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PEMBROKE

Olive Downs Coking Coal Project

Draft Environmental Impact Statement

Section 3

Assessment of Matters of National Environmental Significance

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3 ASSESSMENT OF MATTERS OF NATIONAL ENVIRONMENTAL SIGNIFICANCE

3.1 INTRODUCTION

The purpose of this document is to demonstrate how the Olive Downs Coking Coal Project (the Project) Environmental Impact Statement (EIS) addresses the requirements of the Commonwealth *Environment Protection and Biodiversity Conservation Act, 1999* (EPBC Act). Under the EPBC Act, a project requires approval if it has been determined to be a 'Controlled Action' which will have, or be likely to have, a significant impact on a matter of national environmental significance (MNES), including:

- World Heritage properties;
- National Heritage places;
- wetlands of international importance (Ramsar Wetlands);
- threatened species and ecological communities;
- migratory species;
- Commonwealth marine areas;
- The Great Barrier Reef Marine Park;
- nuclear actions; and
- a water resource, in relation to coal seam gas development and large coal mining development.

Pembroke Olive Downs Pty Ltd (Pembroke) proposes to develop the Project, a metallurgical coal mine and associated infrastructure within the Bowen Basin, located approximately 40 kilometres south-east of Moranbah, Queensland (Figure 2-1). The Project provides an opportunity to develop an open cut metallurgical coal resource within the Bowen Basin mining precinct that can deliver up to 20 million tonnes per annum (Mtpa) of run-of-mine (ROM) coal.

The Project comprises the Olive Downs South and Willunga mining domains and associated linear infrastructure corridors, including a rail spur connecting to the Norwich Park Branch Railway, a water pipeline connecting to the Eungella pipeline network, an electricity transmission line (ETL) and access roads (Figure 2.2). The coal resource would be mined by conventional open cut mining methods, with product coal to be transported by rail to the Dalrymple Bay Coal Terminal.

The four key Project components were referred to the Commonwealth Department of Environment and Energy (DEE) via separate referrals on 24 January 2017, namely (Figure 3-1):

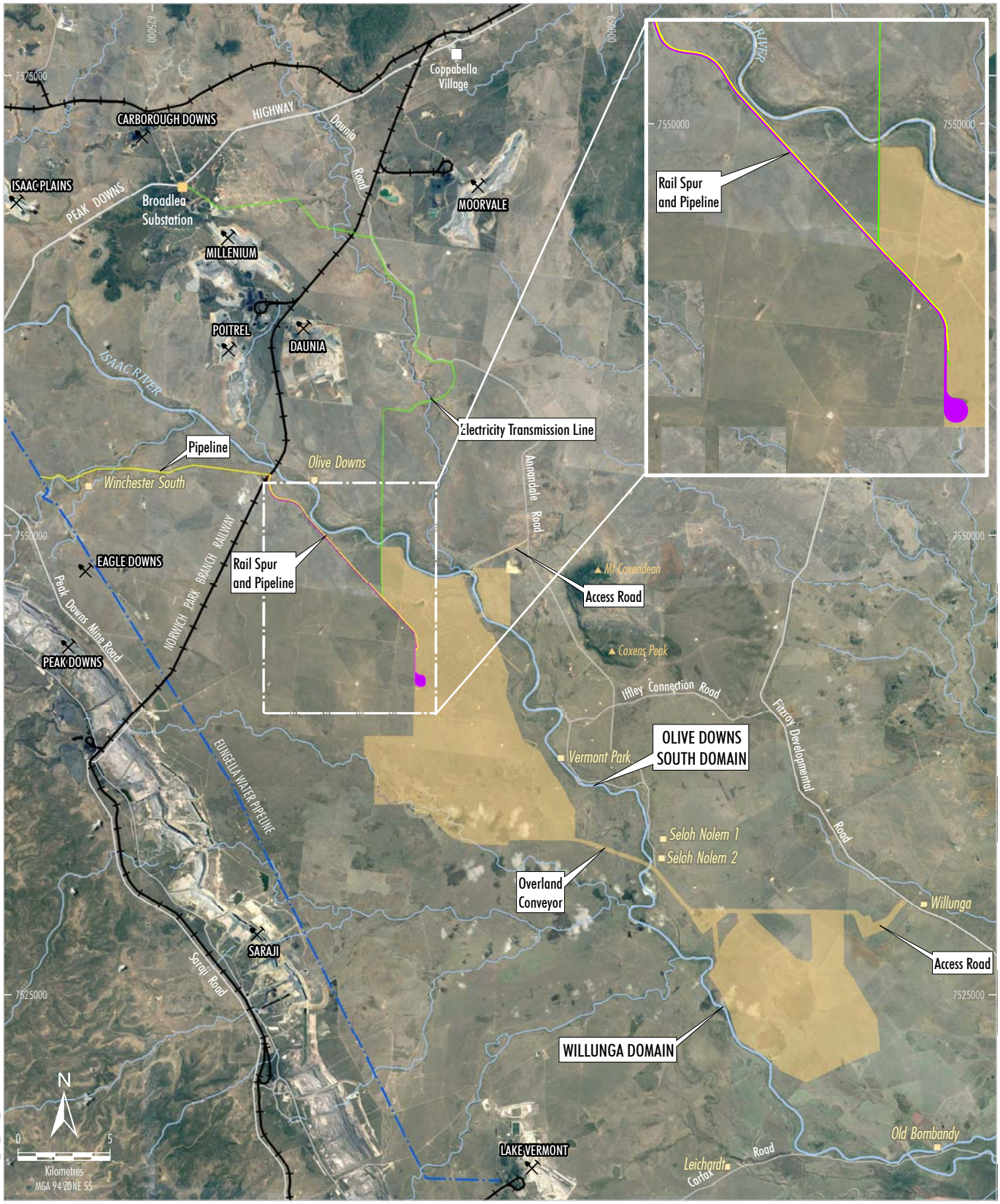
- Olive Downs Project Mine Site and Access Road (EPBC 2017/7867) (herein referred to as the Mine Site and Access Road);
- Olive Downs Project Water Pipeline (EPBC 2017/7868) (herein referred to as the Water Pipeline);
- Olive Downs Project Electricity Transmission Line (EPBC 2017/7869) (herein referred to as the Project ETL); and
- Olive Downs Project Rail Spur (EPBC 2017/7870) (herein referred to as the Rail Loop and Spur).

On 3 March 2017 the four key Project components were determined to be 'Controlled Actions' requiring assessment and approval under the EPBC Act. The following controlling provisions apply for each proposed action under the EPBC Act (Attachment A):

- Mine Site and Access Road;
  - listed threatened species and communities (sections 18 and 18A);
  - listed migratory species (sections 20 and 20A);
  - a water resource, in relation to coal seam gas development and large coal mining development (sections 24D and 24E).
- Water Pipeline;
  - listed threatened species and communities (sections 18 and 18A);
- Project ETL;
  - listed threatened species and communities (sections 18 and 18A);
- Rail Spur and Loop;
  - listed threatened species and communities (sections 18 and 18A).

In December 2017, Pembroke lodged an application to vary the Mine Site and Access Road and the Water Pipeline to incorporate the latest Project layout designs. These variations were accepted by the DEE on 17 April 2018.

Should Pembroke, in the future, decide to transfer the responsibility of the Water Pipeline, Rail Spur and Loop and/or Project ETL to another company (e.g. SunWater, Aurizon or Ergon) all relevant EPBC Act approvals would also need to be transferred.



LEGEND

- Approved/Operating Coal Mine
- Dwelling
- Eungella Pipeline Network
- Railway
- Proposed Creek Diversion
- Olive Downs Project Mine Site and Access Road (EPBC 2017/7867)
- Olive Downs Project Water Pipeline (EPBC 2017/7868)
- Olive Downs Project Rail Spur (EPBC 2017/7870)
- Olive Downs Project Electricity Transmission Line (EPBC 2017/7869)

Source: Pembroke (2018); Department of Natural Resources and Mines (2018); Orthophotography; Google Image (2016)

PEMBROKE

OLIVE DOWNS COKING COAL PROJECT

EPBC Act Assessment Areas

Figure 3-1

The overall approximate extent of surface disturbance (clearance) associated with the four Project components is herein referred to as the Project area. The Project area is approximately 16,300 ha, comprising a disturbance footprint of approximately 16,114 ha for the Mine Site and Access Road, approximately 57 ha for the Water Pipeline, approximately 42 ha for the Project ETL, approximately 103.5 ha for the Rail Spur and Loop.

3.2 BACKGROUND

3.2.1 Proponent details

Pembroke Olive Downs Pty Ltd (Pembroke) (ABN: 53 611 674 376) is the proponent for all four actions described in this assessment.

The registered office and postal address for Pembroke is:

Level 19, 1 Macquarie Place
SYDNEY NSW 2000

Pembroke is a private Australian-based company focused on the acquisition and development of high quality, metallurgical coal assets. Pembroke is backed by leading resources and energy-focused global private equity firm Denham Capital.

Pembroke has adhered to its regulatory responsibilities in associated with the exploration activities at the Project. Pembroke has not been the subject of any environmental legal proceedings.

Pembroke has in place an Environmental Policy for the Project to ensure its activities are planned and managed to minimise impacts to the environment.

As part of the Environmental Policy, Pembroke has developed an Environmental Management Plan for the exploration activities conducted at the Project. The Environmental Policy and Environmental Management Plan will be developed as the Project moves from the exploration phase into the construction and operations phases.

3.2.2 Consultation Undertaken in relation to the Project

Pembroke has commenced engagement with relevant stakeholders to:

- provide Project briefings (including briefings on all components of the Project discussed in this report);
- discuss key assessment considerations;
- discuss community and social impacts, including proposed accommodation and employment strategies;
- form land access agreements to commence baseline environmental surveys and install environmental monitoring equipment;
- describe the environmental assessment process; and
- present the environmental assessment and Project development schedules.

Stakeholders consulted to date include:

- local landholders;
- Isaac Regional Council;
- Native Title parties;
- Office of the Coordinator-General;
- DES;
- DNRME;
- DEE;
- DTMR;
- overlapping tenure holders;
- infrastructure service providers (including Aurizon, Ergon, Sunwater); and
- DBCT Management, including participation in its Capacity Forum.

Pembroke has developed a stakeholder engagement strategy for the Project. The stakeholder engagement strategy has been continued to be implemented during the development and lodgement of this application and will continue to be implemented:

- during preparation and lodgement of the EIS; and
- post EIS lodgement, exhibition and supplementary EIS development, lodgement and exhibition prior to determination.

Implementation of the stakeholder engagement strategy would include engagement and opportunity for consultation with all affected and interested persons, and other relevant stakeholders identified during its implementation.

A range of consultation mechanisms have been proposed for implementation during the assessment and approvals process for the Project including, but not necessarily limited to, the following:

- community information sessions;
- recording of opportunistic stakeholder interactions including one-on-one meetings;
- local government (council) briefings;

- State Government department briefings;
- Commonwealth Government department briefings;
- letters, advertising and notifications;
- site tours;
- newsletters and factsheets;
- media releases;
- regular updates and maintenance of the Pembroke website; and
- publication of application and assessment materials on the Office of the Coordinator-General's Coordinated Project website.

3.2.3 Commonwealth Requirements

Sections 3.11.3 to 3.11.37 of the *Olive Downs Project Terms of Reference* (ToR for the Project), titled *Matters of National Environmental Significance* requires information about the controlled actions and their relevant impact to be addressed in this EIS. This report provides a reference list of the Commonwealth requirements listed in the ToR for the Project (Attachment B) and the corresponding section of this report where the requirements are addressed (Table 3-1)

Table 3-1
Terms of Reference Cross Reference Table

	Matters of National Environmental Significance	Section reference
11.3	*The project was referred as four separate proposed actions under the EPBC Act. It is expected that the EIS will relate to all four proposed actions. Therefore, this section should provide a stand-alone description and detailed assessment of the impacts for each relevant controlling provision under the EPBC Act of each proposed action, inclusive of any avoidance, mitigation and offset measures.*	This Assessment
11.4	*The Commonwealth Minister for the Environment and Energy has determined the following controlling provisions apply for each proposed action under the EPBC Act:* • *Olive Downs Project Mine Site and Access Road (EPBC 2017/7867)* – *Listed threatened species and communities,* – *Listed migratory species,* – *A water resource, in relation to cal seam gas development and large coal mining development.* • *Olive Downs Project Water Pipeline (EPBC2017/7868)* – *Listed threatened species and communities.* • *Olive Downs Project Electricity Transmission Line (EPBC2017/7869)* – *Listed threatened species and communities.* • *Olive Downs Project Rail Spur (EPBC2017/7870)* – *Listed threatened species and communities*	Sections 3.3, 3.4, 3.5 and 3.6
11.5	*In accordance with Section 3.1 of Schedule 1 of the Bilateral Agreement, for each proposed action the EIS must:*	
	a) Assess all relevant impacts that the proposed action has, will have or is likely to have;	Section 3.3.7 to 3.3.10, 3.4.7, 3.4.8, 3.5.7, 3.5.8, 3.6.7 and 3.6.8
	b) Provide enough information about the proposed action and its relevant impacts to allow the Commonwealth Minister for the Environment and Energy to make an informed decision whether or not to approve the action under Part 9 of the EPBC Act.	
	c) Address the matters mentioned in Division 5.2 of the Environment Protection and Biodiversity Conservation Regulations 2000 (cth) (EPBC Regulations).	This Assessment
11.6	*A cross reference to each relevant section in the EIS that addresses each of the matters mentioned in Division 5.2 of the EPBC Regulations*	Refer to Table 3-2
11.7	*Consideration of relevant advise, policy statements, and guidelines including but not limited to:*	
	a) Matters of National Environmental Significance, Significant impact guidelines 1.1, Environment Protection and Biodiversity Conservation Act 1999;	Sections 3.3.7, 3.3.8, 3.3.9, 3.4.7, 3.5.7 and 3.6.7
	b) Significant Impact guidelines 1.2L coal seam gas and large coal mining developments – impacts on water resources;	Section 3.3.9
	c) Information guidelines for the Independent Export Scientific Committee advice on coal seam gas and large coal mining development proposal;	Section 3.3.9
	d) Environment Protection and Biodiversity Conservation Act 1999 Environmental Offsets Policy; and,	Section 3.7

Table 3-1 (Continued)
Terms of Reference Cross Reference Table

Matters of National Environmental Significance		Section Reference
11.7 (Cont.)	*e) Any approved conservation advice, recovery plans and threat abatement plans (as relevant) for listed threatened species, migratory species and ecological communities.*	Sections 3.2.6, 3.2.7, 3.2.7, 3.3.7, 3.3.8, 3.3.9, 3.3.11, 3.4.7, 3.4.9, 3.5.7, 3.5.9, 3.6.7 and 3.6.9
11.8	***Assessment Requirements*** *The EIS must provide background to each proposed action an describe in detail all aspects of each proposed action, including but not limited to the construction, operational and (if relevant) decommissioning aspects, including:*	Sections 3.3.1 to 3.3.6, 3.4.1 to 3.4.6, 3.5.1 to 3.5.6 and 3.6.1 to 3.6.6
	a) The precise location of all works to be undertaken (including associated offsite works and infrastructure, structures to be built or elements of each aspect that may have been impacts on any matter protected by each relevant controlling provision: and,	Sections 3.3.1, 3.3.2, 3.4.1, 3.4.2, 3.5.1, 3.5.2, 3.6.1 and 3.6.2
	b) Details on how the works are to be undertaken (including stages of development and their timing) and design parameters for those parts of the structures or elements that may have impacts on any matter protected by each relevant controlling provision.	Sections 3.3.2, 3.4.2, 3.5.2 and 3.6.2
11.9	*The EIS must provide details on the current status of each proposed action as well as the consequences of not proceeding with each proposed action and the project as a whole.*	Sections 3.3.3, 3.3.4, 3.4.3, 3.4.4, 3.5.3, 3.5.4, 3.6.3 and 3.6.4
11.10	*To the extent reasonably practicable, the EIS must include a discussion of feasible alternatives for each proposed action in accordance with Schedule 4, section 2.01(g) of the EPBC Regulations. The short, medium and long-term advantages and disadvantages of the alternatives must be discussed.*	Sections 3.3.5, 3.4.5, 3.5.5 and 3.6.5
11.11	*Each proposed action should initially be assessed in its own right and address how each proposed action relates to the other proposed actions.*	Sections 3.3.6, 3.4.6, 3.5.6 and 3.6.6
11.12	*The EIS should include an assessment of the cumulative impacts, with respect to each controlling provision for each proposed action and all identified consequential actions related to each proposed action and all known developments (of which the proponent should reasonably be aware) that have been, or are being, taken of that have been approved in the region affected by each proposed action.*	Sections 3.3.7, 3.3.10, 3.4.7, 3.4.8, 3.5.7, 3.5.8, 3.6.7 and 3.6.8
11.13	*With respect to each controlling provision for each proposed action, describe any avoidance measures proposed to reduce the impact on MNES and the anticipated result of proposed avoidance measures. Supporting evidence should be provided to demonstrate the appropriateness of avoidance measures proposed. Where the likely success of avoidance measures cannot be supported by evidence, identify contingencies in the event the avoidance is not successful.*	Sections 3.3.11.1, 3.4.9.1, 3.5.9.1 and 3.6.9.1
11.14	*With respect to each controlling provision for each proposed action, describe any mitigation measures proposed to reduce the impact on MNES and the anticipated result of proposed mitigation measures. Supporting evidence should be provided to success of mitigation measures. Where the likely success of mitigation measures cannot be supported by evidence, identify contingencies in the event the mitigation is not successful.*	Sections 3.3.11.2, 3.4.9.2, 3.5.9.2 and 3.6.9.2
11.15	*Respect to each controlling provision for each proposed action, describe the residual significant impacts of each proposed action after all proposed avoidance and mitigation measures are taken into account and any compensatory measures proposed.*	Section 3.7.2.1
11.16	*For each proposed action the EIS must:*	
	a) Describe the relevant listed threatened species and ecological communities (including EPBC Act listing status, distribution, life history and habitat);	Sections 3.3.7, 3.4.7, 3.5.7 and 3.6.7
	b) Describe the scope, methodology timing and effort of surveys for each proposed action (including areas outside of each proposed action area which may be impacted by each proposed action; and include details of:	Sections 3.2.6, 3.2.7 and 3.2.8
	I. The application of best practice survey guidelines.	
	II. How studies or surveys are consistent with (or a justification for divergence from) published Australian Government guidelines and policy statement;	
	c) Describe and assess the impacts to listed threatened species and ecological communities identified below and any others that are found to be or may potentially be present in areas that may be impacted by each proposed action in accordance with the Matters of National Environmental Significance, Significant impact guidelines 1.1, Environment Protection and Biodiversity Conservation Act, 1999;	Sections 3.3.7, 3.4.7, 3.5.7 and 3.6.7
	d) Identify which aspect of each proposed action is of relevance to each listed threatened species or ecological community or if the threat of impact relates to consequential actions; and	Sections 3.3.7, 3.4.7, 3.5.7 and 3.6.7

Table 3-1 (Continued)
Terms of Reference Cross Reference Table

Matters of National Environmental Significance		Section Reference
11.16 (Cont.)	*e) Where relevant, have regard to any approved conservation advice.*	Sections 3.3.7, 3.3.11, 3.4.7, 3.4.9, 3.5.7, 3.5.9, 3.6.7 and 3.6.9
11.17	*Where relevant, the EIS must demonstrate that each proposed action will not be inconsistent with:* *a) Australia's obligations under:* *I. The Biodiversity Convention;* *II. The Convention on Conservation of Nature in the South Pacific (Apia Convention);* *III. The Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES); and* *b) A recovery plan or threat abatement plan.*	Section 3.3.8
11.18	***List of potential listed threatened species*** *The EIS must address impacts on the following listed threatened species for each proposed action:* *a) Red Goshawk (Erythrotriorchis radiatus) – vulnerable;* *b) Australian Painted Snipe (Rostratula australis) – endangered;* *c) Curlew Sandpiper (Calidris ferruginea) – critically endangered;* *d) Squatter Pigeon (southern) (Geophaps scripta scripta) – vulnerable;* *e) Painted Honeyeater (Grantiella picta) – vulnerable;* *f) Star Finch (eastern) (Neochmia ruficauda ruficauda) – endangered;* *g) Black-throated Finch (southern) (Poephila cincta cincta) – endangered;* *h) Northern Quoll (Dasyurus hallucatus) – endangered;* *i) Koala (combined populations of Queensland, New South Wales and the Australian Capital Territory) (Phascolarctos cinereus (combined populations of Qld, NSW and the ACT)) – vulnerable;* *j) Greater Glider (Petauroides volans) – vulnerable;* *k) Grey-headed Flying-fox (Pteropus poliocephalus) – vulnerable;* *l) Ghost Bat (Macroderma gigas) – vulnerable;* *m) Corben's Long-eared Bat (Nyctophilus corbeni) – vulnerable;* *n) Southern Snapping Turtle (Elseya albagula) – critically endangered;* *o) Fitzroy River Turtle (Rheodytes leukops) – vulnerable;* *p) Yakka Skink (Egernia rugosa) – vulnerable;* *q) Allan's Lerista (Lerista allanae) – endangered;* *r) Ornamental Snake (Denisonia maculata) – vulnerable;* *s) Dunmall's Snake (Furina dunmalli) – vulnerable;* *t) Cycas ophiolitica – endangered;King Blue-grass (Dichanthium queenslandicum) – endangered;* *u) Bluegrass (Dichanthium setosum) – vulnerable;* *v) Black Ironbox (Eucalyptus raveretiana) – vulnerable; and* *w) Quassia (Samadera bidwillii) – vulnerable.*	Sections 3.3.7.1, 3.4.7.1, 3.5.7.1 and 3.6.7.1
11.19	***List of potential listed threatened ecological communities*** *The EIS must address impacts on the following listed threatened ecological communities for each proposed action:* *a) Brigalow (Acacia harpophylla dominant and co-dominant) – endangered;* *b) Natural Grasslands of the Queensland Central Highlands and the northern Fitzroy Basin – endangered; and* *c) Semi-evergreen Vine Thickets of the Brigalow Belt (North and South) and Nandewar Bioregions – endangered.*	Sections 3.3.7.2, 3.4.7.2, 3.5.7.2 and 3.6.7.2

Table 3-1 (Continued)
Terms of Reference Cross Reference Table

	Matters of National Environmental Significance	Section reference
11.20	***Listed migratory species*** *For the proposed mine site and access road (EPBC 2017/7867) the EIS must:*	Section 3.3.8
	a) Describe the listed migratory species identified within the ToR (including distribution, life history, and habitat);	Section 3.3.8 and Table 3-12
	b) Provide details of the scope, methodology, timing and effort of surveys for the proposed action (including areas outside of the proposed action area which may be impacted by the proposed action: and include details of:	Section 3.2.7.4
	I. The application of best practice guidelines: *II. How studies or surveys are consistent with (or a justification for divergence from) published Australian Government guidelines and policy statements;*	
	c) Describe and assess the impacts to the listed migratory species identified within the ToR and any others that are found to be or may potentially be present in areas that may be impacted by the proposed action in accordance with the Matters of National Environmental Significance, Significant impact guidelines 1.1, Environment Protection and Biodiversity Conservation Act 1999; and	Section 3.3.8
	d) Identify which aspect of the proposed action is or relevance to each species or if the threat of impact relates to consequential actions.	Section 3.3.8
11.21	*Where relevant, demonstrate that the proposed action will not be inconsistent with:* *a) Australia's obligations under:* *I. The Bonn Convention;* *II. CAMBA;* *III. JAMBA;* *IV. An international agreement approved under subsection 209(4) of the EPBC Act.*	Section 3.3.8
11.22	*The EIS must address impacts on the following migratory species:* *a) Glossy Ibis (Plegadis falcinellus);* *b) Caspian Tern (Hydroprogne caspia) ;* *c) Fork-tailed Swift (Apus pacificus);* *d) Oriental Cuckoo (Cuculus optatus);* *e) White-throated Needletail (Hirundapus caudacutus);* *f) Black-faced Monarch (Monarcha melanopsis);* *g) Yellow Wagtail (Motacilla flava);* *h) Satin Flycatcher (Myiagra cyanoleuca);* *i) Curlew Sandpiper (Calidris ferruginea);* *j) Latham's Snipe (Gallinago hardwickii);* *k) Osprey (Pandion haliaetus); and* *l) Common Greenshank (Tringa nebularia).*	Section 3.3.8
11.23	***A water resource, in relation to coal seam gas development and large coal mining development*** *The National Partnership Agreement on Coal Seam Gas and Large Coal Mining Development, to which Queensland is a signatory, specifies that all coal seam gas and large coal mining proposals that are likely to have a significant impact on water resources are to be referred to the Independent Expert Scientific Committee on Coal Seam Gas and Large Coal Mining Development (IESC) for advice.*	Section 3.3.9 and Table 3-3
11.24	*In relation to the proposed mine site and access road (EPBC (2017/7876), the EIS must provide details on the current state of groundwater and surface water in the region as well as any use of these resources.*	Section 3.3.9
11.25	*The EIS must describe and assess the impacts to water resources giving consideration to the Significant Impact Guidelines 1.3: Coal Seam gas and large coal mining developments – impacts on water resources.*	Section 3.3.9
11.26	*The EIS must address the information requirements contained in the Information Guidelines for the Independent Expert Scientific Committee advice on coal seam gas and large coal mining development proposals and provide a cross-reference table to identify where each component of the guidelines has been addressed.*	Section 3.3.9 and Table 3-3

Table 3-1 (Continued)
Terms of Reference Cross Reference Table

Matters of National Environmental Significance		Section Reference
11.27	***Offsets*** *The EIS must describe the residual impacts of each proposed action for each relevant matter protected by the EPBC Act, after all proposed avoidance and mitigation measures are taken into account.*	Section 3.7
11.28	*The EIS must identify whether the residual impacts are significant with reference to the Matters of National Environmental Significance, Significant impact guidelines 1.1, Environment Protection and Biodiversity Conservation Act 1999.*	Section 3.7.2.1
11.29	*If those residual impacts are significant the EIS must propose offsets for relevant matters protected by the EPBC Act consistent with the Environment Protection and Biodiversity Conservation Act 1999, Environmental Offsets Policy.*	Section 3.7.2
11.30	***Assumptions and/or Predictions*** *If the EIS utilises predictions of the extent of threat (risk), impact and/or any benefit of any mitigation measures proposed, this must be based on sound science and quantified where possible.*	Sections 3.3.7, 3.3.8, 3.3.9, 3.3.11, 3.4.7, 3.4.9, 3.5.7, 3.5.9, 3.6.7 and 3.6.9
11.31	*The EIS must reference all sources of information relied upon and an estimate of the reliability of predictions must be provided.*	Section 3.8
11.32	*Any positive impacts may also be identified and evaluated.*	Sections 3.3.12 and 3.7
11.33	*The extent of any new field work, modelling or testing should be commensurate with risk and should be such that when used in conjunction with existing information, provides sufficient confidence in predictions that well-informed decisions can be made.*	Section 3.3.9
11.34	***Conclusion*** *The EIS must include an overall conclusion for each proposed action as to the environmental acceptability of the proposed action on each relevant matter protected by the EPBC Act, including:*	Sections 3.3.13, 3.3.14, 3.4.11, 3.4.12, 3.5.11, 3.5.12, 3.6.11 and 3.6.12
	a) a discussion on the consideration with the requirements of the EPBC Act, including the objects of the EPBC Act, the principles of ecologically sustainable development and the precautionary principle;	
	b) reasons justifying undertaking the proposed action in the manner proposed, including the acceptability of the avoidance and mitigation measures; and	Section 3.3.11, 3.4.9, 3.5.9 and 3.6.9
	c) if relevant, a discussion of residual significant impacts and any offsets and compensatory measures proposed or required for residual significant impacts on relevant matters protected by the EPBC Act, and the relative degree of compensation and acceptability.	Section 3.7
11.35	***Other Required Information*** *The EIS must include details of any proceedings under a Commonwealth, State or Territory law for the protection of the environment or the conservation and sustainable use of natural resources against:*	Section 3.2.1
	a) the person proposing to take the action; and	
	b) for an action for which a person has applied for a permit, the person making the application.	
11.36	*If the person proposing to take the action is a corporation—details of the corporation's environmental policy and planning framework must also be included.*	
11.37	*The economic and social impacts of each proposed action, both positive and negative, must be analysed, including but not limited to:* *a) the economic and social impacts at the local, regional and national levels for each proposed action and the project as a whole*	Sections 3.3.3.12, 3.4.10, 3.5.10 and 3.6.10
	i. further to the economic and social impacts for the State's considerations (detailed at section 11.74-11.90 of this document), this may include projected economic costs and benefits of each proposed action, including the basis for their estimation through cost/benefit analysis or similar studies;	
	b) details of the relevant cost and benefits of alternatives to each of the proposed actions	
	i. further to the economic and social impacts for the State's considerations (detailed at section 11.74-11.90 of this document), this may include employment and other opportunities expected to be generated by each proposed action (including construction and operational phases) and the project as a whole;	
	c) identification of affected parties, including a statement mentioning any communities that may be affected and describing their views	
	i. further to the economic and social impacts for the State's considerations (detailed at section 11.74-11.90 of this document), this may include:	
	a) details of any public consultation activities undertaken, and their outcomes; and	
	b) details of any consultation with Indigenous stakeholders.	

This report also provides a reference list of the Division 5.2 of the *Environment Protection and Biodiversity Conservation Regulations, 2000* (EPBC Regulations) and the corresponding section of the this report where the requirements are addressed (Table 3-2)

This report also provides a reference list of the requirements outlined in the *Information Guidelines for the Independent Expert Scientific Committee Aadvice on Coal Seam Gas and Large Coal Mining Development Proposals* and the corresponding section of the this report where the requirements are addressed (Table 3-3).

Table 3-2
Division 5.2 of the EPBC Regulations Cross Reference Table

Division 5.2 of the EPBC Regulations	Section Reference
1 General information	
1.01 The background of the action including	
(a) the title of the action;	Section 3.3.1, 3.4.1, 3.5.1 and 3.6.1
(b) the full name and postal address of the designated proponent;	Section 3.2.1
(c) a clear outline of the objective of the action;	Sections 3.3.2, 3.4.2, 3.5.25 and 3.6.2
(d) the location of the action;	Sections 3.3.1, 3.4.1, 3.5.1 and 3.6.1
(e) the background to the development of the action;	Section 3.3.3, 3.4.3, 3.5.3 and 3.6.3
(f) how the action relates to any other actions (of which the proponent should reasonably be aware) that have been, or are being, taken or that have been approved in the region affected by the action;	Sections 3.3.6, 3.4.6, 3.5.6 and 3.6.6
(g) the current status of the action;	Section 3.3.3, 3.4.3, 3.5.3 and 3.6.3
(h) the consequences of not proceeding with the action.	Sections 3.3.4, 3.4.4, 3.5.4 and 3.6.4
2 Description	
2.01 A description of the action, including:	Sections 3.3.2, 3.3.2, 3.4.2, 3.5.2 and 3.6.2
(a) all the components of the action;	
(b) the precise location of any works to be undertaken, structures to be built or elements of the action that may have relevant impacts;	
(c) how the works are to be undertaken and design parameters for those aspects of the structures or elements of the action that may have relevant impacts;	
(d) relevant impacts of the action;	Sections 3.3.7, 3.3.8, 3.3.9, 3.3.10, 3.4.7, 3.4.8, 3.5.7, 3.5.8, 3.6.7 and 3.6.8
(e) proposed safeguards and mitigation measures to deal with relevant impacts of the action;	Sections 3.3.11, 3.4.9, 3.5.9 and 3.6.9
(f) any other requirements for approval or conditions that apply, or that the proponent reasonably believes are likely to apply, to the proposed action;	Section 3.2.4 and Attachment B
(g) to the extent reasonably practicable, any feasible alternatives to the action, including:	Sections 3.3.5, 3.4.5, 3.5.5 and 3.6.5
(i) if relevant, the alternative of taking no action;	
(ii) a comparative description of the impacts of each alternative on the matters protected by the controlling provisions for the action;	
(iii) sufficient detail to make clear why any alternative is preferred to another;	
(h) any consultation about the action, including:	Section 3.2.2
(i) any consultation that has already taken place;	A detailed Public Consultation Report is also provided in Attachment 5 of the EIS.
(ii) proposed consultation about relevant impacts of the action;	
(iii) if there has been consultation about the proposed action—any documented response to, or result of, the consultation;	
(i) identification of affected parties, including a statement mentioning any communities that may be affected and describing their views.	

Table 3-2 (Continued)
Division 5.2 of the EPBC Regulations Cross Reference Table

Division 5.2 of the EPBC Regulations	Section Reference
3 Relevant Impacts	
3.01 Information given under paragraph 2.01(d) must include:	Sections 3.3.7, 3.3.8, 3.3.9, 3.3.10, 3.4.7, 3.4.8, 3.5.7, 3.5.8, 3.6.7 and 3.6.8
(a) a description of the relevant impacts of the action;	
(b) a detailed assessment of the nature and extent of the likely short term and long term relevant impacts;	Sections 3.3.7 to 3.3.9, 3.4.7, 3.5.7 and 3.6.7
(c) a statement whether any relevant impacts are likely to be unknown, unpredictable or irreversible;	Section 3.3.15
(d) analysis of the significance of the relevant impacts;	Sections 3.3.7 to 3.3.9, 3.4.7, 3.5.7 and 3.6.7
(e) any technical data and other information used or needed to make a detailed assessment of the relevant impacts.	Sections 3.2.6 to 3.2.8
4 Proposed safeguards and mitigation measures	
4.01 Information given under paragraph 2.01(e) must include:	Sections 3.3.11, 3.4.9, 3.5.9 and 3.6.9
(a) a description, and an assessment of the expected or predicted effectiveness of, the mitigation measures;	
(b) any statutory or policy basis for the mitigation measures;	Section 3.3.11.2
(c) the cost of the mitigation measures;	Section 3.3.11.2
(d) an outline of an environmental management plan that sets out the framework for continuing management, mitigation and monitoring programs for the relevant impacts of the action, including any provisions for independent environmental auditing;	Section 3.3.11.3
(e) the name of the agency responsible for endorsing or approving each mitigation measure or monitoring program;	Section 3.3.11.2
(f) a consolidated list of mitigation measures proposed to be undertaken to prevent, minimise or compensate for the relevant impacts of the action, including mitigation measures proposed to be taken by State governments, local governments or the proponent.	Section 3.3.11.2
5 Other approvals and conditions	
5.01 Information given under paragraph 2.01(f) must include:	Section 3.2.4 A detailed description of the regulatory approvals required for the Project is provided in Attachment 3 of the EIS.
(a) details of any local or State government planning scheme, or plan or policy under any local or State government planning system that deals with the proposed action, including	
(i) what environmental assessment of the proposed action has been, or is being, carried out under the scheme, plan or policy;	
(ii) how the scheme provides for the prevention, minimisation and management of any relevant impacts;	
(b) a description of any approval that has been obtained from a State, Territory or Commonwealth agency or authority (other than an approval under the Act), including any conditions that apply to the action;	
(c) a statement identifying any additional approval that is required;	
(d) a description of the monitoring, enforcement and review procedures that apply, or are proposed to apply, to the action.	
6 Environmental record of person proposing to take the action	
6.01 Details of any proceedings under a Commonwealth, State or Territory law for the protection of the environment or the conservation and sustainable use of natural resources against:	Section 3.2.1
(a) the person proposing to take the action; and	
(b) for an action for which a person has applied for a permit, the person making the application	
6.02 If the person proposing to take the action is a corporation—details of the corporation's environmental policy and planning framework.	

Table 3-2 (Continued)
Division 5.2 of the EPBC Regulations Cross Reference Table

Division 5.2 of the EPBC Regulations	Section Reference
7 Information sources	
7.01 For information given in a draft public environment report or environmental impact statement, the draft must state:	Section 3.8
(a) the source of the information; and	
(b) how recent the information is; and	
(c) how the reliability of the information was tested; and	
(d) what uncertainties (if any) are in the information.	

Table 3-3
IESC Guideline Cross Reference Table

Specific Information Needs	Section Addressed
Description of the Proposal	
Provide a regional overview of the proposed project area including a description of the: • *geological basin;*	Section 3.3.9.2
• *coal resource;*	Section 3.3.9.2
• *surface water catchments;*	Section 3.3.9.1
• *groundwater systems;*	Section 3.3.9.3
• *water-dependent assets; and*	Section 3.3.9.4
• *past, present and reasonably foreseeable coal mining and CSG developments.*	Section 3.3.9.5
Describe the statutory context, including information on the proposal's status within the regulatory assessment process and any applicable water management policies or regulations.	Sections 3.2.4 and 3.2.5
Describe the proposal's location, purpose, scale, duration, disturbance area, and the means by which it is likely to have a significant impact on water resources and water-dependent assets.	Sections 3.3.1 and 3.3.2
Describe how impacted water resources are currently being regulated under state or Commonwealth law, including whether there are any applicable standard conditions.	Section 3.2.5
Risk Assessment	
Identify and assess all potential environmental risks to water resources and water-related assets, and their possible impacts. In selecting a risk assessment approach consideration should be given to the complexity of the project, and the probability and potential consequences of risks.	Sections 3.3.9.9 and 3.3.9.10
Assess risks following the implementation of any proposed mitigation and management options to determine if these will reduce risks to an acceptable level based on the identified environmental objectives.	Sections 3.3.9.9 and 3.3.11
Incorporate causal mechanisms and pathways identified in the risk assessment in conceptual and numerical modelling. Use the results of these models to update the risk assessment.	Section 3.3.9.8
The risk assessment should include an assessment of: • *all potential cumulative impacts which could affect water resources and water-related assets; and* • *mitigation and management options which the proponent could implement to reduce these impacts.*	Sections 3.3.10.3 and 3.3.11
Groundwater – Context and Conceptualisation	
Describe and map geology at an appropriate level of horizontal and vertical resolution including: • *definition of the geological sequence(s) in the area, with names and descriptions of the formations and accompanying surface geology, cross-sections and any relevant field data.* • *geological maps appropriately annotated with symbols that denote fault type, throw and the parts of sequences the faults intersect or displace.*	Section 3.3.9.2
Define and describe or characterise significant geological structures (e.g. faults, folds, intrusives) and associated fracturing in the area and their influence on groundwater – particularly groundwater flow, discharge or recharge. • *Site-specific studies (e.g. geophysical, coring / wireline logging etc.) should give consideration to characterising and detailing the local stress regime and fault structure (e.g. damage zone size, open/closed along fault plane, presence of clay/shale smear, fault jogs or splays).* • *Discussion on how this fits into the fault's potential influence on regional-scale groundwater conditions should also be included.*	Sections 3.3.9.2 and 3.3.9.3

Table 3-3 (Continued)
IESC Guideline Cross Reference Table

Specific Information Needs	Section Addressed
Provide site-specific values for hydraulic parameters (e.g. vertical and horizontal hydraulic conductivity and specific yield or specific storage characteristics including the data from which these parameters were derived) for each relevant hydrogeological unit. In situ observations of these parameters should be sufficient to characterise the heterogeneity of these properties for modelling.	Sections 3.3.9.3 and 3.3.9.6
Provide time series level and water quality data representative of seasonal and climatic cycles.	Section 3.3.9.6
Provide data to demonstrate the varying depths to the hydrogeological units and associated standing water levels or potentiometric heads, including direction of groundwater flow, contour maps, and hydrographs. All boreholes used to provide this data should have been surveyed.	Sections 3.3.9.3 and 3.3.9.8
Provide hydrochemical (e.g. acidity/alkalinity, electrical conductivity, metals, and major ions) and environmental tracer (e.g. stable isotopes of water, tritium, helium, strontium isotopes, etc.) characterisation to identify sources of water, recharge rates, transit times in aquifers, connectivity between geological units and groundwater discharge locations.	Sections 3.3.9.6, 3.3.9.7 and 3.3.9.10
Describe the likely recharge, discharge and flow pathways for all hydrogeological units likely to be impacted by the proposed development.	Sections 3.3.9.3 and 3.3.9.7
Assess the frequency (and time lags if any), location, volume and direction of interactions between water resources, including surface water/groundwater connectivity, inter-aquifer connectivity and connectivity with sea water.	Section 3.3.9.7
Groundwater – Analytical and Numerical Modelling	
Provide a detailed description of all analytical and/or numerical models used, and any methods and evidence (e.g. expert opinion, analogue sites) employed in addition to modelling.	Section 3.3.9.8
Undertaken groundwater modelling in accordance with the Australian Groundwater Modelling Guidelines (Barnett et al. 2012), including independent peer review.	Section 3.3.9.8
Calibrate models with adequate monitoring data, ideally with calibration targets related to model prediction (e.g. use baseflow calibration targets where predicting changes to baseflow).	Section 3.3.9.8
Describe each hydrogeological unit as incorporated in the groundwater model, including the thickness, storage and hydraulic characteristics, and linkages between units, if any.	Section 3.3.9.8
Describe the existing recharge/discharge pathways of the units and the changes that are predicted to occur upon commencement, throughout, and after completion of the proposed project.	Sections 3.3.9.7 and 3.3.9.8
Describe the various stages of the proposed project (construction, operation and rehabilitation) and their incorporation into the groundwater model. Provide predictions of water level and/or pressure declines and recovery in each hydrogeological unit for the life of the project and beyond, including surface contour maps for all hydrogeological units.	Section 3.3.9.8
Identify the volumes of water predicted to be taken annually with an indication of the proportion supplied from each hydrogeological unit.	Section 3.3.9.9
Undertake model verification with past and/or existing site monitoring data.	Section 3.3.9.8
Provide an explanation of the model conceptualisation of the hydrogeological system or systems, including multiple conceptual models if appropriate. Key assumptions and model limitations and any consequences should also be described.	Section 3.3.9.8
Consider a variety of boundary conditions across the model domain, including constant head or general head boundaries, river cells and drains, to enable a comparison of groundwater model outputs to seasonal field observations	Section 3.3.9.8
Undertake sensitivity analysis and uncertainty analysis of boundary conditions and hydraulic and storage parameters, and justify the conditions applied in the final groundwater model (see Middlemis and Peeters [in press]).	Section 3.3.9.8
Provide an assessment of the quality of, and risks and uncertainty inherent in, the data used to establish baseline conditions and in modelling, particularly with respect to predicted potential impact scenarios.	Section 3.3.9.8
Undertake an uncertainty analysis of model construction, data, conceptualisation and predictions (see Middlemis and Peeters [in press]).	Section 3.3.9.8
Provide a program for review and update of models as more data and information become available, including reporting requirements.	Section 3.3.11.3
Provide information on the magnitude and time for maximum drawdown and post-development drawdown equilibrium to be reached.	Section 3.3.9.9

Table 3-3 (Continued)
IESC Guideline Cross Reference Table

Specific Information Needs	Section Addressed
Groundwater – Impacts to Water Resources and Water-dependent Assets	
Provide an assessment of the potential impacts of the proposal, including how impacts are predicted to change over time and any residual long-term impacts. Consider and describe: • *any hydrogeological units that will be directly or indirectly dewatered or depressurised, including the extent of impact on hydrological interactions between water resources, surface water/groundwater connectivity, interaquifer connectivity and connectivity with sea water.* • *the effects of dewatering and depressurisation (including lateral effects) on water resources, water-dependent assets, groundwater, flow direction and surface topography, including resultant impacts on the groundwater balance.* • *the potential impacts on hydraulic and storage properties of hydrogeological units, including changes in storage, potential for physical transmission of water within and between units, and estimates of likelihood of leakage of contaminants through hydrogeological units.* • *the possible fracturing of and other damage to confining layers.* • *For each relevant hydrogeological unit, the proportional increase in groundwater use and impacts as a consequence of the proposed project, including an assessment of any consequential increase in demand for groundwater from towns or other industries resulting from associated population or economic growth due to the proposal.*	Section 3.3.9.9
Describe the water resources and water-dependent assets that will be directly impacted by mining or CSG operations, including hydrogeological units that will be exposed/partially removed by open cut mining and/or underground mining.	Section 3.3.9.9
For each potentially impacted water resource, provide a clear description of the impact to the resource, the resultant impact to any water-dependent assets dependent on the resource, and the consequence or significance of the impact.	Section 3.3.9.9
Describe existing water quality guidelines, environmental flow objectives and other requirements (e.g. water planning rules) for the groundwater basin(s) within which the development proposal is based.	Sections 3.3.9.6 and 3.3.9.7
Provide an assessment of the cumulative impact of the proposal on groundwater when all developments (past, present and/or reasonably foreseeable) are considered in combination.	Section 3.3.10.3
Describe proposed mitigation and management actions for each significant impact identified, including any proposed mitigation or offset measures for long-term impacts post mining.	Section 3.3.3.11
Provide a description and assessment of the adequacy of proposed measures to prevent/minimise impacts on water resources and water-dependent assets.	Section 3.3.3.11
Groundwater – Data and Monitoring	
Provide sufficient data on physical aquifer parameters and hydrogeochemistry to establish pre-development conditions, including fluctuations in groundwater levels at time intervals relevant to aquifer processes.	Section 3.3.9.7
Develop and describe a robust groundwater monitoring program using dedicated groundwater monitoring wells – including nested arrays where there may be connectivity between hydrogeological units – and targeting specific aquifers, providing an understanding of the groundwater regime, recharge and discharge processes and identifying changes over time.	Section 3.3.11.3
Develop and describe proposed targeted field programs to address key areas of uncertainty, such as the hydraulic connectivity between geological formations, the sources of groundwater sustaining GDEs, the hydraulic properties of significant faults, fracture networks and aquitards in the impacted system, etc., where appropriate.	Sections 3.3.9.6, 3.3.9.7 and 3.3.9.8
Provide long-term groundwater monitoring data, including a comprehensive assessment of all relevant chemical parameters to inform changes in groundwater quality and detect potential contamination events.	Section 3.3.9.6
Ensure water quality monitoring complies with relevant National Water Quality Management Strategy (NWQMS) guidelines (ANZECC/ARMCANZ 2000) and relevant legislated state protocols (e.g. QLD Government 2013).	Section 3.3.9.7
Surface Water – Context and Conceptualisation	
Describe the hydrological regime of all watercourses, standing waters and springs across the site including: • *geomorphology, including drainage patterns, sediment regime and floodplain features;* • *spatial, temporal and seasonal trends in streamflow and/or standing water levels;* • *spatial, temporal and seasonal trends in water quality data (such as turbidity, acidity, salinity, relevant organic chemicals, metals, metalloids and radionuclides); and* • *current stressors on watercourses, including impacts from any currently approved projects.*	Sections 3.3.9.1, 3.3.9.6 and 3.3.9.7

Table 3-3 (Continued)
IESC Guideline Cross Reference Table

Specific Information Needs	Section Addressed
Describe the existing flood regime, including flood volume, depth, duration, extent and velocity for a range of annual exceedance probabilities. Provide flood hydrographs and maps identifying peak flood extent, depth and velocity. This assessment should be informed by topographic data that has been acquired using lidar or other reliable survey methods with accuracy stated.	Section 3.3.9.7
Provide an assessment of the frequency, volume, seasonal variability and direction of interactions between water resources, including surface water/ groundwater connectivity and connectivity with sea water.	Sections 3.3.9.3 and 3.3.9.7
Surface Water – Analytical and Numerical Modelling	
Provide conceptual models at an appropriate scale, including water quality, stores, flows and use of water by ecosystems.	Section 3.3.9.8
Use methods in accordance with the most recent publication of Australian Rainfall and Runoff (Ball et al,. 2016).	Section 3.3.9.7
Develop and describe a program for review and update of the models as more data and information becomes available.	Section 3.3.11.2
Describe and justify model assumptions and limitations and calibrate with appropriate surface water monitoring data.	Section 3.3.9.8
Provide an assessment of the risks and uncertainty inherent in the data used in the modelling, particularly with respect to predicted scenarios.	Section 3.3.11.2
Provide a detailed description of any methods and evidence (e.g. expert opinion, analogue sites) employed in addition to modelling.	Sections 3.3.9.8 and 3.3.11.2
Surface Water – Impacts to Water Resources and Water-dependent Assets	
Describe all potential impacts of the proposed project on surface waters. Include a clear description of the impact to the resource, the resultant impact to any assets dependent on the resource (including water-dependent ecosystems such as riparian zones and floodplains), and the consequence or significance of the impact. Consider: • *impacts on streamflow under the full range of flow conditions.* • *impacts associated with surface water diversions.* • *impacts to water quality, including consideration of mixing zones.* • *the quality, quantity and ecotoxicological effects of operational discharges of water (including saline water), including potential emergency discharges, and the likely impacts on water resources and water-dependent assets.* • *landscape modifications such as subsidence, voids, post rehabilitation landform collapses, on-site earthworks (including disturbance of acid-forming or sodic soils, roadway and pipeline networks) and how these could affect surface water flow, surface water quality, erosion, sedimentation and habitat fragmentation of water-dependent species and communities.*	Sections 3.3.9.9 and 3.3.9.10
Discuss existing water quality guidelines, environmental flow objectives and requirements for the surface water catchment(s) within which the development proposal is based.	Section 3.3.9.7
Identify processes to determine surface water quality guidelines and quantity thresholds which incorporate seasonal variation but provide early indication of potential impacts to assets.	Sections 3.3.9.7 and 3.3.11.1
Propose mitigation actions for each identified significant impact.	Section 3.3.11.2
Describe the adequacy of proposed measures to prevent or minimise impacts on water resources and water-dependent assets.	Section 3.3.11
Describe the cumulative impact of the proposal on surface water resources and water-dependent assets when all developments (past, present and reasonably foreseeable) are considered in combination.	Section 3.3.10.3
Provide an assessment of the risks of flooding (including channel form and stability, water level, depth, extent, velocity, shear stress and stream power), and impacts to ecosystems, project infrastructure and the final project landform.	Section 3.3.9.9
Surface Water – Data and Monitoring	
Identify monitoring sites representative of the diversity of potentially affected water-dependent assets and the nature and scale of potential impacts, and match with suitable replicated control and reference sites (BACI design) to enable detection and monitoring of potential impacts.	Section 3.3.11.2
Ensure water quality monitoring complies with relevant National Water Quality Management Strategy (NWQMS) guidelines (ANZECC/ARMCANZ 2000) and relevant legislated state protocols (e.g. QLD Government 2013).	Section 3.3.11.2
Identify data sources, including streamflow data, proximity to rainfall stations, data record duration and describe data methods, including whether missing data have been patched.	Sections 3.3.9.6 and 3.3.9.7

Table 3-3 (Continued)
IESC Guideline Cross Reference Table

Specific Information Needs	Section Addressed
Develop and describe a surface water monitoring program that will collect sufficient data to detect and identify the cause of any changes from established baseline conditions, and assess the effectiveness of mitigation and management measures. The program will: • *include baseline monitoring data for physico-chemical parameters, as well as contaminants (e.g. metals);* • *comparison of physico-chemical data to national/regional guidelines or to site-specific guidelines derived from reference condition monitoring if available; and,* • *identify baseline contaminant concentrations and compare these to national guidelines, allowing for local background correction if required.*	Section 3.3.11.2
Describe the rationale for selected monitoring parameters, duration, frequency and methods, including the use of satellite or aerial imagery to identify and monitor largescale impacts.	Section 3.3.11.2
Develop and describe a plan for ongoing ecotoxicological monitoring, including direct toxicity assessment of discharges to surface waters where appropriate.	Section 3.3.9.10
Identify dedicated sites to monitor hydrology, water quality, and channel and floodplain geomorphology throughout the life of the proposed project and beyond.	Section 3.3.11.2
Water-dependent Assets – Context and Conceptualisation	
Identify water-dependent assets, including: • *water-dependent fauna and flora and provide surveys of habitat, flora and fauna (including stygofauna) (see Doody et al. [in press]).* • *public health, recreation, amenity, Indigenous, tourism or agricultural values for each water resource*	Section 3.3.9.4
Identify GDEs in accordance with the method outlined by Eamus et al. (2006). Information from the GDE Toolbox (Richardson et al. 2011) and GDE Atlas (CoA 2017a) may assist in identification of GDEs (see Doody et al. [in press]).	Section 3.3.9.4
Describe the conceptualisation and rationale for likely water-dependence, impact pathways, tolerance and resilience of water-dependent assets. Examples of ecological conceptual models can be found in Commonwealth of Australia (2015).	Sections 3.3.9.3 and 3.3.9.4
Estimate the ecological water requirements of identified GDEs and other water-dependent assets (see Doody et al. [in press]).	Section 3.3.9.8
Identify the hydrogeological units on which any identified GDEs are dependent (see Doody et al. [in press]).	Sections 3.3.9.3 and 3.3.9.4
Provide an outline of the water-dependent assets and associated environmental objectives and the modelling approach to assess impacts to the assets.	Section 3.3.9.4
Describe the process employed to determine water quality and quantity triggers and impact thresholds for water-dependent assets (e.g. threshold at which a significant impact on an asset may occur).	Section 3.3.9.7
Water-dependent Assets – Impacts, Risk Assessment and Management of Risks	
Provide an assessment of direct and indirect impacts on water-dependent assets, including ecological assets such as flora and fauna dependent on surface water and groundwater, springs and other GDEs (see Doody et al. [in press]).	Section 3.3.9.9
Describe the potential range of drawdown at each affected bore, and clearly articulate of the scale of impacts to other water users.	Section 3.3.9.9
Indicate the vulnerability to contamination (e.g. from salt production and salinity) and the likely impacts of contamination on the identified water-dependent assets and ecological processes.	Section 3.3.9.9
Identify and consider landscape modifications (e.g. voids, on-site earthworks, and roadway and pipeline networks) and their potential effects on surface water flow, erosion and habitat fragmentation of water-dependent species and communities.	Section 3.3.9.9
Provide estimates of the volume, beneficial uses and impact of operational discharges of water (particularly saline water), including potential emergency discharges due to unusual events, on water-dependent assets and ecological processes.	Sections 3.3.9.9 and 3.3.9.10
Assess the overall level of risk to water-dependent assets through combining probability of occurrence with severity of impact.	Sections 3.3.9.9 and 3.3.9.10
Identify the proposed acceptable level of impact for each water-dependent asset based on leading-practice science and site-specific data, and ideally developed in conjunction with stakeholders.	Sections 3.3.9.9 and 3.3.9.10
Propose mitigation actions for each identified impact, including a description of the adequacy of the proposed measures and how these will be assessed.	Section 3.3.11

Table 3-3 (Continued)
IESC Guideline Cross Reference Table

Specific Information Needs	Section Addressed
Water-dependent Assets – Data and Monitoring	
Identify an appropriate sampling frequency and spatial coverage of monitoring sites to establish pre-development (baseline) conditions, and test potential responses to impacts of the proposal (see Doody et al. [in press]).	Section 3.3.11
Consider concurrent baseline monitoring from unimpacted control and reference sites to distinguish impacts from background variation in the region (e.g. BACI design, see Doody et al. [in press]).	Section 3.3.11
Develop and describe a monitoring program that identifies impacts, evaluates the effectiveness of impact prevention or mitigation strategies, measures trends in ecological responses and detects whether ecological responses are within identified thresholds of acceptable change (see Doody et al. [in press]).	Section 3.3.11
Describe the proposed process for regular reporting, review and revisions to the monitoring program	Section 3.3.11
Ensure ecological monitoring complies with relevant state or national monitoring guidelines (e.g. the DSITI guideline for sampling stygofauna (QLD Government 2015).	Sections 3.2.8 and 3.3.11
Water and Salt Balance, and Water Quality	
Provide a quantitative site water balance model describing the total water supply and demand under a range of rainfall conditions and allocation of water for mining activities (e.g. dust suppression, coal washing etc.), including all sources and uses.	Section 3.3.11.2
Describe the water requirements and on-site water management infrastructure, including modelling to demonstrate adequacy under a range of potential climatic conditions.	Section 3.3.9.8
Provide estimates of the quality and quantity of operational discharges under dry, median and wet conditions, potential emergency discharges due to unusual events and the likely impacts on water-dependent assets.	Sections 3.3.9.9, 3.3.9.10 and 3.3.11.2
Provide salt balance modelling that includes stores and the movement of salt between stores, and takes into account seasonal and long-term variation.	Sections 3.3.9.8, 3.3.9.9 and 3.3.9.10
Cumulative Impacts – Context and Conceptualisation	
Provide cumulative impact analysis with sufficient geographic and temporal boundaries to include all potentially significant water-related impacts.	Section 3.3.10.3
Consider all past, present and reasonably foreseeable actions, including development proposals, programs and policies that are likely to impact on the water resources of concern in the cumulative impact analysis. Where a proposed project is located within the area of a bioregional assessment consider the results of the bioregional assessment.	Sections 3.3.9.5 and 3.3.10.3
Cumulative Impacts – Impacts	
Provide an assessment of the condition of affected water resources which includes: • *identification of all water resources likely to be cumulatively impacted by the proposed development;* • *a description of the current condition and quality of water resources and information on condition trends;* • *identification of ecological characteristics, processes, conditions, trends and values of water resources;* • *adequate water and salt balances; and,* • *identification of potential thresholds for each water resource and its likely response to change and capacity to withstand adverse impacts (e.g. altered water quality, drawdown).*	Sections 3.3.9.1, 3.3.9.9 and 3.3.9.10
Assess the cumulative impacts to water resources considering: • *the full extent of potential impacts from the proposed project, (including whether there are alternative options for infrastructure and mine configurations which could reduce impacts), and encompassing all linkages, including both direct and indirect links, operating upstream, downstream, vertically and laterally;* • *all stages of the development, including exploration, operations and post closure / decommissioning;* • *appropriately robust, repeatable and transparent methods;* • *the likely spatial magnitude and timeframe over which impacts will occur, and significance of cumulative impacts; and,* • *opportunities to work with other water users to avoid, minimise or mitigate potential cumulative impacts.*	Section 3.3.10.3

Table 3-3 (Continued)
IESC Guideline Cross Reference Table

Specific Information Needs	Section Addressed
Cumulative Impacts – Mitigation, Monitoring and Management	
Identify modifications or alternatives to avoid, minimise or mitigate potential cumulative impacts. Evidence of the likely success of these measures (e.g. case studies) should be provided.	Section 3.3.11
Identify measures to detect and monitor cumulative impacts, pre and post development, and assess the success of mitigation strategies.	Section 3.3.11.2
Identify cumulative impact environmental objectives.	Section 3.3.10.3
Describe appropriate reporting mechanisms.	Section 3.3.11
Propose adaptive management measures and management responses.	Section 3.3.11
Subsidence – Underground Coal Mines and Coal Seam Gas	
Provide predictions of subsidence impact on surface topography, water-dependent assets, groundwater (including enhanced connectivity between aquifers) and the movement of water across the landscape (See CoA 2014b; CoA 2014c). Consider multiple methods of predictions and apply the most appropriate method. Consider the limitations of each method including the adequacy of empirical data and site-specific geological conditions and justify the selected method.	Not applicable.
Provide an assessment of both conventional and unconventional subsidence. For project expansions, an evaluation of past or current effects of geological structures on subsidence and implications for water resources and water-dependent assets should be provided.	Not applicable.
Describe subsidence monitoring methods, including the use of remote or on-ground techniques and explain the predicted accuracy of such techniques.	Not applicable.
Consider geological strata and their properties (strength/hardness/fracture propagation) in the subsidence analysis and/or modelling. Anomalous and near-surface ground movements with implications for water resources and compaction of unconsolidated sediment should also be considered.	Not applicable.
Final Landforms and Voids – Coal Mines	
Identify and consider landscape modifications (e.g. voids, on-site earthworks, and roadway and pipeline networks) and their potential effects on surface water flow, erosion, sedimentation and habitat fragmentation of water-dependent species and communities.	Section 3.3.9.9
Assess the adequacy of modelling, including surface water and groundwater quantity and quality, lake behaviour, timeframes and calibration.	Section 3.3.9.8
Provide an evaluation of stability of void slopes where failure during extreme events or over the long term (for example due to aquifer recovery causing geological heave and landform failure) may have implications for water quality.	Section 3.3.9.10
Evaluate mitigating inflows of saline groundwater by planning for partial backfilling of final voids.	Section 3.3.11
Provide an assessment of the long-term impacts to water resources and water-dependent assets posed by various options for the final landform design, including complete or partial backfilling of mining voids. Assessment of the final landform for which approval is being sought should consider: • *groundwater behaviour – sink or lateral flow from void.* • *water level recovery – rate, depth, and stabilisation point (e.g. timeframe and level in relation to existing groundwater level, surface elevation).* • *seepage – geochemistry and potential impacts.* • *long-term water quality, including salinity, pH, metals and toxicity.* • *measures to prevent migration of void water off-site.* *For other final landform options considered sufficient detail of potential impacts should be provided to clearly justify the proposed option.*	Sections 3.3.9.8, 3.3.9.9 and 3.3.9.10
Assess the probability of overtopping of final voids with variable climate extremes, and management mitigations.	Sections 3.3.9.8, 3.3.9.9 and 3.3.11.2
Acid-forming Materials and Other Contaminants of Concern	
Identify the presence and potential exposure of acid-sulphate soils (including oxidation from groundwater drawdown).	Section 3.3.9.10
Identify the presence and volume of potentially acid-forming waste rock, fine-grained amorphous sulphide minerals and coal reject/tailings material and exposure pathways.	Section 3.3.9.10
Identify other sources of contaminants, such as high metal concentrations in groundwater, leachate generation potential and seepage paths.	Section 3.3.9.10
Describe handling and storage plans for acid-forming material (co-disposal, tailings dam, and encapsulation).	Section 3.3.9.10

Table 3-3 (Continued)
IESC Guideline Cross Reference Table

Specific Information Needs	Section Addressed
Assess the potential impact to water-dependent assets, taking into account dilution factors, and including solute transport modelling where relevant, representative and statistically valid sampling, and appropriate analytical techniques.	Section 3.3.9.10
Describe proposed measures to prevent/minimise impacts on water resources, water users and water-dependent ecosystems and species.	Section 3.3.11.2
CSG Well Construction and Operation	
Describe the scale of fracturing (number of wells, number of fracturing events per well), types of wells to be stimulated (vertical versus horizontal), and other forms of well stimulation (cavitation, acid flushing).	Not applicable.
Describe proposed measuring and monitoring of fracture propagation.	Not applicable.
Identify water source for drilling and hydraulic stimulation, and outline the volume of fluid and mass balance (quantities/volumes).	Not applicable.
Describe the rules (e.g. water sharing plans) covering access to each water source used for drilling and hydraulic stimulation and how the project proposes to comply with them.	Not applicable.
Quantify and describe the quality and toxicity of flowback and produced water and how it will be treated and managed.	Not applicable.
Assess the potential for inter-aquifer leakage or contamination.	Not applicable.
The use of drilling and hydraulic fracturing chemicals should be informed by appropriately tiered deterministic and/or probabilistic hazard and risk assessments, based on ecotoxicological testing consistent with Australian Government testing guidelines (see CoA 2012; MRMMC-EPHCNHMRC 2009).	Not applicable.
Propose waste management measures (including salt and brines) during both operations and legacy after closure.	Not applicable.
List the chemicals proposed for use in drilling and hydraulic stimulation including: • *names of the companies producing fracturing fluids and associated products;* • *proprietary names (trade names) of compounds (fracturing fluid additives) being produced;* • *chemical names of each additive used in each of the fluids;* • *Chemical Abstract Service (CAS) numbers of each of the chemical components used in each of the fluids;* • *general purpose and function of each of the chemicals used;* • *mass or volume proposed for use;* • *maximum concentration (mg / L or g / kg) of the chemicals used;* • *chemical half-life data, partitioning data, and volatilisation data;* • *ecotoxicology; and* • *any material safety data sheets for the chemicals or chemical products used.*	Not applicable.
Chemicals for use in drilling and hydraulic fracturing must be identified as being approved for import, manufacture or use in Australia (that is, confirmed by NICNAS as being listed in the Australian Inventory of Chemical Substances (see CoA 2017b).	Not applicable.

3.2.4 Relevant Legislation and Scope of Approvals Sought through the EIS Process

Attachment 3 of the EIS provides a summary of legislative considerations (e.g. approvals and agreements) for the construction and operation of the Project.

It is anticipated that Pembroke will rely on this EIS to seek draft conditions for relevant approvals for the Project, as summarised in Attachment 3 of the EIS. It is expected that Energy Queensland will seek relevant State and Local Government approvals for the Project ETL.

3.2.5 Relevant Databases and Legislation

The following database and data sources were reviewed for other ecological data relevant to the Study area (DPM, Enviros ciences, 2018a, b and c):

- *EPBC Act Protected Matters Search Tool* (DEE, 2018c);
- *HERBRECS Database* (AVH 2018);
- *Wildlife Online* search (DEHP, 2018b);
- *Queensland Museum Database* (Queensland Museum, 2018);
- *Atlas of Living Australia* Search (ALA, 2018);
- *Protected Plants Flora Survey Trigger Map* (DEHP, 2018a);
- *Matters of State Environmental Significance Mapping Version 4.1* (DEHP, 2014b);
- *Regulated Vegetation Management Map – Version 1.37* (DNRM, 2018a);
- *Vegetation Management – Essential Habitat Map, Version 4.34* (DNRM, 2018b).
- *Bioregional Planning Assessment Mapping* (DEHP, 2009);
- *Queensland Wetland Data Version 4 Series – Queensland Wetlands Map 2015* (DSITI, 2017);
- *WetlandInfo Wetland Summary Information* (including species listings) for the Fitzroy Basin (DEHP, 2017a); and
- *Groundwater Dependent Ecosystem Mapping* (BoM, 2018)

3.2.6 Flora Surveys

DPM Enviros ciences (2018a) (Appendix A of the EIS) undertook flora surveys within a study area covering the Project area and land outside the Project area that may be subject to potential indirect impacts (the Study area) in accordance with the following relevant survey guidelines:

- Queensland *Flora Survey Guidelines – Protected Plants* (DEHP, 2014a); and
- *Methodology for Survey and Mapping of Regional Ecosystems and Vegetation Communities in Queensland* (Neldner *et al.,* 2017).

A spring flora survey was conducted within the Study area from 22-30 November 2016 and again from 26-30 September and 14-20 November 2017. A follow-up autumn flora survey was conducted from 7-9 March 2017 and from 30 May to 10 June 2017. Seasonal surveys were undertaken to maximise detection of threatened flora species that may occur in the Study area, based on the desktop assessment. The rationale for survey timing was to conduct surveys at a time when the majority of targeted species would have reproductive material (to aid in identification) (DPM Enviros ciences, 2018a).

3.2.6.1 Vegetation Sampling and Mapping

Vegetation communities were assessed at a total of 227 sites, comprising five Tertiary level sites and 222 Quaternary level sites. This included 121 sites that were assessed during the first spring survey undertaken from 22-30 November 2017, comprising four Tertiary level sites and 117 Quaternary level sites. In the second round of spring surveys (26-30 September and 14-20 November) another 55 Quaternary level sites were assessed (DPM Enviros ciences, 2018a). In addition, another Tertiary level site and 10 Quaternary level flora survey sites were assessed in the autumn survey period 7-9 March 2017. Autumn surveys (30 May to 10 June 2017), representing seasonal surveys for the Project area, added another 40 Quaternary sites.

The assessments were undertaken in accordance with the Queensland Herbarium vegetation survey methods described in Neldner *et al.* (2017). Survey sites were undertaken within representative communities and as vegetation community types transitioned to aid vegetation mapping and interpretation (DPM Enviros ciences, 2018a).

Tertiary assessments were undertaken to record the more detailed floristic and structural information at a site and included (DPM Enviros ciences, 2018a):

- confirmation of the RE;
- structural characteristics of the vegetation (based on life forms, strata, height and cover);
- relative abundance of each species (dominant, abundant, frequent, occasional or rare);
- groundcover characteristics;
- vegetation condition (integrity as either pristine, excellent, very good, good, average, degraded or completely degraded);

- presence and abundance of WoNS and Restricted weeds;
- presence and population characteristics of EVNT flora;
- landscape characteristics;
- regolith characteristics, including erosion; and
- wetland characteristics (if present).

Quaternary level flora assessments were undertaken to confirm the identity of REs and assist in field-verifying the RE mapping boundaries. The following information was recorded at these sites (DPM Envirosciences, 2018a):

- the dominant and characteristic canopy, midstorey and understorey species (relative abundance measured as dominant, abundant, frequent, occasional or rare);
- field-verified RE;
- vegetation condition (integrity as either pristine, excellent, very good, good, average, degraded or completely degraded);
- presence and population characteristics of flora listed under the EPBC Act;
- presence and abundance of WoNS and Restricted weeds; and
- other notes of relevance, such as community characteristics (size of community), site features (gullies) or evidence of disturbance.

RE boundaries were assessed using the State RE mapping (Version 10.0, DSITI 2017b), aerial imagery taken of the site in August 2017, the latest available aerial imagery for the Bowen Basin and field assessment results.

Vegetation boundaries were mapped at an approximate 1:10,000 scale where possible (DPM Envirosciences, 2018a).

Regional Ecosystem Mapping across the Study area is provided on Figure 3-2.

3.2.6.2 Threatened Ecological Community Mapping

The desktop review identified four threatened ecological communities (TECs) listed under the EPBC Act with potential to occur in the Study area, namely:

- *Brigalow (Acacia harpophylla dominant and co-dominant) ecological community;*
- *Natural grasslands of the Queensland Central Highlands and the northern Fitzroy Basin;*
- *Semi-evergreen vine thickets of the Brigalow Belt (North and South) and Nandewar Bioregions; and*
- *Weeping Myall Woodlands ecological community.*

Where the field surveys identified vegetation communities containing constituent species of a TEC, the condition thresholds described in the following Commonwealth listing advice were considered to determine whether the community meets the TEC status (DPM Envirosciences, 2018a):

- *Approved Conservation Advice for the Brigalow (Acacia harpophylla dominant and co-dominant) ecological community* (DotE, 2013a);
- *Approved Conservation Advice for Natural grasslands of the Queensland Central Highlands and the northern Fitzroy Basin* (DEWHA, 2008b);
- *Commonwealth Listing Advice on Semi-evergreen vine thickets of the Brigalow Belt (North and South) and Nandewar Bioregions* (TSSC, 2001);
- *Commonwealth Listing Advice on Weeping Myall Woodlands* (Threatened Species Scientific Committee, 2008c); and
- *EPBC Act Policy Statement 3.17: Weeping Myall Woodlands* (DEWHA, 2009).

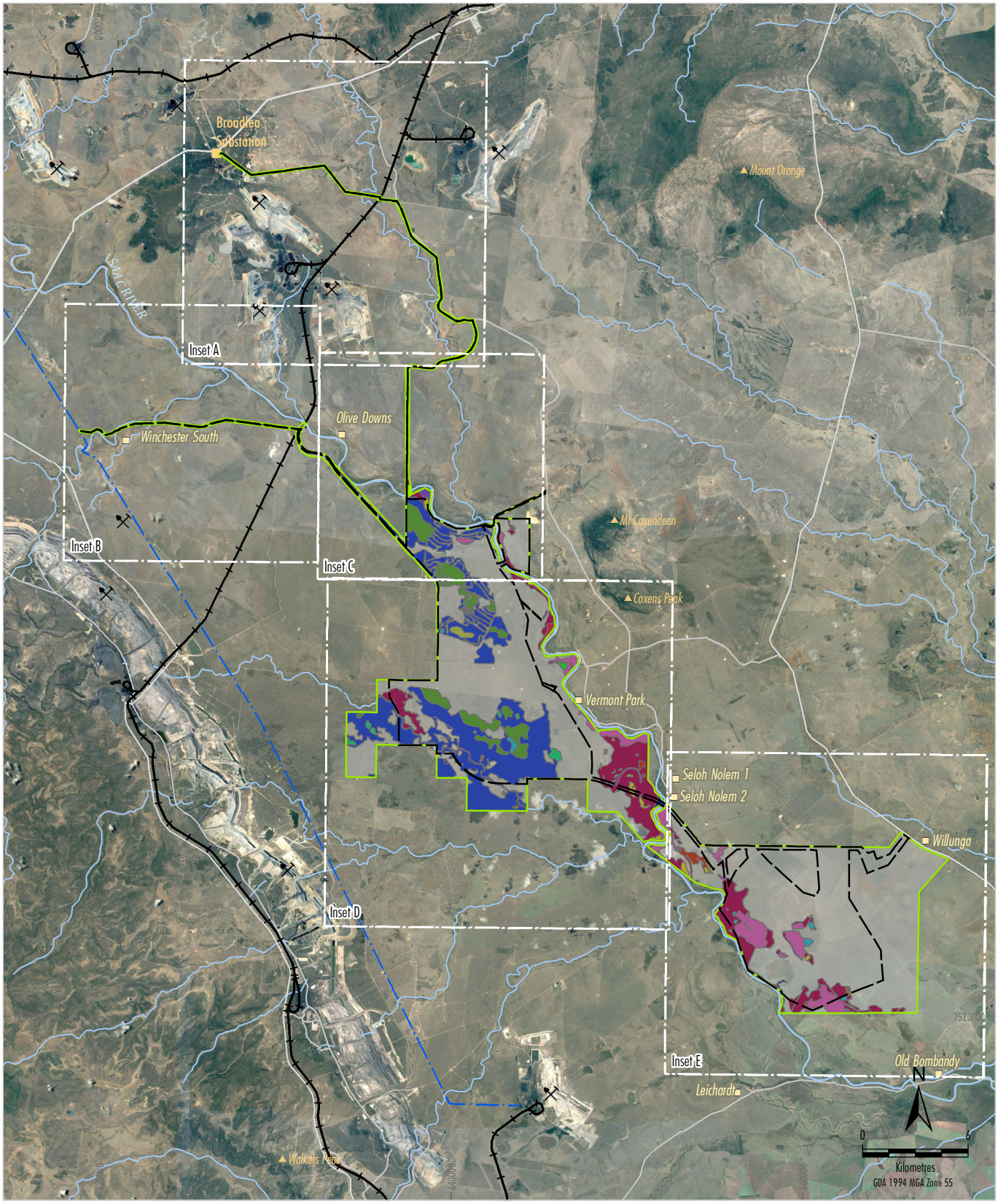
Further detail regarding these condition thresholds and how there were considered is provided in DPM Evirosciences (2018a).

TEC mapping across the Study area is provided on Figure 3-3.

3.2.6.3 Regional Ecosystems

Due to past and ongoing agricultural activities (e.g. clearing, grazing, thinning and cropping), the Project area is predominantly cleared land (approximately 65%) with patches of native vegetation (Figure 3-2).

Field-verified RE mapping undertaken by DPM Envirosciences demonstrated that approximately 9,119 ha of the Study area comprised of remnant (regulated) vegetation, which includes various minor realignments of mapped remnant vegetation, as well as inclusion of a larger patch of previously unmapped remnant vegetation on Wynette. A large component of the differences in mapping is due to the ability of the field surveys to separate mixed vegetation polygons into separate units (DPM Envirosciences, 2018a).



LEGEND

- Study Area
- Approximate Extent of Proposed Surface Development
- Approved/Operating Coal Mine
- Eungella Pipeline Network
- Railway
- Peaks
- Dwelling

Ground-truthed Regional Ecosystem

- 11.3.1 - Brigalow/Belah open forest on alluvial plains
- 11.3.2 - Poplar Box woodland on alluvial plains
- 11.3.25 - Eucalypt woodland on fringing drainage lines
- 11.3.27b - Lacustrine wetland, with fringing Eucalypt woodland
- 11.3.27c - Freshwater wetlands
- 11.3.27f - Palustrine wetland, Eucalypt open woodland with fringing swamps
- 11.3.27i - Palustrine wetland, Eucalypt woodland with sedgeland
- 11.3.3 - Coolibah woodland on alluvial plains
- 11.3.4 - Eucalypt woodland on alluvial plains
- 11.3.7 - Corymbia woodland on alluvial plains
- 11.4.8 - Dawson Gum woodland to open forest
- 11.4.9 - Brigalow shrubby woodland
- 11.5.17 - Eucalypt woodland on Cainozoic sand plains
- 11.5.18 - Capricornia shrubland
- 11.5.3 - Poplar Box woodland on Cainozoic sand
- 11.5.8c - Poplar gum woodland
- 11.5.9 - Narrow-leaved Ironbark and other woodland
- 11.5.9b - Narrow leaved Ironbark, white mahogany woodland
- 11.7.2 - Acacia woodland on Cainozoic lateritic duricrust
- 11.9.2 - Silver-leaved Ironbark woodland
- Non-remnant

Source: DPM (2018), Pembroke (2018), Queensland Department of Natural Resources, Mines and Energy (2017)
Orthophoto: Google Image (2016)

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OLIVE DOWNS COKING COAL PROJECT
Ground-truthed Regional Ecosystems

Figure 3-2

PRN-16-02_EIS_Sect3_225A

LEGEND

- Study Area
- Approximate Extent of Proposed Surface Development
- Peaks
- Dwelling

Ground-truthed Regional Ecosystem

- 11.3.1 - Brigalow/Belah open forest on alluvial plains
- 11.3.2 - Poplar Box woodland on alluvial plains
- 11.3.25 - Eucalypt woodland on fringing drainage lines
- 11.3.7 - Corymbia woodland on alluvial plains
- 11.4.9 - Brigalow shrubby woodland
- 11.5.18 - Capricornia shrubland
- 11.5.3 - Poplar Box woodland on Cainozoic sand
- 11.5.9b - Narrow leaved Ironbark, white mahogany woodland
- 11.7.2 - Acacia woodland on Cainozoic lateritic duricrust
- Non-remnant

Source: DPM (2018), Pembroke (2018), Queensland Department of Natural Resources, Mines and Energy (2017)
Orthophoto: Google Image (2016)
(Entirety of the the Approximate Extent of Proposed Surface Development is contained within Indicitive Stage 1 Disturbance Extent in this figure)

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Ground-truthed Regional Ecosystems

Inset 3-2a

PRN-16-02_E15_Sect3_226A

LEGEND

- Study Area
- Approximate Extent of Proposed Surface Development
- Eungella Pipeline Network
- Peaks
- Dwelling

Ground-truthed Regional Ecosystem

- 11.3.1 - Brigalow/Belah open forest on alluvial plains
- 11.3.2 - Poplar Box woodland on alluvial plains
- 11.3.25 - Eucalypt woodland on fringing drainage lines
- 11.3.4 - Eucalypt woodland on alluvial plains
- 11.4.8 - Dawson Gum woodland to open forest
- 11.4.9 - Brigalow shrubby woodland
- 11.5.3 - Poplar Box woodland on Cainozoic sand
- 11.9.2 - Silver-leaved Ironbark woodland
- Non-remnant

Source: DPM (2018), Pembroke (2018), Queensland Department of Natural Resources, Mines and Energy (2017) Orthophoto: Google Image (2016)

(Entirety of the the Approximate Extent of Proposed Surface Development is contained within Indicitive Stage 1 Disturbance Extent in this figure)

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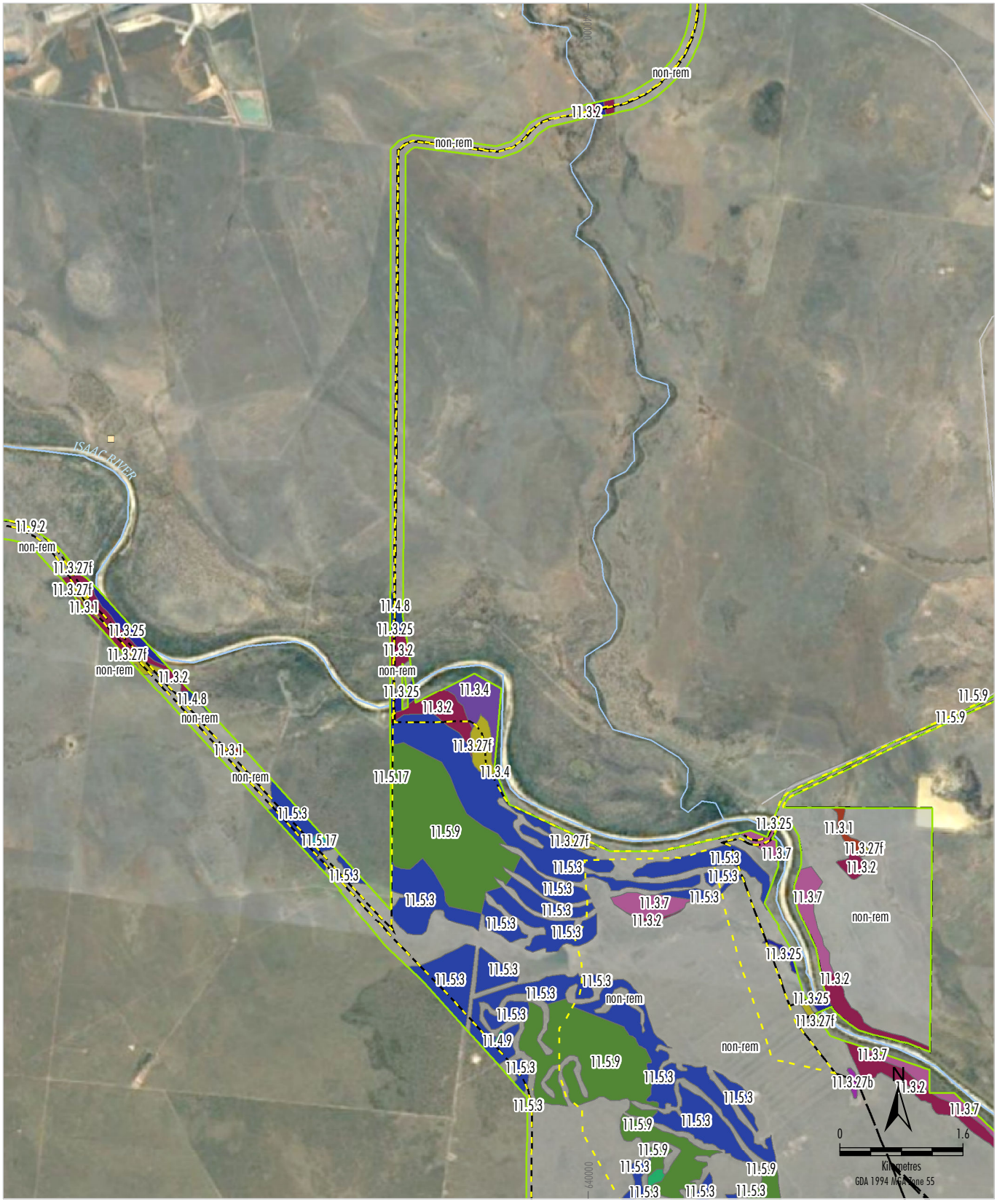
OLIVE DOWNS COKING COAL PROJECT

Ground-truthed Regional Ecosystems

Inset 3-2b



LEGEND

- Study Area
- Indicitive Stage 1 Disturbance Extent
- Approximate Extent of Proposed Surface Development
- Peaks
- Dwelling

Ground-truthed Regional Ecosystem

- 11.3.1 - Brigalow/Belah open forest on alluvial plains
- 11.3.2 - Poplar Box woodland on alluvial plains
- 11.3.25 - Eucalypt woodland on fringing drainage lines
- 11.3.27b - Lacustrine wetland, with fringing Eucalypt woodland
- 11.3.27f - Palustrine wetland, Eucalypt open woodland with fringing swamps
- 11.3.4 - Eucalypt woodland on alluvial plains
- 11.3.7 - Corymbia woodland on alluvial plains
- 11.4.8 - Dawson Gum woodland to open forest
- 11.4.9 - Brigalow shrubby woodland
- 11.5.17 - Eucalypt woodland on Cainozoic sand plains
- 11.5.3 - Poplar Box woodland on Cainozoic sand
- 11.5.9 - Narrow-leaved Ironbark and other woodland
- 11.9.2 - Silver-leaved Ironbark woodland
- Non-remnant

Source: DPM (2018), Pembroke (2018), Queensland Department of Natural Resouces, Mines and Energy (2017),
Orthophoto: Google Image (2016)

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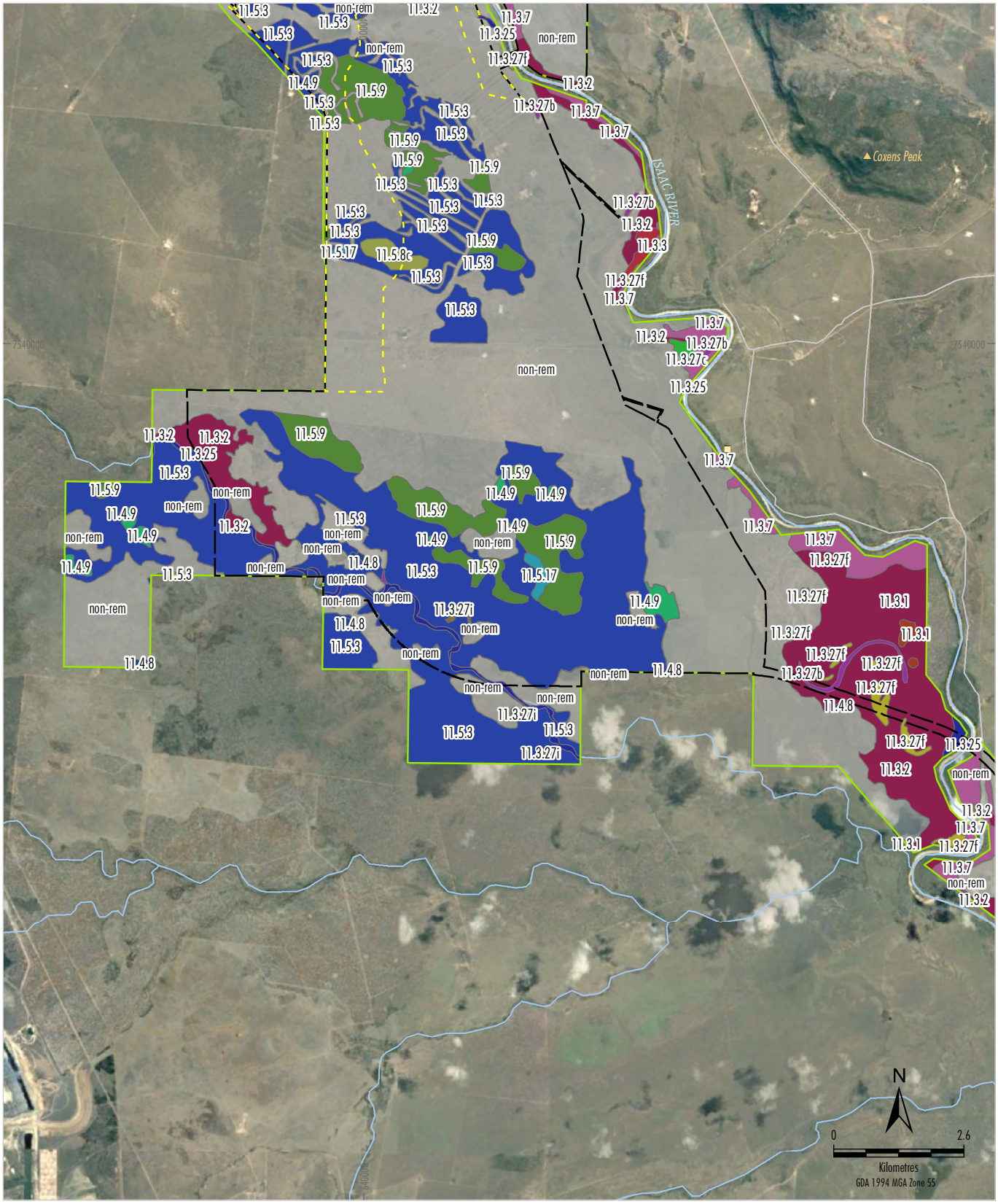
OLIVE DOWNS COKING COAL PROJECT

Ground-truthed Regional Ecosystems

Inset 3-2c



LEGEND

- Study Area
- Indicitive Stage 1 Disturbance Extent
- Approximate Extent of Proposed Surface Development
- Peaks
- Dwelling

Ground-truthed Regional Ecosystem

- 11.3.1 - Brigalow/Belah open forest on alluvial plains
- 11.3.2 - Poplar Box woodland on alluvial plains
- 11.3.25 - Eucalypt woodland on fringing drainage lines
- 11.3.27b - Lacustrine wetland, with fringing Eucalypt woodland
- 11.3.27c - Freshwater wetlands
- 11.3.27f - Palustrine wetland, Eucalypt open woodland with fringing swamps
- 11.3.27i - Palustrine wetland, Eucalypt woodland with sedgeland
- 11.3.3 - Coolibah woodland on alluvial plains
- 11.3.7 - Corymbia woodland on alluvial plains
- 11.4.8 - Dawson Gum woodland to open forest
- 11.4.9 - Brigalow shrubby woodland
- 11.5.17 - Eucalypt woodland on Cainozoic sand plains
- 11.5.3 - Poplar Box woodland on Cainozoic sand
- 11.5.8c - Poplar gum woodland
- 11.5.9 - Narrow-leaved Ironbark and other woodland
- Non-remnant

Source: DPM (2018), Pembroke (2018), Queensland Department of Natural Resources, Mines and Energy (2017)
Orthophoto: Google Image (2016)

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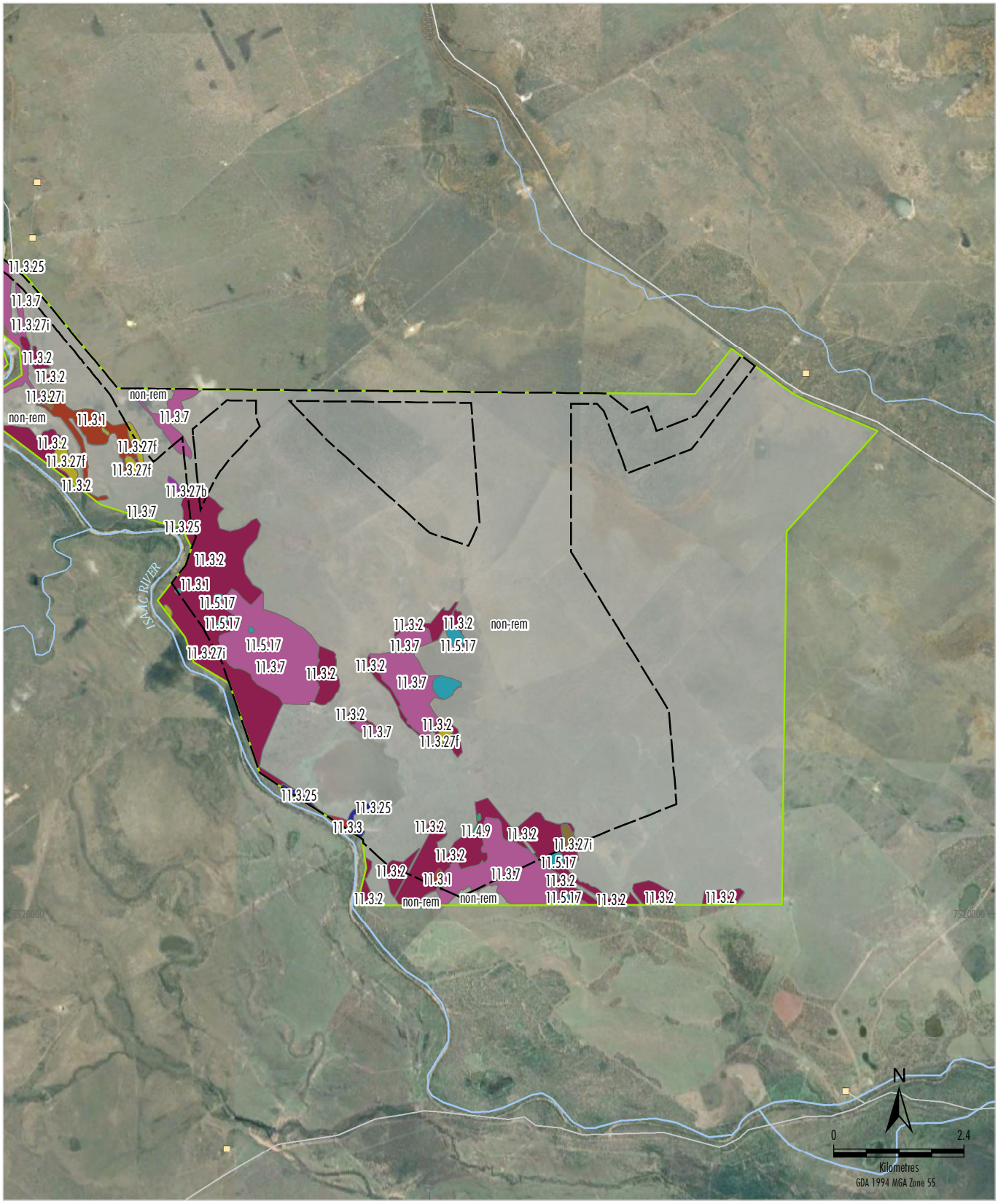
OLIVE DOWNS COKING COAL PROJECT

Ground-truthed Regional Ecosystems

Inset 3-2d



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LEGEND

Approximate Extent of Proposed Surface Development
Study Area
Peaks
Dwelling

Ground-truthed Regional Ecosystem

- 11.3.1 - Brigalow/Belah open forest on alluvial plains
- 11.3.2 - Poplar Box woodland on alluvial plains
- 11.3.25 - Eucalypt woodland on fringing drainage lines
- 11.3.27b - Lacustrine wetland, with fringing Eucalypt woodland
- 11.3.27f - Palustrine wetland, Eucalypt open woodland with fringing swamps
- 11.3.27i - Palustrine wetland, Eucalypt woodland with sedgeland
- 11.3.3 - Coolibah woodland on alluvial plains
- 11.3.7 - Corymbia woodland on alluvial plains
- 11.4.8 - Dawson Gum woodland to open forest
- 11.4.9 - Brigalow shrubby woodland
- 11.5.17 - Eucalypt woodland on Cainozoic sand plains
- Non-remnant

Source: DPM (2018), Pembroke (2018), Queensland Department of Natural Resources, Mines and Energy (2018)
Orthophoto: Google Image (2016)

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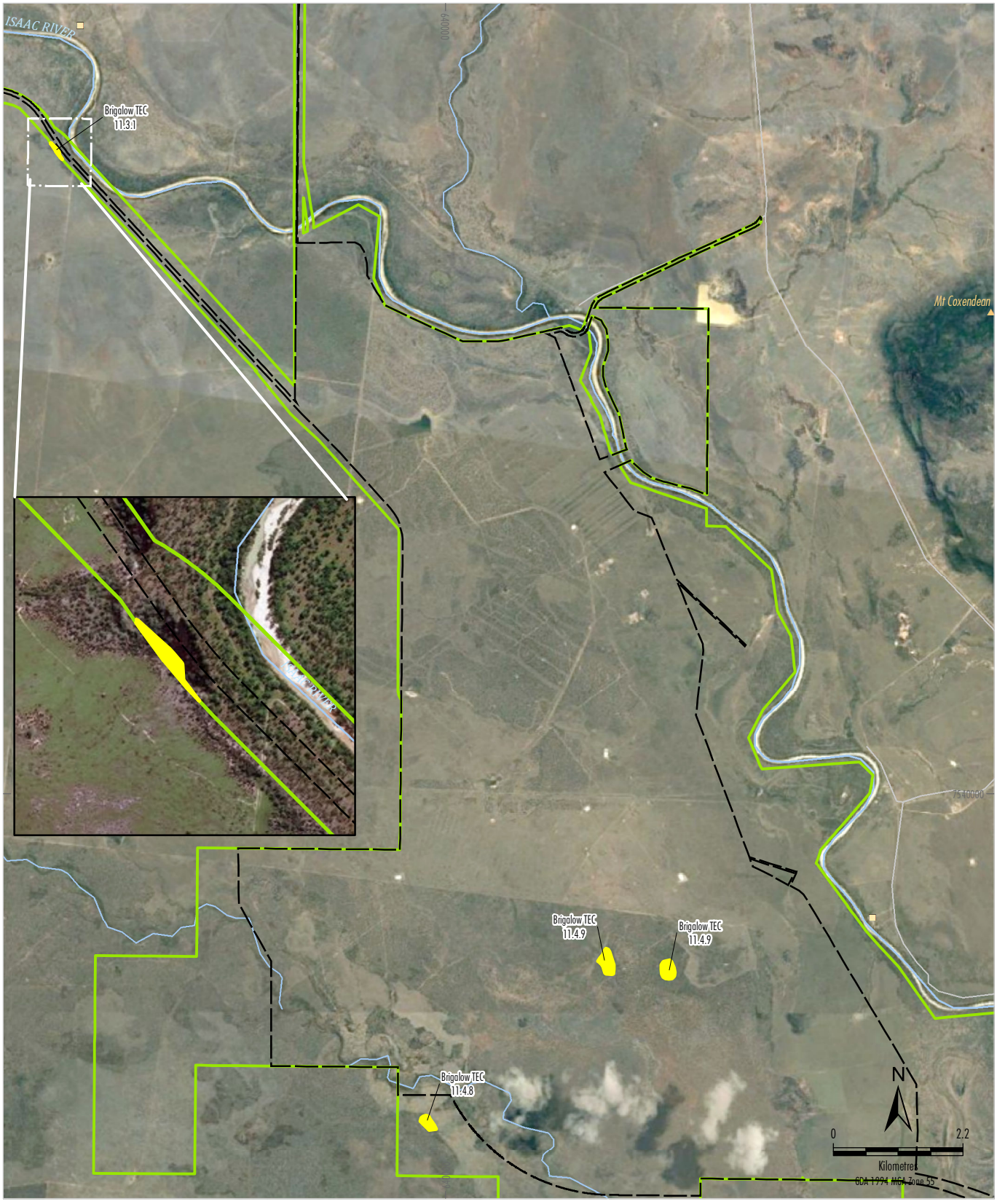
OLIVE DOWNS COKING COAL PROJECT

Ground-truthed Regional Ecosystems

Inset 3-2e



LEGEND
- Brigalow TEC
- Approximate Extent of Proposed Surface Development
- Study Area
- Approved/Operating Coal Mine
- Peaks
- Dwelling
- Railway

Source: DPM (2018), Pembroke (2018)
Orthophoto: Google Image (2015)

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OLIVE DOWNS COKING COAL PROJECT
Threatened Ecological Communities

Figure 3-3

A total of 21 individual native Regional Ecosystems (REs) were ground-truthed within the Project locality (Table 3-4) (Figure 3-2). These REs fall within six broad vegetation groups (DPM Envirosciences, 2018a), including:

- *eucalypt dry woodlands on inland depositional plains (BVG5M:5);*
- *eucalypt open forests to woodlands on floodplains (BVG5M:4);*
- *eucalypt woodlands to open forests (BVG5M:3);*
- *other acacia dominated open forests, woodlands and shrublands (BVG5M:10);*
- *wetland REs (swamps and lakes) (BVG5M:15); and*
- *other coastal communities or heaths (BVG5M:12).*

Property Map of Assessable Vegetation applications under the VM Act (with the ground-truthed vegetation mapping) and RE Assessment Kits have been lodged separately with DNRM and the Queensland Museum.

A detailed description of each RE, and detailed RE mapping is provided in Appendix A.

Endangered and Of Concern Regional Ecosystems

Of the 21 REs identified within the Project locality, four have a conservation status of 'Endangered' under the VM Act (RE 11.3.1, RE 11.4.8, RE 11.4.9 and RE 11.5.17) and five have a conservation status of 'Of Concern' (RE 11.3.2, RE 11.3.3, RE 11.3.3c, RE 11.3.4 and RE 11.5.18) (Table 3-4) (Figure 3-2).

Least Concern Regional Ecosystems

Twelve REs identified within the Project locality have a conservation status of 'Least Concern' under the VM Act (RE 11.3.25, RE 11.3.27b, RE 11.3.27c, RE 11.3.27f, RE 11.3.27i, RE 11.3.7, RE 11.5.3, RE 11.5.8c, RE 11.5.9, RE 11.5.9b, RE 11.7.2 and RE 11.9.2), and are generally dominated by Poplar Box (*Eucalyptus populnea*) and Narrow-leaved Ironbark (*Eucalyptus crebra*) (Table 3-4).

Regrowth Vegetation

There is 17,838 ha of land in the Study area that is not associated with any regulated vegetation. This area has been classified as 'agricultural grasslands dominated by buffel grass (*Cenchrus ciliaris*)'. Much of this area contains sparse Brigalow (Acacia harpophylla) regrowth (which does not meet the criteria to be mapped as Brigalow TEC [DPM Envirosciences, 2018a]), buffel grass and gilgai (DPM Envirosciences, 2018a).

3.2.6.4 Targeted Flora Surveys

Threatened flora species listed under the EPBC Act considered likely to occur based on desktop assessment were targeted during the flora surveys. These included targeted surveys for the following species (DPM Envirosciences, 2018a):

- *Cycas ophiolitica* – listed as Endangered under the EPBC Act;
- King Blue-grass (*Dicanthium queenslandicum*) – listed as Endangered under the EPBC Act;
- Bluegrass (*Dicanthium setosum*) – listed as Vulnerable under the EPBC Act;
- Black Ironbox (*Eucalyptus raveretiana*) – listed as Vulnerable under the EPBC Act; and
- Quassia (*Samadera bidwillii*) – listed as Vulnerable under the EPBC Act.

Target flora species were surveyed for as a component of field verifying REs. Flora species were recorded for each assessment site, as well as whilst traversing the Study area. In addition, EVNT flora species were targeted in areas of potential habitat identified from the desktop assessment (DPM Envirosciences, 2018a).

In the instance that a threatened flora species was located, the survey methodology for protected plant species (i.e. EVNT population survey or EVNT plot survey) was applied to map the extent and numbers involved (*Flora Survey Guidelines – Protected Plants* [DEHP 2016]). Where suspected threatened species could not be identified in the field, samples were collected, pressed and then delivered to the Queensland Herbarium for identification.

These threatened flora species were targeted in areas of potential habitat identified from the desktop assessment and field surveys (DPM Envirosciences, 2018a).

3.2.7 Fauna Surveys

DPM Envirosciences (2018b) (Appendix B of the EIS) undertook fauna surveys within the Study area in accordance with the following relevant survey guidelines (DPM Envirosciences, 2018b):

- *Terrestrial Vertebrate Fauna Survey Guidelines for Queensland* (Eyre et al., 2014);
- *EPBC Act Survey Guidelines for Australia's Threatened Reptiles* (DEWHA, 2011a);
- *EPBC Act Survey Guidelines for Australia's Threatened Birds* (DEWHA 2010a);
- *EPBC Act Survey Guidelines for Australia's Threatened Bats* (DEWHA 2010b);

Table 3-4
Ground-truthed Regional Ecosystems

Regional Ecosystem	Conservation Status[1]		
	VM Act	Biodiversity Status	EPBC Act
RE 11.3.1 Brigalow (*Acacia harpophylla*) and / or Belah (*Casuarina cristata*) open forest on alluvial plains.	E	E	Some patches represent the Brigalow Woodland TEC[2]
RE 11.3.2 Poplar Box (*Eucalyptus populnea*) woodland on alluvial plains.	OC	OC	-
RE 11.3.25 Queensland Blue Gum (*Eucalyptus tereticornis*) or River Red Gum (*E. camaldulensis*) woodland fringing drainage lines.	LC	OC	-
RE 11.3.27b Lacustrine wetland, with fringing woodland, commonly River Red Gum (*Eucalyptus camaldulensis*) or Coolabah (*E. coolabah*).	LC	OC	-
RE 11.3.27c Palustrine wetland (e.g. vegetated swamp). Mixed grassland or sedgeland with areas of open water +/- aquatic species.	LC	OC	-
RE 11.3.27f Palustrine wetland, Coolabah (*Eucalyptus coolabah*) and / or Queensland Blue Gum (*E. tereticornis*) open woodland to woodland fringing swamps.	LC	OC	-
RE 11.3.27i Palustrine wetland (e.g. vegetated swamp). River Red Gum (*Eucalyptus camaldulensis*) or Queensland Blue Gum (*E. tereticornis*) woodland to open woodland with sedgeland ground layer.	LC	OC	-
RE 11.3.3 Coolabah (*Eucalyptus coolabah*) woodland on alluvial plains.	OC	OC	-
RE 11.3.3c Palustrine wetland (e.g. vegetated swamp). Coolabah (*Eucalyptus coolabah*) woodland to open woodland (to scattered trees) with a sedge or grass understorey in back swamps and old channels.	OC	OC	-
RE 11.3.4 Queensland Blue Gum (*Eucalyptus tereticornis*) and / or *Eucalyptus* spp. woodland on alluvial plains.	OC	OC	-
RE 11.3.7 *Corymbia* spp. woodland on alluvial plains.	LC	OC	-
RE 11.4.8 Dawson Gum (*Eucalyptus cambageana*) woodland to open forest with Brigalow (*Acacia harpophylla*) or Blackwood (*A. argyrodendron*) on Cainozoic clay plains.	E	E	Some patches represent the Brigalow Woodland TEC[2]
RE 11.4.9 Brigalow (*Acacia harpophylla*) shrubby woodland with Yellowwood (*Terminalia oblongata*) on Cainozoic clay plains.	E	E	Some patches represent the Brigalow Woodland TEC[2]
RE 11.5.3 Poplar Box (*Eucalyptus populnea*) +/- Silver-leaved Ironbark (*E. melanophloia*) +/- Clarkson's Bloodwood (*Corymbia clarksoniana*) woodland on Cainozoic sand plains and / or remnant surfaces.	LC	NCP	-
RE 11.5.8c Poplar Gum (*Eucalyptus platyphylla*) woodland on white-yellow weathered sands, with grassy ground layer.	LC	NCP	-
RE 11.5.9 Narrow-leaved Ironbark (*Eucalyptus crebra*) and other *Eucalyptus* spp. and *Corymbia* spp. woodland on Cainozoic sand plains and / or remnant surfaces.	LC	NCP	-
RE 11.5.9b Narrow-leaved Ironbark (*Eucalyptus crebra*), Narrow-leafed White Mahogany (*E. tenuipes*), Budgeroo (*Lysicarpus angustifolius*) +/- *Corymbia spp*. woodland.	LC	NCP	-
RE 11.5.17 Palustrine swamp with fringing Queensland Blue Gum (*Eucalyptus tereticornis*) woodland in depressions on Cainozoic sand plains and remnant surfaces.	E	E	-
RE 11.5.18 *Micromyrtus capricornia* shrubland on Cainozoic sand plains and/or remnant surfaces	OC	OC	-
RE 11.7.2 Monospecific stands of *Acacia* spp. forest / woodland on Cainozoic lateritic duricrusts.	LC	NCP	-
RE 11.9.2 Silver-leaf Ironbark (*Eucalyptus melanophloia*) +/- Coolabah (*E. orgadophila*) woodland on fine-grained sedimentary rocks	LC	NCP	-

Source: DPM Enviros ciences 2018a.

[1] Conservation Status – E = Endangered; OC = Of Concern; NCP = No Concern at Present; LC = Least Concern.

[2] Patches of Brigalow Woodland TEC are shown on Figure 3-3.

Note: Highlighted cells are REs within the Project footprint.

- *EPBC Act Survey Guidelines for Australia's Threatened* Mammals (DEWHA, 2011b);
- *EPBC Act Draft Referral Guidelines for the Nationally Listed Brigalow Belt Reptiles* (DSEWPaC, 2011);
- *EPBC Act Referral Guidelines for the Vulnerable Koala* (DotE, 2014);
- *Targeted Species Survey Guidelines – Painted Honeyeater* (Rowland, 2012a);
- *Targeted Species Survey Guidelines – Ghost Bat* (Hourigan, 2011); and
- *Targeted Species Survey Guidelines – Yakka Skink* (Ferguson and Mathieson, 2014).

A comprehensive fauna survey was undertaken from 1-14 November 2016, 23 April to 4 May 2017, 7-14 May 2017, 4-9 September 2017 and 14-20 November (DPM Envirosciences, 2018b). This is consistent with the seasonal survey requirements detailed in the *Terrestrial Vertebrate Fauna Survey Assessment Guidelines for Queensland* (Eyre *et al*., 2014).

3.2.7.1 Survey Methodology

Comprehensive fauna surveys were undertaken at 13 locations within the Study area (FAC1 to FAC14). Targeted survey effort for EVNT species across the broader Study area included an additional eleven camera trap sites, fourteen ultrasonic bat detector sites, four harp trap sites, 46 bird survey sites, 21 active reptile search sites, 50 spotlighting sites and eighteen Koala transects (DPM Envirosciences, 2018b).

Table 3-5 outlines the fauna survey methods undertaken at each comprehensive survey site during both the spring and autumn surveys.

3.2.7.2 Fauna Habitat Assessments

Fauna habitat assessments were undertaken at 225 sites across the Study area across the spring 2016, autumn and spring 2017 surveys. At each site an approximate 1 ha search area was assessed for features including (DPM Envirosciences, 2018b):

- overall condition (pristine, very good, good, average, poor, degraded, or completely degraded);
- level of erosion (absent, scattered, frequent);
- presence and type of disturbance (grazing etc.);
- presence and accessibility of standing water;
- soil type / texture;
- presence of scats, tracks and other traces of fauna;
- abundance (absent, scattered, common, abundant) of:
  - large hollows (>20 cm);
  - small hollows (<20cm);
  - large logs (>50 cm diameter);
  - small logs (<50cm diameter);
  - cliffs and rocky outcrops;
  - large rocks (>30 cm);
  - small rocks (<30 cm);
  - leaf litter;
  - dense grass / shrub shelter;
  - decorticating bark;
  - arboreal and terrestrial termite mounds;
  - seeding grass cover;
  - fruiting plants;
  - nectar and pollen producing plants;
  - Koala feed trees; and
  - gilgai.

Other important habitat features, such as creek banks and connectivity, were also noted where relevant. Table 3-5 provides a summary of the fauna survey effort across the Study area.

Fauna habitat mapping across the Study area is provided on Figure 3-4.

3.2.7.3 Targeted Searches for Terrestrial Threatened Fauna Species

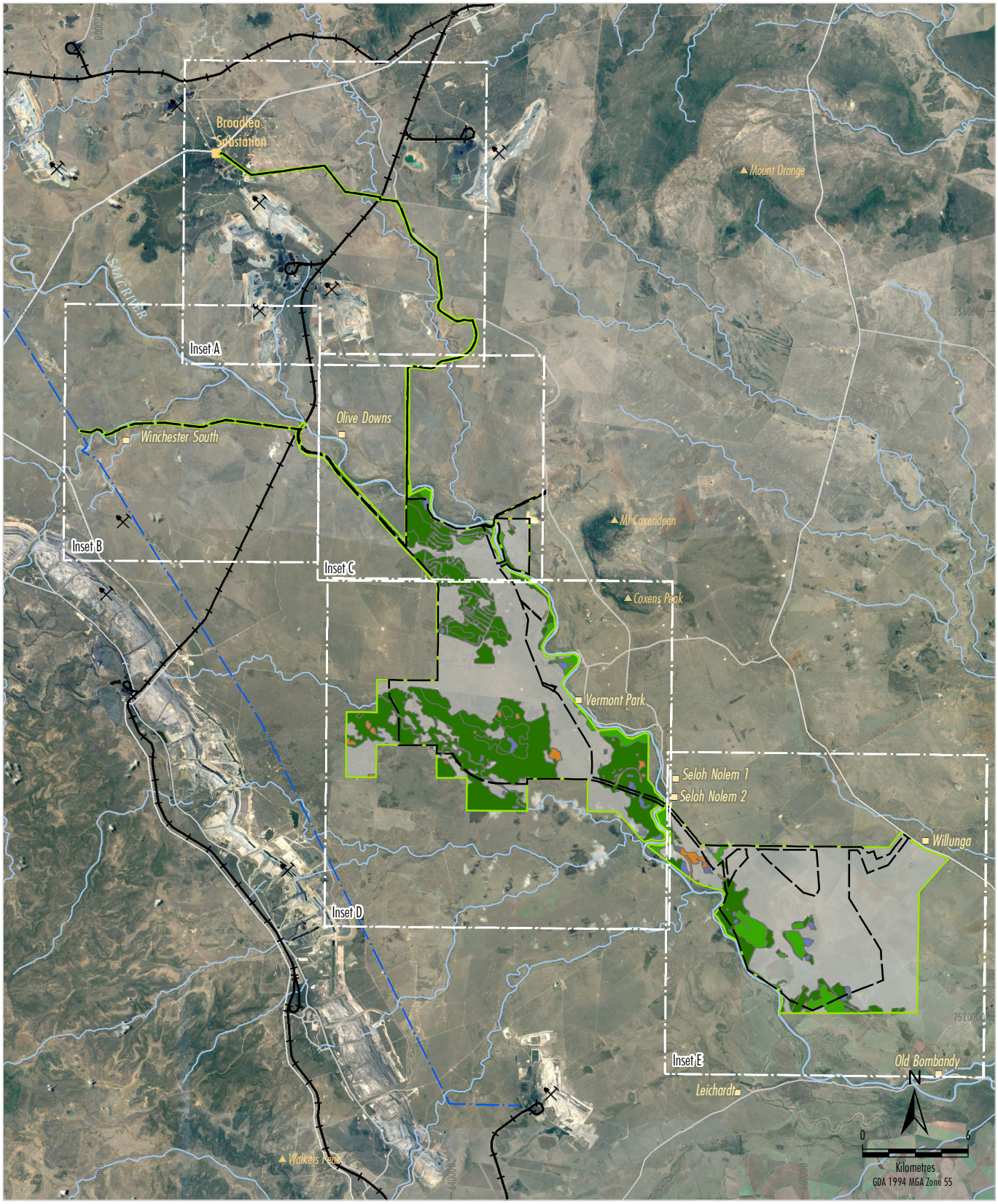
Appendix A of the EIS provides a list of threatened fauna species from the database searches and identifies which were specifically targeted during the surveys by DPM Envirosciences (2018b).

Table 3-6 also list the species that were targeted during the surveys by DPM Envirosciences (2018b) and provides a reconciliation of the survey methods against the recommended State and Commonwealth survey methods. DPM Envirosciences (2018b) determined that all threatened fauna species with the potential to occur in the Study area were surveyed for in accordance with the relevant guidelines (Table 3-6).

Table 3-5
Summary of Terrestrial Fauna Survey Methodology

Survey Technique	Target Fauna	Description
Pitfall Trapping	Amphibians, reptiles, small terrestrial mammals	Pit fall traps were deployed at each comprehensive fauna survey site for four days and four nights for a total of 208 pitfall trap nights.
Funnel Trapping	Amphibians, reptiles	Pit fall traps were deployed at each comprehensive fauna survey site for four days and four nights for a total of 306 funnel trap nights.
Diurnal Active Search	Amphibians, reptiles, small terrestrial mammals	Diurnal active searches were undertaken at each of the 13 comprehensive survey sites along with a further 21 sites within the Study area for a total of 68 active search hours.
Nocturnal Active Search	Amphibians, reptiles, small terrestrial mammals	Nocturnal active searches were undertaken at each of the 13 comprehensive survey sites for a total of 13 hours of nocturnal active searching.
Koala Searches	Koala	A Koala SAT (Spot Assessment Technique) was employed as per (Phillips & Callaghan 2011) at each of the 13 comprehensive survey sites along with a further 18 SAT survey sites within the study area for a total of 31 SAT survey sites.
Elliot Trapping	Small terrestrial mammals	20-25 baited traps were placed at 5-10 m intervals along on a 100 m transect at each of the 13 comprehensive fauna survey sites. These were left open for four days and four nights for a total of 1,300 trap nights.
Diurnal Bird Survey	Diurnal birds	6 x 20 min diurnal bird surveys were undertaken at each of the 13 comprehensive fauna survey sites along with a further 46 bird survey sites. A total of 135.25 hours of diurnal bird surveys were undertaken.
Camera Trapping	Reptiles, medium-large terrestrial mammals	1 baited camera trap was placed at each of the 13 comprehensive fauna survey sites along with an additional 11 sites for four nights. A total of 100 camera trap nights was conducted.
Call Playback	Nocturnal birds, arboreal mammals	Two sessions of call playback for relevant species (e.g. owls and nightjars) was undertaken at each of the 13 comprehensive fauna survey sites along with an additional two sites.
Nocturnal Spotlighting	Nocturnal birds, arboreal mammals, medium-large terrestrial mammals	2 x 30 person-min spotlight search within each of the comprehensive fauna survey sites along with a further 50 spotlighting sites. Spotlighting was also in adjoining habitats and along access tracks. A total of 91.5 hours of spotlighting was undertaken across the study site.
Echo-location Call Detection	Microbats	One bat detector for at least one night per dedicated survey site, as well as in other areas of interest (e.g. waterbodies). These were deployed instead of harp traps (which were not utilised for the comprehensive fauna survey sites).
Harp Trapping	Microbats	Two harp traps were deployed at four locations for two nights within the Study area in locations where suitable flyways were detected. A total of 16 trap nights were undertaken across the Study area.
Scat and Sign Search	Reptiles, medium-large terrestrial mammals, nocturnal birds, arboreal mammals	Scat and sign searches coinciding with systematic diurnal active searches at each dedicated survey site.

Source: DPM Enviroscienses (2018b)



LEGEND

- Study Area
- Approximate Extent of Proposed Surface Development
- Approved/Operating Coal Mine
- Eungella Pipeline Network
- Railway
- Peaks
- Dwelling

Ground-truthed Broad Vegitation Group

- Eucalypt dry woodlands on inland depositional plains
- Eucalypt open forests to woodlands on floodplains
- Acacia dominated open forests, woodlands and shrublands
- Palustrine wetlands
- Lacustrine wetlands
- Other coastal communities and heath
- Agricultural grasslands dominated by buffel grass

Source: DPM (2018), Pembroke (2018)
Orthophoto: Google Image (2015)

PEMBROKE

OLIVE DOWNS COKING COAL PROJECT

Broad Fanua Habitat Types

Figure 3-4

PRN-16-02_EIS_Sect3_2354

LEGEND

- Study Area
- Approximate Extent of Proposed Surface Development
- Approved/Operating Coal Mine
- Eungella Pipeline Network
- Railway
- Peaks
- Dwelling

Ground-truthed Broad Vegitation Group

- Eucalypt dry woodlands on inland depositional plains
- Eucalypt open forests to woodlands on floodplains
- Acacia dominated open forests, woodlands and shrublands
- Other coastal communities and heath
- Agricultural grasslands dominated by buffel grass

Source: DPM (2018), Pembroke (2018)
Orthophoto: Google Image (2015)

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OLIVE DOWNS COKING COAL PROJECT

Borad Fauna Habitat Types

Inset 3-4a

LEGEND

- Study Area
- Approximate Extent of Proposed Surface Development
- Approved/Operating Coal Mine
- Eungella Pipeline Network
- Railway
- Peaks
- Dwelling

Ground-truthed Broad Vegitation Group

- Eucalypt dry woodlands on inland depositional plains
- Eucalypt open forests to woodlands on floodplains
- Acacia dominated open forests, woodlands and shrublands
- Agricultural grasslands dominated by buffel grass

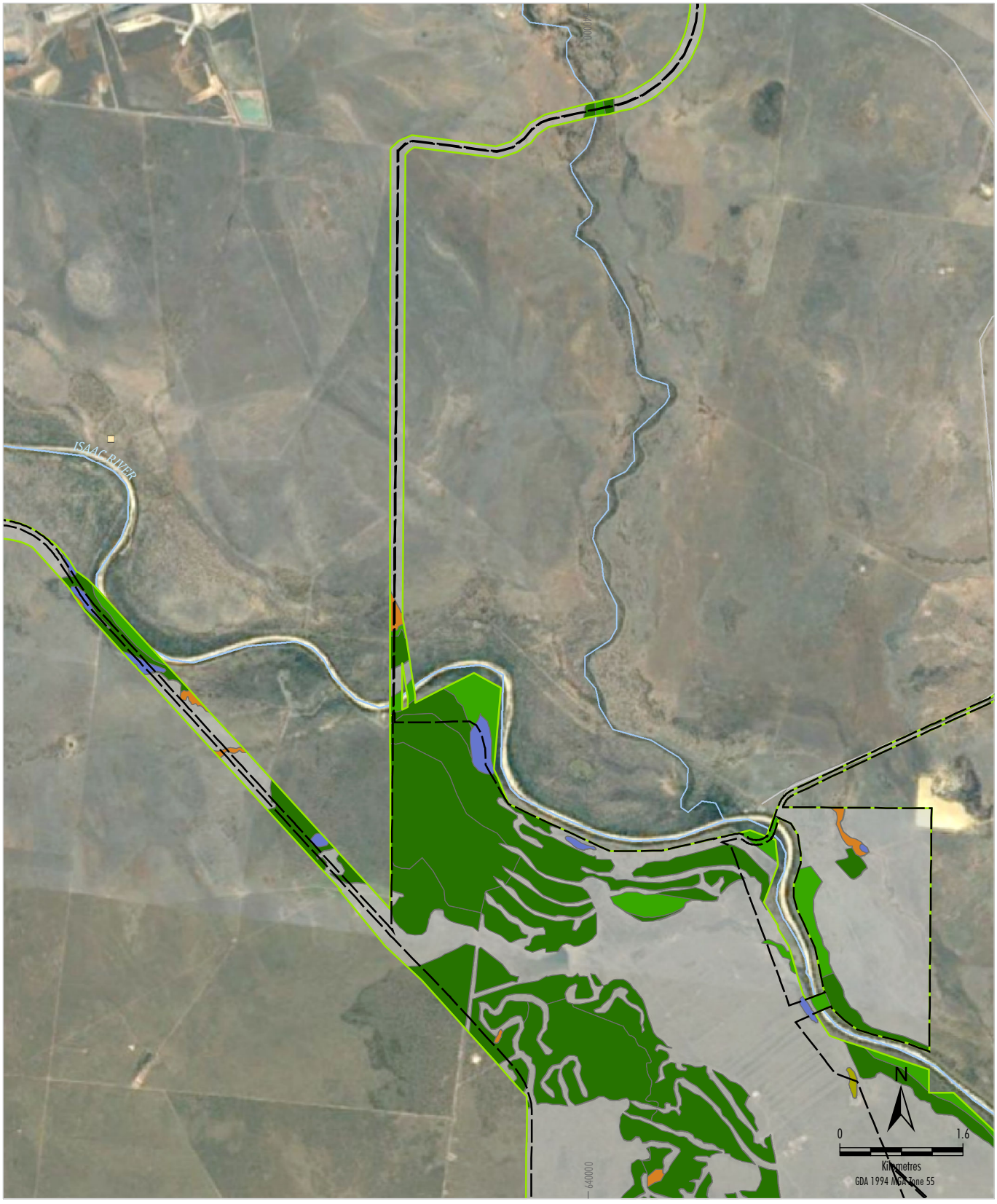
Source: DPM (2018), Pembroke (2018)
Orthophoto: Google Image (2015)

PEMBROKE

OLIVE DOWNS COKING COAL PROJECT

Broad Fauna Habitat Mapping

Inset 3-4b



LEGEND

- Study Area
- Approximate Extent of Proposed Surface Development
- Approved/Operating Coal Mine
- Eungella Pipeline Network
- Railway
- Peaks
- Dwelling

Ground-truthed Broad Vegitation Group

- Eucalypt dry woodlands on inland depositional plains
- Eucalypt open forests to woodlands on floodplains
- Acacia dominated open forests, woodlands and shrublands
- Palustrine wetlands
- Lacustrine wetlands
- Agricultural grasslands dominated by buffel grass

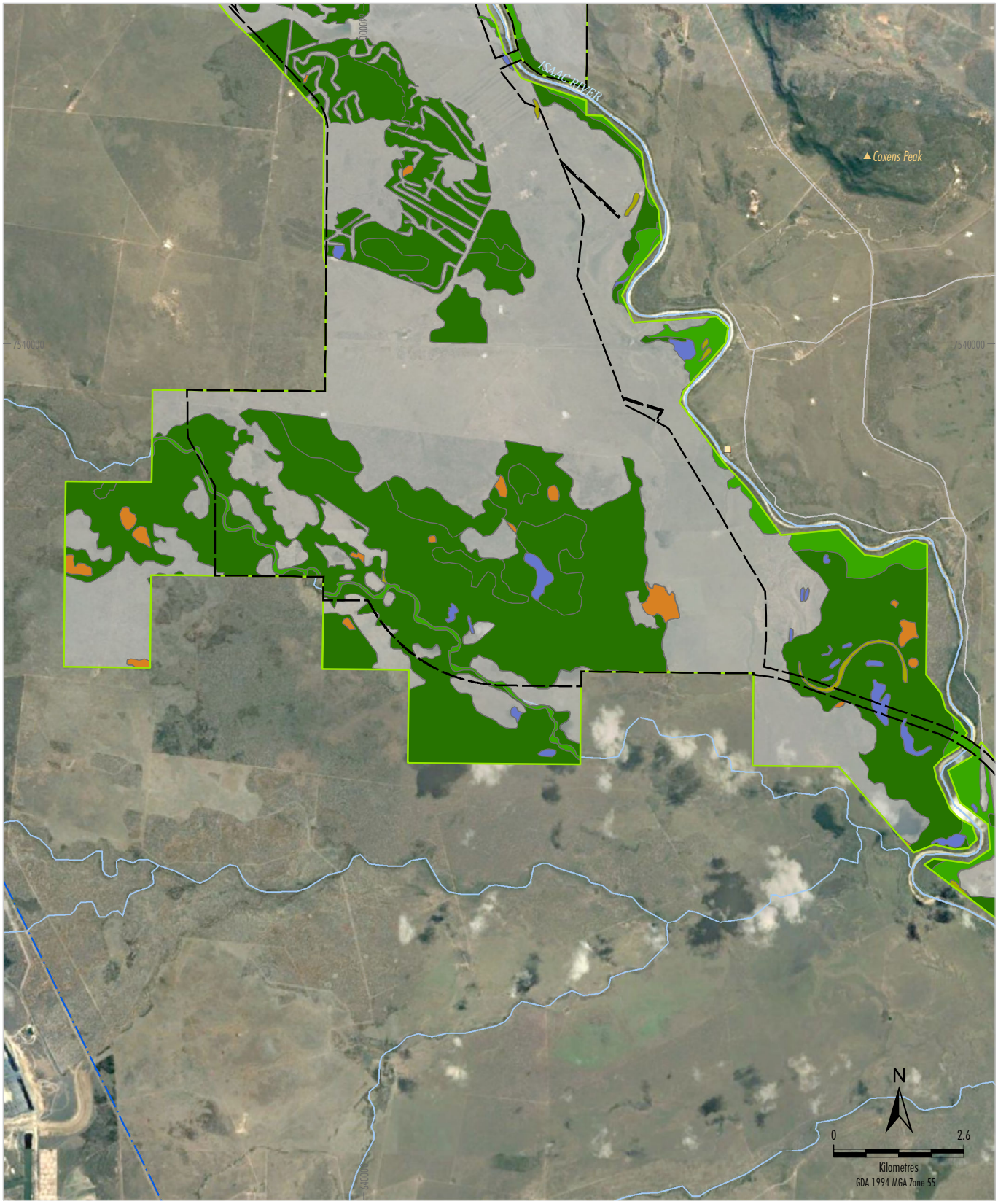
Source: DPM (2018), Pembroke (2018)
Orthophoto: Google Image (2015)

PEMBROKE

OLIVE DOWNS COKING COAL PROJECT

Broad Fanua Habitat Types

Inset 3-4c



LEGEND

- Study Area
- Approximate Extent of Proposed Surface Development
- Approved/Operating Coal Mine
- Eungella Pipeline Network
- Railway
- Peaks
- Dwelling

Ground-truthed Broad Vegitation Group

- Eucalypt dry woodlands on inland depositional plains
- Eucalypt open forests to woodlands on floodplains
- Acacia dominated open forests, woodlands and shrublands
- Palustrine wetlands
- Lacustrine wetlands
- Agricultural grasslands dominated by buffel grass

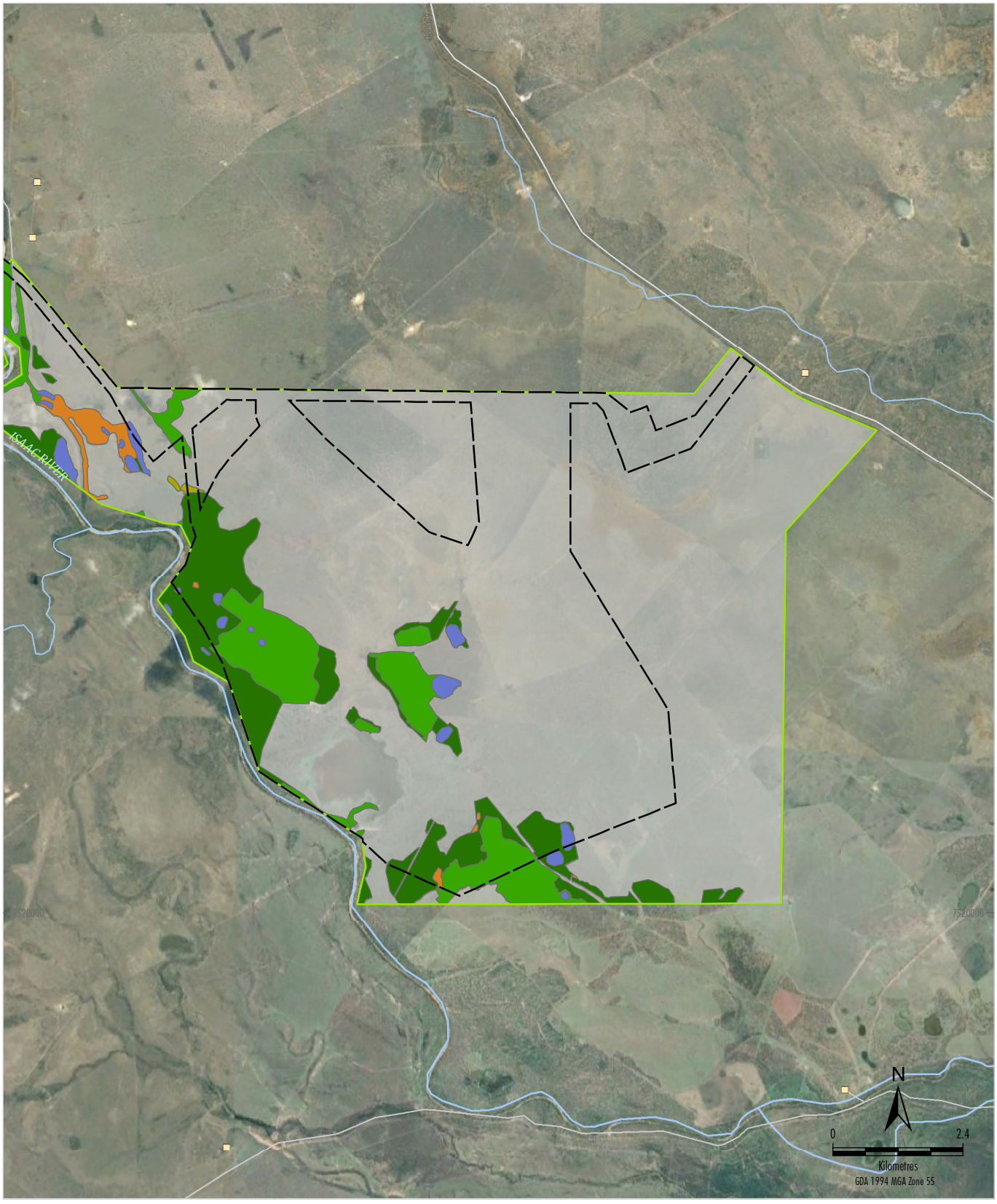
Source: DPM (2018), Pembroke (2018)
Orthophoto: Google Image (2015)

PEMBROKE

OLIVE DOWNS COKING COAL PROJECT

Broad Fanua Habitat Types

Inset 3-4d



PRN-16-02_EIS_Sect3_241A

LEGEND

- Approximate Extent of Proposed Surface Development
- Study Area
- Approved/Operating Coal Mine
- Peaks
- Dwelling
- Railway
- Eungella Pipeline Network

Ground-truthed Broad Vegitation Group

- Eucalypt dry woodlands on inland depositional plains
- Eucalypt open forests to woodlands on floodplains
- Acacia dominated open forests, woodlands and shrublands
- Palustrine wetlands
- Lacustrine wetlands
- Agricultural grasslands dominated by buffel grass

Source: DPM (2018), Pembroke (2018)
Orthophoto: Google Image (2015)

PEMBROKE

OLIVE DOWNS COKING COAL PROJECT

Broad Fanua Habitat Types

Inset 3-4e

Table 3-6
Survey Methods and Effort Employed for Potentially Occurring Threatened Fauna Species

Species Name	Common Name	Conservation Status[1]	Commonwealth Survey Guidelines	EPBC Act Referral Guidelines	Effort and Method Undertaken
Reptiles					
Denisonia maculata	Ornamental Snake	V	• Searches around gilgai habitat while frogs are active, driving roads at night, particularly after wet weather when frogs are active (DEWHA, 2011a) • diurnal searches under sheltering sites (rocks, logs), pitfall and funnel traps could also be trialled (DEWHA, 2011a) • No quantitative survey effort is specified in this guideline.	• One off diurnal searches of microhabitat for 1.5 person hours per ha over a minimum 3 days (SEWPaC, 2011). • Spotlighting (SEWPaC, 2011): • target water-inundated gilgais, wetlands, riparian habitats and surrounding environs and large logs; • warm humid evenings; and • 1.5 person hours per ha over a minimum 3 days. • Opportunistic surveys (SEWPaC, 2011): • whilst driving within the Study area; and • following heaving rainfall events and during warm evenings; • Pitfall and funnel trapping over four days (SEWPaC, 2011): • six 20 L buckets under a 30 m drift fence; • funnel at pitfall line ends; and • 2 replicates per habitat type.	• Surveys were undertaken in September. • 22.5 hours of active searching. • 208 pitfall trap nights and 306 funnel trap nights conducted - 4 buckets at 7.5 m intervals on T-design with a 45 m fence. Left open for four days and nights, checked each morning. • 145.5 hours of spotlighting, including targeted spotlighting in suitable habitat. The total survey effort satisfies the guideline requirements. The species was detected.

Table 3-6 (Continued)
Survey Methods and Effort Employed for Potentially Occurring Threatened Fauna Species

Species Name	Common Name	Conservation Status[1]	Commonwealth Survey Guidelines	EPBC Act Referral Guidelines	Effort and Method Undertaken
Egernia rugosa	Yakka Skink	V	• Searching for burrow systems and communal defecation sites • Species presence can be confirmed by Elliott trapping around the burrows, distant observation with binoculars or by shining a torch down the burrows at night (DEWHA, 2011a).	• Timed from late September to late March • Active searching microhabitats (one off searches). Survey over a minimum of 1.5 person • hours per hectare and survey over a minimum of 3 days (SEWPaC, 2011).Transects searching for colonies (SEWPaC, 2011) • Elliot and cage trapping around suspected burrows (SEWPaC, 2011) • Observation with binoculars (SEWPaC, 2011) • Spotlighting (SEWPaC, 2011)	• Diurnal surveys were undertaken, including active searching for burrows and communal defecation sites. • Camera trapping undertaken at 25 sites and left for four nights. Total of 100 trap nights. • 208 pitfall trap nights and 306 funnel trap nights conducted. • 145.5 hours of spotlighting, including targeted spotlighting in suitable habitat. The total survey effort satisfies the guideline requirements.
Lerista allanae	Allan's Lerista / Retro Slider	E	• Raking surface soil under logs or at the base of bushes and trees, and turning objects under which they shelter • This can be used with pitfall trapping at a time of year when the species is most likely to be active. • Six 10 L buckets spread along a 15 m fence would be adequate for the detecting the species (DEWHA, 2011a).	There are no referral guidelines for this species.	• 208 pitfall trap nights and 306 funnel trap nights conducted. • 2 x 30 person-minute searches within two different 50 x 50 m quadrants at each survey site. • 4 buckets at 7.5 m intervals on T-design with a 45 m fence. Left open for four days and nights, checked each morning. • 6 funnels, 3 m in on distal end of T-design with a 45 m fence. Left open for four days and nights, checked each morning. The total survey effort satisfies the guideline requirements.

Table 3-6 (Continued)
Survey Methods and Effort Employed for Potentially Occurring Threatened Fauna Species

Species Name	Common Name	Conservation Status[1]	Commonwealth Survey Guidelines	EPBC Act Referral Guidelines	Effort and Method Undertaken
Furina dunmalli	Dunmall's Snake	V	None known to reliably detect the species. Recommended methods are active searching of sheltering sites (rocks, logs or human made debris), pitfall trapping, or road driving at night (particularly after we weather).	• Timed from late September to late March • Active searching microhabitats (one off searches). Survey over a minimum of 1.5 person • hours per hectare and survey over a minimum of 3 days (DEWHA, 2011a).Transects searching for colonies (SEWPaC, 2011) • Elliot and cage trapping around suspected burrows (SEWPaC, 2011) • Observation with binoculars (SEWPaC, 2011) • Spotlighting (SEWPaC, 2011)	• 208 pitfall trap nights and 306 funnel trap nights conducted. • 2 x 30 person-minute searches within two different 50 x 50 m quadrants of each survey site. • 4 buckets at 7.5 m intervals on T-design with a 45 m fence. Left open for four days and nights, checked each morning. • 6 funnels, 3 m in on distal end of T-design with a 45 m fence. Left open for four days and nights, checked each morning. The total survey effort satisfies the guideline requirements.
Birds					
Erythrotriorchis radiatus	Red Goshawk	V	• Search for their characteristic nests within patches of the tallest forest • Area searches (50 hrs/5 days for 50 ha) (DEWHA, 2010a) • Driving slowly through woodland (DEWHA, 2010a)	There are no referral guidelines for this species.	• Surveys were undertaken throughout the year. • Diurnal bird surveys were undertaken (including targeted searches for nests). • 135.25 hours of bird surveys were conducted over 56 days. The guideline requirement has been fulfilled.
Geophaps scripta scripta	Squatter Pigeon (southern)	V	• Area searches or transect surveys – 15 hrs/3 days; and • Flushing surveys – 10 hrs/3 days. • These methods apply to areas less than 50 ha (DEWHA, 2010a).	There are no referral guidelines for this species.	• Bird surveys and flushing surveys were conducted throughout the year. • 135.25 hours of bird surveys were conducted over 56 days. • 66 hours of flushing surveys were conducted over 14 days (2 hours per day on average whist traversing the site). • This species was recorded during the surveys. • The total survey effort is 201.25 hours over 56 days. The guideline requirement has been fulfilled. The species was detected.

Table 3-6 (Continued)
Survey Methods and Effort Employed for Potentially Occurring Threatened Fauna Species

Species Name	Common Name	Conservation Status[1]	Commonwealth Survey Guidelines	EPBC Act Referral Guidelines	Effort and Method Undertaken
Rostratula australis	Australian Painted Snipe	E	• Targeted stationary observations at dawn and dusk of suitable foraging locations within wetlands (10 hrs/ 5 days). • Land-based area searches or transect surveys (10 hours/3 days) for sites <50 ha when wetland holds water but is not flooded (DEWHA 2010).	There are no referral guidelines for this species.	• Bird surveys and flushing surveys were conducted throughout the year. • 135.25 hours of bird surveys were conducted over 56 days. • 66 hours of flushing surveys were conducted over 14 days (2 hours per day on average whist traversing the site). • This species was recorded during the surveys. The total survey effort is 201.25 hours over 56 days. The guideline requirement has been fulfilled. The species was detected.
Calidris ferruginea	Curlew Sandpiper	CE	There are no survey guidelines available for this species.	There are no referral guidelines for this species.	• Surveys were undertaken throughout the year. • Diurnal bird surveys were undertaken (including targeted searches for nests). • 135.25 hours of bird surveys were conducted over 56 days. The guideline requirement has been fulfilled.
Grantiella picta	Painted Honeyeater	V	There are no survey guidelines available for this species.	There are no referral guidelines for this species.	• Surveys were undertaken throughout the year. • Diurnal bird surveys were undertaken (including targeted searches for nests). • 135.25 hours of bird surveys were conducted over 56 days. The guideline requirement has been fulfilled.

Table 3-6 (Continued)
Survey Methods and Effort Employed for Potentially Occurring Threatened Fauna Species

Species Name	Common Name	Conservation Status[1]	Commonwealth Survey Guidelines	EPBC Act Referral Guidelines	Effort and Method Undertaken
Neochmia ruficauda ruficauda	Star Finch (eastern subspecies)	E	• Area searches or transect-point surveys in suitable habitat (15 hours/5 days, areas less than 50 ha); • Playback surveys during the morning and evening (15 hours/ 3 days, areas less than 50 ha); and • Targeted searches for waterholes during the dry season (10 hours/ 4 days), may also be useful (DEWHA, 2010a).	There are no referral guidelines for this species.	• Surveys were undertaken throughout the year in suitable habitat. • Diurnal bird surveys were undertaken (including area searches). • 135.25 hours of bird surveys were conducted over 56 days. The guideline requirement has been fulfilled.
Poephila cincta cincta	Southern Black-throated Finch	E	• Land based area searches for areas less than 50 ha (10 hours/ 5 days) and targeted searches (6 hours/2 days) of suitable habitat, • Checking flocks of other finch species and suitable habitat • Waterholes should be targeted for searches (DEWHA, 2010a).	There are no referral guidelines for this species.	• Surveys were undertaken throughout the year. • Diurnal bird surveys were undertaken (including targeted searches for flocks and suitable habitat). • Waterholes were targeted when present. • 135.25 hours of bird surveys were conducted over 56 days.
Mammals					
Phascolarctos cinereus	Koala	V	Koala not included in 'Survey guidelines for Australia's threatened mammals 2011', as it was listed as Vulnerable in 2012.	These guidelines do not prescribe survey effort standards for Koala surveys, but suggest a range of direct and indirect methods to detect Koalas, including: • Strip transects; nocturnal spotlighting; call playback; remote sensor (IR) cameras; mark-resight / mark-recapture; detection dogs; radio or satellite collars; identification of scratching and scats. • Spot Assessment Technique (SAT)	• Scratch and scat searches undertaken across 168 sites in spring and autumn. • SAT searches at 31 sites. • 91.5 hours of spotlighting. • 14 x 1 km strip transects undertaken across the mine site and infrastructure corridors. The total survey effort satisfies the guideline requirements. The species was detected.

Table 3-6 (Continued)
Survey Methods and Effort Employed for Potentially Occurring Threatened Fauna Species

Species Name	Common Name	Conservation Status[1]	Commonwealth Survey Guidelines	EPBC Act Referral Guidelines	Effort and Method Undertaken
Petauroides volans	Greater Glider	V	Greater glider not included in 'Survey guidelines for Australia's threatened mammals 2011' (DEWHA, 2011b), as it was listed as Vulnerable in 2016.	There are no referral guidelines for this species.	• 112.5 hours of spotlighting. • Scratch and scat searches undertaken across 168 sites in spring and autumn. The total survey effort satisfies the guideline requirements. The species was detected.
Dasyurus hallucatus	Northern Quoll	E	In areas up to 5 ha in size: • cage trapping and Elliot trapping surveys are recommended • The minimum effort required for these methods is 80-160 trapping nights, • Trapping to be distributed across distinct representative sampling sites (DEWHA, 2011b)	• Targeted surveying in suitable habitat • remote camera surveying • Targeted surveying using cages should be between April and September to avoid disturbing females with young	• Elliot trapping surveys were conducted at all 13 sites in the appropriate season. 20-25 baited traps at 5-10 m intervals along on a 100 m transect. Left open for four days and nights, checked each morning (1300 trap nights). • Camera trapping undertaken at 25 sites and left for four nights. Total of 100 trap nights. • All suitable habitat types across the project area were sampled. The total survey effort satisfies the guideline requirements.
Pteropus poliocephalus	Grey-headed Flying-fox	V	• Search appropriate databases and information sources for the locations of camps, and to conduct vegetation surveys to identify feeding habitat. • When conducting field surveys, the presence of a smell, scat and bat calls can be used to identify their presence (DEWHA, 2010b)	There are no referral guidelines for this species,	• 112.5 hours of spotlighting. • Searches for flying-fox camps undertaken whilst undertaking field surveys. The total survey effort satisfies the guideline requirements.

Table 3-6 (Continued)
Survey Methods and Effort Employed for Potentially Occurring Threatened Fauna Species

Species Name	Common Name	Conservation Status[1]	Commonwealth Survey Guidelines	EPBC Act Referral Guidelines	Effort and Method Undertaken
Macroderma gigas	Ghost Bat	V	No specific survey guidelines are published for the Ghost bat, however recommended survey techniques for microbats include mistnets, harp traps, and monitoring of roosting locations (DEWHA, 2010b).	There are no referral guidelines for this species.	• One bat detector for at least one night per dedicated survey site, as well as in other areas of interest (e.g. water bodies) (at least 32 nights). • Searches for roosts undertaken whilst undertaking field surveys. • Two harp traps were deployed at four locations for two nights (16 traps nights) within the Study area in locations where suitable flyways were detected. The total survey effort satisfies the guideline requirements.
Nyctophilus corbeni	Corben's Long-eared Bat	V	• Harp traps and mist nets are effective for this species • Traps and nets should be distributed to give a good representation of the major habitat types in the project area • The minimum effort required for harp traps and mist nets respectively are 5 nights/ 20 traps; and 5 nights/ 20 mist nets (DEWHA, 2010b).	There are no referral guidelines for this species	• Bat detectors were used at least one night per survey site and at other potential bat habitat areas (at least 32 nights). • Bat roosts were searched for whilst undertaking field surveys. • Two harp traps were deployed at four locations for two nights (16 traps nights) within the Study area in locations where suitable flyways were detected The total survey effort satisfies the guideline requirements.

Source: (DPM Envirosciences, 2018b).

[1] Threatened Species Status under the EPBC Act (current as of May 2018).
V = Vulnerable.
E = Endangered.
CE = Critically Endangered.

3.2.7.4 Targeted Searches for Migratory Fauna Species

The following species listed as 'Migratory' under the EPBC Act were identified within the Terms of Reference or within a search area covering the wider locality:

- Glossy Ibis (*Plegadis falcinellus*);
- Caspian Tern (*Hydroprogne caspia*);
- Fork-tailed Swift (*Apus pacificus*);
- Oriental Cuckoo (*Cuculus optatus*);
- White-throated Needletail (*Hirundapus caudacutus*);
- Black-faced Monarch (*Monarcha melanopsis*);
- Yellow Wagtail (*Motacilla flava*);
- Satin Flycatcher (*Myiagra cyanoleuca*);
- Curlew Sandpiper (*Calidris ferruginea*);
- Latham's Snipe (*Gallinago hardwickii*);
- Osprey (*Pandion haliaetus*); and
- Common Greenshank (*Tringa nebularia*).

The above species were targeted by DPM Envirosciences (2018b) during diurnal bird surveys. This included:

- Seasonal surveys undertaken in April, May, September and November.
- 135.25 hours of bird surveys were conducted over 56 days.
- 66 hours of flushing surveys were conducted over 14 days (2 hours per day on average whist traversing the site).

The *EPBC Act Policy Statement 3.21 Industry Guidelines for Avoiding, Assessing and Mitigating Impacts on EPBC Act listed Migratory Shorebird Species* (DEE, 2017) outlines potential survey methodology for migratory birds, however these guidelines focus heavily on survey requirements within coastal and tidal areas. As the Project is not located within a coastal or tidal area, it was determined that the surveys methodology within these guidelines was not of relevance to the Project and it was determined that the diurnal bird surveys undertaken by DPM Envirosciences (2018b) were sufficient to detect these species.

3.2.8 Aquatic Ecology Surveys

Early wet season surveys were undertaken across the Study area by DPM Envirosciences over the period 12-19 December 2016 and again during 2-9 October 2017 and 14-20 November 2017, aligning with the *Queensland Australian River Assessment System (AusRivAS) Sampling and Processing Manual* (DNRM, 2001) 'early wet' sampling season (October to December). Follow-up surveys were undertaken in 22-28 June and 4-11 July 2017 in line with the AusRivAS 'late wet' sampling season (May to July) (DPM Envirosciences, 2018c).

A stygofauna assessment was also undertaken as comprised a desktop review of potential habitat and sampling (conducted in accordance with the *Guideline for the Environmental Assessment of Subterranean Aquatic Fauna* [DSITIA, 2014]).

3.2.8.1 Targeted Threatened Aquatic Fauna Surveys

Threatened fauna species listed under the EPBC Act considered likely to occur based on desktop assessment were targeted during the aquatic ecology surveys. These included targeted surveys for the following species (DPM Envirosciences, 2018c):

- Southern Snapping Turtle (*Elseya albagula*) – listed as Critically Endangered under the EPBC Act; and
- Fitzroy River Turtle (*Rheodytes leukops*) – listed as Vulnerable under the EPBC Act.

The *Survey Guidelines for Australia's Threatened Reptiles* (DSEWPC 2011) suggests that the the Fitzroy River turtle (*Rheodytes leukops*) can be readily observed in riffle zones by diving with a face mask and snorkel, or collected by seine netting, and also that the partly carnivorous diet of this species indicates it might be attracted to meat baits in traps. Survey guidelines for the southern snapping turtle (Elseya albagula) are not identified in DSEWPC (2011) due to the subsequent listing of this species as Critically Endangered (from common / Least Concern) in November 2014. However, this species has been successfully captured using baited cathedral traps on other projects in the Fitzroy River Basin (including for the proposed Arrow Bowen Pipeline) (DPM Envirosciences, 2018c).

The *Terrestrial Vertebrate Fauna Survey Guidelines for Queensland* (DSITIA 2014) suggest that freshwater turtle surveys should employ one or more of the following capture techniques:

- visual survey;
- snorkelling;
- spotlighting;
- trapping; and
- seine netting.

Freshwater turtles were surveyed at most wetted sites by overnight deployment of baited fyke nets and baited cathedral traps, as well as observations of the bank and water surface for sunning and breaching turtles (DPM Enviros ciences, 2018c).

Water clarity was too poor to enable snorkelling surveys at any sites. Further to this, in October and November 2017 many sites were dry and were unable to be surveyed
(DPM Enviros ciences, 2018c).

3.3 OLIVE DOWNS PROJECT MINE SITE AND ACCESS ROAD (EPBC 2017/7867)

3.3.1 Location of the Action

The Mine Site and Access Road is located approximately 170 km south-west of Mackay, in the Bowen Basin region of central Qld (Figure 2-1). The Mine Site and Access Road is located approximately 40 km south-east of Moranbah and 40 km north of Dysart within the Isaac Regional Council Local Government Area (LGA) in a mining precinct comprising several existing mining operations.

The general landscape of the Mine Site and Access Road constitutes gently undulating, to flat plains, with elevations of approximately 200 metres (m) Australian Height Datum (AHD). The overall elevation of the Mine Site and Access Road area ranges from 150 m in the low-lying southeast, to 250 m in the higher areas to the north of the Mine Site and Access Road area.

3.3.2 Description of the Action

A description of the works to be undertaken during the construction, operations and decommissioning phases of the Mine Site and Access Road is provided below. The total disturbance footprint of the Mine Site and Access Road is approximately 16,114 ha (Figure 2-2).

3.3.2.1 Construction

The construction program for the Mine Site and Access Road has many stages and individual construction work packages to be delivered over an extended period of time of approximately 13 years, to enable the production rate to reach 20 Mtpa.

The first phase of construction activities, including early works, are anticipated to commence approximately 18 months to two years in advance of the planned operations (i.e. Stage 1). The works would commence as soon as the relevant planning approvals, EA and mining lease tenements (where required) are granted.

A second phase of construction activities would occur after approximately 10 years to allow the full development rate at the Olive Downs South domain to be achieved (i.e. Stage 2). This would involve expansion of the CHPP, workshops and the ILF cells.

A third phase of construction activities (Stage 3) would be conducted at the Willunga domain following the establishment of operations at the full development rate at the Olive Downs South domain and approximately 12 months in advance of the planned commencement of operations at the Willunga domain.

At the completion of the Stage 3 construction program, the Mine Site and Access Road infrastructure would be capable of delivery of up to 20 Mtpa.

Proposed infrastructure, construction and other development activities, including early works, for the Mine Site and Access Road would be focused initially at establishing operations at the Olive Downs South domain within MLA 700032 and specifically include:

- the access road from Annandale Road to the mine infrastructure area and facilities (including a crossing of the Isaac River) and associated car parking and site security;
- the mine infrastructure area;
- explosives magazine;
- temporary flood protection levees;
- CHPP and associated coal handling infrastructure;
- a dry weather road crossing of the Isaac River to provide access to the eastern out-of-pit waste emplacement area;

- initial rejects storage facilities and ILF cells for storage and disposal of CHPP rejects; and
- rail-loadout facility including product coal stockpile areas.

Water management infrastructure, including up-catchment diversions, sediment dams and water storage dams, would be progressively constructed.

In addition, other key supporting infrastructure elements would be developed including:

- a raw water supply pipeline from the existing Eungella pipeline network (Section 3.4);
- widening and upgrading of the road pavement along Daunia Road and Annandale Road;
- a rail spur and rail loop from the Norwich Park Branch Railway to the rail-loadout facility (Section 3.6); and
- a 66 kV ETL and switching/substation from the existing regional power network for electricity supply (Section 3.5).

Proposed infrastructure, construction and other development activities to establish operations at the Willunga domain would include:

- the access road from the Fitzroy Developmental Road to the Willunga domain mine infrastructure area and facilities and associated car parking and site security;
- the mine infrastructure area;
- overland conveyor to transfer crushed ROM coal to the Olive Downs South domain CHPP;
- explosives magazine;
- temporary flood protection levees;
- installation of on-site ROM coal handling and crushing facilities;
- expansion of the Olive Downs South domain coal processing facilities to process the Willunga domain ROM coal; and
- crossings of the Isaac River between the Olive Downs South and Willunga domains for direct vehicular access and ancillary infrastructure (i.e. water pipeline, electricity supply, fibre-optic communications, overland conveyor).

Similarly, water management infrastructure at the Willunga domain, including up-catchment diversions, sediment dams and water storage dams would be progressively constructed.

3.3.2.2 Operation

The Mine Site and Access Road would comprise seven mining operations stages:

Stage 1: Initial establishment of operations to 6 Mtpa ROM coal production at the Olive Downs South domain within Pits ODS1, ODS2 and ODS3. The two out-of-pit waste rock emplacements in the north of the Olive Downs South domain would be constructed and rehabilitated, and backfilling of Pits ODS1, ODS2 and ODS3 would have commenced. The northern section of the permanent highwall emplacement would have been constructed to isolate the open cuts from the Isaac River.

Stage 2: 6 to 12 Mtpa (peak) ROM coal production at the Olive Downs South domain, as well as establishment of operations at the Willunga domain up to 8 Mtpa (peak) ROM coal production. All pits in the Olive Downs South domain (except Pits ODS7 and ODS8) would be operating. The Ripstone Creek diversion would be constructed, prior to development of the Ripstone Pit. The remaining southern section of the permanent highwall emplacement would have been constructed, isolating the open cuts from the Isaac River floodplain.

Stage 3: Continued peak total ROM coal production up to approximately 20 Mtpa (total) from the Olive Downs South and Willunga domains, before production reduces towards 10 Mtpa. The final voids in Pits ODS1 and ODS2 would be backfilled in this stage, and the western faces of the out-of-pit waste rock emplacements would be rehabilitated.

Stage 4: Steady ROM coal production at approximately 8 to 9 Mtpa from the Olive Downs South and Willunga domains. Mining within Pits ODS1, ODS2, ODS3, ODS4 and ODS9 within the Olive Downs South domain has completed.

Stage 5: Continued steady ROM coal production at approximately 5 to 7 Mtpa from the Olive Downs South and Willunga domains, before reducing production to approximately 2 Mtpa as mining within the Olive Downs South domain Pits ODS5 and ODS6 completes.

Stage 6: Steady ROM coal production of approximately 2 to 3 Mtpa from the Olive Downs South domain Pits ODS7 and ODS8 (operating during daytime hours) and Willunga domain Pits WIL4 and WIL5. Olive Downs South domain pits ODS5 and ODS6 and Willunga domain Pits WIL1, WIL2 and WIL3 have been backfilled.

Stage 7: Mining within the Willunga domain has completed, and ROM coal production at the Olive Downs South domain steadily declines as mining in Pits ODS7 and ODS8 is completed.

An indicative mine schedule for the Project based on the staged progression is provided in Table 3-7.

Further detail regarding construction and operation of the Mine Site and Access Road is provided in Section 2 of the EIS.

3.3.2.3 Decommissioning and Rehabilitation

All infrastructure associated with the Mine Site and Access Road would be assessed on an individual basis for possible removal or to be retained for future land owners. Where infrastructure is removed, the land would be re-contoured, topsoiled, ripped and seeded. All disturbed areas would be rehabilitated with an appropriate seed mix to enable revegetation.

Potentially contaminated areas will undergo Stage 1 and Stage 2 contaminated land assessments and a Remediation Plan will be developed. Remediation works would be undertaken to remove contaminated material, or rip, cap and topsoil inert areas. Areas would then be seeded with native grasses.

Decommissioning of the Mine Site and Access Road would be conducted progressively towards the end of the mine life, as infrastructure and operational areas are no longer required.

As shown in Section 2.5.1, the ROM coal production rate tapers off over the last 20 years of the Mine Site and Access Road. During this period, decommissioning of infrastructure would commence as less demand is placed on the coal handling and processing equipment, and infrastructure areas in general. This period of the mine life would provide a good opportunity for decommissioning of large parts of the Mine Site and Access Road, when product coal would still be produced, supporting decommissioning exercises which would otherwise be left to after the completion of mining activities.

It is anticipated that all Mine Site and Access Road infrastructure would be decommissioned within two years of the completion of mining operations.

A Rehabilitation and Mine Closure Plan would be prepared for the Project and would include detailed rehabilitation goals, objectives, indicators and completion criteria (Section 5.6).

A rehabilitation monitoring program would be submitted with the Plan of Operations (and updated in subsequent Plan of Operations). The Rehabilitation and Mine Closure Plan would be designed to measure the rehabilitation progress on an annual basis.

The rehabilitation monitoring program would specify the sampling intensity and monitoring (including revegetation) requirements to provide sufficient spatial and temporal replication to enable statistically valid conclusions to be made.

Table 3-7
Indicative Mine Schedule

Project Stage	Project Years*	Waste Rock (Mbcm)	ROM Coal Mined (Mtpa)	CHPP Rejects (Mtpa)		Product Coal (Mtpa)
				Coarse Rejects	Fine Rejects	
Stage 1	2020 – 2030	12.2 – 116.3	1.0 – 6.0	0.2 – 1.3	< 0.1 – 0.4	0.8 – 4.5
Stage 2	2031 – 2040	189.0 – 297.2	11.0 – 20.0	2.5 – 4.2	0.7 – 1.3	7.8 – 15.0
Stage 3	2041 – 2050	199.3 – 298.3	13.7 – 20.0	2.7 – 3.9	0.8 – 1.2	10.2 – 15.0
Stage 4	2051 – 2060	123.0 – 148.6	6.4 – 10.8	1.1 – 1.9	0.3 – 0.6	4.9 – 8.4
Stage 5	2061 – 2072	48.9 – 115.2	0.8 – 6.9	0.1 – 1.3	< 0.1 – 0.4	0.7 – 5.3
Stage 6	2073 – 2085	47.5 – 49.3	1.6 – 3.3	0.3 – 0.6	< 0.1 – 0.2	1.2 – 2.6
Stage 7	2086 – 2098	6.3 – 19.4	0.4 – 1.8	< 0.1 – 0.3	< 0.1 – 0.1	0.3 – 1.4
Totals (Stages 1 – 7)			**612 Mt**	**120 Mt**	**36 Mt**	**459 Mt**

Assumed Project commencement date is 1 January 2019 and allowing an initial 18 months to two years initial construction phase.
Mbcm = million bank cubic metres.
Note: totals may have minor discrepancies due to rounding.

3.3.3 Current Status of the Action

The Mine Site and Access Road was referred to the DEE under the EPBC Act on 24 January 2017. On 3 March 2017 the Mine Site and Access Road was determined to be a "Controlled Action". DEE advised that the bilateral assessment under section 45 of the EPBC Act applies to the Mine Site and Access Road.

In December 2017, Pembroke lodged an application to vary the Mine Site and Access Road to incorporate the latest Project layout designs which was accepted by the DEE on 17 April 2018.

Works associated with the Mine Site and Access Road has not commenced.

3.3.4 Consequence of Not Proceeding

Were the Mine Site and Access Road not to proceed, the following consequences are inferred:

- up to 700 construction and up to 1,300 operational jobs and associated flow-on effects would not be created;
- approximately 612 Mt of ROM coal would not be mined;
- a net benefit of approximately $2B would be foregone (Gillespie Economics, 2018);
- company tax revenue of approximately $211M from the Project would not be generated (Gillespie Economics, 2018);
- royalties to the State of Queensland of approximately $1.1B would not be generated (Gillespie Economics, 2018);
- the potential environmental and social impacts described in this EIS would not occur;
- economic and social benefits to the Isaac Regional LGA associate with the Project would not be realized; and
- the Project biodiversity offsets would not be established.

3.3.5 Alternatives Considered

Mining Method

Coal reserves are typically mined in one of two ways:

- underground methods, whereby the coal seams are accessed by a surface opening to underground mining areas where coal is extracted; or
- open cut methods, whereby mining is conducted from the surface downwards to progressively expose the coal.

The use of underground mining methods is generally employed where thick, contiguous seams are present. Underground methods are not an efficient or safe mining method where multiple, thin seams are present, particularly if the structural geology is complex with the presence of faults and other structures, as is the case with the Project coal resource.

As such, the Mine Site and Access Road would use open cut mining methods to access the coal reserves.

Open Cut Extent

Geological data indicates that the coal resource targeted by the Project extends to the north from Pit 1 under the Isaac River. Pembroke defined the northern extent of the open cut to minimise encroachment on the Isaac River floodplain by standing off the river bank by 200 m to 300 m.

Similarly, in response to preliminary flood modelling results, the eastern extent of Pit 8 was pulled back by approximately 300 m to minimise changes to flood characteristics in the Isaac River and its flood plain.

These changes have resulted in less coal resource able to be extracted by the Project but would result in improved environmental outcomes by minimising changes to flood characteristics.

Waste Rock Emplacement Design

The Geochemical Assessment found that some of the waste rock material to be excavated at the Project may be sodic with the potential for dispersion and erosion (Terrenus Earth Science, 2018).

In consideration of the findings from the Geochemical Assessment, and general observations of landform stability at other Bowen Basin mining operations, the out-of-pit waste rock emplacements have been designed with low slope angles of approximately 7 degrees (or 1(V):8(H), or 15%) to improve landform stability and improve rehabilitation outcomes.

Such low slopes on the waste rock emplacements create a constraint to the volume of material that can be emplaced - a landform with steeper slopes can accommodate more material than one with the same footprint and shallow slopes.

This design constraint, along with constraints in the mining tenement boundaries, requires the development of two out-of-pit waste rock emplacements during the initial years of operation (while the box cut is being developed), one to the west of Pit ODS1, and one to the east, on the eastern side of the Isaac River.

This development of two waste rock emplacements increases the footprint of the Mine Site and Access Road, and in the case of the eastern emplacement, requires the construction and use of a crossing of the Isaac River. However, these impacts are considered to be offset by the improved rehabilitation outcomes and landform stability that would be obtained by developing the landforms with shallow slopes.

Mining Sequence and Final Voids

Pembroke has scheduled the Project to improve environmental outcomes by:

- Completely mining Pits ODS1 and ODS2 early in the mine life, such that they can be completely backfilled to prevent final voids being created in close proximity to the Isaac River.
- Hauling waste rock from Pit ODS6 to completely backfill Pit ODS9, to prevent a final void being created in close proximity to Ripstone Creek.
- Operating Pits ODS7 and ODS8 during daytime hours only to minimise noise and air quality impacts at the nearby privately-owned dwellings.

Final voids are normally left at the conclusion of open cut mining with the size of these voids dictated by the depth of the open cut, final slope design criteria, the extent of waste emplacement within the voids and the mining sequence.

Traditionally, Bowen Basin mining operations generally open up a number of individual open cut pits at any one time and progressively mine the pits over the life of the mine, such that large final voids remain at the completion of mining.

The Project's mine schedule has been optimised to minimise the number and extent of final voids, and in particular, avoid the creation of final voids in close proximity to the Isaac River and Ripstone Creek.

At the cessation of mining, final voids would remain within Pit ODS3, Pits ODS7/ODS8 and WIL5.

The volume of the final voids (to the existing ground level) is estimated to be approximately 1,750 Mbcm.

These final voids have been minimised within the constraints of the mining sequence. The catchment areas of the final voids would be minimised through the construction of upslope drains/bunds to direct runoff around the voids to the surrounding landscape.

Pembroke has analysed the feasibility of backfilling the final voids to ground level. The analysis identified that the cost associated with rehandling waste rock from the out-of-pit emplacements to fill the final voids would be in the order of $5 billion (assuming a rehandling cost of $3 per bcm). This cost would render the Project unfeasible.

Pembroke also considered the cost associated with partial backfill of the final voids, such that saline water bodies would not accumulate over time. To achieve this, the voids would need to be backfilled to a level at least equal to the surrounding water table. As the water table level is in the vicinity of 10 m to 17 m below ground level in the vicinity of the final voids (Appendix D), the vast majority of the voids would need to be backfilled to prevent the formation of saline water bodies. Accordingly, the cost for such an exercise would be several billion dollars, again, rendering the Project unfeasible.

Although the Project schedule was developed to minimise the number of final voids, Pembroke acknowledges that the final voids in Pits ODS3 and ODS7/ODS8 are located within the extent of the existing Isaac River floodplain. In consideration of this, Pembroke reviewed the mine plan to determine whether a feasible alternative could be scheduled to keep the final voids beyond the extent of the existing floodplain.

The nature of dipping coal seams dictates that an open cut pit targets the shallowest coal first, and then move to the deeper coal. The coal seams in the Olive Downs South domain generally dip from west to east (i.e. towards the Isaac River). Scheduling the mine plan to develop final voids in the shallower areas was determined to be unfeasible, as it would prevent the mine from operating at the optimum production rate (given the higher strip ratios that would be encountered sooner in the mine life) and would result in significantly greater disturbance areas and material handling costs due to the additional waste rock that would need to be moved to out-of-pit emplacement areas (rather than placed in-pit).

The only other alternative to avoid the development of the final voids on the floodplain would be to forgo mining the coal resources where the voids would be located on the floodplain and could not be feasibly backfilled.

Pembroke analysed the impact this would have to the mine plan and found that avoiding the development of final voids on floodplains would result in the sterilisation of approximately 55 Mt of ROM coal and foregone royalties of approximately $590M. It would also decrease the life of the Olive Downs South domain by approximately 30 years.

Given the proposed design solutions to isolate the final voids from the surrounding floodplain, the significant impact to royalty streams and Project life are not warranted.

3.3.6 Relationship to Other Actions

Three linear infrastructure corridors would be required to connect the Project to the existing regional infrastructure network, including a 15 km rail spur connecting to the Norwich Park Branch Railway, water pipeline connecting to the Eungella pipeline network and an ETL connecting to the Broadlea Substation.

As detailed in Section 3.1, the Mine Site and Access Road, Project ETL, Rail Spur and Loop and Water Pipeline were referred separately to the DEE. Pembroke is the proponent for all four actions.

Given the EPBC Act does not allow individual elements of a single referred action (e.g. Rail Spur and loop, Water Pipeline and/or Project ETL) to be transferred between proponents, Pembroke has decided to lodge four separate referrals covering separate aspects of the Project. This facilitates the transfer of approvals between proponents for the individual elements of the Project.

3.3.7 Impacts on listed Threatened Species and Ecological Communities

3.3.7.1 Threatened Species

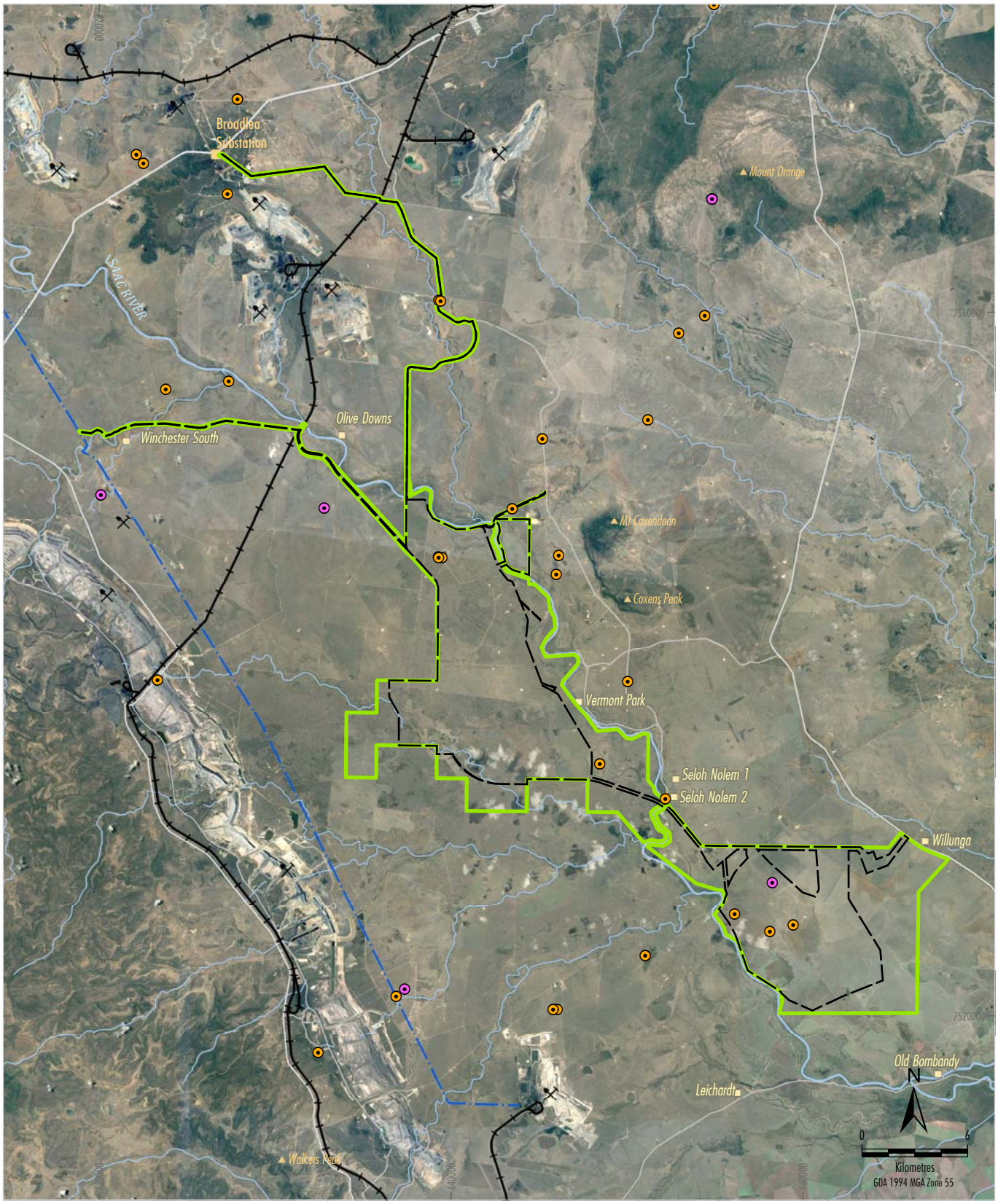
The following threatened fauna species listed under the EPBC Act were recorded from the Mine Site and Access Road area and surrounds during the field surveys (Figures 3-5a to 3-5c)
(DPM Envirosciences, 2018b):

- Ornamental Snake;
- Australian Painted Snipe;
- Squatter Pigeon (southern);
- Koala; and
- Greater Glider.

Further to this, potential impacts to an additional 19 fauna listed in the Terms of Reference, or identified within a search area covering the wider locality, were assessed by DPM Envirosciences (2018b) These include:

- Red Goshawk (*Erythrotriorchis radiatus*);
- Curlew Sandpiper (*Calidris ferruginea*);
- Painted Honeyeater (*Grantiella picta*);
- Star Finch (eastern) (*Neochmia ruficauda ruficauda*);
- Black-throated Finch (southern) (*Poephila cincta cincta*);
- Northern Quoll (*Dasyurus hallucatus*);
- Grey-headed Flying-fox (*Pteropus poliocephalus*);
- Ghost Bat (*Macroderma gigas*);
- Corben's Long-eared Bat (*Nyctophilus corbeni);*
- Southern Snapping Turtle (*Elseya albagula*);
- Fitzroy River Turtle (*Rheodytes leukops*);
- Yakka Skink (*Egernia rugosa*);
- Allan's Lerista (*Lerista allanae*);
- Dunmall's Snake (*Furina dunmalli*);
- *Cycas ophiolitica;*
- King Blue-grass *(Dichanthium queenslandicum);*
- Bluegrass (*Dichanthium setosum*);
- Black Ironbox (*Eucalyptus raveretiana*); *and*
- Quassia (*Samadera bidwillii*).

These species are discussed in detail below.



LEGEND

- Study Area
- Approximate Extent of Proposed Surface Development
- Approved/Operating Coal Mine
- Eungella Pipeline Network
- Railway
- Peaks
- Dwelling

Threatened Species Records (Common Name)

- Australian Painted Snipe
- Squatter Pigeon

Source: DPM (2018), Pembroke (2018)
Orthophoto: Google Image (2015)

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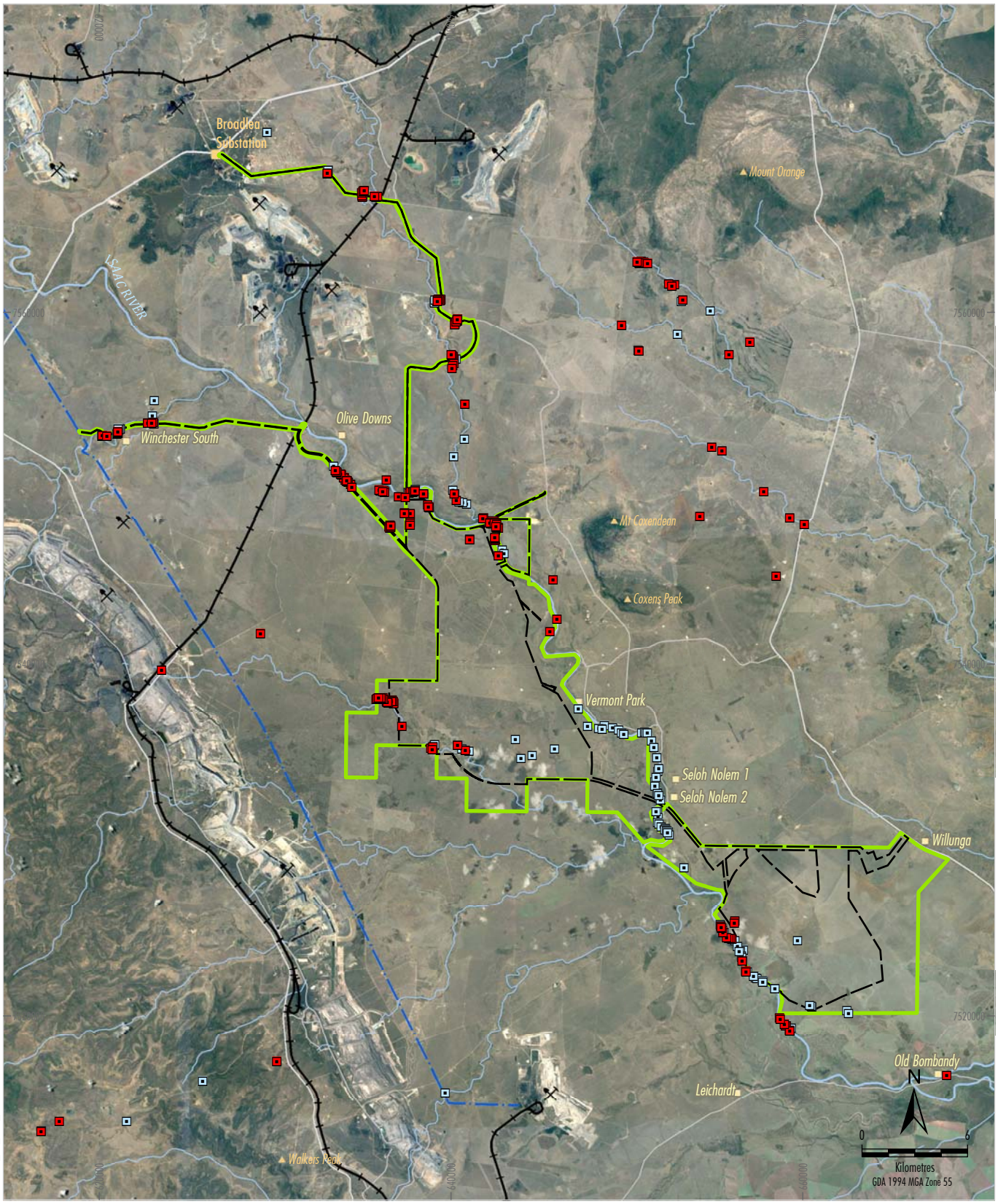
Threatened Species Records
Birds

Figure 3-5a



LEGEND

- Study Area
- Approximate Extent of Proposed Surface Development
- Approved/Operating Coal Mine
- Eungella Pipeline Network
- Railway
- Peaks
- Dwelling

Threatened Species Records (Common Name)

- Koala
- Greater Glider

Source: DPM (2018), Pembroke (2018)
Orthophoto: Google Image (2015)

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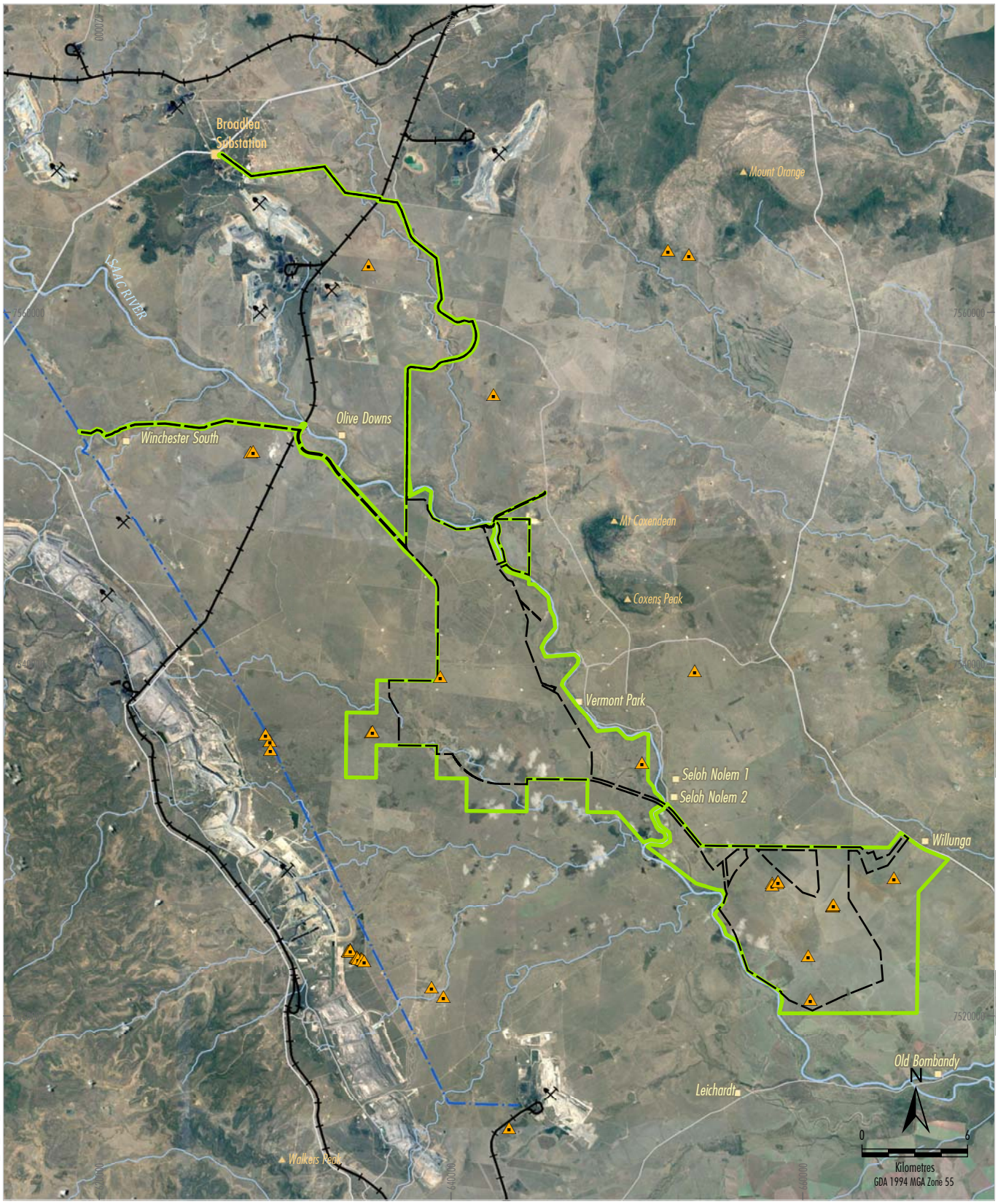
Threatened Species Records
Mammals

Figure 3-5b



LEGEND

- Study Area
- Approximate Extent of Proposed Surface Development
- Approved/Operating Coal Mine
- Eungella Pipeline Network
- Railway
- Peaks
- Dwelling

Threatened Species Records (Common Name)

- Ornamental Snake

Source: DPM (2018), Pembroke (2018)
Orthophoto: Google Image (2015)

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Threatened Species Records
Reptiles

Figure 3-5c

Ornamental Snake (Denisonia maculata)

The Ornamental Snake (*Denisonia maculata*) is listed as 'Vulnerable' under the EPBC Act.

Background/Description

The Ornamental Snake occurs in scattered locations over a large area in Brigalow Belt North and South Bioregions and small portions of the Desert Uplands Bioregion and Central Coast Bioregion in Qld (DEE, 2018a).

Within its distribution, the Ornamental Snake inhabits moist or seasonally moist areas within appropriate refuge habitat and aquatic or fringing vegetation with frog species forming their main prey (Cogger, 2014). The Ornamental Snake is most likely to occur in Qld regional ecosystem Land Zone 4 (DEE, 2018a) and most likely in Brigalow-dominated ecosystems supporting gilgai.

Survey Effort

The survey effort for this species is provided in Table 3-6 and Appendix B.

Habitat Assessment and Definition

The Ornamental Snake prefers habitat that is close to its prey (frogs). It prefers moist woodlands and open forests, particularly gilgai mounds as well as lake margins and wetlands (DEE, 2018). It is found in low-lying subtropical areas with deep-cracking clay soils and persists in cleared, disturbed habitat, particularly where brigalow communities have been cleared (DSEWPaC, 2011).

Four Ornamental Snake were recorded at three locations within the Olive Downs South Domain and a further five locations within the Willunga Domain (Figure 3-5c). The species was identified via a combination nocturnal spotlighting (DPM Enviros ciences, 2018b). These records occurred within agricultural grasslands on cracking clays, around palustrine wetlands, within Acacia dominated open forests, woodland and shrublands, and also one record within Eucalypt dry woodlands on inland depositional plains (expected to be a transient individual) (DPM Enviros ciences, 2018b). Database records for this species are relatively common in the wider locality, with more than 14 records within 15 km of the Mine Site and Access Road.

Ground-truthed soils mapping produced for the *Olive Downs Coking Coal Project Soil and Land Suitability Assessment* by GT Environmental (2018) across the Study area identified areas of gilgai relief, which are the most accurate reflection of potential habitat for this species. GT Environmental (2018) has mapped the following two soil types within the Mine Site and Access Road that would provide suitable habitat for the Ornamental Snake:

- brown light clays with gilgai; and
- grey to brown light to medium clay with gilgai.

Brigalow TEC has been identified as potential habitat for the Ornamental Snake. Mapping in the Mine Site and Access Road area identified two patches as being Brigalow TEC, comprised of RE 11.4.9. In accordance with the *Draft Referral Guidelines for the Nationally Listed Brigalow Belt Reptiles* RE 11.4.9 comprises habitat suitable for the Ornamental Snake.

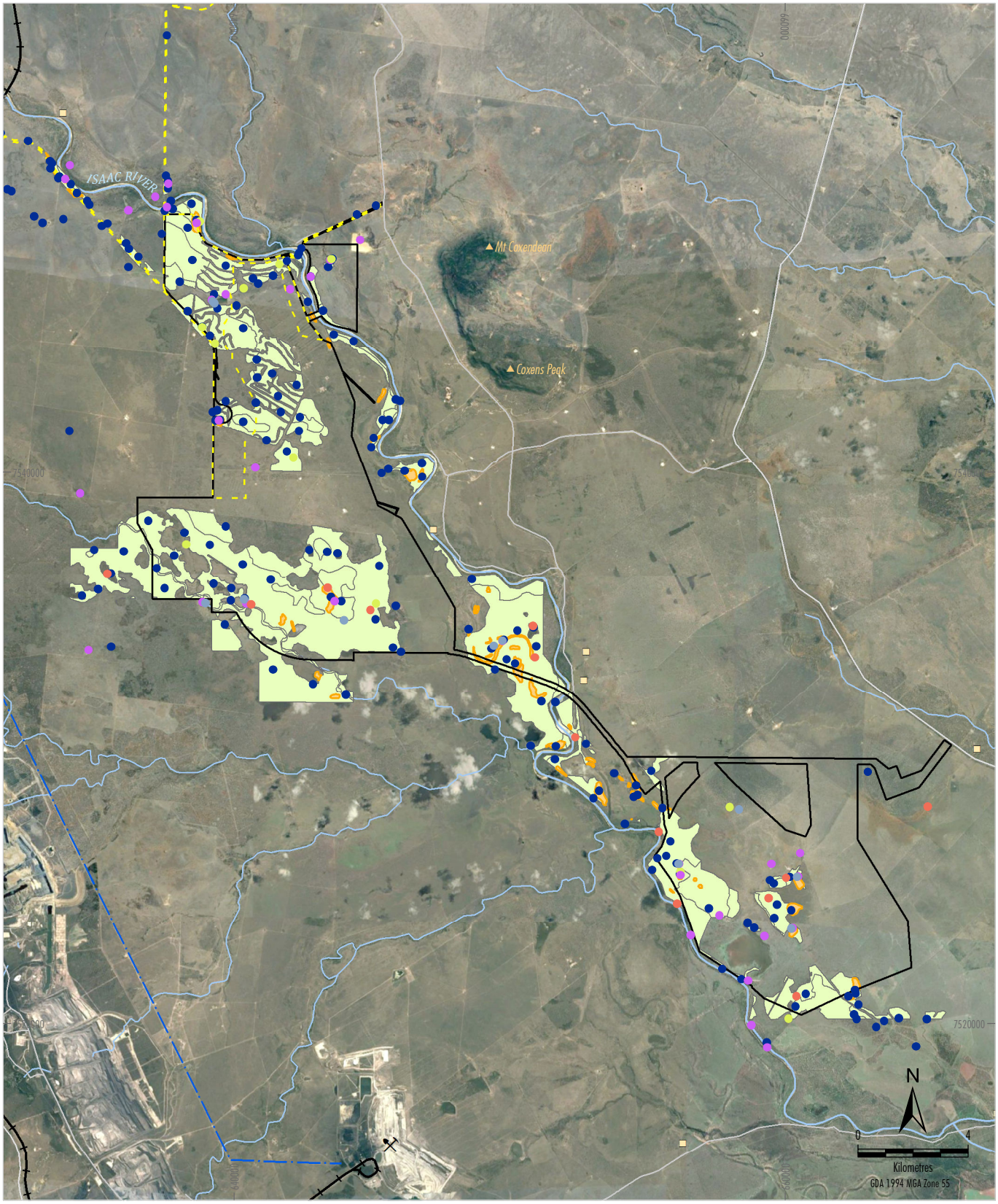
Other patches of Brigalow regrowth have been mapped as potential habitat where suitable habitat features are present (i.e. gilgais, wetlands and suitable prey habitat).

Based on observations of Ornamental Snake across the Study area, areas of potential habitat occur in a significant portion of agricultural grasslands (where there was once brigalow), and small patches of palustrine wetlands (swamps) and Acacia dominated open forests, woodlands and shrublands where these soil types are also present (Figure 3-6b) (DPM Enviros ciences, 2018b).

The areas identified as potential habitat for the Ornamental Snake also contain woody debris (which would provide sheltering habitat for the Ornamental Snake when cracks are not available), are low lying, and during the wet season they would hold water long enough for frogs to inhabit them, providing a food source for the Ornamental Snake.

As the majority of the potential habitat for this species is mapped within the agricultural grasslands, there are a number of existing threats to the Ornamental Snake. These include heavy weed infestation, presence of introduced fauna species (including cane toads), agricultural grazing and habitat fragmentation (DPM Enviros ciences, 2018b).

The other habitat types within the Mine Site and Access Road (including the remaining non-remnant vegetation) are not considered to provide potential habitat for the Ornamental Snake on the basis that they are lacking the cracking clay soils, gilgai habitat and microhabitat features required by this species (DPM Enviros ciences, 2018b).



LEGEND

- Olive Downs Project Mine Site and Access Road (EPBC 2017/7867)
- Indicitive Stage 1 Disturbance Extent
- Approved/Operating Coal Mine
- Eungella Pipeline Network
- Railway
- Peaks
- Dwelling
- Species Habitat - Australian Painted Snipe
- Species Habitat - Squatter Pigeon

Fauna Survey Locations

- Active search
- Bird survey
- Camera trap
- Comprehensive site
- Fauna Habitat Assessment Site

Source: DPM (2018), Pembroke (2018), Queensland Department of Natural Resources, Mines and Energy (2017)
Orthophoto: Google Image (2016)

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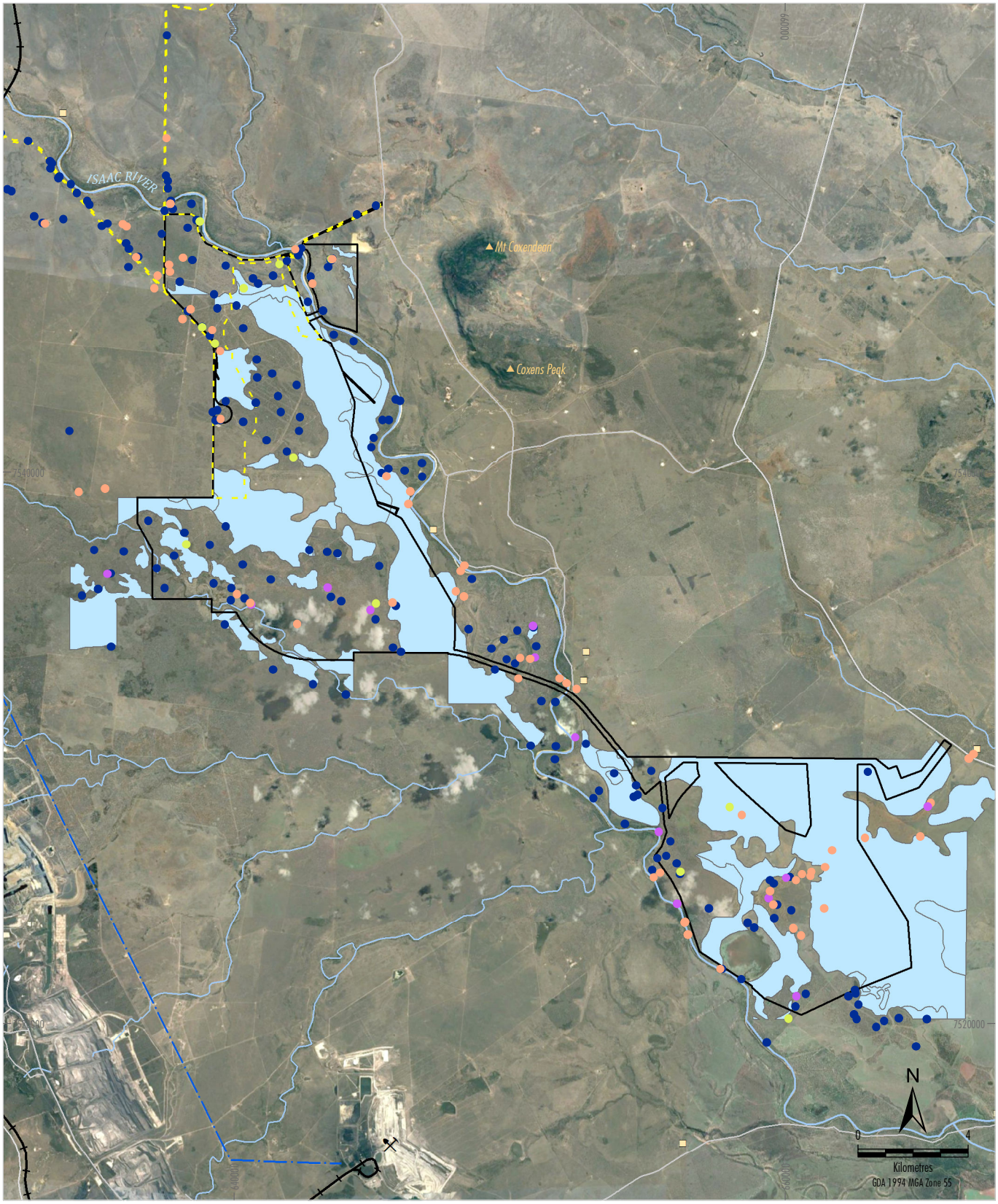
Threatened Species Habitat Mapping
Australian Painted Snipe & Squatter Pigeon
Mine Site

Figure 3-6a



LEGEND

- Olive Downs Project Mine Site and Access Road (EPBC 2017/7867)
- Indicitive Stage 1 Disturbance Extent
- Approved/Operating Coal Mine
- Eungella Pipeline Network
- Railway
- Peaks
- Dwelling
- Species Habitat - Ornamental Snake

Fauna Survey Location

- Active search
- Comprehensive site
- Spotlighting
- Fauna Habitat Assessment Site

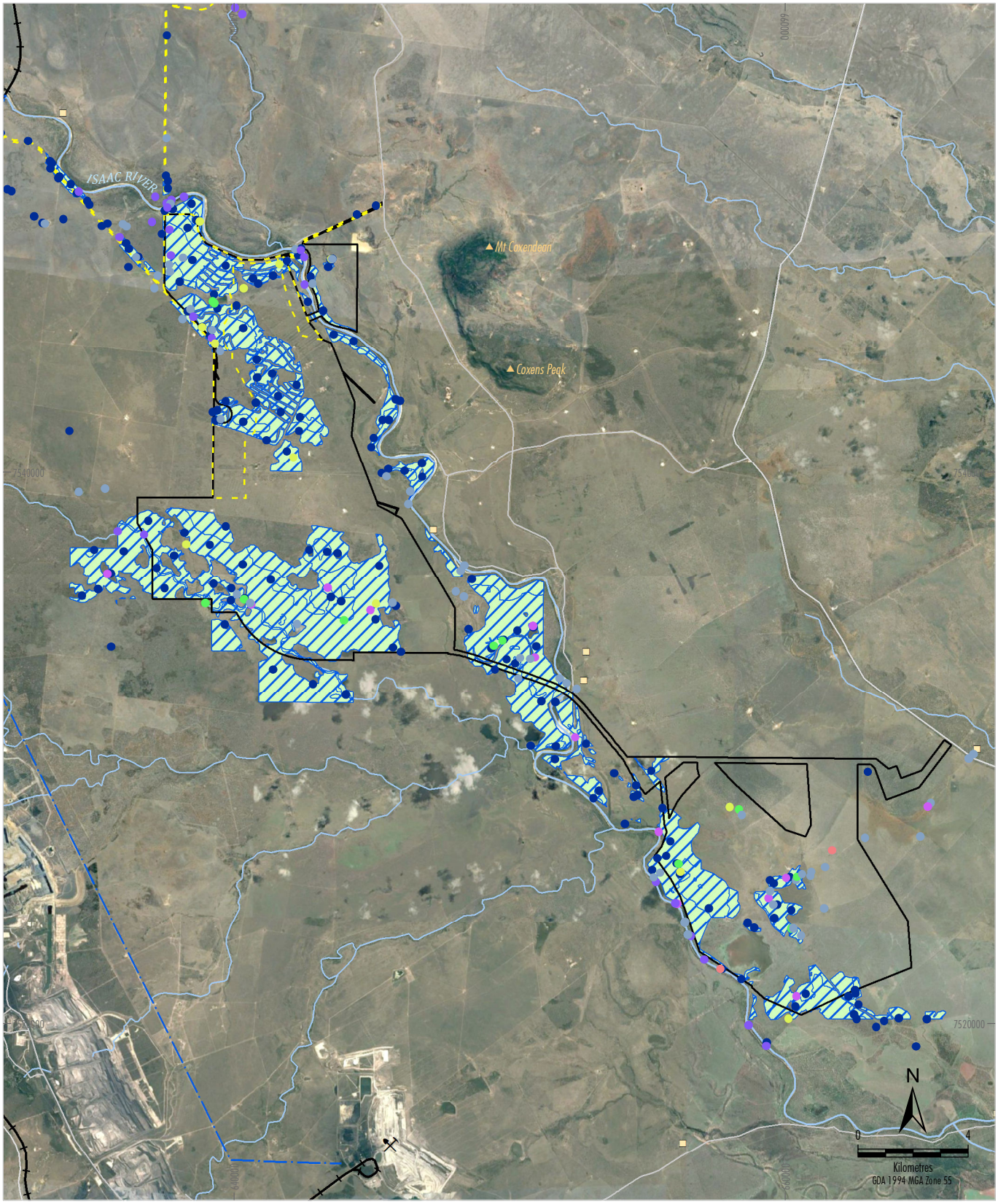
Source: DPM (2018), Pembroke (2018), Queensland Department of Natural Resources, Mines and Energy (2017)
Orthophoto: Google Image (2016)

PEMBROKE

OLIVE DOWNS COKING COAL PROJECT

Threatened Species Habitat Mapping
Ornamental Snake
Mine Site

Figure 3-6b



LEGEND

- Olive Downs Project Mine Site and Access Road (EPBC 2017/7867)
- Indicitive Stage 1 Disturbance Extent
- Approved/Operating Coal Mine
- Eungella Pipeline Network
- Railway
- Peaks
- Dwelling
- Species Habitat - Greater Glider
- Species Habitat - Koala

Flora Survey Location

- Active search
- Call playback
- Camera trap
- Comprahensive site
- Koala transect
- Spotlighting
- Fauna Habitat Assessment Site

Source: DPM (2018), Pembroke (2018), Queensland Department of Natural Resources, Mines and Energy (2017)
Orthophoto: Google Image (2016)

PEMBROKE

OLIVE DOWNS COKING COAL PROJECT

Threatened Species Mapping
Koala & Greater Glider Habitat
Mine Site

Figure 3-6c

DotE (2014b) states that "important populations [of the Ornamental Snake] occur in remnant vegetation on, or surrounding, gilgai mounds and depressions". The draft *Referral Guidelines for the Nationally Listed Brigalow Belt Reptiles* (DSEWPaC, 2011) define important habitat for the Ornamental Snake as:

- *Habitat where the species has been identified during a survey;*
- *Habitat near the limit of the species known range;*
- *Large patches of continuous, suitable habitat and viable landscape corridors (necessary for the purposes of breeding, dispersal or maintaining the genetic diversity of the species over successive generations); or*
- *A habitat type where the species is identified during a survey, but which was previously thought not to support the species.*

Under this definition, areas of habitat where the Ornamental Snake was found are important habitat for the Ornamental Snake. The draft *Referral Guidelines for the Nationally Listed Brigalow Belt Reptiles* (DSEWPaC, 2011a) defines important habitat as a surrogate for important populations (i.e. under this definition, all Ornamental Snakes in their habitat would be part of important populations) (DPM Envirosciences, 2018b). The Study area contains areas of cracking clays affected by gilgai, which can be considered important habitat for the species.

DPM Envirosciences (2018b) considers that the habitat where the Ornamental Snake was recorded is important habitat (by definition above), but it is also not likely to be critical to the survival of the species given:

- the species is more widely distributed in the region and the habitat is not at a limit of the species range; and
- large areas of potential and important habitat (as demonstrated by Ornamental Snake records) are located in the wider locality and would be avoided by the Project.

It should be noted that preferred, breeding and foraging habitat for this species are typically the same (i.e. very hard to distinguish between the three), and given the Ornamental Snake is highly sedentary dispersal habitat has not been separately assessed.

Impacts

The disturbance footprint for the Mine Site and Access Road is approximately 16,114 ha. A total of approximately 7,621.5 ha of potential habitat for the Ornamental Snake would be cleared for the Mine Site and Access Road (DPM Envirosciences, 2018b) (Table 3-8). An assessment of significance has been conducted in accordance with the *Matters of National Environmental Significance; Significant Impact Guidelines 1.1* (DotE, 2013b) and is provided in Table 3-9.

Avoidance, Mitigation and/or Management Measures

As described in Section 3.3.11 of this document, the following measures would be undertaken by Pembroke to reduce potential adverse impacts on the Ornamental Snake:

- Vegetation clearance procedures, including pre-clearance surveys to detect the Ornamental Snake within habitat proposed to be cleared.
- Implementation of a Weed and Pest Management Plan to monitor and control feral animals (including feral pigs which can degrade habitat for the Ornamental Snake [DEE, 2018a]) within the Mine Site and Access Road area and surrounds.
- Bushfire prevention would be undertaken, noting that the Ornamental Snake occurs in Brigalow Woodland and uses groundcover which is susceptible to fire (DEE, 2018a).

A National or State recovery plan has not been prepared for this species. The above measures are predicted to be effective in reducing potential adverse impacts on the Ornamental Snake from the Mine Site and Access Road because they are focused on addressing the recognised threats to the species and are consistent with the relevant threat abatement actions (e.g. avoiding additional habitat loss and reducing the risk of invasive and predatory species in Section 3.3.7.1) (DEE, 2018a).

Summary of EPBC Act Assessment

Four Ornamental Snake were recorded at three locations within the Olive Downs South Domain and a further five locations within the Willunga Domain (Figure 3-5c).

The *draft Referral Guidelines for the Nationally Listed Brigalow Belt Reptiles* (DSEWPaC, 2011) suggests clearing of > 2ha of important habitat is considered to have a high risk of a significant impact to the Ornamental Snake.

Table 3-8
Vegetation and Habitat Clearance Summary - Mine Site and Access Road

Regional Ecosystem Code	Regional Ecosystem Description	Vegetation Clearance (ha)	Habitat Clearance (ha)					
			Brigalow TEC	Ornamental Snake	Squatter Pigeon (Southern)	Australian Painted Snipe	Koala	Greater Glider
Remnant Vegetation								
11.3.1	Brigalow (*Acacia harpophylla*) and / or belah (*Casuarina cristata*) open forest on alluvial plains.	12	0	3.5	0	0	0	0
11.3.2	Poplar box (*Eucalyptus populnea*) woodland to open woodland on alluvial plains.	843.5	0	32	843.5	0	843.5	843.5
11.3.25	Queensland blue gum (*Eucalyptus tereticornis*) or river red gum (*E. camaldulensis*) woodland fringing drainage lines.	80.5	0	5.5	80.5	0	80.5	80.5
11.3.27b	Lacustrine wetland, with fringing woodland, commonly river red gum (*Eucalyptus camaldulensis*) or coolabah (*E. coolabah*).	9.5	0	1.5	0	9.5	9.5	9.5
11.3.27f	Palustrine wetland (e.g. vegetated swamp). Mixed grassland or sedgeland with areas of open water +/- aquatic species.	29	0	4.0	0	29	29	29
11.3.27i	Palustrine wetland (e.g. vegetated swamp). River red gum (*Eucalyptus camaldulensis*) or Queensland blue gum (*E. tereticornis*) woodland to open woodland with sedgeland ground layer.	15.5	0	0	0	15.5	15.5	15.5
11.3.3	Coolabah (*E. coolabah*) open woodland to woodland on alluvial plains.	5.0	0	0	5.0	0	5.0	5.0
11.3.4	Queensland blue gum (*Eucalyptus tereticornis*) and / or *Eucalyptus* spp. woodland on alluvial plains	0.5	0	0	0.5	0	0.5	0.5
11.3.7	*Corymbia* spp. woodland on alluvial plains.	569.5	0	1.5	569.5	0	569.5	569.5
11.4.8	Dawson gum (*Eucalyptus cambageana*) woodland to open forest with brigalow or blackwood (*Acacia argyrodendron*) on Cainozoic clay plains.	3.5	0	0	0	0	0	0
11.4.9	Brigalow (*A. harpophylla*) shrubby woodland to open forest with yellowwood (*Terminalia oblongata*) on Cainozoic clay plains.	57.5	13	51.0	0	0	0	0
11.5.3	Poplar box (*E. populnea*) +/- silver-leaved ironbark (*E. melanophloia*) +/- Clarkson's bloodwood (*C. clarksoniana*) woodland on Cainozoic sand plains and / or remnant surfaces.	2910	0	40	2910	0	2910	2910
11.5.8c	Poplar gum (*Eucalyptus platyphylla*) woodland on white-yellow weathered sands, with grassy ground layer.	48	0	0	48	0	48	48
11.5.9	Narrow-leaved ironbark (*E. crebra*) and other Eucalyptus spp. and Corymbia spp. woodland on Cainozoic sand plains and / or remnant surfaces.	930	0	5.0	930	0	930	930

Table 3-8 (Continued)
Vegetation and Habitat Clearance Summary - Mine Site and Access Road

Regional Ecosystem Code	Regional Ecosystem Description	Vegetation Clearance (ha)	Habitat Clearance (ha)					
			Brigalow TEC	Ornamental Snake	Squatter Pigeon (Southern)	Australian Painted Snipe	Koala	Greater Glider
11.5.17	Palustrine swamp with fringing Queensland blue gum (*Eucalyptus tereticornis*) woodland in depressions on Cainozoic sand plains and remnant surfaces.	59	0	0	0	59	59	59
Subtotal		5,573	**13**	144	5,387	113	5,500	5,500
Subtotal (Fauna/Flora Assessment)		5,573	**13**	7,621.5	5,387	113	5,500	5,500
Non-Remnant Vegetation								
	Agricultural grasslands dominated by buffel grass (*Cenchrus ciliaris*) with gilgai landform	10,514 (incl. gilgai)	0	7,477.5	0	0	0	0
Subtotal		10,514	**0**	7,477.5	0	0	0	0
Total Clearance		**16,087**	**13**	**7,621.5**	**5,387**	**113**	**5,500**	**5,500**
Approximate Area of Habitat within 10 km of Project[1]		-	16,055	21,150	33,926	389	34,315	34,315

[1] Based on the REs identified as potential habitat on DEE (2018a) from the DSITI (2018) regional mapping available over the area

Table 3-9
Likelihood of Significant Adverse Impact of the Mine Site and Access Road on the Ornamental Snake

Assessment Criteria[1] Is the Action likely to:	Assessment
lead to a long-term decrease in the size of an important population of a species	The Mine Site and Access Road would result in the removal of approximately 7,621.5 ha of potential habitat for the species. The reduction in available habitat may lead to a localized decrease in the local population, but due to the amount of available habitat in the region and the number of records surrounding the site (Figure 3-5c) it is unlikely that this decrease would be significant at a regional scale.
reduce the area of occupancy of an important population	The reduction in available habitat associated with the Mine Site and Access Road would likely lead to a localized decrease in the area of occupancy of the local population, but due to the amount of available habitat in the region and the number of records surrounding the site (Figure 3-5c), it is unlikely that this decrease would be significant at a regional scale.
fragment an existing important population into two or more populations	The Mine Site and Access Road is not likely to fragment an existing important population into two or more populations due to the location of the existing important populations and the current level of fragmentation (and cleared land between the areas).
adversely affect habitat critical to the survival of a species (e.g. for activities such as foraging, breeding, roosting, or dispersal or habitat listed in a recovery plan)	The habitat where the Ornamental Snake was recorded is important habitat, but it is also not likely to be critical to the survival of the species given: • the species is more widely distributed in the region and the habitat is not at a limit of the species range; and • large areas of potential and important habitat (as demonstrated by Ornamental Snake records) are located in the wider locality and would be avoided by the Mine Site and Access Road. Given the above, the Mine Site and Access Road is unlikely to adversely impact habitat critical to the survival of this species.
disrupt the breeding cycle of an important population	An important population has been identified, and the Mine Site and Access Road would result in the removal of potential breeding and nesting habitat for the population.
modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	The Mine Site and Access Road would remove approximately 7621.5 ha of habitat for this species. However due to the amount of available habitat in the locality and the number of records surrounding the Mine Site and Access Road area it is unlikely that this decrease would be significant at a regional scale. In addition, as the majority of the potential habitat for this species is mapped within the agricultural grasslands, there are a number of existing threats to the Ornamental Snake. These include, heavy weed infestation, presence of introduced fauna species (including cane toads); agricultural grazing and sever habitat fragmentation. It is therefore unlikely that the Mine Site and Access Road would result in the decline of the species.
result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat	Weed and feral animal threat levels are unlikely to change significantly due to the Mine Site and Access Road given the current agricultural use of the surrounding area. As outlined above, the majority of the potential habitat for this species is mapped within the agricultural grasslands, there are a number of existing threats to the Ornamental Snake. These include, heavy weed infestation, presence of introduced fauna species (including cane toads); agricultural grazing and habitat fragmentation. Through effective pest and weed management, Pembroke's Weed and Pest Management Plan would seek to identify, treat, and propose removal strategies to manage these risks to avoid a significant impact to this species.
introduce disease that may cause the species to decline	The Mine Site and Access Road does not include activities that would result in a disease that may cause the species to decline.
interfere substantially with the recovery of the species.	Although the Mine Site and Access Road would result in the removal of potential habitat for the species, Pembroke would implement mitigation strategies and offsets to assist in minimising impacts to the species. As such, the Mine Site and Access Road would not interfere substantially with the recovery of the species.

Source: DPM Enviros ciences (2018b)

[1] As defined by the *Matters of National Environmental Significance Significant Impact Guidelines 1.1* (DotE, 2013b).

The Mine Site and Access Road would result in the removal of approximately 7,621.5 ha of potential habitat (including areas of important habitat as defined by draft Referral Guidelines for the Nationally Listed Brigalow Belt Reptiles [DSEWPaC, 2011a]) for the species, which would be mitigated and offset as described in Sections 3.3.11 and 3.7.

Australian Painted Snipe (Rostratula australis)

The Australian Painted Snipe is listed as 'Endangered' under the EPBC Act.

Background/Description

The Australian Painted Snipe has been recorded at wetlands in all states of Australia (DEE, 2018a). It is most common in eastern Australia, where it has been recorded at scattered locations throughout much of Queensland, NSW, Victoria and south-eastern South Australia. It has been recorded less frequently at a smaller number of more scattered locations farther west in South Australia, the Northern Territory and Western Australia (DEE, 2018a). It has also been recorded on single occasions in south-eastern Tasmania and at Lord Howe Island (DEE, 2018a).

The Australian Painted Snipe may breed in response to wetland conditions rather than during a particular season. It has been recorded breeding in all months in Australia. In southern Australia most records have been from August to February. Eggs have been recorded from mid August to March, with breeding in northern Queensland also recorded between May and October (DEE, 2018a).

Survey Effort

The survey effort for this species is provided in Table 3-6 and Appendix B.

Habitat Assessment and Definition

The Australian Painted Snipe generally inhabits shallow terrestrial freshwater wetlands, including temporary and permanent lakes, swamps and claypans. They also use inundated or waterlogged grassland or saltmarsh, dams, rice crops, sewage farms and bore drains. Typical sites include those with rank emergent tussocks of grass, sedges, rushes or reeds, or samphire (DEE, 2018).

A single Australian Painted Snipe was observed during the field surveys in a small wetted gilgai within the Agricultural grasslands habitat type in the Willunga Domain (Figure 3-6a) (DPM Enviros ciences, 2018b).

Additional records for this species existing within the wider locality and are all located along waterways, with the closest being approximately 2.5 km south of the Water Pipeline (Figure 3-5a).

In the Study area all areas of wetlands (lacustrine or palustrine) are considered potential habitat for this species (Figure 3-6a). Although the species was observed in wetted gilgai habitat, this habitat is only suitable for a short period after rainfall when the gilgai are full. It is not considered optimal or primary habitat (DPM Enviros ciences, 2018b).

The Mine Site and Access Road area does not support an isolated population, is not on the edge of the species' range, and has not been identified as an area supporting a high density of birds or a high density of particularly high-quality habitat (DPM Enviros ciences, 2018b).

It should be noted that preferred, breeding and foraging habitat for this species are typically the same (i.e. very hard to distinguish between the three) and, as such, have not been separately assessed. Further to this, given the highly mobile nature of this species dispersal habitat would not necessarily be limited to areas of suitable habitat (i.e. it is known to disperse over cleared land to reach areas of suitable habitat).

Impacts

The disturbance footprint for the Mine Site and Access Road is approximately 16,114 ha. A total of approximately 113 ha of potential habitat for the Australian Painted Snipe would be cleared for the Mine Site and Access Road (DPM Enviros ciences, 2018b) (Table 3-8). An assessment of significance has been conducted in accordance with the *Matters of National Environmental Significance; Significant Impact Guidelines 1.1* (DotE, 2013b) and is provided in Table 3-10.

Avoidance, Mitigation and/or Management Measures

As described in Section 3.3.11 of this document, the following measures would be undertaken by Pembroke to reduce potential adverse impacts on the Australian Painted Snipe:

- Vegetation clearance procedures, including demarcation of clearing zones to protect the habitat to be retained.
- Implementation of a Weed and Pest Management Plan to monitor and control feral animals (including foxes and feral cats) within the Mine Site and Access Road area and surrounds.

Table 3-10
Likelihood of Significant Adverse Impact of the Mine Site and Access Road on the Australian Painted Snipe

Assessment Criteria[1] Is the Action likely to:	Assessment
lead to a long-term decrease in the size of a population of a species	The single individual Australian Painted Snipe was observed within gilgai habitats at the Willunga Domain. DPM Envirosciences (2018b) concluded that this species may use the wetted habitats within the Mine Site and Access Road area for occasional foraging, however it is unlikely that the habitat would be necessary to sustain a population. The Mine Site and Access Road is therefore unlikely to lead to a long-term decrease in the size of the species population.
reduce the area of occupancy of the species	Given only a single individual was recorded within the Mine Site and Access Road area, and the species is known to occur widely throughout the rest of Qld and the rest of Australia (ALA, 2018), it is unlikely that the Mine Site and Access Road would reduce the area of occupancy of the species relative to its range.
fragment an existing population into two or more populations	This species is widespread throughout Qld and the rest of Australia (ALA, 2018) and is a highly mobile species. Given this, it is unlikely that a population of this species would be fragmented into two or more populations.
adversely affect habitat critical to the survival of a species (e.g. for activities such as foraging, breeding, roosting, or dispersal or habitat listed in a recovery plan)	No critical habitat for the species has been identified in any recovery plans or listed on the EPBC Act *Register of Critical Habitat* maintained by the Minister of the Environment under the EPBC Act (DEE, 2018). The habitat in the Mine Site and Access Road area for the Australian Painted Snipe is not deemed to meet the definition of 'critical habitat' under the EPBC Act due to the heavily fragmented nature of the habitat which is more widespread in the wider landscape. The Mine Site and Access Road is not at a limit of the species range and the Australian Painted Snipe is known to occur more widely outside the Mine Site and Access Road area given the extent of database records (Figure 3-5a).
disrupt the breeding cycle of a population	The Mine Site and Access Road area does not offer any unique or particularly high quality habitat resources required by the Australian Painted Snipe. Similar or better habitat would remain in the Mine Site and Access Road locality. The species is known to breed throughout the year, hence the Mine Site and Access Road is unlikely to disrupt the breeding cycle of this species.
modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	The loss of potential habitat for this species would not isolate remaining habitat from other patches and it is unlikely that the Mine Site and Access Road would significantly reduce the area of habitat occupied by the species relative to its regional distribution. However, the Mine Site and Access Road would remove approximately 113 ha of habitat for this species.
result in invasive species that are harmful to a critically endangered or endangered species becoming established in the endangered or critically endangered species' habitat	The existing weed and feral animal threat levels are unlikely to change significantly due to the Mine Site and Access Road given the current agricultural use of the surrounding area and implementation of mitigation and management measure proposed to be implemented by Pembroke. Predation by foxes and feral cats has been suggested as a threat to the Australian Painted Snipe (SEWPaC, 2013). However, through effective pest management, Pembroke would seek to identify and propose removal strategies to manage this threat through the implementation of a Weed and Pest Management Plan.
introduce disease that may cause the species to decline	The Mine Site and Access Road does not include activities that would result in a disease that may cause the species to decline.
interfere substantially with the recovery of the species.	The Mine Site and Access Road would not interfere substantially with the recovery of the species because habitat resources for the Australia Painted Snipe (e.g. wetlands) would remain outside of the Mine Site and Access Road area, such that the species is likely to persist in the landscape.

Source: DPM Envirosciences (2018b).

[1] As defined by the *Matters of National Environmental Significance Significant Impact Guidelines 1.1* (DotE, 2013b).

The above measures are predicted to be effective in reducing potential adverse impacts from the Mine Site and Access Road on the Australian Painted Snipe because they are focused on addressing the recognised threats to the species identified in the *Approved Conservation Advice for Rostratula australis Australian Painted Snipe* (DSEWPC, 2013) and are consistent with the relevant threat abatement actions (e.g. avoiding additional habitat loss and controlling feral animals) (after DotE, 2014b).

Summary of EPBC Act Assessment

This species was located in gilgai habitat within the Mine Site and Access Road (EPBC 2017/7867).

There is only evidence of occasional foraging and there are many examples of similar wetland habitats outside the Mine Site and Access Road area (DPM Envirosciences, 2018b). The Mine Site and Access Road would result in the removal of 113 ha of potential habitat for the species which may result in a significant impact to this species.

The Mine Site and Access Road would remove approximately 113 ha of potential habitat for the species which would be mitigated and offset as described in Sections 3.3.13 and 3.7.

Squatter Pigeon (southern) (Geophaps scripta scripta)

The Squatter Pigeon (southern) is listed as 'Vulnerable' under the EPBC Act.

Background/Description

The Squatter Pigeon (southern) has a known distribution extending from the Burdekin-Lynd divide in Central Qld, west to Barcaldine, Longreach and Charleville, east to the coastline between Townsville and Port Curtis (near Gladstone), south to scattered sites throughout south-eastern Qld and the Border Rivers region of northern NSW (DEE, 2018a). The species does not appear to be undergoing a population decline (DEE, 2018a). The Squatter Pigeon (southern) is locally nomadic or sedentary (DEE, 2018a).

Natural foraging habitat for the Squatter Pigeon (southern) comprises any remnant or regrowth open-forest to sparse, open-woodland or scrub dominated by *Eucalyptus*, *Corymbia*, *Acacia* or *Callitris* species, on sandy or gravelly soils, within 3 km of a suitable, permanent or seasonal waterbody (DEE, 2018a).

This species feeds and nests on the ground but roosts in trees. The Squatter Pigeon (southern) withstands habitats with some grazing pressure but is more common in habitat without grazing and no longer occurs in areas with intense grazing (DEE, 2018a).

Survey Effort

The survey effort for this species is provided in Table 3-6 and Appendix B.

Habitat Assessment and Definition

The Squatter Pigeon (southern) has a large distribution extending from the Burdekin-Lynd divide in Central Queensland, west to Charleville and Longreach, east to the coastline between Proserpine and Port Curtis (near Gladstone) and south to a number of scattered sites throughout south-eastern Queensland (DEE, 2018). All of the relatively small isolated and sparsely distributed sub-populations occurring south of the Carnarvon Ranges in Central Queensland are considered to be important subpopulations of the subspecies (DEE, 2018).

The Squatter Pigeon (southern) was identified on ten occasions within Eucalypt dry woodlands on inland depositional plains in the Study area (Figure 3-6a). This includes three locations within the Willunga domain and a further five locations within the Olive Downs Domain (DPM Envirosciences, 2018b). This species was also recorded along the Project ETL. Further to this, the Squatter Pigeon (southern) has been recorded on numerous occasions within 10 km of the Study area (Figure 3-5a).

The Squatter Pigeon (southern) occurs mainly in grassy woodlands and open forests that are dominated by eucalypts (DEE, 2018). In the Mine Site and Access Road area, all areas of Eucalypt dry woodlands on inland depositional plains and Eucalypt open forests to woodlands on floodplains are considered potential habitat for this species (DPM Envirosciences, 2018b).

Other broad habitat types in the Mine Site and Access Road area are not considered potential habitat because they do not support the grassy understorey with a high density of native grasses necessary to provide a food resource for the species (DPM Envirosciences, 2018b).

It should be noted that preferred, breeding and foraging habitat for this species are typically the same (i.e. very hard to distinguish between the three) and, as such, have not been separately assessed.

Further to this, given the highly mobile nature of this species dispersal habitat would not necessarily be limited to areas of suitable habitat (i.e. it is known to disperse over cleared land to reach areas of suitable habitat).

Impacts

The disturbance footprint for the Mine Site and Access Road is approximately 16,114 ha. A total of approximately 5,387 ha of potential habitat for the Squatter Pigeon (southern) would be cleared for the Mine Site and Access Road (Table 3-8) (DPM Enviros ciences, 2018b). An assessment of significance has been conducted in accordance with the *Matters of National Environmental Significance; Significant Impact Guidelines 1.1* (DotE, 2013b) and is provided in Table 3-11

Avoidance, Mitigation and/or Management Measures

As described in Section 3.3.11 of this document, the following measures would be undertaken by Pembroke to reduce potential adverse impacts on the Squatter Pigeon (southern):

- Impact avoidance measures outlined in the table in Section 3.3.11 (since the Squatter Pigeon [southern] was recorded across a variety of habitats).
- Vegetation clearance procedures, including progressive vegetation clearing.
- A Weed and Pest Management Plan would be implemented to monitor and control feral animals (such as the European Rabbit, Feral Cat and European Red Fox) in the Mine Site and Access Road area.

The above measures are predicted to be effective in reducing potential adverse impacts on the Squatter Pigeon (southern) from the Mine Site and Access Road because they are focused on addressing the recognised threats to the species and are consistent with the relevant threat abatement actions (e.g. avoiding additional habitat loss and controlling predators and herbivores) (DEE, 2018a). A National or State recovery plan has not been prepared for this species.

Summary of EPBC Act Assessment

Several individuals were observed in Eucalypt dry woodlands on inland depositional plains within the Mine Site and Access Road (EPBC 2017/7867) (Figure 3-5a). Although the species has been recorded on site, habitat is of sub-optimal quality and the availability of surrounding habitat indicates that it is not of particular regional importance.

Given the amount of habitat proposed to be cleared, the Mine Site and Access Road may interfere with the recovery of the species within the locality. The Mine Site and Access Road would remove approximately 5,387 ha of potential habitat for the species which would be mitigated and offset as described in Sections 3.3.13 and 3.7.

Koala (Phascolarctos cinereus)

The EPBC Act listed 'Vulnerable' Koala is the combined populations of Qld, NSW and the ACT.

Background/Description

The Koala is endemic to Australia. The biological species is currently widespread in coastal and inland areas, with a range that extends over 22° of latitude and 18° of longitude, or about one million square kilometres (DEE, 2018a). The occurrence of animals throughout this distribution is not continuous and is defined by environmental variables (DEE, 2018a).

The life history and habitat of the Koala has been well studied (DEE, 2018a). In late 2013, the DotE released the *Draft EPBC Act Referral Guidelines for the Vulnerable Koala (Combined Populations of Queensland, New South Wales and the Australian Capital Territory)* (EPBC Act Referral Guidelines for the Koala) (DotE, 2013b). The EPBC Act Referral Guidelines for the Koala provides a habitat assessment tool for determining habitat critical to the survival of the Koala and the likelihood of a significant impact on this species.

Survey Effort

The survey effort for this species is provided in Table 3-6 and Appendix B.

Habitat Assessment and Definition

The Koala has one of the largest distributions of any terrestrial threatened species listed under the EPBC Act (DotE, 2014). It occupies a variety of vegetation types across this large distribution, is capable of moving long distances and is variably affected by a range of threats (DEE, 2018). Koala habitat is defined by the vegetation community present and the vegetation structure; Koalas do not necessarily have to be present (DotE, 2014). Any forest or woodland containing species that are known Koala food trees, or shrubland with emergent food trees can be considered as 'potential Koala habitat' (DEE, 2018). This can include remnant and non-remnant vegetation in natural, agricultural, urban and peri-urban environments.

Table 3-11
Likelihood of Significant Adverse Impact of the Mine Site and Access Road on the Squatter Pigeon (southern)

Assessment Criteria[1] Is the Action likely to:	Assessment
lead to a long-term decrease in the size of an important population of a species	The Squatter Pigeon (southern) is commonly recorded in fragmented landscapes in the Brigalow Belt South Bioregion. The population of Squatter Pigeon (southern) in the Mine Site and Access Road locality is likely to occur more widely in the Isaac River catchment given the extent of database records and habitat in locality (Figure 3-5a). In addition, as the Mine Site and Acces Road area is north of the Carnarvon Ranges and habitat is classified as sub-optimal, the Mine Site and Access Road is not considered to contain an important population of this species. As such, the Mine Site and Access Road is unlikely to lead to a long-term decrease in the size of the species population.
reduce the area of occupancy of an important population	Given the abundance of this species and the availability of surrounding potential habitat it is unlikely that the Mine Site and Access Road would significantly reduce the area of occupancy of the species relative to its range.
fragment an existing important population into two or more populations	Given the abundance of this species in the surrounding locality, lack of identified important populations, the availability of surrounding potential habitat, and existing level of habitat fragmentation in the Mine Site and Access Road locality, it is unlikely that the Mine Site and Access Road would fragment an existing important population into two or more populations.
adversely affect habitat critical to the survival of a species (e.g. for activities such as foraging, breeding, roosting, or dispersal or habitat listed in a recovery plan)	No habitat within the Mine Site and Access Road locality has been identified as critical habitat for the Squatter Pigeon (southern) in any recovery plans or listed on the EPBC Act *Register of Critical Habitat* maintained by the Minister of the Environment under the EPBC Act (DEE, 2018). The habitat in the Mine Site and Access Road area for the Squatter Pigeon (southern) is not deemed to meet the definition of 'critical habitat' under the EPBC Act due to the heavily fragmented nature of the habitat which is more widespread in the wider landscape. The Mine Site and Access Road is not at a limit of the species range and the population of Squatter Pigeon (southern) in the Mine Site and Access Road locality is likely to occur more widely outside the Mine Site and Access Road area given the extent of database records and habitat (Figure 3-5a).
disrupt the breeding cycle of an important population	The Mine Site and Access Road area does not offer any unique or particularly high quality habitat resources required by the Squatter Pigeon (southern). Similar or better habitat would remain in the Mine Site and Access Road locality. The species is known to breed throughout the year, hence the Mine Site and Access Road is unlikely to disrupt the breeding cycle of this species.
modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	The Mine Site and Access Road would remove approximately 5,387 ha of habitat for this species. The Mine Site and Access Road would result in the loss of potential habitat that is of sub-optimal quality (due to high occurrence of Buffel Grass). The loss of this habitat would not isolate remaining habitat from other patches of habitat and it is unlikely that the Mine Site and Access Road would significantly reduce the area of habitat occupied by the species relative to its regional distribution. It is therefore unlikely that the Mine Site and Access Road would result in the decline of the species.
result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat	The introduction and spread of invasive weeds and feral animals may occur as a result of the Mine Site and Access Road. However, threat levels are unlikely to change significantly due to the Mine Site and Access Road given the current agricultural use of the surrounding area and implementation of mitigation and management measure proposed to be implemented by Pembroke. Reduction of food resources and cover from the establishment and maintenance of Buffel Grass pastures have been identified as a threat to the Squatter Pigeon (southern) (TSSC, 2015). Along with excessive predation by foxes and feral cats, this often increases in response to disturbance (TSSC, 2015). However, through effective pest, weed and introduced pasture grass management, Pembroke would seek to identify, treat, and propose removal strategies to manage this threat through the implementation of a Weed and Pest Management Plan.
introduce disease that may cause the species to decline	The Mine Site and Access Road does not include activities that would result in a disease that may cause the species to decline.
interfere substantially with the recovery of the species.	Given the amount of habitat proposed to be cleared, the Mine Site and Access Road may interfere with the recovery of the species within the locality.

Source: DPM Enviroscienses (2018b).

[1] As defined by the *Matters of National Environmental Significance Significant Impact Guidelines 1.1* (DotE, 2013b).

Koala food trees can generally be considered to be those of the genus Angophora, Corymbia, Eucalyptus, Lophostemon and Melaleuca (DEE, 2018).

Within the Study area, the Koala was recorded on numerous occasions along the Isaac River and associate tributaries (Figure 3-5b). Recordings included direct observation and identification of scats and scratches within Eucalypt dry woodlands on inland depositional plains, Eucalypt open forest to woodlands on floodplains, and around wetlands (DPM Envirosciences, 2018b).

Within the Study area potential Koala habitat is located within the areas mapped as eucalypt open forests to woodlands on floodplains, eucalypt dry woodlands on inland depositional plains and the vegetation surrounding and within the lacustrine and palustrine wetlands (Figure 3-6c). The potential habitat connections along the waterways (primarily the Isaac River and Ripstone Creek) provide movement corridors and refuge habitat for this species in an otherwise cleared and generally unsuitable landscape (DPM Envirosciences, 2018b).

Those areas of non-remnant vegetation in the Study area are included in the 'Agricultural Grasslands' habitat type, which does not contain an adequate density of Koala trees (Eucalyptus spp. Corymbia spp. Lophostemon spp. or Melaleuca spp. that are > 4 m in height and > 10 cm DBH) to support the species (DPM Envirosciences, 2018b).
Other habitat types, such as 'Other coastal communities and heath' and 'Acacia dominated open forests, woodlands and shrublands', also do not contain an adequate density of Koala trees to support the species (DPM Envirosciences, 2018b).

It should be noted that preferred, breeding and foraging habitat for this species are typically the same (i.e. very hard to distinguish between the three) and, as such, have not been separately assessed. Further to this, given the highly mobile nature of this species dispersal habitat would not necessarily be limited to areas of suitable habitat (i.e. it is known to disperse over cleared land to reach areas of suitable habitat).

Critical Habitat under the EPBC Act

The EPBC Act Referral Guidelines for the Koala (DotE, 2013b) for the Koala provides a habitat assessment tool for determining habitat critical to the survival of the Koala and the likelihood of a significant impact on this species.

Table 3-12 provides an appraisal of the habitat within the Mine Site and Access Road area.

Impacts

The disturbance footprint for the Mine Site and Access Road is approximately 16,114 ha. A total of approximately 5,500 ha of potential habitat for the Koala would be cleared for the Mine Site and Access Road (Table A) (DPM Envirosciences, 2018b). An assessment of significance has been conducted in accordance with the *Matters of National Environmental Significance; Significant Impact Guidelines 1.1* (DotE, 2013b) and is provided in Table 3-13.

Table 3-12
Koala Habitat Appraisal

Attribute*	Score*	Habitat Appraisal
Koala occurrence	+2	This attribute is rated 2 as there is evidence of one or more Koalas within the last 5 years. DPM Envirosciences (2018b) recorded the Koala within the Mine Site and Access Road area.
Vegetation structure and composition	+2	The woodland and riparian woodland habitat within the Mine Site and Access Road area provides habitat for the Koala based on the occurrence of recognised food tree of the Koala. This attribute is rated 2 as the woodland generally has two or more known Koala food tree species in the canopy.
Habitat connectivity	+2	This attribute is rated 2 as the Mine Site and Access Road area is part of a contiguous landscape ≥ 1,000 ha.
Key existing threats	+2	There is little or no evidence of Koala mortality from vehicle strike or dog attack in the area. This attribute is rated 2 based on the lack of evidence of Koala mortality.
Recovery value	0	Habitat is unlikely to be important for achieving the interim recovery objectives for the costal habitat which are described in DotE (2013b).
Total	**8**	

* DotE (2013b)

Table 3-13
Likelihood of Significant Adverse Impact of the Mine Site and Access Road on the Koala

Assessment Criteria[1] Is the Action likely to:	Assessment
lead to a long-term decrease in the size of an important population of a species	The Koala population that has been identified in the Mine Site and Access Road locality is likely to occur more widely in the surrounding locality and the availability of potential habitat surrounding the Mine Site and Access Road area extends along the Isaac River and its associated tributaries. The Mine Site and Access Road would involve three crossings of the Isaac River. These crossings have been minimised through the mine design to the smallest extent practicable to limit the potential impacts on riparian vegetation. As such, it is unlikely that the Mine Site and Access Road would result in a long-term decrease in the size of in an important population.
reduce the area of occupancy of an important population	Given the abundance of this species (ALA 2018) and the availability of surrounding potential habitat that is of similar or better quality (particularly along the Isaac River), it is unlikely that the Mine Site and Access Road would significantly reduce the area of occupancy of the species relative to its distribution.
fragment an existing important population into two or more populations	Due to the abundance of the species and availability of surrounding habitat, and existing level of habitat fragmentation in the Mine Site and Access Road locality, it is unlikely that the Mine Site and Access Road would result in fragmentation of the population into two or more populations. Where possible, impacts to riparian vegetation along the Isaac River has been minimised within the mine design.
adversely affect habitat critical to the survival of a species (e.g. for activities such as foraging, breeding, roosting, or dispersal or habitat listed in a recovery plan)	The Koala Referral Guidelines (DotE 2014) contain a habitat assessment tool for identifying critical habitat. Impact areas that score five or more using the habitat assessment tool for the Koala contain habitat critical to the survival of the Koala. The assessment was completed over all areas of potential habitat in the Mine Site and Access Road area. The Project would remove habitat which meets the definition of 'Critical Habitat' for the Koala as defined in the *EPBC Act referral guidelines for the vulnerable Koala (combined Qld, New South Wales and the Australian Capital Territory)* (DotE, 2014).
disrupt the breeding cycle of an important population	Given the Mine Site and Access Road has been designed to minimise disturbance to the better quality riparian vegetation along the Isaac River where the majority of Koala records exist (Figure 3-5b), it is unlikely that the Mine Site and Access Road would disrupt the breeding cycle of an important population.
modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	The Mine Site and Access Road would remove approximately 5,500 ha of habitat for this species. It is possible that the local population may suffer a small reduction in numbers, however, by minimising disturbance to the better quality riparian habitat along the Isaac River is unlikely that, at a regional level, the species would decline.
result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat	The introduction and spread of invasive weeds and feral animals may occur as a result of the Mine Site and Access Road. However, threat levels are unlikely to change significantly due to the Mine Site and Access Road given the current agricultural use of the surrounding area and implementation of mitigation and management measure proposed to be implemented by Pembroke. Feral dogs have been identified as posing a direct threat to the Koala. However, through effective pest management Pembroke would seek to identify and propose removal strategies through the implementation of a Weed and Pest Management Plan.
introduce disease that may cause the species to decline	Koala populations are threatened by at least two diseases: chlamydia and Koala retrovirus (KoRV). KoRV is estimated to infect up to 100% of Koalas in Queensland, with infection rates slightly lower in southern populations (DEE, 2018a). It is likely that both these diseases already occur in the populations found on and around the Mine Site and Access Road area. The Mine Site and Access Road does not include activities that would result in the spread of a disease that may cause the species to decline.

Table 3-13 (Continued)
Likelihood of Significant Adverse Impact of the Mine Site and Access Road on the Koala

Assessment Criteria1 *Is the Action likely to:*	**Assessment**
interfere substantially with the recovery of the species.	Impacts which are likely to substantially interfere with the recovery of the Koala (DotE 2014) may include: • Increasing Koala fatalities due to dog attacks. • Increasing Koala fatalities due to vehicle-strikes. • Facilitating the introduction or spread of disease or pathogens for example Chlamydia or *Phytophthora cinnamomi* that are likely to significantly reduce the reproductive output of Koalas or reduce the carrying capacity. • Creating a barrier to movement to, between or within habitat for the Koala that is likely to result in a long-term reduction in genetic fitness. • Changing hydrology which degrades habitat for the Koala to the extent that the carrying capacity of the habitat is reduced. The Mine Site and Access Road is unlikely to result in these impacts in consideration of the mitigation measure proposed to be implemented for the Mine Site and Access Road (Section 3.3.11), including the retention of the majority of the Isaac River corridor. As such, the Mine Site and Access Road would not interfere substantially with the recovery of the species

Source: DPM Enviros ciences (2018b).

[1] As defined by the *Matters of National Environmental Significance Significant Impact Guidelines 1.1* (DotE, 2013b).

Avoidance, Mitigation and/or Management Measures

As described in Section 3.3.11 of this document, the following measures would be undertaken by Pembroke to reduce potential adverse impacts on the Koala:

- Impact avoidance measures outlined in the table in Section 3.3.11 (including minimising potential impacts to the riparian corridor associated with the Isaac River).
- Vegetation clearance procedures, including progressive vegetation clearing and retention of hollow-bearing trees where possible.
- Implementation of fauna crossings to ensure safe fauna movement across haul roads where applicable.
- A Weed and Pest Management Plan would be implemented to monitor and control feral animals (such as the Feral dog) in the Mine Site and Access Road area.

The above measures are predicted to be effective in reducing potential adverse impacts on the Koala from the Mine Site and Access Road because they are focused on addressing the recognised threats to the species and are consistent with the relevant threat abatement actions (e.g. avoiding additional habitat loss and controlling predators) (DEE, 2018a). A National or State recovery plan has not been prepared for this species.

Summary of EPBC Act Assessment

This species was recorded during the field surveys within the Mine Site and Access Road (Figure 3-5b). The Mine Site and Access Road would result in the removal of approximately 5,500 ha of potential habitat (including areas of critical habitat as defined by as defined in the *EPBC Act referral guidelines for the vulnerable Koala (combined Qld, New South Wales and the Australian Capital Territory)* (DotE, 2014) for the species (DPM Enviros ciences, 2018b), which would be mitigated and offset as described in Sections 3.3.13 and 3.7.

Greater Glider (Petauroides volans)

The Greater Glider is listed as 'Vulnerable' under the EPBC Act.

Background/Description

The Greater Glider is restricted to eastern Australia, occurring from the Windsor Tableland in north Queensland through to central Victoria (Wombat State Forest), with an elevational range from sea level to 1,200 m above sea level. An isolated inland subpopulation occurs in the Gregory Range west of Townsville, and another in the Einasleigh Uplands (DEE, 2018a).

The Greater Glider is an arboreal nocturnal marsupial, largely restricted to eucalypt forests and woodlands. It is primarily folivorous, with a diet mostly comprising eucalypt leaves, and occasionally flowers (DEE, 2018a). It is typically found in highest abundance in taller, montane, moist eucalypt forests with relatively old trees and abundant hollows (DEE, 2018a). The distribution may be patchy even in suitable habitat (DEE, 2018a). The Greater Glider favours forests with a diversity of eucalypt species, due to seasonal variation in its preferred tree species (DEE, 2018a).

Survey Effort

The survey effort for this species is provided in Table 3-6 and Appendix B.

Habitat Assessment and Definition

The Greater Glider is largely restricted to eucalypt forests and woodlands. It is typically found in higher abundance in taller, montane, moist eucalypt forests with relatively old trees and abundant hollows (TSSC 2016). The distribution may be patchy even in suitable habitat. The Greater Glider favours forests with a diversity of eucalypt species, due to seasonal variation in its preferred tree species (TSSC 2016).

Within the Study area, the Greater Glider was recorded on numerous occasions along the Isaac River and associate tributaries (Figure 3-5b). Recordings included direct observation and identification of scats within Eucalypt dry woodlands on inland depositional plains and Eucalypt open forest to woodlands on floodplains (DPM Envirosciences, 2018b).

In the Study area all areas of eucalypt open forests to woodlands on floodplains and eucalypt dry woodlands on inland depositional plains are considered potential habitat (Figure 3-6c). The potential habitat connections along the waterways (primarily the Isaac River and Ripstone Creek) provide movement corridors and refuge habitat for this species in an otherwise cleared and generally unsuitable landscape (DPM Envirosciences, 2018b).

Other habitat types within the Study area (including the 'Agricultural Grasslands' habitat type) are not considered suitable for the species because they lack a high density of large mature eucalypts, which are important for foraging and denning (DPM Envirosciences, 2018b).

It should be noted that preferred, breeding and foraging habitat for this species are typically the same (i.e. very hard to distinguish between the three) and, as such, have not been separately assessed. Further to this, given the highly mobile nature of this species dispersal habitat would not necessarily be limited to areas of suitable habitat (i.e. it is known to disperse over cleared land to reach areas of suitable habitat).

Impacts

The disturbance footprint for the Mine Site and Access Road is approximately 16,114 ha. A total of approximately 5,500 ha of potential habitat for the Greater Glider would be cleared for the Mine Site and Access Road (Table A) (DPM Envirosciences, 2018b). An assessment of significance has been conducted in accordance with the *Matters of National Environmental Significance; Significant Impact Guidelines 1.1* (DotE, 2013b) and is provided in Table 3-14.

Avoidance, Mitigation and/or Management Measures

As described in Section 3.3.11 of this document, the following measures would be undertaken by Pembroke to reduce potential adverse impacts on the Greater Glider:

- Impact avoidance measures outlined in the table in Section 3.3.11 (including minimising potential impacts to the riparian corridor associated with the Isaac River).
- Vegetation clearance procedures, including progressive vegetation clearing and retention of hollow-bearing trees where possible.
- Implementation of fauna crossings to ensure safe fauna movement across haul roads where applicable.
- A Weed and Pest Management Plan would be implemented to monitor and control pests and feral animals in the Mine Site and Access Road area.

The above measures are predicted to be effective in reducing potential adverse impacts on the Greater Glider from the Mine Site and Access Road because they are focused on addressing the recognised threats to the species and are consistent with the relevant threat abatement actions (e.g. avoiding additional habitat loss and controlling predators) (DEE, 2018a). A National or State recovery plan has not been prepared for this species.

Table 3-14
Likelihood of Significant Adverse Impact of the Mine Site and Access Road on the Greater Glider

Assessment Criteria[1] Is the Action likely to:	Assessment
lead to a long-term decrease in the size of an important population of a species	The Greater Glider population that has been identified in the Mine Site and Access Road locality is likely to occur more widely in the surrounding locality and the availability of potential habitat surrounding the Mine Site and Access Road area extends along the Isaac River and its associated tributaries. The Mine Site and Access Road would involve three crossings of the Isaac River. These crossings have been minimised through the mine design to the smallest extent practicable to limit the potential impacts on riparian vegetation. As such, it is unlikely that the Mine Site and Access Road would result in a long-term decrease in the size of in an important population.
reduce the area of occupancy of an important population	Given the abundance of this species (ALA 2018) and the availability of surrounding potential habitat that is of similar or better quality (particularly along the Isaac River), it is unlikely that the Mine Site and Access Road would significantly reduce the area of occupancy of the species relative to its distribution.
fragment an existing important population into two or more populations	Due to the abundance of the species and availability of surrounding habitat, and existing level of habitat fragmentation in the Mine Site and Access Road locality, it is unlikely that the Mine Site and Access Road would result in fragmentation of the population into two or more populations. Where possible, impacts to riparian vegetation along the Isaac River has been minimised within the mine design.
adversely affect habitat critical to the survival of a species (e.g. for activities such as foraging, breeding, roosting, or dispersal or habitat listed in a recovery plan)	No habitat within the Mine Site and Access Road locality has been identified as important or critical habitat for the Greater Glider in any recovery plans or listed on the EPBC Act *Register of Critical Habitat* maintained by the Minister of the Environment under the EPBC Act (DEE, 2018). The habitat in the Mine Site and Access Road area for the Greater Glider is not deemed to meet the definition of 'important habitat' or 'critical habitat' under the EPBC Act due to the heavily fragmented nature of the habitat which is more widespread in the wider landscape. The Mine Site and Access Road is not at a limit of the species range and the population of Greater Glider in the Mine Site and Access Road locality is likely to occur more widely given the extent of database records and habitat (Figure 3-5b).
disrupt the breeding cycle of an important population	Given the Mine Site and Access Road has been designed to minimise disturbance to the better quality riparian vegetation along the Isaac River where the majority of Greater Glider records exist (Figure 3-5b), it is unlikely that the Mine Site and Access Road would disrupt the breeding cycle of an important population.
modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	The Mine Site and Access Road would remove approximately 5,500 ha of habitat for this species. It is likely that the Mine Site and Access Road would result in the loss of sub-optimal quality habitat and a reduction in supporting woodland from within the Mine Site and Access Road area. However, due to the high occurrence of the species on the east coast, and limited disturbance of the movement corridor and better quality riparian habitat along the Isaac River, it is unlikely that the loss of potential habitat within the Mine Site and Access Road area would result in the overall decline of the species as a whole.
result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat	The introduction and spread of invasive weeds and feral animals may occur as a result of the Mine Site and Access Road. However, threat levels are unlikely to change significantly due to the Mine Site and Access Road given the current agricultural use of the surrounding area and implementation of mitigation and management measure proposed to be implemented by Pembroke. No particular weeds or feral animals have been implicated as a threat to the species. However, threat levels would be managed by Pembroke through effective pest and weed management Pembroke would seek to identify and propose removal strategies through the implementation of a Weed and Pest Management Plan.
introduce disease that may cause the species to decline	The Mine Site and Access Road does not include activities that would result in a disease that may cause the species to decline.
interfere substantially with the recovery of the species.	A recovery plan has not yet been developed for the Greater Glider. Due to the preservation of the majority of the Isaac River riparian corridor, the Mine Site and Access Road is unlikely to interfere with any of the actions listed for the recovery of the species.

[1] As defined by the *Matters of National Environmental Significance Significant Impact Guidelines 1.1* (DotE, 2013b).

Summary of EPBC Act Assessment

This species was recorded during the field surveys within the Mine Site and Access Road area, however records were heavily concentrated around Ripstone Creek and the Isaac River (Figure 3-5b).

The Mine Site and Access Road (EPBC 2017/7867) proposes to remove approximately 5,500 ha of potential habitat for the Greater Glider which would be mitigated and offset as described in Sections 3.3.13 and 3.7.

Other Threatened Species

Other threatened species identified within the Terms of Reference or within a search area covering the wider locality include:

- Red Goshawk (*Erythrotriorchis radiatus*)*;*
- Curlew Sandpiper (*Calidris ferruginea*)*;*
- Painted Honeyeater (*Grantiella picta*)*;*
- Star Finch (eastern) (*Neochmia ruficauda ruficauda*)*;*
- Black-throated Finch (southern) (*Poephila cincta cincta*)*;*
- Northern Quoll (*Dasyurus hallucatus*)*;*
- Grey-headed Flying-fox (*Pteropus poliocephalus*)*;*
- Ghost Bat (*Macroderma gigas*)*;*
- Corben's Long-eared Bat (*Nyctophilus corbeni)*;
- Southern Snapping Turtle (*Elseya albagula*)*;*
- Fitzroy River Turtle (*Rheodytes leukops*)*;*
- Yakka Skink (*Egernia rugosa*);
- Allan's Lerista (*Lerista allanae*)*;*
- Dunmall's Snake (*Furina dunmalli*)*;*
- *Cycas ophiolitica;*
- King Blue-grass *(Dichanthium queenslandicum);*
- Bluegrass (*Dichanthium setosum*)*;*
- Black Ironbox (*Eucalyptus raveretiana*)*; and*
- Quassia (*Samadera bidwillii*)*.*

None of these species were recorded despite targeted surveys (DPM Envirosciences, 2018b). Notwithstanding, potential adverse impacts on the threatened species listed above have been assessed in Table 3-15.

In summary, it is concluded that the Mine Site and Access Road is unlikely to significantly impact any of these species in accordance with the significant impact criteria detailed in the *Significant Impact Guidelines 1.1: Matters of National Environmental Significance* (DotE, 2013b) (DPM Envirosciences, 2018b).

3.3.7.2 Threatened Ecological Communities

The *Brigalow (Acacia harpophylla dominant and co-dominant) ecological community* (Brigalow TEC) was identified within the Study area. Brigalow TEC mapped by DPM Envirosciences (2018a) comprises only those patches of vegetation that meet the condition thresholds identified in the *Approved Conservation Advice for the Brigalow (Acacia harpophylla dominant and co-dominant) ecological community* (DotE, 2013a).

No other TEC listed under the EPBC Act was recorded within the Study area (DPM Envirosciences, 2018a).

Brigalow (Acacia harpophylla dominant and co-dominant) ecological community

Sixteen potential TEC vegetation patches were assessed for floristic values as part of the field surveys in November 2016. This included one Tertiary flora survey site in RE 11.3.1, three Quaternary flora survey sites in RE 11.3.1, six in RE 11.4.8 and six in RE 11.4.9 (DPM Envirosciences, 2018a). Most patches failed to meet the Brigalow TEC condition thresholds, owing primarily to groundcover being dominated by exotic species including Buffel Grass (*Cenchrus ciliaris*) (DPM Envirosciences, 2018a).

Patches of regrowth vegetation within the Study area were also assessed to determine whether they meet the criteria to be mapped as Brigalow TEC (DotE, 2013a). No patches of regrowth vegetation were determined to meet these criteria as the trees were too small to have been more than 15 years old and the understory vegetation was dominated by weeds (i.e. Buffel Grass) (DPM Envirosciences, 2018a).

The disturbance footprint for the Mine Site and Access Road is approximately 16,114 ha. A total of approximately 13 ha of Brigalow TEC would be cleared for the Mine Site and Access Road (Table 3-8) (Figure 3-3) (DPM Envirosciences, 2018a). An assessment of significance has been conducted in accordance with the *Matters of National Environmental Significance; Significant Impact Guidelines 1.1* (DotE, 2013b) and is provided in Table 3-16

Table 3-15
Assessments of Other Threatened Species Relevant to the Mine Site and Access Road Area

Species Name	Common Name	Conservation Status[1]	Presence in the Project Locality and Potential Impact
Erythrotriorchis radiatus	Red Goshawk	V	The Red Goshawk is considered to have potential to occur within the Mine Site and Access Road area as some areas of suitable habitat are present (e.g. eucalypt dry woodlands and the wetlands and waterways). This species typically occurs in tall open forest, woodland, lightly treed savannah and the edge of rainforest (DEHP 2018e). Despite this, the species was not recorded during the targeted surveys and the nearest previous record is located approximately 45 km to the east of the Mine Site and Access Road (ALA, 2018). Nests are in tall trees within 1 km of and often besides, permanent water (river, swamp, pool), usually in fairly open, biologically rich forest or woodland. The average distance of the nest tree to water was 164 m (DEE, 2018). Although the Mine Site and Access Road may remove some areas of potential habitat for this species (e.g. eucalypt dry woodlands and the wetlands and waterways) it is unlikely that it would result in a significant impact on this species given: • this species has not been recorded within the Mine Site and Access Road area or surrounds despite targeted surveys; • areas of potential habitat for this species are likely to occur more widely in the surrounding landscape; and • this species is highly mobile and possesses the ability to disperse into the large areas of potential habitat outside the Mine Site and Access Road.
Calidris ferruginea	Curlew Sandpiper	CE	This species is unlikely to occur within the Mine Site and Access Road area as it was not recorded during the recent surveys undertaken by DPM Envirosciences (2018b) and it has not been previously recorded within 50 km of the Mine Site and Access Road area. This species typically inhabits intertidal mudflats of estuaries, lagoons, mangrove channels, around lakes, dams, flood waters, flooded saltbush surrounds of inland lakes (Morcombe 2003). Although the Mine Site and Access Road would clear wetland and waterway habitats that could provide potential habitat for this species on occasion, it is unlikely that this would result in a significant impact on the Curlew Sandpiper given: • previous targeted searches have found no records of the species within 50 km of the Mine Site and Access Road area; • the species is classified as a migratory shorebird in Marine bioregional plan for the North-west Marine Region (DSEWPC, 2012c); • the species does not breed in Australia (DotE, 2015); • The Mine Site and Access Road area is not classified as internationally important to the species (Bamford et al., 2008) per the Wildlife Conservation Plan for Migratory Shorebirds (DotE, 2015); • the species is wide ranging, with densely distributed records along the coastline of Australia (ALA, 2018); and • habitat is abundant for the species given the densely populated coastlines of Australia (ALA, 2018).

Table 3-15 (Continued)
Assessments of Other Threatened Species Relevant to the Mine Site and Access Road Area

Species Name	Common Name	Conservation Status[1]	Presence in the Project Locality and Potential Impact
Grantiella picta	Painted Honeyeater	V	This species is unlikely to occur within the Mine Site and Access Road area as it was not recorded during the recent surveys undertaken by DPM Envirosciences (2018b) and it has not been previously recorded within 50 km of the Mine Site and Access Road area. This species typically inhabits dry, open forests and woodlands (Box, Ironbark, Yellow Gum, Melaleuca, Casuarina, Callitris, Acacia), usually in areas with flowering and fruiting mistletoe and flowering eucalypts (DEHP, 2018f). Although the Mine Site and Access Road may remove some areas of potential habitat for this species (e.g. euclaypt woodlands) it is unlikely that this would result in a significant impact on this species given: • this species has not been recorded within the Mine Site and Access Road area or surrounds despite targeted surveys; • areas of potential habitat for this species are likely to occur more widely in the surrounding landscape; and • this species is highly mobile and possesses the ability to disperse into the large areas of potential habitat outside the Mine Site and Access Road.
Neochmia ruficauda ruficauda	Star Finch (eastern)	E	This species is unlikely to occur within the Mine Site and Access Road area as it was not recorded during the recent surveys undertaken by DPM Envirosciences (2018b) and it has not been previously recorded within 50 km of the Mine Site and Access Road area. The nearest database record is located approximately 50 km from the Mine Site and Access Road and is from 1956 (ALA, 2018). DEE completed two targeted field surveys for the Star Finch (eastern) which were conducted in central Queensland in 1993-94 and 1996-97 and failed to locate any Star Finches (eastern). In addition, there have been no sightings of the Star Finch (eastern) in the wild since 1995 (DEE, 2018, DPM Envirosciences, 2018). Given the above, it is unlikely that the Mine Site and Access Road would result in a significant impact to this species.
Poephila cincta cincta	Black-throated Finch (southern)	E	This species is unlikely to occur within the Mine Site and Access Road area as it was not recorded during the recent surveys undertaken by DPM Envirosciences (2018b) and it has not been previously recorded within 50 km of the Mine Site and Access Road area. The Black-throated Finch inhabits grassy woodland dominated by eucalypts, paperbarks or acacias where there is accessibility to seeding grasses, with riparian habitat being particularly important (DEHP 2018d). Although the Mine Site and Access Road may remove some areas of potential habitat for this species (e.g. riparian woodlands) it is unlikely that it would result in a significant impact on this species given: • this species has not been recorded within the Mine Site and Access Road area or surrounds despite targeted surveys; • areas of potential habitat for this species (e.g. riparian woodlands) are likely to occur more widely in the surrounding landscape; and • this species is highly mobile and possesses the ability to disperse into the large areas of potential habitat outside the Mine Site and Access Road.

Table 3-15 (Continued)
Assessments of Other Threatened Species Relevant to the Mine Site and Access Road Area

Species Name	Common Name	Conservation Status[1]	Presence in the Project Locality and Potential Impact
Dasyurus hallucatus	Northern Quoll	E	This species is unlikely to occur within the Mine Site and Access Road area as it was not recorded during the recent surveys undertaken by DPM Envirosciences (2018b) and it has not been previously recorded within 50 km of the Mine Site and Access Road area. Further to this, the nearest database record of this species is from 1969. The Northern Quoll is known to inhabit hilly or rocky areas close to permanent water; but occurs in a range of habitats, including open dry sclerophyll forest and woodland, riparian woodland, low dry vine thicket, the margins of notophyll vineforest, mangroves, sugarcane farms and in urban areas (DEHP 2018g). The Mine Site and Access Road area does not contain rocky areas that would provide suitable habitat for the Northern Quoll.
Pteropus poliocephalus	Grey-headed Flying-fox	V	This species is unlikely to occur within the Mine Site and Access Road area as it was not recorded during the recent surveys undertaken by DPM Envirosciences (2018b) and it has not been previously recorded within 50 km of the Mine Site and Access Road area. This species typically roosts in native vegetation near water, including mangrove, rainforest, melaleuca or casuarina (Churchill 2008). The Grey-headed Flying Fox typically commute within 15 km to feed on flowering and fruiting plants, including blossoms of various species of eucalypt, angophora, tea-tree and banksia (Strahan 1995). Although the Mine Site and Access Road may remove some areas of foraging habitat for this species (e.g. eucalypt woodlands) it is unlikely that it would result in a significant impact on this species given: • this species has not been recorded within the Mine Site and Access Road area or surrounds despite targeted surveys; • areas of potential habitat for this species (e.g. eucalypt woodlands) are likely to occur more widely in the surrounding landscape; and • this species is highly mobile and possesses the ability to disperse into the large areas of potential habitat outside the Mine Site and Access Road.
Macroderma gigas	Ghost Bat	V	This species is unlikely to occur within the Mine Site and Access Road area as it was not recorded during the recent surveys undertaken by DPM Envirosciences (2018b) and it has not been previously recorded within 50 km of the Mine Site and Access Road area. The closest sighting in 1978 approximately 70 km from the Mine Site and Access Road. The Ghost Bat typically inhabits spinifex hillsides, black soil grasslands, monsoon forest, open savannah woodland, tall open forest, deciduous vine forest and tropical rainforest, influenced by the availability of caves and mines for roosting (Churchill 2008). Roost sites include caves, rock crevices and disused mine adits. Given the site characteristics (predominately euclypt woodland) and the lack of caves within the Mine Site and Access Road area it is unlikely the Ghost Bat would utilise the habitat within the Project Area.

Table 3-15 (Continued)
Assessments of Other Threatened Species Relevant to the Mine Site and Access Road Area

Species Name	Common Name	Conservation Status[1]	Presence in the Project Locality and Potential Impact
Nyctophilus corbeni	Corben's Long-eared Bat	V	This species is unlikely to occur within the Mine Site and Access Road area as it was not recorded during the recent surveys undertaken by DPM Envirosciences (2018b) and it has not been previously recorded within 50 km of the Mine Site and Access Road area. The Corben's Long-eared Bat is known to inhabit areas with a cluttered understorey layer in river red gum, black box, *Allocasuarina*, belah, mallee, open woodlands, and savannahs; roosting in fissures in branches and under dried sheets of bark still attached to the trunks of trees; utilising tree hollows for maternity sites (Churchill 2008). Although the Mine Site and Access Road may remove some areas of foraging habitat for this species (e.g. eucalypt woodlands) it is unlikely that it would result in a significant impact on this species given: • this species has not been recorded within the Mine Site and Access Road area or surrounds despite targeted surveys; • areas of potential habitat for this species (e.g. eucalypt woodlands) are likely to occur more widely in the surrounding landscape; and • this species is highly mobile and possesses the ability to disperse into the large areas of potential habitat outside the Mine Site and Access Road.
Elseya albagula	Southern Snapping Turtle	CE	This species is unlikely to occur within the Mine Site and Access Road area as it was not recorded during the recent surveys undertaken by DPM Envirosciences (2018b) and it has not been previously recorded within 50 km of the Mine Site and Access Road area. The Southern Snapping Turtle inhabits permanent flowing water habitats where there are suitable shelters and refuges (DEHP 2018h); clear, flowing, well-oxygenated waters of the Fitzroy, Mary and Burnett catchments. Suitable habitat for this species was not identified during the recent aquatic ecology surveys undertaken by DPM Envirosciences (2018c).
Rheodytes leukops	Fitzroy River Turtle	V	This species is unlikely to occur within the Mine Site and Access Road area as it was not recorded during the recent surveys undertaken by DPM Envirosciences (2018b) and it has not been previously recorded within 50 km of the Mine Site and Access Road area. The Fitzroy River Turtle is known to inhabit fast-flowing water of the Fitzroy River and its tributaries (Cogger, 2014). Rivers with large deep pools and rocky, gravelly or sandy substrates, connected by shallow riffles. Preferred areas have high water clarity and are often associated with ribbonweed (*Vallisneria* sp.) (DEE 2017). Suitable habitat for this species was not identified during the recent aquatic ecology surveys undertaken by DPM Envirosciences (2018c).

Table 3-15 (Continued)
Assessments of Other Threatened Species Relevant to the Mine Site and Access Road Area

Species Name	Common Name	Conservation Status[1]	Presence in the Project Locality and Potential Impact
Egernia rugosa	Yakka Skink	V	This species is unlikely to occur within the Mine Site and Access Road area as it was not recorded during the recent surveys undertaken by DPM Envirosciences (2018b) and it has not been previously recorded within 50 km of the Mine Site and Access Road area. The Yakka Skink typically inhabits dry open forests, woodlands and rocky areas (Wilson and Swan 2013). Although the Mine Site and Access Road may remove some areas of foraging habitat for this species (e.g. eucalypt woodlands and brigalow) it is unlikely that it would result in a significant impact on this species given: • this species has not been recorded within the Mine Site and Access Road area or surrounds despite targeted surveys; • areas of potential habitat for this species (e.g. eucalypt woodlands and brigalow) are likely to occur more widely in the surrounding landscape; and • many areas of potentially suitable habitat are considered to be suboptimal based on the lack of suitable microhabitat features.
Lerista allanae	Allan's Lerista	E	This species is unlikely to occur within the Mine Site and Access Road area as it was not recorded during the recent surveys undertaken by DPM Envirosciences (2018b) and it has not been previously recorded within 50 km of the Mine Site and Access Road area. The Allan's Lerista is restricted to road verges and other small areas with friable soils, amid pastoral land dominated by heavy soils in the vicinity of Capella, Clermont and Logan Downs Station (Wilson and Swan 2013). Suitable habitat for this species was not identified within the Mine Site and Access Road area (DPM Envirosciences, 2018b).
Furina dunmalli	Dunmall's Snake	V	This species is unlikely to occur within the Mine Site and Access Road area as it was not recorded during the recent surveys undertaken by DPM Envirosciences (2018b) and it has not been previously recorded within 50 km of the Mine Site and Access Road area. This species typically inhabits woodlands and dry sclerophyll forest, particularly areas featuring brigalow (Wilson and Swan, 2013). It is determined that that this species is unlikely to occur as the elevation of the Mine Site and Access Road is too low (this species prefer habitat 200 to 500 m AHD [DEE, 2018a]).
Cycas ophiolitica	-	E	This species is unlikely to occur within the Mine Site and Access Road area as it was not recorded during the recent surveys undertaken by DPM Envirosciences (2018b) and it has not been previously recorded within 50 km of the Mine Site and Access Road area. This species grows on hills and slopes in sparse, grassy open forest at altitude ranges from 80–400 m above sea level. Although this species reaches its best development on red clay soils near Marlborough, it is more frequently found on shallow, stony, infertile soils, which are developed on sandstone and serpentinite, and is associated with species such as *Corymbia dallachiana, C. erythrophloia, C. xanthope* and *Eucalyptus fibrosa. Cycas ophiolitica* has also been found on mudstone in association with *Corymbia dallachiana, C. erythrophloia* and *Eucalyptus crebra*, and on alluvial loams with *Corymbia intermedia, Eucalyptus drepanophylla* and *E. tereticornis* (DEE 2018a). Habitat for this species was not identified during the recent floristic surveys undertaken by DPM Envirosciences (2018a).

Table 3-15 (Continued)
Assessments of Other Threatened Species Relevant to the Mine Site and Access Road Area

Species Name	Common Name	Conservation Status[1]	Presence in the Project Locality and Potential Impact
Dichanthium queenslandicum	King Blue-grass	E	King Blue-grass is considered to have potential to occur within the Mine Site and Access Road area as some areas of suitable habitat are present. This species typically inhabits black cracking clay in tussock grasslands mainly in association with other species of blue grasses (*Dichanthium* spp. and *Bothriochloa* spp.), but also with other grasses restricted to this soil type (DEE, 2018a). *D. queenslandicum* is mostly confined to natural grassland on the heavy black clay soils (basalt downs, basalt cracking clay, and open downs) on undulating plains (DEHP 2018i). Although the Mine Site and Access Road may remove some areas of potential habitat for this species it is unlikely that it would result in a significant impact on this species given: • this species has not been recorded within the Mine Site and Access Road area despite targeted surveys; • no areas of Natural Grassland TEC were recorded within the Mine Site and Access road; and • areas of potential habitat for this species are likely to occur more widely in the surrounding landscape.
Dichanthium setosum	Bluegrass	V	Bluegrass is considered to have potential to occur within the Mine Site and Access Road area as some areas of suitable habitat are present. This species has been recorded from the Leichardt, Morton, North Kennedy and Port Curtis regions (Henderson, 1997). It is known to occur in the Mistake Range, in Main Range National Park and possibly in Glen Rock Regional Park. Bluegrass is strongly associated with heavy basaltic black soils and stony red-brown hard-setting loam with clay subsoil (DEE 2018a) and is found in moderately disturbed areas such as cleared woodland, grassy roadside remnants, grazed land and highly disturbed pasture (DEE 2017). Although the Mine Site and Access Road may remove some areas of potential habitat for this species it is unlikely that it would result in a significant impact on this species given: • this species has not been recorded within the Mine Site and Access Road area despite targeted surveys; and • areas of potential habitat for this species are likely to occur more widely in the surrounding landscape.
Eucalyptus raveretiana	Black Ironbox	V	Black Ironbox is considered to have potential to occur within the Mine Site and Access Road area as some areas of suitable habitat are present. This species is known to occur along watercourses and occasionally on river flats. It occurs in open forest or woodland communities, preferring sites with moderately fertile soil and adequate sub-soil moisture. The alluvial soils in which it grows are sands, loams, light clays or cracking clays (DEHP, 2018j). Although the Mine Site and Access Road may remove some areas of potential habitat for this species it is unlikely that it would result in a significant impact on this species given: • this species has not been recorded within the Mine Site and Access Road area despite targeted surveys; and • areas of potential habitat for this species are likely to occur more widely in the surrounding landscape.

Table 3-15 (Continued)
Assessments of Other Threatened Species Relevant to the Mine Site and Access Road Area

Species Name	Common Name	Conservation Status[1]	Presence in the Project Locality and Potential Impact
Samadera bidwillii	Quassia	V	This species is unlikely to occur within the Mine Site and Access Road area as it was not recorded during the recent surveys undertaken by DPM Envirosciences (2018b) and it has not been previously recorded within 50 km of the Mine Site and Access Road area. Quassia commonly occurs in lowland rainforest or on rainforest margins, but it can also be found in other forest types, such as open forest and woodland. Quassia is commonly found in areas adjacent to both temporary and permanent watercourses in locations up to 510 m altitude. The species occurs on lithosols, skeletal soils, loam soils, sands, silts and sands with clay subsoils (DEE, 2018a). Habitat for this species was not identified during the recent floristic surveys undertaken by DPM Envirosciences (2018a).

[1] Threatened Species Status under the EPBC Act (current as of May 2018).

V = Vulnerable.

E = Endangered.

CE = Critically Endangered.

Table 3-16
Likelihood of Significant Adverse Impact of the Mine Site and Access Road on the Brigalow TEC

Assessment Criteria[1] Is the Action likely to:	Assessment
Reduce the extent of an ecological community?	There are two patches of Brigalow TEC totalling approximately 13 ha (represented by RE 11.4.9) that would be removed by the Mine Site and Access Road however these patches are already degraded by edge effects and are highly fragmented. In addition, the TSSC (2001) reports that approximately 804,264 hectares (661,314 ha in Queensland and 142,950 ha in New South Wales) remains. The impact area represents 0.002% of the existing extent of Brigalow TEC. Further to this there are two small patches of Brigalow TEC located within the Project locality that would not be cleared by the Project (Figure 3-3).
Fragment or increase fragmentation of an ecological community, for example by clearing vegetation for roads or transmission lines?	The Brigalow TEC community in the Mine Site and Access Road area are already very fragmented, represented by a few small patches in an otherwise disturbed/agricultural landscape. Although the Mine Site and Access Road would clear approximately 13 ha of Brigalow TEC, no patches would be fragmented further as a result of the Project.
Adversely affect habitat critical to the survival of an ecological community?	There is currently no habitat for the Brigalow TEC listed on the Register for Critical Habitat (DEE, 2018b), however DotE (2013a) identifies that all patches of Brigalow TEC that meet key diagnostic characteristics and condition thresholds for the ecological community are critical to its survival. The two patches of Brigalow TEC that have been mapped within the Mine Site and Access Road area are 7 ha and 6 ha; and meet the condition thresholds for a TEC, although the level of existing fragmentation of the patches of Brigalow TEC within the Project area is high.
Modify or destroy abiotic (non-living) factors (such as water, nutrients, or soil) necessary for an ecological community's survival, including reduction of groundwater levels, or substantial alteration of surface water drainage patterns?	The areas of Brigalow TEC within the Mine Site and Access Road area would be removed by the Project, however the Project would be managed so as not to modify environmental factors necessary for the survival of Brigalow TEC surrounding the Project. The small patches of Brigalow that have been mapped outside the Mine Site and Access Road are each located more than 1 km from the disturbance boundary and it is unlikely that any potential indirect impacts would modify environmental factors necessary for the survival of the Brigalow TEC.
Cause a substantial change in the species composition of an occurrence of an ecological community, including causing a decline or loss of functionally important species, for example through regular burning or flora or fauna harvesting?	As stated above, the areas of Brigalow TEC within the Mine Site and Access Road area would be removed by the Project, however the Project would be managed so as not to modify environmental factors necessary for the survival of Brigalow TEC surrounding the Project. The small patches of Brigalow that have been mapped outside the Mine Site and Access Road are each located more than 1 km from the disturbance boundary and it is unlikely that any potential indirect impacts would result in a substantial change in the species composition of the Brigalow TEC.

Table 3-16 (Continued)
Likelihood of Significant Adverse Impact of the Mine Site and Access Road on the Brigalow TEC

Assessment Criteria[1] Is the Action likely to:	Assessment
Cause a substantial reduction in the quality or integrity of an occurrence of an ecological community, including, but not limited to: • assisting invasive species, that are harmful to the listed ecological community, to become established, or • causing regular mobilisation of fertilisers, herbicides or other chemicals or pollutants into the ecological community which kill or inhibit the growth of species in the ecological community, or	The Brigalow TEC in the Mine Site and Access Road area would be cleared by the Project. After clearing, burning and weed invasion are considered the most significant threats to areas of Brigalow TEC in Queensland (Butler 2007a). The Mine Site and Access Road is unlikely to significantly increase the level of threat from weeds already experienced given, a Weed and Pest Management Plan would prepared for the Project. Similarly the threat of fire would be managed through a Emergency Response Procedure proposed to be implemented for the Project.
Interfere with the recovery of an ecological community?	Land clearance is a recognised threat to Brigalow TEC. The Mine Site and Access Road would require clearance of two patches of Brigalow TEC with a combined area of approximately 13 ha (Figure 3-3). The patches of Brigalow TEC are already small, degraded by edge effects and highly fragmented.

[1] As defined by the *Matters of National Environmental Significance Significant Impact Guidelines 1.1* (DotE, 2013b).

Summary of EPBC Act Assessment

Two small patches of Brigalow TEC (totalling approximately 13 ha) would be cleared as a result of the Mine Site and Access Road, however these patches are small (7 ha and 6 ha), already degraded by edge effects and highly fragmented (DPM Enviros ciences, 2018a).

Two further small patch of Brigalow TEC would be avoided by the Project (Figure 3-3) and it is unlikely that any potential indirect impacts would result in significant impacts to these patches of Brigalow TEC.

Given this, and the mitigation measures proposed to be implemented for the Project, it is unlikely that a significant impact to the Brigalow TEC would result from the Mine Site and Access Road.

3.3.8 Migratory Species

As detailed in Section 3.2.7.4, Migratory species identified within the Terms of Reference or within a search area covering the wider locality include:

- Glossy Ibis;
- Caspian Tern;
- Fork-tailed Swift;
- Oriental Cuckoo;
- White-throated Needletail;
- Black-faced Monarch;
- Yellow Wagtail;
- Satin Flycatcher,
- Curlew Sandpiper;
- Latham's Snipe;
- Osprey; and
- Common Greenshank.

Of these, only the Glossy Ibis, Caspian Tern, Satin Flycatcher and Latham's Snipe were recorded within the Mine Site and Access Road area during the recent surveys by DPM Enviros ciences (2018b).

Potential impacts associated with the Mine Site and Access Road includes the direct removal of potential habitat. The Mine Site and Access Road is not expected to result in any consequential impacts to Migratory species listed under the EPBC Act (DPM Enviros ciences, 2018b).

In summary, it is concluded that the removal of potential habitat associated with the Mine Site and Access Road is unlikely to significantly impact any of these species in accordance with the significant impact criteria detailed in the *Significant Impact Guidelines 1.1: Matters of National Environmental Significance* (DotE, 2013b), as it would not:

- substantially modify (including by fragmenting, altering fire regimes, altering nutrient cycles or altering hydrological cycles), destroy or isolate an area of important habitat for a migratory species;
- result in an invasive species that is harmful to the migratory species becoming established in an area of important habitat for the migratory species; or
- seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of a migratory species.

Given the Mine Site and Access Road is unlikely to significantly impact any Migratory species in listed under the EPBC Act, the Mine Site and Acces Road would not be inconsistent with Australia's obligations under:

(i) the Bonn Convention;

(ii) CAMBA;

(iii) JAMBA;

(iv) an international agreement approved under subsection 209(4) of the EPBC Act;

(v) The Biodiversity Convention;

(vi) The Convention on Conservation of Nature in the South Pacific (Apia Convention); or

(vii) The Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES).

Glossy Ibis

Background/Description

Within Australia, the Glossy Ibis is generally located east of the Kimberley in Western Australia and Eyre Peninsula in South Australia. The species is also known to be patchily distributed in the rest of Western Australia and is rare or a vagrant in Tasmania (DEE, 2018).

Survey Effort

Diurnal bird surveys were conducted during spring (1-14 November 2016) and autumn (23 April to 4 May 2017), with six 20 minute searches conducted within the dedicated survey sites (DPM Enviros ciences, 2018b).

Habitat Assessment and Definition

The Glossy Ibis typically inhabits freshwater marshes at the edges of lakes and rivers, lagoons, flood-plains, wet meadows, swamps, reservoirs, sewage ponds, rice-fields and cultivated areas under irrigation. The species is occasionally found in coastal locations such as estuaries, deltas, saltmarshes and coastal lagoons (Morcombe, 2003).

Within the Mine Site and Access Road area, potential habitat for the species consists of the following habitat types:

- eucalypt dry woodlands on inland depostitional plains;
- eucalypt open forest to woodlands on floodplains;
- palustrine wetlands;
- lacustrine wetlands; and
- waterways.

The Glossy Ibis was recorded three times within the Mine Site and Access Road area during the November 2016 and April-May 2017 field surveys (DPM Enviros ciences, 2018b). The habitat the species was recorded in was eucalypt dry woodlands on inland depositional plains (BVG 5) and palustrine wetlands (BVG 15).

Potential Impacts

The Mine Site and Access Road will result in the removal of potential and known habitat for this species. However, this is unlikely to result in significant impacts to this species given:

- the Mine Site and Access Road impact area is not a known breeding place for the Glossy Ibis which typically breeds in America and across the Atlantic coast, with only five recorded sites across Australia, the closest to the Project being on the South Australian border (DEE, 2018; ALA, 2018);
- the species is wide ranging, with records widespread in Eastern Australia and scattered across Western Australia (ALA, 2018); and
- habitat for the species is abundant outside the Mine Site and Access Road impact area, as indicated by the numerous database records for this species (ALA, 2018).

Avoidance, Mitigation and/or Management Measures

As described in Section 3.3.11 of this document, the following measures would be undertaken by Pembroke to reduce potential adverse impacts on the Glossy Ibis:

- Impact avoidance measures outlined in the table in Section 3.3.11 (since the Glossy Ibis could utilise a variety of habitats).
- Vegetation clearance procedures, including progressive vegetation clearing.

The above measures are predicted to be effective in reducing potential adverse impacts on the Glossy Ibis from the Mine Site and Access Road because they are focused on addressing the recognised threats (i.e degradation of habitat) to the species. A National or State recovery plan has not been prepared for this species.

Summary of EBPC Act Assessment

This species was recorded during the diurnal bird surveys within the Mine Site and Access Road area, however records for this species are widespread and the habitat in the Mine Site and Access Road impact area is not classified as important to the species given it is not a known breeding place and habitat for the species is abundant outside the Mine Site and Access Road impact area. As such, it is not likely the Mine Site and Access Road will have a significant impact on the species habitat given it would not (DotE, 2013):

- substantially modify (including by fragmenting, altering fire regimes, altering nutrient cycles or altering biological) cycles, destroy or isolate an area of important habitat for a migratory species;
- result in an invasive species that is harmful to the migratory species becoming established in an area of important habitat for the migratory species; or
- seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of a migratory species.

Caspian Tern

Background/Description

Within Queensland, the species in widespread throughout coastal regions from the southern Gulf of Carpentaria to the Torres Strait, and along the eastern coast. The species is recorded in the western districts, especially the Lake Eyre Drainage Basin, north-west to the Gulf Country north of Mt Isa and Cloncurry, with scattered records in central Queensland (DEE, 2018).

Survey Effort

Diurnal bird surveys were conducted during spring (1-14 November 2016) and autumn (23 April to 4 May 2017), with six 20 minute searches conducted within the dedicated survey sites (DPM Envirosciences, 2018b).

Habitat Assessment and Definition

This species is mostly found in sheltered coastal embayments (harbours, lagoons, inlets, bays, estuaries and river deltas) and those with sandy or muddy margins are preferred. They also occur on near-coastal or inland terrestrial wetlands that are either fresh or saline, especially lakes (including ephemeral lakes), waterholes, reservoirs, rivers and creeks. They also use artificial wetlands, including reservoirs, sewage ponds and saltworks (DEE, 2018).

Within the Mine Site and Access Road area, potential habitat for the species consists of the following habitat types:

- eucalypt dry woodlands on inland depositional plains;
- palustrine wetlands;
- lacustrine wetlands; and
- waterways.

The Caspian Tern was recorded two times within the Study area during the November 2016 and April-May 2017 field surveys (DPM Envirosciences, 2018b). The habitat the species was recorded in was eucalypt dry woodlands on inland depositional plains (BVG 5) and palustrine wetlands (BVG 15).

The Caspian Tern is classified as a seabird in the *Marine bioregional plan for the North Marine Region* (DSEWPC, 2012a) and the *Marine bioregional plan for the South-west Marine Region* (DSEWPC, 2012b). Given the species classification as a seabird, the Mine Site and Access Road (located approximately 100 km away from the coastline) it is not likely to remove any habitat for the Caspian Tern to the extent that this species would be significantly impacted.

Potential Impacts

The Mine Site and Access Road will result in the removal of potential and known habitat for this species. However, this is unlikely to result in significant impacts to this species given:

- the Mine Site and Access Road impact area is not a known breeding place for the Caspian Tern which typically breeds on the Gulf of Carpentaria, islands off the far north coast (from Bird Island, south to Three Isles) and islands around Shoalwater Bay, including Pelican Rock, south to Fairfax Island. Inland breeding records occur at Lake Bindegolly and Lake Moondarra (DEE, 2018);
- the species is wide ranging, with records primarily along the western coast of Western Australia and South Australia, and scattered across Eastern Australia (DEE, 2018); and
- the species prefers coastal habitats, which are not located in the Mine Site and Access Road area.

Avoidance, Mitigation and/or Management Measures

As described in Section 3.3.11 of this document, the following measures would be undertaken by Pembroke to reduce potential adverse impacts on the Caspian Tern:

- Impact avoidance measures outlined in the table in Section 3.3.11 (since the Caspian could utilise a variety of habitats).
- Vegetation clearance procedures, including progressive vegetation clearing.
- A Weed and Pest Management Plan would be implemented to monitor and control feral animals (such as the Feral Cat) in the Mine Site and Access Road area.

The above measures are predicted to be effective in reducing potential adverse impacts on the Caspian Tern from the Mine Site and Access Road because they are focused on addressing the recognised threats (i.e Feral Cats) to the species. A National or State recovery plan has not been prepared for this species.

Summary of EBPC Act Assessment

This species was recorded during the diurnal bird surveys within the Mine Site and Access Road area, however records for this species are widespread and the habitat in the Mine Site and Access Road impact area is not classified as important to the species given it is not a known breeding place and habitat for the species is abundant outside the Mine Site and Access Road impact area. As such, it is not likely the Mine Site and Access Road will have a significant impact on the species habitat given it would not (DotE, 2013).

- substantially modify (including by fragmenting, altering fire regimes, altering nutrient cycles or altering biological) cycles, destroy or isolate an area of important habitat for a migratory species;
- result in an invasive species that is harmful to the migratory species becoming established in an area of important habitat for the migratory species; or
- seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of a migratory species.

Fork-tailed Swift

Background/Description

In Queensland, there are scattered records of the Fork-tailed Swift in the Gulf Country, and a few records on Cape York Peninsula. In the north-east region there are many records east of the Great Divide from near Cooktown and south to Townsville. They are also widespread but scattered in coastal areas from 20 degrees (º) south, south Brisbane and in much of the south south-eastern region. They are more widespread west of the Great Divide and are commonly found west of the line joining Chinchilla and Hughenden. They are found to the west between Richmond and Winton, Longreach, Gowan Range, Maraila National Park and Dirranbandi. They area rarely found further west to Windorah and Thargomindah (DEE, 2018).

Survey Effort

Diurnal bird surveys were conducted during spring (1-14 November 2016) and autumn (23 April to 4 May 2017), with six 20 minute searches conducted within the dedicated survey sites (DPM Environsciences, 2018b).

Habitat Assessment and Definition

The Fork-tailed Swift is typically an aerial species but also utilises rainforest to semi-desert habitats and is most active just ahead of summer storm fronts (Morcombe, 2003).

Within the Mine Site and Access Road, potential habitat for the Fork-tailed Swift consists of the following habitat types:

- eucalypt dry woodlands on inland depositional plains; and
- other coastal communities and heaths.

This species was not recorded during the recent diurnal bird surveys, however, the species has been recorded at Saraji Mine, approximately 6 km west of the Mine Site and Access Road. However, it is unlikely the species will utilise the habitat within the Mine Site and Access Road area given it is almost exclusively aerial.

Potential Impacts

The Mine Site and Access Road will result in the removal of potential habitat for this species. However, this is unlikely to result in significant impacts to this species given:

- the Mine Site and Access Road impact area is not a known breeding place for the Fork-tailed Swift which is classified as a non-breeding migrant from Asia in Draft referral guideline for 14 birds listed as migratory species under the EPBC Act (DotE, 2015);
- the species is wide ranging, with records of the species in all states and territories of Australia (DEE, 2018); and
- the species is almost exclusively aerial and is unlikely to use the habitat within the Mine Site and Access Road impact area.

Avoidance, Mitigation and/or Management Measures

As described in Section 3.3.11 of this document, the following measures would be undertaken by Pembroke to reduce potential adverse impacts on the Fork-tailed Swift:

- Impact avoidance measures outlined in the table in Section 3.3.11 (since the Fork-tailed Swift could utilise a variety of habitats).
- Vegetation clearance procedures, including progressive vegetation clearing.

- A Weed and Pest Management Plan would be implemented to monitor and control feral animals (such as the Feral Cat) in the Mine Site and Access Road area.

The above measures are predicted to be effective in reducing potential adverse impacts on the Fork-tailed Swift from the Mine Site and Access Road because they are focused on addressing the potential threats to the species (i.e. Feral Cats) and are consistent with the relevant threat abatement actions (e.g. avoiding additional habitat loss and controlling predators and herbivores) (DEE, 2018a). A National or State recovery plan has not been prepared for this species.

Summary of EBPC Act Assessment

This species has been recorded approximately 6 km of the Mine Site and Access Road area, however records for this species are widespread and the habitat in the Mine Site and Access Road impact area is not classified as important to the species given it is a non-breeding migrant and habitat for the species is abundant outside the Mine Site and Access Road impact area. As such, it is not likely the Mine Site and Access Road will have a significant impact on the species habitat given it would not (DotE, 2013).

- substantially modify (including by fragmenting, altering fire regimes, altering nutrient cycles or altering biological) cycles, destroy or isolate an area of important habitat for a migratory species;
- result in an invasive species that is harmful to the migratory species becoming established in an area of important habitat for the migratory species; or
- seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of a migratory species.

Oriental Cuckoo

Background/Description

The Oriental Cuckoo is generally located around the north-east to north-west coastal regions of Australia. The species predominantly occurs around the coasts of Queensland with records found in the eastern regions of New South Wales (DEE, 2018).

Survey Effort

Diurnal bird surveys were conducted during spring (1-14 November 2016) and autumn (23 April to 4 May 2017), with six 20 minute searches conducted within the dedicated survey sites (DPM Environsciences, 2018b).

Habitat Assessment and Definition

The Oriental Cuckoo typically inhabits rainforest margins, monsoon forest, vine scrubs, riverine thickets, wetter, densely canopied eucalypt forests, paperbark swamps and mangroves (Morcombe 2003).

Within the Mine Site and Access Road area, potential habitat for the species consists of the following habitat types:

- eucalypt dry woodlands on inland depositional plains;
- eucalypt open forests to woodlands on floodplains;
- palustrine wetlands;
- lacustrine wetlands; and
- waterways.

The species has not been previously recorded within 50 km of the Mine Site and Access Road area despite targeted surveys. As such, it is not likely that the Mine Site and Access Road will remove any habitat to the extent that the species will be significantly impacted.

Potential Impacts

The Mine Site and Access Road will result in the removal of potential habitat for this species. However, this is unlikely to result in significant impacts to this species given:

- previous targeted searches have found no records of the species within 50 km of the Mine Site and Access Road area;
- the species is classified as a regular non-breeding migrant from Asia in Draft referral guideline for 14 birds listed as migratory species under the EPBC Act (DotE, 2015);
- the species is wide ranging, with scattered records of the species in the north-east and north-west regions of Australia and more densely distributed records across the coast of Queensland and New South Wales (ALA, 2018); and

- habitat is abundant for the species given the numerous records of the species found along the coast of northern and eastern Australia (ALA, 2018).

Avoidance, Mitigation and/or Management Measures

As described in Section 3.3.11 of this document, the following measures would be undertaken by Pembroke to reduce potential adverse impacts on the Oriental Cuckoo:

- Impact avoidance measures outlined in the table in Section 3.3.11 (since the Oriental Cuckoo could utilise a variety of habitats).
- Vegetation clearance procedures, including progressive vegetation clearing.
- A Weed and Pest Management Plan would be implemented to monitor and control feral animals (such as the Feral Cat) in the Mine Site and Access Road area.

The above measures are predicted to be effective in reducing potential adverse impacts on the Oriental Cuckoo from the Mine Site and Access Road because they are focused on addressing the potential threats to the species (i.e. Feral Cats) and are consistent with the relevant threat abatement actions (e.g. avoiding additional habitat loss and controlling predators and herbivores) (DEE, 2018a). A National or State recovery plan has not been prepared for this species.

Summary of EBPC Act Assessment

This species was not recorded not during the diurnal bird surveys and previous targeted species surveys within the Mine Site and Access Road area and habitat in the Mine Site and Access Road impact area is not a known breeding place given the species is a non-breeding migrant and habitat for the species is abundant outside the Mine Site and Access Road impact area. As such, it is not likely the Mine Site and Access Road will have a significant impact on the species habitat given it would not (DotE, 2013).

- substantially modify (including by fragmenting, altering fire regimes, altering nutrient cycles or altering biological) cycles, destroy or isolate an area of important habitat for a migratory species;
- result in an invasive species that is harmful to the migratory species becoming established in an area of important habitat for the migratory species; or
- seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of a migratory species.

White-throated Needletail

Background/Description

The White-throated Needletail is widespread in eastern and south-eastern Australia (DEE, 2018). In eastern Australia, it is recorded in all coastal regions of Queensland and New South Wales, extending inland to the western slopes of the Great Divide and occasionally onto the adjacent inland plains (DEE, 2018).

Survey Effort

Diurnal bird surveys were conducted during spring (1-14 November 2016) and autumn (23 April to 4 May 2017), with six 20 minute searches conducted within the dedicated survey sites (DPM Environsciences, 2018b).

Habitat Assessment and Definition

In Australia, the White-throated Needletail is almost exclusively aerial (DEE, 2018). Although this species occurs over most types of habitat, they are recorded most often above wooded areas, including open forest and rainforest, and may also fly between trees or in clearings, below the canopy, but they are less commonly recorded flying above woodland (DEE, 2018).

Within the Mine Site and Access Road area, potential habitat for the species consists of the following habitat types:

- eucalypt dry woodlands on inland depositional plains; and
- eucalypt open forests, woodlands and shrublands.

This species has not been previously recorded within 50 km of the Mine Site and Access Road area despite targeted surveys. As such, it is unlikely that the Mine Site and Access Road will remove any habitat to the extent that the species is significantly impacted.

Potential Impacts

The Mine Site and Access Road will result in the removal of potential habitat for this species. However, this is unlikely to result in significant impacts to this species given:

- previous targeted searches have found no records of the species within 50 km of the Mine Site and Access Road area;
- the species is classified as a regular non-breeding migrant from Asia in Draft referral guideline for 14 birds listed as migratory species under the EPBC Act (DotE, 2015);
- the species is wide ranging, with scattered records of the species in the northern and eastern regions of Queensland and more densely distributed records across the coast of New South Wales and south-east Australia (ALA, 2018); and
- Habitat for the species is abundant given the dense population of records around eastern Australia and south to Tasmania (ALA, 2018).

Avoidance, Mitigation and/or Management Measures

As described in Section 3.3.11 of this document, the following measures would be undertaken by Pembroke to reduce potential adverse impacts on the White-throated Needletail:

- Impact avoidance measures outlined in the table in Section 3.3.11 (since the White-throated Needletail could utilise a variety of habitats).
- Vegetation clearance procedures, including progressive vegetation clearing.

The above measures are predicted to be effective in reducing potential adverse impacts on the White-throated Needletail from the Mine Site and Access Road because they are consistent with the relevant threat abatement actions (e.g. avoiding additional habitat loss and controlling predators and herbivores) (DEE, 2018a). A National or State recovery plan has not been prepared for this species.

Summary of EBPC Act Assessment

This species was not recorded not during the diurnal bird surveys and previous targeted species surveys within the Mine Site and Access Road area and habitat in the Mine Site and Access Road impact area is not a known breeding place given the species is a non-breeding migrant and habitat for the species is abundant outside the Mine Site and Access Road impact area. As such, it is not likely the Mine Site and Access Road will have a significant impact on the species habitat given it would not (DotE, 2013).

- substantially modify (including by fragmenting, altering fire regimes, altering nutrient cycles or altering biological) cycles, destroy or isolate an area of important habitat for a migratory species;
- result in an invasive species that is harmful to the migratory species becoming established in an area of important habitat for the migratory species; or
- seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of a migratory species.

Black-faced Monarch

Background/Description

The Black-faced Monarch is widespread in eastern Australia. In Queensland, it is widespread from the islands of the Torres Strait and on Cape York Peninsula, south along the coasts (occasionally including offshore islands) and the eastern slopes of the Great Divide, to the New South Wales border (DEE, 2018).

Survey Effort

Diurnal bird surveys were conducted during spring (1-14 November 2016) and autumn (23 April to 4 May 2017), with six 20 minute searches conducted within the dedicated survey sites (DPM Environsciences, 2018b).

Habitat Assessment and Definition

The Black-faced Monarch typically inhabits rainforests, mangroves, eucalypt forests and woodlands (Morcombe, 2003).

Within the Mine Site and Access Road area, potential habitat for the species consists of the following habitat types:

- eucalypt dry woodlands on inland depositional plains; and
- eucalypt open forests, woodlands and shrublands.

This species was not recorded during the recent fauna surveys, however the species has been recorded approximately 15 km west of the Mine Site and Access Road (ALA, 2018). However, it is unlikely that the Mine Site and Access Road will remove habitat to the extent that the species is significantly impacted as it is not a breeding place for the species and habitat is abundant outside the Mine Site and Access Road impact area.

Potential Impacts

The Mine Site and Access Road will result in the removal of potential habitat for this species. However, this is unlikely to result in significant impacts to this species given:

- the Mine Site and Access Road area is not a known breeding place of the species, given the core breeding range for the species is along the coast of Queensland (DotE, 2015);
- the species is widespread in eastern Australia (DEE, 2018); and
- habitat is abundant for the species given the densely recorded coastlines of eastern Australia, from the northern tip of Queensland to Victoria (ALA, 2018).

Avoidance, Mitigation and/or Management Measures

As described in Section 3.3.11 of this document, the following measures would be undertaken by Pembroke to reduce potential adverse impacts on the Black-faced Monarch:

- Impact avoidance measures outlined in the table in Section 3.3.11 (since the Black-faced Monarch could utilise a variety of habitats).
- Vegetation clearance procedures, including progressive vegetation clearing.
- A Weed and Pest Management Plan would be implemented to monitor and control feral animals (such as the Feral Cat) in the Mine Site and Access Road area.

The above measures are predicted to be effective in reducing potential adverse impacts on the Black-faced Monarch from the Mine Site and Access Road because they are focused on addressing the potential threats to the species (i.e. Feral Cats) and are consistent with the relevant threat abatement actions (e.g. avoiding additional habitat loss and controlling predators and herbivores) (DEE, 2018a). A National or State recovery plan has not been prepared for this species.

Summary of EBPC Act Assessment

This species was not recorded within approximately 15 km of the Mine Site and Access Road area, however the potential habitat in the Mine Site and Access Road impact area is not considered important given it is not a known breeding place and habitat for the species is abundant outside the Mine Site and Access Road impact area. As such, it is not likely the Mine Site and Access Road will have a significant impact on the species habitat given it would not (DotE, 2013).

- substantially modify (including by fragmenting, altering fire regimes, altering nutrient cycles or altering biological) cycles, destroy or isolate an area of important habitat for a migratory species;
- result in an invasive species that is harmful to the migratory species becoming established in an area of important habitat for the migratory species; or
- seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of a migratory species.

Yellow Wagtail

Background/Description

The Yellow Wagtail has been recorded across the whole of Australia, with scattered sightings in the coastal regions (ALA, 2018).

Survey Effort

Diurnal bird surveys were conducted during spring (1-14 November 2016) and autumn (23 April to 4 May 2017), with six 20 minute searches conducted within the dedicated survey sites (DPM Environsciences, 2018b).

Habitat Assessment and Definition

The Yellow Wagtail typically inhabits open habitats, often near water; in Queensland it is usually coastal (Morcombe, 2003).

Within the Mine Site and Access Road area, potential habitat for the species consists of the following habitat types:

- eucalypt dry woodlands on inland depositional plains; and
- eucalypt open forests, woodlands and shrublands.

This species has not been previously recorded within 50 km of the Mine Site and Access Road area despite targeted surveys. As such, it is unlikely that the Mine Site and Access Road will remove any potential habitat to the extent that the species will be significantly impacted.

Potential Impacts

The Mine Site and Access Road will result in the removal of potential habitat for this species. However, this is unlikely to result in significant impacts to this species given:

- previous targeted searches have found no records of the species within 50 km of the Mine Site and Access Road area;
- the species is classified as an extremely uncommon non-breeding migrant in Draft referral guideline for 14 birds listed as migratory species under the EPBC Act (DotE, 2015); and
- small numbers of this species visits Australia, with sparse records across Australia (ALA, 2018).

Avoidance, Mitigation and/or Management Measures

As described in Section 3.3.11 of this document, the following measures would be undertaken by Pembroke to reduce potential adverse impacts on the Yellow Wagtail:

- Impact avoidance measures outlined in the table in Section 3.3.11 (since the Yellow Wagtail could utilise a variety of habitats).
- Vegetation clearance procedures, including progressive vegetation clearing.

The above measures are predicted to be effective in reducing potential adverse impacts on the Yellow Wagtail from the Mine Site and Access Road because they are consistent with the relevant threat abatement actions (e.g. avoiding additional habitat loss and controlling predators and herbivores) (DEE, 2018a). A National or State recovery plan has not been prepared for this species.

Summary of EBPC Act Assessment

This species was not recorded not during the diurnal bird surveys and previous targeted species surveys within the Mine Site and Access Road area and habitat in the Mine Site and Access Road impact area is not a known breeding place given the species is a non-breeding migrant and is extremely uncommon to Australia. As such, it is not likely the Mine Site and Access Road will have a significant impact on the species habitat given it would not (DotE, 2013).

- substantially modify (including by fragmenting, altering fire regimes, altering nutrient cycles or altering biological) cycles, destroy or isolate an area of important habitat for a migratory species;
- result in an invasive species that is harmful to the migratory species becoming established in an area of important habitat for the migratory species; or
- seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of a migratory species.

Satin Flycatcher

Background/Description

The Satin Flycatcher is widespread in eastern Australia and a vagrant to New Zealand. In Queensland, it is widespread but scattered in the east, being recorded on passage on a few islands in the western Torres Strait. It is patchily recorded on Cape York Peninsula, from the Cape south to a line between Aurukun and Coen. The species is more widespread further south, though still scattered, from Musgrave Station south to c. 24ºS, mostly in coastal areas, but also on the Great Divide and occasionally further west. Satin flycatchers are widespread in south-eastern Queensland, in the area from Fraser Island, west to Goombi and south to the NSW border (DEE, 2018).

Survey Effort

Diurnal bird surveys were conducted during spring (1-14 November 2016) and autumn (23 April to 4 May 2017), with six 20 minute searches conducted within the dedicated survey sites (DPM Environsciences, 2018b).

Habitat Assessment and Definition

The Satin Flycatcher typically inhabits forests and woodlands, mangroves, coastal heath scrubs; in breeding season favours dense, wet gullies of heavy eucalypt forests (Morcombe, 2003).

Within the Mine Site and Access Road area, potential habitat for the species consists of the following habitat types:

- eucalypt dry woodlands on inland depositional plains; and
- eucalypt open forests, woodlands and shrublands.

This species has been recorded at one location within the Mine Site and Access Road area (DPM Enviroscienses, 2018b). The habitat the species was recorded in was eucalypt dry woodlands on inland depositional plains (BVG 5). However, it is unlikely that the Mine Site and Access Road will remove any known or potential habitat to the extent that the species is significantly impacted give the species is highly mobile and the area is not a known breeding place.

Potential Impacts

The Mine Site and Access Road will result in the removal of potential and known habitat for this species. However, this is unlikely to result in significant impacts to this Satin Flycatcher given:

- the Mine Site and Access Road impact area is not a known breeding place (DotE, 2015);
- the species is highly mobile, with records widespread across the coasts of Eastern Australia and Tasmania (ALA, 2018); and
- habitat for the species is abundant outside the Project impact area, as indicated by the numerous database records for this species (ALA, 2018).

Avoidance, Mitigation and/or Management Measures

As described in Section 3.3.11 of this document, the following measures would be undertaken by Pembroke to reduce potential adverse impacts on the Satin Flycatcher:

- Impact avoidance measures outlined in the table in Section 3.3.11 (since the Satin Flycatcher could utilise a variety of habitats).
- Vegetation clearance procedures, including progressive vegetation clearing.

The above measures are predicted to be effective in reducing potential adverse impacts on the Satin Flycatcher from the Mine Site and Access Road because they are consistent with the relevant threat abatement actions (e.g. avoiding additional habitat loss) (DEE, 2018a). A National or State recovery plan has not been prepared for this species.

Summary of EBPC Act Assessment

This species was recorded during the diurnal bird surveys within the Mine Site and Access Road area, however records for this species are widespread and habitat in the Mine Site and Access Road impact area is not classified as important given it is not a known breeding place and habitat for the species is abundant outside the Mine Site and Access Road impact area. As such, it is not likely the Mine Site and Access Road will have a significant impact on the species habitat given it would not (DotE, 2013).

- substantially modify (including by fragmenting, altering fire regimes, altering nutrient cycles or altering biological) cycles, destroy or isolate an area of important habitat for a migratory species;
- result in an invasive species that is harmful to the migratory species becoming established in an area of important habitat for the migratory species; or
- seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of a migratory species.

Curlew Sandpiper

Background/Description

In Australia, Curlew Sandpipers occur around the coasts and are also quite widespread inland, though in smaller numbers. In Queensland, scattered records occur in the Gulf of Carpentaria, with widespread record along the coast south of Cairns. There are sparsely scattered records inland (DEE, 2018).

Survey Effort

Diurnal bird surveys were conducted during spring (1-14 November 2016) and autumn (23 April to 4 May 2017), with six 20 minute searches conducted within the dedicated survey sites (DPM Environsciences, 2018b).

Habitat Assessment and Definition

The Curlew Sandpiper typically occurs on intertidal mudflats in sheltered coastal areas, such as estuaries, bays, inlets and lagoons, and also around non-tidal swamps, lakes and lagoons near the coast, and ponds in saltworks and sewage farms. They are also recorded inland, though less often, including around ephemeral and permanent lakes, dams, waterholes and bore drains, usually with bare edges of mud or sand. They occur in both fresh and brackish waters (DotE, 2015).

Within the Mine Site and Access Road area, potential habitat for this species consists of the following habitat types:

- palustrine wetlands;
- lacustrine wetlands; and
- waterways.

This species has not been previously recorded within 50 km of the Mine Site and Access Road area despite targeted surveys. As such, it is unlikely that the Mine Site and Access Road will remove any potential habitat to the extent that the species is significantly impacted.

Potential Impacts

The Mine Site and Access Road will result in the removal of potential habitat for this species. However, this is unlikely to result in significant impacts to this species given:

- previous targeted searches have found no records of the species within 50 km of the Mine Site and Access Road area;
- the species is classified as a migratory shorebird in Marine bioregional plan for the North-west Marine Region (DSEWPC, 2012c);
- the species does not breed in Australia (DotE, 2015);
- The Mine Site and Access Road area is not classified as internationally important to the species (Bamford et al., 2008) per the Wildlife Conservation Plan for Migratory Shorebirds (DotE, 2015);
- the species is wide ranging, with densely distributed records along the coastline of Australia (ALA, 2018); and
- habitat is abundant for the species given the densely populated coastlines of Australia (ALA, 2018).

Avoidance, Mitigation and/or Management Measures

As described in Section 3.3.11 of this document, the following measures would be undertaken by Pembroke to reduce potential adverse impacts on the Curlew Sandpiper:

- Impact avoidance measures outlined in the table in Section 3.3.11 (since the Curlew Sandpiper could utilise a variety of habitats).
- A Weed and Pest Management Plan would be implemented to monitor and control feral animals (such as the Feral Cat and European Red Fox) in the Mine Site and Access Road area.
- Vegetation clearance procedures, including progressive vegetation clearing.

The above measures are predicted to be effective in reducing potential adverse impacts on the Curlew Sandpiper from the Mine Site and Access Road because they are consistent with the relevant threat abatement actions (e.g. avoiding additional habitat loss and controlling predators and herbivores) (DEE, 2018a). A National or State recovery plan has not been prepared for this species.

Summary of EBPC Act Assessment

This species was not recorded not during the diurnal bird surveys and previous targeted species surveys within the Mine Site and Access Road area and habitat in the Mine Site and Access Road impact area is not classified as important given it is not a known breeding place given the species is a non-breeding migrant and habitat for the species is abundant outside the Mine Site and Access Road impact area. As such, it is not likely the Mine Site and Access Road will have a significant impact on the species habitat given it would not (DotE, 2013).

- substantially modify (including by fragmenting, altering fire regimes, altering nutrient cycles or altering biological) cycles, destroy or isolate an area of important habitat for a migratory species;
- result in an invasive species that is harmful to the migratory species becoming established in an area of important habitat for the migratory species; or
- seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of a migratory species.

Latham's Snipe

Background/Description

Latham's Snipe is a non-breeding visitor to south-eastern Australia, and is a passage migrant throughout northern Australia. The species has been recorded along the east coast of Australia from Cape York Peninsula through to south-eastern South Australia (including the Adelaide plains and Mount Lofty Ranges, and the Eyre Peninsula). The range extends inland over the eastern tablelands in south-eastern Queensland (and occasionally Rockhampon in the north), and west of the Great Dividing Range in New South Wales (DEE, 2018).

Survey Effort

Diurnal bird surveys were conducted during spring (1-14 November 2016) and autumn (23 April to 4 May 2017), with six 20 minute searches conducted within the dedicated survey sites (DPM Environsciences, 2018b).

Habitat Assessment and Definition

The Latham's Snipe typically inhabits low vegetation around wetlands in shallows, sedges, reeds, heath, salt marsh, irrigated crops (Morcombe, 2003). It is a non-breeding visitor that will readily move between locations as conditions become more or less favourable (DotE, 2015).

Within the Mine Site and Access Road area, potential habitat for the species consists of the following habitat types:

- lacustrine wetlands;
- palustrine wetlands; and
- waterways.

This species has been recorded at one location within the Mine Site and Access Road area and a second location, approximately 5 km west of the Mine Site and Access Road (DPM Envirosciences, 2018b).The habitat the species was recorded in was eucalypt dry woodlands on inland depositional plains (BVG 5). However, the species is a non-breeding passage migrant and the Mine Site and Access Road is not a classified important habitat. As such, the Mine Site and Access road would not remove any known or potential habitat to the extent that the species is significantly impacted.

Potential Impacts

The Mine Site and Access Road will result in the removal of potential and known habitat for this species. However, this is unlikely to result in significant impacts to this species given:

- Latham's Snipe is a non-breeding migrant to Australia and breeds in Japan and far eastern Russia (DEE, 2018);
- The Mine Site and Access Road area is not classified as internationally important to the species (Bamford et al., 2008) per the Wildlife Conservation Plan for Migratory Shorebirds (DotE, 2015) guidelines;
- the species is wide ranging, with records widespread in eastern Australia and Tasmania (ALA, 2018); and
- habitat for the species is abundant outside the Mine Site and Access Road impact area, as indicated by the numerous database records for this species (ALA, 2018).

Avoidance, Mitigation and/or Management Measures

As described in Section 3.3.11 of this document, the following measures would be undertaken by Pembroke to reduce potential adverse impacts on Latham's Snipe:

- Impact avoidance measures outlined in the table in Section 3.3.11 (since Latham's Snipe could utilise a variety of habitats).
- A Weed and Pest Management Plan would be implemented to monitor and control feral animals (such as the European Red Fox) in the Mine Site and Access Road area.
- Vegetation clearance procedures, including progressive vegetation clearing.

The above measures are predicted to be effective in reducing potential adverse impacts on Latham's Snipe from the Mine Site and Access Road because they are focused on addressing the recognised threats (i.e. degradation of habitat and European Red Fox) to the species. A National or State recovery plan has not been prepared for this species.

Summary of EBPC Act Assessment

This species was recorded during the diurnal bird surveys within the Mine Site and Access Road area, however records for this species are widespread and the habitat in the Mine Site and Access Road impact area is not classified as important to the species as it is a non-breeding migrant and habitat for the species is abundant outside the Mine Site and Access Road impact area. As such, it is not likely the Mine Site and Access Road will have a significant impact on the species habitat given it would not (DotE, 2013):

- substantially modify (including by fragmenting, altering fire regimes, altering nutrient cycles or altering biological) cycles, destroy or isolate an area of important habitat for a migratory species;
- result in an invasive species that is harmful to the migratory species becoming established in an area of important habitat for the migratory species; or
- seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of a migratory species.

Osprey

Background/Description

The breeding range of the Osprey extends around the northern coast of Australia (including many offshore islands) from Albany in Western Australia to Lack Macquarie in New South Wales; with a second isolated breeding population on the coast of South Australia, extending from Head of Bight east to Cape Spencer and Kangaroo Island. The total range (breeding and non-breeding) around the northern coast is more widespread, extending from Esperance in Western Australia to NSW, where records become scarcer towards the south, and into Victoria and Tasmania, where the species is a rare vagrant. The distribution of the species around the northern coast (south-western Western Australia to south-eastern NSW) appears continuous except for a possible gap at Eighty Mile Beach (DEE, 2018).

Survey Effort

Diurnal bird surveys were conducted during spring (1-14 November 2016) and autumn (23 April to 4 May 2017), with six 20 minute searches conducted within the dedicated survey sites (DPM Environsciences, 2018b).

Habitat Assessment and Definition

Ospreys occur in littoral and coastal habitats and terrestrial wetlands of tropical and temperate Australia and offshore islands. They are mostly found in coastal areas but occasionally travel inland along major rivers, particularly in northern Australia. They require extensive areas of open fresh, brackish or saline water for foraging (DotE, 2015).

Within the Mine Site and Access Road area, potential habitat for the species consists of the following habitat types:

- palustrine wetlands;
- lacustrine wetlands; and
- waterways.

This species has not been previously recorded within 50 km of the Mine Site and Access Road area despite targeted surveys. As such, the Mine Site and Access Road will not result in the removal of potential habitat to the extent that the species is significantly impacted.

Potential Impacts

The Mine Site and Access Road will result in the removal of potential habitat for this species. However, this is unlikely to result in significant impacts to this species given:

- previous targeted searches have found no records of the species within 50 km of the Mine Site and Access Road area;
- the Mine Site and Access Road area is not a known breeding habitat for the species, which typically breeds in the coast of northern Australia and South Australia (DEE, 2018);
- it is widespread across the coasts of Australia and a nationally protected species of the South-east Marine Region in the South-east marine region profile, a description of the ecosystems, conservation values and uses of the South-east Marine region (DotE, 2015; ALA, 2018).

Avoidance, Mitigation and/or Management Measures

As described in Section 3.3.11 of this document, the following measures would be undertaken by Pembroke to reduce potential adverse impacts on the Osprey:

- Impact avoidance measures outlined in the table in Section 3.3.11 (since the Osprey could utilise a variety of habitats).
- Vegetation clearance procedures, including progressive vegetation clearing.

The above measures are predicted to be effective in reducing potential adverse impacts on the Osprey from the Mine Site and Access Road because they are consistent with the relevant threat abatement actions (e.g. avoiding additional habitat loss and controlling predators) (DEE, 2018a). A National or State recovery plan has not been prepared for this species.

Summary of EBPC Act Assessment

This species was not recorded not during the diurnal bird surveys and previous targeted species surveys within the Mine Site and Access Road area and habitat in the Mine Site and Access Road impact area is not classified as important given it is not a known breeding place and habitat for the species is abundant outside the Mine Site and Access Road impact area. As such, it is not likely the Mine Site and Access Road will have a significant impact on the species habitat given it would not (DotE, 2013):

- substantially modify (including by fragmenting, altering fire regimes, altering nutrient cycles or altering biological) cycles, destroy or isolate an area of important habitat for a migratory species;
- result in an invasive species that is harmful to the migratory species becoming established in an area of important habitat for the migratory species; or
- seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of a migratory species.

Common Greenshank

Background/Description

The Common Greenshank does not breed in Australia; however, the species occurs in all types of wetlands and has the widest distribution of any shorebird in Australia. In Queensland, the Common Greenshank is widespread in the Gulf country and eastern Gulf of Carpentaria. It has been recorded in most coastal regions, possibly with a gap between north Cape York Peninsula and Cooktown. Inland, there have been a few records south of a line from near Dalby to MT Guide, and sparsely scattered records elsewhere (DEE, 2018).

Habitat Assessment and Definition

Diverse inland and coastal areas; away from the coast uses both permanent and temporary wetlands – billabongs, swamps, lakes, floodplains, flooded irrigated crops, sewage farms and saltworks ponds; prefers wet and flooded mud and clay rather than sand (Morcombe 2003).

Within the Mine Site and Access Road area, potential habitat for the species consists of the following habitat types:

- palustrine wetlands;
- lacustrine wetlands; and
- waterways.

This species was not recorded during the recent fauna surveys, however the species has been recorded approximately 25 km west of the Mine Site and Access Road (ALA, 2018). It is unlikely, however, that the Mine Site and Access Road will remove potential habitat to the extent that the species will be significantly impacted, given it does not breed in Australia and the impact area is not classified as important to the species.

Potential Impacts

The Mine Site and Access Road will result in the removal of potential habitat for this species. However, this is unlikely to result in significant impacts to this species given:

- it does not breed in Australia (DEE, 2018);
- the Mine Site and Access Road area is not classified as internationally important to the species (Bamford et al., 2008) per the Wildlife Conservation Plan for Migratory Shorebirds (DotE, 2015) guidelines;
- the species is wide ranging, with dense records of the species along the coast of Australia and scattered records inland (ALA, 2018); and
- habitat for the species is abundant outside the Mine Site and Access Road area, as indicated by the numerous records for this species (ALA, 2018).

Avoidance, Mitigation and/or Management Measures

As described in Section 3.3.11 of this document, the following measures would be undertaken by Pembroke to reduce potential adverse impacts on the Common Greenshank:

- Impact avoidance measures outlined in the table in Section 3.3.11 (since the Common Greenshank could utilise a variety of habitats).
- Vegetation clearance procedures, including progressive vegetation clearing.

The above measures are predicted to be effective in reducing potential adverse impacts on the Common Greenshank from the Mine Site and Access Road because they are focused on addressing the potential threats to the species (i.e. degradation of habitat) and are consistent with the relevant threat abatement actions (e.g. avoiding additional habitat loss and controlling predators and herbivores) (DEE, 2018a). A National or State recovery plan has not been prepared for this species.

Summary of EBPC Act Assessment

This species was recorded within 25 km of the Mine Site and Access Road area (ALA, 2018), however records for this species are widespread and habitat in the Mine Site and Access Road impact area is not classified as important to the species given it is not a known breeding place given the species does not breed in Australia and habitat for the species is abundant outside the Mine Site and Access Road impact area. As such, it is not likely the Mine Site and Access Road will have a significant impact on the species habitat given it would not (DotE, 2013):

- substantially modify (including by fragmenting, altering fire regimes, altering nutrient cycles or altering biological) cycles, destroy or isolate an area of important habitat for a migratory species;
- result in an invasive species that is harmful to the migratory species becoming established in an area of important habitat for the migratory species; or
- seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of a migratory species.

3.3.9 Impacts on Water Resources

A detailed reconciliation against each of the IESC information requirements relating to groundwater and surface water resources is presented in the Groundwater Assessment (Appendix D) and Surface Water Assessment (Appendix E).

The following subsections have been largely re-produced based on these assessments.

Potential impacts of the Mine Site and Access Road on water resources have been considered and described based on the following assessments:

- Groundwater Assessment, prepared by HydroSimulations (2018);
- Surface Water Assessment, prepared by Hatch (2018a);
- Geomorphology Assessment, prepared by Fluvial Systems (2018);
- Geochemistry Assessment, prepared by Terrenus Earth Sciences (2018);
- Aquatic Ecology Assessment, prepared by DPM Envirosciences (2018); and
- Flood Assessment, undertaken by Hatch (2018b).

Each of the above assessments are provided as separate appendices with supporting reports/studies as follows which are referred below:

- Groundwater Assessment (Appendix D) (HydroSimulations, 2018)
  - Appendix A: Fieldwork Appendix:
    - Attachment A4: TEM Survey Report (Groundwater Imaging Pty Ltd, 2017)
    - Attachment A5: Bore Census Report (ERNS, 2018)
  - Appendix B: Modelling Appendix:
    - Chapter 5: Sensitivity Analysis
    - Chapter 6: Uncertainty Analysis
- Surface Water Assessment (Appendix E) (Hatch, 2018a): including:
  - Attachment A: Geomorphology Assessment (Fluviual Systems, 2018)
- Flood Assessment (Appendix F) (Hatch, 2018b);
- Geochemistry Assessment (Appendix L) (Terrenus Earth Sciences, 2018); and
- Aquatic Ecology Assessment (Appendix C) (DPM Envirosciences, 2018), including:
  - Chapter 6.5: Subterranean Fauna (Stygofauna); and
  - Chapter 6.6: Groundwater Dependent Ecosystems.

The Groundwater Assessment, Surface Water Assessment, Flood Assessment and Geochemistry Assessment have been peer reviewed by suitably qualified and experienced experts in their respective fields, including:

- Dr Frans Kalf (groundwater);
- Mr Tony Marszalek (surface water and flood); and
- Dr Alan Robertson (geochemistry).

The Groundwater Assessment (Appendix D) has considered the cumulative drawdown impacts of the Mine Site and Access Road and surrounding mines (existing and approved), as well as the approved Bowen Gas Project.

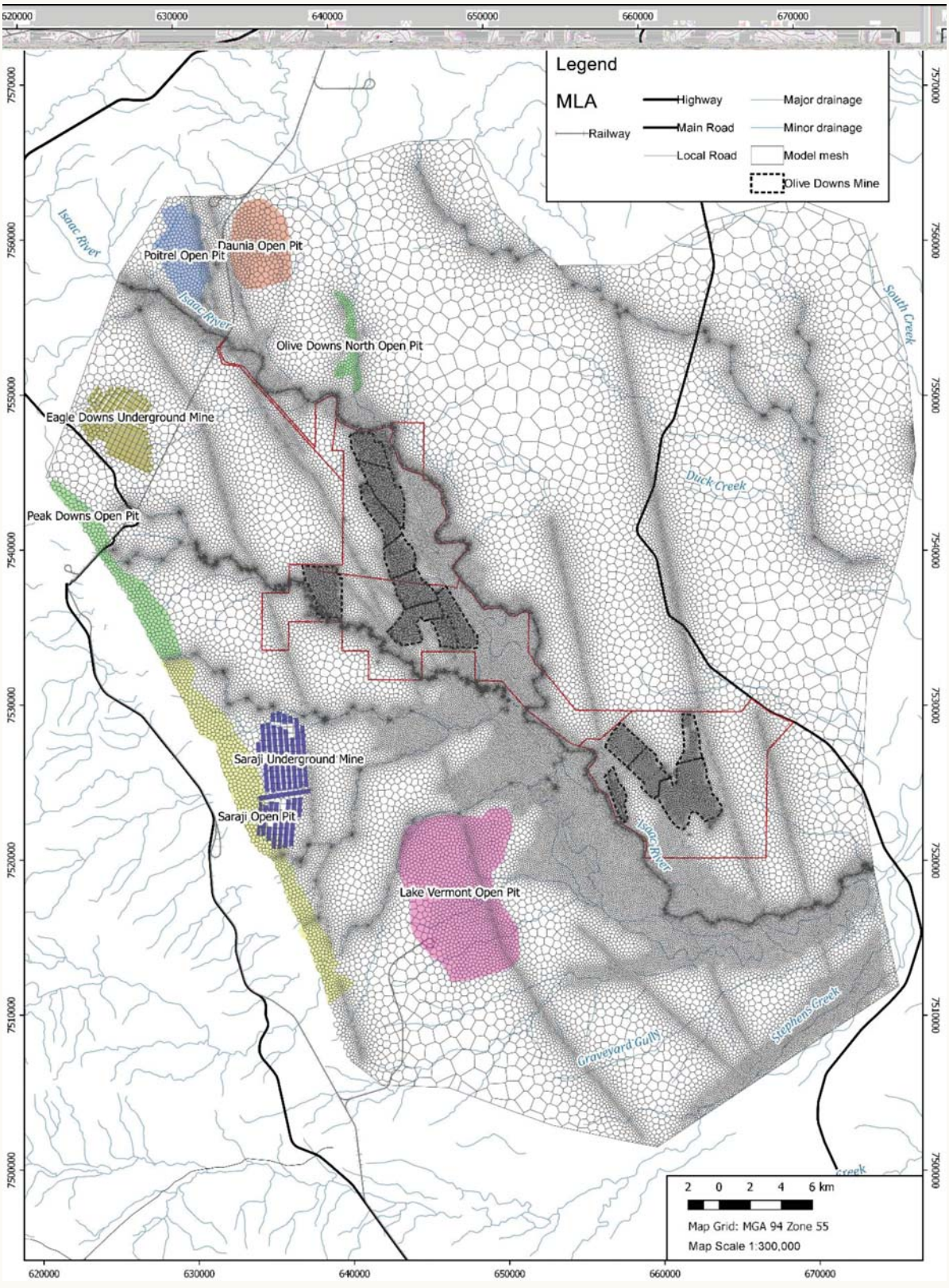
The surrounding mines within the groundwater model include Poitrel, Daunia, Peak Downs, Lake Vermont, Eagle Downs and Saraji (Figure 3-7).

The Surface Water Assessment (Appendix E) has included a cumulative assessment of catchment excision and controlled releases from both the Mine Site and Access Road area and surrounding mines (existing and approved), as well as the approved Bowen Gas Project.

The flood hydrology model developed as part of the Flood Assessment (Appendix F) includes the main branch and tributaries of the Isaac River covering an area of approximately 9,601 km^2 (Figure 3-8). Based on the review of past flood studies for surrounding mines/projects, three existing or approved levees were identified in the region (i.e. Olive Downs North, Lake Vermont and Poitrel) however, only the approved Olive Downs North levees were located at/within the hydraulic model extent in the Flood Assessment (Figure 3-8).

3.3.9.1 Topography, Landform and Catchments

The general landscape of the Mine Site and Access Road area includes gently undulating to flat plains, with elevations of approximately 200 metres (m) Australian Height Datum (AHD). The overall elevation of the Mine Site and Access Road area ranges from 150 m AHD in the low-lying south-east of the Willunga domain to 200 m AHD in the higher areas to the west and north-west of the Mine Site and Access Road area (Figure 3-9).



PRN-16-02_EIS_Sect3_016C

Source: HydroSimulations (2018)

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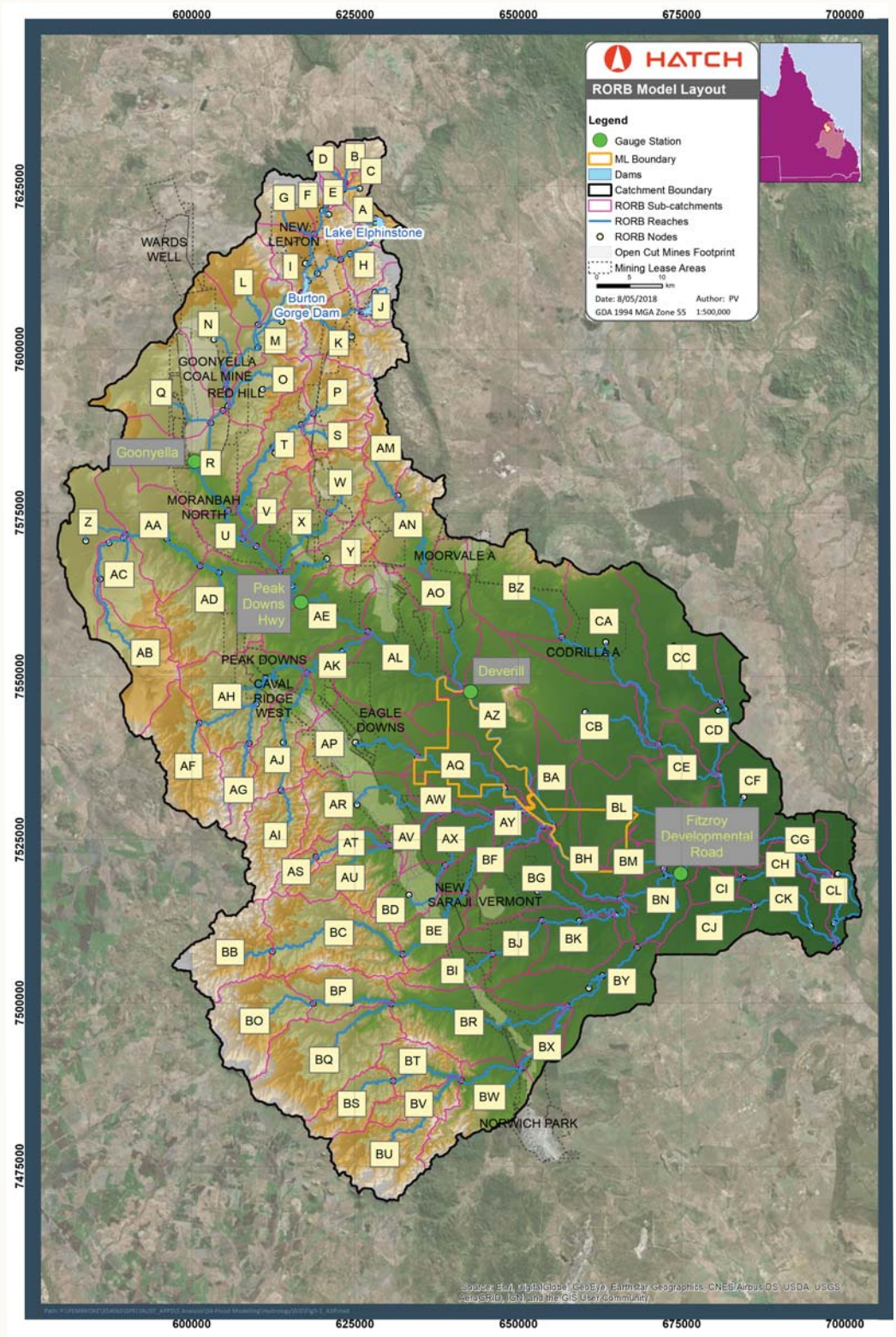
OLIVE DOWNS COKING COAL PROJECT

Numerical Groundwater Flow
Model Extents

Figure 3-7



PRN-116-02_EIS_Sect3_017B

Source: Hatch (2018)

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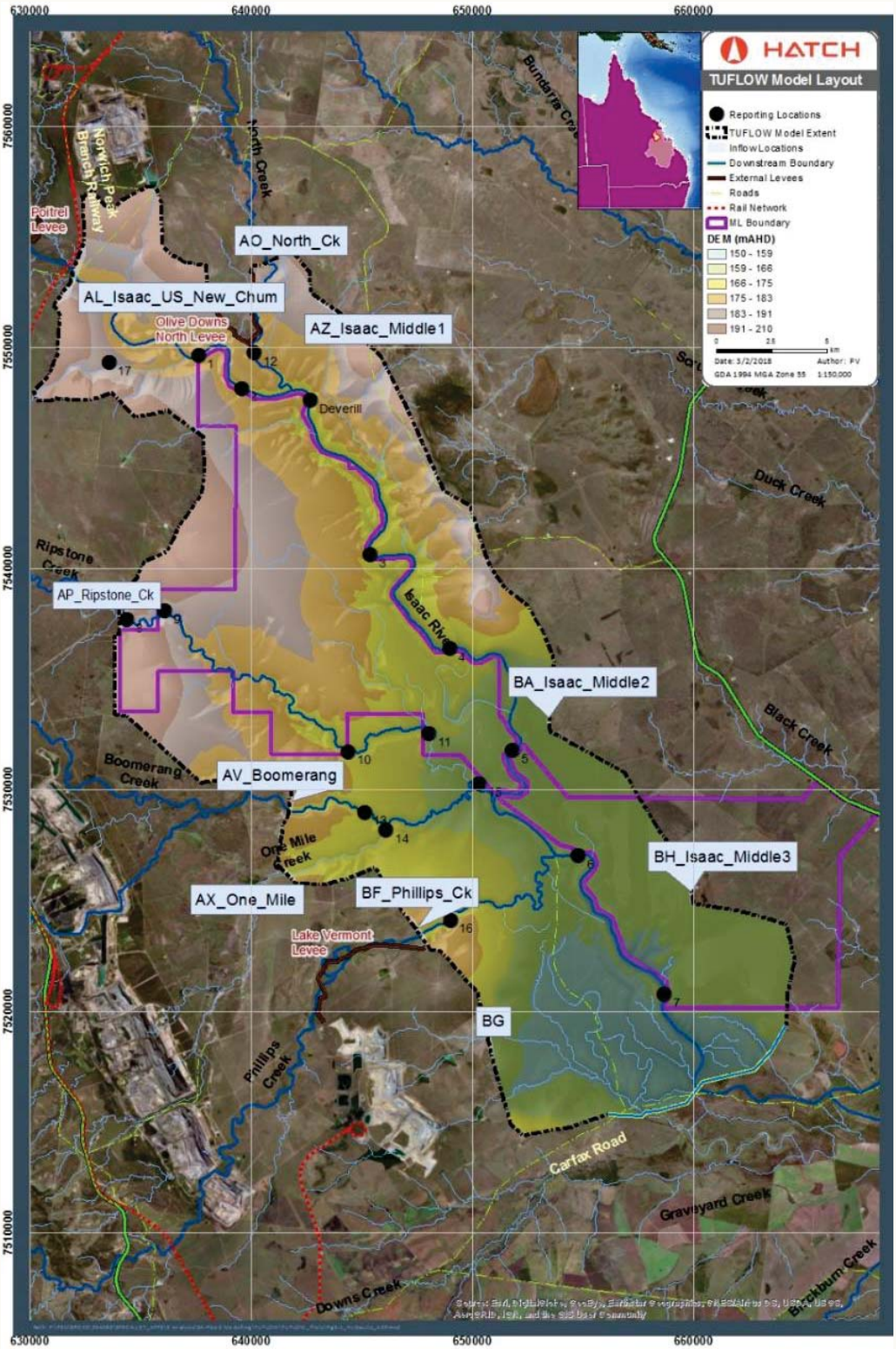
OLIVE DOWNS COKING COAL PROJECT

Flood Model Extent - Hydrology Model

Figure 3-8a



PRN-16-02_EIS_Sect3_029A

Source: Hatch (2018)

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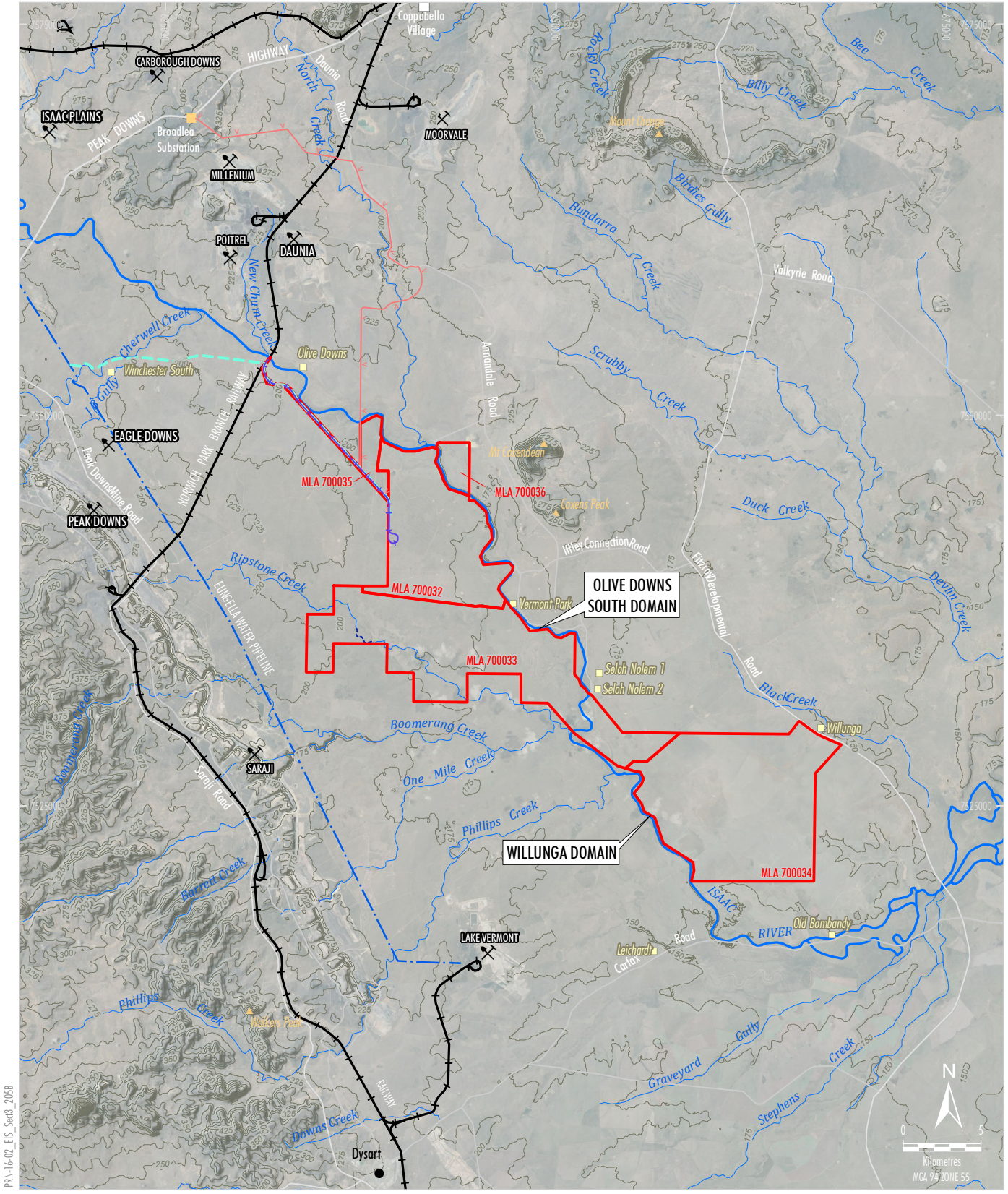
OLIVE DOWNS COKING COAL PROJECT

Flood Model Extent - Hydraulic Model

Figure 3-8b



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LEGEND

- Mining Lease Application Boundary
- Approved/Operating Coal Mine
- Eungella Pipeline Network
- Railway
- Dwelling
- Proposed Creek Diversion
- Proposed Access Road
- Proposed Electricity Transmission Line
- Proposed Rail
- Proposed Water Pipeline

Source: Geoscience Australia - Topographical Data 250K (2006)
Department of Natural Resources and Mines (2016)
Orthophotography: Google Image (2016)

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OLIVE DOWNS COKING COAL PROJECT
Topography

Figure 3-9

Although the topography of the site is relatively flat, a cluster of mountains approximately 5 km east of the Olive Downs South domain (Mt Coxendean, Coxens Peak and Iffley Mountain) reach elevations of 310 m AHD to 471 m AHD and the Harrow and Cherwell Ranges, 15 km to 20 km west, reach elevations of 400 m AHD to 500 m AHD (Figure 3-9).

Regional Catchment

The Mine Site and Access Road area is located within the headwaters of the Isaac River catchment of the greater Fitzroy Basin (Figures 3-10 and 3-11).

The Isaac River is the main watercourse which bisects the site and flows in a north-west to south-east direction, passing the township of Moranbah. The existing Isaac Plains, Millennium, Poitrel and Daunia mines are immediately upstream of the Mine Site and Access Road area (Figure 2-1). The Isaac River flows to the north-east of the Olive Downs South domain and then further downstream to the south of the Willunga domain, before continuing in a south-easterly direction (Figure 2-2).

The Connors River flows into the Isaac River approximately 85 km downstream of the Mine Site and Access Road area (Figure 2-1), with the Isaac River finally converging with the Mackenzie River a further 50 km downstream (Figure 3-10).

Ultimately, the Mackenzie River joins the Fitzroy River, which flows initially north and then east towards the east coast of Queensland, and discharges into the Coral Sea south-east of Rockhampton near Port Alma (Figure 3-12).

At a regional scale, the greater Isaac-Connors sub-catchment area (at the confluence with the Mackenzie River) is approximately 22,364 square kilometres (km²) of the total Fitzroy River catchment of 142,665 km² or, if represented as a percentage, it accounts for 15% of the overall Fitzroy River catchment area.

The lease application areas associated with the Mine Site and Access Road are approximately 250 km^2 and represent approximately 1% and 0.2% of the overall Isaac-Connors and Fitzroy river catchment areas, respectively.

Local Catchments

Tributaries of the Isaac River in the vicinity of the Mine Site and Access Road area include (from upstream to downstream) (Figure 3-11):

- North Creek;
- Ripstone Creek;
- Boomerang Creek (including One Mile Creek); and
- Phillips Creek.

North Creek enters the Isaac River immediately upstream of the Deverill gauging station, north of the Mine Site and Access Road area. The North Creek catchment area upstream of its confluence with the Isaac River is approximately 342 km^2, with predominant land use within the catchment being stock grazing and the Moorvale Mine. The Moorvale Mine has approval to discharge water to North Creek.

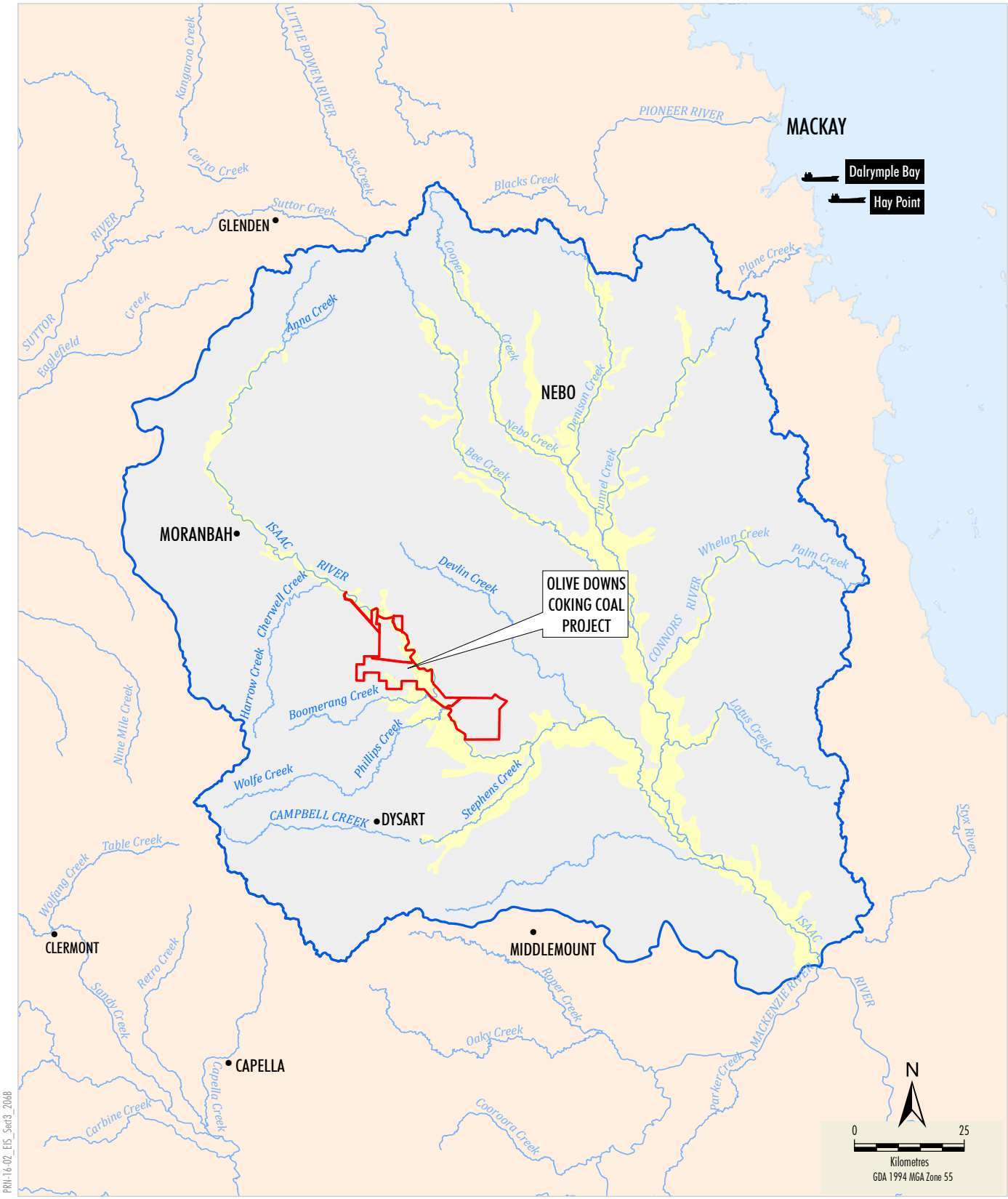
Ripstone Creek runs west to east, south of the Olive Downs South domain, and would be diverted around the south of Pit ODS9 (Figure 3-13).

The Ripstone Creek catchment area is approximately 286 km^2, with predominant land use within the catchment being stock grazing and the Peak Downs mine (which has approval to discharge water to Ripstone Creek).

Boomerang Creek runs west to east, south of the Olive Downs South domain and joins the Isaac River between the Olive Downs South domain and Willunga domain. One Mile Creek is a tributary of Boomerang Creek, with its confluence approximately 4 km upstream of the point at which Boomerang Creek enters the Isaac River.

The Boomerang Creek catchment area (including One Mile Creek) is approximately 156 km^2, with predominant land use within the catchment being stock grazing and the Saraji Coal Mine. The Saraji Coal Mine has an existing diversion of Boomerang Creek and has approval to release water to Boomerang Creek.

Phillips Creek has a catchment area of approximately 487 km^2 to the confluence with the Isaac River. Land uses within the Phillips Creek catchment include low intensity cattle grazing and open cut mining. The Saraji and Lake Vermont mines both have existing diversions/levees on Phillips Creek and approval to discharge waters to Phillips Creek.



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LEGEND

- Olive Downs Project Mining Lease Application Boundary
- Isaac Connors Groundwater Management Area
- Isaac Connors Alluvium Groundwater Sub-area
- Port

Source: Geoscience Australia - Topographical Data 250K (2006); Department of Natural Resources, Mines and Energy (2016)

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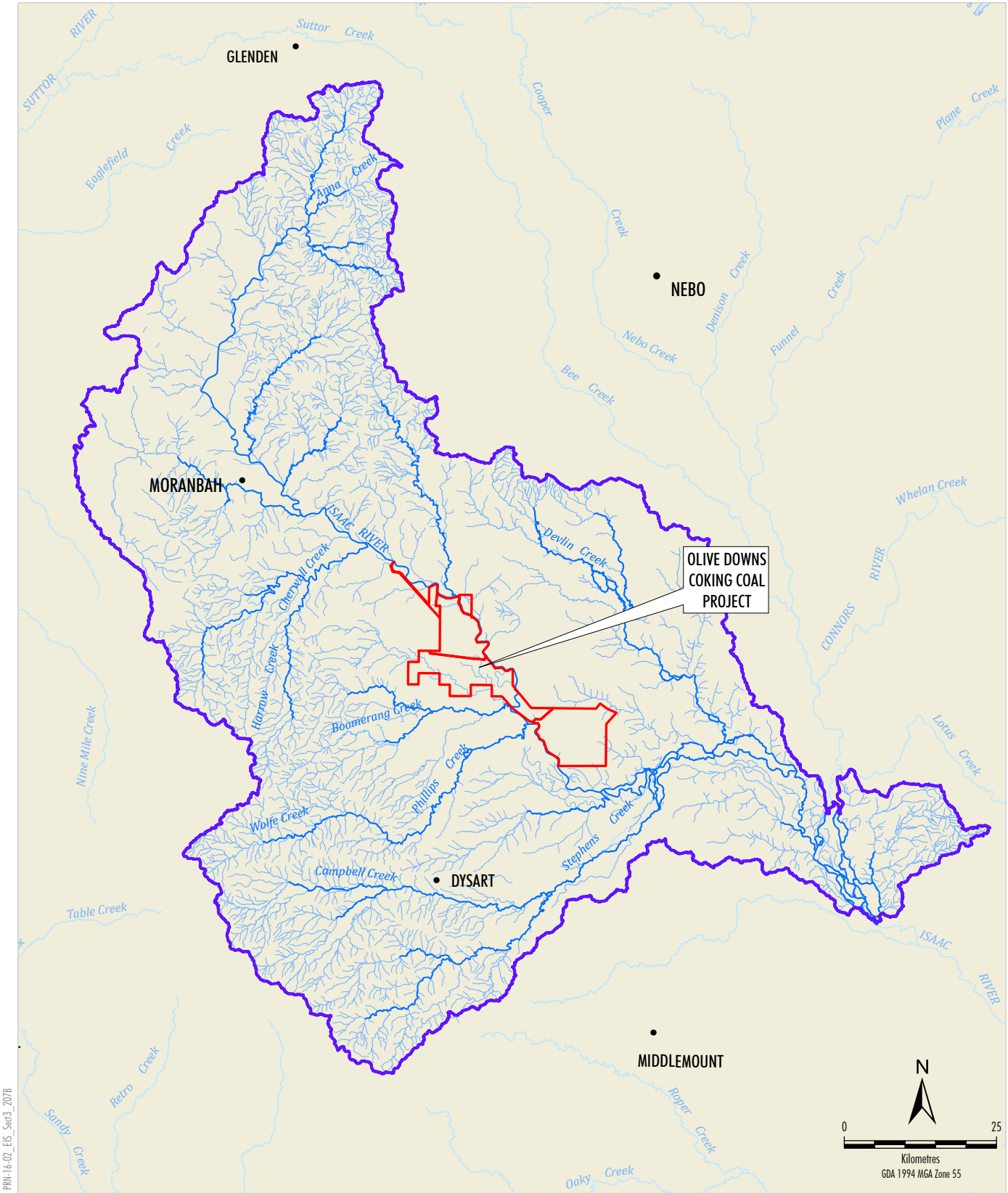
OLIVE DOWNS COKING COAL PROJECT

Isaac Connors

Sub-Catchment of the Fitzroy Basin

Figure 3-10



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LEGEND

Mining Lease Application Boundary

Upper Isaac River Catchment Area

Source: Geoscience Australia - Topographical Data 250K (2006); Queensland Department of Natural Resources, Mines and Energy (2016)

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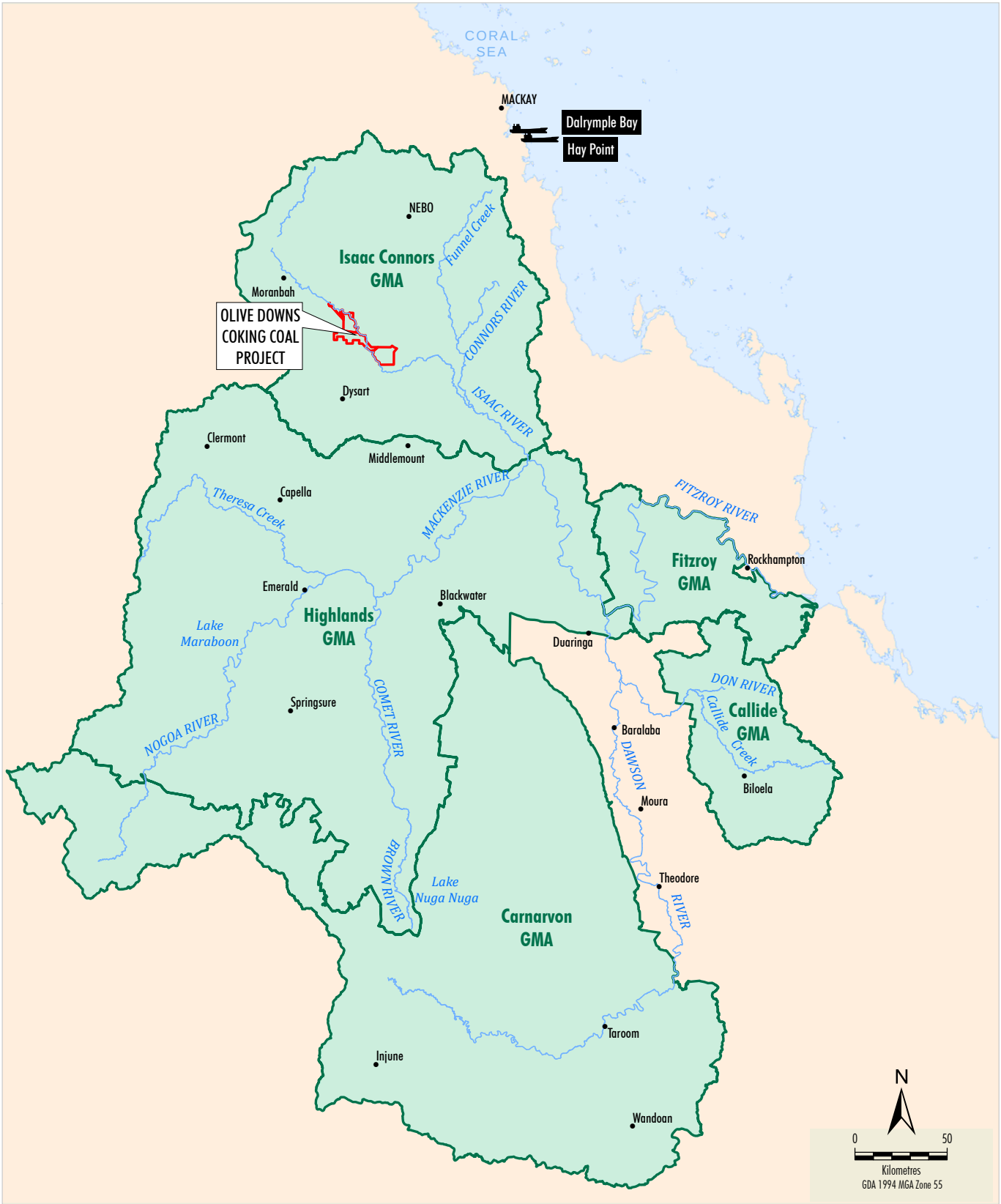
OLIVE DOWNS COKING COAL PROJECT

Isaac River Catchment

Figure 3-11



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LEGEND
Mining Lease Application Boundary
Groundwater Management Area
Port

Source: Geoscience Australia - Topographical Data 250K (2006); Department of Natural Resources, Mines and Energy (2016)

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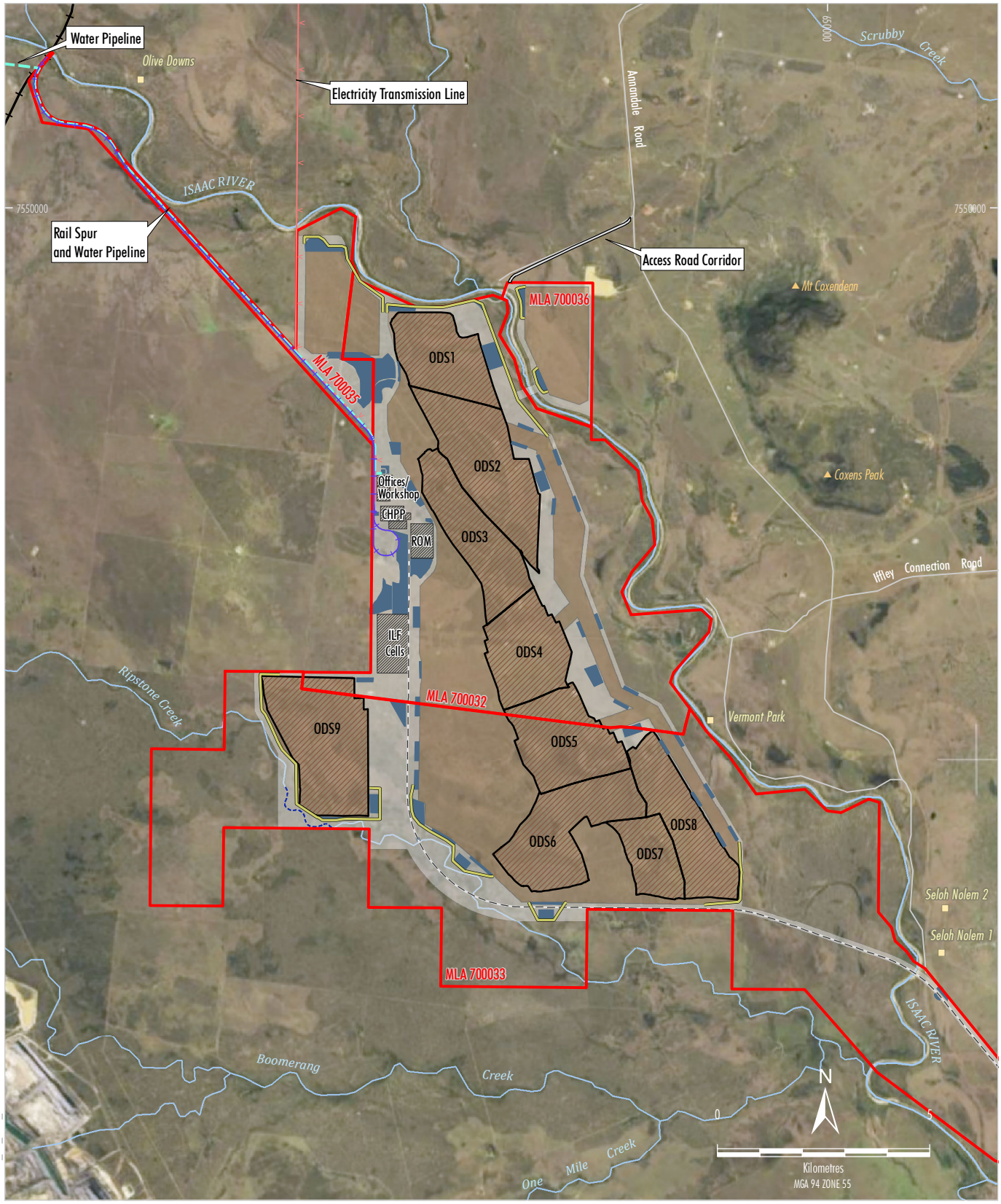
OLIVE DOWNS COKING COAL PROJECT
Groundwater Management Areas of the Fitzroy Basin

Figure 3-12



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LEGEND

- Mining Lease Application Boundary
- Railway
- Dwelling
- Proposed Electricity Transmission Line
- Proposed Rail Spur and Loop
- Proposed Water Pipeline
- Proposed Creek Diversion
- Open Cut Pit Extent (and Pit Numbering)
- Out-of-Pit and In-Pit Waste Rock Emplacement
- Infrastructure Area
- Key Infrastructure Component
- Temporary Levee
- Water Storage
- Overland Conveyor

Source: Geoscience Australia - Topographical Data 250K (2006)
Department of Natural Resources and Mines (2016)
Orthophotography: Google Image (2016)

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OLIVE DOWNS COKING COAL PROJECT
General Arrangement -
Olive Downs South Domain

Figure 3-13

3.3.9.2 Geology and Coal Resource

Depositional Geology

The coal resource is located within the northern part of the Permo-Triassic Bowen Basin.

The Permian sediments occur at outcrop on the eastern and western edges of the basin and are unconformably overlain by the Triassic aged terrestrial sediments within the basin. The outcrop geology of the Permian and Triassic sediments based on 1:500,000 scale mapping of the Bowen Basin (Commonwealth Scientific and Industrial Research Organisation [CSIRO], 2008) is shown on Figure 3-14. Regional faulting is also shown on Figure 3-14.

The regional outcrop geology mapping shows the Permian Fair Hill Formation and Rangal Coal Measures (overlain by the Triassic Rewan Formation) across the Mine Site and Access Road area. Geological cross-sections are presented in the Groundwater Assessment (Appendix D).

The Permian and Triassic sediments are covered by a thin veneer of unconsolidated to semi-consolidated Cainozoic sediments (Tertiary to Quaternary alluvium and colluvium). Broadscale geology testing undertaken by the Department of Environment and Resource Management (DERM) in 2011, indicated the region is dominated by Tertiary sediments, with the Mine Site and Access Road area predominantly containing Cainozoic alluvium, as well as mixed Mesozoic sediments (Raymond and McNeil, 2011). The alluvial sediments are localised along rivers (i.e. Isaac River) and their tributaries.

A TEM survey was conducted by Groundwater Imaging Pty Ltd in July 2017 to verify the extent of the unconsolidated sediments in the Mine Site and Access Road area. The TEM survey identified that alluvial sediments are present across the Mine Site and Access Road area to depths of up to 8 m, with sequences up to 30 m thick present within a narrow corridor along Isaac River.

Within the Mine Site and Access Road area in the Olive Downs South domain there are several regional fault structures with a dominant north-west trend.

The Isaac fault (a thrust fault with a throw of approximately 500 m) divides the area into two structural domains, with the eastern domain being moderately to highly faulted with thrust fault throws of up to 100 m (JBMS, 2016).

Two-dimensional (2D) seismic sections clearly indicate at least four other north-north-west trending east over west thrust fault zones with throws up to 100 m. Seismic data indicates that the fault zones are composed of many smaller faults. Some folding occurs with north-west trending fold axes.

Local folding and thrust faults have caused vertical displacement in some places in the Olive Downs South domain, which has had the effect of the one seam occurring at multiple depths at

the one location (e.g. in a bore). Dips are to the east and appear to be lower in the north, approximately 7 degrees, steepening to up to 15 degrees in the south. Higher dips occur adjacent to faults.

Conversely, the Willunga domain does not appear to have any significant faulting, but rather is subject to localised deformation from folding.

Coal Resource and Target Seams

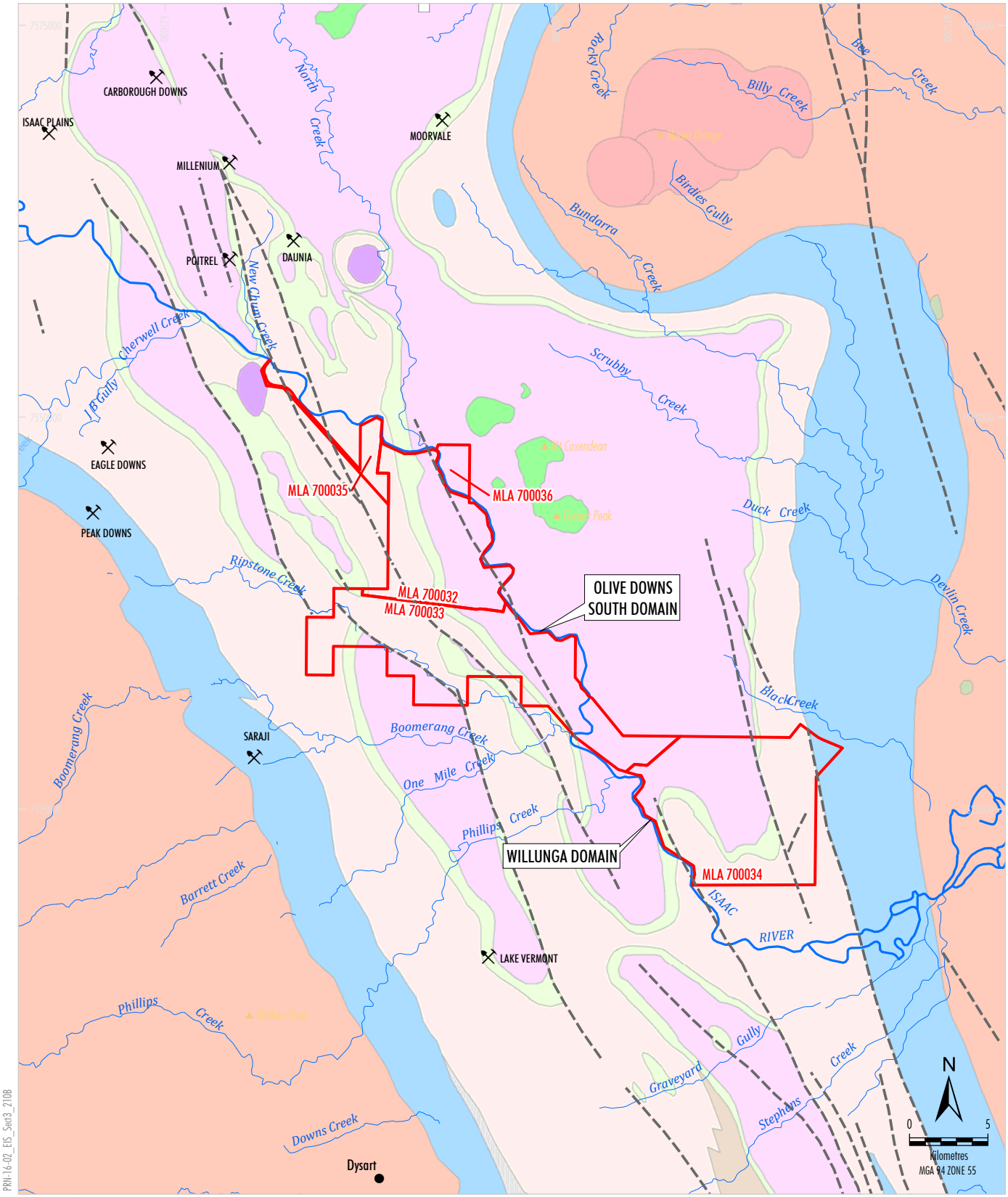
Coal-bearing sediments of the Permian Blackwater Group form the main resource of the numerous mines surrounding the Mine Site and Access Road area.

In increasing depth (age) order, the coal measure sequences of the Blackwater Group include the:

- Rangal Coal Measures;
- Fort Cooper Coal Measures; and
- Moranbah Coal Measures.

The Rangal Coal Measures include the target coal seams. The Rangal Coal Measures range from 90 m to 195 m thick light grey, cross-bedded, fine to medium grained labile sandstones, grey siltstones, mudstones and coal seams.

The Leichhardt and Vermont Seams of the Rangal Coal Measures form the principal economic coal resources in the Olive Downs South and Willunga domains with the cumulative Leichhardt and Vermont Upper Seam coal thickness in the order of 10 m.



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LEGEND

- Mining Lease Application Boundary
- Approved/Operating Coal Mine

Geology

- Clematis Group
- Rewan Formation
- Rangal Coal Measures, Bandanna Formation, Baralaba Coal
- Fair Hill Formation
- Moranbah/German Creek Coal Measures
- Back Creek Group
- Bundarra Granodiorite
- Burngrove Formation
- MacMillan Formation
- Undifferentiated volcanics
- Undivided Intrusives
- Faults

Source: Geoscience Australia - Topographical Data 250K (2006); Department of Natural Resources and Mines (2016); HydroSimulations (2018)

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OLIVE DOWNS COKING COAL PROJECT

Regional Geology - Outcrop Mapping and Faulting

Figure 3-14

The Leichhardt Seam is typically 1.5 m to 2.5 m thick and the Vermont Upper Seam is typically 3.5 m to 4 m thick.

The Olive Downs South domain coal seams will deliver a high rank, low volatile coking coal product and have a JORC resource of 460 million tonnes (Mt). The Willunga domain coal seams will deliver a low volatile PCI product and have a JORC resource of 353 Mt.

3.3.9.3 Groundwater Regime

A conceptual hydrogeological model of the groundwater regime (Figure 3-15) was developed by HydroSimulations (2018) based on the available groundwater data, and the results of the groundwater investigation program and TEM survey (Groundwater Imaging Pty Ltd, 2017).

The hydrogeological regime relevant to the Mine Site and Access Road area comprises the following hydrogeological units (Appendix D):

- Cainozoic sediments:
  - Quaternary alluvium - unconfined aquifer localised along Isaac River;
  - Regolith - unconfined and largely unsaturated unit bordering alluvium;
- Triassic Rewan Group - aquitard;
- Permian coal measures with:
  - Hydrogeologically 'tight' interburden units; and
  - Coal sequences that exhibit secondary porosity through cracks and fissures.

Each of the hydrogeological units is discussed further below in Section 3.3.9.7, based on available data collected during the groundwater and surface water monitoring, and investigation programs.

3.3.9.4 Water Dependent Assets

Water dependent fauna and flora supported by habitat, flora and fauna (including stygofauna surveys) are described in the Terrestrial Flora, Terrestrial Fauna and Aquatic Ecology Assessments (Appendices A to C).

A range of environmental values for water resources have been nominated broadly for the three mapped areas across the Mine Site and Access Road area (Figure 3-16):

- Isaac northern tributaries;
- Isaac western upland tributaries; and
- Isaac and lower Connors River main channel.

All three mapped areas nominate the following environmental values:

- aquatic ecosystems;
- irrigation;
- farm supply/use;
- stock water;
- human consumption;
- primary recreation;
- secondary recreation;
- visual recreation;
- drinking water;
- industrial use; and
- cultural and spiritual values.

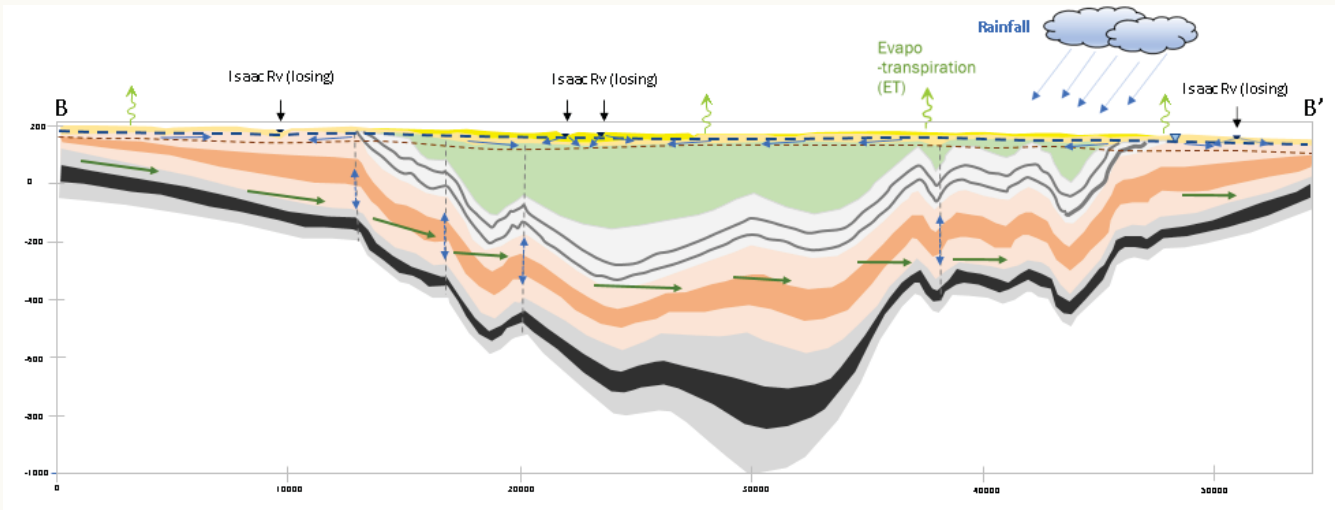
Only the Isaac western upland tributaries mapped areas have 'aquaculture' nominated as an environmental value.

The assessments have been prepared to present a description of the baseline water data and the water quality of the local and regional surface water and groundwater resources to assist in describing the relevant environmental values and corresponding water quality objectives (WQOs).

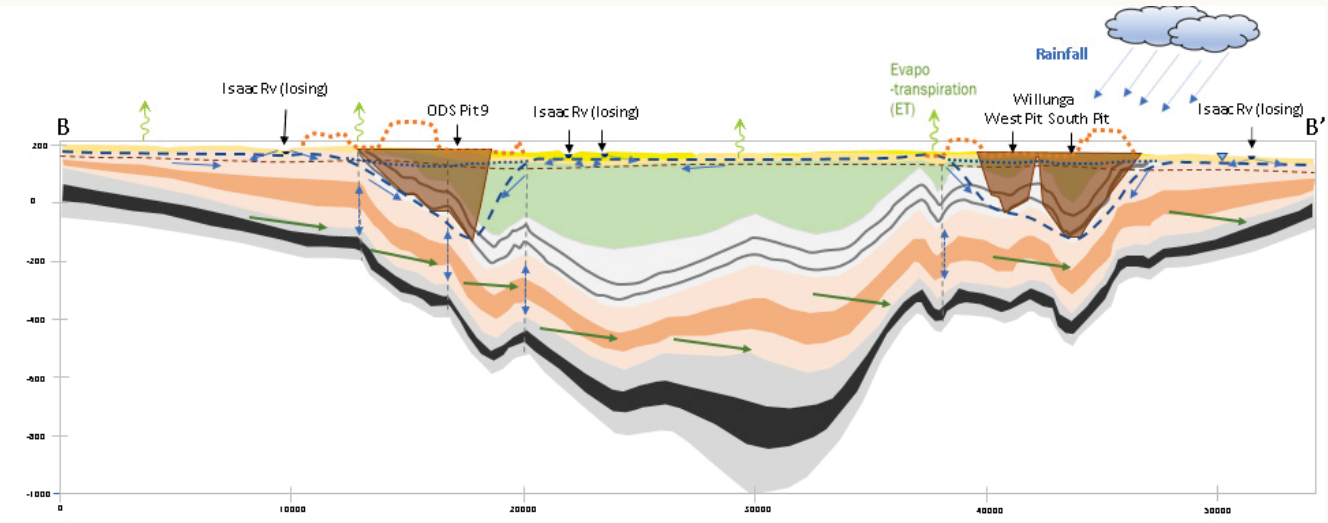
3.3.9.5 Other Coal Mining and CSG Developments

The Mine Site and Access Road area is located in an existing mining precinct comprising several existing or approved nearby coal mining operations, including (Figure 3-17):

- Olive Downs North (2 km north);
- Saraji (5 km south-west);
- Daunia (10 km north-west);
- Peak Downs (12 km west);
- Lake Vermont (12 km south);
- Poitrel (12 km north-west);
- Millennium (15 km north-west);
- Eagle Downs (15 km west);
- Moorvale (18 km north);
- Carborough Downs (20 km north-west); and
- Isaac Plains (25 km north-west).



Pre-Mining



Post-Mining

Source: HydroSimulations (2018)

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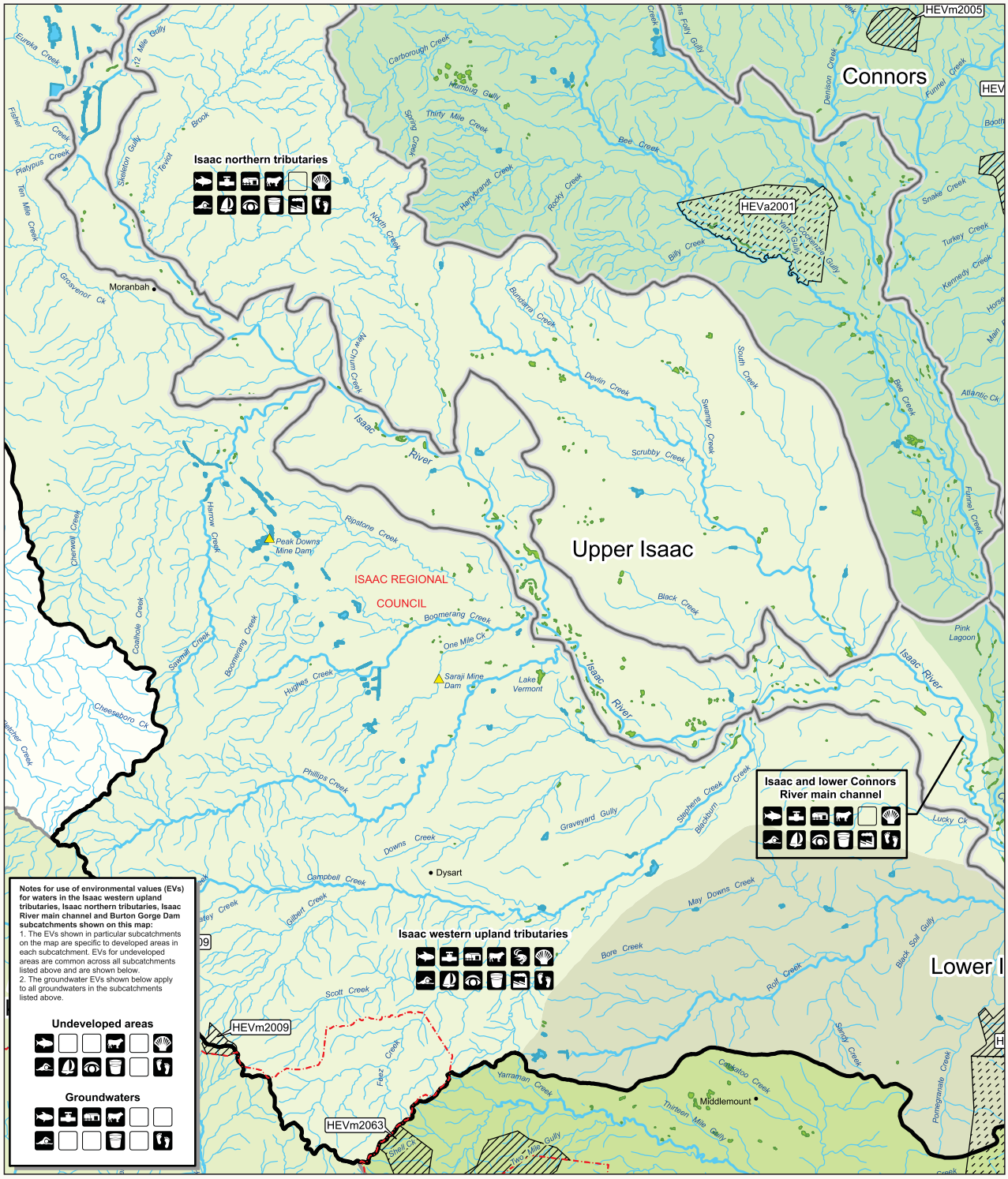
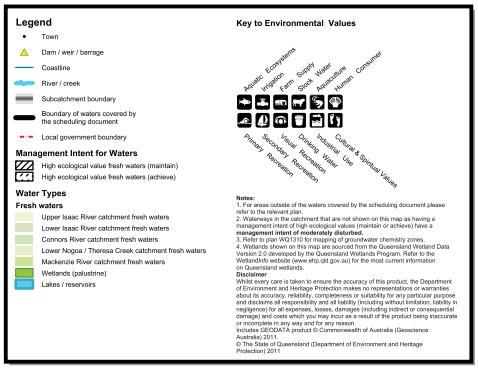
OLIVE DOWNS COKING COAL PROJECT

Conceptual Model of the Groundwater Regime (Pre-Mining and Post-Mining)

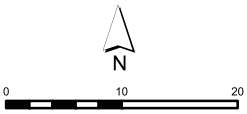
Figure 3-15



PRN-16-02_EIS_App EPBC ACPA_019



Source: Queensland Government (2013)



Projection: Mercator

Horizontal Datum: Geocentric Datum of Australia 1994 (GDA94)

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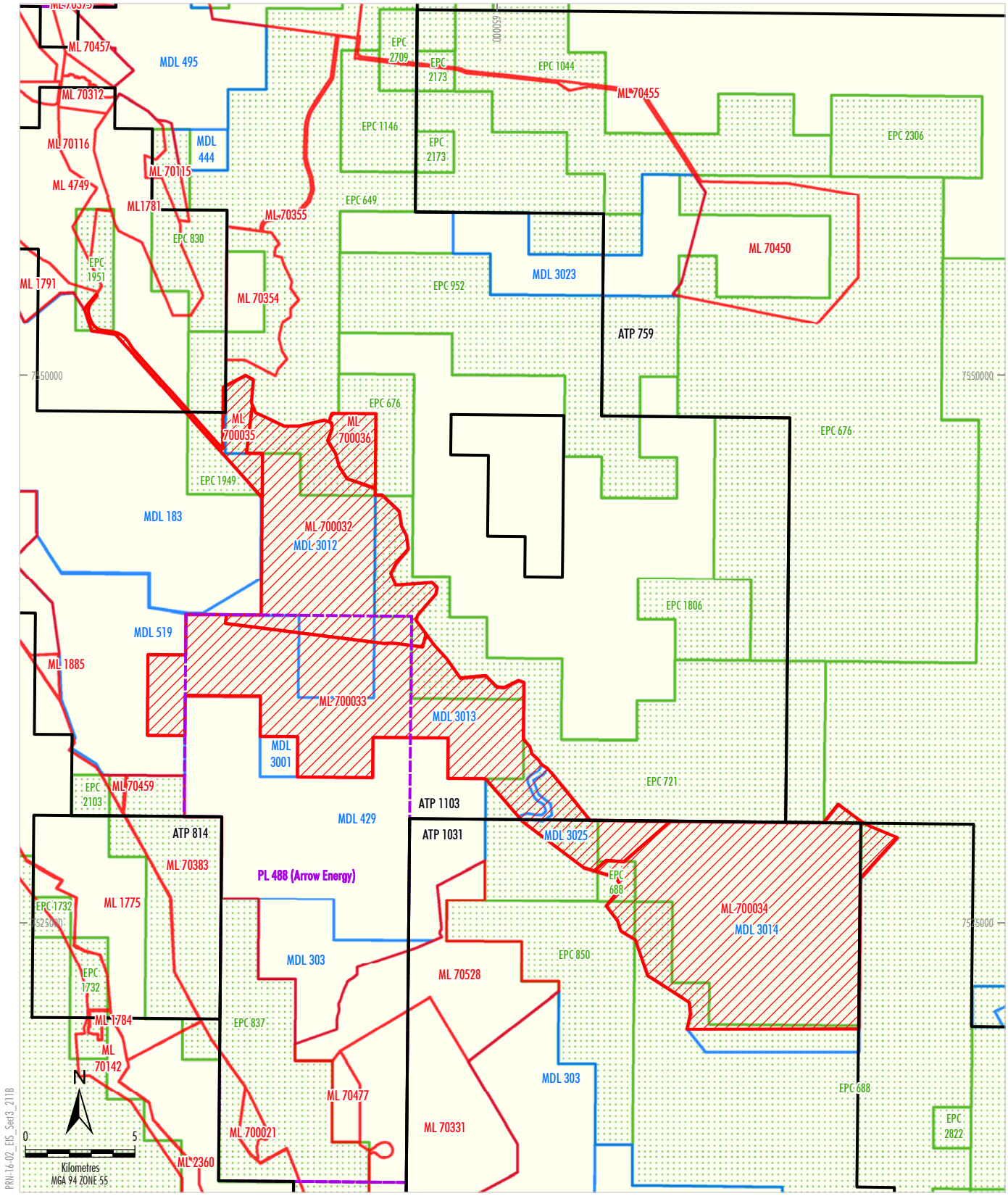
OLIVE DOWNS COKING COAL PROJECT

Environmental Values – Water Quality (Isaac River Sub-basin)

Figure 3-16



LEGEND

- Mining Lease Application Boundary
- EPC Granted
- PL Application
- MDL Permit Granted
- ML Permit
- ATP Granted

Source: Department of Natural Resources, Mines and Engery (2018)

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OLIVE DOWNS COKING COAL PROJECT

Resource Tenements

Figure 3-17

3.3.9.6 Baseline Data

Baseline Water Quality Datasets

Water quality data has been collected and analysed from a number of different sources during the assessment of the Mine Site and Access Road including (Figures 3-3-18):

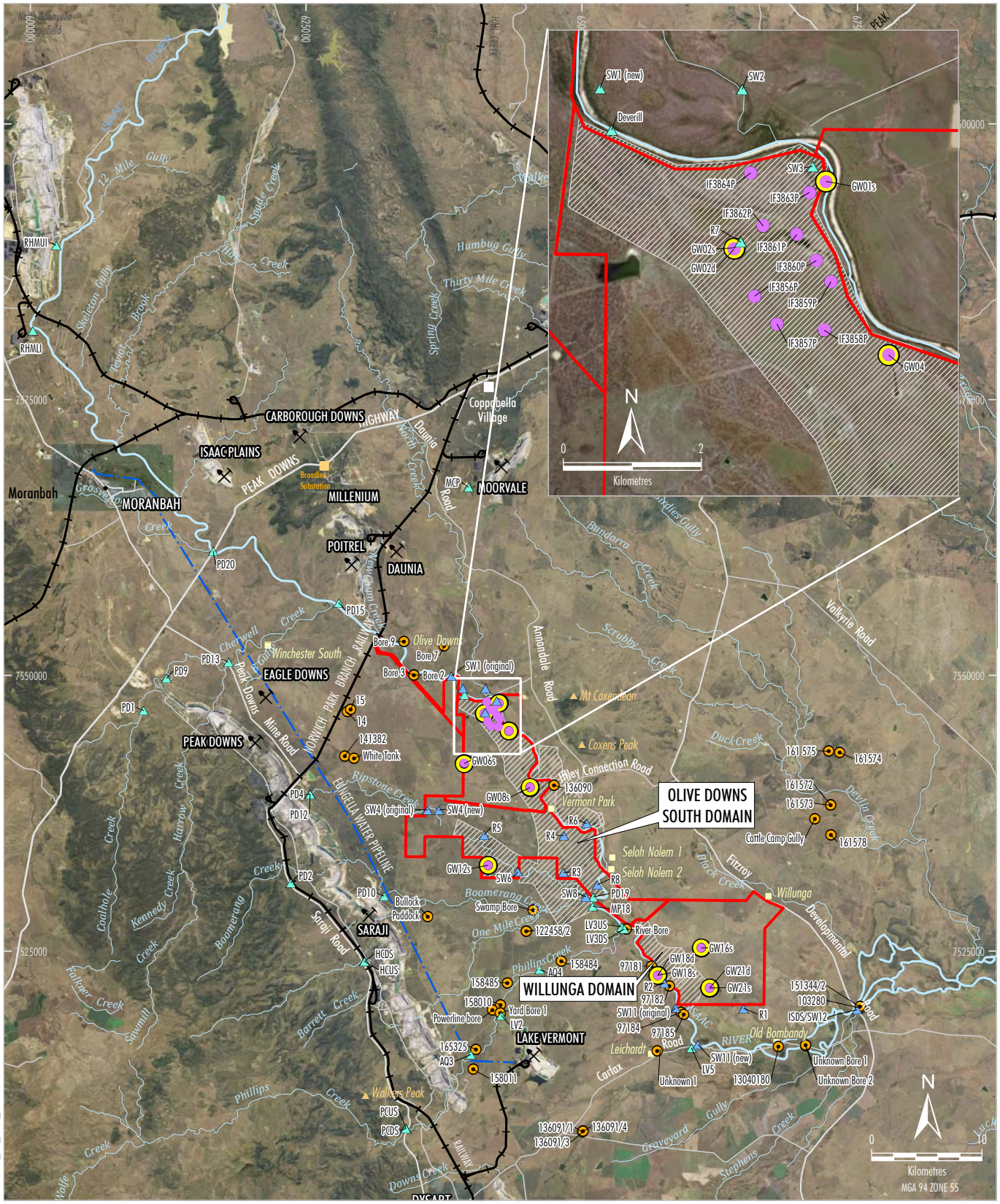
- a range of recorded physio-chemical parameters, including continuous monitoring for select analytes, at the Deverill gauging station on the Isaac River (DNRME) (since 1964);
- upstream surface water quality results for the Isaac River presented as part of the Red Hill Mining Lease EIS (2010-11);
- upstream surface water quality results for North Creek presented as part of the Moorvale Coal Project EIS (2000);
- surface water quality results presented in receiving environment monitoring reports for the Saraji Mine (e.g. Isaac River, Phillips Creek and Hughes Creek [draining to Boomerang Creek]) (Gauge, 2017a; 2017b), Peak Downs Mine (e.g. Isaac River, Boomerang Creek, Ripstone Creek and Cherwell Creek) (Gauge, 2014; 2017c) and Lake Vermont Mine (e.g. Isaac River and Phillips Creek) (AARC, 2012; 2017; and GHD, 2016);
- downstream surface water results for the Isaac River and Phillips Creek presented as part of the Lake Vermont Northern Extension EIS (2013);
- surface water quality results during the opportunistic baseline sampling campaign for the Mine Site and Access Road (during 2017 and 2018) including sites on the:
  - Isaac River (SW1; SW2; SW3; SW8; SW11; SW12); and
  - Ripstone Creek (SW4; SW6);
- surface water quality results during the aquatic ecology surveys conducted in December 2016 and July 2017 by DPM Enviros ciences including sampling sites on the:
  - Isaac River (R2; R6; R8);
  - Ripstone Creek (R5); and
  - unnamed tributaries and riverine wetlands of the Isaac River and Ripstone Creek (R1; R3; R4; R7);
- groundwater quality results during the stygofauna sampling conducted by DPM Enviros ciences (Appendix C);
- continuous (sub-daily) logger records for pH, EC and temperature at the downstream ISDS gauging station on the Isaac River (since late 2016);
- groundwater quality sampling undertaken as part of the groundwater investigation program (commencing in early 2017), including sampling of:
  - 15 tertiary/alluvial standpipe installations (GW01s; GW02s; GW04; GW06s; GW08s; GW12s; IF3856P-IF3864P) at the ODS domain;
  - three tertiary/alluvial standpipe installations (GW16s; GW18s; GW21s) at the Willunga domain;
  - two coal measure standpipe installations (GW18d; GW21d) at the Willunga domain; and
  - one coal measure standpipe installation (G02d) at the ODS domain;
- groundwater quality sampling undertaken at 43 bores as part of the Bore Census for the Mine Site and Access Road in 2017 by ENRS (2018);
- groundwater (resistivity) data from the TEM survey conducted by Groundwater Imaging (2017); and
- groundwater sampling and quality analysis undertaken by DPM Enviros ciences as part of the stygofauna assessment included as part of the Aquatic Ecology Assessment (Appendix C).

Where available, time series water quality data is presented in Hatch, (2018a). HydroSimulations (2018) present hydrochemical datasets used to characterise the groundwater resources. Hydrochemical data for the waste rock and rejects are also presented in the Geochemistry Assessment (Terrenus Earth Sciences, 2018).

Surface Water Flow and Groundwater Datasets

In addition to the baseline data water quality datasets above, available surface water flow and groundwater data has been utilised, including:

- rainfall and evaporation records from BoM and DNRME weather stations with a significant period of record near the Mine Site and Access Road;



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LEGEND

- Mining Lease Application Boundary
- TEM Survey Approximate Extent
- Approved/Operating Coal Mine
- Dwelling
- Eungella Pipeline Network
- Railway
- Other Surface Water Quality Monitoring Site
- Pembroke Surface Water Quality Monitoring Site
- Pembroke Groundwater Quality Monitoring Site
- Sampled Groundwater Bore
- Sampled Stygofauna Site

Source: Geoscience Australia - Topographical Data 250K (2006)
Department of Natural Resources and Mines (2016)
Orthophotography: Google Image (2016)

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Water Quality Monitoring - Baseline Data

Figure 3-18

- data from DNRME streamflow gauges in the Isaac River catchment area (Figure 3-19 and Appendix E);
- data from the ISDS monitoring station installed by Pembroke on the Isaac River, downstream of the Mine Site and Access Road (Figure 3-19 and Appendix E);
- Receiving Environment Monitoring Program (REMP) and Annual Return documents provided by the DES for nearby operating coal mines (Appendix E);
- baseline aquatic ecology surveys undertaken by DPM in December 2016 and July 2017 for the Mine Site and Access Road (Figure 3-20 and Appendix C);
- data from the existing Pembroke groundwater monitoring and investigation program in the vicinity of the Mine Site and Access Road (Figure 3-17 and Appendix D);
- publicly available data from neighbouring Lake Vermont groundwater monitoring sites (Figure 3-17); and
- geomorphology survey in the vicinity of the Mine Site and Access Road (Figure 3-21 and Attachment A of Appendix E).

The baseline groundwater monitoring and investigation program for the Mine Site and Access Road has included the following (Figure 3-20):

- 18 Tertiary/Alluvial Standpipe Installations:
  - GW01s, GW02s, GW04, GW06s, GW08s & GW12s [ODS Domain].
  - Nine Additional Shallow Drillholes (IF3856P – IF3864P) [ODS Domain – Initial Years].
  - GW16s, GW18s & GW21s [Willunga Domain].
- Three (3) Coal Measure Standpipe Installations:
  - GW02d [ODS Domain].
  - GW18d & GW21d [Willunga Domain].
- Five (5) Vibrating Wire Piezometer (VWP) Installations:
  - GW01d, GW06d, GW08d & GW12d [ODS Domain].
  - GW16d [Willunga Domain].
- Six (6) Aquifer Test Sites (Rising/Falling Head Test Methods):
  - Alluvium/Tertiary – GW01s, GW12s & GW18s.
  - Coal Measure – GW02d, GW18d & GW21d.
- Air-lift and Packer Testing at Borehole 1CR04 (from 52 m to 164 m);
- Core Permeability Testwork (in Laboratory) from exploration holes 1CR04, 1CR05 & 1CR17:
  - Horizontal Conductivity (16 samples).
  - Vertical Conductivity (15 samples).
- Bore Census (desktop [DNRME GWDB] and ground-truthing) (ENRS, 2018); and
- TEM Survey (Groundwater Imaging, 2017).

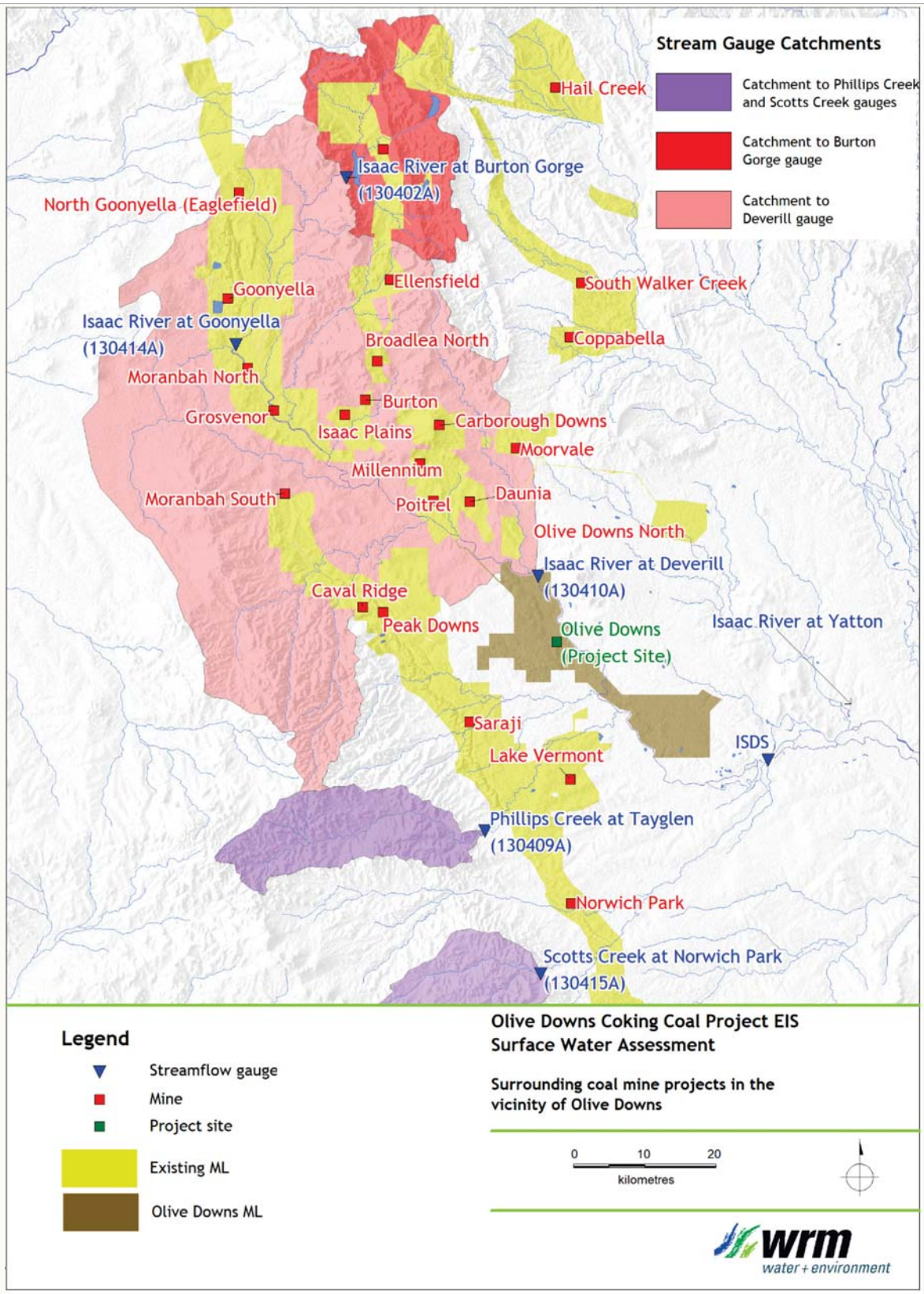
Where available, time series level and flow data is presented in Appendices D and E.

The first groundwater monitoring installations were established in November 2016, and additional alluvial monitoring bores were constructed in November 2017. The bores target a range of hydrostratigraphic units, including:

- Quaternary alluvium;
- regolith (Cainozoic sediments);
- Rewan Group;
- coal seams of the Rangal Coal Measures; and
- interburden and overburden material of the Rangal Coal Measures.

Extensive hydraulic testing was conducted on all major geological units. This included testing of core samples for vertical and horizontal hydraulic conductivity (anisotropy), slug testing (rising/falling head tests) and packer testing for horizontal hydraulic conductivity, as well as documented airlift yields (Appendix D).

To assist with further definition of alluvium in the vicinity of the Mine Site and Access Road, Groundwater Imaging Pty Ltd (2017) completed a TEM survey. The TEM survey results are presented in (Appendix D).



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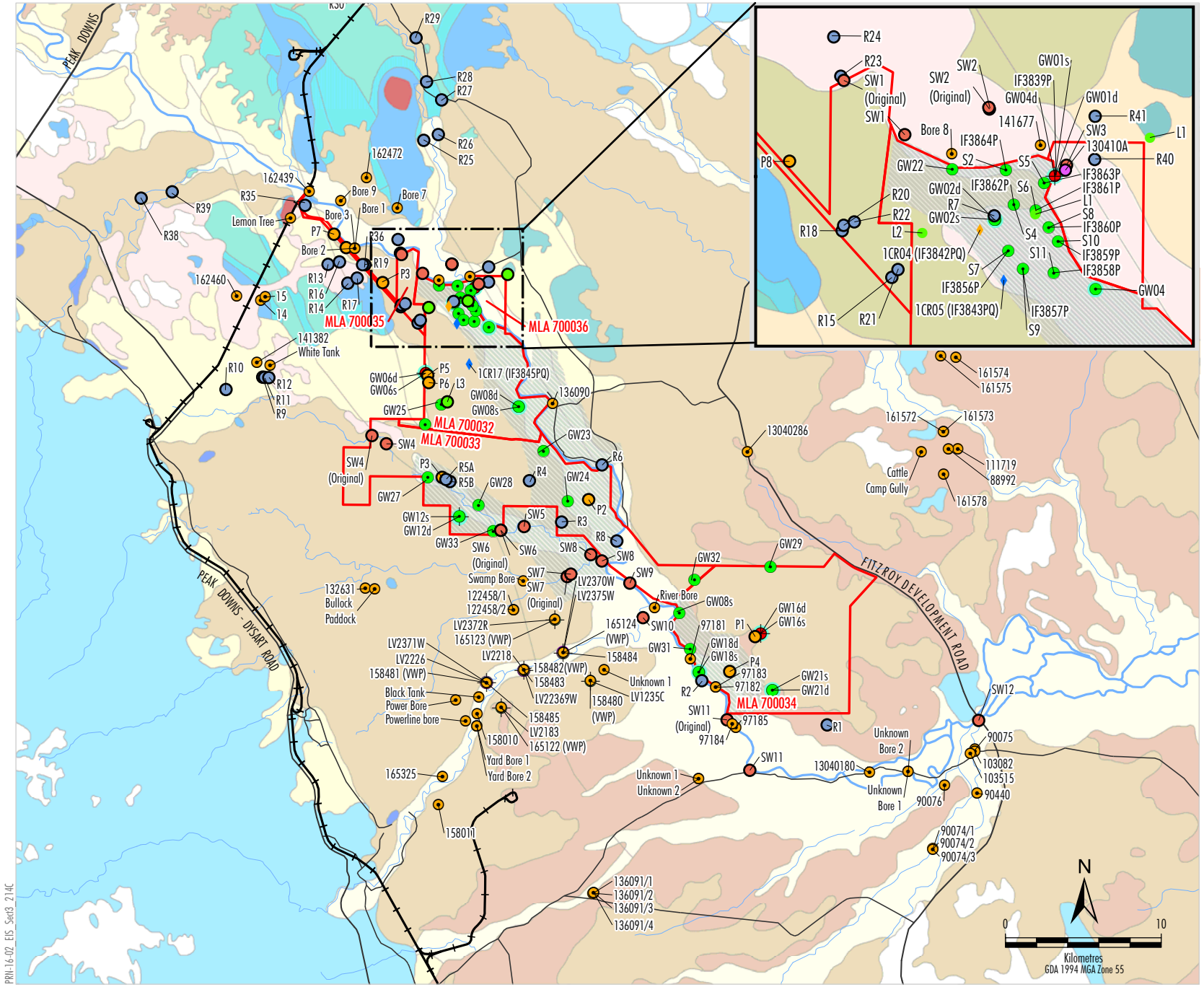
Source: WRM (2018)



LEGEND

- Mining Lease Application Boundary
- TEM Survey Approximate Extent

Groundwater Monitoring Sites

- VWP
- Standpipe
- Stygofauna Sampling Site

Testwork Site

- Air-lift and Packer Testing
- Core Permeability Testwork
- Groundwater Bore Identified in Bore Census

Lake Vermont Groundwater Monitoring Sites

- VWP
- Standpipe

Surface Water Monitoring Sites

- Pembroke Monitoring Site
- Riverine Monitoring Site
- Lacustrine Wetland
- Palustrine Wetland

Surface Geology

- Granitoid Intrusion
- Back Creek Group
- Moranbah Coal Measures
- Rangal Coal Measures
- Fort Cooper Coal Measures
- Quaternary Alluvium
- Quaternary Regolith (Qr)
- Quaternary Regolith (Qr\b)
- Clematis Group
- Rewan Group
- Tertiary to Quaternary Alluvium
- Duaringa Formation

Source: Queensland Department of Natural Resources and Mines (2016), Department of Natural Resources and Mines (2017), DPM (2018), JBT Consulting (2016), Pembroke (2018)

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Groundwater Monitoring and Investigation Sites

Figure 3-20

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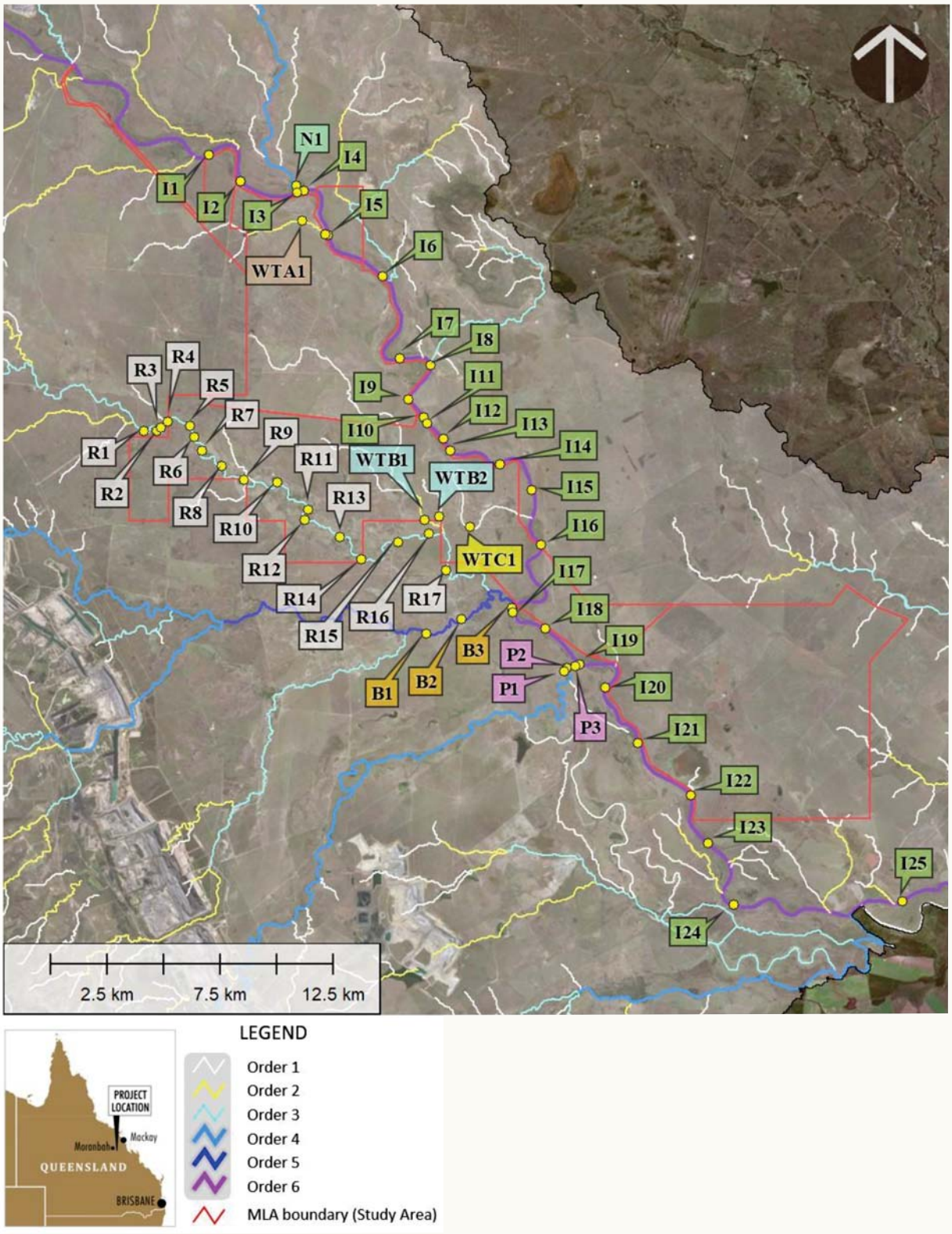

PRN-16-02_EIS_Sect3_021B

Source: Fluvial Systems (2018)

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Geomorphology Survey Sites

Figure 3-21

Surface Water Users

Detailed information regarding individual licences for Isaac River surface water users was obtained through analysis of water licences data provided by DNRME. Some limitations in the dataset include the absence of names of water users, and in some cases, allocated volumes for water licenses due to privacy restrictions (Appendix E).

Details regarding the volume, source and purpose of the licences are presented in Appendix E.

Groundwater Users

A field bore census of groundwater bores and wells within 20 km of the Mine Site and Access Road area was conducted by external field contractors (ENRS) from September to November 2017. Of the bores inspected across the 12 properties, the following was summarised (Appendix D):

- 22 bores were equipped with a submersible pump with variable power sources (i.e. mains power, diesel motor and windmill).
- 25 bores were positioned near water storage tanks, ranging in size from 20 kL to 100 kL, with two bores equipped with a float actuated pressure switch to maintain tank water levels. There were limited details on abstraction volumes and yields, but some report maximum yields of around 1 L/s to 2 L/s.
- Four of the existing bores are within 5 km of the proposed pit footprints within the ODS domain. Three of the bores (Bore 8, RN141677 and RN136090) apparently intersect the Isaac River alluvium. While one bore (Swamp Bore) on the Meadowbrook property intersects Permian coal measures to a depth of around 85 m. Two of the four bores (Bore 8 and RN136090) are equipped with submersible pumps and are used for stock and domestic use, respectively. Bore RN141677 is not currently used and the measured total depth does not match with the drill details, indicating the bore may have collapsed. Swamp Bore is also not currently in use or equipped, but the landholder indicates it has previously been used for stock water supply with a yield of around 1,600 gallons per hour (gph).
- Seven of the bores are within 5 km of the proposed pit footprints within the Willunga Domain. The seven bores (RN97180, RN97181, RN97182, RN97183, RN97184, RN97185 and River Bore) are relatively shallow (< 40 m deep), intersect the Isaac River alluvium and are used for stock water supply. Three of the bores (RN97181, RN97182 and River Bore) are equipped with electric submersible pumps, with a maximum yield of around 1.3 L/s. One of the bores (RN97180) is assumed to be present, but could not be accessed during the bore census but the landholder indicated the bore has had a yield of 800 gph.

3.3.9.7 Analysis of Surveys and Baseline Datasets

Regional Surface Water Flows and Water Quality

The Isaac River is the surface water resource of regional relevance to the Mine Site and Access Road. Further downstream, the Isaac River converges with the Connors River and then the Mackenzie River which joins the Fitzroy River and ultimately flows to the eastern coast of Australia (i.e. Keppel Bay near Rockhampton).

The DNRME Isaac River at Deverill stream gauge (#130410A) is located on the Isaac River adjacent to and in the north-west of the Mine Site and Access Road (Figure 3-19). Historical streamflow data for the Isaac River at Deverill is available from May 1968 and is presented in Appendix E.

Water quality data is available for the Isaac River at locations upstream, adjacent and downstream of potential influences of the Mine Site and Access Road.

Collation and comparison of available regional water quality data for the Isaac River at the Deverill and Yatton gauging stations and further upstream at the Red Hill Mining Lease is included in the Surface Water Assessment (Appendix E). Available datasets presented in receiving environment monitoring reports for the Saraji Mine, Peak Downs Mine and Lake Vermont Mine has also been considered.

Electrical Conductivity – Isaac River

The Deverill gauging station is located near the upstream boundary of the Mine Site and Access Road and would be representative of water quality that drains past the site. The Yatton gauging station is located downstream of the Connors River confluence but includes mining releases from all mines within the Isaac River catchment.

A time history of recorded instantaneous EC and stream flow for the Isaac River at the Deverill gauging station from 2011 is presented on Figure 3-22. The relationship between instantaneous flow and EC is shown on Figure 3-22.

The instantaneous data collected by DNRME at the Deverill gauging station spans the period from 2011 to 2018 and indicates (Appendix E):

- The EC for high flows greater than 200 m^3/s are generally below the high flow WQO EC of 250 µS/cm.
- The EC of instantaneous flows below 100 m^3/s vary significantly from 50 µS/cm to 1,870 µS/cm with many flow events exceeding the low flow WQO EC of 720 µS/cm.
- The mean daily EC has exceeded the low flow WQO on a total of 23 days over this period and all of these days experienced some flow (not stagnant flow).

A time history of recorded instantaneous EC and stream flow for the Isaac River at Yatton gauging station from 2011 is presented on Figure 3-22. The relationship between instantaneous flow and EC recorded from 1995 to 2011 as well as from 2011 to 2018 is shown on Figure 3-22. The results indicate (Appendix E):

- The EC for high flows greater than 200 m^3/s vary much more than at Deverill but are generally below 400 µs/cm.
- The high flow EC since 2011 has generally been below the high flow WQO.
- The low flow EC has frequently been above the low flow WQO of 410 µS/cm. EC rises during extended baseflow periods, which would be associated with either the Connors River or an increase in baseflow in the reach between Deverill and Yatton gauges.
- The recorded low flow EC is generally less than at Deverill.

Sub-daily monitoring data recorded at the ISDS gauging station on the Isaac River downstream of the Mine Site and Access Road since late 2016 is also presented in the Surface Water Assessment (Appendix E). The recorded EC was within the Isaac River WQOs (i.e. less than 720 µs/cm) for most of the event, however there was a period of elevated EC included a spike of around 3,100 µs/cm on 6 April 2017. This spike occurred for about 12 hours and was not recorded at the Deverill gauging station. The cause of this spike in EC is not known but likely due to the release of water from an operating mine between the Deverill and ISDS gauges (Hatch 2018a).

According to the DES website, ten coal mines upstream of the ISDS gauge released to the Isaac River catchment during this period.

There was a second short period of elevated EC in May 2017 that exceed the Isaac River WQOs. However, there were no recorded releases upstream of the gauge during this period.

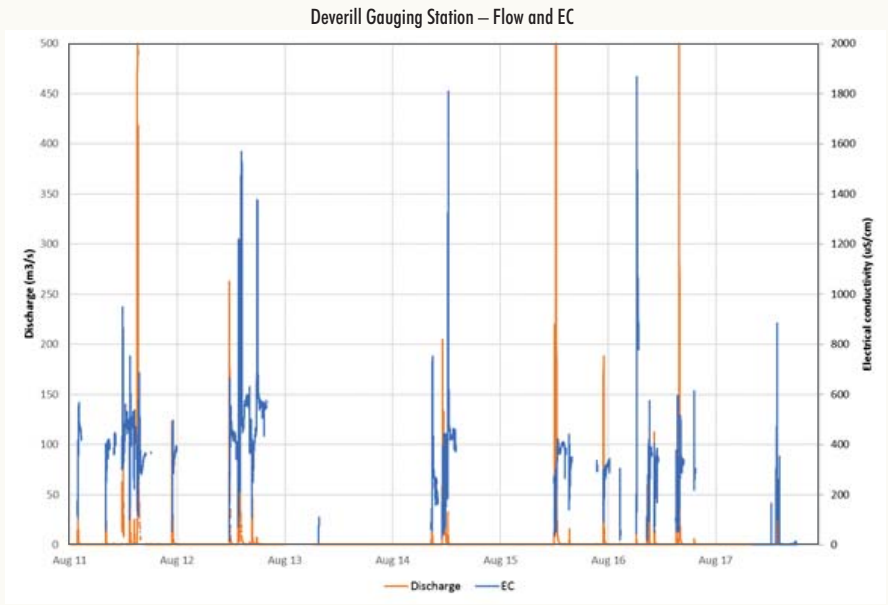
The baseline datasets show that the water quality in the Isaac River during and after significant flow events has exceeded the Isaac River WQOs in the past for short periods of time due to releases from operating coal mines. However, for the most part, the water quality in the Isaac River is within the WQOs.

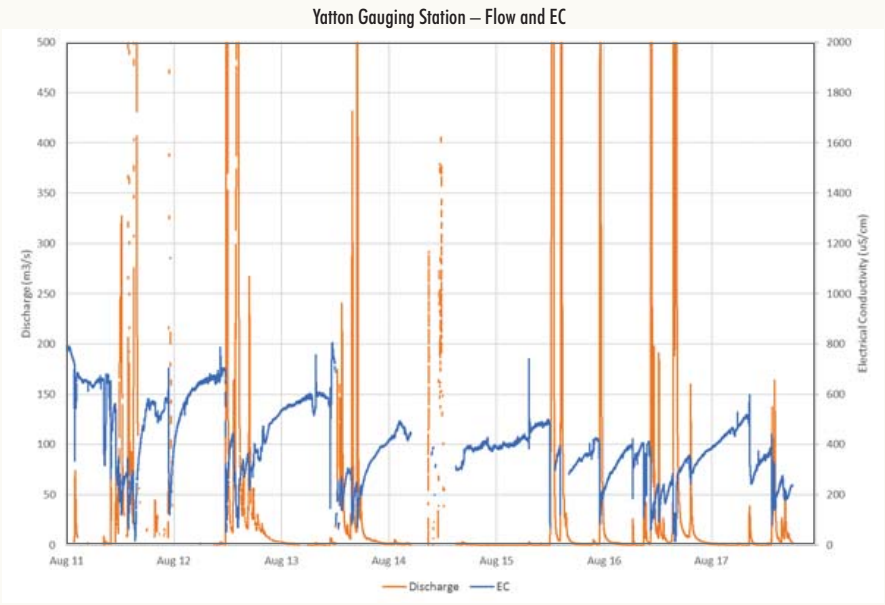
Local Surface Water Quality

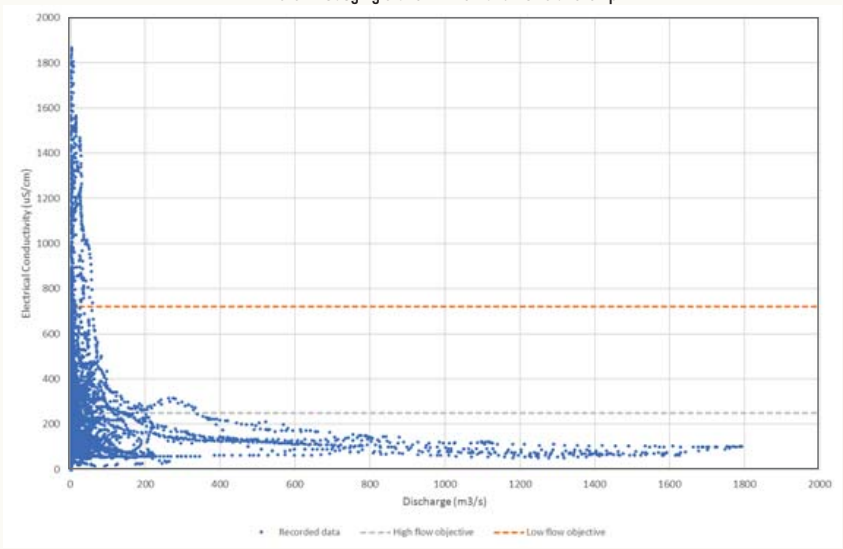
Local surface water quality sampling has been undertaken as a component of the baseline surface water and aquatic assessments for the Mine Site and Access Road.

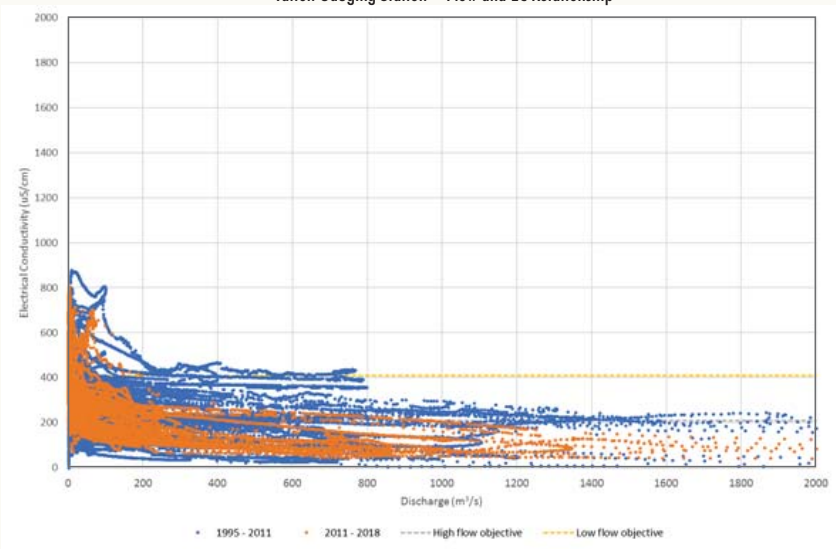
Analyses for a range of physio-chemical parameters were completed at a number of sites along the Isaac River and its local tributaries including (Figure 3-20):

- Isaac River [upstream] (SW1-Original; SW1-New; and SW3);
- North Creek (SW2);
- Ripstone Creek (SW4-Original; SW4-New; and SW6);
- Boomerang Creek (SW8); and
- Isaac River [downstream] (SW11-Original; SW11-New; and SW12).









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Source: Hatch (2018)

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Isaac River Water Quality

Figure 3-22

It is however noted that some of these samples are taken during the baseline campaign were from pooled water as no flow was present at the time of the sampling rounds.

The above sampling sites were supplemented by surface water quality sampling events conducted as part of the aquatic surveys in December 2016 and July 2017 at a number of local riverine sites including (Figure 3-20):

- Isaac River [adjacent] (R2; R6; and R8);
- Ripstone Creek (R3; and R5); and
- other unnamed tributaries draining to the Isaac River (R1; R4; and R7).

The datasets collected as part of the baseline surface water and aquatic assessments for the Mine Site and Access Road were augmented with the surface water quality data presented as part of the Moorvale Coal Project EIS (2000) for North Creek, as well as that presented as part of the Lake Vermont Northern Extension EIS (2013) including Phillips Creek sites (AQ3; AQ4; and MP3) (Figure 3-18).

A comprehensive suite of the local surface water quality results is presented in Hatch (2018a), including comparisons to relevant WQOs (discussed further below).

Groundwater Levels and Pressures

Alluvium

The alluvium is present in the Mine Site and Access Road area and surrounds on the northern and eastern edge of the ODS domain and on the western edge of the Willunga domain. The extent and thickness of the unconsolidated sediments was assessed using a TEM survey, verified with site geological logs, conducted by Groundwater Imaging Pty Ltd in July 2017 (Groundwater Imaging, 2017).

The TEM survey identified that alluvial sediments occur further west than is mapped by the Qld Government at the ODS domain. These sediments are generally less than 12 m thick, but the alluvium can be up to 30 m thick within a narrow corridor along the Isaac River, thinning out with distance from the river (Appendix D).

The findings from the TEM survey, along with the CSIRO Soil and Landscape Grid of Australia (CSIRO, 2015) data and site geological logs have been used to refine the assessments.

Of all the monitoring bores intersecting the alluvium, four (GW04, GW08s, S2 and S11) have remained dry between June and February 2018. The remaining bores recorded a saturated thickness of between 2 m to 12 m within the alluvium (Appendix D).

The surficial alluvium along the upper reaches of tributaries to the Isaac River is largely dry, however the alluvium of the Isaac River itself does appear saturated (Appendix D).

Alluvial groundwater levels at the ODS and Willunga domains are presented in the Groundwater Assessment (Appendix D) including spatial contour distribution of the groundwater levels using a combination of water levels obtained in alluvial monitoring bores installed as part of the investigation program, and from water level observations collected during the landholder bore census survey. Groundwater within the alluvium is unconfined, with water levels generally between 10 m to 20 m below ground surface (the top of the unit) (Appendix D).

The higher groundwater elevations (167 mAHD) were recorded for bores positioned closest to the Isaac River in the north-west (S8 and GW01s). Lower groundwater elevations (140 mAHD) at the Willunga domain in the south-east are approximately 13 m below surface (Appendix D).

The water levels in the alluvium clearly follow the downstream flow gradient of the Isaac River, with south-easterly flow gradients (Appendix D).

Recharge to the alluvium is considered to be mostly from stream flow or flooding, with direct infiltration of rainfall also occurring where there are no substantial clay barriers in the shallow sub-surface. Groundwater within the alluvium is likely discharged as evapotranspiration from riparian vegetation growing along the Isaac River, as well as potential baseflow contributions after significant rainfall and flood events (Appendix D).

The groundwater hydrographs presented in HydroSimulations (2018) demonstrate that the elevation of water (ponded or flowing) between June 2017 and February 2018 at the Deverill stream gauge (located approximately 200 m from bore GW01s which recorded levels more than 3 m below the river elevation), indicate losing conditions, that is no baseflow component in the Isaac River at the ODS domain (Appendix D).

Notwithstanding, occasional periods of baseflow to the Isaac River from the underlying alluvium may occur after prolonged rainfall events or following flood events. Under these conditions, recharged alluvial sediments would drain to the river as the hydraulic gradient reverses and sustains stream-flow for a short period after the rainfall event (Appendix D).

Geological logs indicate the alluvium is underlain by low permeability stratigraphy (i.e. claystone, siltstone and sandstone) at the site, which likely restricts the rate of downward leakage to underlying formations.

Localised perched water tables within the alluvium are evident where waterbodies continue to hold water throughout the dry period (e.g. pools in the Isaac River and floodplain wetlands), occurring where clay layers slow the percolation of surface water (Appendix D).

Regolith

The surficial regolith material covering much of the Mine Site and Access Road area comprises Cainozoic (Quaternary to Tertiary) aged sediments, including alluvium and colluvium. Based on site geological logs, the regolith comprises a heterogeneous distribution of fine to coarse grained sand, clay, sandstone and claystone. The regolith material is generally 15 m to 45 m thick. The units are all recorded as being highly weathered, with the depth of weathering extending to around 50 m below surface, into the underlying coal measures (IMC, 2014).

Groundwater monitoring conducted at the site includes two monitoring bores intersecting the regolith at the ODS domain (GW06s and GW12s) and two within the Willunga domain (GW16s and GW21s). Of these bores, two (GW06s and GW16s) have remained dry (unsaturated) between June 2017 and February 2018. Similar unsaturated conditions have been recorded for exploration holes intersecting the regolith across the site (Appendix D).

Overall, the regolith is considered to be largely unsaturated, with the presence of water restricted to lower elevation areas along the Isaac River and the lower reaches of its tributaries (i.e. Ripstone Creek). Flow within the regolith where it is saturated is likely a reflection of topography, flowing towards nearby drainage lines (Appendix D).

The regolith material comprises low permeability strata (i.e. clay and claystone), which likely restricts rainfall recharge. Groundwater discharge is likely to occur primarily via evapotranspiration, with some baseflow to streams from the regolith under wet climatic conditions. Vertical seepage through the regolith is likely to be limited by the underlying low-permeability Rewan Group and other aquitards (Appendix D).

Triassic (Rewan Group)

The Triassic sediments include an isolated pocket of Clematis Group sediments to the east of the Isaac River near the ODS domain, and the more regionally extensive Rewan Group. The outcrop of Clematis Group is approximately 100 m thick and forms a localised topographic high at an elevation of around 330 mAHD (Appendix D).

The Rewan Group is present throughout the Vermont Park and southern Iffley areas of the ODS domain but is limited to a small area in the north-western corner of Willunga. Where it occurs, the Rewan Group is present beneath the alluvium and regolith. The unit thickens towards the Isaac River, and can be up to 300 m thick at the site (Appendix D).

Groundwater monitoring conducted at the site includes three VWPs with operational sensors targeting the Rewan Group (GW01d, GW08d and GW16d). Confined groundwater conditions occur within the Rewan Group sediments. Groundwater elevations range from 163 mAHD at the northern end of ODS domain (GW01d), down to 136 mAHD at the Willunga domain (GW16d), indicating a general south-easterly hydraulic gradient. It should be noted; however, that the very low permeability strata that comprise the Rewan Group mean that groundwater transmission and flow within this unit is likely very limited (Appendix D).

Groundwater elevations for VWPs GW01d, GW08d and GW16d are presented in the Groundwater Assessment (Appendix D). At all sites, groundwater elevations within the Rewan Group are above those recorded within the deeper Permian coal measures, indicating a downward hydraulic gradient (Appendix D).

Permian Coal Measures

The Permian coal measures underlie the Rewan Group and surficial cover, and outcrop along the ridgelines to the east and west of the Mine Site and Access Road area.

In increasing depth (age) order, the major coal measures of the Blackwater Group in the area include the:

- Rangal Coal Measures;
- Fort Cooper Coal Measures; and
- Moranbah Coal Measures.

The shallowest coal measures, the Rangal Coal Measures, are around 90 m – 195 m thick at the Mine Site and Access Road area and contain the target seams (e.g. Leichardt and Vermont) for the mining operation. The non-coal portions (interburden) of the sequence are predominantly sandstones, siltstones, mudstone and shales.

The Leichhardt Seam occurs at depths of between 25 m and 317 m below surface at the ODS domain. At the Willunga domain, the Leichhardt Seam occurs 30 m to 270 m below surface.

The Fort Cooper Coal Measures conformably underlie the Rangal Coal Measures and also occur at outcrop to the east and west of the Isaac River.

The Moranbah Coal Measures conformably underlie the Fort Cooper Coal Measures. The coal measures occur at subcrop to the west of the Mine Site and Access Road area, where they are targeted as part of the Peak Downs and Saraji mines.

Groundwater occurrence within the Permian coal measures is largely restricted to the more permeable coal seams that exhibit secondary porosity through fractures and cleats (Appendix D).

Groundwater monitoring conducted at the site includes two monitoring bores (GW02d, GW18d) targeting the coal seams, one bore (GW21d) targeting the interburden and five VWP locations (GW01d, GW06d, GW08d, GW12d and GW16d) targeting multiple units within the Permian coal measures sequence.

The water levels in the Permian coal measures generally follow the downstream flow gradient of the Isaac River, with south-east hydraulic gradients. Permian groundwater elevations range from around 170 mAHD north of the ODS domain, down to 130 mAHD at the Willunga domain to the south-east (Appendix D).

Groundwater Quality

An analysis of water quality attributes of groundwater within the Mine Site and Access Road area and surrounds is provided in HydroSimulations (2018).

Available water quality data has been compared to the:

- Fitzroy Basin Zone 34 groundwater quality objectives for deep and shallow water;
- Australian Drinking Water Guidelines (ADWG) (NHMRC 2011); and
- ANZECC (2000) guidelines for aquatic ecosystems, irrigation (long term and short term) and stock water supply.

The main geological units include alluvium, regolith and interburden (sandstone/ siltstone) and coal of the Permian aged coal measures and are discussed below.

Alluvium

While water within the Isaac River is largely fresh, water within the alluvium has recorded ranges from fresh to moderately saline with an average TDS of 1,458 mg/L, ranging between 201 mg/L and 3,430 mg/L. Alluvium groundwaters can be classified as Na-Ca or Na-Mg type water, and are higher in bicarbonate than the other groundwater units (Appendix D).

Spatial distribution of TDS depicts all fresh water quality localised along the Isaac River, with brackish to moderately saline water along the river and tributaries. However, salinity within the alluvium can be highly variable spatially. Results for government alluvial bore RN13040180 indicates EC can range between 199 µS/cm and 7,400 µS/cm (fresh to moderately saline). By comparison, EC as recorded at the Deverill gauging station since 2011, ranges between 49 µS/cm and 1,173 µS/cm (fresh to brackish).

The water quality data for the alluvium occasionally shows an inverse correlation in EC to rainfall residual mass curve, with rising EC recorded during periods of declining/ below average rainfall and vice versa (Appendix D).

Comparing the available data to relevant guideline levels, the summary results indicate that water within the Quaternary alluvium is generally suitable for stock water supply and irrigation. However, the alluvial groundwater generally exceeds guideline levels for drinking water (i.e. TDS, chloride and sodium) and freshwater aquatic systems. The alluvial groundwater also records concentrations of total and dissolved copper above the Fitzroy Plan Water Quality Objectives (WQO) for Zone 34 (shallow) (Appendix D).

Regolith

Water within the regolith material is generally highly saline, but can be brackish to moderately saline with an average TDS of 9,757 mg/L, ranging between 1,460 mg/L and 18,600 mg/L. The proportion of chloride is higher within the regolith material, which can be classified as Na- Cl-SO_4 or Na-Cl-HCO_3 type water (Appendix D).

Water within the regolith material exhibits poorer quality compared to the alluvium and is not considered a suitable groundwater resource for livestock, irrigation, drinking water or aquatic ecosystems. The water within regolith material also exceeds the Fitzroy Plan WQO (Zone 34 – shallow) for EC, chloride, calcium, sodium, hardness, magnesium, sulfate, copper and manganese (Appendix D).

Coal Measures (Interburden and Coal)

Water within the Permian coal measures can range between fresh and highly saline, but is generally saline within the coal seams, and brackish to moderately saline within the interburden units. Coal seam units of the Permian coal measures recorded an average TDS of 7,402 mg/L, ranging between 2,544 mg/L and 14,700 mg/L. The interburden units of the Permian coal measures recorded an average TDS of 4,746 mg/L, ranging between 421 mg/L and 18,400 mg/L. The Permian coal measures generally contain Na-Cl type water, with some also recording a high proportion of Mg but with very little sulphate compared to the other groundwater units (Appendix D).

As expected, the salinity within the coal measures appears to increase with depth. Bores within the coal measures near the sub-crop areas in the west of the Mine Site and Access Road area generally record moderately saline water quality, which increases to saline quality where the coal measures are deepest near the Isaac River. This corresponds with the coal measures being largely recharged by rainfall where they occur at sub-crop (Appendix D).

Water within the siltstones and sandstones of the Permian coal measures is generally suitable for stock water supply, with the exception of some TDS concentrations exceeding guideline levels for pigs and poultry. In contrast, groundwater within the coal seams generally exhibits a higher TDS, which, on average, is higher than the guideline level for beef cattle but below the guideline level for sheep. Comparison of results to the guideline levels indicates the coal measures are not considered a suitable groundwater resource for irrigation, drinking water or aquatic ecosystems. Groundwater within the coal measures (coal and interburden) record concentrations of manganese and iron above the Fitzroy Plan WQO (Zone 34 –shallow) (Appendix D).

Water Quality Objectives (Draft)

Draft water quality objectives (WQOs) have been developed for each physical and chemical parameter, based on a review and consideration of:

- the lowest WQO for each relevant environmental value; and
- the available baseline water quality datasets.

Where the available baseline water quality datasets demonstrate clearly that the lowest WQO could not be achieved, an alternative WQO has been derived.

Where there remains substantial ambiguity, the lowest WQO has been adopted as the default, until such time as ongoing baseline datasets are available to derive an alternative WQO.

The draft water quality objectives for the Mine Site and Access Road area are presented in Table 3-17.

3.3.9.8 Numerical Modelling

Calibrated Numerical Groundwater Flow Model

A 3D numerical groundwater flow model was developed using MODFLOW-USG (Appendix D).

The model is centred over the Mine Site and Access Road area and is elongated in the north-west to south-east direction to follow geological strike. The model is approximately 55 km x 70 km at its widest extents (Figure 3-7). The model domain was selected based on the following considerations:

- The south-west and north-east boundaries are represented by the outcrop of the Back Creek Group, which is considered to be the regional low permeability basement for the purpose of the groundwater flow modelling.
- The north-west and south-east boundaries are approximately 15 km from the edge of the proposed open cut pits and include the surrounding mines for cumulative impact assessment.

Geological fault features are represented by mesh refinement in the model to allow for sensitivity analysis. Over the 14 model layers, the total cell count for the model is 966,821 (Appendix D).

The model was calibrated and verified to existing groundwater levels, using reliable measurements from representative bores within the model domain. Both steady-state and transient calibration models have been developed:

- Steady-state model of average pre-2006 conditions.
- Transient model calibration based on temporal pre-mining data at quarterly time intervals from January 2006 to December 2017.

The objective of the calibration was to replicate the observed groundwater levels in accordance with the modelling guidelines developed by Barnett et al., (2012) and utilise available data and information obtained from the baseline datasets as part of the groundwater monitoring and investigation program including the bore census (ENRS, 2017).

Utilising the available datasets, the steady state and transient calibrations achieved 8.7% and 7.9% scaled root mean square (SRMS) errors, respectively. This indicates a good calibration and is within the Australian guidelines indicator of <10% SRMS (MDBC, 2001; Barnett *et al*., 2012) (Appendix D).

Under the earlier MDBC 2001 modelling guideline (Middlemis et al.,2001), the model is best categorised as an Impact Assessment Model of medium complexity.

Barnett et al. (2012) developed a system within the modelling guidelines to classify the confidence level for groundwater models. Models are classified as Class 1, Class 2 or Class 3 in order of increasing confidence based on key indicators such as available data, calibration procedures, consistency between calibration and predictive analysis and level of stresses. Under these guidelines, this model would be classified as a Confidence Level 2 (Class 2) groundwater model (Appendix D).

Sensitivity analysis was conducted to understand how changes to a range of the groundwater flow model assumptions and variables might influence the model predictions. This included assessment of the influence of selected physical properties (specific yield and waste rock properties), fault structures and the approved Bowen Gas Project.

Table 3-17
Draft Water Quality Objectives

Physio-chemical Parameter	Draft WQO	Relevant Environmental Value
pH	6.5-8.5	Aquatic Ecosystem
Conductivity (EC) – Baseflow	< 720 µS/cm	Aquatic Ecosystem
Conductivity (EC) – High flow	< 250 µS/cm	Aquatic Ecosystem
Total Dissolved Solids	< 2,000 mg/L	Stock Watering
Total Hardness (as $CaCO_3$)	< 150 mg/L	Drinking Water
Suspended Solids	< 55 mg/L	Aquatic Ecosystem
Sodium	< 30 mg/L	Drinking Water
Sulphate	< 25 mg/L	Aquatic Ecosystem
Turbidity	< 50 NTU	Aquatic Ecosystem
Colour	50 Hazen Units	Drinking Water
Dissolved Oxygen	85-110% Saturation	Aquatic Ecosystem
	> 4 mg/L (at surface)	Drinking Water
Iron	< 10 mg/L	Irrigation
Manganese	< 10 mg/L	Irrigation
	< 1.9 mg/L	Aquatic Ecosystem
Aluminium	< 5 mg/L	Stock Watering
	<0.055 mg/L	Aquatic Ecosystem
Boron	< 5 mg/L	Stock Watering
	< 0.37 mg/L	Aquatic Ecosystem
Zinc	< 5 mg/L	Irrigation
	< 0.008 mg/L	Aquatic Ecosystem
Lithium	< 2.5 mg/L	Irrigation
Fluoride	< 2 mg/L	Irrigation
Arsenic	< 2 mg/L	Irrigation
	< 0.5-5 mg/L	Stock Watering
	< 0.024 mg/L	Aquatic Ecosystem
Chromium	< 1 mg/L	Stock Watering
	< 0.001 mg/L	Aquatic Ecosystem
Copper	< 1 mg/L	Stock Watering (Cattle)
	< 0.0014 mg/L	Aquatic Ecosystem
Nickel	< 1 mg/L	Stock Watering
	< 0.011 mg/L	Aquatic Ecosystem
Beryllium	< 0.5 mg/L	Irrigation
Vanadium	< 0.5 mg/L	Irrigation
Cobalt	< 0.1 mg/L	Irrigation
Lead	< 0.1 mg/L	Stock Watering
	< 0.0034 mg/L	Aquatic Ecosystem
Uranium	< 0.1 mg/L	Irrigation
Molybdenum	< 0.05 mg/L	Irrigation
Selenium	< 0.02 mg/L	Stock Watering
	< 0.005 mg/L	Aquatic Ecosystem
Cadmium	< 0.01 mg/L	Stock Watering
	<0.0002 mg/L	Aquatic Ecosystem

Table 3-17 (Continued)
Draft Water Quality Objectives

Physio-chemical Parameter	Draft WQO	Relevant Environmental Value
Mercury	< 0.002 mg/L	Irrigation
	< 0.00006 mg/L	Aquatic Ecosystem
Total Nitrogen	< 500 µg/L	Aquatic Ecosystem
Organic Nitrogen	< 420 µg/L	Aquatic Ecosystem
Oxidised Nitrogen	< 60 µg/L	Aquatic Ecosystem
Total Phosphorus	< 50 µg/L	Aquatic Ecosystem
Filterable Reactive Phosphorus	< 20 µg/L	Aquatic Ecosystem
Ammonia Nitrogen	< 20 µg/L	Aquatic Ecosystem
Chlorophyll a	< 5 µg/L	Aquatic Ecosystem

Source: after Hatch (2018a).

A more complex Monte Carlo style uncertainty analysis was also undertaken where numerous model inputs were changed at the same time, and presents resulting probabilities for predicted spatial drawdown extents (i.e. bores affected by more than 1 m drawdown or more), transient stream (enhanced) leakage and alluvium water take (direct and indirect).

The results of the sensitivity analysis and uncertainty analysis are detailed in the Groundwater Assessment (HydroSimulations, 2018).

Model Layers and Geometry

The large spatial area of the model extent resulted in the need for an unstructured grid with varying cell sizes, and refinement in the areas of interest, in order to reduce the total cell count to a manageable size. The following features have been included in the mesh design:

- Rivers in the immediate vicinity of Olive Downs (Isaac River and Ripstone Creek) have a 50 m Voronoi cell size constraint. All other rivers/creeks have a maximum cell size of 100 m.
- Open cut mine areas at the Olive Downs South and Willunga domains have a 100 m Voronoi cell size constraint.
- Open cut mining at Olive Downs North, Lake Vermont, Poitrel, Daunia, Peak Downs and Saraji have a maximum cell size of 200 m.
- Longwall mining at Eagle Downs has an oriented regular grid of 375 m width squares to represent longwalls. Proposed mining at Saraji East is represented similarly by 400 m squares.
- Faults are represented using a 100 m Voronoi cell constraint.

The cell count for one layer is 91,806. Over the 14 model layers, with pinch-out areas (where a layer is not present) in layers 2 to 14, the total cell count for the model is 966,821.

Groundwater Modelling Layers

The topography of the model relies on LiDAR data provided by Pembroke and topography defined by the Australia Wide 1 Sec DEM-H (Geoscience Australia, 2011). There was a correction of +3 m applied to the Geoscience Australia (2011) data to maintain consistency between the two data sets.

The model domain was discretised into 14 layers. Model layers (lateral and vertical extents) were defined using data available from the following sources (Appendix D):

- Pembroke site geological model (as at May 2017);
- site TEM alluvial survey;
- NGIS/DNRM groundwater bore database;
- Queensland Petroleum Exploration Database (QPED) ;
- reported bore details and cross-sections, particularly from URS (2012); and
- outcrop geology maps where the basal contact of a unit is intercepted with topography to provide a series of layer bottom elevation points at the outcrop extents.

Model layer 1 is fully extensive across the model with an assumed minimum depth of 3 m for colluvium. All other layers are only present to the limit of their outcrop extent, with some inference made for the presence of older units beneath the surface outcrop due to folding and faulting.

The Back Creek Group is considered the regional low-permeability basement for the purpose of this modelling and defines the western, eastern and bottom edges of the model.

It is not possible to represent every individual coal seam (typically <1 m thickness) in a regional groundwater model, therefore a "combined thickness" totalling the individual seam thicknesses for each relevant seam has been simulated. Site specific information regarding the Rangal Coal Measures is available from the site geological model and exploration database. Limited regional information regarding layer thicknesses away from the site as well as thickness of units older than Rangal Coal Measures at site is available, therefore where information was lacking the following layer thicknesses have been assigned based on the average of available data:

- Rangal Coal Measures:
  - Total Thickness: 150 m
  - Leichhardt Seam: 5.5 m
  - Vermont Upper Seam: 4 m
- Fort Cooper Coal Measures:
  - Total thickness 200 m
  - Combined seam thickness 80 m
- Moranbah Coal Measures:
  - Total Thickness: 110 m
  - Combined seam thickness 20 - 40 m

With the exception of Layer 1, the minimum thickness for all model layers is 0.1 m, with any model cell below this thickness pinched out of the model. The minimum thickness of Layer 1 is 3 m.

Geological Faults

The Mine Site and Access Road is located with the highly faulted Jellinbah Fault Zone, in which several easterly dipping thrust faults are present. Major regional faults identified have been included in the model, as well as smaller local faults identified in the site geological model. Most of the local faults occur in the ODS domain, whereas the Willunga domain appears to be more affected by open folding. Mesh refinement (100 m) along the faults has been included in the model build in order to allow the change of hydraulic properties along the fault zones during calibration and sensitivity analysis. The model fault zones are detailed in the Groundwater Assessment (Appendix D).

Model Stress and Boundary Conditions

Regional Groundwater Flow

The model perimeter is set as a 'no-flow' boundary by default, except where regional groundwater flow is likely to enter or leave the active model area in which case a general head boundary (GHB) is specified. The GHB boundary condition is used to represent the regional flow into and out of the model area and has been assigned using GHBs in Layers 1, 2, 5, 7, 10 and 13 using pre-mining head elevation.

Groundwater will enter the model where the head set in the GHB is higher than the modelled head in the adjacent cell, and leave the model when the water level is lower in the GHB.

Conductance is calculated using the modelled hydraulic conductivity of the layer in which the GHB sits divided by the cell area, and is therefore variable in this model due to variable cell-size.

Watercourses

The Isaac River was represented in the model using the Stream Flow Routing (SFR) package. All other watercourses were represented using the MODFLOW River (RIV) package. The rivers were set with the river bed 2 to 6 m below the surrounding topography to represent the steep-banked incised channels.

Surveyed river stage data was available at several locations along the Isaac River. The closest gauging station to the site, located at Deverill, records average monthly water levels. This data was extrapolated to provide contiguous stage elevations. Similarly, a decommissioned gauge located at Phillips Creek at Tayglen was used to provide a seasonal estimate of stage for tributary rivers to the Isaac.

Rainfall Recharge

Rainfall recharge was applied to the model using the MODFLOW-USG recharge (RCH) package. The model distributed the recharge in zones across the model domain according to outcropping geology. The model assigned a proportion of annual rainfall to each of these zones. The proportion of rainfall entering the model as recharge varied through the calibration process. The predictive model adopted the Olive Downs Base Case recharge rates from Table 3-18.

Table 3-18
Rainfall Recharge Ranges

Surface Geology	Bowen Gas Project (Low)		Olive Downs Base Case		Bowen Gas Project (High)	
	(mm/yr)	% rain	(mm/yr)	% rain	(mm/yr)	% rain
Stream Channel	3	0.48	2.8	0.45	27	4.35
Flood Plain Alluvium	2	0.32	5.1	0.82	18	2.90
Other Alluvium	1	0.16	3.1	0.49	9	1.45
Tertiary sediments	0.3	0.05	0.15	0.02	3	0.48
Rewan	0	0.00	0.01	<0.01	0	0.00
Outcropping Coal Measures	0.33	0.05	0.06	0.01	3	0.48

BGP – Arrow Energy Bowen Gas Project.

The recharge rates were calculated using the chloride mass balance (CMB) method for the various units. The CMB calculations were based on available water quality results (chloride concentrations) collected from site monitoring bores and landholder bores. The CMB calculation assumed average annual rainfall of 620 mm as modelled. The calculations also assumed a mean annual rainfall chloride flux of 3 mg/L. No site data was available for the low permeability Rewan Group. Outliers were excluded from the calculations and were identified as readings more than four standard deviations above the mean (U.S. EPA 2009).

This is consistent with the recharge applied in the Bowen Gas Project modelling and has been used as a guide to applicable recharge ranges for each outcropping geological unit. As per the conceptual model, higher recharge occurs through the alluvium and lower recharge in regolith and Permian outcrops. Increased recharge through the alluvium of the Isaac river channel has been used to simulate the potential for the Isaac River to provide rapid recharge to the alluvial groundwater system during rainfall events.

For comparison, other nearby projects have used modelled recharge as a default value across the domain, with Lake Vermont simulating recharge equivalent of 2% mean annual rainfall, and Isaac Plains simulating 0.5% to alluvium and 0.25% elsewhere. These values indicate overall rainfall recharge to the groundwater system is limited.

Evapotranspiration

The MODFLOW Evapotranspiration (EVT) package was used to simulate evapotranspiration from the groundwater system. Extinction depths were set to 2 m below ground across the model domain. Maximum potential rates were set using actual evapotranspiration values (from the Bureau of Meteorology), with the average value (600 mm/year) used as the transient calibration evapotranspiration rate.

Groundwater Use

Private groundwater pumping bores were not included in the model due to lack of information regarding abstraction rates. Due to low groundwater abstraction across the model area, it is likely that the bores have very localised drawdowns and will not significantly impact model results.

Mining

The MODFLOW Drain (DRN) package was used to simulate mine dewatering in the model for the Mine Site and Access Road and the surrounding mines. Drain boundary conditions allow a one-way flow of water out of the model. When the computed head drops below the stage of the drain, the drain cells become inactive. This is an effective way of theoretically representing removal of water seeping into a mine over time, with the actual removal of water being via pumping and evaporation.

The open cut mining at the Mine Site and Access Road and surrounding mines was simulated in the model as MODFLOW Drain (DRN) cells, with drain cells applied in all layers from surface to the base of the lowest mined seam. The longwall extraction at Eagle Downs and Saraji East was represented as drain cells in model layer 13 only (combined Moranbah Coal Measures) and the fracture zone extended up to layer 8. The drain cells applied for the surrounding mines were interpolated from mine schedule information available from EIS documentation and aerial photography.

For open cut mining, Hawkins (1998) and Mackie (2009) indicate that waste rock is more permeable than the undisturbed strata. Completed open cut mining areas will be backfilled with waste overburden as the extraction proceeds. Backfill was given uniform hydraulic conductivity of 0.2 m/day, specific yield of 0.05 and rainfall recharge set to 1 % of average rainfall. In the transient calibration and prediction model, backfill properties are applied two years behind the mine face.

The hydraulic properties were varied with time using the TVM package of MODFLOW-USG Beta. For the underground mines, the hydraulic properties were changed with time in the goaf and overlying fractured zone directly above each longwall panel.

Calibrated Flood Model

Various flooding and surface water related reports in the Isaac River catchment were reviewed and considered during the development of the flooding model, including:

- *Flood Hydrology Technical Report – Red Hill Mining Lease EIS* (URS, 2013a);
- *Flood Impact Assessment Report – Isaac Plains Mine Extension Development Project EAR* (WRM, 2016a);
- *Flood Modelling Report – Grosvenor G200s Coal Mine Expansion Project EAR* (Alluvium, 2016);
- *Olive Downs North Environmental Management Plan* (MEMS, 2005);
- *Surface Water Report – Red Hill Mining Lease EIS* (URS, 2013b);
- *Surface Water Report and Flood Assessment – Caval Ridge Coal Mine Project EIS* (URS, 2009);
- *Surface Water Impact Assessment – Lake Vermont Mine Northern Extension Project EIS* (WRM, 2016b); and
- *Water Resource Report – Millenium Expansion Project EIS* (MetServe, 2010).

The methodology steps for the development of the hydrology model included:

- Review of catchment characteristics and climate to guide overall understanding of flood hydrology;
- Catchment delineation for the Isaac River and its tributaries to subdivide the total catchment into relatively uniform size sub-catchments for rainfall runoff modelling;
- Rainfall runoff routing model setup (RORB software) for Isaac River catchment;
- Calibration of RORB model parameters based on five recorded rainfall events;
- Preparation of design rainfall event inputs for the RORB model;
- Australian Rainfall-Runoff 2016 (AR&R, 2016) and Bureau of Meteorology (BOM) – Areal rainfall data for the Isaac River;
- Review of recommended regional rainfall losses and estimation of the design rainfall losses based on calibration and recommended AR&R 2016 values;
- Adaptation of RORB model routing parameters (Kc and m) based on the median values of calibrated models;
- RORB model simulations and reviews of results;
- Validation of RORB results and input parameters using flood frequency analysis results; and

- Comparison of the following two scenarios to understand the influence of existing mines on two design events (50% annual exceedance probability (AEP) and 1% AEP):
  - all mining lease runoff captured within the existing mines; and
  - all mining lease runoff released from existing mine sites.

The Flood Assessment (Appendix F) presents the current flood risk on maps for a range of annual exceedance probabilities (i.e. 50%, 20%, 10%, 5%, 2%, 1%, 0.1%) up to the probable maximum flood (PMF) for potentially affected waterways including the Isaac River, Ripstone Creek, North Creek, Boomerang Creek, One Mile Creek and Phillips Creek.

The flood hydrology model includes the main branch and tributaries of the Isaac River covering an area of approximately 9,601 km^2 and consists of 90 sub-catchments (Figure 3-8).

The hydrology model has been calibrated against data at the Deverill gauge station for five historical flood events (i.e. August 1998, February 2008, December 2010, February 2016 and March 2017). The calibration results for the developed flood hydrology model were considered to be satisfactory (Appendix F).

Modelling software TUFLOW was used to develop a hydrodynamic two dimensional (2D) hydraulic model of the study area. The TUFLOW modelling software was adopted for the assessment based on the key hydraulic controls influencing flooding behaviour of the Isaac River network near the Mine Site and Access Road area.

The TUFLOW model of the study area was developed for the Isaac River and its tributaries, from downstream of the Norwich Peak Branch Railway crossing over the Isaac River (148°16'44.2" E, 22°7'10.8" S) and continues approximately 60 km downstream to the location that the Isaac River flows along the Carfax Road (148°33'16.4" E, 22°27'9.1" S), 16.5 km west of the Carfax Road intersection with the Fitzroy Developmental Road. The TUFLOW model consisted of 10 inflow locations and the total area of the modelled network is approximately 557 km². The model includes main branch and tributaries of the Isaac River within above mentioned range as well as the following creeks; Boomerang Creek, North Creek, One Mile Creek, Phillips Creek and Ripstone Creek (Figure 3-8).

Topographic Data

Three sources of topographic data were provided as listed below:

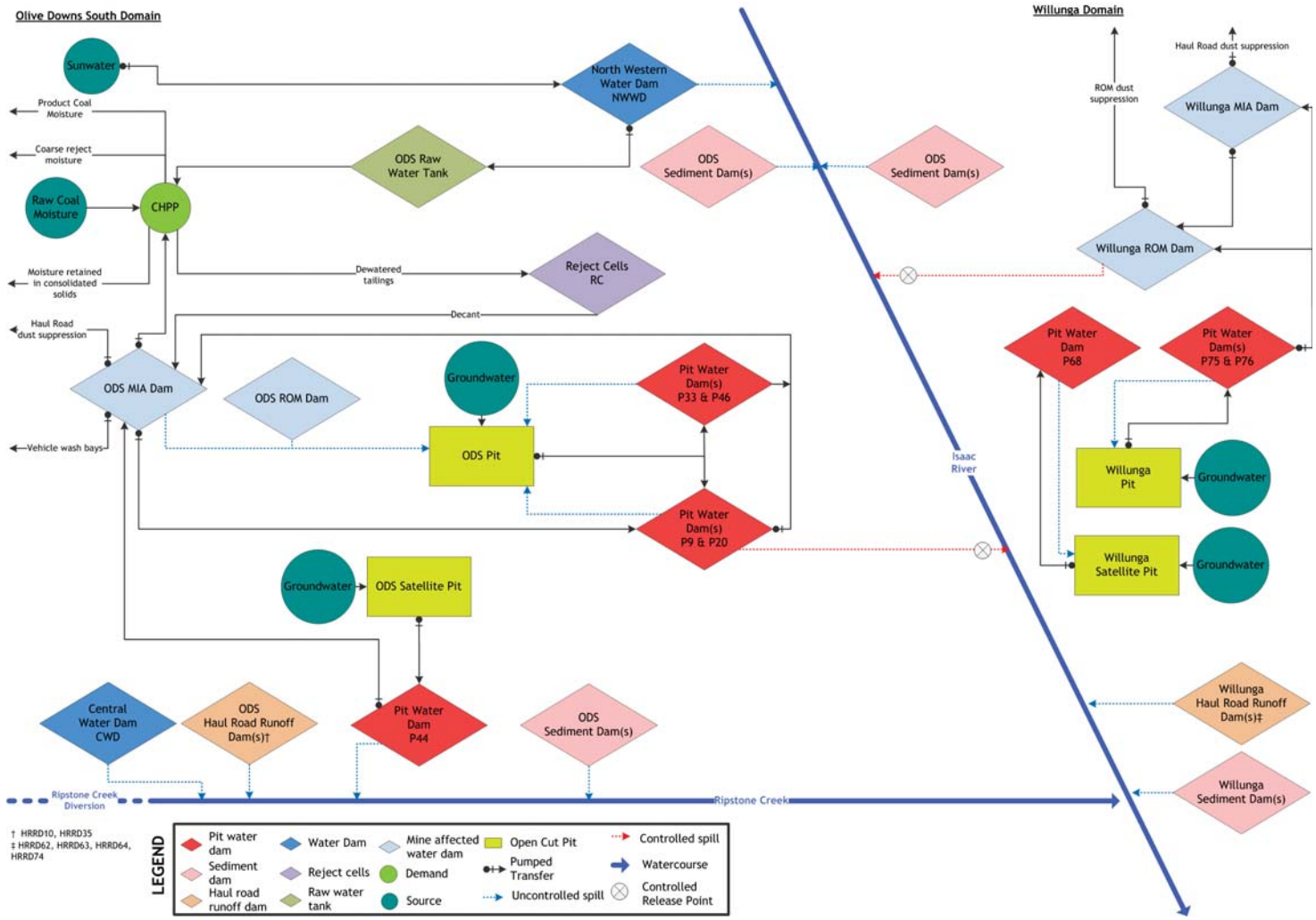
- 3-second (~90 m) Shuttle Radar Topography Mission (SRTM) derived Digital Elevation Models (DEM) Version 1.0 package (Geoscience Australia, 2017);
- 5-metre xyz point data (Minserve Group, April 2017) generated from detailed light detection and ranging (LiDAR) surveys in the region; and
- 1-metre xyz point data (Minserve Group, May 2017) generated from detailed LiDAR surveys in the region.

Site Water Balance

A computer-based operational simulation model (OPSIM) was used to assess the dynamics of the mine water balance under conditions of varying rainfall and catchment conditions throughout the development of the mining operation. The OPSIM model dynamically simulates the operation of the water management system and keeps complete account of all site water volumes and representative water quality on a daily time step.

The model has been configured to simulate the operations of all major components of the water management system. The model configuration and results are presented in detailed in Hatch (2018a). The water management system schematic is shown on Figure 3-23.

The water management system will change over the 79-year mine life, including changes in catchment areas, production profile and site water demands. To represent the evolution of the mine layout over time, the system was modelled in six discrete stages. Seven representative years have been selected to reflect the average conditions over the mine stage.



PRN-116-02_EIS_Sect2_003B

Source: Hatch (2018)

PEMBROKE

OLIVE DOWNS COKING COAL PROJECT

Indicative Water Management Schematic

Figure 3-23

The modelled mining phases stages are summarised in Table 3-19. Construction activities are proposed during Years 2018 and 2019, and these two years were not included in the water balance modelling assessment.

There is around 46 years of recorded rainfall data available for the Moranbah WTP and Moranbah Airport gauges. In order to extend the dataset, long term daily rainfall data for the area from 1 January 1889 to 31 December 2017 (129 years) was obtained from the DSITIA Data Drill service. This data set was corrected for accumulated daily rainfall totals and missing data.

Given the long mine life (79 years), a stochastic rainfall data set based on the DataDrill rainfall data using the Stochastic Climate Library (SCL) software which forms part of the eWater CRC catchment modelling toolkit was generated by Hatch (2018a).

Using the SCL, 100 replicates of a 79-year rainfall sequence were generated for use in the water balance model. The model generates 100 sets of results (or realisations) that reflect the variation in the historical rainfall data (1939 to 2017).

Controlled Release Modelling – Isaac River Salinity

Controlled water release conditions have been developed for releases to the Isaac River and Ripstone Creek, based on the *DEHP Guideline Model Mining Conditions*. The water balance model has been configured to simulate these release conditions, using salt measured as electrical conductivity (EC) as the target parameter. The proposed water release conditions are provided in Table 3-20, based on flow and EC monitoring at the Deverill gauging station on the Isaac River, and the proposed controlled release points at the site.

Table 3-19
Application of Representative Mine Stages to Full Mine Life

Representative Mine Stage	Representative Year	Applied Range of Mine Life	Stage Duration
Stage 1	2027	Year 2020 – 2030	11 years
Stage 2	2036	Year 2031 – 2040	10 years
Stage 3	2046	Year 2041 – 2050	10 years
Stage 4	2056	Year 2051 – 2060	10 years
Stage 5	2066	Year 2061 – 2072	12 years
Stage 6	2076	Year 2072 – 2085	13 years
Stage 7	2091	Year 2086 – 2098	13 years

Source: Hatch (2018a)

Table 3-20
Proposed Controlled Release Conditions

Flow Rate	Receiving Water Flow Criteria (Isaac River*)	Maximum Release Rate (Controlled Release Points Combined Flows^)	Electrical Conductivity Limit (At Release Point)
Medium	4 m^3/s	0.5 m^3/s	1,000 µS/cm
	10 m^3/s	1.0 m^3/s	1,200 µS/cm
High	50 m^3/s	2.0 m^3/s	4,000 µS/cm
	100 m^3/s	3.0 m^3/s	6,000 µS/cm
Very High	300 m^3/s	5.0 m^3/s	10,000 µS/cm

Source:Appendix E.

* Deverill Gauging Station.

^ P9, P20, P33, P46 and WROM.

Note: P44 and WMIA are designated release points, but are not part of the overall controlled release strategy.

The proposed controlled releases strategy comprises a number of mine affected water dams which would have the ability to discharge water to the Isaac River through a gravity pipe system. There are four proposed release points at the Olive Downs South domain and one at the Willunga domain. However, due to the progressive mining activities from north to south at the Olive Downs South domain, it is likely that only two of the four dams would operate simultaneously.

The release point dams would be constructed as aboveground turkey's nest type dams around 5 m deep. Each would be constructed above the natural surface to provide sufficient driving head for gravity discharge. The gravity discharge solution is preferred because it allows for an efficient discharge mechanism and can provide significant discharge capacity during the relatively short discharge opportunities for the Isaac River flow regime. Potential pump solutions to supplement to gravity release system would be considered during the detailed design process.

EC has been continuously monitored and recorded at the Deverill gauging station since August 2011. The monitoring data has been analysed and a relationship between EC and discharge (expressed as runoff depth) has been developed and is presented in the Surface Water Assessment (Appendix E). The flow-EC relationship for the Isaac River has been incorporated into the water balance model.

The water balance modelling results indicate that the proposed controlled release strategy would achieve the water quality objectives for the Isaac River sub-basin (Hatch, 2018).

Final Voids Recovery

A GOLDSIM model (separate to the OPSIM model used for the operational modelling) was used to assess the likely long-term water level behaviour of the final voids. The historical rainfall and evaporation sequences (128 years) were repeated 5 times to create a long-term climate record. The model configuration and results are presented in detailed in Hatch (2018a).

3.3.9.9 Predicted Changes to Water Resources

The potential impacts of the Mine Site and Access Road on water resources include:

- impacts on flows and the flooding regime in Ripstone Creek (including diversion of a section) and the Isaac River and its tributaries;
- loss of catchment area draining to local drainage paths due to capture of runoff within on-site storages and the open cut pits;
- impacts on regional water availability due to the potential need to obtain water from external sources to meet construction and operational water requirements for the Mine Site and Access Road;
- adverse impacts on the quality of surface runoff draining from the disturbance areas to the receiving waters, during both construction and operation of the mine (discussed separately below);
- adverse impacts on environmental values in the Isaac River associated with controlled releases from the mine water management system;
- cumulative surface water impacts of all projects in the region on the environmental values of the receiving waters;
- direct interception of groundwater, requiring licensing of the associated water take from Groundwater Unit 1 (Quaternary alluvium) and Groundwater Unit 2 (sub-artesian aquifers) under the Water Plan (Fitzroy Basin) 2011;
- groundwater drawdown in up to 5 privately-owned bores constructed in alluvium (2) and Permian coal measures (3); and
- cumulative groundwater depressurisation and drawdown with surrounding mines and the Bowen Gas Project.

An assessment of the potential impacts was undertaken as part of the Surface Water Assessment (Appendix E), Flooding Assessment (Appendix F) and Groundwater Assessment (Appendix D) and the results are described below.

Surface Water Flow and Flooding Regimes

Flooding

The results of the Flooding Assessment undertaken by Hatch (2018b) for the 50%, 2%, 1% and 0.1% AEP flood events show that the majority of peak flows would be unchanged by the development, with only a few insignificant changes occurring (Appendix F).

Potential impacts related to flooding and diversion of Ripstone Creek are described separately in Section 3.3.4.3.

Catchment Excision (Operations and Post-Mining)

During active mining operations, the mine water management system would capture runoff from areas that would have previously flowed to receiving waters.

The estimated maximum captured catchment areas during the seven stages of the development are provided in Table 3-21 and excludes areas managed under the Erosion and Sediment Control Plan strategy and areas that are fully rehabilitated.

The maximum captured catchment areas represent:

- less than 13% of the Ripstone Creek catchment to its confluence with the Isaac River; and
- less than 1% of the Isaac River at a location downstream of the Mine Site and Access Road area (i.e. the ISDS stream gauge), which is not significant.

Given that the runoff volumes from the Erosion and Sediment Control Plan areas would be higher than under natural conditions, the loss of stream flows would likely be less than the loss of catchment area. Further, the loss of catchment to Ripstone Creek only affects the furthest downstream reach (approximately 8 km) of the creek adjacent the Mine Site and Access Road area and within the tenement areas (Appendix E).

An area of approximately 49 km^2 would report to the final voids at the completion of mining. The changed topography as a result of the final landform would have the following impacts on catchment areas:

- The catchment draining to Ripstone Creek would reduce by around 19 km^2 (compared to pre-mining conditions), a decrease of less than 7% of the total 286 km^2 catchment area.
- The catchment draining to the Isaac River would reduce by around 49 km^2 (compared to pre-mining conditions), a decrease of less than 1% of the total 7,782 km^2 catchment area.

Table 3-21
Maximum Captured Catchment Area

Stage	Maximum Captured Catchment Area (km^2)	
	Ripstone Creek (to confluence with Isaac River)	Isaac River (to the ISDS stream gauge)
Stage 1	6	10
Stage 2	21	48
Stage 3	26	50
Stage 4	31	48
Stage 5	36	49
Stage 6	35	51
Stage 7	35	38
Total Catchment Area	286	7,782

Source: Appendix E.

Regulated Structures – Risks and Consequence

A preliminary assessment of the Consequence Category of the proposed regulated structures (dams and levees) has been undertaken in accordance with the failure to contain criteria in the *Manual for Assessing Consequence Categories and Hydraulic Performance of Structures* (Version 5.0) (DEHP, 2016) (Appendices E and F).

All proposed mine affected water dams which overflow internally (i.e. would not result in an uncontrolled release to the receiving environment) have been assigned a preliminary category of 'low' consequence due to the low risk of significant consequence in the event of a failure to contain or dam break (Appendix F).

There are only three mine affected water dams that could possibly report (in an overflow event) to the receiving environment (i.e. P44, WROM and WMIA) (Appendix E). These dams have been assessed against Table 1 of the *Manual for Assessing Consequence Categories and Hydraulic Performance of Structures* (Version 5.0) (DEHP, 2016) and have been assigned a 'low' consequence category for the failure to contain criteria based on the predicted water quality results from the water balance model (Appendix E).

All proposed temporary levees have been assigned a preliminary category of 'low' consequence due to the low risk of significant consequence in the event of a failure to contain (Appendix F).

Influence on Baseflow (Groundwater)

The Isaac River is ephemeral in nature, with flows following rainfall events that generate runoff. The baseflow predicted by the groundwater model therefore represents water moving through the shallow sediments in the base of the river under the surface.

While recognising that the Isaac River is largely a losing system, with seepage of surface water into the underlying alluvium, changes to water levels induced by mining would increase the hydraulic gradient between the alluvium and Isaac River.

The Groundwater Assessment (Appendix D) therefore conservatively predicts that the rate of seepage from the Isaac River to the alluvium could increase by an average of 2.6 ML/day (total) over the life of the mine. This represents a potential 0.5% reduction in average flow (Appendix D).

Post mining, the final landform would retain the final voids. The zone of influence would retract around the final voids as groundwater levels recover. This would then result in a reduction in the long-term average from the Isaac River to the alluvium to 1.9 ML/day (total) at post closure equilibrium (Appendix D).

The Groundwater Assessment also considered potential baseflow impacts to Ripstone Creek and concluded that there would be no perceptible change in baseflow (Appendix D).

The potential post-mining surface water impacts, primarily relating to the design of the final landform and performance of the up-catchment diversions and rehabilitated mine landforms in the long-term, are discussed in the sub-sections below.

Regional Water Availability

A significant proportion of mine site water requirements would be sourced from water collected on the site, including rainfall runoff and groundwater inflows to the open cut pits which would be stored in the mine affected water dams for recycling and reuse (Appendix E).

The results of the water balance modelling (Appendix E) show that there is less than a 10% probability that the proposed water licence allocation of 2,250 ML would require supplementing in any year.
If, during operations, there was a risk that the licence allocation could be exceeded, the site water demands could be adjusted accordingly (e.g. reduce dust suppression demand) or alternative water harvesting measures on site could be implemented, to avoid and/or minimise any impacts on regional water availability.

Controlled Releases

Mine affected water would be managed through a mine water management system which is designed to operate in accordance with typical EA conditions and the model water conditions. That is, it would have controlled release conditions and in-stream trigger levels aligned with the WQOs in the EPP (Water).
The outcomes from the water balance modelling indicate that the proposed controlled release strategy would achieve the regional WQOs for the Isaac River and therefore not impact on its environmental values (Appendix E).

Direct Groundwater Inflows/Interception (Water Licensing)

The total annual volumes of groundwater predicted to be intercepted as part of the mine operations are presented in Table 3-22 and HydroSimulations (2018).

The total peak inflow due to the mining operation is expected to be about 4.5 ML/day (1,636 ML/year), while the average is expected to be about 1.7 ML/day (638 ML/year) over the duration of mining (Appendix D).

The mining operation would directly intercept groundwater from the Quaternary alluvium and sub-artesian aquifers under the *Water Plan (Fitzroy Basin) 2011*. Over the mine life, groundwater licensing would vary and involve allocation of up to (Appendix D):

- 623 ML/year for the alluvium; and
- 1,199 ML/year for sub-artesian aquifers.

Post mining, there would be evaporation from the lakes that would form within the final voids. The results indicate that at equilibrium post closure, groundwater licensing requirements would reduce and involve allocation of approximately:

- 146 ML/year for the alluvium; and
- 183 ML/year for sub-artesian aquifers.

Groundwater Drawdown (Impacts on Groundwater Users)

Table 3-23 presents a summary of privately owned bores in the vicinity of the Mine Site and Access Road, that are predicted by the Groundwater Assessment (Appendix D) to experience more than 1 m drawdown due to the mining operation.

The predicted decline in groundwater level of 3.6 m at Bore 8 has the potential to impact on groundwater supply from the bore. However, drawdown within the bore is associated with mining in Pit ODS1, which concludes mining in model year 2044. Based on the mine schedule, alluvial groundwater at Bore 8 is expected to recover to 50% of the pre-mining levels during the life of the Project (Appendix D).

Table 3-22
Predicted Average Groundwater Inflows by Stage

Stage	Years*	Domain (ML/day)		Average (ML/day)
		ODS	Willunga	
Stage 1	2020-2030	0 – 1.1	0 – 0.2	0.8
Stage 2	2031-2040	1.5 – 2.3	0.3 – 2.3	3.3
Stage 3	2041-2050	0.5 – 2.1	0.1 – 2.5	2.3
Stage 4	2051-2060	0.6 - 2.0	<0.1 – 0.1	1.5
Stage 5	2061-2072	0.3 - 0.4	<0.1 – 0.1	0.4
Stage 6	2073-2085	0.2 - 0.3	<0.1 – 0.3	0.4
Stage 7	2086-2098	0.3 - 0.4	<0.1 – 0.1	0.4

Source: HydroSimulations (2018).

Table 3-23
Predicted Maximum Drawdown at Privately-owned Property Bores

Bore ID	Property	Geology	Predicted Maximum Drawdown (m)
Bore 8	Olive Downs	Alluvium	3.6
RN97181 (Pisscutter)	Willunga	Alluvium	1.6
Swamp Bore	Meadowbrook	Permian	14.4
RN122458 (Rolfies #2)	Meadowbrook	Permian	11.5
RN122458 (Rolfies #1)	Meadowbrook	Permian	11.5

Source: after HydroSimulations (2018).

Groundwater levels at RN97181 are predicted to decline by up to 1.6 m. Maintenance works (e.g. lowering of the pump) may be necessary to ensure the groundwater supply is maintained during the life of the mine; however, the mining operations would not impact on the landholder's ability to use the bore. Drawdown within RN97181 is associated with mining at the WIL1 satellite pit that intersects alluvium, which concludes mining in model year 2044. Based on the mine schedule, alluvial groundwater at RN97181 is expected to recover to near pre- mining levels during the life of the mine (Appendix D).

Groundwater levels at Swamp Bore, RN122458 and RN122458 are predicted to decline by 14.4 m, 11.5 m and 11.5 m, respectively. If the bores were to be used, this may influence the installation of pump equipment, but would not impact on the landholders' ability to use the bores. Drawdown within the three bores is largely associated with mining at Pit ODS6, Pit ODS7 and Pit ODS8, which commences from model year 2030. Groundwater levels are predicted to recover slightly by the end of mining, to around 11 mbgl (Swamp Bore) and 18 mbgl (RN122458 bores) (Appendix D).

Final Voids

Post-mining inflows to the final voids would comprise three contributing sources:

- incident rainfall;
- runoff (albeit from a reduced reporting catchment); and
- reducing (with time) groundwater inflows (from the Permian groundwater system as it recovers and adjacent waste rock emplacement infiltration).

Water would be lost from the final voids through evaporation.

A final void water recovery analysis, including predicted groundwater inflows from the groundwater model (Appendix D), has been conducted as part of the Surface Water Assessment (Appendix E). The model results for the long-term water levels simulated in the final voids show the following (Appendix E):

- Pit ODS3 void:
  - The water level reaches equilibrium between 80 m AHD and 90 m AHD after 200 years and generally remains at these levels throughout the remainder of the simulation.
  - The maximum modelled water level is around 82 m below the void of Pit ODS3 overflow level, and around 100 m below the level at which overflows would reach the receiving environment.
  - Salt accumulates within the void of Pit ODS3 at an average rate of around 5,000 tonnes per year. The void becomes hyper-saline (>35,000 mg/L) after around 550 years of simulation.
- Pit ODS7/ODS8 void:
  - The water level reaches equilibrium between 20 m AHD and 30 m AHD after 150 years and generally remains at these levels throughout the remainder of the simulation.
  - The maximum modelled water level is around 130 m below the void of Pits ODS7/ODS8 void overflow level, and around 145 m below the level at which overflows would reach the receiving environment.
  - Salt accumulates within the void of Pits ODS7/ODS8 void at an average rate of around 3,800 tonnes per year. The void becomes hyper-saline (>35,000 mg/L) after around 550 years of simulation.

- Pit WIL5 void:
  - The water level reaches equilibrium between 55 m AHD and 70 m AHD after 100 years and generally remains at these levels throughout remainder of the simulation.
  - The maximum modelled water level is around 85 m below the void of Pit WIL5overflow level, around 90 m below the level at which overflows would reach the receiving environment.
  - Salt accumulates within the void of Pit WIL5 at an average rate of around 3,000 tonnes per year. The void approaches hyper-salinity (>35,000 mg/L) by the end of the 600 year simulation.

The final void modelling indicates that the expected water levels are below the full supply levels for each void, and the voids would remain as long-term groundwater sinks (Figures 3-24a and 3-24b) (Appendix D).

Further, the post-mining flood modelling undertaken by Hatch (2018b) identified that based on the final landform design, flood waters would not enter any of the final voids in events up to and including the PMF event (Appendix F).

The Flood Assessment (Appendix F) describes the current flood risk for a range of annual exceedance probabilities up to the PMF for potentially affected waterways, and assesses (through flood modelling) how the Mine Site and Access Road may potentially change flooding characteristics and be affected by floods.

Design flood hydrographs for events with AEPs of 50%, 20%, 10%, 5%, 2%, 1% and 0.1%, as well as the PMF, were developed based on design rainfalls and the calibrated hydrology model (Appendix F). In accordance with the requirements of the Terms of Reference, the probable maximum precipitation was used to estimate the peak flow for the PMF in the Isaac River (Appendix F).

Threes cases were modelled by Hatch (2018):

- the base case (pre-mining/approved infrastructure);
- the developed case (during operations – all infrastructure); and
- the post-mining case (permanent stable landforms with temporary levees removed).

The impact of the Mine Site and Access Road on flood levels, flow velocity and stream geomorphology for each of the above cases has been evaluated in Hatch (2018b) and Fluvial Systems (2018) and is summarised below.

For comparative purposes, the developed case flood extents for the 50% AEP and 2% AEP are shown on Figures 3-25a and 3-25b, and the changes in afflux between the base case and the developed case for the 2% AEP (i.e. 1 in 50 years) are shown on Figure 3-26.

Flood Levels

The Mine Site and Access Road would excise part of the Isaac River floodplain during operation, which has the potential to increase flood levels in areas of the floodplain adjacent to and potentially upstream of the site. Figure 3-26 shows the “wet now dry” areas along the western side of the Isaac River, north of Ripstone Creek, and the out-of-pit emplacement east of the Deverill gauging station.

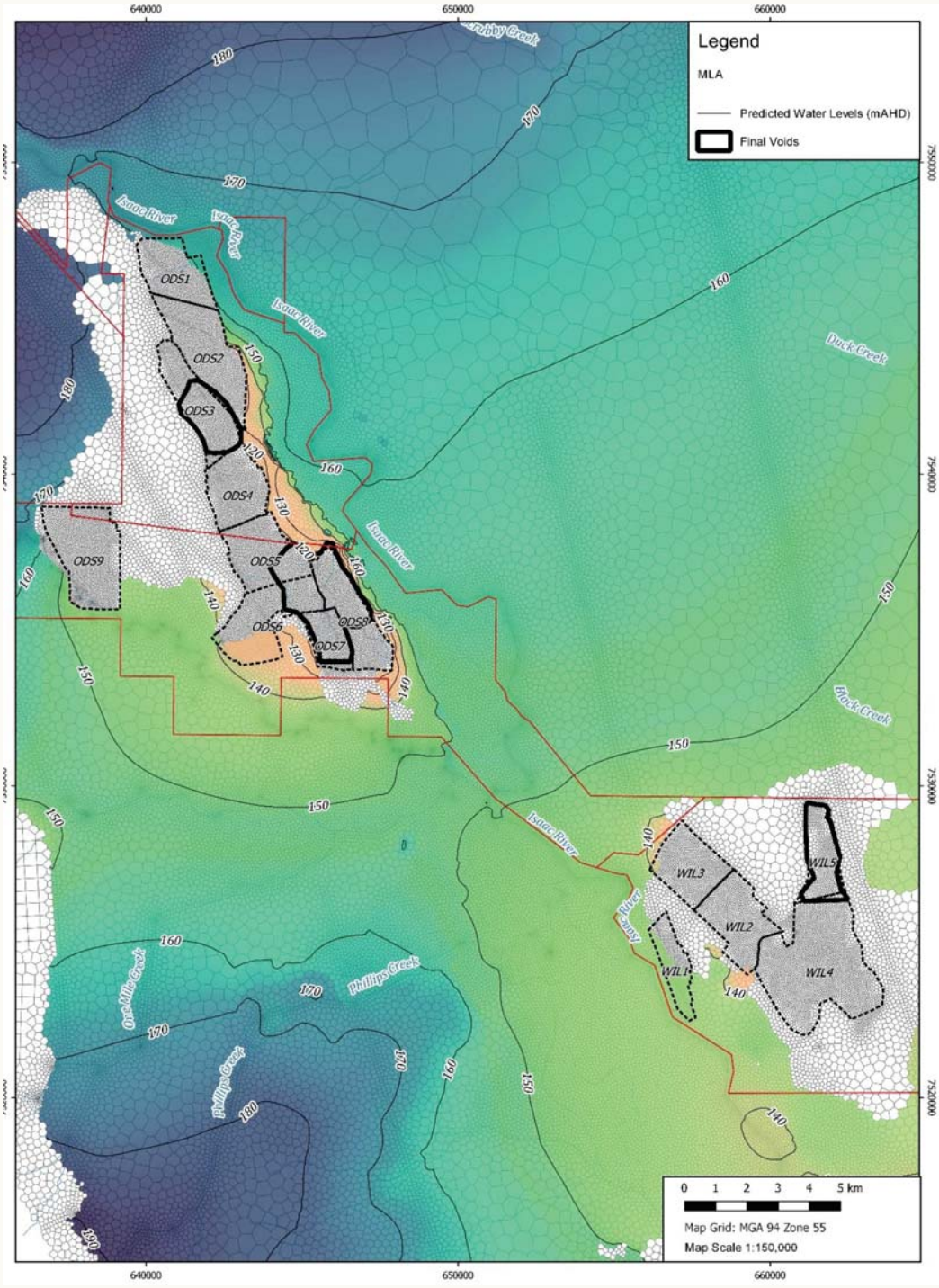
It is however recognised that post-mining, the temporary levees would be removed and the floodplain area excised significantly reduced (Figures 3-27a and 3-27b). Importantly, the post-mining flood modelling results show that water would not enter the final voids located behind the permanent highwall emplacements in events up to and including the PMF event (Appendix F).

Hatch (2018b) considered the risk of the mine landforms increasing flood levels and velocities in the Flood Assessment and concluded that the Mine Site and Access Road is not considered to result in any significant change to the existing flood risk for surrounding privately-owned properties or infrastructure. All roads adjacent to Isaac River are subject to flooding under existing conditions. However, as a result of the Project, the proposed access road located in the north-east of the Project might be subject to flooding more frequently (Appendix F).

Flow Velocity

The averages of maximum stream velocity values along the Isaac River for 50%, 2%, 1% and 0.1% AEPs are between 1.3 m/s to 2.1 m/s. The average of maximum stream velocity along Isaac River for PMF is estimated to be 2.3 m/s (Appendix F).

Based on the developed case modelling results, the averages of maximum stream velocity values along Isaac River for 50%, 2%, 1% and 0.1% AEPs would be between 1.5 m/s to 2.2 m/s (Appendix F).



Predicted Groundwater Levels in Unconsolidated (Layer 1 and 2)– Post Mining Equilibrium

PRN-16-02_EIS_Sec3_024C

Source: HydroSimulations (2018)

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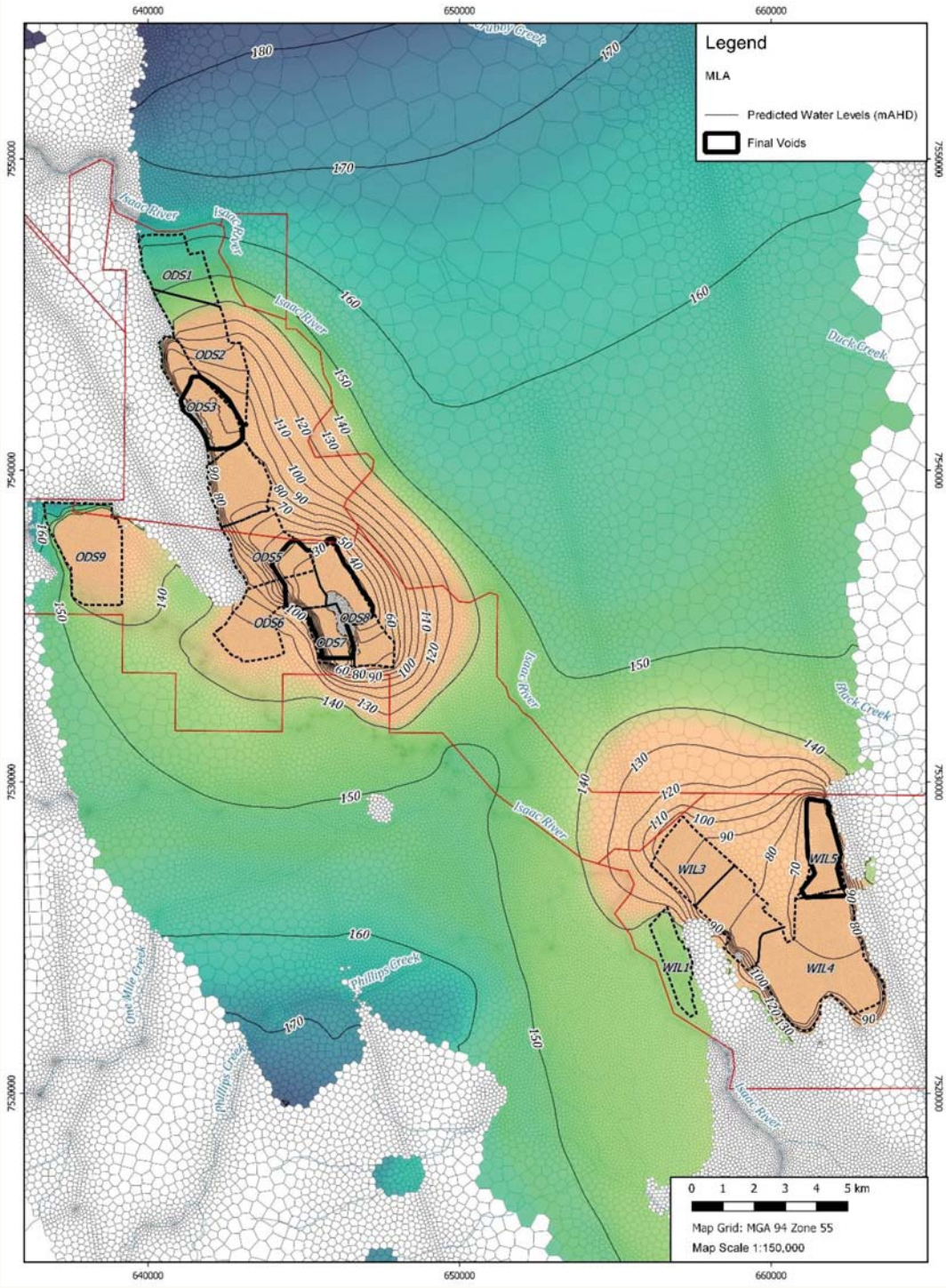
Numerical Groundwater Model – Predicted Groundwater Levels Post-Mining Equilibrium (Unconsolidated)

Figure 3-24a



Predicted Groundwater Levels in Vermont Seam (Layer 7) – Post Mining Equilibrium

PRN-16-02_EIS_Sect3_030B

Source: HydroSimulations (2018)

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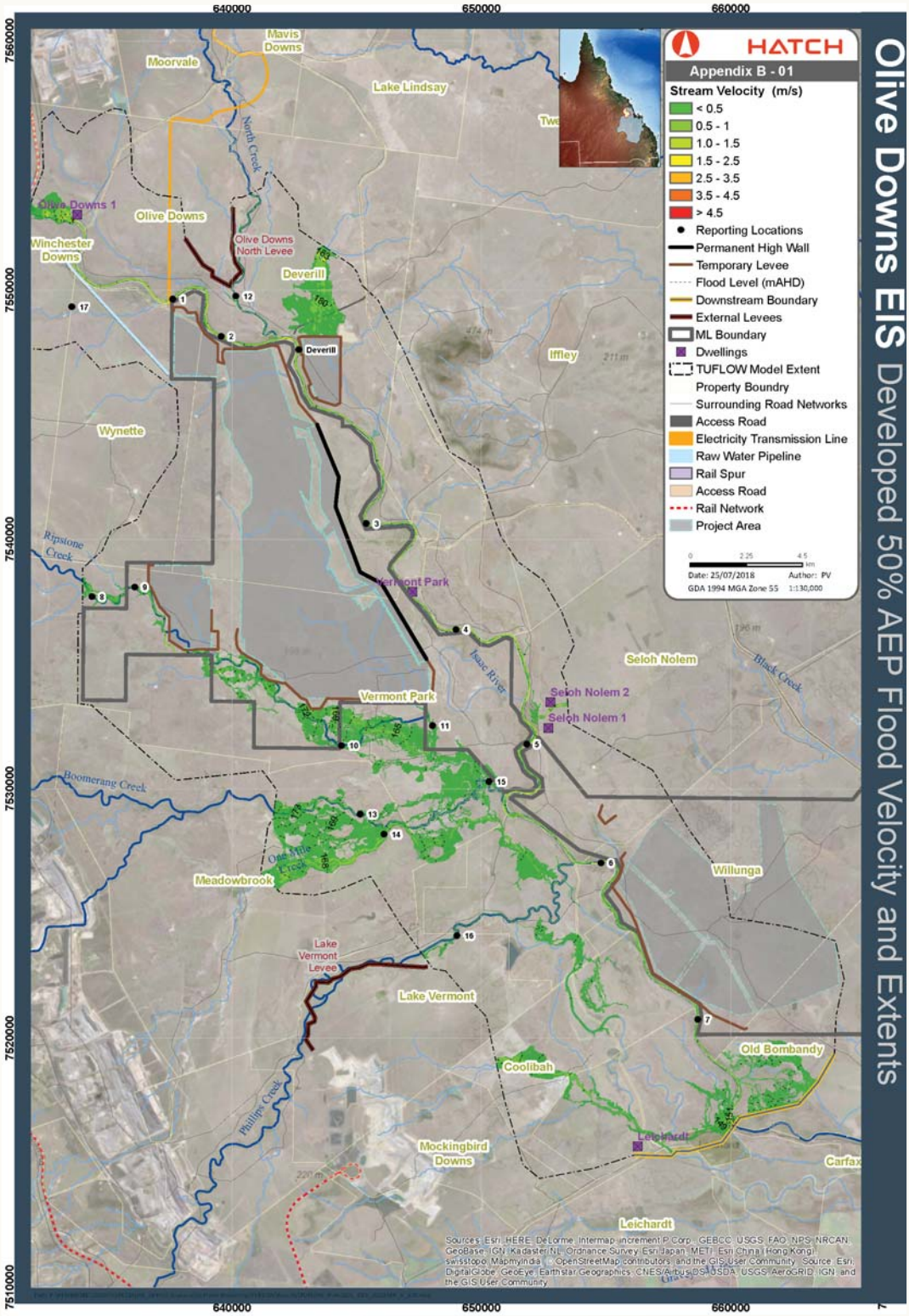
Numerical Groundwater Model – Predicted Groundwater Levels Post-Mining Equilibrium (Vermont Seam)

Figure 3-24b



PRN-16-02_EIS_Sect3_025B

Source: Hatch (2018)

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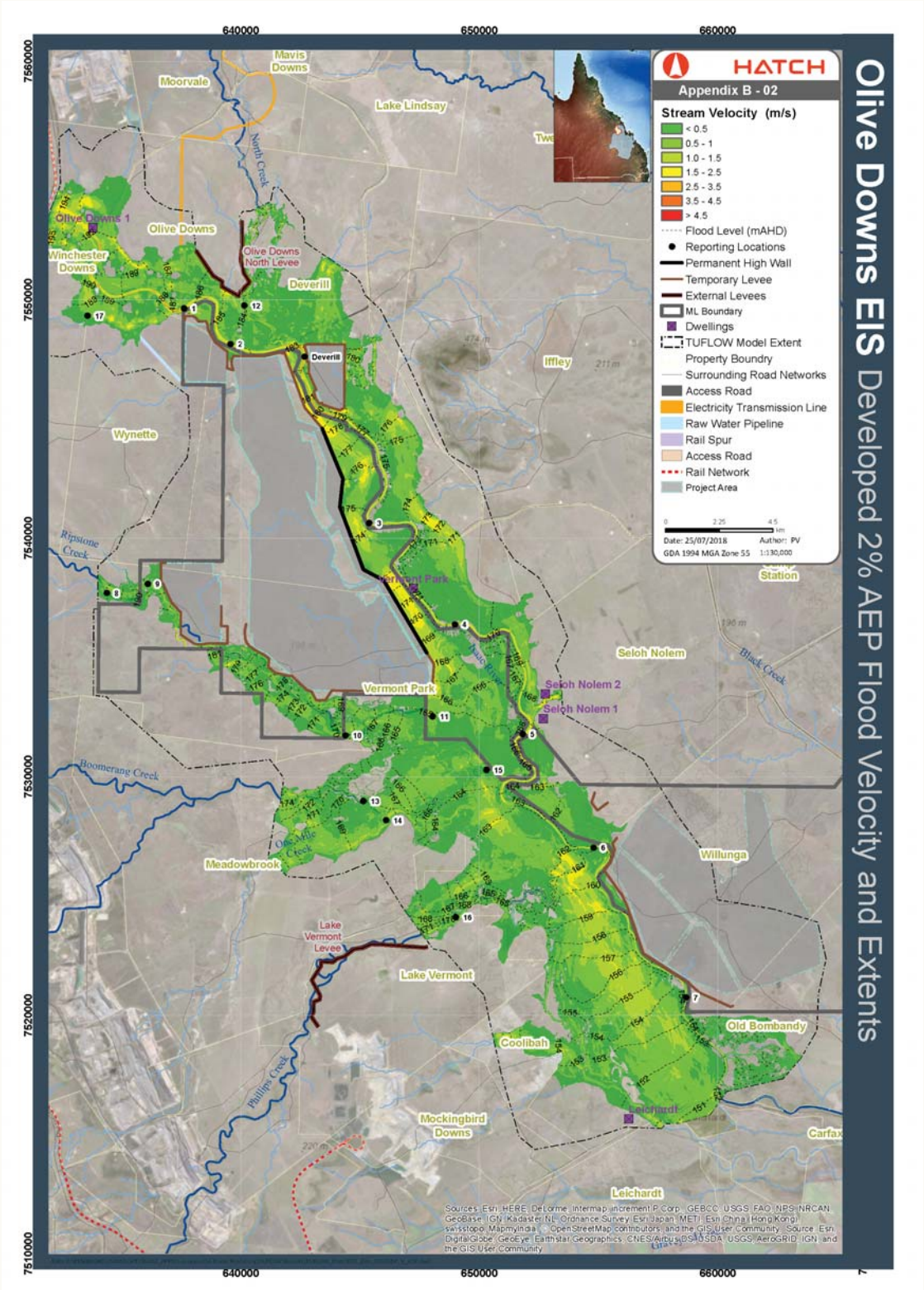
Developed Case Flood Model Predictions (50% AEP)

Figure 3-25a



PRN-16-02_EIS_Sect3_031B

Source: Hatch (2018)

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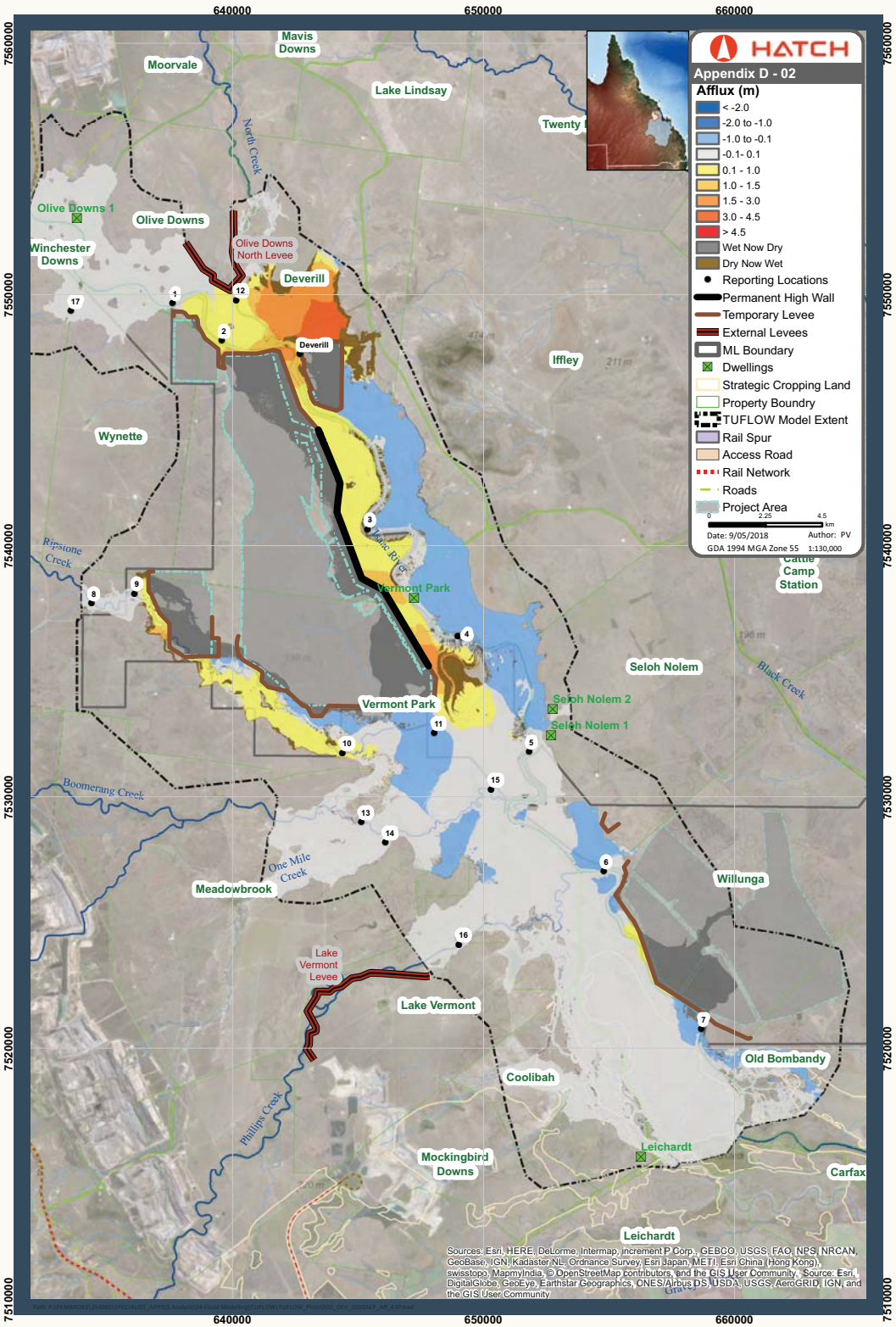
Developed Case Flood Model Predictions (2% AEP)

Figure 3-25b



PRN-16-02_EIS_Sect3_026B

Source: Hatch (2018)

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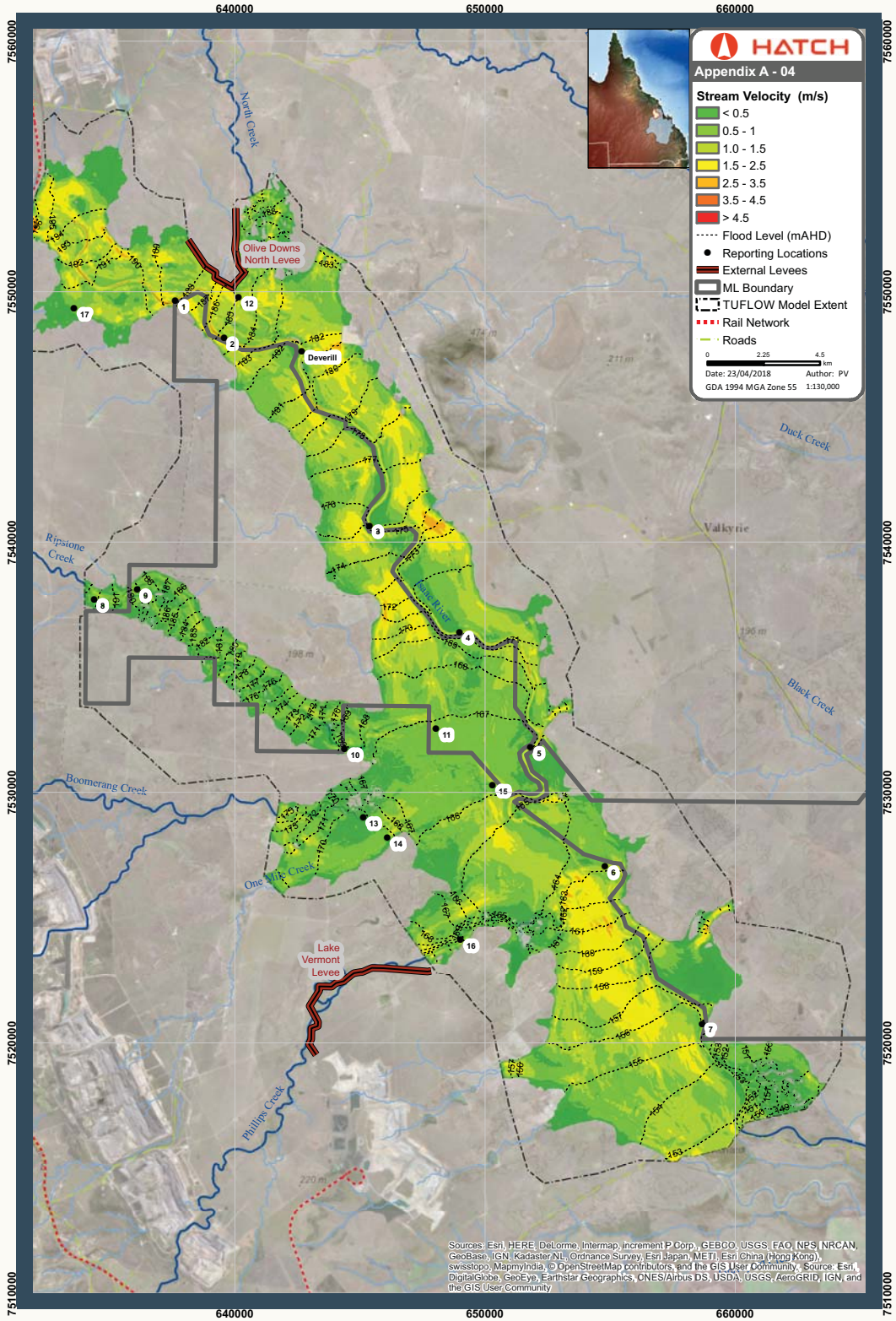
Developed Case Flood Model Predictions (2% AEP) – Afflux and Property Ownership

Figure 3-26



PRN-16-02_EIS_Sect3_032A

Source: Hatch (2018)

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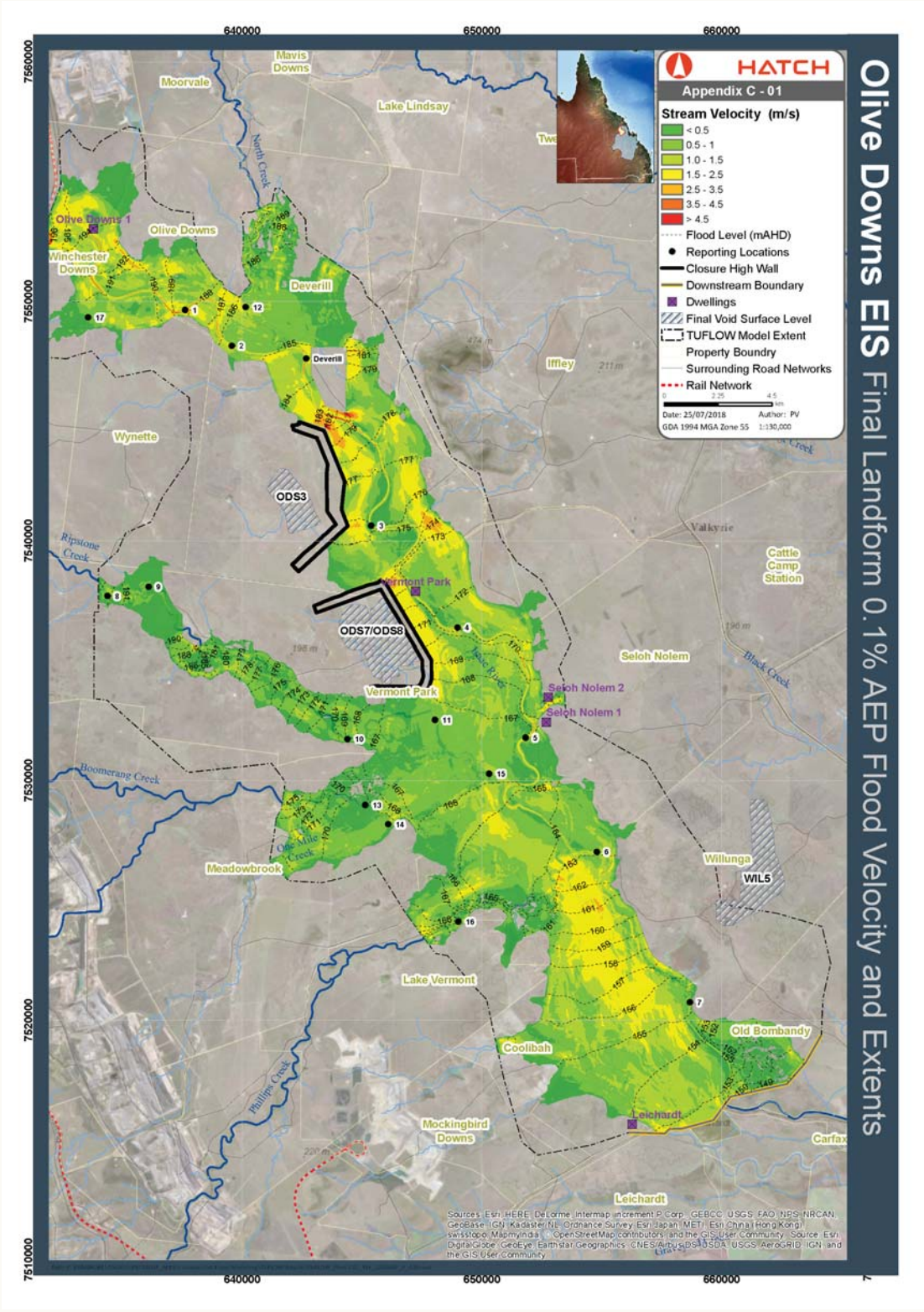
Base Case Flood Model Predictions (0.1% AEP) – Velocity and Extents

Figure 3-27a



PRN-16-02_EIS_Sec13_033B

Source: Hatch (2018)

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Final Landform
Flood Model Predictions (0.1% AEP) –
Velocity and Extents

Figure 3-27b

The changes in flow velocity up to and including the 0.1% AEP event are therefore predicted to be relatively small in most areas adjacent the Mine Site and Access Road area, with absolute flow velocities similar to areas downstream in the natural section of the stream (Figure 3-27).

Stream Power and Bed Shear Stress

Generally, the modelled bed shear stresses are less than 100 newtons per square metre (N/m²), although most values in the central channel area of the Isaac River are close to 100 N/m². The channel bed is bare sand, so would be mobile under these shear stresses (Appendix F).

As expected, the banks of the Isaac River are generally well vegetated and stable, with occasional areas on the outside of bends showing evidence of scour. This is considered part of the normal process of channel migration and adjustment (Appendix F).

Under the developed case, some locations would have higher values of bed shear stress on the areas of the floodplain impacted by confinement, reaching 50 N/m² for the 2% AEP design flood event (Appendix F). The maximum permissible shear stress method suggests that these floodplain surfaces, if maintained with complete and dense vegetation cover should remain stable (Appendix F). More detailed assessment of stream power and bed shear stress has been provided in the geomorphology assessment (Fluvial Systems, 2018) and the conclusions are summarised below.

Stream Geomorphology

The risk of erosion of the Isaac River channel and floodplain was assessed by Fluvial Systems (2018) using the method of maximum permissible bed shear stress and velocity assessment, with the hydraulic variables modelled as part of the Flood Assessment (Appendix F). The assessment of the most critical areas found that while there could be isolated areas subject to somewhat higher risk of scour compared to the existing situation, the overall risk of rapid and significant geomorphic change in the Isaac River due to the Mine Site and Access Road was low (Fluvial Systems, 2018).

3.3.9.10 Predicted Changes to Water Quality

The assessment of impacts on water quality in the Surface Water Assessment (Appendix E) and Groundwater Assessment (Appendix D) has been conducted in accordance with the DEHP Guideline ESR/2015/1837: *Application Requirements for Activities with Impacts to Water*.

Surface Water Quality

Potential impacts of the development on surface water quality include the reduction in surface water quality due to uncontrolled runoff from disturbed areas and/or release of contaminants, drainage/seepage from waste rock and/or reject emplacements, alteration of groundwater quality (including the potential to affect surface water resources), and/or controlled releases. Each of these potential impacts is discussed below.

Runoff and Contaminants

Land disturbance associated with mining activities has the potential to adversely affect the quality of surface runoff by increasing sediment loads from waste rock and reject emplacement areas and releasing mine affected water with high salt loads.

The water balance model was used to assess the risk of uncontrolled releases from the mine affected water management system. No uncontrolled releases to the Isaac River were modelled (Appendix E).

To achieve the ‘no mine affected water storage uncontrolled release’ objective, the mine would be operated such that water could be temporarily stored in the active open pit if required (e.g. as a result of exceedance of the design capacity of the water management system). Alternatively, Pembroke would construct additional pit water dams ahead of mining in the ODS domain to temporarily store any excess mine affected water until there is sufficient out-of-pit storage available.

An overflow could therefore only occur during an extreme rainfall event which would also generate significant volumes of runoff from the surrounding undisturbed catchment, as well as in the receiving waterways. Hence it is unlikely that mine affected dam overflows would have a measurable impact on receiving water quality and therefore the environmental values (Appendix E).

The proposed water management system would have a negligible impact on Wetland Protection Areas located adjacent the Mine Site and Access Road area (Appendix E).

In the operational phase, progressive rehabilitation of the waste rock emplacements would minimise the potential generation of sediment.

An Erosion and Sediment Control Plan would be developed and implemented throughout construction and operations. A 'best practice' approach would be adopted which is consistent with the International Erosion Control Association (IECA) recommendations. The following broad principles would apply:

- minimise the area of disturbance;
- where possible, apply local temporary erosion control measures;
- intercept run-off from undisturbed areas and divert around disturbed areas; and
- where temporary measures are likely to be ineffective, divert run-off from disturbed areas to sedimentation basins prior to release from the site.

If implemented effectively, environmental risks from disturbed area runoff are expected to be low (Appendix E).

In rainfall events below the design standard, runoff from disturbed areas would be intercepted and treated by sediment dams. In larger events that exceed the design standards, these dams would overflow following a period of settlement treatment.

Available geochemical information (Terrenus Earth Sciences, 2018) indicates that the runoff draining to the sediment dams should have low salinity. Overflows would only occur during significant rainfall events which would also generate runoff from surrounding undisturbed catchments. Hence it is unlikely that sediment dam overflows would have a measurable impact on receiving water quality or environmental values (Appendix E).

Geochemistry (Drainage and Seepage)

A Geochemistry Assessment was conducted by Terrenus Earth Sciences (2018).

The assessment was undertaken to evaluate the geochemical nature of potential waste rock and coal reject materials likely to be produced from the mining operation (particularly during the first 10 years of mining operation) and to identify any environmental issues that may be associated with mining, handling and storing these materials. Based on the geochemical testwork, waste rock is expected to:

- be overwhelmingly non-acid forming (NAF) with excess acid neutralising capacity (ANC) and have a negligible risk of developing acid conditions; and
- generate relatively low-salinity surface run-off and seepage with low soluble metals concentrations.

Overall, the geochemical assessment found that approximately 70% of potential coal reject material has essentially no risk associated with acid generation, with the remaining 30% of coal reject material having a relatively low degree of risk associated with potential acid generation. The material has a low sulfur (and sulphide) concentration and low metals/metalloids concentrations (Terrenus Earth Sciences, 2018). By comparison to the life of mine waste rock material (in the order of 9,000 Mbcm), the total proportion of coal rejects would be less than 2%.

The magnitude of any localised acid, saline or metalliferous drainage would be buffered by the presence of the alkaline NAF waste rock. As a bulk material (of relatively small total quantity), coal reject is regarded as posing a generally low risk of environmental harm and health-risk (Appendix L).

It is important to note that the results from the geochemical assessment represent an 'assumed worst case' scenario as the samples are pulverised prior to testing, and therefore have a very high surface area compared to materials in the field and do not account for mixing during emplacement (Terrenus Earth Sciences, 2018).

Notwithstanding, appropriate management practices have been recommended and would be adopted for the handling and placement of coal rejects.

Controlled Releases

Controlled releases would be conducted in accordance with the proposed controlled release strategy.

The outcomes from the water balance modelling indicate that the proposed controlled release strategy would achieve the regional WQOs for the Isaac River and therefore not impact on its environmental values (Appendix E). As shown on Figure 3-28, the modelled downstream EC in the Isaac River (for median climatic conditions) is below the receiving water contaminant trigger level of 700 µS/cm on all controlled release days (Appendix E).

Controlled releases would not occur within Wetland Protection Areas located adjacent the Mine Site and Access Road area.

Rehabilitated Mine Landforms

Sediment dams would be retained until the revegetated surface of the waste rock emplacements are stable and runoff water quality reflects runoff water quality from similar undisturbed areas, at which time these controls would be removed and the areas would be free-draining.

Alteration of Groundwater Quality

Workshops and Storages

There is considered to be limited potential for groundwater contamination to occur with relation to workshops and fuel/chemical storage areas as each would be developed in accordance with current Australian Standards (including adequate bunding and equipped for immediate spill clean-up).

Out of Pit Waste Rock Emplacement Areas

As the mine progresses, waste rock material would be placed within selected out of pit emplacement areas. The out of pit waste rock emplacement areas may produce seepage as a result of rainfall inundation.

Runoff from disturbed areas outside the mining pit and infrastructure areas, such as waste rock emplacement areas (both active and under rehabilitation) would be captured in the sediment dams and managed under the mine water management system. The system would be designed to capture and reuse water on site, with the only offsite discharge being via approved controlled release points.

The waste rock material exhibits similar to improved water quality compared to water within regolith material (Appendix D). While the waste rock material generally exhibits poorer water quality compared to the alluvium, the Cainozoic sediments generally comprise surficial soil and clays, up to 10 m in thickness. Where the low permeability surficial clays are present, they would inhibit potential seepage from the waste rock emplacement to the underlying regolith and alluvium (Appendix D).

In Pit Waste Rock Emplacement Areas

The in-pit waste rock emplacement areas would be rehabilitated progressively as the mine develops. The mine plan includes fully backfilling Pits ODS1 ODS2, ODS4, ODS5, ODS6 and ODS9, as well as partial backfilling areas of Pits ODS3 and ODS7/ODS8. Similarly, the mine plan for the Willunga domain includes fully backfilling Pits WIL1, WIL2, WIL3 and WIL4 and partially backfilling Pit WIL5.

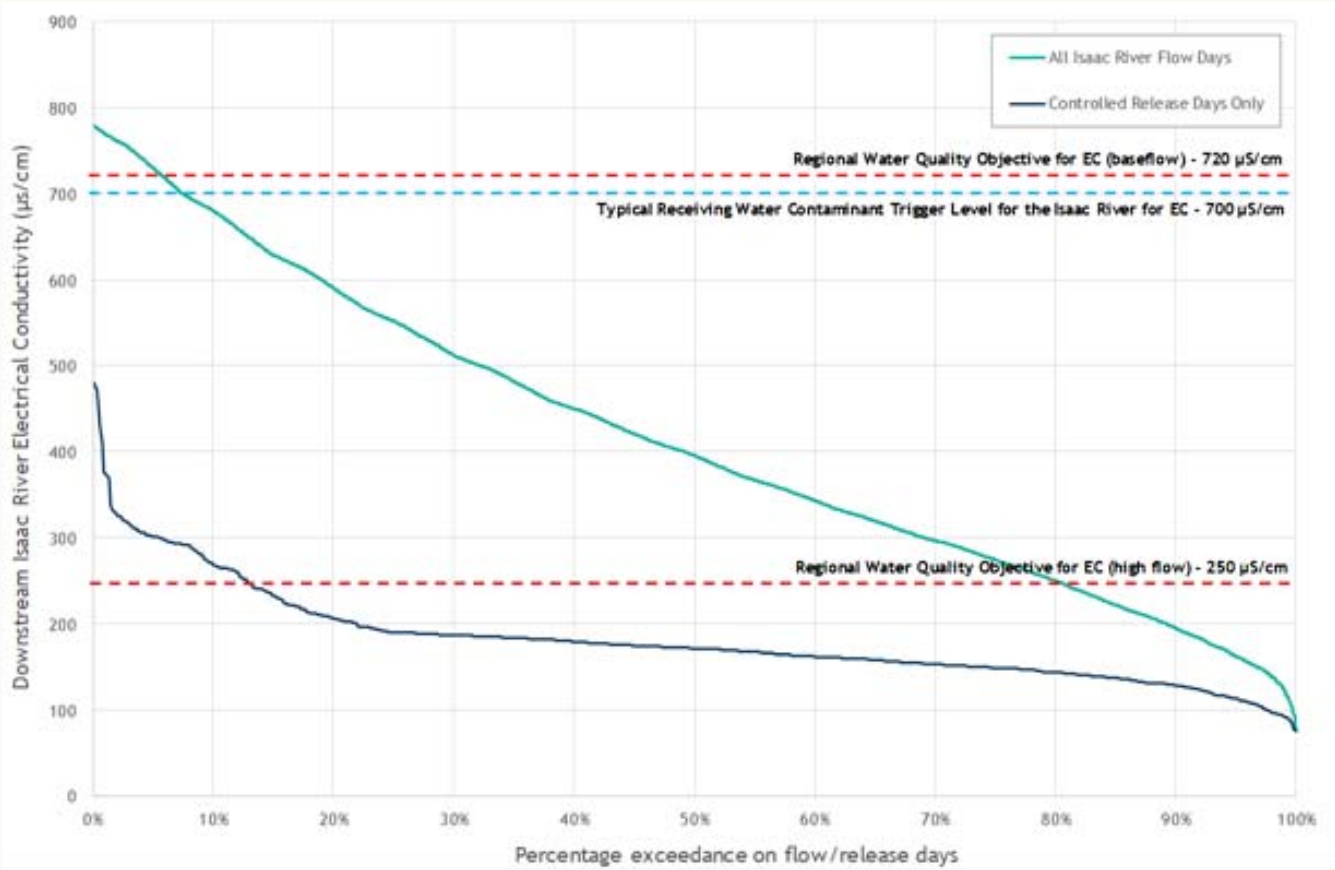
Groundwater within the backfilled pit at the northern end of the Olive Downs South domain (Pit ODS1) and the backfilled pit at Willunga (Pit WIL1) are predicted to recover back towards pre-mining levels (Appendix D).

The waste rock material exhibits similar to improved water quality compared to groundwater within the Permian coal measures and regolith material. While the waste rock material generally exhibits poorer water quality compared to the alluvium, the groundwater levels would either remain below the base of the alluvium or, in cases where above the base of the alluvium, the hydraulic gradient would not exist to enable interaction between water in the in pit waste rock material and surrounding alluvium (Appendix D).

Final Voids

Within the Olive Downs South domain, two final voids are proposed, one at Pit ODS3 and one within Pits ODS7/ODS8. The two voids are separated by waste rock material, which enables flow-through from Pit ODS3 towards Pits ODS7/ODS8.

Modelling determined that the void water levels could recover back to approximately 80 mAHD in Pit ODS3, and to 25 mAHD in Pits ODS7/ODS8. The recovered levels in Pits ODS3 and ODS7/ODS8 are around 65 m and 140 m below the pre-mining groundwater level, which means these final voids would act as a sink to groundwater flow (Appendix D).



PRN-16-02_EIS_App EPBC ACPA_028A

Source: Hatch (2018)

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Modelled Downstream Water Quality – Isaac River Median Climatic Conditions

Figure 3-28

Within the Willunga domain, one final void is proposed within the Pit WIL5, with modelling predicting a final void pit lake level of around 63 mAHD. Based on this, groundwater levels would remain over 77 m below the pre-mining groundwater level, which means the final void would act as a sink to groundwater flow (Appendix D).

Water within these final voids would evaporate from the lake surface and draw in groundwater from the surrounding geological units. Evaporation from the lake surface would concentrate salts in the lake slowly over time. This gradually increasing salinity would not pose a risk to the surrounding groundwater regime as the final voids remain permanent sinks (Appendix D).

3.3.10 Cumulative Impacts

3.3.10.1 Listed Threatened Species and Ecological Communities

The cumulative impacts of the Project (as a whole, including the four Project components) on threatened species and ecological communities are described below.

As described in Section 1, the Project area is approximately 16,300 ha, comprising a disturbance footprint of approximately 16,114 ha for the Mine Site and Access Road, approximately 57 ha for the Water Pipeline, approximately 42 ha for the Project ETL, approximately 103.5 ha for the Rail Spur and Loop.

Cumulative impacts are considered to be the total impact on the environment that would result from the incremental impacts of the Project added to other existing impacts. They include direct and indirect impacts.

As described in Section 3.2, the Project is located within the Brigalow Belt North Bioregion (as defined by DEE [2018]). In a local context, the Project is located within the Bowen Basin mining area where, in parallel with agricultural activities, open cut (and underground) coal mining is a key land use. As a result, the majority of the Mine site and Access Road area comprises agricultural grasslands with tracts of remnant vegetation (DPM Enviros ciences, 2018).

The Project is located immediately south of the approved (yet not constructed) Olive Downs North Mine and within 6 km of an existing mine to the east (Peak Downs and Saraji Mine) and there are many more mines within a 30 km radius of the site to the north and west, including Moorvale, Daunia, Poitrel, Millennium, Eagle Downs and Lake Vermont (Figure 2-2). There are 25 operating coal mines in the region (DSDMIP, 2018).

The cumulative effect of these mines and beef grazing is already evident in the landscape, with large tracts of cleared land in the Isaac River floodplain from Moranbah to Dysart and Rockhampton (DSITI, 2018).

Approximately 5,661.5 ha of remnant vegetation would be cleared within the overall Project area (approximately 16,300 ha), comprising of approximately 5,573 ha for the Mine Site and Access Road, approximately 30.5 ha for the Water Pipeline, approximately 14 ha for the Project ETL, approximately 44 ha for the Rail Spur and Loop (Table 3-24).

It is noted that the Lake Vermont Coal Mine Northern Extension Project (EPBC 2016/7701) (Lake Vermont Project) was approved on 29 June 2018. Although the Lake Vermont Project was not determined to be a Controlled Action for threatened species and communities, the Squatter Pigeon (southern) was recorded during the ecology surveys, and it was determined that suitable habitat for the southern Squatter Pigeon (southern) exists throughout the Lake Vermont Project site (AARC, 2016).

As outlined in Table 3-24, the Project would result in the removal of approximately 5,463.5 ha of potential habitat for the Squatter Pigeon, which would, in conjunction with the Lake Vermont Project, further reduce the area of potential habitat for this species in the locality.

The REs to be cleared during the life of the Project all occur more widely in surrounding landscapes and subregions (Accad *et al.,* 2017), with clearance associated with the Mine Site and Access Road representing approximately 0.4% of the remaining remnant vegetation in the Northern Bowen Basin and Isaac-Comet Downs biodiversity sub-regions (Accad *et.al.*, 2017).

The potential cumulative impacts on each individual MNES for the various components of the Project is provided in Table 3-24.

Table 3-24
Habitat Clearance Summary

Habitat Type	Habitat Clearance (ha)					
	Brigalow EEC	**Ornamental Snake**	**Squatter Pigeon (Southern)**	**Australian Painted Snipe**	**Koala**	**Greater Glider**
Mine Site and Access Road						
Remnant	13	144	5,387	113	5,500	5,500
Non-remnant	0	7,477.5	0	0	0	0
Sub-total	**13**	**7,621.5**	**5,387**	**113**	**5,500**	**5,500**
Water Pipeline						
Remnant	0	0	27.5	1	27.5	27.5
Non-remnant	0	7	0	0	0	0
Sub-total	**0**	**7**	**27.5**	**1**	**27.5**	**27.5**
Project ETL						
Remnant	0	0	12	0	12	12
Non-remnant	0	10.5	0	0	0	0
Sub-total	**0**	**10.5**	**12**	**0**	**12**	**12**
Rail Spur and Loop						
Remnant	0	0	37	6	43	43
Non-remnant	0	27	0	0	0	0
Sub-total	**0**	**27**	**37**	**6**	**43**	**43**
Total	**13**	**7,666**	**5,463.5**	**120**	**5,583.5**	**5,583.5**

In addition to the progressive rehabilitation of the Project, Pembroke would provide a biodiversity offset for the impacts associated with the Mine Site and Access Road in accordance with the *Queensland Environmental Offsets Policy (Version 1.4)* (DEHP, 2017) and *EPBC Act Environmental Offsets Policy* (SEWPaC, 2012a) (and supporting *EPBC Act Offsets Assessment Guide* [SEWPaC, 2012b]) (Section 3.8). The biodiversity offset area (once established) would provide a beneficial conservation outcome for biodiversity in the region.

3.3.10.2 Migratory Species

Cumulative impacts are considered to be the total impact on the environment that would result from the incremental impacts of the Mine Site and Access Road added to other existing impacts. They include direct and indirect impacts.

As described above, the Mine Site and Access Road is located within the Brigalow Belt North Bioregion (as defined by DEE [2018]). In a local context, the Mine Site and Access Road is located within the Bowen Basin mining area where, in parallel with agricultural activities, open cut (and underground) coal mining is a key land use.

As a result, the majority of the Mine site and Access Road area comprises agricultural grasslands with tracts of remnant vegetation and small areas of wetland habitat (DPM Enviros ciences, 2018).

The Mine Site and Access Road is located immediately south of the approved (yet not constructed) Olive Downs North Mine and within 6 km of an existing mine to the east (Peak Downs and Saraji Mine) and there are many more mines within a 30 km radius of the site to the north and west, including Moorvale, Daunia, Poitrel, Millennium, Eagle Downs and Lake Vermont (Figure 2-2). There are 25 operating coal mines in the region (DSDMIP, 2018).

The cumulative effect of these mines and agricultural activities is already evident in the landscape, with most wetlands within the Mine Site and Access Road locality already exhibiting impacts from grazing stock (DPM Enviros ciences, 2018c).

The Mine Site and Access Road would result in the clearance of some areas of wetland habitat, including palustrine (e.g. swamps) and lacustrine (e.g. dams) wetlands, along with areas of gilgai habitat that would provide temporary wetted habitat after rainfall (DPM Enviros ciences, 2018b).

These wetland habitats only represent a very small portion of the wetland habitat available for use by migratory species in the wider locality, and the greater extent of Queensland and Australia as demonstrated by the wide-ranging distribution of these species (DEE, 2018a).

3.3.10.3 Water Resources

Groundwater Depressurisation and Drawdown

Cumulative impacts associated with approved and foreseable open cut and underground coal mines surrounding the Mine Site and Access Road was modelled (Appendix D).

The results show that the zone of depressurisation from surrounding open cut and underground mines reaches the predicted zone of depressurisation from mining at the site. The magnitude of drawdowns is greatest in or closely around the mining area, and gradually reduces with distance from the mine. The zone of depressurisation from mining in the Willunga domain is not affected by mining at surrounding coal mines (i.e. no cumulative impacts).

Maximum cumulative groundwater drawdown within the coal seams extends up to 13 km from mine operations, and is influenced by the extent of the geological unit (Appendix D).

Assessment of cumulative impacts associated with the approved Bowen Gas Project was also undertaken as a sensitivity analysis in the Groundwater Assessment (Appendix D).

Based on the modelling results, cumulative groundwater drawdown extents from the Bowen Gas Project are predicted to be greater than depressurisation and drawdown produced by the mining operation alone (Appendix D).

Flooding

The Flooding Assessment (Appendix F) considered any existing and proposed structures that may affect flood behaviour, as well as structures proposed as part of the mining development. Hatch (2018b) concluded that there are no known projects in the planning or development phase that might result in additional structures on the floodplain in the vicinity of the Mine Site and Access Road.

Cumulative impacts on flooding are not expected to lead to any adverse impacts on human populations, property or other environmental or social values (Appendix F).

Catchment Excision

A comparison of the captured catchment areas of the existing mining projects considered in the cumulative impact assessment with the Isaac River catchment to the ISDS gauge was undertaken in Hatch (2018a).

When taking into account potential controlled release volumes from the operating mines in accordance with their current release rules (as well as the approved Bowen Gas Project), the overall loss of catchment area and associated stream flow reductions estimated would be further reduced by the controlled releases from the mine site (Appendix E).

Water Releases

The site water management system has been designed such that the risk of off-site uncontrolled release of mine affected water during operations is very low and sediment inputs can be controlled through drainage, and erosion and sediment control measures. On this basis, the Mine Site and Access Road is not expected to make any significant contribution to cumulative sediment loads in the Fitzroy River Basin (Appendix E).

It is also noted that any CSG water that may be released into the Isaac River by the Bowen Gas Project would have an insignificant effect on the receiving environment (Appendix E).

Water balance simulation of the final voids post-mining shows that the water surface is expected to reach an equilibrium water level well below the void overflow level and regional water table and would remain a groundwater sink (Appendix E).

The development of the proposed controlled release strategy to the Isaac River has been based on the existing release conditions for nearby operating coal mines.

The release conditions have been developed by the regulators within an overarching strategic framework for the management of the cumulative impacts of water releases from mining activities and are therefore expected to have negligible cumulative impact on surface water quality and associated environmental values (Appendix E).

3.3.11 Impact Avoidance, Mitigation Measures and Management Plans

3.3.11.1 Impact Avoidance Measures

The following measures would be implemented to avoid and / or minimise impacts on MNES associated with the Mine Site and Access Road (DPM Enviros ciences, 2018a):

- Mine pits and waste emplacement – The location of the mine and pits are informed by geological surveys and largely determined by the location of the natural resource, as a result the location of mine impacts are relatively inflexible. Where possible, riparian vegetation along the Isaac River has been avoided in the mine design and a minimum buffer of 200 m between the mine pits and Isaac River (defined bank) has been implemented.
- Overland conveyor – to reduce impacts that would normally be associated with a haul road crossing the Isaac River, an overland conveyor spanning approximately 14 km would be used to link the Willunga Domain to the CHPP within the Olive Downs South Domain. The conveyor would run North-west from the Willunga Domain and cross the Isaac River approximately 4.5 km from its origin point. The conveyor would be restricted to a construction corridor of 180 m however this would be reduced when crossing the Isaac River; where, within 200 m of the defining bank, the construction corridor width would be limited to 45 m to reduce impact on the riparian habitat.
- Access road – the proposed 3.5 km access road would be co-located with existing public and private roads as far as possible to reduce impacts to native vegetation. The access road would make use of an existing private dirt road for a distance of 2.3 km before deviating to cross over the Isaac River and into an area ground-truthed as being RE 11.3.25 of Least Concern. The location of the Isaac River crossing was selected due to the constructability of a low impact crossing at this point. The access road would be restricted to 40 m at the crossing point to reduce the impact on the riparian habitat.
- Haul road crossing – The haul road crossing would provide access to the waste emplacement at Deverill from the Olive Downs South Domain. The crossing would be located approximately 2 km south-south east of the access road where it crosses the Isaac River entering an area ground-truthed as being RE 11.3.25 of Least Concern. The haul road would be restricted to a construction corridor of 60 m.

3.3.11.2 Proposed Mitigation Measures

Mitigation measures proposed to be implemented for the Project are detailed in Table 3-25. Mitigation measures relating to water resources are described below. The measures identified in Table 3-25 are predicted to be effective in reducing potential adverse impacts on the MNES potentially impacted by the Mine Site and Access Road because they are focused on addressing the recognised threats to the relevant species and communities and are not inconsistent with the following documents:

- *Approved Conservation Advice for the Brigalow (Acacia harpophylla dominant and co-dominant) ecological community* (DotE, 2013a).
- *Commonwealth Listing Advice on Brigalow (Acacia harpophylla dominant and co-dominant)* (TSSC, 2001).
- *Approved Conservation Advice for Denisonia maculata (Ornamental Snake)* (DotE, 2014).
- *Approved Conservation Advice for Rostratula australis (Australian Painted Snipe)* (DSEWPaC, 2013).
- *Conservation Advice Geophaps scripta scripta Squatter Pigeon (southern)* (TSSC, 2015).
- *Approved Conservation Advice for Phascolarctos cinereus (combined populations in Queensland, New South Wales and the Australian Capital Territory)* (SEWPaC, 2012)
- *Conservation Advice Petauroides volans Greater Glider* (TSSC, 2016)
- *Threat Abatement Plan for Competition and Land Degradation by Rabbits* (DEE, 2016).
- *Threat Abatement Plan for Predation by Feral Cats* (DotE, 2015).

Table 3-25
Proposed Avoidance and Mitigation Measures for the Mine Site and Access Road

Potential impact	Mitigation measures
Vegetation clearing	• Demarcate exclusion zones prior to clearing to protect areas of vegetation to be retained. • Clearing of native vegetation would be undertaken progressively over the life of the mine and only in areas required for mining activities within the following year. This would have the effect of minimising the area of exposed land. • Vegetation clearing / excavation to be subject to internal permitting system. • Salvage felled vegetation for millable timber, as appropriate. • Collection of native seed from the Project area for use in rehabilitation program. • Implement the Vegetation Management Plan (Section 3.3.11.3). • Implement Rehabilitation and Mine Closure Plan (Section 3.3.11.3).
Fauna mortality	• Where applicable limit time of construction to avoid breeding seasons for threatened species. • Licenced fauna spotter-catchers to undertake detailed inspection of areas to be cleared • Where practical, retain hollow-bearing trees and large stags as potential nesting and roosting habitat. • Appropriate signage in prominent positions to reduce vehicle speeds in the Project area. • Vehicular traffic generally to be restricted to access tracks and an on-site speed limit would be applied.
Fragmentation	• Design bridge structures to maximise vegetation retention. • Where applicable maintain fencing and fauna crossings to ensure safe fauna movement.
Reduction of threatened fauna populations	• Implement management measures for fauna mortality, as outlined above. • Progressive rehabilitation. • Prepare a Species Management Program (in accordance with section 332 of the *Nature Conservation [Wildlife Management] Regulation, 2006*) • Implement Rehabilitation and Mine Closure Plan (Section 3.3.11.3).
Increased numbers of feral animals	• Ensure site waste management measures reduce the potential to attract vermin and other fauna. • Any waste storage facilities associated with the Project to be designed and located to restrict fauna access. • Management of feral animals, particularly dogs, cats and pigs. • Restrictions around allowing domestic pets on-site. • Implement Weed and Pest Management Plan (Section 3.3.11.3)

Table 3-25 (Continued)
Proposed Avoidance and Mitigation Measures for the Mine Site and Access Road

Potential impact	Mitigation measures
Weed management and edge effects	• Clearing of vegetation to be restricted to the minimum required to enable the safe construction, operation and maintenance of the Project, including infrastructure corridors. • Conduct rehabilitation activities for disused areas of the Project, as soon as possible. • Identification of weed infestations. • Prioritisation of treatment of weed infestations or weed species and ongoing treatment regimes (as necessary). • Strategies for preventing weed spread i.e. machinery wash-down, boot scrubbing facilities, appropriate disposal of weed material. • Implement the Weed and Pest Management Plan (Section 3.3.11.3).
Increased occurrence of wildfire	• Provide appropriate buffer distances between the MLA and surrounding bushland and manage vegetation within the buffer areas to maintain safe fuel loads. • Any chemicals used in the Project area would be handled and disposed of in accordance with the relevant Safety Data Sheet. • Access tracks would be able to be used for fire-fighting and other emergency purposes by Queensland Fire and Rescue Service. • Implement an Emergency Response Procedure prepared in consultation with emergency services.

Source: (DPM Envirosciences, 2018b)

- *Threat Abatement Plan for Predation, Habitat Degradation, Competition and Disease Transmission by Feral Pigs (Sus scrofa)* (DEE, 2017).
- *Threat Abatement Plan for the Biological Effects, Including Lethal Toxic Ingestion, Caused by* Cane Toads (SEWPaC, 2015).

Pembroke is responsible for funding the costs of all mitigation measures as required.

Environmental Outcomes

An outcome of the Action would be the enhancement and security of the Stage One Offset Area (as described in Section 3.7) to address the potentially significant residual impacts on threatened species and communities. The desired outcome of the proposed offset is that the extent and condition of the habitat values of threatened species and communities within the offset areas are protected and enhanced. The land in the offset areas will be enhanced so as the currently degraded areas reach remnant status through increasing the structural integrity and extent of vegetation in the area.

Water Management System and Water Flow Management Measures

Key water quality related objectives of the water management system are to maintain separation between runoff from areas undisturbed by mining and water generated within active mining areas where practicable, and to design and operate the mine such that there is no uncontrolled mine affected water overflow to the receiving environment.

Up-Catchment Diversions

Surface water runoff control practices to prevent up-catchment runoff water from entering the open cut mining areas would be generally adopted.

Sediment Dams

Sediment dams would be designed based on Best Practice Sediment and Erosion Control Guideline (International Erosion Control Association [IECA], 2008) for flows with an average recurrence interval of between 3 months and 1 year.

Sediment dams would be retained until the revegetated surface of the waste rock emplacements are stable and runoff water quality reflects runoff water quality from similar undisturbed areas, at which time these controls would be removed and the areas would be free-draining.

Controlled Releases

Controlled releases would be conducted in accordance with the proposed controlled release strategy.

Water Supply and Licensing (Surface Water)

The water balance model results show that there is a greater than 90% probability that an annual water allocation of 2,250 ML would be sufficient to meet all site demands, in any one year across the mine life (Appendix E). Pembroke intends to source this external water demand from SunWater via the water pipeline to the mine site.

If, during operations, there was a risk that the licence allocation could be exceeded, the site water demands could be adjusted accordingly (e.g. reduce dust suppression demand) or alternative water harvesting measures on site could be implemented, to avoid and/or minimise any impacts on regional water availability.

Groundwater Management Measures

Groundwater Inflows

Groundwater inflows/seepage to the pit cannot be prevented and would be pumped from the pit sumps to ensure safe operating conditions. The groundwaters would be collected and contained within mine water dams and utilised for processing and dust suppression on site.

During mining operations, direct groundwater inflows from alluvium exposed in the highwall of the open cut would be intercepted prior to it reaching the floor of the open cut for use in the mine water management system or pumping back to the Isaac River.

This would be achieved by the installation of sumps and a pump/pipe system on a bench of the open cut (as is the current practice for similar circumstances at other mines in Australia) (Appendix D).

Drainage/Seepage from Coal Rejects

The proposed out-of-pit TSF has been located on the western side of the ODS domain, outside of the extent of alluvium and drainage features. As final voids would act as groundwater ‘sinks’, water associated with in-pit rejects would be captured (Appendix D).

Make Good Measures

The potential drawdown impacts on groundwater users (privately owned property bores) are presented in Table 3-23. Make good measures would be put in place with affected landholders to ensure the bore owner has access to a similar quantity and quality of water for the groundwater bore's authorised purpose. This may include deepening a bore to increase its pumping capacity, constructing new water supply bore, providing water from an alternative source or financial compensation.

Licensing for Associated Water (Groundwater)

Underground water rights would be exercised for the life of the mine. The aquifers affected by the mining operation are partitioned according to the two units of the Isaac Connors Groundwater Management Area (GMA), including the Isaac Connors Alluvium Groundwater Sub-Area, as delineated in the *Water Plan (Fitzroy Basin) 2011*.

The Groundwater Assessment (Appendix D) provides a summary of the predicted groundwater take (inflows) requiring licensing. Over the life of the mine, groundwater licensing would vary and involve allocation of up to (Appendix D):

- 623 ML/year for the alluvium; and
- 1,199 ML/year for sub-artesian aquifers.

Post mining, there would be evaporation from the lakes that would form within the final voids. The results indicate that at equilibrium post closure, groundwater licensing requirements would reduce and involve allocation of approximately:

- 146 ML/year for the alluvium; and
- 183 ML/year for sub-artesian aquifers.

Adaptive Management

The results of the Surface Water Assessment (Appendix E) represent the application of the adopted mine water management system rules over the mine life.

There would be numerous options for adaptive management of the mine water management system to accommodate climatic conditions. For example, temporary adjustments to pumping arrangements could be made to accommodate very wet or dry periods. These alternative management approaches would be used to reduce the risks associated with climatic variability and could include, for example:

- advanced dewatering within the proposed open cut pit extents; and
- use of chemical or other dust suppressants to reduce the amount of water required for dust suppression.

Surface Water Monitoring Program – Flows and Volumes

Monitoring of upstream, onsite and downstream water flows (and storage levels and controlled release volumes) would assist in demonstrating that the site water management system is effective in meeting its objective to protect the integrity of local and regional water resources and allow for early detection of any impacts and appropriate corrective action.

The surface water monitoring protocols would:

- be implemented to comply with the Environmental Authority;
- provide valuable information on the performance of the water management system; and
- facilitate adaptive management of water resources on the site.

Monitoring of surface water levels and flows would continue to be undertaken based on data from DNRME streamflow gauges in the Isaac River catchment area as well as data from the ISDS monitoring station installed by Pembroke on the Isaac River, downstream of the Mine Site and Access Road.

Recommendations for dedicated surface water monitoring sites are provided in Hatch (2018a).

Groundwater Level and Pressure Monitoring

Recording of groundwater levels from existing monitoring bores and VWPs would continue and would enable natural groundwater level fluctuations (such as responses to rainfall) to be distinguished from potential groundwater level impacts due to depressurisation resulting from proposed mining activities. Several bores within the mine footprint would continue to be monitored until they are destroyed as the mine progresses.

The existing groundwater monitoring network would be consolidated to remove bores in close proximity to each other (e.g. S6 and S10) and augmented with additional proposed monitoring locations around the pit footprint and proposed coal reject emplacements/ILF cells.

Bores fitted with automatic loggers would record on a daily basis with others manually dipped on a quarterly basis. Subject to accessibility, quarterly groundwater level monitoring would also be conducted on privately-owned landholder bores predicted to be impacted by drawdown associated with the mining operation (Table 3-23).

Recommendations for dedicated groundwater level monitoring sites are provided in HydroSimulations (2018).

Groundwater Level Triggers and Data Review

All site groundwater monitoring bores are located within the zone of predicted groundwater level change due to the mining operation. Therefore, changes in groundwater levels at the site bores would be compared to predicted groundwater trends to evaluate any deviations from the model predictions.

Impact assessment criteria for the site would be documented within a Water Management Plan (WMP).

Each year, an annual review of groundwater level trends would be conducted by a suitably qualified person. The review would assess the change in groundwater levels over the year, compared to historical trends and impact assessment predictions.

Groundwater Model Validation

Every five years, the validity of the groundwater model predictions would be assessed and, if the data indicates significant divergence from the model predictions, the groundwater model would be updated for simulation of mining.

Surface Water Monitoring Program – Water Quality

Monitoring of surface water quality both within and external to the mine site would form a key component of the surface water management system (Figure 3-29). Monitoring of upstream, onsite and downstream water quality would assist in demonstrating that the site water management system is effective in meeting its objective to protect the integrity of local and regional water resources and allow for early detection of any impacts and appropriate corrective action.

The surface water monitoring protocols would:

- be implemented to comply with the Environmental Authority;
- provide valuable information on the performance of the water management system; and
- facilitate adaptive management of water resources on the site.

Surface run-off and seepage from ROM and product coal stockpiles would be monitored for 'standard' water quality parameters including, but not limited to, pH, EC, major anions (sulfate, chloride and alkalinity), major cations (sodium, calcium, magnesium and potassium), TDS and a broad suite of soluble metals/metalloids.

Recommendations for dedicated surface water quality monitoring sites are provided in Hatch (2018a).

Controlled Releases

Controlled releases would be conducted in accordance with the proposed controlled release strategy.

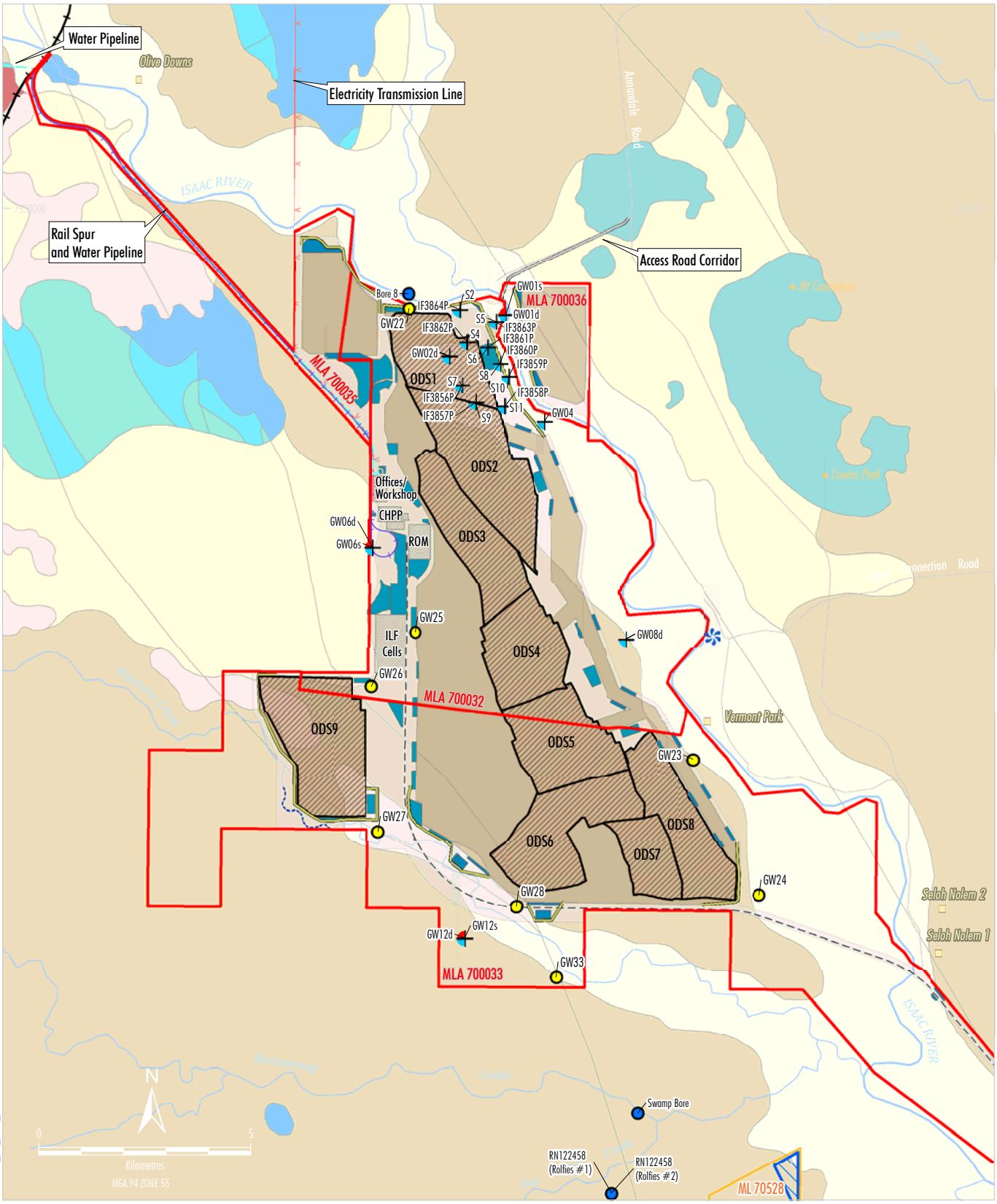
Management and Monitoring of Waste Rock and Coal Rejects (Drainage and Seepage)

Waste Rock Emplacements

Waste rock is expected to be overwhelmingly NAF with excess ANC, and to have a negligible risk of developing acid conditions. Furthermore, waste rock is predicted to generate low- to moderate-salinity surface run-off and seepage with low soluble metal/metalloid concentrations (Terrenus Earth Sciences, 2018). Notwithstanding, Pembroke would undertake validation testwork of potential waste rock materials from the Willunga domain as the mine develops to enable appropriate waste rock management measures to be planned and implemented as required.

Further, surface run-off and seepage from waste rock emplacements, including any rehabilitated areas, would be monitored for 'standard' water quality parameters including, but not limited to, pH, EC, major anions (sulfate, chloride and alkalinity), major cations (sodium, calcium, magnesium and potassium), TDS and a broad suite of soluble metals/ metalloids.

It is however noted that some waste rock materials may be sodic (to varying degrees) with potential for dispersion and erosion (to varying degrees) (Terrenus Earth Sciences, 2018). Where highly sodic and/or dispersive waste rock is identified, this material would not be placed in areas which report to final landform surfaces and would not be used in construction activities.



LEGEND

- Mining Lease Application Boundary
- Railway
- Dwelling
- Proposed Access Road
- Proposed Electricity Transmission Line
- Proposed Rail Spur and Loop
- Proposed Water Pipeline
- Proposed Creek Diversion
- Temporary Levee
- Overland Conveyor
- Open Cut Pit Extent (and Pit Numbering)
- Out-of-Pit and In-Pit Waste Rock Emplacement
- Infrastructure Area
- Key Infrastructure Component
- Sediment Dam
- Other Dam
- Lake Vermont Northern Expansion Mining Lease
- Lake Vermont Northern Expansion Pit Extent
- On-Site Weather Station
- Proposed Groundwater Monitoring Location

Existing Groundwater Monitoring Sites

- Vibrating Wire Piezometer
- Standpipe
- Privately Owned Groundwater Bore

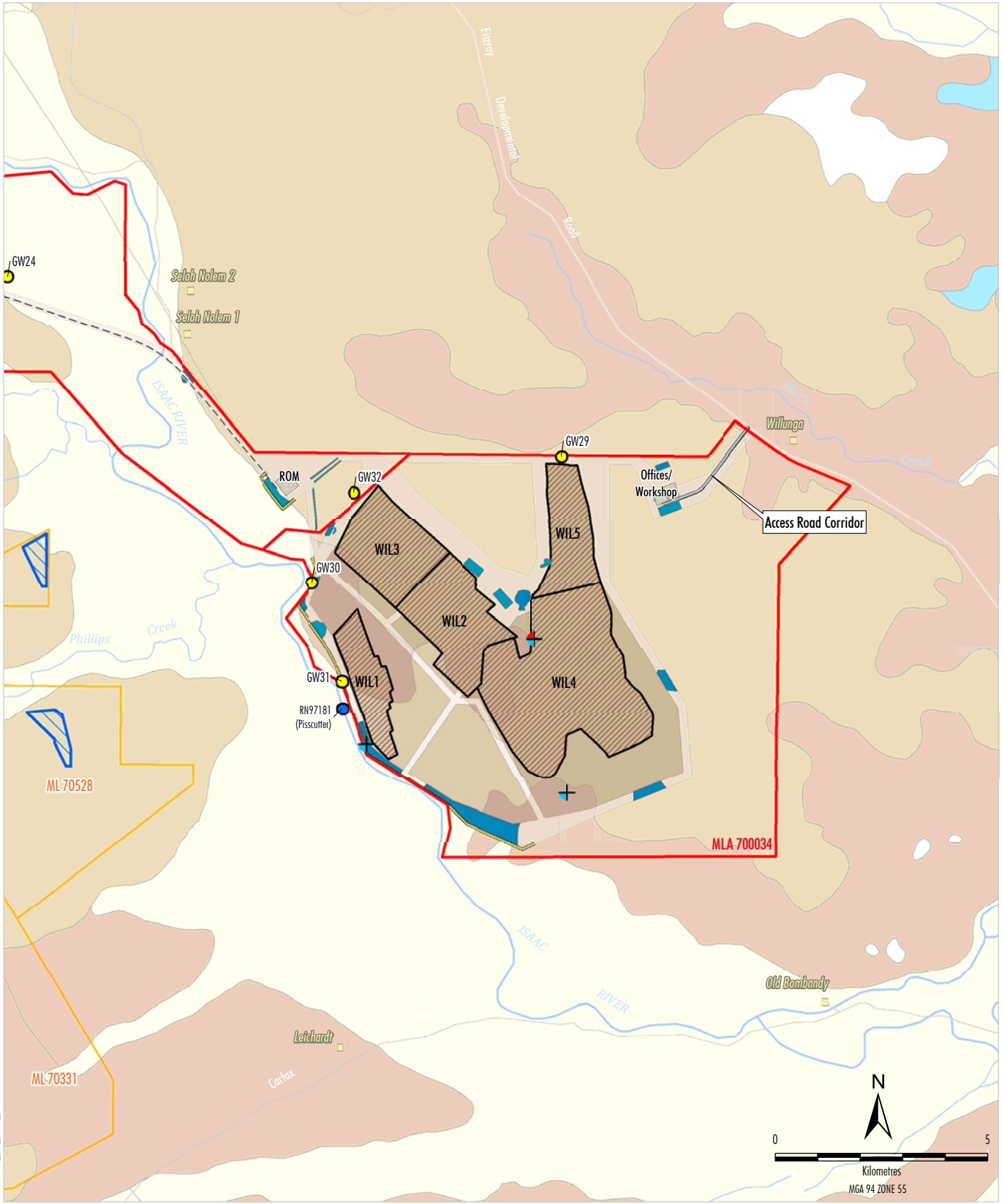
Source: Geoscience Australia - Topographical Data 250K (2006)
Department of Natural Resources and Mines (2016)
Orthophotography: Google Image (2016)
Refer to Figure 3-20 for Geology Legend

PEMBROKE

OLIVE DOWNS COKING COAL PROJECT

Olive Downs South Domain
Proposed Monitoring Network

Figure 3-29a



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LEGEND

- Mining Lease Application Boundary
- Dwelling
- Temporary Levee
- Overland Conveyor
- Open Cut Pit Extent (and Pit Numbering)
- Out-of-Pit and In-Pit Waste Rock Emplacement
- Infrastructure Area
- Key Infrastructure Component
- Other Dam
- Sediment Dam
- Lake Vermont Northern Expansion Mining Lease
- Lake Vermont Northern Expansion Pit Extent
- Proposed Groundwater Monitoring Location

Existing Groundwater Monitoring Sites

- VWP
- Standpipe
- Privately Owned Groundwater Bore

Source: Geoscience Australia - Topographical Data 250K (2006)
Department of Natural Resources and Mines (2016)
Orthophotography: Google Image (2016)
Refer to Figure 3-20 for Geology Legend

PEMBROKE

OLIVE DOWNS COKING COAL PROJECT

Willunga Domain
Proposed Monitoring Network

Figure 3-29b

It is expected that highly sodic and dispersive waste rock may not, in some cases, be able to be selectively handled and preferentially disposed of – although Pembroke would take reasonable measures to identify and selectively place highly sodic and dispersive waste rock. In such cases, waste rock landforms would need to be constructed with short and low (shallow) slopes (indicatively slopes less than 15% and less than 200 m long) and progressively rehabilitated to minimise erosion (Terrenus Earth Sciences, 2018).

Where waste rock is used for construction activities, this would be limited (as much as practical) to unweathered Permian sandstone materials, as these materials have been found to be more suitable for construction and for use as embankment covering on final landform surfaces.

Regardless of the waste rock type, especially where engineering or geotechnical stability is required, testing would be undertaken during construction to determine the propensity of such materials to erode.

Coal Rejects

As concluded in the Geochemistry Assessment (Terrenus Earth Sciences, 2018), when disposed amongst alkaline NAF waste rock within in-pit emplacements (or the out-of-pit emplacement during the early years of mining), the overall risk of environmental harm and health-risk that emplaced coal rejects poses is very low.

Notwithstanding, a Mineral Waste Management Plan would be developed for the handling and disposal of fine reject and coarse reject material for the mining operation.

Pembroke would undertake validation testwork of actual coal reject materials from the CHPP during development of the mine – particularly during the first two years of CHPP operation following commissioning and following commencement of mining and coal processing at the Willunga domain.

Testwork would comprise a broad suite of environmental geochemical parameters, such as pH, EC (salinity), acid-base account parameters, total metals and soluble metals.

Groundwater Quality Monitoring

Groundwater quality sampling of existing monitoring bores would continue in order to provide longer term baseline groundwater quality around the site, and to detect any changes in groundwater quality during and post mining. Several bores within the mine footprint would continue to be monitored until they are destroyed as the mine progresses.

The existing groundwater monitoring network would be consolidated to remove bores in close proximity to each other and augmented with additional proposed monitoring locations around the pit footprint and proposed coal reject emplacements/ILF cells.

Groundwater quality monitoring would continue to be undertaken on a quarterly basis. As part of the full water quality monitoring, in addition to collecting field parameters (EC and pH), water samples would be submitted to a NATA accredited laboratory for analysis of:

- physio-chemical indicators (TDS and total suspended solids [TSS]);
- major ions (calcium, fluoride, magnesium, potassium, sodium, chloride, sulphate), hardness and ionic balance (total anions/cations);
- total alkalinity as $CaCO_3$, HCO_3, CO_3; and
- total and dissolved metals: (Ag, Al, As, B, Ba, Be, Cd, Co, Cr, Cu, Fe, Hg, Pb, Mn, Mo, Ni, Se, U, V and Zn).

Subject to accessibility, quarterly groundwater quality monitoring would also be conducted on privately-owned landholder bores predicted to be impacted by drawdown associated with the mining operation (Table 3-23).

Recommendations for dedicated groundwater quality monitoring sites are provided in HydroSimulations (2018).

Groundwater Quality Triggers and Data Review

Groundwater quality triggers would be established to monitor predicted impacts on both environmental values and predicted changes in groundwater quality, and would be developed in line with the Department of Science, Information Technology and Innovation (DSITI) guideline on *Using monitoring data to assess groundwater quality and potential environmental impacts* (DSITI, 2017). Impact assessment criteria for the site would be documented within a Water Management Plan (WMP).

Groundwater quality triggers would be established for each groundwater unit potentially impacted by the mining operation, being alluvium, regolith and the Permian coal measures.

Each year, an annual review of groundwater quality trends would be conducted by a suitably qualified person. The review would assess the change in groundwater quality over the year, compared to historical trends and impact assessment predictions.

Flood Management Infrastructure Design

The following types of flood management infrastructure would be constructed:

- temporary flood levees; and
- permanent highwall emplacements.

Identification of potential flood protection works for the Mine Site and Access Road was based on the following key criteria:

- 0.1% AEP design event flood protection for open cut pits in accordance with the *Manual for Assessing Consequence Categories and Hydraulic Performance of Structures* (DEHP, 2016);
- 1% AEP design event flood protection for operational infrastructure other than open cut pits; and
- Probable Maximum Precipitation (PMP) design event flood protection for the closure final landform.

Temporary Flood Levees

Construction of temporary flood levees (or sufficiently robust waste rock emplacements) is required to provide immunity for infrastructure and mining operations to flood levels during a 0.1% AEP flood event, if such an event was to occur during the life of the mine.

Each temporary flood levee would be installed progressively and in advance of the open cut mining operational areas it would protect.

The temporary flood levee in the north-east of the ODS domain would be removed or reshaped once the open cut is backfilled and rehabilitated in the northern areas to provide additional flood storage areas adjacent the Isaac River to reduce flood velocities and stream power. Similarly, the temporary flood levees in the south and south-west of the ODS domain adjacent Ripstone Creek would be removed or reshaped once the waste rock emplacements are rehabilitated.

The temporary flood levee in the west of the Willunga domain would also be removed or reshaped once the Pit WIL1 is backfilled and the waste rock emplacements rehabilitated.

Permanent Highwall Emplacements

The construction of permanent highwall emplacements to the east and south-east of the proposed ODS domain open cut pits adjacent to the Isaac River floodplain are required to provide immunity to flood levels up to at least a 0.1% AEP flood event.

The permanent highwall emplacements would generally be approximately 300 m to 400 m wide and approximately 25 m high. In contrast, the PMF event flood level in the vicinity of the permanent highwall emplacements would generally be below 6 m.

No permanent highwall emplacements are proposed for the Willunga domain.

Revegetation of Flood Management Infrastructure

During rehabilitation, vegetation would be established as soon as practicable on the outer batters of the temporary flood levees and permanent highwall emplacements to prevent slope face degradation.

Ripstone Creek Diversion

The Ripstone Creek Diversion has been designed in consideration of the *Water Act, 2000* and the *Environmental Protection Act, 1994*, and to, as far as possible, replicate the natural hydraulic behaviour of the Ripstone Creek waterway.

An assessment of the potential impacts of the diversion was undertaken as part of the Flooding Assessment (Appendix F).

Hatch (2018b) concluded that by comparing the results of the flood modelling with the ACARP guidelines for the Bowen Basin, the diversion would not change the hydraulic behaviour of the waterway significantly.

Flood Management Infrastructure and Geomorphic Monitoring

The flood management infrastructure would be inspected by a suitably qualified and experienced person once per year between the months of May and October (inclusive) (i.e. in advance of the wet season). In addition, a visual inspection of the flood management infrastructure would be carried out following major flood events (e.g. 10% AEP or greater) to identify any potential issues with erosion, settlement or slumping.

Geomorphic monitoring would include topographic survey of the Isaac River channel and floodplain, repeated every year for 3 years, and then either every five years, or after every flood event exceeding the 5 yr ARI event (e.g. 20% AEP or greater).

This would be done using LiDAR technology, flown when the flow is very low. A Before-After, Control-Intervention (BACI) monitoring design would be used, with tolerable limits of change in the intervention reaches set by the observed degree of change in control reaches.

Mitigation measures would be triggered by unexpectedly large changes in channel morphology identified through monitoring along the Isaac River. The most appropriate response would need to be assessed at the time.

A monitoring strategy for the Ripstone Creek Diversion has also been developed and includes monitoring prior to construction, during construction, during operation and for relinquishment (Appendix F).

Monitoring would include:

- photographic reference points;
- aerial imagery;
- historic and LiDAR surveys;
- visual assessment (using a modified version of the Index of Diversion Condition);
- vegetation surveys; and
- flow event analysis.

The frequency of monitoring would be governed by a risk framework developed as part of the detailed design of the diversion.

3.3.11.3 Proposed Management Plans

The following management plans would be implemented by Pembroke for the ongoing management of potential impacts on MNES associated with the Project (including the Mine Site and Access Road):

- Vegetation Management Plan, including:
  - demarcate exclusion zones to protect areas of vegetation to be retained prior to clearing;
  - vegetation clearing / excavation to only be authorised in accordance with clearing / disturbance permitting system to ensure that the Environmental Advisor has reviewed all proposed clearing / excavation activities throughout operation of the Project;
  - salvage of felled vegetation for millable timber, as appropriate; and
  - collection of native seed from Project area prior to clearing for use in rehabilitation program;
- Weed and Pest Management Plan, including:
  - identification of weed infestations;
  - strategies for preventing weed spread (i.e. machinery wash-down, boot scrubbing facilities, appropriate disposal of weed material);
  - prioritisation of treatment of weed infestations or weed species and ongoing treatment regimes (as necessary);
  - recommended weed removal strategies (including those appropriate for aquatic habitats); and
  - weed monitoring protocols and follow-up weed control methods and protocols.
- Fauna Species Management Plan
  - clearing activities would avoid breeding seasons for threatened species;
  - fauna exclusion fencing would be installed around construction sites or operational mine areas;
  - implementation of vehicle speed limits on-site;
  - pets would not be allowed on-site;
  - fencing and fauna crossings would be maintained to allow safe fauna movement;
  - artificial lighting would be minimised and the use of lighting on-site would be in accordance with the relevant Australian Standards; and
  - use of licenced fauna spotter-catchers for relocation of native animals, including native fish and turtles impacted by dewatering habitat.
- Rehabilitation and Mine Closure Plan, including:
  - identification of desired post-mining land use;
  - protocol for progressive rehabilitation and staging of rehabilitation or natural regeneration and site preparation;

- rehabilitation criteria to assess the effectiveness of the rehabilitation work;
- recommended native species to be used during rehabilitation activities; and
- measures to monitor the success of the rehabilitation strategies.

Water Management Plan

A WMP would be prepared cognisant of the DES guideline for the *Preparation of water management plans for mining activities* (DERM, 2010) and would include, but is not necessarily limited to:

- details of the potential sources of contaminants that could impact on water quality;
- a description of the water management system;
- measures to manage and prevent saline drainage and sodicity;
- measures to manage and prevent acid rock drainage;
- corrective actions and contingency procedures for emergencies; and
- a program for monitoring and review of the effectiveness of the WMP.

Erosion and Sediment Control Plan

An Erosion and Sediment Control Plan would be developed and implemented throughout construction and operations.

The Erosion and Sediment Control Plan would be reviewed and revised by an appropriately qualified person and implemented for all stages of the mining activities on the site to minimise erosion and the release of sediment to receiving waters and management of stormwater.

Receiving Environment Monitoring Plan

A Receiving Environment Monitoring Plan (REMP) would be developed in accordance with the model mining conditions. The REMP would be implemented to monitor, identify and describe any adverse impacts to surface water environmental values, quality and flows due to the authorised mining activity. Ecological monitoring would be undertaken in accordance with relevant state or national monitoring guidelines.

Mineral Waste Management Plan

A Mineral Waste Management Plan would be developed for the handling and disposal of fine reject and coarse reject material for the mining operation.

3.3.12 Social and Economic Impacts

The social and economic benefits of the Project (as a whole, including the four Project components) are described below.

A Social Impact Assessment (SIA) was undertaken for the Project (incorporating the Mine Site and Access Road) by Elliott Whiteing (2018).

Potential impacts of the Project on the social values of the local and regional communities were identified through direct engagement with potentially affected stakeholders, and the analysis of potential impacts against the attributes of the existing social environment.

Social impacts and benefits in the Isaac LGA would be likely to include (Elliott Whiteing, 2018):

- temporary population increases during construction of approximately 440 full-time equivalent (FTE) employees during 2019-2020 and 300 FTE employees during 2028, with consequent demands for local health services, emergency services, Council services and facilities, and the road network;
- population increases in the Isaac LGA during operations, in the order of:
  - at least 300 people, and up to 600 people, in 2020;
  - up to 1,300 people by 2032; and
  - up to 1,755 people during the first 14 to 15 years of operation;
- consequent impacts on social resources during operations, including:
  - potential for Project-induced inflation to increase the cost of housing if additional stock is not made available;
  - increased demand for health service provision, school enrolments, childcare places and community services; and
  - labour draw, staff turnover and potential for wage inflation.
- creation of an estimated 500 – 700 construction jobs in 2019-20 and 300 – 500 construction jobs around 2028;
- locally-based employment for Isaac LGA residents, including a focus on gender equity in the Project workforce;

- the availability of 480 operational jobs in 2020 and 960 jobs by 2021, with potential for an increase to 1,300 jobs in 2033 which would be ongoing until around 2050, and would then decline;
- employment and training opportunities for Indigenous people;
- immigration of Project personnel and families to the Isaac LGA, contributing to population growth and community vitality;
- benefits for local and regional businesses from both Project supply opportunities and expenditure by Project personnel and households; and
- potential for supply opportunities for Indigenous businesses.

Consultation with local communities and stakeholders indicated that they were generally very positive about the Project, given its commitments to local employment and co-operation with local stakeholders (Elliott Whiteing, 2018).

Key issues raised included locally-based employment, encouragement of Project-led population growth, the importance of local businesses participating in Project supply chains, and the need for co-operation with stakeholders to maintain access to the capacity of social infrastructure (Elliott Whiteing, 2018).

The Project is also likely to support social resilience and sustainability in Isaac LGA communities by (Elliott Whiteing. 2018):

- offering long term, locally-based employment enabling skills development;
- enabling population growth and stability;
- supporting workforce integration with local communities; and
- increasing demand for local and regional businesses' offerings.

The regional impact analysis in Gillespie Economics (2018) included consideration of the impacts of the Project on the Isaac Regional Council LGA, MW Region and Queensland economies.

The projected impact on the Isaac Regional Council LGA gross product peaks at approximately $1,455 M in 2037.

This peak is due to the higher levels of activity within the Isaac Regional Council LGA associated with peak Project production and the flow-on benefits of purchasing inputs to operate the Project (Gillespie Economics, 2018).

The projected impact on the Queensland gross product peaks at approximately $1,865 M in 2040 (Gillespie Economics, 2018).

Gillespie Economics (2018) estimates the Project would increase gross product in the Isaac Regional Council LGA, MW Region and Queensland economies up to 2050 by some $8.0 B, $212 M and $10.1 B, respectively.

3.3.13 Ecologically Sustainable Development Considerations

The ecologically sustainable development (ESD) considerations relevant to the Project (as a whole, including the four Project components) are described below.

3.3.13.1 Background

The concept of sustainable development came to prominence at the World Commission on Environment and Development (1987), in the report titled *Our Common Future*, which defined sustainable development as:

> *Development that meets the needs of the present without compromising the ability of future generations to meet their own needs.*

In recognition of the importance of sustainable development, the Qld Government participated in the Intergovernmental Agreement on the Environment, which lead to the development of the a *National Strategy for Ecologically Sustainable Development* (NSESD) (Commonwealth of Australia, 1992) that defines ecologically sustainable development (ESD) as:

> *using, conserving and enhancing the community's resources so that ecological processes, on which life depends, are maintained, and the total quality of life, now and in the future, can be increased.*

The NSESD was developed with the following core objectives:

- enhance individual and community well-being and welfare by following a path of economic development that safeguards the welfare of future generations;
- provide for equity within and between generations; and

- protect biological diversity and maintain essential processes and life support systems.

In addition, the NSESD contains the following goal:

> *Development that improves the total quality of life, both now and in the future, in a way that maintains the ecological processes on which life depends.*

In accordance with the core objectives and a view to achieving this goal, the NSESD presents private enterprise in Australia with the following role:

> *Private enterprise in Australia has a critical role to play in supporting the concept of ESD while taking decisions and actions which are aimed at helping to achieve the goal of this Strategy.*

As described in Attachment 3 of the EIS, the Project requires approval under the EP Act. Section 58 of the EP Act provides for the chief executive to consider the following principles in preparing an EIS assessment report:

- the precautionary principle;
- intergenerational equity; and
- conservation of biological diversity and ecological integrity.

In addition, the Project requires approval under both the EPBC Act and the SDPWO Act. In deciding whether or not to approve the Project, the Commonwealth Minister must take into account the principles of ESD pursuant to section 136(2) of the EPBC Act. The relevant definition of the principles of ESD is provided in section 3A of the EPBC Act.

The design, planning and assessment of the Project have been carried out applying the principles of ESD, through:

- incorporation of risk assessment and analysis at various stages in the Project design, environmental assessment and decision-making;
- adoption of high standards for environmental and occupational health and safety performance;
- consultation with regulatory and community stakeholders;
- assessment of potential greenhouse gas emissions associated with the Project; and
- optimisation of the economic benefits to the community arising from the development of the Project.

In addition, it can be demonstrated that the Project can be undertaken in accordance with ESD principles through the application of measures to avoid, mitigate and offset the potential environmental impacts of the Project and where relevant adaptive management would be implemented.

The following sub-sections describe the consideration and application of the principles of ESD to the Project.

3.3.13.2 Precautionary Principle

Environmental assessment involves predicting what the environmental outcomes of a development are likely to be. The precautionary principle emphasises the need to address the threats of irreversible damage, even in circumstances where there is scientific uncertainty about environmental risk.

A Preliminary Risk Assessment (Appendix O of the EIS) was conducted to identify Project related risks and develop appropriate mitigation measures and strategies.

The Preliminary Risk Assessment (Appendix O of the EIS) considers potential environmental impacts associated with the Project, including long-term effects. In addition, long-term risks are considered by the specialist studies conducted in support of this EIS (Section 1 of the EIS). Findings of these specialist assessments are presented in Section 3 of the EIS and relevant appendices.

Measures designed to avoid, mitigate and offset potential environmental impacts arising from the Project are also described in Sections 3 and 5 of the EIS.

The Preliminary Risk Assessment (Appendix O of the EIS) considers off-site risks to people, property and the environment (in the presence of controls) arising from atypical and abnormal hazardous events and conditions (i.e. equipment failure, operator error and external events) from fixed installations. The Preliminary Risk Assessment does not consider those risks that are not atypical or abnormal (e.g. long-term effects of typical dust emissions) or those risks to Pembroke employees or Pembroke-owned property.

The specialist assessments have evaluated the potential for harm to the environment associated with development of the Project.

Assessment of potential short, medium and long-term impacts of the Project have been carried out during the preparation of this EIS on aspects of (but not limited to) groundwater and surface water, noise and blasting, air quality (including greenhouse gas emissions), terrestrial and aquatic ecology, Aboriginal and historic heritage, land, road transport, waste, visual character, social and community infrastructure and economics.

Minimal uncertainty regarding the information used in these specialist assessments is expected given:

- the number of site-based surveys and assessments conducted for the Project;
- the comprehensive nature of the assessments; and
- the consultation process conducted with key stakeholders (Attachment 2 of the EIS).

In addition, for key Project environmental assessment studies, peer review by recognised experts was undertaken (Attachment 4 of the EIS).

A range of measures have been adopted as components of the Project design to minimise the potential for serious and/or irreversible damage to the environment.

These include operational controls (e.g. modification of mining operations during adverse weather conditions) and physical controls (e.g. the use of water trucks for dust suppression along haul roads), the development of environmental management and monitoring programmes and biodiversity offsets (Section 5 of the EIS). Where residual risks are identified, contingency controls have also been considered (Section 5 of the EIS).

3.3.13.3 Social Equity

Social equity is defined by inter-generational and intra-generational equity. Inter-generational equity is the concept that the present generation should ensure that the health, diversity and productivity of the environment is maintained or enhanced for the benefit of future generations, while intra-generational equity is applied within the same generation.

The principles of social equity are addressed through:

- assessment of the social and economic impacts of the Project, including the distribution of impacts between stakeholders and consideration of the potential economic costs of climate change (Appendices H and I of the EIS);
- management measures to be implemented in relation to the potential impacts of the Project on groundwater and surface water, noise and blasting, air quality (including greenhouse gas emissions), terrestrial and aquatic ecology, Aboriginal and historic heritage, land, road transport, waste, visual character, social and community infrastructure and economics (Section 3 of the EIS);
- implementation of environmental management and monitoring programmes (Section 5 of the EIS) to minimise and evaluate potential environmental impacts (which include environmental management and monitoring programmes covering the Project life);
- implementation of biodiversity offsets during the life of the Project to compensate for potential localised impacts that have been identified for the development (Sections 3.1.5 and 5 of the EIS); and
- Pembroke would make continued contributions to the Isaac Regional Council and the local community through rates and infrastructure contributions and ongoing support for community initiatives (Section 3.7 of the EIS).

The Project would benefit current and future generations through employment. It would also provide significant stimulus to local and regional economies and provide Queensland export earnings and royalties, thus contributing to future generations through social welfare, amenity and infrastructure.

As described above, the Project incorporates a range of operational and physical controls and environmental management and mitigation measures (e.g. the Project biodiversity offset strategy) to minimise potential impacts on the environment. The cost of these measures would be met by Pembroke.

Where relevant, these costs have been included in the economic assessment (Appendix I of the EIS), therefore, the potential benefits to current and future generations have been calculated in the context of the mitigated Project.

3.3.13.4 Conservation of Biological Diversity and Ecological Integrity

For the purposes of this EIS, ecological integrity has been considered in terms of ecological health and ecological values.

The Project area is located in a largely agricultural landscape, with grazing land surrounding the Project area where the majority of the vegetation has been cleared for grazing. The majority of the Project area comprises agricultural grasslands with tracts of remnant vegetation, particularly along the riparian corridor of the Isaac River.

Surveys conducted for the Project have identified threatened ecological communities and habitat suitable for conservation significant flora and fauna species. Detailed results from recent terrestrial flora and fauna and aquatic ecology surveys are outlined in Appendices A, B and C of the EIS.

The environmental assessment in Section 3.1 of the EIS (and Appendices A, B and C of the EIS) describes the potential impacts of the Project on local and regional ecology.

In accordance with ESD principles, the Project addresses the conservation of biodiversity and ecological integrity by proposing an environmental management framework designed to conserve ecological values, where practicable, after consideration of potential Project impacts as described in the sub sections below.

Greenhouse Gas Emissions and Biological Diversity and Ecological Integrity

Many natural ecosystems are considered to be vulnerable to climate change. Patterns of temperature and precipitation are key factors affecting the distribution and abundance of species (Preston and Jones, 2006). Projected changes in climate will have diverse ecological implications. Habitat for some species will expand, contract and/or shift with the changing climate, resulting in habitat losses or gains, which could prove challenging, particularly for species that are threatened.

A greenhouse gas assessment was undertaken by Katestone for the Project (Appendix G of the EIS). Section 3.5 of the EIS provides a description of the potential greenhouse gas emissions of the Project. Valuation of potential impacts of greenhouse gas emissions has been incorporated in the Economic Assessment (Appendix I of the EIS) for the Project.

The potential implications of climate change on local groundwater and surface water resources are addressed in Appendices D and E of the EIS, respectively.

Measures to Maintain or Improve the Biodiversity Values of the Surrounding Region

A range of impact avoidance, mitigation and offset measures would be implemented for the Project to maintain or improve the biodiversity values of the surrounding region in the medium to long-term, as described below.

Sections 3.1, 3.14, 4 and 5 of the EIS summarise a number of Project measures that would assist in maintaining the biodiversity of the region. These measures include the long-term viability of existing vegetation communities (i.e. the Project biodiversity offset strategy) and rehabilitation of Project landforms.

An offset strategy has been developed to address the potential residual impacts on biodiversity values associated with the Project, such that biodiversity values of the region are maintained or improved in the medium to long-term (as detailed in Sections 3.1 and 5 and Appendices A and B of the EIS).

Section 3.4 presents Pembroke's rehabilitation strategy for the Project. The disturbance areas associated with the Project would be progressively rehabilitated and revegetated with species characteristic of native woodland/open forest and pasture with scattered trees.

Terrestrial flora, fauna and aquatic ecology management measures including the biodiversity offset strategy are described in Section 3.1 of the EIS.

3.3.13.5 Valuation

One of the common broad underlying goals or concepts of sustainability is economic efficiency, including improved valuation of the environment. Resources should be carefully managed to maximise the welfare of society, both now and for future generations.

In the past, some natural resources have been misconstrued as being free or underpriced, leading to their wasteful use and consequent degradation.

Consideration of economic efficiency, with improved valuation of the environment, aims to overcome the underpricing of natural resources and has the effect of integrating economic and environment considerations in decision making, as required by ESD.

While historically, environmental costs have been considered to be external to Project development costs, improved valuation and pricing methods attempt to internalise environmental costs and include them within Project costing.

The Economic Assessment (Appendix I of the EIS) undertakes an analysis of the Project and incorporates environmental values via direct valuation where practicable (e.g. greenhouse gas emissions of the Project and Project impacts on agricultural values). Furthermore, wherever possible, direct environmental effects of the Project are internalised through the adoption and funding of mitigation measures by Pembroke to mitigate potential environmental impacts (e.g. the Project biodiversity offset strategy).

As outlined in Section 3.3.12, the projected impact on the Isaac Regional Council LGA gross product peaks at approximately $1,455 M in 2037. This peak is due to the higher levels of activity within the Isaac Regional Council LGA associated with peak Project production and the flow-on benefits of purchasing inputs to operate the Project (Gillespie Economics, 2018).

The projected impact on the Queensland gross product peaks at approximately $1,865 M in 2040 (Gillespie Economics, 2018).

Gillespie Economics (2018) estimates the Project would increase gross product in the Isaac Regional Council LGA, MW Region and Queensland economies up to 2050 by some $8.0 B, $212 M and $10.1 B, respectively.

3.3.14 Consideration of the Project against the Objects of the Environment Protection and Biodiversity Conservation Act, 1999

Section 3 of the EPBC Act describes the objects of the EPBC Act as follows:

(1) The objects of this Act are:

(a) to provide for the protection of the environment, especially those aspects of the environment that are matters of national environmental significance; and

(b) to promote ecologically sustainable development through the conservation and ecologically sustainable use of natural resources; and

(c) to promote the conservation of biodiversity; and

(ca) to provide for the protection and conservation of heritage; and

(d) to promote a co-operative approach to the protection and management of the environment involving governments, the community, land-holders and indigenous peoples; and

(e) to assist in the co-operative implementation of Australia's international environmental responsibilities; and

(f) to recognise the role of indigenous people in the conservation and ecologically sustainable use of Australia's biodiversity; and

(g) to promote the use of indigenous peoples' knowledge of biodiversity with the involvement of, and in co-operation with, the owners of the knowledge.

The Project is considered to be generally consistent with the objects of the EPBC Act, because it is a Project which:

- incorporates a range of measures for the protection of the environment, including listed threatened species and ecological communities, water resources and heritage (Section 3 of the EIS);
- incorporates relevant ESD considerations (Section 6.1.1 of the EIS);
- includes a proposal for offset of unavoidable impacts on biodiversity and other compensatory measures (Sections 3.1 and 5 of the EIS);
- includes the involvement and participation of the community, landholders and indigenous people through the Project EIS consultation program (Attachment 5 of the EIS), the public exhibition of the EIS document and assessment of the Project in accordance with the requirements of the SDPWO Act;
- would not result in a significant impact on migratory species protected under international agreements;
- is not predicted to result in a significant impact on water (Sections 3.2 and 3.3 of the EIS);
- includes the involvement of the indigenous community throughout the life of the Project through CHMP; and
- includes target employment of Aboriginal and/or Torres Strait Islander descent (Section 3.6 of the EIS).

3.3.15 Conclusion

Pembroke has assessed a number of alternatives to the Mine Site and Access Road, including alterative mining methods, open cut extents, waste rock emplacements design, mining sequence and final voids.

The final proposed mannor in which the Mine Site and Access Road would be constructed and operated is considered to be environmentally acceptable in consideration of the requirements of the EPBC Act (including the objects of the EPBC Act), the principles of ecologically sustainable development and the precautionary principle.

Potential impacts on listed threatened species and communities associated with the Mine Site and Access Road includes the direct removal of potential and known habitat for threatened species and native vegetation (including patches of Brigalow TEC). The Mine Site and Access Road is not expected to result in any consequential impacts to any threatened species or community listed under the EPBC Act (DPM Enviros ciences, 2018b). Further to this there are no impacts relevant to the Mine Site and Access Road that are unknown, unpredictable or irreversible.

The avoidance and mitigation measures proposed for the Mine Site and Access Road are acceptable and predicted to be effective in reducing potential adverse impacts on the MNES because they are focused on addressing the recognised threats to threatened species and communities and are not inconsistent with the relevant approved conservation advice and threat abatement plans. Significant Impact Assessments have been conducted for all MNES which are known or have the potential to occur within the Mine Site and Access Road area and surrounds in accordance with the *Significant Impact Guidelines 1.1 – Matters of National Environmental Significance* (DotE, 2013b) (DPM Enviros ciences, 2018a and 2018b).

In addition to the progressive rehabilitation of the Mine Site and Access Road area, Pembroke would provide a biodiversity offset for the impacts associated with the Mine Site and Access Road in accordance with the *Queensland Environmental Offsets Policy (Version 1.4)* (DEHP, 2017) and *EPBC Act Environmental Offsets Policy* (SEWPaC, 2012a) (and supporting *EPBC Act Offsets Assessment Guide* [SEWPaC, 2012b]) (Section 3.8). The biodiversity offset area (once established) would provide a beneficial conservation outcome for biodiversity in the region.

3.4 OLIVE DOWNS PROJECT WATER PIPELINE (EPBC 2017/7868)

3.4.1 Location of the Action

The Olive Downs Project Water Pipeline (EPBC 2017/7868) (herein referred to as Water Pipeline) is located approximately 170 km south west of Mackay, in the Bowen Basin region of central Qld (Figure 2-1). The Water Pipeline is located approximately 40 km south-east of Moranbah, and 35 km north of Dysart within the Isaac Regional Council LGA in a mining precinct comprising several existing mining operations.

3.4.2 Description of the Action

A description of the works to be undertaken during the construction, operations and decommissioning phases of the Water Pipeline is provided below. The total disturbance footprint of the Water Pipeline is approximately 57 ha (Figure 2-2).

It should be noted that approximately 15 km of this Water Pipeline has been co-located with the proposed Rail Spur and Loop (Section 3.6). As such, only 18 km of the Water Pipeline would result in additional land clearance.

3.4.2.1 Construction

A raw (external supply) water pipeline (approximately 23 km long) would be constructed for the Project from the existing Eungella water pipeline network (the Eungella Pipeline Southern Extension), with the take off point to be located north of Eagle Downs (Figure 2-1). The Water Pipeline would initially terminate at an existing onsite dam (Figure 2-2) and would supply up to approximately 500 megalitres (ML) per year for construction and the initial establishment of operations.

The Water Pipeline would be consutrcuted during the first Stage of the Project (Section 3.3.2).

3.4.2.2 Operation

Operational water requirements for the Project would be sourced from on-site water storages containing runoff from disturbed mine areas or mine affected water. If required, the operational water demand would be supplemented with external water supply under supply agreements via the Water Pipeline connecting to the Eungella pipeline network (Figure 2-2). Initial discussions with SunWater indicate there is sufficient capacity within the Eungella Pipeline network to provide the estimated raw water requirement for the Project.

The Water Pipeline would remain operational for the duration of the Project.

3.4.2.3 Decommissioning and Rehabilitation

The Water Pipeline would be assessed for possible removal or to be retained for future land owners. Where infrastructure is removed, the land would be re-contoured, topsoiled, ripped and seeded. All disturbed areas would be rehabilitated with an appropriate seed mix to enable revegetation.

It is anticipated that the Water Pipeline would be decommissioned within two years of the completion of mining operations.

3.4.3 Current Status of the Action

The Water Pipeline was referred to the DEE under the EPBC Act on 24 January 2017. On 3 March 2017 the Water Pipeline was determined to be a "Controlled Action". DEE advised that the bilateral assessment under section 45 of the EPBC Act applies to the Project.

In December 2017, Pembroke lodged an application to vary the Water Pipeline to incorporate the latest Project layout designs which was accepted by the DEE on 17 April 2018. Works associated with the Water Pipeline has not commenced.

3.4.4 Consequence of Not Proceeding

The Water Pipeline is one component of the larger Project (Section 3.4.6).

The Water Pipeline would be required for delivery of water to the Project area, and should the Water Pipeline not be constructed, the Project would not be able to proceed.

Section 3.2.4 describes the consequences of the Project not proceeding.

3.4.5 Alternatives Considered

A number of alternative alignments for the Water Pipeline was investigated during pre-feasibility studies.

Although a number of alignments were considered to provide a better engineering design or a lower cost (e.g. alignments that took straighter paths or had fewer road crossings), the final alignment was selected as it:

- minimise impacts to other tenement holders, by locating the Water Pipeline along tenement boundaries;
- minimise impact to existing land uses by co-locating the Water Pipeline with the Rail Spur and Loop in the same corridor; and
- minimise the impacts to private landholdings by locating the Water Pipeline within existing easements and road corridors, where practicable.

3.4.6 Relationship to Other Actions

The Project also includes construction of the Mine Site and Access Road (Section 3.2), Project ETL (Section 3.4) and Rail Spur and Loop (Section 3.5).

As detailed in Section 3.1, the Mine Site and Access Road, Project ETL and Project Rail Spur and Loop and Water Pipeline were referred separately to the DEE. Pembroke is the proponent for all four actions.

Should Pembroke, in the future, decide to transfer the responsibility of the Water Pipeline, Rail Spur and Loop and/or Project ETL to another company (e.g. SunWater, Aurizon or Ergon) all relevant approvals would also need to be transferred. Given the EPBC Act does not allow individual elements of a single referred action (e.g. Water Pipeline, Project ETL and Rail Spur and Loop) to be transferred between proponents, Pembroke has decided to lodge four separate referrals covering separate aspects of the Project. This facilitates the transfer of approvals between proponents for the individual elements of the Project.

3.4.7 Impacts on Listed Threatened Species and Ecological Communities

3.4.7.1 Threatened Species

The following threatened fauna species listed under the EPBC Act were recorded from the Water Pipeline area and surrounds, during the field surveys (Figure 3-5) (DPM Envirosciences, 2018b):

- Ornamental Snake;
- Australian Painted Snipe;
- Squatter Pigeon (southern);
- Koala; and
- Greater Glider.

Further to this, potential impacts to an additional 19 fauna listed in the Terms of Reference, or identified within a search area covering the wider locality, were assessed by DPM Envirosciences (2018b) These include:

- Red Goshawk (*Erythrotriorchis radiatus*)*;*
- Curlew Sandpiper (*Calidris ferruginea*)*;*
- Painted Honeyeater (*Grantiella picta*)*;*
- Star Finch (eastern) (*Neochmia ruficauda ruficauda*)*;*
- Black-throated Finch (southern) (*Poephila cincta cincta*)*;*
- Northern Quoll (*Dasyurus hallucatus*)*;*
- Grey-headed Flying-fox (*Pteropus poliocephalus*)*;*
- Ghost Bat (*Macroderma gigas*)*;*
- Corben's Long-eared Bat (*Nyctophilus corbeni);*
- Southern Snapping Turtle (*Elseya albagula*)*;*
- Fitzroy River Turtle (*Rheodytes leukops*)*;*
- Yakka Skink (*Egernia rugosa*);
- Allan's Lerista (*Lerista allanae*)*;*
- Dunmall's Snake (*Furina dunmalli*)*;*
- *Cycas ophiolitica;*
- King Blue-grass *(Dichanthium queenslandicum);*
- Bluegrass (*Dichanthium setosum*)*;*
- Black Ironbox (*Eucalyptus raveretiana*)*; and*
- Quassia (*Samadera bidwillii*)*.*

These species are discussed in detail below.

Ornamental Snake (Denisonia maculata)

The Ornamental Snake (*Denisonia maculata*) is listed as 'Vulnerable' under the EPBC Act.

Background/Description

The Ornamental Snake occurs in scattered locations over a large area in Brigalow Belt North and South Bioregions and small portions of the Desert Uplands Bioregion and Central Coast Bioregion in Qld (DEE, 2018a).

Within its distribution, the Ornamental Snake inhabits moist or seasonally moist areas within appropriate refuge habitat and aquatic or fringing vegetation with frog species forming their main prey (Cogger, 2014). The Ornamental Snake is most likely to occur in Qld regional ecosystem Land Zone 4 (DEE, 2018a) and most likely in Brigalow-dominated ecosystems supporting gilgai.

Survey Effort

The survey effort for this species is provided in Table 3-5 and Appendix B.

Habitat Assessment and Definition

The Ornamental Snake prefers habitat that is close to its prey (frogs). It prefers moist woodlands and open forests, particularly gilgai mounds as well as lake margins and wetlands (DEE 2018). It is found in low-lying subtropical areas with deep-cracking clay soils and persists in cleared, disturbed habitat, particularly where brigalow communities have been cleared (DSEWPaC, 2011).

Four Ornamental Snake were recorded at three locations within the Olive Downs South Domain and a further five locations within the Willunga Domain (Figure 3-5c). The species was identified via a combination nocturnal spotlighting. These records occurred within agricultural grasslands on cracking clays, around palustrine wetlands, within Acacia dominated open forests, woodland and shrublands, and also one record within Eucalypt dry woodlands on inland depositional plains (expected to be a transient individual) (DPM Envirosciences, 2018b). Database records for this species are relatively common in the wider locality, with more than 14 records within 15 km of the Water Pipeline.

The Ornamental Snake was not recorded within the Water Pipeline area (DPM Envirosciences, 2018b). The closest record is approximately 2.5 km to the south (Figure 3-5c).

Ground-truthed soils mapping produced for the *Olive Downs Coking Coal Project Soils and Land Suitability Assessment* by GT Environmental (2018) across the Study area identified areas of gilgai relief, which are the most accurate reflection of potential habitat for this species (Figure 3-31b). GT Environmental (2018) has mapped the following two soil types within the Water Pipeline area that would provide suitable habitat for the Ornamental Snake:

- brown light clays with gilgai; and
- grey to brown light to medium clay with gilgai.

Brigalow TEC has been identified as potential habitat for the Ornamental Snake. Mapping in the Mine Site and Access Road area identified two patches as being Brigalow TEC, comprised of RE 11.4.9. In accordance with the *Draft Referral Guidelines for the Nationally Listed Brigalow Belt Reptiles* RE 11.4.9 comprises habitat suitable for the Ornamental Snake.

Other patches of Brigalow regrowth have been mapped as potential habitat where suitable habitat features are present (i.e. gilgais, wetlands and suitable prey habitat).

Based on observations of Ornamental Snake across the Study area, areas of potential habitat occur in a significant portion of agricultural grasslands (where there was once brigalow), and small patches of palustrine wetlands (swamps) and Acacia dominated open forests, woodlands and shrublands where these soil types are also present (DPM Envirosciences, 2018b).

The areas identified as potential habitat for the Ornamental Snake also contain woody debris (which would provide sheltering habitat for the Ornamental Snake when cracks are not available), are low lying, and during the wet season they would hold water long enough for frogs to inhabit them, providing a food source for the Ornamental Snake (DPM Envirosciences, 2018b).

As the majority of the potential habitat for this species is mapped within the agricultural grasslands, there are a number of existing threats to the Ornamental Snake. These include heavy weed infestation, presence of introduced fauna species (including cane toads), agricultural grazing and habitat fragmentation (DPM Envirosciences, 2018b).

The other habitat types within the Water Pipeline (including the remaining non-remnant vegetation) are not considered to provide potential habitat for the Ornamental Snake on the basis that they are lacking the cracking clay soils, gilgai habitat and microhabitat features required by this species (DPM Envirosciences, 2018b).

DotE (2014b) states that “important populations [of the Ornamental Snake] occur in remnant vegetation on, or surrounding, gilgai mounds and depressions”.

The draft *Referral Guidelines for the Nationally Listed Brigalow Belt Reptiles* (DSEWPaC, 2011a) define important habitat for the Ornamental Snake as:

- *Habitat where the species has been identified during a survey;*
- *Habitat near the limit of the species known range;*
- *Large patches of continuous, suitable habitat and viable landscape corridors (necessary for the purposes of breeding, dispersal or maintaining the genetic diversity of the species over successive generations); or*
- *A habitat type where the species is identified during a survey, but which was previously thought not to support the species.*

Under this definition, areas of habitat where the Ornamental Snake was found are important habitat for the Ornamental Snake. Given the lack of records within the Water Pipeline area, there are no areas of important habitat for the Ornamental Snake within the Water Pipeline area (DPM Envirosciences, 2018b).

DPM Envirosciences (2018b) considers that the habitat within the Water Pipeline area is also not likely to be critical to the survival of the species given:

- the species is more widely distributed in the region and the habitat is not at a limit of the species range; and
- large areas of potential and important habitat (as demonstrated by Ornamental Snake records) are located in the wider locality and would be avoided by the Project.

It should be noted that preferred, breeding and foraging habitat for this species are typically the same (i.e. very hard to distinguish between the three), and given the Ornamental Snake is highly sedentary dispersal habitat has not been separately assessed.

Impacts

The disturbance footprint for the Water Pipeline is approximately 57 ha. A total of approximately 7 ha of potential habitat for the Ornamental Snake would be cleared for the Water Pipeline (Table 3-26) (DPM Envirosciences, 2018b).

An assessment of significance has been conducted in accordance with the *Matters of National Environmental Significance; Significant Impact Guidelines 1.1* (DotE, 2013b) and is provided in Table 3-27.

Avoidance, Mitigation and/or Management Measures

As described in Section 3.4.9 of this document, the following measures would be undertaken by Pembroke to reduce potential adverse impacts on the Ornamental Snake:

- Vegetation clearance procedures, including pre-clearance surveys to detect the Ornamental Snake within habitat proposed to be cleared.
- Implementation of a Weed and Pest Management Plan to monitor and control feral animals (including feral pigs which can degrade habitat for the Ornamental Snake [DEE, 2018a]) within the Project ETL area and surrounds.

Table 3-26
Vegetation and Habitat Clearance Summary – Water Pipeline

Regional Ecosystem Code	Regional Ecosystem Description	Vegetation Clearance (ha)	Habitat Clearance (ha)				
			Ornamental Snake	Squatter Pigeon (Southern)	Australian Painted Snipe	Koala	Greater Glider
Remnant Vegetation							
11.3.1	Brigalow (*Acacia harpophylla*) and / or belah (*Casuarina cristata*) open forest on alluvial plains.	0.5	0	0	0	0	0
11.3.2	Poplar box (*Eucalyptus populnea*) woodland to open woodland on alluvial plains.	6.0	0	6.0	0	6.0	6.0
11.3.25	Queensland blue gum (*Eucalyptus tereticornis*) or river red gum (*E. camaldulensis*) woodland fringing drainage lines.	1.5	0	1.5	0	1.5	1.5
11.3.27f	Palustrine wetland (e.g. vegetated swamp). Mixed grassland or sedgeland with areas of open water +/- aquatic species.	1	0	0	1	1	1
11.3.4	Queensland blue gum (*Eucalyptus tereticornis*) and / or *Eucalyptus* spp. woodland on alluvial plains	0.5	0	0.5	0	0.5	0.5
11.4.8	Dawson gum (*Eucalyptus cambageana*) woodland to open forest with brigalow or blackwood (*Acacia argyrodendron*) on Cainozoic clay plains.	0.5	0	0	0	0	0
11.4.9	Brigalow (*A. harpophylla*) shrubby woodland to open forest with yellowwood (*Terminalia oblongata*) on Cainozoic clay plains.	1.0	0	0	0	0	0
11.5.3	Poplar box (*E. populnea*) +/- silver-leaved ironbark (*E. melanophloia*) +/- Clarkson's bloodwood (*C. clarksoniana*) woodland on Cainozoic sand plains and / or remnant surfaces.	19.0	0	19.0	0	19.0	19.0
11.5.9	Narrow-leaved ironbark (*E. crebra*) and other Eucalyptus spp. and Corymbia spp. woodland on Cainozoic sand plains and / or remnant surfaces.	0.5	0	0.5	0	0.5	0.5
	Subtotal	30.5	0	27.5	1	27.5	27.5
	Subtotal (Fauna/Flora Assessment)	30.5	7	27.5	1	28.5	28.5
Non-Remnant Vegetation							
-	Agricultural grasslands dominated by buffel grass (*Cenchrus ciliaris*) with gilgai landform	26.5	7	0	0	0	0
	Subtotal	26.5	7	0	0	0	0
	Total Clearance	**57**	**7**	**27.5**	**1**	**28.5**	**28.5**
	Approximate Area of Habitat within 10 km of Project[1]	-	13,300	20,183	152	20,335	20,335

[1] Based on the REs identified as potential habitat on DEE (2018a) from the DSITI (2018) regional mapping available over the area

Table 3-27
Likelihood of Significant Adverse Impact of the Water Pipeline on the Ornamental Snake

Assessment Criteria[1] Is the Action likely to:	Assessment
lead to a long-term decrease in the size of an important population of a species	The Water Pipeline would result in the removal of approximately 7 ha of potential habitat for the species. The small reduction in available habitat is unlikely lead to a localized decrease in the local population, given the lack of records within the Water Pipeline area, the amount of available habitat in the region and the number of records surrounding the site (Figure 3-5c).
reduce the area of occupancy of an important population	The reduction in available habitat associated with the Water Pipeline is not likely to lead to a localized decrease in the area of occupancy of a local population given the lack of records within the Water Pipeline area, the amount of available habitat in the region and the number of records surrounding the site (Figure 3-5c).
fragment an existing important population into two or more populations	The Water Pipeline is not likely to fragment an existing important population into two or more populations due to the location of the existing important populations in the surrounding landscape and the current level of fragmentation (and cleared land between the areas).
adversely affect habitat critical to the survival of a species (e.g. for activities such as foraging, breeding, roosting, or dispersal or habitat listed in a recovery plan)	The habitat within the Water Pipeline is not likely to be critical to the survival of the species given: • the species is more widely distributed in the region and the habitat is not at a limit of the species range; and • large areas of potential and important habitat (as demonstrated by Ornamental Snake records) are located in the wider locality and would be avoided by the Water Pipeline. Given the above, the Water Pipeline is unlikely to adversely impact habitat critical to the survival of this species.
disrupt the breeding cycle of an important population	Given the lack of records within the Water Pipeline area, there are no areas of important habitat for the Ornamental Snake, nor an important population within the Water Pipeline area. As such, the Water Pipeline is not expected to remove any potential breeding and nesting habitat for this species.
modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	The Water Pipeline would result the removal of approximately 7 ha of habitat for this species, however there are no records of the Ornamental Snake within the Water Pipeline area. In addition, due to the amount of available habitat in the locality and the number of records surrounding the Water Pipeline area it is unlikely that this any potential decrease would be significant at a regional scale. In addition, as the majority of the potential habitat for this species is mapped within the agricultural grasslands, there are a number of existing threats to the Ornamental Snake. These include, heavy weed infestation, presence of introduced fauna species (including cane toads); agricultural grazing and sever habitat fragmentation. It is therefore unlikely that the Water Pipeline would result in the decline of the species.
result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat	Weed and feral animal threat levels are unlikely to change significantly due to the Water Pipeline given the current agricultural use of the surrounding area. As outlined above, the majority of the potential habitat for this species is mapped within the agricultural grasslands, there are a number of existing threats to the Ornamental Snake. These include, heavy weed infestation, presence of introduced fauna species (including cane toads); agricultural grazing and sever habitat fragmentation. Through effective pest and weed management, Pembroke's Weed and Pest Management Plan would seek to identify, treat, and propose removal strategies to manage these risks to avoid a significant impact to this species.
introduce disease that may cause the species to decline	The Water Pipeline does not include activities that would result in a disease that may cause the species to decline.
interfere substantially with the recovery of the species.	Although the Water Pipeline would result in the removal of potential habitat for the species, Pembroke would implement mitigation strategies and offsets to assist in minimising impacts to the species. As such, the Water Pipeline would not interfere substantially with the recovery of the species.

Source: DPM Enviros ciences (2018b)

[1] As defined by the *Matters of National Environmental Significance Significant Impact Guidelines 1.1* (DotE, 2013b).

- Bushfire prevention would be undertaken, noting that the Ornamental Snake occurs in Brigalow Woodland and uses groundcover which is susceptible to fire (DEE, 2018a).

A National or State recovery plan has not been prepared for this species. The above measures are predicted to be effective in reducing potential adverse impacts on the Ornamental Snake from the Water Pipeline because they are focused on addressing the recognised threats to the species and are consistent with the relevant threat abatement actions (e.g. avoiding additional habitat loss and reducing the risk of invasive and predatory species in Section 3.4.7.1) (DEE, 2018a).

Summary of EPBC Act Assessment

Four Ornamental Snake were recorded at three locations within the Olive Downs South Domain and a further five locations within the Willunga Domain (Figure 3-5c) but it has not been recorded within the Water Pipeline area.

The Water Pipeline would result in the removal of approximately 7 ha of potential habitat for the species, which is unlikely to result in a significant impact to the Ornamental Snake (DPM Enviros ciences, 2018b). Despite this, the impacts associated with the Project as a whole (including the Water Pipeline area) would be mitigated and offset as described in Sections 3.4.9 and 3.7.

Australian Painted Snipe (Rostratula australis)

The Australian Painted Snipe is listed as 'Endangered' under the EPBC Act.

Background/Description

The Australian Painted Snipe has been recorded at wetlands in all states of Australia (DEE, 2018a). It is most common in eastern Australia, where it has been recorded at scattered locations throughout much of Queensland, NSW, Victoria and south-eastern South Australia. It has been recorded less frequently at a smaller number of more scattered locations farther west in South Australia, the Northern Territory and Western Australia (DEE, 2018a). It has also been recorded on single occasions in south-eastern Tasmania and at Lord Howe Island (DEE, 2018a).

The Australian Painted Snipe may breed in response to wetland conditions rather than during a particular season. It has been recorded breeding in all months in Australia. In southern Australia most records have been from August to February. Eggs have been recorded from mid August to March, with breeding in northern Queensland also recorded between May and October (DEE, 2018a).

Survey Effort

The survey effort for this species is provided in Table 3-5 and Appendix B.

Habitat Assessment and Definition

The Australian Painted Snipe generally inhabits shallow terrestrial freshwater wetlands, including temporary and permanent lakes, swamps and claypans. They also use inundated or waterlogged grassland or saltmarsh, dams, rice crops, sewage farms and bore drains. Typical sites include those with rank emergent tussocks of grass, sedges, rushes or reeds, or samphire (DEE 2018).

A single Australian Painted Snipe was observed during the field surveys in a small wetted gilgai within the Agricultural grasslands habitat type in the Willunga Domain (Figure 2-2). Additional records for this species existing within the wider locality and are all located along waterways, with the closest being approximately 2.5 km south of the Project Water Pipeline (DPM Enviros ciences, 2018b).

In the Study area all areas of wetlands (lacustrine or palustrine) are considered potential habitat for this species (Figure 3-31a) (DPM Enviros ciences, 2018b). Although the species was observed in wetted gilgai habitat, this habitat is only suitable for a short period after rainfall when the gilgai are full. It is not considered optimal or primary habitat.

The Water Pipeline area does not support an isolated population, is not on the edge of the species' range, and has not been identified as an area supporting a high density of birds or a high density of particularly high-quality habitat (DPM Enviros ciences, 2018b).

It should be noted that preferred, breeding and foraging habitat for this species are typically the same (i.e. very hard to distinguish between the three) and, as such, have not been separately assessed. Further to this, given the highly mobile nature of this species dispersal habitat would not necessarily be limited to areas of suitable habitat (i.e. it is known to disperse over cleared land to reach areas of suitable habitat).

Impacts

The disturbance footprint for the Water Pipeline is approximately 57 ha. A total of approximately 1 ha of potential habitat for the Australian Painted Snipe would be cleared for the Water Pipeline (Table 3-26) (DPM Enviros ciences, 2018b). An assessment of significance has been conducted in accordance with the *Matters of National Environmental Significance; Significant Impact Guidelines 1.1* (DotE, 2013b) and is provided in Table 3-28.

Table 3-28
Likelihood of Significant Adverse Impact of the Water Pipeline on the Australian Painted Snipe

Assessment Criteria[1] Is the Action likely to:	Assessment
lead to a long-term decrease in the size of a population of a species	This species has not been recorded within the Water Pipeline area. A single individual Australian Painted Snipe was observed within gilgai habitats at the Willunga Domain. DPM Envirosciences (2018b) concluded that this species may use the wetted habitats within the Water Pipeline area occasional foraging, however it is unlikely that the habitat would be necessary to sustain a population.. The Water Pipeline is therefore unlikely to lead to a long-term decrease in the size of the species population.
reduce the area of occupancy of the species	Given the lack of records within the Water Pipeline area, only a single individual was recorded within the Mine Site and Access Road area, and the species is known to occur widely throughout the rest of Qld and the rest of Australia (ALA, 2018), it is unlikely that the Water Pipeline would reduce the area of occupancy of the species relative to its range.
fragment an existing population into two or more populations	This species is widespread throughout Qld and the rest of Australia (ALA, 2018) and is a highly mobile species. Given this, it is unlikely that a population of this species would be fragmented into two or more populations.
adversely affect habitat critical to the survival of a species (e.g. for activities such as foraging, breeding, roosting, or dispersal or habitat listed in a recovery plan)	No critical habitat for the species has been identified in any recovery plans or listed on the EPBC Act *Register of Critical Habitat* maintained by the Minister of the Environment under the EPBC Act (DEE, 2018b). Given the species was not recorded within the Water Pipeline area (despite repeat attempts to locate the species), it is unlikely that the Water Pipeline area supports a population of this species. The habitat in the Water Pipeline area for the Australian Painted Snipe is not deemed to meet the definition of 'critical habitat' under the EPBC Act due to the heavily fragmented nature of the habitat which is more widespread in the wider landscape. The Water Pipeline is not at a limit of the species range and the Australian Painted Snipe is known to occur more widely outside the Water Pipeline area given the extent of database records (Figure 3-5a).
disrupt the breeding cycle of a population	The Water Pipeline area does not offer any unique or particularly high quality habitat resources required by the Australian Painted Snipe. Similar or better habitat would remain in the Water Pipeline locality. The species is known to breed throughout the year, hence the Water Pipeline is unlikely to disrupt the breeding cycle of this species.
modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	The Water Pipeline would remove approximately 1 ha of habitat for this species. The loss of potential habitat for this species would not isolate remaining habitat from other patches and it is unlikely that the Water Pipeline would significantly reduce the area of habitat occupied by the species relative to its regional distribution. It is therefore unlikely that the Water Pipeline would result in the decline of the species.
result in invasive species that are harmful to a critically endangered or endangered species becoming established in the endangered or critically endangered species' habitat	The existing weed and feral animal threat are unlikely to change significantly due to the Water Pipeline given the current agricultural use of the surrounding area and implementation of mitigation and management measure proposed to be implemented by Pembroke. Predation by foxes and feral cats has been suggested as a threat to the Australian Painted Snipe (DEE, 2018a). However, through effective pest and weed management, Pembroke would seek to identify, treat and propose removal strategies to manage this threat through the implementation of a Weed and Pest Management Plan.
introduce disease that may cause the species to decline	The Water Pipeline does not include activities that would result in a disease that may cause the species to decline.
interfere substantially with the recovery of the species.	The Water Pipeline would not interfere substantially with the recovery of the species because habitat resources for the Australia Painted Snipe (e.g. wetlands) would remain outside of the Water Pipeline area, such that the species is likely to persist in the landscape.

Source: DPM Envirosciences (2018b).

[1] As defined by the *Matters of National Environmental Significance Significant Impact Guidelines 1.1* (DotE, 2013b).

Avoidance, Mitigation and/or Management Measures

As described in Section 3.4.9 of this document, the following measures would be undertaken by Pembroke to reduce potential adverse impacts on the Australian Painted Snipe:

- Vegetation clearance procedures, including demarcation of clearing zones to protect the habitat to be retained.
- Implementation of a Weed and Pest Management Plan to monitor and control feral animals (including foxes and feral cats) within the Water Pipeline and surrounds.

The above measures are predicted to be effective in reducing potential adverse impacts from the Water Pipeline on the Australian Painted Snipe because they are focused on addressing the recognised threats to the species identified in the *Approved Conservation Advice for Rostratula australis Australian Painted Snipe* (DSEWPC, 2013) and are consistent with the relevant threat abatement actions (e.g. avoiding additional habitat loss and controlling feral animals) (after DotE, 2014b).

Summary of EPBC Act Assessment

This species has not been located within the Water Pipeline area, however it was located in gilgai habitat within the Mine Site and Access Road area (DPM Enviros ciences, 2018b). In addition, the species has previously been recorded approximately 2.5 km south of the Water Pipeline area.

There is no evidence of a population in the Water Pipeline area, however there is evidence of occasional foraging within the surrounding landscape and there are many examples of similar wetland habitats outside the Water Pipeline area (DPM Enviros ciences, 2018b). The Water Pipeline would result in the removal of potential habitat for the species, however, given the reasons outlined above, it is unlikely that a significant impact to the Australian Painted Snipe would result from the Water Pipeline (DPM Enviros ciences, 2018b).

Squatter Pigeon (southern) (Geophaps scripta scripta)

The Squatter Pigeon (southern) is listed as 'Vulnerable' under the EPBC Act.

Background/Description

The Squatter Pigeon (southern) has a known distribution extending from the Burdekin-Lynd divide in Central Qld, west to Barcaldine, Longreach and Charleville, east to the coastline between Townsville and Port Curtis (near Gladstone), south to scattered sites throughout south-eastern Qld and the Border Rivers region of northern NSW (DEE, 2018a). The species does not appear to be undergoing a population decline (DEE, 2018a). The Squatter Pigeon (southern) is locally nomadic or sedentary (DEE, 2018a).

Natural foraging habitat for the Squatter Pigeon (southern) comprises any remnant or regrowth open-forest to sparse, open-woodland or scrub dominated by *Eucalyptus*, *Corymbia*, *Acacia* or *Callitris* species, on sandy or gravelly soils, within 3 km of a suitable, permanent or seasonal waterbody (DEE, 2018a).

This species feeds and nests on the ground but roosts in trees. The Squatter Pigeon (southern) withstands habitats with some grazing pressure but is more common in habitat without grazing and no longer occurs in areas with intense grazing (DEE, 2018a).

Survey Effort

The survey effort for this species is provided in Table 3-5 and Appendix B.

Habitat Assessment and Definition

The Squatter Pigeon (southern) has a large distribution extending from the Burdekin-Lynd divide in Central Queensland, west to Charleville and Longreach, east to the coastline between Proserpine and Port Curtis (near Gladstone) and south to a number of scattered sites throughout south-eastern Queensland (DEE, 2018). All of the relatively small isolated and sparsely distributed sub-populations occurring south of the Carnarvon Ranges in Central Queensland are considered to be important subpopulations of the subspecies (DEE, 2018).

The Squatter Pigeon (southern) was identified on ten occasions within Eucalypt dry woodlands on inland depositional plains in the Study area (Figure 3-5a). This includes three locations within the Willunga domain and a further five locations within the Olive Downs Domain, however it was not recorded within the Water Pipeline area (DPM Enviros ciences, 2018b). Further to this, the Squatter Pigeon (southern) has been recorded on numerous occasions within 10 km of the Study area (Figure 3-5a).

The Squatter Pigeon (southern) occurs mainly in grassy woodlands and open forests that are dominated by eucalypts (DEE, 2018). In the Water Pipeline area, all areas of Eucalypt dry woodlands on inland depositional plains and Eucalypt open forests to woodlands on floodplains are considered potential habitat for this species (Figure 3-31a) (DPM Envirosciences, 2018b).

Other broad habitat types in the Water Pipeline area were not considered potential habitat because they do not support the grassy understorey with a high density of native grasses necessary to provide a food resource for the species (DPM Envirosciences, 2018b).

It should be noted that preferred, breeding and foraging habitat for this species are typically the same (i.e. very hard to distinguish between the three) and, as such, have not been separately assessed. Further to this, given the highly mobile nature of this species dispersal habitat would not necessarily be limited to areas of suitable habitat (i.e. it is known to disperse over cleared land to reach areas of suitable habitat).

Impacts

The disturbance footprint for the Water Pipeline is approximately 57 ha. A total of approximately 27.5 ha of potential habitat for the Squatter Pigeon (southern) would be cleared for the Water Pipeline (Table 3-26) (DPM Envirosciences, 2018b). An assessment of significance has been conducted in accordance with the *Matters of National Environmental Significance; Significant Impact Guidelines 1.1* (DotE, 2013b) and is provided in Table 3-29.

Avoidance, Mitigation and/or Management Measures

As described in Section 3.4.9 of this document, the following measures would be undertaken by Pembroke to reduce potential adverse impacts on the Squatter Pigeon (southern):

- Impact avoidance measures outlined in the table in Section 3.4.9 (since the Squatter Pigeon [southern] was recorded across a variety of habitats).
- Vegetation clearance procedures, including progressive vegetation clearing.
- A Weed and Pest Management Plan would be implemented to monitor and control feral animals (such as the European Rabbit, Feral Cat and European Red Fox) in the Water Pipeline area.

The above measures are predicted to be effective in reducing potential adverse impacts on the Squatter Pigeon (southern) from the Water Pipeline because they are focused on addressing the recognised threats to the species and are consistent with the relevant threat abatement actions (e.g. avoiding additional habitat loss and controlling predators and herbivores) (DEE, 2018a). A National or State recovery plan has not been prepared for this species.

Summary of EPBC Act Assessment

Several individuals were observed in Eucalypt dry woodlands on inland depositional plains within the Water Pipeline locality (Figure 3-5). It is unlikely that a significant impact to the Squatter Pigeon (southern) would result from the Water Pipeline, given the species has not been recorded within the Water Pipeline area, habitat is of sub-optimal quality, and the availability of surrounding habitat indicates that it is not of particular regional importance to the species (DPM Envirosciences, 2018b).

The Water Pipeline would result in the removal of approximately 27.5 ha of potential habitat for the species, which is unlikely to result in a significant impact to the Squatter Pigeon (southern) (DPM Envirosciences, 2018b). Despite this, the impacts associated with the Project as a whole (including the Water Pipeline area) would be mitigated and offset as described in Sections 3.5.9 and 3.7.

Koala (Phascolarctos cinereus)

The EPBC Act listed 'Vulnerable' Koala is the combined populations of Qld, NSW and the ACT.

Background/Description

The Koala is endemic to Australia. The biological species is currently widespread in coastal and inland areas, with a range that extends over 22° of latitude and 18° of longitude, or about one million square kilometres (DEE, 2018a). The occurrence of animals throughout this distribution is not continuous and is defined by environmental variables (DEE, 2018a).

The life history and habitat of the Koala has been well studied (DEE, 2018a). In late 2013, the DotE released the *Draft EPBC Act Referral Guidelines for the Vulnerable Koala (Combined Populations of Queensland, New South Wales and the Australian Capital Territory)* (EPBC Act Referral Guidelines for the Koala) (DotE, 2013b).

Table 3-29
Likelihood of Significant Adverse Impact of the Water Pipeline on the Squatter Pigeon (southern)

Assessment Criteria[1] Is the Action likely to:	Assessment
lead to a long-term decrease in the size of an important population of a species	The Squatter Pigeon (southern) is commonly recorded in fragmented landscapes in the Brigalow Belt South Bioregion. The population of Squatter Pigeon (southern) in the Water Pipeline locality is likely to occur more widely in the Isaac River catchment given the extent of database records and habitat in locality (Figure 3-5a). In addition, as the Water Pipeilne area is north of the Carnarvon Ranges and habitat is classified as sub-optimal, the Water Pipeilne is not considered to contain an important population of this species. As such, the Water Pipeilne is unlikely to lead to a long-term decrease in the size of the species population.
reduce the area of occupancy of an important population	Given the abundance of this species and the availability of surrounding potential habitat it is unlikely that the Water Pipeline would significantly reduce the area of occupancy of the species relative to its range.
fragment an existing important population into two or more populations	Given the abundance of this species in the surrounding locality, lack of identified important populations, the availability of surrounding potential habitat, and existing level of habitat fragmentation in the Water Pipeline locality, it is unlikely that the Water Pipeline would fragment an existing important population into two or more populations.
adversely affect habitat critical to the survival of a species (e.g. for activities such as foraging, breeding, roosting, or dispersal or habitat listed in a recovery plan)	No habitat within the Water Pipeline locality has been identified as critical habitat for the Squatter Pigeon (southern) in any recovery plans or listed on the EPBC Act *Register of Critical Habitat* maintained by the Minister of the Environment under the EPBC Act (DEE, 2018b). The habitat in the Water Pipeline area for the Squatter Pigeon (southern) is not deemed to meet the definition of 'critical habitat' under the EPBC Act due to the heavily fragmented nature of the habitat which is more widespread in the wider landscape. The Water Pipeline is not at a limit of the species range and the population of Squatter Pigeon (southern) in the Water Pipeline locality is likely to occur more widely outside the Water Pipeline area given the extent of database records and habitat (Figure 3-5a).
disrupt the breeding cycle of an important population	The Water Pipeline area does not offer any unique or particularly high quality habitat resources required by the Squatter Pigeon (southern). Similar or better habitat would remain in the Water Pipeline locality. The species is known to breed throughout the year, hence the Water Pipeline is unlikely to disrupt the breeding cycle of this species.
modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	The Water Pipeline would remove approximately 27.5 ha of habitat for this species. The Water Pipeline would result in the loss of potential habitat that is of sub-optimal quality (due to high occurrence of Buffel Grass). The loss of this habitat would not isolate remaining habitat from other patches of habitat and it is unlikely that the Water Pipeline would significantly reduce the area of habitat occupied by the species relative to its regional distribution. It is therefore unlikely that the Water Pipeline would result in the decline of the species.
result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat	The introduction and spread of invasive weeds and feral animals may occur as a result of the clearance associated with the Water Pipeline. However, threat levels are unlikely to change significantly due to the Water Pipeline given the current agricultural use of the surrounding area and implementation of mitigation and management measure proposed to be implemented by Pembroke. Reduction of food resources and cover from the establishment and maintenance of Buffel Grass pastures have been identified as a threat to the Squatter Pigeon (southern) (DEE, 2018a). Along with excessive predation by foxes and feral cats, this often increases in response to disturbance (DEE, 2018a). However, through effective pest, weed and introduced pasture grass management, Pembroke would seek to identify, treat, and propose removal strategies to manage this threat through the implementation of a Weed and Pest Management Plan.
introduce disease that may cause the species to decline	The Water Pipeline does not include activities that would result in a disease that may cause the species to decline.
interfere substantially with the recovery of the species.	The Water Pipeline would not interfere substantially with the recovery of the species because habitat resources for the Squatter Pigeon (southern) (e.g. drinking sources, remnant and regrowth vegetation for foraging/roosting and nesting habitat) would remain outside of the Water Pipeline area, such that the species is likely to persist in the landscape.

Source: DPM Enviroscienes (2018b).

[1] As defined by the *Matters of National Environmental Significance Significant Impact Guidelines 1.1* (DotE, 2013b).

The EPBC Act Referral Guidelines for the Koala provides a habitat assessment tool for determining habitat critical to the survival of the Koala and the likelihood of a significant impact on this species.

Survey Effort

The survey effort for this species is provided in Table 3-5 and Appendix B.

Habitat Assessment and Definition

The Koala has one of the largest distributions of any terrestrial threatened species listed under the EPBC Act (DotE, 2014). It occupies a variety of vegetation types across this large distribution, is capable of moving long distances and is variably affected by a range of threats (DEE 2018). Koala habitat is defined by the vegetation community present and the vegetation structure; Koalas do not necessarily have to be present (DotE, 2014). Any forest or woodland containing species that are known Koala food trees, or shrubland with emergent food trees can be considered as 'potential Koala habitat' (DEE, 2018). This can include remnant and non-remnant vegetation in natural, agricultural, urban and peri-urban environments. Koala food trees can generally be considered to be those of the genus Angophora, Corymbia, Eucalyptus, Lophostemon and Melaleuca (DEE, 2018).

Within the Study area, the Koala was recorded on numerous occasions along the Isaac River and associate tributaries, including along the Water Pipeline area (Figure 3-5b) (DPM Enviros ciences, 2018b). Recordings included direct observation and identification of scats and scratches within Eucalypt dry woodlands on inland depositional plains, Eucalypt open forest to woodlands on floodplains, and around wetlands (DPM Enviros ciences, 2018b).

Within the Study area potential Koala habitat is located within the areas mapped as eucalypt open forests to woodlands on floodplains, eucalypt dry woodlands on inland depositional plains and the vegetation surrounding and within the lacustrine and palustrine wetlands (Figure 3-31c). The potential habitat connections along the waterways (primarily the Isaac River and Ripstone Creek) provide movement corridors and refuge habitat for this species in an otherwise cleared and generally unsuitable landscape (DPM Enviros ciences, 2018b).

Those areas of non-remnant vegetation in the Study area are included in the 'Agricultural Grasslands' habitat type, which does not contain an adequate density of Koala trees (Eucalyptus spp. Corymbia spp. Lophostemon spp. or Melaleuca spp. that are > 4 m in height and > 10 cm DBH) to support the species.

Other habitat types, such as 'Other coastal communities and heath' and 'Acacia dominated open forests, woodlands and shrublands', also do not contain an adequate density of Koala trees to support the species (DPM Enviros ciences, 2018b).

It should be noted that preferred, breeding and foraging habitat for this species are typically the same (i.e. very hard to distinguish between the three) and, as such, have not been separately assessed. Further to this, given the highly mobile nature of this species dispersal habitat would not necessarily be limited to areas of suitable habitat (i.e. it is known to disperse over cleared land to reach areas of suitable habitat).

Impacts

The disturbance footprint for the Water Pipeline is approximately 57 ha. A total of approximately 28.5 ha of potential habitat for the Koala would be cleared for the Water Pipeline (Table 3-26) (DPM Enviros ciences, 2018b). An assessment of significance has been conducted in accordance with the *Matters of National Environmental Significance; Significant Impact Guidelines 1.1* (DotE, 2013b) and is provided in Table 3-30.

Avoidance, Mitigation and/or Management Measures

As described in Section 3.4.9 of this document, the following measures would be undertaken by Pembroke to reduce potential adverse impacts on the Koala:

- Impact avoidance measures outlined in the table in Section 3.4.9 (including minimising potential impacts to the riparian corridor associated with the Isaac River).
- Vegetation clearance procedures, including progressive vegetation clearing and retention of hollow-bearing trees where possible.
- A Weed and Pest Management Plan would be implemented to monitor and control feral animals (such as the Feral dog) in the Water Pipeline area.

The above measures are predicted to be effective in reducing potential adverse impacts on the Koala from the Water Pipeline because they are focused on addressing the recognised threats to the species and are consistent with the relevant threat abatement actions (e.g. avoiding additional habitat loss and controlling predators) (DEE, 2018a). A National or State recovery plan has not been prepared for this species.

Table 3-30
Likelihood of Significant Adverse Impact of the Water Pipeline on the Koala

Assessment Criteria[1] Is the Action likely to:	Assessment
lead to a long-term decrease in the size of an important population of a species	The Koala population that has been identified in the Water Pipeline locality is likely to occur more widely in the surrounding locality and the availability of potential habitat surrounding the Water Pipeline area extends along the Isaac River and its associated tributaries. The Water Pipeline would not involve any crossings of the Isaac River and the disturbance would be limited to a 20 m corridor which has been co-located with the Rail Spur and Loop. As such, it is unlikely that the Water Pipeline would result in a long-term decrease in the size of in an important population.
reduce the area of occupancy of an important population	Given the abundance of this species (ALA 2018) and the availability of surrounding potential habitat that is of similar or better quality (particularly along the Isaac River), it is unlikely that the Water Pipeline would significantly reduce the area of occupancy of the species relative to its distribution.
fragment an existing important population into two or more populations	Due to the abundance of the species and availability of surrounding habitat, and existing level of habitat fragmentation in the Water Pipeline locality, it is unlikely that the Water Pipeline would result in fragmentation of the population into two or more populations. Where possible, riparian vegetation along the Isaac River has been avoided within the mine design in aid of reducing population fragmentation and facilitating movement of this species.
adversely affect habitat critical to the survival of a species (e.g. for activities such as foraging, breeding, roosting, or dispersal or habitat listed in a recovery plan)	The Koala Referral Guidelines (DotE, 2014a) contain a habitat assessment tool for identifying critical habitat. Impact areas that score five or more using the habitat assessment tool for the Koala contain habitat critical to the survival of the Koala. The assessment was completed over the potential habitat in the Water Pipeline area. The Water Pipeline would remove habitat which meets the definition of 'Critical Habitat' for the Koala as defined in the *EPBC Act referral guidelines for the vulnerable Koala (combined Qld, New South Wales and the Australian Capital Territory)* (DotE, 2014a).
disrupt the breeding cycle of an important population	Given the Water Pipeline would largely avoid disturbance to the better quality riparian vegetation along the Isaac River where the majority of Koala records exist (Figure 3-5b), it is unlikely that the Water Pipeline would disrupt the breeding cycle of an important population.
modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	The Water Pipeline would remove approximately 28.5 ha of habitat for this species. It is possible that the local population may suffer a small reduction in numbers, however, by avoiding disturbance to the better quality riparian habitat along the Isaac River is unlikely that, at a regional level, the species would decline.
result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat	The introduction and spread of invasive weeds and feral animals may occur as a result of the clearance associated with the Water Pipeline. However, threat levels are unlikely to change significantly due to the Water Pipeline given the current agricultural use of the surrounding area and implementation of mitigation and management measure proposed to be implemented by Pembroke. Feral dogs have been identified as posing a direct threat to the Koala. However, through effective pest and weed introduced pasture management Pembroke would seek to identify, treat and propose removal strategies through the implementation of a Weed and Pest Management Plan.
introduce disease that may cause the species to decline	Koala populations are threatened by at least two diseases: chlamydia and Koala retrovirus (KoRV). KoRV is estimated to infect up to 100% of Koalas in Queensland, with infection rates slightly lower in southern populations (DEE, 2018a). It is likely that both these diseases already occur in the populations found on and around the Water Pipeline area. The Water Pipeline does not include activities that would result in the spread of a disease that may cause the species to decline.

Table 3-30 (Continued)
Likelihood of Significant Adverse Impact of the Water Pipeline on the Koala

Assessment Criteria1 *Is the Action likely to:*	Assessment
interfere substantially with the recovery of the species.	Impacts which are likely to substantially interfere with the recovery of the Koala (DotE, 2014a) may include: • Increasing Koala fatalities due to dog attacks. • Increasing Koala fatalities due to vehicle-strikes. • Facilitating the introduction or spread of disease or pathogens for example Chlamydia or *Phytophthora cinnamomi* that are likely to significantly reduce the reproductive output of Koalas or reduce the carrying capacity. • Creating a barrier to movement to, between or within habitat for the Koala that is likely to result in a long-term reduction in genetic fitness. • Changing hydrology which degrades habitat for the Koala to the extent that the carrying capacity of the habitat is reduced. The Water Pipeline is unlikely to result in these impacts in consideration of the mitigation measure proposed to be implemented (Section 3.4.9), including the retention of the majority of the Isaac River corridor. As such, the Water Pipeline would not interfere substantially with the recovery of the species

Source: DPM Enviroscienses (2018b).

[1] As defined by the *Matters of National Environmental Significance Significant Impact Guidelines 1.1* (DotE, 2013b).

Summary of EPBC Act Assessment

This species was recorded during the field surveys within the Water Pipeline area (Figure 3-5b). The Water Pipeline would result in the removal of approximately 28.5 ha of potential habitat (including areas of critical habitat as defined by as defined in the *EPBC Act referral guidelines for the vulnerable Koala (combined Qld, New South Wales and the Australian Capital Territory)* (DotE, 2014) for the species, which would be mitigated and offset as described in Sections 3.4.9 and 3.7.

Greater Glider (Petauroides volans)

The Greater Glider is listed as 'Vulnerable' under the EPBC Act.

Background/Description

The Greater Glider is restricted to eastern Australia, occurring from the Windsor Tableland in north Queensland through to central Victoria (Wombat State Forest), with an elevational range from sea level to 1,200 m above sea level. An isolated inland subpopulation occurs in the Gregory Range west of Townsville, and another in the Einasleigh Uplands (DEE, 2018a).

The Greater Glider is an arboreal nocturnal marsupial, largely restricted to eucalypt forests and woodlands. It is primarily folivorous, with a diet mostly comprising eucalypt leaves, and occasionally flowers (DEE, 2018a). It is typically found in highest abundance in taller, montane, moist eucalypt forests with relatively old trees and abundant hollows (DEE, 2018a). The distribution may be patchy even in suitable habitat (DEE, 2018a). The Greater Glider favours forests with a diversity of eucalypt species, due to seasonal variation in its preferred tree species (DEE, 2018a).

Survey Effort

The survey effort for this species is provided in Table 3-5 and Appendix B.

Habitat Assessment and Definition

The Greater Glider is largely restricted to eucalypt forests and woodlands. It is typically found in higher abundance in taller, montane, moist eucalypt forests with relatively old trees and abundant hollows (TSSC, 2016). The distribution may be patchy even in suitable habitat. The Greater Glider favours forests with a diversity of eucalypt species, due to seasonal variation in its preferred tree species (TSSC, 2016).

Within the Study area, the Greater Glider was recorded on numerous occasions along the Isaac River and associate tributaries, including within the Water Pipeline area (Figure 3-5b). Recordings included direct observation and identification of scats within Eucalypt dry woodlands on inland depositional plains and Eucalypt open forest to woodlands on floodplains (DPM Enviroscienses, 2018b).

In the Study area all areas of eucalypt open forests to woodlands on floodplains and eucalypt dry woodlands on inland depositional plains are considered potential habitat (Figure 3-31c).

The potential habitat connections along the waterways (primarily the Isaac River and Ripstone Creek) provide movement corridors and refuge habitat for this species in an otherwise cleared and generally unsuitable landscape (DPM Envirosciences, 2018b).

Other habitat types within the Study area (including the 'Agricultural Grasslands' habitat type) are not considered suitable for the species because they lack a high density of large mature eucalypts, which are important for foraging and denning (DPM Envirosciences, 2018b).

It should be noted that preferred, breeding and foraging habitat for this species are typically the same (i.e. very hard to distinguish between the three) and, as such, have not been separately assessed. Further to this, given the highly mobile nature of this species dispersal habitat would not necessarily be limited to areas of suitable habitat (i.e. it is known to disperse over cleared land to reach areas of suitable habitat).

Impacts

The disturbance footprint for the Water Pipeline is approximately 57 ha. A total of approximately 28.5 ha of potential habitat for the Greater Glider would be cleared for the Water Pipeline (Table 3-26) (DPM Envirosciences, 2018b). An assessment of significance has been conducted in accordance with the *Matters of National Environmental Significance; Significant Impact Guidelines 1.1* (DotE, 2013b) and is provided in Table 3-31.

Avoidance, Mitigation and/or Management Measures

As described in Section 3.4.9 of this document, the following measures would be undertaken by Pembroke to reduce potential adverse impacts on the Greater Glider:

- Impact avoidance measures outlined in the table in Section 3.4.9 (including minimising potential impacts to the riparian corridor associated with the Isaac River).
- Vegetation clearance procedures, including progressive vegetation clearing and retention of hollow-bearing trees where possible.
- A Weed and Pest Management Plan would be implemented to monitor and control pests and feral animals in the Water Pipeline area.

The above measures are predicted to be effective in reducing potential adverse impacts on the Greater Glider from the Water Pipeline because they are focused on addressing the recognised threats to the species and are consistent with the relevant threat abatement actions (e.g. avoiding additional habitat loss and controlling predators) (DEE, 2018a). A National or State recovery plan has not been prepared for this species.

Summary of EPBC Act Assessment

This species was recorded during the field surveys within the Water Pipeline area, however records were heavily concentrated around the Isaac River (Figure 3-5b). The Water Pipeline would result in the removal of approximately 28.5 ha of potential habitat for the species, which is unlikely to result in a significant impact to the Greater Glider (DPM Envirosciences, 2018b). Despite this, the impacts associated with the Project as a whole (including the Water Pipeline area) would be mitigated and offset as described in Sections 3.4.9 and 3.7.

Other Threatened Species

Other threatened species identified within the Terms of Reference or within a search area covering the wider locality include:

- Red Goshawk (*Erythrotriorchis radiatus*)*;*
- Curlew Sandpiper (*Calidris ferruginea*)*;*
- Painted Honeyeater (*Grantiella picta*)*;*
- Star Finch (eastern) (*Neochmia ruficauda ruficauda*)*;*
- Black-throated Finch (southern) (*Poephila cincta cincta*)*;*
- Northern Quoll (*Dasyurus hallucatus*)*;*
- Grey-headed Flying-fox (*Pteropus poliocephalus*)*;*
- Ghost Bat (*Macroderma gigas*)*;*
- Corben's Long-eared Bat (*Nyctophilus corbeni);*
- Southern Snapping Turtle (*Elseya albagula*)*;*
- Fitzroy River Turtle (*Rheodytes leukops*)*;*
- Yakka Skink (*Egernia rugosa*);
- Allan's Lerista (*Lerista allanae*)*;*
- Dunmall's Snake (*Furina dunmalli*)*;*
- *Cycas ophiolitica;*
- King Blue-grass *(Dichanthium queenslandicum);*
- Bluegrass (*Dichanthium setosum*)*;*
- Black Ironbox (*Eucalyptus raveretiana*)*; and*
- Quassia (*Samadera bidwillii*)*.*

Table 3-31
Likelihood of Significant Adverse Impact of the Water Pipeline on the Greater Glider

Assessment Criteria[1] Is the Action likely to:	Assessment
lead to a long-term decrease in the size of an important population of a species	The Greater Glider population that has been identified in the Water Pipeline locality is likely to occur more widely in the surrounding locality and the availability of potential habitat surrounding the Water Pipeline area extends along the Isaac River and its associated tributaries. The Water Pipeline would not involve any crossings of the Isaac River and the disturbance would be limited to a 20 m corridor which has been co-located with the Rail Spur and Loop. As such, it is unlikely that the Water Pipeline would result in a long-term decrease in the size of in an important population.
reduce the area of occupancy of an important population	Given the abundance of this species (ALA 2018) and the availability of surrounding potential habitat that is of similar or better quality (particularly along the Isaac River), it is unlikely that the Water Pipeline would significantly reduce the area of occupancy of the species relative to its distribution.
fragment an existing important population into two or more populations	Due to the abundance of the species and availability of surrounding habitat, and existing level of habitat fragmentation in the Water Pipeline locality, it is unlikely that the Water Pipeline would result in fragmentation of the population into two or more populations. Where possible, riparian vegetation along the Isaac River has been avoided within the mine design in aid of reducing population fragmentation and facilitating movement of this species.
adversely affect habitat critical to the survival of a species (e.g. for activities such as foraging, breeding, roosting, or dispersal or habitat listed in a recovery plan)	No habitat within the Water Pipeline locality has been identified as important or critical habitat for the Greater Glider in any recovery plans or listed on the EPBC Act *Register of Critical Habitat* maintained by the Minister of the Environment under the EPBC Act (DEE, 2018b). The habitat in the Water Pipeline area for the Greater Glider is not deemed to meet the definition of 'important habitat' or 'critical habitat' under the EPBC Act due to the heavily fragmented nature of the habitat which is more widespread in the wider landscape. The Water Pipeline is not at a limit of the species range and the population of Greater Glider in the Water Pipeline locality is likely to occur more widely given the extent of database records and habitat (Figure 3-5b).
disrupt the breeding cycle of an important population	Given the Water Pipeline would avoid disturbance to the better quality riparian vegetation along the Isaac River where the majority of Greater Glider records exist (Figure 3-5b), it is unlikely that the Water Pipeline would disrupt the breeding cycle of an important population.
modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	The Water Pipeline would remove approximately 28.5 ha of habitat for this species. It is possible that the local population may suffer a small reduction in numbers, however, by minimising disturbance to the better quality riparian habitat along the Isaac River is unlikely that, at a regional level, the species would decline.
result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat	The introduction and spread of invasive weeds and feral animals may occur as a result of the clearance associated with the Water Pipeline. However, threat levels are unlikely to change significantly due to the Water Pipeline given the current agricultural use of the surrounding area and implementation of mitigation and management measure proposed to be implemented by Pembroke. No particular weeds or feral animals have been implicated as a threat to the species. However, threat levels would be managed by Pembroke through effective pest and weed introduced pasture management Pembroke would seek to identify, treat and propose removal strategies through the implementation of a Weed and Pest Management Plan.
introduce disease that may cause the species to decline	The Water Pipeline does not include activities that would result in a disease that may cause the species to decline.
interfere substantially with the recovery of the species.	A recovery plan has not yet been developed for the Greater Glider. Due to the preservation of the majority of the Isaac River riparian corridor, the Water Pipeline is unlikely to interfere with any of the actions listed for the recovery of the species.

Source: DPM Enviros ciences (2018b).

[1] As defined by the *Matters of National Environmental Significance Significant Impact Guidelines 1.1* (DotE, 2013b).

Potential adverse impacts on the threatened species listed above have been assessed in Table 3-32. None of these species were found despite targeted surveys (Section 3.2.4.3), but they are considered in this section due to the potential for the species to be present in the Water Pipeline and/or adjacent habitats (irrespective of whether the species were detected during targeted surveys) (DPM Envirosciences, 2018b).

Of these, only the Red Goshawk, King Blue-grass, Bluegrass and Black Ironbox are considered to have potential to occur within the Water Pipeline area based on the presence of suitable habitats and previous records
(DPM Envirosciences, 2018b).

In summary, it is concluded that the Water Pipeline is unlikely to significantly impact any of these species in accordance with the significant impact criteria detailed in the *Significant Impact Guidelines 1.1: Matters of National Environmental Significance* (DotE, 2013b) (DPM Envirosciences, 2018b)

3.4.7.2 Threatened Ecological Communities

The *Brigalow (Acacia harpophylla dominant and co-dominant) ecological community* (Brigalow TEC), was identified within the Study area
(DPM Envirosciences, 2018a). Brigalow TEC within the Study area comprises only those patches of vegetation that meet the condition thresholds identified in DotE (2013a).

No other TEC listed under the EPBC Act was recorded within the Study area
(DPM Envirosciences, 2018a).

Brigalow (Acacia harpophylla dominant and co-dominant) ecological community

Sixteen potential TEC vegetation patches were assessed for floristic values as part of the field surveys in November 2016. This included one Tertiary flora survey site in RE 11.3.1, three Quaternary flora survey sites in RE 11.3.1, six in RE 11.4.8 and six in RE 11.4.9 (DPM Envirosciences, 2018a). Most patches failed to meet the Brigalow TEC condition thresholds, owing primarily to groundcover being dominated by exotic species including Buffel Grass (*Cenchrus ciliaris*)
(DPM Envirosciences, 2018a).

Patches of regrowth vegetation within the Study area were also assessed to determine whether they meet the criteria to be mapped as Brigalow TEC (DotE, 2013a).

No patches of regrowth vegetation were determined to meet these criteria as the trees were too small to have been more than 15 years old and the understory vegetation was dominated by weeds (i.e. Buffel Grass) (DPM Envirosciences, 2018a).

The Water Pipeline would avoid all patches of Brigalow TEC that have been mapped within the Study area (Figure 3-3). In addition, Water Pipeline would not result in any indirect impacts to the small patch of Brigalow TEC mapped to the south of the construction corridor
(DPM Envirosciences, 2018a).

As such, it is concluded that the Water Pipeline would not result in a significant impact to Brigalow TEC (DPM Envirosciences, 2018a).

3.4.8 Impact Avoidance, Mitigation Measures and Management Plans

3.4.8.1 Impact Avoidance Measures

The Water Pipeline would connect to the existing Eungella Pipeline west of the Project. The Water Pipeline would be approximately 23 km long and has been co-located with the Rail Spur and Loop as far as possible (for a distance of 15 km from the mine site to the existing Norwich Park Branch) to reduce native vegetation clearance
(DPM Envirosciences, 2018b).

All patches of TEC have been avoided and impacts to Endangered and Of Concern REs minimised by minimising the corridor for the Water Pipeline to 20 m (DPM Envirosciences, 2018a).

3.4.8.2 Proposed Mitigation Measures

Mitigation measures proposed to be implemented for the Project are detailed in Table 3-33. The measures identified in Table 3-33 are predicted to be effective in reducing potential adverse impacts on the MNES potentially impacted by the Water Pipeilne because they are focused on addressing the recognised threats to the relevant species and communities and are not inconsistent with the following documents:

- *Approved Conservation Advice for the Brigalow (Acacia harpophylla dominant and co-dominant) ecological community* (DotE, 2013a);
- *Commonwealth Listing Advice on Brigalow (Acacia harpophylla dominant and co-dominant)* (TSSC, 2001).
- *Approved Conservation Advice for Denisonia maculata (Ornamental Snake)* (DotE, 2014b).

Table 3-32
Assessments for Other Threatened Species Relevant to the Water Pipeline Area

Species Name	Common Name	Conservation Status[1]	Presence in the Project Locality and Potential Impact
Erythrotriorchis radiatus	Red Goshawk	V	The Red Goshawk is considered to have potential to occur within the Water Pipeline area as some areas of suitable habitat are present (e.g. eucalypt dry woodlands and the wetlands and waterways). This species typically occurs in tall open forest, woodland, lightly treed savannah and the edge of rainforest (DEHP 2018e). Despite this, the species was not recorded during the targeted surveys and the nearest previous record is located approximately 50 km to the east of the Water Pipeline (ALA, 2018). Nests are in tall trees within 1 km of and often besides, permanent water (river, swamp, pool), usually in fairly open, biologically rich forest or woodland. The average distance of the nest tree to water was 164 m (DEE, 2018). Although the Water Pipeline may remove some areas of potential habitat for this species it is unlikely that it would result in a significant impact on this species given: • this species has not been recorded within the Water Pipeline area; • areas of potential habitat for this species are likely to occur more widely in the surrounding landscape; and • this species is highly mobile and possesses the ability to disperse into the large areas of potential habitat outside the Water Pipeline.
Calidris ferruginea	Curlew Sandpiper	CE	This species is unlikely to occur within the Water Pipeline area as it was not recorded during the recent surveys undertaken by DPM Enviros ciences (2018b) and it has not been previously recorded within 50 km of the Water Pipeline area. This species typically inhabits intertidal mudflats of estuaries, lagoons, mangrove channels, around lakes, dams, flood waters, flooded saltbush surrounds of inland lakes (Morcombe 2003). Although the Water Pipeline would clear wetland and waterway habitats that could provide potential habitat for this species on occasion, it is unlikely that this would result in a significant impact on the Curlew Sandpiper given: • previous targeted searches have found no records of the species within 50 km of the Water Pipeline area; • the species is classified as a migratory shorebird in Marine bioregional plan for the North-west Marine Region (DSEWPC, 2012c); • the species does not breed in Australia (DotE, 2015); • The Water Pipeline area is not classified as internationally important to the species (Bamford et al., 2008) per the Wildlife Conservation Plan for Migratory Shorebirds (DotE, 2015); • the species is wide ranging, with densely distributed records along the coastline of Australia (ALA, 2018); and • habitat is abundant for the species given the densely populated coastlines of Australia (ALA, 2018).

Table 3-32 (Continued)
Assessments for Other Threatened Species Relevant to the Water Pipeline Area

Species Name	Common Name	Conservation Status[1]	Presence in the Project Locality and Potential Impact
Grantiella picta	Painted Honeyeater	V	This species is unlikely to occur within the Water Pipeline area as it was not recorded during the recent surveys undertaken by DPM Envirosciences (2018b) and it has not been previously recorded within 50 km of the Water Pipeline area. This species typically inhabits dry, open forests and woodlands (Box, Ironbark, Yellow Gum, Melaleuca, Casuarina, Callitris, Acacia), usually in areas with flowering and fruiting mistletoe and flowering eucalypts (DEHP, 2018f). Although the Water Pipeline may remove some areas of potential habitat for this species (e.g. euclaypt woodlands) it is unlikely that this would result in a significant impact on this species given: • this species has not been recorded within the Water Pipeline area or surrounds despite targeted surveys; • areas of potential habitat for this species are likely to occur more widely in the surrounding landscape; and • this species is highly mobile and possesses the ability to disperse into the large areas of potential habitat outside the Water Pipeline.
Neochmia ruficauda ruficauda	Star Finch (eastern)	E	This species is unlikely to occur within the Water Pipeline area as it was not recorded during the recent surveys undertaken by DPM Envirosciences (2018b) and it has not been previously recorded within 50 km of the Water Pipeline area. The nearest database record is located approximately 50 km from the Water Pipeline and is from 1956 (ALA, 2018). DEE completed two targeted field surveys for the Star Finch (eastern) which were conducted in central Queensland in 1993-94 and 1996-97 and failed to locate any Star Finches (eastern). In addition, there have been no sightings of the Star Finch (eastern) in the wild since 1995 (DEE, 2018, DPM Envirosciences, 2018). Given the above, it is unlikely that the Water Pipeline would result in a significant impact to this species.
Poephila cincta cincta	Black-throated Finch (southern)	E	This species is unlikely to occur within the Water Pipeline area as it was not recorded during the recent surveys undertaken by DPM Envirosciences (2018b) and it has not been previously recorded within 50 km of the Water Pipeline area. The Black-throated Finch inhabits grassy woodland dominated by eucalypts, paperbarks or acacias where there is accessibility to seeding grasses, with riparian habitat being particularly important (DEHP 2018d). Although the Water Pipeline may remove some areas of potential habitat for this species (e.g. riparian woodlands) it is unlikely that it would result in a significant impact on this species given: • this species has not been recorded within the Water Pipeline area or surrounds despite targeted surveys; • areas of potential habitat for this species (e.g. riparian woodlands) are likely to occur more widely in the surrounding landscape; and • this species is highly mobile and possesses the ability to disperse into the large areas of potential habitat outside the Water Pipeline.

Table 3-32 (Continued)
Assessments for Other Threatened Species Relevant to the Water Pipeline Area

Species Name	Common Name	Conservation Status[1]	Presence in the Project Locality and Potential Impact
Dasyurus hallucatus	Northern Quoll	E	This species is unlikely to occur within the Water Pipeline area as it was not recorded during the recent surveys undertaken by DPM Enviros ciences (2018b) and it has not been previously recorded within 50 km of the Water Pipeline area. Further to this, the nearest database record of this species is from 1969. The Northern Quoll is known to inhabit hilly or rocky areas close to permanent water; but occurs in a range of habitats, including open dry sclerophyll forest and woodland, riparian woodland, low dry vine thicket, the margins of notophyll vineforest, mangroves, sugarcane farms and in urban areas (DEHP 2018g). The Water Pipeline area does not contain rocky areas that would provide suitable habitat for the Northern Quoll.
Pteropus poliocephalus	Grey-headed Flying-fox	V	This species is unlikely to occur within the Water Pipeline area as it was not recorded during the recent surveys undertaken by DPM Enviros ciences (2018b) and it has not been previously recorded within 50 km of the Water Pipeline area. This species typically roosts in native vegetation near water, including mangrove, rainforest, melaleuca or casuarina (Churchill 2008). The Grey-headed Flying Fox typically commute within 15 km to feed on flowering and fruiting plants, including blossoms of various species of eucalypt, angophora, tea-tree and banksia (Strahan 1995). Although the Water Pipeline may remove some areas of foraging habitat for this species (e.g. eucalypt woodlands) it is unlikely that it would result in a significant impact on this species given: • this species has not been recorded within the Water Pipeline area or surrounds despite targeted surveys; • areas of potential habitat for this species (e.g. eucalypt woodlands) are likely to occur more widely in the surrounding landscape; and • this species is highly mobile and possesses the ability to disperse into the large areas of potential habitat outside the Water Pipeline.
Macroderma gigas	Ghost Bat	V	This species is unlikely to occur within the Water Pipeline area as it was not recorded during the recent surveys undertaken by DPM Enviros ciences (2018b) and it has not been previously recorded within 50 km of the Water Pipeline area. The closest sighting in 1978 approximately 70 km from the Water Pipeline. The Ghost Bat typically inhabits spinifex hillsides, black soil grasslands, monsoon forest, open savannah woodland, tall open forest, deciduous vine forest and tropical rainforest, influenced by the availability of caves and mines for roosting (Churchill 2008). Roost sites include caves, rock crevices and disused mine adits. Given the site characteristics (predominately euclypt woodland) and the lack of caves within the Water Pipeline area it is unlikely the Ghost Bat would utilise the habitat within the Water Pipeline area.

Table 3-32 (Continued)
Assessments for Other Threatened Species Relevant to the Water Pipeline Area

Species Name	Common Name	Conservation Status[1]	Presence in the Project Locality and Potential Impact
Nyctophilus corbeni	Corben's Long-eared Bat	V	This species is unlikely to occur within the Water Pipeline area as it was not recorded during the recent surveys undertaken by DPM Envirosciences (2018b) and it has not been previously recorded within 50 km of the Water Pipeline area. The Corben's Long-eared Bat is known to inhabit areas with a cluttered understorey layer in river red gum, black box, *Allocasuarina*, belah, mallee, open woodlands, and savannahs; roosting in fissures in branches and under dried sheets of bark still attached to the trunks of trees; utilising tree hollows for maternity sites (Churchill 2008). Although the Water Pipeline may remove some areas of foraging habitat for this species (e.g. eucalypt woodlands) it is unlikely that it would result in a significant impact on this species given: • this species has not been recorded within the Water Pipeline area or surrounds despite targeted surveys; • areas of potential habitat for this species (e.g. eucalypt woodlands) are likely to occur more widely in the surrounding landscape; and • this species is highly mobile and possesses the ability to disperse into the large areas of potential habitat outside the Water Pipeline.
Elseya albagula	Southern Snapping Turtle	CE	This species is unlikely to occur within the Water Pipeline area as it was not recorded during the recent surveys undertaken by DPM Envirosciences (2018b) and it has not been previously recorded within 50 km of the Water Pipeline area. The Southern Snapping Turtle inhabits permanent flowing water habitats where there are suitable shelters and refuges (DEHP 2018h); clear, flowing, well-oxygenated waters of the Fitzroy, Mary and Burnett catchments. Suitable habitat for this species was not identified during the recent aquatic ecology surveys undertaken by DPM Envirosciences (2018c).
Rheodytes leukops	Fitzroy River Turtle	V	This species is unlikely to occur within the Water Pipeline area as it was not recorded during the recent surveys undertaken by DPM Envirosciences (2018b) and it has not been previously recorded within 50 km of the Water Pipeline area. The Fitzroy River Turtle is known to inhabit fast-flowing water of the Fitzroy River and its tributaries (Cogger, 2014). Rivers with large deep pools and rocky, gravelly or sandy substrates, connected by shallow riffles. Preferred areas have high water clarity and are often associated with ribbonweed (*Vallisneria* sp.) (DEE 2017). Suitable habitat for this species was not identified during the recent aquatic ecology surveys undertaken by DPM Envirosciences (2018c).

Table 3-32 (Continued)
Assessments for Other Threatened Species Relevant to the Water Pipeline Area

Species Name	Common Name	Conservation Status[1]	Presence in the Project Locality and Potential Impact
Egernia rugosa	Yakka Skink	V	This species is unlikely to occur within the Water Pipeline area as it was not recorded during the recent surveys undertaken by DPM Envirosciences (2018b) and it has not been previously recorded within 50 km of the Water Pipeline area. The Yakka Skink typically inhabits dry open forests, woodlands and rocky areas (Wilson and Swan 2013). Although the Water Pipeline may remove some areas of foraging habitat for this species (e.g. eucalypt woodlands and brigalow) it is unlikely that it would result in a significant impact on this species given: • this species has not been recorded within the Water Pipeline area or surrounds despite targeted surveys; • areas of potential habitat for this species (e.g. eucalypt woodlands and brigalow) are likely to occur more widely in the surrounding landscape; and • many areas of potentially suitable habitat are considered to be suboptimal based on the lack of suitable microhabitat features.
Lerista allanae	Allan's Lerista	E	This species is unlikely to occur within the Water Pipeline area as it was not recorded during the recent surveys undertaken by DPM Envirosciences (2018b) and it has not been previously recorded within 50 km of the Water Pipeline area. The Allan's Lerista is restricted to road verges and other small areas with friable soils, amid pastoral land dominated by heavy soils in the vicinity of Capella, Clermont and Logan Downs Station (Wilson and Swan 2013). Suitable habitat for this species was not identified within the Water Pipeline area (DPM Envirosciences, 2018b).
Furina dunmalli	Dunmall's Snake	V	This species is unlikely to occur within the Water Pipeline area as it was not recorded during the recent surveys undertaken by DPM Envirosciences (2018b) and it has not been previously recorded within 50 km of the Water Pipeline area. This species typically inhabits woodlands and dry sclerophyll forest, particularly areas featuring brigalow (Wilson and Swan, 2013). It is determined that that this species is unlikely to occur as the elevation of the Water Pipeline is too low (this species prefer habitat 200 to 500 m AHD [DEE, 2018a]).
Cycas ophiolitica	-	E	This species is unlikely to occur within the Water Pipeline area as it was not recorded during the recent surveys undertaken by DPM Envirosciences (2018b) and it has not been previously recorded within 50 km of the Water Pipeline area. This species grows on hills and slopes in sparse, grassy open forest at altitude ranges from 80–400 m above sea level. Although this species reaches its best development on red clay soils near Marlborough, it is more frequently found on shallow, stony, infertile soils, which are developed on sandstone and serpentinite, and is associated with species such as *Corymbia dallachiana, C. erythrophloia, C. xanthope* and *Eucalyptus fibrosa. Cycas ophiolitica* has also been found on mudstone in association with *Corymbia dallachiana, C. erythrophloia* and *Eucalyptus crebra*, and on alluvial loams with *Corymbia intermedia, Eucalyptus drepanophylla* and *E. tereticornis* (DEE 2018a). Habitat for this species was not identified during the recent floristic surveys undertaken by DPM Envirosciences (2018a).

Table 3-32 (Continued)
Assessments for Other Threatened Species Relevant to the Water Pipeline Area

Species Name	Common Name	Conservation Status[1]	Presence in the Project Locality and Potential Impact
Dichanthium queenslandicum	King Blue-grass	E	King Blue-grass is considered to have potential to occur within the Water Pipeline area as some areas of suitable habitat are present. This species typically inhabits black cracking clay in tussock grasslands mainly in association with other species of blue grasses (*Dichanthium* spp. and *Bothriochloa* spp.), but also with other grasses restricted to this soil type (DEE, 2018a). *D. queenslandicum* is mostly confined to natural grassland on the heavy black clay soils (basalt downs, basalt cracking clay, and open downs) on undulating plains (DEHP 2018i). Although the Water Pipeline may remove some areas of potential habitat for this species it is unlikely that it would result in a significant impact on this species given: • this species has not been recorded within the Water Pipeline area despite targeted surveys; • no areas of Natural Grassland TEC were recorded within the Water Pipeline area; and • areas of potential habitat for this species are likely to occur more widely in the surrounding landscape.
Dichanthium setosum	Bluegrass	V	Bluegrass is considered to have potential to occur within the Water Pipeline area as some areas of suitable habitat are present. This species has been recorded from the Leichardt, Morton, North Kennedy and Port Curtis regions (Henderson, 1997). It is known to occur in the Mistake Range, in Main Range National Park and possibly in Glen Rock Regional Park. Bluegrass is strongly associated with heavy basaltic black soils and stony red-brown hard-setting loam with clay subsoil (DEE 2018a) and is found in moderately disturbed areas such as cleared woodland, grassy roadside remnants, grazed land and highly disturbed pasture (DEE 2017). Although the Water Pipeline may remove some areas of potential habitat for this species it is unlikely that it would result in a significant impact on this species given: • this species has not been recorded within the Water Pipeline area despite targeted surveys; and • areas of potential habitat for this species are likely to occur more widely in the surrounding landscape.
Eucalyptus raveretiana	Black Ironbox	V	Black Ironbox is considered to have potential to occur within the Water Pipeline area as some areas of suitable habitat are present. This species is known to occur along watercourses and occasionally on river flats. It occurs in open forest or woodland communities, preferring sites with moderately fertile soil and adequate sub-soil moisture. The alluvial soils in which it grows are sands, loams, light clays or cracking clays (DEHP, 2018j). Although the Water Pipeline may remove some areas of potential habitat for this species it is unlikely that it would result in a significant impact on this species given: • this species has not been recorded within the Water Pipeline area despite targeted surveys; and • areas of potential habitat for this species are likely to occur more widely in the surrounding landscape.

Table 3-32 (Continued)
Assessments for Other Threatened Species Relevant to the Water Pipeline Area

Species Name	Common Name	Conservation Status[1]	Presence in the Project Locality and Potential Impact
Samadera bidwillii	Quassia	V	This species is unlikely to occur within the Water Pipeline area as it was not recorded during the recent surveys undertaken by DPM Enviros ciences (2018b) and it has not been previously recorded within 50 km of the Water Pipeline area. Quassia commonly occurs in lowland rainforest or on rainforest margins, but it can also be found in other forest types, such as open forest and woodland. Quassia is commonly found in areas adjacent to both temporary and permanent watercourses in locations up to 510 m altitude. The species occurs on lithosols, skeletal soils, loam soils, sands, silts and sands with clay subsoils (DEE, 2018a). Habitat for this species was not identified during the recent floristic surveys undertaken by DPM Enviros ciences (2018a).

[1] Threatened Species Status under the EPBC Act (current as of May 2018).

V = Vulnerable.

E = Endangered.

CE = Critically Endangered.

Table 3-33
Proposed Avoidance and Mitigation Measures for the Water Pipeline

Potential impact	Mitigation measures
Vegetation clearing	• Demarcate exclusion zones prior to clearing to protect areas of vegetation to be retained. • Vegetation clearing / excavation to be subject to internal permitting system. • Salvage felled vegetation for millable timber, as appropriate. • Collection of native seed from the Water Pipeline area for use in rehabilitation program. • Implement the Vegetation Management Plan (Section 3.4.9.3).
Fauna mortality	• Where applicable limit time of construction to avoid breeding seasons for threatened species. • Licensed fauna spotter-catchers to undertake detailed inspection of areas to be cleared • Where practical, retain hollow-bearing trees and large stags as potential nesting and roosting habitat. • Vehicular traffic generally to be restricted to access tracks and an on-site speed limit would be applied.
Reduction of threatened fauna populations	• Implement management measures for fauna mortality, as outlined above. • Prepare a Species Management Program (in accordance with section 332 of the Nature Conservation [Wildlife Management] Regulation 2006).
Increased numbers of feral animals	• Management of feral animals, particularly dogs, cats and pigs. • Implement Weed and Pest Management Plan (Section 3.4.9.3)
Weed management and edge effects	• Clearing of vegetation to be restricted to the minimum required to enable the safe construction, operation and maintenance of the Water Pipeline. • Identification of weed infestations. • Prioritisation of treatment of weed infestations or weed species and ongoing treatment regimes (as necessary). • Strategies for preventing weed spread i.e. machinery wash-down, boot scrubbing facilities, appropriate disposal of weed material. • Implement the Weed and Pest Management Plan (Section 3.4.9.3).

- *Approved Conservation Advice for Rostratula australis (Australian Painted Snipe)* (DSEWPaC, 2013).
- *Conservation Advice Geophaps scripta scripta Squatter Pigeon (southern)* (TSSC, 2015)
- *Approved Conservation Advice for Phascolarctos cinereus (combined populations in Queensland, New South Wales and the Australian Capital Territory)* (SEWPaC, 2012)
- *Conservation Advice Petauroides volans Greater Glider* (TSSC, 2016)
- *Threat Abatement Plan for Competition and Land Degradation by Rabbits* (DEE, 2016).
- *Threat Abatement Plan for Predation by Feral Cats* (DotE, 2015).
- *Threat Abatement Plan for Predation, Habitat Degradation, Competition and Disease Transmission by Feral Pigs (Sus scrofa)* (DEE, 2017).
- *Threat Abatement Plan for the Biological Effects, Including Lethal Toxic Ingestion, Caused by* Cane Toads (SEWPaC, 2015).

Pembroke is responsible for funding the costs of all mitigation measures as required.

3.4.8.3 Proposed Management Plans

The following management plans would be implemented by Pembroke for the ongoing management of potential impacts on MNES associated with the Project (including the Water Pipeline):

- Vegetation Management Plan, including:
  - demarcate exclusion zones to protect areas of vegetation to be retained prior to clearing;
  - vegetation clearing / excavation to only be authorised in accordance with clearing / disturbance permitting system to ensure that the Environmental Advisor has reviewed all proposed clearing / excavation activities throughout operation of the mine;
  - salvage of felled vegetation for millable timber, as appropriate; and
  - collection of native seed from Project area prior to clearing for use in rehabilitation program;
- Weed and Pest Management Plan, including:
  - identification of weed infestations;
  - strategies for preventing weed spread (i.e. machinery wash-down, boot scrubbing facilities, appropriate disposal of weed material);
  - prioritisation of treatment of weed infestations or weed species and ongoing treatment regimes (as necessary);
  - recommended weed removal strategies (including those appropriate for aquatic habitats); and
  - weed monitoring protocols and follow-up weed control methods and protocols.

Additional management plans are discussed in Section 3.3.11.3.

3.4.9 Consideration of the Project against the Objects of the Environment Protection and Biodiversity Conservation Act, 1999

As described in Section 3.4.6, the Water Pipeline is one component of the larger Project and as such, the consideration of the Project (as a whole) against the objects of the EPBC Act, provided in Section 3.3.14, is relevant to the Water Pipeline.

In conclusion, for the reasons outlined in Section 3.3.14, in consideration of the requirements of the EPBC Act (including the objects of the EPBC Act) the Water Pipeline is considered to be environmentally acceptable.

3.4.10 Conclusion

Pembroke has assessed a number of alternatives to the Water Pipeline. The final proposed mannor in which the Water Pipeline would be constructed and operated is considered to be environmentally acceptable in consideration of the requirements of the EPBC Act (including the objects of the EPBC Act), the principles of ecologically sustainable development and the precautionary principle.

Potential impacts on listed threatened species and communities associated with the Water Pipeline includes the direct removal of potential and known habitat for threatened species and native vegetation. The Water Pipeline is not expected to result in any consequential impacts to any threatened species or community listed under the EPBC Act (DPM Enviroscienses, 2018b). Further to this there are no impacts relevant to the Water Pipeline that are unknown, unpredictable or irreversible.

The avoidance and mitigation measures proposed for the Water Pipeline are acceptable and predicted to be effective in reducing potential adverse impacts on the MNES because they are focused on addressing the recognised threats to threatened species and communities and are not inconsistent with the relevant approved conservation advice and threat abatement plans.

Significant Impact Assessments have been conducted for all MNES which are known or have the potential to occur within the Water Pipeline area and surrounds in accordance with the *Significant Impact Guidelines 1.1 – Matters of National Environmental Significance* (DotE 2013b) (DPM Envirosciences, 2018a and b).

In addition to the rehabilitation of the Water Pipeline area, Pembroke would provide a biodiversity offset for the impacts associated with the Water Pipeline in accordance with the *Queensland Environmental Offsets Policy (Version 1.4)* (DEHP, 2017) and *EPBC Act Environmental Offsets Policy* (SEWPaC, 2012a) (and supporting *EPBC Act Offsets Assessment Guide* [SEWPaC, 2012b]) (Section 3.8). The biodiversity offset area (once established) would provide a beneficial conservation outcome for biodiversity in the region.

3.5 OLIVE DOWNS PROJECT ELECTRICITY TRANSMISSION LINE (EPBC 2017/7869)

3.5.1 Location of the Action

The Olive Downs Project Electricity Transmission Line (EPBC 2017/7869) (herein referred to as Project ETL) is located approximately 170 km south west of Mackay, in the Bowen Basin region of central Qld (Figure 2-1). The Project ETL is located approximately 40 km south-east of Moranbah and 60 km north of Dysart within the Isaac Regional Council LGA in a mining precinct comprising several existing mining operations.

Sections of the Project ETL will be along existing roads (e.g. Daunia Road) (Figure 2-2), while the remaining land within the Project ETL alignment is predominately used for cattle grazing. The land has been largely cleared through past agricultural practices, however some tracts of remnant vegetation exist, particularly along the riparian corridor of the Isaac River.

3.5.2 Description of the Action

A description of the works to be undertaken during the construction, operations and decommissioning phases of the Project ETL is provided below. The total disturbance footprint of the Project ETL is approximately 42 ha (Figure 2-2).

3.5.2.1 Construction

Electricity supply for the Project is to be provided from the existing regional power network, via construction of a 66 kilovolt (kV) ETL from the Broadlea Substation (approximately 42 km in length), and an on-site switching/substation (Figure 2-2).

The Project ETL would consist of towers spaced approximately 200 m apart (although the distance between towers may vary with changes in direction) with a clearance width of approximately 10 m across. Maintenance access would be via the adjacent mine access road (subject to a separate referral) and no formed road is proposed within the Project ETL alignment for the majority of its length.

During the construction phase for establishment of operations at the Willunga Domain, the 11 kV/66 kV overhead distribution system would be extended on-site from the main switching/substation at the Olive Downs South domain approximately 30 km to service the power demand of the overland conveyor and MIA and coal crushing and handling facilities at the Willunga Domain.

The Project ETL would be consutrcuted during the first Stage of the Project (Section 3.3.2).

3.5.2.2 Operation

At full development, the estimated operational electrical load for the Project is approximately 38 megawatt (MW). The alignment for the Project ETL between the Broadlea Substation and the Project is shown on Figure 2-2.

Power supply at 11 kV/66 kV would be required for the following three key areas at the Olive Downs South Domain:

- MIA facilities;
- CHPP and associated coal handling facilities; and
- rail loadout facilities.

The power demands at each area would progressively increase in line with the product coal outputs for the various stages of the operation.

The Project ETL would remain operational for the duration of the Project.

3.5.2.3 Decommissioning and Rehabilitation

The Project ETL would be assessed for possible removal or to be retained for future land owners. Where infrastructure is removed, the land would be re-contoured, topsoiled, ripped and seeded. All disturbed areas would be rehabilitated with an appropriate seed mix to enable revegetation.

It is anticipated that the Project ETL would be decommissioned within two years of the completion of mining operations.

3.5.3 Current Status of the action

The Project ETL was referred to the DEE under the EPBC Act on 24 January 2017. On 3 March 2017 the Project ETL was determined to be a "Controlled Action". DEE advised that the bilateral assessment under section 45 of the EPBC Act applies to the Project.

Works associated with the Project ETL has not commenced.

3.5.4 Consequence of not proceeding

The Project ETL is one component of the larger Project (Section 3.5.6).

The Project ETL would be required for delivery of power to the Project area. Should the Project ETL not be constructed, the Project would not be able to proceed.

Section 3.2.4 describes the consequences of the Project not proceeding.

3.5.5 Alternatives Considered

A number of alternative alignments for the Project ETL was investigated during pre-feasibility studies. Although a number of alignments were considered to provide a better engineering design or a lower cost (e.g. alignments that took straighter paths or had fewer road crossings), the final alignment was selected as it:

- minimise impacts to other tenement holders, by locating the Project ETL along tenement boundaries; and
- minimise the impacts to private landholdings by locating the Project ETL within existing easements and road corridors, where practicable.

3.5.6 Relationship to Other Actions

The Project also includes construction of the Mine Site and Access Road (Section 3.2), Water Pipeline (Section 3.3) and Rail Spur and Loop (Section 3.5).

As detailed in Section 3.1, the Mine Site and Access Road, Project ETL, Rail Spur and Loop and Water Pipeline were referred separately to the DEE. Pembroke is the proponent for all four actions.

Should Pembroke, in the future, decide to transfer the responsibility of the Water Pipeline, Rail Spur and Loop and/or Project ETL to another company (e.g. SunWater, Aurizon or Ergon) all relevant approvals would also need to be transferred.

Given the EPBC Act does not allow individual elements of a single referred action (e.g. Project ETL, Rail Spur and Loop and Water Pipeline) to be transferred between proponents, Pembroke has decided to lodge four separate referrals covering separate aspects of the Project. This facilitates the transfer of approvals between proponents for the individual elements of the Project.

3.5.7 Impacts on Listed Threatened Species and Ecological Communities

3.5.7.1 Threatened Species

The following threatened fauna species listed under the EPBC Act were recorded from the Project ETL area and surrounds during the field surveys (Figure 3-5) (DPM Enviros ciences, 2018b):

- Ornamental Snake;
- Australian Painted Snipe;
- Squatter Pigeon (southern);
- Koala; and
- Greater Glider.

Further to this, potential impacts to an additional 19 fauna listed in the Terms of Reference, or identified within a search area covering the wider locality, were assessed by DPM Enviros ciences (2018b) These include:

- Red Goshawk (*Erythrotriorchis radiatus*);
- Curlew Sandpiper (*Calidris ferruginea*);
- Painted Honeyeater (*Grantiella picta*);
- Star Finch (eastern) (*Neochmia ruficauda ruficauda*);
- Black-throated Finch (southern) (*Poephila cincta cincta*);
- Northern Quoll (*Dasyurus hallucatus*);

- Grey-headed Flying-fox (*Pteropus poliocephalus*)*;*
- Ghost Bat (*Macroderma gigas*)*;*
- Corben's Long-eared Bat (*Nyctophilus corbeni);*
- Southern Snapping Turtle (*Elseya albagula*)*;*
- Fitzroy River Turtle (*Rheodytes leukops*)*;*
- Yakka Skink (*Egernia rugosa*);
- Allan's Lerista (*Lerista allanae*)*;*
- Dunmall's Snake (*Furina dunmalli*)*;*
- *Cycas ophiolitica;*
- King Blue-grass *(Dichanthium queenslandicum);*
- Bluegrass (*Dichanthium setosum*)*;*
- Black Ironbox (*Eucalyptus raveretiana*)*; and*
- Quassia (*Samadera bidwillii*)*.*

These species are discussed in detail below.

Ornamental Snake (Denisonia maculata)

The Ornamental Snake (*Denisonia maculata*) is listed as 'Vulnerable' under the EPBC Act.

Background/Description

The Ornamental Snake occurs in scattered locations over a large area in Brigalow Belt North and South Bioregions and small portions of the Desert Uplands Bioregion and Central Coast Bioregion in Qld (DEE, 2018a).

Within its distribution, the Ornamental Snake inhabits moist or seasonally moist areas within appropriate refuge habitat and aquatic or fringing vegetation with frog species forming their main prey (Cogger, 2014). The Ornamental Snake is most likely to occur in Qld regional ecosystem Land Zone 4 (DEE, 2018a) and most likely in Brigalow-dominated ecosystems supporting gilgai.

Survey Effort

The survey effort for this species is provided in Table 3-5 and Appendix B.

Habitat Assessment and Definition

The Ornamental Snake prefers habitat that is close to its prey (frogs). It prefers moist woodlands and open forests, particularly gilgai mounds as well as lake margins and wetlands (DEE 2018).

It is found in low-lying subtropical areas with deep-cracking clay soils and persists in cleared, disturbed habitat, particularly where brigalow communities have been cleared (DSEWPaC, 2011).

Four Ornamental Snake were recorded at three locations within the Olive Downs South Domain and a further five locations within the Willunga Domain (Figure 3-5c). The species was identified via a combination nocturnal spotlighting (DPM Enviros ciences, 2018b).

These records occurred within agricultural grasslands on cracking clays, around palustrine wetlands, within Acacia dominated open forests, woodland and shrublands, and also one record within Eucalypt dry woodlands on inland depositional plains (expected to be a transient individual) (DPM Enviros ciences, 2018b). Database records for this species are relatively common in the wider locality, with more than 14 records within 15 km of the Project ETL.

The Ornamental Snake was not recorded within the Project ETL area, the closest record is approximately 5 km to the west (Figure 3-5c) (DPM Enviros ciences, 2018b).

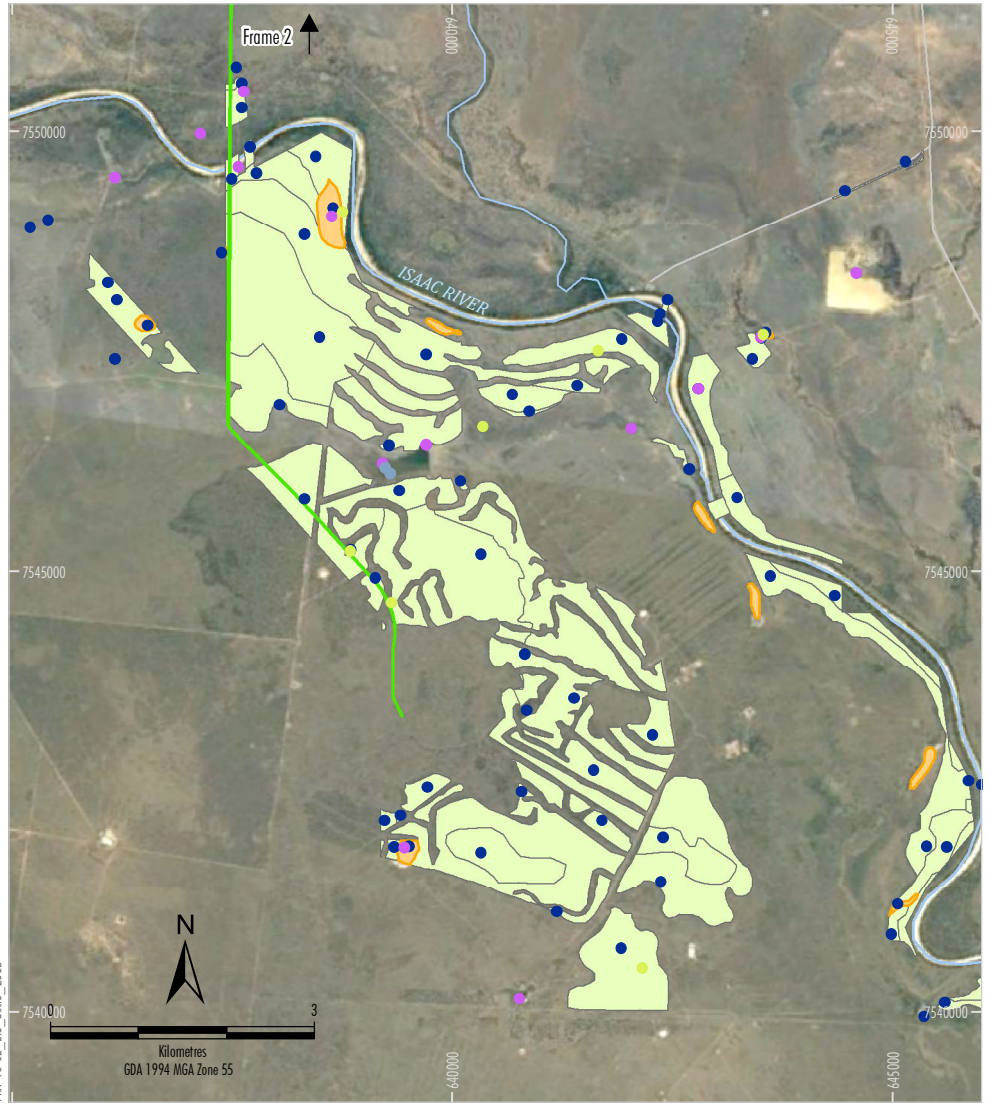
Ground-truthed soils mapping produced for the *Olive Downs Coking Coal Project Soil and Land Suitability Assessment* by GT Environmental (2018) across the Study area identified areas of gilgai relief, which are the most accurate reflection of potential habitat for this species (Figure 3-30b) (DPM Enviros ciences, 2018b).

GT Environmental (2018) has mapped the following two soil types within the Mine Site and Access Road area that would provide suitable habitat for the Ornamental Snake:

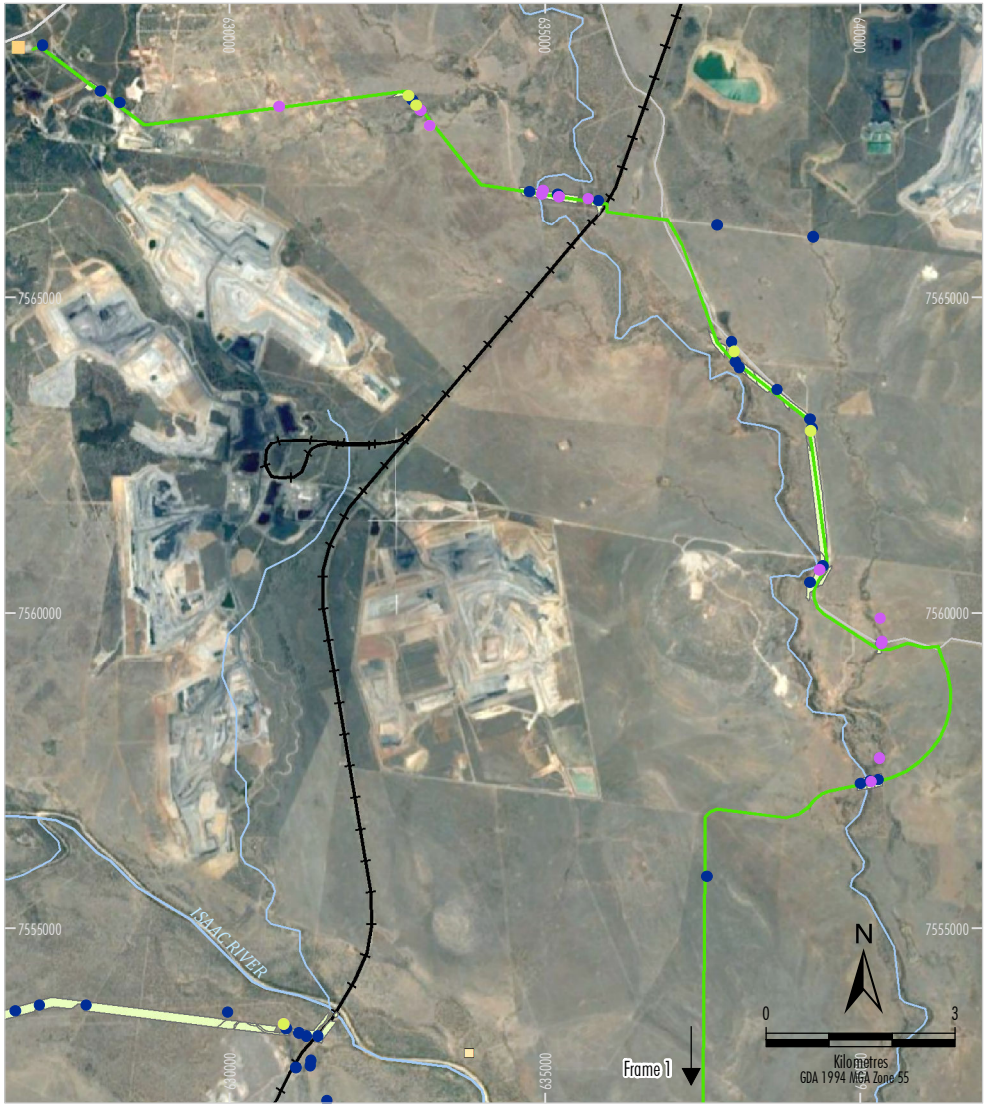
- brown light clays with gilgai; and
- grey to brown light to medium clay with gilgai.

Brigalow TEC has been identified as potential habitat for the Ornamental Snake. Mapping in the Mine Site and Access Road area identified two patches as being Brigalow TEC, comprised of RE 11.4.9. In accordance with the *Draft Referral Guidelines for the Nationally Listed Brigalow Belt Reptiles* RE 11.4.9 comprises habitat suitable for the Ornamental Snake.

Frame 1 - ETL Southern Section



Frame 2 - ETL Northern Section



PRN-16-02_EIS_Sect3_266B

LEGEND

- Olive Downs Project Electricity Transmission Line (EPBC 2017/7869)
- Dwelling
- Railway
- Species Habitat - Australian Painted Snipe
- Species Habitat - Squatter Pigeon

Fauna Survey Locations

- Active search
- Bird survey
- Camera trap
- Comprehensive site
- Fauna Habitat Assessment Site

Source: DPM (2018), Pembroke (2018), Queensland Department of Natural Resources, Mines and Energy (2017)
Orthophoto: Google Image (2016)
(Enirety of the Olive Downs Project Electricity Transmission Line (EPBC 2017/7869) is included in Stage 1 of the Project (Refer to Section 4.1))

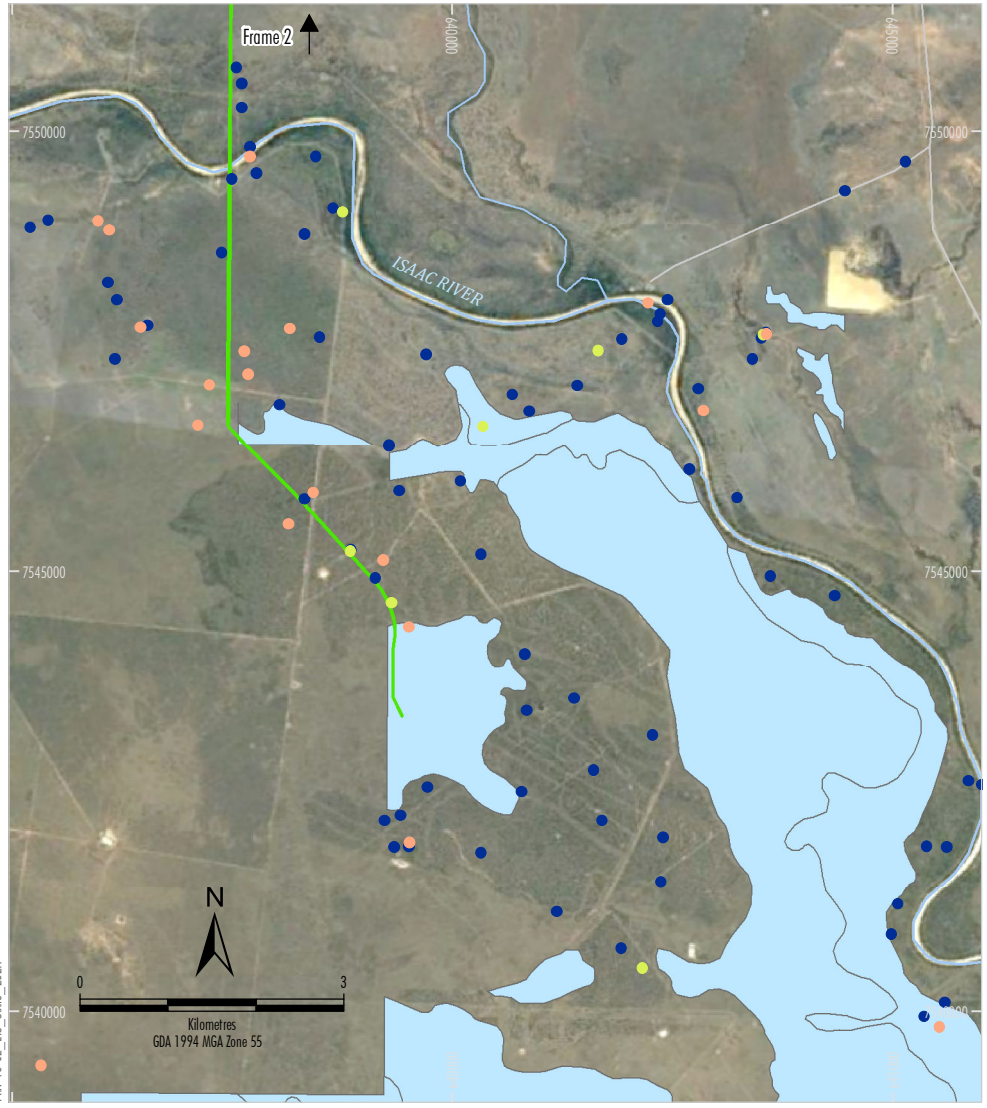
PEMBROKE

OLIVE DOWNS COKING COAL PROJECT

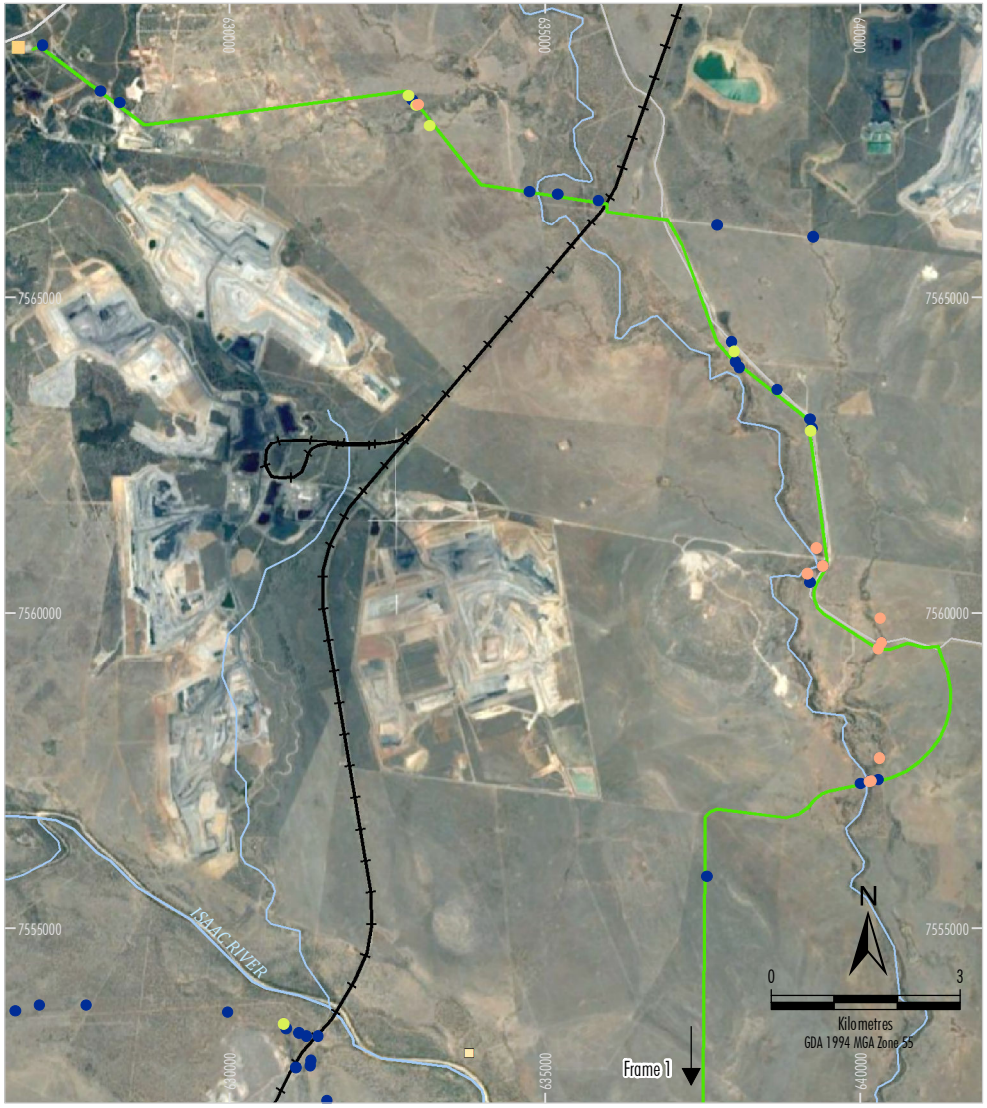
Threatened Species Habitat Mapping
Australian Painted Snipe & Squatter Pigeon

Figure 3-30a

Frame 1 - ETL Southern Section



Frame 2 - ETL Northern Section



PRN-16-02_EIS_Sec3_262A

LEGEND

- Olive Downs Project Electricity Transmission Line (EPBC 2017/7869)
- Dwelling
- Railway
- Species Habitat - Ornamental Snake

Fauna Survey Location

- Active search
- Comprehensive site
- Spotlighting
- Fauna Habitat Assessment Site

Source: DPM (2018), Pembroke (2018), Queensland Department of Natural Resources, Mines and Energy (2017)
Orthophoto: Google Image (2016)
(Enirety of the Olive Downs Project Electricity Transmission Line (EPBC 2017/7869) is included in Stage 1 of the Project (Refer to Section 4.1))

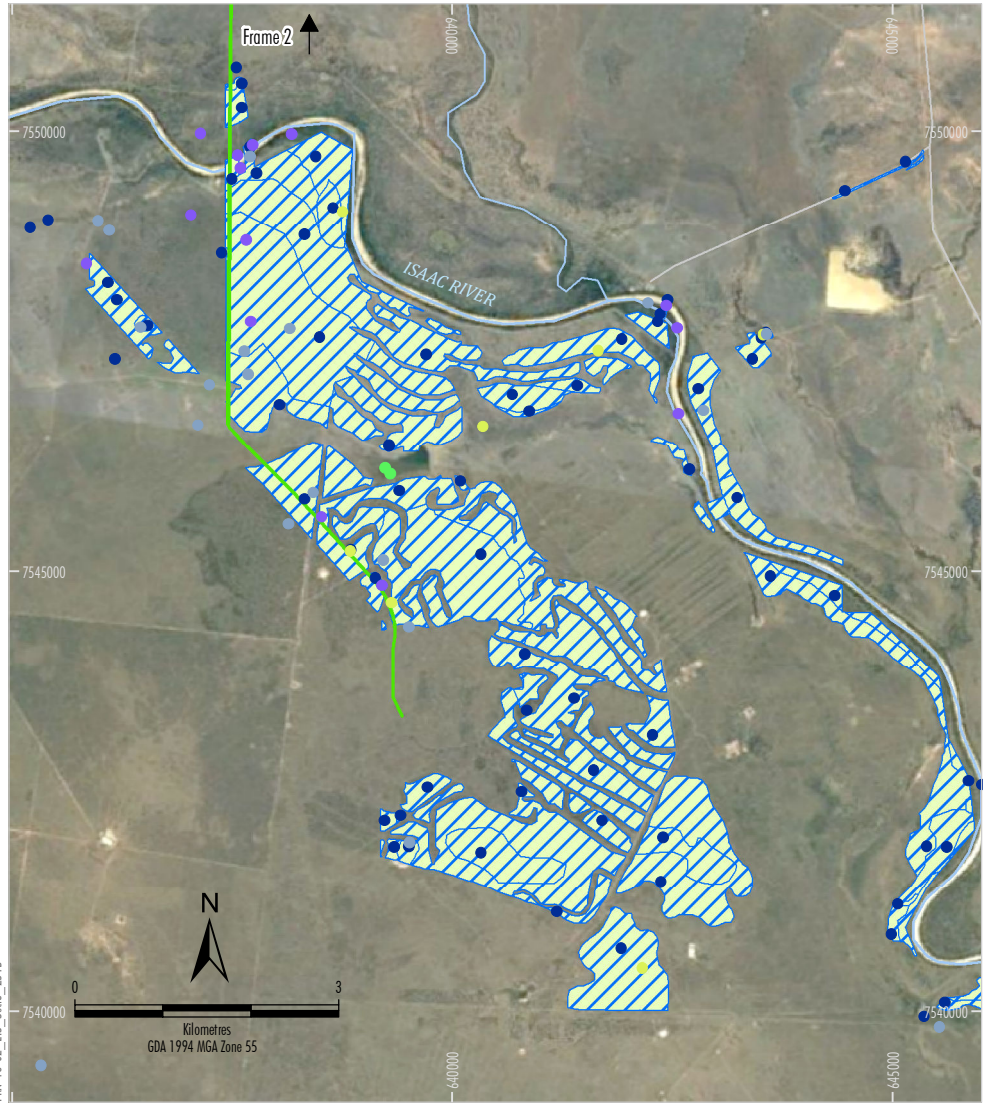
PEMBROKE

OLIVE DOWNS COKING COAL PROJECT

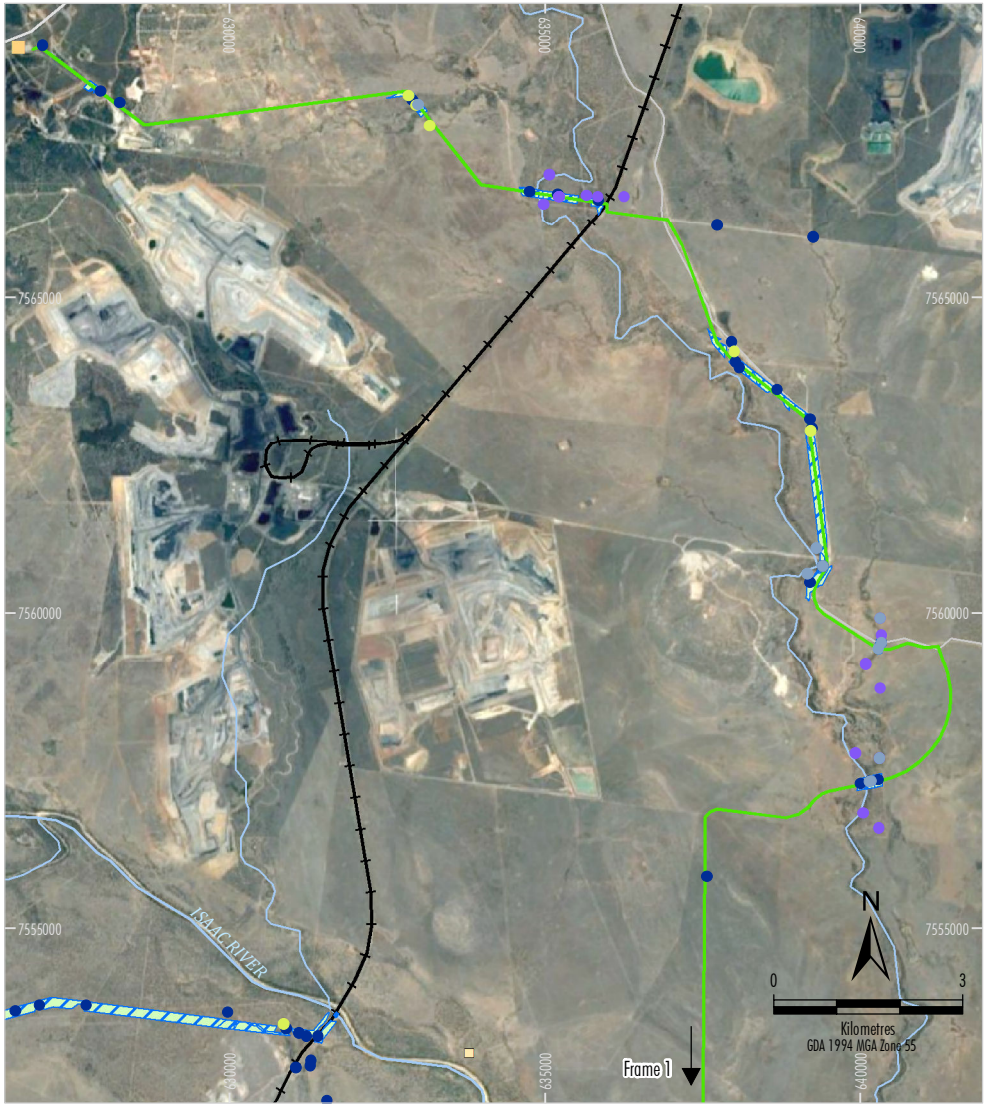
Threatened Species Habitat Mapping Ornamental Snake

Figure 3-30b

Frame 1 - ETL Southern Section



Frame 2 - ETL Northern Section



PRN-16-02_EIS_Sec3_251B

LEGEND

- Olive Downs Project Electricity Transmission Line (EPBC 2017/7869)
- Dwelling
- Railway
- Species Habitat - Greater Glider
- Species Habitat - Koala

Flora Survey Location

- Active search
- Call playback
- Camera trap
- Comprehensive site
- Koala transect
- Spotlighting
- Fauna Habitat Assessment Site

Source: DPM (2018), Pembroke (2018), Queensland Department of Natural Resources, Mines and Energy (2017)
Orthophoto: Google Image (2016)
(Enirety of the Olive Downs Project Electricity Transmission Line (EPBC 2017/7869) is included in Stage 1 of the Project (Refer to Section 4.1))

PEMBROKE

OLIVE DOWNS COKING COAL PROJECT

Threatened Species Mapping
Koala & Greater Glider Habitat

Figure 3-30c

Other patches of Brigalow regrowth have been mapped as potential habitat where suitable habitat features are present (i.e. gilgais, wetlands and suitable prey habitat).

Based on observations of Ornamental Snake across the Study area, areas of potential habitat occur in a significant portion of agricultural grasslands (where there was once brigalow), and small patches of palustrine wetlands (swamps) and Acacia dominated open forests, woodlands and shrublands where these soil types are also present (DPM Envirosciences, 2018b).

The areas identified as potential habitat for the Ornamental Snake also contain woody debris (which would provide sheltering habitat for the Ornamental Snake when cracks are not available), are low lying, and during the wet season they would hold water long enough for frogs to inhabit them, providing a food source for the Ornamental Snake (DPM Envirosciences, 2018b).

As the majority of the potential habitat for this species is mapped within the agricultural grasslands, there are a number of existing threats to the Ornamental Snake. These include heavy weed infestation, presence of introduced fauna species (including cane toads), agricultural grazing and habitat fragmentation (DPM Envirosciences, 2018b).

The other habitat types within the Project ETL (including the remaining non-remnant vegetation) are not considered to provide potential habitat for the Ornamental Snake on the basis that they are lacking the cracking clay soils, gilgai habitat and microhabitat features required by this species (DPM Envirosciences, 2018b).

DotE (2014b) states that “important populations [of the Ornamental Snake] occur in remnant vegetation on, or surrounding, gilgai mounds and depressions”.

The draft *Referral Guidelines for the Nationally Listed Brigalow Belt Reptiles* (DSEWPaC, 2011a) define important habitat for the Ornamental Snake as:

- *Habitat where the species has been identified during a survey;*
- *Habitat near the limit of the species known range;*
- *Large patches of continuous, suitable habitat and viable landscape corridors (necessary for the purposes of breeding, dispersal or maintaining the genetic diversity of the species over successive generations); or*
- *A habitat type where the species is identified during a survey, but which was previously thought not to support the species.*

Under this definition, areas of habitat where the Ornamental Snake was found are important habitat for the Ornamental Snake. Given the lack of records within the Project ETL area, there are no areas of important habitat for the Ornamental Snake within the Project ETL area (DPM Envirosciences, 2018b). DPM Envirosciences (2018b) considers that the habitat within the Project ETL area is also not likely to be critical to the survival of the species given:

- the species is more widely distributed in the region and the habitat is not at a limit of the species range; and
- large areas of potential and important habitat (as demonstrated by Ornamental Snake records) are located in the wider locality and would be avoided by the Project.

It should be noted that preferred, breeding and foraging habitat for this species are typically the same (i.e. very hard to distinguish between the three), and given the Ornamental Snake is highly sedentary dispersal habitat has not been separately assessed.

Impacts

The disturbance footprint for the Project ETL is approximately 42 ha. A total of approximately 10.5 ha of potential habitat for the Ornamental Snake would be cleared for the Project ETL (Table 34) (DPM Envirosciences, 2018b).

An assessment of significance has been conducted in accordance with the *Matters of National Environmental Significance; Significant Impact Guidelines 1.1* (DotE, 2013b) and is provided in Table 3-35.

Table 3-34
Vegetation and Habitat Clearance Summary – Project ETL

Regional Ecosystem Code	Regional Ecosystem Description	Vegetation Clearance (ha)	Habitat Clearance (ha)				
			Ornamental Snake	Squatter Pigeon (Southern)	Australian Painted Snipe	Koala	Greater Glider
Remnant Vegetation							
11.3.1	Brigalow (*Acacia harpophylla*) and / or belah (*Casuarina cristata*) open forest on alluvial plains.	0.5	0	0	0	0	0
11.3.2	Poplar box (*Eucalyptus populnea*) woodland to open woodland on alluvial plains.	5	0	5	0	5	5
11.3.25	Queensland blue gum (*Eucalyptus tereticornis*) or river red gum (*E. camaldulensis*) woodland fringing drainage lines.	0.5	0	0.5	0	0.5	0.5
11.3.7	*Corymbia* spp. woodland on alluvial plains.	0.5	0	0.5	0	0.5	0.5
11.4.8	Dawson gum (*Eucalyptus cambageana*) woodland to open forest with brigalow or blackwood (*Acacia argyrodendron*) on Cainozoic clay plains.	0.5	0	0	0	0	0
11.4.9	Brigalow (*A. harpophylla*) shrubby woodland to open forest with yellowwood (*Terminalia oblongata*) on Cainozoic clay plains.	0.5	0	0	0	0	0
11.5.3	Poplar box (*E. populnea*) +/- silver-leaved ironbark (*E. melanophloia*) +/- Clarkson's bloodwood (*C. clarksoniana*) woodland on Cainozoic sand plains and / or remnant surfaces.	3.5	0	3.5	0	3.5	3.5
11.5.9	Narrow-leaved ironbark (*E. crebra*) and other Eucalyptus spp. and Corymbia spp. woodland on Cainozoic sand plains and / or remnant surfaces.	2	0	2	0	2	2
11.5.9b	Narrow-leaved ironbark (*Eucalyptus crebra*), narrow-leafed white mahogany (*E. tenuipes*), budgeroo (*Lysicarpus angustifolius*) +/- *Corymbia spp*. woodland.	0.5	0	0.5	0	0.5	0.5
11.7.2	Monospecific stands of *Acacia* spp. forest / woodland on Cainozoic lateritic duricrusts.	0.5	0	0	0	0	0
	Subtotal	14	0	12	0	12	12
	Subtotal (Fauna/Flora Assessment)	14	10.5	12	0	12	12
Non-Remnant Vegetation							
-	Agricultural grasslands dominated by buffel grass (*Cenchrus ciliaris*) with gilgai land formation	28.0	10.5	0	0	0	0
	Subtotal	28.0	10.5	0	0	0	0
	Total Clearance	**42.0**	**10.5**	**12**	**0**	**12**	**12**
	Approximate Area of Habitat within 10 km of Project[1]	-	14,362	23,588	146	23,734	23,734

[1] Based on the REs identified as potential habitat on DEE (2018a) from the DSITI (2018) regional mapping available over the area.

Table 3-35
Likelihood of Significant Adverse Impact of the Project ETL on the Ornamental Snake

Assessment Criteria[1] Is the Action likely to:	Assessment
lead to a long-term decrease in the size of an important population of a species	The Project ETL would result in the removal of approximately 10.5 ha of potential habitat for the species. The small reduction in available habitat is unlikely lead to a localized decrease in the local population, given the lack of records within the Project ETL area, the amount of available habitat in the region and the number of records surrounding the site (Figure 3-5b). In addition, disturbance within the Project ETL area would be predominantly slashing of groundcover and trimming of woody vegetation where required. Given this, it is unlikely that the Project ETL would lead to a long-term decrease in the size of an important population of a species.
reduce the area of occupancy of an important population	The reduction in available habitat associated with the Project ETL is not likely to lead to a localized decrease in the area of occupancy of a local population given the lack of records within the Project ETL area, the amount of available habitat in the region and the number of records surrounding the site (Figure 3-5b).
fragment an existing important population into two or more populations	The Project ETL is not likely to fragment an existing important population into two or more populations due to the location of the existing important populations in the surrounding landscape and the current level of fragmentation (and cleared land between the areas).
adversely affect habitat critical to the survival of a species (e.g. for activities such as foraging, breeding, roosting, or dispersal or habitat listed in a recovery plan)	The habitat within the Project ETL is not likely to be critical to the survival of the species given: • the species is more widely distributed in the region and the habitat is not at a limit of the species range; and • large areas of potential and important habitat (as demonstrated by Ornamental Snake records) are located in the wider locality and would be avoided by the Project ETL. Given the above, the Project ETL is unlikely to adversely impact habitat critical to the survival of this species.
disrupt the breeding cycle of an important population	Given the lack of records within the Project ETL area, there are no areas of important habitat for the Ornamental Snake, nor an important population within the Project ETL area. As such, the Project ETL is not expected to remove any potential breeding and nesting habitat for this species.
modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	The Project ETL would remove approximately 10.5 ha of habitat for this species. The Project ETL would result in a reduction in available potential habitat, however there are no records of the Ornamental Snake within the Project ETL area. In addition, due to the amount of available habitat in the locality and the number of records surrounding the Project ETL area it is unlikely that this any potential decrease would be significant at a regional scale. In addition, as the majority of the potential habitat for this species is mapped within the agricultural grasslands, there are a number of existing threats to the Ornamental Snake. These include, heavy weed infestation, presence of introduced fauna species (including cane toads); agricultural grazing and sever habitat fragmentation. It is therefore unlikely that the Project ETL would result in the decline of the species.
result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat	Weed and feral animal threat levels are unlikely to change significantly due to the Project ETL given the current agricultural use of the surrounding area. As outlined above, the majority of the potential habitat for this species is mapped within the agricultural grasslands, there are a number of existing threats to the Ornamental Snake. These include, heavy weed infestation, presence of introduced fauna species (including cane toads); agricultural grazing and sever habitat fragmentation. Through effective pest and weed management, Pembroke's Weed and Pest Management Plan would seek to identify, treat, and propose removal strategies to manage these risks to avoid a significant impact to this species.
introduce disease that may cause the species to decline	The Project ETL does not include activities that would result in a disease that may cause the species to decline.
interfere substantially with the recovery of the species.	One of the listed actions within The Action Plan for Australian Reptiles (Cogger et al. 1993) is to "*ensure ornamental snake conservation is incorporated into appropriate land management decisions*". Although the Project ETL would result in the removal of potential habitat for the species, Pembroke would implement mitigation strategies and offsets to assist in minimising impacts to the species. As such, the Project ETL would not interfere substantially with the recovery of the species.

Source: DPM Enviros ciences (2018b)

[1] As defined by the *Matters of National Environmental Significance Significant Impact Guidelines 1.1* (DotE, 2013b).

Avoidance, Mitigation and/or Management Measures

As described in Section 3.5.9 of this document, the following measures would be undertaken by Pembroke to reduce potential adverse impacts on the Ornamental Snake:

- Vegetation clearance procedures, including pre-clearance surveys to detect the Ornamental Snake within habitat proposed to be cleared.
- Implementation of a Weed and Pest Management Plan to monitor and control feral animals (including feral pigs which can degrade habitat for the Ornamental Snake [DEE, 2018a]) within the Project ETL area and surrounds.
- Bushfire prevention would be undertaken, noting that the Ornamental Snake occurs in Brigalow Woodland and uses groundcover which is susceptible to fire (DEE, 2018a).

A National or State recovery plan has not been prepared for this species. The above measures are predicted to be effective in reducing potential adverse impacts on the Ornamental Snake from the Project ETL because they are focused on addressing the recognised threats to the species and are consistent with the relevant threat abatement actions (e.g. avoiding additional habitat loss and reducing the risk of invasive and predatory species in Section 3.5.7.1) (DEE, 2018a).

Summary of EPBC Act Assessment

Four Ornamental Snake were recorded at three locations within the Olive Downs South Domain and a further five locations within the Willunga Domain (Figure 3-5c) but it has not been recorded within the Project ETL area.

The Project ETL would result in the removal of approximately 10.5 ha of potential habitat for the species, which is unlikely to result in a significant impact to the Ornamental Snake (DPM Envirosciences, 2018b). Despite this, the impacts associated with the Project as a whole (including the Project ETL area) would be mitigated and offset as described in Sections 3.5.9 and 3.7.

Australian Painted Snipe (Rostratula australis)

The Australian Painted Snipe is listed as 'Endangered' under the EPBC Act.

Background/Description

The Australian Painted Snipe has been recorded at wetlands in all states of Australia (DEE, 2018a). It is most common in eastern Australia, where it has been recorded at scattered locations throughout much of Queensland, NSW, Victoria and south-eastern South Australia. It has been recorded less frequently at a smaller number of more scattered locations farther west in South Australia, the Northern Territory and Western Australia (DEE, 2018a). It has also been recorded on single occasions in south-eastern Tasmania and at Lord Howe Island (DEE, 2018a).

The Australian Painted Snipe may breed in response to wetland conditions rather than during a particular season. It has been recorded breeding in all months in Australia. In southern Australia most records have been from August to February. Eggs have been recorded from mid August to March, with breeding in northern Queensland also recorded between May and October (DEE, 2018a).

Survey Effort

The survey effort for this species is provided in Table 3-5 and Appendix B.

Habitat Assessment and Definition

The Australian Painted Snipe generally inhabits shallow terrestrial freshwater wetlands, including temporary and permanent lakes, swamps and claypans. They also use inundated or waterlogged grassland or saltmarsh, dams, rice crops, sewage farms and bore drains. Typical sites include those with rank emergent tussocks of grass, sedges, rushes or reeds, or samphire (DEE 2018).

A single Australian Painted Snipe was observed during the field surveys in a small wetted gilgai within the Agricultural grasslands habitat type in the Willunga Domain (Figure 2-2) (DPM Envirosciences, 2018b). Additional records for this species existing within the wider locality and are all located along waterways, with the closest being approximately 5 km west of the Project ETL (Figure 3-5c).

In the Study area all areas of wetlands (lacustrine or palustrine) are considered potential habitat for this species (Figure 3-30b). Although the species was observed in wetted gilgai habitat, this habitat is only suitable for a short period after rainfall when the gilgai are full. It is not considered optimal or primary habitat (DPM Envirosciences, 2018b).

It should be noted that preferred, breeding and foraging habitat for this species are typically the same (i.e. very hard to distinguish between the three) and, as such, have not been separately assessed. Further to this, given the highly mobile nature of this species dispersal habitat would not necessarily be limited to areas of suitable habitat (i.e. it is known to disperse over cleared land to reach areas of suitable habitat).

Impacts

The disturbance footprint for the Project ETL is approximately 42 ha. The Project ETL would avoid all patches of Australian Painted Snipe habitat that have been mapped within the Study area (Table 3-34) (Figure 3-30b). As such, it is concluded that the Project ETL would not result in a significant impact to the Australian Painted Snipe (DPM Envirosciences, 2018b).

Squatter Pigeon (southern) (Geophaps scripta scripta)

The Squatter Pigeon (southern) is listed as 'Vulnerable' under the EPBC Act.

Background/Description

The Squatter Pigeon (southern) has a known distribution extending from the Burdekin-Lynd divide in Central Qld, west to Barcaldine, Longreach and Charleville, east to the coastline between Townsville and Port Curtis (near Gladstone), south to scattered sites throughout south-eastern Qld and the Border Rivers region of northern NSW (DEE, 2018a). The species does not appear to be undergoing a population decline (DEE, 2018a). The Squatter Pigeon (southern) is locally nomadic or sedentary (DEE, 2018a).

Natural foraging habitat for the Squatter Pigeon (southern) comprises any remnant or regrowth open-forest to sparse, open-woodland or scrub dominated by *Eucalyptus*, *Corymbia*, *Acacia* or *Callitris* species, on sandy or gravelly soils, within 3 km of a suitable, permanent or seasonal waterbody (DEE, 2018a).

This species feeds and nests on the ground but roosts in trees. The Squatter Pigeon (southern) withstands habitats with some grazing pressure but is more common in habitat without grazing and no longer occurs in areas with intense grazing (DEE, 2018a).

Survey Effort

The survey effort for this species is provided in Table 3-5 and Appendix B.

Habitat Assessment and Definition

The Squatter Pigeon (southern) has a large distribution extending from the Burdekin-Lynd divide in Central Queensland, west to Charleville and Longreach, east to the coastline between Proserpine and Port Curtis (near Gladstone) and south to a number of scattered sites throughout south-eastern Queensland (DEE, 2018). All of the relatively small isolated and sparsely distributed sub-populations occurring south of the Carnarvon Ranges in Central Queensland are considered to be important subpopulations of the subspecies (DEE, 2018).

The Squatter Pigeon (southern) was identified on ten occasions within Eucalypt dry woodlands on inland depositional plains in the Study area (Figure 3-30a). This includes three locations within the Willunga domain and a further five locations within the Olive Downs Domain, however it was not recorded within the Project ETL area (DPM Envirosciences, 2018b). Further to this, the Squatter Pigeon (southern) has been recorded on numerous occasions within 10 km of the Study area (Figure 3-5a).

The Squatter Pigeon (southern) occurs mainly in grassy woodlands and open forests that are dominated by eucalypts (DEE 2018). In the in the Project ETL area, all areas of Eucalypt dry woodlands on inland depositional plains and Eucalypt open forests to woodlands on floodplains are considered potential habitat for this species (DPM Envirosciences, 2018b).

Other broad habitat types in the Project ETL area were not considered potential habitat because they do not support the grassy understorey with a high density of native grasses necessary to provide a food resource for the species (DPM Envirosciences, 2018b).

EPBC Act Assessment

The disturbance footprint for the Project ETL is approximately 42 ha. A total of approximately 12 ha of potential habitat for the Squatter Pigeon (southern) would be cleared for the Project ETL (DPM Envirosciences, 2018b). An assessment of significance has been conducted in accordance with the *Matters of National Environmental Significance; Significant Impact Guidelines 1.1* (DotE, 2013b) and is provided in Table 3-36.

Avoidance, Mitigation and/or Management Measures

As described in Section 3.5.9 of this document, the following measures would be undertaken by Pembroke to reduce potential adverse impacts on the Squatter Pigeon (southern):

- Impact avoidance measures outlined in the table in Section 3.5.9 (since the Squatter Pigeon [southern] was recorded across a variety of habitats).
- Vegetation clearance procedures, including progressive vegetation clearing.
- A Weed and Pest Management Plan would be implemented to monitor and control feral animals (such as the European Rabbit, Feral Cat and European Red Fox) in the Project ETL area.

The above measures are predicted to be effective in reducing potential adverse impacts on the Squatter Pigeon (southern) from the Project ETL because they are focused on addressing the recognised threats to the species and are consistent with the relevant threat abatement actions (e.g. avoiding additional habitat loss and controlling predators and herbivores) (DEE, 2018a). A National or State recovery plan has not been prepared for this species.

Summary of EPBC Act Assessment

Several individuals were observed in Eucalypt dry woodlands on inland depositional plains within the Project ETL locality (Figure 3-5a) (DPM Envirosciences, 2018b). It is unlikely that a significant impact to the Squatter Pigeon (southern) would result from the Project ETL, given the species has not been recorded within the Project ETL area, habitat is of sub-optimal quality, and the availability of surrounding habitat indicates that it is not of particular regional importance to the species.

The Project ETL would result in the removal of approximately 12 ha of potential habitat for the species, which is unlikely to result in a significant impact to the Squatter Pigeon (southern). Despite this, the impacts associated with the Project as a whole (including the Project ETL area) would be mitigated and offset as described in Sections 3.3.13 and 3.7 (DPM Envirosciences, 2018b).

Koala (Phascolarctos cinereus)

The EPBC Act listed 'Vulnerable' Koala is the combined populations of Qld, NSW and the ACT.

Background/Description

The Koala is endemic to Australia. The biological species is currently widespread in coastal and inland areas, with a range that extends over 22° of latitude and 18° of longitude, or about one million square kilometres (DEE, 2018a). The occurrence of animals throughout this distribution is not continuous and is defined by environmental variables (DEE, 2018a).

The life history and habitat of the Koala has been well studied (DEE, 2018a). In late 2013, the DotE released the *Draft EPBC Act Referral Guidelines for the Vulnerable Koala (Combined Populations of Queensland, New South Wales and the Australian Capital Territory)* (EPBC Act Referral Guidelines for the Koala) (DotE, 2013b). The EPBC Act Referral Guidelines for the Koala provides a habitat assessment tool for determining habitat critical to the survival of the Koala and the likelihood of a significant impact on this species.

Survey Effort

The survey effort for this species is provided in Table 3-5 and Appendix B.

Habitat Assessment and Definition

The Koala has one of the largest distributions of any terrestrial threatened species listed under the EPBC Act (DotE, 2014). It occupies a variety of vegetation types across this large distribution, is capable of moving long distances and is variably affected by a range of threats (DEE 2018). Koala habitat is defined by the vegetation community present and the vegetation structure; Koalas do not necessarily have to be present (DotE, 2014). Any forest or woodland containing species that are known Koala food trees, or shrubland with emergent food trees can be considered as 'potential Koala habitat' (DEE 2018). This can include remnant and non-remnant vegetation in natural, agricultural, urban and peri-urban environments. Koala food trees can generally be considered to be those of the genus Angophora, Corymbia, Eucalyptus, Lophostemon and Melaleuca (DEE 2018).

Table 3-36
Likelihood of Significant Adverse Impact of the Project ETL on the Squatter Pigeon (southern)

Assessment Criteria[1] Is the Action likely to:	Assessment
lead to a long-term decrease in the size of an important population of a species	The Squatter Pigeon (southern) is commonly recorded in fragmented landscapes in the Brigalow Belt South Bioregion. The population of Squatter Pigeon (southern) in the Project ETL locality is likely to occur more widely in the Isaac River catchment given the extent of database records and habitat in locality (Figure 3-5a). The Project ETL area is north of the Carnarvon Ranges and habitat is classified as sub-optimal, the Project ETL is not considered to contain an important population of this species. In addition, disturbance within the Project ETL area would be predominantly slashing of groundcover and trimming of woody vegetation where required. Given this, it is unlikely that the Project ETL would lead to a long-term decrease in the size of an important population of a species.
reduce the area of occupancy of an important population	Given the abundance of this species and the availability of surrounding potential habitat it is unlikely that the Project ETL would significantly reduce the area of occupancy of the species relative to its range.
fragment an existing important population into two or more populations	Given the abundance of this species in the surrounding locality, lack of identified important populations, the availability of surrounding potential habitat, and existing level of habitat fragmentation in the Project ETL locality, it is unlikely that the Project ETL would fragment an existing important population into two or more populations.
adversely affect habitat critical to the survival of a species (e.g. for activities such as foraging, breeding, roosting, or dispersal or habitat listed in a recovery plan)	No habitat within the Project ETL locality has been identified as critical habitat for the Squatter Pigeon (southern) in any recovery plans or listed on the EPBC Act *Register of Critical Habitat* maintained by the Minister of the Environment under the EPBC Act (DEE, 2018b). The habitat in the Project ETL area for the Squatter Pigeon (southern) is not deemed to meet the definition of 'critical habitat' under the EPBC Act due to the heavily fragmented nature of the habitat which is more widespread in the wider landscape. The Project ETL is not at a limit of the species range and the population of Squatter Pigeon (southern) in the Project ETL locality is likely to occur more widely outside the Project ETL area given the extent of database records and habitat (Figure 3-5a).
disrupt the breeding cycle of an important population	The Project ETL area does not offer any unique or particularly high quality habitat resources required by the Squatter Pigeon (southern). Similar or better habitat would remain in the Project ETL locality. The species is known to breed throughout the year, hence the Project ETL is unlikely to disrupt the breeding cycle of this species.
modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	The Project ETL would remove approximately 12 ha of habitat for this species. The Project ETL would result in the loss of potential habitat that is of sub-optimal quality (due to high occurrence of Buffel Grass). The loss of this habitat would not isolate remaining habitat from other patches of habitat and it is unlikely that the Project ETL would significantly reduce the area of habitat occupied by the species relative to its regional distribution. It is therefore unlikely that the Project ETL would result in the decline of the species.
result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat	The introduction and spread of invasive weeds and feral animals may occur as a result of the clearance associated with the Project ETL. However, threat levels are unlikely to change significantly due to the Project ETL given the current agricultural use of the surrounding area and implementation of mitigation and management measure proposed to be implemented by Pembroke. Reduction of food resources and cover from the establishment and maintenance of Buffel Grass pastures have been identified as a threat to the Squatter Pigeon (southern) (DEE, 2018a). Along with excessive predation by foxes and feral cats, this often increases in response to disturbance (DEE, 2018a). However, through effective pest, weed and introduced pasture grass management, Pembroke would seek to identify, treat, and propose removal strategies to manage this threat through the implementation of a Weed and Pest Management Plan.
introduce disease that may cause the species to decline	The Project ETL does not include activities that would result in a disease that may cause the species to decline.
interfere substantially with the recovery of the species.	The Project ETL would not interfere substantially with the recovery of the species because habitat resources for the Squatter Pigeon (southern) (e.g. drinking sources, remnant and regrowth vegetation for foraging/roosting and nesting habitat) would remain outside of the Project ETL area, such that the species is likely to persist in the landscape.

Source: DPM Envirosciences (2018b).

[1] As defined by the *Matters of National Environmental Significance Significant Impact Guidelines 1.1* (DotE, 2013b).

Within the Study area, the Koala was recorded on numerous occasions along the Isaac River and associate tributaries, including along the Project ETL area (Figure 3-5b) (DPM Envirosciences, 2018b). Recordings included direct observation and identification of scats and scratches within Eucalypt dry woodlands on inland depositional plains, Eucalypt open forest to woodlands on floodplains, and around wetlands (DPM Envirosciences, 2018b).

Within the Study area potential Koala habitat is located within the areas mapped as eucalypt open forests to woodlands on floodplains, eucalypt dry woodlands on inland depositional plains and the vegetation surrounding and within the lacustrine and palustrine wetlands (Figure 3-30c). The potential habitat connections along the waterways (primarily the Isaac River) provide movement corridors and refuge habitat for this species in an otherwise cleared and generally unsuitable landscape (DPM Envirosciences, 2018b).

Those areas of non-remnant vegetation in the Study area are included in the 'Agricultural Grasslands' habitat type, which does not contain an adequate density of Koala trees (Eucalyptus spp. Corymbia spp. Lophostemon spp. or Melaleuca spp. that are > 4 m in height and > 10 cm DBH) to support the species. Other habitat types, such as 'Other coastal communities and heath' and 'Acacia dominated open forests, woodlands and shrublands', also do not contain an adequate density of Koala trees to support the species (DPM Envirosciences, 2018b).

It should be noted that preferred, breeding and foraging habitat for this species are typically the same (i.e. very hard to distinguish between the three) and, as such, have not been separately assessed. Further to this, given the highly mobile nature of this species dispersal habitat would not necessarily be limited to areas of suitable habitat (i.e. it is known to disperse over cleared land to reach areas of suitable habitat).

Impacts

The disturbance footprint for the Project ETL is approximately 42 ha. A total of approximately 12 ha of potential habitat for the Koala would be cleared for the Project ETL (Table 3-34) (DPM Envirosciences, 2018b). An assessment of significance has been conducted in accordance with the *Matters of National Environmental Significance; Significant Impact Guidelines 1.1* (DotE, 2013b) and is provided in Table 3-37.

Avoidance, Mitigation and/or Management Measures

As described in Section 3.5.9 of this document, the following measures would be undertaken by Pembroke to reduce potential adverse impacts on the Koala:

- Impact avoidance measures outlined in the table in Section 3.5.9 (including minimising potential impacts to the riparian corridor associated with the Isaac River).
- Vegetation clearance procedures, including progressive vegetation clearing and retention of hollow-bearing trees where possible.
- A Weed and Pest Management Plan would be implemented to monitor and control feral animals (such as the Feral dog) in the Project ETL area.

The above measures are predicted to be effective in reducing potential adverse impacts on the Koala from the Project ETL because they are focused on addressing the recognised threats to the species and are consistent with the relevant threat abatement actions (e.g. avoiding additional habitat loss and controlling predators) (DEE, 2018a). A National or State recovery plan has not been prepared for this species.

Summary of EPBC Act Assessment

This species was recorded during the field surveys within the Project ETL area (Figure 3-5b) (DPM Envirosciences, 2018b). The Project ETL would result in the removal of approximately 12 ha of potential habitat (including areas of critical habitat as defined by as defined in the *EPBC Act referral guidelines for the vulnerable Koala (combined Qld, New South Wales and the Australian Capital Territory)* (DotE, 2014) for the species, which would be mitigated and offset as described in Sections 3.5.9 and 3.7.

Greater Glider (Petauroides volans)

The Greater Glider is listed as 'Vulnerable' under the EPBC Act.

Background/Description

The Greater Glider is restricted to eastern Australia, occurring from the Windsor Tableland in north Queensland through to central Victoria (Wombat State Forest), with an elevational range from sea level to 1,200 m above sea level. An isolated inland subpopulation occurs in the Gregory Range west of Townsville, and another in the Einasleigh Uplands (DEE, 2018a).

Table 3-37
Likelihood of Significant Adverse Impact of the Project ETL on the Koala

Assessment Criteria[1] Is the Action likely to:	Assessment
lead to a long-term decrease in the size of an important population of a species	The Koala population that has been identified in the Project ETL locality is likely to occur more widely in the surrounding locality and the availability of potential habitat surrounding the Project ETL area extends along the Isaac River and its associated tributaries. In addition, disturbance within the Project ETL area would be predominantly slashing of groundcover and trimming of woody vegetation where required. As such, it is unlikely that the Project ETL would result in a long-term decrease in the size of in an important population.
reduce the area of occupancy of an important population	Given the abundance of this species (ALA 2018) and the availability of surrounding potential habitat that is of similar or better quality (particularly along the Isaac River), it is unlikely that the Project ETL would significantly reduce the area of occupancy of the species relative to its distribution.
fragment an existing important population into two or more populations	Due to the abundance of the species and availability of surrounding habitat, and existing level of habitat fragmentation in the Project ETL locality, it is unlikely that the Project ETL would result in fragmentation of the population into two or more populations. Where possible, riparian vegetation along the Isaac River has been avoided within the mine design in aid of reducing population fragmentation and facilitating movement of this species.
adversely affect habitat critical to the survival of a species (e.g. for activities such as foraging, breeding, roosting, or dispersal or habitat listed in a recovery plan)	The Koala Referral Guidelines (DotE, 2014a) contain a habitat assessment tool for identifying critical habitat. Impact areas that score five or more using the habitat assessment tool for the Koala contain habitat critical to the survival of the Koala. The assessment was completed over the potential habitat in the Project ETL area. The Project ETL would remove habitat which meets the definition of 'Critical Habitat' for the Koala as defined in the *EPBC Act referral guidelines for the vulnerable Koala (combined Qld, New South Wales and the Australian Capital Territory)* (DotE, 2014).
disrupt the breeding cycle of an important population	Given the Project ETL would largely avoid disturbance to the better quality riparian vegetation along the Isaac River where the majority of Koala records exist (Figure 3-5b), it is unlikely that the Project ETL would disrupt the breeding cycle of an important population.
modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	The Project ETL would remove approximately 12 ha of habitat for this species. It is possible that the local population may suffer a small reduction in numbers, however, by minimising disturbance to the better quality riparian habitat along the Isaac River is unlikely that, at a regional level, the species would decline.
result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat	The introduction and spread of invasive weeds and feral animals may occur as a result of the clearance associated with the Project ETL. However, threat levels are unlikely to change significantly due to the Project ETL given the current agricultural use of the surrounding area and implementation of mitigation and management measure proposed to be implemented by Pembroke. Feral dogs have been identified as posing a direct threat to the Koala. However, through effective pest and weed introduced pasture management Pembroke would seek to identify, treat and propose removal strategies through the implementation of a Weed and Pest Management Plan.
introduce disease that may cause the species to decline	Koala populations are threatened by at least two diseases: chlamydia and Koala retrovirus (KoRV). KoRV is estimated to infect up to 100% of Koalas in Queensland, with infection rates slightly lower in southern populations (DEE, 2018a). It is likely that both these diseases already occur in the populations found on and around the Project ETL area. The Project ETL does not include activities that would result in the spread of a disease that may cause the species to decline.
interfere substantially with the recovery of the species.	Impacts which are likely to substantially interfere with the recovery of the Koala (DotE 2014) may include: • Increasing Koala fatalities due to dog attacks. • Increasing Koala fatalities due to vehicle-strikes. • Facilitating the introduction or spread of disease or pathogens for example Chlamydia or *Phytophthora cinnamomi* that are likely to significantly reduce the reproductive output of Koalas or reduce the carrying capacity. • Creating a barrier to movement to, between or within habitat for the Koala that is likely to result in a long-term reduction in genetic fitness. • Changing hydrology which degrades habitat for the Koala to the extent that the carrying capacity of the habitat is reduced. The Project ETL is unlikely to result in these impacts in consideration of the mitigation measure proposed to be implemented (Section 3.5.9), including the retention of the majority of the Isaac River corridor. As such, the Project ETL would not interfere substantially with the recovery of the species

Source: DPM Enviroscienses (2018b).

[1] As defined by the *Matters of National Environmental Significance Significant Impact Guidelines 1.1* (DotE, 2013b).

The Greater Glider is an arboreal nocturnal marsupial, largely restricted to eucalypt forests and woodlands. It is primarily folivorous, with a diet mostly comprising eucalypt leaves, and occasionally flowers (DEE, 2018a). It is typically found in highest abundance in taller, montane, moist eucalypt forests with relatively old trees and abundant hollows (DEE, 2018a). The distribution may be patchy even in suitable habitat (DEE, 2018a). The Greater Glider favours forests with a diversity of eucalypt species, due to seasonal variation in its preferred tree species (DEE, 2018a).

Survey Effort

The survey effort for this species is provided in Table 3-5 and Appendix B.

Habitat Assessment and Definition

The Greater Glider is largely restricted to eucalypt forests and woodlands. It is typically found in higher abundance in taller, montane, moist eucalypt forests with relatively old trees and abundant hollows (TSSC 2016). The distribution may be patchy even in suitable habitat. The Greater Glider favours forests with a diversity of eucalypt species, due to seasonal variation in its preferred tree species (TSSC 2016).

Within the Study area, the Greater Glider was recorded on numerous occasions along the Isaac River and associate tributaries, including within the Project ETL area (Figure 3-5b)
(DPM Envirosciences, 2018b). Recordings included direct observation and identification of scats within Eucalypt dry woodlands on inland depositional plains and Eucalypt open forest to woodlands on floodplains (DPM Envirosciences, 2018b).

In the Study area all areas of eucalypt open forests to woodlands on floodplains and eucalypt dry woodlands on inland depositional plains are considered potential habitat (Figure 3-30c). The potential habitat connections along the waterways (primarily the Isaac River and Ripstone Creek) provide movement corridors and refuge habitat for this species in an otherwise cleared and generally unsuitable landscape
(DPM Envirosciences, 2018b).

Other habitat types within the Study area (including the 'Agricultural Grasslands' habitat type) are not considered suitable for the species because they lack a high density of large mature eucalypts, which are important for foraging and denning
(DPM Envirosciences, 2018b).

It should be noted that preferred, breeding and foraging habitat for this species are typically the same (i.e. very hard to distinguish between the three) and, as such, have not been separately assessed. Further to this, given the highly mobile nature of this species dispersal habitat would not necessarily be limited to areas of suitable habitat (i.e. it is known to disperse over cleared land to reach areas of suitable habitat).

Impacts

The disturbance footprint for the Project ETL is approximately 42 ha. A total of approximately 12 ha of potential habitat for the Greater Glider would be cleared for the Project ETL (Table 3-34) (DPM Envirosciences, 2018b). An assessment of significance has been conducted in accordance with the *Matters of National Environmental Significance; Significant Impact Guidelines 1.1* (DotE, 2013b) and is provided in Table 3-38.

Avoidance, Mitigation and/or Management Measures

As described in Section 3.5.9 of this document, the following measures would be undertaken by Pembroke to reduce potential adverse impacts on the Greater Glider:

- Impact avoidance measures outlined in the table in Section 3.5.9 (including minimising potential impacts to the riparian corridor associated with the Isaac River).
- Vegetation clearance procedures, including progressive vegetation clearing and retention of hollow-bearing trees where possible.
- A Weed and Pest Management Plan would be implemented to monitor and control pests and feral animals in the Project ETL area.

The above measures are predicted to be effective in reducing potential adverse impacts on the Greater Glider from the Project ETL because they are focused on addressing the recognised threats to the species and are consistent with the relevant threat abatement actions (e.g. avoiding additional habitat loss and controlling predators) (DEE, 2018a). A National or State recovery plan has not been prepared for this species.

Summary of EPBC Act Assessment

This species was recorded during the field surveys within the Project ETL area, however records were heavily concentrated around the Isaac River (Figure 3-5b).

Table 3-38
Likelihood of Significant Adverse Impact of the Project ETL on the Greater Glider

Assessment Criteria[1] Is the Action likely to:	Assessment
lead to a long-term decrease in the size of an important population of a species	The Greater Glider population that has been identified in the Project ETL locality is likely to occur more widely in the surrounding locality and the availability of potential habitat surrounding the Project ETL area extends along the Isaac River and its associated tributaries. In addition, disturbance within the Project ETL area would be predominantly slashing of groundcover and trimming of woody vegetation where required. As such, it is unlikely that the Project ETL would result in a long-term decrease in the size of in an important population.
reduce the area of occupancy of an important population	Given the abundance of this species (ALA 2018) and the availability of surrounding potential habitat that is of similar or better quality (particularly along the Isaac River), it is unlikely that the Project ETL would significantly reduce the area of occupancy of the species relative to its distribution.
fragment an existing important population into two or more populations	Due to the abundance of the species and availability of surrounding habitat, and existing level of habitat fragmentation in the Project ETL locality, it is unlikely that the Project ETL would result in fragmentation of the population into two or more populations. Where possible, riparian vegetation along the Isaac River has been avoided within the mine design in aid of reducing population fragmentation and facilitating movement of this species.
adversely affect habitat critical to the survival of a species (e.g. for activities such as foraging, breeding, roosting, or dispersal or habitat listed in a recovery plan)	No habitat within the Project ETL locality has been identified as important or critical habitat for the Greater Glider in any recovery plans or listed on the EPBC Act *Register of Critical Habitat* maintained by the Minister of the Environment under the EPBC Act (DEE, 2018b). The habitat in the Project ETL area for the Greater Glider is not deemed to meet the definition of 'important habitat' or 'critical habitat' under the EPBC Act due to the heavily fragmented nature of the habitat which is more widespread in the wider landscape. The Project ETL is not at a limit of the species range and the population of Greater Glider in the Project ETL locality is likely to occur more widely given the extent of database records and habitat (Figure 3-5b).
disrupt the breeding cycle of an important population	Given the Project ETL would largely avoid disturbance to the better quality riparian vegetation along the Isaac River where the majority of Greater Glider records exist (Figure 3-5b), it is unlikely that the Project ETL would disrupt the breeding cycle of an important population.
modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	The Project ETL would remove approximately 12 ha of habitat for this species. It is possible that the local population may suffer a small reduction in numbers, however, by minimising disturbance to the better quality riparian habitat along the Isaac River is unlikely that, at a regional level, the species would decline.
result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat	The introduction and spread of invasive weeds and feral animals may occur as a result of the clearance associated with the Project ETL. However, threat levels are unlikely to change significantly due to the Project ETL given the current agricultural use of the surrounding area and implementation of mitigation and management measure proposed to be implemented by Pembroke. No particular weeds or feral animals have been implicated as a threat to the species. However, threat levels would be managed by Pembroke through effective pest and weed introduced pasture management Pembroke would seek to identify, treat and propose removal strategies through the implementation of a Weed and Pest Management Plan.
introduce disease that may cause the species to decline	The Project ETL does not include activities that would result in a disease that may cause the species to decline.
interfere substantially with the recovery of the species.	A recovery plan has not yet been developed for the Greater Glider. Due to the preservation of the majority of the Isaac River riparian corridor, the Project ETL is unlikely to interfere with any of the actions listed for the recovery of the species.

Source: DPM Enviros ciences (2018b).

[1] As defined by the *Matters of National Environmental Significance Significant Impact Guidelines 1.1* (DotE, 2013b).

The Project ETL would result in the removal of approximately 12 ha of potential habitat for the species, which is unlikely to result in a significant impact to the Greater Glider (DPM Envirosciences, 2018b). Despite this, the impacts associated with the Project as a whole (including the Project ETL area) would be mitigated and offset as described in Sections 3.5.9 and 3.7.

Other Threatened Species

Other threatened species identified within the Terms of Reference or within a search area covering the wider locality include:

- Red Goshawk (*Erythrotriorchis radiatus*)*;*
- Curlew Sandpiper (*Calidris ferruginea*)*;*
- Painted Honeyeater (*Grantiella picta*)*;*
- Star Finch (eastern) (*Neochmia ruficauda ruficauda*)*;*
- Black-throated Finch (southern) (*Poephila cincta cincta*)*;*
- Northern Quoll (*Dasyurus hallucatus*)*;*
- Grey-headed Flying-fox (*Pteropus poliocephalus*)*;*
- Ghost Bat (*Macroderma gigas*)*;*
- Corben's Long-eared Bat (*Nyctophilus corbeni);*
- Southern Snapping Turtle (*Elseya albagula*)*;*
- Fitzroy River Turtle (*Rheodytes leukops*)*;*
- Yakka Skink (*Egernia rugosa*);
- Allan's Lerista (*Lerista allanae*)*;*
- Dunmall's Snake (*Furina dunmalli*)*;*
- *Cycas ophiolitica;*
- King Blue-grass *(Dichanthium queenslandicum);*
- Bluegrass (*Dichanthium setosum*)*;*
- Black Ironbox (*Eucalyptus raveretiana*)*; and*
- Quassia (*Samadera bidwillii*)*.*

Potential adverse impacts on the threatened species listed above have been assessed in Table 3-39. None of these species were found despite targeted surveys (Section 3.2.4.3), but they are considered in this section due to the potential for the species to be present in the Project ETL and/or adjacent habitats (irrespective of whether the species were detected during targeted surveys) (DPM Envirosciences, 2018b).

Of these, only the Red Goshawk, King Blue-grass, Bluegrass and Black Ironbox are considered to have potential to occur within the Project ETL area based on the presence of suitable habitats and previous records (DPM Envirosciences, 2018b).

In summary, it is concluded that the Project ETL is unlikely to significantly impact any of these species in accordance with the significant impact criteria detailed in the *Significant Impact Guidelines 1.1: Matters of National Environmental Significance* (DotE, 2013b) (DPM Envirosciences, 2018b).

3.5.7.2 Threatened Ecological Communities

The *Brigalow (Acacia harpophylla dominant and co-dominant) ecological community* (Brigalow TEC), was identified within the Study area. Brigalow TEC within the Study area comprises only those patches of vegetation that meet the condition thresholds identified in DotE (2013a) (DPM Envirosciences, 2018a).

No other TEC listed under the EPBC Act was recorded within the Study area.

Brigalow (Acacia harpophylla dominant and co-dominant) ecological community

Sixteen potential TEC vegetation patches were assessed for floristic values as part of the field surveys in November 2016. This included one Tertiary flora survey site in RE 11.3.1, three Quaternary flora survey sites in RE 11.3.1, six in RE 11.4.8 and six in RE 11.4.9 (DPM Envirosciences, 2018a). Most patches failed to meet the Brigalow TEC condition thresholds, owing primarily to groundcover being dominated by exotic species including Buffel Grass (*Cenchrus ciliaris*) (DPM Envirosciences, 2018a).

Patches of regrowth vegetation within the Study area were also assessed to determine whether they meet the criteria to be mapped as Brigalow TEC (DotE, 2013a). No patches of regrowth vegetation were determined to meet these criteria as the trees were too small to have been more than 15 years old and the understory vegetation was dominated by weeds (i.e. Buffel Grass) (DPM Envirosciences, 2018a).

The disturbance footprint for the Project ETL is approximately 42 ha. The Project ETL would avoid all patches of Brigalow TEC that have been mapped within the Study area (Figure 3-3). In addition, the Project ETL would not result in any indirect impacts to the small patch of Brigalow TEC mapped to the south of the construction corridor (DPM Envirosciences, 2018a).

Table 3-39
Assessments for Other Threatened Species Relevant to the Project ETL Area

Species Name	Common Name	Conservation Status[1]	Presence in the Project Locality and Potential Impact
Erythrotriorchis radiatus	Red Goshawk	V	The Red Goshawk is considered to have potential to occur within the Project ETL area as some areas of suitable habitat are present (e.g. eucalypt dry woodlands and the wetlands and waterways). This species typically occurs in tall open forest, woodland, lightly treed savannah and the edge of rainforest (DEHP 2018e). Despite this, the species was not recorded during the targeted surveys and the nearest previous record is located approximately 50 km to the east of the Project ETL (ALA, 2018). Nests are in tall trees within 1 km of and often besides, permanent water (river, swamp, pool), usually in fairly open, biologically rich forest or woodland. The average distance of the nest tree to water was 164 m (DEE, 2018). Although the Project ETL may remove some areas of potential habitat for this species it is unlikely that it would result in a significant impact on this species given: • this species has not been recorded within the Project ETL area; • areas of potential habitat for this species are likely to occur more widely in the surrounding landscape; and • this species is highly mobile and possesses the ability to disperse into the large areas of potential habitat outside the Project ETL.
Calidris ferruginea	Curlew Sandpiper	CE	This species is unlikely to occur within the Project ETL area as it was not recorded during the recent surveys undertaken by DPM Enviros ciences (2018b) and it has not been previously recorded within 50 km of the Project ETL area. This species typically inhabits intertidal mudflats of estuaries, lagoons, mangrove channels, around lakes, dams, flood waters, flooded saltbush surrounds of inland lakes (Morcombe 2003). Although the Project ETL would clear wetland and waterway habitats that could provide potential habitat for this species on occasion, it is unlikely that this would result in a significant impact on the Curlew Sandpiper given: • previous targeted searches have found no records of the species within 50 km of the Project ETL area; • the species is classified as a migratory shorebird in Marine bioregional plan for the North-west Marine Region (DSEWPC, 2012c); • the species does not breed in Australia (DotE, 2015); • The Project ETL area is not classified as internationally important to the species (Bamford et al., 2008) per the Wildlife Conservation Plan for Migratory Shorebirds (DotE, 2015); • the species is wide ranging, with densely distributed records along the coastline of Australia (ALA, 2018); and • habitat is abundant for the species given the densely populated coastlines of Australia (ALA, 2018).

Table 3-39 (Continued)
Assessments for Other Threatened Species Relevant to the Project ETL Area

Species Name	Common Name	Conservation Status[1]	Presence in the Project Locality and Potential Impact
Grantiella picta	Painted Honeyeater	V	This species is unlikely to occur within the Project ETL area as it was not recorded during the recent surveys undertaken by DPM Envirosciences (2018b) and it has not been previously recorded within 50 km of the Project ETL area. This species typically inhabits dry, open forests and woodlands (Box, Ironbark, Yellow Gum, Melaleuca, Casuarina, Callitris, Acacia), usually in areas with flowering and fruiting mistletoe and flowering eucalypts (DEHP, 2018f). Although the Project ETL may remove some areas of potential habitat for this species (e.g. euclaypt woodlands) it is unlikely that this would result in a significant impact on this species given: • this species has not been recorded within the Project ETL area or surrounds despite targeted surveys; • areas of potential habitat for this species are likely to occur more widely in the surrounding landscape; and • this species is highly mobile and possesses the ability to disperse into the large areas of potential habitat outside the Project ETL.
Neochmia ruficauda ruficauda	Star Finch (eastern)	E	This species is unlikely to occur within the Project ETL area as it was not recorded during the recent surveys undertaken by DPM Envirosciences (2018b) and it has not been previously recorded within 50 km of the Project ETL area. The nearest database record is located approximately 50 km from the Project ETL and is from 1956 (ALA, 2018). DEE completed two targeted field surveys for the Star Finch (eastern) which were conducted in central Queensland in 1993-94 and 1996-97 and failed to locate any Star Finches (eastern). In addition, there have been no sightings of the Star Finch (eastern) in the wild since 1995 (DEE, 2018, DPM Envirosciences, 2018). Given the above, it is unlikely that the Project ETL would result in a significant impact to this species.
Poephila cincta cincta	Black-throated Finch (southern)	E	This species is unlikely to occur within the Project ETL area as it was not recorded during the recent surveys undertaken by DPM Envirosciences (2018b) and it has not been previously recorded within 50 km of the Project ETL area. The Black-throated Finch inhabits grassy woodland dominated by eucalypts, paperbarks or acacias where there is accessibility to seeding grasses, with riparian habitat being particularly important (DEHP 2018d). Although the Project ETL may remove some areas of potential habitat for this species (e.g. riparian woodlands) it is unlikely that it would result in a significant impact on this species given: • this species has not been recorded within the Project ETL area or surrounds despite targeted surveys; • areas of potential habitat for this species (e.g. riparian woodlands) are likely to occur more widely in the surrounding landscape; and • this species is highly mobile and possesses the ability to disperse into the large areas of potential habitat outside the Project ETL.
Dasyurus hallucatus	Northern Quoll	E	This species is unlikely to occur within the Project ETL area as it was not recorded during the recent surveys undertaken by DPM Envirosciences (2018b) and it has not been previously recorded within 50 km of the Project ETL area. Further to this, the nearest database record of this species is from 1969. The Northern Quoll is known to inhabit hilly or rocky areas close to permanent water; but occurs in a range of habitats, including open dry sclerophyll forest and woodland, riparian woodland, low dry vine thicket, the margins of notophyll vineforest, mangroves, sugarcane farms and in urban areas (DEHP 2018g). The Project ETL area does not contain rocky areas that would provide suitable habitat for the Northern Quoll.

Table 3-39 (Continued)
Assessments for Other Threatened Species Relevant to the Project ETL Area

Species Name	Common Name	Conservation Status[1]	Presence in the Project Locality and Potential Impact
Pteropus poliocephalus	Grey-headed Flying-fox	V	This species is unlikely to occur within the Project ETL area as it was not recorded during the recent surveys undertaken by DPM Envirosciences (2018b) and it has not been previously recorded within 50 km of the Project ETL area. This species typically roosts in native vegetation near water, including mangrove, rainforest, melaleuca or casuarina (Churchill 2008). The Grey-headed Flying Fox typically commute within 15 km to feed on flowering and fruiting plants, including blossoms of various species of eucalypt, angophora, tea-tree and banksia (Strahan 1995). Although the Project ETL may remove some areas of foraging habitat for this species (e.g. eucalypt woodlands) it is unlikely that it would result in a significant impact on this species given: • this species has not been recorded within the Project ETL area or surrounds despite targeted surveys; • areas of potential habitat for this species (e.g. eucalypt woodlands) are likely to occur more widely in the surrounding landscape; and • this species is highly mobile and possesses the ability to disperse into the large areas of potential habitat outside the Project ETL.
Macroderma gigas	Ghost Bat	V	This species is unlikely to occur within the Project ETL area as it was not recorded during the recent surveys undertaken by DPM Envirosciences (2018b) and it has not been previously recorded within 50 km of the Project ETL area. The closest sighting in 1978 approximately 70 km from the Project ETL. The Ghost Bat typically inhabits spinifex hillsides, black soil grasslands, monsoon forest, open savannah woodland, tall open forest, deciduous vine forest and tropical rainforest, influenced by the availability of caves and mines for roosting (Churchill 2008). Roost sites include caves, rock crevices and disused mine adits. Given the site characteristics (predominately euclypt woodland) and the lack of caves within the Project ETL area it is unlikely the Ghost Bat would utilise the habitat within the Project ETL area.
Nyctophilus corbeni	Corben's Long-eared Bat	V	This species is unlikely to occur within the Project ETL area as it was not recorded during the recent surveys undertaken by DPM Envirosciences (2018b) and it has not been previously recorded within 50 km of the Project ETL area. The Corben's Long-eared Bat is known to inhabit areas with a cluttered understorey layer in river red gum, black box, *Allocasuarina*, belah, mallee, open woodlands, and savannahs; roosting in fissures in branches and under dried sheets of bark still attached to the trunks of trees; utilising tree hollows for maternity sites (Churchill 2008). Although the Project ETL may remove some areas of foraging habitat for this species (e.g. eucalypt woodlands) it is unlikely that it would result in a significant impact on this species given: • this species has not been recorded within the Project ETL area or surrounds despite targeted surveys; • areas of potential habitat for this species (e.g. eucalypt woodlands) are likely to occur more widely in the surrounding landscape; and • this species is highly mobile and possesses the ability to disperse into the large areas of potential habitat outside the Project ETL.

Table 3-39 (Continued)
Assessments for Other Threatened Species Relevant to the Project ETL Area

Species Name	Common Name	Conservation Status[1]	Presence in the Project Locality and Potential Impact
Elseya albagula	Southern Snapping Turtle	CE	This species is unlikely to occur within the Project ETL area as it was not recorded during the recent surveys undertaken by DPM Envirosciences (2018b) and it has not been previously recorded within 50 km of the Project ETL area. The Southern Snapping Turtle inhabits permanent flowing water habitats where there are suitable shelters and refuges (DEHP 2018h); clear, flowing, well-oxygenated waters of the Fitzroy, Mary and Burnett catchments. Suitable habitat for this species was not identified during the recent aquatic ecology surveys undertaken by DPM Envirosciences (2018c).
Rheodytes leukops	Fitzroy River Turtle	V	This species is unlikely to occur within the Project ETL area as it was not recorded during the recent surveys undertaken by DPM Envirosciences (2018b) and it has not been previously recorded within 50 km of the Project ETL area. The Fitzroy River Turtle is known to inhabit fast-flowing water of the Fitzroy River and its tributaries (Cogger, 2014). Rivers with large deep pools and rocky, gravelly or sandy substrates, connected by shallow riffles. Preferred areas have high water clarity and are often associated with ribbonweed (*Vallisneria* sp.) (DEE 2017). Suitable habitat for this species was not identified during the recent aquatic ecology surveys undertaken by DPM Envirosciences (2018c).
Egernia rugosa	Yakka Skink	V	This species is unlikely to occur within the Project ETL area as it was not recorded during the recent surveys undertaken by DPM Envirosciences (2018b) and it has not been previously recorded within 50 km of the Project ETL area. The Yakka Skink typically inhabits dry open forests, woodlands and rocky areas (Wilson and Swan 2013). Although the Project ETL may remove some areas of foraging habitat for this species (e.g. eucalypt woodlands and brigalow) it is unlikely that it would result in a significant impact on this species given: • this species has not been recorded within the Project ETL area or surrounds despite targeted surveys; • areas of potential habitat for this species (e.g. eucalypt woodlands and brigalow) are likely to occur more widely in the surrounding landscape; and • many areas of potentially suitable habitat are considered to be suboptimal based on the lack of suitable microhabitat features.
Lerista allanae	Allan's Lerista	E	This species is unlikely to occur within the Project ETL area as it was not recorded during the recent surveys undertaken by DPM Envirosciences (2018b) and it has not been previously recorded within 50 km of the Project ETL area. The Allan's Lerista is restricted to road verges and other small areas with friable soils, amid pastoral land dominated by heavy soils in the vicinity of Capella, Clermont and Logan Downs Station (Wilson and Swan 2013). Suitable habitat for this species was not identified within the Project ETL area (DPM Envirosciences, 2018b).
Furina dunmalli	Dunmall's Snake	V	This species is unlikely to occur within the Project ETL area as it was not recorded during the recent surveys undertaken by DPM Envirosciences (2018b) and it has not been previously recorded within 50 km of the Project ETL area. This species typically inhabits woodlands and dry sclerophyll forest, particularly areas featuring brigalow (Wilson and Swan, 2013). It is determined that that this species is unlikely to occur as the elevation of the Project ETL is too low (this species prefer habitat 200 to 500 m AHD [DEE, 2018a]).

Table 3-39 (Continued)
Assessments for Other Threatened Species Relevant to the Project ETL Area

Species Name	Common Name	Conservation Status[1]	Presence in the Project Locality and Potential Impact
Cycas ophiolitica	-	E	This species is unlikely to occur within the Project ETL area as it was not recorded during the recent surveys undertaken by DPM Enviros ciences (2018b) and it has not been previously recorded within 50 km of the Project ETL area. This species grows on hills and slopes in sparse, grassy open forest at altitude ranges from 80–400 m above sea level. Although this species reaches its best development on red clay soils near Marlborough, it is more frequently found on shallow, stony, infertile soils, which are developed on sandstone and serpentinite, and is associated with species such as *Corymbia dallachiana, C. erythrophloia, C. xanthope* and *Eucalyptus fibrosa. Cycas ophiolitica* has also been found on mudstone in association with *Corymbia dallachiana, C. erythrophloia* and *Eucalyptus crebra*, and on alluvial loams with *Corymbia intermedia, Eucalyptus drepanophylla* and *E. tereticornis* (DEE 2018a). Habitat for this species was not identified during the recent floristic surveys undertaken by DPM Enviros ciences (2018a).
Dichanthium queenslandicum	King Blue-grass	E	King Blue-grass is considered to have potential to occur within the Project ETL area as some areas of suitable habitat are present. This species typically inhabits black cracking clay in tussock grasslands mainly in association with other species of blue grasses (*Dichanthium* spp. and *Bothriochloa* spp.), but also with other grasses restricted to this soil type (DEE, 2018a). *D. queenslandicum* is mostly confined to natural grassland on the heavy black clay soils (basalt downs, basalt cracking clay, and open downs) on undulating plains (DEHP 2018i). Although the Project ETL may remove some areas of potential habitat for this species it is unlikely that it would result in a significant impact on this species given: • this species has not been recorded within the Project ETL area despite targeted surveys; • no areas of Natural Grassland TEC were recorded within the Project ETL area; and • areas of potential habitat for this species are likely to occur more widely in the surrounding landscape.
Dichanthium setosum	Bluegrass	V	Bluegrass is considered to have potential to occur within the Project ETL area as some areas of suitable habitat are present. This species has been recorded from the Leichardt, Morton, North Kennedy and Port Curtis regions (Henderson, 1997). It is known to occur in the Mistake Range, in Main Range National Park and possibly in Glen Rock Regional Park. Bluegrass is strongly associated with heavy basaltic black soils and stony red-brown hard-setting loam with clay subsoil (DEE 2018a) and is found in moderately disturbed areas such as cleared woodland, grassy roadside remnants, grazed land and highly disturbed pasture (DEE 2017). Although the Project ETL may remove some areas of potential habitat for this species it is unlikely that it would result in a significant impact on this species given: • this species has not been recorded within the Project ETL area despite targeted surveys; and • areas of potential habitat for this species are likely to occur more widely in the surrounding landscape.

Table 3-39 (Continued)
Assessments for Other Threatened Species Relevant to the Project ETL Area

Species Name	Common Name	Conservation Status[1]	Presence in the Project Locality and Potential Impact
Eucalyptus raveretiana	Black Ironbox	V	Black Ironbox is considered to have potential to occur within the Project ETL area as some areas of suitable habitat are present. This species is known to occur along watercourses and occasionally on river flats. It occurs in open forest or woodland communities, preferring sites with moderately fertile soil and adequate sub-soil moisture. The alluvial soils in which it grows are sands, loams, light clays or cracking clays (DEHP, 2018j). Although the Project ETL may remove some areas of potential habitat for this species it is unlikely that it would result in a significant impact on this species given: • this species has not been recorded within the Project ETL area despite targeted surveys; and • areas of potential habitat for this species are likely to occur more widely in the surrounding landscape.
Samadera bidwillii	Quassia	V	This species is unlikely to occur within the Project ETL area as it was not recorded during the recent surveys undertaken by DPM Envirosciences (2018b) and it has not been previously recorded within 50 km of the Project ETL area. Quassia commonly occurs in lowland rainforest or on rainforest margins, but it can also be found in other forest types, such as open forest and woodland. Quassia is commonly found in areas adjacent to both temporary and permanent watercourses in locations up to 510 m altitude. The species occurs on lithosols, skeletal soils, loam soils, sands, silts and sands with clay subsoils (DEE, 2018a). Habitat for this species was not identified during the recent floristic surveys undertaken by DPM Envirosciences (2018a).

[1] Threatened Species Status under the EPBC Act (current as of May 2018).

V = Vulnerable.

E = Endangered.

CE = Critically Endangered.

As such, it is concluded that the Project ETL would not result in a significant impact to Brigalow TEC (DPM Envirosciences, 2018a).

3.5.8 Impact Avoidance, Mitigation Measures and Management Plans

3.5.8.1 Impact Avoidance Measures

The Project ETL would utilise an existing easement between the sub-station on Peak Downs Highway and the rail (Norwich Park Branch), then follows Daunia Road and Annandale Road before heading south for 13 km across predominately cleared land to the MLA.

The Project ETL would be restricted to a construction corridor of 10 m.

3.5.8.2 Proposed Mitigation Measures

Mitigation measures proposed to be implemented for the Project are detailed in Table 3-40.

The measures identified in Table 3-40 are predicted to be effective in reducing potential adverse impacts on the MNES potentially impacted by the Project ETL because they are focused on addressing the recognised threats to the relevant species and communities and are not inconsistent with the following documents:

- *Approved Conservation Advice for the Brigalow (Acacia harpophylla dominant and co-dominant) ecological community* (DotE, 2013a);
- *Commonwealth Listing Advice on Brigalow (Acacia harpophylla dominant and co-dominant)* (TSSC, 2001).
- *Approved Conservation Advice for Denisonia maculata (Ornamental Snake)* (DotE, 2014).
- *Approved Conservation Advice for Rostratula australis (Australian Painted Snipe)* (DSEWPaC, 2013).

Table 3-40
Proposed Avoidance and Mitigation Measures for the Project ETL

Potential impact	Mitigation measures
Vegetation clearing	• Demarcate exclusion zones prior to clearing to protect areas of vegetation to be retained. • Vegetation clearing / excavation to be subject to internal permitting system. • Salvage felled vegetation for millable timber, as appropriate. • Collection of native seed from the Project ETL area for use in rehabilitation program. • Implement the Vegetation Management Plan (Section 3.5.9.3).
Fauna mortality	• Where applicable limit time of construction to avoid breeding seasons for threatened species. • Licensed fauna spotter-catchers to undertake detailed inspection of areas to be cleared • Where practical, retain hollow-bearing trees and large stags as potential nesting and roosting habitat. • Vehicular traffic generally to be restricted to access tracks and an on-site speed limit would be applied..
Reduction of threatened fauna populations	• Implement management measures for fauna mortality, as outlined above. • Prepare a Species Management Program (in accordance with section 332 of the *Nature Conservation [Wildlife Management] Regulation, 2006*).
Increased numbers of feral animals	• Management of feral animals, particularly dogs, cats and pigs. • Implement Weed and Pest Management Plan (Section 3.5.9.3)
Weed management and edge effects	• Clearing of vegetation to be restricted to the minimum required to enable the safe construction, operation and maintenance of the Project ETL. • Identification of weed infestations. • Prioritisation of treatment of weed infestations or weed species and ongoing treatment regimes (as necessary). • Strategies for preventing weed spread i.e. machinery wash-down, boot scrubbing facilities, appropriate disposal of weed material. • Implement the Weed and Pest Management Plan (Section 3.5.9.3).

- *Conservation Advice Geophaps scripta scripta Squatter Pigeon (southern)* (TSSC, 2015).
- *Approved Conservation Advice for Phascolarctos cinereus (combined populations in Queensland, New South Wales and the Australian Capital Territory)* (SEWPaC, 2012)
- *Conservation Advice Petauroides volans Greater Glider* (TSSC, 2016)
- *Threat Abatement Plan for Competition and Land Degradation by Rabbits* (DEE, 2016).
- *Threat Abatement Plan for Predation by Feral Cats* (DotE, 2015).
- *Threat Abatement Plan for Predation, Habitat Degradation, Competition and Disease Transmission by Feral Pigs (Sus scrofa)* (DEE, 2017).
- *Threat Abatement Plan for the Biological Effects, Including Lethal Toxic Ingestion, Caused by* Cane Toads (SEWPaC, 2015).

Pembroke is responsible for funding the costs of all mitigation measures as required

3.5.8.3 Proposed Management Plans

The following management plans would be implemented by Pembroke for the ongoing management of potential impacts on MNES associated with the Project (including the Project ETL):

- Vegetation Management Plan, including:
  - demarcate exclusion zones to protect areas of vegetation to be retained prior to clearing;
  - vegetation clearing / excavation to only be authorised in accordance with clearing / disturbance permitting system to ensure that the Environmental Advisor has reviewed all proposed clearing / excavation activities throughout operation of the mine;
  - salvage of felled vegetation for millable timber, as appropriate; and
  - collection of native seed from Project area prior to clearing for use in rehabilitation program;
- Weed and Pest Management Plan, including:
  - identification of weed infestations;
  - strategies for preventing weed spread (i.e. machinery wash-down, boot scrubbing facilities, appropriate disposal of weed material);
  - prioritisation of treatment of weed infestations or weed species and ongoing treatment regimes (as necessary);
  - recommended weed removal strategies (including those appropriate for aquatic habitats); and
  - weed monitoring protocols and follow-up weed control methods and protocols.

Additional management plans are discussed in Section 3.3.11.3.

Environmental Outcomes

An outcome of the Action would be the enhancement and security of the Stage One Offset Area (as described in Section 3.7) to address the potentially significant residual impacts on threatened species and communities. The desired outcome of the proposed offset is that the extent and condition of the habitat values of threatened species and communities within the offset areas are protected and enhanced. The land in the offset areas will be enhanced so as the currently degraded areas reach remnant status through increasing the structural integrity and extent of vegetation in the area.

3.5.9 Consideration of the Project against the Objects of the Environment Protection and Biodiversity Conservation Act, 1999

As described in Section 3.5.6, the Project ETL is one component of the larger Project and as such, the consideration of the Project (as a whole) against the objects of the EPBC Act, provided in Section 3.3.14, is relevant to the Project ETL.

In conclusion, for the reasons outlined in Section 3.3.14, in consideration of the requirements of the EPBC Act (including the objects of the EPBC Act) the Project ETL is considered to be environmentally acceptable.

3.5.10 Conclusion

Pembroke has assessed a number of alternatives to the Project ETL. The final proposed mannor in which the Project ETL would be constructed and operated is considered to be environmentally acceptable in consideration of the requirements of the EPBC Act (including the objects of the EPBC Act), the principles of ecologically sustainable development and the precautionary principle.

Potential impacts on listed threatened species and communities associated with the Project ETL includes the direct removal of potential and known habitat for threatened species and native vegetation.

The Project ETL is not expected to result in any consequential impacts to any threatened species or community listed under the EPBC Act (DPM Enviros ciences, 2018b). Further to this there are no impacts relevant to the Project ETL that are unknown, unpredictable or irreversible.

The avoidance and mitigation measures proposed for the Project ETL are acceptable and predicted to be effective in reducing potential adverse impacts on the MNES because they are focused on addressing the recognised threats to threatened species and communities and are not inconsistent with the relevant approved conservation advice and threat abatement plans.

Significant Impact Assessments have been conducted for all MNES which are known or have the potential to occur within the Project ETL area and surrounds in accordance with the *Significant Impact Guidelines 1.1 – Matters of National Environmental Significance* (DotE 2013b) (DPM Enviros ciences, 2018a and b).

In addition to the rehabilitation of the Project ETL area, Pembroke would provide a biodiversity offset for the impacts associated with the Project ETL in accordance with the *Queensland Environmental Offsets Policy (Version 1.4)* (DEHP, 2017) and *EPBC Act Environmental Offsets Policy* (SEWPaC, 2012a) (and supporting *EPBC Act Offsets Assessment Guide* [SEWPaC, 2012b]) (Section 3.8). The biodiversity offset area (once established) would provide a beneficial conservation outcome for biodiversity in the region.

3.6 OLIVE DOWNS PROJECT RAIL SPUR (EPBC 2017/7870)

3.6.1 Location of the Action

The Olive Downs Project Rail Spur (EPBC 2017/7868) (herein referred to as Rail Spur and Loop) is located approximately 170 km south west of Mackay, in the Bowen Basin region of central Qld (Figure 2-1). The Rail Spur and Loop is located approximately 40 km south-east of Moranbah, and 35 km north of Dysart within the Isaac Regional Council LGA in a mining precinct comprising several existing mining operations.

3.6.2 Description of the Action

A description of the works to be undertaken during the construction, operations and decommissioning phases of the Rail Spur and Loop is provided below. The total disturbance footprint of the Rail Spur and Loop is approximately 103.5 ha (Figure 2-2).

It should be noted that entirety of the Rail Spur and Loop has been collocated with the Water Pipeline (Section 3.3).

3.6.2.1 Construction

The Project would include the construction of the rail spur from the Norwich Park Branch Railway and rail loop adjacent the rail-loadout facility at the Olive Downs South Domain (Figure 2-2).

Overhead line equipment may be installed for traction power to facilitate train operations, as well as other connecting infrastructure to the main line. Diesel train operations may also be used. Communications and control systems would also be established to integrate with the existing network.

The track and formation levels would be designed to achieve a desirable 1% AEP flood immunity (to the top of ballast), or otherwise match the existing main line level of immunity. Diversion channels and supplemental earthworks would be undertaken if required to protect the alignment and control flood behaviour.

New culvert crossings would be installed along the Rail Spur and Loop to the Olive Downs South Domain with the final locations to be determined during the detailed design. The associated rail loop to be constructed adjacent the rail-loadout facility at the Olive Downs South Domain would be designed for a two train capacity.

The Rail Spur and Loop would be consutrcuted during the first Stage of the Project (Section 3.3.2).

3.6.2.2 Operation

The product coal stockpiles at the Olive Downs South Domain would be delivered progressively up to approximately 550,000 t capacity as the production rate increases over the life of the Project. Approximately 480,000 t would be utilised for coking and PCI coal products with the remaining stockpile capacity for by-products (i.e. thermal coal).

Based on the indicative mine schedule, up to approximately 15 Mtpa of product coal would be transported by rail to the port for export.

To allow for cargo assembly for loading of ships to meet the required performance standards at the port, a peak of up to eight product coal trains per day may be required at times.

The Rail Spur and Loop would remain operational for the duration of the Project.

3.6.2.3 Decommissioning and Rehabilitation

The Rail Spur and Loop will be assessed for possible removal or to be retained for future land owners. Where infrastructure is removed, the land would be re-contoured, topsoiled, ripped and seeded. All disturbed areas would be rehabilitated with an appropriate seed mix to enable revegetation.

It is anticipated that the Rail Spur and Loop would be decommissioned within two years of the completion of mining operations.

3.6.3 Current Status of the Action

The Rail Spur and Loop was referred to the DEE under the EPBC Act on 24 January 2017. On 3 March 2017 the Rail Spur and Loop was determined to be a "Controlled Action". DEE advised that the bilateral assessment under section 45 of the EPBC Act applies to the Project.

Works associated with the Rail Spur and Loop has not commenced.

3.6.4 Consequence of Not Proceeding

The Rail Spur and Loop is one component of the larger Project (Section 3.6.6).

The Rail Spur and Loop would be required for the following transport of product coal from the Project area to the port for export. Should the Rail Spur and Loop not be constructed, the Project would not be able to proceed.

Section 3.2.4 describes the consequences of the Project not proceeding.

3.6.5 Alternatives Considered

A number of alternative alignments for the Rail Spur and Loop was investigated during pre-feasibility studies, including the three options described in the original EPBC Act Referral.

Although a number of alignments were considered to provide a better engineering design or a lower cost (e.g. alignments that took straighter paths or had fewer road crossings), the final alignment was selected as it:

- minimise impacts to other tenement holders, by locating the Rail Spur and Loop along tenement boundaries;
- minimise impact to existing land uses by collocating the Rail Spur and Loop with the Water Pipeline in the same corridor; and
- minimise the impacts to private landholdings by locating the Rail Spur and Loop within existing easements and road corridors, where practicable.

3.6.6 Relationship to Other Actions

The Project also includes construction of the Mine Site and Access Road (Section 3.2), Water Pipeline (Section 3.3) and the Project ETL (Section 3.4).

As detailed in Section 3.1, the Mine Site and Access Road, Project ETL, Rail Spur and Loop and Water Pipeline were referred separately to the DEE. Pembroke is the proponent for all four actions.

Should Pembroke, in the future, decide to transfer the responsibility of the proposed Water Pipeline, Rail Spur and Loop and/or Project ETL to another company (e.g. SunWater, Aurizon or Ergon) all relevant approvals would also need to be transferred.

Given the EPBC Act does not allow individual elements of a single referred action (e.g. Project ETL, Rail Spur and Loop and Water Pipeline) to be transferred between proponents, Pembroke has decided to lodge four separate referrals covering separate aspects of the Project. This facilitates the transfer of approvals between proponents for the individual elements of the Project.

3.6.7 Impacts on Listed Threatened Species and Ecological Communities

3.6.7.1 Threatened Species

The following threatened fauna species listed under the EPBC Act were recorded from the Rail Spur and Loop area and surrounds, during the field surveys (Figure 3-5) (DPM Enviros ciences, 2018b):

- Ornamental Snake;
- Australian Painted Snipe;
- Squatter Pigeon (southern);
- Koala; and
- Greater Glider.

Further to this, potential impacts to an additional 19 fauna listed in the Terms of Reference, or identified within a search area covering the wider locality, were assessed by DPM Enviros ciences (2018b) These include:

- Red Goshawk (*Erythrotriorchis radiatus*);
- Curlew Sandpiper (*Calidris ferruginea*);
- Painted Honeyeater (*Grantiella picta*);

- Star Finch (eastern) (*Neochmia ruficauda ruficauda*)*;*
- Black-throated Finch (southern) (*Poephila cincta cincta*)*;*
- Northern Quoll (*Dasyurus hallucatus*)*;*
- Grey-headed Flying-fox (*Pteropus poliocephalus*)*;*
- Ghost Bat (*Macroderma gigas*)*;*
- Corben's Long-eared Bat (*Nyctophilus corbeni);*
- Southern Snapping Turtle (*Elseya albagula*)*;*
- Fitzroy River Turtle (*Rheodytes leukops*)*;*
- Yakka Skink (*Egernia rugosa*);
- Allan's Lerista (*Lerista allanae*)*;*
- Dunmall's Snake (*Furina dunmalli);*
- *Cycas ophiolitica;*
- King Blue-grass *(Dichanthium queenslandicum);*
- Bluegrass (*Dichanthium setosum*)*;*
- Black Ironbox (*Eucalyptus raveretiana*)*; and*
- Quassia (*Samadera bidwillii*)*.*

These species are discussed in detail below.

Ornamental Snake (Denisonia maculata)

The Ornamental Snake (*Denisonia maculata*) is listed as 'Vulnerable' under the EPBC Act.

Background/Description

The Ornamental Snake occurs in scattered locations over a large area in Brigalow Belt North and South Bioregions and small portions of the Desert Uplands Bioregion and Central Coast Bioregion in Qld (DEE, 2018a).

Within its distribution, the Ornamental Snake inhabits moist or seasonally moist areas within appropriate refuge habitat and aquatic or fringing vegetation with frog species forming their main prey (Cogger, 2014). The Ornamental Snake is most likely to occur in Qld regional ecosystem Land Zone 4 (DEE, 2018a) and most likely in Brigalow-dominated ecosystems supporting gilgai.

Survey Effort

The survey effort for this species is provided in Table 3-5 and Appendix B.

Habitat Assessment and Definition

The Ornamental Snake prefers habitat that is close to its prey (frogs). It prefers moist woodlands and open forests, particularly gilgai mounds as well as lake margins and wetlands (DEE 2018). It is found in low-lying subtropical areas with deep-cracking clay soils and persists in cleared, disturbed habitat, particularly where brigalow communities have been cleared (DSEWPaC, 2011).

Four Ornamental Snake were recorded at three locations within the Olive Downs South Domain and a further five locations within the Willunga Domain (Figure 3-5c). The species was identified via a combination nocturnal spotlighting (DPM Enviros ciences, 2018b). These records occurred within agricultural grasslands on cracking clays, around palustrine wetlands, within Acacia dominated open forests, woodland and shrublands, and also one record within Eucalypt dry woodlands on inland depositional plains (expected to be a transient individual).
Database records for this species are relatively common in the wider locality, with more than 14 records within 15 km of the Rail Spur and Loop (DPM Enviros ciences, 2018b).

The Ornamental Snake was not recorded within the Rail Spur and Loop area, the closest record is approximately 2.5 km to the west (Figure 3-5c) (DPM Enviros ciences, 2018b).

Ground-truthed soils mapping produced for the *Olive Downs Coking Coal Project Soil and Land Suitability Assessment* by GT Environmental (2018) across the Study area identified areas of gilgai relief, which are the most accurate reflection of potential habitat for this species. GT Environmental (2018) has mapped the following two soil types within the Rail Spur and Loop area that would provide suitable habitat for the Ornamental Snake:

- brown light clays with gilgai; and
- grey to brown light to medium clay with gilgai.

Brigalow TEC has been identified as potential habitat for the Ornamental Snake. Mapping in the Mine Site and Access Road area identified two patches as being Brigalow TEC, comprised of RE 11.4.9. In accordance with the *Draft Referral Guidelines for the Nationally Listed Brigalow Belt Reptiles* RE 11.4.9 comprises habitat suitable for the Ornamental Snake.

Other patches of Brigalow regrowth have been mapped as potential habitat where suitable habitat features are present (i.e. gilgais, wetlands and suitable prey habitat).

Based on observations of Ornamental Snake across the Study area, areas of potential habitat occur in a significant portion of agricultural grasslands (where there was once brigalow), and small patches of palustrine wetlands (swamps) and Acacia dominated open forests, woodlands and shrublands where these soil types are also present (Figure 3-31b).

The areas identified as potential habitat for the Ornamental Snake also contain woody debris (which would provide sheltering habitat for the Ornamental Snake when cracks are not available), are low lying, and during the wet season they would hold water long enough for frogs to inhabit them, providing a food source for the Ornamental Snake (DPM Envirosciences, 2018b).

As the majority of the potential habitat for this species is mapped within the agricultural grasslands, there are a number of existing threats to the Ornamental Snake. These include heavy weed infestation, presence of introduced fauna species (including cane toads), agricultural grazing and habitat fragmentation (DPM Envirosciences, 2018b).

The other habitat types within the Rail Spur and Loop (including the remaining non-remnant vegetation) are not considered to provide potential habitat for the Ornamental Snake on the basis that they are lacking the cracking clay soils, gilgai habitat and microhabitat features required by this species (DPM Envirosciences, 2018b).

DotE (2014b) states that “important populations [of the Ornamental Snake] occur in remnant vegetation on, or surrounding, gilgai mounds and depressions”. The draft *Referral Guidelines for the Nationally Listed Brigalow Belt Reptiles* (DSEWPaC, 2011a) define important habitat for the Ornamental Snake as:

- *Habitat where the species has been identified during a survey;*
- *Habitat near the limit of the species known range;*
- *Large patches of continuous, suitable habitat and viable landscape corridors (necessary for the purposes of breeding, dispersal or maintaining the genetic diversity of the species over successive generations); or*
- *A habitat type where the species is identified during a survey, but which was previously thought not to support the species.*

Under this definition, areas of habitat where the Ornamental Snake was found are important habitat for the Ornamental Snake.

Given the lack of records within the Rail Spur and Loop area, there are no areas of important habitat for the Ornamental Snake within the Rail Spur and Loop area
(DPM Envirosciences, 2018b). DPM Envirosciences (2018b) considers that the habitat within the Rail Spur and Loop area is also not likely to be critical to the survival of the species given:

- the species is more widely distributed in the region and the habitat is not at a limit of the species range; and
- large areas of potential and important habitat (as demonstrated by Ornamental Snake records) are located in the wider locality and would be avoided by the Project.

It should be noted that preferred, breeding and foraging habitat for this species are typically the same (i.e. very hard to distinguish between the three), and given the Ornamental Snake is highly sedentary dispersal habitat has not been separately assessed.

Impacts

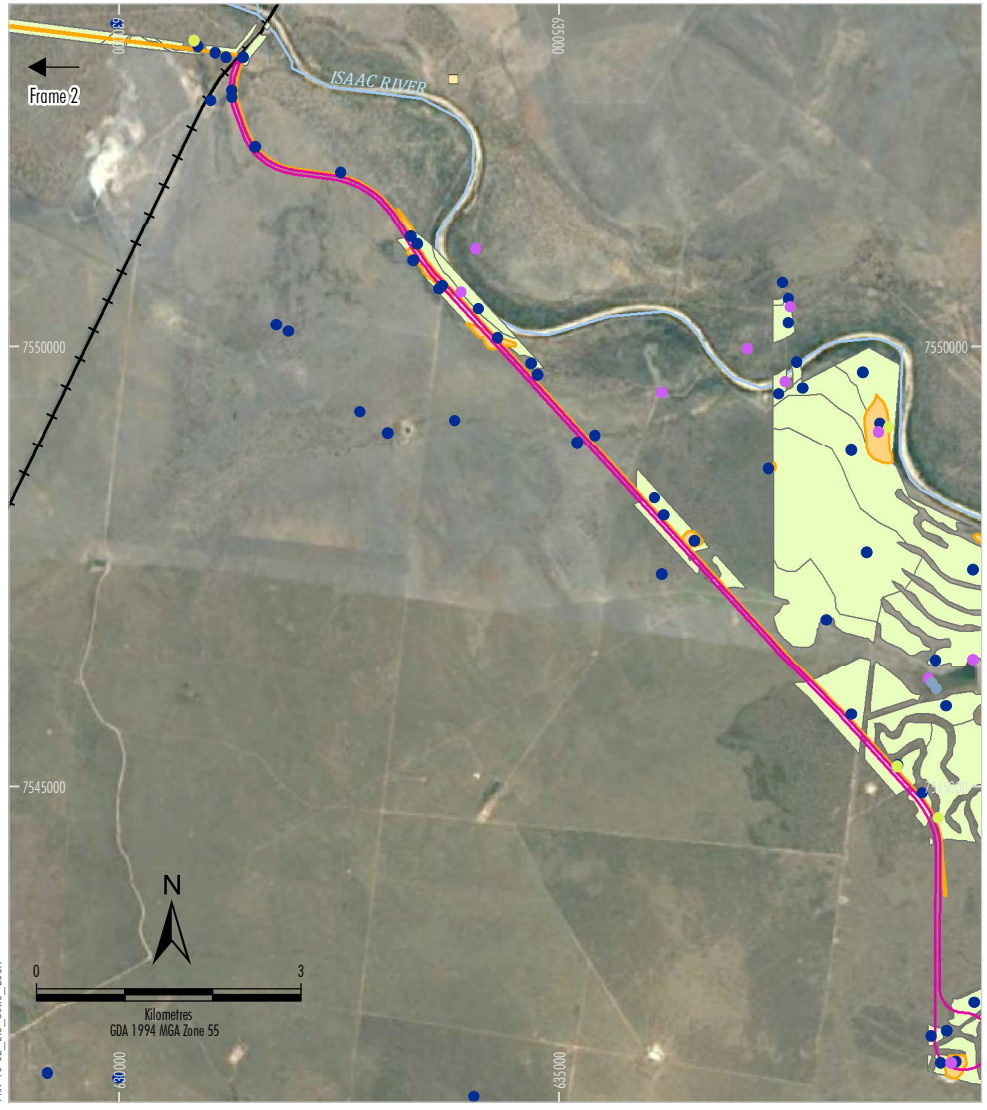
The disturbance footprint for the Rail Spur and Loop is approximately 103.5 ha. A total of approximately 27 ha of potential habitat for the Ornamental Snake would be cleared for the Rail Spur and Loop (Table 3-41) (DPM Envirosciences, 2018b). An assessment of significance has been conducted in accordance with the *Matters of National Environmental Significance; Significant Impact Guidelines 1.1* (DotE, 2013b) and is provided in Table 3-42.

Avoidance, Mitigation and/or Management Measures

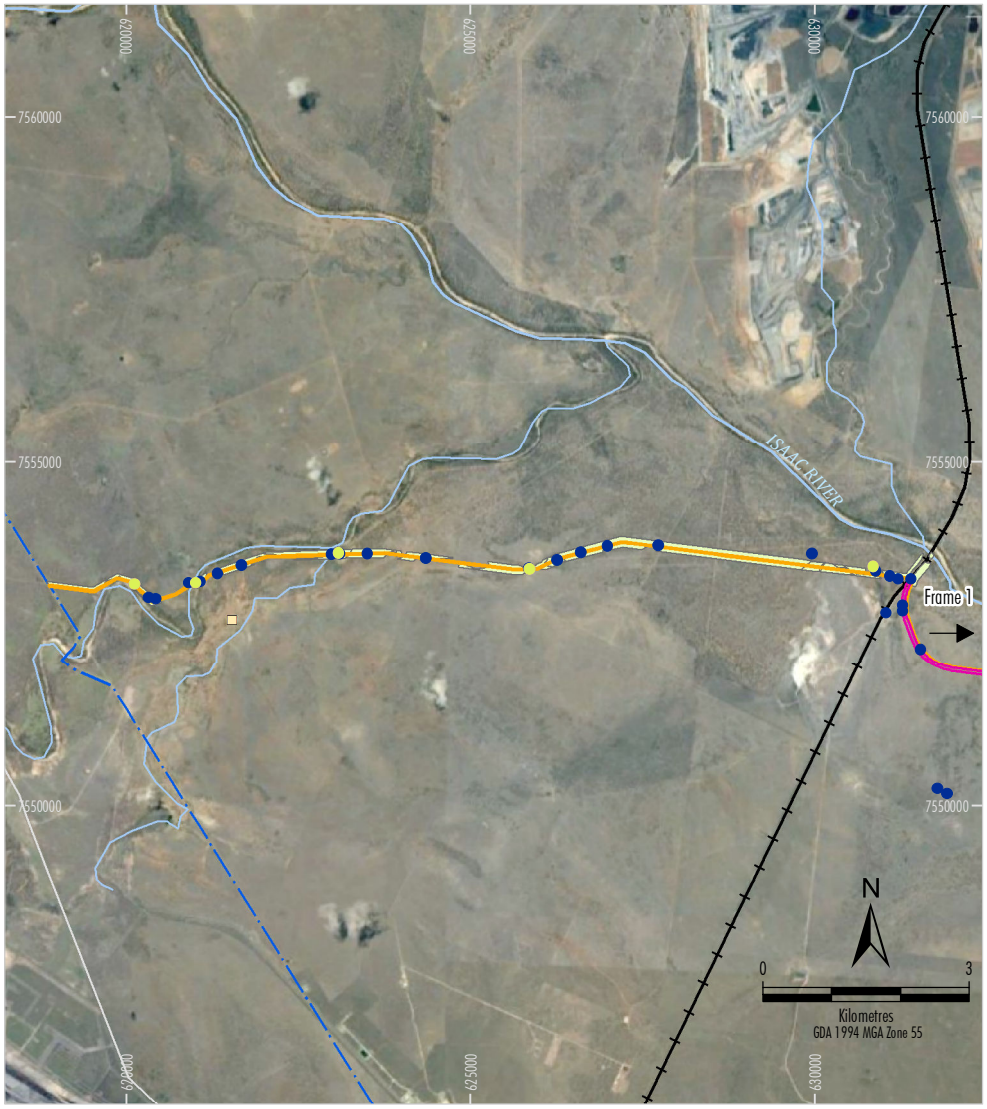
As described in Section 3.6.9 of this document, the following measures would be undertaken by Pembroke to reduce potential adverse impacts on the Ornamental Snake:

- Vegetation clearance procedures, including pre-clearance surveys to detect the Ornamental Snake within habitat proposed to be cleared.
- Implementation of a Weed and Pest Management Plan to monitor and control feral animals (including feral pigs which can degrade habitat for the Ornamental Snake [DEE, 2018a]) within the Rail Spur and Loop area and surrounds.
- Bushfire prevention would be undertaken, noting that the Ornamental Snake occurs in Brigalow Woodland and uses groundcover which is susceptible to fire (DEE, 2018a).

Frame 1 - ETL Southern Section



Frame 2 - ETL Northern Section



PRN-16-02_EIS_Sect3_2654

LEGEND

- Olive Downs Project Rail Spur (EPBC 2017/7870)
- Olive Downs Project Water Pipeline (EPBC 2017/7868)
- Dwelling
- Railway
- Eungella Pipeline Network
- Species Habitat - Australian Painted Snipe
- Species Habitat - Squatter Pigeon

Fauna Survey Locations

- Active search
- Bird survey
- Camera trap
- Comprehensive site
- Fauna Habitat Assessment Site

Source: DPM (2018), Pembroke (2018), Queensland Department of Natural Resources, Mines and Energy (2017)
Orthophoto: Google Image (2016)
(Enirety of the Olive Downs Project Water Pipeline (EPBC 2017/7868) and the Olive Downs Project Rail Spur (EPBC 2017/7870) is included in Stage 1 of the Project (Refer to Section 4.1))

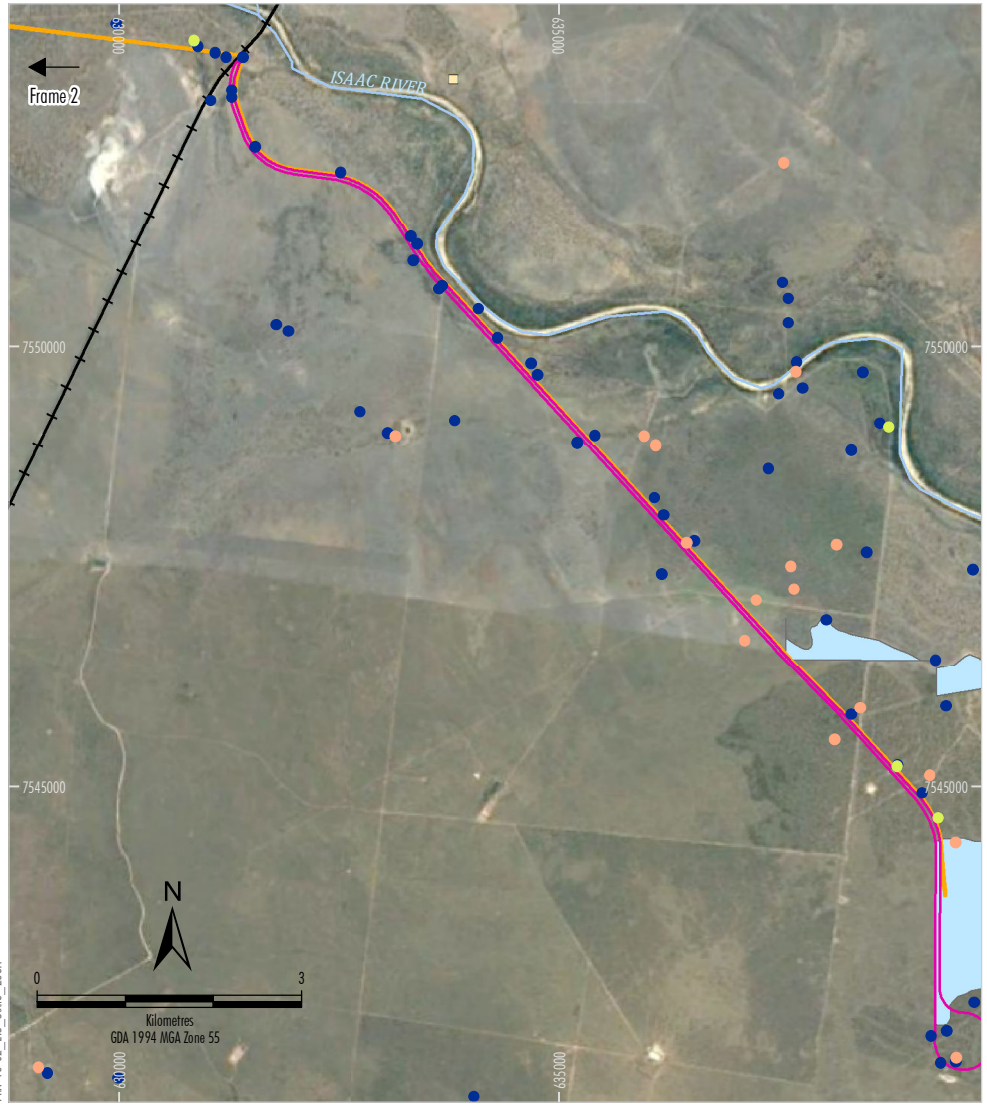
PEMBROKE

OLIVE DOWNS COKING COAL PROJECT

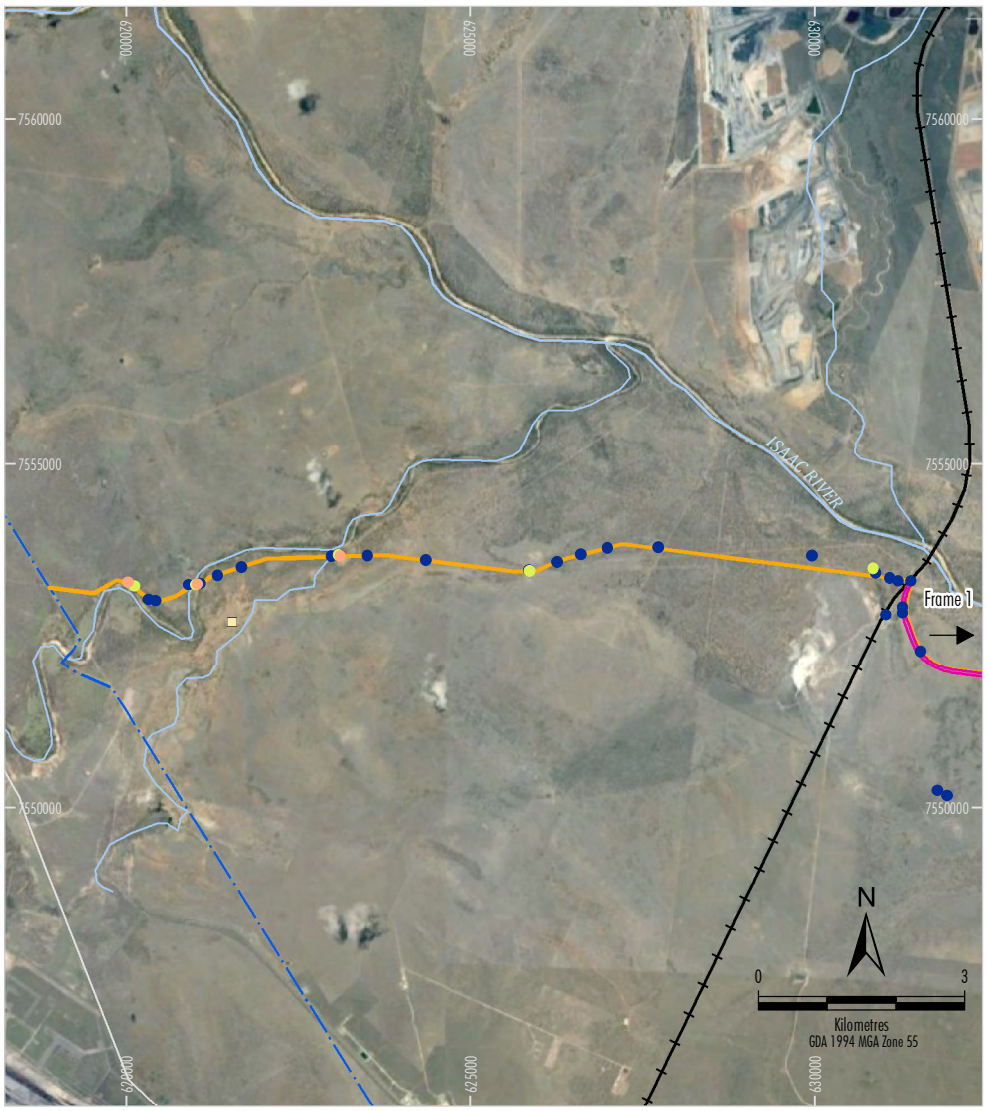
Threatened Species Habitat Mapping Australian Painted Snipe & Squatter Pigeon

Figure 3-31a

Frame 1 - ETL Southern Section



Frame 2 - ETL Northern Section



LEGEND

- Olive Downs Project Rail Spur (EPBC 2017/7870)
- Olive Downs Project Water Pipeline (EPBC 2017/7868)
- Dwelling
- Railway
- Eungella Pipeline Network
- Species Habitat - Ornamental Snake

Fauna Survey Location

- Active search
- Comprehensive site
- Spotlighting
- Fauna Habitat Assessment Site

Source: DPM (2018), Pembroke (2018), Queensland Department of Natural Resources, Mines and Energy (2017)
Orthophoto: Google Image (2016)
(Enirety of the Olive Downs Project Water Pipeline (EPBC 2017/7868) and the Olive Downs Project Rail Spur (EPBC 2017/7870) is included in Stage 1 of the Project (Refer to Section 4.1))

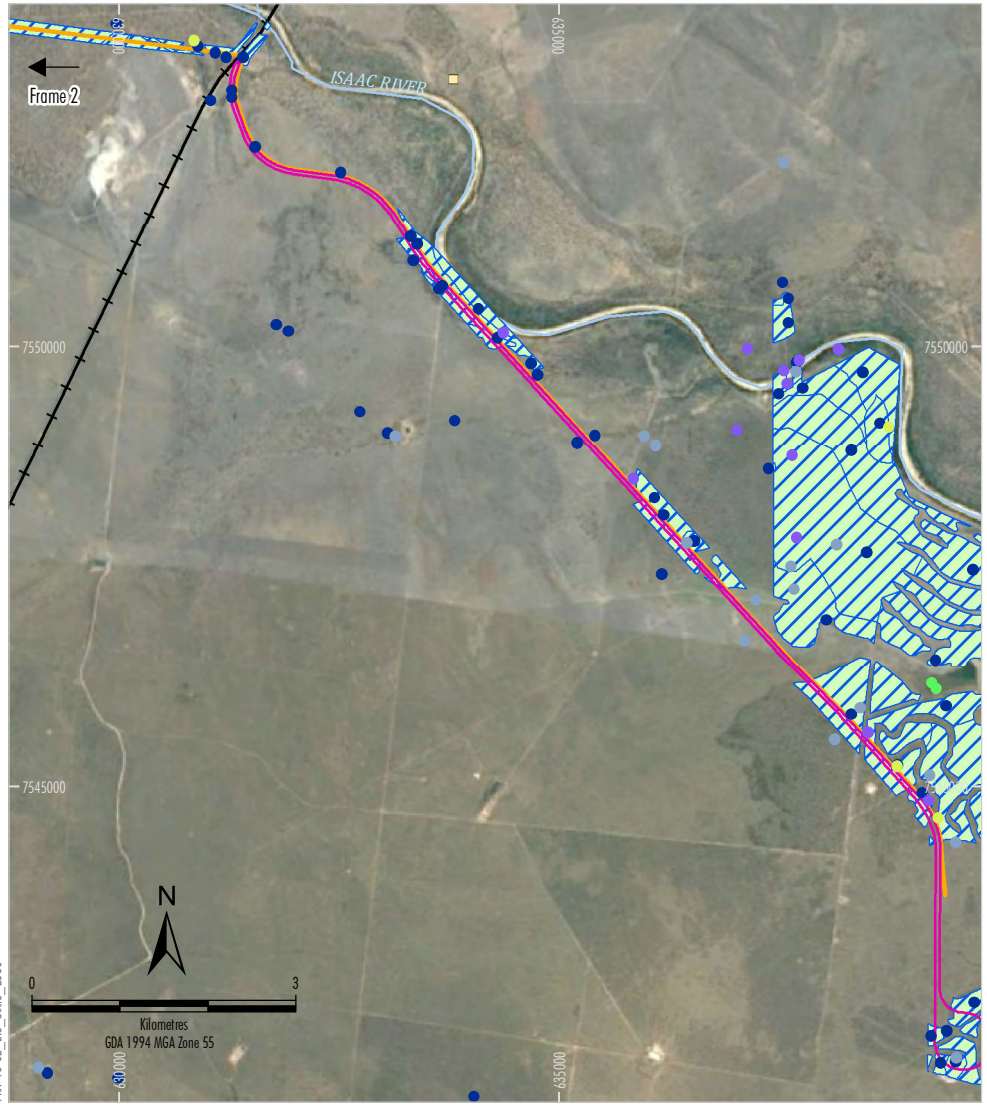
PEMBROKE

OLIVE DOWNS COKING COAL PROJECT

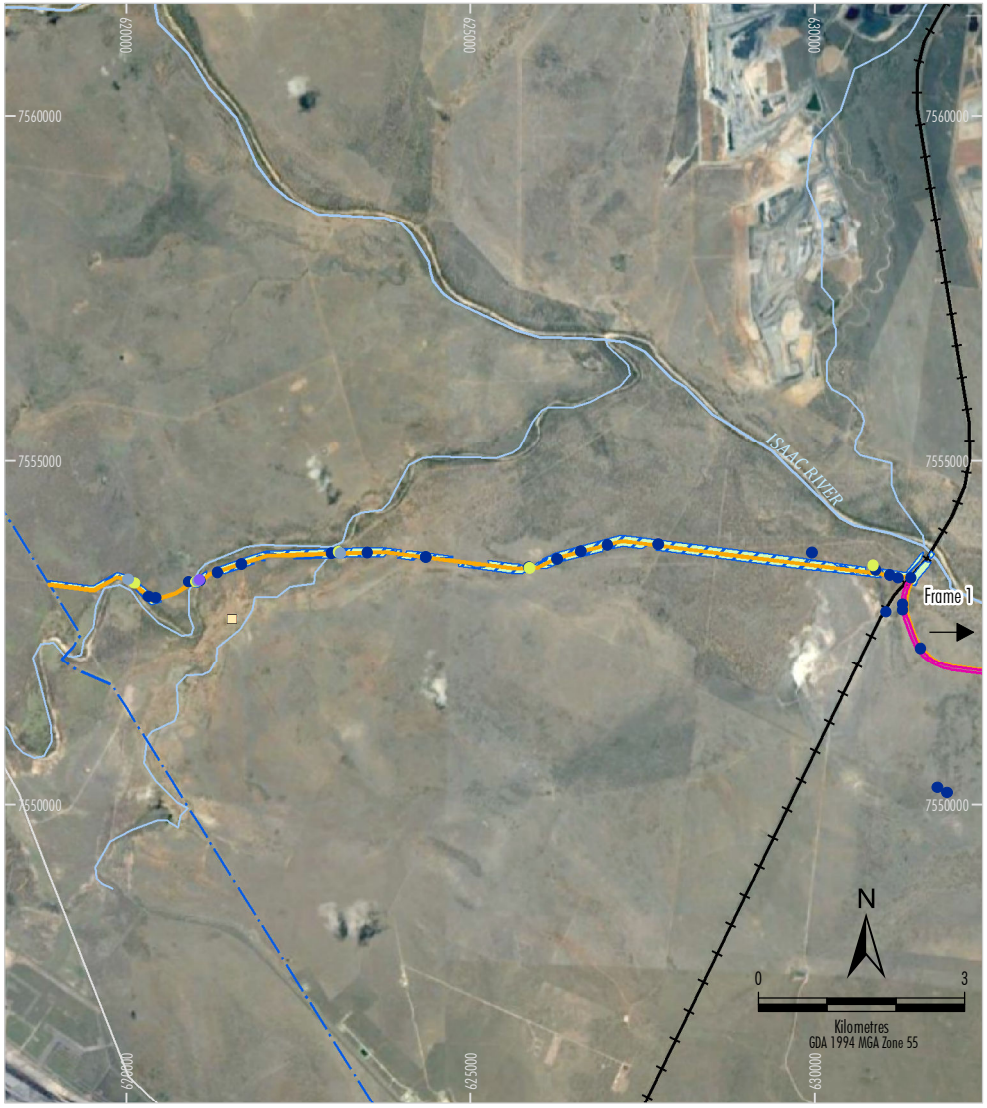
Threatened Species Habitat Mapping Ornamental Snake

Figure 3-31b

Frame 1 - ETL Southern Section



Frame 2 - ETL Northern Section



PRN-16-02_EIS_Sec3_253C

LEGEND

- Olive Downs Project Rail Spur (EPBC 2017/7870)
- Olive Downs Project Water Pipeline (EPBC 2017/7868)
- Dwelling
- Railway
- Eungella Pipeline Network
- Species Habitat - Greater Glider
- Species Habitat - Koala

Flora Survey Location

- Active search
- Call playback
- Camera trap
- Comprahensive site
- Koala transect
- Spotlighting
- Fauna Habitat Assessment Site

Source: DPM (2018), Pembroke (2018), Queensland Department of Natural Resources, Mines and Energy (2017)
Orthophoto: Google Image (2016)
(Enirety of the Olive Downs Project Water Pipeline (EPBC 2017/7868) and the Olive Downs Project Rail Spur (EPBC 2017/7870) is included in Stage 1 of the Project (Refer to Section 4.1))

PEMBROKE

OLIVE DOWNS COKING COAL PROJECT

Threatened Species Mapping
Koala & Greater Glider Habitat

Figure 3-31c

Table 3-41
Vegetation and Habitat Clearance Summary – Rail Spur

Regional Ecosystem Code	Regional Ecosystem Description	Vegetation Clearance (ha)	Habitat Clearance (ha)				
			Ornamental Snake	Squatter Pigeon (Southern)	Australian Painted Snipe	Koala	Greater Glider
Remnant Vegetation							
11.3.1	Brigalow (*Acacia harpophylla*) and / or belah (*Casuarina cristata*) open forest on alluvial plains.	1.0	0	0	0	0	0
11.3.2	Poplar box (*Eucalyptus populnea*) woodland to open woodland on alluvial plains.	5	0	5	0	5	5
11.3.27f	Palustrine wetland, coolabah (*Eucalyptus coolabah*) and / or Queensland blue gum (*E. tereticornis*) open woodland to woodland fringing swamps.	3	0	0	3	3	3
11.5.3	Poplar box (*E. populnea*) +/- silver-leaved ironbark (*E. melanophloia*) +/- Clarkson's bloodwood (*C. clarksoniana*) woodland on Cainozoic sand plains and / or remnant surfaces.	30.5	0	30.5	0	30.5	30.5
11.5.9	Narrow-leaved ironbark (*E. crebra*) and other Eucalyptus spp. and Corymbia spp. woodland on Cainozoic sand plains and / or remnant surfaces.	1.5	0	1.5	0	1.5	1.5
11.5.17	Palustrine swamp with fringing Queensland blue gum (*Eucalyptus tereticornis*) woodland in depressions on Cainozoic sand plains and remnant surfaces.	3	0	0	3	3	3
Subtotal		44	0	37	6	43	43
Subtotal (Fauna/Flora Assessment)		44	27.0	37	6	43	43
Non-Remnant Vegetation							
-	Agricultural grasslands dominated by buffel grass (*Cenchrus ciliaris*) with gilgai land formation	59.5	27.0	0	0	0	0
Subtotal		59.5	27.0	0	0	0	0
Total Clearance		**103.5**	**27.0**	**37**	**6**	**43**	**43**
Approximate Area of Habitat within 10 km of Project		0	11,189	15,856	139.20	15,995	15,995

[1] Based on the REs identified as potential habitat on DEE (2018a) from the DSITI (2018) regional mapping available over the area

Table 3-42
Likelihood of Significant Adverse Impact of the Rail Spur and Loop on the Ornamental Snake

Assessment Criteria[1] Is the Action likely to:	Assessment
lead to a long-term decrease in the size of an important population of a species	The Rail Spur and Loop would result in the removal of approximately 27 ha of potential habitat for the species. The small reduction in available habitat is unlikely lead to a localized decrease in the local population, given the lack of records within the Rail Spur and Loop area, the amount of available habitat in the region and the number of records surrounding the site (Figure 3-5).
reduce the area of occupancy of an important population	The reduction in available habitat associated with the Rail Spur and Loop is not likely to lead to a localized decrease in the area of occupancy of a local population given the lack of records within the Rail Spur and Loop area, the amount of available habitat in the region and the number of records surrounding the site (Figure 3-5).
fragment an existing important population into two or more populations	The Rail Spur and Loop is not likely to fragment an existing important population into two or more populations due to the location of the existing important populations in the surrounding landscape and the current level of fragmentation (and cleared land between the areas).
adversely affect habitat critical to the survival of a species (e.g. for activities such as foraging, breeding, roosting, or dispersal or habitat listed in a recovery plan)	The habitat within the Rail Spur and Loop is not likely to be critical to the survival of the species given: • the species is more widely distributed in the region and the habitat is not at a limit of the species range; and • large areas of potential and important habitat (as demonstrated by Ornamental Snake records) are located in the wider locality and would be avoided by the Rail Spur and Loop. Given the above, the Rail Spur and Loop is unlikely to adversely impact habitat critical to the survival of this species.
disrupt the breeding cycle of an important population	Given the lack of records within the Rail Spur and Loop area, there are no areas of important habitat for the Ornamental Snake, nor an important population within the Rail Spur and Loop area. As such, the Rail Spur and Loop is not expected to remove any potential breeding and nesting habitat for this species.
modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	The Rail Spur and Loop would remove approximately 27 ha of habitat for this species. The Rail Spur and Loop would result in a reduction in available potential habitat, however there are no records of the Ornamental Snake within the Rail Spur and Loop area. In addition, due to the amount of available habitat in the locality and the number of records surrounding the Rail Spur and Loop area it is unlikely that this any potential decrease would be significant at a regional scale. In addition, as the majority of the potential habitat for this species is mapped within the agricultural grasslands, there are a number of existing threats to the Ornamental Snake. These include, heavy weed infestation, presence of introduced fauna species (including cane toads); agricultural grazing and sever habitat fragmentation. It is therefore unlikely that the Rail Spur and Loop would result in the decline of the species.
result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat	Weed and feral animal threat levels are unlikely to change significantly due to the Rail Spur and Loop given the current agricultural use of the surrounding area. As outlined above, the majority of the potential habitat for this species is mapped within the agricultural grasslands, there are a number of existing threats to the Ornamental Snake. These include, heavy weed infestation, presence of introduced fauna species (including cane toads); agricultural grazing and sever habitat fragmentation. Through effective pest and weed management, Pembroke's Weed and Pest Management Plan would seek to identify, treat, and propose removal strategies to manage these risks to avoid a significant impact to this species.
introduce disease that may cause the species to decline	The Rail Spur and Loop does not include activities that would result in a disease that may cause the species to decline.
interfere substantially with the recovery of the species.	One of the listed actions within The Action Plan for Australian Reptiles (Cogger et al. 1993) is to "*ensure ornamental snake conservation is incorporated into appropriate land management decisions*". Although the Rail Spur and Loop would result in the removal of potential habitat for the species, Pembroke would implement mitigation strategies and offsets to assist in minimising impacts to the species. As such, the Rail Spur and Loop would not interfere substantially with the recovery of the species.

Source: DPM Envirosciences (2018b)

[1] As defined by the *Matters of National Environmental Significance Significant Impact Guidelines 1.1* (DotE, 2013b).

A National or State recovery plan has not been prepared for this species. The above measures are predicted to be effective in reducing potential adverse impacts on the Ornamental Snake from the Rail Spur and Loop because they are focused on addressing the recognised threats to the species and are consistent with the relevant threat abatement actions (e.g. avoiding additional habitat loss and reducing the risk of invasive and predatory species in Section 3.6.7.1) (DEE, 2018a).

Summary of EPBC Act Assessment

Four Ornamental Snake were recorded at three locations within the Olive Downs South Domain and a further five locations within the Willunga Domain (Figure 3-5) but it has not been recorded within the Rail Spur and Loop area.

The disturbance footprint for the Rail Spur and Loop is approximately 103.5 ha. The Rail Spur and Loop would result in the removal of approximately 27 ha of potential habitat for the species, which is unlikely to result in a significant impact to the Ornamental Snake (DPM Envirosciences, 2018b). Despite this, the impacts associated with the Project as a whole (including the Rail Spur and Loop area) would be mitigated and offset as described in Sections 3.6.9 and 3.7.

Australian Painted Snipe (Rostratula australis)

The Australian Painted Snipe is listed as 'Endangered' under the EPBC Act.

Background/Description

The Australian Painted Snipe has been recorded at wetlands in all states of Australia (DEE, 2018a). It is most common in eastern Australia, where it has been recorded at scattered locations throughout much of Queensland, NSW, Victoria and south-eastern South Australia. It has been recorded less frequently at a smaller number of more scattered locations farther west in South Australia, the Northern Territory and Western Australia (DEE, 2018a). It has also been recorded on single occasions in south-eastern Tasmania and at Lord Howe Island (DEE, 2018a).

The Australian Painted Snipe may breed in response to wetland conditions rather than during a particular season. It has been recorded breeding in all months in Australia. In southern Australia most records have been from August to February. Eggs have been recorded from mid August to March, with breeding in northern Queensland also recorded between May and October (DEE, 2018a).

Survey Effort

The survey effort for this species is provided in Table 3-5 and Appendix B.

Habitat Assessment and Definition

The Australian Painted Snipe generally inhabits shallow terrestrial freshwater wetlands, including temporary and permanent lakes, swamps and claypans. They also use inundated or waterlogged grassland or saltmarsh, dams, rice crops, sewage farms and bore drains. Typical sites include those with rank emergent tussocks of grass, sedges, rushes or reeds, or samphire (DEE 2018).
A single Australian Painted Snipe was observed during the field surveys in a small wetted gilgai within the Agricultural grasslands habitat type in the Willunga Domain (Figure 3-31a) (DPM Envirosciences, 2018b). Additional records for this species existing within the wider locality and are all located along waterways, with the closest being approximately 2.5 km south of the Project Rail Spur and Loop (Figure 3-5a).

In the Study area all areas of wetlands (lacustrine or palustrine) are considered potential habitat for this species (Figure 3-31a) (DPM Envirosciences, 2018b). Although the species was observed in wetted gilgai habitat, this habitat is only suitable for a short period after rainfall when the gilgai are full. It is not considered optimal or primary habitat (DPM Envirosciences, 2018b). The Rail Spur and Loop area does not support an isolated population, is not on the edge of the species' range, and has not been identified as an area supporting a high density of birds or a high density of particularly high quality habitat (DPM Envirosciences, 2018b).

It should be noted that preferred, breeding and foraging habitat for this species are typically the same (i.e. very hard to distinguish between the three) and, as such, have not been separately assessed. Further to this, given the highly mobile nature of this species dispersal habitat would not necessarily be limited to areas of suitable habitat (i.e. it is known to disperse over cleared land to reach areas of suitable habitat).

Impacts

The disturbance footprint for the Rail Spur and Loop is approximately 103.5 ha. A total of approximately 6 ha of potential habitat for the Australian Painted Snipe would be cleared for the Rail Spur and Loop (Table 3-41) (DPM Envirosciences, 2018b). An assessment of significance has been conducted in accordance with the *Matters of National Environmental Significance; Significant Impact Guidelines 1.1* (DotE, 2013b) and is provided in Table 3-43.

Avoidance, Mitigation and/or Management Measures

As described in Section 3.6.9 of this document, the following measures would be undertaken by Pembroke to reduce potential adverse impacts on the Australian Painted Snipe:

- Vegetation clearance procedures, including demarcation of clearing zones to protect the habitat to be retained.
- Implementation of a Weed and Pest Management Plan to monitor and control feral animals (including foxes and feral cats) within the Rail Spur and Loop and surrounds.

The above measures are predicted to be effective in reducing potential adverse impacts from the Rail Spur and Loop on the Australian Painted Snipe because they are focused on addressing the recognised threats to the species identified in the *Approved Conservation Advice for Rostratula australis Australian Painted Snipe* (DSEWPC, 2013) and are consistent with the relevant threat abatement actions (e.g. avoiding additional habitat loss and controlling feral animals) (after DotE, 2014b).

Summary of EPBC Act Assessment

This species has not been located within the Rail Spur and Loop area, however it was located in wetland habitat within Agricultural grasslands within the Mine Site and Access Road area. In addition, the species has previously been recorded approximately 2.5 km south of the Rail Spur and Loop area.

There is no evidence of a population in the Rail Spur and Loop area, however there is evidence of occasional foraging within the surrounding landscape and there are many examples of similar wetland habitats outside the Rail Spur and Loop area (DPM Enviros ciences, 2018b). The Rail Spur and Loop area would result in the removal of potential habitat for the species, however, given the reasons outlined above, it is unlikely that a significant impact to the Australian Painted Snipe would result from the Rail Spur and Loop area (DPM Enviros ciences, 2018b).

Squatter Pigeon (southern) (Geophaps scripta scripta)

The Squatter Pigeon (southern) is listed as 'Vulnerable' under the EPBC Act.

Background/Description

The Squatter Pigeon (southern) has a known distribution extending from the Burdekin-Lynd divide in Central Qld, west to Barcaldine, Longreach and Charleville, east to the coastline between Townsville and Port Curtis (near Gladstone), south to scattered sites throughout south-eastern Qld and the Border Rivers region of northern NSW (DEE, 2018a). The species does not appear to be undergoing a population decline (DEE, 2018a). The Squatter Pigeon (southern) is locally nomadic or sedentary (DEE, 2018a).

Natural foraging habitat for the Squatter Pigeon (southern) comprises any remnant or regrowth open-forest to sparse, open-woodland or scrub dominated by *Eucalyptus*, *Corymbia*, *Acacia* or *Callitris* species, on sandy or gravelly soils, within 3 km of a suitable, permanent or seasonal waterbody (DEE, 2018a).

This species feeds and nests on the ground but roosts in trees. The Squatter Pigeon (southern) withstands habitats with some grazing pressure but is more common in habitat without grazing and no longer occurs in areas with intense grazing (DEE, 2018a).

Survey Effort

The survey effort for this species is provided in Table 3-5 and Appendix B.

Habitat Assessment and Definition

The Squatter Pigeon (southern) has a large distribution extending from the Burdekin-Lynd divide in Central Queensland, west to Charleville and Longreach, east to the coastline between Proserpine and Port Curtis (near Gladstone) and south to a number of scattered sites throughout south-eastern Queensland (DEE, 2018). All of the relatively small isolated and sparsely distributed sub-populations occurring south of the Carnarvon Ranges in Central Queensland are considered to be important subpopulations of the subspecies (DEE, 2018).

Table 3-43
Likelihood of Significant Adverse Impact of the Rail Spur and Loop on the Australian Painted Snipe

Assessment Criteria[1] Is the Action likely to:	Assessment
lead to a long-term decrease in the size of a population of a species	This species has not been recorded within the Rail Spur and Loop area. A single individual Australian Painted Snipe was observed within gilgai habitats at the Willunga Domain. DPM Envirosciences (2018b) concluded that this species may use the wetted habitats within the Rail Spur and Loop area occasional foraging, however it is unlikely that the habitat would be necessary to sustain a population.. The Rail Spur and Loop is therefore unlikely to lead to a long-term decrease in the size of the species population.
reduce the area of occupancy of the species	Given the lack or records within the Rail Spur and Loop area, only a single individual was recorded within the Mine Site and Access Road area, and the species is known to occur widely throughout the rest of Qld and the rest of Australia (ALA, 2018), it is unlikely that the Rail Spur and Loop would reduce the area of occupancy of the species relative to its range.
fragment an existing population into two or more populations	This species is widespread throughout Qld and the rest of Australia (ALA, 2018) and is a highly mobile species. Given this, it is unlikely that a population of this species would be fragmented into two or more populations.
adversely affect habitat critical to the survival of a species (e.g. for activities such as foraging, breeding, roosting, or dispersal or habitat listed in a recovery plan)	No critical habitat for the species has been identified in any recovery plans or listed on the EPBC Act *Register of Critical Habitat* maintained by the Minister of the Environment under the EPBC Act (DEE, 2018b). Given the species was not recorded within the Rail Spur and Loop area (despite repeat attempts to locate the species), it is unlikely that the Rail Spur and Loop area supports a population of this species. The habitat in the Rail Spur and Loop area for the Australian Painted Snipe is not deemed to meet the definition of 'critical habitat' under the EPBC Act due to the heavily fragmented nature of the habitat which is more widespread in the wider landscape. The Rail Spur and Loop is not at a limit of the species range and the Australian Painted Snipe is known to occur more widely outside the Rail Spur and Loop area given the extent of database records (Figure 3-5).
disrupt the breeding cycle of a population	The Rail Spur and Loop area does not offer any unique or particularly high quality habitat resources required by the Australian Painted Snipe. Similar or better habitat would remain in the Rail Spur and Loop locality. The species is known to breed throughout the year, hence the Rail Spur and Loop is unlikely to disrupt the breeding cycle of this species.
modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	The Rail Spur and Loop would remove approximately 6 ha of habitat for this species. The loss of potential habitat for this species would not isolate remaining habitat from other patches and it is unlikely that the Rail Spur and Loop would significantly reduce the area of habitat occupied by the species relative to its regional distribution. It is therefore unlikely that the Rail Spur and Loop would result in the decline of the species.
result in invasive species that are harmful to a critically endangered or endangered species becoming established in the endangered or critically endangered species' habitat	The existing weed and feral animal threat levels are unlikely to change significantly due to the Rail Spur and Loop given the current agricultural use of the surrounding area and implementation of mitigation and management measure proposed to be implemented by Pembroke.. Predation by foxes and feral cats has been suggested as a threat to the Australian Painted Snipe (DEE, 2018a). However, through effective pest and weed management, Pembroke would seek to identify, treat and propose removal strategies to manage this threat through the implementation of a Weed and Pest Management Plan.
introduce disease that may cause the species to decline	The Rail Spur and Loop does not include activities that would result in a disease that may cause the species to decline.
interfere substantially with the recovery of the species.	The Rail Spur and Loop would not interfere substantially with the recovery of the species because habitat resources for the Australia Painted Snipe (e.g. wetlands) would remain outside of the Rail Spur and Loop area, such that the species is likely to persist in the landscape.

Source: DPM Envirosciences (2018b).

[1] As defined by the *Matters of National Environmental Significance Significant Impact Guidelines 1.1* (DotE, 2013b).

The Squatter Pigeon (southern) was identified on ten occasions within Eucalypt dry woodlands on inland depositional plains in the Study area (Figure 3-5a). This includes three locations within the Willunga domain and a further five locations within the Olive Downs Domain, however it was not recorded within the Rail Spur and Loop area (DPM Envirosciences, 2018b). Further to this, the Squatter Pigeon (southern) has been recorded on numerous occasions within 10 km of the Study area (Figure 3-5a).

The Squatter Pigeon (southern) occurs mainly in grassy woodlands and open forests that are dominated by eucalypts (DEE 2018). In the in the Rail Spur and Loop area, all areas of Eucalypt dry woodlands on inland depositional plains and Eucalypt open forests to woodlands on floodplains are considered potential habitat for this species (DPM Envirosciences, 2018b). Other broad habitat types in the Rail Spur and Loop area were not considered potential habitat because they do not support the grassy understorey with a high density of native grasses necessary to provide a food resource for the species (DPM Envirosciences, 2018b).

It should be noted that preferred, breeding and foraging habitat for this species are typically the same (i.e. very hard to distinguish between the three) and, as such, have not been separately assessed. Further to this, given the highly mobile nature of this species dispersal habitat would not necessarily be limited to areas of suitable habitat (i.e. it is known to disperse over cleared land to reach areas of suitable habitat).

Impacts

The disturbance footprint for the Rail Spur and Loop is approximately 103.5 ha. A total of approximately 37 ha of potential habitat for the Squatter Pigeon (southern) would be cleared for the Rail Spur and Loop (Table 3-41) (DPM Envirosciences, 2018b). An assessment of significance has been conducted in accordance with the *Matters of National Environmental Significance; Significant Impact Guidelines 1.1* (DotE, 2013b) and is provided in Table 3-44

Avoidance, Mitigation and/or Management Measures

As described in Section 3.6.9 of this document, the following measures would be undertaken by Pembroke to reduce potential adverse impacts on the Squatter Pigeon (southern):

- Impact avoidance measures outlined in the table in Section 3.6.9.
- Vegetation clearance procedures, including progressive vegetation clearing.
- A Weed and Pest Management Plan would be implemented to monitor and control feral animals (such as the European Rabbit, Feral Cat and European Red Fox) in the Rail Spur and Loop area.

The above measures are predicted to be effective in reducing potential adverse impacts on the Squatter Pigeon (southern) from the Rail Spur and Loop because they are focused on addressing the recognised threats to the species and are consistent with the relevant threat abatement actions (e.g. avoiding additional habitat loss and controlling predators and herbivores) (DEE, 2018a). A National or State recovery plan has not been prepared for this species.

Summary of EPBC Act Assessment

Several individuals were observed in Eucalypt dry woodlands on inland depositional plains within the Rail Spur and Loop locality (Figure 3-31a) (DPM Envirosciences, 2018b). It is unlikely that a significant impact to the Squatter Pigeon (southern) would result from the Rail Spur and Loop, given the species has not been recorded within the Rail Spur and Loop area, habitat is of sub-optimal quality, and the availability of surrounding habitat indicates that it is not of particular regional importance to the species (DPM Envirosciences, 2018b).

The Rail Spur and Loop would result in the removal of approximately 37 ha of potential habitat for the species, which is unlikely to result in a significant impact to the Squatter Pigeon (southern). Despite this, the impacts associated with the Project as a whole (including the Rail Spur and Loop area) would be mitigated and offset as described in Sections 3.6.9 and 3.7.

Koala (Phascolarctos cinereus)

The EPBC Act listed 'Vulnerable' Koala is the combined populations of Qld, NSW and the ACT.

Background/Description

The Koala is endemic to Australia. The biological species is currently widespread in coastal and inland areas, with a range that extends over 22° of latitude and 18° of longitude, or about one million square kilometres (DEE, 2018a). The occurrence of animals throughout this distribution is not continuous and is defined by environmental variables (DEE, 2018a).

Table 3-44
Likelihood of Significant Adverse Impact of the Rail Spur and Loop on the Squatter Pigeon (southern)

Assessment Criteria[1] Is the Action likely to:	Assessment
lead to a long-term decrease in the size of an important population of a species	The Squatter Pigeon (southern) is commonly recorded in fragmented landscapes in the Brigalow Belt South Bioregion. The population of Squatter Pigeon (southern) in the Rail Spur and Loop locality is likely to occur more widely in the Isaac River catchment given the extent of database records and habitat in locality (Figure 3-5a). The Rail Spur and Loop area is north of the Carnarvon Ranges and habitat is classified as sub-optimal, the Rail Spur and Loop is not considered to contain an important population of this species. Given this, it is unlikely that the Rail Spur and Loop would lead to a long-term decrease in the size of an important population of a species.
reduce the area of occupancy of an important population	Given the abundance of this species and the availability of surrounding potential habitat it is unlikely that the Rail Spur and Loop would significantly reduce the area of occupancy of the species relative to its range.
fragment an existing important population into two or more populations	Given the abundance of this species in the surrounding locality, lack of identified important populations, the availability of surrounding potential habitat, and existing level of habitat fragmentation in the Rail Spur and Loop locality, it is unlikely that the Rail Spur and Loop would fragment an existing important population into two or more populations.
adversely affect habitat critical to the survival of a species (e.g. for activities such as foraging, breeding, roosting, or dispersal or habitat listed in a recovery plan)	No habitat within the Rail Spur and Loop locality has been identified as critical habitat for the Squatter Pigeon (southern) in any recovery plans or listed on the EPBC Act *Register of Critical Habitat* maintained by the Minister of the Environment under the EPBC Act (DEE, 2018b). The habitat in the Rail Spur and Loop area for the Squatter Pigeon (southern) is not deemed to meet the definition of 'critical habitat' under the EPBC Act due to the heavily fragmented nature of the habitat which is more widespread in the wider landscape. The Rail Spur and Loop is not at a limit of the species range and the population of Squatter Pigeon (southern) in the Rail Spur and Loop locality is likely to occur more widely outside the Rail Spur and Loop area given the extent of database records and habitat (Figure 3-5a).
disrupt the breeding cycle of an important population	The Rail Spur and Loop area does not offer any unique or particularly high quality habitat resources required by the Squatter Pigeon (southern). Similar or better habitat would remain in the Rail Spur and Loop locality. The species is known to breed throughout the year, hence the Rail Spur and Loop is unlikely to disrupt the breeding cycle of this species.
modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	The Rail Spur and Loop would remove approximately 37 ha of habitat for this species. The Rail Spur and Loop would result in the loss of potential habitat that is of sub-optimal quality (due to high occurrence of Buffel Grass). The loss of this habitat would not isolate remaining habitat from other patches of habitat and it is unlikely that the Rail Spur and Loop would significantly reduce the area of habitat occupied by the species relative to its regional distribution. It is therefore unlikely that the Rail Spur and Loop would result in the decline of the species.
result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat	The introduction and spread of invasive weeds and feral animals may occur as a result of the clearance associated with the Rail Spur and Loop. However, threat levels are unlikely to change significantly due to the Rail Spur and Loop given the current agricultural use of the surrounding area and implementation of mitigation and management measure proposed to be implemented by Pembroke. Reduction of food resources and cover from the establishment and maintenance of Buffel Grass pastures have been identified as a threat to the Squatter Pigeon (southern) (DEE, 2018a). Along with excessive predation by foxes and feral cats, this often increases in response to disturbance (DEE, 2018a). However, through effective pest, weed and introduced pasture grass management, Pembroke would seek to identify, treat, and propose removal strategies to manage this threat through the implementation of a Weed and Pest Management Plan.
introduce disease that may cause the species to decline	The Rail Spur and Loop does not include activities that would result in a disease that may cause the species to decline.
interfere substantially with the recovery of the species.	The Rail Spur and Loop would not interfere substantially with the recovery of the species because habitat resources for the Squatter Pigeon (southern) (e.g. drinking sources, remnant and regrowth vegetation for foraging/roosting and nesting habitat) would remain outside of the Rail Spur and Loop area, such that the species is likely to persist in the landscape.

Source: DPM Envirosciences (2018b).

[1] As defined by the *Matters of National Environmental Significance Significant Impact Guidelines 1.1* (DotE, 2013b).

The life history and habitat of the Koala has been well studied (DEE, 2018a). In late 2013, the DotE released the *Draft EPBC Act Referral Guidelines for the Vulnerable Koala (Combined Populations of Queensland, New South Wales and the Australian Capital Territory)* (EPBC Act Referral Guidelines for the Koala) (DotE, 2013b). The EPBC Act Referral Guidelines for the Koala provides a habitat assessment tool for determining habitat critical to the survival of the Koala and the likelihood of a significant impact on this species.

Survey Effort

The survey effort for this species is provided in Table 3-5 and Appendix B.

Habitat Assessment and Definition

The Koala has one of the largest distributions of any terrestrial threatened species listed under the EPBC Act (DotE, 2014). It occupies a variety of vegetation types across this large distribution, is capable of moving long distances and is variably affected by a range of threats (DEE, 2018). Koala habitat is defined by the vegetation community present and the vegetation structure; Koalas do not necessarily have to be present (DotE 2014). Any forest or woodland containing species that are known Koala food trees, or shrubland with emergent food trees can be considered as 'potential Koala habitat' (DEE, 2018). This can include remnant and non-remnant vegetation in natural, agricultural, urban and peri-urban environments. Koala food trees can generally be considered to be those of the genus Angophora, Corymbia, Eucalyptus, Lophostemon and Melaleuca (DEE, 2018).

Within the Study area, the Koala was recorded on numerous occasions along the Isaac River and associate tributaries, including along the Rail Spur and Loop area (Figure 3-5b)
(DPM Enviros ciences, 2018b). Recordings included direct observation and identification of scats and scratches within Eucalypt dry woodlands on inland depositional plains, Eucalypt open forest to woodlands on floodplains, and around wetlands (DPM Enviros ciences, 2018b).

Within the Study area potential Koala habitat is located within the areas mapped as eucalypt open forests to woodlands on floodplains, eucalypt dry woodlands on inland depositional plains and the vegetation surrounding and within the lacustrine and palustrine wetlands (Figure 3-31c)
(DPM Enviros ciences, 2018b). The potential habitat connections along the waterways (primarily the Isaac River) provide movement corridors and refuge habitat for this species in an otherwise cleared and generally unsuitable landscape
(DPM Enviros ciences, 2018b).

Those areas of non-remnant vegetation in the Study area are included in the 'Agricultural Grasslands' habitat type, which does not contain an adequate density of Koala trees (Eucalyptus spp. Corymbia spp. Lophostemon spp. or Melaleuca spp. that are > 4 m in height and > 10 cm DBH) to support the species (DPM Enviros ciences, 2018b). Other habitat types, such as 'Other coastal communities and heath' and 'Acacia dominated open forests, woodlands and shrublands', also do not contain an adequate density of Koala trees to support the species (DPM Enviros ciences, 2018b).

It should be noted that preferred, breeding and foraging habitat for this species are typically the same (i.e. very hard to distinguish between the three) and, as such, have not been separately assessed. Further to this, given the highly mobile nature of this species dispersal habitat would not necessarily be limited to areas of suitable habitat (i.e. it is known to disperse over cleared land to reach areas of suitable habitat).

Impacts

The disturbance footprint for the Rail Spur and Loop is approximately 103.5 ha. A total of approximately 43 ha of potential habitat for the Koala would be cleared for the Rail Spur and Loop (Table3-41) (DPM Enviros ciences, 2018b). An assessment of significance has been conducted in accordance with the *Matters of National Environmental Significance; Significant Impact Guidelines 1.1* (DotE, 2013b) and is provided in Table 3-45.

Avoidance, Mitigation and/or Management Measures

As described in Section 3.6.9 of this document, the following measures would be undertaken by Pembroke to reduce potential adverse impacts on the Koala:

- Impact avoidance measures outlined in the table in Section 3.6.9 (including minimising potential impacts to the riparian corridor associated with the Isaac River).
- Vegetation clearance procedures, including progressive vegetation clearing and retention of hollow-bearing trees where possible.
- A Weed and Pest Management Plan would be implemented to monitor and control feral animals (such as the Feral dog) in the Rail Spur and Loop area.

Table 3-45
Likelihood of Significant Adverse Impact of the Rail Spur and Loop on the Koala

Assessment Criteria[1] Is the Action likely to:	Assessment
lead to a long-term decrease in the size of an important population of a species	The Koala population that has been identified in the Rail Spur and Loop locality is likely to occur more widely in the surrounding locality and the availability of potential habitat surrounding the Rail Spur and Loop area extends along the Isaac River and its associated tributaries. The Rail Spur and Loop would not involve any crossings of the Isaac River and the disturbance would maintain an 85 m buffer from the riparian habitat associated with the Isaac River. As such, it is unlikely that the Rail Spur and Loop would result in a long-term decrease in the size of in an important population.
reduce the area of occupancy of an important population	Given the abundance of this species (ALA, 2018) and the availability of surrounding potential habitat that is of similar or better quality (particularly along the Isaac River), it is unlikely that the Rail Spur and Loop would significantly reduce the area of occupancy of the species relative to its distribution.
fragment an existing important population into two or more populations	Due to the abundance of the species and availability of surrounding habitat, and existing level of habitat fragmentation in the Rail Spur and Loop locality, it is unlikely that the Rail Spur and Loop would result in fragmentation of the population into two or more populations. Where possible, riparian vegetation along the Isaac River has been avoided within the mine design in aid of reducing population fragmentation and facilitating movement of this species.
adversely affect habitat critical to the survival of a species (e.g. for activities such as foraging, breeding, roosting, or dispersal or habitat listed in a recovery plan)	The Koala Referral Guidelines (DotE, 2014) contain a habitat assessment tool for identifying critical habitat. Impact areas that score five or more using the habitat assessment tool for the Koala contain habitat critical to the survival of the Koala. The assessment was completed over the potential habitat in the Rail Spur and Loop area. The Rail Spur and Loop would remove habitat which meets the definition of 'Critical Habitat' for the Koala as defined in the *EPBC Act referral guidelines for the vulnerable Koala (combined Qld, New South Wales and the Australian Capital Territory)* (DotE, 2014).
disrupt the breeding cycle of an important population	Given the Rail Spur and Loop would largely avoid disturbance to the better quality riparian vegetation along the Isaac River where the majority of Koala records exist (Figure 3-5b), it is unlikely that the Rail Spur and Loop would disrupt the breeding cycle of an important population.
modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	The Rail Spur and Loop would remove approximately 43 ha of habitat for this species. It is possible that the local population may suffer a small reduction in numbers, however, by minimising disturbance to the better quality riparian habitat along the Isaac River is unlikely that, at a regional level, the species would decline.
result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat	The introduction and spread of invasive weeds and feral animals may occur as a result of the clearance associated with the Rail Spur and Loop. However, threat levels are unlikely to change significantly due to the Rail Spur and Loop given the current agricultural use of the surrounding area and implementation of mitigation and management measure proposed to be implemented by Pembroke. Feral dogs have been identified as posing a direct threat to the Koala. However, through effective pest and weed introduced pasture management Pembroke would seek to identify, treat and propose removal strategies through the implementation of a Weed and Pest Management Plan.
introduce disease that may cause the species to decline	Koala populations are threatened by at least two diseases: chlamydia and Koala retrovirus (KoRV). KoRV is estimated to infect up to 100% of Koalas in Queensland, with infection rates slightly lower in southern populations (DEE, 2018a). It is likely that both these diseases already occur in the populations found on and around the Rail Spur and Loop area. The Rail Spur and Loop does not include activities that would result in the spread of a disease that may cause the species to decline.

Table 3-45 (Continued)
Likelihood of Significant Adverse Impact of the Rail Spur and Loop on the Koala

Assessment Criteria1 *Is the Action likely to:*	**Assessment**
interfere substantially with the recovery of the species.	Impacts which are likely to substantially interfere with the recovery of the Koala (DotE 2014) may include: • Increasing Koala fatalities due to dog attacks. • Increasing Koala fatalities due to vehicle-strikes. • Facilitating the introduction or spread of disease or pathogens for example Chlamydia or *Phytophthora cinnamomi* that are likely to significantly reduce the reproductive output of Koalas or reduce the carrying capacity. • Creating a barrier to movement to, between or within habitat for the Koala that is likely to result in a long-term reduction in genetic fitness. • Changing hydrology which degrades habitat for the Koala to the extent that the carrying capacity of the habitat is reduced. The Rail Spur and Loop is unlikely to result in these impacts in consideration of the mitigation measure proposed to be implemented (Section 3.5.9), including the retention of the majority of the Isaac River corridor. As such, the Rail Spur and Loop would not interfere substantially with the recovery of the species

Source: DPM Enviros ciences (2018b).

[1] As defined by the *Matters of National Environmental Significance Significant Impact Guidelines 1.1* (DotE, 2013b).

The above measures are predicted to be effective in reducing potential adverse impacts on the Koala from the Rail Spur and Loop because they are focused on addressing the recognised threats to the species and are consistent with the relevant threat abatement actions (e.g. avoiding additional habitat loss and controlling predators) (DEE, 2018a). A National or State recovery plan has not been prepared for this species.

Summary of EPBC Act Assessment

This species was recorded during the field surveys within the Rail Spur and Loop area (Figure 3-5b). The Rail Spur and Loop would result in the removal of approximately 43 ha of potential habitat (including areas of critical habitat as defined by as defined in the *EPBC Act referral guidelines for the vulnerable Koala (combined Qld, New South Wales and the Australian Capital Territory)* (DotE, 2014) for the species, which would be mitigated and offset as described in Sections 3.6.9 and 3.7.

Greater Glider (Petauroides volans)

The Greater Glider is listed as 'Vulnerable' under the EPBC Act.

Background/Description

The Greater Glider is restricted to eastern Australia, occurring from the Windsor Tableland in north Queensland through to central Victoria (Wombat State Forest), with an elevational range from sea level to 1,200 m above sea level.

An isolated inland subpopulation occurs in the Gregory Range west of Townsville, and another in the Einasleigh Uplands (DEE, 2018a).

The Greater Glider is an arboreal nocturnal marsupial, largely restricted to eucalypt forests and woodlands. It is primarily folivorous, with a diet mostly comprising eucalypt leaves, and occasionally flowers (DEE, 2018a).

It is typically found in highest abundance in taller, montane, moist eucalypt forests with relatively old trees and abundant hollows (DEE, 2018a). The distribution may be patchy even in suitable habitat (DEE, 2018a). The Greater Glider favours forests with a diversity of eucalypt species, due to seasonal variation in its preferred tree species (DEE, 2018a).

Survey Effort

The survey effort for this species is provided in Table 3-5 and Appendix B.

Habitat Assessment and Definition

The Greater Glider is largely restricted to eucalypt forests and woodlands. It is typically found in higher abundance in taller, montane, moist eucalypt forests with relatively old trees and abundant hollows (TSSC 2016). The distribution may be patchy even in suitable habitat. The Greater Glider favours forests with a diversity of eucalypt species, due to seasonal variation in its preferred tree species (TSSC 2016).

Within the Study area, the Greater Glider was recorded on numerous occasions along the Isaac River and associate tributaries, including within the Rail Spur and Loop area (Figure 3-5b) (DPM Envirosciences, 2018b). Recordings included direct observation and identification of scats within Eucalypt dry woodlands on inland depositional plains and Eucalypt open forest to woodlands on floodplains (DPM Envirosciences, 2018b).

In the Study area all areas of eucalypt open forests to woodlands on floodplains and eucalypt dry woodlands on inland depositional plains are considered potential habitat (Figure 3-31c). The potential habitat connections along the waterways (primarily the Isaac River and Ripstone Creek) provide movement corridors and refuge habitat for this species in an otherwise cleared and generally unsuitable landscape (DPM Envirosciences, 2018b).

Other habitat types within the Study area (including the 'Agricultural Grasslands' habitat type) are not considered suitable for the species because they lack a high density of large mature eucalypts, which are important for foraging and denning (DPM Envirosciences, 2018b).

It should be noted that preferred, breeding and foraging habitat for this species are typically the same (i.e. very hard to distinguish between the three) and, as such, have not been separately assessed. Further to this, given the highly mobile nature of this species dispersal habitat would not necessarily be limited to areas of suitable habitat (i.e. it is known to disperse over cleared land to reach areas of suitable habitat).

Impacts

The disturbance footprint for the Rail Spur and Loop is approximately 103.5 ha. A total of approximately 43 ha of potential habitat for the Greater Glider would be cleared for the Rail Spur and Loop (Table 3-41) (DPM Envirosciences, 2018b). An assessment of significance has been conducted in accordance with the *Matters of National Environmental Significance; Significant Impact Guidelines 1.1* (DotE, 2013b) and is provided in Table 3-46.

Avoidance, Mitigation and/or Management Measures

As described in Section 3.6.9 of this document, the following measures would be undertaken by Pembroke to reduce potential adverse impacts on the Greater Glider:

- Impact avoidance measures outlined in the table in Section 3.6.9.
- Vegetation clearance procedures, including progressive vegetation clearing and retention of hollow-bearing trees where possible.
- A Weed and Pest Management Plan would be implemented to monitor and control pests and feral animals in the Rail Spur and Loop area.

The above measures are predicted to be effective in reducing potential adverse impacts on the Greater Glider from the Rail Spur and Loop because they are focused on addressing the recognised threats to the species and are consistent with the relevant threat abatement actions (e.g. avoiding additional habitat loss and controlling predators) (DEE, 2018a). A National or State recovery plan has not been prepared for this species.

Summary of EPBC Act Assessment

This species was recorded during the field surveys within the Rail Spur and Loop area, however records were heavily concentrated around the Isaac River (Figure 3-5b) (DPM Envirosciences, 2018b).

The Rail Spur and Loop would result in the removal of approximately 43 ha of potential habitat for the species, which is unlikely to result in a significant impact to the Greater Glider (DPM Envirosciences, 2018b). Despite this, the impacts associated with the Project as a whole (including the Rail Spur and Loop area) would be mitigated and offset as described in Sections 3.6.9 and 3.7.

Other Threatened Species

Other threatened species identified within the Terms of Reference or within a search area covering the wider locality include:

- Red Goshawk (*Erythrotriorchis radiatus*);
- Curlew Sandpiper (*Calidris ferruginea*);
- Painted Honeyeater (*Grantiella picta*);
- Star Finch (eastern) (*Neochmia ruficauda ruficauda*);
- Black-throated Finch (southern) (*Poephila cincta cincta*);
- Northern Quoll (*Dasyurus hallucatus*);
- Grey-headed Flying-fox (*Pteropus poliocephalus*);
- Ghost Bat (*Macroderma gigas*);
- Corben's Long-eared Bat (*Nyctophilus corbeni);*
- Southern Snapping Turtle (*Elseya albagula*);
- Fitzroy River Turtle (*Rheodytes leukops*);
- Yakka Skink (*Egernia rugosa*);

Table 3-46
Likelihood of Significant Adverse Impact of the Rail Spur and Loop on the Greater Glider

Assessment Criteria[1] Is the Action likely to:	Assessment
lead to a long-term decrease in the size of an important population of a species	The Greater Glider population that has been identified in the Rail Spur and Loop locality is likely to occur more widely in the surrounding locality and the availability of potential habitat surrounding the Rail Spur and Loop area extends along the Isaac River and its associated tributaries. The Rail Spur and Loop would not involve any crossings of the Isaac River and the disturbance would maintain an 85 m buffer from the riparian habitat associated with the Isaac River. As such, it is unlikely that the Rail Spur and Loop would result in a long-term decrease in the size of in an important population.
reduce the area of occupancy of an important population	Given the abundance of this species (ALA ,2018) and the availability of surrounding potential habitat that is of similar or better quality (particularly along the Isaac River), it is unlikely that the Rail Spur and Loop would significantly reduce the area of occupancy of the species relative to its distribution.
fragment an existing important population into two or more populations	Due to the abundance of the species and availability of surrounding habitat, and existing level of habitat fragmentation in the Rail Spur and Loop locality, it is unlikely that the Rail Spur and Loop would result in fragmentation of the population into two or more populations. Where possible, riparian vegetation along the Isaac River has been avoided within the mine design in aid of reducing population fragmentation and facilitating movement of this species.
adversely affect habitat critical to the survival of a species (e.g. for activities such as foraging, breeding, roosting, or dispersal or habitat listed in a recovery plan)	No habitat within the Rail Spur and Loop locality has been identified as important or critical habitat for the Greater Glider in any recovery plans or listed on the EPBC Act *Register of Critical Habitat* maintained by the Minister of the Environment under the EPBC Act (DEE, 2018b). The habitat in the Rail Spur and Loop area for the Greater Glider is not deemed to meet the definition of 'important habitat' or 'critical habitat' under the EPBC Act due to the heavily fragmented nature of the habitat which is more widespread in the wider landscape. The Rail Spur and Loop is not at a limit of the species range and the population of Greater Glider in the Rail Spur and Loop locality is likely to occur more widely given the extent of database records and habitat (Figure 3-5b).
disrupt the breeding cycle of an important population	Given the Rail Spur and Loop would largely avoid disturbance to the better quality riparian vegetation along the Isaac River where the majority of Greater Glider records exist (Figure 3-5b), it is unlikely that the Rail Spur and Loop would disrupt the breeding cycle of an important population.
modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	The Rail Spur and Loop would remove approximately 43 ha of habitat for this species. It is possible that the local population may suffer a small reduction in numbers, however, by minimising disturbance to the better quality riparian habitat along the Isaac River is unlikely that, at a regional level, the species would decline.
result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat	The introduction and spread of invasive weeds and feral animals may occur as a result of the clearance associated with the Rail Spur and Loop. However, threat levels are unlikely to change significantly due to the Rail Spur and Loop given the current agricultural use of the surrounding area and implementation of mitigation and management measure proposed to be implemented by Pembroke. No particular weeds or feral animals have been implicated as a threat to the species. However, threat levels would be managed by Pembroke through effective pest and weed introduced pasture management Pembroke would seek to identify, treat and propose removal strategies through the implementation of a Weed and Pest Management Plan.
introduce disease that may cause the species to decline	The Rail Spur and Loop does not include activities that would result in a disease that may cause the species to decline.
interfere substantially with the recovery of the species.	A recovery plan has not yet been developed for the Greater Glider. Due to the preservation of the majority of the Isaac River riparian corridor, the Rail Spur and Loop is unlikely to interfere with any of the actions listed for the recovery of the species.

Source: DPM Enviros ciences (2018b).

[1] As defined by the *Matters of National Environmental Significance Significant Impact Guidelines 1.1* (DotE, 2013b).

- Allan's Lerista (*Lerista allanae*)*;*
- Dunmall's Snake (*Furina dunmalli*);
- *Cycas ophiolitica*;
- King Blue-grass (*Dichanthium queenslandicum*);
- Bluegrass (*Dichanthium setosum*);
- Black Ironbox (*Eucalyptus raveretiana*); and
- Quassia (*Samadera bidwillii*).

Potential adverse impacts on the threatened species listed above have been assessed in Table 3-47. None of these species were found despite targeted surveys (Section 3.2.4.3), but they are considered in this section due to the potential for the species to be present in the Rail Spur and Loop and/or adjacent habitats (irrespective of whether the species were detected during targeted surveys) (DPM Envirosciences, 2018b).

Of these, only the Red Goshawk, King Blue-grass, Bluegrass and Black Ironbox are considered to have potential to occur within the Rail Spur and Loop area based on the presence of suitable habitats and previous records (DPM Envirosciences, 2018b).

In summary, it is concluded that the Rail Spur and Loop is unlikely to significantly impact any of these species in accordance with the significant impact criteria detailed in the *Significant Impact Guidelines 1.1: Matters of National Environmental Significance* (DotE, 2013b) (DPM Envirosciences, 2018b).

3.6.7.2 Threatened Ecological Communities

The *Brigalow (Acacia harpophylla dominant and co-dominant) ecological community* (Brigalow TEC), was identified within the Study area. Brigalow TEC within the Study area comprises only those patches of vegetation that meet the condition thresholds identified in DotE (2013a) (DPM Envirosciences, 2018a).

No other TEC listed under the EPBC Act was recorded within the Study area.

Brigalow (Acacia harpophylla dominant and co-dominant) ecological community

Sixteen potential TEC vegetation patches were assessed for floristic values as part of the field surveys in November 2016. This included one Tertiary flora survey site in RE 11.3.1, three Quaternary flora survey sites in RE 11.3.1, six in RE 11.4.8 and six in RE 11.4.9 (DPM Envirosciences, 2018a). Most patches failed to meet the Brigalow TEC condition thresholds. This is due primarily to groundcover being dominated by exotic species including Buffel Grass (*Cenchrus ciliaris*) (DPM Envirosciences, 2018a).

Patches of regrowth vegetation within the Study area were also assessed to determine whether they meet the criteria to be mapped as Brigalow TEC (DotE, 2013a). No patches of regrowth vegetation were determined to meet these criteria as the trees were too small to have been more than 15 years old and the understory vegetation was dominated by weeds (i.e. Buffel Grass) (DPM Envirosciences, 2018a).

The Rail Spur and Loop would avoid all patches of Brigalow TEC that have been mapped within the Study area (Figure 3-3). In addition, Rail Spur and Loop would not result in any indirect impacts to the small patch of Brigalow TEC mapped to the south of the construction corridor (DPM Envirosciences, 2018a).

As such, it is concluded that the Rail Spur and Loop would not result in a significant impact to Brigalow TEC (DPM Envirosciences, 2018a).

3.6.8 Impact Avoidance, Mitigation Measures and Management Plans

3.6.8.1 Impact Avoidance Measures

Alternatives for the location of the Rail Spur and Loop were limited due to the need to connect to the Norwich Park Branch Railway and to avoid existing mining lease areas (and associated mining pits) to the south. The final location would maintain a buffer of approximately 85 m to the bank of the Isaac River at its closest point (affecting 1.5 km of the rail alignment).

The Rail Spur and Loop would avoid all areas of TEC and most Endangered RE (with the exception of minor waterway crossings).

3.6.8.2 Proposed Mitigation Measures

Mitigation measures proposed to be implemented for the Project are detailed in Table 3-48. The measures identified in Table 3-48 are predicted to be effective in reducing potential adverse impacts on the MNES potentially impacted by the Rail Spur and Loop because they are focused on addressing the recognised threats to the relevant species and communities and are not inconsistent with the following documents:

- *Approved Conservation Advice for the Brigalow (Acacia harpophylla dominant and co-dominant) ecological community* (DotE, 2013a);

Table 3-47
Assessments for Other Threatened Species Relevant to the Rail Spur and Loop Area

Species Name	Common Name	Conservation Status[1]	Presence in the Project Locality and Potential Impact
Erythrotriorchis radiatus	Red Goshawk	V	The Red Goshawk is considered to have potential to occur within the Rail Spur and Loop area as some areas of suitable habitat are present (e.g. eucalypt dry woodlands and the wetlands and waterways). This species typically occurs in tall open forest, woodland, lightly treed savannah and the edge of rainforest (DEHP 2018e). Despite this, the species was not recorded during the targeted surveys and the nearest previous record is located approximately 50 km to the east of the Rail Spur and Loop (ALA, 2018). Nests are in tall trees within 1 km of and often besides, permanent water (river, swamp, pool), usually in fairly open, biologically rich forest or woodland. The average distance of the nest tree to water was 164 m (DEE, 2018). Although the Rail Spur and Loop may remove some areas of potential habitat for this species it is unlikely that it would result in a significant impact on this species given: • this species has not been recorded within the Rail Spur and Loop area; • areas of potential habitat for this species are likely to occur more widely in the surrounding landscape; and • this species is highly mobile and possesses the ability to disperse into the large areas of potential habitat outside the Rail Spur and Loop.
Calidris ferruginea	Curlew Sandpiper	CE	This species is unlikely to occur within the Rail Spur and Loop area as it was not recorded during the recent surveys undertaken by DPM Envirosciences (2018b) and it has not been previously recorded within 50 km of the Rail Spur and Loop area. This species typically inhabits intertidal mudflats of estuaries, lagoons, mangrove channels, around lakes, dams, flood waters, flooded saltbush surrounds of inland lakes (Morcombe 2003). Although the Rail Spur and Loop would clear wetland and waterway habitats that could provide potential habitat for this species on occasion, it is unlikely that this would result in a significant impact on the Curlew Sandpiper given: • previous targeted searches have found no records of the species within 50 km of the Rail Spur and Loop area; • the species is classified as a migratory shorebird in Marine bioregional plan for the North-west Marine Region (DSEWPC, 2012c); • the species does not breed in Australia (DotE, 2015); • The Rail Spur and Loop area is not classified as internationally important to the species (Bamford et al., 2008) per the Wildlife Conservation Plan for Migratory Shorebirds (DotE, 2015); • the species is wide ranging, with densely distributed records along the coastline of Australia (ALA, 2018); and • habitat is abundant for the species given the densely populated coastlines of Australia (ALA, 2018).

Table 3-47 (Continued)
Assessments for Other Threatened Species Relevant to the Rail Spur and Loop Area

Species Name	Common Name	Conservation Status[1]	Presence in the Project Locality and Potential Impact
Grantiella picta	Painted Honeyeater	V	This species is unlikely to occur within the Rail Spur and Loop area as it was not recorded during the recent surveys undertaken by DPM Enviros ciences (2018b) and it has not been previously recorded within 50 km of the Rail Spur and Loop area. This species typically inhabits dry, open forests and woodlands (Box, Ironbark, Yellow Gum, Melaleuca, Casuarina, Callitris, Acacia), usually in areas with flowering and fruiting mistletoe and flowering eucalypts (DEHP, 2018f). Although the Rail Spur and Loop may remove some areas of potential habitat for this species (e.g. euclaypt woodlands) it is unlikely that this would result in a significant impact on this species given: • this species has not been recorded within the Rail Spur and Loop area or surrounds despite targeted surveys; • areas of potential habitat for this species are likely to occur more widely in the surrounding landscape; and • this species is highly mobile and possesses the ability to disperse into the large areas of potential habitat outside the Rail Spur and Loop.
Neochmia ruficauda ruficauda	Star Finch (eastern)	E	This species is unlikely to occur within the Rail Spur and Loop area as it was not recorded during the recent surveys undertaken by DPM Enviros ciences (2018b) and it has not been previously recorded within 50 km of the Rail Spur and Loop area. The nearest database record is located approximately 50 km from the Rail Spur and Loop and is from 1956 (ALA, 2018). DEE completed two targeted field surveys for the Star Finch (eastern) which were conducted in central Queensland in 1993-94 and 1996-97 and failed to locate any Star Finches (eastern). In addition, there have been no sightings of the Star Finch (eastern) in the wild since 1995 (DEE, 2018, DPM Enviros ciences, 2018). Given the above, it is unlikely that the Rail Spur and Loop would result in a significant impact to this species.
Poephila cincta cincta	Black-throated Finch (southern)	E	This species is unlikely to occur within the Rail Spur and Loop area as it was not recorded during the recent surveys undertaken by DPM Enviros ciences (2018b) and it has not been previously recorded within 50 km of the Rail Spur and Loop area. The Black-throated Finch inhabits grassy woodland dominated by eucalypts, paperbarks or acacias where there is accessibility to seeding grasses, with riparian habitat being particularly important (DEHP 2018d). Although the Rail Spur and Loop may remove some areas of potential habitat for this species (e.g. riparian woodlands) it is unlikely that it would result in a significant impact on this species given: • this species has not been recorded within the Rail Spur and Loop area or surrounds despite targeted surveys; • areas of potential habitat for this species (e.g. riparian woodlands) are likely to occur more widely in the surrounding landscape; and • this species is highly mobile and possesses the ability to disperse into the large areas of potential habitat outside the Rail Spur and Loop.

Table 3-47 (Continued)
Assessments for Other Threatened Species Relevant to the Rail Spur and Loop Area

Species Name	Common Name	Conservation Status[1]	Presence in the Project Locality and Potential Impact
Dasyurus hallucatus	Northern Quoll	E	This species is unlikely to occur within the Rail Spur and Loop area as it was not recorded during the recent surveys undertaken by DPM Enviroscienses (2018b) and it has not been previously recorded within 50 km of the Rail Spur and Loop area. Further to this, the nearest database record of this species is from 1969. The Northern Quoll is known to inhabit hilly or rocky areas close to permanent water; but occurs in a range of habitats, including open dry sclerophyll forest and woodland, riparian woodland, low dry vine thicket, the margins of notophyll vineforest, mangroves, sugarcane farms and in urban areas (DEHP 2018g). The Rail Spur and Loop area does not contain rocky areas that would provide suitable habitat for the Northern Quoll.
Pteropus poliocephalus	Grey-headed Flying-fox	V	This species is unlikely to occur within the Rail Spur and Loop area as it was not recorded during the recent surveys undertaken by DPM Enviroscienses (2018b) and it has not been previously recorded within 50 km of the Rail Spur and Loop area. This species typically roosts in native vegetation near water, including mangrove, rainforest, melaleuca or casuarina (Churchill 2008). The Grey-headed Flying Fox typically commute within 15 km to feed on flowering and fruiting plants, including blossoms of various species of eucalypt, angophora, tea-tree and banksia (Strahan 1995). Although the Rail Spur and Loop may remove some areas of foraging habitat for this species (e.g. eucalypt woodlands) it is unlikely that it would result in a significant impact on this species given: • this species has not been recorded within the Rail Spur and Loop area or surrounds despite targeted surveys; • areas of potential habitat for this species (e.g. eucalypt woodlands) are likely to occur more widely in the surrounding landscape; and • this species is highly mobile and possesses the ability to disperse into the large areas of potential habitat outside the Rail Spur and Loop.
Macroderma gigas	Ghost Bat	V	This species is unlikely to occur within the Rail Spur and Loop area as it was not recorded during the recent surveys undertaken by DPM Enviroscienses (2018b) and it has not been previously recorded within 50 km of the Rail Spur and Loop area. The closest sighting in 1978 approximately 70 km from the Rail Spur and Loop. The Ghost Bat typically inhabits spinifex hillsides, black soil grasslands, monsoon forest, open savannah woodland, tall open forest, deciduous vine forest and tropical rainforest, influenced by the availability of caves and mines for roosting (Churchill 2008). Roost sites include caves, rock crevices and disused mine adits. Given the site characteristics (predominately euclypt woodland) and the lack of caves within the Rail Spur and Loop area it is unlikely the Ghost Bat would utilise the habitat within the Rail Spur and Loop area.

Table 3-47 (Continued)
Assessments for Other Threatened Species Relevant to the Rail Spur and Loop Area

Species Name	Common Name	Conservation Status[1]	Presence in the Project Locality and Potential Impact
Nyctophilus corbeni	Corben's Long-eared Bat	V	This species is unlikely to occur within the Rail Spur and Loop area as it was not recorded during the recent surveys undertaken by DPM Envirosciences (2018b) and it has not been previously recorded within 50 km of the Rail Spur and Loop area. The Corben's Long-eared Bat is known to inhabit areas with a cluttered understorey layer in river red gum, black box, *Allocasuarina*, belah, mallee, open woodlands, and savannahs; roosting in fissures in branches and under dried sheets of bark still attached to the trunks of trees; utilising tree hollows for maternity sites (Churchill 2008). Although the Rail Spur and Loop may remove some areas of foraging habitat for this species (e.g. eucalypt woodlands) it is unlikely that it would result in a significant impact on this species given: • this species has not been recorded within the Rail Spur and Loop area or surrounds despite targeted surveys; • areas of potential habitat for this species (e.g. eucalypt woodlands) are likely to occur more widely in the surrounding landscape; and • this species is highly mobile and possesses the ability to disperse into the large areas of potential habitat outside the Rail Spur and Loop.
Elseya albagula	Southern Snapping Turtle	CE	This species is unlikely to occur within the Rail Spur and Loop area as it was not recorded during the recent surveys undertaken by DPM Envirosciences (2018b) and it has not been previously recorded within 50 km of the Rail Spur and Loop area. The Southern Snapping Turtle inhabits permanent flowing water habitats where there are suitable shelters and refuges (DEHP 2018h); clear, flowing, well-oxygenated waters of the Fitzroy, Mary and Burnett catchments. Suitable habitat for this species was not identified during the recent aquatic ecology surveys undertaken by DPM Envirosciences (2018c).
Rheodytes leukops	Fitzroy River Turtle	V	This species is unlikely to occur within the Rail Spur and Loop area as it was not recorded during the recent surveys undertaken by DPM Envirosciences (2018b) and it has not been previously recorded within 50 km of the Rail Spur and Loop area. The Fitzroy River Turtle is known to inhabit fast-flowing water of the Fitzroy River and its tributaries (Cogger, 2014). Rivers with large deep pools and rocky, gravelly or sandy substrates, connected by shallow riffles. Preferred areas have high water clarity and are often associated with ribbonweed (*Vallisneria* sp.) (DEE 2017). Suitable habitat for this species was not identified during the recent aquatic ecology surveys undertaken by DPM Envirosciences (2018c).

Table 3-47 (Continued)
Assessments for Other Threatened Species Relevant to the Rail Spur and Loop Area

Species Name	Common Name	Conservation Status[1]	Presence in the Project Locality and Potential Impact
Egernia rugosa	Yakka Skink	V	This species is unlikely to occur within the Rail Spur and Loop area as it was not recorded during the recent surveys undertaken by DPM Envirosciences (2018b) and it has not been previously recorded within 50 km of the Rail Spur and Loop area. The Yakka Skink typically inhabits dry open forests, woodlands and rocky areas (Wilson and Swan 2013). Although the Rail Spur and Loop may remove some areas of foraging habitat for this species (e.g. eucalypt woodlands and brigalow) it is unlikely that it would result in a significant impact on this species given: • this species has not been recorded within the Rail Spur and Loop area or surrounds despite targeted surveys; • areas of potential habitat for this species (e.g. eucalypt woodlands and brigalow) are likely to occur more widely in the surrounding landscape; and • many areas of potentially suitable habitat are considered to be suboptimal based on the lack of suitable microhabitat features.
Lerista allanae	Allan's Lerista	E	This species is unlikely to occur within the Rail Spur and Loop area as it was not recorded during the recent surveys undertaken by DPM Envirosciences (2018b) and it has not been previously recorded within 50 km of the Rail Spur and Loop area. The Allan's Lerista is restricted to road verges and other small areas with friable soils, amid pastoral land dominated by heavy soils in the vicinity of Capella, Clermont and Logan Downs Station (Wilson and Swan 2013). Suitable habitat for this species was not identified within the Rail Spur and Loop area (DPM Envirosciences, 2018b).
Furina dunmalli	Dunmall's Snake	V	This species is unlikely to occur within the Rail Spur and Loop area as it was not recorded during the recent surveys undertaken by DPM Envirosciences (2018b) and it has not been previously recorded within 50 km of the Rail Spur and Loop area. This species typically inhabits woodlands and dry sclerophyll forest, particularly areas featuring brigalow (Wilson and Swan, 2013). It is determined that that this species is unlikely to occur as the elevation of the Rail Spur and Loop is too low (this species prefer habitat 200 to 500 m AHD [DEE, 2018a]).
Cycas ophiolitica	-	E	This species is unlikely to occur within the Rail Spur and Loop area as it was not recorded during the recent surveys undertaken by DPM Envirosciences (2018b) and it has not been previously recorded within 50 km of the Rail Spur and Loop area. This species grows on hills and slopes in sparse, grassy open forest at altitude ranges from 80–400 m above sea level. Although this species reaches its best development on red clay soils near Marlborough, it is more frequently found on shallow, stony, infertile soils, which are developed on sandstone and serpentinite, and is associated with species such as *Corymbia dallachiana, C. erythrophloia, C. xanthope* and *Eucalyptus fibrosa. Cycas ophiolitica* has also been found on mudstone in association with *Corymbia dallachiana, C. erythrophloia* and *Eucalyptus crebra*, and on alluvial loams with *Corymbia intermedia, Eucalyptus drepanophylla* and *E. tereticornis* (DEE 2018a). Habitat for this species was not identified during the recent floristic surveys undertaken by DPM Envirosciences (2018a).

Table 3-47 (Continued)
Assessments for Other Threatened Species Relevant to the Rail Spur and Loop Area

Species Name	Common Name	Conservation Status[1]	Presence in the Project Locality and Potential Impact
Dichanthium queenslandicum	King Blue-grass	E	King Blue-grass is considered to have potential to occur within the Rail Spur and Loop area as some areas of suitable habitat are present. This species typically inhabits black cracking clay in tussock grasslands mainly in association with other species of blue grasses (*Dichanthium* spp. and *Bothriochloa* spp.), but also with other grasses restricted to this soil type (DEE, 2018a). *D. queenslandicum* is mostly confined to natural grassland on the heavy black clay soils (basalt downs, basalt cracking clay, and open downs) on undulating plains (DEHP 2018i). Although the Rail Spur and Loop may remove some areas of potential habitat for this species it is unlikely that it would result in a significant impact on this species given: • this species has not been recorded within the Rail Spur and Loop area despite targeted surveys; • no areas of Natural Grassland TEC were recorded within the Rail Spur and Loop area; and • areas of potential habitat for this species are likely to occur more widely in the surrounding landscape.
Dichanthium setosum	Bluegrass	V	Bluegrass is considered to have potential to occur within the Rail Spur and Loop area as some areas of suitable habitat are present. This species has been recorded from the Leichardt, Morton, North Kennedy and Port Curtis regions (Henderson, 1997). It is known to occur in the Mistake Range, in Main Range National Park and possibly in Glen Rock Regional Park. Bluegrass is strongly associated with heavy basaltic black soils and stony red-brown hard-setting loam with clay subsoil (DEE 2018a) and is found in moderately disturbed areas such as cleared woodland, grassy roadside remnants, grazed land and highly disturbed pasture (DEE 2017). Although the Rail Spur and Loop may remove some areas of potential habitat for this species it is unlikely that it would result in a significant impact on this species given: • this species has not been recorded within the Rail Spur and Loop area despite targeted surveys; and • areas of potential habitat for this species are likely to occur more widely in the surrounding landscape.
Eucalyptus raveretiana	Black Ironbox	V	Black Ironbox is considered to have potential to occur within the Rail Spur and Loop area as some areas of suitable habitat are present. This species is known to occur along watercourses and occasionally on river flats. It occurs in open forest or woodland communities, preferring sites with moderately fertile soil and adequate sub-soil moisture. The alluvial soils in which it grows are sands, loams, light clays or cracking clays (DEHP, 2018j). Although the Rail Spur and Loop may remove some areas of potential habitat for this species it is unlikely that it would result in a significant impact on this species given: • this species has not been recorded within the Rail Spur and Loop area despite targeted surveys; and • areas of potential habitat for this species are likely to occur more widely in the surrounding landscape.

Table 3-47 (Continued)
Assessments for Other Threatened Species Relevant to the Rail Spur and Loop Area

Species Name	Common Name	Conservation Status[1]	Presence in the Project Locality and Potential Impact
Samadera bidwillii	Quassia	V	This species is unlikely to occur within the Rail Spur and Loop area as it was not recorded during the recent surveys undertaken by DPM Envirosciences (2018b) and it has not been previously recorded within 50 km of the Rail Spur and Loop area. Quassia commonly occurs in lowland rainforest or on rainforest margins, but it can also be found in other forest types, such as open forest and woodland. Quassia is commonly found in areas adjacent to both temporary and permanent watercourses in locations up to 510 m altitude. The species occurs on lithosols, skeletal soils, loam soils, sands, silts and sands with clay subsoils (DEE, 2018a). Habitat for this species was not identified during the recent floristic surveys undertaken by DPM Envirosciences (2018a).

[1] Threatened Species Status under the EPBC Act (current as of May 2018).

V = Vulnerable.

E = Endangered.

CE = Critically Endangered.

- *Commonwealth Listing Advice on Brigalow (Acacia harpophylla dominant and co-dominant)* (TSSC, 2001).
- *Approved Conservation Advice for Denisonia maculata (Ornamental Snake)* (DotE, 2014).
- *Approved Conservation Advice for Rostratula australis (Australian Painted Snipe)* (DSEWPaC, 2013).
- *Conservation Advice Geophaps scripta scripta Squatter Pigeon (southern)* (TSSC, 2015)
- *Approved Conservation Advice for Phascolarctos cinereus (combined populations in Queensland, New South Wales and the Australian Capital Territory)* (SEWPaC, 2012)
- *Conservation Advice Petauroides volans Greater Glider* (TSSC, 2016)
- *Threat Abatement Plan for Competition and Land Degradation by Rabbits* (DEE, 2016).
- *Threat Abatement Plan for Predation by Feral Cats* (DotE, 2015).
- *Threat Abatement Plan for Predation, Habitat Degradation, Competition and Disease Transmission by Feral Pigs (Sus scrofa)* (DEE, 2017).
- *Threat Abatement Plan for the Biological Effects, Including Lethal Toxic Ingestion, Caused by Cane Toads* (SEWPaC, 2015).

Pembroke is responsible for funding the costs of all mitigation measures as required.

3.6.8.3 Proposed Management Plans

The following management plans would be implemented by Pembroke for the ongoing management of potential impacts on MNES associated with the Project (including the Rail Spur and Loop):

- Vegetation Management Plan, including:
  - demarcate exclusion zones to protect areas of vegetation to be retained prior to clearing;
  - vegetation clearing / excavation to only be authorised in accordance with clearing / disturbance permitting system to ensure that the Environmental Advisor has reviewed all proposed clearing / excavation activities throughout operation of the mine;
  - salvage of felled vegetation for millable timber, as appropriate; and
  - collection of native seed from Project area prior to clearing for use in rehabilitation program;
- Weed and Pest Management Plan, including:
  - identification of weed infestations;
  - strategies for preventing weed spread (i.e. machinery wash-down, boot scrubbing facilities, appropriate disposal of weed material);
  - prioritisation of treatment of weed infestations or weed species and ongoing treatment regimes (as necessary);
  - recommended weed removal strategies (including those appropriate for aquatic habitats);and
  - weed monitoring protocols and follow-up weed control methods and protocols.

Additional management plans are discussed in Section 3.3.11.3.

Environmental Outcomes

An outcome of the Action would be the enhancement and security of the Stage One Offset Area (as described in Section 3.7) to address the potentially significant residual impacts on threatened species and communities. The desired outcome of the proposed offset is that the extent and condition of the habitat values of threatened species and communities within the offset areas are protected and enhanced. The land in the offset areas will be enhanced so as the currently degraded areas reach remnant status through increasing the structural integrity and extent of vegetation in the area.

Table 3-48
Proposed Avoidance and Mitigation Measures for the Rail Spur and Loop

Potential impact	Mitigation measures
Vegetation clearing	• Demarcate exclusion zones prior to clearing to protect areas of vegetation to be retained. • Vegetation clearing / excavation to be subject to internal permitting system. • Salvage felled vegetation for millable timber, as appropriate. • Collection of native seed from the Rail Spur and Loop area for use in rehabilitation program. • Implement the Vegetation Management Plan (Section 3.6.9.3).
Fauna mortality	• Where applicable limit time of construction to avoid breeding seasons for threatened species. • Licensed fauna spotter-catchers to undertake detailed inspection of areas to be cleared. • Where practical, retain hollow-bearing trees and large stags as potential nesting and roosting habitat. • Vehicular traffic generally to be restricted to access tracks and an on-site speed limit would be applied.
Reduction of threatened fauna populations	• Implement management measures for fauna mortality, as outlined above. • Prepare a Species Management Program (in accordance with section 332 of the *Nature Conservation [Wildlife Management] Regulation, 2006*) • Implement the Vegetation Management Plan (Section 3.6.9.3).
Increased numbers of feral animals	• Management of feral animals, particularly dogs, cats and pigs. • Implement Weed and Pest Management Plan (Section 3.6.9.3).
Weed management and edge effects	• Clearing of vegetation to be restricted to the minimum required to enable the safe construction, operation and maintenance of the Rail Spur and Loop. • Identification of weed infestations. • Prioritisation of treatment of weed infestations or weed species and ongoing treatment regimes (as necessary). • Strategies for preventing weed spread i.e. machinery wash-down, boot scrubbing facilities, appropriate disposal of weed material. • Implement the Weed and Pest Management Plan (Section 3.6.9.3).

3.6.9 Consideration of the Project against the Objects of the Environment Protection and Biodiversity Conservation Act, 1999

As described in Section 3.6.6, the Rail Spur and Loop is one component of the larger Project and as such, the consideration of the Project (as a whole) against the objects of the EPBC Act, provided in Section 3.3.14, is relevant to the Rail Spur and Loop.

In conclusion, for the reasons outlined in Section 3.3.14, in consideration of the requirements of the EPBC Act (including the objects of the EPBC Act) the Rail Spur and Loop is considered to be environmentally acceptable.

3.6.10 Conclusion

Pembroke has assessed a number of alternatives to the Rail Spur and Loop. The final proposed mannor in which the Rail Spur and Loop would be constructed and operated is considered to be environmentally acceptable in consideration of the requirements of the EPBC Act (including the objects of the EPBC Act), the principles of ecologically sustainable development and the precautionary principle.

Potential impacts on listed threatened species and communities associated with the Rail Spur and Loop includes the direct removal of potential and known habitat for threatened species and native vegetation. The Rail Spur and Loop is not expected to result in any consequential impacts to any threatened species or community listed under the EPBC Act (DPM Enviros ciences, 2018b). Further to this there are no impacts relevant to the Rail Spur and Loop that are unknown, unpredictable or irreversible.

The avoidance and mitigation measures proposed for the Rail Spur and Loop are acceptable and predicted to be effective in reducing potential adverse impacts on the MNES because they are focused on addressing the recognised threats to threatened species and communities and are not inconsistent with the relevant approved conservation advice and threat abatement plans.

Significant Impact Assessments have been conducted for all MNES which are known or have the potential to occur within the Rail Spur and Loop area and surrounds in accordance with the *Significant Impact Guidelines 1.1 – Matters of National Environmental Significance* (DotE 2013b) (DPM Envirosciences, 2018a and b).

In addition to the rehabilitation of the Rail Spur and Loop area, Pembroke would provide a biodiversity offset for the impacts associated with the Rail Spur and Loop in accordance with the *Queensland Environmental Offsets Policy (Version 1.4)* (DEHP, 2017) and *EPBC Act Environmental Offsets Policy* (SEWPaC, 2012a) (and supporting *EPBC Act Offsets Assessment Guide* [SEWPaC, 2012b]) (Section 3.8). The biodiversity offset area (once established) would provide a beneficial conservation outcome for biodiversity in the region.

3.7 OFFSET STRATEGY RELEVANT TO MATTERS OF NATIONAL ENVIRONMENTAL SIGNIFICANCE

Offset Requirements

Measures that are proposed to avoid and mitigate impacts from the Project on terrestrial and aquatic flora and fauna (including MSES [Section 4.1] and MNES) are described in Sections 3 and 4.1.4. This section describes an offset strategy aimed at addressing the residual impacts on MNES.

The Terms of Reference for the Project states the following in relation to biodiversity offsets:

11.27 The EIS must describe the residual impacts of each proposed action for each relevant matter protected by the EPBC Act, after all proposed avoidance and mitigation measures are taken into account.

11.28 The EIS must identify whether the residual impacts are significant with reference to the Matters of National Environmental Significance, Significant impact guidelines 1.1, Environment Protection and Biodiversity Conservation Act 1999.

11.29 If those residual impacts are significant the EIS must propose offsets for relevant matters protected by the EPBC Act consistent with the Environment Protection and Biodiversity Conservation Act 1999, Environmental Offsets Policy.

11.53 The EIS should identify whether the project will result in a significant residual impact on matters of State environmental significance (MSES) with reference to the Queensland Environmental Offsets Policy, Significant Residual Impact Guideline 2014.

11.54 For staged offsets, the full extent of potential impacts on prescribed environmental matters from the entire proposal needs to be taken into account as part of the significant residual impact test.

11.55 The proposed offsets should be in line with the requirements set out in the Queensland Environmental Offsets Policy (Version 1.2) 2016. [1]

The EPBC Act and the *EPBC Act Environmental Offsets Policy* (DSEWPC 2012a) (and supporting EPBC Act Offsets Assessment Guide [DSEWPC, 2012b]) are relevant to the environmental offset proposal for MNES.

Significant Residual Impact on National Matters

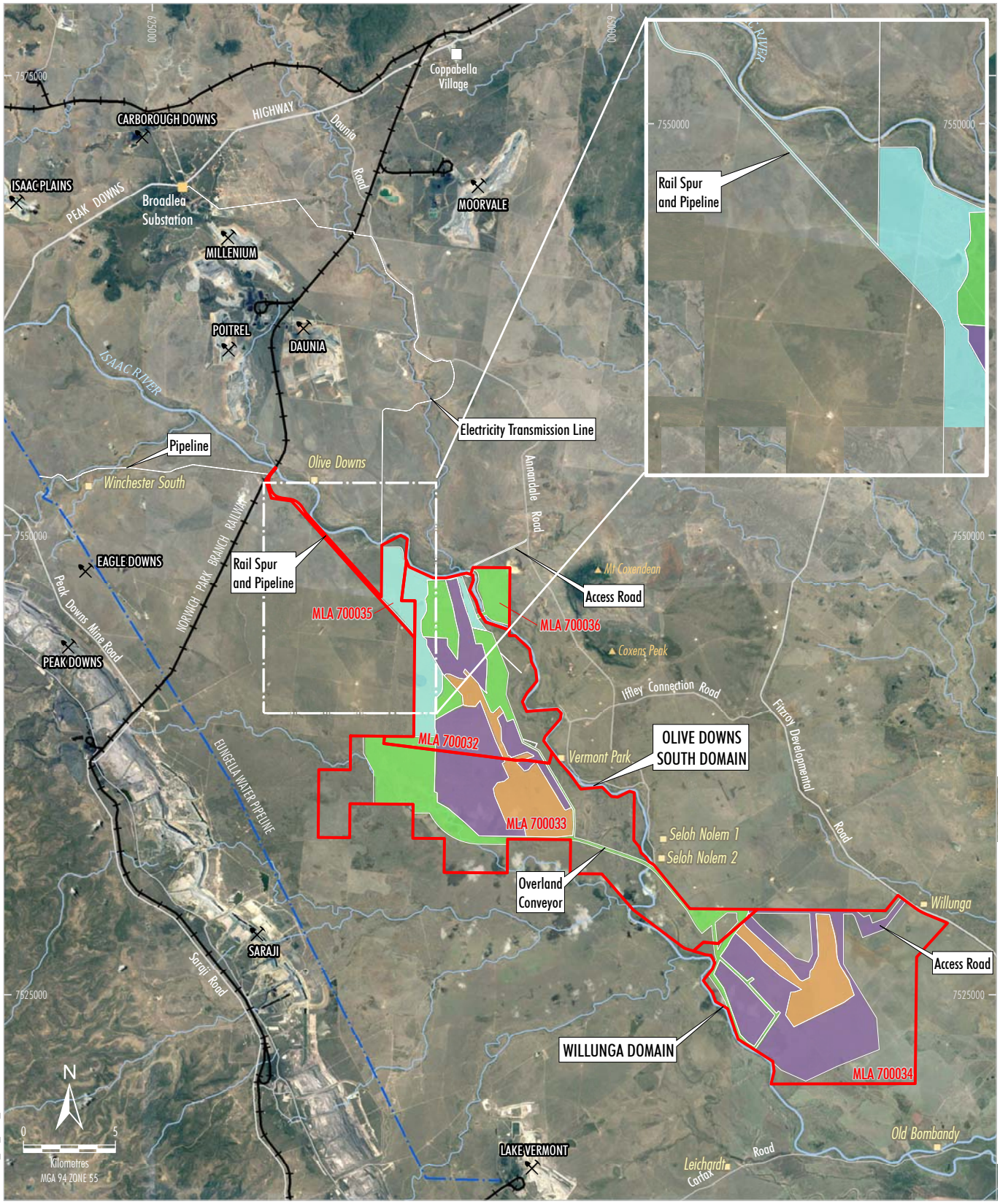
Land clearing for the Project is proposed to occur in multiple stages. Stage 1 would include the following works:

- construction of each of the infrastructure corridors:
  - rail corridor;
  - ETL;
  - water pipeline;
  - Olive Downs South access road;
- construction of the mine infrastructure area (including offices, workshops, CHPP, ROM pad, ILF cells);
- development of the north-western waste emplacement;
- construction of temporary flood levees located within the Stage 1 boundary; and
- commencement of open cut mining in Pit 1.

The Stage 1 disturbance boundary is shown on Figure 3-32. The Stage 1 disturbance boundary includes the full extent of the following Actions:

- Olive Downs Project Water Pipeline (EPBC 2017/7868);
- Olive Downs Project Electricity Transmission Line (EPBC 2017/7869); and
- Olive Downs Project Rail Spur (EPBC 2017/7870).

[1] The *Queensland Environmental Offsets Policy (Version 1.2) 2016* has been replaced by the *Queensland Environmental Offsets Policy (Version 1.6)* (DES 2018).



LEGEND

- Mining Lease Application Boundary
- Approved/Operating Coal Mine
- Eungella Pipeline Network
- Railway
- Dwelling

Indicative Mine Stage

- Stage 1
- Stage 2
- Stage 3
- Stage 4

Source: Pembroke (2018); Department of Natural Resources and Mines (2018); Orthophotography; Google Image (2016)

PEMBROKE

OLIVE DOWNS COKING COAL PROJECT

Indicative Mine Stages for Biodiversity Offset

Figure 3-32

The Stage 1 disturbance boundary would facilitate approximately the first five years of mining of the Olive Downs Project Mine Site and Access Road (EPBC 2017/7867).

As a result of the Significant Impact Assessment, it was determined that a biodiversity offset would be provided for impacts to the following MNES:

- Brigalow EEC – approximately 13 ha to be cleared;
- Ornamental Snake – approximately 7,666 ha of potential habitat to be cleared;
- Australian Painted Snipe – approximately 120ha of potential habitat to be cleared;
- Squatter Pigeon – approximately 5,463.5 ha of potential habitat to be cleared;
- Koala – approximately 5,583.5 ha of potential habitat to be cleared; and
- Greater Glider – approximately 5,583.5 ha of potential habitat to be cleared.

The Significant Impact Assessment indicated that there are no flora species listed under the EPBC Act likely to be significantly impacted (DPM Envirosciences, 2018a).

Mine Site and Access Road

The mine site and access road requires the clearance of potential habitat for threatened fauna species listed under the EPBC Act, including (DPM Envirosciences, 2018b):

- Ornamental Snake – approximately 7,621.5 ha of habitat;
- Australian Painted Snipe – approximately 113 ha of habitat;
- Squatter Pigeon – approximately 5,387 ha of habitat;
- Koala – approximately 5,500 ha of habitat; and
- Greater Glider – approximately 5,500ha of habitat.

Two patches of Brigalow EEC totalling approximately 13 ha (represented by RE11.4.9) would be removed by the mine site and access road. However, these patches are already degraded by edge effects and are highly fragmented.

There is a third small patch of Brigalow that has been mapped more than 1 km to the south-west of the mine site and access road that would not be disturbed (DPM Envirosciences, 2018a).

Water Pipeline

Vegetation clearance for the water pipeline would be restricted to a 20 m wide corridor which would run directly adjacent the rail spur and loop for a distance of 15 km from the mine site to the existing Norwich Park Branch to minimise vegetation clearance (Figure 3-1).

The water pipeline would require the clearance of potential habitat for threatened fauna species listed under the EPBC Act, including (DPM Envirosciences, 2018b):

- Ornamental Snake – approximately 7 ha of habitat;
- Australian Painted Snipe – approximately 1 ha of habitat;
- Squatter Pigeon – approximately 27.5 ha of habitat;
- Koala – approximately 28.5 ha of habitat; and
- Greater Glider – approximately 28.5 ha of habitat.

One small patch of Brigalow EEC was identified adjacent the water pipeline, however the pipeline was designed to avoid impacts to this patch.

As such, no Brigalow EEC would be impacted by the water pipeline (DPM Envirosciences, 2018a).

Project Electricity Transmission Line

The Project ETL has been designed to utilise existing easements and public roads to the maximum extent possible (Figure 3-1). Where this is not possible, vegetation clearance would be restricted to a 10 m wide corridor to minimise vegetation clearance.

The Project ETL would require the clearance of potential habitat for threatened fauna species listed under the EPBC Act, including (DPM Envirosciences, 2018b):

- Ornamental Snake – approximately 10.5 ha of habitat;
- Squatter Pigeon – approximately 12 ha of habitat;
- Koala – approximately 12 ha of habitat; and
- Greater Glider – approximately 12 ha of habitat.

No patches of Brigalow EEC listed under the EPBC Act would be removed by the Project ETL (DPM Envirosciences, 2018b).

Rail Spur

Vegetation clearance for the rail spur would run directly adjacent the water pipeline to minimise vegetation clearance (Figure 3-1).

The rail spur would require the clearance of potential habitat for threatened fauna species listed under the EPBC Act, including (DPM Envirosciences, 2018a):

- Ornamental Snake – approximately 27ha of habitat;
- Australian Painted Snipe – approximately 6 ha of habitat;
- Squatter Pigeon – approximately 37 ha of habitat;
- Koala – approximately 43 ha of habitat; and
- Greater Glider – approximately 43 ha of habitat.

One small patch of Brigalow EEC was identified adjacent the rail spur, however the rail spur was designed to avoid impacts to this patch. As such, no Brigalow EEC would be impacted by the rail spur (DPM Envirosciences, 2018a).

Offset Requirements

Table 3-49 quantifies the significant residual impacts on MNES for each stage of clearance for each Action. The Offset Strategy proposed to compensate for these significant residual impacts is described below.

Biodiversity Offset Strategy

Pembroke propose to offset the significant residual impacts on Matters of National Environmental Significance in accordance with the *EPBC Act Environmental Offsets Policy* (DSEWPC 2012).

Pembroke propose a staged environmental offset in consideration of the staged land clearing described above. The offset for each stage of clearance would be provided before clearing the relevant stage. A land-based proponent-driven offset is proposed to address the relevant impacts from Stage 1.

The Stage One Offset Area would compensate for the impacts associated with each of the following Actions in full:

- Olive Downs Project Water Pipeline (EPBC 2017/7868);
- Olive Downs Project Electricity Transmission Line (EPBC 2017/7869); and
- Olive Downs Project Rail Spur (EPBC 2017/7870).

In addition, the Stage One Offset Area would compensate for the impacts associated with approximately the first five years of mining of the Olive Downs Project Mine Site and Access Road (EPBC 2017/7867).

For subsequent stages (Stages 2 to 4), the offset would be provided before the commencement of each stage. It is likely that the residual significant adverse impacts can be offset given the following (Appendix A):

- The native vegetation communities / fauna habitats to be cleared during the life of the Project (including those listed as 'Endangered' and 'Of Concern') all occur extensively in the surrounding landscape and subregions.
- The surrounding landscape contains large areas of non-remnant vegetation (required to offset the significant residual impact on 'Connectivity').

Stage One Offset Area

The Stage One Offset Area is comprised of three distinct areas located on the eastern side of the Isaac River, adjacent the Project area (Figure 3-33).

The Stage One Offset Area occurs within the same subregion and catchment as the Project, on the eastern side of the Isaac River.

The Stage One Offset Area covers an overall area of approximately 6,065 ha. Within the Stage One Offset Area, there is approximately 1,200 ha which is not required to be included in an offset area for Stage 1 and may be used to offset impacts from subsequent stages. These areas are mapped on Figure 3-33 as 'Areas Retained for Future Offset'. Despite, retaining these areas to account for future stages, these areas would be conserved and managed as part of the greater Stage One Offset Area.

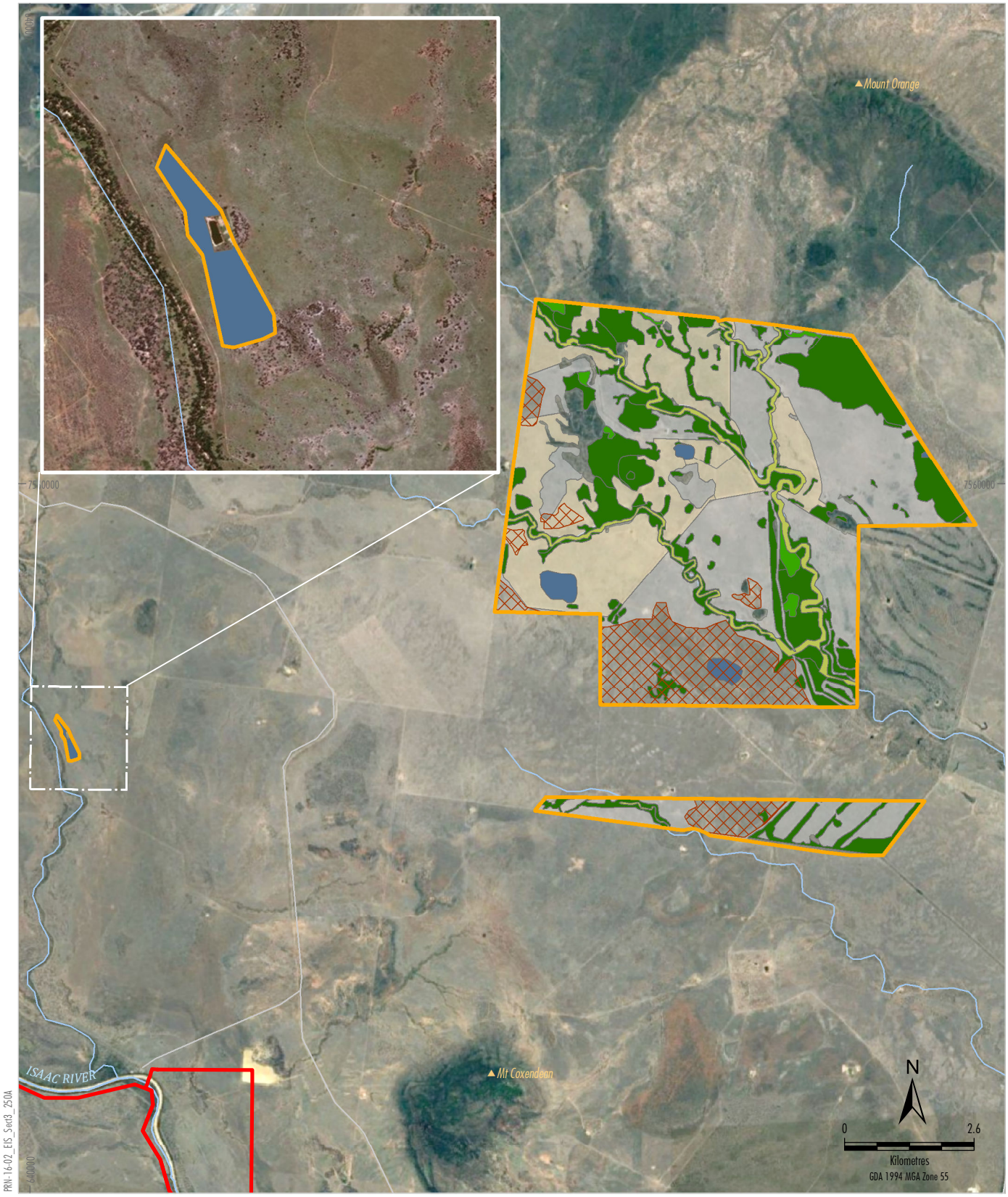
Pembroke owns the land on which the Stage One Offset Area is proposed and there are no other relevant parties with registered interests under the Qld *Land Act 1994* or the Qld *Land Title Act 1994* (Table 3-50).

Table 3-49
Residual Significant Impact on MNES

MNES	Approximate Area of Clearance (ha)									
	Mine Site and Access Road					Water Pipeline*	Project ETL*	Rail Spur*	Total Stage 1	Total Project
	Stage 1	Stage 2	Stage 3	Stage 4	Total					
Brigalow EEC	0	0	13	0	13	0	0	0	**0**	**13**
Ornamental Snake	461.5	1,596	3,916	1,648	7,621.5	7	10.5	27	**506**	**7,666**
Australian Painted Snipe	14	24	50	25	113	1	0	6	**21**	**120**
Squatter Pigeon	729	1,738	2,211	709	5,387	27.5	12	37	**805.5**	**5,463.5**
Koala	743	1,762	2,261	734	5,500	28.5	12	43	**826.5**	**5,583.5**
Greater Glider	743	1,762	2,261	734	5,500	28.5	12	43	**826.5**	**5,583.5**

Source: DPM Enviros ciences (2018a and b).

* All native vegetation clearance associated with construction would occur during Stage 1.



LEGEND

- Mining Lease Application Boundary
- Stage 1 Offset Boundary
- Peaks
- Dwelling

Matters of National Environmental Significance

- Brigalow TEC (habitat for Ornamental Snake)
- Light to medium clay with gilgai (habitat for Ornamental Snake)
- Eucalypt dry woodlands on inland depositional plains (habitat for Koala, Greater Glider and Squatter Pigeon)
- Eucalypt open forests to woodlands on floodplains (habitat for Koala, Greater Glider, and Squatter Pigeon
- Palustrine wetlands (habitat for Koala and Greater Glider)
- Eucalypt dominated regrowth (habitat for Koala, Greater Glider and Squatter Pigeon)
- Areas Retained for Future Offset

Source: DPM (2018), Pembroke (2018), Queensland Department of Natural Resources, Mines and Energy (2017)
Orthophoto: Google Image (2016)

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Matters of National Environmental Significance
Stage 1 Offset Area

Figure 3-33

Table 3-50
Relevant Offset Area Details

Reference	Landholder Details
Registered Owner on Title	Pembroke Olive Downs Pty Ltd
Real Property Descriptions	Twenty Mile – Lot 5, SP 113322 Deverill – Lot 18, SP 113322

Ecology Surveys

Flora and Vegetation Surveys

DPM Enviros ciences (2018a) (Appendix A) undertook flora surveys in the Stage One Offset Area in accordance with contemporary survey guidelines. The flora and vegetation surveys were undertaken in March to May 2018. The detailed methods and findings from these surveys are provided in Appendix H of DPM Enviros ciences (2018a) (Appendix A).

Flora survey techniques included quaternary surveys, ground-truthing regional ecosystems, identification of threatened ecological communities, targeted searches for conservation significant species and random meanders (DPM Enviros ciences, 2018a).

Threatened Fauna Surveys

DPM Enviros ciences (2018a) (Appendix A) undertook fauna surveys across the Stage One Offset Area targeting conservation significant fauna species, including the Koala, Greater Glider, Ornamental Snake, Australian Painted Snipe and Squatter Pigeon.

Habitat for each of the target conservation significant species was mapped in the Stage One Offset Area during the surveys.

Presence of Relevant Matters

The regional ecosystems ground-truthed within the Stage One Offset Area are listed in Table 3-51. Each RE is described in detail in Appendix A.

Table 3-52 provides a reconciliation of the Stage 1 Project offset requirements against the ecological values of the Stage One Offset Area.

As demonstrated in Table 3-52, the Stage One Offset Area contains all matters that require offsetting as part of Stage 1 of the Project and is suitably sized to satisfy the requirements of the *EPBC Act Environmental Offsets Policy* (DSEWPC 2012).

Threatened Fauna Species

Each of the threatened fauna species relevant to the Project offset strategy are both MNES and MSES (Section 4.1). Given this, the *EPBC Act Offsets Assessment Guide* (DSEWPC, 2012b) was applied to determine the offset requirements for each species (Appendix B).

The following threatened fauna species were all recorded in the Stage One Offset Area:

- Koala;
- Greater Glider;
- Ornamental Snake; and
- Squatter Pigeon (southern).

Suitable habitat for each of these species, in addition to the Australian Painted Snipe, occurs in the Stage One Offset Area (Table 3-52).

A combination of remnant vegetation and regrowth eucalypt woodland within the Stage One Offset Area has been mapped as potential habitat for each of these species (Figure 3-33) (Appendix B).
The remnant vegetation within the Stage One Offset Area is described further below. The regrowth eucalypt woodland is generally less than 15 m in height and estimated to be less than 20 years old. It was noted that all areas of regrowth had high levels of weeds, and would benefit from management.

The regrowth vegetation would be managed by Pembroke in order to return these areas to remnant woodland within 20 years, providing further suitable habitat for the Australian Painted Snipe, Squatter Pigeon (southern), Koala, Greater Glider and Ornamental Snake. This would also provide further connectivity of the existing habitats to surrounding vegetation, including the riparian corridor along the Iassc River which currently provide movement corridors and refuge habitat for these species.

Should monitoring indicate that the natural regeneration is not progressing towards remnant status, Pembroke would undertake revegetation activities to assist in this process.

Table 3-51
Ground-truthed Regional Ecosystems within the Stage One Offset Area

Regional Ecosystem	Conservation Status[1]		Area (ha)
	VM Act	EPBC Act	
RE 11.3.1 Brigalow (*Acacia harpophylla*) and / or Belah (*Casuarina cristata*) open forest on alluvial plains.	E	Some patches represent the Brigalow Woodland TEC[2]	30
RE 11.3.2 Poplar Box (*Eucalyptus populnea*) woodland on alluvial plains.	OC	-	505
RE 11.3.25 Forest Red Gum (*Eucalyptus tereticornis*) or River Red Gum (*E. camaldulensis*) woodland fringing drainage lines.	LC	-	219
RE 11.3.27f Palustrine wetland, Coolabah (*Eucalyptus coolabah*) and / or Forest Red Gum (*E. tereticornis*) open woodland to woodland fringing swamps.	LC	-	23
RE 11.4.8 Dawson Gum (*Eucalyptus cambageana*) woodland to open forest with Brigalow (*Acacia harpophylla*) or blackwood (*A. argyrodendron*) on Cainozoic clay plains.	E	Some patches represent the Brigalow Woodland TEC[2]	73
RE 11.4.9 Brigalow (*Acacia harpophylla*) shrubby woodland with Yellowwood (*Terminalia oblongata*) on Cainozoic clay plains.	E	Some patches represent the Brigalow Woodland TEC[2]	154.5
RE 11.5.3 *Eucalyptus populnea +/- E. melanophloia +/- Corymbia clarksoniana* woodland on Cainozoic sand plains and/or remnant surfaces	LC	-	418.5
RE 11.5.9 *Eucalyptus crebra* and other *Eucalyptus* spp. and *Corymbia* spp. woodland on Cainozoic sand plains and/or remnant surfaces			451
RE 11.5.17 Palustrine swamp with fringing Forest Red Gum (*Eucalyptus tereticornis*) woodland in depressions on Cainozoic sand plains and remnant surfaces.	E	-	63.5
RE 11.1.1 *Sporobolus virginicus* grassland on marine clay plains			12.5
		Non-Remnant Vegetation	**4,115**
		Total	**6,065**

Source: Appendix A.

[1] Conservation Status – E = Endangered; OC = Of Concern; NCP = No Concern at Present; LC = Least Concern.

[2] Patches of Brigalow Woodland TEC are shown on Figure 3-33.

Table 3-52
Stage One Offset Area Reconciliation

Relevant Matter	Stage 1 Impact (ha)*	Area within the Stage One Offset Area (ha)*	Offset Requirement Satisfied
Matters of National Environmental Significance			
Ornamental Snake	506	854	Yes[1]
Australian Painted Snipe	21	86	Yes[1]
Squatter Pigeon (southern)	805.5	2,736	Yes[1]
Koala	826.5	2,736	Yes[1]
Greater Glider	826.5	2,736	Yes[1]

[1] In accordance with the *EPBC Act Offsets Assessment Guide* (DSEWPaC, 2012b).

* Approximately 90% of these areas is associated with the Mine Site and Access Road, 3% is associated with the Water Pipeline, 2% is associated with the Project ETL and 5% is associated with the Rail Spur and Loop.

Management Measures

Prior to the commencement of construction, Pembroke would develop an Offset Management Plan for the Project which would detail the following measures proposed to be undertaken within the Stage One Offset Area:

- feral animal control to reduce habitat degradation (particularly by feral pigs);
- reducing weed cover (reducing indirect threats that affect habitat quality);
- addition of species specific Greater Glider nest boxes (to improve sheltering habitat);
- conservation of gilgai areas with offset agreement and covenant on title to ensure long-term protection;
- removal of barbed wire fencing;
- implementation of controlled livestock grazing regimes to encourage natural regeneration of foraging trees and prevent further degradation of habitat; and
- fuel management to avoid high intensity bushfires.

Pembroke would commence the implementation of these management measures upon commencement of the Project. The Offset Management Plan would include a detailed description around the timing, frequency and duration of the proposed offset management measures, including proposed performance targets/indicators and completion criteria.

Long-term conservation

Pembroke would seek to secure the Stage One Offset Area as a Nature Refuge, as requested by DNRME and DES during consultation regarding the Project.

Pembroke would seek to secure the Stage One Offset Area within two years of Project commencement.

Reconciliation of the Stage One Offset Area against EPBC Act Environmental Offsets Policy

A reconciliation of the Stage One Offset Area against the EPBC Act Environmental Offsets Policy (SEWPaC, 2012) is provided in Table 3-53.

Table 3-53
Reconciliation of the Proposed Offset Strategy against EPBC Act Environmental Offsets Policy

Offset Principles*	Elements of the Project Offset that address these Requirements
Deliver an overall conservation outcome that improves or maintains the viability of the aspect of the environment that is protected by national environmental law and affected by the action.	The Stage One Offset Area has been specifically tailored to the protected matters relevant to Stage One of the Project (i.e. Ornamental Snake, Australian Painted Snipe, Squatter Pigeon [southern], Koala and Greater Glider) and would deliver an overall conservation outcome that improves or maintains the viability of each protected matter.
Be built around direct offsets but may include other compensatory measures.	The Commonwealth offset requirements for Stage One of the Project would be satisfied by the Stage One Offset Area.
Be in proportion to the level of statutory protection that applies to protected matter.	The Stage One Offset Area would provide for greater than 100% of the offset liability for each protected matter relevant to Stage One of the Project. This has been determined by applying the *EPBC Act Offsets Assessment Guide* (DSEWPC 2012b).
Be of a size and scale proportionate to the impacts on the protected matter.	The Stage One Offset Area would provide for greater than 100% of the offset liability for each protected matter relevant to Stage One of the Project. This has been determined by applying the *EPBC Act Offsets Assessment Guide* (DSEWPC 2012b). Given this, it is determined that the Stage One Offset Area would be of a suitable size and scale proportionate to the impacts of each protected matter.
Effectively account for and manage the risks of the offset not succeeding.	The *EPBC Act Offsets Assessment Guide* (DSEWPC 2012b), which has been applied to Stage One of the Project accounts for the risk of the offset not succeeding. In addition, measures to manage the Stage One Offset Area would provide for ongoing adaptive management in the unlikely event that the offset is not succeeding. The implementation of the offset strategy is likely to be a condition of Environmental Approval.
Be additional to what is already required, determined by law or planning regulations or agreed to under other schemes or programs.	The implementation of the offset strategy is beyond existing requirements, in that it is not part of any private conservation reserve system. The enduring protection that would be applied to the Stage One Offset Area would be new and additional under duty of care or any environmental planning laws.
Be efficient, effective, transparent, proportionate, scientifically robust and reasonable.	The Stage One Offset Area would efficiently and effectively compensate for the impacts on the protected matters and help maintain the viability of the protected matters. Flora and fauna surveys of the Stage One Offset Area have been undertaken to determine: • the area of the offset in comparison to the area of impact; • the nationally threatened fauna species present (or predicted to occur) and their conservation status; and • the connectivity and condition of the native vegetation / fauna habitat; and • management actions.
Have transparent governance arrangements including being able to be readily measured, monitored, audited and enforced.	Pembroke would seek to secure the offset area as a Nature Refuge, as requested by DNRME and DES during consultation regarding the Project. Further, the management of the Stage One Offset Area would be detailed within an Offset Management Plan.

Source: DPM Enviros ciences (2018a)

* *EPBC Act Environmental Offsets Policy* (SEWPaC, 2012a).