



## Species Management Plans

Carmichael Rail Project – NGBR

Prepared for  
Carmichael Rail Network Pty Ltd

November 2019



## DOCUMENT TRACKING

Item	Detail
Project Name	Species Management Plan Carmichael Rail Project – NGBR
Project Number	998
Status	Final
Version Number	4a
Last saved on	8 November 2019

This report should be cited as ‘Eco Logical Australia 2019. *Species Management Plan Carmichael Rail Project* (Updated Version 4a) – NGBR Section Prepared for Adani Mining Pty Ltd.’

---

### Disclaimer

*This document may only be used for the purpose for which it was commissioned and in accordance with the contract between Eco Logical Australia Pty Ltd and Adani Mining Pty Ltd. The scope of services was defined in consultation with Adani Mining Pty Ltd, by time and budgetary constraints imposed by the client, and the availability of reports and other data on the subject area. Changes to available information, legislation and schedules are made on an ongoing basis and readers should obtain up to date information.*

*Eco Logical Australia Pty Ltd accepts no liability or responsibility whatsoever for or in respect of any use of or reliance upon this report and its supporting material by any third party. Information provided is not intended to be a substitute for site specific assessment or legal advice in relation to any matter. Unauthorised use of this report in any form is prohibited.*

Template 08/05/2014



# Contents

<b>1</b>	<b>Introduction.....</b>	<b>9</b>
1.1	Background.....	9
1.2	Review and update of plan (December 2018 and August 2019) .....	9
1.3	Purpose of management plan .....	10
1.4	Relationship with other management plans .....	11
1.5	Structure of this report .....	15
1.6	Compliance with approval conditions .....	15
<b>2</b>	<b>Project Description.....</b>	<b>21</b>
<b>3</b>	<b>Legislative and Regulatory Framework .....</b>	<b>23</b>
3.1	Approval conditions relevant to management plans.....	23
3.2	Key legislation and NGBR approvals .....	23
<b>4</b>	<b>Existing Environment.....</b>	<b>25</b>
4.1	Environmental setting .....	25
4.2	Ecological values .....	25
4.3	Approval conditions .....	26
<b>5</b>	<b>General Approach .....</b>	<b>28</b>
5.1	Overview.....	28
5.2	Method.....	30
5.3	Mitigation measures .....	30
5.4	Monitoring approach and rationale.....	42
<b>6</b>	<b>Threatened Ecological Communities Management Plans .....</b>	<b>46</b>
6.1	Brigalow ( <i>Acacia harpophylla</i> dominant and co-dominant) TEC.....	46
6.2	Natural Grasslands of the Queensland Central Highlands and the Northern Fitzroy Basin TEC.....	53
6.3	Semi-evergreen Vine Thickets of the Brigalow Belt (North and South) and Nandewar Regions TEC.....	61
6.4	Poplar Box Grassy Woodland on Alluvial Plains TEC.....	67
<b>7</b>	<b>Outstanding Universal Value of the Great Barrier Reef World Heritage Area.....</b>	<b>73</b>
7.1	Overview.....	73
7.2	Values.....	73
7.3	Threats.....	74
7.4	Mitigation and management measures .....	75
7.5	Monitoring .....	78

<b>8</b>	<b>Species Management Plans (Flora)</b> .....	<b>80</b>
8.1	<i>Dichanthium queenslandicum</i> (King Blue-grass) .....	80
8.2	<i>Dichanthium setosum</i> (Bluegrass) .....	86
8.3	<i>Eucalyptus raveretiana</i> (Black Ironbox).....	92
<b>9</b>	<b>Species Management Plans (Fauna)</b> .....	<b>97</b>
9.1	<i>Geophaps scripta scripta</i> (Squatter Pigeon) .....	97
9.2	<i>Numenius madagascariensis</i> (Eastern Curlew) .....	111
9.3	<i>Poephila cincta cincta</i> (Black-throated Finch) .....	123
9.4	<i>Rostratula australis</i> (Australian Painted Snipe).....	138
9.5	<i>Acanthophis antarcticus</i> (Common Death Adder) .....	153
9.6	<i>Crocodylus porosus</i> (Estuarine/Salt-water Crocodile) .....	168
9.7	<i>Denisonia maculata</i> (Ornamental Snake) .....	180
9.8	<i>Phascolarctos cinereus</i> (Koala).....	196
9.9	<i>Petauroides volans</i> (Greater Glider).....	211
9.10	<i>Grantiella picta</i> (Painted Honeyeater) .....	214
<b>10</b>	<b>Discussion</b> .....	<b>217</b>
10.1	Summary of key management issues .....	217
10.2	Implementation .....	217
<b>11</b>	<b>Reporting and Compliance</b> .....	<b>219</b>
11.1	Updating this plan .....	219
11.2	Reporting .....	220
11.3	Qualifications .....	220
	<b>References</b> .....	<b>223</b>
	<b>Appendix A Maps of Threatened Ecological Communities</b> .....	<b>235</b>
	<b>Appendix B Maps of Threatened Flora</b> .....	<b>236</b>
	<b>Appendix C Maps of Threatened Fauna</b> .....	<b>237</b>
	<b>Appendix D Overview of Project Management Plans</b> .....	<b>238</b>
	<b>Appendix E Summary of Findings of EIS Process</b> .....	<b>241</b>
	<b>Appendix F Indicative Locations Of Monitoring Sites</b> .....	<b>246</b>

## List of figures

Figure 1 Flow chart showing the interactions among examples of key management plans and sub-plans for the Carmichael Rail Project.....	13
Figure 2 Environmental Management Plan (EMP) Framework Hierarchy .....	14
Figure 3 Map showing the location of the Project. ....	22
Figure 4 Summary of management planning process .....	29

## List of tables

Table 1 NGBR EPBC Approval (EPBC 2013/6885) Conditions .....	16
Table 2 NGBR Coordinator-Generals' Report (Queensland Government).....	18
Table 3 Generic mitigation measures to be implemented across the Project Area. ....	31
Table 4 Mitigation and management measures for all communities listed in this Plan.....	33
Table 5 Mitigation and management measures for all flora species listed in this Plan.....	36
Table 6 Mitigation and management measures for all fauna species listed in this Plan.....	39
Table 7 Generic monitoring measures to be implemented across the Project Area.....	42
Table 8 Details of monitoring program for threatened ecological communities .....	44
Table 9 Details of monitoring program for threatened flora .....	44
Table 10 Details of monitoring program for threatened fauna .....	45
Table 11 Known location of Brigalow TEC associated Regional Ecosystems within the Project Area. ..	46
Table 12 Regional Ecosystems located within the Project Area that are associated with Brigalow TEC	48
Table 13 Potential impacts from the Project on Brigalow TEC .....	49
Table 14 Mitigation and management measures for Brigalow TEC.....	50
Table 15 Details of monitoring program for Brigalow TEC.....	52
Table 16 Known location of Grassland TEC associated Regional Ecosystems within the Project Area.	54
Table 17 Indicator grass species for the Grassland TEC .....	54
Table 18 Condition classes for the Grassland TEC .....	55



Table 19 Regional Ecosystems located within the Project Area that are associated with the Grassland TEC .....	56
Table 20 Potential impacts from the Project on to Grassland TEC.....	56
Table 21 Mitigation and management measures for Grassland TEC .....	58
Table 22 Details on monitoring program for Grassland TEC .....	59
Table 23 Known location of SEVT associated Regional Ecosystems within the Project Area. ....	61
Table 24 Regional Ecosystems located within the Project Area that are associated with the SEVT TEC .....	62
Table 25 Potential impacts from the Project on to SEVT TEC.....	63
Table 26 Mitigation and management measures for SEVT TEC .....	64
Table 27 Details of monitoring program for SEVT TEC .....	66
Table 28: PBGW TEC Condition categories and thresholds .....	68
Table 29 Regional Ecosystems located within the Project Area that are associated with the PBGW TEC .....	69
Table 30 Potential impacts of the Project on PBGW TEC .....	70
Table 31 Mitigation and management measures for PBGW TEC .....	71
Table 32 Management measures for the protection of OUV of the GBRWHA. ....	76
Table 33 Details of monitoring program for OUV of the GBRWHA.....	78
Table 34 Regional Ecosystems providing potential habitat for <i>Dichanthium queenslandicum</i> within the Project Area.....	81
Table 35 Known locations of <i>Dichanthium queenslandicum</i> habitat within the Project Area .....	82
Table 36 Potential impacts from the Project on <i>Dichanthium queenslandicum</i> habitat.....	82
Table 37 Mitigation and management measures for <i>Dichanthium queenslandicum</i> .....	84
Table 38 Details of monitoring program for <i>Dichanthium queenslandicum</i> .....	84
Table 39 Regional Ecosystems providing potential habitat for <i>Dichanthium setosum</i> within the Project Area .....	87
Table 40 Known locations of <i>Dichanthium setosum</i> habitat within the Project Area .....	88
Table 41 Potential impacts from the Project on <i>Dichanthium setosum</i> habitat.....	88
Table 42 Mitigation and management measures for <i>Dichanthium setosum</i> .....	90
Table 43 Details of monitoring program for <i>Dichanthium setosum</i> .....	90

Table 44 Regional Ecosystems providing potential habitat for <i>Eucalyptus raveretiana</i> within the Project Area .....	93
Table 45 Known locations of <i>Eucalyptus raveretiana</i> habitat within the Project Area .....	93
Table 46 Potential impacts from the Project on <i>Eucalyptus raveretiana</i> habitat.....	94
Table 47 Mitigation and management measures for <i>Eucalyptus raveretiana</i> .....	95
Table 48 Details of monitoring program for <i>Eucalyptus raveretiana</i> .....	96
Table 49 Regional Ecosystem associations for the Squatter Pigeon .....	98
Table 50 Potential impacts from the Project on Squatter Pigeons.....	100
Table 51 Mitigation and management measures for the Squatter Pigeon.....	102
Table 52 Details of monitoring program for the Squatter Pigeon.....	108
Table 53 Potential impacts from the Project on the Eastern Curlew.....	113
Table 54 Mitigation and management measures for the Eastern Curlew .....	115
Table 55 Details of monitoring program for the Eastern Curlew .....	120
Table 56 Regional Ecosystems associated with the Black-throated Finch in the Project Area.....	124
Table 57 Potential impacts from the Project on Black-throated Finch (southern).....	127
Table 58 Mitigation and management measures for the Black-throated Finch (southern) .....	130
Table 59 Details of monitoring program for the Black-throated Finch (southern) .....	135
Table 60 Regional Ecosystem that are known habitat for the Australian Painted Snipe .....	138
Table 61 Potential impacts from the Project on the Australian Painted Snipe.....	140
Table 62 Mitigation and management measures for the Australian Painted Snipe .....	143
Table 63 Details of monitoring program for the Australian Painted Snipe .....	150
Table 64 Wooded Regional Ecosystem that are not considered to be suitable habitat for the Common Death Adder .....	154
Table 65 Likely Common Death Adder habitat within the Project Area .....	154
Table 66 Potential impacts from the Project on Common Death Adders.....	156
Table 67 Mitigation and management measures for the Common Death Adder.....	158
Table 68 Details of monitoring program for the Common Death Adder.....	165
Table 69 Known and likely locations of Estuarine Crocodiles within the Project Area .....	169
Table 70 Potential impacts from the Project on Estuarine Crocodiles .....	170
Table 71 Mitigation and management measures for the Estuarine Crocodile .....	172

Table 72 Details of monitoring program for the Estuarine Crocodile .....	177
Table 73 Current and pre-clearing Regional Ecosystem associations for the Ornamental Snake* . ....	181
Table 74 Potential impacts from the Project on Ornamental Snakes .....	183
Table 75 Mitigation and management measures for the Ornamental Snake .....	185
Table 76 Details of monitoring program for the Ornamental Snake.....	192
Table 77 Regional Ecosystem associations for the Koala .....	196
Table 78 Potential impacts from the Project on Koalas .....	199
Table 79 Mitigation and management measures for the Koala .....	201
Table 80 Details of monitoring program for the Koala.....	207
Table 81 Regional Ecosystem associations for the Greater Glider .....	211
Table 82 Regional Ecosystem associations for the Painted Honeyeater .....	214
Table 83 Listed species which may occur within the Project Area. ....	219
Table 84 Qualification requirements for fauna pre-clearance surveys and monitoring.....	221



# Abbreviations

Abbreviation	Description
Adani	Adani Mining Pty Ltd
AHD	Australian Height Datum, or mean sea level.
ASS	Acid Sulphate Soils
BioCondition	A vegetation condition assessment tool which provides a measure of how well a terrestrial ecosystem is functioning for the maintenance of biodiversity values at a local or property scale.
BOS	Biodiversity Offsets Strategy
CEMP	Construction Environmental Management Plan
DEHP	Queensland Department of Environment and Heritage Protection (now DES)
DES	Queensland Department of Environment and Science
DoEE	Commonwealth Department of the Environment and Energy
EA	Environmental Authority issued under the <i>Environmental Protection Act 1994</i>
EIS	Environmental Impact Statement
ELA	Eco Logical Australia Pty Ltd
EMP	Environmental Management Plan
EPBC Act	<i>Environment Protection and Biodiversity Conservation Act 1999</i> (Commonwealth)
EPBC Approval	Approval granted by the Commonwealth under the EPBC Act
ER	Environmental Representative
GBRWHA	Great Barrier Reef World Heritage Area.
GDEMP	Groundwater Dependent Ecosystems Management Plan
MNES	Matters of National Environmental Significance, as defined under the EPBC Act.
NC Act	Queensland <i>Nature Conservation Act 1992</i>
NGBR	North Galilee Basin Rail Project; a 311 km section of the Carmichael Rail Project located between Mistake Creek and the Port of Abbot Point.
OAMP	Offset Area Management Plan
OEMP	Operations Environmental Management Plan
OUV	Outstanding Universal Value.
RE	Regional Ecosystem
SDPWO Act	<i>State Development and Public Works Organisation Act 1971</i> (Queensland).
SEIS	Supplementary Environmental Impact Statement, prepared in response to comments on the draft EIS.
SEVT	Semi-evergreen Vine Thickets of the Brigalow Belt (North and South) and Nandewar Regions
SP1	Separable Portion 1; a 77 km section of the Carmichael Rail Project located between the Carmichael Mine and Mistake Creek.
TEC	Threatened Ecological Community as defined under the EPBC Act.
ToR	Terms of Reference

# 1 Introduction

## 1.1 Background

Eco Logical Australia (ELA) has been engaged by Carmichael Rail Network Pty Ltd (Adani) to develop a species management plan (SMP) for the construction and operation of the Carmichael Coal Mine in the Galilee Basin of central Queensland and associated rail infrastructure to the Port of Abbot Point. The mine and rail components of the project are comprised of the following two elements:

1. Carmichael Coal Mine and Rail Project, comprising the Carmichael Coal Mine and 77 km of rail line known as Separable Portion 1 (SP1)
2. North Galilee Basin Rail (NGBR) Project, comprising 311 km of rail from the connection with SP1 to the Port of Abbot Point.

Collectively SP1 and NGBR comprise the Carmichael Rail Project. The Carmichael Coal Mine and Rail Project and the NGBR Project have been assessed by the Commonwealth and Queensland governments through separate Environmental Impact Statement (EIS) processes. Conditional approval of the Carmichael Coal Mine and Rail Project was granted by the Queensland Coordinator-General on 8 May 2014 and the Commonwealth Minister for the Environment on 14 October 2015 (EPBC 2010/5736). Conditional approval of the NGBR Project was granted by the Queensland Coordinator-General on 12 August 2014 and the Commonwealth Minister for the Environment on 14 October 2015 (EPBC 2013/6885).

The development of a SMP is a requirement of the Commonwealth and Queensland approval conditions (Section 1.6), to protect listed species of fauna, flora, ecological communities and the Outstanding Universal Value (OUV) of the Great Barrier Reef World Heritage Area (GBRWHA) from impacts associated with the mine and rail projects.

These combined rail components, incorporating SP1 and NGBR, of the development are hereafter referred to as the Carmichael Rail Project. This report provides a SMP for the NGBR component of the Carmichael Rail Project and is hereafter referred to as the Project. Species management plans for the Carmichael Coal Mine and SP1 component of the Carmichael Rail Project have been addressed in separate documents.

Adani has also revised the NGBR Project design from standard to narrow gauge and plans to develop a reduced footprint for the first 210 km of the rail alignment, according to the approved route (EPBC 2013/6885), from the CCMR Project to a connection point with the existing rail network. However, this plan still covers the full extent of the NGBR Project footprint as approved EPBC 2013/6885.

## 1.2 Review and update of plan (December 2018 and August 2019)

A review of this SMP was completed in December 2018 and subsequently in August 2019 and a summary of amendments made is as follows:

- Grammatical, structural and general administrative updates. This includes updating Department names and legislation
- Mapping updates to accurately reflect the final Project alignment and the results of pre-clearance surveys that have been conducted
- Updates to management measures to:
  - Link specific measures to Project approvals
  - To provide necessary flexibility to administer management measures

- To incorporate the need for measures to be undertaken in accordance with stakeholder negotiations
- Consolidation of management measures and monitoring that apply to all species in an upfront section of the document. This eliminated repetition in species profile sections.
- Development of species profiles for the Greater Glider and Painted Honeyeater as these species are now listed under the Commonwealth *Environment Protection and Biodiversity Conservation Act* (EPBC Act).

The amendments have been made in consideration of the Department of Environment and Energy's (DoEE) 'Guidance on 'new or increased impact' relating to changes to approved management plans under EPBC Act' environmental approvals (the Guidance).

The Guidance assists approval holders and officers of the DoEE in determining whether or not a change is likely to have a 'new or increased impact' on a protected matter and whether the revised management plan should be submitted to the Minister for approval or if it can be implemented without further approval. Specifically, the Guidance stipulates the following are considered unlikely to be a new or increased impact:

- Changes to the structure or layout of a plan or other administrative changes that are unrelated to environmental impacts or risks
- A change to a plan which does not affect EPBC Act protected matters
- A clear improvement to a measure that avoids, mitigates or offsets the impacts of a proposal.

Amendments to this SMP do not meet the definition of a 'new impact or increased impact'. The amendments do not provide a mechanism for new activities that may impact on protected matters, nor do they increase risks or uncertainty associated with an impact. The majority of changes are administrative in nature. They do not reduce the mitigation and management intent of the management measures and will not create a level of unmitigated risk for any EPBC Act protected matter covered in the SMP. As such, the amendments are consistent with the Guidance and the implementation of the updated plan does not trigger a requirement to seek approval by the Minister.

In addition, the SMP was amended in September 2019 to include a new chapter on the Poplar Box Grassy Woodland on Alluvial Plains Threatened Ecological Community, which was listed as Endangered under the EPBC Act on 4 July 2019, and has been identified on the Mount Lookout Property during ecological surveys.

### 1.3 Purpose of management plan

The purpose of the SMP is to reduce the environmental impacts of the Project on listed species and communities and the outstanding values of the GBRWHA, through the development of mitigation and monitoring measures. The measures will be implemented across various stages of the Project, including prior to construction, during construction, during operations and as part of the decommissioning process. The management plans are consistent with relevant guidelines and policies on the protection of Matters of National Environmental Significance (MNES) under the EPBC Act, and the management of threatened species listed under the Queensland *Nature Conservation Act 1992* (NC Act).

Objectives of the SMP are as follows:

- Describe practical measures to mitigate impacts of the Project (described in Section 2) on listed species and ecological communities
- Describe monitoring measures that will be implemented to assess the effectiveness of mitigation measures, and inform adaptive management actions



- Provide a consistent framework across the Project for the mitigation of risks to species and ecological communities listed under Commonwealth and Queensland legislation
- Collate relevant Project commitments relating to mitigation and monitoring of ecological values, to assist in streamlining their implementation, the monitoring of compliance and reporting
- Achieve consistency with other management plans for the Project, related to biodiversity offsets, groundwater dependent ecosystems, construction activities and operations
- Achieve compliance with relevant Commonwealth and Queensland approval conditions.

Pre-clearance surveys will be undertaken prior to the commencement of works. In locations where these surveys confirm that no MNES or State-listed species will be impacted, specific mitigation and monitoring measures for that location will not be required.

#### **1.4 Relationship with other management plans**

Various other management plans are to be developed and implemented to address the requirements of approval conditions under Commonwealth and Queensland legislation. There will be some interaction among the plans during construction and operations, as illustrated in Figure 1.

The SMP has been prepared to be consistent with the following management plans in various stages of development:

- Biodiversity Offsets Strategy for the Carmichael Coal Mine and Rail Project; and
- Black-throated Finch Management Plan for the Carmichael Coal Mine.

This was achieved by liaising with Adani and other companies preparing the management plans, and where relevant, aligning the management and monitoring objectives.

A Construction Environmental Management Plan (CEMP) has been developed, reviewed and certified by an independent third party. The purpose of the third-party review is to ensure that the CEMP meets all the requirements of applicable Project approvals and provides suitable management and mitigation measures to adequately manage impacts of the Project.

Sub management plans of the CEMP to be developed and implemented as part of the rail construction and operation include:

- Air quality management plan
- Greenhouse gas emissions management plan
- Soil, erosion and sediment management plan
- General and hazardous waste management plan
- Noise and vibration management plan
- Surface water and groundwater management plan
- Stormwater management plan
- Scenic amenity and lighting management plan
- Traffic management plan
- Social management plan
- Cultural heritage management plan
- Hazardous substances management plan
- Emergency/disaster management plan
- Bushfire management plan
- Decommissioning and rehabilitation management plan
- Pest management plan
- Dust management plan.

The Environmental Management Plan (EMP) Framework Hierarchy is shown in Figure 2, to illustrate the interaction between the CEMP and various sub-plans. Collectively, these plans will provide detailed measures to reduce the impacts of the Project on specific elements of the environment. This SMP has been prepared to be consistent with the objectives and management actions of the above mentioned management plans.

This SMP is separate to a Species Management Program required under the *Nature Conservation Act 1992*, for tampering with a protected animal breeding place in Queensland. A Species Management Program authorises activities that will impact on breeding places of animals protected under the *Nature Conservation Act 1992*. Adani will undertake a survey of animal breeding places prior to clearing activities and develop a Species Management Program for approval, consistent with guidelines provided by DES.

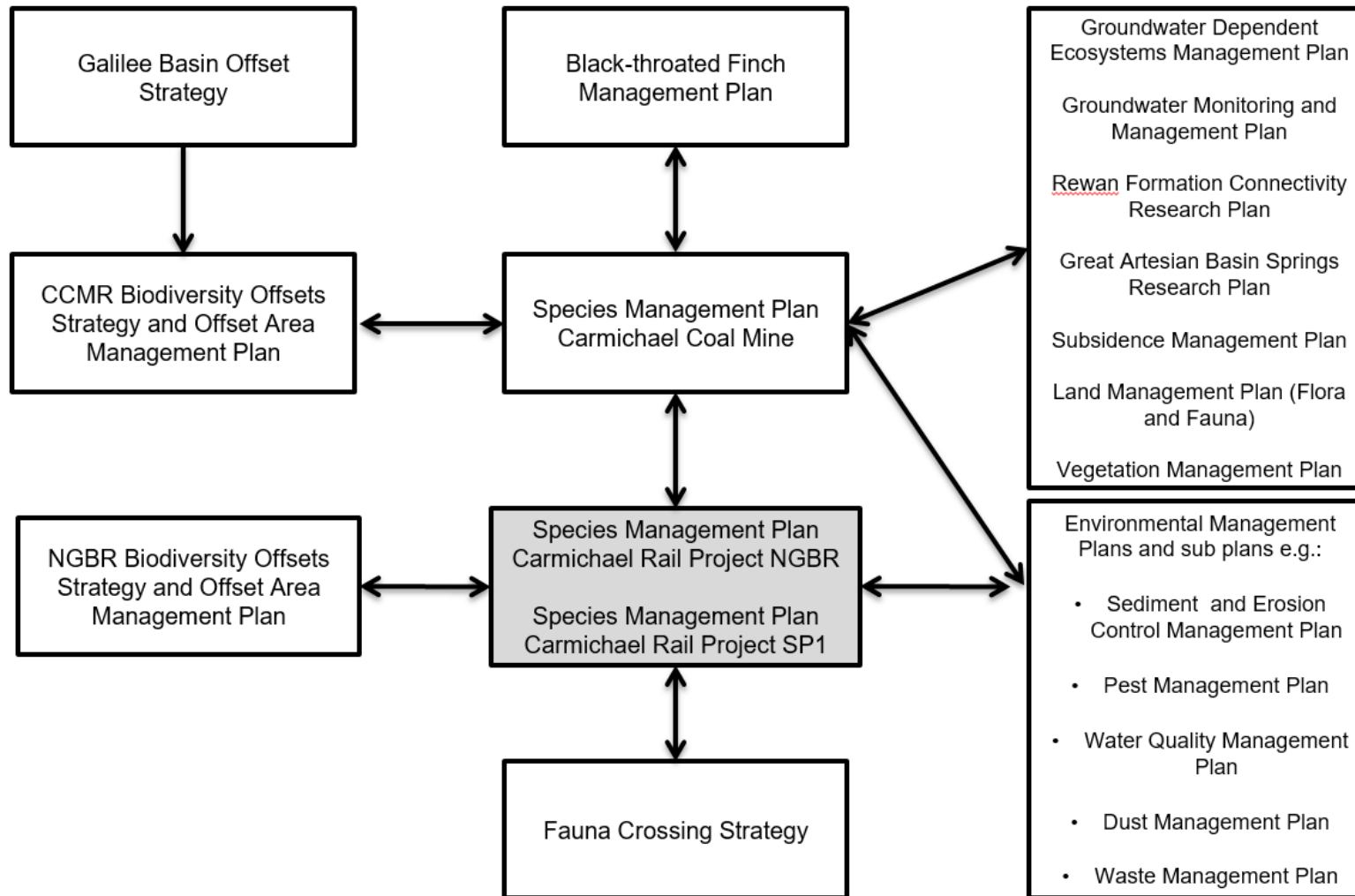


Figure 1 Flow chart showing the interactions among examples of key management plans and sub-plans for the Carmichael Rail Project



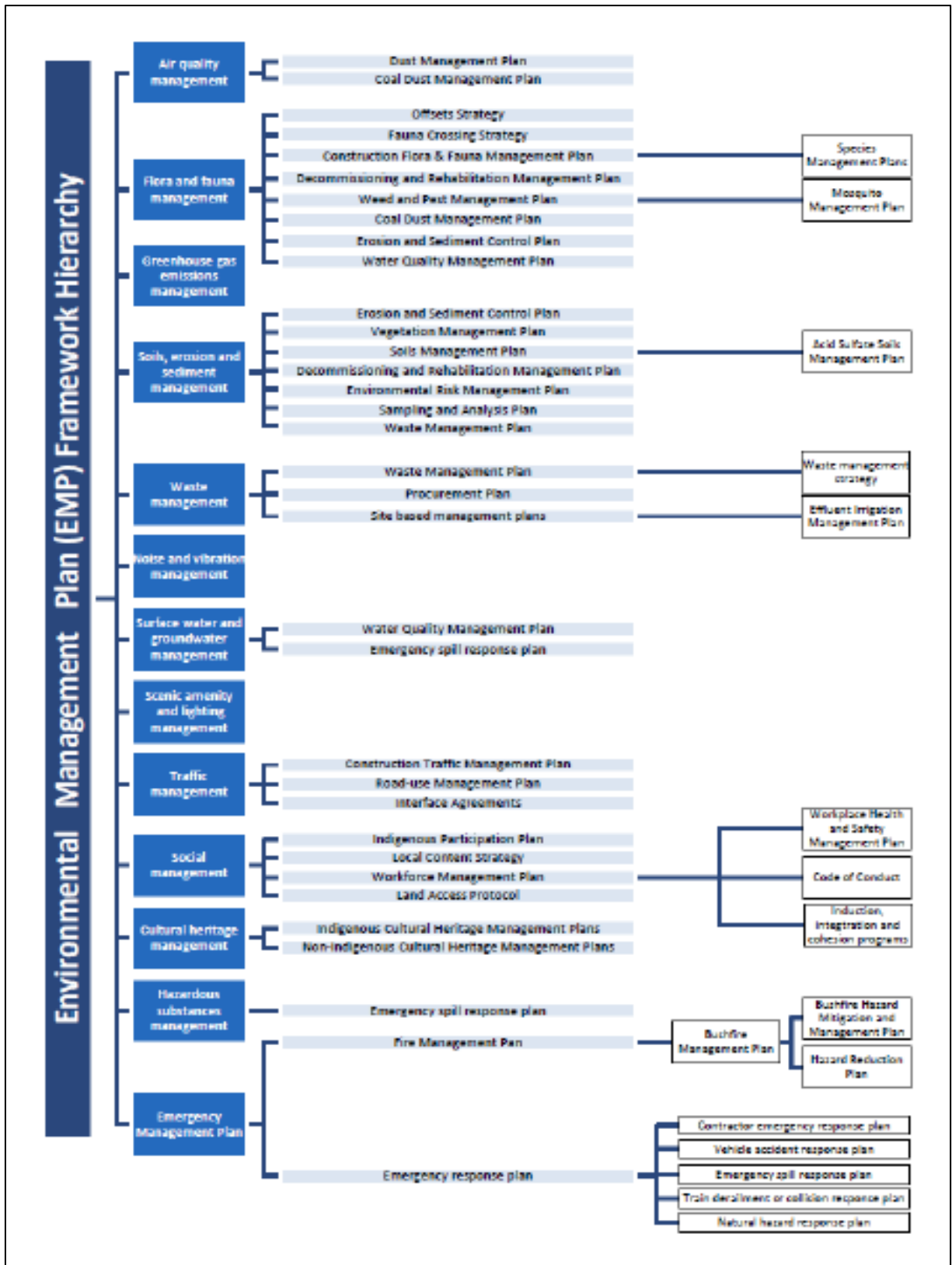


Figure 2 Environmental Management Plan (EMP) Framework Hierarchy

## 1.5 Structure of this report

This report has been structured to address the requirements of relevant approval conditions and to facilitate practical implementation of management measures ‘on the ground’. A summary of key sections is provided below:

- A contextual description of the Project (Section 2)
- Overview of the legislative framework and approval conditions to be addressed within the species management plans (Section 3)
- General description of the existing environmental along the rail corridor (Section 4)
- The general approach to the preparation of the management plan (Section 5)
- Management plans for MNES and species listed under Queensland legislation (Section 6 to 9)
- A discussion of the key outcomes of the management planning process (Section 10)
- Arrangements for reporting and monitoring compliance with species management plan actions (Section 11)

Maps showing the location of Threatened Ecological Communities (TECs), threatened flora and threatened fauna are presented in Appendix A, Appendix B and Appendix C respectively. Appendix D provides an overview of other management plans for the project and includes a link to where such plans may be found online. A summary of the major findings of the EIS process in relation to TECs and threatened species is provided in Appendix E. Maps showing the indicative locations of monitoring sites are provided in Appendix F.

## 1.6 Compliance with approval conditions

Table 1 and Table 2 provide compliance matrices indicating where approval conditions relevant to the SMP have been addressed within this document.

Table 1 NGBR EPBC Approval (EPBC 2013/6885) Conditions

EPBC Condition Number	Description Extract* *Note – full description not included – refer to EPBC approval for completeness	Section of Plan
4	<p>At least three months prior to commencement, the approval holder must submit to the Minister for approval Matters of National Environmental Significance management plan/s for the management of direct and indirect impacts of the proposed action on Matters of National Environmental Significance, being for the purposes of the MNESMP: the species and communities listed in Table 1, and the Outstanding Universal Value of the Great Barrier Reef World Heritage Area.</p> <p><i>Note: if the MNESMP does not address any specific future activities it should be updated in accordance with Condition 20 and submitted to the Department prior to these specific future activities being undertaken.</i></p>	Sections 5 (general approach), Section 6 (TECs), Section 7 (OUV of the GBRWHA), Section 8 (Flora) and Section 9 (Fauna).
5	<p>The MNESMP must be consistent with relevant recovery plans, threat abatement plans and approved conservation advices and must include:</p> <ol style="list-style-type: none"> <li>a. A description of environmental values for each of the Matters of National Environmental Significance addressed in the MNESMP</li> <li>b. Details of baseline and impact monitoring measures to be implemented for each of the Matters of National Environmental Significance including control and impact sites to be monitored throughout the life of the project. The monitoring must provide sufficient data to quantify likely impacts resulting from the proposed action, to determine appropriate habitat management goals (See Conditions 5e and 5f).</li> <li>c. Details of potential impacts, including area of impact, on each of the Matters of National Environmental Significance from the proposed action, including impacts from: <ol style="list-style-type: none"> <li>a. Vegetation clearing</li> <li>b. Earthworks</li> <li>c. Construction works</li> <li>d. Noise and vibration</li> <li>e. Train strike</li> <li>f. Emissions (including dust)</li> <li>g. Light spill and other visual impacts</li> <li>h. Waterway crossings</li> <li>i. Weeds and pests</li> </ol> </li> </ol>	<p>Sections 5, 6, 7, 8 and 9.</p> <p>For each MNES chapter:</p> <ol style="list-style-type: none"> <li>a) Status and Ecology and Distribution Sections</li> <li>b) Monitoring section, plus Section 5.4</li> <li>c) Threats and Impacts Section</li> </ol>
	<ol style="list-style-type: none"> <li>d. Measures that will be undertaken to mitigate and manage impacts on Matters of National Environmental Significance resulting from the proposed action. These measure must include but not be limited to: <ol style="list-style-type: none"> <li>i. For Matters of National Environmental Significance to which the MNESMP apply (see Conditions 4, 7 and 9), relevant mitigation measures proposed in sections 7.6, 7.8 and 7.9 of Volume 2 Appendix D of the Final EIS</li> </ol> </li> </ol>	<p>d) Section 5.3 and Section 5.4.</p> <p>For each MNES Chapter, Mitigation and</p>

EPBC Condition Number	Description Extract* *Note – full description not included – refer to EPBC approval for completeness	Section of Plan
	<ul style="list-style-type: none"> <li>ii. The use of fauna spotters prior to and during all vegetation clearing activities to ensure impacts on Matters of National Environmental Significance are minimised</li> <li>iii. Measures to avoid impacts on Matters of National Environmental Significance and their habitat located in the Project Area, but outside areas to be cleared or constructed upon, including adjacent to cleared areas</li> <li>iv. Measures to rehabilitate all disturbed areas of habitat for Matters of National Environmental Significance addressed in the MNESMP (see Conditions 4, 7 and 9)</li> <li>e. Goals for habitat management of each relevant Matters of National Environmental Significance</li> </ul>	<p>Management Measures section.</p> <p>e) Monitoring Section</p>
	<ul style="list-style-type: none"> <li>f. A table of specific criteria for assessing the success for management measures against goals, and triggers for implementing corrective measures if criteria are not met with in specified timeframes. Goals and triggers must be based on the baseline condition of the Matters of National Environmental Significance as determined through baseline monitoring (see Condition 5b). Corrective measures must include provision of offsets where it is determined that corrective management measures have not achieved goals within specified timeframes</li> <li>g. An ongoing monitoring program to determine the success of mitigation and management measures against the criteria required in Condition 5f, including monitoring locations, parameters and timing.</li> <li>h. Details of how non-compliances will be reported.</li> <li>i. Details of how the MNESMP will be updated to incorporate and address outcomes from surveys undertaken for Matters of National Environmental Significance under this and any state approvals, including updating of goals, criteria and triggers (as required under Conditions 5e and 5f)</li> <li>j. Provisions to ensure that suitably qualified and experienced persons are responsible for undertaking monitoring, review, and implementation of the MNESMP.</li> </ul>	<p>Sections 5, 6, 7, 8 and 9.</p> <p>For each MNES Chapter:</p> <p>f) Mitigation and Management Measures Section, and Section 5.3</p> <p>g) Monitoring Section and Section 5.4</p> <p>h) Section 11</p> <p>i) Section 5.1</p> <p>j) Section 11.3</p>
6	<p>The approval holder must not commence until all the required MNESMP have been approved by the Minister in writing. The approved plan/s must be implemented.</p>	<p>Work will not commence until the management plan is approved.</p>

EPBC Condition Number	Description Extract* *Note – full description not included – refer to EPBC approval for completeness	Section of Plan
7	Where pre-clearance surveys, as required under state approvals, identify individuals of, or habitat for, an EPBC Act listed species or community not previously identified and reported to the Department, the approval holder must notify the Department in writing within five business days of finding these individuals or habitat, and within 40 business days of finding these individuals or habitat must submit to the Department for the Minister's written approval updated MNESMP detailing how impacts to the newly identified EPBC Act listed species or community will be avoided, mitigated and/or offset. Once approved, the revised MNESMP must be implemented.	Included as a requirement in Section 11.1.
8	The approval holder must revise the MNESMP following pre-clearance surveys required under state approvals, and resubmit the MNESMP to the Department of the Minister's written approval within 3 months of pre-clearance surveys being completed. Once approved the revised MNESMP must be implemented.	Included as a requirement in Section 11.1.
9	If, through pre-clearance surveys as required under state approvals, individuals of, or habitat for, an EPBC Act listed species or community not previously identified and reported to the Department are identified, the approval holder must not start or, in the case of work already commenced, must immediately cease any part of the proposed action that may significantly impact that EPBC Act listed species or community, until the MNESMP addressing these impacts have been approved by the Minister in writing. Once approved, the revised MNESMP must be implemented.  Note: Management plans may also be required under associated EPBC approvals (EPBC 2010/5736 and EPBC 2011/6194) and under state approvals. Whenever possible a combined document should be prepared to address both state government and EPBC Act approval conditions.	Included as a requirement in Section 11.1.

Table 2 NGBR Coordinator-Generals' Report (Queensland Government)

Number	Description Extract* *Note – full description not included – refer to Coordinator-General's Report for completeness	Section of Plan
Schedule 2, Part A, Recommendation 2	(a) Prior to commencement of construction, the proponent must conduct pre-clearance ecological surveys of areas to be impacted, consistent with: <ul style="list-style-type: none"> <li>i. Queensland state government survey guidelines</li> <li>ii. Australian government threatened species guidelines.</li> </ul> (b) The surveys must be sufficient to identify the extent to which the following will be unavoidably impacted by the project: <ul style="list-style-type: none"> <li>i. Matters of state environmental significance as defined by the State Planning Policy</li> </ul>	Section 5.3. Section 6, 7, 8 and 9.



Number	Description Extract* *Note – full description not included – refer to Coordinator-General's Report for completeness	Section of Plan
	<ol style="list-style-type: none"> <li>1. a detailed description of the land to which the strategy relates, the values affected and the extent and likely timing of impact on each value</li> <li>2. evidence that values impacted can be offset</li> <li>3. the offset delivery mechanism(s) comprising one or more of: land-based offsets; direct benefit management plans; offset transfers and/or offset payments</li> <li>4. a legally binding mechanism that ensures protection and management of offset areas</li> </ol> <p>(b) The offsets strategy must be provided to the Coordinator-General for approval within 60 days of an approval decision under the Environment Protection and Biodiversity Conservation Act 1999 and no later than 2 months prior to the commencement of construction.</p> <p>(c) The approved offsets strategy must be implemented as directed by the Coordinator-General.</p>	

## 2 Project Description

The Carmichael Rail Project involves construction of a 388 km rail development from the Carmichael Mine in the Galilee Basin to the Port of Abbot Point, near Bowen (Figure 3). The most western section of the corridor (SP1) will comprise a dual gauge section of rail line approximately 77 km in length from the Carmichael Coal Mine to the east in the vicinity of Mistake Creek. The second section of the rail corridor (NGBR) will continue in a northerly direction and comprise approximately 311 km of standard gauge line. This section will start the vicinity of Mistake Creek and extend to the Port of Abbot Point.

In addition to the rail infrastructure, the Project involves the construction of temporary workers accommodation facilities, concrete batching plants, bridge laydown areas, quarries and depot facilities.

Construction of the Project will be completed over a period of two years. Once completed, the new rail infrastructure is projected to have a 90 year life span, with operations commencing when outputs from the Carmichael Coal Mine are available.

Environmental constraints were considered at the design stage of the project and evaluated through a multi-criteria analysis. Additional criteria included engineering requirements for rail formation, waterway crossings, drainage and road crossings.

While the rail development will adhere to the natural ground profile where practicable, significant cut and fill activities are required to maintain ruling gradients and flood resilience (Adani 2015). The primary construction materials will include imported fill, structure fill, capping material, concrete, ballast, sleepers and rail lengths. A variety of cross drainage structures and bridges will also be constructed.

Construction will be conducted over the following four phases (Adani 2015):

- Site preparation
- Drainage structure, earthworks and bridges
- Track laying
- Signal and communications

Clearing will generally occur immediately prior to the earthworks to prevent erosion. Temporary roads and stockpile areas will be established along the rail corridor during construction. Plant and equipment will include heavy earth moving equipment and bridge construction equipment.

At the Port of Abbot Point, the Project will connect with the Terminal 0 balloon loop offloading infrastructure proposed by Adani APT. Export of coal from the Port of Abbot Point will occur through the existing Terminal 1, currently leased by Adani APT, and proposed Terminal 0 once constructed.

The Carmichael Coal Mine is estimated to have an operational life of 60 years. Decommissioning of the rail development will most likely occur after that event, unless in use by third parties. A decommissioning and rehabilitation plan will be developed with the overall aim of minimising the amount of land disturbed at any one time during the life of the Project.



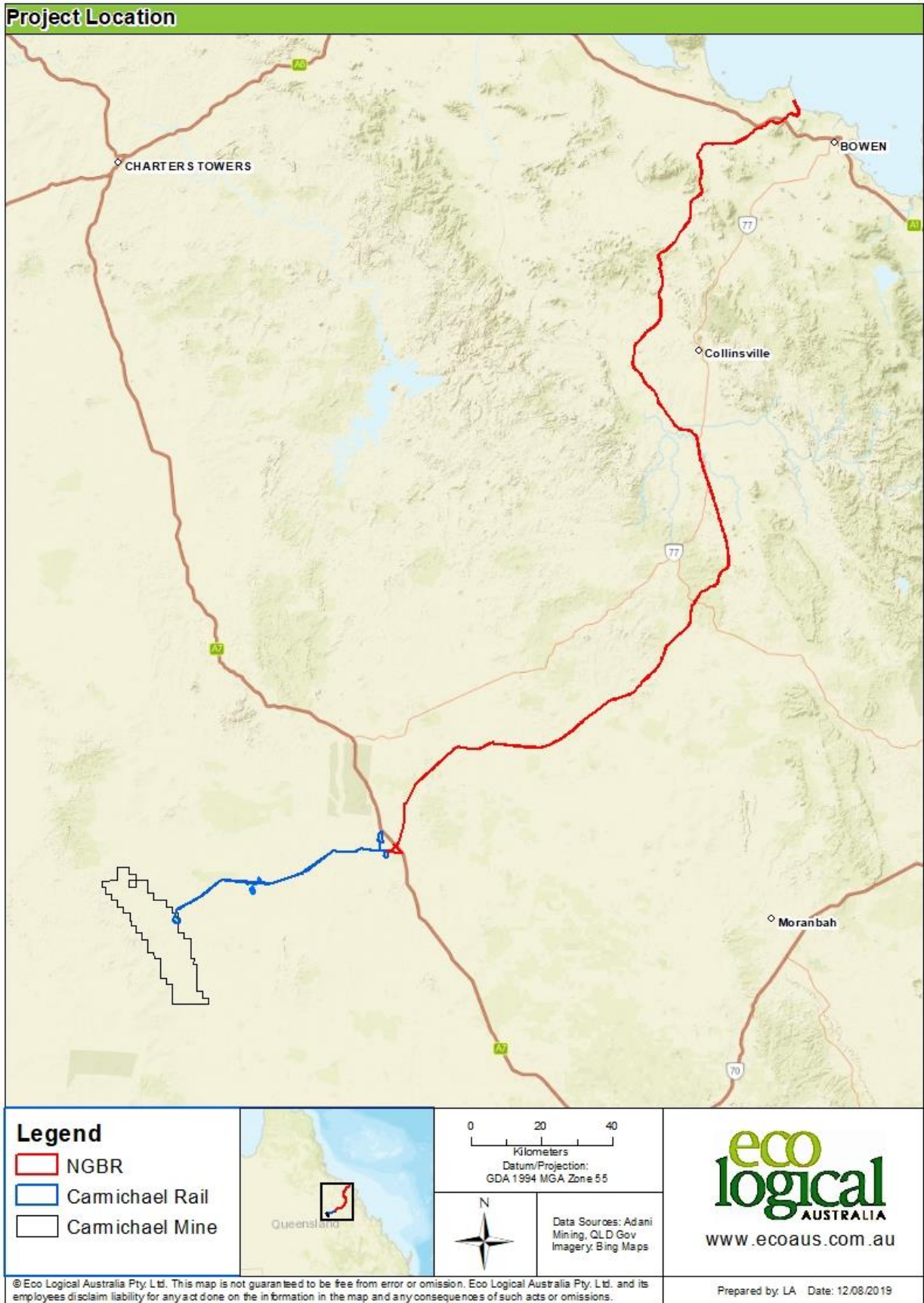


Figure 3 Map showing the location of the Project.

## 3 Legislative and Regulatory Framework

### 3.1 Approval conditions relevant to management plans

There are multiple Commonwealth and Queensland approval conditions that require Adani to prepare a SMP, describing how potential impacts of the Project on ecological values will be mitigated and monitored. The management plans in this report address the requirements of these conditions for both Commonwealth and Queensland legislation.

For each of the Carmichael Rail Project components, there are separate approvals under the EPBC Act (Commonwealth) and from the Queensland Coordinator-General (State). Some approval conditions relating to ecological matters differ between the Carmichael Coal Mine and Rail (SP1) and the NGBR Projects. For example, there are disturbance limits for specified threatened species and ecological communities outlined in Condition 3 the Commonwealth approval for the NGBR (EPBC 2013/6885). However, no disturbance limits are specified for the Carmichael Coal Mine and Rail Project. Monitoring compliance with the disturbance limits must therefore occur within the NGBR component of the Carmichael Rail Project, rather than across the entire rail corridor. Such factors have been taken into account when developing the SMPs.

An inventory of all relevant NGBR Commonwealth and State approval conditions is provided in Section 1.6, with a description of the location within this report where each condition has been addressed. As noted in Section 1.4, management plans for certain environmental values are being developed separately and are not addressed within this report. Such arrangements are also specified within Section 1.6.

### 3.2 Key legislation and NGBR approvals

Assessment of the Project by the Commonwealth Government occurred through the EIS process under the Commonwealth EPBC Act. This assessment considered potential impacts of the Project on MNES, such as federally listed threatened species, migratory species, threatened ecological communities and the GBRWHA.

Assessment of the Project by the Queensland Government occurred through the EIS process under the *State Development and Public Works Organisation Act 1971* (SDPWO Act). This act provides for the assessment of 'coordinated projects' by the Coordinator-General, while considering other Queensland legislation relevant to the activity, including the:

- *Environmental Protection Act 1994*
- *Planning Act 2016*
- *Water Act 2000*
- *Fisheries Act 1994*
- *Nature Conservation Act 1992*
- *Vegetation Management Act 1999*

Adani began formal environmental assessment of the Carmichael Coal Mine and Rail Project in 2010, through preparation of an EIS, to address the Commonwealth and Queensland government approval requirements. Conditional approval of the NGBR Project was granted by the Queensland Coordinator-General on 12 August 2014 and the Commonwealth Minister for the Environment on 14 October 2015 (EPBC 2013/6885).

The SP1 and NGBR sections of rail alignment have been separated into five packages, for which Material Change of Use (MCU) applications have been submitted and approved. The NGBR portion of the rail alignment comprises MCU2 to MCU5 Packages, located east of the Gregory Developmental Road. Chainages (distance from Abbot Point in km) for each MCU package are as follows:

- MCU2 – Chainage 210 to 310
- MCU3 – Chainage 130 to 210
- MCU4 – Chainage 20 to 130
- MCU5 – Chainage 0 to 20

## 4 Existing Environment

This section provides a general description of the ecological values of the Project area which are relevant to the development of the SMP.

### 4.1 Environmental setting

The Carmichael Rail Project is located within the northern section of the Brigalow Belt Bioregion of Queensland. The Brigalow Belt Bioregion is a large and complex area characterised by clay soils with forests and woodlands dominated by Brigalow (*Acacia harpophylla*). The bioregion is located in semi-arid to tropical climates with predominant summer rainfall. The general land types include undulating rugged ranges to alluvial plains, with the bioregion further divided into provinces (sub-bioregions; Young *et al.* 1999). The Carmichael Rail Project traverses three sub-bioregions: Bogie River Hills, Northern Bowen Basin and Belyando Downs

The northern extent of the rail corridor is located at the Port of Abbot Point and is surrounded by low lying coastal and marine ecosystems. This area is located within the Bogie Hills Sub-bioregion which is characterised by undulating hilly areas with duplex and shallow, stony soils. The nationally-significant Caley Valley Wetland is located at Abbot Point, and provides important habitat for a range of migratory and resident shorebirds. The GBRWHA also extends seaward of the low water mark, and encompasses a vast geographic area of coastal and marine ecosystems which support a variety of listed marine species.

The rail corridor traverses several waterway crossings, many of which are semi-permanent to ephemeral. The Northern Bowen Basin is dominated by undulating areas of low hills and sandstone ridges. Belyando Downs is extensively undulating with variable geology. Inland areas are located in a semi-arid climate, with land use dominated by cattle grazing. Such practices have led to extensive clearing of vegetation.

### 4.2 Ecological values

A variety of ecological communities and habitat types occur within the northern Brigalow Belt and are of relevance to the Project. These include:

- Remnants of Regional Ecosystem (RE) of State Significance, including semi-evergreen vine thicket
- Spinifex ridges between Collinsville and Mount Coolon
- Areas of contiguous remnant vegetation of high value as wildlife refugia
- Several wildlife corridors, including those associated with the Great Eastern Range, the Leichhardt Range and Mount Abbot.

Broad habitats along the rail corridor include grassland, semi-evergreen vine thicket, *Acacia* dominated woodland/shrubland, Eucalypt woodlands, fringing riparian vegetation, coastal wetland, aquatic habitat and non-remnant cleared land.

There are three Threatened Ecological Communities (TECs) listed under the EPBC Act along the rail corridor:

- Brigalow (*Acacia harpophylla* dominant and co-dominant)
- Natural Grassland of the Queensland Central Highlands and the Northern Fitzroy Basin
- Semi-evergreen vine thickets of the Brigalow Belt (North and South) and Nandewar Bioregions

Field surveys in 2013 identified over 250 species of fauna along the rail corridor, including birds, mammals, reptiles and amphibians. Over 180 species of birds were recorded from the Project Area, including birds of prey, ducks, honeyeaters, parrots and migratory shorebirds. Bird densities were dominated by species that travel in large flocks and have broad habitat preferences.

A variety of native and introduced mammal species were observed during surveys, with ground mammal fauna dominated by macropods. Several species of snakes, lizards and frogs are also known to occur along the rail alignment, including reptiles of the Brigalow Belt.

### 4.3 Approval conditions

The rail corridor provides habitat for a variety of threatened species, listed under the EPBC Act or the *Nature Conservation Act 1992* (NC Act). State and Commonwealth approval conditions require the development of management plans for those species and ecological communities that were considered most likely to be affected by the project.

For the Commonwealth NGBR approval, these species and communities are as follows:

- Australian Painted Snipe (*Rostratula australis*)
- Black-throated Finch (southern; *Poephila cincta cincta*)
- Squatter Pigeon (southern; *Geophaps scripta scripta*)
- Ornamental Snake (*Denisonia maculata*)
- Koala (*Phascolarctos cinereus*)
- Black Ironbox (*Eucalyptus raveretiana*)
- King Bluegrass (*Dichanthium queenslandicum*)
- Bluegrass (*Dichanthium setosum*)
- Brigalow (*Acacia harpophylla* dominant and co-dominant) TEC
- Natural Grasslands of the Queensland Central Highlands and the Northern Fitzroy Basin TEC
- Semi-evergreen vine thickets of the Brigalow Belt (north and south) and Nandewar Bioregions TEC
- Outstanding Universal Value (OUV) of the GBRWHA.

For the State NGBR approval, a species list was also provided within Table 5.3 of the Coordinator-General's evaluation report outlining six threatened species that were 'confirmed to be present' within the Project Area (Black-necked Stork, Cotton Pygmy-goose, Freckled Duck, Little Pied Bat, Ornamental Snake and Squatter Pigeon). A further 10 species were listed in the table as 'likely to occur' in the Project Area (Australian Painted Snipe, Black-chinned Honeyeater, Black-throated Finch, Brigalow Scaly-foot, Common Death Adder, Eastern Curlew, Estuarine Crocodile, Koala, Little Tern and Square-tailed Kite). The Coordinator-General recommended in Schedule 2 of Appendix 1 of its report that species management plans be prepared for all threatened species known or likely to occur within the project Area (16 species).

On 12 December 2014, there were legislative changes affecting the conservation status of some of these species under the NC Act, with the status of eight of the threatened species being downgraded to 'Least Concern'. Management plans for those species are therefore no longer required under the State approval process. A list of all 16 fauna species is provided below, with those for which management plans are no longer required indicated in brackets:

- Black-necked Stork (*Ephippiorhynchus asiaticus*; has since been listed as Least Concern)
- Cotton Pygmy-goose (*Nettapus coromandelianus*; has since been listed as Least Concern)
- Freckled Duck (*Stictonetta naevosa*; has since been listed as Least Concern)

- Little Pied Bat (*Chalinolobus picatus*; has since been listed as Least Concern)
- Ornamental Snake (*Denisonia maculata*)
- Squatter Pigeon (*Geophaps scripta scripta*)
- Australian Painted Snipe (*Rostratula australis*)
- Black-chinned Honeyeater (*Melithreptus gularis*; has since been listed as Least Concern)
- Black-throated Finch (*Poephila cincta cincta*)
- Brigalow Scaly Foot (*Paradelma orientalis*; has since been listed as Least Concern)
- Common Death Adder (*Acanthophis antarcticus*)
- Eastern Curlew (*Numenius madagascariensis*)
- Estuarine Crocodile (*Crocodylus porosus*)
- Koala (*Phascolarctos cinereus*)
- Little Tern (*Sternula albifrons*; has since been listed as Least Concern)
- Square Tailed Kite (*Lophoictinia isura*; has since been listed as Least Concern)

## 5 General Approach

### 5.1 Overview

A summary of the management planning process is provided in Figure 4. The desktop assessment and pre-clearance surveys/baseline monitoring stages are used to confirm the information in the EIS regarding the presence of threatened species and communities. In the event that new species or TECs are found, then DoEE and/or DES will be notified within five business days and Adani will outline how the conditions of this approval will still be met within 20 business days. This will include updating the species management plans for re-assessment, based on the new information. Changes may also be required to the offsets strategy. Compliance with the disturbance limits are constantly monitored, based on information from the pre-clearance surveys. In the event that disturbance limits are likely to be exceeded, then DoEE is notified and a similar process of updating the management plans and offsets strategy is adopted. Collectively, these stages are known as the 'compliance loop', and have the objective of confirming the scale of environmental impact on threatened species and communities.

Once compliance with approval conditions has been established within the compliance loop, implementation of the management plan commences. Monitoring is undertaken, by a suitably qualified person (see Section 11.3 for details), to determine the effectiveness of mitigation measures. If mitigation measures are ineffective at preventing significant impacts on threatened species and communities, then they are reviewed in consultation with DoEE and/or DES. Enhanced mitigation measures are implemented, and monitoring is undertaken to determine their effectiveness. This process is referred to as the adaptive management loop. If significant impacts are not detected by the monitoring program, then results are reported to DoEE and DES.

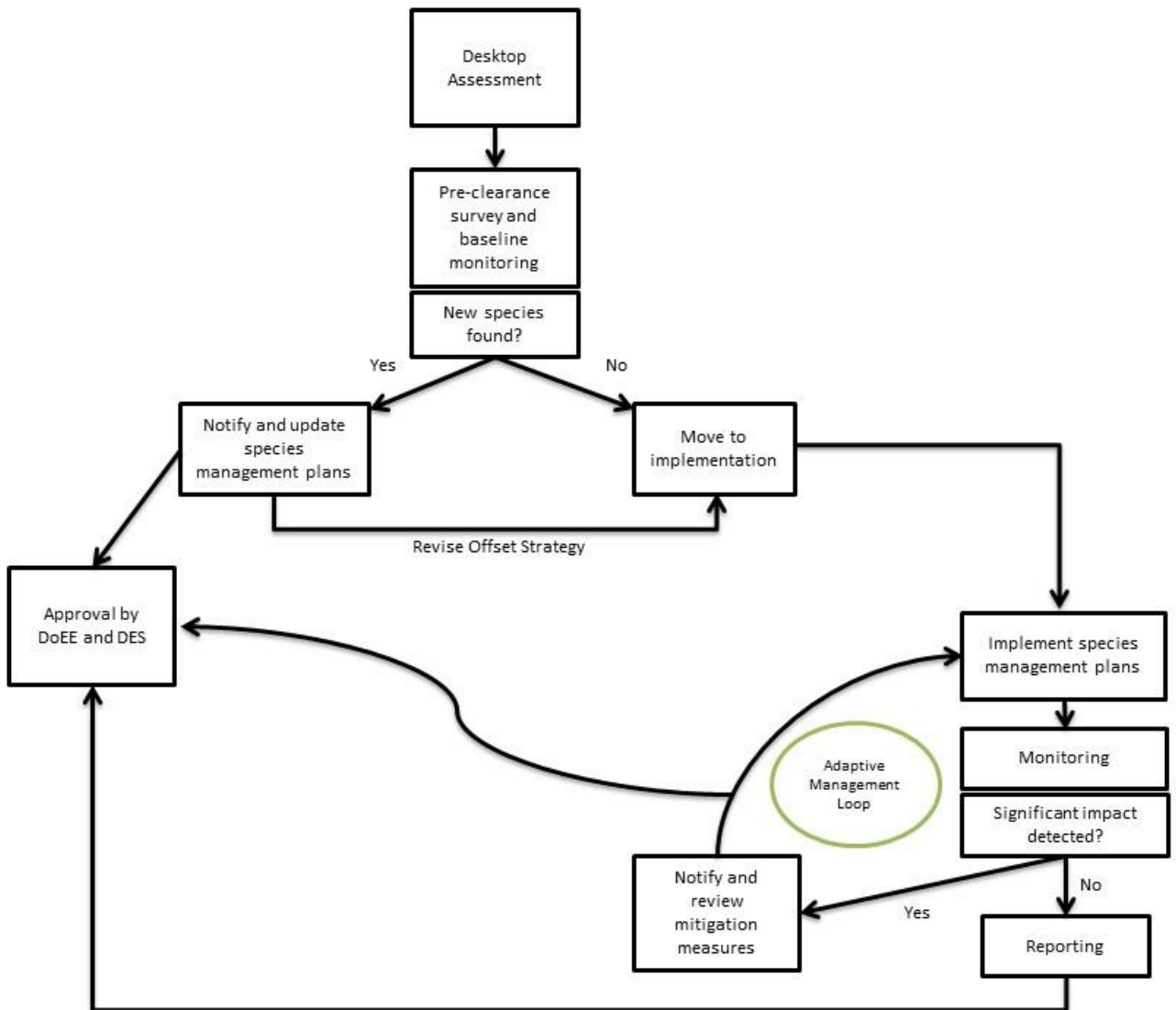


Figure 4 Summary of management planning process



## 5.2 Method

ELA established a team of experienced ecologists with local knowledge of the Project Area and its species and communities to develop the SMP. The plan's development was guided by relevant Commonwealth and State approval conditions, other legislative requirements for native flora and fauna, relevant species recovery plans, and best-practice approaches to species management. The following key steps were taken to develop the management plan for each threatened ecological community or species:

- A review of the environmental values relating to the TEC or threatened species was conducted, drawing upon the EIS studies, published literature and relevant database searches
- The impacts from a range of activities associated with construction and operation of the rail Project were considered, including vegetation clearing, earthworks, construction works, the generation of noise and vibration, train strike, emissions such as dust, light spill, other visual impacts, waterway crossings and the spread of weed and pest species.
- Measures to mitigate the impacts of the Project on the community or species were described, including at locations located adjacent to areas of direct disturbance. Mitigation measures were informed by commitments within the EIS, and the technical knowledge and experience of ecologists developing the plans.
- An approach to monitoring communities or species was developed for a variety of project stages. These included before the commencement of work (baseline monitoring and pre-clearance surveys), monitoring of impacts during construction, assessing recovery post-construction and monitoring the impacts of ongoing operations.
- Goals, triggers and corrective actions were developed for mitigation measures, to establish a framework of adaptive management for communities and species with the potential to be affected by the Project.
- An ongoing system of monitoring was described to determine the effectiveness of the mitigation measures.

Consideration was also given to the potential for impacts at a landscape level and groups of similar species, as Project impacts may not necessarily be manifested on individual communities or species in isolation. The findings of the management planning process for each threatened community and species were described in a separate section of this report.

A similar approach was taken to the development of a management plan for the OUV of the GBRWHA, although some adjustments to the scale of the assessment were necessary. While listed communities and species are relatively straightforward to define, the OUV of the GBRWHA includes many environmental attributes across a vast geographic scale of thousands of kilometres. The management plan was therefore focussed on those attributes of OUV that were assessed as most likely to be affected by the Project. Importantly, development of the management plan included consideration of existing threats to the GBRWHA, which may act cumulatively with the indirect impacts of the Project.

## 5.3 Mitigation measures

While some threatened communities or species will have specific mitigation measures that are implemented to reduce Project-related impacts on those values, there are some mitigation measures that are generic and relevant to all species and ecological communities. For example, pre-clearance surveys will provide information on the composition and area of vegetation and habitat to be disturbed prior to construction works, mitigating the risk of disturbing environmental values that were not identified during the EIS process, and monitoring compliance with approved disturbance limits.

A description of the generic mitigation measures applying to all communities and species is provided in Table 3, Table 4, Table 5 and Table 6. Management plans have a simplified description of these mitigation measures where applicable, to avoid repetition throughout the report. Additionally, specific mitigation measures which are tailored to protect the threatened community or species and build upon the generic mitigation measures are described within each species management plan. Many mitigation measures are derived from those developed within other environmental management plans. A summary of project environmental management plans is provided in Appendix D.

**Table 3 Generic mitigation measures to be implemented across the Project Area.**

Objectives	Actions
<p>Educate staff and contractors about the presence and identification of threatened species, and maintain awareness during construction and operations.</p>	<p><b>Education</b></p> <ul style="list-style-type: none"> <li>• Induction program for staff and contractors about threatened species, their habitats and identification.</li> <li>• Identification posters in prominent work locations to maintain awareness.</li> <li>• Implement sound land management practices.</li> </ul>
<p>Reduce the magnitude of disturbance to threatened communities and threatened species within the Project Area.</p>	<p><b>Minimise placement of infrastructure in threatened communities and threatened species habitat</b></p> <ul style="list-style-type: none"> <li>• There will be some discretion in the precise location of some infrastructure. Where possible, such infrastructure will be located in areas which avoid disturbance to ecological values.</li> </ul>
<p>Determine the environmental baseline, prior to construction activities.</p> <p>Identify threatened communities or species not previously identified in the area, prior to their disturbance.</p> <p>Avoid the disturbance of threatened ecological communities and threatened species and their habitat, where possible (i.e., for the location of supporting infrastructure).</p> <p>Monitor compliance with approval conditions that specify a habitat disturbance limit for threatened communities or species.</p>	<p><b>Undertake pre-clearance surveys</b></p> <ul style="list-style-type: none"> <li>• Conduct surveys of vegetation and threatened species habitat extent and condition, and receive approval for an updated SMP that incorporates this information, prior to the commencement of any clearing or disturbance activities.</li> <li>• Define the area (hectares) of threatened ecological communities and threatened species habitat to be cleared.</li> </ul>
<p>Minimise impacts of construction on threatened communities and species.</p> <p>Identify threatened fauna species not previously identified within the Project Area.</p>	<p><b>Use licensed fauna spotter-catchers during vegetation clearing</b></p> <ul style="list-style-type: none"> <li>• Survey of area to be disturbed prior to and during construction.</li> <li>• Fauna to be recorded and translocated to suitable habitat adjacent to the disturbance area, where practical.</li> <li>• Fauna deaths and injuries to be recorded, and managed in accordance with relevant guidelines.</li> </ul>
<p>Minimise impacts on threatened communities and species, and their habitat.</p> <p>Promote post-construction recovery of the natural ecosystem.</p> <p>Maintain ecosystem functionality.</p>	<p><b>Rehabilitate all temporarily disturbed areas (e.g. lay down areas and turning circles)</b></p> <ul style="list-style-type: none"> <li>• All temporarily disturbed areas will be rehabilitated as soon as possible following completion of use, where such activity does not compromise the ongoing operation of the project (e.g. increase bushfire risk).</li> </ul>

Objectives	Actions
<p>Educate staff and contractors about the presence and identification of threatened species, and maintain awareness during construction and operations.</p>	<p><b>Education</b></p> <ul style="list-style-type: none"> <li>• Induction program for staff and contractors about threatened species, their habitats and identification.</li> <li>• Identification posters in prominent work locations to maintain awareness.</li> <li>• Implement sound land management practices.</li> </ul>
<p>No net loss of threatened communities and species. Maintain the integrity of ecological habitats within the region.</p>	<p><b>Implement environmental offsets (for selected species and ecological communities)</b></p> <ul style="list-style-type: none"> <li>• Offset the habitat values of threatened ecological communities, and used by threatened species, within the Project Area by securing ecologically equivalent areas elsewhere.</li> </ul>
<p>Reduce the impact of lighting on threatened species.</p>	<p><b>Manage light pollution</b></p> <ul style="list-style-type: none"> <li>• Use directional lighting and strategic timing and placement of lights to minimise light spill into known threatened species habitat and TECs.</li> </ul>

Table 4 Mitigation and management measures for all communities listed in this Plan

Goal	Performance Criteria	Mitigation and Management Measures	Trigger	Corrective Actions
Minimise clearing of threatened ecological communities (TEC)	All areas of TEC within and adjacent to the Project Area are identified and mapped	<p>Pre-clearance targeted surveys will be undertaken by a suitably qualified person(s) (see Section 11.3) to determine the presence/absence, condition status and spatial extent of this community prior to any clearing or associated works occurring. The surveys will target areas of mapped remnant and regrowth RE's within and directly adjacent the Project Area.</p> <p>This information will be included in a revised SMP to be submitted to DoEE for approval within 3 months following the completion of pre-clearance surveys.</p> <p>Where possible surveys of grassland REs will be undertaken following periods of rainfall (November – January) and by a suitably qualified person.</p>	Areas of TEC occur within or adjacent to the Project Area, that are not mapped	Update mapping and submit revised SMP to DoEE within 5 business days, for approval.
	Avoid unnecessary or unapproved clearing	<p>Using the information from the targeted survey, the extent of the TEC to be cleared will be restricted to the minimum area necessary for the construction of the rail corridor and ancillary infrastructure. All vegetation clearing operations are to be monitored for compliance by a suitably qualified person. Information gathered from the survey will be considered by site Environmental Representatives (ERs) before issuing "Permits to Disturb" (mandatory for all vegetation clearing activities).</p> <p>During detailed design, temporary construction areas, such as site offices, stockpiles and machinery/equipment laydown area will be preferentially located outside of areas identified as TEC.</p>	Any clearing of TEC outside the clearing footprint.	<p>Where this not achievable and works are not covered under current approvals, additional state and federal approvals will be required prior to clearing.</p> <p>If a TEC is cleared outside the defined Project Area, clearing is to cease immediately and DoEE will be notified of the incident by Adani. It will be recorded as an incident in the Adani reporting system. Following this the area is to be assessed by a suitably qualified person and corrective actions will be taken, with the corrective actions dependent on incident investigation outcomes. Potential management actions include TEC</p>

Goal	Performance Criteria	Mitigation and Management Measures	Trigger	Corrective Actions
		<p>Prior to the commencement of site works, any conditions listed in the “Permit to Disturb” must be implemented - e.g. clearing extents clearly marked, trees/areas requiring protection clearly marked, or barricaded. All vegetation clearing operations will be monitored for compliance by a suitably qualified person, able to identify and clearly demarcate the relevant TECs in this plan.</p> <p>For areas where there is some discretion in the location of clearing, that clearing should avoid the most undisturbed remnants of TEC, where possible.</p>		<p>rehabilitation, and incorporating the area of disturbance into the expected losses for the applicable TEC.</p>
		<p>Vehicles will only drive on designated access tracks, and the access tracks will be defined in the EMP</p>	<p>Degradation of TEC due to vehicles</p>	<p>Non-conformances with this requirement will be recorded as an incident in Adani’s incident reporting system, and actions taken will depend on investigation findings.</p>
	<p>Clearing of TEC does not exceed maximum disturbance limits</p>	<p>Pre-clearance surveys will accurately identify the extent of TECs to be disturbed within the Project Area footprint.</p> <p>Undertake monthly monitoring of the amount of TECs cleared and maximum disturbance limit balance (as per the Monitoring Program).</p>	<p>Clearing of TEC reaches 80% of maximum disturbance limits</p>	<p>If pre-clearance surveys identify that impacts to a TEC are likely to exceed the maximum disturbance limit, clearing is to cease immediately (“Permits to Disturb” will not be issued by site ERs) and DoEE is to be notified within 5 business days. A review of clearing requirements in relation to the location of the TEC will be undertaken.</p> <p>If the disturbance limit is increased additional offsets may also be required. A revised Biodiversity Offset Strategy (BOS) will be submitted to DoEE within 40 business days following approval.</p>

Goal	Performance Criteria	Mitigation and Management Measures	Trigger	Corrective Actions
		<p>Where additional areas of TEC are identified within the Project Area, DoEE will be notified of locations within 5 business days, and an account of how the conditions of this approval will still be met will be submitted to DoEE within 20 business days .</p>		<p>Vegetation maps will be updated to ensure clearing of TECs does not exceed permitted limits via investigating measures to decrease clearing elsewhere. Additional offsets may be required. If so, a revised BOS will be submitted to DoEE as part of the account of how the conditions of this approval will be met.</p>
		<p>All personnel involved in clearing activities must be made aware of the “Permit to Disturb” conditions and any relevant requirements to be implemented. All workers will receive environmental awareness training as part of their site induction, including specific topics on MNES, risks and protective measures. This training will include the locations and extent of TECs.</p>	<p>Site induction not completed</p>	<p>No workers will be permitted to commence work on site until they have completed the site induction.</p>
<p>Minimise degradation of retained areas of TEC adjacent to the Project Area</p>	<p>Determine the condition of TECs adjacent to the Project Area</p>	<p>Undertake BioCondition assessments in suitable areas during baseline monitoring (as outlined in the Monitoring Program). This information will be included in the annual compliance report.</p>	<p>Reduction in TEC condition adjacent to the project area, which is not reflected in the control sites.</p>	<p>An annual monitoring report will be submitted to DoEE. Revise and implement an updated Management Plan within 30 days of receiving monitoring results, to reduce the impact on TEC.</p>
	<p>Maintain existing condition of retained areas of TEC adjacent to the Project Area</p>	<p>The monitoring program will be implemented during and following construction to identify any changes in vegetation condition or habitat structure that could occur as a result of development activities. This information will be included in the annual compliance report.</p> <p>Avoid mowing or slashing grassland TECs during peak flowering periods (spring/summer).</p> <p>Ensure weed control chemicals and mechanisms do not adversely impact the Grassland TEC.</p>		

Goal	Performance Criteria	Mitigation and Management Measures	Trigger	Corrective Actions
	Limit disturbance from emissions (dust) on photosynthetic ability of the community	<p>Annual monitoring of TEC condition in retained areas.</p> <p>Actions and thresholds will be outlined in relevant management plan (i.e. CEMP and Operational Environmental Management Plan (OEMP)). Mitigation and management measures should include but not be limited to:</p> <ul style="list-style-type: none"> <li>Dust suppression (e.g. watering) during vegetation clearing, earthworks and construction</li> <li>Coal wagon veneering during operation</li> </ul>	Growth of vegetation in TEC adjacent to the Project Area inhibited due to dust emissions	Where monitoring shows a reduction in habitat condition due to dust emission, investigate source of dust and upgrade strategies outlined in the Dust Management Plan to reduce dust emissions impacts on habitat.

Table 5 Mitigation and management measures for all flora species listed in this Plan

Goal	Performance Criteria	Mitigation and Management Measures	Trigger	Corrective Action
Minimise habitat loss of threatened species	All areas of threatened flora habitat within and adjacent to the Project Area are identified and mapped	<p>Pre-clearance targeted surveys for threatened flora (<i>Dichanthium queenslandicum</i>, <i>Dichanthium setosum</i> and <i>Eucalyptus raveretiana</i>) will be undertaken by a suitably qualified person (see Section 11.3) The survey will aim to determine the presence/absence of these species, population status, key threats (weeds) and area extent of these species prior to any clearing or associated works occurring. The surveys will target suitable habitat for these species within and directly adjacent to the active Project Area.</p> <p>All records of these species will be marked, photographed and mapped. As <i>Dichanthium queenslandicum</i> and <i>Dichanthium setosum</i> have not been recorded in the Project Area, DoEE will be notified within five business days of any new records.</p> <p>Where possible surveys for <i>Dichanthium queenslandicum</i> and <i>Dichanthium setosum</i> will be undertaken following periods of rainfall (November – January) at a suitable time to detect these species.</p> <p>This SMP will be revised and submitted to DoEE within 3 months following the completion of pre-clearance surveys.</p>	Areas of threatened flora habitat occur within or adjacent to the Project Area, that are not mapped	Update mapping and submit revised SMP to DoEE within 5 business days, for approval.

Goal	Performance Criteria	Mitigation and Management Measures	Trigger	Corrective Action
	Avoid unnecessary or unapproved clearing	<p>Using the information from the targeted survey, the extent of species habitat to be cleared will be restricted to the minimum area necessary for the construction and operation of the rail and ancillary infrastructure. All vegetation clearing operations are to be monitored for compliance by a suitably qualified person. Information gathered from the survey will be considered by site ER's before issuing "Permits to Disturb" (mandatory for all vegetation clearing activities).</p>	<p>Any clearing of threatened flora habitat outside the clearing footprint.</p>	<p>Where this not achievable and works are not covered under current approvals, additional state and federal approvals will be required prior to clearing.</p> <p>If clearing limits and exclusions are not clearly marked, clearing is to cease until limits and exclusions can be appropriately established.</p> <p>If threatened flora habitat is cleared outside the defined Project Area, clearing is to cease immediately and DoEE will be notified of the incident by Adani. It will be recorded as an incident in the Adani reporting system. Following this the area is to be assessed by a suitably qualified person and corrective actions will be taken, with the corrective actions dependent on incident investigation outcomes. Potential management actions include habitat rehabilitation, and incorporating the area of disturbance into the expected losses for the applicable threatened flora species.</p>
		<p>During detailed design, temporary construction areas, such as site offices, stockpiles and machinery/equipment laydown areas will be preferentially located outside of areas identified as known threatened flora habitat.</p>		
		<p>Prior to the commencement of site works, any conditions listed in the "Permit to Disturb" must be implemented - e.g. clearing extents clearly marked, trees/areas requiring protection clearly marked, or barricaded. All vegetation clearing operations are to be monitored for compliance by a suitably qualified person able to identify and clearly demarcate threatened flora habitat.</p>	<p>Degradation of threatened flora habitat due to vehicles</p>	<p>Non-conformances with this requirement will be recorded as an incident in Adani's incident reporting system. Disciplinary action will be taken, including involvement in the restoration of any habitats impacted. Impacted habitats will be restored to pre-impact condition.</p>
		<p>Vehicles will only drive on designated access tracks, and the access tracks will be defined in relevant management plans - CEMP and OEMP.</p>		



Goal	Performance Criteria	Mitigation and Management Measures	Trigger	Corrective Action
	Clearing of threatened flora habitat does not exceed maximum disturbance limits	Pre-clearance surveys will accurately identify the extent of threatened flora habitat (and number of individuals of <i>Eucalyptus raveretiana</i> ) to be disturbed within the Project Area footprint.	Clearing of threatened flora habitat reaches 80% of maximum disturbance limits	If pre-clearance surveys identify that impacts to threatened flora habitat are likely to exceed the expected losses, "Permits to Disturb" won't be issued by site ERs, and a review of clearing requirements in relation to the location of threatened flora habitat will be undertaken.
		Undertake regular monitoring of the area of threatened flora habitat cleared and maximum disturbance limit balance (as per the Monitoring Program).		Vegetation maps will be updated to ensure clearing of threatened flora habitat doesn't exceed permitted limits via investigating measures to decrease clearing elsewhere. Additional offsets may be required. If so, a revised BOS will be submitted to DoEE as part of the account of how the conditions of this approval will be met.
		Where additional specimens or habitat are identified in the Project Area, DES and DoEE will be notified of locations within 5 business days, and an account of how the conditions of this approval will still be met will be submitted to DoEE within 20 business days.		
		All personnel involved in clearing activities must be made aware of the "Permit to Disturb" conditions and any relevant requirements to be implemented. All workers will receive environmental awareness training as part of their site induction, including specific topics on MNES, risks and protective measures. This training will include the locations and extent of threatened flora habitat.	Site induction not completed	No workers will be permitted to commence work on site until they have completed the site induction.
Minimise degradation of retained areas of threatened flora habitat adjacent to the Project Area	Determine the condition of threatened flora habitat adjacent to the Project Area	Undertake BioCondition assessments in suitable areas during baseline monitoring (as outlined in the Monitoring Program). This information will be included in the annual compliance report.	Reduction in threatened flora habitat condition adjacent to the project area, which is not reflected in the control sites.	An annual monitoring report will be submitted to DoEE. Revise and implement an updated Management Plan within 30 days of receiving monitoring results, to reduce the impact on threatened flora habitat.
	Maintain existing condition of retained areas of threatened flora habitat adjacent to the Project Area	The monitoring program will be implemented during and following construction to identify any changes in vegetation condition and habitat structure that could occur as a result of development activities. This information will be included in the annual compliance report.		

Goal	Performance Criteria	Mitigation and Management Measures	Trigger	Corrective Action
	Limit disturbance from emissions (dust) on photosynthetic ability of threatened flora species	<p>Actions and thresholds will be outlined in relevant management plan (i.e. CEMP and OEMP). Mitigation and management measures should include but not be limited to:</p> <ul style="list-style-type: none"> <li>Dust suppression (e.g. watering) during vegetation clearing, earthworks and construction</li> <li>Coal wagon veneering during operation</li> </ul>	Growth of vegetation in threatened flora habitat adjacent to the Project Area inhibited due to dust emissions	Where monitoring shows a reduction in habitat condition due to dust emission, investigate source of dust and upgrade strategies outlined in the Dust Management Plan to reduce dust emissions impacts on habitat.
Minimise invasive weeds	Minimise increase to Buffel Grass prevalence and prevent the spread of existing weeds and the introduction of new weeds, specifically Parthenium and Parkinsonia ( <i>Dichanthium queenslandicum</i> habitat), Coolatai grass, Lippia and African Lovegrass ( <i>Dichanthium setosum</i> habitat) and Rubber Vine, Lantana and <i>Panicum maximum</i> ( <i>Eucalyptus raveretiana</i> habitat)	<p>A Pest Management Plan (PMP) will be developed and implemented prior to construction activities. This PMP will specify, but not be limited to:</p> <ul style="list-style-type: none"> <li>Ongoing (yearly) monitoring of weed species</li> <li>Specify control measures for known and potential weeds. The PMP will develop Rubber Vine management protocols in line with the Strategic Plan for this species (ARMCANZ 2000).</li> <li>Ensure that any herbicides used for weed control within the rail corridor do not have significant adverse impact on threatened flora species.</li> </ul>	<p>&gt;10% increase in the population or cover of each weed or pest species present, from baseline scores</p> <p>Presence of new weeds or pests</p>	PMP to be updated if additional weeds are identified or weed spread continues during construction activities. Increase pest management efforts.

**Table 6 Mitigation and management measures for all fauna species listed in this Plan**

Goal (Impact)	Performance Criteria	Management Measures	Trigger	Corrective Action
Minimise loss of habitat through vegetation clearing	Avoid unnecessary or unapproved clearing	Prior to the commencement of site works, any conditions listed in the “Permit to Disturb” must be implemented - e.g. clearing extents clearly marked, trees/areas requiring protection clearly marked. All vegetation clearing operations are to be monitored for compliance by a suitably qualified person able to identify and clearly demarcate threatened fauna species habitat.	Any clearing outside clearing footprint in threatened fauna species habitat	If threatened fauna species habitat is cleared outside the defined clearing footprint, clearing is to cease immediately and DoEE and DES will be notified of the incident by Adani. It will be recorded as an incident in the Adani reporting system. Following this, the area is to be assessed and corrective actions will be taken, with the corrective actions depending on incident investigation outcomes.

Goal (Impact)	Performance Criteria	Management Measures	Trigger	Corrective Action
		<p>Vehicles will only drive on designated access tracks, and the access tracks will be defined in relevant management plans - CEMP and OEMP.</p> <p>Temporary stockpile sites for soil and equipment, access routes, laydown yards and other associated infrastructure will be located in cleared areas, where possible.</p>		<p>Non-conformances with this requirement will be recorded as an incident in Adani's incident reporting system, and actions taken will depend on investigation findings</p>
	Clearing of threatened fauna species habitat does not exceed maximum disturbance limits	Ongoing monitoring of the amount of threatened fauna species habitat that is cleared.	Clearing of threatened fauna species habitat reaches 80% of maximum disturbance limits	Seek DoEE approval to increase the amount of threatened fauna species habitat to be cleared if the area will exceed expected losses, incorporating the predicted increase in impact area.
Minimise the influence of Project activities on bushfire risk.	No bushfires sparked by project activities	<p>Bushfire mitigation measures will be outlined in the Bushfire and Disaster Management plan and should include but not be limited to:</p> <ul style="list-style-type: none"> <li>Monitoring of weather conditions to identify high fire risk days, with controls to be upgraded on these days</li> <li>Restrictions on vehicles being left idling with the exhaust in contact with dry grass</li> <li>Designation of smoking areas.</li> <li>Identification of bushfire fuel management practices within corridor (i.e. regularity of slashing).</li> </ul> <p>In addition, the Bushfire and Disaster Management plan will include best practice measures outlined in the Bioregional Management Plan, if available, It will also outline review triggers and timelines to monitor the effectiveness of management actions</p>	<p>Additional information from baseline research or Bioregional Management Plan regarding best practice mitigation and management measures regarding fire.</p> <p>Review indicates that management actions are not effective.</p>	<p>Revise and implement an updated PMP.</p>
			<p>Bushfire sparked by construction activities</p>	<p>Immediately implement actions to suppress the spread of the fire.</p> <p>Incidences will be recorded in a register as per the CEMP.</p> <p>Review adherence to control procedures to ensure compliance. Take remedial action where compliance has not been adhered to. Increase training to ensure breach does not re-occur.</p>

Goal (Impact)	Performance Criteria	Management Measures	Trigger	Corrective Action
Reduce degradation of suitable water sources	Emissions (i.e. dust, coal and heavy metals) do not degrade water source quality in threatened fauna species habitat	Dust emissions will be managed in accordance with the Dust and Coal Dust Management Plans, and should include but not be limited to: <ul style="list-style-type: none"> <li>• Regular watering of dusty areas in accordance with Dust Management Plan.</li> <li>• Ensuring trains are not overloaded.</li> <li>• Use of veneers to minimise the loss of coal particles in transit.</li> </ul>	Exceedance of EA water quality parameters. Emissions settlement in waterways breach industry standards	Inform DES within 24 hours. Investigate source of any exceedance, implement remedial actions as per environmental approval conditions and CEMP requirements. Within 10 business days following the initial notification of an emergency or incident, or receipt of monitoring results, whichever is the latter, further written advice will be provided to the administering authority, including the following: <ol style="list-style-type: none"> <li>a) results and interpretation of any samples taken and analysed;</li> <li>b) outcomes of actions taken at the time to prevent or minimise unlawful environmental harm; and</li> <li>c) proposed actions to prevent a recurrence of the emergency or incident.</li> </ol>
	Manage acid sulfate soils in accordance with accepted guidelines	<ul style="list-style-type: none"> <li>• Effectively store and treat disturbed acid sulphate soils, in alignment with an approved Acid Sulphate Soils (ASS) Management Plan.</li> </ul>	Baseline ASS risk to be determined prior to disturbance	Investigate source of sulphate increase, implement appropriate corrective measures and report as per environmental approval conditions and CEMP requirements, if required. Inform DES of monitoring results. Review Acid Sulphate Soils Management Plan and implement strategies to reduce ASS risk.

The results of all mitigation actions will be recorded and reported to the DoEE and DES as specified in approval conditions. Further details of such reporting are provided in Section 11.

#### 5.4 Monitoring approach and rationale

A monitoring program will be implemented to inform assessments of the effectiveness of mitigation measures. The level of disturbance of Project activities on ecological values will also be measured and the success of rehabilitation activities evaluated. As with mitigation measures, some monitoring activities will be generic and broadly applicable across multiple ecological values. Other monitoring activities will be species-specific and tailored to measure the effectiveness of mitigation measures at reducing the impacts of the Project on specific ecological attributes.

A description of generic monitoring measures to be implemented across the Project Area is provided in Table 7, Table 8, Table 9 and Table 10.

**Table 7 Generic monitoring measures to be implemented across the Project Area.**

Monitoring Measure	Description	Objectives
Pre-clearance surveys	Confirm and identify the spatial extent and condition of threatened species habitat to be disturbed, within 12 months prior to any clearing or disturbance commencing, through pre-clearance surveys, focusing on species that were not detected during field surveys for the EIS	Record the areas of occupancy for all threatened species and communities prior to clearing activities that occur within the Project Area (including offsite infrastructure areas). Receive approval for an updated species management plan that incorporates this information. Comply with approval conditions.
Disturbance limits	Monitoring the spatial extent of habitat to be disturbed, through pre-clearance surveys (within 12 months of works commencing). Monitor compliance with approved disturbance limits for some habitat values.	Reduce the disturbance of habitat for threatened species and communities. Comply with approval conditions.
Condition	Monitor the condition of threatened species habitat, adjacent to corridor.	Ensure the natural condition of habitats and TECs adjacent to the rail corridor is maintained.
Weeds	Monitor the presence of declared weeds, and abundance of environmental weeds.	Inform pest management plan and control activities. No increase in the cover of environmental weeds as a result of the project.
Pests	Monitor the presence and population abundance of invasive fauna.	No increase in populations (abundance) of invasive fauna as a result of the project. Inform pest management plan and control activities.
Vegetation rehabilitation areas	Measure the effectiveness of rehabilitation activities through BioCondition monitoring.	Measure the effectiveness of mitigation measures involving rehabilitation. Identify areas where rehabilitation effectiveness needs to be improved to achieve environmental objectives.
Waterway quality	Measure the effectiveness of rehabilitation activities, by monitoring water quality in accordance with the EMP.	Maintain the natural condition of waterways.
Offset areas	Measure the effectiveness of offset investments, by monitoring the quality of offset areas in accordance with the OAMP.	Measure the effectiveness of mitigation measures involving offsets. Identify areas where offset effectiveness needs to be improved to achieve environmental objectives.

Monitoring Measure	Description	Objectives
Fauna mortality and injuries	Arrange for identification of injured and/or deceased wildlife by a qualified person (e.g. ecologist, museum staff, onsite ER).	Accurate identification of injured and/or deceased fauna
Dust	Monitor dust within and adjacent to construction activities in accordance with the EMP.	Measure the effectiveness of dust control measures at limiting disturbance to adjacent areas.
Fire	Monitor incidence of Project-related fire, and undertake BioCondition monitoring.	Limit changes to the existing fire regime due to Project-related activities (e.g. altered fuel loads).

Table 8 Details of monitoring program for threatened ecological communities

Performance Criteria	Triggers	Monitoring Program	Outcomes
Identify/confirm TEC patches and their condition within and immediately adjacent to the rail corridor prior to any ground disturbance	N/A	Pre-clearance targeted surveys for TECs and their condition within and directly adjacent to the Project Area. Surveys to be undertaken at any time of the year for Brigalow and SEVT TECs (and between the first rains in spring/summer and the drying of vegetation in autumn for Grassland TEC).	Record and map TEC locations and condition in the vicinity of the Project Area, to ensure appropriate mitigating management measures are implemented.
Clearing of TECs does not exceed maximum disturbance limits	Clearing of TEC reaches 80% of maximum disturbance limits	Regular assessment and calculation of TEC cleared against the maximum disturbance limit balance to be undertaken by site ER, as part of the 'Permit to Disturb' register.	Provides information to allow Adani to review management actions, if necessary, as the disturbance limit is approached, and comply with EPBC conditions.
Prevent the spread and introduction of pests and weeds	Increase in weed cover or pest species abundance over 2-3 years (>10%) Presence of new weeds or pests	Annual weed and pest surveys will be undertaken within and adjacent to the Project Area to identify the presence of any new weed species or spread of existing weeds.	Baseline condition of Brigalow TEC determined prior to clearing to allow effective monitoring of the Projects impacts and compliance with EPBC conditions. Adani to review monitoring results and report annually and revise management actions if any trigger is exceeded.

Table 9 Details of monitoring program for threatened flora

Performance Criteria	Triggers	Monitoring Program	Outcomes
Identify/confirm locations of threatened flora species and habitat condition within and immediately adjacent to the rail corridor prior to any ground disturbance	N/A	Pre-clearance targeted surveys for threatened flora species and habitat condition within and directly adjacent to the Project Area. Surveys to be undertaken at any time of the year.	Record and map threatened flora species locations and condition in the vicinity of the Project Area, to ensure appropriate mitigating management measures are implemented.
Clearing of threatened flora species habitat does not exceed maximum disturbance limits	Clearing of threatened flora species habitat reaches 80% of maximum disturbance limits	Regular assessment and calculation of threatened flora species habitat cleared against the maximum disturbance limits, to be undertaken by site ER as part of the 'Permit to Disturb' register.	Provides information to allow Adani to review management actions, if necessary, as the clearing limit is approached, and comply with EPBC conditions.
Prevent the spread and introduction of pests and weeds	Increase in weed cover over 2-3 years (<10%) Presence of new weeds	Annual weed and pest surveys will be undertaken within and adjacent to the Project Area to identify the presence of any new weed species	Baseline condition of threatened flora species habitat determined prior to clearing to allow effective monitoring of the Projects impacts and compliance with EPBC conditions.

Performance Criteria	Triggers	Monitoring Program	Outcomes
			Adani to review monitoring results and report annually and revise management actions if any trigger is exceeded.

Table 10 Details of monitoring program for threatened fauna

Performance Criteria	Triggers	Monitoring Program	Outcomes
No vegetation clearing outside set Project Area	Any clearing outside set Project Area	Ongoing monitoring of clearing footprint compliance by on-site ER.	Ensure compliance with EPBC conditions.
Clearing of threatened fauna species habitat does not exceed maximum disturbance limits	Clearing of threatened fauna species habitat reaches 80% of maximum disturbance limits	Monthly monitoring of the amount of threatened fauna species habitat that is cleared. Monthly review of maximum disturbance limits and area of habitat cleared.	Up-to-date information and prior warning when approaching disturbance limits.



## 6 Threatened Ecological Communities Management Plans

### 6.1 Brigalow (*Acacia harpophylla* dominant and co-dominant) TEC

#### 6.1.1 Status

Brigalow TEC is listed as endangered under the EPBC Act.



#### 6.1.2 Ecology and Distribution

##### Distribution:

The Brigalow TEC extends from south of Charters Towers in Queensland, in a broad band east of Blackall, Charleville and Cunnamulla, south to northern New South Wales near Narrabri and Burke (DoE 2015).

In Queensland, the TEC occurs predominately within the Brigalow Belt North, Brigalow Belt South, Darling Riverine Plains and Southeast Queensland Bioregions, with smaller amounts in the Mitchell Grass Downs, Mulga Lands and Einasleigh Uplands bioregions (DoE 2015).

##### Known Locations within the Project Area:

The location of the Brigalow TEC within the NGBR has been verified by field assessment using quaternary points (Adani 2013). REs associated with the Brigalow TEC are mapped within close proximity to the majority of the Carmichael Rail Project. However, known locations within the Project Area are restricted to numerous patches between Kilometre Point (KP) 113 and 296 (Appendix A). Specific locations of patches are specified in Table 11.

**Table 11 Known location of Brigalow TEC associated Regional Ecosystems within the Project Area.**

Kilometre Points (KP)			
113-115	164	187	285-286
122-124	173	189-191	288-290
136-137	174	196-197	294-296
138-139	179-180	273-274	
160-161	186	280-283	

**Characteristics:**

Brigalow (*Acacia harpophylla* dominant and co-dominant) TEC is characterised by the presence of *Acacia harpophylla* as one of the three most abundant tree species. Brigalow is usually either dominant or co-dominant in the tree layer with species such as *Casuarina cristata*, other species of *Acacia*, or species of *Eucalyptus*. Occasionally *Casuarina cristata*, or species of *Acacia* or *Eucalyptus* may be more common than Brigalow within the broad matrix of Brigalow vegetation (DoE 2015).

The structure of the vegetation ranges from open forest to open woodland. The height of the tree layer varies from about 9 m in low rainfall areas to around 25 m in higher rainfall areas. A prominent shrub layer is usually present, and typically includes Yellowwood *Terminalia oblongata*, False Sandalwood *Eremophila mitchellii* and/or Wilga *Geijera parviflora* (DoE 2015). A variety of other shrub and vine species, such as *Alectryon* spp., *Capparis* spp. and Northern Silk-pod *Parsonsia lanceolata*, are also typically present in this ecological community (DoE 2015).

The ground layer of the Brigalow TEC typically has sparse vegetation composed of graminoids such as *Enteropogon acicularis*, *Panicum decompositum*, *Paspalidium* spp. and the sedge *Cyperus gracilis* (DoE 2015). Sub-shrubs such as *Sclerolaena* spp. and Ruby Saltbush *Enchylaena tomentosa* are also commonly present (DoE 2015). The ground layer of the Brigalow TEC is typically dominated by a thick leaf litter layer and ample fallen woody debris (DoE 2015).

In Queensland, about 85% of the TECs remnants occur on flat to gently undulating Cainozoic clay plains that are not associated with current alluvium, and on gently undulating landscapes on more or less horizontally bedded fine grained sedimentary rocks. About 10% of remnants are associated with river and creek flats, and the remainder with old loamy and sandy plains, basalt plains and hills, or hills and lowlands on metamorphic or granitic rocks (DoE 2015). The soils are predominantly cracking clays where Brigalow is dominant, however where *Eucalyptus* species are co-dominant, texture contrast soils are common (DoE 2015).

**Associated Fauna:**

The Brigalow TEC provides many key habitat resources for fauna, including leaf litter, extensive woody debris on the forest floor, large trees with hollows and pockets under their bark, and sources of nectar and fruit (TSSC 2013c). The leaf litter component of the Brigalow TEC is important habitat for specialised fauna, especially reptiles and invertebrates (WWF 2001, TSSC 2013c). The mature Belah *Casuarina cristata* trees associated with this community provide food for the Glossy Black Cockatoo *Calyptorhynchus lathami* (TSSC 2013c). Hollows within the Brigalow TEC, and the furrowed and flaking bark of Brigalow and other co-dominant tree species provide shelter and nesting sites for bats, birds, mammals, and arboreal reptiles (TSSC 2013c). The mistletoes provide fleshy fruits for many woodland frugivores, including the Painted Honeyeater *Grantiella picta* (Oliver *et al.* 2003). These resources are more readily available in brigalow woodlands in good condition and in higher rainfall environments (TSSC 2013c).

**Condition Thresholds:**

Throughout its range Brigalow communities occur in both remnant and regrowth states with varying degrees of ecological condition. However, for the purpose of the EPBC Act, the Brigalow TEC only

includes remnant areas and areas of regrowth that retain the species composition and structural elements of its undisturbed corresponding RE (DoE 2015). This excludes:

- vegetation that has been comprehensively cleared (not just thinned) within the last 15 years;
- vegetation in which exotic perennial plants have more than 50% cover, assessed in a minimum area of 0.5 ha, and
- individual patches of Brigalow that are smaller than 0.5 ha.

It is recommended that patches of Brigalow with the following attributes should be prioritised for protection and enhancement:

- Large size and/or a large area to boundary ratio
- Evidence of recruitment of key native plant species or, the presence of a range of age cohorts (including through successful assisted regeneration)
- Meet a diversity of habitat requirements and contribute to movement corridors
- High native plant and fauna species richness
- Presence of threatened species or key functional species such as pollinators and dispersers
- Few weeds or feral animals, or where these can be efficiently managed
- Connectivity to other native vegetation remnants or restoration works, particularly linkages
- In an area where the ecological community has been heavily cleared and degraded
- At the edge of the Brigalow TEC range

#### Regional Ecosystems Associations:

In Queensland, the Brigalow TEC is comprised of 16 different REs, eight of which are known to occur within the Project Area (Table 12).

**Table 12 Regional Ecosystems located within the Project Area that are associated with Brigalow TEC**

RE	VM Status	Biodiversity Status	RE Description
11.3.1	Endangered	Endangered	<i>Acacia harpophylla</i> and/or <i>Casuarina cristata</i> open forest on alluvial plains.
11.4.8	Endangered	Endangered	Open forest of <i>Eucalyptus populnea</i> with <i>Acacia harpophylla</i> and/or <i>Casuarina cristata</i> on Cainozoic clay plains.
11.4.9	Endangered	Endangered	<i>Acacia harpophylla</i> shrubby open forest with <i>Terminalia oblongata</i> on Cainozoic clay plains.
11.5.16	Endangered	Endangered	<i>Acacia harpophylla</i> and/or <i>Casuarina cristata</i> open forest in depressions on Cainozoic sand plains/remnant surfaces.
11.9.1	Endangered	Endangered	<i>Acacia harpophylla</i> - <i>Eucalyptus cambageana</i> open forest on Cainozoic fine-grained sedimentary rocks.
11.9.5	Endangered	Endangered	<i>Acacia harpophylla</i> and/or <i>Casuarina cristata</i> open forest on Cainozoic fine-grained sedimentary rocks.
11.11.14	Endangered	Endangered	<i>Acacia harpophylla</i> open forest on deformed and metamorphosed sediments and interbedded volcanics.
11.12.21	Endangered	Endangered	<i>Acacia harpophylla</i> open forest on igneous rocks; colluvial lower slopes.

### 6.1.3 Threats and Impacts

Historically the main threat to Brigalow communities has come from extensive clearing for cropping and/or pasture. This impact has been further compounded through altered fire regimes and the introduction of exotic plant and animal species (DoE 2015).

Currently the most important threats are those that reduce the community's extent, cause a decline in the condition of the vegetation, or impede its recovery. These are mainly restricted to clearing, fire, plant and animal pests, grazing, and climate change. In addition, fragmentation of the community can compound the impacts of weed invasion and overgrazing by native species (DoE 2015).

Table 13 outlines all potential impacts to Brigalow TEC that are relevant to activities associated with the Project; including those identified in the conservation listing, Condition 5c of the EPBC Approval, Appendix 1 of the Coordinator-General's Report and each EIS (Adani 2012; Adani 2013).

**Table 13 Potential impacts from the Project on Brigalow TEC**

Impacts	Potential impacts associated with the Project	Project Phase
Vegetation Clearing	Removal or disturbance of Brigalow TEC. A disturbance limit of 195.2 ha is in place within the EPBC Act approval.	Construction
	Removal and disturbance of land adjacent to Brigalow TEC, leading to an increase in edge effects and habitat fragmentation and/or degradation.	
Fire	Retained areas of Brigalow TEC may be degraded through increased fire intensity and frequency as a result of altered fuel characteristics and ignition sources.	Construction and Operation
Dust emissions	An increase in dust emissions may potentially impact the photosynthetic abilities of plants within Brigalow TEC in areas adjacent to the Project Area.	Construction and Operation
Weeds and pest	Dispersal of existing weeds throughout the Project Area by vehicles and machinery.	All phases
	Introduction and dispersal of new weed species.	
	Increased levels of disturbance may lead to increase prevalence of pest species and consequently further degradation in condition (e.g. increase in disturbance from pigs).	

### 6.1.4 Mitigation and Management Measures

There is currently no finalised recovery plan for Brigalow TEC (DoE 2015). A draft recovery plan has been developed and outlines key priority actions that should be considered for its management. Additional information is available in the conservation advice for the Brigalow TEC (TSSC 2013c). These actions have been considered where relevant to the management of Brigalow TEC within the Project Area.

Table 14 outlines all relevant mitigation and management measures for Brigalow TEC which are consistent with the draft recovery plan, conservation advice and meet the conditions of the EPBC Approval and Coordinator-General's Report.

Table 14 Mitigation and management measures for Brigalow TEC

Goal	Performance Criteria	Mitigation and Management Measures	Trigger	Corrective Actions
Minimise degradation of retained areas of Brigalow TEC adjacent to the Project Area	Limit disturbance from fire through altered fuel loads and construction activities	<p>Actions and thresholds will be outlined in relevant management plans (i.e. CEMP and OEMP). Mitigation and management measures should include but not be limited to:</p> <ul style="list-style-type: none"> <li>• Parking of vehicles in designated areas</li> <li>• Ensuring hot-works are undertaken under appropriate permitting</li> </ul> <p>Regular maintenance (e.g. mowing) of vegetation within Project Area during operational phase</p>	Uncontrolled fire in the Project Area	<p>Immediately implement actions to suppress the spread of the fire.</p> <p>Incidences will be recorded in a register as per the EMP.</p> <p>Review adherence to control procedures to ensure compliance. Take remedial action where compliance has not been adhered to. Increase training to ensure breach does not re-occur.</p>
Temporary disturbance areas are rehabilitated to existing condition as soon as possible	<p>Regrowth Brigalow suckers are present within 3 years of rehabilitation commencing</p> <p>Species composition and structural elements typical of the original Brigalow RE, within 10 years (using RE benchmarks as a guide)</p>	<p>Develop Rehabilitation Management Plan (RMP) prior to the commencement of rehabilitation activities. RMP to outline, but not be limited to:</p> <ul style="list-style-type: none"> <li>• relevant native species to be regenerated or replanted</li> <li>• seed collection (if applicable)</li> <li>• landscaping, including creation of supplementary habitats</li> </ul> <p>Rehabilitation to commence as soon as temporary construction areas are no longer required.</p>	<p>Rehabilitated areas have no evidence of Brigalow suckers within 3 years</p> <p>Species composition and structural elements typical of the original Brigalow RE not attained within 10 years (using RE benchmarks as a guide)</p>	<p>An annual rehabilitation monitoring report will be submitted to DoEE, including rehabilitated Brigalow TEC monitoring. Where rehabilitated areas fail to reach target values outlined in the RMP, Adani will implement any measures necessary to achieve the objectives in the RMP.</p>

Goal	Performance Criteria	Mitigation and Management Measures	Trigger	Corrective Actions
Minimise invasion of weed and pest species	Prevent the spread of existing pest and weeds and the introduction of new pest and weeds	<p>A Pest Management Plan (PMP) will be developed and implemented prior to construction activities. This PMP will specify, but not be limited to:</p> <ul style="list-style-type: none"> <li>• Ongoing (yearly) monitoring of weed and pest species</li> <li>• Specify control measures for known and potential pest and weeds</li> <li>• Ensure that any herbicides and poisons used for weed and pest control within the Project Area do not have significant adverse impact on the community or associated fauna species</li> </ul>	<p>&gt;10% increase in the population or cover of each weed or pest species present, from baseline scores</p> <p>Presence of new weeds or pests</p>	PMP to be updated if additional pest and weeds are identified or spread continues during construction activities. Increase pest management efforts,

### 6.1.5 Monitoring

The potential impacts of activities will be monitored in accordance the monitoring program outlined in Table 15. The design of the on-going monitoring program, including the location and extent of monitoring sites, will be determined by a suitably qualified person to ensure that sufficient data are collected to quantify likely impacts resulting from the action, and to determine the appropriate habitat management goals. The monitoring program will include both impact and control sites to monitor the progress of recovery, including effectiveness of management actions, and adapt if necessary. Monitoring will occur between the first rains in spring/summer and the drying of vegetation in autumn. Annual condition monitoring will occur for the duration of railway activities.

BioCondition monitoring will be used to assess Brigalow TEC condition, supplemented by specific Brigalow TEC condition measures as outlined in Table 15. BioCondition assesses a suite of ecological community factors, including:

- Woody perennial species recruitment, native tree, shrub, grass and forb species richness, number of large native trees
- Tree canopy height, and tree and shrub canopy cover
- Cover of perennial grasses, organic litter, coarse woody debris, weeds
- Size, connectedness and context of patch, including distance to permanent water

**Table 15 Details of monitoring program for Brigalow TEC**

Performance Criteria	Triggers	Monitoring Program	Outcomes
Maintain existing condition of retained areas of Brigalow TEC adjacent to the Project Area	Progressive decline in habitat condition over 2-3 years.	Annual BioCondition assessments will commence prior to construction activities to determine the condition of Brigalow TEC in impact and control sites. This will include an assessment of perennial plant cover and patch size. Impact plots will be located within 200 m of the Project Area, while control plots will be located <1 km from the Project Area. Observations will be made on the presence of frugivorous fauna during monitoring.	Baseline condition of Brigalow TEC determined prior to clearing to allow effective monitoring of the Projects impacts and compliance with EPBC conditions. Adani to review monitoring results and report annually and revise management actions if any trigger is exceeded.
Limit disturbance from emissions (dust) on photosynthetic ability of the community		A series of 5 dust monitoring plots (1 m x 1 m) will be established within 5 m of the exclusion fence, and within equivalent habitat between 500 m and 1 km from the exclusion fence, every 5 km along the rail corridor, on alternating sides within Brigalow TEC. The plot boundaries will be mapped and clearly marked with pegs. Baseline and photo monitoring will occur prior to construction, and annually thereafter using the method outlined for grass plots in DEHP (2014).	
Limit disturbance from fire through altered fuel loads			
Brigalow regeneration (i.e. regrowth suckers) are evident within 3 years of rehabilitation commencing Species composition and structural elements typical of the original Brigalow RE are attained within 10 years (using RE benchmarks as a guide)	No evidence of Brigalow recruitment within 3 years Species composition and structural elements typical of the original Brigalow RE not attained within 10 years (using RE benchmarks as a guide)	A pre-disturbance BioCondition Assessment and annual post disturbance BioCondition Assessments will be undertaken to determine the effectiveness of rehabilitation works. This will include an assessment of perennial plant cover and patch size.	

## 6.2 Natural Grasslands of the Queensland Central Highlands and the Northern Fitzroy Basin TEC



**Plate 2:** Grassland TEC

### 6.2.1 Status

The Natural Grasslands of the Queensland Central Highlands and the Northern Fitzroy Basin (Grassland) TEC is listed as endangered under the EPBC Act.

### 6.2.2 Ecology and Distribution

#### Distribution:

The Natural Grasslands of the Queensland Central Highlands and the Northern Fitzroy Basin (Grassland) TEC is endemic to Queensland. It broadly occurs where the Fitzroy River Basin and the Brigalow Belt North coincide. It extends from Collinsville in the north to Carnarvon National Park in the south. It is bounded to the south by the Expedition, Carnarvon, Great Dividing, Drummond and Narrien ranges; and to the north by the Clark, Denham, Connors and Broadsound ranges (TSSC 2008b).

The Grassland TEC mostly occurs within the Fitzroy River Basin, but its distribution does extend part way into adjoining catchments, for example where five of the subregions extend into the Burdekin River Basin and where one extends into the Warrego River Basin (TSSC 2008b).

The TEC occurs within eight subregions, as identified by the Interim Biogeographic Regionalisation for Australia (IBRA). The subregions are within the Brigalow Belt North (BBN) and Brigalow Belt South (BBS) bioregions (TSSC 2008b). They are:

- Brigalow Belt North subregions
  - Northern Bowen Basin (BBN 6)
  - Anakie Inlier (BBN 9)
  - Basalt Downs (BBN 10)
  - Isaac-Comet Downs (BBN 11)
  - Nebo-Connors Range (BBN 12)
  - South Drummond Basin (BBN 13)
- Brigalow Belt South subregions
  - Claude River Downs (BBS 1)
  - Buckland Basalts(BBS 9)

#### Known Locations within the Project Area:

The location of the Grassland TEC within the NGBR has been verified by field assessment using quaternary points (Adani 2013). REs associated with the Grassland TEC are mapped within proximity of the Carmichael Rail Project from Collinsville in the east to the end of the Project Area at Carmichael Mine



in the west (Appendix A). Known locations within the Project Area however occur across a slightly smaller extent from KP91 to KP184 (Appendix A). Specific locations of patches are specified in Table 16.

**Table 16 Known location of Grassland TEC associated Regional Ecosystems within the Project Area.**

Kilometre Points (KP)			
91-95	108-111	165-166	180-184
100-103	124-125	168-169	
106-107	148-149	176-178	

### Characteristics:

The Grassland TEC is typically composed of a mixture of native grasses and forbs (i.e. herbs that are broad-leaved and not grass-like). The perennial native grasses are the primary indicators, based on their prominence and utility as indicators (TSSC 2008b). A list of indicator perennial native grass species is presented in Table 17. The grasslands of the Queensland Central Highlands are mostly dominated by *Dichanthium* spp., with tropical *Aristida* spp. and *Panicum* spp. also a major component. Temperate grasses, such as *Austrostipa* spp. and *Austrodanthonia* spp., are lacking and are more a feature of grasslands further south. Drier sites of the ecological community may include a higher proportion of *Astrelba* spp. (TSSC 2008b). Common forb species which may be present include *Commelina ensifolia*, *Corchorus trilocularis*, *Ipomoea lonchophylla*, *Vigna lanceolata*, *Vigna radiata*, *Desmodium campylocaulon*, *Neptunia gracilis*, *Psoralea tenax*, *Rhynchosia minima*, *Crotalaria dissitiflora*, *Glycine latifolia* and *Hibiscus trionum* var. *vesicarius* (TSSC 2008b).

**Table 17 Indicator grass species for the Grassland TEC**

Species Name	Common Name
<i>Aristida latifolia</i>	Feather-top Wiregrass
<i>Aristida leptopoda</i>	White Speargrass
<i>Astrelba elymoides</i>	Hoop Mitchell Grass
<i>Astrelba lappacea</i>	Curly Mitchell Grass
<i>Astrelba squarrosa</i>	Bull Mitchell Grass
<i>Bothriochloa erianthoides</i>	Satin-top Grass
<i>Dichanthium queenslandicum</i>	King Bluegrass
<i>Dichanthium sericeum</i>	Queensland Bluegrass
<i>Eriochloa crebra</i>	Cup Grass
<i>Panicum decompositum</i>	Native Millet
<i>Panicum queenslandicum</i>	Yabila Grass
<i>Paspalidium globoideum</i>	Shot Grass
<i>Thellungia advena</i>	Coolibah Grass

Shrub and tree canopy layers are usually absent or occur in low frequencies. If present shrub layers are typically dominated by species such as *Acacia salicina* and Mimosa Bush *Vachellia farnesiana*, and in some areas may have a cover of up to 50%. The tree canopy layer is usually sparser with cover up to

10%, and dominated by species including *Corymbia erythrophloia*, *Eucalyptus coolabah*, *Eucalyptus crebra*, *Eucalyptus melanophloia*, *Eucalyptus orgadophila*, *Eucalyptus populnea*, and *Melaleuca bracteata* (TSSC 2008b).

The Grassland TEC usually occurs on flat ground or gently undulating rises. It occurs on soils that have formed either in situ on the fresh basalt, or on fine-grained sedimentary rocks, or where this material has been transported to form extensive alluvial plains along ancient and flood-prone watercourses. The soils are fine textured vertosols (cracking clay), often deep and dark in colour, although soils may be shallower on ridges or sloping land (TSSC 2008b).

#### Associated Fauna:

The Grassland TEC supports habitat-specific reptiles, birds and small mammals (Young and Butler 2011). They are also used for foraging by a range of generalist fauna species such as birds and bats (Young and Butler 2011). The structure of the grasslands, with their deep cracking black soils and tussocky grasses, provide key habitats for grassland-dependent mammals and birds such as the planigales, the Pale Field Rat *Rattus tunneyi* and the Fat-tailed Dunnart *Sminthopsis crassicaudata*, and quails and button-quails. Grasslands also support an array of generalist and grassland dependent raptors, for example the spotted harrier *Circus assimilis* (Butler 2007).

#### Condition Thresholds:

There are very few patches of undisturbed native grasslands remaining with most patches having some degree of disturbance and degradation. The listed Grassland TEC comprises those patches that meet the key diagnostic characteristics described above, and the condition thresholds in Table 18. Only areas qualifying as 'Best quality' and 'Good quality' patches are included in the listed ecological community (TSSC 2008b).

**Table 18 Condition classes for the Grassland TEC**

	<b>Best Quality</b>	<b>Good Quality</b>
<b>Patch Size</b>	At least 1ha; <b>and</b>	At least 5ha; <b>and</b>
<b>Grasses</b>	<b>At least 4</b> native perennial grass species from the list of perennial native grass indicator species; <b>and</b>	<b>At least 3</b> native perennial grass species from the list of perennial native grass indicator species; <b>and</b>
<b>Tussock cover</b>	<b>At least 200</b> native grass tussocks per 0.1ha; <b>and</b>	<b>At least 200</b> native grass tussocks per 0.1ha; <b>and</b>
<b>Woody shrub cover</b>	Total projected canopy cover of shrubs is <b>less than 30%</b> ; <b>and</b>	Total projected canopy cover of shrubs is <b>less than 50%</b> ; <b>and</b>
<b>Introduced species</b>	Perennial non-woody introduced species are <b>less than 5%</b> of the total projected perennial plant cover.	Perennial non-woody introduced species are <b>less than 30%</b> of the total projected perennial plant cover.

### Regional Ecosystems Associations:

Within the specified IBRA subregions the Grassland TEC includes seven REs, five of which are located within the Project Area (Table 19).

**Table 19 Regional Ecosystems located within the Project Area that are associated with the Grassland TEC**

RE	VM Status	Biodiversity Status	RE Description
11.4.4	Least Concern	Of Concern	<i>Dichanthium</i> spp., <i>Astrebla</i> spp. grassland on Cainozoic clay plains.
11.4.11	Of Concern	Of Concern	<i>Dichanthium sericeum</i> , <i>Astrebla</i> spp. and patchy <i>Acacia harpophylla</i> , <i>Eucalyptus coolabah</i> on Cainozoic clay plains.
11.8.11	Of Concern	Of Concern	<i>Dichanthium sericeum</i> grassland on Cainozoic igneous rocks.
11.9.3	Least Concern	No concern at present	<i>Dichanthium</i> spp., <i>Astrebla</i> spp. grassland on fine-grained sedimentary rocks.
11.9.12	Endangered	Endangered	<i>Dichanthium sericeum</i> grassland with clumps of <i>Acacia harpophylla</i> on fine-grained sedimentary rocks.

### 6.2.3 Threats and Impacts

The main threats to the Grassland TEC include ongoing loss in extent, persistent heavy grazing, cumulative effects of loss in extent over many years, pasture development, invasive species, disturbance to remnants on stock routes and road reserves, and lack of knowledge about and appreciation of the value of natural grasslands (Young and Butler 2011). Restoration of grasslands can be a viable where there is adequate propagule pressure: perennial exotic species generally do not monopolise these areas, due to being outcompeted by *Dichanthium sericeum* in rich poorly-drained soils (Fensham *et al.* 2016).

Table 20 outlines all potential impacts to Grassland TEC that are relevant to activities associated with the Project; including those identified in the draft recovery plan, Condition 5c of the EPBC Approval, Appendix 1 of the Coordinator-General's Report and each EIS (Adani 2012; 2013).

**Table 20 Potential impacts from the Project on to Grassland TEC**

Impacts	Potential impacts associated with the Project	Project phase
Vegetation Clearing	Removal or disturbance of Grassland TEC. A disturbance limit of 133.2 ha is in place in the EPBC Act approval.	Construction
	Removal and disturbance of land adjacent to Grassland TEC, leading to an increase in edge effects and habitat fragmentation and/or degradation.	
Dust Emissions	An increase in dust emissions may potentially impact the photosynthetic abilities of plants within Grassland TEC in areas adjacent to the Project Area.	Construction and Operation
Weeds and Pests	Dispersal of existing weeds throughout the Project Area by vehicles and machinery.	All phases
	Introduction and dispersal of new weed species, particularly <i>Parthenium</i> ( <i>Parthenium hysterophorus</i> ), <i>Parkinsonia</i> ( <i>Parkinsonia aculeata</i> ), Prickly Acacia ( <i>Acacia nilotica</i> subsp. <i>indica</i> ), Buffel Grass ( <i>Cenchrus ciliaris</i> ), and the House Mouse ( <i>Mus musculus</i> ).	
	Increased levels of disturbance may lead to increase prevalence of pest species and consequently further	

Impacts	Potential impacts associated with the Project	Project phase
	degradation in condition (e.g. increase in disturbance from pigs).	

#### 6.2.4 Mitigation and Management Measures

There is currently no finalised recovery plan for Grassland TEC (DoE 2015). A draft recovery plan has been developed and outlines key priority actions that should be considered for its management. Additional information is available in the conservation advice for the Grassland TEC (TSSC 2008c). These actions have been considered where relevant to the management of Grassland TEC within the Project Area.

Table 21 outlines all relevant mitigation and management measures for Grassland TEC which are consistent with the draft recovery plans, conservation advice and meet the conditions of the EPBC Approval and Coordinator-General's Report.

Table 21 Mitigation and management measures for Grassland TEC

Goal	Performance Criteria	Mitigation and Management Measures	Trigger	Corrective Actions
Temporary disturbance areas are rehabilitated to existing condition as soon as possible	Within 10 years of rehabilitation commencing, habitat meets Good Quality condition thresholds as defined in Table 18 and Native species richness is >70% of baseline richness	Develop Rehabilitation Management Plan (RMP) prior to the commencement of rehabilitation activities. RMP to outline, but not be limited to: <ul style="list-style-type: none"> <li>relevant native species to be replanted</li> <li>seed collection (if applicable)</li> <li>landscaping, including creation of supplementary habitats</li> </ul> Rehabilitation to commence as soon as temporary construction areas are no longer required.	Within 10 years of rehabilitation commencing, habitat does not meet Good Quality condition thresholds as defined in Table 18 and Native species richness is <70% of baseline richness	An annual rehabilitation monitoring report will be submitted to DoEE, including rehabilitated Grassland TEC monitoring. Where rehabilitated areas fail to reach target values outlined in the RMP, Adani will implement any measures necessary to achieve the objectives in the RMP.
Minimise invasion of weed and pest species	Prevent the spread of existing pest and weeds and the introduction of new pest and weeds, particularly Parthenium, Parkinsonia and Mimosa Bush	A Pest Management Plan (PMP) will be developed and implemented prior to construction activities. This PMP will specify, but not be limited to: <ul style="list-style-type: none"> <li>Ongoing (yearly) monitoring of weed and pest species</li> <li>Specify control measures for known and potential weeds and pests such as Parthenium (<i>Parthenium hysterophorus</i>), Parkinsonia (<i>Parkinsonia aculeata</i>), Prickly Acacia (<i>Acacia nilotica</i> subsp. <i>indica</i>), Buffel Grass (<i>Cenchrus ciliaris</i>), and the House Mouse (<i>Mus musculus</i>).</li> <li>Ensure that any herbicides and poisons used for weed and pest control within the Project Area do not have significant adverse impact on the community</li> </ul>	>10% increase in the population or cover of each weed or pest species present, from baseline scores Presence of new weeds or pests	PMP to be updated if additional weeds or pests are identified or weed spread continues during construction activities.

### 6.2.5 Monitoring

The potential impacts of the proposed activities will be monitored in accordance the monitoring program outlined in Table 22. The design of the on-going monitoring program, including the location and extent of monitoring sites, will be determined by a suitably qualified person to ensure that sufficient data are collected to quantify likely impacts resulting from the proposed action, and to determine the appropriate habitat management goals. The monitoring program will include both impact and control sites to monitor the progress of recovery, including effectiveness of management actions, and adapt if necessary. Monitoring will occur between the first rains in spring/summer and the drying of vegetation in autumn. Annual condition monitoring will occur for the duration of railway activities.

BioCondition monitoring will be used to assess Grassland TEC condition, supplemented by specific Grassland TEC condition measures as outlined in Table 22 below. BioCondition assesses a suite of ecological community factors, including:

- Woody perennial species recruitment, native tree, shrub, grass and forb species richness, number of large native trees
- Tree canopy height, and tree and shrub canopy cover
- Cover of perennial grasses, organic litter, coarse woody debris, weeds
- Size, connectedness and context of patch, including distance to permanent water

**Table 22 Details on monitoring program for Grassland TEC**

Performance Criteria	Triggers	Monitoring Program	Outcomes
Maintain existing condition of retained areas of Grassland TEC adjacent to the Project Area	Progressive decline in habitat condition over 2-3 years	Annual BioCondition Assessments will commence prior to construction activities to determine the baseline condition of Grassland TEC in impact and control sites. A minimum of three impact and 3 control sites will be established along the alignment. Impact plots will be located within 200 m of the Project Area, while control plots will be located <1 km from the Project Area.	Baseline condition of Grassland TEC determined prior to clearing to allow effective monitoring of the Projects impacts and compliance with EPBC conditions Adani to review monitoring results and report annually and revise management actions if any trigger is exceeded.
Limit disturbance from emissions (dust) on photosynthetic ability of the community		In addition to BioCondition Assessments (which assess patch size, shrub and canopy cover, and the cover of non-woody perennial introduced species), a transect of 50 x 20 m plots will also be surveyed at each monitoring site to determine the number of indicator perennial grass species present as well as the number of native grass tussocks.  A series of 5 dust monitoring plots (1 m x 1 m) will be established within 5 m of the exclusion fence, and within equivalent habitat between 500 m and 1 km from the exclusion fence, every 5 km along the rail corridor, on alternating sides within Grassland TEC. The plot boundaries will be mapped and clearly marked with pegs. Baseline and photo monitoring will occur prior to construction, and annually thereafter using the method outlined for grass plots in DEHP (2014).	
Within 10 years of rehabilitation commencing, habitat meets Good Quality condition threshold as defined in Table 18 and Native species richness	After 3 years native species richness and/or native grass tussock abundance are <25% of baseline records and/or no indicator perennial grass species are present.	A pre-disturbance BioCondition Assessment and annual post disturbance BioCondition Assessments will be undertaken to determine the effectiveness of rehabilitation works.  A transect of 50 x 20 m plots will also be surveyed at each monitoring site to determine the number of indicator perennial grass species present as well as the number of native grass tussocks per 0.1ha.	

Performance Criteria	Triggers	Monitoring Program	Outcomes
is >70% of baseline richness	After 6 years native species richness and/or native grass tussock abundance are <50% of baseline records and/or <2 indicator perennial grass species are present.		

**6.3 Semi-evergreen Vine Thickets of the Brigalow Belt (North and South) and Nandewar Regions TEC**



**6.3.1 Status**

The Semi-evergreen Vine Thickets of the Brigalow Belt (North and South) and Nandewar Regions (SEVT) TEC is listed as endangered under the EPBC Act.

**Plate 3: SEVT TEC**

**6.3.2 Ecology and Distribution**

**Distribution:**

The SEVT TEC extends from the Townsville area in Queensland to northern New South Wales. It is mostly located within the Brigalow Belt Bioregion. In Queensland the remnant vine thicket patches are mostly scattered from coastal dunes and river deltas in the vicinity of Townsville and Ayr through the northern and central parts of the Brigalow Belt Bioregion to its south-eastern parts between Jandowae and Killarney on the Queensland/New South Wales border (DoE 2015).

**Known Locations within the Rail Management Area:**

The known location of SEVT within the NGBR has been verified by field assessment using quaternary points (Adani 2013). REs associated with SEVT TEC are mapped in proximity to the Carmichael Rail Project from the start of the Project area at Abbot Point in the east to KP281 in the west (Appendix A). Known locations within the Project Area however occur across slightly smaller extent from KP2 to KP193 (Appendix A). Specific locations of patches are specified in Table 23.

**Table 23 Known location of SEVT associated Regional Ecosystems within the Project Area.**

Kilometre Points (KP)		
2-5	180	190-193

**Characteristics:**

SEVT is considered an extreme form of dry seasonal subtropical rainforest and is generally characterised by the prominence of trees with microphyll sized leaves (i.e. leaves usually 2.5–7.6 cm long), the presence of *Brachychiton* spp. as emergents from the vegetation, and the thickets occurring in areas with a subtropical, seasonally dry climate on soils of high to medium fertility (DoE 2015).

The northern SEVT (north of about Rockhampton) is floristically diverse, with several species that are always present, and approximately 50% of all plant species in this community are fire-sensitive and only found in SEVT.

Typical northern SEVT tree species include the Bottle Tree *Brachychiton australis*, Yellow Tulip *Drypetes deplanchei*, *Diospyros humilis*, *Gyrocarpus americanus*, Brush Wilga *Geijera salicifolia*, *Pouteria cotinifolia* and Strychnine *Strychnos psilosperma*, and the vines *Cissus reniformis* and *Jasminum didymum*. Ooline *Cadellia pentastylis* is absent from this community.



Emergent trees can be either fully or semi-deciduous, and the lower canopy species show a great range in their deciduousness. Moss species are often present in northern SEVT (DoE 2015).

The SEVT TEC in Queensland is most common on undulating plains on fine grained sedimentary rocks (frequently shale) and on basalt hills and plains, occurring less often on coastal dunes, Quaternary alluvium, Tertiary clay plains, old loamy and sandy plains, or hills and lowlands on metamorphic rocks. The ecological community is often associated with more elevated, freely drained sites (DoE 2015).

### Regional Ecosystems Associations:

In Queensland, the SEVT TEC is comprised of 10 different REs, five of which are known to occur within the Project Area (Table 24).

**Table 24 Regional Ecosystems located within the Project Area that are associated with the SEVT TEC**

RE	VM Status	Biodiversity Status	RE Description
11.2.3	Of Concern	Of Concern	Microphyll vine forest ("beach scrub") on sandy beach ridges and dune swales.
11.5.15	Least Concern	Endangered	Semi-evergreen vine thicket on Cainozoic sand plains and/or remnant surfaces.
11.8.3	Endangered	Endangered	Semi-evergreen vine thicket and microphyll vine forest on Cainozoic igneous rocks.
11.11.18	Endangered	Endangered	Semi-evergreen vine thicket on old sedimentary rocks with varying degrees of metamorphism and folding.
11.12.4	Least concern	No concern at present	Semi-evergreen vine thicket and microphyll vine forest on igneous rocks.

### Associated Fauna:

The fruits of lower canopy and understorey plant species within SEVT are most commonly dispersed by birds (McDonald 1996). The Glossy Black Cockatoo, Little Pied Bat, Brigalow Scaly-foot, Brush-tailed Rock-wallaby, and Black-breasted Button-quail are listed as threatened species that are frequently found in SEVT (McDonald 2010).

### 6.3.3 Threats and Impacts

Historically the major threat to SEVT TEC has come from extensive clearing for cropping, grazing and/or pasture. This also included the removal of SEVT to remove shelter for wallaby populations which had substantial impact on pastures (DoE 2015).

Current threats include high level of fragmentation, lack of connectivity between fragments, continued clearing, inappropriate fire regimes, invasion by introduced pasture species, and increased grazing by domestic stock and native animals. RE 11.2.3, which occurs in coastal areas in Queensland, is also considered to be threatened by coastal development (DoE 2015). Weeds are also considered to be a threat to SEVT (DoE 2015).

Table 25 outlines all potential impacts to SEVT TEC that are relevant to activities associated with the Project; including those identified in the national recovery plan, Condition 5c of the EPBC Approval, Appendix 1 of the Coordinator-General's Report and each EIS (Adani 2012; 2013).

**Table 25 Potential impacts from the Project on to SEVT TEC**

Impacts	Potential impacts associated with the Project	Project phase
Vegetation Clearing	Removal or disturbance of SEVT TEC. A disturbance limit of 55.7 ha is in place in the EPBC Act approval.	Construction
	Removal and disturbance of land adjacent to SEVT TEC, leading to an increase in edge effects and habitat fragmentation and/or degradation.	
Fire	Retained areas of SEVT TEC may be degraded through increased fire intensity and frequency as a result of altered fuel characteristics and ignition sources.	Construction and Operation
Dust emissions	An increase in dust emissions may potentially impact the photosynthetic abilities of plants within SEVT TEC in areas adjacent to the Project Area.	Construction and Operation
Waterway Crossings	Reduced SEVT condition due to altered hydrology	Construction
Weeds and Pests	Dispersal of existing weeds throughout the Project Area by vehicles and machinery.	All phases
	Introduction and dispersal of new weed species, particularly Parthenium, Buffel Grass ( <i>Cenchrus ciliaris</i> ), Green Panic ( <i>Megathyrsus maximus</i> var. <i>pubiglumis</i> ), Lantana ( <i>Lantana camara</i> ), Rubber Vine ( <i>Cryptostegia grandiflora</i> ), Velvety Tree Pear ( <i>Opuntia tomentosa</i> ), Brazilian Nightshade ( <i>Solanum seaforthianum</i> ), and Coral Berry ( <i>Rivina humilis</i> )	
	Increased levels of disturbance may lead to increase prevalence of pest species and consequently further degradation in condition (e.g. increase in disturbance from pigs).	

#### 6.3.4 Mitigation and Management Measures

The national recovery plan for the “Semi-evergreen vine thickets of the Brigalow Belt (North and South) and Nandewar Bioregions” ecological community (McDonald 2010) outlines key priority actions that should be considered for the management of this community. These actions have been considered where relevant to the management of SEVT TEC within the Project Area.

Table 26 outlines all relevant mitigation and management measures for SEVT TEC which are consistent with the national recovery plan, conservation advice and meet the conditions of the EPBC Approval and Coordinator-General's Report.

Table 26 Mitigation and management measures for SEVT TEC

Goal	Performance Criteria	Mitigation and Management Measures	Trigger	Corrective Actions
Minimise degradation of retained areas of SEVT TEC adjacent to the Project Area	Limit disturbance from fire through altered fuel loads and construction activities	<p>Bushfire mitigation measures will be outlined in the Bushfire and Disaster Management plan and should include but not be limited to:</p> <ul style="list-style-type: none"> <li>Monitoring of weather conditions to identify high fire risk days, with controls to be upgraded on these days</li> <li>Restrictions on vehicles being left idling with the exhaust in contact with dry grass</li> <li>Designation of smoking areas</li> </ul> <p>Identification of bushfire fuel management practices within corridor (i.e. regularity of slashing).</p> <p>Review and implement existing Bushfire and Disaster Management Plan, ensuring consideration of ecological values and Rural Fire Service recommendations.</p> <p>Work sites will be provided with adequate fire-fighting equipment (water cart) and training</p>	Uncontrolled fire in the Project Area	<p>Immediately implement actions to suppress the spread of the fire.</p> <p>Incidences will be recorded in a register as per the CEMP.</p> <p>Review adherence to control procedures to ensure compliance. Take remedial action where compliance has not been adhered to. Increase training to ensure breach does not re-occur.</p>
	No permanent changes to waterway hydrology within 1km of SEVT	Waterway diversions that are required within 1km of SEVT, will occur during dry conditions only and ensure the continuity of water flow and depth during and after construction.	A permanent change to waterway hydrology within 1km of SEVT	Inform DES of monitoring results. Revise and implement an updated Rehabilitation Management Plan, focusing on implementing actions to restore water flow and profile.
Temporary disturbance areas are rehabilitated to existing condition as soon as possible	Native species richness is >50% of baseline richness within 10 years of rehabilitation commencing	<p>Develop Rehabilitation Management Plan (RMP) prior to the commencement of rehabilitation activities. RMP to outline, but not be limited to:</p> <ul style="list-style-type: none"> <li>relevant native species to be replanted</li> <li>seed collection (if applicable)</li> <li>landscaping, including creation of supplementary habitats</li> </ul> <p>Rehabilitation to commence as soon as temporary construction areas are no longer required.</p>	Native species richness is <50% of baseline richness within 10 years of rehabilitation commencing	An annual rehabilitation monitoring report will be submitted to DoEE, including rehabilitated SEVT TEC monitoring. Where rehabilitated areas fail to reach target values outlined in the RMP, Adani will implement any measures necessary to achieve the objectives in the RMP.

Goal	Performance Criteria	Mitigation and Management Measures	Trigger	Corrective Actions
Minimise invasion of weed and pest species	Prevent the spread of existing pest and weeds and the of introduction of new pest and weeds, particularly Rubber Vine and Lantana	<p>A Pest Management Plan (PMP) will be developed and implemented prior to construction activities. This PMP will specify, but not be limited to:</p> <ul style="list-style-type: none"> <li>• Ongoing (yearly) monitoring of weed and pest species</li> <li>• Specify control measures for known and potential pest and weeds, particularly Parthenium, Buffel Grass (<i>Cenchrus ciliaris</i>), Green Panic (<i>Megathyrsus maximus</i> var. <i>pubiglumis</i>), Lantana (<i>Lantana camara</i>), Rubber Vine (<i>Cryptostegia grandiflora</i>), Velvety Tree Pear (<i>Opuntia tomentosa</i>), Brazilian Nightshade (<i>Solanum seaforthianum</i>), and Coral Berry (<i>Rivina humilis</i>).</li> <li>• Control of pigs</li> <li>• Ensure that any herbicides and poisons used for weed and pest control within the Project Area do not have significant adverse impact on the community</li> </ul>	<p>&gt;10% increase in the population or cover of each weed or pest species present, from baseline scores</p> <p>Presence of new weeds or pests</p>	PMP to be updated if additional pest and weeds are identified or spread continues during construction activities. Increase pest management efforts.

### 6.3.5 Monitoring

The potential impacts of the proposed activities will be monitored in accordance the monitoring program outlined in Table 27. The design of the on-going monitoring program, including the location and extent of monitoring sites, will be determined by a suitably qualified person to ensure that sufficient data are collected to quantify likely impacts resulting from the proposed action, and to determine the appropriate habitat management goals. The monitoring program will include both impact and control sites to monitor the progress of recovery, including effectiveness of management actions, and adapt if necessary. Monitoring will occur between the first rains in spring/summer and the drying of vegetation in autumn. Annual condition monitoring will occur for the duration of railway activities.

BioCondition monitoring will be used to assess SEVT condition as outlined in Table 27. BioCondition assesses a suite of ecological community factors, including:

- Woody perennial species recruitment, native tree, shrub, grass and forb species richness, number of large native trees
- Tree canopy height, and tree and shrub canopy cover
- Cover of perennial grasses, organic litter, coarse woody debris, weeds

- Size, connectedness and context of patch, including distance to permanent water

Table 27 Details of monitoring program for SEVT TEC

Performance Criteria	Triggers	Monitoring Program	Outcomes
Maintain existing condition of retained areas of SEVT TEC within the Project Area	Progressive decline in habitat condition over 2-3 years.	Annual BioCondition assessments will commence prior to construction activities to determine the condition of SEVT TEC in impact and control sites. A minimum of 3 impact and 3 control sites will be established along the alignment. Impact plots will be located within 200 m of the Project Area, while control plots will be located <1 km from the Project Area.  A series of 5 dust monitoring plots (1 m x 1 m) will be established within 5 m of the exclusion fence, and within equivalent habitat between 500 m and 1 km from the exclusion fence, every 5 km along the rail corridor, on alternating sides within SEVT. The plot boundaries will be mapped and clearly marked with pegs. Baseline and photo monitoring will occur prior to construction, and annually thereafter using the method outlined for grass plots in DEHP (2014).	Baseline condition of SEVT TEC determined prior to clearing to allow effective monitoring of the Projects impacts and compliance with EPBC conditions  Adani to review monitoring results and report annually and revise management actions if any trigger is exceeded.
Limit disturbance from emissions (dust) on photosynthetic ability of the community			
Limit disturbance from fire through altered fuel loads			
No permanent changes to waterway hydrology within 1km of SEVT	Waterway depth and flow is significantly altered during or after construction	Water profile and flow will be assessed for baseline measures, and then bi-annually at low and high flow periods	
Native species richness is >50% of baseline richness within 10 years of rehabilitation commencing	Native species richness is <20% of baseline richness after 3 years and <35% after 6 years	A pre-disturbance BioCondition Assessment and annual post disturbance BioCondition Assessments will be undertaken to determine the effectiveness of rehabilitation works.	

## 6.4 Poplar Box Grassy Woodland on Alluvial Plains TEC

### 6.4.1 Status

The Poplar Box Grassy Woodland on Alluvial Plains (PBGW) TEC is listed as Endangered under the EPBC Act.



Plate 4: PBGW TEC

### 6.4.2 Ecology and Distribution

#### Distribution:

The PBGW TEC has a broad distribution west of the Great Dividing Range in Queensland and northern New South Wales. The TEC extends from south of Charters Towers in Queensland, in a broad belt east of Longreach in Queensland and Hillston in NSW, west of Ipswich in Queensland and Armidale in NSW to north of Leeton in NSW. The TEC occurs on palaeo and recent depositional soils in flat terrain and occasionally along watercourses in undulating country. In Queensland, the TEC occurs predominantly within the Brigalow Belt North and Brigalow Belt South bioregions, extending into the South Eastern Queensland bioregion (DoEE 2019).

#### Known Locations within the Rail Management Area:

PBGW TEC was listed under the EPBC Act on 4 July 2019 and was therefore not included in the initial field assessments as part of the project impact assessment. It has since been identified on the Mt Lookout property within the Project area, and is likely to occur in other locations within the alignment. Listed PBGW TEC REs are currently mapped by DES in the southern part of the alignment, between Mt Coolon and Glenden. Field validation is required to confirm the presence and extent of PBGW TEC within the NGBR.

#### Characteristics:

PBGW TEC structure varies from grassy woodland to open grassy woodland and occasionally open forest. The canopy is dominated by *Eucalyptus populnea* (Poplar Box), with an understorey predominantly comprised of grasses and perennial herbs. The TEC mostly occurs on gently undulating to flat landscapes and occasionally on gentle slopes on a wide range of soil types of alluvial and depositional origin (Webb *et al.* 1980). The species composition can vary significantly due to the range of the ecological community, historical biogeography and other environmental factors, such as disturbance.

Vegetative ground cover can be very sparse during dry periods but become mid-dense after rain, particularly if fire has been absent for a long time. Where the Poplar Box Grassy Woodland occurs near creek lines and low-lying areas, species adapted to occasional inundation, such as sedges and rushes, may dominate during these wetter periods. The cover of understorey shrubs may increase with distance from watercourses, in lower fire frequencies and lower soil fertility (Clarke and Knox 2002; Graham *et al.* 2014).

Although the canopy of PBGW is dominated by *Eucalyptus populnea* (Poplar Box) of up to 20 metres in height, tree species of similar height can occasionally occur in the canopy. Tall shrubs and small trees may occur in the mid layer, although they are typically scattered or patchy and variable in composition. They may include *Acacia aneura* (Mulga), *Alectryon oleifolius* subsp. *canescens* (Western Rosewood), *Apophyllum anomalum* (Warrior Bush), *Atalaya hemiglauca* (Whitewood), *Capparis mitchellii* (Native

Orange), *Eremophila mitchellii* (Budda) and *Geijera parviflora* (Wilga; Beeston *et al.* 1980). The mid layer also includes juvenile trees of canopy species. The ground layer has the most variation in species composition but is typically open, low and dominated by a variety of summer-growing or C4 grasses such as *Aristida* spp. (Wiregrass), *Bothriochloa* spp. (Red Grass), *Dichanthium* spp. (Bluegrass), *Heteropogon* sp. and *Themeda* sp. (Kangaroo Grass).

### Associated Fauna:

The PBGW forms a mosaic amongst the agricultural landscape in many parts of its range and as a result, many of the fauna species which occur within the bioregion are not restricted exclusively to the ecological community. It supports a wide range of fauna including larger mammalian herbivores, smaller ground-dwelling mammals and arboreal mammals. Poplar Box are a key hollow-forming species and provide important habitat to a range of native fauna. The PBGW TEC provides essential habitat for a number of species protected under Commonwealth and Queensland legislation, including Koala and Squatter Pigeon, both of which are present within the project area.

### Condition Thresholds:

The PBGW TEC exhibits natural variation in structure and composition throughout its range, however, many areas are also affected by some degree of disturbance and degradation. The listed TEC is restricted to patches of vegetation that are in relatively good condition. The PBGW TEC comprises those patches that meet the key diagnostic characteristics and condition thresholds described in the Conservation Advice (DoEE, 2019). The key diagnostic characteristics for the TEC include the location and physical environment criteria described in the sections above, as well as the following structure criteria:

- A grassy woodland to grassy open woodland with a tree crown cover of 10% or more at patch scale
- A tree canopy must be present that shows these features:
  - Canopy tree species are capable of reaching 10m or more in height
  - Poplar Box (and / or Poplar Box hybrids) must be present in the canopy and be the dominant tree species
- Mid layer (1 – 10m) crown cover of shrubs to small trees is low, about 30% or less.

Only patches of vegetation that meet the criteria for either Class A, Class B or Class C are included in the listed ecological community (Table 28).

**Table 28: PBGW TEC Condition categories and thresholds**

Category	Native cover and diversity thresholds	Minimum patch size thresholds
<b>Class A - Highest quality</b>		
Category A1	The crown cover of canopy trees in the patch is $\geq 10\%$ <b>AND</b> $\geq 90\%$ of perennial vegetation cover in the ground layer is native <b>AND</b> $\geq 30$ native plant species per patch in the ground layer	$\geq 1$ ha
Category A2	The crown cover of canopy trees in the patch is $\geq 10\%$ <b>AND</b> $\geq 70\%$ of perennial vegetation cover in the ground layer is native	$\geq 5$ ha

Category	Native cover and diversity thresholds	Minimum patch size thresholds
	<b>AND</b> ≥ 30 native plant species per patch in the ground layer	
<b>Category B – Good quality</b>		
Category B	The crown cover of canopy trees in the patch is ≥ 10% <b>AND</b> ≥ 50% of perennial vegetation cover in the ground layer is native <b>AND EITHER</b> ≥ 20 perennial native plant species per patch in the ground layer <b>OR</b> ≥ 10 mature trees per ha with ≥ 30cm dbh (and / or hollows)	
<b>Category C – Moderate quality</b>		
Category C	The crown cover of canopy trees in the patch is ≥ 10% <b>AND</b> If < 50% of perennial vegetation cover in the ground layer is native, then the patch <b>must</b> have: ≥ 20 native plant species per patch in the ground layer <b>AND</b> ≥ 10 mature trees per ha with ≥ 30cm dbh ((and / or hollows) <b>AND</b> smaller trees, saplings or seedlings suggestive of periodic recruitment	

### Regional Ecosystems Associations:

In Queensland, the PBGW TEC corresponds with five REs, four of which occur within the same bioregion as the Project Area (Table 29).

**Table 29 Regional Ecosystems located within the Project Area that are associated with the PBGW TEC**

RE	VM Status	Biodiversity Status	RE Description
11.3.2	Of Concern	Of Concern	<i>Eucalyptus populnea</i> woodland on alluvial plains.
11.3.17	Of Concern	Endangered	<i>Eucalyptus populnea</i> woodland with <i>Acacia harpophylla</i> and/or <i>Casuarina cristata</i> on alluvial plains.
11.4.7	Endangered	Endangered	<i>Eucalyptus populnea</i> with <i>Acacia harpophylla</i> and/or <i>Casuarina cristata</i> open forest to woodland on Cainozoic clay plains.
11.4.12	Endangered	Endangered	<i>Eucalyptus populnea</i> woodland on Cainozoic clay plains.

### 6.4.3 Inclusion in SMP

As per the conditions of approval, the SMP is to be updated based on either the identification of a new species within the Project corridor or if a species is listed under the EPBC Act post approval of the Project. The PBGW TEC was listed as Endangered under the EPBC Act on 4 July 2019, which is after the approval of the Project and as such has been included in this SMP.



Under Section 158A of the EPBC Act, listing events that occur after a Section 75 decision (whether an action is a controlled action) will not apply to the Proposed Action that was referred. Specifically, as per Section 158A(4)(a) the listing event is to be disregarded in making any further approval process decision in relation to the relevant action. The Project was referred on 3 November 2010 with a Section 75 decision made on 6 January 2011 and approval granted on 14 October 2015. Consequently, the listing of the PBGW TEC is not included in any impact assessment.

#### 6.4.4 Threats and Impacts

The current threats to the PBQW TEC include clearance of habitat, fragmentation, weed invasion, increasing grass fires, grazing, dieback of vegetation, chemical impacts from spray drift for agriculture, hydrological changes, salinisation, nutrient enrichment, invasive fauna and climate change exacerbating some of these threatening processes.

Table 30 outlines all potential impacts to PBGW TEC that are relevant to activities associated with the Project; including those identified in the conservation advice.

**Table 30 Potential impacts of the Project on PBGW TEC**

Impacts	Potential impacts associated with the Project	Project phase
Vegetation Clearing	Removal or disturbance of PBGW TEC.	Construction
	Removal and disturbance of land adjacent to PBGW TEC, leading to an increase in edge effects and habitat fragmentation and/or degradation.	
Fire	Retained areas of PBGW TEC may be degraded through increased fire intensity and frequency as a result of altered fuel characteristics and ignition sources.	Construction and Operation
Dust emissions	An increase in dust emissions may potentially impact the photosynthetic abilities of plants within PBGW TEC in areas adjacent to the Project area.	Construction and Operation
Altered hydrology	Reduced PBGW condition due to altered hydrology from waterway crossings	Construction
Weeds and Pests	Dispersal of existing weeds throughout the Project area by vehicles and machinery.	All phases
	Introduction and dispersal of new weed species, particularly Parthenium, Buffel Grass ( <i>Cenchrus ciliaris</i> ) and Coolatai Grass ( <i>Hyparrhenia hirta</i> ).	
	Increased levels of disturbance may lead to increase prevalence of pest species and consequently further degradation in condition (e.g. increase in disturbance from pigs).	

#### 6.4.5 Mitigation and Management Measures

There is currently no recovery plan required for PBGW TEC and a decision to have a Recovery Plan is unlikely to lead to substantial additional conservation benefits given the resources required to develop a plan (DoEE 2019). Table 31 outlines all relevant mitigation and management measures for PBGW TEC which are consistent with the conservation advice and with the conditions of the EPBC Approval and Coordinator-General's Report in relation to other TECs.

Table 31 Mitigation and management measures for PBGW TEC

Goal	Performance Criteria	Mitigation and Management Measures	Trigger	Corrective Actions
<p>Minimise degradation of retained areas of PBGW TEC adjacent to the Project Area</p>	<p>Limit disturbance from fire through altered fuel loads and construction activities</p>	<p>Bushfire mitigation measures will be outlined in the Bushfire and Disaster Management plan and should include but not be limited to:</p> <ul style="list-style-type: none"> <li>• Monitoring of weather conditions to identify high fire risk days, with controls to be upgraded on these days</li> <li>• Restrictions on vehicles being left idling with the exhaust in contact with dry grass</li> <li>• Designation of smoking areas</li> </ul> <p>Identification of bushfire fuel management practices within corridor (i.e. regularity of slashing).</p> <p>Review and implement existing Bushfire and Disaster Management Plan, ensuring consideration of ecological values and Rural Fire Service recommendations.</p> <p>Work sites will be provided with adequate fire-fighting equipment (water cart) and training</p>	<p>Uncontrolled fire in the Project Area</p>	<p>Immediately implement actions to suppress the spread of the fire.</p> <p>Incidences will be recorded in a register as per the CEMP.</p> <p>Review adherence to control procedures to ensure compliance. Take remedial action where compliance has not been adhered to. Increase training to ensure breach does not re-occur.</p>
<p>Temporary disturbance areas are rehabilitated to existing condition as soon as possible</p>	<p>Native species richness is &gt;50% of baseline richness within 10 years of rehabilitation commencing</p>	<p>Develop Rehabilitation Management Plan (RMP) prior to the commencement of rehabilitation activities. RMP to outline, but not be limited to:</p> <ul style="list-style-type: none"> <li>• relevant native species to be replanted</li> <li>• seed collection (if applicable)</li> <li>• landscaping, including creation of supplementary habitats</li> </ul> <p>Rehabilitation to commence as soon as temporary construction areas are no longer required.</p>	<p>Native species richness is &lt;50% of baseline richness within 10 years of rehabilitation commencing</p>	<p>An annual rehabilitation monitoring report will be submitted to DoEE, including rehabilitated PBGW TEC monitoring. Where rehabilitated areas fail to reach target values outlined in the RMP, Adani will implement any measures necessary to achieve the objectives in the RMP.</p>

**Species Management Plan Carmichael Rail Project – NGBR Section**

Goal	Performance Criteria	Mitigation and Management Measures	Trigger	Corrective Actions
Minimise invasion of weed and pest species	Prevent the spread of existing pest and weeds and the of introduction of new pests and weeds	<p>A Pest Management Plan (PMP) will be developed and implemented prior to construction activities. This PMP will specify, but not be limited to:</p> <ul style="list-style-type: none"> <li>• Ongoing (yearly) monitoring of weed and pest species</li> </ul> <p>Specify control measures for known and potential pest and weeds, minimising spread of Buffel Grass (<i>Cenchrus ciliaris</i>) and Coolatai Grass.</p> <ul style="list-style-type: none"> <li>• Control of pigs</li> <li>• Ensure that any herbicides and poisons used for weed and pest control within the Project Area do not have significant adverse impact on the community</li> </ul>	<p>&gt;10% increase in the population or cover of each weed or pest species present, from baseline scores</p> <p>Presence of new weeds or pests</p>	<p>PMP to be updated if additional pest and weeds are identified or spread continues during construction activities. Increase pest management efforts.</p>

## 7 Outstanding Universal Value of the Great Barrier Reef World Heritage Area

### 7.1 Overview

This section addresses the requirement of Condition 4 of the Commonwealth approval EPBC2013/6885 to develop a management plan for the direct and indirect impacts of the Project on the OUV of the GBRWHA.

OUV is natural or cultural heritage which is so exceptional, that it transcends national boundaries as is of such significance to humanity as a whole, that it is worthy of special protection (GBRMPA 2014a). The Great Barrier Reef was inscribed onto the World Heritage List in 1981, based on it:

- having superlative natural phenomena and areas of exceptional natural beauty;
- being an outstanding example of major stages in the Earth's evolutionary history;
- representing significant ongoing ecological and biological processes and Traditional Owners' interaction with the natural environment; and
- containing the most important and significant natural habitats for *in situ* conservation of biological diversity.

The GBRWHA includes tidal waters in the vicinity of Abbot Point, with the landward boundary of the World Heritage Area being the low water mark. While the Project does not involve any development activities within the World Heritage boundary, there is potential for the Project to affect the OUV of the GBRWHA indirectly through disturbance of adjacent coastal and riverine waterways, which are connected to the World Heritage Area.

### 7.2 Values

The broad nature of the criteria used to list the Great Barrier Reef as a World Heritage Area mean that many aspects of the ecosystem contribute to its OUV. Given the large geographic scale of the Great Barrier Reef (more than 2,000 km in length), the consideration of values and threats relevant to the protection of OUV needs to be considered at various spatial scales.

At a broad scale, the Great Barrier Reef Marine Park Authority publishes its 'Outlook Report' every five years. This includes a description of the current status of the reef and an assessment of its threats and long-term outlook. The 2014 Outlook Report (GBRMPA 2014b) assessed that "the Great Barrier Reef is an icon under pressure" (p. v) and that "the overall outlook for the Great Barrier Reef is poor, has worsened since 2009 and is expected to further deteriorate in the future" (p. vi).

Threats to the World Heritage Area originate from a variety of sources, and include climate change, poor water quality from land-based runoff, coastal development, fishing, extreme weather events and outbreaks of the crown-of-thorns starfish (GBRMPA 2014b). The Commonwealth and Queensland Governments are developing a Long Term Sustainability Plan for the Great Barrier Reef, which aims to address many of these threats and improve the condition of key environmental values (Commonwealth of Australia and Queensland Government 2014). Water quality is the threat which has the greatest potential to be influenced in some way by the rail development Project.

At a local scale, the Port of Abbot Point is located midway along the coastal zone of the Great Barrier Reef. The coastal interface in the region is comprised mostly of sandy beaches, with intermittent areas of tidal wetland habitats (e.g. Euri Creek) and rocky headlands (e.g. Cape Upstart). A small number of near-

shore fringing coral reefs are also located approximately 20 km from the Port (e.g. Holbourne Island and Camp Island).

Marine habitats of the World Heritage Area within the Abbot Point region are generally comprised of sandy sediments, with patches of seagrass and soft-bottom benthic invertebrates. Extensive coral reefs occur to the east and north at distances greater than 40 km from the Port, and comprise the mid and outer shelf environments of the Great Barrier Reef. The Abbot Point region provides habitat for a range of threatened marine species, including turtles, dugong and migratory shorebirds. Collectively, these aspects of the local environment contribute to the OUV of the GBRWHA.

There are several rivers which flow into the World Heritage Area which will be crossed by the rail corridor. These include the Bowen, Bogie and Suttor Rivers, which flow into the Burdekin River to the north of Abbot Point. Additionally, some perennial and ephemeral streams (e.g. Elliot River and Saltwater Creek) are intersected by the rail corridor, and subsequently flow into Abbot Bay, part of the GBRWHA. Collectively, these connecting water bodies provide a potential pathway for the rail construction works and operations to have an indirect impact on the OUV of the GBRWHA.

Environmental values and processes that are most relevant to the consideration of potential impacts of the rail development on the OUV of the GBRWHA are:

- Water quality
- Seagrass meadows
- Beaches and coastlines
- Soft bottom benthic communities
- Connecting water bodies
- Indigenous heritage values
- Aesthetics

All of these values are related directly or indirectly to the quality of water and sediment being discharged into the World Heritage Area from waterways along the rail corridor.

### 7.3 Threats

A comprehensive assessment of the direct and indirect impacts of the Project on the OUV of the GBRWHA was completed in Appendix D of the Additional Information to the EIS (Adani 2014). A summary of the conclusions of this assessment is provided below:

- There will be no direct impacts of the Project on the OUV of the GBRWHA, as the most northern section of rail development at the Port of Abbot point is located outside of the boundary of the World Heritage Area.
- The rail corridor traverses several watercourses which flow into the GBRWHA, and there is potential for indirect impacts associated with construction works to affect the quality of water flowing to the World Heritage Area. Such impacts could occur through the disturbance of acid sulphate soils, increased sediment runoff from disturbed areas, accidental spills of contaminants into waterways and the introduction of weed and pest species into waterways.
- The likelihood of such impacts affecting the OUV of the GBRWHA is very remote, given the scale of the rail project works in the region and the nature of the potential mode of impacts. Management measures will be implemented during construction and operations to mitigate the risk.

#### **7.4 Mitigation and management measures**

Environmental controls to be implemented for the Project include measures to manage stormwater and wastewater discharges to waterways. Such measures will minimise the potential for the release of contaminants, sediments and the introduction of weeds into surrounding waters. Construction-specific management measures will be implemented to minimise or avoid impacts from vegetation clearing and associated land-based works. Such measures will focus on reducing the potential for the mobilisation of sediments or pollutants, and limiting sediment transport from exposed areas. Mitigation measures are outlined in Table 32.

**Table 32 Management measures for the protection of OUV of the GBRWHA.**

Goal	Performance Criteria	Mitigation and Management Measures	Corrective Action
<p>No adverse impacts on water quality of the GBRWHA as a result sediment runoff from Project activities</p>	<p>Control surface water movement through construction sites, with an emphasis on sediment-laden water</p>	<p>A Site Based Management Plan will be developed for waterway crossings where it is determined that there is a high risk of environmental impacts, such as bank erosion or effects on water quality.</p> <p>Implement an Erosion and Sediment Control Plan in accordance with IECA guidelines as prescribed in the relevant project approvals.</p> <p>Design and construct sediment basins to capture and store sediment-laden water, prior to discharge.</p> <p>Develop contingency plans for implementation in the event of high rainfall events.</p> <p>Implement a monitoring program for water quality, to assess the effectiveness of drainage and sediment controls.</p> <p>Waterway profiles at temporary construction access roads and facility areas will be reinstated and disturbed areas will be promptly stabilised following completion of construction works.</p> <p>Utilise existing disturbed areas to access waterways.</p> <p>The route used by machinery in and out of the work sites on waterways will be controlled and the need for access of heavy machinery to the bed of the waterways will be avoided.</p> <p>Works will be undertaken from the top of waterway banks, to minimise disturbance.</p>	<p>In the event that water quality monitoring indicates that mitigation measures are ineffective, stop work and reassess mitigation measures.</p>
	<p>Minimise the extent and duration of soil disturbance and erosion</p>	<p>Locate soil stockpile areas away from watercourses, with sediment barriers in place.</p> <p>Identify high risk areas for erosion, potential acid sulphate soils and dispersive soils.</p> <p>Implement management controls to prevent discharges to waterways.</p> <p>Promptly stabilise disturbed areas to maximise sediment retention on site.</p>	<p>Environmental Supervisor to increase the effectiveness of sediment retention and stockpile practices, in the event that mitigation measures are ineffective at reducing sediment discharges to waterways.</p>

Goal	Performance Criteria	Mitigation and Management Measures	Corrective Action
<p>Minimise the disturbance of acid sulphate soils.</p> <p>Implement treatment practices to effectively protect water quality</p>	<p>Avoid disturbance of acid sulphate soils where possible</p>	<p>Develop and implement an ASS management plan prior to construction works for areas below 5 m AHD.</p> <p>Complete an ASS survey in areas where the rail corridor has the potential to disturb ASS.</p>	<p>In the event that ASS impacts are detected or management practices are not followed, all works on site to cease until remediation has taken place.</p>
	<p>Manage acid sulphate soils in accordance with accepted guidelines</p> <p>No spills of contaminants from the works site into waterways</p>	<p>Chemically neutralise ASS using Aglime and mechanical mixing by plough or excavator to provide adequate homogeneity of the sediment-lime mix. If this isn't possible, use the less preferred method of anoxic storage or placement below the water table and beneath clean, non-ASS fill.</p>	
<p>No adverse impacts on water quality of the GBRWHA due to the discharge of contaminants to waterways</p>		<p>Control the discharge of waste water to waterways</p>	<p>Dewatering procedures will be developed and implemented to manage construction groundwater inflow or on-site stormwater collection including appropriate capture, treatment and disposal measures.</p> <p>Conduct works during dry or low flow periods.</p> <p>All construction camp stormwater captured on site will be reused for irrigation, dust suppression or stored within sediment basins before being appropriately treated and discharged.</p> <p>Wastewater from concrete batching plants will be captured, stored and either reused in concrete batching or treated and disposed appropriately.</p>
	<p>Minimise project-related changes to the natural connectivity of rivers, estuaries</p>	<p>Maintain the connectivity of waterways and prevent inundation of the works site.</p>	<p>Install culverts within permanent infrastructure (where required) in stages to maintain connectivity and reduce the likely impact of infrastructure on flows and afflux during the wet season.</p> <p>Perimeter bunds to be established around construction areas to divert surface runoff and prevent flooding of the area during construction works.</p>



Goal	Performance Criteria	Mitigation and Management Measures	Corrective Action
and the World Heritage Area			
Minimise the spread of pests and weeds along watercourses	Implement best practice approaches to weed and pest management during construction and operations.	<p>Develop and implement weed and pest management plan.</p> <p>Dispose of green waste in designated areas.</p> <p>Utilise vehicle and plant wash down areas to avoid spreading weeds.</p> <p>Implement industry standard marine pest guidelines for operational activities at the Port of Abbot Point (e.g. transport of materials by sea) to minimise the likelihood of introducing pests.</p>	Investigate any non-compliance with procedures and apply corrective actions to prevent re-occurrence.

## 7.5 Monitoring

The potential impacts of the proposed activities will be monitored in accordance the monitoring program outlined in Table 33.

**Table 33 Details of monitoring program for OUV of the GBRWHA**

Performance Criteria	Monitoring Program	Triggers	Outcomes
Control surface water movement through construction sites, with an emphasis on sediment-laden water	<p>The effectiveness of sediment barriers (including location and design) will be monitored in line with IECA guidelines as prescribed in relevant project approvals. Inspect the integrity of sediment barriers daily during construction works.</p> <p>Design and implement a water quality monitoring program (turbidity) in accordance with the water quality management plan. Water quality should return to background levels within 100 m of works site.</p>	Uncontrolled runoff from construction site into waterway.	<p>Any breaches in sediment barriers are identified quickly.</p> <p>Adani to review monitoring results and report annually and revise management actions if any trigger is exceeded.</p>
Avoid disturbance of acid sulphate soils where possible. Manage acid sulphate soils in accordance with accepted guidelines.	<p>Complete an ASS survey in areas where the rail corridor has the potential to disturb ASS.</p> <p>Monitor the effectiveness of soil treatment practices with Aglime, by testing a sub sample of treated soil in accordance with ASS management plan.</p>	Management of disturbed of ASS to be in accordance with ASS management plan.	Baseline ASS risk determined prior to disturbance. Data available to guide management practices for ASS treatment.

Performance Criteria	Monitoring Program	Triggers	Outcomes
<p>No spills of contaminants from the works site into waterways.</p> <p>Control the discharge of waste water to waterways.</p>	<p>Design and implement a water quality monitoring program (total petroleum hydrocarbons and metals) in accordance with the water quality management plan. Water quality should return to background levels within 100 m of works site.</p> <p>The impacts of any contaminant spill on adjacent waterways will be monitored through a tailored monitoring program suitable to the situation.</p>	<p>Water quality 100 m downstream from works site equivalent to upstream control site (factoring in the influence of tide for estuarine sites).</p>	<p>In the event that water quality is impacted beyond trigger values, review mitigation measures and enhance the treatment of discharged water.</p>
<p>Implement best practice approaches to weed and pest management during construction and operations.</p>	<p>Weed surveys of riparian habitats will be completed before and after the commencement of construction works for crossings, and annually thereafter.</p>	<p>Increase in weed cover over 2-3 years (&lt;10%)</p> <p>Presence of new weeds</p>	<p>Results to inform implementation of the pest management plan.</p> <p>Adani to review monitoring results and report annually and revise management actions if any trigger is exceeded.</p>

The design of the on-going monitoring program, including the location and extent of monitoring sites, will be determined by a suitably qualified person to ensure that sufficient data are collected to quantify likely impacts resulting from the proposed action, and to determine the appropriate habitat management goals. The monitoring program will include both impact and control sites to monitor the progress of recovery, including effectiveness of management actions, and adapt if necessary.

## 8 Species Management Plans (Flora)

### 8.1 *Dichanthium queenslandicum* (King Blue-grass)

#### 8.1.1 Status

*Dichanthium queenslandicum* is listed as Endangered under the EPBC Act and Vulnerable under the NC Act.

#### 8.1.2 Ecology and Distribution

##### Description:

*Dichanthium queenslandicum* is a perennial, tufted, erect grass growing up to 80cm tall (TSSC 2013d; TSSC 2013w). The culms are rarely branched, and the nodes are bearded (Stanley and Ross 1989; Plate 5). The leaf sheaths have long spreading tubercular-based hairs; ligules up to 1.5mm long; linear leaf blades, an attenuate apex, and long spreading tubercular-based hairs (Stanley and Ross 1989). The racemes are solitary, rarely paired, and up to 10cm long, with long spreading hairs, and the sessile spikelet is 7.5-8.5mm long, with the lower glume as long as the spikelet, glabrous, and scabrid on the margin, and the upper glume as long as spikelet and glabrous (Stanley and Ross 1989).

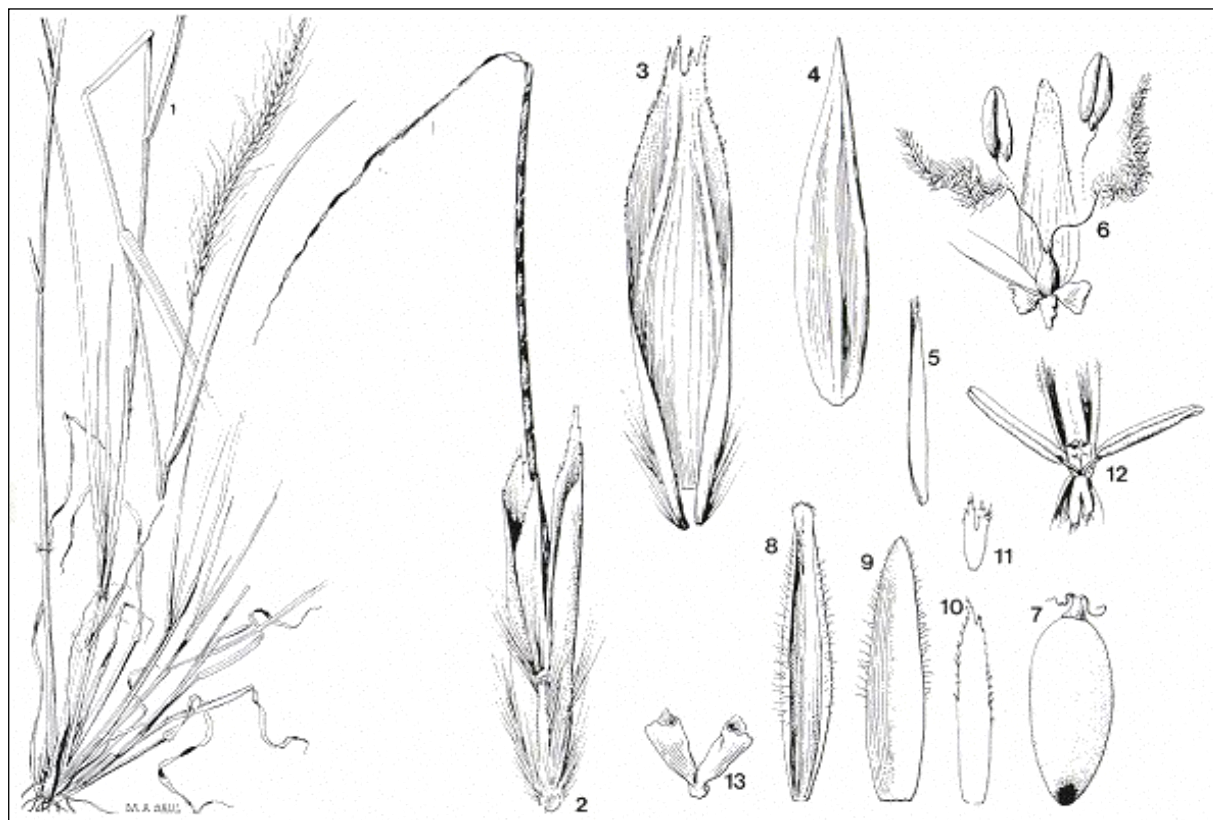


Plate 5 – *Dichanthium queenslandicum*. Source: Queensland Herbarium, 2002.

**Distribution and ecology:**

*Dichanthium queenslandicum* is endemic to central and southern Queensland, occurring in three disjunct populations: Hughenden district, Nebo to Monto and Dalby district in the Darling Downs (TSSC 2013d). In these areas, the species is confined to natural grassland on heavy black clay soils and mainly in association with other species of blue grasses, *Dichanthium* spp. and *Bothriochloa* spp. (Simon 2011; TSSC 2013d). Flowering of *Dichanthium queenslandicum* occurs between November and January, after rainfall (Simon 2011).

The distribution of this species also overlaps two TEC which occur within the Project Area (TSSC 2013d):

- Brigalow (*Acacia harpophylla* dominant and co-dominant); and
- Natural Grasslands of the Queensland Central Highlands and the northern Fitzroy Basin.

Currently, the distribution of *Dichanthium queenslandicum* is substantially reduced with only small remnant patches remaining (Butler 2007).

**Known Locations within Project Area:**

*Dichanthium queenslandicum* was not observed within the Project Area during random meander surveys undertaken during the EIS but has the potential to occur in the area based on the suitability of the habitat and its current known distribution (GHD 2012; GHD 2014). The nearest *Dichanthium queenslandicum* record is 30 km northwest of Glenden, 1.5 km south of the Project Area (Appendix B; Queensland Herbarium 2015).

Potential *Dichanthium queenslandicum* habitat in the Project Area has been described as natural grasslands that are either associated REs that meet the description for Grassland TEC or open woodlands with a grassy understory (Table 34).

**Table 34 Regional Ecosystems providing potential habitat for *Dichanthium queenslandicum* within the Project Area**

RE	RE Description	VM Class
11.3.31	<i>Ophiuros exaltatus</i> , <i>Dichanthium</i> spp. grassland on alluvial plains	Least Concern
11.4.4	<i>Dichanthium</i> spp., <i>Astrebla</i> spp. grassland on Cainozoic clay plains	Least Concern
11.4.11	<i>Dichanthium sericeum</i> and <i>Astrebla</i> spp. grassland with patchy <i>Acacia harpophylla</i> or <i>Eucalyptus coolabah</i> on Cainozoic clay plains	Of Concern
11.8.5	<i>Eucalyptus orgadophila</i> open woodland on Cainozoic igneous rocks	Least Concern
11.8.11	<i>Dichanthium sericeum</i> grassland on Cainozoic igneous rocks	Of Concern
11.9.2	<i>Eucalyptus melanophloia</i> ± <i>E. orgadophila</i> woodland on fine-grained sedimentary rocks	Least Concern
11.9.3	<i>Dichanthium</i> spp., <i>Astrebla</i> spp. grassland on fine-grained sedimentary rocks	Least Concern
11.9.12	<i>Dichanthium sericeum</i> grassland with clumps of <i>Acacia harpophylla</i> on fine-grained sedimentary rocks	Endangered

Although Brigalow TEC has also been described within the Project Area, *Dichanthium queenslandicum* is unlikely to be associated with REs that meet the description of this TEC. *Dichanthium queenslandicum* potential habitat is mapped within proximity to the majority of the Carmichael Rail Project, however known

habitat locations within the Project Area are restricted to numerous patches between KP91 and KP188 (Appendix B). Specific known habitat locations are specified in Table 35.

**Table 35 Known locations of *Dichanthium queenslandicum* habitat within the Project Area**

Kilometre Points (KP)		
91-98	128-129	162-169
100-103	141-142	175-188
106-107	148-153	
108-111	154-158	
124-125	159-160	

The presence of *Dichanthium queenslandicum* and the extent of its potential habitat in the Project Area will be confirmed during pre-clearance surveys undertaken during the course of the Project.

### 8.1.3 Threats and Impacts

The key known threat affecting *Dichanthium queenslandicum* is loss of habitat due to land clearing, habitat fragmentation and/or habitat degradation that is associated with agricultural and mining activities, road construction and other infrastructure developments (TSSC 2013d). Unsustainable grazing practices and invasion of weeds are also known threats. Two Commonwealth Weeds of National Significance, Parthenium (*Parthenium hysterophorus*) and Parkinsonia (*Parkinsonia aculeata*), are known to threaten the habitat of *Dichanthium queenslandicum*. Both of these weed species are likely to occur within the rail corridor.

Table 36 outlines all potential impacts to *Dichanthium queenslandicum* habitat that are relevant to activities associated with the Project; including those identified in the draft recovery plan, Condition 5c of the EPBC Approval, Appendix 1 of the Coordinator-General's Report and each EIS (GHD 2012; GHD 2014).

**Table 36 Potential impacts from the Project on *Dichanthium queenslandicum* habitat**

Impacts	Potential impacts associated with the Project	Project phase
Vegetation Clearing	Removal or disturbance of <i>Dichanthium queenslandicum</i> habitat. A disturbance limit of 263.3 ha is in place in the EPBC Act approval.	Construction
	Removal and disturbance of land adjacent to <i>Dichanthium queenslandicum</i> habitat, leading to an increase in edge effects i.e. habitat fragmentation/disturbance	
Dust emissions	An increase in dust emissions may potentially impact the photosynthetic ability of <i>Dichanthium queenslandicum</i> in areas adjacent to the Project Area	Construction and Operation
Weeds	Dispersal of existing weeds throughout the Project Area by vehicles and machinery	All phases
	Introduction and dispersal of new weed species, specifically Parthenium and Parkinsonia.	

#### 8.1.4 Mitigation and Management Measures

There is currently no specific recovery plan for *Dichanthium queenslandicum* (DoE 2015). A draft recovery plan has been developed for 'Bluegrass (*Dichanthium* spp.) dominant grassland of the Brigalow Belt Bioregions (north and south)' endangered ecological community (Butler 2007). There is also a recovery plan for the Natural Grassland of the Queensland Central Highlands and the Northern Fitzroy Basin TEC and it outlines additional key priority actions that should be considered for management of natural grasslands (Young and Butler 2011). Additional information is available in the conservation advice for *Dichanthium queenslandicum* (TSSC 2013d). These documents have been considered where relevant to the management of *Dichanthium queenslandicum* within the Project Area.

Table 37 outlines all relevant mitigation and management measures for *Dichanthium queenslandicum* which are consistent with existing recovery plans, conservation advice and meet the conditions of the EPBC Approval and Coordinator-General's Report.

Table 37 Mitigation and management measures for *Dichanthium queenslandicum*

Goal	Performance Criteria	Mitigation and Management Measures	Trigger	Corrective Action
Temporary disturbance areas are rehabilitated to existing condition as soon as possible	Where <i>Dichanthium queenslandicum</i> was identified in the habitat during baseline surveys, the species must occur at 80% of its baseline abundance within 10 years of rehabilitation commencing.	Develop Rehabilitation Management Plan (RMP) prior to the commencement of rehabilitation activities. RMP to outline, but not be limited to: <ul style="list-style-type: none"> <li>relevant native species to be replanted</li> <li>seed collection (if applicable)</li> <li>landscaping, including creation of supplementary habitats</li> </ul> Rehabilitation to commence as soon as temporary construction areas are no longer required.	Occurrence of <i>Dichanthium queenslandicum</i> is <80% of baseline abundance within 10 years of rehabilitation commencing.	An annual rehabilitation monitoring report will be submitted to DoEE, including rehabilitated <i>Dichanthium queenslandicum</i> habitat monitoring. Where rehabilitated areas fail to reach target values outlined in the RMP, Adani will implement any measures necessary to achieve the objectives in the RMP.

### 8.1.5 Monitoring

The potential impacts of the proposed activities will be monitored in accordance the monitoring program outlined in Table 38. The design of the on-going monitoring program, including the location and extent of monitoring sites, will be determined by a suitably qualified person to ensure that sufficient data are collected to quantify likely impacts resulting from the proposed action, and to determine the appropriate habitat management goals. The monitoring program will include both impact and control sites to monitor the progress of recovery, including effectiveness of management actions, and adapt if necessary. Monitoring will occur immediately after the first good rains in summer, when a seed head is present. Annual monitoring will occur for the duration of railway activities.

Table 38 Details of monitoring program for *Dichanthium queenslandicum*

Performance Criteria	Triggers	Monitoring Program	Outcomes
Maintain existing condition of retained areas of <i>Dichanthium queenslandicum</i> habitat adjacent to the Project Area	Progressive decline in habitat condition over 2-3 years	Annual BioCondition assessments will be commence prior to construction activities to determine the condition of ecosystems containing <i>Dichanthium queenslandicum</i> in impact and control sites. A minimum of 3 impact and 3 control sites will be established along the alignment. Impact plots will be located within 200 m of the Project Area, while control plots will be located <1 km from the Project Area.	Baseline condition of <i>Dichanthium queenslandicum</i> habitat determined prior to clearing to allow effective monitoring of the Projects impacts and compliance with EPBC conditions.  Adani to review monitoring results and report annually and revise management actions if any trigger is exceeded.
Limit disturbance from emissions (dust) on photosynthetic ability of <i>Dichanthium queenslandicum</i>		In addition to these assessments, targeted searches for <i>Dichanthium queenslandicum</i> will be undertaken within potential habitat after suitable rainfall (November – January). If this species is recorded, an additional five 1 m x 1 m plots will be assessed along the permanent assessment transect to determine the abundance of the species.  A series of 5 dust monitoring plots (1 m x 1 m) will be established within 5 m of the exclusion fence, and within equivalent habitat	

Performance Criteria	Triggers	Monitoring Program	Outcomes
		between 500 m and 1 km from the exclusion fence, every 5 km along the rail corridor, on alternating sides within known <i>Dichanthium queenslandicum</i> habitat. The plot boundaries will be mapped and clearly marked with pegs. Baseline and photo monitoring will occur prior to construction, and annually thereafter using the method outlined for grass plots in DEHP (2014).	
Where <i>Dichanthium queenslandicum</i> was identified in the habitat during baseline surveys, the species must occur at 80% of its baseline abundance within 10 years of rehabilitation commencing.	After 3 years native species richness is <25% of baseline richness and/or <i>Dichanthium queenslandicum</i> abundance is <10% of its baseline abundance After 6 years native species richness is <50% of baseline richness and/or <i>Dichanthium queenslandicum</i> abundance is <40% of its baseline abundance	A pre-disturbance BioCondition Assessment and annual post disturbance BioCondition Assessments will be undertaken to determine the effectiveness of rehabilitation works. In habitats where <i>Dichanthium queenslandicum</i> is recorded these assessments will also include an additional five 1 m x 1 m plots to determine the abundance of the species.	



## 8.2 *Dichanthium setosum* (Bluegrass)

### 8.2.1 Status

*Dichanthium setosum* is listed as Vulnerable under the EPBC Act and Least Concern under the NC Act.

### 8.2.2 Ecology and Distribution

#### Description:

*Dichanthium setosum* is an upright perennial grass to 1m tall, with mostly hairless leaves 2-3mm wide (DoE 2015). The flowers are densely hairy and clustered together along a cylinder shape stalk and appear mostly during summer (Plate 6; TSSC 2008a).

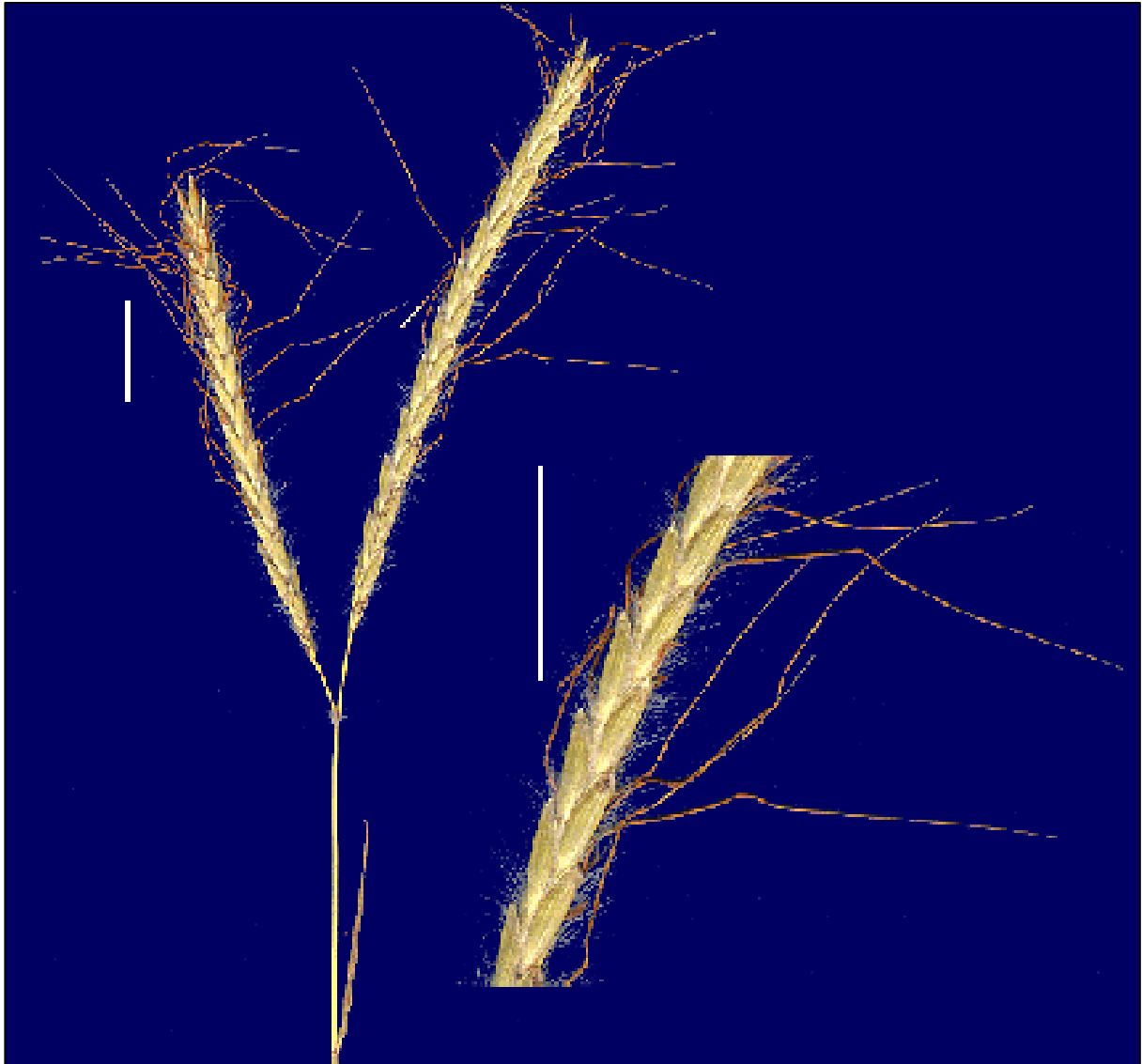


Plate 6 – *Dichanthium setosum*. Source: Queensland Herbarium, 2002.

**Distribution and ecology:**

The main area of distribution for *Dichanthium setosum* is from inland NSW to Queensland (DoE 2015). Within Queensland, this species has been recorded from the Leichhardt, Moreton, North Kennedy and Port Curtis pastoral districts (Henderson 1997).

*Dichanthium setosum* is associated with heavy basaltic black soils and stony red-brown loam with clay subsoil and has been observed in moderately disturbed areas such as cleared woodland, grassy roadside remnants, grazed land and highly disturbed pastures (TSSC 2008a).

The distribution of this species also overlaps two EPBC Act-listed threatened ecological communities that occur within the Project Area (TSSC 2008 agn):

- Brigalow (*Acacia harpophylla* dominant and co-dominant); and
- Semi-evergreen vine thickets of the Brigalow Belt (North and South) and Nandewar Bioregions.

This species can be found in moderately disturbed area, and can occur in either pure swards or as scattered clumps (TSSC 2008 agn).

**Known Locations within Project Area:**

*Dichanthium setosum* has previously been observed in proximity to the Project Area during random meander surveys (GHD 2014). This species has also been recorded is approximately 30 km south-east of Mt Coolon, 7km south of the Project Area (Appendix B).

*Dichanthium setosum* habitat in the Project Area has been described as natural grasslands and grassy woodlands associated with eight REs, with some coinciding with the Natural Grasslands of the Queensland Central Highlands and the Northern Fitzroy Basin TEC (Table 39).

**Table 39 Regional Ecosystems providing potential habitat for *Dichanthium setosum* within the Project Area**

RE	RE Description	VM Class
11.3.31	<i>Ophiuros exaltatus</i> , <i>Dichanthium</i> spp. grassland on alluvial plains	Least Concern
11.3.25	<i>Eucalyptus tereticornis</i> or <i>E. camaldulensis</i> woodland fringing drainage lines	Least Concern
11.8.5	<i>Eucalyptus orgadophila</i> open woodland on Cainozoic igneous rocks	Least Concern
11.8.11	<i>Dichanthium sericeum</i> grassland on Cainozoic igneous rocks	Of Concern
11.9.2	<i>Eucalyptus melanophloia</i> ± <i>E. orgadophila</i> woodland on fine-grained sedimentary rocks	Least Concern
11.9.3	<i>Dichanthium</i> spp., <i>Astrebla</i> spp. grassland on fine-grained sedimentary rocks	Least Concern
11.9.9	<i>Eucalyptus crebra</i> woodland on fine-grained sedimentary rocks	Least Concern
11.9.9b	<i>Eucalyptus crebra</i> +/- <i>E. exserta</i> +/- <i>Corymbia</i> spp. woodland on fine-grained sedimentary rocks	Least Concern

*Dichanthium setosum* potential habitat is mapped within proximity to the majority of the Carmichael Rail Project, however known habitat locations within the Project Area are restricted to numerous patches between KP24 and KP252 (Appendix B). Specific known habitat locations are specified in Table 40.

**Table 40 Known locations of *Dichanthium setosum* habitat within the Project Area**

Kilometre Points (KP)				
20	124-125	151-158	197	238
24	128-129	159-160	203-204	249-252
37	129-131	161-169	208	
98-99	138-142	173-174	212-213	
106-110	147-150	175-188	215	

The presence of *Dichanthium setosum* and the extent of its potential habitat in the Project Area will be confirmed during pre-clearance surveys undertaken during the course of the Project.

### 8.2.3 Threats and Impacts

The main identified threats to *Dichanthium setosum* are heavy grazing by domestic stock; loss of habitat through clearing for pasture improvement and cropping; frequent fires, especially regular burning for agricultural purposes; invasion by introduced grasses, such as Coolatai grass (*Hyparrhenia hirta*), Lippia (*Phyla canescens*) and African Lovegrass (*Eragrostis curvula*); and road widening (DoE 2015).

Table 41 outlines all potential impacts to *Dichanthium setosum* habitat that are relevant to activities associated with the Project; including those identified in the draft recovery plan, Condition 5c of the EPBC Approval, Appendix 1 of the Coordinator-General's Report and each EIS (GHD 2012; GHD 2014).

**Table 41 Potential impacts from the Project on *Dichanthium setosum* habitat**

Impacts	Potential impacts associated with the Project	Project phase
Vegetation Clearing	Removal or disturbance of <i>Dichanthium setosum</i> habitat. A disturbance limit of 354.2 ha is in place in the EPBC Act approval.	Construction
	Removal and disturbance of adjacent land to <i>Dichanthium setosum</i> habitat, leading to an increase in edge effects i.e. habitat fragmentation/disturbance.	
Fire	<i>Dichanthium setosum</i> habitat may be degraded and individual plants destroyed through increased fire severity and frequency, as a result of altered fuel characteristics.	Construction and Operation
Dust emissions	An increase in dust emissions may potentially impact the photosynthetic ability of <i>Dichanthium setosum</i> in areas adjacent to the Project Area.	Construction and Operation
Weeds	Dispersal of existing weeds throughout the Project Area by vehicles and machinery.	All phases
	Introduction and dispersal of new weed species, particularly Coolatai grass, Lippia and African Lovegrass.	

#### 8.2.4 Mitigation and Management Measures

There is currently no specific recovery plan for *Dichanthium setosum* (DoE 2015). A draft recovery plan has been developed for 'Bluegrass (*Dichanthium* spp.) dominant grassland of the Brigalow Belt Bioregions (north and south)' endangered ecological community (Butler 2007). There is also a recovery plan for the Natural Grassland of the Queensland Central Highlands and the Northern Fitzroy Basin TEC and it outlines additional key priority actions that should be considered for management of natural grasslands (Young and Butler 2011). Additional information is available in the conservation advice for *Dichanthium setosum* (TSSC 2008a). These documents have been considered where relevant to the management of *Dichanthium setosum* within the Project Area.

Table 42 outlines all relevant mitigation and management measures for *Dichanthium setosum* which are consistent with existing recovery plans, conservation advice and meet the conditions of the EPBC Approval and Coordinator-General's Report.

Table 42 Mitigation and management measures for *Dichanthium setosum*

Goal	Performance Criteria	Mitigation and Management Measures	Trigger	Corrective Action
Minimise degradation of retained areas of <i>Dichanthium setosum</i> habitat adjacent to the Project Area	Limit disturbance from fire through altered fuel loads and construction activities	<p>Actions and thresholds will be outlined in relevant management plans (i.e. CEMP and OEMP). Mitigation and management measures should include but not be limited to:</p> <ul style="list-style-type: none"> <li>• Parking of vehicles in designated areas</li> <li>• Ensuring hot-works are undertaken under appropriate permitting</li> </ul> <p>Regular maintenance (e.g. mowing) of vegetation within Project Area during operational phase</p>	Uncontrolled fire in the Project Area	<p>Immediately implement actions to suppress the spread of the fire.</p> <p>Incidences will be recorded in a register as per the CEMP.</p> <p>Review adherence to control procedures to ensure compliance. Take remedial action where compliance has not been adhered to. Increase training to ensure breach does not re-occur.</p>
Temporary disturbance areas are rehabilitated to existing condition as soon as possible	Where <i>Dichanthium setosum</i> was identified in the habitat during baseline surveys, the species must occur at 80% of its baseline abundance within 10 years of rehabilitation commencing	<p>Develop Rehabilitation Management Plan (RMP) prior to the commencement of rehabilitation activities. RMP to outline, but not limited to:</p> <ul style="list-style-type: none"> <li>• relevant native species to be replanted</li> <li>• seed collection (if applicable)</li> <li>• landscaping, including creation of supplementary habitats</li> </ul> <p>Rehabilitation to commence as soon as temporary construction areas are no longer required.</p>	Occurrence of <i>Dichanthium setosum</i> is <80% of baseline abundance within 10 years of rehabilitation commencing.	An annual rehabilitation monitoring report will be submitted to DoEE, including rehabilitated <i>Dichanthium setosum</i> habitat monitoring. Where rehabilitated areas fail to reach target values outlined in the RMP, Adani will implement any measures necessary to achieve the objectives in the RMP.

### 8.2.5 Monitoring

The potential impacts of the proposed activities will be monitored in accordance the monitoring program outlined in Table 43. The design of the on-going monitoring program, including the location and extent of monitoring sites, will be determined by a suitably qualified person to ensure that sufficient data are collected to quantify likely impacts resulting from the proposed action, and to determine the appropriate habitat management goals. The monitoring program will include both impact and control sites to monitor the progress of recovery, including effectiveness of management actions, and adapt if necessary. Monitoring will occur immediately after the first good rains in summer, when a seed head is present. Annual monitoring will occur for the duration of railway activities.

Table 43 Details of monitoring program for *Dichanthium setosum*

Performance Criteria	Triggers	Monitoring Program	Outcomes
Maintain existing condition of retained areas of		Annual BioCondition assessments will be commence prior to construction activities to determine the condition of <i>Dichanthium setosum</i> habitat in impact	Baseline condition of <i>Dichanthium</i>

Performance Criteria	Triggers	Monitoring Program	Outcomes
<p><i>Dichanthium setosum</i> adjacent to the Project Area</p> <p>Limit disturbance from fire through altered fuel loads and construction activities</p> <p>Limit disturbance from emissions (dust) on photosynthetic ability of <i>Dichanthium setosum</i></p>	<p>Progressive decline in habitat condition over 2-3 years</p>	<p>and control sites. A minimum of 3 impact and 3 control sites will be established along the alignment. Impact plots will be located within 200 m of the Project Area, while control plots will be located &lt;1 km from the Project Area.</p> <p>In addition to these Assessments, there will be targeted searches for <i>Dichanthium setosum</i> within each habitat area after suitable rainfall (November – January). If this species is recorded, an additional five 1 m x 1 m plots will be assessed along the permanent Assessment transect, totalling ten 1 m x 1 m plots along 100 m transect.</p> <p>A series of 5 dust monitoring plots (1 m x 1 m) will be established within 5 m of the exclusion fence, and within equivalent habitat between 500 m and 1 km from the exclusion fence, every 5 km along the rail corridor, on alternating sides within known <i>Dichanthium setosum</i> habitat. The plot boundaries will be mapped and clearly marked with pegs. Baseline and photo monitoring will occur prior to construction, and annually thereafter using the method outlined for grass plots in DEHP (2014).</p>	<p><i>queenslandicum</i> habitat determined prior to clearing to allow effective monitoring of the Projects impacts and compliance with EPBC conditions.</p> <p>Adani to review monitoring results and report annually and revise management actions if any trigger is exceeded.</p>
<p>Where <i>Dichanthium setosum</i> was identified in the habitat during baseline surveys, the species must occur at 80% of its baseline abundance within 10 years of rehabilitation commencing.</p>	<p>After 3 years native species richness is &lt;25% of baseline richness and/or <i>Dichanthium setosum</i> abundance is &lt;10% of its baseline abundance</p> <p>After 6 years native species richness is &lt;50% of baseline richness and/or <i>Dichanthium setosum</i> abundance is &lt;40% of its baseline abundance</p>	<p>A pre-disturbance BioCondition Assessment and annual post disturbance BioCondition Assessments will be undertaken to determine the effectiveness of rehabilitation works. In habitats where <i>Dichanthium setosum</i> is recorded these assessments will also include an additional five 1 m x 1 m plots to determine the abundance of the species.</p>	

### 8.3 *Eucalyptus raveretiana* (Black Ironbox)

#### 8.3.1 Status

*Eucalyptus raveretiana* is listed as Vulnerable under the EPBC Act and Least Concern under the NC Act. This species was listed as Vulnerable under the NC Act at the time of the EIS's but was reclassified in December 2014.

#### 8.3.2 Ecology and Distribution

##### Description:

*Eucalyptus raveretiana* (Plate 7) is medium sized tree to 25 m high. The bark is rough on the trunk and the largest branches; slightly furrowed, hard and dark grey. Most branches are smooth, white, grey or pale blue. Branchlets are reported to have glandular pith, unlike any other Queensland eucalypt species. Adult leaves are stalked, lance-shaped, 8–15 cm long, 1–3.5 cm wide, dark green on upper surface and much paler below. Flowers are formed in terminal clusters, with seven buds per umbel. Flower buds are diamond-shaped, 3–4 mm long when mature, on stalks 2–4 mm long. Fruit is hemispherical, approximately 2 mm long and wide, with three or four fruit valves prominently exerted (DoE 2015).

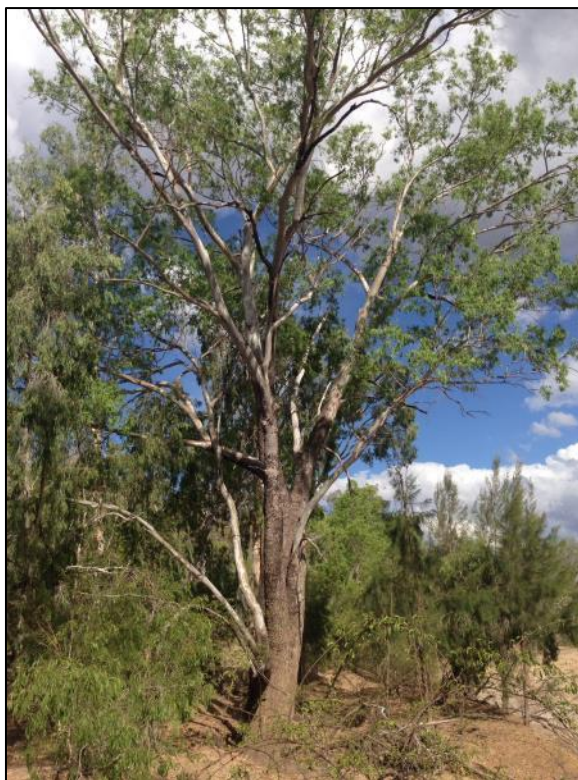


Plate 7 – *Eucalyptus raveretiana*.

##### Distribution and Ecology:

*Eucalyptus raveretiana* is endemic to Queensland and known from 23 scattered and disjunct locations in two main regions: from Townsville to Nebo; and around Rockhampton. The species has been recorded in Eungella and Godebella National Parks but neither of these is actively managed for the species (TSSC 2012a).

*Eucalyptus raveretiana* Occurs on banks of rivers, creeks and other watercourses on clayey or loamy soil. Does not occur in pure stands but is co-dominant with species such as White Paperbark (*Melaleuca leucadendra*), Silver-crowned Paperbark (*Melaleuca fluviatilis*), Forest Redgum (*Eucalyptus tereticornis*), Moreton Bay Ash (*Corymbia tessellaris*), and occasionally in semi-evergreen vine thicket. Soil type is variable. Altitudinal range is 0–300 m and annual rainfall is 650–1100 mm (TSSC 2012a).

### Known Locations within Project Area

*Eucalyptus raveretiana* has been recorded on numerous occasions within the Project Area during random meander surveys (Adani 2013). The species has been recorded along almost every watercourse from Rosella Creek, in the south-west, to approximately 10 km south of Guthalungra, in the north-east (Appendix B). Habitat for the species within the Project Area includes predominately remnant riparian communities dominated by *Eucalyptus tereticornis* / *Eucalyptus camaldulensis* or *Eucalyptus coolabah* or *Melaleuca leucadendra* / *Melaleuca fluviatilis*. Within the Project Area these habitats are consistent with three different REs (Table 44).

**Table 44 Regional Ecosystems providing potential habitat for *Eucalyptus raveretiana* within the Project Area**

RE	RE Description	VM Class
11.3.25	<i>Eucalyptus tereticornis</i> or <i>E. camaldulensis</i> woodland fringing drainage lines	Least Concern
11.3.25b	Riverine wetland or fringing riverine wetland. <i>Melaleuca leucadendra</i> and/or <i>M. fluviatilis</i> , <i>Nauclea orientalis</i> open forest	Least Concern
11.3.37	<i>Eucalyptus coolabah</i> fringing woodland on alluvial plains	Least Concern

Potential habitat is mapped between KP8 to KP180. Specific known habitat locations are specified in Table 45.

**Table 45 Known locations of *Eucalyptus raveretiana* habitat within the Project Area**

Kilometre Points (KP)				
8-9	29-32	56-58	105-106	158
12-14	33-35	61	131	164
20	37-38	64-66	139-141	173-174
23-24	47	78-83	148	179-180
27-28	52-55	98-99	153-154	

The number of individuals of *Eucalyptus raveretiana* and the extent of its occurrence within the Project Area will be confirmed during pre-clearance surveys undertaken during the course of the Project.

### 8.3.3 Threats and Impacts

The main threat identified to *Eucalyptus raveretiana* is habitat disturbance and smothering by Rubber Vine (*Cryptostegia grandiflora*). Other threats include habitat disturbance (e.g. erosion) from timber



harvesting, habitat loss from water resource developments, and invasion of weed species (i.e. Lantana and *Panicum maximum*), including their ability to increase fire frequency and intensity (DoE 2015).

Table 46 outlines all potential impacts to *Eucalyptus raveretiana* habitat that are relevant to activities associated with the Project; including those identified in Condition 5c of the EPBC Approval, Appendix 1 of the Coordinator-General's Report and each EIS (GHD 2012; GHD 2014).

**Table 46 Potential impacts from the Project on *Eucalyptus raveretiana* habitat**

Impacts	Potential impacts associated with the Project	Project phase
Vegetation Clearing	Removal or disturbance of <i>Eucalyptus raveretiana</i> habitat. A disturbance limit of 175.4 ha is in place in the EPBC Act approval.	Construction
	Removal and disturbance of adjacent land to <i>Eucalyptus raveretiana</i> habitat, leading to an increase in edge effects i.e. habitat fragmentation/disturbance	
Fire	<i>Eucalyptus raveretiana</i> habitat may be degraded and individual plants destroyed through increased fire severity and frequency, as a result of altered fuel characteristics	Construction and Operation
Dust emissions	An increase in dust emissions may potentially impact the photosynthetic ability of <i>Eucalyptus raveretiana</i>	Construction and Operation
Watercourse Bank Erosion	Bank erosion caused by the construction of waterway crossings	Construction
Weeds	Dispersal of existing weeds throughout the Project Area by vehicles and machinery	All phases
	Introduction and dispersal of new weed species from adjacent areas, specifically Rubber Vine, Lantana and <i>Panicum maximum</i>	

#### 8.3.4 Mitigation and Management Measures

There is currently no recovery plan for *Eucalyptus raveretiana* (DoE 2015). As such key priority measures for the species were taken from the conservation advice (TSSC 2008afz) and draft federal species management plan.

Table 47 outlines all relevant mitigation and management measures for *Eucalyptus raveretiana* which are consistent with the conservation advice and meets the conditions of the EPBC Approval and Coordinator-General's Report.

Table 47 Mitigation and management measures for *Eucalyptus raveretiana*

Goal	Performance Criteria	Mitigation and Management Measures	Trigger	Corrective Action
Minimise degradation of retained areas of <i>Eucalyptus raveretiana</i> habitat adjacent to the Project Area	Limit disturbance from fire through altered fuel loads and construction activities	<p>Actions and thresholds will be outlined in relevant management plans (i.e. CEMP and OEMP). Mitigation and management measures should include but not be limited to:</p> <ul style="list-style-type: none"> <li>• Parking of vehicles in designated areas</li> <li>• Ensuring hot-works are undertaken under appropriate permitting</li> <li>• Regular maintenance (e.g. mowing) of vegetation within Project Area during operational phase</li> </ul>	Uncontrolled fire in the Project Area	<p>Immediately implement actions to suppress the spread of the fire.</p> <p>Incidences will be recorded in a register as per the CEMP.</p> <p>Review adherence to control procedures to ensure compliance. Take remedial action where compliance has not been adhered to. Increase training to ensure breach does not re-occur.</p>
	Limit watercourse bank erosion	<p>Actions and thresholds are outlined in relevant management plans i.e. CEMP. Individual site based CEMPs will be developed for waterways with the potential significant bank erosion.</p>	Continual or significant bank erosion evident during construction or operation in <i>Eucalyptus raveretiana</i> habitat	<p>Implement measures immediately to reduce further bank erosion. Review CEMP and upgrade erosion strategies to ensure no further erosion.</p>
Waterway crossing areas are rehabilitated with native understorey species	<p>Within 10 years native understorey species richness is 80% of baseline richness and weed cover is &lt;10%.</p>	<p>Develop Rehabilitation Management Plan (RMP) prior to the commencement of rehabilitation activities. RMP to outline, but not limited to:</p> <ul style="list-style-type: none"> <li>• relevant native species to be replanted</li> <li>• seed collection (if applicable)</li> <li>• landscaping, including creation of supplementary habitats</li> </ul> <p>Rehabilitation to commence as soon as temporary construction areas are no longer required.</p>	<p>Within 10 years native understorey species richness is &lt;80% of baseline richness and weed cover is &gt;10%.</p>	<p>An annual rehabilitation monitoring report will be submitted to DoEE, including rehabilitated <i>Eucalyptus raveretiana</i> habitat monitoring. Where rehabilitated areas fail to reach target values outlined in the RMP, Adani will implement any measures necessary to achieve the objectives in the RMP.</p>

### 8.3.5 Monitoring

The potential impacts of the proposed activities will be monitored in accordance the monitoring program outlined in Table 48. The design of the on-going monitoring program, including the location and extent of monitoring sites, will be determined by a suitably qualified person to ensure that sufficient data are collected to quantify likely impacts resulting from the proposed action, and to determine the appropriate habitat management goals. The monitoring program will include both impact and control sites to monitor the progress of recovery, including effectiveness of management actions, and adapt if necessary. Annual monitoring will occur for the duration of railway activities.

Table 48 Details of monitoring program for *Eucalyptus raveretiana*

Performance Criteria	Triggers	Monitoring Program	Outcomes
Maintain existing condition of retained areas of <i>Eucalyptus raveretiana</i> habitat adjacent to the Project Area	Progressive decline in habitat condition over 2-3 years	Annual BioCondition assessments will commence prior to construction activities to determine the condition of <i>Eucalyptus raveretiana</i> habitat in impact and control sites. A minimum of 3 impact and 3 control sites will be established along the alignment. Impact plots will be located within 200 m of the Project Area, while control plots will be located <1 km from the Project Area.	Baseline condition of <i>Eucalyptus raveretiana</i> habitat determined prior to clearing to allow effective monitoring of the Project's impacts and compliance with EPBC conditions. Adani to review monitoring results and report annually and revise management actions if any trigger is exceeded.
Limit disturbance from emissions (dust) on photosynthetic ability of <i>Eucalyptus raveretiana</i>		In addition to these Assessments, tree health of retained <i>Eucalyptus raveretiana</i> within the assessment plots will also be assessed.	
Limit disturbance from fire through altered fuel loads and construction activities		A series of 5 dust monitoring plots (1 m x 1 m) will be established within 5 m of the exclusion fence, and within equivalent habitat between 500 m and 1 km from the exclusion fence, every 5 km along the rail corridor, on alternating sides within known <i>Eucalyptus raveretiana</i> habitat. The plot boundaries will be mapped and clearly marked with pegs. Baseline and photo monitoring will occur prior to construction, and annually thereafter using the method outlined for grass plots in DEHP (2014).	
Limit watercourse bank erosion	Continual or significant bank erosion evident during construction or operation	Monthly monitoring of bank erosion to occur with any evidence of bank erosion to be photographed and reported.	
Within 10 years native understorey species richness is 80% of baseline richness and weed cover is <10%	Annually weed cover is >10%. After 3 years native understorey species richness is <40% of baseline richness. After 6 years native understorey species richness is <60% of baseline richness.	A pre-disturbance BioCondition Assessment and annual post disturbance BioCondition Assessments will be undertaken to determine the effectiveness of rehabilitation works.	

## 9 Species Management Plans (Fauna)

### 9.1 *Geophaps scripta scripta* (Squatter Pigeon)

#### 9.1.1 Status

EPBC Act = Vulnerable

NC Act = Vulnerable

#### 9.1.2 Ecology and Distribution

##### Description of the Species:



Plate 8: Squatter Pigeon

The Squatter Pigeon (southern) is a medium-sized ground dwelling pigeon approximately 30 cm long. Adults of both sexes are generally grey-brown with black and white stripes on the face and throat, have iridescent green or violet patches on the wings, a blue-grey lower breast and white flanks and lower belly. The southern Squatter Pigeon sub-species has a blue-grey patch of skin around the eye, whereas the northern Squatter Pigeon has an orange-red orbital skin patch (TSSC 2015a).

##### Distribution:

Squatter Pigeons are largely restricted to Queensland. The species is known to occur north of the Burdekin River, east to Townsville and Proserpine and south to the Queensland-New South Wales Border and west as far as Longreach. Where Squatter Pigeon occurs it can be locally abundant (Reis 2012).

The estimated extent of occurrence is approximately 440,000 km<sup>2</sup> (DoE 2015). The estimated total population of the species is considered to be of low reliability as no systematic surveys have been undertaken. However, in 2000 the population was estimated at 40,000 breeding birds (Garnett and Crowley 2000). Given the Squatter Pigeon's ubiquitous nature and relative abundance, the population is thought to be stable at present. It is also thought this species occurs as a single, contiguous (i.e. inter-breeding) population (DoE 2015).

##### Habitat for the Species:

The squatter pigeon forages in 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 (Table 49), within 3 km of a suitable, permanent or seasonal water body (Squatter Pigeon Workshop 2011). This species is never far from water (Pizzey and Knight 2007, NPWS 1999). Although it is most common in grassy woodlands and open forests dominated by eucalypts (DoE 2015), it has no close associations with any particular vegetation type (NPWS 1999). Non-remnant and regrowth areas are also used by this species, in areas within 3 km of suitable water. Squatter Pigeons are commonly recorded in areas of disturbed habitat including grazed grasslands, scrub, and areas adjacent to roads and railway lines (DoE 2015).

Table 49 Regional Ecosystem associations for the Squatter Pigeon

RE	Short Descriptions
11.3.1	<i>Acacia harpophylla</i> and/or <i>Casuarina cristata</i> open forest on alluvial plains
11.3.2	<i>Eucalyptus populnea</i> woodland on alluvial plains
11.3.3	<i>Eucalyptus coolabah</i> woodland on alluvial plains
11.3.4	<i>Eucalyptus tereticornis</i> and/or <i>Eucalyptus spp.</i> woodland on alluvial plains
11.3.5	<i>Acacia cambagei</i> woodland on alluvial plains
11.3.7	<i>Corymbia spp.</i> woodland on alluvial plains
11.3.9	<i>Eucalyptus platyphylla</i> , <i>Corymbia spp.</i> woodland on alluvial plains
11.3.10	<i>Eucalyptus brownii</i> woodland on alluvial plains
11.3.25	<i>Eucalyptus tereticornis</i> or <i>E. camaldulensis</i> woodland fringing drainage lines
11.3.27x1c	Palustrine wetland (e.g. vegetated swamp). Sedgeland to grasslands on Quaternary deposits.
11.3.30	<i>Eucalyptus crebra</i> , <i>Corymbia dallachiana</i> woodland on alluvial plains
11.3.33	<i>Eremophila mitchellii</i> open woodland on alluvial plains
11.3.34	<i>Acacia tephрина</i> woodland on alluvial plains
11.3.35	<i>Eucalyptus platyphylla</i> , <i>Corymbia clarksoniana</i> woodland on alluvial plains
11.3.37	<i>Eucalyptus coolabah</i> fringing woodland on alluvial plains
11.4.2	<i>Eucalyptus spp.</i> and/or <i>Corymbia spp.</i> grassy or shrubby woodland on Cainozoic clay plains
11.4.4	<i>Dichanthium spp.</i> , <i>Astrebла spp.</i> grassland on Cainozoic clay plains
11.4.5	<i>Acacia argyrodendron</i> woodland on Cainozoic clay plains
11.4.6	<i>Acacia cambagei</i> woodland on Cainozoic clay plains
11.4.8	<i>Eucalyptus cambageana</i> woodland to open forest with <i>Acacia harpophylla</i> or <i>A. argyrodendron</i> on Cainozoic clay plains
11.4.9	<i>Acacia harpophylla</i> shrubby woodland with <i>Terminalia oblongata</i> on Cainozoic clay plains
11.4.11	<i>Dichanthium sericeum</i> and <i>Astrebла spp.</i> grassland with patchy <i>Acacia harpophylla</i> or <i>Eucalyptus coolabah</i> on Cainozoic clay plains
11.5.3	<i>Eucalyptus populnea</i> +/- <i>E. melanophloia</i> +/- <i>Corymbia clarksoniana</i> on Cainozoic sand plains and/or remnant surfaces
11.5.9b	<i>Eucalyptus crebra</i> , <i>E. tenuipes</i> , <i>Lysicarpus angustifolius</i> +/- <i>Corymbia spp.</i> woodland
11.5.9c	<i>Eucalyptus crebra</i> +/- <i>Corymbia intermedia</i> +/- <i>E. moluccana</i> +/- <i>C. dallachiana</i> woodland
11.5.16	<i>Acacia harpophylla</i> and/or <i>Casuarina cristata</i> open forest in depressions on Cainozoic sand plains and remnant surfaces
11.7.2	<i>Acacia spp.</i> woodland on Cainozoic lateritic duricrust. Scarp retreat zone
11.7.3	<i>Eucalyptus persistens</i> , <i>Triodia mitchellii</i> open woodland on stripped margins of Cainozoic lateritic duricrust
11.7.4	<i>Eucalyptus decorticans</i> and/or <i>Eucalyptus spp.</i> , <i>Corymbia spp.</i> , <i>Acacia spp.</i> , <i>Lysicarpus angustifolius</i> woodland on Cainozoic lateritic duricrust
11.8.5	<i>Eucalyptus orgadophila</i> open woodland on Cainozoic igneous rocks
11.8.11	<i>Dichanthium sericeum</i> grassland on Cainozoic igneous rocks
11.9.1	<i>Acacia harpophylla</i> - <i>Eucalyptus cambageana</i> woodland to open forest on fine-grained sedimentary rocks
11.9.3	<i>Dichanthium spp.</i> , <i>Astrebла spp.</i> grassland on fine-grained sedimentary rocks
11.9.5	<i>Acacia harpophylla</i> and/or <i>Casuarina cristata</i> open forest on fine-grained sedimentary rocks

RE	Short Descriptions
11.9.10	<i>Eucalyptus populnea</i> open forest with a secondary tree layer of <i>Acacia harpophylla</i> and sometimes <i>Casuarina cristata</i> on fine-grained sedimentary rocks
11.9.12	<i>Dichanthium sericeum</i> grassland with clumps of <i>Acacia harpophylla</i> on fine-grained sedimentary rocks
11.11.9	<i>Eucalyptus thozetiana</i> , <i>Acacia harpophylla</i> woodland on old sedimentary rocks with varying degrees of metamorphism and folding
11.11.13	<i>Acacia harpophylla</i> or <i>A. argyrodendron</i> low open forest with a secondary tree layer of <i>Terminalia oblongata</i> on deformed and metamorphosed sediments and interbedded volcanics
11.11.14	<i>Acacia harpophylla</i> open forest on deformed and metamorphosed sediments and interbedded volcanics
11.12.21	<i>Acacia harpophylla</i> open forest on igneous rocks. Colluvial lower slopes

### Essential Microhabitat:

The Squatter Pigeon is only found in areas near suitable water sources. Suitable water sources include permanent or seasonal rivers, creeks, lakes, ponds and waterholes, and artificial dams with a small patch of gently sloping, bare ground on which to approach and stand at the water's edge (Squatter Pigeon Workshop 2011, DoE 2015).

The squatter pigeon prefers to forage and dust-bathe on bare ground under an open canopy of trees (Squatter Pigeon Workshop 2011), particularly in sandy areas dissected by gravel ridges (Frith 1982). Squatter Pigeons are usually seen in pairs or small groups (Crome 1976, Frith 1982), particularly where patchy grasses and shrubs cover less than 33% of the ground area (DoE 2015).

### Known Populations and Relationships within the Project Area:

The Squatter Pigeon is likely to be common in suitable habitat within the Project Area, where permanent water sources occur within 3 km (GHD 2014). Suitable habitat for this species in the Project Area includes all remnant and regrowth *Eucalyptus* and *Acacia* woodlands with an open, grassy understory (Land Zones 3, 4, 5, 7, 8, 9, 11 and 12; Table 49). To date, the Squatter Pigeon has been observed, incidentally and during standardised bird surveys, in open, grassy woodlands along the railway corridor at Cerito, Stratford/Warrigal, Avon Downs, Nevada, Glen Alpine, Disney/Bonicordi, and Mt Lookout (GHD 2014, ELA 2015, SKM 2013), and at farm dams on Fig Tree and Nevada (GHD 2014). The Squatter Pigeon is regularly observed in small numbers around the wetlands, including the rail loop, at Abbot Point (Eco Logical and Open Lines 2012, GHD 2014).

### Movement Patterns:

Squatter Pigeons are considered sedentary or locally nomadic, following food resources (Frith 1982, Squatter Pigeon Workshop 2011). There is no evidence to show that Squatter Pigeons undertake long-distance movements (Griffioen and Clarke 2002). When danger approaches Squatter Pigeons generally freeze in position on the ground (NPWS 1999).

### Breeding Biology:

Squatter Pigeons nest on the ground, usually laying two eggs in sheltered positions, generally amongst vegetation (Crome 1976; Frith 1982). They prefer to nest on stony rises on sandy or gravelly soils (i.e. land zones 5 and 7), within 1 km of a suitable (and permanent) water body (Squatter Pigeon Workshop 2011).

Squatter pigeons typically breed from April to October, although this is variable and highly dependent on the availability of food, primarily grass seeds (Frith 1982, Squatter Pigeon Workshop 2011). Nests are depressions scraped into the ground beneath a tussock of grass, bush, fallen tree or log, and sparsely lined with grass (Chisholm 1944, Frith 1982, Lord 1956, North 1913-14). Usually two eggs are laid and incubated for about 17 days. Chicks remain in the nest for two to three weeks and are dependent on their parents for around four weeks (DoE 2015).

### Feeding Ecology:

The squatter pigeon forages for seeds on bare ground between sparse grasses under an open canopy of trees (Squatter Pigeon Workshop 2011, Crome 1976, Frith 1982). They also consume legumes, herbs and forbs, acacia seeds, insects and ticks (DoE 2015).

### 9.1.3 Threats and Impacts

The primary threats to the Squatter Pigeon (southern) are overgrazing during drought, ongoing clearing of habitat for farming and development, overgrazing of habitat by livestock and feral herbivores such as rabbits, thickening of understorey vegetation, and predation by invasive mammals such as cats and foxes (TSSC 2015a). Their susceptibility to freezing when disturbed makes Squatter Pigeons particularly vulnerable to predation by foxes and cats. Other known threats include fragmentation of habitat, trampling of nests by domestic stock and feral herbivores, invasion of habitat by weeds such as *Cenchrus ciliaris* (Buffel Grass), drought, and bushfires (DEHP 2015a, DoE 2015). Changes in hydrological regimes can also affect Squatter Pigeons by changing the distance between water sources and feeding habitat; affecting their movement through the landscape (Reis 2012).

Table 50 outlines all the potential impacts of the project that are applicable to Squatter Pigeons, taking into account the conservation listing, Condition 5c of the EPBC Approval, Appendix 1 of the Coordinator-General's Report, and specific impacts outlined in the EIS (GHD 2012; GHD 2014). The construction footprint and surrounding area are not considered to support an 'important population' or 'habitat critical to the survival' of Squatter Pigeon (Squatter Pigeon Workshop 2011, DoE 2015).

**Table 50 Potential impacts from the Project on Squatter Pigeons**

Impacts	Potential impacts associated with the Project	Project phase
Vegetation Clearing/ Habitat Loss	Removal of Squatter Pigeon habitat (foraging and nesting sites) and disturbance to breeding. A disturbance limit of 1361.8 ha is in place within the EPBC Act approval	Pre-construction, Construction
Degradation of Habitat due to grazing	No livestock will be grazed in the Project Area during construction or operations, due to exclusion fencing, potentially leading to a thickening of understory vegetation.	Construction, Operations
	Loss of food resources due to grazing by resident introduced herbivores (i.e. rabbits and goats).	Construction, Operations
Predation by Invasive Mammals	Loss of individuals to predation by feral foxes and cats, which are known to inhabit the area traversed by the Project and use fauna crossings as funnel points for attacks.	Construction, Operations
Fragmentation (Connectivity) and Edge Effects	Fragmentation of woodland vegetation, associated with Project development, improves access and hunting opportunities for feral cats and foxes, increasing the likelihood of predation.	Pre-construction, Construction, Operations

Impacts	Potential impacts associated with the Project	Project phase
	Fragmentation of habitat. This is unlikely to affect the connectivity of Squatter Pigeon populations, due to their mobility.	Impact unlikely
Trampling of Nests	Destruction of nests by vehicles and machinery, people, and large herbivores.	Construction, Operations
Weeds (including Buffel Grass)	Dispersal of weeds throughout the project area by vehicles, machinery, and people, degrading habitat quality and reducing food resources.	Construction, Operations
	Invasion of new weed species from adjacent areas.	
Bushfire	Changes in land cover in the Project Area (forest to grassland) may increase the spread of bushfires, which cause temporary and permanent losses of food resources.	Construction, Operations
	Increased risk of bushfire due to construction machinery sparking, and increased anthropogenic activity in the Project Area.	Construction
Changes in Hydrological Regimes	Changes to critical water resources due to the use of channel diversions during waterway crossing construction.	Construction
Earthworks	Siltation of critical water resources due to construction activities at waterway crossings.	Construction
Noise and Vibration	Temporary loss of useable habitat due to noise and vibration disturbance. This is unlikely to be a concern for Squatter Pigeons, except at nests, given their ability to inhabit noisy disturbed areas, including road and railway corridors, and homesteads.	Construction
Vehicle and Train Strike	Mortality and injury from vehicle and train strike. Vehicle and train strike will be a high risk threat, given the propensity for Squatter Pigeons to freeze when disturbed.	Construction, Operations
Emissions i.e. dust	Dust emissions from coal transport may potentially reduce habitat quality for the Squatter Pigeons, in and immediately adjacent to the Project Area. However, dust is unlikely to be a direct concern for Squatter Pigeons.	Construction Operation
Light Spill	Temporary loss of useable habitat due to light disturbance at night. This is unlikely to be a concern for Squatter Pigeons, given their diurnal activity patterns and their ability to inhabit disturbed areas. Permanent lighting is not proposed along the railway.	Impact unlikely
Entrapment	Uncovered Barbed wire located near permanent water sources may lead to Squatter Pigeon entanglement.	Construction

#### 9.1.4 Mitigation and Management Measures

Table 51 outlines all relevant management measures for the Squatter Pigeon that are consistent with the conservation advice (TSSC 2015a) for this species and meet the conditions of the EPBC Approval and Coordinator-General's Report. There is currently no recovery plan for the Squatter Pigeon (DoE 2015).

All appropriate management measures will be implemented during construction and operations in habitats known or likely to support Squatter Pigeons. Additional Sightings of Squatter Pigeons outside known populations during construction and operation will be reported to the ER and confirmed by the Queensland Museum for verification. Where additional populations are identified, DES and DoEE will be notified of locations and appropriate management actions will be implemented.



Table 51 Mitigation and management measures for the Squatter Pigeon

Goal (Impact)	Performance Criteria	Management Measures	Trigger	Corrective Action
Minimise loss of habitat	Rehabilitation of disturbed areas that are no longer required for operations	Progressive rehabilitation of disturbed areas will be undertaken as soon as possible after the completion of construction activities. Vegetation rehabilitation will use locally-sourced seeds for native grasses, herbs and woody plants.	Rehabilitated areas fail to reach 70% of baseline and control scores within 15 years	An annual rehabilitation monitoring report will be sent to DES and DoEE. Revise and implement an updated Rehabilitation Management Plan if targets are not achieved within 15 years.
Reduce habitat degradation from grazing by introduced herbivores	No increase in rabbit, goat, fox and cat numbers in the Project Area	A Pest Management Plan (PMP) will be developed and implemented prior to construction, including measures for controlling invasive rabbits, goats, foxes, cats and weeds. The PMP will be developed in conjunction with neighbouring land owners, and will target waterway crossings, habitat edges and fixed sites such as workers camps. The Pest Management Plan will incorporate measures recommended in the Threat Abatement Plans for the control of feral cats, foxes, and rabbits.  Domestic animals will not be permitted into the Project area.  Weed control will focus on declared weeds from the Project Area and adjacent areas, during construction and operations.	>10% increase in the population of each grazing herbivore species from baseline scores	Inform DES of monitoring results. Increase feral herbivore management efforts, in conjunction with neighbouring land owners.
Minimise predation risk by invasive mammals			>10% increase in the population of each invasive predator species from baseline scores	Inform DES of monitoring results. Increase invasive predator management efforts, in conjunction with neighbouring land owners.
Reduce weed competition	No increase in declared pest plant species from the Project Area and adjacent areas		Presence of declared pest plant species at any time	Increase weed management efforts, in conjunction with neighbouring land owners, where relevant.
Ensure understory thickening does not occur in squatter pigeon habitat	No thickening of the understory in squatter pigeon habitat	Monitor understory density and grass cover in squatter pigeon habitat.	Thickening of understory in squatter pigeon habitat	Implement approved vegetation management program to reduce understory thickening and promote grass growth in affected areas

Goal (Impact)	Performance Criteria	Management Measures	Trigger	Corrective Action
Eliminate trampling of nests	No nests trampled	<p>All areas suitable for nesting will be surveyed by a suitably qualified person, prior to vegetation clearing at any time of year. Nests observed in, and adjacent to, the Project Area will be marked and mapped, appropriately fenced, and monitored during construction works. Marking of nests will occur from a distance of at least 5 m, to ensure the adult isn't flushed whilst doing so. Marking will consist of a series of four clearly visible flags surrounding the nest, each displaying a direction and bearing.</p> <p>Buffer areas around nests are to be demarcated using high visibility tape, and communicated as no-go zones until eggs have hatched and juveniles have dispersed into adjacent, suitable, undisturbed habitat.</p> <p>Access is to occur along designated access tracks only.</p> <p>Any identification of additional nesting sites will be verified by a suitably qualified person.</p>	Trampling of a nest	<p>Complete an incident report and notify DoEE and DES.</p> <p>Review adherence to control procedures to ensure compliance. Take remedial action where compliance has not been adhered to. Increase training to ensure breach does not re-occur.</p>
Minimise noise and vibration disturbance	No abandonment of Squatter Pigeon nests due to noise and vibration	Noise and vibration-causing construction activities should be limited as much as possible within 200 m of a known active Squatter Pigeon nest. Nesting sites are to be verified by a qualified person.	Abandonment of a Squatter Pigeon nest due to noise and vibration	Investigate source of disturbance and implement controls, where possible. Report as per environmental approval conditions and CEMP requirements, if required. Update SMP to increase the buffer distance where control procedures have been complied with and proven to be inadequate.

Goal (Impact)	Performance Criteria	Management Measures	Trigger	Corrective Action
Reduce the risk of bushfire spread	No uncontrolled fires (bushfires) in the Project Area	Review and implement existing Bushfire and Disaster Management Plan, ensuring consideration of ecological values and Rural Fire Service recommendations. Work sites will be provided with adequate fire-fighting equipment (water cart) and training	Uncontrolled fire in the Project Area	Immediately implement actions to suppress the spread of the fire. Incidences will be recorded in a register as per the CEMP. Review adherence to control procedures to ensure compliance. Take remedial action where compliance has not been adhered to. Increase training to ensure breach does not re-occur.
Reduce the impact of drought	No net loss of suitable permanent water sources unless approved	Permanent water sources in suitable Squatter Pigeon habitat will not be drained during construction, unless suitable alternative water supplies (permanent water with gently sloping, bare ground at the edge) are available within a 1 km radius. This includes permanent water sources at waterway crossings.  Erosion and sediment control measures will be designed and managed in accordance with IECA guidelines as prescribed in the relevant project approvals, to prevent sedimentation run-off into permanent water sources during construction.  Where possible, designs should limit the creation of suitable Cane Toad breeding areas (e.g. sediment fencing).  Inspect the integrity of sediment barriers daily during construction works. Regularly re-assess the effectiveness of the location and design of sediment barriers and update as necessary.	Draining of suitable permanent water source without a offset water source provided	Implement remedial actions to provide supplementary water sources, where possible.
Minimise loss of permanent water sources			Siltation of a suitable permanent water source in Squatter Pigeon habitat	Investigate source of siltation, implement appropriate corrective measures and report as per environmental approval conditions and CEMP requirements, if required.
Minimise siltation of water resources during construction				

Goal (Impact)	Performance Criteria	Management Measures	Trigger	Corrective Action
Minimise the risk of light vehicle and machinery strike	No death or injury due to light vehicle or machinery strike during construction and operations	<p>Prior to any earthworks and/or or vegetation clearing activities occurring in habitat known or likely to contain Squatter Pigeons, pre-clearing surveys will be undertaken by a spotter-catcher, to flush and relocate any Squatter Pigeons within and directly adjacent to all areas where works will occur.</p> <p>Vegetation clearing will occur slowly and in a sequential pattern, to allow Squatter Pigeons to disperse from work areas, ahead of machinery.</p>	Light vehicle or machinery strike during vegetation clearing and grubbing	<p>Incidents will be reported to the site ER as soon as possible. DoEE and DES will be notified within 24 hours.</p> <p>Depending on the extent of injuries, any injured Squatter Pigeon will be either taken to the nearest qualified veterinary practitioner or wildlife carer, or humanely euthanised on site by a suitably qualified person (see Section 11.3).</p>
		<p>All relevant site personnel, including contractors, will be made aware of the locations of Squatter Pigeon populations and the propensity of this species to feed on dusty roads and freeze when threatened.</p> <p>Identification posters for all threatened species with the potential to occur in the Project Area will be installed in prominent positions at each work site.</p> <p>Vehicles and plant will drive on pre-determined roads only, and adhere to all speed limits, which will be clearly signposted.</p>	Light vehicle or machinery strike during other activities	<p>Complete an incident report and notify DES and DoEE.</p> <p>Depending on the extent of injuries, any injured Squatter Pigeons will be either taken to the nearest qualified veterinary practitioner or wildlife carer, or humanely euthanised on site by a suitably qualified person (see Section 11.3).</p>
Minimise risk of train strike	No death or injury due to train strike during operations	<p>Train drivers will be trained in identifying Squatter Pigeons, and an identification poster for all threatened species with the potential to occur in the Project Area will be installed in the train cabin.</p> <p>Additional sightings of Squatter Pigeons will be reported to the ER and confirmed by the Queensland Museum for verification.</p>	Train strike	Complete an incident report and notify DES and DoEE.

Goal (Impact)	Performance Criteria	Management Measures	Trigger	Corrective Action
Minimise emissions (dusts)	Limit disturbance from emissions (dust) on photosynthetic ability of grasses in Squatter Pigeon habitat	Dust emissions will be managed in accordance with the Dust and Coal Dust Management Plans, and should include but not be limited to: <ul style="list-style-type: none"> <li>Regular watering of dusty areas in accordance with Dust Management Plan.</li> <li>Ensuring trains are not overloaded.</li> <li>Use of veneers to minimise the loss of coal particles in transit.</li> </ul>	Growth of grasses in known Squatter Pigeon habitat adjacent to the Project Area inhibited due to dust emissions	An annual monitoring report will be submitted to DoEE. Where monitoring shows a reduction in habitat condition due to dust emission, investigate source of dust and upgrade strategies outlined in the Dust Management Plan to reduce dust emissions impacts on habitat.
Eliminate entrapment	No trapped Squatter Pigeons	No sharp equipment with the potential to entangle fauna (e.g. wire, mesh fencing) is to be left unattended and uncovered near water bodies or dusty areas with sparse vegetation growth (up to 30% cover).	Squatter Pigeon entangled	Complete an incident report and notify DoEE and DES if death or injury occur. Review materials storage procedures and fencing protocols, and implement actions to ensure entanglement does not re-occur. Depending on the extent of injuries, any injured Squatter Pigeon will be either taken to the nearest qualified veterinary practitioner or wildlife carer, or humanely euthanised on site by a suitably qualified person (see Section 11.3).

### 9.1.5 Monitoring

Pre-clearance surveys will be undertaken at suitable times to detect the species, and identify and map suitable water bodies and nesting opportunities in the development area, prior to any clearing or associated works occurring. The surveys will target suitable habitat for this species within and directly adjacent to the Project Area. This Management Plan must be revised and submitted to DoEE within three months following pre-clearance surveys.

Survey Methodology: Targeted surveys will be completed in suitable habitat in and near the Project Area. The optimal habitats to target are open dusty areas (e.g. roads) and suitable water bodies. The optimal period for detecting Squatter Pigeons during targeted surveys is from sunrise to 9am and from 3:30pm until sunset, in conditions that don't impair visibility, between May and October (DoE 2015). The Squatter Pigeon has a distinctive call and is readily approachable (DoE 2015).

Targeted vehicle surveys for Squatter Pigeons in dusty areas should occur along the same route, in the same manner, on consecutive days, in areas within and adjacent to natural habitat throughout the Project Area (Squatter Pigeon Workshop 2011). Walking transect surveys can be undertaken at any time of the day to flush Squatter Pigeons from feeding and shelter areas that are inaccessible to vehicles (DoE 2015). Targeted stationary surveys at suitable water bodies should occur at prime detection time, for two consecutive days, preferably after the completion of vehicle and walking surveys (DoE 2015).

Design of the on-going monitoring program, including the location and extent of sites, will be determined by a suitably qualified person to ensure that sufficient data are collected to quantify likely impacts resulting from the action, and to determine appropriate habitat management goals. The monitoring program will include both impact and control sites to monitor the progress of recovery, including effectiveness of management actions, and adapt if necessary. Annual monitoring will occur for the duration of railway activities.

The potential impacts of the proposed activities will be monitored in accordance the monitoring program outlined in Table 52.

Table 52 Details of monitoring program for the Squatter Pigeon

Performance Criteria	Monitoring Program	Trigger for Corrective Action	Outcomes
Monitoring within and immediately adjacent to the rail corridor	Pre-clearance targeted surveys for Squatter Pigeon targeting suitable habitat for this species within and directly adjacent to the Project Area. Surveys to be undertaken at any time of the year; however surveys will be most effective during dry seasons, when suitable water bodies can be targeted.	N/A	Record and map Squatter Pigeon locations in the vicinity of the Project Area, to ensure appropriate mitigating management measures are implemented.
Rehabilitation of disturbed areas in Squatter Pigeon Habitat that are no longer required for construction or operations	BioCondition Assessments and photo monitoring will be undertaken prior to rehabilitation works and then annually after rehabilitation to determine the condition of Squatter Pigeon habitat in proposed rehabilitation and control sites. For each proposed rehabilitation area, a minimum of two permanent plots will be located in the rehabilitated area and a minimum of two permanent plots will be located in matched habitat between 1 km and 2 km from the Project Area (control areas). In addition to these Assessments, there will be targeted searches for Squatter Pigeons within each rehabilitated area.	Rehabilitated areas fail to reach 70% of baseline and control scores within 15 years	Baseline habitat quality for comparison during monitoring. Ability to assess rehabilitation quality against rehabilitation and offset requirements. Adani to review monitoring results and report annually and revise management actions if any trigger is identified.
Limit disturbance from emissions (dust) on photosynthetic ability of grasses in Squatter Pigeon habitat	A series of 5 grass monitoring plots (1 m x 1 m) will be established within 5 m of the exclusion fence, and within equivalent habitat between 500 m and 1 km from the exclusion fence, every 5 km along the rail corridor, on alternating sides within Squatter Pigeon habitat. The plot boundaries will be mapped and clearly marked with pegs. Baseline and photo monitoring will occur prior to construction, and annually thereafter using the method outlined for grass plots in DEHP (2014). In Squatter Pigeon habitat, an identical series of plots will be established in four locations adjacent to the boundary of quarries and other non-railway Project Areas – at the centre of the northern, southern, eastern and western boundaries or their equivalent for non-rectangular sites.	Growth of grasses adjacent to the Project Area inhibited due to dust emissions	Early detection of dust effects on adjacent habitat, allowing adaptive management of dust emissions where necessary.
No increase in rabbit, goat, fox and cat numbers in the Project Area	Baseline and annual monitoring of feral goat, pig, fox and cat populations at waterway and artificial fauna crossings in Squatter Pigeon habitat. Monitoring will include track and scat monitoring and photo monitoring using baited infrared cameras.	>10% increase in the population of each invasive species, from baseline scores	Ensure compliance with PMP.

Performance Criteria	Monitoring Program	Trigger for Corrective Action	Outcomes
Eliminate declared pest plant species from the Project Area and adjacent areas	Annual monitoring (including photo monitoring) for declared pest plants in the Project Area, understory and grass growth in Squatter Pigeon habitat, Monitoring will occur at the optimal time for detecting and identifying pest plant species.	Presence of declared pest plant species at any time	Ensure compliance with PMP.
No thickening of the understory in squatter pigeon habitat		Thickening of the understory in squatter pigeon habitat	Compliance with SMP.
Minimal growth of vegetation immediately adjacent to the railway		Growth of vegetation within 5 m of the centre of the railway	Knowledge of bush fire risk along railway corridor.
No trampling of nests	Breaches reported to DES and DoEE by onsite ER.	Trampling of a nest	Compliance with SMP.
No abandonment of Squatter Pigeon nests due to noise and vibration		Abandonment of a Squatter Pigeon nest due to noise and vibration	
No death or injury due to light vehicle or machinery strike during construction and operations		Light vehicle or machinery strike	
No death or injury due to train strike during operations		Train strike	
No trapped Squatter Pigeons		Squatter Pigeon trapped	
No bushfires sparked by project activities		Wildfire sparked by construction activities	



Performance Criteria	Monitoring Program	Trigger for Corrective Action	Outcomes
No net loss of suitable permanent water sources	Annual monitoring (including photo monitoring) of water source availability, in the driest season.	Draining of suitable permanent water source without offset watercourse provided. Siltation of a suitable permanent water source in Squatter Pigeon habitat.	Compliance with Species Management Plans.
Emissions (i.e. dust, coal and heavy metals) do not degrade water source quality in Squatter Pigeon habitat	Design and implement a monitoring program, in accordance with the Water Quality Management Plan, that targets dust and heavy metal toxicity in Squatter Pigeon habitat. The monitoring program will target key areas with low flow, close proximity to the Project Area and all water sources within 3 km of known Squatter Pigeon locations. Water and sediment samples will be collected at each site to test for the presence of 15 heavy metals. A dust particulate sampler will also be erected at each site to compare aerial collection of coal dust and heavy metal values with waterway monitoring results. Sediment and dust samples will be assessed for baseline measures, and then annually at low flow periods. This survey is to be undertaken in line with the ANZECC/ARMCANZ Interim Sediment Quality Guidelines.	Emissions settlement in water breach industry standards	Compliance with EPBC conditions and Species Management Plans.

## 9.2 *Numenius madagascariensis* (Eastern Curlew)

### 9.2.1 Status

EPBC Act = Critically Endangered, Marine, Migratory (Bonn, CAMBA, JAMBA, ROKAMBA)

NC Act = Near Threatened



**Plate 9:** Eastern Curlew

### 9.2.2 Ecology and Distribution

#### Description of the Species:

The Eastern Curlew is a large wader with a long neck, long legs, and a heavy bill that curves downwards (DoE 2015). This species is the largest wading bird that visits Australia, with females (the larger of the sexes) reaching up to 66 cm tall (DEHP 2015b). The Eastern Curlew is pale brown above and below with finely streaked black-brown mottling over their head, neck and breast and heavy dark brown mottling on the back (DEHP 2015b). The bill is distinctively elongated and dark brown in colour with a pinkish base, and the legs and feet are blue-grey (DoE 2015).

#### Distribution:

The Eastern Curlew is a non-breeding migrant found in coastal areas around Australia during the non-breeding season, including Tasmania (DoE 2015). In Australia, this species has a continuous distribution from approximately Broome in Western Australia to the southern parts of New South Wales, and a patchy distribution elsewhere (DoE 2015). Eastern Curlews are rarely recorded inland (DoE 2015). It is estimated that approximately 28 000 individuals (from the world population estimate of 38 000) occur in Australia during the non-breeding season (Barter 2002).

#### Habitat for the Species:

The Eastern Curlew is most commonly associated with sheltered coasts, especially estuaries, bays, harbours, inlets and coastal lagoons, with large intertidal mudflats or sandflats, often with beds of seagrass (DoE 2015). This species is often recorded among saltmarsh and on mudflats fringed by mangroves, and sometimes use the mangroves (DoE 2015).

#### Regional Ecosystems Associations:

The Eastern Curlew is a shorebird that is strongly associated with intertidal zones (i.e. mudflats, sandflats and saltflats) of beaches, estuaries and wetlands. It has no strong RE associations.

#### Essential Microhabitat:

The Eastern Curlew does not have specific microhabitat requirements.

#### Known Populations and Relationships within the Project Area:

Within the Project Area, the Eastern Curlew is only likely to be found in the far western Caley Valley Wetlands area at Abbot Point, where it has been observed during standardised bird surveys (BAAM 2012, BMT WBM 2012). The Caley Valley Wetlands are not considered to be a site of international importance for the Eastern Curlew in Australia (DoE 2015 sensu Bamford *et al.* 2008).

**Movement Patterns:**

The Eastern Curlew breeds in the Northern Hemisphere and migrates to the southern hemisphere for the Austral summer (DoE 2015). This species usually migrates along coasts approximately 100 m from shore (Marchant and Higgins 1993). In Australia, immature birds, which do not migrate, move northward in winter (DoE 2015). Eastern Curlews arrive in north-west and north-eastern Australia as early as July (Lane 1987), moving down the eastern coast from mid-to-late August until December (DoE 2015). Population numbers are stable at most sites in November or between December-February (Alcorn 1988, Lane 1987). Most Eastern Curlews leave Australia between late February and March-April (Marchant and Higgins 1993).

Eastern Curlews move locally between the high-tide roost-site and the intertidal feeding zone, both day and night (Marchant and Higgins 1993). For this reason, the eastern curlew needs two types of habitat in order to survive, one within the tidal zone, and one above it (DEHP 2015b). Roost sites are usually on sandy spits and islets, especially on dry beach sand near the high-water mark, and among coastal vegetation including low saltmarsh or mangroves, and occasionally on near-coastal wetlands (DoE 2015). This species has also been recorded roosting in trees (Marchant and Higgins 1993). Eastern Curlews typically roost in large flocks, separate from other waders (Marchant and Higgins 1993).

**Breeding Biology:**

The Eastern Curlew does not breed in Australia (DoE 2015).

**Feeding Ecology:**

The Eastern Curlew mainly forages on saltflats and in saltmarsh, and on soft, sheltered intertidal sandflats or mudflats that are open and without vegetation or covered with seagrass, and often located near mangroves (DoE 2015). This species mainly eats crustaceans (including crabs, shrimps and prawns), small molluscs, as well as some insects and mudskippers (DoE 2015, Rogers 1999).

**9.2.3 Threats and Impacts**

The greatest threat to the Eastern Curlew is the loss of habitat in its northern hemisphere breeding grounds (i.e. China and SE Asia) and flyways (IUCN 2012), which include Northern and Eastern Australia. In Australia, the greatest threat to the Eastern Curlew is disturbance at feeding and resting sites (IUCN 2012). Waders are very easily disturbed by activity that can interrupt their feeding or resting and any action causing an eastern curlew to take flight represents a significant disturbance because they use critical energy during flight, which is required for migration and breeding (DEHP 2015b). Disturbances, particularly repeated disturbances that occur before or after migration, are particularly damaging because, without sufficient energy reserves, they may be unable to complete their migration or breed (DEHP 2015b). The main disturbances to eastern curlews are from human activities including vehicles and unrestrained dogs (DEHP 2015b).

Eastern Curlews may also be threatened by changes to hydrology due to water diversion, sedimentation of water, and contamination of water by pollutants (DoE 2015).

Table 53 outlines all the potential impacts of the project that are applicable to Eastern Curlews, taking into account action plans (Garnett *et al.* 2011), Condition 5c of the EPBC Approval, and Appendix 1 of the Coordinator-General's Report. Eastern Curlews are only likely to occur in the northern terminus of the

construction footprint on the south-eastern edge of the Caley Valley Wetlands, which are not considered to be a site of international importance for the Eastern Curlew in Australia.

**Table 53 Potential impacts from the Project on the Eastern Curlew**

Impacts	Potential impacts associated with the Project	Project phase
Habitat Loss	Loss of saltflat, sandflats, mudflat and/or saltmarsh feeding habitat.	Pre-construction, Construction
Disturbance (including noise and vibration)	Loss of body condition due to disturbance causing flight.	Construction, Operations
	Loss of useable habitat due to noise and vibration from construction and operations.	
Water Diversion (Waterway Crossings)	Habitat degradation due to temporary and permanent diversions of water in the south-eastern edge of the Caley Valley Wetlands and Saltwater Creek.	Construction, Operations
Sedimentation of Water	Sedimentation of Caley Valley Wetlands caused by construction activities.	Construction
	Trampling and disturbance of substrate by stock on the south-eastern edge of the Caley Valley Wetlands. This is unlikely to be exacerbated by the Project because the Project Area runs parallel to the existing railway alignment in this area and does not alter accessibility to this area for stock.	Impact unlikely
Water Nutrient Enrichment	Enrichment of water nutrients by construction and rehabilitation activities (fertilisers) leading to altered food availability.	Construction
Vegetation Clearing	This is unlikely to affect the Eastern Curlew as it does not generally feed in vegetated areas.	Impact unlikely
Emissions i.e. dust	Dust emissions from construction and coal transport may potentially reduce feeding habitat quality for the Eastern Curlew in the south-eastern edge of the Caley Valley Wetlands.	Construction, Operations
Light Spill	Temporary loss of useable feeding and roosting habitat due to light disturbance at night. Permanent lighting is not proposed along the railway.	Construction
Invasive Weeds	Transport and establishment of invasive weeds into new areas on the south-eastern edge of the Caley Valley Wetlands. This is unlikely to affect the Eastern Curlew as it does not generally feed in vegetated areas.	Impact unlikely
Entrapment	Uncovered wire and mesh located near the Caley Valley Wetlands may lead to Eastern Curlew entanglement.	Construction
Connectivity	Temporary and permanent loss of connectivity between suitable habitats. This will not affect the Eastern Curlew populations, due to their mobility.	Impact unlikely

#### 9.2.4 Mitigation and Management Measures

Table 54 outlines all relevant management measures for the Eastern Curlew that are consistent with the conservation advice for this species (TSSC 2015c) and meet the conditions of the EPBC Approval and Coordinator-General's Report. There is currently no recovery plan for the Eastern Curlew. All appropriate management measures will be implemented during construction and operations in habitats known or likely to support Eastern Curlew populations. Sightings of Eastern Curlews outside known populations during construction and operations will be reported to the ER and confirmed by Queensland Museum. Where

additional populations are identified, DES will be notified of locations and appropriate management actions will be implemented.

Table 54 Mitigation and management measures for the Eastern Curlew

Goal (Impact)	Performance Criteria	Management Measures	Trigger	Corrective Action
Minimise loss of habitat	Avoid unnecessary or unapproved clearing	Temporary stockpile sites for soil and equipment, access routes, laydown yards and other associated infrastructure will be located at least 200 m from the Caley Valley Wetland fringes and Saltwater Creek.	Any clearing outside set clearing footprint in Eastern Curlew habitat	If Eastern Curlew habitat is cleared outside the defined clearing footprint, clearing is to cease immediately and DoEE and DES will be notified of the incident by Adani. It will be recorded as an incident in the Adani reporting system. Following this, the area is to be assessed and corrective actions will be taken, with the corrective actions depending on incident investigation outcomes.
	Rehabilitation of disturbed saltmarsh areas that are no longer required for operations	Progressive rehabilitation of disturbed saltmarsh areas will be undertaken as soon as possible after the completion of construction activities. Rehabilitation will use locally-sourced saltmarsh. Earth formations will be rehabilitated using original topsoil and configured in a way that mirrors the original slope of the wetland terrain.	Rehabilitated saltmarsh areas fail to reach 70% of baseline and control scores within 15 years	An annual rehabilitation monitoring report will be sent to DES. Revise and implement an updated Rehabilitation Management Plan if targets are not achieved within 15 years.
Minimise disturbance	No disturbance causing flight	Prior to site entry, all relevant site personnel, including contractors, will be made aware of the	Disturbance causing flight	Investigate source of disturbance and implement controls, where possible.

Goal (Impact)	Performance Criteria	Management Measures	Trigger	Corrective Action
	Minimal noise and vibration impacts in surrounding habitat	<p>migratory patterns and energy needs of the Eastern Curlew, and the need to ensure they are not disturbed.</p> <p>Identification posters for all threatened species with the potential to occur in the Project Area will be installed in prominent positions at each work site.</p> <p>Domestic animals will not be permitted into the Project area.</p> <p>Where possible construction activities adjacent to the south-east edge of the Caley Valley Wetlands are to occur in the non-resident period for Eastern Curlews (March to August).</p> <p>Noise and vibration-causing construction activities should be limited as much as possible within 500m of the Caley Valley Wetland.</p> <p>Ensure all plant and equipment is serviced and maintained to minimise machinery noise.</p>	Excessive noise or vibration that causes Eastern Curlew to abandon suitable habitat within Caley Valley Wetland.	Report as per environmental approval conditions and CEMP requirements, if required
Minimise light spill	Minimal light spill into adjacent habitat during works	Install light controlling devices to deflect construction lighting away from habitat adjacent to the Project Area in the south-eastern section of the Caley Valley Wetlands (including Saltwater Creek).	Direct light spill >50 m into known Eastern Curlew habitat	Upgrade light controlling devices, or adjust location of light, to reduce light spill and lighting levels below trigger levels. Where corrective action is not immediately taken, this will be reported as an incident and managed in accordance with Adani's incident management procedure
	Construction night work is limited to minimum disturbance activities in or adjacent to known Eastern Curlew habitat.	Clearing and piling is not to be undertaken at night within or adjacent to Eastern Curlew habitat,	Clearing or piling occurs at night within or adjacent to Curlew habitat	Review adherence to control procedures to ensure compliance. Take remedial action where a compliance breach has occurred.

Goal (Impact)	Performance Criteria	Management Measures	Trigger	Corrective Action
Minimise changes in Waterway Hydrology at Waterway Crossings	No permanent changes to waterway hydrology in Eastern Curlew habitat	<p>Progressive rehabilitation of waterways will be undertaken as construction is completed at the Saltwater Creek waterway crossing.</p> <p>Earth formations at the Saltwater Creek waterway crossing will be rehabilitated in a way that mirrors the original waterway profile.</p>	After construction and rehabilitation, the waterway hydrology altered and Eastern Curlew no longer inhabit the waterway	Inform DES of monitoring results. Revise waterway construction design, and submit an updated rehabilitation plan within 30 days of receiving monitoring results. Implement updated rehabilitation plan once approved.
	Minimise siltation of wetlands and waterways during construction	<p>Erosion and sediment control measures will be designed and managed in accordance with IECA guidelines as prescribed in the relevant project approvals, to prevent sedimentation run-off into permanent water sources during construction.</p> <p>Where possible, designs should limit the creation of suitable Cane Toad breeding areas (e.g. sediment fences).</p> <p>Inspect the integrity of sediment barriers daily during construction works. Regularly re-assess the effectiveness of the location and design of sediment barriers and update as necessary.</p> <p>Vegetation clearing and construction activities adjacent to the Caley Valley Wetlands, and at Saltwater Creek, are to occur in the dry season only (after May).</p>	Siltation of the Caley Valley Wetlands or Saltwater Creek in, or adjacent to the Project Area	Investigate source of siltation, implement appropriate corrective measures and report as per environmental approval conditions and CEMP requirements, if required.
Minimise water nutrient enrichment	Water nutrient enrichment	<p>No use of fertilisers during rehabilitation activities.</p> <p>No untreated sewage will be released into waterways or stored in areas that could contaminate waterways during flooding events.</p> <p>Food wastes will be buried or carried offsite.</p>	>20% increase in the nutrient (NPK) content of Caley Valley Wetland or Saltwater Creek waters in or adjacent to the Project Area	Investigate source of nutrient increase, implement appropriate corrective measures and report as per environmental approval conditions and EMP requirements, if required.



Goal (Impact)	Performance Criteria	Management Measures	Trigger	Corrective Action
Eliminate entrapment	No trapped Eastern Curlews	No sharp equipment with the potential to entangle fauna (e.g. wire, mesh fencing) is to be left unattended and uncovered (including overnight) during construction activities adjacent to the Caley Valley Wetlands and Saltwater Creek.	Eastern Curlew trapped	<p>Complete an incident report and notify DoEE and DES if death or injury occur.</p> <p>Review materials storage procedures and fencing protocols, and implement actions to ensure entanglement does not re-occur.</p> <p>Depending on the extent of injuries, any injured Eastern Curlew will be either taken to the nearest qualified veterinary practitioner or wildlife carer, or humanely euthanised on site by a suitably qualified person (see Section 11.3).</p>

### 9.2.5 Monitoring

Pre-clearance surveys will be undertaken at suitable times to detect the species, and identify and map suitable habitat in the development area, prior to any clearing or associated works occurring. The surveys will target suitable habitat for this species within and directly adjacent to the active rail development area. The SMP must be revised and submitted to DES within three months following pre-clearance surveys.

Survey Methodology: The Eastern Curlew most often counted using ground-based surveys within Australia (DoE 2015). This is a basic method for ground surveys of waterbirds, which involves an area search, by walking around the shore, or scanning from vantage points using binoculars and a spotting scope (Eyre *et al.* 2014). As an international migratory species, it is critical to avoid disturbing Eastern Curlews during surveys, especially in the weeks before departure on migratory flights (Eyre *et al.* 2014).

Ground-based area searches and vantage point scanning surveys targeting the south-eastern sections of the Caley Valley Wetlands will be the survey methods used for detecting Eastern Curlews during for this Project. Surveys will occur between August and March, when this species is likely to be present based on migratory pattern.

Design of the on-going monitoring program, including the location and extent of sites, will be determined by a suitably qualified person to ensure that sufficient data are collected to quantify likely impacts resulting from the proposed action, and to determine appropriate habitat management goals. The monitoring program will include both impact and control sites to monitor the progress of recovery, including effectiveness of management actions, and adapt if necessary. Annual monitoring will occur for the duration of railway activities.

The potential impacts of the proposed activities will be monitored in accordance the monitoring program outlined in Table 55.

Table 55 Details of monitoring program for the Eastern Curlew

Performance Criteria	Monitoring Program	Trigger for Corrective Action	Outcomes
Identify populations within and immediately adjacent to the Project Area	Pre-clearance targeted surveys for Eastern Curlews targeting wetland habitat for this species within and adjacent to the Project Area in the south-east of the Caley Valley Wetlands. Surveys are to be undertaken between August and March, when Eastern Curlews are most likely to be present. Surveys will be undertaken using the survey methods outlined above.	N/A	Record and map Eastern Curlew locations in the vicinity of the Project Area, to ensure appropriate mitigating management measures are implemented.
Rehabilitation of disturbed saltmarsh areas that are no longer required for operations	BioCondition Assessments and photo monitoring will be undertaken prior to rehabilitation activities, annually (5 years) and at 15 years after rehabilitation to determine the condition of saltmarsh habitat in proposed rehabilitation and control sites in the northern terminus (Caley Valley Wetlands) of the Project Area. For each proposed rehabilitation area, a minimum of two permanent monitoring plots will be located in the rehabilitated area and a minimum of two permanent monitoring plots will be located in matched habitat between 1 km and 2 km from the Project Area (control areas).	Rehabilitated saltmarsh areas fail to reach 70% of baseline and control scores within 15 years	Baseline saltmarsh habitat quality for comparison during monitoring. Ability to assess rehabilitation quality against rehabilitation and offset requirements. Adani to review monitoring results and report annually and revise management actions if any trigger is identified.
Minimal noise and vibration impacts in surrounding habitat	Baseline monitoring by a suitably qualified person (s), of the noise and vibration intensity in surrounding habitat caused by significant vibration-causing construction activities (e.g. drilling, earthworks and movement of large machinery). Daily monitoring by onsite ER of active construction footprint for significant noise and vibration-causing construction activities.	Excessive noise or vibration that causes Eastern Curlew to abandon suitable habitat within Caley Valley Wetland.	Compliance with Coordinator-General conditions and SMP.
Minimal light spill into known Eastern Curlew habitat during works	Regular monitoring by onsite ER.	Direct light spill >50 m into known Eastern Curlew habitat or within 50 m of Saltwater Creek	Compliance with Coordinator-General conditions and SMP.

Performance Criteria	Monitoring Program	Trigger for Corrective Action	Outcomes
Construction night work is limited to minimum disturbance activities in or adjacent to known Eastern Curlew habitat.		Clearing or piling occurs at night within or adjacent to Curlew habitat	
Manage ASS in accordance with accepted guidelines.	Complete a baseline acid sulphate soils survey in areas where the Project has the potential to disturb acid sulphate soils, focusing on known and potential habitat for the Eastern Curlew. This survey is to be undertaken by a suitably qualified soil scientist(s). Monitor the effectiveness of soil treatment practices in accordance with an approved ASS Management Plan.	Baseline ASS risk to be determined prior to disturbance.	Data available to guide management practices for ASS treatment.
No permanent changes to waterway hydrology in Eastern Curlew habitat	Design and implement a water quality monitoring program in accordance with the Water Quality Management Plan focusing on water flow and profile, water nutrient levels, and Total Suspended Sediments (TSS). The monitoring program will outline the need to adequately assess seasonal and spatial variation in surface water movement across the Project Area and the influence of this on waterway sedimentation. The monitoring program will ensure that the south-eastern edge of the Caley Valley Wetlands and Saltwater Creek, which are likely habitat for the Eastern Curlew are prioritised for monitoring.	After construction and rehabilitation, the waterway hydrology is significantly altered and Eastern Curlew no longer inhabit the waterway	Ensure compliance with Coordinator-General conditions. Baseline water quality for comparison during monitoring. Adani to review monitoring results and report annually and revise management actions if any trigger is identified.
Minimise siltation of wetlands and waterways during construction	Design and implement a monitoring program, in accordance with the Water Quality Management Plan, that targets dust and heavy metal toxicity in the Caley Valley Wetlands adjacent to the Project Area, and Saltwater Creek. The monitoring program will target key Eastern Curlew feeding areas with low flow and close proximity to the Project Area. Water and sediment samples will be collected at each site to test for the presence of 15 heavy metals.	Siltation of the Caley Valley Wetlands or Saltwater Creek in, or adjacent, to the Project Area	
Emissions (i.e. dust, coal and heavy metals) do not degrade water quality	A dust particulate sampler will also be erected at each site to compare aerial collection of coal dust and heavy metal values with waterway monitoring results. Sediment and dust samples will be assessed for baseline measures, and then annually at low flow periods.	Emissions settlement in waterways breach industry standards	
Water nutrient enrichment	All monitoring will be undertaken in line with the Queensland's Water Quality Guidelines 2009 and ANZECC/ARMCANZ Interim Sediment Quality Guidelines.	>20% increase in the nutrient (NPK) content of Caley Valley Wetland or Saltwater Creek waters in or adjacent to the Project Area	
	Breaches reported to DES by onsite ER.		
No disturbance causing flight		Disturbance causing flight	

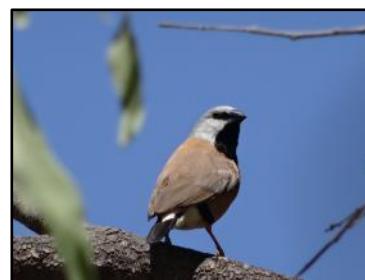
Performance Criteria	Monitoring Program	Trigger for Corrective Action	Outcomes
No trapped Eastern Curlews		Eastern Curlew trapped	Compliance with Coordinator-General conditions and SMP.

### 9.3 *Poephila cincta cincta* (Black-throated Finch)

#### 9.3.1 Status

EPBC Act = Endangered

NC Act = Endangered



**Plate 10:** Black-throated Finch

#### 9.3.2 Ecology and Distribution

##### Description of the Species:

The Black-throated Finch, at a species level, is described as a small, stocky, granivorous bird that measures up to 12 cm in length (BTF Recovery Team 2007; DoE 2015). It has a conspicuous large black bib over the chin, throat and upper breast with a grey head and neck (DoE 2015). The rump, tail (rounded or square-tipped) and bill are also black. Other distinctive colourings of the Black-throated Finch at a species level includes a white lower underbody with a black patch on the rear flanks and brown breast, back, belly and wings (DoE 2015). The wings are a darker brown with a white narrow white stripe along the leading edge. Higgins *et al.* (2006) noted that juveniles appear very similar to adults, but with duller colouring.

The subspecies can be distinguished primarily by the colouring of the upper-tail coverts, which are white in the southern subspecies (DoE 2015). Black-throated Finch (southern) also has a richer brown plumage of the body (Grince 2012).

##### Distribution:

The historical distribution of the Black-throated Finch (southern) ranged from the north-east NSW to Queensland Atherton Tablelands and west to central Queensland (BTF Recovery Team 2007). There was also a broad region of interbreeding and intergradation between the northern and southern subspecies along the Burdekin-Lynd Divide in a broad band west-southwest (TSSC 2005s).

This subspecies appears to be now confined to the northern part of this range, where it occurs in two general locations: the Townsville region (where it is locally common) and scattered sites in central-eastern Queensland. Since 1998, it has been recorded at the following sites (DoE 2015):

- Townsville and its surrounds (Giru, Serpentine Lagoon, Toonpan, and near Ross River Dam)
- Ingham, and sites nearby (near Mutarnee [at Ollera Creek], and near Mount Fox)
- scattered sites in central-eastern Queensland (Great Basalt Wall, Yarrowmere Station, Moonoomoo Station, Doongmabulla Station, Fortuna Station and Aramac).

These sites cover four bioregions within Queensland: Brigalow Belt North, Desert Uplands, Einasleigh Uplands and Wet Tropics (BTF Recovery Team 2007).

The distribution of the Black-throated Finch (southern) also appears to be severely fragmented, with the area of occupancy estimated to be 5,000 km<sup>2</sup> (DoE 2015; Garnet *et al.* 2011).

##### Habitat for the Species:

The Black-throated Finch (southern) mainly occurs in grassy, open woodlands and forests (typically dominated by *Eucalyptus*, *Corymbia* and *Melaleuca* species), that are in the vicinity of water and with

seeding grasses (DoE 2015). Common Eucalypt species found in these woodlands and forests include Narrow-leaved Ironbark (*E. crebra*), River Red Gum (*E. camaldulensis*), Silver-leaved Ironbark (*E. melanophloia*), Reid River Box (*E. brownii*), Yellowjacket (*E. similis*) and Forest Red Gum (*E. tereticornis*; DoE 2015). This species can also occur in tussock grasslands and freshwater wetlands, with the grasslands comprising genera such as *Astrebla*, *Dichanthium* or *Panicum* (BTF Recovery Team 2007). NRA (2005) has recorded Black-throated Finches (southern) breeding in non-remnant native vegetation associated with solodic soils and alluvial plains.

Mitchell (1996) noted that the southern subspecies requires a mosaic of different habitats during the wet season in which to find seed. Yet this subspecies has been recorded in degraded habitats, including cultivated areas in the vicinity of woodlands and also a heavily grazed paddock (DoE 2015). The Black-throated Finch Recovery Plan identified regional ecosystems in the Brigalow Belt North bioregion in which this species has been previously recorded. Table 56 lists all regional ecosystems identified in the Project Area that are considered as potential habitat, with REs highlighted in bold identified in the Recovery Plan.

**Table 56 Regional Ecosystems associated with the Black-throated Finch in the Project Area**

RE	Short Descriptions
11.2.5	<i>Corymbia-Melaleuca</i> woodland complex of beach ridges and swales
11.3.2	<i>Eucalyptus populnea</i> woodland on alluvial plains
11.3.27x1c	Sedgeland to grasslands on Quaternary deposits
11.3.3	<i>Eucalyptus coolabah</i> woodland on alluvial plains
11.3.31	<i>Ophiuros exaltatus</i> , <i>Dichanthium</i> spp. grassland on alluvial plains
11.3.4	<i>Eucalyptus tereticornis</i> and/or <i>Eucalyptus</i> spp. woodland on alluvial plains
11.3.7	<i>Corymbia</i> spp. woodland on alluvial plains
11.3.9	<i>Eucalyptus platyphylla</i> , <i>Corymbia</i> spp. woodland on alluvial plains
11.3.10	<i>Eucalyptus brownii</i> woodland on alluvial plains
11.3.25	<i>Eucalyptus tereticornis</i> or <i>E. camaldulensis</i> woodland fringing drainage lines
<b>11.3.25b</b>	<b><i>Eucalyptus tereticornis</i> or <i>E. camaldulensis</i> open-forest to woodland fringing drainage lines</b>
<b>11.3.30</b>	<b><i>Eucalyptus crebra</i>, <i>Corymbia dallachiana</i> woodland on alluvial plains</b>
<b>11.3.35</b>	<b><i>Eucalyptus platyphylla</i>, <i>Corymbia clarksoniana</i> woodland on alluvial plains</b>
11.3.37	<i>Eucalyptus coolabah</i> fringing woodland on alluvial plains
11.4.2	<i>Eucalyptus</i> spp. and/or <i>Corymbia</i> spp. grassy or shrubby woodland on Cainozoic clay plains
11.4.4	<i>Dichanthium</i> spp., <i>Astrebla</i> spp. grassland on Cainozoic clay plains
11.4.11	<i>Dichanthium sericeum</i> and <i>Astrebla</i> spp. grassland with patchy <i>Acacia harpophylla</i> or <i>Eucalyptus coolabah</i> on Cainozoic clay plains
11.5.3	<i>Eucalyptus populnea</i> +/- <i>E. melanophloia</i> +/- <i>Corymbia clarksoniana</i> on Cainozoic sand plains and/or remnant surfaces
11.5.9b	<i>Eucalyptus crebra</i> , <i>E. tenuipes</i> , <i>Lysicarpus angustifolius</i> +/- <i>Corymbia</i> spp. woodland
11.5.9c	<i>Eucalyptus crebra</i> +/- <i>Corymbia intermedia</i> +/- <i>E. moluccana</i> +/- <i>C. dallachiana</i> woodland
11.7.3	<i>Eucalyptus persistens</i> , <i>Triodia mitchellii</i> open woodland on stripped margins of Cainozoic lateritic duricrust
11.7.4	<i>Eucalyptus decorticans</i> and/or <i>Eucalyptus</i> spp., <i>Corymbia</i> spp., <i>Acacia</i> spp., <i>Lysicarpus angustifolius</i> woodland on Cainozoic lateritic duricrust
11.8.11	<i>Dichanthium sericeum</i> grassland on Cainozoic igneous rocks

RE	Short Descriptions
11.8.5	<i>Eucalyptus orgadophila</i> open woodland on Cainozoic igneous rocks
11.9.2	<i>Eucalyptus melanophloia</i> +/- <i>E. orgadophila</i> woodland on fine-grained sedimentary rocks
11.9.2	<i>Eucalyptus melanophloia</i> +/- <i>E. orgadophila</i> woodland on fine-grained sedimentary rocks
11.9.9	<i>Eucalyptus crebra</i> woodland on fine-grained sedimentary rocks
11.9.10	<i>Eucalyptus populnea</i> open forest with a secondary tree layer of <i>Acacia harpophylla</i> and sometimes <i>Casuarina cristata</i> on fine-grained sedimentary rocks
11.9.12	<i>Dichanthium sericeum</i> grassland with clumps of <i>Acacia harpophylla</i> on fine-grained sedimentary rocks
<b>11.11.9</b>	<b><i>Eucalyptus populnea</i> or <i>E. brownii</i> woodland on deformed and metamorphosed sediments and interbedded volcanics</b>
11.12.1	<i>Eucalyptus crebra</i> woodland on igneous rocks
11.12.2	<i>Eucalyptus melanophloia</i> woodland on igneous rocks
11.12.7	<i>Eucalyptus crebra</i> woodland with patches of semi-evergreen vine thicket on igneous rocks (boulder-strewn hillsides)
11.12.13	<i>Eucalyptus crebra</i> , <i>Corymbia</i> spp., <i>E. acmenoides</i> woodland on igneous rocks. Coastal hills

\* Bold text indicates REs where this species has been previously recorded in north Queensland since 1994.

#### Essential Microhabitat:

The Black-throated Finch (southern) requires three key resources: water sources, grass seeds and trees providing suitable nesting habitat (DEHWA 2009; Garnett *et al.* 2011)

A critical resource is water, with individuals required to drink at least daily and numerous times throughout the day during dry periods (DEHWA 2009). This species will utilise various kinds of watering points, including natural waterholes, farm dams and stock troughs (McCullough and Payet 2009). McCullough and Payet (2009) also noted that watering points are not located in extensively cleared landscapes, nor are they completely covered by tree canopies. It is likely that this subspecies occurs around more permanent sources of water during the dry season or a drought (NRA 2007). The average distance to water of a nest site was calculated to be between 280 m from semi-permanent water and 400 m from permanent water (NRA 2005).

At a species level, the Black-throated Finch favours the seeds of grasses including *Urochloa mosambicensis*, *Digitaria ciliaris*, *Melinis repens*, *Alloteropsis cimicina*, *Alloteropsis semialata*, *Setaria apiculata*, *Chrysopogon fallax*, *Eragrostis* spp. and *Chloris* spp. (Mitchell 1996; NRA 2005, Isles 2007). During the breeding season, the southern subspecies requires access to a mosaic of different habitats to find seed (Mitchell 1996), and nests are often built in a hollow branch of a tree, or in a fork of a tree, shrub or sapling (DoE 2015). Recent records also suggest that riparian habitat is important as it provides shelter in highly fragmented and modified environments (DEHP 2015c), and habitat for seeding grasses

Therefore important habitat would be all REs with a confirmed record of black-throated finch (southern) that intersect with a 5 km buffer around the finch record, including non-remnant vegetation. A 5 km buffer was considered likely to cover habitat critical to the survival of the species necessary for activities such as foraging, breeding roosting or dispersal (DEHWA 2009).

#### Known Populations and Relationships within the Project Area:

The Black-throated Finch (southern) has historically been recorded from the northern, central and southern sections of the Project Area during standardised bird surveys and incidental sightings (GHD



2014). This species has been recorded at Splitters Creek, 14 km south-west of Abbot Point (GHD 2014) and also at Gregory Developmental Road at Belyando, 40 km north of the rail alignment (DEHP 2015c).

The Black-throated Finch (southern) was not observed in the rail corridor during field surveys (SKM 2013; GHD 2014). The Black-throated Finch has been recorded during the Carmichael Coal Mine and Rail Project EIS, with numerous sightings both within the Mine and adjacent Moray Downs property (GHD 2014).

Rail: There have been no direct observations within the rail corridor but this species is considered to likely occur, given the proximity of observations to the rail alignment and the availability of suitable habitat in the Project Area that meets all the critical habitat requirements (access to water, native grasslands, and woodlands for nesting; GHD 2014).

### **Movement Patterns:**

The movement patterns of the Black-throated Finch (southern) are poorly known and there is no quantitative information on home ranges or territories (DoE 2015). It is believed that the species is sedentary in nature and make small daily movements between foraging sites (McCutcheon 1976; Blakers *et al.* 1984, DEWHA 2009). Recent surveys indicate that the Black-throated Finch (southern) remains around the nest site during the non-breeding season and is likely to forage more widely (NRA 2005). It may also move further away in response to drought or rainfall, prompted by changes in food availability (Mitchell 1996).

### **Breeding Biology:**

The Black-throated Finch (southern) can breed throughout the year under optimal conditions (DoE 2015). The breeding season in Townsville typically occurs during the wet season (February to May; Mitchell 1996; Higgins *et al.* 2006; NRA 2007a). In other areas, breeding can occur from August to December (DoE 2015).

Pairs of this subspecies separate from the flock to breed (BTF Recovery Team 2007), yet a single tree can contain up to three nesting pairs (NRA 2005). Both sexes participate in all aspects of breeding, including the construction of nests, incubation, feeding and brooding (Zann 1996; NRA 2005). Nests are usually constructed from grasses and are 'bottle-shaped' with a spout-like entrance, usually five or more metres above the ground (McCullough and Payet 2009; DoE 2015). The Black-throated Finch (southern) can build both breeding and non-breeding nests, with some non-breeding nests also used during the breeding season (NRA 2005).

One clutch can vary from three to nine eggs, with usually five to six eggs laid (Campbell 1974; Mitchell 1996; North 1901-14; Storr 1984) The Black-throated Finch (southern) can also produce two broods per year (DEHP 2015c). Eggs are incubated for a period of approximately 12 days, chicks fledge at approximately 21 days old, and fledglings become independent approximately 40 days after leaving the nest (DEHP 2015c).

### **Feeding Ecology:**

The Black-throated Finch (southern) usually feeds on the seeds of grasses, which they mainly obtain by pecking from the ground, yet they can also obtain seeds from inflorescences (DoE 2015). In the dry season, it feeds on the seed of annual grasses like *Schizachyrium* spp., switching to half-ripe grass seeds in the wet season, as well as insects and their larvae (Immelman 1982; Smedley 1904; Zann 1976). When searching for insects, this species will hawk for extended periods of time (BTF Recovery Team 2007).

They may also drink throughout the day if water is abundant or only drink either in the early morning and late afternoon when water is scarce (DoE 2015). When drinking, this species will utilise various kinds of watering points, including natural waterholes, farm dams and stock troughs (McCullough and Payet 2009). McCullough and Payet (2009) also noted that watering points are not located in extensively cleared landscapes, nor are they completely covered by tree canopies.

### 9.3.3 Threats and Impacts

The principle threats to the Black-throated Finch (southern) include (DEWHA 2009; Garnett *et al.* 2011; Grice 2012):

- clearing and fragmentation of nesting sites
- clearing and fragmentation of foraging habitat (grasslands and grassy woodlands)
- reduction in the availability (location and duration) of water
- alteration in grass species composition or seed availability, affecting the subspecies ability to find food throughout the seasons
- inappropriate grazing regimes
- inappropriate fire regimes, and
- introduction of exotic weeds, especially grasses that may degrade the habitat and reduce resource availability.

The sedentary lifestyle of the Black-throated Finch (southern) makes it vulnerable any loss, disturbance or modification to any of the three key resources of water sources, grass seeds and trees providing suitable nesting habitat (DEWHA 2009).

Other potential threats to the Black-Throated Finch (southern) are illegal trapping, hybridisation with escapees of the northern subspecies, resource bottlenecks associated with drought and changes in land management practices and impacts on seasonal breeding success from cyclonic activity (i.e. destruction of nests) (BTF Recovery Team 2007; DoE 2015).

Table 57 outlines all the potential impacts of the Project that are applicable to the Black-throated Finch (southern), taking into account the conservation listing, significant impact guidelines, Condition 5c of the EPBC Approval, Appendix 1 of the Coordinator General (CG) report, and specific impacts outlined in the EIS (GHD 2012; GHD 2014 ).

A residual impact assessment against the guidelines determined that the project may impact habitat critical to the survival of the species, which may result in a significant impact to the Black-throated Finch (southern; GHD 2014).

**Table 57 Potential impacts from the Project on Black-throated Finch (southern)**

Impacts	Potential impacts associated with the Project	Project phase
Vegetation Clearing/ Habitat Loss (foraging and nesting sites)	Removal of Black-throated Finch (southern) habitat (foraging and nesting sites) and disturbance to breeding. A disturbance limit of 1,836.2 ha is in place in the EPBC Act approval.	Pre-construction, Construction
Fragmentation (Connectivity) and edge effects	Fragmentation of vegetation within 5 km of water sources will reduce habitat availability due to loss of critical resources	Pre-construction, Construction, Operations

Impacts	Potential impacts associated with the Project	Project phase
	Fragmentation of woodland and grassland vegetation, associated with Project development, can reduce habitat availability due to the sedentary nature of the Black-throated Finch (southern)	
	Fragmentation can lead to alteration in grass species composition or seed availability, affecting the subspecies ability to find food throughout the seasons	
Drought/waterway crossings	Loss of critical water resources due to changes in hydrology at water crossings	Construction, Operations
Changes in Hydrological Regimes	Changes to critical water resources due to the use of channel diversions during waterway crossing construction	Construction
Degradation of habitat due to grazing	No livestock will be grazed in the Project Area during construction or operations, due to exclusion fencing	Impact unlikely
	Loss or alteration of grass species due to grazing by resident introduced herbivores (i.e. rabbits and goats). These species may also result in soil disturbance that results in grassland monocultures.	Construction, Operations
Bushfire	Large scale wildfires may result in homogenisation of grasslands, destroy significant seed sources on the ground and impact availability of nest trees	All phases
	Changes in land cover in the Project Area (forest to grassland) may increase the spread of bushfires, which cause temporary and permanent losses of food resources	Construction, Operations
	Increased risk of bushfire due to construction machinery sparking, and increased anthropogenic activity in the Project Area	Construction
	Increased risk of bushfire from transporting thermal coal	Operations
Weeds (including Buffel Grass)	Dispersal of weeds throughout the project area by vehicles, machinery, and people, degrading habitat quality and reducing food resources	Construction, Operations
	Invasion of new weed species from adjacent areas	
Pests	Disturbance of feeding areas and water sources by feral pigs via wallowing and rooting.	All phases
	Predation on adult birds, nests or eggs from feral animals	
Earthworks	Siltation of critical water resources due to construction activities at waterway crossings	Construction
Noise and Vibration	Temporary loss of useable habitat due to noise and vibration disturbance.	Construction, Operations
Vehicle and Train Strike	Individual mortality and injury from vehicle and train strike, especially in areas around water sources within 5 km of potential habitat.	Construction, Operations
Emissions i.e. dust	Dust emissions from coal transport may potentially reduce quality of resources for the Black-throated Finch (southern), in and immediately adjacent to the Project Area. In particular, grassland habitat.	Construction, Operations
Light Spill	Temporary loss of useable habitat due to light disturbance at night. This is unlikely to be a concern for Black-throated Finch (southern), given their diurnal activity patterns and their ability to inhabit disturbed areas. Permanent lighting is not proposed along the railway.	Impact unlikely

Impacts	Potential impacts associated with the Project	Project phase
Entrapment	Uncovered wire and mesh located near permanent water sources, within 5 km food habitat and 400 m of suitable nesting trees, may lead to Black-throated Finch (southern) entanglement as they drink daily	Construction

### 9.3.4 Mitigation and Management Measures

There is a recovery plan for the Black-throated Finch (Southern; BTF Recovery Team 2007). In addition to this recovery plan, a draft Black-throated Finch (Southern) Management Plan for the mine component of the Project was developed during the SEIS (GHD 2014). The Coordinator General's report on the EIS for Carmichael Coal Mine and Rail Project has conditioned (Condition 1) that baseline research on the Black-throated Finch (southern) is undertaken to determine:

- movement patterns, habitat requirements and population dynamics, including dietary requirements, home range, nesting requirements
- responses to grazing management, fire management and water body locations.

Although this research will target habitat related to the mine component of the Project, research outcomes may be applicable to this species management plan.

The proponent is also required to contribute to a Black-throated Finch (southern) Bioregional Management Plan that will be developed to assess the population and habitat in the Galilee Basin and Desert Uplands (Condition 4). Key outputs from this Bioregional Management Plan for the Black-throated Finch (southern) will be best practice mitigation and management measures that focus on artificial water points; fire management; exotic plant management; predator management and disturbance management.

Table 58 outlines all relevant mitigation and management measures for the Black-throated Finch (southern) that are consistent with conservation advice and recovery plan for this species and meets the conditions of the EPBC Act.

All appropriate mitigation and management measures will be implemented during construction and operations in habitats known or likely to support Black-throated Finch (southern). A key management action outlined in both the Significant Impact Guidelines and Recovery Plan is the monitoring of management effectiveness. Adaptive management actions have been included in this management plan as triggers. This will involve the inclusion or update of mitigation and management measures if additional information from baseline research and / or the development of the Black-throated Finch (southern) Bioregional Management Plan is applicable. An updated species management plan will be sent to DoEE and DES within 30 days for approval.

Additional sightings of Black-throated Finch (southern) outside suitable habitat during pre-clearance, construction and operation will be reported to the ER and confirmed by the Queensland Museum for verification. Where additional habitat and /or populations are identified, DES and DoEE will be notified of locations and appropriate management actions will be implemented.

Table 58 Mitigation and management measures for the Black-throated Finch (southern)

Goal (Impact)	Performance Criteria	Management Measures	Trigger	Corrective Action
Minimise loss of habitat through vegetation clearing	Rehabilitation of disturbed areas that are no longer required for operations	Progressive rehabilitation of disturbed areas will be undertaken as soon as possible after the completion of construction activities. Vegetation rehabilitation will use locally-sourced seeds for native grasses and woody plants.	Additional information from baseline research is obtained on artificial water body locations	Revise and implement an updated Rehabilitation Management Plan within 30 days of receiving research results.
			Rehabilitated areas fail to reach 70% of baseline and control scores within 15 years.	An annual rehabilitation monitoring report will be sent to DES and DoEE. Revise and implement an updated Rehabilitation Management Plan if targets are not achieved within 15 years.
Reduce the impact of drought	No net loss of suitable permanent water sources	Permanent water sources in suitable Black-throated Finch (southern) habitat will be identified and mapped by a suitably qualified person for the development of an essential habitat map.	Additional permanent water sources installed during construction.	Assess locality of permanent water sources to grass seeds and trees, thus potentially providing suitable nesting habitat. Implement remedial actions to provide supplementary water sources, where possible. Refer to Black-throated Finch (southern) Bioregional Management Plan regarding best practice measures for artificial water body locations
Minimise loss of permanent water sources		Permanent water sources in suitable Black-throated Finch (southern) habitat, that have previously been identified and mapped as part of pre-clearance surveys, will not be drained during construction, unless suitable alternative water supplies (permanent water with gently sloping, bare ground at the edge) are available within a 500 m radius. This includes permanent water sources at waterway crossings. The provision of alternative water supplies will be undertaken in discussion with adjacent landholders, as water supplies cannot always be located in the rail corridor	Draining of suitable permanent water source with no suitable alternative available	

Goal (Impact)	Performance Criteria	Management Measures	Trigger	Corrective Action
Minimise siltation of water resources during construction		<p>Erosion and sediment control measures will be designed and managed in accordance with IECA guidelines as prescribed in the relevant project approvals, to prevent sedimentation run-off into permanent water sources during construction</p> <p>Where possible, designs should limit the creation of suitable Cane Toad breeding areas (e.g. sediment fences).</p> <p>Inspect the integrity of sediment barriers daily during construction works. Regularly re-assess the effectiveness of the location and design of sediment barriers and update as necessary.</p>	Siltation of a suitable permanent water source in Black-throated Finch (southern) habitat	Investigate source of siltation, implement appropriate corrective measures and report as per environmental approval conditions and CEMP requirements, if required.
Reduce habitat degradation from grazing by introduced herbivores	No increase in rabbit, goat, fox and cat numbers in the Project Area	<p>A Pest Management Plan (PMP) will be developed and implemented prior to construction, including measures for controlling invasive rabbits, goats, foxes, cats and weeds. The PMP will include best practice measures outlined in the Bioregional Management Plan, if available, It will also outline review triggers and timelines to monitor the effectiveness of management actions</p> <p>The PMP will also be developed in conjunction with neighbouring land owners, and will target waterway crossings, habitat edges and fixed sites such as workers camps. The Pest Management Plan will incorporate measures recommended in the Threat Abatement Plan for the control of rabbits and the five listed grasses.</p>	<p>Additional information from baseline research or Bioregional Management Plan regarding best practice mitigation and management measures for weeds and predators.</p> <p>Review indicates that management actions are not effective.</p>	Revise and implement an updated PMP.
Minimise predation risk by invasive mammals			<p>&gt;10% increase in the population of each grazing herbivore species from baseline scores</p> <p>&gt;10% increase in the population of each invasive predator species from baseline scores</p>	<p>Increase feral herbivore management efforts, in conjunction with neighbouring land owners.</p> <p>Increase invasive predator management efforts, in conjunction with neighbouring land owners.</p>
Reduce weed competition	Eliminate declared pest plant species (with the exception of Red Natal Grass) from the Project Area and adjacent areas	<p>Domestic animals will not be permitted into the Project area.</p> <p>Weed control will focus on eradicating declared pests from the Project Area and adjacent areas, during construction and operations.</p>	Presence of declared pest plant species at any time	Increase weed management efforts, in conjunction with neighbouring land owners, where relevant.

Goal (Impact)	Performance Criteria	Management Measures	Trigger	Corrective Action
Minimise noise and vibration disturbance	No abandonment of Black-throated Finch (southern) nests due to noise and vibration	Noise and vibration-causing construction activities should be limited as much as possible within 200 m of a known active Black-throated Finch (southern) nest and associated water source. Nesting sites are to be verified by a suitably qualified person.	Abandonment of a Black-throated Finch (southern) nest due to noise and vibration	Review adherence to control procedures to ensure compliance. Take remedial action where compliance has not been adhered to. Update Species Management Plan
Minimise the risk of light vehicle and machinery strike	No death or injury due to light vehicle or machinery strike during construction and operations	Prior to site entry, all relevant site personnel, including contractors, will be made aware of the Black-throated Finches foraging habits around waterholes and grasslands. In addition, speed limits will be reduced to 20 km/h in areas adjacent to known habitat. Vehicles and plant will drive on pre-determined roads only, and adhere to all speed limits, which will be clearly signposted.	Light vehicle or machinery strike when clearing and grubbing	Incidents will be reported to the site ER as soon as possible. DoEE and DES will be notified within 24 hours. Depending on the extent of injuries, any injured Squatter Pigeon will be either taken to the nearest qualified veterinary practitioner or wildlife carer, or humanely euthanised on site by a suitably qualified person (see Section 11.3).
		All relevant site personnel, including contractors, will be made aware of the locations of Black-throated Finch (southern) populations and the propensity of this species to feed on dusty roads and freeze when threatened. Identification posters for all threatened species with the potential to occur in the Project Area will be installed in prominent positions at each work site. Vehicles and plant will drive on pre-determined roads only, and adhere to all speed limits, which will be clearly signposted.	Light vehicle or machinery strike during other activities	Complete an incident report and notify DES and DoEE. Depending on the extent of injuries, any injured Black-throated Finch (southern) will be either taken to the nearest qualified veterinary practitioner or wildlife carer, or humanely euthanised on site by a suitably qualified person (see Section 11.3).
Minimise risk of train strike	No death or injury due to train strike during operations	An identification poster for all threatened species with the potential to occur in the Project Area will be installed in the train cabin. Additional sightings of Black-throated Finch (southern) will be reported to the ER and confirmed by the Queensland Museum for verification.	Train strike	Complete an incident report and notify DES and DoEE. Depending on the extent of injuries, any injured Black-throated Finch (southern) will be either taken to the nearest qualified veterinary practitioner or wildlife carer, or humanely euthanised on site by a suitably qualified person (see Section 11.3).

Goal (Impact)	Performance Criteria	Management Measures	Trigger	Corrective Action
Minimise emissions (dusts)	Limit disturbance from emissions (dust) on photosynthetic ability of grasses in Black-throated Finch (southern) habitat	Dust emissions will be managed in accordance with the Dust and Coal Dust Management Plans, and should include but not be limited to: <ul style="list-style-type: none"> <li>• Regular watering of dusty areas in accordance with Dust Management Plan.</li> <li>• Ensuring trains are not overloaded.</li> <li>• Use of veneers to minimise the loss of coal particles in transit.</li> </ul>	Growth of grasses adjacent to the Project Area inhibited due to dust emissions	Investigate source of dust emissions, implement appropriate corrective measures and report as per environmental approval conditions and EMP requirements, if required.
	No additional dust emissions outside industry standards and no fouling of nests or water sources		Fouling of nests or adjacent water sources to known breeding sites. Parameters do not meet ANZECC guidelines.	
Minimise construction light spill into known Black-throated finch nesting habitat	No light spill into known Black-throated Finch nesting habitat	Use of directional lighting and shields during construction. During operation, limit lighting to the single maintenance depot and 200 m buffer.	Abandonment of a Black-throated Finch (southern) nest due to light spill	Review adherence to control procedures to ensure compliance. Take immediate remedial action where the compliance breach has occurred.
Eliminate entrapment	No trapped Black-throated Finch (southern)	No sharp equipment with the potential to entangle fauna (e.g. wire, mesh fencing) is to be left unattended and uncovered near water bodies or dusty areas with sparse vegetation growth (up to 30% cover).	Black-throated Finch (southern) entangled	Complete an incident report and notify DoEE and DES if death or injury occur. Review materials storage procedures and fencing protocols, and implement actions to ensure entanglement does not re-occur. Depending on the extent of injuries, any injured Black-throated Finch (southern) will be either taken to the nearest qualified veterinary practitioner or wildlife carer, or humanely euthanised on site by a suitably qualified person (see Section 11.3).



### 9.3.5 Monitoring

Pre-clearance surveys will be undertaken at suitable times to detect the species, and identify and map suitable water bodies and nesting opportunities in the development area, prior to any clearing or associated works occurring. The surveys will target suitable habitat for this species within and directly adjacent to the Project Area. This Management Plan must be revised and submitted to DoEE within three months following pre-clearance surveys.

Survey Methodology: The Black-throated Finch (southern) can be confused with the northern subspecies (*Poephila cincta atropygialis*) but is distinguished by the white upper-tail coverts and the zone of integration is around the Burdekin-Lynd divide (DEWHA 2010; DoE 2015).

The survey guidelines for Australia's threatened birds recommend both land-based area and targeted searches of suitable habitat for the Black-throated Finch (southern; DEWHA 2010). Targeted searches should occur in areas with waterholes and wood swallow nests, with a minimum survey effort of 6 hours over 2 days. Land-based area searches, in areas less than 50 ha, should have a minimum survey effort of 10 hours over 5 days.

Targeted surveys will be completed in suitable habitat in and near the Project Area. Optimal habitats to target are regional ecosystems listed in Table 59 and that are in the vicinity (up to 3 km) of suitable water bodies. The Black-throated Finch needs to drink every day during the dry season; therefore targeted surveys should be conducted at core waterholes during this time (McCullough and Payet 2009). Black-throated Finches (southern) are most likely to start drinking from sunrise, and surveys should be conducted 30 minutes after official sunrise and for a period of three hours (McCullough and Payet 2009). This species is usually seen and heard in small flocks of up to 20 birds, more readily near waterholes or flying up into low trees (DEWHA 2010).

Design of the on-going monitoring program, including the location and extent of sites, will be determined by a suitably qualified person to ensure that sufficient data are collected to quantify likely impacts resulting from the proposed action, and to determine appropriate habitat management goals. The monitoring program will include both impact and control sites to monitor the progress of recovery, including effectiveness of management actions, and adapt if necessary. Annual monitoring will occur for the duration of railway activities.

The potential impacts of the proposed activities will be monitored in accordance the monitoring program outlined in Table 59.

Table 59 Details of monitoring program for the Black-throated Finch (southern)

Performance Criteria	Monitoring Program	Trigger for Corrective Action	Outcomes
Identify populations within and immediately adjacent to the rail corridor	Pre-clearance targeted surveys for Black-throated Finch (southern) targeting suitable habitat for this species within and directly adjacent to the Project Area. Surveys to be undertaken at any time of the year by a suitably qualified person. Surveys will be most effective during dry seasons, when suitable water bodies can be targeted.	N/A	Record and map Black-throated Finch (southern) locations in the vicinity of the Project Area, to ensure appropriate mitigating management measures are implemented.
Rehabilitation of disturbed areas in Black-throated Finch habitat that are no longer required for operations	BioCondition Assessments and photo monitoring will be undertaken prior to rehabilitation activities and then annually after rehabilitation to determine the condition of Black-throated Finch (southern) habitat in proposed rehabilitation and control sites. For each proposed rehabilitation area, a minimum of two permanent plots will be located in the rehabilitated area and a minimum of two permanent plots will be located in matched habitat between 1 km and 2 km from the Project Area (control areas). In addition to these Assessments, there will be targeted searches for Black-throated Finches (southern) within each rehabilitated area.	Rehabilitated areas fail to reach 70% of baseline and control scores within 15 years	Baseline habitat quality for comparison during monitoring. Ability to assess rehabilitation quality against rehabilitation and offset requirements. Adani to review monitoring results and report annually and revise management actions if any trigger is identified.
Limit disturbance from emissions (dust) on photosynthetic ability of grasses in Black-throated Finch (southern) habitat	A series of 5 grass monitoring plots (1 m x 1 m) will be established within 5 m of the exclusion fence, and within equivalent habitat between 500 m and 1 km from the exclusion fence, every 5 km along the rail corridor, on alternating sides within Black-throated Finch (southern) habitat. The plot boundaries will be mapped and clearly marked with pegs. Baseline and photo monitoring will occur prior to construction, and annually thereafter using the method outlined for grass plots in DES (2014). In Black-throated Finch (southern) habitat, an identical series of plots will be established in four locations adjacent to the boundary of quarries and other non-railway Project Areas – at the centre of the northern, southern, eastern and western boundaries or their equivalent for non-rectangular sites. Where possible, these plots should be located within areas of preferred grass species ( <i>Urochloa mosambicensis</i> , <i>Digitaria ciliaris</i> , <i>Melinis repens</i> and <i>Chloris inflata</i> ).	Growth of grasses adjacent to the Project Area inhibited due to dust emissions	Early detection of dust effects on adjacent habitat, allowing adaptive management of dust emissions where necessary.

Performance Criteria	Monitoring Program	Trigger for Corrective Action	Outcomes
No increase in rabbit, goat, fox and cat numbers in the Project Area	Baseline and annual monitoring of feral goat, pig, fox and cat populations at waterway and artificial fauna crossings in Black-throated Finch (southern) habitat. Monitoring will include track and scat monitoring and photo monitoring using baited infrared cameras.	>10% increase in the population of each invasive species, from baseline scores	Ensure compliance with PMP.
Eliminate declared pest plant species from the Project Area and adjacent areas	Annual monitoring (including photo monitoring) of weeds and vegetation growth in the Project Area, and weed development in Black-throated Finch (southern) habitat adjacent to the Project Area. Monitoring will occur at the optimal time for detecting and identifying pest plant species.	Presence of declared pest plant species at any time	Ensure compliance with PMP.
No abandonment of Black-throated Finch (southern) nests due to noise and vibration	Breaches reported to DES and DoEE by onsite ER.	Abandonment of a Black-throated Finch (southern) nest due to noise and vibration	Compliance with SMP.
No death or injury due to light vehicle or machinery strike during construction and operations		Light vehicle or machinery strike	
No death or injury due to train strike during operations		Train strike	
No entangled Black-throated Finch (southern)		Black-throated Finch (southern) trapped	
No bushfires sparked by project activities		Wildfire sparked by construction activities	
No net loss of suitable permanent water sources	Annual monitoring (including photo monitoring) of water source availability, in the driest season.	Draining of suitable permanent water source. Siltation of a suitable permanent water source in Black-throated Finch (southern) habitat.	Compliance with SMP.

Performance Criteria	Monitoring Program	Trigger for Corrective Action	Outcomes
Emissions (i.e. dust, coal and heavy metals) do not degrade water source quality in Black-throated Finch (southern) habitat	<p>Design and implement a monitoring program, in accordance with the Water Quality Management Plan, that targets dust and heavy metal toxicity in Black-throated Finch (southern) habitat. The monitoring program will target key areas with low flow, close proximity to the Project Area and all water sources within 3 km of known Black-throated Finch (southern) locations. Water and sediment samples will be collected at each site to test for the presence of 15 heavy metals. A dust particulate sampler will also be erected at each site to compare aerial collection of coal dust and heavy metal values with waterway monitoring results. Sediment and dust samples will be assessed for baseline measures, and then annually at low flow periods.</p> <p>This survey is to be undertaken in line with the ANZECC/ARMCANZ Interim Sediment Quality Guidelines.</p>	Emissions settlement in water breach industry standards	Compliance with EPBC conditions and SMP.

## 9.4 *Rostratula australis* (Australian Painted Snipe)

### 9.4.1 Status

EPBC Act = Endangered, Marine

NC Act = Vulnerable

### 9.4.2 Ecology and Distribution

#### Description of the Species:

The Australian Painted Snipe is a stocky wading bird approximately 24–30 cm in length, with a wingspan of 50–54 cm (TSSC 2013a). This species is chocolate-brown above with a comma-shaped white marking around the eye, a chestnut patch on the neck, densely barred olive and black back and wings, and a diagnostic white 'harness marking' runs from sternum to the shoulder (TSSC 2013a). The underparts of this species unmarked white, and it has olive-grey legs (Pizzey and Knight 2007). The adult female is more colourful than the male, which also has no chestnut colouring on the neck (DoE 2015). The bill of the Australian Painted Snipe is distinctive, being pinkish, longish, slightly drooping, and swollen at the tip (Pizzey and Knight 2007). This species is well-camouflaged and rarely seen.

#### Distribution:

The Australian Painted Snipe is endemic to Australia (TSSC 2013a). It occurs throughout much of Australia, except for the far north of the Gulf of Carpentaria, Tasmania (no records since 1912), and the dry areas south-west of Alice Springs (DoE 2015). Important areas for this species include the Murray-Darling Basin, Queensland Channel Country, Fitzroy Basin of Central Queensland, and south-eastern South Australia and adjoining areas in Victoria (TSSC 2013a).

#### Habitat for the Species:

The Australian Painted Snipe occurs in shallow temporary wetlands, including lakes, swamps and claypans, inundated grasslands, dams, rice crops, sewage farms and bore drains (Rogers *et al.* 2005, Tzaros 2012). It is usually found in freshwater but occasionally uses brackish areas and saltmarshes (DoE 2015). Wetlands within and adjacent to non-remnant and regrowth areas may also be used including the margins of well vegetated farm dams and sewage treatment ponds (Pizzey and Knight 2007).

#### Regional Ecosystems Associations:

The Australian Painted Snipe has strong associations with wetland REs (Table 60).

**Table 60 Regional Ecosystem that are known habitat for the Australian Painted Snipe**

RE	Short Description
11.3.27x1c	Palustrine wetland (e.g. vegetated swamp). Sedgeland to grasslands on Quaternary deposits. Sedgeland areas typically dominated by <i>Schoenoplectus subulatus</i> .
11.1.1	<i>Sporobolus virginicus</i> grassland on marine clay plains
11.1.2	Samphire forbland on marine clay plains



**Plate 11:** Australian Painted Snipe  
(Photo: Birdlife Australia 2014)

**Essential Microhabitat:**

Australian painted snipes generally remain in dense cover when feeding but may also forage over nearby mudflats, ploughed land or grassland (Marchant and Higgins 2003). They require areas with a good cover of grasses, rushes and reeds, low scrub, *Muehlenbeckia* spp. (lignum), open timber or samphire (Marchant and Higgins, 2003). This species sometimes uses areas that are lined with trees, or that have some scattered fallen or washed-up timber (Marchant and Higgins 1993).

**Known Populations and Relationships within the Project Area:**

The Australian Painted Snipe is known to occur in the eastern Caley Valley Wetlands, with 27 sightings during two standardised survey periods (February and June) in 2012 (GHD 2014). The Caley Valley Wetlands are evidently valuable habitat for this species (Appendix C), with this area supporting an ecologically significant proportion (>0.1 %) of the population (Appendix C). The Australian Painted Snipe is only likely to occur in the Caley Valley Wetlands complex in the northern terminus of the Project Area.

**Movement Patterns:**

The Australian Painted Snipe is believed to disperse from east to central and northern Australia for at least part of the year to exploit favourable seasonal conditions (Black *et al.* 2010). It is likely that a significant proportion of the eastern Australian population migrates to coastal tropical Queensland during February to August, and also to inundated wetlands in western Queensland, when available (Black *et al.* 2010).

Australian Painted Snipes are generally seen singly or in pairs, sometimes forming loose gatherings around a group of nests (TSSC 2013a). Flocks of up to 30 individuals have been recorded post-breeding (TSSC 2013a). They fly <3m high when flushed, but can fly higher when travelling long distances (Marchant and Higgins 2003).

The Australian Painted Snipe is nocturnal, being most active at night, dawn and dusk, and sitting quietly under grass or reeds during the day (TSSC 2013a). Although this species is mainly crepuscular, it can be detected during the day through flushing (DEWHA 2010).

**Breeding Biology:**

The Australian Painted Snipe has been recorded as breeding between May and October in northern Queensland (Marchant and Higgins 1993). However, there are records of this species breeding in all months in Australia, and it may breed in response to wetland conditions rather than during a particular season (DoE 2015). There are breeding records from Ayr, Queensland, from the 1950s (Marchant and Higgins 1993).

Nesting usually occurs in drying ephemeral wetlands that have complex shorelines (Rogers *et al.* 2005), with almost all nesting records from or near small wetland islands with a combination of very shallow water, exposed mud, dense low cover and sometimes some tall dense cover (Rogers *et al.* 2005). Nests are occasionally located on shores of swamps or on banks of channel, in canegrass swamps, flooded areas including samphire, grazing land, among cumbungi, sedges, grasses, salt water couch (*Paspalum*), saltbush (*Halosarcia*) and grass, and also in ground cover of water-buttons and grasses, at the base of tussocks and under low saltbush (Marchant and Higgins 1993).

In some situations this species is loosely colonial, although nests are widely separated (Lowe 1963). This species often breeds near nesting Red-necked Avocets (*Recurvirostra novaehollandiae*), Banded Stilts

(*Cladorhynchus leucocephalus*), Red-kneed Dotterels (*Erythrogonys cinctus*) and Black-tailed Native-hens (*Gallinula ventralis*; Lowe 1963).

Nests are placed among tall rank tussocks surrounded by shallow fresh water (Marchant and Higgins 2003). The male builds the nest, incubates the eggs (usually four) and rears the young, which hatch after 19-20 days (Morcombe 2008). Nests consist of a scrape in the ground lined with grass and leaves (Pringle 1987). Chicks are precocial (well-developed, eyes are open and are capable of moving around shortly after birth) and are able to leave the nest shortly after hatching, but they are brooded and dependent for the first few days (DoE 2015).

#### Feeding Ecology:

The Australian Painted Snipe eats vegetation, seeds, insects, worms and molluscs, crustaceans and other invertebrates (Marchant and Higgins 1993). They generally remain in dense cover when feeding, although they may forage over nearby mudflats and other open areas such as ploughed land or grassland (Marchant and Higgins 1993).

#### 9.4.3 Threats and Impacts

The Australian painted snipe is inferred to have undergone a severe decline in the number of mature individuals since the 1950s (Garnett and Crowley 2000; Lane and Rogers 2000, Rogers *et al.* 2005, Garnett *et al.* 2011) and specifically over the last three generations (~26 years) due to the loss and degradation of its wetland habitat (Rogers *et al.* 2005).

The loss and degradation of wetland habitat is primarily from drainage and the diversion of water for agriculture and reservoirs (Lane and Rogers 2000, Garnett *et al.* 2000), and from the stabilisation of water levels so that water becomes too deep, or continuous reed beds develop inhibiting nesting behaviour (Rogers *et al.* 2005). Other threats to the survival of the Australian Painted Snipe include changes to vegetation through increased cropping (Rogers *et al.* 2005) and overgrazing and trampling (of habitat and nests) by cattle, particularly in arid areas (Johnstone and Storr 1998).

Potential threats to the Australian Painted Snipe include changes in wetland vegetation due to altered fire regimes (Rogers *et al.* 2005), nutrient enrichment and disturbance to substrate by livestock (Johnstone and Storr 1998, Rogers *et al.* 2005), predation of individuals and nests by feral foxes and cats (TSSC 2013a), infrastructure development near the species' autumn-winter sites on the central Queensland coast (TSSC 2013a), replacement of native wetland vegetation by invasive weeds such as *Parkinsonia aculeata* (Rogers *et al.* 2005), and water quality declines due to increased nutrient and saline content (DoE 2015).

Table 61 outlines all the potential impacts of the project that are applicable to Australian Painted Snipes, taking into account action plans (Tzaros *et al.* 2012), Condition 5c of the EPBC Approval, and Appendix 1 of the Coordinator-General's Report. The northern terminus of the construction footprint includes the edge of the Caley Valley Wetlands, which supports an overwintering population and an ecologically significant proportion (>0.1 %) of the Australian Painted Snipe population (Appendix C).

**Table 61 Potential impacts from the Project on the Australian Painted Snipe**

Impacts	Potential impacts associated with the Project	Project phase
Habitat Loss	Loss of fringing wetland habitat supporting a significant population. A disturbance limit of 45.6 ha of habitat is in place in the EPBC Act approval.	Pre-construction, Construction

Impacts	Potential impacts associated with the Project	Project phase
	Clearing of riparian vegetation on the south-eastern edge of the Caley Valley Wetlands.	
Habitat Degradation	Overgrazing, trampling and disturbance of substrate by stock on the south-eastern edge of the Caley Valley Wetlands. This is unlikely to be exacerbated by the Project because the Project Area runs parallel to the existing railway alignment in this area and does not alter accessibility to this area for stock.	Impact unlikely
	Sedimentation of Caley Valley Wetlands and Saltwater Creek caused by construction activities.	Construction
Stabilisation of hydrology	Habitat degradation due to permanent stabilisation of water levels and reed expansion on the south-eastern edge of the Caley Valley Wetlands.	Construction, Operations
Altered Fire Regimes	Habitat degradation due to loss of fringing vegetation on the south-eastern edge of the Caley Valley Wetlands. Fire regimes are unlikely to be altered by the Project because the Project Area runs parallel to the existing railway alignment in this area and does not alter fire risk.	Impact unlikely
Water Nutrient Enrichment	Enrichment of water nutrients by construction and rehabilitation activities (fertilisers) leading to altered food availability.	Construction
Predation by Invasive Mammals	Loss of individuals to predation by feral foxes and cats, which are known to inhabit the area traversed by the Project and use fauna crossings as funnel points for attacks.	Construction, Operations
Invasive Weeds	Transport and establishment of invasive weeds, particularly <i>Parkinsonia aculeata</i> (Parkinsonia) and <i>Vachellia nilotica</i> (Prickly Acacia), into new areas on the south-eastern edge of the Caley Valley Wetlands.	Construction, Operations
Increased water salinity	Degradation of habitat due to increased water salinity on the south-eastern edge of the Caley Valley Wetlands. This is unlikely given the fresh to brackish conditions of Saltwater Creek and the lack of tidal water movement through this area (BMT WBM 2012).	Impact unlikely
Earthworks	Mortality and injury (of nests and individuals) due to machinery strike.	Construction
Noise and Vibration	Loss of useable habitat due to noise and vibration disturbance from construction activities and operations.	Construction, Operations
Light Spill	Temporary loss of useable habitat due to light disturbance at night. Permanent lighting is not proposed along the railway.	Construction
Changes in Waterway Conditions at Waterway Crossings	Temporary loss of habitat due to alteration of water flows due to the use of channel diversions at Saltwater Creek during waterway crossing construction.	Construction
Entrapment	Uncovered wire and mesh located near the Caley Valley Wetlands may lead to Australian Painted Snipe entanglement.	Construction
Connectivity	Temporary loss of connectivity between suitable habitats due to waterhole drainage during waterway crossing construction. This is unlikely to affect the connectivity of Australian Painted Snipe populations, due to their mobility.	Impact unlikely



#### 9.4.4 Mitigation and Management Measures

Table 62 outlines all relevant management measures for the Australian Painted Snipe that are consistent with the conservation advice for this species (TSSC 2013b) and meet the conditions of the EPBC Approval and Coordinator-General's Report. There is currently no recovery plan for the Australian Painted Snipe, although Tzaros *et al.* (2012) suggest generic recovery actions, which were taken into account when developing mitigation and management measures. All appropriate management measures will be implemented during construction and operations in habitats known or likely to support Australian Painted Snipe. Sightings of Australian Painted Snipe outside known populations during construction and operations will be reported to the ER and confirmed by the Queensland Museum. Where additional populations are identified, DES and DoEE will be notified of locations and appropriate management actions will be implemented.

Table 62 Mitigation and management measures for the Australian Painted Snipe

Goal (Impact)	Performance Criteria	Management Measures	Trigger	Corrective Action
Minimise loss of habitat through vegetation clearing	Rehabilitation of disturbed areas that are no longer required for operations	<p>Progressive rehabilitation of disturbed areas will be undertaken as soon as possible after the completion of construction activities. Vegetation rehabilitation will use locally-sourced wetland plants.</p> <p>Earth formations in wetland areas will be rehabilitated using original topsoil and configured in a way that mirrors the original slope of the terrain.</p>	Rehabilitated areas fail to reach 70% of baseline and control scores within 15 years	An annual rehabilitation monitoring report will be sent to DES and DoEE. Revise and implement an updated Rehabilitation Management Plan if targets are not achieved within 15 years.
Minimise changes in waterway hydrology at waterway crossings	No permanent changes to waterway hydrology in Australian Painted Snipe habitat	<p>Progressive rehabilitation of waterways will be undertaken as construction is completed at the Saltwater Creek waterway crossing.</p> <p>Earth formations at the Saltwater Creek waterway crossing will be rehabilitated in a way that mirrors the original waterway profile and flow.</p>	After construction and rehabilitation, the waterway profile and flow is significantly altered and Australian Painted Snipe no longer inhabit the waterway	Undertake remedial action to restore waterway profile to existing condition. Revise waterway construction design, and submit an updated rehabilitation plan. Implement updated rehabilitation plan once approved.
	Minimise siltation of wetlands and waterways during construction	<p>Erosion and sediment control measures will be designed and managed in accordance with IECA guidelines as prescribed in the relevant project approvals, to prevent sedimentation run-off into Caley Valley Wetlands and Saltwater Creek during construction.</p> <p>Where possible, designs should limit the creation of suitable Cane Toad breeding areas (e.g. sediment fences).</p> <p>Inspect the integrity of sediment barriers daily during construction works. Regularly re-assess the effectiveness of the location and design of sediment barriers and update as necessary.</p> <p>Vegetation clearing and construction activities adjacent to the Caley Valley Wetlands, and at Saltwater Creek, are to occur in the dry season only (after August).</p>	Siltation of the Caley Valley Wetlands or Saltwater Creek in, or adjacent to the Project Area	Investigate source of siltation, implement appropriate corrective measures and report as per environmental approval conditions and CEMP requirements, if required.

Goal (Impact)	Performance Criteria	Management Measures	Trigger	Corrective Action
Minimise water nutrient enrichment	Water nutrient enrichment	No use of fertilisers during rehabilitation activities. No untreated sewage will be stored in areas that could contaminate waterways during flooding events. Food wastes will be carried offsite for disposal.	>20% increase in the nutrient (NPK) content of Caley Valley Wetland or Saltwater Creek waters in or adjacent to the Project Area	Investigate source of siltation, implement appropriate corrective measures and report as per environmental approval conditions and EMP requirements, if required
Minimise predation risk by invasive mammals	No increase in fox and cat numbers in the Project Area	A Pest Management Plan (PMP) will be developed and implemented prior to construction, including measures to control invasive foxes and cats. The PMP will be developed in conjunction with neighbouring land owners, and will target, fixed sites, waterway crossings and south-eastern edge of the Caley Valley Wetlands.	>10% increase in the population of each invasive predator species over any 5 year period	Increase invasive predator management efforts, in conjunction with neighbouring land owners.
Reduce weed competition	Eliminate Parkinsonia, Prickly Acacia, and other declared pest plant species from the Project Area and adjacent areas	Domestic animals will not be permitted into the Project area. Weed control will focus on eradicating <i>Parkinsonia aculeata</i> (Parkinsonia) and <i>Vachellia nilotica</i> (Prickly Acacia) from the Project Area and adjacent areas, during construction and operations.	Presence of Parkinsonia, Prickly Acacia, and other declared pest plant species at any time	Increase weed management efforts, in conjunction with neighbouring land owners, where relevant.

Goal (Impact)	Performance Criteria	Management Measures	Trigger	Corrective Action
Eliminate trampling of nests	No nests trampled	<p>All areas suitable for nesting in the south-eastern edge of the Caley Valley Wetlands will be surveyed by a suitably qualified person, prior to vegetation clearing at any time of year. Nests observed in, and adjacent to, the Project Area will be marked and mapped, appropriately fenced, and monitored during construction works. Marking of nests will occur from a distance of at least 5 m, to ensure the adult isn't flushed whilst doing so. Marking will consist of a series of four clearly visible flags surrounding the nest, each displaying a direction and bearing.</p> <p>Buffer areas around nests are to be demarcated using high visibility tape, and communicated as no-go zones until eggs have hatched and juveniles have dispersed into adjacent, suitable, undisturbed habitat.</p> <p>Access is to occur along designated access tracks only.</p> <p>Vegetation clearing and construction activities adjacent to the known Australian Painted Snipe habitat are to occur outside the known breeding season (May to October).</p>	Trampling of a nest	<p>Complete an incident report and notify DoEE and DES.</p> <p>Review adherence to control procedures to ensure compliance. Take remedial action where compliance has not been adhered to. Increase training to ensure breach does not re-occur.</p>

Goal (Impact)	Performance Criteria	Management Measures	Trigger	Corrective Action
Minimise the risk of machinery and light vehicle strike	No death or injury due to machinery or light vehicle strike during construction and operations	<p>Suitably qualified spotter-catcher(s) will be present when all earthworks or drainage activities are occurring in and adjacent to the Caley Valley Wetlands and Saltwater Creek. If an Australian Painted Snipe is sighted in the work area, all work will cease until the Australian Painted Snipes move out of the area of work. In addition, speed limits will be reduced to 20 km/h in areas adjacent to known habitat.</p> <p>Earthworks in the south-eastern edge of the Caley Valley Wetlands and at Saltwater Creek will occur slowly and in a sequential pattern, to allow Australian Painted Snipes the opportunity to disperse from work areas, ahead of machinery.</p> <p>Vehicles and plant will drive on pre-determined roads only, and adhere to all speed limits, which will be clearly signposted.</p>	Machinery or light vehicle strike during clearing and grubbing	<p>Incidents will be reported to the site ER as soon as possible. DoEE and DES will be notified within 24 hours.</p> <p>Depending on the extent of injuries, any injured Squatter Pigeon will be either taken to the nearest qualified veterinary practitioner or wildlife carer, or humanely euthanised on site by a suitably qualified person (see Section 11.3).</p>
		<p>All relevant site personnel, including contractors, will be made aware of the locations of Squatter Pigeon populations and the propensity of this species to feed on dusty roads and freeze when threatened.</p> <p>Identification posters for all threatened species with the potential to occur in the Project Area will be installed in prominent positions at each work site.</p> <p>Vehicles and plant will drive on pre-determined roads only, and adhere to all speed limits, which will be clearly signposted.</p>	Light vehicle or machinery strike during other activities	<p>Complete an incident report and notify DES and DoEE.</p> <p>Depending on the extent of injuries, any injured Australian Painted Snipe will be either taken to the nearest qualified veterinary practitioner or wildlife carer, or humanely euthanised on site by a suitably qualified person (see Section 11.3).</p>
Minimise noise and vibration disturbance	Minimal noise and vibration impacts in surrounding habitat	<p>Noise and vibration-causing construction activities should be limited as much as possible within 500m of Caley Valley Wetlands or known Australian Painted Snipe habitat.</p> <p>Ensure all plant and equipment is serviced and maintained to minimise machinery noise.</p>	Excessive noise or vibration that causes Australian Painted Snipe to abandon suitable habitat within Caley Valley Wetland.	Investigate source of disturbance and implement controls, where possible. Report as per environmental approval conditions and CEMP requirements, if required. Update SMP to increase the buffer distance where control procedures

Goal (Impact)	Performance Criteria	Management Measures	Trigger	Corrective Action
	No abandonment of Australian Painted Snipe nests due to noise and vibration	Noise and vibration-causing construction activities are to be limited as much as possible within 500 m of a known active Australian Painted Snipe nest. Nesting sites are to be verified by a suitably qualified person. Where possible vegetation clearing and construction activities adjacent to the known Australian Painted Snipe habitat are to occur from May to October, outside the known breeding season.	Abandonment of a Australian Painted Snipe nest due to noise and vibration	have been complied with and proven to be inadequate.
Minimise light spill	Minimal light spill into known Australian Painted Snipe habitat during works	Install light controlling devices to deflect construction lighting away from habitat adjacent to the Project Area in the south-eastern section of the Caley Valley Wetlands (including Saltwater Creek). Install light controlling devices to deflect construction lighting away from Saltwater Creek.	Direct light spill >50 m into known Australian Painted Snipe habitat or within 50 m of Saltwater Creek	Upgrade light controlling devices, or adjust location of light, to reduce light spill and lighting levels below trigger levels. Where corrective action is not immediately taken, this will be reported as an incident and managed in accordance with Adani's incident management procedure
	Construction night works are limited to minimum disturbance activities in or adjacent to known Australian Painted Snipe habitat.	Clearing and piling is not to be undertaken at night within or adjacent to Australian Painted Snipe habitat	Clearing or piling occurs at night within or adjacent to Australian Painted Snipe habitat	Review adherence to control procedures to ensure compliance. Take remedial action where a compliance breach has occurred.

Goal (Impact)	Performance Criteria	Management Measures	Trigger	Corrective Action
Eliminate entrapment	No entangled Australian Painted Snipes	No sharp equipment with the potential to entangle fauna (e.g. wire, mesh fencing) is to be left unattended and uncovered (including overnight) during construction activities adjacent to the Caley Valley Wetlands and Saltwater Creek.	Australian Painted Snipe entangled	<p>Complete an incident report and notify DoEE and DES if death or injury occur.</p> <p>Review materials storage procedures and fencing protocols, and implement actions to ensure entanglement does not re-occur.</p> <p>Depending on the extent of injuries, any injured Australian Painted Snipe will be either taken to the nearest qualified veterinary practitioner or wildlife carer, or humanely euthanised on site by a suitably qualified person (see Section 11.3).</p>

#### 9.4.5 Monitoring

Pre-clearance surveys will be undertaken at suitable times to detect the species, and identify and map suitable habitat in the development area, prior to any clearing or associated works occurring. The surveys will target suitable habitat for this species within and directly adjacent to the active rail development area. This Management Plan must be revised and submitted to DoEE within three months following pre-clearance surveys.

Survey Methodology: The Australian Painted Snipe is a distinctive bird and unlikely to be confused with any other species (Marchant and Higgins 1993).

The recommended survey methods for Australian Painted Snipe according to the National Bird Survey Guidelines (DEWHA 2010) are targeted stationary observations at dawn and dusk in suitable foraging locations in wetlands, and area searches or transects through suitable wetlands to sight and flush individuals. A brief spotlight search shortly after dusk may also detect birds. Due to the cryptic nature of this species, and difficulty in detecting it, the Guidelines recommend a minimum of 10 hours of targeted dawn and dusk surveys over 5 days, and a minimum of 10 hours of areas searches or transects over three days for an area of less than 50 ha to detect this species. Trials of broadcast (playback) have not been successful to date (DEWHA 2010).

Targeted searches for Australian Painted Snipe will occur when the Caley Valley Wetlands are holding water (but not flooded) and the species is likely to be present based on migratory patterns (February to August). Targeted stationary observations at dawn and dusk, and area searches to sight and flush individuals are the survey methods that will be used for this project to detect Australian Painted Snipes in the Caley Valley Wetlands and other wetlands in and adjacent to the Project Area. All surveys for Australian Painted Snipe will be undertaken by a suitably qualified ornithologist(s) with experience in detecting the Australian Painted Snipe.

Design of the on-going monitoring program, including the location and extent of sites, will be determined by a suitably qualified person to ensure that sufficient data are collected to quantify likely impacts resulting from the proposed action, and to determine appropriate habitat management goals. The monitoring program will include both impact and control sites to monitor the progress of recovery, including effectiveness of management actions, and adapt if necessary. Annual monitoring will occur for the duration of railway activities.

The potential impacts of the proposed activities will be monitored in accordance the monitoring program outlined in Table 63.



Table 63 Details of monitoring program for the Australian Painted Snipe

Performance Criteria	Monitoring Program	Trigger for Corrective Action	Outcomes
Identify populations within and immediately adjacent to the Project Area	Pre-clearance targeted surveys for Australian Painted Snipes targeting wetland habitat for this species within and directly adjacent to the Project Area. Surveys are to be undertaken between February and August, when the Caley Valley Wetlands contain ample water but are not flooded. Surveys will be undertaken using the survey methods outlined above.	N/A	Record and map Australian Painted Snipe locations in the vicinity of the Project Area, to ensure appropriate mitigating management measures are implemented.
Rehabilitation of disturbed areas that are no longer required for operations	BioCondition Assessments and photo monitoring will be undertaken prior to construction activities and then annually after rehabilitation to determine the condition of Australian Painted Snipe habitat in proposed rehabilitation and control sites. For each proposed rehabilitation area, a minimum of two permanent monitoring plots will be located in the rehabilitated area and a minimum of two permanent monitoring plots will be located in matched habitat between 1 km and 2 km from the Project Area (control areas). In addition to these Assessments, there will be annual targeted searches for Australian Painted Snipes within each of the rehabilitated areas.	Rehabilitated areas fail to reach 70% of baseline and control scores within 15 years	Baseline habitat quality for comparison during monitoring. Ability to assess rehabilitation quality against rehabilitation and offset requirements. Adani to review monitoring results and report annually and revise management actions if any trigger is identified
Manage ASS in accordance with accepted guidelines.	Complete a baseline acid sulphate soils survey in areas where the Project has the potential to disturb acid sulphate soils, focusing on potential habitat for the Painted Snipe. This survey is to be undertaken by a suitably qualified soil scientist(s). Monitor the effectiveness of soil treatment practices in accordance with an approved ASS Management Plan.	Baseline ASS risk to be determined prior to disturbance.	Data available to guide management practices for ASS treatment.
No permanent changes to waterway hydrology in Australian Painted Snipe habitat	Design and implement a water quality monitoring program in accordance with the Water Quality Management Plan focusing on water flow and profile, water nutrient levels, and Total Suspended Sediments (TSS). The monitoring program will outline the need to adequately assess seasonal and spatial variation in surface water movement across the Project Area and the influence of this on waterway sedimentation. The monitoring program will ensure that the south-eastern edge of the Caley Valley Wetlands and Saltwater Creek, which are likely habitat for the Eastern Curlew are prioritised for monitoring.	After construction and rehabilitation, the waterway profile and flow is significantly altered and Australian Painted Snipe no longer inhabit the waterway	Ensure compliance with Coordinator-General conditions. Baseline water quality for comparison during monitoring.

Performance Criteria	Monitoring Program	Trigger for Corrective Action	Outcomes
Minimise siltation of wetlands and waterways during construction	Design and implement a monitoring program, in accordance with the Water Quality Management Plan, that targets dust and heavy metal toxicity in the Caley Valley Wetlands adjacent to the Project Area, and Saltwater Creek. The monitoring program will target key Australian Painted Snipe feeding areas with low flow and close proximity to the Project Area. Water and sediment samples will be collected at each site to test for the presence of 15 heavy metals. A dust particulate sampler will also be erected at each site to compare aerial collection of coal dust and heavy metal values with waterway monitoring results. Sediment and dust samples will be assessed for baseline measures, and then annually at low flow periods.  All monitoring will be undertaken in line with the Queensland's Water Quality Guidelines 2009 and ANZECC/ARMCANZ Interim Sediment Quality Guidelines.	Siltation of the Caley Valley Wetlands or Saltwater Creek in, or adjacent, to the Project Area	Adani to review monitoring results and report annually and revise management actions if any trigger is identified.
Emissions (i.e. dust, coal and heavy metals) do not degrade water quality		Emissions settlement in water breach industry standards	
Water nutrient enrichment		>20% increase in the nutrient (NPK) content of Caley Valley Wetland or Saltwater Creek waters in or adjacent to the Project Area	
No nests trampled	Breaches reported to DES by onsite ER.	Trampling of a nest	Compliance with Coordinator-General conditions and SMP.
No death or injury due to machinery or light vehicle strike during construction and operations		Machinery or light vehicle strike	
Minimal death or injury due to train strike during operations		Australian Painted Snipe located inside the fenced area of the railway corridor	
No entangled Australian Painted Snipes		Australian Painted Snipe entangled	
No increase in fox and cat numbers in the Project Area	Baseline and annual monitoring of feral cat and fox populations along the south-east edge of the Caley Valley Wetlands and the Saltwater Creek crossing. Monitoring will include track and scat monitoring and photo monitoring using baited infrared cameras.	>10% increase in the population of each invasive predator from baseline scores	Ensure compliance with PMP.

Performance Criteria	Monitoring Program	Trigger for Corrective Action	Outcomes
Eliminate Parkinsonia, Prickly Acacia, and other declared pest plant species from the Project Area and adjacent areas	Annual monitoring (including photo monitoring) of weeds, including Parkinsonia and Prickly Acacia, in the Project Area, and weed development in Australian Painted Snipe habitat adjacent to the Project Area.	Presence of Parkinsonia, Prickly Acacia, and other declared pest plant species at any time	Compliance with Coordinator-General conditions and SMP.
Minimal noise and vibration impacts in surrounding habitat	Baseline monitoring by a suitably qualified person(s), of the noise and vibration intensity in surrounding habitat caused by significant vibration-causing construction activities (e.g. drilling, earthworks and movement of large machinery). Daily monitoring by onsite ER of active construction footprint for significant noise and vibration-causing construction activities.	Active construction activities that cause significant noise and vibrations in the surrounding habitat are spread over >500 m stretch at any given time, with less than 1 km gap between significant noise and vibration-causing activities	
No abandonment of Australian Painted Snipe nests due to noise and vibration	Targeted surveys for potential Australian Painted Snipe nesting sites in suitable habitat within the Project Area and Adjacent Habitat, to a distance of 1 km.	Abandonment of a Australian Painted Snipe nest due to noise and vibration	Compliance with Coordinator-General conditions and SMP.
Minimal light spill into known Australian Painted Snipe habitat during works	Regular monitoring by onsite ER.	Direct light spill >50 m into known Australian Painted Snipe habitat or within 50 m of Saltwater Creek	
Construction night works are limited to minimum disturbance activities in or adjacent to known Australian Painted Snipe habitat.		Clearing or piling occurs at night within or adjacent to Australian Painted Snipe habitat	

## 9.5 *Acanthophis antarcticus* (Common Death Adder)

### 9.5.1 Status

EPBC Act = Not Listed

NC Act = Vulnerable



**Plate 12:** Common Death Adder

### 9.5.2 Ecology and Distribution

#### Description of the Species:

The Common Death Adder is a very stout (short and fat) snake, with a rapidly tapering tail. The body colour can vary from orange-red to grey, with alternating light and dark coloured bands. The head is broad and triangular, and very distinct from the neck, and the lips are banded with dark and pale bars. The segmented tail tip can vary from cream to black, and is worm-like in appearance. The average length of the death adder is 40 cm Snout-Vent Length (SVL), although individuals up to 100 cm long have been recorded (Wilson and Swan 2008, DEHP 2015d, Carpenter *et al.* 1978).

#### Distribution:

The Common Death Adder has a widespread distribution in two disjunct populations: (1) in Eastern Australia from the Northern Territory side of the Gulf of Carpentaria to eastern Victoria; and (2) in southern Australia from the Eyre peninsular almost to Perth (Wilson and Swan 2008, DEHP 2015d). This species was once abundant, but has experienced a dramatic reduction in numbers across its range (DEHP 2015d).

Populations of the Common Death Adder are sparsely distributed across landscapes. Where it is found, this species can be locally common (Wilson pers. Comm.). However, locally common populations can crash dramatically; with death adders becoming very rare at localities where they were long considered an abundant species e.g. the southern Brigalow Belt, and the D'Aguillar Range in South-east Queensland (Wilson 2015).

#### Habitat for the Species:

The Common Death Adder is found in a wide variety of habitats with deep leaf litter, including rainforests, wet sclerophyll forests, woodland, grasslands, chenopod dominated shrublands, and coastal heathlands (DEHP 2015d). The importance of these habitats to this species is not known (DEHP 2015e).

#### Regional Ecosystems Associations:

The Common Death Adder does not have strong associations with REs. It can occur in any wooded ecosystem (remnant or regrowth) that develops a leaf litter layer, particularly where a healthy shrub layer exists.

#### Essential Microhabitat:

The Common Death Adder is strongly associated with leaf litter, and shrubs and tussocks that offer vegetative ground cover (Ehmann 1992, DEHP 2015d). Therefore, it is mainly reliant on wooded ecosystems. This is a highly cryptic species that spends most of its time concealed under leaf litter (Cogger 2000, Wilson and Swan 2008).

### Known Populations and Relationships within the Project Area:

The Common Death Adder is known to occur north and south of the Project Area, and on the Bowen River adjacent to the Project Area (Richardson 2006, DEHP 2015f). Three specimens were recorded within 10 km of the Project area in November 2014; 6 km west of Weetalaba South (Wilson 2015). This secretive species is often overlooked and has the potential to occur in any wooded habitat with a leaf litter layer within the Project Area (Adani 2013). The REs that occur in and adjacent to the Project Area that are not considered suitable habitat for the Common Death Adder are presented in Table 64.

**Table 64 Wooded Regional Ecosystem that are not considered to be suitable habitat for the Common Death Adder**

RE	Short Description
11.1.1	<i>Sporobolus virginicus</i> grassland on marine clay plains
11.1.2	Samphire forbland on marine clay plains
11.2.1	<i>Corymbia tessellaris</i> woodland on flat coastal dunes
11.2.2	Complex of <i>Spinifex sericeus</i> , <i>Ipomoea pes-caprae</i> and <i>Casuarina equisetifolia</i> grassland and herbland on fore dunes
11.3.3x1	<i>Atriplex spp.</i> , <i>Sclerolaena spp.</i> +/- <i>Astrelba spp.</i> +/- short grasses on scalded Cainozoic alluvial plains.
11.3.25f	Riverine wetland or fringing riverine wetland. Main river channels. Open water or exposed stream bed and bars.
11.3.27 (all subsets)	Freshwater wetlands
11.3.31	<i>Ophiuros exaltatus</i> , <i>Dichanthium spp.</i> grassland on alluvial plains
11.4.4	<i>Dichanthium spp.</i> , <i>Astrelba spp.</i> grassland on Cainozoic clay plains
11.8.11	<i>Dichanthium sericeum</i> grassland on Cainozoic igneous rocks
11.9.3	<i>Dichanthium spp.</i> , <i>Astrelba spp.</i> grassland on fine-grained sedimentary rocks

The specific locations of likely Common Death Adder habitat within the Project Area are specified in Table 65.

**Table 65 Likely Common Death Adder habitat within the Project Area**

Kilometre Points (KP)					
-1-6	21-25	103-109	173-193	238-244	294-300
-9	26-55	110-137	195-213	246-253	
-10-9	56-57	138-142	214-217	257-261	
12-14	60-87	147-150	219-222	262-265	
19-20	88-102	151-170	223-228	274-291	

### Movement Patterns:

The Common Death Adder is a slow-moving sedentary snake that feeds during the day and moves between shelters at night, although night activity is dependent on temperature (DEHP 2015d, DEHP

2015e). The species is secretive and relies on cryptic colouration to avoid detection (DEHP 2015d). The Common Death Adder lies motionless and partly concealed under leaf litter and low vegetation, where it uses its worm-like tail to lure prey within striking range of its head (Wilson and Swan 2010, Carpenter *et al.* 1978).

On warm evenings, Common Death Adders are known to move slowly across roads and other warm surfaces. This species is most commonly encountered in January, and rarely recorded in winter (ALA 2015). Common Death Adders are most likely to be active between September and March, with group aggregations known to occur in November near the Project Area (DSITIA 2015, Wilson 2015).

#### **Breeding Biology:**

The Common Death Adder is live-bearing with litter sizes generally between 10 and 20, which are born in late summer or early autumn (DEHP 2015d, DEHP 2015e). Females mature at 3.5 years of age, and may only reproduce every second year (Shine 1980).

#### **Feeding Ecology:**

Common Death Adders have a broad diet, although they generally focus on reptiles and frogs as juveniles, and mammals and birds as adults (DEHP 2015d, Shine 2000).

### **9.5.3 Threats and Impacts**

The Common Death Adder is known to be threatened by loss of wooded habitat across its range, including regrowth habitat (DERM 2010, Richardson 2006), degradation of habitat via the loss of thick shrubs, leaf litter and other ground-level shelters through inappropriate grazing and fire regimes (DERM 2010, DEHP 2015d, QPWS 2001, Richardson 2006), road mortality (DERM 2010, and death from attempted Cane Toad *Rhinella marina* ingestion (Covacevich and Archer 1975, Wilson and Knowles 1988 DEHP 2015d). This species is also suspected to be threatened by predation from feral cats, foxes and pigs (QPWS 2001, Richardson 2006), habitat degradation by feral pigs (DEHP 2015d), deliberate killing of snakes (QPWS 2001), trampling by livestock (Ehmann 1992), and mortality from preying on poisoned rodents, e.g. House Mouse (Gilbertson 1981, DEHP 2015e).

Table 66 outlines all the potential impacts of the project that are applicable to Common Death Adders, taking into account recovery plans (Cogger 1993, Richardson 2006), Condition 5c of the EPBC Approval, and Appendix 1 of the Coordinator-General's Report. The construction footprint and surrounding area are not considered to support an 'important population' or 'habitat critical to the survival' of Common Death Adders.

**Table 66 Potential impacts from the Project on Common Death Adders**

Impacts	Potential impacts associated with the Project	Project phase
Vegetation Clearing/ Habitat Loss	Removal of Common Death Adder Habitat.	Pre-construction, Construction
Inappropriate Stock Grazing Regimes	Degradation of habitat due to loss of ground cover and thick shrubs. Mortality due to stock trampling. No livestock will be grazed in the Project Area during construction or operations, due to exclusion fencing.	Impact unlikely
Trampling by Livestock		
Grazing by Feral Herbivores	Degradation of habitat due to loss of ground cover and thick shrubs, and death from trampling by hard-hoofed feral herbivores such as pigs and goats.	Construction, Operations
Inappropriate Fire Regimes and Bushfires	Degradation of habitat due to widespread loss of leaf litter, shrubs, and woody ground cover shelters.	Construction, Operations
Vehicle and Train Strike	Mortality and injury due to the slow movement of Common Death Adders across warm surfaces such as roads and railway lines in the early evening, and the reluctance of this species to move away from approaching machinery and livestock.	Construction, Operations
Poisoning	Death from ingestion of Cane Toads, which use linear infrastructure and pathways for dispersal, and can increase in abundance in degraded waterways.	Construction, Operations
	Death from ingestion of poisoned rodents such as the house mouse.	
Predation by Invasive Mammals	Loss of individuals to predation by feral foxes, cats, and pigs which are known to inhabit the area traversed by the Project and use fauna crossings as funnel points for attacks.	Construction, Operations
Killing of Snakes	Mortality from intentional killing by people.	Construction, Operations
Earthworks	Mortality due to machinery strike.	Construction
Noise and Vibration	Temporary loss of useable habitat due to vibration disturbance. Noise does not impact on snakes.	Construction
Emissions i.e. dust	Dust emissions from coal transport may potentially reduce habitat quality for the Common Death Adder, in and immediately adjacent to the Project Area. However, dust is unlikely to be a direct concern for Common Death Adders.	Construction Operation
Light Spill	Temporary loss of useable habitat due to light disturbance at night. Permanent lighting is not proposed along the railway.	Construction
Waterway Crossings	Temporary loss and degradation of waterways. This is unlikely to adversely impact the Common Death Adder, which is not known to use rivers and creeks for drinking water, or feed predominately on species that will be adversely affected by temporary loss and degradation of waterways.	Impact unlikely
Weeds	Degradation of habitat. Weeds may adversely impact the Common Death Adder through changes to leaf litter and ground vegetation cover.	Construction, Operations
Entrapment	Injury or mortality due to entanglement in open cavities and pits.	Construction
Connectivity	Loss of connectivity between suitable habitats.	Pre-construction, Construction, Operations

#### **9.5.4 Mitigation and Management Measures**

Table 67 outlines all relevant management measures for the Common Death Adder that are consistent with conservation advice for this species and meet the conditions of the EPBC Approval and Coordinator-General's Report. There is currently no recovery plan for the Common Death Adder. All appropriate management measures will be implemented during construction and operations in habitats known or likely to support Common Death Adders. Common Death Adders sighted outside known populations during construction and operations will be photographed and reported to the ER, with the photograph to be sent to Queensland Museum for identification confirmation. Where additional populations are identified, DES will be notified of locations and appropriate management actions will be implemented.



Table 67 Mitigation and management measures for the Common Death Adder

Goal (Impact)	Performance Criteria	Management Measures	Trigger	Corrective Action
Minimise loss of habitat through vegetation clearing	Rehabilitation of disturbed areas that are no longer required for operations	Progressive rehabilitation of disturbed areas will be undertaken as soon as possible after the completion of construction activities. Vegetation rehabilitation will use locally-sourced seeds for native grasses, herbs and woody plants. Local leaf litter, rocks and woody debris will be salvaged and stockpiled prior to construction, to be replaced during rehabilitation.	Rehabilitated areas fail to reach 70% of baseline and control scores within 15 years	An annual rehabilitation monitoring report will be sent to DES. Revise and implement an updated Rehabilitation Management Plan if targets are not achieved within 15 years.
Reduce the risk of trampling by feral herbivores	No increase in goat and rabbit numbers in the Project Area	A Pest Management Plan (PMP) will be developed and implemented prior to construction, including measures for monitoring and controlling invasive rabbits, goats, foxes, cats and pigs. The PMP will be developed in conjunction with neighbouring land owners, and will target waterway crossings, habitat edges and fixed sites such as workers camps.	>10% increase in the population of each feral herbivore species from baseline scores	Increase goat and rabbit management efforts, in conjunction with neighbouring land owners.
Reduce degradation of habitat by feral herbivores			>10% increase in the population of each invasive predator species from baseline scores	
Minimise predation risk by invasive mammals	No increase in fox, cat and pig numbers in the Project Area	Domestic animals will not be permitted into the Project area. Weed control will focus on eradicating declared pest plant species from the Project Area and adjacent areas, during construction and operations.		Increase invasive predator management efforts, in conjunction with neighbouring land owners.
Reduce weed competition	Eliminate declared pest plant species from the Project Area and adjacent areas		Presence of declared pest plant species in, or adjacent to the Project Area	Increase weed management efforts, in conjunction with neighbouring land owners, where relevant.

Goal (Impact)	Performance Criteria	Management Measures	Trigger	Corrective Action
Reduce the risk of poisoning by ingestion of poisoned rodents	No mortality due to ingestion of poisoned rodents	Poison baits will not be used for control of invasive rodents (rats and mice) in the Project Area. Where rodent control is required, baited live capture traps will be deployed, and cleared and monitored daily.	Mortality due to ingestion of poisoned rodents	<p>Complete an incident report and notify DoEE and DES.</p> <p>Depending on the extent of injuries, any injured Common Death Adder will be either taken to the nearest qualified veterinary practitioner or wildlife carer, or humanely euthanised on site by a suitably qualified person (see Section 11.3).</p> <p>Euthanised snakes will be retained and lodged with the Queensland Museum along with GPS data, date and habitat notes.</p>
Minimise the risk of light vehicle and machinery strike	No death or injury due to light vehicle or machinery strike during construction and operations	<p>Suitably qualified spotter-catcher(s) will be present when all earthworks and vegetation clearing are occurring in habitat known or likely to contain Common Death Adders. Daily pre-clearing surveys will be undertaken by suitably qualified spotter-catcher (s), prior to construction activities, to: (1) find and relocate any Common Death Adders within and directly adjacent to all areas where vegetation clearing and construction works will occur, and (2) identify all areas likely to be sheltering Common Death Adders prior to construction activities each day. Manipulation of all potential Common Death Adder shelters by machinery operators will be under the strict supervision and direction of the spotter-catcher(s). In addition, speed limits will be reduced to 20 km/h in areas adjacent to known habitat.</p>	Light vehicle or machinery strike during clearing and grubbing	<p>Incidents will be reported to the site ER as soon as possible. DoEE and DES will be notified within 24 hours.</p> <p>Depending on the extent of injuries, any injured Common Death Adder will be either taken to the nearest qualified veterinary practitioner or wildlife carer, or humanely euthanised on site by a suitably qualified person (see Section 11.3).</p>
		<p>Prior to site entry, all relevant site personnel, including contractors, will be made aware of the propensity of Common Death Adders to slowly cross warm surfaces such as roads and tracks, on warm and humid evenings.</p>	Light vehicle or machinery strike during other activities	<p>Complete an incident report and notify DoEE and DES.</p> <p>Depending on the extent of injuries, any injured Common Death Adder will be either taken to</p>

Goal (Impact)	Performance Criteria	Management Measures	Trigger	Corrective Action
		<p>Identification posters for all threatened species with the potential to occur in the Project Area will be installed in prominent positions at each work site.</p> <p>Vegetation clearing will occur slowly and in a sequential pattern, to allow Common Death Adders the opportunity to disperse from work areas, ahead of machinery.</p> <p>Vehicles and plant will drive on pre-determined roads only, and adhere to all speed limits, which will be clearly signposted.</p>		<p>the nearest qualified veterinary practitioner or wildlife carer, or humanely euthanised on site by a suitably qualified person (see Section 11.3).</p> <p>Euthanised snakes will be retained and lodged with the Queensland Museum along with GPS data, date and habitat notes.</p>
<p>Minimise risk of train strike</p>	<p>Minimal death or injury due to train strike during operations</p>	<p>In areas where designated crossing points coincide with known Common Death Adder habitat fencing should consist of smooth material to a height of 40 cm. The material will be buried 10 cm into the earth. This will assist in funnel Common Death Adders to designated crossing areas and in turn minimise the risk of train strike. The fence line will be regularly monitored for potential breaches.</p> <p>An identification poster for all threatened species with the potential to occur in the Project Area will be installed in the train cabin, and prominently in site offices.</p> <p>Additional sightings of Common Death Adders will be reported to the ER and confirmed by a suitably qualified and experienced herpetologist for verification.</p>	<p>Any terrestrial snake located inside the fenced area of the railway corridor traversing Common Death Adder habitat</p> <p>Common Death Adder located inside the fenced area of the railway corridor</p>	<p>Search for and remedy potential breach areas in both railway fences within 500 m of the location.</p> <p>Complete an incident report and notify DoEE and DES.</p> <p>Depending on the extent of injuries, any injured Common Death Adder will be either taken to the nearest qualified veterinary practitioner or wildlife carer, or humanely euthanised on site by a suitably qualified person (see Section 11.3).</p> <p>Euthanised snakes will be retained and lodged with the Queensland Museum along with GPS data, date and habitat notes.</p>

Goal (Impact)	Performance Criteria	Management Measures	Trigger	Corrective Action
Eliminate intentional killing of snakes	No mortality or injury due to intentional killing	<p>Prior to site entry, all relevant site personnel, including contractors, will undergo an induction where they are informed about Common Death Adder identification, the protected status of this species, and the ecological and legal consequences of intentionally killing this species.</p> <p>Identification posters for all threatened species with the potential to occur in the Project Area will be installed in prominent positions at each work site.</p>	Mortality or injury due to intentional killing	<p>Complete an incident report and notify DoEE and DES.</p> <p>Depending on the extent of injuries, any injured Common Death Adder will be either taken to the nearest qualified veterinary practitioner or wildlife carer, or humanely euthanised on site by a suitably qualified person (see Section 11.3).</p> <p>Euthanised snakes will be retained and lodged with the Queensland Museum along with GPS data, date and habitat notes.</p>
Minimise vibration disturbance	Minimal noise and vibration impacts in breeding habitat	Noise and vibration-causing construction activities should be limited as much as possible within 200 m of known habitat. Ensure all plant and equipment is serviced and maintained to minimise machinery vibration.	Excessive noise or vibrations that disturbs breeding of Common Death Adder	Investigate source of disturbance and implement controls, where possible. Report as per environmental approval conditions and CEMP requirements, if required.
Minimise emissions (dusts)	Limit disturbance from emissions on the photosynthetic ability of grasses in Death Adder habitat	<p>Dust emissions will be managed in accordance with the Dust and Coal Dust Management Plans, and should include but not be limited to:</p> <ul style="list-style-type: none"> <li>• Regular watering of dusty areas in accordance with Dust Management Plan.</li> <li>• Ensuring trains are not overloaded.</li> <li>• Use of veneers to minimise the loss of coal particles in transit.</li> </ul>	<p>Growth of grasses adjacent to the Project Area inhibited due to dust emissions</p> <p>Thresholds are outlined in the Dust Management Plan</p>	An annual monitoring report will be submitted to DoEE. Where monitoring shows a reduction in habitat condition due to dust emissions, investigate source of dust and upgrade strategies outlined in the Dust Management Plan to reduce dust emissions impacts on habitat.

Goal (Impact)	Performance Criteria	Management Measures	Trigger	Corrective Action
Minimise light spill	Minimal light spill into known Common Death Adder habitat adjacent works	Install light controlling devices to deflect construction lighting away from known Common Death Adder habitat.	Direct light spill >50 m into adjacent known Common Death Adder habitat	Upgrade light controlling devices, or adjust location of light, to reduce light spill and lighting levels below trigger levels. Where corrective action is not immediately taken, this will be reported as an incident and managed in accordance with Adani's incident management procedure.
Eliminate entrapment	No deaths or injuries from trapped Common Death Adders	<p>Wherever possible, all excavations should have ramped edges/ends no greater than 45 degrees.</p> <p>Fauna ramps (e.g. wooden planks) or earthen ramps will be installed in all cavities deeper than 20 cm, with smooth sides, to provide a means for trapped Common Death Adders (and other fauna) to escape. The fauna ramps or earthen ramps will be clearly marked and all construction staff will be informed of their purpose.</p> <p>All excavations in or adjacent to Common Death Adder habitat will be checked daily by a qualified spotter-catcher, including immediately prior to these cavities being filled in.</p>	Common Death Adder mortality or injury due to entanglement	<p>Complete an incident report and notify DoEE and DES if death or injury occur.</p> <p>Depending on the extent of injuries, any injured Common Death Adder will be either taken to the nearest qualified veterinary practitioner or wildlife carer, or humanely euthanised on site by a suitably qualified person (see Section 11.3).</p> <p>Euthanised snakes will be retained and lodged with the Queensland Museum along with GPS data, date and habitat notes.</p>

Goal (Impact)	Performance Criteria	Management Measures	Trigger	Corrective Action
Maintain connectivity	Connectivity between known Common Death Adder habitats on either side of the Project Area	In known Common Death Adder habitat, fauna passes will be incorporated into the railway design, which allow Common Death Adders to pass beneath the railway unimpeded. Waterway crossings may act as Common Death Adder fauna passes, where suitable vegetation and leaf litter cover are provided for the length of the fauna pass. The level of suitable cover will be assessed by a qualified herpetologist. The design of artificial fauna passes for Common Death Adders will incorporate suitable substrate, including leaf litter, and cover between connected habitats, and be approved by a qualified herpetologist. In known Common Death Adder habitat, fauna passes for this species will be spaced at intervals of less than 100 m to facilitate passage during fire and flood events.	No Common Death Adders observed using the fauna passage within 2 years of the completion of construction >10% reduction in riparian vegetation and leaf litter from baseline scores at waterway crossings in Common Death Adder habitat	Inform DES of monitoring results. Upgrade fauna passage design to ensure Common Death Adders are amenable to using fauna passes.

### 9.5.5 Monitoring

Pre-clearance surveys will be undertaken at suitable times to detect the species, and identify and map suitable habitat in the development area, prior to any clearing or associated works occurring. The surveys will target suitable habitat for this species within and directly adjacent to the Project Area. The SMP must be revised and submitted to DES within three months following pre-clearance surveys.

Survey Methodology: All survey techniques for Common Death Adders are likely to yield very low detection rates (DSITIA 2015). Nocturnal vehicle transects is the best method for detecting Common Death Adders (DSITIA 2015). However, the minimum effort required to detect the Common Death Adder is 500 km of vehicle transects over at least two nights in each of two separate survey periods (DSITIA 2015). Trapping arrays, particularly funnel trap arrays with drift fences, and raking of leaf litter at the base of trees, are additional survey approaches known to detect Common Death Adders in areas without formed tracks. However, the detection rates for these methods are very low, with Common Death Adders often not detected using these methods in areas they are known to inhabit, despite extensive trapping and search efforts. Nocturnal vehicle transects will yield much greater returns for effort than pitfall and funnel trap arrays (DSITIA 2015). If it is not feasible to invest the required quantity of nocturnal vehicle transects to detect Common Death, then the Common Death Adder should be assumed to be present where suitable habitat is present in the Project Area (DSITIA 2015).

Surveys for Common Death Adders should be undertaken after the first significant rainfall event from September to late November (Eyre *et al.* 2014), and again in January. Rainfall is a major trigger for increased reptile activity, and this is likely to be so for Common Death Adders. Therefore, conducting surveys immediately following rainfall events from September to late November, and when this species is most often encountered in January, is critical (Eyre *et al.* 2014).

Nocturnal vehicle transects will be the primary survey method used for detecting Common Death Adders for this Project. These surveys require well-maintained tracks with limited vegetation and debris, and should only be undertaken on warm humid nights by experienced herpetologists (DSITIA 2015). For each habitat, transects must be repeated over the same section(s) of road, and over multiple nights, covering at least 500 km of transects during two separate survey periods (DSITIA 2015). Funnel trap arrays with drift fencing, and raking of leaf litter at the base of trees are additional survey approaches that may supplement nocturnal driving searches in areas without formed tracks. However, the detection rate of Common Death Adders using these methods is low and a habitat cannot be assessed as unsuitable for Common Death Adders, using these methods.

Design of the on-going monitoring program, including the location and extent of sites, will be determined by a suitably qualified person to ensure that sufficient data are collected to quantify likely impacts resulting from the proposed action, and to determine appropriate habitat management goals. The monitoring program will include both impact and control sites to monitor the progress of recovery, including effectiveness of management actions, and adapt if necessary. Annual monitoring will occur for the duration of railway activities.

The potential impacts of the proposed activities will be monitored in accordance the monitoring program outlined in Table 68.

Table 68 Details of monitoring program for the Common Death Adder

Performance Criteria	Monitoring Program	Trigger for Corrective Action	Outcomes
Identify populations within and immediately adjacent to the Project Area	Pre-clearance targeted surveys for Common Death Adders targeting suitable habitat for this species within and directly adjacent to the Project Area. Surveys can be undertaken any time of the year. However, surveys will be most effective after significant rains from September to April, using the survey methods outlined above.	N/A	Record and map Common Death Adder locations in the vicinity of the Project Area, to ensure appropriate mitigating management measures are implemented.
Rehabilitation of disturbed areas that are no longer required for operations	BioCondition Assessments and photo monitoring will be undertaken prior to rehabilitation activities and then annually after rehabilitation to determine the condition of Common Death Adder habitat in proposed rehabilitation and control sites. For each proposed rehabilitation area, a minimum of two permanent monitoring plots will be located in the rehabilitated area and a minimum of two permanent monitoring plots will be located in matched habitat between 1 km and 2 km from the Project Area (control areas). In addition to these Assessments, there will be annual targeted searches for Common Death Adders within each of the rehabilitated areas.	Rehabilitated areas fail to reach 70% of baseline and control scores within 15 years	Baseline habitat quality for comparison during monitoring. Ability to assess rehabilitation quality against rehabilitation and offset requirements. Adani to review monitoring results and report annually and revise management actions if any trigger is identified.
No increase in feral goat, rabbit, pig, fox and cat numbers in the Project Area	Baseline and annual monitoring of feral goat, pig, fox and cat populations at waterway and artificial fauna crossings in Common Death Adder habitat. Monitoring will include track and scat monitoring, photo monitoring using baited infrared cameras, and auditory and active monitoring of toads during summer rainfall periods.	>10% increase in the population of each invasive species, from baseline scores	Ensure compliance with PMP.
Minimise increase to Buffel Grass prevalence and other declared pest plant species from the Project Area and adjacent areas	Annual monitoring (including photo monitoring) of weeds in the Project Area, and weed development in Death Adder habitat adjacent to the Project Area. Monitoring will occur at the optimal time for detecting and identifying weed species.	Presence of declared pest plant species in, or adjacent to the Project Area	



Performance Criteria	Monitoring Program	Trigger for Corrective Action	Outcomes
No mortality due to ingestion of poisoned rodents	Breaches reported to DES by onsite ER.	Mortality due to ingestion of poisoned rodents	Compliance with Coordinator-General conditions and SMP.
No bushfires sparked by project activities		Wildfire sparked by construction activities	
No death or injury due to light vehicle or machinery strike during construction and operations		Light vehicle or machinery strike	
Minimal death or injury due to train strike during operations		Any terrestrial snake located inside the fenced area of the railway corridor traversing Common Death Adder habitat Common Death Adder located inside the fenced area of the railway corridor	
No mortality or injury due to intentional killing		Mortality or injury due to intentional killing	
No deaths or injuries from trapped Common Death Adders		Common Death Adder mortality or injury due to entanglement	
Minimal light spill into habitat known Common Death Adder habitat	Regular monitoring by onsite ER.	Direct light spill >50 m into known Common Death Adder habitat	
Minimal growth of vegetation immediately adjacent to the railway	Annual monitoring (including photo monitoring) of vegetation growth adjacent to the railway at the time of maximum vegetation growth i.e. midsummer.	Growth of vegetation within 5 m of the centre of the railway	Knowledge of bush fire risk along railway corridor.

Performance Criteria	Monitoring Program	Trigger for Corrective Action	Outcomes
Minimal noise and vibration impacts in surrounding habitat	<p>Baseline monitoring by a qualified geologist, of the vibration intensity in surrounding habitat caused by significant vibration-causing construction activities (e.g. drilling, earthworks and movement of large machinery).</p> <p>Daily monitoring by onsite ER of active construction footprint for significant vibration-causing construction activities.</p>	Excessive noise or vibrations that disturbs breeding of Common Death Adder	Compliance with Coordinator-General conditions and SMP.
Limit disturbance from emissions (dust) on photosynthetic ability of grasses in Common Death Adder habitat	<p>A series of 5 grass monitoring plots (1 m x 1 m) will be established within 5 m of the exclusion fence, and within equivalent habitat between 500 m and 1 km from the exclusion fence, every 1 km along the rail corridor, on alternating sides within Common Death Adder habitat. The plot boundaries will be mapped and clearly marked with pegs. Baseline monitoring (including photo monitoring) will occur prior to construction, and annually thereafter using the method outlined for grass plots in DES (2014).</p> <p>In Common Death Adder habitat, an identical series of plots will be established in four locations adjacent to the boundary of quarries and infrastructure areas – at the centre of the northern, southern, eastern and western boundaries or their equivalent for non-rectangular sites.</p>	Growth of grasses adjacent to the Project Area inhibited due to dust emissions	Early detection of dust effects on known Common Death Adder habitat, allowing adaptive management of dust emissions where necessary.
Connectivity between known Common Death Adder habitats on either side of the Project Area	<p>Monitoring of fauna passage use. Potential monitoring methods include sand/mud plots at each end of artificial fauna passages, manual and automated PIT tag passage monitoring (e.g. Baxter-Gilbert <i>et al.</i> 2013), and a co-ordinated radio-tracking program with a tertiary research institute. Monitoring will coincide with the periods of greatest Common Death Adder activity i.e. spring to early autumn.</p> <p>A co-ordinated monitoring plan will be created and established to monitor known Common Death Adder populations and condition on either side of selected natural and artificial Common Death Adder crossings.</p> <p>Baseline monitoring (including photo monitoring) of riparian waterway vegetation and leaf litter cover at all waterway crossings in Common Death Adder habitat. Annual monitoring (including photo monitoring) of riparian waterway vegetation and leaf litter cover after the completion of construction.</p>	<p>No snakes observed using the fauna passage within 2 years of the completion of construction</p> <p>&gt;10% reduction in riparian cover from baseline scores at waterway crossings in Common Death Adder habitat</p>	Compliance with Coordinator-General conditions and SMP.

## 9.6 *Crocodylus porosus* (Estuarine/Salt-water Crocodile)

### 9.6.1 Status

EPBC Act = Marine, Migratory (Bonn)

NC Act = Vulnerable

### 9.6.2 Ecology and Distribution



**Plate 13:** Estuarine Crocodile

#### Description of the Species:

The Estuarine Crocodile is the largest species of crocodilian, growing to 7m in length and 1 000kg in mass (Wilson and Swan 2008, DoE 2015); although a length of 3-4m and a mass of 150-300 kg is more usual (DEHP 2015g). Skin colour varies (depending on where they live) from almost black to grey and olive-brown with ragged, dark mottling (DEHP 2015g). The head of the Estuarine Crocodile is wider than that of the Freshwater Crocodile (*C. johnstoni*), and knobby (DEHP 2015g).

#### Distribution:

The Estuarine Crocodile is found from Broome in Western Australia, across the top end to Gladstone in Queensland (DEHP 2015g, Wilson and Swan 2008). This species is usually found within 200 km of the coast, particularly in Queensland, although individuals have been found hundreds of kilometres upstream in the Fitzroy River (Read *et al.* 2004).

#### Habitat for the Species:

Estuarine Crocodiles inhabit freshwater lagoons and lakes, beaches, coastal rivers and swamps, and inland rivers and swamps along major drainage systems (DEHP 2015g, Wilson and Swan 2008, Webb *et al.* 1987). They can occupy fresh and salt water, and are occasionally observed in the open sea (Wilson and Swan 2008).

#### Regional Ecosystems Associations:

As an aquatic species, the Estuarine Crocodile has no RE Associations.

#### Essential Microhabitat:

The Estuarine Crocodile has no essential microhabitat associations.

#### Known Populations and Relationships within the Project Area:

The Estuarine Crocodile is known to occur in low numbers in the Burdekin River (Read *et al.* 2004), downstream of the Burdekin Dam (SEIS). Estuarine Crocodiles are likely to occur wherever there are large, permanent pools of water within the major rivers and tributaries of the Burdekin River Catchment, in the north of the Project Area, such as the Bowen and Bogie Rivers and at Pelican Creek (Adani 2012, 2013). Large crocodile slides have been observed in the Bowen River within 2 km of the Project Area (Brad Dreis pers. comm.). Estuarine Crocodiles may also occur within the deeper tidal creeks and wetlands of the Caley Valley area at Abbot Point (Adani 2013). Specific locations where the Estuarine Crocodile is known or likely to occur are outlined in Table 69 and displayed in Appendix C.

**Table 69 Known and likely locations of Estuarine Crocodiles within the Project Area**

Kilometre Point and Location Description*					
6-7	<b>Caley Valley Wetlands</b>	58	Spring Ck	<b>105.5</b>	<b>Pelican Ck</b>
20	Splitters Ck	<b>61</b>	<b>Bogie River</b>	<b>131</b>	<b>Bowen River</b>
23	Plain Ck	<b>64.5</b>	<b>Sandy Ck</b>	<b>141</b>	<b>Rosella Ck</b>
25.5	Kangaroo Ck	80	Oakey Ck	153.5	Stony Ck
35	Elliot River	98	Strathmore Ck	158	Plum Ck

\* Bold indicates known or highly likely (shown in green on the map). Plain text indicates likely (smaller creek crossings in the north of the Project Area).

#### **Movement Patterns:**

Adult Estuarine Crocodiles regularly move long distances up and downstream, and between river catchments (Campbell *et al.* 2010, Campbell *et al.* 2013), and are capable of traversing hundreds of kilometres during dispersal and after relocation (Campbell *et al.* 2010, Walsh and Whitehead 1993). Hatchlings Estuarine Crocodiles are known to disperse over 20 km within six months (Magnusson 1979). Some males become very mobile in October/November, during the mating season (Campbell *et al.* 2013).

Estuarine Crocodiles mainly move and hunt in the late afternoon and at night, resting on riverbanks or motionless in the water during the day (Brien *et al.* 2008, Wilson and Swan 2008). There is continual movement into and out of water to thermoregulate (DoE 2015).

#### **Breeding Biology:**

Female Estuarine Crocodiles lay eggs in mounds of vegetation within 10 m of non-tidal rivers or wetlands (Webb *et al.* 1987). The female guards the nest for three months, between December and April, carrying the hatchlings down to the water once they emerge (Wilson and Swan 2008).

Male Estuarine Crocodiles reach sexual maturity at about 17 years of age and approximately 3.3m long, and females at about 12 years of age and approximately 2.3m long (DEHP 2015g).

#### **Feeding Ecology:**

Juvenile Estuarine Crocodiles feed on insects and crustaceans (Davenport *et al.* 2009). Subadult Estuarine Crocodiles feed primarily on crustaceans, occasionally taking fish, birds and mammals (Webb *et al.* 1991, Taylor 1979). Only large individuals feed on vertebrate prey, such as birds, sea turtles, fish, flying foxes, dingoes, cats, dogs, pigs, buffalo, cattle, horses, and occasionally humans (Webb and Manolis 1989, Taylor 1979).

### 9.6.3 Threats and Impacts

The primary threat to the Estuarine Crocodile is habitat loss from the development of swamps, wetlands, mangroves and rivers (DEHP 2015g, Taplin 1987). This species is also threatened by a decline in wetland habitat quality caused by the actions of buffalo and feral pigs (DoE 2015), mortality from illegal hunting and collecting (DoE 2015, DEHP 2015g), removal as pests and predators on people and livestock (Webb *et al.* 2010), mortality from fishing nets (Taplin 1987), and unhatched embryo mortality (70-80%) from a combination of overheating, flooding, and predation by goannas and feral pigs.

Table 70 outlines all the potential impacts of the project that are applicable to the Estuarine Crocodile, taking into account recovery plans (Cogger 1993, Richardson 2006), Condition 5c of the EPBC Approval, and Appendix 1 of the Coordinator-General's Report. The construction footprint and surrounding area are not considered to support an 'important population' or 'habitat critical to the survival' of the Estuarine Crocodile.

**Table 70 Potential impacts from the Project on Estuarine Crocodiles**

Impacts	Potential impacts associated with the Project	Project phase
Habitat Loss	Loss of aquatic habitat.	Pre-construction, Construction
Habitat Degradation	Degradation of waterways by feral pigs.	Construction, Operations
	Degradation of waterways by pollutants.	
Illegal Hunting and Collecting	Risk of mortality from illegal hunting and collecting.	Construction, Operations
Human-Dangerous Wildlife Interaction	Increased risk of human-Estuarine Crocodile interaction, and subsequent mortality of problem crocodiles.	Construction, Operations
Entanglement	Drowning from entanglement in construction materials.	Construction
Predation by Invasive Predators	Egg predation by feral pigs.	Construction, Operations
Vegetation Clearing	Siltation of waterways. Estuarine Crocodiles are not known to be impacted by siltation of waterways.	Impact unlikely
Earthworks	Mortality and injury due to machinery strike.	Construction
Noise and Vibration	Temporary loss of useable habitat due to noise and vibration disturbance.	Construction
Vehicle and Train Strike	Mortality and injury from vehicle strike	Construction, Operations
Emissions i.e. dust	Dust emissions from coal transport may potentially reduce waterway habitat quality for the Estuarine Crocodile, in and immediately adjacent to the Project Area.	Construction Operation
Light Spill	Temporary loss of useable habitat due to light disturbance at night. Permanent lighting is not proposed along the railway.	Construction
Waterway Crossings	Changes to waterway habitat due to the use of channel diversions during waterway crossing construction.	Construction
Weeds	Degradation of habitat. Estuarine Crocodiles are not known to be impacted by weed invasion.	Impact unlikely
Entrapment	Injury or mortality due to entanglement in open cavities and pits.	Construction
Connectivity	Temporary loss of connectivity between suitable habitats due to waterhole drainage during waterway crossing construction. This is unlikely to affect Estuarine Crocodiles.	Impact unlikely

#### **9.6.4 Mitigation and Management Measures**

Table 71 outlines all relevant management measures for the Estuarine Crocodile that are consistent with conservation advice for this species and meet the conditions of the EPBC Approval and Coordinator-General's Report. There is currently no recovery plan for the Estuarine Crocodile. All appropriate management measures will be implemented during construction and operations in habitats known or likely to support Estuarine Crocodiles. Prior to working within potential habitat for Estuarine Crocodiles (mostly river and creek crossings), spotlighting will be conducted at night to identify the presence of crocodiles in the area. The findings of such surveys will inform safety and environmental management procedures. Sightings of Estuarine Crocodiles outside known populations during construction and operations will be reported to the ER and confirmed by the Queensland Museum. Where additional populations are identified, DES and will be notified of locations and appropriate management actions will be implemented.

Table 71 Mitigation and management measures for the Estuarine Crocodile

Goal (Impact)	Performance Criteria	Management Measures	Trigger	Corrective Action
Minimise changes to waterways leading to loss of aquatic habitat	No permanent changes to waterway hydrology in Estuarine Crocodile habitat	No changes to waterway profile and flow except during waterway crossing construction. Where changes to waterways are required during construction (e.g. drainage of a permanent waterhole), prior to any changes occurring Estuarine Crocodiles residing in the area to be drained are to be relocated downstream by a conservation officer or a person holding a Damage Mitigation Permit with authority to relocate Estuarine Crocodiles.	After rehabilitation, waterway profile and flow is significantly altered and Estuarine Crocodiles no longer inhabit the waterway	Inform DES of monitoring results. Revise and implement an updated Rehabilitation Management Plan, focusing on implementing actions to restore water flow and profile.
	Rehabilitation of waterway flow and profile after construction of waterway crossings in Estuarine Crocodile habitat	Progressive rehabilitation of waterways will be undertaken as soon as possible after the completion of construction activities at each waterway crossing. Earth formations at waterway crossings will be rehabilitated in a way that mirrors the original waterway profile.		
Reduce degradation of waterways	Emissions (i.e. dust, coal and heavy metals) do not degrade waterway quality in Estuarine Crocodile habitat	Dust emissions will be managed in accordance with the Dust and Coal Dust Management Plans, and should include but not be limited to: <ul style="list-style-type: none"> <li>Regular watering of dusty areas in accordance with Dust Management Plan.</li> <li>Ensuring trains are not overloaded.</li> <li>Use of veneers to minimise the loss of coal particles in transit.</li> </ul>	Emissions settlement in water breach industry standards	Inform DES within 24 hours. Investigate source of any exceedance, implement remedial actions as per STP SOPs and EA. Within 10 business days following the initial notification of an emergency or incident, or receipt of monitoring results, whichever is the latter, further written advice will be provided to the

Goal (Impact)	Performance Criteria	Management Measures	Trigger	Corrective Action
	No pollution of waterways	Any sites used for chemical and fuel storage will be at least 200 metres from waterways, with bunding or other raised barrier, resistant to normal flood events, between chemicals and habitat. Trains will be cleaned and maintained to minimise the introduction of contaminants such as soil and fuel.	Pollution of waterways	administering authority, including the following: a) results and interpretation of any samples taken and analysed; b) outcomes of actions taken at the time to prevent or minimise unlawful environmental harm; and c) proposed actions to prevent a recurrence of the emergency or incident.
	No increase in feral pig numbers in the Project Area	A Pest Management Plan (PMP) will be developed and implemented prior to construction, including measures to control invasive feral pigs. The PMP will be developed in conjunction with neighbouring land owners, and will target waterway crossings and potential Estuarine Crocodile nesting areas (if they occur).	>10% increase in the population of feral pigs	Increase feral pig management efforts, in conjunction with neighbouring land owners.
Reduce egg predation by feral pigs	No egg predation by feral pigs		Egg predation by feral pigs	
Reduce risk of mortality from illegal hunting and collecting	No illegal hunting or collecting	Prior to work in potential Estuarine Crocodile habitat, spotlighting will be undertaken to identify the presence of any individuals. In addition, prior to site entry, all relevant site personnel, including contractors, will undergo an induction where they are informed about the protected status of Estuarine Crocodiles, the safety issues involved in working in Estuarine Crocodile habitat, the ecological and legal consequences of intentionally killing or collecting this species, and the legal requirement to be at least 10 m from Estuarine Crocodiles (including in vehicles) at all times.	Mortality or injury due to hunting or collecting	Complete an incident report and notify DoEE and DES.
Reduce risk of human-Estuarine Crocodile interaction, and subsequent mortality of problem crocodiles	No human-Estuarine Crocodile interactions	Identification posters for all threatened species with the potential to occur in the Project Area will be installed in prominent positions at each work site.	Human-Estuarine Crocodile interaction	Depending on the extent of injuries, any injured Estuarine Crocodiles will be either taken to the nearest qualified veterinary practitioner or wildlife carer, or humanely euthanised on site by a suitably qualified person (see Section 11.3). Euthanised crocodiles will be retained and lodged with the Queensland Museum along with GPS data, date and habitat notes.
Eliminate entanglement	No deaths or injuries from entangled Estuarine Crocodiles	No equipment with the potential to entangle fauna (e.g. wire, mesh fencing) is to be left unattended and uncovered near water bodies.	Estuarine Crocodile death or injury from entanglement	



Goal (Impact)	Performance Criteria	Management Measures	Trigger	Corrective Action
Minimise the risk of machinery strike	No death or injury due to machinery strike during construction and operations	<p>Suitably qualified spotter-catcher(s) will be present when all earthworks or drainage activities are occurring at waterway crossings in potential Estuarine Crocodile habitat. If an Estuarine Crocodile is sighted in the work area, all work will cease until the Estuarine Crocodile is relocated downstream by a conservation officer or a person holding a Damage Mitigation Permit with authority to relocate Estuarine Crocodiles.</p> <p>Earthworks at waterway crossings will occur slowly and in a sequential pattern, to allow Estuarine Crocodiles the opportunity to disperse from work areas, ahead of machinery.</p> <p>Vehicles and plant will drive on pre-determined roads only, and adhere to all speed limits, which will be clearly signposted.</p>	Machinery strike	<p>Incidents will be reported to the site ER as soon as possible. DoEE and DES will be notified within 24 hours.</p> <p>Depending on the extent of injuries, any injured Estuarine Crocodile will be either taken to the nearest qualified veterinary practitioner or wildlife carer, or humanely euthanised on site by a suitably qualified person (see Section 11.3).</p>
Minimise noise and vibration disturbance	Minimal noise and vibration impacts	<p>Noise and vibration-causing construction activities should be limited as much as possible within 200 m of an active Estuarine Crocodile nest.</p> <p>Ensure all plant and equipment is serviced and maintained to minimise machinery noise.</p>	Abandonment of a Estuarine Crocodile nest due to noise and vibration	Investigate source of disturbance and implement controls, where possible. Report as per environmental approval conditions and CEMP requirements, if required.
Minimise light spill	Minimal light spill into waterways during works	Install light controlling devices to deflect construction lighting away from waterways in Estuarine Crocodile habitat.	Direct light spill within 50 m of a waterway	Upgrade light controlling devices, or adjust location of light, to reduce light spill and lighting levels below trigger levels. Where corrective action is not immediately taken, this will be reported as an incident and managed in accordance with Adani's incident management procedure.

Goal (Impact)	Performance Criteria	Management Measures	Trigger	Corrective Action
	<p>No night work at waterway crossings known to be inhabited by Estuarine Crocodiles, without a detailed risk assessment of safety and environmental issues.</p> <p>If night work is to occur it must be limited to minimal impact activities</p>	<p>No night work is to be undertaken at waterway crossings known to be inhabited by Estuarine Crocodiles, without a detailed risk assessment of safety and environmental issues.</p> <p>Night work will not include clearing or piling</p>	<p>Night work at waterway crossings known to be inhabited by Estuarine Crocodiles, without a detailed risk assessment or involves clearing or piling</p>	<p>This will be reported as an incident and managed in accordance with Adani's incident management procedure</p>
Eliminate entrapment	<p>No deaths or injuries from trapped Estuarine Crocodiles</p>	<p>Temporary fencing will be erected around pits and cavities within 50 m of waterways known to be inhabited by Estuarine Crocodiles.</p>	<p>Estuarine Crocodile mortality or injury due to entanglement</p>	<p>Complete an incident report and notify DoEE and DES if death or injury occur.</p> <p>Depending on the extent of injuries, any injured Estuarine Crocodiles will be either taken to the nearest qualified veterinary practitioner or wildlife carer, or humanely euthanised on site by a suitably qualified person (see Section 11.3).</p> <p>Euthanised crocodiles will be retained and lodged with the Queensland Museum along with GPS data, date and habitat notes.</p>

### 9.6.5 Monitoring

Pre-clearance surveys will be undertaken at suitable times to detect the species, and identify and map suitable habitat in the development area, prior to any clearing or associated works occurring. The surveys will target suitable habitat for this species within and directly adjacent to the active rail development area. This Management Plan must be revised and submitted to DES within three months following pre-clearance surveys.

*Survey Methodology:* Nocturnal spotlighting from a boat is the standard method for surveying crocodiles (Magnusson 1980, Graham 1988, Fukuda *et al.* 2013), although spotlight surveys on foot can also be effective (Graham 1988), and may be a suitable substitute in areas that are inaccessible by boat. Crocodiles are spotted using a hand-held spotlight of at least 100W (200 000 candlepower). Light intensity may be lowered for better spotting in narrow creeks and billabongs (Fukuda *et al.* 2013). Aerial daylight surveys from 20-50 m above water level can also be effective for surveying crocodiles in areas with limited riparian vegetation, although this method rarely detects small animals (Magnusson 1980, Graham 1988). Daylight ground surveys reveal only a small proportion of crocodile populations (Magnusson 1980, Graham 1988). Nocturnal spotlight surveys can be supplemented by diurnal searches for tracks and slides (Magnusson 1980). Surveys for Estuarine Crocodiles in tidal areas are best undertaken to coincide with the falling tide, when more crocodiles are visible due to an increase in the amount of exposed mud bank (Messel *et al.* 1981).

Targeted searches for Estuarine Crocodile populations can occur at any time for this project. Nocturnal boat and foot searches will be the survey methods used for detecting Estuarine Crocodiles in potential waterways. Each search will occur between 8 pm and 12 midnight, and be repeated over three nights at each waterway. Waterways within 1 km upstream and 1 km downstream of waterway crossings in potential Estuarine Crocodile habitat will be surveyed for 2 hours during each search.

Design of the on-going monitoring program, including the location and extent of sites, will be determined by a suitably qualified person to ensure that sufficient data are collected to quantify likely impacts resulting from the proposed action, and to determine appropriate habitat management goals. The monitoring program will include both impact and control sites to monitor the progress of recovery, including effectiveness of management actions, and adapt if necessary. Annual monitoring will occur for the duration of railway activities.

The potential impacts of the proposed activities will be monitored in accordance the monitoring program outlined in Table 72.

Table 72 Details of monitoring program for the Estuarine Crocodile

Performance Criteria	Monitoring Program	Trigger for Corrective Action	Outcomes
Identify populations within and immediately adjacent to the Project Area	Pre-clearance targeted surveys for Estuarine Crocodiles targeting suitable habitat for this species within and directly adjacent to the Project Area. Surveys to be undertaken at any time of year using the survey methods outlined above.	N/A	Record and map Estuarine Crocodile locations in the vicinity of the Project Area, to ensure appropriate mitigating management measures are implemented.
No permanent changes to waterway hydrology in Estuarine Crocodile habitat	Design and implement a water quality monitoring program in accordance with the Water Quality Management Plan focusing on water flow and profile, and emissions dust and heavy metal toxicity at waterway crossings. The monitoring program will ensure that waterway crossings known and likely to be inhabited by Estuarine Crocodiles are prioritised for monitoring, and waterway crossings with low flow will be targeted. Water and sediment samples will be collected at each site to test for the presence of 15 heavy metals. A dust particulate sampler will also be erected at each site to compare aerial collection of coal dust and heavy metal values with waterway monitoring results. Water profile and flow, and sediment and dust samples will be assessed for baseline measures, and then bi-annually at low and high flow periods for water profile and flow, and annually at low flow periods for sediment and dust samples.	After rehabilitation, waterway profile and flow is significantly altered and Estuarine Crocodiles no longer inhabit the waterway	Ensure compliance with Coordinator-General conditions. Baseline water quality for comparison during monitoring.
Rehabilitation of waterway flow and profile after construction of waterway crossings in Estuarine Crocodile habitat			Adani to review monitoring results and report annually and revise management actions if any trigger is identified.
Emissions (i.e. dust, coal and heavy metals) do not degrade waterway quality in Estuarine Crocodile habitat	All monitoring will be undertaken in line with the Queensland's Water Quality Guidelines 2009 and ANZECC/ARMCANZ Interim Sediment Quality Guidelines. Targeted searches for Estuarine Crocodiles within each of the rehabilitated areas. Surveys to be undertaken at any time of year, by a suitably qualified person, using the survey methods outlined above.	Emissions settlement in water breach industry standards	
Manage ASS in accordance with accepted guidelines	Complete a baseline ASS survey in areas where the Project has the potential to disturb acid sulphate soils, focusing on potential habitat for Estuarine Crocodiles. This survey is to be undertaken by a suitably qualified soil scientist(s). Monitor the effectiveness of soil treatment practices in accordance with an approved ASS Management Plan.	Baseline ASS risk to be determined prior to disturbance	Data available to guide management practices for ASS treatment.
No increase in feral pig numbers in the Project Area	Baseline and annual monitoring of feral pig populations at waterway in Estuarine Crocodile habitat. Monitoring will include track and scat monitoring and photo monitoring using baited infrared cameras.	>10% increase in the population of feral pigs, from baseline scores	Ensure compliance with PMP.

Performance Criteria	Monitoring Program	Trigger for Corrective Action	Outcomes
No egg predation by feral pigs	Targeted surveys for potential Estuarine Crocodile nesting sites within 1 km upstream and 1 km downstream of all waterway crossings in the Project Area.  Breaches reported to DES by onsite ER.	Egg predation by feral pigs	Compliance with CEMP.  Compliance with Coordinator-General conditions and SMP.
No pollution of waterways		Pollution of waterways	
No illegal hunting or collecting		Mortality or injury due to hunting or collecting	
No human-Estuarine Crocodile interactions		Human-Estuarine Crocodile interaction	
No deaths or injuries from entangled Estuarine Crocodiles		Estuarine Crocodile death or injury from entanglement	
No death or injury due to machinery strike during construction and operations		Machinery strike	
Minimal death or injury due to train strike during operations		Estuarine Crocodile located inside the fenced area of the railway corridor	
Eliminate entrapment		Estuarine Crocodile mortality or injury due to entanglement	
Minimal noise and vibration impacts in surrounding habitat	Baseline monitoring of the noise and vibration intensity in surrounding habitat caused by significant vibration-causing construction activities (e.g. drilling, earthworks and movement of large machinery). Daily monitoring by onsite ER of active construction footprint for significant vibration-causing construction activities.	Active construction activities that cause significant noise and/or vibrations in the surrounding habitat are spread over >500 m stretch at any given time, with less than 1 km gap between significant noise and/or vibration-causing activities	Compliance with Coordinator-General conditions and SMP.

Performance Criteria	Monitoring Program	Trigger for Corrective Action	Outcomes
<p>Minimal light spill into waterways during works</p> <hr/> <p>No night work at waterway crossings known to be inhabited by Estuarine Crocodiles, without a detailed risk assessment of safety and environmental issues.</p> <p>If night work is to occur it must be limited to minimal impact activities</p>	<p>Regular monitoring by onsite ER.</p>	<p>Direct light spill within 50 m of a waterway</p> <hr/> <p>Night work at waterway crossings known to be inhabited by Estuarine Crocodiles, without detailed risk assessment or involves clearing or piling</p>	<p>Compliance with Coordinator-General conditions and SMP.</p>

## 9.7 *Denisonia maculata* (Ornamental Snake)

### 9.7.1 Status

EPBC Act = Vulnerable

NC Act = Vulnerable

### 9.7.2 Ecology and Distribution



**Plate 14:** Ornamental Snake

#### Description of the Species:

The Ornamental Snake is a stout brown, grey-brown or grey-black snake with a darkly flecked or overall darker head with the lips distinctly barred in white/cream. The belly is white or cream with dark spots/flecks on the outer edges (TSSC 2014). The iris is usually golden and the tail often grades to a lighter orange-brown at the tip.

#### Distribution:

The Ornamental Snake is only known from the Brigalow Belt North, and parts of the Brigalow Belt South Bioregions (DoE 2015). The stronghold of this species is within the Fitzroy and Dawson River catchments (McDonald *et al.* 1991), particularly in the area surrounding Moranbah (DoE 2015).

#### Habitat for the Species:

The Ornamental Snake inhabits low-lying areas with cracking clay soils, where it can be locally abundant (Wilson and Swan 2008). However, populations are sparsely distributed across this species' range (Ehmann 1992, McDonald *et al.* 1991).

The Ornamental Snake prefers moist areas and adjoining elevated ground, particularly areas associated with gilgai development (DoE 2015, TSSC 2014). Gilgais support an abundance of frogs, which are their preferred, almost exclusive, prey (TSSC 2014). Areas dominated by Brigalow (*Acacia harpophylla*), gidgee (*Acacia cambagei*), blackwood (*Acacia argyrodendron*), and coolabah (*Eucalyptus coolabah*) are the habitats where the Ornamental Snake is most likely to be found (DoE 2015), which includes riverside woodlands and open forest on levees (Cogger *et al.* 1993).

Locality records for 144 Ornamental Snakes between Moranbah and Myuna Station were compared with the estimated pre-clearance brigalow occurrence. There was an extremely strong correlation, with snakes persisting where brigalow was cleared (Wilson and Swan in press).

#### Regional Ecosystems Associations:

This species is not restricted exclusively to remnant vegetation – it also occurs in cleared and regrowth areas (Wilson and Swan 2015 in press). REs highlighted in bold in Table 73 indicate other REs that the Ornamental Snake has regularly been recorded in association with. The DoEE considers that an occurrence of important habitat for the Ornamental Snake is a surrogate for an 'important population' of the species (DoE 2015).

Table 73 Current and pre-clearing Regional Ecosystem associations for the Ornamental Snake\*.

RE	Short Descriptions
11.3.1	<i>Acacia harpophylla</i> and/or <i>Casuarina cristata</i> open forest on alluvial plains
<b>11.3.3</b>	<b><i>Eucalyptus coolabah</i> woodland on alluvial plains</b>
11.3.4	<i>Eucalyptus tereticornis</i> and/or <i>Eucalyptus spp.</i> woodland on alluvial plains
11.3.5	<i>Acacia cambagei</i> woodland on alluvial plains
11.3.33	<i>Eremophila mitchellii</i> open woodland on alluvial plains
11.3.34	<i>Acacia tephрина</i> woodland on alluvial plains
11.4.4	<i>Dichanthium spp.</i> , <i>Astrebla spp.</i> grassland on Cainozoic clay plains
11.4.5	<i>Acacia argyrodendron</i> woodland on Cainozoic clay plains
<b>11.4.6</b>	<b><i>Acacia cambagei</i> woodland on Cainozoic clay plains</b>
<b>11.4.8</b>	<b><i>Eucalyptus cambageana</i> woodland to open forest with <i>Acacia harpophylla</i> or <i>A. argyrodendron</i> on Cainozoic clay plains</b>
<b>11.4.9</b>	<b><i>Acacia harpophylla</i> shrubby woodland with <i>Terminalia oblongata</i> on Cainozoic clay plains</b>
11.4.11	<i>Dichanthium sericeum</i> and <i>Astrebla spp.</i> grassland with patchy <i>Acacia harpophylla</i> or <i>Eucalyptus coolabah</i> on Cainozoic clay plains
<b>11.5.16</b>	<b><i>Acacia harpophylla</i> and/or <i>Casuarina cristata</i> open forest in depressions on Cainozoic sand plains and remnant surfaces</b>
11.8.11	<i>Dichanthium sericeum</i> grassland on Cainozoic igneous rocks
11.9.1	<i>Acacia harpophylla</i> - <i>Eucalyptus cambageana</i> woodland to open forest on fine-grained sedimentary rocks
11.9.3	<i>Dichanthium spp.</i> , <i>Astrebla spp.</i> grassland on fine-grained sedimentary rocks
11.9.5	<i>Acacia harpophylla</i> and/or <i>Casuarina cristata</i> open forest on fine-grained sedimentary rocks
11.9.10	<i>Eucalyptus populnea</i> open forest with a secondary tree layer of <i>Acacia harpophylla</i> and sometimes <i>Casuarina cristata</i> on fine-grained sedimentary rocks
11.9.12	<i>Dichanthium sericeum</i> grassland with clumps of <i>Acacia harpophylla</i> on fine-grained sedimentary rocks
11.11.13	<i>Acacia harpophylla</i> or <i>A. argyrodendron</i> low open forest with a secondary tree layer of <i>Terminalia oblongata</i> on deformed and metamorphosed sediments and interbedded volcanics
11.11.14	<i>Acacia harpophylla</i> open forest on deformed and metamorphosed sediments and interbedded volcanics
11.12.21	<i>Acacia harpophylla</i> open forest on igneous rocks. Colluvial lower slopes

\* Bold text indicates REs where this species is commonly encountered.

#### Essential Microhabitat:

Hydrology (low-lying sites subject to inundation) and substrate (clay soils prone to form cracks) are considered core habitat features for the Ornamental Snake (Wilson and Swan 2015 in press). This species is strongly associated with gilgais, either within the gilgai development area itself or nearby surrounds (DoE 2015). Soil cracks on the high ground of gilgai development provide shelter for Ornamental Snakes during dry periods, and an abundance of frogs in gilgai areas provide food resources during wet periods (Brigalow Belt Reptiles Workshop 2010). Ornamental Snakes prefer areas with ground cover such as logs and coarse woody debris, and ground litter, which it uses for shelter (DoE 2015, Richardson 2006).



**Known Populations and Relationships within the Project Area:**

The Project Area traverses locations that are modelled as known/likely to support Ornamental Snake populations (DSEWPaC 2011). Although targeted diurnal and nocturnal active search surveys during May/June and October 2013 did not detect this species along the proposed railway corridor, it is not clear if the October surveys targeted post-rainfall events when the Ornamental Snake is most active. There are no known survey methods for detecting Ornamental Snakes during dry or cool weather, when they are inactive and probably sheltering beneath the ground in soil cracks rather than under accessible surface debris (DSEWPaC 2011).

**Movement Patterns:**

The Ornamental Snake is nocturnal, moving only at night. It is probably active year-round but can remain inactive in shelters for periods of months during dry conditions (DSEWPaC 2011). Peak activity is likely to be late spring to early summer (DSEWPaC 2011), although Ornamental Snakes have also been recorded as active in April (Steve Wilson pers. comm.). Ornamental Snakes are known to bask on the road and other warm surfaces in the evening (DSEWPaC 2011).

**Breeding Biology:**

The Ornamental Snake bears live young (Cogger 2000). Little else is known about the breeding biology of this species.

**Feeding Ecology:**

The Ornamental Snake is known to feed on Spotted Grass Frogs *Limnodynastes tasmaniensis*, and is found in association with Green-striped Burrowing Frogs *Cyclorana alboguttata*, and Knife-footed/Short-footed Frogs *Cyclorana cultripipes/brevipes*, which it also presumably feeds on (Steve Wilson pers. comm. 2015).

**9.7.3 Threats and Impacts**

The primary threat to the Ornamental Snake is a legacy of historical broad-scale clearing for grazing and habitat degradation by cattle (TSSC 2014, Cogger 1993) combined with ongoing habitat loss for agriculture and development (Cogger 1993). Feral pigs are also of great concern, given their degradation of wet areas, competition for frog prey (Richardson 2006, TSSC 2014) and potential predation on any snakes they uncover. Toads are a concern for the ornamental snake, potentially poisoning individuals of this species (Cogger 1993, Phillips *et al.* 2003). The degradation of wetlands and vegetation clearing create habitat that favour reproduction by toads over native species, increasing the likelihood of the Ornamental Snake encountering toads (Curtis *et al.* 2012). Linear infrastructure and pathways are also known to aid Cane Toad dispersal (Anstis 2014).

The AEIS (GHD 2014) also identifies alteration of landscape hydrology and water quality in gilgai environments (which affect the primary prey species of the Ornamental Snake), invasive weeds, and predation by feral predators (foxes and cats) as potential threats to the Ornamental Snake. Direct impacts from the Project include injury and mortality from earthworks, light vehicles and railway operations.

Table 74 outlines all the potential impacts of the project that are applicable to Ornamental Snakes, taking into account the conservation listing, recovery plans (Cogger 1993, Richardson 2006), Condition 5c of the EPBC Approval, Appendix 1 of the Coordinator-General's Report, and specific impacts outlined in the EIS (GHD 2012; GHD 2014). The Commonwealth environment department considers that an occurrence

of important habitat for the Ornamental Snake (highlighted in bold in Table 73) is a surrogate for an 'important population' of this species (DoE 2015).

**Table 74 Potential impacts from the Project on Ornamental Snakes**

Impacts	Potential impacts associated with the Project	Project phase
Vegetation Clearing/ Habitat Loss	Removal Ornamental Snake habitat. A disturbance limit of 421.6 ha is in place in the EPBC Act approval.	Pre-construction, Construction
Livestock Grazing	Degradation of habitat through trampling and loss of vegetation cover. No livestock will be grazed in the Project Area during construction or operations, due to exclusion fencing.	Impact unlikely
Degradation of Gilgai's and Waterways	Degradation and fouling of gilgais and waterways due to rooting activity of pigs, which are known to inhabit the area traversed by the Project.	Construction, Operations
	Loss of food resources (frogs) due to fouling of waterways.	
Poisoning	Death from ingestion of Cane Toads, which use linear infrastructure and pathways for dispersal, and can increase in abundance in degraded waterways.	Construction, Operations
Changes in Hydrological Regimes at waterway crossings	Loss of food resources through fouling and diversion of waterways.	Construction
Weeds	Degradation of gilgais and waterways due to aquatic and marsh weed invasion.	Construction, Operations
Predation by Invasive Mammals	Loss of individuals to predation by feral foxes and cats, which are known to inhabit the area traversed by the Project and use fauna crossings as funnel points for attacks.	Construction, Operations
Killing of Snakes	Mortality from intentional killing by people.	Construction, Operations
Earthworks	Mortality due to machinery strike.	Construction
Noise and Vibration	Temporary loss of useable habitat due to vibration disturbance. Noise does not impact on snakes.	Construction
Vehicle Strike	Mortality and injury due to the habit of Ornamental Snakes to bask on warm surfaces such as roads in the early evening.	Construction, Operations
Emissions i.e. dust	Dust emissions from coal transport may potentially reduce habitat quality for the Ornamental Snakes, in and immediately adjacent to the Project Area. However, dust is unlikely to be a direct concern for Ornamental Snakes.	Construction Operation
Light Spill	Temporary loss of useable habitat due to light disturbance at night. Permanent lighting is not proposed along the railway.	Construction
Entrapment	Injury or mortality due to entanglement in open cavities and pits.	Construction
Connectivity	Loss of connectivity between suitable habitats.	Pre-construction, Construction, Operations

#### 9.7.4 Mitigation and Management Measures

Table 75 outlines all relevant management measures for the Ornamental Snake that are consistent with conservation advice for this species (TSSC 2014) and meet the conditions of the EPBC Approval and Coordinator-General's Report. There is currently no up-to-date recovery plan for the Ornamental Snake (DoE 2015). All appropriate management measures will be implemented during construction and operations in habitats known or likely to support Ornamental Snakes. Ornamental Snakes sighted outside known populations during construction and operations will be photographed and reported to the ER, with the photograph to be sent to Queensland Museum for identification confirmation. Where additional

populations are identified, DES and DoEE will be notified of locations and appropriate management actions will be implemented.

Table 75 Mitigation and management measures for the Ornamental Snake

Goal (Impact)	Performance Criteria	Management Measures	Trigger	Corrective Action
Minimise loss of habitat through vegetation clearing	Rehabilitation of disturbed areas that are no longer required for operations	<p>Progressive rehabilitation of disturbed areas will be undertaken as soon as possible after the completion of construction activities. Vegetation rehabilitation will use locally-sourced seeds for native grasses, herbs and woody plants.</p> <p>Earth formations in gilgai areas and waterways will be rehabilitated using original topsoil and configured in a way that mirrors the original undulating terrain.</p> <p>Local leaf litter, rocks and woody debris will be salvaged and stockpiled prior to construction, to be replaced during rehabilitation.</p>	Rehabilitated areas fail to reach 70% of baseline and control scores within 15 years	An annual rehabilitation monitoring report will be sent to DES. Revise and implement an updated Rehabilitation Management Plan if targets are not achieved within 15 years.
Minimise changes to hydrological regimes	Siltation and changes to hydrological regimes of waterways and gilgais do not affect frog populations	<p>Avoid changes to hydrological regimes. Where changes are unavoidable, prior to any changes occurring, resident frogs and tadpoles are to be relocated upstream where appropriated, or to temporary artificially created water sources that have similar properties to the original water source. This means they must be dry for much of the year, but be structured and sited so they fill temporarily after rain. Artificially created water sources must be accessible to Ornamental Snakes.</p> <p>Ongoing monitoring of frog populations will be required in artificially created water sources.</p>	Changes to the hydrology or vegetation cover of a watercourse leads to reduction in <i>Limnodynastes tasmaniensis</i> , <i>Cyclorana alboguttata</i> , <i>C. cultripes</i> and <i>C. brevipes</i> populations of >20% over any 2 year period.	<p>Implement remedial actions to provide supplementary water sources, where possible.</p> <p>Inform DES of monitoring results.</p> <p>Upgrade artificial water source management protocols and implement corrective actions to improve management of artificial water sources.</p>

Goal (Impact)	Performance Criteria	Management Measures	Trigger	Corrective Action
Reduce degradation of gilgais and waterways		<p>Erosion and sediment control measures will be designed and managed in accordance with IECA guidelines as prescribed in the relevant project approvals, to prevent sedimentation run-off into permanent water sources during construction.</p> <p>Where possible, designs should limit the creation of suitable Cane Toad breeding areas (e.g. sediment fences).</p> <p>Inspect the integrity of sediment barriers daily during construction works. Regularly re-assess the effectiveness of the location and design of sediment barriers and update as necessary.</p>	<p>Siltation of a waterways and gilgais in Ornamental Snake habitat reduces the abundance of frogs</p>	<p>Inform DES within 24 hours. Investigate source of any exceedance, implement remedial actions. Within 10 business days following the initial notification of an emergency or incident, or receipt of monitoring results, whichever is the latter, further written advice will be provided to the administering authority, including the following:</p> <p>a) results and interpretation of any samples taken and analysed;</p> <p>b) outcomes of actions taken at the time to prevent or minimise unlawful environmental harm; and</p> <p>c) proposed actions to prevent a recurrence of the emergency or incident.</p>
	Emissions (i.e. dust, coal and heavy metals) do not degrade waterway quality	<p>Dust emissions will be managed in accordance with the Dust and Coal Dust Management Plans, and should include but not be limited to:</p> <ul style="list-style-type: none"> <li>• Regular watering of dusty areas in accordance with Dust Management Plan.</li> <li>• Ensuring trains are not overloaded.</li> <li>• Use of veneers to minimise the loss of coal particles in transit.</li> </ul>	<p>Emissions settlement in water breach industry standards</p>	
	No pollution of gilgais and waterways	<p>Any sites used for chemical and fuel storage will be at least 200 metres from waterways, with bunding or other raised barrier, resistant to normal flood events, between chemicals and habitat.</p> <p>Trains will be cleaned and maintained to minimise the introduction of contaminants such as soil and fuel.</p>	<p>Pollution of gilgais and waterways</p>	
	No increase in feral pig numbers in the Project Area	<p>A PMP will be developed and implemented prior to construction, including measures to control invasive toads, foxes, cats, and weeds. The PMP will be developed in conjunction with neighbouring</p>	<p>&gt;10% increase in the population of feral pigs</p>	

Goal (Impact)	Performance Criteria	Management Measures	Trigger	Corrective Action
Minimise predation risk by invasive mammals	No increase in fox and cat numbers in the Project Area	land owners, and will target waterway crossings, habitat edges and fixed sites such as workers camps. The Pest Management Plan will incorporate measures recommended in the Threat Abatement Plans for the control of foxes and cats.	>10% increase in the population of each invasive predator species from baseline scores	Increase invasive predator management efforts, in conjunction with neighbouring land owners.
Reduce weed competition	Eliminate declared pest plant species from the Project Area and adjacent areas, focusing on waterway and marsh weeds	Domestic animals will not be permitted into the project area. Weed control will focus on eradicating declared marsh and waterway weeds from waterway crossings and areas with gilgai development in the Project Area and adjacent areas.	Presence of declared pest waterway and marsh plant species	Increase weed management efforts, in conjunction with neighbouring land owners, where relevant.
Minimise the risk of light vehicle and machinery strike	No death or injury due to light vehicle or machinery strike during construction and operations	Suitably qualified spotter-catcher(s) will be present when all earthworks and vegetation clearing are occurring in habitat known or likely to contain Ornamental Snakes. Daily pre-clearing surveys will be undertaken by suitably qualified spotter-catcher (s), prior to construction activities, to: (1) find and relocate any Ornamental Snakes within and directly adjacent to all areas where vegetation clearing and construction works will occur, and (2) identify all areas likely to be sheltering Ornamental Snakes prior to construction activities each day. Manipulation of all potential Ornamental Snake shelters by machinery operators will be under the strict supervision and direction of the spotter-catcher(s).	Light vehicle or machinery strike during clearing and grubbing	Incidents will be reported to the site ER as soon as possible. DoEE and DES will be notified within 24 hours. Depending on the extent of injuries, any injured Ornamental Snakes will be either taken to the nearest qualified veterinary practitioner or wildlife carer, or humanely euthanised on site by a suitably qualified person (see Section 11.3).
		Prior to site entry, all relevant site personnel, including contractors, will be made aware of the propensity of Ornamental Snakes to bask on warm surfaces such as roads and tracks, on warm and humid evenings, and the need to avoid striking them in these circumstances. Identification posters for all threatened species with the potential to occur in the Project Area will	Light vehicle or machinery strike during other activities	Complete an incident report and notify DoEE and DES. Depending on the extent of injuries, any injured Ornamental Snakes will be either taken to the nearest qualified veterinary practitioner or wildlife carer, or humanely euthanised on site by a

Goal (Impact)	Performance Criteria	Management Measures	Trigger	Corrective Action
		<p>be installed in prominent positions at each work site.</p> <p>Vehicles and plant will drive on pre-determined roads only, and adhere to all speed limits, which will be clearly signposted.</p>		<p>suitably qualified person (see Section 11.3).</p> <p>Euthanised snakes will be retained and lodged with the Queensland Museum along with GPS data, date and habitat notes.</p>
Minimise risk of train strike	Minimal death or injury due to train strike during operations	<p>In areas where designated crossing points coincide with known Ornamental Snake habitat fencing should consist of smooth material to a height of 40 cm. The material will be buried 10 cm into the earth. This will assist in funnel Ornamental Snakes to designated crossing areas and in turn minimise the risk of train strike. The fence line will be regularly monitored for potential breaches.</p> <p>An identification poster for all threatened species with the potential to occur in the Project Area will be installed in the train cabin, and prominently in site offices.</p> <p>Additional sightings of Ornamental Snake will be reported to the ER and confirmed by Queensland Museum.</p>	<p>Any terrestrial snake located inside the fenced area of the railway corridor traversing Ornamental Snake habitat</p> <p>Ornamental snake located inside the fenced area of the railway corridor</p>	<p>Search for and remedy potential breach areas in both railway fences within 500 m of the location.</p> <p>Complete an incident report and notify DoEE and DES.</p> <p>Depending on the extent of injuries, any injured Ornamental Snake will be either taken to the nearest qualified veterinary practitioner or wildlife carer, or humanely euthanised on site by a suitably qualified person (see Section 11.3).</p>
Eliminate intentional killing of snakes	No mortality or injury due to intentional killing	<p>Prior to site entry, all relevant site personnel, including contractors, will undergo an induction where they are informed about Ornamental Snake identification, the protected status of this species, and the ecological and legal consequences of intentionally killing this species.</p> <p>Identification posters for all threatened species with the potential to occur in the Project Area will be installed in prominent positions at each work site.</p>	Mortality or injury due to intentional killing	<p>Complete an incident report and notify DoEE and DES.</p> <p>Depending on the extent of injuries, any injured Ornamental Snake will be either taken to the nearest qualified veterinary practitioner or wildlife carer, or humanely euthanised on site by a suitably qualified person (see Section 11.3).</p>

Goal (Impact)	Performance Criteria	Management Measures	Trigger	Corrective Action
Minimise vibration disturbance	Minimal vibration impacts in breeding habitat	Noise and vibration-causing construction activities should be limited as much as possible within 200 m of Ornamental Snake breeding habitat. . Ensure all plant and equipment is serviced and maintained to minimise machinery vibration.	Excessive noise or vibrations that disturbs breeding of Ornamental Snake	Investigate source of disturbance and implement controls, where possible. Report as per environmental approval conditions and CEMP requirements, if required.
Minimise emissions (dust)	Limit disturbance from emissions (dust) on photosynthetic ability of grasses in Ornamental Snake habitat	Dust emissions will be managed in accordance with the Dust and Coal Dust Management Plans, and should include but not be limited to: <ul style="list-style-type: none"> <li>• Regular watering of dusty areas in accordance with Dust Management Plan.</li> <li>• Ensuring trains are not overloaded.</li> <li>• Use of veneers to minimise the loss of coal particles in transit.</li> </ul>	Growth of grasses adjacent to the Project Area, in known Ornamental Snake habitat, inhibited due to dust emissions	An annual monitoring report will be submitted to DoEE. Where monitoring shows a reduction in habitat condition due to dust emissions, investigate source of dust and upgrade strategies outlined in the Dust Management Plan to reduce dust emissions impacts on habitat.
Minimise light spill	Minimal light spill into habitat adjacent works	Install light controlling devices to deflect construction lighting away from known Ornamental Snake habitat.	Direct light spill >50 m into known Ornamental Snake habitat	Upgrade light controlling devices, or adjust location of light, to reduce light spill and lighting levels below trigger levels. Where corrective action is not immediately taken, this will be reported as an incident and managed in accordance with Adani's incident management procedure.
	Construction night works are limited to minimum disturbance activities in or adjacent to known Ornamental Snake habitat.	Clearing and piling is not to be undertaken at night within or adjacent to Ornamental Snake habitat,	Clearing or piling occurs at night within or adjacent to Ornamental Snake habitat	This will be reported as an incident and managed in accordance with Adani's incident management procedure.



Goal (Impact)	Performance Criteria	Management Measures	Trigger	Corrective Action
Eliminate entrapment	No deaths or injuries from trapped Ornamental Snakes	<p>Wherever possible, all excavations should have ramped edges/ends no greater than 45 degrees. Fauna ramps (e.g. wooden planks) or earthen ramps will be installed in all cavities deeper than 20 cm, with smooth sides, to provide a means for trapped Common Death Adders (and other fauna) to escape. The fauna ramps or earthen ramps will be clearly marked and all construction staff will be informed of their purpose.</p> <p>All excavations in or adjacent to Ornamental Snake habitat will be checked daily by a suitably qualified person, including immediately prior to these cavities being filled in.</p>	Ornamental Snake mortality or injury due to entanglement	<p>Complete an incident report and notify DoEE and DES if death or injury occur.</p> <p>Depending on the extent of injuries, any injured Ornamental Snake will be either taken to the nearest qualified veterinary practitioner or wildlife carer, or humanely euthanised on site by a suitably qualified person (see Section 11.3).</p>
Maintain connectivity	Connectivity between known Ornamental Snake habitats on either side of the Project Area	<p>In known and likely Ornamental Snake habitat, fauna passes will be incorporated into the railway design, which allow Ornamental Snakes to pass beneath the railway unimpeded. Waterway crossings may act as Ornamental Snake fauna passes, where suitable vegetation and cover are provided for the length of the fauna pass. The level of suitable cover will be assessed. The design of artificial fauna passes for Ornamental Snakes will incorporate suitable substrate and cover between connected habitats.</p> <p>In Ornamental Snake habitat, fauna passes for this species will be spaced at intervals of less than 100 m to facilitate passage during fire and flood events.</p>	<p>No Ornamental Snakes observed using the fauna passage within 2 years of the completion of construction</p> <p>&gt;10% reduction in riparian vegetation cover from baseline scores at waterway crossings in Ornamental Snake habitat</p>	<p>Inform DES of monitoring results. Upgrade fauna passage design to ensure Ornamental Snake are amenable to using fauna passes.</p>

### 9.7.5 Monitoring

Pre-clearance surveys will be undertaken at suitable times to detect the species, and identify and map suitable habitat in the development area, prior to any clearing or associated works occurring. The surveys will target suitable habitat for this species within and directly adjacent to the Project Area. This Management Plan must be revised and submitted to DoEE within three months following pre-clearance surveys.

*Survey Methodology:* No survey methods are known to reliably detect the Ornamental Snake during dry weather (DSEWPaC 2011). Targeted nocturnal searches in and around suitable gilgai habitat when frogs are active is the most effective way to encounter this species (DSEWPaC 2011 – survey). Driving paved roads at night after wet weather, in and near gilgai development, can supplement targeted searches, as can pitfall and funnel trapping and diurnal searches under shelter sites (DSEWPaC 2011). However, these methods are likely to yield low returns (DSEWPaC 2011) and will not be used as the primary survey method for Ornamental Snakes in this Project.

Targeted surveys for Ornamental Snakes will be undertaken on warm and humid nights between the first significant rainfall event in spring/summer, and when night temperatures start to drop in mid-autumn. Rainfall during warm months is a major trigger for increased reptile activity, and this is likely to be so for Ornamental snakes (Eyre *et al.* 2014). Therefore, conducting surveys (or a second survey) immediately following a rainfall event is optimal (Eyre *et al.* 2014).

Targeted nocturnal surveys will be the primary survey method. These surveys will occur from sunset until midnight on warm and humid nights, at a minimum rate of 1.5 person hours per hectare, over a minimum of three nights (DSEWPaC 2011). These surveys will be supplemented by diurnal searches of microhabitats during the coolest parts of the day, and may be supplemented further by nocturnal driving searches, where applicable, and pit and funnel trapping.

Design of the on-going monitoring program, including the location and extent of sites, will be determined by a suitably qualified person to ensure that sufficient data are collected to quantify likely impacts resulting from the proposed action, and to determine appropriate habitat management goals. The monitoring program will include both impact and control sites to monitor the progress of recovery, including effectiveness of management actions, and adapt if necessary. Annual monitoring will occur for the duration of railway activities.

The potential impacts of the proposed activities will be monitored in accordance the monitoring program outlined in Table 76.

Table 76 Details of monitoring program for the Ornamental Snake

Performance Criteria	Monitoring Program	Trigger for Corrective Action	Outcomes
Identify populations within and immediately adjacent to Project Area	<p>Pre-clearance targeted surveys for Ornamental Snakes targeting suitable habitat for this species within and directly adjacent to the Project Area.</p> <p>Surveys can be undertaken any time of the year. However, surveys will be most effective after significant rains from September to April, using the survey methods outlined above.</p>	N/A	Record and map Ornamental Snake locations in the vicinity of the Project Area, to ensure appropriate mitigating management measures are implemented.
Rehabilitation of disturbed areas in Ornamental Snake habitat that are no longer required for operations	<p>BioCondition Assessments and photo monitoring will be undertaken prior to rehabilitation activities and then annually after rehabilitation to determine the condition of Ornamental Snake habitat in proposed rehabilitation and control sites. For each proposed rehabilitation area, a minimum of two permanent monitoring plots will be located in the rehabilitated area and a minimum of two permanent monitoring plots will be located between 1 km and 2 km from the Project Area (control areas).</p> <p>In addition to these Assessments, there will be annual targeted searches for Ornamental Snakes within each of the rehabilitated areas.</p>	Rehabilitated areas fail to reach 70% of baseline and control scores within 15 years	<p>Baseline habitat quality for comparison during monitoring.</p> <p>Ability to assess rehabilitation quality against rehabilitation and offset requirements. Adani to review monitoring results and report annually and revise management actions if any trigger is identified</p>
Siltation and changes to hydrological regimes of waterways and gilgais do not affect frog populations	Design and implement a water quality monitoring program in accordance with the Water Quality Management Plan focusing on water flow and emissions dust and heavy metal toxicity in gilgais and waterways in Ornamental Snake habitat. The monitoring program will ensure that gilgais in areas known to be inhabited by Ornamental Snakes, in close proximity to the Project Area, are prioritised for monitoring. Water and sediment samples will be collected at each site to test for the presence of 15 heavy metals.	<p>Visible layer of particulate dust matter</p> <p>Siltation of a waterways and gilgais in Ornamental Snake habitat reduces the abundance of frogs</p>	Compliance with EPBC conditions and SMP.

Performance Criteria	Monitoring Program	Trigger for Corrective Action	Outcomes
Emissions (i.e. dust, coal and heavy metals) do not degrade waterway quality	All monitoring will be undertaken in line with the Queensland's Water Quality Guidelines 2009 and ANZECC/ARMCANZ Interim Sediment Quality Guidelines. Baseline and annual monitoring of frog populations in gilgais and waterways in known Ornamental Snake habitat within and adjacent to the Project Area.	Changes in waterway hydrology leading to a reduction in <i>Limnodynastes tasmaniensis</i> , <i>Cyclorana alboguttata</i> , <i>C. cultripes</i> and <i>C. brevipes</i> populations of >20% over any 2 year period.	
No increase in feral pig, fox and cat numbers in the Project Area	Baseline and annual monitoring of feral goat, pig, fox and cat populations at waterway and artificial fauna crossings in Ornamental Snake habitat. Monitoring will include track and scat monitoring, photo monitoring using baited infrared cameras, and auditory and active monitoring of toads during summer rainfall periods.	>10% increase in the population of each invasive species, from baseline scores	
Eliminate declared pest plant species from the Project Area and adjacent areas, focusing on waterway and marsh weeds	Annual monitoring (including photo monitoring) of weeds and vegetation growth in waterways and marshes of the Project Area, and weed development in Ornamental Snake habitat adjacent to the Project Area. Monitoring will occur at the optimal time for detecting and identifying weed species.	Presence of any waterway or marsh pest plant species at any time	Ensure compliance with PMP.
No pollution of gilgais and waterways		Pollution of gilgais and waterways	Compliance with CEMP.
No death or injury due to light vehicle or machinery strike during construction and operations	Breaches reported to DES and DoEE by onsite ER.	Light vehicle or machinery strike	Compliance with EPBC conditions and SMP.

Performance Criteria	Monitoring Program	Trigger for Corrective Action	Outcomes
Minimal death or injury due to train strike during operations		Any terrestrial snake located inside the fenced area of the railway corridor traversing Ornamental Snake habitat Ornamental snake located inside the fenced area of the railway corridor	
No deaths or injuries from trapped Ornamental Snakes		Ornamental snake mortality or injury due to entanglement	
No mortality or injury due to intentional killing		Mortality or injury due to intentional killing	
Minimal light spill into habitat adjacent works	Regular monitoring by onsite ER.	Direct light spill >50 m in known Ornamental Snake habitat	
Construction night works are limited to minimum disturbance activities in or adjacent to known Ornamental Snake habitat.		Clearing or piling occurs at night within or adjacent to Ornamental Snake habitat	

Performance Criteria	Monitoring Program	Trigger for Corrective Action	Outcomes
Minimal noise and vibration impacts in surrounding habitat	<p>Baseline monitoring by a qualified geologist, of the vibration intensity in surrounding habitat caused by significant vibration-causing construction activities (e.g. drilling, earthworks and movement of large machinery).</p> <p>Daily monitoring by onsite ER of active construction footprint for significant vibration-causing construction activities.</p>	Active construction activities that cause significant vibrations in the surrounding habitat are spread over >500 m stretch at any given time, with less than 1 km gap between significant vibration-causing activities	Compliance with Coordinator-General conditions and SMP.
Limit disturbance from emissions (dust) on photosynthetic ability of grasses in Ornamental Snake habitat	<p>A series of 5 grass monitoring plots (1 m x 1 m) will be established within 5 m of the exclusion fence, and within equivalent habitat between 500 m and 1 km from the exclusion fence, every 1 km along the rail corridor, on alternating sides within Ornamental Snake habitat. The plot boundaries will be mapped and clearly marked with pegs. Baseline monitoring (including photo monitoring) will occur prior to construction, and annually thereafter using the method outlined for grass plots in DES (2014).</p> <p>In Ornamental Snake habitat, an identical series of plots will be established in four locations adjacent to the boundary of quarries and infrastructure areas – at the centre of the northern, southern, eastern and western boundaries or their equivalent for non-rectangular sites.</p>	Growth of grasses adjacent to the Project Area inhibited due to dust emissions	Early detection of dust effects on known Ornamental Snake habitat, allowing adaptive management of dust emissions where necessary.
Connectivity between known Ornamental Snake habitats on either side of the Project Area	<p>Monitoring of fauna passage use. Potential monitoring methods include sand/mud plots at each end of artificial fauna passages, manual and automated PIT tag passage monitoring (e.g. Baxter-Gilbert <i>et al.</i> 2013), and a co-ordinated radio-tracking program with a tertiary research institute. Monitoring will coincide with the periods of greatest Ornamental Snake activity i.e. spring to early autumn.</p> <p>A co-ordinated monitoring plan will be created and established to monitor known Ornamental Snake populations and condition on either side of selected natural and artificial Ornamental Snake crossings.</p> <p>Baseline monitoring (including photo monitoring) of riparian waterway vegetation cover at all waterway crossings in Ornamental Snake habitat. Annual monitoring (including photo monitoring) of riparian waterway vegetation cover after the completion of construction.</p>	<p>No snakes observed using the fauna passage within 2 years of the completion of construction</p> <p>&gt;10% reduction in riparian cover from baseline scores at waterway crossings in Ornamental Snake habitat</p>	Compliance with EPBC conditions and SMP.

## 9.8 *Phascolarctos cinereus* (Koala)

### 9.8.1 Status

EPBC Act = Vulnerable

NC Act = Special Least Concern (Vulnerable in South-east Queensland, Least Concern elsewhere)

### 9.8.2 Ecology and Distribution

#### Description of the Species:

The Koala is one of Australia's most distinctive wildlife species (TSSC 2012b). It is a large grey, arboreal mammal with woolly fur, long black claws, a large black nose, fluffy ears, and no tail (Strahan 2002).

#### Distribution:

The Koala is found in eastern Australia in fragmented populations, from the temperate south to the tropical north (Strahan 2002, Martin and Handasyde 1999). The current range of the Koala in Queensland is approximately 30% of the former range (Krockenberger *et al.* 2012).

In Queensland, Koala populations occur in moist forests along the coast, subhumid woodlands in southern and central Queensland, and in some eucalypt woodlands along watercourses in the semiarid environments of the western part of the State (Melzer *et al.* 2000). The distribution of the Koala extends inland, following drainage lines supporting River Red Gum *Eucalyptus camaldulensis* (Strahan 2002, Smith *et al.* 2013a), although Koalas have also been found to occur in non-riverine communities in semiarid areas (Sullivan *et al.* 2003).

In the west and north of their range in Queensland, the distribution of Koalas is determined by heat in combination with water availability (Munks *et al.* 1996, Sullivan *et al.* 2003). Phases of population crashes and recovery, associated with rainfall variability, occur in the semi-arid west of the Koala's distribution (Gordon *et al.* 1988, Gordon and Hrdina 2005).

#### Habitat for the Species:

The Koala is strongly associated with eucalypt forests (Table 77), which it feeds on (Strahan 2002). Habitat quality for Koalas is based on the identification of local preferences for food tree species and quantification of the availability of those species (Phillips and Callaghan 2000, Phillips *et al.* 2000). Koalas are more likely to persist in more intact landscapes (Smith *et al.* 2013a). Koalas have been recorded establishing home ranges within revegetated eucalypt woodlands (TSSC 2012b).

#### Regional Ecosystems Associations:

**Table 77 Regional Ecosystem associations for the Koala**

RE	Short Descriptions
11.2.5	Corymbia-Melaleuca woodland complex of beach ridges and swales
11.3.2	<i>Eucalyptus populnea</i> woodland on alluvial plains
11.3.3	<i>Eucalyptus coolabah</i> woodland on alluvial plains
11.3.4	<i>Eucalyptus tereticornis</i> and/or <i>Eucalyptus spp.</i> woodland on alluvial plains



**Plate 15:** Koala

RE	Short Descriptions
11.3.7	<i>Corymbia</i> spp. woodland on alluvial plains
11.3.9	<i>Eucalyptus platyphylla</i> , <i>Corymbia</i> spp. woodland on alluvial plains
11.3.10	<i>Eucalyptus brownii</i> woodland on alluvial plains
11.3.25	<i>Eucalyptus tereticornis</i> or <i>E. camaldulensis</i> woodland fringing drainage lines
11.3.25b	Riverine wetland or fringing riverine wetland. <i>Melaleuca leucadendra</i> and/or <i>M. fluviatilis</i> , <i>Nauclea orientalis</i> open forest.
11.3.30	<i>Eucalyptus crebra</i> , <i>Corymbia dallachiana</i> woodland on alluvial plains
11.3.35	<i>Eucalyptus platyphylla</i> , <i>Corymbia clarksoniana</i> woodland on alluvial plains
11.3.37	<i>Eucalyptus coolabah</i> fringing woodland on alluvial plains
11.4.2	<i>Eucalyptus</i> spp. and/or <i>Corymbia</i> spp. grassy or shrubby woodland on Cainozoic clay plains
11.5.3	<i>Eucalyptus populnea</i> +/- <i>E. melanophloia</i> +/- <i>Corymbia clarksoniana</i> on Cainozoic sand plains and/or remnant surfaces
11.5.9b	<i>Eucalyptus crebra</i> , <i>E. tenuipes</i> , <i>Lysicarpus angustifolius</i> +/- <i>Corymbia</i> spp. woodland
11.5.9c	<i>Eucalyptus crebra</i> +/- <i>Corymbia intermedia</i> +/- <i>E. moluccana</i> +/- <i>C. dallachiana</i> woodland
11.7.3	<i>Eucalyptus persistens</i> , <i>Triodia mitchellii</i> open woodland on stripped margins of Cainozoic lateritic duricrust
11.7.4	<i>Eucalyptus decorticans</i> and/or <i>Eucalyptus</i> spp., <i>Corymbia</i> spp., <i>Acacia</i> spp., <i>Lysicarpus angustifolius</i> woodland on Cainozoic lateritic duricrust
11.8.5	<i>Eucalyptus orgadophila</i> open woodland on Cainozoic igneous rocks
11.9.2	<i>Eucalyptus melanophloia</i> +/- <i>E. orgadophila</i> woodland on fine-grained sedimentary rocks
11.9.9	<i>Eucalyptus crebra</i> woodland on fine-grained sedimentary rocks
11.11.9	<i>Eucalyptus thozetiana</i> , <i>Acacia harpophylla</i> woodland on old sedimentary rocks with varying degrees of metamorphism and folding
11.12.1	<i>Eucalyptus crebra</i> woodland on igneous rocks
11.12.2	<i>Eucalyptus melanophloia</i> woodland on igneous rocks
11.12.7	<i>Eucalyptus crebra</i> woodland with patches of semi-evergreen vine thicket on igneous rocks (boulder-strewn hillsides)
11.12.13	<i>Eucalyptus crebra</i> , <i>Corymbia</i> spp., <i>E. acmenoides</i> woodland on igneous rocks. Coastal hills

### Essential Microhabitat:

Koalas rely on eucalyptus trees for food and shelter. This species feeds on approximately 50 different eucalypt species across its range, with food preferences varying locally and across regions (Krockenberger *et al.* 2012). There is a growing body of evidence that identifies the importance of shelter (non-food) trees to Koalas, with Crowther *et al.* (2013) suggesting that shelter trees are equally important as food tree. Shelter trees play an essential role in thermoregulation and are likely to be selected based on height, canopy cover and elevation, with large trees occurring in gullies being preferable (Crowther *et al.* 2013).

Koalas are restricted to riparian/drainage lines at the more arid, western edge of their range (Davies *et al.* 2013). During drought, dryland populations persists in lower numbers but, following episodes of drought-breaking rainfall, may expand out from riparian zones to occupy adjacent habitat as population size increases (TSSC 2012b). Gordon *et al.* (1988) suggest that the regional persistence of Koalas in dry areas during drought may rely on the protection of 'survival' habitats around permanent water holes.



**Known Populations and Relationships within the Project Area:**

Koalas occur at low densities in the northern Brigalow Belt Bioregion, where they are associated with creek lines (Ellis *et al.* 2002 Munks *et al.* 1996). Koalas are known to occur north and south of the project area (GHD 2014, DEHP 2015h), specifically, at Wilandspey on the Belyando River, in Nairana National Park, on Pasha between Mount Coolon and Moranbah, at the town of Mt Coolon, at Tiverton on the upper reaches of the Bowen River, and adjacent to the town of Collinsville (DEHP 2015h, DEHP 2015i).

The Koala has also been recorded on two occasions in the vicinity of Abbot Point (GHD 2014, DEHP 2015h). Within the Project Area and adjacent properties, a Koala was observed on White Kangaroo in October 2013, and fresh Koala pellets were observed in fringing riparian woodland on the Mt Lookout property in the same month (GHD 2014). Confirmed Koala scratches were observed at Disney Quarry (SKM 2013). Koalas are likely to occur at low densities in remnant and regrowth eucalypt woodland across the Project Area (GHD 2014).

**Movement Patterns:**

The Koala is solitary and spends much of its time in distinct home ranges (Strahan 2002, Davies *et al.* 2013). This species is not territorial and the home ranges of individuals overlap extensively in dense populations (Ellis *et al.* 2009), but are discrete at lower abundances (Strahan 2002). Young female Koalas often stay in similar areas as their mother, whereas males disperse to new areas once they reach 2-3 years old (Strahan 2002). At Blair Athol in central Queensland, home ranges are estimated at 135 ha for males and 101 ha for females (Ellis *et al.* 2009).

The Koala is inactive for approximately 20 hours per day (Strahan 2002). This species generally moves between feeding trees at dawn, dusk and night (Crowther *et al.* 2013). These moves can be several hundred metres (Strahan 2002), making Koalas particularly vulnerable to attacks by wild and domestic dogs at this time. Koala activity generally peaks between August and January, and breeding females with back-young are most easily observed at this time (DoE 2014). Individuals tend to use the same set of trees, but generally not at the same time, and they change trees only a few times per day (TSSC 2012b).

Koalas rarely venture more than 1 km from waterways in drylands (Smith *et al.* 2013b).

**Breeding Biology:**

In Queensland, Koalas breed between September and April (Krockenberger *et al.* 2012). Female Koalas can breed annually, from 2 years of age (Strahan 2002). Koala joeys remain in the pouch for approximately 6 months and become independent at 12 months of age (Strahan 2002).

**Feeding Ecology:**

The Koala feeds almost exclusively on eucalyptus leaves. It may also consume foliage of related genera, including *Corymbia*, *Angophora* and *Lophostemon*, and at times supplement its diet with species from the genera *Leptospermum* and *Melaleuca* (Martin and Handasyde 1999; Moore and Foley 2000). In the northern parts of Australia, the preferred food trees are River Red Gum (*Eucalyptus camaldulensis*), Forest Red Gum (*Eucalyptus tereticornis*), Tallowwood (*Eucalyptus microcorys*) and Grey Gum (*Eucalyptus punctata*; Strahan 2002). Food trees vary with location and are usually limited to one or a few species present at a given site (Moore and Foley 2000).

The preferred food tree species can vary with rainfall conditions e.g. the proportion of poplar box (*Eucalyptus populnea*) in the diet of dryland Koalas increases post-flood, and the proportion of coolabah (*Eucalyptus coolabah*) decreases (Davies *et al.* 2014).

### 9.8.3 Threats and Impacts

The primary threats to the Koala are the loss and fragmentation of habitat resulting in loss of food and shelter trees, increased risk of vehicle strike and dog mortality, and isolation of populations (Krockenberger *et al.* 2012, TSSC 2012b). Dogs and cars are two threats to Koalas that are closely associated with urban expansion; however, these threats may also apply to rural areas (Crowther *et al.* 2010, SECRC 2011). Habitat fragmentation results in isolated high density population areas where the risk of disease transmission is increased (Strahan 2002, Melzer *et al.* 2000, DECC 2008) and the potential to recolonise dryland areas post-drought is impeded (TSSC 2012b).

Wildfire and drought are semi-natural processes that are also considered to threaten Koala populations, particularly in dryland areas where water sources and the availability of shelter trees have been anthropogenically altered (Krockenberger *et al.* 2012, TSSC 2012b). Days of extreme heat have also been invoked as a threat to Koalas (Kavanagh and Barrott 2001). Prior to changes in vegetation clearing legislation in 2006, land clearing was a significant cause of mortality to Koalas in Queensland, particularly in the Brigalow Belt Bioregion (Cogger *et al.* 2003).

Table 78 outlines all the potential impacts of the project that are applicable to Koalas, taking into account the conservation listing, recovery plans (e.g. Krockenberger *et al.* 2012, DECC 2008), Condition 5c of the EPBC Approval, Appendix 1 of the Coordinator-General's Report (NGBR Project), and specific impacts outlined in the EIS (GHD 2012; GHD 2014). The Commonwealth environment department considers that it is currently difficult to specify important populations for the Koala, and such a proposition must be assessed on a case by case basis, using the information available for a particular location (DoE 2015). The results of surveys completed during the planning and assessment stage of the project demonstrate that the construction footprint and surrounding study area are not considered to support an 'important population' or 'habitat critical to the survival' of the Koala (GHD 2014).

**Table 78 Potential impacts from the Project on Koalas**

Impacts	Potential impacts associated with the Project	Project phase
Vegetation Clearing/Habitat Loss	Removal of Koala habitat. A disturbance limit of 2,047.6 ha is in place in the EPBC Act approval.	Construction
	Loss of Koala food trees.	
	Loss of Koala shelter trees.	
Vehicle and Train Strike	Mortality and injury due to the propensity of Koalas to cross roads and railway lines at dawn and in the early evening.	Construction, Operations
Predation by Invasive Mammals	Mortality and injury due to predation by feral dogs, which are known to inhabit the area traversed by the Project and use fauna crossings as funnel points for attacks.	Construction, Operations
Fragmentation (Connectivity)	Loss of connectivity between suitable habitats.	Construction, Operations
Bushfire	Potential increased risk of bushfire due construction activities and altered fire regimes.	Construction, Operations
Earthworks	Mortality and injury due to machinery strike.	Construction
Noise and Vibration	Loss of useable habitat due to noise and vibration disturbance.	Construction, Operations

Impacts	Potential impacts associated with the Project	Project phase
Emissions i.e. dust	Dust emissions from coal transport may potentially reduce habitat quality for the Koala, in and immediately adjacent to the Project Area.	Construction Operation
Light Spill	Temporary loss of useable habitat due to light disturbance at night. Permanent lighting is not proposed along the railway.	Construction
Waterway crossings	Potential loss of water resources and reduction in food tree availability due to sedimentation and changes in hydrology at water crossings.	Construction, Operations
Weeds and Pests	Degradation of habitat and direct mortality. Weeds and Pests (apart from feral dogs) are not known to affect Koalas.	Impact unlikely
Entrapment	Injury or mortality due to entanglement in open cavities and pits.	Construction

#### 9.8.4 Mitigation and Management Measures

Table 79 outlines all relevant management measures for the Koala that are consistent with the conservation advice, referral and recovery plans for this species (e.g. DoE 2014, DECC 2008, NRMCC 2009, TSSC 2012b) and meet the conditions of the EPBC Approval and Coordinator-General's Report. All appropriate management measures will be implemented during construction and operations in habitats known or likely to support Koalas. Sightings of Koalas outside known populations during construction and operations will be reported to the ER. Where additional populations are identified, DES and DoEE will be notified of locations and appropriate management actions will be implemented.

Table 79 Mitigation and management measures for the Koala

Goal (Impact)	Performance Criteria	Management Measures	Trigger	Corrective Action
Minimise loss of habitat through vegetation clearing	Rehabilitation of disturbed areas that are no longer required for construction or operations	<p>Progressive rehabilitation of disturbed areas will be undertaken as soon as possible after the completion of construction activities. Vegetation rehabilitation will use locally-sourced plants and incorporate local Koala food tree species where the rehabilitated area adjoins known and potential Koala habitat.</p> <p>Earth formations in waterways will be rehabilitated using original topsoil and configured in a way that mirrors the original terrain.</p>	Rehabilitated areas fail to reach 70% of baseline and control scores within 15 years.	An annual rehabilitation monitoring report will be sent to DES. Revise and implement an updated Rehabilitation Management Plan if targets are not achieved within 15 years.
	No net loss of Koala food and shelter trees unless approved	<p>Map and mark Koala food and shelter trees within the Project Area. Consult with construction team about options to retain Koala food and shelter trees where possible, focusing on riparian areas.</p> <p>During rehabilitation, use strategic re-planting of preferred food and shelter tree species in riparian areas (see Mitchell 2015). Plantings will occur in depths of soil appropriate for the healthy, long-term survival of the plant species to be grown.</p>	<p>Failure to mark Koala food and shelter trees prior to vegetation clearing.</p> <p>Unapproved clearing of Koala food and shelter trees.</p> <p>&gt;10% of planted Koala food trees fail to successfully regenerate within 10 years.</p>	<p>Non-conformances with this requirement will be recorded as an incident in Adani's incident reporting system. Review of construction procedures to ensure breach does not re-occur.</p> <p>Review and revise Rehabilitation Management Plan.</p>
Minimise the effects of extreme heat on Koalas				
Minimise the risk of light vehicle and machinery strike	No death or injury due to light vehicle or machinery strike during construction and operations	Suitably qualified spotter-catcher(s) will be present when vegetation clearing is occurring in habitat known or likely to contain Koalas. Daily pre-clearing surveys will be undertaken by suitably qualified spotter-catcher(s), prior to construction activities, to: (1) find any Koalas within and directly adjacent to all areas where vegetation clearing and construction works will occur, and (2) identify/confirm all Koala food and shelter trees prior to construction activities each day.	Light vehicle or machinery strike during clearing	<p>Incidents will be reported to the site ER as soon as possible. DoEE and DES will be notified within 24 hours.</p> <p>Depending on the extent of injuries, any injured Koala will be either taken to the nearest qualified veterinary practitioner or wildlife carer, or humanely euthanised on site by a suitably qualified person (see Section 11.3).</p>

Goal (Impact)	Performance Criteria	Management Measures	Trigger	Corrective Action
		<p>Fauna spotter-catcher(s) are not to physically move a Koala from a tree in which it is residing, unless it is in direct mortal danger or requires veterinary assistance. No tree housing a Koala is to be felled, damaged, or interfered with until the Koala moves away of its own volition. Once the animal has moved out of the area, work may commence. The fauna spotter-catcher(s) will monitor all Koalas in the area to ensure that works do not cause any stress to the animals.</p> <p>Vegetation clearing will occur in a sequential pattern, to allow Koalas the opportunity to disperse from work areas, ahead of machinery.</p>		
		<p>Prior to site entry, all relevant site personnel, including contractors, will be made aware of the propensity of Koalas to cross tracks and railway lines at dawn and dusk, and during the night.</p> <p>Vehicles and plant will drive on designated roads and tracks only, and adhere to all speed limits, which will be clearly sign posted. Speed limits in and adjacent to, Koala habitat will be set after consultation with the onsite ER, and reviewed bi-annually</p>	<p>Light vehicle or machinery strike during other activities</p>	<p>Complete an incident report and notify DoEE and DES.</p> <p>Depending on the extent of injuries, any injured Koala will be either taken to the nearest qualified veterinary practitioner or wildlife carer, or humanely euthanised on site by a suitably qualified person (see Section 11.3).</p>
<p>Minimise risk of train strike</p>	<p>No death or injury due to train strike during operations</p>	<p>In areas where designated crossing points coincide with known Koala habitat fencing will consist of interlock mesh with a minimum height of 2m, be 5 m from any retained trees or plantings to minimise the potential for Koalas to climb over the fence, have a minimum 50 cm wide anti-climb panelling along the top, or 'floppy tops' installed, along the length of the fence to minimise the ability of Koalas to climb the fence. Fences will guide Koalas to suitable crossing areas (waterways and artificial fauna crossings). Regular monitoring of the fence line for potential breach locations will be undertaken.</p>	<p>Koala located inside the fenced area of the railway corridor.</p> <p>Koala death or injury due to train strike.</p>	<p>Complete an incident report and notify DoEE and DES.</p> <p>Depending on the extent of injuries, any injured Koala will be either taken to the nearest qualified veterinary practitioner or wildlife carer, or humanely euthanised on site by a suitably qualified person (see Section 11.3).</p>

Goal (Impact)	Performance Criteria	Management Measures	Trigger	Corrective Action
		<p>An identification poster for all threatened species with the potential to occur in the Project Area will be installed in the train cabin, and prominently in site offices.</p> <p>Additional sightings of Koalas will be reported to the ER and confirmed.</p>		
Minimise predation risk by feral dogs	No increase in feral dog numbers in the Project Area	<p>A Pest Management Plan (PMP) will be developed and implemented prior to construction, including measures to control feral dogs (not dingoes). The PMP will be developed in conjunction with neighbouring land owners, and will target waterway crossings, habitat edges and fixed sites such as workers camps.</p> <p>Domestic animals will not be permitted into the project area.</p>	>10% increase in the population of feral dogs from baseline scores	Increase feral dog management efforts, in conjunction with neighbouring land owners.
Maintain connectivity	Connectivity between known Koala habitats on either side of the Project Area.	<p>In known and likely Koala habitat, fauna passes will be incorporated into the railway design, which allow Koalas to pass beneath the railway unimpeded, as outlined in the Fauna Crossing Strategies (Saunders-Havill 2013; 2014). Waterway crossings may act as Koala fauna passes, where suitable trees and climbing apparatus are provided for the length of the fauna pass. The level of suitable trees and climbing apparatus will be assessed by a suitably qualified person.</p> <p>The design of artificial Koala underpasses will incorporate culverts that are a maximum of 40 m in length, be at least 2.4 m high, be at least 2.4 m wide, and have low-flow channel incorporated in the design. Artificial culverts will use timber climbing structures at least 1.5 m high along the length of the culvert, to allow Koalas a dry crossing. All artificial fauna crossing designs and locations will be approved by a suitably qualified person prior to construction.</p>	No Koalas recorded using fauna passages within 2 years of the completion of construction in known Koala habitat.	Inform DES of monitoring results. Upgrade fauna passage design to ensure Ornamental Snake are amenable to using fauna passes.

Goal (Impact)	Performance Criteria	Management Measures	Trigger	Corrective Action
		<p>Suitable fencing will be used to guide Koalas to waterways and artificial fauna crossings.</p> <p>The final design and location of artificial fauna crossing locations will include input from consultant ecologists.</p>		
Minimise noise and vibration disturbance.	Minimal noise and vibration impacts in surrounding habitat.	<p>No noise and/or vibration-causing construction activities to occur near Koala, unless the koala has the capacity to safely move away from the activity.</p> <p>Ensure all plant and equipment is serviced and maintained to minimise machinery vibration.</p>	Noise and/or vibration-causing construction activities occur within 100 m of a Koala that is unable to safely move away from the activity.	Investigate source of disturbance and implement controls, where possible. Report as per environmental approval conditions and CEMP requirements, if required
Minimise light spill	Minimal light spill into habitat adjacent works.	Install light controlling devices to deflect construction lighting away from known Koala habitat.	Direct light spill >50 m into known Koala habitat.	Upgrade light controlling devices, or adjust location of light, to reduce light spill and lighting levels below trigger levels. Where corrective action is not immediately taken, this will be reported as an incident and managed in accordance with Adani's incident management procedure.
	Construction night works are limited to minimum disturbance activities in or adjacent to known Koala habitat.	Clearing and piling is not to be undertaken at night within or adjacent to Koala habitat,	Clearing or piling occurs at night within or adjacent to Koala habitat	This will be reported as an incident and managed in accordance with Adani's incident management procedure.
Minimise changes to hydrological regimes leading to food tree degradation and death along waterways.	No permanent changes to waterway hydrology in Koala habitat.	<p>No changes to waterway profile and flow except during waterway crossing construction.</p> <p>Where changes to waterways are required during construction (e.g. drainage of a permanent waterhole), prior to any changes occurring an impact assessment on downstream vegetation will be undertaken and mitigation measures approved by DoEE will be implemented.</p>	<p>After waterway rehabilitation, waterway flow and profile is significantly altered.</p> <p>Koala food tree death and degradation within 1 km upstream or 1 km</p>	<p>Inform DES of monitoring results.</p> <p>Revise and implement an updated Rehabilitation Management Plan, focusing on implementing actions to restore water flow and profile.</p>

Goal (Impact)	Performance Criteria	Management Measures	Trigger	Corrective Action
	Rehabilitation of waterway flow and profile after construction of waterway crossings in Koala habitat.	<p>Progressive rehabilitation of waterways will be undertaken as soon as possible after the completion of construction activities at each waterway crossing.</p> <p>Earth formations at waterway crossings will be rehabilitated in a way that mirrors the original waterway terrain.</p>	downstream of the rehabilitated waterway.	
Eliminate entrapment.	No deaths or injuries from trapped Koalas.	<p>Wherever possible, all excavations should have ramped edges/ends no greater than 45 degrees.</p> <p>Fauna ramps (e.g. wooden planks) or earthen ramps will be installed in all cavities deeper than 20 cm, with smooth sides, to provide a means for trapped Common Death Adders (and other fauna) to escape. The fauna ramps or earthen ramps will be clearly marked and all construction staff will be informed of their purpose.</p> <p>All excavations in or adjacent to Koala habitat will be checked daily by a qualified spotter-catcher, including immediately prior to these cavities being filled in.</p>	Koala mortality or injury due to entanglement.	<p>Complete an incident report and notify DoEE and DES if death or injury occur.</p> <p>Injured and dehydrated Koalas will be taken to the nearest qualified veterinary practitioner or wildlife carer.</p>



### 9.8.5 Monitoring

Pre-clearance surveys will be undertaken at suitable times to detect the species, and identify and map suitable habitat in the development area, prior to any clearing or associated works occurring. The surveys will target suitable habitat for this species within and directly adjacent to the Project Area. This SMP must be revised and submitted to DoEE within three months following pre-clearance surveys.

*Survey Methodology:* Koalas are difficult to detect and occur at low densities in many parts of their range (DoE 2014). Therefore, direct observations of Koalas are most appropriate where Koala density is high (DoE 2014). To maximise detectability in dry inland populations, direct surveys undertaken during dry periods should be centred on riparian areas and other dry-period refugia (DoE 2014). Direct surveys are best undertaken both day and night, using spotlight to maximise eye shine detection during nocturnal searches (DoE 2014).

Indirect survey methods are often the most effective way to gather presence/absence data for Koalas, particularly in dry populations with low densities (DoE 2014). Indirect methods include searching smooth-barked trees for scratches, which are specific to Koalas, and searching for scats near the base of food trees (DoE 2014).

Failure to detect animals or sign in a single survey does not necessarily mean the Koala is absent; repeated surveys are required to identify true absence (DoE 2014).

Indirect surveys along transects will be the primary survey method used to detect Koalas in wooded and regrowth areas for this project. These surveys can occur at any time of year, but are preferred in the dry season. Transects will cover the areas immediately adjacent to the Project Area, with greater search effort along drainage lines and watercourses. Indirect surveys will be supplemented by direct observation transects (day and/or night) in areas where undergrowth and dense leaf litter obscure the detection of faecal pellets, and rough-barked food trees prevent the detection of scratches. Where Koalas are confirmed to occur, the spot assessment technique will be carried out to estimate the relative importance of the habitat to local Koala populations (Phillips and Callaghan 2011). All surveys for Koalas will be undertaken by a suitably qualified specialist, with demonstrated skill and experience in conducting vegetation and/or Koala surveys (DoE 2014).

Design of the on-going monitoring program, including the location and extent of sites, will be determined by a suitably qualified person to ensure that sufficient data are collected to quantify likely impacts resulting from the action, and to determine appropriate habitat management goals. The monitoring program will include both impact and control sites to monitor the progress of recovery, including effectiveness of management actions, and adapt if necessary. Annual monitoring will occur for the duration of railway activities.

The potential impacts of activities will be monitored in accordance the monitoring program outlined in Table 80.

Table 80 Details of monitoring program for the Koala

Performance Criteria	Monitoring Program	Trigger for Corrective Action	Outcomes
Identify populations within and immediately adjacent to Project Area	Pre-clearance targeted surveys for Koalas targeting suitable habitat for this species within and directly adjacent to the Project Area. Surveys to be undertaken anytime of the year using the survey methods outlined above.	N/A	Record and map Koala locations in the vicinity of the Project Area, to ensure appropriate mitigating management measures are implemented.
Rehabilitation of disturbed areas in Koala habitat that are no longer required for operations.	BioCondition Assessments and photo monitoring will be undertaken prior to rehabilitation activities and then annually after rehabilitation to determine the condition of Koala habitat in proposed rehabilitation and control sites. For each proposed rehabilitation area, a minimum of two permanent monitoring plots will be located in the rehabilitated area and a minimum of two permanent monitoring plots will be located between 1 km and 2 km from the Project Area (control areas). In addition to these Assessments, there will be annual targeted searches for Koalas within each of the rehabilitated areas.	Rehabilitated areas fail to reach 70% of baseline and control scores within 15 years.	Baseline habitat quality for comparison during monitoring. Ability to assess rehabilitation quality against rehabilitation and offset requirements. Adani to review monitoring results and report annually and revise management actions if any trigger is identified
No net loss of Koala food and shelter trees.	Annual monitoring (including photo monitoring) of planted koala food and shelter tree height and canopy cover.	>10% of planted Koala food trees fail to successfully regenerate within 10 years. Failure to mark Koala food and shelter trees prior to vegetation clearing.	Compliance with Coordinator-General conditions, SMP and relevant legislation.
No death or injury due to light vehicle or machinery strike during construction and operations.	Monitoring by onsite ER	Light vehicle or machinery strike.	
No death or injury due to train strike during operations		Koala located inside the fenced area of the railway corridor. Koala death or injury due to train strike.	

Performance Criteria	Monitoring Program	Trigger for Corrective Action	Outcomes
No bushfires sparked by project activities		Bushfire sparked by project activities.	
Minimal growth of vegetation adjacent to the railway		Growth of vegetation within 5 m of the centre of the railway.	
No pollution of waterways		Pollution of waterways.	
No deaths or injuries from trapped Koalas		Koala mortality or injury due to entanglement.	
No increase in feral dog numbers in the Project Area	Baseline and annual monitoring of feral dog populations at waterway and artificial fauna crossings in Koala habitat. Monitoring will include track and scat monitoring, photo monitoring, and using baited infrared cameras.	>10% increase in the population of feral dogs from baseline scores	Ensure compliance with PMP.
Connectivity between known Koala habitats on either side of the Project Area.	<p>Continual monitoring of all fauna passages (waterways and artificial crossings) in known and likely Koala habitat. Monitoring will include continuous photo monitoring using infra-red motion sensitive cameras at both ends of each crossing, and inspection of climbing structures within artificial fauna crossings for Koala scat and scratches. Additional monitoring options include manual and automated PIT tag passage monitoring (e.g. Baxter-Gilbert <i>et al.</i> 2013), and a tertiary institution-based radio-tracking program.</p> <p>A co-ordinated monitoring plan will be created and established to monitor known Koala populations and condition on either side of selected natural and artificial Koala crossings.</p> <p>Baseline monitoring (including photo monitoring) of riparian Koala food tree condition and growth rates at all waterway crossings in known and likely Koala habitat. Annual monitoring (including photo monitoring) of riparian Koala food tree condition and growth rates after the completion of waterway crossing construction.</p>	No Koalas recorded using fauna passages within 2 years of the completion of construction in known Koala habitat.	Compliance with EPBC conditions and SMP.
No permanent changes to waterway flow or profile in Koala habitat	Baseline and bi-annual monitoring (including photo monitoring) of water flow and profile at all waterway crossings in known Koala habitat. Monitoring will occur at peak high water and low water profile each year, and be undertaken by a suitably qualified person.	After rehabilitation, waterway profile and flow is significantly altered.	

Performance Criteria	Monitoring Program	Trigger for Corrective Action	Outcomes
Rehabilitation of waterway flow and profile after construction of waterway crossings in Koala habitat		Koala food tree death and degradation within 1 km upstream or 1 km downstream of the rehabilitated waterway.	
<p>No net loss of suitable permanent water sources.</p> <p>No exceedance of suspended sediment levels at specified monitoring locations</p>	<p>Annual monitoring (including photo monitoring) of water source availability, in the driest season. Design and implement a water quality monitoring program in accordance with the Water Quality Management Plan focusing on emissions dust and heavy metal toxicity at waterway crossings in known Koala habitat. The monitoring program will ensure that waterways in areas known to be inhabited by Koalas are prioritised for monitoring. Water and sediment samples will be collected at each site to test for the presence of 15 heavy metals. A dust particulate sampler will also be erected at each site to compare aerial collection of coal dust and heavy metal values with waterway monitoring results. Sediment and dust samples will be assessed for baseline measures, and then annually at low flow periods for sediment and dust samples.</p> <p>All monitoring will be undertaken in line with the Queensland's Water Quality Guidelines 2009 and ANZECC/ARMCANZ Interim Sediment Quality Guidelines.</p>	<p>Draining of suitable permanent water source.</p> <p>Siltation of a suitable permanent water source in Koala habitat.</p> <p>Emissions settlement in water sources breach industry standards.</p>	
Minimal noise and vibration impacts in surrounding habitat.	<p>Baseline monitoring by a qualified geologist, of the vibration intensity in surrounding habitat caused by significant vibration-causing construction activities (e.g. drilling, earthworks and movement of large machinery).</p> <p>Daily monitoring by onsite ER of active construction footprint for significant vibration-causing construction activities.</p>	<p>Noise and/or vibration-causing construction activities occur within 100 m of a Koala that is unable to safely move away from the activity.</p> <p>Active construction activities that cause significant vibrations in the surrounding habitat are spread over &gt;500 m stretch at any given time, with less than 1 km gap between significant vibration-causing activities</p>	Compliance with EPBC conditions and SMP.

Performance Criteria	Monitoring Program	Trigger for Corrective Action	Outcomes
Minimal light spill into habitat adjacent works.	Regular monitoring by onsite ER.	Direct light spill >50 m into known Koala habitat.	
Construction night works are limited to minimum disturbance activities in or adjacent to known Koala habitat		Clearing or piling occurs at night within or adjacent to Koala habitat	

## 9.9 *Petauroides volans* (Greater Glider)

### 9.9.1 Status

EPBC Act = Vulnerable

NC Act = Vulnerable

### 9.9.2 Ecology and Distribution

#### Description of the Species:

The Greater Glider is the largest gliding possum in Australia, with a head and body length of 35.46 cm and a long furry tail measuring 45-60 cm (TSSC 2016). It is an arboreal nocturnal mammal with large furry ears, a short snout and fur colour white or cream below, that varies from dark grey, dusky brown through to light mottled grey and cream above (TSSC 2016).

#### Distribution:

The Greater Glider is restricted to eastern Australia, where is occurring from the Windsor Tableland in north Queensland, through to central Victoria (Wombat State Forest), with an elevation range from sea level to 1,200 m above sea level (TSSC 2016). An isolated inland subpopulation occurs in the Gregory Range, west of Townsville, with another in the Einasleigh Uplands (TSSC 2016). Since European settlement, it is unlikely that the range of the Greater Glider has changed; although, localised occupancy has significantly decreased as a result of habitat clearing (TSSC 2016).

#### Habitat for the Species:

The Greater Glider is largely restricted to eucalypt forest and woodlands (Table 81), where it is typically found in highest abundance in taller, montane, moist eucalypt forests with relatively old trees and abundant hollows (TSSC 2016). During the day, the species shelters in tree hollows, with a particular selection for large hollows in large, old trees (TSSC 2016).

#### Regional Ecosystems Associations:

**Table 81 Regional Ecosystem associations for the Greater Glider**

RE	Short Descriptions
11.2.5	Corymbia-Melaleuca woodland complex of beach ridges and swales
11.3.2	<i>Eucalyptus populnea</i> woodland on alluvial plains
11.3.3	<i>Eucalyptus coolabah</i> woodland on alluvial plains
11.3.4	<i>Eucalyptus tereticornis</i> and/or <i>Eucalyptus</i> spp. woodland on alluvial plains
11.3.7	<i>Corymbia</i> spp. woodland on alluvial plains
11.3.9	<i>Eucalyptus platyphylla</i> , <i>Corymbia</i> spp. woodland on alluvial plains
11.3.10	<i>Eucalyptus brownii</i> woodland on alluvial plains
11.3.25	<i>Eucalyptus tereticornis</i> or <i>E. camaldulensis</i> woodland fringing drainage lines



**Plate 16:** Greater Glider

RE	Short Descriptions
11.3.25b	Riverine wetland or fringing riverine wetland. <i>Melaleuca leucadendra</i> and/or <i>M. fluviatilis</i> , <i>Nauclea orientalis</i> open forest.
11.3.30	<i>Eucalyptus crebra</i> , <i>Corymbia dallachiana</i> woodland on alluvial plains
11.3.35	<i>Eucalyptus platyphylla</i> , <i>Corymbia clarksoniana</i> woodland on alluvial plains
11.3.37	<i>Eucalyptus coolabah</i> fringing woodland on alluvial plains
11.4.2	<i>Eucalyptus</i> spp. and/or <i>Corymbia</i> spp. grassy or shrubby woodland on Cainozoic clay plains
11.5.3	<i>Eucalyptus populnea</i> +/- <i>E. melanophloia</i> +/- <i>Corymbia clarksoniana</i> on Cainozoic sand plains and/or remnant surfaces
11.5.9b	<i>Eucalyptus crebra</i> , <i>E. tenuipes</i> , <i>Lysicarpus angustifolius</i> +/- <i>Corymbia</i> spp. woodland
11.5.9c	<i>Eucalyptus crebra</i> +/- <i>Corymbia intermedia</i> +/- <i>E. moluccana</i> +/- <i>C. dallachiana</i> woodland
11.7.3	<i>Eucalyptus persistens</i> , <i>Triodia mitchellii</i> open woodland on stripped margins of Cainozoic lateritic duricrust
11.7.4	<i>Eucalyptus decorticans</i> and/or <i>Eucalyptus</i> spp., <i>Corymbia</i> spp., <i>Acacia</i> spp., <i>Lysicarpus angustifolius</i> woodland on Cainozoic lateritic duricrust
11.8.5	<i>Eucalyptus orgadophila</i> open woodland on Cainozoic igneous rocks
11.9.2	<i>Eucalyptus melanophloia</i> +/- <i>E. orgadophila</i> woodland on fine-grained sedimentary rocks
11.9.9	<i>Eucalyptus crebra</i> woodland on fine-grained sedimentary rocks
11.11.9	<i>Eucalyptus thozetiana</i> , <i>Acacia harpophylla</i> woodland on old sedimentary rocks with varying degrees of metamorphism and folding
11.12.1	<i>Eucalyptus crebra</i> woodland on igneous rocks
11.12.2	<i>Eucalyptus melanophloia</i> woodland on igneous rocks
11.12.7	<i>Eucalyptus crebra</i> woodland with patches of semi-evergreen vine thicket on igneous rocks (boulder-strewn hillsides)
11.12.13	<i>Eucalyptus crebra</i> , <i>Corymbia</i> spp., <i>E. acmenoides</i> woodland on igneous rocks. Coastal hills

### Essential Microhabitat:

The Greater Glider shelters in tree hollows throughout the day, with a particular selection for large hollows in large, older trees (TSSC 2016). They tend to use a small number of 'primary dens' but will use as many hollows as they have available to them. Additionally, they appear to use hollows opportunistically, indicating that minor reductions in hollow-bearing trees may not impact on localised populations. The species is the largest of the Australian gliding possum species and as such, it requires a hollow entrance of a minimum of 80 mm, with internal hollow measurements reaching 250 x 250 mm (TSSC 2016).

### Movement Patterns:

The Greater Glider has a relatively small home range of 1-4ha, with ranges larger in lower productivity forest and more open woodlands where they can be up to 16 ha (TSSC 2016). Home ranges are larger

for males than they are for females with male home ranges being predominantly non-overlapping (TSSC 2016).

Although the Greater Glider has a relatively small home range, due in part to its low dispersal ability, the species may be sensitive to fragmentation and as a result, have a low persistence in small forest fragments. The species is also known to disperse poorly across vegetation that is not native forest. Modelling suggests that they require suitable habitat of at least 160km<sup>2</sup> to maintain viable populations (TSSC 2016).

#### **Breeding Biology:**

The Greater Glider breeds between March and June, with females giving birth to a single young between April and June (TSSC 2016). Sexual maturity is reached at two years of age, with longevity estimated at 15 years, making generation length approximately seven to eight years (TSSC 2016).

#### **Feeding Ecology:**

The Greater Glider is primarily folivorous, with a diet mostly comprising eucalyptus leaves, in particular young leaves due to their high levels of nitrogen and low levels of fibre (TSSC 2016). The species is also known to occasionally feed on the buds and flowers of eucalypts. They prefer forests with a diversity of eucalypt species, due to seasonal variation in preferred tree species (TSSC 2016).

### **9.9.3 Inclusion in SMP**

As per the conditions of approval, the SMP is to be updated based on either the identification of a new species within the Project corridor or if a species is listed under the EPBC Act post approval of the Project. The Greater Glider was listed as Vulnerable under the EPBC on 5 May 2016, which is after the approval of the Project and as such has been included in this SMP.

Section 158A of the EPBC Act, listing events that occur after a Section 75 decision (whether an action is a controlled action) will not apply to the Proposed Action that was referred. Specifically, as per Section 158A(4)(a) the listing event is to be disregarded in making any further approval process decision in relation to the relevant action. The Project was referred on 3 November 2010 with a Section 75 decision made on 6 January 2011 and approval granted on 14 October 2015. Consequently, the listing of the Greater Glider is not included in any impact assessment and no species-specific mitigation, management and monitoring has been included within this plan.

However, it is noted that habitat for the Greater Glider is predominantly co-located in areas of vegetation that provide habitat for Koala and Squatter Pigeon. Accordingly, the mitigation and management measures that have been developed for these species will assist in mitigating any potential impacts to the Greater Glider.



## 9.10 *Grantiella picta* (Painted Honeyeater)

### 9.10.1 Status

EPBC Act = Vulnerable

NC Act = Vulnerable

### 9.10.2 Ecology and Distribution

#### Description of the Species:



Plate 17: Painted Honeyeater

The painted honeyeater has a deep pink bill and red eye with black upperparts and yellow underparts. It has black spots on its flanks and yellow edges to the flight and tail feathers. The females are smaller with a browner back than the male, often with fewer streaks or spots on their breast and flanks (TSSC 2015b).

#### Distribution:

The species is broadly distributed across eastern Australia, but sparse. Almost all records of breeding come from south of 26°S, on inland slopes of the Great Dividing Range between the Grampians, Victoria and Roma, Queensland (TSSC 2015b). The species exhibits seasonal north-south movements primarily dictated by the fruiting of mistletoe. The breeding season is generally matched with that of the mistletoe fruiting season after which many birds move to semi-arid regions such as north-eastern South Australia, central and western Queensland, and central Northern Territory. Despite its dispersive habits, the species is considered to have a single population (TSSC 2015b).

#### Habitat for the Species:

The Painted Honeyeater inhabits dry open forests and woodlands typically dominated by *Acacia* spp. (including Brigalow, *Acacia pendula* and *Acacia aneura*), Belah (*Casuarina cristata*) and Bull-oak (*Allocasuarina luehmannii*). It also occurs in woodlands of black box and river red gum, box-ironbark-yellow gum woodlands, paperbarks, callitris, and trees on farmland or gardens with a high abundance of mistletoes. It has no close associations with any particular regional ecosystem as it favours areas where mistletoe (Loranthaceae species) occurs. Preferred habitat is that which contains a higher number of mature trees, as they generally host more mistletoe (TSSC 2015b).

#### Regional Ecosystem Associations:

Table 82 Regional Ecosystem associations for the Painted Honeyeater

RE	Short Descriptions
11.3.2	<i>Eucalyptus populnea</i> woodland on alluvial plains
11.3.3	<i>Eucalyptus coolabah</i> woodland on alluvial plains
11.3.4	<i>Eucalyptus tereticornis</i> and/or <i>Eucalyptus</i> spp. woodland on alluvial plains
11.3.9	<i>Eucalyptus platyphylla</i> , <i>Corymbia</i> spp. woodland on alluvial plains
11.3.10	<i>Eucalyptus brownii</i> woodland on alluvial plains
11.3.25	<i>Eucalyptus tereticornis</i> or <i>E. camaldulensis</i> woodland fringing drainage lines
11.3.25b	<i>Eucalyptus tereticornis</i> or <i>E. camaldulensis</i> open-forest to woodland fringing drainage lines

RE	Short Descriptions
11.3.30	<i>Eucalyptus crebra</i> , <i>Corymbia dallachiana</i> woodland on alluvial plains
11.3.35	<i>Eucalyptus platyphylla</i> , <i>Corymbia clarksoniana</i> woodland on alluvial plains
11.3.37	<i>Eucalyptus coolabah</i> fringing woodland on alluvial plains
11.4.2	<i>Eucalyptus</i> spp. and/or <i>Corymbia</i> spp. grassy or shrubby woodland on Cainozoic clay plains
11.4.8	<i>Eucalyptus cambageana</i> woodland to open forest with <i>Acacia harpophylla</i> or <i>A. argyrodendron</i> on Cainozoic clay plains
11.5.3	<i>Eucalyptus populnea</i> +/- <i>E. melanophloia</i> +/- <i>Corymbia clarksoniana</i> on Cainozoic sand plains and/or remnant surfaces
11.5.9b	<i>Eucalyptus crebra</i> , <i>E. tenuipes</i> , <i>Lysicarpus angustifolius</i> +/- <i>Corymbia</i> spp. woodland
11.5.9c	<i>Eucalyptus crebra</i> +/- <i>Corymbia intermedia</i> +/- <i>E. moluccana</i> +/- <i>C. dallachiana</i> woodland
11.7.3	<i>Eucalyptus persistens</i> , <i>Triodia mitchellii</i> open woodland on stripped margins of Cainozoic lateritic duricrust
11.7.4	<i>Eucalyptus decorticans</i> and/or <i>Eucalyptus</i> spp., <i>Corymbia</i> spp., <i>Acacia</i> spp., <i>Lysicarpus angustifolius</i> woodland on Cainozoic lateritic duricrust
11.8.5	<i>Eucalyptus orgadophila</i> open woodland on Cainozoic igneous rocks
11.9.2	<i>Eucalyptus melanophloia</i> +/- <i>E. orgadophila</i> woodland on fine-grained sedimentary rocks
11.9.9	<i>Eucalyptus crebra</i> woodland on fine-grained sedimentary rocks
11.9.10	<i>Eucalyptus populnea</i> open forest with a secondary tree layer of <i>Acacia harpophylla</i> and sometimes <i>Casuarina cristata</i> on fine-grained sedimentary rocks
11.11.9	<i>Eucalyptus thozetiana</i> , <i>Acacia harpophylla</i> woodland on old sedimentary rocks with varying degrees of metamorphism and folding
11.12.1	<i>Eucalyptus crebra</i> woodland on igneous rocks
11.12.2	<i>Eucalyptus melanophloia</i> woodland on igneous rocks
11.12.7	<i>Eucalyptus crebra</i> woodland with patches of semi-evergreen vine thicket on igneous rocks (boulder-strewn hillsides)
11.12.13	<i>Eucalyptus crebra</i> , <i>Corymbia</i> spp., <i>E. acmenoides</i> woodland on igneous rocks. Coastal hills

#### Essential Microhabitat:

Regrowth woodland that contains similar or higher densities of mistletoe (Loranthaceae species) than remnant woodland is a key habitat source for the species. Although the species is more common in wider blocks of remnant woodlands than in narrower strips, such as within a road reserve, the species can still occur within narrow roadside strips if ample mistletoe fruit is available (TSSC 2015b).

**Movement Patterns:**

The species often occurs singly or in pairs, and less often in small flocks. The Painted Honeyeater spends the non-breeding season in the semi-arid woodlands of inland and northern Australia, generally spending the breeding season in the southern portion of its distribution (TSSC 2015b).

**Breeding Biology:**

Breeding occurs from October to March (in-line with mistletoe fruiting season). Typically found in the drooping branches of trees between 3 m and 20 m from the ground, the Painted Honeyeater builds delicate cup nests made of plant-fibre, spiders' webs and rootlets. Both parents incubate the nest (typically 2-3 eggs), brood and feed young (TSSC 2015b).

**Feeding Ecology:**

The species has a highly specialised diet of mainly mistletoe fruit and is typically found in the vicinity of abundant fruiting mistletoes. The species relies heavily on the Loranthaceae species of mistletoe (OEH, 2016; Rowland, 2012).

**9.10.3 Inclusion in SMP**

As per the conditions of approval, the SMP is to be updated based on either the identification of a new species within the Project corridor or if a species is listed under the EPBC Act post approval of the Project. The Painted Honeyeater was listed as Vulnerable under the EPBC on 8 July 2015.

The Project was referred on 3 November 2010 with a Section 75 decision made on 6 January 2011 and approval granted on 14 October 2015. Consequently, the listing of the Painted Honeyeater is not included in any impact assessment and no species-specific mitigation, management and monitoring has been included within this plan.

However, it is noted that habitat for the Painted honeyeater is predominantly co-located in areas of vegetation that provide habitat for Koala, Squatter Pigeon and Black Throated Finch. Accordingly, the mitigation and management measures that have been developed for these species will assist in mitigating any potential impacts to the Painted Honeyeater.

## 10 Discussion

### 10.1 Summary of key management issues

The following management approaches are important for minimising impacts of the Project on TECs, threatened flora and threatened fauna species:

- Pre-clearance surveys to confirm the area of habitat to be disturbed, identify threatened species or TECs not previously recorded in the Project Area and monitor compliance with disturbance limits
- Use of spotter-catchers before and during clearing activities to mitigate the direct impacts of construction activities on wildlife and record and report fauna mortality and injuries
- Limit disturbance to pre-defined areas and implement controls to minimise noise, lighting, vibrations and dust
- Implementing sediment control practices at waterway crossings to maintain the connectivity and natural condition of riverine systems, the Caley Valley Wetland and the OUV of the GBRWHA
- Rehabilitate areas that are to be disturbed, to restore habitat values where practicable. Monitor the effectiveness of rehabilitation activities.
- Monitor the direct and indirect impacts of construction and operations on threatened communities and species (and their habitats), both within and adjacent to the Project Area.
- Evaluate the effectiveness of mitigation measures, and revise them if necessary to improve environmental outcomes.

The SMP will be implemented in conjunction with several other management plans specific to threatened species (e.g. Black-throated Finch Management Plan), habitats (ground-water dependent ecosystems) or threats (weed and pest management plan). Collectively, the management plans will achieve a high standard of environmental management.

### 10.2 Implementation

Adani recognises the importance of taking a whole-of-ecosystem approach to the implementation of this plan and the minimisation of environmental impacts arising from the Project. While TECs and threatened species are listed individually under legislation, they interact through food-webs and overlaps in habitat and resource use, are part of a larger environmental landscape and have inter-related and differential sensitivities to Project activities. In this context, managing species and TECs with consideration of broader ecosystem-scale interactions and processes, is likely to be a more effective and efficient approach than managing them individually.

During implementation of this plan, and in particular at the construction planning stage, Adani will take the following approach to increasing the effectiveness of the management plan:

- Identify locations where multiple species/TECs require management and/or monitoring, and ensure such measures are effectively implemented in parallel
- Give consideration to the management of environmental impacts for all threatened species (at an ecosystem scale), rather than particular species in isolation. For example, in habitat overlap areas, ecosystem management should seek an appropriate balance between the contrasting preferred habitats of the Squatter Pigeon (open areas with grass seeds) and the Common Death Adder (vegetated areas with leaf litter).

- Maintain awareness of the changes in the vulnerability of species and TECs during different seasons. For example, most reptiles are more active and more susceptible to entanglement and vehicle mortality during warmer months; migratory shorebirds are only present and susceptible to disturbance at specific times of the year; and TECs are more likely to be successfully rehabilitated if seeded during hot, wet conditions.

# 11 Reporting and Compliance

## 11.1 Updating this plan

This management plan will be reviewed annually and amended as required, and in response to new information, such as changes in the status of listed species or the identification of listed species in the Project Area that had not previously been known to occur or considered likely to occur. Table 83 provides a summary of listed species which may occur within the Project Area. Updates to the SMP will be made in consultation with DoEE and DES.

**Table 83 Listed species which may occur within the Project Area.**

Species	Scientific Name	EPBC Act	NC Act	Habitat
Red Goshawk	<i>Erythrorchis radiatus</i>	Vulnerable	Endangered	Eucalypt woodland, open forest, tall open forest, swamp, sclerophyll forest.
Yakka Skink	<i>Egernia rugosa</i>	Vulnerable	Vulnerable	Brigalow, mulga, bendee, lancewood, belah, poplar box, ironbark.
Dunmall's Snake	<i>Furina dunmalli</i>	Vulnerable	Vulnerable	Known from ecosystems dominated by brigalow, acacia, buloke, lemon-scented gum, ironbark and dry vine scrub. Known from black alluvial cracking clay and clay loams, sandstone derived soils, and ironstone (Land Zone 7).
Retro Slider	<i>Lerista allanae</i>	Endangered	Endangered	Black soil downs on basalt, shale, sandstone and unconsolidated sediments such as gravelly hills. Ridges and gullies. Habitat associations include grasslands, mountain coolabah/red bloodwood open woodlands, black tea-tree closed scrub, and low closed-forest. Recent records are in RE 11.8.5 and RE 11.8.11/11.8.5.
Undescribed species of grassland earless dragon (Emerald)	<i>Tympanocryptis c.f. lineata</i>	Not applicable	Not applicable	Grasslands – found as far north as Myuna Station.
Coastal Sheath-tail Bat	<i>Taphozous australis</i>		Vulnerable	Within 1 km of the ocean. Sand dune scrub, mangroves, melaleuca swamps, coastal heathland, open eucalypt forest, and grasslands.
Northern Quoll	<i>Dasyurus hallucatus</i>	Endangered		Rocky areas, beach-scrub communities, eucalypt forests with termite mounds and/or tree hollows.

Where pre-clearance surveys identify individuals of, or habitat for, a listed species or community not previously identified and reported to DoEE and DES, Adani will notify the Departments in writing within five business days of finding these individuals or habitat. Within 40 business days of finding these

individuals or habitat, Adani will submit an updated management plan to the DoEE and/or DES for approval.

Work that has the potential to impact listed communities or species not previously identified must cease until the updated management plan has been considered by DoEE. The updated management plan will detail how impacts to the newly identified listed species or community will be avoided, mitigated and/or offset. Once approved, the revised management plan will be implemented.

In all other circumstances, Adani will revise the management plan following pre-clearance surveys in accordance with the relevant EPBC Act approval conditions.

## 11.2 Reporting

Adani will prepare an annual report on the implementation of this management plan. The annual report will summarise the activities implemented under the plan, and discuss the effectiveness of mitigation measures, based on the results of monitoring activities.

Adani will conduct periodic audits to monitor compliance with management plan commitments, in accordance with the Adani quality system. Non-compliances with the plan will be reported as described in the individual species monitoring tables above. Adani will integrate the management plan commitments with other aspects of the rail line construction and operations, to avoid actions being overlooked. It should be noted that reporting timeframes outlined in this plan apply only to threatened species and TECs.

## 11.3 Qualifications

Persons implementing key tasks described in this management plan will have appropriate skills and qualifications in ecology.

Persons reviewing this SMP will have a demonstrable knowledge of the threats and impacts of mining and railway activities on species and TECs referred to within this document.

For TEC and flora surveys and threatened species habitat monitoring, the lead ecologist will have >2 years of experience undertaking BioCondition assessments in the Brigalow Belt Bioregion and be able to demonstrate identification skills for each listed species.

Persons demarcating clearing exclusion zones must have a proven ability to identify all the TECs and threatened species habitats addressed in this SMP.

Fauna spotter-catchers must have demonstrable identification and handling skills, and behaviour knowledge (including nesting requirements) for all threatened fauna species that may, are likely, or are known to occur in the Project Area.

Fauna spotter-catchers assisting with works in known Koala habitat require a Koala Spotter-Catcher approval by Adani, in line with the requirements of Policy 6 of the *Nature Conservation (Koala) Conservation Plan 2006* i.e. the person has worked with Koalas in their natural habitat by conducting Koala surveys, Koala monitoring, or involved with Koala rescue for example, or experience in fauna surveys or fauna spotting in Koala habitat areas. Further requirements for personnel undertaking fauna monitoring and pre-clearance surveys are summarised in Table 84.

Where the identification of a suspected threatened species is not clear, the Queensland Museum will be the first contact for identification confirmation (via photographs and / or specimens), followed by persons with demonstrable identification skills for the suspected threatened species, as outlined in Table 84.

Persons undertaking the euthanasia of native wildlife are required to do so in accordance with and the *Animal Care and Protection Act 2001*.

The requirements for personnel undertaking pest animal population monitoring surveys are summarised in Table 84.

Weeds monitors will have weed monitoring experience and demonstrable identification skills for all potential terrestrial, marsh and waterway weeds in the Project Area.

Water quality monitoring will be undertaken by suitably qualified persons as outlined in the Surface Water Management Plan. The availability of suitable water resources will be monitored by the onsite ER, in consultation with an ecologist who is familiar with the water resource requirements of the relevant threatened species.

**Table 84 Qualification requirements for fauna pre-clearance surveys and monitoring**

Species	Qualifications required	Experience required	Demonstrable identification skills required	Demonstrable knowledge of behaviour (including nesting behaviour for birds and the Estuarine Crocodile)
TEC	Ecologist	TEC and RE surveys in the Brigalow Belt	Yes	Na
<i>Dichanthium queenslandicum</i>	Botanist	Grassland surveys	Yes	Na
<i>Dichanthium setosum</i>	Botanist	Grassland surveys	Yes	Na
<i>Eucalyptus raveretiana</i>	Botanist	<i>Eucalyptus</i> surveys	Yes	Na
Squatter Pigeon	Ecologist/ornithologist	Bird surveys	Yes	Yes
Eastern Curlew	Ecologist/ornithologist	Shorebird surveys	Yes	Yes
Black-throated Finch	Ecologist/ornithologist	Finch surveys	Yes	Yes
Australian Painted Snipe	Ecologist/ornithologist	Wetland bird surveys	Yes	Yes
Common Death Adder	Ecologist/herpetologist	Venomous snake handling/ relocation certificate Snake surveys	Yes	Yes
Estuarine Crocodile	Ecologist/herpetologist	Crocodile surveys	Yes	Yes
Ornamental Snake	Ecologist/herpetologist	Venomous snake handling/ relocation certificate Snake surveys	Yes	Yes



<b>Species</b>	<b>Qualifications required</b>	<b>Experience required</b>	<b>Demonstrable identification skills required</b>	<b>Demonstrable knowledge of behaviour (including nesting behaviour for birds and the Estuarine Crocodile)</b>
Koala	Tertiary qualification in ecology, wildlife biology, or environmental science	Koala scat and direct observation surveys	Yes	Yes
Feral dog	Nil	Pest surveys	Yes	Yes
Feral cat	Nil	Pest surveys	No	Yes
Feral pig	Nil	Pest surveys	No	Yes
Fox	Nil	Pest surveys	No	Yes
Goat	Nil	Pest surveys	No	Yes
Gambusia	Aquatic ecologist/ichthyologist	Fish surveys	Yes	Yes
Tilapia	Aquatic ecologist/ichthyologist	Fish surveys	Yes	Yes
Carp	Aquatic ecologist/ichthyologist	Fish surveys	Yes	Yes

# References

- Adani (2012) Carmichael Coal Mine and Rail Project Environmental Impact Statement, Prepared by GHD.
- Adani (2013) North Galilee Basin Rail Project Environmental Impact Statement, Prepared by GHD.
- Adani (2015) Material Change of Use for Rail Infrastructure in the Galilee Basin State Development Area. Planning Report for MCU Package 1. Prepared by GHD.
- Agriculture and Resource Management Council of Australia and New Zealand, Australian and New Zealand Environment and Conservation Council and Forestry Ministers, (ARMCANZ; 2000) Weeds of National Significance Rubber Vine (*Cryptostegia grandiflora*) Strategic Plan. National Weeds Strategy Executive Committee, Launceston.
- Alcorn R (1988) Australasian Wader Study Group Regular Wader Counts Project Interim report to June 1987: migratory waders. Stilt 12:7-23.
- Anstis M (2013) Tadpoles and Frogs of Australia, New Holland Publishers, Sydney.
- Atlas of Living Australia (ALA; 2015) Available at: <http://bie.ala.org.au/species/Acanthophis+antarcticus> Accessed Feb 2015.
- BAAM (2012) Cumulative Impact Assessment: Migratory Shorebird and Waterbird Surveys, Caley Valley Wetland, Port of Abbot Point. Report prepared for North Queensland Bulk Ports Corporation, (including follow up survey results reported in June, Nov, Dec 2012).
- Bamford M, Watkins D, Bancroft W, Tischler G, Wahl J (2008) Migratory Shorebirds of the East Asian - Australasian Flyway: Population estimates and internationally important sites. Canberra, ACT. Department of the Environment, Water, Heritage and the Arts. Wetlands International-Oceania, Available from: <http://www.environment.gov.au/biodiversity/migratory/publications/shorebirds-east-asia.html> Accessed Feb 2015.
- Barter MA (2002) Shorebirds of the Yellow Sea: Importance, Threats and Conservation Status. Wetlands International Global Series No. 8, International Wader Studies 12. Canberra, ACT: Wetlands International.
- Baxter-Gilbert J, Lesbarreres D, Litzgus JD (2013) On the road again: measuring the effectiveness of mitigation structures for reducing reptile road mortality and maintaining population connectivity. Proceedings of the 2013 International Conference on Ecology and Transportation.
- Beeston GR, Walker PJ, Purdie R and Pickard John (1980) Plant communities of the Poplar Box (*Eucalyptus populnea*) lands of eastern Australia. Australian Rangelands Journal 2/1, 1–16.
- Black R, Houston W, Jaensch R (2010) Evidence of regular seasonal migration by Australian painted snipe *Rostratula australis* to the Queensland tropics in autumn and winter. Stilt 58:1–9.
- Blakers M, Davies SJJF, Reilly PN (1984) The Atlas of Australian Birds, Royal Australian Ornithologists Union and Melbourne University Press, Melbourne.
- BMT WBM (2012) Kaili (Caley) Valley Wetlands Baseline Report Prepared for the Office of the Coordinator-General, Department of State Development, Infrastructure and Planning.

- Brien ML, Read MA, McCallum HI, Grigg GC (2008) Home range and movements of radio-tracked estuarine crocodiles (*Crocodylus porosus*) within a non-tidal waterhole. *Wildlife Research* 35:140-149.
- Brigalow Belt Reptiles Workshop (2010) Proceedings from the workshop for the nine listed reptiles of the Brigalow Belt bioregions, 18-19 August. Brisbane: Queensland Herbarium.
- Black-throated Finch Recovery Team, Department of Environment and Climate Change (NSW) and Queensland Parks and Wildlife Service. (2007) National recovery plan for the black-throated finch southern subspecies *Poephila cincta cincta*. Report to the Department of the Environment and Water Resources, Canberra. Department of Environment and Climate Change (NSW), Hurstville and Queensland Parks and Wildlife Service, Brisbane.
- Butler DW (2007) Draft recovery plan for the 'Bluegrass (*Dichanthium* spp.) dominant grassland of the Brigalow Belt Bioregions (north and south)' endangered ecological community, 2007–2011. Report to Department of the Environment and Heritage, Canberra. Queensland Parks and Wildlife Service, Brisbane.
- Campbell AJ (1974) Nests and Eggs of Australian Birds: Including the Geographical Distribution of the Species and Popular Observations Thereon. Melbourne: Wren.
- Campbell HA, Watts ME, Sullivan S, Read MA, Choukroun S, Irwin S, Franklin CE (2010) Estuarine crocodiles ride surface currents to facilitate long-distance travel, *Journal of Animal Ecology* 79: 955-964.
- Campbell HA, Dwyer RG, Irwin TR, Franklin CE (2013) Home range utilisation and long-range movement of estuarine crocodiles during the breeding and nesting season. *PLoS ONE* 8(5): e62127. doi:10.1371/journal.pone.0062127.
- Carpenter CC, Murphy JB and Carpenter GC (1978) Tail Luring in the Death Adder, *Acanthophis antarcticus* (Reptilia, Serpentes, Elapidae). *Journal of Herpetology* 12: 574-577.
- Chisholm AH (1944) Birds of the Gilbert diary. *Emu*. 44:131-150.
- Clarke PJ and Knox KJE (2002) Post-fire response of shrubs in the tablelands of eastern Australia: do existing models explain habitat differences? *Australian Journal of Botany* 50, 53–62.
- Cogger H, Ford H, Johnson C, Holman J, Butler D (2003) Impacts of land clearing on Australian wildlife in Queensland. WWF Australia Brisbane.
- Cogger H, Cameron E, Sadler R, P Egger (1993) The Action Plan for Australian Reptiles. Australian Museum, Sydney.
- Cogger HG (2000) Reptiles and amphibians of Australia (sixth edition) Reed New, Holland, Sydney
- Commonwealth of Australia and Queensland Government (2014) Reef 2050 Long-Term Sustainability Plan, Draft for Public Comment, 89 pp.
- Covacevich J, Archer M (1975) The distribution of the Cane Toad, *Bufo marinus*, in Australia and its effects on indigenous vertebrates. *Memoirs of the Queensland Museum* 17, 395-310.
- Crowther M, Lunney D, Lemon J, Stalenberg E, Wheeler R, Madani G, Ross K, Ellis M (2013) Climate-mediated habitat selection in an arboreal folivore. *Ecography* 36:1-8.

Crowther MS, Lunney D, Lemon J, Wheeler R, Madani G (2010) Restoration of koala habitat in Gunnedah II: movement of koalas across a patchy rural landscape. In: Australian Mammal Society 56th Meeting. Canberra.

Curtis LK, Dennis AJ, McDonald KR, Kyne PM, Debus SJS (2012) Queensland's Threatened Animals, CSIRO Publishing, Melbourne.

Davenport J, Grove DJ, Cannon J, Ellis TR, Stables R (2009) Food capture, appetite, digestion rate and efficiency in hatchling and juvenile *Crocodylus porosus* Journal of Zoology 220: 569-592.

Davies N, Gramotnev G, Seabrook L, Bradley A, Baxter G, Rhodes J, Lunney D, McAlpine C (2013) Movement patterns of an arboreal marsupial at the edge of its range: a case study of the Koala, Movement Ecology 1:8 doi:10.1186/2051-3933-1-8.

Davies N, Gramotnev G, Seabrook L, McAlpine C, Baxter G, Lunney D, Bradley A (2014) Climate-driven changes in diet composition and physiological stress in an arboreal folivore at the semi-arid edge of its distribution, Biological Conservation 172: 80-88.

Department of the Environment (2014) EPBC Act referral guidelines for the vulnerable Koala (combined populations of Queensland, New South Wales and the Australian Capital Territory). Australian Government, Available at: <http://www.environment.gov.au/system/files/resources/dc2ae592-ff25-4e2c-ada3-843e4dea1dae/files/Koala-referral-guidelines.pdf>

Department of the Environment (2015) Community and Species Profile and Threats Database, Department of the Environment, Canberra, Available at: <http://www.environment.gov.au/cgi-bin/sprat/public/sprat.pl>

Department of the Environment and Energy (DoEE) (2019). Conservation Advice (including listing advice) for the Poplar Box Grassy Woodland on Alluvial Plains. Canberra: Department of the Environment and Energy. Available from: <http://www.environment.gov.au/biodiversity/threatened/communities/pubs/141pb-conservation-advice.pdf>.

Department of Environment and Climate Change (2008) Recovery plan for the Koala (*Phascolarctos cinereus*), New South Wales Government, Available at: <http://www.environment.nsw.gov.au/resources/threatenedspecies/08450krp.pdf>

Department of Environment and Heritage Protection (2014) Draft Guide to Determining Terrestrial Habitat Quality Version 0.1, Queensland Government.

Department of Environment and Heritage Protection (2015a) Species profile—*Geophaps scripta* (Columbidae). Queensland Government, Available at: <http://environment.ehp.qld.gov.au/species-search/details/?id=1784> Accessed Mar 2015.

Department of Environment and Heritage Protection (2015b) Eastern Curlew, Queensland Government, Available at: [https://www.ehp.qld.gov.au/wildlife/animals-az/eastern\\_curlew.html](https://www.ehp.qld.gov.au/wildlife/animals-az/eastern_curlew.html) Accessed Feb 2015.

Department of Environment and Heritage Protection (DEHP 2015c) Species profile—*Poephila cincta cincta* (Estrildidae). Available at: <https://environment.ehp.qld.gov.au/species-search/details/?id=1365> Accessed March 2015.

Department of Environment and Heritage Protection (2015d) Common Death Adder, Available at: [https://www.ehp.qld.gov.au/wildlife/animals-az/common\\_death\\_adder.html](https://www.ehp.qld.gov.au/wildlife/animals-az/common_death_adder.html) Accessed Feb 2015

Department of Environment and Heritage Protection (2015e) Common death adder – *Acanthophis antarcticus*, Available at: <http://wetlandinfo.ehp.qld.gov.au/wetlands/ecology/components/species/?acanthophis-antarcticus> Accessed Feb 2015

Department of Environment and Heritage Protection (2015f) Sightings data downloaded from Species profile—*Acanthophis antarcticus* (Elapidae). Queensland Government, Available at: <https://environment.ehp.qld.gov.au/species-search/details/?id=511> Accessed Mar 2015.

Department of Environment and Heritage Protection (2015g) Estuarine crocodile. Available at: [http://www.ehp.qld.gov.au/wildlife/livingwith/crocodiles/estuarine\\_crocodile.html](http://www.ehp.qld.gov.au/wildlife/livingwith/crocodiles/estuarine_crocodile.html) Accessed Feb 2015

Department of Environment and Heritage Protection (2015h) Species profile—*Phascolarctos cinereus* (southeast Queensland bioregion; Phascolarctidae). Queensland Government, Available at: <http://environment.ehp.qld.gov.au/species-search/details/?id=29186> Accessed Mar 2015.

Department of Environment and Heritage Protection (2015i). Sightings data downloaded from Species profile—*Phascolarctos cinereus* (Phascolarctidae). Queensland Government, Available at: <https://environment.ehp.qld.gov.au/species-search/details/?id=860> Accessed Mar 2015.

Department of Environment and Resource Management (2010), Burdekin Natural Resource Management Region Back on Track Actions for Biodiversity, Department of Environment and Resource Management, Brisbane.

Department of the Environment, Water, Heritage and the Arts (2009). Significant impact guidelines for the endangered black-throated finch (southern; *Poephila cincta cincta*). EPBC Act policy statement 3.13.

Department of Environment, Water, Heritage and the Arts (2010) Survey Guidelines for Australia's Threatened Birds, EPBC Act survey guidelines 6.2, Available at: <http://www.environment.gov.au/resource/survey-guidelines-australias-threatened-birds-guidelines-detecting-birds-listed-threatened> Accessed Feb 2015.

Department of Science, Information Technology, Innovation, and the Arts (2015) Targeted species survey guidelines – Common death adder *Acanthophis antarcticus*, Available from: <https://www.qld.gov.au/environment/assets/documents/plants-animals/biodiversity/common-deathadder.pdf> Accessed Feb 2015

Department of Sustainability, Environment, Water, Populations and Communities (2011) Draft referral guidelines for the nationally listed Brigalow Belt reptiles, Australian Government.

Dingle H (2004) The Australo-Papuan bird migration system: another consequence of Wallace's Line. *Emu* 104:95-108.

Eco Logical Australia (2015) North Galilee Basin Rail Biodiversity Offsets Strategy Habitat Quality Assessment, Report prepared for Adani.

Eco Logical Australia (ELA) and OpenLines (2012) Abbot Point Cumulative Impact Assessment. Report prepared for the Abbot Point Working Group, October 2012.

Ehmann H (1992) Encyclopedia of Australian animals: reptiles, Angus and Robertson, Pymble, New South Wales.

Ellis WAH, Melzer A, Carrick FN and Hasegawa M (2002) Tree use, diet and home range of the Koala (*Phascolarctos cinereus*) at Blair Athol, central Queensland. *Wildlife Research* 29:303-311.

Ellis WAH, Melzer A and Bercovitch FB (2009) Spatiotemporal dynamics of habitat use by Koalas: the checkerboard model. *Behavioural Ecology and Sociobiology* 63:1181-1188.

Eyre TJ, Ferguson DJ, Hourigan CL, Smith GC, Mathieson MT, Kelly AL, Venz MF, Hogan LD, Rowland J (2014) *Terrestrial Vertebrate Fauna Survey Assessment Guidelines for Queensland*. Department of Science, Information Technology, Innovation and the Arts, Queensland Government, Brisbane.

Fensham RJ, Butler DW, Fairfax RJ, Quinton AR, Dwyer JM (2016) Passive restoration of subtropical grasslands after abandonment of cultivation. *Journal of Applied Ecology* 53: 274-283

Frith HJ (1982) *Pigeons and Doves of Australia*, Rigby, Melbourne.

Fukuda Y, Saalfeld K, Webb G, Manolis, C, Risk R (2013) Standardised method of spotlight surveys for crocodiles in the tidal rivers of the Northern Territory, *Australia Northern Territory Naturalist* 24:14-32.

Garnett ST, Crowley GM (2000) *The Action Plan for Australian Birds 2000*, Environment Australia and Birds Australia, Canberra, ACT. Available from: <http://www.environment.gov.au/biodiversity/threatened/publications/action/birds2000/index.html>  
Accessed May 2012.

Garnett ST, Szabo J, Dutson G (2011) *The action plan for Australian birds 2010*. CSIRO Publishing, Victoria.

GBRMPA (2014a) *Great Barrier Reef Region Strategic Assessment Report*, Great Barrier Reef Marine Park Authority, Townsville, 684 pp.

GBRMPA (2014b) *Great Barrier Reef Outlook Report*, Great Barrier Reef Marine Park Authority, Townsville, 328 pp.

Gilbertson K (1981) A note on Death Adder mortality following the laying of poison. *Herpetofauna* 12: 36.

Griffioen PA, Clarke MF (2002) Large-scale bird movement patterns evident in eastern Australian atlas data. *Emu* 102: 99-125.

GHD (2012) *Report for Carmichael Coal and Rail Project, Ecology Report 25215-D-RP-0023*, Prepared for Adani Mining Pty Ltd.

GHD (2014) *North Galilee Basin Rail Project, Additional information to the Environmental Impact Statement, Appendix D Revised Matters of National Environmental Significance*, Prepared for Adani Mining Pty Ltd.

Gordon G, Brown AS, Pulsford T (1988) A Koala (*Phascolarctos cinereus* Goldfuss) population crash during drought and heatwave conditions in south-western Queensland. *Australian Journal of Ecology* 13:451-462.

Gordon G, Hrdina F (2005) Koala and possum populations in Queensland during the harvest period, 1906-1936, *Australian Zoologist* 33:69-99.

Graham A (1988) 'Methods of surveying and monitoring crocodiles', in JM Hutton, JNB Mphande, AD Graham and HH Roth, eds., *Proceedings of the SADCC Workshop on Management and Utilization of*

Crocodiles in the SADCC Region of Africa. Kariba, Zimbabwe, 2-6 June 1987. CIDA and WWF-USA, Kariba, Zimbabwe.

Graham M, Watson P and Tierney D (2015) Hotspots fire project. Fire and the vegetation of the Murrumbidgee region. Grice A (2012). Black-throated Finch (white-rumped subspecies) *Poephila cincta cincta*. In Curtis, L.K., Dennis, A.J., McDonald, K.R., Kyne P.M. and Debus, S.J.S. (Eds), Queensland's Threatened Animals, pp. 324–325. CSIRO Publishing, Melbourne.

Henderson RJF (1997) Queensland Plants Names and Distribution, Queensland Herbarium, Indooroopilly.

Higgins PJ (ed.; 1999) Handbook of Australian, New Zealand and Antarctic Birds. Volume Four - Parrots to Dollarbird. Oxford University Press, Melbourne.

Higgins PJ, Peter JM, Cowling SJ eds. (2006). Boatbill to Starlings. In: Handbook of Australian, New Zealand and Antarctic Birds. 7. Melbourne: Oxford University Press.

Immelmann K (1982). Australian Finches, 2nd ed., Angus and Robertson, Sydney.

International Union for the Conservation of Nature (2012) *Numenius madagascariensis*. Available at: <http://www.iucnredlist.org/details/22693199/0> Accessed Feb 2015.

Isles N (2007). Patterns of Foraging Behaviour of the Black-throated Finch during Breeding Season. Honours Thesis, James Cook University.

Johnstone RE, Storr GM (1998) Handbook of Western Australia, Volume 1, Non-passerines (Emu to Dollarbird) Western Australian Museum, Perth.

Kavanagh RP, Barrott E (2001) Koala populations in the Pilliga forests, In: Perfumed Pineries: Environmental history of Australia's Callitris forests. CRES, Australian National University, Canberra pp 93-103.

Krockenberger A, Gordon G and Dennis AJ (2012) Koala (South-east Qld Bioregion) *Phascolarctos cinereus* (Goldfuss, 1817). In: Curtis LK, Dennis AJ, McDonald KR, Kyne PM and Debus SJS (Eds), Queensland's Threatened Animals. CSIRO Publishing, Melbourne.

Lane BA (1987) Shorebirds in Australia, Reed, Sydney, NSW.

Lane BA, Rogers D (2000) The Australian painted snipe *Rostratula (benghalensis) australis*: An endangered species? Stilt 36: 26–34.

Lord EAR (1956). The Birds of the Murphy's Creek District, southern Queensland. Emu. 56:100-128.

Lowe VT (1963). Observations on the Painted Snipe. Emu. 62: 220-37.

Magnusson WE (1979) Dispersal of hatchling crocodiles (*Crocodylus porosus*; Reptilia, Crocodylidae), Journal of Herpetology 13: 227-231.

Magnusson W E (1980) 'Techniques of surveying for crocodylians', In: Crocodiles: Proceedings of the Fifth Working Meeting of the IUCN/SSC Crocodile Specialist Group. Florida, USA, 12-16 August 1980. IUCN: Gland, Switzerland.

- Marchant S, Higgins PJ (eds.; 1993) Handbook of Australian, New Zealand and Antarctic Birds Oxford University Press, Australia.
- Martin R, Handasyde K (1999) The Koala: Natural history, conservation and management. UNSW Press, Sydney.
- McCullough M, Payet R (2009) The Black-throated Finch Sightings Manual. Black-throated Finch Recovery Team, Townsville, Australia.
- McCutcheon, AO 1976, 'A record of the Black-throated finch at 'Berida', Gilgandra, Australian Birds 11: 12.
- McDonald KR, Covacevich JA, Ingram GJ, Couper PJ (1991) The status of frogs and reptiles. In: Ingram GJ and Raven RJ (eds.) An atlas of Queensland's frogs, reptiles, birds and mammals. Queensland Museum, Brisbane, pp. 338-345.
- McDonald WJF (1996) Spatial and temporal patterns in the dry season subtropical rainforests of eastern Australia, with particular reference to the vine thickets of central and southern Queensland. PhD thesis, Botany Department, University of New England, Armidale.
- McDonald WJF (2010) National recovery plan for the Semi-evergreen vine thickets of the Brigalow Belt (North and South) and Nandewar Bioregions ecological community. Available at: <http://www.environment.gov.au/system/files/resources/7994b254-82ed-40cf-9985-29fa09138ff4/files/semi-evergreen-vine-thickets.pdf> Accessed Jan 2016
- Melzer A, Carrick F, Menkhorst P, Lunney D, John BS (2000) Overview, critical assessment, and conservation implications of koala distribution and abundance. Conservation Biology 14:619-628.
- Messel H, Vorijscek GC, Wells AG and Green WJ (1981) Surveys of tidal river systems in the Northern Territory of Australia and their crocodile populations. Pergamon Books Inc., New York.
- Mitchell DF (1996). Foraging Ecology of the Black-throated Finch *Poephila cincta cincta*. M.Sc. Thesis. Townsville: James Cook University of North Queensland.
- Moore BD, Foley WJ (2000) A review of feeding and diet selection in Koalas (*Phascolarctos cinereus*). Australian Journal of Zoology 48:317-333.
- Munks SA, Corkrey R, Foley WJ (1996) Characteristics of arboreal marsupial habitat in the semi-arid woodlands of northern Queensland, Wildlife Research 23: 185-195.
- National Parks and Wildlife Services (NPWS; 1999) Squatter Pigeon Threatened Species Information Sheet. NSW National Parks and Wildlife Service, Hurstville, NSW.
- Natural Resource Assessment Environmental Consultants (NRA; 2005). Enertrade North Queensland Gas Pipeline Black-throated Finch Studies (Post-Construction). Unpublished report prepared for Enertrade, Brisbane.
- Natural Resource Assessment Environmental Consultants (NRA; 2007). Survey and Assessment of the Black-throated Finch (*Poephila cincta cincta*) at the Chisholm Trail Rural Residential Development, Townsville. Unpublished report prepared for the Department of Environment and Water Resources.



Natural Resource Management Ministerial Council (NRMMC; 2009). National Koala Conservation and Management Strategy 2009–2014. Department of the Environment, Water, Heritage and the Arts, Canberra.

North AJ (1901-1914). Nests and Eggs of Birds Found Breeding in Australia and Tasmania. Sydney, NSW: Australian Museum.

North AJ (1913-1914) Nests and Eggs of Birds Found Breeding in Australia and Tasmania. In: Special Catalogue 1. 4. Australian Museum, Sydney.

Office of Environment and Heritage (OEH) (2016). *Painted Honeyeater – Profile*, Viewed on 21.02.2017. Available at:  
<http://www.environment.nsw.gov.au/threatenedspeciesapp/profile.aspx?id=10357>

Phillips BL, Brown GP and Shine R (2003) Assessing the potential impact of cane toads on Australian snakes, *Conservation Biology* 17:171-175.

Phillips S, Callaghan J (2000) Tree species preferences of Koalas (*Phascolarctos cinereus*) in the Campbelltown area south-west of Sydney, New South Wales, *Wildlife Research* 27:509-516.

Phillips S, Callaghan J (2011) The Spot Assessment Technique: a tool for determining localised levels of habitat use by Koalas *Phascolarctos cinereus*. *Australian Zoologist* 35: 774-780.

Phillips S, Callaghan J, Thompson V (2000) The tree species preferences of Koalas (*Phascolarctos cinereus*) inhabiting forest and woodland communities on Quaternary deposits in the Port Stephens area, New South Wales. *Wildlife Research* 27: 1-10.

Pizzey G, Knight F (2007) *The field guide to Birds of Australia*. HarperCollins Publishers, Sydney, NSW.

Pringle JD (1987) *The Shorebirds of Australia*. Angus and Robertson, Sydney, NSW.

Queensland Herbarium (2014) *Herbreccs Database*, Accessed Feb 2015.

Read MA, Miller JD, Bell IP, Felton A (2004) The distribution and abundance of the estuarine crocodile, *Crocodylus porosus*, in Queensland. *Wildlife Research* 31:527-534.

Reis T (2012) Squatter Pigeon (Southern Subspecies), In: Curtis LK, Dennis AJ, McDonald KR, Kyne PM and Debus SJS, *Queensland's Threatened Animals*, CSIRO Publishing, Collingwood.

Richardson R (2006) Queensland Brigalow Belt Reptile Recovery Plan 2008 – 2012. Report to the Department of the Environment, Water, Heritage and the Arts, Canberra. WWF-Australia, Brisbane

Rogers D (1999) Roost choice in the waders of Roebuck Bay: is avoiding heat stress their main consideration? *Stilt* 35: 65.

Rogers D, Hnace I, Paton S, Tzaros C, Griffioen P, Herring M, Jaensch R, Oring L, Silcocks A, Weston M (2005). The breeding bottleneck: Breeding habitat and population decline in the Australian painted snipe. Status and Conservation of Shorebirds in the East Asian-Australasian Flyway, Proceedings of the Australasian Shorebirds Conference, 13–15 December 2003, Canberra, Australia.

Rowland. J. (2012). *Targeted species survey guidelines: Painted Honeyeater (Grantiella picta)*. Department of Science, Information Technology, Innovation and the Arts, Brisbane.

Saunders-Havill Group (2013) Carmichael Coal Project (Rail) Separable Portion 1 Fauna Crossing Strategy Report, Prepared for Adani Mining Pty Ltd, March 2013.

Saunders-Havill Group (2014) North Galilee Basin Rail Fauna Crossing Strategy Report, Prepared for Adani Mining Pty Ltd, September 2014. Senate Environment and Communications References Committee (SECRC; 2011) The koala—saving our national icon. In: Senate Printing Unit, Parliament House, Canberra.

Shine R (1980) Ecology of the Australian death adder *Acanthophis antarcticus* (Elapidae): evidence for convergence with the Viperidae. *Herpetologica* 36(4):281-289.

Shine R (2000) Australian Snakes: A Natural History, Reed New Holland, Sydney.

Simon BK (2011) *Dichanthium queenslandicum*. AusGrass2, Available at: <http://ausgrass2.myspecies.info/content/dichanthium-queenslandicum>. Accessed 17 Feb 2015

SKM (2013) Species Management Program – Carmichael Coal Rail and Offsite Infrastructure Project, Prepared for Adani Mining Pty Ltd.

Smedley, J.H. 1904, 'Stray feathers', *Emu* 4:69.

Smith AG, McAlpine CA, Rhodes JR, Lunney D, Seabrook L, Baxter G (2013) Out on a limb: habitat use of a specialist folivore, the Koala, at the edge of its range in a modified semi-arid landscape *Landscape Ecology* 28: 415-426.

Smith AG, McAlpine C, Rhodes J, Seabrook L, Lunney D, Baxter G (2013) Are there habitat thresholds in Koala occupancy in the semiarid landscapes of the Mulgalands Bioregion? *Wildlife Research* 40:413-426.

Storr, G.M. (1984). Revised list of Queensland birds. *Records of the Western Australian Museum Supplement*. 19:1-189.

Strahan R (2002) *The Mammals of Australia* 2nd Edition. Reed New Holland, Sydney.

Sullivan BJ, Norris WM, Baxter GS (2003) Low-density Koala (*Phascolarctos cinereus*) populations in the mulgalands of south-west Queensland II. Distribution and diet. *Wildlife Research* 30:331-338

Taplin LE (1987) The management of crocodiles in Queensland, Australia, In: Webb GJW, SC Manolis and PJ Whitehead (Eds.) *Wildlife Management: Crocodiles and Alligators*. Page(s) 129-140. Sydney, Surrey Beatty and Sons.

Taylor JA (1979) The foods and feeding habits of subadult *Crocodylus porosus* Schneider in Northern Australia. *Australian Wildlife Research* 6: 347-359.

Threatened Species Scientific Committee (TSSC; 2005s). Commonwealth Listing Advice on Southern Black-throated Finch (*Poephila cincta cincta*). Available at: <http://www.environment.gov.au/node/16484> Accessed Jan 2016

Threatened Species Scientific Committee (TSSC; 2008a). Commonwealth Conservation Advice on *Dichanthium setosum*, Available at: <http://www.environment.gov.au/biodiversity/threatened/species/pubs/14159-conservation-advice.pdf> Accessed Feb 2015.

Threatened Species Scientific Committee (TSSC; 2008b). Commonwealth Listing Advice on Natural Grasslands of the Queensland Central Highlands and the northern Fitzroy Basin. Available at: <http://www.environment.gov.au/biodiversity/threatened/communities/pubs/99-listing-advice.pdf> Accessed Feb 2015.

Threatened Species Scientific Committee (TSSC; 2008c). Commonwealth Conservation Advice on Natural Grasslands of the Queensland Central Highlands and the northern Fitzroy Basin. Available at: <http://www.environment.gov.au/biodiversity/threatened/communities/pubs/99-conservation-advice.pdf> Accessed Jan 2016.

Threatened Species Scientific Committee (TSSC; 2012a) Commonwealth Listing Advice on *Eucalyptus raveretiana*, Available at: <http://www.environment.gov.au/biodiversity/threatened/species/pubs/16344-listing-advice.pdf> Accessed Feb 2015.

Threatened Species Scientific Committee (TSSC; 2012b) Commonwealth Conservation Advice on *Phascolarctos cinereus* (combined population in Queensland, New South Wales and the Australian Capital Territory), Available at: <http://www.environment.gov.au/biodiversity/threatened/species/pubs/197-conservation-advice.pdf> Accessed Feb 2015.

Threatened Species Scientific Committee (TSSC; 2013a) Commonwealth Listing Advice on *Rostratula australis* (Australian Painted Snipe). Available at: <http://www.environment.gov.au/biodiversity/threatened/species/pubs/77037-listing-advice.pdf> Accessed Feb 2015.

Threatened Species Scientific Committee (TSSC; 2013b) Commonwealth Conservation Advice on *Rostratula australis* (Australian Painted Snipe). Available at: <http://www.environment.gov.au/biodiversity/threatened/species/pubs/77037-conservation-advice.pdf> Accessed Jan 2016.

Threatened Species Scientific Committee (TSSC; 2013c) Commonwealth Conservation Advice on Brigalow (*Acacia harpophylla* dominant and co-dominant) ecological community. Available at: <http://www.environment.gov.au/biodiversity/threatened/communities/pubs/028-conservation-advice.pdf>

Accessed Feb 2015.

Threatened Species Scientific Committee (TSSC; 2013d) Commonwealth Conservation Advice on *Dichanthium queenslandicum* (king blue-grass). Available at: <http://www.environment.gov.au/biodiversity/threatened/species/pubs/5481-conservation-advice.pdf> Accessed Feb 2015.

Threatened Species Scientific Committee (TSSC; 2014) Approved Conservation Advice for *Denisonia maculata* (Ornamental Snake). Available at: <http://www.environment.gov.au/biodiversity/threatened/species/pubs/1193-conservation-advice.pdf> Accessed Feb 2015.

Threatened Species Scientific Committee (TSSC; 2015a) Approved Conservation Advice for *Geophaps scripta scripta* (Squatter Pigeon (southern)). Available at: <http://www.environment.gov.au/biodiversity/threatened/species/pubs/64440-conservation-advice-31102015.pdf> Accessed Jan 2016.

Threatened Species Scientific Committee (TSSC; 2015b) Approved Conservation Advice for *Grantiella picta* (Painted Honeyeater). Available at:

<http://www.environment.gov.au/biodiversity/threatened/species/pubs/470-conservation-advice.pdf>

Threatened Species Scientific Committee (TSSC; 2015c) Approved Conservation Advice for *Numenius madagascariensis* (Eastern Curlew). Available at:

<http://www.environment.gov.au/biodiversity/threatened/species/pubs/847-conservation-advice.pdf>

Accessed Jan 2016.

Tzaros C, Ingwersen D, Rogers D (2012) Australian Painted Snipe *Rostratula australis* (Gould, 1838). In: Curtis LK, Dennis AJ, McDonald KR, Kyne PM and Debus SJS (Eds) Queensland's Threatened Animals. CSIRO Publishing, Melbourne.

Walsh B, Whitehead PJ (1993) Problem crocodiles, *Crocodylus porosus*, at Nhulunbuy, Northern Territory: an assessment of relocation as a management strategy. *Wildlife Research* 20:127-135.

Webb AA, Walker PJ, Gunn RH and Mortlock AT (1980) Soils of the Poplar Box (*Eucalyptus populnea*) communities of eastern Australia. *Australia Rangelands Journal* 2/1, 17–30.

Webb GJW, Whitehead PJ, Manolis SC (1987) Crocodile management in the Northern Territory of Australia, In: Webb GJW, SC Manolis and PJ Whitehead (Eds.) *Wildlife Management: Crocodiles and Alligators*. Page(s) 107-124. Surrey Beatty and Sons, Sydney.

Webb GJW, Nollis GJ, Manolis S C (1991) Feeding, growth, and food conversion rates of wild juvenile saltwater crocodiles (*Crocodylus porosus*). *Journal of Herpetology* 25: 462-473.

Webb G, Manolis C (1989) *Crocodiles of Australia*. Page(s) 160. Reed, Sydney.

Webb GJW, Manolis SC, Brien ML (2010) Saltwater Crocodile *Crocodylus porosus*, In: *Crocodiles: Status Survey and Conservation Action Plan, Third Edition*, SC Manolis and C Stevenson (Eds.) Crocodile Specialist Group, Darwin, pp. 99-113.

Wilson SK, Knowles DG (1988) *Australia's Reptiles: A Photographic Reference to the Terrestrial Reptiles of Australia*, Collins Publishers Australia, Sydney.

Wilson S, Swan G (2008) *A Complete Guide to Reptiles of Australia 2nd Edition*. New Holland Publishers, Sydney.

Wilson S, Swan G (in press). *A Complete Guide to Reptiles of Australia*. New Holland Publishers, Sydney

World Wide Fund for Nature WWF (2001). *Reptiles under threat in Queensland's southern Brigalow Belt*. WWF Australia.

Young P, Butler D (2011) National recovery plan for the "Natural grasslands of the Queensland Central Highlands and the northern Fitzroy Basin" ecological community. Report to Department of Sustainability, Environment, Water, Population and Communities, Canberra. Vegworx, Brisbane Queensland and Queensland Department of Environment and Resource Management, Brisbane.

Young PAR, Wilson BA, McCosker JC, Fensham RJ, Morgan G, Taylor PM (1999) Brigalow Belt in The Conservation Status of Queensland's Bioregional Ecosystems, In: Sattler PS and Williams RD (Eds), *Environmental Protection Agency*, Brisbane.

Zann R (1976) 'Distribution, status and breeding of Black-throated finches *Poephila cincta* in northern Queensland', Emu 76: 201-206.

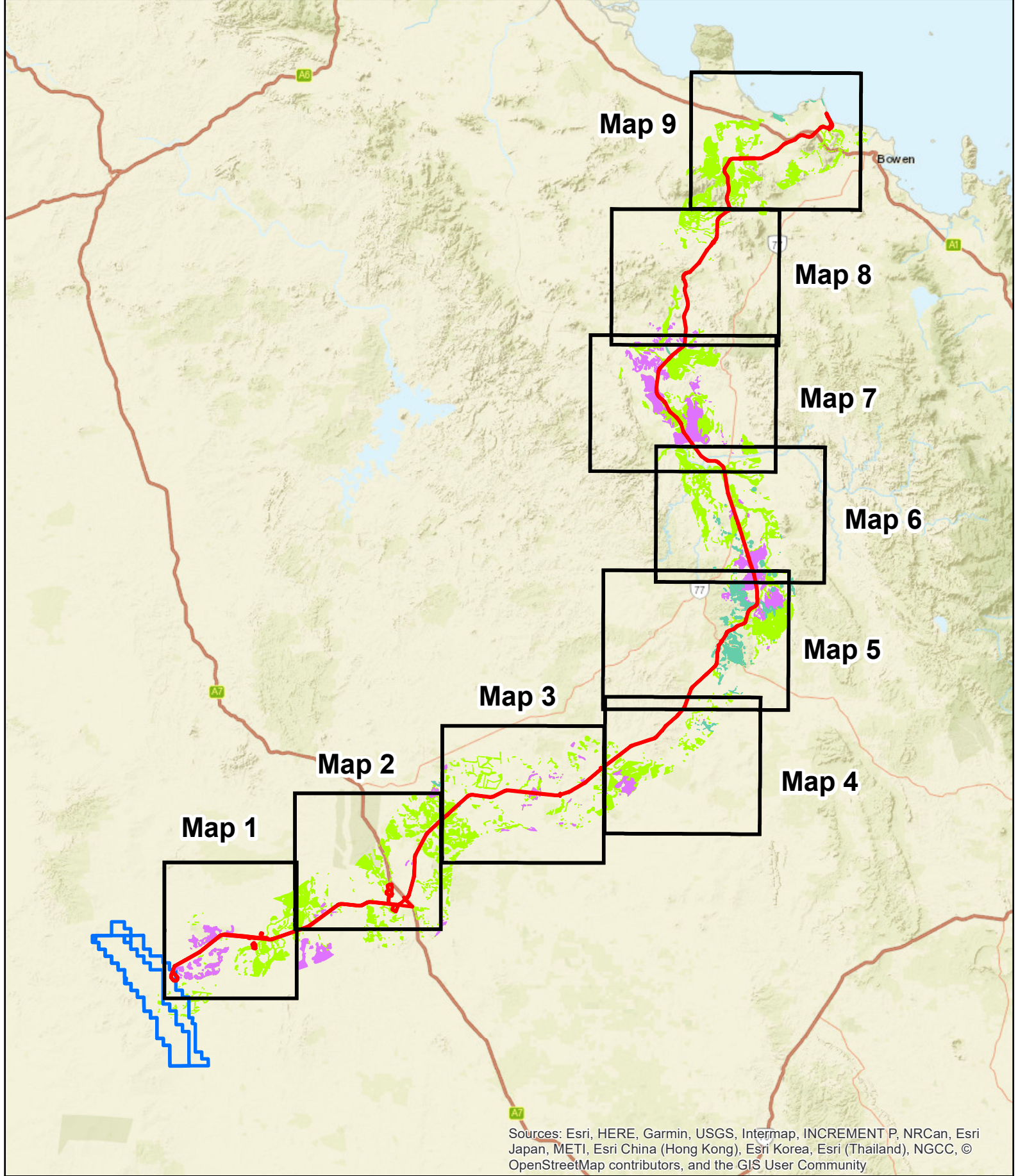
# Appendix A Maps of Threatened Ecological Communities

Maps of known locations of TEC associated REs are provided on the following pages.

Map series run from west (Gregory Development Road; Map 2) to east (Abbot Point; Map 10)



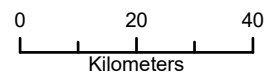
# Potential TEC Habitat Surrounding the Project Area



Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, © OpenStreetMap contributors, and the GIS User Community

## Legend

- Carmichael Rail Network
- Carmichael Mine
- Potential SEVT TEC Habitat
- Potential Grassland TEC Habitat
- Potential Brigalow TEC Habitat



Datum/Projection:  
GDA 1994 MGA Zone 55



Data Sources: Adani Mining, QLD Gov  
Imagery: Bing Maps



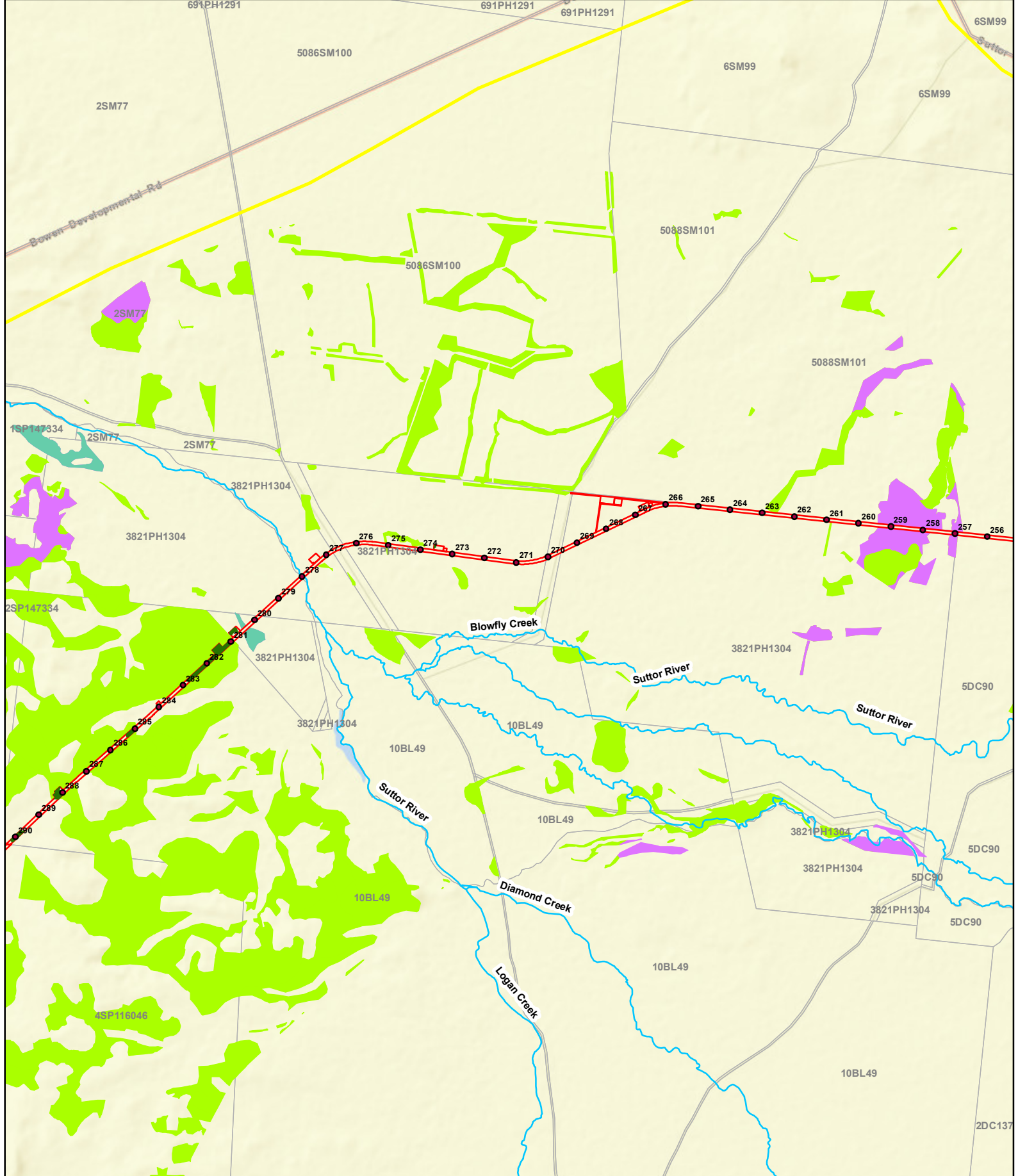
[www.ecoaus.com.au](http://www.ecoaus.com.au)






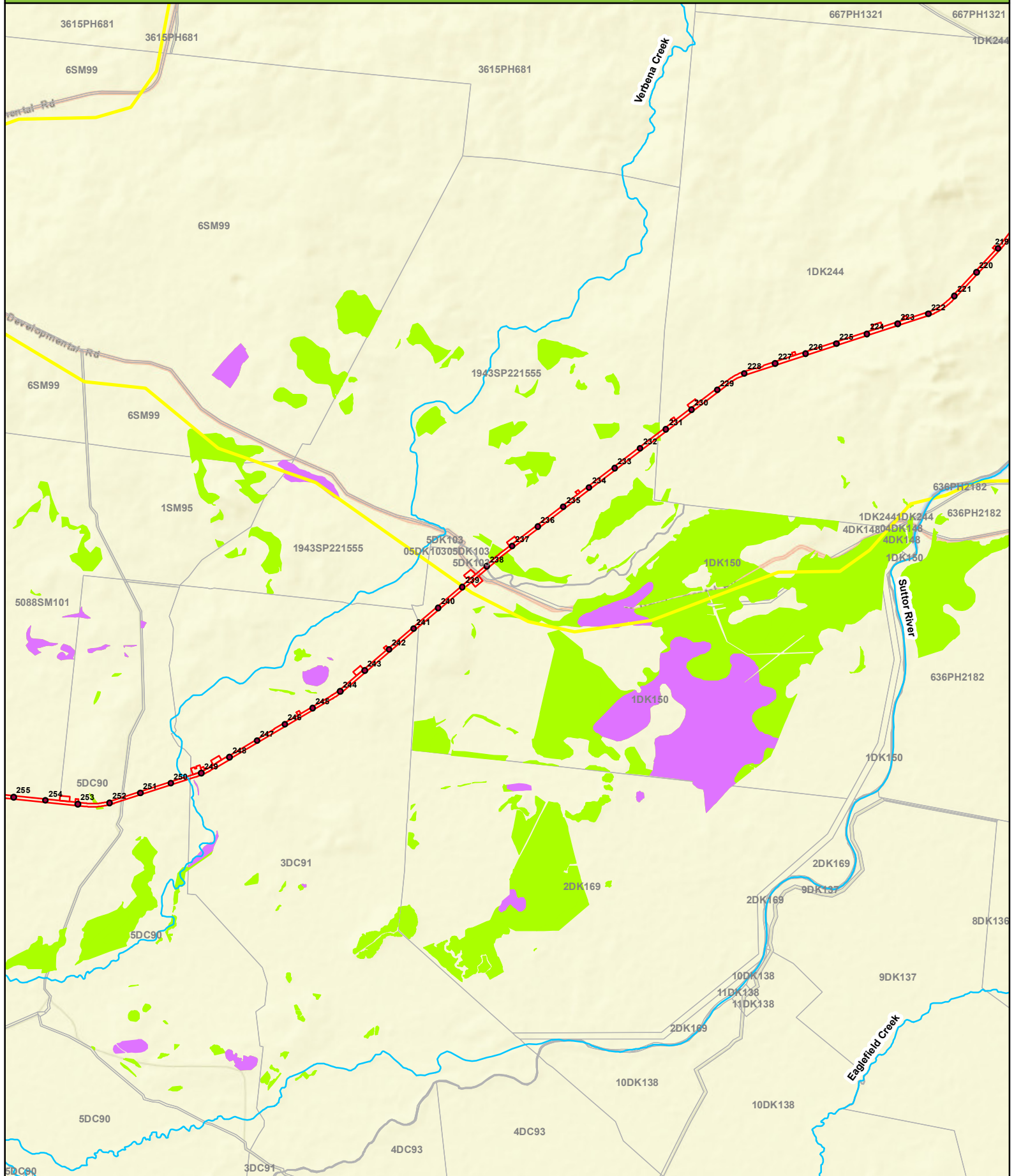


# Known locations of TEC associated REs within the Project Area: Map 3



<p><b>Legend</b></p> <ul style="list-style-type: none"> <li><span style="border: 1px solid red; display: inline-block; width: 15px; height: 10px; margin-right: 5px;"></span> Carmichael Rail Network</li> <li><span style="display: inline-block; width: 10px; height: 10px; border: 1px solid black; border-radius: 50%; margin-right: 5px;"></span> Kilometre Points</li> <li><span style="border-bottom: 2px solid grey; width: 20px; margin-right: 5px;"></span> State Road</li> <li><span style="border-bottom: 2px solid yellow; width: 20px; margin-right: 5px;"></span> Local Road</li> <li><span style="border-bottom: 2px solid blue; width: 20px; margin-right: 5px;"></span> Major Watercourse</li> <li><span style="border-bottom: 1px solid grey; width: 20px; margin-right: 5px;"></span> Property Boundary</li> </ul>	<p><b>Known TEC REs</b></p> <ul style="list-style-type: none"> <li><span style="display: inline-block; width: 15px; height: 10px; background-color: #008000; margin-right: 5px;"></span> Brigalow</li> <li><span style="display: inline-block; width: 15px; height: 10px; background-color: #800080; margin-right: 5px;"></span> Grassland</li> <li><span style="display: inline-block; width: 15px; height: 10px; background-color: #008080; margin-right: 5px;"></span> SEVT</li> </ul> <p><b>Potential TEC REs</b></p> <ul style="list-style-type: none"> <li><span style="display: inline-block; width: 15px; height: 10px; background-color: #90EE90; margin-right: 5px;"></span> Brigalow</li> <li><span style="display: inline-block; width: 15px; height: 10px; background-color: #DDA0DD; margin-right: 5px;"></span> Grassland</li> <li><span style="display: inline-block; width: 15px; height: 10px; background-color: #4682B4; margin-right: 5px;"></span> SEVT</li> </ul>	<p>0      2,250      4,500</p> <p style="text-align: center;">Meters</p> <p style="text-align: center;">Datum/Projection: GDA 1994 MGA Zone 55</p>	<div style="text-align: center;">  <p><a href="http://www.ecoaus.com.au">www.ecoaus.com.au</a></p> </div>
--	---	--	--

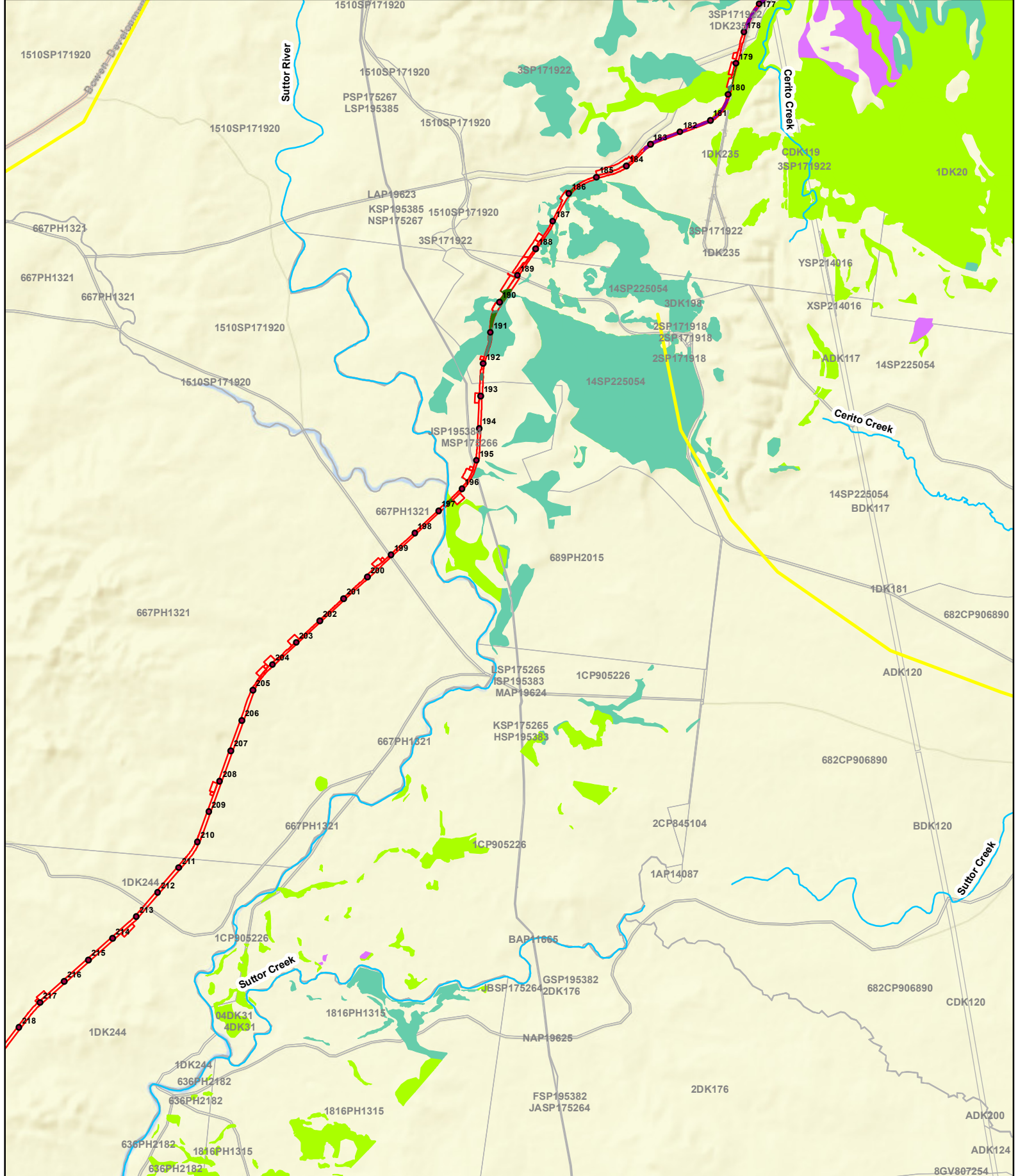
# Known locations of TEC associated REs within the Project Area: Map 4





<p><b>Legend</b></p> <ul style="list-style-type: none"> <li><span style="border: 1px solid red; display: inline-block; width: 15px; height: 10px; margin-right: 5px;"></span> Carmichael Rail Network</li> <li><span style="display: inline-block; width: 10px; height: 10px; border: 1px solid black; border-radius: 50%; margin-right: 5px;"></span> Kilometre Points</li> <li><span style="border-bottom: 2px solid brown; width: 20px; margin-right: 5px;"></span> State Road</li> <li><span style="border-bottom: 2px solid yellow; width: 20px; margin-right: 5px;"></span> Local Road</li> <li><span style="border-bottom: 2px solid blue; width: 20px; margin-right: 5px;"></span> Major Watercourse</li> <li><span style="border: 1px solid gray; width: 20px; height: 10px; margin-right: 5px;"></span> Property Boundary</li> </ul>	<p><b>Known TEC REs</b></p> <ul style="list-style-type: none"> <li><span style="display: inline-block; width: 15px; height: 10px; background-color: darkgreen; margin-right: 5px;"></span> Brigalow</li> <li><span style="display: inline-block; width: 15px; height: 10px; background-color: purple; margin-right: 5px;"></span> Grassland</li> <li><span style="display: inline-block; width: 15px; height: 10px; background-color: teal; margin-right: 5px;"></span> SEVT</li> </ul> <p><b>Potential TEC REs</b></p> <ul style="list-style-type: none"> <li><span style="display: inline-block; width: 15px; height: 10px; background-color: lightgreen; margin-right: 5px;"></span> Brigalow</li> <li><span style="display: inline-block; width: 15px; height: 10px; background-color: pink; margin-right: 5px;"></span> Grassland</li> <li><span style="display: inline-block; width: 15px; height: 10px; background-color: lightteal; margin-right: 5px;"></span> SEVT</li> </ul>	<p>0      2,250      4,500</p> <p>Meters</p> <p>Datum/Projection: GDA 1994 MGA Zone 55</p>	<p style="text-align: center;"><b>eco logical</b> AUSTRALIA</p> <p style="text-align: center;"><a href="http://www.ecoaus.com.au">www.ecoaus.com.au</a></p>
--	---	--	---

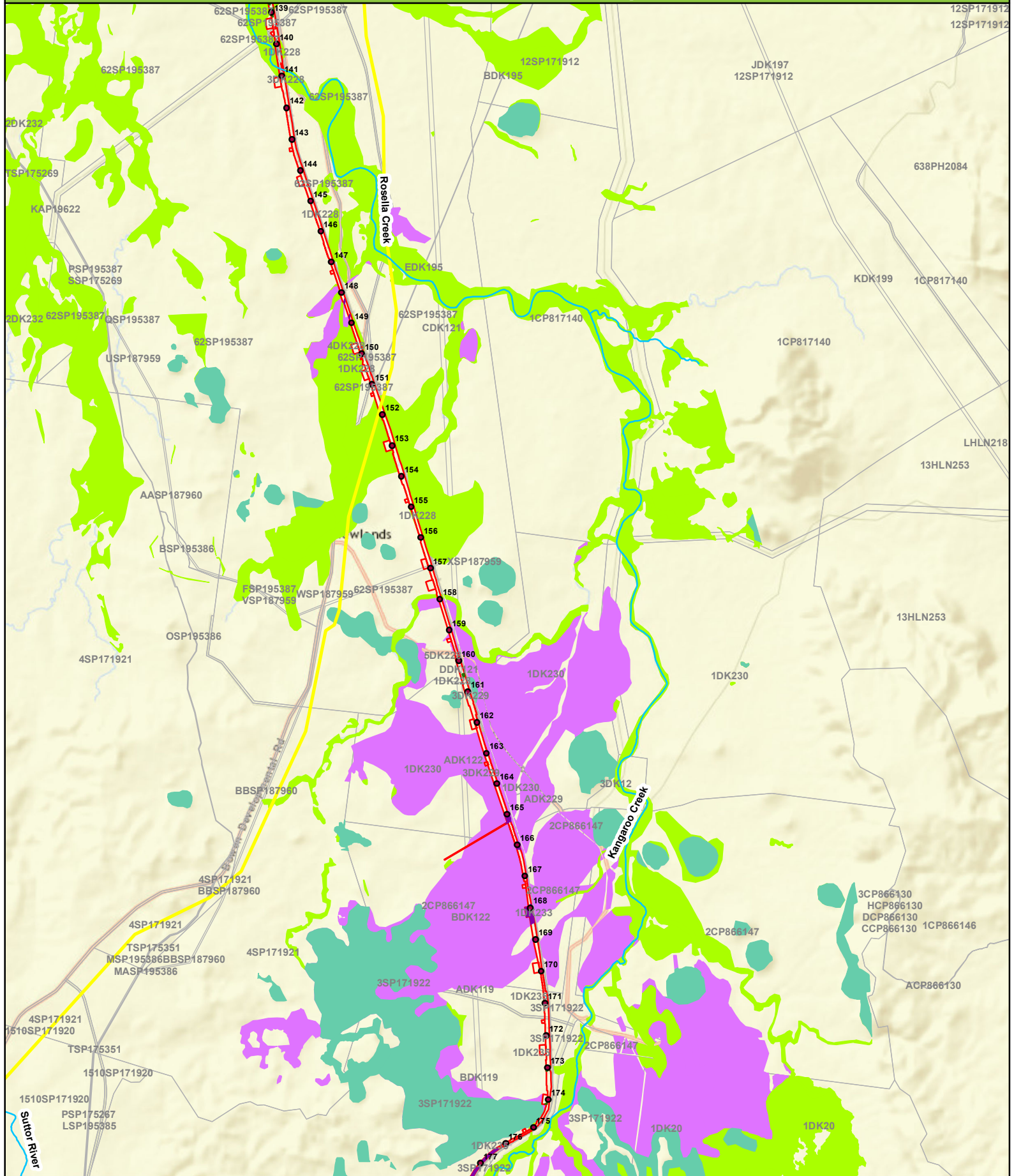


# Known locations of TEC associated REs within the Project Area: Map 5



<p><b>Legend</b></p> <ul style="list-style-type: none"> <li><span style="border: 1px solid red; display: inline-block; width: 20px; height: 10px; margin-right: 5px;"></span> Carmichael Rail Network</li> <li><span style="color: red; font-size: 1.2em; margin-right: 5px;">●</span> Kilometre Points</li> <li><span style="border-bottom: 2px solid grey; width: 20px; margin-right: 5px;"></span> State Road</li> <li><span style="border-bottom: 2px solid yellow; width: 20px; margin-right: 5px;"></span> Local Road</li> <li><span style="border-bottom: 2px solid blue; width: 20px; margin-right: 5px;"></span> Major Watercourse</li> <li><span style="border: 1px solid grey; width: 20px; height: 10px; margin-right: 5px;"></span> Property Boundary</li> </ul>	<p><b>Known TEC REs</b></p> <ul style="list-style-type: none"> <li><span style="display: inline-block; width: 15px; height: 10px; background-color: darkgreen; margin-right: 5px;"></span> Brigalow</li> <li><span style="display: inline-block; width: 15px; height: 10px; background-color: purple; margin-right: 5px;"></span> Grassland</li> <li><span style="display: inline-block; width: 15px; height: 10px; background-color: teal; margin-right: 5px;"></span> SEVT</li> </ul> <p><b>Potential TEC REs</b></p> <ul style="list-style-type: none"> <li><span style="display: inline-block; width: 15px; height: 10px; background-color: lightgreen; margin-right: 5px;"></span> Brigalow</li> <li><span style="display: inline-block; width: 15px; height: 10px; background-color: pink; margin-right: 5px;"></span> Grassland</li> <li><span style="display: inline-block; width: 15px; height: 10px; background-color: lightteal; margin-right: 5px;"></span> SEVT</li> </ul>	<p>0      2,250      4,500</p> <p style="text-align: center;">Meters</p> <p>Datum/Projection: GDA 1994 MGA Zone 55</p> <div style="text-align: center;">  <p>N</p> </div>	<div style="text-align: center;">  <p>www.ecoaus.com.au</p> </div> <p>Data Sources: Adani Mining, QLD Gov Imagery: Bing Maps</p>
---	---	--	---

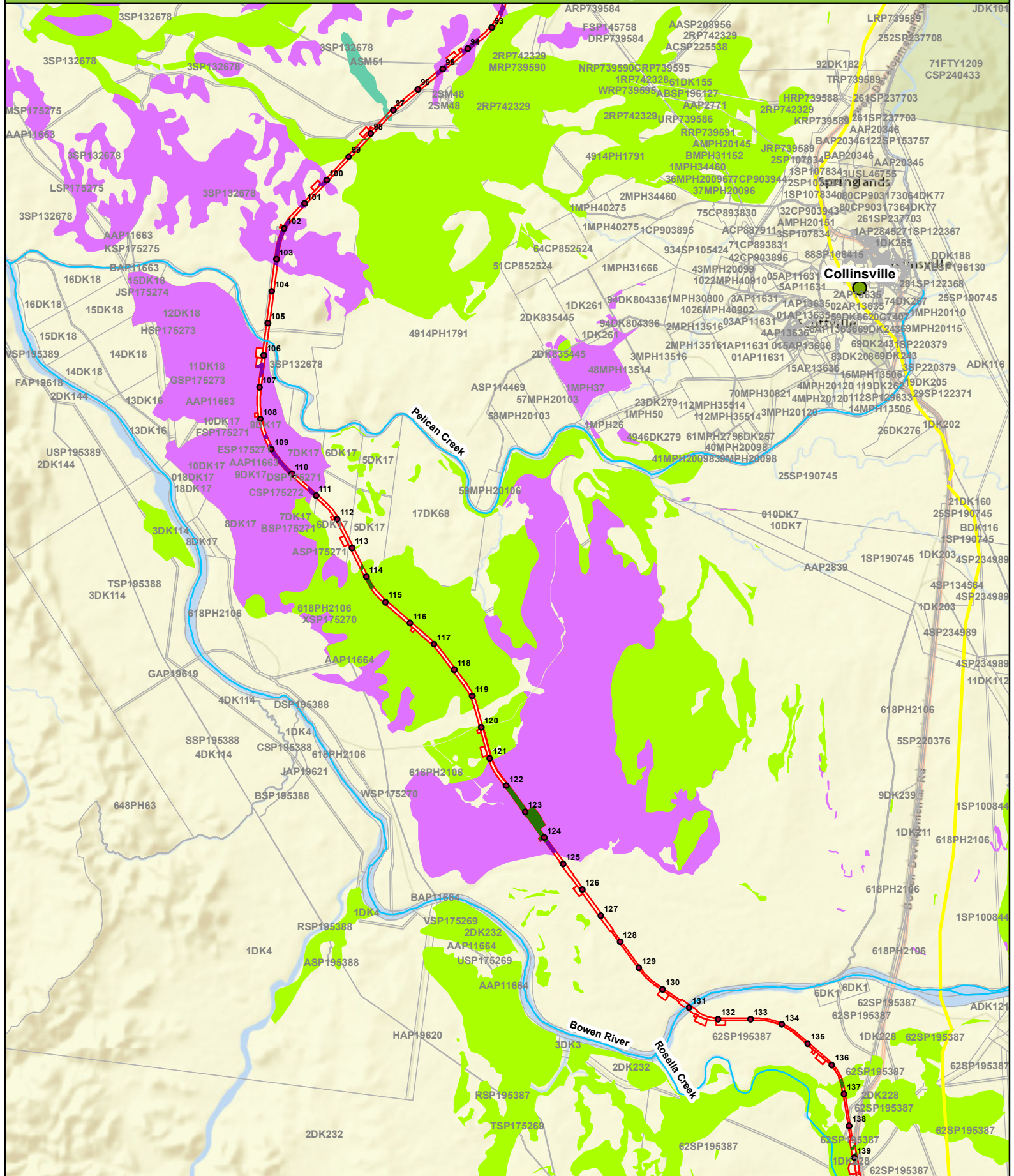
# Known locations of TEC associated REs within the Project Area: Map 6




<p><b>Legend</b></p> <ul style="list-style-type: none"> <li><span style="border: 1px solid red; display: inline-block; width: 20px; height: 10px; margin-right: 5px;"></span> Carmichael Rail Network</li> <li><span style="display: inline-block; width: 10px; height: 10px; border: 1px solid black; border-radius: 50%; margin-right: 5px;"></span> Kilometre Points</li> <li><span style="border-bottom: 2px solid brown; width: 20px; margin-right: 5px;"></span> State Road</li> <li><span style="border-bottom: 2px solid yellow; width: 20px; margin-right: 5px;"></span> Local Road</li> <li><span style="border-bottom: 2px solid blue; width: 20px; margin-right: 5px;"></span> Major Watercourse</li> <li><span style="border: 1px solid grey; width: 20px; height: 10px; margin-right: 5px;"></span> Property Boundary</li> </ul>	<p><b>Known TEC REs</b></p> <ul style="list-style-type: none"> <li><span style="display: inline-block; width: 15px; height: 15px; background-color: darkgreen; margin-right: 5px;"></span> Brigalow</li> <li><span style="display: inline-block; width: 15px; height: 15px; background-color: purple; margin-right: 5px;"></span> Grassland</li> <li><span style="display: inline-block; width: 15px; height: 15px; background-color: teal; margin-right: 5px;"></span> SEVT</li> </ul> <p><b>Potential TEC REs</b></p> <ul style="list-style-type: none"> <li><span style="display: inline-block; width: 15px; height: 15px; background-color: lightgreen; margin-right: 5px;"></span> Brigalow</li> <li><span style="display: inline-block; width: 15px; height: 15px; background-color: magenta; margin-right: 5px;"></span> Grassland</li> <li><span style="display: inline-block; width: 15px; height: 15px; background-color: lightteal; margin-right: 5px;"></span> SEVT</li> </ul>	<p>0      2,250      4,500</p> <p style="text-align: center;">Meters</p> <p style="text-align: center;">Datum/Projection: GDA 1994 MGA Zone 55</p> <div style="text-align: center;"> <p>N</p> </div>	<div style="text-align: center;"> <p><b>eco logical</b> AUSTRALIA</p> </div> <p style="text-align: center;">Data Sources: Adani Mining, QLD Gov Imagery: Bing Maps</p> <p style="text-align: center;"><a href="http://www.ecoaus.com.au">www.ecoaus.com.au</a></p>
--	--	--	--



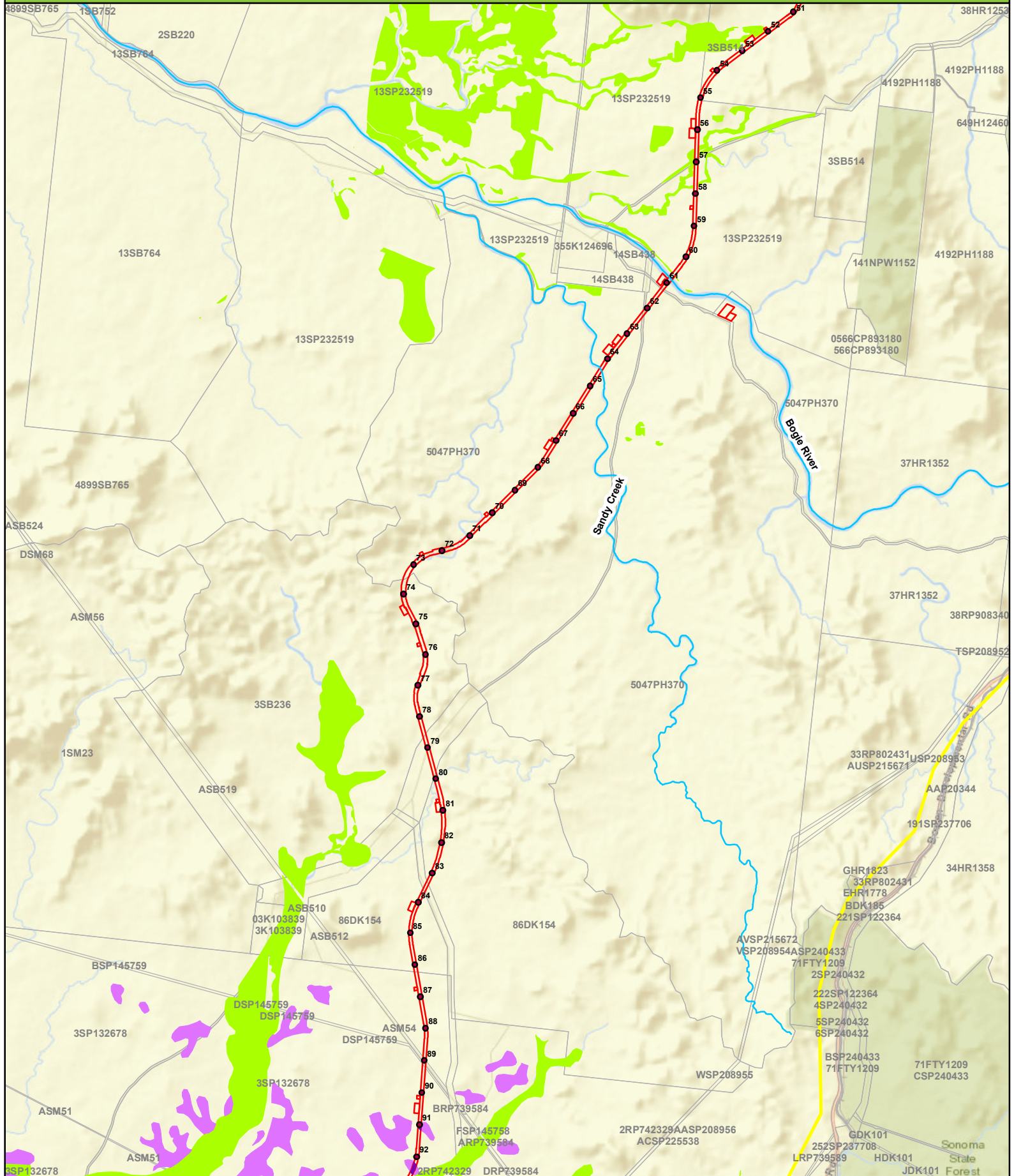
# Known locations of TEC associated REs within the Project Area: Map 7





<p><b>Legend</b></p> <ul style="list-style-type: none"> <li><span style="border: 1px solid red; display: inline-block; width: 20px; height: 10px; margin-right: 5px;"></span> Carmichael Rail Network</li> <li><span style="display: inline-block; width: 10px; height: 10px; border: 1px solid black; border-radius: 50%; margin-right: 5px;"></span> Kilometre Points</li> <li><span style="border-bottom: 2px solid brown; width: 20px; margin-right: 5px;"></span> State Road</li> <li><span style="border-bottom: 2px solid yellow; width: 20px; margin-right: 5px;"></span> Local Road</li> <li><span style="border-bottom: 2px solid blue; width: 20px; margin-right: 5px;"></span> Major Watercourse</li> <li><span style="border-bottom: 1px solid gray; width: 20px; margin-right: 5px;"></span> Property Boundary</li> </ul>	<p><b>Known TEC REs</b></p> <ul style="list-style-type: none"> <li><span style="display: inline-block; width: 15px; height: 15px; background-color: darkgreen; margin-right: 5px;"></span> Brigalow</li> <li><span style="display: inline-block; width: 15px; height: 15px; background-color: purple; margin-right: 5px;"></span> Grassland</li> <li><span style="display: inline-block; width: 15px; height: 15px; background-color: teal; margin-right: 5px;"></span> SEVT</li> </ul> <p><b>Potential TEC REs</b></p> <ul style="list-style-type: none"> <li><span style="display: inline-block; width: 15px; height: 15px; background-color: lightgreen; margin-right: 5px;"></span> Brigalow</li> <li><span style="display: inline-block; width: 15px; height: 15px; background-color: lightpurple; margin-right: 5px;"></span> Grassland</li> <li><span style="display: inline-block; width: 15px; height: 15px; background-color: lightteal; margin-right: 5px;"></span> SEVT</li> </ul>	<p>0      2,250      4,500</p> <p>Meters</p> <p>Datum/Projection: GDA 1994 MGA Zone 55</p> <div style="text-align: center;">  </div> <p>Data Sources: Adani Mining, QLD Gov Imagery: Bing Maps</p>	<p style="text-align: center; font-size: 2em; font-weight: bold; color: green;">eco logical</p> <p style="text-align: center; font-weight: bold;">AUSTRALIA</p> <p style="text-align: center;">www.ecoaus.com.au</p>
---	--	---	--

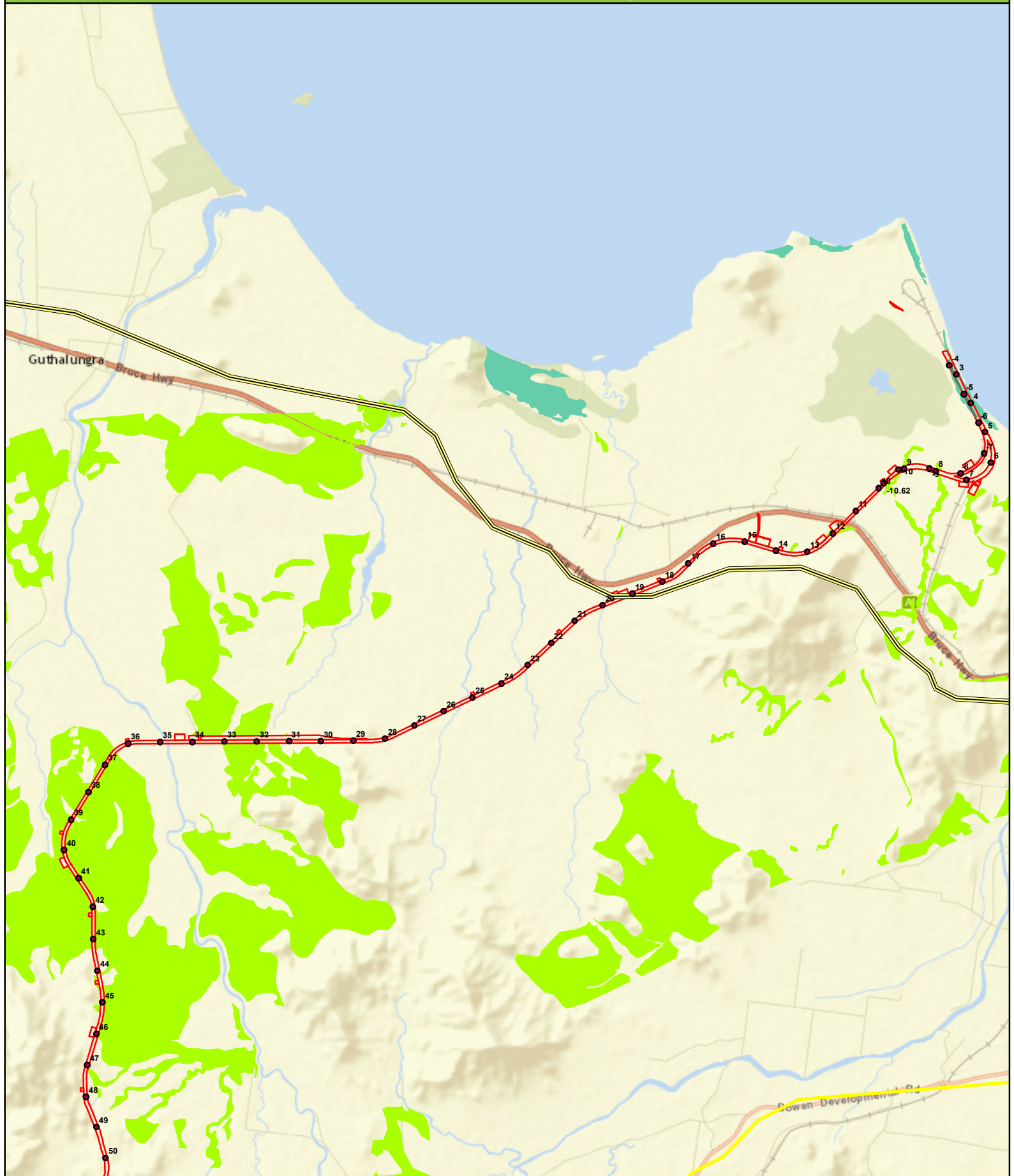


# Known locations of TEC associated REs within the Project Area: Map 8



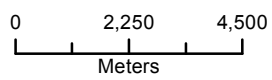
<p><b>Legend</b></p> <ul style="list-style-type: none"> <li><span style="border: 1px solid red; display: inline-block; width: 15px; height: 10px; margin-right: 5px;"></span> Carmichael Rail Network</li> <li><span style="display: inline-block; width: 10px; height: 10px; border: 1px solid black; border-radius: 50%; margin-right: 5px;"></span> Kilometre Points</li> <li><span style="border-bottom: 2px solid brown; width: 20px; margin-right: 5px;"></span> State Road</li> <li><span style="border-bottom: 2px solid yellow; width: 20px; margin-right: 5px;"></span> Local Road</li> <li><span style="border-bottom: 2px solid blue; width: 20px; margin-right: 5px;"></span> Major Watercourse</li> <li><span style="border: 1px solid grey; width: 20px; height: 10px; margin-right: 5px;"></span> Property Boundary</li> </ul>	<p><b>Known TEC REs</b></p> <ul style="list-style-type: none"> <li><span style="display: inline-block; width: 15px; height: 10px; background-color: green; margin-right: 5px;"></span> Brigalow</li> <li><span style="display: inline-block; width: 15px; height: 10px; background-color: purple; margin-right: 5px;"></span> Grassland</li> <li><span style="display: inline-block; width: 15px; height: 10px; background-color: teal; margin-right: 5px;"></span> SEVT</li> </ul> <p><b>Potential TEC REs</b></p> <ul style="list-style-type: none"> <li><span style="display: inline-block; width: 15px; height: 10px; background-color: lightgreen; margin-right: 5px;"></span> Brigalow</li> <li><span style="display: inline-block; width: 15px; height: 10px; background-color: magenta; margin-right: 5px;"></span> Grassland</li> <li><span style="display: inline-block; width: 15px; height: 10px; background-color: lightteal; margin-right: 5px;"></span> SEVT</li> </ul>	<p>0      2,250      4,500</p> <p style="text-align: center;">Meters</p> <p>Datum/Projection: GDA 1994 MGA Zone 55</p>	<div style="text-align: center;">  </div> <p>Data Sources: Adani Mining, QLD Gov Imagery: Bing Maps</p> <div style="text-align: right;">  <p><a href="http://www.ecoaus.com.au">www.ecoaus.com.au</a></p> </div>
--	--	--	--

# Known locations of TEC associated REs within the Project Area: Map 9

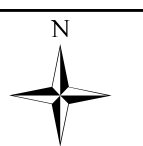


- Legend**
- Carmichael Rail Network
  - Kilometre Points
  - State Road
  - Local Road
  - Major Watercourse

- Known TEC REs**
- Brigalow
  - Grassland
  - SEVT
- Potential TEC REs**
- Brigalow
  - Grassland
  - SEVT



Datum/Projection:  
GDA 1994 MGA Zone 55



Data Sources: Adani Mining, QLD Gov  
Imagery: Bing Maps



[www.ecoaus.com.au](http://www.ecoaus.com.au)

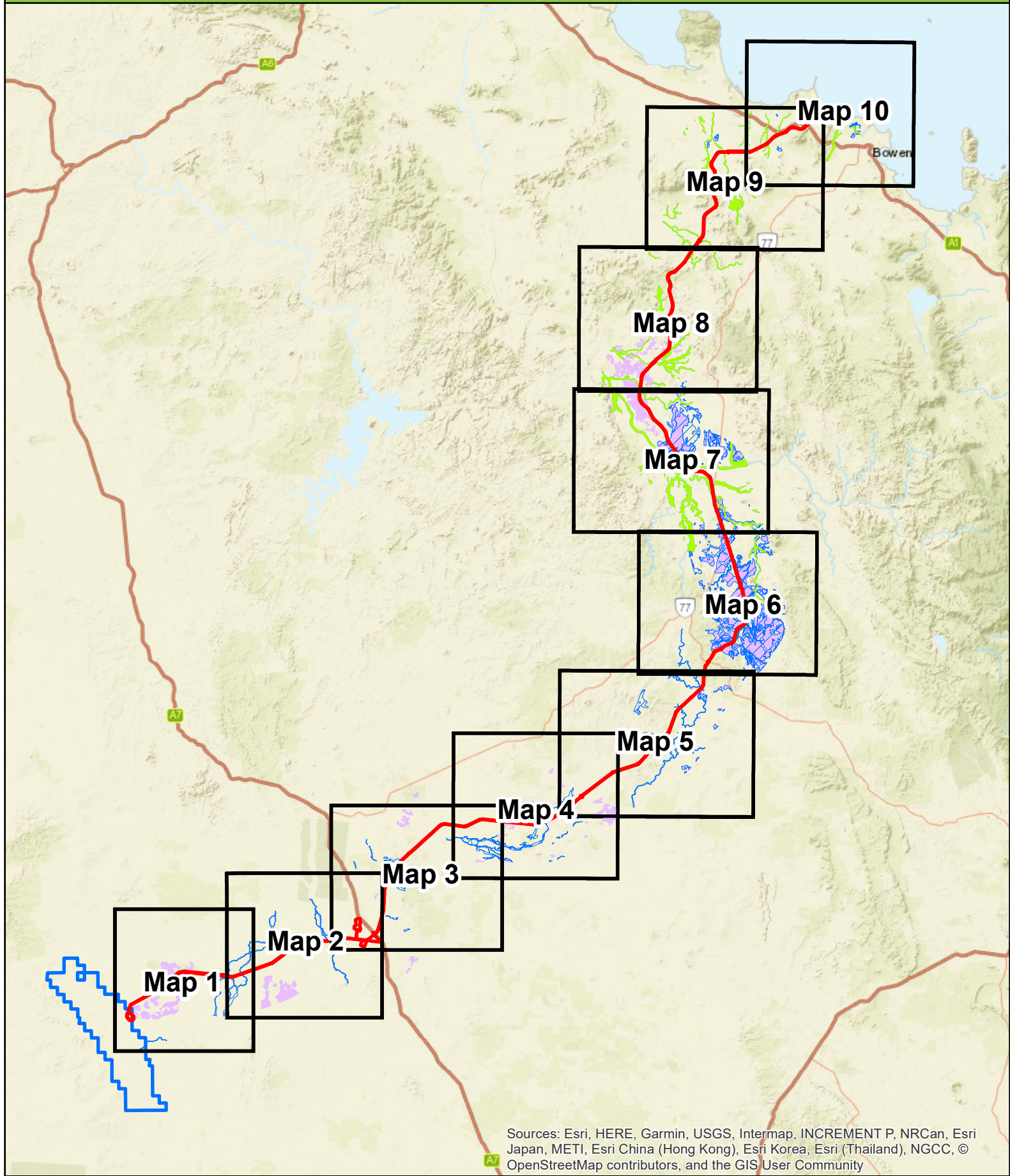
## Appendix B Maps of Threatened Flora

Maps of known locations of threatened flora habitat are provided on the following pages.

Map series run from west (Gregory Development Road; Map 3) to east (Abbot Point; Map 10)



# Potential Threatened Flora Habitat Surrounding the Project Area



Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, © OpenStreetMap contributors, and the GIS User Community

**Legend**

- Carmichael Rail Network
- Carmichael Mine
- Potential *Dichanthium queenslandicum* Habitat
- Potential *Dichanthium setosum* Habitat
- Potential *Eucalyptus raveretiana* Habitat

0      20      40  
Kilometers

Datum/Projection:  
GDA 1994 MGA Zone 55

N

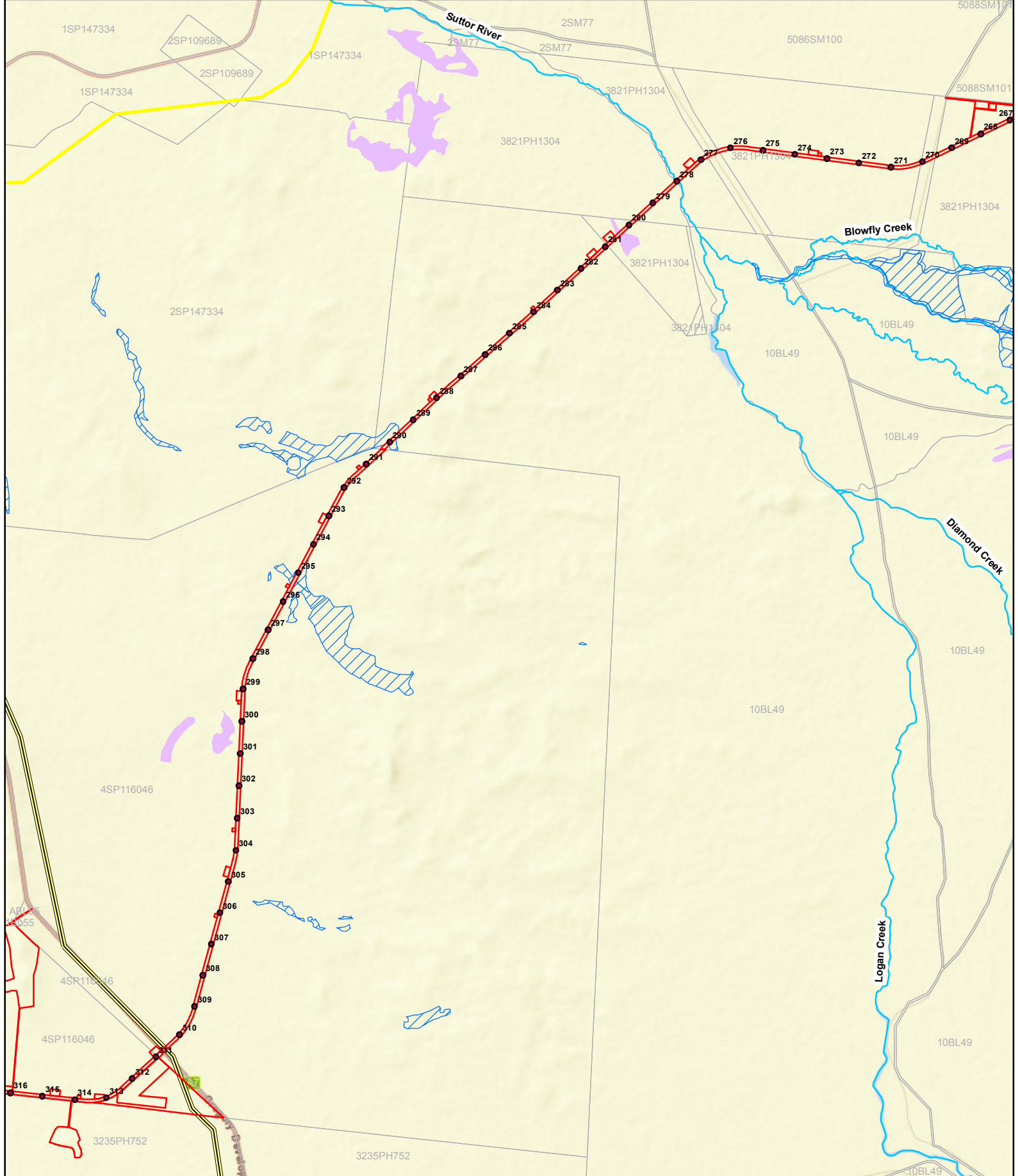
Data Sources: Adani Mining, QLD Gov  
Imagery: Bing Maps

**eco logical**  
AUSTRALIA

[www.ecoaus.com.au](http://www.ecoaus.com.au)

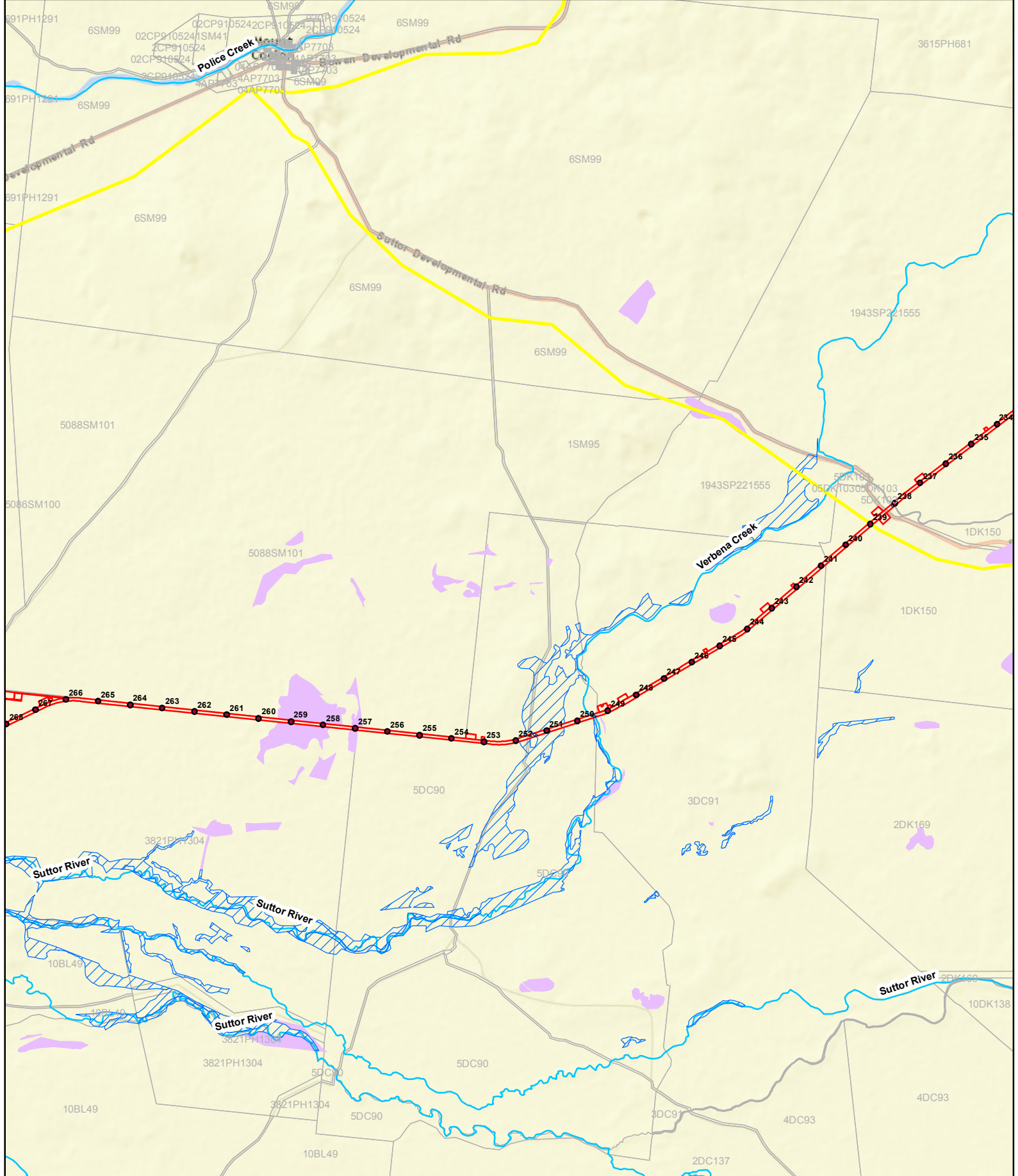


# Known locations of threatened flora habitat within the Project Area: Map 3



<p><b>Legend</b></p> <ul style="list-style-type: none"> <li><span style="border: 1px solid red; display: inline-block; width: 15px; height: 10px; margin-right: 5px;"></span> Carmichael Rail Network</li> <li><span style="display: inline-block; width: 15px; height: 10px; border-bottom: 2px solid black; margin-right: 5px;"></span> Kilometre Points</li> <li><span style="border-bottom: 2px solid grey; display: inline-block; width: 15px; margin-right: 5px;"></span> State Road</li> <li><span style="border-bottom: 2px solid yellow; display: inline-block; width: 15px; margin-right: 5px;"></span> Local Road</li> <li><span style="border-bottom: 1px solid blue; display: inline-block; width: 15px; margin-right: 5px;"></span> Major Watercourse</li> <li><span style="border-bottom: 1px dashed grey; display: inline-block; width: 15px; margin-right: 5px;"></span> Property Boundary</li> </ul> <p><b>Known Locations</b></p> <ul style="list-style-type: none"> <li><span style="display: inline-block; width: 10px; height: 10px; border: 1px solid yellow; border-radius: 50%; margin-right: 5px;"></span> <i>Dichanthium queenslandicum</i></li> <li><span style="display: inline-block; width: 10px; height: 10px; border: 1px solid blue; border-radius: 50%; margin-right: 5px;"></span> <i>Dichanthium setosum</i></li> <li><span style="display: inline-block; width: 10px; height: 10px; border: 1px solid red; border-radius: 50%; margin-right: 5px;"></span> <i>Eucalyptus raveretiana</i></li> </ul>	<p><b>Likely Threatened Flora Habitat</b></p> <ul style="list-style-type: none"> <li><span style="display: inline-block; width: 15px; height: 10px; background-color: purple; margin-right: 5px;"></span> <i>Dichanthium queenslandicum</i></li> <li><span style="display: inline-block; width: 15px; height: 10px; border: 1px solid blue; background-color: white; margin-right: 5px;"></span> <i>Dichanthium setosum</i></li> <li><span style="display: inline-block; width: 15px; height: 10px; background-color: green; margin-right: 5px;"></span> <i>Eucalyptus raveretiana</i></li> </ul> <p><b>Potential Threatened Flora Habitat</b></p> <ul style="list-style-type: none"> <li><span style="display: inline-block; width: 15px; height: 10px; border: 1px solid blue; background-color: white; margin-right: 5px;"></span> <i>Dichanthium queenslandicum</i></li> <li><span style="display: inline-block; width: 15px; height: 10px; border: 1px solid blue; background-color: lightblue; margin-right: 5px;"></span> <i>Dichanthium setosum</i></li> <li><span style="display: inline-block; width: 15px; height: 10px; border: 1px solid green; background-color: white; margin-right: 5px;"></span> <i>Eucalyptus raveretiana</i></li> </ul>	<p>0      2,250      4,500</p> <p style="text-align: center;">Meters</p> <p>Datum/Projection: GDA 1994 MGA Zone 55</p> <div style="text-align: center;"> <p>N</p> </div>	<div style="text-align: center;"> <p><b>eco logical</b> AUSTRALIA</p> <p>www.ecoaus.com.au</p> </div> <p>Data Sources: Adani Mining, QLD Gov Imagery: Bing Maps</p>
---	--	--	---

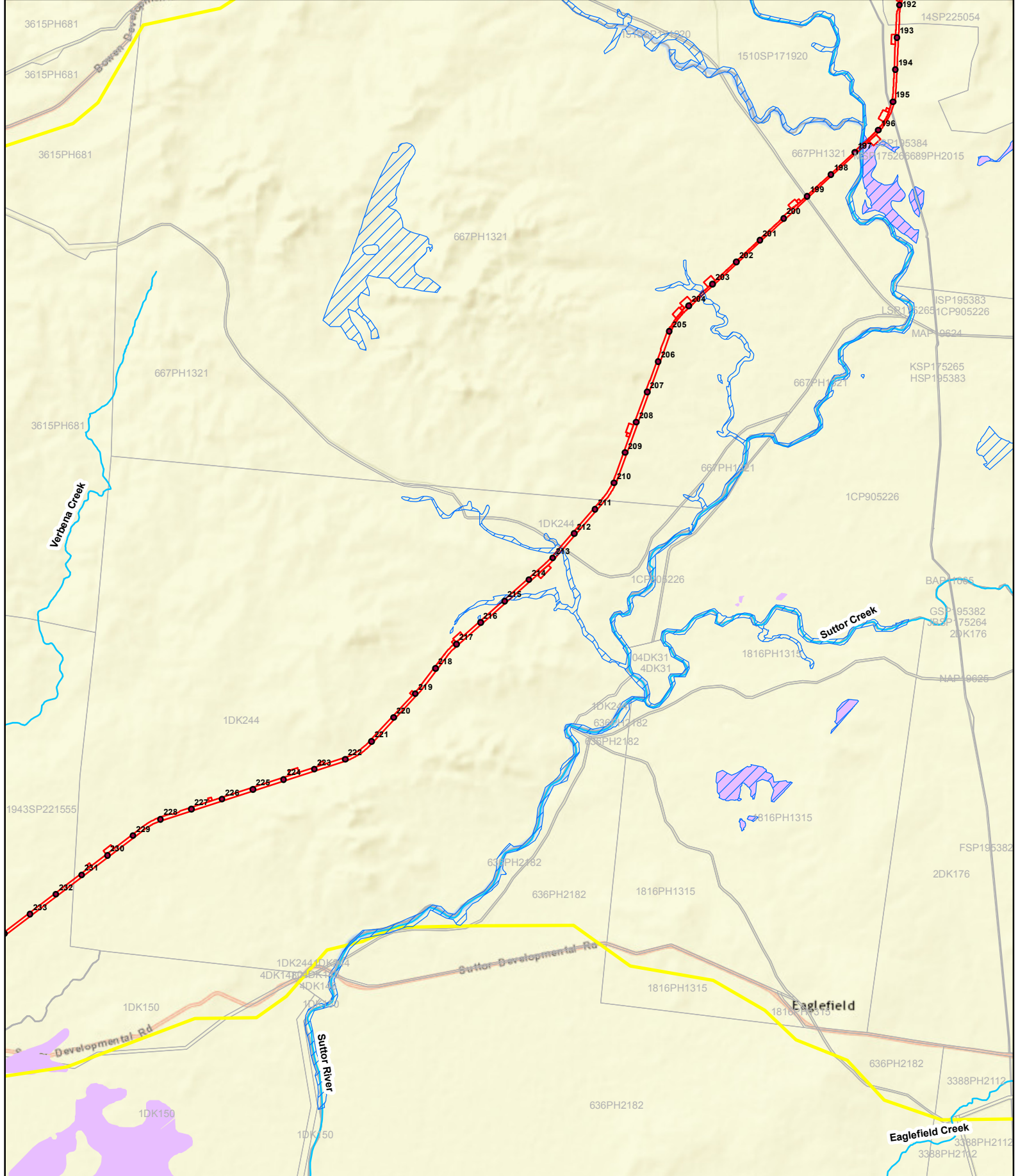
# Known locations of threatened flora habitat within the Project Area: Map 4



<p><b>Legend</b></p> <ul style="list-style-type: none"> <li><span style="border: 1px solid red; display: inline-block; width: 15px; height: 10px; margin-right: 5px;"></span> Carmichael Rail Network</li> <li><span style="display: inline-block; width: 15px; height: 10px; border-bottom: 1px solid black; margin-right: 5px;"></span> Kilometre Points</li> <li><span style="border-bottom: 2px solid brown; width: 15px; margin-right: 5px;"></span> State Road</li> <li><span style="border-bottom: 2px solid yellow; width: 15px; margin-right: 5px;"></span> Local Road</li> <li><span style="border-bottom: 1px solid blue; width: 15px; margin-right: 5px;"></span> Major Watercourse</li> <li><span style="border-bottom: 1px solid grey; width: 15px; margin-right: 5px;"></span> Property Boundary</li> </ul> <p><b>Known Locations</b></p> <ul style="list-style-type: none"> <li><span style="border: 1px solid yellow; border-radius: 50%; width: 10px; height: 10px; display: inline-block; margin-right: 5px;"></span> <i>Dichanthium queenslandicum</i></li> <li><span style="border: 1px solid blue; border-radius: 50%; width: 10px; height: 10px; display: inline-block; margin-right: 5px;"></span> <i>Dichanthium setosum</i></li> <li><span style="border: 1px solid red; border-radius: 50%; width: 10px; height: 10px; display: inline-block; margin-right: 5px;"></span> <i>Eucalyptus raveretiana</i></li> </ul>	<p><b>Likely Threatened Flora Habitat</b></p> <ul style="list-style-type: none"> <li><span style="background-color: purple; width: 15px; height: 10px; display: inline-block; margin-right: 5px;"></span> <i>Dichanthium queenslandicum</i></li> <li><span style="background-color: purple; border: 1px solid blue; width: 15px; height: 10px; display: inline-block; margin-right: 5px;"></span> <i>Dichanthium setosum</i></li> <li><span style="background-color: green; width: 15px; height: 10px; display: inline-block; margin-right: 5px;"></span> <i>Eucalyptus raveretiana</i></li> </ul> <p><b>Potential Threatened Flora Habitat</b></p> <ul style="list-style-type: none"> <li><span style="background-color: lightpurple; width: 15px; height: 10px; display: inline-block; margin-right: 5px;"></span> <i>Dichanthium queenslandicum</i></li> <li><span style="background-color: lightblue; border: 1px solid blue; width: 15px; height: 10px; display: inline-block; margin-right: 5px;"></span> <i>Dichanthium setosum</i></li> <li><span style="background-color: lightgreen; width: 15px; height: 10px; display: inline-block; margin-right: 5px;"></span> <i>Eucalyptus raveretiana</i></li> </ul>	<p>0      2,250      4,500</p> <p>Meters</p> <p>Datum/Projection: GDA 1994 MGA Zone 55</p> <div style="text-align: center;"> <p>N</p> </div> <p>Data Sources: Adani Mining, QLD Gov Imagery: Bing Maps</p>	<p style="text-align: center; font-size: 2em; font-weight: bold; color: green;">eco logical</p> <p style="text-align: center; font-weight: bold;">AUSTRALIA</p> <p style="text-align: center;">www.ecoaus.com.au</p>
---	---	--	--

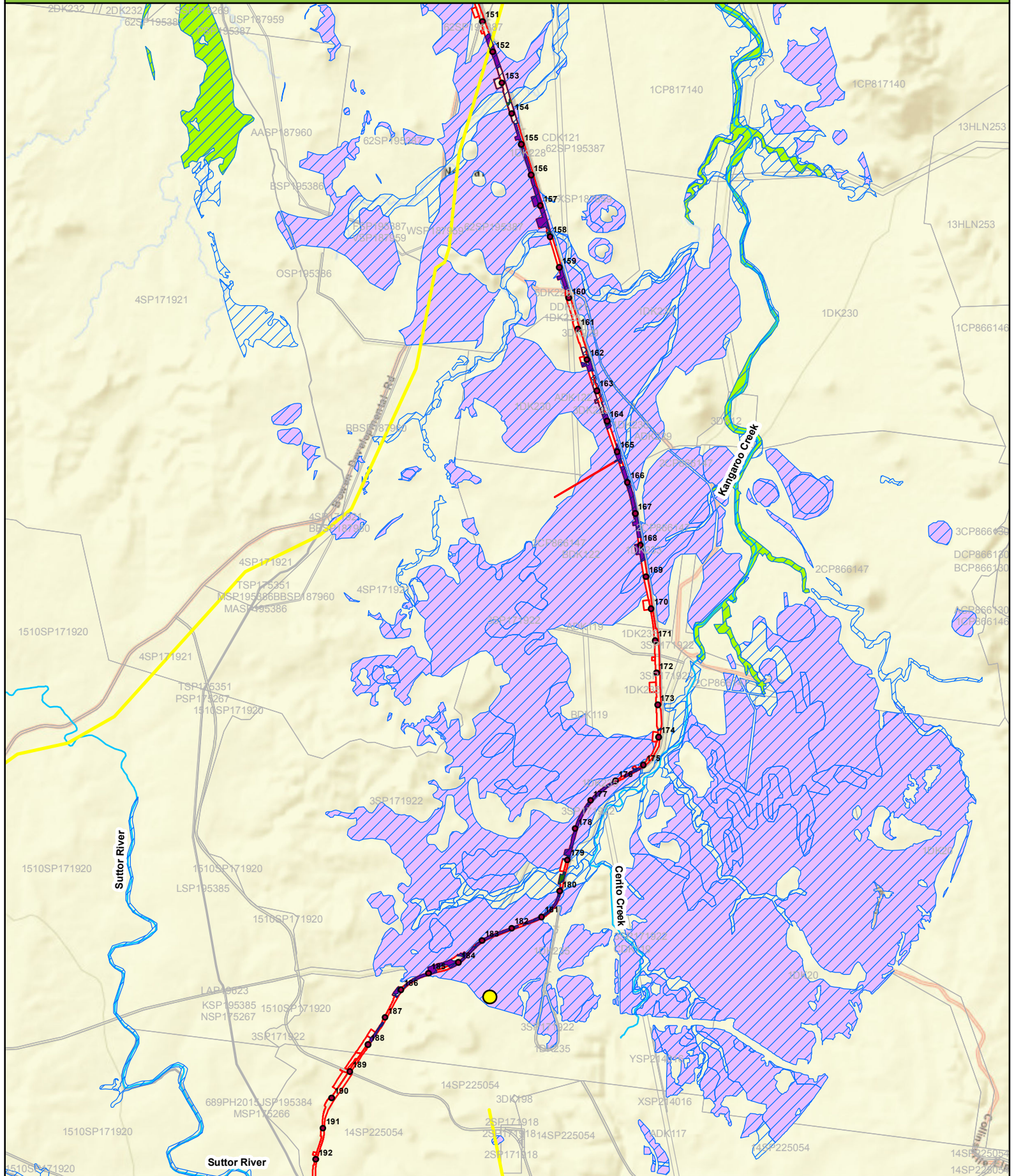


# Known locations of threatened flora habitat within the Project Area: Map 5



<p><b>Legend</b></p> <ul style="list-style-type: none"> <li><span style="border: 1px solid red; width: 20px; height: 10px; display: inline-block;"></span> Carmichael Rail Network</li> <li><span style="display: inline-block; width: 20px; height: 2px; background-color: black; margin-right: 5px;"></span> Kilometre Points</li> <li><span style="border-bottom: 2px solid black; width: 20px; display: inline-block;"></span> State Road</li> <li><span style="border-bottom: 2px solid yellow; width: 20px; display: inline-block;"></span> Local Road</li> <li><span style="border-bottom: 2px solid blue; width: 20px; display: inline-block;"></span> Major Watercourse</li> <li><span style="border-bottom: 1px solid grey; width: 20px; display: inline-block;"></span> Property Boundary</li> </ul> <p><b>Known Locations</b></p> <ul style="list-style-type: none"> <li><span style="border: 1px solid yellow; border-radius: 50%; width: 10px; height: 10px; display: inline-block;"></span> <i>Dichanthium queenslandicum</i></li> <li><span style="border: 1px solid blue; border-radius: 50%; width: 10px; height: 10px; display: inline-block;"></span> <i>Dichanthium setosum</i></li> <li><span style="border: 1px solid red; border-radius: 50%; width: 10px; height: 10px; display: inline-block;"></span> <i>Eucalyptus raveretiana</i></li> </ul>	<p><b>Known Threatened Flora Habitat</b></p> <ul style="list-style-type: none"> <li><span style="background-color: purple; width: 20px; height: 10px; display: inline-block;"></span> <i>Dichanthium queenslandicum</i></li> <li><span style="background-color: blue; width: 20px; height: 10px; display: inline-block;"></span> <i>Dichanthium setosum</i></li> <li><span style="background-color: green; width: 20px; height: 10px; display: inline-block;"></span> <i>Eucalyptus raveretiana</i></li> </ul> <p><b>Potential Threatened Flora Habitat</b></p> <ul style="list-style-type: none"> <li><span style="background-color: lightpurple; width: 20px; height: 10px; display: inline-block;"></span> <i>Dichanthium queenslandicum</i></li> <li><span style="background-color: lightblue; width: 20px; height: 10px; display: inline-block;"></span> <i>Dichanthium setosum</i></li> <li><span style="background-color: lightgreen; width: 20px; height: 10px; display: inline-block;"></span> <i>Eucalyptus raveretiana</i></li> </ul>	<p>0      2,250      4,500</p> <p style="text-align: center;">Meters</p> <p>Datum/Projection: GDA 1994 MGA Zone 55</p> <div style="text-align: center;"> <p>N</p> </div>	<div style="text-align: center;"> <p><b>eco logical</b> AUSTRALIA</p> </div> <p>Data Sources: Adani Mining, QLD Gov Imagery: Bing Maps</p> <p style="text-align: center;"><a href="http://www.ecoaus.com.au">www.ecoaus.com.au</a></p>
---	--	--	--

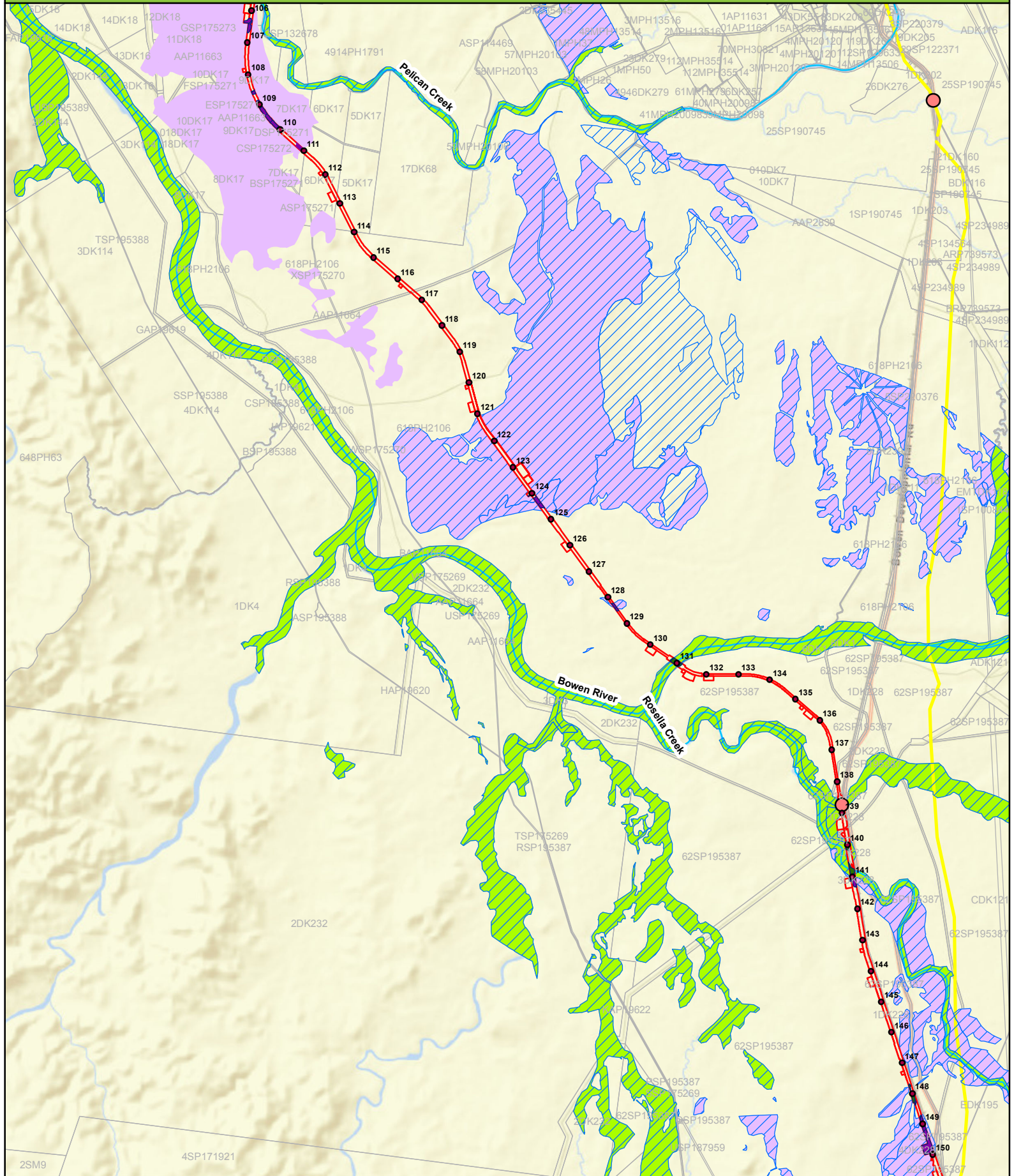
# Known locations of threatened flora habitat within the Project Area: Map 6



<p><b>Legend</b></p> <ul style="list-style-type: none"> <li><span style="border: 1px solid red; display: inline-block; width: 15px; height: 10px; margin-right: 5px;"></span> Carmichael Rail Network</li> <li><span style="border-bottom: 1px solid black; display: inline-block; width: 15px; margin-right: 5px;"></span> Kilometre Points</li> <li><span style="border-bottom: 2px solid black; display: inline-block; width: 15px; margin-right: 5px;"></span> State Road</li> <li><span style="border-bottom: 2px solid yellow; display: inline-block; width: 15px; margin-right: 5px;"></span> Local Road</li> <li><span style="border-bottom: 1px solid blue; display: inline-block; width: 15px; margin-right: 5px;"></span> Major Watercourse</li> <li><span style="border-bottom: 1px dashed black; display: inline-block; width: 15px; margin-right: 5px;"></span> Property Boundary</li> </ul> <p><b>Known Locations</b></p> <ul style="list-style-type: none"> <li><span style="background-color: yellow; border-radius: 50%; width: 10px; height: 10px; display: inline-block; margin-right: 5px;"></span> <i>Dichanthium queenslandicum</i></li> <li><span style="background-color: cyan; border-radius: 50%; width: 10px; height: 10px; display: inline-block; margin-right: 5px;"></span> <i>Dichanthium setosum</i></li> <li><span style="background-color: red; border-radius: 50%; width: 10px; height: 10px; display: inline-block; margin-right: 5px;"></span> <i>Eucalyptus raveretiana</i></li> </ul>	<p><b>Known Threatened Flora Habitat</b></p> <ul style="list-style-type: none"> <li><span style="background-color: purple; border: 1px solid black; display: inline-block; width: 15px; height: 10px; margin-right: 5px;"></span> <i>Dichanthium queenslandicum</i></li> <li><span style="background-color: lightblue; border: 1px solid black; display: inline-block; width: 15px; height: 10px; margin-right: 5px;"></span> <i>Dichanthium setosum</i></li> <li><span style="background-color: green; border: 1px solid black; display: inline-block; width: 15px; height: 10px; margin-right: 5px;"></span> <i>Eucalyptus raveretiana</i></li> </ul> <p><b>Potential Threatened Flora Habitat</b></p> <ul style="list-style-type: none"> <li><span style="background-color: lightpurple; border: 1px solid black; display: inline-block; width: 15px; height: 10px; margin-right: 5px;"></span> <i>Dichanthium queenslandicum</i></li> <li><span style="background-color: lightblue; border: 1px solid black; display: inline-block; width: 15px; height: 10px; margin-right: 5px;"></span> <i>Dichanthium setosum</i></li> <li><span style="background-color: lightgreen; border: 1px solid black; display: inline-block; width: 15px; height: 10px; margin-right: 5px;"></span> <i>Eucalyptus raveretiana</i></li> </ul>	<p>0      2,250      4,500</p> <p style="text-align: center;">Meters</p> <p>Datum/Projection: GDA 1994 MGA Zone 55</p> <div style="text-align: center;"> <p>N</p> </div>	<div style="text-align: right;"> <p><b>eco logical</b> AUSTRALIA</p> <p>www.ecoaus.com.au</p> </div> <p>Data Sources: Adani Mining, QLD Gov Imagery: Bing Maps</p>
---	---	--	--



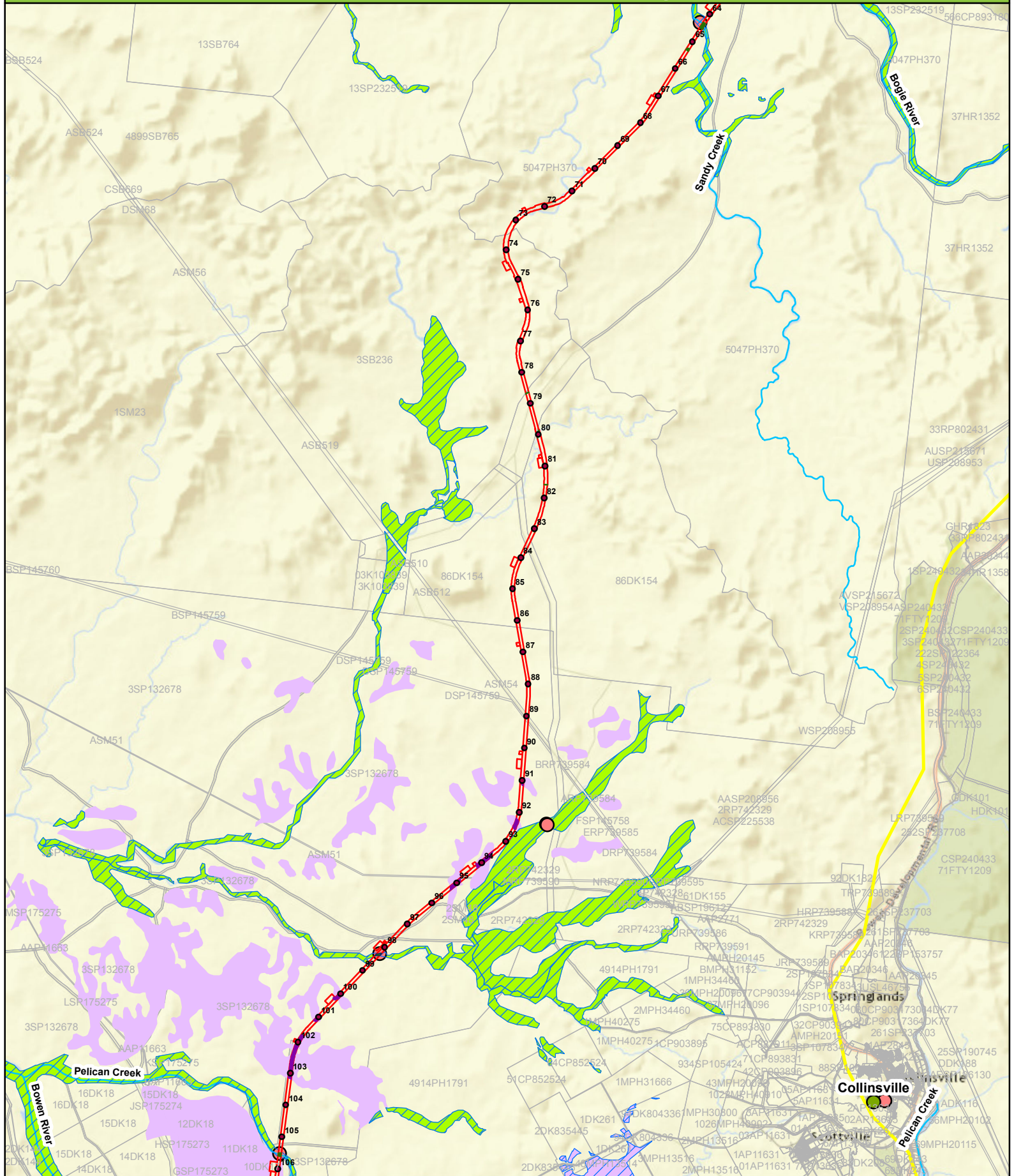
# Known locations of threatened flora habitat within the Project Area: Map 7



<p><b>Legend</b></p> <ul style="list-style-type: none"> <li><span style="border: 1px solid red; width: 20px; height: 10px; display: inline-block;"></span> Carmichael Rail Network</li> <li><span style="display: inline-block; width: 20px; height: 2px; background-color: black; margin-right: 5px;"></span> Kilometre Points</li> <li><span style="border-bottom: 2px solid black; width: 20px; display: inline-block;"></span> State Road</li> <li><span style="border-bottom: 2px solid yellow; width: 20px; display: inline-block;"></span> Local Road</li> <li><span style="border-bottom: 2px solid blue; width: 20px; display: inline-block;"></span> Major Watercourse</li> <li><span style="border-bottom: 1px solid grey; width: 20px; display: inline-block;"></span> Property Boundary</li> </ul> <p><b>Known Locations</b></p> <ul style="list-style-type: none"> <li><span style="display: inline-block; width: 10px; height: 10px; background-color: yellow; border-radius: 50%; border: 1px solid black; margin-right: 5px;"></span> <i>Dichanthium queenslandicum</i></li> <li><span style="display: inline-block; width: 10px; height: 10px; background-color: blue; border-radius: 50%; border: 1px solid black; margin-right: 5px;"></span> <i>Dichanthium setosum</i></li> <li><span style="display: inline-block; width: 10px; height: 10px; background-color: red; border-radius: 50%; border: 1px solid black; margin-right: 5px;"></span> <i>Eucalyptus raveretiana</i></li> </ul>	<p><b>Known Threatened Flora Habitat</b></p> <ul style="list-style-type: none"> <li><span style="display: inline-block; width: 20px; height: 10px; background-color: purple; border: 1px solid black; margin-right: 5px;"></span> <i>Dichanthium queenslandicum</i></li> <li><span style="display: inline-block; width: 20px; height: 10px; background: repeating-linear-gradient(45deg, transparent, transparent 2px, blue 2px, blue 4px); border: 1px solid black; margin-right: 5px;"></span> <i>Dichanthium setosum</i></li> <li><span style="display: inline-block; width: 20px; height: 10px; background: repeating-linear-gradient(-45deg, transparent, transparent 2px, green 2px, green 4px); border: 1px solid black; margin-right: 5px;"></span> <i>Eucalyptus raveretiana</i></li> </ul> <p><b>Potential Threatened Flora Habitat</b></p> <ul style="list-style-type: none"> <li><span style="display: inline-block; width: 20px; height: 10px; background-color: lightpurple; border: 1px solid black; margin-right: 5px;"></span> <i>Dichanthium queenslandicum</i></li> <li><span style="display: inline-block; width: 20px; height: 10px; background: repeating-linear-gradient(45deg, transparent, transparent 2px, lightblue 2px, lightblue 4px); border: 1px solid black; margin-right: 5px;"></span> <i>Dichanthium setosum</i></li> <li><span style="display: inline-block; width: 20px; height: 10px; background: repeating-linear-gradient(-45deg, transparent, transparent 2px, lightgreen 2px, lightgreen 4px); border: 1px solid black; margin-right: 5px;"></span> <i>Eucalyptus raveretiana</i></li> </ul>	<p>0      2,250      4,500</p> <p style="text-align: center;">Meters</p> <p>Datum/Projection: GDA 1994 MGA Zone 55</p> <div style="text-align: center;"> </div> <p>Data Sources: Adani Mining, QLD Gov Imagery: Bing Maps</p>	<p style="text-align: center; font-size: 2em; font-weight: bold; color: green;">eco logical</p> <p style="text-align: center; font-weight: bold;">AUSTRALIA</p> <p style="text-align: center;">www.ecoaus.com.au</p>
---	--	---	--



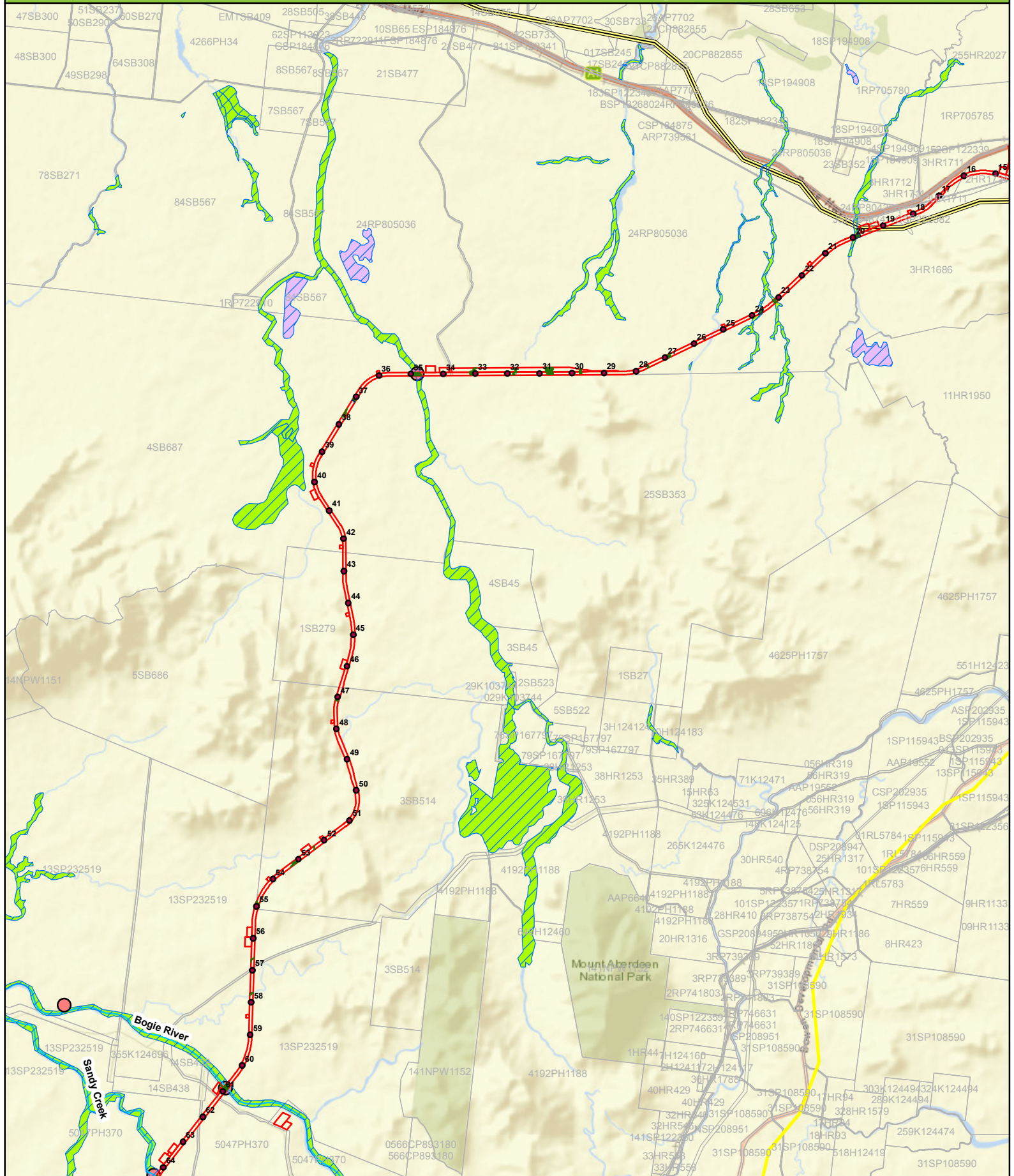
# Known locations of threatened flora habitat within the Project Area: Map 8





<p><b>Legend</b></p> <ul style="list-style-type: none"> <li><span style="border: 1px solid red; width: 20px; height: 10px; display: inline-block;"></span> Carmichael Rail Network</li> <li><span style="border: 1px solid black; width: 20px; height: 10px; display: inline-block;"></span> Kilometre Points</li> <li><span style="border: 1px solid black; width: 20px; height: 10px; display: inline-block;"></span> State Road</li> <li><span style="border: 1px solid yellow; width: 20px; height: 10px; display: inline-block;"></span> Local Road</li> <li><span style="border: 1px solid blue; width: 20px; height: 10px; display: inline-block;"></span> Major Watercourse</li> <li><span style="border: 1px solid grey; width: 20px; height: 10px; display: inline-block;"></span> Property Boundary</li> </ul> <p><b>Known Locations</b></p> <ul style="list-style-type: none"> <li><span style="background-color: yellow; width: 10px; height: 10px; border-radius: 50%; display: inline-block;"></span> <i>Dichanthium queenslandicum</i></li> <li><span style="background-color: cyan; width: 10px; height: 10px; border-radius: 50%; display: inline-block;"></span> <i>Dichanthium setosum</i></li> <li><span style="background-color: red; width: 10px; height: 10px; border-radius: 50%; display: inline-block;"></span> <i>Eucalyptus raveretiana</i></li> </ul>	<p><b>Known Threatened Flora Habitat</b></p> <ul style="list-style-type: none"> <li><span style="background-color: purple; width: 20px; height: 10px; display: inline-block;"></span> <i>Dichanthium queenslandicum</i></li> <li><span style="background-color: green; width: 20px; height: 10px; display: inline-block;"></span> <i>Dichanthium setosum</i></li> <li><span style="background-color: darkgreen; width: 20px; height: 10px; display: inline-block;"></span> <i>Eucalyptus raveretiana</i></li> </ul> <p><b>Potential Threatened Flora Habitat</b></p> <ul style="list-style-type: none"> <li><span style="background-color: lightpurple; width: 20px; height: 10px; display: inline-block;"></span> <i>Dichanthium queenslandicum</i></li> <li><span style="background-color: lightgreen; width: 20px; height: 10px; display: inline-block;"></span> <i>Dichanthium setosum</i></li> <li><span style="background-color: limegreen; width: 20px; height: 10px; display: inline-block;"></span> <i>Eucalyptus raveretiana</i></li> </ul>	<p>0      2,250      4,500</p> <p style="text-align: center;">Meters</p> <p>Datum/Projection: GDA 1994 MGA Zone 55</p> <div style="text-align: center;"> </div> <p>Data Sources: Adani Mining, QLD Gov Imagery: Bing Maps</p>	<div style="text-align: center;"> <p><b>eco logical</b> AUSTRALIA</p> <p><a href="http://www.ecoaus.com.au">www.ecoaus.com.au</a></p> </div>
---	---	---	--



# Known locations of threatened flora habitat within the Project Area: Map 9



<p><b>Legend</b></p> <ul style="list-style-type: none"> <li><span style="border: 1px solid red; display: inline-block; width: 15px; height: 10px; margin-right: 5px;"></span> Carmichael Rail Network</li> <li><span style="display: inline-block; width: 15px; height: 10px; border-bottom: 1px solid black; margin-right: 5px;"></span> Kilometre Points</li> <li><span style="border-bottom: 2px solid black; width: 15px; margin-right: 5px;"></span> State Road</li> <li><span style="border-bottom: 2px solid yellow; width: 15px; margin-right: 5px;"></span> Local Road</li> <li><span style="border-bottom: 1px solid blue; width: 15px; margin-right: 5px;"></span> Major Watercourse</li> <li><span style="border-bottom: 1px dashed gray; width: 15px; margin-right: 5px;"></span> Property Boundary</li> </ul> <p><b>Known Locations</b></p> <ul style="list-style-type: none"> <li><span style="display: inline-block; width: 10px; height: 10px; background-color: yellow; border-radius: 50%; margin-right: 5px;"></span> <i>Dichanthium queenslandicum</i></li> <li><span style="display: inline-block; width: 10px; height: 10px; background-color: cyan; border-radius: 50%; margin-right: 5px;"></span> <i>Dichanthium setosum</i></li> <li><span style="display: inline-block; width: 10px; height: 10px; background-color: red; border-radius: 50%; margin-right: 5px;"></span> <i>Eucalyptus raveretiana</i></li> </ul>	<p><b>Known Threatened Flora Habitat</b></p> <ul style="list-style-type: none"> <li><span style="display: inline-block; width: 15px; height: 10px; background-color: purple; border: 1px solid black; margin-right: 5px;"></span> <i>Dichanthium queenslandicum</i></li> <li><span style="display: inline-block; width: 15px; height: 10px; background-color: purple; border: 1px solid black; border-style: dashed; margin-right: 5px;"></span> <i>Dichanthium setosum</i></li> <li><span style="display: inline-block; width: 15px; height: 10px; background-color: green; border: 1px solid black; margin-right: 5px;"></span> <i>Eucalyptus raveretiana</i></li> </ul> <p><b>Potential Threatened Flora Habitat</b></p> <ul style="list-style-type: none"> <li><span style="display: inline-block; width: 15px; height: 10px; background-color: lightpurple; border: 1px solid black; margin-right: 5px;"></span> <i>Dichanthium queenslandicum</i></li> <li><span style="display: inline-block; width: 15px; height: 10px; background-color: lightblue; border: 1px solid black; margin-right: 5px;"></span> <i>Dichanthium setosum</i></li> <li><span style="display: inline-block; width: 15px; height: 10px; background-color: lightgreen; border: 1px solid black; margin-right: 5px;"></span> <i>Eucalyptus raveretiana</i></li> </ul>	<p>0      2,250      4,500</p> <p style="text-align: center;">Meters</p> <p>Datum/Projection: GDA 1994 MGA Zone 55</p> <div style="text-align: center;">  <p>N</p> </div> <p>Data Sources: Adani Mining, QLD Gov Imagery: Bing Maps</p>	<div style="text-align: center;">  <p>www.ecoaus.com.au</p> </div>
--	--	--	---



# Known locations of threatened flora habitat within the Project Area: Map 10



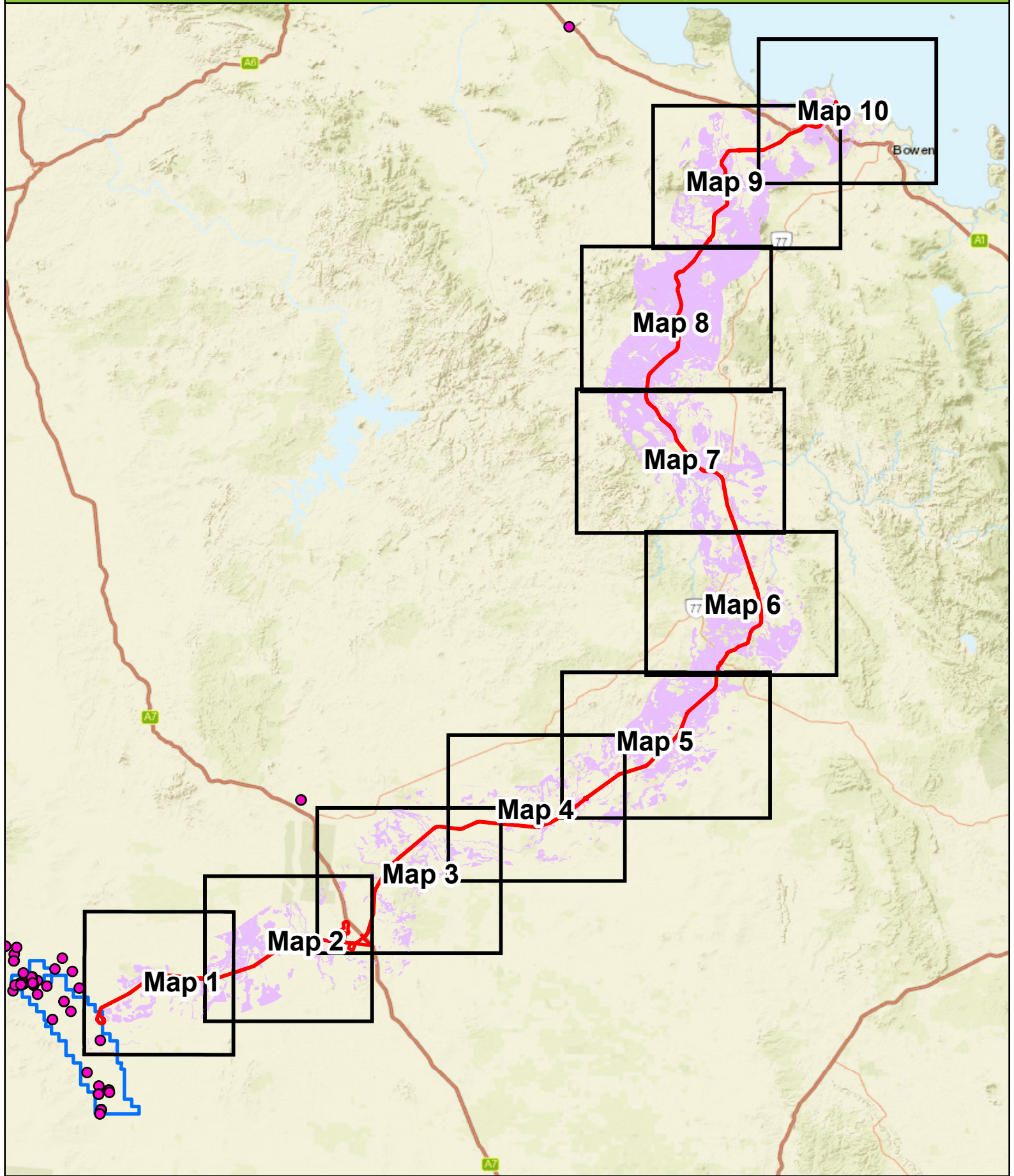
<p><b>Legend</b></p> <ul style="list-style-type: none"> <li><span style="border: 1px solid red; display: inline-block; width: 15px; height: 10px; margin-right: 5px;"></span> Carmichael Rail Network</li> <li><span style="display: inline-block; width: 15px; height: 10px; border-bottom: 1px solid black; margin-right: 5px;"></span> Kilometre Points</li> <li><span style="border-bottom: 2px solid yellow; width: 15px; margin-right: 5px;"></span> State Road</li> <li><span style="border-bottom: 2px solid orange; width: 15px; margin-right: 5px;"></span> Local Road</li> <li><span style="border-bottom: 2px solid blue; width: 15px; margin-right: 5px;"></span> Major Watercourse</li> </ul> <p><b>Known Locations</b></p> <ul style="list-style-type: none"> <li><span style="display: inline-block; width: 10px; height: 10px; background-color: yellow; border-radius: 50%; margin-right: 5px;"></span> <i>Dichanthium queenslandicum</i></li> <li><span style="display: inline-block; width: 10px; height: 10px; background-color: cyan; border-radius: 50%; margin-right: 5px;"></span> <i>Dichanthium setosum</i></li> <li><span style="display: inline-block; width: 10px; height: 10px; background-color: pink; border-radius: 50%; margin-right: 5px;"></span> <i>Eucalyptus raveretiana</i></li> </ul>	<p><b>Likely Threatened Flora Habitat</b></p> <ul style="list-style-type: none"> <li><span style="display: inline-block; width: 15px; height: 10px; background-color: purple; margin-right: 5px;"></span> <i>Dichanthium queenslandicum</i></li> <li><span style="display: inline-block; width: 15px; height: 10px; border: 1px dashed blue; margin-right: 5px;"></span> <i>Dichanthium setosum</i></li> <li><span style="display: inline-block; width: 15px; height: 10px; background-color: green; margin-right: 5px;"></span> <i>Eucalyptus raveretiana</i></li> </ul> <p><b>Potential Threatened Flora Habitat</b></p> <ul style="list-style-type: none"> <li><span style="display: inline-block; width: 15px; height: 10px; border: 1px dashed pink; margin-right: 5px;"></span> <i>Dichanthium queenslandicum</i></li> <li><span style="display: inline-block; width: 15px; height: 10px; border: 1px dashed lightblue; margin-right: 5px;"></span> <i>Dichanthium setosum</i></li> <li><span style="display: inline-block; width: 15px; height: 10px; background-color: lightgreen; margin-right: 5px;"></span> <i>Eucalyptus raveretiana</i></li> </ul>	<p>0      2,250      4,500</p> <p style="text-align: center;">Meters</p> <p style="text-align: center;">Datum/Projection: GDA 1994 MGA Zone 55</p> <div style="text-align: center;"> <p>N</p> </div>	<div style="text-align: center;"> <p>www.ecoaus.com.au</p> </div> <p>Data Sources: Adani Mining, QLD Gov Imagery: Bing Maps</p>
---	---	--	---

## Appendix C Maps of Threatened Fauna

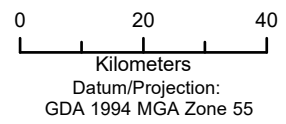
Maps of likely and potential threatened fauna habitat are provided on the following pages.

Map series run from west (Gregory Development Road; Map 3) to east (Abbot Point; Map 10) for each value.

# Potential Black-Throated Finch Habitat Surrounding the Project Area



- Legend**
- Known Black-Throated Finch Locations
  - Carmichael Rail Network
  - Carmichael Mine
  - Likely Black-Throated Finch Habitat
  - Potential Black-Throated Finch Habitat



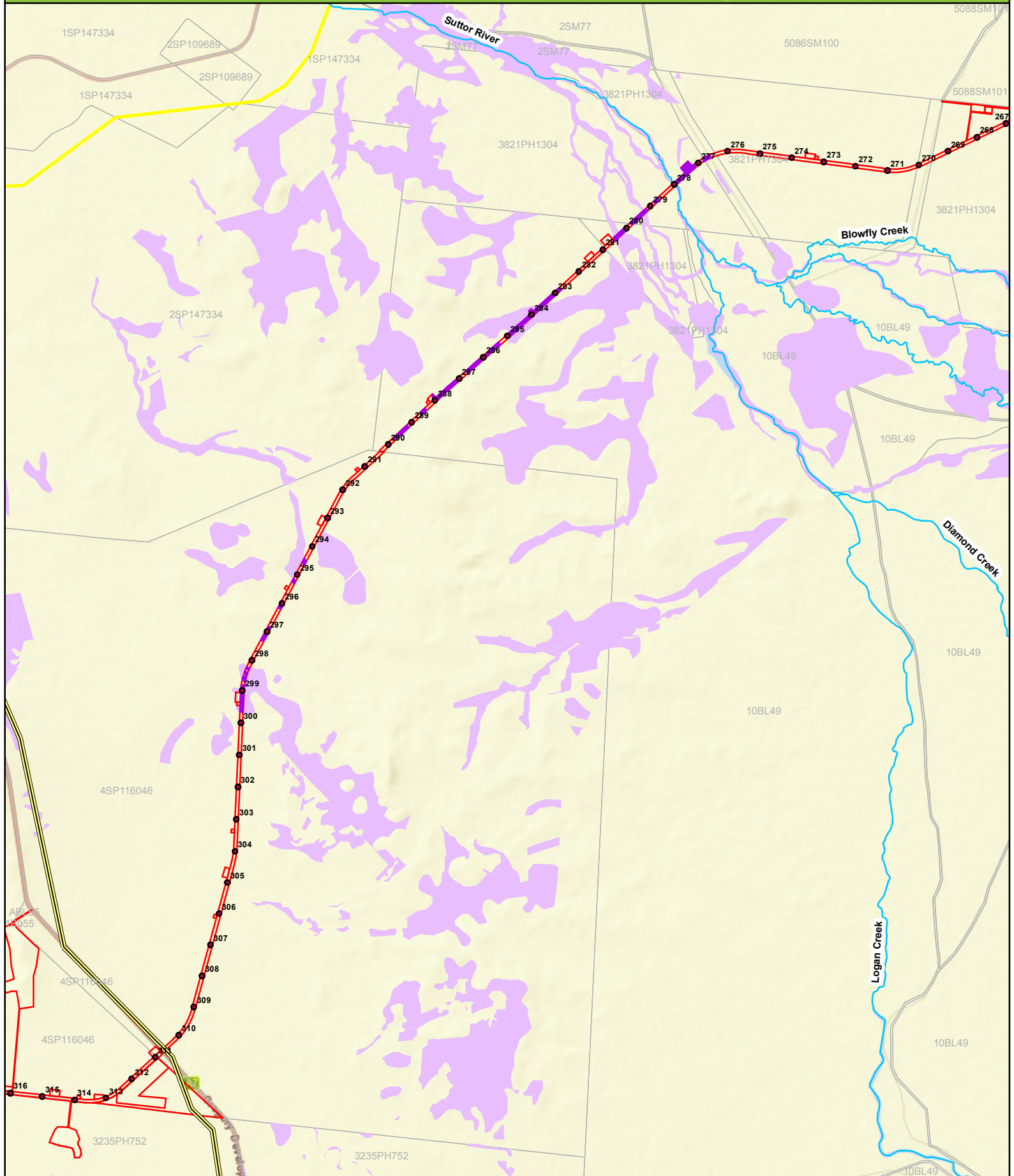
Data Sources: Adani Mining, QLD Gov  
Imagery: Bing Maps

  
[www.ecoaus.com.au](http://www.ecoaus.com.au)

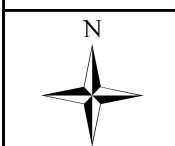
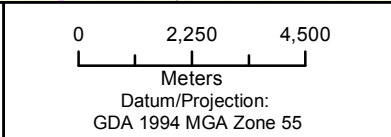
© Eco Logical Australia Pty. Ltd. This map is not guaranteed to be free from error or omission. Eco Logical Australia Pty. Ltd. and its employees disclaim liability for any act done on the information in the map and any consequences of such acts or omissions.



# Likely and Potential Black-throated Finch habitat within the Project Area: Map 3



- Legend**
- Carmichael Rail Network
  - Known Black-Throated Finch Locations
  - Kilometre Points
  - Likely Black-Throated Finch Habitat
  - Potential Black-Throated Finch Habitat
  - State Road
  - Local Road
  - Major Watercourse
  - Property Boundary

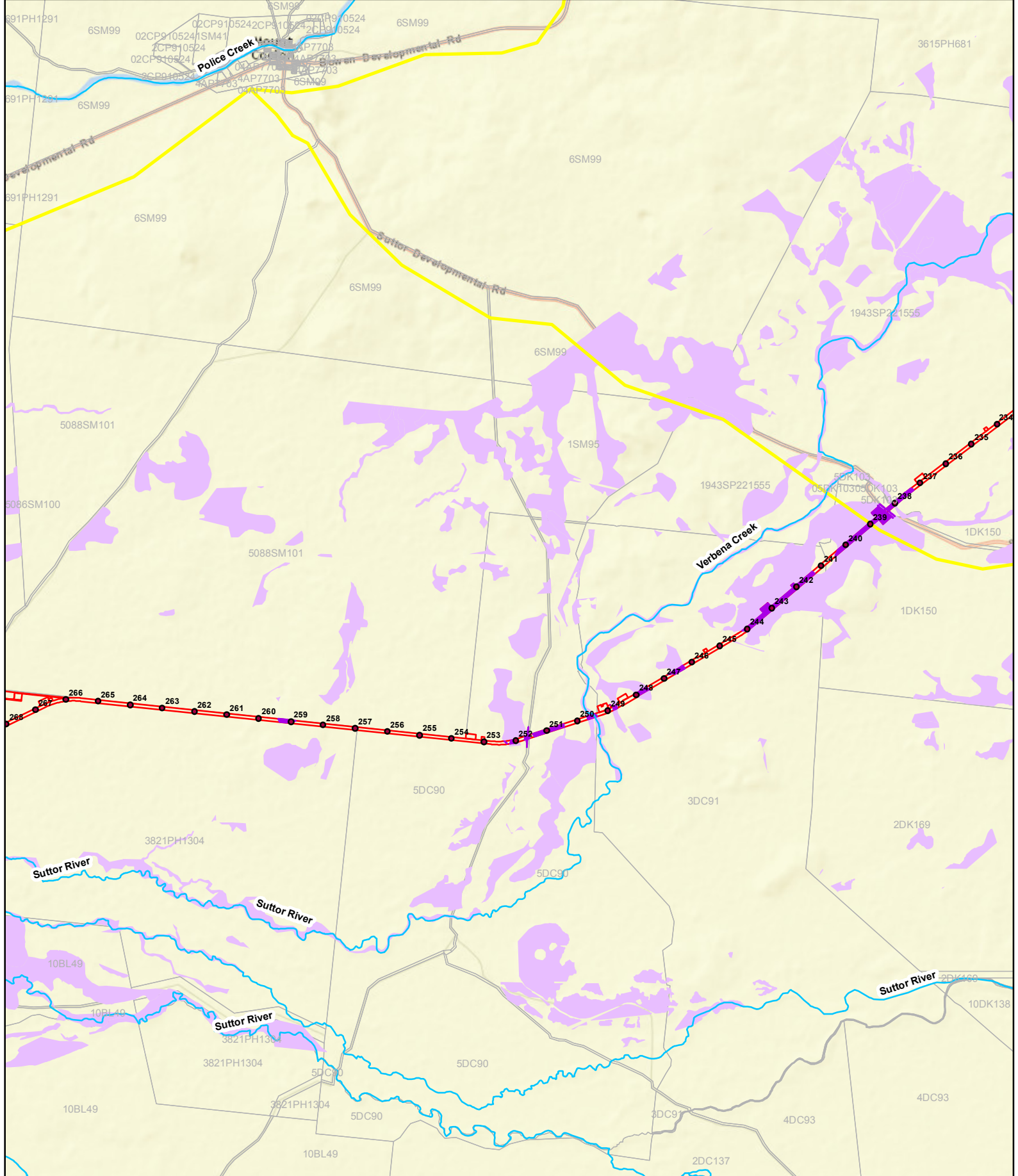


Data Sources: Adani Mining, QLD Gov  
Imagery: Bing Maps

  
[www.ecoaus.com.au](http://www.ecoaus.com.au)

© Eco Logical Australia Pty. Ltd. This map is not guaranteed to be free from error or omission. Eco Logical Australia Pty. Ltd. and its employees disclaim liability for any act done on the information in the map and any consequences of such acts or omissions.

# Likely and Potential Black-throated Finch habitat within the Project Area: Map 4



**Legend**

- Carmichael Rail Network
- Kilometre Points
- State Road
- Local Road
- Major Watercourse
- Property Boundary
- Known Black-Throated Finch Locations
- Likely Black-Throated Finch Habitat
- Potential Black-Throated Finch Habitat

0      2,250      4,500  
Meters

Datum/Projection:  
GDA 1994 MGA Zone 55

N

Data Sources: Adani Mining, QLD Gov  
Imagery: Bing Maps

eco  
logical

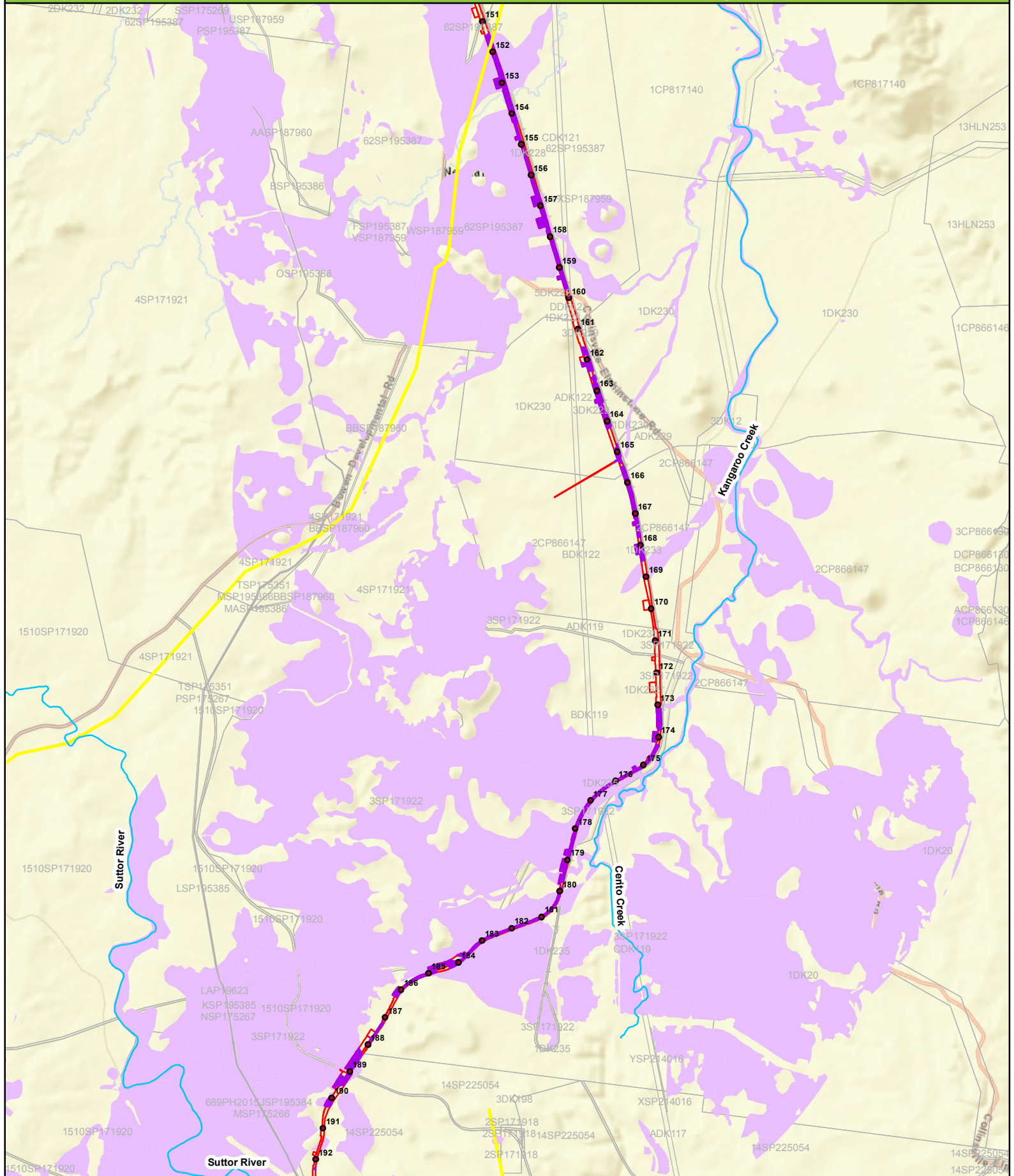
AUSTRALIA

www.ecoaus.com.au





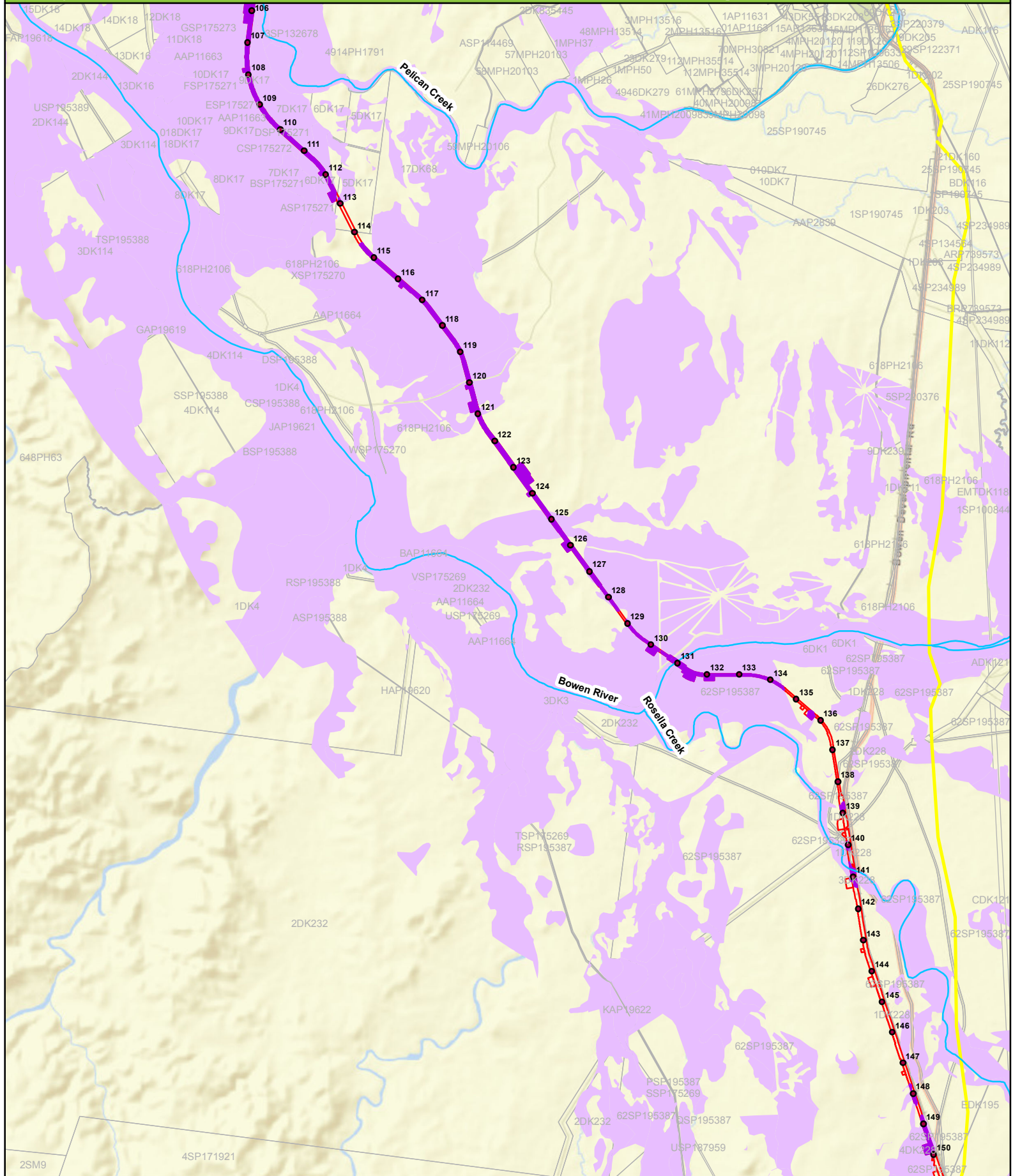
# Likely and Potential Black-throated Finch habitat within the Project Area: Map 6



<p><b>Legend</b></p> <ul style="list-style-type: none"> <li><span style="border: 1px solid red; display: inline-block; width: 15px; height: 10px; margin-right: 5px;"></span> Carmichael Rail Network</li> <li><span style="display: inline-block; width: 10px; height: 10px; border: 1px solid black; border-radius: 50%; margin-right: 5px;"></span> Kilometre Points</li> <li><span style="border-bottom: 2px solid grey; width: 20px; margin-right: 5px;"></span> State Road</li> <li><span style="border-bottom: 2px solid yellow; width: 20px; margin-right: 5px;"></span> Local Road</li> <li><span style="border-bottom: 2px solid blue; width: 20px; margin-right: 5px;"></span> Major Watercourse</li> <li><span style="border-bottom: 1px solid grey; width: 20px; margin-right: 5px;"></span> Property Boundary</li> <li><span style="display: inline-block; width: 10px; height: 10px; background-color: purple; border-radius: 50%; margin-right: 5px;"></span> Known Black-Throated Finch Locations</li> <li><span style="display: inline-block; width: 20px; height: 10px; background-color: purple; margin-right: 5px;"></span> Likely Black-Throated Finch Habitat</li> <li><span style="display: inline-block; width: 20px; height: 10px; background-color: lightpurple; margin-right: 5px;"></span> Potential Black-Throated Finch Habitat</li> </ul>	<p>0      2,250      4,500</p> <p>Meters</p> <p>Datum/Projection: GDA 1994 MGA Zone 55</p> <div style="text-align: center;"> </div>	<div style="text-align: right;"> <p><a href="http://www.ecoaus.com.au">www.ecoaus.com.au</a></p> </div> <p>Data Sources: Adani Mining, QLD Gov Imagery: Bing Maps</p>
---	---	---



# Likely and Potential Black-throated Finch habitat within the Project Area: Map 7



**Legend**

- Carmichael Rail Network
- Known Black-Throated Finch Locations
- Kilometre Points
- Likely Black-Throated Finch Habitat
- State Road
- Potential Black-Throated Finch Habitat
- Local Road
- Major Watercourse
- Property Boundary

0      2,250      4,500  
Meters

Datum/Projection:  
GDA 1994 MGA Zone 55

N

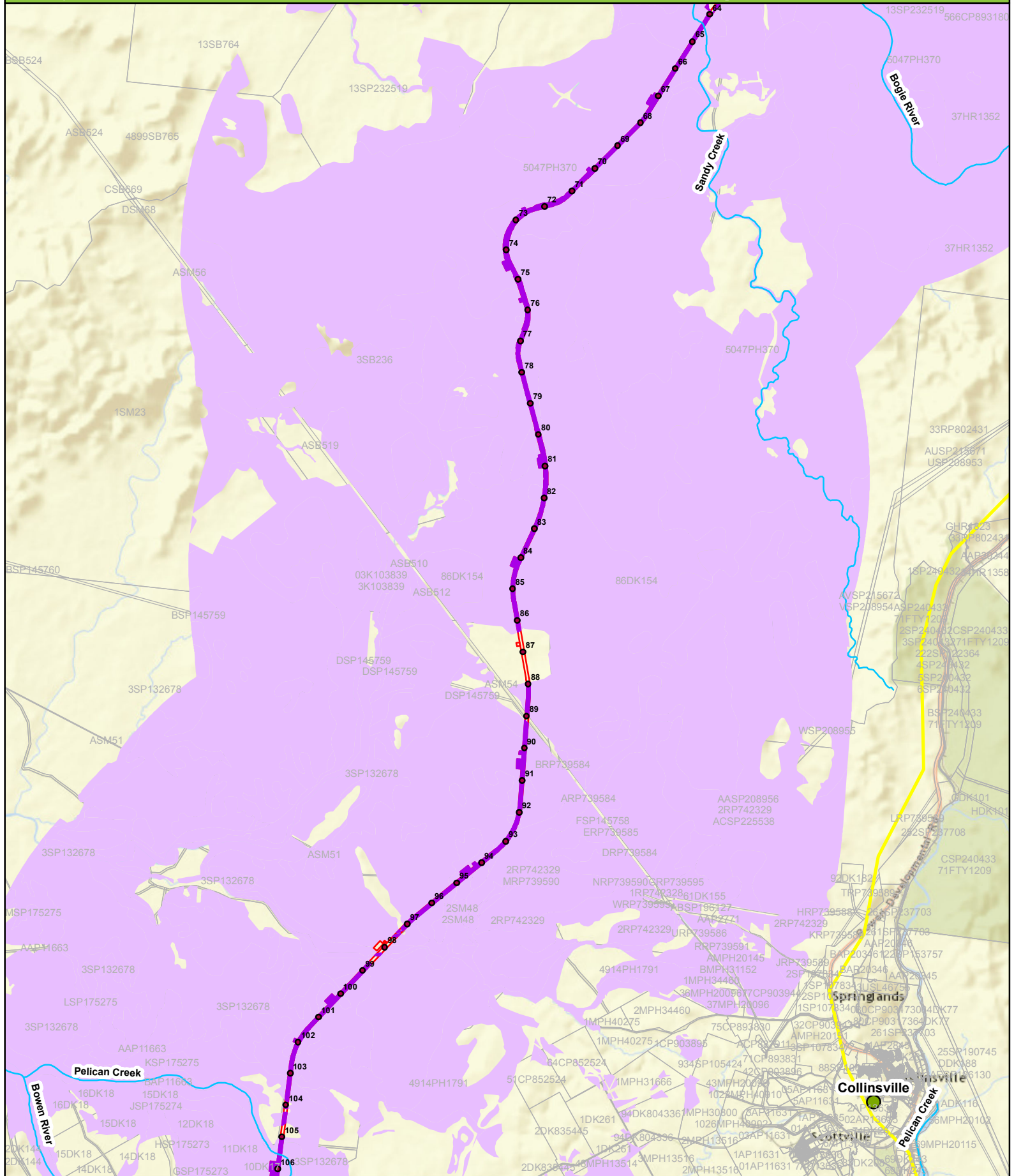
Data Sources: Adani Mining, QLD Gov  
Imagery: Bing Maps

**eco logical**  
AUSTRALIA

[www.ecoaus.com.au](http://www.ecoaus.com.au)



# Likely and Potential Black-throated Finch habitat within the Project Area: Map 8



**Legend**

- Carmichael Rail Network
- Known Black-Throated Finch Locations
- Kilometre Points
- Likely Black-Throated Finch Habitat
- State Road
- Potential Black-Throated Finch Habitat
- Local Road
- Major Watercourse
- Property Boundary

0      2,250      4,500

Meters

Datum/Projection:  
GDA 1994 MGA Zone 55

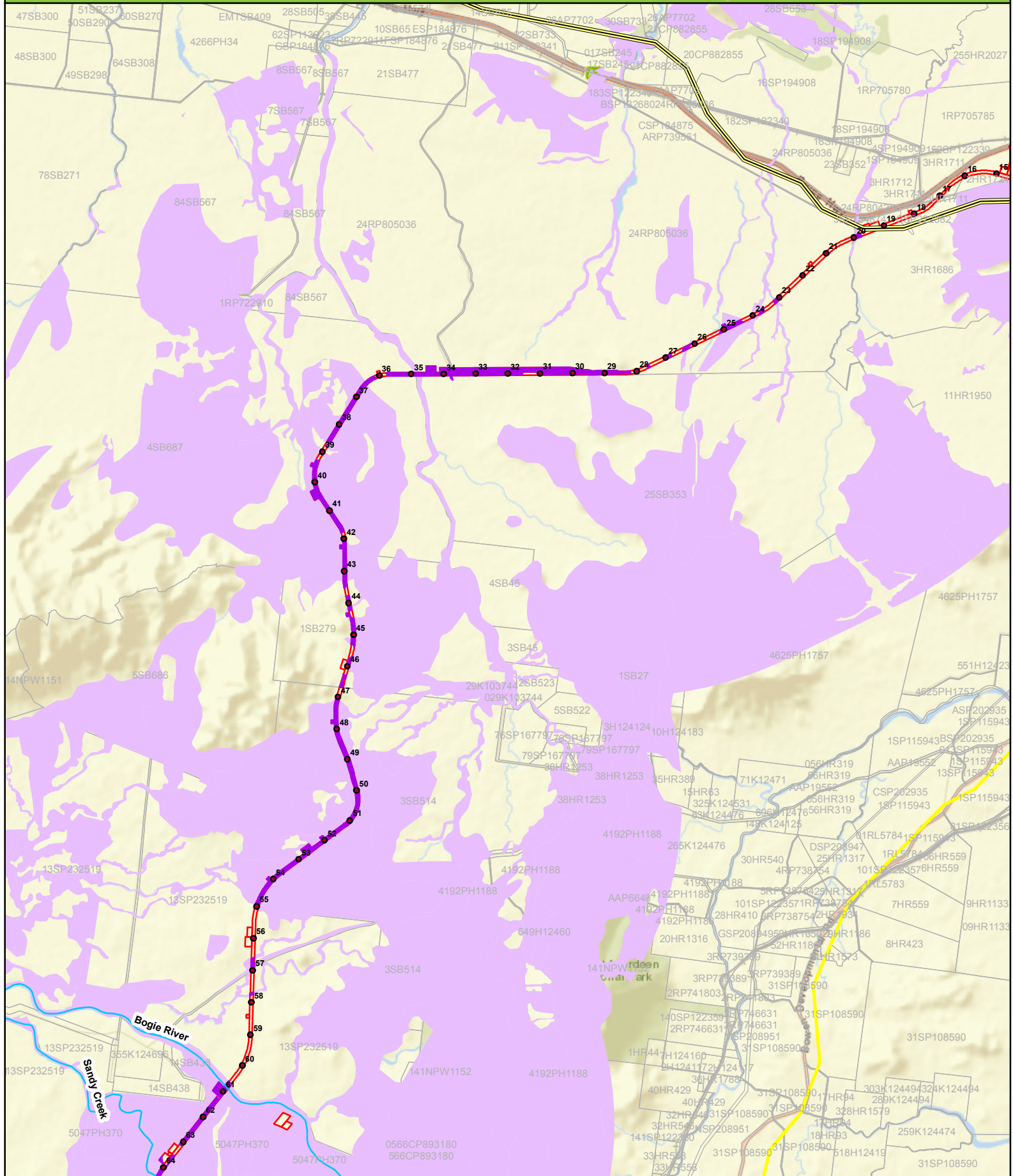
N

Data Sources: Adani Mining, QLD Gov  
Imagery: Bing Maps

**eco logical**  
AUSTRALIA

[www.ecoaus.com.au](http://www.ecoaus.com.au)

# Likely and Potential Black-throated Finch habitat within the Project Area: Map 9



**Legend**

- Carmichael Rail Network
- Kilometre Points
- State Road
- Local Road
- Major Watercourse
- Property Boundary
- Known Black-Throated Finch Locations
- Likely Black-Throated Finch Habitat
- Potential Black-Throated Finch Habitat

0      2,250      4,500  
Meters

Datum/Projection:  
GDA 1994 MGA Zone 55

Data Sources: Adani Mining, QLD Gov  
Imagery: Bing Maps

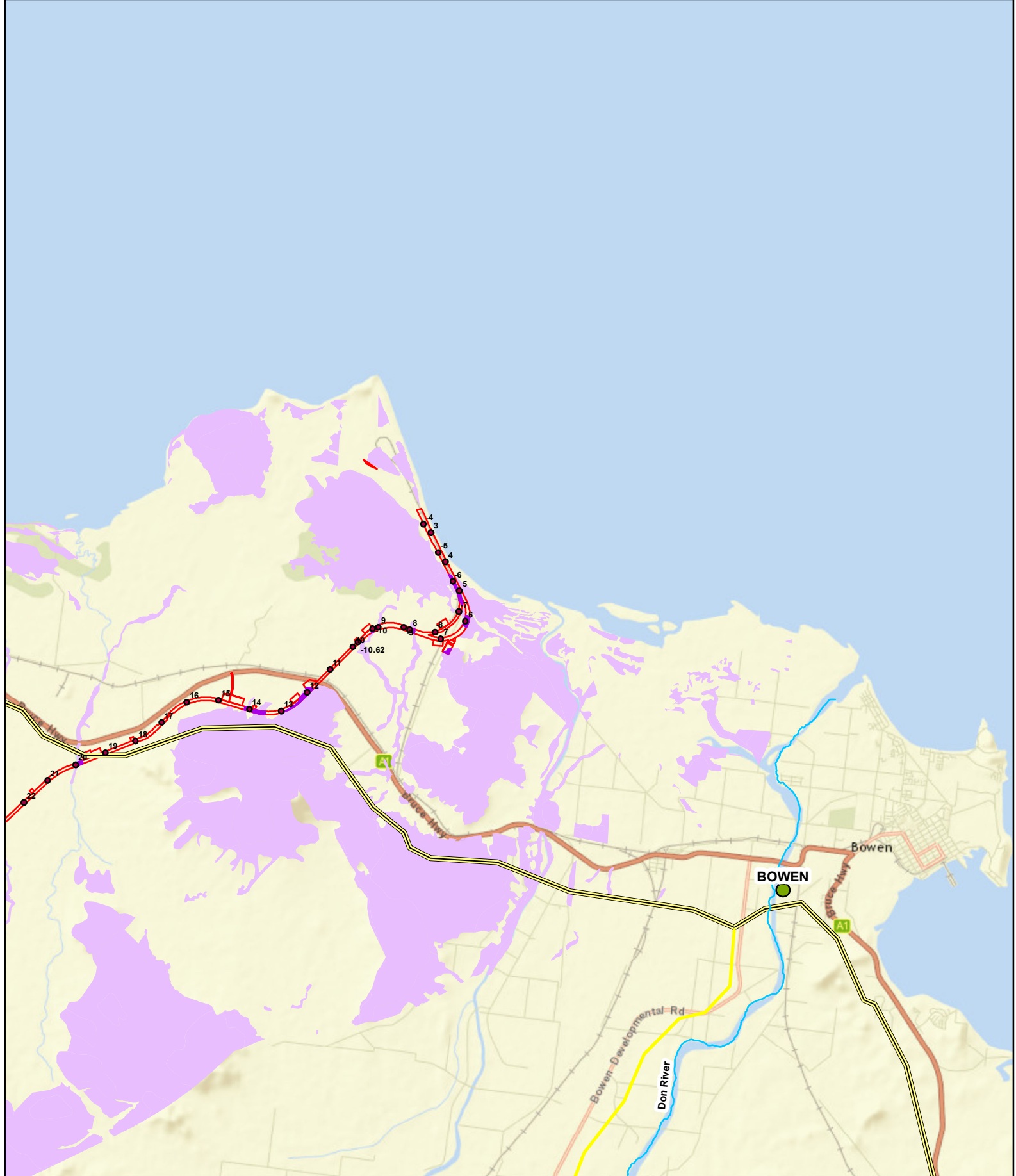
eco  
logical

AUSTRALIA

www.ecoaus.com.au



# Likely and Potential Black-throated Finch habitat within the Project Area: Map 10



**Legend**

- Carmichael Rail Network
- Kilometre Points
- State Road
- Local Road
- Major Watercourse
- Known Black-Throated Finch Locations
- Likely Black-Throated Finch Habitat
- Potential Black-Throated Finch Habitat

0      2,250      4,500  
Meters

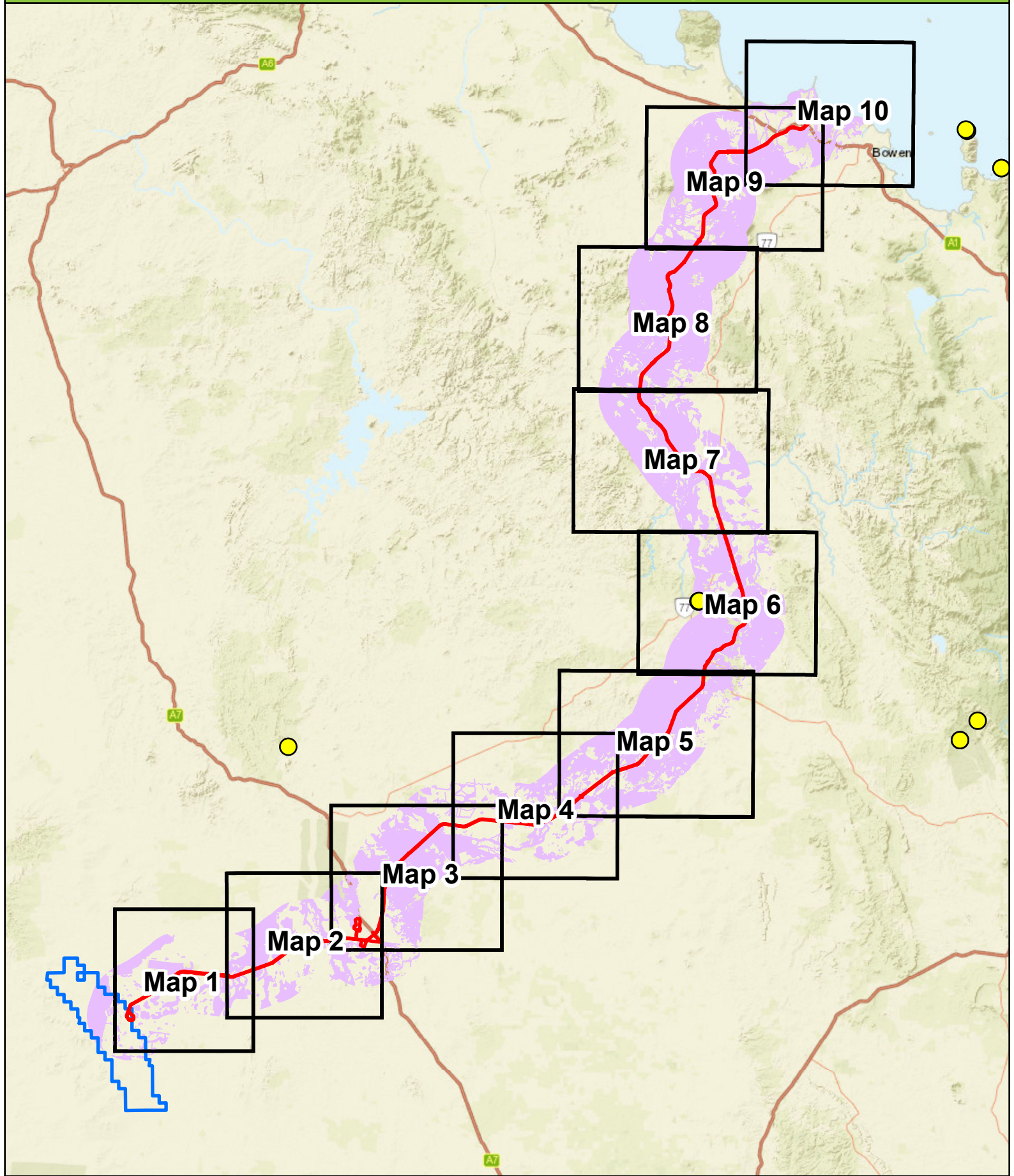
Datum/Projection:  
GDA 1994 MGA Zone 55

N





Data Sources: Adani Mining, QLD Gov Imagery: Bing Maps

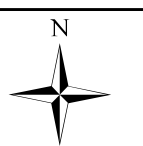
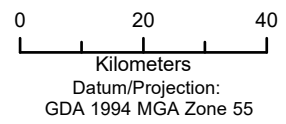
www.ecoaus.com.au

# Potential Common Death Adder Habitat Surrounding the Project Area



## Legend

-  Known Common Death Adder Locations
-  Carmichael Rail Network
-  Carmichael Mine
-  Potential Common Death Adder Habitat



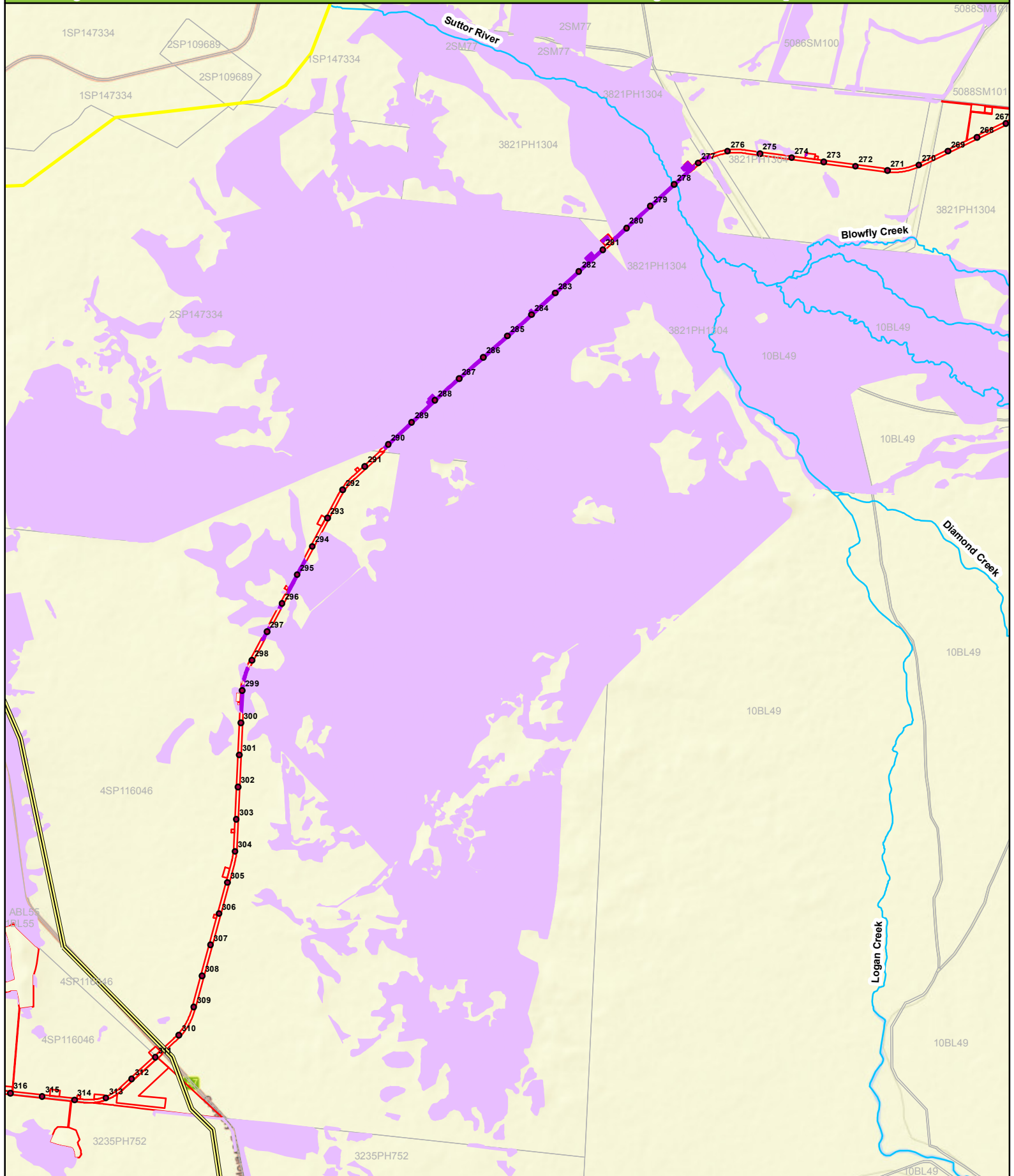
Data Sources: Adani Mining, QLD Gov  
Imagery: Bing Maps



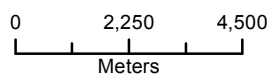
[www.ecoaus.com.au](http://www.ecoaus.com.au)



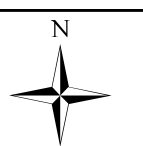
# Likely and Potential Common Death Adder habitat within the Project Area: Map 3



- Legend**
- Carmichael Rail Network
  - Kilometre Points
  - State Road
  - Local Road
  - Major Watercourse
  - Property Boundary
  - Likely Common Death Adder Habitat
  - Potential Common Death Adder Habitat



Datum/Projection:  
GDA 1994 MGA Zone 55

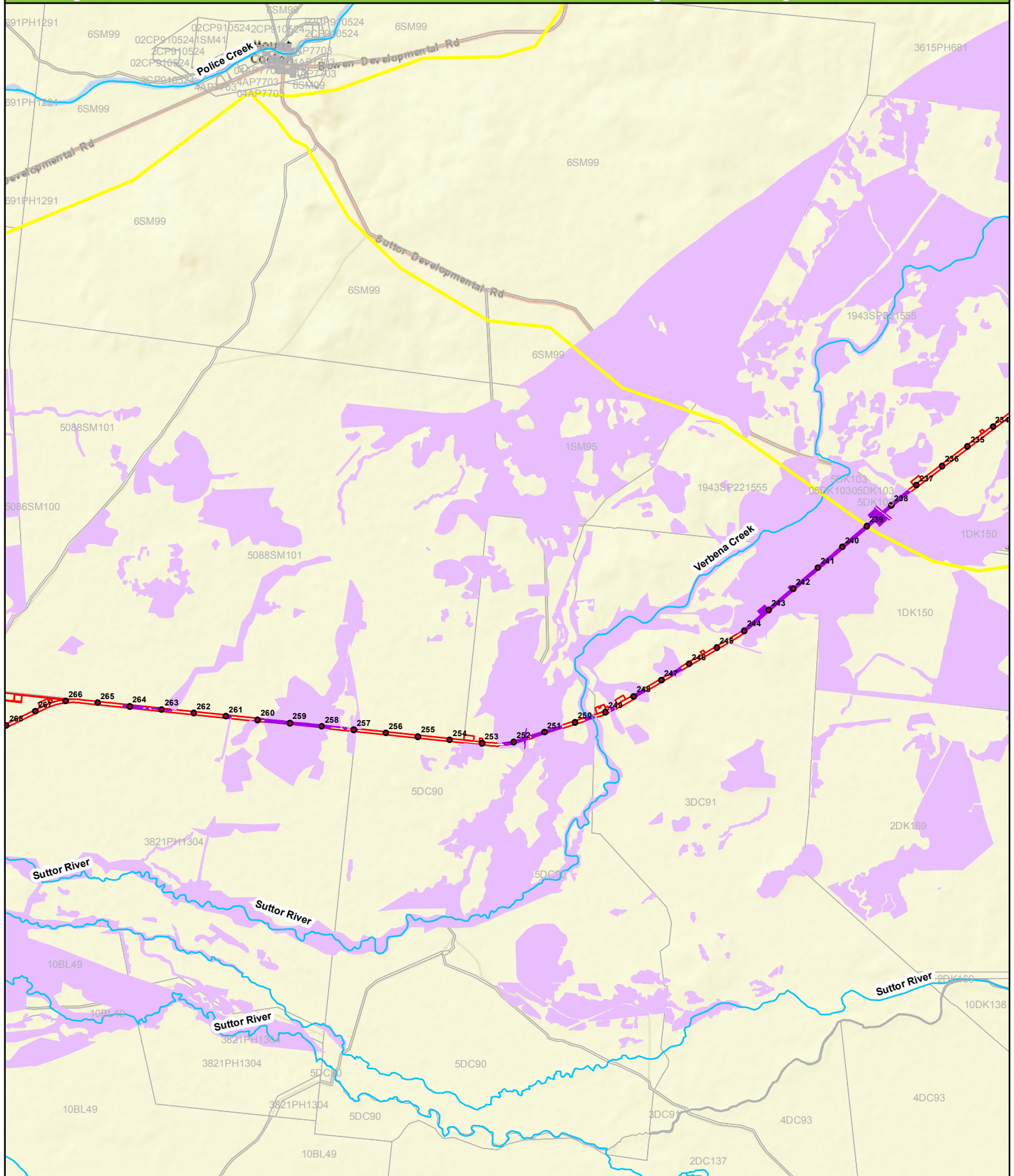


Data Sources: Adani Mining, QLD Gov Imagery: Bing Maps

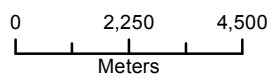


[www.ecoaus.com.au](http://www.ecoaus.com.au)

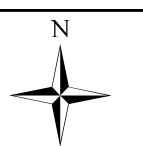
# Likely and Potential Common Death Adder habitat within the Project Area: Map 4



- Legend**
- Carmichael Rail Network
  - Kilometre Points
  - State Road
  - Local Road
  - Major Watercourse
  - Property Boundary
  - Likely Common Death Adder Habitat
  - Potential Common Death Adder Habitat



Datum/Projection:  
GDA 1994 MGA Zone 55



Data Sources: Adani Mining, QLD Gov Imagery: Bing Maps

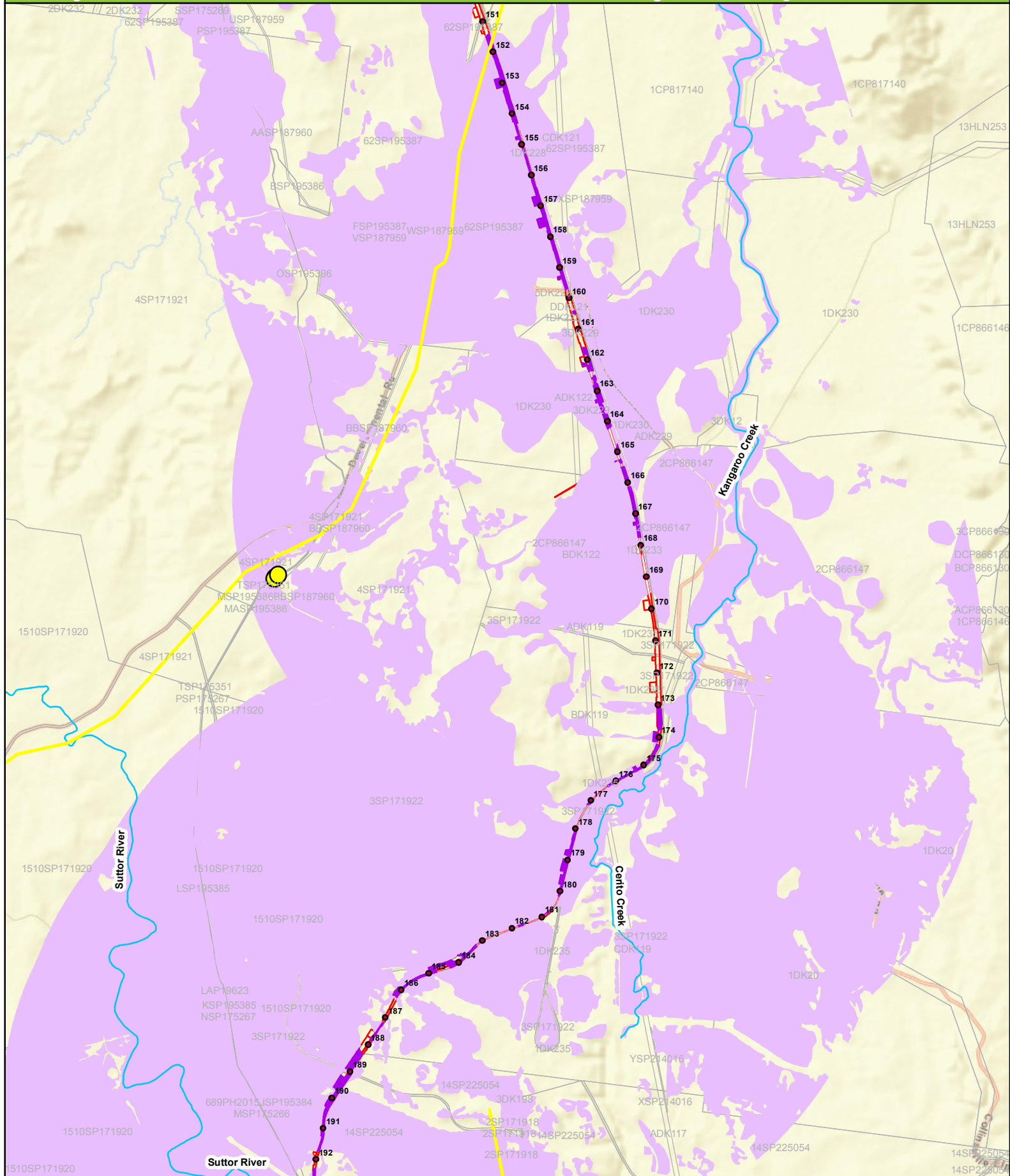


[www.ecoaus.com.au](http://www.ecoaus.com.au)

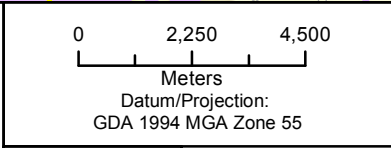




# Likely and Potential Common Death Adder habitat within the Project Area: Map 6



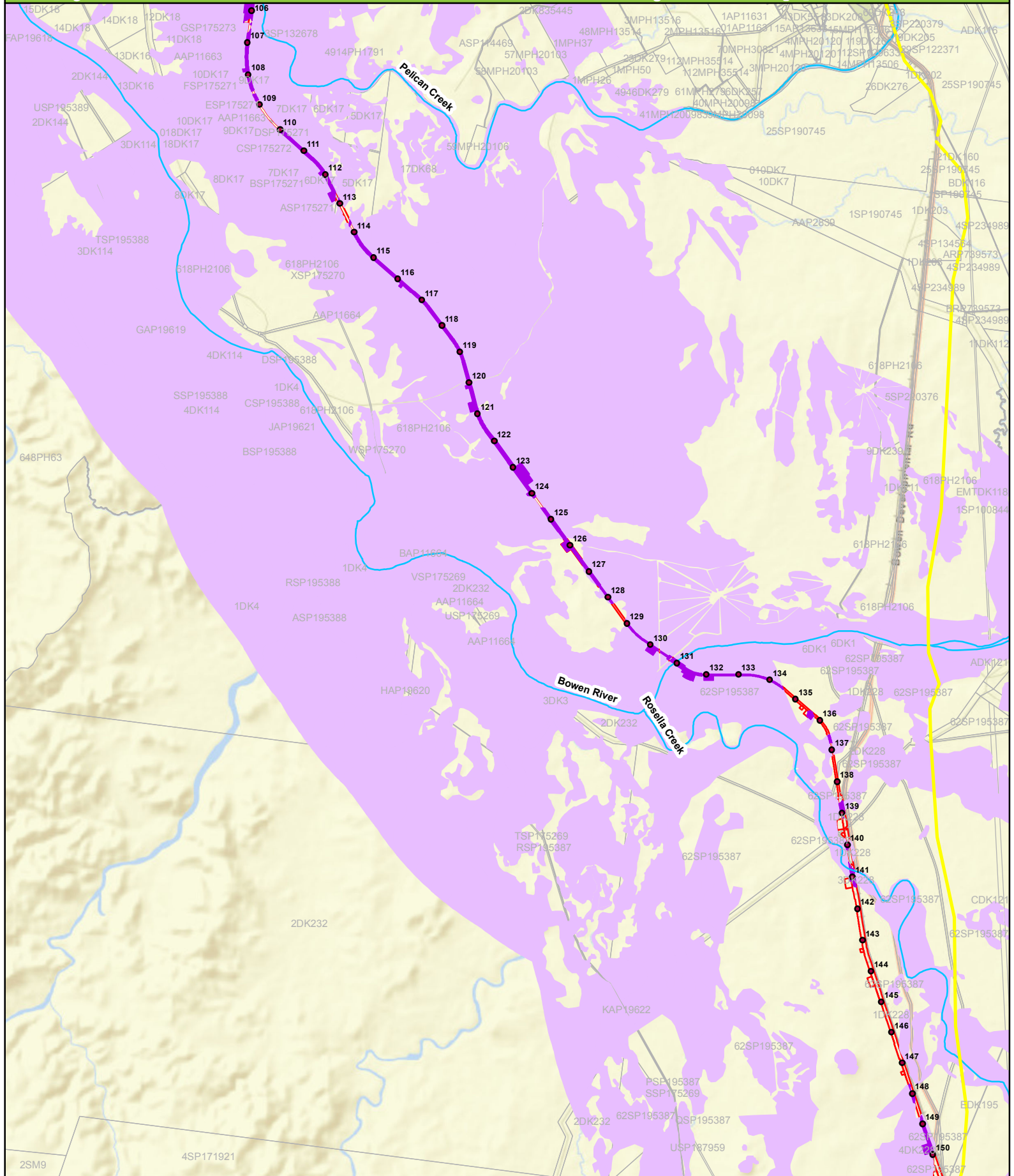
- Legend**
- Carmichael Rail Network
  - Kilometre Points
  - State Road
  - Local Road
  - Major Watercourse
  - Property Boundary
  - Known Common Death Adder Locations
  - Likely Common Death Adder Habitat
  - Potential Common Death Adder Habitat



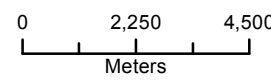
Data Sources: Adani Mining, QLD Gov  
Imagery: Bing Maps



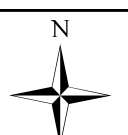
# Likely and Potential Common Death Adder habitat within the Project Area: Map 7



- Legend**
- Carmichael Rail Network
  - Kilometre Points
  - State Road
  - Local Road
  - Major Watercourse
  - Property Boundary
  - Likely Common Death Adder Habitat
  - Potential Common Death Adder Habitat



Datum/Projection:  
GDA 1994 MGA Zone 55

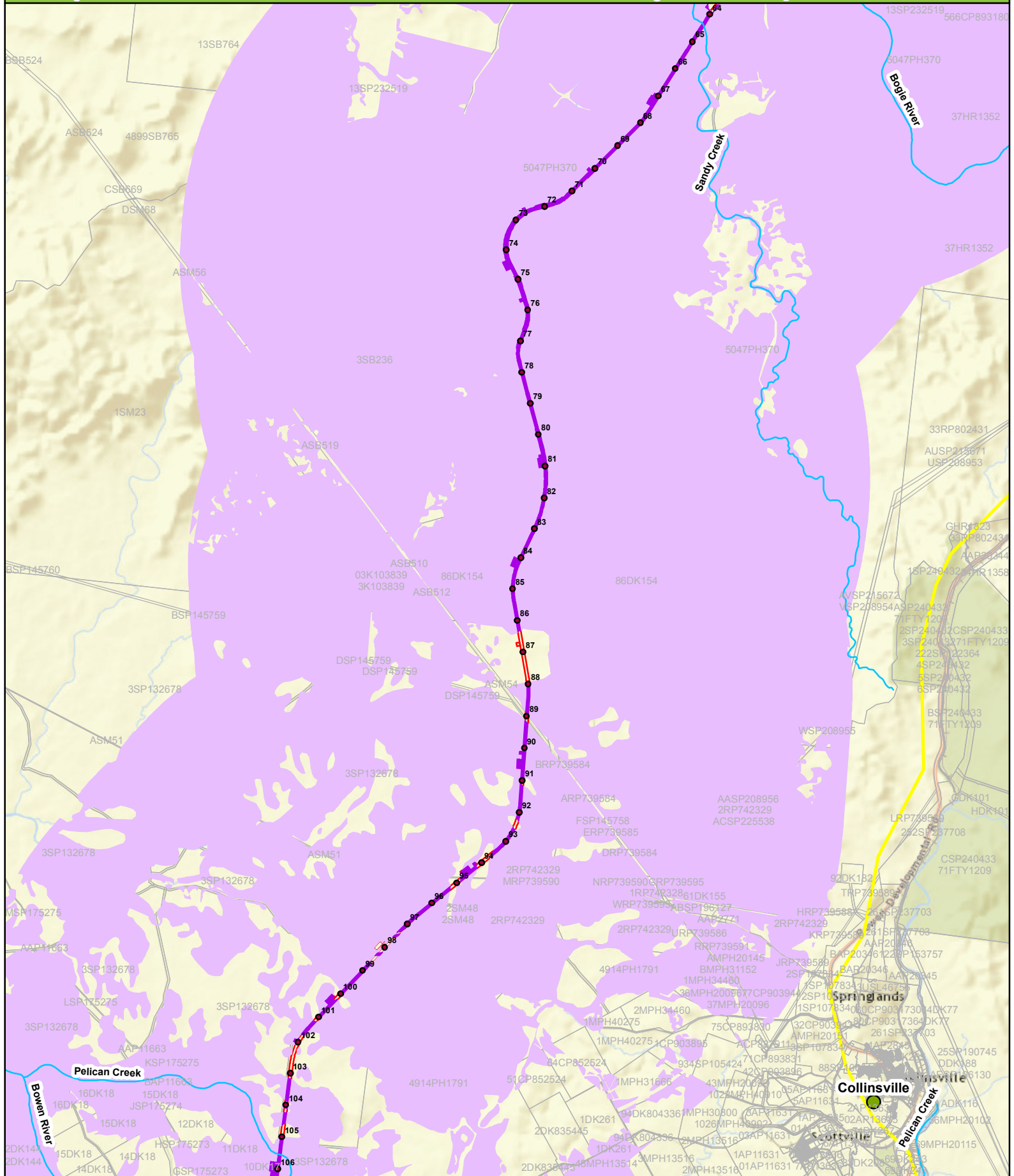


Data Sources: Adani Mining, QLD Gov Imagery: Bing Maps

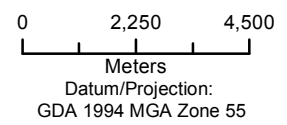


[www.ecoaus.com.au](http://www.ecoaus.com.au)

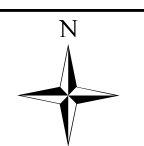
# Likely and Potential Common Death Adder habitat within the Project Area: Map 8



- Legend**
- Carmichael Rail Network
  - Kilometre Points
  - State Road
  - Local Road
  - Major Watercourse
  - Property Boundary
  - Likely Common Death Adder Habitat
  - Potential Common Death Adder Habitat



Datum/Projection:  
GDA 1994 MGA Zone 55



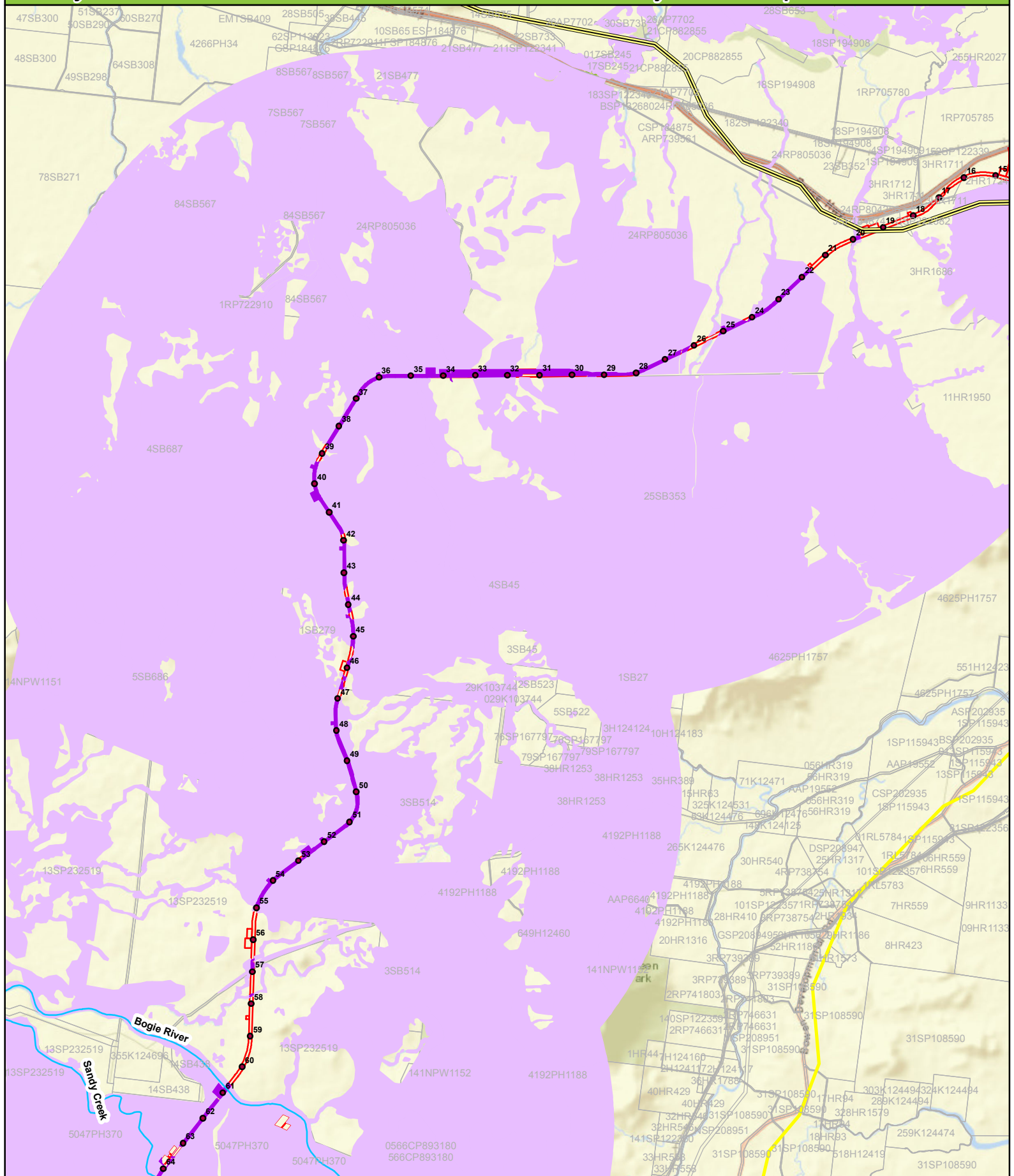
Data Sources: Adani Mining, QLD Gov  
Imagery: Bing Maps

**eco logical**  
AUSTRALIA

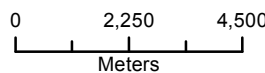
[www.ecoaus.com.au](http://www.ecoaus.com.au)



# Likely and Potential Common Death Adder habitat within the Project Area: Map 9



- Legend**
- Carmichael Rail Network
  - Kilometre Points
  - State Road
  - Local Road
  - Major Watercourse
  - Property Boundary
  - Likely Common Death Adder Habitat
  - Potential Common Death Adder Habitat



Datum/Projection:  
GDA 1994 MGA Zone 55

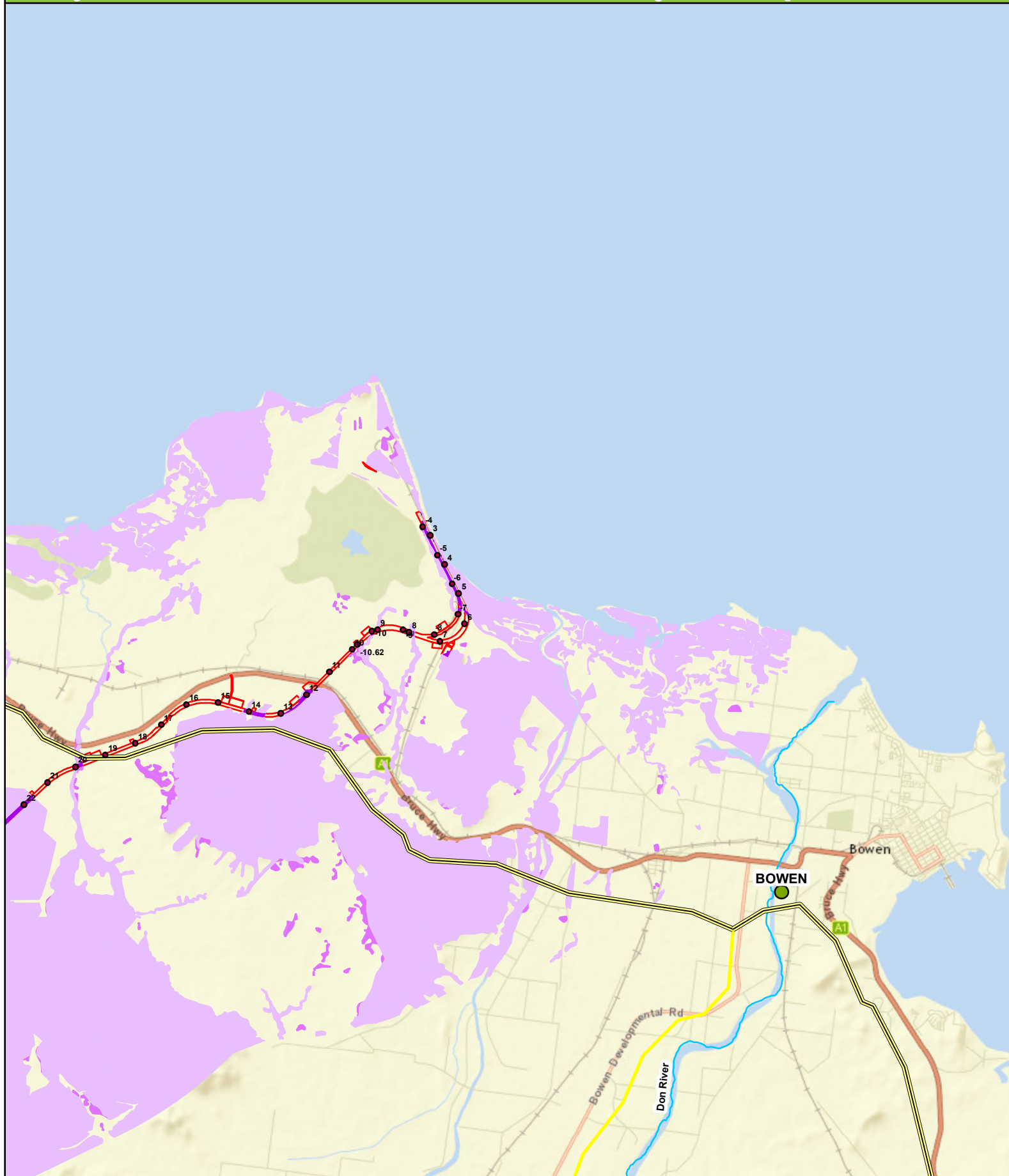


Data Sources: Adani Mining, QLD Gov  
Imagery: Bing Maps

**eco logical**  
AUSTRALIA

[www.ecoaus.com.au](http://www.ecoaus.com.au)

Likely and Potential Common Death Adder habitat within the Project Area: Map 10



- Legend**
- Carmichael Rail Network
  - Kilometre Points
  - State Road
  - Local Road
  - Major Watercourse
  - Likely Common Death Adder Habitat
  - Potential Common Death Adder Habitat

0 2,250 4,500  
Meters

Datum/Projection:  
GDA 1994 MGA Zone 55



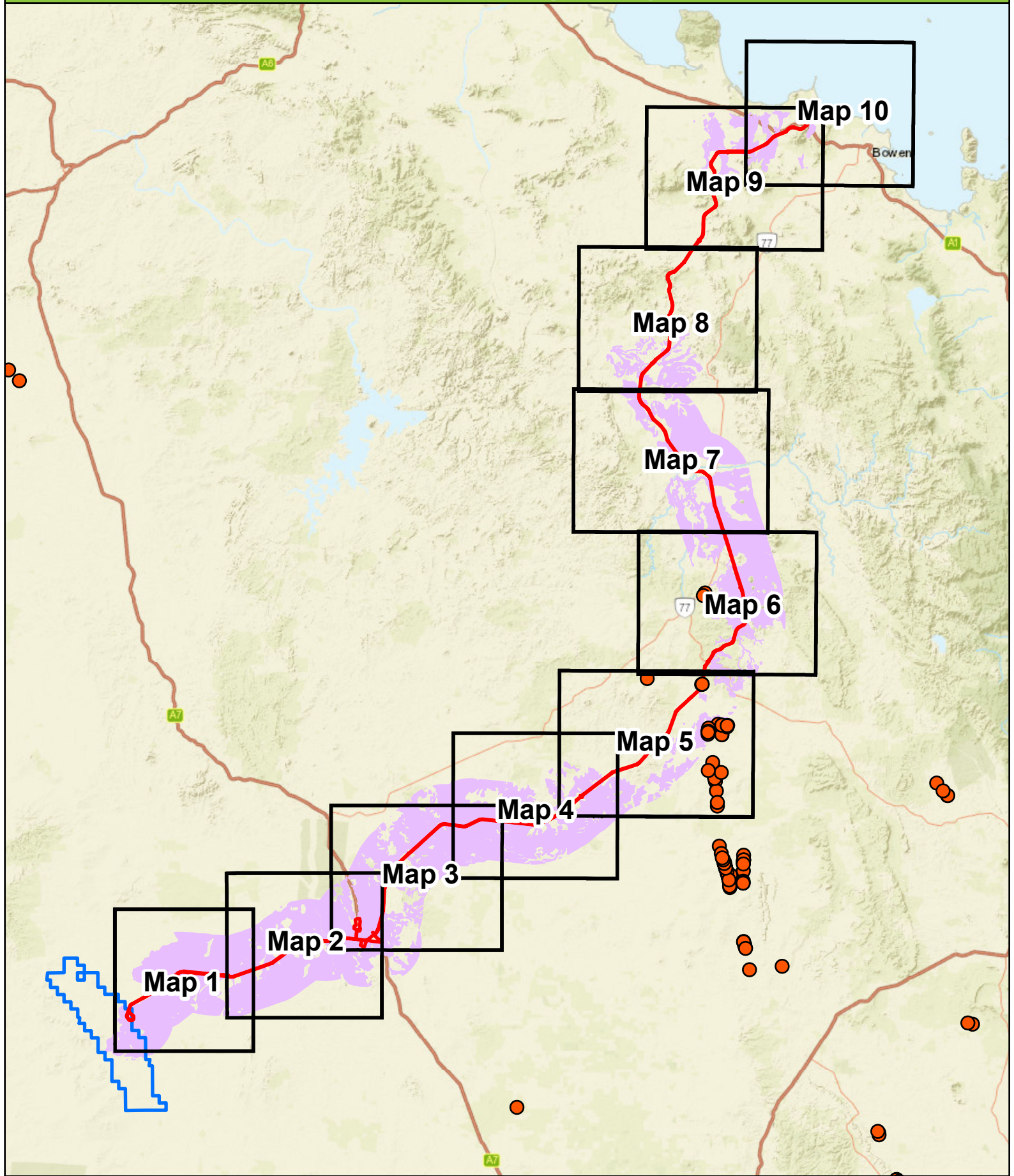
Data Sources: Adani Mining, QLD Gov Imagery: Bing Maps

**eco logical**  
AUSTRALIA

[www.ecoaus.com.au](http://www.ecoaus.com.au)

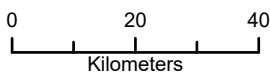


# Potential Ornamental Snake Habitat Surrounding the Project Area



## Legend

- Known Ornamental Snake Locations
- Carmichael Rail Network
- Carmichael Mine
- Potential Ornamental Snake Habitat



Datum/Projection:  
GDA 1994 MGA Zone 55

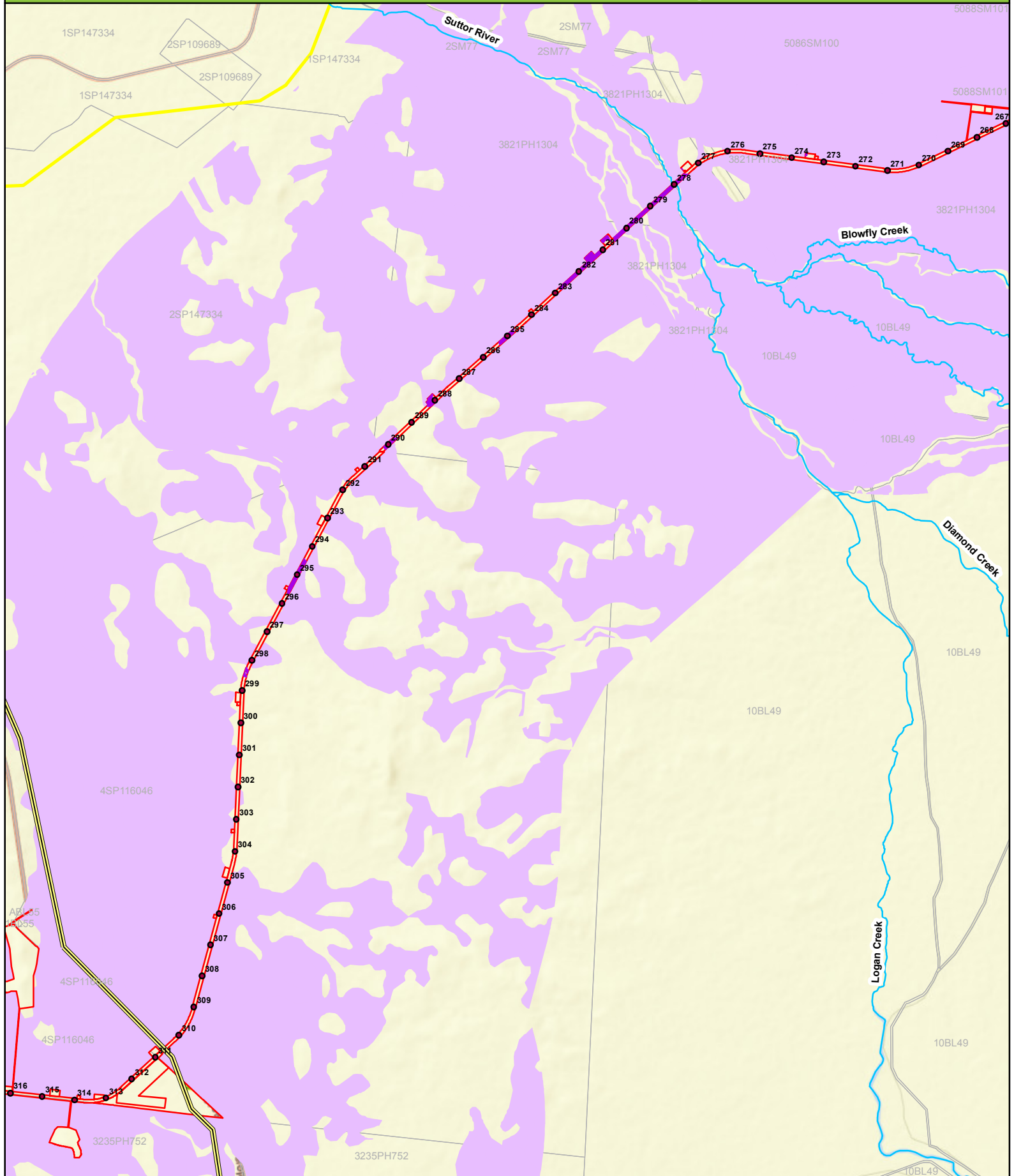


Data Sources: Adani Mining, QLD Gov  
Imagery: Bing Maps



[www.ecoaus.com.au](http://www.ecoaus.com.au)

# Likely and Potential Ornamental Snake habitat within the Project Area: Map 3



**Legend**

- Carmichael Rail Network
- Known Ornamental Snake Locations
- Kilometre Points
- Likely Ornamental Snake Habitat
- State Road
- Potential Ornamental Snake Habitat
- Local Road
- Major Watercourse
- Property Boundary

0 2,250 4,500  
Meters  
Datum/Projection:  
GDA 1994 MGA Zone 55

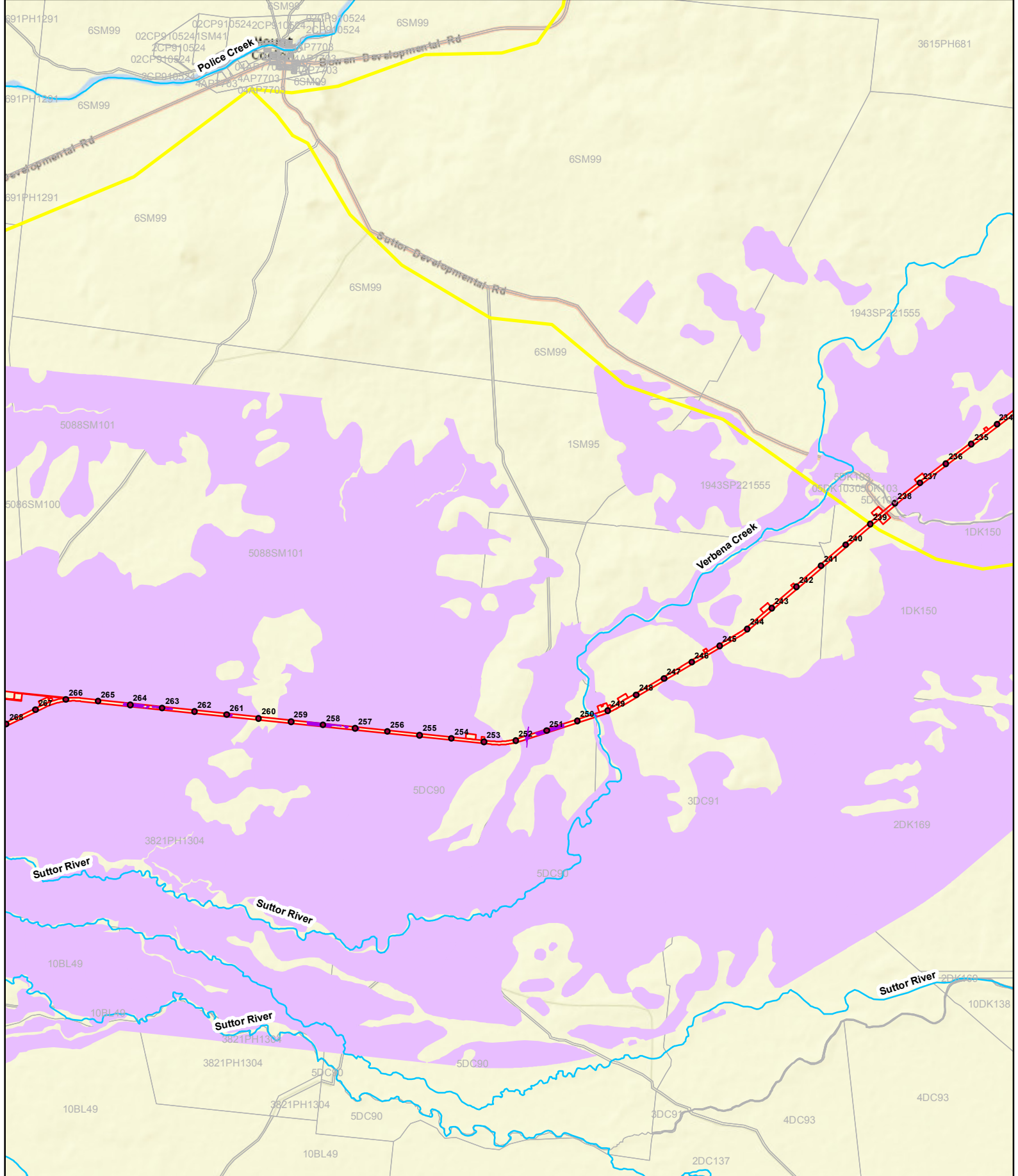
N

**eco  
logical**  
AUSTRALIA

[www.ecoaus.com.au](http://www.ecoaus.com.au)



# Likely and Potential Ornamental Snake habitat within the Project Area: Map 4

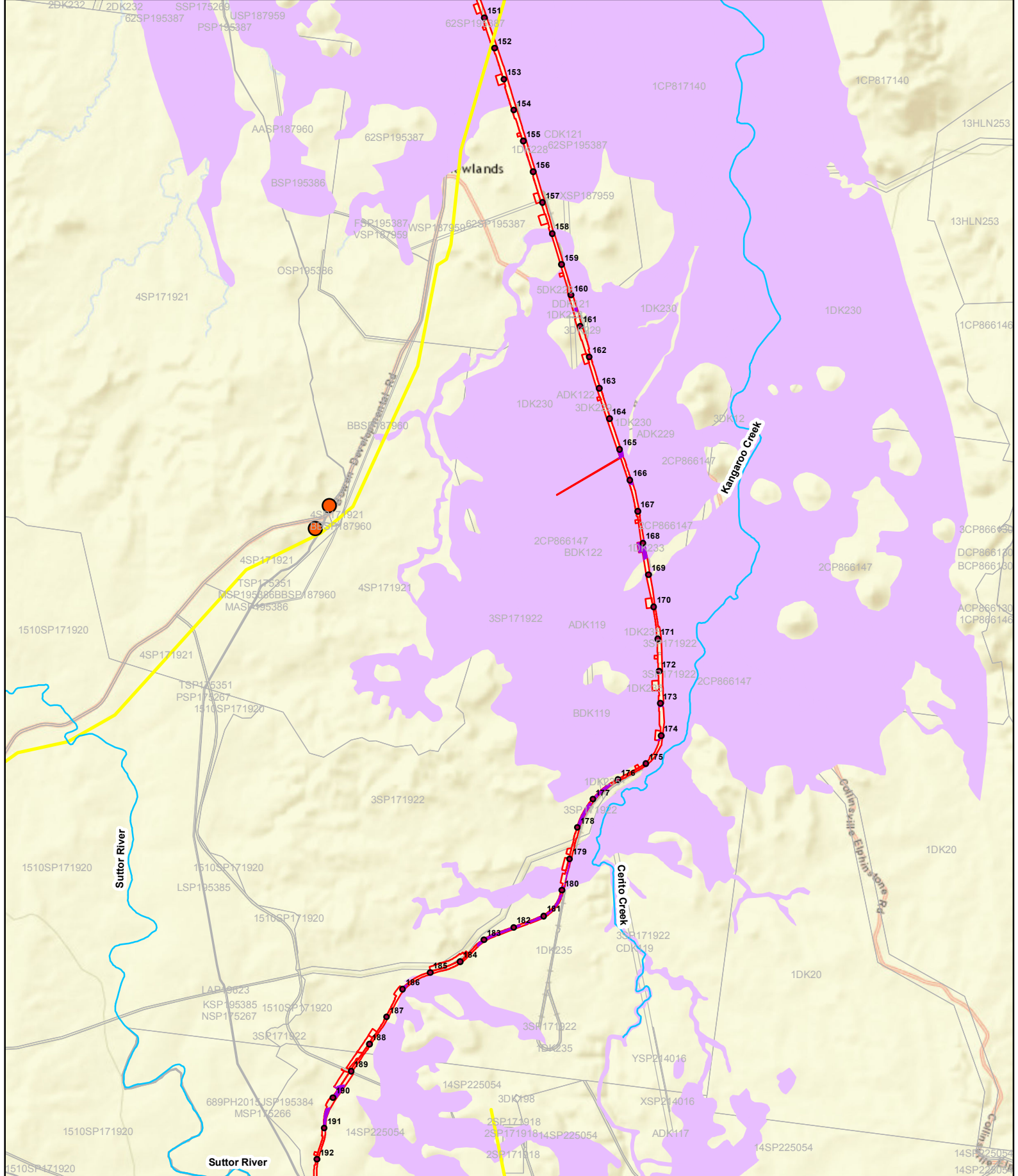


<b>Legend</b> Carmichael Rail Network Kilometre Points State Road Local Road Major Watercourse Property Boundary		Known Ornamental Snake Locations Likely Ornamental Snake Habitat Potential Ornamental Snake Habitat		0      2,250      4,500 Meters Datum/Projection: GDA 1994 MGA Zone 55		 www.ecoaus.com.au
				Data Sources: Adani Mining, QLD Gov Imagery: Bing Maps		





# Likely and Potential Ornamental Snake habitat within the Project Area: Map 6



**Legend**

- Carmichael Rail Network
- Known Ornamental Snake Locations
- Kilometre Points
- Likely Ornamental Snake Habitat
- State Road
- Potential Ornamental Snake Habitat
- Local Road
- Major Watercourse
- Property Boundary

0      2,250      4,500  
Meters

Datum/Projection:  
GDA 1994 MGA Zone 55

N

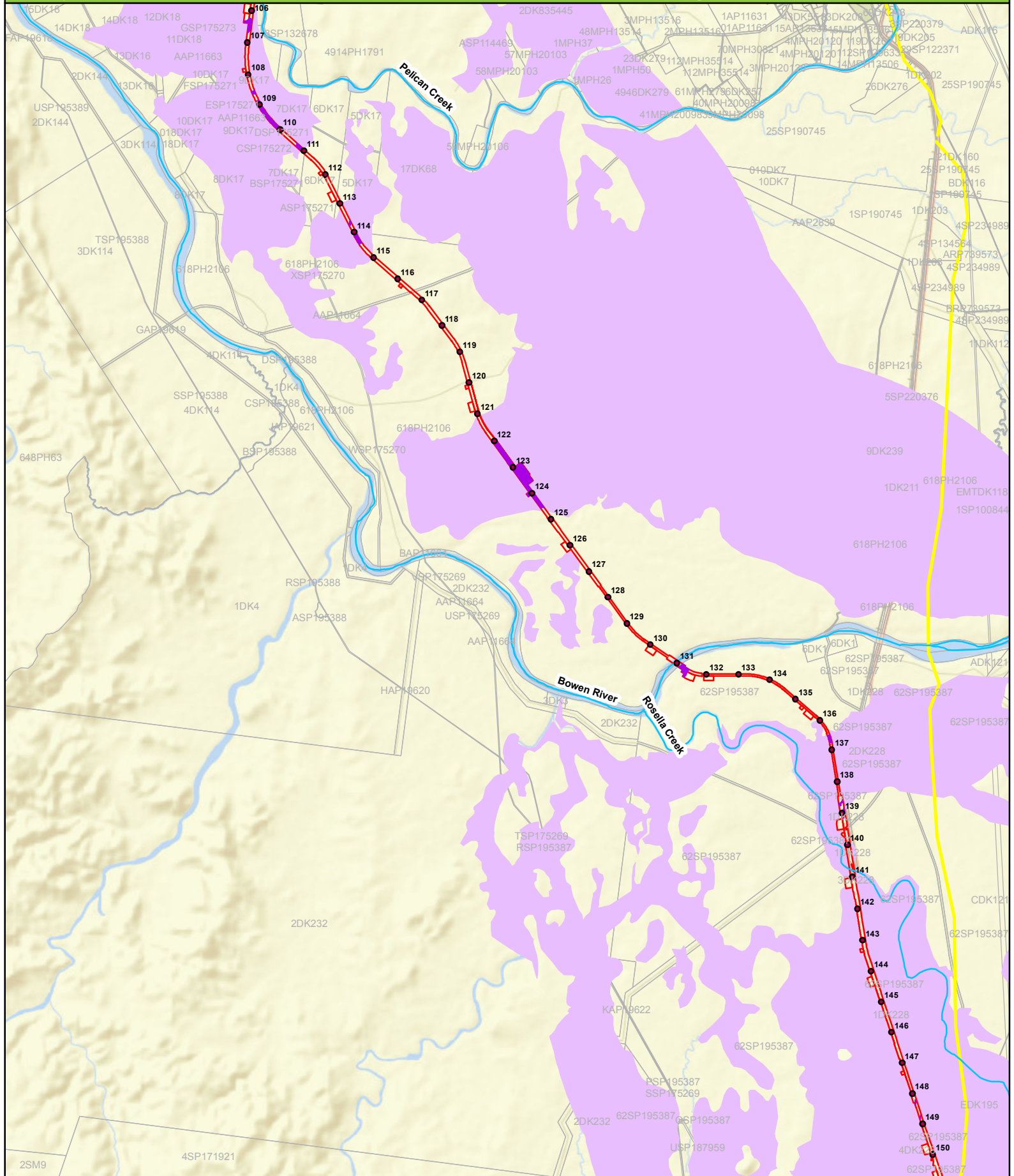
Data Sources: Adani Mining, QLD Gov  
Imagery: Bing Maps

eco  
logical

AUSTRALIA

www.ecoaus.com.au

# Likely and Potential Ornamental Snake habitat within the Project Area: Map 7



**Legend**

- Carmichael Rail Network
- Known Ornamental Snake Locations
- Kilometre Points
- Likely Ornamental Snake Habitat
- State Road
- Potential Ornamental Snake Habitat
- Local Road
- Major Watercourse
- Property Boundary

0 2,250 4,500  
Meters

Datum/Projection:  
GDA 1994 MGA Zone 55

N

Data Sources: Adani Mining, QLD Gov Imagery: Bing Maps

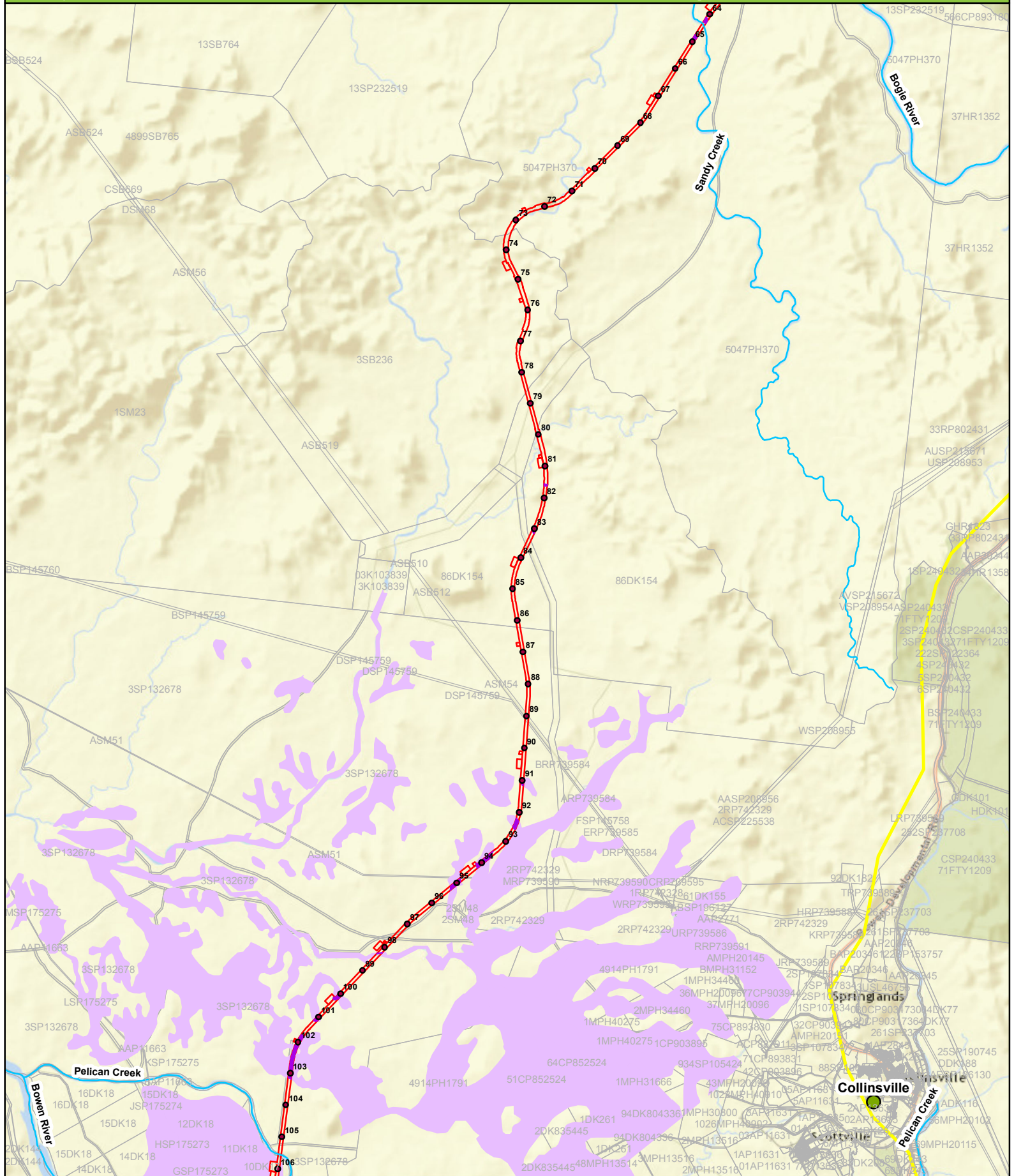
eco  
logical


AUSTRALIA

www.ecoaus.com.au



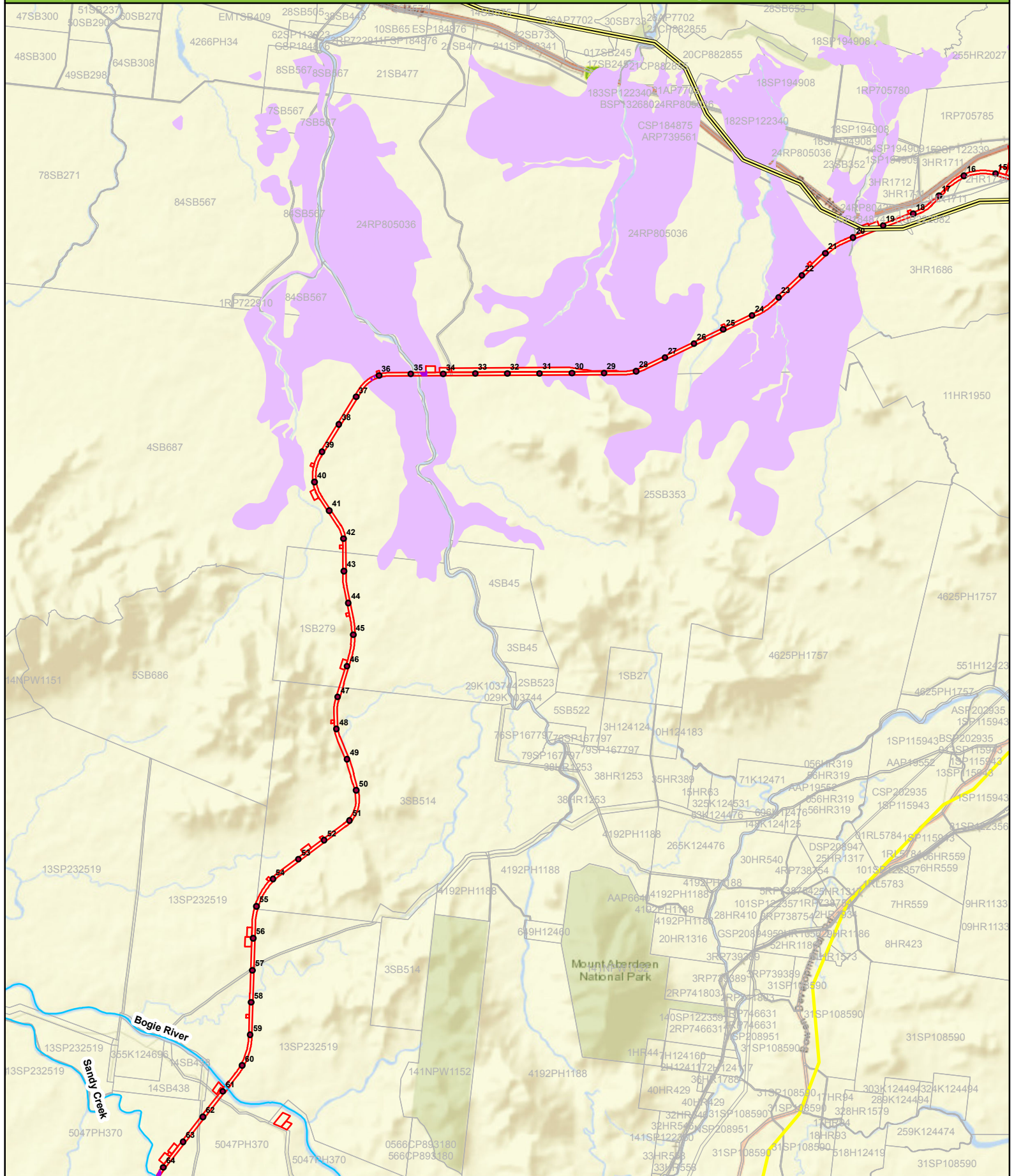
# Likely and Potential Ornamental Snake habitat within the Project Area: Map 8



<b>Legend</b> <ul style="list-style-type: none"> <li><span style="border: 1px solid red; display: inline-block; width: 15px; height: 10px; margin-right: 5px;"></span> Carmichael Rail Network</li> <li><span style="display: inline-block; width: 10px; height: 10px; border: 1px solid black; border-radius: 50%; margin-right: 5px;"></span> Kilometre Points</li> <li><span style="border-bottom: 2px solid black; width: 20px; margin-right: 5px;"></span> State Road</li> <li><span style="border-bottom: 2px solid yellow; width: 20px; margin-right: 5px;"></span> Local Road</li> <li><span style="border-bottom: 2px solid blue; width: 20px; margin-right: 5px;"></span> Major Watercourse</li> <li><span style="border-bottom: 1px solid gray; width: 20px; margin-right: 5px;"></span> Property Boundary</li> <li><span style="display: inline-block; width: 10px; height: 10px; background-color: orange; border-radius: 50%; margin-right: 5px;"></span> Known Ornamental Snake Locations</li> <li><span style="display: inline-block; width: 15px; height: 15px; background-color: purple; margin-right: 5px;"></span> Likely Ornamental Snake Habitat</li> <li><span style="display: inline-block; width: 15px; height: 15px; background-color: lightpurple; margin-right: 5px;"></span> Potential Ornamental Snake Habitat</li> </ul>		<p>0      2,250      4,500</p> <p>Meters</p> <p>Datum/Projection: GDA 1994 MGA Zone 55</p>	 <a href="http://www.ecoaus.com.au">www.ecoaus.com.au</a>
<p><b>Legend</b></p> <p><span style="display: inline-block; width: 15px; height: 15px; background-color: white; border: 1px solid black; margin-right: 5px;"></span> North Arrow</p> <p>Data Sources: Adani Mining, QLD Gov Imagery: Bing Maps</p>			



# Likely and Potential Ornamental Snake habitat within the Project Area: Map 9



**Legend**

- Carmichael Rail Network
- Kilometre Points
- State Road
- Local Road
- Major Watercourse
- Property Boundary
- Known Ornamental Snake Locations
- Likely Ornamental Snake Habitat
- Potential Ornamental Snake Habitat

0      2,250      4,500  
Meters

Datum/Projection:  
GDA 1994 MGA Zone 55

N

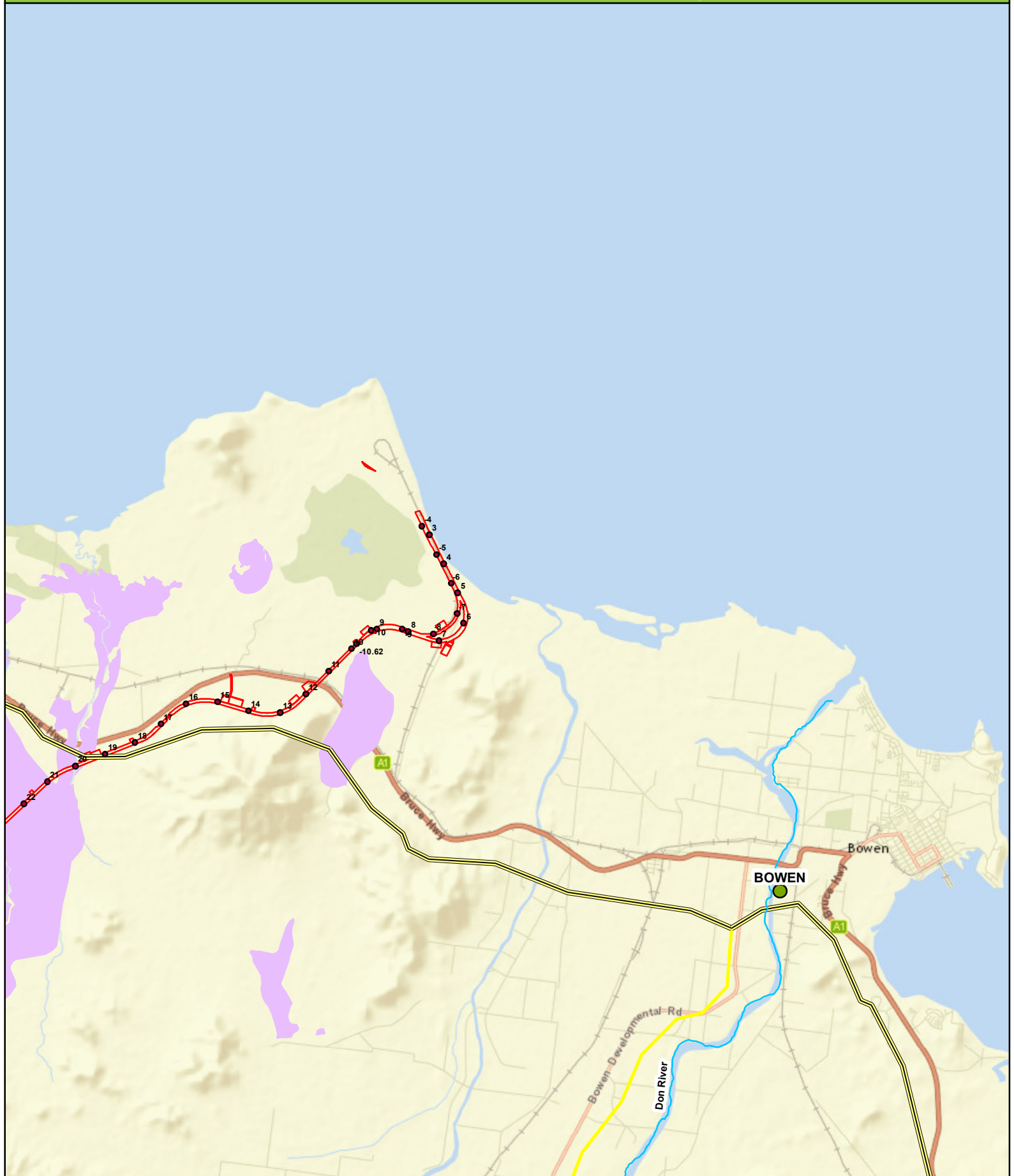
Data Sources: Adani Mining, QLD Gov  
Imagery: Bing Maps

eco  
logical

AUSTRALIA

www.ecoaus.com.au

# Likely and Potential Ornamental Snake habitat within the Project Area: Map 10



Legend	
Carmichael Rail Network	Known Ornamental Snake Locations
Kilometre Points	Likelily Ornamental Snake Habitat
State Road	Potential Ornamental Snake Habitat
Local Road	
Major Watercourse	

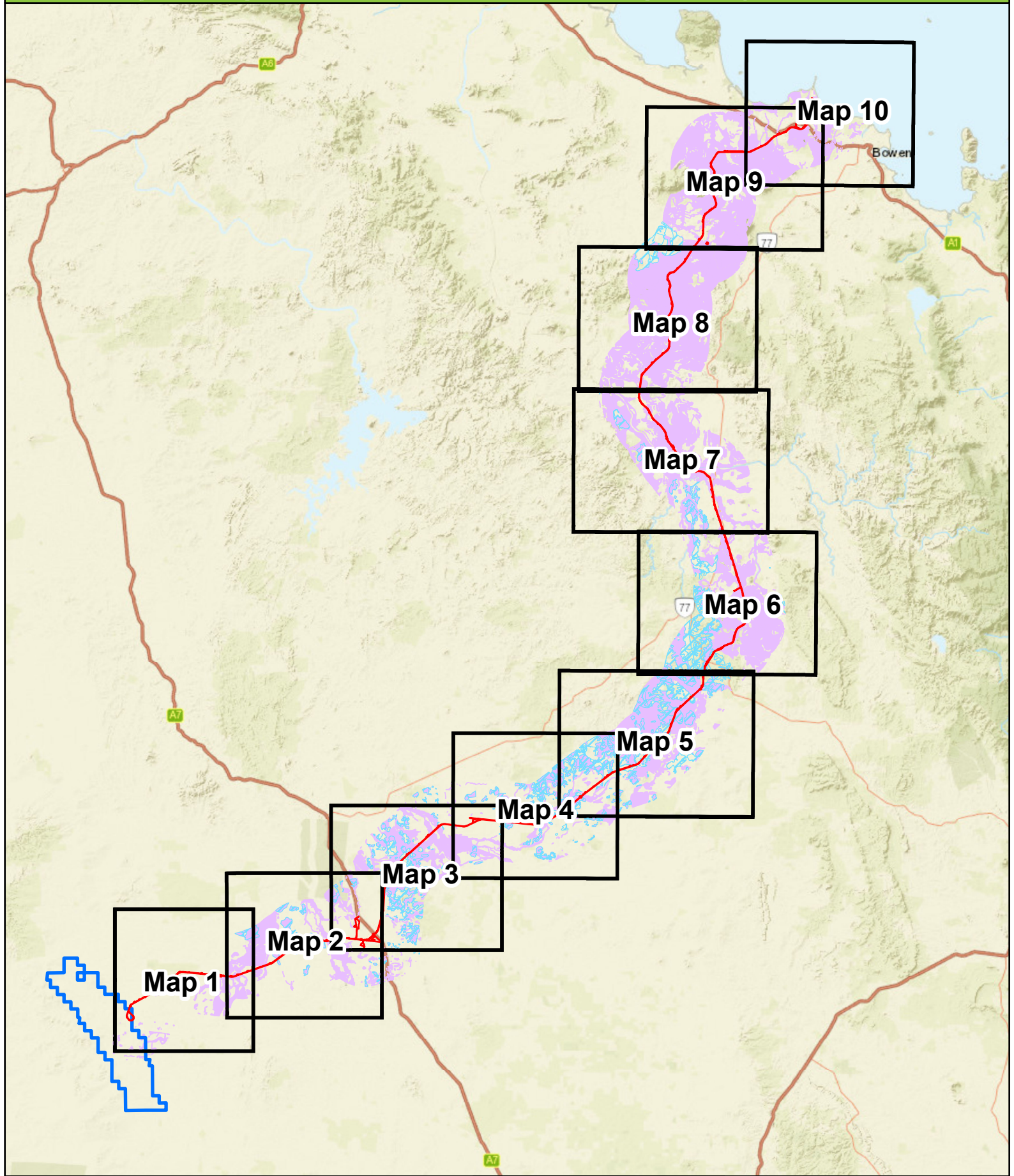
0 2,250 4,500  
Meters  
Datum/Projection:  
GDA 1994 MGA Zone 55

Data Sources: Adani Mining, QLD Gov Imagery: Bing Maps





www.ecoaus.com.au

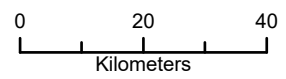


# Potential Squatter Pigeon and Koala Habitat Surrounding the Project Area



## Legend

-  Carmichael Mine
-  Carmichael Rail Network
-  Potential Squatter Pigeon Nesting Habitat
-  Potential Koala Habitat



Datum/Projection:  
GDA 1994 MGA Zone 55



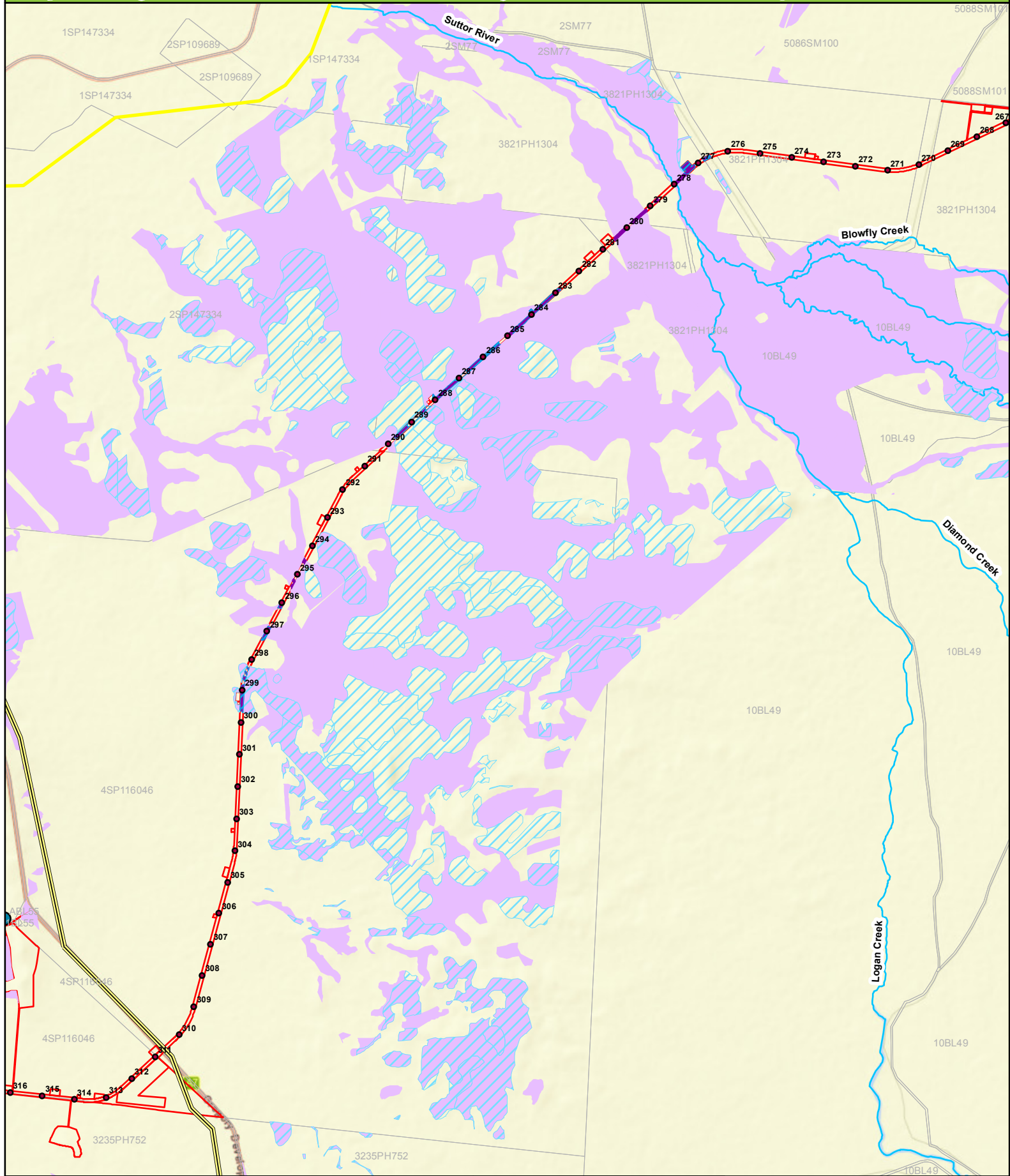
Data Sources: Adani Mining, QLD Gov  
Imagery: Bing Maps



[www.ecoaus.com.au](http://www.ecoaus.com.au)

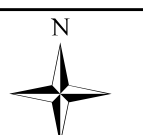
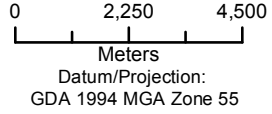


# Squatter Pigeon and Koala habitat within the Project Area and surrounds: Map 3



- Legend**
- Carmichael Rail Network
  - Kilometre Points
  - State Road
  - Local Road
  - Major Watercourse
  - Property Boundary
  - Known Locations
  - Squatter Pigeon
  - Koala

- Likely Habitat**
- Squatter Pigeon Nesting
  - Koala Habitat
- Potential Habitat**
- Squatter Pigeon Nesting
  - Koala Habitat



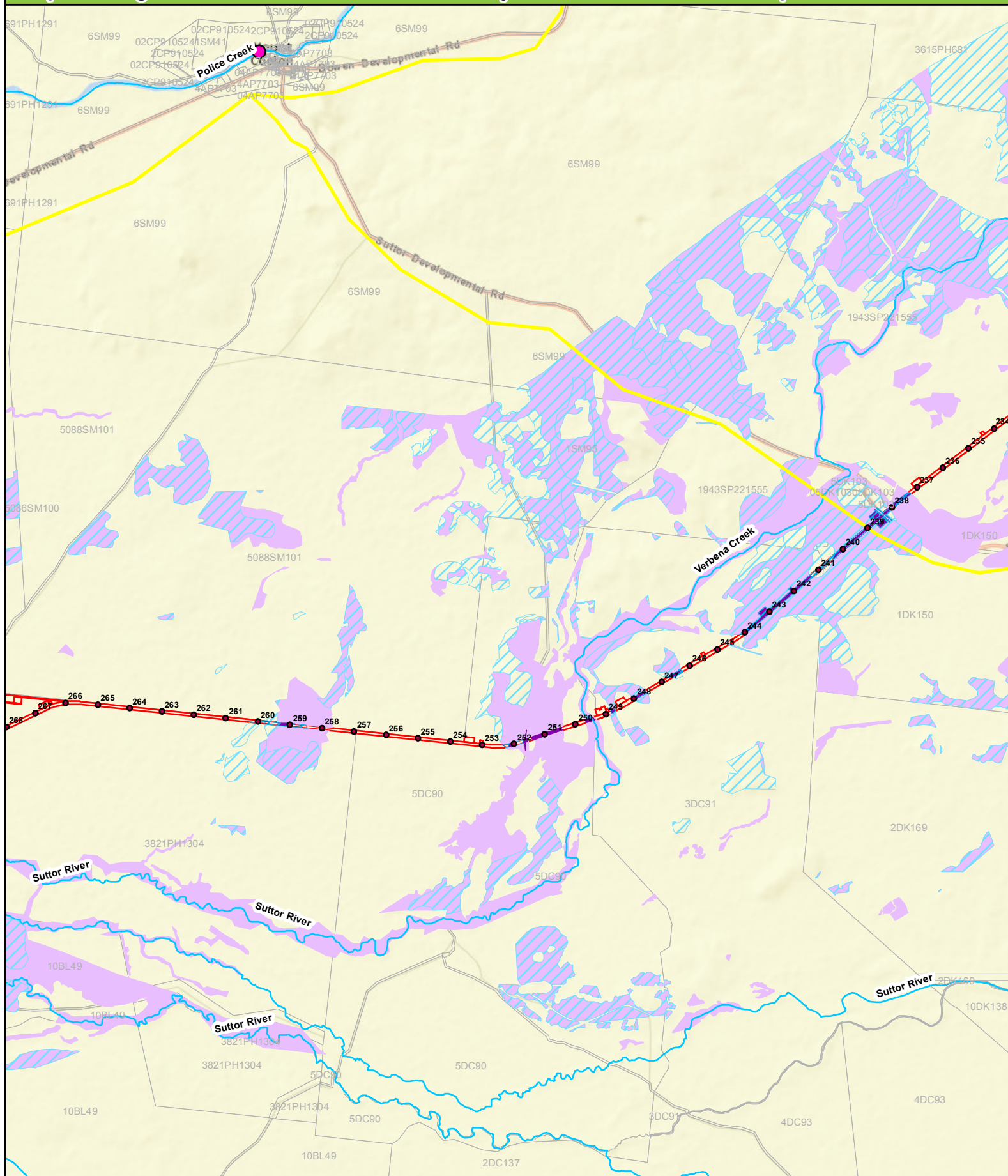
Data Sources: Adani Mining, QLD Gov  
Imagery: Bing Maps

eco  
logical

AUSTRALIA

www.ecoaus.com.au

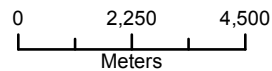
# Squatter Pigeon and Koala habitat within the Project Area and surrounds: Map 4



## Legend

- Carmichael Rail Network
- Kilometre Points
- State Road
- Local Road
- Major Watercourse
- Property Boundary
- Known Locations**
- Squatter Pigeon
- Koala

- Likely Habitat**
- Squatter Pigeon Nesting
- Koala Habitat
- Potential Habitat**
- Squatter Pigeon Nesting
- Koala Habitat



Datum/Projection:  
GDA 1994 MGA Zone 55

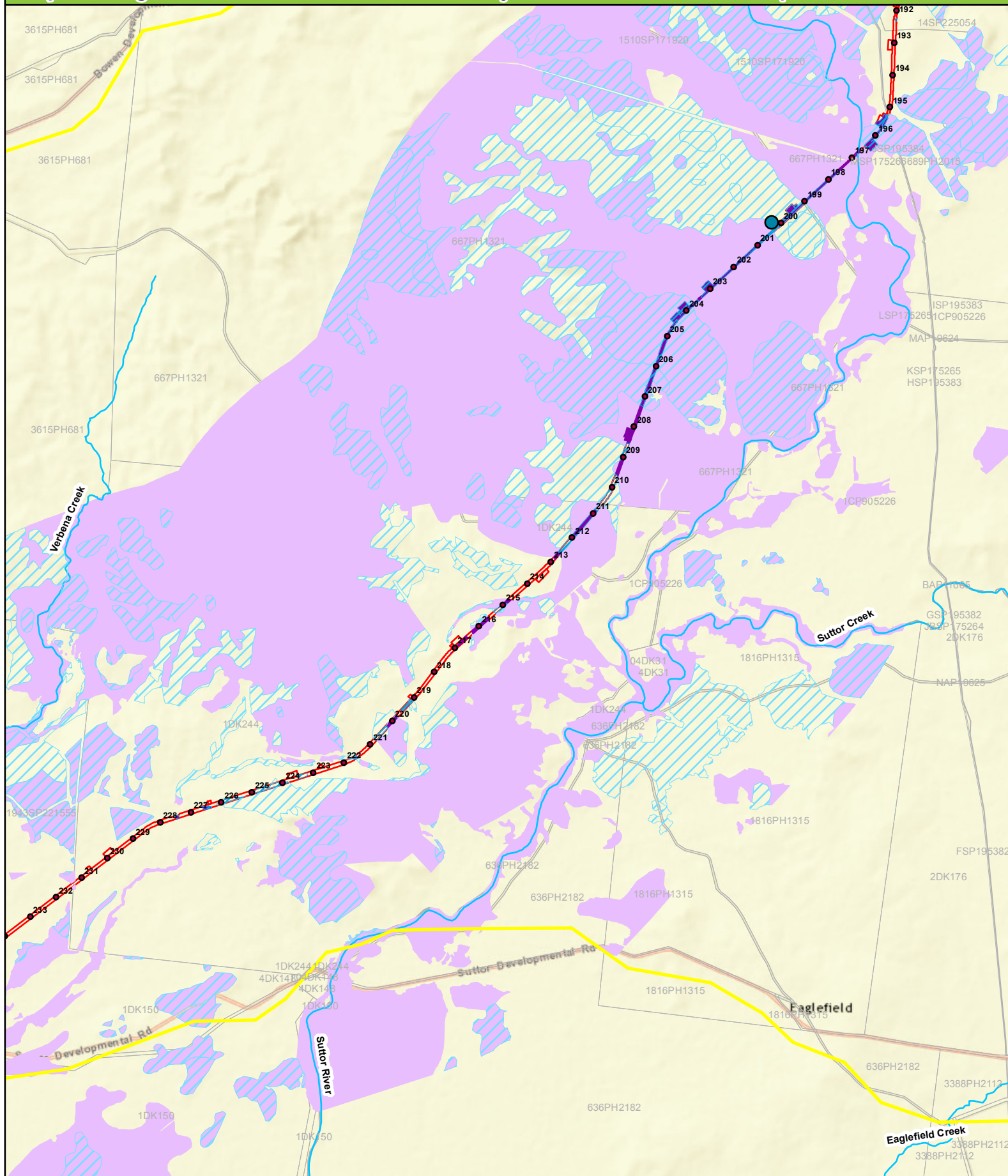


Data Sources: Adani Mining, QLD Gov  
Imagery: Bing Maps

**eco logical**  
AUSTRALIA  
[www.ecoaus.com.au](http://www.ecoaus.com.au)



# Squatter Pigeon and Koala habitat within the Project Area and surrounds: Map 5



## Legend

- Carmichael Rail Network
- Kilometre Points
- State Road
- Local Road
- Major Watercourse
- Property Boundary

### Known Locations

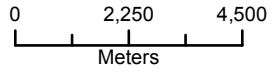
- Squatter Pigeon
- Koala

### Likely Habitat

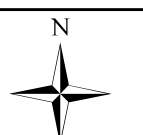
- Squatter Pigeon Nesting
- Koala Habitat

### Potential Habitat

- Squatter Pigeon Nesting
- Koala Habitat



Datum/Projection:  
GDA 1994 MGA Zone 55

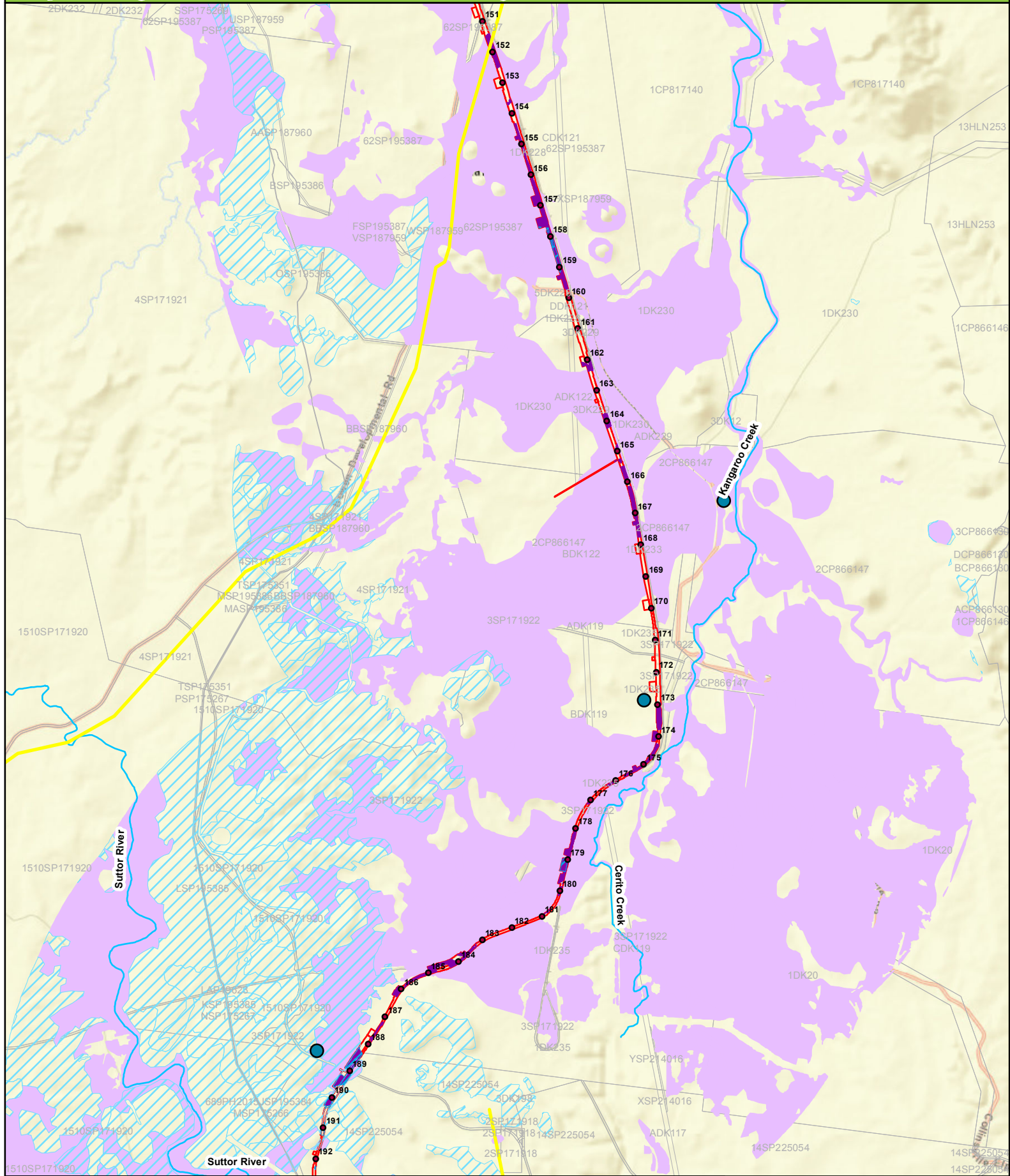


Data Sources: Adani Mining, QLD Gov  
Imagery: Bing Maps



[www.ecoaus.com.au](http://www.ecoaus.com.au)

# Squatter Pigeon and Koala habitat within the Project Area and surrounds: Map 6



- Legend**
- Carmichael Rail Network
  - Kilometre Points
  - State Road
  - Local Road
  - Major Watercourse
  - Property Boundary
  - Known Locations
  - Squatter Pigeon
  - Koala

- Likely Habitat**
- Squatter Pigeon Nesting
  - Koala Habitat
- Potential Habitat**
- Squatter Pigeon Nesting
  - Koala Habitat

0      2,250      4,500  
Meters

Datum/Projection:  
GDA 1994 MGA Zone 55

N

**eco logical**  
AUSTRALIA

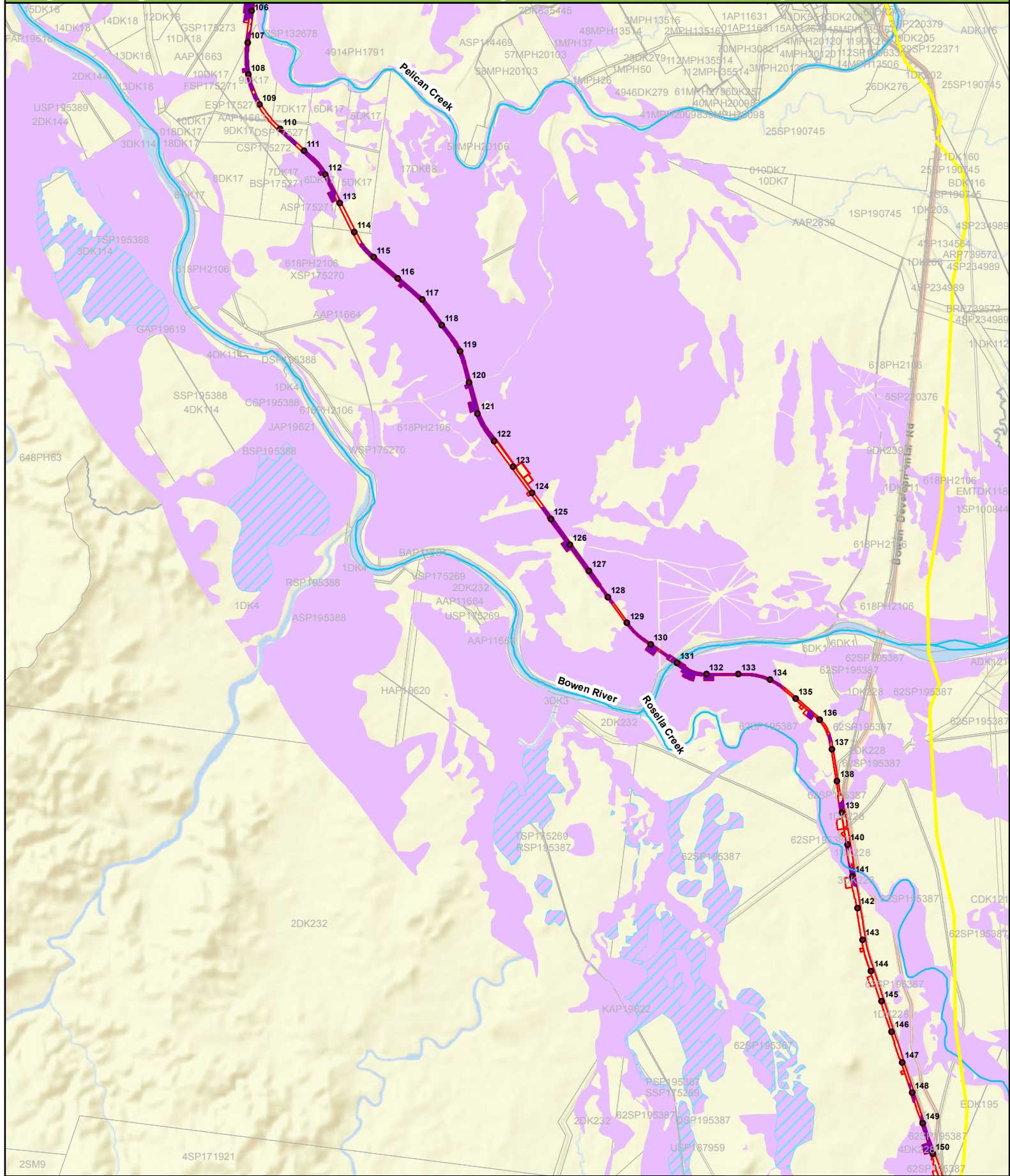
www.ecoaus.com.au

Data Sources: Adani Mining, QLD Gov  
Imagery: Bing Maps

© Eco Logical Australia Pty. Ltd. This map is not guaranteed to be free from error or omission. Eco Logical Australia Pty. Ltd. and its employees disclaim liability for any act done on the information in the map and any consequences of such acts or omissions.



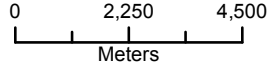
# Squatter Pigeon and Koala habitat within the Project Area and surrounds: Map 7



## Legend

- Carmichael Rail Network
- Kilometre Points
- State Road
- Local Road
- Major Watercourse
- Property Boundary
- Known Locations**
- Squatter Pigeon
- Koala

- Likely Habitat**
- Squatter Pigeon Nesting
- Koala Habitat
- Potential Habitat**
- Squatter Pigeon Nesting
- Koala Habitat



Datum/Projection:  
GDA 1994 MGA Zone 55

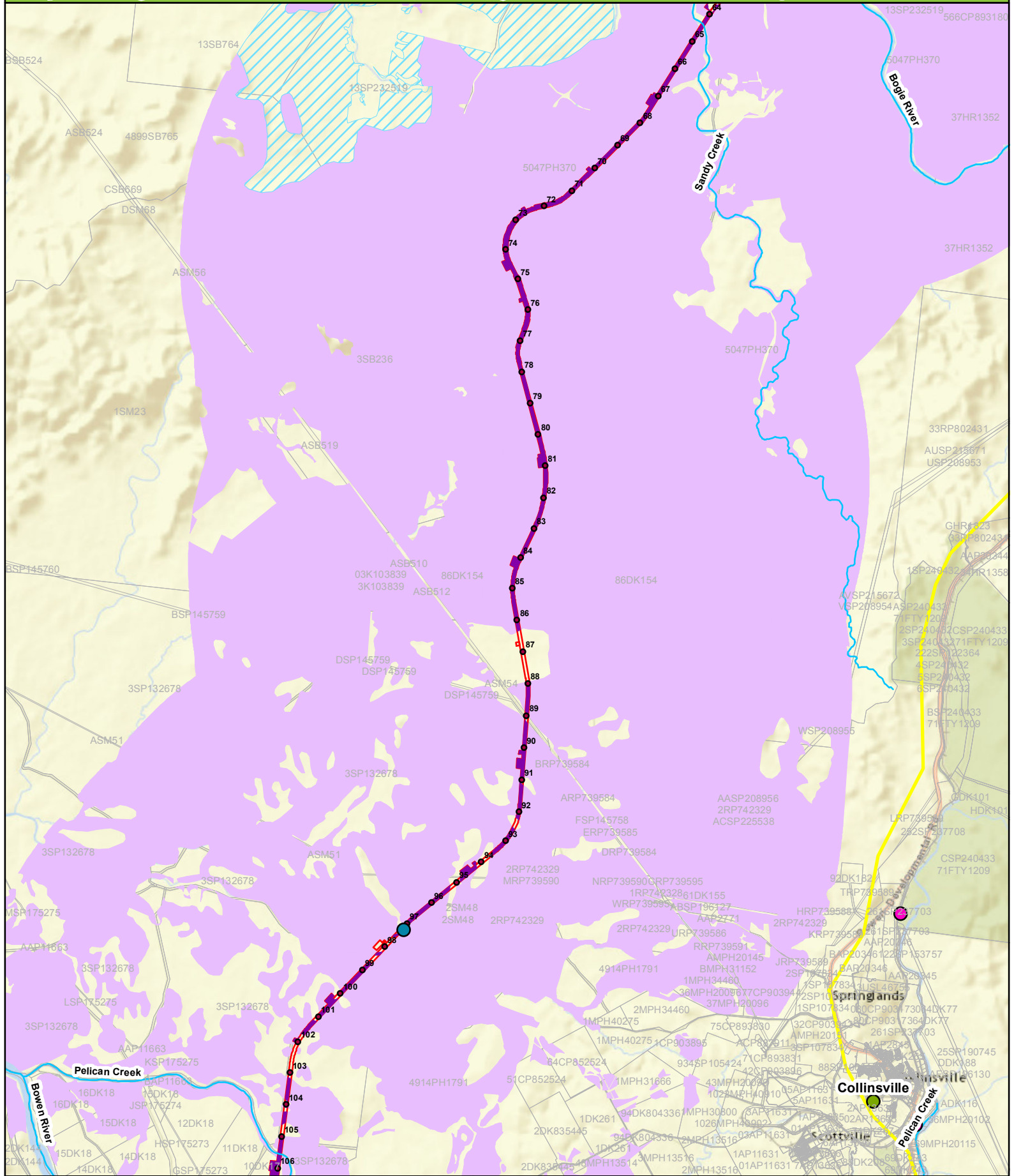


Data Sources: Adani Mining, QLD Gov Imagery: Bing Maps



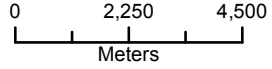
[www.ecoaus.com.au](http://www.ecoaus.com.au)

# Squatter Pigeon and Koala habitat within the Project Area and surrounds: Map 8



- Legend**
- Carmichael Rail Network
  - Kilometre Points
  - State Road
  - Local Road
  - Major Watercourse
  - Property Boundary
  - Known Locations
  - Squatter Pigeon
  - Koala

- Likely Habitat**
- Squatter Pigeon Nesting
  - Koala Habitat
- Potential Habitat**
- Squatter Pigeon Nesting
  - Koala Habitat



Datum/Projection:  
GDA 1994 MGA Zone 55



Data Sources: Adani Mining, QLD Gov  
Imagery: Bing Maps

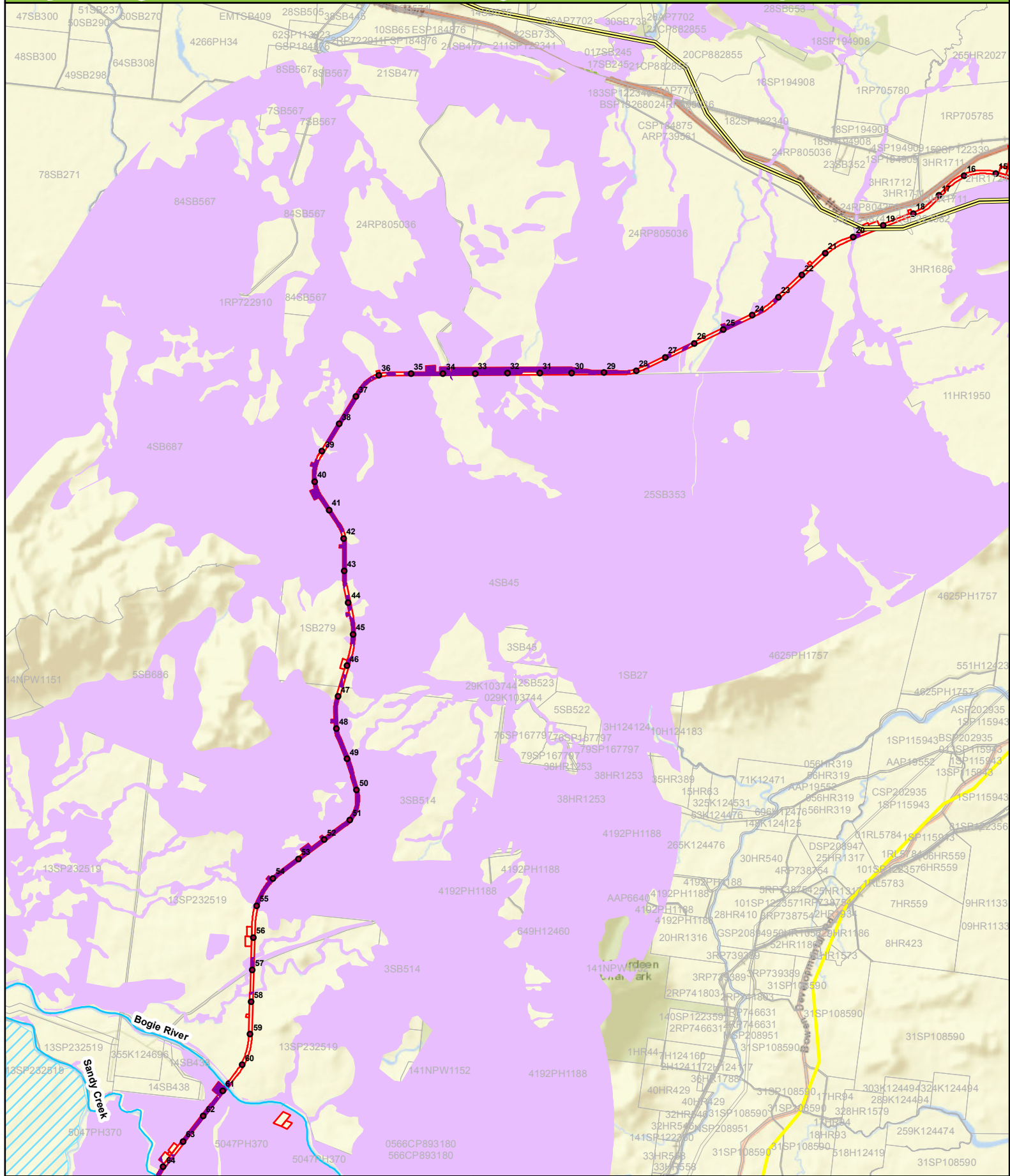
**eco logical**  
AUSTRALIA

[www.ecoaus.com.au](http://www.ecoaus.com.au)

© Eco Logical Australia Pty. Ltd. This map is not guaranteed to be free from error or omission. Eco Logical Australia Pty. Ltd. and its employees disclaim liability for any act done on the information in the map and any consequences of such acts or omissions.

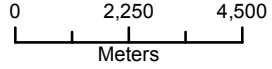


# Squatter Pigeon and Koala habitat within the Project Area and surrounds: Map 9

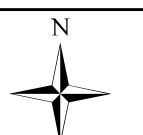


## Legend

- Carmichael Rail Network
  - Kilometre Points
  - State Road
  - Local Road
  - Major Watercourse
  - Property Boundary
  - Known Locations
  - Squatter Pigeon
  - Koala
- 
- Likely Habitat**
  - Squatter Pigeon Nesting
  - Koala Habitat
  - Potential Habitat**
  - Squatter Pigeon Nesting
  - Koala Habitat



Datum/Projection:  
GDA 1994 MGA Zone 55

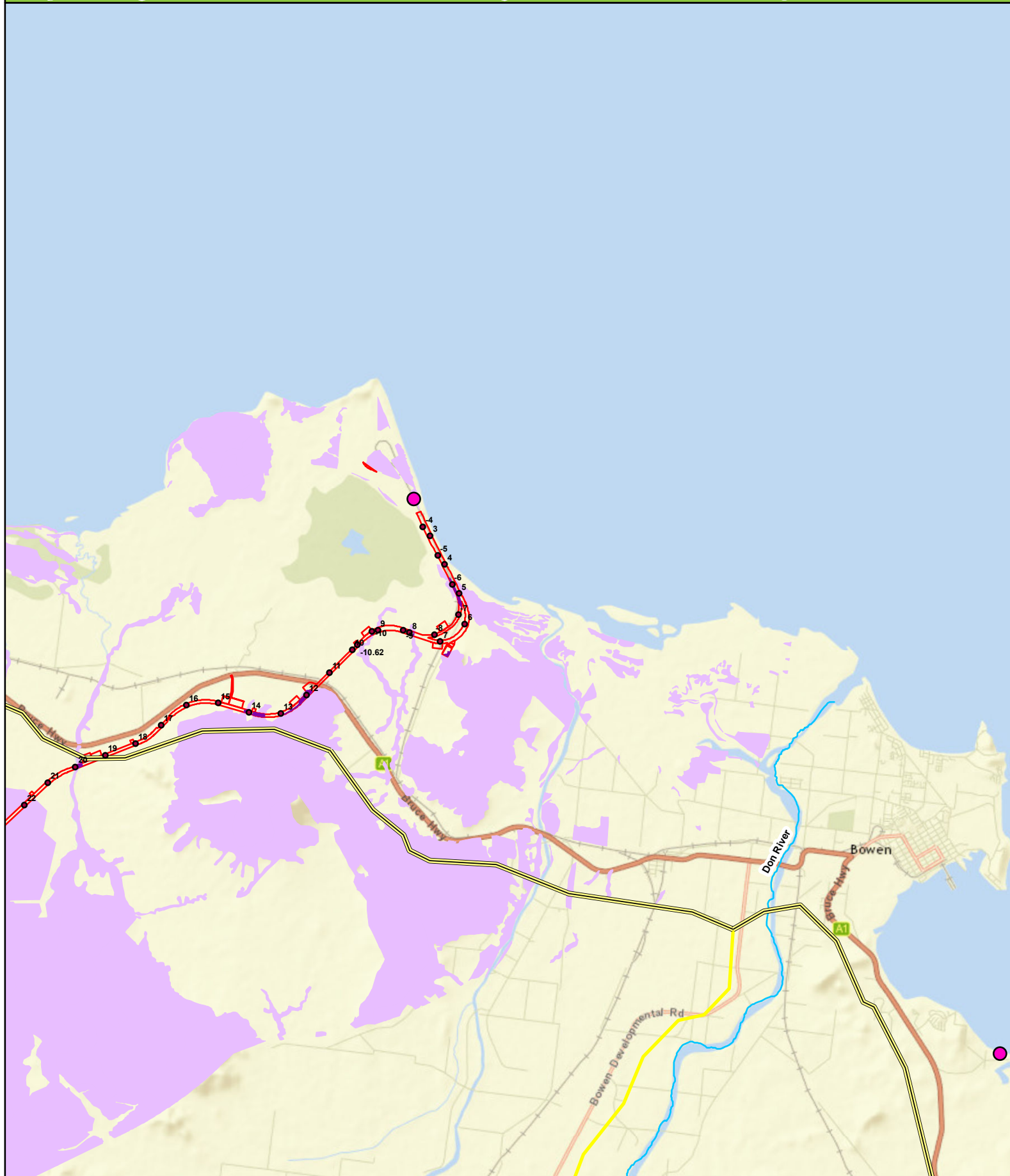


Data Sources: Adani Mining, QLD Gov  
Imagery: Bing Maps



[www.ecoaus.com.au](http://www.ecoaus.com.au)

# Squatter Pigeon and Koala habitat within the Project Area and surrounds: Map 10



## Legend

- Carmichael Rail Network
- Kilometre Points
- State Road
- Local Road
- Major Watercourse
- Known Locations**
- Squatter Pigeon
- Koala

- Likely Habitat**
- Squatter Pigeon Nesting
- Koala Habitat
- Potential Habitat**
- Squatter Pigeon Nesting
- Koala Habitat

0 2,250 4,500  
Meters

Datum/Projection:  
GDA 1994 MGA Zone 55



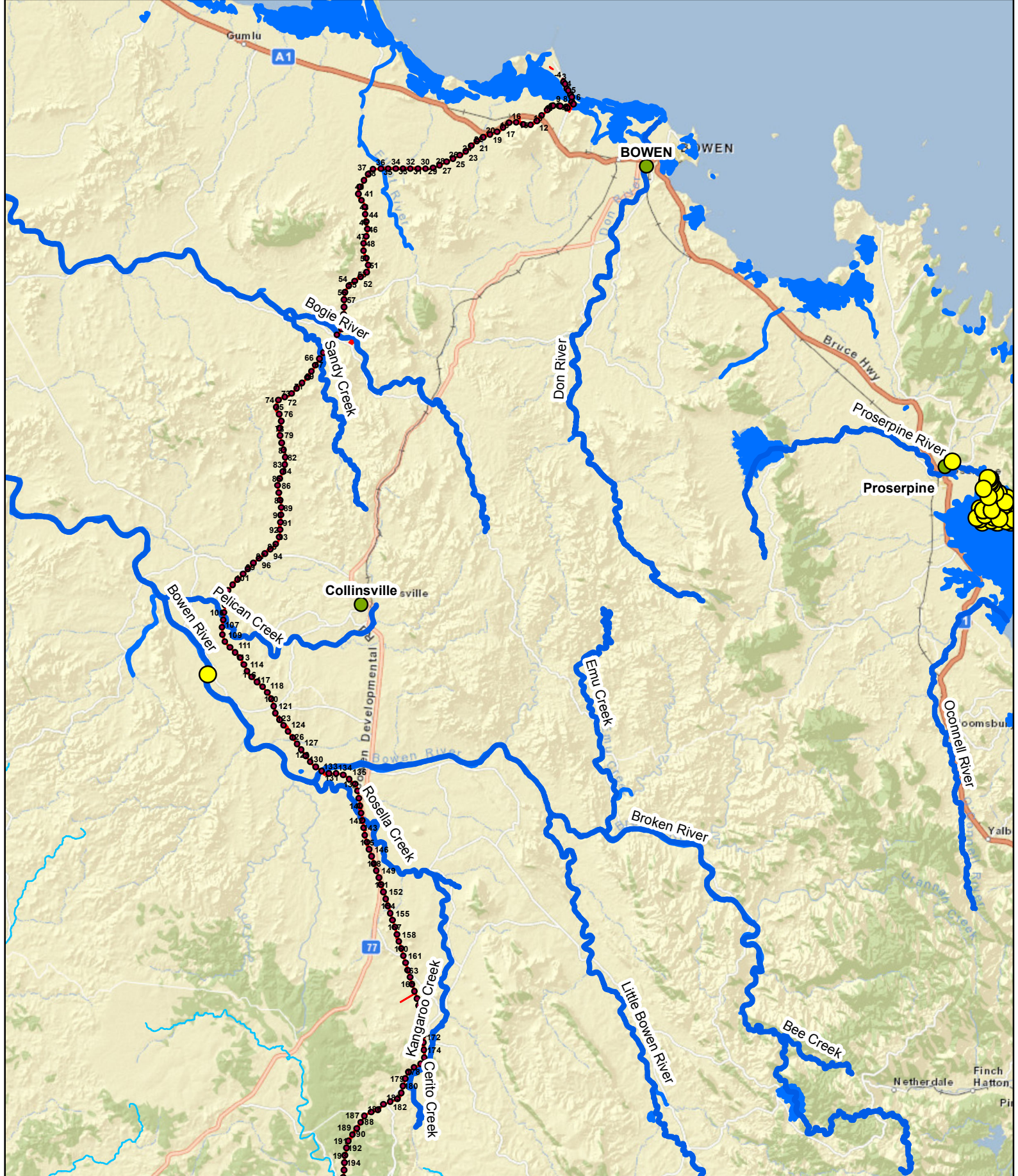
Data Sources: Adani Mining, QLD Gov  
Imagery: Bing Maps

**eco logical**  
AUSTRALIA

[www.ecoaus.com.au](http://www.ecoaus.com.au)

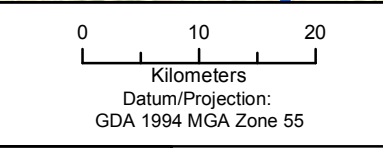
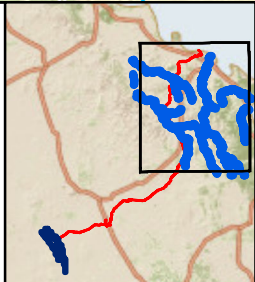


# Known and likely locations of Estuarine Crocodiles within the Project Area



**Legend**

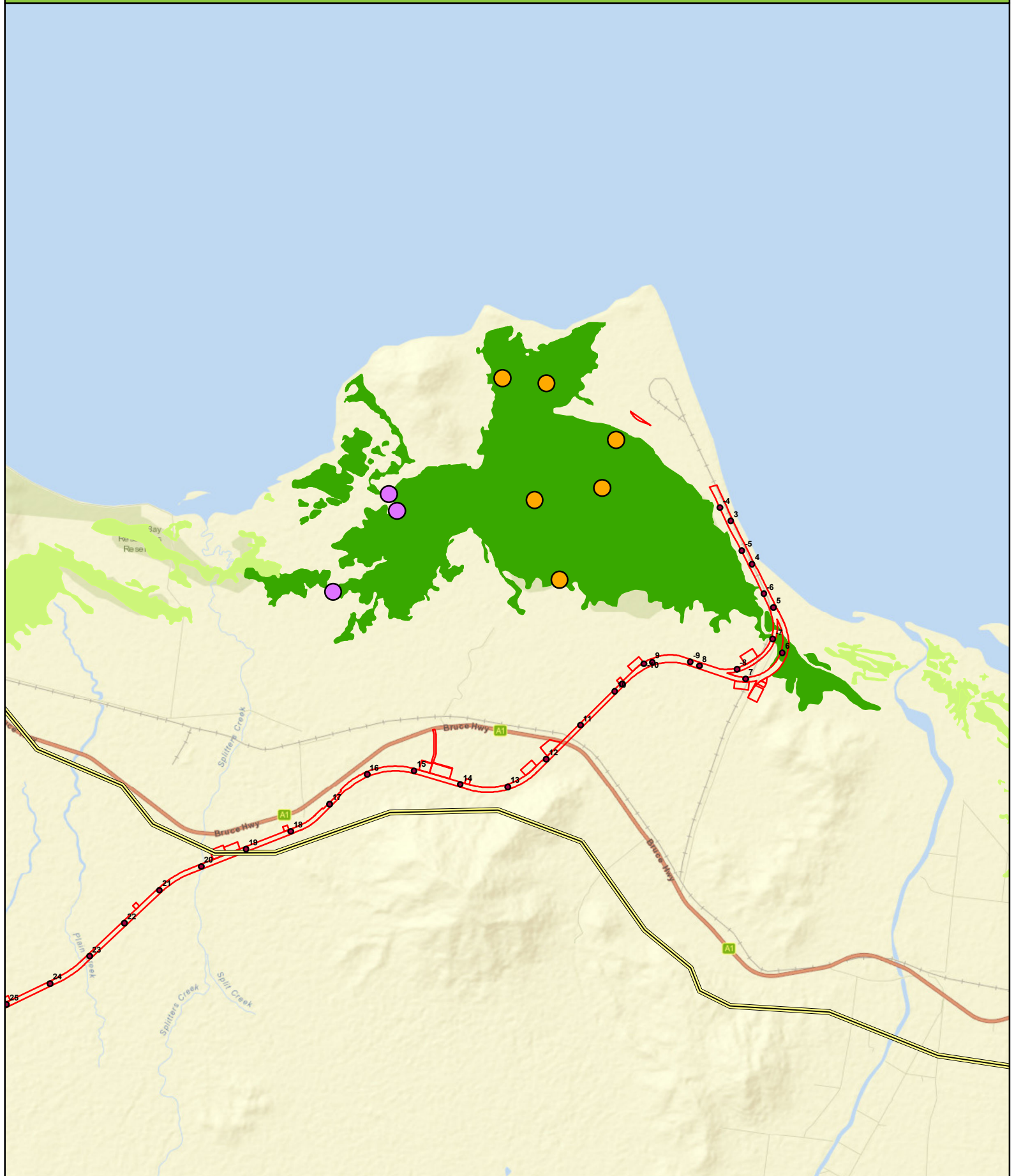
- Carmichael Rail Network
- Kilometre Points
- Known Estuarine Crocodile Locations
- Known and Likely Estuarine Crocodile Habitat
- Major Watercourse



Data Sources: Adani Mining, QLD Gov  
Imagery: Bing Maps



# Australian Painted Snipe and Eastern Curlew locations and habitat in the Project Area



<p><b>Legend</b></p> <ul style="list-style-type: none"> <li><span style="border: 1px solid red; display: inline-block; width: 15px; height: 10px; margin-right: 5px;"></span> Carmichael Rail Network</li> <li><span style="display: inline-block; width: 10px; height: 10px; border: 1px solid black; border-radius: 50%; margin-right: 5px;"></span> Kilometre Points</li> <li><span style="border-bottom: 2px solid brown; width: 20px; display: inline-block; margin-right: 5px;"></span> State Road</li> </ul> <p><b>Known Records</b></p> <ul style="list-style-type: none"> <li><span style="border: 1px solid purple; border-radius: 50%; width: 15px; height: 15px; display: inline-block; margin-right: 5px;"></span> Eastern Curlew</li> <li><span style="border: 1px solid orange; border-radius: 50%; width: 15px; height: 15px; display: inline-block; margin-right: 5px;"></span> Australian Painted Snipe</li> <li><span style="background-color: #008000; width: 20px; height: 10px; display: inline-block; margin-right: 5px;"></span> Known Australian Painted Snipe and Eastern Curlew Habitat</li> <li><span style="background-color: #90EE90; width: 20px; height: 10px; display: inline-block; margin-right: 5px;"></span> Likely Australian Painted Snipe and Eastern Curlew Habitat</li> </ul>		<p>0 1.5 3 Kilometers Datum/Projection: GDA 1994 MGA Zone 55</p> <p>N</p>	<p><b>eco logical</b> AUSTRALIA</p> <p>www.ecoaus.com.au</p> <p>Data Sources: Adani Mining, QLD Gov Imagery: Bing Maps</p>
---	--	---	--

# Appendix D Overview of Project Management Plans

This section provides a summary of the Environmental Management Plan (EMP) prepared to support vegetation clearing and construction for the NGBR Project. The summary is intended to assist readers of the Species Management Plan (SMP) understand the other management plans in place and how they relate to the management of threatened species and communities. The summary reflects the findings and recommendations of studies undertaken for the EIS.

Each management plan component covers design, construction and operational activities. The management plans consider railway activities and their associated maintenance facilities and support infrastructure.

The project EMP provides details and implementation details for the following aspects: air quality, flora and fauna, greenhouse gas emissions and energy, soils, erosion and sediment, waste, noise and vibration, surface water, groundwater, general and hazardous waste, noise and vibration, surface water and groundwater, scenic amenity and lighting, traffic, social, cultural heritage and hazardous substances management. A summary of those plans most relevant to the protection of Matters of National Environmental Significance (MNES) is summarised below.

The EMP is a dynamic document and will be updated as required to reflect changes in impacts or project activities, changes in legal and other obligations and changes from learning and corrective actions through monitoring activities.

## ***Air Quality***

The management objective for air quality is to prevent or minimise any air quality impacts at the location of sensitive receptors during construction and operation of the NGBR Project. Particulate matter could affect fauna and plants through coating of plant leaves, making them less palatable and affecting photosynthesis.

The Plan specifies that dust minimisation will be considered as a factor in stockpile, coal wagon and load-out facility design. During construction, dust will be minimised through planning and sequencing of exposed soils; stockpile stabilisation; and suppression activities for stockpiles and haul roads, access tracks and work areas. The Plan also specifies design and operational controls to minimise dust generation from the concrete batching plants, sewage treatment plants and flash butt welding depot.

Adani will prepare a Coal Dust Management Plan identifying control measures to mitigate the emission of dust from loaded and unloaded coal trains. The plan will be consistent with the aims, objectives and mitigation measures proposed in the QR (2010) Coal Dust Management Plan. When operating on any Aurizon Operation Ltd (Aurizon) railway line, Adani will comply with the recommendations stated in the QR (2010) Coal Dust Management Plan.

Dust generation will be monitored visually at haul roads, access roads, and other cleared areas as well as during train loading and operation. Corrective action applied where train loading or operation is generating excessive dust. Air quality monitoring may be conducted following a complaint.

**Noise and vibration**

The Noise and Vibration Plan aims to protect the qualities of the acoustic environment that are conducive to protecting biodiversity. Potential impacts are possible due to civil works, pile driving, rock breaking, blasting, and operation of heavy machinery during construction and rail operations. In general most of these activities are not expected to affect sensitive receptors.

Impacts from noise will be managed to meet the Rail Noise criteria adopted from Queensland Rail's Code of Practice for Railway Noise Management (QR, 2007):

- 65 dB(A) –assessed as the 24 hour average equivalent continuous A-weighted sound pressure level (LAeq)
- 87 dB(A) - assessed as a single event maximum sound pressure level (LAmax)

Construction noise will be controlled by keeping trafficked areas in good condition, limiting horn use, confine impact pile driving to general building work hours, minimising drop heights during loading and using noise suppression equipment on machinery. Impacts from airblast overpressure will be managed to meet acoustic quality objectives and avoid disturbance to homesteads surrounding the Rail. If blasting is required, controls will be implemented to minimise the associated noise and vibration including optimal spacing and orientation.

During operation controls will include training for train operators in appropriate use of horns and warning devices.

All noise complaints will be recorded, acknowledged, considered and responded to as soon as is practicable and noise or vibration monitoring will be undertaken in response to any complaint to ensure objectives are not being exceeded.

**Surface Water and Groundwater**

The Surface Water and Groundwater Management Plan aims to prevent or minimise environmental impacts on surface water and groundwater from the NGBR Project. Performance criteria include no degradation of water quality downstream relative to upstream values attributable to the NGBR Project.

Contamination of surface water resources could result from wastewater generation and treatment, hydrocarbon leaks or spills, spoil disposal, release of sediments through clearing and earthworks, or draining of low quality water from existing farm dams.

The key management actions to be employed in the prevention of surface water impacts include:

- Storing fuels, chemicals, wastes and other potentially environmentally hazardous substances in contained areas away from watercourses
- Refuelling to take place away from watercourses. Spill kits are available during refuelling.
- Existing disturbed areas will be utilised to access waterways
- Wastewater from concrete batching plants will be captured, stored and either reused in concrete batching or treated and disposed appropriately

Monitoring will include surface water quality during construction and regular inspections of dams and infrastructure.

**Pests and Weeds (Flora and Fauna Management)**

Management objectives are to achieve no increase in the level of declared weed and pest infestation as a result of construction and operational activities for the NGBR Project. The plan will manage potential

environmental impacts from pests and weeds through vehicle movements, construction activities and ongoing operations. Proposed controls include the following activities:

- Mapping of weeds prior to commencement of construction activities
- Containment of food scraps in sealed containers
- Limitations on the movement of vegetation and soil waste
- Use of weed wash down areas for vehicles and equipment

There will be ongoing monitoring of pests and weeds throughout the project area, using baseline and reference sites.

### ***Bushfire Management***

The Bushfire Management Plan provides a framework and guidance for:

- Identifying, monitoring and prioritising the management of fire risk in the Operational Area
- Preventing bushfires and managing fires throughout the Operational Area
- Developing site-specific and/or activity specific fire management procedures across the life of the project.

The plan is focussed on an overarching strategy to identify, avoid, prevent, minimise and control bushfires. Specific measures are provided on how this will be achieved, and include mapping of relevant environmental features, maintain fire infrastructure (e.g. fire breaks) and levels of fire preparedness.

# Appendix E Summary of Findings of EIS Process

The species and communities included in the NGBR Species Management Plan (SMP) in response to Commonwealth conditions of approval include:

- Australian Painted Snipe
- Squatter Pigeon
- Ornamental Snake
- Koala
- Black Ironbox
- King Bluegrass
- Bluegrass
- Brigalow (Acacia harpophylla dominant and co-dominant) TEC
- Natural grasslands of the Queensland central highlands and the northern Fitzroy Basin TEC
- Semi-evergreen vine thickets of the Brigalow Belt (north and south) and Nandewar regions TEC

This appendix provides a summary of the potential impacts on these Matter of National Environmental Significance (MNES) as a result of the construction and operation of the NGBR portion of the rail corridor. These impacts provide the context for the mitigation and management measures that have been identified in the SMP.

The information provided in this summary has been extracted from the EIS (Adani 2013) and AEIS (GHD 2014). Both of these documents are available for download from the Adani website at <http://www.adaniaustralia.com.au>

It should be noted that this appendix provides detail of all potential impacts to these MNES, prior to consideration of mitigation and management. With the implementation of the measures identified in the SMP, actual residual impacts will be substantially reduced. In consideration of these mitigation and management measures along with proposed offsets, the Commonwealth Minister for the Environment has determined that the Project will not have any unacceptable impacts on any of the listed threatened species or ecological communities.

The following sections provide detail on the potential impacts that will be mitigated and managed during operation and construction of the rail corridor, through the measures outlined in the Threatened Species Management Plan. These potential impacts could result from:

- Vegetation clearing
- Introduction of a barrier to fauna movement
- Disturbance of surface watercourses
- Introduction or exacerbation of weeds and feral animals species
- Altered exposure to disturbance.

### *Vegetation clearing*

Vegetation clearing has the potential to result in direct vegetation and habitat loss, fauna mortality, habitat fragmentation and habitat degradation through erosion of topsoils and dust deposition on plants or water resources. Disturbance limits for MNES have been established in EPBC Act approval conditions to limit the impacts of vegetation clearing.

Impacts on fauna and fauna habitat has been avoided through locating a large extent of the construction footprint, where possible in areas of non-remnant vegetation or cleared land. However, it is recognised that, in spite of this avoidance and implementation of management and mitigation measures, unavoidable loss of fauna habitat will occur.

The specific loss of terrestrial fauna habitat consequential to the construction of the Project includes the removal of mature vegetation and hollow logs. Loss of these habitat features in turn creates a loss of perching, foraging and nesting resources for the threatened species. A subsequent increase in competition for resources such as food and shelter in remaining remnant habitats may occur.

During clearing it is anticipated that fauna mortality will occur, particularly for those cryptic and/or less mobile animals that may not be detected by the fauna spotter-catcher prior to or during vegetation clearing activities. Fauna residing in vegetation in particular are at risk of mortality, particularly those that roost or shelter in hollows, or beneath rocks, logs and bark (i.e. arboreal mammals, nocturnal birds, reptiles and frogs). This includes the Ornamental Snake, which is cryptic, and may be more vulnerable if in torpor at the time of clearance or where located underground. The Squatter Pigeon may also be affected as it often forages on the ground and tends to freeze or remain hidden as part of its defence.

Fauna mortality during construction will result in a local reduction in the abundance of some less mobile species including the Ornamental Snake. Vehicles and machinery used to undertake land clearing have the potential to lead to direct mortality of fauna. With respect to the operation phase of the Project, the risk of fauna mortality relates predominantly to train and vehicle strikes. The risk to fauna posed by vehicular traffic is significantly less than the risk posed throughout the construction phase of the Project. The rail corridor is fenced and fauna passage facilitated at designated points. It is not considered likely that adverse impacts on fauna will result as a consequence of train or vehicle strikes during operations.

Much of the landscape surrounding the proposed Rail and Infrastructure Corridor has experienced broadscale vegetation clearing resulting in remnant vegetation remaining as fragmented. As such, fragmentation associated with construction at this location is more likely to reduce the size and connectivity of existing isolated patches, rather than create new fragments. Nonetheless, many of the patches of remnant vegetation that intersect with the construction footprint are narrow and vegetation clearing may reduce the capacity of some less mobile fauna to move within and between habitats. This is particularly relevant to small, ground-dwelling fauna such as the Ornamental Snake.

Although often somewhat degraded by the current grazing practices within the rail corridor, the small riparian corridors or small patches of remnant and advanced regrowth patches act as habitat linkages between larger vegetated patches. The clearing of vegetation can sever or severely reduce the extent of these habitat linkages and may impede or reduce the ability of fauna to move across the landscape. Species that are particularly likely to be susceptible to the impacts related to reduction in habitat linkages are those with larger habitat ranges including the koala.

Habitat degradation that may result from clearing is discussed under the heading of 'Altered exposure to disturbance'.

*Barrier to movement*

With respect to the operation of the rail corridor, the Project will create a permanent linear barrier to fauna movement, reducing the overall habitat value of remnant vegetation adjacent to the rail corridor, increasing edge effects on habitat and restricting the access to water sources.

At a regional scale it is unlikely that this fragmentation will result in adverse impacts. Locally however, patches of remnant vegetation that intersect the Study Area are narrow, and provide some of the few remaining wildlife corridors in the landscape.

*Disturbance of surface watercourses;*

Potential indirect impacts to flora and fauna species may result as a consequence of minor localised run-off and sedimentation of watercourses and waterbodies (e.g. gilgais and dams) throughout the operational life of the Project. Localised run-off and sedimentation may reduce water quality and introduce contaminants or pollutants into local water supplies. This could potentially affect species associated with surface water resources such as the Ornamental Snake and Painted Snipe. Permanent water sources, such as farm dams adjacent to the rail footprint and less ephemeral watercourses, are considered more sensitive to indirect impacts from sedimentation and run-off. However, run off and sedimentation is localised and unlikely to result in adverse long-term degradation of downstream habitats.

The rail corridor will cross both major and minor watercourses requiring bridge crossings and culvert installations. The operation footprint is typically located in a low gradient catchment with extensive floodplains. The permanent fixture of the rail line will cross floodplains and create a potential barrier to the previous flow of water. The alteration of floodplain hydrology may impact downstream locations and consequently may impact upon the ecology of communities and species dependent on floodplain processes, such as Black Ironbox.

*Introduction or exacerbation of weeds and feral animals species; and*

Increased movement of people, vehicles, machinery, vegetation waste and soil may facilitate the spread of weeds at and near the Study Area. Increasing the prevalence of weeds may reduce the quality of habitats for the fauna species, increase competition for the threatened flora and fauna species or affect the composition of TECs.

Disturbance may result in increased weed levels from existing seed banks, affecting the ability for native vegetation to re-establish. There is also significant potential for weeds, either as seeds or other plant propagules, to be introduced to sites attached to dirty vehicles and equipment or to be contained in soil or seed mixes brought to the site.

Following clearing, buffel grass may build up along the edges of native vegetation thereby increasing fuel loads and leading to hotter fire intensity in these areas. This in turn facilitate further incursion of buffel grass into the remnant vegetation thus disadvantaging the native woody flora in particular.

Feral animals such as pigs, rats, mice, cats and dogs could be attracted to the rail corridor and associated infrastructure by increased food resources associated with human food waste, particularly during construction. There is also potential for pest species to use the rail infrastructure corridor as a linear pathway for movement, leading to the introduction of pest species in previously pest-free habitats.

The threatened fauna species could be impacted by increased competition for resources, increased predation, or habitat degradation such as trampling by feral pigs or rabbit burrowing. Habitat degradation by feral animals could also affect the flora species and TECs.



*Altered exposure to disturbance.*

Clearing of native vegetation may result in the degradation of vegetation adjacent to areas being cleared as well as downstream habitats. Edge effects may occur where previously intact remnant vegetation (and the habitat it provides) is exposed to a distinct ecotone associated with construction of infrastructure. This may occur where remnant vegetation persists in a continuous tract across the Rail and Infrastructure Corridor, particularly along watercourses.

Clearing of vegetation and construction activities undertaken within the Project footprint will cause temporary localised increases in noise, vibration and artificial light disturbance. In addition, further degrading effects to habitat may include increased exposure to dust and wind. Exposure to any of these effects may alter habitat composition (i.e. reduced flora diversity and simplified ecosystem structure) and quality (i.e. reduced availability of forage resources, increased exposure to predators) at the ecotone, thereby potentially changing species diversity in the altered habitat. Where edge effects degrade or simplify habitat at the edge, it is possible the species diversity and habitat utilisation within this edge habitat will be altered and the diversity of native species reduced.

Vegetation clearing also has the potential to facilitate erosion (water and wind) particularly on soil types with a high erosion potential (such as sodic soils) and on high gradient slopes. Where vegetation clearing occurs near drainage lines, erosion may cause sedimentation of waterways, potentially degrading downstream aquatic and riparian habitats.

During construction, dust settling on vegetation could suppress vegetation growth by limiting the photosynthesis potential of plants in close proximity to corridor during construction. This could affect the threatened flora species and plants with dust on leaves may also be less palatable as a food source for the threatened fauna species. The impacts from dust are likely to be more pronounced where construction activities are located in and adjacent to sensitive habitats (i.e. watercourses and riparian vegetation). It is important to note that these impacts will be temporary (i.e. only during the construction period).

Similarly, coal dust could create impacts during operation of the rail infrastructure. This could degrade the function and health of the vegetation community; cause plant dieback with prolonged exposure; and reduce food resource availability for fauna species utilising the affected vegetation community. Excessive dust settling on water bodies has the potential to decrease aquatic habitat value within the immediate and downstream areas as a result of reduced water quality. As such, impacts to flora from coal dust may occur where vegetation is growing immediately adjacent to the rail corridor. Long term exposure to coal dust may result in changes to vegetation communities immediately adjacent to the rail line, which may in turn alter habitat type and quality for fauna within and adjacent to the operation footprint and surrounding region.

Noise and dust generated through operations is transient and predicted to be within acceptable guideline/criteria limits. Maintenance personnel and vehicle movements will be localised and confined to the operational footprint. Potential impacts are likely to be localised.

Increased human activity may alter the fire regime of the local landscape, either deliberately through the need to manage bushfire risk, or through the accidental ignition of bushfires. For example, the rail corridor may act as a fire break and consequently reduce the natural fire frequency and in turn increase the fuel load which would increase the fire risk for the region. The potential for accidentally-lit fires is potentially increased through the operation phase as a result of sparking during rail operation. The incidence of regulated 'management burns' may also change in frequency.

Spontaneous combustion of accumulated or stockpiled coal has the potential to occur within and around the rail corridor, associated rail infrastructure (i.e. rail spurs, loops and unloading stations) and coal waste dumps. Spontaneous combustion typically occurs when oxygen comes into contact with coal and the generated heat cannot dissipate. Ignition of accumulated coal may also occur as a result of any rail maintenance and hot work.

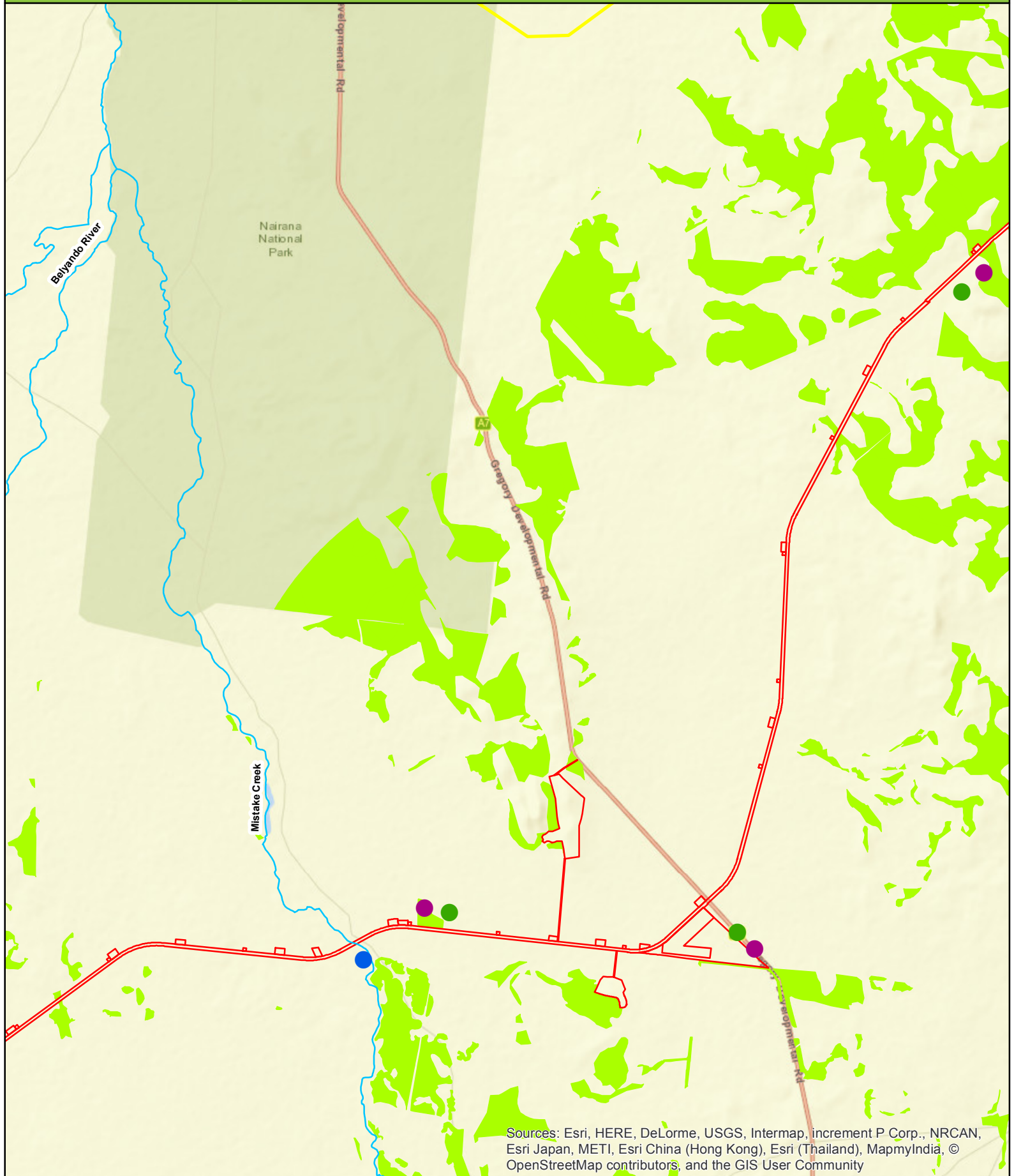
Accidental or uncontrolled fires have the potential to negatively impact upon vegetation (and habitat) within, and adjacent to, the rail and infrastructure corridor in particular. Depending on fire intensity, such burns may alter the structural integrity and natural regeneration capacity of affected vegetation.

# Appendix F Indicative Locations Of Monitoring Sites

Maps showing the indicative locations of monitoring sites are provided on the following pages.

Map series run from west (Gregory Development Road; Map 3) to east (Abbot Point; Map 10).

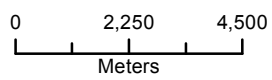
# Indicative Monitoring Locations: Map 2



Sources: Esri, HERE, DeLorme, USGS, Intermap, increment P Corp., NRCAN, Esri Japan, METI, Esri China (Hong Kong), Esri (Thailand), MapmyIndia, © OpenStreetMap contributors, and the GIS User Community

## Legend

- Carmichael Rail Network
- Local Road
- Major Watercourse
- Woodland\_Monitoring\_Locations
- Riparian\_Monitoring\_Locations
- Brigalow\_Monitoring\_Locations
- Brigalow



Datum/Projection:  
GDA 1994 MGA Zone 55

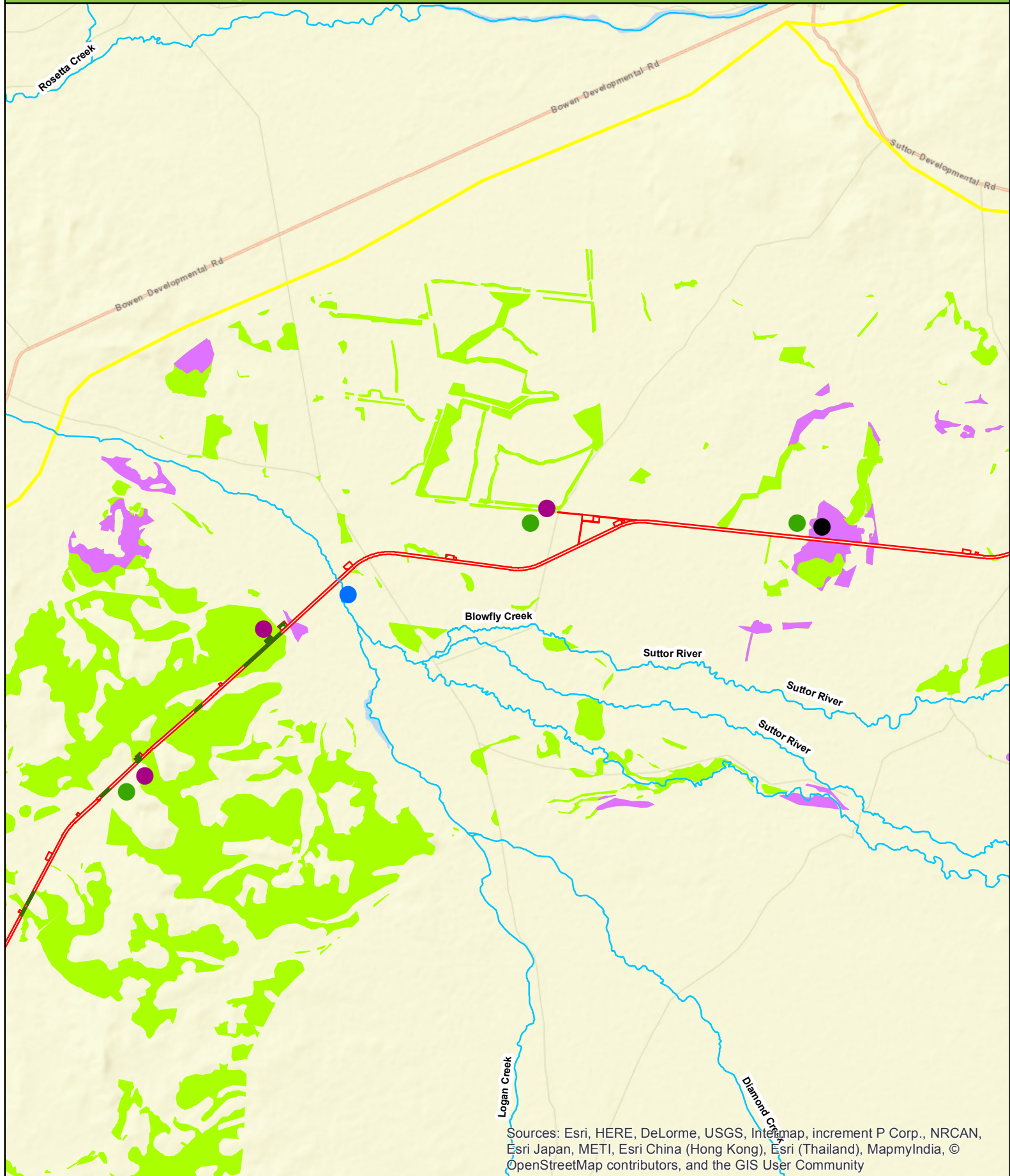


Data Sources: Adani Mining, QLD Gov  
Imagery: Bing Maps



[www.ecoaus.com.au](http://www.ecoaus.com.au)

# Indicative Monitoring Locations: Map 3



Sources: Esri, HERE, DeLorme, USGS, Intermap, increment P Corp., NRCAN, Esri Japan, METI, Esri China (Hong Kong), Esri (Thailand), MapmyIndia, © OpenStreetMap contributors, and the GIS User Community

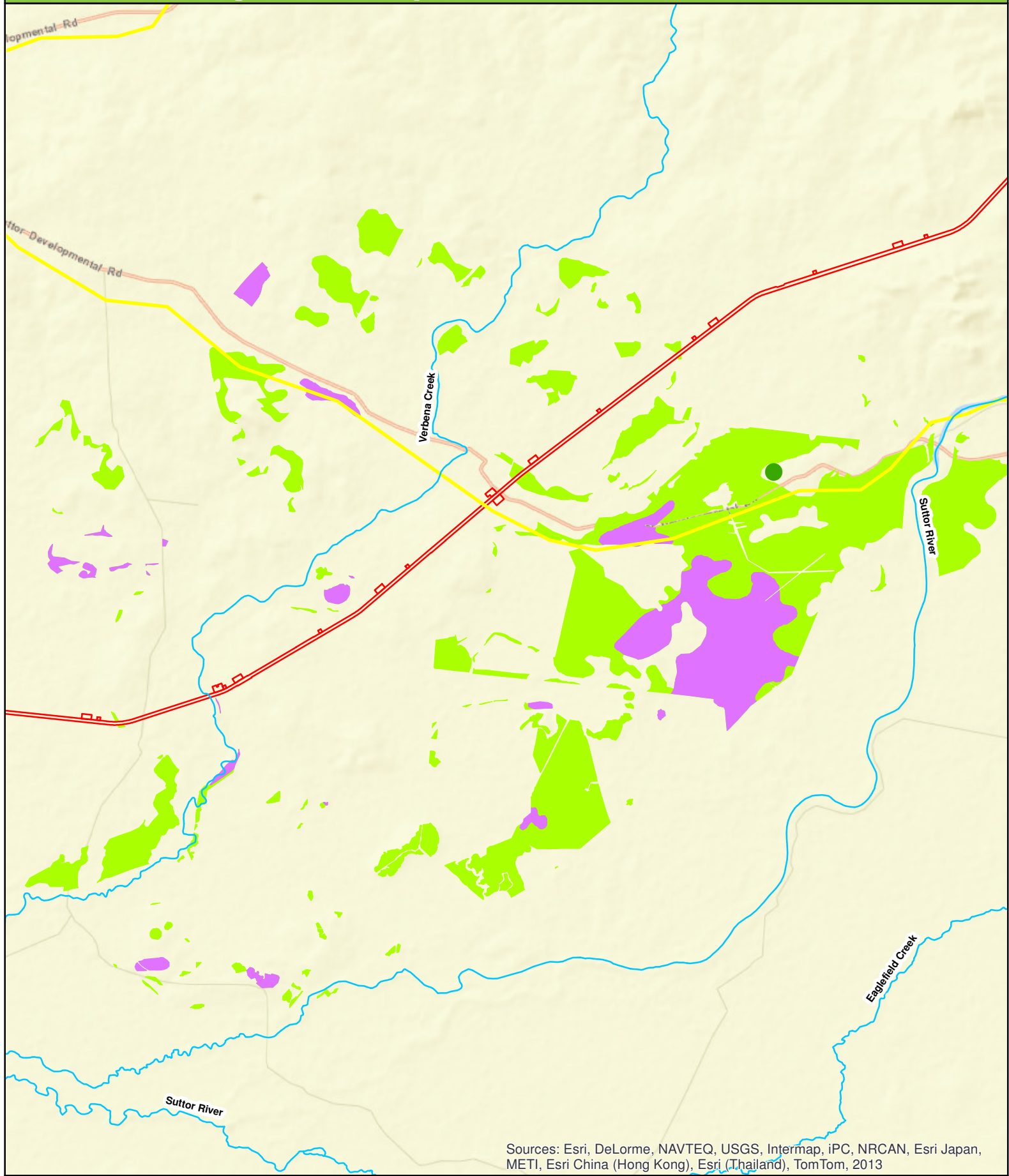
<b>Legend</b>	
	Carmichael Rail Network
	Local Road
	Major Watercourse
	Grassland_Monitoring_Locations
	SEVT_Monitoring_Locations
	Woodland_Monitoring_Locations
	Riparian_Monitoring_Locations
	Brigalow_Monitoring_Locations
	Brigalow
	Grassland

 Datum/Projection: GDA 1994 MGA Zone 55	
	Data Sources: Adani Mining, QLD Gov Imagery: Bing Maps

[www.ecoaus.com.au](http://www.ecoaus.com.au)

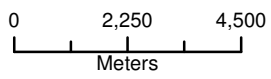


# Indicative Monitoring Locations: Map 4

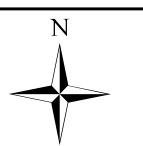


Sources: Esri, DeLorme, NAVTEQ, USGS, Intermap, iPC, NRCAN, Esri Japan, METI, Esri China (Hong Kong), Esri (Thailand), TomTom, 2013

- Legend**
- ▬ Carmichael Rail Network
  - ▬ Local Road
  - ▬ Major Watercourse
  - Grassland\_Monitoring\_Locations
  - SEVT\_Monitoring\_Locations
  - Woodland\_Monitoring\_Locations
  - Riparian\_Monitoring\_Locations
  - Brigalow\_Monitoring\_Locations



Datum/Projection:  
GDA 1994 MGA Zone 55

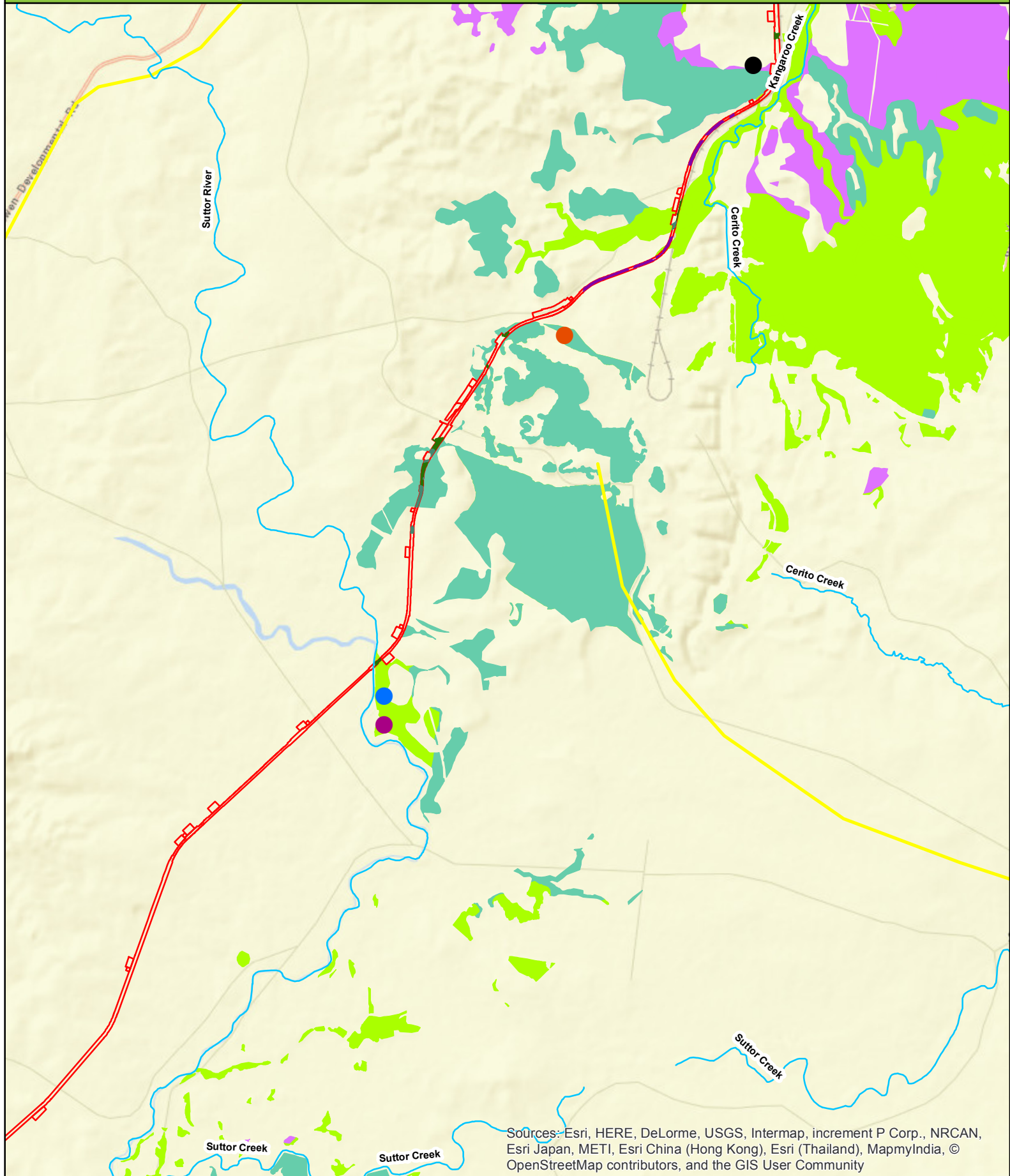


Data Sources: Adani Mining, QLD Gov  
Imagery: Bing Maps



[www.ecoaus.com.au](http://www.ecoaus.com.au)

# Indicative Monitoring Locations: Map 5



Sources: Esri, HERE, DeLorme, USGS, Intermap, increment P Corp., NRCAN, Esri Japan, METI, Esri China (Hong Kong), Esri (Thailand), MapmyIndia, © OpenStreetMap contributors, and the GIS User Community

Carmichael Rail Network	SEVT
Local Road	Bigalow
Major Watercourse	Grassland
Grassland_Monitoring_Locations	SEVT_Monitoring_Locations
Woodland_Monitoring_Locations	Riparian_Monitoring_Locations
Bigalow_Monitoring_Locations	

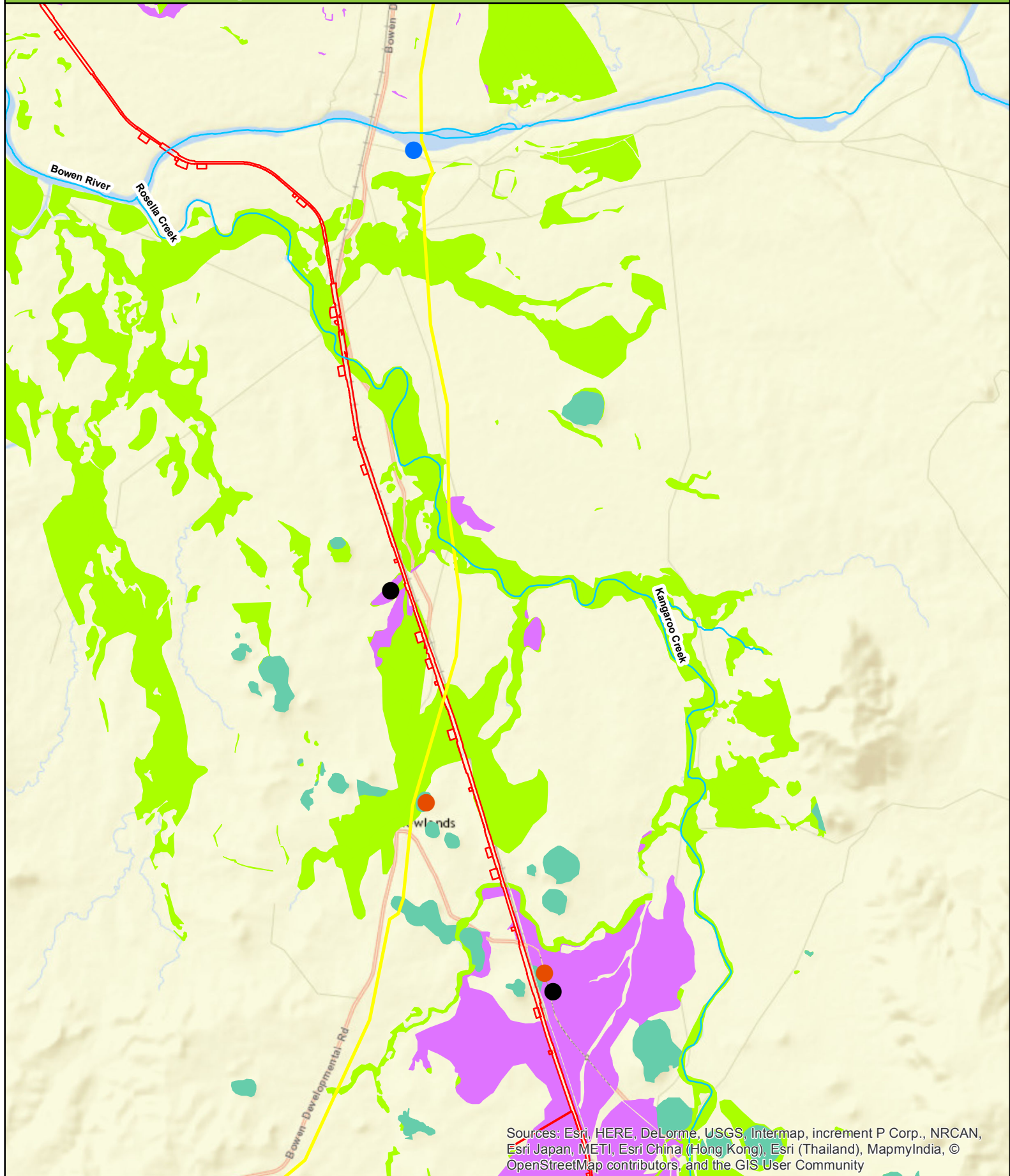
0 2,100 4,200  
Meters  
Datum/Projection:  
GDA 1994 MGA Zone 55

www.ecoaus.com.au

Data Sources: Adani Mining, QLD Gov Imagery: Bing Maps



# Indicative Monitoring Locations: Map 6



Sources: Esri, HERE, DeLorme, USGS, Intermap, increment P Corp., NRCAN, Esri Japan, METI, Esri China (Hong Kong), Esri (Thailand), MapmyIndia, © OpenStreetMap contributors, and the GIS User Community

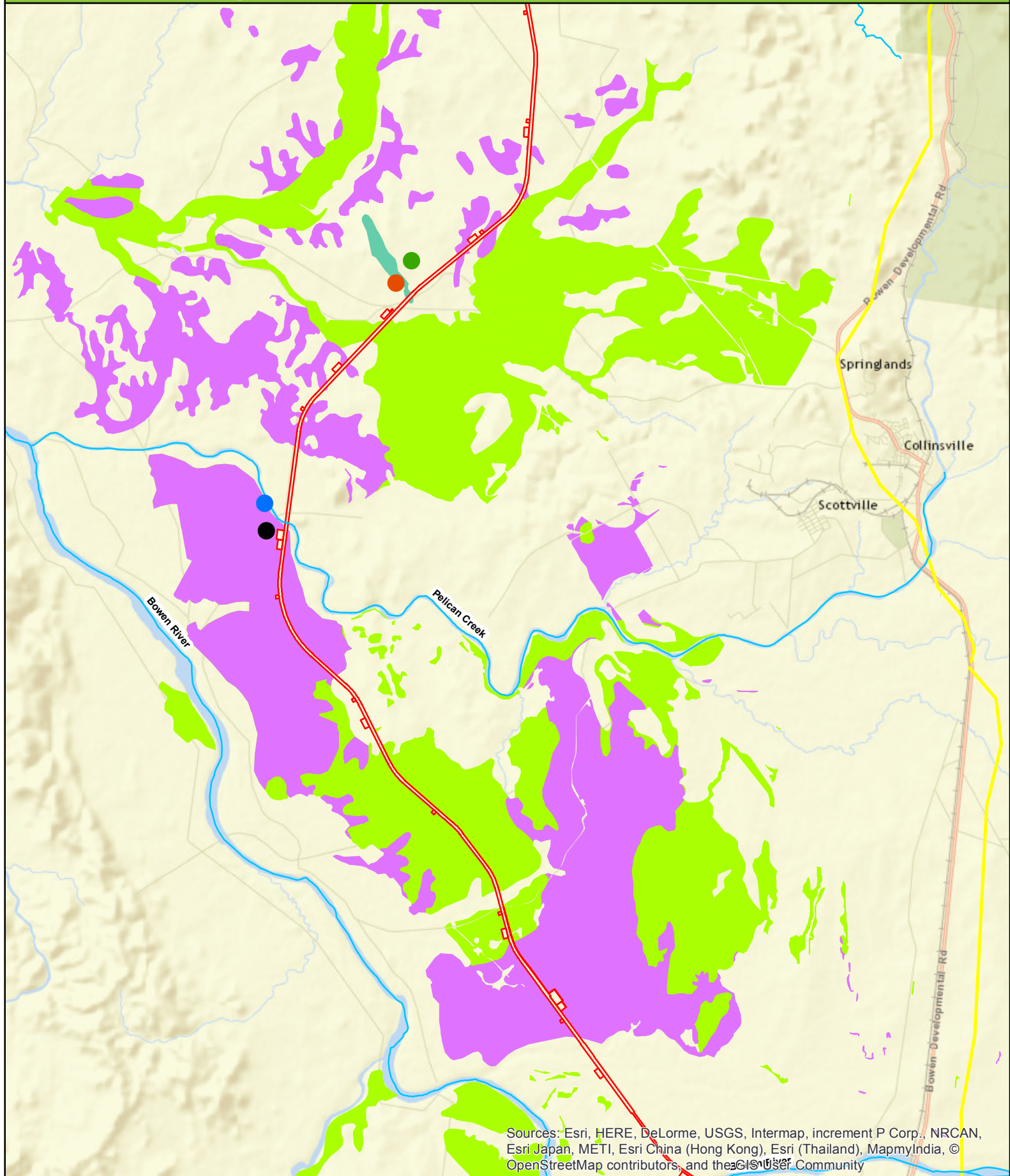
Legend	
	Carmichael Rail Network
	Local Road
	Major Watercourse
	Grassland_Monitoring_Locations
	SEVT_Monitoring_Locations
	Woodland_Monitoring_Locations
	Riparian_Monitoring_Locations
	Brigalow_Monitoring_Locations
	SEVT
	Brigalow
	Grassland

0 2,250 4,500  
Meters  
Datum/Projection:  
GDA 1994 MGA Zone 55

Data Sources: Adani Mining, QLD Gov  
Imagery: Bing Maps

www.ecoaus.com.au

# Indicative Monitoring Locations: Map 7



Sources: Esri, HERE, DeLorme, USGS, Intermap, increment P Corp., NRCAN, Esri Japan, METI, Esri China (Hong Kong), Esri (Thailand), MapmyIndia, © OpenStreetMap contributors, and the GIS User Community

Legend	
Carmichael Rail Network	Grassland
Local Road	Brigalow
Major Watercourse	SEVT
Grassland_Monitoring_Locations	
SEVT_Monitoring_Locations	
Woodland_Monitoring_Locations	
Riparian_Monitoring_Locations	
Brigalow_Monitoring_Locations	

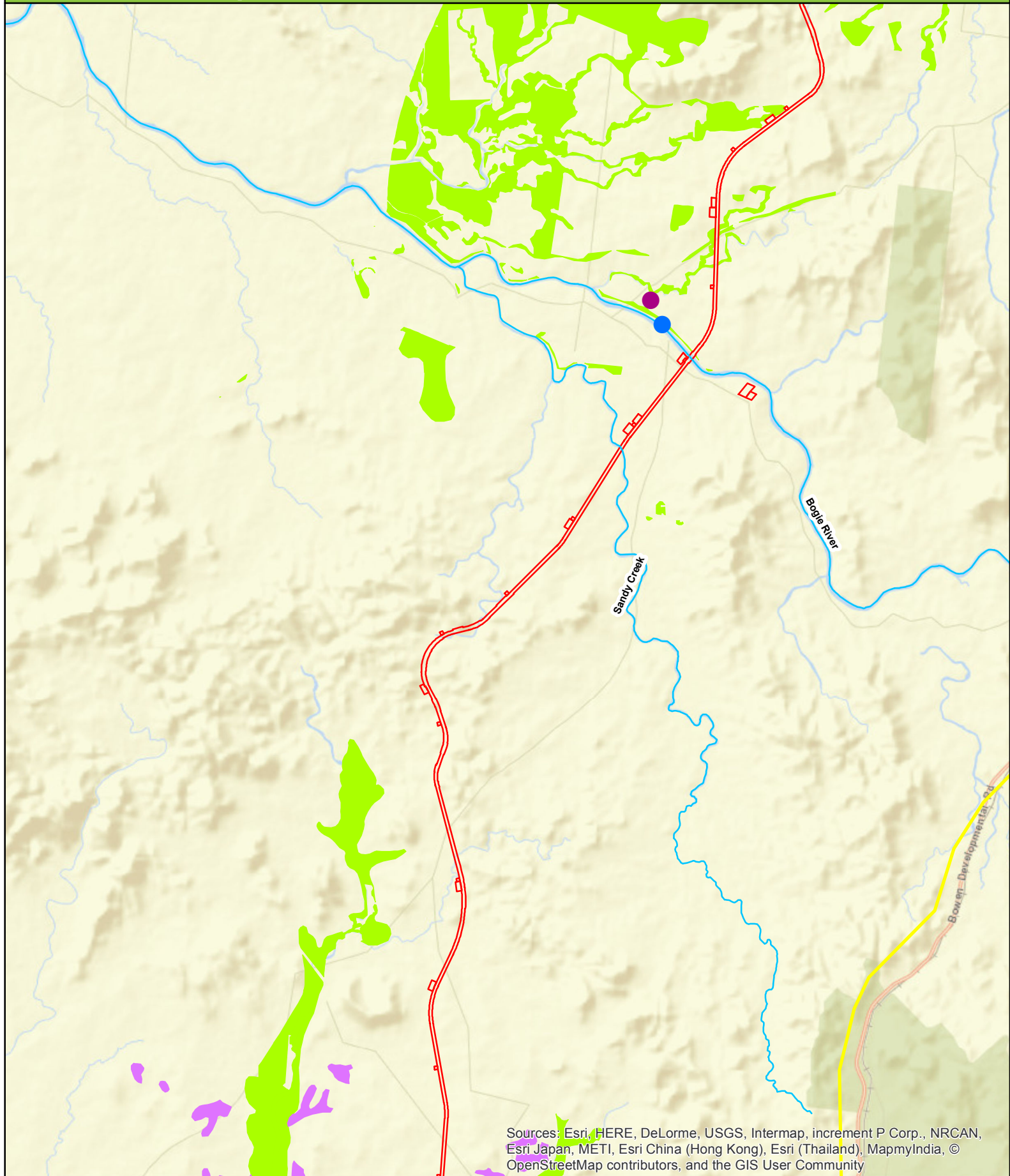
0 2,250 4,500  
Meters  
Datum/Projection:  
GDA 1994 MGA Zone 55

Data Sources: Adani Mining, QLD Gov  
Imagery: Bing Maps

www.ecoaus.com.au



# Indicative Monitoring Locations: Map 8



Sources: Esri, HERE, DeLorme, USGS, Intermap, increment P Corp., NRCAN, Esri Japan, METI, Esri China (Hong Kong), Esri (Thailand), MapmyIndia, © OpenStreetMap contributors, and the GIS User Community

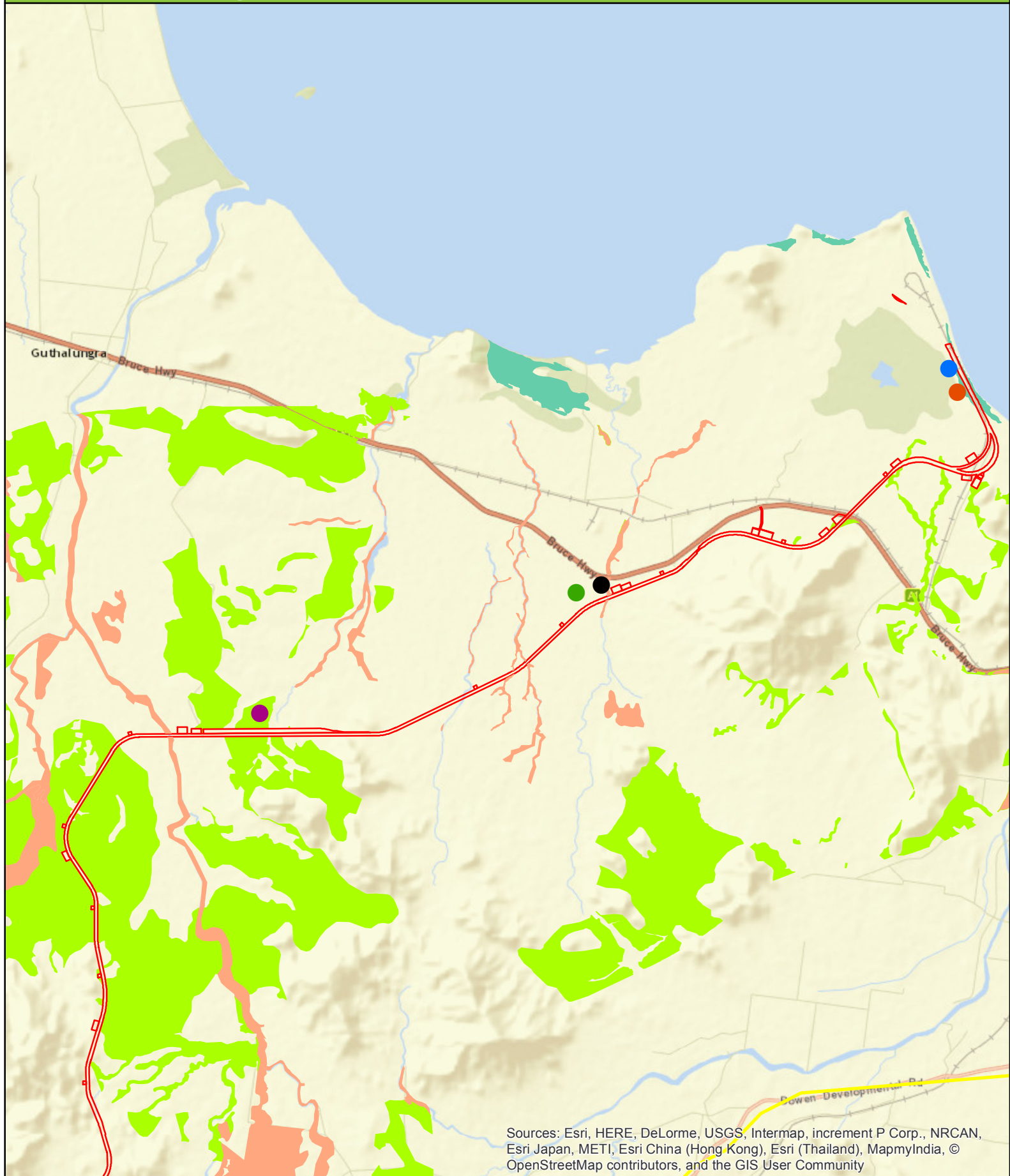
Legend	
	Carmichael Rail Network
	Local Road
	Major Watercourse
	Grassland_Monitoring_Locations
	SEVT_Monitoring_Locations
	Woodland_Monitoring_Locations
	Riparian_Monitoring_Locations
	Brigalow_Monitoring_Locations
	SEVT
	Grassland
	Brigalow

0 2,250 4,500  
Meters  
Datum/Projection:  
GDA 1994 MGA Zone 55

Data Sources: Adani Mining, QLD Gov Imagery: Bing Maps

www.ecoaus.com.au

# Indicative Monitoring Locations: Map 9



Sources: Esri, HERE, DeLorme, USGS, Intermap, increment P Corp., NRCAN, Esri Japan, METI, Esri China (Hong Kong), Esri (Thailand), MapmyIndia, © OpenStreetMap contributors, and the GIS User Community

Legend	
Carmichael Rail Network	SEVT
Local Road	Grassland
Major Watercourse	Brigalow
Grassland_Monitoring_Locations	Dichanthium_setosum_habitat
SEVT_Monitoring_Locations	
Woodland_Monitoring_Locations	
Riparian_Monitoring_Locations	
Brigalow_Monitoring_Locations	

0 2,250 4,500  
Meters  
Datum/Projection:  
GDA 1994 MGA Zone 55

Data Sources: Adani Mining, QLD Gov Imagery: Bing Maps

www.ecoaus.com.au



eco  
logical  
AUSTRALIA



**HEAD OFFICE**

Suite 4, Level 1  
2-4 Merton Street  
Sutherland NSW 2232  
T 02 8536 8600  
F 02 9542 5622

**SYDNEY**

Level 6  
299 Sussex Street  
Sydney NSW 2000  
T 02 8536 8650  
F 02 9264 0717

**ST GEORGES BASIN**

8/128 Island Point Road  
St Georges Basin NSW 2540  
T 02 4443 5555  
F 02 4443 6655

**CANBERRA**

Level 2  
11 London Circuit  
Canberra ACT 2601  
T 02 6103 0145  
F 02 6103 0148

**NEWCASTLE**

Suites 28 and 29, Level 7  
19 Bolton Street  
Newcastle NSW 2300  
T 02 4910 0125  
F 02 4910 0126

**NAROOMA**

5/20 Canty Street  
Narooma NSW 2546  
T 02 4476 1151  
F 02 4476 1161

**COFFS HARBOUR**

35 Orlando Street  
Coffs Harbour Jetty NSW 2450  
T 02 6651 5484  
F 02 6651 6890

**ARMIDALE**

92 Taylor Street  
Armidale NSW 2350  
T 02 8081 2681  
F 02 6772 1279

**MUDGEES**

Unit 1, Level 1  
79 Market Street  
Mudgee NSW 2850  
T 02 4302 1230  
F 02 6372 9230

**PERTH**

Suite 1 and 2  
49 Ord Street  
West Perth WA 6005  
T 08 9227 1070  
F 08 9322 1358

**WOLLONGONG**

Suite 204, Level 2  
62 Moore Street  
Austinmer NSW 2515  
T 02 4201 2200  
F 02 4268 4361

**GOSFORD**

Suite 5, Baker One  
1-5 Baker Street  
Gosford NSW 2250  
T 02 4302 1220  
F 02 4322 2897

**DARWIN**

16/56 Marina Boulevard  
Cullen Bay NT 0820  
T 08 8989 5601  
F 08 8941 1220

**BRISBANE**

Suite 1 Level 3  
471 Adelaide Street  
Brisbane QLD 4000  
T 07 3503 7191  
F 07 3854 0310

1300 646 131  
[www.ecoaus.com.au](http://www.ecoaus.com.au)