Adani Mining Pty Ltd

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Report for Carmichael Coal Mine and Rail Project

Ecology Report 25215-D-RP-0023

20 September 2012

Revision 2

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Abbreviations and Glossary

Project Specific Terminology	
Abbreviation	**Term**
BVC	Broad Vegetation Community – refers to the unique set of Broad Vegetation Groups defined for the Project (Rail).
the EIS	Carmichael Coal Mine and Rail Project Environmental Impact Statement
the Proponent	Adani Mining Pty Ltd
the Project	Carmichael Coal Mine and Rail Project
the Project (Mine)	Carmichael Coal Mine and Rail Project: Mine component
the Project (Rail)	Carmichael Coal Mine and Rail Project: Rail component
Study Area	A 2 km wide investigation area that encapsulates the Project (Rail) and associated rail-related infrastructure and temporary infrastructure over the length of approximately 189 km between the Project (Mine) and the connection with the QR National Goonyella rail system, 8 km south of Moranbah

Generic Terminology	
Abbreviation	**Term**
ANZECC	Australian and New Zealand Environment and Conservation Council
BBN	Brigalow Belt North
BOM	Bureau of Meteorology
BPA	Biodiversity Planning Assessment
BVC	Broad Vegetation Community
BVG	Broad Vegetation Group
CAMBA	Agreement between the Government of Australia and the Government of the People's Republic of China for the Protection of Migratory Birds and their Environment
DAFF	Department of Agriculture, Fisheries and Forestry
DEEDI	Former Department of Employment, Economic Development and Innovation
DEHP	Department of Environment and Heritage Protection
DERM	Former Department of Environment and Resource Management

Generic Terminology	
Abbreviation	**Term**
DEWHA	Former Department of Environment, Water, Heritage and the Arts
DNRM	Department of Natural Resources and Mines
DSEWPaC	Department of Sustainability, Environment, Water, Population and Communities
EP Act	*Environmental Protection Act 1994*
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999*
EPC	Exploration Permit for Coal
ERA	Environmentally Relevant Activity
FPC	Foliage Protective Cover
GAB	Great Artesian Basin
GIS	Geographic Information System
GPS	Global Positioning System
Ha	Hectares
HES	High Ecological Significance
IBRA	Interim Biogeographic Regionalisation of Australia
IRC	Isaac Regional Council
JAMBA	Agreement between the Government of Australia and the Government of Japan for the Protection of Migratory Birds in Danger of Extinction and their Environment
LP Act	*Land Protection (Pest and Stock Route Management) Act 2002*
NC Act	*Nature Conservation Act 1992*
NC Reg	Nature Conservation Regulation 2006
NES	National Environmental Significance
NRM	Natural Resource Management
ROKAMBA	Agreement between the Government of Australia and the Government of the Republic of Korea on the Protection of Migratory Birds
Qld	Queensland
QPIF	Queensland Primary Industries and Fisheries
RE	Regional ecosystem
SDPWO Act	*State Development and Public Works Organisation Act 1971*

Generic Terminology	
Abbreviation	**Term**
SEVT	Semi-evergreen Vine Thicket
SLATS	Statewide Landcover and Tree Study
SP Act	*Sustainable Planning Act 2009*
SPP	State Planning Policy
TEC	Threatened Ecological Community
ToR	terms of reference
TSSC	Threatened Species Scientific Committee
VAST	Vegetation Assets, States and Transitions
VM Act	*Vegetation Management Act 1999*
WONS	Weeds of National Significance

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Executive Summary

The Carmichael Coal Mine and Rail Project in central Queensland comprises two major components, one of which is a proposed coal mine on Exploration Permit for Coal (EPC) 1690 and part of EPC 1080. The mine will consist of both open cut and underground mining areas, and associated infrastructure. The second element is a greenfield rail line linking the mine to Moranbah. At full operation the mine is proposed to produce 60 million tonnes per annum of coal for export to the Port of Abbot Point and/or the Port of Hay Point.

This report summarises the findings of ecological assessments conducted along the proposed rail corridor (including associated rail-related–infrastructure and temporary infrastructure and associated Study Area). This report also assesses the potential impacts to flora and fauna, identifies any significant ecological constraints to development and recommends mitigation measures to manage potential impacts. For the purposes of this assessment and report, the rail corridor includes a 95 m wide corridor whereas the Study Area comprises a 2 km wide investigation area that encapsulates the rail corridor, infrastructure areas and construction camps over the length of approximately 190 km between Carmichael Mine and Moranbah the area.

To describe the existing environmental values of the Study Area, a combination of desktop assessments and field studies were conducted. The desktop assessment comprised a review of relevant literature, database searches and existing technical reports. Two field surveys (spring and autumn) were conducted to identify the existing terrestrial and aquatic ecological values of the Study Area and to supplement the information acquired from the desktop assessment. Flora and fauna surveys incorporated:

- Twenty four rapid flora assessment sites
- Two comprehensive and 22 rapid fauna assessment sites
- Additional field surveys undertaken during geotechnical investigations

The key findings from this assessment include:

Vegetation Communities, Habitats and the Study Area

The Project (Rail) occurs in a highly fragmented landscape, where land clearing to facilitate agriculture has been extensive. Remnant vegetation coverage occurs over approximately 20 per cent (367 ha) of the rail corridor and infrastructure and construction camp footprints. Where remnant vegetation occurs, a more complex assortment of habitat resources is available for fauna when contrasted with open cleared land.

At a landscape level, strips of remnant vegetation within the Study Area provide connectivity between larger tracts of remnant vegetation at several locations within and surrounding the Study Area. The Study Area is typically comprised of fragmented patches of remnant vegetation and extensive areas of non-remnant vegetation due to the historic broadscale land clearing that has taken place in recent decades.

In general, across the Study Area, disturbance to fauna habitats from cattle, weeds and feral animals was observed to be moderate to high. These disturbances were mainly observed in cleared areas and at watercourses and dams across the Study Area.

The Study Area contains a range of fauna habitat types that share broadly similar habitat values (based on habitat structure), but vary in their value for wildlife based on the specific forage and shelter resources they provide. A total of eight fauna habitat types were identified during the field surveys. Open cleared land was the most common and widespread fauna habitat type within the rail corridor and infrastructure and construction camp footprints. This habitat type typically provides a low diversity of suitable resources for fauna (including threatened species), as compared to the higher ecological value of remnant vegetation which occurred typically in association with watercourses and creek lines throughout the Study Area.

The Queensland Department of Environment and Heritage Protection (DEHP) Biodiversity Planning Assessment (BPA) mapping indicated that some remnant vegetation within and surrounding the Study Area is of regional ecosystem (RE) value, while much of this remnant vegetation is ranked as having very high or high ecosystem diversity and (ecosystem) context and connection.

The *Environment Protection and Biodiversity Conservation Act* 1999 (EPBC Act) listed threatened ecological community (TEC), Brigalow (*Acacia harpophylla* dominant and codominant) was identified as present onsite from field surveys and through a review of vegetation mapping. The presence of the Brigalow TEC was recorded from the occurrence of regional ecosystems 11.3.1, 11.4.8 and 11.4.9 within the rail corridor and temporary infrastructure and construction camp footprints, comprising a total area of 37.4 ha.

No DNRM mapped essential habitat occurs at the Study Area, although a number of patches (for a variety of species) occur in the landscape around the Study Area. No protected areas occur within the Study Area; however eleven protected areas were identified to occur within 50 km of the Study Area.

Flora Species

The Study Area supports a diversity of flora species – consolidated desktop search results for the region (i.e. the desktop search extent) revealed 311 vascular plant taxa have been previously recorded from the database Wildlife Online and 378 vascular taxa plant have been previously recorded from the HERBRECS database.

Native flora species were prevalent across much of the Study Area that was associated with remnant vegetation. Field studies identified 114 native flora taxa and 11 introduced taxa at the Study Area. Of the 11 introduced taxa species, three are declared weeds under the LP Act.

No threatened flora species listed under the EPBC Act were recorded within the Study Area from field surveys. Two EPBC Act listed threatened flora species (*Acacia ramiflora* and *Dichanthium queenslandicum* (king bluegrass)) may occur within the Study Area based on suitability of habitat within the Study Area and current known distribution. No threatened flora species listed under the NC Act were recorded within the Study Area from field surveys. Two threatened flora species listed under the NC Act have the potential to occur at the Study Area based on suitability of habitat, and current known distribution.

Fauna Species

The Study Area supports a diversity of fauna species – consolidated desktop search results for the region (i.e. the desktop search extent) revealed 238 species have been previously recorded. Fauna species diversity recorded in field surveys was low for the region and, in general, the fauna recorded

in the May and September surveys were relatively common species. In total, field surveys recorded 129 species.

The vast majority of fauna species recorded from the Study Area were common, widely distributed species. A total of six introduced fauna species were recorded. Notwithstanding the cane toad (*Rhinella marina*), introduced animals were recorded to occur at relatively low densities.

One threatened bird listed under the EPBC Act was recorded – *Geophaps scripta scripta* (squatter pigeon (southern)). The squatter pigeon is likely to be locally common where suitable habitat was present at the Study Area. Potential habitat occurring within and beyond the Study Area for this species was identified. A further ten EPBC Act listed threatened fauna species are considered as likely to occur or may occur at the Study Area (based on suitability of habitat, previous records from region, current known distribution). Potential habitat for these species (*Egernia rugosa* (yakka skink), *Denisonia maculata* (ornamental snake), *Paradelma orientalis* (brigalow scaly-foot), *Furina dunmalli* (Dunmall's snake), *Dasyurus hallucatus* (northern quoll), *Nyctophilus timoriensis* (greater long-eared bat), *Phascolarctos cinereus* (koala), *Pomatostomus temporalis* (black-throated finch), *Erythrotriorchis radiatus* (red goshawk) and *Rostratula australis* (Australian painted snipe)) was identified.

Two common EPBC Act listed migratory bird species (*Ardea alba* (great egret) and *Merops ornatus* (rainbow bee-eater)) were recorded at the Study Area. In addition to these, two EPBC Act listed migratory bird species not recorded during field studies are considered as likely to occur within the Study Area (*Haliaeetus leucogaster* (white-bellied sea-eagle) and *Myiagra cyanoleuca* (satin flycatcher)).. Habitats at the Study Area are not considered likely to support important assemblages of migratory species.

In addition to the EPBC Act listed squatter pigeon (southern), one NC Act listed fauna species, *Chalinolobus picatus* (little pied bat) was recorded from field surveys. Three threatened fauna species listed under the NC Act (in addition to those also listed under the EPBC Act) are considered likely to occur in the Study Area based on suitability of habitat, previous records from region, current known distribution. These are the *Ephippiorhynchus asiaticus* (black-necked stork), *Falco hypoleucos* (grey falcon) and *Nettapus coromandelianus* (cotton pygmy-goose).

Potential Impacts and Mitigation Measures

Potential impacts to terrestrial and aquatic ecology values associated with the Project have been summarised into four broad categories which include:

- Clearing of vegetation
- Disturbances of watercourses and changes to surface water flows
- Increased anthropogenic activity leading to disturbance
- Introduction of weeds and feral pest species

In general, the construction footprint and surrounding Study Area is not considered to support an 'important population' or 'habitat critical to the survival' of any EPBC Act listed threatened fauna species (i.e. squatter pigeon (southern), ornamental snake, yakka skink, brigalow scaly-foot, Dunmall's snake, greater long-eared bat, red goshawk, northern quoll, Australian painted snipe). Thus, the Project (Rail) (and associated impacts) is not considered to constitute a 'significant impact' to any of these species.

Clearing for the construction footprint will result in the loss of REs that have the potential to also qualify as an EPBC Act listed TEC. The total area of potential TEC (to be confirmed through further ground-truthing) to be cleared from within the construction footprint includes:

- 37.4 ha of REs that are constituents of the Brigalow (*Acacia harpophylla* dominant and co-dominant) TEC.

A suite of mitigation measures have been outlined to address impacts from the Project on environmental values. Mitigation measures to address the potential impacts of the Project can be broadly summarised into the following categories:

- Avoidance
- Minimisation
- Offsets

Offsets will be required under Commonwealth and State legislation where unavoidable impacts to identified ecological values cannot be reasonably managed / mitigated. The exact interaction between the State and Federal legislation is yet to be determined. However there is likely to be a combination of both pieces of legislation. An offset strategy will need to be provided which clearly identifies the residual Project impacts and associated offset requirements, and proposes various offset options that meet relevant legislative requirements

The strategy required to meet offset obligations should include:

- Quantifying offset requirements (including threatened species) under state and federal policies
- Identifying offset opportunities onsite and on land owned by Adani Mining Pty Ltd
- Identifying neighbouring properties that have the potential to meet offset requirementsMaking financial contributions for residual requirements

1. Introduction

1.1 Overview

Adani is proposing to develop a 60 million tonne (product) per annum (Mtpa) thermal coal mine in the north Galilee Basin approximately 160 kilometres (km) north-west of the town of Clermont, Central Queensland. All coal will be railed via a privately owned rail line connecting to the existing QR National rail infrastructure, and shipped through coal terminal facilities at the Port of Abbot Point and the Port of Hay Point (Dudgeon Point expansion). The Carmichael Coal Mine and Rail Project (the Project) will have an operating life of approximately 90 years.

The Project comprises of two major components:

- The Project (Mine): a greenfield coal mine over EPC1690 and the eastern portion of EPC1080, which includes both open cut and underground mining, on mine infrastructure and associated mine processing facilities (the Mine) and the Mine (offsite) infrastructure including:
  - A workers accommodation village and associated facilities
  - A permanent airport site
  - Water supply infrastructure
- The Project (Rail): a greenfield rail line connecting the Mine to the existing Goonyella and Newlands rail systems to provide for the export of coal via the Port of Hay Point (Dudgeon Point expansion) and the Port of Abbot Point, respectively; including:
  - Rail (west): a 120 km dual gauge portion from the Mine site running west to east to Diamond Creek
  - Rail (east): a 69 km narrow gauge portion running east from Diamond Creek connecting to the Goonyella rail system south of Moranbah

The Project has been declared a 'significant project' under the *State Development and Public Works Organisation Act 1971* (SDPWO Act) and as such, an Environmental Impact Statement (EIS) is required for the Project. The Project is also a 'controlled action' and requires assessment and approval under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

The Project EIS has been developed with the objective of avoiding or mitigating all potential adverse impacts to environmental, social and economic values and enhancing positive impacts. Detailed descriptions of the Project are provided in Volume 2 Section 2 Project Description (Mine) and Volume 3 Section 2 Project Description (Rail).

Figure 1-1 shows the Project location.

LEGEND

- Town
- Major Port
- Other Rail Network
- Goonyella System
- Newlands System
- State Road
- Local Road
- Watercourse
- Local Government Area
- Project (Rail)
- Rail (West)
- Rail (East)
- Project (Mine)
- Mine (Offsite)

1:2,000,000 (at A4)

0 10 20 30 40 50

Kilometres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia (GDA)
Grid: Map Grid of Australia 1994, Zone 55

N

Adani Mining Pty Ltd

Carmichael Coal Mine and Rail Project

Job Number 41-25215
Revision L
Date 28-08-2012

Project Location

Figure: 1-1

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Level 4, 201 Charlotte St Brisbane QLD 4000 T +61 7 3316 3000 F +61 7 3316 3333 E bnemail@ghd.com W www.ghd.com

Data Source: © Commonwealth of Australia (Geoscience Australia): Town, Railways, Watercourses (2007); DERM: LGA, (2011), Hillshade (2009); DMR: State Roads (2008); Gassman/Hyder: Mine (Offsite) (2012); DME: EPC1690 (2010), EPC1080 (2011); Adani: Alignment Opt9 Rev3 (2012). Created by: BW, JVC

1.2 Assessment Scope

For the purposes of this Project (Rail) assessment and report, the following definitions apply:

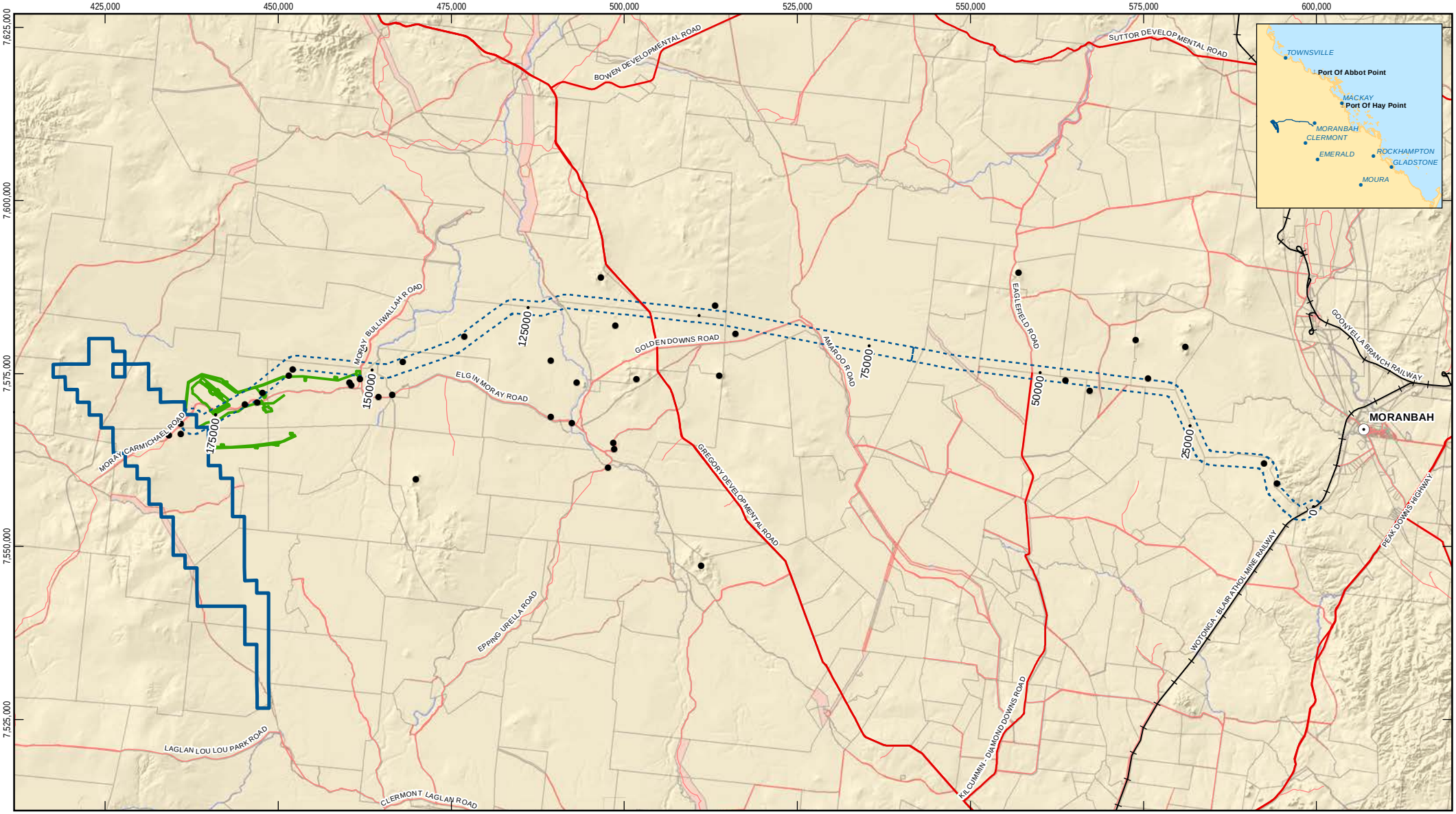
- Rail and associated rail-related infrastructure corridor (the 'rail corridor') – a nominally 95 m wide rail corridor for the Project (Rail) that comprises a greenfield rail line (approximately 189 km) connecting the Project (Mine) to the existing Goonyella rail system.
- Additional temporary infrastructure areas (i.e. laydown areas) and temporary construction camps– areas outside of the 95 m wide rail that will be exposed to temporary disturbance during the construction phase of the Project.

To inform the assessment of impacts of the Project (Rail), a 2 km 'Study Area' was defined. This area, encapsulating the rail corridor (including associated rail-related infrastructure) and additional temporary infrastructure, was the focus of desktop and field studies. The objective of the assessment was to characterise the ecological values of this Study Area, through a review of desktop information and field survey data, such that impacts occurring within this area could be informed. The assessment also considered the context of the values identified from the Study Area with respect to the surrounding landscape in which it occurs. This broader scale assessment allowed for impacts to landscape-scale processes such as wildlife movement to be informed, as well as providing a context for the values identified within the Study Area, and importantly, the potential impacts to these values.

The Study Area is shown in Figure 1-2.

Calculations presented in this report (i.e. relating to areas of vegetation, areas of habitat) relate to impact areas; that is, areas that will be exposed to direct disturbance as a result of activities associated with the Project (Rail), such as vegetation clearing during the construction phase.

Note: in addition to the rail corridor and additional infrastructure areas, 30 preliminary locations have been identified for the sourcing of quarry material for ballast and borrow material (fill) for sub-grade formation earthworks. At this stage, these locations are indicative only, and will be refined as the resources are proven through geotechnical investigations and Project design progresses. The actual number of locations that will be disturbed for the sourcing of material will be less than the 30 that are being considered currently. Due to the uncertainty regarding these sites, impacts associated with this facet of the Project (Rail) have not been presented in this assessment. It is acknowledged that when more certainty about the location and extent of these quarry and borrow areas is known, assessment of impacts to ecological values will need to be undertaken.



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0 5 10 15 20 25

Kilometres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia (GDA)
Grid: Map Grid of Australia 1994, Zone 55

N

LEGEND

- Investigation Areas
- Town
- State Road
- Local Road
- Other Railway
- Cadastral Parcel
- Road Reserve
- Watercourse Reserve
- Mine (Onsite)
- Mine (Offsite)
- Study Area

Adani Mining Pty Ltd

Carmichael Coal Mine and Rail Project

Project (Rail) Ecology Study Area

Job Number	41-25215
Revision	D
Date	14-09-2012

Figure 1-2

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Data source: DERM: DEM (2008), DCDB (2010); DME: EPC1690 (2010) / EPC1080 (2011); Adani: Alignment Opt9 Rev3 (SP1&2), Investigation Areas (2012);
 Created by: BW, MS, CA

Section 3.3 of the Project terms of reference (May, 2011) identifies the attributes and values of the terrestrial and aquatic environment that are to be specifically investigated in the EIS. This ecological assessment addresses the terms of reference relevant to the Project (Rail). Cross reference with the terms of reference is provided in Appendix A and summarised in Table 1-1.

Table 1-1 Terms of Reference Cross Reference

Terms of Reference Requirement/Section Number	Cross-reference
Nature Conservation	
Detail the existing nature conservation that may be affected.	Section 2
Flora and Fauna Surveys should address species structure, assemblage, diversity and abundance.	Section 1.4
Describe methodologies and standards used for flora and fauna surveys and compare them to best practice in the appendices in the EIS.	Section 1.4
Identify key flora and fauna indicators of ongoing monitoring.	Section 2.4 and 2.5
3.3.1 Sensitive Environmental Areas On a map of suitable scale, identify areas in proximity to the project that are environmentally sensitive. This should include areas classified as having national, state, regional or local biodiversity significance, or flagged as important for their integrated biodiversity values.	Figure 2-2, Figure 2-4, Figure 2-6 and Figure 3-13
Refer also to both Queensland and Commonwealth Government legislation and policies on threatened species and ecological communities.	Section 3
Discuss all the likely direct and indirect impacts of the project on species, communities and habitats of local, regional or national significance in sensitive environmental areas as identified above.	Section 5
Cover terrestrial and aquatic environments and address any fragmentation impacts.	Section 5.2, 5.3, 6.2 and 6.3
Also, include human impacts and the control of any domestic animals introduced to the area.	Section 5.4, 5.5, 6.4 and 6.5
Demonstrate how the project would comply with the following hierarchy: avoiding impact on areas of remnant vegetation and other areas of conservation value including listed species and their habitat	Section 5.2
mitigating impacts through rehabilitation and restoration including, where relevant, a discussion of any relevant previous experience or trials of the proposed rehabilitation	Section 5.2
measures to be taken to replace or offset the loss of conservation values where avoiding and mitigating impacts cannot be achieved	Section 7 Volume 1 Section 11 Draft Offsets Strategy

Terms of Reference Requirement/Section Number	Cross-reference
Nature Conservation	
Explain why the measures above would not apply in areas where loss would occur.	Section 5.2
Discuss the boundaries of the areas impacted by the project within or adjacent to an endangered ecological community, including details of footprint width.	Section 3.2
Where the project area would impact upon a threatened community, the discussion should include reasons for the preferred alignment and the viability of alternatives.	Section 3.2
Consider the high biodiversity values of Bygana West NR and, in accordance with mining best practice, first demonstrate ways to avoid impacting this area, second demonstrate mitigating measures and offsetting impacts relating to Bygana West Nature Refuge.	Section 1.1
Address any actions of the project or likely impacts that require an authority under the NC Act, and/or would be assessable development for the purposes of the VM Act.	Section 1.1
Outline proposed mitigation measures will be implemented in the overall EMP for the project.	Volume 3 Section 13 Environmental Management Plan
Where relevant, discuss environmental offset requirements in accordance with the *Queensland Government Environmental Offsets Policy* and take into account the applicable specific-issue offset policies as follows: Policy for Vegetation Management Offsets	Section 7.3
Mitigation and Compensation for Works or Activities Causing Marine Fish Habitat Loss	Section7.3
Draft Policy for Biodiversity Offsets Proposals to offset unavoidable impacts to biodiversity values are to be made via use of the framework outlined in the draft Policy for Biodiversity Offsets, a specific issues offset policy in accordance with the Queensland Government Environmental Offsets Policy (QGEOP). The draft policy is due for finalisation in 2011. Any offset package should include offsets for the ecological values that will be lost as a result of the mine development and should be consistent with the principles of the Queensland Government Environmental Offset Policy 2008.	Section 7.3
Describe where, if any, departures from a no net loss of ecological values occurs	Section 5.2 Volume 1 Section 11 Draft Offsets Strategy
3.3.2 Terrestrial Flora Specifically assess any potential impacts on a Category A or B environmentally sensitive area and propose measures and impacts.	N/A

Terms of Reference Requirement/Section Number	Cross-reference
Nature Conservation	
Describe and assess the potential impacts of any actions of the project or likely impacts that require an authority under the NC Act.	Section 1.3
Provide vegetation mapping for all relevant project sites.	Figure 2-2

1.3 Relevant Legislation

1.3.1 Environment Protection and Biodiversity Conservation Act 1999

The EPBC Act is the Commonwealth's principle piece of environmental protection legislation. It provides a national framework for the protection of the Australian environment and its unique biodiversity. Specifically, the EPBC Act aims to protect the environment by reducing significant impacts to matters of National Environmental Significance (NES), these being:

- World heritage properties
- National heritage places
- Wetlands of international importance (listed under the Ramsar Convention)
- Listed threatened species and ecological communities
- Migratory species (protected under international agreements)
- Commonwealth marine areas
- Great Barrier Reef Marine Park
- Nuclear actions

The EPBC Act also provides a systematic framework for assessment and approval of actions potentially impacting matters of NES. The Project was declared a 'controlled action' requiring assessment and approval under the EPBC Act on 6 January 2011 due to the likely potential impacts on matters of NES. The controlling provisions for the Project (i.e. those matters of NES which the Project (mine and rail) is likely to have a significant impact on) include:

- World Heritage properties (section 12 & 15A)
- National Heritage places (section 15B & 15C)
- Wetlands (Ramsar) (section 16 & 17B)
- Listed threatened species and communities (sections 18 & 18a)
- Listed migratory species (section 20 & 20A)
- Great Barrier Reef Marine Park (section 24B & 24C)

1.3.2 State Development and Public Works Organisation Act 1974

The SDPWO Act facilitates the timely, coordinated and environmentally responsible infrastructure planning and development in Queensland. It is the framework used to declare proposed development as a 'significant project' requiring an EIS. The Commonwealth has accredited the Queensland EIS process under the SDPWO Act and as such, projects are assessed by the Commonwealth Environment Minister under a bilateral agreement with the Queensland Government.

Approval for the Project under Part 9 of the EPBC Act will be required from the Commonwealth Environment Minister before it can proceed.

1.3.3 Nature Conservation Act 1992

The NC Act provides for the conservation of nature through protection of all native plants and animals in Queensland. Protection is provided under the NC Act through conservation of land in the form of protected areas outside of protected areas estate. Actions impacting on protected native flora and fauna are regulated under the NC Act. Permits for disturbance to native flora and fauna can be administered under the NC Act. The Queensland NC Reg lists flora and fauna species considered to be extinct in the wild, endangered, vulnerable, near threatened or special least concern in Queensland. Additionally, where NC Act-listed threatened species will be impacted by the Project (Rail), offsets will be required under the *Biodiversity Offset Policy* (DERM, 2011c) (refer Volume 1 Section 11 Draft Offsets Strategy).The NC Act applies to the Project (Rail) where any least concern native flora and fauna species, conservation significant flora and fauna species, and their habitat and/or breeding places are likely to be impacted (See Section 3.3.4).

1.3.4 Vegetation Management Act 1999

The VM Act provides a framework for the regulation of woody, terrestrial native vegetation located outside of protected areas. The stated purpose of the VM Act is to regulate the clearing of native vegetation in a way that:

- Conserves remnant vegetation that is an endangered, of concern or least concern RE
- Conserves vegetation in declared areas
- Ensures clearing does not cause land degradation
- Prevents biodiversity loss
- Maintains ecological processes
- Manages the environmental effects of the clearing to ensure the above purposes are obtained

The Act provides for the establishment and mapping of REs that encompass vegetation community descriptions within a geological and bioregional context and for the creation and use of clearing codes (among other things). In addition, it provides a process for RE mapping changes by the public, and for the investigation and prosecution of clearing offences. Details on what clearing activities require assessment against the various regional clearing codes authorised under the VM Act are provided by the *Sustainable Planning Act 2009* (SP Act). The codes that apply to vegetation clearing for the Project (Rail) include:

- *Regional Vegetation Management Code for Brigalow Belt and New England Tablelands Bioregions – version 2* (DERM, 2009b)

- *Regional Vegetation Management Code for Western Bioregions – version 2* (DERM, 2009c)

Clearing activities, involving the loss of REs, as part of the Project (Rail) will be regulated by the VM Act (see Section 2.4.1).

1.3.5 Sustainable Planning Act 2009

The purpose of the SP Act is to achieve ecological sustainability by:

- Managing the process by which development takes place, including ensuring that the process is accountable, effective and efficient and delivers sustainable outcomes
- Managing the effects of development on the environment
- Providing for the coordination and integration of planning at the local, regional and State levels

Clearing of assessable vegetation in Queensland is regulated through the SP Act in conjunction with the VM Act. Schedule 3, Table 4 of the SP Act identifies when a permit is required for the clearing of native vegetation. A permit for the removal of remnant native vegetation is required for freehold, road reserve, lease hold, trust land, unallocated State land or land subject to a licence or permit under the *Land Act 1994* unless otherwise exempt as prescribed under Schedule 24 of the *Sustainable Planning Regulation 2009* (the SP Regulation).

1.3.6 Land Protection (Pest and Stock Route Management) Act 2002

The *Land Protection (Pest and Stock Route Management) Act 2002* (LP Act) identifies declared pest plant and animal species, and provides for their control. The LP Act imposes a legal responsibility on all landowners to control declared species on their land (subject to certain conditions). Specific management actions are required by landholders depending on the classification of declared pests under the LP Act, with three separate categories of declared pest prescribed including Class 1, Class 2 and Class 3. Landowners are required to remove Class 1 and Class 2 pests from their property and prevent them spreading to other areas. Class 3 pests cannot be sold or traded but are required to be controlled only if growing adjacent to an environmentally sensitive area (as declared by local councils). Weed species associated with the Project (Rail) and relevant to the LP Act are highlighted in Section 2.4.5.

1.3.7 Environmental Protection Act 1994

The aim of the *Environmental Protection Act 1994* (the EP Act) is to protect Queensland's environment while allowing for development that improves the quality of life as well as maintaining the ecological processes on which it depends.

The EP Act also imposes a general environmental duty on all persons (including corporations) such that they must not conduct any activity that causes, or is likely to cause, environmental harm, unless they take all reasonable and practicable measures to prevent or minimise the harm.

The *Environmental Protection Regulation 2008* supports the environmental impact statement process and identifies environmental relevant activities (ERAs) prescribed under the EP Act. Among other matters, the regulation defines Category A and Category B environmentally sensitive areas.

1.3.8 State Planning Policy

State Planning Policy 4/11: Protecting Wetlands of High Ecological Significance in Great Barrier Reef Catchments

State Planning Policy (SPP) 4/11: Protecting Wetlands of High Ecological Significance in Great Barrier Reef Catchments (SPP 4/11) seeks to ensure development involving high impact earthworks in or near wetlands of high ecological significance (HES) is planned, located, designed, constructed and operated appropriately to prevent the loss or degradation of wetlands and their environmental values, or to enhance these values. SPP 4/11 was released in November 2011. DEHP has produced a map of referrable wetlands, indicating where SPP 4/11 applies. Wetlands considered being of high ecological significance in Great Barrier Reef catchments have been mapped as Wetland Protection Areas. These core protection areas have a 500 m assessable development trigger area (measured from the wetland boundary) around them. SPP 4/11 includes an assessment code to guide decision makers with regards to future development in wetlands considered to be of high ecological significance in Great Barrier Reef catchments.

SPP 4/11 for the protection of wetlands of high ecological significance in Great Barrier Reef Catchments is a statutory instrument under the SP Act.

1.4 Approach and Methodology

A combination of desktop assessments and field studies were undertaken to describe the existing terrestrial and aquatic ecological values of the Study Area and to allow for the potential direct and indirect impacts of the Project (Rail) on ecological values to be assessed, such that the extent and magnitude of impacts can be appropriately minimised and managed.

The desktop assessment comprised a review of relevant literature, database searches and existing technical reports. Field studies were conducted to obtain ecological information relevant to the Project and to ground-truth results from desktop assessments.

This section outlines the approach to describing the existing terrestrial and aquatic ecological values of the Study Area.

1.4.1 Nomenclature

Scientific and common names for flora and fauna are consistent with those used in the following sources:

- Census of the Queensland Flora (Bostock and Holland, 2010) and botanical binomials presently accepted by the Queensland Herbarium, DEHP
- RE descriptions follow those in the Regional Ecosystem Description Database (v6.0b) (Queensland Herbarium, 2011)
- Handbook of Australian, New Zealand and Antarctic Birds Volume 1 – Volume 7 (Marchant and Higgins, 2004)
- A Field Guide to the Mammals of Australia (Menkhorst and Knight, 2004)
- A Complete Guide to Reptiles of Australia (Wilson and Swan, 2008)
- A Field Guide to Australian Frogs (Barker *et al.*, 1995)

1.4.2 Desktop Assessment

Desktop studies were undertaken to provide information on mapped vegetation assemblages, sensitive areas and aquatic and terrestrial flora and fauna species presence (known or predicted) within and/or of relevance to the Study Area.

Information relating to the terrestrial and aquatic ecological values of the Study Area was obtained from a variety of literature and database sources. Details of these sources are provided in Table 1-2.

Table 1-2 Summary of Desktop Sources

Source and name	Description of information source	Desktop Search extent	Limitations of use
DSEWPaC Protected Matters Search Tool and Environmental Reporting Tool	The Protected Matters Search Tool identifies matters of NES and other matters protected by the EPBC Act that may occur within or relate to the Study Area. The tool predicts the potential presence of a species/ecological community in an area based on bioclimatic modelling, known distribution and habitat preferences. The DSEWPaC Environmental Reporting Tool was also queried to provide information on invasive species that have the potential to occur, and nationally important wetlands within or near the Study Area.	Line searches (approximating with the centrelines of the rail corridors of the Study Area: -22.01, 146.37 - western extent; -22.10, 147.96 - eastern extent) with 10 km buffers were undertaken. Point searches using central coordinates of each borrow area, each with a 2 km buffer, were undertaken.	This is a predictive tool only – it does not necessarily indicate that a species/ecological community occur in a defined area. Presence of a species/ecological community is predicted based on a combination of bioclimatic modelling, known distribution and habitat preferences. In predicting species/community presence, it allows for field survey efforts to be targeted.
DSEWPaC Directory of Important Wetlands	The Directory of Important Wetlands identifies nationally important wetlands. The DSEWPaC Protected Matters Search Tool (see above) lists nationally important wetlands occurring within or related to prescribed search extents.	Line searches (approximating with the centrelines of the rail corridors of the Study Area: -22.01, 146.37 - western extent; -22.10, 147.96 - eastern extent) with 10 km buffers were undertaken. Point searches using central coordinates of each borrow area, each with a 2 km buffer, were undertaken.	NA - this mapping identifies the location of wetlands that satisfy at least one criterion agreed upon by the Australian and New Zealand Environment and Conservation Council (ANZECC) Wetlands Network in 1994.

Source and name	Description of information source	Desktop Search extent	Limitations of use
DERM / DNRM RE mapping (Version 6.0b)	The Queensland DNRM maps remnant vegetation using the RE classification system. REs are defined as vegetation communities in a bioregion that are consistently associated with a particular combination of geology, landform and soil (Sattler and Williams, 1999). REs are classified under the Queensland VM Act as being endangered, of concern or least concern.	Mapping was obtained for the Study Area and the adjacent landscape in an electronic data layer for analysis in a Geographic Information System (GIS) environment.	RE mapping is informed by interpretation of landform, substrate, photo/satellite imagery and where available, field data. The mapping has undergone little or no ground-truthing in many parts of Queensland. Because of this, and the scale at which the mapping is created, RE mapping does not always accurately depict vegetation assemblages on the ground. As such, ground-truthing of REs is a fundamental aspect of field studies for ecological survey.
DERM / DNRM Regrowth vegetation mapping (Version 2)	Mapped 'high value regrowth vegetation' produced by DNRM. Regrowth vegetation comprises non-remnant vegetation that has reached an advanced stage of growth and not been cleared since 31 December 1989.	Mapping obtained for the Study Area and adjacent landscape in an electronic data layer for GIS analysis.	Regrowth mapping is informed by statewide landcover and tree study (SLATS) foliage protective cover (FPC) and pre-clearing RE mapping. The mapping has undergone little or no ground-truthing in many parts of Queensland and like the RE mapping does not always accurately depict on the ground characteristics As such, ground-truthing is required.
DERM / DNRM Essential habitat mapping (Version 3)	Essential habitat is defined as 'vegetation in which a species that is endangered, vulnerable or near threatened under the NC Act has been known to occur' (DERM, 2011a). DNRM maps Essential Habitat (and Essential Regrowth Habitat) in conjunction with remnant and regrowth vegetation mapping.	Mapping obtained for the Study Area and adjacent landscape in an electronic data layer for GIS analysis.	As Essential Habitat and Essential Regrowth Habitat mapping is underpinned by RE/regrowth mapping, the constraints associated with mapping scale and lack of ground-truthing are applicable to this information source.
DERM / DEHP Wetland mapping	Various mapping layers produced by DEHP (including Wetland Protection Areas).	Mapping obtained for the Study Area and adjacent landscape in an electronic data layer for GIS analysis.	Wetlands are identified using the DEHP AquaBAMM Methodology – the on-ground values of individual wetlands identified through this methodology have not necessarily been assessed, as designation is primarily based on existing literature and expert opinion. As such, designation does not reveal the value of these systems for local flora and fauna.

Source and name	Description of information source	Desktop Search extent	Limitations of use
DERM / DEHP Biodiversity Planning Assessment (BPA) mapping – Brigalow Belt bioregion and Desert Uplands bioregion and Biodiversity Planning Assessment expert panel reports	Identifies landscape scale biodiversity features at varying levels of significance (local, regional, state). The mapping methodology is underpinned by DNRM's remnant vegetation (i.e. RE) mapping. Expert panel reports provide information on the landscape-scale values of bioregions, and in some instances identify bioregional priority taxa.	Mapping obtained for the Study Area and adjacent landscape in an electronic data layer for GIS analysis.	As BPA mapping is underpinned by RE mapping, the constraints associated with mapping scale and lack of ground-truthing is applicable to this information source.
DERM / DEHP *Burdekin Natural Resource Management Region Back on Track Actions for Biodiversity* report (DERM, 2010a)	This document identifies priority species in the Burdekin Natural Resource Management (NRM) region, details the regional threatening processes impacting upon these species, and proposes a range of actions to address regional threats. Priority taxa are identified through the DEHP Back on Track species prioritisation framework, in consultation with a range of stakeholders from the region. The document seeks to guide priority species conservation in the region over the next five years.	The document covers the entire Burdekin NRM region (in which a large portion of the Study Area occurs).	Some species/impacts listed in this document are not relevant to the Study Area, as the Burdekin NRM region encompasses a large area of central Queensland.
DERM / DEHP Wildlife Online database	The DEHP Wildlife Online database maintains a catalogue of animal and plant species records from specific localities across Queensland. As well as common species, records of animals and plants listed as threatened under the NC Act are contained within the database.	A rectangular area was searched, approximating with the centreline of the Study Area: -22.01, 146.37 - western extent; -22.10, 147.96 - eastern extent with a 10 km buffer was undertaken. Point searches using central coordinates of each borrow area, each with a 2 km buffer, were undertaken.	This database catalogues known records of species in a defined area. DEHP recommend that independent verification of records should be undertaken to inform the accuracy and completeness of information catalogued within this database (i.e. field surveys).

Source and name	Description of information source	Desktop Search extent	Limitations of use
DERM / DEHP (Queensland Herbarium) HERBRECS specimen database	The HERBRECS database catalogues flora specimen records obtained throughout Queensland.	A rectangular area was searched, approximating with the centreline of the Study Area: -22.01, 146.37 - western extent; -22.10, 147.96 - eastern extent) with a 20 km buffer.	This database catalogues known records of species in a defined area. The age and lack of spatial precision of species records may limit their value for inclusion in current studies in some instances.
Queensland Museum Queensland Museum Data Search	The Queensland Museum catalogues vertebrate fauna specimen records obtained throughout Queensland.	A rectangular area was searched, approximating with the centreline of the Study Area: -22.01, 146.37 - western extent; -22.10, 147.96 - eastern extent) with a 10 km buffer.	This database catalogues known records of species in a defined area. The age and lack of spatial precision of species records may limit their value for inclusion in current studies in some instances.
Birds Australia Bird Atlas Data	Birds Australia maintains a database of bird records from across Australia.	A rectangular area was searched, approximating with the centreline of the Study Area: -22.01, 146.37 - western extent; -22.10, 147.96 - eastern extent) with a 10 km buffer.	This database catalogues known records of species in a defined area. The age and lack of spatial precision of species records may limit their value for inclusion in current studies in some instances.
Publically available EIS documents for projects in the wider region surrounding the Study Area.	Alpha Coal Project EIS (Hancock Prospecting Pty Ltd, 2010) Galilee Coal Project EIS (Waratah Coal Pty Ltd, 2011) (also known as China First Coal Project).	The description of the existing environmental values of landscapes in which other major development projects are proposed to occur were assessed – namely with respect to results of surveys and detection of threatened species.	The EIS project areas do not always correlate with the Project (Rail) Study Area. Consequently, this may limit the applicability of the information presented in these EIS documents to the current Study Area.

1.4.3 Field Surveys

Field surveys were undertaken within and near the Project (Rail) corridor as discussed below. The description of the ecological values associated with quarry and borrow areas is based on desktop assessments.

Field surveys were conducted within and near the Study Area to identify the existing terrestrial and aquatic ecological values of the Study Area and to supplement and ground truth the information acquired from the desktop assessment (including verification of the likelihood of occurrence of EPBC Act and NC Actlisted flora and fauna species). Verification of the desktop assessment results was based on direct observations of flora, REs, fauna, fauna traces or suitable habitat for flora and fauna species.

An autumn survey was undertaken in dry conditions between 16 May 2011 and 20 May 2011 (hereafter referred to as the May survey). A spring survey was undertaken in dry conditions between 5 September 2011 and 9 September 2011 (hereafter referred to as the September survey).

1.4.3.1 Survey Weather Conditions

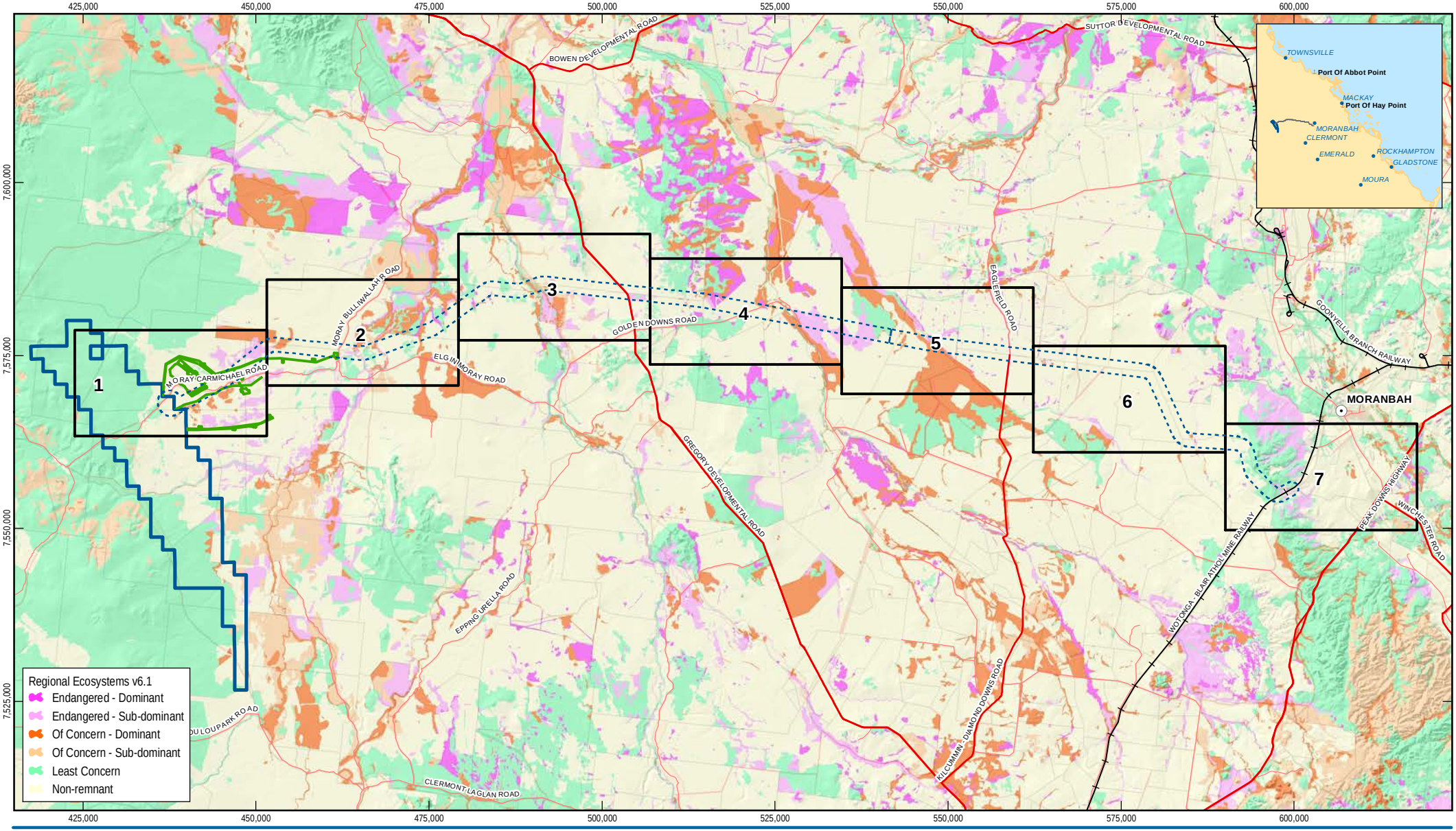
All weather data presented below was sourced from the nearest Australian Bureau of Meteorology (BOM) weather station, namely – Clermont Sirus Street (Station ID035019), located approximately 150 km south from the approximate centre of the Study Area (BOM, 2011).

In the three months leading up to the May survey (i.e. February – April 2011) 225 mm of rain was recorded in Clermont. This is comparable with the long-term average (1870-2011) of 228.4 mm for these three months, however February recorded lower than average rainfall and March recorded higher than average rainfall (BOM, 2011). During the five day survey period in early May, conditions were fine but cool and windy. Temperatures ranged between an overnight minimum of 7.2 °C (mean of 8.8 °C) and a daily maximum of 24.6 °C (mean of 23.6 °C). No rainfall was recorded in the week of survey, although isolated showers were observed in the district (BOM, 2011).

In the three months leading up to the September survey (i.e. June – August 2011) 43.1 mm of rain was recorded in Clermont. This is below the long-term average (1870-2011) of 77.9 mm for these three months however, 10.9 mm of rainfall was recorded during the two weeks leading up to the field survey (BOM, 2011). Weather conditions during the September survey were typified by warm, clear days and mild to cool nights. Temperatures ranged between an overnight minimum of 10°C (mean 12.1°C) and a daily maximum of 27.3°C (mean 25.7°C).

1.4.3.2 Terrestrial Flora Survey Techniques

Flora surveys were undertaken at 24 rapid survey sites within and near the Study Area. Rapid survey sites equate to a quaternary level of survey using the methodology developed by the Queensland Herbarium (DEHP) and outlined in *Methodology for Survey and Mapping of Regional Ecosystems and Vegetation Communities in Queensland* (Neldner *et al*., 2005). Given the timing of surveys and the greater dependency of other assessment methods (e.g. BioCondition, Secondary-level assessments) on the presence of species in the ground layer, quaternary-level assessment methods were considered as best practice for the Project (Rail). Additionally, quaternary assessments are recognised and recommended by DEHP for undertaking surveys to obtain records of field traverses and to verify regional ecosystem mapping (Neldner *et al.*, 2005). Locations of terrestrial flora survey sites are presented in Figure 1-3. GPS coordinates for each survey site are provided in Appendix B.



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Kilometres

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Horizontal Datum: Geocentric Datum of Australia (GDA)
Grid: Map Grid of Australia 1994, Zone 55

N

LEGEND

- Town
- State Road
- Local Road
- Other Railway
- Cadastral Parcel
- Road Reserve
- Watercourse Reserve
- Mine (Onsite)
- Mine (Offsite)
- Study Area

Adani Mining Pty Ltd
Carmichael Coal Mine and Rail Project

Terrestrial Flora Survey Sites and Aquatic Survey Sites

Job Number 41-25215
Revision C
Date 05-09-2012

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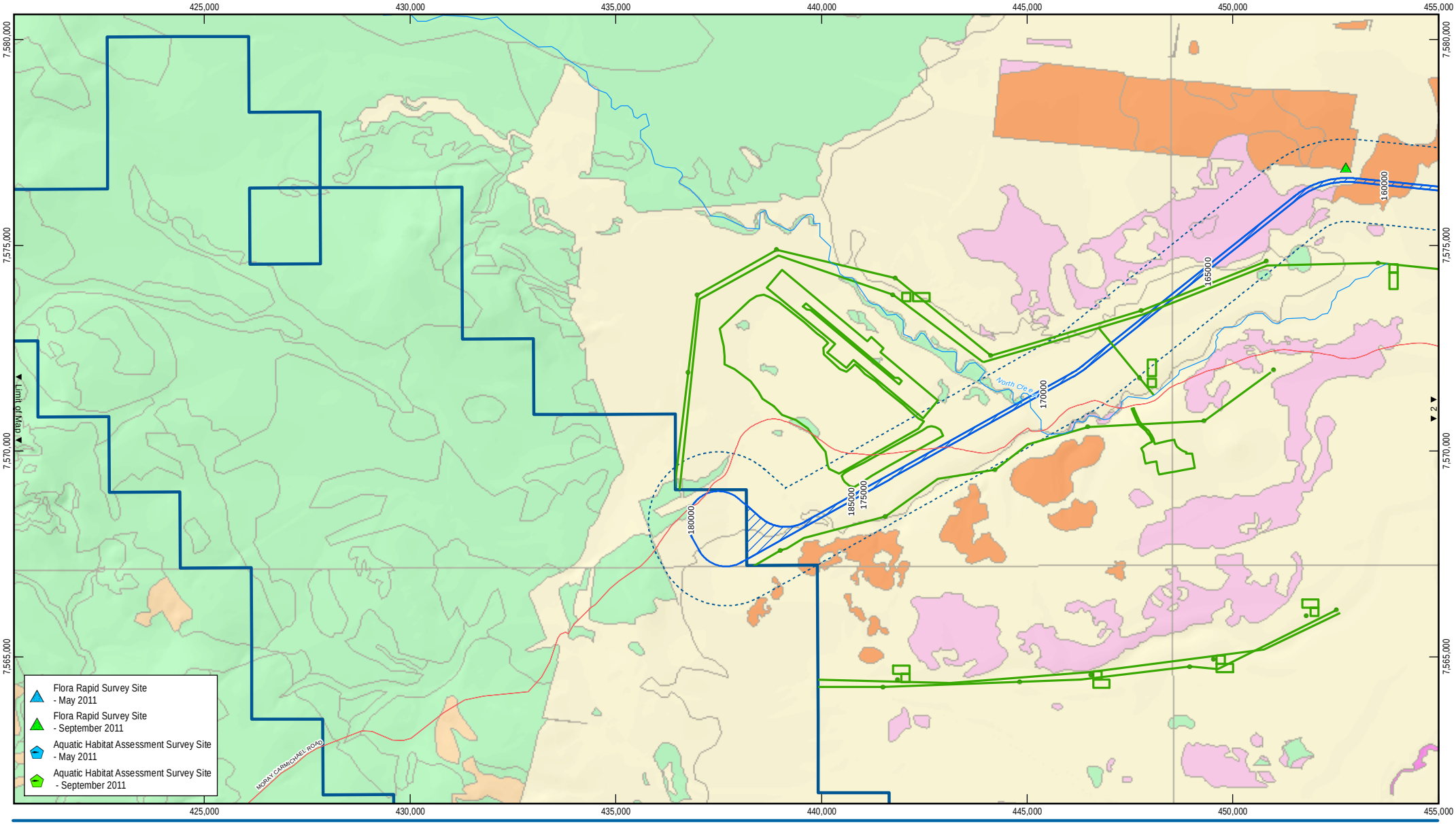
Data source: DERM: DEM (2008), DCDB (2010), RE v6.1 (2011); DME: EPC1690 (2010)/EPC1080 (2011); © Commonwealth of Australia (Geoscience Australia): Localities, Railways, Roads (2007); Adani: Alignment Opt9 Rev3 (2012); Gassman/Hyder: Mine (Offsite) (2012). Created by: BW, MS, CA



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Horizontal Datum: Geocentric Datum of Australia (GDA)
Grid: Map Grid of Australia 1994, Zone 55

N

LEGEND

- State Road
- Local Road
- Other Railway
- Watercourse
- Mine (Onsite)
- Mine (Offsite)
- Mine (Offsite)
- Rail (West)
- Rail (East)
- Study Area

Regional Ecosystems v6.1

- Endangered - Dominant
- Endangered - Sub-dominant
- Of Concern - Dominant
- Of Concern - Sub-dominant
- Least Concern
- Non-remnant

Adani Mining Pty Ltd

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Terrestrial Flora Survey Sites and Aquatic Survey Sites

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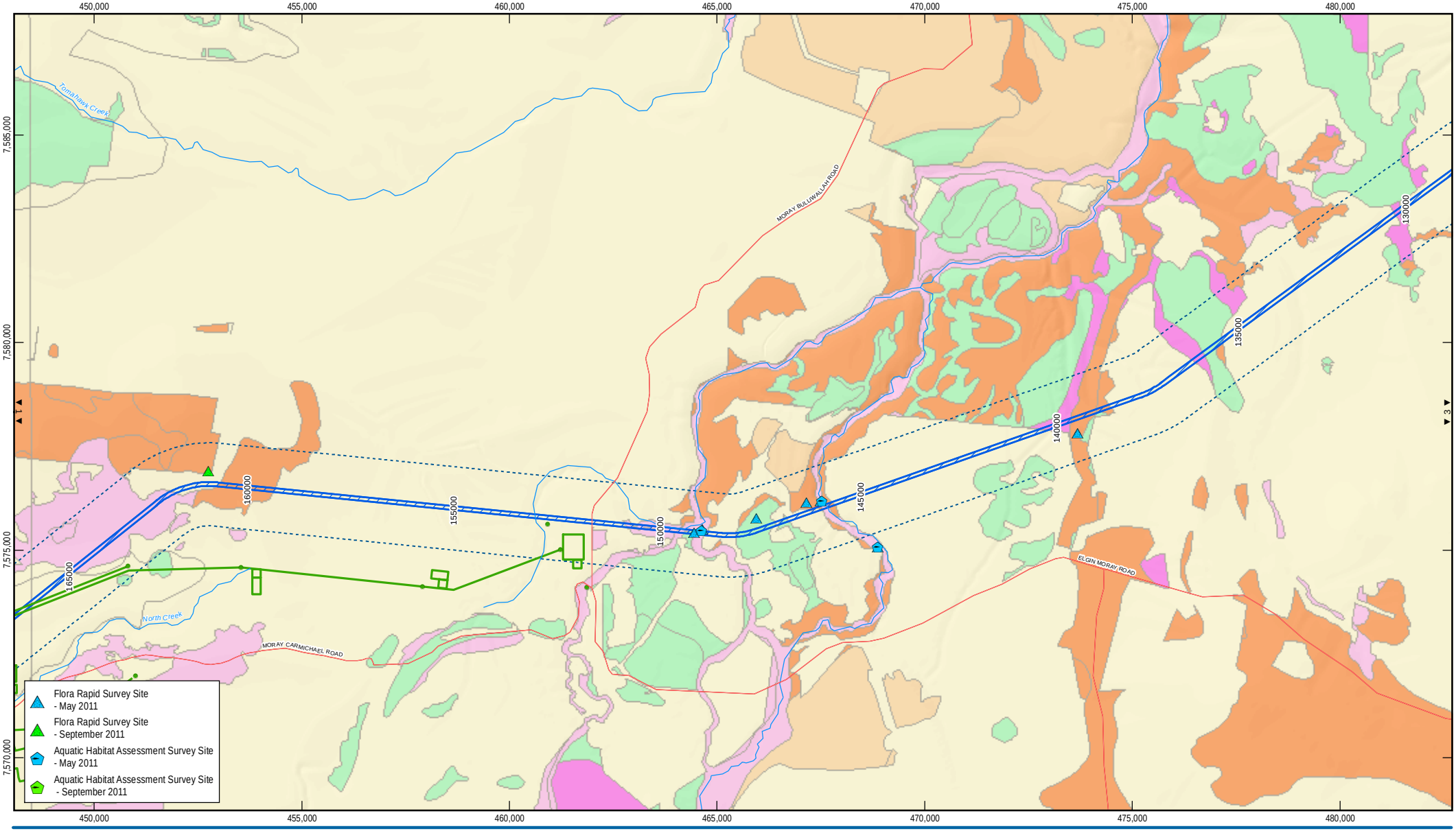

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Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia (GDA)
Grid: Map Grid of Australia 1994, Zone 55

N

LEGEND

- State Road
- Local Road
- Other Railway
- Watercourse
- Mine (Onsite)
- Mine (Offsite)
- Mine (Offsite)
- Rail (West)
- Rail (East)
- Study Area

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- Endangered - Dominant
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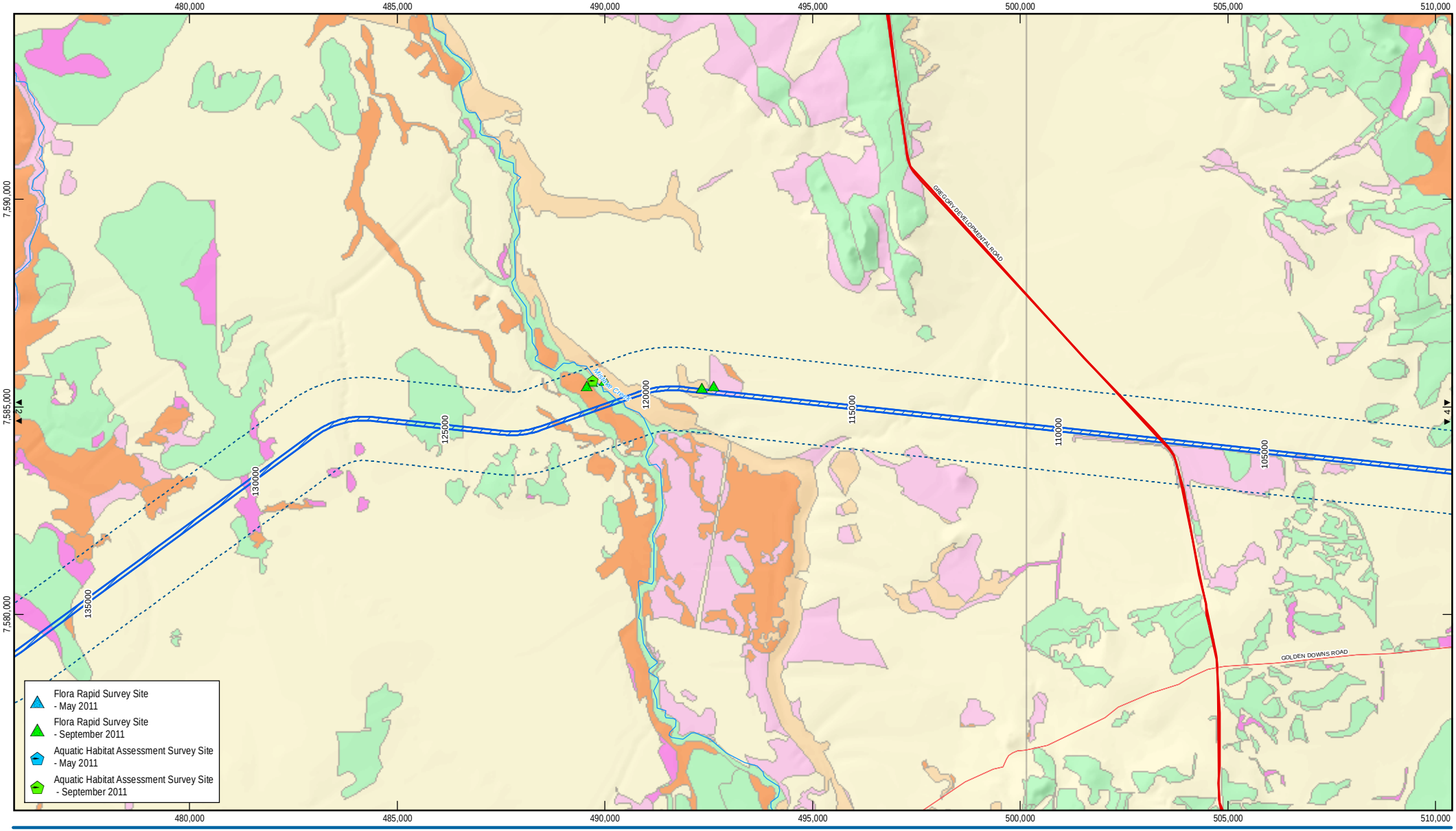

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Kilometres

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Horizontal Datum: Geocentric Datum of Australia (GDA)
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N

LEGEND

- State Road
- Local Road
- Other Railway
- Watercourse
- Mine (Onsite)
- Mine (Offsite)
- Mine (Offsite)
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- Rail (East)
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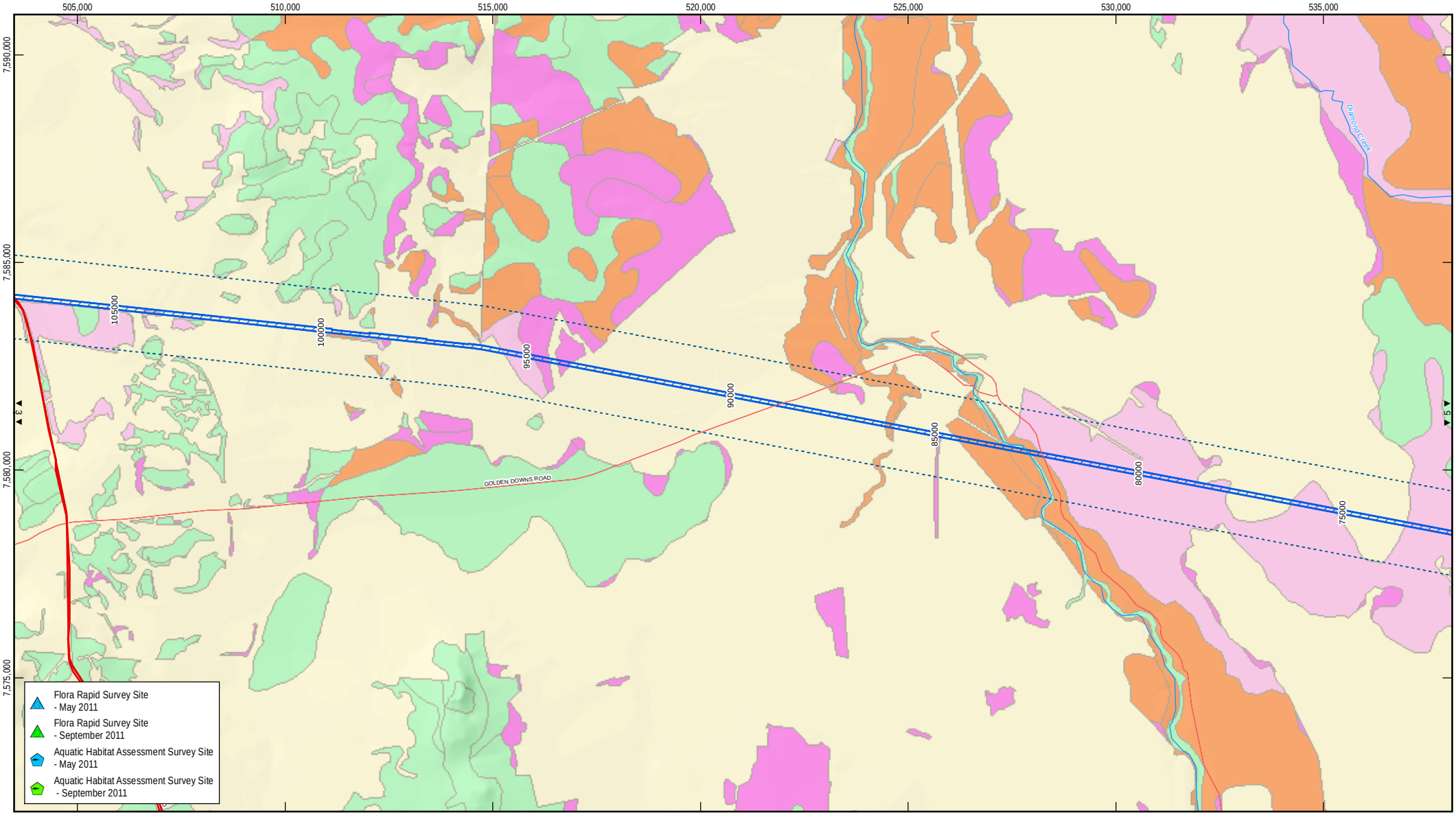

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Kilometres

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Horizontal Datum: Geocentric Datum of Australia (GDA)
Grid: Map Grid of Australia 1994, Zone 55

N

LEGEND

- State Road
- Local Road
- Other Railway
- Watercourse
- Mine (Onsite)
- Mine (Offsite)
- Mine (Offsite)
- Rail (West)
- Rail (East)
- Study Area

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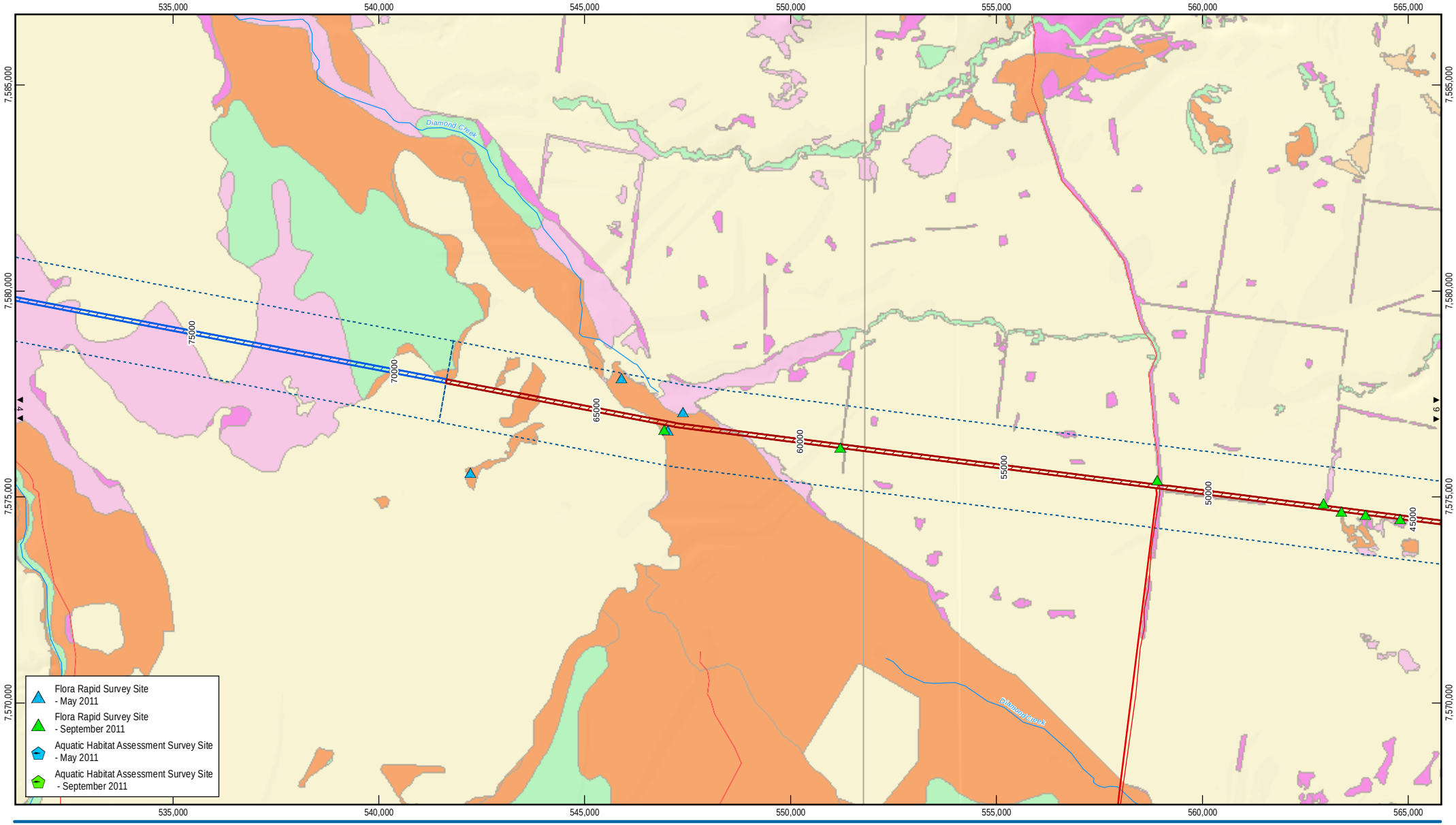

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Kilometres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia (GDA)
Grid: Map Grid of Australia 1994, Zone 55

N

LEGEND

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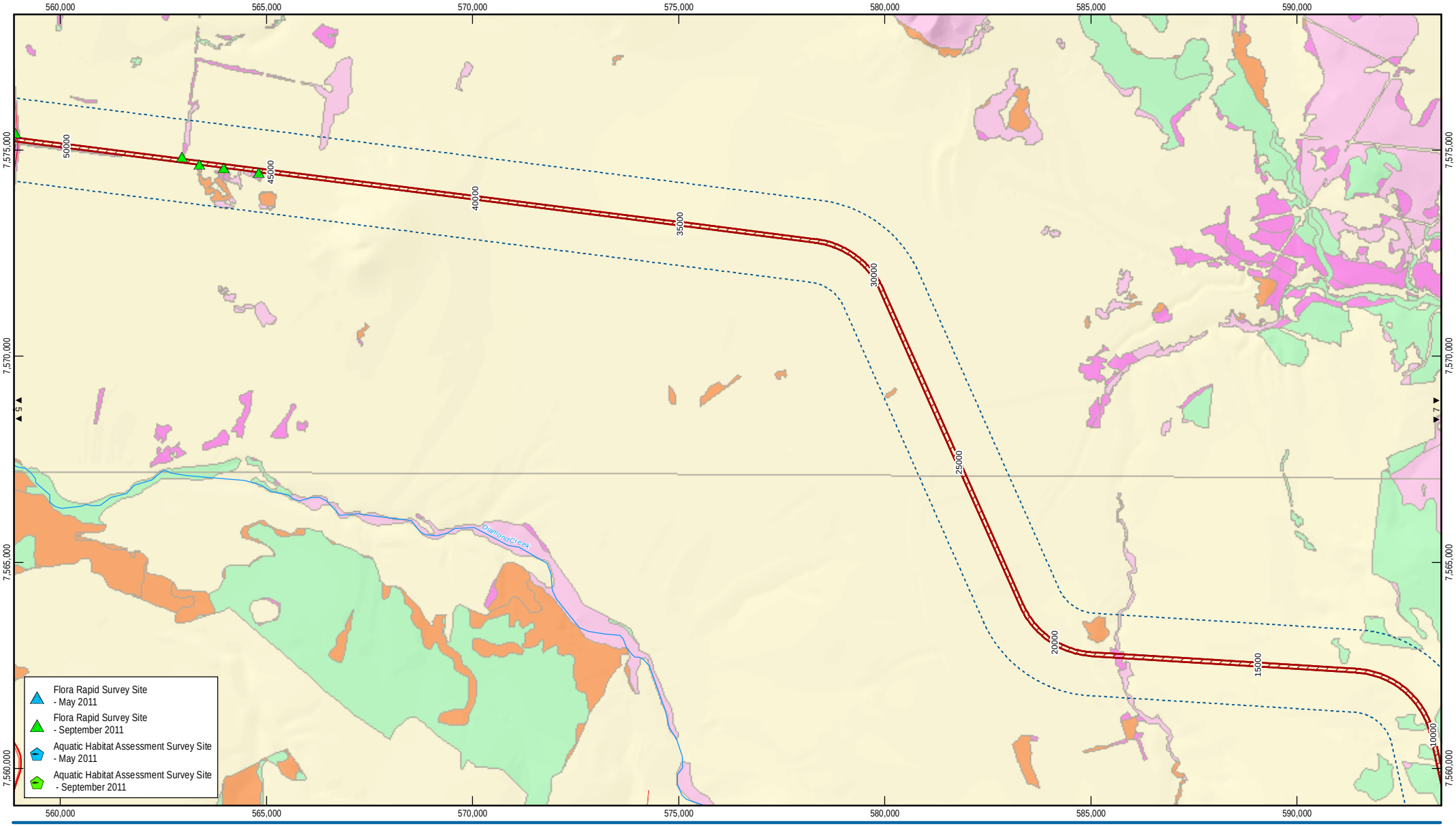

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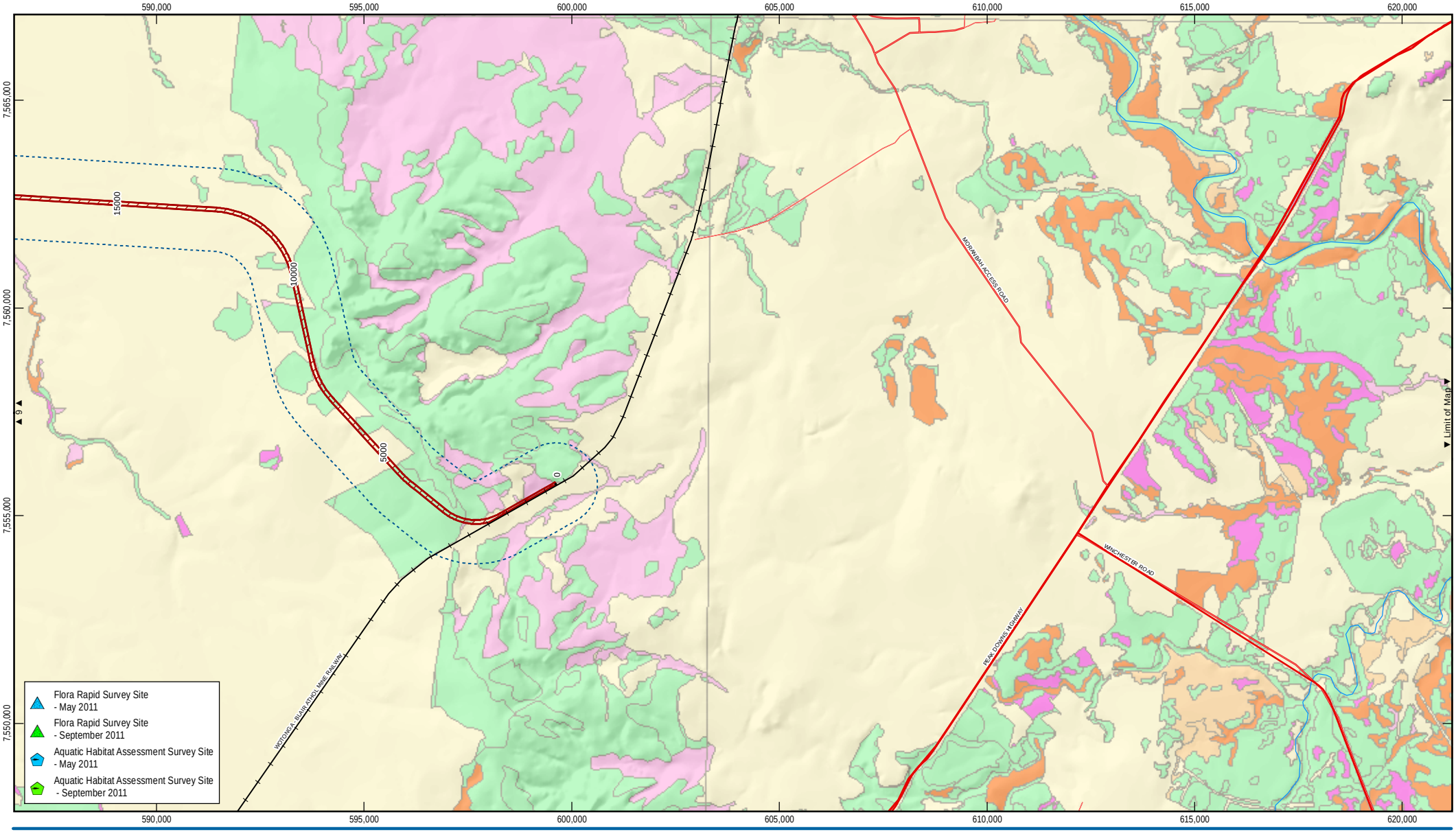

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Data source: DERM: DEM (2008), RE v6.1 (2011), © Commonwealth of Australia (Geoscience Australia): Localities, Railways, Roads, Watercourse (2007); GHD: Terrestrial Flora / Aquatic Survey Sites, Fauna Habitat Type (2011)
Adani: Alignment Corridors Opt9 Rev3 (2012); DME: EPC1690 (2010) / EPC1080 (2011); Gassman/Hyder: Mine (Offsite) (2012). Created by: BW, MS, CA

A summary of rapid flora survey methods is shown in Table 1-3 and are described in greater detail below.

Table 1-3 Summary of Terrestrial Flora Survey Methods

Rapid Survey Sites	Targeted and Random Meander Searches
◗ Equates to a quaternary CORVEG site ◗ Plotless sampling technique ◗ Level of detail collected varies – at all sites, dominant species recorded ◗ Extensive species list generated at some sites ◗ RE verification ◗ Brief notes recorded on landform, geology, soils, weeds	◗ Literature review to identify habitat requirements of rare and threatened species ◗ Targeted searches conducted at sites based on habitat requirements ◗ Random meander searches were also utilised

Floristic surveys were conducted using CORVEG methods defined by the Queensland Herbarium (Neldner *et al*., 2005), with the objective to investigate the suite of vegetation types occurring within the Study Area. Field surveys were conducted in areas of remnant vegetation including mapped REs. Flora sampling methods included:

- **Brief Site Descriptions**

At each rapid sampling site, a brief description of the vegetation community was taken to support the RE verification, which focuses on the composition and structure of vegetation communities. Specifically, site descriptions noted any disturbances (natural and artificial; past and present), any infestation by weed species, and potential habitat for conservation significant flora species.

- **Site Species List**

At each rapid sampling site, a species inventory was collected. Quaternary site assessment can be conducted at a range of detail. At all quaternary level assessment sites, a brief list of the dominant species and relevant landscape information was collected, although in some cases, quaternary site data included a relatively detailed species list. Plant species were identified in the field or collected for later identification. For species that could not be identified, a voucher specimen was sent to the Queensland Herbarium. Dry and cool conditions immediately prior to and during field surveys were not conducive to plant growth and flowering and limited the ability to identify the full diversity of floral species present.

- **Random Meander and Targeted Habitat Searches**

The random meander technique (Cropper, 1993) is a widely accepted method to survey for rare or threatened plant species or other species of interest that may occur in an area or sample site. This technique is particularly suitable for locating species that typically occur at very low densities, or that may be grouped in isolated clumps, as is the case with many conservation significant flora species. These methods were employed where suitable habitat existed for rare and threatened plant species.

Literature reviews of habitat requirements were conducted to assist in targeted searches for rare and threatened species.

- **Verification of Mapped Regional Ecosystems**

The certified RE mapping (v6.0b) for the Study Area was verified at 24 quaternary level assessment sites. Quaternary site assessments are used primarily as a record of field traverses and to verify RE/vegetation mapping. The objective of quaternary surveys (as they were undertaken for the Project (Rail)) was to gather enough information to confirm and ground-truth existing or suspected vegetation community mapping, and the level of information recorded was adjusted accordingly. As a minimum, dominant species were recorded for the ecologically dominant layer (generally the tallest layer, with the exception of emergent layers). Quaternary sites were collected wherever possible when vegetation patterns were observed to have changed.

Subsequent to the May and September surveys (as reported in this report), the Saunders Havill Group (refer Volume 4, Appendix E Study Team) undertook further site assessments within the Project (Rail) corridor. The objective of the site assessments was to map and define vegetation within the rail corridor into categories defined by the Queensland Herbarium in order to support the requirements of a properly made Property Map of Assessable Vegetation (PMAV) submission. Volume 4, Appendix AA2 and Apprendix AA3 provide details. The outcomes of these surveys are summarised in Volume 3, Section 5 Nature Conservation.

1.4.3.3 Terrestrial Fauna Survey Techniques

Permits

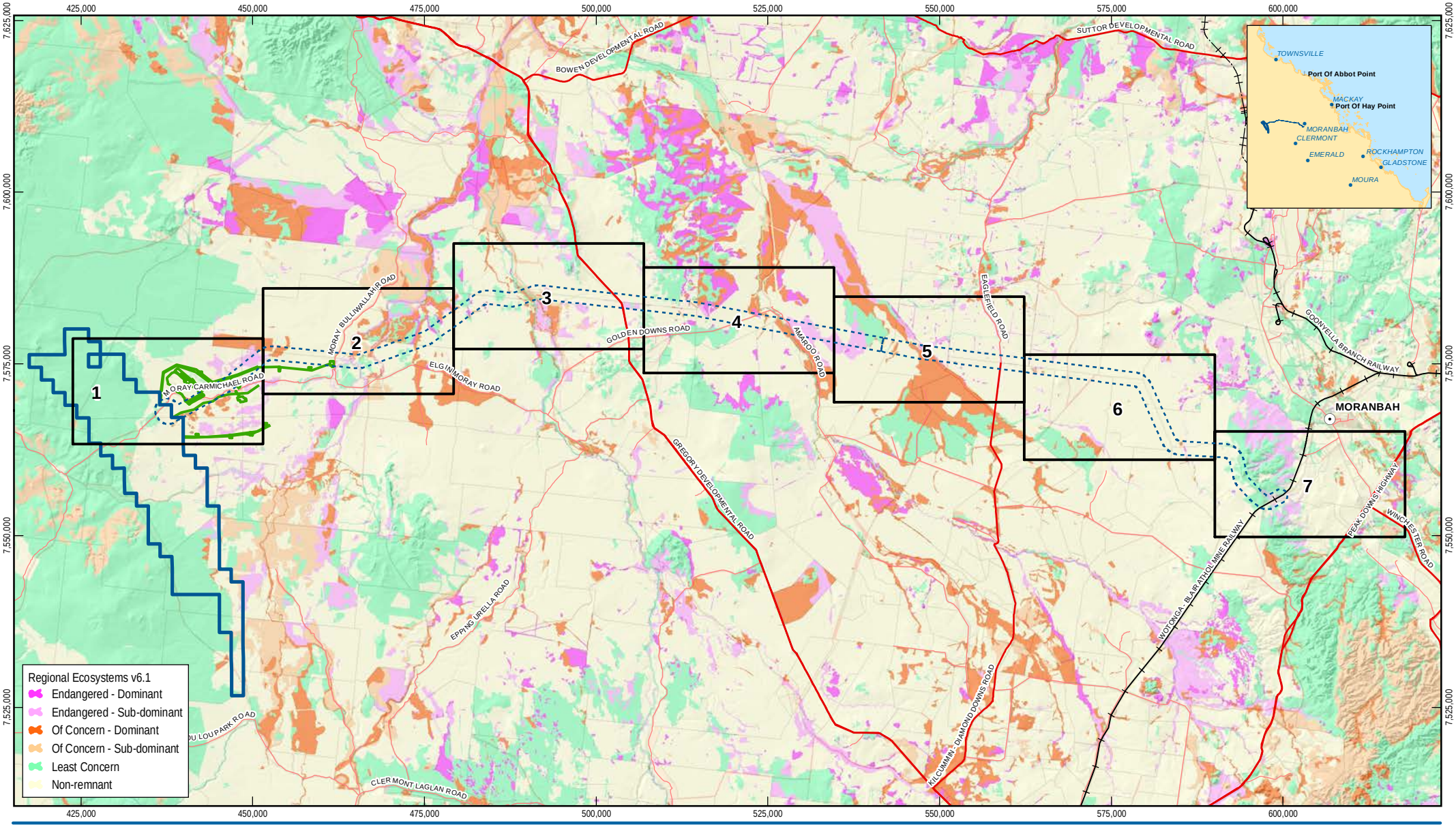
All surveys were conducted in accordance with the Queensland *Animal Care and Protection Act 2001* and the following permits:

- GHD Queensland Department of Agriculture, Fisheries and Forestry (DAFF) Scientific Users Registration Certificate (Registration Number 132)
- Queensland DEHP Scientific Purposes Permit (Permit Number WISP06498409)
- Queensland Primary Industries and Fisheries (QPIF) Animal Ethics Permits (Permit Number CA2009/11/398 and CA2008/07/280).

Survey techniques were approved by the accredited GHD Animal Ethics Committee and undertaken by appropriately qualified ecologists.

Overview

Terrestrial fauna surveys were undertaken at two comprehensive survey sites in the May survey and at 22 rapid assessment sites across the two survey periods. The distribution of fauna survey sites across the accessible areas of the Study Area is presented in Figure 1-4. Terrestrial fauna surveys were undertaken in keeping with standard methods for systematic survey of terrestrial fauna in eastern Australia as outlined in Eyre *et al*. (1997) and based on the recommended approach outlined in DSEWPaC's *Survey guidelines for Australias threatened mammals* where applicable (DSEWPaC, 2011). In addition, bird surveys were conducted in accordance with the Australian standard outlined by Birds Australia.



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Kilometres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia (GDA)
Grid: Map Grid of Australia 1994, Zone 55

N

LEGEND

- Town
- State Road
- Local Road
- Other Railway
- Cadastral Parcel
- Road Reserve
- Watercourse Reserve
- Mine (Onsite)
- Mine (Offsite)
- Study Area

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Carmichael Coal Mine and Rail Project

Terrestrial Fauna Survey Sites

Job Number 41-25215
Revision C
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Figure 1-4
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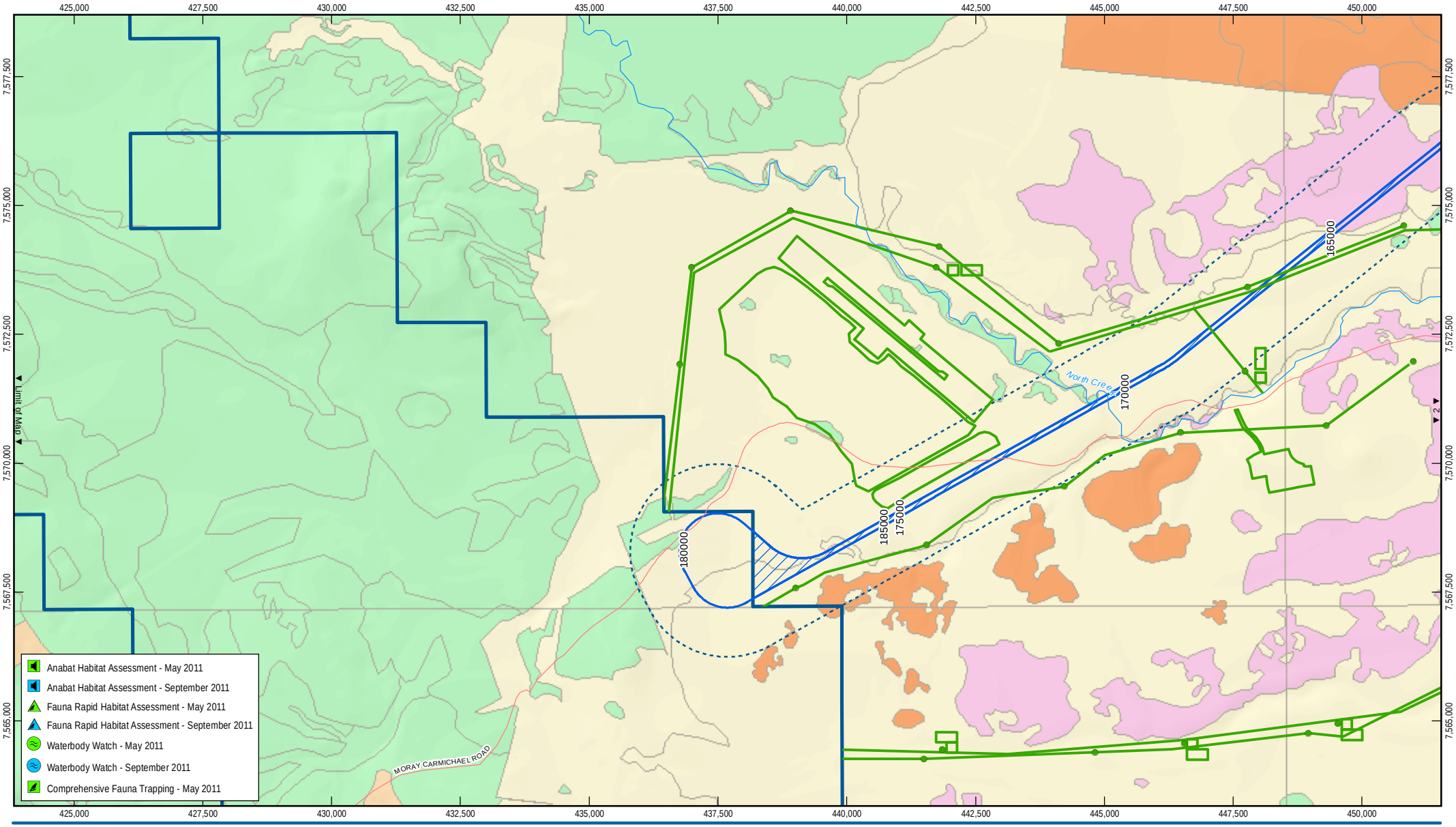

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Horizontal Datum: Geocentric Datum of Australia (GDA)
Grid: Map Grid of Australia 1994, Zone 55

N

LEGEND

- State Road
- Local Road
- Other Railway
- Watercourse
- Mine (Onsite)
- Mine (Offsite)
- Mine (Offsite)
- Rail (West)
- Rail (East)
- Study Area

Regional Ecosystems v6.1

- Endangered - Dominant
- Endangered - Sub-dominant
- Of Concern - Dominant
- Of Concern - Sub-dominant
- Least Concern
- Non-remnant

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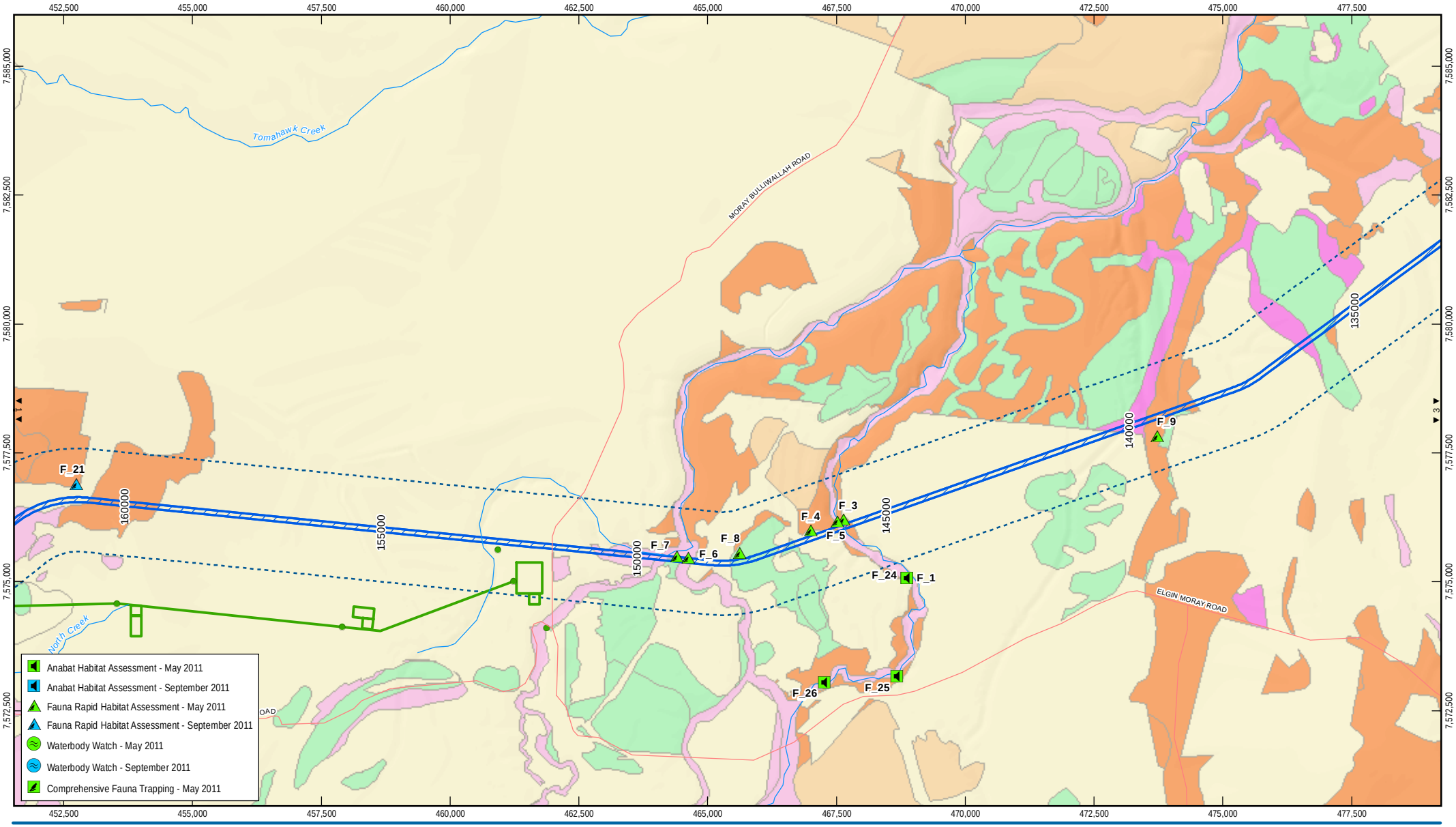

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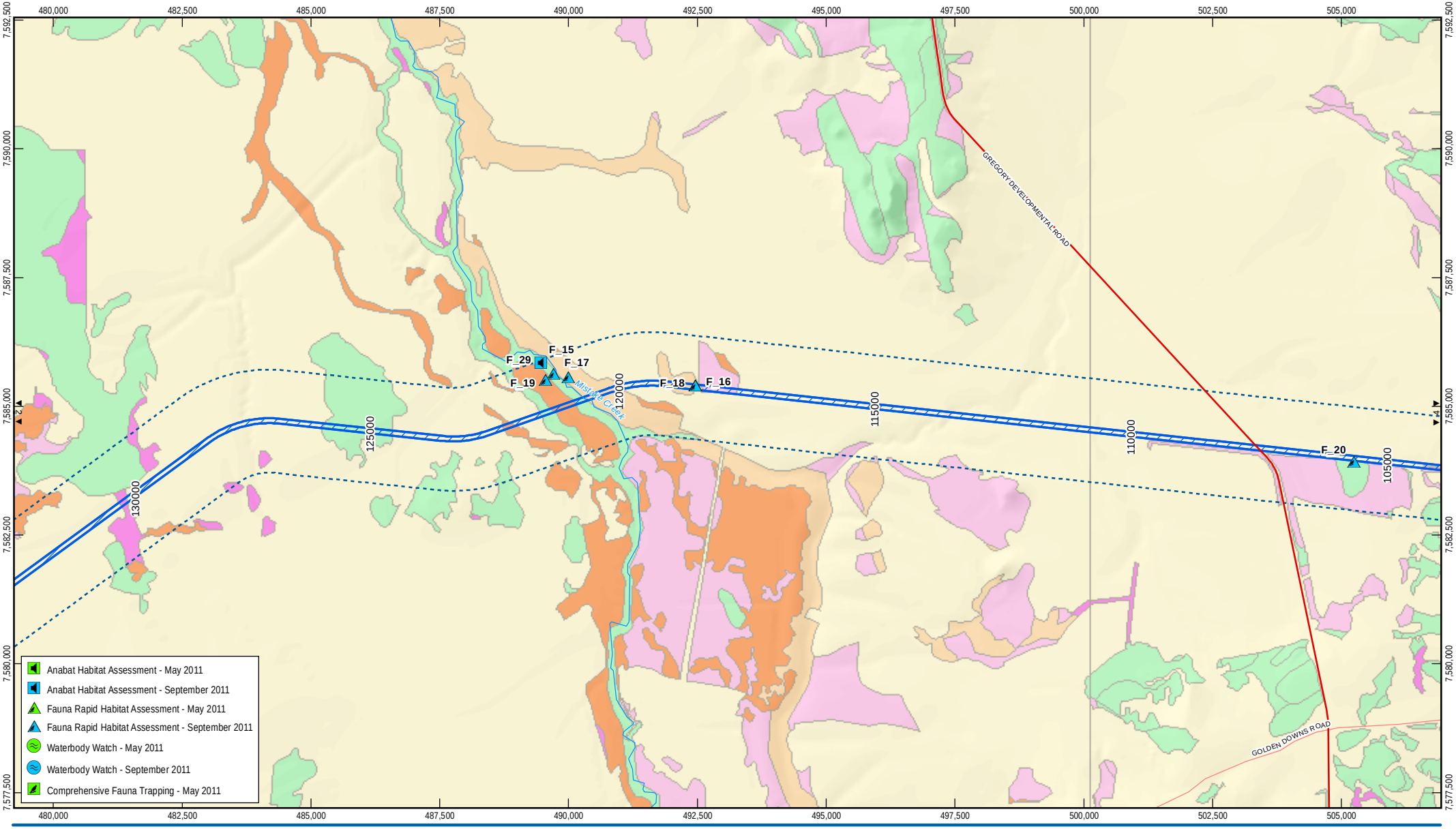

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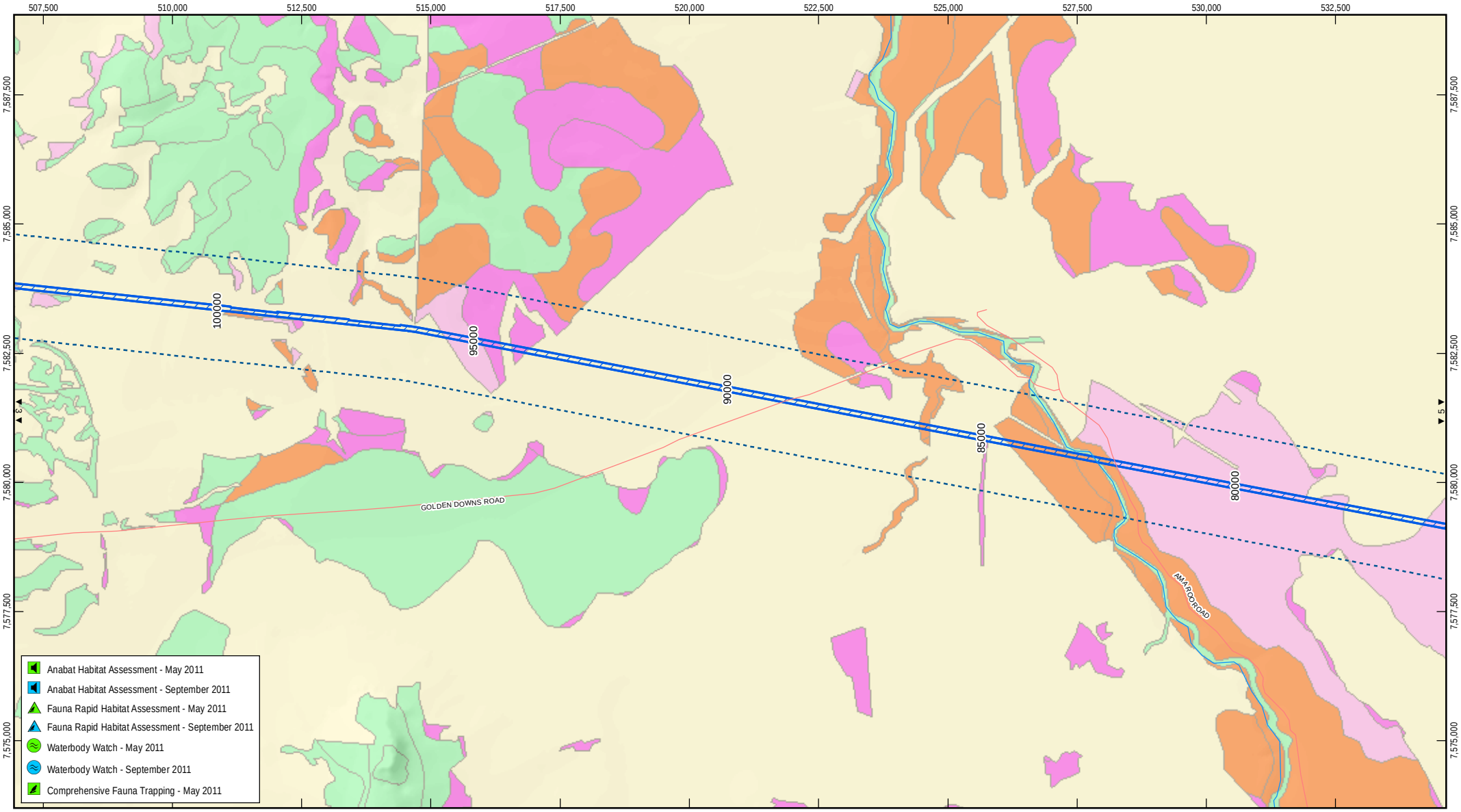

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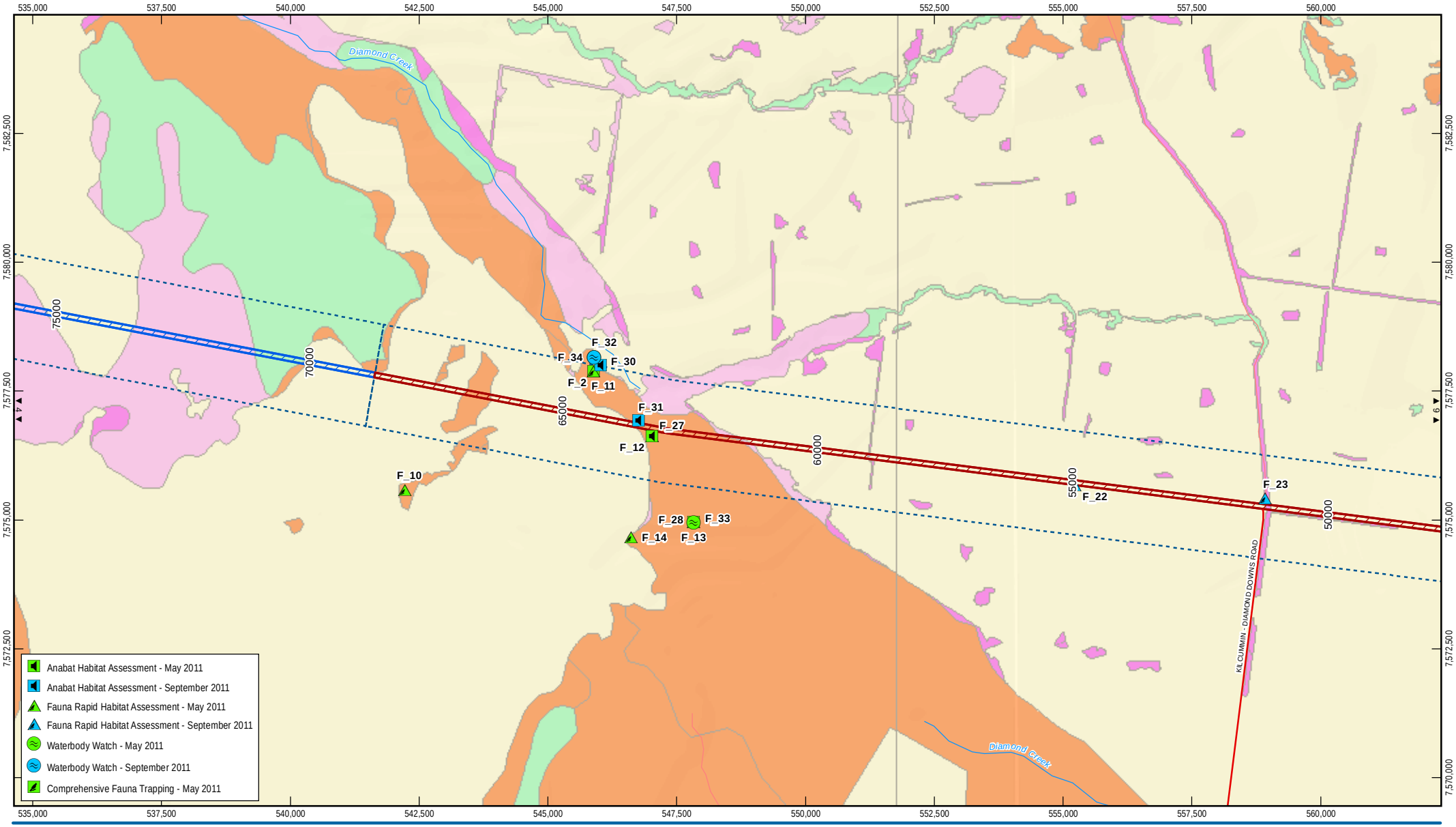

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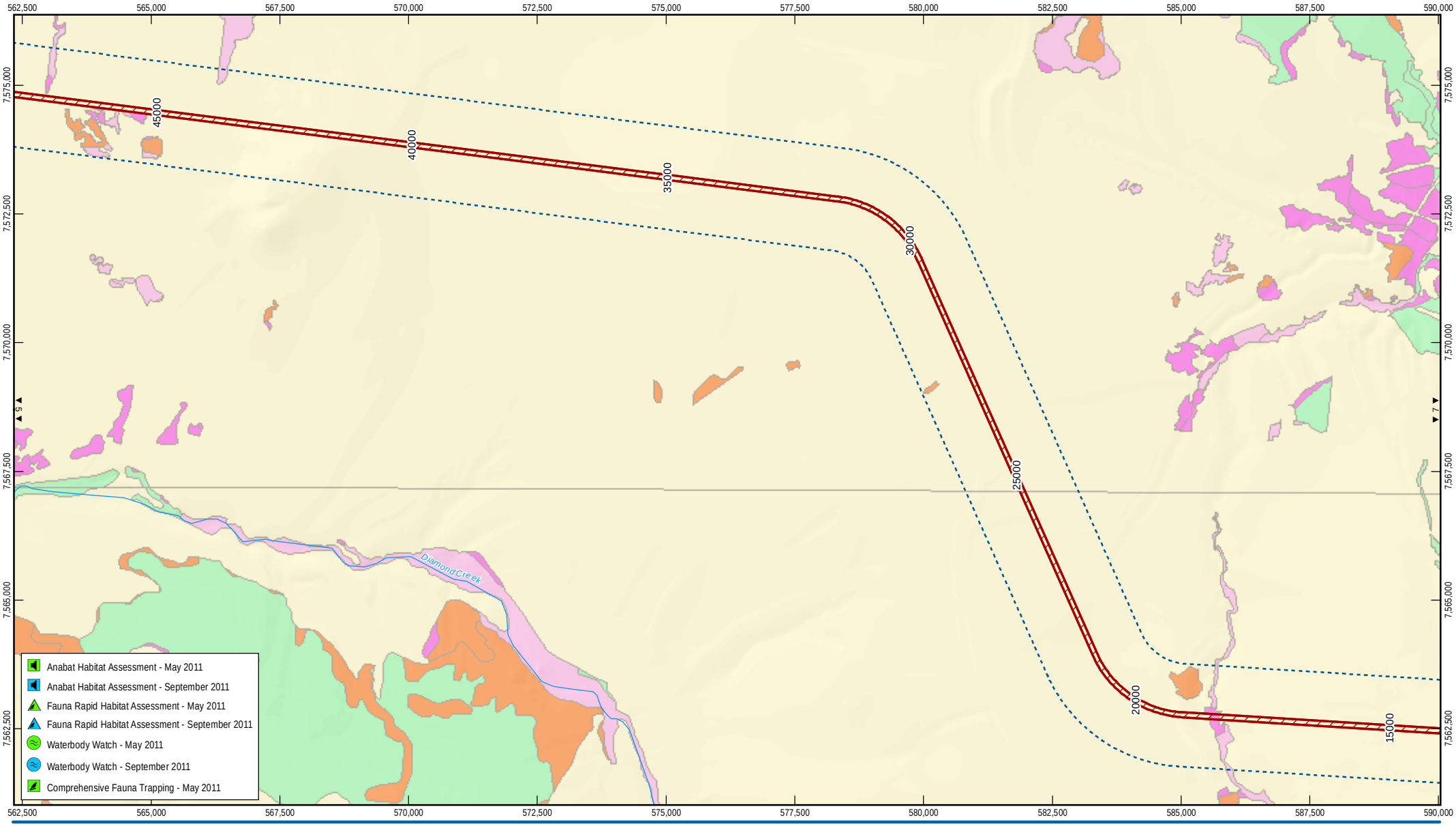

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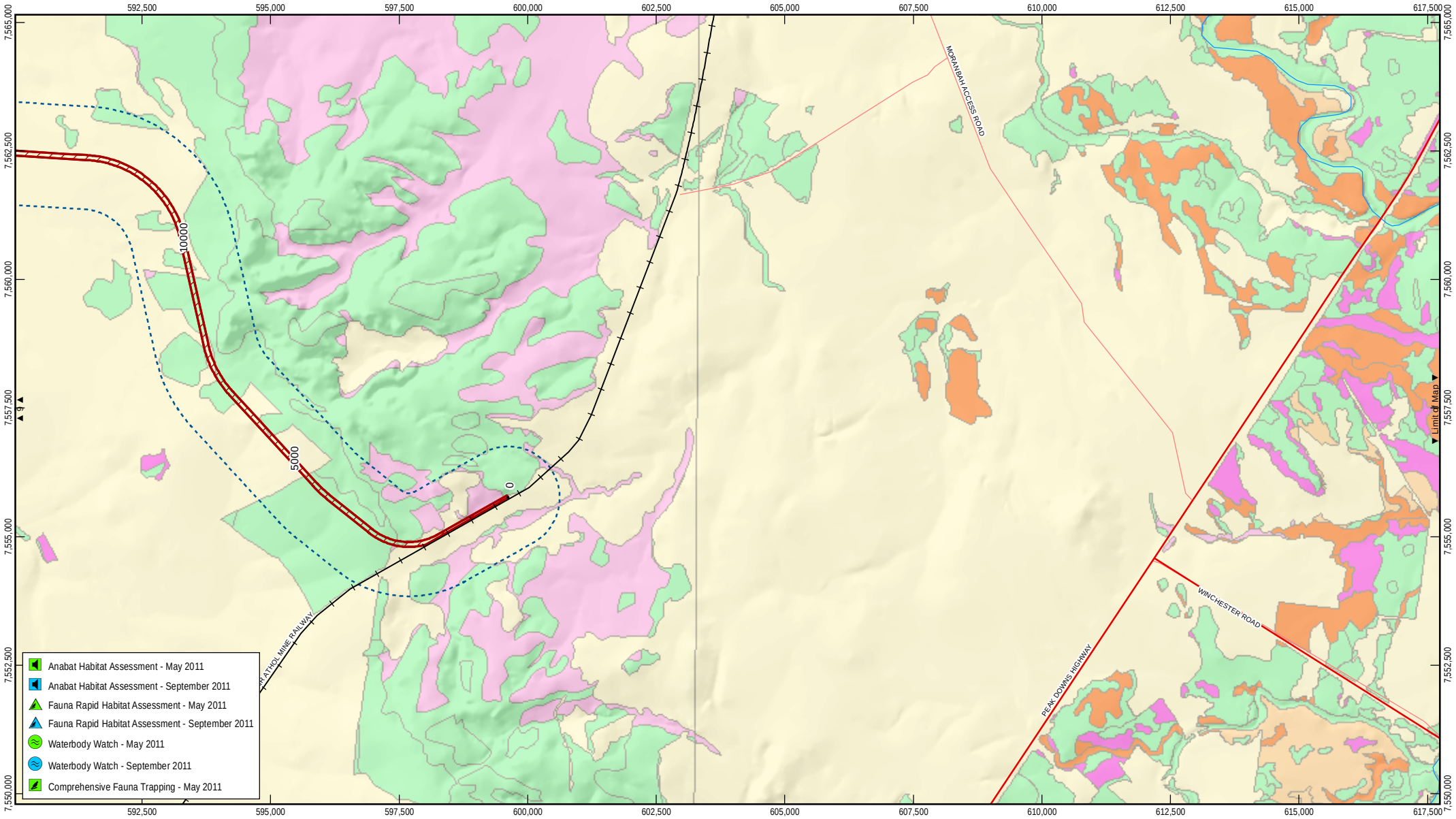

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Survey site selection was based on a review of desktop results, RE mapping, and site accessibility. Survey sites targeted representative vegetation communities and fauna habitat types present in the Study Area. RE mapping and aerial photography were primarily used to provide a broad indication of the diversity and distribution of habitats across the Study Area prior to selecting potential survey sites for targeting in the field. Due to restricted vehicle access the comprehensive fauna trap sites were located slightly outside the Project (Rail) corridor, but still in habitat types representative of those within the Project (Rail) corridor (refer Section 2.5.1).

For the purposes of this assessment, terrestrial fauna are defined as animals that only spend limited periods of time in aquatic environments. This includes amphibians and semi-aquatic species such as water birds. Species considered as aquatic fauna include fish, freshwater turtles, aquatic macroinvertebrates and mammals that are entirely confined to or spend extended durations in aquatic environments..

Terrestrial fauna survey methods employed at comprehensive and rapid survey sites are summarised in Table 1-4 and described in greater detail below.

Table 1-4 Summary of Terrestrial Fauna Survey Methods

Comprehensive Survey Sites	Rapid Assessment Sites	Additional Areas throughout Study Area
◗ Systematic trapping (comprising 20 Elliott 'A' traps, 10 cage traps, 8 funnel traps, 4 pitfall traps) ◗ Remote cameras set for a minimum of three nights ◗ Habitat assessment ◗ Opportunistic search for wildlife traces ◗ Three standardised (20 minute) bird surveys ◗ One hour of active searches for herpetofauna (e.g. snakes, lizards, etc.) ◗ One night (minimum) of ultrasonic bat detection (Anabat) ◗ Standardised spotlighting for nocturnal fauna ◗ Call-playback for owls and frogs	<u>All rapid assessment sites</u> ◗ Habitat assessment ◗ Opportunistic search for wildlife traces ◗ One standardised (20 minute) bird survey ◗ Half an hour of active searches for herpetofauna <u>Some rapid assessment sites</u> ◗ One night (minimum) of ultrasonic bat detection (Anabat) ◗ Standardised spotlighting for nocturnal fauna ◗ Call-playback for owls and frogs	◗ Remote camera ◗ Waterbody watches ◗ Opportunistic wildlife records

Terrestrial Fauna Habitat Assessment

Fauna habitat assessments (rapid assessments) were undertaken within each of the vegetation communities surveyed within the Project (Rail) corridor of the Study Area. Where possible, these sites coincided with the locations of rapid flora assessments. Habitat assessments were also undertaken at both comprehensive survey sites. Habitat assessments provided information on vegetation characteristics, microhabitats, adjacent land uses, connectivity, evidence of faunal presence, and overall inferred value of habitat for fauna species. Habitat assessments were performed at 12 locations during the May survey and 10 locations during the September survey (refer field survey sites figure). These sites were targeted to represent the suite of vegetation communities and habitat types present within the Study Area.

The following parameters were recorded during habitat assessments:

- Landscape context (size, shape, connectivity or relative isolation of habitat remnants)
- Structural and floristic complexity of vegetation (i.e. tree density, canopy cover, vertical structural complexity of vegetation strata – canopy, shrub and understorey layers, ground cover)
- Structural complexity and relative heterogeneity of ground-level microhabitats (i.e. substrate type, vegetation cover, leaf litter, woody debris, presence of rocks, logs or boulders)
- Habitat features (i.e. hollows, fallen logs, rock outcrops, nests, burrows, water bodies, gilgais)
- Relative abundance of hollows and hollow-bearing (habitat) trees
- Sources of disturbance (i.e. adjacent land-uses, feral animals, predation, weed infestation)

Systematic Trapping Surveys

At both of the comprehensive sites, systematic fauna trapping surveys were conducted over a four night period between 16 May 2011 and 20 May 2011, with equal trapping effort applied to each site. At each comprehensive site traps were deployed along two parallel linear transects comprising 20 Elliott 'A' traps and 10 cage traps, set within optimal microhabitats for conservation significant species. Four pitfall trap/funnel trap/drift fence complexes were placed at each site, set in areas with suitable microhabitat adjacent to the linear transects. Anabat detectors were placed at each site to detect the presence of microchiropteran bats and remote cameras were deployed to detect the presence of other fauna, including conservation significant species. The trap configuration comprised:

Pitfall traps, funnel traps and drift fence: Four complexes were established at each site. Each complex consisted of an approximate six metre long (30 cm high) flywire drift fence with two funnel traps along the fence line either side of a 20 L bucket (Figure 1-5 and Plate 1-1). Wet sponges were placed in each bucket and funnel to provide moisture for trapped fauna. Funnel traps were then covered with vegetation to provide shade and protection.

- Elliott 'A' box traps: Each site comprised up to 20 Elliott 'A' traps baited with universal bait (a mixture of peanut butter, rolled oats and sardines and/or honey) (Plate 1-2). Traps were located in shady areas or covered with vegetation to minimise heat exposure to animals.
- Cage traps: 10 cage traps were set at each site. Cages were baited with universal bait and covered with hessian to shelter trapped animals (Plate 1-2).

Figure 1-5 Pit-fall trap - funnel traps - drift fence complex layout

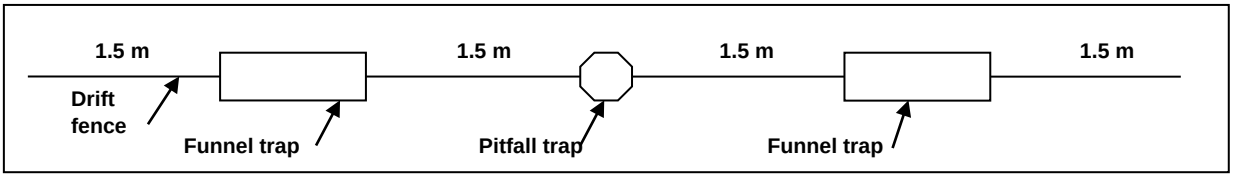

Plate 1-1 Pitfall trap – funnel traps – drift fence complexes

Plate 1-2 Elliott 'A' trap and cage trap

In addition to the systematic trapping regime outlined above the following non-systematic survey techniques were undertaken at each comprehensive and rapid assessment site. These survey techniques are detailed further below:

Opportunistic Surveys for Wildlife Traces

At each comprehensive survey site and rapid assessment site, a minimum of one person hour was spent searching for wildlife traces (i.e. bones, hair traces, tracks, scats, diggings, burrows, nests, skins) that could indicate the presence of additional fauna species.

Standardised Bird Surveys

Standardised bird surveys were undertaken at each survey site using the methods recommended for surveys by Birds Australia. This involved a timed 20 minute survey of a two hectare search area, recording the number of birds seen or heard calling. Bird surveys were undertaken in early morning or afternoon in clear conditions. Standardised bird surveys were undertaken once at each of the rapid assessment sites and a minimum of three times at the comprehensive survey sites.

Diurnal Active Searches for Reptiles and Amphibians

Active searches were undertaken for reptiles and amphibians at each site. This involved searching beneath rocks, logs, bark, and corrugated iron and among soil and leaf litter. Vegetation at the edges of local waterbodies was also searched for frogs and aquatic reptiles. Diurnal active searches were standardised by time, with each diurnal active search event lasting one person hour at each comprehensive survey site and rapid assessment site.

Nocturnal Spotlighting and Call Playback

Nocturnal spotlighting surveys were undertaken at both comprehensive survey sites and at six rapid assessment sites. One person hour was spent at each site, using a combination of high-powered spotlights and head torches. Visual surveys were undertaken in a two hectare area, searching trees, shrubs and understorey habitats for aboreal mammals, ground mammals, reptiles, frogs and nocturnal birds.

Call playback surveys were undertaken at both comprehensive sites and at six rapid assessment sites to detect nocturnal birds. Call playback surveys involved broadcasting the call of individual target species for two minutes. This was followed by a listening period of two minutes. Species featured in call-playback included:

- Spotted nightjar (*Eurostopodus argus*)
- White-throated nightjar (*Eurostopodus mystacalis*)
- Australian owlet-nightjar (*Aegotheles cristatus*)
- Tawny frogmouth (*Podargus strigoides*)
- Southern boobook (*Ninox novaeseelandiae*)
- Barking owl (*Ninox connivens*)
- Masked owl (*Tyto novaehollandiae*)
- Eastern grass owl (*Tyto longimembris*)
- Eastern barn owl (*Tyto javanica*)

These species are cryptic in behaviour and are most successfully detected using the call playback method. A greater range of fauna groups could thus be accounted for by including spotlighting and call playback survey methods.

Microchiropteran Bats

Anabat bat detectors were used to survey microchiropteran (insectivorous) bats by recording their echolocation calls. Detectors were placed at each of the comprehensive survey sites for a minimum of one night and at seven additional habitat assessment sites (four in May, three in September), where habitat was considered suitable (refer Figure 1-4). Anabat units were placed in potential bat

'flyways' just before dusk and left to record calls overnight. Detectors were positioned on the ground with the microphone orientated upwards at a 45° angle from the ground (Plate 1-3). All bat calls recorded were sent to an experienced bat-call analyst (Greg Ford from Balance Environmental) for identification. Only bat calls positively identified were included in the results.

Plate 1-3 Anabat bat detector at dam (May survey)

Remote Cameras

Remote cameras were deployed for between one and four consecutive nights at sites throughout the Study Area. Typically these cameras were placed in areas likely to concentrate wildlife – for example, stock water troughs, dams, riparian habitats and fauna movement trails in dense vegetation.

Threatened Species Surveys

Targeted surveys for threatened species were incorporated into the sampling methodologies outlined above (i.e. ground-trapping and opportunistic searches for threatened reptiles, Anabat detection for threatened bats). Additional techniques with regard to surveys for threatened species included:

- *Peophila cincta cincta* (black-throated finch (southern))

  Targeted surveys were undertaken for the black-throated finch (southern) (*Poephila cincta cincta*). These comprised the use of remote fauna cameras deployed at potential drinking sites and evening dam-watch surveys (visually monitoring potential drinking sites at dusk) to identify any individuals drinking at the water source.

  Waterbody watches were undertaken at two properties within the Study Area during the May survey and at one property within the Study Area during the September survey (Figure 1-4). A total of nine person hours were invested in waterbody watches for black-throated finches (southern) with surveys undertaken following the recommended methods outlined in the 'Background Paper' to the black-throated finch (southern) significant impact guidelines (DEWHA, 2009a). However, no high quality suitable habitat for black-throated finch (southern) was identified within the Study Area surveyed. Given limited access within the Study Area (refer Section 1.5) it was not possible to assess the level of impact the Project may incur to this species based on field survey alone. Therefore, a conservative desktop approach is relied upon in combination with the limited field survey effort to assess impacts to this species.

  Should further field surveys be undertaken in places previously inaccessible then it is likely that the areas of suitable habitat currently mapped for this species will be reduced. Should high

quality suitable habitat be encountered within the study area for this species then additional targeted field surveys will be undertaken in accordance with the survey methodology (with a reduced intensity) outlined in the significant impact guidelines. If during these field investigations, the species is encountered then the intensity of surveys will increase and targeted searches will also be carried out to further document the extent of suitable habitat.

- *Paradelma orientalis (*brigalow scaly-foot*)*, *Denisonia maculata (*ornamental snake*), Furina dunmalli (*Dunmall's snake*), and Egernia rugosa (*yakka skink*)*

  A number of listed reptile species were considered to potentially occur within the Study Area. The brigalow scaly-foot, ornamental snake, Dunmall's snake and yakka skink occur in vegetation communities that have been heavily impacted by historical land clearing (e.g. brigalow, *Acacia harpophylla*) and are listed for this reason. Specific microhabitats were targeted (i.e. brigalow-gilgai formations, grass tussocks, sandstone slabs and cracking black clays). Targeted searches were also undertaken for the distinctive communal scat piles of the yakka skink.

1.4.3.4 Aquatic Ecosystems Survey Techniques

Dry conditions during the field surveys prevented comprehensive aquatic assessments at river and creek crossings and therefore survey methods were limited to aquatic habitat assessments. However, the general nature of waterways within the Study Area has been described previously (refer Volume 4 Appendix AC Rail Hydrology Report) and these descriptions have been used in the identification of potential impacts on aquatic ecosystems.

In general, waterways that intersect the Project (Rail) corridor are known to be ephemeral with small base flows during the dry season. Once storm flow reaches the rivers and creeks, they rapidly fill and overflow into floodplains where flooding can persist for several days at a time. After the flooding recedes, the majority of waterway main channels become a series of waterholes sustained by a slow base flow. Farm dams often dry out by the beginning of the next wet season, unless maintained by pumped groundwater (refer Volume 4 Appendix AC Rail Hydrology Report). Further information to support general observations was gathered through habitat assessments at four water crossings within the Study Area.

The locations of the aquatic habitat assessment sites and timing of assessment are detailed on Figure 1-3 and summarised in Table 1-5.

An assessment site is defined as a 100 m reach for water bodies and includes bed and banks. The assessment considers all the habitats within this area.

Table 1-5 Aquatic Habitat Assessment Sites

Site No.	Waterbody Type	Stream Order	Watercourse	Habitat Assessment	
				May	September
1	Riverine	8	Belyando River	✓	
2	Drainage line	1	Belyando River tributary	✓	
3	Palustrine	1	Belyando River ox-bow	✓	
4	Riverine	6	Mistake Creek		✓

Aquatic habitat assessments were undertaken within the Study Area to characterise the water bodies with respect to ecological values for aquatic flora and fauna. Visual habitat assessments of the 100 m reach of water bodies that were accessible during the field surveys were used to describe the aquatic ecosystems in terms of habitat diversity and extent, suitability for aquatic fauna groups, sensitivity to change, existing disturbances/modifications or barriers and riparian condition. Habitat assessment provided an understanding of habitat availability and character. Assessments were undertaken using an adapted standardised proforma approach that has been modelled on the Queensland Australian River Assessment System (AusRivAs) assessment protocols.

Key features noted at each aquatic habitat assessment location included substrate, snags and woody debris, habitat attributes, sediment deposits, water odour and variety of habitats. In addition to the key features listed, observations relating to intactness and size of the riparian zone, shading, disturbances and water quality were considered.

Aquatic flora assessments were undertaken in conjunction with aquatic habitat assessments which recorded species present in the macrophyte and riparian community and relative abundance. In addition, riparian assessments were conducted in riparian vegetation communities across the Study Area as part of the terrestrial flora ecology assessment (refer Section 1.4.3.2).

1.4.4 Likelihood of Occurrence Assessment

The information acquired through the desktop and field assessments described above was used to characterise the existing terrestrial and aquatic ecological values of the Study Area. For conservation significant flora and fauna species, a likelihood of occurrence assessment was undertaken to inform the impact identification process. This assessment considered information relating to:

- Habitat preferences
- Distribution
- Relative abundance
- Previous records from the region
- The occurrence of suitable habitat at the Study Area based on field observations
- The confirmed presence of conservation significant species at the Study Area

A likelihood of occurrence ranking was attributed to each conservation significant species, based on the following framework:

- **Unlikely to occur**: species has not been recorded in the region (no records from desktop searches) **AND/OR** current known distribution does not encompass Study Area **AND/OR** suitable habitat is generally lacking from the Study Area.
- **May occur**: species has not been recorded in the region (desktop searches) although species' distribution incorporates Study Area **AND** potentially suitable habitat occurs at the Study Area.
- **Likely to occur**: species has been recorded in the region (desktop searches) and suitable habitat is present at the Study Area
- **Confirmed present**: species recorded during field surveys at the Study Area

1.4.5 Potential Habitat Mapping

In consideration of the extensive size of the Study Area and the inability to access many parts during the May and September field surveys a mapping methodology has been adopted whereby potential habitat for species of conservation significance and TECs is mapped within the Study Area and in the adjacent wider landscape. Species of conservation significance and TECs that are mapped through this process are those considered as likely to occur, may occur, or are confirmed as present within the Study Area based on the likelihood of occurrence assessment in Section 1.4.4.

The mapping methodology has taken into consideration the known distribution, ecology and preferred habitat characteristics of each species and TEC to which it has been applied. Habitat mapping criteria was selected to map potential habitat for 11 threatened fauna species and two TECs of relevance to the Study Area. The criteria used consisted of either REs known as essential habitat for the species (where this occurs) or community of interest, or where this information was not available broad habitat types were used based on known habitat preferences.

The species and TECs that have been mapped according to this methodology comprise:

- Black-throated finch southern
- Reptiles of the brigalow belt, including ornamental snake, Dunmall's snake, brigalow scaly-foot and yakka skink
- *Dasyurus hallucatus* (northern quoll)
- *Phascolarctos cinereus* (koala)
- *Geophaps scripta scripta* (squatter pigeon (southern))
- *Nyctophilus timoriensis* (greater long-eared bat)
- *Erythrotriorchis radiatus* (red goshawk)
- *Rostratula australis* (Australian painted snipe)
- 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

The expected impact buffers (direct and indirect) associated with the Project (Rail) have been overlaid on the potential habitat maps, so as to provide an estimated quantification of Project (Rail) impacts on potential threatened species habitat and TEC's (refer Section 6). It is expected that this mapping will be refined based on the outcomes as presented by Saunders Havill Group in Volume 4, Appendix AA2 and Appendix AA3 and summarised in Volume 3, Section 5 Nature Conservation.

1.4.6 Impact Assessment

In consideration of construction and operational activities of the Project (Rail), potential impacts have been identified and described with respect to flora and fauna species, their confirmed and potential habitat and vegetation communities that occur within or are of relevance to the Study Area.

Mitigation measures to avoid/minimise/offset impacts to identified terrestrial ecological values resulting from the construction and operational activities associated with the Project (Rail) are

proposed. Particular consideration has been made to conservation significant ecological values identified as present or having the potential to occur within the Study Area.

1.5 Limitations and Qualifications

Limitations and qualifications of the study include:

- Given the restricted ability to sample seasonal variability across the Study Area due to site inaccessibility during wet weather and land holder access limitations, addressing the requirements of the Project terms of reference has been supported by substantial desktop research in combination with the May and September field surveys. Additionally, where possible, survey sites were located within vegetation communities (REs) and fauna habitat types that were representative of vegetation communities and habitat, particularly those in good condition, across the entire Study Area.
- Dry and cool conditions immediately prior to and during both field surveys were not conducive to plant growth and flowering and limited the ability to identify the full diversity of floral species present and reduced the subsequent capture of seasonal changes in terrestrial flora and fauna assemblages, habitat condition and utilisation. Habitat assessment where possible and species profiles have been used to provide an understanding of the variation in flora and fauna communities across seasonal variation.
- Since completion of both survey events, approximately 38 km of the proposed rail corridor has undergone re-alignment. The realignment occurs between approximately 63 km and 101 km. The extent over which the re-alignment occurred is in an area that was largely inaccessible during the field surveys. As the re-alignment still occurred within the bounds of the 2 km Study Area, the desktop studies undertaken for the assessment incorporated the adjusted route.
- Due to limited access and limitations in the level of survey undertaken with respect to targeting species of conservation significance, survey effort was not strictly in accordance with DSEWPaC guidelines. However, a conservative desktop approach was relied upon in combination with the field survey effort to assess impacts to these species in accordance with the precautionary principle. Where uncertainties exist in determining the likelihood of occurrence of a species within the Study Area, the more conservative options under consideration were adopted.
- The habitat mapping method was underpinned by a number of assumptions due to the large area over which predictive mapping was undertaken, and in some cases the lack of fine-scaled and species-specific habitat data.

Sampling success along linear infrastructure is limited given the large distances over which it extends and the diversity of vegetation communities / habitat types that occur and within which sampling should be undertaken. As such, desktop data makes up a substantial component of the ecological assessment and is relied on when describing the ecological values of the Study Area. However, where ground-truthing was not undertaken, a conservative approach has been adopted for the mapping of occurrence of conservation significant habitat and species. Potential impacts associated with the Project (Rail) are thus, considered valid and conservative management approaches are proposed to compensate for potential impacts associated with the Project (Rail).

Recent (June – September 2012) improved site access has facilitated further vegetation assessments (refer Volume 4, Appendix AA2 and Appendix AA3 and Volume 3, Section 5 Nature Conservation). The outcomes of these assessments will be used to refine outcomes of this report.

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2. Existing Environment

2.1 Regional Environment

The Study Area occurs in central Queensland within the Burdekin and Fitzroy Basin Catchments and is located entirely within the Isaac Regional Council local government area. The vast majority of the Study Area is within the Brigalow Belt bioregion, save the extreme western extent of the Study Area which is within the boundary of the Desert Uplands bioregion.

The nearest towns to the Study Area are the regional centres of Moranbah (located at the eastern extent of the Study Area), Alpha (approximately 150 km south of the western extent of the Study Area) and Clermont (approximately 116 km south of the centre of the Study Area). The town of Emerald is further afield, at approximately 207 km south-east of the centre of the Study Area. The Study Area extends up to approximately 320 km west of the coast of central Queensland.

There are 12 major waterways that cross the rail corridor. There are also 76 minor waterway crossings. Minor crossings have catchment areas of less than 100 km^2. The main riverine feature of the Study Area is the Belyando River, which is joined by the Carmichael River approximately 20 km downstream of the eastern boundary of the Project (Mine) site. The Belyando River flows in a northerly direction to join the Suttor River and the waterway eventually drains into the Burdekin River.

2.1.1 Fitzroy Basin Catchment

The Fitzroy Basin is located in central eastern Queensland and is one of the largest basins in Queensland encompassing an area of approximately 142,600 km^2 (DERM, 2009a). It is the largest river basin draining to the east coast of Australia where it outflows into the southern end of the Great Barrier Reef (DERM, 2009a). Only a small portion of the eastern extent of the Study Area (approximately 15 per cent or 30 km) is located within the northern region of the Fitzroy Basin Catchment. The proposed Project (Rail) intersects minor tributaries of Grosvenor Creek (stream order 3), which flows into the Isaac River near Moranbah. The Study Area, therefore, does not intersect any major waterways in the Fitzroy catchment.

The catchment is characterised by a sub-tropical, semi-arid climate with high rainfall variability and comprises six major sub catchments: the Nogoa, Comet, Isaac-Connors, Mackenzie, Dawson and Fitzroy Rivers. The main land use in the basin is grazing while the main water user is agriculture. Tourism and fishing (recreational and commercial) are also important in the region (DERM, 2009a).

Three bioregions are represented in the Fitzroy Basin Catchment (the Brigalow belt, central Queensland coast and south-east Queensland) however the Study Area passes through only one of these, the Brigalow Belt (refer Section 2.1.3 for bioregion descriptions).

2.1.2 Burdekin Catchment

The Burdekin Catchment is the second largest catchment on the east coast of Australia, covering an area of approximately 130,057 km^2 within north-east and central Queensland (DERM, 2011a). The catchment comprises four main sub catchments, the Upper Burdekin, the Belyando/Suttor, the Bowen/Broken, and the lower Burdekin and Coastal Plains.

The vast majority of the Study Area (approximately 85 per cent) is located within the Burdekin Catchment, of which all is located within the Belyando/Suttor sub catchment. Land use within the Burdekin Catchment is dominated by cattle grazing, which covers over 96 per cent of the catchment area (Dight, 2009). Additional land uses within the catchment include: sugar and horticulture cropping; aquaculture and mining. The Burdekin Catchment exhibits distinct seasonal climatic conditions with a pronounced wet summer and dry winter. Mean annual rainfall in the catchment ranges from less than 500 mm to over 2500 mm and is generally highest in the eastern coastal areas and lowest in the western and southern regions (Dight, 2009; BOM, 2011).

The Belyando/Suttor sub catchment encompasses and area of approximately 73,335 km^2 and is the largest system within the Burdekin Catchment, comprising almost 60 per cent of the total area (DSEWPaC, 2009c). The sub catchment is bounded by the Great Dividing Range in the west with Denham and Drummond Ranges to the east (DSEWPaC, 2009c). Topography within the Belyando/Suttor sub catchment is notably different from other sub catchments in the Burdekin Basin due to the lack of high mountain backdrops and its representation of a drier, typically semi-arid western landscape (DSEWPaC, 2009c).

Three bioregions are represented in the Burdekin Catchment however the Study Area passes through only two of these, the Brigalow Belt and the Desert Uplands bioregions (refer Section 2.1.3 for bioregion descriptions).

2.1.3 Bioregions

2.1.3.1 Desert Uplands Bioregion

The Desert Uplands bioregion covers approximately 70,000 km^2 of central northern Queensland, between Blackall and Pentland (Morgan, 1999). The bioregion is dominated by sandstone ranges and sand plains, with soils that are typically of poor structure and low fertility (Morgan, 1999). The climate is semi-arid (Morgan, 1999). *Eucalyptus whitei, Eucalyptus similis* and *Corymbia trachyphloia* woodlands are the predominant vegetation communities in the Desert Uplands (DSEWPaC, 2009c). Vegetation clearing has historically occurred in the south-east of the bioregion, corresponding with areas of acacia vegetation on heavier soils (Morgan, 1999). More recently, eucalypt woodlands on less fertile sand plains have experienced clearing (Morgan, 1999). The introduced pasture grass, buffel grass (*Cenchrus ciliaris*) forms extensive stands in the bioregion (Morgan, 1999). Approximately 2.3 per cent of the total area of the bioregion is under conservation tenure (DSEWPaC, 2009e).

Three subregions comprise the Desert Uplands Bioregion of which one (Alice Tableland Subregion (refer Section 2.2.3) is intersected by the western extent of the Study Area as it enters the Carmichael Mine site.

2.1.3.2 Brigalow Belt Bioregion

The Brigalow Belt bioregion occurs over 364,000 km^2 of central Queensland, from Townsville in the north, south to Narrabri in New South Wales (Young *et. al.*, 1999). Brigalow (*Acacia harpophylla*) forests and woodlands growing on clay soils are one of the major vegetation types that characterise the region (Young *et. al.*, 1999). Historically brigalow vegetation covered up to six million hectares of the bioregion in Queensland, but extensive broadscale clearing, predominantly for conversion to pastures, has greatly reduced brigalow communities through the bioregion (Young *et. al.*, 1999). In addition to remnant brigalow vegetation, other ecosystems that typify the bioregion include eucalypt

forest and woodlands, grasslands, dry rainforest, cypress pine woodland and riparian communities (Young *et. al.*, 1999).

The Interim Biogeographic Regionalisation of Australia (IBRA) divides the Brigalow Belt bioregion into the Brigalow Belt North and Brigalow Belt South (Young *et. al.*, 1999), of which almost all save the very western extent of the Study Area (which falls within the Desert Uplands bioregion refer above) is located in the Brigalow Belt North bioregion. None of the Study Area is located in the Brigalow Belt South bioregion.

The geology of the Brigalow Belt North bioregion features Permian volcanics and Permian-Triassic sediments, Carboniferous and Devonian sediments and volcanics, and Cambrian and Ordovician rocks (and associated Tertiary deposits) (DSEWPaC, 2009d). The climate is sub-humid to semi-arid (DSEWPaC, 2009d). Approximately 1.2 per cent of the total area of the bioregion is under conservation tenure (DSEWPaC, 2009d).

The Brigalow Belt North bioregion comprises 13 subregions, of which two are intersected by the Study Area. These being, as discussed further in Sections 2.2.1 and 0:

- Northern Bowen Basin
- Belyando Downs

2.2 Local Environment

The Study Area intersects three subregions of the Brigalow Belt and Desert Uplands bioregions. Starting at the eastern extent of the Study Area near Moranbah, the rail alignment commences in the Northern Bowen Basin subregion of the Brigalow Belt and runs west until approximately 18 km where it intersects with the Belyando Downs subregion. At approximately 165 km the rail alignment enters into the Alice Tableland subregion of Desert Uplands bioregion, north of Alpha. These three subregions vary in their ecological characteristics and value for threatened species and diversity.

2.2.1 Northern Bowen Basin Subregion

The geology and landform of the Northern Bowen Basin subregion is typically Triassic and Permian sediments on undulating areas of low hills and sandstone ridges (Young *et al.*, 1999). The subregion is characterised by *Acacia harpophylla* (brigalow) – eucalypt open forest communities. Broadly the predominant vegetation communities can be described as:

- Brigalow and *Eucalyptus cambageana* communities on clay soils
- Narrow-leaved ironbark (*Eucalyptus crebra*) or poplar box (*Eucalyptus populnea*) open woodlands with shrubby understorey on shallow texture-contrast soils
- Queensland bluegrass (*Dichanthium sericeum*) grasslands
- Sandstone ranges dominated by narrow-leaved ironbark and bloodwood (*Corymbia* spp.)
- Watercourses fringed by black ironbox (*Eucalyptus raveretiana*) (Young *et al.*, 1999)

2.2.2 Belyando Downs Subregion

Variable geology through the Belyando Downs subregion is associated with a number of predominant vegetation communities, namely:

- Brigalow and gidgee (*Acacia cambagei*) communities on fine textured soils
- Silver-leafed ironbark (*Eucalyptus melanophloia*) woodlands on plateau remnants of upper Tertiary surfaces
- On Palaeozoic rock outcrops, lancewood (*Acacia shirleyi*) and bendee (*Acacia catenulata*) occurs on rocky hills with skeletal soils, and cypress (*Callitris glaucophylla*) and ironbark woodland occurs where deeper soils are present.
- Poplar box woodlands and Queensland bluegrass grasslands on Tertiary surfaces
- Poplar box and brigalow communities on widespread alluvial deposits (Young *et al.*, 1999)

2.2.3 Alice Tableland Subregion

The geology of the Alice Tableland subregion is characterised by sandstone ranges and deep red soils of intact Tertiary sand sheets (Morgan, 1999). Other, less extensive geological features of the Alice Tableland include calcareous sandstone outcrops in valleys of the central east, dune areas and associated clay lake deposits, and alluvial clay soils along watercourses (in southern areas) (Morgan, 1999). Two large internal drainage basins occur in the Alice Tableland, within 50 km of the Project (Rail) corridor – Lake Galilee and Lake Buchanan.

The main vegetation communities of the Alice Tableland subregion include yellow jacket woodlands, White's ironbark woodlands and mixed bloodwood/ironbark woodlands (Morgan, 1999). *Acacia* spp. dominated communities occur in some areas associated with clays (Morgan, 1999).

2.3 Local Land Use

The Project Area is located within the Regional Landscape and Rural Production Area land use category under the Mackay, Isaac and Whitsunday Regional Plan 2012 (DLGP, 2012). The Regional Landscape and Rural Production Area includes land with significant biodiversity values, good quality agricultural land (GQAL), cultural and landscape heritage values, extractive resources of economic significance (e.g. mining), water catchments, native forests, coastal wetlands, land unsuitable for urban/rural residential purposes and rural towns and associated activities (DLGP, 2012). Cattle breeding and fattening makes up the major use of land within the Study Area.

Much of the Study Area has been impacted through extensive grazing by cattle. Such impacts associated with grazing activities are evident in the form of vegetation clearing, the introduction and increased spread of exotic pasture grasses and subsequent displacement and reduction of native herbs and grasses, trampling and compaction of creek beds and subsequent erosion and reduced ground cover of creek banks.

2.4 Terrestrial Flora

2.4.1 Regional Ecosystems

2.4.1.1 The Regional Ecosystem Framework

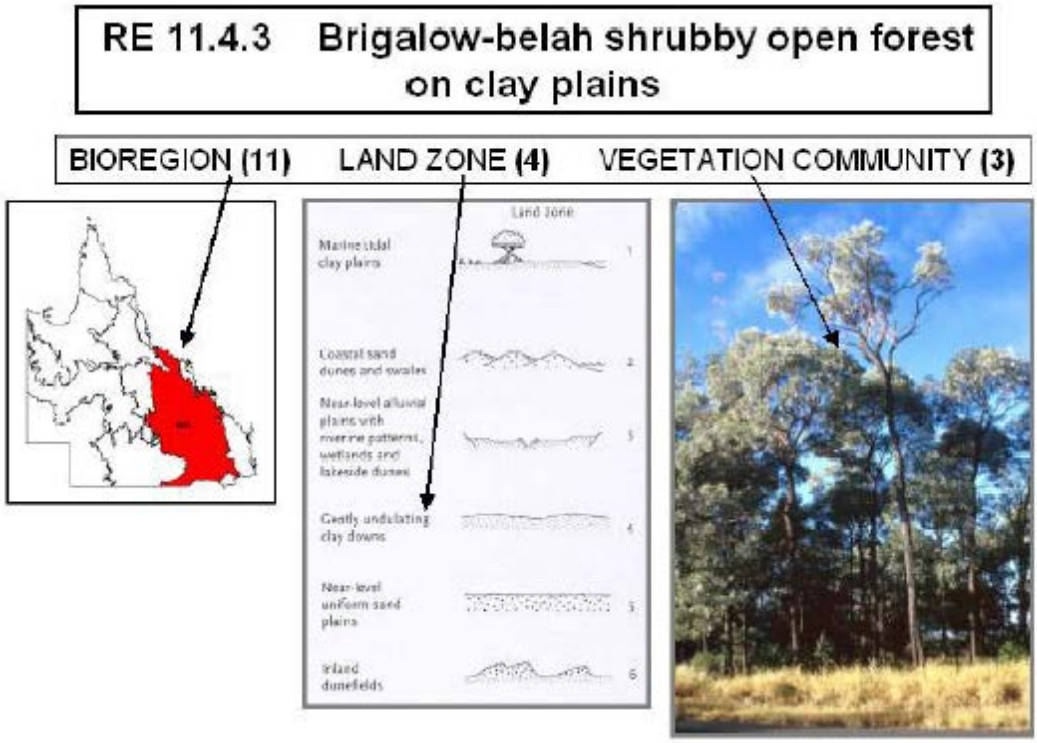
Remnant vegetation, in the form of REs is mapped across Queensland. Vegetation is remnant, and included within the RE framework, if it meets the following criteria:

- Fifty per cent of the predominant canopy cover that would exist if the vegetation community were undisturbed
- Seventy per cent of the height of the predominant canopy that would exist if the vegetation community were undisturbed
- Composed of the same floristic species that would exist if the vegetation community were undisturbed

Vegetation that does not meet these criteria is non-remnant (see Section 2.4.1.4), and is regulated regrowth vegetation if it has not been cleared since 31 December 1989 (see Section 2.4.1.3).

REs are ordered on three levels, reflected in the three part codes used to identify them (see example in Figure 2-1). At the highest level is the bioregion – the Queensland Herbarium has adopted the Stanton and Morgan (1977) bioregional mapping for Queensland as outlined in Sattler and Williams (1999). Each bioregion is given a number, which is the first number that appears in the RE code (for example, the RE 11.7.2 belongs to bioregion 11). Bioregions are in turn divided into subregions, although this information is not incorporated into the RE code (although it can be of value in determining the identification of an RE). As discussed in Section 2.1.3, the Project (Rail) traverses the Desert Uplands and Brigalow Belt bioregions, these being bioregion 10 and bioregion 11, respectively.

Figure 2-1 Example of Regional Ecosystem Classification



The second level is that of the land zone, of which there are 12 (the land zone is the second number – the RE 11.7.2 is found on land zone seven). Land zones are a landscape unit based on a generalised combination of geology, pedology and land form pattern. The final level of organisation is the ecosystem (described in terms of the dominant vegetation in terms of above ground biomass), which is specific to a land zone within a bioregion (unlike bioregional organisation and land zone units, which are consistent across Queensland) (Sattler and Williams, 1999). Therefore, the RE 11.7.2 is the second described ecosystem on land zone seven in bioregion eleven. Ecosystem descriptions within each bioregion have been derived from Queensland Herbarium detailed sampling in combination with other published sources, which are usually quoted with each RE description.

REs are rated or classed in two ways. Under the VM Act, the remnant extent of a RE is measured against the estimated extent before mechanical clearing (Sattler and Williams, 1999). This is a quantitative measure of a REs remnant extent and has legislative force. The categories under the VM Act are as follows:

- Endangered REs are those that have either:
  - Less than 10 per cent of the pre-clearing extent remaining; or
  - 10 to 30 per cent of the pre-clearing extent remaining and the remnant vegetation remaining is less than 10,000 ha
- Of concern REs are those that have either:
  - 10 to 30 per cent of the pre-clearing extent remaining; or

  - More than 30 per cent of the pre-clearing extent remaining and the remnant vegetation remaining is less than 10,000 ha
- Least concern REs are those that have more than 30 per cent of the pre-clearing extent remaining and the remnant vegetation remaining is more than 10,000 ha

The second method of rating REs is by the biodiversity status. This method takes into account the condition of the RE as well as its remnant extent and perceived threat. Condition is assessed based on soil quality, species diversity and the ability of species diversity to recover. In addition, the presence of threatening processes such as clearing, development pressure, inappropriate fire management, fragmentation and weed incursion are considered. Therefore, this is a rating system that combines quantitative and qualitative data with a threat assessment, assigning ratings of endangered, of concern and no concern at present. Sattler and Williams (1999) give the following rationale for these ratings:

- 'The **endangered** class is based upon the category established for plant species, namely a species at serious risk of disappearing from the wild within 10 – 20 years if present land use and other causal factors continue to operate.'
- 'The **of concern** class indicates that a significant reduction in the distribution or condition of a RE has occurred and that a particular management response is needed to ensure that it does not become endangered.'
- 'The **no concern at present** class indicates that the ecosystem is relatively widespread.'

The biodiversity status can be used in determining offsets where the VM Act classifications have no legislative force (i.e. mining projects). However, the biodiversity status is not applicable to infrastructure associated with mines (e.g. rail) and therefore the VM Act classification takes precedence for the Project (Rail).

The current certified version of the RE mapping (v6.0b) represents the extent of remnant vegetation and REs as of 2006 and is based on the VM Act classification. As such, some areas may have been cleared since 2006.

2.4.1.2 Regional Ecosystems in the Study Area

Regional Ecosystems, as mapped, typically occur as fragmented patches in what is a predominantly cleared landscape. Within the rail corridor, mapped REs comprise approximately 343 ha. Within the additional infrastructure areas footprint, mapped REs comprise approximately 19 ha, while within the proposed construction camps footprint, mapped REs comprise approximately 5 ha.

A total of 18 Brigalow Belt REs are mapped within the rail corridor and associated infrastructure and construction camp footprints (RE descriptions are presented in Table 2-2, mapping in Figure 2-2 and fine scale mapping in Appendix H). The mapped Brigalow Belt REs include three endangered, five of concern and 10 least concern REs.

The results of the flora and vegetation surveys indicated some inaccuracies in the mapped REs. However, due to limited access to entire RE extents and the timing of the surveys (which limited species identification), a full detailed assessment of RE mapping inaccuracies was not carried out at the time of preparing this report. As discussed in Section 1.1.1, further fieldwork and resulting data will result in map modifications (refer Volume 4, Appendix AA2 and Appendix AA3 and Volume 3, Section 5 Natture Conservation).

Within the rail corridor and infrastructure and construction camps footprints, REs occur on six land zones (see Appendix G for a full description of these units), as summarised in Table 2-1.

Table 2-1 Land Zones within Study Area

Land Zone	Description	Area (ha) in rail corridor and infrastructure and construction camp footprints
3	Represented by alluvial plains associated with Logan Creek, Mistake Creek and Belyando River and their tributaries.	106.2 ha
4	Represented by clay plains with minor gilgai micro-relief in places – much of this land zone has been cleared and is now dominated by pasture grasses; this land zone is the most common in terms of area, with large clay plains associated with alluvium present across the majority of the Study Area.	187.7 ha
5	Represented by Cainozoic plains with sandy or loamy soils.	68.5 ha
7	Represented by ironstone jump-ups.	1.6 ha
9	Represented by gently undulating landscapes formed from fine-grained sedimentary rocks.	1.4 ha
10	Represented by sandstone ranges.	1.1 ha

***** Only land zones with REs represented within the rail corridor and infrastructure and construction camp footprints have been included in this table.

Land zone 3 is the second most common land zone within the rail corridor and infrastructure and construction camp footprints . It is represented by seven REs within the Brigalow Belt bioregion. This land zone is represented by Quaternary aged alluvial deposits associated with watercourses. Of the REs within land zone 3, five are described as low open woodland or woodland which are dominated by eucalypt species, including coolabah (*Eucalyptus coolabah*), Reid River box (*Eucalyptus brownii*), silver-leaved ironbark (*Eucalyptus melanophloia*), narrow-leaved ironbark (*Eucalyptus crebra*) or forest red gum (*Eucalyptus tereticornis*) (REs 11.3.3, 11.3.7, 11.3.10, 11.3.25and 11.3.37). Other commonly occurring tree species include ghost gum (*Corymbia dallachiana*) and river teatree (*Melaleuca trichostachya*). One of the open woodland or low open woodland REs is dominated by acacia species, specifically brigalow and gidgee (RE 11.3.5). The remaining RE is an acacia open forest, dominated by brigalow (11.3.1). Not all of the land zone 3 REs were assessed during surveys (see Table 2-2).

Land zone 3 REs also occur as open forest fringing watercourses. The RE 11.3.25 is dominated by river red gum (*Eucalyptus camaldulensis*) and weeping paperbark (*Melaleuca leucadendra*) and is restricted to watercourses, such as Mistake Creek. One land zone 3 RE is classed as endangered (RE 11.3.1), and one is classed as of concern (RE 11.3.3) under the VM Act. In addition, RE 11.3.1 is a component of the Brigalow TEC.

Land zone 4 is the land zone with the greatest area within the rail corridor and infrastructure and construction camp footprints. The land zone occurs on level to gently undulating plains formed on Cainozoic clay deposits. This land zone is represented by six REs within the Brigalow Belt bioregion. Two of the land zone four REs are grasslands dominated by Queensland bluegrass (*Dichanthium sericeum*) and *Astrebla* spp. (11.4.4 and 11.4.11). Eucalypt species are represented by one RE within this land zone, the dominant species including Dawson's gum (*Eucalyptus cambageana*) (11.4.8). The three remaining REs within land zone 4 comprise acacia woodlands or open forests that are dominated by brigalow (11.4.9), gidgee (11.4.6) and blackwood (*Acacia argyrodendron*) (11.4.5). These REs are likely to have been more common in the area prior to European settlement. However, as clay plains are often highly suitable for improved pastures, they have generally been targeted for broad-scale clearing, and as a consequence they are now poorly represented in terms of area. The REs on land zone 4 as a group have the highest conservation value of all of the REs within the Study Area – three REs are classed as of concern (REs 11.4.5, 11.4.6 and 11.4.11) and two are classed as endangered (REs 11.4.8 and 11.4.9). In addition, four of the REs within this land zone are components of EPBC Act-listed endangered TECs. The REs 11.4.8 and 11.4.9 are components of the endangered Brigalow TEC. REs 11.4.4 and 11.4.11 is a component of the Natural Grassland TEC within the Northern Bowen Basin subregion. Not all of the land zone 4 REs were assessed during surveys (see Table 2-2).

Land zone 5 is represented by Cainozoic sand plains comprised of either red or grey sand. There are two REs mapped in the certified mapping for this land zone, both of which are woodlands dominated by eucalypt/corymbia species. Dominant species for these REs include silver-leaved ironbark (11.5.3), poplar box (11.5.3), narrow-leaved ironbark (11.5.9c) and various corymbia species (11.5.3 and 11.5.9c). Both of the land zone 5 REs occur within the Brigalow Belt bioregion and have a status of least concern. Land zone 5 REs are concentrated at the eastern extent of the rail corridor near Moranbah and occur as both single and mixed polygons in isolated and continuous patches. One site was assessed within RE 11.5.3 in the central section of the alignment. The dominant species within

this woodland RE included ghost gum and Reid river box. Not all of the land zone 5 REs were assessed during surveys (see Table 2-2).

One land zone 7 RE occurs within the rail corridor and temporaray infrastructure footprints. Land zone 7 incorporates land forms characterised by Cainozoic duricrust, which in the Study Area are likely to take the form of ferricrete capping over sandstone. The land zone 7 RE mapped by the certified RE mapping as being present was not assessed during field surveys due to limited access (see Table 2-2). This RE occurs in small patches in the central part of the rail corridor as individual REs and as mixed polygons. This RE is a woodland dominated by acacia species (11.7.2).

Land zone 9 is represented by one Brigalow Belt RE. This land zone is represented by gently undulating landscapes on sandstone rocks, the sandstone forming land zone 9 in the majority of the Study Area is from the Triassic period, and is generally located beneath a shallow soil profile. Land zone 9 REs were not assessed during field surveys due to limited access. According to the certified RE mapping the land zone 9 RE is a woodland dominated by eucalyptus species, namely poplar box (11.9.10).

Land zone 10 is associated with medium to coarse-grained Cainozoic to Proterozoic consolidated sedimentary rocks, often forming crests and scarps. Land zone 10 REs occur in continuous remnant patches around Moranbah at the eastern most extent of the Study Area. No REs within this land zone were assessed during field surveys. However, one least concern RE within this land zone is represented within the rail corridor and infrastructure and construction camp footprints. This RE is a Brigalow Belt RE and features open forests dominated by bendee (*Acacia catenulata*) and lancewood (*Acacia shirleyi*) (11.10.3).

2.4.1.3 Regulated Regrowth Vegetation in the Study Area

Regulated regrowth (or high value regrowth) vegetation as defined by the VM Act comprises non-remnant vegetation that has reached an advanced stage of growth and not been cleared since 31 December 1989. Regulated regrowth vegetation is categorised into three broad categories based on the pre-clear RE mapping and the known or predicted species composition within each polygon. These categories comprise regulated regrowth containing an endangered RE, regulated regrowth containing an of concern RE and regulated regrowth containing a least concern RE.

Several patches of regulated regrowth vegetation are mapped within the rail corridor and infrastructure and construction camp footprints, with 19.7 ha of regulated regrowth vegetation occurring in rail corridor and infrastructure and construction camp footprints. Regulated regrowth comprises least concern (1.5 ha), of concern (6.6 ha) and endangered (11.6 ha) regrowth REs. Regrowth mapping is provided at Figure 2-2.

2.4.1.4 Non-remnant Vegetation in the Study Area

Vegetation that does not meet the criteria defined under the VM Act for remnant vegetation, and has been cleared since 31 December 1989 (regulated regrowth vegetation) is non-remnant.

Mapping and field survey (access permitting) shows that the majority of vegetation within the Study Area, including the rail corridor and infrastructure and construction camp footprints is non-remnant, open cleared land with low native species diversity and cover and a high occurrence of weed species. In total, approximately 27,649 ha of non-remnant vegetation is present in the Study Area. Within the

rail corridor and infrastructure and construction camp footprints, the areas of non-remnant vegetation is approximately 1,401 ha, 92 ha and 5 ha, respectively.

2.4.1.5 Essential Habitat in the Study Area

No areas of essential habitat for species are mapped within the Study Area (DERM, 2011a).

Table 2-2 Regional Ecosystem Descriptions

RE	VM Act class/ Biodiversity status	Land Form	Description	Comments (incl. area (ha) in rail corridor and infrastructure and construction camp footprints)
11.3.1	endangered/ endangered	Associated soils are predominantly deep to very deep cracking clays, sometimes with gilgai or texture contrast soils with sandy surface (particularly where Eucalyptus populnea is present).	Open-forest dominated by *Acacia harpophylla* and/or *Casuarina cristata* (particularly in southern parts), with or without scattered emergent *Eucalyptus* spp. such as *E. coolabah*, *E. largiflorens, E. populnea, E. orgadophila* and *E. woollsiana*. A low tree layer dominated by *Geijera parviflora* and *Eremophila mitchellii* is usually present. The vegetation sometimes occurs as low open-forest or woodland. Tree height generally about 11-15 m and the low tree (to tall shrub) understorey layer is between 2 and 8 m high (where present). Ground cover is generally sparse. Associated with Cainozoic alluvial plains which may be occasionally flooded. Landforms range from level to very gently sloping plains, alluvial flats, drainage floors, back-swamps and abandoned channels.	Present in small patches and along watercourses (North Creek, Mistake Creek, Grosvenor Creek, and Logan Creek) with gidgee and eucalypt communities, on alluvial plains associated with the Belyando River One site was assessed and was found to be dominated by Reid river box. Part of the EPBC Act Threatened Ecological Community 'Brigalow'. Approximately 11.0 ha within the rail corridor footprint. Approximately 36.5 ha occurs within the borrow areas footprint. This RE does not occur within the infrastructure footprint.

RE	VM Act class/ Biodiversity status	Land Form	Description	Comments (incl. area (ha) in rail corridor and infrastructure and construction camp footprints)
11.3.3	of concern/ of concern	Occurs on Cainozoic alluvial plains or levees with clay or sometimes texture contrast soils.	*Eucalyptus coolabah* woodland to open-woodland with a grassy understorey. A mid layer is often absent but scattered tree or shrub species, such as *E. populnea, Melaleuca bracteata, Alectryon oleifolius, Terminalia oblongata* (in the north) and *Acacia pendula, A. cambagei,* and occasionally *Muehlenbeckia florulenta* may be present. The ground layer is dominated by a range of grass and forb species depending on season, soil and management conditions. Can include small areas of grassland with scattered trees.	Occurs in association with watercourses including Belyando River, Mistake Creek and Sullivan Creek. Other vegetation communities with which it exists include brigalow and gidgee woodlands, Reid river box and river red gum and forest red gum (when in mixed polygons fringing watercourses). This RE was the most comprehensively assessed across the Study Area and confirmed consistent with the certified mapping. Approximately 45.4 ha occurs within the rail corridor footprint. Approximately 20.8 ha occurs within the borrow areas footprint. Approximately 1.2 ha occurs within the infrastructure footprint.

RE	VM Act class/ Biodiversity status	Land Form	Description	Comments (incl. area (ha) in rail corridor and infrastructure and construction camp footprints)
11.3.5	least concern/ of concern	Occurs on levees on alluvial plains which are rarely flooded. Associated soils are often texture contrast with sandy surfaces	*Acacia cambagei +/- A. harpophylla low* woodland or open-forest sometimes clumped, on Cainozoic alluvial plains. *Acacia cambagei* dominates the canopy (8-16 m high) sometimes in association with *A. harpophylla* as a sub-dominant. *Eucalyptus coolabah, E. largiflorens* (subregion 35) or *Acacia harpophylla* may be present. Often *Eremophila mitchellii* is present as an open low tree layer (1.5-4 m high) or as scattered shrubs to small trees. *Psydrax oleifolia* and *Atalaya hemiglauca* are occasionally present. A small shrub layer sometimes occurs dominated by *Senna artemisioides* with or without suckers of *Acacia cambagei* or both species may occur as scattered shrubs. The ground layer is often poorly formed except under the canopy where there is usually a very sparse cover of dominants which include *Paspalidium caespitosum, Sporobolus actinocladus* and *Brachyachne convergens*. Other graminoids frequently present are *Bothriochloa ewartiana, Iseilema vaginiflorum, Eragrostis microcarpa* and *Aristida latifolia*.	Occurs adjacent to Belyando River and Mistake Creek and across the alluvium associated with these watercourses. Associated species include coolabah and Reid river gum. Sites were assessed within this RE which verified the presence of characteristic species (brigalow and gidgee) in small patches within mixed polygons. Approximately 20.4 ha occurs within the rail corridor footprint. Approximately 70.0 ha occurs within the borrow areas footprint This RE does not occur within the infrastructure footprint.
11.3.7	least concern/ of concern	Occurs on levees and plains formed from Quaternary alluvial deposits. Soils are usually deep uniform sands with minor areas of sandy red earths.	*Corymbia clarksoniana, C. tessellaris* and *C. dallachiana* tall woodland to open-woodland (12-17 m high). There is usually a low open-woodland tree layer (7-11 m high) dominated by species such as *Acacia salicina, Lysiphyllum hookeri* or *Grevillea striata*.	Present as two large mixed polygons in the western section of the Study Area. Coolabah was found to be the dominant species. Assessed and verified as 11.3.7, though coolabah was dominant in areas. Approximately 5.6 ha occurs within the rail corridor footprint. This RE does not occur within the borrow areas footprint. This RE does not occur within the infrastructure footprint.

RE	VM Act class/ Biodiversity status	Land Form	Description	Comments (incl. area (ha) in rail corridor and infrastructure and construction camp footprints)
11.3.10	least concern/ no concern at present	Occurs on Cainozoic alluvial plains.	*Eucalyptus brownii* grassy woodland. This unit usually occurs as a woodland of *Eucalyptus brownii*. There is usually a grassy ground layer of *Aristida* spp., *Chloris* spp., *Fimbristylis dichotoma, Eriachne* spp., *Eragrostis* spp. and *Chrysopogon fallax*. Areas subject to less intensive grazing or on better soils contain *Heteropogon contortus, Bothriochloa bladhii* and *Chrysopogon fallax*.	Occurs within alluvium associated with Belyando River and Mistake Creek. Associated vegetation communities include acacia woodlands and open forests and coolabah open woodlands. Some sites within this RE at the western extent of the Study Area were assessed and found to be consistent with the certified RE mapping. Approximately 10.0 ha occurs within the rail corridor footprint. Approximately 31.8 ha occurs within the borrow areas footprint. This RE does not occur within the infrastructure footprint.

RE	VM Act class/ Biodiversity status	Land Form	Description	Comments (incl. area (ha) in rail corridor and infrastructure and construction camp footprints)
11.3.25	least concern/ of concern	Occurs on fringing levees and banks of major rivers and drainage lines of alluvial plains throughout the region. Soils are very deep, alluvial, grey and brown cracking clays with or without some texture contrast. These are usually moderately deep to deep, soft or firm, acid, neutral or alkaline brown sands, loams or black cracking or non-cracking clays, and may be sodic at depth (Burgess 2003).	*Eucalyptus camaldulensis* or *E. tereticornis* open-forest to woodland. Other tree species such as *Casuarina cunninghamiana, E. coolabah, Melaleuca bracteata, Melaleuca viminalis, Livistona* spp. (in north), *Melaleuca* spp. and *Angophora floribunda* are commonly present and may be locally dominant. An open to sparse, tall shrub layer is frequently present dominated by species including *Acacia salicina, A. stenophylla* or *Lysiphyllum carronii*. Low shrubs are present, but rarely form a conspicuous layer. The ground layer is open to sparse and dominated by perennial grasses, sedges or forbs such as *Imperata cylindrica, Bothriochloa bladhii, B. ewartiana, Chrysopogon fallax, Cyperus dactylotes, C. difformis, C. exaltatus, C. gracilis, C. iria, C. rigidellus, C. victoriensis, Dichanthium sericeum, Leptochloa digitata, Lomandra longifolia* or *Panicum* spp.	Present as fringing woodland along watercourses, including Belyando River, Mistake Creek, Grosvenor Creek and other minor watercourses. Often associated with coolabah and brigalow. Assessed at Mistake Creek and Belyando River. Approximately 9.8 ha occurs within the rail corridor footprint. Approximately 15.7 ha occurs within the borrow areas footprint. Approximately 0.5 ha occurs within the infrastructure footprint.

RE	VM Act class/ Biodiversity status	Land Form	Description	Comments (incl. area (ha) in rail corridor and infrastructure and construction camp footprints)
11.3.37	least concern/ no concern at present	Occurs on fringing stream channels, usually braided. Soils are bed loads of clay or silt with cobbles and boulders in some areas. Predominantly western sub-regions of the Brigalow Belt, for example the Suttor River catchment.	*Eucalyptus coolabah* with *Eucalyptus camaldulensis* form a distinct but discontinuous woodland to low woodland canopy layer (7-11 m high). Other scattered trees such as *Lysiphyllum gilvum, Melaleuca trichostachya, Melaleuca bracteata* and *Eucalyptus populnea* may occur. The mid layer varies from absent to a tall shrubland dominated by species such as *Acacia stenophylla* and *Acacia salicina*. Ground cover is variable composed of grasses and sedges. Includes larger waterholes within the stream channels.	Present as fringing woodland along watercourses, including Belyando River, Mistake Creek and Grosvenor Creek and is often associated with brigalow. Assessed at Mistake Creek and Belyando River. Approximately 2.2 ha occur within the rail corridor footprint. Approximately 14.3 ha occurs within the borrow areas footprint. This RE does not occur within the infrastructure footprint.
11.4.4	least concern/ of concern	Occurs on flat to gently undulating clay plains formed from Cainozoic or weathered basalt unconsolidated sediments. Soils are generally moderately to deep to very deep dark grey self-mulching cracking clays with linear gilgai. Gravel or stone may be present in some areas.	Tussock grassland dominated by *Dichanthium* spp. +/- *Astrebla* spp. (mainly *A. lappacea* and *A. pectinata).* Other grasses frequently present include *Thellungia advena, Panicum* spp. and *Aristida* spp. Forbs and annual grasses may become common with seasonal rains. Occasional shrubs and trees may be present in places.	Occurs in a single large expanse of remnant vegetation mapped as grassland at the centre of the Study Area. Part of the EPBC Act Threatened Ecological Community 'Natural Grasslands' only within the Northern Bowen Basin Subregion of the project Area. Approximately 8.8 ha occurs within the rail corridor footprint. This RE does not occur within the borrow areas footprint. This RE does not occur within the infrastructure footprint.

RE	VM Act class/ Biodiversity status	Land Form	Description	Comments (incl. area (ha) in rail corridor and infrastructure and construction camp footprints)
11.4.5	of concern/ endangered	Occurs on flat to gently undulating plains formed from unconsolidated Cainozoic deposits.	*Acacia argyrodendron* dominates the very sparse canopy (12-16 m high). There are usually scattered small trees (6-10 m high) including *A. argyrodendron, Terminalia oblongata, Owenia acidula, Lysiphyllum carronii* and *Eremophila mitchellii*. Grasses usually dominate the very sparse to mid-dense ground layer. *Dichanthium sericeum, Panicum decompositum* and *Aristida latifolia* can also be dominants.	Occurs in relatively large and intact areas of remnant vegetation, often in association with gidgee, and also coolabah. Occurs in association with grasslands south-west of North Creek at the western extent of the Study Area. One site within this RE was assessed and verified in the field. Approximately 2.9 ha occurs within the rail corridor footprint. Approximately 17.4 ha occurs within the borrow areas footprint. Approximately 0.6 ha occurs within the infrastructure footprint.
11.4.6	of concern/ endangered	Occurs on gently undulating plains formed from Cainozoic sediments. Associated soils are texture contrast with thin sandy or loamy surface horizons and strongly alkaline clay subsoils.	*Acacia cambagei* dominates the tree canopy (10-13 m high). There is a sparse to open low tree layer (7-9 m high) dominated by *Lysiphyllum carronii, Geijera parviflora, Acacia harpophylla*, and sometimes *A. argyrodendron, Terminalia oblongata,* and *Eremophila mitchellii*. An open shrub layer (1 m high) dominated by species such as *Carissa ovata, Capparis lasiantha, Eremophila deserti, Apophyllum anomalum* and *Alectryon diversifolius* is also often present. The ground layer is sparse to open and dominated by grasses.	Present across much of the Study Area in small isolated patches on its own, and large and relatively continuous remnant patches in mixed polygon. Often associated with brigalow, blackwood, Dawson's gum and coolabah. Few sites within this RE were assessed and verified in the field. Approximately 20.4 ha occurs within the rail corridor footprint. Approximately 360.52 ha occurs within the borrow areas footprint. Approximately 0.3 ha occurs within the infrastructure footprint.

RE	VM Act class/ Biodiversity status	Land Form	Description	Comments (incl. area (ha) in rail corridor and infrastructure and construction camp footprints)
11.4.8	endangered/ endangered	Occurs on level to gently undulating plains formed from Cainozoic deposits. Associated soils are usually deep texture contrast with thin loamy or sandy surface horizons overlying strongly alkaline clay subsoils. Surface or subsurface gravel is common	Woodland to open-forest dominated by *Eucalyptus cambageana* and *Acacia harpophylla* or, sometimes in the north, *A. argyrodendron. E. thozetiana* is sometimes present on shallower soils. There is a moderately dense low tree layer (5 m high) layer dominated by species such as *Eremophila mitchellii* and a low shrub layer (2 m high) dominated by species such as *Carissa ovata* and *Geijera parviflora..*	Occurs across the entire extent of the Study Area in small to large and continuous remnant vegetation patches. Often associated with eucalypt species, gidgee and blackwood. Part of the EPBC Act Threatened Ecological Community 'Brigalow'. Several sites were assessed and verified as 11.4.8, specifically in the eastern section of the Study Area. Part of the EPBC Act Threatened Ecological Community 'Brigalow'. Approximately 2.5 ha occurs within the rail corridor footprint. Approximately 94.7 ha occurs within the borrow areas footprint. Approximately 0.01 ha occurs within the infrastructure footprint.

RE	VM Act class/ Biodiversity status	Land Form	Description	Comments (incl. area (ha) in rail corridor and infrastructure and construction camp footprints)
11.4.9	endangered/ endangered	Occurs on level to gently undulating Cainozoic plains, including weathered basalt. Associated soils are predominantly moderately deep to deep cracking clays that may be brown, red-brown or grey-brown, and with much surface gravel in some areas.	Open-forest, occasionally woodland, dominated by *Acacia harpophylla* usually with a low tree mid-storey of *Terminalia oblongata* and *Eremophila mitchellii*. *Casuarina cristata* sometimes replaces *Acacia harpophylla* in the overstorey and *Lysiphyllum cunninghamii* sometimes co-dominates. Other low tree or shrub species such as *Alectryon diversifolius, Carissa ovata, Pittosporum spinescens, Ehretia membranifolia, Geijera parviflora* and *Flindersia dissosperma* may occur in the mid-storey or low shrub layer. *Acacia harpophylla* trees have been recorded as 11- 17 m high, the mid-storey layer 2- 8 m high and the low shrub layer 1-2 m high.	Occurs across the entire extent of the Study Area in small to large and continuous remnant vegetation patches. Often associated with eucalypt species, gidgee and blackwood. Part of the EPBC Act Threatened Ecological Community 'Brigalow'. One site within this RE was assessed and verified in the field. Approximately 14.8 ha occurs within the rail corridor footprint. Approximately 344.3 ha occurs within the borrow areas footprint. Approximately 4.4 ha occurs within the infrastructure footprint and approximately 4.6 ha occurs within construction camp areas

RE	VM Act class/ Biodiversity status	Land Form	Description	Comments (incl. area (ha) in rail corridor and infrastructure and construction camp footprints)
11.4.11	of concern/ of concern	Occurs in shallow open valleys and poorly drained Cainozoic clay plains with deep cracking clay soils.	*Dichanthium sericeum* and *Astrebla* spp. grassland with patches of low *Acacia harpophylla* or *Eucalyptus coolabah*. Grassland dominated by *Dichanthium sericeum* and forms a mosaic with clumps of *Acacia harpophylla, Lysiphyllum hookeri* and *L. carronii* (usually 8+/-3 m high). A wide range of other grass and forb species is usually present and may dominant depending on seasonal conditions and management regime. Frequently occurring species include the grasses *Aristida leptopoda, A. latifolia, Astrebla lappacea, Bothriochloa erianthoides, Digitaria brownii, D. divaricatissima, Eriochloa crebra, Panicum decompositum, P. queenslandicum, Paspalidium globoideum* and the forbs *Abelmoschus ficulneus, Boerhavia dominii, Corchorus trilocularis, Cyperus bifax, Glycine latifolia, Hibiscus trionum* var. *vesicarius, Ipomoea lonchophylla, Phyllanthus maderaspatensis, Tribulus micrococcus* and *Rhynchosia minima.*	Present commonly in association with acacia open woodlands and open forests. Patches are often large and/or attached to large tracts of remnant vegetation and occur predominantly in the eastern half of the Study Area. Part of the EPBC Act Threatened Ecological Community 'Natural Grasslands' only within the Northern Bowen Basin subregion of the Project Area. Assessments of this RE were undertaken at two locations where brigalow and gidgee were present and often dominant. Approximately 120.4 ha occurs within the rail corridor footprint. Approximately 212.2 ha occurs within the borrow areas footprint. Approximately 7.8 ha occurs within the infrastructure footprint.

RE	VM Act class/ Biodiversity status	Land Form	Description	Comments (incl. area (ha) in rail corridor and infrastructure and construction camp footprints)
11.5.3	least concern/ no concern at present	Occurs on flat to gently undulating plains formed from Cainozoic sediments. Associated soils are generally deep texture contrast with thick sandy surface horizons with some deep red earths.	*Eucalyptus populnea* +/- *E. melanophloia* +/- *Corymbia clarksoniana* +/- *C. dallachiana* and occasionally *E. cambageana* or *E. brownii* dominate the tree layer (14 m median height and 11-15 m range) woodland. Localised areas may be dominated by *E. melanophloia*, occasionally *E. crebra* and other canopy species. There is generally a distinctive low tree layer (8, 6-11 m high) dominated by species such as *Eremophila mitchellii, Geijera parviflora, Archidendropsis basaltica, Erythroxylum australe, Cassia brewsteri, Ventilago viminalis* and occasionally *Allocasuarina luehmannii* or *Callitris glaucophylla*. A low shrub layer (2-6 m high) dominated by species such as *Carissa ovata, Erythroxylum australe, Capparis lasiantha* is also often present.	Present at the western extent of the Study Area commonly associated with 11.5.9c (*Eucalyptus* spp. woodland). Also present along adjacent to and above two minor watercourses near Moranbah where it is associated with river red gum and forest red gum. This RE was not assessed during field surveys. Approximately 37.6 ha occurs within the rail corridor footprint. Approximately 1207.3 ha occurs within the borrow areas footprint. Approximately 3.1 ha occurs within the infrastructure footprint.

RE	VM Act class/ Biodiversity status	Land Form	Description	Comments (incl. area (ha) in rail corridor and infrastructure and construction camp footprints)
11.5.9c	least concern/ no concern at present	Occurs on plateaus and broad crests of hills and ranges which are formed by Cainozoic sandplains. Soils are generally deep red earths.	*Eucalyptus crebra* and/or *Eucalyptus melanophloia* woodland. Other tree species that may be present and locally dominant include *Corymbia citriodora* or *C. clarksoniana* sometimes in association with *C. intermedia, C. dallachiana, C. lamprophylla, E. tenuipes, E. exserta, E. cloeziana, E. acmenoides.* The mid layer ranges from absent to a sparse to dense shrubland typically dominated by Acacia spp. (such as *A. excelsa, A. leiocalyx), Petalostigma pubescens, Lysicarpus angustifolius, Alphitonia excelsa* and occasionally *Melaleuca nervosa* (on texture contrast soils).	Occurs as small mixed polygons associated with a range of communities as well as on its own adjacent to large areas of remnant vegetation in the eastern section of the Study Area near Moranbah. Present near two minor watercourses near Moranbah where it is associated with riparian vegetation, including river red gum and forest red gum. This RE was not assessed during field surveys. Approximately 27.1 ha occurs within the rail corridorfootprint. Approximately 107.0 ha occurs within the borrow areas footprint. Approximately 0.7 ha occurs within the infrastructure footprint.

RE	VM Act class/ Biodiversity status	Land Form	Description	Comments (incl. area (ha) in rail corridor and infrastructure and construction camp footprints)
11.7.2	least concern/ no concern at present	Occurs on scarps and adjacent tops and slopes of dissected tablelands, mesas and buttes formed from chemically altered sediments and duricrusts. The soils are shallow to very shallow lithosols with surface stone and boulders. The vegetation is often growing in pockets of shallow lithosol soil between bare rock.	Monospecific stands of *Acacia* spp. forest/woodland on Cainozoic lateritic duricrusts. *Acacia shirleyi* and or *Acacia catenulata* usually predominate the woodland to low woodland to low open-forest tree canopy (7-12 m high). Other *Acacia* spp. that commonly occur and occasionally dominate the tree layer include *A. rhodoxylon, A. burrowii, A. sparsiflora, A. crassa* and *A. blakei*. Emergent eucalypt species such as *Eucalyptus thozetiana, E. crebra, E. decorticans* and *E. exserta* may be present. A low shrub layer is sometimes present and dominated by species such as *Acalypha eremorum, Croton phebalioides* and *Carissa ovata*. The ground layer is extremely sparse and dominated by grasses such as *Aristida caput-medusae, Paspalidium rarum, Urochloa foliosa*. Forbs are usually rare although *Sida filiformis* may be conspicuous.	Present in small isolated remnant patches and in mixed polygons adjacent to natural grasslands in the central section of the Study Area. Occurs with other vegetation communities dominated by Dawson's gum, *Eucalyptus persistens* and brigalow. This RE was not assessed during field surveys. Approximately 1.4 ha occurs within the rail corridor footprint. Approximately 496.0 ha occurs within the borrow areas footprint. Approximately 0.2 ha occurs within the infrastructure footprint.

RE	VM Act class/ Biodiversity status	Land Form	Description	Comments (incl. area (ha) in rail corridor and infrastructure and construction camp footprints)
11.9.10	of concern/ endangered	Occurs on Cainozoic to Proterozoic consolidated, fine-grained sediments. Occurs on lower parts of undulating plains often with deep texture-contrast soils. Occurs on sodic and saline soils which may act as a discharge area if adjacent to alluvium.	*Eucalyptus populnea* predominates forming a distinct but discontinuous canopy (15-18 m tall). *Acacia harpophylla* and sometimes *Casuarina cristata* usually forms a lower tree layer (8-14 m tall) which occasionally becomes the dominant layer. An open to moderately dense layer of tall shrubs is usually present and dominated by *Eremophila mitchellii* and *Geijera parviflora* with *Acacia excelsa, Atalaya hemiglauca, Psydrax oleifolia, Alectryon oleifolius* frequent. Scattered low shrubs such as *Carissa ovata* and *Eremophila deserti* are frequently present. The ground cover is usually sparse, and dominated by the grasses *Aristida ramosa, Enteropogon acicularis, Bothriochloa decipiens* and *Paspalidium* spp.	Present near the centre of the Study Area as both homogeneous and mixed polygons. Also present as a mixed polygon with RE 11.5.3 within borrow area 10. Where mixed polygons occur this community is associated with poplar box, Dawson's gum and brigalow. This RE was not assessed during field surveys. Approximately 1.4 ha occurs within the rail corridor footprint. Approximately 10.7 ha occurs within the borrow areas footprint. This RE does not occur within the infrastructure footprint.
11.10.3	least concern/ no concern at present	Occurs on crests and ridge tops formed on consolidated, medium to coarse-grained sediments.	*Acacia catenulata* and/or *A. shirleyi* form a distinct but discontinuous low open-forest to open-forest canopy (8-12, rarely 18 m high). Other *Acacia* spp. such as *A. sparsiflora* and *A. rhodoxylon* may form part of the canopy and in places may predominate. Scattered *Eucalyptus* spp. emergents (up to 25 m high) occur, the most frequent being *E. decorticans. Eucalyptus exserta* is conspicuous in places. Scattered tall shrubs may occur. A low shrubby layer is usually conspicuous. The ground layer is sparse and composed of both grasses and forbs.	Present as a homogeneous polygon and a mixed polygon with spotted gum communities in the western-most extent of the Study Area, near Moranbah. This RE was not assessed during field surveys. Approximately 0.7 ha occurs within the rail corridor footprint. Approximately 56.7 ha occurs within the borrow areas footprint. Approximately 0.4 ha occurs within the infrastructure footprint.

1:750,000 (at A4)

0 5 10 15 20 25

Kilometres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia (GDA)
Grid: Map Grid of Australia 1994, Zone 55

N

LEGEND

- Town
- State Road
- Local Road
- Other Railway
- Cadastral Parcel
- Road Reserve
- Watercourse Reserve
- Mine (Onsite)
- Mine (Offsite)
- Study Area

Adani Mining Pty Ltd
Carmichael Coal Mine and Rail Project

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DERM Certified Regional Ecosystems v 6.1 and Regulated Regrowth v 2.1 Mapping

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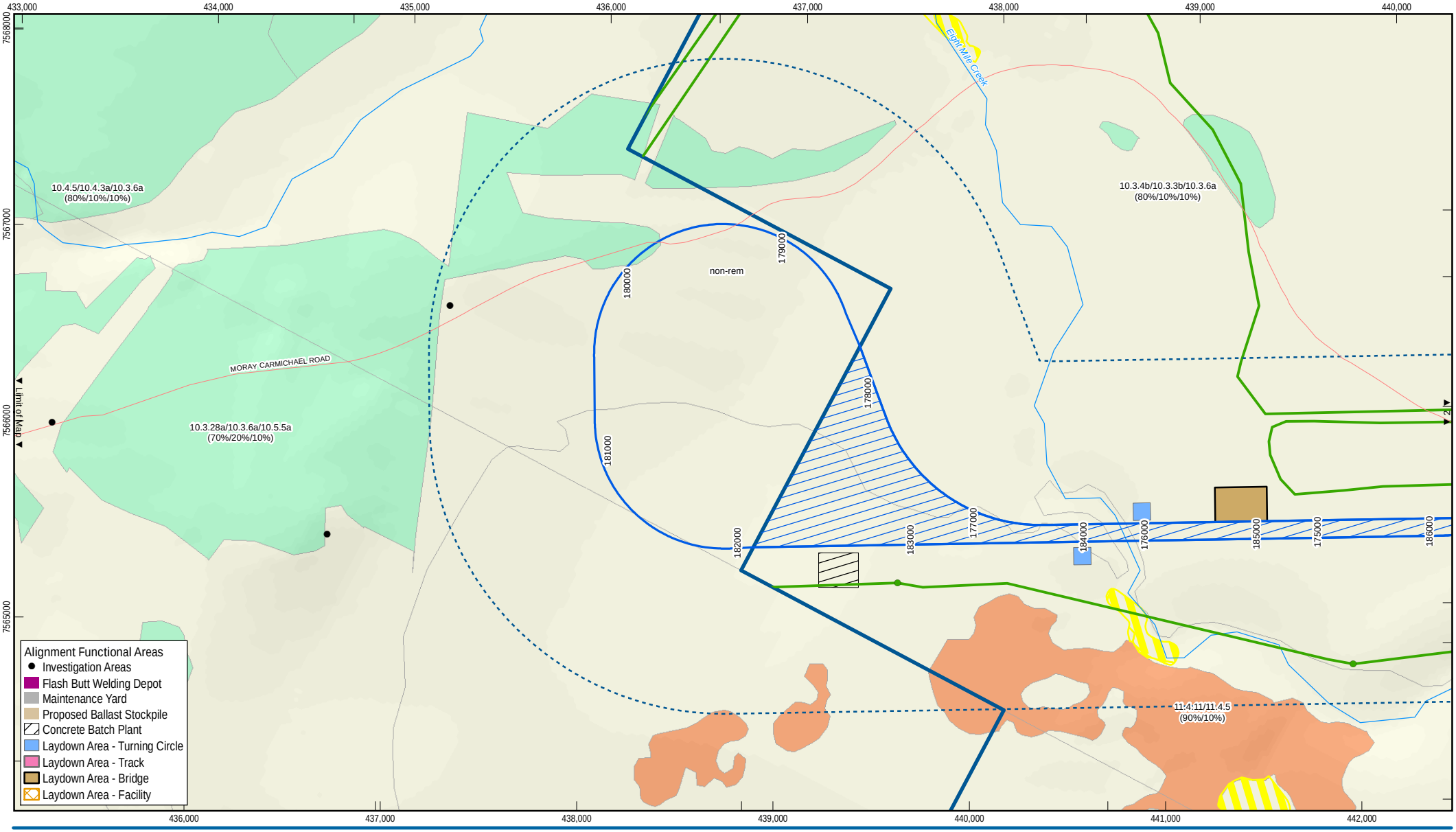

1:30,000 (at A4)

0 200 400 600 800 1,000

Metres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia (GDA)
Grid: Map Grid of Australia 1994, Zone 55

LEGEND

- Construction Camp
- State Road
- Local Road
- Watercourse
- Other Railway
- Mine (Onsite)
- Mine (Offsite)
- Mine (Offsite)
- Rail (West)
- Rail (East)
- Study Area

Regional Ecosystems v6.1

- Endangered - Dominant
- Endangered - Sub-dominant
- Of Concern - Dominant
- Of Concern - Sub-dominant
- Least Concern
- Non-remnant
- High Value Regrowth

Adani Mining Pty Ltd

Carmichael Coal Mine and Rail Project

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DERM Certified Regional Ecosystems v 6.1 and Regulated Regrowth v 2.1 Mapping

Figure 2-2
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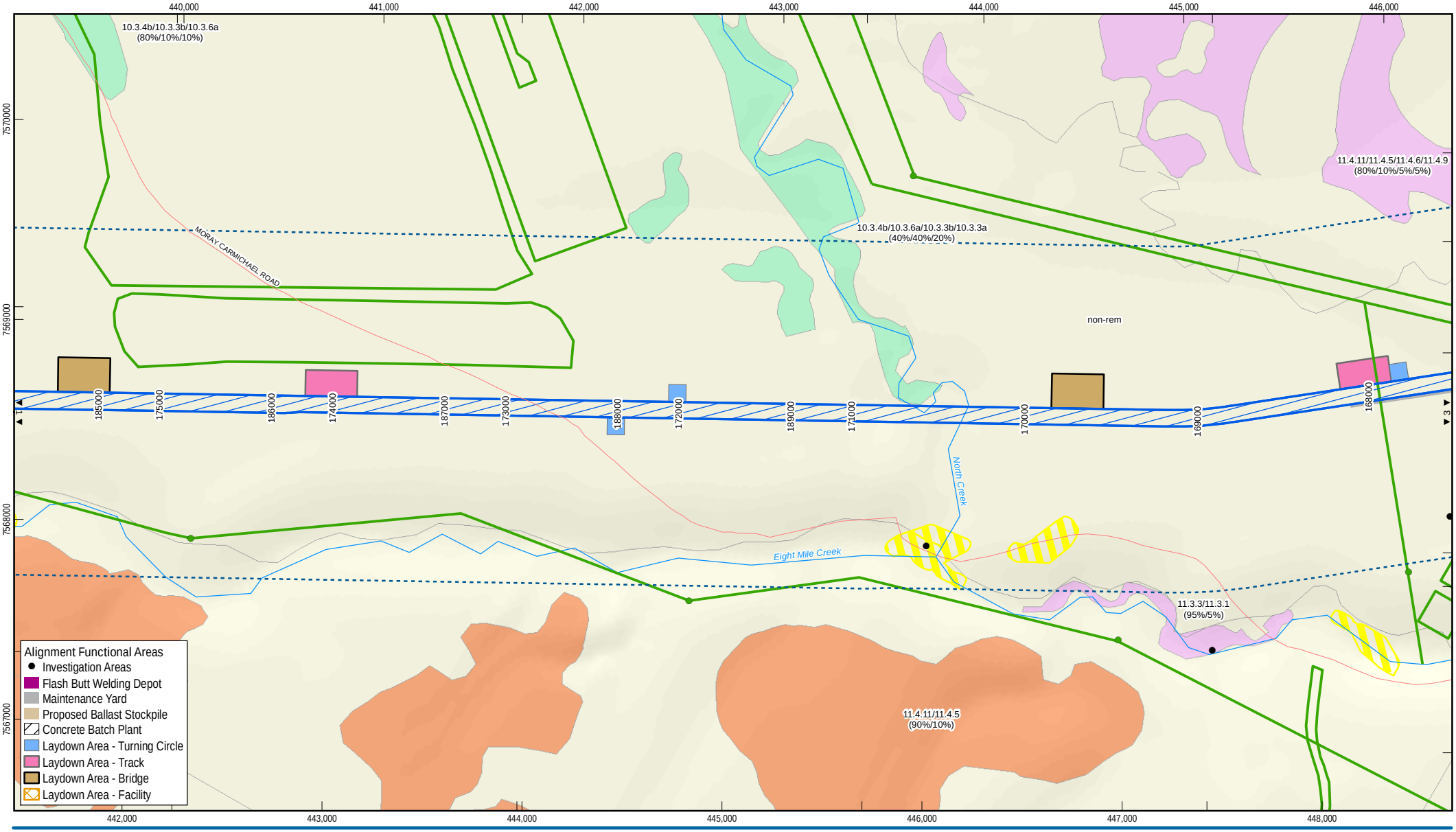

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0 200 400 600 800 1,000

Metres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia (GDA)
Grid: Map Grid of Australia 1994, Zone 55

LEGEND

- Construction Camp
- State Road
- Local Road
- Watercourse
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- Mine (Offsite)
- Mine (Offsite)
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- Rail (East)
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Regional Ecosystems v6.1

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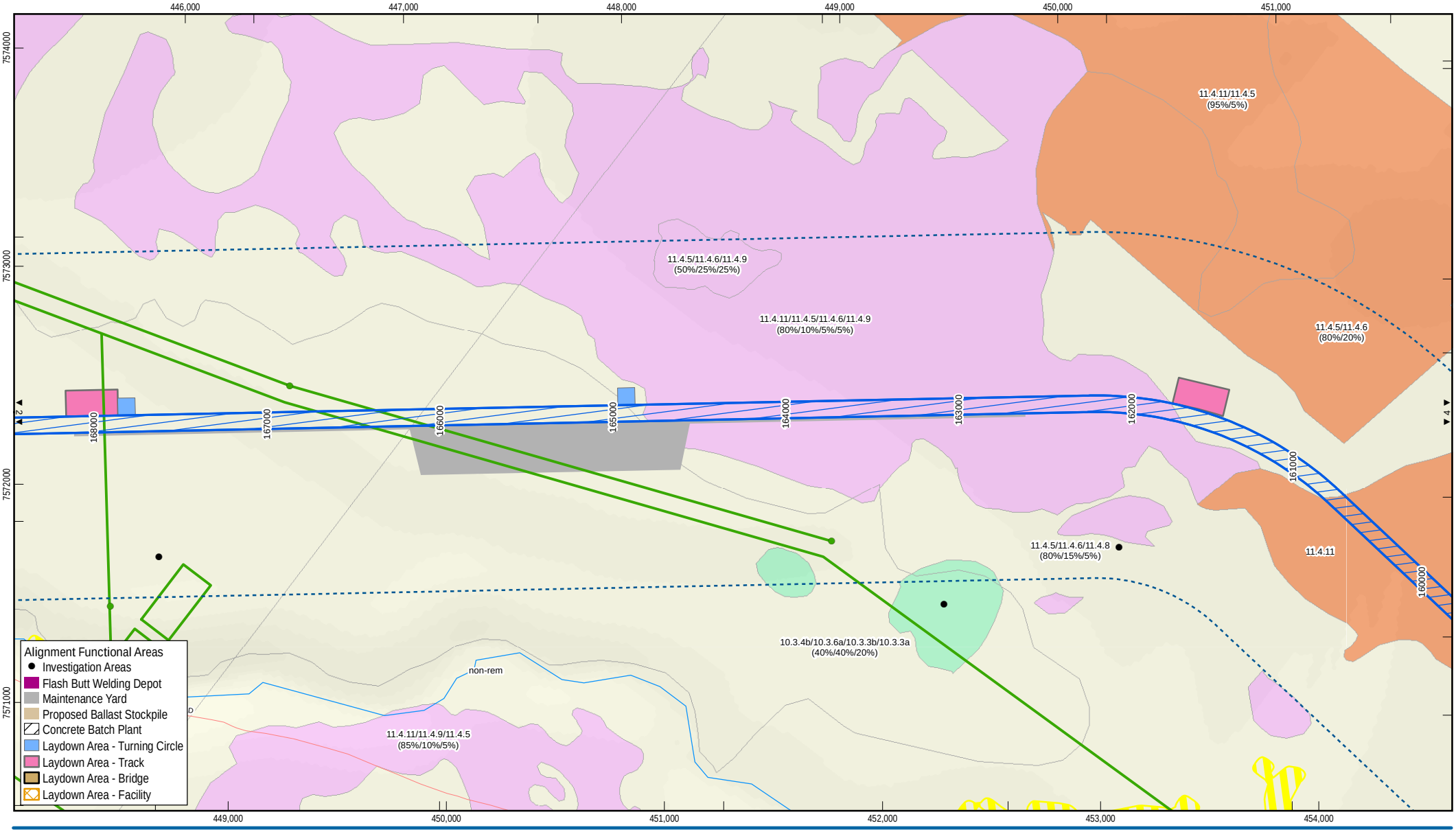

1:30,000 (at A4)

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Metres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia (GDA)
Grid: Map Grid of Australia 1994, Zone 55

LEGEND

- Construction Camp
- State Road
- Local Road
- Watercourse
- Other Railway
- Mine (Onsite)
- Mine (Offsite)
- Mine (Offsite)
- Rail (West)
- Rail (East)
- Study Area

Regional Ecosystems v6.1

- Endangered - Dominant
- Endangered - Sub-dominant
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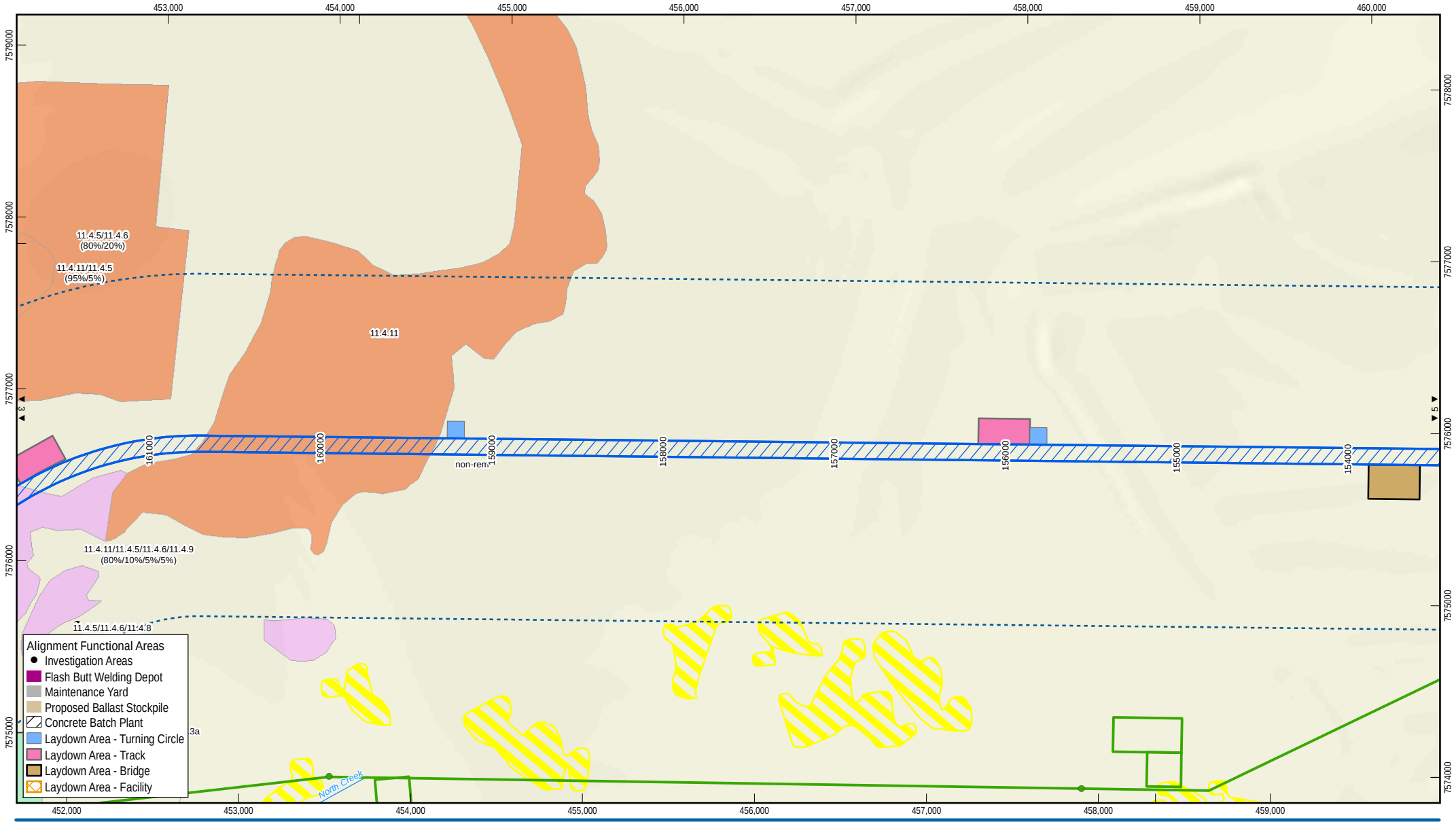

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0 200 400 600 800 1,000

Metres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia (GDA)
Grid: Map Grid of Australia 1994, Zone 55

N

LEGEND

- Construction Camp
- State Road
- Local Road
- Watercourse
- Other Railway
- Mine (Onsite)
- Mine (Offsite)
- Mine (Offsite)
- Rail (West)
- Rail (East)
- Study Area

Regional Ecosystems v6.1

- Endangered - Dominant
- Endangered - Sub-dominant
- Of Concern - Dominant
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- Least Concern
- Non-remnant
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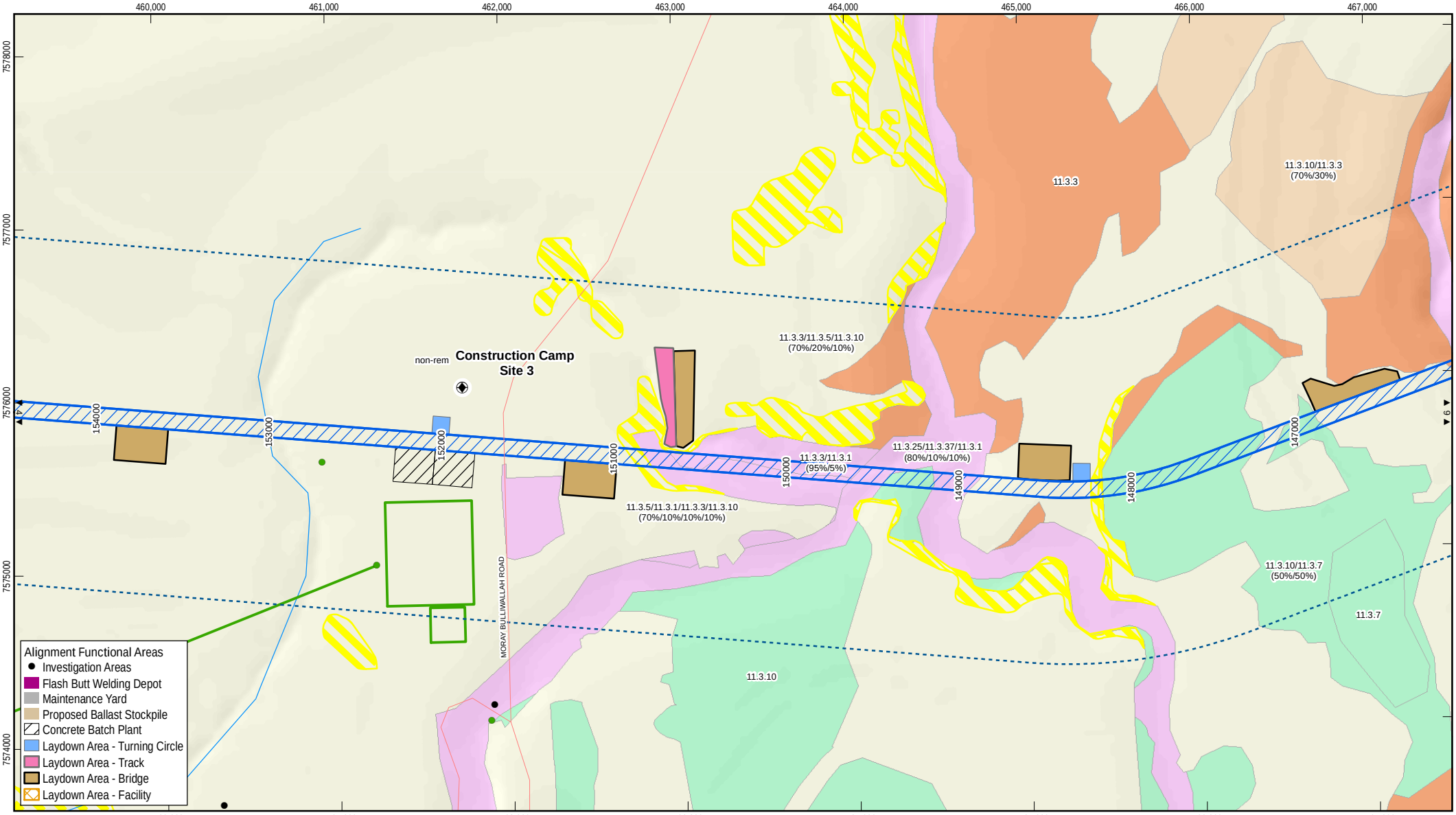

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Metres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia (GDA)
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N

LEGEND

- Construction Camp
- State Road
- Local Road
- Watercourse
- Other Railway
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- Mine (Offsite)
- Mine (Offsite)
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- Rail (East)
- Study Area

Regional Ecosystems v6.1

- Endangered - Dominant
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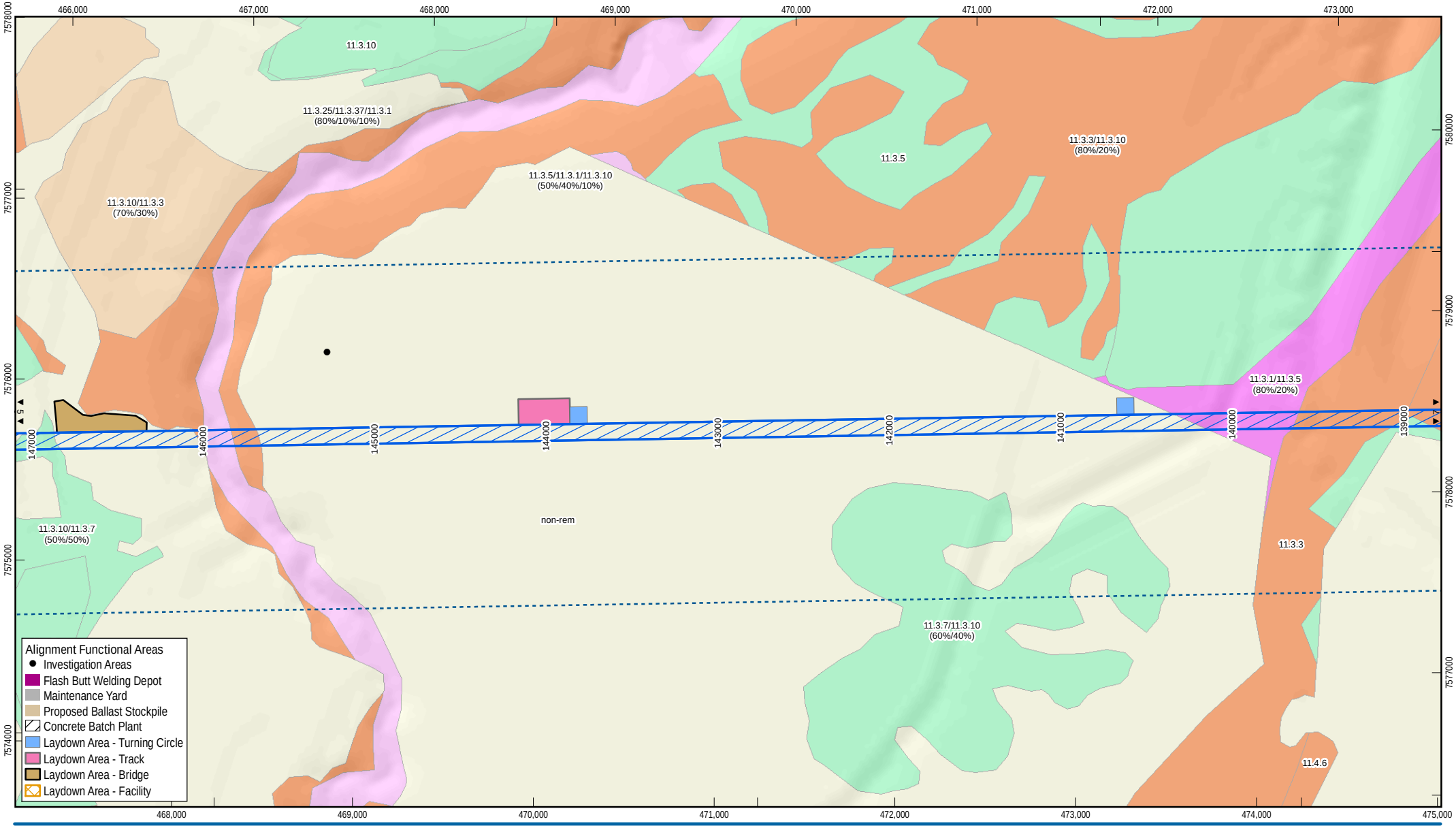

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Metres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia (GDA)
Grid: Map Grid of Australia 1994, Zone 55

N

LEGEND

- Construction Camp
- State Road
- Local Road
- Watercourse
- Other Railway
- Mine (Onsite)
- Mine (Offsite)
- Mine (Offsite)
- Rail (West)
- Rail (East)
- Study Area

Regional Ecosystems v6.1

- Endangered - Dominant
- Endangered - Sub-dominant
- Of Concern - Dominant
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- Least Concern
- Non-remnant
- High Value Regrowth

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DERM Certified Regional Ecosystems v 6.1 and Regulated Regrowth v 2.1 Mapping

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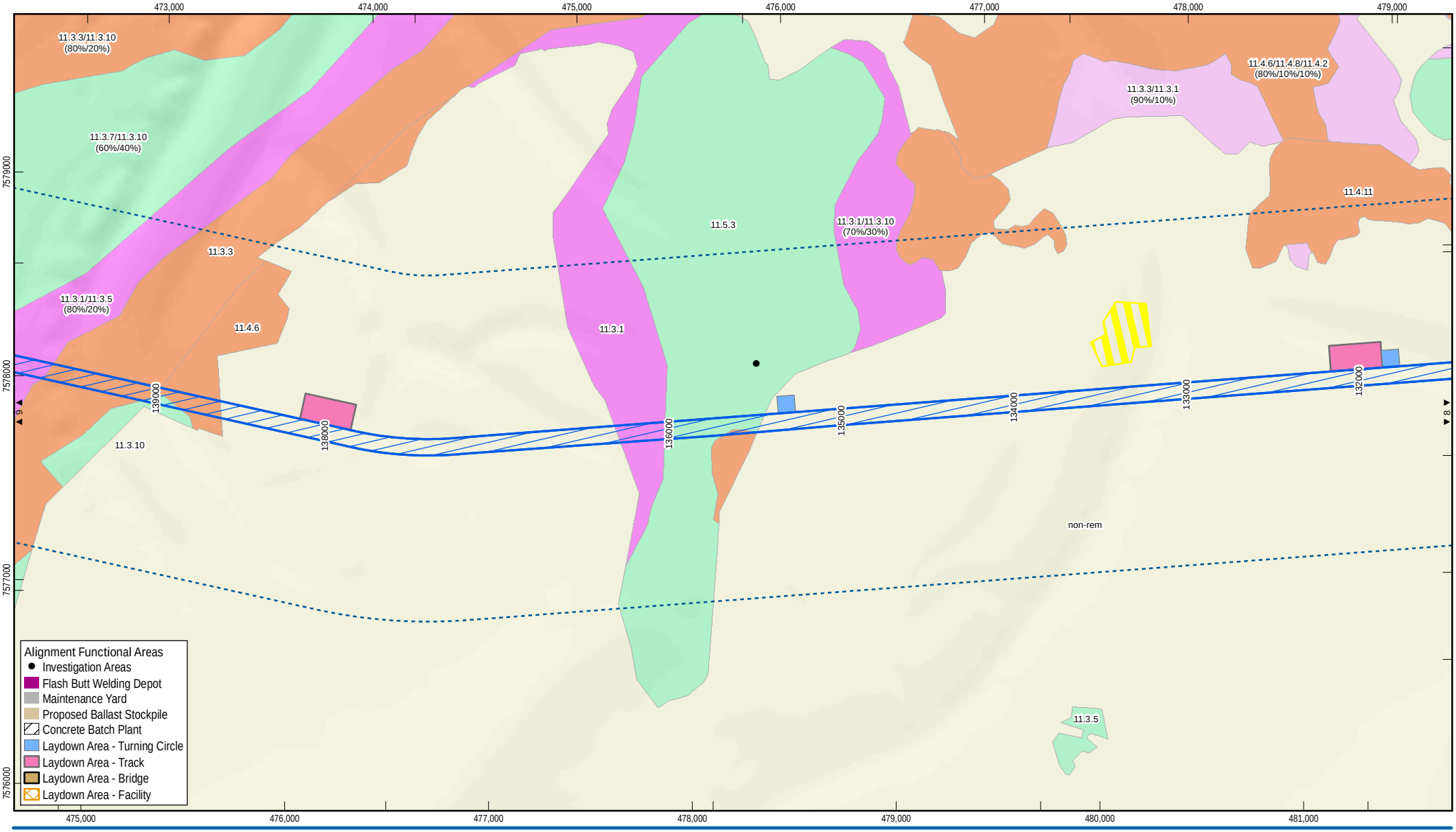

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0 200 400 600 800 1,000

Metres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia (GDA)
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N

LEGEND

- Construction Camp
- State Road
- Local Road
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- Mine (Offsite)
- Mine (Offsite)
- Rail (West)
- Rail (East)
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Regional Ecosystems v6.1

- Endangered - Dominant
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DERM Certified Regional Ecosystems v 6.1 and Regulated Regrowth v 2.1 Mapping

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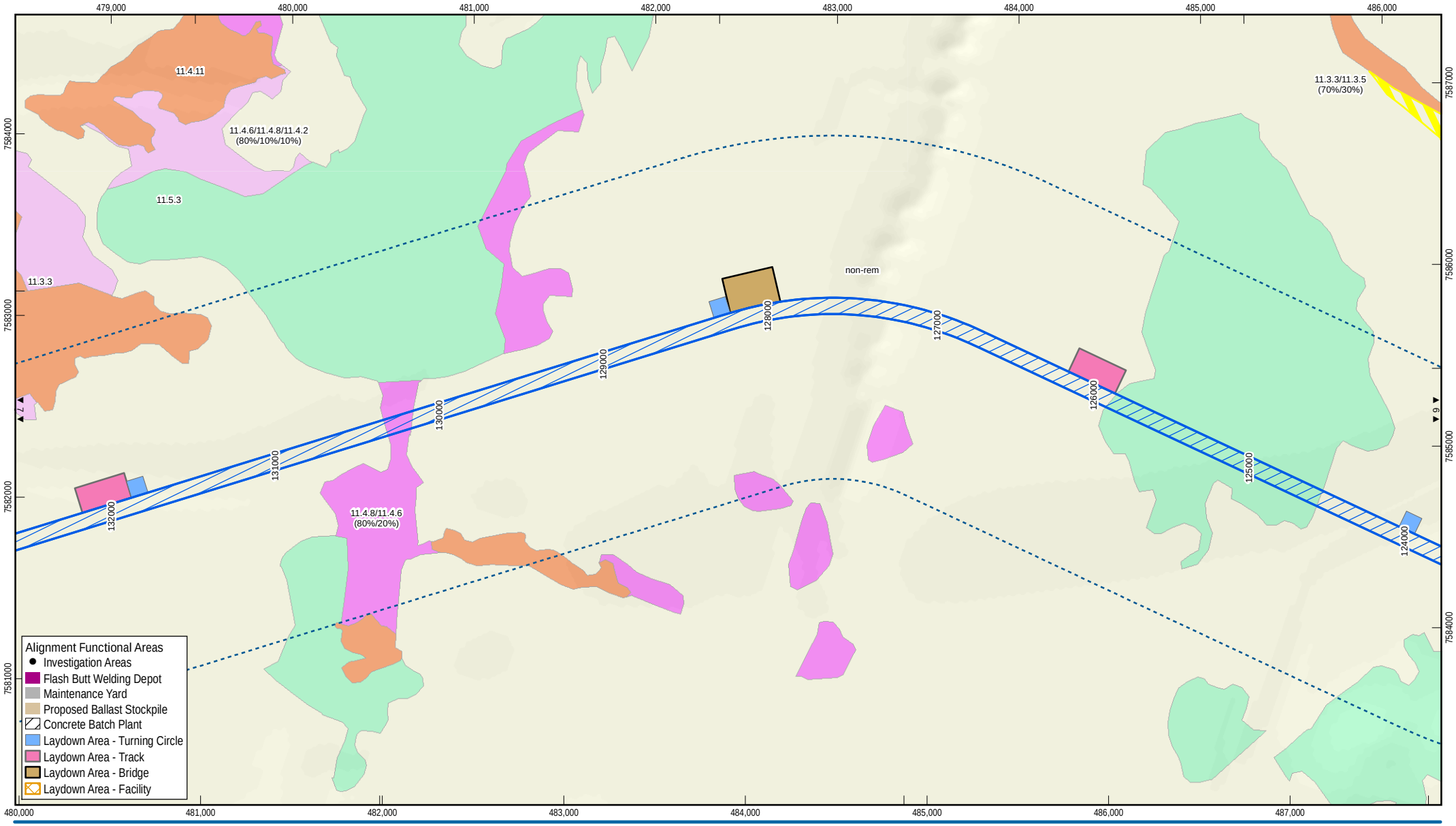

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0 200 400 600 800 1,000

Metres

Map Projection: Universal Transverse Mercator
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N

LEGEND

- Construction Camp
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- Mine (Offsite)
- Rail (West)
- Rail (East)
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Regional Ecosystems v6.1

- Endangered - Dominant
- Endangered - Sub-dominant
- Of Concern - Dominant
- Of Concern - Sub-dominant
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- Non-remnant
- High Value Regrowth

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DERM Certified Regional Ecosystems v 6.1 and Regulated Regrowth v 2.1 Mapping

Figure 2-2
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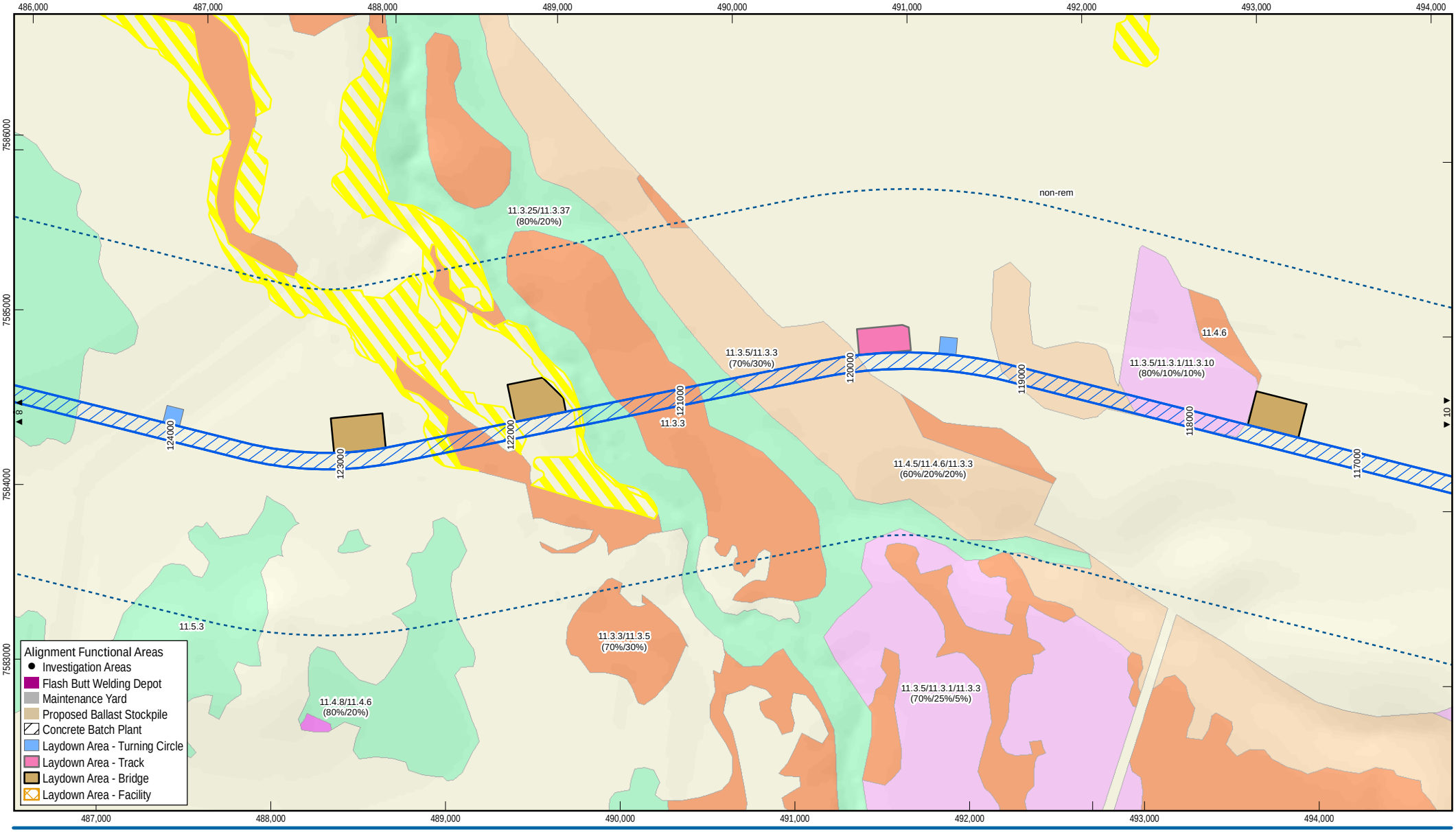

1:30,000 (at A4)

0 200 400 600 800 1,000

Metres

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N

LEGEND

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Regional Ecosystems v6.1

- Endangered - Dominant
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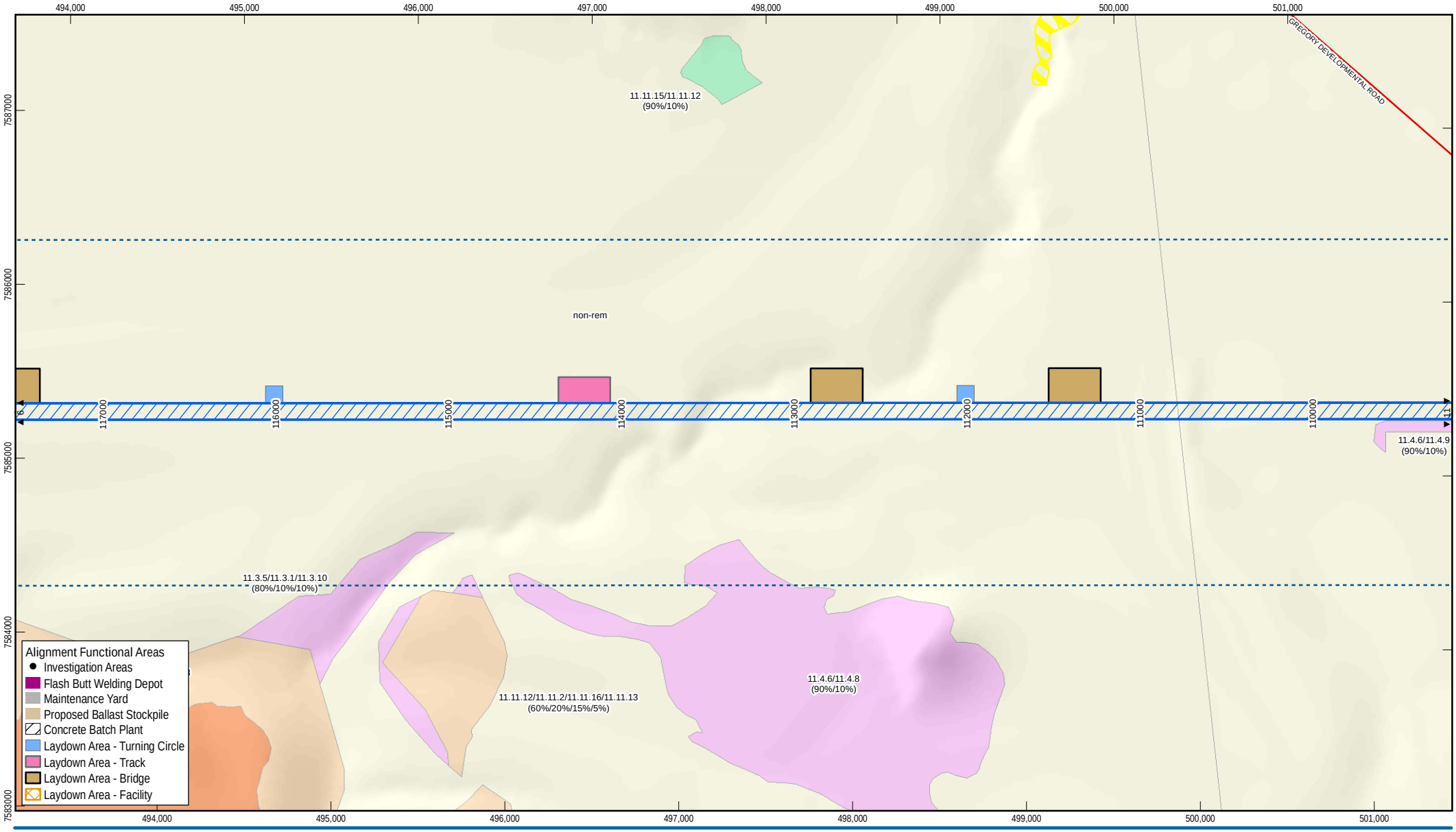

1:30,000 (at A4)

0 200 400 600 800 1,000

Metres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia (GDA)
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N

LEGEND

- Construction Camp
- State Road
- Local Road
- Watercourse
- Other Railway
- Mine (Onsite)
- Mine (Offsite)
- Mine (Offsite)
- Rail (West)
- Rail (East)
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Regional Ecosystems v6.1

- Endangered - Dominant
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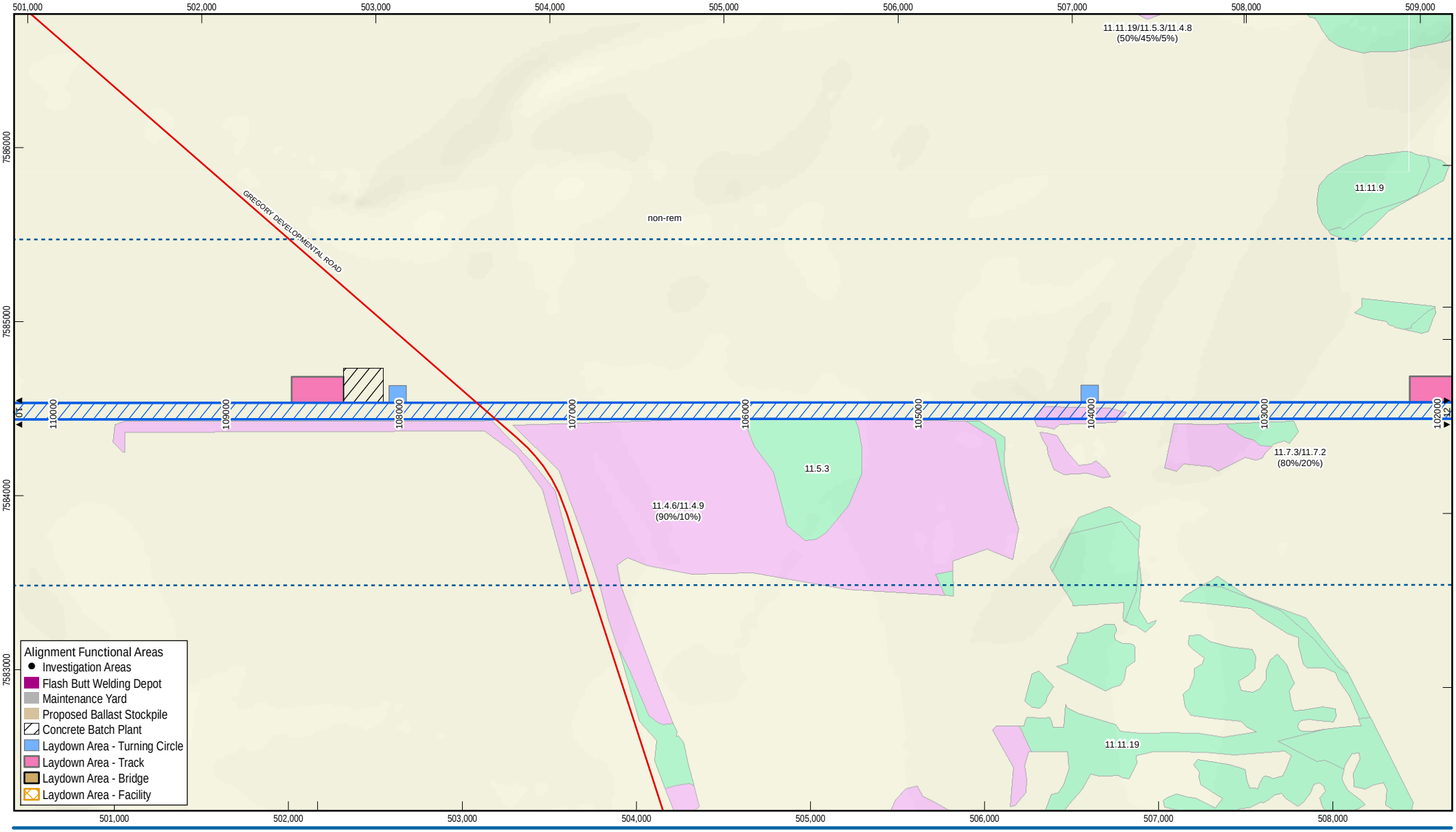

1:30,000 (at A4)

0 200 400 600 800 1,000

Metres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia (GDA)
Grid: Map Grid of Australia 1994, Zone 55

N

LEGEND

- Construction Camp
- State Road
- Local Road
- Watercourse
- Other Railway
- Mine (Onsite)
- Mine (Offsite)
- Mine (Offsite)
- Rail (West)
- Rail (East)
- Study Area

Regional Ecosystems v6.1

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- Endangered - Sub-dominant
- Of Concern - Dominant
- Of Concern - Sub-dominant
- Least Concern
- Non-remnant
- High Value Regrowth

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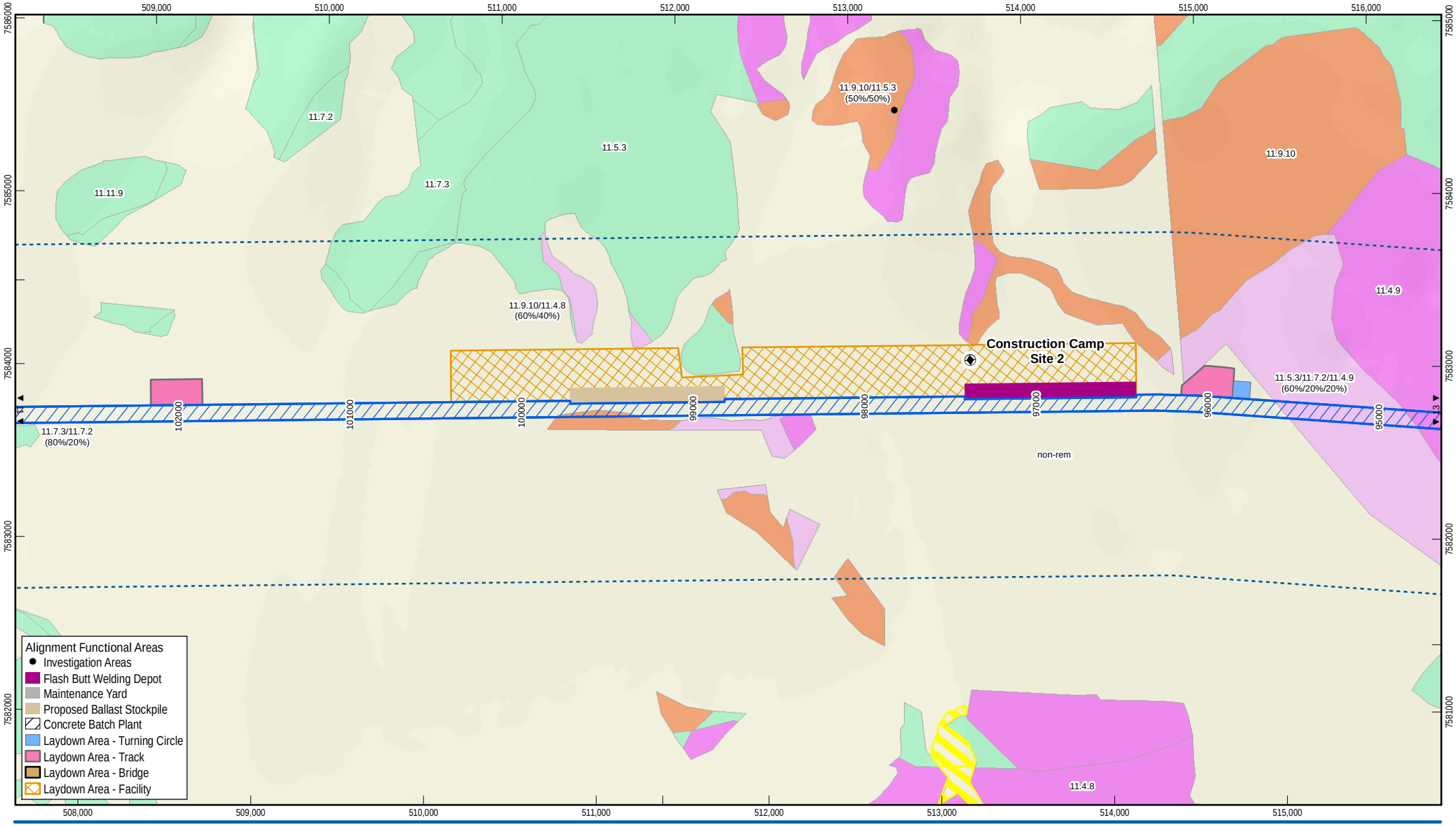

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0 200 400 600 800 1,000

Metres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia (GDA)
Grid: Map Grid of Australia 1994, Zone 55

N

LEGEND

- Construction Camp
- State Road
- Local Road
- Watercourse
- Other Railway
- Mine (Onsite)
- Mine (Offsite)
- Mine (Offsite)
- Rail (West)
- Rail (East)
- Study Area

Regional Ecosystems v6.1

- Endangered - Dominant
- Endangered - Sub-dominant
- Of Concern - Dominant
- Of Concern - Sub-dominant
- Least Concern
- Non-remnant
- High Value Regrowth

Adani Mining Pty Ltd

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DERM Certified Regional Ecosystems v 6.1 and Regulated Regrowth v 2.1 Mapping

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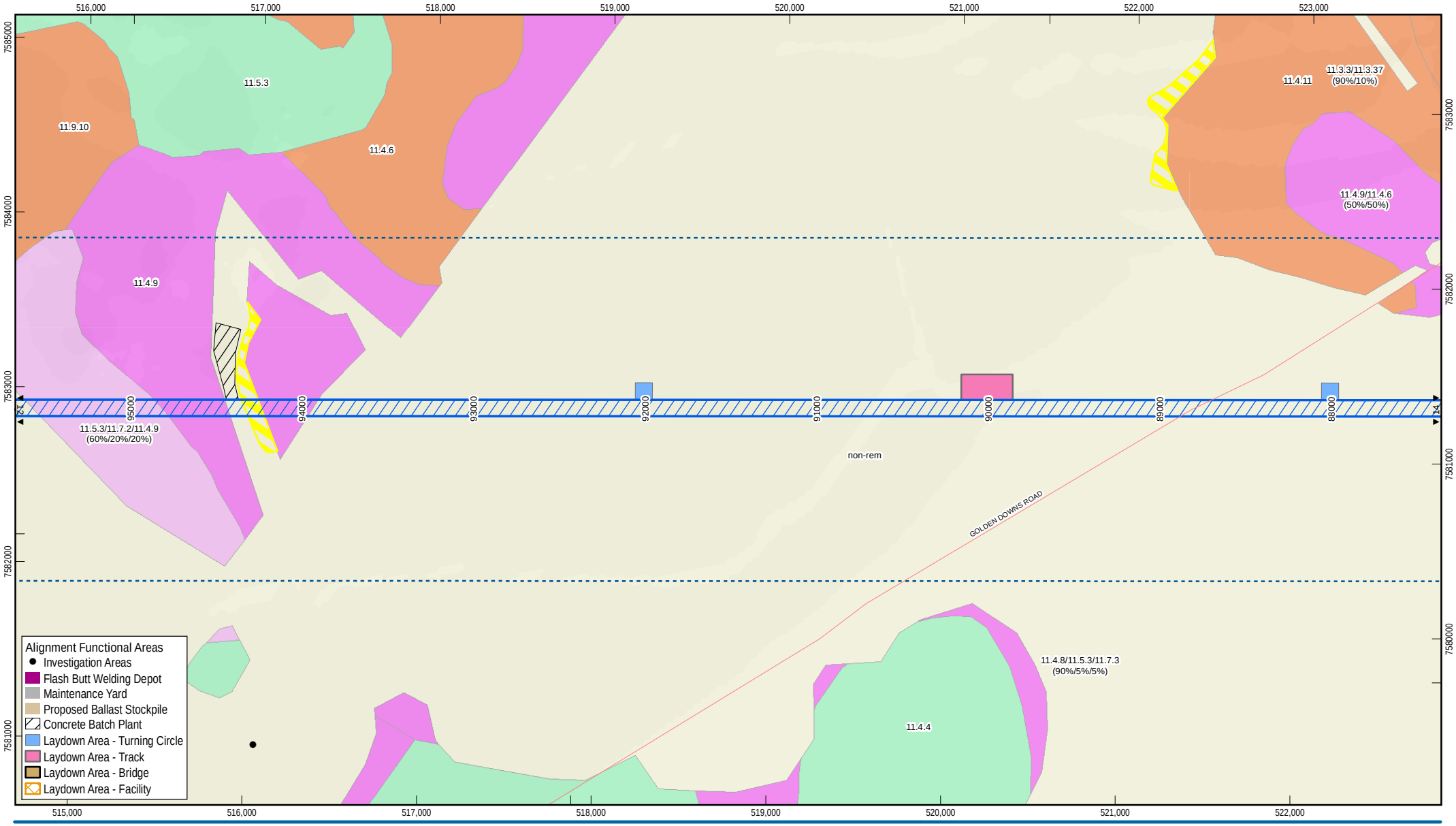

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Metres

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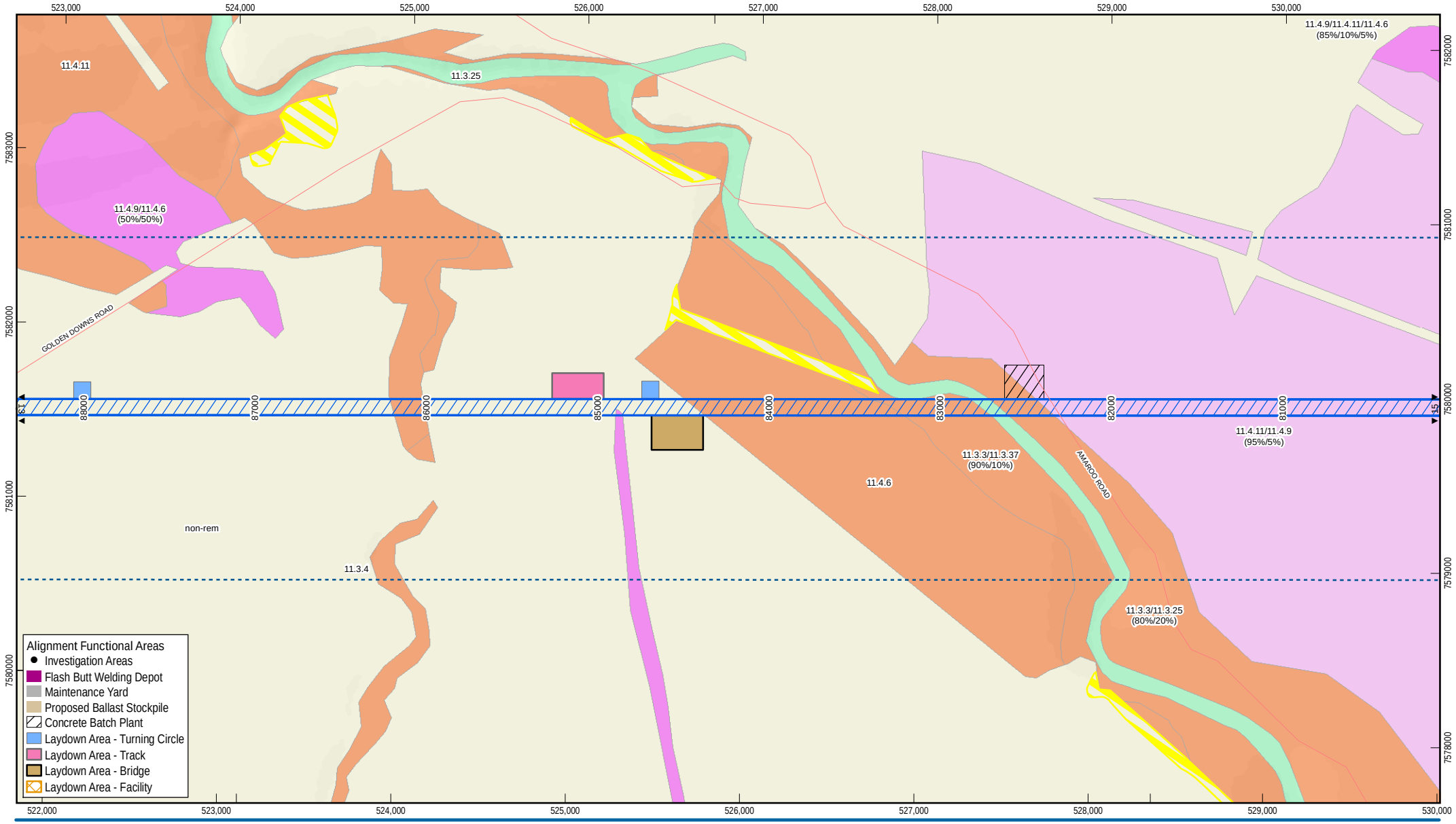

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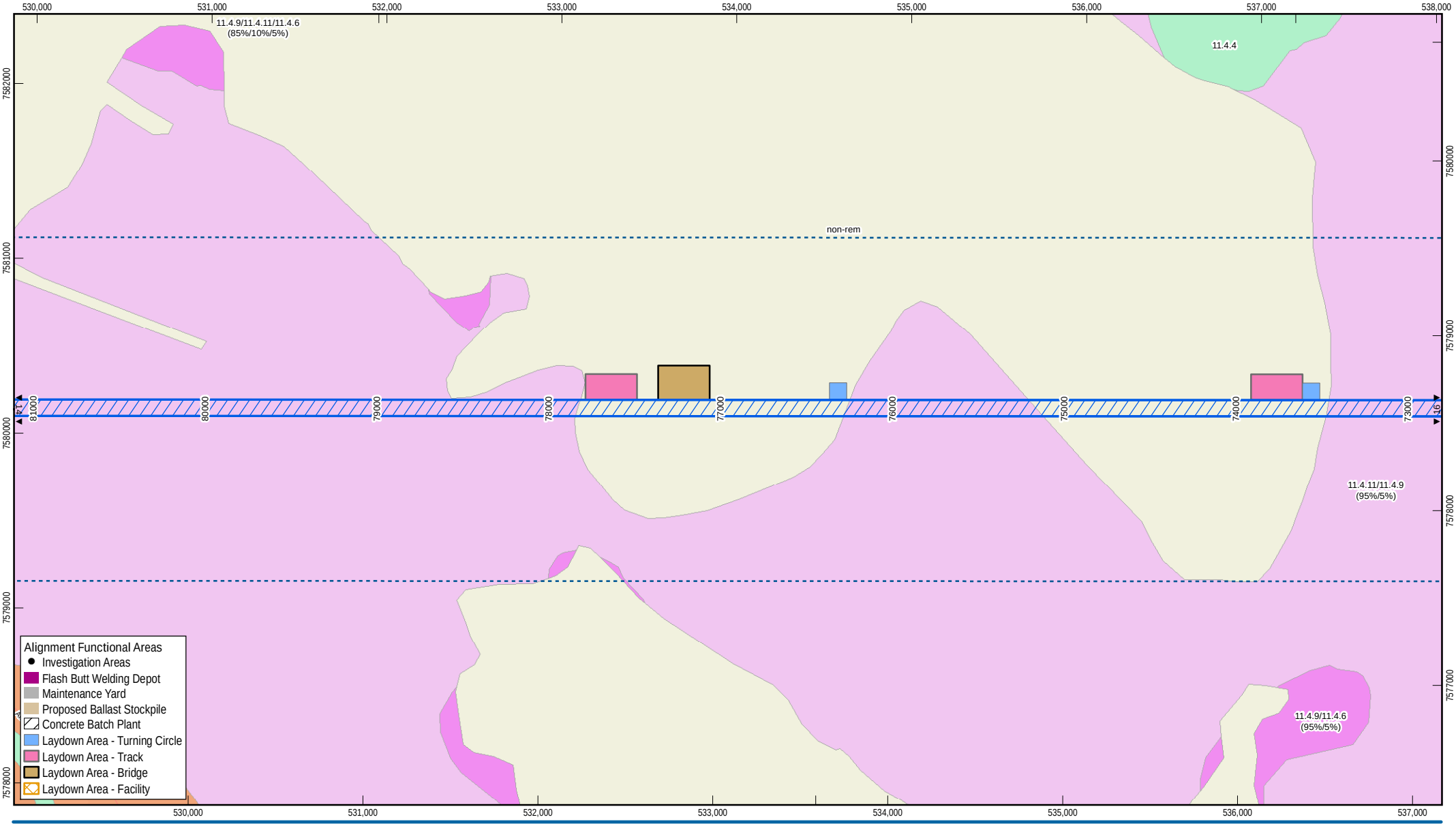

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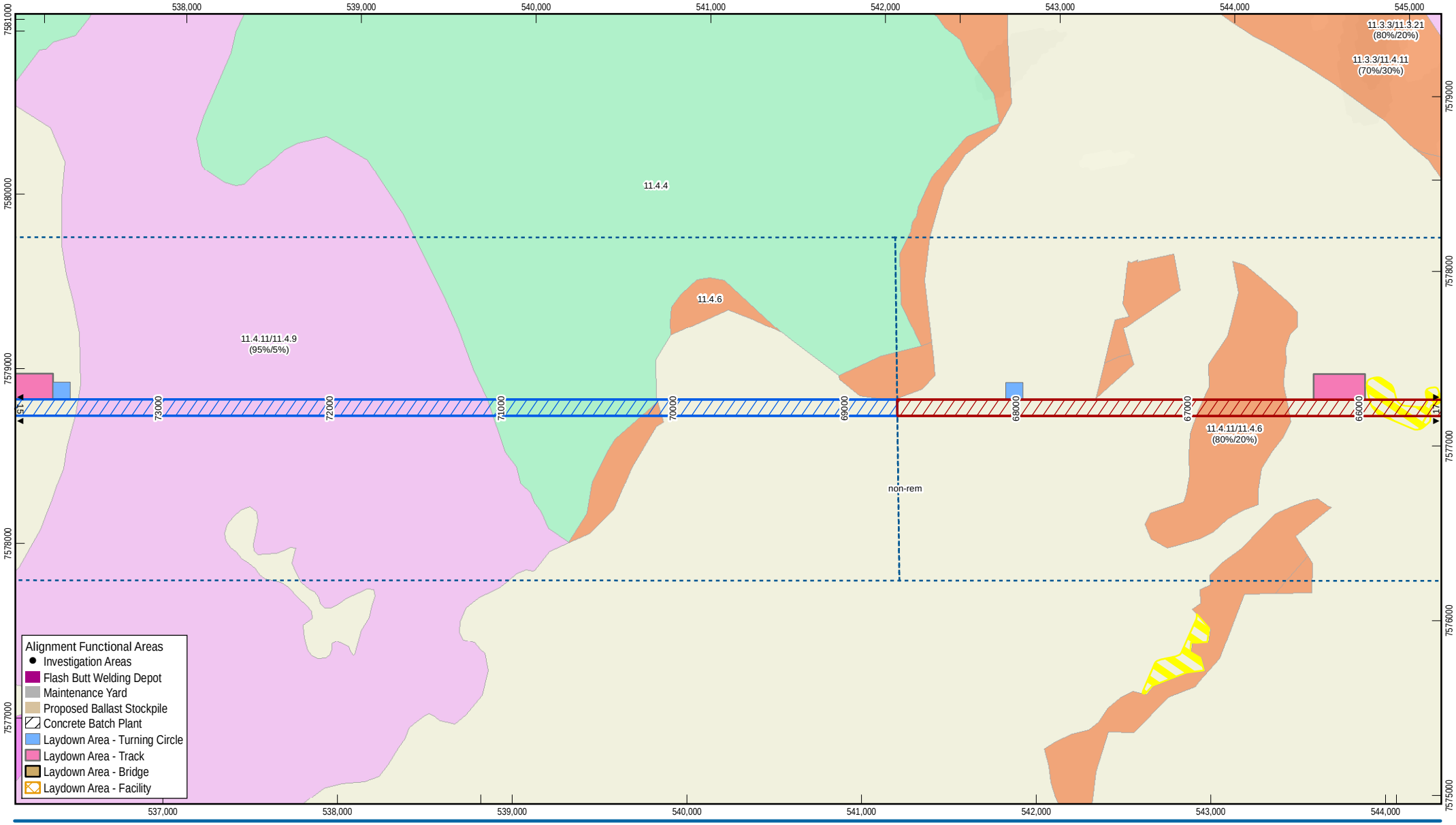

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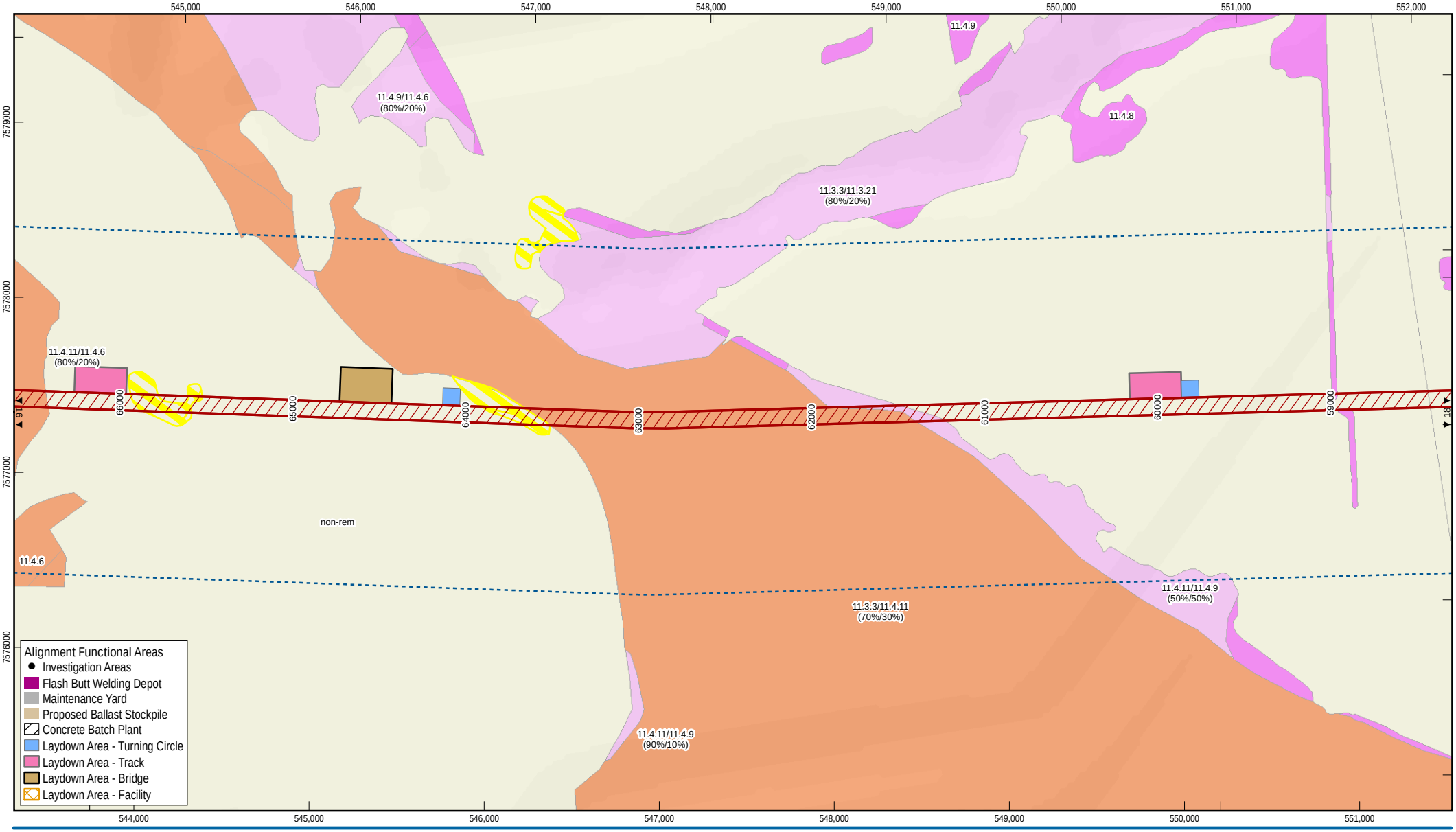

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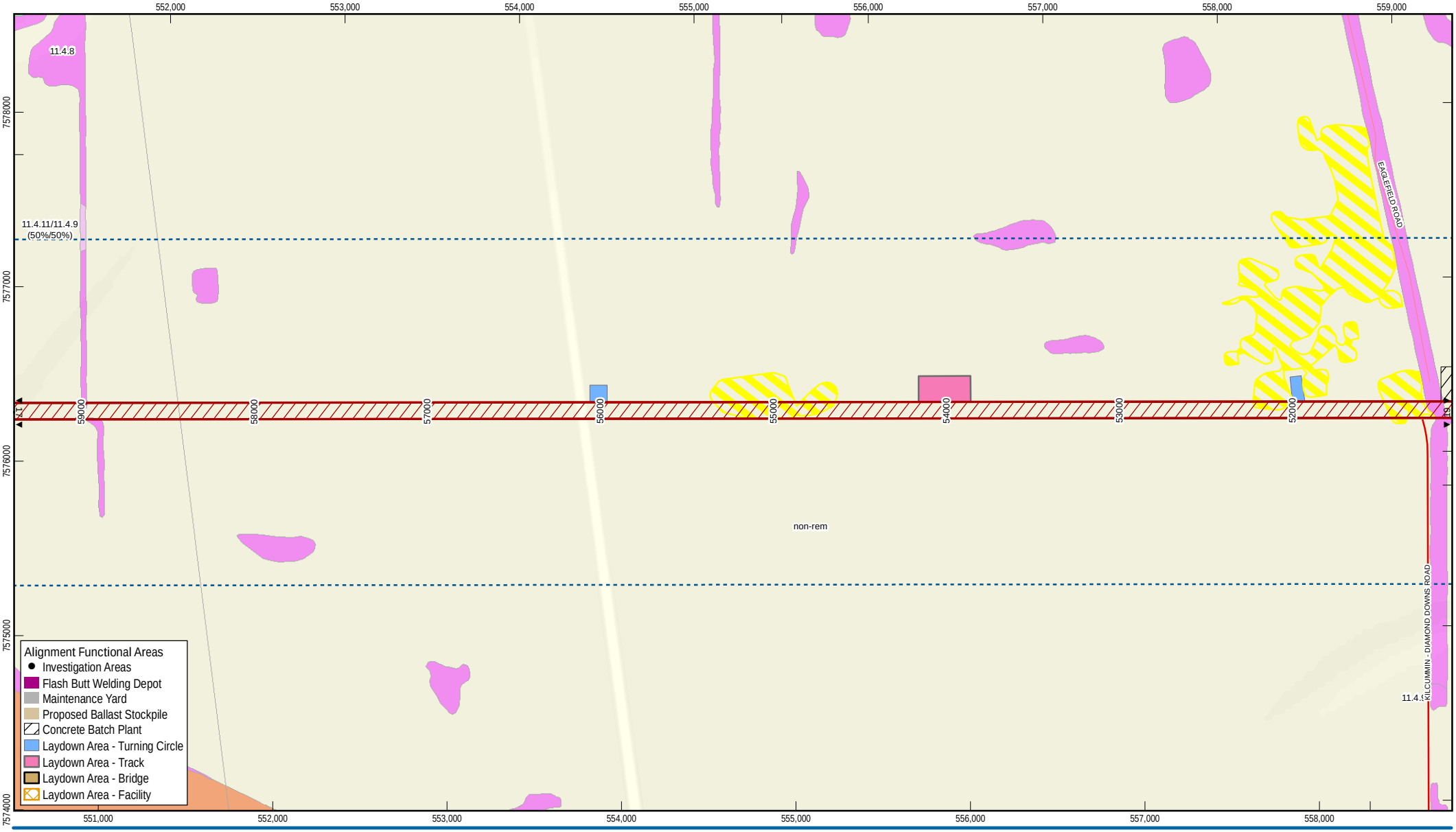

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DERM Certified Regional Ecosystems v 6.1 and Regulated Regrowth v 2.1 Mapping

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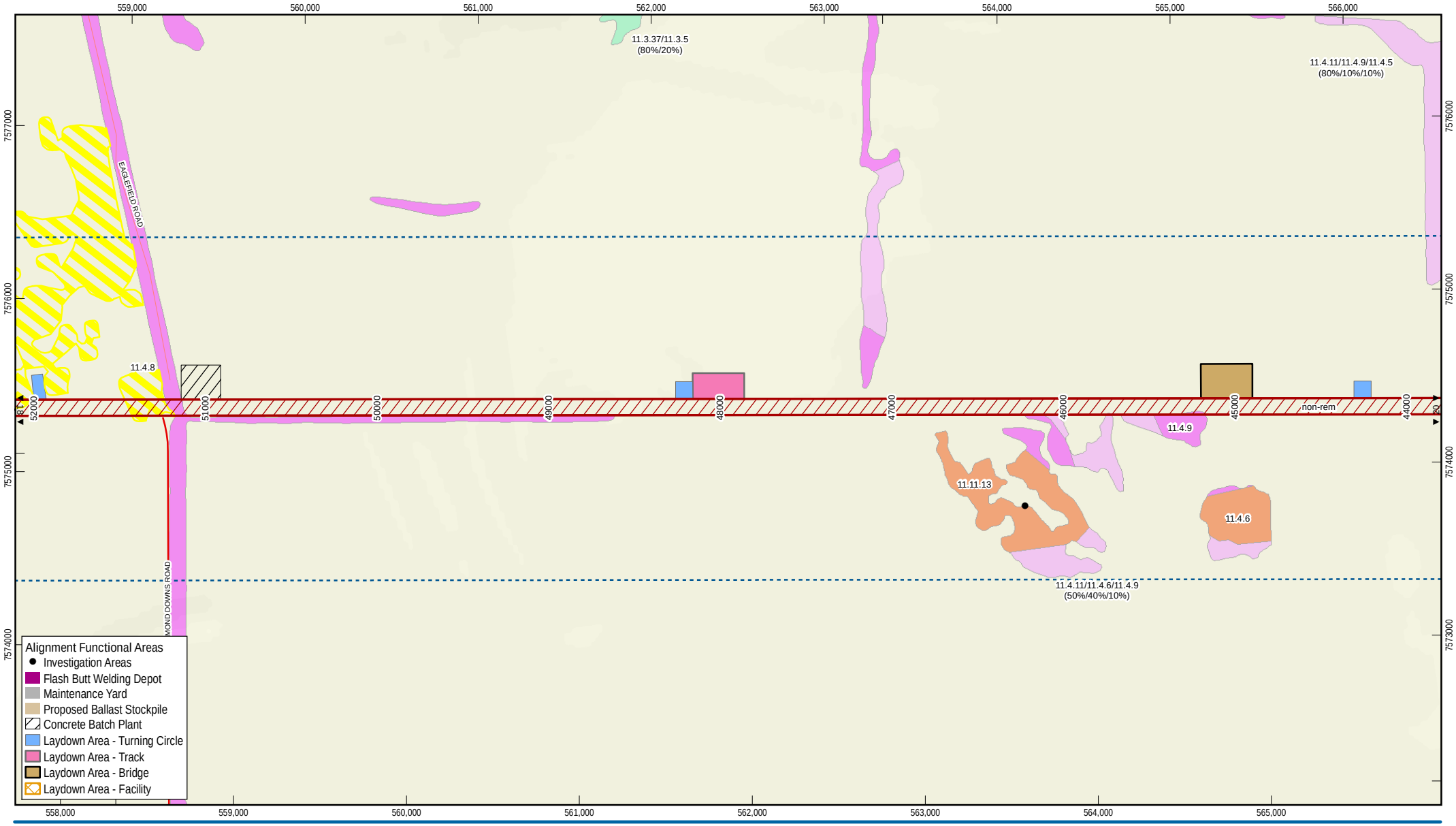

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DERM Certified Regional Ecosystems v 6.1 and Regulated Regrowth v 2.1 Mapping

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Sheet 19 of 25

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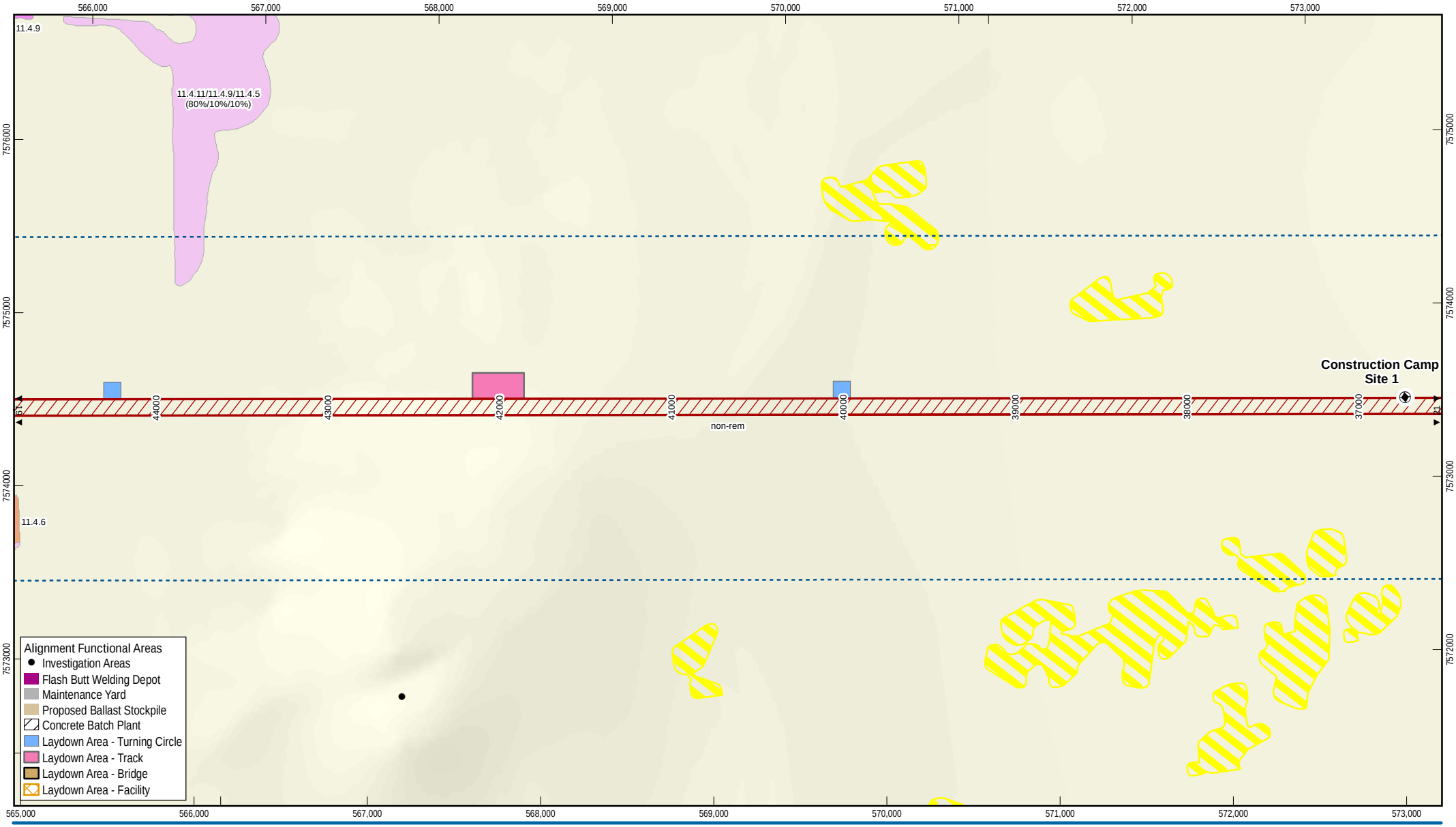

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DERM Certified Regional Ecosystems v 6.1 and Regulated Regrowth v 2.1 Mapping

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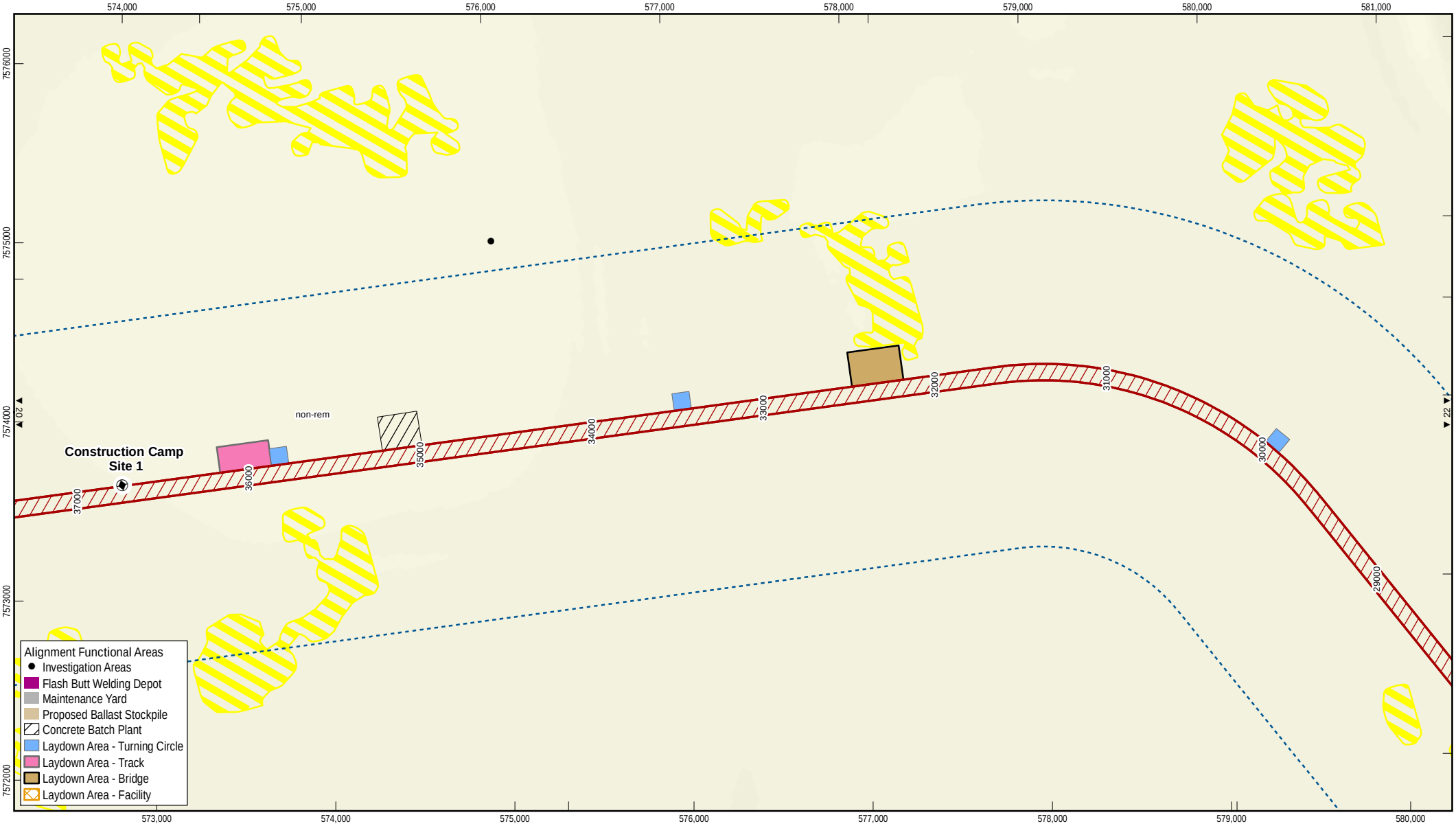

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DERM Certified Regional Ecosystems v 6.1 and Regulated Regrowth v 2.1 Mapping

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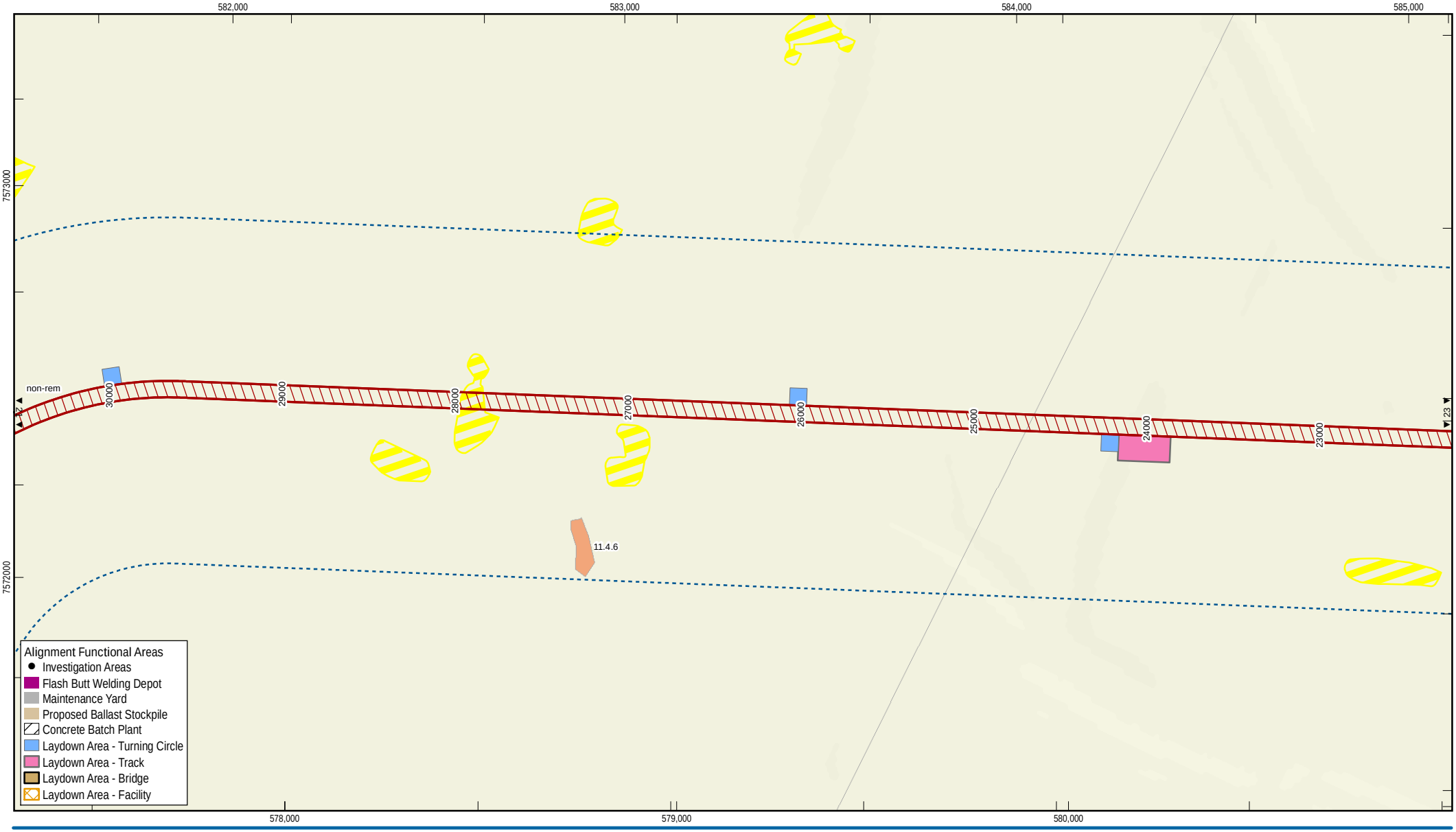

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DERM Certified Regional Ecosystems v 6.1 and Regulated Regrowth v 2.1 Mapping

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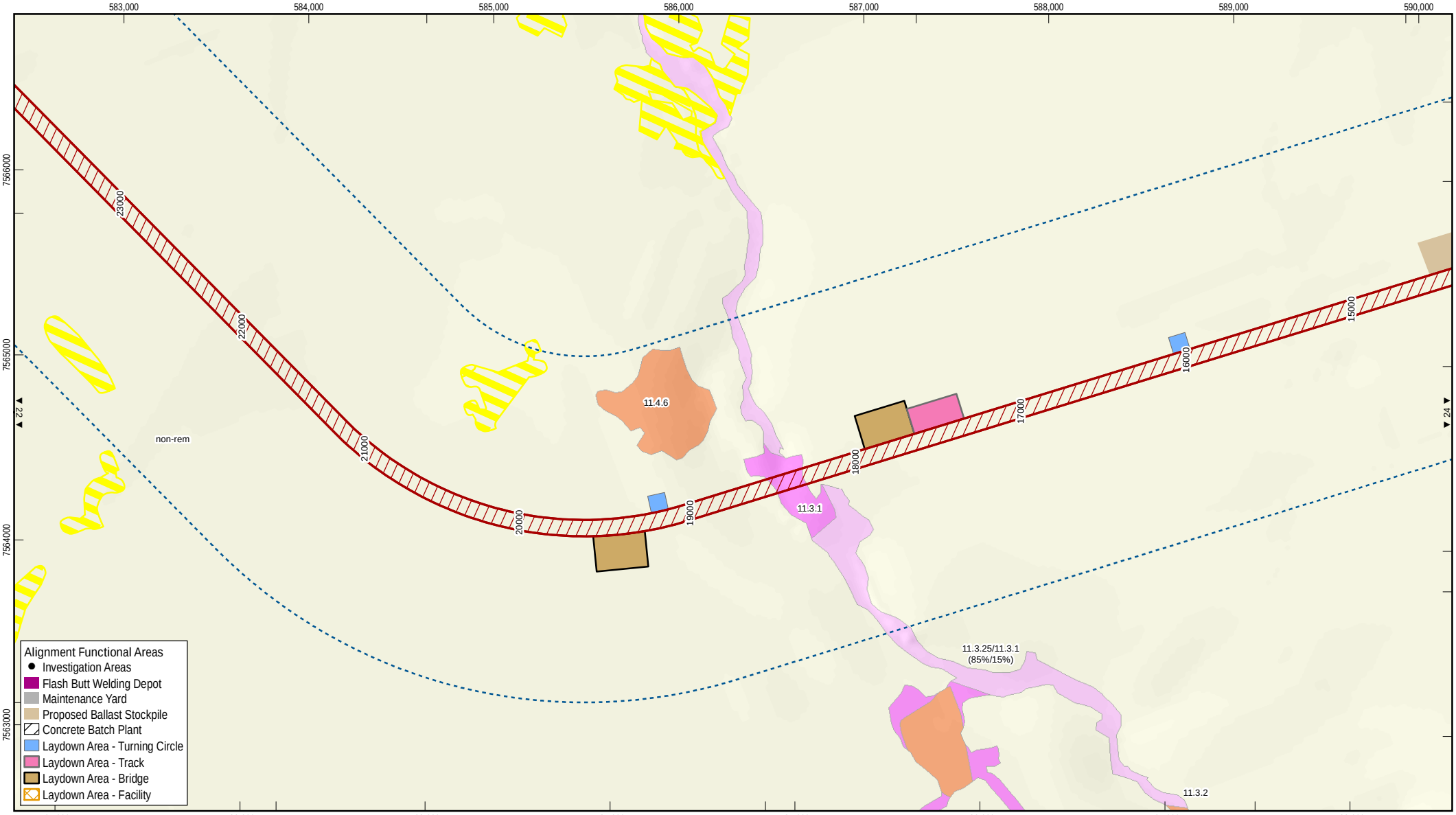

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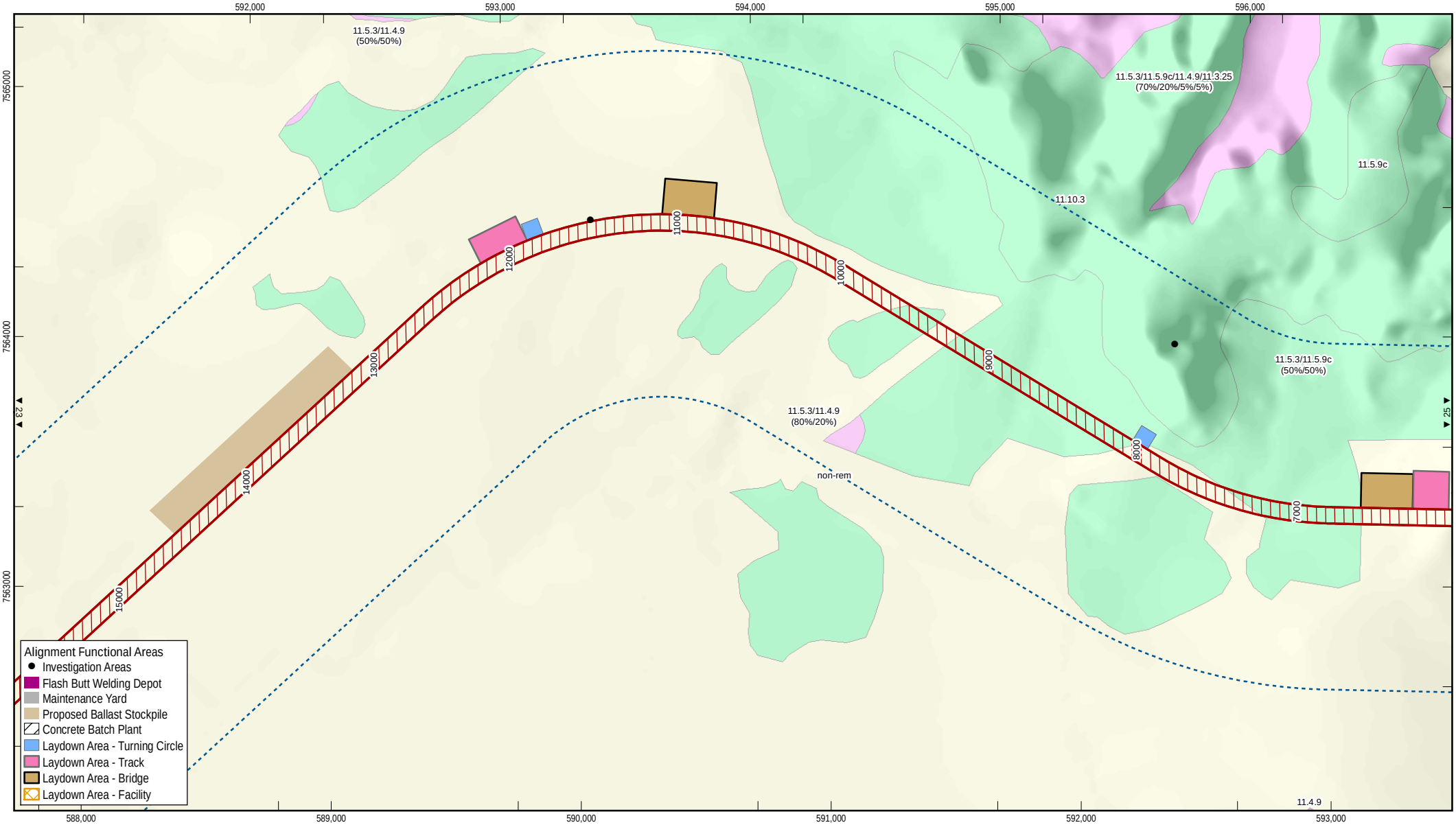

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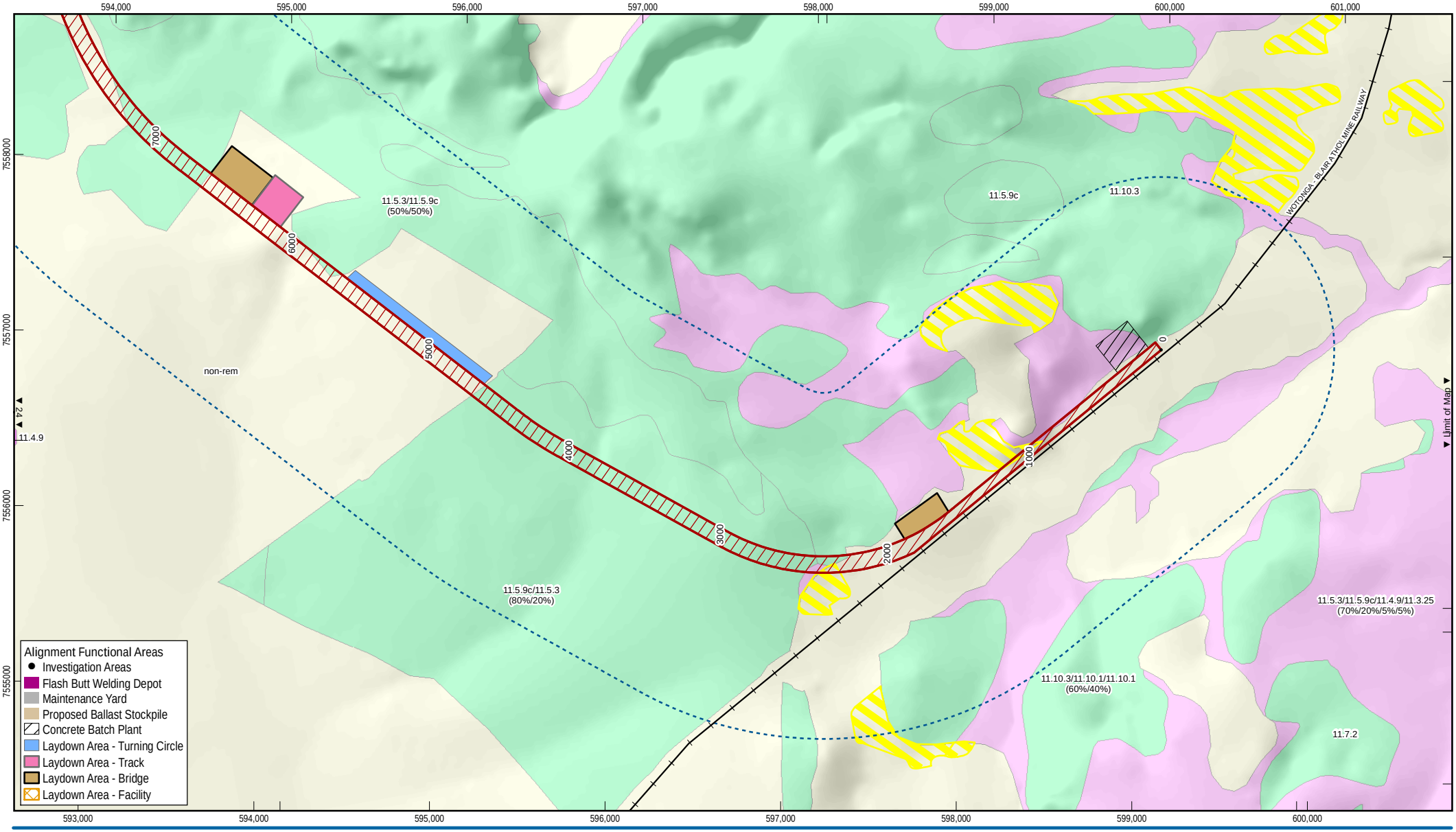

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Metres
Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia (GDA)
Grid: Map Grid of Australia 1994, Zone 55

N

LEGEND
- Construction Camp
- State Road
- Local Road
- Watercourse
- Other Railway
- Mine (Onsite)
- Mine (Offsite)
- Mine (Offsite)
- Rail (West)
- Rail (East)
- Study Area

Regional Ecosystems v6.1
- Endangered - Dominant
- Endangered - Sub-dominant
- Of Concern - Dominant
- Of Concern - Sub-dominant
- Least Concern
- Non-remnant
- High Value Regrowth

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DERM Certified Regional Ecosystems v 6.1 and Regulated Regrowth v 2.1 Mapping

Figure 2-2
Sheet 25 of 25

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Level 4, 201 Charlotte St Brisbane QLD 4000 T +61 7 3316 3000 F +61 7 3316 3333 E bnemail@ghd.com W www.ghd.com

Data source: DERM: DEM (2008), Regional Ecosystems v6.1 (2011), High Value Regrowth (2011); © Commonwealth of Australia (Geoscience Australia): Localities, Railways, Roads, Watercourse (2007); Adani: Alignment Opt9 Rev3, Investigation Areas (2012); DME: EPC1690 (2010) / EPC1080 (2011); Gassman/Hyder: Mine (Offsite) (2012). Created by: BW, CA

2.4.2 Vegetation Communities

Within the natural environment vegetation occurs in climax communities, which are units displaying a consistent species composition and structure (canopy cover and height). Vegetation communities can be described at a number of levels by focusing on the varying species composition of understorey layers, the landform and substrate that a community usually occurs on (e.g. hills and ranges of Palaeozoic granite), or even the geography (coastal, sub-coastal, within a coastal bioregion etc.). The basic unit is the association and the level of detail of the description can vary depending on the level of detail required (or the mapping scale it is intended to be utilised with).

An association is a climax community in which the dominant stratum (the stratum with the greatest above ground biomass) has a relatively uniform species composition and structure (Neldner *et al.,* 2005). Associations can incorporate a number of seemingly disparate vegetation units as they are broad in their description (Sattler and Williams, 1999; Neldner *et al*., 2005). Patches that represent associations generally look similar from the outside. However, often within one association, vegetation patches at different sites may have sub-dominant strata that have different characteristic species.

For instance, two woodlands dominated by coolabah, one with no other tree species present, the other having a mix of one or two subdominant tree species could be classed as the same association. However, at a sub-association level, these associations could be split, by considering the composition of the sub-canopy layers, and can then be mapped at a larger scale. Sub-associations focus on the species composition of both the dominant and sub-dominant species within a community, and are more sensitive to differences in structure. Queensland REs are described at the association level, and many have further sub-associations described within them (Neldner *et al*., 2005).

The alliance is the peak floristic grouping. An alliance is a group of associations whose dominant strata have the same structure but with related species composition (Neldner *et al*., 2005). As an example, within the alliance 'dry eucalypt woodlands/open woodlands primarily on sandplains or depositional plains' there can sit the associations 'ironbark woodlands on Cainozoic sandplains' and 'poplar gum open woodland on broad Quaternary alluvial plains'. At this level alliances can be readily mapped at very coarse levels even though members of the alliance may appear quite different (although in the case of highly distinctive associations, it may be possible to group them at a higher level and the association and alliance may be identical).

The 'broad vegetation group' (BVG) community units developed by the Queensland Herbarium comprise a set of vegetation alliances described at increasing coarse scales. The first grouping is at the 1:1 million scale, with 100 BVG/alliances described. At the 1:2 million scale there are 35 BVG/alliances, and these have been refined even further at the 1:5 million scale to 16 BVG/alliances. The RE unit is the basic association on which these alliances are built – REs are designed to be mapped at scales ranging from 1:100,000 and finer.

In order to provide a broad understanding of the vegetation alliances within the Study Area, a unique (to the Project (Rail)) set of seven BVGs (called Broad Vegetation Communities or BVCs for the Project) have been developed. These were considered the best descriptors for the vegetation communities identified within the Study Area and are based on the particular communities and land forms present within the Study Area. BVCs were developed by grouping vegetation communities with similar attributes into broad groups allowing for ease of categorising the vegetation into communities

and for informing the fauna habitat values across the Study Area. Table 2-3 presents these BVCs that occur within the corridor and infrastructure and construction camp footprints, and provides a description. Mapping of each BVC across the Study Area is shown in Figure 2-3.

Table 2-3 Broad Vegetation Communities

Community name	REs	Landform	Characteristic species	Sites	Comments
Eucalypt open woodland with native grass and shrubby understorey (Eucalypt open woodland)	11.3.10, 11.5.3, 11.5.9c,	Level to undulating Tertiary sand plains, sometimes derived from alluvium (11.3.10). Soils are cracking clays, clay loams and some sandstone cobble	*Eucalyptus coolabah*, *Terminalia oblongata, Eremophila mitchellii, Acacia salicina, A. excelsa, A. stenophylla, Carissa ovata, Panicum decompositum, Cenchrus ciliaris, Sporobolus* spp., *Aristida calycina.*	May Q1, Q2, Q3, Q5, Q6, Q8, Q10, Q11 September Q13, Q16, Q20	◗ Present over 78.5 ha of the rail corridor and infrastructure and construction camps footprints. ◗ Generally with high native grass species diversity where observed in Study Area.
Gidgee or mixed acacia woodland, on clay and clay loam plains with sparse shrub layer (Acacia woodland or forest)	11.3.5, 11.4.5, 11.4.6, 11.7.2, 11.10.3	Level to undulating Cainozoic clay plains, generally with heavy, cracking clay soils.	*Acacia cambagei, A. harpophylla, Eremophila mitchellii, Terminalia oblongata, Geijera parviflora, Carissa ovata, Sporobolus disjunctus, Panicum decompositum, *Cenchrus ciliaris*.*	May Q4 September Q14, Q17, Q18, Q21, Q22, Q23, Q24	◗ Present over 46.8 ha of the rail corridor and infrastructure and construction camps footprints ◗ Generally in relatively high quality, intact large patches where observed in Study Area. ◗ Gidgee woodlands were the most dominant acacia woodland observed.

Eucalypt open woodland BVC representative image: Study Area, May 2011

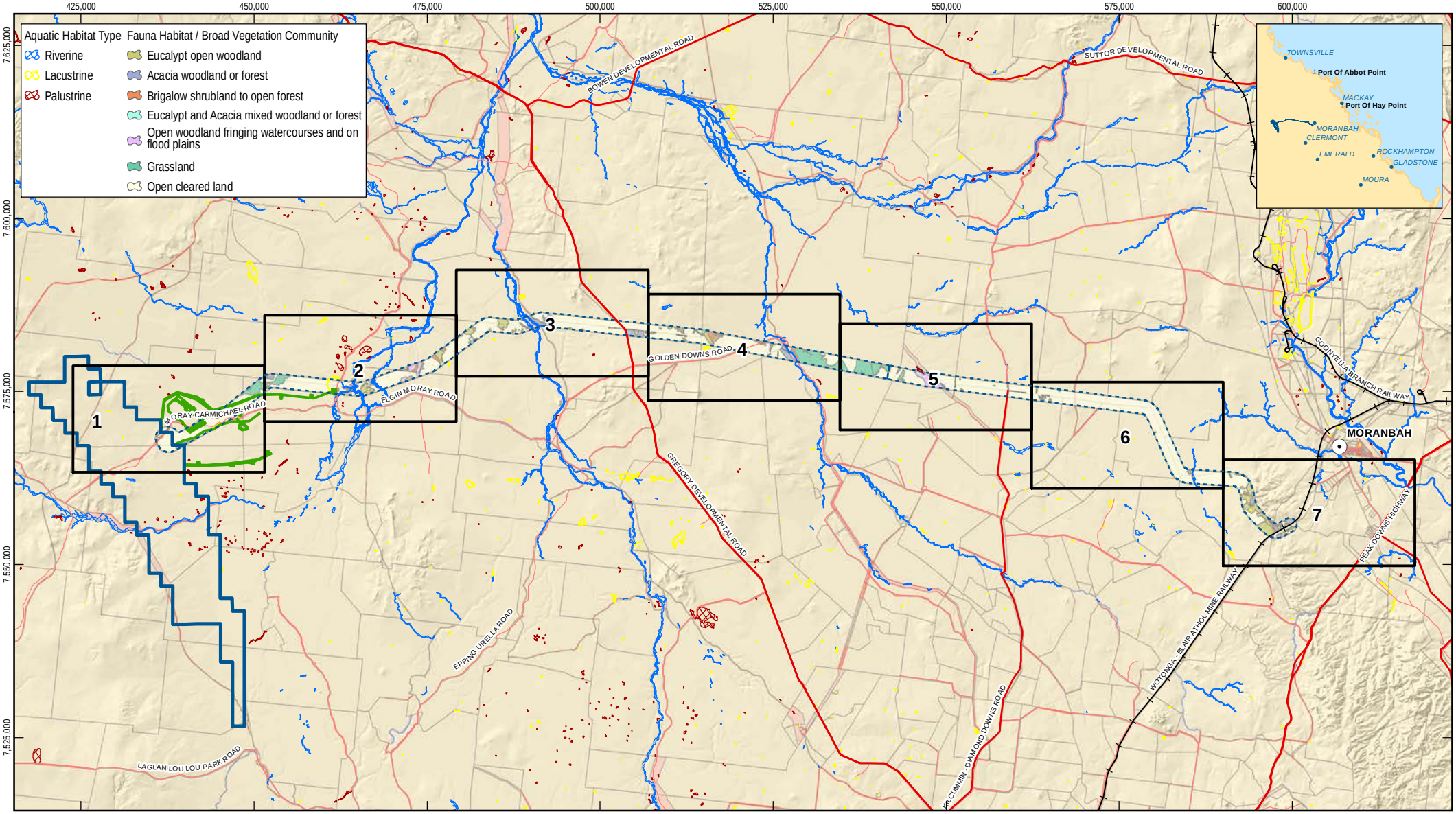
Community name	REs	Landform	Characteristic species	Sites	Comments
				 Acacia woodland or forest BVC representative image: Study Area, September 2011.	
Brigalow shrubby woodland or open forest typically on clay and clay loam plains (Brigalow shrubland to open forest)	11.3.1, 11.4.9	Level to undulating Cainozoic clay plains, generally with heavy, cracking clay soils.	*Acacia harpophylla, Eucalyptus coolabah, A. cambagei, Flindersia dissosperma, Terminalia oblongata, Eremophila polyclada, Carissa ovata, Sporobolus disjunctus, Bothriochloa pertusa.*	<u>May</u> No sites <u>September</u> Q15	◗ Present over 34.9 ha of the rail corridor and infrastructure and construction camps footprints . ◗ Observed at one site during surveys of Study Area in small and discontinuous patches of moderate quality.  Brigalow shrubland to open forest BVC representative image: Study Area, May 2011

Community name	REs	Landform	Characteristic species	Sites	Comments
Eucalypt and acacia mixed woodland or forest often on clay soils (Eucalypt and Acacia mixed woodland or forest)	11.4.8, 11.9.10	Mostly level to undulating Cainozoic clay plains, generally with heavy, cracking clay soils. Occasionally found on sedimentary rocks with varying degrees of metamorphism and folding.	*Eucalyptus thozetiana, E. coolabah, Acacia cambagei, A. harpophylla, Eremophila* spp., *Enchylaena tomentosa, Cenchrus ciliaris, Panicum decompositum, Cyperus polystachyus*	May Q9 September Q19	◗ Present over 3.9 ha of the rail corridor and infrastructure and construction camps footprints . ◗ Generally in relatively high quality patches where observed in Study Area.
					 Eucalypt and Acacia mixed woodland or forest BVC representative image: Study Area, September 2011.
Riparian woodland or forest fringing watercourses, and Coolabah open woodland on grassy floodplain often with weedy understorey (Open woodland fringing watercourses and on flood plains)	11.3.3, 11.3.7, 11.3.25, 11.3.37	Watercourse banks, meander plains and flood plains. Soils are sandy or clay alluvium.	*Eucalyptus camaldulensis, E. coolabah, Melaleuca* spp., *Terminalia oblongata, Acacia salicina, Eremophila bignoniiflora, Panicum decompositum, Paspalidium distans, Lomandra longifolia, Heteropogon contortus.*	May Q7 September Q12,	◗ Present over 164.7 ha of the rail corridor and infrastructure and construction camps footprints (along watercourses). ◗ Riparian zones of relatively high quality where weeds and localised disturbance (i.e. cattle crossings) not present. ◗ This community was observed along the Belyando river and at Mistake Creek.

Community name	REs	Landform	Characteristic species	Sites	Comments
					
				Open woodland fringing watercourses and on flood plains BVC representative image: Study Area, May 2011.	
Native grassland with absent woody canopy or shrub layer (Grassland)	11.4.4, 11.4.11	Generally located on clay plains in lower catchment positions	No species data	No sites though potential grasslands were noted during surveys	◗ Present over 137 ha of the rail corridor and infrastructure and construction camps footprints . ◗ Assessments were not undertaken due to the timing of surveys (late post wet season), which was not ideal for obtaining maximum species diversity or identification of non-flowering plants when sampling.
					
				Grassland BVC representative image: Study Area, September 2011.	

Community name	REs	Landform	Characteristic species	Sites	Comments
Open, previously cleared areas lacking native remnant vegetative cover and/or with patchy regrowth (Open cleared land & regrowth)	Non-remnant	Generally located on clay plains in lower catchment positions across most of the Study Area, particularly in the eastern extent.	Buffel grass (*Cenchrus ciliaris*)	No sites	◗ Covers 1502of the rail corridor and infrastructure and construction camps footprints , (primarily on the more fertile clay plains). ◗ Generally contains low habitat value for flora and fauna, and has high levels of disturbance (grazing, weed invasions) present. ◗ Dominant particularly at the eastern extent of the Study Area.

Open cleared land and regrowth representative image



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Kilometres

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Horizontal Datum: Geocentric Datum of Australia (GDA)
Grid: Map Grid of Australia 1994, Zone 55

N

LEGEND

- Town
- State Road
- Local Road
- Other Railway
- Cadastral Parcel
- Road Reserve
- Watercourse Reserve
- Mine (Onsite)
- Mine (Offsite)
- Study Area

Adani Mining Pty Ltd

Carmichael Coal Mine and Rail Project

Broad Vegetation Communities and Terrestrial and Aquatic Fauna Habitat Types

Job Number 41-25215
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Date 05-09-2012

Figure 2-3
Series Index

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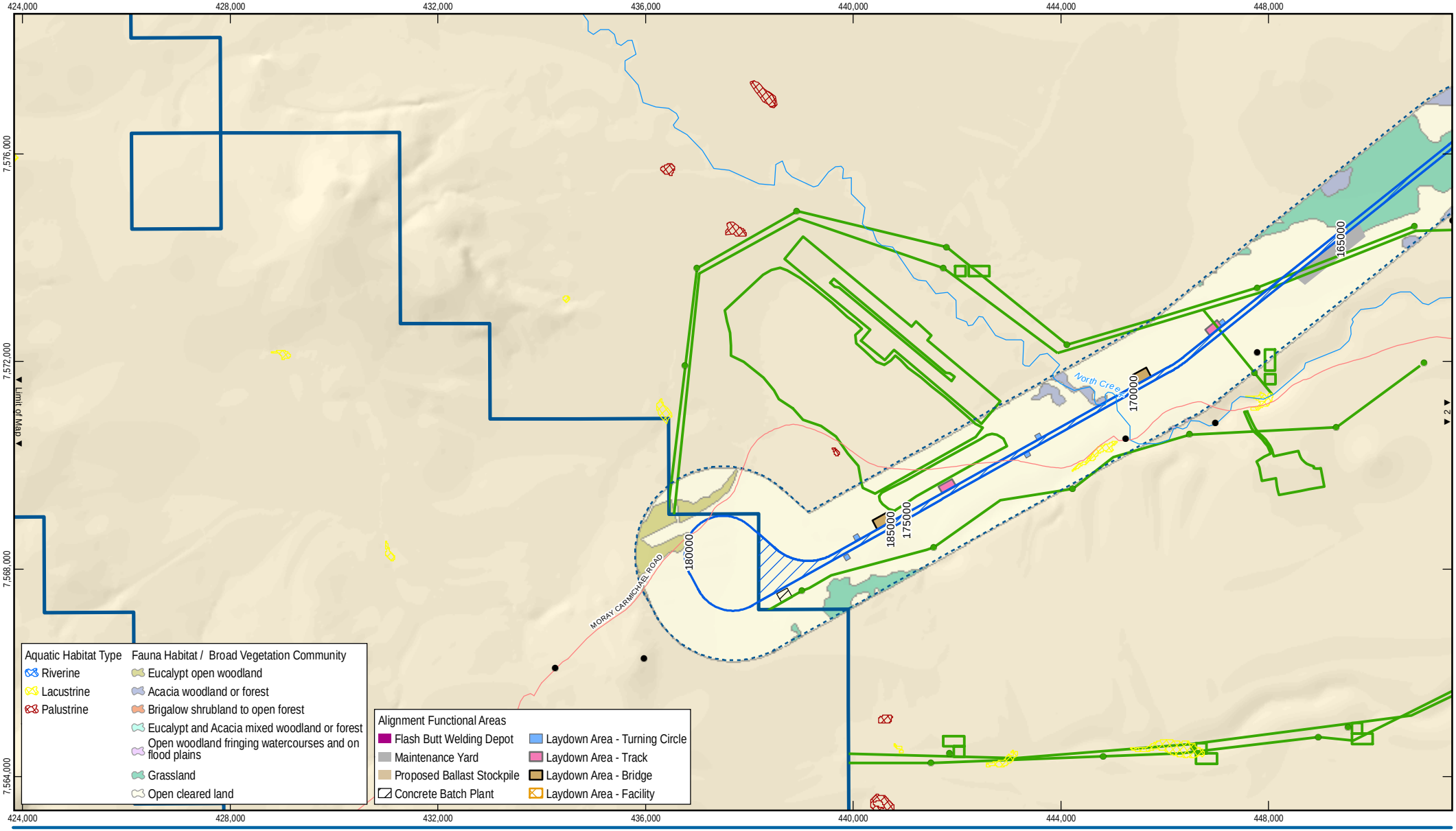
Data source: DERM: DEM (2008), Aquatic Habitat Type / Fauna Habitat / Broad Vegetation Community (2009), DCDB (2010); DME: EPC1690 (2010)/EPC1080 (2011); © Commonwealth of Australia (Geoscience Australia):Localities, Railways, Roads (2007); Adani: Alignment Opt9 Rev3 (2012); Gassman/Hyder: Mine (Offsite) (2012). Created by: BW, MS, CA



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Kilometres

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Horizontal Datum: Geocentric Datum of Australia (GDA)
Grid: Map Grid of Australia 1994, Zone 55

N

LEGEND

- Investigation Areas
- Construction Camp
- State Road
- Local Road
- Watercourse
- Other Railway
- Study Area
- Mine (Onsite)
- Mine (Offsite)
- Mine (Offsite)
- Rail (West)
- Rail (East)

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Carmichael Coal Mine and Rail Project

Broad Vegetation Communities and Terrestrial and Aquatic Fauna Habitat Types

Job Number 41-25215
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Figure 2-3
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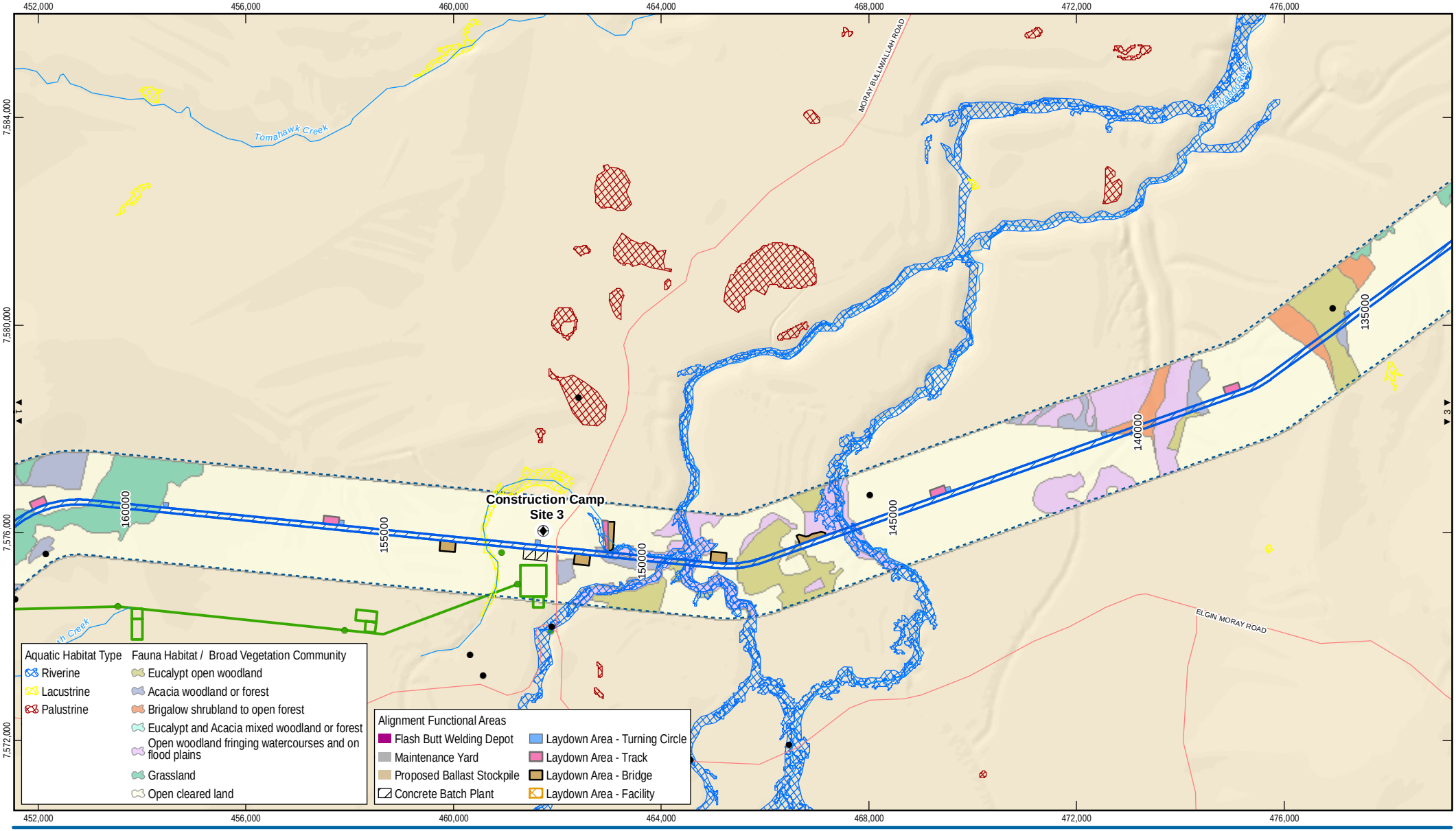

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Grid: Map Grid of Australia 1994, Zone 55

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- Local Road
- Watercourse
- Other Railway
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- Mine (Offsite)
- Mine (Offsite)
- Rail (West)
- Rail (East)

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Carmichael Coal Mine and Rail Project

Broad Vegetation Communities and Terrestrial and Aquatic Fauna Habitat Types

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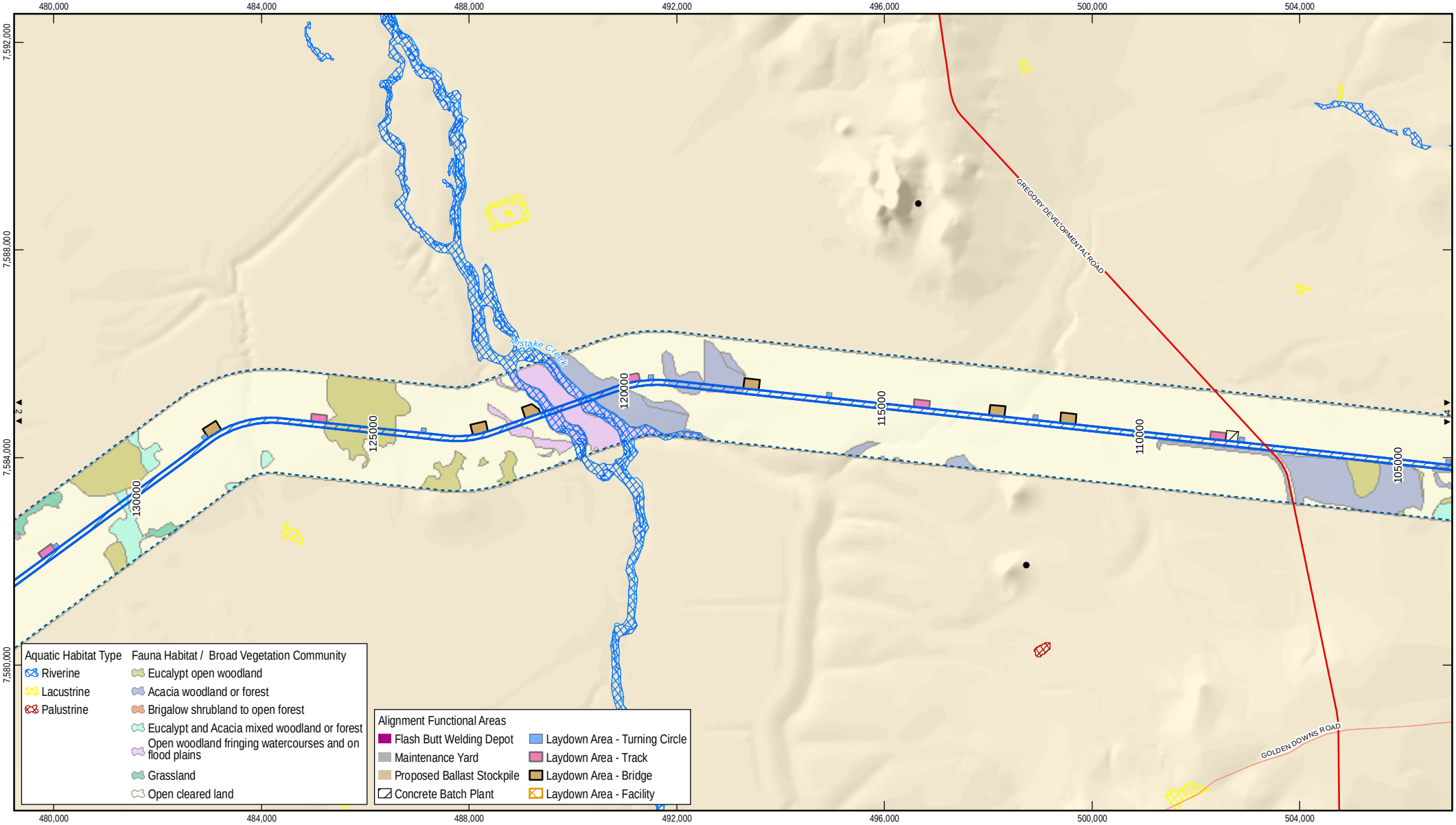

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Grid: Map Grid of Australia 1994, Zone 55

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LEGEND

- Investigation Areas
- Construction Camp
- State Road
- Local Road
- Watercourse
- Other Railway
- Study Area
- Mine (Onsite)
- Mine (Offsite)
- Mine (Offsite)
- Rail (West)
- Rail (East)

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Broad Vegetation Communities and Terrestrial and Aquatic Fauna Habitat Types

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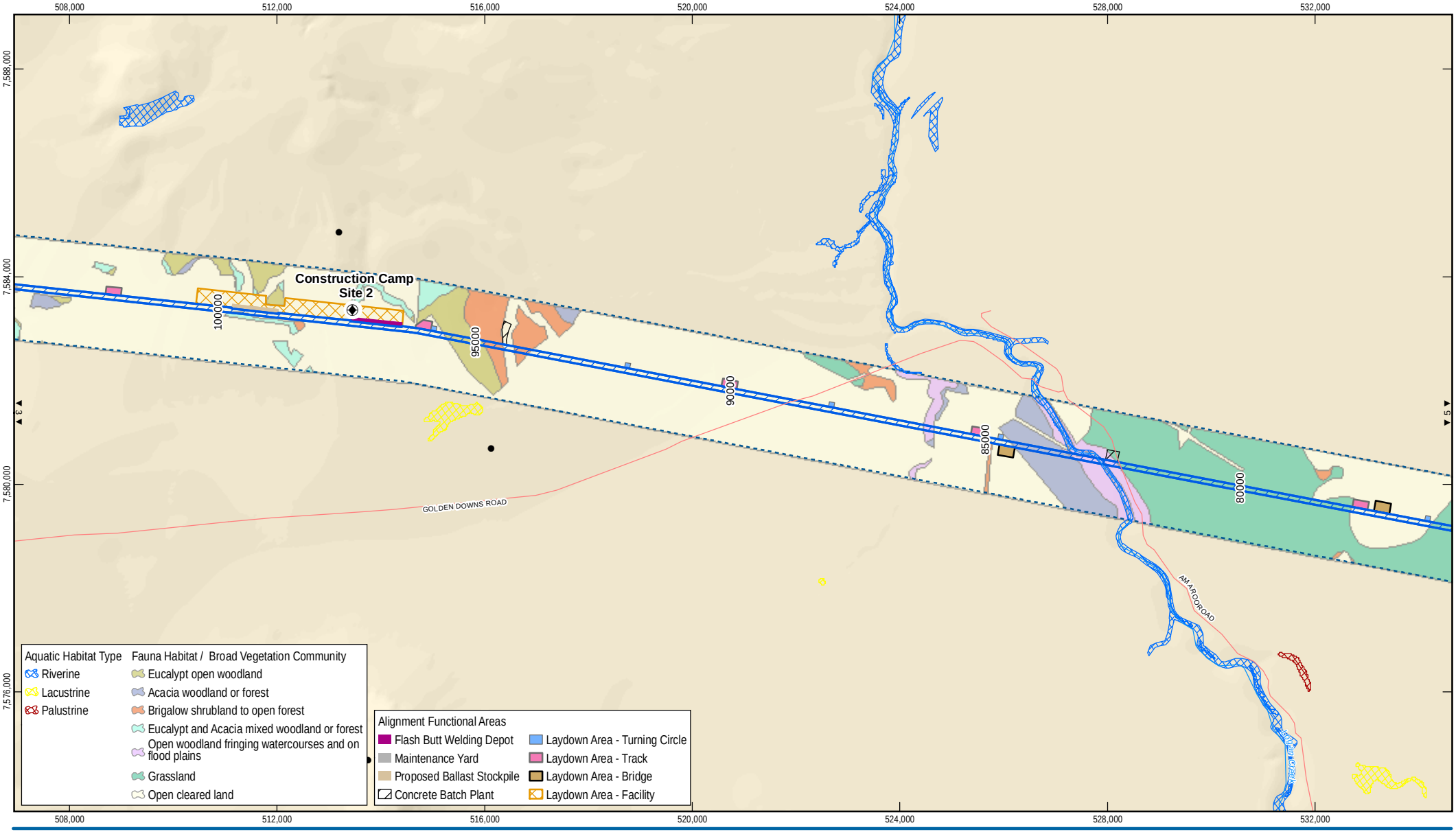

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LEGEND

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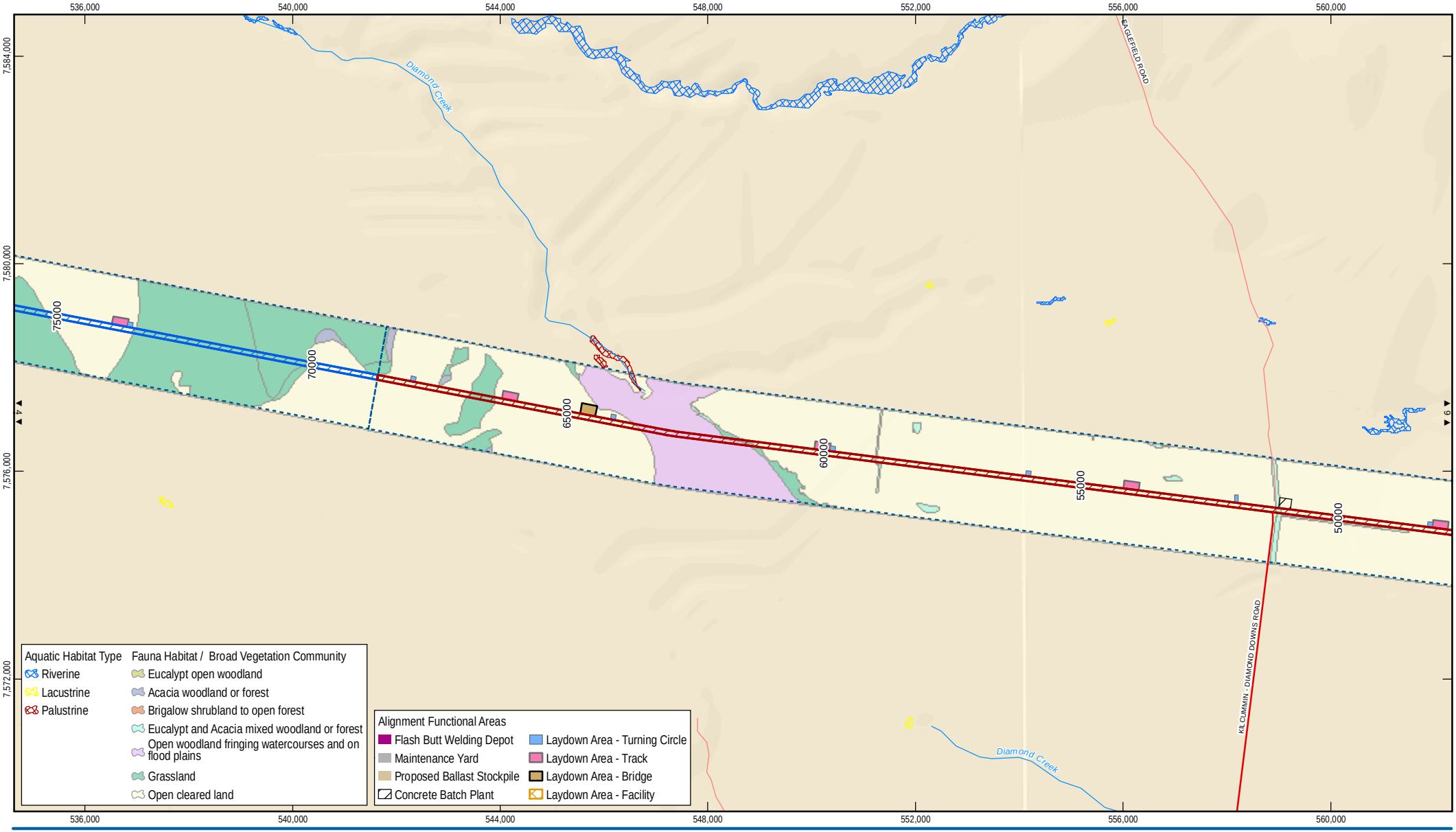

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LEGEND

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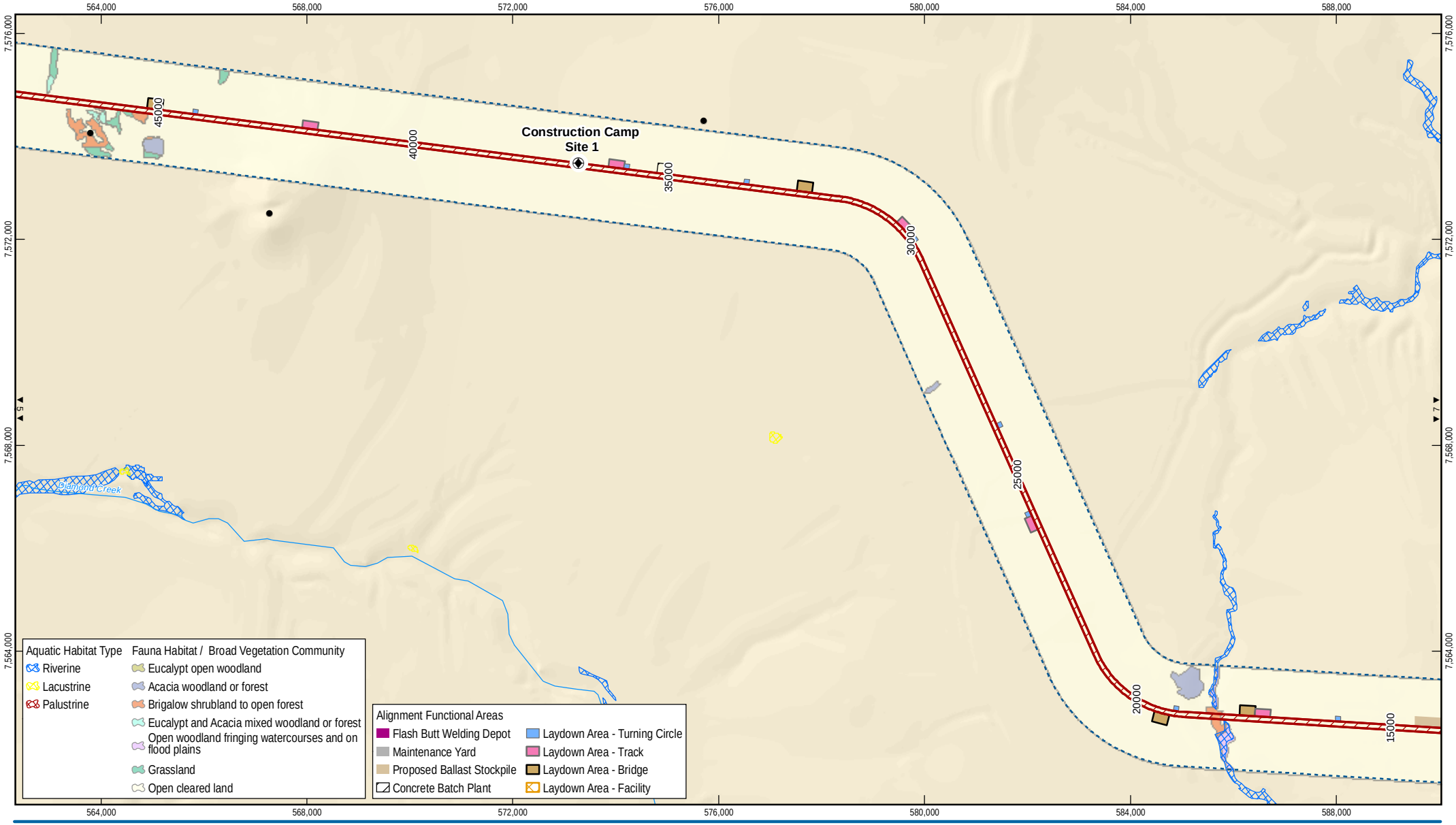

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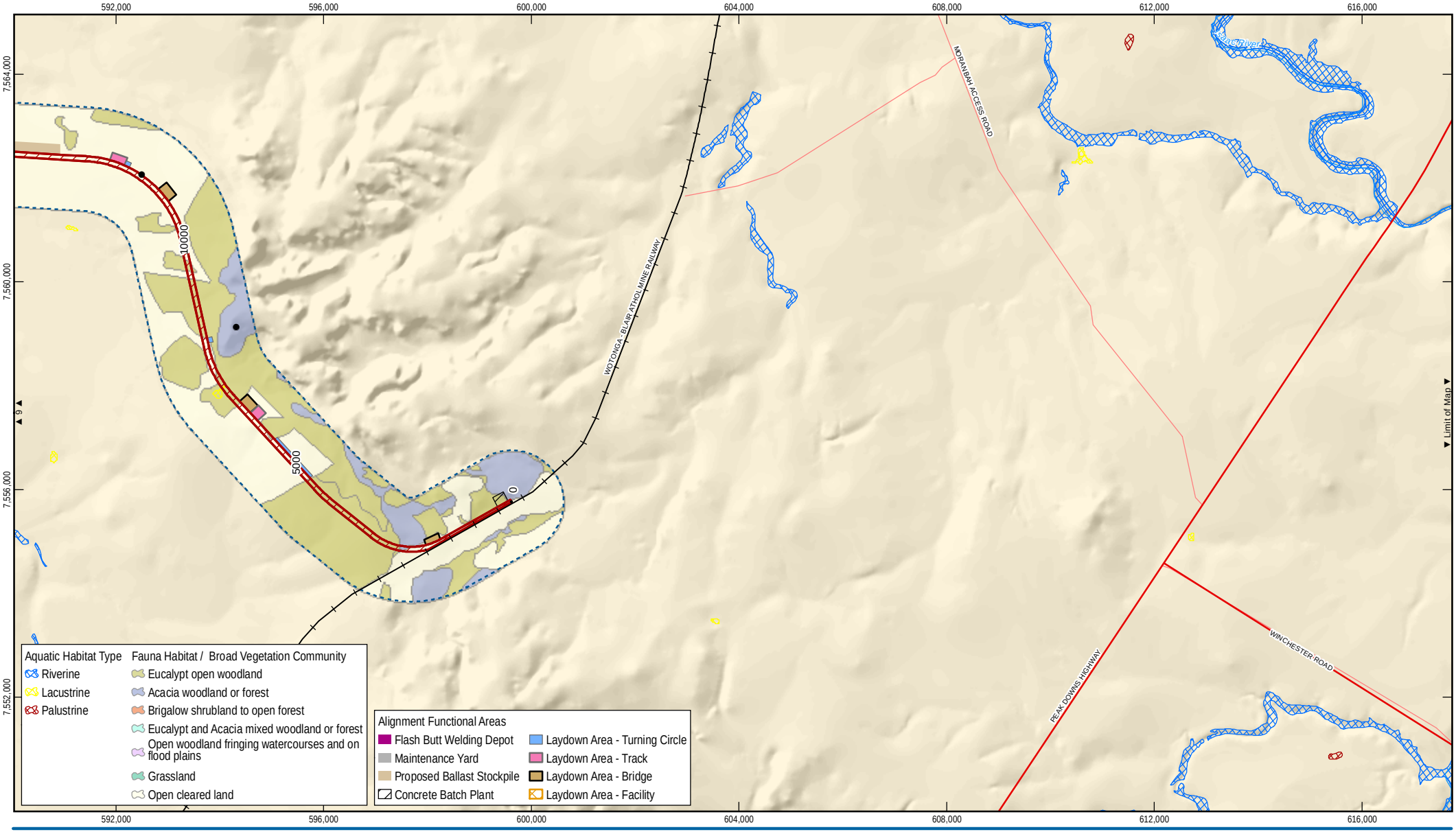

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2.4.3 Flora Species Diversity

2.4.3.1 Desktop Results

Searches of the relevant databases (Appendix C) and existing reports for the area identified a broad diversity of flora species within the 2 km wide Study Area and within the broader region. These investigations were combined and summarised below:

- Predicted species data:
  - Protected Matters Search Tool and Environment Reporting Tool: three threatened flora species, and seven Weeds of National Significance (WONS)
- Existing species records databases:
  - Wildlife online: 311 vascular taxa of which 26 are introduced species
  - HERBRECS: 378 vascular taxa of which 16 are introduced species

A total of nine threatened flora species were identified from the Study Area or surrounding region through desktop review, including eight flora species identified from the Project ToR. These include:

- Acacia deuteroneura
- Acacia ramiflora
- Black ironbox (Eucalyptus raveretiana)
- Finger panic grass (Digitaria porrecta)
- King blue-grass (Dichanthium queenslandicum)
- Marlborough blue cycad (Cycas ophiolitica)
- Northern beard heath (Leucopogon cuspidatus)
- Ozothamnus eriocephalus
- Solanum adenophorum

These species are discussed in Section 3.2.4.1 and Section 3.3.4.1 and Table 3-2 and Table 3-8.

2.4.3.2 Field Survey Flora Diversity

Field surveys recorded 125 plant taxa, of which 114 were native (91 per cent) (refer Appendix D). Eighty-seven of these taxa were recorded in May 2011, while 77 taxa were recorded during the September 2011 surveys. Overall, 40 plant families were recorded in the Study Area. The most species rich plant families recorded in the Study Area were:

- Poaceae (29 taxa)
- Mimosaceae (9 taxa)
- Myrtaceae (8 taxa)
- Asteraceae (8 taxa)

2.4.4 Horticultural Crops

Strategic cropping land is an important, finite resource that is subject to competing land uses from the agriculture, mining and urban development sectors. The government controls this land such that a balance is achieved between these sectors to help maintain the long-term viability of our food and fibre industries, and support economic growth for regional communities.

Field surveys did not identify any active horticultural activities within the Study Area. However, small areas of strategic cropping land (management area) have been mapped within the rail corridor (approximately 115ha. The majority of strategic cropping land (management area) is located in the eastern half of the rail corridor. Refer to Volume 4 Appendix Y Rail Soils Assessment and Appendix Z1 Rail Land Use Report.

2.4.5 Exotic or Weed Flora Species

A desktop review of weed and exotic flora species within the Study Area and surrounding region was undertaken utilising the following resources:

- EPBC Environment Reporting Tool Search results
- Queensland Herbarium specimen database (HERBRECS) search results
- Queensland Wildlife Online search results
- Biosecurity Queensland's Annual Pest Distribution Survey 2008 data and predictive map
- Isaac Regional Council Draft Pest Management Plan 2011-2015 (IRC, 2011). The draft plan lists 17 weed species that are identified as a priority for the management within the Local Government Area (LGA).

The information gathered from the above sources included predictive weed mapping information (based on climate suitability) over the region and historical confirmed records of weed species in the Study Area and surrounding region. The desktop review for weed species identified 29 species of 'declared plants' under the LP Act or listed as priority species in the Isaac Regional Council Draft Pest Management Plan 2011-2015 (IRC, 2011) that have been previously recorded within the search extent or that have a species' distribution that overlaps with the Study Area. These are listed in Appendix D.

During the field surveys 11 exotic introduced species were recorded, of which three species are 'declared plants' under the LP Act. These species are listed in Table 2-4.

Table 2-4 Declared Plants recorded within the Study Area

Scientific Name	Common Name	Study Area Distribution
Class 2*		
Opuntia sp. (most likely *O stricta* or *O. tomentosa*)	prickly pear	Brigalow and gidgee patches as single individuals
Harrisia martinii	harrisia cactus	Brigalow, gidgee and coolabah woodlands as single individuals
Parthenium hysterophorus	parthenium	Non-remnant areas, coolabah woodlands, brigalow, generally in mid-dense clusters

* LP Act Class two declared plants

2.4.6 Communities of Cultural, Commercial or Recreational Significance

As mentioned above, small areas of strategic cropping land have been mapped within the rail corridor (approximately 115.0 ha) and within the Study Area (approximately 2,075.4 ha) near the east end of the corridor. These areas either currently, or have the potential to, support communities of commercially significant plants.

Additionally, 11 protected areas exist within 50 km of the Study Area. These areas have value for recreational activities (hiking, camping, etc.) as well as the potential to support culturally significant plant communities, such as grass trees.

2.5 Terrestrial Fauna

2.5.1 Fauna Habitats

The Study Area, including the rail corridor, generally intersects portions of land that have been extensively cleared and devoted to cattle grazing and consequently has relatively low ecological value (i.e. providing habitat for a limited number of species and unlikely to support species listed under the NC Act and EPBC Act). Remnants of native vegetation are present intermittently throughout the Study Area and where these occur they represent areas of greater habitat value, providing habitat for an increased number and diversity of fauna species, including some conservation significant species protected under the NC Act and EPBC Act.

The diversity of vegetation communities and habitat types across the surveyed area was generally low with often only minor variation in vegetation structure between different fauna habitat types. Given the lack of variation in vegetation structure observed and consistency of REs across the landscape, the structure of vegetation communities is likely to remain relatively invariable across the Study Area.

Fauna habitat types are defined by the structural complexity and dominant flora species present, the presence of habitat features such as coarse woody debris, hollows, leaf litter, rocks/crevices/caves and the presence of permanent or ephemeral water. In general, the ecological value of habitat types varied with the level of grazing pressure and weed infestation affecting the understorey. Eight broad habitat types were identified during the May and September surveys. The general characteristics of these broad habitat types are summarised in Table 2-4 and discussed further below. The spatial distribution of fauna habitats at the Study Area is presented in Figure 3-2. The fauna habitats generally correspond with the vegetation communities identified in Section 4.4.

Table 2-5 Fauna Habitat Types at Study Area

Broad habitat type	General characteristics	Suitability for listed species	Representative photos
Eucalypt open woodland with native grass understorey (Eucalypt open woodland*)	Eucalypt open woodland typically comprises a low to moderate density canopy layer, sparse to absent shrub layer and ground layer of typically native (sometimes mixed with non-native) grasses. These areas provide a diversity of microhabitats, particularly at the ground and understorey level and provide foraging resources for folivorous mammals, nectarivorous mammals and birds, granivores, insectivorous mammals, reptiles and birds, and grazing mammals. Species diversity was generally moderate, supporting a variety of woodland birds, possums, gliders, macropods and ground-dwelling reptiles and mammals (such as bandicoots and echidnas). Eucalypt open woodland provides potentially suitable habitat for predators including birds of prey, snakes and dingos. Shelter resources within Eucalypt open woodland include occasional hollows in mature eucalypts (density dependent on age of woodland and tree species), log piles, dense ground cover and leaf litter. Ephemeral waterways and drainage lines are often associated with this habitat type. Permanent water is present occasionally in the form of farm dams and troughs. Average tree hollow density* = 34 per cent (0 - 80) (n=7).	Potential suitable habitat for listed species including: ◗ brigalow scaly-foot ◗ ornamental snake ◗ yakka skink ◗ red goshawk ◗ grey falcon ◗ black-throated finch ◗ greater long-eared bat ◗ northern quoll Confirmed habitat for: ◗ little pied bat ◗ squatter pigeon	 Eucalypt open woodland within Study Area, May 2011.  Eucalypt open woodland within Study Area, September 2011.

Broad habitat type	General characteristics	Suitability for listed species	Representative photos
Gidgee or mixed acacia woodland, on clay and clay loam plains with sparse shrub layer (Acacia woodland or forest)* <u>May sites</u> Rapid: 0 <u>September sites</u> Rapid: 4	Isolated remnants of mixed acacia woodland occur in a number of locations within the Study Area, can comprise a sparse to dense canopy layer. Typically it comprises a sparse shrub layer, with a ground layer of native (sometimes introduced) grasses. This habitat type supports a high diversity of wildlife including canopy, shrub and ground-dwelling birds, macropods, echidnas, bandicoots, tree-frogs and a range of reptiles. Good foraging resources are available for nectarivorous mammals and birds, granivores and insectivores Acacia woodland or forest provides suitable habitat for predators including birds of prey, snakes and dingos. Shelter resources within Acacia woodland or forest includes log piles and shed bark, decorticating bark and cracking soils. There are few hollows. Gilgais are often associated with this habitat type – seasonal and localised water habitat resource Average tree hollow density* = 0 per cent (n= 2)	Potential suitable habitat for listed species including: ◗ brigalow scaly-foot ◗ ornamental snake ◗ yakka skink ◗ red goshawk ◗ Dunmall's snake	 Acacia woodland or forest within Study Area, September 2011.  Acacia woodland or forest within Study Area, September 2011.

Broad habitat type	General characteristics	Suitability for listed species	Representative photos
Brigalow shrubby woodland or open forest typically on clay and clay loam plains (Brigalow shrubland to open forest*) <u>May sites</u> Rapid: 0 <u>September sites</u> Rapid: 0	Patches of brigalow forest occur in a number of locations within the Study Area and typically comprise a mid-dense to dense canopy layer. The shrub layer is often sparse, if not entirely absent, with a ground layer of typically introduced grasses. This habitat type supports a diversity of wildlife including canopy, shrub and ground-dwelling birds, macropods, echidnas, bandicoots and a range of reptiles. Suitable habitat is provided by this habitat type for predators such as snakes and dingos. Shelter resources within brigalow shrubland to open forest include log piles and shed bark, decorticating bark and cracking soils. No hollows are present. Gilgais and/or drainage channels are often associated with this habitat type – seasonal and localised water habitat resource Average tree hollow density* = 0 per cent (n=1)	Potential suitable habitat for listed species including: ◗ brigalow scaly-foot ◗ ornamental snake ◗ yakka skink ◗ Dunmall's snake	 Brigalow shrubland to open forest within Study Area, May 2011.  Brigalow shrubland to open forest within Study Area, September 2011.

Broad habitat type	General characteristics	Suitability for listed species	Representative photos
Eucalypt and Acacia mixed woodland or forest often on clay soils (Eucalypt and Acacia mixed woodland or forest*) <u>May sites</u> Rapid: 0 <u>September sites</u> Rapid: 1	This habitat type comprises an open to mid-dense canopy layer with a sparse shrub layer often with regrowth *Acacia* spp. It has a ground layer of native (less often introduced) grasses. These areas provide a diversity of microhabitats, and provide foraging resources for folivorous mammals, nectarivorous mammals and birds, granivores, insectivorous mammals, reptiles and birds, and grazing mammals. Predators within Eucalypt and Acacia mixed woodland or forest include birds of prey, monitors, snakes and dingos. Shelter resources in this habitat include log piles and shed bark, decorticating bark and cracking soils and to a small degree leaf litter. There are few hollows typically present in eucalypt trees. Gilgais are sometimes associated with this habitat type which can provide a seasonal water source and localised habitat. Small drainage lines also occasionally present Average tree hollow density* = 15 per cent (0 – 30) (n=2)	Potential suitable habitat for listed species including: ◗ brigalow scaly-foot ◗ ornamental snake ◗ yakka skink ◗ red goshawk ◗ black-throated finch ◗ greater long-eared bat ◗ northern quoll Confirmed habitat for: ◗ little pied bat ◗ squatter pigeon	 Eucalypt and Acacia mixed woodland or forest within Study Area, September 2011.  Eucalypt and Acacia mixed woodland or forest within Study Area, September 2011.

Broad habitat type	General characteristics	Suitability for listed species	Representative photos
Riparian woodland or forest fringing watercourses, and coolabah open woodland on grassy floodplain often with weedy understorey (Open woodland fringing watercourses and on flood plains*) <u>May sites</u> Comprehensive: 2 Rapid: 8 <u>September sites</u> Rapid: 1	This habitat type is restricted to the riparian zone and the adjacent floodplain of rivers and major creeks. The canopy layer is open with a sparse or absent shrub layer. Ground cover is often dense immediately adjacent to creek lines with a mix of grasses and sedges and patches of weed infestation. The substrate is typically sandy. This habitat type provides nesting and feeding sites for woodland birds, hollows and blossoms for possums and gliders and shelter and food for macropods. The abundance of weeds and seasonal inundation reduces the diversity of microhabitats available in the understory. Forage resources are available for folivorous mammals, nectarivorous mammals and birds, granivores, insectivorous mammals, reptiles and birds, and grazing mammals. Predators include birds of prey, snakes and dingos Mature *Eucalyptus coolabah* support a relatively high density of hollows. Other shelter resources include log piles (flood debris), shed bark and in places, dense ground cover. Average tree hollow density* = 44 per cent (13 – 69) (n=3)	Potential suitable habitat for listed species including: ◗ ornamental snake ◗ yakka skink ◗ red goshawk ◗ grey falcon ◗ black-throated finch ◗ greater long-eared bat ◗ black-necked stalk Confirmed habitat for: ◗ little pied bat ◗ squatter pigeon	 Open woodland fringing watercourses and on flood plains habitat within Study Area, May 2011.  Open woodland fringing watercourses and on flood plains habitat within Study Area, September 2011.

Broad habitat type	General characteristics	Suitability for listed species	Representative photos
Native pastures or grassland with absent canopy or shrub layer (Grassland*) <u>May sites</u> Rapid: 1 <u>September sites</u> Rapid: 0	A large patch of native grassland occurs within the central portion of the Study Area. Native grasses provide suitable habitat for grass-dwelling birds such as quails and pipits, as well as snakes and reptiles and larger fauna such as macropods, birds of prey, emus and bustards Foraging resources suitable for some granivores and insectivores, and grazing mammals are available. Predators include birds of prey, snakes and dingos Shelter resources are limited, although log piles resultant from historic clearing are likely to shelter grassland reptile species Average tree hollow density* = NA	Potential suitable habitat for listed species including: ◗ squatter pigeon ◗ black-throated finch	 Grassland within Study Area, September 2011.  Grassland within Study Area, September 2011.

Broad habitat type	General characteristics	Suitability for listed species	Representative photos
Open, previously cleared areas lacking native remnant vegetative cover and/or with patchy regrowth (Open cleared land and regrowth*) May sites Rapid: 0 September sites Rapid: 1	Grazing areas are the dominant habitat type within the Study Area. These areas are characterised by the absence of canopy and shrub-level vegetation and the presence of a pasture grass-dominated ground layer, typically dominated by introduced buffel grass. Forage resources are limited, although habitat supports some granivores and insectivores, and grazing mammals. Predators include birds of prey, snakes and dingos. Shelter resources are limited, although log piles resultant from historic clearing are likely to shelter grassland reptile species. Average tree hollow density* = NA	Potential suitable habitat for listed species including: ◗ squatter pigeon	 Open cleared land and regrowth habitat within Study Area, May 2011.  Open cleared land and regrowth habitat within Study Area, September 2011.

Broad habitat type	General characteristics	Suitability for listed species	Representative photos
Natural and artificial water bodies (Natural and artificial water bodies) May sites Rapid: 2 September sites Rapid: 1	Natural waterways include rivers, wetlands, creeks and gilgai while artificial water bodies include numerous small to large farm dams. Water bodies (and adjacent vegetation) provide a drinking resource for numerous animal species and breeding habitat for some (i.e. amphibians, some birds). Natural waterways in some places contained emergent and submerged macrophytes which provide food and nesting sites for aquatic birds, calling substrates for frogs and shelter for fish and crustaceans. This habitat type provides foraging habitat for predatory species including some birds of prey and some snakes. Average tree hollow density* = NA	Potential suitable habitat for listed species including: ◗ ornamental snake ◗ yakka skink ◗ red goshawk ◗ little pied bat ◗ squatter pigeon ◗ black-throated finch ◗ Australia painted snipe ◗ black-necked stork ◗ cotton pygmy-goose	 Natural and artificial water bodies habitat within Study Area, May 2011.  Natural and artificial water bodies habitat within Study Area (farm dam), May 2011.

* Average tree hollow density = number of trees with hollows / number of trees counted during a random meander throughout the site (range of values presented) (n = number of sites where hollows counted).

#indicates the BVC that coincides with the broad habitat type.

2.5.1.1 Summary of Fauna Habitat Values within the Study Area

In general, the Study Area occurs in a region in which native vegetation has been extensively cleared and fragmented by pastoral land-use. Field observations made in accessible areas of the Study Area were consistent with this assessment. Much of the Study Area investigated contains extensive areas of cleared grazing land which has relatively low ecological value for native wildlife (Hannah *et. al.,* 2007). Nonetheless, the Study Area retains a variety of intact stands of remnant native vegetation particularly in association with watercourses and creek lines. The area of remnant vegetation within the Study Area covers approximately 8,289 ha accounting for a total of only 23 per cent of the Study Area.

Areas of remnant vegetation have typically moderate ecological value, providing refuges for native plants and animals. These remnants are subject to cattle grazing and their relative habitat value varies greatly depending on the intensity of local grazing pressure and weed infestation. In general, weeds and exotic pasture grasses were abundant and widespread throughout the Study Area with many of the surveyed remnants of native vegetation having moderate to high levels of disturbance. The riparian zones adjacent to creek lines and watercourses typically contained a moderate abundance and diversity of weeds and localised areas were subjected to damage from cattle trampling, soil compaction and erosion (refer Plate 2-1). Despite signs of disturbance (such as weeds and cattle trampling) this riparian habitat provides landscape connectivity that allows local movement of native fauna.

Plate 2-1 Watercourse Condition

Source: GHD, September 2011. Water course disturbance due to cattle trampling (left) and localised degradation (e.g. erosion) (right).

Areas of brigalow regrowth were encountered within the survey extent of the Study Area (refer Plate 2-2). At the time of survey these areas had relatively low habitat value. These areas have been subject to extensive clearing in recent years and therefore do not currently contain sufficient complexity to provide habitat for many native wildlife species. They have the potential to increase in value in future years as brigalow vegetation regenerates and structural complexity at the shrub and understorey layer increases (Bowen *et. al.*, 2009).

Plate 2-2 Patches of Brigalow Regrowth (September, 2011)

Source: GHD, September 2011.

Marked seasonal variability in the structure and composition of fauna habitat types was not observed across the Study Area between the autumn and spring surveys (in May and September, respectively). Such changes would only be expected in grassland and riparian habitats. Both survey efforts exhibited dry conditions typical for the time of year which corresponds with the beginning and end of central Queensland's typical dry season.

With respect to fauna habitats, it is considered likely that:

- Availability of forage resources for herbivorous animals (i.e. grazers, nectarivores, grainivores and folivores) is likely to be seasonally variable, and driven by local climatic conditions. This may result in variable use of different habitats by resident and sedentary species during the year and temporary occupancy in response to availability of forage resources by nomadic and migratory species.
- Availability of prey for predators may change during the year in response to variable densities and diversity of herbivorous animals
- The extent of habitat for semi-aquatic species (e.g. amphibians, water birds) is likely to fluctuate during the year in response to rainfall. Large water bodies (e.g. some farm dams) that retain water throughout the year may become localised nodes for water birds in response to regional reduction in extent of aquatic habitat during dry seasons.
- Microhabitats are likely to vary during the year in response to changes in climate (such as reduced ground cover during the dry season)
- Less predictable forces such as fire and flooding may alter the availability of important habitat resources for ground-dwelling/ground-foraging animals and arboreal animals

The potential value of identified habitat for conservation significant terrestrial fauna is discussed in more detail in Section 2.6.1.

2.5.1.2 Connectivity

A review of RE mapping (DERM Version 6.0b) indicates that much of the landscape surrounding the Study Area has experienced broadscale vegetation clearing, and as such, remnant vegetation coverage is fragmented (refer Certified RE Mapping Figure 2-2). The significance of remnant

vegetation patches within the Study Area as potential habitat is evaluated in Section 2.5.1.3 and shown in Figure 2-4 to Figure 2-6

A large area of relatively intact remnant vegetation occurs to the west of the Study Area beyond where the rail corridor enters the proposed Project (Mine) site and extends in all directions, maintaining remnant coverage for some distance beyond the Project. The eastern extent of the rail alignment also intersects with a relatively contiguous area of intact remnant vegetation associated with Peak Downs National Park which extends to the north and south of the Study Area.

Mapped remnant vegetation fringing the Belyando River and its tributaries forms a slightly fragmented north-south network of regionally interconnected habitat in the western extent of the Study Area. This tract of vegetation connects Wilandspey Conservation Park in the north to the Bygana Nature Refuge and the East Top Nature Refuge in the south (as well as to the north beyond the Study Area, and to the south beyond the Study Area). The landscape east of the Gregory Developmental Road is more fragmented and almost entirely devoid of remnant vegetation in some areas. Narrow bands of native remnant vegetation fringe Logan Creek and Diamond Creek (tributaries of Suttor River) which both cross the Study Area in a north-south direction. Each of these riparian corridors is likely to facilitate north-south movement of fauna within the wider landscape of the Study Area.

A narrow riparian corridor associated with Carmichael River also links to remnant vegetation along the Belyando River south of the western extent of the Study Area. Despite the narrowness of this corridor, it is likely to facilitate east-west movement between the Belyando River and large tracts of remnant vegetation within and to the north, west and south of the Study Area (refer Volume 4, Appendix N1 Mine Terrestrial Ecology Report and Appendix O Mine Aquatic Ecology Report).

The east-west corridor connecting to the floodplain of the Belyando River (north-south corridor) may allow for dispersal away from the more fragmented landscape in the east of the Study Area through to the large tracts of remnant vegetation west, north and south of the Study Area.

The riparian corridors are likely to provide passage for wildlife seeking to access the river and riparian habitats as part of normal seasonal movements, or in response to variable climatic conditions (i.e. prolonged dry weather).

2.5.1.3 Biodiversity Planning Assessment Mapping

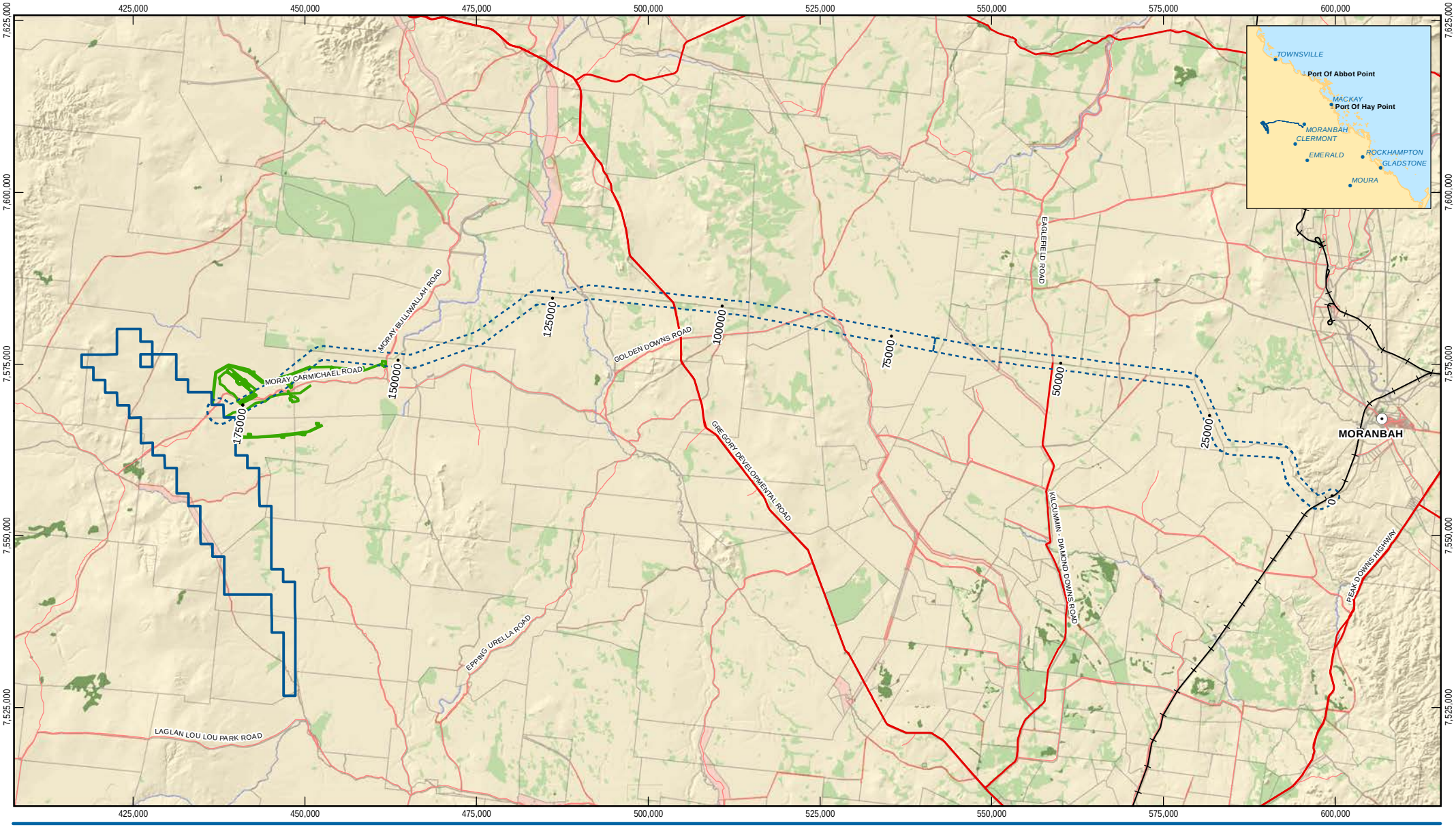
The BPA mapping for the Brigalow Belt and Desert Uplands bioregions was reviewed to provide an indication of the quality and value of remnant vegetation within and proximal to the Study Area. Specifically, three BPA mapping criteria were applied to the Study Area and surrounding landscape, such that the potential habitat values within and beyond the Study Area could be described.

The criteria applied include:

- Criterion B2 – Ecosystem value at regional scale. This criterion categorises RE polygons according to the biodiversity status of the constituent REs (of that polygon), and their extent in Queensland's protected area estate (EPA, 2002). The RE value mapping layer was applied to the Study Area and adjacent surrounding landscape (Figure 2-4). Only the 'very high' and 'high' ecosystem values were depicted in the mapping. As can be seen in Figure 2-4, a number of remnant vegetation patches considered to be regionally significant with respect to biodiversity value occur in the landscape around the Study Area. These areas typically correspond with of concern and endangered RE and in particular occur in association with the Belyando River and

areas of remnant vegetation to the north and south of the Study Area. Several small patches occur within the Study Area in association with of concern and endangered REs.

- Criterion F – Ecosystem diversity. This criterion describes habitat complexity, based on the number and size of ecosystems and wetlands present in an area (EPA, 2002). The concepts of 'richness' (number of different ecosystems) and 'evenness' (relative abundance of ecosystems) are considered when attributing an ecosystem diversity rating to a particular area (EPA, 2002). By way of example, areas with high ecosystem diversity typically have relatively many REs and ecotones (EPA, 2002). Simpson's Diversity Index is used to determine ecosystem diversity (EPA, 2002). RE polygons categorised as being of 'very high' or 'high' ecosystem diversity are presented in Figure 2-5. All of the remnant vegetation within the Study Area is categorised as having very high or high ecosystem diversity (Figure 2-5). Similarly, much of the landscape to the north, west and south of the Study Area is similarly ranked as having very high or high ecosystem diversity. Remnant vegetation coverage is patchy and fragmented across the majority of the Study Area, particularly in the east. However remnant vegetation ranked as having very high or high ecosystem diversity does form important east to west linkages from the Belyando River through to intact remnant vegetation north, south and west of the Belyando River flood plain. Further, very high or high ecosystem diversity linkages (between the north and the south of the wider landscape adjacent to the Study Area) occur associated with Logan and Diamond Creeks in the western half of the Study Area.
- Criterion G – Context and connection. This criterion is based upon the extent to which a mapped RE polygon incorporates or buffers other ecologically noteworthy areas (i.e. other remnant vegetation units and/or wetlands/waterways) (EPA, 2002). With respect to connection, remnant vegetation units that are connected to other REs are considered to be more representative of biodiversity, contribute more to a habitat network (i.e. connectivity) and exhibit greater resilience to disturbance (EPA, 2002). Where it intersects with patches of remnant vegetation, the Study Area is mapped as a mixture of both high and very high as shown in Figure 2-6. Very high category areas of remnant vegetation are mapped largely uninterrupted to the north-west and south-west of the western extent of the Study Area and to the north-east and south-east of the eastern extent of the Study Area, whilst to the west it is more fragmented (refer Section 5.2.2). Immediately to the south and north of the Study Area large tracts of non-remnant vegetation are present and are thus not mapped under this criterion.



1:750,000 (at A4)

0 5 10 15 20 25

Kilometres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia (GDA)
Grid: Map Grid of Australia 1994, Zone 55

N

LEGEND

- Town
- State Road
- Local Road
- Other Railway
- Cadastral Parcel
- Road Reserve
- Watercourse Reserve
- Mine (Onsite)
- Mine (Offsite)
- Study Area
- Biodiversity Planning Assessment - Criteria B2 Ecosystem Value at Regional Level
  - Very High
  - High

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Biodiversity Planning Assessment - Criteria B2
Ecosystem Value at Regional Level

Figure 2-4

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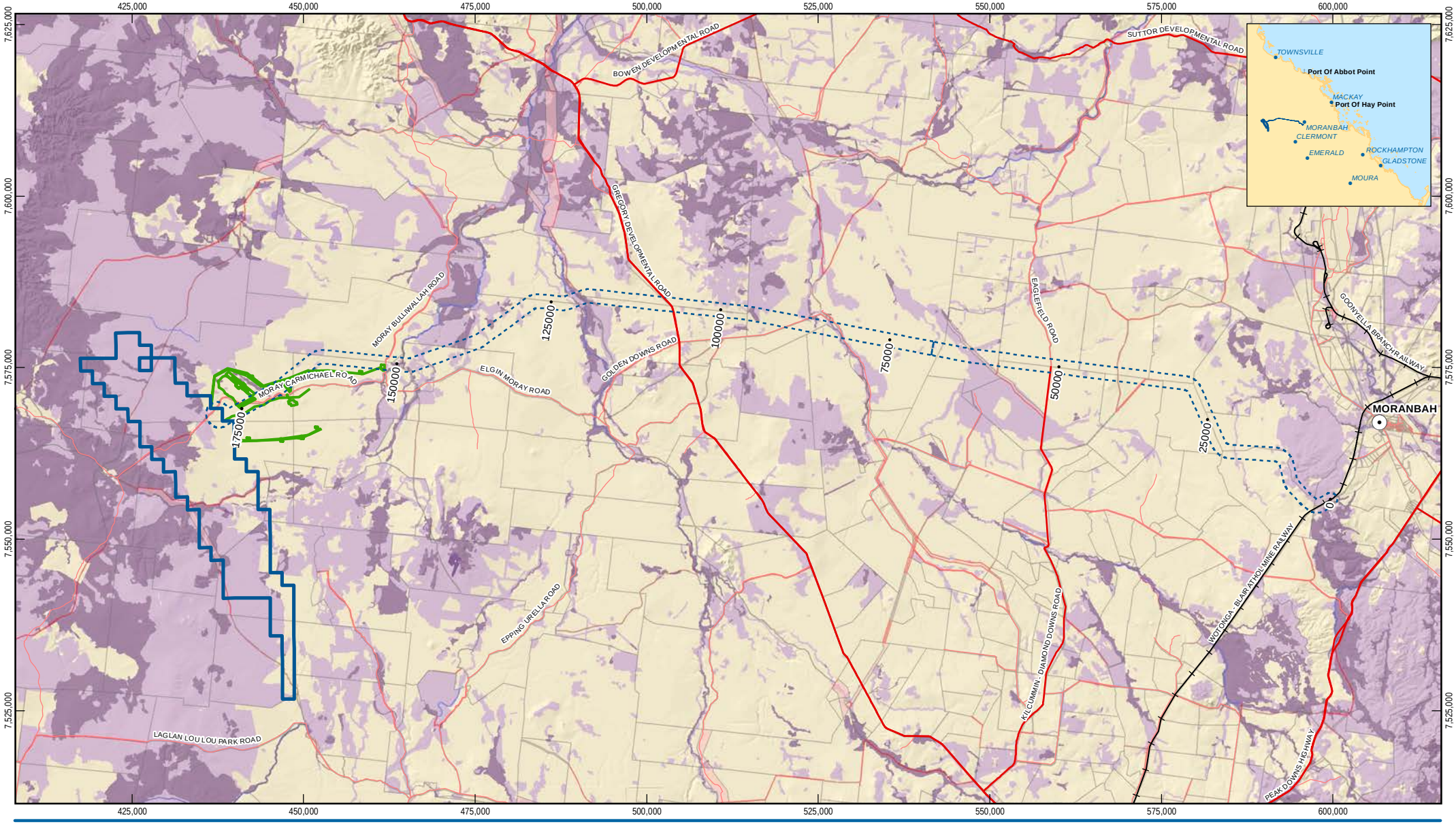
Level 4, 201 Charlotte St Brisbane QLD 4000 T +61 7 3316 3000 F +61 7 3316 3333 E bnemail@ghd.com W www.ghd.com

Data source: DERM: Biodiversity Planning Assessment (2010), DEM (2008), DCDB (2010); DME: EPC1690 (2010)/EPC1080 (2011); © Commonwealth of Australia (Geoscience Australia): Localities, Railways, Roads (2007); Adani: Alignment Opt9 Rev3 (2012); Gassman/Hyder: Mine (Offsite) (2012). Created by: BW, MS, CA



1:750,000 (at A4)

0 5 10 15 20 25

Kilometres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia (GDA)
Grid: Map Grid of Australia 1994, Zone 55

N

LEGEND

- Town
- State Road
- Local Road
- Other Railway
- Cadastral Parcel
- Road Reserve
- Watercourse Reserve
- Mine (Onsite)
- Mine (Offsite)
- Study Area
- Biodiversity Planning Assessment - Criteria F Ecosystem Diversity
  - Very High
  - High

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Biodiversity Planning Assessment - Criteria F
Ecosystem Diversity

Figure 2-5

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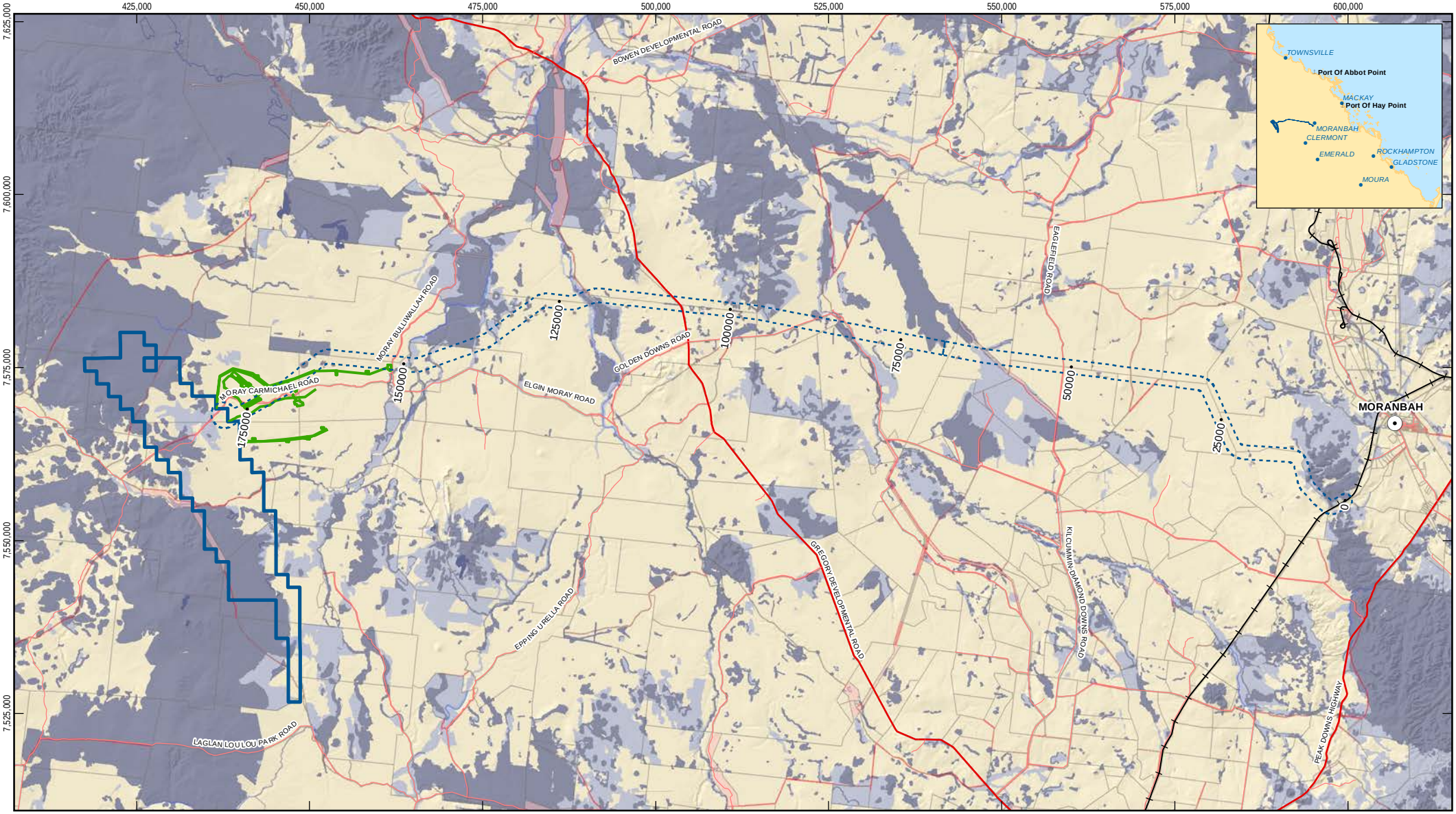
Data source: DERM: Biodiversity Planning Assessment (2010), DEM (2008), DCDB (2010); DME: EPC1690 (2010)/EPC1080 (2011); © Commonwealth of Australia (Geoscience Australia): Localities, Railways, Roads (2007); Adani: Alignment Opt9 Rev3 (2012); Gassman/Hyder: Mine (Offsite) (2012). Created by: BW, MS, CA



1:750,000 (at A4)

0 5 10 15 20 25

Kilometres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia (GDA)
Grid: Map Grid of Australia 1994, Zone 55

N

LEGEND

- Town
- State Road
- Local Road
- Other Railway
- Mine (Onsite)
- Mine (Offsite)
- Study Area
- Cadastral Parcel
- Road Reserve
- Watercourse Reserve
- Biodiversity Planning Assessment - Criteria G -Context and Connection
  - Very High
  - High

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Revision B
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Biodiversity Planning Assessment - Criteria G Context and Connection

Figure 2-6

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Data source: DERM: Biodiversity Planning Assessment (2010), DEM (2008), DCDB (2010); DME: EPC1690 (2010)/EPC1080 (2011); © Commonwealth of Australia (Geoscience Australia): Localities, Railways, Roads (2007); Adani: Alignment Opt9 Rev3 (2012); Gassman/Hyder: Mine (Offsite) (2012). Created by: BW, CA

2.5.2 Fauna Species

Desktop Assessment Summary

The results of the desktop assessment for terrestrial fauna species is summarised in Table 2-6. These species were determined to have the potential to occur, or have been previously recorded, within the Study Area.

Table 2-6 Summary of Desktop Assessment Results – Terrestrial Fauna

	Protected Matters search and Environmental Reporting tool (predicted to occur)	DEHP Wildlife Online database (historically recorded)	Queensland Museum specimen database (historically recorded)	Birds Australia Atlas (historically recorded)
Species diversity		10 amphibians 36 reptiles 27 mammals 131 birds	7 amphibians 30 reptiles 14 mammals 7 birds	71 birds
EPBC Act and/or NC Act threatened species	6 reptiles 2 mammals 5 birds	1 reptile 2 mammals 4 birds	1 reptile	1 bird
EPBC marine and/or migratory birds	13 migratory 12 marine	2 migratory 19 marine		1 migratory 11 marine
Introduced/pest species	1 amphibian 4 mammals	1 amphibian 6 mammals 1 bird	1 amphibian	

A review of the Wildlife Online, Queensland Museum and Birds Australia databases revealed that 238 terrestrial fauna species have been previously recorded from the Study Area and broader region, comprising:

- 13 amphibian species (12 native least concern species, one introduced species)
- 49 reptile species (48 native least concern species, one threatened species)
- 35 mammal species (27 native least concern species, two threatened species, six introduced species)
- 141 bird species (136 native least concern species, four threatened species, one introduced species)

Threatened and conservation significant fauna species (including a likelihood of occurrence assessment) are discussed in more detail in Section 5.2.6 and Section 3.3.4.2.

The desktop database search results are provided in full in Appendix C.

Field Assessment Summary

The number of fauna species detected in field surveys was low and, in general, the fauna recorded were relatively common species. The number of species recorded should be considered a conservative estimate of the total number of fauna species potentially present Cool, dry and windy conditions are likely to have subdued the activity of birds, amphibians, bats and reptiles and reduced the number of species detected.

A total of 92 fauna species were identified in the May field survey and a total of 91 identified in the September field survey. The results of the field studies across the Study Area are presented in Table 2-7. The terrestrial fauna field surveys species lists are provided in Appendix F.

Table 2-7 Summary of Terrestrial Fauna Field Assessment Results

		Amphibians	Reptiles	Mammals	Birds	Total
May 2011 Survey	Total species	2 (4)*	8 (5)	18 (12)	64 (70)	92 (91)
	Introduced species	1 (1)	-	4 (1)	-	5 (2)
	Threatened species	-	-	1	- (1)	1 (1)
	EPBC Act migratory	-	-	-	- (1)	- (1)
	EPBC Act marine	-	-	-	5 (9)	5 (9)
		Amphibians	**Reptiles**	**Mammals**	**Birds**	**Total**
Total (both surveys)	Total species	5	10	20	94	129
	Introduced species	1	0	4	-	5
	Threatened species	-	-	1	1	2
	EPBC Act migratory	-	-	-	2	2
	EPBC Act marine	-	-	-	11	11

*Bracketed numbers indicate September survey results

Fauna diversity by fauna habitat type across both survey events is summarised in Table 2-8. It is important to note that this data only includes species records from comprehensive survey sites (two sites in 'open woodland fringing watercourses and on floodplains' habitat type), habitat assessment sites and anabat survey sites and does not include data collected from opportunistic recordings. Additionally, only five of the eight described habitat types were sampled during survey events.

A low diversity and abundance of species was recorded from non-remnant vegetation. This is likely due to the low quality and low diversity of microhabitat available within non-remnant vegetation (e.g. pasture grasslands). Additionally, eucalypt and acacia mixed woodland and forest habitat recorded low diversity and abundance of fauna species, comparable to non-remnant habitats. These communities frequently appeared as regrowth or young growth forests with minimal structural diversity and an absence of tree stags and hollow logs.

Open woodland fringing watercourses and on floodplains recorded the greatest number of each group of fauna species. This habitat is often diverse in terms of the flora species available, and hence, structural diversity and habitat availability. Additionally, tree stags may be abundant in old eucalypts and litter on the ground can be abundant from past flood events. These factors provide habitat for a range of fauna species (e.g. owls (stags) and lizards (litter)).

Table 2-8 Fauna Diversity by Habitat Type

	Eucalypt open woodland	Grassland	Open woodland fringing watercourses and on floodplains	Acacia woodland	Eucalypt and acacia mixed woodland or forest	Non-remnant
Amphibians	1	0	3	0	0	0
Reptiles	1	1	10	0	0	0
Mammals	2	1	14	1	3	0
Birds	30	19	65	26	8	7
Total species	**34**	**21**	**92**	**27**	**11**	**7**

2.5.2.1 Amphibians

Five amphibian species from three families were recorded from within and near the Study Area over both field surveys. No species of conservation significance were detected. One introduced species (cane toad (*Rhinella marina*)) was recorded (refer Section 2.5.2.5).

The native amphibian abundance and diversity was generally low. Amphibians rely on water sources for breeding and survival. The low abundance and diversity of amphibians is thus likely due to the season during which surveys were undertaken (e.g. dry season) and the lack of water available in the Study Area as a result. Amphibian species encountered included three common tree frogs (genus *Litoria*) from the family Hylidae, and one ground-dwelling frog from the family Myobatrachidae, the spotted grass frog (*Limnodynastes tasmaniensis*). Plate 2-3 shows the desert tree frog (*Litoria rubella*) and Plate 2-4 shows the green tree frog (*Litoria caerulea*) recorded during the field surveys.

Plate 2-3 Desert Tree Frog

Source: GHD, May 2011

Plate 2-4 Green Tree Frog

Source: GHD, September 2011

2.5.2.2 Reptiles

A total of ten reptiles species from four families were recorded from within and near the Study Area during field investigations. No reptiles of conservation significance were detected. No introduced species were recorded.

Reptile abundance and diversity was generally low and should be considered a conservative indication of the number of species likely to be present based on the quality of reptile habitats in areas of remnant vegetation. The low reptile abundance and diversity is attributed to the cool, dry conditions experienced at the time of survey which is likely to have limited reptile activity. Skinks dominated the reptile diversity, with six species from the family Scincidae recorded. Of these, the most commonly encountered species were *Carlia munda* and wall skink (*Cryptoblepharus virgatus*). Other reptile species encountered included the dubious gecko (*Gehyra dubia*) (Plate 2-5), blue-tongue lizard (*Tiliqua scincoides*), Tommy round-head (*Diporiphora australis*), black-headed python (*Aspidites melanocephalus*) and yellow-faced whip-snake (*Demansia psammophis*).

Plate 2-5 Dubious gecko

Source: GHD, September 2011

2.5.2.3 Mammals

A total of 20 mammal species from nine families were recorded from within and near the Study Area during field investigations. Two species of State significance were detected, namely, the near threatened little pied bat (*Chalinolobus picatus*) and the echidna (*Tachyglossus aculeatus*) which is listed as special least concern. Further discussion on conservation significant species is provided in Section 2.6.1. No mammals of Commonwealth or regional significance were detected.

Other ground-dwelling mammals observed included the red kangaroo (*Macropus rufus*) and eastern-grey kangaroo (*Macropus giganteus*) (Plate 2-5). Habitat for arboreal mammals was present through parts of the Study Area in the form of (mature) open woodland habitat that characterised in particular riparian areas where mature trees supported a large number of hollows of varying sizes. Although, hollow-bearing trees were recorded across the Study Area, the only arboreal mammal recorded during the field surveys was the brushtail possum (*Trichosurus vulpecula*). The koala (*Phascolarctos cinereus*), listed as special least concern and recorded in the Wildlife Online desktop search may occur in low densities in woodland habitats but was not identified during the field surveys. However, the koala has been previously recorded in the region and has been recently identified within riparian vegetation along watercourses intersected by the Project (Rail) (H. Jones *pers.comm* 07/09/2011).

Five introduced mammals were recorded from the Study Area: the pig (*Sus scrofa*) (Plate 2-7), dog (*Canis familiaris*), cat (*Felis catus*), European fox (*Vulpes vulpes*), and European rabbit (*Oryctolagus cuniculus*) (refer Section 2.5.2.5).

Anabat detectors positively identified 12 species of microchiropteran bats. An additional three species not positively identified. The species attributed with the most number of calls were Gould's wattled bat (*Chalinolobus gouldii*) and the yellow-bellied sheathtail bat (*Saccolaimus flaviventris*). The little pied bat was the only listed bat species recorded by the Anabat detectors.

Plate 2-6 Eastern Grey Kangaroo

Source: GHD May 2011

Plate 2-7 Pig

Source: GHD May 2011

2.5.2.4 Birds

A total of 94 bird species were recorded from within and near the Study Area during field investigations. A number of conservation significant bird species were detected, namely:

- Squatter pigeon (southern) (*Geophaps scripta scripta*) listed as vulnerable under the EPBCAct and NC Act

- Great egret (*Ardea alba*) and rainbow bee-eater (*Merops ornatus*) listed as marine and migratory under the EPBC Act and as special least concern under the NC Act
- Eleven birds listed as marine and / or migratory under the EPBC Act (refer Section 3.2.6 for more details on marine and migratory bird species)

Further discussion on conservation significant species is provided in Section 2.6.1.

In general, the avian fauna of the Study Area comprised a mix of common and widespread woodland, grassland and waterbirds. Species that were abundant and commonly observed in grazed areas were Australasian pipit (*Anthus novaeseelandiae*), brown quail (*Coturnix ypsilophora*) and crested pigeon (*Ocyphaps lophotes*) with emu (*Dromaius novaehollandiae*). Australian bustard (*Ardeotis australis*) and brolga (*Grus rubicundus*) were observed in lower numbers. Birds commonly encountered in woodland areas included the brown treecreeper (*Climacteris picumnus*), pale-headed rosella (*Platycercus adscitus*) (Plate 2-8), double-barred finch (*Poephila bichenovii*), galah (*Cacatua roseicapilla*), Torresian crow (*Corvus orru*) and variegated wren (*Malurus lamberti*). Ducks such as the plumed whistling duck (*Dendrocygna eytoni*) (Plate 2-9), were commonly observed at farm dams and waterbodies throughout the Study Area.

Marine and migratory bird species were detected at farm dams and other waterbodies, as well as flying over the Study Area.

Plate 2-8 Pale-headed Rosella

Source: GHD May 2011

Plate 2-9 Plumed whistling Duck

Source: GHD September 2011

2.5.2.5 Introduced Fauna Species

Six introduced terrestrial vertebrate pest species were recorded from within and near the Study Area and comprised:

- One amphibian – cane toad
- Five mammals – pig (Plate 2-7), wild dog, cat (*Felis catus*), European fox, and European rabbit

All of these species are Class 2 Declared Animals under the LP Act. Class 2 Declared Animals are species that are established in Queensland and currently do, or potentially may, have a notable negative economic, environmental or social impact. Local governments, communities and landowners are required to manage these species under the LP Act.

Cane toads were ubiquitous across all habitats, and common across the Study Area. Based on the generalist habitat requirements of the other introduced species recorded, it is considered likely that these species would also be prevalent through much of the Study Area (where suitable habitat occurs).

Biosecurity Queensland has produced Queensland's Annual Pest Distribution Survey 2008 predictive maps indicating the distribution and abundance of a range of pest animal species. These maps were reviewed to provide further information on the likely extent of occurrence (and potential abundance) of pest species over the Study Area. Within the context of the landscape in which the Study Area occurs the maps indicated that:

- Cats are considered to be widespread (distribution) and common (abundance) (Department of Primary Industries and Fisheries (DPIF), 2007a)
- Wild dogs are considered to be widespread and common (DPIF, 2007b)
- European rabbits are considered to be widespread and occasionally present (DPI & F, 2008a)
- Cane toads are considered to be widespread and common (DPIF, 2008b)
- Pigs are considered to be widespread and common (DPIF, 2008c)
- European fox is considered to be widespread and common (DPIF, 2007c)

Other introduced species that may occur in the Study Area (based upon desktop assessments, and excluding livestock) include the common myna (*Sturnus tristis*) and the house mouse (*Mus musculus)* – however, neither is declared under the LP Act.

The Isaac Regional Council (IRC) Draft Pest Management Plan (IRC, 2011) identifies the following vertebrate animals as priority species (for management):

- Dingo/wild dog
- Cat
- Pig
- Canefield rat (*Rattus sordidus*) – a native species that can occur at high densities
- European rabbit
- Deer - Chital (*Axis axis*) (LP Act Class 2 Declared Animal); fallow deer (*Dama dama*) (LP Act Class 3 Declared Animal); red deer (*Cervus elaphus*) (LP Act Class 3 Declared Animal); rusa (*Cervus timoriensis*) (LP Act Class 2 Declared Animal).

The dog, cat, pig and European rabbit were confirmed present during field studies. While considered a 'pest' species requiring management, the canefield rat is not an introduced species. It was not recorded during field studies, nor was it revealed as occurring/potentially occurring in the region surrounding the Study Area through desktop assessments. Based on current known distribution (DEEDI, 2008d), none of the four deer species listed as priority species for management are considered likely to occur at the Study Area.

2.6 Aquatic Habitats

2.6.1 Aquatic Habitats Types

The proposed Project (Rail) intersects major watercourses at 12 locations and minor watercourses at 76 locations. This includes the crossing of Eight Mile Creek (3rd order stream), North Creek (2nd order stream), Belyando River (8th order stream), Mistake Creek (6th order stream) Gowrie Creek (4th order stream), Logan Creek (5th order stream), Diamond Creek (3rd order stream) and Grosvenor Creek (3rd order stream).

Only some of these crossings and other aquatic habitats within the Study Area (for example farms dams and gilgais) were accessible during field surveys and hence desktop and catchment information has been considered in understanding the potential aquatic habitats available.

Aquatic habitats can generally be categorised into five broad waterbody types that vary in size and geomorphology, these being: lacustrine, palustrine, riverine, drainage lines and gilgais. Figure 2-3 shows the lacustrine, palustrine and riverine habitats across the Study Area and surrounding landscape according to DERM's waterbody mapping layer. Observations within aquatic habitats were made at five locations within and near the Study Area and the habitat features are described in Table 2-9.

2.6.1.1 Lacustrine Habitat

Lacustrine habitat describes wetland and deep water habitats located in a topographic depression or a damned river channel (i.e. a lake or pond with free water). They have vegetation (including trees, shrubs, persistent emergents, mosses or lichens) coverage less than 30 per cent (DERM, 2011a). Within the Study Area these habitats are most likely to be permanent farm dams or other isolated pools with limited aquatic vegetation.

2.6.1.2 Palustrine Habitat

Palustrine habitat describes waterbodies that are dominated by vegetation (including trees, shrubs, persistent emergents, mosses or lichens) (DERM, 2011b). Similar to lacustrine, palustrine habitat can also represented by dams with the difference being the greater presence of macrophytes or trees and shrubs (greater than 30 per cent cover) in palustrine habitat. Mapping (Figure 2-3) identifies this habitat category within the Study Area and wider landscape in areas occurring typically in association with watercourses.

2.6.1.3 Riverine Habitat

Riverine habitats are those with a formed channel that periodically or continuously contain flowing water (DERM, 2011b). The Belyando River and Mistake Creek in the west of the Study Area and Logan Creek and Diamond Creek in the east can be classified as riverine. There are a number of drainage lines that have established stream banks and a formed channel, however, these lines provide limited long term aquatic habitat. The Belyando River (8th order stream) represents the largest watercourse within the Study Area. It is a large, multi-channelled meandering river that originates in the Drummond Range, east of Alpha and flows north, through central Queensland and into the Burdekin Dam. Within the Study Area, the Belyando River has high ecological value and maintains aquatic habitat for flora and fauna throughout the year, even if in isolated pools.

2.6.1.4 Drainage Habitat

Drainage lines are narrow drainage paths (often 1st order streams or not mapped) and occur at the top of stream catchments and meander in other areas of the Study Area. These paths do not have defined banks; rather they can be identified by a change in substrate from the adjacent area. These lines provide a pathway for runoff during high volume downpours and are not expected to accommodate long term flows or isolated pools. There is likely to be very little erosion observed in these shallow profile drainage lines.

2.6.1.5 Gilgais

Gilgais are micro-relief land forms of mounds and depressions formed on shrink-swell and cracking clay soils where water can collect seasonally to form gilgai wetlands (DERM, 2011b). They are depressions in the landscape that can contain water and can attract a variety of reptiles, amphibians, birds, mammals and invertebrates (DERM, 2011b). Gilgais are likely to be distributed across the Study Area particularly in association with brigalow communities, and are likely to be ephemeral. Potential gilgais were detected where natural depressions occurred on clay and clay loam soils. No potential gilgais or depressions identified during the field surveys contained permanent water to support aquatic fauna.

Table 2-9 Aquatic Habitat Types

Site number and name	Habitat assessment summary	General description and habitat characteristics	Photo
Site 1 Belyando River	*Substrate:* 50 per cent sand/50 per cent gravel *Snags and woody debris:* logs and woody debris present providing instream structure. *Aquatic plants:* sedges and reeds present on edges. *Variety of habitat:* shallow, deep, pool, woody debris, rootballs. *Shading:* 60 per cent. *Disturbance:* minor areas experiencing trampling by cattle.	The Belyando River provides an example of a typical riverine habitat type. It is fringed on both sides by a riparian zone of mature eucalypt woodland with a grassy ground cover. The riparian zone provides shading of the water body and grassy ground cover stabilises the banks. No erosion was observed. Habitat features such as submerged woody debris and overhanging and trailing bank vegetation provide a variety of habitats for aquatic species. Large pools and long meandering slow flowing areas were observed during the May field visit. It is expected that this major watercourse provides important dry season refuge for aquatic and terrestrial fauna. The Belyando River experiences strong seasonal variation in flow and is expected to provide an important movement corridor for terrestrial fauna that are restricted to forest remnants.	 Source: GHD, May 2011

Site number and name	Habitat assessment summary	General description and habitat characteristics	Photo
Site 2 2nd order tributary of the Belyando River	*Substrate:* 40/30/30 per cent sand/clay/silt. Snags and woody debris: little fallen woody debris and few logs present. *Aquatic plants: none* *Variety* of habitat: shallow pools. Shading: 50 per cent. *Disturbance: pig* and cattle trampling evident.	The Belyando River tributary is an ephemeral second order stream that is fringed by mature eucalypts and gidgee. It is considered to be representative of riverine habitat. This creek consists of a series of narrow, 5 metre-wide channels that were turbid at the time of survey (May 2011). At the time of survey, this reach of watercourse had dried to a series of isolated pools. Riparian vegetation is likely to act as an important refuge and movement corridor for terrestrial fauna.	 Source: GHD, May 2011.
Site 3 Belyando River ox-bow	*Substrate:* 40/30/30 per cent sand/clay/silt Snags and woody debris: logs and large stags are present providing instream structure. *Aquatic plants: macrophytes (*lilies) and sedges are present near edges. Variety of habitat: shallow pool, woody debris. *Shading: 5* per cent. Disturbance: cattle and pig trampling is evident.	The Study Area intersects a large oxbow lake of the Belyando River. It is representative of lacustrine aquatic habitat. This aquatic system provides permanent habitat for aquatic species, including aquatic flora. The oxbow system contains many large stags and mature hollow-bearing eucalypts. These permanent water bodies are likely to have localised value for wetland birds, fish, turtles, crustaceans and macro-invertebrates.	 Source: GHD, May 2011.

Site number and name	Habitat assessment summary	General description and habitat characteristics	Photo
Site 4 Mistake Creek	*Substrate:* 50/50 per cent sand/silt *Snags and woody debris:* logs and woody debris present providing instream structure. Overhanging branches present. *Aquatic plants:* large sedges and reeds present on edges. *Variety of habitat:* shallow, deep, pool, woody debris, rootballs. *Shading:* 40 per cent. *Disturbance:* cattle trampling and weed invasion evident.	Mistake Creek is fringed on both sides by a riparian zone of mature eucalypt woodland with a grassy and weedy understorey. It is considered representative of riverine habitat. It experiences strong seasonal variation in flow. At the time of survey (September 2011), the creek was in a period of low flow typical of the dry season conditions. Water levels were reduced to winding slow-flowing runs and open pools. Erosion and undercutting of the banks was evident. Mistake Creek provides a dry season refuge for terrestrial fauna, a movement corridor for species that are restricted to forest remnants and wet season habitat for aquatic flora and fauna.	 Source: GHD, September 2011.

Site number and name	Habitat assessment summary	General description and habitat characteristics	Photo
Permanent dams	*Substrate:* 50/50 per cent sand/gravel. *Snags and woody debris:* none present. *Aquatic plants:* few lily pads observed. *Variety of habitat:* deep pool. *Shading:* None. *Disturbance:* Cattle and pig trampling and weed invasion evident.	Farm dams were observed throughout the Study Area, often devoid of remnant vegetation. Farm dams can be defined as lacustrine aquatic habitat. Dams represent permanent water sources and can contain suitable micro-habitat in the form of macrophyte beds and occasional woody debris. Farm dams have no natural connectivity to other water sources and there are very limited opportunities for recruitment and dispersal for fish species.	 Source: GHD, May 2011.

2.6.2 Aquatic Species

2.6.2.1 Overview

Identification of aquatic species with potential to use the aquatic habitats within or intersected by the Study Area is derived from desktop sources. Basin scale datasets identify species previously recorded in the Burdekin and Fitzroy catchments and subsets of these datasets specific to the Study have been queried.

The Burdekin Catchment covers 85 per cent of the Project (Rail) while the Fitzroy Basin Catchment covers a smaller component of the Project (Rail) (15 per cent) in the upper area of the catchment. Consequently, the information derived should be considered in the context of the relative Project (Rail) area within each catchment or basin.

2.6.2.2 Macrophytes and other aquatic-dependent flora

Aquatic-dependent flora includes both riparian and macrophyte species and are defined as: '*Those species that are adapted to and dependant on living and wet conditions for at least part of their lifecycle and found either within or immediately adjoining a non-riverine or riverine wetland'* (Inglis and Howell, 2009a and 2009b).

The Great Barrier Reef catchments Aquatic Conservation Assessments (ACA) (November 2011) for both riverine and non-riverine wetlands identify aquatic-dependent flora within the Burdekin and Fitzroy catchments are as follows:

- Burdekin Basin:
  - Riverine wetlands: 54 native species, 17 exotic species
  - Non-riverine wetlands: 128 native species, 16 exotic species (with some overlap of species between riverine and non-riverine wetlands)
- Fitzroy Basin:
  - Riverine wetlands: 168 native species, 88 exotic species
  - Non-riverine wetlands: 175 native species, 92 exotic species (with some overlap of species between riverine and non-riverine wetlands)

Within the Study Area, 26 of the aquatic dependent flora species have been previously recorded, as indicated by Wildlife Online and HERBRECS queries (Table 2-10). Majority of these species are listed as least concern under the NC Act and none are identified as conservation significant under the EPBC Act.

Table 2-10 Aquatic Dependant Flora Species with the Potential to Occur within the Study Area

Species name	Common Name	Desktop source	Type*	Burdekin Basin	Fitzroy Basin
Least Concern Species					
Acacia salicina	Sally wattle	Wildlife Online	R	✓	
Acacia stenophylla	belalie	Wildlife Online	R	✓	
Ammannia	jerry-jerry	Wildlife Online	M	✓	

Species name	Common Name	Desktop source	Type*	Burdekin Basin	Fitzroy Basin
multiflora					
Casuarina cunninghamiana	river oak	Wildlife Online	R		✓
Corymbia tessellaris	Moreton Bay ash	Wildlife Online	R		✓
Cyperus bifax	western nutgrass	HERBRECS	M		✓
Cyperus concinnus	trim flat-sedge	HERBRECS	M		✓
Cyperus exaltatus	giant sedge	HERBRECS	M		✓
Cyperus gilesii	Giles' flat-sedge	HERBRECS	M		✓
Cyperus isabellinus	umbrella-sedge	HERBRECS	M		✓
Cyanotis axillaris		Wildlife Online	M	✓	
Eleocharis pallens	pale spike rush	Wildlife Online, HERBRECS	M	✓	✓
Eucalyptus camaldulensis	river red gum	Wildlife Online, HERBRECS	R	✓	✓
Eucalyptus coolabah	coolabah	Wildlife Online	R	✓	
Fimbristylis aestivalis		Wildlife Online, HERBRECS	M	✓	✓
Ipomoea aquatica	water spinach	Wildlife Online, HERBRECS	M	✓	
Marsilea drummondii	common nardoo	Wildlife Online	M	✓	
Marsilea hirsuta	short-fruited nardoo	Wildlife Online	M	✓	
Melaleuca bracteata	black teatree	HERBRECS	R	✓	✓
Melaleuca linariifolia	river teatree	Wildlife Online	R	✓	
Melaleuca	river teatree	HERBRECS	R	✓	

Species name	Common Name	Desktop source	Type*	Burdekin Basin	Fitzroy Basin
trichostachya					
Muehlenbeckia florulenta	lignum	HERBRECS	R		✓
Nymphoides crenata	yellow-fringed waterflower	Wildlife Online, HERBRECS	M	✓	✓
Exotic Species					
Cardiospermum halicacabum var. halicacabum	balloon vine	HERBRECS	M	✓	
Parkinsonia aculeata	parkinsonia	HERBRECS	R	✓	
Xanthium occidentale	noogoora burr	HERBRECS	R		✓

*Type: M - Macrophye; R - Riparian

Field investigations at the nearby Project (Mine) site (refer Volume 4 Appendix O Aquatic Ecology Report) identified four macrophyte species at Cabbage Tree Creek and in one of the large farm dams (Swamp Tank):

- White smartweed (*Persicaria attenuata*)
- Swamp lily (*Ottelia ovalifolia*)
- Dirty dora (*Cyperus difformis*)
- Monochoria (*Monochoria cyanea*)

2.6.2.3 Fish

Desktop assessment identified 51 fish species known to occur within the Burdekin Basin and 47 within the Fitzroy Basin (DERM, 2011g; Carter and Tait, 2008). Forty of the identified species are common to both catchments.

Threatened species that have been previously recorded within the basins include:

- Australian lungfish (*Neoceratodus forsteri)* is listed as vulnerable under the EPBC Act. It has been recorded for both the Burdekin and the Fitzroy basins however the distribution of the species is restricted to south-eastern Queensland (DSEWPaC, 2011a) and not found within the Study Area. Furthermore, the only record of the species in the basins is from 1870 with no recent records (Wildlife Online).
- Murray cod (*Maccullochella peelii*) is listed as vulnerable under the EPBC Act. It has been previously recorded within the Fitzroy Basin (DERM 2011h) though there are no previous records of this species occurring in the Study Area.
- The freshwater sawfish (*Pristis microdon*) is listed as vulnerable under the EPBC Act and has historically been recorded in the Burdekin Catchment (Inglis and Howell, 2009). The species were

recorded within the search extent but is not considered likely to occur based on availability of suitable habitat. The freshwater sawfish occurs in the lower reaches of large river systems in areas of mud bottoms though it is occasionally found up to 400 km upstream (DSEWPaC, 2011a). Individuals are thought to move up stream after flooding (DSEWPaC, 2011a). The species is not found near riparian vegetation (DSEWPaC, 2011a). As a result of the Burdekin River barriers (the dam and weirs) it is considered unlikely that this species occurs within the Study Area and surrounds.

- Based on migration patterns, fish species can be classified as either diadromous or potamodromous. Diadromous fish species migrate between the marine and freshwater environment while potamodromous species move only within freshwater. For the Burdekin Basin, most, if not all, diadromous species are thought to be restricted to the lower Burdekin River sub-catchment (Pusey *et al*., 1998; Cater and Tait, 2008) as a result of a direct influence by both natural and artificial barriers to fish passage (Pusey *et al*., 1998). Fish community structure and distribution within the Burdekin River catchment has been directly influenced by the Burdekin Falls in the lower end of the catchment, historically acting as a natural barrier to fish passage and preventing the colonisation of upstream habitats by diadromous species. Artificial impoundments such as Burdekin Falls Dam and Clare Weir have further restricted the distribution of these species. The Burdekin Falls Dam has been in place since 1985 and diadromous species populations would not have been sustained since this barrier was installed given a lack of access to marine areas for lifecycle processes. The impact of raising the Burdekin Falls Dam on fish passage, however, may not be an issue, given that the Falls have historically been a barrier to fish movement. Potamodromous species are thought more likely to persist. As such, fish species found in the Burdekin Basin portion of the Study Area are likely to be potamodromous species.

Based on species distribution information, 17 of the freshwater fish species known from the Burdekin and Fitzroy basins have the potential to occur in waterways intersected by, or of relevance to, the Study Area (Carter and Tait 2008, Allen *et al* 2003). None of these species are listed under the EPBC Act or the NC Act. The species are listed in Table 2-11.

Field investigations at the nearby Mine Site for the Project (Mine) (refer Volume 4 Appendix O Aquatic Ecology Report) recorded eleven of the species detailed in Table 2-11.

. All are common freshwater species which have been previously recorded in the upper Burdekin Catchment. Agassiz's glassfish (*Ambassis agassizii*) and Midgley's carp gudgeon (*Hypseleotris species 1*) were the most commonly recorded species during Project (Mine) field surveys though were detected only at locations with macrophytes and no flow. Other species captured in the vicinity of the Mine Site included purple-spotted gudgeon (*Mogurnda adspersa*), sleepy cod (*Oxyeleotris lineolata*), eastern rainbowfish (*Melanotaenia splendida splendida*), Hyrtl's tandan (*Neosilurus hyrtlii*) and spangled perch (*Leiopotherapon unicolor*). These field investigation results may be considered representative of the fish communities in the Project (Rail) Study Area.

Pest Species

Desktop investigations recognised a number of introduced species that may occur in the Burdekin and Fitzroy basins (DERM 2011h, Carter and Tait 2008). The pest species with potential to occur include:

- Mozambique tilapia (*Oreochromis mossambicus*)

- Spotted tilapia (*Tilapia mariae*)
- Mosquitofish (*Gambusia holbrooki*)
- Guppy (*Poecilia reticulate*)
- Goldfish (*Carassius auratus*)

Field studies at the nearby Mine Site for the Project (Mine) did not detect any pest species (refer Volume 4 Appendix O Aquatic Ecology Report).

Table 2-11 Fish Species with the Potential to Occur within the Study Area

Family	Species	Distribution with respect to the Study Area	Habitat preferences	Movement behaviour	Environmental tolerance
Atherinidae	Fly-specked hardyhead (*Craterocephalus stercusmuscarum*)	Known to occur throughout the Burdekin and parts of the Fitzroy catchments, but is less common in turbid environments. Highly turbid waters were observed in the Carmichael and Belyando Rivers, in the vicinity of the Project (Rail), and flows to the Belyando River. Species is abundant in streams that are periodically disconnected during low flow. These are present within the Study Area (e.g. Mistake Creek) (Pusey *et al.*, 1998; Carter and Tait, 2008).	Occurs in a variety of habitats including flood plains, billabongs, brackish estuaries and impoundments. Prefers low flow environments which contain macrophyte beds and gravel substrates (Pusey *et al.*, 2004).	Potamodromous Undertakes local dispersal and colonisation movements (Pusey *et al.*, 2004).	Increasing water temperature and elevated flows are likely to stimulate movement (Pusey *et al.*, 2004).
Chandidae	Agassiz's glassfish (*Ambassis agassizii*)	Known to occur throughout the Burdekin Catchment (Carter and Tait, 2008) and Fitzroy Basin (Allen *et al.* 2003). It is relatively widespread in eastern Australian coastal and inland drainages (Pusey *et al.*, 2004). Recorded at the nearby Project (Mine) Mine site during field survey.	Well-vegetated areas in rivers, creeks, swamps and ponds, generally in areas of little or no flow. Utilises macrophyte and submerged marginal vegetation, which is preferred for spawning (Pusey *et al.*, 2004).	Potamodromous. Adults and juveniles move upstream (September-February) for habitat and dispersal, possibly in response to flooding (Pusey *et al.*, 2004).	Tolerant of a wide range of physicochemical conditions (temperature, dissolved oxygen, pH and salinity). Increases in water temperature and elevated flows are believed to be cues for movement (Pusey *et al.*, 2004).

Family	Species	Distribution with respect to the Study Area	Habitat preferences	Movement behaviour	Environmental tolerance
Clupeidae	Bony bream (*Nematalosa erebi*)	Known to occur throughout the Burdekin Catchment (Carter and Tait, 2008) and Fitzroy Basin (Allen *et al.* 2003). Species is widespread throughout Australia and found in most major Queensland basins (Pusey *et al.*, 2004).	Known from a wide variety of habitats including salt lakes, lagoons, floodplains and streams. Preference is for low or no flow environments (Pusey *et al.*, 2004).	Potamodromous. Adults and juveniles move upstream for dispersal.	Tolerant of a range of environmental conditions including high turbidity (records in the Belyando River of 581 nephelometric turbidity units (NTU) (Pusey *et al.*, 2004), though susceptible to low dissolved oxygen levels (Carter and Tait, 2008). Reductions in abundance observed in streams receiving mine effluents with elevated copper concentrations (Pusey *et al.*, 2004).
Eleotridae	Flathead gudgeon (*Philypnodon grandiceps*)	Recorded in the upper Burdekin River (Carter and Tait, 2008) and in some parts of the Fitzroy Basin (Allen *et al.,* 2003). Species occurs in coastal catchments from central Queensland to south-eastern Australia (Pusey *et al.*, 2004).	Prefers freshwater habitats (creeks, rivers, billabongs) with little or no flow, and underwater structure (vegetation, undercut banks, logs). Prefers areas with abundant cover. Rocks and woody debris are required for oviposition (egg-laying) (Pusey *et al.*, 2004).	Facultative potamodromous. A predominantly freshwater species where access to estuarine or marine environments is not an essential component of the life history. However known to move through systems, possibly in response to periods of peak flow (August to April) (Pusey *et al.*, 2004).	Species tolerant of a wide range of physicochemical conditions, including those associated with habitat degradation (Pusey *et al.,* 2004).

Family	Species	Distribution with respect to the Study Area	Habitat preferences	Movement behaviour	Environmental tolerance
Eleotridae	Midgley's carp gudgeon (*Hypseleotris species 1*)	Known to occur throughout the Burdekin Catchment (Carter and Tait, 2008) with a limited distribution in the Fitzroy Basin (Allen *et al.,* 2003). It is found in most coastal drainages of eastern Australia (Pusey *et al.*, 2004). Recorded at the nearby Project (Mine) Mine Site.	Species utilises macrophyte beds, detritus, root balls and undercut banks. Found in streams, creeks, swamps, wetlands and ponds. Hard surfaces near the substrate are preferred for oviposition (Pusey *et al.*, 2004).	Potamodromous. Undertakes local dispersal and colonisation movements. Spawning peaks between September and January (Pusey *et al.*, 2004).	Regarded as a hardy species that can tolerate poor water quality. The species has been collected in heavily degraded habitats. Increased water temperature and day length are suspected as cues for movement (Pusey *et al.*, 2004).
Eleotridae	Purple-spotted gudgeon (*Mogurnda adspersa*)	Widely distributed throughout the Burdekin Catchment (Carter and Tait, 2008) and Fitzroy Basin (Allen *et al.,* 2003). It occurs in most coastal drainages of eastern Australia from the Cape York Peninsula to northern New South Wales (Pusey *et al.*, 2004). Recorded at the Project (Mine) Mine Site.	Avoids areas of high water flow. Inhabits areas of aquatic vegetation in slow-flowing parts of rivers and streams, often where rocky substrate is present. Noted in still water bodies including billabongs. The species is highly dependent on bank-side structure. Aquatic macrophytes, rocks and woody debris required for oviposition (Pusey *et al.*, 2004).	Potamodromous. Increasing water temperature suspected as a cue for movement (Pusey *et al.*, 2004).	Species is known to occur over a relatively wide range of physicochemical conditions (Pusey *et al.*, 2004).

Family	Species	Distribution with respect to the Study Area	Habitat preferences	Movement behaviour	Environmental tolerance
Eleotridae	Sleepy cod (*Oxyeleotris lineolata*)	Occurs widely in northern Australia including easterly flowing rivers of Queensland (Pusey *et al.*, 2004). Limited to a coastal distribution in the Fitzroy catchment (Allen *et al.,* 2003). Species has been translocated above Burdekin Falls and is now widely distributed in the upper catchment (Carter and Tait, 2008). Recorded at the Project (Mine) Mine Site.	Slow-flowing water amongst submerged structures (vegetation, timber) in rivers, creeks, floodplains, lagoons and billabongs. Large woody debris is a key requirement for spawning and general cover (Pusey *et al.*, 2004).	Potamodromous. Does not make substantial migrations (Pusey *et al.*, 2004).	Tolerant of turbid conditions. Known from muddy lagoons with mud substrate. Species is not a powerful swimmer and is considered to be a still/slow flow species. Tolerant of hypoxia in still pools. Not tolerant of saline conditions and can only survive in freshwater (Pusey *et al.*, 2004).
Eleotridae	Western carp gudgeon (*Hypseleotris klunzingeri*)	Known to occur throughout the Burdekin Catchment (Carter and Tait, 2008), southern extent of the Fitzroy Basin (Allen *et al.,* 2003) and in coastal drainages south to central New South Wales (Pusey *et al.*, 2004). The northern extent of the distribution is uncertain and records in the Burdekin River may be mis-identifications or translocations (Pusey *et al.*, 2004).	Inhabits aquatic vegetation in slow-flowing parts of rivers and streams, as well as still water bodies such as lakes and impoundments. Aquatic macrophytes, submerged marginal vegetation and woody debris may be important for oviposition (Pusey *et al.*, 2004).	Potamodromous. May move upstream to spawn during the wet season.	Tolerant of a wide range of physicochemical conditions (Pusey *et al.*, 2004).

Family	Species	Distribution with respect to the Study Area	Habitat preferences	Movement behaviour	Environmental tolerance
Melanotaeniidae	Eastern rainbowfish (*Melanotaenia splendida splendida*)	Known to occur throughout the Burdekin Catchment (Carter and Tait, 2008), northern region of the Fitzroy Basin (Allen *et al.,* 2003) and the east coast of Queensland (Pusey *et al.*, 2004). Recorded in the nearby Project (Mine) Mine Site area.	A habitat generalist that occurs in a wide array of still to slow-flowing freshwater habitats. This includes creeks, swamps, wetlands, rivers and impoundments (Allen *et al.*, 2003) Aquatic vegetation and root masses preferred for oviposition (Pusey *et al.*, 2004).	Potamodromous. Rising flows and increasing water temperature are suspected as cues for movement.	Tolerant of a large range of water quality conditions (Pusey *et al.*, 2004).
Percichthyidae	Golden perch[1] (*Macquaria ambigua*)	Deliberately and accidentally translocated into the Burdekin Catchment (Carter and Tait, 2008) and has been widely translocated into eastern Australian rivers (Pusey *et al.*, 2004). Also found in some regions of the Fitzroy catchment (Allen *et al.,* 2003).	Inhabits rivers, creeks, billabongs and lakes. Favours deeper, slow-flowing, turbid habitats with an abundance of in-stream debris and shade (Pusey *et al.*, 2004).	Potamodromous. Movement recorded in the Fitzroy River (through the Fitzroy Barrage) during spring and summer months (Pusey *et al.*, 2004). Spawning and recruitment triggered by increased flows and water temperatures above 23° C (Pusey *et al.*, 2004).	Tolerant of a wide range of temperatures and low oxygen levels. Can move between freshwater and saline environments. Tolerant to high turbidity levels.

Family	Species	Distribution with respect to the Study Area	Habitat preferences	Movement behaviour	Environmental tolerance
Plotosidae	Black catfish (*Neosilurus ater*)	Widespread and abundant throughout the Burdekin Catchment (Carter and Tait, 2008). Species also occurs in the Fitzroy catchment (Allen *et al.,* 2003) and across northern Australia (Pusey *et al*., 2004).	A benthic species that prefers still/slow flowing waters in streams, rivers, wetlands, pools, slow-flowing tributaries and side-channels of rivers (Allen *et al*., 2003). Can occur in intermittent tributary streams as well as large rivers.	Potamodromous. Migrations upstream thought to coincide with spawning at the outset of the wet season (January-February). Rising flows are suspected as cues for spawning (Pusey *et al*., 2004).	Adapted to forage in elevated turbidity and low light conditions (Pusey *et al*., 2004).
Plotosidae	Hyrtl's tandan (*Neosilurus hyrtlii*)	Widely distributed across the Burdekin and Fitzroy Catchments (Carter and Tait, 2008; Allen *et al.,* 2003) and also Australia (Pusey *et al*., 2004). Recorded in the nearby Project (Mine) Mine Site area.	A benthic species that occurs in most freshwater habitats above estuarine reaches. Tributary streams and gravel substrates may be important for spawning (Pusey *et al*., 2004).	Potamodromous. Upstream migrations from dry season refugia thought to coincide with spawning (Pusey *et al*., 2004). Rising flows suspected as cue for movement (Pusey *et al*., 2004).	Barbels allow the species to forage in elevated turbidity and low light conditions.
Plotosidae	Rendahl's catfish (*Porochilus rendahli*)	Widely distributed throughout the Burdekin Catchment (Carter and Tait, 2008), some parts of the Fitzroy Catchment (Allen *et al.,* 2003) and patchily across northern Australia ((Pusey *et al*., 2004).	A benthic species inhabiting river channels and tributaries generally containing muddy substrate ((Pusey *et al*., 2004).	Potamodromous. Adults migrate downstream to spawn in flooded lowland lagoons (Pusey *et al*., 2004).	Like other species of catfish, the species can tolerate highly turbid water. Well-developed tolerance to hypoxia (Pusey *et al*., 2004).

Family	Species	Distribution with respect to the Study Area	Habitat preferences	Movement behaviour	Environmental tolerance
Plotosidae	Soft-spined catfish[1] *Neosilurus mollespiculum*	Endemic to the Burdekin Catchment with a patchy distribution. Reported in the Belyando River subcatchment (Carter and Tait, 2008)	Rocky pools of large creek and main rivers' channels (Allen *et al.*, 2003).	Potamodromous Very little known (Pusey *et al.*, 2004).	Limited data. Recorded in freshwater only. Observed in both clear waters and areas with high sediment load (Pusey *et al.*, 2004).
Terapontidae	Small-headed grunter[1] (*Scortum parviceps*)	Endemic to the Burdekin Catchment though patchily distributed (Carter and Tait, 2008). Most common in the main channel of the Burdekin River and larger south-west tributaries (Pusey *et al.*, 2004).	Most common in riverine reaches. Thought to prefer deep (>1 m) habitats with a sand, fine gravel substrate and little or no flow (Pusey *et al.*, 2004).	Potamodromous. Movement patterns relatively unknown, however upstream migration prior to spawning is predicted (Pusey *et al.*, 2004).	Recorded in freshwater only and unlikely to tolerate elevated salinity. Tolerant of high turbidity levels (Pusey *et al.*, 2004).
Terapontidae	Spangled perch (*Leiopotherapon unicolor*)	Widely distributed throughout the Burdekin and Fitzroy Catchments (Carter and Tait, 2008; Allen *et al.,* 2003) and Australia (Pusey *et al.*, 2004). Recorded in the nearby Project (Mine) Mine Site area.	A generalist species that occurs in most permanent and temporary freshwater habitats including billabongs, bores, impoundments, rivers and streams (Allen *et al.*, 2003).	Potamodromous. Depending on locality, it moves upstream or downstream within the freshwater environment to spawn. Spawning migrations coincide with the wet season (October – April). This species may also undertake substantial movements away from dry season habitats as they recede (Pusey *et al.*, 2004).	Highly tolerant of environmental variability. Can tolerant saline conditions but rarely encountered in estuarine areas. Rising flows and increasing water temperature are suspected as cues for movement (Pusey *et al.*, 2004).

Family	Species	Distribution with respect to the Study Area	Habitat preferences	Movement behaviour	Environmental tolerance
Toxotidae	Seven-spot archerfish (*Toxotes chatareus*)	Widely distributed in the Burdekin River (Carter and Tait, 2008) and also northern Australia (Pusey *et al.*, 2004). Current known distribution does not include the Fitzroy Catchment (Allen *et al.,* 2003) so unlikely to occur.	Inhabits large, low gradient rivers. Not believed to frequent fast-flowing streams. Heavily reliant on intact riparian zones. Waterways associated with degraded riparian systems contain very few individuals. Juveniles observed in macrophyte beds (Pusey *et al.*, 2004).	Potamodromous. Disperses widely during the wet season. Does not require access to estuarine or marine environment at any stage of its life cycle. However barriers to movement expected to have negative impact (reduced food dispersal and passive transport of juveniles downstream) on species (Pusey *et al.*, 2004).	This species is a visual predator that has a low tolerance to turbidity. Slight increases in turbidity can cause reduction in species abundance. Tolerant of a wide range of temperatures and dissolved oxygen levels (Pusey *et al.*, 2004).

[1] endemic species; [2] translocated species

2.6.2.4 Reptiles

Nine aquatic reptiles, listed in Table 2-12, are known to inhabit the Burdekin and Fitzroy basins (DERM 2011g). Eight of these are freshwater turtle species, the remaining species is the estuarine crocodile (*Crocodylus porosus*). No aquatic reptiles have been previously recorded in the Study Area.

Table 2-12 Freshwater Reptiles Previously Recorded in the Burdekin and Fitzroy Basins (DERM, 2011h)

Scientific name	Common name	NC Act	EPBC Act	Endemicity	Burdekin basin	Fitzroy basin
Chelodina canni	Cann's longneck turtle	LC		Queensland and interstate	✓	
Chelodina expansa	broad-shelled river turtle	LC		Queensland and interstate		✓
Chelodina longicollis	Eastern snake-necked turtle	LC		Queensland and interstate	✓	✓
Elseya albagula	white-throated (prev. Southern) snapping turtle	LC		Queensland		✓
Elseya irwini	Irwin's turtle	LC		Queensland	✓	
Emydura macquarii krefftii	Krefft's river turtle	LC		Queensland and interstate	✓	✓
Rheodytes leukops	Fitzroy River turtle	V	V	Queensland		✓
Wollumbinia latisternum	saw-shelled turtle	LC		Queensland and interstate	✓	✓
Crocodylus porosus	estuarine crocodile	V	Marine / migratory	Not endemic to Australia	✓	✓

The Fitzroy River turtle (*Rheodytes leukops*) is listed as vulnerable under the EPBC Act and the NC Act. This species is endemic to the natural permanent riverine habitats of the Fitzroy River catchment (e.g. Fitzroy, Mackenzie and Dawson Rivers) hence the potential suitable habitat occurs only within the Fitzroy Basin portion of the Study Area. Preferred habitats include downstream from riffles, where the water is well oxygenated, as well as areas with an abundance of submerged logs, undercut banks and tree trunks (Cann, 2008). There are no records of its occurrence in the Study Area and it is considered not likely to occur.

The estuarine crocodile (*Crocodylus porosus*) is listed as vulnerable under the NC Act, and marine/migratory under the EPBC Act. The species occurs within the lower reaches of both the

Burdekin and Fitzroy basins. The estuarine crocodile has only been recorded below the Burdekin Dam and as such is not considered likely to be found in the Study Area.

The turtle species of the Burdekin catchment inhabit a variety of habitats ranging from ephemeral waterholes and pools to structurally complex rivers and creeks. None of these species are listed as conservation significant.

Irwin's turtle is endemic to the Burdekin Catchment and has been listed as a high priority for conservation under the DEHP 'Back on Track' prioritisation framework for conservation management of Queensland's wildlife. 'Back on Track' species are discussed in further detail in Section 3.4.2. Irwin's turtle generally prefers sandy riverine habitats with an abundance of macrophytes and in-stream debris (Cann, 1998; Cann, 2008). The species is likely to be primarily restricted to the Bowen and, potentially, the Bogie Rivers. These rivers are not traversed by the Project (Rail) and it is not considered likely that Irwin's turtle occurs in the Study Area.

Cann's longneck turtle and the Eastern snake-necked turtle are primarily encountered in off-stream habitat such as lagoons, billabongs and swamps (Cann, 2008). Farm dams and still water bodies (such as those developed during periods of low flow) in the Study Area may provide suitable habitat for this species. Gilgais are expected to occur across the Study Area and may provide temporary habitat for the Cann's long-necked turtle and eastern snake-necked turtle.

The broad-shelled river turtle favours lagoons, lakes, rivers and swamps (Wilson, 2009). Its distribution extends into the lower and middle reaches of the Fitzroy catchment (Wilson, 2009). Approximately 15 per cent of the Study Area is located within the upper Fitzroy Basin are considered to be at the edge of this species' range. Riverine areas within the Fitzroy basin portion of the Study Area may provide suitable habitat for this species.

The white-throated snapping turtle is widely distributed in suitable habitat within river systems showing a preference for sheltering under log tangles and shaded sections with over-hanging trees, in flowing habitats (Cann, 2008). This species is endemic to the Fitzroy River, Burnett River and Mary River catchments (Hamann *et al.,* 2007). The Study Area is on the outer edges of the species distribution and it is not considered likely that suitable habitat exists with the Study Area to support this species.

Krefft's River turtle is a generalist species occurring in most freshwater habitats, including rivers, creeks, swamps, lagoons, lakes and dams (Wilson, 2009). It is widespread and abundant across most of the Burdekin Catchment and Fitzroy Basin (Cann, 2008). Most riverine environments in the Study Area are potentially suitable for this species.

The saw-shelled turtle is commonly observed in upstream water courses as well as lagoons and billabongs that support abundant in-stream habitat (Cann, 1998). It is known to occur in both the Burdekin River and the Fitzroy River catchments (Cann, 2008). Habitats displaying these characteristics within the Study Area have the potential to provide habitat for the species.

2.6.2.5 Mammals

The Burdekin and Fitzroy Catchments occur within the known distribution of the platypus (*Ornithorhynchus anatinus*) (Van Dyck, 2008; DERM 2011g). Platypus is listed as 'special least concern' wildlife under the NC Act.

Platypus inhabits freshwater environments, with a preference for areas that have steep, well vegetated banks. The species is territorial and occupies small home ranges up to several kilometres in length. Individuals also have a limited ability to travel overland (Grant and Temple-Smith, 1998). The species requires permanently inundated waterbodies that support resources necessary for burrowing (i.e. earthen banks consolidated by the roots of riparian vegetation, overhanging vegetation, undercut banks (Grant and Temple-Smith, 1998)). Platypus is unlikely to occur within the Study Area. Although the Carmichael River and other ephemeral watercourses may contain suitable habitat for foraging purposes (ephemeral rivers and creeks), these habitats must be located adjacent to permanent waterbodies that have suitable stream bank characteristics. This combination of habitat features was not observed within the Study Area.

Further, the species has not been recorded within a 50 km buffer of the Study Area. It is not considered likely that suitable habitat exists within the Study area to support platypus.

2.6.2.6 Invertebrates

The redclaw crayfish (*Cherax quadricarinatus*) is known to occur in the Fitzroy Basin area (DERM, 2011g). Redclaw crayfish are not considered threatened under state or federal legislation. This species is endemic to Australia, occurring in Queensland and interstate.

Field investigations at the nearby Project (Mine) site (refer Volume 2 Section 5.2) detected redclaw crayfish in riverine and palustrine habitats. Redclaw crayfish are tolerant of a wide variety of habitats and conditions, and is also likely to be present in man-made waterbodies such as dams (Jones and Morgan 2007). The species has the potential to occur in the Study Area.

The species detected have habitat preferences that include aquatic vegetation, woody debris, root balls and detritus, which were characteristics more prevalent on the Carmichael River compared to watercourses within the Study Area, where a greater diversity was detected. While these habitat preferences are displayed in the Carmichael River, they are not as extensive as compared to the dominant sandy bed and bank habitat.

2.6.2.7 Macroinvertebrates

Macroinvertebrate sampling was undertaken at the Carmichael River and along Cabbage Tree Cree at the nearby Project (Mine) site (refer Volume 2 Section 2.3). A total of 230 individuals were collected from 41 families of aquatic macroinvertebrates across the five sites sampled. The highly variable and unpredictable environmental conditions of the river systems represented in the Burdekin Catchment are reflective of the relatively low macroinvertebrate diversity and community composition (Parsons Brinkerhoff, 2009).

The species detected at the Project (Mine) site have habitat preferences that include aquatic vegetation, woody debris, root balls and detritus, which were characteristics more prevalent on the Carmichael River where a greater diversity was detected. However, a uniform sandy substrate, as detected in the Carmichael River, is expected to substantially influence the low macroinvertebrate community diversity across the Project (Mine) site.

The habitat preferences that were detected during macroinvertebrate sampling for the Project (Mine) are likely to be detected for the Project (Rail) site. Aquatic habitat diversity varied across the Project (Rail) site. Table 2-9 summarises the aquatic habitat values at assessment sites across the Project (Rail) site. It is likely that given the preferences observed for the Project (Mine) sites, the diversity of

macroinvertebrates will be low. The exception may be the Belyando River oxbow (Site 3) which offers a diverse range of micro habitats including stags, woody debris and macrophytes.

2.7 Threatening Processes

The landscape in which the Study Area occurs has undergone extensive clearing, and continues to experience a diverse array of threatening processes. Sattler and Williams (1999) identified the major threats to biodiversity in the Brigalow Belt bioregion as continued vegetation clearing, high total grazing pressure and invasion of exotic species. Similar major threats to the Desert Uplands Bioregion have also been identified with the differences being unsustainable total grazing pressure and increasing tree clearing/pasture development.

Other threatening processes occurring in both bioregions include:

- Landscape fragmentation
- Changed fire regimes
- Changed hydrology (of waterways)
- Salinity
- Pathogens
- Firewood collection (DSEWPaC, 2009d; DSEWPaC, 2009e)

The Burdekin and Fitzroy Back on Track reports (DERM, 2010a and b) detail a variety of threatening processes impacting upon priority taxa in the region. These are largely analogous to those mentioned above, and include:

- Feral animals
- Inappropriate grazing regimes
- Drainage of habitat
- Ground water extraction
- Weeds
- Altered flow regimes
- Vegetation clearing
- Site/road maintenance
- Mining
- Urban development
- Baiting
- Disease
- Road kill

Within the Study Area, the historic and currently occurring threatening processes are largely linked to the vast areas of agricultural and pastoral land use. Historic vegetation clearing has occurred over much of the Study Area, resulting in loss of habitat, landscape fragmentation and, potentially, direct mortality of flora and fauna. Other threatening processes such as habitat degradation of riparian

habitat areas through cattle trampling and subsequent erosion and sedimentation was evident in localised areas throughout the Study Area. Feral animals and weeds were also recorded across the Study Area.

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3. Conservation Significant Terrestrial and Aquatic Ecological Values

3.1 Overview

Conservation significant areas and species occurring within or of relevance to the Study Area include those classified as having Commonwealth, State and/or regional biodiversity significance. The conservation significant terrestrial and aquatic ecological values identified during desktop and field investigations of the Study Area are summarised in Table 3-1 and discussed in detail in this section.

Table 3-1 Summary of Conservation Significant Terrestrial Ecological Values

Significance classification	Summary	Section discussed
Commonwealth		
Commonwealth EPBC Act – matters of NES (controlling provisions based on referral of Project (EPBC 2010/5736))		
World Heritage properties (section 12 & 15A)	No World Heritage properties within or of relevance to Study Area	Section 3.2.1
National Heritage places (section 15B & 15C)	No National Heritage Places within or of relevance to Study Area	Section 3.2.2
Wetlands (Ramsar) (section 16 & 17B)	No Wetlands of International Significance within or of relevance to Study Area	Section 4
Listed threatened species and communities (sections 18 & 18a)	No EPBC Act-listed threatened flora species recorded during field surveys in Study Area (four predicted to occur based on desktop study)	Section 3.2.4 (threatened species)
	One EPBC Act-listed threatened fauna species (squatter pigeon (southern)) recorded during field surveys in Study Area; a further 12 were predicted to occur based on desktop study.	Section 4 (TECs)
	Two EPBC Act-listed TECs recorded during field surveys in Study Area (One of these TECs, the Natural grasslands of the Queensland Central Highlands and the northern Fitzroy Basin TEC, requires survey in the wet season to confirm its presence) (Three TECs were predicted to occur)	
Listed migratory species (section 20 & 20A)	Two EPBC Act-listed migratory species recorded during field surveys in Study Area (a further nine predicted to occur based on desktop study)	Section 3.2.6
Great Barrier Reef Marine Park (section 24B & 24C)	Not applicable to Study Area	Section 3.2.7

Significance classification	Summary	Section discussed
Other Commonwealth matters		
Places on the Register of the National Estate	Two Places on the Register of the National Estate occur within 50 km of the study area: ◗ Epping Forest National Park ◗ Wilandspey Conservation Park	Section 3.2.8
Listed marine Species	11 EPBC Act-listed marine species recorded during field surveys in Study Area including two birds also listed as migratory under the EPBC Act (a further 11 marine birds predicted to occur based on desktop study)	Section 3.2.8
State		
Queensland VM Act		
Regional Ecosystems	Approximately 8652 ha of REs occur in Study Area, of which 367 ha occur in the rail corridor and infrastructure and construction camp footprints (based on RE mapping), comprising: ◗ 37 ha of endangered REs ◗ 201 ha of concern REs ◗ 129 ha of least concern REs	Section 3.3.1
Regrowth vegetation	Approximately 396 ha of mapped regrowth vegetation occurs in the Study Area, of which 19.7 ha occur in the rail corridor and infrastructure and construction camp footprints	Section 3.3.2
Essential habitat	No Essential Habitat occurs within the Study Area	Section 3.3.3
Queensland NC Act		
Threatened flora species	No NC Act-listed threatened flora species recorded during field surveys in Study Area (eight predicted to occur based on desktop study)	Section 3.3.4.1
Threatened fauna species	Two NC Act-listed threatened fauna species were recorded during field surveys in the Study Area (little pied bat and squatter pigeon (southern)). A further 11 NC Act-listed threatened fauna species were predicted to occur.	Section 3.3.4

Significance classification	Summary	Section discussed
Protected areas	No protected areas occur within the Project (Rail) or Study Area. Eleven protected areas occur within 50 km of the Study Area: ◗ Nairana National Park ◗ Doongmabulla Mound Springs Nature Reserve ◗ Wilandspey Conservation (formerly Environmental) Park ◗ Bygana West Nature Refuge ◗ Bygana Nature Refuge ◗ Nibbereena Creek Nature Refuge ◗ Eaglefield Creek Nature Refuge ◗ Mazeppa National Park ◗ Blackwood National Park ◗ East Top Nature Refuge ◗ Epping Forest National Park (scientific)	Section 3.3.6
Great Barrier Reef Wetland Protection Areas	There are no Westland Protection Areas within the Study Area or Project (Rail) corridor. A total of 107 Wetland Protection Areas, totalling an area of approximately 3176 ha, occur within 50 km of the rail and infrastructure corridor.	Section 3.3.5
Queensland Fish Habitat Areas	No Queensland Fish Habitat Areas occur within 50 km of the Study Area.	
Regional		
Biodiversity Planning Assessment	Summary of BPA mapping – landscape scale ecological values: ◗ Criterion B2: Ecosystem value at regional scale ◗ Criterion F: Ecosystem diversity ◗ Criterion G: Context and connection	Section 3.4.1
Burdekin and Fitzroy Natural Resource Management (NRM) Region Back on Track Actions for Biodiversity reports priority taxa	Burdekin: Report identifies priority vertebrate fauna taxa for the Burdekin NRM region, including: ◗ Two plants ◗ Eight vertebrate fauna Fitzroy: Report identifies priority vertebrate fauna taxa for the Fitzroy NRM region, including: ◗ Three plants ◗ Five vertebrate fauna	Section 3.4.2

3.2 Commonwealth Matters of National Environmental Significance

3.2.1 World Heritage Properties

World heritage properties are identified as a controlling provision for the Project under the EPBC Act. The two closest world heritage properties to the Study Area are the Great Barrier Reef World Heritage Area and the Wet Tropics World Heritage Area (refer Volume 1 Section 12 Matters of National Environmental Significance Report).

The eastern extent of the Study Area is located approximately 150 km due west and approximately 320 km upstream of the Great Barrier Reef World Heritage Area. The Study Area falls within two river catchments that drain to the Great Barrier Reef, the Fitzroy Basin Catchment and the Burdekin Catchment. Only a small portion, approximately 15 per cent, of the Study Area falls into the Fitzroy Basin. The remaining 85 per cent of the Study Area is located within the Burdekin Catchment, specifically the Belyando/Suttor subcatchment.

Activities associated with the Project (Rail) have the potential to impact upon the water quality of streams intersected by and downstream of the project (Rail). A variety of management and mitigation measures are proposed to address this (Section 5 and Section 6). Adopting these controlling measures it is predicted that there will not be a substantial change in water quality downstream of the site that could adversely impact on the values for which the reef is recognised. Although aquatic habitat will be lost none of the site habitats are important for species important to the values of the Great Barrier Reef World Heritage Area. No onsite habitat impacts are expected to detrimentally affect the values for which the Great Barrier Reef is recognised. No impacts associated with the Project (Rail) are expected to result in a substantial and measurable change in the hydrological regime of the Great Barrier Reef World Heritage Area waters and, therefore, no effects on the Marine Park are predicted either. The distance from the protected area and barriers (dam etc.) would impede site conditions from having an influence, directly or indirectly, on the protected values of the Great Barrier Reef World Heritage Area or Marine Park.

The Study Area is located approximately 272 km south of the Wet Tropics World Heritage Area.

Volume 4, Appendix J provides a detailed description on matters of NES.

3.2.2 National Heritage Places

National Heritage Places are identified as a controlling provision for the Project under the EPBC Act. In addition to the World Heritage Places, which are also listed as National Heritage Places, one other place of national heritage significance is identified.

Aside from the Great Barrier Reef, which is also listed under National Heritage (see above), the Tree of Knowledge and curtilage at Barcaldine is the closest National Heritage Place to the Study Area. It is located approximately 200 km south-west of the western extent of the Study Area (refer Volume 1 Section 12 Matters of National Environmental Significance).

3.2.3 Ramsar Wetlands

There are no Ramsar wetlands within or near the Study Area.

The closest wetland of international importance (Ramsar Wetland) is the Bowling Green Bay wetland, approximately 208 km north of the Study Area.

3.2.4 Listed Threatened Species

3.2.4.1 Listed Threatened Flora

A likelihood of occurrence assessment for EPBC Act listed threatened flora species (previously recorded, predicted to occur and as referenced in the ToR) was undertaken in accordance with the definitions outlined in Section 1.4.4. The outcomes of this assessment are presented in Table 3-2and discussed further below.

Table 3-2 Commonwealth Listed Threatened Flora Species – Likelihood of Occurrence

Species	EPBC Act/NC Act status	Predicted to occur#	Previously recorded*	Recorded at study site	Habitat preferences and known distribution	Likelihood of occurrence
Acacia deuteroneura	vulnerable / vulnerable	x	x	x	This taxon is only known from two locations: one 64 km north-north-east of Tambo in central western Queensland, growing on a knoll of weathered sandstone with *Eucalyptus bakeri* (Maslin, 2001) and the other 10 km east of Malta Station on Savaltor Rosa – Tambo Road. Both locations are mapped as RE 11.10.9 which does not occur in the Study Area. Closest known location is >230 km south of the Study Area (HERBRECS, 2011).	Not previously recorded in region and current known distribution does not incorporate Study Area **Unlikely to occur**
Acacia ramiflora	vulnerable / not listed	✓	Galilee Coal Project EIS (Waratah, 2011)	x	This species is known from the Mitchell, South and North Kennedy districts and grows in woodland on sandstone hills (Pedley 1978, 1987). A previous collection of the species from Hughendon in Queensland records it growing in pebbly red earth in low open woodland of *Eucalyptus whitei* and *Triodia* sp. (DSEWPaC, 2011b). Closest known location is 43 km to the north-east of the Study Area (Waratah, 2011). Suitable habitat is present within the Study Area (in particular, REs 11.10.3, 11.9.10 and possibly 11.5.9c).	Predicted to occur in the region (i.e. desktop search area) Potentially suitable habitat occurs at Study Area **May occur**

Species	EPBC Act/NC Act status	Predicted to occur#	Previously recorded*	Recorded at study site	Habitat preferences and known distribution	Likelihood of occurrence
black ironbox *Eucalyptus raveretiana*	vulnerable / vulnerable	x	Galilee Coal Project EIS (Waratah, 2011) Alpha Coal Project EIS (Hancock Prospecting Pty Ltd, 2010)	x	Occurs in riparian woodlands on alluvial flats along creek and river banks on sandy or alluvial soils (Calvert *et al.,* 2005). Closest known location is approximately 200 km to the north of the Study Area (Waratah, 2011).	Although previously recorded in the broad region the current known distribution does not incorporate the Study Area. No suitable habitat for the species is present in the Study Area **Unlikely to occur**
finger panic grass *Digitaria porrecta*	endangered / near threatened	✓	x	x	Usually occurring in natural grasslands on extensive basaltic plains, undulating woodlands and open forests with an underlying basaltic geology. Within these habitat types this species usually occurs on dark and fine textured soils with some degree of seasonal cracking (Leigh *et al.,* 1984; Fletcher 2001; Halford, 1995a). Common communities with which the taxon is known to occur include hills and sloped dominated by *Eucalyptus orgadophila* and drainage lines dominated by *E. tereticornis and E. populnea*.	Current known distribution does not incorporate Study Area No suitable habitat occurs in the Study Area **Unlikely to occur**

Species	EPBC Act/NC Act status	Predicted to occur#	Previously recorded*	Recorded at study site	Habitat preferences and known distribution	Likelihood of occurrence
king blue-grass *Dichanthium queenslandicum*	vulnerable / vulnerable	✓	x	x	Typically confined to the natural grasslands on the heavy black clay soils of the Central Highlands (Fletcher, 2001). HERBRECS (2011) data identifies that the closest known population is >130 km south-east of the Study Area. Potential suitable habitat is present within the Study Area within the mapped REs comprising the Natural Grassland TEC, REs 11.4.4 and 11.4.11.	Predicted to occur in the region (i.e. desktop search area) Potentially suitable habitat occurs at Study Area **May occur**
Marlborough blue cycad *Cycas ophiolitica*	endangered / endangered	x	x	x	*Cycas ophiolitica* inhabits eucalypt open forest and woodland communities with a grassy understorey. They occur on hill tops or steep slopes, at altitudes of 80-620 m above sea level. It grows on shallow, stony, red clay loams or sandy soils, usually derived from serpentinite (Halford, 1995b). Closest known location is over 350 km to the east-south-east of the Study Area (IBIS, 2011).	Not previously recorded in region and current known distribution does not incorporate Study Area **Unlikely to occur**
northern beard heath *Leucopogon cuspidatus*	vulnerable / not listed	x	x	x	Usually occurs on mountain tops on poor skeletal soils, amongst granite or serpentinite outcrops in stunted open woodlands or shrublands (Calvert *et al.,* 2005). Closest known population is >190 km north-west and east of the Study Area (HERBRECS, 2011).	Not previously recorded in region and current known distribution does not incorporate Study Area. **Unlikely to occur**

Species	EPBC Act/NC Act status	Predicted to occur#	Previously recorded*	Recorded at study site	Habitat preferences and known distribution	Likelihood of occurrence
Ozothamnus eriocephalus	vulnerable / vulnerable	x	x	x	This species typically grows on rocky escarpments, slopes and creek gullies in closed rainforest margins and open eucalypt forest (HERBRECS, 2011) Closest known population is >200 km north-east of the Study Area (HERBRECS, 2011).	Not previously recorded in region and required habitat not present in Study Area, **Unlikely to occur**

Predicted to occur within approximately 10 km of Study Area: DSEWPaC Protected Matters Search Tool

* Previously recorded within approximately 10 -50 km of Study Area: desktop sources including Wildlife Online / HERBRECS, EIS documents for projects in the region including Hancock Prospecting Pty Ltd (2010) and Waratah Coal (2011)

The desktop assessment indicated that three EPBC Act listed threatened flora species have been previously recorded or are predicted to occur within the desktop search extent encompassing the Study Area and the broader Project region (Appendix C). This includes three EPBC Act listed threatened flora species, listed in the Project terms of reference for consideration in this assessment.

A further five EPBC Act listed threatened flora species were identified in the Project terms of reference for consideration in this assessment. None of these species were identified through the desktop assessment (i.e. predicted to occur or previously recorded in the region), nor were any confirmed present during field investigations.

One of these five species, black ironbox, has been identified as being present in the broader region (Waratah, 2011; Hancock Prospecting Pty Ltd, 2010). However, black ironbox is not considered likely to occur within the Study Area of the Project (Rail) as the eastern extent of Study Area falls approximately 100 km to west of the edge of the species' known distribution.

Listed Threatened Flora – May Occur

The likelihood of occurrence assessment indicated that the following EPBC Act-listed threatened flora species may occur at the Study Area, based on distribution and/or presence of potentially suitable habitat:

- *Acacia ramiflora*
- King blue-grass

These species were not recorded during field surveys undertaken in the Study Area. Both species may occur based on their known geographic distribution and the presence of suitable habitat:

- *Acacia ramiflora* - Areas of RE on land zones consisting of sedimentary rock particularly land zone 10, sandstone ranges, and also land zones 9 and 5, undulating country on fine grained sedimentary rock and sandstone hills may provide suitable habitat. REs that may form suitable habitat in the Study Area may include RE 11.10.3, 11.9.10 and possibly 11.5.9c.
- King blue-grass – Areas of RE on landzones consisting of heavy black clay soils, such as landzones 3 and 4 and where natural grasslands exist. REs that may form suitable habitat in the Study Area include REs 11.3.21, 11.4.4 and 11.4.11.

Listed Threatened Flora – Unlikely to Occur

The following six EPBC Act listed threatened flora species were predicted to occur within the Study Area by the Protected Matters Search Tool (or were identified in the Project ToR for consideration in this assessment). However, these species are considered unlikely to occur (as detailed in Table 3-3) based on their current known distribution and/or the lack of suitable habitat within the Study Area:

- *Acacia deuteroneura*
- Marlborough blue cycad
- Finger panic grass
- Black ironbox
- Northern beard heath
- *Ozothamnus eriocephalus*

3.2.4.2 Listed Threatened Fauna

The desktop assessment indicated that 14 EPBC Act listed threatened fauna species have been previously recorded or predicted to occur within the desktop search extent encompassing the Study Area. Of these, one species was confirmed to be present during field surveys, this being the squatter pigeon (southern) (*Geophaps scripta scripta*). Another EPBC Act listed threatened species, the greater long-eared bat (*Nyctophilus timoriensis*), was potentially recorded during field surveys however a positive identification to species level was unable to be made (refer Section 2.5.2.3).

A likelihood of occurrence assessment for EPBC Act listed threatened fauna species was undertaken in accordance with the definitions outlined in Section 1.4.4. The outcomes of this assessment are presented in Table 3-3 and discussed further below.

Table 3-3 Commonwealth Listed Threatened Fauna Species- Likelihood of Occurrence

Species	EPBC Act/NC Act status	Predicted to occur#	Previously recorded*	Recorded at study site	Habitat preferences and known distribution	Likelihood of occurrence
Reptiles						
ornamental snake *Denisonia maculata*	vulnerable / vulnerable	✓	Wildlife Online Queensland Museum Hancock Prospecting Pty Ltd, 2010	x	The ornamental snake's distribution is confined to the northern brigalow belt bioregion. This species is typically found in areas of brigalow, riverside woodland and open forest on natural levees (DSEWPaC, 2011c). Habitats featuring cracking clay and sandy substrates are known to be utilised by the species.	Previously recorded in region Suitable habitat occurs within Study Area **Likely to occur**
yakka skink *Egernia rugosa*	vulnerable / vulnerable	✓	x	x	The yakka skink is endemic to dry open forests, woodlands and rocky areas of central and eastern Queensland. Yakka skinks live in communal burrow complexes, and often take refuge among low vegetation or under heaped dead timber, logs, rocks and in deep rock crevices (Wilson 2005; DSEWPaC, 2011d). The species occurs in a wide variety of vegetation types including poplar box (*Eucalyptus populnea*), ironbark (*Eucalyptus* spp.), brigalow (*Acacia harpophylla*), white cypress pine (*Callitris* spp.), mulga (*Acacia aneura*), bendee (*Acacia catenulata*) and lancewood (Acacia *shirleyi*) woodland and open forest (DSEWPaC, 2011d).	Species distribution incorporates Study Area Potentially suitable habitat occurs within Study Area **May occur**
Dunmall's snake *Furina dunmalli*	vulnerable / vulnerable	✓	x	x	Dunmall's snake occurs in central and south-east Queensland – the northern limit of its known range extends between Yeppoon and the Expedition Range (DERM, 2011e). It inhabits open forest and woodland habitats. Brigalow growing on cracking clay and loam soils on floodplains is a known habitat for the species (DERM, 2011e).	Species distribution incorporates Study Area Potentially suitable habitat occurs within Study Area **May occur**

Species	EPBC Act/NC Act status	Predicted to occur#	Previously recorded*	Recorded at study site	Habitat preferences and known distribution	Likelihood of occurrence
retro slider *Lerista allanae*	endangered / endangered	✓	x	x	The retro slider is known only from black soil downs regions of the Oxford land system within the brigalow belt bioregion. This species has been recorded in habitats associated with mountain coolibah (*Eucalyptus orgadophila*)/ red bloodwood (*E. erythrophloia*) open woodlands and black tea-tree (*Melaleuca bracteata*) closed scrub to low closed-forest gravely hills, ridges and gullies as well as scattered *Bauhinia* spp. on plains (DSEWPaC, 2011f).	Current known distribution does not incorporate Study Area Suitable potential habitat may occur within the Study Area, however, as this habitat falls outside the known distribution for the species it is not considered likely that the species will utilise them. Not recorded in the region **Unlikely to occur**
brigalow scaly-foot *Paradelma orientalis*	vulnerable / vulnerable	✓	x	x	The brigalow scaly-foot inhabits a variety of open forest habitats in central and south-east Queensland. Acacia and eucalypt woodlands are known to be utilised by this species. The species has been recorded from habitats featuring substrates including cracking clays and sandy alluvium (DSEWPaC, 2011g).	Species distribution incorporates Study Area Potentially suitable habitat occurs within Study Area **May occur**
Fitzroy River turtle *Rheodytes leukops*	vulnerable / vulnerable	✓	x	x	**The Fitzroy River turtle is only found within the Fitzroy River system, usually inhabiting rivers with large deep pools with rocky, gravelly or sandy substrates, connected by shallow riffles (DSEWPaC, 2011h). This species preferred habitat is often riparian vegetation including forest red gums (*Eucalyptus tereticornis*), river oaks (*Casuarina cunninghamiana*), weeping bottlebrushes (*Melaleuca viminalis*) and paperbarks (*Melaleuca linariifolia*) (Tucker *et al*. 2001).**	Species has not been recorded within the region Suitable habitat generally lacking from the Study Area **Unlikely to occur**

Species	EPBC Act/NC Act status	Predicted to occur#	Previously recorded*	Recorded at study site	Habitat preferences and known distribution	Likelihood of occurrence
Mammals						
northern quoll *Dasyurus hallucatus*	endangered / not listed	✓	Queensland Museum	x	While the distribution of the northern quoll covers much of north-eastern Australia, the current range of the species has contracted considerably such that it is now though to be restricted to six discrete areas across northern Australia (Strahan, 1995). While the species does not have highly specific habitat requirements, rocky areas associated with open woodland and open forest are considered optimal habitat for the northern quoll (Hill and Ward, 2010). The preference for rocky habitat may be related to reduced exposure to threatening processes (i.e. vegetation clearing, fire, cane toads, reduced competition with cats) and the diversity of micro-habitats available (Hill and Ward, 2010).	One previous record from the region The modelled distribution of the species, as presented in the Commonwealth Government's *Referral Guidelines for the Northern Quoll Dasyurus hallucatus* (DSEWPaC, 2011p) indicates that the species' (modelled) distribution does not encompass the western part of the Study Area, whilst the easternmost part of the study area coincides with the modelled 'may occur' distribution for the species Potentially suitable habitat is present in higher relief areas near the easternmost part of the Study Area **May occur**
koala (QLD, NSW and ACT populations) *Phascolarctos cinereus*	vulnerable / special least concern	✓	Wildlife Online H. Jones pers.comm 07/09/2011	x	In Queensland, the species contains scattered populations throughout moist forests along the coastline, subhumid woodlands in central and southern regions and within eucalypt woodlands along watercourses within semi-arid areas further west (Melzer *et al.* 2000). The greatest density of koalas occur in south-east Queensland, with lower densities occurring through central and eastern areas including the Brigalow Belt, Mitchell Grass Downs, Mulga lands and the Desert Uplands (Patterson 1996).	Previous records occur from the region Suitable habitat occurs within open eucalypt woodland habitat and mature riparian woodland fringing watercourses **Likely to occur**
greater long-eared bat *Nyctophilus timoriensis* (south eastern form)	vulnerable / vulnerable	✓	x	✓^	The greater long-eared bat generally inhabits woodland vegetation in arid and semi-arid inland areas (Strahan, 1995). It is more typically known from south-east Australia (especially the Murray-Darling Basin), and is not known north of the Tropic of Capricorn (Strahan, 1995).	Species has not been previously recorded in the Study Area Species distribution incorporates Study Area Suitable habitat is present within the Study Area **May occur**

Species	EPBC Act/NC Act status	Predicted to occur#	Previously recorded*	Recorded at study site	Habitat preferences and known distribution	Likelihood of occurrence
Birds						
red goshawk *Erythrotriorchis radiatus*	vulnerable / vulnerable	✓	x	x	The red goshawk is an uncommon bird species of eastern and northern Australia. It prefers landscapes containing a mosaic of habitats including coastal and sub-coastal tall open forest, woodland and rainforest edges (Marchant and Higgins, 1993). Forests of intermediate density are particularly favoured, as are ecotones between variably dense habitats (i.e. ecotone between rainforest and sclerophyll forest) (DSEWPaC, 2011i). Large bird populations (the primary prey of this species) are also an important determinant of red goshawk habitat utilisation (DSEWPaC, 2011i). It generally avoids open habitats, and is only rarely encountered over agricultural land (Marchant and Higgins, 1993). Nesting occurs in tall trees within one km of permanent water, generally in open, biologically-rich forest or woodland (Marchant and Higgins, 1993). The species occurs at low densities.	Species has not been recorded in the Study Area Species distribution incorporates Study Area Potentially suitable habitat is present within the Study Area **May occur**
squatter pigeon (southern) *Geophaps scripta scripta*	vulnerable / vulnerable	✓	Wildlife Online Birds Australia Project (Mine) Volume 4 Appendix N1 Hancock Prospecting Pty Ltd, 2010	✓	The squatter pigeon is locally abundant within the northern part of its range (i.e. Brigalow Belt (North) and Desert Uplands Bioregions) (DSEWPaC, 2011j). It is considered to be common in grazing country north of the Tropic of Capricorn (DSEWPaC, 2011j). The species occurs in a wide range of habitats wherever there is a grassy understorey. It is often found within close proximity of water bodies (DSEWPaC, 2011j).	Species recorded in the Study Area Species distribution incorporates Study Area Suitable habitat is present within the Study Area **Confirmed present**

Species	EPBC Act/NC Act status	Predicted to occur#	Previously recorded*	Recorded at study site	Habitat preferences and known distribution	Likelihood of occurrence
star finch (eastern and southern) *Neochmia ruficauda ruficauda*	endangered / endangered	✓	x	x	The distribution of the subspecies of the star finch is poorly known, however it is restricted to eastern Queensland (and is likely to be severely fragmented (DSEWPaC, 2011k). Areas of permanently occupied habitat or permanent populations have not been identified (DSEWPaC, 2011k). An estimate (considered to be of low reliability) puts the extant wild population of the subspecies at 50 birds (DSEWPaC, 2011k). The subspecies has disappeared from much of its former eastern and central Queensland range, with scattered records from the 1990s considered likely to be aviary escapes (Higgins *et al*., 2006). Habitat preferences include grasslands and grassy woodlands near water, sedegelands, swamps and wetlands (Higgins *et al*., 2006; DSEWPaC, 2011k). The subspecies is also known from disturbed habitats including farmland (Higgins *et al*., 2006; DSEWPaC, 2011k).	Not previously recorded in region Uncertainty as to whether subspecies persists in central and eastern Queensland, with lack of recent records and observed disappearance from much of former range Potentially suitable habitat occurs within Study Area **Unlikely to occur**
black-throated finch (southern) *Poephila cincta cincta*	endangered / endangered	✓	Project (Mine) Volume 4 Appendix N1	x	This subspecies has experienced a large reduction in range and population size in recent decades (DSEWPaC, 2011l). It is now known from three general l areas – Townsville, Ingham and scattered sites in central Queensland. The black-throated finch typically occurs in native grasslands and woodlands along creeks and riverbanks. Mosaics of habitat types that provide sufficient foraging resources (i.e. seed) through the wet season are thought to be required by this species (DSEWPaC, 2011l).	Previously recorded in region Suitable habitat occurs within open woodland habitat featuring and understorey of native grasses, where water is locally available **Likely to occur**

Species	EPBC Act/NC Act status	Predicted to occur#	Previously recorded*	Recorded at study site	Habitat preferences and known distribution	Likelihood of occurrence
Australian painted snipe *Rostratula australis*	vulnerable / vulnerable	✓	x	x	The Australian painted snipe has a scattered distribution across eastern and northern Australia (DSEWPaC, 2011m). Shallow freshwater wetlands are the main habitat for the Australian painted snipe (Marchant and Higgins, 1993). Such wetlands may include lakes, swamps, claypans, inundated / waterlogged grassland, dams, irrigated crop land and sewage ponds (Marchant and Higgings, 1993). Preferred wetland habitats boast emergent vegetation (including tussocks, grasses, sedges, rushes, reeds, canegrass and/or Melaleuca) (Marchant and Higgins, 1993). Nesting occurs amongst vegetation in or adjacent to wetlands (DSEWPaC, 2011m).	Species has not been recorded in the region Species distribution incorporates Study Area Potentially suitable habitat may occur within Study Area in association with large farm dams **May occur**

Predicted to occur within approximately 10 km of Study Area: DSEWPaC Protected Matters Search Tool

* Previously recorded within approximately 10- 50 km of Study Area: desktop sources including Wildlife Online / Birds Australia / Queensland Museum, EIS documents for projects in the region including Hancock Prospecting Pty Ltd (2010)

^ *Nyctophilus* sp. was detected, however identification to species level was not possible

Listed threatened fauna – Confirmed Present

Squatter pigeon (southern)

The squatter pigeon (southern) is a ground-dwelling pigeon, listed as vulnerable under both the EPBC Act and NC Act. This species distribution extends from central Queensland as far north as the Burdekin-Lynd divide to the south-east of the state (DSEWPaC, 2011j). At present the total population size of the squatter pigeon (southern) is estimated to be around 40,000 breeding birds, with the population likely to be stable (DSEWPaC, 2011j). The squatter pigeon (southern) is locally abundant at some locations in the northern part of its current distribution and is considered to be common in cattle grazed country north of the Tropic of Capricorn (DSEWPaC, 2011j).

Habitat for this subspecies occurs mainly in grassy woodlands and open forests dominated by eucalypts, particularly those near water (DSEWPaC, 2011j). This species has also been recorded less frequently in disturbed habitats such as stockyards, railways, and settlements (DSEWPaC, 2011j). The breeding season for the squatter pigeon (southern) typically extends from late winter months through to summer, although if conditions are suitable birds are said to be able to breed throughout most of the year (DSEWPaC, 2011j). The diet of the squatter pigeon (southern) generally consists of grass seeds, legumes, herbs and forbs, as well as insects and ticks (DSEWPaC, 2011j).

Three main threats to the squatter pigeon (southern) exist:

- Loss of habitat due to clearing for agricultural or industrial purposes
- Degradation of habitat by grazing herbivores
- Excessive predation, particularly by foxes and cats (DSEWPaC, 2011j)

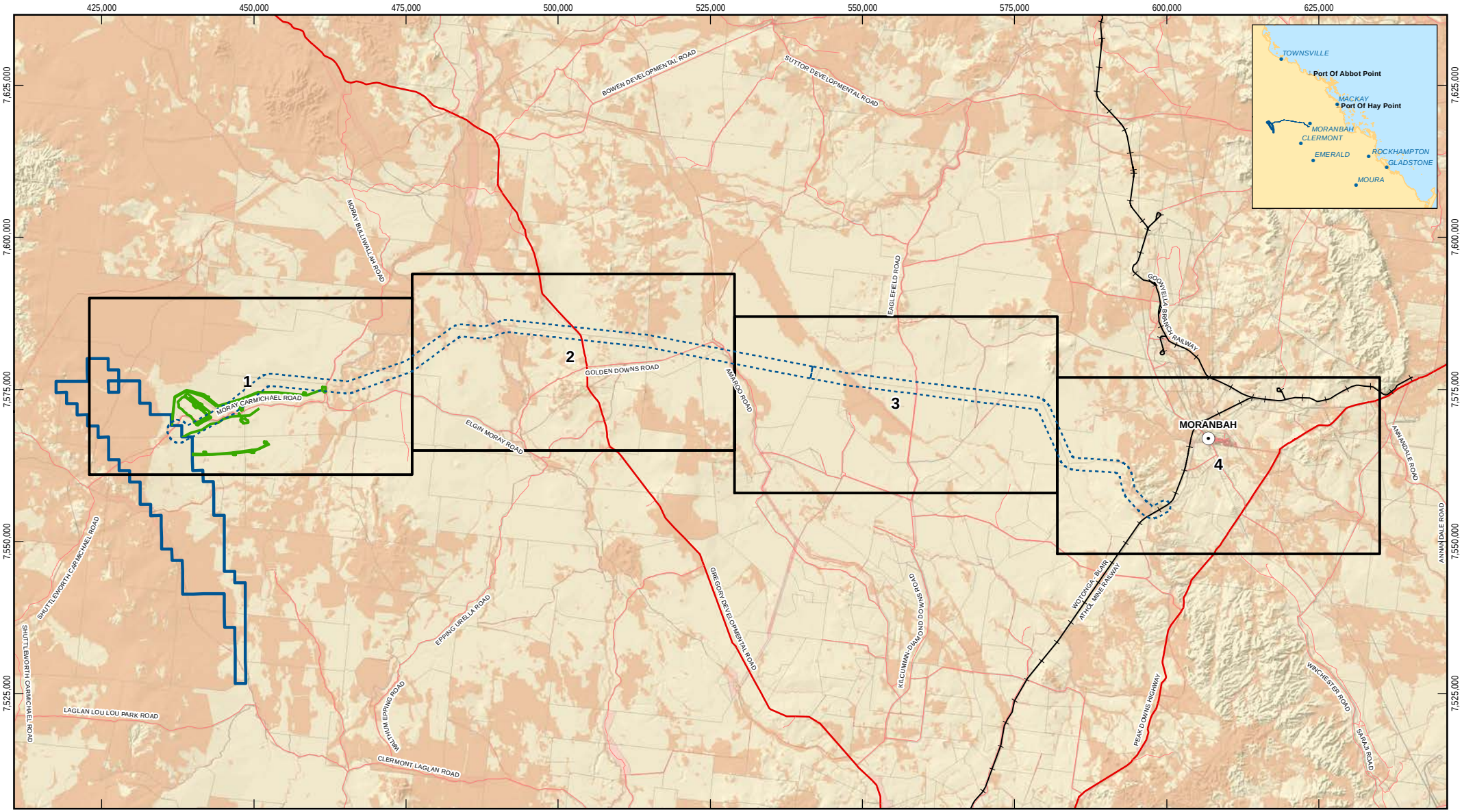
Squatter pigeons (southern) at the Study Area

Squatter pigeons (southern) were recorded on one occasion during the September survey event as shown on Figure 3-1. A group of three individuals was observed. This subspecies was encountered on a track within open woodland habitat featuring a complex grassy and rocky understorey. Distribution of the squatter pigeon (southern) is likely to be limited across the Study Area by the availability of drinking water.

Figure 3-1 provides an indication of habitat that may be utilised by the squatter pigeon (southern) within, and adjacent, to the Study Area. REs characterised by open woodland and forest vegetation were identified and mapped based on known habitat preferences for the squatter pigeon (southern). REs from land zone 7 (ironstone jump-ups) and land zone 9 (undulating country on fine grained sedimentary rocks) were not considered for the analysis as they are not considered likely to provide habitat for the subspecies. The limiting factor to utilisation of this potentially suitable habitat is likely to be availability of water. Where water is present (i.e. farm dams, stock troughs, natural waterbodies (i.e. gilgais, Belyando River and Creeks)) it is considered likely that the squatter pigeon (southern) will be present.

The presence of potentially suitable habitat extends beyond the Study Area and suggests that the squatter pigeon (southern) is likely to be present in much of the wider landscape, particularly to the west where remnant vegetation dominates the landscape. However, much of the landscape immediately surrounding the Study Area is dominated by non-remnant vegetation with fragmented remnant vegetation often restricted to watercourses. Habitat utilisation and abundance is likely to be influenced by availability of water and prevalence of predators (especially cats and foxes). Predator

prevalence may be related to the management regime of individual properties in the landscape surrounding the Study Area.



1:850,000 (at A4)

0 5 10 15 20 25

Kilometres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia (GDA)
Grid: Map Grid of Australia 1994, Zone 55

N

LEGEND

- Town
- State Road
- Local Road
- Other Railway
- Cadastral Parcel
- Road Reserve
- Watercourse Reserve
- Mine (Onsite)
- Mine (Offsite)
- Study Area
- Potential Squatter Pigeon (Southern) Habitat - Based on DERM Certified Regional Ecosystems Version 6.0b

Adani Mining Pty Ltd

Carmichael Coal Mine and Rail Project

Location of Squatter Pigeon Sightings and Potential Squatter Pigeon (southern) Habitat Within the Study Area and Surrounding Landscape

Job Number	41-25215
Revision	B
Date	10-09-2012

Figure 3-1
Series Index

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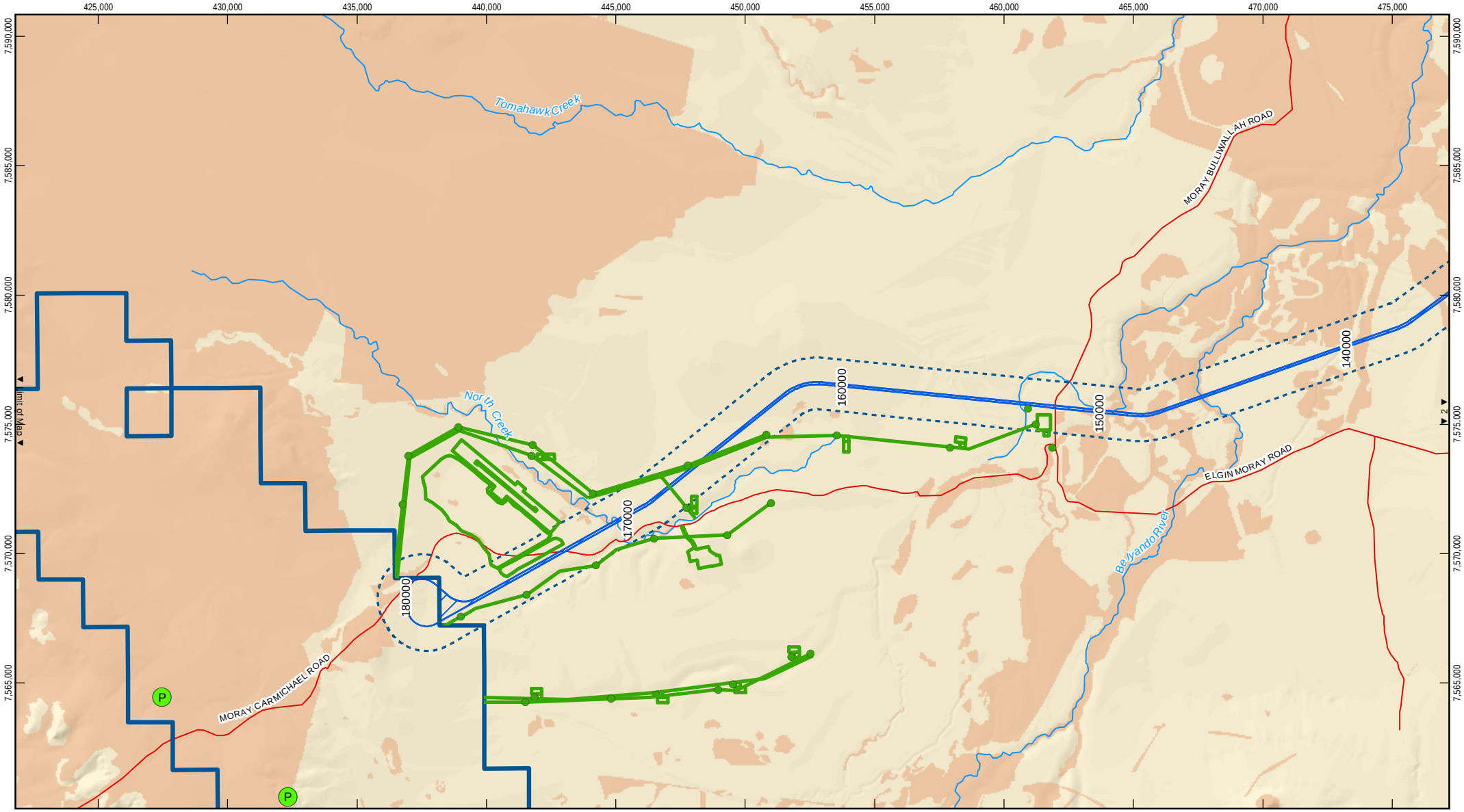
Level 4, 201 Charlotte St Brisbane QLD 4000 T +61 7 3316 3000 F +61 7 3316 3333 E bnemail@ghd.com W www.ghd.com

Data source: DERM: DEM (2008), DCDB (2010); DME: EPC1690 (2010)/EPC1080 (2011); © Commonwealth of Australia (Geoscience Australia): Localities, Railways, Roads (2007); Adani: Alignment Corridors Opt9 Rev3 (2012); GHD: Northern Missing Link (2011), Potential Squatter Pigeon Habitat, Sightings (2012); Gassman/Hyder: Mine (Offsite) (2012). Created by: BW, CA



1:200,000 (at A4)

0 1 2 3 4 5

Kilometres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia (GDA)
Grid: Map Grid of Australia 1994, Zone 55

N

LEGEND

- Squatter Pigeon Sighting - Spring 2011
- Town
- Road
- Other Railway
- Watercourse
- Rail (West)
- Rail (East)
- Study Area
- Mine (Onsite)
- Mine (Offsite)
- Mine (Offsite)
- Potential Squatter Pigeon (Southern) Habitat - Based on DERM Certified Regional Ecosystems Version 6.0b

Adani Mining Pty Ltd

Carmichael Coal Mine and Rail Project

Location of Squatter Pigeon Sightings and Potential Squatter Pigeon (southern) Habitat within the Study Area and Surrounding Landscape

Job Number	41-25215
Revision	B
Date	05-09-2012

Figure 3-1
Sheet 1 of 4

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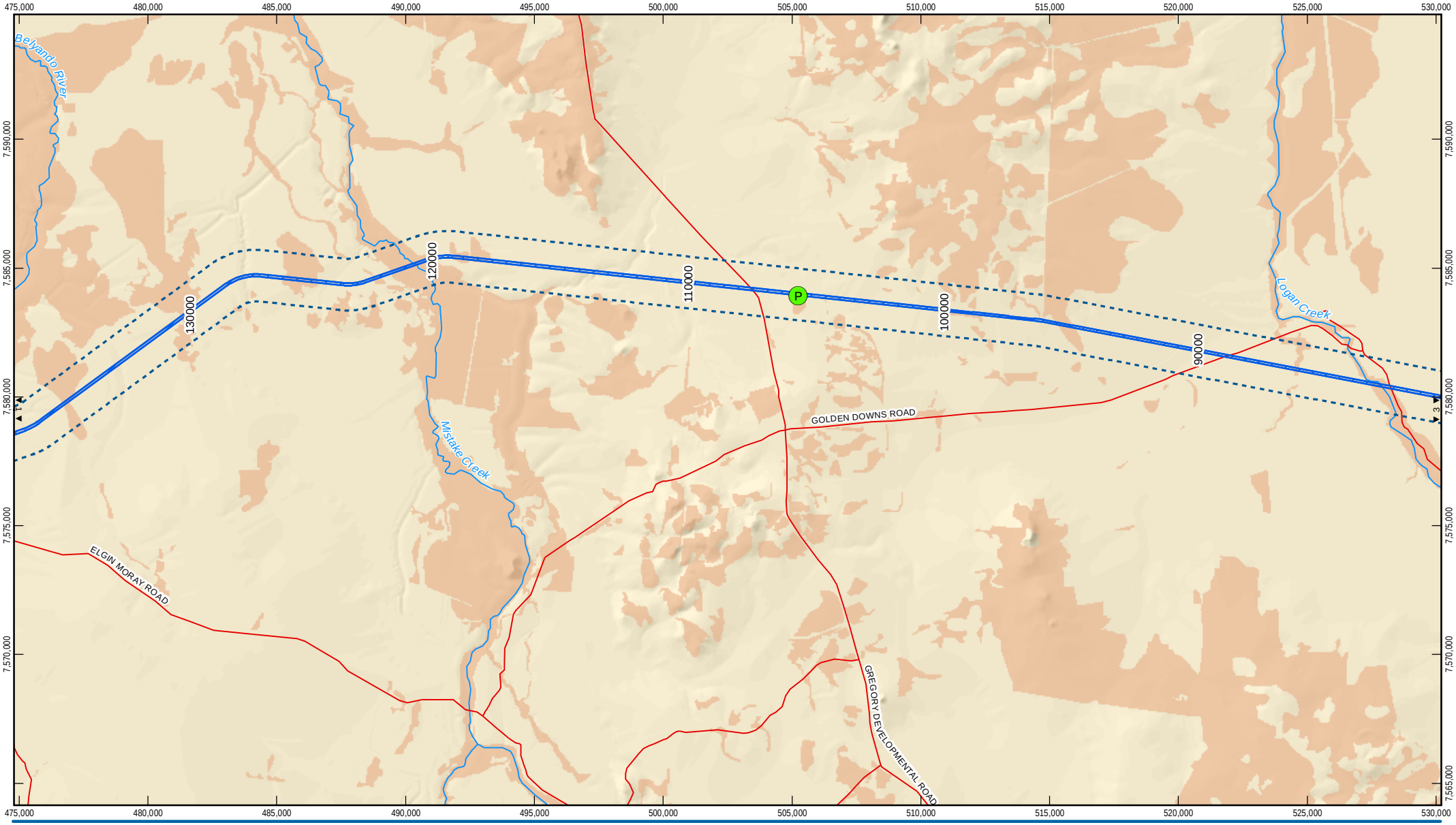
Data source: DERM: DEM (2008), © Commonwealth of Australia (Geoscience Australia): Localities, Railways, Roads, Watercourse (2007); Potential Squatter Pigeon Habitat, Sightings (2012); Adani: Alignment Opt9 Rev3 (2012); DME: EPC1690 (2010) / EPC1080 (2011); Gassman/Hyder: Mine (Offsite) (2012). Created by: MR, CA



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Kilometres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia (GDA)
Grid: Map Grid of Australia 1994, Zone 55

N

LEGEND

- Squatter Pigeon Sighting - Spring 2011
- Town
- Road
- Other Railway
- Watercourse
- Rail (West)
- Rail (East)
- Study Area
- Mine (Onsite)
- Mine (Offsite)
- Mine (Offsite)
- Potential Squatter Pigeon (Southern) Habitat - Based on DERM Certified Regional Ecosystems Version 6.0b

Adani Mining Pty Ltd

Carmichael Coal Mine and Rail Project

Location of Squatter Pigeon Sightings and Potential Squatter Pigeon (southern) Habitat within the Study Area and Surrounding Landscape

Job Number	41-25215
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Sheet 2 of 4

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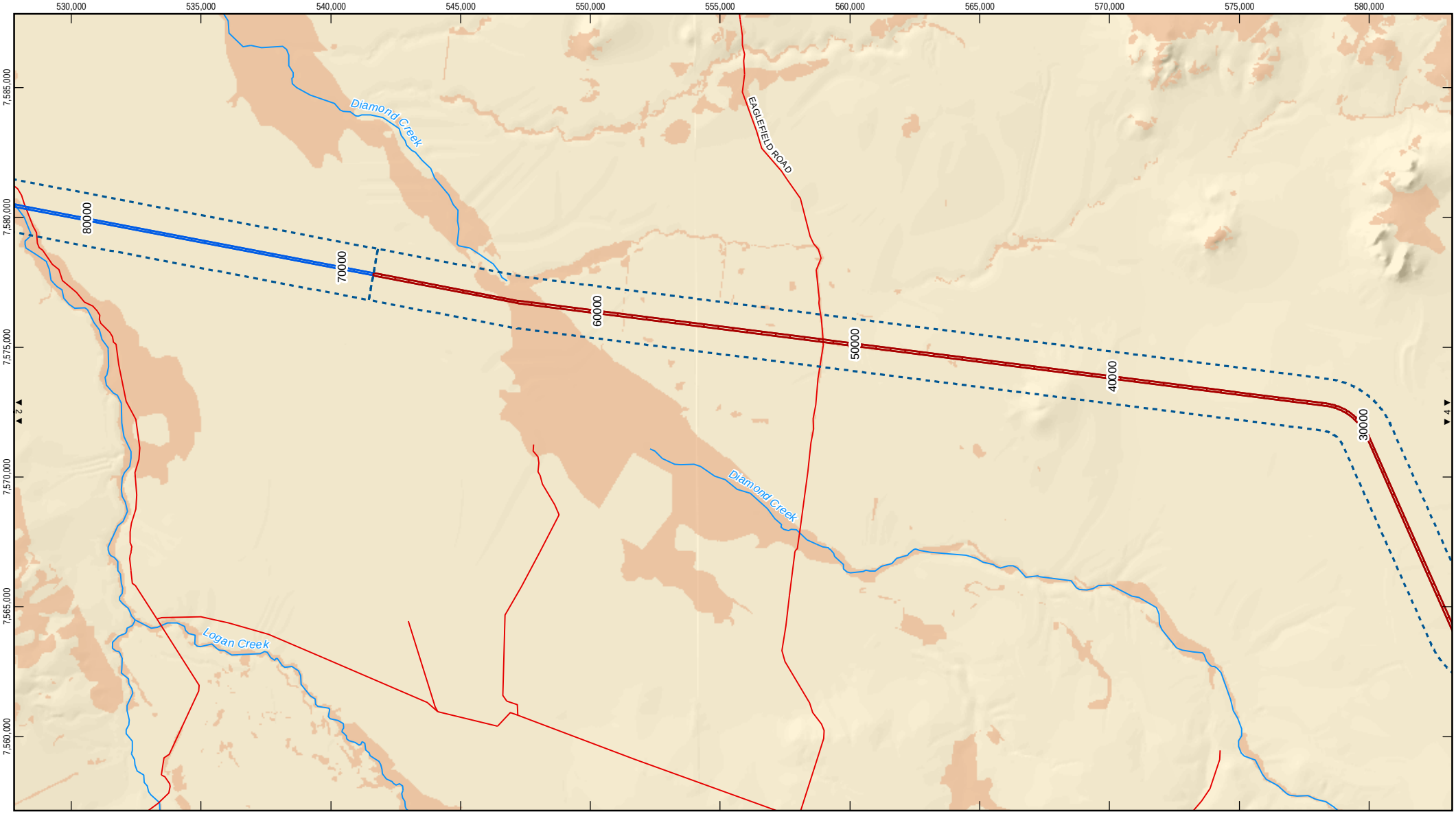

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Kilometres

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Horizontal Datum: Geocentric Datum of Australia (GDA)
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Adani Mining Pty Ltd

Carmichael Coal Mine and Rail Project

Location of Squatter Pigeon Sightings and Potential Squatter Pigeon (southern) Habitat within the Study Area and Surrounding Landscape

Job Number	41-25215
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Figure 3-1
Sheet 3 of 4

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Level 4, 201 Charlotte St Brisbane QLD 4000 T +61 7 3316 3000 F +61 7 3316 3333 E bnemail@ghd.com W www.ghd.com

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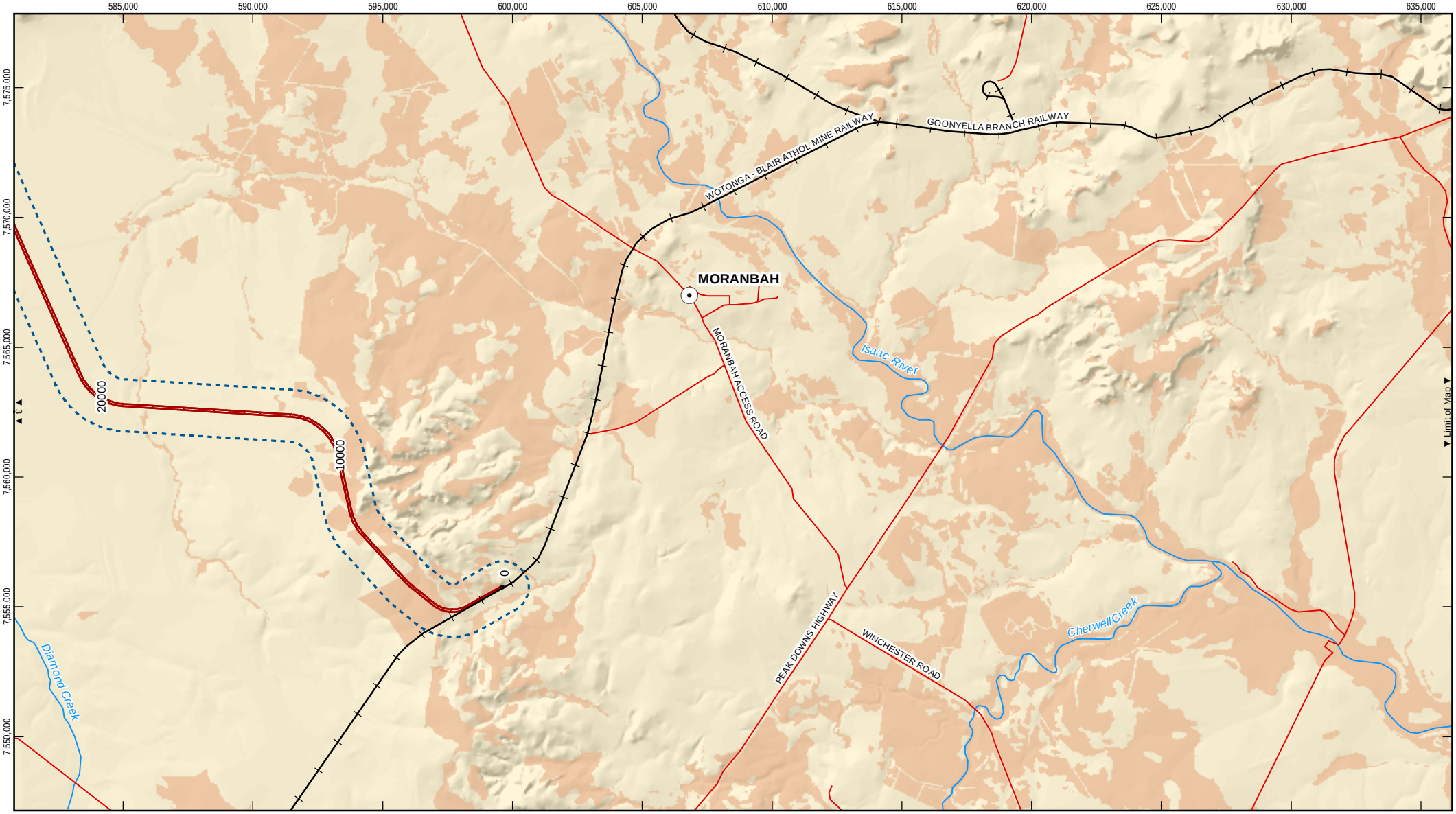

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Kilometres

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Adani Mining Pty Ltd

Carmichael Coal Mine and Rail Project

Location of Squatter Pigeon Sightings and Potential Squatter Pigeon (southern) Habitat within the Study Area and Surrounding Landscape

Job Number	41-25215
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Figure 3-1
Sheet 4 of 4

G:\41\25215\GIS\Maps\MXD\400_Ecology\41-25215_459_200k_rev_b.mxd Level 4, 201 Charlotte St Brisbane QLD 4000 T +61 7 3316 3000 F +61 7 3316 3333 E bnemail@ghd.com W www.ghd.com

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Across its range the subspecies is thought to occur as a continuous, inter-breeding population, with no single populations identified as being important for its long-term survival or recovery (DSEWPaC, 2011j). With respect to the Significant Impact Guidelines (DEWHA (now DSEWPaC), 2009b), it is not considered that squatter pigeons (southern) at the Study Area are part of an 'important population' (of an EPBC Act-listed vulnerable species). That is, squatter pigeons (southern) at the Study Area are not considered to be a part of *a population that is necessary for a species' long-term survival and recovery, including populations identified as such in recovery plans, and/or that are:*

- *Key source populations either for breeding or dispersal*
- *Populations that are necessary for maintaining genetic diversity, and/or*
- *Populations that are near the limit of the species range* (DEWHA (now DSEWPaC), 2009b)

Based on the availability of similarly suitable habitat in the landscape surrounding the Project Area, and the stable nature of the subspecies' population at present, it is not considered that the Project Area represents *habitat critical to the survival of the (sub)species.*

Listed threatened fauna - Likely to Occur

The following EPBC Act listed threatened species are likely to occur at the Study Area, based on distribution, presence of potentially suitable habitat and previous records from the region:

- *Ornamental snake (Denisonia maculata)*
- *Black-throated finch (southern) (Poephila cincta cincta)*
- *Koala (Phascolarctos cinereus)*

Bird surveys, opportunistic surveys and trapping for ground-dwelling mammals and reptiles failed to detect the threatened species listed above. These species occur in low densities and failure to detect their presence is not necessarily indicative of their absence throughout the Study Area. The following broad vegetation communities and habitats may provide habitat for listed threatened species (refer Figure 2-4 for map of spatial distribution of fauna habitat types within the Study Area and Table 2-5 for the general habitat characteristics of each habitat type listed):

- *Eucalypt open woodland with native grass understorey* – ornamental snake, black-throated finch, koala
- *Gidgee or mixed acacia woodland, on clay and clay loam plains with sparse shrub layer* – ornamental snake
- *Brigalow shrubby woodland or open forest typically on clay and clay loam plains* – ornamental snake
- *Eucalypt and acacia mixed woodland or forest often on clay soils* – ornamental snake, black-throated finch
- *Riparian woodland or forest fringing watercourses, and coolabah open woodland on grassy floodplain often with weedy understorey* – ornamental snake, black-throated finch
- *Native grassland with absent canopy or shrub layer* – black-throated finch
- *Open, previously cleared areas lacking native remnant vegetative cover and/or patchy regrowth* – possibly ornamental snake and black-throated finch
- *Natural and artificial water bodies* – ornamental snake and black-throated finch

Ornamental snake

The ornamental snake is listed as vulnerable under the EPBC Act (and vulnerable under the NC Act). The species occurs in the Brigalow Belt bioregion, where the majority of natural vegetation has been cleared for agriculture, mining and urban development, and has been degraded by overgrazing by stock. This has resulted in a decline in abundance in the past few decades (Cogger *et. al.*, 1993). Additional factors contributing to this decline include:

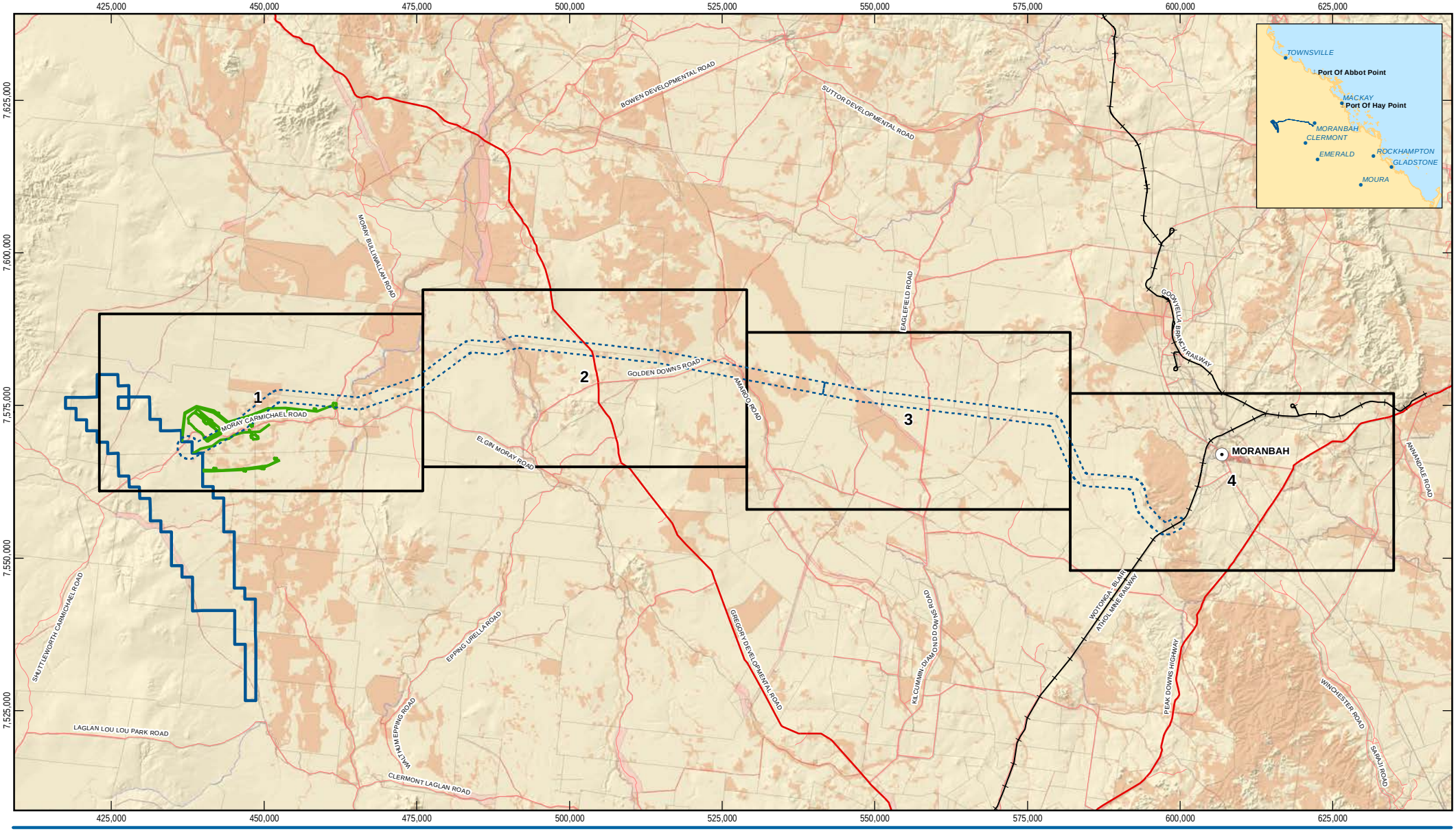
- Habitat loss and fragmentation through clearing
- Habitat degradation by overgrazing by stock
- Contact with cane toads
- Predation by feral species
- Invasion by weeds

Ornamental snakes are nocturnally active, sheltering during the day under fallen timber, rocks, bark and in deep soil cracks. The species is probably active year round with the exception of the cooler months, with peak activity likely to be early summer through to the wet season. During dry times the snake can remain inactive in suitable shelter sites for months (DSEWPaC 2011c).

The ornamental snake prefers habitat within, or close to, habitat that is favoured by its prey (namely frogs). Preferred habitat includes woodlands and open forests associated with moist areas, particularly gilgai (melon-hole) mounds and depressions in Queensland RE land zone 4 (DSEWPaC, 2011c). The most common habitat of ornamental snake is brigalow, gidgee, blackwood or Coolabah dominated vegetation communities, or pure grasslands associated with gilgais (DSEWPaC, 2011c). REs from which this species is most commonly recorded in Queensland that are mapped within the Study Area include:

- RE 11.4.6 *Acacia cambagei* woodland on Cainozoic clay plains
- RE 11.4.8 *Eucalyptus cambageana* woodland to open forest with *Acacia harpophylla* or *A. argyrodendron* on Cainozoic clay plains
- RE 11.4.9 *Acacia harpophylla* shrubby open forest to woodland with *Terminalia oblongata* on Cainozoic clay plains
- 11.3.3 *Eucalyptus coolabah* woodland on alluvial plains

No ornamental snakes were detected during either the May or September field surveys. However, potential habitat for this species within the Study Area and broader surrounding landscape exists. Figure 3-2shows the extent of potential habitat for the ornamental snake in both the Study Area and the surrounding landscape. Mapping of suitable habitat for this species was based on habitat types considered to be potentially suitable to support the ornamental snake using DERM Version 6.0b RE mapping (refer Table 2-5). The main limiting factor determining the utilisation of identified potentially suitable habitat by the ornamental snake is likely to be related to the density of frog populations, which in turn may be driven by the localised availability of frog breeding sites (i.e. standing water associated with gilgais, ephemeral creeks and rivers).



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Kilometres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia (GDA)
Grid: Map Grid of Australia 1994, Zone 55

N

LEGEND

- Town
- State Road
- Local Road
- Other Railway
- Cadastral Parcel
- Road Reserve
- Watercourse Reserve
- Mine (Onsite)
- Mine (Offsite)
- Study Area
- Potential Ornamental Snake Habitat - Based on DERM Certified Regional Ecosystems Version 6.0b

Adani Mining Pty Ltd

Carmichael Coal Mine and Rail Project

Potential Ornamental Snake Habitat Within the Study Area and Surrounding Landscape

Job Number 41-25215
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Date 10-09-2012

Figure 3-2
Series Index

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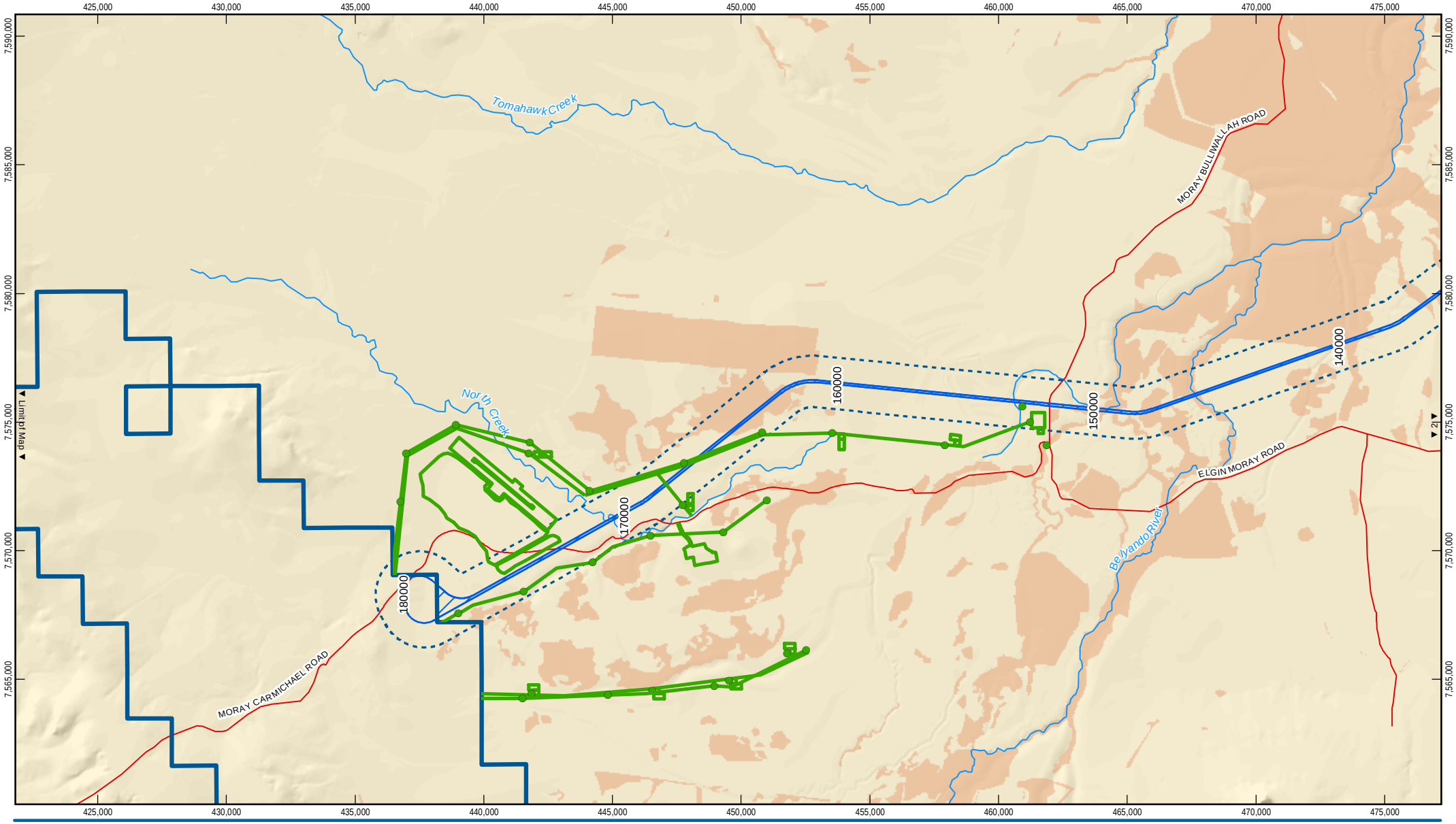

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Adani Mining Pty Ltd

Carmichael Coal Mine and Rail Project

Potential Ornamental Snake Habitat Within the Study Area and Surrounding Landscape

Job Number	41-25215
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Figure 3-2
Sheet 1 of 4

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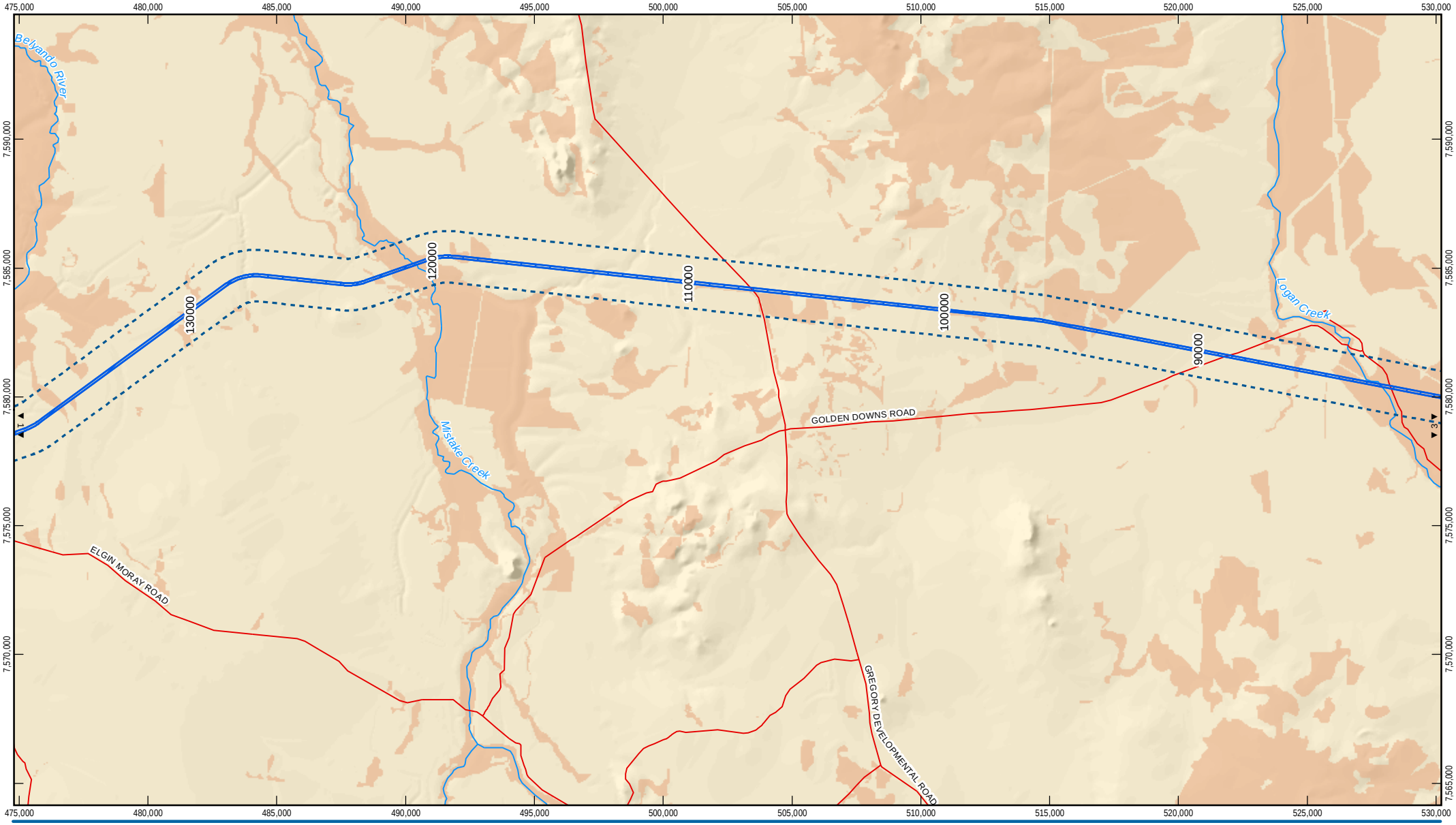

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Adani Mining Pty Ltd

Carmichael Coal Mine and Rail Project

Potential Ornamental Snake Habitat Within the Study Area and Surrounding Landscape

Job Number 41-25215
Revision B
Date 05-09-2012

Figure 3-2
Sheet 2 of 4

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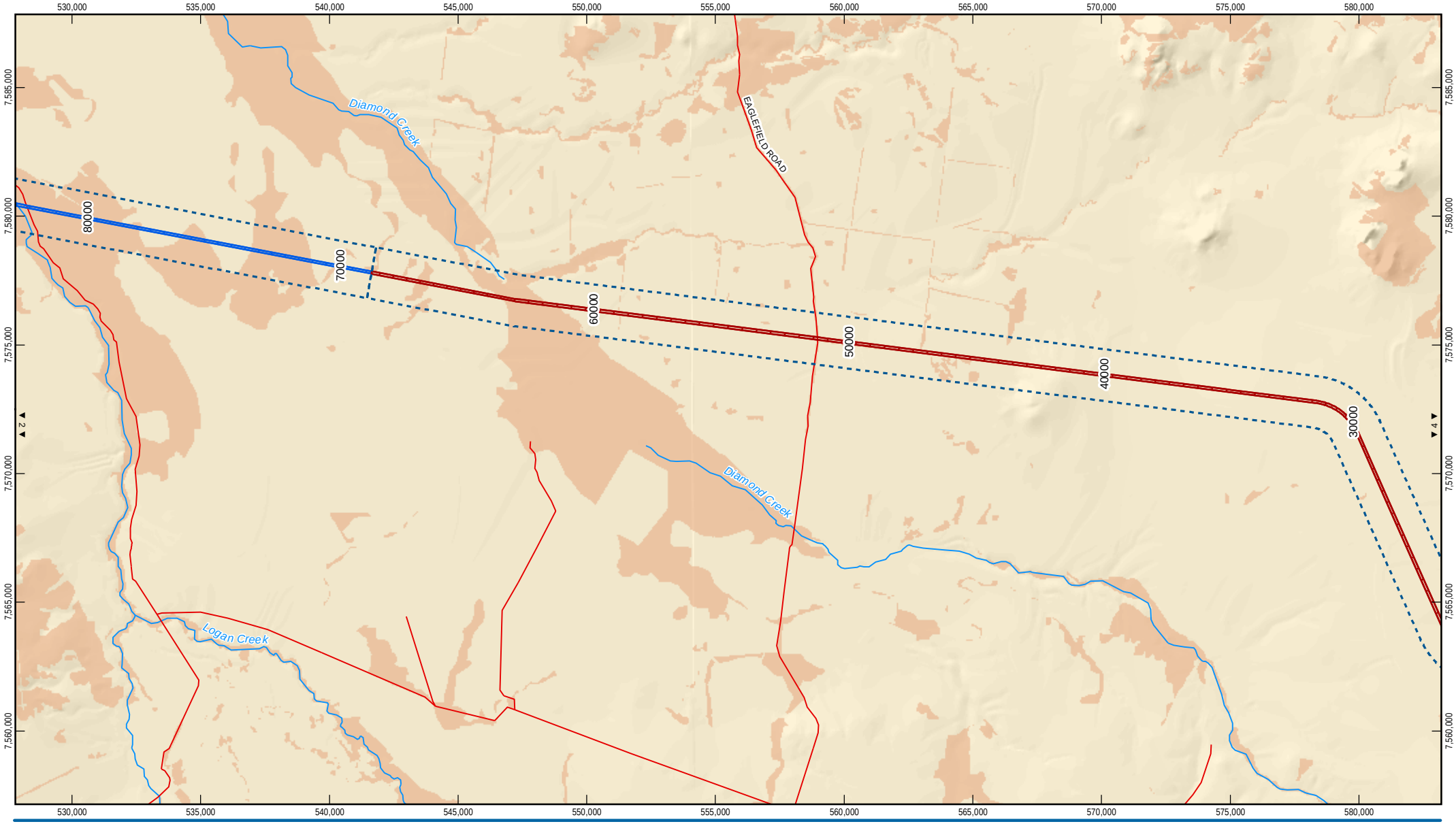

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Adani Mining Pty Ltd

Carmichael Coal Mine and Rail Project

Potential Ornamental Snake Habitat Within the Study Area and Surrounding Landscape

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Figure 3-2
Sheet 3 of 4

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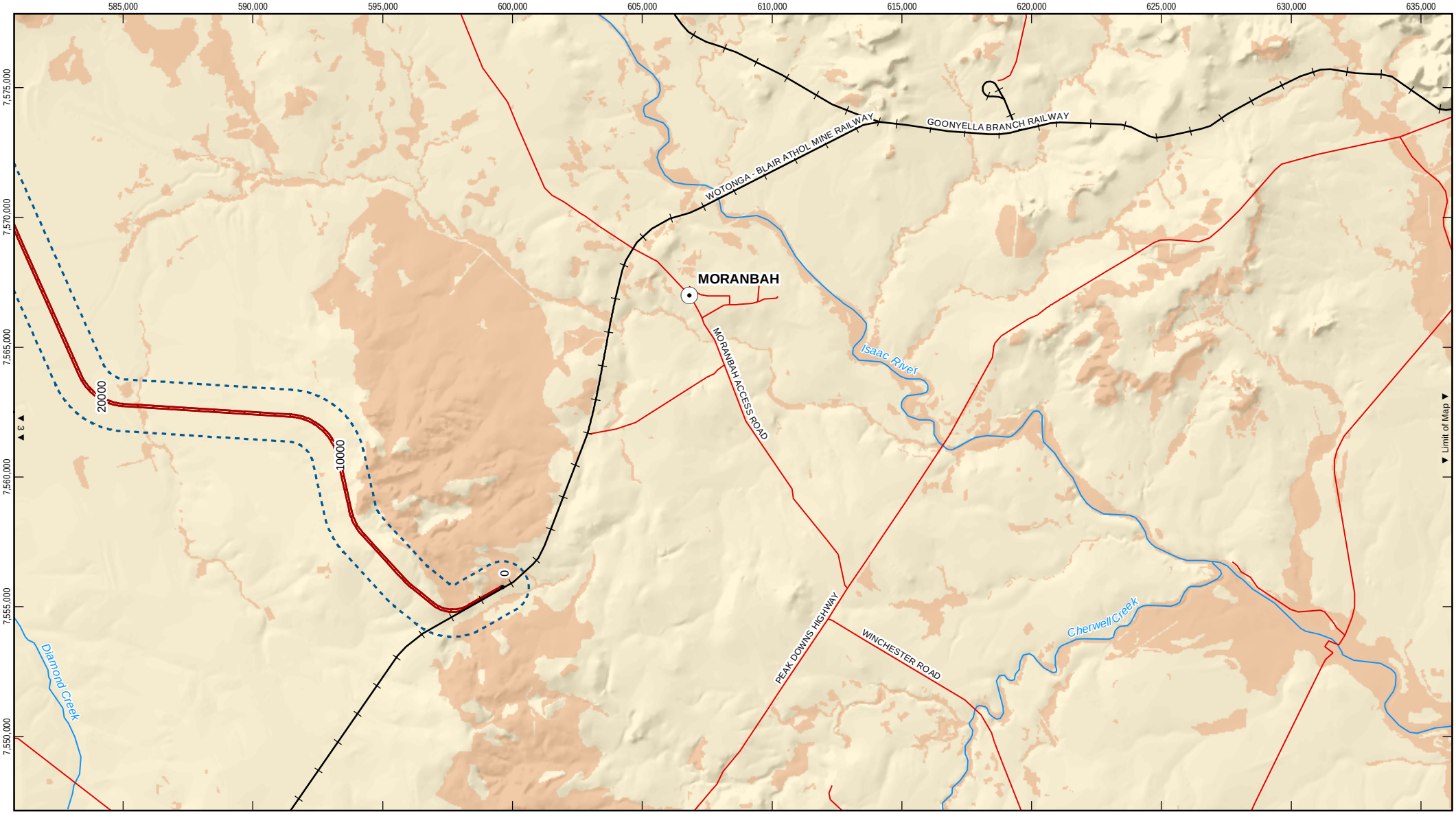

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Adani Mining Pty Ltd
Carmichael Coal Mine and Rail Project

Potential Ornamental Snake Habitat Within the Study Area and Surrounding Landscape

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Black-throated finch (southern)

The black-throated finch (southern) (Plate 3-1) is listed as endangered under the EPBC Act (and endangered under the NC Act). This small grass-finch has experienced a large decline in range in recent decades (DSEWPaC, 2011l). Where it was once previously found throughout eastern and central Queensland north of the New South Wales border, it is now only known from the Townsville region and scattered sites in central Queensland (DSEWPaC, 2011l). The extent of occurrence of the species (i.e. *Poephila cincta*) has declined by approximately 80 per cent since the 1980s, with the majority of this decline in the range of the endangered southern subspecies (DSEWPaC, 2011l).

Plate 3-1 Black-throated finches (southern)

Source: GHD 2011- photos from Project (Mine) Study Area

The black-throated finch (southern) is predominantly a sedentary (BTF Recovery Team, 2007; DEWHA, 2009a) and gregarious species that typically forages in groups of up to 30 birds (DEWHA, 2009a). During the breeding season (in the Townsville region breeding coincides with wet season (February to May)), only small daily movements between forage sites are made. Movements of up to three km a day may occur during periods where forage resources are scarce. Larger movements are thought to be related to periods of drought and/or when water availability is reduced (DEWHA (now DSEWPaC), 2009a). It often forms loose breeding colonies, where a number of nests are made in a single tree, or in neighbouring trees. The average clutch size is five, with chicks reaching sexual maturity at six months (DEWHA, 2009a).

The subspecies inhabits grassy open woodland and open forest habitats characterised by trees belonging to the genera *Eucalyptus, Corymbia, Acacia* and *Melaleuca* (DSEWPaC, 2011l). Generally it occurs in habitats near watercourses or waterbodies - almost all recent records of the subspecies south of the tropics have been in riparian areas (DSEWPaC, 2011l). Three critical habitat resources are required to support the subspecies:

- Water sources (both natural and artificial)
- Grass seeds (a mosaic of species that provide forage throughout the year (particularly during the wet season)
- Trees that provide suitable nesting habitat (DEWHA (now, 2009a; DSEWPaC, 2011a)

Grass species that are considered to be important forage species for the black-throated finch (southern) include *Urochloa mosambicensis, Enteropogon acicularis, Panicum decompositum, Panicum effusum, Dichanthium sericeum, Alloteropsis semialata, Eragrostis sororia* and *Themeda triandra* (DEWHA, 2009a). REs from which the subspecies has been recorded in north Queensland since 1994 (as presented in the National Recovery Plan for the Black-throated Finch Southern Subspecies (BTF Recovery Team, 2007) that are mapped within the Study Area include:

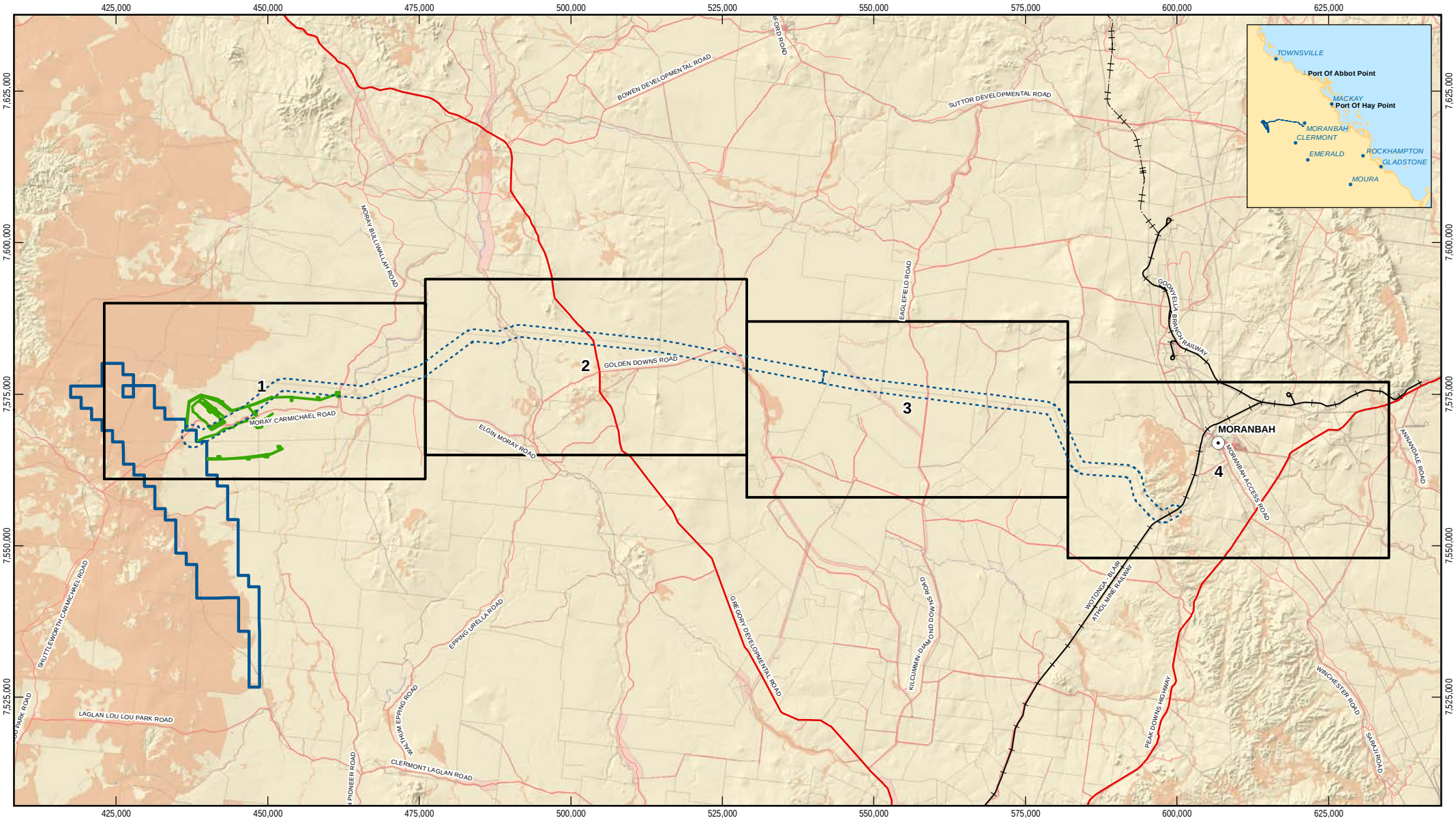
- RE 10.3.6 *Eucalyptus brownii* open woodland on alluvial plains
- RE 10.3.28 *Eucalyptus melanophloia* or *E. crebra* open woodland on sandy alluvial fans
- RE 10.5.5 *Eucalyptus melanophloia* open woodland on sand plains
- RE 11.3.25b *Eucalyptus tereticornis* or *E. camaldulensis* woodland fringing drainage lines – this RE occurs within the rail corridor and infrastructure footprints.

Existing populations of the black-throated finch (southern) are thought to be highly fragmented (DSEWPaC, 2011a). As such, the *Significant Impact Guidelines for the Endangered Black-throated Finch (southern) (Poephila cincta cincta)* (hereafter, the 'Black-throated Finch (southern) Significant Impact Guidelines') (DEWHA, 2009a) define any habitat within five km of a post-1995 sighting as an 'important area' for the subspecies. The guidelines also state "that the presence of the black-throated finch (southern) at a site indicates that existing management regime is likely to be compatible with maintaining suitable habitat for the subspecies".

No black-throated finches (southern) were detected during the May and September field surveys and potential suitable habitat observed within the Study Area was of low quality. However, suitable habitat occurs at the western extent of the Project (Rail), near the Mine Site, and the species was recorded on 27 separate occasions during autumn surveys undertaken for the Project (Mine) (refer Volume 4 Section 5.1).Records of sightings of black-throated finches (southern) were concentrated at the northern and southern parts of the Project (Mine) and not in close proximity (within 5 km) to where the proposed rail connects to Mine Site.

Those REs from which the subspecies has been recorded in north Queensland since 1994 (as presented in the *National Recovery Plan for the Black-throated Finch Southern Subspecies* (BTF Recovery Team, 2007) that may represent potentially suitable habitat for the subspecies within the Study Area and within the broader landscape beyond the Study Area, were mapped. Figure 3-3 suggests that suitable habitat for the subspecies is concentrated in the remnant vegetation associated with the Desert Uplands Bioregion. Much of the fragmented patches of remnant vegetation to the north, east and south of the Study Area provides limited potentially suitable habitat for the black-throated finch (southern), based on the underlying RE mapping. Habitat utilisation within the Study Area and beyond will be largely influenced by the degree of connectivity/fragmentation of potential habitat patches, and the presence of the three critical habitat resources required by the subspecies (mosaic of native grasses, nesting trees and access to water - i.e. farm dams, stock troughs, natural water bodies (i.e. rivers and creeks)).

The subspecies has been recorded (post-1998) by the black-throated finch (southern) recovery team within approximately 10-20 km of the Study Area (at Doongmabulla Station) (DSEWPaC, 2011l).



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0 5 10 15 20 25

Kilometres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia (GDA)
Grid: Map Grid of Australia 1994, Zone 55

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Adani Mining Pty Ltd

Carmichael Coal Mine and Rail Project

Location of Black-throated Finch Sightings and Potential Black-throated Finch (southern) Habitat within the Study Area and the Surrounding Landscape

Job Number 41-25215
Revision B
Date 14-09-2012

Figure 3-3
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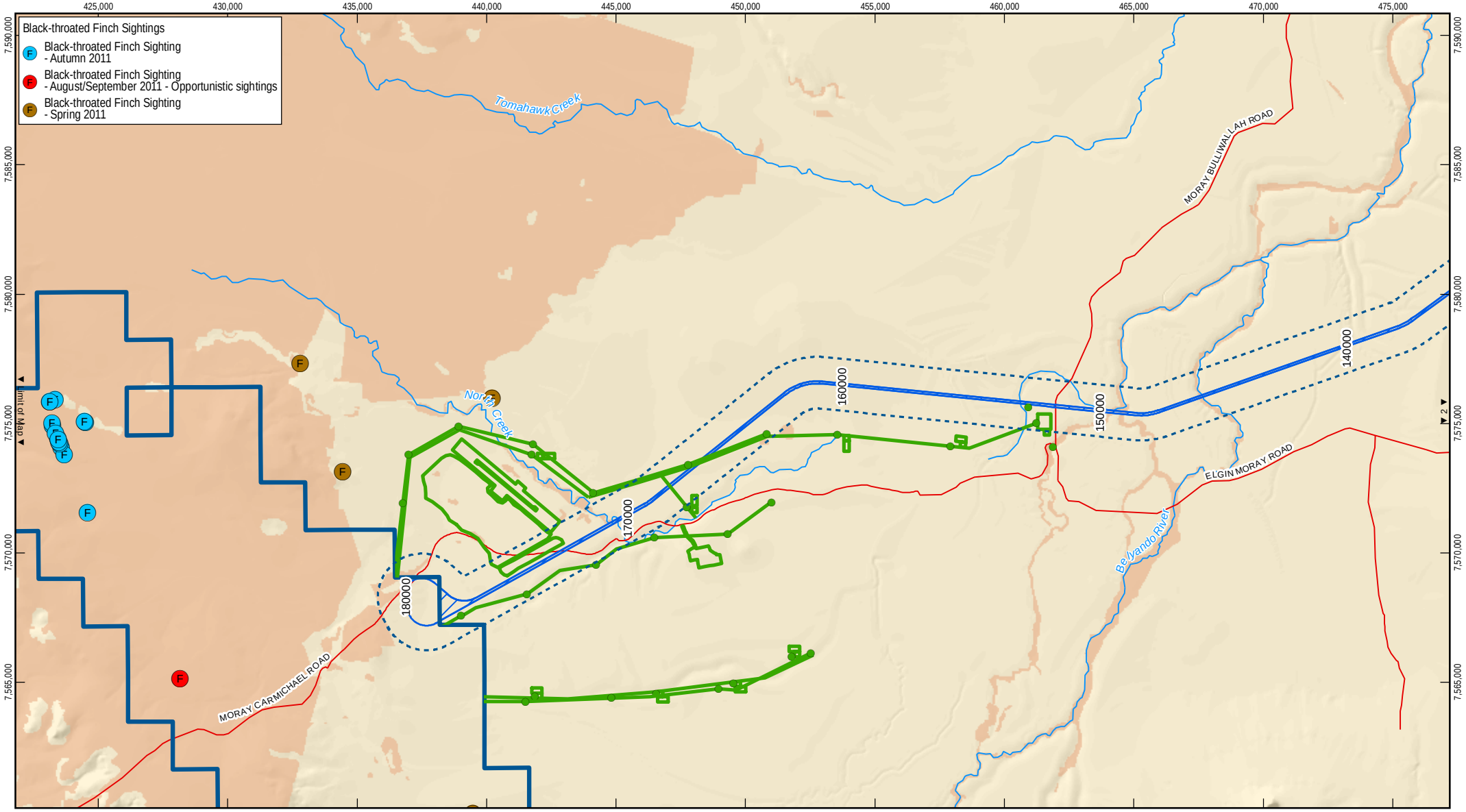

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Kilometres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia (GDA)
Grid: Map Grid of Australia 1994, Zone 55

N

LEGEND

- Town
- Road
- Other Railway
- Watercourse
- Mine (Onsite)
- Mine (Offsite)
- Mine (Offsite)
- Rail (West)
- Rail (East)
- Study Area
- Potential Black-Throated Finch (Southern) Habitat - Based on DERM Certified Regional Ecosystems Version 6.0b

Adani Mining Pty Ltd

Carmichael Coal Mine and Rail Project

Location of Black-throated Finch Sightings and Potential Black-throated Finch (southern) Habitat within the Study Area and the Surrounding Landscape

Job Number 41-25215
Revision B
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Figure 3-3
Sheet 1 of 4

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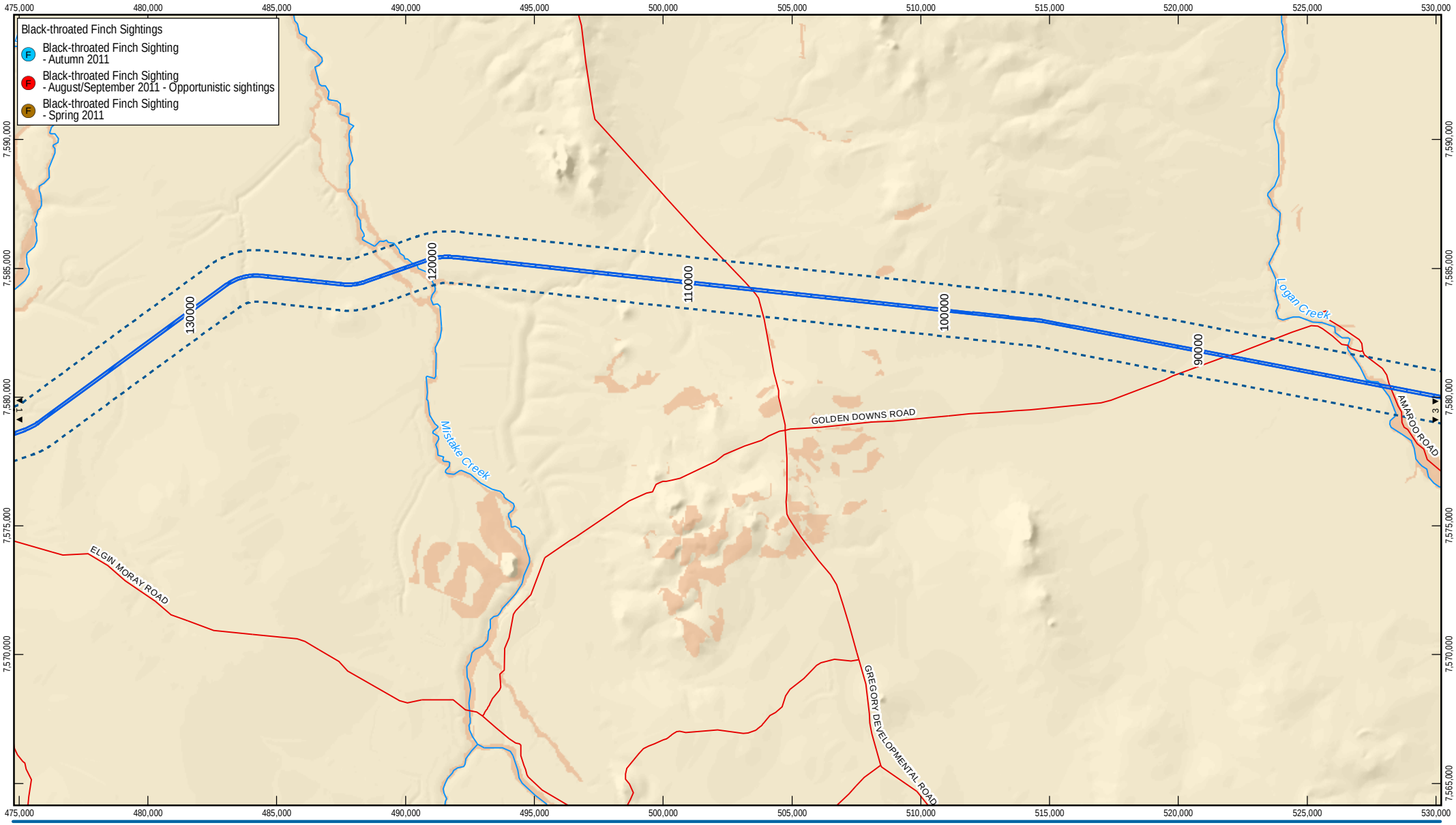

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Kilometres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia (GDA)
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Adani Mining Pty Ltd

Carmichael Coal Mine and Rail Project

Location of Black-throated Finch Sightings and Potential Black-throated Finch (southern) Habitat within the Study Area and the Surrounding Landscape

Job Number 41-25215
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Date 14-09-2012

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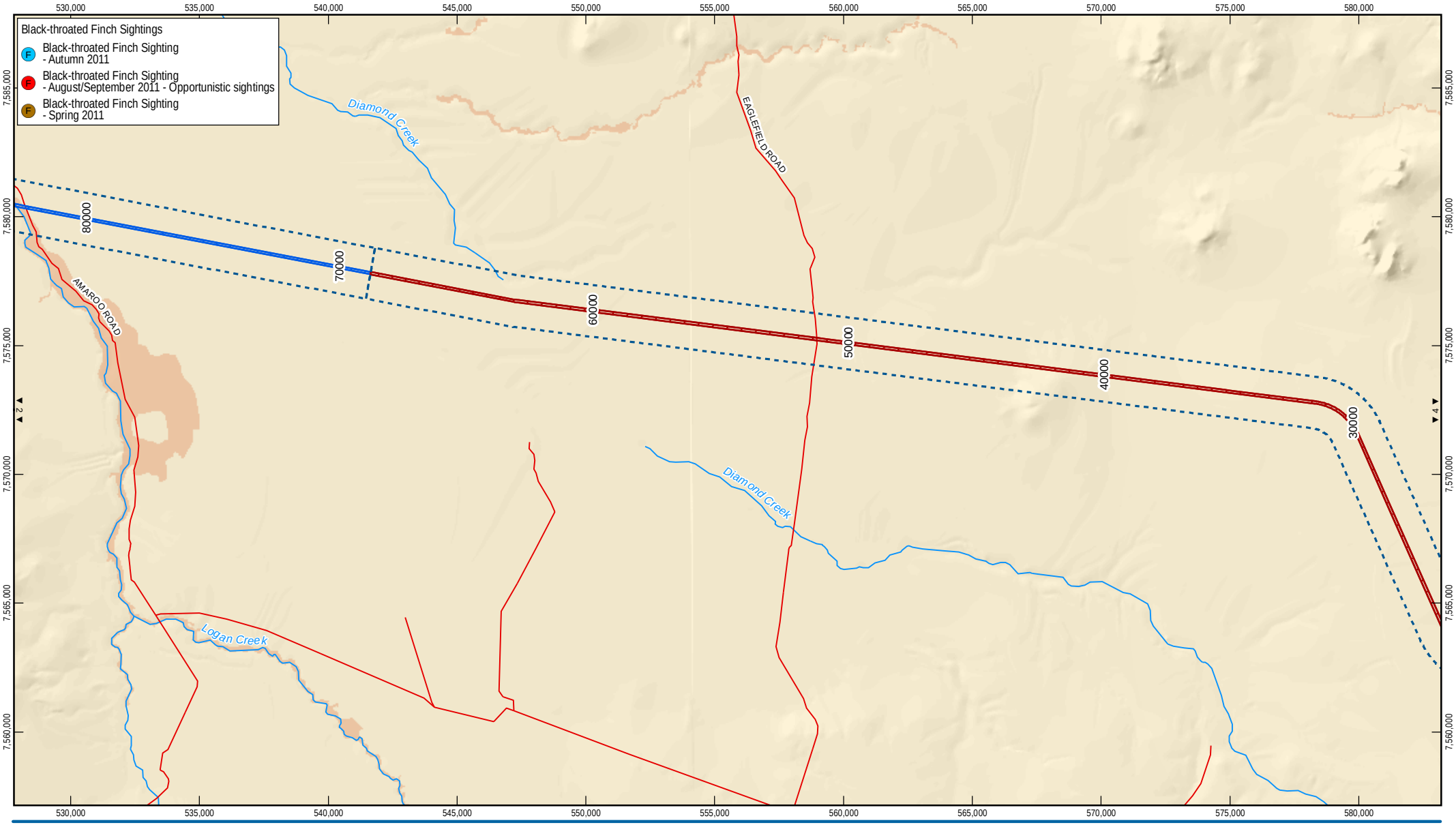

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Kilometres
Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia (GDA)
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LEGEND

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Adani Mining Pty Ltd

Carmichael Coal Mine and Rail Project

Location of Black-throated Finch Sightings and Potential Black-throated Finch (southern) Habitat within the Study Area and the Surrounding Landscape

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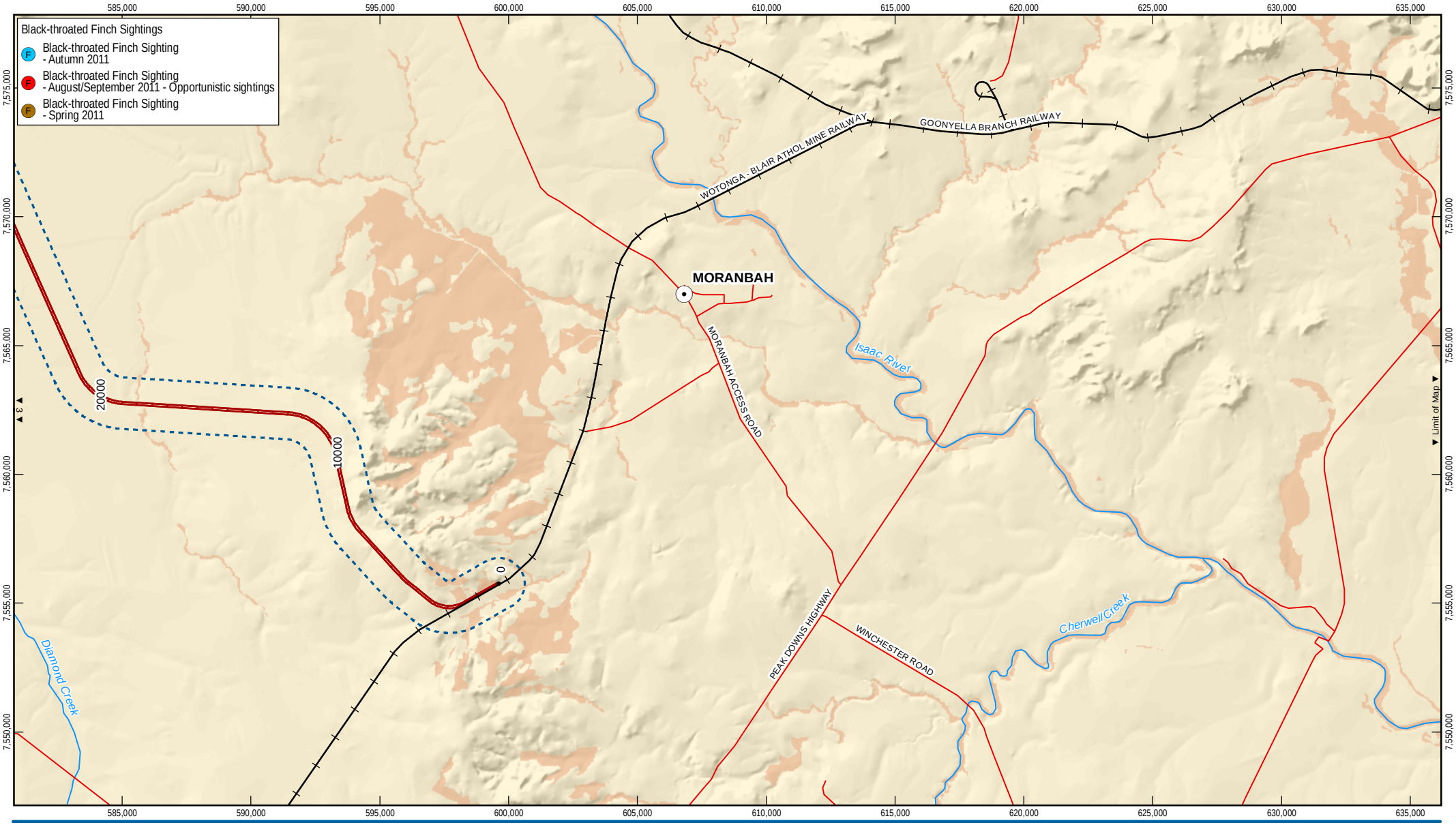

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Kilometres
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N

LEGEND
Town
Road
Other Railway
Watercourse
Mine (Onsite)
Mine (Offsite)
Mine (Offsite)
Rail (West)
Rail (East)
Study Area
Potential Black-Throated Finch (Southern) Habitat - Based on DERM Certified Regional Ecosystems Version 6.0b

Adani Mining Pty Ltd
Carmichael Coal Mine and Rail Project
Location of Black-throated Finch Sightings and Potential Black-throated Finch (southern) Habitat within the Study Area and the Surrounding Landscape

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Figure 3-3
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Koala

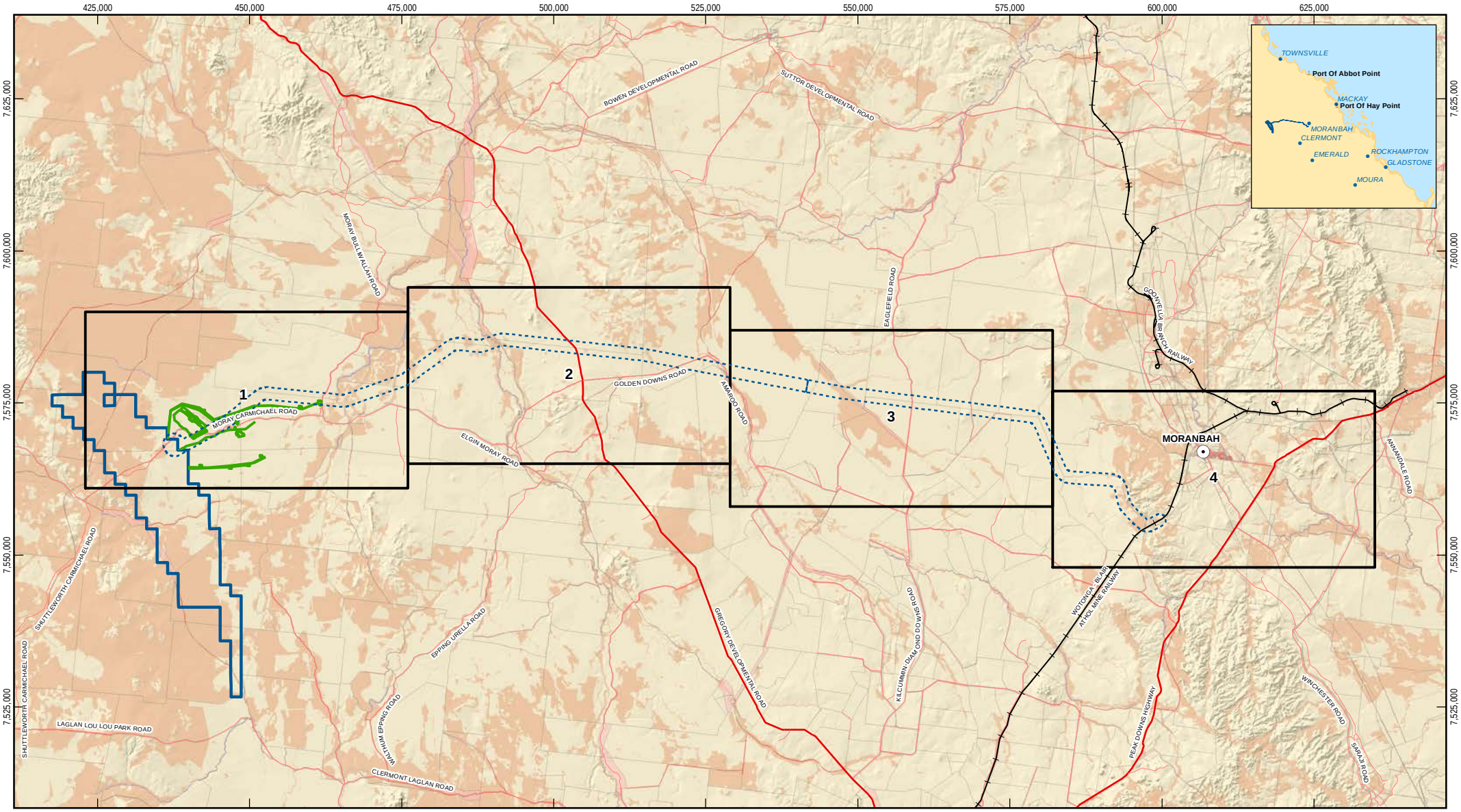
The koala (combined populations of Queensland, New South Wales and Australian Capital Territory) is listed as vulnerable under the EPBC Act. The natural range of this species extends from north-east Queensland to the south-east corner of South Australia. However, the koala's distribution is not continuous across this range and it occurs in a number of populations that are separated by cleared land or unsuitable habitat (DSEWPaC 2012c). Koalas occupy a range of habitats including temperate, sub-tropical and tropical forest, woodland and semi-arid communities dominated eucalypt species (DSEWPaC 2012c). In central Queensland, the species occurs in scattered populations within eucalypt woodlands generally along watercourses. Koalas in the Brigalow Belt bioregion also typically occur in low densities and have large home ranges (DSEWPaC 2012c). Six main threats identified by DSEWPaC (2012c) that have influenced the decline of this species include:

- Habit loss, fragmentation and/or degradation
- Encounter mortality - dogs and cars
- Disease
- Climate change and drought
- Habitat degradation due to over browsing
- Low genetic variability

No koalas were detected during either the May or September field surveys. However, the koala has been previously recorded in the region, particularly within riparian vegetation along watercourses intersected by the Project (Rail) (H. Jones *pers. comm* 07/09/2011). Potential habitat for the koala is considered to include open eucalypt woodland and mature riparian woodland fringing watercourses habitats. Within the rail corridor and infrastructure and construction camps footprints, these habitat types include the following RE types:

- 11.3.3 *Eucalyptus coolabah* woodland on alluvial plains
- 11.3.7 *Corymbia spp*. woodland on alluvial plains. Sandy soils
- 11.3.10 *Eucalyptus brownii* woodland on alluvial plains
- 11.3.25 *Eucalyptus tereticornis* or *E. camaldulensis* woodland fringing drainage lines
- 11.5.3 *Eucalyptus populnea* and/or *E. melanophloia* and/or *Corymbia clarksoniana* on Cainozoic sand plains/remnant surfaces
- 11.5.9c *Eucalyptus crebra* +/- *Corymbia intermedia* +/- *E. moluccana* +/- *C. dallachiana* woodland.

Potential habitat for the koala within the Study Area and broader landscape surrounding the Study Area is mapped in Figure 3-5. Mapping of suitable habitat for this species was based on habitat types considered to be potentially suitable to support the koala (refer Table 2-5).



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Kilometres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia (GDA)
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N

LEGEND

- Town
- State Road
- Local Road
- Other Railway
- Cadastral Parcel
- Road Reserve
- Watercourse Reserve
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- Mine (Offsite)
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- Potential Koala Habitat - Based on DERM Certified Regional Ecosystems Version 6.1b

Adani Mining Pty Ltd

Carmichael Coal Mine and Rail Project

Potential Koala Habitat Within the Study Area and Surrounding Landscape

Job Number 41-25215
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Date 14-09-2012

Figure 3-4
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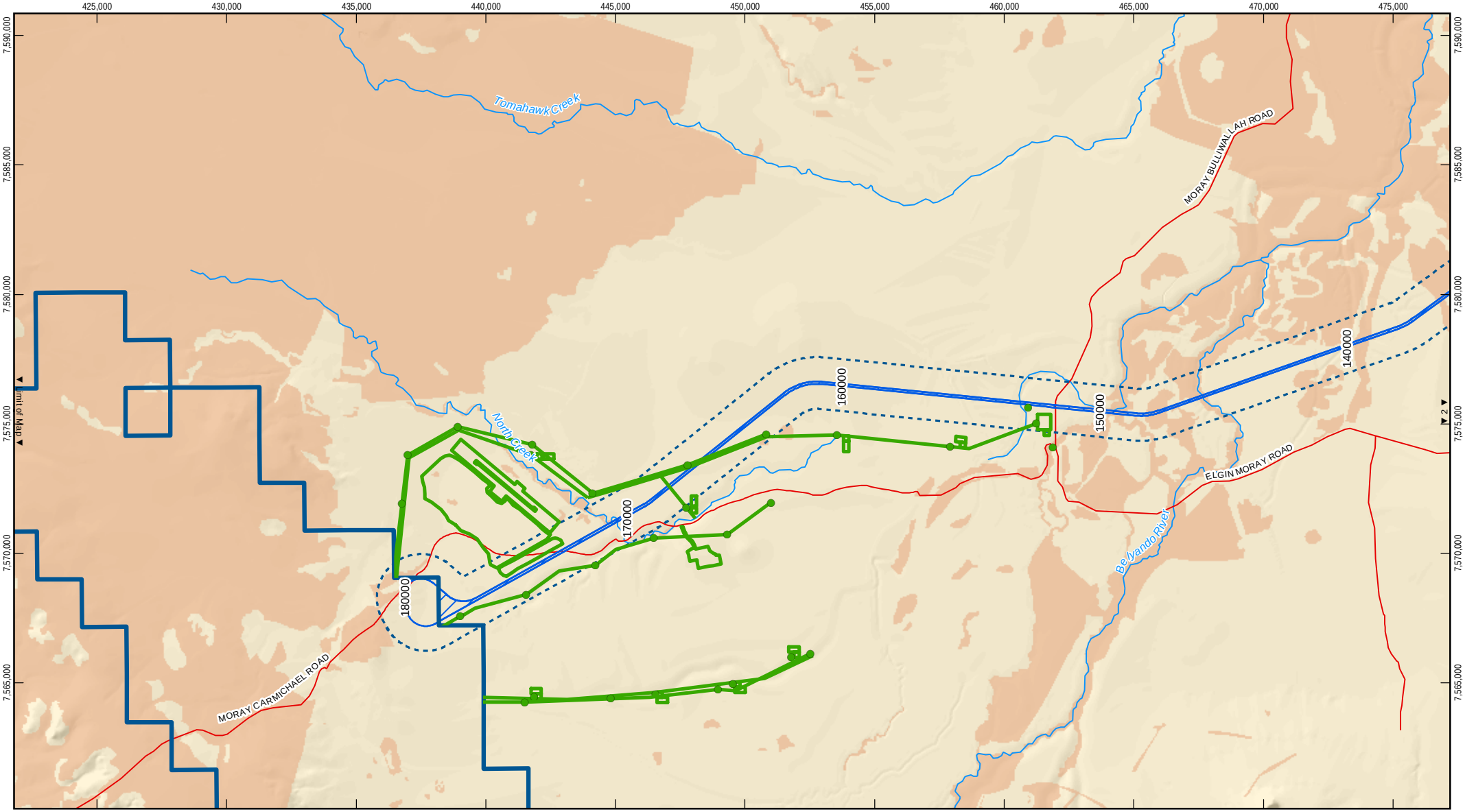

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Kilometres

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LEGEND

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- Watercourse
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- Mine (Offsite)
- Mine (Offsite)
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- Rail (East)
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- Potential Koala Habitat - Based on DERM Certified Regional Ecosystems Version 6.1b

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Carmichael Coal Mine and Rail Project

Potential Koala Habitat Within the Study Area and Surrounding Landscape

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Figure 3-4
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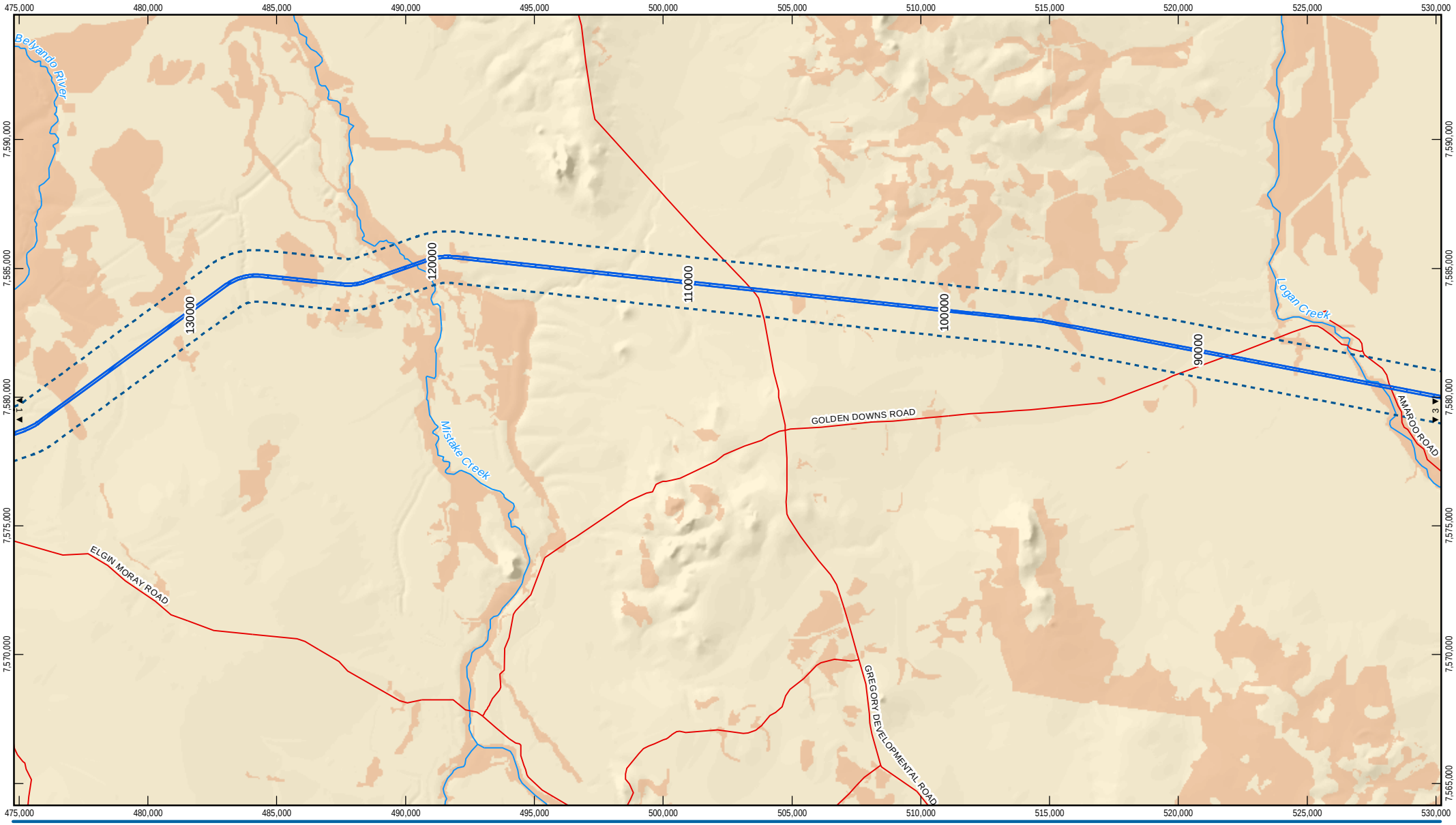

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Carmichael Coal Mine and Rail Project

Potential Koala Habitat Within the Study Area and Surrounding Landscape

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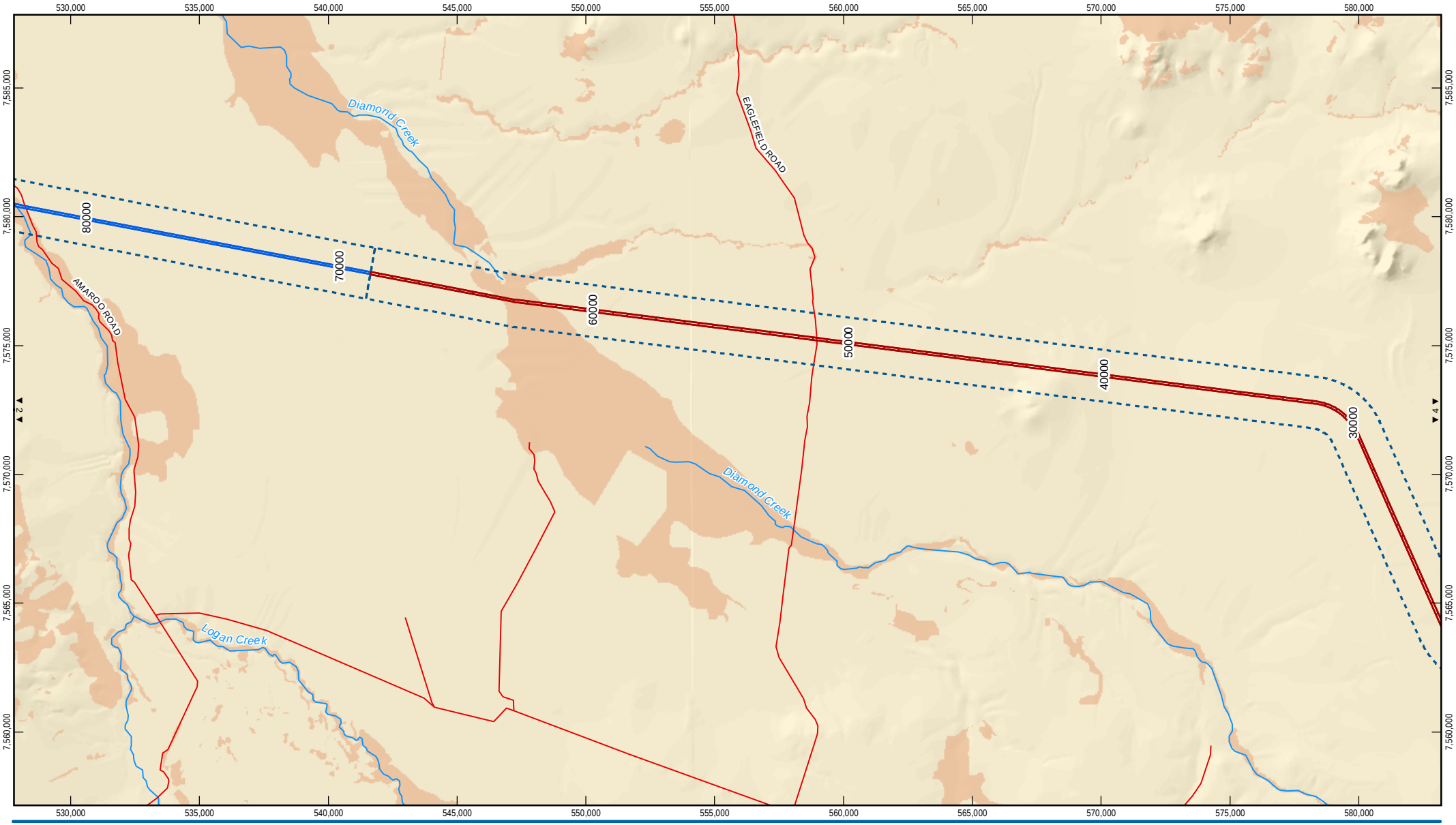

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- Potential Koala Habitat - Based on DERM Certified Regional Ecosystems Version 6.1b

Adani Mining Pty Ltd
Carmichael Coal Mine and Rail Project

Potential Koala Habitat Within the Study Area and Surrounding Landscape

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Figure 3-4
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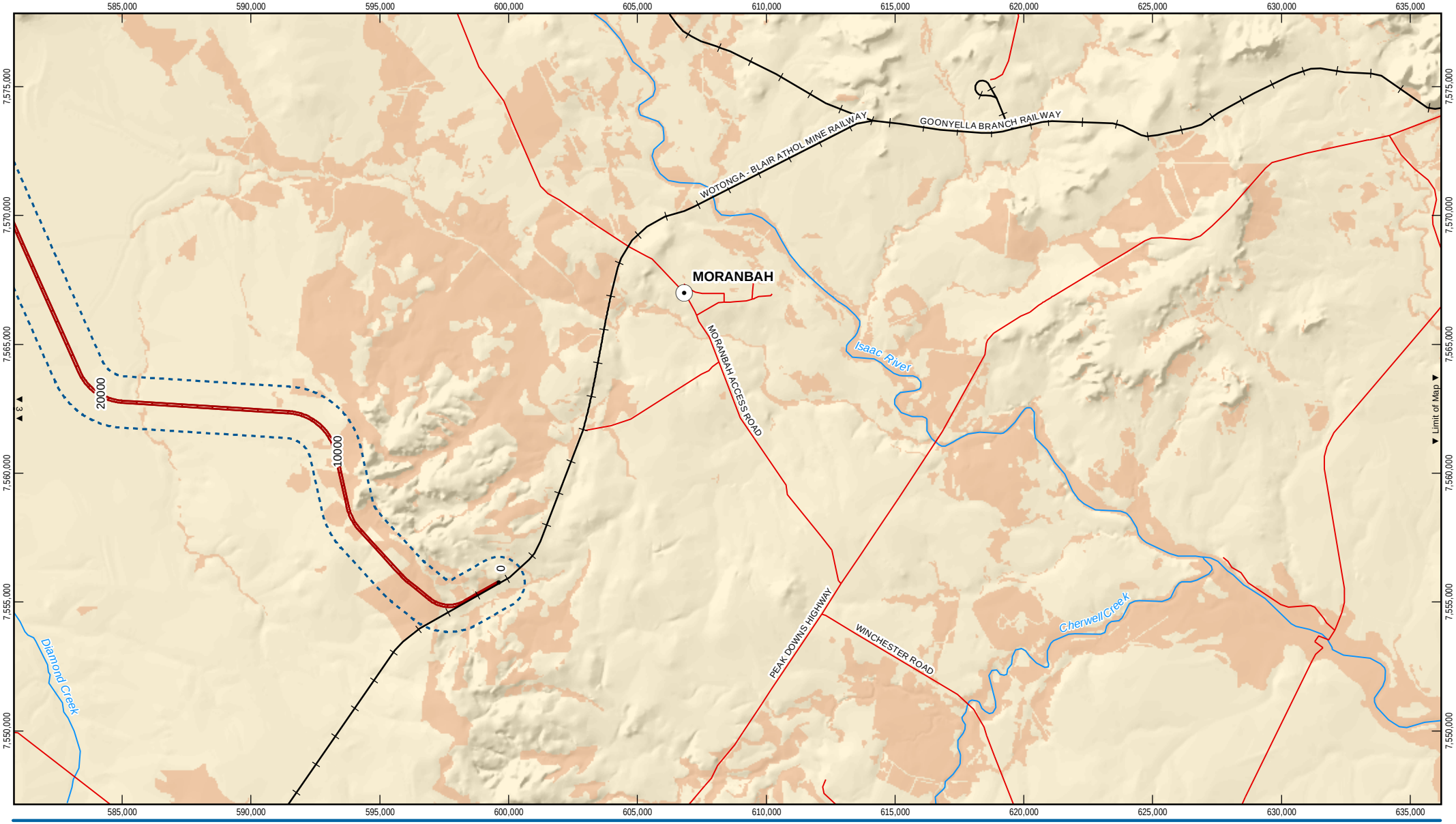

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Potential Koala Habitat Within the Study Area and Surrounding Landscape

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Listed threatened fauna – May Occur

The likelihood of occurrence assessment indicated that the following EPBC Act-listed threatened species may occur at the Study Area, based on distribution and/or presence of potentially suitable habitat:

- Yakka skink (*Egernia rugosa*) – vulnerable EPBC Act, vulnerable NC Act
- Dunmall's snake (*Furina dunmalli*) – vulnerable EPBC Act, vulnerable NC Act
- Brigalow scaly-foot (*Paradelma orientalis*) – vulnerable EPBC Act, vulnerable NC Act
- Northern quoll (*Dasyurus hallucatus*) –endangered EPBC Act, not listed NC Act
- Greater long-eared bat (*Nyctophilus timoriensis*) (south-eastern form) – vulnerable EPBC Act, vulnerable NC Act
- Red goshawk (*Erythrotriorchis radiatus*) – vulnerable EPBC Act, endangered NC Act
- Australian painted snipe (*Rostratula australis*) – vulnerable EPBC Act, vulnerable NC Act

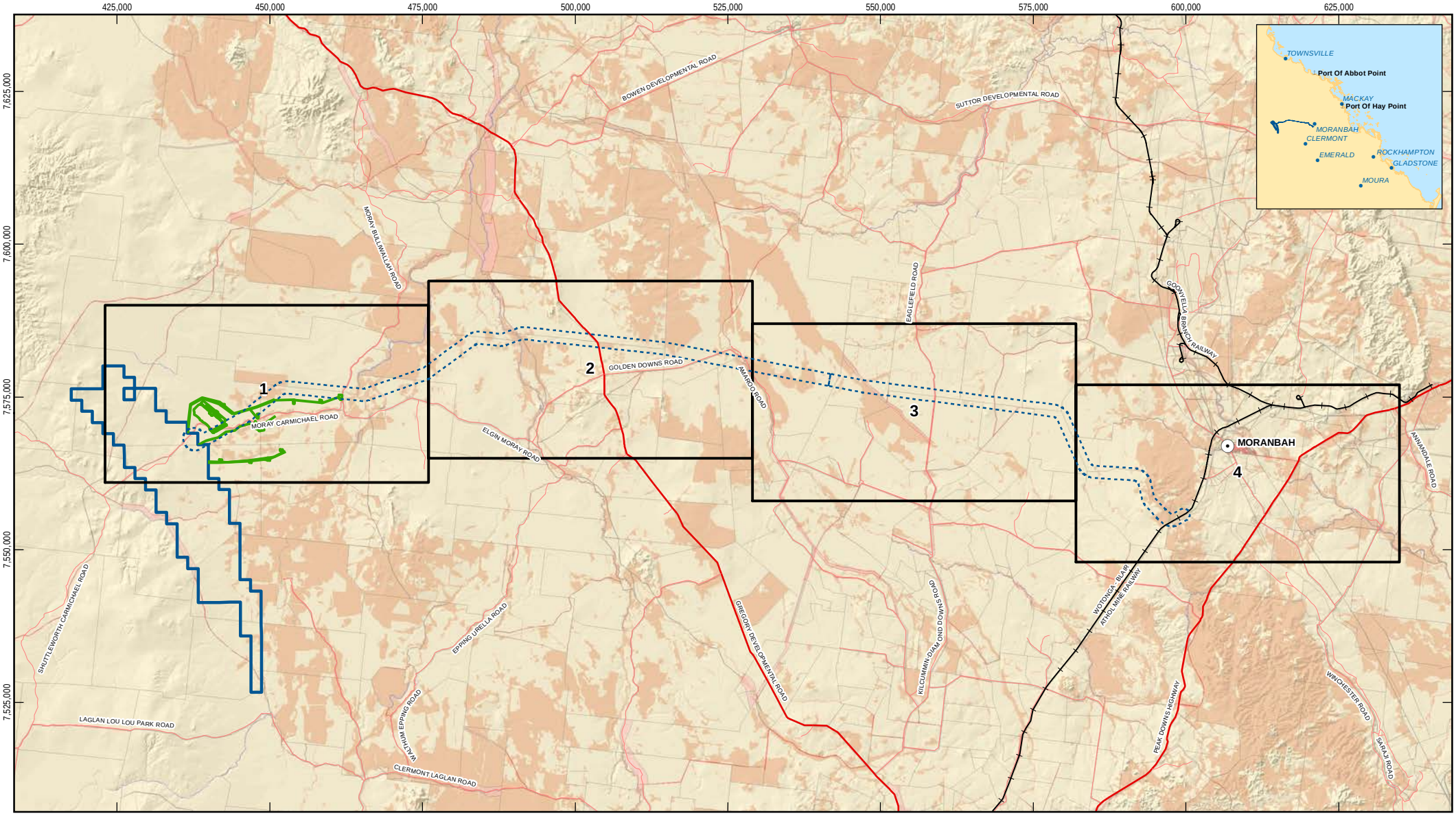
These species were not detected during field studies at the Study Area. They may occur based on the presence of suitable habitat (as depicted in Figure 2-3), namely:

- *Eucalypt open woodland with native grass understorey* – yakka skink, brigalow scaly-foot, red goshawk, great long-eared bat, northern quoll (easternmost part of Study Area only)
- *Gidgee or mixed acacia woodland, on clay and clay loam plains with sparse shrub layer* – brigalow scaly-foot, yakka skink, red goshawk, Dunmall's snake
- *Brigalow shrubby woodland or open forest typically on clay and clay loam plains* – brigalow scaly-foot, yakka skink, Dunmall's snake
- *Eucalypt and acacia mixed woodland or forest often on clay soils* – brigalow scaly-foot, yakka skink, red goshawk, greater long-eared bat, northern quoll (easternmost part of Study Area only)
- *Riparian woodland or forest fringing watercourses, and coolabah open woodland on grassy floodplain often with weedy understorey* – yakka skink, red goshawk, greater long-eared bat, northern quoll (easternmost part of Study Area only)
- *Natural and artificial water bodies* – Australian painted snipe, red goshawk

Refer to Table 2-3 for the flora attributes, and Table 2-5 for the general habitat characteristics of each habitat type listed above.

Potential habitat for these three species within the Study Area and broader landscape is presented in the following figures:

- Yakka skink (Egernia rugosa) - Figure 3-5
- Dunmall's snake (*Furina dunmalli*) - Figure 3-6
- Brigalow scaly-foot (*Paradelma orientalis*) - Figure 3-7
- Greater long-eared bat (*Nyctophilus timoriensis*) (south-eastern form) - Figure 3-8
- Northern quoll (*Dasyurus hallucatus*) – Figure Figure 3-9
- Red goshawk (*Erythrotriorchis radiatus*) - Figure 3-9
- Australia painted snipe (*Rostratula australus*) - Figure 3-10



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Kilometres

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Carmichael Coal Mine and Rail Project

Potential Yakka Skink Habitat Within the Study Area and Surrounding Landscape

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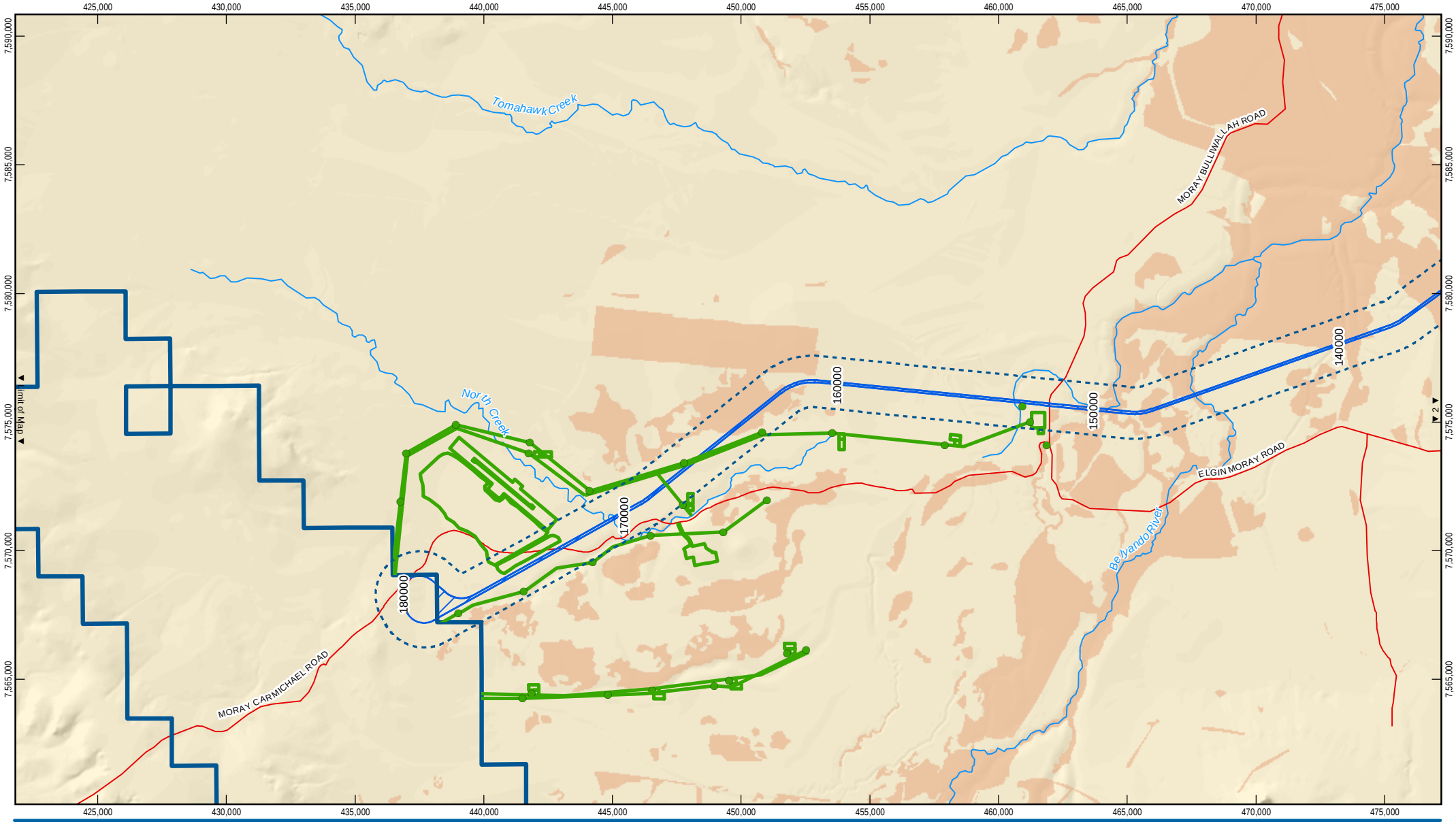

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Potential Yakka Skink Habitat Within the Study Area and Surrounding Landscape

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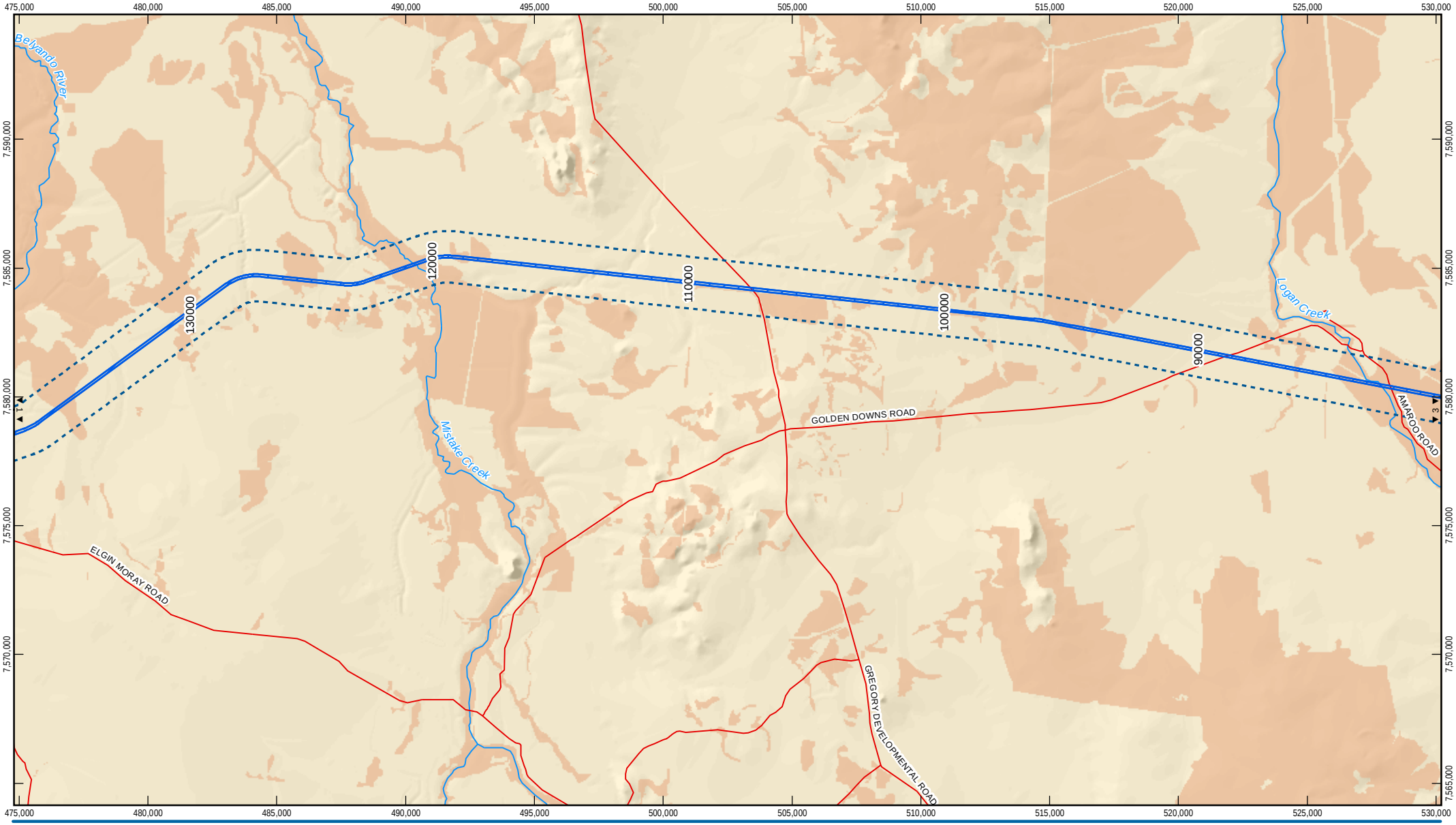

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Carmichael Coal Mine and Rail Project

Potential Yakka Skink Habitat Within the Study Area and Surrounding Landscape

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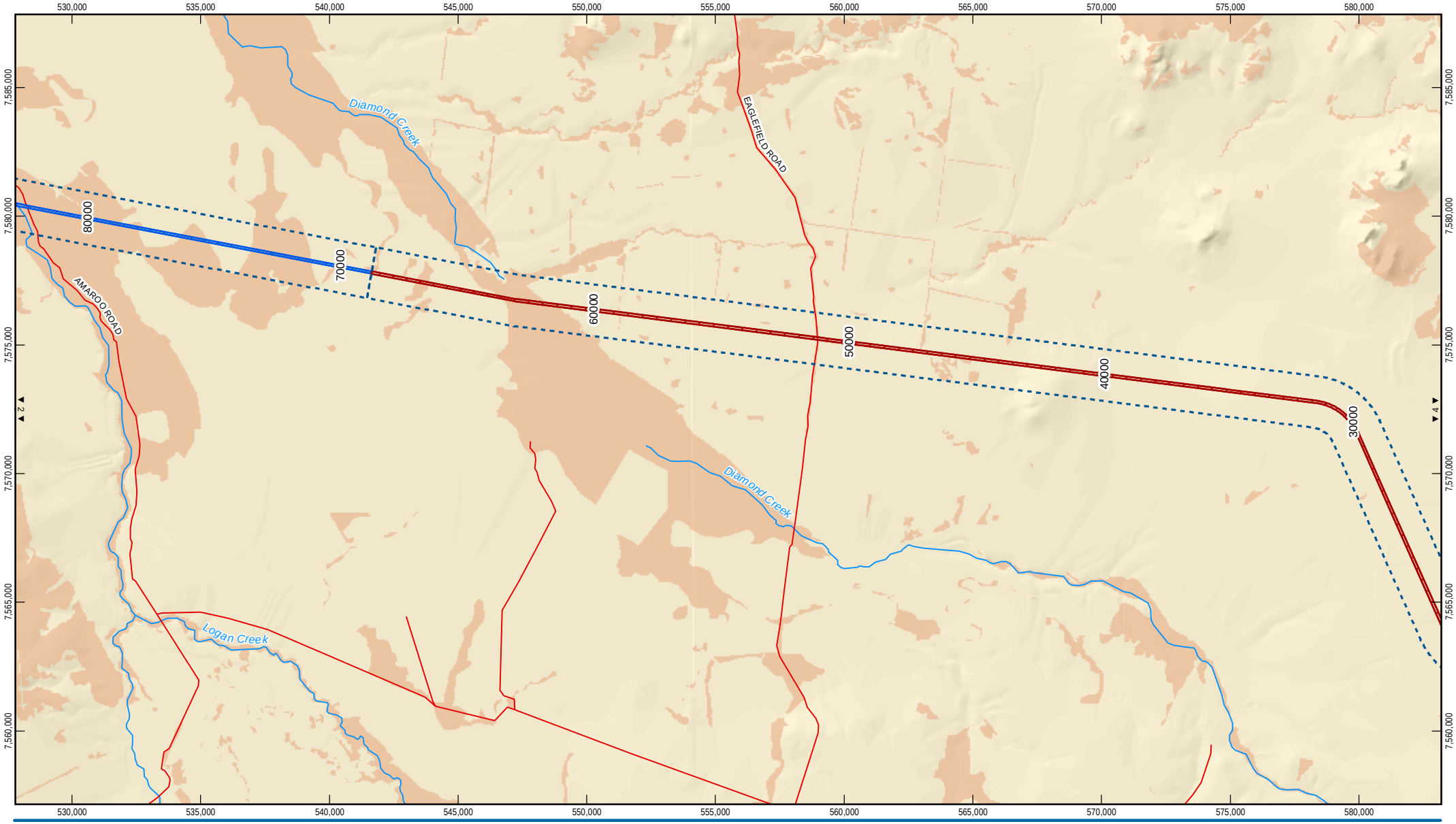
Data source: DERM: DEM (2008), © Commonwealth of Australia (Geoscience Australia): Localities, Railways, Roads, Watercourse (2007); GHD: Potential Yakka Skink Habitat (2011); Adani: Alignment Opt9 Rev3 (2012); DME: EPC1690 (2010) / EPC1080 (2011); Gassman/Hyder: Mine (Offsite) (2012). Created by: MR, CA



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Kilometres
Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia (GDA)
Grid: Map Grid of Australia 1994, Zone 55

N

LEGEND

- Town
- Road
- Other Railway
- Watercourse
- Mine (Onsite)
- Mine (Offsite)
- Mine (Offsite)
- Rail (West)
- Rail (East)
- Study Area
- Potential Yakka Skink Habitat - Based on DERM Certified Regional Ecosystems Version 6.0b

Adani Mining Pty Ltd
Carmichael Coal Mine and Rail Project

Potential Yakka Skink Habitat Within the Study Area and Surrounding Landscape

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Level 4, 201 Charlotte St Brisbane QLD 4000 T +61 7 3316 3000 F +61 7 3316 3333 E bnemail@ghd.com W www.ghd.com

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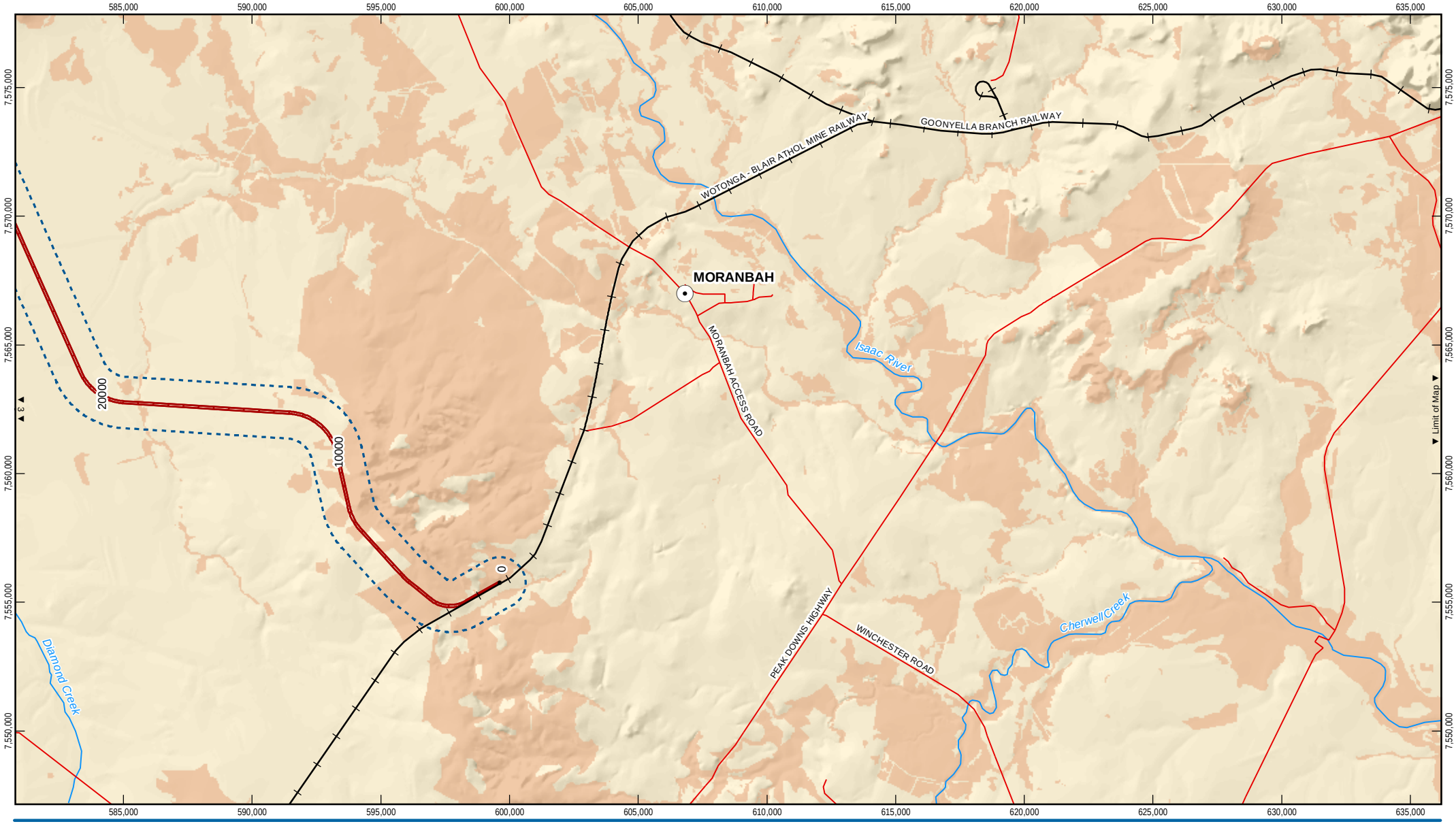

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0 1 2 3 4 5

Kilometres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia (GDA)
Grid: Map Grid of Australia 1994, Zone 55

N

LEGEND

- Town
- Road
- Other Railway
- Watercourse
- Mine (Onsite)
- Mine (Offsite)
- Mine (Offsite)
- Rail (West)
- Rail (East)
- Study Area
- Potential Yakka Skink Habitat - Based on DERM Certified Regional Ecosystems Version 6.0b

Adani Mining Pty Ltd

Carmichael Coal Mine and Rail Project

Potential Yakka Skink Habitat Within the Study Area and Surrounding Landscape

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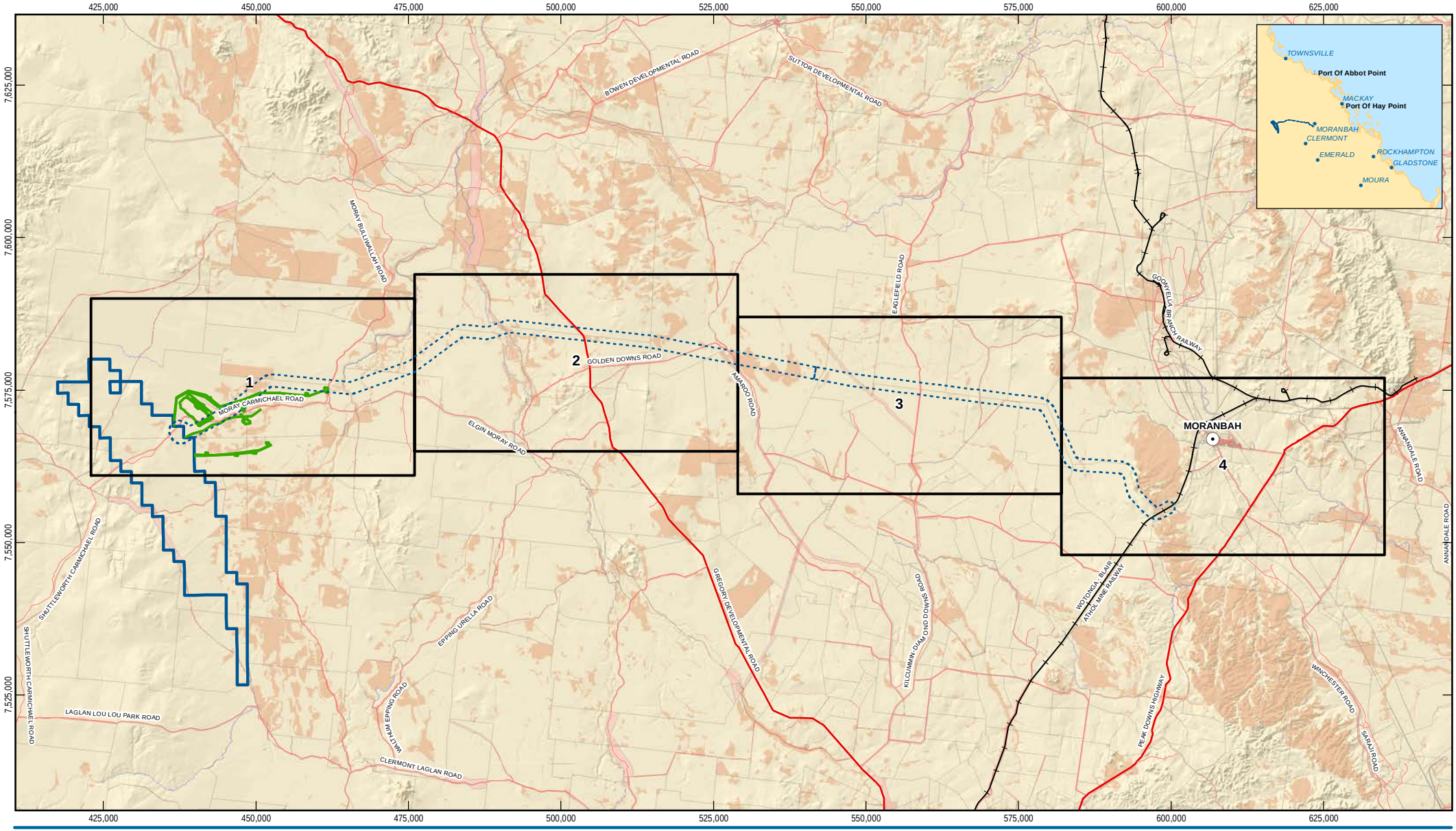

1:850,000 (at A4)

0 5 10 15 20 25

Kilometres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia (GDA)
Grid: Map Grid of Australia 1994, Zone 55

N

LEGEND

- Town
- State Road
- Local Road
- Other Railway
- Cadastral Parcel
- Road Reserve
- Watercourse Reserve
- Mine (Onsite)
- Mine (Offsite)
- Study Area
- Potential Dunmall's Snake Habitat - Based on DERM Certified Regional Ecosystems Version 6.0b

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Carmichael Coal Mine and Rail Project

Potential Dunmall's Snake Habitat Within the Study Area and Surrounding Landscape

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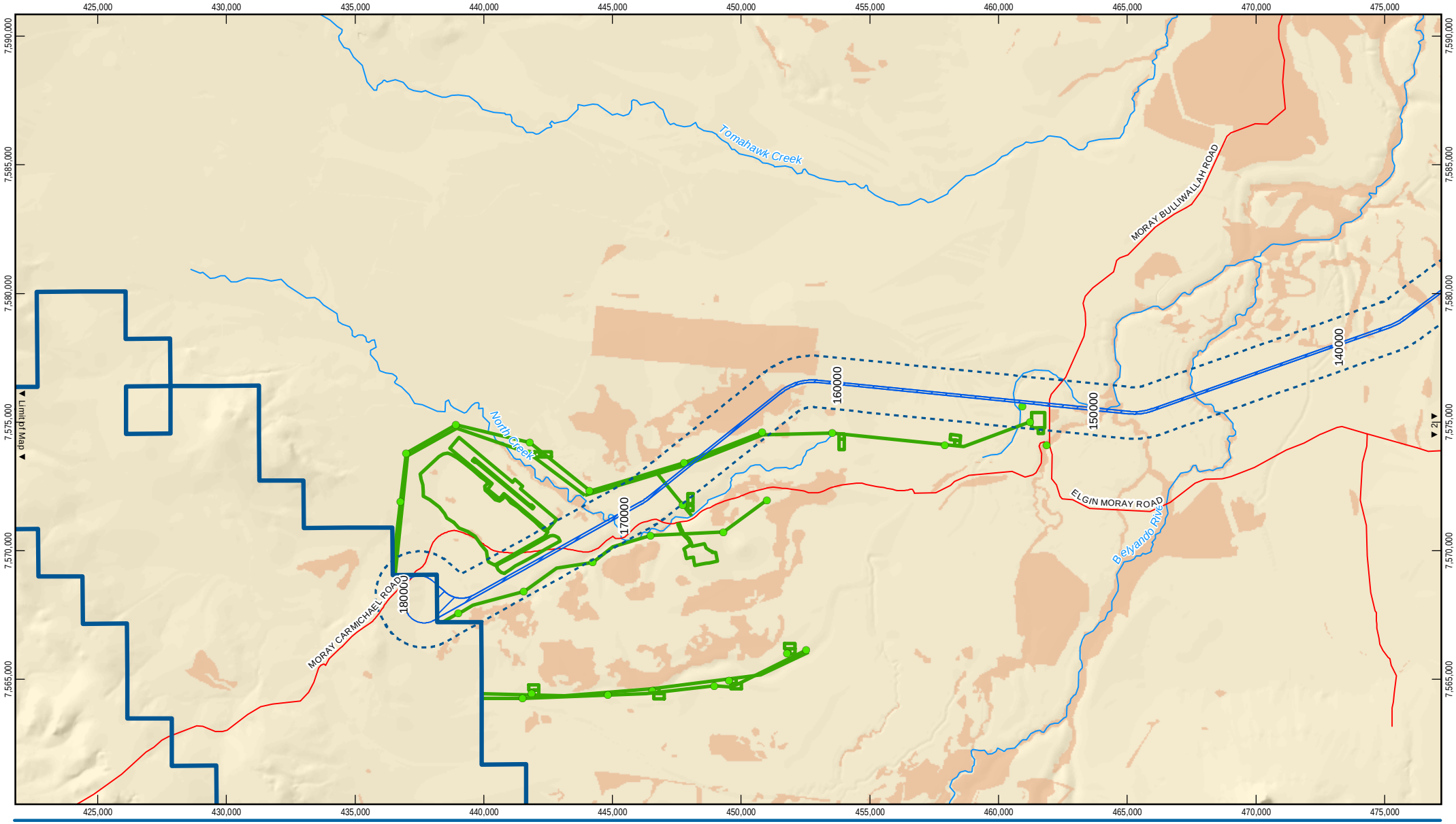

1:200,000 (at A4)

0 1 2 3 4 5

Kilometres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia (GDA)
Grid: Map Grid of Australia 1994, Zone 55

N

LEGEND

- Town
- State Road
- Local Road
- Other Railway
- Watercourse
- Study Area
- Mine (Onsite)
- Mine (Offsite)
- Mine (Offsite)
- Rail (West)
- Rail (East)
- Potential Dunmall's Snake Habitat - Based on DERM Certified Regional Ecosystems Version 6.0b

Adani Mining Pty Ltd

Carmichael Coal Mine and Rail Project

Potential Dunmall's Snake Habitat Within the Study Area and Surrounding Landscape

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Figure 3-6
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G:\41\25215\GIS\Maps\MXD\400_Ecology\41-25215_464_200k_rev_b.mxd Level 4, 201 Charlotte St Brisbane QLD 4000 T +61 7 3316 3000 F +61 7 3316 3333 E bnemail@ghd.com W www.ghd.com

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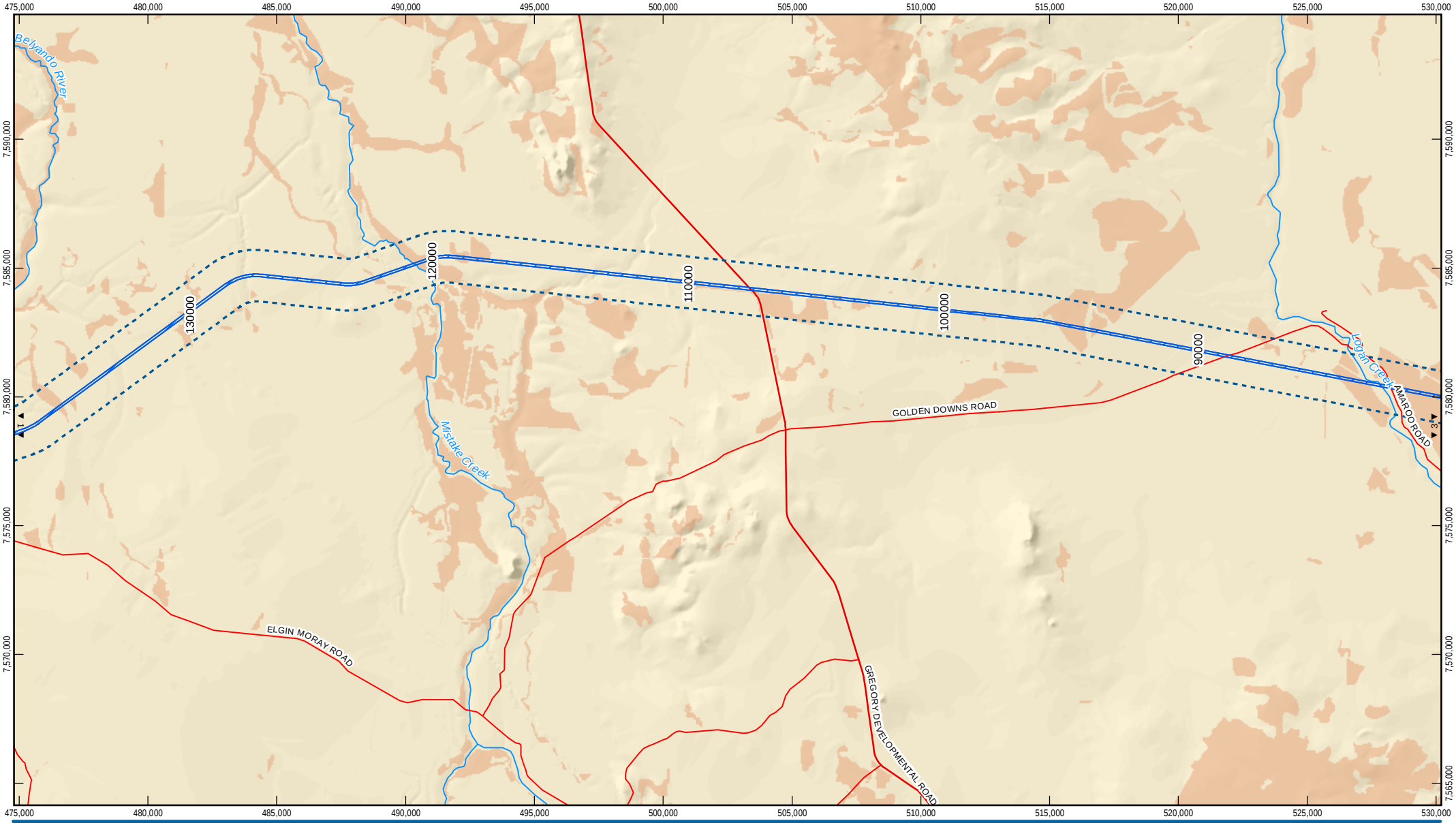

1:200,000 (at A4)

0 1 2 3 4 5

Kilometres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia (GDA)
Grid: Map Grid of Australia 1994, Zone 55

N

LEGEND

- Town
- State Road
- Local Road
- Other Railway
- Watercourse
- Study Area
- Mine (Onsite)
- Mine (Offsite)
- Mine (Offsite)
- Rail (West)
- Rail (East)
- Potential Dunmall's Snake Habitat - Based on DERM Certified Regional Ecosystems Version 6.0b

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Potential Dunmall's Snake Habitat Within the Study Area and Surrounding Landscape

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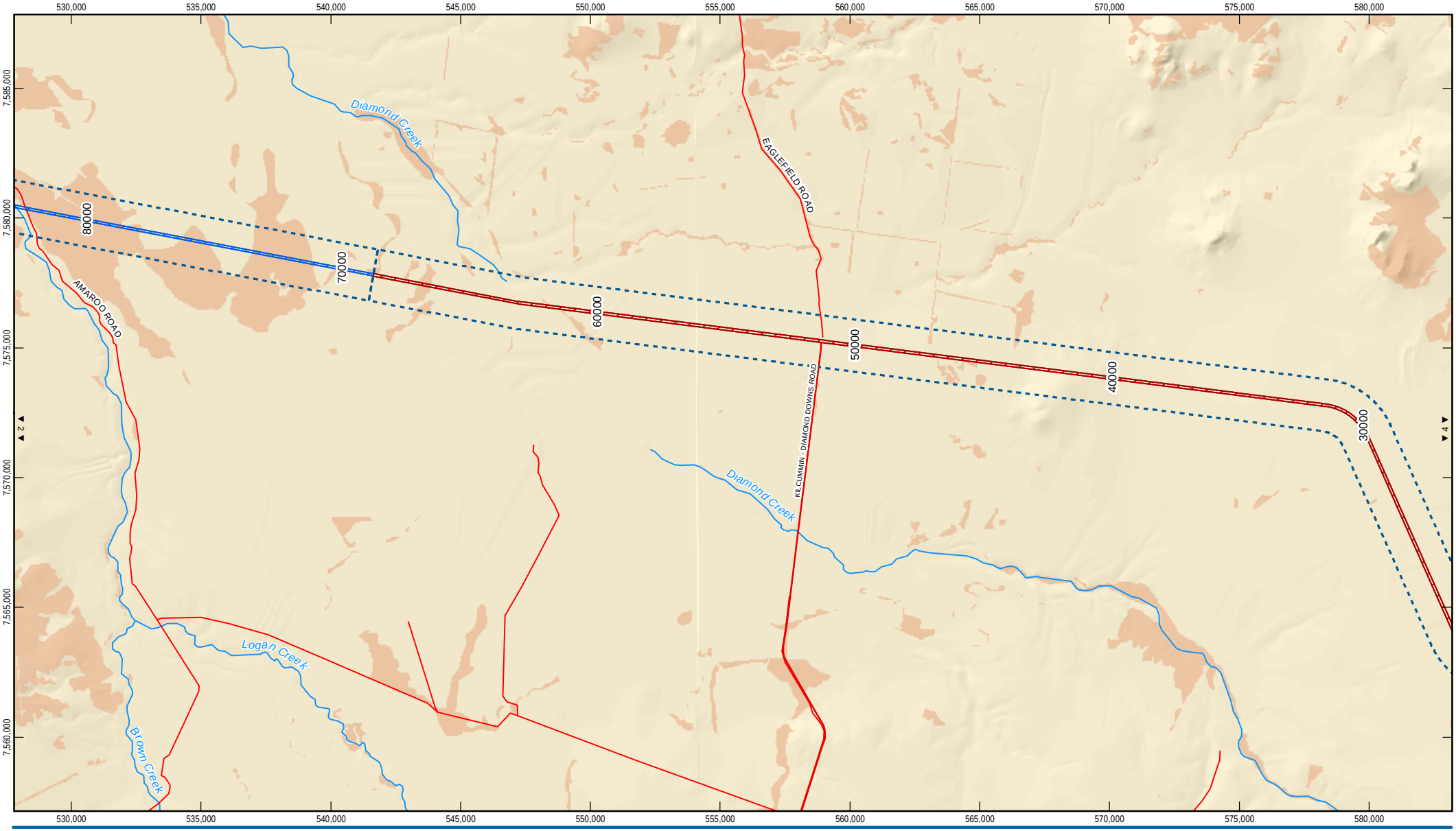

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Kilometres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia (GDA)
Grid: Map Grid of Australia 1994, Zone 55

N

LEGEND

- Town
- State Road
- Local Road
- Other Railway
- Watercourse
- Study Area
- Mine (Onsite)
- Mine (Offsite)
- Mine (Offsite)
- Rail (West)
- Rail (East)
- Potential Dunmall's Snake Habitat - Based on DERM Certified Regional Ecosystems Version 6.0b

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Potential Dunmall's Snake Habitat Within the Study Area and Surrounding Landscape

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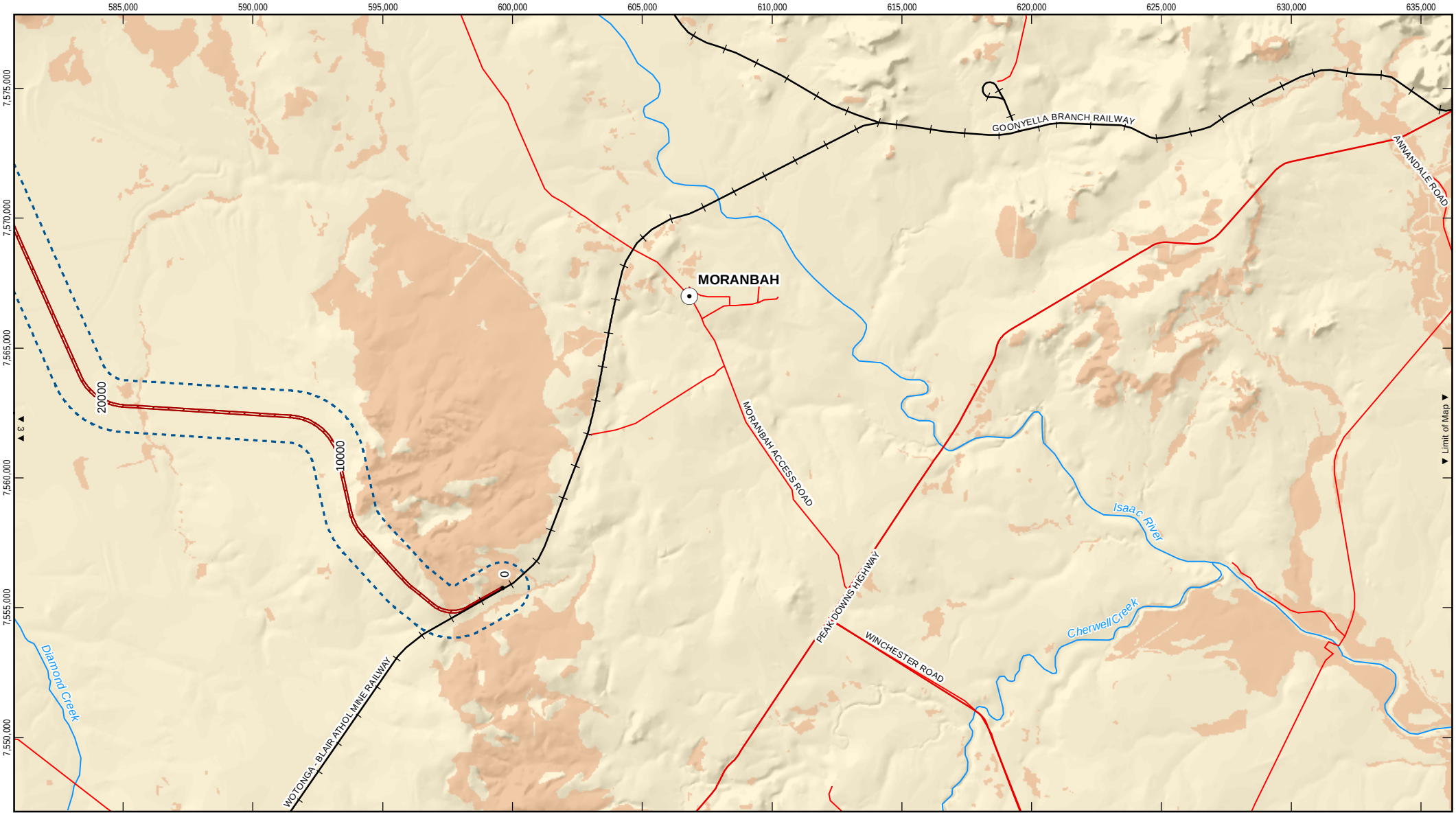

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Kilometres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia (GDA)
Grid: Map Grid of Australia 1994, Zone 55

N

LEGEND

- Town
- State Road
- Local Road
- Other Railway
- Watercourse
- Study Area
- Mine (Onsite)
- Mine (Offsite)
- Mine (Offsite)
- Rail (West)
- Rail (East)
- Potential Dunmall's Snake Habitat - Based on DERM Certified Regional Ecosystems Version 6.0b

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Potential Dunmall's Snake Habitat Within the Study Area and Surrounding Landscape

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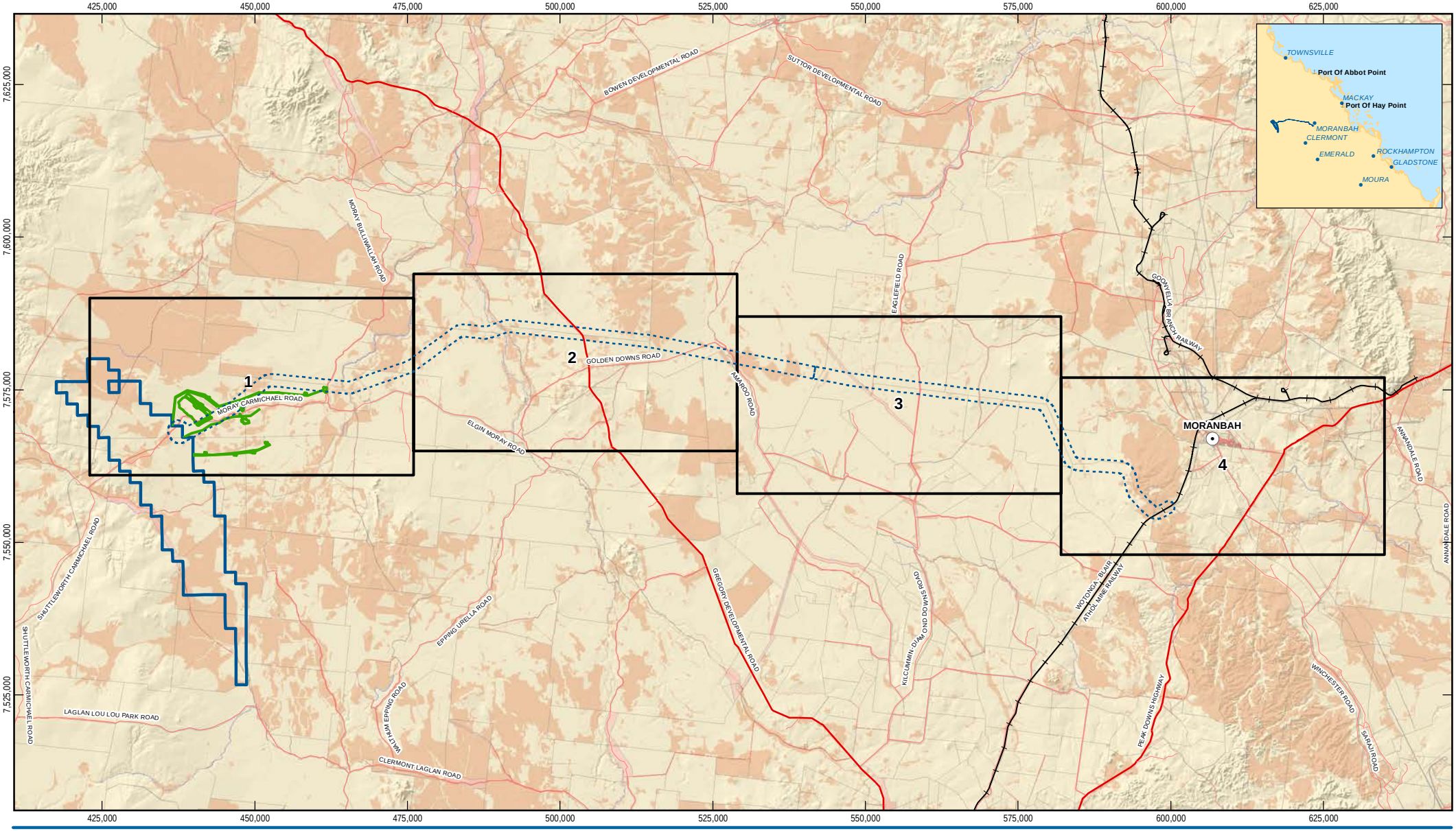

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0 5 10 15 20 25

Kilometres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia (GDA)
Grid: Map Grid of Australia 1994, Zone 55

N

LEGEND

- Town
- State Road
- Local Road
- Other Railway
- Cadastral Parcel
- Road Reserve
- Watercourse Reserve
- Mine (Onsite)
- Mine (Offsite)
- Study Area
- Potential Brigalow Scaly-foot Habitat - Based on DERM Certified Regional Ecosystems Version 6.0b

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Carmichael Coal Mine and Rail Project

Potential Brigalow Scaly-foot Habitat Within the Study Area and Surrounding Landscape

Job Number 41-25215
Revision B
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Figure 3-7
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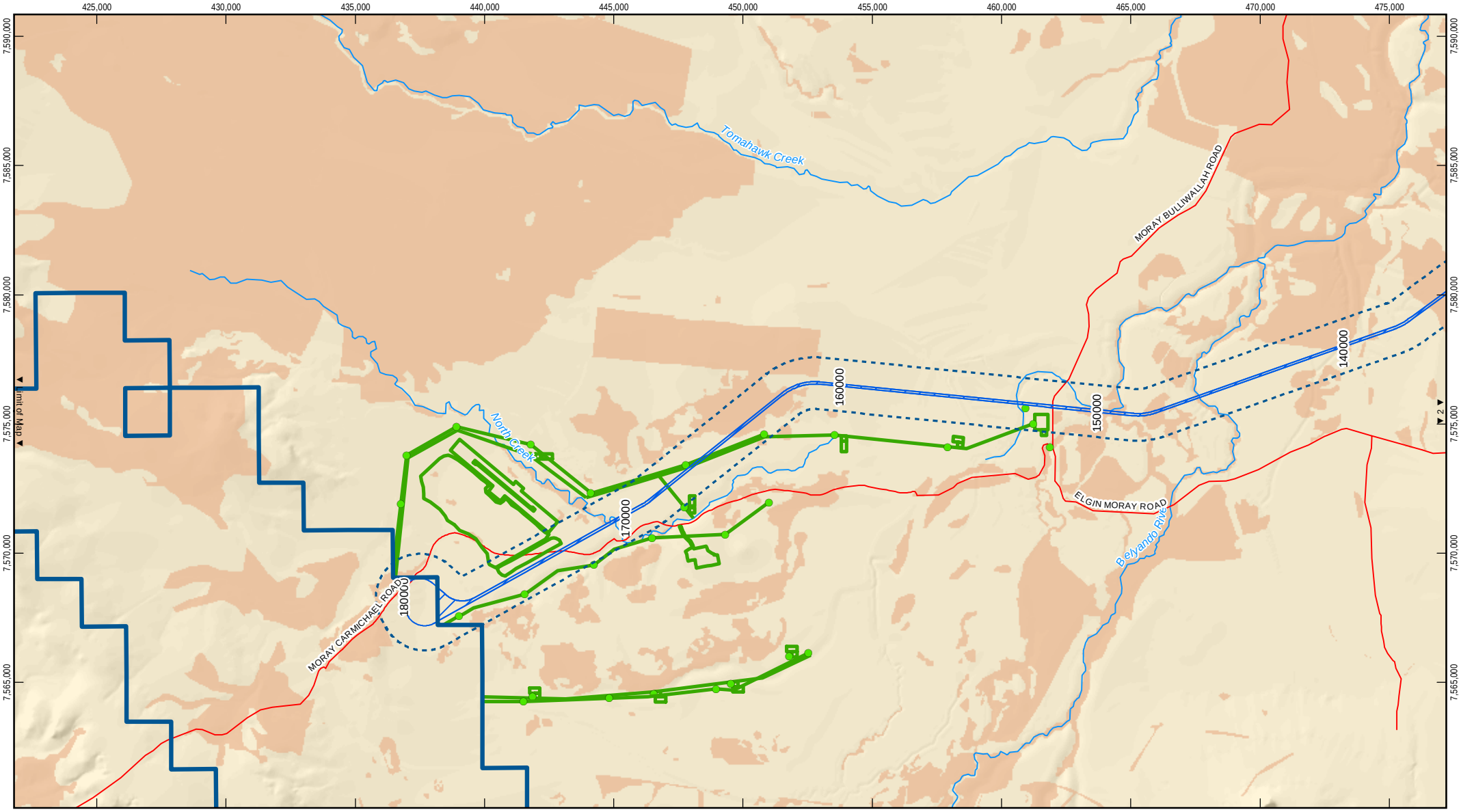

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0 1 2 3 4 5

Kilometres

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Horizontal Datum: Geocentric Datum of Australia (GDA)
Grid: Map Grid of Australia 1994, Zone 55

N

LEGEND

- Town
- State Road
- Local Road
- Other Railway
- Watercourse
- Study Area
- Mine (Onsite)
- Mine (Offsite)
- Mine (Offsite)
- Rail (West)
- Rail (East)
- Potential Brigalow Scaly-foot Habitat - Based on DERM Certified Regional Ecosystems Version 6.0b

Adani Mining Pty Ltd

Carmichael Coal Mine and Rail Project

Potential Brigalow Scaly-foot Habitat Within the Study Area and Surrounding Landscape

Job Number	41-25215
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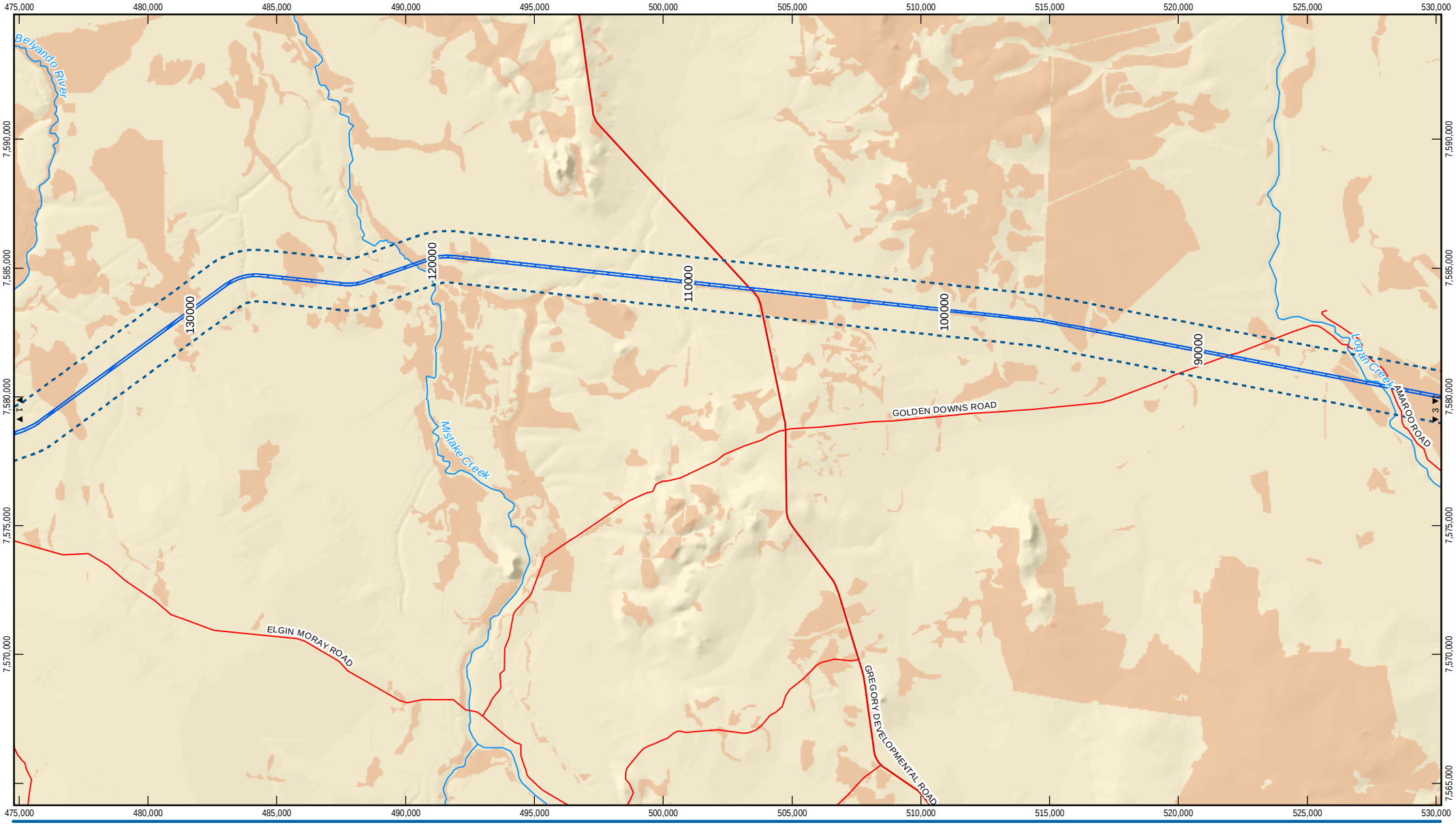

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0 1 2 3 4 5

Kilometres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia (GDA)
Grid: Map Grid of Australia 1994, Zone 55

N

LEGEND

- Town
- State Road
- Local Road
- Other Railway
- Watercourse
- Study Area
- Mine (Onsite)
- Mine (Offsite)
- Mine (Offsite)
- Rail (West)
- Rail (East)
- Potential Brigalow Scaly-foot Habitat - Based on DERM Certified Regional Ecosystems Version 6.0b

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Potential Brigalow Scaly-foot Habitat Within the Study Area and Surrounding Landscape

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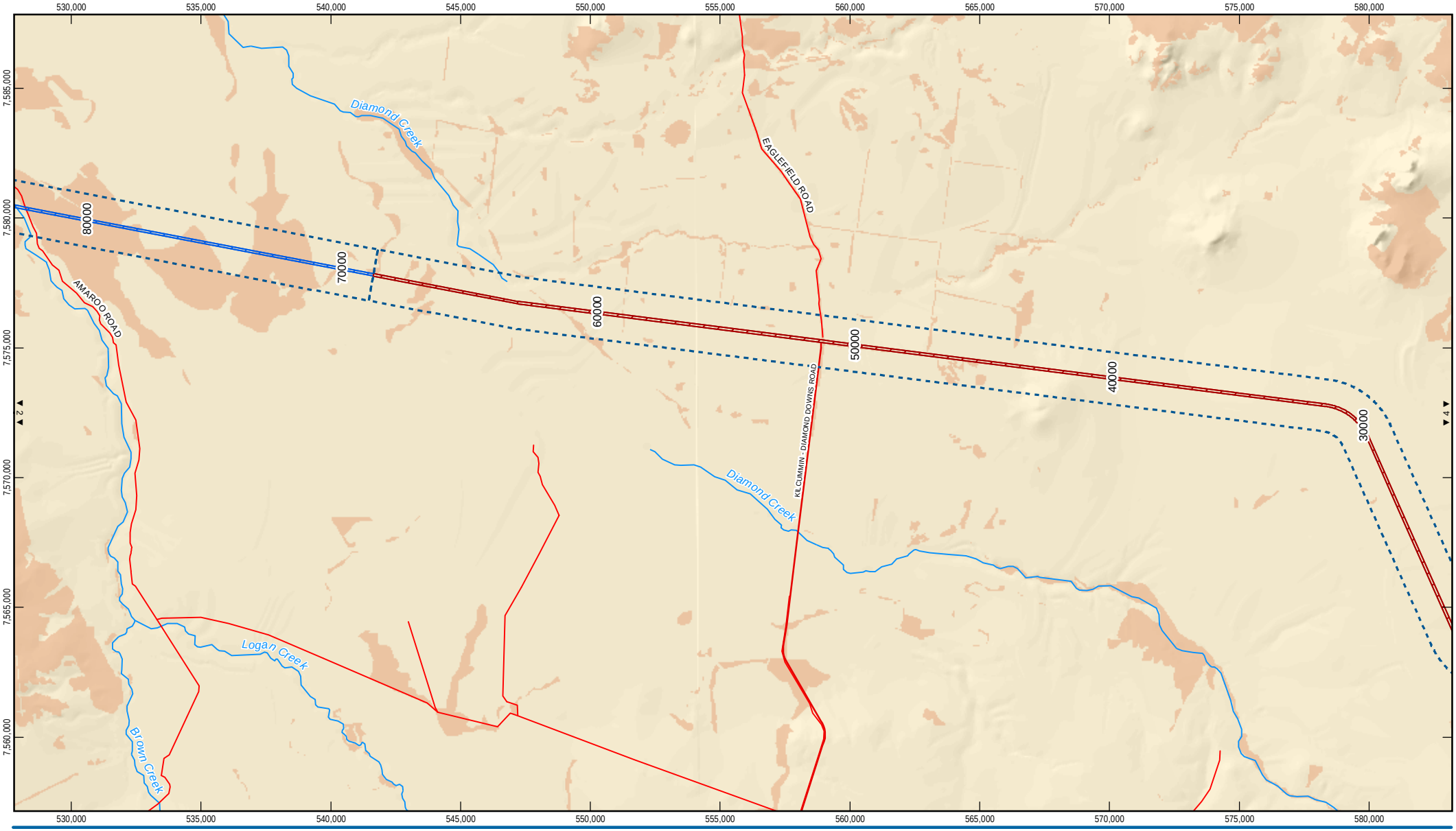

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0 1 2 3 4 5

Kilometres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia (GDA)
Grid: Map Grid of Australia 1994, Zone 55

N

LEGEND

- Town
- State Road
- Local Road
- Other Railway
- Watercourse
- Study Area
- Mine (Onsite)
- Mine (Offsite)
- Mine (Offsite)
- Rail (West)
- Rail (East)
- Potential Brigalow Scaly-foot Habitat - Based on DERM Certified Regional Ecosystems Version 6.0b

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Potential Brigalow Scaly-foot Habitat Within the Study Area and Surrounding Landscape

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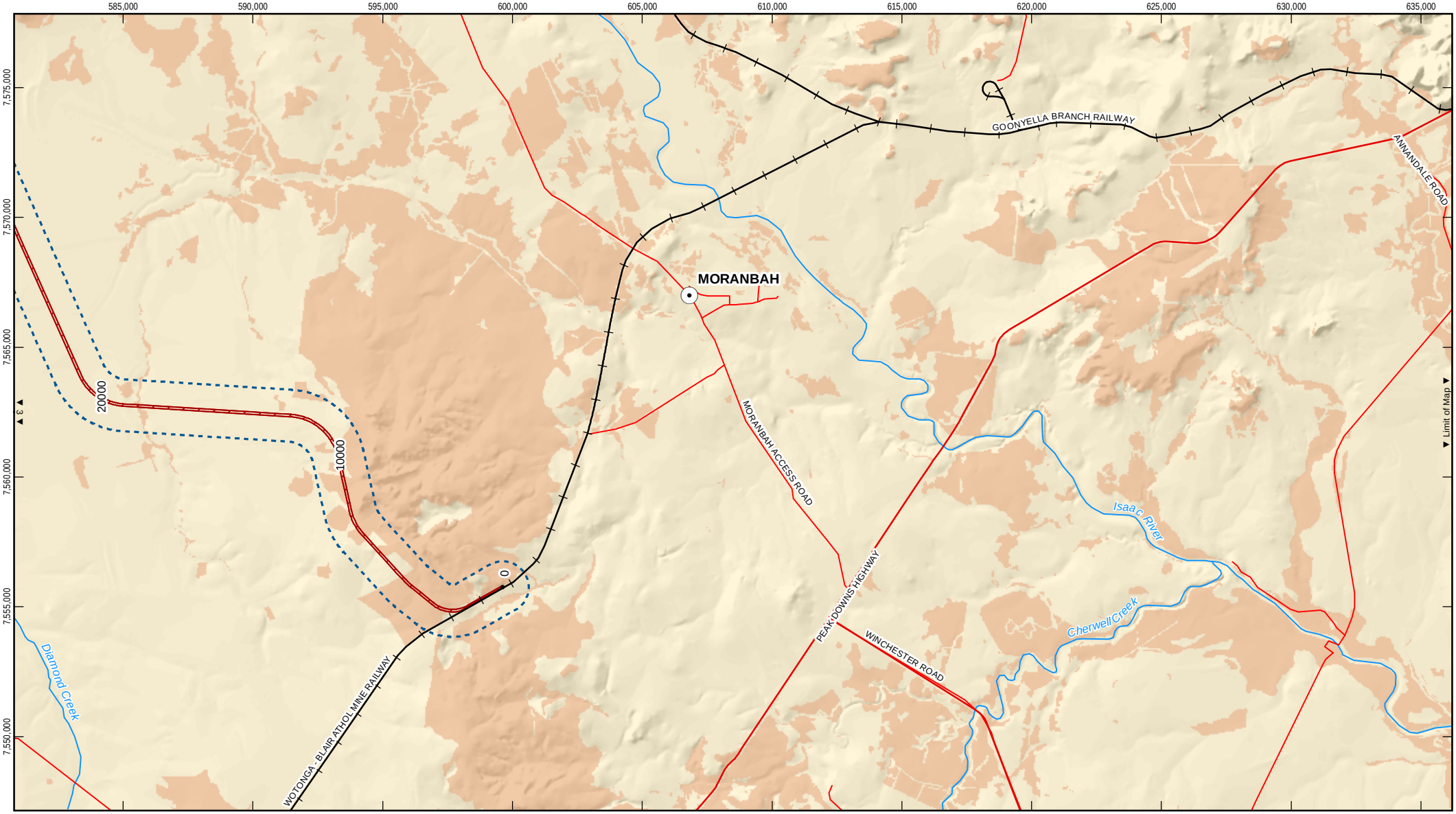

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0 1 2 3 4 5

Kilometres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia (GDA)
Grid: Map Grid of Australia 1994, Zone 55

N

LEGEND

- Town
- State Road
- Local Road
- Other Railway
- Watercourse
- Study Area
- Mine (Onsite)
- Mine (Offsite)
- Mine (Offsite)
- Rail (West)
- Rail (East)
- Potential Brigalow Scaly-foot Habitat - Based on DERM Certified Regional Ecosystems Version 6.0b

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Potential Brigalow Scaly-foot Habitat Within the Study Area and Surrounding Landscape

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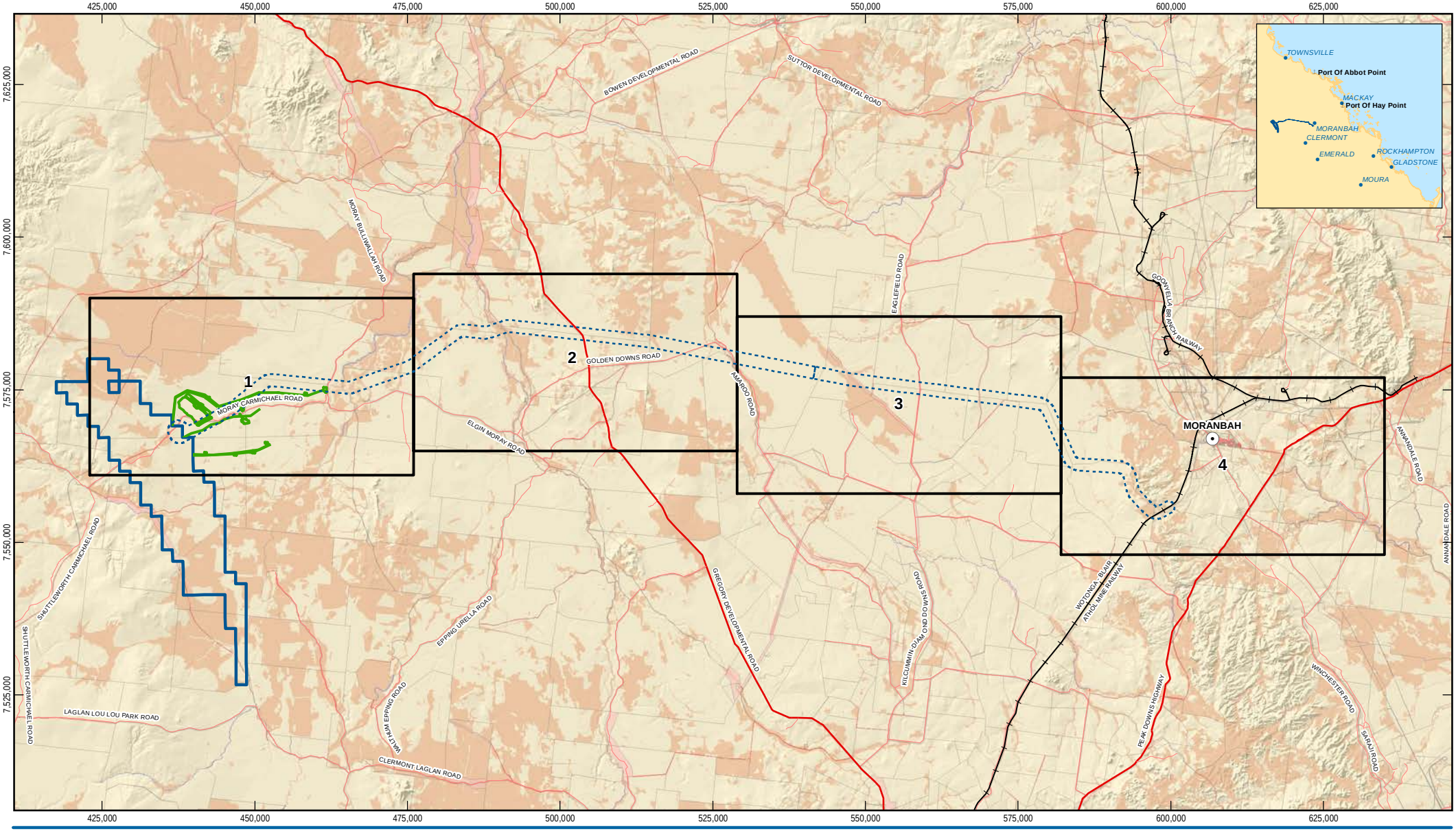

1:850,000 (at A4)

0 5 10 15 20 25

Kilometres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia (GDA)
Grid: Map Grid of Australia 1994, Zone 55

N

LEGEND

- Town
- State Road
- Local Road
- Other Railway
- Cadastral Parcel
- Road Reserve
- Watercourse Reserve
- Mine (Onsite)
- Mine (Offsite)
- Study Area
- Potential Greater long-eared Bat Habitat - Based on DERM Certified Regional Ecosystems Version 6.0b

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G:\41\25215\GIS\Maps\MXD\400_Ecology\41-25215_466_200k_Index_Map_rev_b.mxd

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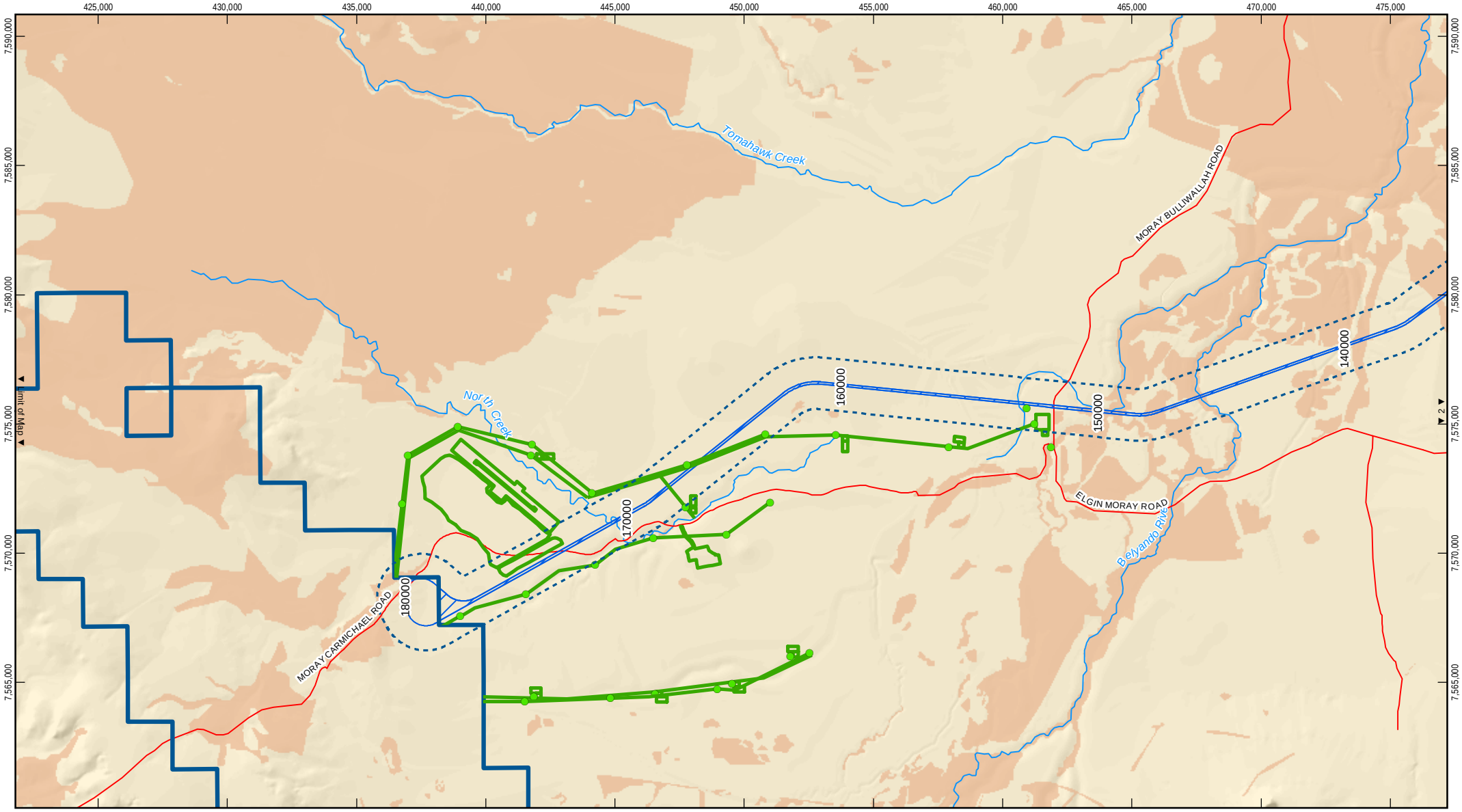

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0 1 2 3 4 5

Kilometres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia (GDA)
Grid: Map Grid of Australia 1994, Zone 55

N

LEGEND

- Town
- State Road
- Local Road
- Other Railway
- Watercourse
- Study Area
- Mine (Onsite)
- Mine (Offsite)
- Mine (Offsite)
- Rail (West)
- Rail (East)
- Potential Greater long-eared Bat Habitat - Based on DERM Certified Regional Ecosystems Version 6.0b

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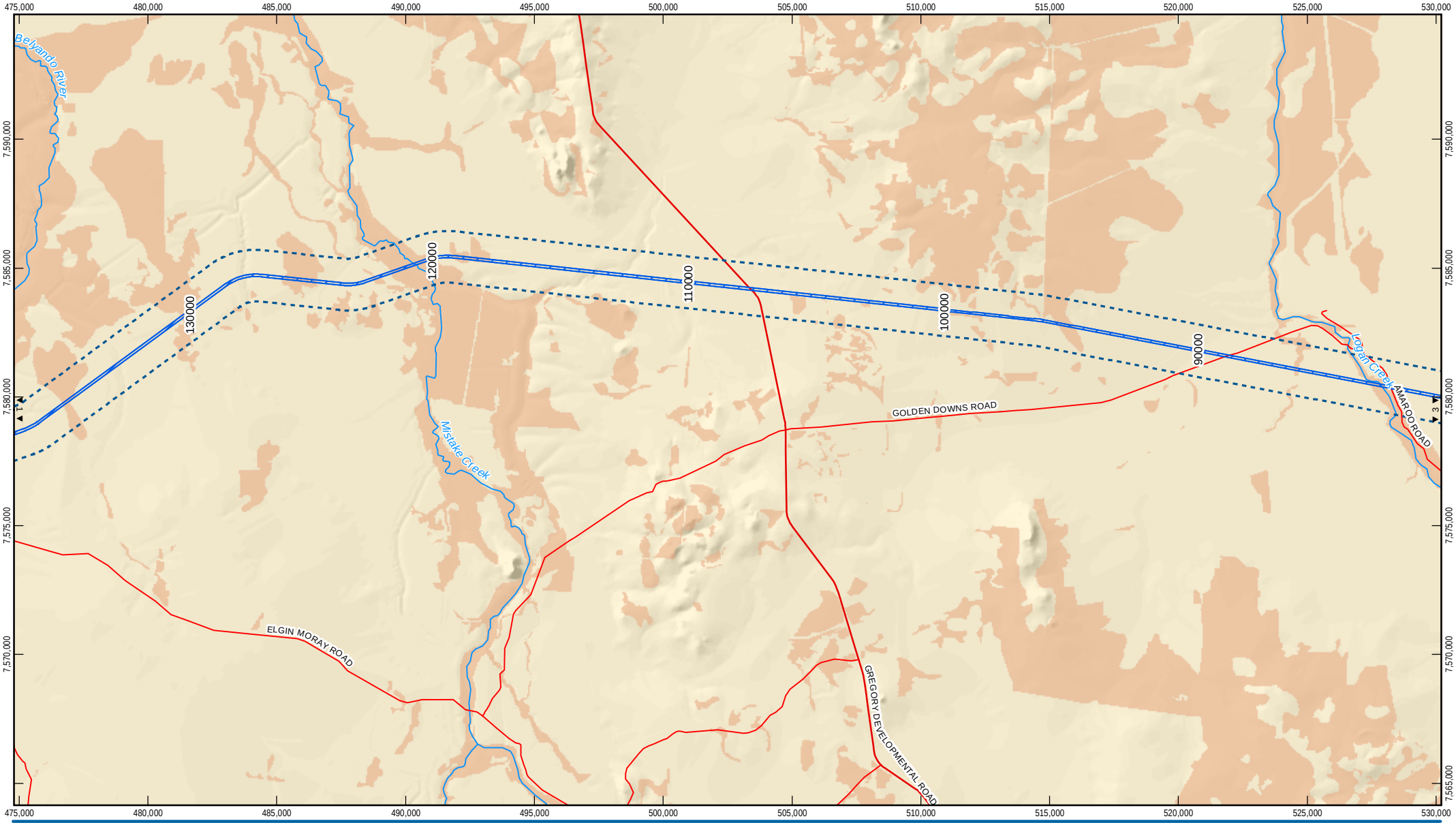

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Kilometres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia (GDA)
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N

LEGEND

- Town
- State Road
- Local Road
- Other Railway
- Watercourse
- Study Area
- Mine (Onsite)
- Mine (Offsite)
- Mine (Offsite)
- Rail (West)
- Rail (East)
- Potential Greater long-eared Bat Habitat - Based on DERM Certified Regional Ecosystems Version 6.0b

Adani Mining Pty Ltd

Carmichael Coal Mine and Rail Project

Potential Greater Long-eared Bat Habitat Within the Study Area and Surrounding Landscape

Job Number	41-25215
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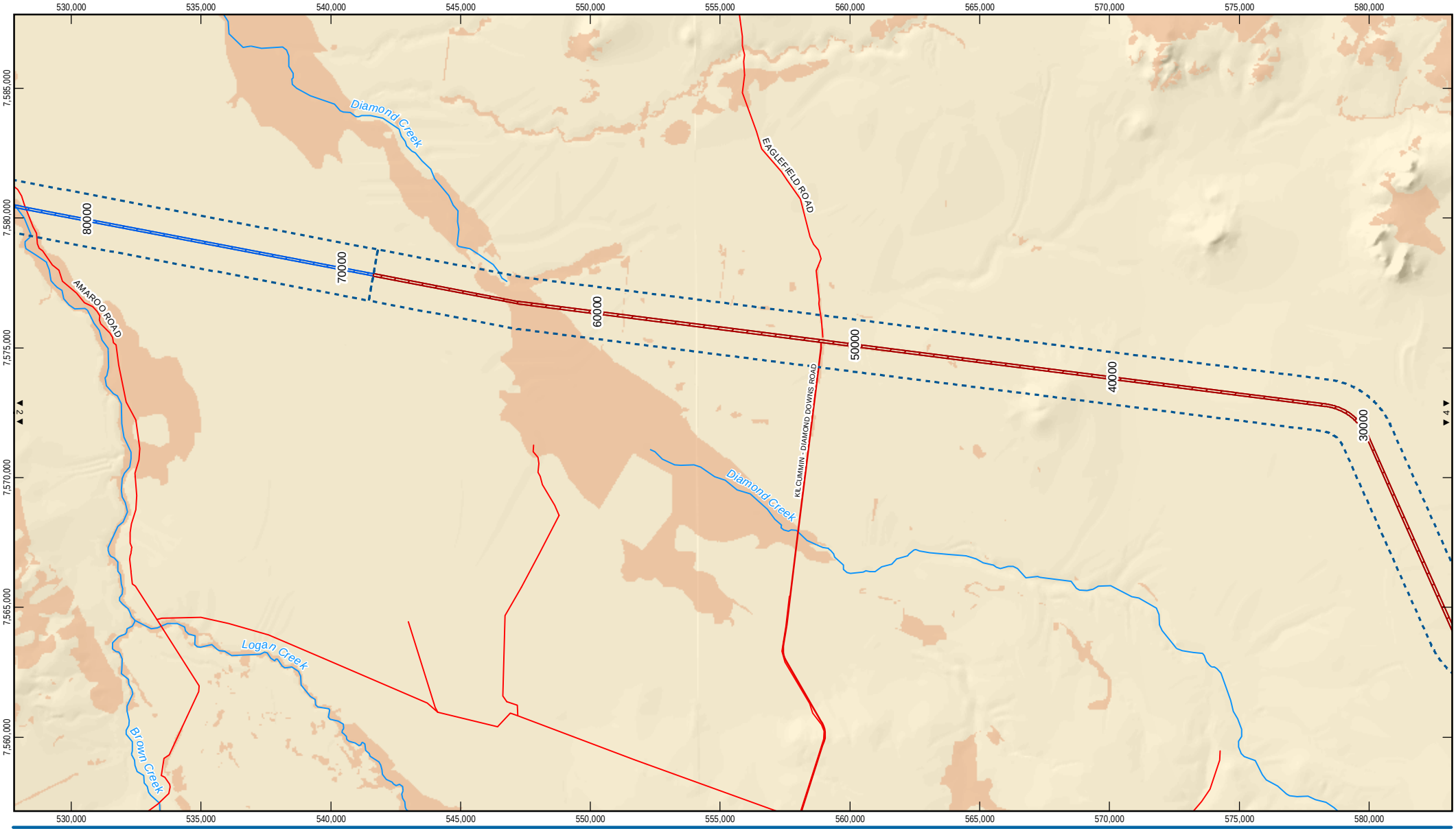
Date	14-09-2012

Figure 3-8
Sheet 2 of 4

G:\41\25215\GIS\Maps\MXD\400_Ecology\41-25215_466_200k_rev_b.mxd Level 4, 201 Charlotte St Brisbane QLD 4000 T +61 7 3316 3000 F +61 7 3316 3333 E bnemail@ghd.com W www.ghd.com

Data source: DERM: DEM (2008), © Commonwealth of Australia (Geoscience Australia): Localities, Railways, Roads, Watercourse (2007); GHD: Potential Greater Long-eared Bat Habitat (2011); Adani: Alignment Opt9 Rev3 (2012); DME: EPC1690 (2010) / EPC1080 (2011); Gassman/Hyder: Mine (Offsite) (2012). Created by: MR, CA



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0 1 2 3 4 5

Kilometres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia (GDA)
Grid: Map Grid of Australia 1994, Zone 55

N

LEGEND

- Town
- State Road
- Local Road
- Other Railway
- Watercourse
- Study Area
- Mine (Onsite)
- Mine (Offsite)
- Mine (Offsite)
- Rail (West)
- Rail (East)
- Potential Greater long-eared Bat Habitat - Based on DERM Certified Regional Ecosystems Version 6.0b

Adani Mining Pty Ltd

Carmichael Coal Mine and Rail Project

Potential Greater Long-eared Bat Habitat Within the Study Area and Surrounding Landscape

Job Number	41-25215
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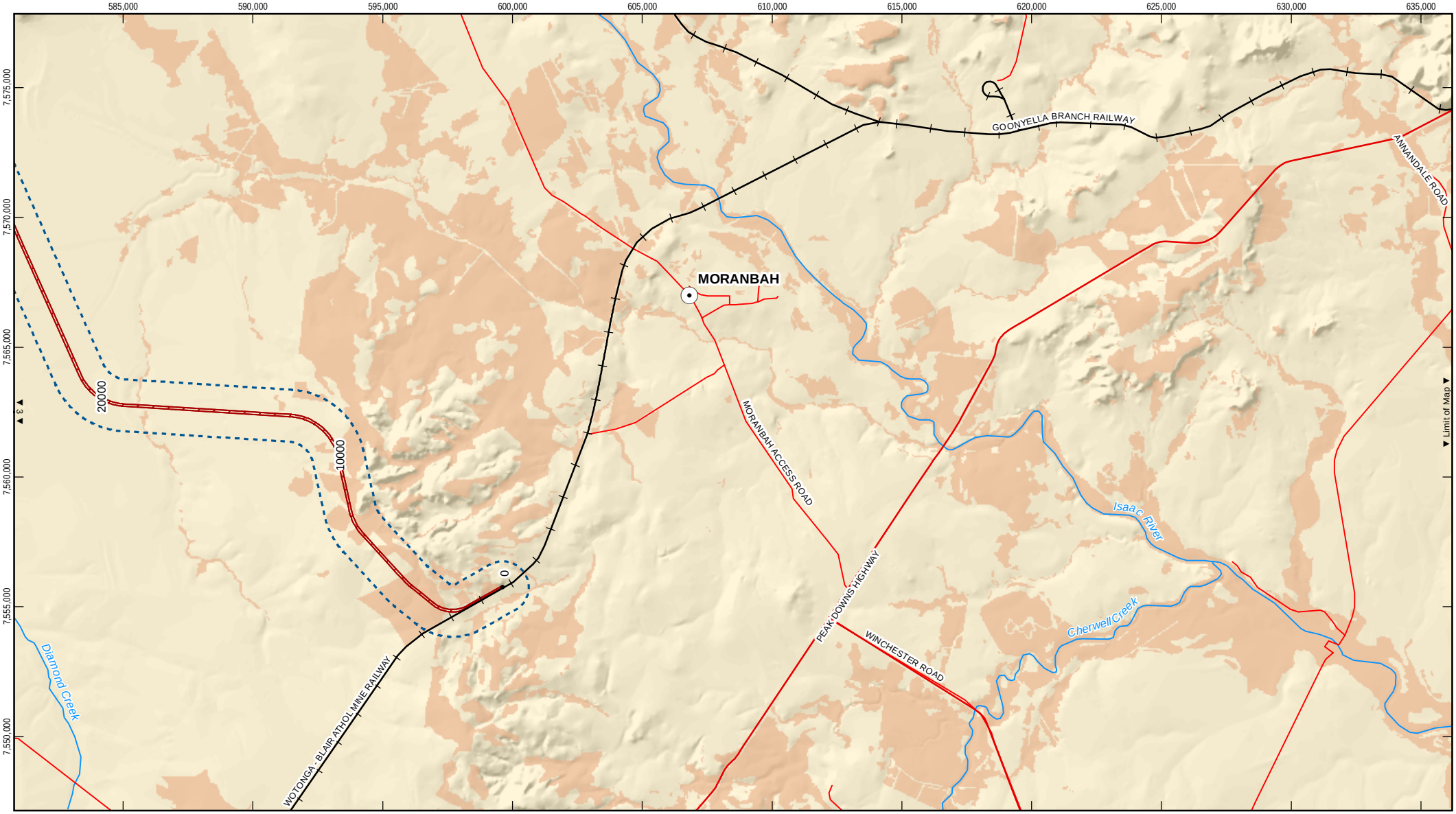
Figure 3-8
Sheet 3 of 4

G:\41\25215\GIS\Maps\MXD\400_Ecology\41-25215_466_200k_rev_b.mxd Level 4, 201 Charlotte St Brisbane QLD 4000 T +61 7 3316 3000 F +61 7 3316 3333 E bnemail@ghd.com W www.ghd.com

Data source: DERM: DEM (2008), © Commonwealth of Australia (Geoscience Australia): Localities, Railways, Roads, Watercourse (2007); GHD: Potential Greater Long-eared Bat Habitat (2011); Adani: Alignment Opt9 Rev3 (2012); DME: EPC1690 (2010) / EPC1080 (2011); Gassman/Hyder: Mine (Offsite) (2012). Created by: MR, CA



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0 1 2 3 4 5

Kilometres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia (GDA)
Grid: Map Grid of Australia 1994, Zone 55

N

LEGEND

- Town
- State Road
- Local Road
- Other Railway
- Watercourse
- Study Area
- Mine (Onsite)
- Mine (Offsite)
- Mine (Offsite)
- Rail (West)
- Rail (East)
- Potential Greater long-eared Bat Habitat - Based on DERM Certified Regional Ecosystems Version 6.0b

Adani Mining Pty Ltd
Carmichael Coal Mine and Rail Project

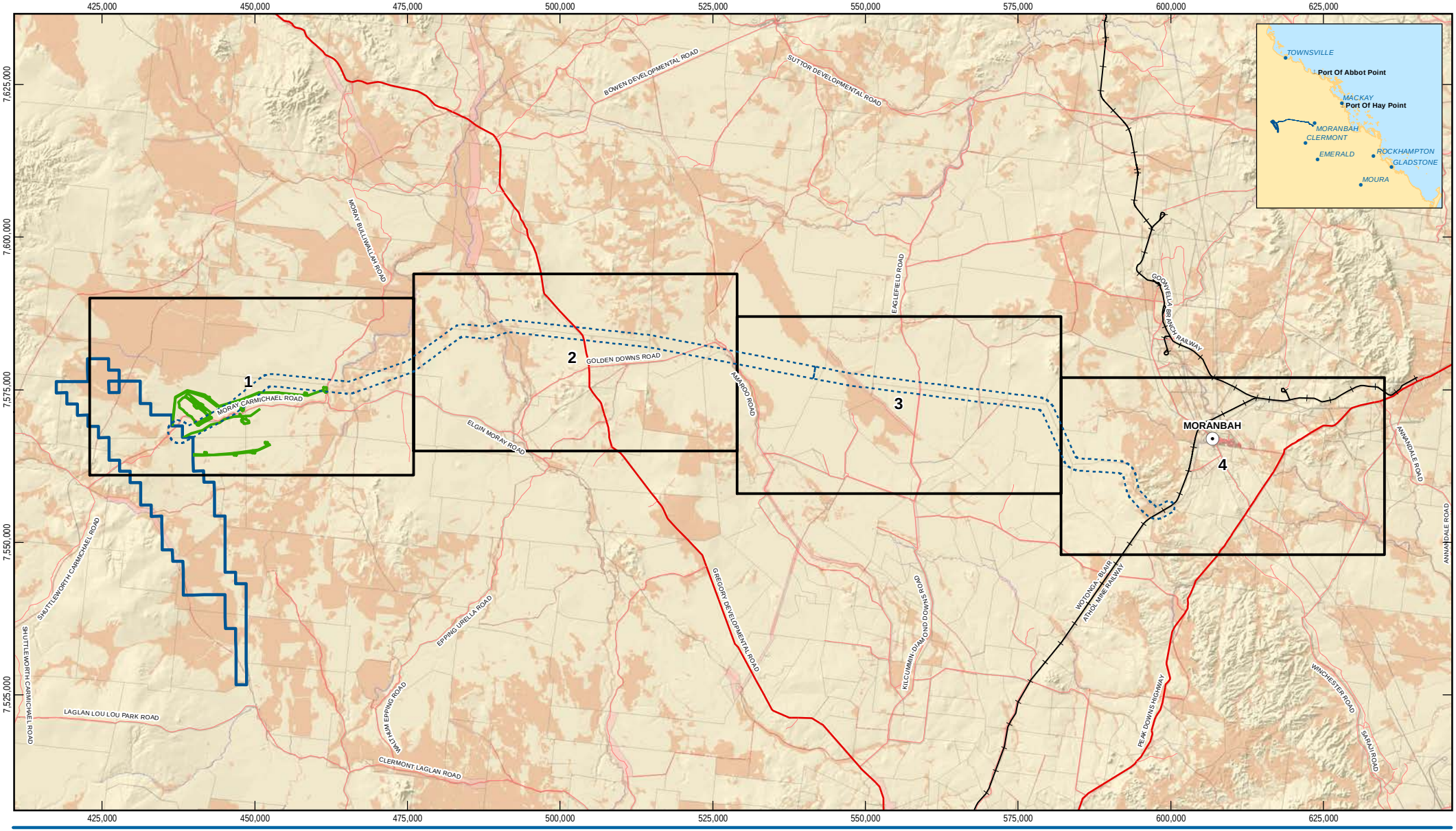
Potential Greater Long-eared Bat Habitat Within the Study Area and Surrounding Landscape

Job Number 41-25215
Revision B
Date 14-09-2012

Figure 3-8
Sheet 4 of 4

G:\41\25215\GIS\Maps\MXD\400_Ecology\41-25215_466_200k_rev_b.mxd Level 4, 201 Charlotte St Brisbane QLD 4000 T +61 7 3316 3000 F +61 7 3316 3333 E bnemail@ghd.com W www.ghd.com

Data source: DERM: DEM (2008), © Commonwealth of Australia (Geoscience Australia): Localities, Railways, Roads, Watercourse (2007); GHD: Potential Greater Long-eared Bat Habitat (2011); Adani: Alignment Opt9 Rev3 (2012); DME: EPC1690 (2010) / EPC1080 (2011); Gassman/Hyder: Mine (Offsite) (2012). Created by: MR, CA



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0 5 10 15 20 25

Kilometres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia (GDA)
Grid: Map Grid of Australia 1994, Zone 55

N

LEGEND

- Town
- State Road
- Local Road
- Other Railway
- Cadastral Parcel
- Road Reserve
- Watercourse Reserve
- Mine (Onsite)
- Mine (Offsite)
- Study Area
- Potential Red Goshawk Habitat - Based on DERM Certified Regional Ecosystems Version 6.0b

Adani Mining Pty Ltd

Carmichael Coal Mine and Rail Project

Potential Red Goshawk Habitat Within the Study Area and Surrounding Landscape

Job Number	41-25215
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Date	14-09-2012

Figure 3-9
Series Index

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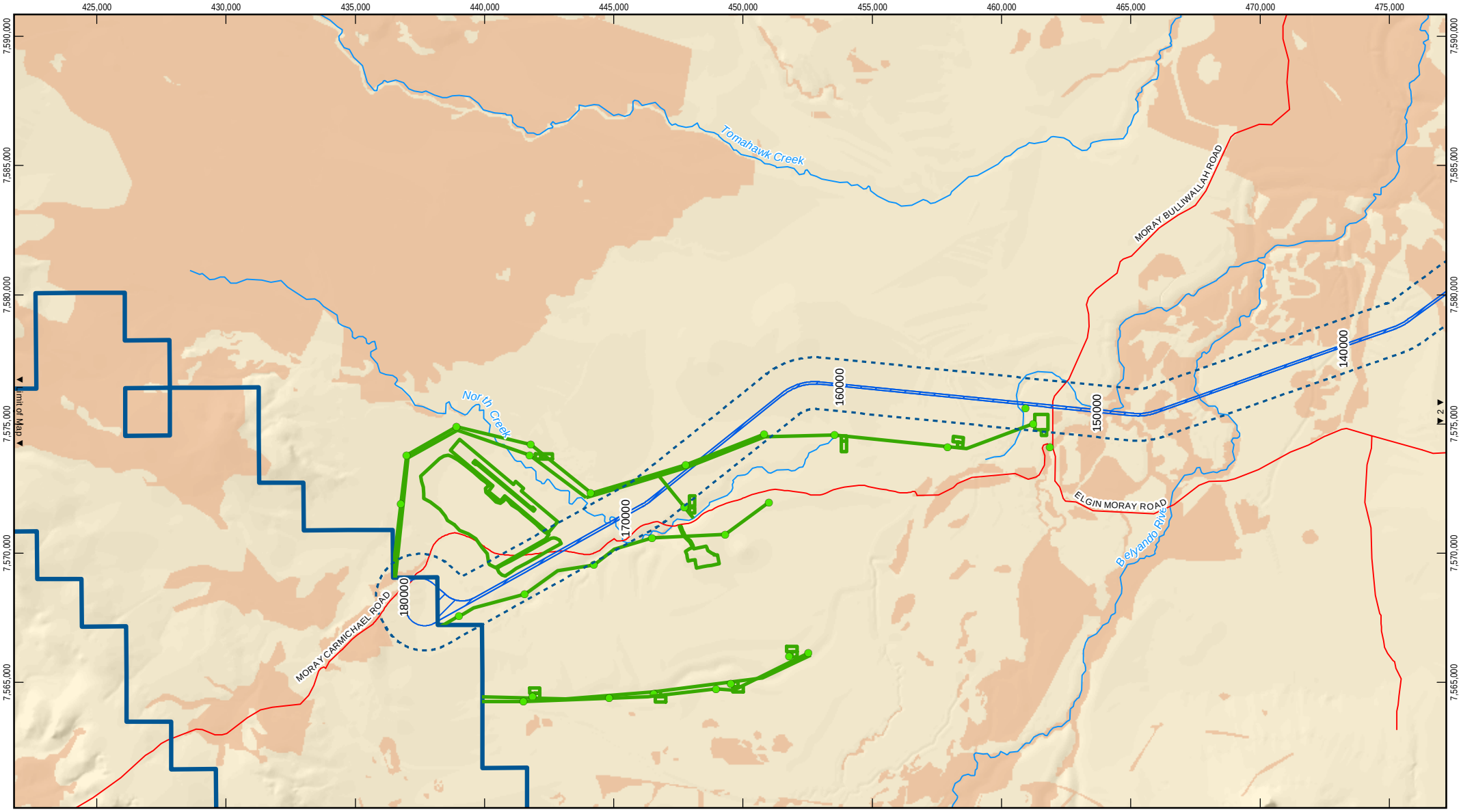

1:200,000 (at A4)

0 1 2 3 4 5

Kilometres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia (GDA)
Grid: Map Grid of Australia 1994, Zone 55

N

LEGEND

- Town
- State Road
- Road
- Other Railway
- Watercourse
- Study Area
- Mine (Onsite)
- Mine (Offsite)
- Mine (Offsite)
- Rail (West)
- Rail (East)
- Potential Red Goshawk Habitat - Based on DERM Certified Regional Ecosystems Version 6.0b

Adani Mining Pty Ltd

Carmichael Coal Mine and Rail Project

Potential Red Goshawk Habitat Within the Study Area and Surrounding Landscape

Job Number	41-25215
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Figure 3-9
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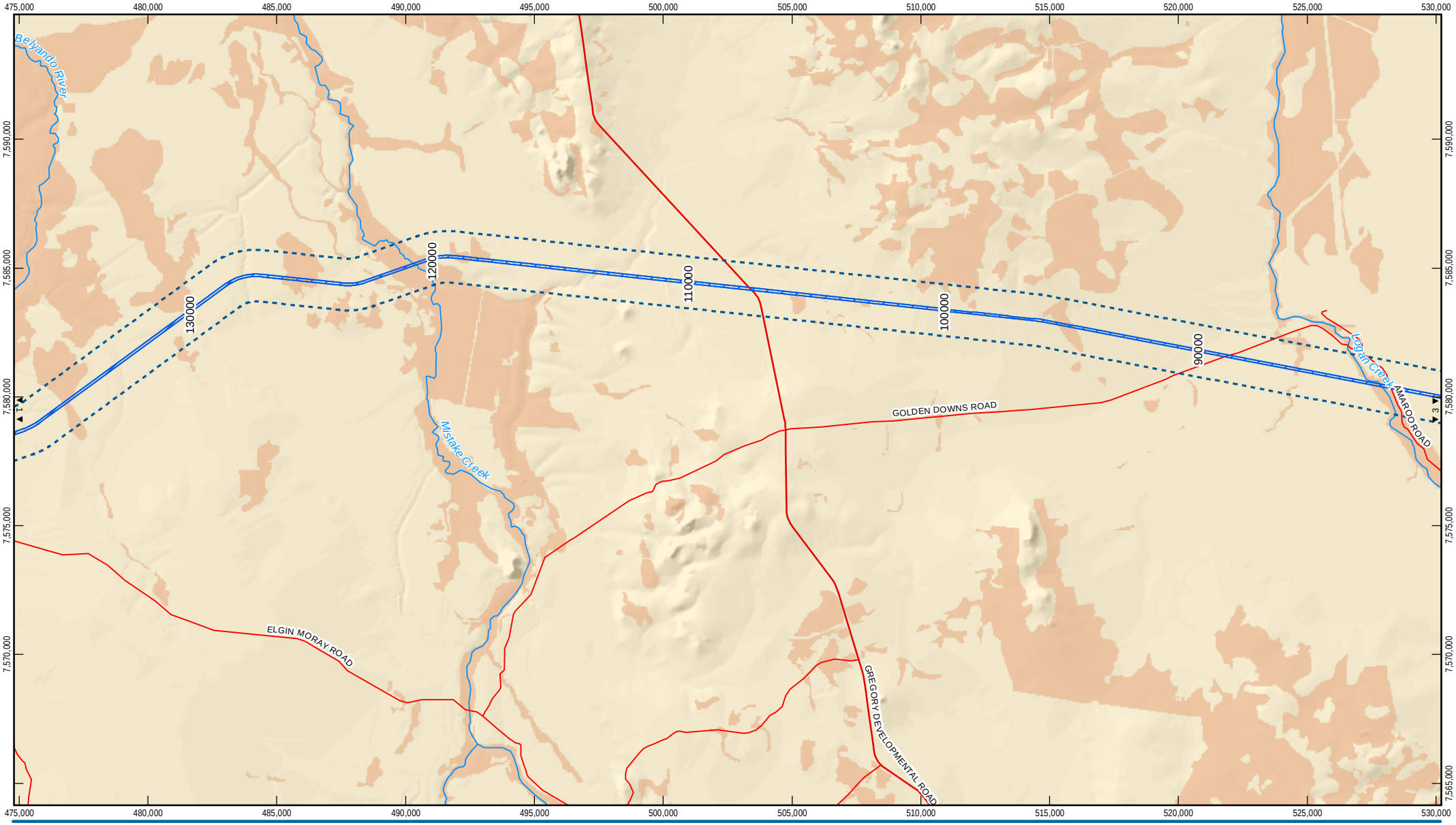
G:\41\25215\GIS\Maps\MXD\400_Ecology\41-25215_467_200k_rev_b.mxd Level 4, 201 Charlotte St Brisbane QLD 4000 T +61 7 3316 3000 F +61 7 3316 3333 E bnemail@ghd.com W www.ghd.com

Data source: DERM: DEM (2008), © Commonwealth of Australia (Geoscience Australia): Localities, Railways, Roads, Watercourse (2007); GHD: Potential Red Goshawk Habitat (2011); Adani: Alignment Opt9 Rev3 (2012); DME: EPC1690 (2010) / EPC1080 (2011); Gassman/Hyder: Mine (Offsite) (2012). Created by: MR, CA



1:200,000 (at A4)

0 1 2 3 4 5

Kilometres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia (GDA)
Grid: Map Grid of Australia 1994, Zone 55

N

LEGEND

- Town
- State Road
- Road
- Other Railway
- Watercourse
- Study Area
- Mine (Onsite)
- Mine (Offsite)
- Mine (Offsite)
- Rail (West)
- Rail (East)
- Potential Red Goshawk Habitat - Based on DERM Certified Regional Ecosystems Version 6.0b

Adani Mining Pty Ltd

Carmichael Coal Mine and Rail Project

Potential Red Goshawk Habitat Within the Study Area and Surrounding Landscape

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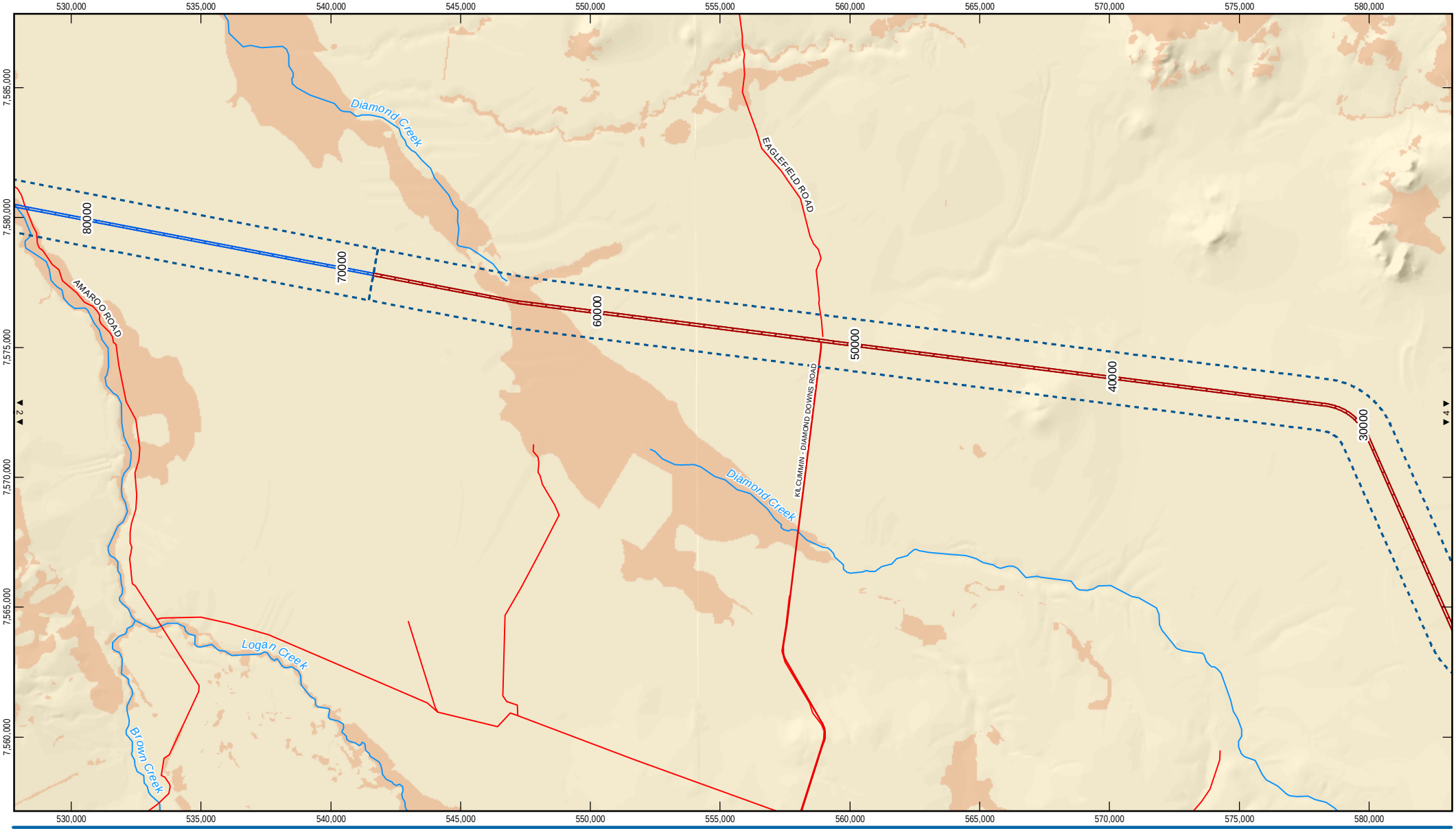
G:\41\25215\GIS\Maps\MXD\400_Ecology\41-25215_467_200k_rev_b.mxd Level 4, 201 Charlotte St Brisbane QLD 4000 T +61 7 3316 3000 F +61 7 3316 3333 E bnemail@ghd.com W www.ghd.com

Data source: DERM: DEM (2008), © Commonwealth of Australia (Geoscience Australia): Localities, Railways, Roads, Watercourse (2007); GHD: Potential Red Goshawk Habitat (2011); Adani: Alignment Opt9 Rev3 (2012); DME: EPC1690 (2010) / EPC1080 (2011); Gassman/Hyder: Mine (Offsite) (2012). Created by: MR, CA



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0 1 2 3 4 5

Kilometres

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Horizontal Datum: Geocentric Datum of Australia (GDA)
Grid: Map Grid of Australia 1994, Zone 55

N

LEGEND

- Town
- State Road
- Road
- Other Railway
- Watercourse
- Study Area
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- Mine (Offsite)
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- Rail (East)
- Potential Red Goshawk Habitat - Based on DERM Certified Regional Ecosystems Version 6.0b

Adani Mining Pty Ltd

Carmichael Coal Mine and Rail Project

Potential Red Goshawk Habitat Within the Study Area and Surrounding Landscape

Job Number	41-25215
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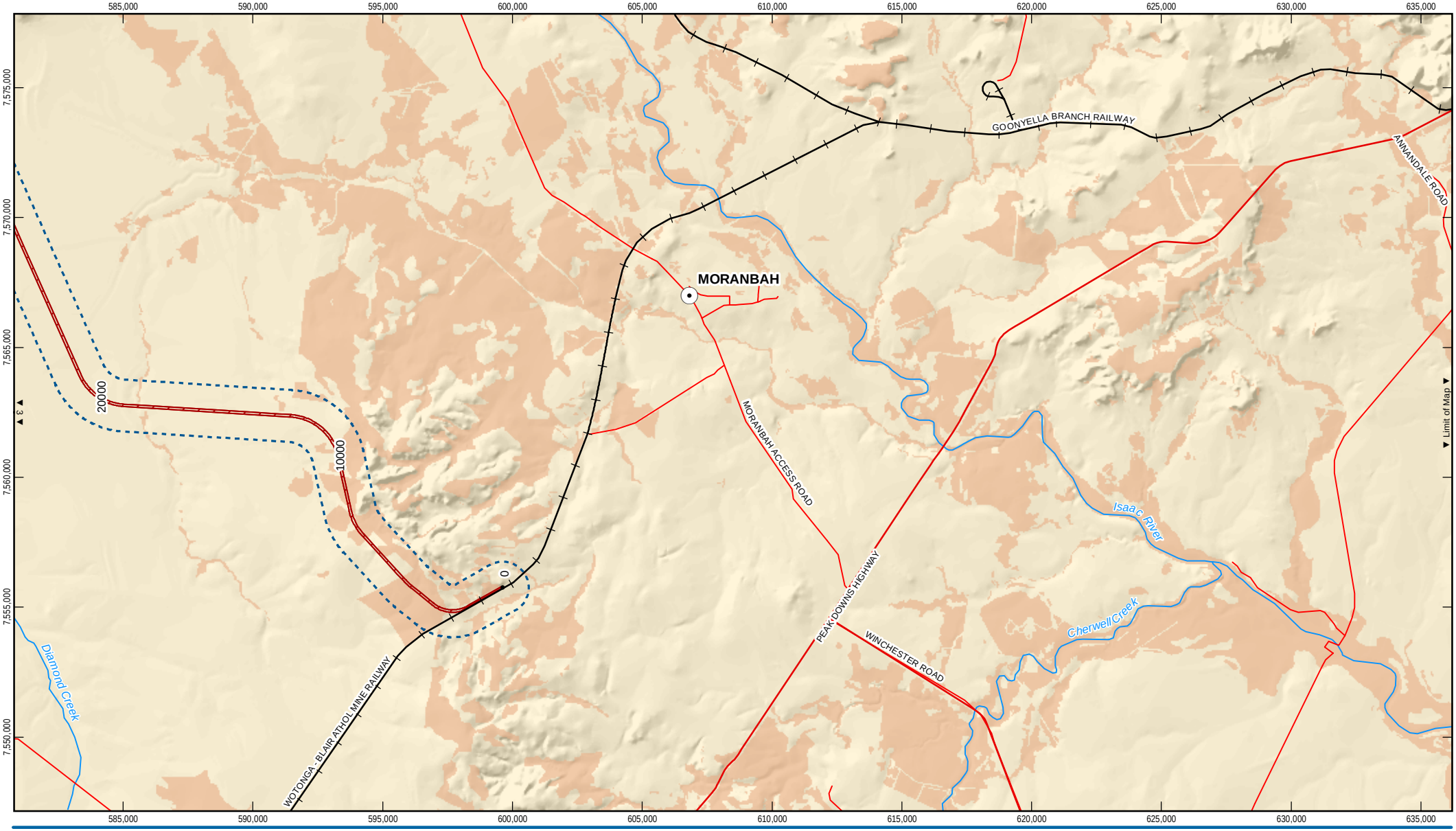
G:\41\25215\GIS\Maps\MXD\400_Ecology\41-25215_467_200k_rev_b.mxd Level 4, 201 Charlotte St Brisbane QLD 4000 T +61 7 3316 3000 F +61 7 3316 3333 E bnemail@ghd.com W www.ghd.com

Data source: DERM: DEM (2008), © Commonwealth of Australia (Geoscience Australia): Localities, Railways, Roads, Watercourse (2007); GHD: Potential Red Goshawk Habitat (2011); Adani: Alignment Opt9 Rev3 (2012); DME: EPC1690 (2010) / EPC1080 (2011); Gassman/Hyder: Mine (Offsite) (2012). Created by: MR, CA



1:200,000 (at A4)

0 1 2 3 4 5

Kilometres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia (GDA)
Grid: Map Grid of Australia 1994, Zone 55

N

LEGEND

- Town
- State Road
- Road
- Other Railway
- Watercourse
- Study Area
- Mine (Onsite)
- Mine (Offsite)
- Mine (Offsite)
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- Rail (East)
- Potential Red Goshawk Habitat - Based on DERM Certified Regional Ecosystems Version 6.0b

Adani Mining Pty Ltd
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Potential Red Goshawk Habitat Within the Study Area and Surrounding Landscape

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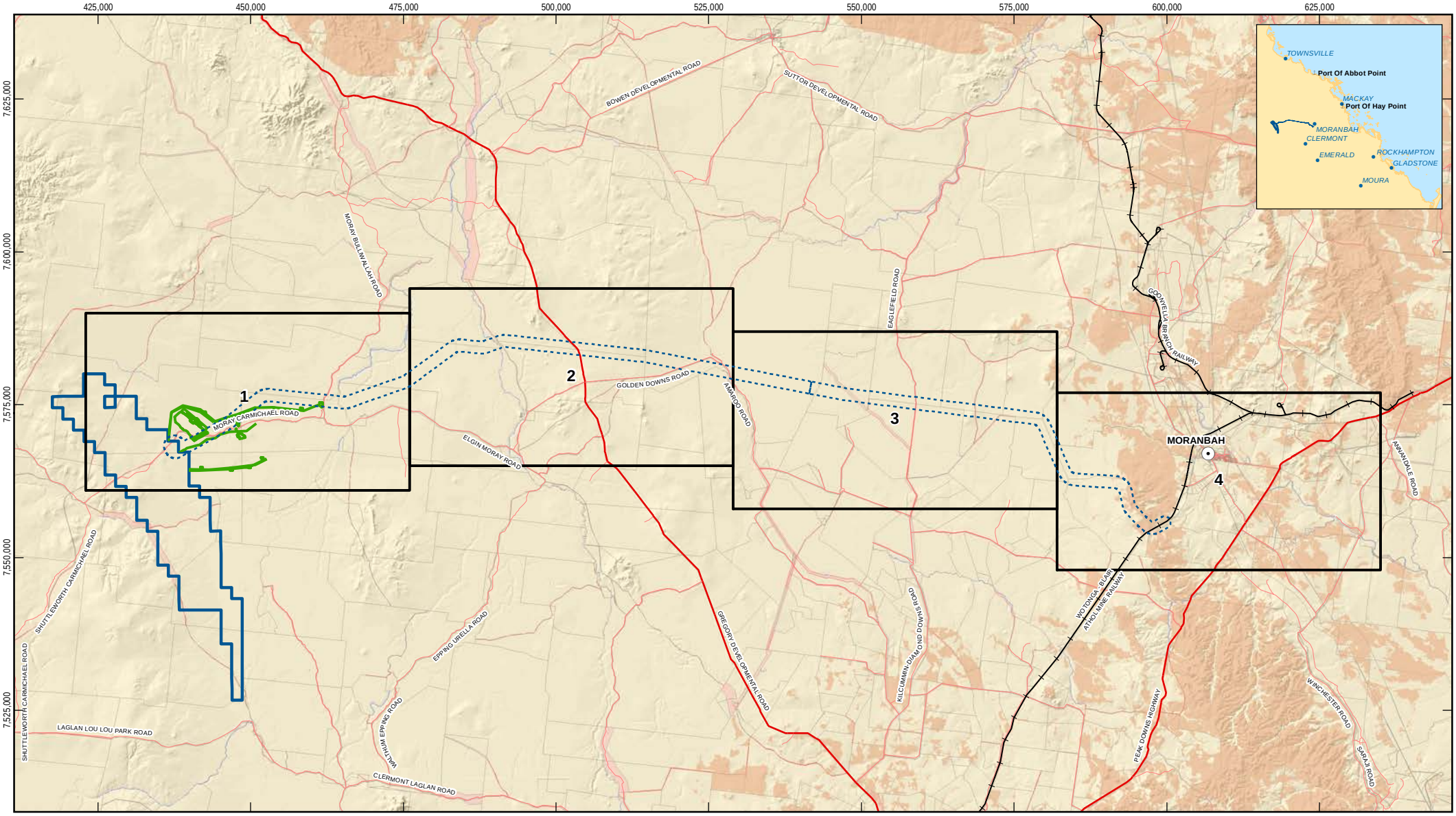
G:\41\25215\GIS\Maps\MXD\400_Ecology\41-25215_467_200k_rev_b.mxd Level 4, 201 Charlotte St Brisbane QLD 4000 T +61 7 3316 3000 F +61 7 3316 3333 E bnemail@ghd.com W www.ghd.com

Data source: DERM: DEM (2008), © Commonwealth of Australia (Geoscience Australia): Localities, Railways, Roads, Watercourse (2007); GHD: Potential Red Goshawk Habitat (2011); Adani: Alignment Opt9 Rev3 (2012); DME: EPC1690 (2010) / EPC1080 (2011); Gassman/Hyder: Mine (Offsite) (2012). Created by: MR, CA



1:850,000 (at A4)

0 5 10 15 20 25

Kilometres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia (GDA)
Grid: Map Grid of Australia 1994, Zone 55

N

LEGEND

- Town
- State Road
- Local Road
- Other Railway
- Cadastral Parcel
- Road Reserve
- Watercourse Reserve
- Mine (Onsite)
- Mine (Offsite)
- Study Area
- Potential Northern Quoll Habitat - Based on DERM Certified Regional Ecosystems Version 6.0b

Adani Mining Pty Ltd
Carmichael Coal Mine and Rail Project

Potential Northern Quoll Habitat within the Study Area and Surrounding Landscape

Job Number	41-25215
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Date	14-09-2012

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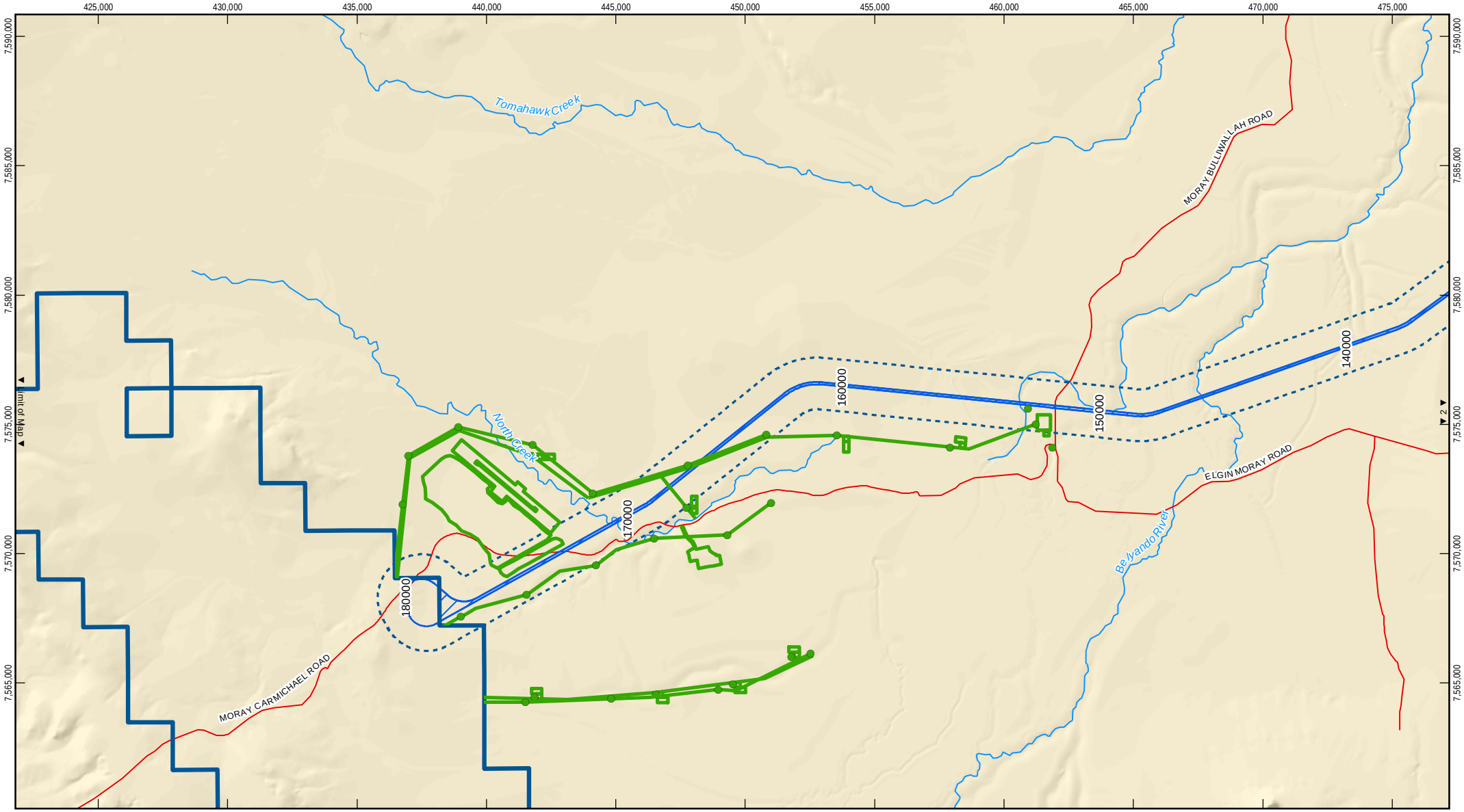
Data source: DERM: DEM (2008), DCDB (2010); DME: EPC1690 (2010)/EPC1080 (2011); © Commonwealth of Australia (Geoscience Australia): Localities, Railways, Roads (2007); Adani: Alignment Opt9 Rev3 (2012); GHD: Potential Northern Quoll Habitat (2012); Gassman/Hyder: Mine (Offsite) (2012). Created by: BW, CA



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0 1 2 3 4 5

Kilometres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia (GDA)
Grid: Map Grid of Australia 1994, Zone 55

N

LEGEND

- Town
- Road
- Other Railway
- Watercourse
- Mine (Onsite)
- Mine (Offsite)
- Mine (Offsite)
- Rail (West)
- Rail (East)
- Study Area
- Potential Northern Quoll Habitat - Based on DERM Certified Regional Ecosystems Version 6.0b

Adani Mining Pty Ltd

Carmichael Coal Mine and Rail Project

Potential Northern Quoll Habitat Within the Study Area and Surrounding Landscape

Job Number	41-25215
Revision	C
Date	14-09-2012

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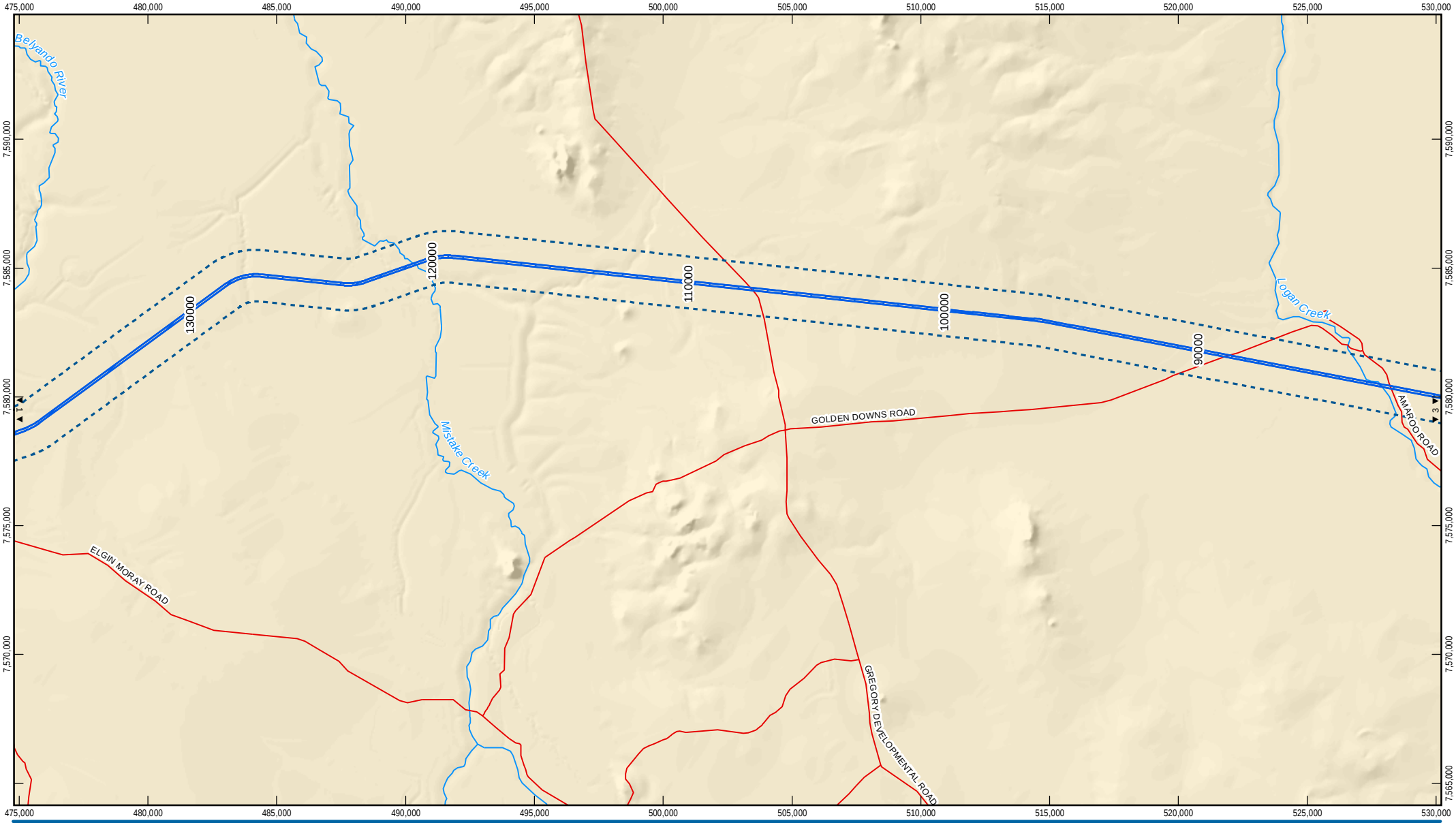
Data source: DERM: DEM (2008), © Commonwealth of Australia (Geoscience Australia): Localities, Railways, Roads, Watercourse (2007); GHD: Potential Northern Quoll Habitat (2012); Adani: Alignment Opt9 Rev3 (2012); DME: EPC1690 (2010) / EPC1080 (2011); Gassman/Hyder: Mine (Offsite) (2012). Created by: MR, CA



1:200,000 (at A4)

0 1 2 3 4 5

Kilometres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia (GDA)
Grid: Map Grid of Australia 1994, Zone 55

N

LEGEND

- Town
- Road
- Other Railway
- Watercourse
- Mine (Onsite)
- Mine (Offsite)
- Mine (Offsite)
- Rail (West)
- Rail (East)
- Study Area
- Potential Northern Quoll Habitat - Based on DERM Certified Regional Ecosystems Version 6.0b

Adani Mining Pty Ltd

Carmichael Coal Mine and Rail Project

Potential Northern Quoll Habitat Within the Study Area and Surrounding Landscape

Job Number	41-25215
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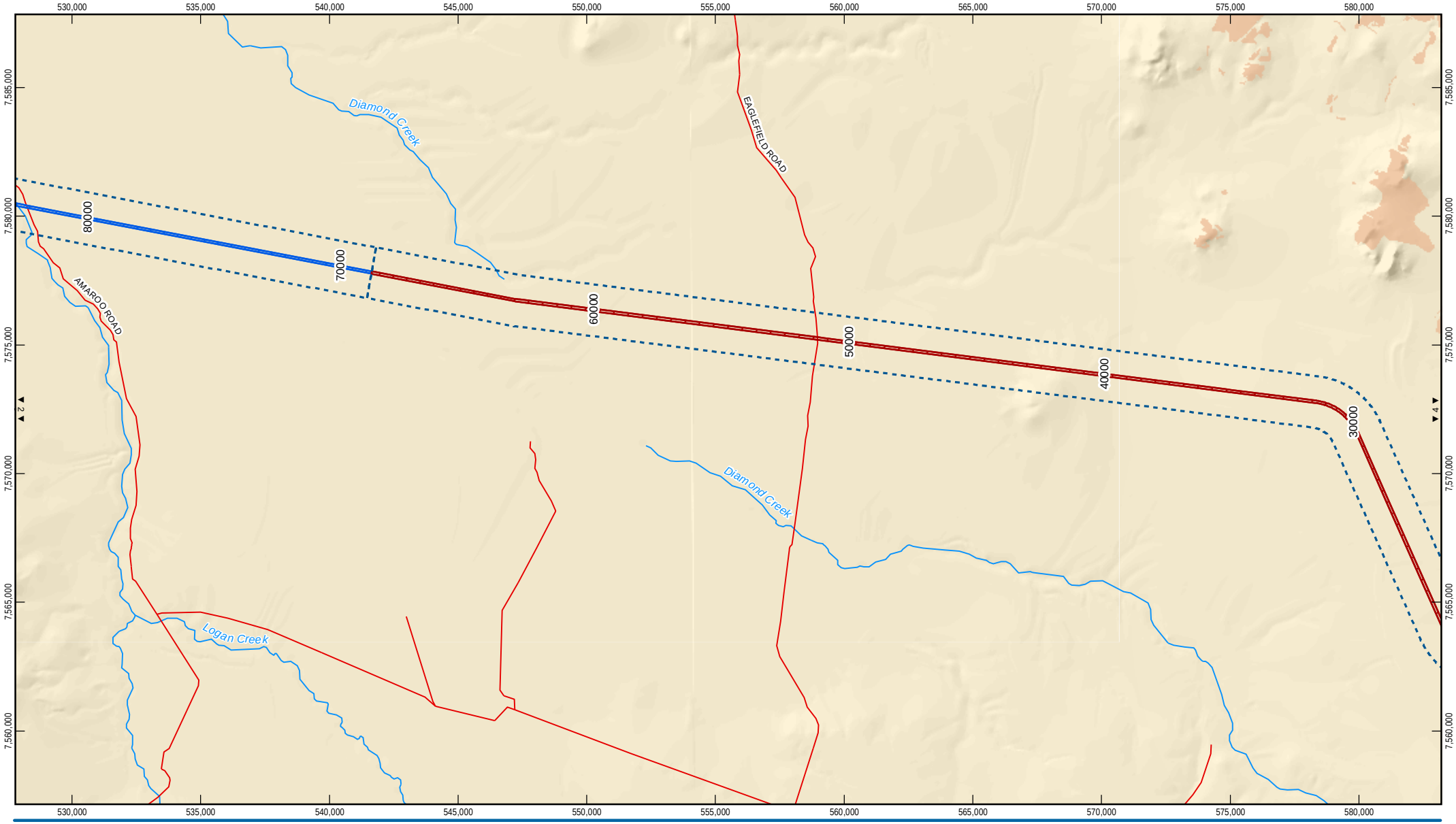

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0 1 2 3 4 5

Kilometres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia (GDA)
Grid: Map Grid of Australia 1994, Zone 55

N

LEGEND

- Town
- Road
- Other Railway
- Watercourse
- Mine (Onsite)
- Mine (Offsite)
- Mine (Offsite)
- Rail (West)
- Rail (East)
- Study Area
- Potential Northern Quoll Habitat - Based on DERM Certified Regional Ecosystems Version 6.0b

Adani Mining Pty Ltd

Carmichael Coal Mine and Rail Project

Potential Northern Quoll Habitat Within the Study Area and Surrounding Landscape

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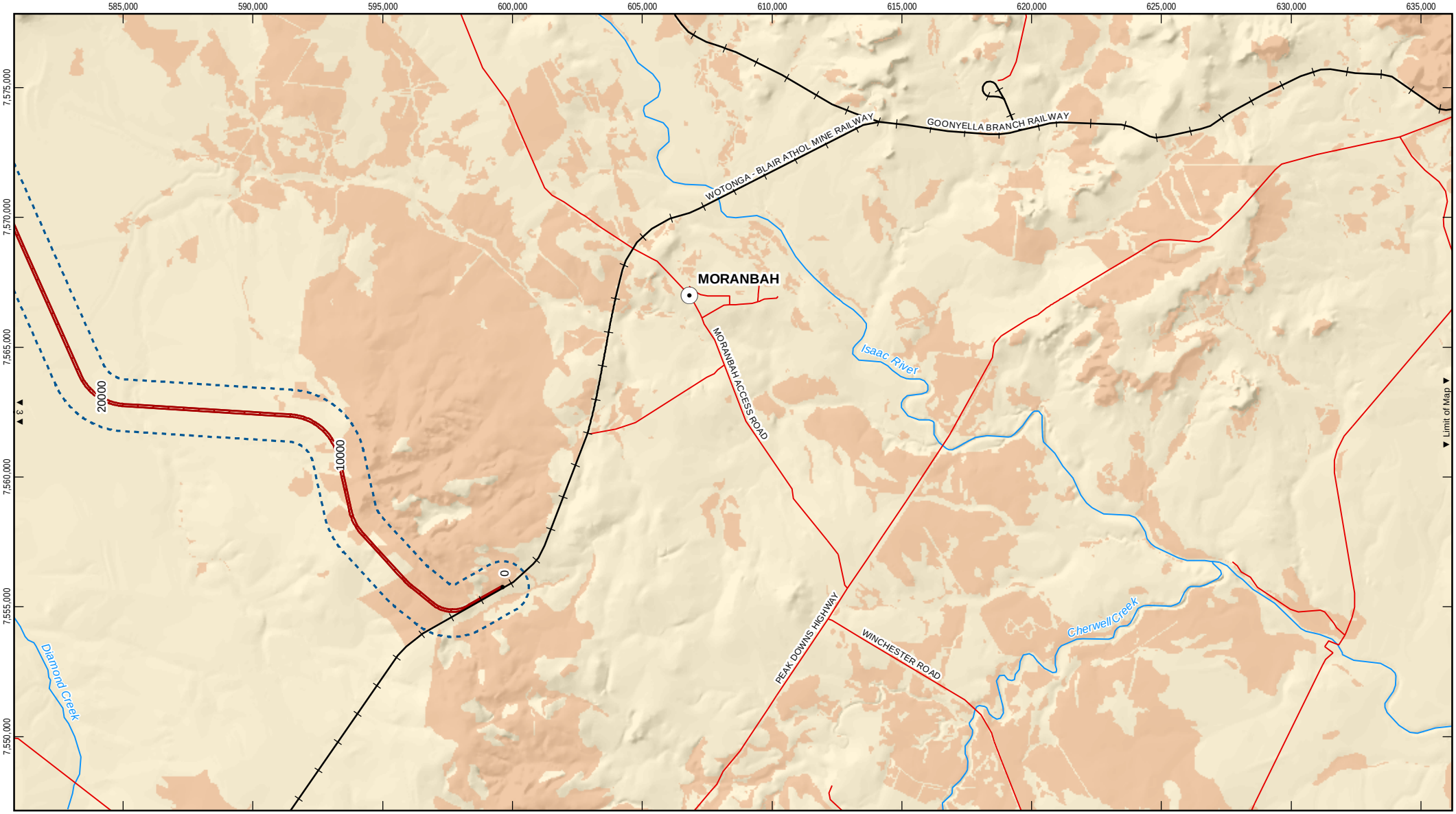
Data source: DERM: DEM (2008), © Commonwealth of Australia (Geoscience Australia): Localities, Railways, Roads, Watercourse (2007); GHD: Potential Northern Quoll Habitat (2012); Adani: Alignment Opt9 Rev3 (2012); DME: EPC1690 (2010) / EPC1080 (2011); Gassman/Hyder: Mine (Offsite) (2012). Created by: MR, CA



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0 1 2 3 4 5

Kilometres

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Horizontal Datum: Geocentric Datum of Australia (GDA)
Grid: Map Grid of Australia 1994, Zone 55

N

LEGEND

- Town
- Road
- Other Railway
- Watercourse
- Mine (Onsite)
- Mine (Offsite)
- Mine (Offsite)
- Rail (West)
- Rail (East)
- Study Area
- Potential Northern Quoll Habitat - Based on DERM Certified Regional Ecosystems Version 6.0b

Adani Mining Pty Ltd

Carmichael Coal Mine and Rail Project

Potential Northern Quoll Habitat Within the Study Area and Surrounding Landscape

Job Number	41-25215
Revision	C
Date	14-09-2012

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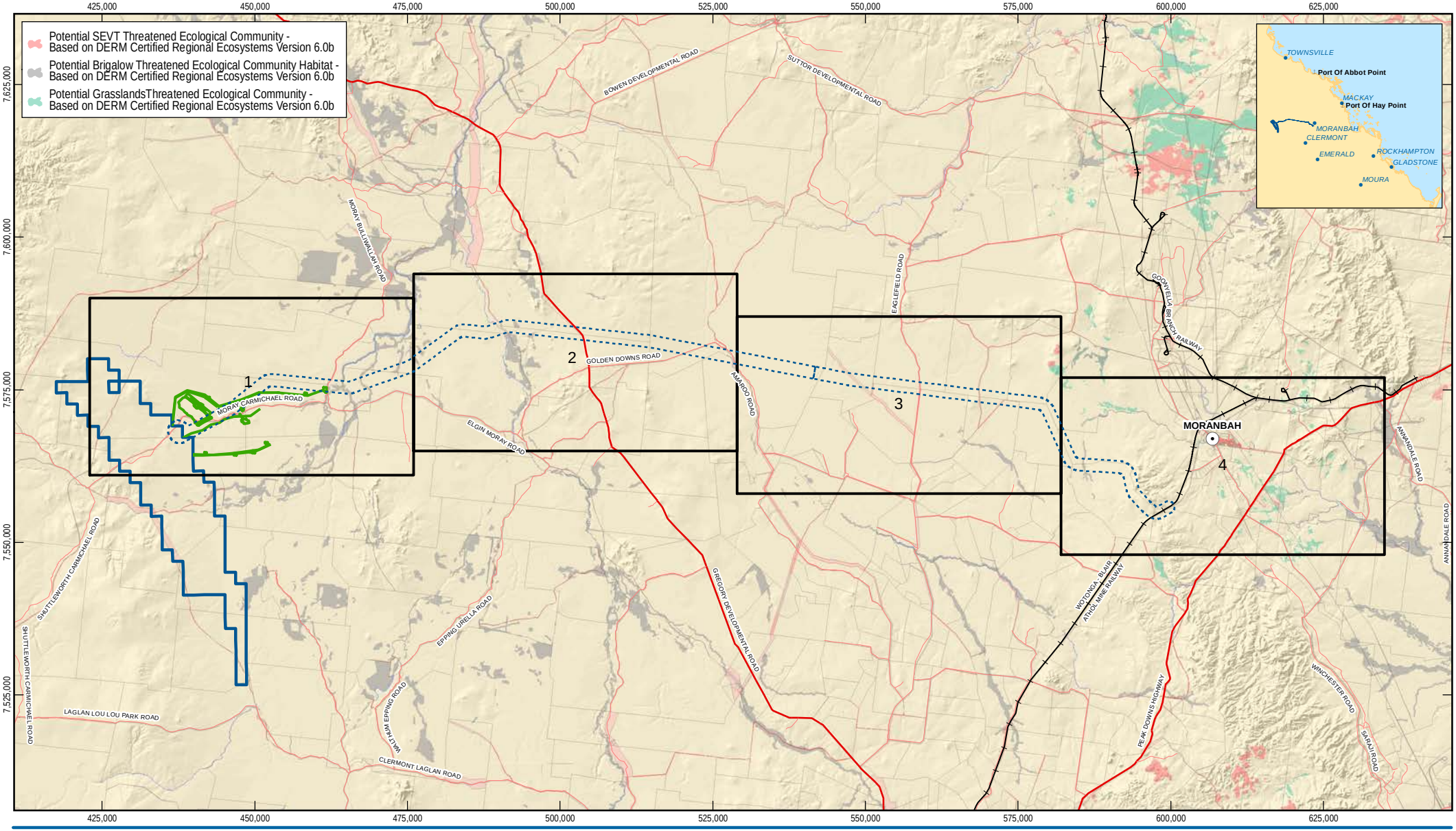
Data source: DERM: DEM (2008), © Commonwealth of Australia (Geoscience Australia): Localities, Railways, Roads, Watercourse (2007); GHD: Potential Northern Quoll Habitat (2012); Adani: Alignment Opt9 Rev3 (2012); DME: EPC1690 (2010) / EPC1080 (2011); Gassman/Hyder: Mine (Offsite) (2012). Created by: MR, CA



1:850,000 (at A4)

0 5 10 15 20 25

Kilometres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia (GDA)
Grid: Map Grid of Australia 1994, Zone 55

N

LEGEND

- Town
- State Road
- Local Road
- Other Railway
- Cadastral Parcel
- Road Reserve
- Watercourse Reserve
- Mine (Onsite)
- Mine (Offsite)
- Study Area

Adani Mining Pty Ltd

Carmichael Coal Mine and Rail Project

Potential Threatened Ecological Communities Within the Study Area and Surrounding Landscape

Job Number 41-25215
Revision C
Date 10-09-2012

Figure 3-12
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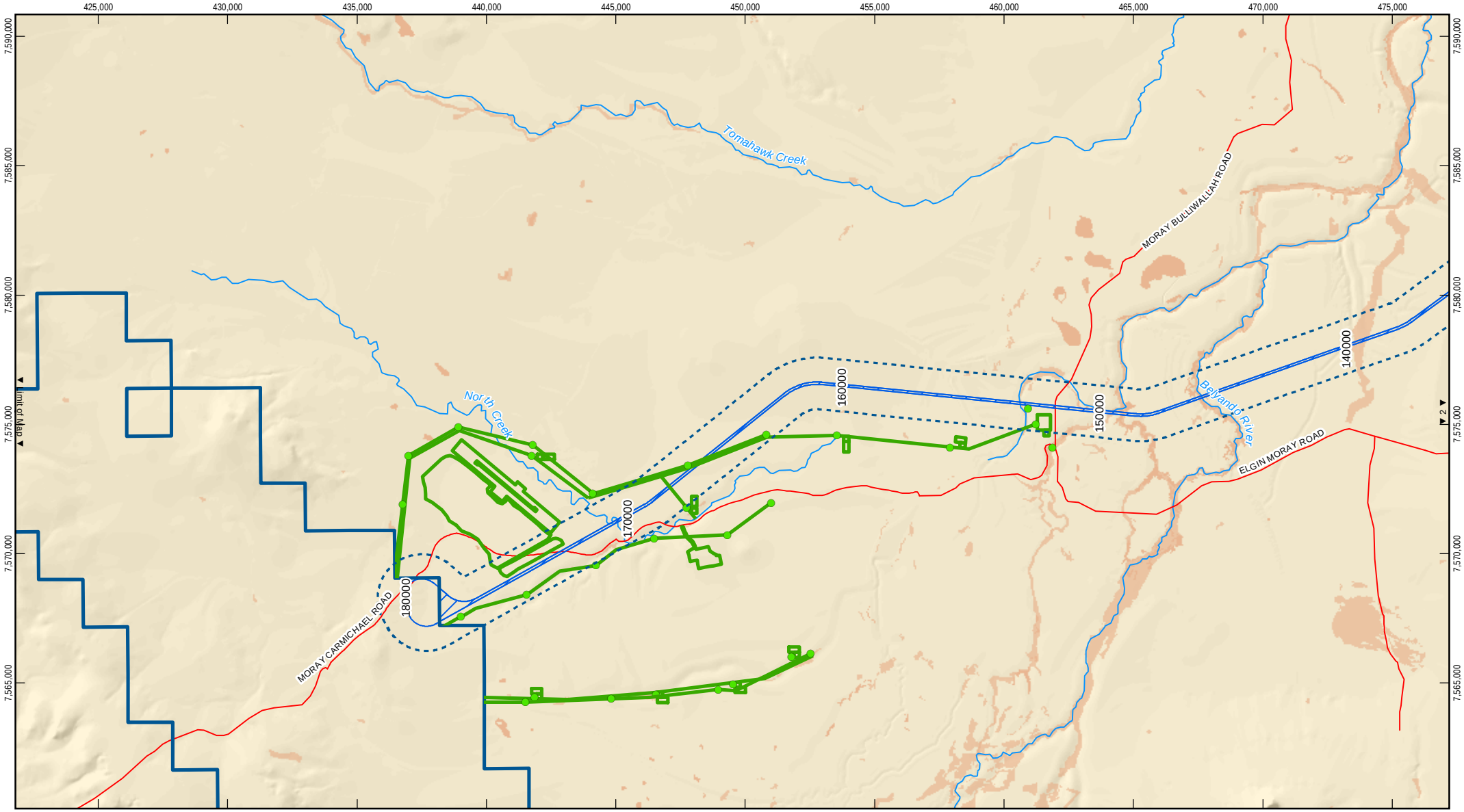

1:200,000 (at A4)

0 1 2 3 4 5

Kilometres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia (GDA)
Grid: Map Grid of Australia 1994, Zone 55

N

LEGEND

- Town
- State Road
- Local Road
- Other Railway
- Watercourse
- Study Area
- Mine (Onsite)
- Mine (Offsite)
- Mine (Offsite)
- Rail (West)
- Rail (East)
- Potential Australian Painted Snipe Habitat - Based on DERM Certified Regional Ecosystems Version 6.0b

Adani Mining Pty Ltd

Carmichael Coal Mine and Rail Project

Potential Australian Painted Snipe Habitat Within the Study Area and Surrounding Landscape

Job Number	41-25215
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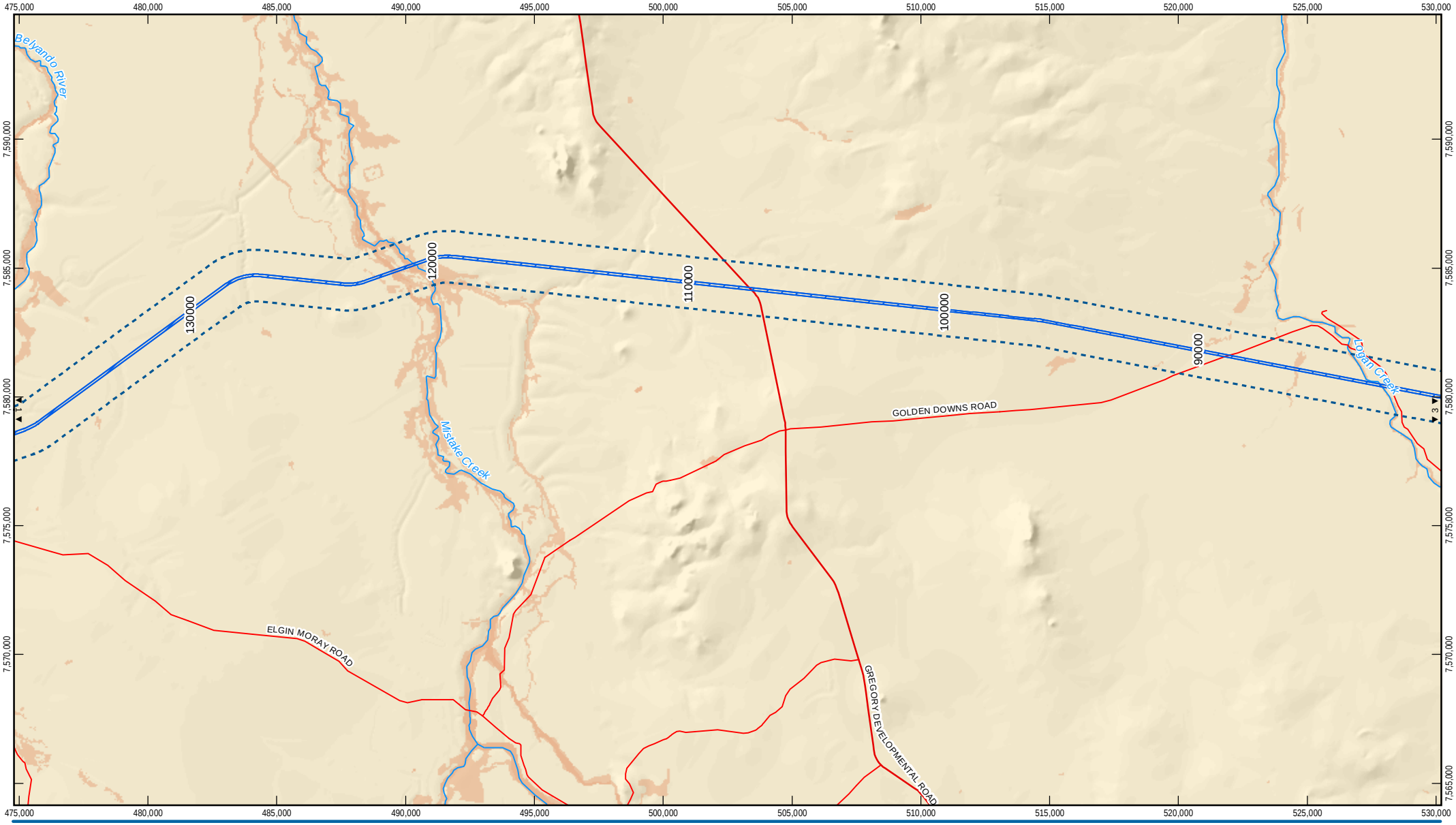

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Kilometres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia (GDA)
Grid: Map Grid of Australia 1994, Zone 55

N

LEGEND

- Town
- State Road
- Local Road
- Other Railway
- Watercourse
- Study Area
- Mine (Onsite)
- Mine (Offsite)
- Mine (Offsite)
- Rail (West)
- Rail (East)
- Potential Australian Painted Snipe Habitat - Based on DERM Certified Regional Ecosystems Version 6.0b

Adani Mining Pty Ltd

Carmichael Coal Mine and Rail Project

Job Number 41-25215
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Potential Australian Painted Snipe Habitat Within the Study Area and Surrounding Landscape

Figure 3-11
Sheet 2 of 4

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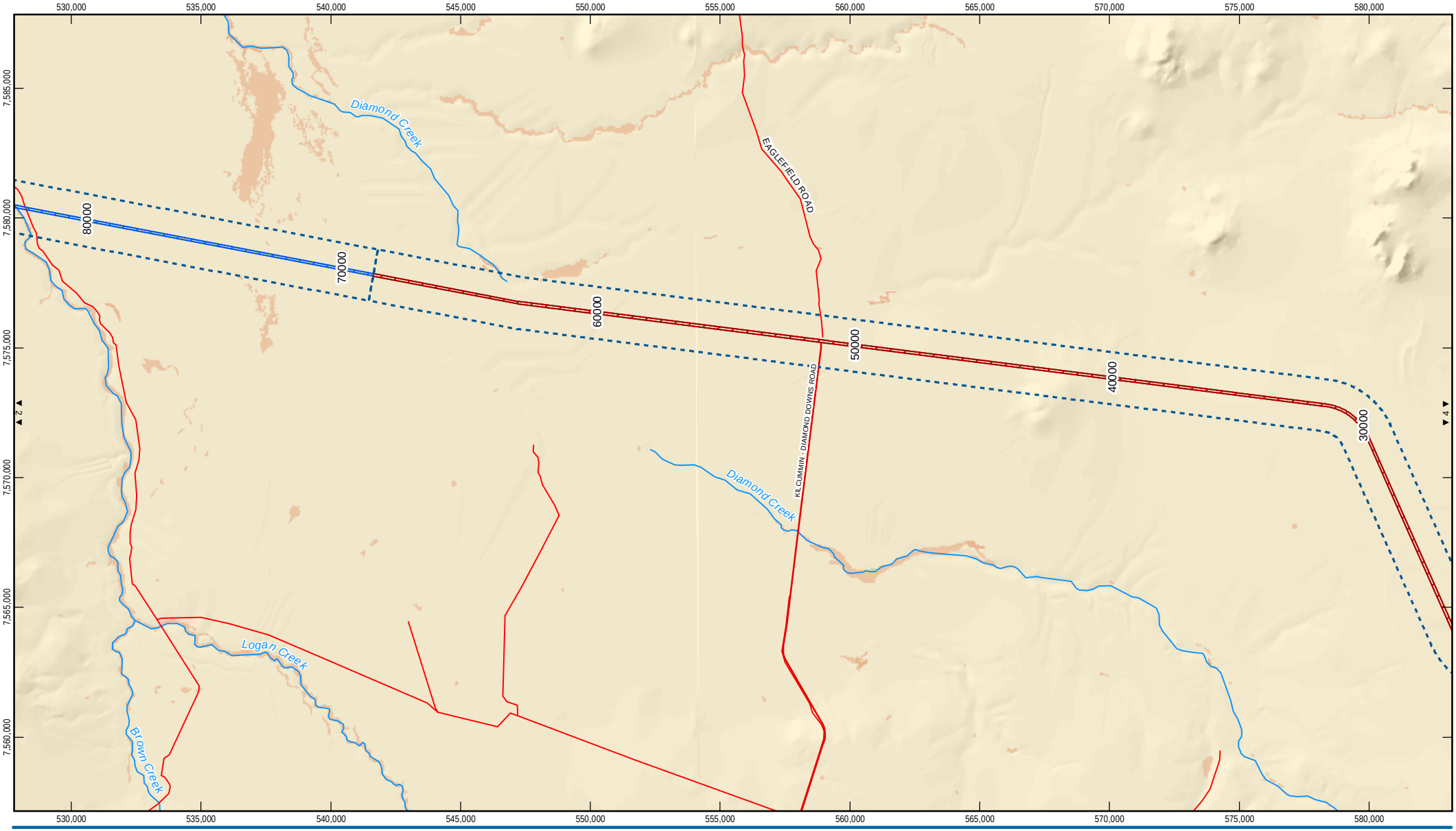
Data source: DERM: DEM (2008), © Commonwealth of Australia (Geoscience Australia): Localities, Railways, Roads, Watercourse (2007); GHD: Potential Australian Painted Snipe Habitat (2011); Adani: Alignment Opt9 Rev3, SP3 (2012); DME: EPC1690 (2010) / EPC1080 (2011); Gassman/Hyder: Mine (Offsite) (2012). Created by: MR, CA



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Kilometres
Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia (GDA)
Grid: Map Grid of Australia 1994, Zone 55

N

LEGEND

- Town
- State Road
- Local Road
- Other Railway
- Watercourse
- Study Area
- Mine (Onsite)
- Mine (Offsite)
- Mine (Offsite)
- Rail (West)
- Rail (East)
- Potential Australian Painted Snipe Habitat - Based on DERM Certified Regional Ecosystems Version 6.0b

Adani Mining Pty Ltd
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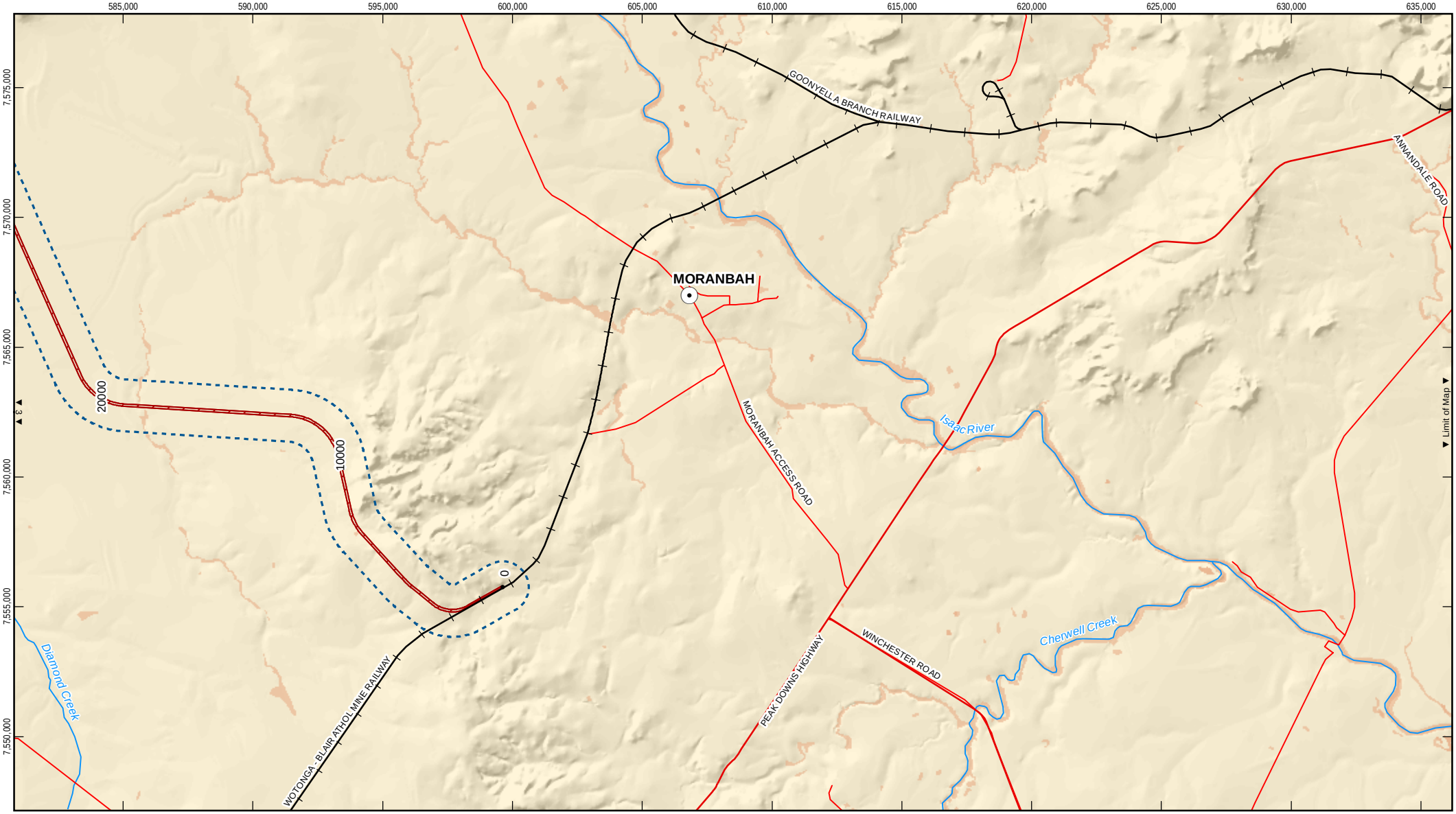
Potential Australian Painted Snipe Habitat Within the Study Area and Surrounding Landscape

Figure 3-11
Sheet 3 of 4

G:\41\25215\GIS\Maps\MXD\400_Ecology\41-25215_468_200k_rev_b.mxd Level 4, 201 Charlotte St Brisbane QLD 4000 T +61 7 3316 3000 F +61 7 3316 3333 E bnemail@ghd.com W www.ghd.com

Data source: DERM: DEM (2008), © Commonwealth of Australia (Geoscience Australia): Localities, Railways, Roads, Watercourse (2007); GHD: Potential Australian Painted Snipe Habitat (2011); Adani: Alignment Opt9 Rev3, SP3 (2012); DME: EPC1690 (2010) / EPC1080 (2011); Gassman/Hyder: Mine (Offsite) (2012). Created by: MR, CA



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0 1 2 3 4 5

Kilometres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia (GDA)
Grid: Map Grid of Australia 1994, Zone 55

N

LEGEND

- Town
- State Road
- Local Road
- Other Railway
- Watercourse
- Study Area
- Mine (Onsite)
- Mine (Offsite)
- Mine (Offsite)
- Rail (West)
- Rail (East)
- Potential Australian Painted Snipe Habitat - Based on DERM Certified Regional Ecosystems Version 6.0b

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Carmichael Coal Mine and Rail Project

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Job Number 41-25215
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G:\41\25215\GIS\Maps\MXD\400_Ecology\41-25215_468_200k_rev_b.mxd Level 4, 201 Charlotte St Brisbane QLD 4000 T +61 7 3316 3000 F +61 7 3316 3333 E bnemail@ghd.com W www.ghd.com

Data source: DERM: DEM (2008), © Commonwealth of Australia (Geoscience Australia): Localities, Railways, Roads, Watercourse (2007); GHD: Potential Australian Painted Snipe Habitat (2011); Adani: Alignment Opt9 Rev3, SP3 (2012); DME: EPC1690 (2010) / EPC1080 (2011); Gassman/Hyder: Mine (Offsite) (2012). Created by: MR, CA

Listed threatened fauna- Unlikely to Occur

The following EPBC Act-listed species have been predicted to occur at the Study Area by the Protected Matters Search Tool. No previous records exist. They are considered unlikely to occur based on current knowledge of their distribution and/or the lack of suitable habitat within the Study Area:

- Retro slider (*Lerista allanae*) – endangered EPBC Act, endangered NC Act
- Fitzroy River turtle (*Rheodytes leukops*) – vulnerable EPBC Act, vulnerable NC Act
- Star finch (*Neochmia ruficauda ruficauda*) (eastern and southern) – endangered EPBC Act, endangered NC Act

3.2.5 Listed Threatened Ecological Communities

Ecological communities are naturally occurring biological assemblages that comprise a particular habitat type. TECs are ecological communities that have been assessed under the EPBC Act and assigned to one of five categories related to the status of the threat to the community, i.e. conservation dependant, vulnerable, endangered, critically endangered and extinct in the wild.

Three TECs listed as endangered under the EPBC Act were identified as having potential to occur in the Study Area and potential quarry and borrow areas from desktop results. The TECs are as follows:

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

The Brigalow TEC was identified as occurring in the Study Area from field surveys and vegetation mapping.

Brigalow (Acacia harpophylla dominant and co-dominant)

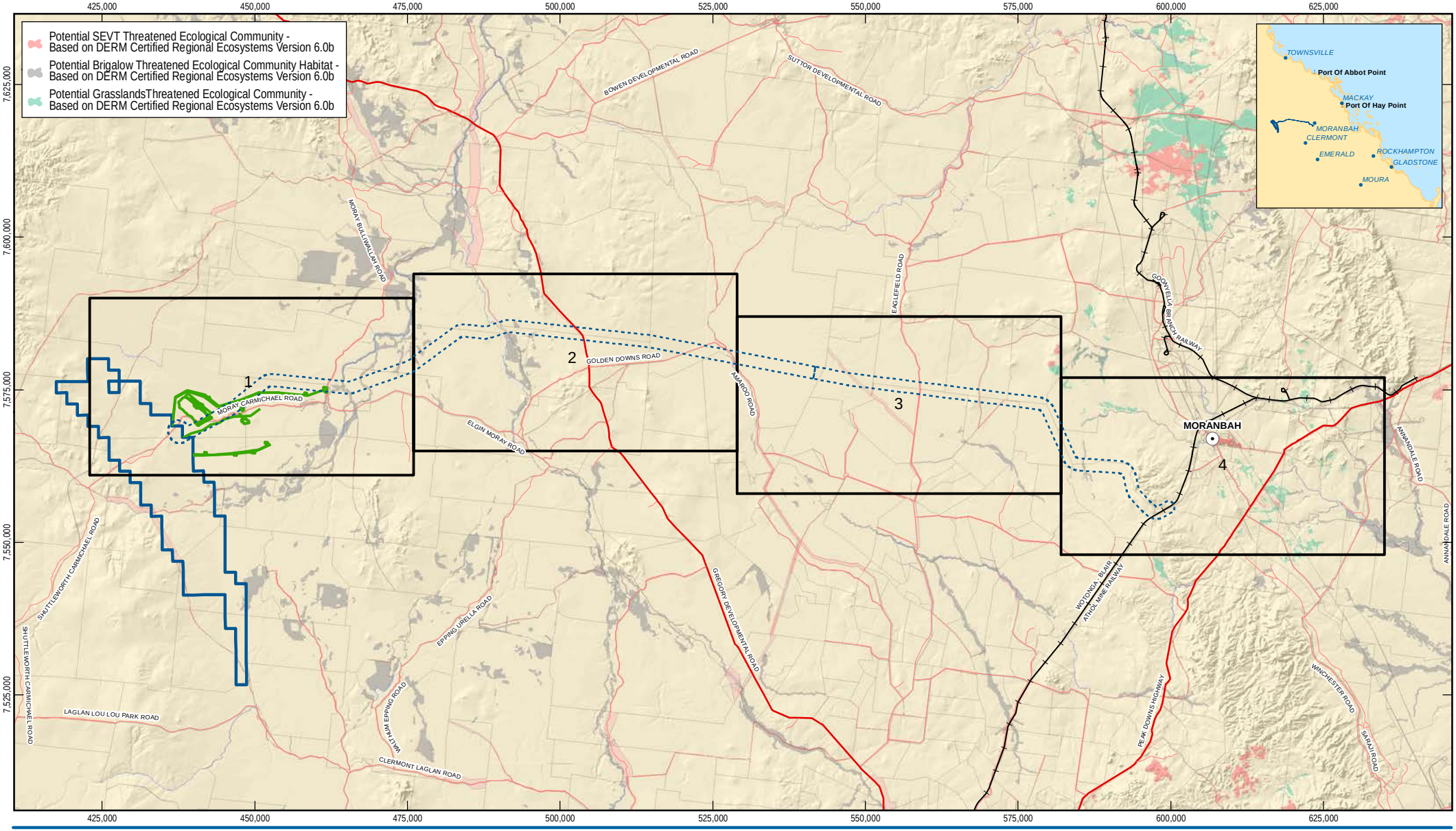
The Brigalow TEC comprises vegetation communities dominated or co-dominated by brigalow. Within Queensland, 16 REs are described as forming part of this TEC. All of these REs are located in the Brigalow Belt, South-East Queensland or Mulga Lands bioregions – none are located in the Desert Uplands bioregion.

The Brigalow TEC has been nominated for listing under the EPBC Act because brigalow communities have undergone a severe decline since the 1940s, and now occupy 10 per cent of their former range (DEH, 2001). The main threatening process is broad scale clearing, a practice that saw massive swathes of brigalow and other acacia communities on the fertile clay plains of Central Queensland and northern New South Wales cleared over a short period. This was done primarily to create grasslands for grazing, which are now dominated by exotic pasture grasses such as buffel grass and creeping bluegrass. Broad scale clearing of remnant and regrowth vegetation is now managed through legislation in Queensland in an attempt to alleviate the decline.

Of the REs listed as forming part of the TEC, only the REs 11.3.1, 11.4.8 and 11.4.9 occur within the Study Area, representing approximately 636 ha (1.8 per cent) of the total Study Area. Of this,

approximately 37 ha occurs within the rail corridor and infrastructure and construction camps footprints. The majority of brigalow is located west of the Gregory Developmental Road, with several small patches occurring close to Diamond Creek, Mistake Creek and approaching the Belyando River. Brigalow communities were generally found in small and fragmented patches within eucalypt communities. In general, where brigalow (i.e. *Acacia harpohphylla*) was observed at field survey sites, it was not considered to form a component of the Brigalow TEC, given its patchy occurrence in communities characterised by eucalypt woodlands. It is likely that brigalow TEC may occur in the broader area of the Project (Rail), as is indicated in RE mapping

The distribution of Brigalow TEC within the Study Area and in the context of the wider landscape is based on RE mapping and is presented in Figure 3-12.



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0 5 10 15 20 25

Kilometres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia (GDA)
Grid: Map Grid of Australia 1994, Zone 55

N

LEGEND

- Town
- State Road
- Local Road
- Other Railway
- Cadastral Parcel
- Road Reserve
- Watercourse Reserve
- Mine (Onsite)
- Mine (Offsite)
- Study Area

Adani Mining Pty Ltd

Carmichael Coal Mine and Rail Project

Potential Threatened Ecological Communities Within the Study Area and Surrounding Landscape

Job Number 41-25215
Revision C
Date 10-09-2012

Figure 3-12
Series Index

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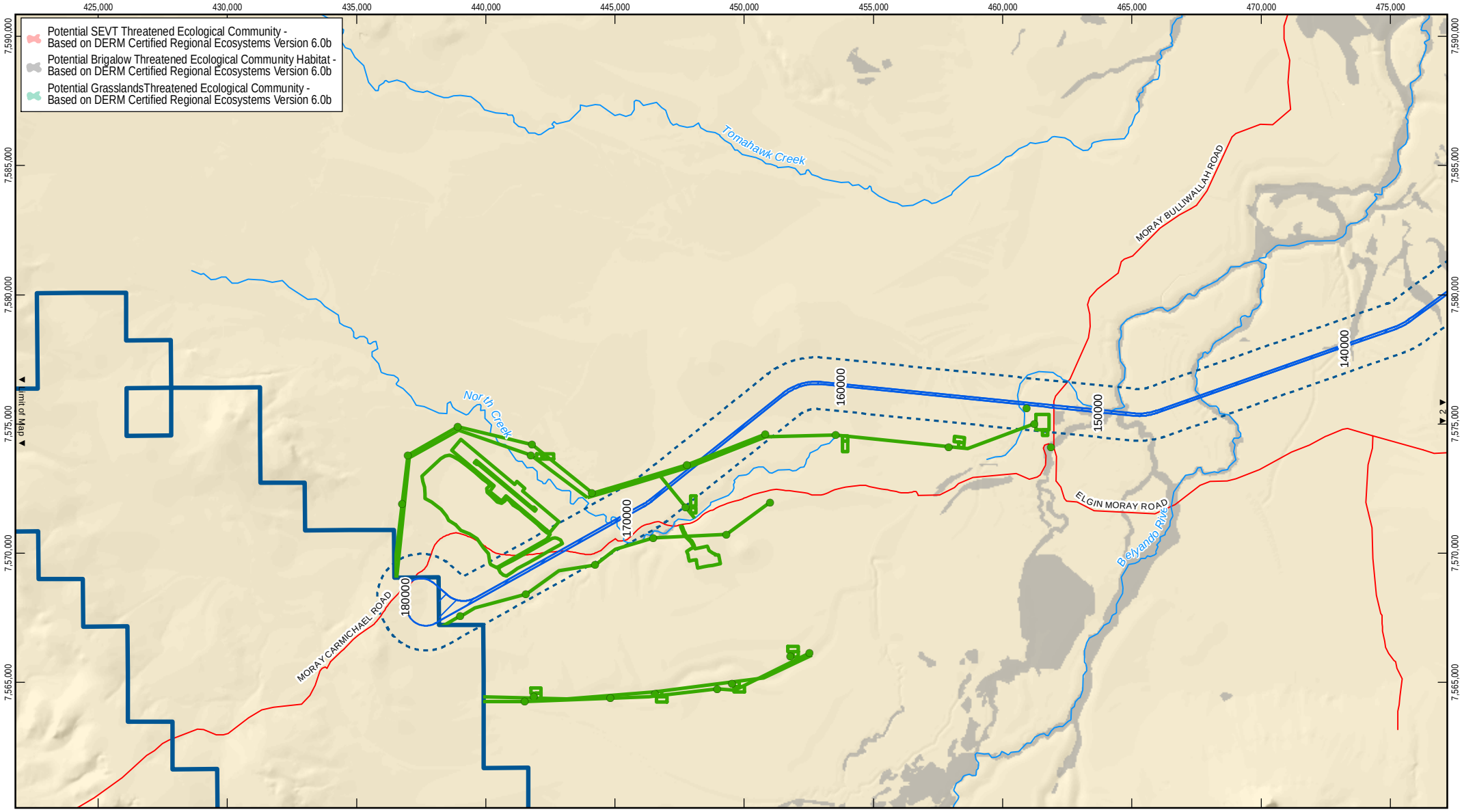
Level 4, 201 Charlotte St Brisbane QLD 4000 T +61 7 3316 3000 F +61 7 3316 3333 E bnemail@ghd.com W www.ghd.com

Data source: DERM: DEM (2008), DCDB (2010); DME: EPC1690 (2010)/EPC1080 (2011); © Commonwealth of Australia (Geoscience Australia): Localities, Railways, Roads (2007); Adani: Alignment Corridors Opt9 Rev3 (2012); GHD: Northern Missing Link (2011); Gassman/Hyder: Mine (Offsite) (2012). Created by: BW, CA



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Kilometres
Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia (GDA)
Grid: Map Grid of Australia 1994, Zone 55

N

LEGEND
Town
State Road
Local Road
Watercourse
Other Railway
Mine (Onsite)
Mine (Offsite)
Mine (Offsite)
Rail (West)
Rail (East)
Study Area

Adani Mining Pty Ltd
Carmichael Coal Mine and Rail Project

Potential Threatened Ecological Communities within the Rail Study Area and Surrounding Landscape

Job Number 41-25215
Revision C
Date 10-09-2012

Figure 3-12
Sheet 1 of 4

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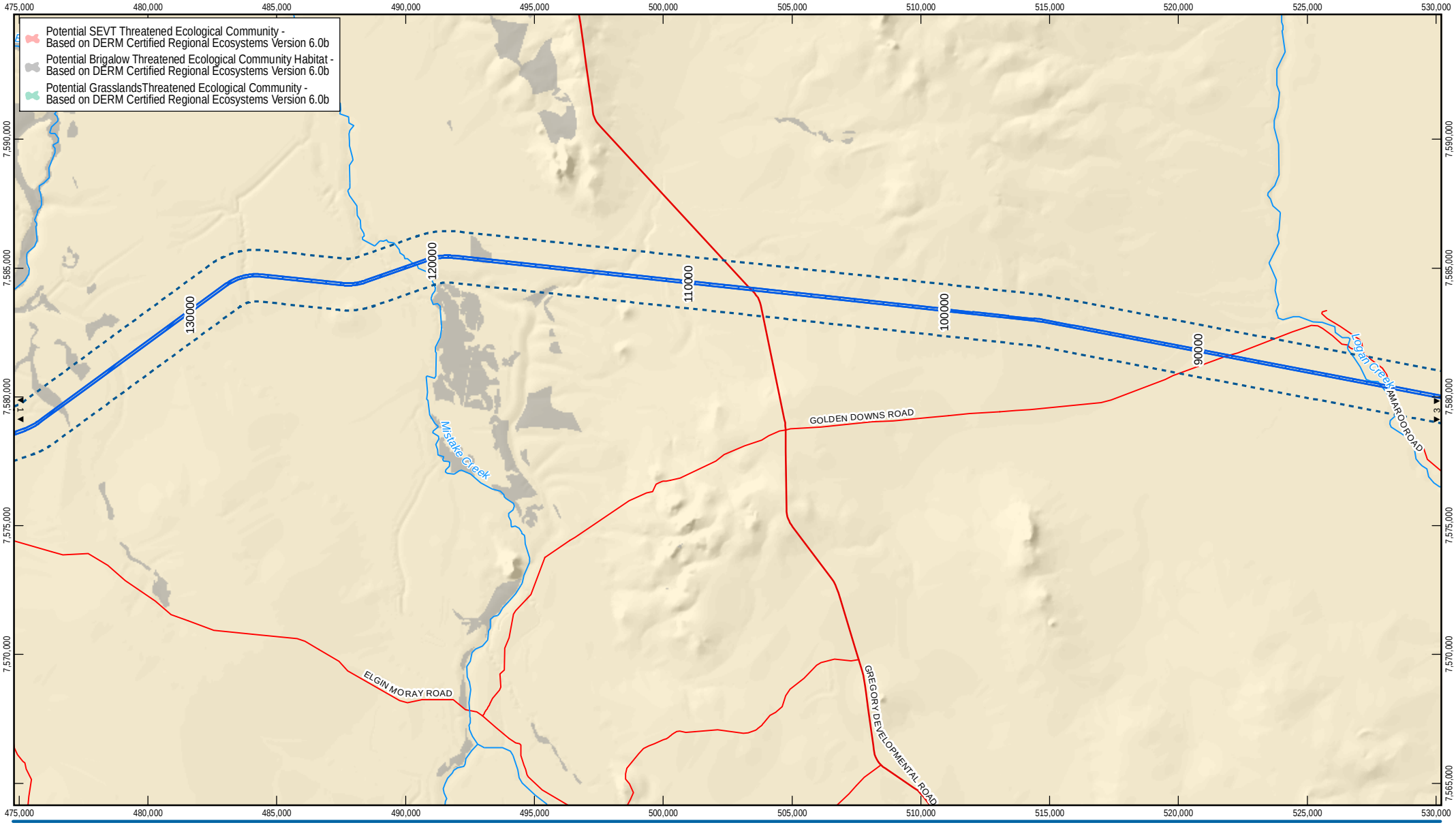
Data source: DERM: DEM (2008), © Commonwealth of Australia (Geoscience Australia): Localities, Railways, Roads, Watercourse (2007); GHD: Potential Threatened Ecological Communities (2012); Adani: Alignment Opt9 Rev3 (2012); DME: EPC1690 (2010) / EPC1080 (2011); Gassman/Hyder: Mine (Offsite) (2012). Created by: MR, CA



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Kilometres
Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia (GDA)
Grid: Map Grid of Australia 1994, Zone 55

N

LEGEND
- Town
- State Road
- Local Road
- Watercourse
- Other Railway
- Mine (Onsite)
- Mine (Offsite)
- Mine (Offsite)
- Rail (West)
- Rail (East)
- Study Area

Adani Mining Pty Ltd
Carmichael Coal Mine and Rail Project

Potential Threatened Ecological Communities within the Rail Study Area and Surrounding Landscape

Job Number 41-25215
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Figure 3-12
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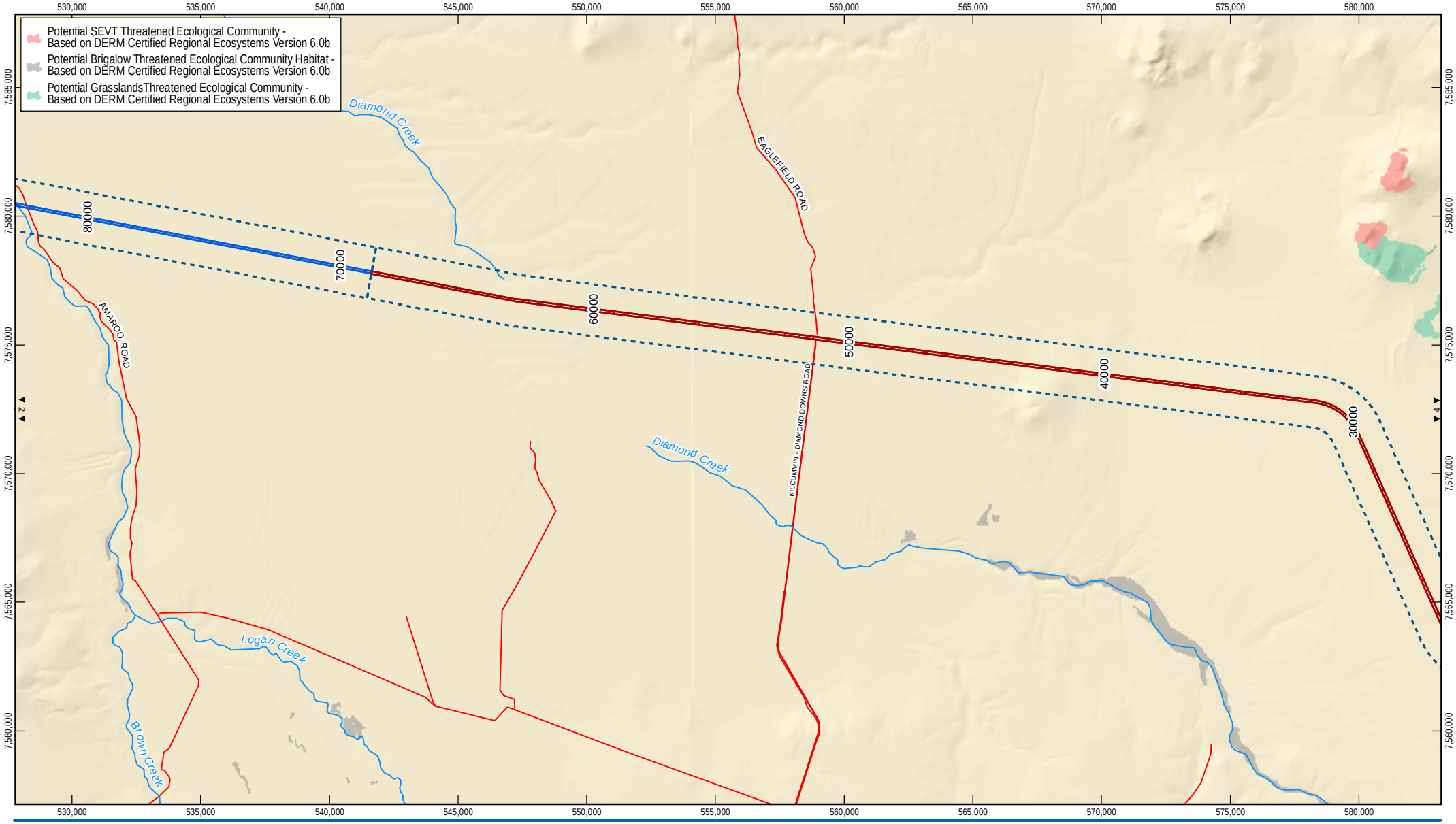
Data source: DERM: DEM (2008), © Commonwealth of Australia (Geoscience Australia): Localities, Railways, Roads, Watercourse (2007); GHD: Potential Threatened Ecological Communities (2012); Adani: Alignment Opt9 Rev3 (2012); DME: EPC1690 (2010) / EPC1080 (2011); Gassman/Hyder: Mine (Offsite) (2012). Created by: MR, CA



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Kilometres
Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia (GDA)
Grid: Map Grid of Australia 1994, Zone 55

N

LEGEND

- Town
- State Road
- Local Road
- Watercourse
- Other Railway
- Mine (Onsite)
- Mine (Offsite)
- Mine (Offsite)
- Rail (West)
- Rail (East)
- Study Area

Adani Mining Pty Ltd
Carmichael Coal Mine and Rail Project

Potential Threatened Ecological Communities within the Rail Study Area and Surrounding Landscape

Job Number 41-25215
Revision C
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Figure 3-12
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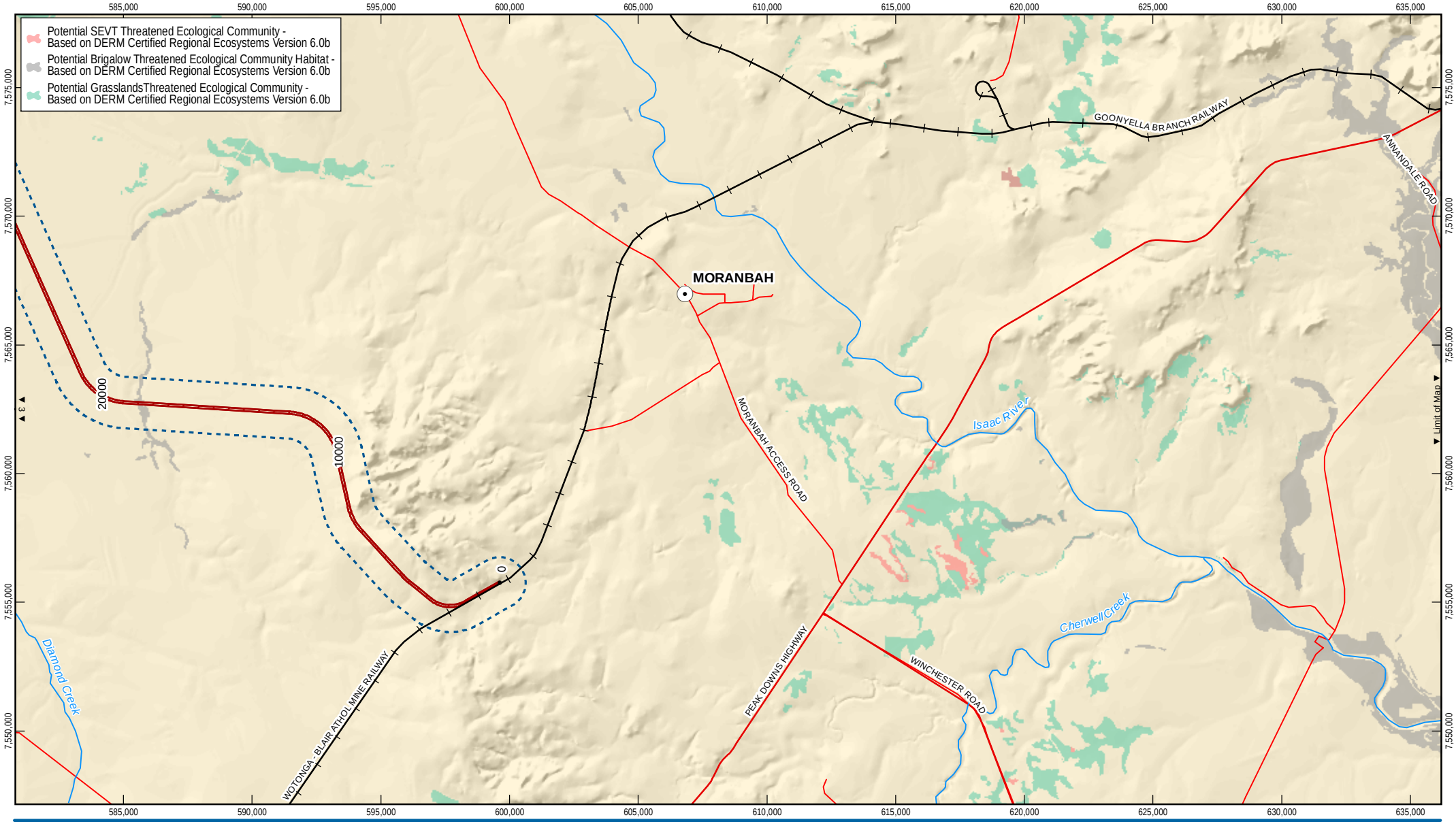
Data source: DERM: DEM (2008), © Commonwealth of Australia (Geoscience Australia): Localities, Railways, Roads, Watercourse (2007); GHD: Potential Threatened Ecological Communities (2012); Adani: Alignment Opt9 Rev3 (2012); DME: EPC1690 (2010) / EPC1080 (2011); Gassman/Hyder: Mine (Offsite) (2012). Created by: MR, CA



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Kilometres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia (GDA)
Grid: Map Grid of Australia 1994, Zone 55

N

LEGEND

- Town
- State Road
- Local Road
- Watercourse
- Other Railway
- Mine (Onsite)
- Mine (Offsite)
- Mine (Offsite)
- Rail (West)
- Rail (East)
- Study Area

Adani Mining Pty Ltd
Carmichael Coal Mine and Rail Project

Potential Threatened Ecological Communities within the Rail Study Area and Surrounding Landscape

Job Number	41-25215
Revision	C
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Figure 3-12
Sheet 4 of 4

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Data source: DERM: DEM (2008), © Commonwealth of Australia (Geoscience Australia): Localities, Railways, Roads, Watercourse (2007); GHD: Potential Threatened Ecological Communities (2012); Adani: Alignment Opt9 Rev3 (2012); DME: EPC1690 (2010) / EPC1080 (2011); Gassman/Hyder: Mine (Offsite) (2012). Created by: MR, CA

Natural Grasslands of the Queensland Central Highlands and the Northern Fitzroy Basin

The Natural Grasslands TEC is a tussock grassland community comprised of a number of native grass species throughout its range, depending upon factors such as rainfall, soil and geology. The TEC is endemic to Queensland and broadly occurs where the Fitzroy River Basin and the Brigalow Belt North coincide extending from Collinsville in the north to Carnarvon National Park in the south. Seven REs are identified as forming part of this TEC.

The Natural Grasslands TEC is eligible for listing as endangered because of the severe decline its geographic distribution has undergone. It is currently restricted to smaller remnants that face continuing threats as a result of the ecological community's decline, severe reduction in integrity and the rate of detrimental change its undergoing (TSSC, 2008). The main threats to the TEC that have been identified are: grazing, conversion to cropping and pasture improvement; weeds and pest animals; mining activities; construction of roads and other infrastructure (TSSC, 2008). Lack of knowledge about grasslands has also been identified as a potential threat and could contribute to the severity of the key threatening processes, particularly where identification of the TEC is not always obvious.

The expression of the TEC may vary over short periods or across small distances with three key diagnostic characteristics that need to be met for grassland community to qualify as part of the TEC. First, it must occur within the Brigalow Belt North or South subregions identified which are largely within the Central Highlands and northern Fitzroy River Basin regions of Queensland. Second, the tree canopy must be absent or sparse and the grassland not originally derived from a cleared woodland area. Third, the ground layer must contain three indicator native grass species from a list of 12 species, for example *Dichanthium queenslandicum* (TSSC, 2008).

Within the Project (Rail), the Natural Grassland TEC only occurs within the Northern Bowen Basin subregion of the Brigalow Belt bioregion (TSSC, 2008). None of these REs, and thus the Natural grassland TEC, are mapped within the Northern Bowen Basin subregion of the Study Area. .

The distribution of mapped Natural Grasslands TEC at the Study Area is presented in Figure 3-12.

Semi-evergreen Vine Thickets of the Brigalow Belt (North and South) and Nandewar Bioregions

Semi-evergreen vine thicket TEC comprises semi-evergreen vine thickets (SEVT) in eastern Queensland and northern New South Wales. It is an extreme form of dry seasonal rainforest characterised by trees with microphyll sized leaves and the presence of bottle trees (*Brachychiton* spp.) as emergents (DSEWPaC 2011n).

Ten REs comprise the SEVT TEC in Queensland. The distribution of SEVT TEC within the Study Area and in the context of the wider landscape as based on RE mapping is presented inFigure 3-12.

3.2.6 Listed Migratory Species

Two EPBC Act-listed migratory birds were confirmed present at the Study Area:

- Great egret (*Ardea alba*) – migratory (JAMBA[1], CAMBA), marine EPBC Act; special least concern NC Act
- Rainbow bee-eater (*Merops ornatus*) - migratory (JAMBA), marine EPBC; special least concern NC Act

The great egret and rainbow bee-eater are common and widespread species. Habitat at the Study Area is likely to be used on a temporary to permanent basis by these species. As these species are common and widespread, and suitable habitat is likely to occur over much of the surrounding landscape, habitat at the Study Area for the great egret and rainbow bee-eater is not considered to constitute 'important habitat' as defined in the Significant Impact Guidelines (DEWHA, 2009b). For information pertaining to location of species records, refer to Appendix B.

The likelihood of occurrence assessment, presented in Table 3-4 (based upon definitions outlined in Section 1.4.4), indicated that two additional EPBC Act-listed migratory species are likely to occur at the Study Area, based on distribution, presence of potentially suitable habitat and previous records from the region. A further seven EPBC Act-listed migratory species, including two nominated in the Project terms of reference (spectacled monarch (*Monarcha trivirgatus*); and black-faced monarch (*Monarcha melanopsis*)) may occur at the Study Area, based on distribution and presence of potentially suitable habitat. Broad fauna habitat types mapped across the Study Area (as detailed in Table 2-5 and Figure 2-3. Figure 2-3 that may be utilised by EPBC Act-listed migratory species that are confirmed present, or are considered as likely to occur or may occur, are outlined in Table 3-5.

[1] Agreement between the Government of Australia and the Government of Japan for the Protection of Migratory Birds in Danger of Extinction and their Environment

Table 3-4 Commonwealth listed Migratory Species – Likelihood of Occurrence

Species	EPBC Act / NC Act status	Predicted to occur #	Previously recorded*	Recorded at Study Area	Habitat preferences and known distribution	Likelihood of occurrence
Australian painted snipe *Rostratula benghalensis* s. lat	See Table 3-3 Section 3.2.4.2					
black-faced monarch *Monarcha melanopsis*	migratory (Bonn), marine / special least concern	✓	x	x	Rainforest and open forest, gullies and open woodlands (when migrating). Predominantly coastal but range extends inland (Pizzey and Knight, 2007).	Not previously recorded in region Suitable habitat occurs at Study Area **May occur**
cattle egret *Ardea ibis*	migratory (CAMBA, JAMBA), marine / special least concern	✓	x	x	Occurs in stock paddocks, croplands, wetlands, tidal mudflats and drains. Widespread distribution in northern and eastern Australia, summer-Autumn migrant to Queensland (Pizzey and Knight, 2007).	Not previously recorded in region Suitable habitat occurs at Study Area **May occur**
fork-tailed swift *Apus pacificus*	migratory (CAMBA,JAMBA, ROKAMBA), marine / special least concern	✓	x	x	Habitat preferences include open country from semi-deserts to coasts. Common and widespread across Australia, this species is a summer migrant to Australia (October-April) (Pizzey and Knight, 2007).	Not previously recorded in region Suitable habitat occurs at Study Area **May occur**
great egret *Ardea alba*	migratory (CAMBA, JAMBA, ROKAMBA), marine/special least concern	✓	x	✓	Inhabits shallows of rivers, estuaries, tidal mudflats, freshwater wetlands, sewage ponds, irrigation areas and larger dams. This species is widespread throughout Australia (Pizzey and Knight, 2007).	**Confirmed present**

Species	EPBC Act / NC Act status	Predicted to occur #	Previously recorded*	Recorded at Study Area	Habitat preferences and known distribution	Likelihood of occurrence
Latham's snipe *Gallinago hardwickii*	migratory (Bonn; CAMBA; JAMBA; ROKAMBA), marine / special least concern	✓	x	x	Habitat preferences include soft wet ground or shallow water with tussocks and other green or dead growth, wet parts of paddocks or near dams, scrub or open woodland. Summer migrant to eastern Australia (arriving July-Aug) (Pizzey and Knight, 2007).	Not previously recorded in region Suitable habitat occurs at Study Area **May occur**
rainbow bee-eater *Merops ornatus*	migratory (JAMBA), marine / special least concern	✓	Wildlife Onine	✓	Inhabits open woodlands with sandy, loamy soil, riverbanks, beaches, cliffs, mangroves, rainforests and woodlands. Common and widespread distribution (Pizzey and Knight, 2007).	**Confirmed present**
satin flycatcher *Myiagra cyanoleuca*	migratory (Bonn), marine / special least concern	✓	Project (Mine) Volume 4 Appendix N1.	x	Inhabits heavily vegetated gullies in forests, taller woodlands, trees in open country and coastal forests along eastern Australia (Pizzey and Knight, 2007).	Previously recorded in region Suitable habitat occurs at Study Area **Likely to occur**
spectacled monarch *Monarcha trivirgatus*	migratory (Bonn), marine / special least concern	x	x	x	Typically inhabits understorey of densely vegetated areas (rainforests, gullies, riparian areas). Predominantly coastal but range extends inland (Pizzey and Knight, 2007).	Not previously recorded in region Suitable habitat occurs at Study Area **May occur**
white-bellied sea-eagle *Haliaeetus leucogaster*	migratory (CAMBA), marine / special least concern	✓	Alpha Coal Project EIS (Hancock Prospecting Pty Ltd, 2010)	x	Inhabits coasts, estuaries, large rivers and inland lakes. Occurs around coastal Australia and larger lakes and storages, some far inland (Pizzey and Knight, 2007).	Previously recorded in region during Alpha Coal Project EIS surveys. Suitable habitat occurs at Study Area **Likely to occur**

Species	EPBC Act / NC Act status	Predicted to occur #	Previously recorded*	Recorded at Study Area	Habitat preferences and known distribution	Likelihood of occurrence
white-throated needletail *Hirundapus caudacutus*	migratory (CAMBA; JAMBA, ROKAMBA), marine / special least concern	✓	x	x	Occupies airspace over forests, woodlands, farmlands, plains, lakes and favoured timbered ranges. Summer migrant to eastern Australia (October-April) (Pizzey and Knight, 2007).	Not previously recorded in region Suitable habitat occurs at Study Area **May occur**

Predicted to occur within approximately 10 km of Study Area: DSEWPaC Protected Matters Search Tool

* Previously recorded within approximately 10-50 km of Study Area: desktop sources including Wildlife Online / Queensland Museum/Birds Australia, EIS documents for projects in the region including Hancock Prospecting Pty Ltd (2010)

Bonn: Convention on the Conservation of Migratory Species of Wild Animals

CAMBA: Agreement between the Government of Australia and the Government of the People's Republic of China for the Protection of Migratory Birds and their Environment

JAMBA: Agreement between the Government of Australia and the Government of Japan for the Protection of Migratory Birds in Danger of Extinction and their Environment

ROKAMBA: Agreement between the Government of Australia and the Government of the Republic of Korea on the Protection of Migratory Birds

Table 3-5 Habitats for Listed Migratory Species

	Eucalypt open woodland	Acacia woodland or forest	Brigalow shrubland to open forest	Eucalypt and Acacia mixed woodland or forest	Open woodland fringing watercourses and on flood plains	Grassland	Open cleared land	Natural and artificial water bodies
Black-faced monarch	✓		✓	✓	✓			
Cattle egret					✓		✓	✓
Fork-tailed swift	✓	✓	✓	✓	✓	✓	✓	✓
Great egret					✓			✓
Latham's snipe	✓				✓			✓
Rainbow bee-eater	✓	✓	✓	✓	✓	✓	✓	✓
Satin flycatcher	✓			✓	✓			
Spectacled monarch					✓			
White-bellied sea-eagle					✓			✓
White-throated needletail	✓	✓	✓	✓	✓	✓	✓	✓
Australian painted snipe					✓			✓

3.2.7 Great Barrier Reef Marine Park

The Study Area is located over 200 km due west and approximately 320 km upstream of the Great Barrier Reef Marine Park (refer to Section 3.2.1– World Heritage Properties).

3.2.8 Other Commonwealth Matters of Conservation Significance

Places on the Register of the National Estate

Two Places on the Register of the National Estate occur within 50 km of the study area:

- Epping Forest National Park (scientific):
  - Located approximately 48 km south-west of the centre of the study area)
  - Located upstream of the Study Area (i.e. Belyando River flows north past Epping Forest National Park (scientific) prior to its confluence with the Carmichael River)

- Wilandspey Conservation (formerly Environmental) Park:
  - Located approximately 17 km north west of the centre of the Study Area
  - Located within the Carmichael River sub-catchment

These two places on the Register of the National Estate are not matters of NES and are no longer protected under the EPBC Act. As of February 2012, places on the Register of the National Estate that are not World Heritage or National Heritage matters of NES are not protected under the EPBC Act. However, these places may be otherwise protected under relevant state or local legislations.

Listed Marine Species

A total of 11 EPBC Act-listed marine species were recorded during field surveys. This includes the great egret and rainbow bee-eater, also listed as migratory (see Section 3.2.6). No threatened EPBC Act listed marine birds were recorded in the Study Area. The EPBC Act listed marine birds detected from the Study Area are widespread, common, woodland and/or wetland species, and are likely to be occur only in low densities across the landscape wherever suitable habitat is available. No wetlands serving as a localised resource where marine birds would occur in high densities is present within the Study Area. A likelihood of occurrence assessment for EPBC listed marine species is detailed in Table 3-6 below.

Table 3-6 Commonwealth Listed Marine Species – Likelihood of Occurrence

Scientific name	EPBC Act status / NC Act status	Predicted to occur#	Previously recorded*	Recorded at Study Area	Habitat preferences and known distribution	Likelihood of occurrence
Australian painted snipe *Rostratula benghalensis* s. lat	See Table 3-3, Section 3.2.4.2					
Australasian pipit *Anthus novaeseelandiae*	marine / not listed	x	Wildlife Online Birds Austyralia Project (Mine) Volume 4, Appendix N1	✓	Habitat incudes grasslands, open woodlands, coastal dunes and other open paddocks such as crops and pastures, golf courses and roadsides. Widespread throughout the whole of Australia (Pizzey and Knight, 2007).	**Confirmed present**
Australian pelican *Pelecanus conspicillatus*	marine / not listed	x	Project (Mine) Volume 4, Appendix N1)	✓	Prefers large shallow waters including: fresh, brackish and saline waters, coastal and inland waters; sometimes open sea. Also occurs on islands, mudflats and sandspits. Occurs across most of Australia except inland Western Australia and the corner of inland Northern Territory and Victoria (Pizzey and Knight, 2007).	**Confirmed present**
Australian white ibis *Threskiornis molucca*	marine / not listed	x	Wildlife Online	x	Inhabits freshwater / brackish/ saline wetlands, irrigated areas, margins of dams, floodplains, tidal mudflats, lawns, gardens and orchids. Occurs across the north, east and west of Australia and has recently extended its range to Tasmania (Pizzey and Knight, 2007)	This species has been recorded in the region Suitable habitat occurs within the Study Area **Likely to occur**

Scientific name	EPBC Act status / NC Act status	Predicted to occur#	Previously recorded*	Recorded at Study Area	Habitat preferences and known distribution	Likelihood of occurrence
black-faced cuckoo-shrike *Coracina novaehollandiae*	marine / not listed	x	Wildlife Online Birds Austyralia Project (Mine) Volume 4, Appendix N1	✓	Inhabits a variety of habitat types including rainforests, forests, woodlands, scrublands, woodlands fringing watercourses as well as orchards, parks and gardens. Widespread throughout Australia (Pizzey and Knight, 2007).	**Confirmed present**
black-winged stilt *Himantopus himantopus*	marine / not listed	X	Wildlife Online	x	Inhabits fresh and brackish swamps, shallow rivers and lake edges, flooded clay pans, dams, sewage ponds, commercial salt fields, saltmarsh, tidal estuaries and mudflats. Widespread across Australia in suitable habitat (areas with water sources) (Pizzey and Knight, 2007).	This species has been recorded in the region Suitable habitat occurs within the Study Area **Likely to occur**
brown goshawk Accipiter fasciatus	marine / not listed	X	Wildlife Online	x	Inhabits open forests, woodlands, scrublands and margins, farmlands, sewage farms as well as golf courses, parks and gardens. Widespread across Australia including Tasmania (Pizzey and Knight, 2007)	This species has been recorded in the region Suitable habitat occurs within the Study Area **Likely to occur**
cattle egret *Ardea ibis*	Table 3-4, Section 3.2.6					
channel-billed cuckoo *Scythrops novaehollandiae*	marine / not listed	x	Wildlife Online Project (Mine) Volume 4, Appendix N1	✓	Habitat preferences include rainforest, open forest, woodland, swamp woodland, trees in fruit on farming land also roadsides. Present throughout the northern and eastern Australian coast and inland from the Kimberleys in Western Australia (rare) to about Sydney in New South Wales (Pizzey and Knight, 2007).	**Confirmed present**

Scientific name	EPBC Act status / NC Act status	Predicted to occur#	Previously recorded*	Recorded at Study Area	Habitat preferences and known distribution	Likelihood of occurrence
common koel *Eudynamys scolopacea*	marine / not listed	x	Project (Mine) Volume 4, Appendix N1 Alpha Coal Project EIS (Hancock Prospecting Pty Ltd, 2010).	x	The common koel prefers leafy, fruiting trees on fringes of various habitats including rainforests, woodlands, streams and farmlands (Pizzey and Knight, 2007).	This species has been recorded in the region Suitable habitat for this species occurs in the Study Area **Likely to occur**
cotton pygmy-goose *Nettapus coromandelianus*	marine / near threatened	✓	Wildlife Online Birds Australia	x	Inhabits deeper freshwater swamps, lagoons or dams with waterlilies and other semi-emergent water plants. Occurs along coastal eastern Queensland (Pizzey and Knight, 2007).	Previously recorded in region Suitable habitat occurs at Study Area **Likely to occur**
dollarbird *Eurystomus orientalis*	marine / not listed	x	Project (Mine) Volume 4, Appendix N1 Alpha Coal Project EIS (Hancock Prospecting Pty Ltd, 2010).	x	The dollarbird occurs in and around rainforest margins, forest, woodlands, watercourses, wetlands and farmlands. This species is occurs across coastal northern and eastern Australia (Pizzey and Knight, 2007).	This species has been recorded in the region Suitable habitat for this species occurs in the Study Area **Likely to occur**
forest kingfisher *Todiramphus macleayii*	marine / not listed	x	Project (Mine) Volume 4, Appendix N1	x	The forest kingfisher prefers open forest, woodland, timbered watercourses, farmlands and canefields. This species occurs from the top end of the Northern Territory to the central coast of New South Wales (Pizzey and Knight, 2007).	This species has been recorded in the region Suitable habitat for this species occurs in the Study Area **Likely to occur**

Scientific name	EPBC Act status / NC Act status	Predicted to occur#	Previously recorded*	Recorded at Study Area	Habitat preferences and known distribution	Likelihood of occurrence
great egret *Ardea alba*	Table 3-4, Section 3.2.6					**Confirmed present**
Horsfield's bronze-cuckoo *Chrysococcyx basalis*	marine / not listed	x	Project (Mine) Volume 4, Appendix N1	✓	Inhabits woodlands, mallee, mulga, saltbush, saltmarsh, and mangroves habitats as well as roadsides and golf courses. This species is widespread across Australia (Pizzey and Knight, 2007).	**Confirmed present**
intermediate egret *Ardea intermedia*	marine / not listed	x	Project (Mine) Volume 4, Appendix N1 Alpha Coal Project EIS (Hancock Prospecting Pty Ltd, 2010).	x	The intermediate egret prefers freshwater wetlands, pastures, croplands, tidal mudflats and floodplains. It is a common species (Pizzey and Knight, 2007).	This species has been recorded in the region Suitable habitat for this species occurs in the Study Area **Likely to occur**
Latham's snipe *Gallinago hardwickii*	Section 3.2.6					
magpie goose *Anseranas semipalmata*	marine / not listed	✓	x	x	Distribution of this species extends up to 300 km from the coast in eastern and northern Australia. Habitat preferences include large seasonal wetlands and well vegetated dams with rushes and sedges; wet grasslands and floodplains (Pizzey and Knight, 2007).	Not previously recorded in region Suitable habitat occurs at Study Area **May occur**

Scientific name	EPBC Act status / NC Act status	Predicted to occur#	Previously recorded*	Recorded at Study Area	Habitat preferences and known distribution	Likelihood of occurrence
nankeen kestrel *Falco cenchroides*	marine / not listed	x	Wildlife Online Birds Australia Project (Mine) Volume 4, Appendix N1	✓	Habitat preferences include grasslands, plains, gibber deserts, foothills, high plains, beach wastes, dunes and cliffs. Also present in farmlands, crops, road sides, grains silos, railyards and other buildings. Widespread throughout all of Australia (Pizzey and Knight, 2007).	**Confirmed present**
pallid cuckoo *Cacomantis pallidus*	marine / not listed	x	Wildlife Online	x	Habitat preferences include woodlands, scrublands, mangroves, pastoral country, farmland as well as golf courses, roadsides, rail reserves and gardens. Breeding migrant that occurs throughout Australia, arriving September-October (Pizzey and Knight, 2007).	This species has been recorded in the region Suitable habitat occurs within the Study Area **Likely to occur**
purple swamphen *Porphyrio porphyrio*	marine / not listed	x	Wildlife Online	x	Inhabits margins of swamps, lakes, shallow rivers with dense reeds/ rushes/cumbungi. Also common in built areas including town lakes, airports, golf courses and sewage ponds. Widespread across eastern Australia, but also occurs in the north and south-west of the country (Pizzey and Knight, 2007).	This species has been recorded in the region Suitable habitat occurs within the Study Area **Likely to occur**
rainbow bee-eater *Merops ornatus*	Table 3-4, Section 3.2.6					**Confirmed present**
satin flycatcher *Myiagra cyanoleuca*	Table 3-4, Section 3.2.6					

Scientific name	EPBC Act status / NC Act status	Predicted to occur#	Previously recorded*	Recorded at Study Area	Habitat preferences and known distribution	Likelihood of occurrence
sacred kingfisher *Todiramphus sanctus*	marine / not listed	x	Project (Mine) Volume 4, Appendix N1 Alpha Coal Project EIS (Hancock Prospecting Pty Ltd, 2010).	x	The sacred kingfisher prefers open forests/woodlands, river margins, lakes, mangroves and mudflats. This species occurs across much of mainland Australia (Pizzey and Knight, 2007).	This species has been recorded in the region Suitable habitat for this species occurs in the Study Area **Likely to occur**
silvereye *Zosterops lateralis*	marine / not listed	x	Project (Mine) (Volume 4 Appendix O)	✓	Occurs in most vegetated habitats across coastal/subcoastal Australia. Range extends throughout the eastern Australian coast and the southern Western Australian coast (Pizzey and Knight, 2007).	**Confirmed present**
southern boobook *Ninox novaeseelandiae*	marine / not listed	x	Project (Mine) Volume 4, Appendix N1) Alpha Coal Project EIS (Hancock Prospecting Pty Ltd, 2010).	x	The southern boobook occurs in a variety of habitats including rainforests, woodlands, mallee, dense mulga and lightly timbered habitats. This species is widespread across Australia (Pizzey and Knight, 2007).	This species has been recorded in the region Suitable habitat for this species occurs in the Study Area **Likely to occur**

Scientific name	EPBC Act status / NC Act status	Predicted to occur#	Previously recorded*	Recorded at Study Area	Habitat preferences and known distribution	Likelihood of occurrence
spangled drongo *Dicrurus bracteatus*	marine / not listed	x	Project (Mine) Volume 4, Appendix N1) Alpha Coal Project EIS (Hancock Prospecting Pty Ltd, 2010).	x	The spangled drongo prefers rainforest edges, isolated leafy trees, eucalypt forests/woodlands, paperbarks and coastal scrub. This species occurs in coastal northern and eastern Australia (Pizzey and Knight, 2007).	This species has been recorded in the region Suitable habitat for this species occurs in the Study Area **Likely to occur**
spectacled monarch *Monarcha trivirgatus*	Table 3-4, Section 3.2.6					
spotted nightjar *Eurostopodus argus*	marine / not listed	x	Project (Mine) Volume 4, Appendix N1 Alpha Coal Project EIS (Hancock Prospecting Pty Ltd, 2010).	x	The spotted nightjar occurs in drier eucalypt woodlands, stony ridges, mallee, mulga and spinifex associations. This species is widespread in mainland Australia (Pizzey and Knight, 2007).	This species has been recorded in the region Suitable habitat for this species occurs in the Study Area **Likely to occur**
straw-necked ibis *Threskiornis spinicollis*	marine / not listed	x	Project (Mine) Volume 4 Appendix N1	x	The straw-necked ibis occurs in freshwater wetlands, irrigated areas, dam margins, floodplains, saline wetlands and mudflats. This species is found in eastern, south-eastern and northern Australia with recent expansions to south-western Australia (Pizzey and Knight, 2007).	This species has been recorded in the region Suitable habitat for this species occurs in the Study Area **Likely to occur**

Scientific name	EPBC Act status / NC Act status	Predicted to occur#	Previously recorded*	Recorded at Study Area	Habitat preferences and known distribution	Likelihood of occurrence
tree martin *Petrochelidon nigricans*	marine / not listed	x	Wildlife Online Project (Mine) Volume 4, Appendix N1	✓	Prefers open country where large trees are present e.g. river red gums, also along watercourses, rivers, lakes and wetlands. Widespread throughout Australia in inland patches on the Western Australia /Northern Territory border, and the Queensland/Victoria border (Pizzey and Knight, 2007).	**Confirmed present**
whistling kite *Haliastur sphenurus*	marine / not listed	x	Project (Mine) Volume 4, Appendix N1 Alpha Coal Project EIS (Hancock Prospecting Pty Ltd, 2010).	✓	The whistling kite prefers open forests and foothills that are near water, timbered watercourses, lakes, swamps and tidal inlets. This species is common across Australia and migratory or nomadic to coastal northern Australia in the dry season (Pizzey and Knight, 2007).	**Confirmed present**
white-bellied cuckoo-shrike *Coracina papuensis*	marine / not listed	x	Project (Mine) Volume 4, Appendix N1 Alpha Coal Project EIS (Hancock Prospecting Pty Ltd, 2010).	x	The white-bellied cuckoo-shrike prefers forests/woodlands, river red gums, open grasslands and mangroves. This species occurs from tropical northern Australia south to Victoria (Pizzey and Knight, 2007).	This species has been recorded in the region Suitable habitat for this species occurs in the Study Area **Likely to occur**
white-bellied sea-eagle *Haliaeetus leucogaster*	Table 3-4, Section 3.2.6					

Scientific name	EPBC Act status / NC Act status	Predicted to occur#	Previously recorded*	Recorded at Study Area	Habitat preferences and known distribution	Likelihood of occurrence
white-throated needletail *Hirundapus caudacutus*	Table 3-4, Section 3.2.6					

Predicted to occur within approximately 10 km of Study Area: DSEWPaC Protected Matters Search Tool

* Previously recorded within approximately 10 - 50 km of Study Area: desktop sources including Wildlife Online / Birds Australia / Queensland Museum, EIS documents for projects in the region including Hancock Prospecting Pty Ltd (2010)

3.3 State Matters of Conservation Significance

3.3.1 Regional Ecosystems

The occurrence of REs within the Study Area is discussed in Section 2.4.1.2.

Table 2-2 details each RE description, location and area calculation within the Study Area. RE mapping is presented in Figure 2-2.

3.3.2 Mapped Regrowth Vegetation

Mapped regrowth vegetation regulated under the VM Act within the Study Area is discussed in Section 2.4. The regrowth mapping within the Study Area is detailed on Figure 2-2.

3.3.3 Essential Habitat

No Essential Habitat occurs within the Study Area.

Essential Habitat for three EPBC Act species and four NC Act species occurs within 50 km of the Study Area as summarised in Table 3-7.

Table 3-7 Essential Habitat within 50 km of Study Area

Species	EPBC Act / NC Act Status	Approximate distance of Essential Habitat patch from centre of Study Area centreline	Approximate co-ordinate of centre of Essential habitat patch
Reptiles			
Ctenotus capricorni	not listed / near threatened	34 km south-east	55k 458317. 7538990
ornamental snake *Denisonia maculata*	vulnerable / vulnerable	14 km north-east	55k 596244, 7576212
		22 km north-east	55k 595911, 7584768
		35 km north	55k 592243, 7598101
		40 km north	55k 592799, 7601545
		42 km north	55k 590798, 7601545
		45 km north	55k 589464, 7607879
Mammals			
northern hairy-nosed wombat *Lasiorhinus krefftii*	endangered / endangered	48 km south-east	55k 468098, 758768
little pied bat *Chalinolobus picatus*	not listed / near threatened	34 km north	55k 504108, 7618545
		13 km north-east	55k 601468, 7569434
		14 km north-east	55k 596244, 7576212

Species	EPBC Act / NC Act Status	Approximate distance of Essential Habitat patch from centre of Study Area centreline	Approximate co-ordinate of centre of Essential habitat patch
Plant			
Peripleura scabra	not listed / near threatened	30 km north	55k 488548. 7615767
Acacia armitii	not listed / near threatened	43 km north-west	55k 468987, 7626212
Dicanthium setosum	vulnerable / near threatened	35 km north-east	55k 604135, 7594990

3.3.4 Threatened and Conservation Significant Flora and Fauna

3.3.4.1 Nature Conservation Act 1992 Listed Threatened Flora

The desktop assessment indicated that in addition to those species listed under the EPBC Act (refer to Section 3.2.4.1), a further two NC Act listed threatened flora species have been previously recorded or are predicted to occur within the desktop search extent encompassing the Study Area or the broader Project (Rail) region. Of these, none were confirmed present during field surveys in the Study Area. A further six NC Act listed threatened flora species were identified in the Project terms of reference for consideration in this assessment. None of these species are considered likely to occur within the Study Area.

A likelihood of occurrence assessment for NC Act -listed threatened flora species was undertaken in accordance with the definitions outlined in Section 1.4.4. The outcomes of this assessment are presented in Table 3-8and discussed further below.

Table 3-8 Nature Conservation Act 1992 listed Threatened Flora - Likelihood of Occurrence

Species	EPBC Act / NC Act status	Predicted to occur[#]	Previously recorded*	Recorded at study site	Habitat preferences and known distribution	Likelihood of occurrence
Acacia deuteroneura	vulnerable / vulnerable	Refer to Table 3-2 (Section 3.2.4.1) for discussion of this species				**Unlikely to occur**
black ironbox *Eucalyptus raveretiana*	vulnerable / vulnerable	Refer to Table 3-2 (Section 3.2.4.1) for discussion of this species				**Unlikely to occur**
Bonamia dietrichiana	not listed / near threatened	x	Alpha Coal Project EIS (Hancock Prospecting Pty Ltd, 2010)	x	This species occurs from near Marlborough in central Queensland to Magnetic Island and the Whitsunday Islands on the north Queensland coast. It is a vine found in vine thickets on granite boulders scrambling over low trees, shrubs and boulders. Common associated canopy include *Pleiogynium timorense* and *Terminalia melanocarpa* (Calvert *et. al.* 2005).	Although previously recorded in the broad region the current known distribution does not incorporate the Study Area. No suitable vine thicket habitat for the species is present in the Study Area. **Unlikely to occur**
finger panic grass *Digitaria porrecta*	endangered/ near threatened	Refer to Table 3-2 (Section 3.2.4.1) for discussion of this species				**Unlikely to occur**
king blue-grass *Dichanthium queenslandicum*	vulnerable / vulnerable	Refer to Table 3-2 (Section 3.2.4.1) for discussion of this species				**May occur**
Marlborough blue cycad *Cycas ophiolitica*	endangered / endangered	Refer to Table 3-2 (Section 3.2.4.1) for discussion of this species				**Unlikely to occur**

Species	EPBC Act / NC Act status	Predicted to occur#	Previously recorded*	Recorded at study site	Habitat preferences and known distribution	Likelihood of occurrence
Ozothamnus eriocephalus	vulnerable / vulnerable	Refer to Table 3-2 (Section 3.2.4.1) for discussion of this species				**Unlikely to occur**
Solanum adenophorum	not listed / endangered	x	HERBRECS Ildlife Online	x	This species occurs mostly in brigalow and gidgee woodland including very gently inclined slopes and deep cracking clay soils (DERM, 2009d).	The species has been recorded in the desktop assessment search area. Potentially suitable habitat occurs within the Study Area, particularly within the acacia woodland or forest and the brigalow shrubland to open forest broad vegetation communities. **Likely to occur**

Predicted to occur within approximately 10 km of Study Area: DSEWPaC Protected Matters Search Tool

* Previously recorded within approximately 10 - 50 km of Study Area: desktop sources including Wildlife Online / HERBRECS, EIS documents for projects in the region including Hancock Prospecting Pty Ltd (2010).

Nature Conservation Act 1992 Listed Threatened Flora – Likely to Occur

In addition to the species listed under the EPBC Act and discussed in Section 3.2.4.1 *Solanum adenophorum* (endangered, NC Act) is considered likely to occur within the Study Area. There are two records of this species from within the desktop search extent and suitable habitat exists within the Study Area. One of the existing records for this species is from 1957 and the location precision is therefore questionable. The other record is from the wildlife online database and has no date or specific location information associated with it.

This species has the potential to occur within the Study Area within the acacia woodland or forest and the brigalow shrubland to open forest broad vegetation communities, particularly on slopes and inclines and REs on cracking clay soils such as RE 11.4.9.

Nature Conservation Act 1992 listed Threatened Flora – May Occur

As discussed in Section 3.2.4.1 *Dichanthium queenslandicum* has not been recorded in the region, however, the current known distribution does incorporate the Study Area and suitable grassland habitat for the species is present. It is considered that this species may occur within the Study Area.

Nature Conservation Act 1992 listed Threatened Flora – Unlikely to Occur

In addition to the EPBC Act species discussed in Section 3.2.4.1 *Bonamia dietrichiana* has been recorded in the region; however, the current known distribution does not incorporate the Study Area. It is considered unlikely that this species will occur within the Study Area.

3.3.4.2 Nature Conservation Act 1992 Listed Threatened Fauna

In addition to threatened fauna species detailed in Section 3.2.4.2 that are listed under both the EPBC Act and NC Act, the desktop assessment indicated that a further four NC Act listed threatened fauna species have been previously recorded or are predicted to occur within the desktop search extent encompassing the Study Area. Of these, the little pied bat was confirmed present during field surveys in the area. The EPBC Act listed squatter pigeon (also listed as vulnerable under the NC Act) was also confirmed present in the Study Area and is further described in Section 3.2.4.2.

An additional NC Act listed threatened species (greater long-eared (*Nyctophilus timoriensis*)) was identified in the Project ToR for consideration in this assessment. The greater long-eared bat was predicted to occur and was potentially recorded during field surveys; however, a positive identification to species level was unable to be made.

A likelihood of occurrence assessment for NC Act listed threatened fauna species was undertaken in accordance with the definitions outlined in Section 1.4.4. The outcomes of this assessment are presented in Table 3-9 and discussed further below.

Table 3-9 Nature Conservation Act 1992 Listed Threatened Fauna - Likelihood of Occurrence

Species	EPBC Act/NC Act status	Predicted to occur#	Previously recorded*	Recorded at study site	Habitat preferences and known distribution	Likelihood of occurrence
Reptiles						
ornamental snake	vulnerable / vulnerable	Refer to Table 3-3 (Section 3.2.4.2) for discussion of this species				**Likely to occur**
yakka skink	vulnerable / vulnerable	Refer to Table 3-3 (Section 3.2.4.2) for discussion of this species				**May occur**
Dunmall's snake	vulnerable / vulnerable	Refer to Table 3-3 (Section 3.2.4.2) for discussion of this species				**May occur**
retro slider	endangered / endangered	Refer to Table 3-3 (Section 3.2.4.2) for discussion of this species				**Unlikely to occur**
brigalow scaly-foot	vulnerable / vulnerable	Refer to Table 3-3 (Section 3.2.4.2) for discussion of this species				**May occur**
Fitzroy River turtle	vulnerable / vulnerable	Refer to Table 3-3 (Section 3.2.4.2) for discussion of this species				**Unlikely to occur**
Mammals						
little pied bat *Chalinolobus picatus*	not listed / near threatened	x	Wildlife Online Alpha Coal Project EIS (Hancock Prospecting Pty Ltd, 2010)	✓	The little pied bat is located through central Queensland and into north-west New South Wales. In central western Queensland this species reaches its greatest relative abundance in riverine open forest communities (Churchill, 2008). A variety of woodland and open forest habitats are utilised by this species (Churchill, 2008). Roosting habitat includes tree hollows, caves and abandoned buildings and mines (Churchill, 2008).	Species distribution incorporates the Study Area Species recorded in the region and within the Study Area **Confirmed present**

Species	EPBC Act/NC Act status	Predicted to occur#	Previously recorded*	Recorded at study site	Habitat preferences and known distribution	Likelihood of occurrence
greater long-eared bat	vulnerable / vulnerable	Refer to Table 3-3 (Section 3.2.4.2) for discussion of this species				**May occur**

Species	EPBC Act/NC Act status	Predicted to occur[#]	Previously recorded*	Recorded at study site	Habitat preferences and known distribution	Likelihood of occurrence
Birds						
black-necked stork *Ephippiorhynchus asiaticus*	not listed / near threatened	x	Wildlife Online Project (Mine) Volume 4, Appendix N1	x	The black necked-stork occurs throughout eastern and central Queensland, and across much of northern Australia. It favours habitats featuring wetlands, swamps and riverine areas (Marchant and Higgins, 2004). It occasionally occurs in woodland and grassland habitats. (Marchant and Higgins, 2004). Nesting usually occurs at the top of tall trees (Marchant and Higgins, 2004).	Species distribution incorporates Study Area Recorded in the region Suitable habitat occurs at Study Area **Likely to occur**
red goshawk	vulnerable / endangered	Refer to Table 3-3 (Section 3.2.4.2) for discussion of this species				**May occur**
grey falcon *Falco hypoleucos*	not listed / near threatened	x	Wildlife Online Birds Ausltralia	x	The grey falcon occurs either as a resident or nomadic visitor to inland parts of all mainland states (Pizzey and Knight, 2007). This species prefers lightly treed inland plains, gibber deserts, sandridges, pastoral lands, and timbered watercourses (Pizzey and Knight, 2007).	Species distribution incorporates Study Area although uncommon. Recorded in the region Suitable habitat occurs at Study Area **Likely to occur**
squatter pigeon (southern) *Geophaps scripta scripta*	vulnerable / vulnerable	Refer to Table 3-3 (Section 3.2.4.2) for discussion of this species				**Confirmed present**
star finch (eastern and southern)	endangered / endangered	Refer to Table 3-3 (Section 3.2.4.2) for discussion of this species				**Unlikely to occur**

Species	EPBC Act/NC Act status	Predicted to occur#	Previously recorded*	Recorded at study site	Habitat preferences and known distribution	Likelihood of occurrence
cotton pygmy-goose *Nettapus coromandelis*	marine / near threatened	✓	Wildlife Online Birds Australia Alpha Coal Project EIS (Hancock Prospecting Pty Ltd, 2010)	x	The cotton pygmy-goose occurs in eastern and central Queensland. It is an almost entirely aquatic species, with a preference for deep, permanent fresh water bodies (Marchant and Higgins, 2004). Habitats featuring floating and submerged vegetation interspersed with open water are favoured (Marchant and Higgins, 2004).	Recorded in the region Suitable habitat occurs at Study Area **Likely to occur**
black-throated finch (southern)	endangered / endangered	Refer to Table 3-3 (Section 3.2.4.2) for discussion of this species				**Likely to occur**
Australian painted snipe	vulnerable / vulnerable	Refer to Table 3-3 (Section 3.2.4.2) for discussion of this species				**May occur**

Predicted to occur within approximately 10 km of Study Area: DSEWPaC Protected Matters Search Tool

***** Previously recorded within approximately 10-50 km of Study Area: desktop sources including Wildlife Online / Birds Australia / Queensland Museum (QM), EIS documents for projects in the region including Hancock Prospecting Pty Ltd (2010).

Nature Conservation Act 1992 listed Threatened Fauna – Confirmed Present

Two NC Act listed threatened fauna species were recorded from the Study Area – the squatter pigeon (southern) and the little pied bat. The squatter pigeon (southern) is discussed in Section 3.2.4.2, the little pied bat is discussed below.

Little pied bat

The little pied bat was recorded via Anabat throughout the May surveys in four separate locations throughout the Study Area, three of which were forest habitats adjacent to watercourses (refer Figure 1-3).

The little pied bat is sparsely distributed throughout the southern half of Queensland. It is often associated with dry sclerophyll forest, and woodlands and often forages along watercourses (Menkhorst and Knight, 2004). A number of habitats within the Study Area could provide habitat for the little pied bat. More specifically, forest and woodland habitats that provide hollows or are adjacent to watercourses are likely to provide suitable roosting and foraging habitat. This corresponds with the following habitat types in the Study Area (as discussed in Table 2-5 and presented on Figure 2-3):

- Eucalypt open woodland with native grass understorey
- Eucalypt and acacia mixed woodland or forest often on clay soils
- Riparian woodland or forest fringing watercourses, and coolabah open woodland on grassy floodplain often with weedy understorey
- Natural and artificial water bodies

Nature Conservation Act 1992 listed Threatened Fauna – Likely to Occur

In addition to the ornamental snake and black-throated finch (discussed in Section 3.2.4.2), the following NC Act listed threatened fauna species are considered likely to occur at the Study Area, based on distribution, previous records and habitat suitability:

- Black-necked stork
- Grey falcon
- Cotton pygmy-goose

The grey falcon has the potential to occur in woodland vegetation in the Study Area. Suitable habitat corresponds with the following habitat types in the Study Area (as discussed in Table 2-5 and presented on Figure 2-3):

- Eucalypt open woodland with native grass understorey
- Eucalypt and acacia mixed woodland or forest often on clay soils
- Riparian woodland or forest fringing watercourses, and coolabah open woodland on grassy floodplain often with weedy understorey

Natural and artificial waterbodies have potential to provide suitable habitat for the black-necked stork and cotton pygmy-goose.

Nature Conservation Act 1992 listed Threatened Fauna – May Occur

As discussed in Section 3.3.4.2, and presented in the likelihood of occurrence assessment Table 3-9.

Nature Conservation Act 1992 listed Threatened Fauna – Unlikely to Occur

As discussed in Section 3.3.4.2 and presented in the likelihood of occurrence assessment Table 3-9.

Nature Conservation Act 1992 listed Threatened Fauna – Special Least Concern

Special least concern species under the NC Act includes the following species:

- Koala
- Echidna
- Platypus
- Migratory least concern birds listed under JAMBA, CAMBA, and/or Bonn conventions

Decision makers are required to take into account the special cultural significance and the need to conserve existing populations of special least concern animals, in addition to the management of least concern wildlife documented in the NC Act Wildlife Regulation.

Evidence of echidna was noted from the central part of the alignment in the September surveys. The echidna is a widespread, common, generalist species and is likely to occur across much of the Study Area where remnant vegetation is present.

No evidence of the koala was detected from the field surveys however the koala has been previously recorded in the region and has been recently identified within riparian vegetation along watercourses intersected by the Project (Rail) (H. Jones *pers.comm* 07/09/2011). Potential habitat for the koala is considered to be open eucalypt woodland habitat and mature riparian woodland fringing watercourses (refer Section 3.2.4.2).

Suitable habitat for the platypus is generally lacking across much of the Study Area. The majority of watercourses within the Study Area are considered to be too ephemeral to support this species, (see Section 2.6.2.5).

The great egret and rainbow bee-eater are migratory species under JAMBA and CAMBA, respectively. These species are special least concern migratory birds under the NC Act and were confirmed present at the Study Area (see Section 3.2.6).

3.3.5 Great Barrier Reef Wetland Protected Areas

Great Barrier Reef (GBR) Wetland Protection Areas have been mapped by DEHP using the Aquatic Biodiversity Assessment Mapping Methodology (AquaBAMM) (Clayton *et al*., 2006) which identifies relative wetland conservation values within a catchment. The mapping uses a range of criteria, indicators and measures in combination with peer review to categorise the riverine and non-riverine freshwater wetlands in the catchment.

No GBR Wetland Protection Areas are mapped within the Study Area, although 140 Wetland Protection Areas exist within 50 km of the Study Area (Figure 3-13).

3.3.6 Protected Areas

Eleven protected areas occur within 50 km of the Study Area boundary as shown on Figure 3-13.

- Nairana National Park (10 km)
- Doongmabulla Mound Springs Nature Reserve (14 km)
- Wilandspey Conservation (formerly Environmental) Park (17 km)
- Bygana West Nature Refuge (17 km)
- Bygana Nature Refuge (23 km)
- Nibbereena Creek Nature Refuge (20 km)
- Eaglefield Creek Nature Refuge (25 km)
- Mazeppa National Park (25 km)
- Blackwood National Park (44 km)
- East Top Nature Refuge (35 km)
- Epping Forest National Park (scientific) (48 km)

Nairana National Park

The 9250 ha Nariana National Park is located outside the Study Area approximately 10 km north of the Project (Rail) at 121 km along its length. The dominant mapped remnant vegetation includes:

- RE 11.3.5: *Acacia cambagei* woodland on alluvial plains (VM Act: least concern)
- RE 11.4.5: *Acacia argyrodendron* woodland on Cainozoic clay plains (VM Act: of concern)

Doongmabulla Mound Springs Nature Refuge

Doongmabulla Mound Springs Nature Refuge is located approximately 14 km south-west of the Study Area and the Project (Mine). The nature refuge consists of two discrete sections (separated east-west by a gap of approximately 1.4 km). The total area of the nature refuge is 280 ha.

As documented in the *Nature Conservation (Protected Areas) Amendment Regulation (No. 5) 2000*, Doongmabulla Mound Springs Nature Refuge is characterised by the following values:

- Contains significant artesian springs
- Supports the largest Australian populations of the plants *Eryngium fontanum* (endangered – EPBC Act; NC Act) and *Sporobolus pamelae* (endangered – NC Act)
- Supports the endangered plant *Eriocaulon carsonii* (near artesian springs).

Remnant vegetation is mapped as occurring within and surrounding the Doongmabulla Mound Springs Nature Refuge (refer Volume 4, Appendix N2 Doongmabulla Springs Report). This remnant vegetation extends in a largely intact tract to the north, south and west of the nature refuge. Remnant vegetation extends eastwards from the nature refuge to the Study Area.

Wilandspey Conservation Park

The 5200 ha Wilandspey Conservation Park (formerly Wilandspey Environmental Park) is located outside the Study Area, being approximately 17 km north-east of the Study Area at 158 km along the Project (Rail) corridor. Sandy Creek flows through the park to the Belyando River. Mapped remnant

vegetation is dominated by the of concern RE 11.4.6 (*Acacia cambagei* woodland on Cainozoic clay plains). Other of concern and endangered REs in the park include:

- RE 11.3.3: *Eucalyptus coolabah* woodland on alluvial plains (VM Act: of concern)
- RE 11.4.5: *Acacia argyrodendron* woodland on Cainozoic clay plains (VM Act: of concern)
- RE 11.4.8: *Eucalyptus cambageana* woodland to open forest with *Acacia harpophylla* or *A. argyrodendron* on Cainozoic clay plains (VM Act: endangered)

A narrow tract of remnant vegetation to the west and south-west of Wilandspey Conservation Park links to a more extensive block of (least concern) remnant vegetation to the south-west, which extends to and occurs within the northern part of the Study Area.

Bygana West Nature Refuge

The 1487 ha Bygana West Nature Refuge extends in an approximately south-west to north-east direction approximately 17 km south of the rail corridor at 185 km along its length (refer Volume 4, Appendix N1 Mine Terrestrial Ecology Report). The northern border extends for approximately 8.2 km while at its widest point the nature refuge is 2.4 km.

As documented in the Queensland *Nature Conservation (Protected Areas) Amendment Regulation (No. 1) 2005*, Bygana West Nature Refuge is characterised by the following values:

- Contains endangered RE 11.4.6 (*Acacia cambagei* woodland on Cainozoic clay plains)
- Contains endangered RE 11.4.8 (*Eucalyptus cambageana* woodland to open forest with *Acacia harpophylla* or *A. argyrodendron* on Cainozoic clay plains)
- Contains other REs that are poorly represented in the protected area estate
- Due to its location at the boundary of the Brigalow Belt and Desert Uplands bioregions, Bygana West has potential to support high diversity of species and REs
- Contains suitable habitat for a variety of animals, including the koala - a special least concern species under the NC Act

Bygana Nature Refuge

The 331 ha Bygana Nature Refuge is located outside the Study Area, approximately 23 km south of the Project (Rail) at 165 km along its length. The south-west corner of the nature refuge is approximately 0.4 km east of the Belyando River. The nature refuge is dominated by an concern RE mixed polygon comprising three floodplain vegetation assemblages, namely:

- RE 11.3.5: *Acacia cambagei* woodland on alluvial plains (VM Act least concern)
- RE 11.3.3: *Eucalyptus coolabah* woodland on alluvial plains (VM Act of concern)
- RE 11.3.10: *Eucalyptus brownii* woodland on alluvial plains (VM Act least concern)

The Bygana Nature Refuge retains connectivity to the Bygana West Nature Refuge via an east-west belt of remnant vegetation that is bisected by the Belyando River to the immediate west of Bygana Nature Refuge.

Nibbereena Creek Nature Refuge

The 202 ha Nibereena Creek Nature Refuge is located outside the Study Area approximately 20 km north of the Project (Rail) at 54 km along its length. Under the Nature Conservation (Protected Areas)

Amendment Regulation (No.7) (1999), the nature refuge is considered to support endangered Brigalow Belt REs and remnant forests of brigalow (*Acacia harpophylla*) and gidgee (*Acacia cambagei*). Mapped remnant vegetation in the Nibbereena Creek Nature Refuge includes:

- RE 11.4.9: *Acacia harpophylla* shrubby open forest to woodland with *Terminalia oblongata* on Cainozoic clay plains (VM Act: endangered)
- RE 11.4.2: *Eucalyptus* spp. and/or *Corymbia* spp. grassy or shrubby woodland on Cainozoic clay (VM Act: of concern)

Eaglefield Creek Nature Refuge

The Eaglefield Creek Nature Refuge covers an area of about 93 ha and occurs outside the Study Area approximately 25 km north of the Project (Rail) at 48 km along its length. Under the Nature Conservation (Protected Areas) Amendment Regulation (No.2) (2003), the Eaglefield Creek Nature Refuge supports several REs including brigalow and belah open forest, *Acacia cambagei* woodland, and coolabah woodland. Mapped regional ecosystems are:

- RE 11.3.25: *Eucalyptus tereticornis* or *Eucalyptus camaldulensis* woodland fringing drainage lines (VM Act: least concern)
- RE 11.3.1: *Acacia harpophylla* and/or Casuarina cristata open forest on alluvial plains (VM Act: endangered)

Mazeppa National Park

The Mazeppa National Park is located outside the Study Area approximately 37 km south of the Project (Rail) at 74 km along its length. The national park was gazetted in 1972 to protect 4,130 ha of remnant *Acacia harpophylla* and *Acacia cambagei* woodlands. Mazeppa creek runs through the northern sections of the park. Mapped remnant vegetation is dominated by:

- RE 11.4.6: (VM Act: of concern)
- RE 11.3.7: *Corymbia* spp. woodland on alluvial plains with sandy soils (VM Act: least concern)

Blackwood National Park

The 1,648 ha Blackwood National Park is located outside the Study Area approximately 25 km north of the Project (Rail) at 132 km along its length. Mapped REs within Blackwood National Park include:

- RE 11.5.10: *Melaleuca tamariscina* shrubland on Cainozoic sand plains/remnant surfaces (VM Act: of concern)
- RE: 11.7.1: *Acacia harpophylla* and/or *Casuarina cristata* and *Eucalyptus thozetiana* or *Eucalyptus macrocarpa* woodland on lower scarp slopes on Cainozoic lateritic duricrust (VM Act: least concern)
- RE: 11.11.13: *Acacia harpophylla* or *Acacia argyrodendron*, *Terminalia oblongata* low open forest on deformed and metamorphosed sediments and interbedded volcanics (VM Act: of concern)
- RE 11.11.16: *Eucalyptus cambageana*, *Acacia harpophylla* woodland on old sedimentary rocks with varying degrees of metamorphism and folding (VM Act: of concern)
- RE 11.11.19: *Eucalyptus thozetiana*, *Acacia harpophylla* woodland on old sedimentary rocks with varying degrees of metamorphism and folding (VM Act: least concern)

East Top Nature Refuge

The 875 ha East Top Nature Refuge is located outside the Study Area, approximately 35 km south of the Project (Rail) at 150 km along its length. It is approximately 9 km east of the Belyando River. The nature refuge is dominated by an endangered RE mixed polygon comprising four floodplain vegetation assemblages, namely:

- RE 11.3.5: *Acacia cambagei* woodland on alluvial plains (VM Act: least concern)
- RE 11.3.3: *Eucalyptus coolabah* woodland on alluvial plains (VM Act : of concern)
- RE 11.3.1: *Acacia harpophylla* and/or *Casuarina cristata* open forest on alluvial plains (VM Act: endangered)
- RE 11.3.10*: Eucalyptus brownii* woodland on alluvial plains (VM Act : least concern)

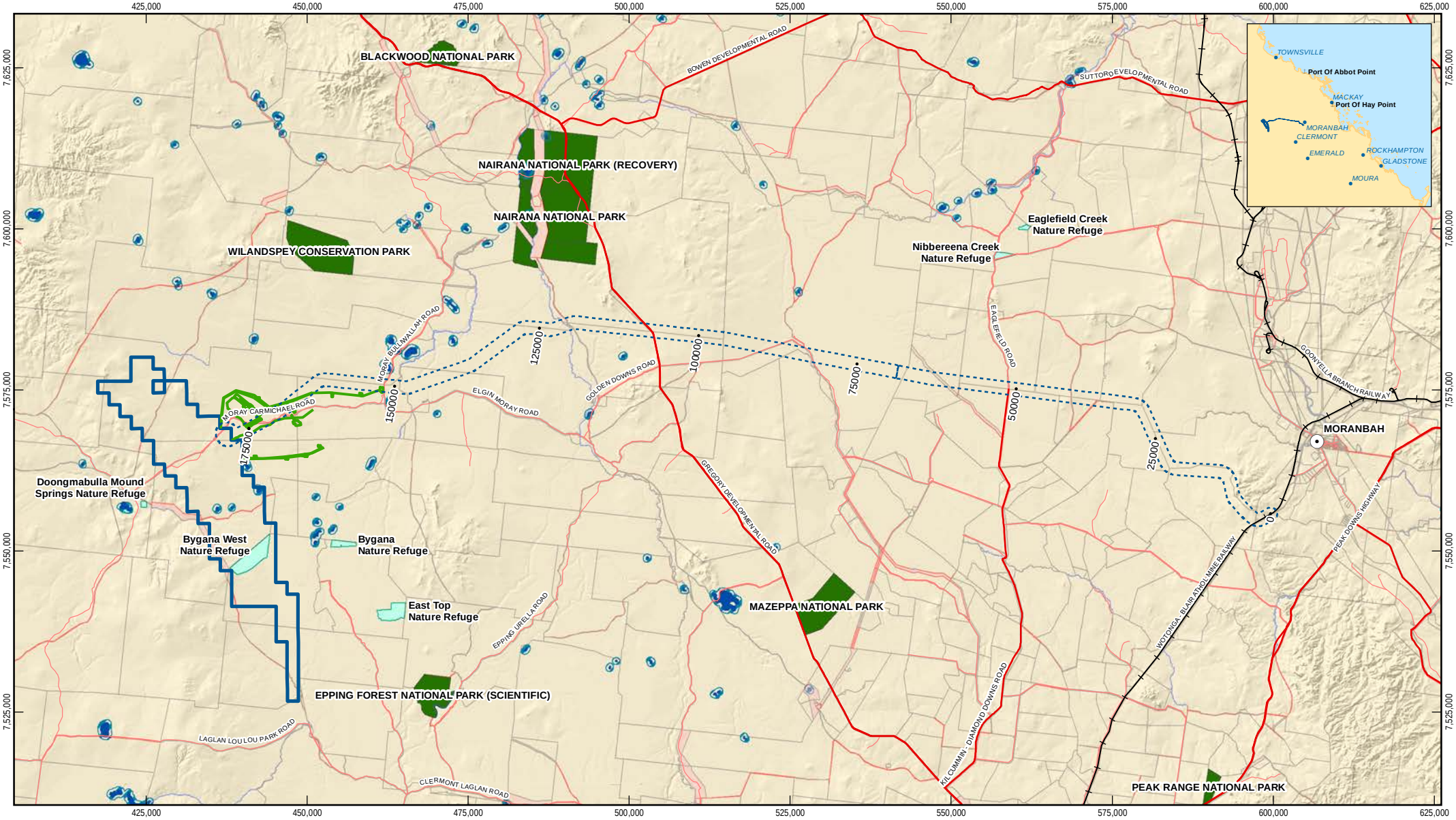
The least concern RE 11.3.7 (*Corymbia* spp. woodland on alluvial plains (sandy soils)) is also present in several small areas within the nature refuge.

The East Top Nature Refuge retains connectivity to the Study Area via a belt of remnant vegetation along an unnamed watercourse to the north of the nature refuge, which in turn links to a larger area of remnant vegetation (including that encompassing Bygana Nature Refuge). Remnant vegetation west of the Bygana Nature Refuge connects with remnant vegetation in the southern part of the Study Area (at Bygana West Nature Refuge).

Epping Forest National Park (Scientific)

Epping Forest National Park (Scientific) is located outside the Study Area, being approximately 48 km south of the Project (Rail) at 138 km along its length. The 2,750 ha park was gazetted in 1971. The landscape within the park is generally flat, and is characterised by a clay pan intersected by ancient and ephemeral watercourses (and associated alluvial deposits) (DERM, 2011d). Vegetation communities in sandy areas (associated with ancient watercourses) are dominated by open eucalypt woodlands, while heavy, grey non-cracking soils support acacia (brigalow and gidgee) scrub (DERM, 2011d).

The primary management intent of Epping Forest National Park is to protect the world's largest surviving population of endangered northern hairy-nosed wombats (*Lasiorhinus krefftii*). In 2007 the population of the species in the park was estimated at 138 (DERM, 2011d). Until the translocation of a small number of wombats offsite (post-2008), a 600 ha part of Epping Forest National Park was the only place in the world known to support the northern hairy-nosed wombat (DERM, 2011d). In addition to the northern hairy-nosed wombat, Epping Forest National Park supports a diversity of common fauna species (10 amphibians, 43 reptiles, 25 mammals, 127 birds). Three other threatened fauna species have been recorded from the park – squatter pigeon (southern), yakka skink and ornamental snake.



1:800,000 (at A4)

0 5 10 15 20 25

Kilometres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia (GDA)
Grid: Map Grid of Australia 1994, Zone 55

N

LEGEND

- Town
- State Road
- Local Road
- Other Railway
- Mine (Onsite)
- Mine (Offsite)
- Study Area
- Cadastral Parcel
- Road Reserve
- Watercourse Reserve
- National Park
- Great Barrier Reef Wetland Protection Area
- Great Barrier Reef Wetland Protection Trigger Area
- Nature Refuge

Adani Mining Pty Ltd

Carmichael Coal Mine and Rail Project

Great Barrier Reef Wetland Protetions Areas and Other Protected Areas within and adjacent to the Study Area

Job Number 41-25215
Revision B
Date 05-09-2012

Figure 3-13

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Data source: DERM: DEM (2008), DCDB (2010), GBR Wetland Protection Areas (2010), Nature Refuge (2010), National Park (2010); DME: EPC1690 (2010)/EPC1080 (2011); © Commonwealth of Australia (Geoscience Australia): Localities, Railways, Roads (2007); Adani: Alignment Opt9 Rev3 (2012); GHD: Northern Missing Link (2011); Gassman/Hyder: Mine (Offsite) (2012). Created by: JB, CA

3.4 Regional Matters of Conservation Significance

3.4.1 Department of Environment and Heritage Protection Biodiversity Planning Assessment Mapping

The DEHP BPA mapping, including an overview of regional values, is discussed in Section 2.5.1.3, whilst a summary is provided as follows.

A number of patches of remnant vegetation that are considered to be of regional significance with respect to biodiversity value (Criterion B2 – ecosystem value at regional scale) occur in the landscape surrounding the study area. Several small patches, associated with endangered and of concern REs occur in the study area. Some remnant vegetation along the Belyando River also meets the criteria for regionally significant biodiversity value. Much of the remnant vegetation in the landscape, and all of the remnant vegetation mapped as occurring within the study area, is categorised as having very high or high ecosystem diversity (Criterion F – ecosystem diversity). Whilst this remnant coverage is fragmented across much of the study area, there are areas where landscape linkages occur, particularly associated with major watercourses. The context and connection criterion (Criterion G) reveals that remnant vegetation ranked as being 'high' or 'very high' with respect to this criterion is predominantly located outside of the study area. Large tracts of non-remnant vegetation that occur within and adjacent to the study area are not mapped under this criterion.

Biodiversity Planning Assessment Expert Panel Reports

Two expert panel reports have relevance to the Study Area:

- Brigalow Belt North Landscape Expert Panel Report (EPA, 2008)
- Desert Uplands Flora, Fauna and Landscape Expert Panel Report (EPA, 2005) ('DEU report')

Noteworthy ecological features described in the Brigalow Belt North report of relevance to the Study Area include:

- A number of corridors radiate from the Denham Range (adjacent to the eastern extent of the Study Area) forming a westward link from the Denham Range to the Great Dividing Range in the Desert Uplands bioregion.
- The Carborough Range Corridor running south from the Denham Range along the Carborough Range, which is the watershed between the Isaac River in the west and Funnel Creek to the east. This corridor continues through to Dipperu National Park.
- Four short corridors linking from the Great Dividing Range in the Desert Uplands bioregion to the remnant vegetation along Alpha Creek, Native Companion Creek and the Belyando River in the Brigalow Belt Bioregion.
- The following major rivers and creeks relevant to the Study Area that have been identified as significant riparian corridors within the Upper Belyando Floodout (the only fragmented sub-region in the Burdekin catchment):
  - Logan and Diamond Creeks which flow from the northern and western slopes of the Drummond and Denham Ranges forming a corridor down to the Suttor River
  - sections of the Belyando and Suttor Rivers above Lake Dalrymple

Noteworthy ecological features described in the Desert Uplands report of relevance to the Study Area include:

- Several REs which have special biodiversity values in some instances (dependent variably on condition/position in landscape/patch size) – namely RE 10.3.6, 10.3.4 and 10.3.28. The occurrence of these REs in the Alice Tablelands sub-region is notable as they contribute to a biogeographically significant landscape (high species turnover, refuge and disjunction), and contribute to north-south connectivity through the Desert Uplands (associated with the Great Dividing Range).

3.4.2 Burdekin and Fitzroy Natural Resource Management Regions Priority Taxa

The Burdekin and the Fitzroy NRM 'Back on Track Actions for Biodiversity' reports (the 'Back on Track report') (DERM, 2010a and 2010b) identify priority species in the Burdekin and the Fitzroy NRM regions, detail the regional threatening processes impacting upon these species, and propose a range of actions to address regional threats. Priority taxa are identified through the DEHP Back on Track species prioritisation framework, in consultation with a range of stakeholders from the region. The Back On Track reports seek to guide priority species conservation in their respective NRM regions over the next five years.

Burdekin Natural Resource Management Region

Two priority plant species and eight priority vertebrate fauna species listed in the Burdekin Back on Track report have been recorded in the desktop search extent or the broader region for the Study Area. None of these species were recorded during field surveys at the Study Area. Table 3-10 details 'Back on Track' species from the Burdekin region of relevance to the Study Area, including their regional-specific threats (as documented in the Back on Track report), and whether the species are likely to occur in the Study Area.

Fitzroy Natural Resource Management Region

Three priority plant species and five priority vertebrate fauna species listed in the Fitzroy Back on Track report have been recorded in the desktop search extent or the broader region for the Study Area. None of these species were recorded during field surveys at the Study Area. Table 3-10 details 'Back on Track' species from the Fitzroy region of relevance to the Study Area, including their regional-specific threats (as documented in the Back on Track report), and whether the species are likely to occur at the Study Area.

Table 3-10 Burdekin and Fitzroy Back on Track Priority Taxa of Relevance to Study Area

Species	Threats and threat impact	Burdekin Region	Fitzroy Region	Species likelihood of occurrence at Study Area
Plants				
Solanum adenophorum	Weeds - buffel grass - competition Clearing of vegetation - loss of habitat	✓	✓	**Likely to occur** (see Section 3.3.4.1)

Species	Threats and threat impact	Burdekin Region	Fitzroy Region	Species likelihood of occurrence at Study Area
black ironbox	Inappropriate grazing regimes – habitat degradation Weeds (rubber vine, exotic pasture species) – habitat degradation Feral animals (pigs) – habitat degradation	✓	✓	**Unlikely to occur** (see Section 3.2.4.1)
Marlborough blue	Urban development - Loss of habitat Mining - Loss of habitat inappropriate fire regimes - Loss and / or removal of individuals Clearing of vegetation - Loss and / or removal of individuals Collectors - Loss and / or removal of individuals		✓	**Unlikely to occur** (see Section 3.2.4.1)
Reptiles				
ornamental snake	Clearing of vegetation – habitat loss Feral animals (cane toads, pigs) - loss and/or removal of individuals, competition	✓	✓	**Likely to occur** (see Section 3.2.4.2)
yakka skink	Inappropriate fire regimes – habitat loss Inappropriate grazing regimes – habitat loss Site maintenance – habitat degradation Feral animals (cats, foxes) – loss and/or removal of individuals Road maintenance – habitat loss	✓	✓	**May occur** (see Section 3.2.4.2)
brigalow scaly-foot	Clearing of vegetation – habitat loss Inappropriate fire regimes – habitat loss Inappropriate grazing regimes – habitat loss Feral animals (cats) – loss and/or removal of individuals	✓		**May occur** (see Section 3.3.4.1)
retro slider	Lack of information in the region - Inappropriate management	✓	✓	**Unlikely to occur** (see Section 3.3.4.1)

Species	Threats and threat impact	Burdekin Region	Fitzroy Region	Species likelihood of occurrence at Study Area
Fitzroy river turtle	Water quality - Loss of habitat Ferals - Foxes - Disruption of breeding and / or resting Weeds - Disruption of breeding and / or resting Ferals - Wild dogs / Dogs - Disruption of breeding and / or resting Ferals - Cats - Disruption of breeding and / or resting Impoundments - Loss of habitat Ferals - Pigs - Disruption of breeding and / or resting Collectors - Loss and / or removal of individuals Inappropriate grazing regimes - Disruption of breeding and / or resting		✓	**Unlikely to occur** (see Section 3.3.4.1)
Birds				
red goshawk	*Inappropriate fire regimes – habitat degradation* *Clearing of vegetation – habitat loss* *Inappropriate grazing regimes – habitat degradation* *Drainage of habitat – loss of food resources* *Weeds – habitat degradation*	✓	✓	**May occur** (see Section 3.3.4)

Species	Threats and threat impact	Burdekin Region	Fitzroy Region	Species likelihood of occurrence at Study Area
black-throated finch (southern)	Inappropriate grazing regimes – habitat degradation Urban development – habitat loss Inappropriate fire regimes – habitat degradation Mining – habitat degradation Collectors – loss and/or removal of individuals Feral animals (cats) – loss and/or removal of individuals Weeds – habitat degradation	✓		**Likely to occur** (see Section 3.3.4)
Australian painted snipe	Weeds (exotic ponded pasture species) – habitat loss Inappropriate grazing regimes – habitat degradation Feral animals (pigs) – habitat degradation Drainage of habitat – habitat degradation Flow regime – habitat loss	✓		**May occur** (see Section 3.3.4)

Species	Threats and threat impact	Burdekin Region	Fitzroy Region	Species likelihood of occurrence at Study Area
Mammals				
northern quoll	Feral animals (cane toads, wild dogs, cats) - loss and/or removal of individuals, competition Urban development – habitat loss Baiting – loss and/or removal of individuals Inappropriate fire regimes – habitat degradation Road kill – loss and/or removal of individuals	✓		**May occur** (see Section 3.3.4)

Source: DERM, 2010a

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4. Summary of Existing Terrestrial and Aquatic Ecological Values

4.1 Overview

A combined desktop and field assessment was undertaken to describe the existing terrestrial and aquatic ecological values of the Study Area. Key findings from this assessment are summarised below and will form the focal point of the impact assessment on the terrestrial and aquatic values within the Study Area (refer to Sections 2 and 3 respectively). Mitigation measures to be developed during construction and operation phases to avoid and alleviate potential impacts on these ecological values are also discussed (refer to Section 5 and Section 6, respectively).

4.2 General Site Description

Remnant vegetation coverage occurs over approximately 23 per cent (8,367 ha) of the Study Area. Of this, 367 ha occurs within the rail corridor and infrastructure and construction camp footprints, comprising 37 ha of endangered REs, 201 ha of of concern REs, and 129 ha of LC REs. Where remnant vegetation occurs, a more complex assortment of habitat resources is available for fauna when contrasted with open cleared land. The remaining areas are largely cleared to support grazing activities and offer limited habitat values.

The Study Area contains a range of fauna habitat types that share broadly similar habitat values (based on habitat structure), but vary in their value for wildlife based on the specific forage and shelter resources they provide. A total of eight fauna habitat types were identified during the field surveys that have been applied across the entire Study Area. Open cleared land was the most common and widespread fauna habitat type within the Study Area. This habitat type typically provides a low diversity of suitable resources for fauna (including threatened species), as compared to the higher ecological value of remnant vegetation that typically occurred in association with watercourses and creek lines throughout the Study Area.

In general, disturbance to fauna habitats from cattle, weeds and feral animals was observed to be moderate to high across the Study Area. These disturbances were mainly observed in cleared areas such as paddocks and at watercourses and dams across the Study Area.

Aquatic habitats can generally be categorised into five broad waterbody types that vary in size and geomorphology, these being: lacustrine, palustrine, riverine, drainage lines and gilgais.

Field studies determined aquatic substrates to consist of sand/gravel and sand/clay/silt.

4.3 Landscape Connectivity

Much of the landscape surrounding the Study Area has experienced broadscale vegetation clearing, and as such, remnant vegetation coverage is fragmented. Connectivity of remnant vegetation at a landscape level is maintained by tracts of remnant vegetation often associated with watercourses that also traverse the Study Area in a north-south direction. The eastern extent of the Study Area intersects a large tract of remnant vegetation associated with the Peak Downs National Park. In the western extent of the Study Area where the Project (Rail) enters the proposed Project (Mine), a large

patch of relatively intact remnant vegetation exists which extends west and maintains remnant coverage for approximately 14 km.

4.4 Vegetation Communities

The DEHP BPA mapping indicated that some remnant vegetation within and surrounding the Study Area is of regional value, with much of this remnant vegetation is ranked as having high or very high ecosystem diversity and (ecosystem) context and connection.

Seven BVCs have been identified for the Project (Rail) based on the particular vegetation communities and land forms present within the Study Area.

A total of 18 Brigalow BeltREs were identified within the the rail corridor and infrastructure and construction camp footprints.

The EPBC Act listed TEC, Brigalow (*Acacia harpophylla* dominant and codominant), was recorded during field surveys. The presence of the Brigalow TEC was recorded from the occurrence of REs 11.3.1, 11.4.8 and11.4.9 within the the rail corridor and infrastructure and construction camp footprints. A total area of approximately 636 ha is mapped as occurring within the Study Area and 607 ha. Of this, approximately 37 ha occurs within the rail corridor and infrastructure and construction camps footprints.

4.5 Terrestrial Flora

No threatened flora species listed under the EPBC Act were recorded within the Study Area from field surveys. Two EPBC Act listed threatened flora species (*Acacia ramiflora* and king blue-grass) may occur at the Study Area based on suitability of habitat within the Study Area and the current known distribution of these species.

No threatened flora species listed under the NC Act were recorded within the Study Area during field surveys. One threatened flora species listed under the NC Act (*Solanum Adenophorum*) is considered likely to occur (in addition to those that may occur listed under the EPBC Act) in the Study Area based on suitability of habitat, and current known species distribution.

The Study Area supports a diversity of flora species. Consolidated desktop search results for the region (i.e. the desktop search extent) revealed 311 vascular plant taxa have been previously recorded from the database Wildlife Online and 378 vascular taxa plant have been previously recorded from the HERBRECS database. A total of 125 vascular plant taxa were recorded during field studies across the Study Area comprising 114 native and 11 introduced taxa. Of the 111 introduced taxa species, three are declared weeds under the LP Act.

4.6 Terrestrial Fauna

The Study Area supports a diversity of fauna species. Consolidated desktop search results for the region (i.e. the desktop search extent) revealed 238 vertebrate fauna species have been previously recorded. Fauna species diversity recorded during field surveys was relatively low for the region and, in general, the fauna recorded in the May and September surveys were relatively common species. In total, field surveys recorded 129 vertebrate fauna species.

The vast majority of fauna species recorded in the Study Area were common, widely distributed species. A total of six introduced fauna species were recorded. Notwithstanding the cane toad, introduced animals were recorded to occur at relatively low densities.

One threatened bird listed under the EPBC Act was recorded, this being the squatter pigeon (southern). The squatter pigeon (southern) is likely to be locally common where suitable habitat is present in the Study Area. Potential habitat occurring within and beyond the Study Area for this species was identified during field investigations. A further three EPBC Act listed threatened fauna species are considered likely to occur in the Study Area (based on suitability of habitat, previous records from region, current known distribution). These species include the ornamental snake, koala and black-throated finch (southern). Potential habitat for these species was recorded in the Study Area.

Two common EPBC Act listed migratory bird species (great egret and rainbow bee-eater) were recorded in the Study Area. In addition to these, two EPBC Act listed migratory bird species are considered likely to occur at the Study Area. Habitats in the Study Area are not considered likely to support important assemblages of migratory species.

No mapped Essential Habitat occurs within the Study Area. Essential Habitat for three EPBC Act species and an additional four NC Act species occurs within 50 km of the Study Area.

One threatened fauna species listed under the NC Act (in addition to the EPBC Act listed squatter pigeon (southern)) was recorded – this was the little pied bat. Potential habitat occurring within the Study Area for these this species was identified. An additional three threatened fauna species listed under the NC Act (in addition to those also listed under the EPBC Act) are considered likely to occur in the Study Area (based on suitability of habitat, previous records from region, current known distribution). These species include the black-necked stork, grey falcon and the cotton pygmy goose.

Three NC Act listed special least concern fauna species were recorded in the Study Area (this consisted of two EPBC Act-listed migratory birds mentioned above, and the echidna). In addition, two EPBC Act-listed migratory (and thus NC Act listed special least concern) birds are considered likely to occur in the Study Area. The koala is also considered likely to occur in low densities in ironbark-box woodland habitats.

No protected areas occur within the Study Area. Eleven protected areas occur within 50 km of the Study Area.

No priority fauna species described in the Burdekin or Fitzroy NRM ‘Back on Track Actions for Biodiversity’ reports (DERM, 2010a) were recorded in the Study Area.

4.7 Aquatic Flora and Fauna

A total of 26 aquatic dependent flora species have been previously recorded in the Study Area, of which 23 species are classified as being of least concern and three species are classified as exotic species.

In the Burdekin and Fitzroy basins, 51 and 47 freshwater fish species respectively are known to occur (with 40 species similar between the two basins). Of these species, 17 have the potential to occur in waterways intersected by, or of relevance to, the Study Area. This includes five pest species which have the potential to occur in the Study Area.

Threatened fish species recorded in the basins include the Australian Lungfish, Murray Cod and the Freshwater Sawfish. These are not considered likely to occur in the Study Area (based on habitat range, previous records and known species distributions).

Aquatic reptiles that are known to occur in the Fitzroy and Burdekin basins include eight freshwater turtle species and the estuarine crocodile. The estuarine crocodile and the Fitzroy river turtle are listed as 'vulnerable', and are considered unlikely to occur in the Study Area. The remaining species are least concern and may occur in the Study Area.

The only invertebrate previously recorded in the Study Area is the redclaw crayfish. The only aquatic mammal that has the potential to occur in the Study Area is the platypus, which is listed as special least concern. Suitable habitat for the platypus is limited throughout the Study Area, as the watercourses present are generally considered to be too ephemeral to support this species.

Aquatic species with the potential to occur in the Study Area inhabit a range of environments and display a range of environmental tolerances, as discussed in Section 2.6.2.

No wetlands of international, national, state or regional significance occur in the Study Area.

5. Potential Impacts and Mitigation Measures — Construction Phase

5.1 Overview

The construction phase of the Project (Rail) will require the construction of both permanent and temporary infrastructure, which will each require the clearing of remnant vegetation.

Permanent infrastructure includes:

- Construction of a nominally 95 m wide rail corridor to accommodate track (including passing loops and bad order sidings) and a service/access maintenance road. The footprint includes clearing of remnant vegetation.
- Construction of a maintenance yard to facilitate operational requirements. The footprint includes clearing of remnant vegetation.
- Construction of quarry and borrow areas that are to be used beyond the rail construction timeframe. The footprint includes clearing of remnant vegetation - at this stage, the location of these areas are indicative only, and these remain investigative areas. The final number and location of these areas will be refined as the Project (Rail) progresses, upon which time detailed assessment of impacts at these localities will be undertaken.

Temporary infrastructure includes:

- Construction of temporary construction camps – footprint includes clearing of some remnant vegetation
- Construction of laydown and ancillary areas to accommodate construction plant, for example flashbutt welding depot, concrete batch plants, ballast stacking and casting yard – footprint includes some remnant vegetation.
- Construction of quarry and borrow areas that are to be used for rail construction works only – footprint includes some remnant vegetation – at this stage, the location of these areas are indicative only, and these remain investigative areas. The final number and location of these areas will be refined as the Project (Rail) progresses, upon which time detailed assessment of impacts at these localities will be undertaken.

For the purposes of this section, the following definitions apply:

- Rail Corridor: comprises the rail corridor, equating to a width of approximately 95 m for the length of the Project (Rail) along with necessary maintenance facilities as required for the operations and maintenance of the infrastructure.
- Temporary infrastructure: comprises the laydown areas and construction plant areas
- Temporary construction camps: comprises the accomodation for the rail construction workforce.
- Footprint refers to the anticipated area of potential impact

Collectively, the temporary and permanent infrastructure for the Project (Rail) footprint for the construction phase is an area in the order of approximately 1,868 ha. This figure does not include quarry and borrow areas as these locations are yet to be confirmed. The extent of the Project (Rail)

footprint is presented in Figure 5-1**.** The locations of laydown and ancillary construction plant areas are indicated.

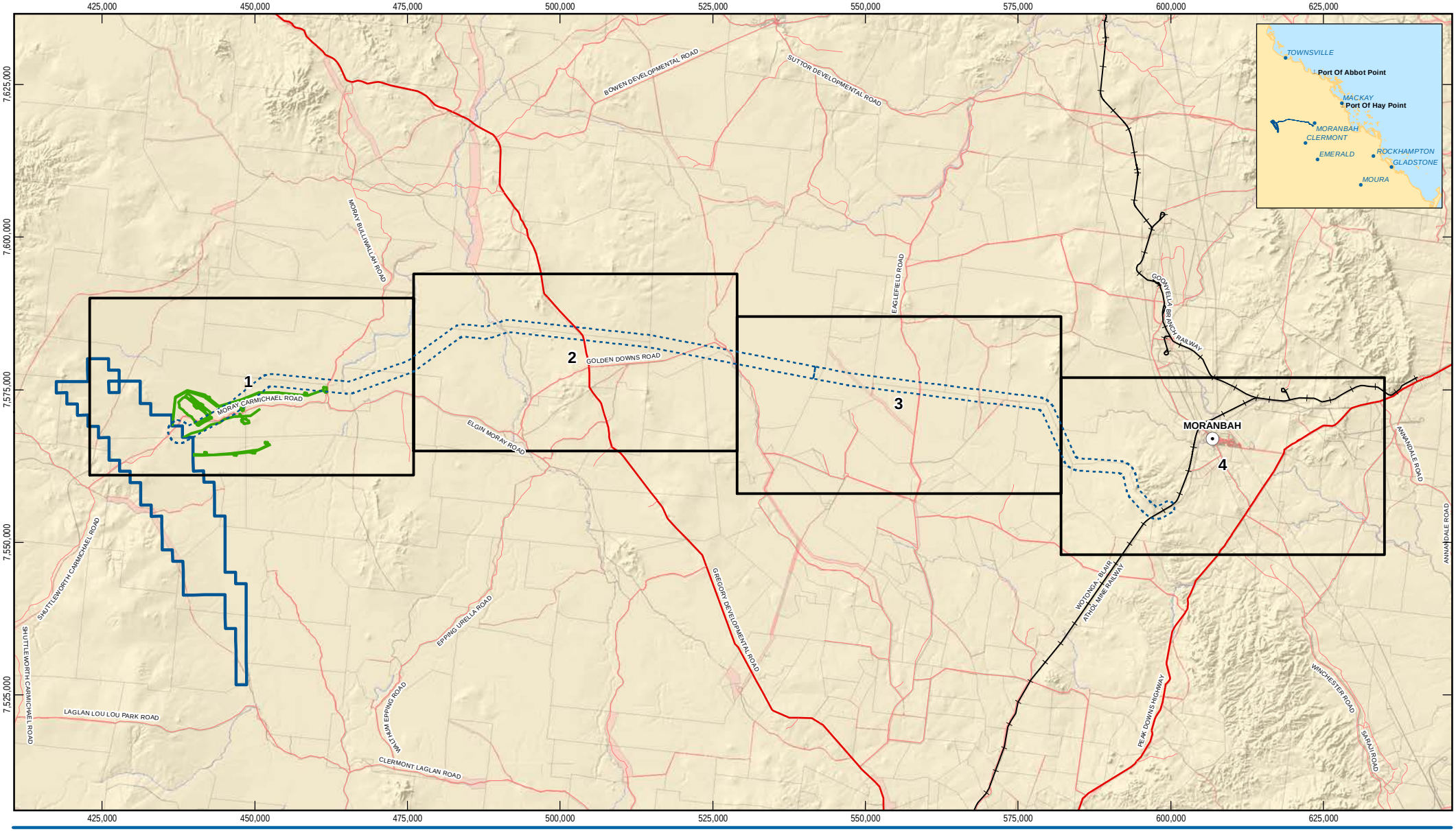
In addition to offsetting for unavoidable impacts associated with vegetation removal, the mitigation and management strategies described below will seek to preserve and, where possible, enhance the ecological values of those vegetation communities and fauna habitats in areas not subject to direct impacts associated with the construction activities for the Project (Rail).

Following the ecological assessments, and based on the description of ecological features in Section 2 of report, a number of potential direct and indirect impacts were identified for the Project (Rail) footprint. Potential impacts to terrestrial and aquatic ecology values associated with the construction phase of the Project (Rail) have been summarised into four broad categories which include:

- Clearing of vegetation
- Disturbances of watercourses and changes to surface water flows
- Increased anthropogenic activity leading to disturbance
- Introduction of weeds and feral pest species

Each of the potential impacts and proposed mitigation measures are described in Sections 5.2 to 5.5. A conceptual diagram of potential construction phase impacts is provided in Figure 5-2.

Potential impacts and mitigation measures associated with the operational phase of the Project are described in Section 6.



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Kilometres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia (GDA)
Grid: Map Grid of Australia 1994, Zone 55

N

LEGEND

- Town
- State Road
- Local Road
- Other Railway
- Cadastral Parcel
- Road Reserve
- Watercourse Reserve
- Mine (Onsite)
- Mine (Offsite)
- Study Area

Adani Mining Pty Ltd
Carmichael Coal Mine and Rail Project

Project (Rail) footprint - including temporary works

Job Number	41-25215
Revision	C
Date	05-09-2012

Figure 5-1
Series Index

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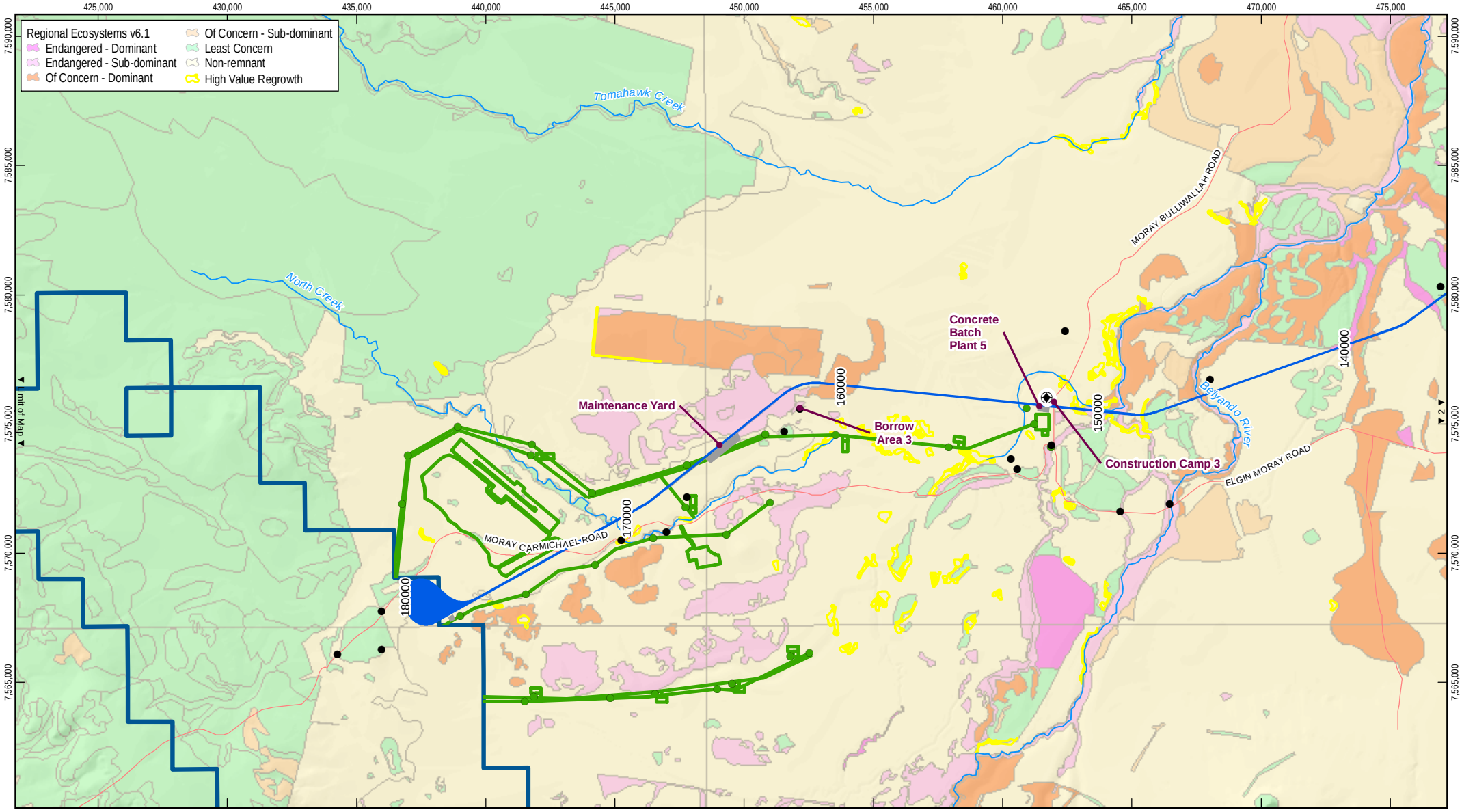
Level 4, 201 Charlotte St Brisbane QLD 4000 T +61 7 3316 3000 F +61 7 3316 3333 E bnemail@ghd.com W www.ghd.com

Data source: DERM: DEM (2008), DCDB (2010); DME: EPC1690 (2010)/EPC1080 (2011); © Commonwealth of Australia (Geoscience Australia): Localities, Railways, Roads (2007); Adani: Alignment Corridors Opt9 Rev3 (2012); Gassman/Hyder: Mine (Offsite) (2012). Created by: BW, CA



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Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia (GDA)
Grid: Map Grid of Australia 1994, Zone 55

N

LEGEND
- Town
- Construction Camp
- Investigation Areas
- State Road
- Local Road
- Watercourse
- Other Railway
- Mine (Onsite)
- Mine (Offsite)
- Mine (Offsite)
- Rail (West)
- Rail (East)
- Rail (Infrastructure)

Adani Mining Pty Ltd
Carmichael Coal Mine and Rail Project

Project (Rail) Footprint - Including Temporary Works

Job Number	41-25215
Revision	C
Date	14-09-2012

Figure 5-1
Sheet 1 of 4

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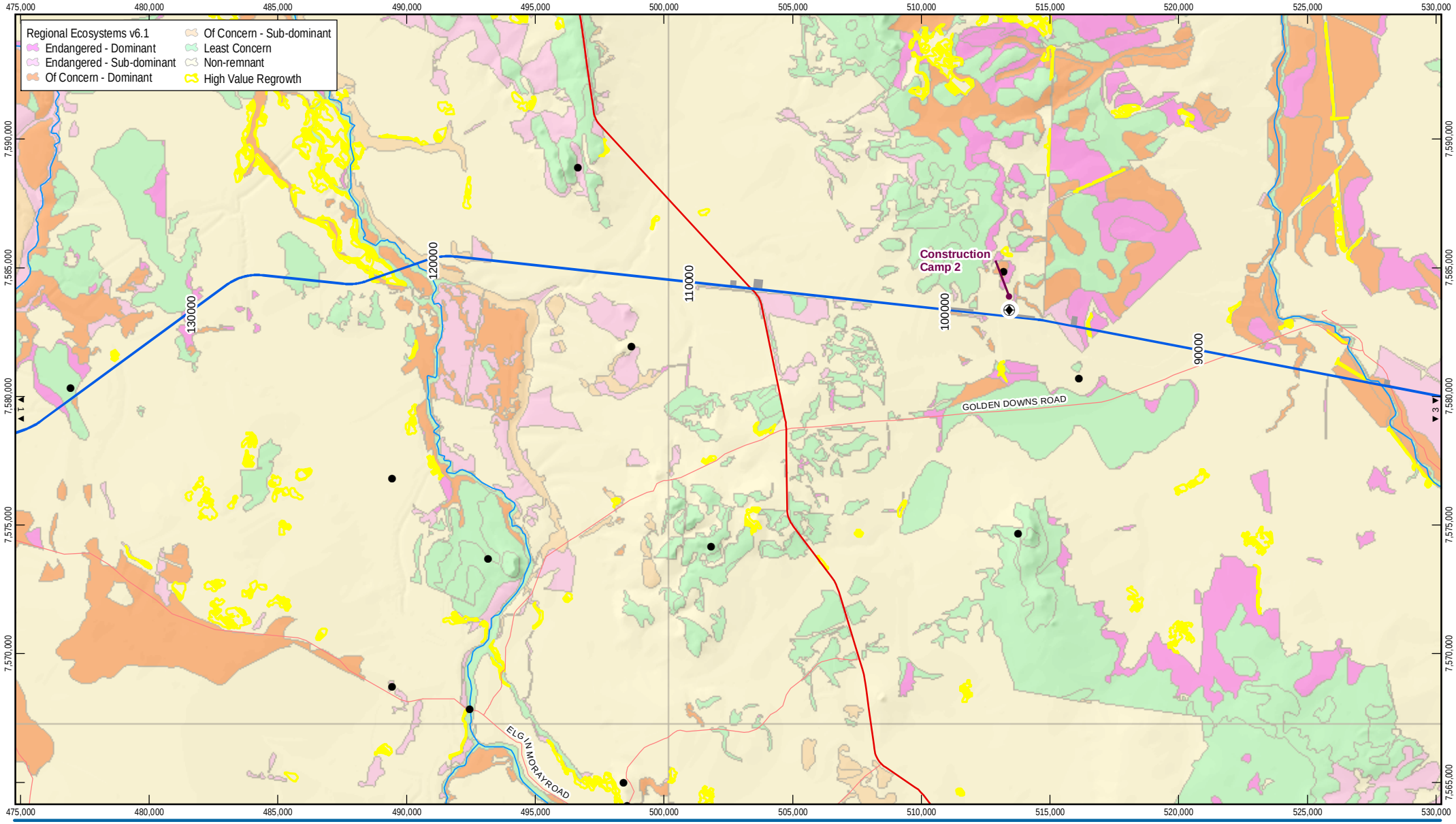
Data source: DERM: DEM (2008), RE v6.1, HVR (2011); © Commonwealth of Australia (Geoscience Australia): Localities, Railways, Roads, Watercourse (2007); Adani: Alignment Opt9 Rev3, Rail Infrastructure, Investigation Areas (2012); DME: EPC1690 (2010)/EPC 1080(2011); Gassman/Hyder: Mine (Offsite) (2012). Created by: MR, CA



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Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia (GDA)
Grid: Map Grid of Australia 1994, Zone 55

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LEGEND
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- Construction Camp
- Investigation Areas
- State Road
- Local Road
- Watercourse
- Other Railway
- Mine (Onsite)
- Mine (Offsite)
- Mine (Offsite)
- Rail (West)
- Rail (East)
- Rail (Infrastructure)

Adani Mining Pty Ltd
Carmichael Coal Mine and Rail Project

Project (Rail) Footprint - Including Temporary Works

Job Number 41-25215
Revision C
Date 14-09-2012

Figure 5-1
Sheet 2 of 4

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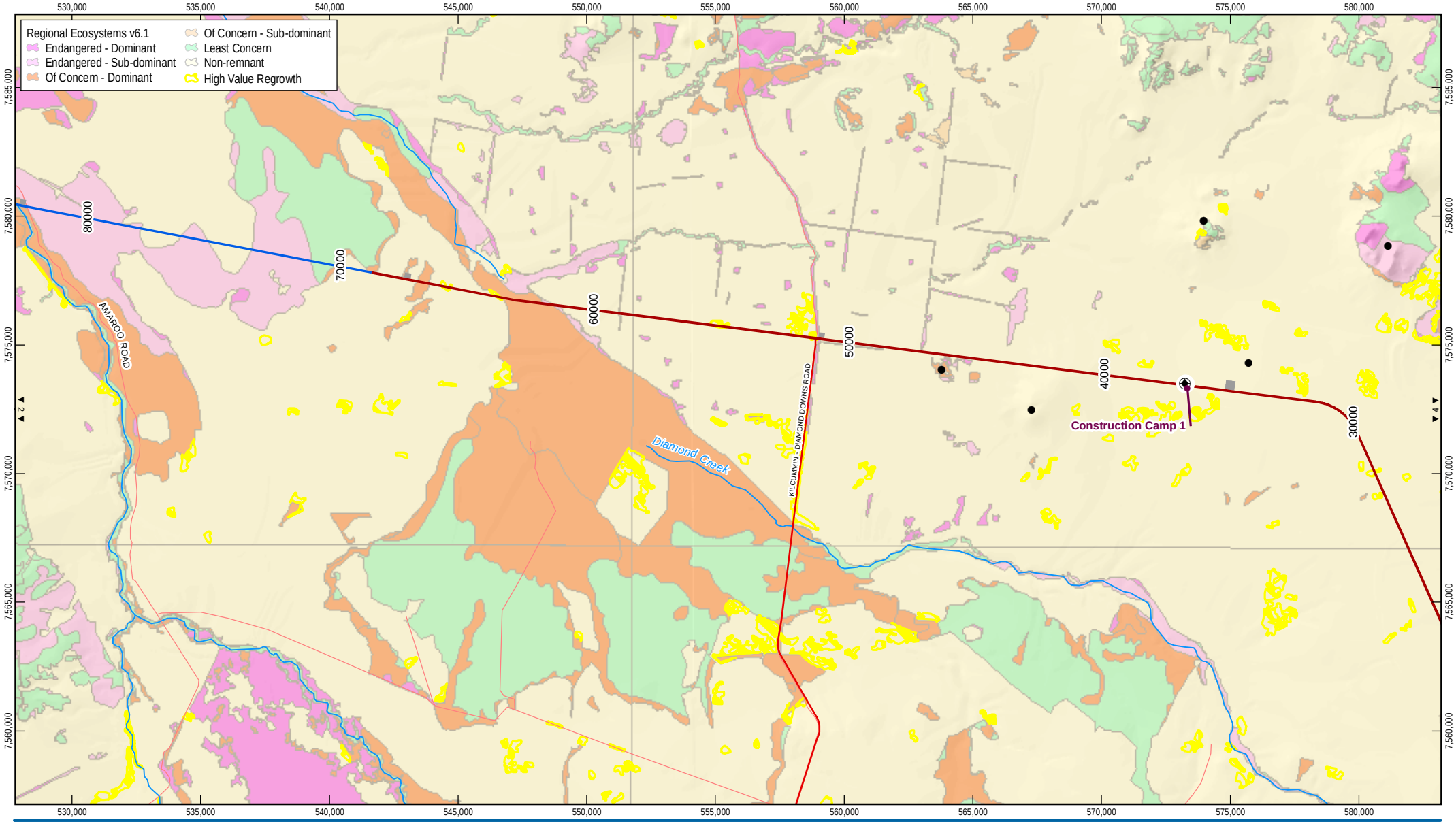
Data source: DERM: DEM (2008), RE v6.1, HVR (2011); © Commonwealth of Australia (Geoscience Australia): Localities, Railways, Roads, Watercourse (2007); Adani: Alignment Opt9 Rev3, Rail Infrastructure, Investigation Areas (2012); DME: EPC1690 (2010)/EPC 1080(2011); Gassman/Hyder: Mine (Offsite) (2012). Created by: MR, CA



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Horizontal Datum: Geocentric Datum of Australia (GDA)
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N

LEGEND
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Adani Mining Pty Ltd
Carmichael Coal Mine and Rail Project

Project (Rail) Footprint - Including Temporary Works

Job Number 41-25215
Revision C
Date 14-09-2012

Figure 5-1
Sheet 3 of 4

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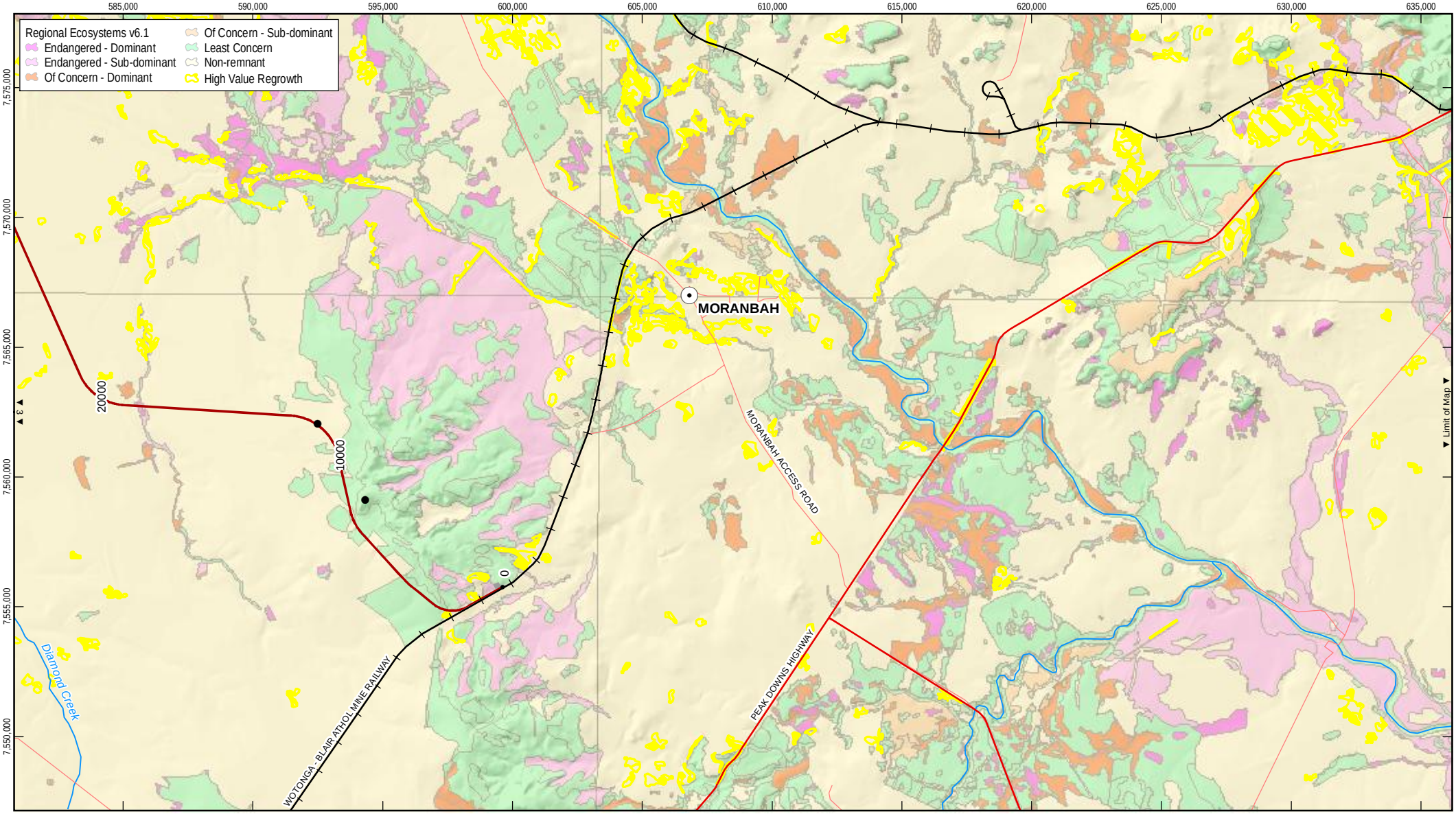
Data source: DERM: DEM (2008), RE v6.1, HVR (2011); © Commonwealth of Australia (Geoscience Australia): Localities, Railways, Roads, Watercourse (2007); Adani: Alignment Opt9 Rev3, Rail Infrastructure, Investigation Areas (2012); DME: EPC1690 (2010)/EPC 1080(2011); Gassman/Hyder: Mine (Offsite) (2012). Created by: MR, CA



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Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia (GDA)
Grid: Map Grid of Australia 1994, Zone 55

N

LEGEND

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- Rail (East)
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Adani Mining Pty Ltd
Carmichael Coal Mine and Rail Project

Project (Rail) Footprint - Including Temporary Works

Job Number	41-25215
Revision	C
Date	14-09-2012

Figure 5-1
Sheet 4 of 4

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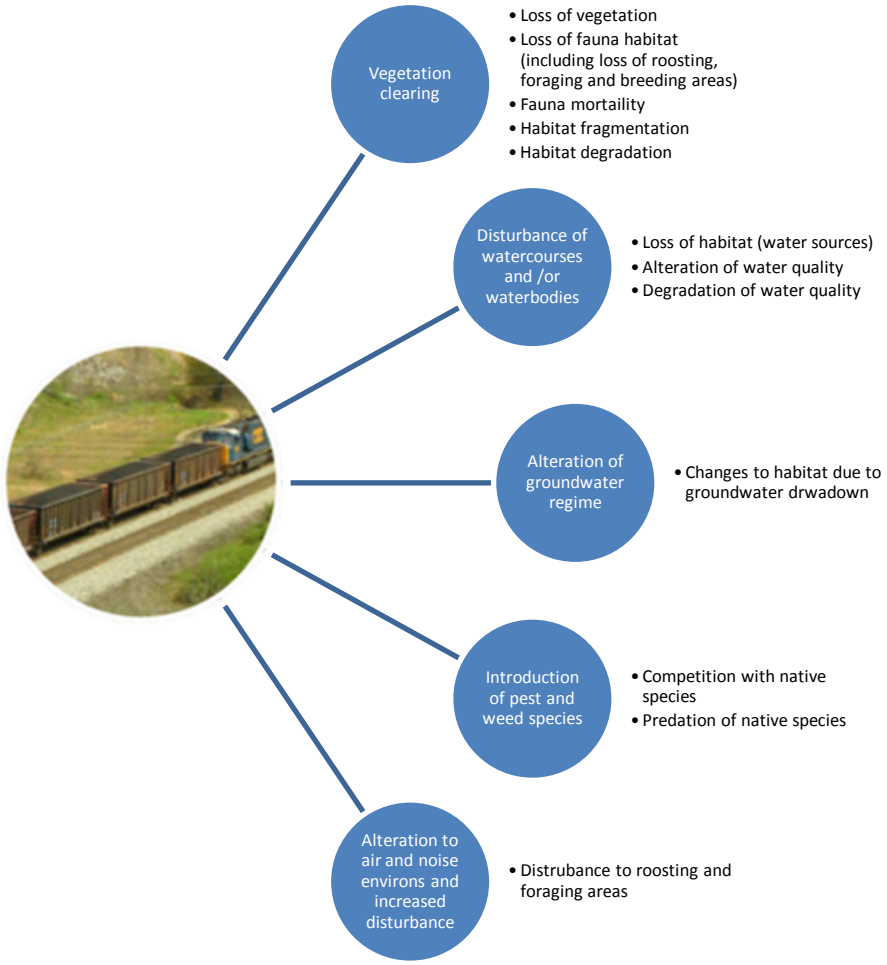
Data source: DERM: DEM (2008), RE v6.1, HVR (2011); © Commonwealth of Australia (Geoscience Australia): Localities, Railways, Roads, Watercourse (2007); Adani: Alignment Opt9 Rev3, Rail Infrastructure, Investigation Areas (2012); DME: EPC1690 (2010)/EPC 1080(2011); Gassman/Hyder: Mine (Offsite) (2012). Created by: MR, CA

Figure 5-2 Conceptual Diagram of Potential Construction Phase Impacts



5.2 Clearing of Vegetation

5.2.1 Overview

The total extent of vegetation clearing, and in particular remnant vegetation, required for the construction phase has been minimised in the design phase of the Project (Rail) through avoidance. The Project (Rail) alignment has as far as is practicable (and in consideration of other environmental, social and technical constraints) been located in areas that have been previously cleared or degraded by both past and current land use practices (refer Volume 1 Section 3 Introduction for discussion on Project alternatives). Residual potential impacts arising from vegetation clearing during the construction phase may include:

- Loss of remnant vegetation in the form of REs, flora habitat and vegetation community extents
- Loss of habitat (roosting, shelter, foraging, breeding) for native fauna including conservation significant fauna

- Degradation of terrestrial and aquatic habitat adjacent to and downstream of cleared areas
- Landscape fragmentation, reduction in connectivity and reduced capacity for fauna dispersal
- Fauna mortality

Detail on each of these potential impacts arising from clearing of vegetation is discussed in Sections 5.2.2 to 5.2.6.

5.2.2 Loss of Remnant Vegetation

Clearing of vegetation within the construction footprint of the Project (Rail) will potentially result in the loss of approximately 367 ha of remnant vegetation. This encompasses 18 RE types within the Brigalow Belt bioregion. The total area of potential impact to endangered, of concern and least concern REs within the bioregion is provided in Table 5-1. Refer to Table 2-2 for detailed RE descriptions.

Table 5-1 Total Area of Impact to each RE within the Construction Footprint

RE status	Clearing extent			
	Rail corridor	Accommodation camps	Temporary and permanent infrastructure	**Total**
Brigalow Belt bioregion				
Endangered	28.4 ha	4.6 ha	4.4 ha	**37.4 ha**
Of concern	190.6 ha	-	9.8 ha	**200.4 ha**
Least concern	123.7 ha	-	4.8 ha	**128.5 ha**
Total	**342.7 ha**	**4.6 ha**	**19.1 ha**	**366.4 ha**

5.2.2.1 Potential Impacts

Loss of High Conservation Status REs

Overall, within the construction footprint, that is, the rail corridor and infrastructure and construction camp footprints, the REs that will likely be impacted to the greatest extent with respect to clearing are of concern REs 11.4.11 (128.1 ha) and 11.3.3 (46.7 ha) which together equates to approximately 9.4 per cent of the total clearing extent within the construction footprint and 47.7 per cent of the total extent of clearing of remnant vegetation. Following these extents, all impact to other REs is less than 24 ha, ranging between 1.4 ha and 23.9 ha (refer Table 5-2).

Table 5-2 provides the current extent of each RE in the protected area estate, which includes National Park, State Forest, Timber Reserves and Conservation Parks. Conservation REs listed as least concern have generally not been included in these tables. Exceptions are made for threshold REs.

Table 5-2 Impact of Clearing to Higher conservation status REs - Brigalow Belt Bioregion

REs	VM Act/ EPBC Act status	Proposed clearing area	Bioregion current extent[1]	Subregion [2] current extent[1]	%[3]	Protected area estate (% of total current extent)[4]
Construction Footprint – rail corridor and infrastructure and construction camps						
Endangered REs (Total 37.4 ha)						
11.3.1	endangered	11.0 ha	80,806 ha	16,679 ha	0.07	30,702 ha (38.1 %)
11.4.8	endangered	2.5 ha	71,909 ha	31,968 ha	0.01	7,025 ha (9.7 %)
11.4.9	endangered	23.9 ha	96,425 ha	40,916 ha	0.06	25,851 ha (26.8 %)
Of concern REs (Total 200.4 ha)						
11.3.3	of concern	46.7 ha	28,1347 ha	66,455 ha	0.07	33,025 ha (11.7 %)
11.4.5	of concern	3.5 ha	13,257 ha	12,907 ha	0.03	2,866 ha (21.6 %)
11.4.6	of concern	20.7 ha	34,718 ha	26,097 ha	0.08	9,399 ha (26.8 %)
11.4.11	of concern	128.1 ha	23,795 ha	23, 191 ha	0.55	200 ha (0.8%)
11.9.10	of concern	1.4 ha	83,107 ha	15,328 ha	0.01	6,973 ha (8.4 %)
TEC constituents (Total 37.4 ha)						
11.3.1	endangered	11.0 ha	80,806 ha	16,679 ha	0.07	30,702 ha (38.1 %)
11.4.8	endangered	2.5 ha	71,909 ha	31,968 ha	0.01	7,025 ha (9.7 %)
11.4.9	endangered	23.9 ha	96,425 ha	40,916 ha	0.06	25,851 ha (26.8 %)
Threshold REs (Total 20.4 ha)						
11.3.5	least concern Threshold RE	20.4 ha	55,395 ha	37,214 ha	0.05	6,036 ha (10.7 %)

[1]Figures calculated from DERM 2010c: 'current extent' is of 2006, where this is <10, 000 ha it is shown in bold; [2] This is the sum of each REs current extent from all of the subregions/provinces traversed by the alignment; [3] % = proposed clearing extent as % of subregion current extent – if less than 0.01% then 0.00% is shown; [4] Protected area estate = national park, state forest, conservation park, timber reserve, figures are from 2005.

Loss of Threatened Ecological Communities

Clearing for the construction footprint will result in the loss of REs that have the potential to also qualify as EPBC Act listed TECs. Much of the area of TEC within the rail corridor and infrastructure and construction camp footprints has not been confirmed in the field due to limited access. The total clearing extent provided is therefore a conservative estimate of the situation and the actual extent of REs and TECs to be cleared is likely to be reduced upon further confirmation of REs in the field.

The total area of potential TECs to be cleared from within the construction footprint, based on mapped REs, includes:

- 37.4 ha of REs potentially consistent with the Brigalow TEC

Table 5-3 Areas of Impact for Threatened Ecological Community REs

RE	VMA Status	Short RE Description[1]	Construction Footprint[2]
Brigalow (*Acacia harpophylla* dominant and co-dominant)			
11.3.1	E	*Acacia harpophylla* and/or *Casuarina cristata* open forest on alluvial plains	11.0 ha
11.4.8	E	*Eucalyptus cambageana* woodland to open forest with *Acacia harpophylla* or *A. argyrodendron* on Cainozoic plains	2.5 ha
11.4.9	E	*Acacia harpophylla* shrubby open forest to woodland with *Terminalia oblongata* on Cainozoic plains	23.9 ha
11.9.5	E	Open-forest dominated by *Acacia harpophylla* and/or Casuarina cristata or *Acacia harpophylla* with a semi-evergreen vine thicket understorey	-
Brigalow TEC TOTAL			**37.4 ha**

[1] From REDD (Queensland Herbarium, 2011) [2] Construction Area – rail corridor, construction camps and rail infrastructure only

It should be noted that a conservative approach has been taken. Some of the REs listed here may in fact not have sufficient quality of vegetation composition to be classified as a TEC under the EPBC Act.

Loss of Regulated Regrowth

A total of approximately 19.6 ha of regulated high value regrowth vegetation is currently proposed to be cleared during the construction phase of the Project. Of this, approximately 11.5 ha is categorised as being high value regrowth containing an endangered RE, 6.6 ha is high value regrowth containing an of concern RE, and 1.5 ha is high value regrowth containing a least concern RE.

Loss of Vegetation Communities

Broad vegetation communities have been categorised with fauna habitat types and mapped within the construction footprint (refer Figure 2-2). As such, the extent of each broad vegetation community (as defined in Table 2-4) potentially to be impacted as a result of vegetation clearing for the construction phase of the Project (Rail) are detailed with the fauna habitat types discussed in Section 5.2.

Loss of Flora Species and their Habitat

A total of 114 native flora species from 40 families (all listed as least concern under the NC Act) were recorded during the field surveys. Individuals and/ or populations of some of these species will be lost from the local environment due to clearing proposed for the construction phase of the Project (Rail). As such, this may reduce the genetic diversity within populations of these species and population dynamics and ecosystem functioning may be altered as suitable habitat for dispersal and germination will be lost. In addition, isolation of some populations of flora species (particularly those that require outcrossing for viable seed production) may increase the risk of inbreeding depression.

Furthermore, loss of vegetation may also affect local water and nutrient cycles, affect drainage patterns, remove carbon sinks and lead to increased erosion.

The outcomes of a likelihood of occurrence assessment for EPBC Act and NC Act listed threatened flora species are presented in Table 3-2 and Table 3-8. Following this assessment, it was determined that one threatened flora species, *Solanum adenophorum* (not listed – EPBC Act; endangered – NC Act), was considered as 'likely to occur' based on potentially suitable habitat present within the Study Area. The total impact to potential habitat for this species as a result of the proposed constriction activities for the Project is 82 ha.

Loss of Cleared Land/Paddocks

In addition to the area of remnant vegetation and regulated regrowth vegetation that will be impacted within the construction footprint (rail corridor and infrastructure and construction camp footprints), a further 1,502 ha of non-remnant land (predominantly utilised for grazing purposes) will be utilised for construction of the Project (Rail). This equates to a total of 80.4 per cent of the total clearing area of the Project (Rail).

5.2.2.2 Management and Mitigation Measures

Impact on native vegetation has been reduced where possible by locating the proposed infrastructure within previously cleared areas. Where native vegetation clearing cannot be avoided, the following management and mitigation measures are proposed:

- Design and layout of the temporary and permanent structures and infrastructure within the construction footprint (including construction areas, such as site offices, construction stockpile locations, machinery/equipment laydown areas and storages, access tracks and temporary construction camps) will further consider avoidance of remnant vegetation (in particular endangered, of concern and threatened REs) and make use of previously cleared, non-remnant land.
- The extent of vegetation clearing will be restricted to the minimum amount necessary for the construction of the Project, particularly in the vegetation types:
  - REs listed as constituents of TECs protected under the EPBC Act
  - Endangered and of concern REs
  - Threshold REs
- The extent of vegetation clearing must be clearly identified on construction plans and in the field. Areas that must not be cleared or damaged are to also be clearly identified on construction plans and in the field. Clearing extents are to be communicated to all necessary construction personnel involved.

- Vegetation clearing operations are to be supervised by a suitably qualified ecologist to monitor compliance of vegetation clearing with the defined clearing extents
- Where clearing TECs and REs of conservation significance is absolutely unavoidable, offsets will be required (refer Volume 1 Section 10 Draft Offsets Strategy)
- Clearing within areas of high ecological value, such as riparian corridors, must be undertaken with caution, and rehabilitated to restore connectivity to the highest realistic extent following clearing (i.e. to a level that considers the requirements of maintaining permanent infrastructure but rehabilitates in all areas no longer required in a way that facilitates the movement of fauna).
- As soon as possible after cleared areas are no longer required (outside of the rail corridor), suitable rehabilitation seeding and/or planting must commence using flora species of local provenance and species specific to the RE cleared at that site. Management of previously disturbed land must occur in accordance with a Project Land Rehabilitation Plan. This plan will provide key performance indicators and detail how the disturbed land will be managed and rehabilitated, including (but not limited to) details regarding seed collection, restoration of soil structure, weed management, flora regeneration, landscape design.

5.2.2.3 Summary

The construction footprint, that is the rail corridor and infrastructure and construction camps, is predicted to result in clearing of native vegetation as follows:

- 37.4 ha endangered RE (inclusive of 37.4 ha brigalow TEC)
- 200.4 ha of concern RE
- 128.5 ha least concern RE

Less than one per cent of the current subregional RE extent for all endangered and of concern REs impacted by the Project (Rail) will be lost.

The loss of vegetation, resulting in a loss of flora species and habitat, will incur impacts regardless of management and mitigation measures. Where impacts to the loss of flora species and habitat cannot be successfully managed and mitigated, relevant offsets may be required in accordance with State offset policies (refer Volume 1 Section 10 Draft Offsets Strategy). Likely offset requirements for the Project are discussed further in Section 7.

The clearing of REs for the construction phase of the Project (Rail) will result in a reduction in the size of RE extents or in some cases, the removal of smaller RE patches within the construction footprint. Following implementation of management and mitigation measures, the removal of remnant vegetation will still be required. While opportunities exist for management and mitigation with regard to the potential impacts, clearing of vegetation is largely unavoidable.

Least concern REs impacted within the construction footprint are considered to have a lower conservation status within their respective bioregions. Therefore, residual impacts relating to the permanent decline in size of these REs within the construction footprint in relation to the current bioregional extents are considered to be within reasonable limits. The highest level of impact is to of concern REs (accounting for over 54 per cent of remnant vegetation impacted) followed by endangered REs (approximately 10 per cent of remnant vegetation impacted). Residual impacts to the current bioregional extents of each RE are 1 per cent of the total current remnant extent or less.

Therefore, in general terms of the permanent removal of area, the Project (Rail) will have a minor impact on the REs.

The flora species and habitats identified within the construction footprint are in general considered to be relatively common in the landscape. Notwithstanding, clearing of vegetation for the construction phase of the Project (Rail) will result in localised reductions in population extents, diversity and abundance of flora species and general ecosystem resources encompassed within the construction footprint.

5.2.3 Loss of Terrestrial Fauna Habitat

5.2.3.1 Potential Impacts

The loss of terrestrial fauna habitat as a result of construction of the Project (Rail) includes the removal of mature vegetation, hollow-bearing trees and hollow logs. Loss of these habitat features in turn creates a loss of perching, foraging and den/nesting resources for native species. A subsequent increase in competition for resources such as food and shelter in remaining remnant habitats may occur. Hollow-bearing trees are recognised as a limited resource in most grazing lands due to previous clearing and, as such, the loss of these habitat features are considered to be a major threat to Australia's biodiversity (Gibbons and Lindenmayer 2002).

The total clearing footprint for the construction phase of the Project (Rail) is approximately 1,868 ha. This encompasses the following vegetation community/fauna habitat types:

- 78 ha of eucalypt open woodland
- 47 ha of acacia woodland or forest
- 35 ha of brigalow shrubland to open forest
- 4 ha of eucalypt and acacia mixed woodland or forest
- 65 ha of open woodland fringing watercourses and on flood plains
- 137 ha of native pastures or grasslands
- 1,502 ha of open cleared land and regrowth

In addition to these vegetation communities (and associated fauna habitat types), two dams (based on DERM's Waterbodies mapping layer, 2010) and 12 major and 76 minor mapped watercourses are also likely to be impacted by construction activities. Cattle water toughs also provide a source of water to avian fauna in particular and are common throughout the proposed construction footprint. Consequently, construction activities will reduce local availability of habitats associated with natural and artificial water bodies.

Loss of terrestrial fauna habitat types (listed above) will reduce localised resource availability (for foraging, roosting and breeding) for an array of fauna species, including:

- Amphibians – suitable potential fauna habitat types include: open woodland fringing watercourses and on flood plains and natural and artificial waterbodies
- Ground-dwelling and arboreal reptiles – suitable potential fauna habitat types include: Eucalypt open woodland, Acacia woodland or forest, Brigalow shrubland to open forest, Eucalypt and Acacia mixed woodland or forest and open woodland fringing watercourses and on flood plains.

- Woodland and grassland birds – suitable potential fauna habitat types include: Eucalypt open woodland, Acacia woodland or forest, Brigalow shrubland to open forest, Eucalypt and Acacia mixed woodland or forest, open woodland fringing watercourses and on flood plains and grassland.
- Terrestrial, arboreal and flying mammals – suitable potential fauna habitat types include: Eucalypt open woodland, Eucalypt and Acacia mixed woodland or forest and open woodland fringing watercourses and on flood plains.

Impacts to aquatic fauna and habitat types are detailed in Section 5.3.1.

Loss of Habitat – EPBC Act listed Fauna

The outcomes of a likelihood of occurrence assessment for EPBC Act listed threatened fauna species are presented in Table 3-3. Following this assessment it was determined that of the 14 fauna species predicted to occur within the Study Area, one species was confirmed present, four species were considered as 'likely to occur' and six species were considered as 'may occur' based on potentially suitable habitat present within the Study Area. The total impact to potential habitat for EPBC Act listed fauna species as a result of the proposed constriction activities for the Project (Rail) is summarised in Table 5-4.

Vegetation clearing for the construction of the Project (Rail) may also reduce the local availability of habitat resources for the two EPBC Act listed migratory birds confirmed to be present within the Study Area, the three migratory birds considered 'likely to occur' and the seven migratory bird species considered as 'may occur'.

Table 5-4 Impact to EPBC Act listed Fauna Potential Habitat

EPBC Act-listed fauna species	EPBC Act / NC Act status	Total clearing extent*	Map reference
Confirmed present			
squatter pigeon (southern)	vulnerable / vulnerable	145.7 ha	Figure 3-1
Likely to occur			
Ornamental snake	vulnerable / vulnerable	229.5 ha	Figure 3-2
Black-throated finch (southern)	endangered / endangered	64.7 ha	Figure 3-3
Koala ((QLD, NSW and ACT populations)	vulnerable / special least concern	143.2 ha	Figure 3-4
May occur			
Yakka skink	vulnerable / vulnerable	229.5 ha	Figure 3-5

EPBC Act-listed fauna species	EPBC Act / NC Act status	Total clearing extent*	Map reference
Dunmall's snake	vulnerable / vulnerable	82.4 ha	Figure 3-6
Brigalow scaly-foot	vulnerable / vulnerable	164.8 ha	**Error! Not a valid result for table.**
Greater long-eared bat	vulnerable / vulnerable	143.2 ha	**Error! Not a valid result for table.**
Northern quoll	endangered / not listed	47.6 ha	Figure 3-9
Red goshawk	vulnerable / endangered	194.6 ha	Figure 3-10
Australian painted snipe	vulnerable; marine; migratory (CAMBA)	66 ha	**Error! Not a valid result for table.**

*total clearing extent is based on the broad vegetation community/ fauna habitat types as they apply to each species. Exceptions are with black throated finch (which has had its mapped potential habitat refined through mapping only those REs that known records of species have been obtained) and the squatter pigeon (which has had its habitat mapped based on REs characterised by open woodland and forest vegetation).

Loss of Habitat – NC Act-listed Fauna

The outcomes of a likelihood of occurrence assessment for NC Act listed threatened fauna species are presented in Table 3-9. Following this assessment, it was determined that of the 16 fauna species predicted to occur within the Study Area, two species (squatter pigeon and little pied bat) were confirmed to be present.

In addition to those species also listed under the EPBC Act (and therefore captured within Table 5-4), the construction footprint of the Project (Rail) is considered to encompass potentially suitable habitat for four fauna species either confirmed present or that are predicted as likely to occur. The total impact to potential habitat for these four NC Act-listed fauna species comprise:

- Little pied bat (near threatened – NC Act): 147.1 ha of potentially suitable habitat
- Black-neck stork (near threatened – NC Act): 66 ha of potentially suitable habitat
- Grey falcon (near threatened – NC Act): 147.1 ha of potentially suitable habitat
- Cotton pygmy-goose (near threatened – NC Act): 66 ha of potentially suitable habitat

5.2.3.2 Management and Mitigation Measures

Management and mitigation measures to reduce the impact of habitat loss on the biodiversity features within the construction footprint and surrounding adjacent landscape include:

- Design and layout of the temporary and permanent structures and infrastructure within the construction footprint (including construction areas, such as site offices, construction stockpile locations, machinery/equipment laydown areas and storages, access tracks and temporary accommodation camps) will further consider avoidance of remnant vegetation (in particular endangered, of concern and threatened REs) and make use of previously cleared, non-remnant land.

- Suitable fauna-friendly culverts that enable the safe passage of fauna (in particular macropods, quolls and small mammals) across the rail corridor will be co-located with culverts, bridges and other crossing structures, particularly in important habitat areas. For example culverts to facilitate movement of fauna (e.g. incorporation of ledges, allow for lighting through use of grids, protect and enhance entries and exits) are advised to be installed where the Project bisects watercourses, drainage lines and remnant vegetation, including the areas mapped as potentially suitable habitat for EPBC Act listed species which are considered likely to occur. The suitability of culvert size will be a consideration during the design of permanent structures. For example, when targeting common fauna such as macropods, larger culverts willencourage use of these structures.
- Prior to vegetation clearing, trees and habitat features (i.e. log piles) that may be used by fauna for nesting or shelter will be marked. During clearing activities, a qualified fauna spotter-catcher will supervise the activity and recommend provisions for the relocation of.
- Habitat features such as hollows and log piles will be salvaged, where possible, and placed in nearby (retained) habitat areas. Where this is not possible, the loss of habitat features will be supplemented in adjacent habitat areas with artificial habitat (i.e. nest boxes, artificial water sources).
- As soon as possible after cleared areas are no longer required (areas outside of the rail corridor), suitable rehabilitation will commence using flora species of local provenance and species appropriate to the cleared REs. Management of previously disturbed land should occur in accordance with a Project Land Rehabilitation Plan. This plan should provide key performance indicators and detail how the disturbed land will be managed and rehabilitated, including (but not limited to) details regarding seed collection, restoration of soil structure, weed management, flora regeneration and landscape design.
- Land clearing activities will, where possible, seek to avoid alteration to waterways such that the impacts to water quality and downstream flows are minimised to the greatest extent possible. Management of erosion and sedimentation in and adjacent to cleared areas must be undertaken in accordance with a Project (Rail) Construction Environmental Management Plan (refer Volume 3 Section 14 Environmental Management Plan.
- Restore and rehabilitate watercourse areas – improve connectivity and enhance provision of suitable habitat
- Restore and protect habitat elsewhere in the area

5.2.3.3 Summary

General Fauna

Clearing of vegetation will result in potential habitat loss for native fauna species. The impact to fauna and fauna habitat has been avoided through locating a large extent (approximately 80 per cent) of the construction footprint, where possible in areas of non-remnant vegetation or cleared land. Standardised monitoring and auditing of the application and performance of management and mitigation strategies will be undertaken, with corrective actions implemented where required.

Despite the proposed management actions detailed above, unavoidable impacts to fauna habitat will arise as a result of vegetation clearing, particularly localised habitat loss in riparian areas. Where

these unavoidable impacts cannot be satisfactorily managed or mitigated, offsets will need to be provided in accordance with Commonwealth and State policies (refer Volume 1 Section 10 Draft Offsets Strategy).

Conservation Significant Fauna

In general, the construction footprint and surrounding Study Area are not considered to support an 'important population' or 'habitat critical to the survival' of any EPBC Act listed threatened fauna species (i.e. squatter pigeon (southern), ornamental snake, yakka skink, brigalow scaly-foot, Dunmall's snake, greater long-eared bat, red goshawk, northern quoll, Australian painted snipe). Thus, vegetation clearing (and associated impacts) is not considered to constitute a 'significant impact' to any of these species. Similarly, the construction footprint and surrounding Study Area are not considered to support 'important habitat' for EPBC Act listed migratory species, and thus, vegetation clearing (and associated impacts) is not considered to constitute a 'significant impact' to these species.

The impact of clearing of vegetation on potentially suitable habitat for the black-throated finch (southern) is also not considered to constitute a 'significant impact' to this species. Potentially suitable habitat is limited in association with the Project (Rail) and largely confined to fragmented patches of remnant vegetation associated with rivers and creeks. As Figure 3-3 indicates, suitable habitat for the species is concentrated in the remnant vegetation associated with the Desert Uplands Bioregion to the far north-west of the Study Area (refer Volume 4 Appendix O for discussion on the black-throated finch (southern) in respect of potential impacts associated with the Project (Mine)). As for other fauna, where unavoidable impacts (i.e. habitat loss) cannot be satisfactorily managed/ mitigated and are considered to be a significant impact, offsets will need to be provided in accordance with Commonwealth and State policies (refer Section 7).

5.2.4 Habitat Degradation

5.2.4.1 Potential Impacts

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 (Belyando River, Mistake Creek, Logan Creek, and Diamond Creek).

Clearing of vegetation and construction activities undertaken within the Project footprint will cause temporary localised increases in noise, vibration and light disturbance. In addition, further degrading effects to habitat may include increased exposure to dust, wind, weeds and introduced animals. 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 in 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, further detail on soils within Study Area is provided in Volume 4 Appendix Y Rail Soils Report) 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.

5.2.4.2 Management and Mitigation Measures

Impacts to habitats immediately adjacent to and downstream of cleared areas can be avoided or minimised through:

- Locate where possible temporary infrastructure within previously disturbed/degraded and/or cleared areas or within areas of non-remnant vegetation
- Limiting lighting to work areas and employing directional lighting where lighting is required in areas near remnant vegetation.
- Ensuring all plant and equipment is appropriately serviced and maintained to minimise machinery noise where possible
- Dust suppression during construction in cleared areas, rehabilitation, and the use of stabilised surfaces where possible
- Management of weeds in and adjacent to cleared areas in accordance with a Project Weed Management Plan. This plan should include details relating to the monitoring, management and where necessary, eradication of weeds, disposal of green waste, and vehicle/plant weed wash down protocols (refer Volume 3 Section 13 Environmental Management Plan).
- Management of fauna pest species during construction in and adjacent to cleared areas in accordance with a Project Introduced Animals Plan. This plan should include details relating to the monitoring and management of pest animals (refer Volume 3 Section 13 Environmental Management Plan).
- Management of sewage and other potentially harmful waste should be best-practice and in accordance with applicable guidelines/policies
- Implementation of a Project Waste and Hazardous Materials Management Plan, which will include waste management and disposal protocols and procedures (refer Volume 3 Section 13 Environmental Management Plan).
- Vegetation clearing activities should, where possible, seek to avoid alteration to waterways such that the impacts to water quality and downstream flows are minimised to the greatest extent possible. Management of erosion and sedimentation in and adjacent to cleared areas should be undertaken in accordance with a Project Erosion Management Plan (refer Volume 3 Section 13 Environmental Management Plan).

5.2.4.3 Summary

Clearing of vegetation has the potential to result in habitat degradation of adjacent and downstream habitats. Actions seeking to manage these potential indirect impacts will be implemented. In consideration of the relatively localised nature and short-term duration of impacts associated with the construction phase of the Project and following implementation of the mitigation measures discussed, it is not expected that adverse or long-term impacts on fauna habitat are likely. Standardised

monitoring and auditing of the application and performance of management and mitigation strategies will be undertaken, with corrective actions implemented where required.

5.2.5 Habitat Fragmentation

5.2.5.1 Potential Impacts

Vegetation clearing may result in localised fragmentation of habitat in the vicinity of the construction footprint. Much of the landscape surrounding the proposed rail corridor has experienced broadscale vegetation clearing resulting in remnant vegetation remaining as fragmented patches (Figure 5-1). 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 at this localised scale 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 amphibians, reptiles and small ground-dwelling and arboreal mammals.

Fragmentation of regional and state significant bioregional wildlife corridors could occur as a result of vegetation clearing during the construction phase of the Project (Rail). Although often somewhat degraded by the current grazing practices within the Study Area, the small riparian corridors or small patches of remnant and advanced regrowth patches act as habitat linkages between larger vegetated patches. Vegetation of a low condition rating can act as important refuges for native fauna, including conservation significant species within the typically degraded.

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 such as macropods and echidnas.

5.2.5.2 Management and Mitigation Measures

Management and mitigation measures to reduce the impacts of habitat fragmentation to local fauna populations include:

- Landscape permeability will be retained where possible. Where fencing is required around cleared areas, it will be designed such that fauna can move through it (excluding those instances where fenced areas seek to protect fauna from threats such as trains, trenches, human contact). Consideration should be given to not using barbed wire on the top strand of wire fences or suitable fencing to maintain a level of landscape permeability.
- Suitable fauna-friendly culverts that enable the safe passage of fauna (in particular macropods, quolls and small mammals) across the rail corridor will be co-located with culverts, bridges and other crossing structures, particularly in important habitat areas. For example culverts to facilitate movement of fauna (e.g. incorporation of ledges, allow for lighting through use of grids, protect and enhance entries and exits) are advised to be installed where the Project bisects watercourses, drainage lines and remnant vegetation, including the areas mapped as potentially suitable habitat for EPBC Act listed species which are considered likely to occur. The suitability of culvert size will be a consideration during the design of permanent structures. For example, when targeting common fauna such as macropods, larger culverts willencourage use of these structures.Design will consider suitable watercourse crossings structures, for example bridge

spans, culverts and openings such that fauna passage is facilitated across the Project (Rail) footprint.

- Vegetation clearing will be undertaken in a sequential manner to allow more mobile fauna species the opportunity to disperse away from cleared areas and clearing activities.
- Following clearing, rehabilitation will occur in areas no longer required as track construction progresses to facilitate fauna passage around the construction footprint.
- Suitable fauna habitat features (logs, hollows etc) will be relocated to areas of adjacent larger, intact habitat to encourage use. Artificial habitat will be provided (as appropriate and practical) in these relocation areas to encourage use.
- The construction footprint will be reduced in environmentally sensitive areas, particularly at river and creek crossings.

5.2.5.3 Summary

In consideration of the present fragmented nature of the Study Area due to historic clearing and current land use practices (cattle grazing) and with implementation of the mitigation measures provided, the resulting habitat fragmentation associated with construction of the Project (Rail) is considered to be localised.

5.2.6 Fauna Mortality

5.2.6.1 Potential Impacts

Construction activities involved in the clearing of vegetation, including the use of vehicles and machinery have the potential to lead to direct mortality of fauna in the event individuals are struck. 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) and ground animals that typically tend to hide rather than flee in response to approaching danger (i.e. bandicoots, quails and pigeons) . In addition, nocturnal fauna species that are inactive during daylight hours and therefore unable to disperse away from clearing activities are particularly susceptible to injury or death. This includes conservation significant species such as the yakka skink, ornamental snake and brigalow scaly-foot.

5.2.6.2 Management and Mitigation Measures

Management and mitigation measures to reduce the potential for fauna mortality as a result of land clearing activities include:

- All vegetation clearing will be undertaken in the presence of a qualified fauna spotter-catcher. Pre-demarcated habitat features will be thoroughly checked by fauna spotter-catcher prior to clearing. Provisions for the relocation of fauna should be made prior to the commencement of clearing.
- Vegetation clearing will be undertaken in a sequential manner to allow mobile fauna to disperse away from clearing areas
- All vehicles and plant associated with vegetation clearing must adhere to site rules relating to speed limits. Speed limits will be restricted, and clearly signposted so as to minimise the potential for road kill.

- Temporary fencing should be erected around construction zones to exclude mobile fauna and livestock from vegetation clearing areas
- A fauna species relocation plan (as part of the Species Management Plan (SMP)) will be developed to facilitate relocation of all native fauna encountered during clearing activities. For conservation significant fauna species considered as having the potential to occur, relocation techniques specific to each of the species requirements will be documented within the SMP and if encountered these specific techniques will be carried out accordingly.
- A fauna mortality register will be maintained to document the location and frequency of mortality and the fauna species most susceptible to injury and death, to enable on-going modifications to fauna conservation management strategies where necessary.
- Site inductions for all staff are to include education sessions regarding the local fauna that may be present on the site and protocols to be undertaken if fauna are encountered
- Sites are to be kept clean and free of waste to prevent the attraction of fauna species to areas of high activity and movement (refer Volume 3 Section 13 Environmental Management Plan)
- Work areas are to be inspected daily prior to commencement and fauna present to be relocated or moved

5.2.6.3 Summary

Direct mortality of fauna during the construction phase of the Project (Rail) is expected to be reduced should the management and mitigation protocols outlined above be appropriately implemented. Nonetheless it is expected that some fauna mortality will occur during vegetation clearing activities.

5.3 Disturbance of Surface Watercourses and Waterbodies

5.3.1 Overview

Within the construction footprint for the Project, aquatic habitat (including surface watercourses and waterbodies) will be removed as a result of construction activities. Habitat loss will occur where there is intersection with the construction footprint for the rail corridor (refer Figure 5-1). A total of 12 major watercourse crossings and approximately 76 minor watercourse crossings (including unmapped ephemeral drainage lines) have been identified along the proposed rail corridor (refer Volume 4 Appendix AB Rail Hydrology Report). Of these watercourses, 24 have been mapped by DEHP.

The major watercourses identified by Golder Associates (2011) are all named watercourses (with the exception of an unnamed tributary of the Belyando River) and comprise the following (running west to east):

- Eight Mile Creek (stream order 3): KM 176.1
- North Creek (stream order 2): KM 170.4
- Belyando River (stream order 8): KM 149
- Mistake Creek west tributary (stream order 6): KM 121.5
- Mistake Creek east tributary (stream order 2): KM 120.6
- Gowrie Creek west tributary (stream order 4): KM 113.5

- Gowrie Creek east tributary (stream order 2): KM 110.6
- Logan Creek (stream order 5): KM 82.6
- Grosvenor Creek (stream order 3): KM 18.5

The minor watercourse crossings are typically located in areas of low topography and are often without a natural stream channel. Drainage crossing structures are likely to be required to avoid water ponding. Potential ecological impacts arising from construction activities resulting in disturbance to surface water and aquatic environments include:

- Change in aquatic habitat availability and/or suitability for terrestrial species – specifically avifauna and species using water bodies as a water resource (refer to Section5.3.2))
- Degradation of riparian habitat (refer to Section5.2.4 and Section 5.3.1)
- Loss of or change in aquatic habitat availability and/or suitability for aquatic flora and fauna (discussed in Section 5.3.2)
- Aquatic fauna mortality (discussed in Section 5.3.4)

Impacts arising from aquatic habitat loss and degradation to aquatic habitat specific to aquatic flora and fauna have been summarised into three categories which comprise:

- Loss of aquatic habitat for aquatic flora and fauna
- Degradation of aquatic habitat and riparian zones
- Aquatic fauna mortality

5.3.2 Loss of Aquatic Habitat

5.3.2.1 Potential Impacts

Aquatic habitat to be removed within the construction footprint for the Project includes at least two farm dams (based on watercourse mapping) and riparian habitat associated with watercourses. No declared fish habitat is mapped within the Study Area or within the construction footprint.

Within the construction footprint, the aquatic habitat at farm dams are categorised as lacustrine and typically provide limited value for native aquatic flora and fauna. Notwithstanding, there may be a localised impact to any resident native fish, macroinvertebrates and turtle species when the dams are drained or filled with material. No palustrine habitat is mapped within the construction footprint.

The majority of the watercourses intersected by the construction footprint are ephemeral streams that have established stream banks and a formed channel; however, these lines provide limited long term aquatic habitat and therefore disturbance impacts are limited at these locations. Belyando River (8^{th} order stream) and Mistake Creek (6^{th} order stream) in the west of the Study Area, and Logan Creek (5^{th} order stream) in the east portion of the Study Area can be classified as riverine. Belyando River and Mistake Creek, in particular, are considered to have high ecological value and maintain aquatic habitat for flora and fauna throughout the year, even if in isolated pools. Localised, short-term impacts as a result of construction disturbance are likely particularly within riverine habitat.

The ephemeral habitat of these watercourses that typically have an intermittent base flow that is often reduced to unconnected waterholes is characteristic of the Burdekin Catchment (Negus *et al*., 2008). The habitat within the Study Area is considered characteristic and well represented on a regional

scale. The removal of the aquatic habitat described within the Project (Rail) construction footprint may reduce the availability of aquatic habitat on a local scale however the impact to or loss of these habitats is not expected to have an impact to the aquatic biodiversity of the region as:

- The types of habitat are well represented within the Burdekin and Fitzroy Basin Catchments
- Much of the aquatic habitat is ephemeral waterways or farm dams that do not contribute to regional recolonisation or connect permanent aquatic habitats

Infilling or excavation of farm dams may have a localised impact to native aquatic flora and fauna diversity however is unlikely to have an impact on a regional scale.

The crossing infrastructure at watercourses intersected by the proposed Project (Rail) alignment will be designed such that infrastructure to be placed in the beds of the watercourses will occur in drier periods. The installation of crossing infrastructure within watercourses will potentially result in a small loss of aquatic habitat, create a barrier to movement for native aquatic fauna species and/or alter hydrological flow. Barriers to fish movement have the potential to result in a reduction in species abundance and distribution, localised extinction and a reduction in diversity (refer Section 6.2). This may influence the connectivity of macroinvertebrate populations. For species that are capable of overland dispersal (e.g. crayfish) or aerial dispersal (e.g. mayflies), this barrier may be overcome entirely, or may only present a partial obstacle to movement. Sedentary species (for instance freshwater mussels) or taxa that are confined to aquatic environments (including species with predominantly aquatic life stages) may experience some losses in connectivity between habitats and neighbouring populations. This restriction of access to habitat areas has the potential to reduce biodiversity of the higher order watercourses such as the Belyando River in particular within, upstream and downstream of the Study Area.

For other creeks of a smaller stream order intersected by the construction footprint, such as Logan Creek and Grosvenor Creek, these are expected to facilitate periodic flows only, rather than permanent or even short term habitat for aquatic flora and fauna. The potential direct impact to flora and fauna communities will occur only in periods of inundation. However, in the event the location of the crossing of creeks during construction coincides with isolated pools, there will also be an impact to aquatic flora and fauna communities at these locations.

5.3.2.2 Management and Mitigation Measures

- Avoid and minimise disturbance to rivers and creeks. Construction methodology provides for (as far as is practicable) construction within rivers and creeks to be undertaken in the drier periods and ahead of rail construction. This will reduce disturbance and interference to surface flows and subsequent impacts on aquatic habitats.
- Route selection identified watercourse areas (amongst others) as constraints and sought to minimise impacts to watercourses through avoidance, selection of suitable bridge spans or location in narrower crossing areas, crossing of a tributary rather than the main waterbody, etc.
- Avoid and minimise human and vehicle access to river and creek bed and banks. Construction of river/watercourse crossings ahead of rail construction (as far as is possible) will reduce the need for personnel, equipment, machinery and plant to traverse the river/watercourse and limit disturbance to bed and banks.

- Temporary stream or channel diversion may be required to facilitate activities in wet periods. Stream flow is maintained to provide connectivity between aquatic habitats and facilitate aquatic fauna passage.

5.3.2.3 Summary

As a result of construction activities, there is likely to be a loss of aquatic habitat with localised, short-term impacts particularly in riverine habitat. With the implementation of the management and mitigation measures provided above, the residual impact to aquatic habitats is expected to be low.

5.3.3 Degradation of Aquatic Habitat and Riparian Zones

5.3.3.1 Potential Impacts

The riparian zones of watercourses, in particular those with established riparian vegetation (of note – Belyando River, Mistake Creek, Logan Creek and Diamond Creek) play an important role in the composition, function and protection of aquatic ecosystems and are likely to experience localised impacts during construction activities. Impacts are likely in established zones where they assist in stabilising soil, filtering toxicants and nutrients, and providing shade, large woody debris and organic matter for the production of aquatic ecosystems. Construction activities within or adjacent to the creek systems of the watercourses intersected by the construction footprint have the potential to disturb bed and bank substrates and lead to localised erosion and sediment transport to downstream habitats. Sedimentation of water downstream subsequently has the potential to degrade aquatic habitats in the downstream catchment.

Water Quality

Changes in water quality are described in Volume 4 Appendix AD Rail Hydrology Report. The assessment identifies that changes in water quality are most likely to be associated with the potential for increased turbidity, the mobilisation of sediments and pollutants and introduction of contaminants from construction machinery and wastes.

Clearing of vegetation within the Project (Rail) construction footprint will result in exposed earth surfaces and a reduction of vegetated buffers at watercourse (and the protection it provides) between the construction activities and the watercourses. The source of most suspended particulates (and in turn increase in turbidity) in waterways is land runoff due to soil erosion (ANZECC 2000), including stream bank erosion. The majority of the watercourses likely to be disturbed during construction are not expected to be regularly inundated due to their ephemeral nature. However, clearing in the catchment at any time creates exposed surfaces with greater potential for erosion during rain periods. Disturbance of the bed and banks when dry will also create volatile areas with a higher potential for erosion when flows resume and catchment runoff occur.

Suspended particulates can influence the aquatic ecosystem when:

- In suspension – when in water column particulates reduce light penetration and thus primary production as well as affecting gill function of fish
- Settling out – when settled sediments can smother organisms and their habitats (ANZECC 2000)

The turbidity of the aquatic ecosystems within the watercourses fluctuates seasonally as a result of the variation in the flow and depth of water between wet and dry seasons. Although riparian ecosystems are likely to be adapted to high turbidity during some periods (i.e. during rain periods and/

or periods of flash flooding), an increase in the magnitude of the peaks of turbidity due to construction activities has the potential to have a detrimental effect on aquatic ecosystems.

Oils, fuel, lubricants and other substances containing chemicals will be required to operate construction machinery and commonly contain elements that, at high concentrations, can be toxic to aquatic organisms. Accidental spills or leaks anywhere within the water catchments have the potential to result in contaminants being transported to the aquatic environment with rainfall runoff.

Surface Flows

Changing the direction or volume of runoff flows to the watercourses within the construction footprint has the potential to change the geomorphology of the area as a result of scour and deposition. The mobilisation and subsequent deposition of sediments into watercourses has the potential to locally change bed and bank profiles. Physical changes such as these have the potential to reduce habitat suitability for existing communities and change the diversity and/or structure of the community by creating or removing microhabitat types to which the existing community has adapted. If water inputs are reduced, changes to the availability of habitats downstream may be realised. Changes to surface flows are discussed in further detail in Volume 4 Appendix AB Rail Hydrology Report.

Management and Mitigation:

- Design and layout of the components of the infrastructure will maximise development on existing cleared lands as priority to avoid impacts to the creek bed, banks and riparian areas and the aquatic values that may be provided when inundated (mainly during high water flows).
- Clear, on-ground demarcation of areas to be cleared adjacent to watercourse crossing locations will be undertaken prior to clearing to avoid accidental clearing or stockpiling of cleared vegetation in sensitive areas. Identification of this area for protection where possible will minimise the potential for unnecessary impact to the creek and consequently downstream areas.
- Disturbance to creek banks and control of site runoff from all areas disturbed during construction activities will be managed through the development and implementation of a Project Sediment and Erosion Control Plan. This plan will limit the potential for the degradation of downstream aquatic habitat. The plan will include (but is not limited to):
  - Requirement to construct across watercourses during dry conditions to limit localised erosion at construction areas
  - Requirement to clearly identify areas for land clearing and earthworks on construction plans and on the ground to avoid unnecessary disturbance to areas outside the construction area
  - Installation and maintenance standards for sediment fences and other sediment control devices, in particular for areas near earthworks, watercourses and key stormwater flow paths
  - Locating any soil or mulch stockpiles away from watercourses and key stormwater flow paths to limit potential for transport of these substances into the watercourses via runoff
  - Emergency response protocols and procedures for implementation in the event of a contaminant spill or leak
  - Requirement for the use of vehicles and machinery in good working order to limit potential for oil leaks
  - Rehabilitation and/or requirements to protect/stabilise exposed earth areas from water or wind erosion

- Revegetation of creek banks disturbed during construction
- Monitoring requirements for the purposes of detecting changes in water quality downstream of the construction area
- Monitoring requirements to maintain the effectiveness of installed control mechanisms, including frequency and corrective actions to be undertaken in the event that erosion control mechanisms are not operating appropriately.

- For those unavoidable impacts (i.e. habitat loss) that cannot be managed, offsets will need to be provided in accordance with Commonwealth and State policies (Refer Section 7)

5.3.3.2 Summary

As a result of construction activities, there is an increased potential for degradation to aquatic habitats downstream of the construction area as a result of changes to water quality and removal of the riparian habitat. With the implementation of the management and mitigation measures provided above, the residual impact to aquatic habitats is expected to be low.

5.3.4 Aquatic Fauna Mortality

5.3.4.1 Potential Impacts

Mortality or injury to aquatic fauna has the potential to occur when construction activities are undertaken within or adjacent to a waterbody. This is generally due to vehicle/machinery strike or strike from falling vegetation or woody debris. It is unlikely that there will be aquatic fauna communities in many of the minor ephemeral tributaries during the construction period, as these areas typically provide aquatic habitat during flash flows only. The potential for mortality or injury to aquatic fauna species at these locations is unlikely.

Farm dams located within the construction footprint potentially provide suitable habitat for aquatic fauna such as native fish, macroinvertebrates and turtles. Removal of this habitat through filling or draining the dam may result in the mortality of this community, depending on local conditions and timing (i.e. removal when dams are dry). Farm dams are disconnected from other aquatic habitats; so fish and mollusc populations in these environments are isolated populations likely to have been established as a result of stocking or incidental transfer by birds or the like. It is unlikely that these populations contribute to the local biodiversity or genetic diversity of the aquatic communities in the river and creek systems in the wider region. Nevertheless, though these aquatic fauna communities may not be important in the context of local biodiversity, protection of native species under the NC Act must be considered. Alternatively, certain macroinvertebrate species are capable of overland and/or aerial dispersal, and so populations in farm dams may have undergone a natural colonisation event. In these instances, it is possible that these environments harbour diverse and genetically differentiated macroinvertebrate populations/communities. However, this is dependent on:

- The ephemerality of the farm dam
- The age of the dam (i.e. how long ago it was constructed).

5.3.4.2 Management and Mitigation Measures

Mitigation measures to address potential impacts arising from aquatic habitat loss and degradation of relevance to terrestrial fauna are outlined in Section 2.5, and Section 4.2, respectively. Mitigation measures to address potential impacts to aquatic flora and fauna include:

- Design and layout of the components of the infrastructure will maximise development on existing cleared lands as priority to avoid impacts to the creek bed, banks and riparian areas and the aquatic values that may be provided when inundated (mainly during high water flows).
- Design and layout of watercourse crossings will consider the requirement for fish and macroinvertebrate movement including under flow conditions. This will be done in accordance with DAFF and/or DTMR guidelines for the design of stream crossings (Cotterell, 1998) for fish passage.
- To avoid mortality of aquatic fauna within farm dams impacted by construction activities, a Fauna Salvage and Relocation Plan will be required. Relocation would require preliminary sampling of dams to identify the native species present, followed by the development of an appropriate salvage plan for approval by the relevant agencies prior to removal of the habitat. The plan will require consideration of the relocated location in terms of suitability and availability of habitat and resources for the community.
- To avoid mortality of aquatic fauna within higher order watercourses (namely, Belyando River, Mistake Creek, Logan Creek and Diamond Creek) construction activities should be undertaken during dry season conditions.
- Disturbance to creek banks and control of site runoff from all areas disturbed during construction activities will be managed through the development and implementation of a Project Sediment and Erosion Control Plan. This plan will limit the degradation of downstream aquatic habitat. The plan will include (but is not limited to):
  - Requirement to construct across watercourses preferably during dry conditions to limit localised erosion at construction areas
  - Requirement to clearly identify areas for land clearing and earthworks on construction plans and on the ground to avoid unnecessary disturbance to areas outside the construction area
  - Installation and maintenance standards for sediment fences and other sediment control devices, in particular for areas near earthworks, watercourses and key stormwater flow paths
  - Locating any soil or mulch stockpiles away from watercourses and key stormwater flow paths to limit potential for transport of these substances into the watercourses via runoff
  - Emergency response protocols and procedures for implementation in the event of a contaminant spill or leak
  - Requirement for the use of vehicles and machinery in good working order to limit potential for oil leaks
  - Rehabilitation and/or requirements to protect/stabilise exposed earth areas from water or wind erosion
  - Revegetation of creek banks disturbed during construction
  - Monitoring requirements for the purposes of detecting changes in water quality downstream of the construction area
  - Monitoring requirements to maintain the effectiveness of installed control mechanisms, including frequency and corrective actions to be undertaken in the event that erosion control mechanisms are not operating appropriately.
- For those unavoidable impacts (i.e. habitat loss) that cannot be managed, offsets will need to be provided in accordance with Commonwealth and State policies (Refer Section 7.2)

5.3.4.3 Summary

There is potential for aquatic fauna mortality to occur through impacts to farm dams and watercourse crossings as a result of construction activities. With the implementation of the management and mitigation measures provided above, the residual impact to aquatic fauna is expected to be low.

5.4 Increased Anthropogenic Activity Leading to Disturbance

5.4.1 Overview

Habitat degradation, behavioural disruption, injury and mortality may arise as a result of increased vehicular activity and a change in disturbance types within the construction footprint. Habitat degradation and associated behavioural disruption may result from increased dust mobilisation, erosion/sedimentation, and increased exposure to noise, light and vibration, chemical contamination and alteration of waterways. Injury and mortality may occur where animals are struck by vehicles or plant machinery, or where animals become entrapped in active construction areas (pits, trenches, building sites etc.).

Potential ecological impacts arising from disturbances generated from a general increase in activities in the area include:

- Fauna behavioural disruption associated with habitat degradation (refer to Section 5.2.4 and Section 5.4.2 below)
- Fauna mortality (refer to Section 5.2.6 and Section 5.2.4 below)
- Change in fire regime and risk of fire (refer to Section 5.4.2 below)

5.4.2 Fauna Behavioural Disruption

5.4.2.1 Potential Impacts

The higher intensity of land use at and near the construction zones associated with the rail corridor and associated infrastructure may disrupt local fauna behaviour, largely as a result of increased exposure to light, noise, dust, vehicles and people. Behavioural disruption may be direct (i.e. increased susceptibility to predation due to increased noise reducing prey vigilance, or increased light increasing prey detectability) or indirect (i.e. habitat degradation reducing local resource availability therefore increasing foraging dispersal distances for fauna). In addition, there is expected to be localised disturbance to wildlife behaviours and dynamics (i.e. foraging, breeding and nesting) adjacent to the construction footprint.

Direct impacts to flora may be incurred through excessive dust settling on plants which can suppress plant growth by limiting the photosynthesis potential of species in close proximity to the construction area (Nanos & Ilias, 2007). The impacts from dust is likely to be a more pronounced where construction activities are located in and adjacent to sensitive habitats (i.e. watercourses and riparian vegetation). In addition, water quality of aquatic environments may be impacted through excessive dust settling on waterbodies that may indirectly affect aquatic flora and fauna. It is important to note that these impacts will be temporary (i.e. only during the construction period), and will be addressed through management relating to dust suppression actions.

Human settlements in the form of construction camps substantially increase the generation of waste materials in the area and consequently may provide additional resources (i.e. food scraps) for feral animals such as pigs, cats and dogs. Feral animals, some of which were confirmed to be present within the Study Area during field surveys, may increase in abundance if easier access to foraging resources is provided.

Further still, increased movement of people, vehicles, machinery, vegetation waste and soil may facilitate the spread of weeds in the Study Area. A total of 11 introduced plants were detected within the Study Area, of which, three (these being parthenium, harrisia cactus and prickly pear) are 'declared plants' under the LP Act. Increasing the prevalence of weeds within the construction footprint and the potential for weeds to spread to the surrounding landscape may reduce the quality of habitats for some fauna species.

5.4.2.2 Management and Mitigation Measures

Management and mitigation measures to reduce disruption to fauna behaviour during construction activities include:

- Directional lighting will be used where lighting is required in areas near remnant vegetation, to avoid disturbance to sensitive habitat (i.e. watercourses and wetlands/ ox-bows
- Dust suppression actions will be undertaken in all cleared areas and on all unsealed roads at suitably regular intervals
- Frequent maintenance of construction machinery and plant will be undertaken to minimise unnecessary noise
- Management of sewage and other potentially harmful waste should be best-practice and in accordance with applicable guidelines/policies
- A Project Waste and Hazardous Materials Management Plan will be implemented, and include waste management and disposal protocols and procedures. This plan must incorporate protocols relating to the:
  - Disposal of green waste (in a manner that minimises potential for spread of weeds)
  - Disposal of food scraps and the like (to minimise potential for pest animals to access food wastes)
- Management of weeds in, and adjacent to, cleared areas in accordance with a Project Weed Management Plan. This plan should include details relating to the monitoring, management and, where necessary, eradication of weeds, disposal of green waste, and vehicle/plant weed wash down protocols.
- Management of pest animals in, and adjacent to, cleared areas in accordance with a Project Fauna Pest Species Plan. This plan should include details relating to the monitoring and management of pest animals. Camps and laydown areas to be fenced to prevent encroachment of feral species. Waste material to be appropriately sealed and stored to discourage encroachment by feral species.

5.4.2.3 Summary

Throughout the construction phase of the Project, habitats adjacent to construction areas will increasingly become more exposed to long-term disturbance. This includes noise and light disturbance in habitats adjacent to the construction footprint, and disturbance from dust and noise in

areas adjacent to all roads and access tracks utilised to facilitate vehicle movement within the wider Study Area Given that the majority of the Study Area is already degraded by cattle grazing to a large extent, and following the implementation of the mitigation measures that seek to prevent/reduce exposure to these potentially disruptive activities, the residual impact is likely to be low.

5.4.3 Fauna Mortality

5.4.3.1 Potential Impacts

The risk of mortality to terrestrial fauna, with respect to clearing of vegetation, is discussed in Section 5.2.6 and the risk of mortality to aquatic fauna is discussed in Section 5.3. In addition to the information provided, activities other than land clearing, for example general vehicle movement and construction (i.e. civil works) also have the potential to lead to fauna mortality, including livestock if an interaction between machinery and fauna occurs. Animals that are unable to disperse away from areas under active clearing or construction are particularly susceptible to injury or death. This includes amphibians, reptiles, small ground-dwelling mammals and nocturnal species that are inactive during daylight hours. Furthermore, livestock and wildlife that are highly mobile are at risk of being trapped or injured in open pits or trenches within the construction zone. In addition to those measures already mentioned in previous sections, the incidence of direct mortality can be reduced by implementing the mitigation measures outlined below.

5.4.3.2 Management and Mitigation Measures

Mitigation measures to reduce fauna mortality should include:

- Temporary fencing should be erected around construction zones to exclude mobile animals from civil works areas within the construction zone.
- If any pits/trenches are to remain open after daily site works have been completed, they will be fenced, covered by an impenetrable barrier, or if possible, fauna ramps should be put in place to provide a potential means of escape for trapped fauna.
- Work areas will be checked for fauna that may have become trapped before work commences each day
- Employees must be made aware of environmental responsibilities during inductions
- All vehicles and plant will adhere to site rules relating to speed limits. Speed limits should be developed so as to minimise the potential for road kill
- Reduce the number of construction vehicles mobilising to and from site daily – retain vehicles within the construction zone and transfer personnel by means of bus to and from the work front daily to reduce the exposure for animal strike in areas away from the construction footprint.

5.4.3.3 Summary

Civil works and increased vehicle movements have the potential to result in fauna mortality. Management actions seeking to avoid or reduce impacts will be implemented. In consideration of the extensive areas of existing disturbance within the construction footprint, the relatively localised nature of impacts associated with civil works, and the management of these impacts through an integrated suite of management actions, avoidable impacts to fauna are considered to be low. Similarly, with the implementation of site rules relating to vehicle movements (including speed limits), negative fauna encounters on roads may be minimised. Standardised monitoring and auditing of the application and

performance of management and mitigation strategies will be undertaken, with corrective actions implemented where required.

5.4.4 Change to Fire Regime and Risk of Fire

5.4.4.1 Potential Impacts

The construction footprint for the Project traverses land mapped as being low to medium bushfire risk based on the Queensland Fire and Rescue Services Bushfire Risk Analysis mapping for the Isaac Regional Council (DES, 2008). Increased human activity may alter the fire regime of the local landscape. In particular, construction activities that involve tasks such as welding can greatly increase the risk of bushfire incidents. Bushfires can result in significant mortality of native fauna and flora, and for cattle. Depending on fire intensity, such burns may alter the structural integrity and natural regeneration capacity of affected vegetation, for example, fire in grasslands or grazing pasture during dry seasons can be catastrophic for landowners in periods of drought. Considering the potential impacts of uncontrolled or accidental fires it is therefore essential that effective measures are taken to prevent this occurrence.

5.4.4.2 Management and Mitigation Measures

A Project Fire Management Plan (refer Volume 3 Section 14 Environmental Management Plan) will be implemented to address and minimise fire hazards. As well as documenting protocols and actions for preventing accidentally-lit fires, this plan should outline how fuel loads will be monitored and maintained across the Study Area and include training procedures to instruct staff how to use fire-fighting equipment. Ecological considerations will be incorporated into the development of this plan and response procedures developed.

- Clearing of the construction footprint immediately adjacent to the work front will reduce fire risk associated with hot work activities such as welding. Hot work activities will be undertaken in open, cleared areas, in areas of lower fire risk and with adequate fire prevention controls in place.
- Nominate designated smoking areas and actively monitor and enforce no smoking outside of these areas
- Workfronts will be provided with adequate fire fighting equipment (water cart) and training
- Staff awareness during inductions regarding fire safety risks

5.4.4.3 Summary

Implementation of a Project Fire Management Plan may reduce the potential for destructive high intensity fires to disturb habitats within the construction footprint and adjacent surrounding landscape.

5.5 Introduction of Pest and Feral Species

5.5.1 Overview

Increased access to areas during construction activities and associated construction practices such as vegetation clearing and soil disturbance can facilitate the introduction and spread of pest and feral species. Pest and feral species can have adverse impacts on the flora and fauna diversity of a region and disrupt ecosystems by outcompeting and replacing native species, thereby altering species diversity and potentially disrupting ecosystem function. A total of 11 introduced flora taxa were

recorded from the Study Area, three of which are declared as WONs and are declared weeds under the LP Act. Six introduced fauna species comprising five mammals and one amphibian declared under the LP Act were recorded during field studies.

5.5.2 Habitat Degradation and Reduction in Resource Availability

5.5.2.1 Potential Impacts

Increased movement of people, vehicles, machinery, vegetation waste and soil may facilitate the spread of weeds at the Study Area. New weed species can be introduced through activities associated with construction, such as the use of contaminated materials (i.e. for fill required for construction) or machinery. Likewise, vegetation clearing through areas of continuous habitats (i.e. at watercourses) and along linear corridors can create the potential for fauna pests and feral predators to penetrate further into bushland areas.

While three introduced plants declared under the LP Act were recorded during field surveys, they were not found to be prevalent across much of the Study Area. Watercourses and associated riparian vegetation in particular are sensitive receptors for weeds and small infestations can be spread over long distances if seeds enter the waterway system. An increase in the prevalence of weeds within the construction footprint and potentially beyond to the surrounding landscape may in turn reduce the quality of habitats for some fauna species.

Human settlement at temporary construction camps (with associated waste production) may provide additional resources for feral animals, for example, pigs and dogs. These feral pest fauna species, confirmed as present within the Study Area (among others), may increase in abundance if easier access to foraging resources is provided. An increase in the prevalence of these animals may adversely impact native fauna as it may lead to:

- Increased competition for resources
- Increased predation (of native species by introduced animals
- Habitat degradation (i.e. physical pig damage of riparian areas)

5.5.2.2 Management and Mitigation Measures

Pest and feral species spread and the potential for introduction will require management during all activities at the site. An integrated suite of actions will be developed to manage pest species, including:

- A Project Waste and Hazardous Materials Management Plan will be implemented, and include waste management and disposal protocols and procedures. This plan should incorporate protocols relating to the:
  - Disposal of vegetation waste (in a manner that minimises potential for spread of weeds)
  - Disposal of food scraps and the like (to minimise potential for pest animals to access food wastes)
- Management of pest animals in, and adjacent, to cleared areas in accordance with a Project Fauna Pest Speices Plan. This plan should include details relating to the monitoring and management of pest animals. Waste material to be appropriately managed and stored to discourage pests.

- Management of weeds in, and adjacent to, cleared areas in accordance with a Project Weed Management Plan. This plan should include details relating to the monitoring, management and, where necessary, eradication of weeds, disposal of green waste, and vehicle/plant weed wash down protocols.
- A weed audit targeting high risk locations should be conducted at a suitable time of the year when growing conditions and identification of weed species are optimal (i.e. late wet season). High risk locations may include areas such as riparian corridors and areas of black soil. Following the audit, appropriate scale weed mapping can be undertaken to identify weed hotspots and for the preparation of the Project Weed Management Plan.
- All construction machinery and materials brought onto site will be inspected and certified as free of weeds and weed seeds. Records are to be kept of compliance with this requirement.
- Signage should be in place in areas along the construction footprint where parthenium occurs advising staff when they are entering or leaving infestation 'hotspots'.
- Soil stripped and stockpiled from areas containing known weed infestations, particularly of declared weeds, are to be stored separately and are not to be moved to areas free of weeds.
- Staff involved with the construction activities must be educated on weed management procedures and protocols and restrictions placed on bringing domestic animals to the Study Area.

5.5.2.3 Summary

Rigorous implementation of the proposed mitigation strategies, largely via the development and execution of the abovementioned plans, should assist in minimising the potential for pest plants and animals to increase in abundance within and adjacent to the construction footprint. Regular, standardised monitoring will be a core component of the successful implementation of these plans, with corrective actions (including eradication) to be undertaken at the earliest opportunity after monitoring reveals a new pest plant or animal outbreak.

6. Potential Impacts and Mitigation Measures — Operation Phase

6.1 Introduction

The operation phase for Project includes:

- Transport of up to 60 Mtpa of product
- 24 hour, 7 day week operations and maintenance of trains and tracks
- Rail corridor (nominally 95 m wide) (fenced and inclusive of maintenance/service road, passing loops and bad order sidings)

Maintenance yard For the purposes of this section, these areas comprise the Project footprint for the operation phase of the Project (Rail). The extent of the Project footprint for the operation phase is wholly contained within the construction footprint for the rail corridor presented in Figure 5-1. A conceptual diagram of potential operational phase impacts is provided in Figure 6-1.

No clearing of vegetation (outside of the construction phase) is expected to occur within the operation phase of the Project (Rail) other than that required for maintenance of infrastructure and access tracks. The proposed operation footprint will be wholly contained within the existing disturbance footprint created during the construction phase. As such, the assessment below considers the on-going potential impacts to terrestrial and aquatic flora and fauna within the proposed operation footprint over the life of the Project. The mitigation and management strategies described below seek to preserve and, where possible, enhance the ecological values of those vegetation communities and fauna habitats in areas not subject to direct impacts associated with the operation of the Project.

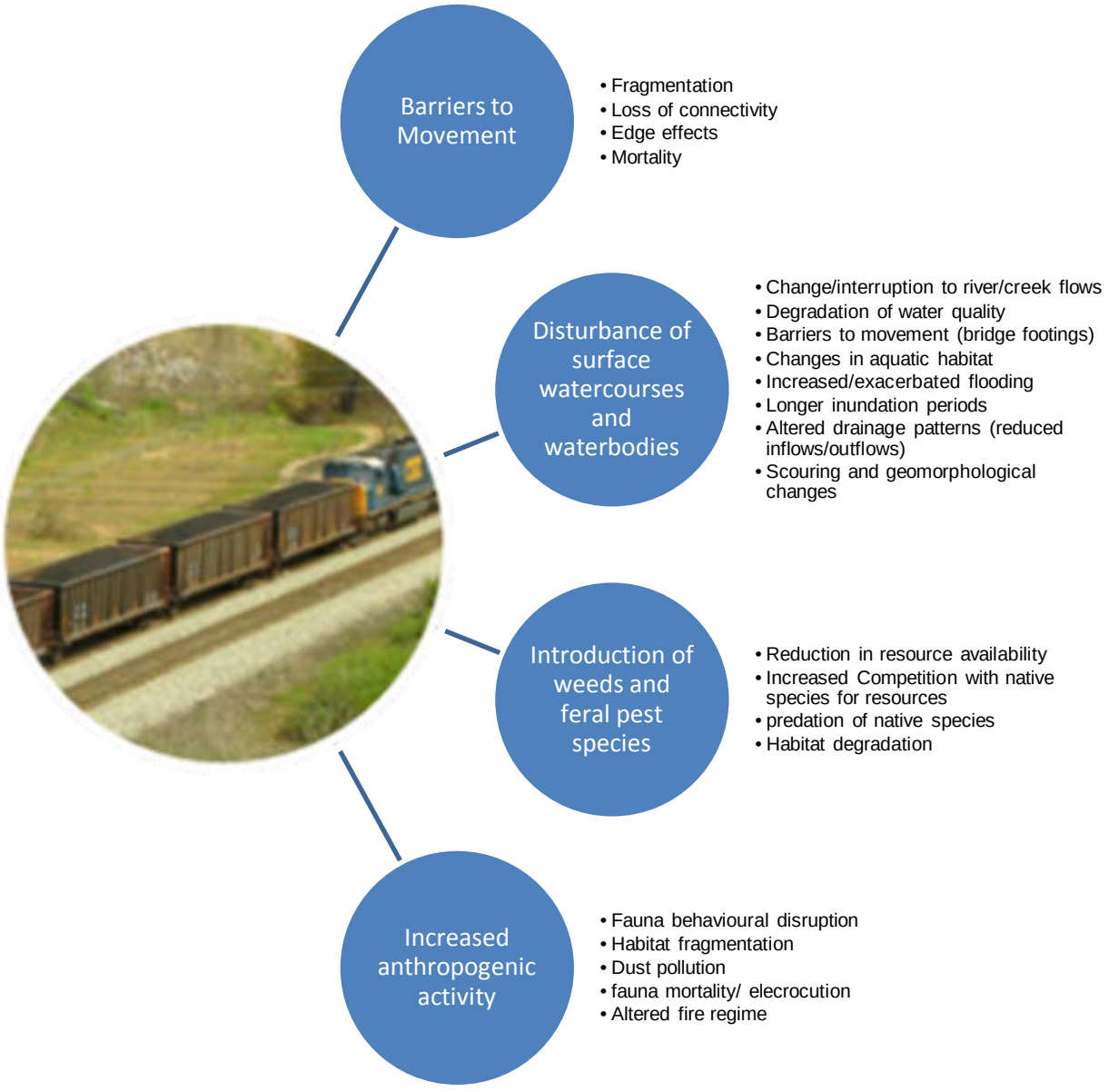


Figure 6-1 Conceptual Diagram of Potential Operation Phase Impacts

6.2 Barriers to Movement

6.2.1 Overview

The Project (Rail) will create a permanent linear barrier across the landscape for fauna movement. Although the land surrounding the Project (Rail) has been subject to historical land clearing, important wildlife corridors have been retained throughout the Study Area. Fauna mortality as a result of vehicle strikes and other operational activities is also likely to have an adverse impact on native fauna values within the Project (Rail) footprint.

6.2.2 Habitat Fragmentation

6.2.2.1 Potential Impacts

Much of the landscape surrounding the proposed rail corridor has experienced broadscale vegetation clearing, and as a result remnant patches of vegetation are fragmented. As previously stated, construction is more likely to reduce the size and connectivity of existing isolated patches, rather than create new patches. With respect to the operation of the rail corridor, the Project is likely to create a permanent linear barrier for 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 and are likely to be particularly important for less mobile fauna to move within and between habitats. This is particularly relevant to small, ground-dwelling fauna such as amphibians, reptiles and small ground-dwelling and arboreal mammals.

6.2.2.2 Management and Mitigation

Management and mitigation measures to reduce the impact of habitat fragmentation to local fauna populations during the operation phase of the Project include:

- Minimise disturbance to wildlife corridors, particularly within riparian vegetation and at watercourses. Rehabilitate and reduce operational areas in the vicinity of watercourse crossings and where possible reinstate riparian habitat below infrastructure.
- Install fauna underpasses/culverts within suitable habitats and bioregional corridor areas to promote fauna movement. Fauna underpasses will require revegetation, fencing, grids and gaps to allow light in to promote fauna use.
- Install fencing along the rail corridor. Consideration should be given to reducing the chance of fauna mortality by avoiding the use of barbed wire on the top strand of wire fences.

6.2.2.3 Summary

Rail operations may reduce the ability for fauna to disperse across the landscape, particularly where the Project (Rail) intersects remnant vegetation that provides corridors for fauna movement. The mitigation measures outlined above aim to retain and rehabilitate known wildlife corridors and reduce the impact of habitat fragmentation during the operation phase of the Project.

6.2.3 Fauna Mortality

With respect to the operation phase of the Project, the risk of fauna mortality relates predominantly to train and maintenance vehicle strikes. The risk to fauna posed by vehicular traffic is significantly less than the risk posed throughout the construction phase of the Project. Vehicular traffic will be lower than that during the construction phase and vehicles will adhere to strict speed limits.

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.

6.2.3.1 Management and Mitigation Measures

Mitigation measures to reduce fauna mortality during operation will include:

- Rail infrastructure will be appropriately fenced to restrict livestock movement within the rail corridor.
- Fauna underpasses within important habitat areas will be incorporated into the design of the rail corridor. Appropriate fencing and revegetation is required to encourage use by fauna species.
- Incidents of fauna strike and mortality are to be monitored during operation.

6.2.3.2 Summary

Vehicular traffic, from both trains and maintenance vehicles, has the potential to result in fauna mortality. Management actions seeking to avoid or reduce impacts will be implemented. In consideration of the relatively low likelihood of occurrence, localised nature of impacts and the management of these impacts through an integrated suite of management actions, impacts to fauna are considered to be low. Similarly, with the implementation of site rules relating to vehicle movements (including speed limits), negative fauna encounters of roads will be minimised. Standardised monitoring and auditing of the application and performance of management and mitigation strategies will be undertaken, with corrective actions implemented where required.

6.3 Disturbance of Surface Watercourses and Waterbodies

6.3.1 Overview

The operation phase of the Project (Rail) has the potential for on-going impacts to surface watercourses and waterbodies located within and downstream of the footprint of the Project. The alteration and/or loss of potential habitat for terrestrial and aquatic species, including those associated with riparian areas and standing water bodies, is discussed in Section 5.2.3 (terrestrial fauna habitat loss), Section 5.2.4 (terrestrial fauna habitat degradation) and Section 5.3.2 (aquatic habitat loss). Potential impacts specific to the operation phase of the Project are discussed in Section 6.3.2 below.

6.3.2 Change in Aquatic Habitat Availability and/or Suitability for Terrestrial and Aquatic Species

6.3.2.1 Potential Impacts

Potential indirect impacts to terrestrial and aquatic flora and fauna species may result as a consequence of minor localised run-off and sedimentation of watercourses and waterbodies (e.g. gilgais, dams) throughout the operational life of the Project. Localised run-off and sedimentation may reduce water quality and the introduce contaminants or pollutants into local water supplies.

Permanent water sources, such as farm dams adjacent to the Project footprint and less ephemeral watercourses, such as the Belyando River are considered more sensitive to indirect impacts from sedimentation and run-off.

Run off and sedimentation is localised and unlikely to result in adverse long-term degradation of downstream and off stream aquatic habitats.

6.3.2.2 Management and Mitigation Measures

Management and mitigation measures to reduce changes in aquatic habitat availability and/or suitability for terrestrial and aquatic species during operation activities include:

- Ensure all permanent erosion and sediment control devices are functional prior to commencement of railway operation and maintain and repair all devices throughout the life of the Project.
- Current best practice for erosion and sediment control measures will be taken in accordance with the 2008 International Erosion Control Association's Best Practice Erosion and Sediment Control Guidelines (2008) to minimise the potential for sedimentation of receiving waters. This may include, but is not limited to, the establishment of vegetated drains and sediment catch dams to buffer sensitive flora and fauna habitats; and establishment of sediment traps, silt fencing and biofilters at strategic locations to protect waterbodies.
- Trains should remain clean and be maintained to minimise the introduction of contaminants such as oil and fuel.
- A Waste and Hazardous Materials Management Plan will be developed and will include fuel and chemical storage protocols and spill responses (refer Volume 3 Section 14 Environmental Management Plan).
- Rehabilitate and maintain aquatic habitats and riparian areas in accordance with rehabilitation plans for a period of one year post construction.
- Weed and pest management within operation footprint in accordance with Environmental Management Plan.
- For unavoidable impacts (i.e. habitat loss) that cannot be managed, offsets will need to be provided in accordance with Commonwealth and State policies

6.3.2.3 Summary

Potential impacts on aquatic habitat during operations as a result of runoff and sedimentation are unlikely to lead to long-term degradation of downstream areas. Implementation of mitigation strategies during operation will further reduce the potential for impact to aquatic habitat availability or suitability for terrestrial and aquatic species. Regular, standardised monitoring will be a core component of the successful implementation of these actions, with corrective actions to be undertaken at the earliest opportunity if monitoring reveals a detrimental change in water quality.

6.3.3 Changes to Floodplain Hydrology

6.3.3.1 Potential Impacts

As with the construction phase of the Project, the Rail and Infrastructure Corridor during operation will cross 12 major watercourses and approximately 76 minor watercourses (refer Volume 4 Appendix AD Rail Hydrology Report). As such the operation footprint is typically located in a low gradient catchment with extensive floodplains. Extensive flooding has been identified in at least three of the major watercourses (Belyando River, Mistake Creek and Diamond Creek) with Belyando River in particular extending approximately 15 km wide at the proposed point of crossing for the Rail and Infrastructure Corridor during a 2008 flood event (Golder Associates, 2011).

The permanent fixture of the rail line will cross floodplains and create a potential barrier to the previous flow of water (refer Volume 4 Appendix AB Rail Hydrology Report).

The alteration of floodplain hydrology may impact downstream locations and consequently may impact upon the ecology of aquatic species. Changes to flood plain hydrology have the potential to impact on the movement of aquatic species between viable water bodies. Movement of aquatic fauna within and between aquatic habitats is a critical life cycle component of many species and is particularly important for dispersal and breeding (Marsden and Power, 2007; Tucker, 1999). If dispersal migrations of species are restricted this may cause a reduction in gene flow leading to genetically isolated populations, cause a decline in species abundance, or may physically isolate populations of aquatic fauna leading to localised extinction (Tucker, 1999).

Pooling or ponding of water upstream of water crossings as a result of impeded or restricted flow has the potential to adversely impact aquatic and terrestrial habitat.

Aquatic habitats may also be increasingly degraded through the alteration of floodplain hydrology. For example, the channel morphology may change downstream due to increased sediment load following increased erosion as a result of the construction and operation activities. In addition the transport of habitat features such as woody debris may be limited due to sedimentation and drainage structures placed at watercourse crossing points (Wheeler *et al*., 2005).

6.3.3.2 Management and Mitigation Measures

Mitigation measures proposed to reduce the changes to floodplain hydrology during operation include:

- Minimising the impact to estuarine and lacustrine/palustrine hydrology by avoiding fragmenting these habitats during the design phase
- Design and layout of watercourse crossings and use of culverts to bridge aquatic habitats will consider the requirement for fish movement including under flow conditions. This will be done in accordance with DAFF and DTMR guidelines for the design of stream crossings for fish passage (Cotterell, 1998).
- Culverts will be provided at key areas within floodplain habitats (i.e. lacustrine/palustrine habitats)
- Design will consider suitable watercourse crossings structures, for example bridge spans, culverts and openings such that sufficient flows are maintained across the Project (Rail)
- Iterative hydrological modelling will be undertaken through the design phase to better inform flood hydrology and refine the likelihood of potential adverse impacts

6.3.3.3 Summary

Changes to flood plain hydrology have the potential to impact on the quality of aquatic habitats and the movement of species between viable water bodies. The implementation of the management and mitigation measures provided above should aid in reducing the ecological consequences of this impact so that residual impacts to floodplain hydrology are minimal. Regular, standardised monitoring will be a core component of the successful implementation of these actions, with corrective actions to be undertaken at the earliest opportunity should monitoring reveal a detrimental change in floodplain hydrology.

6.4 Increased Anthropogenic Activity Leading to Disturbance

6.4.1 Overview

Cattle grazing is the predominant land use in the Study Area and in the surrounding landscape. The Project will result in a change to the land use of the Study Area and immediate surrounds. Most notably, habitat fragmentation and faunal disturbance are likely to increase due to the operational characteristics of the Project and to a lesser extent, increased human activity within the Study Area.

6.4.2 Fauna Behavioural Disruption

6.4.2.1 Potential Impacts

The higher intensity of activity at and near disturbed areas associated with rail operations may disrupt local fauna behaviour, largely as a result of increased exposure to light maintenance facility), noise, dust, vehicles and people. Behavioural disruption may be direct (i.e. increased susceptibility to predation due to increased noise reducing prey vigilance, or increased light increasing prey detectability) or indirect (i.e. habitat degradation reducing local resource availability therefore increasing foraging dispersal distances for fauna).

It is not proposed that the railway infrastructure will be lit, excepting for the balloon loop (within the mining lease) and maintenance facility. 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 movement of people, vehicles, machinery, vegetation waste and soil may facilitate the spread of weeds within the operational area. Eleven introduced plants were detected within the Study Area, of which, three are ‘declared plants’ under the LP Act (parthenium, harrisia cactus and prickly pear). Increasing the prevalence of weeds within the operation footprint and the potential for weed spread beyond to the surrounding landscape may reduce the quality of habitats for some fauna species locally.

6.4.2.2 Management and Mitigation

Management and mitigation measures to reduce disruption to fauna behaviour during operation activities include:

- Frequent maintenance of machinery and plant must be regularly undertaken to minimise unnecessary noise
- Management of weeds in and adjacent to cleared areas in accordance with a Project Weed Management Plan. This plan will include details relating to the monitoring, management and where necessary eradication of weeds, disposal of green waste, and vehicle/plant weed wash down protocols.
- Lighting is not proposed along the railway. Lighting at the maintenance facility will be shielded to avoid lighting non-operational areas unnecessarily
- Operation staff and maintenance personnel will remain within the operation footprint and make use of designated access and tracks at all times

- Noise and dust monitoring will be undertaken in response to complaints and/or train operations requirements (refer Volume 3 Section 14 Environmental Management Plan)

6.4.2.3 Summary

Areas adjacent to rail infrastructure corridor will be exposed to disturbance throughout the operation phase of the Project. Implementation of the mitigation measures referenced to and listed above will seek to prevent and reduce exposure to these potentially disruptive activities and processes.

It is considered that management and mitigation opposed will reduce and limit the potential adverse impacts of Project (Rail) operations on fauna behaviour.

6.4.3 Habitat Degradation

6.4.3.1 Potential Impacts

Following the extraction, processing and stockpiling, coal is transported to port via the rail infrastructure. Coal dust emissions from coal trains present potential issues in the region with respect to economic loss, public nuisance and environmental impacts. Dust deposition on leaves of plants can reduce the photosynthetic capacity of the plants and impede plant growth. Such an impact 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.

An environmental evaluation, commissioned by QR, reviewed the available literature for the impacts of coal dust on flora and fauna, crops and livestock. Connel Hatch (2008) concluded that a dust deposition rate of 500 mg/m²/day can be used as a suitable threshold for negative impacts on crops, livestock and vegetation. With respect to deposition distance adjacent the rail line, records indicate that the highest coal deposition rates, of about 90 mg/m²/day, are likely to occur within the rail corridor with rates dropping rapidly as distance from the tracks increases (i.e. 30 mg/m²/day at 10 metres from the tracks) (Connell Hatch 2008). These measured values are substantially lower than the values noted in literature as being likely to have an impact on crops and livestock. No recent literature has been found that measures such impacts on native vegetation and fauna; however it is likely that the same conclusions will be achieved.

In consideration of the views of the research outlined above, and with the implementation of the management and mitigation measures provided below, it is unlikely that coal dust deposition will have a major impact on the flora and fauna within and adjacent to the operation footprint and surrounding region.

6.4.3.2 Management and Mitigation

It is recommended that the following dust suppression techniques be implemented during the operation phase of the Project (refer to Volume 4 Appendix AF Rail Air Quality Assessment):

- Train operations are to be conducted in accordance with a Dust Management Plan

- An Erosion and Sediment Management Control Plan will be developed and should include measures to minimise coal dust run-off into aquatic habitats
- Trains are to be cleaned regularly and are not to be overloaded
- Use of veneers where appropriate to minimise the loss of coal particles
- Regular maintenance and repair of locomotives as it is locomotive emissions that contribute to the overall total suspended particles

6.4.3.3 Summary

Predicted dust deposition is considered to be within threshold limits at which adverse impacts on flora and fauna would be experienced. It is unlikely that dust deposition as a result of Project (Rail) operations will adversely impact native flora and fauna. Some localised impacts may occur.

6.4.4 Changes to Fire Regime

6.4.4.1 Potential Impacts

Increased human activity may alter the fire regime of the local landscape. For example, the Rail and Infrastructure 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. 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.

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.

6.4.4.2 Management and Mitigation Measures

Mitigation measures to reduce changes to fire regimes during operation phase should include:

- A Project Fire Management Plan will be implemented for all phases of the Project. As well as documenting protocols and actions for preventing accidentally-lit fires, this plan should outline how fuel loads will be monitored and maintained across the Study Area. Ecological considerations will be incorporated into the development of this plan and response procedures developed.
- Management of land will be undertaken in accordance with a Project Land Management (Flora and Fauna) Plan. This will complement the Project Fire Management Plan.
- Maintain adequate fire breaks within the rail line. A corridor of approximately 95 m is allowed to accommodate the rail line, and will a will accommodate a maintenance/service road and cleared area that will act as fire break.
- Liaison with Rural Fire Brigade and support services in developing the Fire Management Plan. Assign adequate resources to provision of fire fighting equipment

- Identify specific areas of risk and times of risk; for example, high fire risk days (refer Volume 3 Section 12 Hazard and Risk)

6.4.4.3 Summary

Implementation of controls developed as part of a Project Fire Management Plan will reduce the potential for destructive high intensity fires to disturb habitats within the Project (Rail) area during operations.

6.5 Introduction of Pests and Feral Species

6.5.1 Overview

Pest and feral species were recorded during field surveys and may disrupt ecosystems by outcompeting and replacing native species, thus altering ecosystem diversity and potentially disrupting ecosystem function. It has been suggested that one introduced species in particular; buffel grass (*Cenchrus ciliaris*) may disrupt existing fire regimes and create a positive fire-invasion feedback loop (Butler and Fairfax, 2003). 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 (Butler and Fairfax, 2003).

6.5.1.1 Potential Impacts

Increased movement of people, vehicles, machinery, vegetation waste and soil may facilitate the spread of weeds. While introduced plants were detected across the Study Area, weeds were not found to be prevalent. Increasing in the prevalence of weeds at the Study Area (and potentially beyond to the surrounding landscape) has the potential to reduce the quality of habitats for some fauna species.

Potential for pest species to use the rail infrastructure corridor as a linear pathway for movement also exists, leading to the introduction of pest species in previously pest-free habitats. An increase in the prevalence of these animals may adversely impact native fauna in that it may lead to:

- Increased competition for resources
- Increased predation (of native species by introduced animals
- Habitat degradation (i.e. pig damage of riparian areas)

6.5.1.2 Management and Mitigation Measures

An integrated suite of actions should be developed to manage pest species during the operation phase of the Project, including:

- Management of introduced animals in and adjacent to cleared areas in accordance with a Project Fauna Pest Species Plan. This plan should include details relating to the monitoring and management of pest animals.
- Management of weeds in and adjacent to cleared areas in accordance with a Project Weed Management Plan. This plan should include details relating to the monitoring, management and where necessary eradication of weeds, disposal of green waste, and vehicle/plant weed wash down protocols.

- Monitor corridor edge remnant vegetation for the presence of weeds and buffel grass. Undertake eradication and/or rehabilitation/restoration activities to prevent the spread of these species into remnant vegetation areas.

6.5.2 Summary

Rigorous implementation of the proposed mitigation strategies, largely via the development and execution of the abovementioned plans, should assist in minimising the potential for pest plants and animals to increase in abundance within at and near the Study Area. Regular, standardised monitoring will be a core component of the successful implementation of these plans, with corrective actions (including eradication) to be undertaken at the earliest opportunity after monitoring reveals a new pest plant or animal outbreak.

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7. Offsets

7.1 Introduction

Offsets will be required under Commonwealth and State legislation where unavoidable impacts to identified ecological values cannot be reasonably avoided or mitigated. Offsets for the Project are addressed in Volume 1 section 10 Draft Offsets Strategy.

7.2 Commonwealth

Under the EPBC Act, environmental offsets (direct or indirect) are considered a mechanism to compensate for the adverse impacts of developments on matters of NES protected by the EPBC Act. The Commonwealth Government's *EPBC Act Environmental Offsets Policy (Consultation Draft)* (DSEWPaC, 2011o) outlines the Australian Government's position on the use of environmental offsets under the EPBC Act. While offsets may not necessarily ameliorate 'onsite' impacts to matters of national environmental significance, they seek to provide a net environmental gain through targeted actions (on or offsite). Under the EPBC Act, environmental offsets can be used to maintain or enhance the health, diversity and productivity of the environment as it relates to matters protected by the Act. However, environmental offsets are not applicable to all approvals under the EPBC Act, and they should not be applied where the impacts of a development are considered to be minor in nature or could reasonably be mitigated.

Matters of national environmental significance recorded during field surveys for the Project (Rail) include:

- One threatened ecological community:
  - Brigalow (*Acacia harpophylla* dominant and co-dominant) – EPBC Act endangered
- One threatened species:
  - Squatter pigeon (southern) (Geophaps scripta scripta) – EPBC Act and NC Act vulnerable
- Two migratory / marine species:
  - Great egret (*Ardea alba*)
  - Rainbow bee-eater (*Merops ornatus*)

Direct impacts to the listed matters of NES include loss and alteration of habitat. A number of indirect impacts may also be associated with the Project. Proposed management actions (i.e. weed management, restoration activities etc.) will seek to minimise indirect impacts on these matters of national environmental significance.

Within the construction footprint, approximately 37.4 ha of the brigalow occurs. Where clearing is unaviodable offsetting under the EPBC Act will be required (refer Volume 1, Section 9 Draft Offset Strategy).

In addition, the potential habitat for the squatter pigeon and two EPBC Act listed migratory / marine species (all confirmed to be present within the Study Area) is not expected to be significantly impacted on by the Project (Rail). However, direct impacts (i.e. direct loss of known or potential habitat) to these species that cannot be reasonably mitigated will require offsetting under the EPBC Act. In consideration of the availability of potential habitat in the surrounding region, and the results of

field and desktop assessments, the residual impact (mitigated and managed) of vegetation clearing associated with construction phase of the Project (Rail) on conservation significant fauna is, in general, considered to be low. Overall, the construction footprint (rail corridor and infrastsructue and construction camp footrprints) and surrounding Study Area is not considered to support an 'important population' or 'habitat critical to the survival' of any EPBC Act-listed threatened fauna species (e.g. squatter pigeon (southern)). However, where habitat for EPBC Ac listed threatened fauna species will be lost, offsets may be required.

7.3 State

7.3.1 Overview

The Queensland Government Environmental Offsets Policy (QGEOP) (Queensland Government, 2008) provides a framework for the use of environmental offsets in Queensland, in order to counterbalance unavoidable, negative environmental impacts that result from an activity or a development. This policy is based on the premise that offsets are used consistently and transparently across the State, and are only considered after all environmental impacts have been avoided and minimised and all other government environmental standards have been met (Queensland Government, 2008).

In Queensland, four specific-issue offset policies have been developed to provide detailed direction for offsets that address specific environmental issues:

- Vegetation Management — '*Policy for Vegetation Management Offsets (Version 3)'* (DERM, 2011e)
- Queensland Government Policy for Biodiversity Offsets (QBOP) (Version 1) (DERM, 2011f)
- Fish Habitat Management Operational Policy (FHMOP 005): '*Mitigation and Compensation for Works or Activities Causing Marine Fish Habitat Loss*' (Dixon and Beumer, 2002)
- Koala Habitat — '*Offsets for Net Benefit to Koalas and Koala Habitat*' (EPA, 2006)

Marine plants will not be impacted by the Project, and as such these specific-issue offset policy does not apply to the Project.

7.3.2 Vegetation Management Act 1999

Vegetation clearing in Queensland is regulated through the *Vegetation Management Act 1999* which outlines the rules and regulations that guide what clearing can be done, and how it must be done in order to comply with the requirements of the law.

The current *Policy for Vegetation Management Offsets (Version 3*) (DERM, 2011e) was developed by the chief executive in accordance with the provisions set out in the VM Act. This policy sets the requirements for an offset as a condition of a development approval that the chief executive considers is necessary or desirable for achieving the purpose of the VM Act (DERM, 20011e).

Under this policy, offsets may be proposed by an applicant for particular development activities as a solution to meet specific performance requirements that require a development to maintain the current extent of a particular RE. However, offsets can only be considered once the applicant has

demonstrated that the impacts of the development on vegetation have first been avoided and mitigated.

Clearing of native vegetation in Queensland is regulated by a set of performance criteria outlined in Part S (Requirements for clearing for significant projects) of the *Regional Vegetation Management Code for Brigalow Belt and New England Bioregions* (DERM, 2009b) and the *Regional Vegetation Management Code for Western Bioregions – Version 2* (DERM, 2009c). The purpose of the performance requirements outlined in these clearing codes is to "*regulate the clearing of vegetation in a way that conserves remnant vegetation that are regional ecosystems, does not cause land degradation, prevents the loss of biodiversity and maintains ecological processes."*

The Regional Vegetation Management Codes offer an acceptable solution for each of the performance criteria listed within the code. Where these acceptable solutions cannot be met, offsetting can be offered as an alternative solution for meeting the performance requirements.

Under the applicable clearing codes for the Brigalow Belt and Desert Uplands bioregions, offsetting will be required to meet a number of performance requirements, including those addressing:

- Clearing in watercourses
- The disruption of ecological connectivity
- Clearing in threshold, of concern and endangered REs
- This Project will require the removal of approximately 37.4 ha of endangered REs, 200.4 ha of of concern REs, and 20.4 ha of least concern REs (Threshold or TEC)

Calculation of the offset will be dependent on a number of factors (the use of offsets to meet the watercourse and connectivity performance requirements in particular is complex), including the quality of the vegetation being cleared and of the vegetation being offered as the offset (e.g. ecological equivalence). Areas offered as offsets must be ecologically equivalent to the area being cleared, and the total offset area required will be proportionate to the ecological value of the offset vegetation. The Ecological Equivalence Methodology (EEM) Guideline (DERM, 2011j) was developed by DERM (now DEHP) to assist in determining ecological equivalence between the areas proposed for clearing and potential offset areas, under the *Policy for Vegetation Management Offsets* (DERM, 2011fe), and the Queensland Biodiversity Offset Policy (DERM, 2011b).

As DEHP's current Policy for Vegetation Management Offsets does not specify ratios, it is impossible to state the total offset area that may be required. However, habitat quality should be used as a guide rather than area when determining offset areas required to meet ecological equivalence.

7.3.3 High Value Regrowth

Clearing of regulated high value regrowth is subject to a self-assessable code in accordance with the VM Act. However, under Schedule 24 Part 2 of the VM Act, clearing of regulated regrowth vegetation that occurs on freehold land (item 2(n)) or leasehold land (item 4 (1) (i)) for a significant community project is not required to address the self-assessable regrowth clearing code, unless the regrowth vegetation is located in an area that is mapped as category A (an area subject to a revegetation or rehabilitation order) on a Property Map of Assessable Vegetation (PMAV). Category A areas are not mapped within the construction footprint. Should the Project (Rail) be deemed by DNRM as satisfactory to meet the definition of a significant community project under the VM Act (as has applied to other rail projects within central Queensland), then this exemption will apply to the Project.

7.3.4 Nature Conservation Act 1992

Clearing of protected plants listed as being conservation significant (that is, near threatened, vulnerable, endangered, extinct in the wild etc.) under the NC Act requires a permit. In addition, clearing of protected plants listed as least concern (that is, of no or minimal conservation significance) under the NC Act will require a permit unless the clearing occurs on land owned by the proponent (the entity doing the clearing). In order to obtain these permits, it is necessary to demonstrate that impacts have been adequately offset.

To facilitate this requirement, offsets may be driven by the QBOP, particularly when determining appropriate offset ratios for improving conservation outcomes. There is scope for NC Act offset requirements for flora being satisfied under the VM Act offset policy. Discussions with DEHP will be required to confirm an appropriate strategy for satisfying multiple offset requirements.

7.3.5 Nature Conservation (Wildlife Management) Regulation 2006

Under Section 332, of the *Nature Conservation (Wildlife) Regulation 2006*, any activity that will 'tamper' (i.e. remove, damage, impair, degrade, etc) with the confirmed breeding place of a native animal (that is endangered, vulnerable, near threatened and least concern wildlife) requires authorisation under a Damage Mitigation Permit (DMP). For larger impacts, and particularly where potential breeding places of endangered, vulnerable, near threatened or least concern species, or Essential Habitat for these species, is involved, a Species Management Program (SMP) will be required rather than a DMP.

Confirmed breeding places of native fauna necessary for a DMP will be identified through detailed pre-clearing surveys. It is likely that SMPs for tampering with animal breeding places will be required for vegetation clearing and other activities associated with the construction phase of the Project. The SMP will identify and detail potential impacts of the proposed works on fauna and breeding places, management actions to address impacts, roles and responsibilities and monitoring and reporting requirements. The SMPs will be developed prior to construction commencing on-site.

7.4 Summary

The delivery of offsets under State legislation may, in some instances, be able to be combined with offsets under Commonwealth legislation (i.e. for threatened species protected under both jurisdictions – squatter pigeon). An offset strategy will need to be prepared which clearly identifies the Project impacts and associated offset requirements, and proposes various offset options that meet relevant legislative requirements.

The strategy required to meet offset obligations should include:

- Quantifying offset requirements (including threatened species) under state and federal policies
- Identifying offset opportunities onsite and on land owned by Adani Mining Pty Ltd
- Identifying neighbouring properties that have the potential to meet offset requirements

Making financial contributions for residual requirements.

8. Conclusion

This report presents the findings of ecological assessments conducted for the Project (Rail), assesses the potential impacts to flora and fauna and identifies possible mitigation measures to manage potential impacts. The assessment considers the Project (Rail) rail corridor (approximately 95 m) and infrastructure and construction camps,as well as a surrounding 2 km wide Study Area and is based on a combination of desktop studies and two field survey events. A summary of the key findings are presented below.

The Project (Rail) passes through a predominantly cleared and fragmented landscape, of the approxaimtely 37,000 ha Study Area, 28,242 ha is non-remnant vegetation (76 per cent) and 8,367 ha is remnant. Within the highly fragmented remnant vegetation, a range of vegetation communities and habitat types are present.

One TEC is mapped as being present within the rail corridor and infrastructure and construction camp footprints footprint based on the presence of its constituent REs. The Brigalow TEC comprised a total area of approximately 37.4 ha of the construction footrpint. The occurrence of the TECs, including those not mapped as occurring in the construction footprint but in the Study Area and the wider landscape is mapped.

No threatened flora species listed under the EPBC Act or the NC Act were recorded within the Study Area from field surveys. One EPBC Act listed threatened flora species and one NC Act listed flora species are considered likely to occur within the Study Area.

Eight terrestrial fauna habitat types are defined across the Study Area, these contain broadly similar habitat values in terms of structure, but provide varying value for wildlife based on their specific forage and shelter resources. Open cleared land was the most common and widespread fauna habitat type within the Study Area, typically providing a low diversity of suitable resources for fauna compared to the higher ecological value of remnant vegetation, which typically occurred in association with watercourses and creek lines.

One threatened bird listed under the EPBC Act was recorded –*Geophaps scripta scripta* (squatter pigeon (southern)). The squatter pigeon is likely to be locally common within the Study Area, and the broader region, where suitable habitat is present. A further four EPBC Act listed threatened fauna species (one reptile, two mammals and one bird) are considered likely to occur at the Study Area, potential habitat for these species within the Study Area, including within the construction footprint was identified and mapped.

Two common EPBC Act listed migratory bird species were recorded at the Study Area. In addition, two EPBC Act listed migratory bird species not recorded during field studies are considered likely to occur. However, habitats at the Study Area, including those within the construction footprint are not considered likely to support important assemblages of migratory species.

Aquatic habitats throughout the Study Area are categorised into five broad waterbody types that vary in size and geomorphology. No conservation significant aquatic species were recorded within these habitats, nor are any considered likely to occur.

In relation to EPBC Act listed fauna species, the Project (Rail) is not considered to support an important population or habitat critical to the survival, therefore, it is not considered to constitute a 'significant impact' to any of these species.

Potential impacts to the identified terrestrial and aquatic ecological values throughout the construction and operation phases of the Project (Rail) are summarised into four broad categories;

- Clearing of vegetation
- Disturbances of watercourses and changes to surface water flows
- Increased anthropogenic activity leading to disturbance
- Introduction of weeds and feral pest species

Clearing for the construction footprint (excluding potential quarry and borrow areas) will result in the loss of approximately 367 ha of remnant vegetation. Of this, 37.4 ha of EPBC Act listed Brigalow TEC is endangered remnant vegetation, while 200.4 ha of of concern REs and 128.5 ha of least concern REs are proposed to be cleared..

To address these impacts mitigation measures are outlined, including avoidance of ecologically sensitive areas, the preparation of Management Plans, the design of fauna-friendly culverts and fish passageways to facilitate fauna and fish passage, on-going monitoring and offsetting to address loss of fauna habitat and vegetation where impacts cannot be adequately avoided or mitigated.

Offsets under a combination of Commonwealth and State legislation will be required. An offset strategy will be provided to identify and manage residual impacts and propose various offset options that meet the relevant legislative requirements

In consideration of the extensive areas of existing disturbance within the proposed rail corridor, the relatively localised nature of impacts associated with civil works, the management of these impacts through an integrated suite of actions, and with the provision of offsets, the overall impacts of the Project (Rail) can be significantly reduced.

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Appendix A

Terms of Reference Cross-reference

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Terms of Reference Requirement/Section Number	Cross-reference
Nature Conservation	
Detail the existing nature conservation that may be affected.	Section 2
Flora and Fauna Surveys should address species structure, assemblage, diversity and abundance.	Section 1.4
Describe methodologies and standards used for flora and fauna surveys and compare them to best practice in the appendices in the EIS.	Section 1.4
Identify key flora and fauna indicators of ongoing monitoring.	Section 2.4 and 2.5
3.3.1 Sensitive Environmental Areas On a map of suitable scale, identify areas in proximity to the project that are environmentally sensitive. This should include areas classified as having national, state, regional or local biodiversity significance, or flagged as important for their integrated biodiversity values.	Figure 2-4, Figure 2-6 and Figure 3-13
Refer also to both Queensland and Commonwealth Government legislation and policies on threatened species and ecological communities.	Section 3
Areas regarded as sensitive with respect to flora and fauna have one or more of the following features that should be identified and mapped:	Sections 3.2 and 1.1
important habitats of species listed as extinct in the wild, endangered, vulnerable or near threatened under the *Nature Conservation Act 1992* (Qld) or as extinct, extinct in the wild, critically endangered, endangered, vulnerable and conservation dependent under the EPBC Act.	Figure 3-1 to Figure 3-12
regional ecosystems listed as 'endangered' or 'of concern' under state legislation, and/or ecological communities listed under the EPBC Act	Sections 2.4 and 3.2
good representative examples of remnant regional ecosystems or regional ecosystems which are described as having 'medium' or 'low' representation in the protected area estate as defined in the Regional Ecosystem Description Database (REDD)	Section 2.4 Table 2-2 and Table 5-1
sites listed under international treaties such as Ramsar wetlands and World Heritage areas	Section 3.2
sites containing near threatened or bio-regionally significant species or essential, viable habitats for near-threatened or bio-regionally significant species	Section 3.2 and 1.1
sites in, or adjacent to, areas containing important resting, feeding or breeding sites for migratory species of conservation concern listed under the Convention of Migratory Species of Wild Animals, and/or bilateral agreements between Australia and Japan (JAMBA) and between Australia and China (CAMBA)	Section 3.2
sites adjacent to nesting beaches, feeding, resting or calving areas of species of special interest, such as marine turtles, dugong and cetaceans	N/A
sites containing common species that represent a distributional limit and are of scientific value or which contain feeding, breeding or resting areas for populations of echidna, koala, platypus and other species of special cultural significance	Section 2.5

Terms of Reference Requirement/Section Number	Cross-reference
Nature Conservation	
sites containing high biodiversity, for example areas identified in both the Desert Uplands and Brigalow Belt North Biodiversity Planning Assessments, that are of a suitable size or with connectivity to corridors/protected areas to ensure survival in the longer term; such land may contain: natural vegetation in good condition or other habitat in good condition (e.g. wetlands) degraded vegetation or other habitat that still supports high levels of biodiversity or acts as an important corridor for maintaining high levels of biodiversity in the area	Section 2.5
a site containing other special ecological values, for example, high habitat diversity and areas of high endemism	Section 2.5
ecosystems that provide important ecological functions such as:	
wetlands of national, state and regional significance	Section 1.1
coral reefs	N/A
riparian vegetation	Section 2.5
important buffer to a protected area	Section 1.1
important habitat corridor between areas	Section 2.5
sites that contain significant palaeontologic values, such as fossil sites	N/A
sites of geomorphological significance, such as lava tubes or karst	N/A
protected areas which have been proclaimed under the NC Act and *Marine Parks Act 1982* (Qld) or are under consideration for proclamation	Section 1.1
areas of major interest, or critical habitat declared under the NC Act, high nature conservation value areas or areas vulnerable to land degradation under the VM Act.	Section 2.4 and 2.4
areas of special sensitivity include: the marine environment and wetlands	Section 3
wildlife breeding or roosting areas	Section 2.5
any significant habitat or relevant bird flight paths for migratory species	Section 3.2
bat roosting and breeding caves including existing structures such as adits and shafts	Section 2.5
colonial breeding species	Section 2.5
habitat of threatened plants, animals and communities	Section 3.2, 3.2 and 1.1
protected areas which have been proclaimed under the NCA, including the Bygana West Nature Refuge.	Section 1.1
Discuss all the likely direct and indirect impacts of the project on species, communities and habitats of local, regional or national significance in sensitive environmental areas as identified above.	Section 5

Terms of Reference Requirement/Section Number	Cross-reference
Nature Conservation	
Cover terrestrial and aquatic environments and address any fragmentation impacts.	Section 5.2, 5.3, 6.2 and 6.3
Also, include human impacts and the control of any domestic animals introduced to the area.	Section 5.4, 5.5, 6.4 and 6.5
Demonstrate how the project would comply with the following hierarchy: avoiding impact on areas of remnant vegetation and other areas of conservation value including listed species and their habitat	Section 5.2
mitigating impacts through rehabilitation and restoration including, where relevant, a discussion of any relevant previous experience or trials of the proposed rehabilitation	Section 5.2
measures to be taken to replace or offset the loss of conservation values where avoiding and mitigating impacts cannot be achieved	Section 7 Volume 1 Section 11 Draft Offsets Strategy
Explain why the measures above would not apply in areas where loss would occur.	Section 5.2
Discuss the boundaries of the areas impacted by the project within or adjacent to an endangered ecological community, including details of footprint width.	Section 3.2
Where the project area would impact upon a threatened community, the discussion should include reasons for the preferred alignment and the viability of alternatives.	Section 3.2
Consider the high biodiversity values of Bygana West NR and, in accordance with mining best practice, first demonstrate ways to avoid impacting this area, second demonstrate mitigating measures and offsetting impacts relating to Bygana West Nature Refuge.	Section 1.1
Address any actions of the project or likely impacts that require an authority under the NC Act, and/or would be assessable development for the purposes of the VM Act.	Section 1.1
Outline proposed mitigation measures will be implemented in the overall EMP for the project.	Volume 3 Section 13 Environmental Management Plan
Where relevant, discuss environmental offset requirements in accordance with the *Queensland Government Environmental Offsets Policy* and take into account the applicable specific-issue offset policies as follows: Policy for Vegetation Management Offsets	Section 7.3
Mitigation and Compensation for Works or Activities Causing Marine Fish Habitat Loss	Section7.3

Terms of Reference Requirement/Section Number	Cross-reference
Nature Conservation	
Draft Policy for Biodiversity Offsets Proposals to offset unavoidable impacts to biodiversity values are to be made via use of the framework outlined in the draft Policy for Biodiversity Offsets, a specific issues offset policy in accordance with the Queensland Government Environmental Offsets Policy (QGEOP). The draft policy is due for finalisation in 2011. Any offset package should include offsets for the ecological values that will be lost as a result of the mine development and should be consistent with the principles of the Queensland Government Environmental Offset Policy 2008.	Section 7.3
Describe where, if any, departures from a no net loss of ecological values occurs	Section 7.3 Volume 1 Section 11 Draft Offsets Strategy
3.3.2 Terrestrial Flora Specifically assess any potential impacts on a Category A or B environmentally sensitive area and propose measures and impacts.	N/A
Describe and assess the potential impacts of any actions of the project or likely impacts that require an authority under the NC Act.	Section 1.3
Provide vegetation mapping for all relevant project sites.	Figure 2-3
Survey and describe terrestrial vegetation within the affected areas at an appropriate scale (max. 1:10,000), showing: Location and extent of vegetation types Location of vegetation types of conservation significance based on regional ecosystem types and occurrence of species listed as protected plants under the Nature Conservation (Wildlife) Regulation 2006 and subsequent amendments Current extent of protected vegetation types of conservation significance within the protected area estate Location of horticultural crops in the vicinity Location and abundance of any exotic weed species Any plant communities of cultural, commercial or recreational significance	Section 2.4 Table 5-2
Highlight sensitive or important vegetation types, containing: Review of published information assessing the significance of the vegetation to conservation, recreation, scientific, educational and historical interests A description of vegetation to indicate any areas of national, state, regional or local significance	Section 2.4

Terms of Reference Requirement/Section Number	Cross-reference
Nature Conservation	
Vegetation surveys should be undertaken at an appropriate number of sites, and satisfying the following: Relevant regional vegetation management codes Site date recorded in a form compatible with the Qld Herbarium CORVEG database Minimum site size of 10 x 50 m Complete list of species present at each site Species structure, assemblage, diversity and abundance Relative abundance of plant species present Plant species of conservation, cultural, commercial or recreational significance Survey data should include tree heights, canopy cover, species composition sufficient to determine the remnant status of the vegetation and identify the regional ecosystems Specimens of species of conservation significance Existing information may be used instead of new survey work, provided that the data is derived from previous surveys at the site consistent with the above methodology	Section 1.4
Discuss all foreseen direct and indirect impacts on vegetation and the potential level of environmental harm to the ecological values of the area	Section 5.2
Describe action plans for protecting rare or threatened species and vegetation identified as having high conservation value	Section 5.2
Weed management strategies are required for containing existing weed species and ensuring no new plants are introduced	Section 5.2
Measures to mitigate the impacts of the project on vegetation types identified as having high conservation values	Section 5.2
3.3.3 Terrestrial Fauna Describe the terrestrial and riparian fauna occurring in the areas affected by the proposal, and include: Species diversity Poorly known species and suspected of being near-threatened or threatened Habitat requirements and sensitivity to changes Existence of feral or introduced animals Existence (actual or likely) of any species / communities of conservation significance Habitat requirements and sensitivity to change An estimate of commonness or rarity Use of the area by migratory and nomadic fauna (breeding or significant congregation) Indication of how well any affected communities are represented and protected elsewhere in the bio-region Relevant site data	Section 2.5, 3.2 and Appendix F

Terms of Reference Requirement/Section Number	Cross-reference
Nature Conservation	
The assessment of potential impact should discuss all foreseen direct and indirect effects, including: Direct and indirect impacts due to loss of range/habitat, food supply, nest sites, breeding/recruiting potential or movement corridors or as a result of hydrological change Impacts on species conservation significance Cumulative effects of direct and indirect impacts Identification of the conservation importance of identified populations at the regional, state and national levels Whether the proposal will bisect habitat areas Threatening processes leading to progressive loss	Section 5.2, 5.3, 5.4, 6.2 and 6.4
Strategies for protecting rare of threatened species should be described	Section 5.2, 5.3, 5.4, 6.2 and 6.4
Describe and assess the potential impacts of any actions of the project or likely impacts that will require an authority	Volume 4 Appendix D Project Approvals and Planning Assessment
Provide the following (mitigation strategies): Measures to avoid and mitigate the identified impacts Details of the methodologies that would be used to avoid injuries to livestock and native fauna from the projects construction and operational works Strategies for complying with the objectives and management practices of relevant recovery plans	Section 5.2, 5.3, 5.4, 6.2 and 6.4
Outline proposed mitigation measures will be implemented in the overall EMP for the project.	S13 EIS
Outline EPBC or State recover plans for potentially affected threatened species	Section 3.2, 1.1
Address feral animal management strategies and practices	Section 5.5, 6.5
3.3.4 Aquatic Ecology	
Describe the aquatic flora and fauna occurring in the areas affected by the proposal, noting the patterns and distribution in the waterways (e.g. rivers, streams, creeks and other bodies of water) and any associated wetlands. The description of the flora and fauna present or likely to be present in the area should include: fish species, mammals, reptiles, amphibians, crustaceans and aquatic invertebrates occurring in the waterways within the affected area and any associated wetlands	Section 2.6
any near-threatened or threatened aquatic species	Section 2.6
reference to Ramsar wetlands of international importance in terms of proximity to proposal and likelihood of impacts	Section 3.2
a description of the habitat requirements and the sensitivity of aquatic species to changes in flow regime, water levels and water quality in the project areas	Section 2.6

Terms of Reference Requirement/Section Number	Cross-reference
Nature Conservation	
aquatic plants including native and exotic/weed species. Refer to Biosecurity Queensland's Annual Pest Distribution Survey 2008 data and predictive maps and use the data in conjunction with Queensland Herbarium naturalised flora data to determine the occurrence of aquatic pest plants in the project area. Use Local Government area pest management plans to determine the occurrence of priority aquatic pest plants in the project area	Section 2.6
aquatic and benthic substrate	Section 2.6
habitat upstream and downstream of the project or potentially impacted due to currents in associated lacustrine and aquatic environments	Section 2.6
an identification of the diversity of groundwater-dependent ecosystems occurring within and outside the Project area and those potentially impacted by Project activities.	Volume 4 Appendix R Hydrogeology Report
Include a description, to the taxonomic rank of Order or Family, of the presence and nature of stygofauna occurring in groundwater likely to be impacted by the Project.	Volume 4 Appendix R Hydrogeology Report
Sampling and survey methods should be in accordance with the best practice guideline currently published by the Western Australian Environmental Protection Authority – Guidance for the assessment of environmental factors No.54 (December 2003) and No.54a (August 2007).	Section 1.4
Assess the environmental water requirements for protecting the identified groundwater-dependent ecosystems. Groundwater-dependent ecosystems may include: subterranean ecosystems phreatophytic terrestrial and riparian vegetation springs and other wetlands stream communities dependent on baseflow	Volume 4 Appendix R Hydrogeology Report
aquatic substrate and stream type, including the locations and extent of any permanent and semi-permanent water holes or streams potentially affected by the mine and its operations and location.	Section 2.6
Describe the significance of national, state or regional wetlands including wetlands of international importance, and their values and importance for aquatic flora and fauna species.	Sections 2.6 and 1.1
A map is to be included which identifies aquatic ecosystems in the project area and regional scale.	Figure 2-3
Discuss the potential permanent and temporary impacts of the project on the aquatic ecosystems and describe proposed measures to avoid, minimise or mitigate actions, including: details of proposed stream diversions, causeway construction and crossing facilities, stockpiled material and other impediments that would restrict free movement of aquatic fauna	Section 5.3, 6.3
measures to avoid fish spawning periods, such as seasonal construction of waterway crossings and measures to facilitate fish movements through water crossings	Section 5.3
details of alternatives to waterway crossings where possible	Section 5.3, 6.3

Terms of Reference Requirement/Section Number	Cross-reference
Nature Conservation	
offsets proposed for unavoidable, permanent loss of fisheries habitat	Section 7
a description of methods to minimise the potential for introducing and/or spreading weed species or plant disease	Section 5.5, 6.5
A description of measures to avoid or mitigate potential impacts on groundwater-dependent ecosystems, including the proposed monitoring for each identified groundwater-dependent ecosystem. Ingroundwater aquifers found to contain stygofauna, describe the potential impacts of changes in the quality and quantity of the groundwater on stygofauna, and describe the measures proposed to mitigate identified impacts	Volume 4 Appendix R Hydrogeology Report
monitoring of aquatic ecology health, productivity and biodiversity in areas upstream and downstream of the project area.	Section 5.3, 6.3
Address any actions of the project or likely impacts that require an authority under the relevant legislation including the NC Act and/or the Fisheries Act 1994.	Section 5.3, 6.3
Outline proposed mitigation measures will be implemented in the overall EMP for the project.	Volume 3 Section 13 Environmental Management Plan

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Appendix B

Survey Effort and Locations

Fauna Survey Effort and Locations

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Flora Rapid (Quaternary) Sites	Co-ordinates	
	East	North
May Surveys		
1	545889	7577886
2	547021	7576629
3	547391	7577066
4	542224	7575583
5	468866	7575081
6	464447	7575422
7	464646	7575501
8	465944	7575775
9	467151	7576147
10	467491	7576186
11	473685	7577822
September Surveys		
12	489686	7585607
13	489561	7585508
14	489998	7585635
15	492330	7585465
16	492620	7585509
17	452747	7576901
18	551206	7576196
19	558902	7575415
20	546936	7576636
21	564810	7574460
22	563964	7574568
23	563373	7574646
24	562949	7574841

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Appendix C

Desktop Database Search Results

DSEWPaC Protected Matters Search

DERM Wildlife Online

DERM HERBRECS Database

Queensland Museum Database

Birds Australia Database

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Australian Government
Department of Sustainability, Environment, Water, Population and Communities

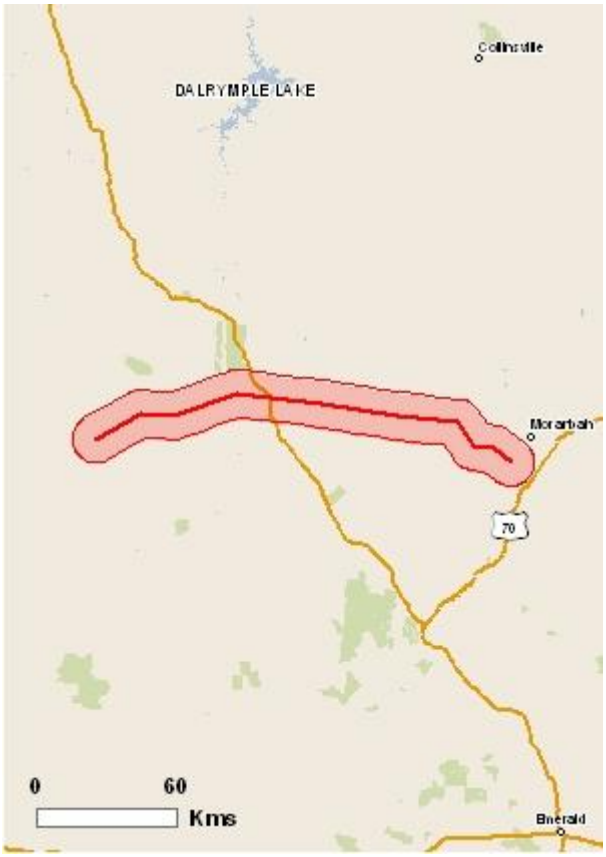
EPBC Act Protected Matters Report: Coordinates

This report provides general guidance on matters of national environmental significance and other matters protected by the EPBC Act in the area you have selected.

Information on the coverage of this report and qualifications on data supporting this report are contained in the caveat at the end of the report.

Information about the EPBC Act including significance guidelines, forms and application process details can be found at http://www.environment.gov.au/epbc/assessmentsapprovals/index.html

Report created: 25/10/11 16:30:18



Coordinates
Buffer: 10.0Km

Summary

Matters of National Environmental Significance

This part of the report summarises the matters of national environmental significance that may occur in, or may relate to, the area you nominated. Further information is available in the detail part of the report, which can be accessed by scrolling or following the links below. If you are proposing to undertake an activity that may have a significant impact on one or more matters of national environmental significance then you should consider the Administrative Guidelines on Significance - see http://www.environment.gov.au/epbc/assessmentsapprovals/guidelines/index.html.

World Heritage Properties:	None
National Heritage Places:	None
Wetlands of International Significance (Ramsar Wetlands):	None
Great Barrier Reef Marine Park:	None
Commonwealth Marine Areas:	None
Threatened Ecological Communitites:	3
Threatened Species:	17
Migratory Species:	13

Other Matters Protected by the EPBC Act

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the environment anywhere.

The EPBC Act protects the environment on Commonwealth land, the environment from the actions taken on Commonwealth land, and the environment from actions taken by Commonwealth agencies. As heritage values of a place are part of the 'environment', these aspects of the EPBC Act protect the Commonwealth Heritage values of a Commonwealth Heritage place and the heritage values of a place on the Register of the National Estate. Information on the new heritage laws can be found at http://www.environment.gov.au/heritage/index.html

Please note that the current dataset on Commonwealth land is not complete. Further information on Commonwealth land would need to be obtained from relevant sources including Commonwealth agencies, local agencies, and land tenure maps.

A permit may be required for activities in or on a Commonwealth area that may affect a member of a listed threatened species or ecological community, a member of a listed migratory species, whales and other cetaceans, or a member of a listed marine species. Information on EPBC Act permit requirements and application forms can be found at http://www.environment.gov.au/epbc/permits/index.html.

Commonwealth Lands:	None
Commonwealth Heritage Places:	None
Listed Marine Species:	12
Whales and Other Cetaceans:	None

Critical Habitats:	None
Commonwealth Reserves:	None

Report Summary for Extra Information

This part of the report provides information that may also be relevant to the area you have nominated.

Place on the RNE:	None
State and Territory Reserves:	1
Regional Forest Agreements:	None
Invasive Species:	12
Nationally Important Wetlands:	None

Details

Matters of National Environmental Significance

Threatened Ecological Communities [Resource Information]

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Name	Status	Type of Presence
Brigalow (Acacia harpophylla dominant and co-dominant)	Endangered	Community known to occur within area
Natural Grasslands of the Queensland Central Highlands and the northern Fitzroy Basin	Endangered	Community likely to occur within area
Semi-evergreen vine thickets of the Brigalow Belt (North and South) and Nandewar Bioregions	Endangered	Community likely to occur within area

Threatened Species [Resource Information]

Name	Status	Type of Presence
BIRDS		
Erythrotriorchis radiatus Red Goshawk [942]	Vulnerable	Species or species habitat likely to occur within area
Geophaps scripta scripta Squatter Pigeon (southern) [64440]	Vulnerable	Species or species habitat likely to occur within area
Neochmia ruficauda ruficauda Star Finch (eastern), Star Finch (southern) [26027]	Endangered	Species or species habitat likely to occur within area
Poephila cincta cincta Black-throated Finch (southern) [64447]	Endangered	Species or species habitat likely to occur within area
Rostratula australis		

Australian Painted Snipe [77037]	Vulnerable	Species or species habitat may occur within area
MAMMALS		
Dasyurus hallucatus		
Northern Quoll [331]	Endangered	Species or species habitat may occur within area
Nyctophilus timoriensis (South-eastern form)		
Greater Long-eared Bat, South-eastern Long-eared Bat [66888]	Vulnerable	Species or species habitat may occur within area
OTHER		
Cycas ophiolitica		
[55797]	Endangered	Species or species habitat likely to occur within area
PLANTS		
Acacia ramiflora		
[7242]	Vulnerable	Species or species habitat likely to occur within area
Dichanthium queenslandicum		
King Blue-grass [5481]	Vulnerable	Species or species habitat likely to occur within area
Digitaria porrecta		
Finger Panic Grass [12768]	Endangered	Species or species habitat likely to occur within area
REPTILES		
Denisonia maculata		
Ornamental Snake [1193]	Vulnerable	Species or species habitat likely to occur within area
Egernia rugosa		
Yakka Skink [1420]	Vulnerable	Species or species habitat likely to occur within area
Furina dunmalli		
Dunmall's Snake [59254]	Vulnerable	Species or species habitat may occur within area
Lerista allanae		
Allan's Lerista, Retro Slider [1378]	Endangered	Species or species habitat may occur within area
Paradelma orientalis		
Brigalow Scaly-foot [59134]	Vulnerable	Species or species habitat may occur within area
Rheodytes leukops		
Fitzroy River Turtle, Fitzroy Tortoise, Fitzroy Turtle [1761]	Vulnerable	Species or species habitat may occur within area

Migratory Species [Resource Information]

Name	Status	Type of Presence
Migratory Marine Birds		
Apus pacificus		
Fork-tailed Swift [678]		Species or species habitat may occur within area
Ardea alba		
Great Egret, White Egret [59541]		Species or species habitat may occur within area
Ardea ibis		
Cattle Egret [59542]		Species or species habitat may occur within area
Migratory Terrestrial Species		
Haliaeetus leucogaster		

White-bellied Sea-Eagle [943]		Species or species habitat likely to occur within area
Hirundapus caudacutus		
White-throated Needletail [682]		Species or species habitat may occur within area
Merops ornatus		
Rainbow Bee-eater [670]		Species or species habitat may occur within area
Monarcha melanopsis		
Black-faced Monarch [609]		Species or species habitat may occur within area
Myiagra cyanoleuca		
Satin Flycatcher [612]		Species or species habitat likely to occur within area
Migratory Wetlands Species		
Ardea alba		
Great Egret, White Egret [59541]		Species or species habitat may occur within area
Ardea ibis		
Cattle Egret [59542]		Species or species habitat may occur within area
Gallinago hardwickii		
Latham's Snipe, Japanese Snipe [863]		Species or species habitat may occur within area
Nettapus coromandelianus albipennis		
Australian Cotton Pygmy-goose [25979]		Species or species habitat may occur within area
Rostratula benghalensis s. lat.		
Painted Snipe [889]	Vulnerable*	Species or species habitat may occur within area

Other Matters Protected by the EPBC Act

Listed Marine Species **[Resource Information]**

Name	Status	Type of Presence
Birds		
Anseranas semipalmata		
Magpie Goose [978]		Species or species habitat may occur within area
Apus pacificus		
Fork-tailed Swift [678]		Species or species habitat may occur within area
Ardea alba		
Great Egret, White Egret [59541]		Species or species habitat may occur within area
Ardea ibis		
Cattle Egret [59542]		Species or species habitat may occur within area
Gallinago hardwickii		
Latham's Snipe, Japanese Snipe [863]		Species or species habitat may occur within area
Haliaeetus leucogaster		
White-bellied Sea-Eagle [943]		Species or species habitat likely to occur within area
Hirundapus caudacutus		
White-throated Needletail [682]		Species or species habitat may occur within area
Merops ornatus		
Rainbow Bee-eater [670]		Species or species habitat may occur within area
Monarcha melanopsis		
Black-faced Monarch [609]		Species or species habitat may occur within area
Myiagra cyanoleuca		

Satin Flycatcher [612]		Species or species habitat likely to occur within area
Nettapus coromandelianus albipennis		
Australian Cotton Pygmy-goose [25979]		Species or species habitat may occur within area
Rostratula benghalensis s. lat.		
Painted Snipe [889]	Vulnerable*	Species or species habitat may occur within area

Extra Information

State and Territory Reserves [Resource Information]

Nairana (Recovery), QLD

Invasive Species [Resource Information]

Weeds reported here are the 20 species of national significance (WoNS), along with other introduced plants that are considered by the States and Territories to pose a particularly significant threat to biodiversity. The following feral animals are reported: Goat, Red Fox, Cat, Rabbit, Pig, Water Buffalo and Cane Toad. Maps from Landscape Health Project, National Land and Water Resouces Audit, 2001.

Name	Status	Type of Presence
Frogs		
Bufo marinus		
Cane Toad [1772]		Species or species habitat likely to occur within area
Mammals		
Felis catus		
Cat, House Cat, Domestic Cat [19]		Species or species habitat likely to occur within area
Oryctolagus cuniculus		
Rabbit, European Rabbit [128]		Species or species habitat likely to occur within area
Sus scrofa		
Pig [6]		Species or species habitat likely to occur within area
Vulpes vulpes		
Red Fox, Fox [18]		Species or species habitat likely to occur within area
Plants		
Acacia nilotica subsp. indica		
Prickly Acacia [6196]		Species or species habitat may occur within area
Cryptostegia grandiflora		
Rubber Vine, Rubbervine, India Rubber Vine, India Rubbervine, Palay Rubbervine, Purple Allamanda [18913]		Species or species habitat likely to occur within area
Hymenachne amplexicaulis		
Hymenachne, Olive Hymenachne, Water Stargrass, West Indian Grass, West Indian Marsh Grass [31754]		Species or species habitat likely to occur within area
Lantana camara		
Lantana, Common Lantana, Kamara Lantana, Large-leaf Lantana, Pink Flowered Lantana, Red Flowered Lantana,		Species or species habitat likely to occur within area

Red-Flowered Sage, White Sage, Wild Sage [10892]	
Parkinsonia aculeata	
Parkinsonia, Jerusalem Thorn, Jelly Bean Tree, Horse Bean [12301]	Species or species habitat likely to occur within area
Parthenium hysterophorus	
Parthenium Weed, Bitter Weed, Carrot Grass, False Ragweed [19566]	Species or species habitat likely to occur within area
Prosopis spp.	
Mesquite, Algaroba [68407]	Species or species habitat likely to occur within area

Caveat

The information presented in this report has been provided by a range of data sources as acknowledged at the end of the report.

This report is designed to assist in identifying the locations of places which may be relevant in determining obligations under the Environment Protection and Biodiversity Conservation Act 1999. It holds mapped locations of World Heritage and Register of National Estate properties, Wetlands of International Importance, Commonwealth and State/Territory reserves, listed threatened, migratory and marine species and listed threatened ecological communities. Mapping of Commonwealth land is not complete at this stage. Maps have been collated from a range of sources at various resolutions.

Not all species listed under the EPBC Act have been mapped (see below) and therefore a report is a general guide only. Where available data supports mapping, the type of presence that can be determined from the data is indicated in general terms. People using this information in making a referral may need to consider the qualifications below and may need to seek and consider other information sources.

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

For species where the distributions are well known, maps are digitised from sources such as recovery plans and detailed habitat studies. Where appropriate, core breeding, foraging and roosting areas are indicated under 'type of presence'. For species whose distributions are less well known, point locations are collated from government wildlife authorities, museums, and non-government organisations; bioclimatic distribution models are generated and these validated by experts. In some cases, the distribution maps are based solely on expert knowledge.

Only selected species covered by the following provisions of the EPBC Act have been mapped:

- migratory and
- marine

The following species and ecological communities have not been mapped and do not appear in reports produced from this database:

- threatened species listed as extinct or considered as vagrants
- some species and ecological communities that have only recently been listed
- some terrestrial species that overfly the Commonwealth marine area
- migratory species that are very widespread, vagrant, or only occur in small numbers.

The following groups have been mapped, but may not cover the complete distribution of the species:

- non-threatened seabirds which have only been mapped for recorded breeding sites;
- seals which have only been mapped for breeding sites near the Australian continent.

Such breeding sites may be important for the protection of the Commonwealth Marine environment.

Coordinates

-22.01137 146.37083,-21.91215 146.54162,-21.92341 146.66822,-21.83625 146.91074,-21.87472 147.24022,-21.92129 147.52917,-21.94817 147.76182,-22.03703 147.81947,-22.04841 147.90074,-22.10028 147.96578

Acknowledgements

This database has been compiled from a range of data sources. The department acknowledges the following custodians who have contributed valuable data and advice:

-Department of Environment, Climate Change and Water, New South Wales
-Department of Sustainability and Environment, Victoria
-Department of Primary Industries, Parks, Water and Environment, Tasmania
-Department of Environment and Natural Resources, South Australia
-Parks and Wildlife Service NT, NT Dept of Natural Resources, Environment and the Arts
-Environmental and Resource Management, Queensland
-Department of Environment and Conservation, Western Australia
-Department of the Environment, Climate Change, Energy and Water
-Birds Australia
-Australian Bird and Bat Banding Scheme
-Australian National Wildlife Collection
-Natural history museums of Australia
-Museum Victoria
-Australian Museum
-SA Museum
-Queensland Museum
-Online Zoological Collections of Australian Museums
-Queensland Herbarium
-National Herbarium of NSW
-Royal Botanic Gardens and National Herbarium of Victoria
-Tasmanian Herbarium
-State Herbarium of South Australia
-Northern Territory Herbarium
-Western Australian Herbarium
-Australian National Herbarium, Atherton and Canberra
-University of New England
-Ocean Biogeographic Information System
-Australian Government, Department of Defence
-State Forests of NSW
-Other groups and individuals

The Department is extremely grateful to the many organisations and individuals who provided expert advice and information on numerous draft distributions.

Please feel free to provide feedback via the Contact Us page.

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| Australian Government |

Queensland DERM Wildlife Online Database Search Results - Fauna

Family	Scientific Name	Common Name	NC Act Status	EPBC Act Status
Amphibians				
Hylidae	*Litoria latopalmata*	broad palmed rocketfrog		
Hylidae	*Litoria inermis*	bumpy rocketfrog		
Bufonidae	*Rhinella marina*	cane toad	Introduced	
Hylidae	*Litoria caerulea*	common green treefrog		
Hylidae	*Cyclorana novaehollandiae*	eastern snapping frog		
Hylidae	*Cyclorana alboguttata*	greenstripe frog		
Hylidae	*Litoria rothii*	northern laughing treefrog		
Limnodynastidae	*Platyplectrum ornatum*	ornate burrowing frog		
Hylidae	*Litoria rubella*	ruddy treefrog		
Limnodynastidae	*Limnodynastes tasmaniensis*	spotted grassfrog		
Birds				
Corcoracidae	*Struthidea cinerea*	apostlebird		
Anhingidae	*Anhinga novaehollandiae*	Australasian darter		
Oriolidae	*Sphecotheres vieilloti*	Australasian figbird		
Podicipedidae	*Tachybaptus novaehollandiae*	Australasian grebe		
Motacillidae	*Anthus novaeseelandiae*	Australasian pipit		Marine
Otididae	*Ardeotis australis*	Australian bustard		
Falconidae	*Falco longipennis*	Australian hobby		
Artamidae	*Cracticus tibicen*	Australian magpie		
Aegothelidae	*Aegotheles cristatus*	Australian owlet-nightjar		
Corvidae	*Corvus coronoides*	Australian raven		
Threskiornithidae	*Threskiornis molucca*	Australian white ibis		Marine
Anatidae	*Chenonetta jubata*	Australian wood duck		
Charadriidae	*Vanellus tricolor*	banded lapwing		
Accipitridae	*Milvus migrans*	black kite		
Anatidae	*Cygnus atratus*	black swan		
Cuculidae	*Chalcites osculans*	black-eared cuckoo		Marine
Campephagidae	*Coracina novaehollandiae*	black-faced cuckoo-shrike		Marine
Artamidae	*Artamus cinereus*	black-faced woodswallow		
Charadriidae	*Elseyornis melanops*	black-fronted dotterel		
Ciconiidae	*Ephippiorhynchus asiaticus*	black-necked stork		
Accipitridae	*Elanus axillaris*	black-shouldered kite		
Recurvirostridae	*Himantopus himantopus*	black-winged stilt		Marine
Meliphagidae	*Entomyzon cyanotis*	blue-faced honeyeater		
Gruidae	*Grus rubicunda*	brolga		
Falconidae	*Falco berigora*	brown falcon		
Accipitridae	*Accipiter fasciatus*	brown goshawk		Marine
Meliphagidae	*Lichmera indistincta*	brown honeyeater		
Phasianidae	*Coturnix ypsilophora*	brown quail		
Climacteridae	*Climacteris picumnus*	brown treecreeper		

Family	Scientific Name	Common Name	NC Act Status	EPBC Act Status
Burhinidae	*Burhinus grallarius*	bush stone-curlew		
Cuculidae	*Scythrops novaehollandiae*	channel-billed cuckoo		Marine
Estrildidae	*Lonchura castaneothorax*	chestnut-breasted mannikin		
Cacatuidae	*Nymphicus hollandicus*	cockatiel		
Columbidae	*Phaps chalcoptera*	common bronzewing		
Sturnidae	*Sturnus tristis*	common myna	Introduced	
Anatidae	*Nettapus coromandelianus*	cotton pygmy-goose	Near Threatened	Marine
Columbidae	*Ocyphaps lophotes*	crested pigeon		
Estrildidae	*Taeniopygia bichenovii*	double-barred finch		
Tytonidae	*Tyto javanica*	eastern barn owl		
Ardeidae	*Ardea modesta*	eastern great egret		Marine, Migratory (CAMBA, JAMBA)
Casuariidae	*Dromaius novaehollandiae*	emu		
Hirundinidae	*Petrochelidon ariel*	fairy martin		
Cacatuidae	*Eolophus roseicapillus*	galah		
Cisticolidae	*Cisticola exilis*	golden-headed cisticola		
Artamidae	*Cracticus torquatus*	grey butcherbird		
Falconidae	*Falco hypoleucos*	grey falcon	Near Threatened	
Rhipiduridae	*Rhipidura albiscapa*	grey fantail		
Pachycephalidae	*Colluricincla harmonica*	grey shrike-thrush		
Anatidae	*Anas gracilis*	grey teal		
Pomatostomidae	*Pomatostomus temporalis*	grey-crowned babbler		
Meliphagidae	*Ptilotula plumulus*	grey-fronted honeyeater		
Campephagidae	*Coracina maxima*	ground cuckoo-shrike		
Anatidae	*Aythya australis*	hardhead		
Podicipedidae	*Poliocephalus poliocephalus*	hoary-headed grebe		
Alaudidae	*Mirafra javanica*	Horsfield's bushlark		
Acanthizidae	*Acanthiza apicalis*	inland thornbill		
Ardeidae	*Ardea intermedia*	intermediate egret		Marine
Petroicidae	*Microeca fascinans*	jacky winter		
Halcyonidae	*Dacelo novaeguineae*	laughing kookaburra		
Phalacrocoracidae	*Phalacrocorax sulcirostris*	little black cormorant		
Turnicidae	*Turnix velox*	little button-quail		
Accipitridae	*Hieraaetus morphnoides*	little eagle		
Meliphagidae	*Philemon citreogularis*	little friarbird		
Phalacrocoracidae	*Microcarbo melanoleucos*	little pied cormorant		
Artamidae	*Artamus minor*	little woodswallow		
Monarchidae	*Grallina cyanoleuca*	magpie-lark		
Charadriidae	*Vanellus miles miles*	masked lapwing (northern subspecies)		
Nectariniidae	*Dicaeum hirundinaceum*	mistletoebird		
Falconidae	*Falco cenchroides*	nankeen kestrel		Marine

Family	Scientific Name	Common Name	NC Act Status	EPBC Act Status
Ardeidae	*Nycticorax caledonicus*	Nankeen night-heron		Marine
Meliphagidae	*Philemon corniculatus*	noisy friarbird		
Meliphagidae	*Manorina melanocephala*	noisy miner		
Oriolidae	*Oriolus sagittatus*	olive-backed oriole		
Anatidae	*Anas superciliosa*	Pacific black duck		
Psittacidae	*Platycercus adscitus*	pale-headed rosella		
Psittacidae	*Platycercus adscitus palliceps*	pale-headed rosella (southern form)		
Cuculidae	*Cacomantis pallidus*	pallid cuckoo		Marine
Columbidae	*Geopelia striata*	peaceful dove		
Falconidae	*Falco peregrinus*	peregrine falcon		
Cuculidae	*Centropus phasianinus*	pheasant coucal		
Artamidae	*Cracticus nigrogularis*	pied butcherbird		
Artamidae	*Strepera graculina*	pied currawong		
Anatidae	*Malacorhynchus membranaceus*	pink-eared duck		
Anatidae	*Dendrocygna eytoni*	plumed whistling-duck		
Rallidae	*Porphyrio porphyrio*	purple swamphen		
Meropidae	*Merops ornatus*	rainbow bee-eater		Marine, Migratory (JAMBA)
Psittacidae	*Trichoglossus haematodus moluccanus*	rainbow lorikeet		
Maluridae	*Malurus melanocephalus*	red-backed fairy-wren		
Halcyonidae	*Todiramphus pyrrhopygius*	red-backed kingfisher		
Petroicidae	*Petroica goodenovii*	red-capped robin		
Psittacidae	*Aprosmictus erythropterus*	red-winged parrot		
Monarchidae	*Myiagra inquieta*	restless flycatcher		
Megaluridae	*Cincloramphus mathewsi*	rufous songlark		
Pachycephalidae	*Pachycephala rufiventris*	rufous whistler		
Halcyonidae	*Todiramphus sanctus*	sacred kingfisher		Marine
Meliphagidae	*Gavicalis virescens*	singing honeyeater		
Strigidae	*Ninox boobook*	southern boobook		Marine
Meliphagidae	*Acanthagenys rufogularis*	spiny-cheeked honeyeater		
Ptilonorhynchidae	*Ptilonorhynchus maculatus*	spotted bowerbird		
Accipitridae	*Circus assimilis*	spotted harrier		
Columbidae	*Geophaps scripta*	squatter pigeon		
Columbidae	*Geophaps scripta scripta*	squatter pigeon (southern subspecies)	Vulnerable	Vulnerable
Threskiornithidae	*Threskiornis spinicollis*	straw-necked ibis		Marine
Pardalotidae	*Pardalotus striatus*	striated pardalote		
Meliphagidae	*Plectorhyncha lanceolata*	striped honeyeater		
Phasianidae	*Coturnix pectoralis*	stubble quail		Marine
Cacatuidae	*Cacatua galerita*	sulphur-crested cockatoo		
Maluridae	*Malurus cyaneus*	superb fairy-wren		
Podargidae	*Podargus strigoides*	tawny frogmouth		
Corvidae	*Corvus orru*	Torresian crow		

Family	Scientific Name	Common Name	NC Act Status	EPBC Act Status
Hirundinidae	*Petrochelidon nigricans*	tree martin		Marine
Neosittidae	*Daphoenositta chrysoptera*	varied sittella		
Campephagidae	*Lalage leucomela*	varied triller		
Maluridae	*Malurus lamberti*	variegated fairy-wren		
Accipitridae	*Aquila audax*	wedge-tailed eagle		
Acanthizidae	*Smicrornis brevirostris*	weebill		
Acanthizidae	*Gerygone fusca*	western gerygone		
Accipitridae	*Haliastur sphenurus*	whistling kite		Marine
Artamidae	*Artamus leucorynchus*	white-breasted woodswallow		
Ardeidae	*Egretta novaehollandiae*	white-faced heron		
Ardeidae	*Ardea pacifica*	white-necked heron		
Acanthizidae	*Gerygone albogularis*	white-throated gerygone		
Eurostopodidae	*Eurostopodus mystacalis*	white-throated nightjar		Marine
Campephagidae	*Lalage sueurii*	white-winged triller		
Rhipiduridae	*Rhipidura leucophrys*	willie wagtail		
Acanthizidae	*Acanthiza nana*	yellow thornbill		
Threskiornithidae	*Platalea flavipes*	yellow-billed spoonbill		
Acanthizidae	*Acanthiza chrysorrhoa*	yellow-rumped thornbill		
Meliphagidae	*Manorina flavigula*	yellow-throated miner		
Estrildidae	*Taeniopygia guttata*	zebra finch		
Corvidae	*Corvus* sp.			
Mammals				
Molossidae	*Mormopterus beccarii*	Beccari's freetail bat		
Felidae	*Felis catus*	cat	Introduced	
Muridae	*Pseudomys delicatulus*	delicate mouse		
Muridae	*Pseudomys desertor*	desert mouse		
Canidae	*Canis familiaris*	dog	Introduced	
Vespertilionidae	*Vespadelus troughtoni*	eastern cave bat		
Molossidae	*Mormopterus sp. 2*	eastern freetail bat		
Macropodidae	*Macropus giganteus*	eastern grey kangaroo		
Bovidae	*Bos taurus*	European cattle	Introduced	
Dasyuridae	*Sminthopsis crassicaudata*	fat-tailed dunnart		
Vespertilionidae	*Chalinolobus gouldii*	Gould's wattled bat		Vulnerable
Vespertilionidae	*Chalinolobus nigrogriseus*	hoary wattled bat		
Muridae	*Mus musculus*	house mouse	Introduced	
Phascolarctidae	*Phascolarctos cinereus*	koala		
Vespertilionidae	*Chalinolobus picatus*	little pied bat	Near Threatened	
Dasyuridae	*Planigale ingrami*	long-tailed planigale		
Molossidae	*Chaerephon jobensis*	northern freetail bat		
Suidae	*Sus scrofa*	pig	Introduced	
Leporidae	*Oryctolagus cuniculus*	rabbit	Introduced	
Macropodidae	*Macropus rufus*	red kangaroo		

Family	Scientific Name	Common Name	NC Act Status	EPBC Act Status
Potoroidae	*Aepyprymnus rufescens*	rufous bettong		
Tachyglossidae	*Tachyglossus aculeatus*	short-beaked echidna		
Dasyuridae	*Sminthopsis macroura*	stripe-faced dunnart		
Molossidae	*Tadarida australis*	white-striped freetail bat		
Emballonuridae	*Saccolaimus flaviventris*	yellow-bellied sheathtail bat		
Molossidae	*Mormopterus* sp.			
Muridae	*Pseudomys* sp.			
Reptiles				
Agamidae	*Pogona barbata*	bearded dragon		
Boidae	*Aspidites melanocephalus*	black-headed python		
Varanidae	*Varanus tristis*	black-tailed monitor		
Pygopodidae	*Lialis burtonis*	Burton's legless lizard		
Gekkonidae	*Heteronotia binoei*	Bynoe's gecko		
Elapidae	*Cryptophis boschmai*	Carpentaria whip snake		
Colubridae	*Dendrelaphis punctulata*	common tree snake		
Scincidae	*Ctenotus taeniolatus*	copper-tailed skink		
Elapidae	*Brachyurophis australis*	coral snake		
Elapidae	*Pseudonaja textilis*	eastern brown snake		
Diplodactylidae	*Diplodactylus conspicillatus*	fat-tailed diplodactylus		
Elapidae	*Suta suta*	myall snake		
Scincidae	*Eremiascincus fasciolatus*	narrow-banded sand swimmer		
Elapidae	*Denisonia maculata*	ornamental snake	Vulnerable	Vulnerable
Elapidae	*Hoplocephalus bitorquatus*	pale-headed snake		
Scincidae	*Cryptoblepharus pannosus*	ragged snake-eyed skink		
Diplodactylidae	*Strophurus williamsi*	soft-spined gecko		
Elapidae	*Pseudonaja guttata*	speckled brown snake		
Boidae	*Antaresia maculosa*	spotted python		
Diplodactylidae	*Lucasium steindachneri*	Steindachner's gecko		
Elapidae	*Demansia psammophis*	yellow-faced whip snake		
Diplodactylidae	*Oedura rhombifer*	zig-zag gecko		
Agamidae	*Amphibolurus burnsi*			
Scincidae	*Carlia pectoralis*			
Scincidae	*Cryptoblepharus plagiocephalus sensu lato*			
Scincidae	*Ctenotus leonhardii*			
Scincidae	*Ctenotus robustus*			
Agamidae	*Diporiphora australis*			
Gekkonidae	*Gehyra catenata*			
Gekkonidae	*Gehyra dubia*			
Scincidae	*Lerista fragilis*			
Scincidae	*Menetia greyii*			
Scincidae	*Morethia boulengeri*			
Diplodactylidae	*Oedura monilis*			

Family	Scientific Name	Common Name	NC Act Status	EPBC Act Status
Typhlopidae	*Ramphotyphlops ligatus*			
Typhlopidae	*Ramphotyphlops* sp.			

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Family	Scientific Name	Common Name	NC Act Status	EPBC Act Status
Malvaceae	*Abutilon*			
Malvaceae	*Abutilon fraseri subsp. fraseri*			
Malvaceae	*Abutilon oxycarpum*			
Mimosaceae	*Acacia bancroftiorum*			
Mimosaceae	*Acacia cambagei*	gidgee		
Mimosaceae	*Acacia catenulata*	bendee		
Mimosaceae	*Acacia conferta*			
Mimosaceae	*Acacia crassa*			
Mimosaceae	*Acacia excelsa subsp. excelsa*			
Mimosaceae	*Acacia galioides*			
Mimosaceae	*Acacia harpophylla*	brigalow		
Mimosaceae	*Acacia hyaloneura*			
Mimosaceae	*Acacia lazaridis*			
Mimosaceae	*Acacia leiocalyx*			
Mimosaceae	*Acacia leptostachya*	Townsville wattle		
Mimosaceae	*Acacia oswaldii*	miljee		
Mimosaceae	*Acacia rhodoxylon*	ringy rosewood		
Mimosaceae	*Acacia sericophylla*			
Mimosaceae	*Acacia shirleyi*	lancewood		
Mimosaceae	*Acacia tenuissima*			
Mimosaceae	*Acacia tephrina*			
Amaranthaceae	*Achyranthes aspera*			
Sapindaceae	*Alectryon diversifolius*	scrub boonaree		
Sapindaceae	*Alectryon oleifolius subsp. elongatus*			
Casuarinaceae	*Allocasuarina luehmannii*	bull oak		
Poaceae	*Alloteropsis cimicina*			
Rhamnaceae	*Alphitonia excelsa*	soap tree		
Apocynaceae	*Alstonia constricta*	bitterbark		
Amaranthaceae	*Alternanthera denticulata var. micrantha*			
Amaranthaceae	*Alternanthera nodiflora*	joyweed		
Lythraceae	*Ammannia multiflora*	jerry-jerry		
Loranthaceae	*Amyema quandang*			
Capparaceae	*Apophyllum anomalum*	broom bush		

Mimosaceae	*Archidendropsis basaltica*	red lancewood		
Poaceae	*Aristida*			
Poaceae	*Aristida calycina*			
Poaceae	*Aristida holathera var. holathera*			
Poaceae	*Aristida jerichoensis var. subspinulifera*			
Poaceae	*Aristida latifolia*	feathertop wiregrass		
Poaceae	*Astrebla*			
Poaceae	*Astrebla elymoides*	hoop mitchell grass		
Poaceae	*Astrebla lappacea*	curly mitchell grass		
Poaceae	*Astrebla squarrosa*	bull mitchell grass		
Sapindaceae	*Atalaya hemiglauca*			
Lamiaceae	*Basilicum polystachyon*			
Nyctaginaceae	*Boerhavia*			
Nyctaginaceae	*Boerhavia paludosa*			
Nyctaginaceae	*Boerhavia pubescens*			
Nyctaginaceae	*Boerhavia sp. (St George A.Hill AQ399299)*			
Poaceae	*Bothriochloa decipiens*			
Poaceae	*Bothriochloa ewartiana*	desert bluegrass		
Poaceae	*Brachyachne convergens*	common native couch		
Goodeniaceae	*Brunonia australis*	blue pincushion		
Acanthaceae	*Brunoniella australis*	blue trumpet		
Asphodelaceae	*Bulbine bulbosa*	golden lily		
Pittosporaceae	*Bursaria incana*			
Johnsoniaceae	*Caesia parviflora var. vittata*			
Portulacaceae	*Calandrinia pickeringii*			
Asteraceae	*Calotis cuneifolia*	burr daisy		
Capparaceae	*Capparis lasiantha*	nipan		
Capparaceae	*Capparis umbonata*			
Apocynaceae	*Carissa lanceolata*			
Apocynaceae	*Carissa ovata*	currantbush		
Caesalpiniaceae	*Cassia brewsteri*			
Casuarinaceae	*Casuarina cunninghamiana*			
Poaceae	*Cenchrus ciliaris*		Introduced	
Poaceae	*Cenchrus pennisetiformis*		Introduced	
Euphorbiaceae	*Chamaesyce dallachyana*	mat spurge		
Euphorbiaceae	*Chamaesyce hyssopifolia*		Introduced	
Adiantaceae	*Cheilanthes distans*	bristly cloak fern		
Chenopodiaceae	*Chenopodium auricomum*			
Chenopodiaceae	*Chenopodium desertorum subsp. anidiophyllum*			
Chenopodiaceae	*Chenopodium murale*	green fat-hen	Introduced	
Poaceae	*Chrysopogon fallax*			
Poaceae	*Cleistochloa subjuncea*			
Lamiaceae	*Clerodendrum floribundum*			

Commelinaceae	*Commelina*			
Commelinaceae	*Commelina ensifolia*	scurvy grass		
Commelinaceae	*Commelina lanceolata*			
Convolvulaceae	*Convolvulaceae*			
Asteraceae	*Coronidium lanuginosum*			
Myrtaceae	*Corymbia clarksoniana*			
Myrtaceae	*Corymbia dallachiana*			
Myrtaceae	*Corymbia lamprophylla*			
Myrtaceae	*Corymbia tessellaris*	Moreton Bay ash		
Amaryllidaceae	*Crinum*			
Fabaceae	*Crotalaria*			
Fabaceae	*Crotalaria medicaginea*	trefoil rattlepod		
Euphorbiaceae	*Croton phebalioides*	narrow-leaved croton		
Cucurbitaceae	*Cucumis melo*			
Cucurbitaceae	*Cucumis melo subsp. agrestis*			
Fabaceae	*Cullen cinereum*			
Orchidaceae	*Cymbidium canaliculatum*			
Poaceae	*Cymbopogon bombycinus*	silky oilgrass		
Poaceae	*Cymbopogon refractus*	barbed-wire grass		
Poaceae	*Cynodon dactylon*		Introduced	
Cyperaceae	*Cyperus*			
Cyperaceae	*Cyperus alterniflorus*			
Cyperaceae	*Cyperus bifax*	western nutgrass		
Cyperaceae	*Cyperus iria*			
Cyperaceae	*Cyperus isabellinus*			
Cyperaceae	*Cyperus leiocaulon*			
Cyperaceae	*Cyperus polystachyos var. polystachyos*			
Cyperaceae	*Cyperus rotundus*	nutgrass	Introduced	
Poaceae	*Dactyloctenium radulans*	button grass		
Fabaceae	*Desmodium*			
Fabaceae	*Desmodium campylocaulon*			
Fabaceae	*Desmodium muelleri*			
Poaceae	*Dichanthium aristatum*	angleton grass	Introduced	
Poaceae	*Digitaria brownii*			
Sapindaceae	*Diploglottis macrantha*			
Acanthaceae	*Dipteracanthus australasicus*			
Acanthaceae	*Dipteracanthus australasicus subsp. corynothecus*			
Sapindaceae	*Dodonaea dodecandra*			
Sapindaceae	*Dodonaea lanceolata var. subsessilifolia*			
Chenopodiaceae	*Dysphania kalpari*			
Chenopodiaceae	*Dysphania rhadinostachya subsp. inflata*			
Boraginaceae	*Ehretia membranifolia*	weeping koda		
Chenopodiaceae	*Einadia nutans subsp. linifolia*			

Cyperaceae	*Eleocharis pallens*	pale spikerush		
Poaceae	*Elytrophorus spicatus*			
Chenopodiaceae	*Enchylaena tomentosa*			
Poaceae	*Enneapogon lindleyanus*			
Poaceae	*Enneapogon virens*			
Poaceae	*Enteropogon ramosus*			
Asteraceae	*Epaltes australis*	spreading nutheads		
Poaceae	*Eragrostis lacunaria*	purple lovegrass		
Poaceae	*Eragrostis sororia*			
Poaceae	*Eragrostis speciosa*			
Myoporaceae	*Eremophila bignoniiflora*	eurah		
Myoporaceae	*Eremophila deserti*			
Myoporaceae	*Eremophila longifolia*	berrigan		
Myoporaceae	*Eremophila maculata*			
Myoporaceae	*Eremophila maculata subsp. maculata*			
Myoporaceae	*Eremophila mitchellii*			
Poaceae	*Eriachne*			
Poaceae	*Eriachne mucronata*			
Poaceae	*Eriachne mucronata forma (Alpha C.E.Hubbard 7882)*			
Poaceae	*Eriochloa procera*	slender cupgrass		
Poaceae	*Eriochloa pseudoacrotricha*			
Fabaceae	*Erythrina vespertilio*			
Erythroxylaceae	*Erythroxylum australe*	cocaine tree		
Myrtaceae	*Eucalyptus brownii*	Reid River box		
Myrtaceae	*Eucalyptus coolabah*	coolabah		
Myrtaceae	*Eucalyptus crebra*	narrow-leaved red ironbark		
Myrtaceae	*Eucalyptus drepanophylla*			
Myrtaceae	*Eucalyptus melanophloia*			
Myrtaceae	*Eucalyptus persistens*			
Myrtaceae	*Eucalyptus populnea*	poplar box		
Myrtaceae	*Eucalyptus thozetiana*			
Myrtaceae	*Eucalyptus xanthoclada*	yellow-branched ironbark		
Euphorbiaceae	*Euphorbia stevenii*	bottle tree spurge		
Euphorbiaceae	*Euphorbia tannensis subsp. eremophila*			
Convolvulaceae	*Evolvulus alsinoides*			
Convolvulaceae	*Evolvulus alsinoides var. decumbens*			
Fabaceae	*Flemingia parviflora*	flemingia		
Rutaceae	*Flindersia dissosperma*			
Phyllanthaceae	*Flueggea leucopyrus*			
Asteraceae	*Gamochaeta pensylvanica*		Introduced	
Rutaceae	*Geijera salicifolia*	brush wilga		
Amaranthaceae	*Gomphrena celosioides*	gomphrena weed	Introduced	
Goodeniaceae	*Goodenia armitiana*			

Goodeniaceae	*Goodenia fascicularis*			
Goodeniaceae	*Goodenia hirsuta*			
Goodeniaceae	*Goodenia lunata*			
Goodeniaceae	*Goodenia strangfordii*			
Malvaceae	*Gossypium australe*			
Proteaceae	*Grevillea decora subsp. decora*			
Proteaceae	*Grevillea pteridifolia*	golden parrot tree		
Sparrmanniaceae	*Grewia latifolia*	dysentery plant		
Sparrmanniaceae	*Grewia retusifolia*			
Proteaceae	*Hakea lorea subsp. lorea*			
Cactaceae	*Harrisia martinii*		Introduced	
Poaceae	*Heteropogon contortus*	black speargrass		
Malvaceae	*Hibiscus meraukensis*	Merauke hibiscus		
Malvaceae	*Hibiscus sp. (Emerald S.L.Everist 2124)*			
Fabaceae	*Hovea parvicalyx*			
Violaceae	*Hybanthus monopetalus*			
Violaceae	*Hybanthus stellarioides*			
Clusiaceae	*Hypericum gramineum*			
Fabaceae	*Indigofera haplophylla*			
Convolvulaceae	*Ipomoea aquatica*			
Convolvulaceae	*Ipomoea brownii*			
Convolvulaceae	*Ipomoea calobra*			
Poaceae	*Iseilema membranaceum*	small flinders grass		
Poaceae	*Iseilema vaginiflorum*	red flinders grass		
Fabaceae	*Jacksonia ramosissima*			
Convolvulaceae	*Jacquemontia paniculata*			
Oleaceae	*Jasminum didymum subsp. racemosum*			
Pedaliaceae	*Josephinia eugeniae*	josephinia burr		
Byttneriaceae	*Keraudrenia collina*			
Poaceae	*Leptochloa ligulata*			
Caesalpiniaceae	*Lysiphyllum carronii*	ebony tree		
Chenopodiaceae	*Maireana microphylla*			
Chenopodiaceae	*Maireana villosa*			
Malvaceae	*Malva parviflora*	small-flowered mallow	Introduced	
Malvaceae	*Malvastrum americanum var. americanum*		Introduced	
Apocynaceae	*Marsdenia australis*	doubah		
Apocynaceae	*Marsdenia microlepis*			
Marsileaceae	*Marsilea*			
Marsileaceae	*Marsilea drummondii*	common nardoo		
Marsileaceae	*Marsilea hirsuta*	hairy nardoo		
Myrtaceae	*Melaleuca nervosa*			
Myrtaceae	*Melaleuca pallescens*			
Myrtaceae	*Melaleuca tamariscina*			

Pentapetaceae	*Melhania oblongifolia*			
Poaceae	*Melinis repens*	red natal grass	Introduced	
Convolvulaceae	*Merremia peltata*	Cook's glory		
Loganiaceae	*Mitrasacme neldneri*			
Polygonaceae	*Muehlenbeckia florulenta*	lignum		
Commelinaceae	*Murdannia*			
Myoporaceae	*Myoporum acuminatum*	coastal boobialla		
Myoporaceae	*Myoporum montanum*	boobialla		
Mimosaceae	*Neptunia gracilis forma gracilis*			
Mimosaceae	*Neptunia monosperma*			
Menyanthaceae	*Nymphoides crenata*	wavy marshwort		
Rubiaceae	*Oldenlandia coerulescens*			
Convolvulaceae	*Operculina aequisepala*			
Cactaceae	*Opuntia*		Introduced	
Cactaceae	*Opuntia tomentosa*	velvety tree pear	Introduced	
Meliaceae	*Owenia acidula*	emu apple		
Poaceae	*Oxychloris scariosa*	winged chloris		
Bignoniaceae	*Pandorea pandorana*	wonga vine		
Poaceae	*Panicum effusum*			
Poaceae	*Panicum queenslandicum*			
Apocynaceae	*Parsonsia eucalyptophylla*	gargaloo		
Apocynaceae	*Parsonsia lanceolata*	northern silkpod		
Asteraceae	*Parthenium hysterophorus*	parthenium weed	Introduced	
Poaceae	*Paspalidium*			
Poaceae	*Paspalidium caespitosum*	brigalow grass		
Poaceae	*Paspalidium constrictum*			
Poaceae	*Paspalidium disjunctum*			
Poaceae	*Paspalidium distans*	shotgrass		
Poaceae	*Paspalidium jubiflorum*	warrego grass		
Poaceae	*Pennisetum ciliare*			
Poaceae	*Pennisetum pennisetiforme*		Introduced	
Scrophulariaceae	*Peplidium foecundum*			
Poaceae	*Perotis rara*	comet grass		
Picrodendraceae	*Petalostigma pubescens*	quinine tree		
Caesalpiniaceae	*Petalostylis labicheoides*			
Rutaceae	*Phebalium nottii*	pink phebalium		
Phyllanthaceae	*Phyllanthus carpentariae*			
Phyllanthaceae	*Phyllanthus collinus*			
Phyllanthaceae	*Phyllanthus maderaspatensis*			
Phyllanthaceae	*Phyllanthus sp. (Pentland R.J.Cumming 9742)*			
Phyllanthaceae	*Phyllanthus virgatus*			
Pittosporaceae	*Pittosporum angustifolium*			
Lamiaceae	*Plectranthus parviflorus*			
Convolvulaceae	*Polymeria pusilla*			

Portulacaceae	*Portulaca oleracea*	pigweed	Introduced	
Portulacaceae	*Portulaca pilosa*		Introduced	
Lamiaceae	*Prostanthera*			
Lamiaceae	*Prostanthera collina*			
Acanthaceae	*Pseuderanthemum variabile*	pastel flower		
Rubiaceae	*Psydrax attenuata*			
Amaranthaceae	*Ptilotus macrocephalus*	green pussytails		
Amaranthaceae	*Ptilotus nobilis*			
Amaranthaceae	*Ptilotus nobilis subsp. semilanatus*			
Amaranthaceae	*Ptilotus polystachyus*			
Fabaceae	*Rhynchosia minima*			
Euphorbiaceae	*Ricinocarpos ledifolius*	scrub wedding bush		
Acanthaceae	*Rostellularia adscendens*			
Acanthaceae	*Ruellia tuberosa*		Introduced	
Chenopodiaceae	*Salsola kali*			
Santalaceae	*Santalum lanceolatum*			
Apocynaceae	*Sarcostemma viminale subsp. brunonianum*			
Chenopodiaceae	*Sclerolaena muricata*			
Chenopodiaceae	*Sclerolaena muricata var. muricata*			
Chenopodiaceae	*Sclerolaena tetracuspis*	brigalow burr		
Scrophulariaceae	*Scoparia dulcis*	Scoparia	Introduced	
Caesalpiniaceae	*Senna artemisioides subsp. zygophylla*			
Fabaceae	*Sesbania*			
Fabaceae	*Sesbania cannabina*			
Fabaceae	*Sesbania cannabina var. cannabina*			
Poaceae	*Setaria surgens*			
Malvaceae	*Sida*			
Malvaceae	*Sida everistiana*			
Malvaceae	*Sida rohlenae*			
Malvaceae	*Sida trichopoda*			
Solanaceae	*Solanum*			
Solanaceae	*Solanum adenophorum*			
Solanaceae	*Solanum ellipticum*	potato bush	Endangered	
Solanaceae	*Solanum esuriale*	quena		
Asteraceae	*Sonchus oleraceus*	common sowthistle	Introduced	
Rubiaceae	*Spermacoce brachystema*			
Poaceae	*Sporobolus*			
Poaceae	*Sporobolus caroli*	fairy grass		
Poaceae	*Sporobolus mitchellii*	rat's tail couch		
Poaceae	*Sporobolus scabridus*			
Scrophulariaceae	*Stemodia florulenta*			
Asteraceae	*Streptoglossa adscendens*	desert daisy		
Fabaceae	*Stylosanthes guianensis var. intermedia*		Introduced	

Fabaceae	*Stylosanthes hamata*		Introduced	
Fabaceae	*Swainsona campylantha*			
Fabaceae	*Tephrosia astragaloides var. (Belyando Crossing E.J.Thompson+ 139)*			
Fabaceae	*Tephrosia filipes subsp. filipes*			
Combretaceae	*Terminalia oblongata*			
Lamiaceae	*Teucrium integrifolium*			
Poaceae	*Thellungia advena*	coolibah grass		
Poaceae	*Themeda triandra*	kangaroo grass		
Myrtaceae	*Thryptomene parviflora*			
Aizoaceae	*Trianthema triquetra*	red spinach		
Zygophyllaceae	*Tribulus micrococcus*	yellow vine		
Zygophyllaceae	*Tribulus terrestris*	caltrop		
Asteraceae	*Tridax procumbens*	tridax daisy	Introduced	
Poaceae	*Triodia longiceps*	giant grey spinifex		
Poaceae	*Triodia pungens*			
Poaceae	*Urochloa mosambicensis*	sabi grass	Introduced	
Rhamnaceae	*Ventilago viminalis*	supplejack		
Byttneriaceae	*Waltheria indica*			
Fabaceae	*Zornia floribunda*			

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Family	Botanical Name	NC Act Status	EPBC Act Status
Malvaceae	*Abelmoschus ficulneus* (L.) Wight & Arn. ex Wight		
Malvaceae	*Abutilon fraseri* (Hook.) Hook. ex Walp. subsp. *fraseri*		
Malvaceae	*Abutilon malvifolium* (Benth.) J.M.Black		
Malvaceae	*Abutilon nobile* Domin		
Mimosaceae	*Acacia argyrodendron* Domin		
Mimosaceae	*Acacia bancroftiorum* Maiden		
Mimosaceae	*Acacia cambagei* R.T.Baker		
Mimosaceae	*Acacia cowleana* Tate		
Mimosaceae	*Acacia cretata* Pedley - A.leiocalyx (Domin) Pedley		
Mimosaceae	*Acacia decora* Rchb.		
Mimosaceae	*Acacia excelsa* Benth. subsp. *excelsa*		
Mimosaceae	*Acacia galioides* Benth.		
Mimosaceae	*Acacia harpophylla* F.Muell. ex Benth.		
Mimosaceae	*Acacia hyaloneura* Pedley		
Mimosaceae	*Acacia julifera* Benth. *subsp. julifera*		
Mimosaceae	*Acacia julifera* subsp. *curvinervia (*Maiden) Pedley		
Mimosaceae	*Acacia lazaridis* Pedley		
Mimosaceae	*Acacia leptostachya* Benth.		
Mimosaceae	*Acacia melleodora* Pedley		
Mimosaceae	*Acacia multisiliqua* (Benth.) Maconochie		
Mimosaceae	*Acacia orthocarpa* F.Muell.		
Mimosaceae	*Acacia sericophylla* F.Muell.		
Mimosaceae	*Acacia shirleyi* Maiden		
Mimosaceae	*Acacia stenophylla* A.Cunn. ex Benth.		
Mimosaceae	*Acacia stipuligera* F.Muell.		
Mimosaceae	*Acacia tenuissima* F.Muell.		
Mimosaceae	*Acacia tephrina* Pedley		
Mimosaceae	*Acacia umbellata* A.Cunn. ex Benth.		
Amaranthaceae	*Achyranthes aspera* L.		
Poaceae	*Acrachne racemosa* (B.Heyne ex Roem. & Schult.) Ohwi		
Sapindaceae	*Alectryon diversifolius* (F.Muell.) S.T.Reynolds		
Sapindaceae	*Alectryon oleifolius subsp. elongatus* S.T.Reynolds		
Rhamnaceae	*Alphitonia excelsa* (Fenzl) Benth.		
Amaranthaceae	*Alternanthera denticulata* var. *micrantha* Benth.		
Amaranthaceae	*Alternanthera nodiflora* R.Br.		
Lythraceae	*Ammannia multiflora* Roxb.		
Loranthaceae	*Amyema miquelii (*Lehm. ex Miq.) Tiegh.		
Loranthaceae	*Amyema quandang var. bancroftii* (F.M.Bailey) Barlow		
Santalaceae	*Anthobolus leptomerioides* F.Muell.		
Capparaceae	*Apophyllum anomalum* F.Muell.		
Papaveraceae	*Argemone ochroleuca Sweet* subsp. *ochroleuca*	Introduced	
Poaceae	*Aristida calycina* R.Br.		
Poaceae	*Aristida calycina* R.Br. var. *calycina*		
Poaceae	*Aristida caput-medusae* Domin		
Poaceae	*Aristida holathera Domin* var. *holathera*		
Poaceae	*Aristida ingrata* Domin		
Poaceae	*Aristida jerichoensis* (Domin) Henrard var.		

Family	Botanical Name	NC Act Status	EPBC Act Status
	jerichoensis		
Poaceae	*Aristida jerichoensis var. subspinulifera Henrard*		
Poaceae	*Aristida latifolia Domin*		
Poaceae	*Aristida leptopoda Benth.*		
Poaceae	*Aristida pruinosa Domin*		
Poaceae	*Aristida sciuroides Domin*		
Rubiaceae	*Asperula conferta Hook.f.*		
Poaceae	*Astrebla elymoides F.Muell. ex F.M.Bailey*		
Poaceae	*Astrebla lappacea (Lindl.) Domin*		
Poaceae	*Astrebla squarrosa C.E.Hubb.*		
Sapindaceae	*Atalaya hemiglauca (F.Muell.) F.Muell. ex Benth.*		
Chenopodiaceae	*Atriplex lindleyi Moq. subsp. lindleyi*		
Pittosporaceae	*Auranticarpa rhombifolia (A.Cunn. ex Hook.) L.Cayzer, Crisp & I.Telford*		
Lamiaceae	*Basilicum polystachyon (L.) Moench*		
Nyctaginaceae	*Boerhavia*		
Nyctaginaceae	*Boerhavia pubescens R.Br.*		
Nyctaginaceae	*Boerhavia sp. (St George A.Hill AQ399299)*		
Convolvulaceae	*Bonamia media (R.Br.) Hallier f.*		
Poaceae	*Bothriochloa bladhii (Retz.) S.T.Blake subsp. bladhii*		
Poaceae	*Bothriochloa erianthoides (F.Muell.) C.E.Hubb.*		
Poaceae	*Bothriochloa ewartiana (Domin) C.E.Hubb.*		
Asteraceae	*Brachyscome dentata Gaudich.*		
Acanthaceae	*Brunoniella australis (Cav.) Bremek.*		
Asphodelaceae	*Bulbine bulbosa (R.Br.) Haw.*		
Pittosporaceae	*Bursaria incana Lindl.*		
Johnsoniaceae	*Caesia parviflora var. vittata (R.Br.) R.J.F.Hend.*		
Portulacaceae	*Calandrinia pickeringii A.Gray*		
Amaryllidaceae	*Calostemma luteum Sims*		
Asteraceae	*Calotis xanthosioidea Domin*		
Capparaceae	*Capparis mitchellii Lindl.*		
Sapindaceae	*Cardiospermum halicacabum L. var. halicacabum*	Introduced	
Apocynaceae	*Carissa lanceolata R.Br.*		
Apocynaceae	*Carissa ovata R.Br.*		
Asteraceae	*Carthamus lanatus L.*	Introduced	
Caesalpiniaceae	*Cassia brewsteri (F.Muell.) F.Muell. ex Benth.*		
Casuarinaceae	*Casuarina cristata Miq.*		
Poaceae	*Cenchrus ciliaris L.*	Introduced	
Poaceae	*Cenchrus pennisetiformis Hochst. & Steud.*	Introduced	
Euphorbiaceae	*Chamaesyce dallachyana (Baill.) D.C.Hassall*		
Adiantaceae	*Cheilanthes distans (R.Br.) Mett.*		
Chenopodiaceae	*Chenopodium auricomum Lindl.*		
Poaceae	*Chionachne hubbardiana Henrard*		
Poaceae	*Chrysopogon fallax S.T.Blake*		
Rutaceae	*Citrus glauca (Lindl.) Burkill*		
Lamiaceae	*Clerodendrum floribundum R.Br.*		
Lamiaceae	*Clerodendrum tomentosum (Vent.) R.Br.*		
Commelinaceae	*Commelina ensifolia R.Br.*		
Commelinaceae	*Commelina lanceolata R.Br.*		
Convolvulaceae	*Convolvulus graminetinus R.W.Johnson*		
Asteraceae	*Coronidium glutinosum (Hook.) Paul G.Wilson*		

Family	Botanical Name	NC Act Status	EPBC Act Status
Asteraceae	*Coronidium lanuginosum (A.Cunn. ex DC.) Paul G.Wilson*		
Myrtaceae	*Corymbia clarksoniana (D.J.Carr & S.G.M.Carr) K.D.Hill & L.A.S.Johnson*		
Myrtaceae	*Corymbia lamprophylla (Brooker & A.R.Bean) K.D.Hill & L.A.S.Johnson*		
Myrtaceae	*Corymbia setosa subsp. pedicellaris K.D.Hill & L.A.S.Johnson*		
Fabaceae	*Crotalaria dissitiflora Benth. subsp. dissitiflora*		
Fabaceae	*Crotalaria mitchellii Benth. subsp. mitchellii*		
Euphorbiaceae	*Croton phebalioides F.Muell. ex Muell.Arg.*		
Cucurbitaceae	*Cucumis anguria L. var. anguria*	Introduced	
Cucurbitaceae	*Cucumis melo subsp. agrestis (Naudin) Pangalo*		
Commelinaceae	*Cyanotis axillaris (L.) D.Don*		
Poaceae	*Cymbopogon bombycinus (R.Br.) Domin*		
Poaceae	*Cymbopogon queenslandicus S.T.Blake*		
Poaceae	*Cymbopogon refractus (R.Br.) A.Camus*		
Poaceae	*Cynodon dactylon (L.) Pers. var. dactylon*	Introduced	
Cyperaceae	*Cyperus bifax C.B.Clarke*		
Cyperaceae	*Cyperus concinnus R.Br.*		
Cyperaceae	*Cyperus exaltatus Retz.*		
Cyperaceae	*Cyperus gilesii Benth.*		
Cyperaceae	*Cyperus isabellinus K.L.Wilson*		
Poaceae	*Dactyloctenium radulans (R.Br.) P.Beauv.*		
Loranthaceae	*Dendrophthoe glabrescens (Blakely) Barlow*		
Rubiaceae	*Dentella repens (L.) J.R.Forst. & G.Forst.*		
Fabaceae	*Desmodium campylocaulon F.Muell. ex Benth.*		
Fabaceae	*Desmodium muelleri Benth.*		
Hemerocallidaceae	*Dianella longifolia R.Br. var. longifolia*		
Poaceae	*Dichanthium fecundum S.T.Blake*		
Poaceae	*Dichanthium sericeum (R.Br.) A.Camus subsp. sericeum*		
Poaceae	*Dichanthium tenue (R.Br.) A.Camus*		
Poaceae	*Digitaria breviglumis (Domin) Henrard*		
Poaceae	*Digitaria brownii (Roem. & Schult.) Hughes*		
Acanthaceae	*Dipteracanthus australasicus subsp. corynothecus (F.Muell. ex Benth.) R.M.Barker*		
Chenopodiaceae	*Dissocarpus biflorus var. cephalocarpus (F.Muell.) A.J.Scott*		
Sapindaceae	*Dodonaea dodecandra (Domin) M.G.Harr.*		
Sapindaceae	*Dodonaea lanceolata var. subsessilifolia J.G.West*		
Chenopodiaceae	*Dysphania rhadinostachya subsp. inflata (Aellen) Paul G.Wilson*		
Poaceae	*Echinochloa turneriana (Domin) J.M.Black*		
Boraginaceae	*Ehretia membranifolia R.Br.*		
Chenopodiaceae	*Einadia nutans (R.Br.) A.J.Scott subsp. nutans*		
Chenopodiaceae	*Einadia nutans subsp. linifolia (R.Br.) Paul G.Wilson*		
Cyperaceae	*Eleocharis pallens S.T.Blake*		
Poaceae	*Elytrophorus spicatus (Willd.) E.G.Camus & A.Camus*		
Chenopodiaceae	*Enchylaena tomentosa R.Br.*		
Poaceae	*Enneapogon gracilis (R.Br.) P.Beauv.*		
Poaceae	*Enneapogon lindleyanus (Domin) C.E.Hubb.*		
Poaceae	*Enneapogon robustissimus (Domin) N.T.Burb.*		

Family	Botanical Name	NC Act Status	EPBC Act Status
Poaceae	*Enneapogon truncatus Kakudidi*		
Poaceae	*Enneapogon virens (Lindl.) Kakudidi*		
Poaceae	*Enteropogon ramosus B.K.Simon*		
Asteraceae	*Epaltes australis Less.*		
Poaceae	*Eragrostis confertiflora J.M.Black*		
Poaceae	*Eragrostis elongata (Willd.) J.Jacq.*		
Poaceae	*Eragrostis exigua Lazarides*		
Poaceae	*Eragrostis falcata (Gaudich.) Gaudich. ex Steud.*		
Poaceae	*Eragrostis lacunaria F.Muell. ex Benth.*		
Poaceae	*Eragrostis parviflora (R.Br.) Trin.*		
Poaceae	*Eragrostis setifolia Nees*		
Poaceae	*Eragrostis sororia Domin*		
Poaceae	*Eragrostis speciosa (Roem. & Schult.) Steud.*		
Poaceae	*Eragrostis tenellula (Kunth) Steud.*		
Poaceae	*Eragrostis xerophila Domin*		
Myoporaceae	*Eremophila bignoniiflora (Benth.) F.Muell.*		
Myoporaceae	*Eremophila deserti (A.Cunn. ex Benth.) Chinnock*		
Myoporaceae	*Eremophila glabra (R.Br.) Ostenf. - E.latrobei F.Muell.*		
Myoporaceae	*Eremophila latrobei F.Muell.*		
Myoporaceae	*Eremophila longifolia (R.Br.) F.Muell.*		
Myoporaceae	*Eremophila maculata (Ker Gawl.) F.Muell. subsp. maculata*		
Myoporaceae	*Eremophila mitchellii Benth.*		
Myoporaceae	*Eremophila polyclada (F.Muell.) F.Muell.*		
Poaceae	*Eriachne aristidea F.Muell.*		
Poaceae	*Eriachne mucronata forma (Alpha C.E.Hubbard 7882)*		
Poaceae	*Eriachne obtusa R.Br.*		
Poaceae	*Eriochloa crebra S.T.Blake*		
Poaceae	*Eriochloa procera (Retz.) C.E.Hubb.*		
Poaceae	*Eriochloa pseudoacrotricha (Stapf ex Thell.) J.M.Black*		
Apiaceae	*Eryngium plantagineum F.Muell.*		
Myrtaceae	*Eucalyptus camaldulensis subsp. acuta Brooker & M.W.McDonald*		
Myrtaceae	*Eucalyptus cambageana Maiden*		
Myrtaceae	*Eucalyptus cloeziana F.Muell.*		
Myrtaceae	*Eucalyptus crebra F.Muell. x E.populnea F.Muell.*		
Myrtaceae	*Eucalyptus drepanophylla F.Muell. ex Benth.*		
Myrtaceae	*Eucalyptus melanophloia F.Muell. x E.populnea F.Muell.*		
Myrtaceae	*Eucalyptus persistens L.A.S.Johnson & K.D.Hill*		
Myrtaceae	*Eucalyptus populnea F.Muell.*		
Myrtaceae	*Eucalyptus thozetiana F.Muell. ex R.T.Baker*		
Myrtaceae	*Eucalyptus xanthoclada Brooker & A.R.Bean*		
Poaceae	*Eulalia aurea (Bory) Kunth*		
Euphorbiaceae	*Euphorbia tannensis subsp. eremophila (A.Cunn.) D.C.Hassall*		
Anacardiaceae	*Euroschinus falcatus var. angustifolius Benth.*		
Convolvulaceae	*Evolvulus alsinoides (L.) L.*		
Convolvulaceae	*Evolvulus alsinoides var. decumbens (R.Br.) Ooststr.*		
Santalaceae	*Exocarpos sparteus R.Br.*		

Family	Botanical Name	NC Act Status	EPBC Act Status
Cyperaceae	*Fimbristylis aestivalis (Retz.) Vahl*		
Cyperaceae	*Fimbristylis neilsonii F.Muell.*		
Asteraceae	*Flaveria trinervia (Spreng.) C.Mohr*	Introduced	
Phyllanthaceae	*Flueggea leucopyrus Willd.*		
Cyperaceae	*Fuirena incrassata S.T.Blake*		
Fabaceae	*Galactia tenuiflora var. lucida Baker*		
Rutaceae	*Geijera parviflora Lindl.*		
Rutaceae	*Geijera salicifolia Schott*		
Molluginaceae	*Glinus lotoides L.*		
Phyllanthaceae	*Glochidion ferdinandi (Muell.Arg.) F.M.Bailey*		
Fabaceae	*Glycine falcata Benth.*		
Goodeniaceae	*Goodenia*		
Goodeniaceae	*Goodenia armitiana F.Muell.*		
Goodeniaceae	*Goodenia byrnesii Carolin*		
Goodeniaceae	*Goodenia fascicularis F.Muell. & Tate*		
Goodeniaceae	*Goodenia hirsuta F.Muell.*		
Goodeniaceae	*Goodenia strangfordii F.Muell.*		
Malvaceae	*Gossypium australe F.Muell.*		
Proteaceae	*Grevillea decora Domin subsp. decora*		
Proteaceae	*Grevillea parallela Knight*		
Proteaceae	*Grevillea sessilis C.T.White & W.D.Francis*		
Sparrmanniaceae	*Grewia latifolia F.Muell. ex Benth.*		
Proteaceae	*Hakea lorea (R.Br.) R.Br. subsp. lorea*		
Boraginaceae	*Heliotropium geocharis Domin*		
Boraginaceae	*Heliotropium ovalifolium Forssk.*		
Boraginaceae	*Heliotropium tenuifolium R.Br.*		
Malvaceae	*Herissantia crispa (L.) Brizicky*		
Poaceae	*Heteropogon contortus (L.) P.Beauv. ex Roem. & Schult.*		
Malvaceae	*Hibiscus sp. (Emerald S.L.Everist 2124)*		
Malvaceae	*Hibiscus trionum var. vesicarius (Cav.) Hochr.*		
Fabaceae	*Hovea parvicalyx I.Thomps.*		
Violaceae	*Hybanthus stellarioides (Domin) P.I.Forst.*		
Hypoxidaceae	*Hypoxis arillacea R.J.F.Hend.*		
Fabaceae	*Indigastrum parviflorum (B.Heyne ex Wight & Arn.) Schrire*		
Fabaceae	*Indigofera haplophylla F.Muell.*		
Fabaceae	*Indigofera hirsuta L.*		
Convolvulaceae	*Ipomoea aquatica Forssk.*		
Convolvulaceae	*Ipomoea brownii Roem. & Schult.*		
Convolvulaceae	*Ipomoea calobra W.Hill & F.Muell.*		
Convolvulaceae	*Ipomoea lonchophylla J.M.Black*		
Poaceae	*Iseilema membranaceum (Lindl.) Domin*		
Poaceae	*Iseilema vaginiflorum Domin*		
Fabaceae	*Jacksonia ramosissima Benth.*		
Convolvulaceae	*Jacquemontia paniculata (Burm.f.) Hallier f.*		
Convolvulaceae	*Jacquemontia sp. (Fairview R.W.Johnson 4026)*		
Oleaceae	*Jasminum didymum subsp. racemosum (F.Muell.) P.S.Green*		
Pedaliaceae	*Josephinia eugeniae F.Muell.*		
Byttneriaceae	*Keraudrenia collina Domin*		
Byttneriaceae	*Keraudrenia hookeriana Walp.*		

Family	Botanical Name	NC Act Status	EPBC Act Status
Byttneriaceae	*Keraudrenia nephrosperma Benth.*		
Brassicaceae	*Lepidium sagittulatum Thell.*		
Poaceae	*Leptochloa fusca (L.) Kunth subsp. fusca*		
Poaceae	*Leptochloa ligulata Lazarides*		
Fabaceae	*Leptosema oxylobioides F.Muell.*		
Myrtaceae	*Lithomyrtus microphylla (Benth.) N.Snow & Guymer*		
Campanulaceae	*Lobelia concolor R.Br.*		
Caesalpiniaceae	*Lysiphyllum carronii (F.Muell.) Pedley*		
Chenopodiaceae	*Maireana villosa (Lindl.) Paul G.Wilson*		
Malvaceae	*Malvastrum americanum (L.) Torr. var. americanum*	Introduced	
Apocynaceae	*Marsdenia microlepis Benth.*		
Apocynaceae	*Marsdenia viridiflora R.Br. subsp. viridiflora*		
Marsileaceae	*Marsilea hirsuta R.Br.*		
Celastraceae	*Maytenus cunninghamii (Hook.) Loes.*		
Myrtaceae	*Melaleuca*		
Myrtaceae	*Melaleuca bracteata F.Muell.*		
Myrtaceae	*Melaleuca nervosa (Lindl.) Cheel subsp. nervosa*		
Myrtaceae	*Melaleuca pallescens Byrnes*		
Myrtaceae	*Melaleuca tamariscina Hook.f.*		
Myrtaceae	*Melaleuca trichostachya Lindl.*		
Pentapetaceae	*Melhania ovata (Cav.) Spreng.*		
Scrophulariaceae	*Mimulus*		
Loganiaceae	*Mitrasacme neldneri Dunlop*		
Polygonaceae	*Muehlenbeckia florulenta Meisn.*		
Rutaceae	*Murraya ovatifoliolata (Engl.) Domin*		
Myoporaceae	*Myoporum montanum R.Br.*		
Oleaceae	*Notelaea microcarpa R.Br. var. microcarpa*		
Menyanthaceae	*Nymphoides crenata (F.Muell.) Kuntze*		
Lamiaceae	*Ocimum tenuiflorum L.*		
Rubiaceae	*Oldenlandia coerulescens (F.Muell.) F.Muell.*		
Rubiaceae	*Oldenlandia galioides (F.Muell.) F.Muell.*		
Meliaceae	*Owenia acidula F.Muell.*		
Oxalidaceae	*Oxalis corniculata L.*	Introduced	
Poaceae	*Oxychloris scariosa (F.Muell.) Lazarides*		
Poaceae	*Panicum decompositum R.Br. var. decompositum*		
Poaceae	*Panicum laevinode Lindl.*		
Poaceae	*Panicum larcomianum Hughes*		
Caesalpiniaceae	*Parkinsonia aculeata L.*	Introduced	
Apocynaceae	*Parsonsia eucalyptophylla F.Muell.*		
Asteraceae	*Parthenium hysterophorus L.*	Introduced	
Poaceae	*Paspalidium caespitosum C.E.Hubb.*		
Poaceae	*Paspalidium disjunctum S.T.Blake*		
Poaceae	*Paspalidium globoideum (Domin) Hughes*		
Poaceae	*Paspalidium gracile (R.Br.) Hughes*		
Poaceae	*Paspalidium jubiflorum (Trin.) Hughes*		
Poaceae	*Paspalidium rarum (R.Br.) Hughes*		
Scrophulariaceae	*Peplidium foecundum W.R.Barker*		
Poaceae	*Perotis rara R.Br.*		
Polygonaceae	*Persicaria attenuata (R.Br.) Sojak*		
Polygonaceae	*Persicaria lapathifolia (L.) Gray*		
Picrodendraceae	*Petalostigma banksii Britten & S.Moore*		

Family	Botanical Name	NC Act Status	EPBC Act Status
Picrodendraceae	*Petalostigma pubescens Domin*		
Caesalpiniaceae	*Petalostylis labicheoides R.Br.*		
Rutaceae	*Phebalium nottii (F.Muell.) Maiden & Betche*		
Phyllanthaceae	*Phyllanthus collinus Domin*		
Phyllanthaceae	*Phyllanthus fuernrohrii F.Muell.*		
Phyllanthaceae	*Phyllanthus maderaspatensis L.*		
Phyllanthaceae	*Phyllanthus virgatus G.Forst.*		
Asteraceae	*Pluchea baccharoides (F.Muell.) F.Muell. ex Benth.*		
Asteraceae	*Pluchea dunlopii Hunger*		
Plumbaginaceae	*Plumbago zeylanica L.*		
Convolvulaceae	*Polymeria longifolia Lindl.*		
Convolvulaceae	*Polymeria marginata Benth.*		
Convolvulaceae	*Polymeria pusilla R.Br.*		
Portulacaceae	*Portulaca sp. (Blackall G.Le Gros AQ101965)*		
Lamiaceae	*Prostanthera collina Domin*		
Acanthaceae	*Pseuderanthemum variabile (R.Br.) Radlk.*		
Asteraceae	*Pseudognaphalium luteoalbum (L.) Hilliard & B.L.Burtt*		
Asteraceae	*Pterocaulon serrulatum (Montrouz.) Guillaumin var. serrulatum*		
Amaranthaceae	*Ptilotus nobilis subsp. semilanatus (Lindl.) A.R.Bean*		
Amaranthaceae	*Ptilotus polystachyus (Gaudich.) F.Muell.*		
Fabaceae	*Rhynchosia minima var. australis (Benth.) C.Moore*		
Brassicaceae	*Rorippa eustylis (F.Muell.) L.A.S.Johnson*		
Acanthaceae	*Rostellularia adscendens var. clementii (Domin) R.M.Barker*		
Chenopodiaceae	*Salsola australis R.Br.*		
Santalaceae	*Santalum lanceolatum R.Br.*		
Apocynaceae	*Sarcostemma viminale subsp. brunonianum (Wight & Arn.) P.I.Forst.*		
Gentianaceae	*Schenkia australis (R.Br.) G.Mans.*		
Poaceae	*Schizachyrium fragile (R.Br.) A.Camus*		
Chenopodiaceae	*Sclerolaena bicornis Lindl.*		
Chenopodiaceae	*Sclerolaena muricata (Moq.) Domin var. muricata*		
Chenopodiaceae	*Sclerolaena tetracuspis (C.T.White) A.J.Scott*		
Chenopodiaceae	*Sclerolaena tricuspis (F.Muell.) Ulbr.*		
Apocynaceae	*Secamone elliptica R.Br.*		
Poaceae	*Sehima nervosum (Rottler) Stapf*		
Caesalpiniaceae	*Senna artemisioides subsp. oligophylla (F.Muell.) Randell*		
Caesalpiniaceae	*Senna circinnata (Benth.) Randell*		
Caesalpiniaceae	*Senna coronilloides (Benth.) Randell*		
Caesalpiniaceae	*Senna costata (J.F.Bailey & C.T.White) Randell*		
Fabaceae	*Sesbania cannabina (Retz.) Poir. var. cannabina*		
Poaceae	*Setaria dielsii R.A.W.Herrm.*		
Poaceae	*Setaria paspalidioides Vickery*		
Malvaceae	*Sida aprica var. solanacea Domin*		
Malvaceae	*Sida atherophora Domin*		
Malvaceae	*Sida rohlenae Domin subsp. rohlenae*		
Malvaceae	*Sida trichopoda var. (Palardo S.T.Blake 7600)*		
Solanaceae	*Solanum adenophorum F.Muell.*	Endangered	
Solanaceae	*Solanum ellipticum R.Br.*		
Solanaceae	*Solanum esuriale Lindl.*		

Family	Botanical Name	NC Act Status	EPBC Act Status
Solanaceae	*Solanum galbinum A.R.Bean*		
Asteraceae	*Sonchus oleraceus L.*	Introduced	
Poaceae	*Sorghum bicolor (L.) Moench*	Introduced	
Asteraceae	*Sphaeranthus indicus L.*		
Poaceae	*Sporobolus actinocladus (F.Muell.) F.Muell.*		
Poaceae	*Sporobolus australasicus Domin*		
Poaceae	*Sporobolus caroli Mez*		
Poaceae	*Sporobolus contiguus S.T.Blake*		
Poaceae	*Sporobolus disjunctus R.Mills ex B.K.Simon*		
Poaceae	*Sporobolus mitchellii (Trin.) C.E.Hubb. ex S.T.Blake*		
Poaceae	*Sporobolus scabridus S.T.Blake*		
Scrophulariaceae	*Stemodia florulenta W.R.Barker*		
Scrophulariaceae	*Stemodia glabella W.R.Barker*		
Scrophulariaceae	*Stemodia grossa Benth.*		
Asteraceae	*Streptoglossa adscendens (Benth.) Dunlop*		
Fabaceae	*Stylosanthes guianensis var. intermedia (Vogel) Hassl.*	Introduced	
Fabaceae	*Tephrosia astragaloides var. (Belyando Crossing E.J.Thompson+ 139)*		
Fabaceae	*Tephrosia brachyodon var. longifolia (Benth.) Domin*		
Fabaceae	*Tephrosia filipes Benth. subsp. filipes*		
Combretaceae	*Terminalia aridicola Domin subsp. aridicola*		
Combretaceae	*Terminalia oblongata F.Muell. subsp. oblongata*		
Lamiaceae	*Teucrium integrifolium F.Muell.*		
Poaceae	*Thellungia advena Stapf ex Probst*		
Poaceae	*Themeda avenacea (F.Muell.) Maiden & Betche*		
Poaceae	*Themeda triandra Forssk.*		
Myrtaceae	*Thryptomene parviflora (F.Muell. ex Benth.) Domin*		
Poaceae	*Tragus australianus S.T.Blake*		
Aizoaceae	*Trianthema triquetra Rottb. ex Willd.*		
Zygophyllaceae	*Tribulus micrococcus Domin*		
Boraginaceae	*Trichodesma zeylanicum (Burm.f.) R.Br. var. zeylanicum*		
Poaceae	*Triodia pungens R.Br.*		
Poaceae	*Tripogon loliiformis (F.Muell.) C.E.Hubb.*		
Poaceae	*Triraphis mollis R.Br.*		
Poaceae	*Urochloa gilesii (Benth.) Hughes var. gilesii*		
Poaceae	*Urochloa piligera (F.Muell. ex Benth.) R.D.Webster*		
Poaceae	*Urochloa praetervisa (Domin) Hughes*		
Poaceae	*Urochloa reptans (L.) Stapf*		
Rhamnaceae	*Ventilago viminalis Hook.*		
Verbenaceae	*Verbena macrostachya F.Muell.*		
Poaceae	*Whiteochloa airoides (R.Br.) Lazarides*		
Asteraceae	*Xanthium occidentale Bertol.*	Introduced	
Fabaceae	*Zornia adenophora (Domin) Mohlenbr.*		
Fabaceae	*Zornia floribunda S.T.Reynolds & A.E.Holland*		

Queensland Museum Database Search Results

Family	Scientific Name	Common Name	NC Act Status	EPBC Act Status
Amphibians				
Hylidae	Cyclorana alboguttata	Green-stripe Frog		
Hylidae	Cyclorana brevipes	Superb Collared-frog		
Hylidae	Cyclorana novaehollandiae	New Holland Frog		
Limnodynastidae	Platyplectrum ornatum	Ornate Burrowing Frog		
Hylidae	Litoria rubella	Naked Treefrog		
Hylidae	Litoria wilcoxii			
Bufonidae	Rhinella marina	Cane Toad		
Limnodynastidae	Notaden bennettii	Holy Cross Toad		
Reptiles				
Agamidae	Amphibolurus nobbi	Nobbi Dragon		
Pythonidae	Antaresia maculosa	Spotted Python		
Scincidae	Carlia pectoralis	Open-litter Rainbow Skink		
Scincidae	Carlia rhomboidalis	Blue-throated Rainbow-skink		
Scincidae	Cryptoblepharus plagiocephalus	Callose-palmed Shinning-skink		
Scincidae	Cryptoblepharus virgatus	Wall Skink		
Elapidae	Cryptophis boschmai	Carpentaria Snake		
Scincidae	Ctenotus ingrami	Unspotted Yellow-sided Ctenotus		
Scincidae	Ctenotus robustus	Eastern Striped Skink		
Scincidae	Ctenotus strauchii	Eastern Barred Wedge-snout Cteno		
Scincidae	Ctenotus taeniolatus	Copper-tailed Skink		
Elapidae	Demansia psammophis	Yellow-faced Whip Snake		
Elapidae	Denisonia maculata	Ornamental Snake		Vulnerable
Diplodactylidae	Diplodactylus conspicillatus	Fat-tailed Gecko		
Diplodactylidae	Diplodactylus vittatus	Stone Gecko		
Varanidae	Varanus tristis	Black-headed Monitor		
Gekkonidae	Heteronotia binoei	Bynoe's Gecko		
Scincidae	Lampropholis adonis			
Scincidae	Lampropholis delicata	Garden Skink		
Scincidae	Lerista fragilis	Eastern Mulch-slider		
Pygopodidae	Lialis burtonis	Burton's Snake Lizard		
Diplodactylidae	Strophurus williamsi	Eastern Spiny-tailed Gecko		
Scincidae	Eremiascincus fasciolatus	Narrow-banded Sand-swimmer		
Diplodactylidae	Lucasium steindachneri	Box-patterned Gecko		
Scincidae	Menetia greyii	Common Dwarf Skink		
Scincidae	Morethia boulengeri	South-eastern Morethia Skink		
Carphodactylidae	Nephrurus asper	Prickly Knob-tailed Gecko		
Scincidae	Saproscincus hannahae			
Typhlopidae	Ramphotyphlops ligatus	Robust Blind Snake		
Typhlopidae	Ramphotyphlops unguirostris	Claw-snouted Blind Snake		
Diplodactylidae	Oedura ocellata	Ocellated Velvet Gecko		
Mammals				
Macropodidae	Macropus dorsalis	Black-striped wallaby		
Macropodidae	Macropus giganteus	Eastern grey kangaroo		
Macropodidae	Macropus robustus	Common wallaroo		
Macropodidae	Macropus rufus	Red kangaroo		
Dasyuridae	Sminthopsis sp	Dunnart		

Family	Scientific Name	Common Name	NC Act Status	EPBC Act Status
Potoroidae	Aepyprymnus rufescens	Rufous bettong		
Dasyuridae	Dasyurus hallucatus	Northern quoll		Endangered
Phalangeridae	Trichosurus vulpecula	Common brushtail possum		
Macropodidae	Wallabia bicolor	Swamp wallaby		
Macropodidae	Lagorchestes conspicillatus	Spectacled Hare -wallaby		
Peramelidae	Isoodon macrourus	Northern brown bandicoot		
Emballonuridae	Saccolaimus flaviventris	Yellow-bellied sheathtail-bat		
Muridae	Pseudomys delicatulus	Delicate mouse		
Macropodidae	Petrogale assimilis	Allied Rock-wallaby		
Birds				
Meliphagidae	Lichenostomus penicillatus	White-plumed Honeyeater		
Meliphagidae	Lichenostomus plumulus	Grey-fronted Honeyeater		
Charadriidae	Elseyornis melanops	Black-fronted Dotterel		
Psittacidae	Melopsittacus undulatus	Budgerygah		
Petroicidae	Microeca fascinans	Jacky Winter		
Strigidae	Ninox novaeseelandiae	Boobook Owl		Marine
Podargidae	Podargus strigoides	Tawny Frogmouth		

Birds Australia Database Search Results

Family	Scientific Name	Common Name	NC Act Status	EPBC Act Status
Anatidae	Anas gracilis	Grey Teal		
Anatidae	Anas superciliosa	Pacific Black Duck		
Anhingidae	Anhinga novaehollandiae	Australasian Darter		
Motacillidae	Anthus novaeseelandiae	Australasian Pipit		Marine
Psittacidae	Aprosmictus erythropterus	Red-winged Parrot		
Accipitridae	Aquila audax	Wedge-tailed Eagle		
Ardeidae	Ardea intermedia	Intermediate Egret		Marine
Ardeidae	Ardea modesta	Eastern Great Egret		Marine
Ardeidae	Ardea pacifica	White-necked Heron		
Otitidae	Ardeotis australis	Australian Bustard		
Artamidae	Artamus cinereus	Black-faced Woodswallow		
Artamidae	Artamus leucorynchus	White-breasted Woodswallow		
Anatidae	Aythya australis	Hardhead		
Cacatuidea	Cacatua galerita	Sulphur-crested Cockatoo		
Cacatuidea	Cacatua sanguinea	Little Corella		
Cuculidae	Cacomantis variolosus	Brush Cuckoo		
Cuculidae	Centropus phasianinus	Pheasant Coucal		
Accipitridae	Circus assimilis	Spotted Harrier		
Campephagidaea	Coracina novaehollandiae	Black-faced Cuckoo-shrike		Marine
Corvidae	Corvus coronoides	Australian Raven		
Corvidae	Corvus orru	Torresian Crow		
Phasianidae	Coturnix pectoralis	Stubble Quail		Marine
Artamidae	Cracticus nigrogularis	Pied Butcherbird		
Artamidae	Cracticus tibicen	Australian Magpie		
Artamidae	Cracticus torquatus	Grey Butcherbird		
Halcyonidae	Dacelo novaeguineae	Laughing Kookaburra		
Anatidae	Dendrocygna eytoni	Plumed Whistling-Duck		
Ardeidae	Egretta novaehollandiae	White-faced Heron		
Accipitridae	Elanus axillaris	Black-shouldered Kite		
Meliphagidae	Entomyzon cyanotis	Blue-faced Honeyeater		
Cacatuidea	Eolophus roseicapillus	Galah		
Falconidae	Falco berigora	Brown Falcon		
Falconidae	Falco cenchroides	Nankeen Kestrel		Marine
Falconidae	Falco hypoleucos	Grey Falcon	Near Threatened	
Falconidae	Falco longipennis	Australian Hobby		
Rallidae	Gallinula tenebrosa	Dusky Moorhen		
Columbidae	Geophaps scripta	Squatter Pigeon	Vulnerable	Vulnerable
Monarchidae	Grallina cyanoleuca	Magpie-lark		
Gruidae	Grus rubicunda	Brolga		
Accipitridae	Haliastur sphenurus	Whistling Kite		Marine

Family	Scientific Name	Common Name	NC Act Status	EPBC Act Status
Hirundinidae	Hirundo neoxena	Welcome Swallow		
Jacanidae	Irediparra gallinacea	Comb-crested Jacana		
Meliphagidae	Lichenostomus penicillatus	White-plumed Honeyeater		
Anatidae	Malacorhynchus membranaceus	Pink-eared Duck		
Meliphagidae	Manorina flavigula	Yellow-throated Miner		
Phalacrocoracidae	Microcarbo melanoleucos	Little Pied Cormorant		
Accipitridae	Milvus migrans	Black Kite		
Anatidae	Nettapus coromandelianus	Cotton Pygmy-goose	NT	Marine
Ardeidae	Nycticorax caledonicus	Nankeen Night-Heron		Marine
Cacatuidea	Nymphicus hollandicus	Cockatiel		
Columbidae	Ocyphaps lophotes	Crested Pigeon		
Hirundinidae	Petrochelidon ariel	Fairy Martin		
Phalacrocoracidae	Phalacrocorax sulcirostris	Little Black Cormorant		
Meliphagidae	Philemon citreogularis	Little Friarbird		
Threskiornithidae	Platalea flavipes	Yellow-billed Spoonbill		
Psittacidae	Platycercus adscitus	Pale-headed Rosella		
Podicipedidae	Poliocephalus poliocephalus	Hoary-headed Grebe		
Pomatostomidae	Pomatostomus temporalis	Grey-crowned Babbler		
Rallidae	Porphyrio porphyrio	Purple Swamphen		
Ptilonorhynchidae	Ptilonorhynchus maculatus	Spotted Bowerbird		
Rhipiduridae	Rhipidura albiscapa	Grey Fantail		
Rhipiduridae	Rhipidura leucophrys	Willie Wagtail		
Oriolidae	Sphecotheres vieilloti	Australasian Figbird		
Corcoracidae	Struthidea cinerea	Apostlebird		
Podicipedidae	Tachybaptus novaehollandiae	Australasian Grebe		
Threskiornithidae	Threskiornis molucca	Australian White Ibis		Marine
Threskiornithidae	Threskiornis spinicollis	Straw-necked Ibis		Marine
Halcyonidae	Todiramphus pyrrhopygius	Red-backed Kingfisher		
Psittacidae	Trichoglossus chlorolepidotus	Scaly-breasted Lorikeet		
Psittacidae	Trichoglossus haematodus	Rainbow Lorikeet		
Turnicidae	Turnix velox	Little Button-quail		

Appendix D

Flora Survey Results

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Flora Species List

Family	Taxon[1]	Common Name	Life Form[2]	May 2011 Site	Sept 2011 Site
Amaranthaceae	*Alternanthera micrantha*	joyweed	H	Q3, Q7, Q8, Q9, Q10	
Amaranthaceae	*Alternanthera nana*	hairy joyweed	H	Q1, Q2, Q5, Q8, Q11	Q12, Q14, Q15
Amaryllidaceae	*Crinum sp.*	a lily	R		Q15
Apocynaceae	*Carissa ovata*	current bush	S	Q4, Q6	Q13, Q15, Q16, Q17, Q23
Apocynaceae	*Parsonsia sp.*	geebung	S		Q24
Apocynaceae	*Sarcostemma viminale subsp. brunonianum*	caustic vine	V	Q4	
Asteraceae	*Acmella grandiflora var. brachyglossa*	yellow daisy		Q8, Q9	
Asteraceae	*Calotis cuneifolia*	purple burr-daisy	H		Q14, Q15, Q20
Asteraceae	*Gnaphalium diamantinense*		H	Q6	
Asteraceae	*Pterocaulon sphacelatum*	fruit-salad plant	H	Q6	Q12
Asteraceae	**Xanthium occidentale*	Noogoora burr	H	Q8, Q9	Q12
Asteraceae	*Brachyscome sp.*	white daisy	H	Q2, Q3	
Asteraceae	*Centipeda sp.*		H	Q5	
Asteraceae	**Parthenium hysterophorus*	parthenium	H	Q4, Q11	Q12, Q13, Q14, Q15, Q21, Q22, Q24
Boraginaceae	*Ehretia membranifolia*	peach bush	S		Q17
Brassicaceae	*Lepidium bonariense*	cut-leaf peppercress	H	Q1, Q2, Q5, Q7, Q9, Q10	
Cactaceae	**Harrisia martinii*	harrisa cactus	S	Q6	Q18, Q19, Q22, Q23, Q24
Cactaceae	**Opuntia sp.*	prickly pear	S	Q4	
Caesalpiniaceae	*Lysiphyllum sp.*	bauhinia	ST	Q6, Q8	Q12, Q13, Q23

Family	Taxon[1]	Common Name	Life Form[2]	May 2011 Site	Sept 2011 Site
Caesalpiniaceae	*Senna sp.*		S	Q1, Q2, Q3, Q7, Q11	
Capparaceae	*Apophyllum anomalum*	warrior bush	S	Q1	Q18. Q23
Capparaceae	*Capparis lasiantha*	wait-a-while	S	Q6	Q15, Q23
Capparaceae	*Capparis lucida*	coast caper	S		Q23
Celastraceae	*Maytenus cunninghamii*	yellow berry bush	S		Q17
Chenopodiaceae	*Atriplex muelleri*	Mueller's saltbush	H		Q23
Chenopodiaceae	*Chenopod sp.*		H		Q13, Q15
Chenopodiaceae	*Salsola kali*	soft roly-poly	H		Q15, Q23
Chenopodiaceae	*Sclerolaena muricata*	black roly-poly	H		Q18. Q22, Q23, Q23
Chenopodiaceae	*Einadia polygonoides*	a saltbush	H	Q1, Q2	
Chenopodiaceae	*Enchylaena tomentosa*	ruby saltbush	H	Q4, Q5	Q19, Q23, Q24
Combretaceae	*Terminalia oblongata*	yellow wood	ST	Q1, Q4, Q7, Q8, Q9, Q10	Q13, Q15, Q16, Q23
Cyperaceae	*Cyperus gilesii*		R	Q4	
Cyperaceae	*Cyperus sp.*		R	Q1, Q3	Q20, Q24
Cyperaceae	*Cyperus victoriensis*		R	Q1, Q2, Q3, Q7	
Cyperaceae	*Fimbristylis sp.*		R		Q20
Erythroxylaceae	*Erythroxylum australe*	erythroxylum	S		Q17
Fabaceae	*Chamaecrista sp.*		H		Q20
Fabaceae	*Cullen tenax*	emu foot	H	Q7, Q8	
Fabaceae	*Desmodium sp.*		H	Q7, Q8, Q9	
Fabaceae	*Rhynchosia minima*	rhynchosia	V	Q4, Q6	
Fabaceae	*Sesbania sp.*	Sesbania pea	H		Q15
Fabaceae	**Stylosanthes sp.*		H	Q6	Q16
Goodeniaceae	*Scaevola spinescens*	maroon bush	S	Q4	

Family	Taxon[1]	Common Name	Life Form[2]	May 2011 Site	Sept 2011 Site
Gyrostemonaceae	*Codonocarpus attenuatus*	bell fruit	ST		Q17
Juncaceae	*Juncus sp.*		R	Q1, Q2, Q3, Q11	
Lamiaceae	*Clerodendrum inerme*	scrambling clerodendrum	H		Q13
Laxmanniaceae	*Lomandra longifolia*		R	Q9	Q12
Loranthaceae	*Amyema quandang*	grey mistletoe	e	Q3	Q18, Q19, Q22, Q23, Q24
Loranthaceae	*Lysiana subfalcata*	lemon-flowered mistletoe	e		Q23
Malvaceae	*Abutilon calliphyllum*	velvet lantern-flower	H	Q1, Q2	
Malvaceae	*Hibiscus sp.*		S	Q4	
Malvaceae	*Sida filiformis*	fine sida	H	Q4, Q6	
Malvaceae	**Sida rhombifolia*	common sida	H	Q7	Q14, Q16
Marsileaceae	*Marsilea sp.*	nardoo	H	Q1, Q2, Q3	Q20
Mimosaceae	*Acacia cambagei*	gidgee	ST	Q4, Q5, Q6, Q7	Q13, Q14, Q15, Q17, Q18, Q19, Q21, Q22, Q23, Q24
Mimosaceae	*Acacia coriacea subsp. sericophylla*		ST	Q4	
Mimosaceae	*Acacia excelsa subsp. Excelsa*	ironwood	ST	Q6	Q16, Q23
Mimosaceae	*Acacia farnesiana*	mimosa bush	ST	Q9, Q11	
Mimosaceae	*Acacia harpophylla*	brigalow	ST	Q6, Q10	Q 13, Q15, Q18, Q19, Q21, Q22, Q24
Mimosaceae	*Acacia juncifolia*	rush-leaf wattle	ST	Q7	
Mimosaceae	*Acacia salicina*	sally wattle	ST	Q6, Q8, Q9	Q12, Q13
Mimosaceae	*Acacia stenophylla*	belalie	ST	Q7, Q8 , Q9, Q10	Q12
Mimosaceae	*Archidendropsis basaltica*	dead finish	ST		Q23
Myoporaceae	*Eremophila bignoniiflora*	dogwood	S		Q14, Q18

Family	Taxon[1]	Common Name	Life Form[2]	May 2011 Site	Sept 2011 Site
Myoporaceae	*Eremophila maculata*	spotted fuchsia bush	S	Q4, Q5, Q7, Q8	
Myoporaceae	*Eremophila mitchellii*	false sandalwood	S	Q6, Q7	Q16, Q17, Q21, Q23
Myoporaceae	*Eremophila polyclada*	twiggy emu-bush	S		Q15
Myoporaceae	*Eremophila deserti*	Ellangowan poison bush	S	Q4	
Myoporaceae	*Myoporum montanum*	western boobialla	S	Q6	Q19
Myrtaceae	*Corymbia dallachiana*	ghost gum	T	Q6	Q12, Q13, Q16
Myrtaceae	*Eucalyptus brownii*	Reid river box	T		Q16
Myrtaceae	*Eucalyptus camaldulensis*	river red gum	T	Q9	Q12
Myrtaceae	*Eucalyptus coolabah*	coolabah	T	Q1, Q2, Q3, Q5, Q6, Q7, Q8, Q9, Q10, Q11	Q12, Q13, Q15, Q20
Myrtaceae	*Eucalyptus thozetiana*	napunyah	T		Q19
Myrtaceae	*Melaleuca leucadendra*	weeping paperbark	T	Q9	
Myrtaceae	*Melaleuca tamariscina*	tea tree	T		Q18
Myrtaceae	*Melaleuca trichostachya*	river teatree	T	Q7, Q8, Q9, Q10	Q12
Oleaceae	*Jasminum didymum*	desert jasmine	V		Q13, Q23
Orchidaceae	*Cymbidium canaliculatum*	black orchid	e	Q3, Q7, Q8	Q13
Passofloraceae	**Passiflora foetida*	stinking passion flower	V	Q6	
Phyllanthaceae	*Phyllanthus virgatus*	spurge	H	Q5, Q7, Q8	
Poaceae	*Aristida calycina*	dark wiregrass	G		Q16
Poaceae	*Aristida jerichoensis* var. *subspinulifera*	Jericho wiregrass	G		Q16
Poaceae	*Aristida latifolia*	feathertop wiregrass	G		Q16
Poaceae	*Aristida leptopoda*	white speargrass	G	Q4	
Poaceae	*Astrebla sp.*	Mitchell grass	G		Q15, Q24
Poaceae	**Bothriochloa pertusa*	Indian bluegrass	G		Q13, Q15, Q22

Family	Taxon[1]	Common Name	Life Form[2]	May 2011 Site	Sept 2011 Site
Poaceae	*Bothriochloa sp.*		G	Q6	
Poaceae	**Cenchrus ciliaris*	buffel grass	G	Q4, Q6, Q7, Q8	Q13, Q16, Q17, Q18, Q19, Q21, Q23, Q24
Poaceae	*Chloris sp.*		G		Q13
Poaceae	*Chloris ventricosa*	tall chloris	G	Q7, Q10	
Poaceae	*Chrysopogon fallax*	golden beard grass	G	Q9	
Poaceae	*Chrysopogon sp.*		G		
Poaceae	*Couch sp.*		G		
Poaceae	*Dichanthium sericeum*	Queensland blue grass	G	Q4, Q9	
Poaceae	*Elytrophorus spicatus*	spikegrass	G		Q18
Poaceae	*Eragrostis sp.*	lovegrass	G	Q1, Q6	
Poaceae	*Heteropogon contortus*	black spear grass	G	Q6	Q12, Q13, Q16
Poaceae	*Imperata cylindrica*	blady grass	G	Q6	
Poaceae	*Iseilema vaginiflorum*	red flinders grass	G	Q1	
Poaceae	*Leptochloa sp.*		G	Q11	
Poaceae	*Panicum decompositum*		G	Q1, Q2, Q3, Q4, Q6, Q7, Q8, Q9, Q10, Q11	Q12, Q15, Q18, Q19, Q21, Q24
Poaceae	*Paspalidium distans*		G		
Poaceae	*Paspalidium globoideum*	shotgrass	G	Q4	
Poaceae	*Paspalidium sp.*		G	Q5, Q7, Q8, Q9, Q10	
Poaceae	*Sporobolus actinocladus*	Katoora grass	G		Q21, Q23
Poaceae	*Sporobolus australasicus*		G		Q13, Q14, Q15, Q18, Q24
Poaceae	*Sporobolus disjunctus*		G		Q15, Q18, Q23, Q24
Poaceae	*Themeda sp.*		G	Q4	

Family	Taxon[1]	Common Name	Life Form[2]	May 2011 Site	Sept 2011 Site
Poaceae	**Triticum sp.*	wheat species	G	Q4	
Polygonaceae	*Muehlenbeckia florulenta*	lignum	S	Q1, Q2, Q3, Q7, Q8, Q10	Q12, Q20
Rhamnaceae	*Alphitonia excelsa*	soap ash	ST	Q6	
Rhamnaceae	*Ventilago viminalis*	supplejack	ST		Q13, Q23
Rubiaceae	*Oldenlandia sp.*		S	Q4	
Rubiaceae	*Psydrax longipes*	myrtle	S		Q16, Q19, Q23
Rutaceae	*Citrus glauca*	wild lime	ST		Q15, Q16, Q23
Rutaceae	*Flindersia dissosperma*	scrub leaopardwood	ST		Q15, Q16, Q23, Q24
Rutaceae	*Geijera parviflora*	wilga	S		Q17
Santalaceae	*Santalum lanceolatum*	sandalwood	ST	Q4	Q18, Q19, Q23, Q24
Sapindaceae	*Alectryon diversifolius*	scrub boonaree	S	Q4	Q17, Q23
Sapindaceae	*Alectryon oleifolius*	western rosewood	S	Q1, Q4, Q5, Q6, Q7, Q8, Q10, Q11	
Sapindaceae	*Atalaya hemiglauca*	cattle bush	ST	Q4, Q6, Q7, Q8	Q13, Q15, Q16, Q23
Scrophulariaceae	*Stemodia sp.*		H		Q20
Sparrmanniaceae	*Grewia latifolia*	dog's balls	H	Q4, Q6	Q16
Verbenaceae	**Verbena bonariensis*	purple verbena	H	Q4	

[1] Status: * indicates introduced species; NC Act and EPBC Act status: no listed species observed.
[2] Life form: T, tree; ST, short tree; S, shrub; H, herb/forb; G, grass; R, sedge/rush/lily; V, vine; a, aquatic; e, epiphytic; p, parasitic

Appendix E

Weeds

Summary of Desktop Weed Search

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Species	Common Name	Status	Source
Prosopis spp.	mesquite	WoNs, Class 2 declared	Protected Matters Search, Biosec mapping (Unsuitable to Suitable)
Lantana camara	lantana	WoNs , Class 3 declared	Protected Matters Search, Biosec mapping (Marginal)
Cryptostegia grandiflora	rubber vine	WoNs, Class 2 declared	Protected Matters Search, Biosec mapping (Marginal to Suitable)
Hymenachne amplexicaulis	hymenachne	WoNS, Class 2 declared	Protected Matters Search, Herbrecs, IRC medium priority weed species
Parkinsonia aculeata	parkinsonia	WoNS, Class 2 declared	Protected Matters Search, Herbrecs, Biosec mapping (Highly suitable), IRC medium priority weed species
Parthenium hysterophorus	parthenium weed	WoNS, Class 2 declared	Protected Matters Search, Herbrecs, Wildlife Online, Biosec mapping (Suitable), IRC high/medium priority weed species
Harrisia martini	harrisia cactus	Class 2 declared	Wildlife Online, IRC medium priority weed species, Biosec mapping (Unsuitable to Suitable)
Opuntia tomentosa	velvety tree pear	Class 2 declared	Wildlife Online
Sporobolus fertilis	giant Parramatta grass	Class 2 declared	Biosec mapping (Unsuitable to Marginal)
Pennisetum setaceum	African fountain grass	Class 3 declared	Biosec mapping (High to Very High)
Nassella neesiana	Chilean needlegrass	WoNS, Class 1 declared	Biosec mapping (Moderate suitability to Suitable)
Ziziphus mauritiana	chinese apple	Class 2 declared	Biosec mapping (Suitable to Highly Suitable), IRC medium priority weed species
Myriophyllum spicatum	Eurasian water milfoil	Class 1 declared	Biosec mapping (Marginal)
Acacia karroo	karoo thorn	Class 1 declared	Biosec mapping (High)
Prosopis pallida	mesquite	WoNS, Class 2 declared	Biosec mapping (Highly suitable)
Bryophyllum delagoense	mother of millions	Class 2 declared	Biosec mapping (Highly suitable), IRC low priority weed species
Acacia nilotica	prickly acacia	WoNS, Class 2 declared	Protected Matters Search, Biosec mapping (Suitable), IRC high priority weed species

Species	Common Name	Status	Source
Sesbania punicea	red sesbania	Class 1 declared	Biosec mapping (High to Very High)
Eichhornia crassipes	water hyacinth	Class 2 declared	Biosec mapping (Highly suitable)
Pistia stratiotes	water lettuce	Class 2 declared	Biosec mapping (Highly suitable)
Striga asiatica	witch weeds	Class 1 declared	Biosec mapping (Moderate to High)
Tecoma stans	yellow bells	Class 3 declared	Biosec mapping (Moderate to High)

Appendix F

Fauna Survey Results

May Survey Fauna Species List

September Survey Fauna Species List

Total Species List

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May 2011 Species List

Family	Scientific name	Common name	NC Act Status	EPBC Act Status	Comprehensive Survey Site Number		Rapid Survey Site Number												Anabat	Opportunistic
					1	2	1	2	3	4	5	6	7	8	9	10	11	12		
					Fauna Habitat Type															
					C	C	C	C	C	A	C	A	C	D	C	C	A	C	C	
Amphibians																				
Bufonidae	**Rhinella marina*	cane toad								✓										✓
Myobatrachidae	*Limnodynastes tasmaniensis*	spotted grass frog			✓	✓														
Reptiles																				
Agamidae	*Amphibolurus burnsi*	Burns' dragon							✓											
Elapidae	*Demansia psammophis*	yellow-faced whipsnake				✓														
Gekkonidae	*Gehyra dubia*	dubious gecko				✓								✓						
Scincidae	*Tiliqua scincoides*	common blue-tongue							✓			✓								
Scincidae	*Ctenotus robustus*	eastern striped skink													✓					
Scincidae	*Cryptoblepharus virgatus*	wall skink														✓				
Scincidae	*Carlia munda*				✓															
Scincidae	*Menetia greyii*					✓														
Mammals																				
Canidae	**Canis lupus*	dog																		✓
Emballonuridae	*Saccolaimus flaviventris*	yellow-bellied sheathtail-bat																	✓	
Felidae	**Felis catus*	cat																		✓
Leporidae	**Oryctolagus cuniculus*	European rabbit												✓						✓
Macropodidae	*Macropus giganteus*	eastern grey kangaroo									✓	✓								✓
Macropodidae	*Macropus rufus*	red kangaroo																		✓
Molossidae	*Austronomus australis*	White-striped freetail bat																	✓	
Molossidae	*Chaerephon jobensis*	northern freetail-bat																	✓	
Molossidae	*Mormopterus beccarii*	Beccari's freetail-bat																	✓	
Suiidae	**Sus scrofa*	pig																		✓

Family	Scientific name	Common name	NC Act Status	EPBC Act Status	Comprehensive Survey Site Number		Rapid Survey Site Number												Anabat	Opportunistic
					1	2	1	2	3	4	5	6	7	8	9	10	11	12		
					Fauna Habitat Type															
					C	C	C	C	C	A	C	A	C	D	C	C	A	C	C	
Vespertilionidae	*Chalinolobus gouldii*	Gould's wattled bat																	✓	
Vespertilionidae	*Chalinolobus picatus*	Little pied bat	NT																✓	
Vespertilionidae	*Nyctophilus* sp.	Eastern-long-eared bat (potentially)	V	V															✓	
Vespertilionidae	*Scotorepens balstoni*	inland broad-nosed bat																	✓	
Vespertilionidae	*Scotorepens greyii / S. sanborni*	little broad-nosed bat / northern broad-nosed bat																	✓	
Vespertilionidae	*Vespadelus baverstocki*	inland forest bat																	✓	
Vespertilionidae	*Vespadelus troughtoni*	Eastern cave bat																	✓	
Birds																				
Acanthizidae	*Smicrornis brevirostris*	weebill												✓		✓	✓			✓
Accipitridae	*Milvus migrans*	black kite																		✓
Accipitridae	*Aquila audax*	wedge-tailed eagle																		
Accipitridae	*Haliastur sphenurus*	whistling kite		Mar					✓		✓									✓
Anatidae	*Chenonetta jubata*	Australian wood duck							✓											
Anatidae	*Anas superciliosa*	Pacific black duck															✓			✓
Anatidae	*Dendrocygna eytoni*	plumed whistling duck															✓			
Anhingidae	*Anhinga melanogaster*	Australasian darter															✓			
Ardeidae	*Ardea pacifica*	white-necked heron															✓			✓
Artamidae	*Gymnorhina tibicen*	Australian magpie			✓				✓				✓		✓					
Artamidae	*Artamus cinereus*	black-faced woodswallow			✓												✓			✓
Artamidae	*Artamus cyanopterus*	dusky woodswallow																		
Artamidae	*Cracticus torquatus*	grey butcherbird			✓		✓		✓		✓		✓	✓						✓

Family	Scientific name	Common name	NC Act Status	EPBC Act Status	Comprehensive Survey Site Number		Rapid Survey Site Number												Anabat	Opportunistic
					1	2	1	2	3	4	5	6	7	8	9	10	11	12		
					Fauna Habitat Type															
					C	C	C	C	C	A	C	A	C	D	C	C	A	C	C	
Artamidae	*Artamus personatus*	masked woodswallow							✓											
Artamidae	*Cracticus nigrogularis*	pied butcherbird													✓		✓			✓
Cacatuidae	*Eolophus roseicapillus*	Galah															✓	✓		✓
Campephagidae	*Centropus phasianinus*	pheasant coucal							✓					✓						
Charadriidae	*Elseyornis melanops*	black-fronted dotterel																		✓
Charadriidae	*Vanellus miles*	masked lapwing																		
Ciconiidae	*Grus rubicundus*	brolga															✓			✓
Climacteridae	*Climacteris picumnus*	brown treecreeper			✓		✓		✓				✓			✓				✓
Columbidae	*Geopelia striata*	peaceful dove			✓								✓	✓						
Columbidae	*Ocyphaps lophotes*	crested pigeon					✓		✓											
Corvidae	*Corvus coronoides*	Australian raven															✓			
Corvidae	*Corvus orru*	Torresian crow			✓															
Cuculidae	*Scythrops novaehollandiae*	channel-billed cuckoo		Mar	✓															
Dicaeidae	*Dicaeum hirundinaceum*	mistletoebird			✓															
Dicruridae	*Rhipidura fuliginosa*	grey fantail			✓				✓	✓				✓						
Dicruridae	*Microeca fascinans*	jacky winter			✓				✓				✓		✓					
Dicruridae	*Grallina cyanoleuca*	magpie-lark							✓			✓	✓				✓			✓
Dicruridae	*Myiagra inquieta*	restless flycatcher															✓			
Dicruridae	*Rhipidura leucophrys*	willie wagtail			✓				✓				✓	✓		✓	✓			✓
Falconidae	*Falco hypoleucos*	grey falcon																		
Falconidae	*Falco cenchroides*	nankeen kestrel							✓											
Halcyonidae	*Todiramphus pyrrhopygius*	red-backed kingfisher													✓					
Hirundinidae	*Petrochelidon nigricans*	tree martin		Mar																✓

Family	Scientific name	Common name	NC Act Status	EPBC Act Status	Comprehensive Survey Site Number		Rapid Survey Site Number												Anabat	Opportunistic
					1	2	1	2	3	4	5	6	7	8	9	10	11	12		
					Fauna Habitat Type															
					C	C	C	C	C	A	C	A	C	D	C	C	A	C	C	
Maluridae	*Malurus melanocephalus*	red-backed fairy-wren							✓			✓								
Maluridae	*Malurus lamberti*	variegated fairy-wren												✓	✓	✓				
Meliphagidae	*Lichmera indistincta*	brown honeyeater			✓					✓	✓									
Meliphagidae	*Manorina melanocephala*	noisy miner												✓						
Meliphagidae	*Lichenostomus virescens*	singing honeyeater							✓					✓						
Meliphagidae	*Acanthagenys rufogularis*	spiny-cheeked honeyeater												✓						
Meliphagidae	*Plectorhyncha lanceolata*	striped honeyeater												✓						
Meliphagidae	*Lichenostomus penicillatus*	white-plumed honeyeater			✓															✓
Meliphagidae	*Lichenostomus flavicollis*	yellow-throated honeyeater							✓				✓							✓
Motacillidae	*Anthus novaeseelandiae*	Richard's pipit		Mar									✓					✓		
Oriolidae	*Oriolus sagittatus*	olive-backed oriole												✓						
Otididae	*Ardeotis australis*	Australian bustard																✓		
Pachycephalidae	*Colluricincla harmonica*	grey shrike-thrush			✓			✓	✓					✓						✓
Pachycephalidae	*Pachycephala rufiventris*	rufous whistler												✓						
Pardalotidae	*Acanthiza pusilla*	brown thornbill						✓												
Pardalotidae	*Acanthiza reguloides*	buff-rumped thornbill			✓															
Pardalotidae	*Pardalotus striatus*	striated pardalote									✓				✓	✓				✓
Pardalotidae	*Gerygone olivacea*	white-throated gerygone												✓	✓					
Pardalotidae	*Acanthiza nana*	yellow thornbill								✓										✓
Passeridae	*Poephila bichenovii*	double-barred finch			✓		✓			✓										✓
Passeridae	*Taeniopygia guttata*	zebra finch												✓			✓			✓
Phalacrocoracidae	*Phalacrocorax varius*	pied cormorant							✓								✓			✓

Family	Scientific name	Common name	NC Act Status	EPBC Act Status	Comprehensive Survey Site Number		Rapid Survey Site Number												Anabat	Opportunistic
					1	2	1	2	3	4	5	6	7	8	9	10	11	12		
					Fauna Habitat Type															
					C	C	C	C	C	A	C	A	C	D	C	C	A	C	C	
Phasianidae	*Coturnix ypsilophora*	brown quail														✓		✓		
Plataleidae	*Platalea regia*	royal spoonbill															✓			
Pomatostomidae	*Pomatostomus temporalis*	grey-crowned babbler			✓															
Psittacidae	*Glossopsitta pusilla*	little lorikeet																		
Psittacidae	*Platycercus adscitus*	pale-headed rosella			✓				✓				✓	✓			✓	✓		✓
Psittacidae	*Aprosmictus erythropterus*	red-winged parrot												✓				✓		
Ptilonorhynchidae	*Ptilonorhynchus maculatus*	spotted bowerbird												✓						
Strigidae	*Ninox novaeseelandiae*	southern boobook																✓		
Turnicidae	*Turnix pyrrhothorax*	red-chested buttonquail										✓								✓
Zosteropidae	*Zosterops lateralis*	silvereye		Mar					✓											
* Introduced species																				

Habitat types:
A: Eucalypt open woodland
B: Acacia woodland or forest
C: Open woodland fringing watercourses and on floodplains
D: Grassland
E: Eucalypt and acacia mixed woodland or forest Eucalypt and acacia mixed woodland or forest
F: Non-remnant vegetation

Acronyms and abbreviations:
SLC: Special Least Concern
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V: Vulnerable
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Ma: Marine
Mig: Migratory
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JAMBA: Agreement between the Government of Australia and the Government of Japan for the Protection of Migratory Birds in Danger of Extinction and their Environment

September 2011 Species List

Family Name	Scientific Name	Common Name	NC Act Status	EPBC Act Status	Rapid Survey Site Number										Anabat	Opportunistic
					1	2	3	4	5	6	7	8	9	10		
					Fauna Habitat Type											
					C	B	B	B	C	A	B	F	A	E	C	
Amphibians																
Bufonidae	**Rhinella marina*	cane toad														✓
Hylidae	*Litoria inermis*	bumpy rocket frog			✓											
Hylidae	*Litoria rubella*	desert tree frog			✓											
Hylidae	*Litoria caerulea*	green tree frog														✓
Reptiles																
Agamidae	*Diporiphora australis*	tommy roundhead							✓							
Gekkonidae	*Geyhra dubia*	dubious gecko														✓
Scincidae	*Tiliqua scincoides*	common blue-tongue														✓
Scincidae	*Carlia vivax*	lively rainbow skink			✓											
Scincidae	*Cryptoblepharus virgatus*	wall skink			✓											✓
Mammals																
Leporidae	**Oryctolagus cuniculus*	European rabbit														✓
Macropodidae	*Macropus giganteus*	eastern grey kangaroo					✓							✓		✓
Macropodidae	*Macropus rufus*	red kangaroo														✓
Phalangeridae	*Trichosurus vulpecula*	common brushtail											✓	✓		✓

Family Name	Scientific Name	Common Name	NC Act Status	EPBC Act Status	Rapid Survey Site Number										Anabat	Opportunistic
					1	2	3	4	5	6	7	8	9	10		
					Fauna Habitat Type											
					C	B	B	B	C	A	B	F	A	E	C	
		possum														
Tachyglossidae	*Tachyglossus aculeatus*	echidna	SLC						✓							
Emballonuridae	*Saccolaimus flaviventris*	yellow-bellied sheathtail-bat													✓	
Molossidae	*Mormopterus beccarii*	Beccari's freetail-bat													✓	
Vespertilionidae	*Chalinolobus gouldii*	Gould's wattled bat													✓	
Vespertilionidae	*Chalinolobus morio*	chocolate wattled bat													✓	
Vespertilionidae	*Scotorepens balstoni*	inland broad-nosed bat													✓	
Vespertilionidae	*Scotorepens greyii / S. sanborni*	little broad-nosed bat / northern broad-nosed bat													✓	
Vespertilionidae	*Vespadelus baverstocki*	inland forest bat													✓	
Birds																
Acanthizidae	*Smicrornis brevirostris*	weebill					✓	✓	✓					✓		✓
Accipitridae	*Haliastur sphenurus*	whistling kite		Ma			✓						✓			✓
Aegothelidae	*Aegotheles cristatus*	Australian-owlet nightjar							✓							✓
Ardeidae	*Ardea alba*	great egret	SLC	Ma, Mig												✓

Family Name	Scientific Name	Common Name	NC Act Status	EPBC Act Status	Rapid Survey Site Number										Anabat	Opportunistic
					1	2	3	4	5	6	7	8	9	10		
					Fauna Habitat Type											
					C	B	B	B	C	A	B	F	A	E	C	
				(CAMBA, JAMBA)												
Ardeidae	*Ardea picata*	pied heron								✓						✓
Ardeidae	*Ardea pacifica*	white-necked heron														✓
Artamidae	*Gymnorhina tibicen*	Australian magpie										✓		✓		
Artamidae	*Artamus cinereus*	black-faced woodswallow														✓
Artamidae	*Cracticus torquatus*	grey butcherbird			✓		✓									✓
Artamidae	*Artamus minor*	little woodswallow							✓							
Artamidae	*Cracticus nigrogularis*	pied butcherbird			✓		✓	✓	✓							✓
Cacatuidae	*Nymphicus hollandicus*	cockatiel														✓
Cacatuidae	*Eolophus roseicapillus*	Galah										✓				✓
Cacatuidae	*Cacatua galerita*	sulphur-crested cockatoo			✓											✓
Campephagidae	*Coracina novaehollandiae*	black-faced cuckoo-shrike		Ma	✓											
Campephagidae	*Centropus phasianinus*	pheasant coucal														✓
Casuaridae	*Dromaius novaehollandiae*	Emu														✓
Charadriidae	*Vanellus miles*	masked lapwing														✓

Family Name	Scientific Name	Common Name	NC Act Status	EPBC Act Status	Rapid Survey Site Number										Anabat	Opportunistic
					1	2	3	4	5	6	7	8	9	10		
					Fauna Habitat Type											
					C	B	B	B	C	A	B	F	A	E	C	
Ciconiidae	*Grus rubicundus*	Brolga									✓					✓
Cisticolidae	*Cisticola exilis*	golden-headed cisticola								✓						✓
Climacteridae	*Climacteris picumnus*	brown treecreeper						✓	✓							✓
Columbidae	*Geophaps scripta scripta*	squatter pigeon (southern subspecies)	V	V						✓						
Columbidae	*Ocyphaps lophotes*	crested pigeon							✓							
Corcoracidae	*Struthidea cinerea*	apostlebird			✓	✓										✓
Corvidae	*Corvus coronoides*	Australian raven														✓
Corvidae	*Corvus orru*	Torresian crow							✓			✓	✓			
Cuculidae	*Chrysococcyx basalis*	horsfield's bronze-cuckoo		Ma								✓				
Cuculidae	*Scythrops novaehollandiae*	channel-billed cuckoo		Ma		✓										
Dicruridae	*Rhipidura fuliginosa*	grey fantail			✓											
Dicruridae	*Microeca fascinans*	jacky winter						✓	✓							✓
Dicruridae	*Myiagra rubecula*	leaden flycatcher			✓	✓										
Dicruridae	*Grallina cyanoleuca*	magpie-lark			✓			✓								

Family Name	Scientific Name	Common Name	NC Act Status	EPBC Act Status	Rapid Survey Site Number										Anabat	Opportunistic
					1	2	3	4	5	6	7	8	9	10		
					Fauna Habitat Type											
					C	B	B	B	C	A	B	F	A	E	C	
Dicruridae	*Rhipidura leucophrys*	willie wagtail					✓	✓	✓					✓		✓
Falconidae	*Falco cenchroides*	nankeen kestrel		Ma												✓
Halcyonidae	*Todiramphus macleayii*	forest kingfisher			✓											
Halcyonidae	*Dacelo novaeguineae*	laughing kookaburra			✓											✓
Maluridae	*Malurus melanocephalus*	red-backed fairy-wren			✓			✓						✓		✓
Meliphagidae	*Entomyzon cyanotis*	blue-faced honeyeater					✓									
Meliphagidae	*Lichmera indistincta*	brown honeyeater			✓		✓									
Meliphagidae	*Philemon citreogularis*	little friarbird			✓		✓	✓								
Meliphagidae	*Philemon corniculatus*	noisy friarbird														✓
Meliphagidae	*Manorina melanocephala*	noisy miner						✓	✓							
Meliphagidae	*Lichenostomus virescens*	singing honeyeater					✓	✓	✓				✓	✓		✓
Meliphagidae	*Plectorhyncha lanceolata*	striped honeyeater			✓		✓	✓						✓		
Meliphagidae	*Lichenostomus albogularis*	white-throated honeyeater			✓											
Meliphagidae	*Manorina flavigula*	yellow-throated miner							✓							✓
Meropidae	*Merops ornatus*	rainbow bee-						✓								✓

Family Name	Scientific Name	Common Name	NC Act Status	EPBC Act Status	Rapid Survey Site Number										Anabat	Opportunistic
					1	2	3	4	5	6	7	8	9	10		
					Fauna Habitat Type											
					C	B	B	B	C	A	B	F	A	E	C	
		eater														
Motacillidae	*Anthus novaeseelandiae*	Richard's pipit		Ma							✓	✓				✓
Otididae	*Ardeotis australis*	Australian bustard														✓
Pachycephalidae	*Colluricincla harmonica*	grey shrike-thrush														✓
Pachycephalidae	*Pachycephala rufiventris*	rufous whistler			✓				✓				✓	✓		✓
Pardalotidae	*Pardalotus punctatus*	spotted pardalote			✓									✓		✓
Pardalotidae	*Pardalotus striatus*	striated pardalote			✓				✓							✓
Pardalotidae	*Gerygone olivacea*	white-throated gerygone			✓											✓
Pardalotidae	*Acanthiza chrysorrhoa*	yellow-rumped thornbill										✓				
Passeridae	*Poephila bichenovii*	double-barred finch			✓			✓	✓							
Passeridae	*Taeniopygia guttata*	zebra finch			✓											✓
Pelecanidae	*Pelecanus conspicillatus*	Australian pelican		Ma												✓
Phalacrocoracidae	*Phalacrocorax sulcirostris*	little black cormorant														✓
Plataleidae	*Platalea regia*	royal spoonbill														✓
Podargidae	*Podargus strigoides*	tawny frogmouth														✓

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					1	2	3	4	5	6	7	8	9	10		
					Fauna Habitat Type											
					C	B	B	B	C	A	B	F	A	E	C	
Pomatostomidae	*Pomatostomus temporalis*	grey-crowned babbler				✓	✓		✓			✓				✓
Psittacidae	*Platycercus adscitus*	pale-headed rosella						✓	✓				✓			✓
Psittacidae	*Trichoglossus haematodus*	rainbow lorikeet			✓		✓									
Psittacidae	*Aprosmictus erythropterus*	red-winged parrot					✓									✓
Psittacidae	*Trichoglossus chlorolepidotus*	scaly breasted lorikeet			✓											
Ptilonorhynchidae	*Ptilonorhynchus maculatus*	spotted bowerbird														✓
Sylviidae	*Cincloramphus mathewsi*	rufous songlark							✓							✓
Tytonidae	*Tyto alba*	barn owl														✓
* Introduced species																

Habitat types:
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QUEENSLAND SITE INFORMATION SHEET

Queensland Government
Natural Resources and Mines

SITE NUMBER .....

SITE NAME .....

LATITUDE ..... LONGITUDE .....

GRID REFERENCE .....GPS.....

MAP NAME ..... MAP NUMBER ..... SCALE .....

ALTITUDE (m) ..... STREAM ORDER .....

SLOPE (m/m) ..... DISTANCE FROM SOURCE (km) .....

AMTD (km)..... REACH upland midland lowland

CATCHMENT AREA (km^2) .....

REFERENCE or TEST ASSESSMENT (see last page).....

NEAREST RAINFALL STATION .....

NEAREST WEATHER STATION .....

ACCESS DETAILS

Directions .....
.....
.....
.....
.....
Property Owner ..... Phone No. .....
Contact ..... Phone No. .....
Access Instructions .....
.....
.....
.....
Notify before each visit? [ ] Yes [ ] No
Permission required? [ ] Yes [ ] No
Key required? [ ] Yes [ ] No
Key available from .....
.....

MUDMAP OF ACCESS ROUTE

SKETCH OF REACH

No.	Reference Condition Selection Criteria	Level of impact *
1	Influence of intensive agriculture upstream.* Intensive agriculture is that which involves irrigation, widespread soil disturbance, use of agrochemicals and pine plantations. Dry-land grazing does not fall into this category.	
2	Influence of major extractive industry (current or historical) upstream.* This includes mines, quarries and sand/gravel extraction.	
3	Influence of major urban area upstream. This will be relative to population size, river size and distance between the site and the impact.	
4	Influence of significant point-source waste water discharge upstream.* Exceptions can be made for small discharges into large rivers.	
5	Influence of dam or major weir* Sites within the ponded area of impoundments also fail.	
6	Influence of alteration to seasonal flow regime This may be due to abstraction or regulation further upstream than the coverage by Criterion 5. Includes either an increase or decrease in seasonal flow.	
7	Influence of alteration to riparian zone Riparian vegetation should be intact and dominated by native species.	
8	Influence of erosion and damage by stock on riparian zone and banks. Stock damage to the stream bed may be included in this category.	
9	Influence of major geomorphological change on stream channel Geomorphological change includes bank slumping, shallowing, braiding and unnatural aggradation or degradation.	
10	Influence of alteration to instream conditions and habitats This may be due to excessive algal and macrophyte growth, by sedimentation and siltation, by reduction in habitat diversity by drowning or drying out of habitats (e.g. riffles) or by direct access of stock into the river	
	SITE ASSESSMENT	

* Note: the level of impact at a site will generally decrease as the distance from the source of impact increases.

Each criterion relates to an aspect of human activity that impacts on freshwater ecosystems, where impact is defined as a 'change from natural condition'. Each criterion is given a score according to the following categories:

1. Very major impact
2. Major impact
3. Moderate impact
4. Minor impact
5. Indiscernible impact

Potential reference sites are assessed using the total score for the ten criteria. To be considered as being in reference condition, a site must score no less than '4' on each criterion. Any sites that fail reference are 'test' sites.

1. LONGITUDINAL PROFILE SKETCH OF STREAM REACH

Scale: _____

Please indicate on sketch and tick off each item when completed.

- ☐ Biological sampling sites for each habitat type.
- ☐ Water quality measurement and water sample collection sites.
- ☐ Location from where photograph(s) taken.
- ☐ Flow direction
- ☐ Location of cross-sectional profile sketch.
- ☐ Riparian vegetation (include approx. heights).
- ☐ Riparian zone width.

2. CROSS-SECTIONAL PROFILE SKETCH OF STREAM REACH

Scale: _____

Please indicate on sketch and tick off each item when completed.

- ☐ Bankfull bank height
- ☐ Bankfull stream width
- ☐ Stream wetted width
- ☐ "Normal" wetted width
- ☐ Riparian vegetation height
- ☐ Riparian zone width
- ☐ Water depth

3. COMMENTS

_____

_____

_____

_____

_____

_____

_____

(*Office use only*) Entered into AQEIS ___/___/___ by _____ Checked on ___/___/___ by _____

REACH OBSERVATIONS (of 100 m stream length)

Upstream landuse: .....

Adjacent landuse: Left bank: Score ..... Type ..... Right bank: Score ..... Type .....

0. Urban/semi-urban, industrial
1. Irrigated cropping, intensive forestry or heavy grazing
2. Non-irrigated cropping, moderate grazing
3. Light grazing, vegetation clearing
4. Natural

Local catchment erosion:	None	Little	Some	Moderate	Extensive
Water colour:	Clear	Green	Opaque	Tannin	Other .....
Sediment deposits:	None	Sand	Silt	Other	
Algae: On substrate:	None	Little	Some	Moderate	Extensive
In water column:	None	Little	Some	Moderate	Extensive
Water odour:	No	Yes	Specify		
Substrate odour:	No	Yes	Specify		
Water surface:	Normal	Slick	Scum	Foaming	Other .....
Variety of habitat: (circle all types)	Shallow	Deep	Pool	Run	Riffle
	Undercut bank		LWD	Macrophytes	Other .....

Bars: (bed surface protruding from normal water level and forming a bar) ..... %

Flow level: (relative to 'watermark' i.e. normal inundation level shown by limit of terrestrial grasses, or by eroded area, or boundary in bank sediment types).

No flow	Low	Moderate	High	Flood
(dry/isolated)	(<watermark)	(=watermark)	(>watermark)	

RIPARIAN ZONE (to maximum 100 m width)

Width of riparian zone:	Left bank ..... m			Right bank ..... m	
* **Bare ground**	None	Little	Some	Moderate	Extensive
* **Grass**	None	Little	Some	Moderate	Extensive
* **Shrubs**	None	Little	Some	Moderate	Extensive
* **Trees <10 m high**	None	Little	Some	Moderate	Extensive
* **Trees >10 m high**	None	Little	Some	Moderate	Extensive
Presence of exotic riparian species	None	Little	Some	Moderate	Extensive
Width of continuous tree zone from bank:	Left bank ..... m			Right bank ..... m	

None = 0% Little = 1–10% Some = 10–50% Moderate = 50–75% Extensive >75% * Can add to >100%

MACROPHYTES Indicate the presence and abundance of the following common taxa in the 100 m reach:

Native											
Azolla	N	L	S	M	E	Water Ribbon (*Triglochin*)	N	L	S	M	E
Duckweed	N	L	S	M	E	Water Lettuce (*Pistia stratiotes*)	N	L	S	M	E
Hornwort (*Ceratophyllum*)	N	L	S	M	E	Water Primrose (*Ludwigia*)	N	L	S	M	E
Stoneworts (*Chara* or *Nitella*)	N	L	S	M	E	Sedge (*Cyperus*)	N	L	S	M	E
Hydrilla	N	L	S	M	E	Common Rush (*Juncus*)	N	L	S	M	E
Water Milfoil (*Myriophyllum*)	N	L	S	M	E	Cumbungi (*Typha*)	N	L	S	M	E
Pondweeds (*Potamogeton*)	N	L	S	M	E	Slender Knotweed (*Persicaria*)	N	L	S	M	E
Ribbonweed (*Vallisneria*)	N	L	S	M	E	.....	N	L	S	M	E
.....	N	L	S	M	E	.....	N	L	S	M	E
Exotic											
Water Hyacinth (*Eichhornia*)	N	L	S	M	E	Alligator Weed (*Alternanthera*)	N	L	S	M	E
Salvinia	N	L	S	M	E	Elodea	N	L	S	M	E
Para Grass (*Urochloa*)	N	L	S	M	E	*Egeria*	N	L	S	M	E
.....	N	L	S	M	E	.....	N	L	S	M	E

Comments: .....

.....

N = none L = 1-10% (little) S = 10-50% (some) M = 50-75% (moderate) E = >75% (extensive)

River Bioassessment Program

HABITAT ASSESSMENT FIELD SHEET cont.

Habitat Variable	CATEGORY			
	Excellent	**Good**	**Fair**	**Poor**
6. Pool/riffle, run/bend ratio. *(Distance between riffles divided by stream width)*	0-7 Variety of habitat. Deep riffles and pools. 15, 14, 13, 12	7-15 Adequate depth in pools and riffles. Bends provide habitat. 11, 10, 9, 8	15-25 Occasional riffle or bend. Bottom contours provide some habitat. 7, 6, 5, 4	>25 Essentially a straight stream. Generally all flat water or shallow riffle. Poor habitat. 3, 2, 1, 0
7. Bank stability	Stable. No evidence of erosion or bank failure. Side slopes generally <30%. Little potential for future problem. 10, 9	Moderately stable. Infrequent, small areas of erosion mostly healed over. Side slopes up to 40% on one bank. Slight potential in extreme floods. 8, 7, 6	Moderately unstable. Moderate frequency and size of erosional areas. Side slopes up to 60% on some banks. High erosion potential during extreme/high flows. 5, 4, 3	Unstable. Many eroded areas. Side slopes > 60% common. 'Raw' areas frequent along straight sections and bends. 2, 1, 0
8. Bank vegetative stability	Over 80% of the streambank surfaces covered by vegetation or boulders and cobble. 10, 9	50-79% of the streambank surfaces covered by vegetation, gravel or larger material. 8, 7, 6	25-49% of the streambank covered by vegetation, gravel or larger material. 5, 4, 3	Less than 25% of the streambank surfaces covered by vegetation, gravel or larger material. 2, 1, 0
9. Streamside cover	Dominant vegetation is of tree form. 10, 9	Dominant vegetation shrub. 8, 7, 6	Dominant vegetation is grass, sedge, ferns. 5, 4, 3	Over 50% of the streambank has no vegetation and dominant material is soil, rock, bridge materials, culverts, or mine tailings. 2, 1, 0

Column Totals				

Score

AEF007

River Bioassessment Program

Queensland Government
Natural Resources and Mines

HABITAT ASSESSMENT FIELD SHEET

SITE NUMBER: [| | | | | |] **SITE NAME:** _____

Date: ___/___/___ **Time (24 hrs): [| | |]** **GPS:** _____ **Project Name:** _____

Habitat Variable	CATEGORY			
	Excellent	**Good**	**Fair**	**Poor**
1. Bottom substrate/available cover	Greater than 50% rubble, gravel, submerged logs, undercut banks or other stable habitat. 20, 19, 18, 17, 16	30-50% rubble, gravel or other stable habitat. Adequate habitat. 15, 14, 13, 12, 11	10-30% rubble, gravel or other stable habitat. Habitat availability less than desirable. 10, 9, 8, 7, 6	Less than 10% rubble, gravel or stable habitat. Lack of habitat is obvious. 5, 4, 3, 2, 1, 0
2. Embeddedness	Gravel, cobble and boulder particles are between 0 & 25% surrounded by fine sediment. 20, 19, 18, 17, 16	Gravel, cobble and boulder particles are between 25% & 50% surrounded by fine sediment. 15, 14, 13, 12, 11	Gravel, cobble and boulder particles are between 50 & 75% surrounded by fine sediment. 10, 9, 8, 7, 6	Gravel, cobble and boulder particles are over 75% surrounded by fine sediment. 5, 4, 3, 2, 1, 0
3. Velocity/depth category	Slow deep (<0.3 m/s & >0.5 m); slow shallow; fast deep; fast shallow; habitats all present. 20, 19, 18, 17, 16	Only 3 of the four habitat categories present (missing riffles or runs receive lower score than missing pools). 15, 14, 13, 12, 11	Only two of the four habitat categories present (missing riffles/runs receive lower score). 10, 9, 8, 7, 6	Dominating by one velocity/depth category (usually pool). 5, 4, 3, 2, 1, 0
4. Channel alteration	Little or no enlargement of islands or point bars and/or no channelisation. 15, 14, 13, 12	Some new increase in bar formation, mostly from coarse gravel; and/or some channelisation present. 11, 10, 9, 8	Moderate deposition of new gravel, coarse sand, on old and new bars; pools partly filled with silt; and/or embankments on both banks. 7, 6, 5, 4	Heavy deposits of fine materials, increased bar development; most pools filled with silt; and/or extensive channelisation. 3, 2, 1, 0
5. Bottom scouring and deposition	Less than 5% of the bottom affected by scouring and deposition. 15, 14, 13, 12	5-30% affected. Scours at constrictions and where grades steepen, some deposition in pools. 11, 10, 9, 8	30-50% affected. Deposits and scours at obstructions and bends. Some deposition in pools. 7, 6, 5, 4	More than 50% of the bottom changing nearly year long. Pools almost absent due to deposition. Only large rocks in riffle exposed. 3, 2, 1, 0

DU503400RSC.P65 (UA3883) 20/8/98

Final Fauna Species List - Summary

Family	Scientific name	Common name	NC Act Status	EPBC Act Status	May 2011 Survey	Sept 2011 Survey	
Amphibians							
Bufonidae	**Rhinella marina*	cane toad			✓	✓	
Hylidae	*Litoria caerulea*	green tree frog				✓	
Hylidae	*Litoria inermis*	bumpy rocket frog				✓	
Hylidae	*Litoria rubella*	desert tree frog				✓	
Myobatrachidae	*Limnodynastes tasmaniensis*	spotted grass frog			✓		**Total**
					2	**4**	**5**
Reptiles							
Agamidae	*Amphibolurus burnsi*	Burns' dragon			✓		
Diporiphora	*Diporiphora australis*	tommy roundhead				✓	
Elapidae	*Demansia psammophis*	yellow-faced whipsnake			✓		
Gekkonidae	*Gehyra dubia*	dubious gecko			✓	✓	
Scincidae	*Carlia munda*				✓		
Scincidae	*Carlia vivax*	lively rainbow skink				✓	
Scincidae	*Cryptoblepharus virgatus*	wall skink			✓	✓	
Scincidae	*Ctenotus robustus*	eastern striped skink			✓		
Scincidae	*Menetia greyii*				✓		
Scincidae	*Tiliqua scincoides*	common blue-tongue			✓	✓	**Total**
					8	**5**	**10**
Mammals							
Canidae	**Canis lupus*	dog			✓		
Felidae	**Felis catus*	cat			✓		
Leporidae	**Oryctolagus cuniculus*	European rabbit			✓	✓	

Family	Scientific name	Common name	NC Act Status	EPBC Act Status	May 2011 Survey	Sept 2011 Survey	
Macropodidae	*Macropus giganteus*	eastern grey kangaroo			✓	✓	
Macropodidae	*Macropus rufus*	red kangaroo			✓	✓	
Phalangeridae	*Trichosurus vulpecula*	common brushtail possum				✓	
Tachyglossidae	*Tachyglossus aculeatus*	echidna	SLC			✓	
Emballonuridae	*Saccolaimus flaviventris*	yellow-bellied sheathtail-bat			✓	✓	
Molossidae	*Austronomus australis*	White-striped freetail bat			✓		
Molossidae	*Chaerephon jobensis*	northern freetail-bat			✓		
Molossidae	*Mormopterus beccarii*	Beccari's freetail-bat			✓	✓	
Suiidae	**Sus scrofa*	pig			✓		
Vespertilionidae	*Chalinolobus gouldii*	Gould's wattled bat			✓	✓	
Vespertilionidae	*Chalinolobus morio*	chocolate wattled bat			✓	✓	
Vespertilionidae	*Chalinolobus picatus*	little pied bat	NT		✓		
Vespertilionidae	*Nyctophilus* sp.	eastern long-eared bat (potentially)	V	V	✓		
Vespertilionidae	*Scotorepens balstoni*	inland broad-nosed bat			✓	✓	
Vespertilionidae	*Scotorepens greyii / S. sanborni*	little broad-nosed bat / northern broad-nosed bat			✓	✓	
Vespertilionidae	*Vespadelus baverstocki*	inland forest bat			✓	✓	
Vespertilionidae	*Vespadelus troughtoni*	eastern cave bat			✓		**Total**
					18	**12**	**20**
Birds							
Acanthizidae	*Smicrornis brevirostris*	weebill			✓	✓	
Accipitridae	*Haliastur sphenurus*	whistling kite		Mar	✓	✓	
Accipitridae	*Milvus migrans*	black kite			✓		
Aegothelidae	*Aegotheles cristatus*	Australian-owlet nightjar				✓	
Anatidae	*Anas superciliosa*	Pacific black duck			✓		

Family	Scientific name	Common name	NC Act Status	EPBC Act Status	May 2011 Survey	Sept 2011 Survey	
Anatidae	*Chenonetta jubata*	Australian wood duck			✓		
Anatidae	*Dendrocygna eytoni*	plumed whistling duck			✓		
Anhingidae	*Anhinga melanogaster*	Australasian darter			✓		
Ardeidae	*Ardea alba*	great egret	SLC	Ma, Mig (CAMBA, JAMBA)		✓	
Ardeidae	*Ardea pacifica*	white-necked heron			✓	✓	
Ardeidae	*Ardea picata*	pied heron				✓	
Artamidae	*Artamus cinereus*	black-faced woodswallow			✓	✓	
Artamidae	*Artamus minor*	little woodswallow				✓	
Artamidae	*Artamus personatus*	masked woodswallow			✓		
Artamidae	*Cracticus nigrogularis*	pied butcherbird			✓	✓	
Artamidae	*Cracticus torquatus*	grey butcherbird			✓	✓	
Artamidae	*Gymnorhina tibicen*	Australian magpie			✓	✓	
Cacatuidae	*Cacatua galerita*	sulphur-crested cockatoo				✓	
Cacatuidae	*Eolophus roseicapillus*	galah			✓	✓	
Cacatuidae	*Nymphicus hollandicus*	cockatiel				✓	
Campephagidae	*Centropus phasianinus*	pheasant coucal			✓	✓	
Campephagidae	*Coracina novaehollandiae*	black-faced cuckoo-shrike		Ma		✓	
Casuaridae	*Dromaius novaehollandiae*	emu				✓	
Charadriidae	*Elseyornis melanops*	black-fronted dotterel			✓		
Charadriidae	*Vanellus miles*	masked lapwing				✓	
Ciconiidae	*Grus rubicundus*	brolga			✓	✓	
Cisticolidae	*Cisticola exilis*	golden-headed cisticola				✓	
Climacteridae	*Climacteris picumnus*	brown treecreeper			✓	✓	
Columbidae	*Geopelia striata*	peaceful dove			✓		

Family	Scientific name	Common name	NC Act Status	EPBC Act Status	May 2011 Survey	Sept 2011 Survey	
Columbidae	*Geophaps scripta scripta*	squatter pigeon (southern subspecies)	V	V		✓	
Columbidae	*Ocyphaps lophotes*	crested pigeon			✓	✓	
Corcoracidae	*Struthidea cinerea*	apostlebird			✓	✓	
Corvidae	*Corvus coronoides*	Australian raven			✓	✓	
Corvidae	*Corvus orru*	Torresian crow			✓	✓	
Cuculidae	*Chrysococcyx basalis*	horsfield's bronze-cuckoo		Ma		✓	
Cuculidae	*Scythrops novaehollandiae*	channel-billed cuckoo		Ma	✓	✓	
Dicaeidae	*Dicaeum hirundinaceum*	mistletoebird			✓		
Dicruridae	*Grallina cyanoleuca*	magpie-lark			✓	✓	
Dicruridae	*Microeca fascinans*	jacky winter			✓	✓	
Dicruridae	*Myiagra inquieta*	restless flycatcher			✓		
Dicruridae	*Myiagra rubecula*	leaden flycatcher				✓	
Dicruridae	*Rhipidura fuliginosa*	grey fantail			✓	✓	
Dicruridae	*Rhipidura leucophrys*	willie wagtail			✓	✓	
Falconidae	*Falco cenchroides*	nankeen kestrel		Ma		✓	
Halcyonidae	*Dacelo novaeguineae*	laughing kookaburra				✓	
Halcyonidae	*Todiramphus macleayii*	forest kingfisher				✓	
Halcyonidae	*Todiramphus pyrrhopygius*	red-backed kingfisher			✓	✓	
Hirundinidae	*Petrochelidon nigricans*	tree martin		Ma	✓		
Maluridae	*Malurus lamberti*	variegated fairy-wren			✓		
Maluridae	*Malurus melanocephalus*	red-backed fairy-wren			✓	✓	
Meliphagidae	*Acanthagenys rufogularis*	spiny-cheeked honeyeater			✓		
Meliphagidae	*Entomyzon cyanotis*	blue-faced honeyeater				✓	
Meliphagidae	*Lichenostomus albogularis*	white-throated honeyeater				✓	
Meliphagidae	*Lichenostomus flavicollis*	yellow-throated honeyeater			✓		

Family	Scientific name	Common name	NC Act Status	EPBC Act Status	May 2011 Survey	Sept 2011 Survey	
Meliphagidae	*Lichenostomus penicillatus*	white-plumed honeyeater			✓		
Meliphagidae	*Lichenostomus virescens*	singing honeyeater			✓	✓	
Meliphagidae	*Lichmera indistincta*	brown honeyeater			✓	✓	
Meliphagidae	*Manorina flavigula*	yellow-throated miner				✓	
Meliphagidae	*Manorina melanocephala*	noisy miner			✓	✓	
Meliphagidae	*Philemon citreogularis*	little friarbird				✓	
Meliphagidae	*Philemon corniculatus*	noisy friarbird				✓	
Meliphagidae	*Plectorhyncha lanceolata*	striped honeyeater			✓	✓	
Meropidae	*Merops ornatus*	rainbow bee-eater	SLC	Ma, Mig, JAMBA		✓	
Motacillidae	*Anthus novaeseelandiae*	Richard's pipit		Ma	✓	✓	
Oriolidae	*Oriolus sagittatus*	olive-backed oriole			✓		
Otididae	*Ardeotis australis*	Australian bustard			✓	✓	
Pachycephalidae	*Colluricincla harmonica*	grey shrike-thrush			✓	✓	
Pachycephalidae	*Pachycephala rufiventris*	rufous whistler			✓	✓	
Pardalotidae	*Acanthiza chrysorrhoa*	yellow-rumped thornbill				✓	
Pardalotidae	*Acanthiza nana*	yellow thornbill			✓		
Pardalotidae	*Acanthiza pusilla*	brown thornbill			✓		
Pardalotidae	*Acanthiza reguloides*	buff-rumped thornbill			✓		
Pardalotidae	*Gerygone olivacea*	white-throated gerygone			✓	✓	
Pardalotidae	*Pardalotus punctatus*	spotted pardalote				✓	
Pardalotidae	*Pardalotus striatus*	striated pardalote			✓	✓	
Passeridae	*Poephila bichenovii*	double-barred finch			✓	✓	
Passeridae	*Taeniopygia guttata*	zebra finch			✓	✓	
Pelicanidae	*Pelecanus conspicillatus*	Australian pelican		Ma		✓	
Phalacrocoracidae	*Phalacrocorax sulcirostris*	little black cormorant				✓	

Family	Scientific name	Common name	NC Act Status	EPBC Act Status	May 2011 Survey	Sept 2011 Survey	
Phalacrocoracidae	*Phalacrocorax varius*	pied cormorant			✓		
Phasianidae	*Coturnix ypsilophora*	brown quail			✓		
Plataleidae	*Platalea regia*	royal spoonbill			✓	✓	
Podargidae	*Podargus strigoides*	tawny frogmouth			✓	✓	
Pomatostomidae	*Pomatostomus temporalis*	grey-crowned babbler			✓	✓	
Psittacidae	*Aprosmictus erythropterus*	red-winged parrot			✓	✓	
Psittacidae	*Platycercus adscitus*	pale-headed rosella			✓	✓	
Psittacidae	*Trichoglossus chlorolepidotus*	scaly breasted lorikeet				✓	
Psittacidae	*Trichoglossus haematodus*	rainbow lorikeet				✓	
Ptilonorhynchidae	*Ptilonorhynchus maculatus*	spotted bowerbird			✓	✓	
Strigidae	*Ninox novaeseelandiae*	southern boobook			✓		
Sylviidae	*Cincloramphus mathewsi*	rufous songlark				✓	
Turnicidae	*Turnix pyrrhothorax*	red-chested buttonquail			✓		
Tytonidae	*Tyto alba*	barn owl				✓	
Zosteropidae	*Zosterops lateralis*	silvereye		Ma	✓		**Total**
					64	**70**	**94**
				Total	**92**	**91**	**129**

Acronyms and abbreviations:

Special LC: Special Least Concern
NT: Near threatened
V: Vulnerable
E: Endangered
Ma: Marine
Mig: Migratory
CAMBA: Agreement between the Government of Australia and the Government of the People's Republic of China for the Protection of Migratory Birds and

their Environment
JAMBA: Agreement between the Government of Australia and the Government of Japan for the Protection of Migratory Birds in Danger of Extinction and their Environment

Appendix G

Landzone Descriptions

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Queensland Government

Environment and Resource Management

Land zone definitions

Land Zone 1

	Short description	deposits subject to periodic tidal inundation
	General term	tidal flats and beaches

Quaternary estuarine and marine deposits subject to periodic inundation by saline or brackish marine waters. Includes mangroves, saltpans, off-shore tidal flats and tidal beaches. Soils are predominantly Hydrosols (saline muds, clays and sands) or beach sand.

Land Zone 2

	Short description	Quaternary coastal sand deposits
	General term	coastal dunes

Quaternary coastal dunes and beach ridges. Includes degraded dunes, sand plains and swales, lakes and swamps enclosed by dunes, as well as coral and sand cays. Soils are predominantly Rudosols and Tenosols (siliceous or calcareous sands), Podosols and Organosols.

Land Zone 3

	Short description	Quaternary alluvial systems
	General term	alluvium (river and creek flats)

Quaternary alluvial systems, including floodplains, alluvial plains, alluvial fans, terraces, levees, swamps, channels, closed depressions and fine textured palaeo-estuarine deposits. Also includes estuarine plains currently under fresh water influence, inland lakes and associated dune systems (lunettes). Excludes talus slopes, colluvial deposits and pediments.Includes a diverse range of soils, predominantly Vertosols and Sodosols, also with Hydrosols in higher rainfall areas.

Land Zone 4

	Short description	flat to gently undulating Tertiary clay plains
	General term	clay plains not associated with current alluvium

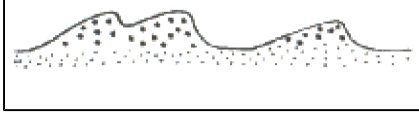
Cainozoic clay deposits, usually forming level to gently undulating plains above current alluvial systems. Excludes clay plains and downs formed in-situ on bedrock. Mainly Vertosols with gilgai microrelief, but includes small areas of thin sandy or loamy surfaced Sodosols and Chromosols.

Land Zone 5

	Short description	plains and plateaus on Tertiary land surfaces, generally with medium to coarse textured soils
	General term	old loamy and sandy plains

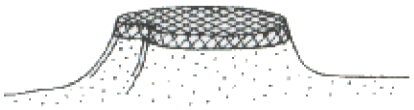
Extensive, uniform near level or gently undulating Cainozoic plains with sandy or loamy soils. Includes dissected remnants of these surfaces. Also includes plains with sandy or loamy soils of uncertain origin, and plateau remnants with deep soils usually overlying duricrust. Excludes Quaternary alluvial deposits (land zone 3), exposed duricrust (land zone 7), and soils derived from underlying bedrock (land zones 8 to 12). Soils are usually Tenosols and Kandosols, also minor deep sandy surfaced Sodosols and Chromosols. There may be a duricrust at depth.

Land Zone 6

	Short description	Quaternary inland dunefields
	General term	inland dunefields

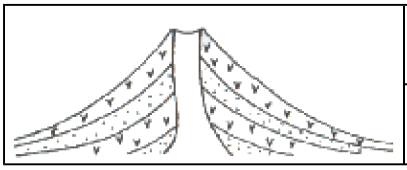
Quaternary inland dunefields, interdune areas, degraded dunefields, and associated aeolian sandplains. Excludes alluvial systems, which may traverse this zone, and intermittent lakes and claypans (land zone 3). Soils are predominantly Rudosols and Tenosols, some Kandosols and minor Calcarosols.

Land Zone 7

	Short description	exposed or shallowly covered duricrusts
	General term	ironstone jump-ups

Cainozoic duricrusts formed on a variety of rock types, usually forming mesas or scarps. Includes exposed ferruginous, siliceous or mottled horizons and associated talus and colluvium, and remnants of these features, for example low stony rises on downs. Soils are usually shallow Rudosols and Tenosols, with minor Sodosols and Chromosols on associated pediments, and shallow Kandosols on plateau margins and larger mesas.

Land Zone 8

	Short description	plains and hills on Cainozoic flood basalts
	General term	basalt plains and hills

Cainozoic igneous rocks, predominantly flood basalts forming extensive plains and occasional low scarps. Also includes hills, cones and plugs on trachytes and rhyolites, and associated interbedded sediments, and talus. Excludes springs (land zone 3), and deep soils overlying duricrust (land zone 5). Soils include Vertosols, Ferrosols, and shallow Dermosols.

Land Zone 9

	Short description	gently undulating landscapes on more or less horizontally bedded fine grained sedimentary rocks
	General term	undulating country on fine grained sedimentary rocks

Fine-grained sedimentary rocks, generally with little or no deformation, forming undulating landscapes with a broad range of fine textured soils of moderate to high fertility. Siltstones, mudstones, shales, calcareous sediments, and lithic and labile sandstones are typical rock types although minor interbedded volcanics may occur. Excludes areas of duricrust (land zone 7). Includes a diverse range of soils of moderate to high fertility, predominantly Vertosols, Sodosols, and Chromosols.

Land Zone 10

	Short description	plateaus, scarps and ledges with shallow soils on more or less horizontally bedded medium- to coarse-grained sedimentary rocks
	General term	sandstone ranges

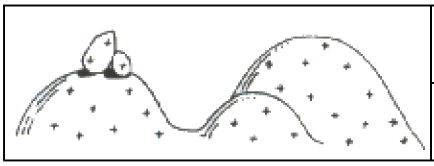
Medium to coarse-grained sedimentary rocks, with little or no deformation, forming plateaus, ledges and scarps. Includes siliceous sandstones, conglomerates and minor interbedded volcanics, and springs associated with these rocks. Excludes overlying Cainozoic sand deposits (land zone 5). Soils are predominantly shallow Rudosols and Tenosols of low fertility, but include sandy surfaced Kandosols, Kurosols, Sodosols and Chromosols.

Land Zone 11

	Short description	hills and lowlands on metamorphosed sedimentary rocks
	General term	hills and lowlands on metamorphic rocks

Metamorphosed rocks, forming ranges, hills and lowlands. Primarily lower Permian and older sedimentary formations which are generally moderately to strongly deformed. Includes low- to high-grade and contact metamorphics such as phyllites, slates, gneisses of indeterminate origin and serpentinite, and interbedded volcanics. Soils are mainly shallow, gravelly Rudosols and Tenosols, with Sodosols and Chromosols on lower slopes and gently undulating areas. Soils are typically of low to moderate fertility.

Land Zone 12

	Short description	hills and lowlands on granitic and other pre Cainozoic igneous rocks
	General term	hills and lowlands on granitic rocks

Mesozoic to Proterozoic igneous rocks, forming ranges, hills and lowlands. Predominantly granitic rocks and intermediate to acid volcanics such as granites, granodiorites, andesites and rhyolites, as well as minor areas of associated interbedded sediments and basic intrusive rock types such as gabbros and dolerites. Excludes serpentinites (land zone 11) and younger igneous rocks (land zone 8). Soils are mainly Tenosols and Rudosols on steeper slopes with Chromosols and Sodosols on lower slopes and gently undulating areas. Soils are typically of low to moderate fertility.

Last reviewed 12 April 2011
Last updated 18 November 2010

Land zone 3: Quaternary alluvial systems, including floodplains, alluvial plains, alluvial fans, terraces, levees, swamps, channels, closed depressions and fine textured palaeo-estuarine deposits. Also includes estuarine plains currently under fresh water influence, inland lakes and associated dune systems (lunettes). Excludes talus slopes, colluvial deposits and pediments.Includes a diverse range of soils, predominantly Vertosols and Sodosols, also with Hydrosols in higher rainfall areas.

Land zone 4: Cainozoic clay deposits, usually forming level to gently undulating plains above current alluvial systems. Excludes clay plains and downs formed in-situ on bedrock. Mainly Vertosols with gilgai microrelief, but includes small areas of thin sandy or loamy surfaced Sodosols and Chromosols.

Land zone 5: Extensive, uniform near level or gently undulating Cainozoic plains with sandy or loamy soils. Includes dissected remnants of these surfaces. Also includes plains with sandy or loamy soils of uncertain origin, and plateau remnants with deep soils usually overlying duricrust. Excludes Quaternary alluvial deposits (land zone 3), exposed duricrust (land zone 7), and soils derived from underlying bedrock (land zones 8 to 12). Soils are usually Tenosols and Kandosols, also minor deep sandy surfaced Sodosols and Chromosols. There may be a duricrust at depth.

Land zone 7: Cainozoic duricrusts formed on a variety of rock types, usually forming mesas or scarps. Includes exposed ferruginous, siliceous or mottled horizons and associated talus and colluvium, and remnants of these features, for example low stony rises on downs. Soils are usually shallow Rudosols and Tenosols, with minor Sodosols and Chromosols on associated pediments, and shallow Kandosols on plateau margins and larger mesas.

Land zone 9: Fine-grained sedimentary rocks, generally with little or no deformation, forming undulating landscapes with a broad range of fine textured soils of moderate to high fertility. Siltstones, mudstones, shales, calcareous sediments, and lithic and labile sandstones are typical rock types although minor interbedded volcanics may occur. Excludes areas of duricrust (land zone 7). Includes a diverse range of soils of moderate to high fertility, predominantly Vertosols, Sodosols, and Chromosols.

Land zone 10: Medium to coarse-grained sedimentary rocks, with little or no deformation, forming plateaus, ledges and scarps. Includes siliceous sandstones, conglomerates and minor interbedded volcanics, and springs associated with these rocks. Excludes overlying Cainozoic sand deposits (land zone 5). Soils are predominantly shallow Rudosols and Tenosols of low fertility, but include sandy surfaced Kandosols, Kurosols, Sodosols and Chromosols.

Land zone 11: Metamorphosed rocks, forming ranges, hills and lowlands. Primarily lower Permian and older sedimentary formations which are generally moderately to strongly deformed. Includes low- to highgrade and contact metamorphics such as phyllites, slates, gneisses of indeterminate origin and serpentinite, and interbedded volcanics. Soils are mainly shallow, gravelly Rudosols and Tenosols, with Sodosols and Chromosols on lower slopes and gently undulating areas. Soils are typically of low to moderate fertility.

Source: Department of Environment and Resource Management, 2011.

Appendix H

Fine Scale Certified Regional Ecosystems Version 6.0b and Regulated Regrowth Version 2.0 Mapping (Source: DERM)

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1:750,000 (at A4)

0 5 10 15 20 25

Kilometres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia (GDA)
Grid: Map Grid of Australia 1994, Zone 55

N

LEGEND

- Town
- State Road
- Local Road
- Other Railway
- Cadastral Parcel
- Road Reserve
- Watercourse Reserve
- Mine (Onsite)
- Mine (Offsite)
- Study Area

Adani Mining Pty Ltd
Carmichael Coal Mine and Rail Project

Area of Proposed Clearing

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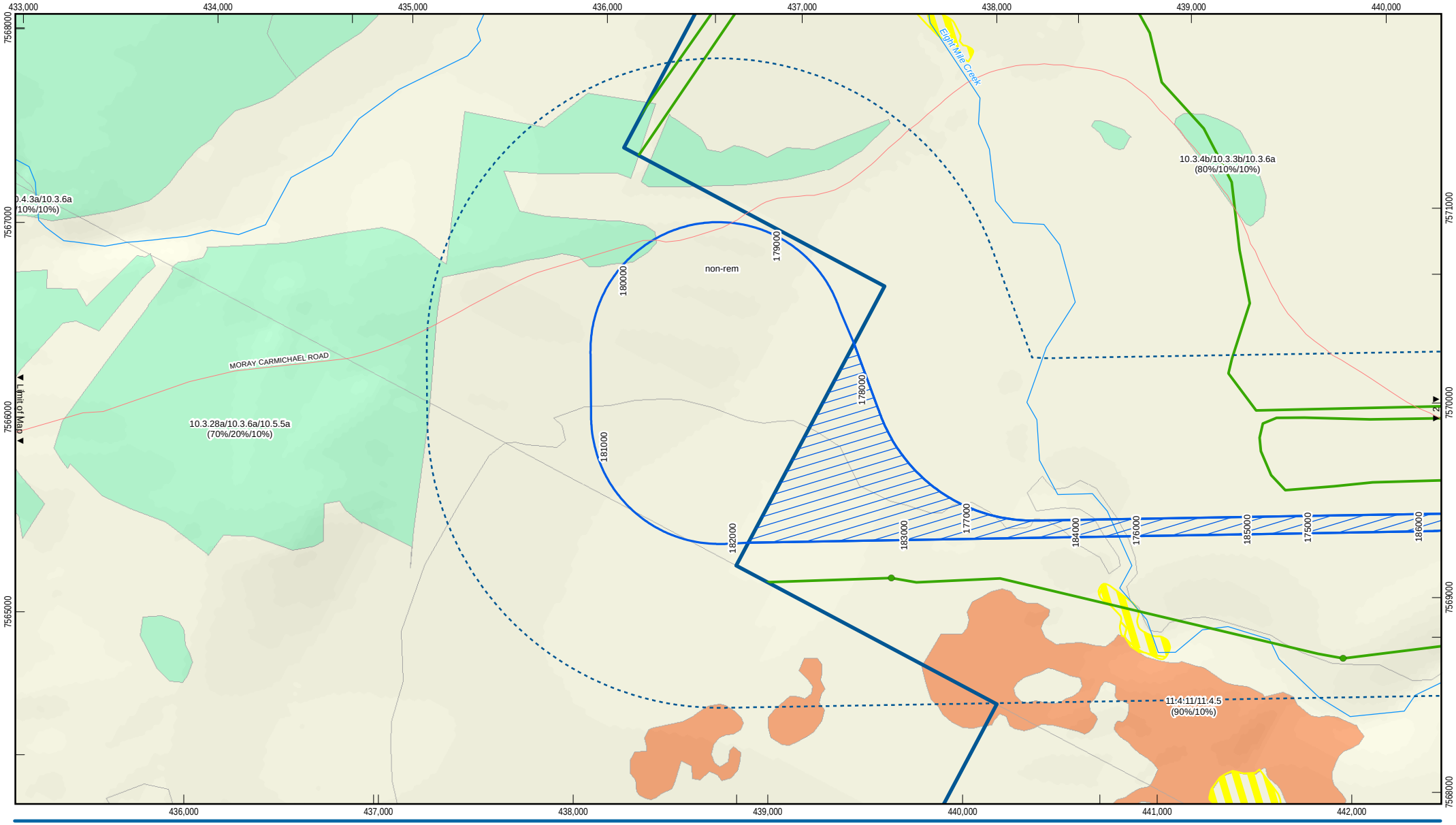
Data source: DERM: DEM (2008), DCDB (2010), RE v6.1 (2011), High Value Regrowth (2011); DME: EPC1690 (2010) / EPC1080 (2011); © Commonwealth of Australia (Geoscience Australia): Localities, Railways, Roads (2007); Adani: Alignment Opt9 Rev3, (2012); Gassman/Hyder: Mine (Offsite) (2012); GHD: Northern Missing Link (2011). Created by: BW, CA



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0 200 400 600 800 1,000

Metres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia (GDA)
Grid: Map Grid of Australia 1994, Zone 55

LEGEND

- State Road
- Local Road
- Watercourse
- Other Railway
- Mine (Onsite)
- Mine (Offsite)
- Mine (Offsite)
- Rail (West)
- Rail (East)
- Study Area

Regional Ecosystems v6.1

- Endangered - Dominant
- Endangered - Sub-dominant
- Of Concern - Dominant
- Of Concern - Sub-dominant
- Least Concern
- Non-remnant
- High Value Regrowth

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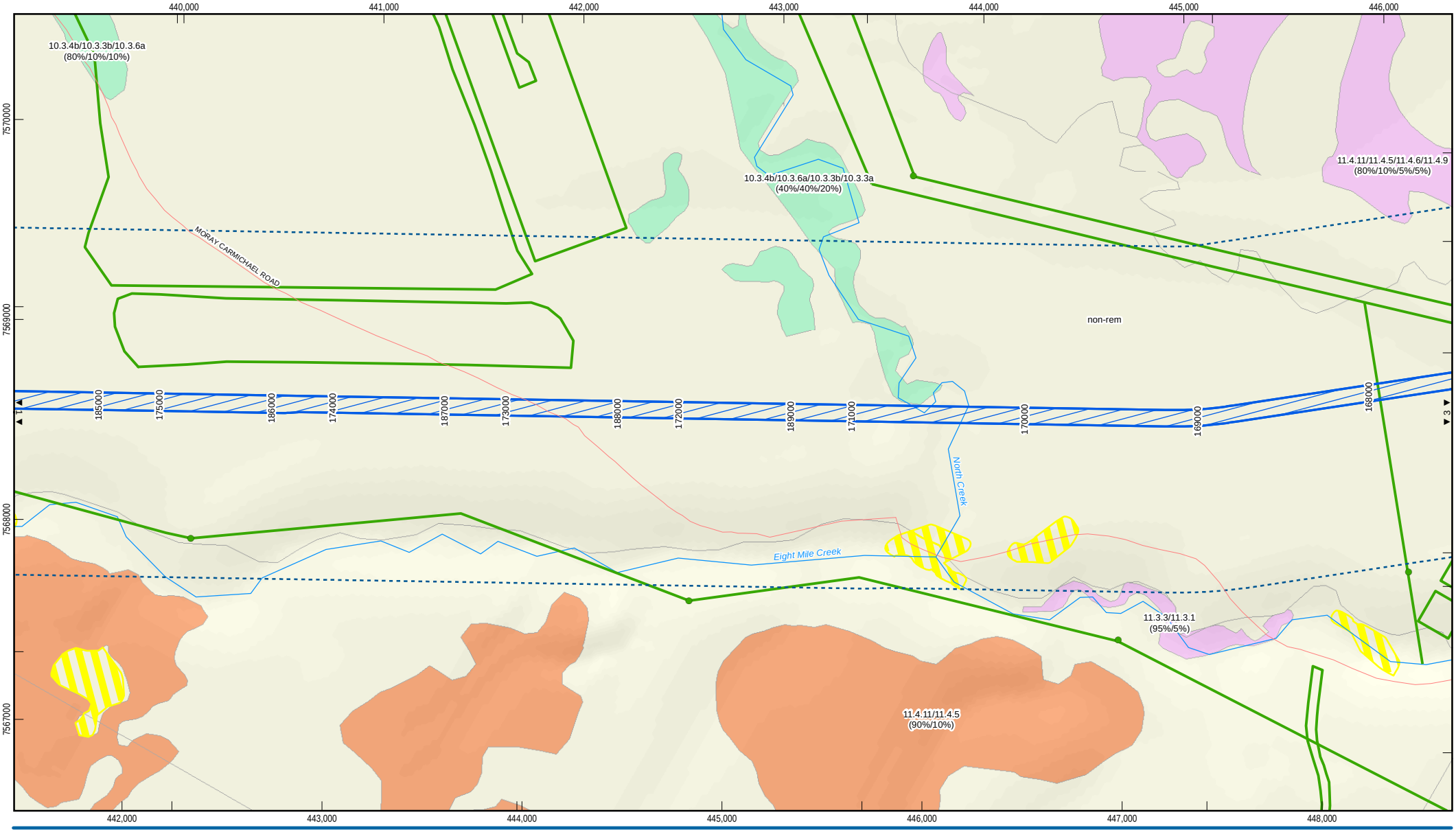

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Metres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia (GDA)
Grid: Map Grid of Australia 1994, Zone 55

LEGEND

- State Road
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- Other Railway
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- Mine (Offsite)
- Mine (Offsite)
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- Rail (East)
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Regional Ecosystems v6.1

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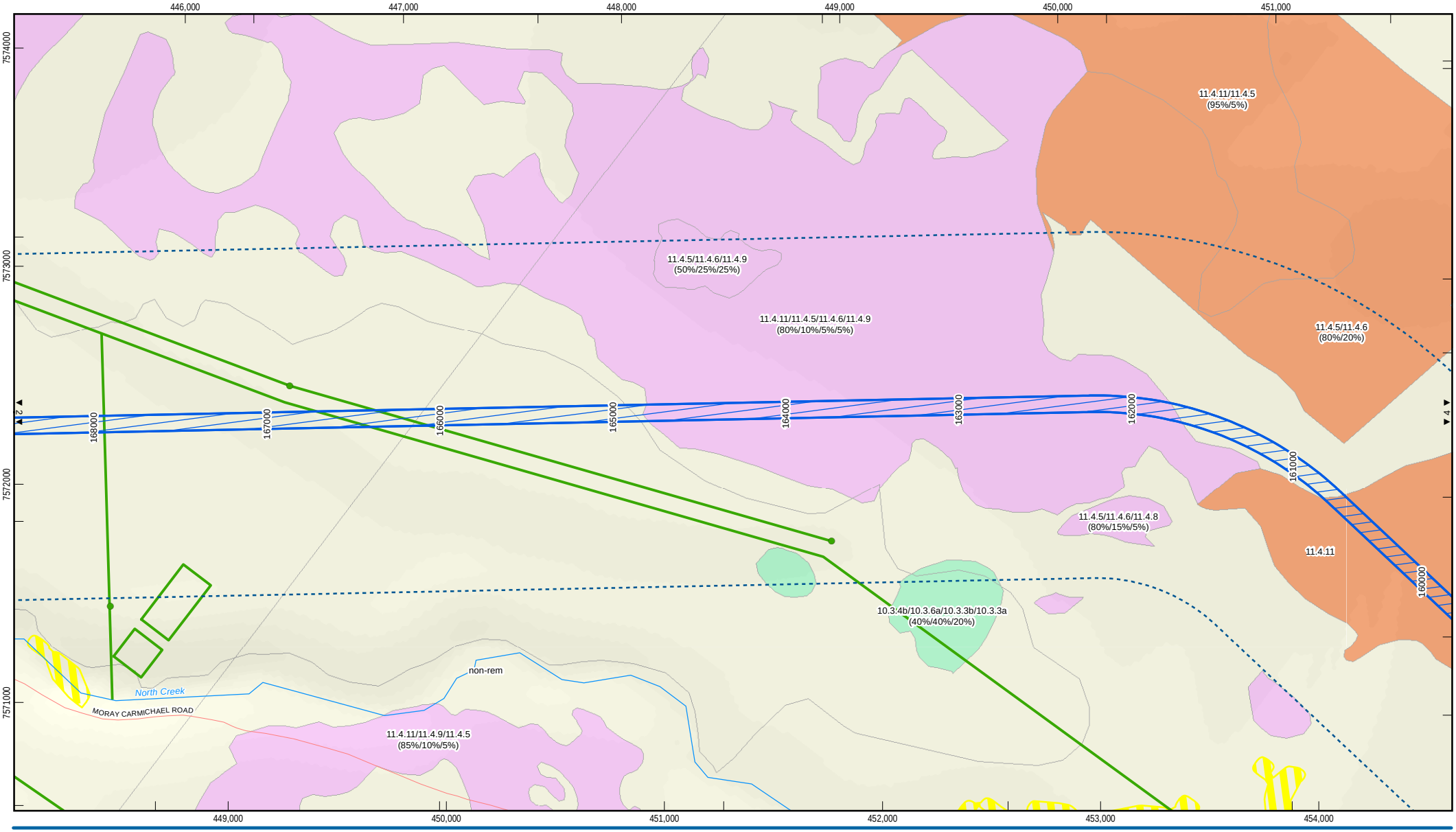

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Metres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia (GDA)
Grid: Map Grid of Australia 1994, Zone 55

LEGEND

- State Road
- Local Road
- Watercourse
- Other Railway
- Mine (Onsite)
- Mine (Offsite)
- Mine (Offsite)
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- Rail (East)
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Regional Ecosystems v6.1

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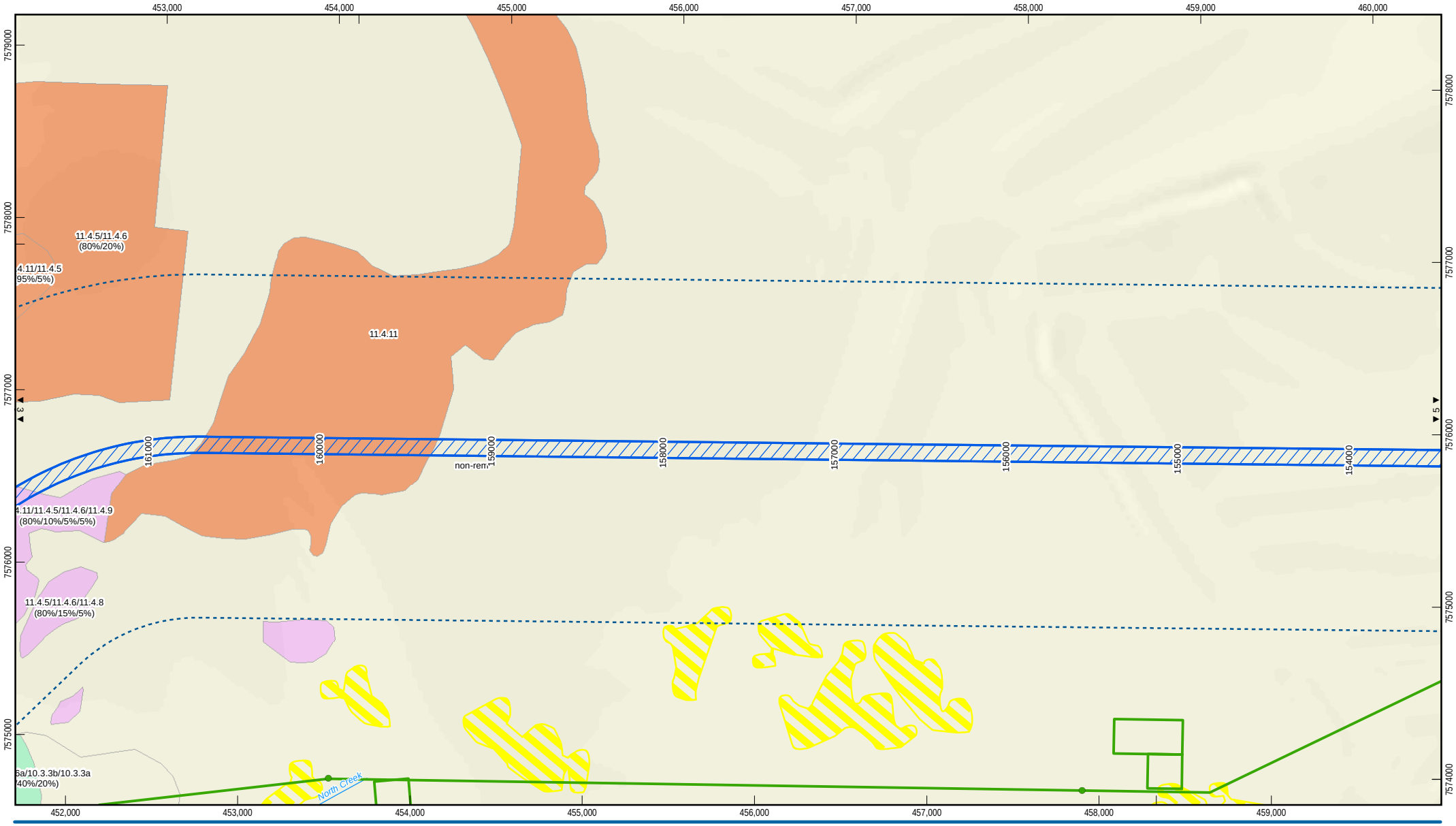

1:30,000 (at A4)

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Metres

Map Projection: Universal Transverse Mercator
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N

LEGEND

- State Road
- Local Road
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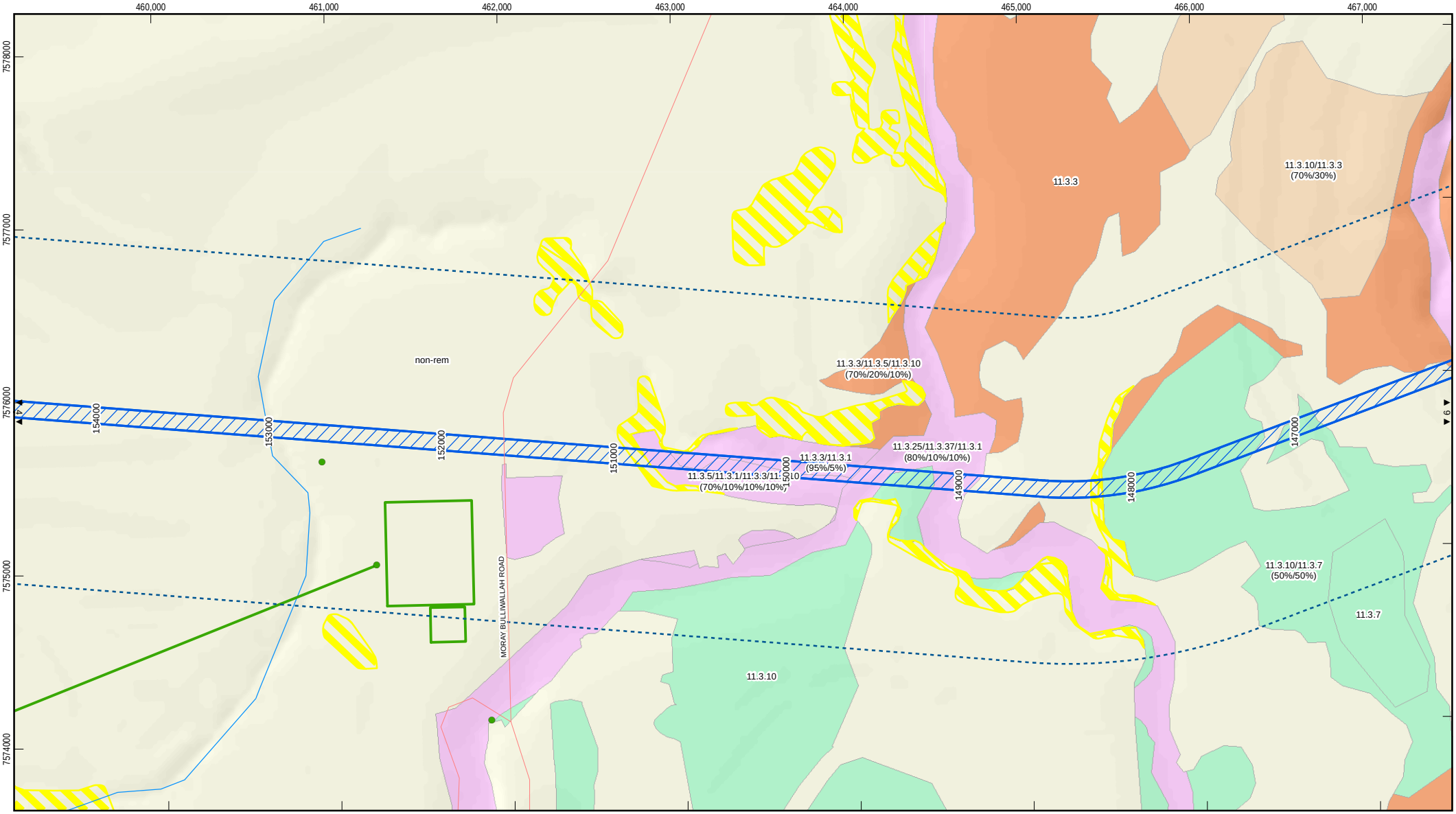

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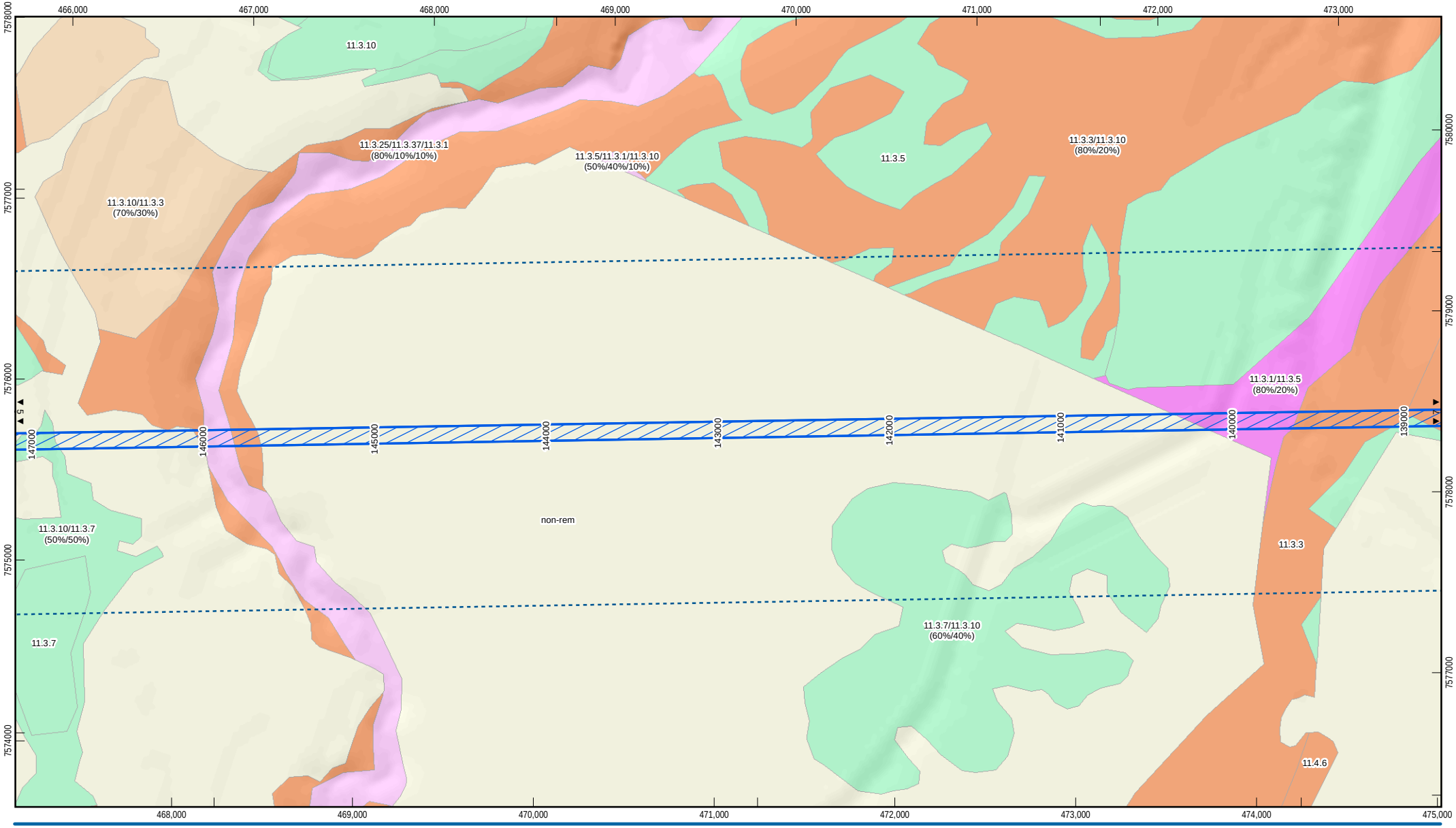

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Metres

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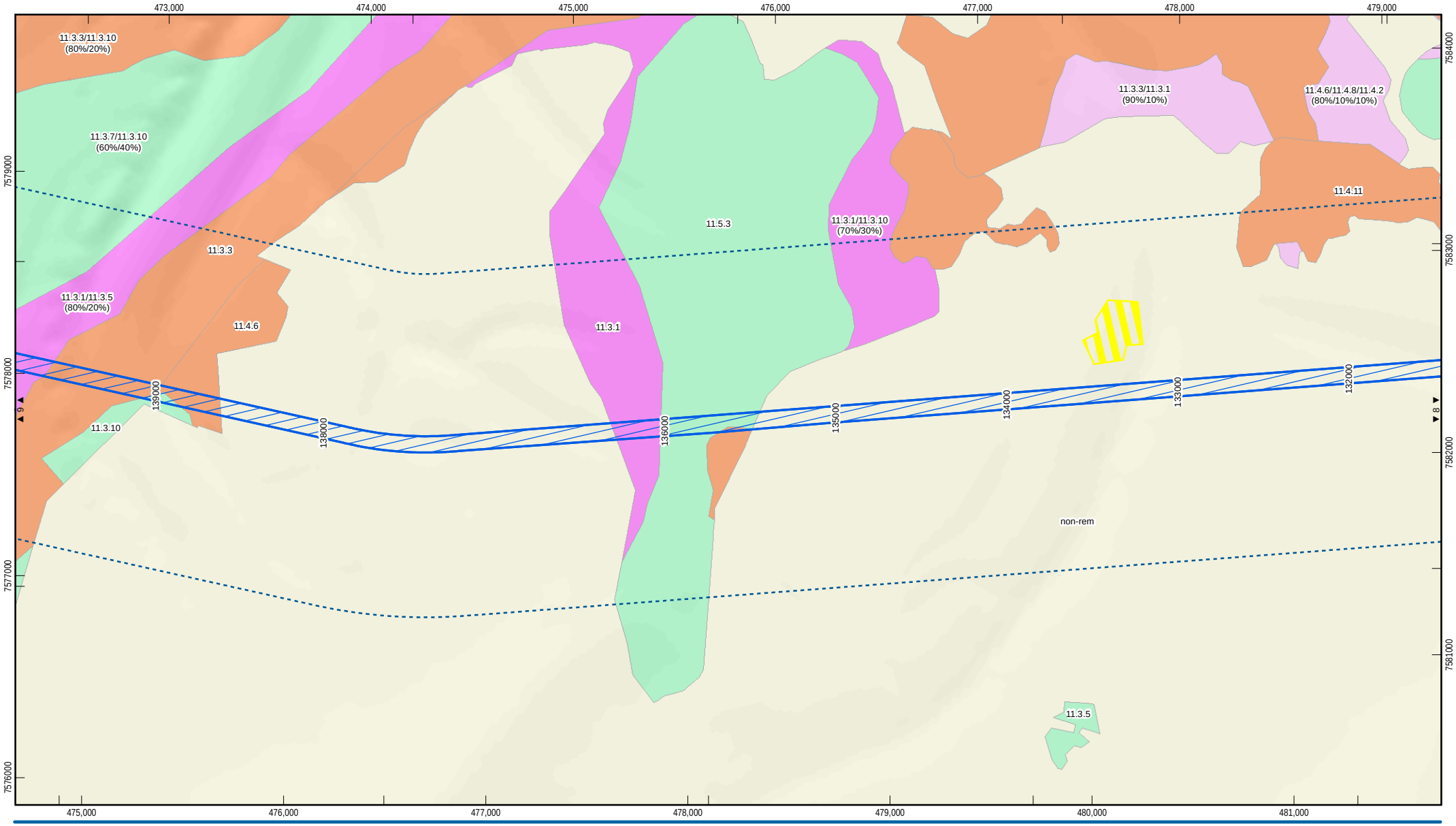

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Map Projection: Universal Transverse Mercator
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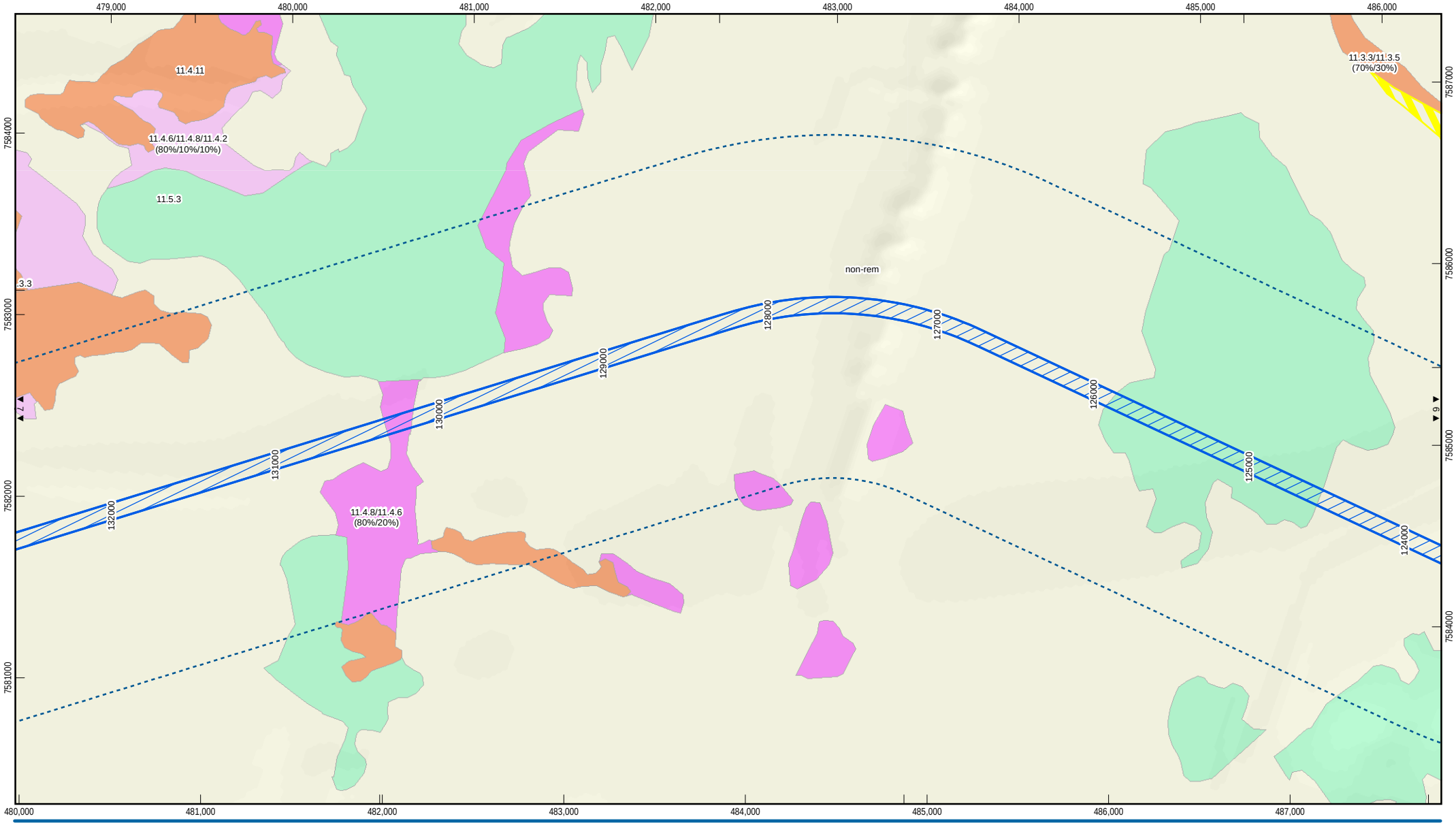

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Metres

Map Projection: Universal Transverse Mercator
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N

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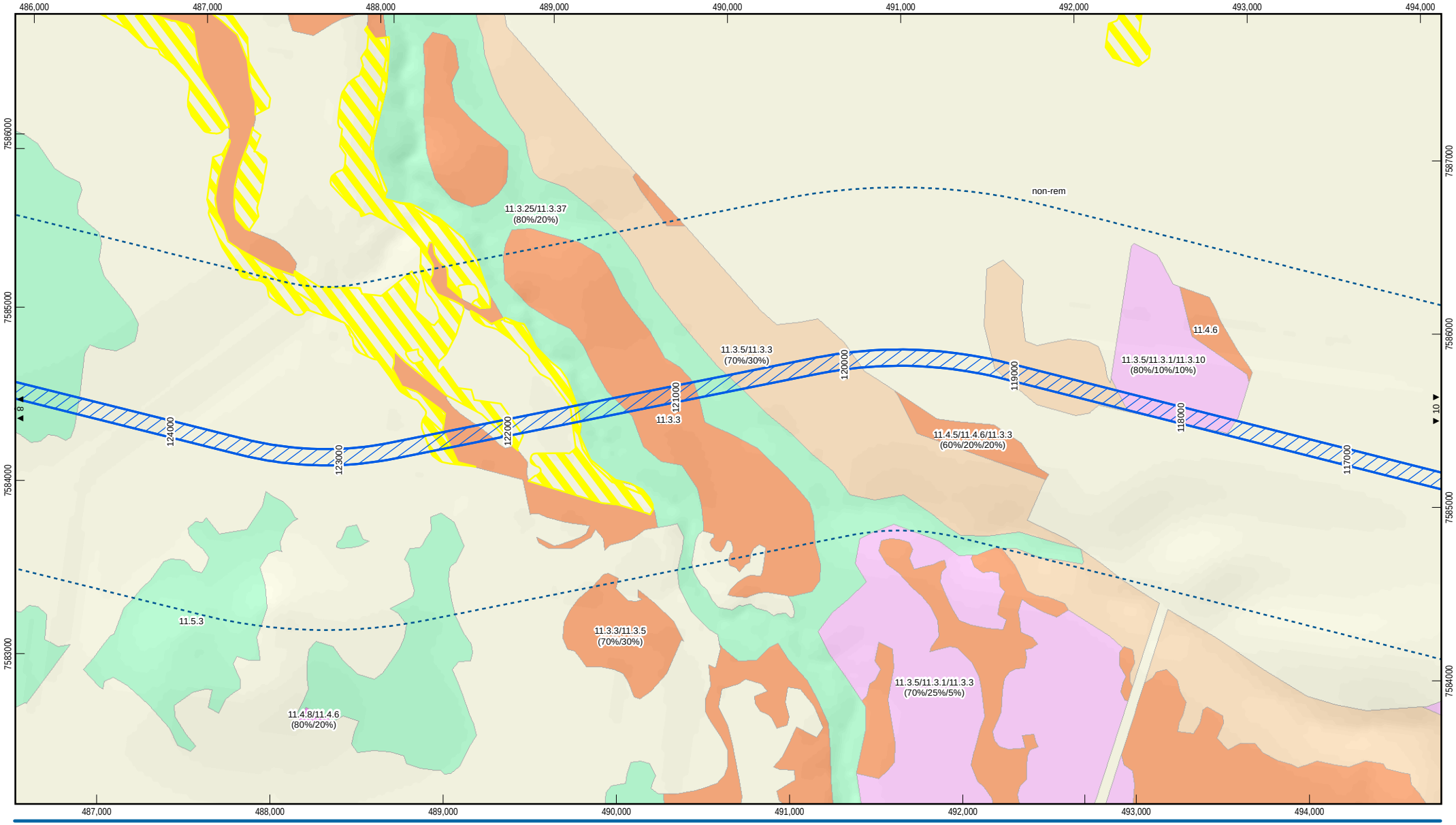

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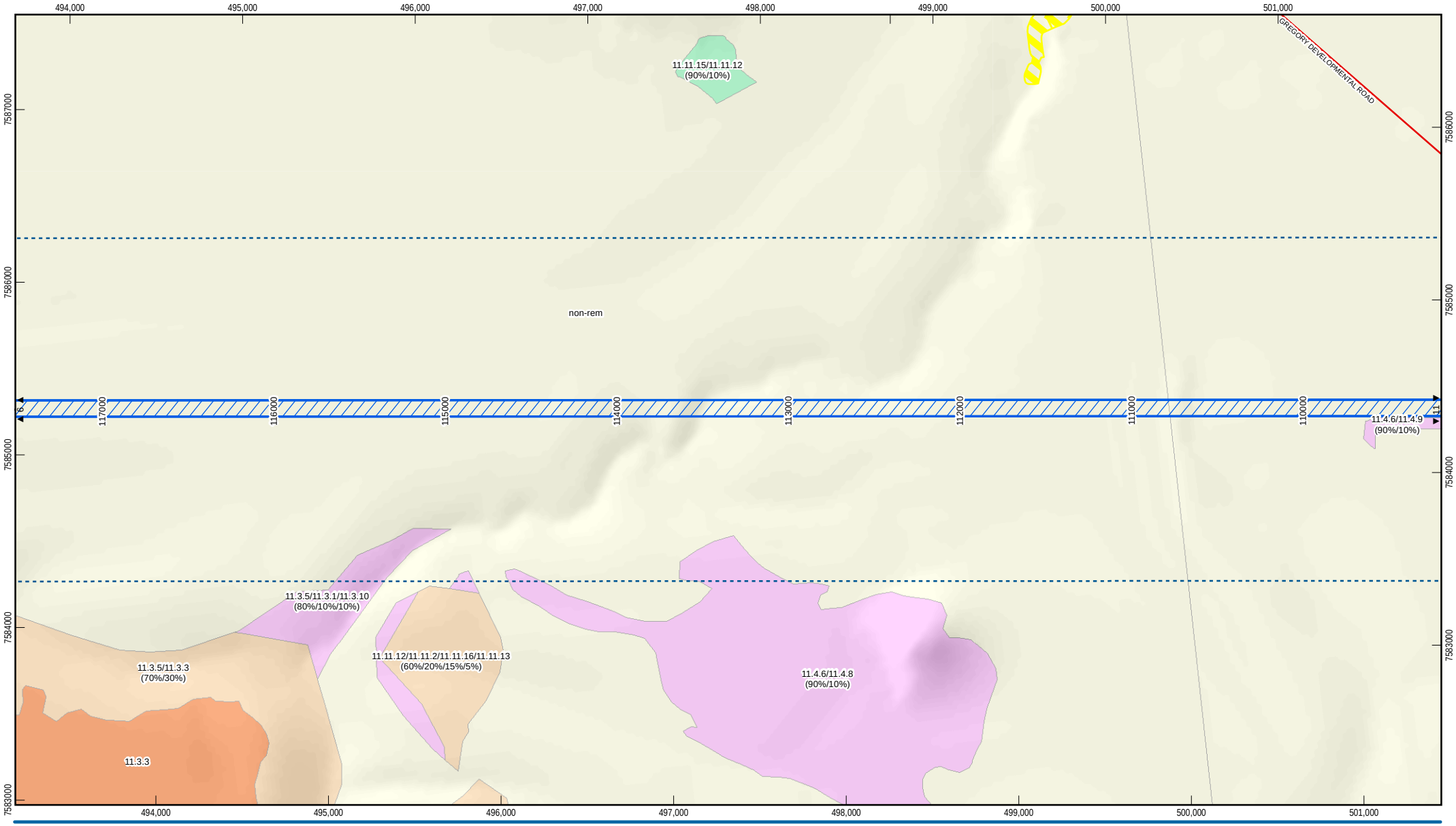
Data source: DERM: DEM (2008), Regional Ecosystems v6.1 (2010), High Value Regrowth (2011); © Commonwealth of Australia (Geoscience Australia): Localities, Railways, Roads, Watercourse (2007); Adani: Alignment Opt9 Rev3 (2012); GHD: Northern Missing Link (2011); DME: EPC1690 (2010) / EPC1080 (2011); Gassman/Hyder: Mine (Offsite) (2012). Created by: BW, CA



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0 200 400 600 800 1,000

Metres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia (GDA)
Grid: Map Grid of Australia 1994, Zone 55

N

LEGEND

- State Road
- Local Road
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- Rail (East)
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Regional Ecosystems v6.1

- Endangered - Dominant
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Adani Mining Pty Ltd

Carmichael Coal Mine and Rail Project

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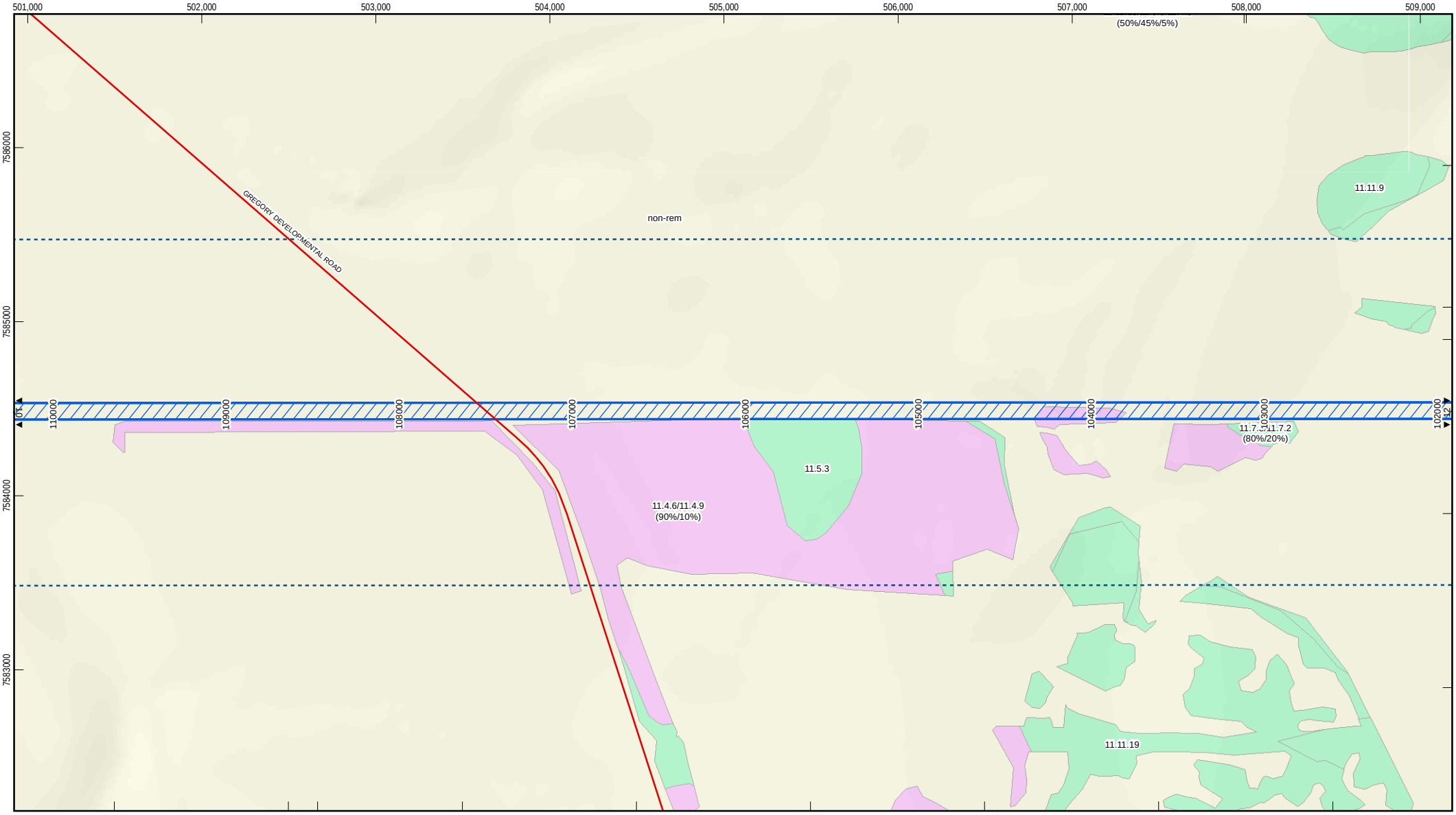

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Adani Mining Pty Ltd

Carmichael Coal Mine and Rail Project

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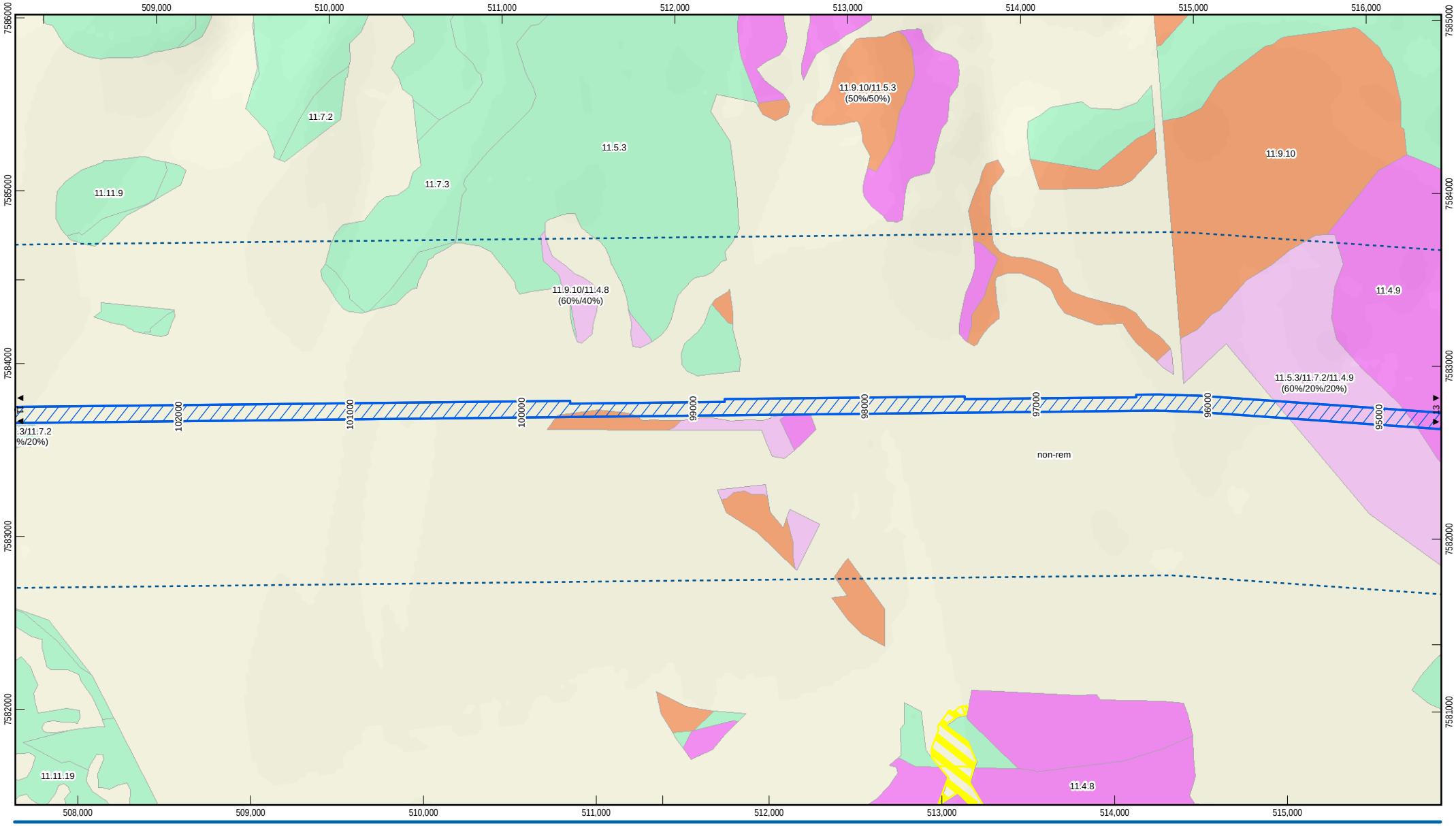

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Carmichael Coal Mine and Rail Project

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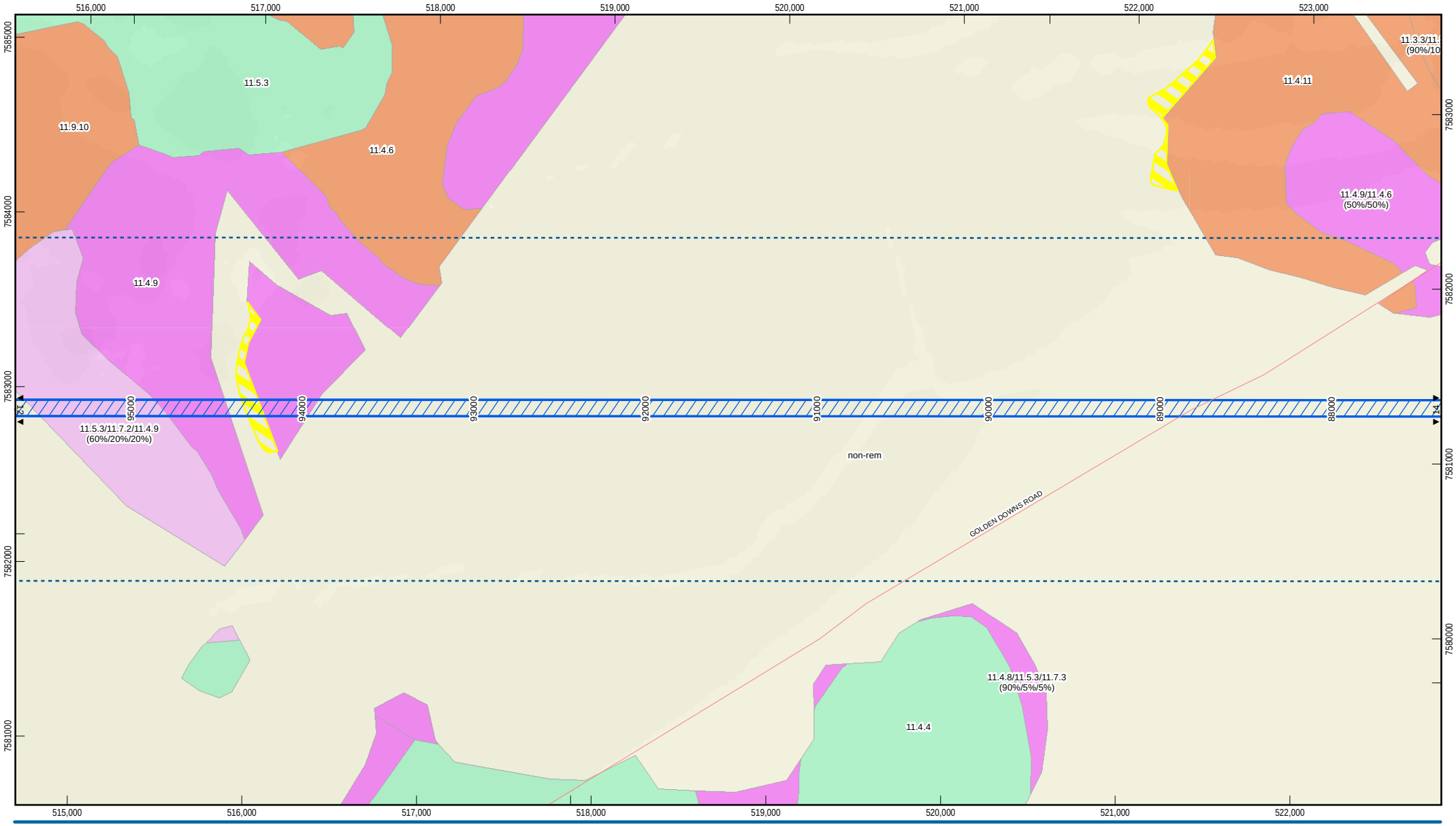

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Carmichael Coal Mine and Rail Project

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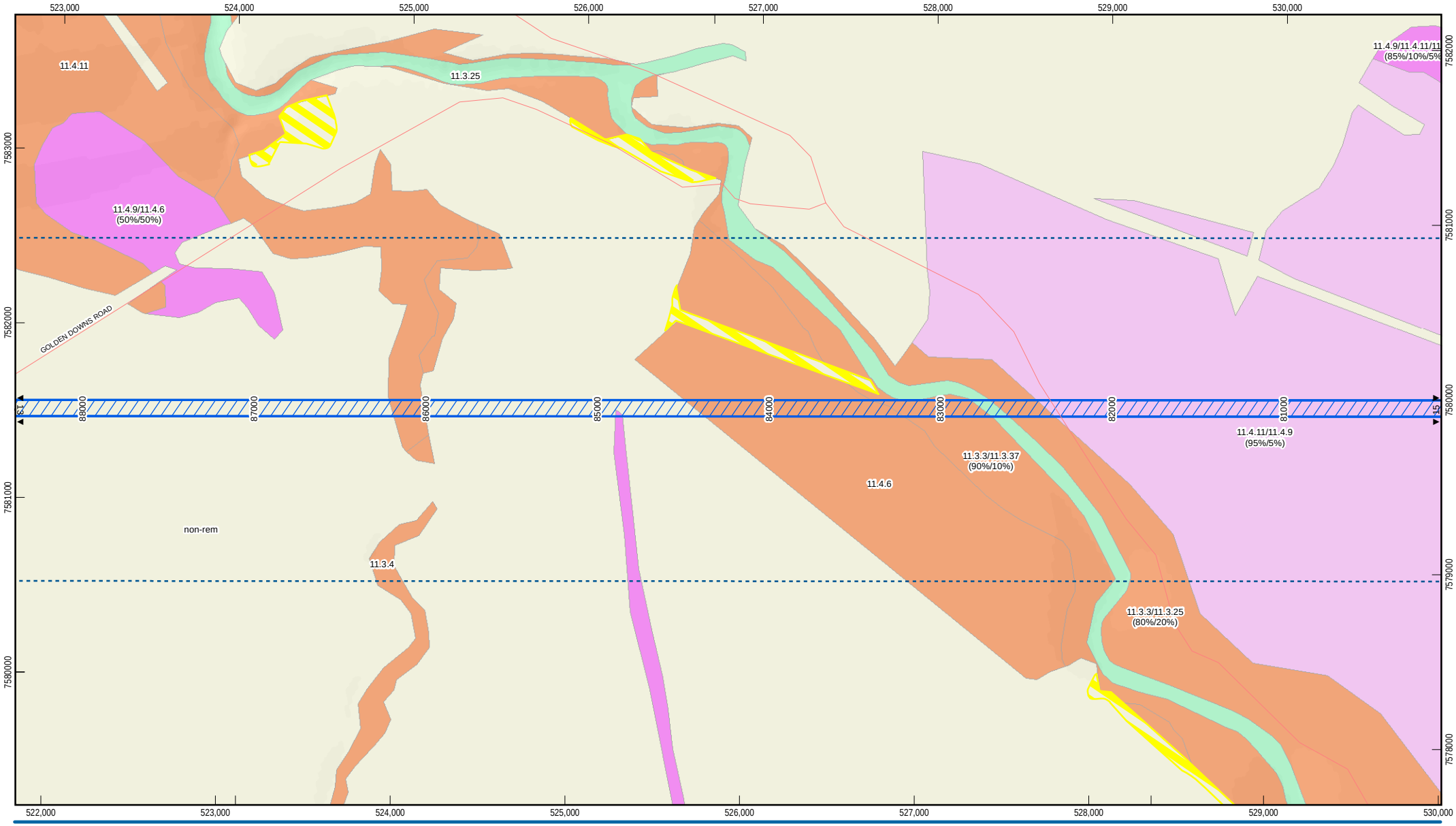

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Carmichael Coal Mine and Rail Project

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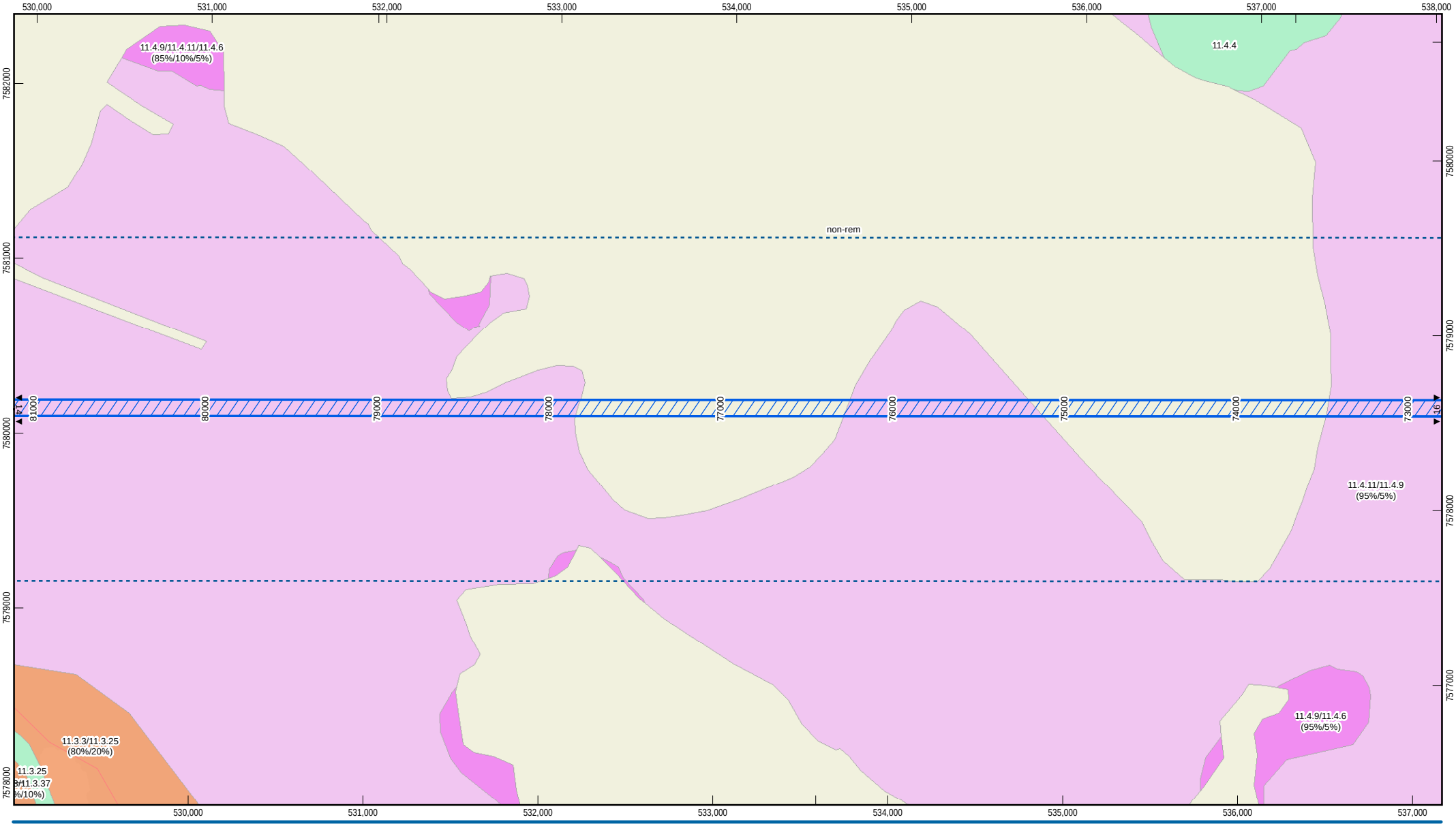

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Carmichael Coal Mine and Rail Project

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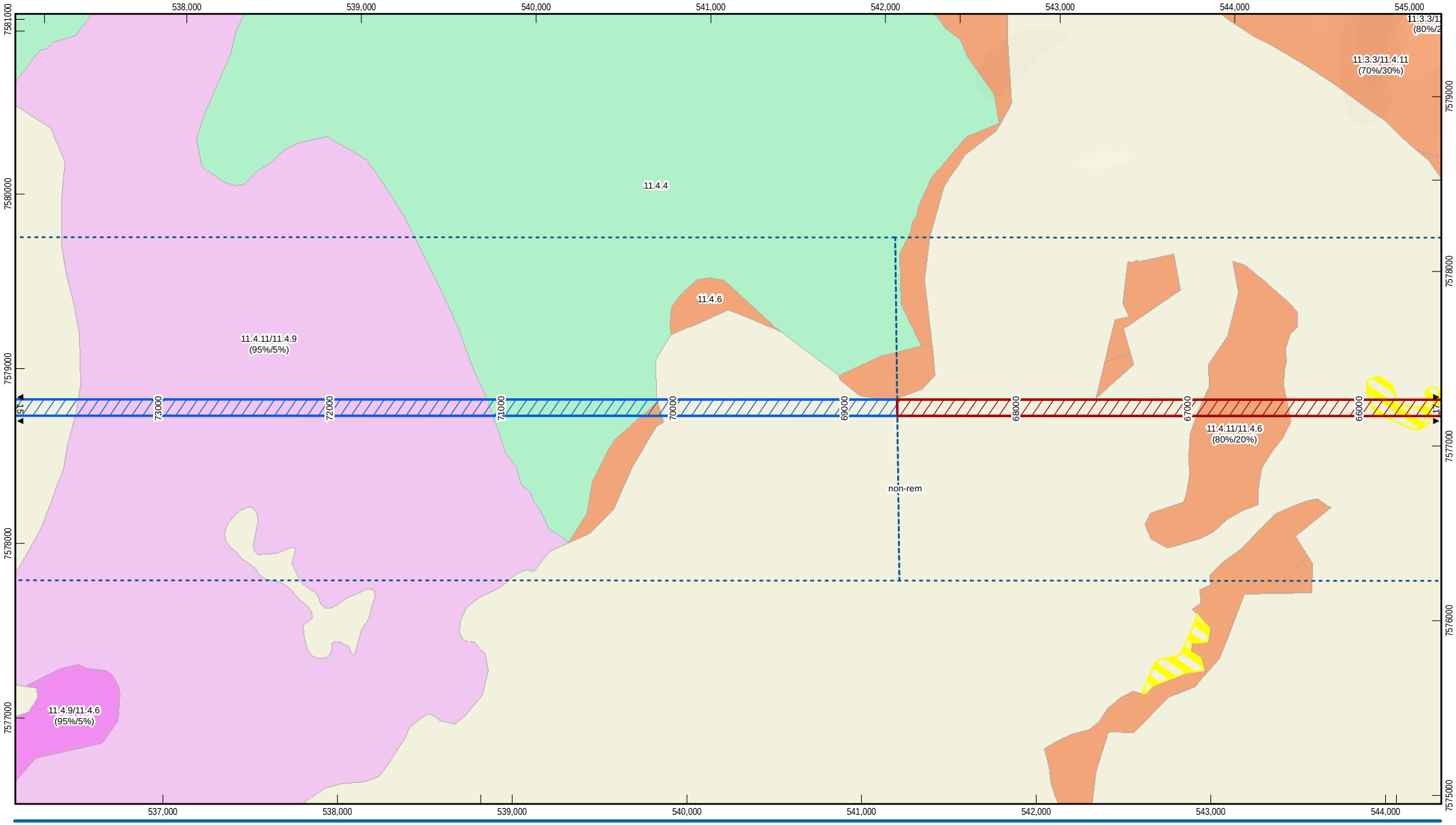

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Adani Mining Pty Ltd

Carmichael Coal Mine and Rail Project

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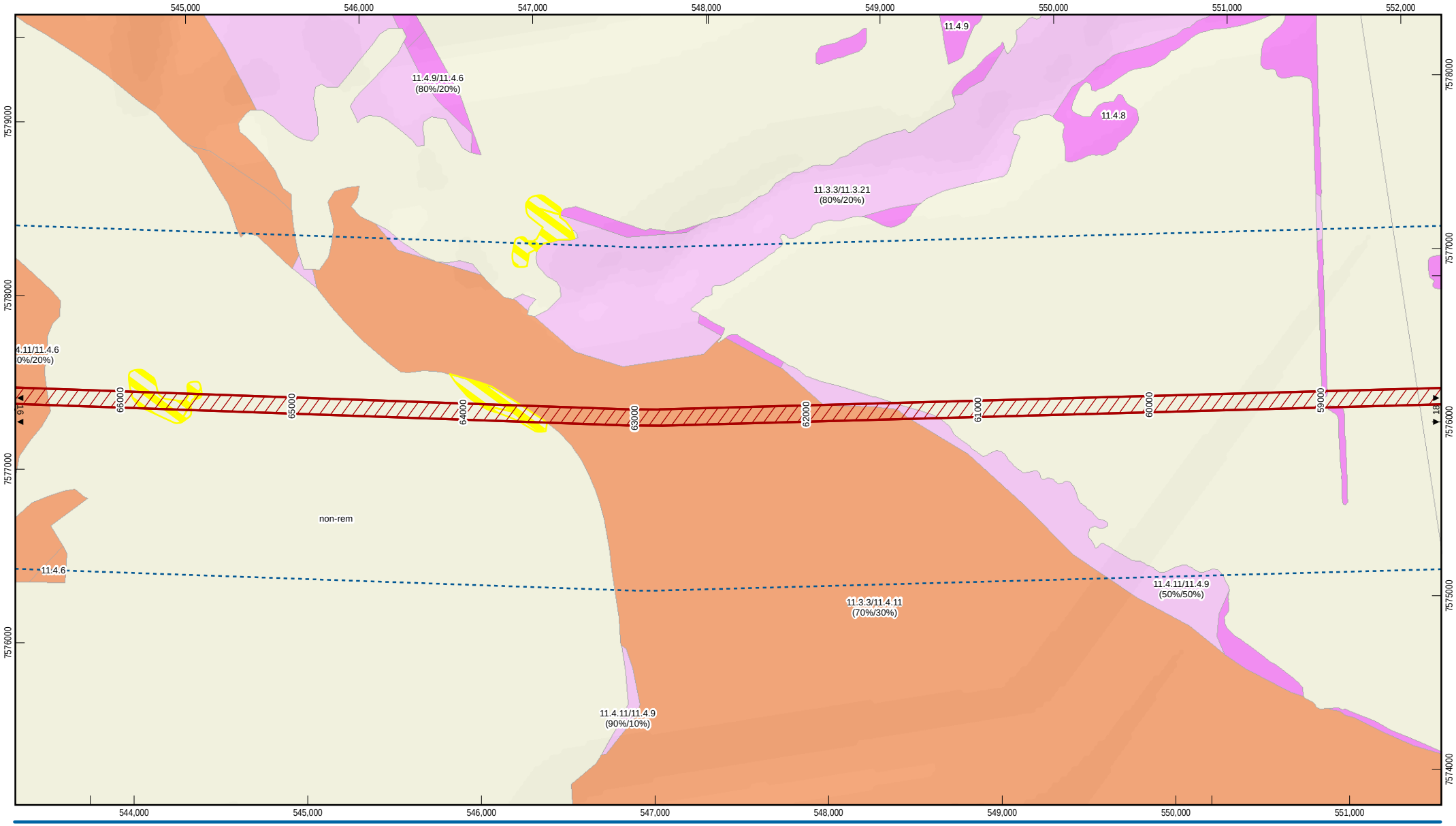

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Adani Mining Pty Ltd

Carmichael Coal Mine and Rail Project

Area of Proposed Clearing

Job Number 41-25215
Revision A
Date 05-09-2012

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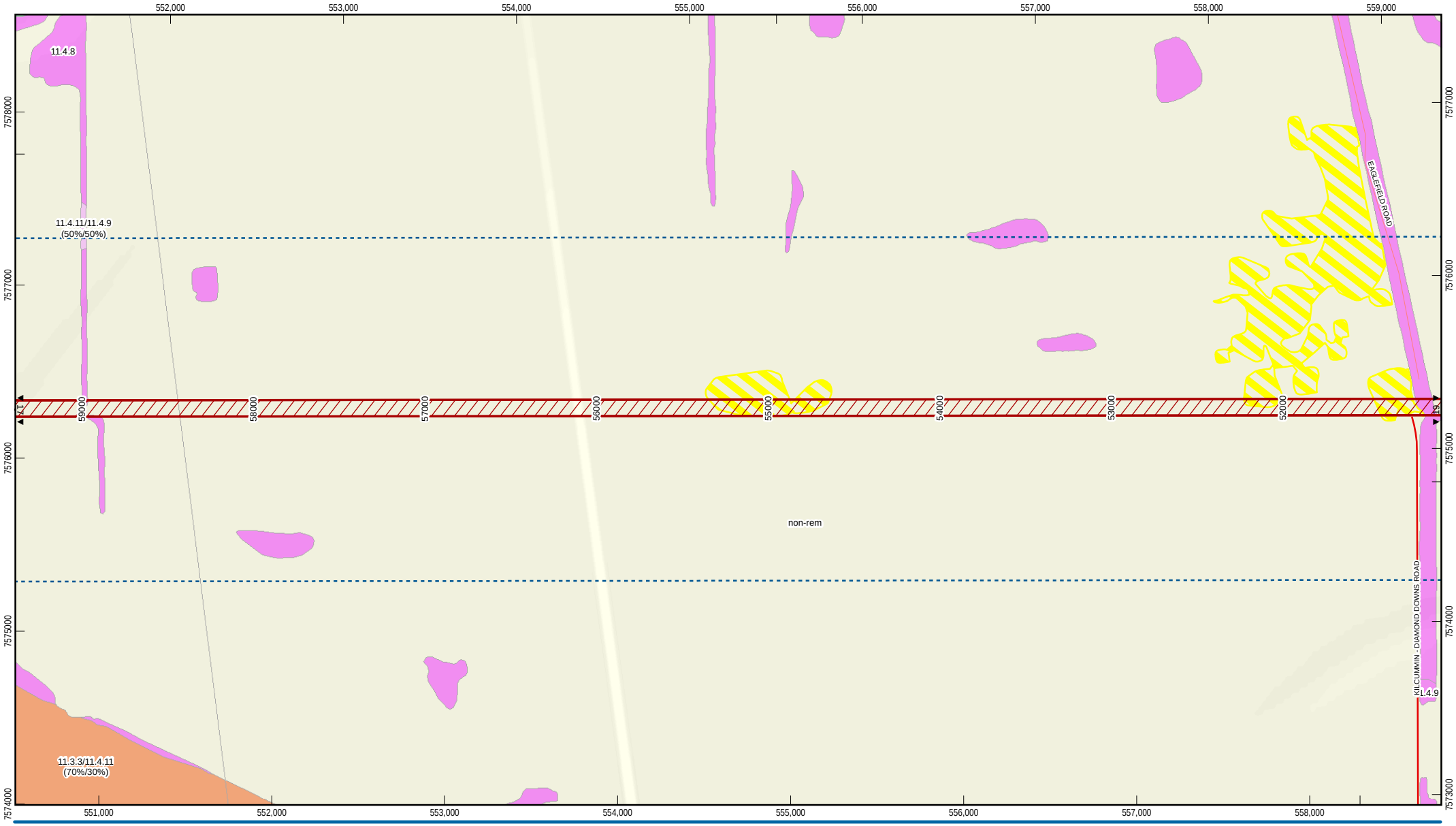

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Adani Mining Pty Ltd

Carmichael Coal Mine and Rail Project

Area of Proposed Clearing

Job Number 41-25215
Revision A
Date 05-09-2012

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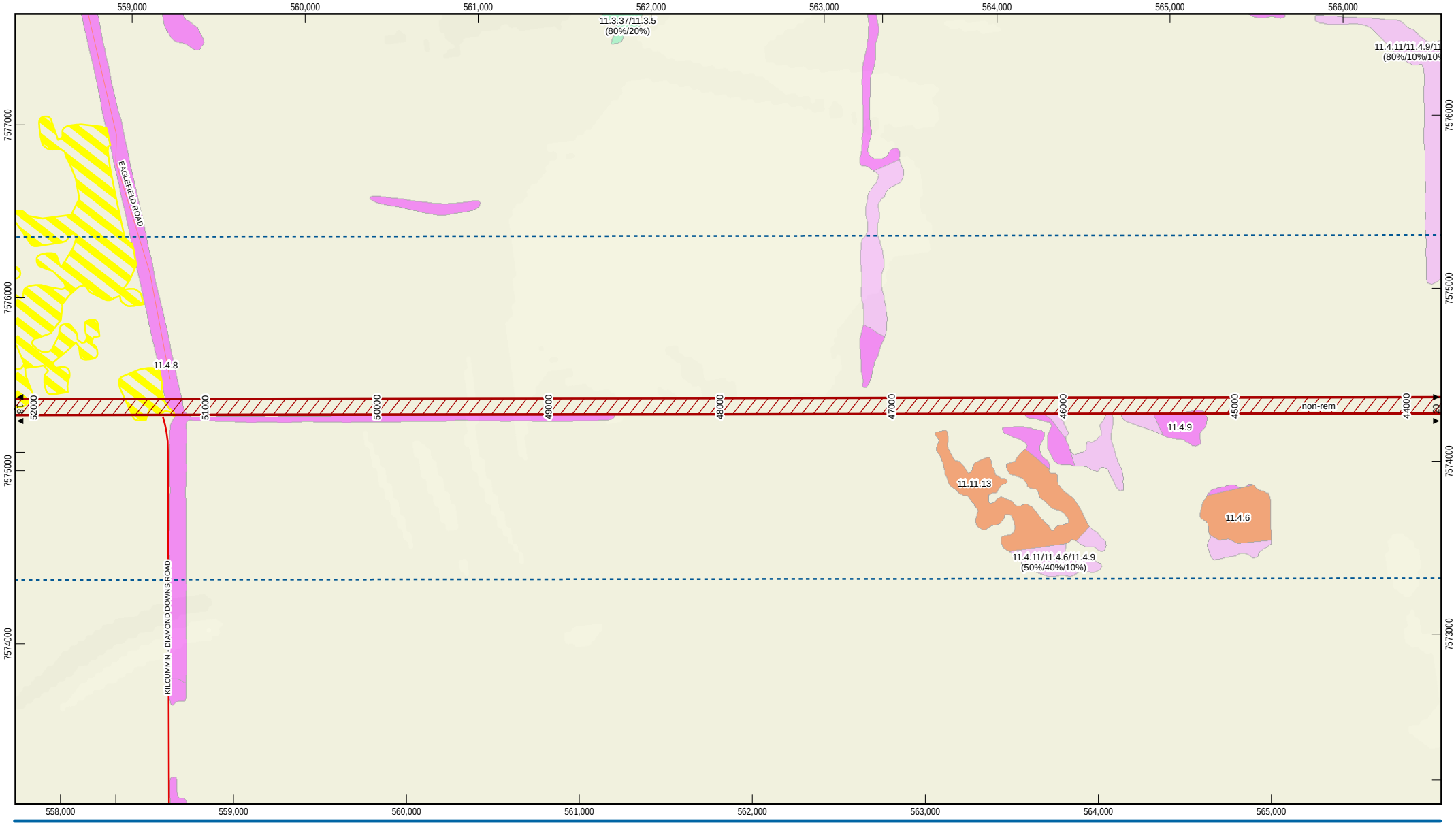

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Adani Mining Pty Ltd

Carmichael Coal Mine and Rail Project

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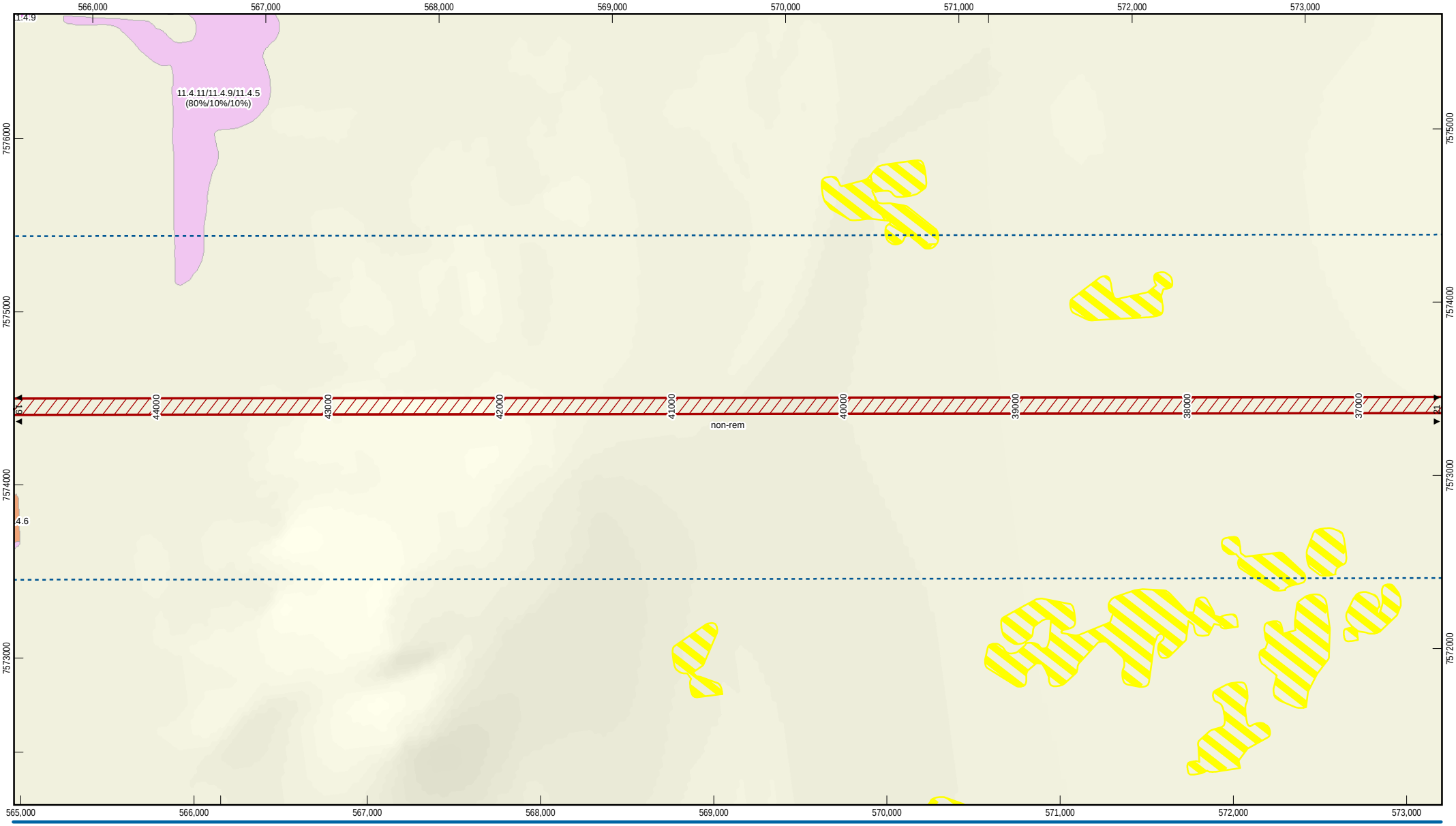

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Carmichael Coal Mine and Rail Project

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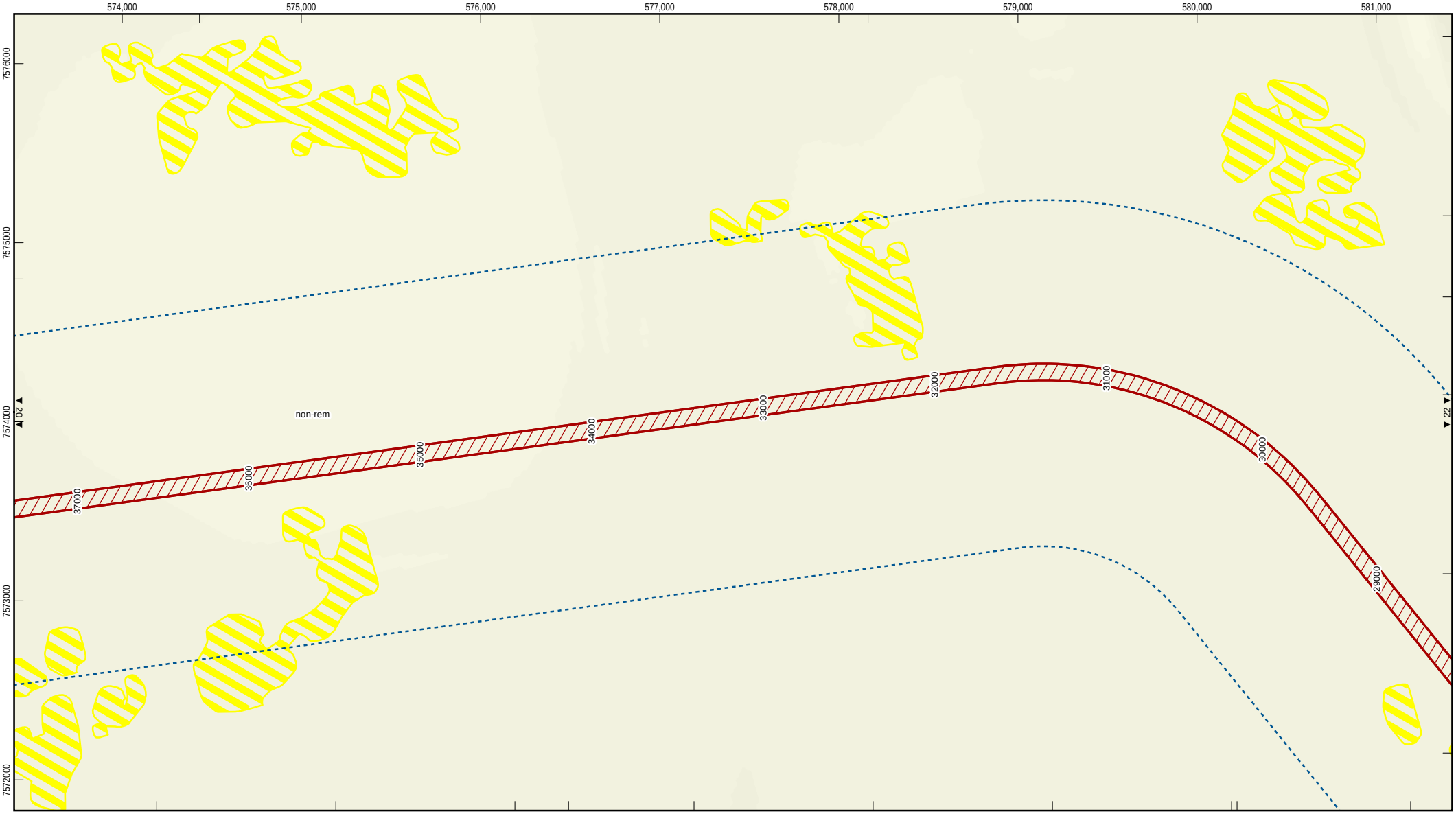

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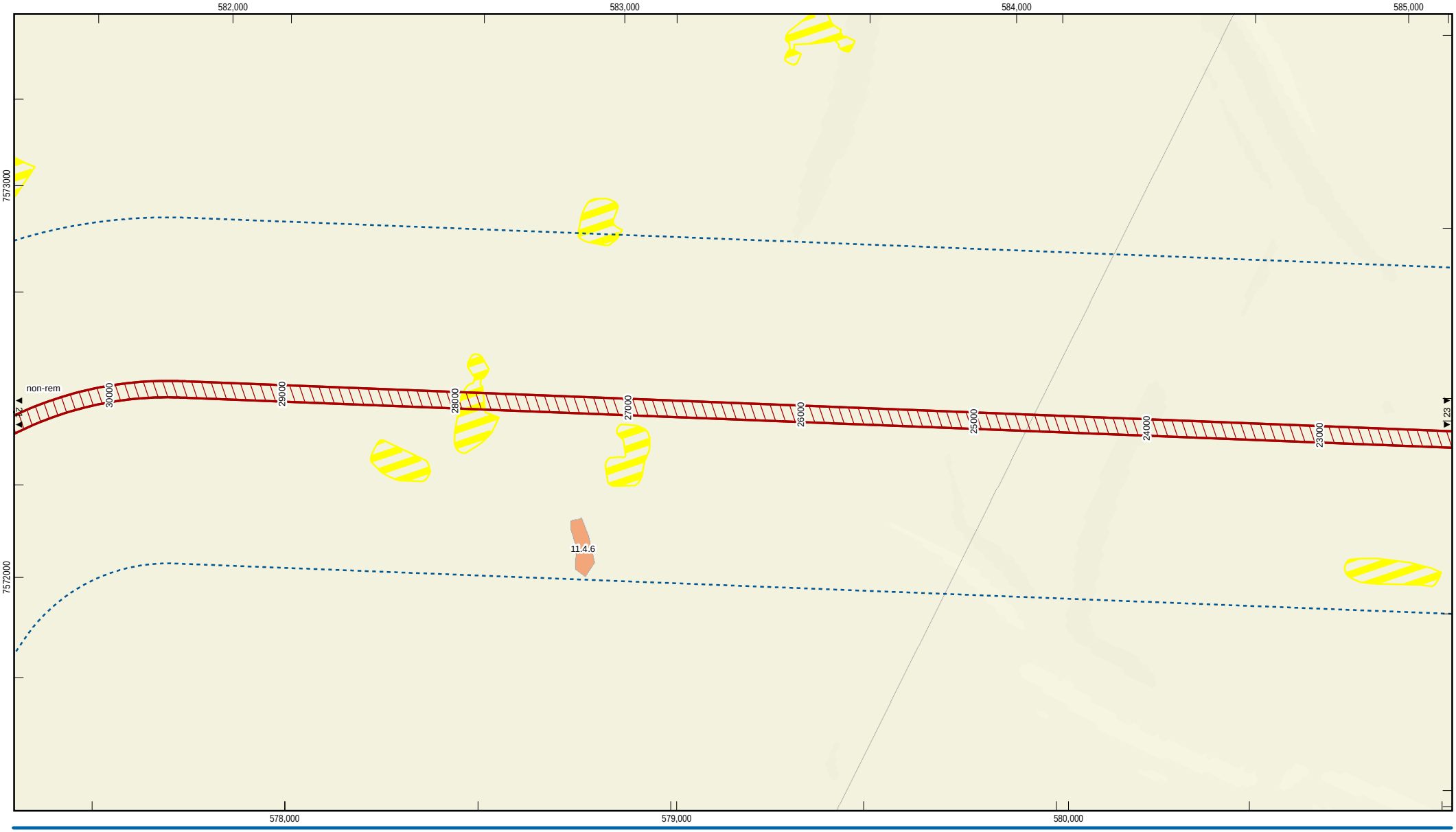

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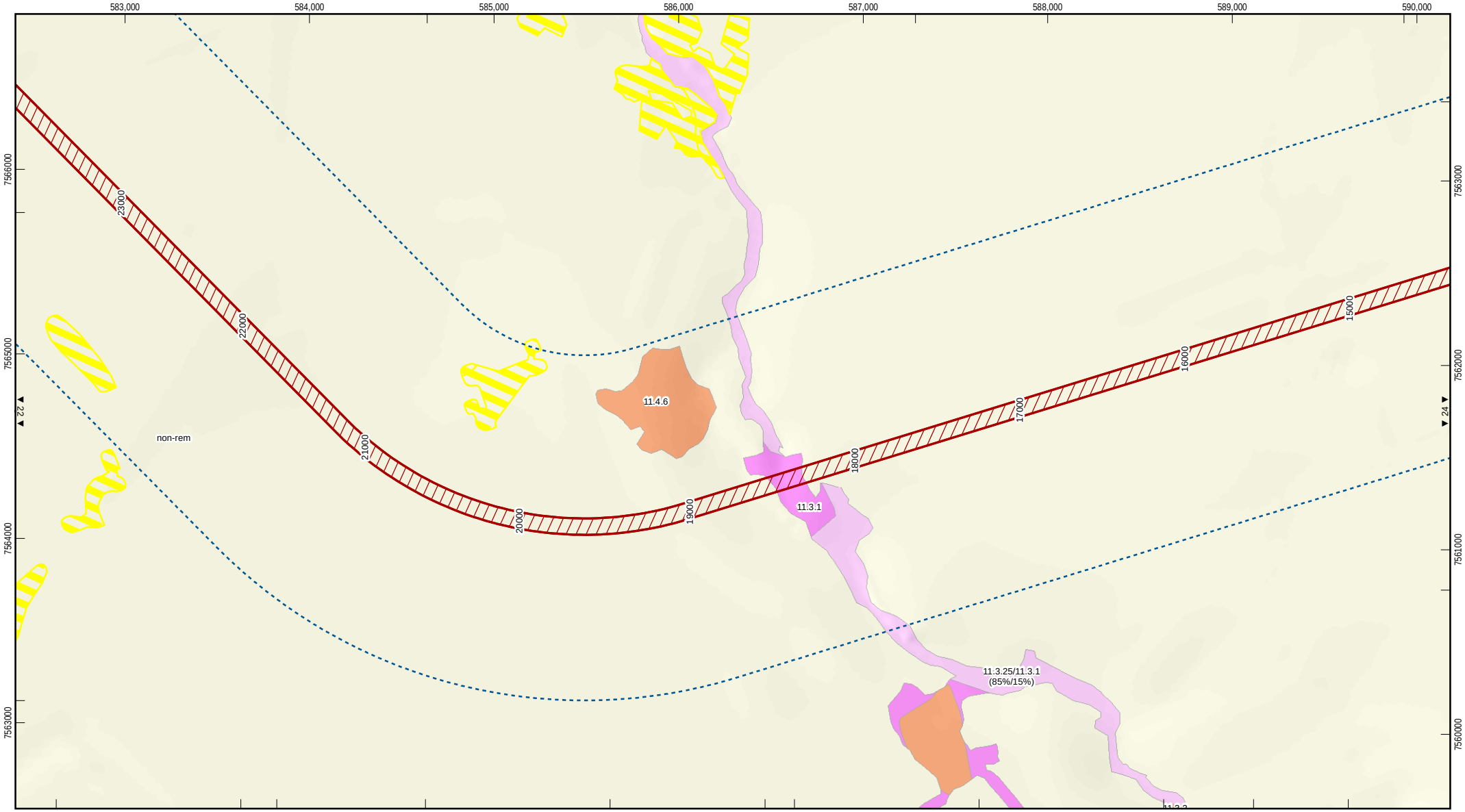

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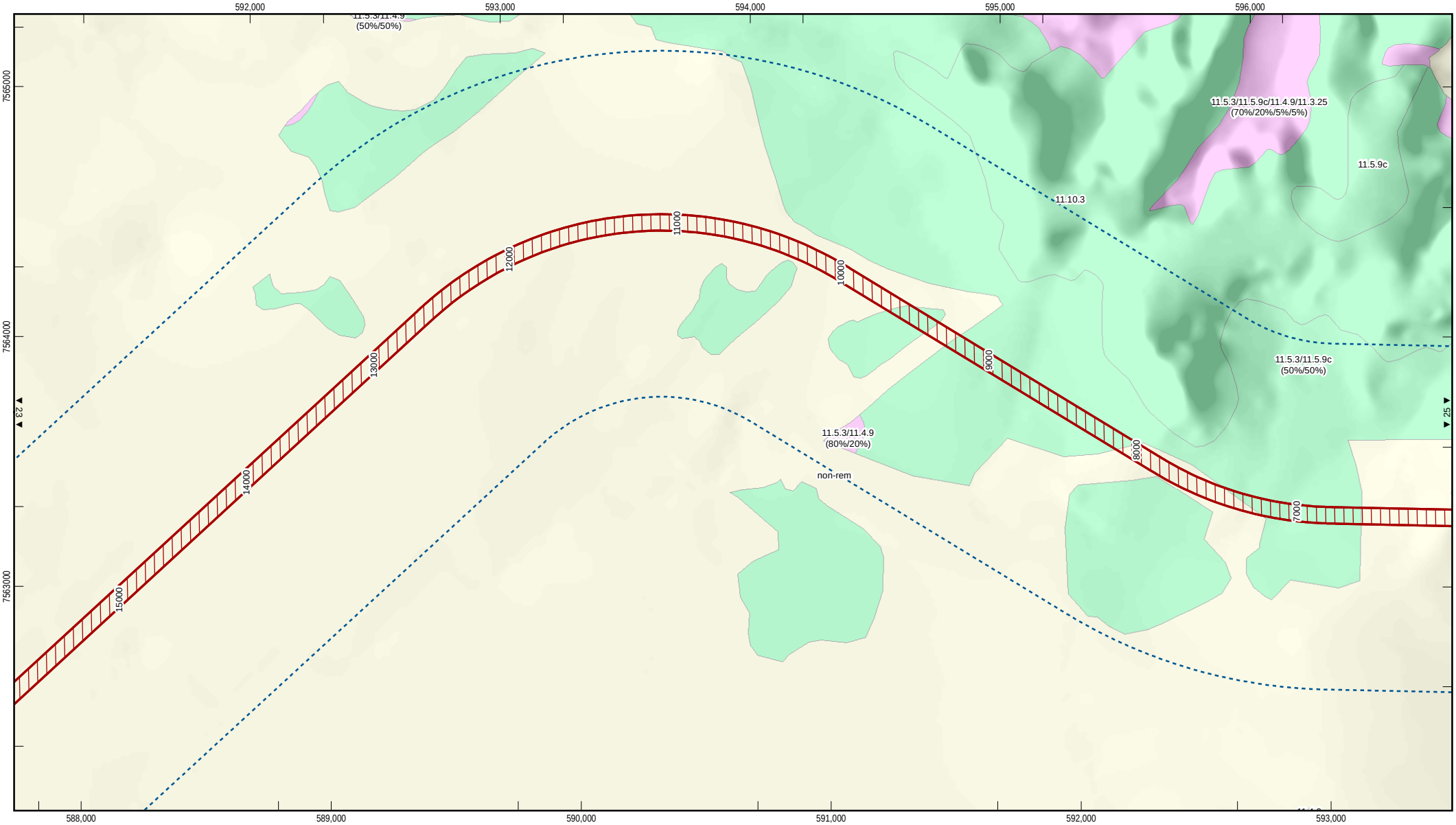
Level 4, 201 Charlotte St Brisbane QLD 4000 T +61 7 3316 3000 F +61 7 3316 3333 E bnemail@ghd.com W www.ghd.com

Data source: DERM: DEM (2008), Regional Ecosystems v6.1 (2010), High Value Regrowth (2011); © Commonwealth of Australia (Geoscience Australia): Localities, Railways, Roads, Watercourse (2007); Adani: Alignment Opt9 Rev3 (2012); GHD: Northern Missing Link (2011); DME: EPC1690 (2010) / EPC1080 (2011); Gassman/Hyder: Mine (Offsite) (2012). Created by: BW, CA



1:30,000 (at A4)

0 200 400 600 800 1,000

Metres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia (GDA)
Grid: Map Grid of Australia 1994, Zone 55

LEGEND

- State Road
- Local Road
- Watercourse
- Other Railway
- Mine (Onsite)
- Mine (Offsite)
- Mine (Offsite)
- Rail (West)
- Rail (East)
- Study Area

Regional Ecosystems v6.1

- Endangered - Dominant
- Endangered - Sub-dominant
- Of Concern - Dominant
- Of Concern - Sub-dominant
- Least Concern
- Non-remnant
- High Value Regrowth

Adani Mining Pty Ltd

Carmichael Coal Mine and Rail Project

Area of Proposed Clearing

Job Number	41-25215
Revision	A
Date	05-09-2012

Figure H-1
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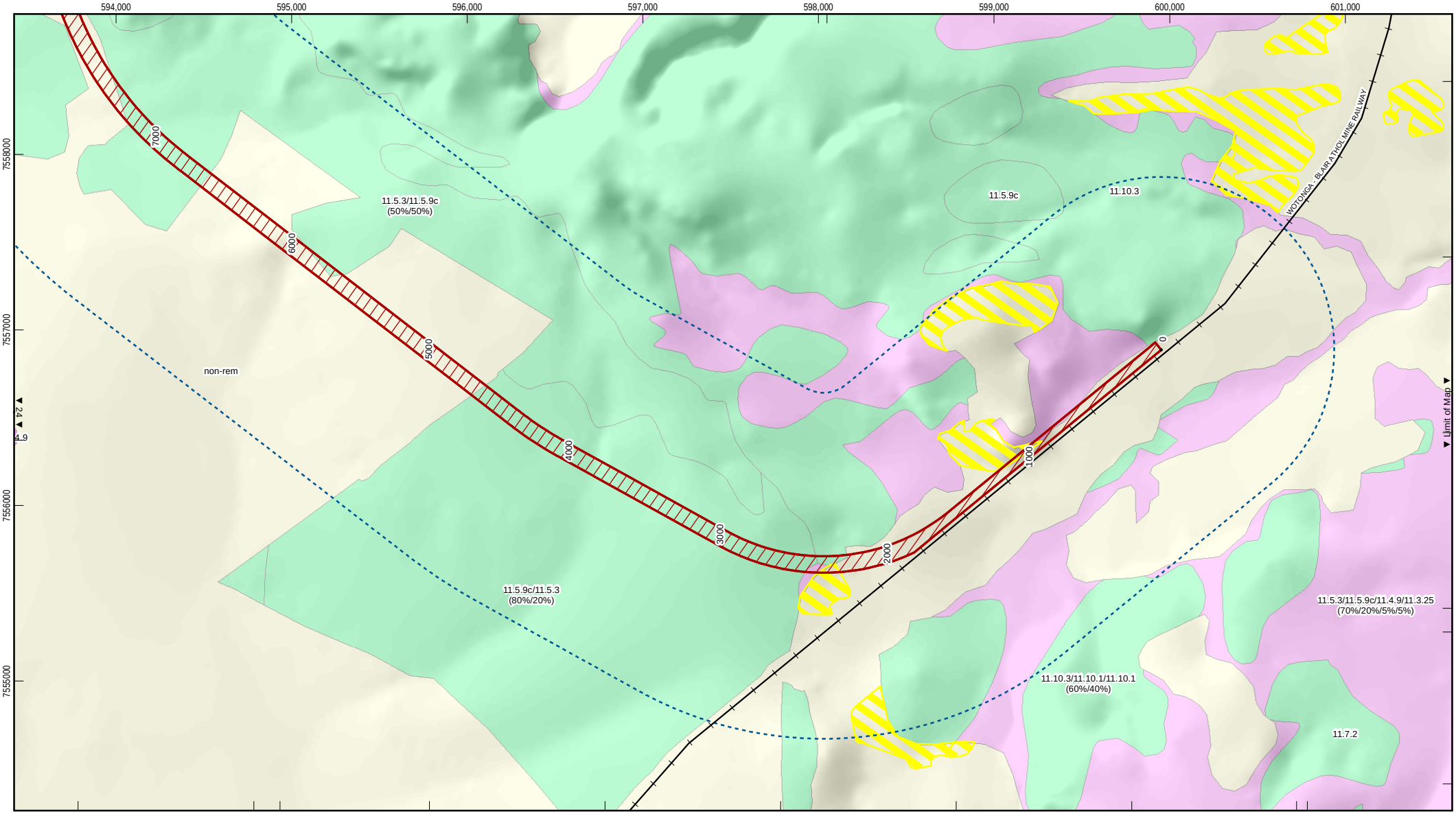
Level 4, 201 Charlotte St Brisbane QLD 4000 T +61 7 3316 3000 F +61 7 3316 3333 E bnemail@ghd.com W www.ghd.com

Data source: DERM: DEM (2008), Regional Ecosystems v6.1 (2010), High Value Regrowth (2011); © Commonwealth of Australia (Geoscience Australia): Localities, Railways, Roads, Watercourse (2007); Adani: Alignment Opt9 Rev3 (2012); GHD: Northern Missing Link (2011); DME: EPC1690 (2010) / EPC1080 (2011); Gassman/Hyder: Mine (Offsite) (2012). Created by: BW, CA



1:30,000 (at A4)

0 200 400 600 800 1,000

Metres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia (GDA)
Grid: Map Grid of Australia 1994, Zone 55

N

LEGEND

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Adani Mining Pty Ltd

Carmichael Coal Mine and Rail Project

Area of Proposed Clearing

Job Number	41-25215
Revision	A
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Figure H-1
Sheet 25 of 25

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Document Status

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2	L Muller	N Harwood G Squires		J Keane		17/09/2012