvenile)`					Potential SRE		X						
	Aganippe `MYG065`					Potential SRE		X						
	Aganippe `MYG075`					Potential SRE		X						
	Aganippe `MYG123’					Potential SRE		X						
	Aganippe `salt lake sp. 1 [= `haroldi`]					Potential SRE		X						
	Aganippe `sp. 1`					Potential SRE		X						
	Aganippe `sp. B11`					Potential SRE		X						
	Aganippe `MYG065`					Potential SRE		X						
	Aganippe `MYG075`					Potential SRE		X						
	Aganippe `MYG123’					Potential SRE		X						
	Aganippe `salt lake sp. 1 [= `haroldi`]					Potential SRE		X						
	Aganippe `sp. 1`					Potential SRE		X						
	Aganippe `sp. B11`					Potential SRE		X						
	Aganippe `sp. B12`					Potential SRE		X						
	Aganippe `sp. B13`					Potential SRE		X						
	Aganippe `sp. B14`					Potential SRE		X						
	Aganippe `sp. indet. (female)` & `sp. indet. (juvenile)`					Potential SRE		X						
	Aganippe `sp. nov.`					Potential SRE		X						
	Aganippe `species A (Biota)`					Potential SRE		X						
	Aganippe `twig-lining sp.`					Potential SRE		X						
	Arbanitinae `Biota sp. C`					Potential SRE		X						
	Arbanitinae `Biota sp. D`					Potential SRE		X						
	Arbanitinae `Biota sp. E’					Potential SRE		X						
Dipluridae	*Cethegus* ‘sp.’					Potential SRE		X						
Barychelidae	`Genus indet.` ‘sp. indet. (juvenile)’					Potential SRE		X						
	`Genus indet.`					Potential SRE		X						
	Idiommata `salt lake sp. 1’					Potential SRE		X						
	Idiommata `sp. indet. (juvenile)`					Potential SRE		X						
	Idiommata `yelbeni`					Potential SRE		X						
	Stanwellia `MYG359-DNA`					Likely SRE		X						

Family	SPECIES	Common Name	EPBC Act	WC/BC Act	DPaW	SRE status	PMST	WAM database search	Burbidge et al. 2004	WAM database	DPaW listing (South Coast)	Ravensthorpe (Biota 2004)	NatureMap record close by	Field survey (Ecoscape)
	Synothele `forrestiana`					Potential SRE		X						
	Synothele `nr sp. B03`					Potential SRE		X						
	Synothele `pseudidiommata`					Potential SRE		X						
	Synothele `salt lake sp. 1`					Potential SRE		X						
	Synothele `sp. B06`					Potential SRE		X						
	Synothele `sp. indet. (juvenile)`					Potential SRE		X						
	Synothele parifusca					Potential SRE		X						
Anaminae	*Teyl `Biota sp. F`*					Potential SRE		X						
	Teyl `double-door sp. `					Potential SRE		X						
	Teyl `Fitzgerald sp. 1`					Potential SRE		X						
	Teyl `MYG068`					Potential SRE		X						
	Teyl `MYG192`					Potential SRE		X						
	Teyl `MYG455`					Potential SRE		X						
	Teyl `MYG455`					Potential SRE		X						
	Teyl `MYG456`					Potential SRE		X						
	Teyl `MYG510`					Potential SRE		X						
	Teyl `sp. indet. (juvenile)`					Potential SRE		X						
	Teyl `sp. nov.`					Potential SRE		X						
	Yilgarnia `MYG458`					Potential SRE		X						
	Yilgarnia `sp. indet. (female)`					Potential SRE		X						
	Yilgarnia currycomboides					Potential SRE		X						
Ctenizidae	*Conothele* `MYG059`					Potential SRE		X						
	Conothele `salt lake sp. 1`					Potential SRE		X						
PSEUDOSCOPRIONES														
Olpiidae	*`Beierolpium`* `sp. B08`					Potential SRE		X						
	`Beierolpium` `sp. B09`					Potential SRE		X						
	`Beierolpium` `sp. B10`					Potential SRE		X						
	Indolpium `sp. B13`					Potential SRE		X						
	Indolpium `sp. B14`					Potential SRE		X						
	`Beierolpium` `sp. B08`					Potential SRE		X						
Neopilionidae	`Genus indet.` `sp. indet. (female)` & `sp. indet. (juvenile)`					Potential SRE		X						
Iulomorphidae	`indet.` `sp. B03`					Potential SRE		X						
Tridenchtehoniidae	Dithella sp.					Potential SRE		X						
CRUSTACEANS														
Daphniidae														
Daphne jollyi		(Water flea)			P1						X		X	
MILLIPEDES														
Spirostreptida														
Iulomorphidae	*Atelomastix anancita*			S3	Vu			X			X		X	
	Atelomastix 'bamfordi?'					Potential SRE		X						
	Atelomastix brennani			S3	Vu			X			X		X	
	Atelomastix dendritica	Recherche Atelomastix Millipede		S3	Vu			X			X		X	
	Atelomastix grandis			S3	Vu			X			X		X	
	Atelomastix gibsoni					Confirmed SRE		X						
	Atelomastix lengae			S3	Vu			X			X		X	
	Atelomastix longbottomi			S3	Vu			X			X		X	
	Atelomastix melindae			S3	Vu			X			X		X	
	Atelomastix priona			S3	Vu			X			X		X	
	Atelomastix psittacina					Potential SRE		X						
	Atelomastix sarahae			S3	Vu			X			X		X	

Family	SPECIES	Common Name	EPBC Act	WC/BC Act	DPaW	SRE status	PMST	WAM database search	Burbidge et al. 2004	WAM database	DPaW listing (South Coast)	Ravensthorpe (Biota 2004)	NatureMap record close by	Field survey (Ecoscape)
	Atelomastix `*sp. indet. (female)*`					Potential SRE		X						
	Podykipus ``East Mt Barren`					Potential SRE		X						
	Podykipus `sp. `					Potential SRE		X						
	Samichus `Cape Arid`					Potential SRE		X						
	Samichus`*Le Grand*`					Potential SRE		X						
	Samichus `*sp.7*`					Potential SRE		X						
Polydesmida														
Paradoxosomatidae	*Antichiropus* `East Mt Barren`					Potential SRE		X						
	Antichiropus `*FNP*`					Potential SRE		X						
	Antichiropus `*LeGrand east*`					Potential SRE		X						
	Antichiropus `*Mt Arid*`					Potential SRE		X						
	Antichiropus `*pasley*`					Potential SRE		X						
	Antichiropus `*RA1*`					Potential SRE		X						
	Antichiropus `*recherche*`					Potential SRE		X						
	Antichiropus `*saeda*`					Potential SRE		X						
	Antichiropus baudini					Potential SRE		X						
	Antichiropus buchanorum					Potential SRE		X						
	Antichiropus cuspis					Potential SRE		X						
	Antichiropus equinus					Potential SRE		X						
	Antichiropus exclamatus					Potential SRE		X						
	Antichiropus lacustrinus					Potential SRE		X						
	Antichiropus laticlavius					Potential SRE		X						
	Antichiropus rex					Potential SRE		X						
	Antichiropus simpulus					Potential SRE		X						
	Antichiropus `*sp. indet. (female)*` & `*sp. indet. (juvenile)*`					Potential SRE		X						
Cyliosomatidae														
Cyliosoma sarahae (ex *Epicycliosoma)*		Sarah's Pill Millipede		S3	Vu	Confirmed SRE		X			X			
Chilopoda														
Chilenophilidae	*Sepedonophilus* `sp. B04`					Potential SRE		X						
Scorpiones														
Buthidae	*Lychas* `*sp.1*`					Potential SRE		X						
	Lychas `*sp.*`					Potential SRE		X						
Urodacidae	*Urodacus* `sp.1`					Potential SRE		X						
	Urodacus`sp B08`					Potential SRE		X						
	Urodacus`sp`					Potential SRE		X						
	Urodacus `twotone-spiny?`					Potential SRE		X						
	Urodacus `woodwardii?`					Potential SRE		X						
	Urodacus `sp.B03`					Potential SRE		X						
Molluscs														
Bothriembryontidae	*Bothriembryon* cf. *balteolus*					Potential SRE		X						
	Bothriembryon cf. *rhodostomus*					Potential SRE		X						
	Bothriembryon rhodostomus					Potential SRE		X						

10.3.5 Habitat connectivity

The Proposal alignment follows the edge of the Esperance agricultural area with largely cleared farmland to the south and largely intact vegetation in the lower rainfall western woodlands to the north and east. Due to clearing for agriculture, the landscape is highly fragmented between the western woodlands and the coast.

The South Coast Macro Corridor Network (Wilkins et al. 2006) identifies four macro corridors that are important to landscape connectivity in the vicinity of the Proposal (Figure 10-5 and Figure 10-6):

- Fitzgerald River National Park to Cape Arid National Park – near continuous
- Oldfield River (41 km; near continuous)
- Young River Corridor (65 km; near continuous)
- Lort River Corridor (70 km; near continuous).

The river corridors are the only corridors identified through the Esperance agricultural region but were not listed as high priority corridors (Figure 10-6). The coastal corridor from Fitzgerald River NP to Cape Arid NP was listed as Priority 1 as it links two very high value nature conversation areas.

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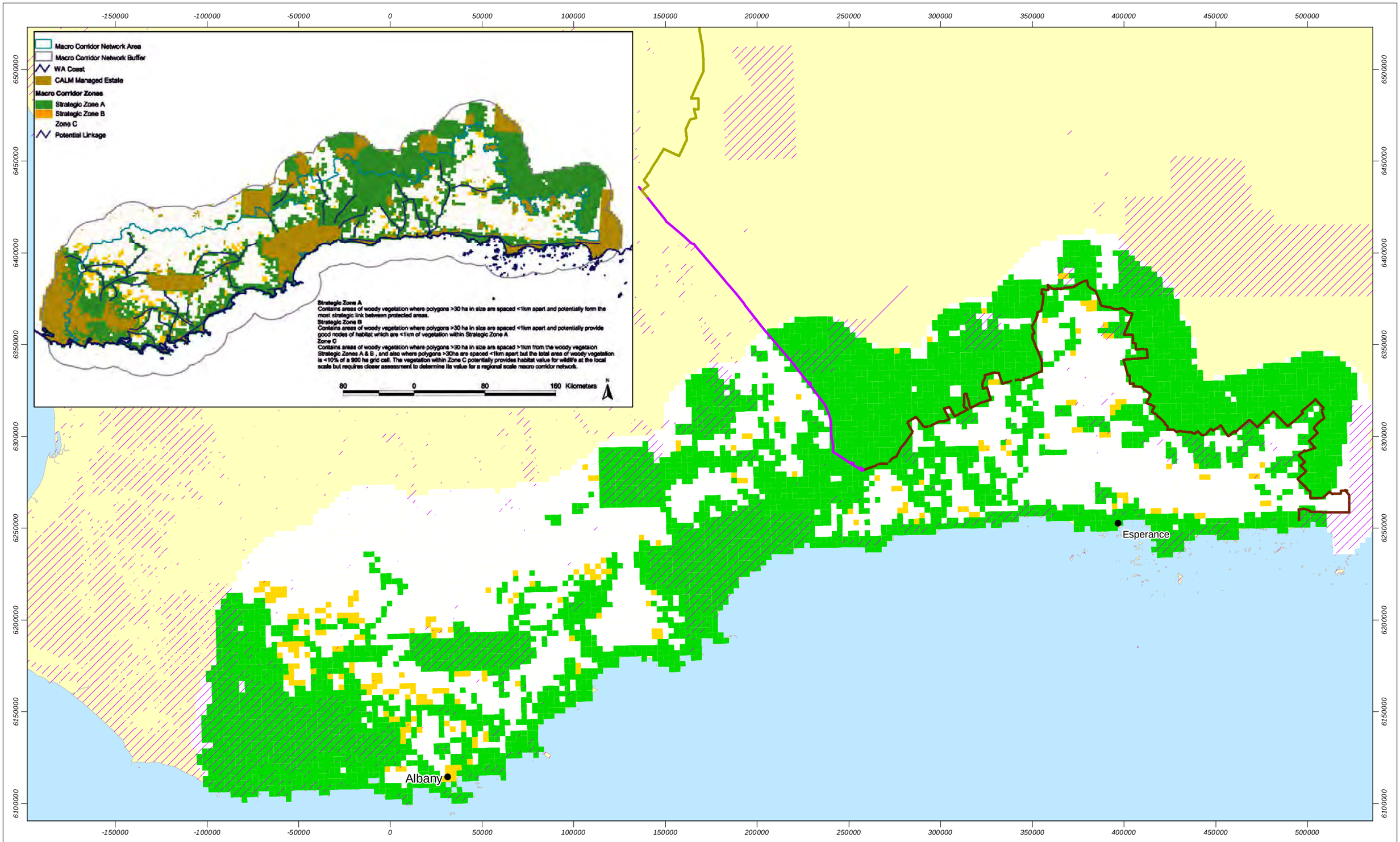


Figure 10-5: Landscape connectivity in the Great Southern

Scale 1:1,900,000at A3

0 25 50 75 100 125 km

Coordinate System: GDA 1994 MGA Zone 51
Note that positional errors may occur in some areas
Date: 1/08/2017
Author: DWhite

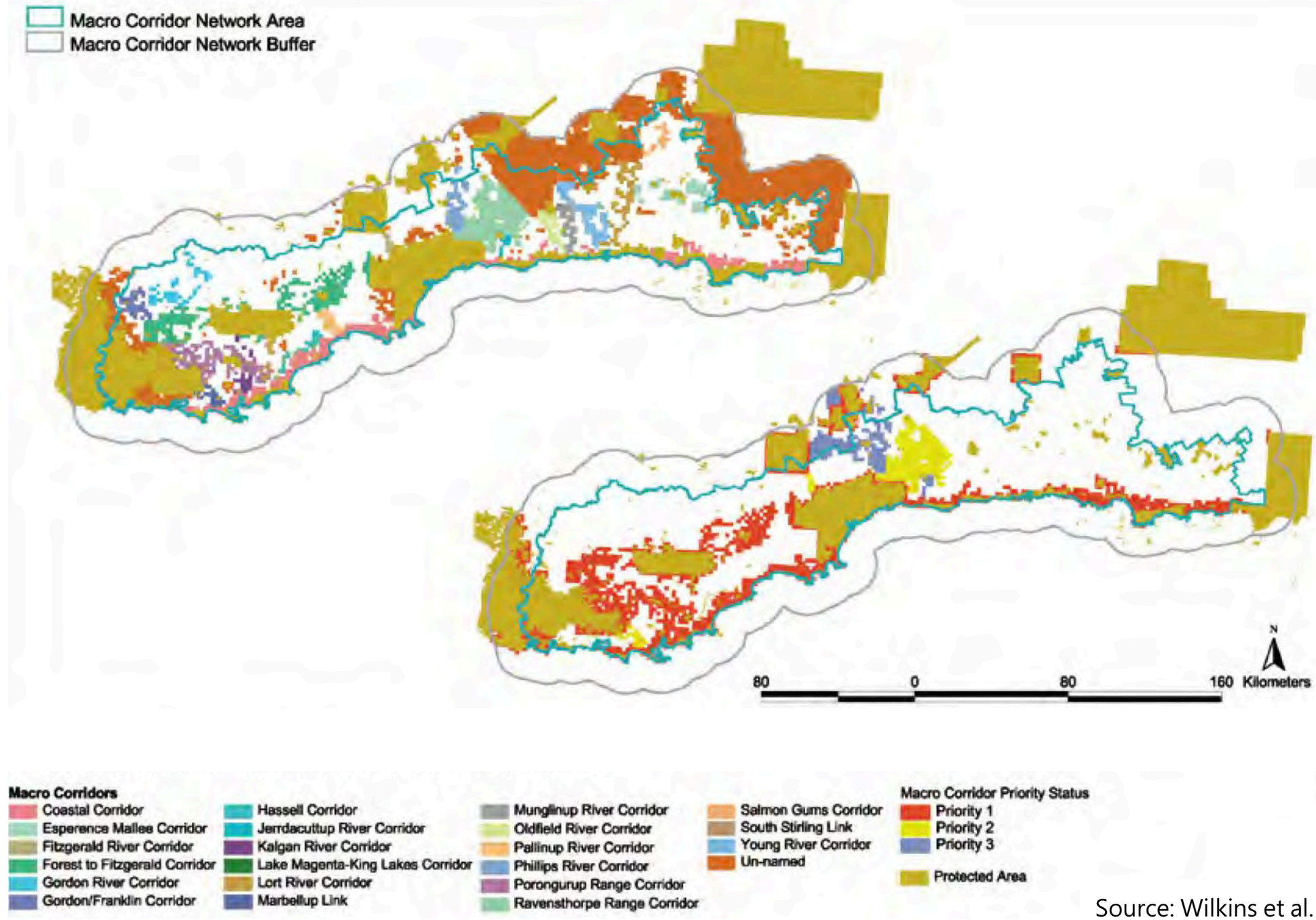
Legend

- Existing SBF
- Yilgarn Gap
- Town
- Reserves
- Proposal alignment
- Strategic Zone A
- Strategic Zone B
- Zone C
- Ocean

Source: Coastline: SLIP database; Landgate 2017; Macro Corridor Zones: Parks and Wildlife 2017; Reserves: DPaW 2012; Inset: Wilkins et al. (2006)

Path: Q:\Consult\2016\DAF\DAF16515\ArcMap_documents\R001\DAF16515_01_R001_RevE_F0010-5.mxd

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Source: Wilkins et al. (2006)

Figure 10-6: Great Southern Macro Corridors and Priority status

10.4 Potential impacts

In accordance with the ESD (Appendix 1) this PER identifies direct and indirect impacts from clearing of fauna habitat and the provision of a physical barrier against fauna movement. These direct and indirect impacts are outlined in Section 10.7.

The ESD identifies the requirement to describe and assess potential impacts resulting from clearing of habitat and the physical barrier to fauna movement as part of the Proposal. The ESD has identified the following potential impacts on the environmental factor Terrestrial Fauna:

1. Direct impacts to fauna through collisions and entrapment with the fence.
2. Direct and indirect impacts to fauna through the clearing of fauna habitat.
3. Direct and indirect impacts to fauna from fragmentation of habitat and a reduction in ecological connectivity.
4. Indirect impacts to fauna may occur as a result of:
    - prevention of dispersal and access to resources
    - restriction of fauna movement during fires
    - separation, isolation and changes of populations and faunal communities resulting in loss of genetic diversity
    - changes to predator behaviour such as preferential predation along fence lines
    - changes to feral animal abundance and distribution
    - changes in anti-predator behaviour in prey species.

10.5 Application of the mitigation hierarchy

In accordance with the Administrative Procedures (GoWA 2012), consideration was given during the planning for the Proposal to avoid, minimise and rectify or rehabilitate the potential impacts. These measures are summarised in Table 10-3.

The planned mitigation measures are taken into account when predicting the residual impacts of the Proposal.

Table 10-10: Application of the mitigation hierarchy to potential impacts on fauna

Potential impacts	Avoid	Minimise	Rectify/rehabilitate	Offset
Collision and entrapment	The unfenced gaps in the Proposal alignment associated with the three main river systems and along the coast will avoid collision and entrapment potential along these important fauna corridors.	The mesh dimensions for the proposed barrier fence are large enough to allow the majority of fauna species to pass through. No barbed wire or electrical wires will be used to reduce entanglement and injury potential. Fence specifications have been modified to include fluorescent orange droppers every 7 m (half way between fence posts which are also 7 m apart) to increase the visibility of the proposed barrier fence. The number of fluorescent orange fence droppers would also be doubled (two droppers 2.3 m apart between the star pickets which are 7 m apart) along approximately 115 km of Proposal alignment near the Western Ground Parrot habitat at Cape Arid NP (Figure 10-2). An existing farm boundary fence will be replaced with a high visibility barrier fence for this section. A CMP will be developed by DPIRD following approval which will include the restriction of public access to the proposed barrier fence to minimise stress to animals. The Proposal alignment has been significantly modified to reduce the number of bottlenecks/acute angles that emus may aggregate in.	Regular inspections of the Proposal alignment will be conducted by DPIRD staff and contractors during construction and particularly during the first year of operation while wildlife become familiar with the proposed barrier fence. In the event of entrapped animals, they would be cared for, released or euthanized. The frequency of inspections will be more frequent adjacent to Cape Arid NP. The private farm fences near Cape Arid NP will also be regularly monitored by landholders during their normal farming operations.	Not applicable.
Clearing of habitat	The requirement for clearing has been avoided along large sections of the Proposal alignment by following existing fire management breaks and already cleared areas within private property.	The clearing of habitat has been minimised by reducing the total width to as low as possible (15–20 m) and requiring complete clearing of only a 6 m width for the construction and maintenance of the proposed barrier fence. The remaining 9 to 14 m width of clearing will be undertaken by chaining and potentially mulching. A CMP will be developed by DPIRD following approval and will include the following key actions: • no clearing will be undertaken between August and November for sections of the Proposal alignment that are adjacent to Cape Arid NP to minimise potential impacts on breeding and juvenile Western Ground Parrots. These areas are associated with the road verges between existing farm boundary fences, and the 1.6 km of UCL adjacent to Merivale Rd (please note: sections of private farm fence may be replaced by the SBF in this region; however, no clearing is required other than potential branch trimming)	Not applicable.	Not applicable.

Potential impacts	Avoid	Minimise	Rectify/rehabilitate	Offset
		• accurately delineating the fence reserve boundary via pegging to provide accuracy to the limits of the allowable clearing lines • targeted searches for conservation significant fauna (such as Malleefowl mounds), including potential habitat trees and hollows will be undertaken prior to clearing within any section of the Proposal alignment that has not been previously surveyed[10] (due to changes as a result of avoidance of heritage or ecological values) • avoid or minimise impacts to habitat features of conservation significant habitat features (such as Malleefowl mounds and potential habitat trees) based on outcomes of searches • avoidance of priority areas containing conservation significant habitat features (such as Malleefowl mounds and potential habitat trees) during installation of water diversion turnouts.		
Fragmentation of habitat	The Proposal alignment has been significantly modified to reduce isolation of large sections of the Great Western Woodlands compared with the original scoping studies preferred alignment (GHD 2012). While this has increased the Proposal length and costs significantly, it has been adopted to improve environmental and cultural outcomes. The Proposal alignment has also been modified (in agreement with the landholders) onto private property for approximately 129.4 km where high environmental and cultural concerns were identified. This will be achieved in various sections by replacing existing farm fences with a barrier fence and no new clearing would be undertaken.	The three main river systems on the west of the Proposal alignment and the coastal corridor to the southeast of the alignment will be left open allowing some fauna movement. Malleefowls can fly over the fence or pass through as juveniles. Thomas River is a small creek where the fence is proposed to cross. The crossing is located on freehold land in a highly disturbed area next to concrete culverts and adjacent to Merivale Road, as such impacts at this location are expected to negligible. Most larger native taxa such as echidnas, quolls, and quenda can pass through the proposed mesh size.	Not applicable.	Not applicable.

[10] A targeted search for potential habitat trees has been undertaken by GS Biologic (2017) for the Salmon Gum section of the Proposal alignment which identified 103 potential habitat trees within the Proposal alignment that could be affected by clearing. Potential habitat trees will be avoided where possible, a pre-clearing survey will be conducted for the potential habitat trees where clearing cannot be avoided.

Potential impacts	Avoid	Minimise	Rectify/rehabilitate	Offset
Prevention of dispersal and access to resources	The avoidance of this impact for large target species is not applicable as the prevention of access for wild dogs, emus and kangaroos from the rangelands and adjacent woodlands is the purpose of the Proposal. Approximately 69.3 km (in straight line kilometres) of the Proposal alignment is located in uncleared bushland. The alignment across these bushland areas is intended to minimise the use of acute corners and creation of pockets of vegetation with a barrier fence on three sides, which could cause aggregating emus to 'bottleneck' in the event of an emu migration possibly leading to injury or damage to the fence.	The gaps in the Proposal alignment associated with the three main river systems and along the coast ensure that dispersal and access to resources can still occur along the key ecological corridors. The fence mesh dimensions will allow the majority of fauna to pass through. Thomas River is a small creek where the fence is proposed to cross. The crossing is located on freehold land in a highly disturbed area next to concrete culverts and adjacent to Merivale Road, as such impacts at this location are expected to negligible. The Proposal alignment utilises 'soft barriers' of existing firebreaks and existing farm boundary fences for the majority of the Proposal alignment.	Not applicable.	Not applicable.
Restriction of fauna movement during fires	Not applicable.	The Proposal will predominantly be constructed within an existing fire buffer area managed by DBCA that is 80–100 m wide or within previously cleared farm boundaries. This will minimise the fire risk to fauna as well as human life and property. The fence mesh dimensions will allow the majority of fauna to pass through.	Not applicable.	Not applicable.
Loss of genetic diversity	Not applicable.	The Proposal includes four unfenced gaps in the Proposal alignment associated with the three main river systems and a 3.2 km gap to the coast so that genetic isolation of populations of large fauna is not expected to be significant. The fence mesh dimensions will allow the majority of fauna to pass through. The height of the fence is low enough that birds and bats can pass over the proposed barrier fence.	Not applicable.	Not applicable.

Potential impacts	Avoid	Minimise	Rectify/rehabilitate	Offset
Preferential predation along fence lines	Not applicable.	The Proposal alignment along existing fire management buffers and fire tracks, and existing farm boundary fences will not create new effects.	Wild dog and fox baiting for 0–20 km on either side of the proposed barrier fence is currently being undertaken by Biosecurity Groups under DPIRD legislation as part of an ongoing wild dog and fox control program. This will minimise the potential for preferential predation along the Proposal alignment. A PPCMP will be implemented by DPIRD for fox and wild dog control at the three river corridor fence gaps, previously uncleared areas and the 3.2 km coastal corridor.	Not applicable.
Change to feral animal abundance and distribution	Not applicable.	The Proposal alignment along existing fire management buffers and existing farm boundary fences will not create any new effects. Predator and Pest Control Management Plan will be implemented by DPIRD to monitor feral animal abundance.	Wild dog and fox baiting for 0–20 km on either side of the proposed barrier fence is currently being undertaken by Biosecurity Groups under DPIRD legislation as part of an ongoing wild dog and fox control program. This will minimise the potential for preferential predation by wild dogs and foxes along the Proposal alignment. A PPCMP will be implemented by DPIRD for fox and wild dog control at the three river corridor fence gaps, previously uncleared areas and the 3.2 km coastal corridor. The control of Declared Pests such as wild dogs and foxes on private property will remain the legal responsibility of the landholder.	Not applicable.
Change in anti-predator behaviour in prey species	Not applicable.	The Proposal alignment follows the edge of the agricultural area where wild dogs are already managed. Therefore, anti-predator behaviour in prey species is unlikely to change significantly.	Not applicable.	Not applicable.

DPIRD has undertaken extensive consultation with stakeholders and been informed by consultant reports to develop a Proposal that minimises unintended impacts on fauna species. The recommendations by GS Bio Logic (2015) and Ecoscape (2017a) and how they have been incorporated into the Proposal is outlined in Table 10-11.

Table 10-11: Consultant recommendations regarding fauna management and incorporation into the Proposal

Recommendation	Proposed approach	Recommendation to be implemented?
GS Bio Logic recommendations		
Avoid clearing between August and November for Western Ground Parrot (and if possible between August and February to include the breeding range for other species).	The Proposal alignment has been modified to replace existing farm fences on freehold land with a high visibility barrier fence for around 115 km near Cape Arid NP. No additional clearing will be undertaken, only branch trimming where necessary. For the 1.6 km section of UCL adjacent to Merivale Rd, no clearing will be undertaken between August and November.	Yes
Ensure a licensed and experienced fauna surveyor conducts pre-clearance surveys to ensure appropriate management and relocation of injured or displaced fauna.	Pre-clearance surveys will be undertaken in the small parts of the Proposal where the alignment has been altered (to minimise environmental and cultural impacts) since fauna surveys were undertaken.	Yes
Installation of visual identifiers along the top of the fence at appropriate, defined intervals (e.g. 10 m) to decrease the likelihood of accidental collision of wildlife with the fence.	Fence specifications have been modified to include fluorescent orange droppers every 7 m (half way between fence posts which are also 7 m apart) to increase the visibility of the proposed barrier fence. The number of fluorescent orange fence droppers would also be doubled (two droppers 2.3 m apart between the star pickets which are 7 m apart) along approximately 115 km of fence near the Western Ground Parrot habitat at Cape Arid NP (Burbidge A [DBCA] 2016, pers. comm. 19 April).	Yes
General controls and mitigation measures should be implemented through an Environmental Management Plan (EMP). The EMP would ensure roles and responsibilities are clearly defined, site audits are conducted and construction staff are inducted to the fauna habitat values of the site. *Phytophthora* dieback management and soil hygiene and fauna preclearance survey requirements. Appropriate reporting would also be addressed through the EMP in line with standard operating procedures.	A number of management plans will be in place to outline general controls and mitigation measures for the Proposal. Roles and responsibilities, and requirements for environmental inductions for construction staff will be defined in the environmental management plans following approval. Site audits and reporting requirements will be conducted and outlined as part of the future Ministerial Statement to be issued for the Proposal. *Phytophthora* dieback management and soil hygiene and fauna preclearance survey requirements will be outlined in the PPDMP and the CMP.	Yes
Final designs should quantify the amount of native vegetation required to be cleared and this should be assessed against any matters of National Environment Significance (e.g. Carnaby's Black Cockatoo foraging habitat.	The Proposal (including proposed clearing of Carnaby's Black-Cockatoo foraging habitat) was referred to DEE under the EPBC Act and received a not a controlled action decision.	Yes
Ecoscape (2017a) recommendations		
Minimise impact to Threatened Fauna critical habitat.	Clearing has been minimised along the entire Proposal alignment.	Yes

Recommendation	Proposed approach	Recommendation to be implemented?
Bushfire management.	The management of bushfire risk during construction and ongoing maintenance will be addressed in the environmental management plans prepared for the Proposal prior to construction.	Yes
Adopt fence design to minimise risk of collision/entanglement by fauna, especially in areas potentially traversed by Western ground parrot.	The proposed design avoids use of barbed wire and includes features for visibility enhancement. Ecoscape (2017a) concluded that these measures "*are expected to reduce collision risk to an acceptable level for all fauna*."	Yes
Coordinated control program for foxes and feral cats.	The Proposal will be implemented in conjunction with • fox and wild dog baiting programs implemented by Biosecurity Groups on either side of the proposed barrier fence within 0–20 km • fox and wild dog baiting program as part of the PPCMP to be implemented by DPIRD for unfenced gaps, previously uncleared areas and 3.2 km coastal gap. Feral cats are not currently declared under the BAM Act and; therefore, cannot be managed under legislation in a similar manner to foxes and wild dogs. Feral cat baiting could be conducted using Eradicat 1080 feral cat baits either as a local program (if approved) or part of a wider fauna recovery program such as Western Shield (if applicable). However, this is not proposed as part of this Proposal. The registration of Eradicat restricts its use to lands managed by DBCA and lands approved by DBCA. There is precedence elsewhere in the state for Eradicat use on private land following approval (Rafferty D 2016 [DBCA] pers. comm. 13 January).	Yes
General recommendations for minimising the overall impact to flora, vegetation and fauna, including: • utilise low fuel modified buffer strip instead of clearing undisturbed vegetation • placement of the fence as close as possible to the existing agricultural boundary • limiting unauthorised access to the fence.	All three mitigation measures recommended have been adopted in the Proposal.	Yes
Environmental inductions regarding wildlife interactions and waste disposal for all construction teams.	This will be included in the environmental management plans to be prepared for the Proposal construction prior to implementation.	Yes

10.6 The rationale for proposed fence gaps

The Proposal includes four unfenced gaps in the proposed barrier fence at the Oldfield, Young and Lort Rivers and at the coast where the Proposal alignment will terminate (Figure 10-6 to Figure 10-10). The purpose of the unfenced gaps is to avoid cultural heritage values associated with the rivers and to maintain ecological linkages. The width of the gaps was developed in consultation with Traditional Owners and includes all riparian vegetation associated with the rivers (i.e. no riparian vegetation types were mapped on either side of the gap by Ecoscape [2017a]).

The proposed gaps coincide with the four macro corridors identified in the South Coast Macro Corridor Network (Wilkins et al. 2006). There are no other macro corridors in the vicinity of the Proposal that were identified.

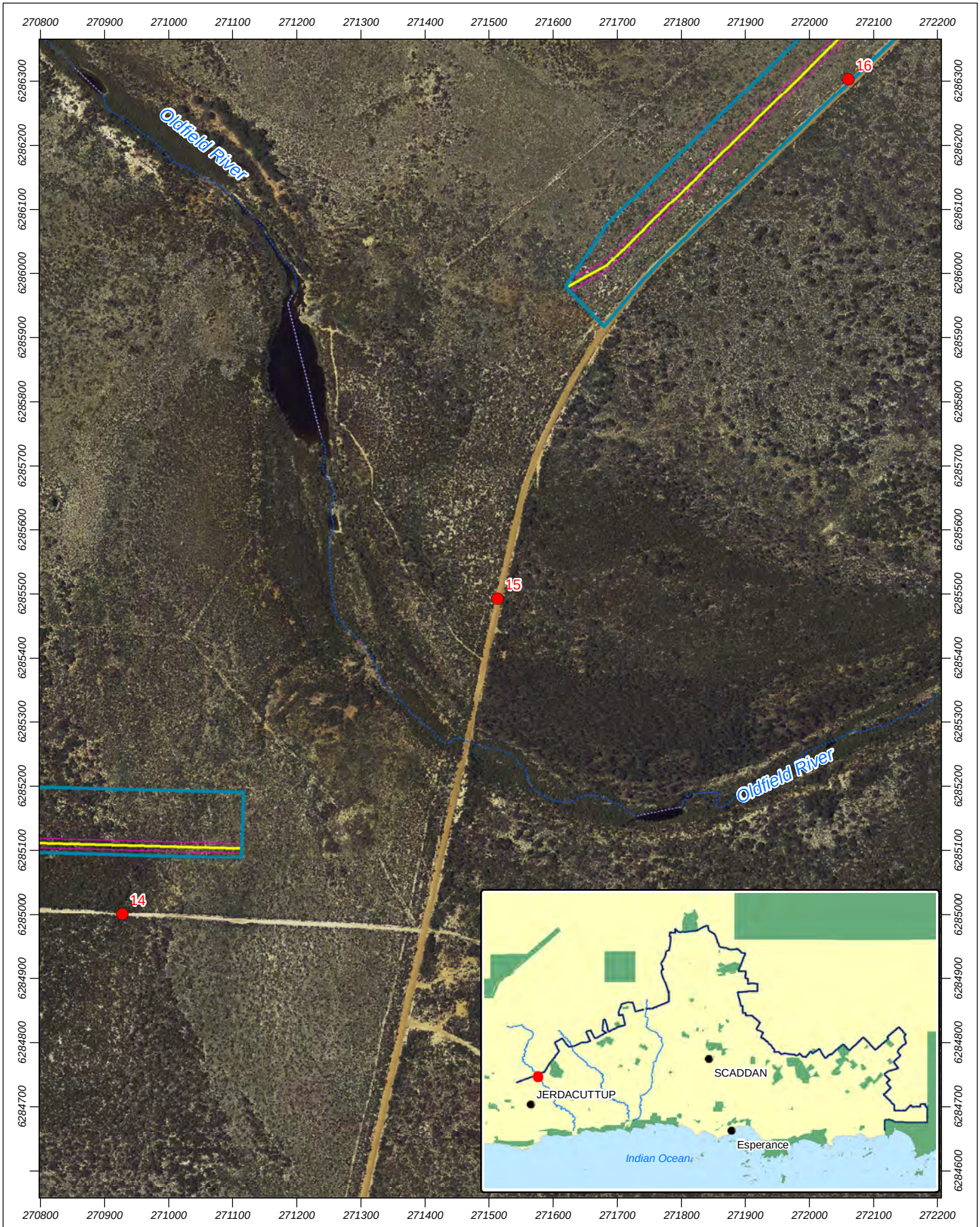


Figure 10-7: Oldfield River 1 km Proposal alignment

Scale 1:8,000 at A4

0 50 100 150 200 250 m

Coordinate System: GDA 1994 MGA Zone 51

Note that positional errors may occur in some areas

Date: 1/08/2017

Author: DWhite

Source: Aerial: Client 2016; Watercourse: SLIP databse, Landgate 2017

km divisions based on previous Proposal alignment options

Path: Q:\Consult\2016\DAF\DAF16515\ArcMap_documents\R001\DAF16515_01_R001_RevE_F0010-7.mxd

Legend

- Km divisions
- Clearing footprint
- Development Envelope
- Reserves
- **Proposal alignment existing environment conditions**
- Previously chained firebreak

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Figure 10-8: Young River 0.4 km Proposal alignment gap

Scale 1:8,000 at A4

0 50 100 150 200 250 m

Coordinate System: GDA 1994 MGA Zone 51

Note that positional errors may occur in some areas

Date: 1/08/2017

Author: DWhite

Source: Aerial: Client 2016; Watercourse: SLIP database, Landgate 2017

km divisions based on previous Proposal alignment options

Path: Q:\Consult\2016\DAF\DAF16515\ArcMap_documents\R001\DAF16515_01_R001_RevE_F0010-8.mxd

Legend

- Km divisions
- Clearing footprint
- Development Envelope
- Reserves

Proposal alignment existing environment conditions

- Previously chained firebreak

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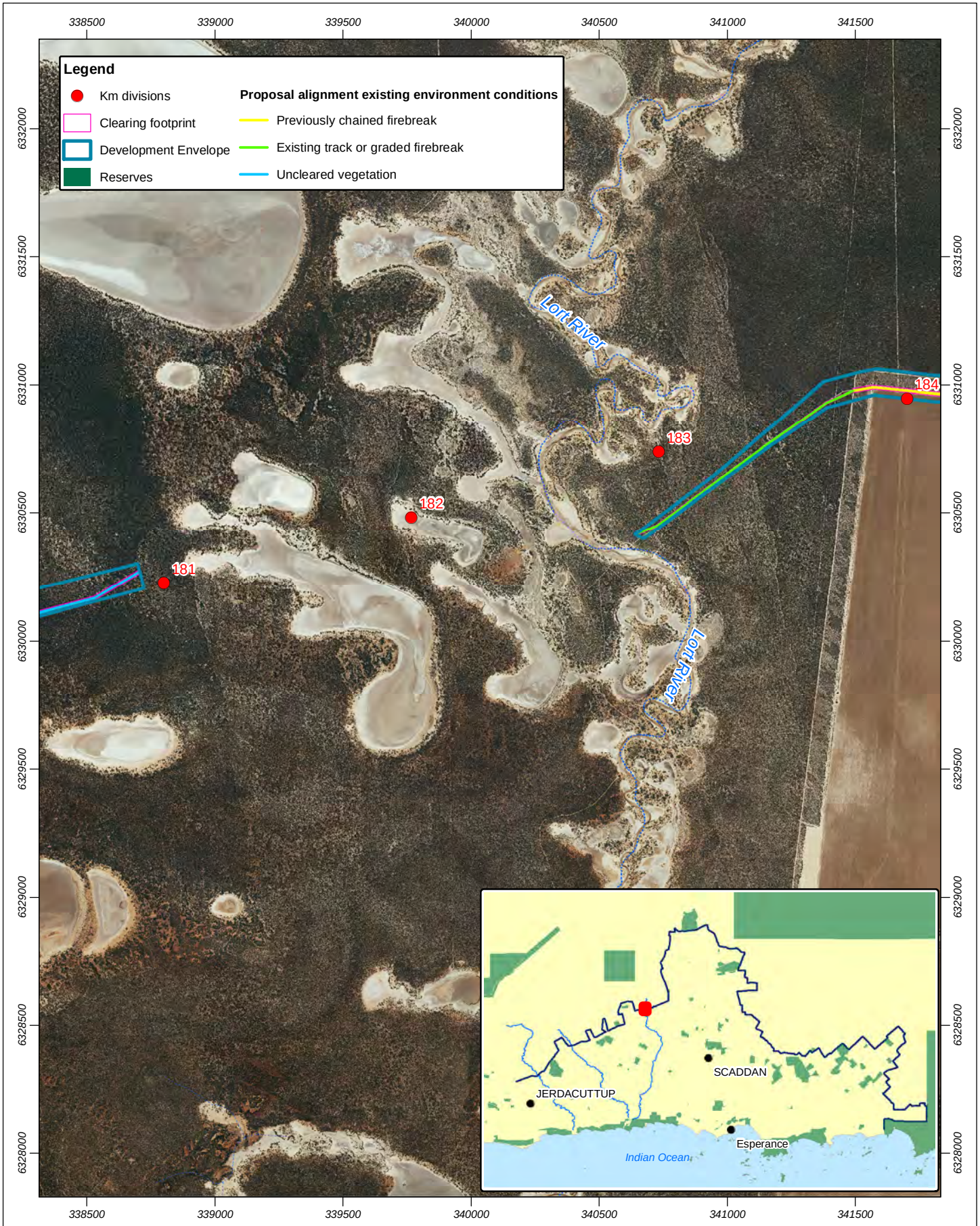


Figure 10-9: Lort River 2 km Proposal alignment gap

Scale 1:20,000 at A4

0 50 100 150 200 250 m

Coordinate System: GDA 1994 MGA Zone 51

Note that positional errors may occur in some areas

Date: 1/08/2017

Author: DWhite

Source: Aerial: Client 2016; Watercourse: SLIP database, Landgate 2017

km divisions based on previous Proposal alignment options

Path: Q:\Consult\2016\DAF\DAF16515\ArcMap_documents\R001\DAF16515_01_R001_RevE_F0010-9.mxd

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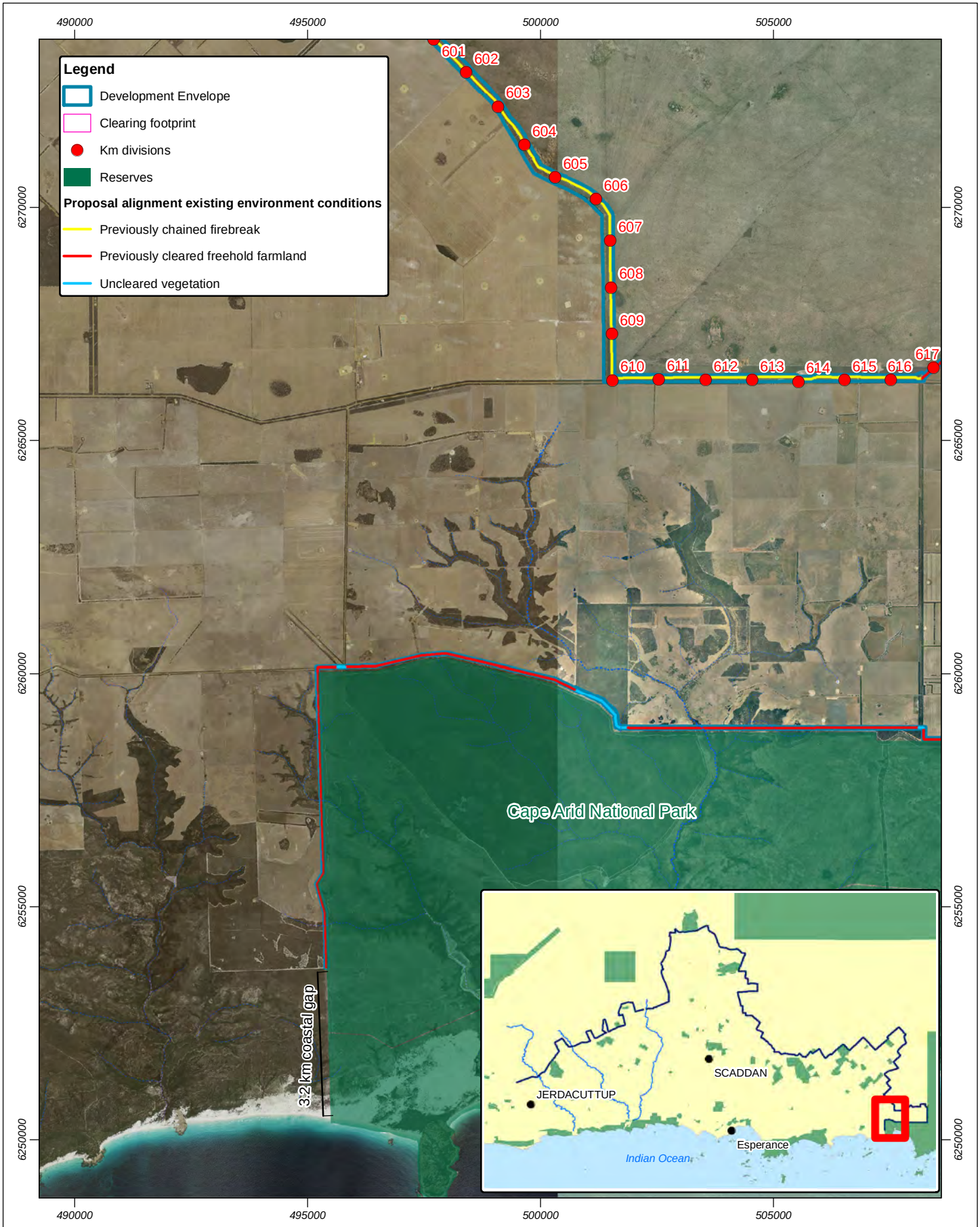


Figure 10-10: Coastal 3.2 km Proposal alignment gap

Scale 1:110,000 at A4

0 1 2 3 4 5 Kilometers

N

Coordinate System: GDA 1994 MGA Zone 51

Note that positional errors may occur in some areas

Date: 1/08/2017

Author: DWhite

Source: Aerial: Client 2016; Watercourse: SLIP databse, Landgate 2017

km divisions based on previous Proposal alignment options

Path: Q:\Consult\2016\DAF\DAF16515\ArcMap_documents\R001\DAF16515_01_R001_RevE_F0010-10.mxd

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10.7 Assessment of predicted direct and indirect residual impacts

As stated in Section 10.4 the ESD has identified the following potential impacts on the environmental factor Terrestrial Fauna:

1. Direct impacts to fauna through collisions and entrapment with the fence.
2. Direct and indirect impacts to fauna through the clearing of fauna habitat.
3. Direct and indirect impacts to fauna from fragmentation of habitat and a reduction in ecological connectivity.
4. Indirect impacts to fauna may occur as a result of:
    - prevention of dispersal and access to resources
    - restriction of fauna movement during fires
    - separation, isolation and changes of populations and faunal communities resulting in loss of genetic diversity
    - changes to predator behaviour such as preferential predation along fence lines
    - changes to feral animal abundance and distribution
    - changes in anti-predator behaviour in prey species.

Table 10-12 provides a summary of the potential impact risks for each conservation significant fauna species. Sections 10.7.1 to 10.7.4 present an assessment of predicted direct and indirect residual impacts on fauna after the mitigation hierarchy has been applied (as described in Section 10.5).

Table 10-12: Summary of potential impacts risks for conservation significant fauna

Species	Occurrence	Habitat type*	Direct impact			Indirect impact
			Collision	Clearing of habitat	Fragmentation	
Mammals						
Dasyurus geoffroii Chuditch or Western Quoll	Present	1,4,7	-	Minor	-	-
Phascogale calura Red-tailed Phascogale	Likely	1,2,3,4,5,7	-	-	Minor	Minor Predation
Isoodon obesulus fusciventer Quenda	Present	2,3,5,6,7	-	Minor	Minor	Minor Predation
Notamacropus [Macropus] irma Brush Wallaby	Present	1,2,3,4,7	Minor	-	Minor	-
Nyctophilus major Greater Long-eared Bat	Potential	1,4,7	Minor	Minor	-	-
Pseudomys occidentalis Western Mouse	Potential	2,3	-	Minor	Minor	Minor Predation
Pseudomys shortridgei Heath Mouse	Unlikely	-	-	-	-	-
Acanthophis antarcticus Southern Death Adder	Likely	1,2,3,4,5	-	Minor	-	-

Species	Occurrence	Habitat type*	Direct impact			Indirect impact
			Collision	Clearing of habitat	Fragmentation	
Paroplocephalus atriceps Lake Cronin Snake	Potential (northwest part)	Any	-	Minor	-	-
Birds						
Leipoa ocellata Malleefowl	Present	1,2,3,4,5	H,P,C - minor	-	-	-
Plegadis falcinellus Glossy Ibis	Likely visitor	6,8	-	-	-	-
Falco peregrines Peregrine Falcon	Likely	any	-	Minor / none	-	-
Charadrius rubricollis Hooded Plover	Likely (winter)	6,8	-	Minor	-	-
Actitis hypoleucos Common Sandpiper	Potential visitor	6,8	-	Minor	-	-
Tringa nebularia Common Greenshank	Likely visitor	6,8	-	Minor	-	-
Tringa stagnatilis Marsh Sandpiper	Potential visitor	6,8	-	Minor / none	-	-
Tringa glareola Wood Sandpiper	Likely visitor	6,8	-	Minor	-	-
Calidris canutus Red Knot	Potential visitor	6,8	-	Minor / none	-	-
Calidris ruficollis Red-necked Stint	Likely visitor	6,8	-	Minor	-	-
Calidris acuminata Sharp-tailed Sandpiper	Likely visitor	6,8	-	Minor	-	-
Calidris ferruginea Curlew Sandpiper	Likely visitor	6,8	-	Minor	-	-
Calyptorhynchus latirostris Carnaby's Black-Cockatoo	Present	1,2,3,4,5,7	-	Minor	-	-
Platycercus icterotis xanthogenys Western Rosella	Present	any	-	Minor	-	-
Pezoporus flaviventris Western Ground Parrot	Potential	2,3,5	Minor/none	-	-	-
Merops ornatus Rainbow Bee-eater	Present	all	-	Minor	-	-

Species	Occurrence	Habitat type*	Direct impact			Indirect impact
			Collision	Clearing of habitat	Fragmentation	
Psophodes nigrogularis Oberon Western Whipbird	Potential	1,2,4,5 (western part)	-	Minor	-	-

*Habitat type: As per Table 10-4.

10.7.1 Direct impacts to fauna through collisions and entrapment

A range of species including large mammals and emus, but also including other birds (some nocturnal species), bats, reptiles and smaller mammals can be affected by collisions and entanglement with fences resulting in mortality (Caughley et al. 1987; van der Ree 1999; Long & Robley 2004 cited in DAFWA 2016b). As a result, some fauna entanglements/collisions were identified in the ESD to be a potential impact resulting from the Proposal.

Kangaroo and emus

Injury to emus and kangaroos is most likely to occur when large numbers congregate along the Proposal alignment and/or animals are stressed by humans (e.g. legal or illegal shooting, pursuit with vehicles or dogs) (DAFWA 2001; Johnson 2006 as cited in Ecoscape 2017a).

The existing SBF is regularly inspected by DPIRD for entrapment monitoring and maintenance purposes. Inspections are undertaken by DPIRD staff looking in detail for any trapped fauna, broken wires, erosion or other maintenance concerns.

A total of 40 kangaroo and emu entrapments (plus one goat) over the eight year period (2007–2015) along 1190 km of the existing SBF was recorded by DPIRD staff (Figure 10-11). The frequency of recorded wildlife entanglements is very low with an average of 0.0043 animals entangled per km per year. This may be an underestimate of animals affected by the existing SBF due to:

- potential for rapid decomposition or scavenging removing visible signs of carcasses before seen by DPIRD staff (this applies particularly to relatively small species such as birds)
- some mortality may occur after animals are injured by collision but are able to escape from the fence, and; therefore, not recorded
- collisions and entanglements are expected to be most likely to occur immediately after construction, as animals are unfamiliar with the barrier across their usual movement paths (Long & Robley 2004 cited in Ecoscape 2017a), this is supported by the following observations from DPIRD fence staff who have noted:
    - mortality to kangaroos was highest in the first year of construction of the 170 km Yilgarn Gap in 2013–seven kangaroos became entangled and died over the first 12 months
    - the number of kangaroo carcasses removed from the Yilgarn Gap after the first year declined with 6 kangaroo carcasses removed in 2015, and 4 kangaroo carcasses removed in 2016
- mortality may be much higher during emu migration events, none of which occurred in the period for which data were available.

The numbers are still likely to be very low despite the underestimate of the frequency of entanglements for the existing SBF.

In a broader context, a review of feral animal exclusion fences for conservation purposes across Australia was undertaken by Long & Robley (2004, cited in DAFWA 2016b). The review found that occurrence of native animals injured or killed due to exclusion fences is infrequent, and not expected to constitute a serious impact on resident fauna populations. The fences in this review were also generally much taller, electrified, barbed and/or had significantly smaller mesh size than the Proposal specifications. Recommendations made in Long & Robley (2004) to mitigate entanglement or collisions of wildlife with the fence included larger mesh size, plain wire as opposed to barbed wire, lower fence heights, high visibility materials attached to the fence (these materials also recommended by DBCA [Burbidge A 2016 pers. comm. 19 April]) and regular inspections; all of which have been incorporated into the Proposal (Section 10.5).

Short-beaked Echidna

Concern for the Short-beaked Echidna, which could become caught while burrowing under or attempting to push through the mesh of the proposed barrier fence, was raised during the stakeholder consultation process.

No records of entanglement or injury of the Short-beaked Echidna has been recorded for the existing SBF. The potential for entanglement or injury for the Short-beaked Echidna is not expected due to (Mawson P [Perth Zoo] 2016 pers. comm. 13 December):

- the 10x15 cm mesh size for the proposed barrier fence is large enough for juveniles of the species to pass through
- entrapment of Echidnas due to their spines is only an issue if the proposed barrier fence is electrified, which is not part of the Proposal
- the behaviour of echidnas to avoid passages less than their shoulder width.

Although larger animals would be easier to identify trapped in the proposed barrier fence due to their size and the length of time their carcass remains, the fact that there have been no records of smaller fauna trapped in the existing SBF indicates that this is not expected to occur regularly. In addition to the regular monitoring, DPIRD installed motion detecting cameras along the existing SBF between Lake Moore, south of Payne's Find and the Great Northern Highway near Kalbarri National Park over a 14 month period from August 2014 to September 2015. This equates to 2311 "camera trap days". No collision or entanglement of any species was recorded over this period.

Western Ground Parrot

The general risk of fauna entanglement for non-target species is expected to be negligible; however, any injury or mortality to Western Ground Parrot would be treated as highly significant due to their Critically Endangered status with approximately 110 birds left in the wild. DBCA advised deaths due to collision between Western Ground Parrots and the proposed barrier fence are possible, but the Department is uncertain whether there is likely to be a population level impact. The known range of the species is approximately 2 km south of the Proposal alignment in Cape Arid NP but could extend to the proposed barrier fence (Ecoscape 2017a;Figure 10-2).

Mortality from a single fence collision has been documented in the closely related Night Parrot *Pezoporus occidentalis* (Ecoscape 2017a). The Proposal alignment does not intersect any known occupied habitat or paths between inhabited sites so intersection with the proposed barrier fence is expected to be unlikely for the existing population. However, juvenile or young birds can travel several kilometres from breeding grounds and into farmland areas and could intersect the Proposal. The risk of impact on populations cannot be quantified but is expected to be low, particularly because young birds dispersing long distances are likely to be lost to the breeding population in any case, due to the low probability of encountering suitable habitat and mates.

To further reduce the risk to the Western Ground Parrot, the Proposal includes fluorescent orange droppers every 2.3 m between fence posts within the 115 km section of the Proposal alignment adjacent to the Cape Arid NP. This mitigation will increase the visibility of the fence and will reduce the potential for bird collisions.

Mitigation strategies

Previous monitoring by DPIRD indicates that kangaroos and emus are the most susceptible to collision and entanglement. These collisions are very rare unless animals are put under stress (e.g. by hunting in vehicles). The Proposal has been adjusted to minimise the risk of fauna collisions and entanglement through:

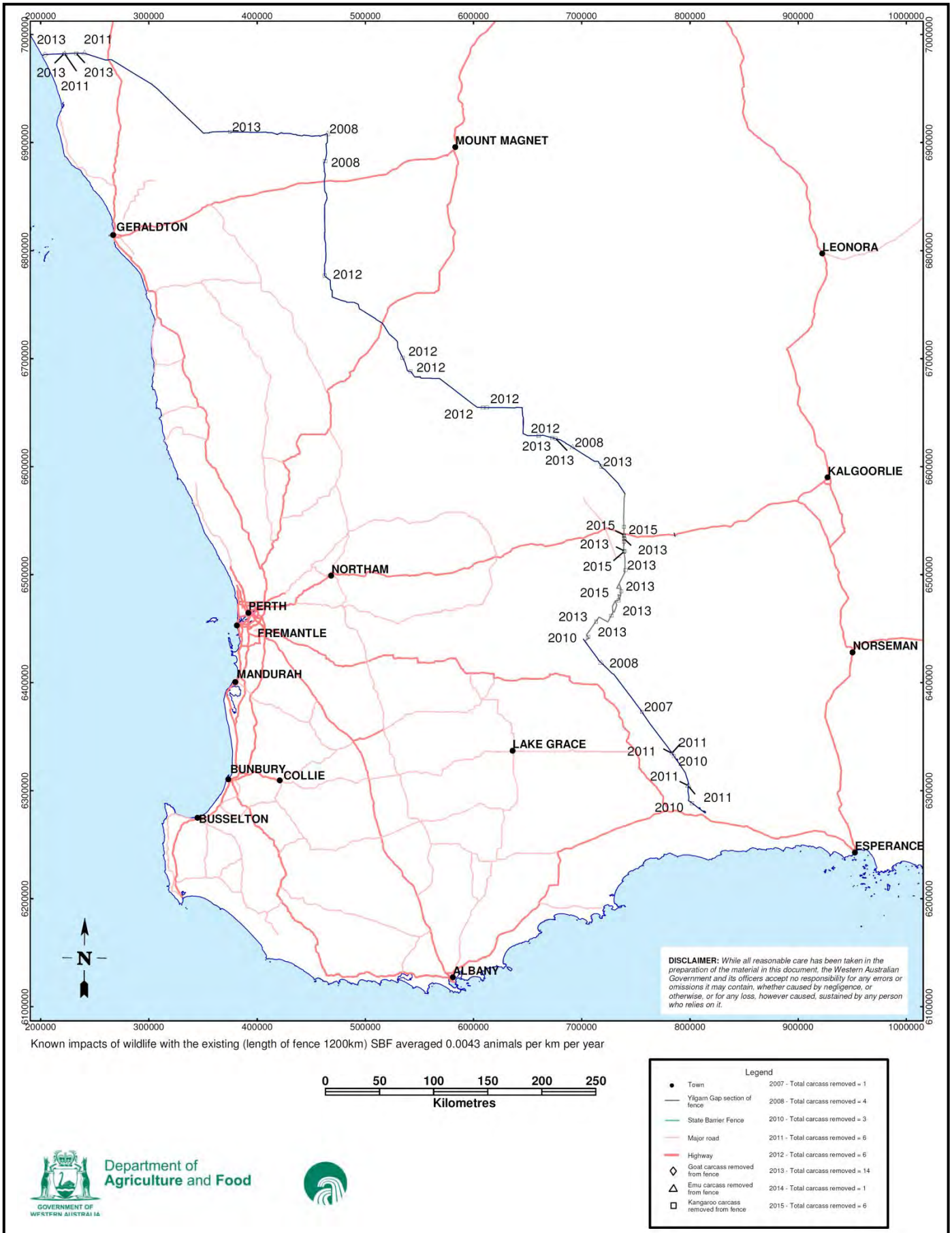
1. Restricting public access along the Proposal alignment– access will be legally prohibited unless a permit is issued by DPIRD. DPIRD has power under BAM Act to issue Infringement Notices for illegal access to the proposed fence.
2. Fence design to incorporate:
   - high visibility fluorescent orange droppers every seven metres (half way between fence posts which are also seven metres apart) to increase fence visibility to fauna
   - a doubling of the number of fluorescent orange fence droppers (two droppers 2.3 m apart between the star pickets which are seven metres apart) along approximately 115 km of Proposal alignment near the Western Ground Parrot habitat at Cape Arid NP
   - fence mesh dimensions are large enough to allow the majority of fauna species to pass through
   - no barbed wire or electrical wires will be used to reduce entanglement and injury potential
   - Proposal alignment to avoid bottlenecks/acute angles that emus may aggregate in.
3. Implementation of an Emu Migration procedure by DPIRD which includes measures to minimise human pressures on emus during migration or if animals are intersecting the proposed barrier fence.
4. Amending the Proposal alignment to minimise the creation of semi-enclosed 'pockets' of vegetation outside the proposed barrier fence. If the Proposal alignment had been deviated to exclude all contiguous remnant vegetation from the agricultural area this would have created pockets of vegetation with a barrier fence on three sides and the potential for fauna to become trapped. The potential avoidance of habitat fragmentation was not considered by DPIRD in all cases to be of sufficient benefit to counter the potential risk to fauna of enclosed pockets.
5. Implementation of the following plans:
   (a) CMP–actions to include:
   - pre-clearing survey for potential black-cockatoo hollows prior to construction works and avoidance where practical of the 103 potential habitat trees identified within vegetation in the Salmon Gum section of the Proposal alignment
   - no clearing between August and November for sections of the Proposal alignment adjacent to Cape Arid NP, to minimise impacts on breeding and juvenile Western Ground Parrots
   - accurately delineating the fence reserve boundary via pegging to provide accuracy to the limits of the allowable clearing lines
   - targeted searches for conservation significant fauna (such as Malleefowl mounds), including significant trees and hollows will be undertaken prior to clearing within any section of the Proposal alignment that has not been previously surveyed[11] (due to changes as a result of avoidance of heritage or ecological values)
   - avoid or minimise impacts to habitat features of conservation significant habitat features (such as Malleefowl mounds and potential habitat trees) based on outcomes of searches
   - avoidance of priority areas containing conservation significant habitat features (such as Malleefowl mounds and significant trees) during installation of water diversion turnouts
   - restriction of public access to the proposed barrier fence to minimise stress to animals
   - further contingency measures to be developed in consultation with DBCA and implemented in order to avoid or minimise impacts to significant fauna if identified during searches

[11] A targeted search for potential habitat trees has been undertaken, which identified that there are 103 trees that could be affected by the clearing. While these trees will be avoided where possible, a pre-clearing survey will be conducted for the trees where clearing cannot be avoided.

(b) PPCMP–actions to include:

- predator (wild dogs and fox) control measures 0–20 km from Proposal alignment, including proposed barrier fence gaps (Oldfield River, Lort River, Young River and 3.2 km coastal gap), and previously uncleared areas.

Based on the mitigation incorporated into the Proposal, the risk of fauna entanglement is expected to be minor for kangaroos and emus and negligible for non-target species, with the exception of the Western Ground Parrot where risk is uncertain.



Source: Ecoscape (2017a)

Figure 10-11: State Barrier Fence Wildlife Entanglement Data from January 2007 to June 2015

10.7.2 Direct and indirect impacts through clearing of fauna habitat

The Proposal will result in the loss or disturbance of up to 816 ha of fauna habitat. The Proposal has been designed to minimise clearing of fauna habitat by:

- only requiring full vegetation clearing (grading) of a 6 m wide track, and the remaining width of the clearing footprint (up to 14 m) will be chained or potentially mulched
  - the inner most graded DBCA fire track will preferentially be used or re-graded where possible
- allowing a 20 m wide clearing footprint in previously uncleared areas (particularly Salmon Gum habitat) to reduce trees falling and damaging the integrity of the proposed barrier fence, and to also allow a greater distance for fauna to 'pull up'/avoid colliding with the proposed barrier fence if they are moving quickly through the bush
- adjusting the alignment to utilise existing cleared areas where possible
- implementing the CMP.

Following the implementation of mitigation measures outlined in Table 10-10, the disturbance will consist of:

- 373.8 ha (45.8%) of re-chaining within existing chained fire management buffers
- 248.6 ha (30.5%) of grading (full clearing) within existing chained fire management buffers
- 146.0 ha (17.9%) of chaining within uncleared areas
- 41.6 ha (5%) of permanent grading (for a 6 m wide access track) within uncleared vegetation
- 6 ha full clearing for water diversion turnouts (potential impacts on vegetation from water turnouts are presented in Section 9.6.1.

A total of 129.4 km of the Proposal alignment will be undertaken within private property and requires no vegetation clearing.

New disturbance to fauna habitat is limited to 188.0 ha (22.5% of total vegetation disturbance), predominantly north of Salmon Gums township in the northern section of the Proposal alignment. Approximately, 5% of the vegetation clearing is full clearing within previously uncleared areas. As the Proposal alignment follows the edge of the agricultural area and is adjacent to almost 16 million ha of uncleared vegetation in the Great Western Woodlands, the loss of fauna habitat overall is not considered significant.

Of the conservation listed fauna species that were identified in desktop searches as potentially occurring in the vicinity of the Proposal alignment, many were considered 'out of range' or to have negligible potential for interaction with the proposed barrier fence or associated vegetation clearing due to the habitat preference of the species concerned. In every other case, potential impacts were considered by Ecoscape (2017a) to be 'minor' in proportion to the current distribution and populations (Ecoscape 2017a). A summary assessment of potential impact on conservation significant fauna listed under both EPBC Act and WC Act and likely or known to occur in the Proposal area is provided below.

Chuditch or Western Quoll

There is extensive habitat surrounding the proposed fence alignment (refer to Table 10-4, Table 10-6, Table 10-7), as such the clearing of undisturbed vegetation is unlikely to have a significant impact on the species. Due to the low density and large individual ranges in this species, direct impacts of associated clearing on individuals are likely to be minor. Disruption of den/refuge sites may be more significant, and care should be taken to minimise disturbance of hollow logs or existing burrows (Ecoscape 2017a).

Red-tailed Phascogale

There is some potential habitat present in the proposed alignment i.e. eucalypt woodlands that contain large trees with the potential for hollows (Ecoscape 2017a). However, the old growth Wandoo woodlands where this species now persists is absent from the proposed alignment; therefore, the proposed clearing of undisturbed vegetation is unlikely to have a significant impact on the species.

Malleefowl

There is extensive Malleefowl habitat surrounding the proposed barrier fence alignment (refer to Table 10-4, Table 10-6, Table 10-7 and Ecoscape 2017a),as such the clearing of undisturbed vegetation is unlikely to have a significant impact on the species.

Carnaby's Black Cockatoo

A total of 103 potential habitat trees (i.e. trees considered large enough for breeding/nesting) were identified within a 20 m corridor of the Proposal alignment in an area of potential fauna habitat near Salmon Gums; however, the proposed alignment is outside of the species' breeding range (Table 10-8, Ecoscape 2017a and GS Biologic 2017). As there is extensive of Carnaby's Black Cockatoo foraging habitat surrounding the proposed barrier fence alignment (refer to Table 10-4, Table 10-6, Table 10-7 and GS Biologic 2017), the clearing of undisturbed vegetation is unlikely to have a significant impact on the species foraging habitat.

Further information on the impact assessment for conservation significant fauna is provided in the Ecoscape (2017a) report (Appendix 3).

Cumulative impacts

The development of the Esperance region for agriculture between the 1960s and 1980s means that the landscape between the Great Western Woodlands and the coast is predominantly cleared and habitat remnants are highly fragmented. The Proposal alignment follows the edge of the Esperance agricultural area with largely cleared farmland to the south and largely intact vegetation in the lower rainfall Great Western Woodlands to the north and east.

The additional clearing of up to 816 ha of fauna habitat, with 20% of the clearing footprint in previously undisturbed areas, will not significantly change the availability of fauna habitat either locally or regionally.

Significant habitat fragmentation effects have largely been avoided through the maintenance of ecological corridors and Proposal alignment along the boundary of the agricultural area (Section 10.7.3).

Pre-existing clearing and disturbance in the region has resulted in some species being threatened. As no significant impact on conservation significant species is predicted, the Proposal is not expected to affect the conservation status of any of these species.

10.7.3 Direct and indirect impacts to fauna from fragmentation

Clearing of native vegetation results in fragmentation, the process by which initially contiguous areas of habitat are separated into a number of smaller areas. Fragmentation impacts include the creation of small isolated populations with limited gene flow between populations, leading to inbreeding depression and reduced potential to adapt to environmental change. Fragmentation also leads to the loss or severe modification of the interactions between species, including those interactions that are important for the survival of species. Small isolated populations may be subject to local extinction from stochastic events. The hostility of the surrounding (cleared) environment is a major factor in limiting movement of organisms between patches. The physical environment within patches may be altered as a result of creation of edges and anthropogenic influences.

Important variables that must be considered in assessing the impacts of fragmentation include the distance apart of the fragments, the area of the fragments and their shape. Increasing the edge/area ratio increases the impacts of edge effects such as changed microclimate and susceptibility to invasion by non-indigenous species. This response of particular species to fragmentation will be affected by the mobility of the species (both as adult and in dispersal stages) and the scale of the fragmentation relative to the environmental scale of the species habitat.

Fragmentation of habitat has largely been avoided by closely following the boundaries of the agricultural area, utilising previously cleared areas such as existing farm boundary fences, roads and firebreaks and through leaving gaps in the proposed barrier fence for the main ecological corridors along the Lort, Young and Oldfield Rivers and along the coast. Along much of the alignment the Proposal represents a hardening of existing barriers associated with existing farm boundary fences and clearing (such as that present across Thomas River). A total of 69.3 km of the Proposal alignment traverses uncleared areas with no previous disturbance.

The notable exception to the strategy of following the agricultural boundary is in areas where remnant vegetation extends into the agricultural area and exclusion of the area would create a semi-enclosed pocket of vegetation which could become a trap for fauna.

Fragmentation risks to species depend on their size, habitat requirements and movement patterns. The Proposal is designed to prevent access of large fauna; however, populations of kangaroos and emus will continue to exist within the proposed barrier fence and be connected to the outside populations through the gaps in the alignment. Wild dogs are already actively managed within the agricultural area and no significant change to the population is expected.

Small fauna will be able to readily pass through the proposed barrier fence, but the clearing associated with the construction of the proposed barrier fence will contribute to existing habitat fragmentation for some species where new clearing is required. Agricultural landscapes contain small remnants of habitat between farmland which are more or less completely uninhabitable for vertebrate fauna species (Ecoscape 2017a). A minority of species can readily cross considerable gaps to make use of isolated remnant vegetation patches, or forage and conduct other activities within farmland. For small woodland and forest vertebrates, including some birds as well as terrestrial species, a 1–200 m strip either completely cleared or reduced to low shrubland by chaining represents a significant barrier to dispersal (Brooker *et al*. 1999 as cited in Ecoscape 2017a). For species unable to easily cross such gaps, it may lead to genetic isolation and risk of long-term decline, similar to those target species blocked by the proposed barrier fence itself. However, this impact will be relatively low because most parts of the corridor are at the boundary of previously cleared land.

Medium size fauna was expected to be the most likely to be at risk of habitat fragmentation. The Brush Wallaby (Priority 4) and unlisted Short-Beaked Echidna were identified as being at risk from loss of ecological connectivity. To determine the possible effect of habitat fragmentation on the Brush Wallaby from the Proposal, an assessment was conducted by Everard & Bamford (2016) of the areas of remnant vegetation situated inside the fence. Further consideration of the echidna concluded that adult echidnas are strong diggers and could burrow under the proposed barrier fence (and lap wire) if needed while juvenile echidnas could climb through (Mawson P [Perth Zoo] 2016 pers. comm. 13 December).

Fifteen areas of remnant vegetation (Table 10-13 and Figure 10-12) that potentially could be affected by fragmentation (inside and close to the fence) were identified, comprising both DBCA managed land and other remnant vegetation held in freehold or by the Shire of Esperance (Everard & Bamford 2016). Vegetation remnants that occur along the south coast (where vegetation is more or less continuous) or in areas connected to a river system will maintain ecological connectivity through unfenced gaps in the Proposal alignment and these were not identified as being at risk. Areas of vegetation at risk also did not include the many small fragments of native vegetation that are already largely isolated within the agricultural landscape.

Table 10-13: Vegetation remnants potentially at risk of fragmentation inside the Proposal alignment

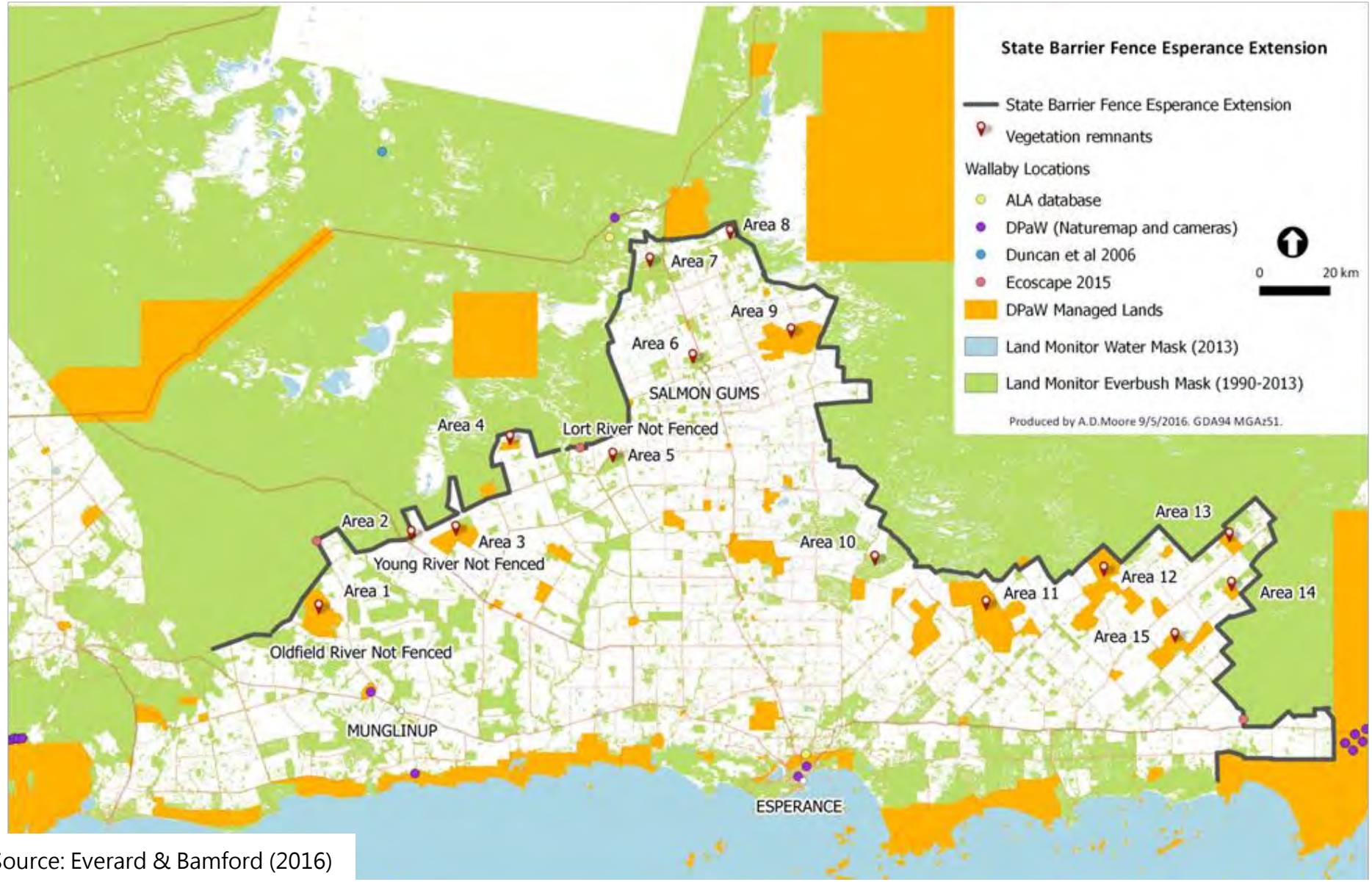
Native vegetation remnants	Tenure	Vegetation type	Area (ha)
Area 1–Cheadanup Nature Reserve, R 31754	DBCA	Mallee - Eucalypt shrubland *Eucalyptus eremophila*, *E. redunca*, *E*. spp. (Beard *et al.* 2013).	6828
Area 2–Cascades Road, east of Young River	Other*	Mallee - Eucalypt shrubland *Eucalyptus eremophila*, *E. redunca*, *E*. spp. (Beard *et al.* 2013).	400
Area 3–Griffiths Nature Reserve, R 30583	DBCA	Mallee - Eucalypt shrubland *Eucalyptus eremophila*, *E. redunca*, *E*. spp. (Beard *et al.* 2013).	5415

Native vegetation remnants	Tenure	Vegetation type	Area (ha)
Area 4–Nature Reserve, R 43949	DBCA	Mallee - Eucalypt shrubland *Eucalyptus eremophila*, *E. redunca*, *E*. spp. (Beard *et al.* 2013). Woodland-other - Wheatbelt; York gum, salmon gum etc. *Eucalyptus loxophleba*, *E. salmonophloia*. Goldfields; gimlet, redwood etc. *E. salubris, E. oleosa*. Riverine; rivergum *E. camaldulensis* (Beard *et al.* 2013).	717
Area 5–Williams Road, East of Lort River	Other*	Mallee - Eucalypt shrubland *Eucalyptus eremophila*, *E. redunca*, *E*. spp. (Beard *et al.* 2013). Woodland-other - Wheatbelt; York gum, salmon gum etc. *Eucalyptus loxophleba*, *E. salmonophloia*. Goldfields; gimlet, redwood etc. *E. salubris, E. oleosa*. Riverine; rivergum *E. camaldulensis* (Beard *et al.* 2013).	2700
Area 6–Salmon Gums	Other*	Woodland / Mallee (Beard *et al.* 2013).	~ 3000
Area 7–West of Coolgardie – Esperance Highway	Other*	Woodland / Mallee (Beard et al. 2013).	~12000
Area 8–Fagan Road, East of Coolgardie – Esperance Highway	Other*	Woodland / Mallee (Beard et al. 2013). Woodland-other - Wheatbelt; York gum, salmon gum etc. *Eucalyptus loxophleba*, *E. salmonophloia*. Goldfields; gimlet, redwood etc. *E. salubris, E. oleosa*. Riverine; rivergum *E. camaldulensis* (Beard *et al.* 2013).	~6150
Area 9–Salmon Gums Nature Reserve, R 33113	DBCA	Woodland / Mallee (Beard et al. 2013).	~14780
Area 10–Mount Ridley Nature Reserve, R 27386 and other land	DBCA, Other*	Mallee - Eucalypt shrubland *Eucalyptus eremophila*, *E. redunca*, *E*. spp. (Beard et al. 2013).	1417 and ~36 800
Area 11–Kau Nature Reserve, R 32777	DBCA	Mallee - Eucalypt shrubland *Eucalyptus eremophila*, *E. redunca*, *E*. spp. (Beard et al. 2013). Woodland-other - Wheatbelt; York gum, salmon gum etc. *Eucalyptus loxophleba*, *E. salmonophloia*. Goldfields; gimlet, redwood etc. *E. salubris, E. oleosa*. Riverine; rivergum *E. camaldulensis* (Beard et al. 2013).	8544
Area 12–Beaumont Nature Reserve, R 32783	DBCA	Mallee - Eucalypt shrubland *Eucalyptus eremophila*, *E. redunca*, *E*. spp. (Beard et al. 2013). Thicket - Wattle, casuarina and teatree acacia-*allocasuarina-melaleuca* alliance (Beard *et al.* 2013).	7078
Area 13–Clyde Hill Nature Reserve, R 38545	DBCA	Mallee - Eucalypt shrubland *Eucalyptus eremophila*, *E. redunca*, *E*. spp. (Beard et al. 2013). Salt lake, lagoon, clay pan (Beard *et al*. 2013).	1669
Area 14–Niblick Nature Reserve, R 38544	DBCA	Mallee - Eucalypt shrubland *Eucalyptus eremophila*, *E. redunca*, E. spp. (Beard et al. 2013).	838
Area 15–Muntz Nature Reserve, R 31799 and Neredup Nature Reserve, R 32784	DBCA	Mallee - Eucalypt shrubland *Eucalyptus eremophila*, *E. redunca*, E. spp. (Beard et al. 2013). Mallee-heath - Mixed heath with scattered mallee e.g. tallerack *Eucalyptus tetragona* (Beard et al. 2013). Salt lake, lagoon, clay pan (Beard et al. 2013).	2750

*Other: freehold, unallocated crown land or Shire land.
Adapted from: Everard & Bamford (2016).

Everard & Bamford (2016) concluded that Brush Wallaby populations were most at risk in remnants smaller than 1500 ha and where there is a lack of connectivity between remnants on the agricultural side of the Proposal alignment. Three of the fifteen remnants identified in Table 10-13 were smaller than 1500 ha. The potential for genetic isolation in these areas is further discussed in Section 10.7.4.

The Proposal will contribute to existing habitat fragmentation at the boundary of the agricultural area; however, the impacts are expected to be minor and not significantly affect any fauna abundance, distribution or diversity in the region.



Source: Everard & Bamford (2016)

Figure 10-12: Regional Brush Wallaby records and areas of remnant native vegetation

10.7.4 Indirect impacts to fauna

Indirect impacts to fauna as a result of the Proposal were identified in the ESD:

- prevention of dispersal and access to resources
- restriction of fauna movement during fires
- separation, isolation and changes of populations and faunal communities resulting in loss of genetic diversity
- changes to predator behaviour such as preferential predation along fence lines
- changes to feral animal abundance and distribution
- changes in anti-predator behaviour in prey species.

Prevention of dispersal and access to resources

Fragmentation risks associated with the Proposal include the prevention of access to resources. Most species are not expected to be reliant for survival on resources such as water and food sources on the other side of the Proposal alignment. This has not been identified as a risk for Brush Wallaby (Everard & Bamford 2016) but may affect individuals and local populations of emus and kangaroos used to foraging on the relatively high energy content of crop lands or pastures and drinking from anthropogenic water sources. Considering the isolated, remnant nature of habitat within the agricultural zone, the construction of the proposed barrier fence would represent a hardening of a barrier rather than a new barrier along most of the Proposal alignment.

Emu migration events resulting in high numbers of emus along the SBF have been found to correspond to drought conditions that prevail about every 7-11 years (DAWA 2001 as cited in Ecoscape 2017a). Other factors which may influence emu migrations include vegetation condition, seasonal variables or specific weather events (Ecoscape 2017a).

One of the main intended functions of the existing SBF is to prevent or limit movement of emus from the arid shrubland towards near-coastal croplands during times of peak population pressure and/or drought-induced food and water stress (Ecoscape 2017a). Therefore, the Proposal is expected to largely prevent migrating emus from rangeland or woodland areas from accessing resources within the agricultural area. Emus will still be able to utilise the ecological corridors along the Lort, Young and Oldfield Rivers and some emus may still reach the coast to the east of the agricultural area. The prevention of access to anthropogenic food and water sources during a drought is not expected to have a significant ecological impact.

To minimise the risk of emu mortality during migrations, access to the proposed barrier fence will be managed to avoid hurrying or harassing the emus. Individuals that are weak and can no longer walk will be euthanized.

Legislation under the Biosecurity and Agriculture Management Regulations 2013 governing barrier fences is intended to impede the movement of declared pests such as emus and wild dogs via erecting, maintaining and managing barrier fences. The legislation also has provisions to control the movement of people and vehicles along barrier fences providing a coordinated and consistent management approach. Without a barrier fence, farmers may attempt to prevent access or cull emus entering their property. A coordinated approach to monitoring and management is considered preferable in terms of the anticipated animal welfare outcomes for migrating emus.

The existing SBF along the interface of the rangelands and northern agricultural region has provided an effective, non-lethal means of emu control during migrations.

Restriction of fauna movement during fires

The Proposal alignment will predominantly be constructed within an existing 80–100 m wide fire buffer area that is designed to protect human life, property and agricultural land from fires that start in the adjacent woodlands. Vegetation within the 15–20 m wide cleared footprint of the Proposal will be maintained and cleared of any larger/flammable vegetation to protect the proposed barrier fence from wildfire and maintain access and fence visibility.

A total of 69.3 km of the Proposal alignment traverses uncleared vegetation with no previous disturbance. In this area, the width of disturbance will be widened to 20 m (including 6 m of grading and 14 m of chaining) to ensure there is an effective firebreak and fence visibility.

The restriction of fauna movement during fire may have a local impact on individuals but is not expected to have a broader population effect.

Separation, isolation and changes of populations and faunal communities resulting in loss of genetic diversity

The likely habitat fragmentation associated with the Proposal is described in Section 10.7.3. Loss of genetic diversity (leading to in-breeding and risk to breeding success) occurs when habitats are fragmented to the extent that there is no genetic exchange between populations.

The unfenced gaps in the proposed barrier fence will enable movement of highly mobile species (such as emus and kangaroos) between the agricultural areas and the outside of the fence. Populations of these species will remain within the agricultural area as they do at the moment. Baiting programs will aim to manage any wild dog and fox populations within the agricultural area.

Small animals will be able to move through or over the fence and will not become genetically isolated as a result of the Proposal.

The Brush Wallaby and the Short-beaked Echidna have been identified as possibly affected by population isolation associated with the proposed barrier fence. Echidnas can dig burrows/tunnels parallel to the surface of the ground for up to 3 m and juveniles are likely to pass through; as such, the fence and lapwire proposed will be no impediment to them (Mawson P [Perth Zoo] 2016, pers. comm. 13 December). Given the fence will not prevent access for echidnas it is not expected that genetic isolation of this species is likely to occur.

The potential for Brush Wallabies to be affected by fragmentation and genetic isolation was assessed in Everard & Bamford (2016) (Appendix 3). Fifteen potentially isolated vegetation remnants within the proposed barrier fence were identified in Table 10-13 and Figure 10-12 ranging in area from 400 ha to 36 800 ha. The area of remnant vegetation required to support a viable population of Brush Wallabies was estimated to be approximately 1500 ha based on literature research and studies at Whiteman Park (Bamford and Bamford 2002). Three of the remnant vegetation areas within the agricultural area are less than 1500 ha in size and; therefore, any resident population could be at risk of increased genetic isolation as a result of the Proposal if there is a lack of internal connectivity between remnants (Everard & Bamford 2016). At Whiteman Park wallabies almost never left cover (Bamford and Bamford 2002), and; therefore, in agricultural areas movement between remnants is expected to occur only if there are corridors of dense vegetation alongside roads. Brush Wallaby populations in small remnants in agricultural areas are expected to be isolated with little if any genetic exchange unless some connectivity exists.

Mills and Allendorf (1996) hypothesise that somewhere between one and ten migrants per generation is sufficient to maintain genetic diversity in substantially isolated mammal populations (Everard & Bamford 2016). The generation time of the Brush Wallaby is estimated to be less than 10 years (Bamford and Bamford 2002) while that of larger macropods is more than 10 years (Russell 1989). It is expected that the migration of one wallaby per year would be sufficient to maintain genetic diversity.

The level of connectivity between native vegetation remnants less than 1500 ha (Table 10-13) is shown in Figure 10-13 to Figure 10-15.

Area 2 (Reserve 30583; Griffiths Nature Reserve) is 400 ha but has road verge and some creek connectivity to the Young River reserves approximately 10 km away (Figure 10-13). It is possible that some animals could successfully utilise those road corridors.

Area 4 (Reserve 43949) has an area of 717 ha. This reserve connects with an approximate 385 ha area of bush to the south via a road reserve. The combined area of these reserves is less than 1500 ha and so any resident population of the Brush Wallaby (if they currently occur) could be at risk of genetic isolation (Figure 10-14).

Area 14 (Reserve 38544, Niblick Nature Reserve) is 838 ha. There are road verge connections to Clyde Hill Nature Reserve (Reserve 38545) comprising 1669 ha to the north, and to Neredup Nature Reserve (Reserve 1720 ha) to the southwest (Figure 10-15). Therefore, this remnant vegetation is at lower risk of becoming genetically isolated.

Of the three reserves identified to be less than 1500 ha and at risk of genetic isolation, two have some connection to other substantial remnants through vegetated road reserves. Area 4 (Figure 10-14) has little connection to other substantial vegetation remnants so any population of the Brush Wallaby (if they occur) could be at risk of genetic isolation. This impact would be highly localised and is not expected to significantly alter the representation of Brush Wallabies in the agricultural area at the regional scale.

In addition to connectivity along road reserves, Brush wallabies have been observed to leap over a 1.2 m capture net (Everard & Bamford 2016), so some individuals may occasionally pass over the proposed barrier fence which is 1.35 m high. The majority of large remnant native vegetation areas inside the proposed barrier fence are also large enough to support viable populations of Brush Wallabies.

Changes to predator behaviour such as preferential predation along fence lines

The Proposal has the potential to create pathways for access to habitats for introduced feral predators such as the red fox, feral cat and wild dogs. Adult foxes may be unable to cross the fence, but younger foxes and cats smaller in size are not expected to be limited by it. Roads (and other cleared areas in fragmented habitat mosaics) are frequently used by feral predators for movement and foraging and may enable predators to access areas of thick or *Gastrolobium*-containing vegetation which would normally provide refuges for prey. This effect may allow increased predator home range size and/or more effective detection and capture of prey.

The Proposal alignment utilises existing disturbance areas where possible with 69.3 km of the 660 km Proposal alignment is within uncleared vegetation. Therefore, the opening up of new pathways for predation is limited to this area.

The Proposal will be implemented in conjunction with an ongoing, long-term baiting program for wild dogs and foxes which will minimise the effect of increased preferential predation along fence lines for these species. Cat numbers and movements are not expected to be significantly affected overall but they could utilise the fence for preferential predation. Feral cats are not currently declared under the BAM Act and therefore cannot be managed under legislation in a similar manner to foxes and wild dogs. Feral cat baiting could be conducted using Eradicat 1080 feral cat baits either as a local program (if approved) or part of a wider fauna recovery program such as Western Shield (if applicable). However, the use of Eradicat 1080 feral cat baits is not proposed as part of this Proposal. The registration of Eradicat restricts its use to lands managed by DBCA and lands approved by DBCA. There is precedence elsewhere in the state for Eradicat use on private land following approval (Rafferty D 2016 [DBCA] pers. comm. 13 January).

Existing management practices for predator and pest control in Esperance

Under the BAM Act landholders and landowners/occupiers are responsible for wild dog and fox control on their own properties. Control techniques to manage wild dogs for the existing SBF include baiting with meat poisoned with 1080 (sodium fluoroacetate) and to a lesser extent, trapping and shooting.

The management approach for the PPCMP integrates existing SBF management practices for predator and pest control. This includes integration of relevant elements of the Western Australian Wild Dog Action Plan 2016–2021 (the Action Plan) (WA WDAG 2016) and the DPIRD Emu Migration Procedure. The PPCMP is complementary to the Action Plan; however, each is to be implemented separately, with the Action Plan to be implemented in full by a range of parties such as private landholders and Biosecurity Groups.

WA Wild Dog Action Plan 2016-2021

The Action Plan is an industry driven plan that considers the economic, environmental and social impacts of wild dogs and identifies key issues for managing them throughout Western Australia. The Action Plan has been designed to protect the livestock industries and public safety, and recognises the ecological and cultural values of the dingo. The Action Plan co-ordinates the control of wild dogs by developing partnership arrangements between industry, Biosecurity Groups, Government and the community to deliver a sustained, whole-of-industry benefit.

The objectives of the Action Plan are to:

- target control appropriate to the local area and wild dog pressure, determined by impact on assets
- reduce the impact of wild dogs on agricultural production and biodiversity by 10% per annum
- ensure Biosecurity Groups are responsible for ongoing integrated control to protect agricultural production and biodiversity
- develop the capacity of the agricultural industry to manage the wild dog impact with identified public support.

Eight key principles to guide future investment and action were identified in the Action Plan to manage wild dogs. These key principles were informed by current research, broad stakeholder consultation and a benefit cost analysis (WA WDAG 2016):

1. **Targeted management**: Western Australia's strategy for managing wild dogs is focused on targeted control appropriate to the local area and wild dog pressure, determined by impact on the assets to be protected. For example, the direct threat to small livestock by wild dogs inside the State Barrier Fence is a high priority for a coordinated campaign aimed at eradication of wild dogs.
2. **Coordination**: The Action Plan recognises that wild dog management requires shared solutions and coordination amongst industry and land managers, in partnership with all levels of government and the community - with a common sense 'no boundary' (nil tenure) approach and delivered at the local level.
3. **Shared responsibility and accountability**: Managing wild dogs requires leadership and engagement from those with 'skin in the game' to invest in maintaining vibrant industries, and with a clear understanding of the roles, responsibilities and accountability under the BAM Act.
4. **Co-investment**: Co-investment in the industry driven Action Plan moving within five years to a focus of self-reliance based on sound infrastructure, and clear systems for governance and funding between affected industries and the public sector.
5. **Proactive management to reduce impact**: Setting strategic direction and priorities for and investment in wild dog management will be based on sound business analysis demonstrating potential for return on investment to achieve a balance between efficacy, humaneness, community perception, feasibility and emergency impact needs.
6. **Research and monitoring**: The development, monitoring and review of integrated wild dog management strategies needs to be underpinned by science and measurable information which in turn will provide confidence to all parties for continued investment and support.
7. **Capacity development**: Effective wild dog management requires capacity-building across industry, land managers, government and the community.
8. **Communication**: Effective and collaborative communication and education will optimise public and community understanding of competing interests, interaction and support, and will assist to inform any future incentives.

The strategies and tactics to be implemented as part of the Action Plan are outlined in Table 10-14.

Table 10-14: Action Plan strategies and associated tactics

Strategy	Tactics
Provide leadership and coordination for effective management of wild dogs in identified priority areas.	1. Establish the Western Australian Wild Dog Alliance to provide integration and alignment with WA Biosecurity Groups and the National Wild Dog Action Plan. 2. Invest in efficient and effective management of Biosecurity Groups to ensure coordinated and cost-effective wild dog management in each region. 3. DPIRD investment will support and collaborate with the Wild Dog Alliance. 4. Ensure the declaration of wild dogs under the BAM Act is appropriate for its current spread and distribution.
Achieve a high level of adoption, responsibility and proactive management of wild dogs.	1. Develop and deliver a comprehensive engagement and communications strategy. 2. Investigate and map the impact of wild dogs on biodiversity and agricultural production. 3. Provide education and information for the community and tourists. 4. Improve engagement of all landholders to become involved in the control program.
Reduce impacts of wild dogs on production to increase economic returns.	1. Complete the State Barrier Fence and strive to maintain its integrity. 2. Targeted use of relevant best practice management determined by economic and technical evaluation. 3. Invest in on property best practice management and encourage and monitor participation. 4. Development of exclusion or cluster fencing including co-funding investment models for cell fencing in strategic regions of the impacted areas of Western Australia. 5. Invest in ongoing research.
Monitor, evaluate and report to inform and continuously improve wild dog management.	1. Integrate with the National metrics program. 2. Feralscan will be the medium for management activity and reporting. 3. Monitor landholder engagement and compliance. 4. Balance the actions of landholders with neighbours and public expectations.

Source: WA WDAG (2016).

The Action Plan has been provided in Appendix 2.

Feralscan

Feralscan is a free online resource for landholders, the community and pest controllers to map sightings of feral animals (including wild dogs, cats, and foxes), their impacts, and control activities in their local area. The program is used to document wild dog activity, communicate impact and control within pre-defined groups of landholders, communicate the problem to members of the public, and identify priority areas for feral animal control.

Western Shield

Western Shield is the DBCA lead animal conservation program. Western Shield aims to return the balance and mix of native animals in selected areas of the WA environment to levels comparable to pre-European settlement, and has a particular focus on threatened species (Parks and Wildlife 2016b).

As part of this conservation effort, Western Shield currently implements and will continue to implement baiting programs targeted at feral foxes and cats. Western Shield wildlife recovery program has continued to implement broad scale, integrated fox and feral cat baiting for native animal conservation. In 2015/2016 approximately 3.8 million hectares of conservation reserves and State forest were baited (Parks and Wildlife 2016b). Western Shield activities are limited to conservation reserves and State forest and cat baiting cannot legally be undertaken outside these areas.

Emergency baiting using Eradicat feral cat baits has been carried out in fire-affected parks and reserves on the south coast to protect threatened species. Eradicat feral cat baits were trialled as part of the Integrated Fauna Recovery Project in Cape Arid, Fitzgerald River and Waychinicup National Parks as well as Mount Manypeaks and Two Peoples Bay nature reserves. Results demonstrated that when combined with fox baiting, Eradicat was effective in reducing the number of feral cats and foxes across the target reserves. Monitoring associated with this project has also recorded increases in the quenda (*Isoodon obesulus fusciventer*) population and stabilisation of the population of the critically endangered Western Ground Parrot in Cape Arid NP.

The Western Shield 1080 poison risk areas for 2015–2020 within the Ravensthorpe, Esperance, Munglinup and Cape Arid region include:

- Fitzgerald NP and Ravensthorpe Range
- Stokes NP located along the southern coastline
- Cape Le Grand NP located south of Merivale Road
- Cape Arid NP associated with Fisheries Road, and Nuytsland NR.

These 1080 poison risk areas are predominantly south of the Proposal alignment and do not cover the three main river systems (Oldfield, Lort and Young River) associated with the gaps in the Proposal alignment.

DPIRD Emu Migration Procedure

The DPIRD Emu Migration Procedure (the Procedure) describes the process to be followed by DPIRD staff to manage an emu migration at the existing SBF. The Procedure is summarised below.

Current operational procedures during an event of an emu migration include:

- notification and documentation of visual observations of increased emu numbers and congregation along the existing SBF to the SBF Manager
- confirmation of the likelihood of a migration, and report to the Director, Invasive Species
- identification of sections of the existing SBF likely to be impacted by the emu migration
- recording of emu numbers and direction of movement along the existing SBF
- restriction of human presence/movement along the existing fence to avoid congregation of emus and pressure on the fence
- application for a Damage Licence from DBCA to enable for the lawful killing of native fauna in the above events
- humane destruction by DPIRD SBF staff of emus found on the SBF Reserve on the inside of the fence during a migration event
- humane destruction by DPIRD SBF staff of any emu outside the existing SBF which is unable to stand or walk
- reporting by DPIRD officers on activity in their area as per the Operations Manager's requirements - this shall include advising other DPIRD staff on the existing SBF of the movement of emu mobs.

The most critical strategy for risk mitigation during migrations is to keep human activity along the proposed barrier fence to a minimum to prevent unlawful culling of emus and to prevent emus being stressed, hurried or forced along/into the proposed barrier fence.

Changes to feral animal abundance and distribution

The number of wild dogs and foxes in the vicinity of the Proposal alignment will be controlled through a sustained baiting program. With the sustained wild dog management that already occurs in the agricultural area, wild dogs are not expected to be at a sufficient density to regulate emus, kangaroos, cats or foxes. As a result, the abundance of foxes and cats within the Esperance agricultural area is not expected to change either side of the proposed barrier fence. There may be some localised increase in rabbits due to the foraging potential associated with re-growth on chained areas. However, rabbits utilise all habitats in the region and numbers are controlled through disease rather than lack of resources.

Changes in anti-predator behaviour in prey species

Long term loss of predators such as wild dogs has been documented to affect the anti-predator behaviour in prey species (Hayward & Kerley 2009). Wild dogs have not been at sufficient numbers to provide a regulatory role in the Esperance agricultural area for some time due to sustained wild dog management so little new impact is expected.

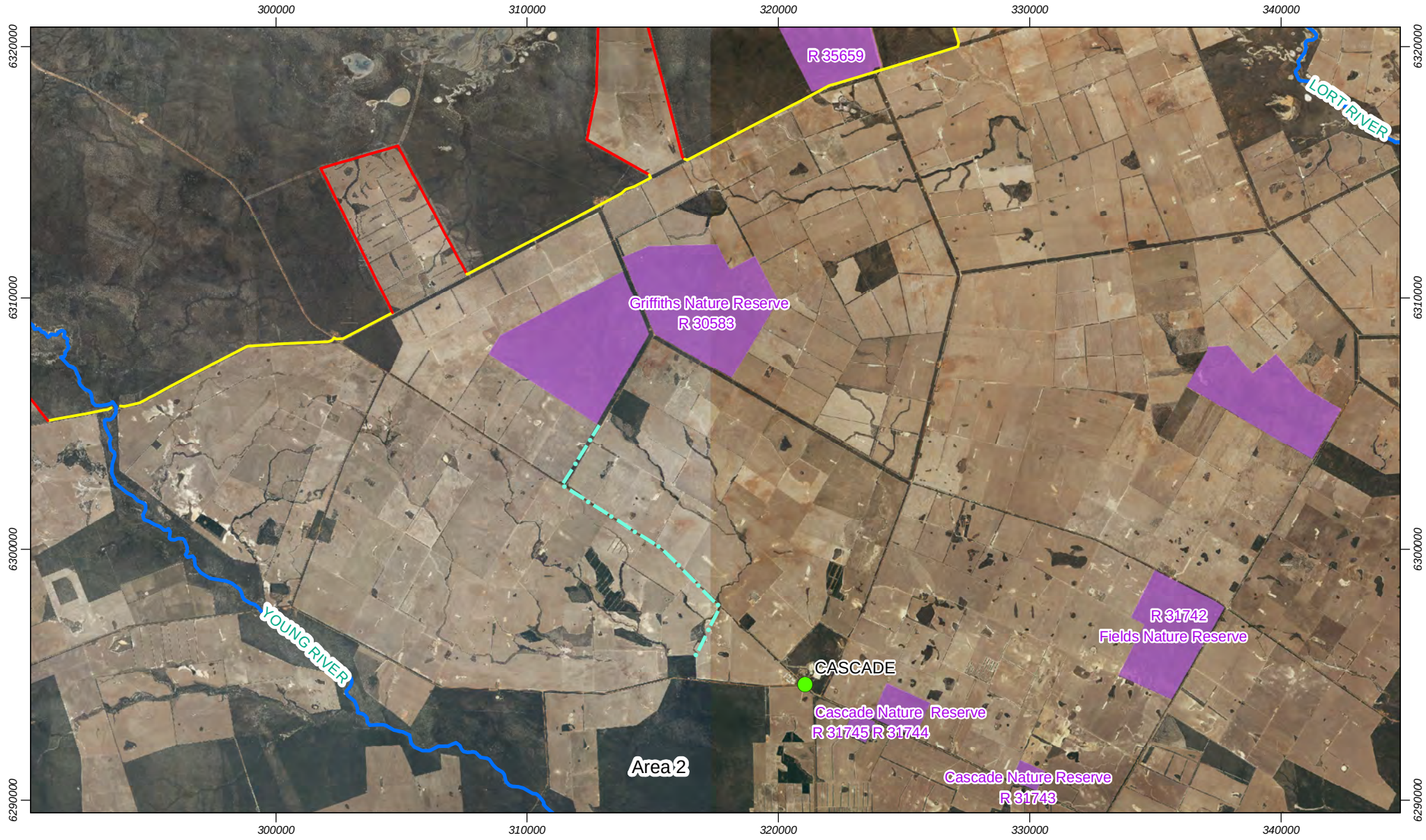


Figure 10-13: Area 2 native vegetation remnant connections

Scale 1:210,000 at A4

0 2 4 6 8 10 km

Coordinate System: GDA 1994 MGA Zone 51
Note that positional errors may occur in some areas
Date: 1/08/2017
Author: DWhite
Source: Aerial & Data: Client 2016; Reserves: DPaW 2012; Watercourses: SLIP: Landgate 2017.

Legend

- Connectivity between remnant vegetation
- Town
- Reserves
- Major watercourses

Proposal alignment existing environment conditions

- Previously chained firebreak
- Previously cleared freehold farmland



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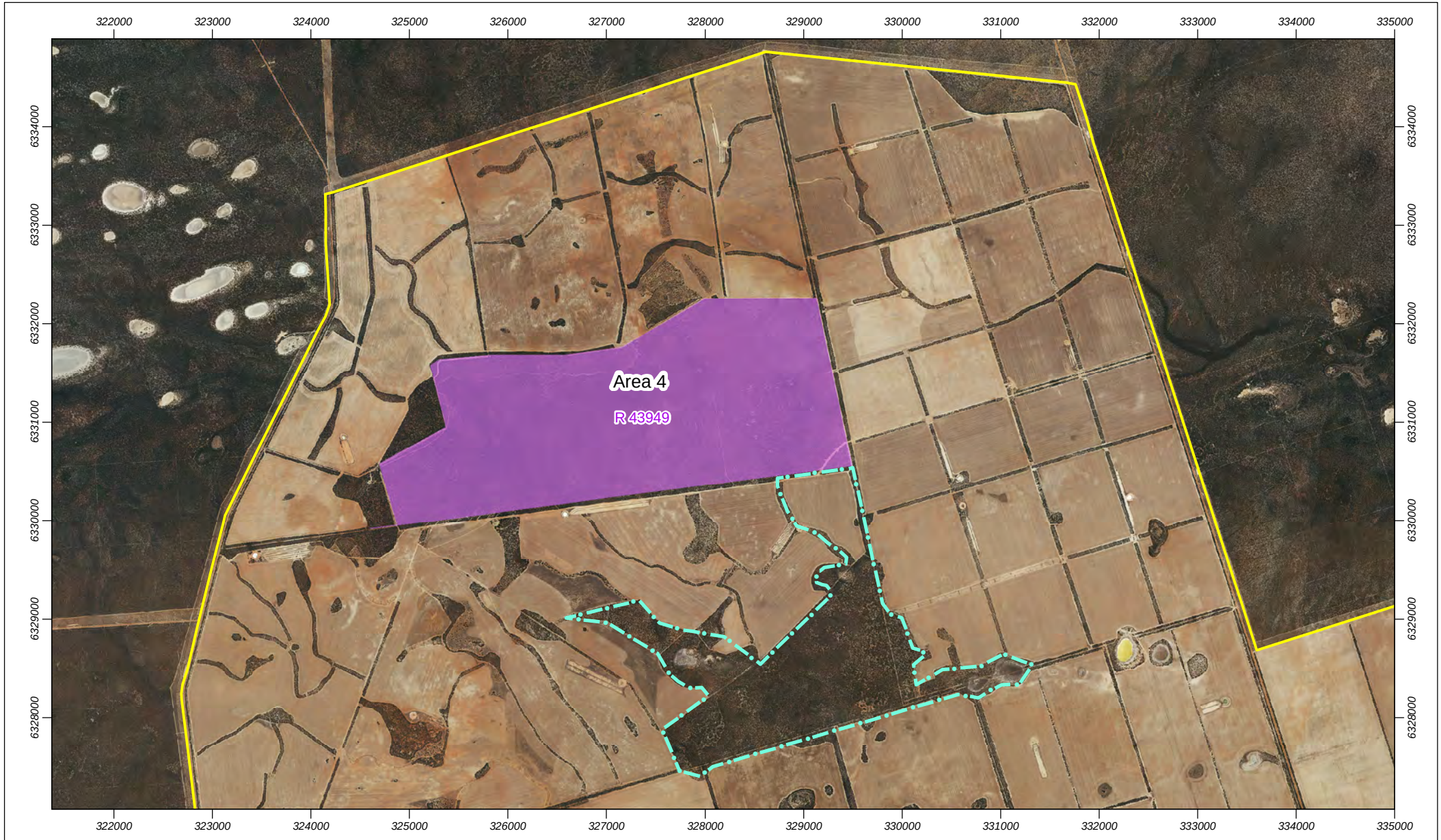


Figure 10-14: Area 4 native vegetation remnant connections

Scale 1:52,500 at A4

0 0.5 1 1.5 2 km

Coordinate System: GDA 1994 MGA Zone 51
Note that positional errors may occur in some areas
Date: 1/08/2017
Author: DWhite
Source: Data: Client 2016; Reserves: DPaW 2012; Watercourses: SLIP: Landgate 2016.

Legend

- Connectivity between remnant vegetation
- Reserves

Proposal alignment existing environment conditions

- Previously chained firebreak



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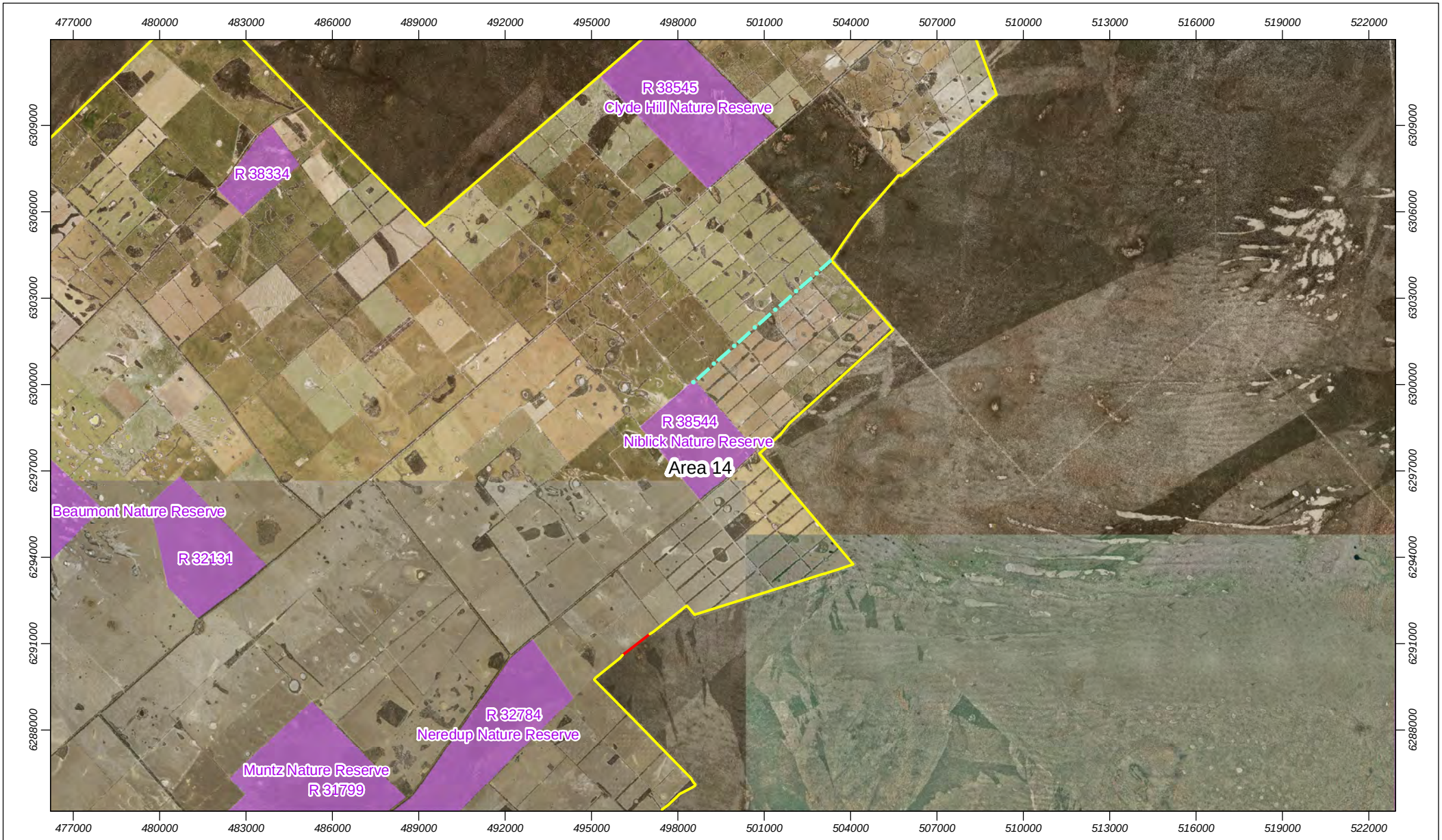


Figure 10-15: Area 14 native vegetation remnant connections

Scale 1:180,000 at A4

0 1 2 3 4 km

Coordinate System: GDA 1994 MGA Zone 51
Note that positional errors may occur in some areas
Date: 1/08/2017
Author: DWhite
Source: Data & aerial: Client 2016; Reserves: DPaW 2012; Watercourses: SLIP database: Landgate 2017.

Legend

- Connectivity between remnant vegetation
- Reserves

Proposal alignment existing environment conditions

- Previously chained firebreak
- Previously cleared freehold farmland



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10.7.5 Summary of impacts to conservation significant fauna

Western Ground Parrot (Pezoporus flaviventris) (Critically endangered)

The main identified threats to the Western Ground Parrot are large or frequent fires and predation by feral species such as the European red fox and feral cats (Ecoscape 2017a).

The South Coast Threatened Birds Recovery Plan identifies the far southeast section of the Proposal alignment (adjacent to the Cape Arid NP, near the Merivale Road 1.6 km of chaining) as within Management Area 2 for the species (Figure 10-3; GS Bio logic 2015). The southeast section of the Proposal alignment has potential for (minor) impact on individuals, limited to a low risk of collision with the proposed barrier fence by juvenile birds dispersing beyond the currently occupied range (GS Biologic 2015). Ecoscape (2017a) supports this, noting mortality from proposed barrier fence and vehicle collisions are documented in the closely related Night Parrot *Pezoporus occidentalis*. Whilst flights are most likely to be above treetop level (i.e. above fence height), actual flight trajectories and heights have never been documented.

The implementation of the Proposal alignment is not expected to increase the magnitude from existing threatening processes on the species for the following reasons:

- Proposal alignment within the known and potential habitat for Western Ground Parrots replace existing farm boundary fences and will use high visibility fence droppers spaced every 2.3 m
- Proposal alignment to be positioned within areas previously disturbed for fire management.

There is limited knowledge around the dispersal and home ranges of the Western Ground Parrot. Existing private farm fences are currently located where the proposed barrier fence would be located in this area, so the risk of collision is not new. Strategen understand from DBCA that visibility enhancement features (fluorescent orange droppers at regular intervals) and chaining will reduce the potential for bird collisions with the proposed barrier fence. Collision rates between fauna and fence infrastructure have been demonstrated to decline over time in numerous international studies, specifically the grouse in the United Kingdom (Baines & Andrew 2003; Petty 1995; Pfennigwerth 2008). The number of fluorescent orange fence droppers would also be doubled for approximately 115 km of fence near known Western Ground Parrot habitat in Cape Arid NP where dispersing juvenile ground parrots could possibly encounter or cross the fence if they expand from their known range (Figure 10-2). Two fluorescent orange droppers would be installed in between each seven metre-spaced solid star picket, i.e. an approximate 2.3 m spacing, to further reduce collision risk in this area.

Figure 10-2 shows current occupied habitat (recorded individuals and anecdotal records) of Western Ground Parrots within their accepted distribution.

Greater Long-eared Bat (Nyctophilus major) (Priority 4)

If the species occurs within the Proposal area, any clearing or pruning of hollow-bearing trees in woodland or forest habitat would represent loss of breeding or roosting habitat. In addition, fences are a collision and entanglement hazard for bats during foraging and other movements. Ecoscape (2017a) advised that any potential impact on this species is expected to be much lower if barbed wire is not used in the design of the Proposal. Barbed wire will not be part of the fence specifications for this Proposal; therefore, no significant impact is expected on this species.

Western Mouse (Pseudomys occidentalis) (Priority 4)

Ecoscape (2017a) described some localised potential impact on this species due to clearing of foraging and nesting habitat for construction of the proposed barrier fence and access roads, and indirect effects that may occur via movement of predators. Direct impacts will be limited to a small proportion of the species range in the vicinity of the proposed barrier fence, but reduced habitat connectivity may result in larger-scale population effects (e.g. lower rate of reoccupation after local extinction of isolates) (Ecoscape 2017a).

Malleefowl (Leipoa ocellata) (Vulnerable)

No nesting mounds occur in the Ecoscape (2017a) study area so no resident birds are expected to be affected directly, but clearing will result in marginal reduction of available foraging habitat. The proposed barrier fence may present a collision hazard during flights, but not a significant barrier to movement (adults can easily fly above fence height, juveniles can pass through the mesh) and may also provide a corridor facilitating access to occupied habitat by feral predators. Direct impacts on this species from the Proposal will be minor to none, as the proposed barrier fence will not be a barrier to animal movement patterns and; therefore, will not restrict potential distribution.

Brush Wallaby (Notomacropus [Macropus] irma) (Priority 4)

DBCA classes the Brush Wallaby as Priority 4, which means that the population has declined and requires monitoring, but is considered not currently threatened or in need of special protection, but could be if present circumstances change. The Proposal is situated in the eastern part of the species' current distribution.

Western Rosella (Platycercus icterotis xanthogenys) (Priority 4)

No significant impact to this species is expected because of the absence of potential nesting trees within the Ecoscape (2017a) study area; only minor impact to foraging habitat may occur, which is not a limiting factor due to its diverse diet including pasture and weed species.

Quenda (Isoodon obesulus fusciventer) (Priority 4)

Known threatening processes include fragmentation of habitat, fire in habitat already fragmented, and predation by cats, dogs and foxes. Disturbance of potential nesting sites (logs, shrubs, debris piles and litter) may impact some individuals, and may cause death or injury directly, or through forced relocation resulting in increased intraspecific competition and exposure to predators. As the Proposal is mainly peripheral to areas already cleared, impacts to populations are expected to be minor.

Rainbow Bee-Eater (Merops ornatus) (Migratory)

Disturbance to sites utilised by the Rainbow Bee-eater, such as sand banks of creeks and drainage lines used to burrow to create nesting chambers, may have some impact on the breeding success of this species (Ecoscape 2017a). However, historical disturbance does not represent a major issue to this species and it is common in cleared and semi-cleared habitats (Ecoscape 2017a). The Proposal alignment also has gaps at the major drainage lines. No significant impact to this species is expected.

Carnaby's Black-Cockatoo (Endangered)

The Proposal may result in the clearing of approximately 2.8 ha of heath and closed scrub identified on Merivale Road from the GS Bio Logic (2015) assessment which contains numerous species of plants (e.g. *Banksia)* that are commonly used for foraging by black cockatoos. A total of 6189 ha of low value potential foraging habitat for Carnaby's Black Cockatoo was indicated by Ecoscape (2017a) to be within its study area[12]. Direct impacts on this species from the Proposal will be minor to none given the proportionally marginal disturbance of habitat, and as the proposed barrier fence will not be a barrier to animal movement patterns; therefore, not restricting potential distribution.

10.8 Summary of predicted residual impacts

The predicted residual impacts of the Proposal include:

1. Disturbance of up to 816 ha of fauna habitat with approximately:
    - 373.8 ha for re-chaining (if necessary) of previously chained areas
    - 248.6 ha of grading within chained areas, where the inner graded fire track will be used preferentially where possible
    - 146.0 ha of chaining within uncleared vegetation
    - 41.6 ha (5%) of permanent grading (for a 6 m wide access track) within uncleared vegetation
    - 6 ha for water diversion turnouts for erosion control.
2. Low mortality of a low number of emus and kangaroos through entanglement in the proposed barrier fence.
3. Loss of connection of vegetation remnants inside the proposed barrier fence with areas outside the agricultural areas:
    - fifteen vegetation remnants were identified as potentially being isolated with three of these being small enough to suffer population decline of Brush Wallabies due to genetic isolation; and one of these having little connection with other remnants in the agricultural region.
4. Uncertain risk to the Critically Endangered Western Ground Parrot as the Proposal alignment is outside (approximately two kilometres from) the known occurrence of the species.
5. Potential loss of up to 103 potential habitat trees within uncleared vegetation located in the Salmon Gum area.
6. Local risk of increased predation along the 69.3 km of the Proposal alignment that does not follow existing disturbance areas.

The Proposal can be managed to meet the EPA objective for Terrestrial Fauna as outlined in EPA EAG8 (2015a).

The key mitigation strategies to minimise clearing and isolation of fauna habitat, collision/entrapment risk, and restriction of fauna movement includes:

- altering 89.5% of the originally proposed barrier fence length to utilise existing linear disturbance areas such as existing fire management breaks and already cleared areas within private property
- reducing the total clearing footprint to a 15–20 m width
- adjusting the Proposal alignment to:
    - allow for unfenced areas associated with three main river systems and coastal corridors to retain the ecological connection with vegetation on both sides of the proposed barrier fence
    - reduce the number of bottlenecks/acute angles that emus may aggregate in

[12] Note that the Ecoscape (2017a) study area does not completely cover the current maximum clearing footprint. However, the 6189 ha of potential foraging habitat mapped provides a good indicator of the extent of regional habitat.

- proposed barrier fence design that incorporates:
  - mesh dimensions are large enough to allow the majority of fauna species to pass through
  - no barbed wire or electrical wires will be used to reduce entanglement and injury potential
  - fence specifications have been modified to include fluorescent orange droppers every seven metres (half way between fence posts which are also seven metres apart) to increase the visibility of the proposed barrier fence
  - number of fluorescent orange fence droppers to be doubled (two droppers 2.3 m apart between the star pickets which are seven metres apart) along approximately 115 km of Proposal alignment near the Western Ground parrot habitat at Cape Arid NP to mitigate risk of collision–an existing farm boundary fence will be replaced with a high visibility barrier fence for this section
- implementation of the following plans during construction and ongoing maintenance of the proposed barrier fence to manage direct and indirect impacts from the Proposal on Terrestrial Fauna:
  - CMP–action items to include no clearing of native vegetation between August and November for sections of the Proposal alignment that are adjacent to Cape Arid NP to minimise impacts on breeding and juvenile birds, targeted searches for conservation significant fauna (such as Malleefowl mounds and potential habitat trees) will be undertaken prior to clearing within any section of the Proposal alignment that has not been previously surveyed, and the restriction of public access to the proposed barrier fence to minimise stress to animals
  - PPCMP–action items to include management actions that monitor feral animal abundance.

The proposed mitigation and management strategies are expected to be effective in minimising potential impacts. No significant impact on the representation, diversity, viability and ecological function of fauna is anticipated at the species, population and assemblage level. The Proposal will not result in significant residual impacts to any conservation significant flora species vegetation community or ecosystems, with the exception of uncertain risk to the Western Ground Parrot.

Table 13-2 summarises the inherent potential environmental impacts (prior to mitigation), the mitigation measures as well as an assessment against EPA objectives.

11. Heritage

The regulatory guidelines, legislative framework, potential impacts and the avoidance, mitigation and management of potential impacts of the Proposal alignment are detailed in Sections 11.1 to 11.6. These sections will demonstrate that the Proposal will meet the EPA objective for Heritage values and fulfil the requirements of Required Work Items 14 to 19 outlined in the ESD.

Two heritage survey reports prepared by Dr James Taylor and Applied Archaeology Australia have been used to inform this section of the PER (AAA 2015; Taylor 2016). The reports provide information on sensitive cultural material. These reports have been provided to the EPA and the DAA for review; however, due to the sensitive nature of the information they contain, these reports are confidential and will not be made available to the public, at the request of the Traditional Owners.

11.1 Relevant environmental objectives, legislation, policies and guidelines

11.1.1 Environmental objectives

The EPA environmental objectives for Heritage, as well as potential environmental aspects of the Proposal that may impact this environmental factor are provided in Table 11-1.

Table 11-1: Key environmental factors, objectives and Proposal environmental aspects

Environmental factor	EPA objective	Proposal environmental aspect
Heritage	To ensure that historical and cultural associations, and natural heritage, are not adversely affected.	Proposal construction and vehicle movements.

11.1.2 Requirements of the ESD

The ESD outlines the work required for the environmental impact assessment of key environmental factors for the PER. These requirements for Heritage are presented in Table 11-2.

Table 11-2: Heritage required work for the Proposal as per the ESD

Item	Requirement	Section in the PER
14	Conduct surveys to characterise the historical, cultural associations and natural heritage values of the proposal area threat are likely to be directly impacted and any other areas that may be indirectly impacted to identify sites of significance and their relevance within the wider regional context. *Note: if the proponent has already undertaken heritage surveys at the referral stages, then the survey results are to be included in the PER, along with demonstration that they meet the "Required Work" and relevant policies.*	Section 11.3
15	Describe the proposed disturbance and impacts to heritage associated with the proposal.	Section 11.4
16	Assess the impacts of the proposal on historical, cultural associations and natural heritage values as a result of implementation of the proposal, including those arising from changes to the environment which may impact on cultural and heritage significance. The assessment of Aboriginal heritage should be conducted in accordance with EPA Guidance Statement 41.	Section 11.6
17	Predict the residual impact on heritage for direct, indirect and cumulative impacts after considering avoidance and minimisation measures.	Section 11.6
18	Outline the management, monitoring, trigger and contingency actions to ensure impacts to heritage (direct and indirect) are not greater than predicted.	Section 11.5
19	Demonstrated and document in the PER how the EPA's objective for this factor can be met.	Section 11.8

11.1.3 Legislation, policies and guidelines

Relevant EPA policy and guidelines outlined in the ESD (Appendix 1) and an explanation on how the Proposal meets EPA policy and guidelines are presented in Section 11.1.4 and Table 11-3.

Table 11-3: Relevant EPA policies and guidelines for Heritage

Policy/guideline	Summary of policy/guideline	Requirements to address the policy/guideline
EPA guidance statement No. 41 (2004) *Assessment of Aboriginal Heritage.* Perth, Western Australia	This Guidance considers 'Aboriginal heritage' as a relevant environmental factor in circumstances where they are linked directly to physical and biological attributes of the environment, and when the protection and management of those attributes are threatened as a result of a proposed development.	To meet the Guidance Statement No. 41 the Proposal must demonstrate: • consider heritage matters to the extent that they may be affected by the impacts of the Proposal on the physical or biological surroundings • the Proponent adequately considers and addresses environmental issues during project design, construction and operation • the Proponent should demonstrate that the relevant Aboriginal heritage issues have or will be identified (to the satisfaction of the DAA and that the Proponent has adequately considered how to minimise any adverse impact by the proposal on heritage values • the EPA expects that any relevant reports prepared in the course of the above actions will be made available to the EPA and the DAA, subject to any relevant confidentiality requirements. The key findings of any such surveys and consultations should be referred to in the environmental review document • that they have provided a basis for sound environmental advice to decision-makers.
Department of Aboriginal Affairs and Department of Premier and Cabinet. 2013. *Aboriginal Heritage – Due Diligence Guidelines, Version 3.0.* Perth, Western Australia	Gives guidance to relevant stakeholders on the factors considered relevant to the DAA in assessing any potential impact on Aboriginal Heritage. The guidance gives advice on features and the landscape landforms which may potentially host Aboriginal Heritage sites, a range of activities likely to cause harm to Aboriginal Heritage sites and the actions which need to be performed by proponents to demonstrate mitigation of potential impacts.	In order to meet the Due Diligence Guidelines, the Proposal must demonstrate: • that the landscape where the activity is to take place has been assessed • assess the proposed activity and the potential impact on the landscape • include a search of the register of Aboriginal Sites and the Aboriginal Heritage Inquiry System • consultation with the relevant Aboriginal people • that an Aboriginal Heritage survey has been undertaken.

11.1.4 Guidance Statement No. 41 (EPA 2004c)

The EPA requires that the quality of information and scope of field surveys meets the standards, requirements and protocols as determined and published by the EPA.

Guidance Statement 41 (EPA 2004) outlines five actions which may be pertinent to the factor of Aboriginal heritage (before, during or following the environmental impact assessment process). These actions and how they have been addressed by DPIRD are outlined below:

1. *Consult with staff of the DIA (now DAA) and review any site records (desk-top review) in accordance with the AH Act.*
   DPIRD consulted DAA extensively between 2014 and 2016. A desktop review of site records was undertaken in 2012 (GHD 2012) and again in 2015 to identify known registered Aboriginal Heritage Sites along the Proposal alignment using DAA Aboriginal Heritage Inquiry System (AAA 2015; Taylor 2015).

2. *Undertake an Aboriginal heritage survey (if it is noted from a desk-top review that an adequate survey has not been undertaken for an area to be developed) which should include both consultation with appropriate Aboriginal people, which may include an anthropological survey, and, if necessary, an archaeological survey.*
   Heritage surveys were undertaken of the Proposal alignment by the appropriate Traditional Owner groups with qualified consultants (Taylor 2015, AAA 2015). The survey methodology included ground and air surveys and involved appropriate representative participants who could speak for country and provide advice to the surveys on matters of cultural significance.
3. *Inform the relevant Aboriginal people about details of the proposed development, including potential environmental impacts.*
   DPIRD initiated contact with the Goldfields Land and Sea Council and Esperance Tjaltjraak Native Title Aboriginal Corporation in 2010 to announce the Proposal to the groups and discuss the scope of required heritage surveys. Subsequent to the initial contact, DPIRD continued to liaise with the groups to request they nominate the appropriate people to participate in a heritage survey of the Proposal. The Activity Statement prepared by DPIRD for the heritage surveys as required under the Esperance Nyungar Government Standard Heritage Agreement provides full details of the Proposal, construction and potential environmental impacts.
4. *Consult with relevant Aboriginal people to enable them to make known to the proponent their concerns in regard to environmental impacts as they affect heritage matters.*
   The relevant Aboriginal groups were consulted regarding the environmental impacts of the Proposal as part of the heritage survey work.
5. *Demonstrate that any concerns raised by Aboriginal people have been adequately considered by the proponent in its management of environmental impacts, and any changes as a result of this process are made known to the relevant Aboriginal people.*
   Section 11.5 outlines how the majority of identified cultural areas (AAA 2015) have been avoided by the Proposal. This information was provided to the Aboriginal groups in a report by DPIRD dated 20 January 2016. As this report references confidential material it cannot be provided in this PER but has been provided to DAA and the EPA. Taylor (2015) concluded that there were no culturally significant areas expected to be impacted by the Proposal alignment.

11.1.5 Aboriginal Heritage – Due Diligence Guidelines Version 3.0 (DAA & DPC 2013)

The Proposal meets the Due Diligence Statement Version 3.0 on the basis of:

1. On ground heritage surveys of the site, each survey also included a helicopter flyover and landings in the area by the Ngadju and Esperance Nyungar representatives to assess broad areas of interest to Aboriginal people. The landscape assessment included a desktop study of the Proposal alignment using GIS mapping to determine the most suitable course for the proposed line.
2. A search of the Aboriginal Heritage Inquiry System was conducted to detect any registered Aboriginal Sites along the Proposal alignment.
3. Appropriate consultation was sought by DPIRD through the two representative Aboriginal groups of the area, the Esperance Tjaltjraak Native Title Aboriginal Corporation and the Goldfields Land and Sea Council (representing the Ngadju Traditional Owners). These two bodies coordinated the direct consultation with local family groups to ensure equal and appropriate representation by those who could speak for country across each specific area of the Proposal alignment (Taylor 2015).
4. DPIRD engaged the services of Applied Archaeology Australia (AAA) and Dr James Taylor to conduct ethnographic and archaeological surveys of the proposal alignment with the involvement of the two representative groups. The surveys were conducted with the assistance and guidance of local Aboriginal families specific to each region along the Proposal alignment.

11.2 Required work

Consistent with the requirements of the ESD (Required Work Item 14 for Heritage) the following studies have been undertaken for the Proposal to characterise the Heritage values present within the Development Envelope:

- Applied Archaeology Australia (AAA 2015), *Report of an Aboriginal Cultural Heritage survey of the State Barrier Fence proposed extension, Esperance Shire, Western Australia*
- Taylor (2015), *Anthropological Heritage survey work clearance area*.

The results of these Heritage studies have been used to inform Section 11.3 to characterise Heritage values.

11.3 Findings from Heritage surveys

The Esperance Tjaltjraak Native Title Aboriginal Corporation archaeological assessment took place over four weeks from 21 July 2015 through to 15 August 2015. The survey method involved three groups of 2–3 archaeologists and Traditional Owner representatives walking 5–10 m apart within the corridor of planned disturbance. Three Traditional representatives surveyed each week, so that each family was represented for two weeks of the four week archaeological survey. An ethnographic assessment took place following the archaeological survey but it also involved the archaeological team. The ethnographic survey was completed over three weeks from 24 August–11 September 2015.

A separate Ngadju Native Title holder ethnographic survey was conducted over four days from 19–22 October 2015 with a nominated team of Ngadju Aboriginal Consultants. The survey area as part of the Ngadiu Native Title claim covers the extent of the Proposal alignment and commenced approximately 16 km south west of Salmon Gums, north to Lake Gilmore and then south approximately15 km south of the Salmon Gums Nature Reserve. The survey area is at the boundary between the Ngadju Native Title Claim and The Esperance Nyungars Native Title Claim.

Desktop review of historical, cultural and natural heritage values

The Esperance area appears to have been inhabited for the past 13 000 years according to archaeological evidence (Smith 1993). The evidence of this human occupation across the landscape include stone artefact scatters, gnamma holes (water holes), lizard traps, quarry sites, scattered trees, burials, rock art sites and hearths/camps (AAA 2015).

The desktop survey of heritage values within the vicinity of the Proposal alignment revealed several Registered Heritage Sites with the DAA, as shown in Table 11-5 and Table 11-6 below. Several landscape features were identified with cultural and historical significance. The Oldfield, Young and the Lort rivers hold significance for their links to the Dreaming and they historically facilitated human and animal migrations both toward the coast and inland (AAA 2015). The river systems were an important source of food and replenishment of nutrients within the catchment during flooding events. Granite outcrops were identified as important meeting places, and the locations for ceremonial activities within the region were often associated with gnamma holes which provided water sources after winter rains. Several hills were identified within the landscape features as meeting places with important heritage values. The rivers, granite outcrops and significant hills were all avoided by changing the Proposal alignment (if needed) to avoid these sites.

Emus and kangaroos are recognised by Traditional Owners as part of the ecology of the landscape. Emus are known to propagate and transport plant seeds, additionally both species cause small pockets of disturbance throughout the landscape facilitating species turnover (AAA 2015; Taylor 2015). The report (AAA 2015) noted that by preventing these animals from traversing the landscape, the Proposal could restrict plant propagation and species turnover.

The Traditional Owners identified several cultural plants along the Proposal alignment, these plants have been classified as a culturally significant resource but no further details regarding their locations or species were reported due to the sensitive nature of the information (AAA 2015).

Cultural areas

The initial inspection of the Proposal alignment was conducted with a helicopter flyover of the area by the archaeologists and the Traditional Owner representatives. The initial inspection identified areas of interest based on topography, possible water sources and vegetation density along the Proposal alignment (AAA 2015; Taylor 2015). The on-ground survey method involved several groups of 2–3 people with a mix of archaeologists and Traditional Owner representatives in each group walking the designated survey area in parallel lines spaced 10 m apart along the length of the alignment. The Traditional Owner representatives rotated through the survey team and families were represented for a period of two weeks each.

The heritage survey by AAA (2015) identified 37 places it classified as 'cultural areas' along the Proposal alignment, including five on private land (Table 11-4). The artefacts uncovered during the survey were predominantly stone fragments (Plate 7).

The Traditional Owners have elected not to provide the Heritage Information Submission Forms required under the Esperance Nyungar Government Standard Heritage Agreement to the DAA at this stage. The heritage values of the identified 37 cultural areas have not been formally assessed by DAA with respect to whether these cultural areas may be considered Aboriginal Sites under the AH Act.

Table 11-4: Identified cultural areas observed during the survey for the Proposal

Site No.	Heritage characteristics
SBF_001	Small stone artefact scatter
SBF_002	Small stone artefact scatter in association with a granite outcrop and lizard trap
SBF_003	Small artefact scatter in association with granite outcrop
SBF_004	Artefact scatter exposed in track with gnamma hole/medicine rock (Maburn)
SBF_005	Small artefact scatter in association with granite outcrop
SBF_006	Small artefact scatter in association with granite outcrop
SBF_007	Small artefact scatter
SBF_008	Small artefact scatter associated with lizard trap
SBF_009	Small artefact scatter associated with a small lake
SBF_010	Small stone artefact scatter
SBF_011	Small stone artefact scatter
SBF_012	Extensive and dense stone artefact scatter
SBF_013	Extensive stone artefact scatter exposed in clay track, w/ sub-surface potential.
SBF_014	Small stone artefact scatter
SBF_015	Extensive and dense stone artefact quarry and scatter
SBF_016	Small artefact scatter in association with a lake
SBF_017	Large site complex
SBF_018	Small stone artefact scatter
SBF_019	Small stone artefact scatter
SBF_020	Small stone artefact scatter
SBF_021	Large scatter across track
SBF_022	Small stone artefact scatter
SBF_023	Small stone artefact scatter with subsurface potential
SBF_024	Small stone artefact scatter in association with a natural quartz outcrop/ridge
SBF_025	Small stone artefact scatter
SBF_026	Small stone artefact scatter
SBF_027	Small stone artefact scatter

Site No.	Heritage characteristics
SBF_028	Artefact scatter associated with yellow ochre
SBF_029	Medium-sized stone artefact scatter
SBF_030	Small stone artefact scatter
SBF_031	Small stone artefact scatter
SBF_032	Ethnographic site - natural features - cultural trees and water source
Private land	
SBF_PA_1	Medium-sized stone artefact scatter
SBF_PA_2	Medium-sized stone artefact scatter in association with swamp
SBF_PA_3	Large scatter across track associated with a swamp
SBF_PA_4	Extension of previously registered site Mt Ney 1757
SBF_PA_5	Small stone artefact scatter (next to registered Aboriginal site)

A management boundary has been established for each cultural area identified by the archaeological survey to act as a buffer area for developmental impacts from the Proposal. This management boundary was developed by the archaeological survey team. An example of a management boundary established around a cultural area is shown in Figure 11-1.

Isolated finds

In addition to the 37 cultural areas identified, the survey also identified a total of 127 isolated finds along the Proposal alignment. Isolated finds were defined in the report as areas where a few artefacts or fragments of artefacts were discovered within an area. There may have been several discoveries within a few metres of each other, however, there was not enough material discovered to classify it as a cultural area. These finds were discovered in sections of the survey area where disturbance has occurred (Plate 8 and Plate 9). Therefore, their discovery may be the result of the disturbance exposing the artefacts and potentially more artefacts may be undiscovered below the surface (AAA 2015).



Source: AAA 2015

Plate 7: Broken artefact identified within a cultural area

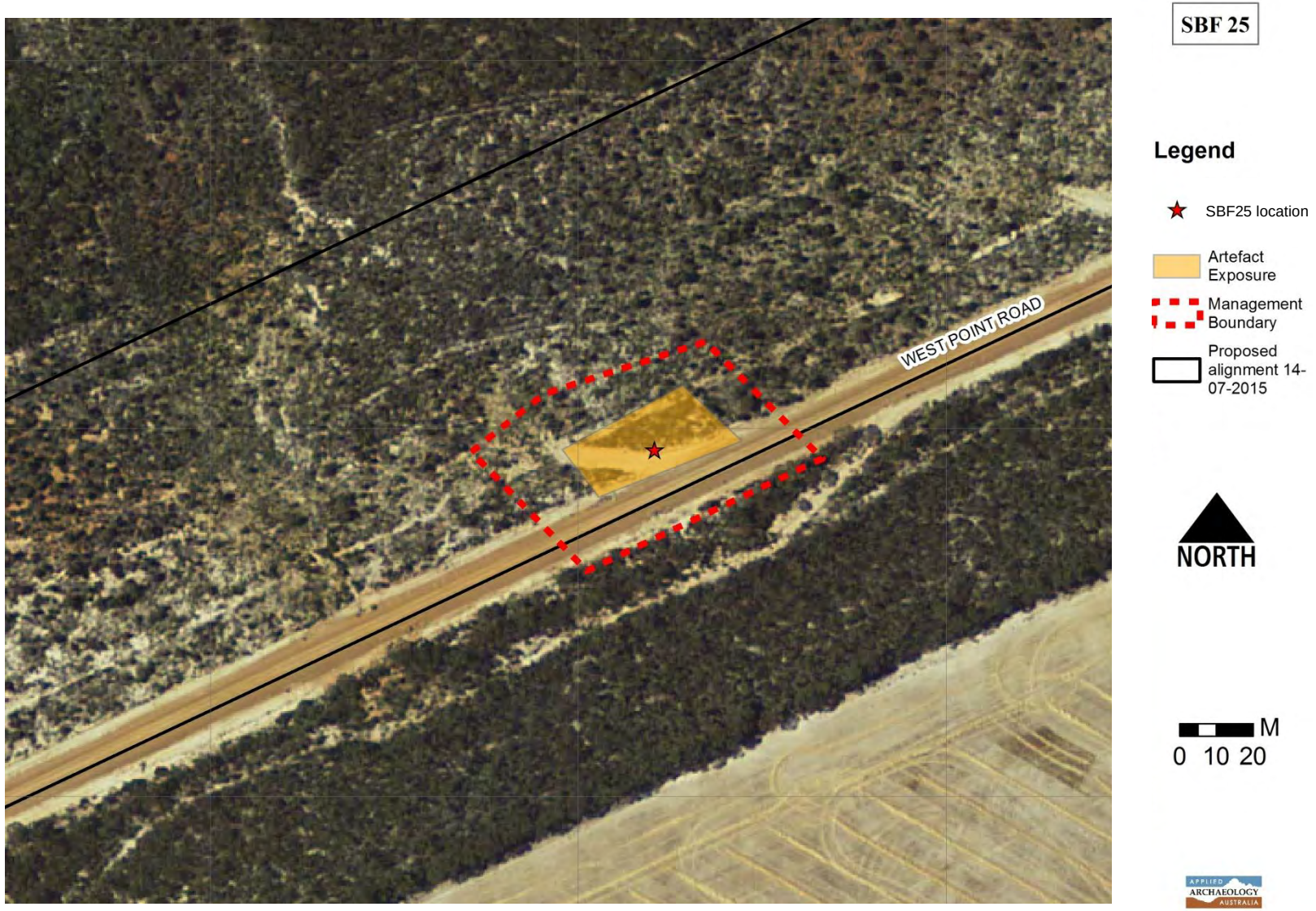


Plate 8: Stone fragment identified within an isolated find along a disturbed track



Source: AAA 2015

Plate 9: Disturbed track where stone fragment was identified in Plate 8



Source: AAA 2015

Figure 11-1: Survey site and management boundary

Indigenous heritage

A search of the DAA Aboriginal Heritage Inquiry System (search conducted in 2016) identified seven Registered Aboriginal Heritage Sites listed with the DAA that intersect the Proposal alignment. Consultation with the DAA identified an additional two sites that were yet to be formally assessed (lodged status) also occurring along the early Proposal alignment. Registered and Lodged Aboriginal Sites identified as intersecting the Proposal alignment are listed in Table 11-5.

Table 11-5: DAA listed registered Aboriginal Sites intersecting with the Proposal alignment

Site No.	Status	Site name	Heritage characteristics
26265	Registered Aboriginal Site	Oldfield River	Mythological
26264	Registered Aboriginal Site	Young River	Mythological
26266	Registered Aboriginal Site	Lort River	Mythological
2396	Registered Aboriginal Site	Reserve Stone Arrangement	Artefact scatter ceremonial
1757	Registered Aboriginal Site	Mount Ney	Artefact scatter
2641	Registered Aboriginal Site	Thomas River Station	Artefact scatter
2642	Registered Aboriginal Site	Boyalup Hill	Artefact scatter, rock shelter, water source
2685	Lodged with the DAA currently under assessment	Hawes Hill	Artefacts scatter
17991	Lodged with the DAA currently under assessment	Granite outcrop south of Hawes Hill	Artefacts scatter

The DAA Aboriginal Heritage Inquiry System also identified Registered Aboriginal Heritage Sites and Other Heritage Places which do not directly intersect the Proposal alignment but occur within a 2 km buffer of the Proposal alignment; they are presented below in Table 11-6.

Table 11-6: Registered Aboriginal Sites and Other Heritage Places near the Proposal alignment

Site No.	Status	Heritage characteristics	Distance from the Proposal alignment (km)
2646	Registered Aboriginal Site	Artefact scatter	0.5
2918	Other Heritage Places	Artefact scatter	0.6
2160	Registered Aboriginal Site	Artefact scatter	1.3
2882	Registered Aboriginal Site	Artefact scatter	1.3
2158	Registered Aboriginal Site	Artefact scatter	1.3

11.4 Potential impacts and risks

An exercise was undertaken at the referral stage to scope the key elements of the Proposal which have the potential to impact heritage values. This was carried out in consultation with DPIRD, DAA and the DWER consistent with *EAG 10: Scoping a proposal* (EPA 2013). The potential impact as identified in the ESD is:

- loss or disturbance impacts to heritage values.

The Proposal to remove vegetation along the Proposal alignment via mechanical methods outlined in Section 4 presents a risk to identified cultural areas and Registered Aboriginal Heritage Sites along the Proposal alignment through the destruction and disturbance of the sites, thereby degrading the heritage values contained within each site impacted. Broken artefacts were found during the survey; often these artefacts were broken as a result of vehicles or farming practices as shown in Plate 9 (AAA 2015; Taylor 2015).

Further consideration of potential impacts through the heritage surveys identified that disturbance to heritage values could result from the following mechanisms:

- physical disturbance of cultural and heritage sites and artefacts via the installation of the proposed barrier fence
- physical disturbance through the action of chaining to remove vegetation for the fire protection zone
- installation of a physical barrier preventing animal movement across the landscape and disrupting ecological connectivity
- installing the proposed barrier fence across the rivers preventing movement of fauna and people resulting in a 'broken songline'
- the chaining of the vegetation destroying cultural plants which were identified by the group but not disclosed in the report for cultural reasons - these plants occur across the length of the Proposal alignment.

11.5 Application of the mitigation hierarchy

In accordance with the Administrative Procedures (GoWA 2012), consideration was given during the planning for the Proposal to avoid, minimise and rectify or rehabilitate the potential impacts. These measures are summarised in Table 11-7.

The planned mitigation measures are taken into account when predicting the residual impacts of the Proposal.

Table 11-7: Application of the mitigation hierarchy to potential impacts on Heritage

Potential impacts	Avoid	Minimise	Rectify/rehabilitate	Offset
Loss or disturbance impacts to heritage values	The requirement for a new clearing footprint has been avoided along large sections of the Proposal alignment by following existing fire management breaks and already cleared areas within private property. The Proposal alignment is to avoid listed sites and unlisted cultural areas, wherever practicable. The river systems are of particular heritage significance and gaps have been incorporated into the Proposal in consultation with Traditional Owners to avoid impacts to these systems and mitigate the ecological fragmentation of the landscape that was identified as a potential risk by traditional owners.	The Proposal has been designed to minimise new disturbance to vegetation, which will also reduce the risk of new disturbance to known and unknown sites by positioning the Proposal alignment in existing disturbed areas. Clearing and chaining activities will not take place in areas where the Proposal alignment intersects with Registered Aboriginal Sites, and identified cultural areas. DBCA has advised DPIRD that the cultural areas identified in this PER document which occur within their previously chained boundaries will no longer be subject to chaining activities (Turnbull D [DBCA] 2017 pers. comm. 26 April 2017). In all instances where clearing will be undertaken as part of the Proposal alignment installation, the boundary of clearing will be surveyed and flagged prior to clearing being undertaken. DPIRD will seek to enact, with the landholders permission and with prior written notice and consultation with the Native Title group, s 18 procedures for Heritage Sites identified to intersect with the Proposal alignment. In addition to this, DPIRD may seek a s 18 approval for disturbance of any of the 18 cultural areas identified in the AAA (2015) survey where complete avoidance of impact is not practicable if they are found to be Heritage Sites. In areas where an impact to Registered Aboriginal Heritage Sites has been predicted (and approved under the AH Act) DPIRD will engage the services of an appropriate Aboriginal heritage monitor to be on site during construction through the Site. DPIRD must also comply with s 15 of the Esperance Nyungar Government Standard Heritage Agreement (ENGSHA) (see Section 11.6.2) in the event that ancestral remains or objects were identified.	Not applicable.	Not applicable.
Physical disturbance of cultural sites and artefacts via the installation of the proposed barrier fence	The Proposal alignment will largely be located within existing tracks and graded firebreaks, and previously chained areas where possible to avoid physical disturbance of cultural sites and artefacts. The impacts to whole sites have been avoided by the realignment of the Proposal alignment to the edge of management boundaries.	The Proposal alignment along existing fire management buffers and fire tracks, and existing farm boundary fences will minimise these effects.	Not applicable.	Not applicable.

Potential impacts	Avoid	Minimise	Rectify/rehabilitate	Offset
Physical disturbance through the action of chaining to remove vegetation for the fire protection zone	The requirement for clearing of native vegetation has been avoided along large sections of the Proposal alignment by following existing fire management breaks and already cleared areas within private property.	The disturbance required for the Proposal has been minimised by reducing the total clearing footprint width to as low as possible (15–20 m width). Clearing activity within the 15–20 m wide clearing footprint has been modified from bulldozing and grading the entire 20 m wide area, to only bulldozing/grading a 6 m wide track. The 6 m wide track within the clearing footprint will be used for the construction and ongoing maintenance of the proposed barrier fence. The remaining area adjacent to the 6 m wide track (up to 14 m) will be chained and potentially mulched (instead of bare earth cleared) to minimise the cultural heritage disturbance. Clearing and chaining activities will not take place in areas where the Proposal alignment intersects with Registered Aboriginal Heritage Sites and identified cultural areas. DBCA has advised that the cultural areas identified in this PER document which occur within their previously chained boundaries will no longer be subject to chaining activities (Turnbull D [DBCA] 2017 pers. comm. 26 April 2017). In all instances where clearing will be undertaken as part of the Proposal alignment installation, the boundary of clearing will be surveyed and flagged prior to clearing being undertaken. DPIRD will seek to enact, with the landholders permission and with prior written notice and consultation with the Native Title group, s.18 procedures for Heritage Sites identified to intersect with the Proposal alignment. In addition to this, DPIRD may seek a s 18 approval for disturbance of any of the 18 cultural areas identified in the AAA (2015) survey where complete avoidance of impact is not practicable if they are found to be Heritage Sites. In areas where an impact to Registered Aboriginal Heritage Sites has been predicted (and approved under the AH Act) DPIRD will engage the services of an appropriate Aboriginal heritage monitor to be on site during construction through the Site. DPIRD must also comply with s 15 of the ENGSHA (see Section 11.6.2) in the event that ancestral remains or objects were identified.	Not applicable.	Not applicable.

Potential impacts	Avoid	Minimise	Rectify/rehabilitate	Offset
A physical barrier preventing animal movement across the landscape	The avoidance of this impact for large target species is not applicable as the prevention of access for wild dogs, emus and kangaroos from the rangelands and adjacent woodlands is the purpose of the Proposal. Approximately 69.3 km (in straight line kilometres) of the Proposal alignment is located in uncleared bushland. The alignment across these bushland areas is intended to minimise the use of acute corners and creation of pockets of vegetation with a barrier fence on three sides, which could cause aggregating emus to 'bottleneck' in the event of an emu migration possibly leading to injury or damage to the fence.	The gaps in the Proposal alignment associated with the three main river systems and along the coast ensure that dispersal and access to resources can still occur along the key ecological corridors. The fence mesh dimensions will allow the majority of fauna to pass through. The Proposal alignment utilises 'soft barriers' of existing firebreaks and existing farm boundary fences for the majority of the Proposal alignment.	Not applicable.	Not applicable.
Disrupting ecological connectivity	The Proposal alignment has been moved (in agreement with the landholders) onto private property for approximately 129.4 km where high environmental and cultural concerns were identified. This will be achieved in various sections by replacing existing farm boundary fences on freehold land with the proposed barrier fence. As a result, no new clearing would be undertaken.	The Proposal includes four unfenced gaps in the Proposal alignment associated with the three main river systems and a 3.2 km gap to the coast so that genetic isolation of populations of large fauna is not expected to be significant. The fence mesh dimensions will allow the majority of fauna to pass through. The height of the fence is low enough that birds and bats can pass over the proposed barrier fence.	Not applicable.	Not applicable.

Potential impacts	Avoid	Minimise	Rectify/rehabilitate	Offset
Installing the proposed barrier fence across the rivers preventing movement of fauna and people resulting in a 'broken songline'	The Proposal alignment has been modified to reduce isolation of large sections of the Great Western Woodlands compared to the original scoping studies preferred alignment (GHD 2012). The Proposal alignment has also been moved (in agreement with the landholders) onto private property for approximately 129.4 km where high environmental and cultural concerns were identified. This will be achieved in various sections by replacing existing farm boundary fences on freehold land with the proposed barrier fence. As a result, no new clearing would be undertaken. Additional clearing on freehold land has been restricted to 3 ha over 1.5 km to avoid a cultural place and deep salt lake.	The three main river systems in the west of the Proposal alignment and the coastal corridor to the southeast of the Proposal alignment will be unfenced to allow for the maintenance of these ecological corridors. The barrier fence specifications have been designed to minimise impacts to non-target fauna species. Small animals and birds will be able to pass through or over the proposed barrier fence retaining the ecological connection with vegetation on both sides of the Proposal alignment. The Proposal alignment has been developed to utilise existing linear infrastructure and firebreaks where possible. This has significantly reduced the fragmentation of vegetation by the Proposal. The width and type of clearing has also been minimised which reduces the overall clearing footprint and the level of vegetation fragmentation caused by the Proposal.	Not applicable	Not applicable

A summary of the Traditional Owner recommendations and how they have been incorporated in the Proposal is outlined in Table 11-8.

Table 11-8: Traditional Owner recommendations and proposed approach for heritage management for the Proposal

Recommendation	Proposed approach	Recommendation to be implemented?
In the event that the fence goes ahead as proposed, we recommend that existing corridors of disturbance (such as vehicle tracks, road verges or existing fence line) are used for the alignment wherever possible.	Where other environmental considerations do not constrain the Proposal alignment, the proposed barrier fence will be positioned on existing disturbed areas within the Development Envelope.	Yes
All water sources to remain outside of the SBF enclosure. This means the SBF alignment to be kept along the existing farmer's fence line when water sources are encountered within the corridor.	The Proposal alignment has been modified inside known fresh water sources, such as the granite outcrops and swampy areas identified by the cultural heritage survey report, within the approximate 100 m corridor. However, varying seasonal conditions may result in some fresh water bodies appearing during wet weather events that could not reasonably be predicted. It is also assumed by DPIRD this recommendation is referring to naturally occurring, fresh water sources (i.e. not private dams or saline water bodies).	Yes
Due to the high potential for sub-surface cultural materials to be present - but not visible during archaeological surveys - we recommend that monitors be present during all earthmoving activities.	DPIRD will seek to enact, with the landholders' permission and with prior written notice and consultation with the Native Title group, s 18 procedures for Aboriginal Heritage Sites identified to intersect with the Proposal alignment. In addition to this, DPIRD may seek a s 18 approval for disturbance of any of the 18 cultural areas identified in the AAA (2015) survey where complete avoidance of impact is not practicable if they are found to be Heritage Sites. In areas where an impact to Registered Aboriginal Heritage Sites (defined under s 5 of the AH Act) DPIRD will engage the services of an appropriate Aboriginal heritage monitor to be on site during construction through the Site. DPIRD must also comply with s 15 of the ENGSHA (see Section 11.6.2) in the event that ancestral remains or objects were identified.	Partially
At identified heritage sites, including all rivers, we recommend that monitors be onsite during all works.	The three main river systems (the Lort, Young and Oldfield Rivers) are not included in the Proposal alignment and the fence has been stopped at these areas specifically so ground disturbing activities do not impact near these Aboriginal sites. If a location is believed to be an Aboriginal site under s 5 of the AH Act, it is recommended a Heritage Information Submission Form is completed and submitted to the DAA as per the Esperance Nyungar Government Standard Heritage Agreement.	Yes
As native titleholders, we always aim to maximise active involvement and employment outcomes for our people, in projects on our country. On this basis, we recommend that due consideration be given to maximizing Aboriginal employment outcomes on the construction and particularly the ongoing maintenance of the fence.	Consideration will be given to maximising Aboriginal employment outcomes on the construction and ongoing maintenance of the fence but DPIRD will need to remain consistent with WA Government procurement policies. These negotiations would more appropriately be conducted as part of the 'Future Act' Native Title Act process. If the proposed barrier fence is approved, funded and constructed, beneficiaries of the fence would likely be required to contribute to future maintenance of the barrier fence via an appropriate industry funding mechanism under the BAM Act.	Yes

Recommendation	Proposed approach	Recommendation to be implemented?
To avoid misunderstandings and unexpected delays in works programs, we recommend that the proponents read, consider and agree to all of our recommendations before works begin. In the event that the proponent wishes to discuss, dispute or renegotiate a particular recommendation, it is critical that this is done before the commencement of the works program to avoid delays and budget blow-outs during the project.	DPIRD agrees to continue to consult with the Goldfields Land and Sea Council, Ngadju and Esperance Tjaltjraak Native Title Aboriginal Corporation on the Proposal and throughout the proposed barrier fence construction phase (if the Proposal is approved and funded). DPIRD does not agree with all of the recommendations in the report but will endeavour to resolve any issues prior to any works being undertaken.	Partially
No fence construction to take place within the identified cultural places.	The proposed barrier fence has been deviated away from identified cultural areas. Cultural values that may be potentially impacted by the Proposal are located in previously disturbed areas.	Yes
The SBF should stay as close to the existing farm fence as possible.	A total of 129.4 km of the Proposal will replace existing farm boundary fences and the alignment will be positioned near existing farm fences where possible and where other on-ground constraints allow.	Yes
Fence construction must be diverted around some identified heritage complexes that encompass and extend beyond the 100m surveyed corridor.	The Proposal alignment has been diverted to utilise 129.4 km of existing farm boundary fence line and has avoided management boundaries where possible.	Yes
A formal heritage monitoring plan is developed to provide for an effective and streamlined operation. The monitoring plan is to be based on an up-to-date scope of works.	There is no significant residual impact to identified cultural areas therefore a formal heritage monitoring plan is not required.	No
Cultural monitors are engaged across the approximately 52km of the proposed alignment that is located in un-cleared bushland during the fence construction.	DPIRD will seek to enact, with the landholders permission and with prior written notice and consultation with the Native Title group, s 18 procedures for Aboriginal Heritage Sites identified to intersect with the Proposal alignment. In addition to this, DPIRD may seek a s 18 approval for disturbance of any of the 18 cultural areas identified in the AAA (2015) survey where complete avoidance of impact is not practicable if they are found to be Heritage Sites. In areas where an impact to Registered Aboriginal Heritage Sites (defined under s 5 of the AH Act) is identified, DPIRD will engage the services of an appropriate Aboriginal heritage monitor to be on site during construction through the Site. DPIRD must also comply with s 15 of the ENGSHA (see Section 11.6.2) in the event that ancestral remains or objects were identified.	Partially
Heritage sites that are being impacted and eroded by the current use of the corridor (tracks, firebreaks, vegetation clearing, farming) are to be rehabilitated.	DPIRD has no control or jurisdiction over the existing vacant UCL adjacent to the agricultural areas. The preservation of Heritage Sites should be dealt with through the AH Act. Any rehabilitation would be as required by statute. Ongoing use of freehold farm land by farmers is expected to continue, unless s 5 of the AH Act was to apply to a particular site, in which case the DAA would need to consult with the relevant landholder/s.	No

Recommendation	Proposed approach	Recommendation to be implemented?
For those sites that cannot be avoided from impacts, a formal archaeological assessment with representatives of the Traditional Owners is required develop a significance assessment and site mitigation program.	DPIRD funded comprehensive archaeological and ethnographic surveys of the Proposal alignment and requested that, "in the event that Aboriginal archaeological sites were found in the proposed 100 m survey corridor, the area outside of that corridor be surveyed to a distance of approximately 200 m on Esperance Tjaltjraak Native Title Aboriginal Corporation to provide an alternative alignment option to construct the fence". If alternatives were not provided as per above, DPIRD has considered a preferred option to minimise any impacts in consultation with the DPLH and, the Esperance Tjaltjraak Native Title Aboriginal Corporation. DPIRD has considered a preferred option to minimise any impacts in consultation with the DAA.	Yes

11.6 Assessment of predicted direct and indirect residual impacts

11.6.1 Direct impacts

The Proposal has been designed to minimise new disturbance to vegetation, which will also reduce the risk of new disturbance to known and unknown Aboriginal Heritage sites by positioning the Proposal alignment in existing disturbed areas.

Of the 51 sites identified by the survey and desktop study in Table 11-4 to Table 11-6 near the Proposal alignment, five do not align with the Proposal and 24 were avoided by altering the Proposal alignment; the remaining 22 cultural sites and Registered Aboriginal Heritage Sites are subject to a residual impact due to the boundary of the Proposal alignment intersecting with the management boundary of the site. In all instances where a site could not be avoided the Proposal alignment will utilise existing cleared land in the form of vehicle tracks or farm land (Table 11-9 and Table 11-10). This strategy further minimises the need for heavy vehicles to clear vegetation reducing the risk of cultural material being damaged as a result of installing the Proposal alignment. This approach has been designed by the proponent to minimise the impact to Heritage Sites and cultural areas whilst limiting the need for clearing native vegetation.

The disturbance to the 18 cultural areas identified by the surveys that may be impacted by the Proposal alignment (Table 11-9) consists of:

1. Eight cultural areas will have the edge of their management boundary disturbed but only on existing, disturbed freehold farm land. This would involve removing an existing farm fence and replacing it with a barrier fence. No new clearing will be undertaken. This re-alignment option was considered preferable to extending outside the management boundary and clearing undisturbed bushland.
2. Three cultural areas will be disturbed on farm land by replacing an existing fence.
3. The management boundary of four cultural areas would be disturbed but on an existing fire track.
4. One cultural area will be disturbed within a previously chained area.
5. Minor disturbance of two cultural areas (SBF PA1 and SBF PA2) identified to have artefact scatters; however, these sites are adjacent to an existing disturbed communications line and road - the proposed barrier fence would be located near a below ground Telstra telecommunications cable running parallel to the road, situated approximately 10 m north of the road alignment. The alternative fence alignment at this location (replacing the private fence line around the UCL) is not proposed as it would involve two crossings of a Thomas River tributary, additional vegetation clearing and very steep terrain.

Where a Registered Aboriginal Heritage Site could not be avoided, impacts have been minimised by utilising existing tracks and farm boundary fence boundaries (Table 11-10). Figure 11-2 highlights the approaches taken to minimise disturbance to these sites. No new impacts to Registered Aboriginal Heritage Sites are expected as disturbance activities will take place along already disturbed areas (existing tracks and replacing existing farm boundary fences).

DPIRD has also specifically modified the Proposal alignment to avoid listed s 5 sites and unlisted cultural areas, wherever practicable. The river systems are of particular heritage significance and gaps have been incorporated into the Proposal in consultation with Traditional Owners to avoid impacts on these systems and mitigate the ecological fragmentation of the landscape that was identified as a potential risk by traditional owners. The specific mitigation measures employed and the outcomes for each site identified in the survey are detailed below in Table 11-9 and Table 11-10.

Table 11-9: Mitigation measures for cultural areas

Site No.	Mitigation measure	Outcome
SBF_001	Proposal alignment altered to be positioned on private land and replace existing farm boundary fence, no additional clearing required.	Site avoided.
SBF_002	Proposal alignment does not intersect the site.	Site avoided.
SBF_003	Deviate Proposal alignment onto private land and replace existing farm boundary fence, no additional clearing required. Avoids granite exposure.	May impact within management boundary but on crop land.
SBF_004	Deviate Proposal alignment onto private land and replace existing farm boundary fence, no additional clearing required.	May impact within management boundary but on crop land.
SBF_005	Deviate Proposal alignment north around granite outcrop to avoid management boundary.	Site avoided.
SBF_006	Deviate Proposal alignment southeast of management boundary.	Site avoided.
SBF_007	Deviate Proposal alignment northwest around management boundary and granite outcrop.	Site avoided.
SBF_008	Deviate Proposal alignment south around management boundary.	Site avoided.
SBF_009	Deviate Proposal alignment south around management boundary.	Site avoided.
SBF_010	Proposed barrier fence to be located in recently re-chained area (re-chained during November 2015 fires). Proposal alignment was previously altered after aerial flights to avoid large granite outcrops and virgin bushland near Mount Ridley.	May impact within existing recently re-chained area.
SBF_011	Deviate Proposal alignment west to edge of management boundary.	May impact on edge of management boundary- existing track used.
SBF_012	Deviate Proposal alignment onto private land and replace existing farm boundary fence, no additional clearing required.	May impact within management boundary but on crop land.
SBF_013	Deviate Proposal alignment onto private land and replace existing farm boundary fence, no additional clearing required.	May impact within management boundary but on crop land.
SBF_014	Deviate Proposal alignment east of management boundary.	Site avoided.
SBF_015	Deviate Proposal alignment onto private land and replace existing farm boundary fence, no additional clearing required.	May impact within management boundary but on crop land.
SBF_016	Deviate Proposal alignment south approximately 350 m to existing farm boundary fence and then replacing existing fence.	May impact within management boundary but on crop land.
SBF_017	Deviate Proposal alignment onto private land and replace existing farm boundary fence, no additional clearing required.	May impact within management boundary but on crop land.
SBF_018	Locate Proposal alignment as close as possible to existing farm boundary fence.	May impact on edge of management boundary- existing track used.

Site No.	Mitigation measure	Outcome
SBF_019	Deviate Proposal alignment south closer to Rolland Rd to avoid management boundary.	Site avoided.
SBF_020	Deviate Proposal alignment north to follow an existing track.	May impact on edge of management boundary- existing track used.
SBF_021	Deviate Proposal alignment onto private land approximately 700 m and replace existing farm boundary fence, no additional clearing required.	May impact within management boundary but on crop land.
SBF_022	Deviate Proposal alignment west to edge of management boundary, and utilise existing track.	Site avoided.
SBF_023	Deviate Proposal alignment west to edge of management boundary, and utilise existing track.	Site avoided.
SBF_024	Deviate Proposal alignment north to avoid management boundary.	Site avoided.
SBF_025	Deviate Proposal alignment north to avoid management boundary.	Site avoided.
SBF_026	Position the Proposal alignment along northern edge of chained area.	May impact on edge of management boundary- existing track used.
SBF_027	Deviate Proposal alignment north to avoid management boundary.	Site avoided.
SBF_028	Deviate Proposal alignment north to avoid management boundary.	Site avoided.
SBF_029	Deviate Proposal alignment north to avoid management boundary.	Site avoided.
SBF_030	Deviate Proposal alignment north to avoid management boundary.	Site avoided.
SBF_031	Deviate Proposal alignment northwest of management boundary on existing track.	Site avoided.
SBF_032	Deviate Proposal alignment south-west to avoid management boundary.	Site avoided.
Private Land		
SBF_PA_1	Position Proposal alignment near a below ground Telstra telecommunications cable running parallel to a nearby road, situated approximately 10 m north of the road alignment.	Minor impact but adjacent to existing disturbed communications line and road. The alternative Proposal alignment along the private fence line around the UCL would involve two crossings of a Thomas River tributary on very steep terrain.
SBF_PA_2	Locate the Proposal alignment near below-ground Telstra telecommunications cable running parallel to a nearby road, situated approximately 10 m north of the road alignment.	Minor impact but adjacent to existing disturbed communications line and road. The alternative Proposal alignment along the private fence line around the UCL would involve two crossings of a Thomas River tributary on very steep terrain.
SBF_PA_3	Fence is located on private land already- replace existing farm boundary fence with the proposed barrier fence, no additional clearing required.	Minor impact but on existing disturbed crop land.
SBF_PA_4	Fence is located on private land already- replace existing farm boundary fence with the proposed barrier fence, no additional clearing required.	Minor impact but on existing disturbed crop land.

Site No.	Mitigation measure	Outcome
SBF_PA_5	Fence is located on private land already- replace existing farm boundary fence with the proposed barrier fence, no additional clearing required.	Minor impact but on existing disturbed crop land.

Table 11-10: Mitigation measures for Registered Sites

Site No.	Site Name	Mitigation measure	Outcome
26265	Oldfield River	No construction of Proposal alignment across river.	Site avoided.
26264	Young River	No construction of Proposal alignment across river.	Site avoided.
26266	Lort River	No construction of Proposal alignment across river.	Site avoided.
2396	Reserve Stone Arrangement	Proposal alignment to replace existing farm boundary fence. Proposal alignment will result in the clearing of 0.95 ha of previously uncleared vegetation and 1.64 ha of previously chained vegetation across the north western corner of Site 2396 (Figure 11-2).	Disturbance through site; however, Site 2396 is within previously disturbed areas and replaces an existing farm boundary fence. 0.95 ha of Site 2396 will incur disturbance within previously uncleared vegetation and 1.64 ha within previously disturbed areas (Figure 11-2).
1757	Mount Ney	Proposal alignment to replace existing fence.	Site avoided.
2641	Thomas River Station	Proposal alignment to replace existing farm boundary fence.	Interaction with management boundary and impact on small area of site but through existing degraded area where an existing farm boundary fence is currently located.
2642	Boyatup Hill	Proposal alignment to follow previously chained areas.	Site avoided.
2685	Hawes Hill	Proposal alignment to replace existing farm boundary fence.	Disturbance through site however, the site is located on a previously cleared area and replaces existing farm boundary fence. There is no new disturbance to this site.
17991	Granite outcrop south of Hawes Hill	Proposal alignment to replace existing farm boundary fence.	Disturbance through site; however, the site is located on a previously cleared area and replaces existing farm boundary fence. There is no new disturbance to this site.

The impacts to identified cultural areas which may occur as a result of the Proposal alignment are relatively minor due to the highly localised nature of any disturbance from the fence installation. Furthermore, the cultural areas are within or near to previously disturbed areas. The land is currently used for cropping, access tracks and firebreaks for the agricultural activities which occur along the Proposal alignment; as a result, these sites are often in an already highly disturbed state and the impact from the installation of the Proposal alignment will be consistent with current land management activities.

11.6.2 Management and monitoring

Consistent with the requirement of the ESD (Required Work Item 18 Heritage), an outline of the management, monitoring, trigger and contingency actions to ensure impacts to heritage are not greater than predicted is provided below.

All appropriate information regarding the Proposal alignment will be provided by DPIRD to the construction crews to ensure that the Proposal alignment does not intersect with identified cultural areas or Registered Heritage Sites other than that stated in this PER.

Clearing and chaining activities will not take place in areas where the Proposal alignment intersects with Registered Heritage Sites and identified cultural areas. DBCA has advised that the cultural areas identified in this PER document which occur within previously chained boundaries will no longer be subject to chaining activities (Turnbull D [DBCA] 2017 pers. comm. 26 April 2017). In all instances where clearing will be undertaken as part of the Proposal alignment installation, the boundary of clearing will be surveyed and flagged prior to clearing being undertaken.

DPIRD will seek to enact, with the landholders permission and with prior written notice and consultation with the Native Title group, s 18 procedures for the four Heritage Sites identified to intersect with the Proposal alignment (2396, 2641, 2685 & 17991). In addition to this, DPIRD may seek a s 18 approval for disturbance of any of the 18 cultural areas identified in the survey where complete avoidance of impact is not practicable if they are found to be s 5 heritage sites. Most of the 18 cultural areas are predicted to be impacted along their established management boundary and disturbance to the archaeological material is expected to be avoided.

In areas where an impact on Registered Aboriginal Heritage Sites has been predicted (and approved under the AH Act) DPIRD will engage the services of an appropriate Aboriginal heritage monitor to be on site during earth works through the Site. The monitor will identify any culturally significant material which may be revealed as a result of the disturbance and ensure any material discovered is appropriately and sensitively cared for. As per Clause 7.2 of the ENGSHA DPIRD will ensure contractors are made aware of all relevant obligations pursuant to the AH Act and the ENGSHA, including by providing the internet web address through which copies of the AH Act and the ENGSHA are available to the contractors.

DPIRD must also comply with s 15 of the ENGSHA as per below in the event that ancestral remains or objects were identified.

> *S15. Identification and Relocation of Ancestral Remains or Objects*
>
> *(a) Where, as a result of an Activity, the Government Proponent uncovers skeletal remains or identifies an area or object which it reasonably suspects of being an Aboriginal Site or Aboriginal Object, the Government Proponent must:*
>
> > *(a) cease all operations and activities in the immediate vicinity of such remains, area or objects;*
> >
> > *(b) immediately notify the DAA and other relevant authorities in accordance with the Aboriginal Heritage Act and other applicable statutory law; and*
> >
> > *(c) notify the Native Title Group of the findings and, subject to other statutory requirements, meet on site where the Native Title Group and Government Proponent will discuss in good faith a culturally appropriate method of managing the discovery and how to deal with it in accordance with the provisions of the Aboriginal Heritage Act or other applicable statutory law.*
>
> *(b) For the avoidance of doubt, and subject to other statutory requirements, the Activity may continue in areas which are not in the immediate vicinity of the suspected skeletal remains or suspected Aboriginal Site or Aboriginal Object.*

11.7 Proposed disturbance and assessment of the impacts to historical, cultural and natural heritage

Consistent with the requirements of the ESD (Required Work Item 15 & 16 Heritage), a description of the proposed disturbance and impacts to heritage associated with the Proposal, and an assessment of the potential impacts of the Proposal on historical, cultural associations and natural heritage values as a result of implementation of the Proposal is provided below.

In all cases where cultural areas and Heritage Sites are expected to be impacted, there is flexibility to use an existing track or cleared farm land to construct the proposed barrier fence; therefore, eliminating or reducing ground disturbing activities. The installation of the fence posts may cause damage to artefacts across the Proposal alignment; however, these impacts will be highly localised to every seven metres along the Proposal alignment. In most instances, the Proposal alignment occurs along a management boundary and the cultural area or Heritage Site is unlikely to be impacted (Figure 11-1 and Figure 11-2 to Figure 11-6). Large portions of the vegetation along the Proposal alignment have been historically cleared via chaining by DBCA. The vegetation clearing for the Proposal alignment will involve chaining vegetation 9–14 m from the Proposal alignment. This activity will occur within the 100 m wide chained areas already established by DBCA. Since the discovery of the cultural areas, DBCA advises chaining activities have ceased at these sites.

The desktop analysis and the surveys identified a total of 51 cultural areas within the vicinity of the Proposal alignment. Five of the registered sites are outside the development envelope and no impacts are predicted. Of the 46 areas remaining, 19 cultural areas were avoided by a slight adjustment of the Proposal alignment, the three registered sites 26264, 26265 & 26266 (the Young, the Loft and the Oldfield rivers) were avoided by stopping the Proposal alignment before the boundary of the river and then continuing the Proposal alignment on the other side of the river. The gaps in the Proposal alignment include all riparian vegetation and were developed in consultation with the Traditional Owners of the area. A further two registered sites (1757 & 2642) were avoided by installing the Proposal alignment on freehold land (Figure 11-3) and previously chained areas (Figure 11-4).

A total of 18 cultural areas, two registered sites and two sites yet to be assessed by the DAA may be disturbed as a result of constructing the Proposal alignment, these areas and the potential impact to them are detailed below in Table 11-11.

Table 11-11: Potential disturbance of heritage places

Site No.	Potential impact
SBF_003	Cultural artefacts disturbed or destroyed along edge of management boundary
SBF_004	Cultural artefacts disturbed or destroyed along edge of management boundary
SBF_010	Disturbance of surface material across whole site due to chaining
SBF_011	Disturbance of surface material along management boundary
SBF_012	Cultural artefacts disturbed or destroyed along edge of management boundary
SBF_013	Cultural artefacts disturbed or destroyed along edge of management boundary
SBF_015	Cultural artefacts disturbed or destroyed along edge of management boundary
SBF_016	Cultural artefacts disturbed or destroyed along edge of management boundary
SBF_017	Cultural artefacts disturbed or destroyed along edge of management boundary
SBF_018	Disturbance of surface material along management boundary
SBF_020	Disturbance of surface material along management boundary
SBF_021	Cultural artefacts disturbed or destroyed along edge of management boundary
SBF_026	May impact artefacts on edge of management boundary
SBF_PA_1	Possible damage or disturbance to artefacts
SBF_PA_2	Possible damage or disturbance to artefacts through part of site
SBF_PA_3	Possible damage or disturbance to artefacts along edge of management boundary
SBF_PA_4	Possible damage or disturbance to artefacts along edge of management boundary but along already disturbed fence line
SBF_PA_5	Possible damage or disturbance to artefacts along already disturbed fence line
2396	Disturbance or damage of surface material within site but along already disturbed fence line
2641	Possible disturbance of surface material along management boundary
2685	Disturbance or damage of surface material within site but along already disturbed fence line
17991	Disturbance or damage of surface material within site but along already disturbed fence line

Many Aboriginal sites are fragile and can be easily damaged (DAA 2016b). Ground clearing and installation activities threaten site integrity which may result in artefact damage and site destruction. The impacts on whole sites have been avoided by the realignment of the Proposal alignment to the edge of management boundaries, which are significantly wider (in some cases hundreds of metres wider) than the actual location of cultural material. The remaining potential impacts on cultural heritage are expected to be minor due to the relatively small and highly localised soil disturbance associated with the installation of the proposed barrier fence. The impacts associated with the fence construction are likely to be exposure of buried material and possible broken artefacts from heavy machinery and fence post installation. Chaining will result in minor soil disturbance.

In addition to the significance of the artefacts discovered along the Proposal alignment (Table 11-4), the cultural significance of several specific locations was also discussed. Locations were identified within the reports which outlined historical and cultural significance as meeting places, food resources, the provision of materials (ochre sources) and well know camp sites (AAA 2015; Taylor 2015). These locations were often associated with artefacts. All known meeting places, granite outcrops, gnamma holes camp sites and ochre sources have been avoided by the Proposal alignment.

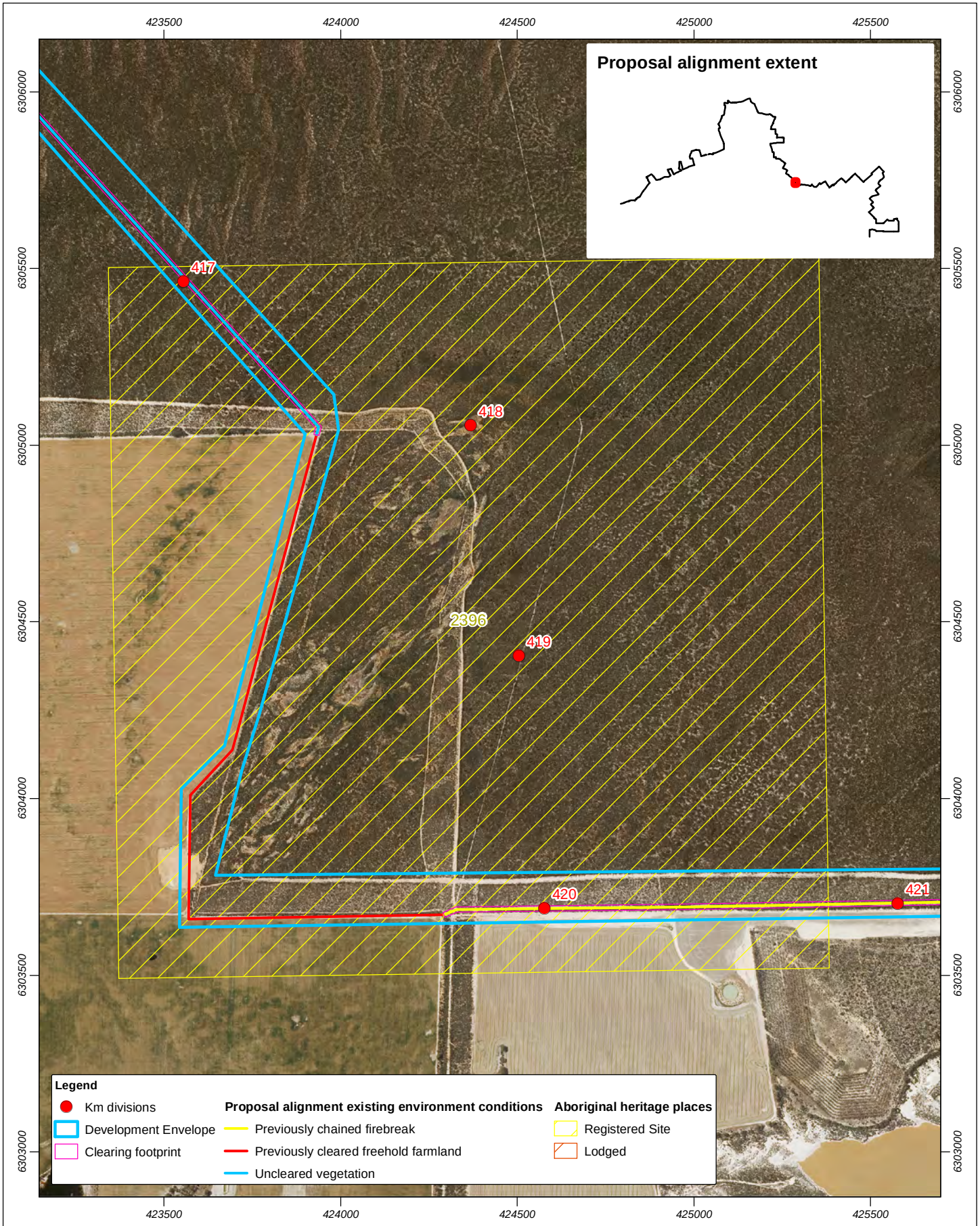


Figure 11-2: Registered Heritage Places (Site: 2396) intersecting the Proposal alignment

Scale 1:14,500 at A4

N

0 100 200 300 400 500 Meters

Coordinate System: GDA 1994 MGA Zone 51

Note that positional errors may occur in some areas

Date: 1/08/2017

Author: DWhite

Source: Aerial & Data: client 2016; Registered Heritage Sites: DAA 2016.

*Km divisions based on previous alignment options

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Figure 11-3: Registered Heritage Places (Site: 1757) avoiding the Proposal alignment

Scale 1:14,500 at A4

N

0 100 200 300 400 500 Meters

Coordinate System: GDA 1994 MGA Zone 51

Note that positional errors may occur in some areas

Date: 1/08/2017

Author: DWhite

Source: Aerial & Data: client 2016; Registered Heritage Sites: DAA 2016.

*Km divisions based on previous alignment options

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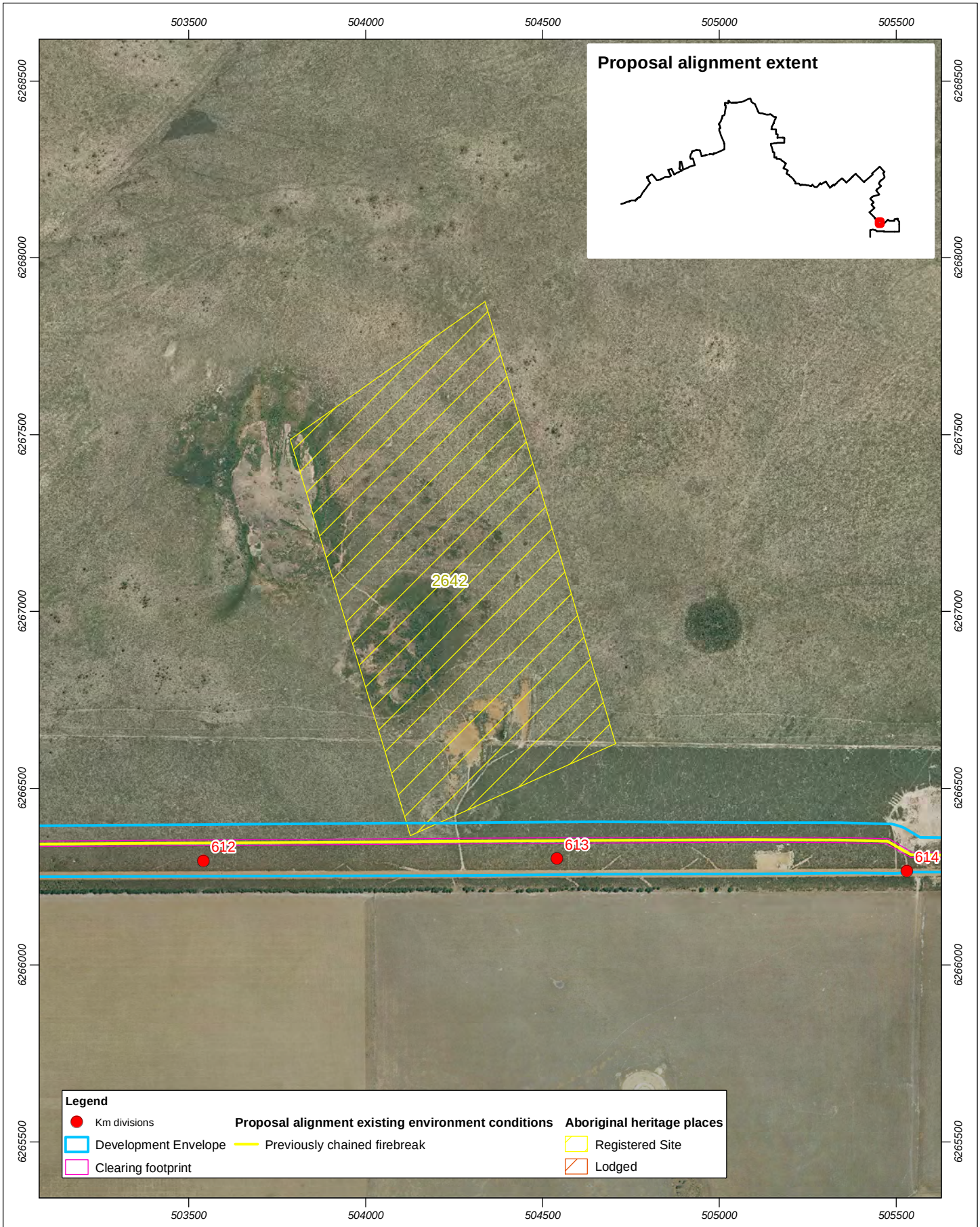


Figure 11-4: Registered Heritage Places (Site: 2642) avoiding the Proposal alignment

Scale 1:14,500 at A4

N

0 100 200 300 400 500 Meters

Coordinate System: GDA 1994 MGA Zone 51

Note that positional errors may occur in some areas

Date: 1/08/2017

Author: DWhite

Source: Aerial & Data: client 2016; Registered Heritage Sites: DAA 2016.

*Km divisions based on previous alignment options

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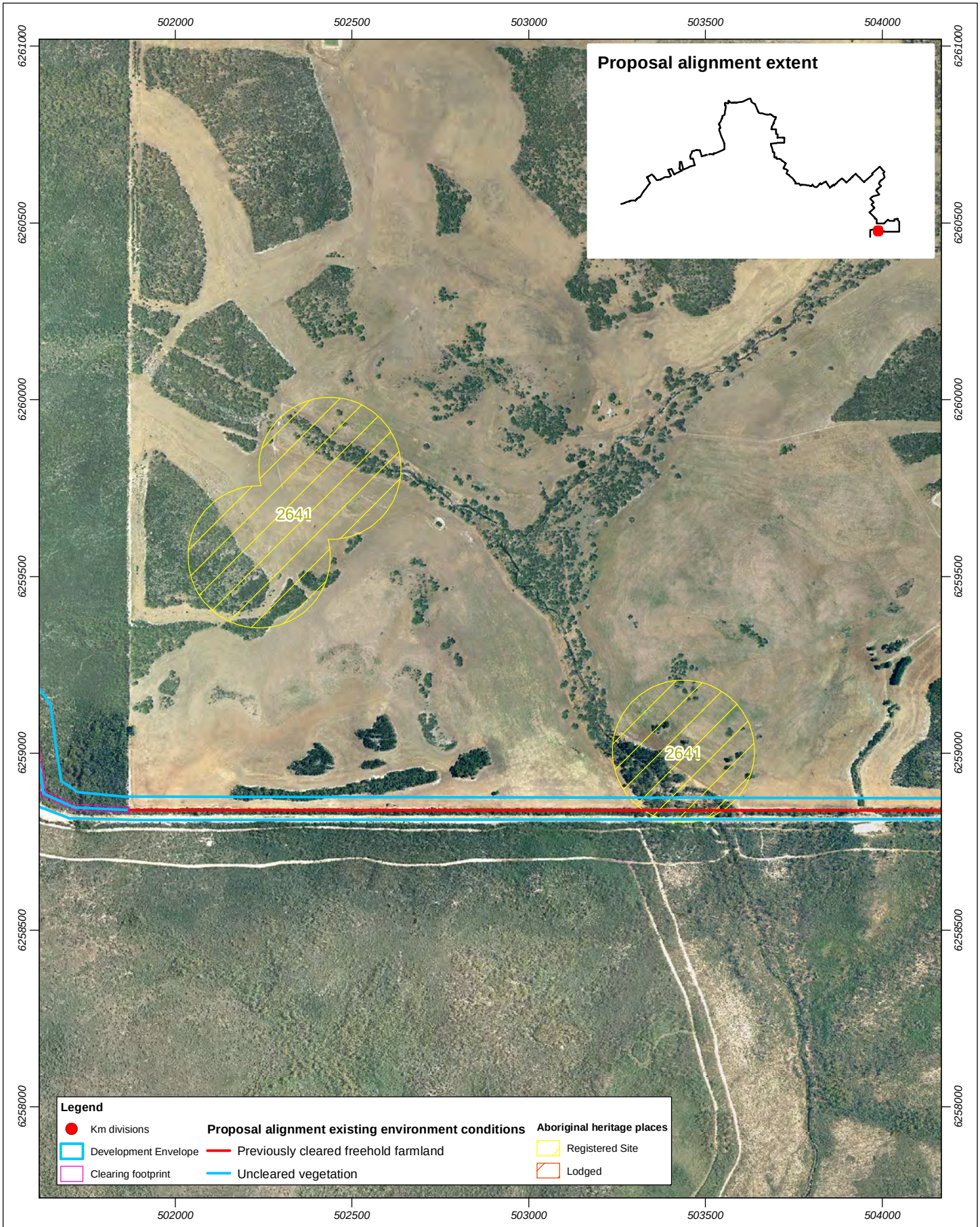


Figure 11-5: Registered Heritage Places (Site: 2641) intersecting the Proposal alignment

Scale 1:14,500 at A4

N

0 100 200 300 400 500 Meters

Coordinate System: GDA 1994 MGA Zone 51

Note that positional errors may occur in some areas

Date: 1/08/2017

Author: DWhite

Source: Aerial & Data: client 2016; Registered Heritage Sites: DAA 2016.

*Km divisions based on previous alignment options

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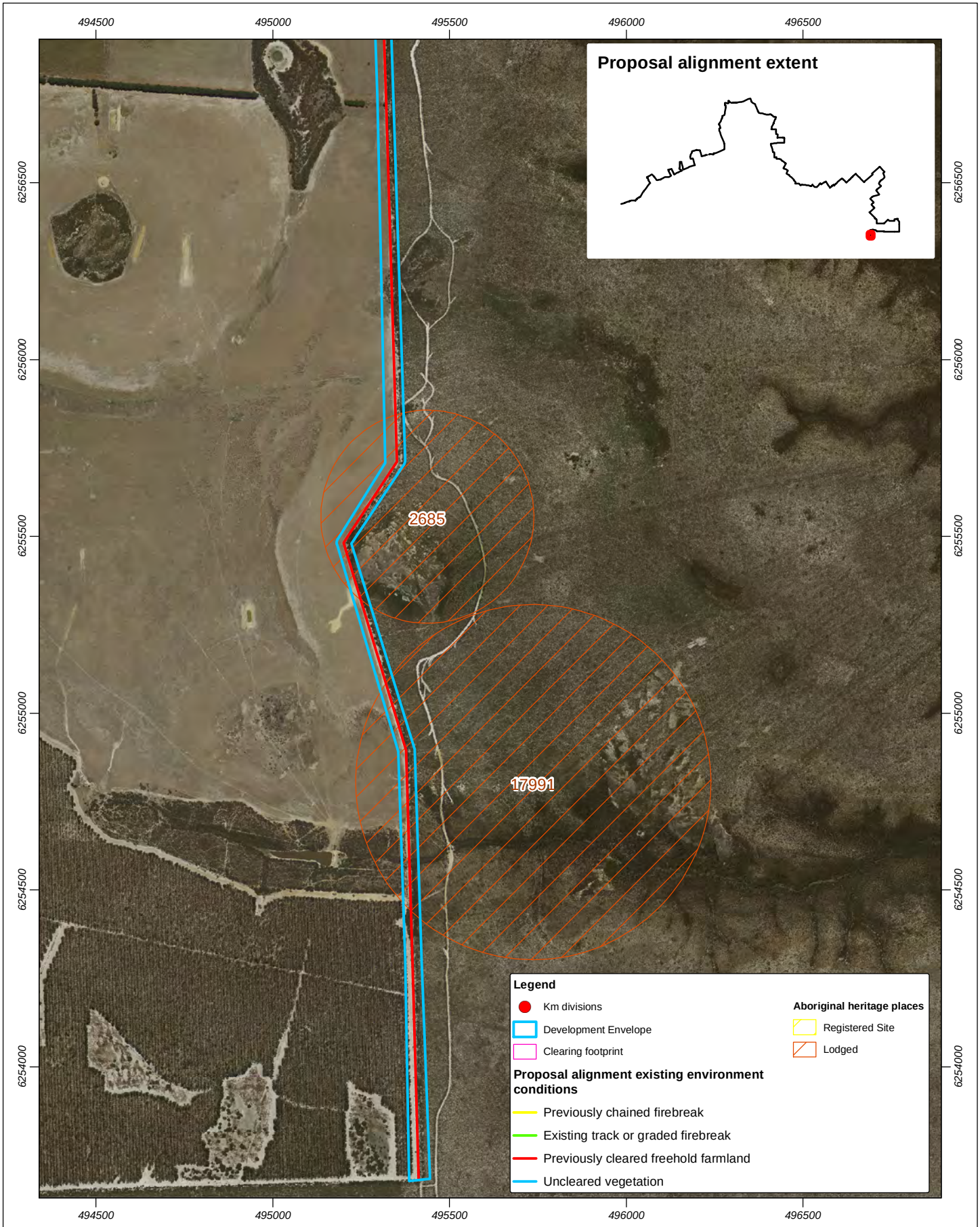


Figure 11-6: Registered Heritage Places (Site: 2685 and Site: 17991) intersecting the Proposal alignment

Scale 1:14,500 at A4

N

0 100 200 300 400 500 Meters

Coordinate System: GDA 1994 MGA Zone 51

Note that positional errors may occur in some areas

Date: 1/08/2017

Author: DWhite

Source: Aerial & Data: client 2016; Registered Heritage Sites: DAA 2016.

*Km divisions based on previous alignment options

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11.7.1 Indirect impacts

The Proposal will likely result in a reduction of emus migrating across the landscape, this may have some ecological consequences for vegetation which relies on transportation and propagation of seeds via emu digestive tracks (Calvino-Cancela et al 2006). However, this effect is not expected to be significant as emus will still occur on both sides of the Proposal alignment once construction is completed; additionally, the Proposal alignment will retain corridors for ecological connectivity along the rivers. These gaps in the Proposal alignment will allow emus to move within these corridors, thus maintaining ecological connectivity across the landscape.

The potential for impacts on fauna have been assessed in Section 10.7. This assessment concluded that there would be mortality of a low number of emus and kangaroos through entanglement in the proposed barrier fence but there was a low additional risk to fauna from habitat fragmentation. The maintenance of ecological corridors and the maintenance of access for small non-target fauna will minimise impacts to these natural heritage values.

11.7.2 Cumulative impacts

The large-scale clearing of land for agriculture in the Great Southern has disturbed the historical, cultural and natural heritage values of the land making any additional impact more significant. The heritage values of the Great Western Woodlands are more intact as a result of being outside the agricultural area.

The Proposal will result in minor disturbance of 18 cultural areas and four Registered Heritage Sites. All identified sites with cultural significance such as rivers, caves and granite outcrops have been avoided. The Proposal is not expected to result in a significant additional loss of heritage values in the region.

11.8 Summary of predicted residual impacts

The predicted residual impacts of the Proposal alignment on Heritage are:

1. Ground disturbance potentially damaging buried artefacts within 18 cultural areas (or their management boundaries) and four Registered Heritage Sites–in all cases, the disturbance will be within existing cleared farm land, vehicle tracks or previously chained areas (one cultural area only), further:
    (a) eight cultural areas will have the edge of their management boundary disturbed but only on existing, disturbed freehold farm land. This would involve removing an existing farm boundary fence and replacing it with a barrier fence. No new clearing will be undertaken. This re-alignment option was considered preferable to extending outside the management boundary and clearing undisturbed bushland
    (b) three cultural areas will be disturbed on farm land (an already highly modified landscape) by replacing an existing fence
    (c) the management boundary of four places would be disturbed but on an existing firebreak
    (d) one cultural area will be disturbed within a previously chained area
    (e) minor disturbance of two cultural areas (SBF PA1 and SBF PA2) where artefact scatters were identified; however, the sites are adjacent to an existing disturbed communications line and road. The proposed barrier fence would be located near a below ground Telstra telecommunications cable running parallel to the road, situated approximately 10 m north of the road alignment. The alternative Proposal alignment at this location (replacing the existing farm boundary fences around the UCL) is not proposed as it would involve two crossings of a Thomas River tributary, additional vegetation clearing and very steep terrain.
2. Ground disturbance within two Registered Aboriginal Heritage Sites and two lodged Aboriginal Heritage Sites within previously disturbed areas, further:
    (a) three sites may be affected within the management boundary but the Proposal alignment will replace an existing fence and use already disturbed areas (Sites 2641 [Figure 11-5], 2685 & 17991 [Figure 11-6])

(b) one Registered Site (Site 2396) may be impacted as 5.3 km of the Proposal alignment traverses through this Site. The Proposal alignment will replace current farm boundary fences and utilise previously chained areas and uncleared areas. The Proposal will result in the clearing of 0.95 ha of previously uncleared vegetation and 1.64 ha of previously chained vegetation within Site 2396 (Figure 11-2). The balance of the Proposal alignment will replace existing farm boundary fences and will require no clearing.

3. The potential loss of cultural plants along the Proposal alignment from chaining activities (unable to be assessed through the confidentiality of the identified cultural plants).
4. Fauna deaths of emus and kangaroos that become entangled in the proposed barrier fence.

Impacts from Proposal construction activities will be highly localised.

The ecological connectivity throughout the region is not expected to be significantly impacted; emus and kangaroos occur on both sides of the Proposal alignment, migration inland and toward the coast is still possible via three gaps in the fence line along the intersection of the rivers and east-west along the coastal corridor. Animals which inhabit either side of the Proposal alignment will continue to move through the landscape on both sides and provide ecological connectivity.

The Proposal can be managed to meet the EPA objective for Heritage as outlined in EPA EAG 8 (2015a).

The key mitigation strategies to minimise loss or disturbance impacts to heritage values include:

- altering 89.5% of the proposed barrier fence length to utilise existing linear disturbance areas such as existing fire management breaks and already cleared areas within private property
- reducing total clearing footprint to a 15–20 m width
- using highly visible materials to construct the proposed barrier fence to increase visibility to fauna animals
- adjusting the Proposal alignment to:
  - allow for unfenced areas associated with three main river systems and coastal corridor to retain the ecological connection with vegetation on both sides of the proposed barrier fence
  - re-align away from identified cultural areas and Registered Heritage Sites.

With Registered Heritage Sites where a potential impact is predicted, DPIRD will seek to submit a s 18 permit under the AH Act for each site potentially disturbed. This will be done with the land owners' permission (as the applicant) and with prior written notice and consultation with the Native Title group as per Clause 16 of the ENGSHA. The s 18 permit will include provision for monitors to be present at the Registered Heritage Site during construction to ensure the risk to the site is minimised and any artefact disturbed is sensitively and appropriately cared for. Additionally, DPIRD may also seek to submit a s 18 approval for any cultural area that is found to be a Registered Heritage Site following assessment by DAA.

DPIRD may stop constructing the proposed barrier fence where approval to impact a s 5 site cannot be obtained or the time and cost of the process is considered too high for the scope of the Proposal. A decision as to whether or not to upgrade the freehold farm boundary fence would then be left to the landholder at that location.

The proposed mitigation and management strategies are expected to be effective in minimising potential impacts. No significant impact is expected for the loss and disturbance of heritage values as the Proposal is not expected to compromise historical and cultural associations, and natural heritage either locally or regionally.

Table 13-2 summarises the inherent environmental impacts (prior to mitigation), the mitigation measures as well as an assessment against EPA objectives.

12. Integrating factors - Offsets

12.1 Relevant environmental objectives, legislation, policies and guidelines

12.1.1 Environmental objectives

The EPA environmental objectives for integrating factors - Offsets, as well as potential environmental aspects of the Proposal that may impact the consideration for Offsets are provided in Table 12-1.

Table 12-1: Key environmental factors, objectives and Proposal environmental aspects

Environmental factor	EPA objective	Proposal environmental aspect
Offsets	To counterbalance any significant residual environmental impacts or uncertainty through the application of offsets.	Residual environmental impacts will be determined through the assessment in alignment with the WA Environmental Offsets guidelines.

12.1.2 Requirements of the ESD

The ESD outlines the work required for the environmental impact assessment of key environmental factors in the PER; these requirements for consideration of offsets and where they have been addressed are outlined in Table 12-2.

Table 12-2: Integrating factors – Offsets required work for the Proposal as per the ESD

Item	Requirement	Section in the PER
20	Describe the residual impacts for the proposal and analyse these impacts to identify and detail any that are significant.	Section 12.2.1
21	If the proposal is likely to have any significant residual environmental impacts, identify environmental offsets consistent with the requirements of: a) WA Environmental Offsets Guidelines, which includes the use of the WA Environmental Offsets template; and b) EPA Environmental Protection Bulletin No. 1.	Section 12.2.2

12.1.3 Legislation, policies and guidelines

Relevant EPA policy and guidelines outlined in the ESD and an explanation on how the Proposal meets EPA policy and guidelines are presented in Table 12-3.

Table 12-3: Relevant EPA policies and guidelines for Offsets

Policy/guideline	Summary of policy/guideline	Requirements to address the policy/guideline
EPA Environmental Protection Bulletin No. 1 (2014) Environmental offsets. Perth, Western Australia	This bulletin clarifies how the EPA will consider offsets through the environmental impact assessment (EIA) process.	The PER should include: • a section in the PER discussing how the document has applied the mitigation hierarchy to the Proposal • description of all potential impacts and identification of actions that will be applied to avoid, minimise or rehabilitate the impacts • description of all residual impacts • analysis of impacts to identify and detail which of these residual impacts are significant. Include the following details if the offset is required: • proposed offset projects • objectives and completion criteria • plans and policies • timelines and milestones • governance arrangements • financial arrangements • risk management • monitoring • reporting.
Government of Western Australia (2011) *WA Environmental Offsets Policy.* Perth, Western Australia	Ensures that economic and social development may occur while supporting long term environmental and conservation values.	The following principles have been followed in relation to the use of environmental offsets: 1. Environmental offsets will only be considered after avoidance and mitigation options have been pursued. 2. Environmental offsets are not appropriate for all projects. 3. Environmental offsets will be cost-effective, as well as relevant and proportionate to the significance of the environmental value being impacted. 4. Environmental offsets will be based on sound environmental information and knowledge. 5. Environmental offsets will be applied within a framework of adaptive management. 6. Environmental offsets will be focussed on longer term strategic outcomes.
Government of Western Australia (2014) *WA Environmental Offsets Guidelines.* Perth, Western Australia	Clarifies the determination and application of environmental offsets in Western Australia, and the application of this guideline will ensure that decisions made on environmental offsets are consistent and accountable under the *Environmental Protection Act 1986.*	If an offset is required, the Proposal follows the guidelines in this document. This includes: • the application of the residual impact significance model • quantification of the significant impact/s and identification of mitigation actions.
WA Environmental Offsets template (230914). Perth, Western Australia	NA.	NA.

12.2 Required work

Consistent with the requirements of the ESD (Required Work Item 20 for Integrating factors - Offsets) the Proposal was evaluated to determine the potential for a residual environmental impact on vegetation and flora, fauna and heritage values.

12.2.1 Significance of residual impacts

Flora and Vegetation

The predicted residual impacts of the Proposal on Vegetation and Flora following the application of the mitigation hierarchy in Table 9-9 include:

1. Disturbance of up to 816 ha of native vegetation with approximately:
    - 373.8 ha for re-chaining (if necessary) of previously chained areas
    - 248.6 ha of grading within chained areas, where the inner graded fire track will be used preferentially where possible
    - 146.0 ha of chaining within uncleared vegetation
    - 41.6 ha (5%) of permanent grading (for a 6 m wide access track) within uncleared vegetation
    - 6 ha for water diversion turnouts for erosion control (predicted impacts are not expected to impact vegetation at a local or regional scale).
2. Disturbance of the following vegetation associations with less than 30% of their extent remaining:
    - 28.1 ha of Vegetation Association 47
    - 64.2 ha of Vegetation Association 512
    - 3.6 ha of Vegetation Association 4801 with 1.2 ha of this clearing located in uncleared vegetation.
3. Disturbance of 655 m Proteaceae Dominated Kwongkan Shrubland TEC (0.87 ha) (re-chaining proposed as part of the Proposal) within an existing and recently re-chained firebreak.
4. Fragmentation and localised edge effects along the 69.3 km of the Proposal alignment that is within uncleared vegetation.
5. Clearing of 36 species of Priority flora, with 11 Priority Flora species located within uncleared vegetation.

There will be no new clearing of records of threatened flora species which occur in the vicinity of the Proposal alignment (*Conostylis lepidospermoides*, *Anigozanthos bicolor* subsp. *minor, Eucalyptus merrickiae*, *Rhizanthella gardneri)*, and the proposed clearing will not significantly change the percentage remaining of any Vegetation Associations. Disturbance of 0.87 ha of Proteaceae Dominated Kwongkan Shrubland TEC also represents no new impact as this disturbance is located within a previously chained area.

The key mitigation strategies to minimise clearing and fragmentation of native vegetation include:

- altering the proposed barrier fence length to utilise existing linear disturbance areas such as existing fire management breaks and already cleared areas within private property
- reducing the total clearing footprint to a 15–20 m width
- provision of three unfenced gaps associated with three main river systems and coastal corridor to retain the ecological connection with vegetation on both sides of the proposed barrier fence
- Proposal alignment to avoid of any records of threatened flora species in uncleared vegetation areas
- implementation of the CMP and WHP.

Terrestrial Fauna

The predicted residual impacts of the Proposal on Terrestrial Fauna following the application of the mitigation hierarchy in Table 10-10 include:

- loss of 816 ha of fauna habitat within disturbance areas
- mortality of a low number of emus and kangaroos through entanglement in the proposed barrier fence
- loss of connection of vegetation remnants inside the fence with areas outside the agricultural areas

    - fifteen vegetation remnants were identified as potentially being isolated with three of these being small enough to suffer population decline of Brush Wallabies due to genetic isolation and one of these having little internal connection with other remnants
- uncertain risk to the Critically Endangered Western Ground Parrot as the Proposal alignment is outside (approximately 2 km from) the known occurrence of the species and the risk of collision will be mitigated through the use of fluorescent orange markers every 2.3 m between fence posts
- local risk of increased predation along the 69.3 km of the Proposal alignment that does not follow existing disturbance areas will be mitigated through baiting programs for wild dogs and foxes
- loss of 103 potential habitat trees located within uncleared vegetation in Salmon Gums section of the Proposal alignment
- no significant impact on any conservation significant species.

The key mitigation strategies of minimising clearing, fence design, utilising existing disturbance and adjusting the Proposal alignment to minimise isolation of vegetation are anticipated to be effective in mitigating potential impacts. No significant impact on the representation, diversity, viability and ecological function of fauna is expected at the species, population and assemblage level.

Heritage

The predicted residual impacts of the Proposal on Heritage following the application of the mitigation hierarchy in Section 11.5 include:

- ground disturbance potentially damaging buried artefacts within 18 cultural areas (or their management boundaries) and five Heritage Sites–in all cases, the disturbance will be within existing cleared farm land, vehicle tracks or previously chained areas (one cultural area only)
- ground disturbance within four Registered Heritage sites within previously disturbed areas
- the potential loss of cultural plants along the Proposal alignment from chaining activities (unable to be assessed through the confidentiality of the identified cultural plants)
- fauna deaths of emus and kangaroos that become entangled in the proposed barrier fence.

Impacts from installation of the proposed barrier fence and grading activities will be highly localised. The level of site disturbance associated with the Proposal is small (grading and installation of the fence) and is unlikely to result in the significant loss of historical and cultural associations, and natural heritage, in the Proposal area. Disturbance of heritage sites will be managed under s 18 of the AH Act.

The significance of residual impacts was determined through the application of the residual impact significance model in the WA Environmental Offsets Guidelines (EPA 2014). The model identifies four levels of significance for residual impacts:

1. Unacceptable impacts–those impacts which are environmentally unacceptable or where no offset can be applied to reduce the impact. Offsets are not appropriate in all circumstances, as some environmental values cannot be offset.
2. Significant impacts requiring an offset–any significant residual impact of this nature will require an offset. These generally relate to any impacts to species, ecosystems, or reserve areas protected by statute or where the cumulative impact is already determined to be at a critical level.
3. Potentially significant impact which may require an offset– the residual impact may be significant depending on the context and extent of the impact. These relate to impacts that are likely to result in a species or ecosystem requiring protection under statute or increasing the cumulative impact to a critical level. Whether these impacts require an offset, it will be determined by the decision-maker based on information provided by the proponent or applicant and expert judgement.
4. Impacts which are not significant–impacts which do not trigger the above categories are not expected to have a significant impact on the environment and; therefore, do not require an offset.

Table 12-4 consolidates all the predicted residual impacts across the environmental factors and outlines whether the predicted residual impacts are significant and an offset is required.

The predicted residual impacts across the environmental factors do not constitute a significant impact at a regional scale.

12.2.2 Requirement for offsets

No significant residual impact on vegetation and flora, fauna or heritage was identified following the impact assessment undertaken in this PER. Therefore, no offsets are proposed as part of this Proposal.

Table 12-4: Significance of predicted residual impacts for environmental factors

Predicted residual impact	Application of the Residual Impact Significance Model	Residual impacts following mitigation strategies and significance
Environmental Factor: Flora and Vegetation		
Disturbance of up to 816 ha of native vegetation with approximately: • 390.2 ha for re-chaining (if necessary) of previously chained areas • 248.6 ha of grading within chained areas • 146.0 ha of chaining within uncleared areas • 41.6 ha of permanent clearing (for a 6 m wide graded track) within uncleared areas • Max. 6 ha of full clearing for water diversion turnouts (predicted impacts as presented in Table 9-14).	Impacts which are not significant.	The Proposal will result in 188.0 ha of new disturbance (excluding a maximum of 6 ha for water diversion turnouts) through the clearing of vegetation within uncleared areas. The balance of the clearing required for the Proposal (622.4 ha) will commence within previously disturbed areas. Only 5% of the 188.0 ha of new disturbance (41.6 ha) will be permanent clearing for a 6 m wide graded track. The 41.6 ha permanent clearing is not expected to be a significant impact as the Proposal alignment follows the edge of the agricultural area and is adjacent to almost 16 million hectares of uncleared vegetation in the Great Western Woodlands, noting an existing approximately 69 000 ha of disturbance within the Great Western Woodlands associated with linear infrastructure, and additional disturbance associated with townships and mines. Due to the small scale of clearing for the Proposal the overall clearing of vegetation is not expected to be significant and offsets are not proposed. Total predicted residual impacts to the mapped extent of local vegetation types (which include water turnout diversions) are less than 20% and; therefore, no significant impacts to vegetation at a local or regional scale is expected as a result of the Proposal.
Disturbance of vegetation associations with less than 30% remaining consists of approximately:" • 21.8 ha of Vegetation Association 47 • 64.2 ha of Vegetation Association 512 • 3.6 ha of Vegetation Association 4801.	Impacts which are not significant.	No new disturbance to these vegetation associations is expected with the exception of 1.2 ha of Vegetation Association 4801 located in previously uncleared area. No new disturbance is expected for the areas of Vegetation Association 47, 512 and 2.4 ha of Vegetation Association 4081 as they are located in a previously chained area. New disturbance of 1.2 ha associated with Vegetation Association 4801 in a previously uncleared area is not expected to be a significant impact as 1.2 ha will not significantly change the current extent of Vegetation Association 4801. The proposed clearing across Vegetation Association 47, 512 and 4801 will also not significantly change the percentage remaining of these vegetation associations at a regional scale; therefore, offsets are not proposed.
Disturbance of local vegetation types.	Impacts which are not significant.	Total predicted residual impacts to the mapped extent of local vegetation types (which include water turnout diversions) are less than 20% and; therefore, no significant impacts to vegetation at a local or regional scale is expected as a result of the Proposal.
655 m of the Proposal alignment intersecting Proteaceae Dominated Kwongan Shrubland TEC.	Impacts which are not significant.	A total of 0.87 ha of Proteaceae Dominated Kwongkan Shrubland TEC will be re-chained as part of the Proposal. This is not expected to be a significant impact as the 0.87 ha is located within previously chained areas; therefore, there is no new disturbance of this TEC. Offsets are therefore not proposed.
Fragmentation and localised edge effects along the 69.3 km of the Proposal alignment that is within uncleared vegetation.	Impacts which are not significant.	The potential for increased fire risk, weed invasion and the spread of disease will be management through the prevention of public access and implementation of the WHP and PDMP. As a result, impacts from fragmentation and localised edge effects along the 69.3 km of the Proposal alignment that is within uncleared vegetation is not expected to be significant and offsets are not proposed.
Clearing of 36 species of Priority flora, with 11 of these species located within uncleared vegetation.	Impacts which are not significant.	The clearing of these Priority Flora species records within uncleared areas is not expected to have a significant impact on Priority flora species and offsets are not proposed.

Predicted residual impact	Application of the Residual Impact Significance Model	Residual impacts following mitigation strategies and significance
Environmental Factor: Terrestrial Fauna		
Disturbance of up to 816 ha of native vegetation with approximately: • 390.2 ha for re-chaining (if necessary) of previously chained areas • 248.6 ha of grading within chained areas • 146.0 ha of chaining within uncleared areas • 41.6 ha of permanent clearing (for a 6 m wide graded track) within uncleared areas • max. 6 ha of full clearing for water diversion turnouts (predicted impacts as presented in Table 9-14).	Impacts which are not significant.	The Proposal will result in 188.0 ha of new disturbance (excluding 6 ha for water diversion turnouts) through the clearing of vegetation within uncleared areas. The balance of the clearing required for the Proposal (622.4 ha) will commence within previously disturbed areas. Only 5% of the 188.20 ha of new disturbance (41.6 ha) will be permanent clearing for a 6 m wide graded track. The 41.6 ha permanent clearing is not expected to be a significant impact as the Proposal alignment follows the edge of the agricultural area and is adjacent to almost 16 million hectares of uncleared vegetation in the Great Western Woodlands, noting an existing approximately 69 000 ha of disturbance within the Great Western Woodlands associated with linear infrastructure, and additional disturbance associated with, townships and mines. Due to the small scale of clearing for the Proposal the overall clearing of vegetation is not expected to be significant.
Mortality of a low number of emus and kangaroos through entanglement in the proposed barrier fence.	Impacts which are not significant.	The mortality of a low number of emus and kangaroos through entanglement in the proposed barrier fence is not expected to be a significant impact.
Loss of connection of vegetation remnants inside the fence with areas outside the agricultural areas.	Impacts which are not significant.	Fifteen vegetation remnants were identified as potentially being isolated within the proposed barrier fence with three of these being small enough to suffer population decline of Western Brush Wallabies due to genetic isolation (less than 1500 ha in size). One of these remnants was identified as having little internal connection with other remnants. Based on the vegetation present, Mallee woodland and shrubland, the majority of the sites have the potential to support wallabies and the majority of large remnants inside the fence are large enough to support viable populations of wallabies. For remnants less than 1500 ha in size, impacts on the Western Brush Wallaby populations are not expected to be significant as there are sufficient large remnants inside the fence to maintain viable populations, and; therefore, there is no significant impact to the species regionally at the population level.
Uncertain risk to the Critically Endangered Western Ground Parrot as the Proposal alignment is outside (approximately 2 km from) the known occurrence of the species.	Impacts which are not significant.	The eastern part of the proposed fence extension has potential for (minor) impact on the Critically Endangered Western Ground Parrot (*Pezoporus flaviventris*), limited to a low risk of collision for individual birds dispersing beyond the currently occupied range, but not acting as a barrier; any collision risk will be further reduced by enhancement of fence visibility. Impacts of vegetation clearing and fence construction to fauna (including all species, not only conservation listed) are likely to be predominantly negative but relatively minor. As a result, impacts on the Western Ground Parrot are not expected to be significant.
Local risk of increased predation along the 69.3 km of the Proposal alignment that does not follow existing disturbance areas.	Impacts which are not significant.	Local risk of increased predation along the 69.3 km of the Proposal alignment within previously uncleared areas is not expected to be a significant impact. There are existing baiting programs for wild dogs and foxes implemented by Biosecurity Groups within 0–20 km of the proposed barrier fence in place. There is also the proposed monitoring program (under the PPCMP) to be implemented at the unfenced gaps associated with the Oldfield, Lort and Young rivers, the 3.2 km coastal gap and along the 63.3 km alignment associated with previously uncleared areas.

Predicted residual impact	Application of the Residual Impact Significance Model	Residual impacts following mitigation strategies and significance
Potential loss of up to 103 potential habitat trees within uncleared vegetation located in the Salmon Gum area.	Impacts which are not significant.	The possible removal of 103 potential habitat trees is not expected to be significant at a local or regional scale as: • large trees were typically found to occur in clusters which often extended beyond the 20 m corridor for the Proposal alignment • pre-clearing survey will be conducted as part of the CMP prior to construction for potential breeding hollows • potential habitat trees lie outside the known breeding range for Carnaby's Black Cockatoo.
Environmental Factor: Heritage		
Ground disturbance potentially damaging buried artefacts within 18 cultural areas (or their management boundaries) and five Heritage Sites.	Impacts which are not significant.	Disturbance within the 18 cultural areas (or management boundaries) all occur within previously disturbed areas. Impacts are not expected to be significant as there is no new disturbance to these areas.
Ground disturbance within four Registered Heritage sites within previously disturbed areas.	Impacts which are not significant.	Disturbance is restricted to areas within existing cleared farm land, vehicle tracks or previously chained areas. Impacts are not expected to be significant as there is no new disturbance to these Registered Heritage Sites. Please note: 0.95 ha of uncleared bushland in Site 2396 is proposed to be cleared. The clearing in this Site will be well away from the archaeological/ethnographic feature ('Reserve Stone Arrangement') on which the Site listing is based. The Proposal alignment has been surveyed though this area by an archaeologist and Traditional Owners and no surface material was identified.
The potential loss of cultural plants along the Proposal alignment from chaining activities (unable to be assessed through the confidentiality of the identified cultural plants).	Impacts which are not significant.	Cultural plants exist throughout the Proposal alignment. Disturbance to these cultural plants are not expected to be significant as their cultural values relate to use of the integrated cultural landscape. Mitigation strategies involve the re-alignment of the Proposal onto existing disturbed areas. Emu dispersal was also identified to spread cultural plants. The Proposal alignment has unfenced gaps to allow for ecological connectivity outside and inside of the proposed barrier fence. Overall, impacts to cultural plants are not expected to be significant.
Fauna deaths of emus and kangaroos that become entangled in the proposed barrier fence.	Impacts which are not significant.	The mortality of a low number of emus and kangaroos through entanglement in the proposed barrier fence is not expected to be a significant impact.

13. Summary of likely environmental measures and controls

13.1 Environmental factors and management

Table 13-2 provides a summary of the assessment, management and predicted outcomes after the application of management measures. The predicted outcomes are also assessed against the relevant EPA objective for each preliminary key environmental factor.

13.2 Consistency with environmental principles

In 2003, the EP Act was amended to include a core set of Principles that are applied by the EPA in assessing proposals. These environmental protection principles listed in s4a of the EP Act are set out in Table 13-1 together with a summary of how DPIRD has considered these principles in its design and planned implementation of the Proposal.

Table 13-1: Consistency with Principles of Environmental Protection

Environmental Protection Principle	Consideration given in the Proposal
1. **The precautionary principle** Where there are threats of serious or irreversible damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation. In application of this precautionary principle, decisions should be guided by – • careful evaluation to avoid, where practicable, serious or irreversible damage to the environment; and • assessment of the risk-weighted consequences of various options.	The impact assessment for this PER is based on detailed environmental investigations. The only specific threat of serious or irreversible damage identified in the impact assessment is the potential for further decline of the Critically Endangered Western Ground Parrot. DBCA advised deaths due to collision between Western Ground Parrots and the proposed barrier fence are possible, but DBCA are uncertain whether there is likely to be a population level impact. However, DBCA further advised they considered the likelihood is "probably fairly low". Where there are areas of uncertainty regarding potential impacts, conservative assumptions have been made and documented to facilitate decision making. These assumptions will be reviewed through the proposed DPIRD staff fence monitoring program.
2. **The principle of intergenerational equity** The present generation should ensure that the health, diversity and productivity of the environment is maintained and enhanced for the benefit of future generations.	No significant residual impact on fauna, vegetation and flora or heritage is predicted from the Proposal. The key mitigation strategies of minimising clearing, fence design, utilising existing disturbance and adjusting the Proposal alignment to minimise isolation of vegetation are anticipated to be effective in mitigating potential impacts. Therefore, the Proposal is not expected to be at variance to this principle.
3. **The principle of conservation of biological diversity and ecological integrity** Conservation of biological diversity and ecological integrity should be a fundamental consideration.	The conservation of biological diversity and ecological integrity is a main environmental consideration for the Proposal. Detailed investigation into the vegetation and flora and fauna values of the Proposal alignment has been undertaken. The Proposal has been designed to minimise clearing and to avoid conservation significant values and identified ecological corridors.

Environmental Protection Principle	Consideration given in the Proposal
4. **The principles relating to improved valuation, pricing and incentive mechanisms** Environmental factors should be included in the valuation of assets and services. The polluter pays principles – those who generate pollution and waste should bear the cost of containment, avoidance and abatement. The user of goods and services should pay prices based on the full life cycle costs of providing goods and services, including the use of natural resources and assets and the ultimate disposal of any waste. Environmental goals, having been established, should be pursued in the most cost effective way, by establishing incentive structure, including market mechanisms, which enable those best placed to maximise benefits and/or minimise costs to develop their own solution and responses to environmental problem.	DPIRD accepts that the cost of the Proposal must include the proposed mitigation measures, monitoring and maintenance activities. These requirements have been incorporated into the overall Proposal costs. The WA Wild Dog Action Plan 2016–2021 proposes a transition from Government to include significant industry contribution to ongoing maintenance of the entire State Barrier Fence over the next four years. This is being investigated under legislation contained in the BAM Act.
5. **The principle of waste minimisation** All reasonable and practicable measures should be taken to minimise the generation of waste and its discharge into the environment.	The Proposal is not expected to generate any significant amount of waste. All domestic waste produced by the construction contractors will be removed and disposed of in appropriate waste disposal facilities.

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Table 13-2: Summary of impacts, mitigation and assessment

Inherent Impact	Environmental Aspect	Mitigation actions to address residual impacts	Proposed regulatory mechanisms for ensuring mitigation	Outcome to demonstrate that Proposal meets EPA objective
Flora and Vegetation - To maintain representation, diversity, viability and ecological function at the species, population and community level.				
Context/key survey findings • eighty-nine vegetation types were identified within the Ecoscape (2017a) study area for the Proposal • vegetation condition ranged from Degraded to Pristine but was predominantly Very Good or better in condition • Vegetation Associations 512, 4801, 47 have 10–30% of their Pre-European extent remaining at various scales • 60 Priority Flora were recorded in the Ecoscape (2017a) study area, an additional Priority 3 taxon *Hibbertia hamata* was identified from the Merivale Rd (UCL) section by GS Biologic (2015) • twenty-six introduced flora (weed) species were recorded by Ecoscape (2017a), including three species which are Declared Pest species under the *Biosecurity and Agriculture Management 2007* (BAM Act). Impacts without mitigation • direct clearing of native vegetation during construction • the introduction and spread of weeds • the introduction and spread of *Phytophthora cinnamomi* • fragmentation of vegetation • change in fauna aided seed dispersal.	Clearing of native vegetation.	Avoidance • altering 89.5% of the Proposal alignment length to utilise existing linear disturbance areas such as existing fire management breaks and already cleared areas within private property for farm boundary fences • Proposal alignment avoids instances of Threatened Flora in previously uncleared areas • Proposal alignment has unfenced areas associated with the three main river systems and coastal corridor to retain ecological connection with vegetation on both sides of the proposed barrier fence. Minimisation • minimising the width of the clearing footprint to 15–20 m • only bare earth clearing a width of 6 m and chaining the remaining 9–14 m disturbance width within the clearing footprint within previously disturbed areas • preparation and implementation of the following plans during construction and operation of the proposed barrier fence: 1. Construction Management Plan (CMP)–action items to include: • delineating the fence reserve boundary via pegging to provide accuracy to the limits of the allowable clearing lines • pre-clearing survey of unsurveyed areas to identify potential Declared Pests or Weeds of National Significance (WONS), and Threatened and Priority flora species prior to installation of the proposed barrier fence. 2. Phytophthora Dieback Management Plan (PDMP)–action items to include: • implementation of vehicle/soil hygiene measures. 3. Weed Hygiene Plan (WHP)–action items to include: • implementation of vehicle/soil hygiene measures. Residual impacts: • disturbance of up to 816 ha of native vegetation with approximately 373.8 ha for re-chaining (if necessary) of previously chained areas, 248.6 ha of grading within chained areas, 146.0 ha of chaining within uncleared vegetation, 41.6 ha of permanent clearing within uncleared vegetation and 6 ha for water diversion turnouts (predicted residual impacts from water turn outs are presented in Table 9-14) • fragmentation and localised edge effects along the 69.3 km of the Proposal alignment that is within uncleared vegetation • loss of approximately 28.1 ha of Vegetation Association 47, 64.2 ha of Vegetation Association 512, and 3.6 ha of Vegetation Association 4801, of which only 1.2 ha of Vegetation Association 4801 required to be chained/graded is within uncleared vegetation (the remainder is within previously chained areas) • 655 m Proteaceae Dominated Kwongkan Shrubland TEC (0.87 ha) (to be re-chained as part of the Proposal) within an existing and recently re-chained firebreak • clearing of 36 species of Priority Flora, with only 11 of these species located in uncleared vegetation–the other 25 are located in previously disturbed areas and are resilient to ongoing disturbance from chaining.	Future Ministerial Statement under EP Act.	Following the application of mitigation measures outlined in Section 9.5, the Proposal is expected to result in the removal of up to 816 ha of native vegetation, with only 23.0% (187.6 ha) of the maximum clearing footprint being new disturbance (i.e. in previously uncleared areas). The Proposal can be managed to meet the EPA objective for Flora and Vegetation through the implementation of key mitigation strategies such as: 1. Minimising clearing of native vegetation by reducing the clearing footprint width. 2. Adjusting the Proposal alignment to avoid areas of conservation significance. 3. Positioning 89.5% the proposed barrier fence length in existing disturbance areas to minimise isolation of vegetation. 4. Where the Proposal alignment intersects uncleared vegetation, the Proposal alignment has been adjusted to avoid any records of Threatened Flora species. The Proposal will also be managed through the implementation of a CMP, PDMP and WHP to avoid or minimise impact on Flora and Vegetation. In addition, the future Ministerial Statement under the EP Act will also be used to manage the potential impacts to Flora and Vegetation from the Proposal. These mitigation strategies are expected to be effective in mitigating potential impacts to Flora and Vegetation. The 655 m (0.87 ha) of Proteaceae Dominated Kwongkan Shrubland TEC to be re-chained as part of the Proposal. The TEC may regrow, but will be subject to future rechaining events. The TEC is located within existing and recently re-chained firebreak and; therefore, located within a previously disturbed area. There is no new loss of this TEC as part of this Proposal. There will also be no new clearing records of four Threatened Flora species (*Conostylis lepidospermoides*, *Anigozanthos bicolor* subsp. *Minor* (located in previously chained areas in the clearing footprint), *Eucalyptus merrickiae*, *Rhizanthella gardneri*) located within 100 m of the Proposal alignment. The loss of approximately 28.1 ha of Vegetation Association 47, 64.2 ha of Vegetation Association 512, and 3.6 ha of Vegetation Association 4801 is not expected to significantly change the percentage remaining of these Vegetation Associations in the region. The majority of the clearing required for these vegetation associations is within previously chained areas and; therefore, does not represent a new impact. Only 1.2 ha of Vegetation Association 4801 required to be chained/graded is within uncleared vegetation. The remaining and ongoing disturbance of these three Vegetation Associations will result from re-chaining not from grading. Total predicted residual impacts to the mapped extent of local vegetation types (which include water turnout diversions) are less than 20% and; therefore, no significant impacts to vegetation at a local or regional scale is expected from the Proposal. The Proposal will not result in significant residual impacts to any conservation significant flora species, vegetation community or ecosystems. No significant impact on the representation, diversity, viability and ecological function of vegetation and flora is anticipated at the species, population and assemblage level. No significant residual impacts are anticipated and offsets for Flora and Vegetation are; therefore, not required as part of this Proposal.
Terrestrial Fauna - To maintain representation, diversity, viability and ecological function at the species, population and assemblage level.				
Context/key survey findings • eight fauna habitats were identified across the Proposal alignment (Ecoscape 2017a) • habitat condition ranged from Very Good to Completely Degraded • three threatened species recorded within the vicinity of the Proposal alignment: i. Malleefowl (*Leipoa ocellata*) ii. Western Quoll or 'Chuditch' (*Dasyurus geoffroii*) iii. Carnaby's Black Cockatoo (*Calyptorhynchus latirostris*) • three Priority 4 species observed across the Proposal alignment, and one Migratory species	Clearing of habitat and the physical barrier to fauna movement.	Avoidance • altering 89.5% of the Proposal alignment length to utilise existing linear disturbance areas such as existing fire management breaks and already cleared areas within private property for farm boundary fences • avoid or minimise impacts to habitat features of conservation significant habitat features (such as Malleefowl mounds and potential habitat trees) based on outcomes of searches • Proposal alignment has unfenced gaps associated with the three main river systems to maintain the identified ecological corridors in the region • Proposal alignment has been modified to reduce the number of bottlenecks/acute angles that emus may aggregate in. Minimisation • reducing the total clearing footprint to a 15–20 m width	Future Ministerial Statement under EP Act.	Following the application of mitigation measures outlined in Section 10.5, the Proposal is expected to result in the removal of up to 816 ha of native vegetation, with only 23.0% (187.6 ha) of the clearing footprint located in uncleared vegetation. The Proposal can be managed to meet the EPA objective for Terrestrial Fauna through the implementation of key mitigation strategies including reducing the clearing footprint for the Proposal, avoidance of the use of electric or barbed wire fencing in Proposal design, and utilising existing disturbance areas along 89.5% of the length of the Proposal alignment, and adjusting the Proposal alignment to minimise isolation of fauna habitat. The number of fluorescent orange fence droppers will be doubled (two droppers 2.3 m apart between the star pickets which are 7 m apart) along approximately 115 km of Proposal alignment near the Western Ground Parrot habitat at the border of Cape Arid NP to mitigate risk of collision. The Proposal will also be managed through the implementation of a CMP and PPCMP to avoid or minimise impact on Terrestrial Fauna. In addition, the future Ministerial Statement under the EP Act will also be used to manage the potential impacts to Terrestrial Fauna from the

Inherent Impact	Environmental Aspect	Mitigation actions to address residual impacts	Proposed regulatory mechanisms for ensuring mitigation	Outcome to demonstrate that Proposal meets EPA objective
• one species was identified to likely utilise the area within the Proposal alignment but were not observed: i. Red-tailed Phascogale (*Phascogale calura*) • four macro corridors likely to be used by fauna: i. Fitzgerald River NP to Cape Arid NP ii. Oldfield River iii. Young River Corridor iv. Lort River Corridor. • the Western Ground Parrot occurs in the Cape Arid NP but its range is not intersected by the Proposal alignment. <u>Impacts without mitigation</u> • direct clearing of habitat during construction • fragmentation of habitat • fauna collisions with Proposal alignment resulting in entanglement and death • loss of genetic diversity • no significant impact on any conservation significant fauna.		• the dimensions of the mesh used in constructing the proposed barrier fence will be wide enough to enable the majority of fauna to pass through • number of fluorescent orange fence droppers to be doubled (two droppers 2.3 m apart between the star pickets which are 7 m apart) along approximately 115 km of Proposal alignment near the Western Ground Parrot habitat at Cape Arid NP to mitigate risk of collision–an existing farm boundary fence will be replaced with a high visibility barrier fence for this section • no barbed or electrical wire to be used in constructing the propose barrier fence • use of high visibility fluorescent marker to reduce risk of fauna collisions with the proposed barrier fence • limiting public access • replacing existing farm boundary fences with a high visibility fence for 129.4 km • preparation and implementation of the following plans during construction and operation of the proposed barrier fence: 1. CMP–action items to include: • no clearing of native vegetation between August and November for sections of the Proposal alignment that is adjacent to Cape Arid NP to minimise impacts on breeding and juvenile birds • targeted searches for conservation significant fauna (such as Malleefowl mounds), including potential habitat trees and hollows, to be undertaken prior to clearing within any section of the Proposal alignment that has not been previously surveyed • any new mounds should also be readily detected during construction works and could be avoided • restriction of public access to the proposed barrier fence to minimise stress to animals • further contingency actions to be developed in consultation with DBCA and implemented in order to avoid or minimise impacts to significant fauna if identified during searches. 2. PPCMP–action items to include: • management actions that monitor feral animal abundance. 3. DPIRD Emu Mitigation Procedure to mitigate risk of emu migrations. <u>Residual impacts</u> • disturbance of up to 816 ha of native vegetation with approximately 373.8 ha for re-chaining (if necessary) of previously chained areas, 248.6 ha of grading within chained areas, 146.0 ha of chaining within uncleared vegetation, 41.6 ha of permanent clearing within uncleared vegetation and 6 ha for water diversion turnouts • mortality of a low number of emus and kangaroos through entanglement in the proposed fence • loss of connection of vegetation remnants inside the proposed barrier fence with areas outside the agricultural areas–fifteen vegetation remnants were identified as potentially being isolated with three of these being less than 1500 ha in size, small enough to suffer population decline of Western Brush Wallabies due to genetic isolation, and one of these having little internal connection with other remnants • loss of up to 103 potential habitat trees located in uncleared vegetation associated with the Salmon Gum area • uncertain risk to the Critically Endangered Western Ground Parrot as the Proposal alignment is outside (approximately 2 km from) the known occurrence of the species • local risk of increased predation along the 69.3 km of the Proposal alignment that does not follow existing disturbance areas.		Proposal. These mitigation strategies are expected to be effective in mitigating potential impacts to Terrestrial Fauna. The Proposal will not result in significant residual impacts to any conservation significant fauna species or the representation, diversity, viability and ecological function of fauna is anticipated at the species, population and assemblage level. No significant residual impacts or offsets are expected for Terrestrial Fauna.
Heritage – To ensure that historical and cultural associations, and natural heritage, are not adversely affected.				
<u>Context/key survey findings</u> • two surveys across the length of the Proposal alignment identified 37 cultural areas, 127 isolated finds, seven Registered Heritage Sites, and two lodged Heritage Sites intersecting with the Proposal alignment • thirty-seven cultural areas and the 127 isolated finds were mostly small stone artefact scatters • Proposal alignment avoids 19 of the cultural areas identified.	Proposal construction and vehicle movements.	<u>Avoidance</u> • altering 89.5% of the proposed fence length to utilise existing linear disturbance areas such as existing fire management breaks and already cleared areas within private property • Proposal alignment re-aligns away from Registered Heritage Sites, or culturally significant areas where possible • Proposal alignment intersects with management boundary only and avoids locations of identified archaeological material	s 18 of the *Aboriginal Heritage Act 1972.*	Following the application of mitigation measures outlined in Section 11.5, the Proposal is expected to impact on 18 cultural areas and four Heritage Sites. The residual impacts are not significant as the Proposal alignment for all sites identified to be potentially impacted are located within previously disturbed areas. Chaining activities to reduce vegetation will not occur in identified cultural areas or Heritage Sites to remove any potential for impact on surface material. A total of 0.95 ha of uncleared bushland in Site 2396 will be cleared. The clearing in this Site is well away from its key archaeological/ethnographic feature (a Reserve Stone Arrangement).

Inherent Impact	Environmental Aspect	Mitigation actions to address residual impacts	Proposed regulatory mechanisms for ensuring mitigation	Outcome to demonstrate that Proposal meets EPA objective
Impacts without mitigation • loss or disturbance impacts to heritage values • physical disturbance of cultural sites and artefacts from the installation of the proposed barrier fence • physical disturbance through the action of chaining to remove vegetation for the fire protection zone • installation of a physical barrier preventing animal movement across the landscape and disrupting ecological connectivity • installing the proposed barrier fence across the rivers preventing movement of fauna and people resulting in a 'broken songline'.		• fence design has unfenced areas associated with the three main river systems and coastal corridor to retain ecological connection with vegetation on both sides of the proposed barrier fence. Minimisation • minimising the width of the clearing footprint to 15–20 m • use of high visibility fluorescent marker to reduce risk of fauna collisions with the proposed barrier fence. Residual impact • ground disturbance potentially damaging buried artefacts within 18 cultural areas (or their management boundaries) and four Heritage Sites i. eight cultural areas will have the edge of their management boundary disturbed but only on existing cleared freehold land ii. three cultural areas will be disturbed on farm land (an already highly modified landscape) by replacing an existing fence iii. the management boundary of four cultural areas would be disturbed but on an existing firebreak iv. one Site will be disturbed within a previously chained area v. minor disturbance of two sites that identified artefact scatters • two Registered and two Lodged Aboriginal Heritage Sites may be impacted by the Proposal alignment located within previously disturbed areas • the potential loss of cultural plants along the Proposal alignment from chaining activities (unable to be assessed through the confidentiality of the identified cultural plants) • deaths of emus and kangaroos which become entangled in the proposed barrier fence.		The Proposal alignment has been surveyed though this area by an archaeologist and Traditional Owners and no surface material was identified. Approval under s 18 of the *Aboriginal Heritage Act 1972* (AH Act) will be sought for any Registered Heritage Site that may be disturbed. If the s 18 applications are not supported or approved then the Proposal may be stopped at those sites by DPIRD and recommence after the site. No significant impact on heritage values is expected and; therefore, no offsets for Heritage are required.
Offsets - To counterbalance any significant residual environmental impacts or uncertainty through the application of offsets.				
No significant residual impact on vegetation and flora, fauna or heritage was identified following the impact assessment undertaken in this PER. No offsets are proposed as part of this Proposal.	Residual environmental impacts have been determined through the assessment in alignment with the WA Environmental Offsets guidelines.	Not applicable.	Not applicable.	Not applicable.

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14. Acronyms and short titles

Acronyms/short title	Title
Action Plan	Western Australian Wild Dog Action Plan 2016-2021
Administrative Procedures	*Environmental Impact Assessment (Part IV Divisions 1 and 2) Administrative Procedures 2012*
BAM Act	*Biosecurity and Agriculture Management Act 2007*
BCR	Benefit Cost Ratio
BoM	Bureau of Meteorology
Clearing footprint	the 15-20 m wide disturbance footprint that will be required to construct the proposed barrier fence including maintenance tracks and a previously chained firebreak by DBCA for fuel management.
CMP	Construction Management Plan
CWR	Critical Weight Range (mammals)
DPIRD	Department of Agriculture and Food Western Australia (now Department of Primary Industries and Regional Development)
DEE	Department of Environment and Energy
Development Envelope	the up to 100 m wide corridor within which the proposed fence will be constructed
DotE	Department of the Environment (currently DEE)
DRF	Declared Rare Flora (also termed Threatened Flora)
EERG	Esperance Extension Reference Group
ENGSHA	Esperance Nyungar Government Standard Heritage Agreement
EPA	Environmental Protection Authority
EP Act	*Environmental Protection Act 1986*
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999*
ESD	Environmental Scoping Document
IBRA	Interim Biogeographic Regionalisation for Australia
LPMT	Licensed Pest Management Technicians
MNES	Matters of National Environmental Significance
NMDSG	Northern Mallee Declared Species Group
NP	National Park
NR	Nature Reserve
DBCA	Department of Biodiversity, Conservation and Attractions, formerly Department of Parks and Wildlife
PER	Public Environmental Review
PDMP	Phytophthora Dieback Management Plan
PPCMP	Predator and Pest Control Management Plan
Proposal alignment	the route chosen for the proposed barrier fence
RBG	Regional Biosecurity Group
SBF	State Barrier Fence
SRE	Short Range Endemics
Target fauna	Emus, wild dogs and kangaroos collectively
TEC	Threatened Ecological Community
AH Act	*Aboriginal Heritage Act 1972*
UCL	Unallocated Crown Land
WA	Western Australia

Acronyms/short title	Title
WAGEMS	Warren, Avon Wheatbelt, Geraldton Sandplains, Esperance Plains, Mallee, Swan (largely cleared) bioregion
WA WDAG	Western Australian Wild Dog Action Group
WC Act	*Wildlife Conservation Act 1950*
WHP	Weed Hygiene Plan

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