Carmichael Coal Mine and Rail Project
Supplementary Environmental Impact Statement

Volume 4, Appendix C5c – Moray Quarry Applications

Containing

- IDAS Form 1 – Application details
- IDAS Form 5 – Material change of use assessable against a planning scheme
- IDAS Form 8 – Environmentally relevant activity
- IDAS Form 8 – Attachment for an application for an environmental authority
- IDAS Form 11 – Clearing native vegetation
- Moray Quarry supporting information by CDM Smith

IDAS form 1—Application details

(*Sustainable Planning Act 2009* version 3.0 effective 1 July 2013)

This form must be used for **ALL** development applications.

You **MUST** complete **ALL** questions that are stated to be a mandatory requirement unless otherwise identified on this form.

For all development applications, you must:

- complete this form (*IDAS form 1—Application details)*
- complete any other forms relevant to your application
- provide any mandatory supporting information identified on the forms as being required to accompany your application.

Attach extra pages if there is insufficient space on this form.

All terms used on this form have the meaning given in the *Sustainable Planning Act 2009* (SPA) or the Sustainable Planning Regulation 2009.

This form and any other IDAS form relevant to your application must be used for development applications relating to strategic port land and Brisbane core port land under the *Transport Infrastructure Act 1994* and airport land under the *Airport Assets (Restructuring and Disposal) Act 2008*. Whenever a planning scheme is mentioned, take it to mean land use plan for the strategic port land, Brisbane core port land or airport land.

PLEASE NOTE: This form is not required to accompany requests for compliance assessment.

This form can also be completed online using MyDAS at www.dsdip.qld.gov.au/MyDAS

Mandatory requirements

Applicant details (Note: the applicant is the person responsible for making the application and need not be the owner of the land. The applicant is responsible for ensuring the information provided on all IDAS application forms is correct. Any development permit or preliminary approval that may be issued as a consequence of this application will be issued to the applicant.)

Name/s (individual or company name in full)	Adani Mining Pty Ltd			
For companies, contact name	Hamish Manzi - General Manager Environment and Sustainability			
Postal address	GPO Box 2569			
	Suburb	Brisbane		
	State	Queensland	Postcode	4000
	Country	Australia		
Contact phone number	07 3223 4800			
Mobile number (non-mandatory requirement)				
Fax number (non-mandatory requirement)	07 3223 4850			

Email address (non-mandatory requirement)	Reception.Australia @adani.com
Applicant's reference number (non-mandatory requirement)	

1. What is the nature of the development proposed and what type of approval is being sought?

Table A—Aspect 1 of the application (If there are additional aspects to the application please list in Table B—Aspect 2.)

a) What is the nature of the development? (Please only tick one box.)

☑ Material change of use ☐ Reconfiguring a lot ☐ Building work ☐ Operational work

b) What is the approval type? (Please only tick one box.)

☐ Preliminary approval under s241 of SPA ☐ Preliminary approval under s241 and s242 of SPA ☑ Development permit

c) Provide a brief description of the proposal, including use definition and number of buildings or structures where applicable (e.g. six unit apartment building defined as a *multi-unit dwelling*, 30 lot residential subdivision etc.)

Material Change of Use Development Application for Extractive Industry Involving Screening and Crushing Activities.

d) What is the level of assessment? (Please only tick one box.)

☑ Impact assessment ☐ Code assessment

Table B—Aspect 2 of the application (If there are additional aspects to the application please list in Table C—Additional aspects of the application.)

a) What is the nature of development? (Please only tick one box.)

☐ Material change of use ☐ Reconfiguring a lot ☐ Building work ☑ Operational work

b) What is the approval type? (Please only tick one box.)

☐ Preliminary approval under s241 of SPA ☐ Preliminary approval under s241 and s242 of SPA ☑ Development permit

c) Provide a brief description of the proposal, including use definition and number of buildings or structures where applicable (e.g. six unit apartment building defined as a *multi-unit dwelling*, 30 lot residential subdivision etc.)

Operational Works Development Application for Clearing of Native Vegetation

d) What is the level of assessment?

☐ Impact assessment ☑ Code assessment

Table C—Additional aspects of the application (If there are additional aspects to the application please list in a separate table on an extra page and attach to this form.)

☐ Refer attached schedule ☑ Not required

2. Location of the premises (Complete Table D and/or Table E as applicable. Identify each lot in a separate row.)

Table D—Street address and lot on plan for the premises or street address and lot on plan for the land adjoining or adjacent to the premises (Note: this table is to be used for applications involving taking or interfering with water). (Attach a separate schedule if there is insufficient space in this table.)

☑ Street address **and** lot on plan (All lots must be listed.)

☐ Street address **and** lot on plan for the land adjoining or adjacent to the premises (Appropriate for development in water but adjoining or adjacent to land, e.g. jetty, pontoon. All lots must be listed.)

Street address					**Lot on plan description**		**Local government area** (e.g. Logan, Cairns)
Lot	Unit no.	Street no.	Street name and official suburb/ locality name	Post-code	Lot no.	Plan type and plan no.	
i)		5509	Elgin Road, Clermont	4721	662	PH1491	Isaac Regional Council
ii)							
iii)							

Planning scheme details (If the premises involves multiple zones, clearly identify the relevant zone/s for each lot in a separate row in the below table. Non-mandatory)

Lot	Applicable zone / precinct	Applicable local plan / precinct	Applicable overlay/s
i)	Rural	Belyando Shire Planning Scheme 200	N/A
ii)			
iii)			

Table E—Premises coordinates (Appropriate for development in remote areas, over part of a lot or in water not adjoining or adjacent to land e.g. channel dredging in Moreton Bay.) (Attach a separate schedule if there is insufficient space in this table.)

Coordinates (Note: place each set of coordinates in a separate row)				**Zone reference**	**Datum**	**Local government area (if applicable)**
Easting	Northing	Latitude	Longitude			
					☐ GDA94 ☐ WGS84 ☐ other	Refer to maps in Supporting Document

3. Total area of the premises on which the development is proposed (indicate square metres)

91.2 hectares (Approximately 912,000m2)

4. Current use/s of the premises (e.g. vacant land, house, apartment building, cane farm etc.)

- Historic quarrying activities; and
- Rural activities - cattle breeding and fattening.

5. Are there any current approvals (e.g. a preliminary approval) associated with this application? (Non-mandatory requirement)

☑ No ☐ Yes—provide details below

List of approval reference/s	Date approved (dd/mm/yy)	Date approval lapses (dd/mm/yy)

6. Is owner's consent required for this application? (Refer to notes at the end of this form for more information.)

☐ No

☑ Yes—complete either Table F, Table G or Table H as applicable

Table F	
Name of owner/s of the land	
I/We, the above-mentioned owner/s of the land, consent to the making of this application.	
Signature of owner/s of the land	
Date	

Table G	
Name of owner/s of the land	State of Queensland (Owner) Adani Mining Pty Ltd (Leaseholder)
☑ The owner's written consent is attached or will be provided separately to the assessment manager.	

Table H	
Name of owner/s of the land	
☐ By making this application, I, the applicant, declare that the owner has given written consent to the making of the application.	

7. Identify if any of the following apply to the premises (Tick applicable box/es.)

☑ Adjacent to a water body, watercourse or aquifer (e.g. creek, river, lake, canal)—complete Table I

☐ On strategic port land under the *Transport Infrastructure Act 1994*—complete Table J

☐ In a tidal water area—complete Table K

☐ On Brisbane core port land under the *Transport Infrastructure Act 1994* (No table requires completion.)

☐ On airport land under the *Airport Assets (Restructuring and Disposal) Act 2008* (no table requires completion)

Table I
Name of water body, watercourse or aquifer
North Creek

Table J	
Lot on plan description for strategic port land	Port authority for the lot

Table K	
Name of local government for the tidal area (if applicable)	Port authority for the tidal area (if applicable)

8. Are there any existing easements on the premises? (e.g. for vehicular access, electricity, overland flow, water etc)

☑ No ☐ Yes—ensure the type, location and dimension of each easement is included in the plans submitted

9. Does the proposal include new building work or operational work on the premises? (Including any services)

☐ No ☑ Yes—ensure the nature, location and dimension of proposed works are included in plans submitted

10. Is the payment of a portable long service leave levy applicable to this application? (Refer to notes at the end of this form for more information.)

☐ No—go to question 12 ☑ Yes

11. Has the portable long service leave levy been paid? (Refer to notes at the end of this form for more information.)

☑ No

☐ Yes—complete Table L and submit with this application the yellow local government/private certifier's copy of the receipted QLeave form

Table L		
Amount paid	Date paid (dd/mm/yy)	QLeave project number (6 digit number starting with A, B, E, L or P)

12. Has the local government agreed to apply a superseded planning scheme to this application under section 96 of the *Sustainable Planning Act 2009*?

☑ No

☐ Yes—please provide details below

Name of local government	Date of written notice given by local government (dd/mm/yy)	Reference number of written notice given by local government (if applicable)

13. List below all of the forms and supporting information that accompany this application (Include all IDAS forms, checklists, mandatory supporting information etc. that will be submitted as part of this application. Note: this question does not apply for applications made online using MyDAS)

Description of attachment or title of attachment	Method of lodgement to assessment manager
IDAS Forms 1, 5 8 and 11	Supplementary EIS
Development Application Supporting Documentation	Supplementary EIS
Traffic and Transport Report (Attachment to Supporting Documentation)	Supplementary EIS
Air and Noise Impact Assessment Reports (Attachment to Supporting Documentation)	Supplementary EIS
Vegetation Clearing Report (Attachment to Supporting Documentation)	Supplementary EIS

14. Applicant's declaration

☑ By making this application, I declare that all information in this application is true and correct (Note: it is unlawful to provide false or misleading information)

Notes for completing this form

- Section 261 of the *Sustainable Planning Act 2009* prescribes when an application is a properly-made application. Note, the assessment manager has discretion to accept an application as properly made despite any non-compliance with the requirement to provide mandatory supporting information under section 260(1)(c) of the *Sustainable Planning Act 2009*

Applicant details

- Where the applicant is not a natural person, ensure the applicant entity is a real legal entity.

Question 1

- Schedule 3 of the Sustainable Planning Regulation 2009 identifies assessable development and the type of assessment. Where schedule 3 identifies assessable development as "various aspects of development" the applicant must identify each aspect of the development on Tables A, B and C respectively and as required.

Question 6

- Section 263 of the *Sustainable Planning Act 2009* sets out when the consent of the owner of the land is required for an application. Section 260(1)(e) of the *Sustainable Planning Act 2009* provides that if the owner's consent is required under section 263, then an application must contain, or be accompanied by, the written consent of the owner, or include a declaration by the applicant that the owner has given written consent to the making of the application. If a development application relates to a state resource, the application is not required to be supported by evidence of an allocation or entitlement to a state resource. However, where the state is the owner of the subject land, the written consent of the state, as landowner, may be required. Allocation or entitlement to the state resource is a separate process and will need to be obtained before development commences.

Question 11

- The *Building and Construction Industry (Portable Long Service Leave) Act 1991* prescribes when the portable long service leave levy is payable.
- The portable long service leave levy amount and other prescribed percentages and rates for calculating the levy are prescribed in the Building and Construction Industry (Portable Long Service Leave) Regulation 2002.

Question 12

- The portable long service leave levy need not be paid when the application is made, but the *Building and Construction Industry (Portable Long Service Leave) Act 1991* requires the levy to be paid before a development permit is issued.
- Building and construction industry notification and payment forms are available from any Queensland post office or agency, on request from QLeave, or can be completed on the QLeave website at www.qleave.qld.gov.au. For further information contact QLeave on 1800 803 481 or visit www.qleave.qld.gov.au.

Privacy—The information collected in this form will be used by the Department of State Development, Infrastructure and Planning (DSDIP), assessment manager, referral agency and/or building certifier in accordance with the processing and assessment of your application. Your personal details should not be disclosed for a purpose outside of the IDAS process or the provisions about public access to planning and development information in the *Sustainable Planning Act 2009*, except where required by legislation (including the *Right to Information Act 2009*) or as required by Parliament. This information may be stored in relevant databases. The information collected will be retained as required by the *Public Records Act 2002*.

OFFICE USE ONLY

Date received		Reference numbers	

NOTIFICATION OF ENGAGEMENT OF A PRIVATE CERTIFIER

To _____ Council. I have been engaged as the private certifier for the building work referred to in this application

Date of engagement	Name	BSA Certification license number	Building classification/s

QLEAVE NOTIFICATION AND PAYMENT (For completion by assessment manager or private certifier if applicable.)

Description of the work	QLeave project number	Amount paid ($)	Date paid	Date receipted form sighted by assessment manager	Name of officer who sighted the form

The *Sustainable Planning Act 2009* is administered by the Department of State Development, Infrastructure and Planning. This form and all other required application materials should be sent to your assessment manager and any referral agency.

IDAS form 5—Material change of use assessable against a planning scheme

(*Sustainable Planning Act 2009* version 3.0 effective 1 July 2013)

This form must be used for development applications for a material change of use assessable against a planning scheme.

You **MUST** complete **ALL** questions that are stated to be a mandatory requirement unless otherwise identified on this form.

For all development applications, you must:

- complete *IDAS form 1—Application details*
- complete any other forms relevant to your application
- provide any mandatory supporting information identified on the forms as being required to accompany your application.

Attach extra pages if there is insufficient space on this form.

All terms used on this form have the meaning given in the Sustainable Planning Act 2009 (SPA) or the Sustainable Planning Regulation 2009.

This form must also be used for material change of use on strategic port land and Brisbane core port land under the *Transport Infrastructure Act 1994* and airport land under the *Airport Assets (Restructuring and Disposal) Act 2008* that requires assessment against the land use plan for that land. Whenever a planning scheme is mentioned, take it to mean land use plan for the strategic port land, Brisbane core port land or airport land.

This form can also be completed online using MyDAS at www.dsdip.qld.gov.au/MyDAS

Mandatory requirements

1. Describe the proposed use. (Note: this is to provide additional detail to the information provided in question 1 of *IDAS form 1—Application details*. Attach a separate schedule if there is insufficient space in this table.)

General explanation of the proposed use	Planning scheme definition (include each definition in a new row) (non-mandatory)	No. of dwelling units (if applicable) or gross floor area (if applicable)	Days and hours of operation (if applicable)	No. of employees (if applicable)
Quarrying	Extractive Industry	N/A	24hrs a day, 7	8-10 personnel

2. Are there any current approvals associated with the proposed material change of use? (e.g. a preliminary approval.)

☐ No ☑ Yes—provide details below

List of approval reference/s	Date approved (dd/mm/yy)	Date approval lapses (dd/mm/yy)

3. Does the proposed use involve the following? (Tick all applicable boxes.)

The reuse of existing buildings on the premises	☐	No	☐	Yes
New building work on the premises	☐	No	☐	Yes
The reuse of existing operational work on the premises	☑	No	☐	Yes
New operational work on the premises	☐	No	☑	Yes

Mandatory supporting information

4. Confirm that the following mandatory supporting information accompanies this application

Mandatory supporting information	Confirmation of lodgement	Method of lodgement
All applications		
A site plan drawn to an appropriate scale (1:100, 1:200 or 1:500 are **recommended** scales) which shows the following: • the location and site area of the land to which the application relates (*relevant land*) • the north point • the boundaries of the relevant land • any road frontages of the relevant land, including the name of the road • the location and use of any existing or proposed buildings or structures on the relevant land (note: where extensive demolition or new buildings are proposed, two separate plans [an existing site plan and proposed site plan] may be appropriate) • any existing or proposed easements on the relevant land and their function • the location and use of buildings on land adjoining the relevant land • all vehicle access points and any existing or proposed car parking areas on the relevant land. Car parking spaces for persons with disabilities and any service vehicle access and parking should be clearly marked • for any new building on the relevant land, the location of refuse storage • the location of any proposed retaining walls on the relevant land and their height • the location of any proposed landscaping on the relevant land • the location of any stormwater detention on the relevant land.	☑ Confirmed	Supplementary EIS for the Carmichael Coal Mine and Rail Project.
A statement about how the proposed development addresses the local government's planning scheme and any other planning instruments or documents relevant to the application.	☑ Confirmed	Supplementary EIS for the Carmichael Coal
A statement about the intensity and scale of the proposed use (e.g. number of visitors, number of seats, capacity of storage area etc.).	☑ Confirmed	Supplementary EIS
Information that states: • the existing or proposed floor area, site cover, maximum number of storeys and maximum height above natural ground level for existing or new buildings (e.g. information regarding existing buildings but not being reused) • the existing or proposed number of on-site car parking bays, type of vehicle cross-over (for non-residential uses) and vehicular servicing arrangement (for non-residential uses).	☑ Confirmed ☐ Not applicable	Supplementary EIS for the Carmichael Coal Mine and Rail Project.

A statement addressing the relevant part(s) of the State Development Assessment Provisions (SDAP).	☑ Confirmed ☐ Not applicable	Supplementary EIS
When the application involves the reuse of existing buildings		
Plans showing the size, location, existing floor area, existing site cover, existing maximum number of storeys and existing maximum height above natural ground level of the buildings to be reused.	☐ Confirmed ☑ Not applicable	
When the application involves new building work (including extensions)		
Floor plans drawn to an appropriate scale (1:50, 1:100 or 1:200 are **recommended** scales) which show the following: • the north point • the intended use of each area on the floor plan (for commercial, industrial or mixed use developments only) • the room layout (for residential development only) with all rooms clearly labelled • the existing and the proposed built form (for extensions only) • the gross floor area of each proposed floor area.	☐ Confirmed	N/A
Elevations drawn to an appropriate scale (1:100, 1:200 or 1:500 are **recommended** scales) which show plans of all building elevations and facades, clearly labelled to identify orientation (e.g. north elevation)	☐ Confirmed	N/A
Plans showing the size, location, proposed site cover, proposed maximum number of storeys, and proposed maximum height above natural ground level of the proposed new building work.	☐ Confirmed ☑ Not applicable	
When the application involves reuse of other existing work		
Plans showing the nature, location, number of on-site car parking bays, existing area of landscaping, existing type of vehicular cross-over (non-residential uses), and existing type of vehicular servicing arrangement (non-residential uses) of the work to be reused.	☐ Confirmed ☑ Not applicable	
When the application involves new operational work		
Plans showing the nature, location, number of new on-site car parking bays, proposed area of new landscaping, proposed type of new vehicle cross-over (non-residential uses), proposed maximum new vehicular servicing arrangement (non-residential uses) of the proposed new operational work.	☑ Confirmed ☐ Not applicable	Supplementary EIS for the Carmichael Coal Mine and Rail

Privacy—Please refer to your assessment manager, referral agency and/or building certifier for further details on the use of information recorded in this form.

OFFICE USE ONLY

Date received		Reference numbers	

The *Sustainable Planning Act 2009* is administered by the Department of State Development, Infrastructure and Planning. This form and all other required application materials should be sent to your assessment manager and any referral agency.

IDAS form 8—Environmentally relevant activity

(*Sustainable Planning Act 2009* version 3.0 effective 1 July 2013)

This form must be used for development applications for an environmentally relevant activity.

You **MUST** complete **ALL** questions that are stated to be a mandatory requirement unless otherwise identified on this form.

For all development applications, you must:

- complete *IDAS form 1—Application details*
- complete any other forms relevant to your application
- provide any mandatory supporting information identified on the forms as being required to accompany your application.

Attach extra pages if there is insufficient space on this form.

All terms used on this form have the meaning given in either the *Sustainable Planning Act 2009* (SPA), the Sustainable Planning Regulation 2009, the *Environmental Protection Act 1994* or the Environmental Protection Regulation 2008.

This form can also be completed online using MyDAS at www.dsdip.qld.gov.au/MyDAS

Mandatory requirements

1. What is the nature of the proposed environmentally relevant activity (ERA)? (complete a new Table A for each proposed ERA—including ERAs that are not concurrence ERAs)

Table A	
ERA number and name	ERA 16 - Extractive and Screening Activities
ERA threshold	Extracting more than 100,000 tonnes of material
Applicable fees	$ 551
Proposed scale/capacity	Approximately 652,000 tonnes
Type of approval sought	☑ Development permit and environmental authority (see notes) ☐ Preliminary approval
Is the proposed ERA a concurrence ERA?	☐ No ☐ Yes

2. Are there any existing ERAs on or associated with the premises?

☑ No

☐ Yes—complete a new Table B for each existing ERA

Table B	
ERA number and name	
ERA threshold	
Existing scale/capacity	
Is the ERA proposed to continue on site?	☐ No ☐ Yes

3. Does the proposed activity involve any of the following? (Tick all applicable boxes.)

☐ Release of water or waste to a wetland for treatment

☐ Release of waste directly to groundwater

Mandatory supporting information

4. Confirm that the following mandatory supporting information accompanies this application

About the subject land	**Confirmation of lodgement**	**Method of lodgement**
Description of the site, including site maps showing vegetation, topography and any areas of cultural or heritage significance.	☑ Confirmed	Supplementary EIS for the
Details of any known acid sulphate soils within or adjoining the premises.	☐ Confirmed ☐ Not applicable	Supplementary EIS for the
Details about how the choice of the site, at which the activity is to be carried out, minimises serious environmental harm on areas of high conservation value and special significance and sensitive land uses at adjacent places.	☑ Confirmed	Supplementary EIS for the Carmichael Coal
Details about how the location for the activity on a site protects all environmental values relevant to adjacent sensitive uses.	☐ Confirmed	Supplementary EIS for the
Details about how the design of the facility permits the operation of the site, at which the activity is to be carried out, in accordance with best practice environmental management.	☑ Confirmed	Supplementary EIS for the Carmichael Coal
About the proposed ERA		
Attachment to IDAS form 8—application for an environmental authority (EM941) completed and required information provided.	☐ Confirmed	Supplementary EIS for the
A statement addressing the relevant part(s) of the State Development Assessment Provisions (SDAP).	☑ Confirmed ☐ Not applicable	Supplementary EIS for the

Notes for completing this form:

- An environmental authority is required to operate an ERA.
- A development approval is only required if at least one of the ERAs to be operated is a concurrence ERA.
- Schedule 2 of the *Environmental Protection Regulation 2008* states the aggregate environmental scores, the thresholds that apply to ERAs, and which ERAs are concurrence ERAs (denoted by a 'C' in schedule 2, column 3).
- This development application is taken to be an application for an environmental authority. This application is not properly made unless it includes the Attachment to IDAS form 8—application for an environmental authority (EM941).
- There are annual fees associated with the operation of an ERA. These fees are initially payable 20 business days after the environmental authority takes effect. After this initial payment, annual fees will be payable on the anniversary of the take effect day. Chapter 8 and Schedule 10 of the Environmental Protection Regulation 2008 contain all information about the applicable fees and how they are calculated.

Privacy—Please refer to your assessment manager, referral agency and/or building certifier for further details on the use of information recorded in this form.

OFFICE USE ONLY

Date received		Reference numbers	

The *Sustainable Planning Act 2009* is administered by the Department of State Development, Infrastructure and Planning. This form and all other required application materials should be sent to your assessment manager and any referral agencies.

Department of State Development, Infrastructure and Planning
PO Box 15009 City East Qld 4002
tel 13 QGOV (13 74 68)
info@dsdip.qld.gov.au

www.dsdip.qld.gov.au

Attachment

Environmental Protection Act 1994

IDAS form 8—attachment for an application for an environmental authority

This form is to be attached to the IDAS form 8 when making a development application for prescribed environmentally relevant activities (ERAs). Under section 115 of the Environmental Protection Act 1994 *(EP Act) the development approval application is taken to be an application for an environmental authority for the prescribed ERAs.*

It is recommended that applicants read the technical information requirement on what to provide with an ERA application, prior to making an application. This information is located on the business and industry website **www.business.qld.gov.au**.

All applicants must be a registered suitable operator before carrying out an ERA. If you are not already registered as, or have applied for registration as, a suitable operator, fill in the application form in Attachment 2 of this form and submit it with this form and the IDAS application.

If you would like to have a pre-lodgement meeting please fill out and lodge the form Application for a Pre-Design/Pre-Lodgement Meeting (EM1125[1]), prior to lodging this application form.

Definitions of terms used in this form

Where there is inconsistency between the definition of terms here and the terms used in the EP Act, the terms in the EP Act apply.

Environmentally relevant activity (ERA)	A resource activity or a prescribed ERA
Prescribed ERA	An environmentally relevant activity that is not a resource activity and is prescribed under section 19 of the EP Act.
Registered suitable operator	A person who, or a corporation which, under section 318I of the EP Act has been assessed as being suitable to carry out an ERA and has been listed on the suitable operator register.
Resource activity	An activity that is any of the following: (a) a geothermal activity (b) a greenhouse gas (GHG) storage activity (c) a mining activity (d) a petroleum activity.

[1] This is the publication number. The publication number can be used as a search term to find the latest version of a publication at **www.qld.gov.au**.

GUIDE

Take particular care in filling out the applicant details as these are legally required for the issuing of any environmental authority. Applicant details, including the name and the address should reflect the details of the person or registered legal entity.

If more space is required for any responses, please attach additional information as a separate page.

A sole applicant is an applicant where there is only 1 person or business applying to obtain an environmental authority.

A principal applicant is the individual or business nominated to act on behalf of joint applicants.

It is particularly important to enter the correct Australian business number (ABN); Australian company number (ACN) of the incorporated company; association number (AN) of the incorporated association; or the title and section of the legislation that gives the statutory corporation its legal status.

If there is an agent acting on behalf of the sole or principal applicant, provide details in this section. An agent could be a consultant or a contact for the environmental authority holder.

As statutory documents need to be sent to all applicants, this section can also be used when there are multiple environmental authority holders to nominate an address for statutory documentation to be sent 'care of' to.

Application details

1. Applicant details

SOLE OR PRINCIPAL APPLICANT DETAILS	
INDIVIDUAL OR BUSINESS NAME (INCLUDE TRADING NAME IF RELEVANT) ADANI MINING PTY LTD	
ABN/ACN/AN (IF RELEVANT) 27 145 455 205	
RESIDENTIAL ADDRESS OR REGISTERED BUSINESS ADDRESS (NOT A POST OFFICE BOX ADDRESS) LEVEL 25, 10 EAGLE STREET, BRISBANE, QLD 40	
POSTAL ADDRESS (IF DIFFERENT FROM ABOVE) GPO BOX 2569, BRISBANE, QLD 4001	
CONTACT PERSON HAMISH MANZI	
PHONE 07 3223 4800	FACSIMILE 07 3223 4850
EMAIL HAMISH.MANZI@ADANI.COM	

When there is more than 1 applicant complete Attachment 1—Appointment of principal applicant by all joint applicants.

Agent for principal applicant / address for service

The address supplied here will also be used as a service address for sending statutory documents. If blank, statutory documents will be sent to the sole or principal applicant.

INDIVIDUAL OR BUSINESS NAME (INCLUDE TRADING NAME IF RELEVANT)	
RESIDENTIAL ADDRESS OR REGISTERED BUSINESS ADDRESS (NOT A POST OFFICE BOX ADDRESS)	
POSTAL ADDRESS (IF DIFFERENT FROM ABOVE)	
CONTACT PERSON	
PHONE	FACSIMILE

EMAIL	

All applicants, including joint applicants must include their details in this section.

Once a person or corporation has been registered as a suitable operator for the carrying out of an ERA, no further suitable operator applications need to be made as long as the applicant for the environmental authority matches the name (including ABN/ACN etc, if applicable) recorded on the suitable operator register.

A person who holds a valid registration certificate given under the former section 73F of the EP Act or a valid environmental authority given under the former chapter 5 or 5A of the EP Act is taken to be a registered suitable operator under section 705 of the EP Act.

If you have previously been approved as a registered suitable operator, you can find the suitable operator registration number on the decision notice advising you of your approved application or, if you have a valid existing registration certificate, the approval number listed on the registration certificate.

2. Registered suitable operator

Have all applicants been registered as a suitable operator? Tick the box that applies and provide any further requested detail.

APPLICANT NAME	SUITABLE OPERATOR REGISTRATION STATUS	SUITABLE OPERATOR REGISTRATION NUMBER
	☒ I am a registered suitable operator. You must provide your suitable operator registration number in the adjacent column. ☐ I have lodged an application to be registered suitable operator and am waiting for it to be decided ☐ I am not an existing registered suitable operator and I have not yet lodged an application to become a registered suitable operator. You must complete the application form in Attachment 2 and submit it with the development application. Attachment 2 must be completed in full. The application form in Attachment 2 is taken to be lodged when it is received by Permit and Licence Management within the Department of Environment and Heritage Protection.	649121

There are currently 8 matters of national environmental significance (MNES) which have been defined in the *Environmental Protection and Biodiversity Conservation Act 1999.* These are:

- 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
- the Great Barrier Reef Marine Park
- nuclear actions (including uranium mines)

To determine whether the proposed ERA will have a significant impact on MNES and for referral requirements, please refer to the guidance provided by the Federal Department of Sustainability, Environment, Water, Population and Communities on **www.australia.gov.au**

3. Matters of national environmental significance

Is the proposed ERA/ERA project likely to have a significant impact on a matter of national environmental significance?

☒ Yes → please select 1 of the following:

- ☒ the proposed amendment has been referred to the Federal Government Environment Minister or delegate
- ☐ the proposed amendment has not yet been referred to the Federal Government Environment Minister or delegate.

☐ No

4. Details of the prescribed ERAs

Do any of the ERAs in Table A of IDAS form 8 have eligibility criteria developed that you can comply with?

☐ Yes→ attach details of these ERAs and identify the standard conditions that you can comply with

☒ No

5. Will the ERAs be carried out as a single integrated operation?

Will more than one ERA be operated at the location?

☐ Yes → complete the rest of this question

☒ No → go to question 6

Will the ERAs be operated as a single integrated operation?

☐ Yes → provide supporting information in the following table

☐ No → go to question 6

SUPPORTING INFORMATION

A single integrated operation must meet all the following criteria:

(a) the activities are carried out under the day-to-day management of a single responsible individual, for example, a site or operations manager

(b) the activities are operationally interrelated

(c) the activities are, or will be, carried out at 1 or more places

(d) the places where the activities are carried out are separated by distances short enough to make feasible the integrated day-to-day management of the activities.

6. Take effect date

You may choose to nominate a date or event for when the environmental authority will take effect. An event can include a phase of your project you know will occur before you commence operation (for example commissioning of equipment). This take effect date or event will be the date or event from which your annual fees will commence to be charged (your anniversary date).

Where you have nominated a take effect date, you must not commence any activities approved under the environmental authority until the take effect date stated on the environmental authority occurs. If you nominated an event, you will need to give written notice to the administering authority that the stated event has occurred before you commence your operation.

Do you want the environmental authority to take effect on a nominated date or event?

☐ Yes → nominate the date or event below and then go to question 7

NOMINATED TAKE EFFECT DATE OR EVENT

☒ No → go to question 7

7. Biodiversity offsets

A biodiversity offset is required where an applicant has demonstrated they have made all practical and reasonable efforts to avoid and minimise impacts on state significant biodiversity values, but there is a residual development impact on 1 or more of these values

The Queensland Biodiversity Offsets Policy can be accessed at **www.ehp.qld.gov.au**.

Are the ERAs administered by a local government?

☐ Yes → go to question 8

☒ No → complete the rest of this question

Do the activities involve a negative impact to a state significant biodiversity value?

☐ Yes→ attach supporting information that:

☐ demonstrates that all practical and reasonable efforts to avoid and minimise impacts on state significant

biodiversity values has been undertaken.

☐ describes how the requirements of the Queensland Biodiversity Offsets Policy will be met.

☒ No

☐ Don't know/uncertain

For further information on technical information to provide with your application, please refer to the business and industry website **www.business.qld.gov.au**

8. Assessment of the environmental impact and provision of specific supporting information

You must provide an assessment of the likely impact of each ERA on environmental values, including:

- a description of the environmental values likely to be affected by each relevant activity
- details of any emissions or releases likely to be generated by each relevant activity
- a description of the risk and likely magnitude of impacts on the environmental values
- details of the management practices proposed to be implemented to prevent or minimise adverse impacts
- details of how the land the subject of the application will be rehabilitated after each relevant activity ceases.

☒ Tick to indicate that an assessment of the environmental impact and provision of specific supporting information has been attached.

For further information on technical information to provide with your application, please refer to the business and industry website **www.business.qld.gov.au**

9. Details of waste management

A description of the proposed measures for minimising and managing waste generated by the ERAs must be attached.

☒ Tick to indicate attachment

10. Details of contaminated land

Is there a site management plan in effect for contaminated land that relates to the land that is the subject of this application.

☐ Yes → attach details of the site management plan

☒ No

Where there is more than 1 applicant, this declaration is to be signed by all applicants, unless a principal applicant has been nominated in Attachment 1, in which case the principal applicant can sign on behalf of all the joint applicants.

11. Declaration

Note: If you have not told the truth in this application you may be prosecuted.

I declare that:

- I am the applicant or an authorised signatory for the applicant.

Where the sole or principal applicant is a company, this form is to be signed by an authorised person for that company.

Privacy statement

Where ERAs are administered by the Queensland Government:

The Department of Environment and Heritage Protection and Department of Agriculture, Fisheries and Forestry are collecting the information on this form to process your application for an environmental authority. This collection is authorised under sections 115 and 125 of the *Environmental Protection Act 1994*. Your personal information will only be accessed by authorised employees within these departments and will not be disclosed to any other parties unless authorised or required by law. For queries about privacy matters please email **privacy@ehp.qld.gov.au** or telephone: (07) 3330 5436.

Where ERAs are administered by a local government:

Contact the local government for their privacy information.

- I have identified in question 4, any ERAs that can comply with the eligibility criteria and standard conditions.
- The information provided is true and correct to the best of my knowledge. I understand that it is an offence under section 480 of the *Environmental Protection Act 1994* to give to the administering authority or an authorised person a document containing information that I know is false, misleading or incomplete in a material particular
- I understand that failure to provide sufficient information may result in the application being refused
- I understand that all information supplied on or with this application form may be disclosed publicly in accordance with the *Right to Information Act 2009* and the *Evidence Act 1977*.
- I understand that I am responsible for managing the environmental impacts of these activities, and that approval of this application is not an endorsement by the administering authority of the effectiveness of management practices proposed or implemented.

APPLICANT'S NAME HAMISH MANZI - ADANI MINING PTY LTD	
SIGNATURE	
POSITION OF SIGNATORY GENERAL MANAGER-ENVIRONMENT AND SUSTAINABILITY	DATE 16 JULY 2013
JOINT APPLICANT'S NAME (IF APPLICABLE)	JOINT APPLICANT'S SIGNATURE (IF APPLICABLE)
JOINT APPLICANT'S NAME (IF APPLICABLE)	JOINT APPLICANT'S SIGNATURE (IF APPLICABLE)

Applicant checklist

☒ Application form has been signed and completed.

☐ Attachment 1: Appointment of principal applicant by all joint applicants has been signed and completed (if applicable).

☐ Attachment 2: Application to be registered as a suitable operator signed and completed (if applicable).

☐ Question 4: Identification of the prescribed ERAs where eligibility criteria and

standard conditions can be met, have been attached (if applicable).

☒ Question 7: Supporting information for biodiversity offsets (if applicable).

☒ Question 8: Information for assessment of environmental impacts attached (if applicable).

☒ Question 9: Details of waste management attached (if applicable).

☐ Question 10: Details of contaminated land attached (if applicable).

All requested information must be provided with this application, otherwise it will not be considered properly made.

Please include a word searchable electronic PDF copy of the application documents when you lodge your application.

Please submit this attachment, together with any additional information, with all relevant IDAS forms to the assessment manager for the development application.

Further information

The latest version of this publication and other publications referenced in this document can be found at **www.qld.gov.au** using the publication number (EM941 for this document) as a search term.

IDAS form 11—Clearing native vegetation

(*Sustainable Planning Act 2009* version 3.0 effective 1 July 2013)

This form must be used for development applications that involve the clearing of native vegetation.

You **MUST** complete **ALL** questions that are stated to be a mandatory requirement unless otherwise identified on this form.

For all development applications, you must:

- complete *IDAS form 1—Application details*
- complete any other forms relevant to your application
- provide any mandatory supporting information identified on the forms as being required to accompany your application
- include the relevant application fee, noting that referral agency fees (where applicable) are to be paid to the referral agency

Attach extra pages if there is insufficient space on this form.

All terms used on this form have the meaning given in the *Sustainable Planning Act 2009* (SPA) or the Sustainable Planning Regulation 2009.

This form can also be completed online using MyDAS at www.dsdip.qld.gov.au/MyDAS

Mandatory requirements

1. What type of development is proposed?

- [x] Operational work for clearing vegetation made assessable under Schedule 3 of the Sustainable Planning Regulation 2009
- [x] Material change of use of the premises
- [ ] Reconfiguring a lot

2. What type of approval is being sought?

- [x] Development permit
- [ ] Preliminary approval
- [ ] Both—provide details below

Mandatory supporting information

3. Confirm that the following mandatory supporting information accompanies this application

For ALL applications	Confirmation of lodgement	Method of lodgement
A property vegetation management plan including as defined under the Vegetation Management Act 1999 schedule. Note: A property vegetation management plan must show the matters prescribed in s.11 of the Vegetation Management Regulation 2012.	☑ Confirmed	Supplementary EIS for the Carmichael Coal Mine and Rail
A statement addressing the relevant part(s) of the State Development Assessment Provisions (SDAP).	☐ Confirmed ☐ Not applicable	Supplementary EIS for the

For ALL applications	Confirmation of lodgement	Method of lodgement
For an operational work application for which the assessment manager is the local government		
Written confirmation that the chief executive of the Department of Natural Resources and Mines is satisfied the proposed clearing is for a relevant purpose under the *Vegetation Management Act 1999*, section 22A.	☑ Confirmed ☐ Not applicable	Supplementary EIS for the
For an operational work application where the assessment manager is the Department of Natural Resources and Mines		
Either of the following: • written confirmation that the chief executive of the Department of Natural Resources and Mines is satisfied the proposed clearing is for a relevant purpose under the *Vegetation Management Act 1999*, section 22A; or • information identifying the relevant purpose under the *Vegetation Management Act 1999*, section 22A and demonstrating how the proposed clearing is for that purpose.	☐ Confirmed ☑ Not applicable	Supplementa
For applications for a material change of use or reconfiguring a lot		
The following additional detail to be included in the property vegetation management plan: • details of the location and extent of: – infrastructure, including buildings, fences, roads and electrical, telecommunication or sewerage services; and – firebreaks and fire management lines; and • details of the way the proposed clearing complies with the applicable concurrence agency policy under the *Vegetation Management Act 1999*.	☑ Confirmed ☑ Not applicable	

Notes for completing this form

- The Department of Natural Resource and Mines (DNRM) website contains a comprehensive range of information about the *Vegetation Management Act 1999*, including assessment codes and policies, as well as the *Landholder's guide to vegetation clearing applications.*
- Question 3 for operational work applications —Under the *Vegetation Management Act 1999*, the proposed vegetation clearing is only for a relevant purpose if the applicant satisfies the chief executive of the Department of Natural Resources and Mines (DNRM) that the development applied for is one of the purposes listed in section 22A of that Act. If the assessment manager is the local government, the applicant must obtain confirmation from the chief executive of DNRM that the proposed clearing is for a relevant purpose and provide this with the application. However, if DNRM is the assessment manager, the applicant has the choice of either obtaining this confirmation before making the application, or providing adequate information for DNRM to make the decision on whether the proposed clearing is for a relevant purpose at the time the application is received.

Privacy—Please refer to your assessment manager, referral agency and/or building certifier for further details on the use of information recorded in this form.

OFFICE USE ONLY

Date received		Reference numbers	

The *Sustainable Planning Act 2009* is administered by the Department of State Development, Infrastructure and Planning. This form and all other required application materials should be sent to your assessment manager and any referral agency.

Adani Mining Pty Ltd

Moray Quarry

Material Change of Use for Extractive Industry, Environmentally Relevant Activity 16 and Operational Works for Vegetation Clearing

Adani Mining Pty Ltd

Moray Quarry

12 July 2013

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Executive Summary

CDM Smith Australia (CDM Smith) has been engaged by Adani Mining Pty Ltd (Adani) to obtain approvals to support the development of a quarry at Moray Downs, approximately 145 km north of Clermont in the Isaac Regional Council (IRC) area. Adani is seeking to develop the Carmichael Coal Mine and Rail Project in the Galilee Basin, approximately 160 kilometres (km) north-west of the town of Clermont, Central Queensland. As part of the development, Adani will require significant quantities of quarry material for the construction of infrastructure associated with the mine and rail including, but not limited to, roads, camps, pads, dams and mine civil works. To supply the necessary quarry material, Adani propose to develop six new quarries.

This application is for the Moray Quarry, a new road construction and rail embankment material quarry proposed to be located on Lot 662 PH1491. The site is bounded by Bulliwallah Road to the east and Moray Carmichael Road to the south-east. The lot is within the Isaac Regional Council (IRC) area and is zoned Rural under the *Belyando Shire Planning Scheme 2009* and although the property is primarily used for agricultural activities, the site of the proposed Moray Quarry has been utilised for historic quarrying operations (Plate 1-1).

This application seeks a Development Permit for:

- Development Permit for Material Change of Use for Extractive Industry;
- An Environmentally Relevant Activity 16 (ERA) for Extractive and Screening Activities triggered for extracting 100,000 tonnes (t) of material per year; and
- Operational Works for Vegetation Clearing.

This report provides the information necessary for the Assessment Manager and Referral Agencies to efficiently assess the proposed development against relevant statutory planning and environmental instruments. The land use and planning assessment (Section 5) has established that the quarry is generally consistent with the requirements of the *Belyando Shire Planning Scheme 2009* and State Planning instruments.

Summary of Extraction and Quarry Operations

The initial site development will consist of implementing environmental controls, access and haul roads. The creation of a hardstand areas and infrastructure areas will be undertaken, with site infrastructure being brought in and set up, including crib and office buildings, ablution facilities and fuel storage.

Extraction will start by development of a series of linear rip faces with the dozer ripping and pushing material to a stockpile which will then be loaded via loader/excavator either straight into a truck. The quarry development will be undertaken using a number of separate cells which will be ripped to 8 metres (m) deep.

The extraction will begin with stripping topsoils and stockpiling of the residual soil profile for latter rehabilitation over the first few cells of the area to be developed. Clearing and overburden stripping will only be undertaken for one or two cell ahead of the current active cell. Following the complete extraction of the cell, progressive rehabilitation will commence.

A total of 652,000 t will be extracted for embankment fill to support the construction of the Carmichael Coal Mine and Rail Project and the operational life of the quarry will be approximately

three to four years. Once construction of the Carmichael Coal Mine and Rail Project is complete this site will be converted into dams and exposed areas rehabilitated.

In summary, the objectives of this quarry development are to:

- Provide short term quarry operation to provide necessary construction material for the Carmichael Coal Mine and Rail Project construction;
- Minimise any potential environmental impact associated with the operation;
- Preserve adjacent vegetation by maintaining a buffer between the operational quarry and the vegetated riparian areas of North Creek and the Belyando River;
- Provide employment for the local workforce;
- Minimise impacts to local and state roads; and
- Rehabilitate the land post quarry production.

In summary, the Moray Quarry development provides essential construction material for the Carmichael Coal Mine and Rail Project and is located strategically close the rail corridor to minimise haulage requirements. Consideration of environmental and conservation issues has largely determined the location, extent and design of this quarry.

Summary of Environmental Aspects

Environmental issues and constraints were examined and considered in the planning and design of the quarry development. The location, layout and staging of the proposed development has to a large extent, been determined by consideration of environmental issues and constraints. Issues of particular recognition were the transport and haulage of material, minimisation of the impact on visual amenity, limiting noise and dust emissions as well as impacts to the nearby waterway (North Creek and the Belyando River).

In particular, preliminary site surveys undertaken for fauna and flora by CDM Smith and Saunders Havill Group identified that the area is extensively disturbed and contains very minimal vegetation (Plate 1-1). Vegetation onsite is mapped as non-remnant vegetation over the northern section and not of concern over the southern section of the proposed quarry (Plate 1-2). During the first fauna survey on the 29th January to 3rd February 2013 potential signs of Koala (Vulnerable – EPBC Act) activity, in the form of tree scratches, were recorded at the proposed Moray Quarry site. Nevertheless, no scats were found to indicate recent activity and no individuals were sighted during the field surveys. The density of this vegetation is not considered ideal for Koala habitat, however they are not necessarily restricted to bushland or remnant areas and are known to exist and breed within farmland (Dique DS, 2004). Relatively minor clearing is required for the quarry development.

Comprehensive acoustic and air quality reports have been prepared by VIPAC Engineers and Scientists. Modelling of acoustic emissions was undertaken based on the highest production month and demonstrates that quarry operations can comply with the indoor noise criteria of 30dB $L_{Aeq.adj,1hr}$ during the night during peak production. In addition, dust modelling illustrates that the quarry can achieve compliance with the *Environmental Protection (Air) Policy 2008* (EPP (Air)). Management measures will be implemented to ensure impacts from noise and dust remain minimal.

TTM Traffic Engineering Group undertook a detailed assessment of the traffic impacts in accordance with the Guidelines for assessment of road impacts of developments (GARID) guidelines. This established that Moray Quarry and associated quarries will not have a significant or assessable pavement impact on the State Controlled Road (SCR) network. Access into the site will predominately be via two private access roads directly from the realigned Moray Carmichael Road.

Active weed monitoring and control will be undertaken to ensure clean weed free fill is provided from the site to prevent and spread of weed species through the removal and transport of fill.

Erosion and sediment controls will be designed, implemented and maintained in accordance with International Erosion Control Association 2008 Guidelines (IECA 2008). Site stormwater will be collected and reused onsite for dust suppression and quarry operations where possible. A Stormwater Management Plan will be developed and implemented prior to operations. The quarry extraction area will also be progressively rehabilitated to minimise exposure to erosion and sediment loss. Clean stormwater will be diverted away from the quarry workings.

Diesel and hydrocarbons will be stored in hard stand areas which will be bunded pursuant to *Australian Standard 1940 Storage and Handling of Flammable and Combustible Liquids*.

A cultural heritage clearance survey was undertaken by the Jangga People for the initial geotechnical investigations. Fifteen test pit locations were assessed within the Moray Quarry area and the preliminary findings confirmed the site to be clear of Indigenous cultural heritage constraints by the Jangga representatives. In accordance with the current Cultural Heritage Management Plan (CHMP), a further survey is required prior to obtaining final cultural heritage clearance for the Moray Quarry site.

Adani have provided ongoing environmental management and mitigation commitments which have been comprehensively identified within this report (Section 4). These environmental management commitments address construction and operational requirements under the *Environmental Protection Act 1994* (EP Act), *Environmental Protection Regulation 2008* (EP Regulation) and subordinate legislation. The impact assessment has determined that the environmental management of the site will adequately address (avoid, reduce or manage) the potential environmental impacts.

Section 1 Introduction

1.1 Purpose and Scope

This report has been prepared to provide the necessary supporting information for a development application to the State Assessment and Referral Agency (SARA). The purpose of this report is to address all requirements for the proposed development under Queensland and Local government environmental and planning legislation.

The application provides sufficient information for IRC as the Assessment Manager, Referral Agencies and other interested parties to adequately assess the potential impacts and controls regarding the development. The scope of the assessment considers the construction, operation and rehabilitation of the Moray Quarry and all works associated with the quarry. It also addresses direct and indirect impacts on the environment, community and local transport network.

1.2 The Proponent

The proponent for this quarry development is Adani Mining Pty Ltd (Adani), who is also the Proponent of the Carmichael Coal Mine and Rail Project. Adani is an Australian subsidiary of Adani Enterprises Limited, a company based in Ahmedabad, India. Adani Enterprises Limited has diverse interests in global trading, development and operation of ports, inland container terminals, establishment of special economic zones, oil refining, logistics, gas distribution, power generation, transmission and trading.

Adani established in Australia in mid-2010 with the intent of engaging in exploration and mining coal resources. Adani initially purchased the right to seek a Mining Lease Application (MLA 70441) over Exploration Permit for Coal (EPC) 1690 and then secured similar rights to the eastern and northern parts of EPC 1080 in December 2011. This initiated the development of the Carmichael Coal Mine and Rail Project. Adani Abbot Point Terminal Pty Ltd (AAPT), also an Australian subsidiary of Adani Enterprises Limited, has purchased the lease of Abbot Point Coal Terminal 1 and is seeking to develop Abbot Point Coal Terminal 0 as part of their overall programme for coal exportation.

Adani has not been subject to any proceedings under a Commonwealth, State or Territory law for the protection of the environment or the conservation and sustainable use of natural resources. Since establishing in Australia, Adani has sought to deliver community benefit from its business involvement. Adani's Environment and Sustainability Policy is included in **Appendix A**.

1.3 Project Overview

Adani is developing the Carmichael Coal Mine and Rail Project in the Galilee Basin, approximately 160 km north-west of the town of Clermont, Central Queensland. Whilst providing material to support the construction of the overall Carmichael Coal Mine and Rail Project, the Adani quarries will also provide material to upgrade local infrastructure and roads as agreed with IRC and possibly provide material fill to other Adani projects in the area.

To supply the necessary quarry material, Adani proposes to develop the Moray Quarry, the subject of this report. The proposed Moray Quarry will be an expansion of an existing road construction and embankment material quarry proposed to be located on Lot 662 PH1491 with site access directly onto the realigned Moray Carmichael Road (Plate 1-1). The site is bounded by Bulliwallah Road to the east and Moray Carmichael Road to the south-east, approximately 145 km north of

Clermont in the IRC area. The lots are zoned Rural under the *Belyando Shire Planning Scheme 2009* and are primarily used for agricultural activities.

Total fill requirements are approximately 34 million tonnes (Mt), for construction of the Project and associated local council road upgrades. The Moray Quarry has an inferred resource quantity of 1,881,600 cubic metres (m^3) [3,763,200 tonnes (t)], a proposed operational footprint of 91.2 hectares (ha) and a depth of 8 m below ground level (mbgl). However, only 6υς,000 t of this material is being sought for current requirements and further material may be extracted for ongoing maintenance following completion of the works. It is anticipated that the material extracted from the Moray Quarry would be used for new road construction and rail embankments.

Plate 1-1: Cleared area within Moray Quarry

Plate 1-2: Vegetation in the southern section of Moray Quarry

146°20'0"E
146°30'0"E
146°40'0"E
146°50'0"E
21°50'0"S
22°0'0"S

BOWEN
Collinsville
MACKAY
Mackay
Moranbah

Wilandspey Conservation Park
Nairana National Park
SANDY CREEK
WILANDSPEY
Proposed Rd
Moray Gulliwallah Road
UM GULLY
ROCKY CREEK
TOMAHAWK CREEK
4SP116046
1SP147546
2SP119925
Moray Gulliwallah Road
BEENBOONA
MISTAKE CREEK
LAGUNA CREEK
BELYANDO RIVER
TWELVE MILE OUTSTATION
3235PH752
637PH1980
Moray Quarry
3BL26
CASSIOPEIA
662PH1491
NORTH CREEK
PEAR GULLY
Moray Carmichael Boundary Road
MORAY DOWNS
Elgin Moray Road
Reserved Road
656SP138788
ELGIN DOWNS
EIGHTMILE CREEK
LABONA
OBUNGEENA CREEK
OGENBEENA CREEK
OGUNGEENA CREEK
FOX CREEK
MIDDLE CREEK
DOONE CREEK
DOONGMABULLA
CARMICHAEL RIVER
MOUNT GREGORY

Adani Quarry Permits and Approvals
Figure 1-1 Quarry project area

Legend

- Town
- Homestead
- Carmichael Mine - ML 70441
- National Park
- Morray Quarry Investigation Area
- Proposed Adani Rail Corridor
- Minor Road
- Major Road
- Railway
- Ergon Electricity Network
- Major watercourse
- Minor watercourse
- Haulage Route

0 2,500 5,000
Metres

DISCLAIMER
CDM Smith has endeavoured to ensure accuracy and completeness of the data. CDM Smith assumes no legal liability or responsibility for any decisions or actions resulting from the information contained within this map.
Data source:
Adani, 2012;
DERM, 2010;
Base Layer by Bingmaps, 2011.

N W E S
CAIRNS
TOWNSVILLE
MOUNT ISA
ROCKHAMPTON
BRISBANE

adani™
CDM Smith
cdmsmith.com

Job: B12849_021-R1_Moray
Date: 4/07/2013

1.4 Development Approval Process

Approvals under State and local legislation are required to be obtained before the development can proceed to the construction phase. The Moray Quarry is required for activities and development of resource operations relating to actions occurring under the *Mineral Resources Act 1989* (MR Act) and the *State Development and Public Works Organisation Act 1971* (SDPWO Act). This application has been submitted with the Supplementary EIS for the Carmichael Coal Mine and Rail Project. Accordingly, under s37 of the SDPWO Act the decision period for this application will commence on the date of issue of the Queensland Coordinator General's Report. The information and referral stages do not apply to the application as they will be undertaken as part of the SEIS process.

Queensland's *Sustainable Planning Act 2009* (SP Act) and *Sustainable Planning Regulation 2009* (SP Regulation) seek to achieve sustainable planning outcomes through managing the process in which development takes place, managing the effects of development on the environment, and continuing the coordination and integration of local, regional and state planning.

Under the SP Act (Sch 8, Section 10(1)), a Material Change of Use (MCU) of premises generally means:

(i) The start of a new use of the premises; or

(ii) The re-establishment on the premises of a use that has been abandoned; or

(iii) A material increase in the intensity or scale of the use of the premises.

Although historic quarrying operations at Moray Quarry may proceed under 'existing use right' a significant increase in the intensity and scale of the operations is necessary and therefore an MCU application under the SP Act is required. In accordance with the SP Regulation [Sch 3, Table 3, (1)], Reconfiguring a Lot applications are required for subdivisions or boundary realignments under the *Land Title Act 1994* (LT Act). No boundary reconfigurations are proposed as part of this application.

The following approvals are being sought with this application:

Table 1-1 Development approvals subject to this application

Approval	Trigger	Assessment
MCU Development Permit for Extractive Industry	Sch 8, Section 10(1) - *Sustainable Planning Regulations 2009* *4.4.1 - Belyando Shire Planning Scheme 2009* Impact Assessable where an industrial use is a 'total use area is over 150m2 in a rural zone.	Impact Assessable
Environmental Authority for Environmentally Relevant Activity 16 – Extractive and Screening Activities. Threshold 1 (c).	Sch 3, Table 2, Item 1 - *Sustainable Planning Regulations 2009* *Environmental Protection Regulations 2008*	Impact Assessable
Operational Works Development Permit for Vegetation Clearing	Sch 3, Table 4, (1)(c) *Sustainable Planning Regulations 2009* *Vegetation Management Act 1999*	Code Assessable under the Brigalow Belt and New England Tablelands Bioregion RVMC – Version 2

Under s37 of the SDPWO Act the decision period for this application will commence on the date of issue of the CG's Report. The information and referral stages do not apply to the application as they will be undertaken as part of the SEIS process.

1.5 Application Requirements Cross-Reference

The content required for development applications is specified within the following legislation:

- *Belyando Shire Planning Scheme 2009* – Planning Scheme Policy 1 (Information Council May Request);
- *Sustainable Planning Act 2009* (SP Act) – Section 314 (Impact assessment-generally); and
- *Environmental Protection Act 1994* (EP Act) – Schedule 4 Dictionary (standard criteria).

A cross-reference table for the requirements of the above listed legislation has been provided below:

Table 1-2 *Belyando Shire Planning Scheme 2009* requirements cross-reference

No.	Criteria to be Addressed	Section of this Document
2.1 Plans		
1 (a)	Plans should contain - a site analysis plan identifying and describing all existing site features, such as the cadastral boundaries of the site, "buildings", structures", Roads, vehicle and pedestrian access, car parking, servicing areas, vegetation, topographic, hydraulic and geological features	Figure 1-1 and Figure 3-1
1 (b)	Plans should contain - a proposal plan identifying and describing the extent of modification of site features, such as, the cadastral boundaries of the site, "buildings", "structures", roads, vehicle and pedestrian access, car parking, servicing areas, vegetation, topographic, hydraulic and geological features.	Figure 3-1
1 (c)	Plans should contain - a landscaping plan detailing the location, extent, densities and species of proposed plantings and other external treatments.	Not provided, refer to Alternative Solution – PC 11 in Table 5-3
2	Plans should be drawn to scale and observe recognised drafting conventions.	Figure 1-1 and Figure 3-1
2.2 Existing "Use" and Site Details		
1 (a)	Details provided should include - existing and previous "use" of the site.	Section 3.1
1 (b)	Details provided should include - existing and previous "use" of adjoining or adjacent sites.	Section 3.1
1 (c)	Details provided should include - floor areas of "buildings" and other external activity areas, including car parking, storage areas and the like.	Not relevant for existing use as no existing buildings are being used
1 (d)	Details provided should include - site characteristics e.g. levels and contours	Figure 1-1 and Figure 3-1
1 (e)	Details provided should include - descriptions of surrounding land uses, including the height and appearance of "buildings".	Section 3.1
1 (f)	Details provided should include - the nature and location of all services and infrastructure, including easement details.	Section 3.1 and Figure 3-1

No.	Criteria to be Addressed	Section of this Document
2.3 Proposed "Use" and Site Details		
1 (a)	Details provided should include - details of the proposed "use", including floor area of "buildings", external materials, treatments and colours of "buildings" and "structures".	Section 3
1 (b)	Details provided should include - details of external activity areas, including car parking, storage areas and the like.	Section 3
2.4 Amenity		
1 (a)	Hours of operation.	Section 3.4.11
1 (b)	Deliver times of goods.	Section 3
1 (c)	Heights of "buildings" and structures.	Stockpiles - 3.4.7 Lighting - 3.4.13 Demountables - 3.4.8
1 (d)	Setbacks and boundary clearances of all "buildings" and structures".	Section 3.1
1 (e)	External lighting arrangements.	Section 3.4.13
2.5 Infrastructure		
1 (a)	Known or determined flood levels.	Section 4.2.2
1 (b)	Proposed water supply.	Section 3.4.12.1
1 (c)	Proposed effluent disposal.	Section 3.4.12.2
1 (d)	Proposed stormwater disposal.	Section 3.4.3
1 (e)	Proposed method of liquid and solid waste disposal.	Section 3.4.14
1 (f)	Proposed electricity supply.	Section 3.4.12.1
1 (g)	Proposed telecommunication.	Section 3.4.12.1
2.6 Traffic and Servicing		
1 (a)	Traffic likely to be generated by the proposal.	Appendix B
1 (b)	The number, type and frequency of vehicles likely to service the proposal.	Appendix B
1 (c)	The times and arrangements for servicing of the "premises".	Appendix B
1 (d)	Anticipated carparking requirements.	Appendix B
1 (e)	The extent of car parking, vehicle manoeuvring areas, crossover/access details, loading/unloading areas, service areas.	Appendix B
2.7 Emissions		
1 (a)	The nature of any anticipated emissions (including odour, noise, dust, run-off and the like).	Section 4.7
1 (b)	Measures proposed for the control of emissions.	Section 4.7
1 (c)	The location and methods of containment and control of waste disposal and waste storage areas.	Section 3.4.14
1 (d)	Types, quantities, storage methods, and protection measures relating to storage and use of chemicals.	Section 3.4.10
1 (e)	Emergency equipment and procedures to be utilised.	Section 3.4.16
2.8 Environmental		
1 (a)	Location of ridgelines and escarpments.	Figure 1-1 and Figure 3-1
1 (b)	Location of "watercourses" and "lakes" and the extent of associated riparian buffers.	Figure 4-3
1 (c)	Location of effluent disposal areas.	Section 3.4.12.2
1 (d)	Location and extent of existing vegetation.	Section 4.1.1 and Figure 4-1
1 (e)	Location and extent of vegetation to be retained.	Appendix C
1 (f)	Location of any known sites of indigenous, cultural or natural heritage.	Section 4.11
2.9 Constraint Areas		
1	Sufficient detail should be provided to enable "Council" to accurately determine the likely impact of the proposal on constraint areas, as identified in the Planning Scheme.	Section 3.3

Note: Section 2.10 - Reconfiguring a Lot has not been addressed in this cross-reference table as this is not part of the development.

Table 1-3 *Sustainable Planning Act 2009* requirements cross-reference

No.	Criteria to be Addressed (as per Section 314)	Section of this Document
(2) The assessment manager must assess the part of the application against each of the following matters or things to the extent the matter or thing is relevant to the development—		
(a)	The State planning regulatory provisions.	Section 5.1.3
(b)	The regional plan for a designated region, to the extent it is not identified in the planning scheme as being appropriately reflected in the planning scheme.	Section 5.1.3
(c)	If the assessment manager is not a local government—the laws that are administered by, and the policies that are reasonably identifiable as policies applied by, the assessment manager and that are relevant to the application.	Not ! pplicable
(d)	State planning policies.	Section 5.1.1
(e)	Temporary local planning instruments.	Not ! pplicable
(f)	Preliminary approval to which section 242 applies.	Not ! pplicable – No Preliminary Approvals relevant to the quarry.
(g)	The planning scheme.	5.2.1
(h)	For development not in a planning scheme area—any planning scheme or temporary local planning instrument for a planning scheme area that may be materially affected by the development.	Not ! pplicable
(i)	If the assessment manager is an infrastructure provider—an adopted infrastructure charges resolution or the priority infrastructure plan.	Not ! pplicable
(3) In addition to the matters or things against which the assessment manager must assess the application under subsection (2), the assessment manager must assess the part of the application having regard to the following		
(a)	The common material.	Not ! pplicable
(b)	Any development approval for, and any lawful use of, premises the subject of the application or adjacent premises.	No known relevant approvals
(c)	Any referral agency's response for the application.	Application to be submitted through EIS process

Table 1-4 *Environment Protection Act 1994* requirements cross-reference

No.	Criteria to be Addressed (as per "standard criteria" definition)	Section of this Document
(a)	The principles of ecologically sustainable development as set out in the 'National Strategy for Ecologically Sustainable Development.	Section 6
(b)	Any applicable environmental protection policy.	Appendix I and Appendix J
(c)	Any applicable Commonwealth, State or local government plans, standards, agreements or requirements.	Section 5
(d)	Any applicable environmental impact study, assessment or report.	This document
(e)	The character, resilience and values of the receiving environment.	Section 4
(f)	All submissions made by the applicant and submitters.	Not Application
(g)	The best practice environmental management for activities under any relevant instrument, or proposed instrument, as follows: (i) an environmental authority; (ii) a transitional environmental program; (iii) an environmental protection order; (iv) a disposal permit; and (v) a development approval.	No environmental authorities or development approvals have been granted for the proposed development.
(h)	The financial implications of the requirements under an instrument, or proposed instrument, mentioned in paragraph (g) as they would relate to the type of activity or industry carried out, or proposed to be carried out, under the instrument.	As above, not applicable.
(i)	The public interest.	Section 2
(j)	Any applicable site management plan.	Activities will be carried out in accordance with the quarry CEMP.
(k)	Any relevant integrated environmental management system or proposed integrated environmental management system.	Not !pplicable
(l)	Any other matter prescribed under a regulation.	As set out in Table 1-2 and Table 1-3

Section 2 Development Justification

2.1 Need for Quarry Material

Quarry material is used in the building and construction industry as an essential base component for a range of infrastructure. The quarry industry is largely tied to infrastructure development, therefore, with major growth in the resource sector the necessity for quarry material has greatly increased over the past few decades. Quarries throughout Queensland help facilitate the development of the States resource sector and are vital to the construction of local public infrastructure such as roads.

Adani is proposing to develop a 60 million tonne per annum (Mtpa) thermal coal mine in the north Galilee Basin. All coal will be railed via a privately owned rail line connecting to the existing Aurizon rail infrastructure near Moranbah, and shipped through coal terminal facilities at the Port of Abbot Point and/or the Port of Hay Point (Dudgeon Point expansion). The Carmichael Coal Mine and Rail Project will have an operating life to 2071 with rehabilitation until 2074.

The Carmichael Coal Mine and Rail Project is comprised of two major components:

- The Project (Mine): a greenfield coal mine over EPC1690 and the eastern part of EPC1080, which includes both open cut and underground mining, on mine infrastructure and associated mine processing facilities and offsite infrastructure; and
- The Project (Rail): a greenfield rail line connecting the Mine to the existing Goonyella rail system to provide for export of coal via the Port of Abbot Point and/or the Port of Hay Point (Dudgeon Point expansion).

Adani Enterprises Limited sees supply from Queensland coal resources as key to meeting its target of generating 20,000 megawatts (MW) of power from its Indian power plants by 2020. If the Carmichael Coal Mine and Rail Project does not proceed it would likely lead to Adani's demand for coal being met outside of Australia and the benefits of significant economic investment would not be realised.

A key component of the Carmichael Coal Mine and Rail Project is the supply of suitable local quarry material. The Carmichael Coal Mine and Rail Project will require a significant amount of quarry material for upgrade and maintenance works on existing infrastructure and the construction of new infrastructure. Provisional amounts of fill expected to be needed for the project totals approximately 34 Mt.

Region-wide investigations have identified an acute shortage of appropriate quarry material for construction of roads and other infrastructure. Just like the current Moray Quarry site, existing quarries in the area are primarily historic, small and do not contain appropriate infrastructure to immediately utilise. The existing quarries (including Moray Quarry) contain limited supplies of material and are not capable of supplying the wide variety or volumes required for different infrastructure purposes. Therefore, the development of Moray Quarry will complement the expansion of other existing quarries in the area to supply necessary material for the upgrade and maintenance of essential infrastructure.

The development of the Moray Quarry will provide royalties to the State for the sale of the quarry material, provide local jobs through direct employment and support services, and provide necessary material for the construction and upgrading of local infrastructure. Therefore, it is

considered that the quarries are an essential development for the local area, region and the State as a whole.

2.1.1 Quarried Products Uses and Specification

The construction of the rail and road require certain quarry materials with characteristics that ensure the infrastructure meets the engineered design life. Quarry material needs to be of a particular sound, strength, durability, resistance and have particular behaviours to be useful for construction requirements.

The construction of the Carmichael Coal Mine and Rail Project and local road upgrades will require:

- Embankment fill;
- Structural fill;
- Ballast; and
- MRD types of material.

2.1.2 Transport Costs

Quarry materials are high bulk, low cost materials. Transport costs can be a significant proportion of the total cost of the material. The majority of quarried products are carted in tip truck, dog and truck configurations. Cartage rates per tonne effectively reflect the hourly rate and the cost of transporting road base which is about 30 – 40% of the cost of the material to the user.

It would be economically unfeasible for quarry material to be transported from significant distances for the construction of the Carmichael Coal Mine and Rail Project and local road infrastructure. In addition, there would be increased impact to the environment (fuel consumption, emissions and dust), state and local roads and the community if material is required to have long cartage distances.

There is currently no operational or approved quarry within short cartage distance along this portion of the rail corridor to source quarry material, therefore, a new quarry development is required. Moray Downs is an ideal quarry option as it is in close proximity to the rail corridor (900 m) and contains an abundant source of embankment material for construction of the railway.

2.2 Alternatives to the Project

The development of the quarries will significantly support the construction of the Carmichael Coal Mine and Rail development and must be located in close proximity to the Project. Transportation of material from surrounding regions is not considered to be a viable alternative.

2.2.1 Alternatives Considered for the Carmichael Coal Mine and Rail Project

In accordance with the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) [Schedule 4, Section 2.01(g)], alternatives to the Carmichael Coal Mine and Rail Project were reviewed and discussed as part of the EIS. The EIS noted that Adani had access to EPC 1690 and part of EPC 1080 however, has no other access to coal mining within Australia (GHD,

November 2012). Therefore, there are currently no other commercially available alternative for Adani to proceed with a major open cut and underground coal mine.

The Galilee Basin is not currently serviced by any rail infrastructure which would enable export of coal product from the Carmichael Coal Mine and Rail Project, or other resource activities. Adani has also identified opportunities to link the rail to current and proposed rail infrastructure, to minimise the potential environment and social impacts of linear infrastructure within the rural environs while facilitating the export of resources from the Galilee Basin region. Transport of coal by rail is the only economically feasible option for transport to the ports for export.

A no action option, that is, that Adani does not develop the Carmichael Coal Mine and Rail Project, would likely lead to Adani's demand for coal being met from outside of Australia. The no action option would see significant capital investment totalling approximately $21.5 billion foregone. Estimates have indicated that $5.9 billion will be spent in the years preceding 2022. The remaining $15.6 billion will be spent over the remaining years of operation (GHD, November 2012).

2.2.2 Alternatives Considered for Quarry Developments

The location of suitable resources is limited due to the constraints imposed by geology, access, land and environmental values. Ideally quarries should be conveniently located to limit heavy truck transport and so reduce end user costs and environmental and infrastructure impacts associated with haulage.

As part of the Project development, 37 quarry locations were identified for investigation. Geotechnical investigations undertaken in late 2012 determined the nature of potential resources at each location and in combination with environmental constrains analyses eight sites were chosen to proceed for further investigations with five sites proposed to proceed with development.

In addition to environmental constraints, investigations have identified an acute shortage of appropriate quarry material for construction of a project the size of the Carmichael Coal Mine and Rail development. Existing quarries in the area are primarily historic, small and do not contain appropriate infrastructure to immediately utilise. Moray Quarry is an ideal quarry option as it is located adjacent to the Moray Carmichael Road, which is planned to have a significant upgrade. The Moray Quarry contains weathered sandstones and other sedimentary rocks [California Bearings Ratio (CBR) 15] useful for the upgrade and maintenance of roads.

Investigations have also considered hauling material from larger existing quarries in the surrounding areas of Clermont, Moranbah, Charters Towers, Townsville and Emerald. However, due to the distance it was determined that haulage costs and the potential impact on the road network would be excessive and this was rejected as an alternative option.

2.2.3 Alternative Methods of Operation

A number of locations and layout plans were also considered in the development of the quarry plan. The adopted layout is considered optimum for containing potential environmental impacts without compromising economic efficiency.

Section 3 Project Details

3.1 Site Details

The Moray Quarry is proposed to be located on Lot 662 PH1491, adjacent to the Moray Carmichael Road. The site is approximately 145 km north of Clermont in the IRC area. Table 3-1 details the lot on which the development is proposed and identifies the use for each lot, and the planning scheme zone under the *Belyando Shire Planning Scheme 2009.* No further lots are part of this application and nothing related to this development will hinder access to, or operation of, activities on surrounding lots.

Table 3-1 Site details

Lot and Plan	Address	Area	Zoning	Current Use(s)	Proposed Use(s)
Lot 662 PH1491 (Leasehold)	5509 Elgin Road, Clermont	120.7 ha	Rural	Pastoral lease	Moray Quarry over part of lot

The site lies within the Northern Brigalow Belt bioregion, however extant vegetative conditions vary considerably. The surrounding areas are primarily used for cattle grazing and fattening. The northern section of the proposed Moray Quarry is predominately cleared and is subject to intermittent quarry extraction while the southern section is sparsely vegetated (Plate 3-1). The topography of the site is generally flat, however slopes slightly north and west towards North Creek and east towards the Belyando River located approximately 400 m away. Site inspections have confirmed that historical quarrying has occurred in the location of the proposed Moray Quarry (Plate 1-1) and the area is highly disturbed.

Plate 3-1: Vegetation present onsite at Moray Quarry (southern section)

The nearest residential buildings (sensitive receptors) to the quarry is located approximately 1 km to the south-east of the proposed quarry and is situated adjacent to the Belyando River. These residences will be screened from the quarry operations by a vegetation corridor along the Belyando River which occurs in a general north-south direction (Figure 4-1).

3.2 Development Description

The applicant proposes to initiate formal quarry operations on Lot 662 PH1491, as per Figure 3-1 below. The development proposal includes the construction of all ancillary facilities specifically:

- Crushing and screening plant;
- Stockpile areas;
- Demountable site buildings;
- Fuel storage and treatment facilities;
- Water storage and treatment facilities; and
- Internal and external access roads.

Equipment used in the abovementioned areas will generally consist of one small dozer, one loader, one water truck, three ALLIGHT plants, one light vehicle, one 10 Kilo Volt Amperes (kVA) generator and two 75 t AB triple trucks. Additionally, minor ancillary equipment, including service trucks, will be onsite when required. Temporary facilities may be erected onsite which could include a demountable office, crib room, ablution facilities and a small car park. A small hardstand lay down area, and suitably bunded fuel storage area will be located near the site infrastructure at the main point of egress from the site. All refuelling will be completed on a hard stand area, and waste materials will be disposed of offsite at a licensed facility.

The extraction area for Moray Quarry has been defined as 91.2 ha. Embankment material will be extracted from the quarry and transported, via the Moray Carmichael Road and Bulliwallah Roads, to the Carmichael Rail Corridor. The construction of the rail corridor and activities associated with it, including quarry material haulage, are addressed within the Carmichael Coal Mine and Rail EIS and are therefore not part of this application.

3.3 Project Planning and Design

A range of environmental, social, geological, construction and cultural constraints were considered during the design and location of the quarries. Initially desktop constraints maps were generated to identify the following constraints:

- Rivers, waterways, water bodies, dams and wetlands [particularly those triggered under State Planning Policy (SPP) 4/11 – Protecting Wetlands of High Ecological Significance in the Great Barrier Reef Catchments];
- Topography and landforms;
- Available resources (identified through exploratory drilling at each of the potential quarries and borrow pits);
- Regional Ecosystems (REs), in particular endangered and of concern REs, high value regrowth vegetation and Essential Habitat;
- Indigenous cultural heritage and Native Title claims;
- Environmental features such as restricted areas, nature refuges and reserves;
- The degree of existing disturbance (e.g. currently cleared areas and sites already utilised for quarrying activities);
- The presence of other infrastructure (including homesteads and settlements), mining and exploration lease and permit boundaries, coal resource areas, roads, power lines and pipelines; and
- Strategic Cropping Land (SCL).

Following the desktop constraints assessment, two site inspections including a vegetation assessment was undertaken to ground truth the site features. The findings of these site inspections were fed into the location and design of the quarry plan to ensure minimal impact to the environment.

Consideration was given to safety, noise, visual amenity, water quality, rock quality, engineering constraints, capital and operating costs and distance of the site from the required construction areas.

Moray Quarry was determined to be a preferred location due to proximity to rail corridor, shielding of operational impacts from the topography (air, dust, noise, visual impacts). The design and staging within the quarry development plans further took into account site features including existing disturbance, proximity to local road, protection of the adjacent waterway and minimising footprint through progressive rehabilitation.

3.4 Quarry Development Proposal

3.4.1 Initial Construction and Commissioning Phase

This stage of development will involve:

- Demarcating the extent of the approved quarry area with durable permanent markers;
- Vegetation clearing and topsoil removal from first stage of quarry development;
- Stabilisation and revegetation of any final infrastructure batters and embankments;
- Construction of temporary internal haul road;
- Establishing initial stormwater runoff and erosion controls;
- Access road upgrades and road drainage works;
- Creation of hard stand areas;
- Installation of ancillary services (fuel storage, site office etc); and
- Installation of mobile crushing and screening plant.

Site preparation is likely to commence in early 2014.

3.4.2 Site Access and Internal Roads

The proposed Moray Quarry will maintain only two all weather access points. The track will directly access the realigned Moray Carmichael Road. The traffic and transport arrangements for the Moray Quarry are further discussed in **Appendix B** – Traffic and Transport Impact Assessment.

Site access roads will be constructed with a gravel pavement with a minimum of 9 m width. An internal haul road will be developed along the edges of the rip areas to transport material off the site (Figure 3-1). The internal haul roads will be relocated as the linear cell extraction is moved onto the next row of cells to be extracted.

3.4.3 Water Storages, Stormwater and Erosion Control

The site erosion and sediment controls will be designed in accordance with International Erosion Control Association (IECA) Guidelines 2008 recommended drainage design standards for temporary drainage structures in QLD with an anticipated design life of greater than 24 months.

Where possible, stormwater will be harvested for use onsite and ultimately the site is designed to be self sufficient for water required for all onsite operations other than potable water requirements.

All quarry workings will be free draining and the following will be undertaken:

- Stormwater will be captured in a water storage and re-used onsite for dust suppression and progressive rehabilitation;
- Clean water will be diverted away from the quarry workings into undisturbed catchment and drainage lines;

- Erosion and sediment controls will be designed, implemented and maintained in accordance with IECA 2008; and
- Water diversion structures will be established in advance of land disturbance where possible.

Each stage of the quarry development plan requires establishing a number of physical controls prior to commencement of topsoil stripping and vegetation clearing. This includes installing culverts along the haul road, construction of diversion channels to divert clean water from entering areas of disturbance and establishing a sediment pond/capacity sump to collect site water runoff for reuse onsite.

All water runoff collected in the sediment ponds will be reused onsite where possible. The water usage requirements for Moray Quarry are outlined in Table 3-2 below.

Table 3-2 Water Usage

Quantity	Dust Suppression Truck	Dust Suppression Plant	Plant Pugmill	General Usage
Litres Per Day (L/day)	90,000	N/A	N/A	15,000
Total Kiloliters Per Month (kl/month) - 3150				

A water storage dam will be constructed to collect rain and stormwater and allow for a 1 in 1 year storm event for water supply for onsite water use. This storage will have a capacity of 45 megalitres (ML), under the *Water Resources (Burdekin Basin) Plan 2007* a permit for taking overland flow is not required for storages under 250 ML.

Adani will consider a number of alternative options of water supply should additional water be deemed necessary for the quarry. This may include bore water supply, large water storages and sourcing from an existing water supply. Any alternative water supply options will be permitted separately and are not discussed herein.

3.4.4 Vegetation Clearing and Topsoil Management

The site clearing includes removal of any remaining vegetation and debris. There is minimal vegetation on the proposed working area and much of the vegetation to the south has been preserved. However, approximately 18.7 ha of mapped remnant vegetation is proposed to be cleared for this quarry and this is further addressed in **Appendix C**.

In order to avoid large areas of the quarry being unnecessarily exposed to the erosive effects of wind and rain, areas will be opened/cleared immediately in advance of extraction fronts in accordance with the quarry plan.

All turf, topsoil and other organic and unsuitable material shall be stripped from the site. Wherever possible, such material will be stockpiled and reused for site rehabilitation. Topsoil stockpiles will be to a maximum height of approximately 3.5 m and stabilised, revegetated and generally treated to facilitate the retention of soil production for later rehabilitation.

Fencing is required due to the high concentrations of livestock on the properties adjacent to the proposed quarry area. Fencing standards will be confirmed upon consultation with relevant landowners and in accordance with requirements to facilitate fauna movement.

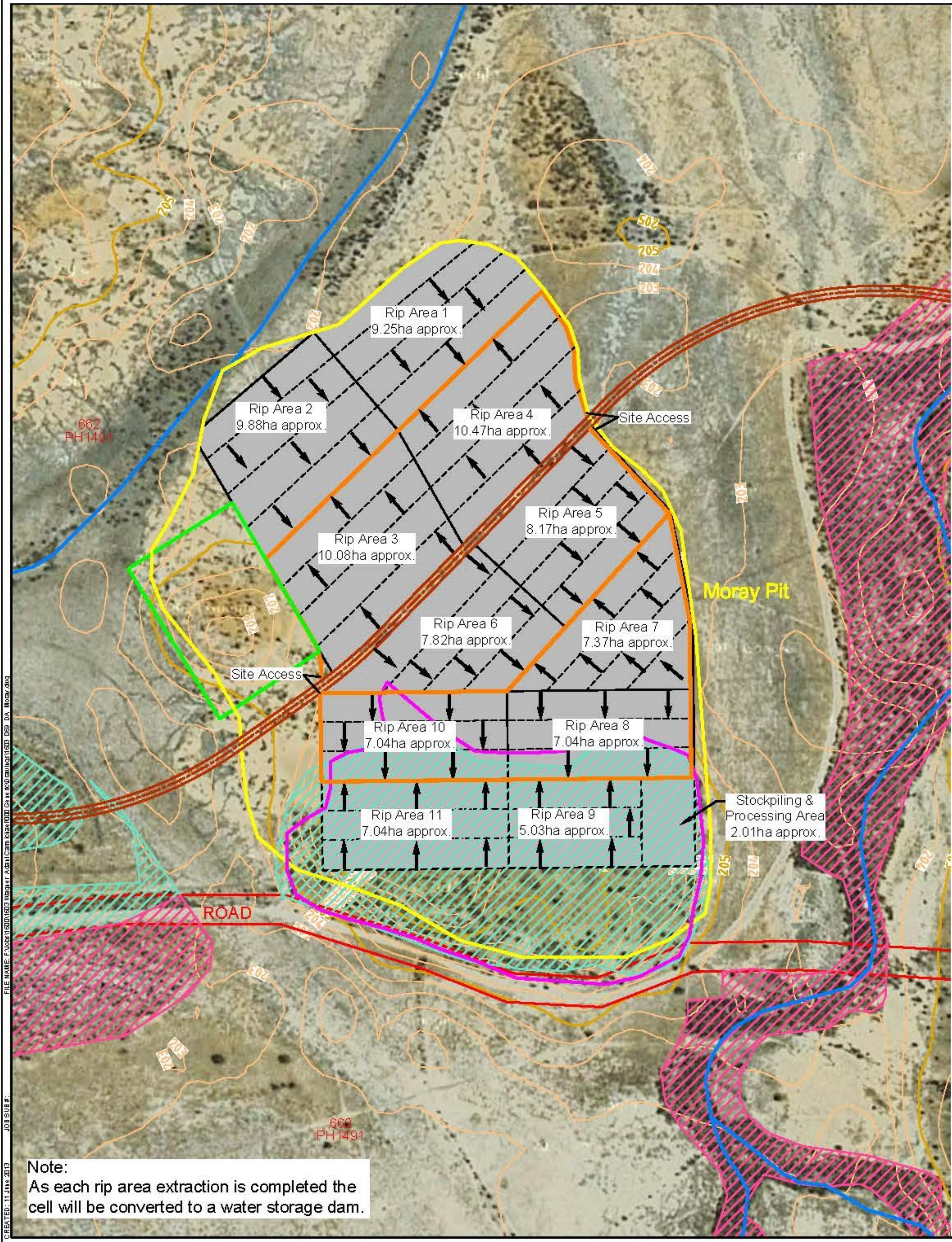
3.4.5 Development of Extraction Cells

The Moray Quarry is proposed to be a potential western source of road construction and embankment materials for the rail corridor. Extraction for this quarry will start by development of linear rip faces with the dozer ripping and pushing material to a stockpile which will then be loaded via loader/excavator either straight into truck or through a screening plant dependent upon the material quality. The area of disturbance will be in general keeping with the area already disturbed. As outlined in Figure 3-1 there will be 11 defined rip areas ranging in size from 5.03 ha to 10.47 ha. Internal haul roads will be constructed between the rip areas to allow material to be moved back into the stockpile area in the south-east corner of the site.

3.4.5.1 Sequence of Extraction

An outline of the proposed quarry development layout and sequence of working is presented graphically in Figure 3-1. A Quarry Development Plan will guide the development of the quarry and this plan is largely self explanatory. Once the quarry workings have been established quarry development will progress in a logical and sequential fashion with clearing of the next cell in preparation of workings and progressive rehabilitation of the expired extraction areas.

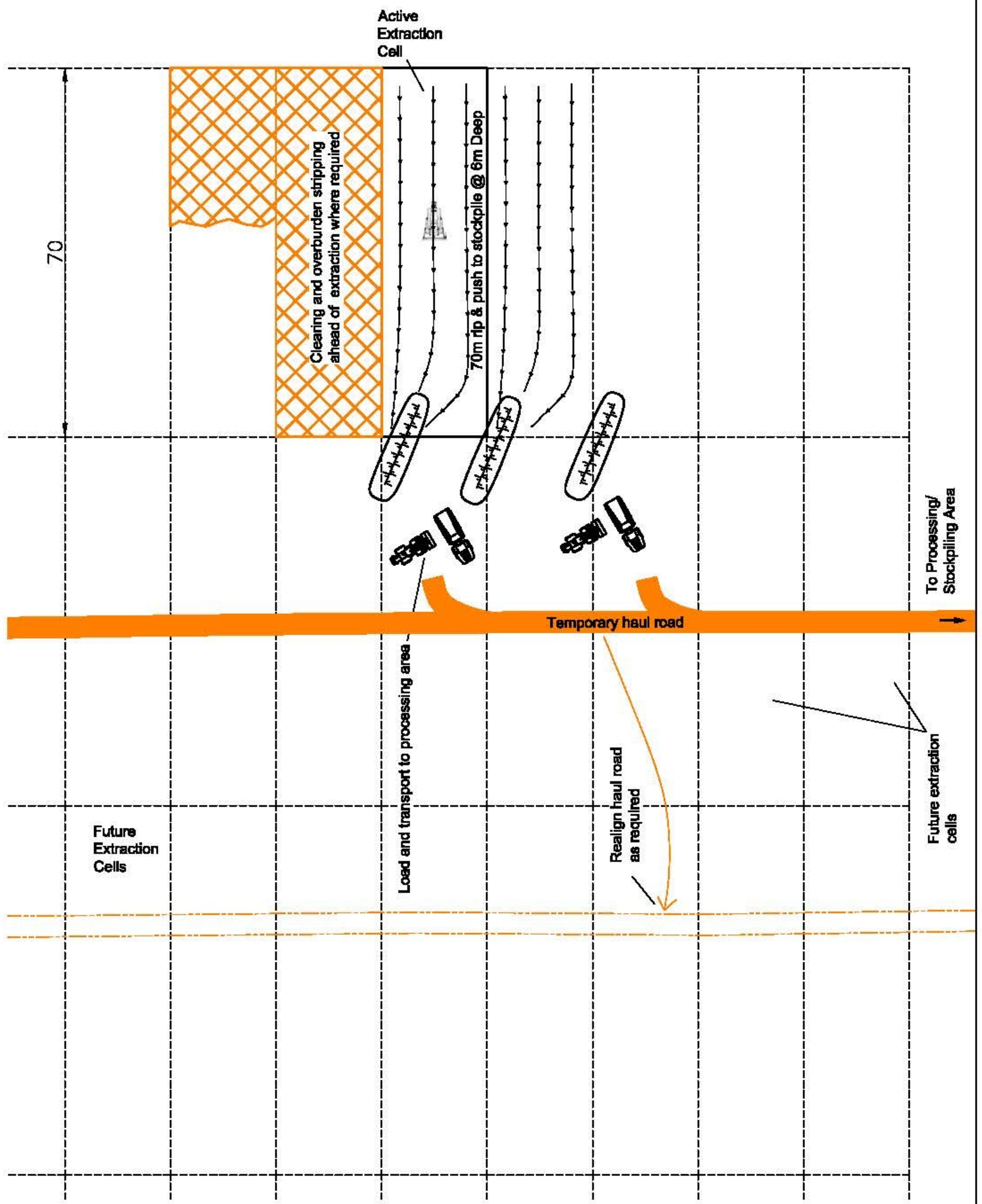
Material volumes at Moray Quarry are based on a rippable thickness of eight metres and it is highly probable that additional volumes of rippable material will exist below this, albeit the feasibility of ripping this material is unknown and accordingly further test work will help delineate the depth the resources.



Note:
As each rip area extraction is completed the cell will be converted to a water storage dam.

Conceptual Extraction Sequence

Scale 1:1,000



REV	DESCRIPTION	DATE	BY

Data Sources:
Photography: Google Maps. Date accessed: 2013-01-23
Topography: 1s SRTM 2008 DEM-S © Commonwealth of Australia (Geoscience Australia) 2012
Cadastre:
Ecosystem:
Other:

Legend:
- Site Boundary
- Cadastral Boundary
- Easement Boundary
- General Direction of Extraction
- Isaac Regional Council Quarry Extent
- Remnant Vegetation Containing Endangered Regional Ecosystems
- Remnant Vegetation Containing Least Concern Ecosystems
- Overburden Stripping
- Temporary Haul Road
- Survey of Koala Area (CDM Smith, 2013)
- Proposed Road Alignment (CDM Smith, 2013)

PROJECT: Moray Quarry

CLIENT: Wagner Quarries Pty Ltd

TITLE: Figure 3-1 Extraction and schematic site layout

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3.4.6 Material Processing

Material on the Moray Quarry site will be processed through a screening or crushing process. It is expected that material will be ripped and stockpiled ready of dispatch to laydown areas along the rail construction corridor.

3.4.6.1 Products Produced and Production Rates

The Moray Quarry will be a short term operation commencing in late 2014 and operating until construction of the Carmichael Mine and Rail Project is completed. There may be slight changes to the operation life of the quarry as it is dependent upon the construction schedule for the Carmichael Coal Mine and Rail Project.

It is anticipated that 652,000 t of embankment material will be required from this site over a three year period, an average of 23,000 t a month. The highest annual production rate for a year is expected to be during 2015 when up to 322,000 t of material may be extracted. This volume and demand may change and is dependent upon construction schedule and construction progress of the Carmichael Coal Mine and Rail Project.

3.4.7 Product Stockpiling and Despatch

3.4.7.1 Location of Stockpiles and Management

Stockpiling of processed products is necessary to meet construction requirements and schedules and for quality control testing. Some product stockpiles will be maintained at the proposed quarry site in the area to the south-east of the extraction cells and closest to the current Moray Carmichael Road alignment. The road base and fill stockpile will be approximately 3.5 m high. Material will predominately be transported offsite to stockpile locations along the rail corridor to await use in construction. Stockpiles will be arranged to provide ready access to different products and to provide maximum benefit for noise attenuation from fixed and mobile plant.

3.4.7.2 Dispatch and Quantity Records

The volume carried in each truck will be recorded. All records on a per trip/per day basis will be maintained with logged records of tonnes per load and destination kept.

Quarry material will be hauled with road registered triples, capable of holding 75 t. It is anticipated that quarry operations will generate maximum daily traffic movements of approximately 60 vehicles (in/out) (**Appendix B**).

All loads accessing public roads will be covered. No trucks will be permitted to leave the site unless the load is legal and secure. A driver's code will apply to all truck drivers and its requirement will apply to driver behaviour and attitudes both on and off the site. The internal site access road between the site access points will be hard packed with a gravel pavement.

Road signs and internal quarry road speed limits will be restricted to 40 km per hour and access road speed limits of 80 km per hour enforced onsite to minimise dust and ensure safe operation of the site.

3.4.8 Ancillary Facilities

The following facilities will be erected at Moray Quarry to service operations on the site and at the nearby North Creek Quarry:

- One crib and ablution block;
- One spares container 20 ft;
- Security gates and cameras; and
- One portable water tank (25,000 L) and pumps.

3.4.9 Machinery and Equipment

The following is an indicative list of equipment that will be used onsite

- One D10T bulldozer;
- One CAT980H loader;
- One water truck (Mack 8x4 wheeler);
- Three light plants (ALLIGHT);
- One light vehicle;
- One 10 kVA Genset; and
- Two 75 t AB triple trucks.

Major machinery and equipment to be deployed permanently onsite will include the excavator, loader, haul trucks and water truck. Other equipment to be deployed on an 'as needed' basis will potentially include bull dozers, screening and or crushing plant. Equipment will be maintained in accordance with manufacturer's recommendations and inspected daily with a regular maintenance program in place.

Minor servicing of mobile plant will be undertaken onsite. Major servicing will be generally undertaken by specialist service providers and equipment repair will generally be carried out onsite. Refuelling of mobile plant will be undertaken at the bunded above ground fuel tank.

3.4.10 Storage of Fuels, Lubricants and Chemicals

Fuel storage onsite will be in a self bunded fuel tank and will store up to 25,000 L maximum of diesel at any one time. This will require refilling once a month by a fuel tanker. Fuel will be on a hard stand area with spill kits located beside the refill area. Any spill will be cleaned up immediately.

Minor amounts of oils, hydraulic fluids, greases, coolants and other maintenance items will be stored onsite in the self bunded 20 ft storage container. In addition, minor amounts of cleaning solvents, paints and thinners will also be stored.

Weed control chemicals and sprays may be stored onsite for maintenance weed control. Any weed control program will be undertaken by a contractor who will supply and remove remaining

herbicides from the site. In addition, fertilisers and pesticides in small quantities required for progressive rehabilitation works will be stored onsite.

All minor chemical and other substances will be safely stored with required separation distances, bunding and within a lockable storage.

3.4.11 Hours of Operation

Details for hours of operation are as follows:

- Extraction, stockpiling and dispatching – 24 hours (Monday to Sunday); and
- Plant and equipment maintenance – 24 hours (Monday to Sunday).

3.4.12 Public Utility and Services

3.4.12.1 Electricity, Telecommunications and Potable Water

The following will be the utilities and services at the site:

- Electricity supply will be by a 10 kVA generator as no connection to main powers is available at the site;
- Telecommunications will be by a satellite phone in the office building, as no mobile reception is available at the site; and
- Potable water supplies will the trucked in and stored in a 25,000 L water tank onsite for drinking and ablutions operation. Onsite water for construction and dust suppression will be captured onsite from stormwater in retention dams and reused onsite.

3.4.12.2 Sewage and Waste Water Management

Waste water will be treated in portable treatment plants comprising modular units with capacity to treat up to 21 Equivalent Persons (EP). Waste water from the system will be disposed off through sub-surface irrigation to a fixed landscape. It is expected that less than a 10 EP work force onsite will produce a maximum of 500 L/day. The sub surface irrigation will be physically separated from any work area in a suitable location.

The onsite system is not required to have licensing under the EP Act as the facility is not deemed to be a "sewage treatment plant" as it has a peak design capacity of less than 21 EP. However, the installations will comply with the *Sewerage and Water Supply Act 1949* which require approvals to install, change or take away onsite sewage facilities.

Sewage systems will be managed in accordance with the AS1547.200 - Onsite domestic wastewater management, as this standard applies to systems dealing with up to 10 persons.

The functional requirements of onsite sewage treatment systems are that they be designed, operated and maintained to:

- Ensure that wastewater effluent reuse practices do not create a mode of transmission for disease;
- Encourage the application of wastewater effluent to the landscape in the most efficient and sustainable method;

- Bring about simple, safe and cost-effective operation and routine service requirements;
- Ensure soil condition is not degraded;
- Ensure that by-products are disposed in an hygienic manner which is not detrimental to the environment or public health; and
- Ensure that the wastewater effluent is maintained within the boundary of the property from which it is produced so that offsite impacts are minimised or prevented (e.g. contamination of surface water and groundwater by nitrogen and phosphorus from the effluent, environmental nuisance).

3.4.13 Lighting

It is proposed that the quarry will operate 24 hours a day, as such lighting for night operations is required. Lighting will be provided at the extraction face, the site office and the access roads to allow for night operations.

Illumination of the Moray Quarry will be provided by three industry recognised COMBILITE. The COMBILITE features four 1500 W metal halide lights with automatic start-up and shut down and an integrated control panel. The light output will be a strong and clear pure-white illumination with a 350 degree mast rotation function whilst fully extended and operational.

When compacted for transport, the unit itself stands at 2.35 m; when the mast is fully extended the unit can reach a nominal maximum height of 9 m. Width of the actual unit is 1.65 m whilst the draw bar has an ability to extend to 3.14 m. The unit runs off a 1.1 L, 3 cylinder Perkins 403D-11 engine, meeting all current and proposed Australian emissions legislation. The unit is also fitted with a fluid containment tray to prevent any environmental spills.

The lights will be located at the entry and exit of the site, the quarry working face and processing areas. The lights will be moved and positioned according to the stage of quarry development. Consideration will be given to reducing light spill from the boundary of the site.

3.4.14 Waste Management

Quarry developments do not generate a significant amount of waste. Types of waste likely to be generated on site include:

- Paper and general wastes from the officers, workshop and amenities facilities;
- Scrap metals;
- Oils, greases and waste fuels; and
- Contaminated soils from any clean up of fuel, oil or grease spill.

Wastes will be sorted and recycled where possible. Paper and general wastes from the offices, workshops and amenities will be stored in appropriate containers prior to delivery to designated landfill, refuse transfer or recycling depots. The nearest landfill is located Turrama Road, Clermont QLD 4721. General waste will be transported to this facility. Scrap metals will be collected by a contractor for recycling. Oils, greases and waste fuels from machinery servicing will be collected and securely stored onsite in a bunded area prior to disposal offsite to licensed refuse site or recycling agency.

3.4.15 Workforce

There will be approximately 8–10 full time employees on site during the quarry operations. Employees will be sourced from the local area or if fly in fly out, accommodated in the local mine construction camp to the west of the Moray Quarry. Employees will use the rail haul road or Moray Carmichael Road where possible to access the Moray Quarry.

Employees will be transported to the quarry site in a single vehicle and returned to the temporary camp accommodation at the end of the shift. In addition, to the site personnel, part time and casual truck drivers, maintenance fitters, drill and blast personnel and other sub contractors may be employed either directly or as sub contractors.

3.4.16 Health and Safety and Emergency Response

3.4.16.1 Public Safety

The need to ensure the safety of the public from quarrying and quarry related activities is recognised by the proponent. Statutory requirements will be enforced and other company initiatives will be implemented to avoid injury to the public. These would include fencing, erection of signage, machinery marking and alarms, and safety procedures.

Site safety procedures will be implemented and reviewed as necessary. The quarry will be operated in accordance with the *Mining and Quarrying Safety and Health Act 1999* (MQSH Act) and associated regulations.

3.4.16.2 Occupational Health and Safety

A site safety plan will be prepared and updated as necessary. The plan will include induction procedures, standard work procedures, risk assessment procedures, employee training and all occupational health and safety requirements to ensure statutory compliance, audit and monitoring obligations are adhered to.

3.4.16.3 Emergency Response

In accordance with the Guidance Note QGN 15: (Emergency Preparedness for small mines and quarries document), an individual Emergency Response Plan (ERP) will be developed prior to construction which considers, as a minimum:

- The type of operation;
- Site hazards;
- The range of personnel;
- Training of personnel;
- Geography of the surrounding area and remoteness; and
- Available equipment.

Adani will identify and record who should receive copies of the ERP. If information changes there will be a system developed that ensures changes are made to the site ERP and any controlled copies. The ERP will be written in plain English with critical information well indexed and easily

referenced. The ERP will consist of a number of elements that contain relevant information relating to the site including the following generic topics:

- Quarry information;
- Plans and drawings;
- Risk management;
- Emergency equipment/facilities;
- First aid requirements;
- Personnel training;
- Incident control;
- Communication;
- Contact lists;
- Securing the site;
- Procedures for controlling site specific hazards; and
- Records.

3.4.17 Rehabilitation and Landscaping

Landscaping of the site is not considered necessary given the rural nature of the location. Visual amenity impacts to the public are likely to be minimal as stockpiling will act to visual screen the operations from Moray Carmichael Road. Due to the short duration of the quarry, planting vegetation as screen would not be effective due to the length of time vegetation screens take to grow and become successful.

Rehabilitation is an essential component of quarry planning and development. Rehabilitation will be staged to ensure the minimum disturbed area is open at any time.

Any remaining open extraction areas will be rehabilitated. The following rehabilitation methods will be applied:

- All temporary infrastructure and facilities will be removed;
- Disturbed land will be reinstated to a stable form to enable land to reach pre-existing condition similar to the surrounding contour of the land;
- There will be void left for ongoing water source for the mine and rail construction and operation;
- Permanent erosion and sediment controls will be designed to provide long-term stability to the disturbed area;
- Reinstate the topsoil over the contoured profile;
- Seed of native grasses or sterile crops during initial reinstatement works to assist in stabilising the area and reducing the potential for weed outbreaks;
- Allow natural regeneration of vegetation where viable, if not successful assisted regeneration using local species and sourced stock will be used;

- Fertilisers and soil supplements will be used only as necessary and with the agreement of landholders and authorities;
- Temporary access roads will be closed and rehabilitated to a condition compatible with the surrounding land; and
- Weed control and ongoing monitoring will be implemented to ensure successful regeneration.

Revegetation will be carried out in consultation with the leaseholder and with the relevant government department or agency to ensure the measures proposed are acceptable and have a high likelihood of success. The current proposed rehabilitation schedule is provided in Table 3-3 below.

Table 3-3 Proposed rehabilitation schedule

Area	Area of disturbance (ha)	Year of extraction	Year of rehabilitation
1	9.25	2016 -2017	2018
2	9.88	2016 - 2017	2018
3	10.08	2015 -2016	2017
4	10.47	2015 - 2016	2017
5	8.17	2014 -2015	2016
6	7.82	2014 -2015	2016
7	7.37	2014 -2015	2016
8	7.04	2014 -2015	2016

Section 4 Environment and Management

4.1 Terrestrial Ecology

The Moray Quarry site occurs within an agricultural area primarily used for grazing. Part of the proposed quarry area is currently used as an active quarry site for local council requirements. As a result of historic and current grazing activities, the extent, connectivity and ecological integrity of vegetation communities and the fauna habitat they provide, have been altered considerably. The Moray Quarry area comprises a mix of remnant and regrowth vegetation and cleared areas, however the southern area proposed to be cleared is mapped as not of concern RE (Figure 4-1). No major watercourses run through the site, however North Creek, which is a minor tributary of the Belyando River, lies adjacent to the north-west boundary.

4.1.1 Vegetation Communities and Fauna Habitats

The proposed site is within the Brigalow Belt North Bioregion a region with a high diversity of RE (Sattler and Williams 1999). Biodiversity loss is widespread and affects most areas of the region to varying degrees (Dight, 2009).

The quarry area encompasses a low rise in the south sloping down to North Creek in the north and west. The existing quarry area is located in the south-west of the site and is devoid of vegetation. Remnant eucalypt woodland is mapped to the east of the existing quarry (Plate 4-1). The remainder has been cleared in the past and only scattered trees remain. The introduced Buffel Grass (*Cenchrus* ciliaris) dominates the grass layer outside of the remnant areas. Large trees are generally restricted to the remnant vegetation. The remnant vegetation contains native grasses and large woody debris and retains the best habitat for fauna. The entire area is currently subject to cattle grazing. Two REs have been mapped within the investigation area and another three are mapped nearby along North Creek. Descriptions of the REs within the investigation area are provided below in Table 4-1 and illustrated in Figure 4-1.

Table 4-1 Mapped REs within the Moray Quarry investigation area

RE	Vegetation Management Act 1999 class	Biodiversity status	Short description
REs within the Investigation Area			
11.3.7	Least concern	Of concern	Tall *Corymbia spp.* woodland to open-woodland. Occurs on levees and plains formed from Quaternary alluvial deposits.
11.3.10	Least concern	No concern at present	*Eucalyptus brownii* grassy woodland on Cainozoic alluvial plains.
REs within close proximity to the site			
11.3.1	Endangered	Endangered	Open-forest dominated by *Acacia harpophylla* and/or *Casuarina cristata* with scattered emergent eucalypts associated with Cainozoic alluvial plains.
11.3.25	Least concern	Of concern	*Eucalyptus camaldulensis/tereticornis* open-forest to woodland on fringing levees and banks of rivers and drainage lines.
11.3.37	Least concern	No concern at present	*Eucalyptus coolabah + E. Camaldulensis* discontinuous woodland occurring on fringing streams which are often braided.

146°34'0"E
146°36'0"E
146°38'0"E
21°55'0"S
21°56'0"S
21°57'0"S

2SP119925
662PH1491
3BL26
Moray Boundary Road
Moray Carmichael Road
Moray Carmichael Boundary Road
BELYANDO RIVER
MORAY DOWNS

11.3.3/11.3.5/11.3.10
11.3.3/11.3.1
11.3.5/11.3.1/11.3.3/11.3.10
11.3.10
11.3.25/11.3.37/11.3.1
11.3.7/11.3.10

Adani Quarry Permits and Approvals
Figure 4-1 Ecological values within and surrounding the site

Legend

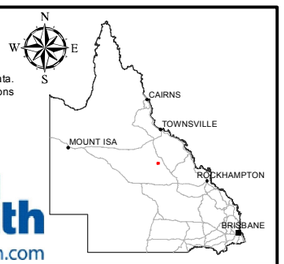
- Carmichael Mine - ML 70441
- Threatened Ecological Community (EPBC)
- Wetland
- Moray Quarry Extraction Area
- Stockpiling and Processing Area
- Property Boundary
- Moray Quarry Access Road
- Proposed Moray Road Re-Alignment
- Proposed Adani Rail Corridor
- Minor Road
- Major watercourse
- Minor watercourse
- Homestead

Regional Ecosystems v6.1

- Endangered Subdominant
- Of Concern Dominant
- Not of Concern

0 500 1,000
Metres

Data source:
Adani, 2012;
DERM, 2010;
Base Layer by Bingmaps, 2011.



adani™ CDM Smith cdmsmith.com

Job: G:\Projects\B12849_QuarryInvestigation\mxd\final\022-R1_MorayEcol.mxd Date: 4/07/2013

Plate 4-1: Remnant woodland in southern section of Moray Quarry

4.1.1.1 Flora Species

The EPBC Protected Matters search results indicated that there is a potential for a Threatened Ecological Community (TEC) listed as Endangered (under the EPBC Act) to occur within the area: Brigalow (*Acacia harpophylla* dominant and co-dominant). Field observations indicated there is no Brigalow on the site. Additionally, the EPBC Protected Matters search results indicated *Acacia ramiflora* (listed as Vulnerable) is likely to occur within the area, however, no species were observed onsite. This species occurs in woodland on sandstone hills (SEWPaC, 2013). Sandstone underlies the geology of this area. Scattered *Acacia cambagei* (Stinking Wattle) were sparsely distributed on the site, and a number of post-clearing regrowth species were also present.

The Queensland Government Wildlife Online search (**Appendix D**) lists 86 conservation significant plant species as potentially occurring at the site. All of these species are listed as least concern under the *Nature Conservation Act 1992* (NC Act) except for *Peripleura scabra* which is listed as Near Threatened. The field survey confirmed that no species listed as conservation significant in the Wildlife Online Search were present at the site.

4.1.1.2 Weed Species

According to the EPBC Protected Matters search, the following four Weeds of National Significance (WoNS) have the potential to occur in the quarry area:

- Rubber Vine (*Cryptostegia grandiflora*);
- Olive Hymenachne (*Hymenachne amplexicaulis*);
- Parkinsonia (*Parkinsonia aculeata*); and

- Parthenium (*Parthenium hysterophorus*).

All four of these species are also listed as Class 2 pests under the Queensland *Land Protection (Pest and Stock Route Management) Act 2002* (LP Act). A total of two introduced weed species were identified within the Moray Quarry survey area: Buffel Grass (*Pennisetum ciliare*) and Rhodes Grass (*Chloris gayana*). Neither of these species is listed under the LP Act or as a WoNs.

4.1.1.3 Fauna Species

The desktop assessment of EPBC protected matters and EHP Wildlife online database records indicated the previous occurrence of 13 fauna species listed as Endangered, Vulnerable or Near Threatened (EVNT) under the NC Act and EPBC Act. It also recorded eight species listed as Migratory under the EPBC Act. The EPBC Protected Matters search predicted the presence of a further three species listed as Endangered or Vulnerable (EPBC Act) and three species listed as Migratory potentially occurring at the site. The results from the EPBC Protected Matters search are provided in Table 4-2, with their respective field observations. A full list of predicted conservation significant fauna species and their potential to occur on the site are provided in **Appendix E**.

Species identified in the database searches were subsequently categorised as to their potential to occur in the study areas following onsite habitat assessments (refer to Table 4-2). Four categories were used to classify the likelihood of a species being present. Categories were defined as:

1. Known – confirmed during field assessments;
2. Likely – suitable good quality habitat observed during field assessments and desktop records from the area;
3. Potential – possibility of suitable habitat and records of the species occurring within the wider quarry area; and
4. Unlikely – no suitable habitat or not known to occur within the local region.

Table 4-2 Protected Matters Search Results for with respective field observations

Species	EPBC Act	Preferred habitat	Potential to occur
Birds			
Erythrotriorchis radiatus (Red Goshawk)	Vulnerable	Prefers areas close to the coast featuring extensive open forest and woodland with a mosaic of vegetation types. Nests in tall emergent trees close to water.	**Unlikely** - Landscape heavily cleared and unsuitable.
Geophaps scripta scripta (Squatter Pigeon)	Vulnerable	Occurs in dry woodland. Generally on sandy soils close to water.	**Likely** - Observed on two occasions in general area. Potential foraging habitat in remnant vegetation onsite.
Peophila cincta cincta (Black-throated Finch - southern)	Endangered	Occurs in grassy open woodlands near water. Prefers areas of intact woodlands.	**Potential** - foraging habitat in remnant vegetation onsite.
Rostratula australis (Australian Painted Snipe)	Vulnerable, Migratory	Prefers temporary shallow wetlands. Nests in freshly flooded wetlands with low vegetation.	**Unlikely** - No suitable habitat.
Mammal			
Phascolarctos cinereus (Koala)	Vulnerable	Occurs in a variety of eucalypt woodlands and open forest.	**Potential** - Potential signs of Koala activity (tree scratches) observed in remnant vegetation onsite.

Species	EPBC Act	Preferred habitat	Potential to occur
Reptiles			
Denisonia maculata (Ornamental Snake)	Vulnerable	Prefers seasonally inundated areas on deep cracking clay soils and adjacent habitat. Feeds exclusively on frogs. Rare to absent where Cane Toads are abundant.	**Unlikely** - No suitable habitat.
Egernia rugosa (Yakka Skink)	Vulnerable	Occurs in a variety of dry sclerophyll woodlands largely in the Brigalow Belt. Constructs burrows in a variety of soil types.	**Potential** - Habitat in remnant vegetation suitable
Migratory Marine Birds			
Apus pacificus (Fork-tailed Swift)	Migratory	Aerial foraging species that occur over a variety of landscapes including highly modified environments.	**Potential**
Ardea modesta (Eastern Great Egret)	Migratory	Eastern Great Egret occurs on a variety of wetlands and intertidal habitats.	**Known** - Observed in general area.
Ardea ibis (Cattle Egret)	Migratory	Cattle Egret prefers damp grassy areas for feeding, particularly pasture.	**Potential** - Potential to occur in area however quarry site is unsuitable
Gallinago hardwickii (Latham's Snipe)	Migratory	Occurs in generally low numbers in a variety of permanent or ephemeral wetlands across eastern Australia.	**Potential** - Potential to occur in area however quarry site is unsuitable
Migratory Terrestrial Species			
Haliaeetus leucogaster (White-bellied Sea-Eagle)	Migratory	Occurs in coastal areas including beaches, estuaries and lagoons, but may range well inland on larger rivers. Predominantly feeds on fish.	**Unlikely** - No suitable habitat.
Merops ornatus (Rainbow Bee-eater)	Migratory	Widespread species that may occur in a variety of habitats. Nests in burrows in sandy banks.	**Known** - Observed in general area

The Queensland Government Wildlife Online search (**Appendix D**) lists 60 protected fauna species (including amphibians, birds, insects, mammals and reptiles) as potentially occurring at the site. All of these species are listed as least concern under the NC Act except for the Squatter Pigeon which is listed as Vulnerable. An overview of conservation significant fauna observed in the area is provided in Section 4.1.1.4 below.

4.1.1.4 Conservation Significant Fauna Observed

Three terrestrial fauna species listed as EVNT under the EPBC Act and/or NC Act were recorded within the quarry area or surrounds:

- Cotton Pygmy-goose (*Nettapus coromandelianus*) (NC Act – Near Threatened; EPBC - Migratory) – minimum of 30 individuals observed on large farm dam over 30 km east of the proposed Moray Quarry;
- Squatter Pigeon (EPBC Act and NC Act – Vulnerable) – five individuals observed within vegetated southern portion of Moray Quarry; and
- Ornamental Snake (EPBC Act – Vulnerable; NC Act – Vulnerable) – recorded over 30 km east of the proposed Moray Quarry.

In addition, potential signs of Koala (EPBC Act – Vulnerable (QLD, NSW and ACT)) in the form of tree scratches were recorded in the area of the proposed Moray Quarry.

Conservation significant species locations are depicted in Figure 4-2. An additional four species listed as Migratory under the EPBC were also sighted in the surrounding areas:

- White-throated Needletail (*Hirundapus caudacutus*);
- Eastern Great Egret;
- Glossy Ibis (*Plegadis falcinellus*); and
- Rainbow Bee-eater.

Of the species listed above only Squatter Pigeons and potential signs of Koala activity were recorded in the southern area of the proposed Moray Quarry. The remaining species were recorded in the surrounding search area (Figure 4-2).

146°40'0"E
146°50'0"E
147°0'0"E
21°50'0"S
22°0'0"S

Disney
Borrow 7
Back Creek South
North Creek
Moray Quarry
TOMAHAWK CREEK
Moray Bullivallah Road
BELYANDO RIVER
GOWRIE CREEK
Gregory Developmental Road
MISTAKE CREEK
Elgin Moray Road
Reserved Road
OG UNGEENA CREEK
CARMICHAEL RIVER
FOX CREEK

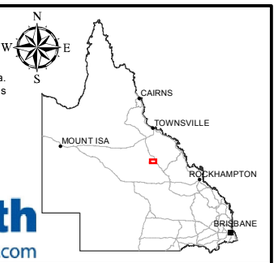
Adani Quarry Permits and Approvals
Figure 4-2 Conservation significant species locations

Legend

- Minor Road
- Major Road
- Major watercourse
- Minor watercourse
- Quarry Investigation Area
- Squatter Pigeon
- Potential Koala Scratches
- Ornamental Snake
- Cotton Pygmy-Goose and Glossy Ibis
- Rainbow Bee-eater
- Eastern Great Egret
- White-throated Needletail

0 1,250 2,500 5,000
Metres

Data source:
Survey by CDM Smith, 2013; Adani, 2013; DERM, 2010;
Base Layer by Bingmaps, 2011.



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4.1.1.5 Protected Areas

Four protected areas are located in the vicinity of the proposed Moray Creek Quarry: Wilandspey Conservation Park; Nairana National Park; Mazeppa National Park; and Epping Forest National Park (Scientific). Nairana National Park lies 29 km north-west of the quarry area. Wilandspey Conservation Park is located approximately 19 km north of the site. Both parks protect extensive tracts of Brigalow woodlands.

Mazeppa National Park is located 71 km south-east of the site and is adjacent to the east side of the Gregory Development Road. Epping Forest National Park is located approximately 44 km south of the site and is accessed from Elgin Road. Epping Forest National Park is well known as the location of the last remaining wild population of the Northern Hairy-nosed Wombat (*Lasiorhinus krefftii*). All of the protected areas are a considerable distance from the proposed quarry site, will not need to be traversed for site access and will not be impacted by the developments activities.

4.1.2 Potential Impacts to Terrestrial Ecology

The development of the Moray Quarry is likely to have the following direct impacts on the terrestrial ecology:

- Clearing of 18.7 ha of mapped least concern vegetation and additional grasses not listed as conservation significant;
- Removal of existing habitat within the quarry footprint (91.2 ha) until site is rehabilitated. Most animals will be able to move away from the area of primary impact into adjacent areas, this will be further encouraged through the progressive clearing of the cells just prior to extraction; and
- Potential animal strikes from vehicle movements both from clearing operations and from material haulage.

A number of potential indirect impacts will also be present due to the operation of the quarry itself through increased noise, dust emissions and traffic increases, including:

- Disturbance to fauna, distress from operational noise;
- Increase in dust residue on plant foliage decreasing the sunlight absorption and photosynthesis process; and
- Potential to increase weed distribution through spread of weed within the fill, or on vehicles carting the quarry material.

4.1.3 Terrestrial Ecology Management

The main objectives in regards to flora and fauna include:

- Avoid (where possible) and minimise disturbance and adverse impacts on native flora and fauna;
- Ensuring no injury or death to native fauna;
- Ensuring no vegetation is disturbed outside of areas designated for clearing within the quarry area;
- Regularly monitoring (visually) to ensure no new weed species are introduced or other weeds are spread outside the proposed development area;

- Ensuring vehicles are certified as 'clean' of soil or vegetation from other sites prior to entering the quarry area; and
- Avoid any spread or increase in weed distribution through quarry operations.

4.1.3.1 Flora Management

To avoid high-value habitat including Brigalow communities within the area the quarry footprint has been strategically located within already cleared areas. The quarry operation will include the following (as minimum):

- Methods to prevent mortality of native species during pre-construction, construction and operation;
- All surveys will be undertaken by suitably qualified persons; and
- Measures to rehabilitate areas that have been disturbed during construction.
- Vegetation outside the quarry area will be protected from heavy machinery and other development-related disturbances.

4.1.3.2 Fauna Management

Initial surveys have failed to identify any hollows or breeding places. Nevertheless, during the preclearance survey, large and small hollows that may provide shelter for fauna will be identified and marked. These hollows will then be saved (recovered) and used for habitat in non-disturbed areas in the quarry surrounds.

All fauna will be identified, captured and released to suitable habitat locations. These locations will be established prior to clearing activities in a manner suitable to the needs of species or species groups, in accordance with relevant permits.

In the event any native fauna are injured as a result of quarry activities, they will be transported to a native animal hospital/refuge facility. Records of all captures and deaths will be kept by the site's Environmental Officer and notification procedures and field audits will be established. The cause of any injuries or deaths will be investigated and new management measures will be implemented to minimise the potential of it occurring again.

Fencing will be established around construction activities to exclude fauna from entering the site. Fencing will be inspected regularly to ensure no fauna species are trapped. A speed limit will also be established on site to limit the incidence of fauna mortality. Targeted training and awareness for terrestrial ecology matters and responsibilities will be provided to all staff and contractors during site inductions. Ongoing training including the observance of (and compliance with) speed limits and reporting of on site fauna observations and fauna mortality will be implemented.

4.1.3.3 Pest and Weeds

Feral animal and weed management will be implemented for the construction and operational phases of the development. Management measures will include, as a minimum:

- A pre-construction weed audit will be undertaken;
- If noxious weeds are identified, weed control will be undertaken in the surrounding area to minimise any contamination of fill material to be transported offsite;

- Routine inspections that will include observations for declared plants, listed weeds, feral cat and pig, rabbit, red fox and other identified pests within the construction area;
- A control/eradication plan for pests that may potentially occur on the quarry site;
- Identification of treatment methods and techniques, chemicals, equipment and sources of assistance for pest and weed management;
- Weed hygiene declaration forms to accompany plant and machinery being brought to site;
- Vehicle wash-down protocols and processes to ensure vehicles and their loads as per the Weed Hygiene Declaration (Part 2);
- Methods for monitoring and control of weed populations within the site;
- Control measures and processes of how to maintain weed infestations; and
- Processes to ensure weed free certifications can be provided with the fill material as per the Weed Hygiene Declaration (Part 1).

Training will be provided to all construction personnel regarding pest plant, weed and pest and feral animal awareness. A car park for housing vehicles entering the site will be provided and regularly checked for any weed and pest animal infestations. Treatment of weeds will be undertaken in accordance with Biosecurity Queensland guidelines and fact sheets for each species as well as other appropriate sources of weed management.

4.2 Aquatic Ecology, Surface Water and Hydrology

4.2.1 Aquatic Ecology

North Creek, a minor tributary of Belyando River traverses the north-west boundary of the quarry area and no other drainage lines were observed on site. The observed section of the creek did not contain any water at the time of the survey and would likely only flow intermittently following heavy rainfall periods. Pooled water had formed on the existing quarry site as a result of quarry operations (Plate 4-2).

The EHP Wildlife Online Search (**Appendix D**) has indicated the potential presence of a range of aquatic dependant flora in the area. Previous studies undertaken for the Carmichael Coal Mine and Rail Project have identified 26 aquatic dependant flora. The majority of these are listed as least concern under the NC Act and none are identified as conservation significant under the EPBC Act (GHD, November 2012). As there is no aquatic habitat within the Moray Quarry site none of these species were observed in the proposed quarry site.

A desktop assessment identified 51 fish species know to occur within the Burdekin Basin. Threatened species that have been previously recorded within the basin include:

- Australian Lungfish (*Neoceratodus forsteri*) (EPBC Act – Vulnerable);
- Murray Cod (*Maccullochella peelii*) (EPBC Act – Vulnerable); and
- Freshwater Sawfish (*Pristis microdon*) (EPBC Act – Vulnerable). (GHD, November 2012)

Nine aquatic reptiles (eight Turtles and one Crocodile) are known to inhabit the Burdekin Basin. The turtle species of the Burdekin catchment utilise a variety of habitats ranging from ephemeral waterholes and pools to structurally complex rivers and creeks, such as the Belyando. None of

these species are listed as conservation significant (GHD, November 2012). Due to the ephemeral, low water retention capacity of North Creek, it is unlikely that the Creek supports these species and they are more likely to occur in the Belyando River.

The EPBC Protected Matters search results indicated the potential presence of four Migratory wetland species:

- Great White Egret (*Ardea alba*);
- Cattle Egret (*Aredea ibis*)
- Latham's Snipe or Japanese Snipe (*Gallinago hardwickii*)
- Painted Snipe (*Rostratula benghalensis*).

The quarry site and adjacent North Creek provide little value for these species, although Eastern Great Egret may occur on the pooled areas.

4.2.2 Surface Water and Hydrology

4.2.2.1 Existing Environment

The site is located within the Burdekin River Basin, which forms part of Australia's North East Coast Drainage Division (NLWRA, 2002). The Burdekin River is one of Australia's largest and carries a massive sediment load. On average it is the biggest single source of sediment and fresh water to the Great Barrier Reef lagoon (NRM, 2002). Specifically, the site is located within the Suttor River Sub-basin area, which drains into arid inland areas in the south and central west via the smaller Cape River (Board, 2005). Two EHP mapped wetlands are located close to the quarry area: a lacustrine wetland (farm dam) associated with North Creek directly to the north; and riverine wetland associated with the Belyando River directly to the east.

In accordance with the Burdekin Water Quality Improvement Plan (2009), the site is located within the Belyando Floodplain sub-catchment. Onsite studies identified the presence of pooled water (Plate 4-2), however there was no water in North Creek at the time of site surveys (Plate 4-3). North Creek is a tributary of the Belyando River which has a more consistent flow. The overall condition of the North Creek is consistent with other tributaries in the Belyando Floodplain sub-catchment and therefore the environmental values of the sub-catchment are considered representative of North Creek. It was noted during field surveys from the 29 January to 3 February 2013 that despite the Clermont region having received a total of 144.8 mm of rainfall in the previous month (BOM, 2013) there was no flowing or pooled water in North Creek.

North Creek has slumped eroded banks and beds choked with loose sediment. This material is mobilised readily once there is appreciable flow. The condition of North Creek is consistent with the greater Belyando Floodplain sub-catchment which has experienced significant decline in the quality of riparian areas over the last 30 years (Dight, 2009). Soil loss within the Belyando Floodplain sub-catchment primarily comes from hillslope erosion (40%), stream bank erosion (32%) and gully erosion (28%) (Dight, 2009).

Very little is known about the ecology and condition of aquatic habitats in the Burdekin Basin and no known aquatic studies have been conducted in this sub-catchment (Dight, 2009). The aquatic habitat is considered slightly to moderately disturbed, however the biological communities are thought to be relatively healthy and ecosystem integrity has been largely retained (Dight, 2009).

Models and water quality monitoring data from the CSIRO shows that the water quality in the Belyando Floodplain sub-catchment contains slightly elevated sediment concentrations and loads during wet season flow events (Roth, 2002).

Plate 4-2: Pooled water observed within the existing quarry area

Plate 4-3: North Creek adjacent to Moray Quarry

Monthly rainfall data has been examined from the records at Moranbah, Alpha and Moray Downs. Rainfall characteristics include:

- Rainfall patterns, in terms of summer maxima, winter minima and annual totals are broadly similar across this relatively large area. The annual total depths for the three rain gauges are 588 millimetres (mm), 559 mm and 521 mm. These totals are consistent with the Bureau of Meteorology (BOM) regional average of 550 mm;
- In any month of the year, including in the typical wet season months, there can be zero rainfall; and
- The monthly rainfall trends described above are reflected in the gauged daily river flows. Similarly, the pronounced annual variations in rainfall, including the persistence of both dry years and wet years, are evident in the annual discharges at St Annes (Belyando / Suttor Rivers) and Goonyella.

The Moray Quarry site slopes from the south with an elevation of 213 m AHD from the Moray Carmichael Road north to north-west down towards the creek line at 202 m AHD. Surface water runoff will flow down this slope towards the quarry area; this will be diverted around the site by diversion bunds. Surface water falling within the site will be directed into a sediment pond/water storage for reuse onsite. This storage will be located in the northern corner at lowest elevation of the extraction area.

4.2.2.2 Flooding

The site is within the Belyando floodplain and is not directly within a watercourse. Figure 4-3 shows that the proposed quarry is located within the extent of 100 yr ARI flood extent predicted by the Queensland Reconstruction Authority – known as the Queensland Interim Floodplain Assessment Overlay (QIFAO). The QIFAO represents a floodplain area within drainage sub-basins in Queensland. It has been developed for use by local governments as a potential flood hazard area. It represents an estimate of areas potentially at threat of inundation by flooding. The data has been developed through a process of drainage sub-basin analysis utilising data sources including 10 m contours, historical flood records, vegetation and soils mapping and satellite imagery. This data represents an initial assessment and will be subject to refinement by respective Local Government Authorities. Of note, it is developed from 10 m contours and is not recommended for use at a scale of less than 1:100,000. Figure 4-3 is significantly less than this at 1:10,000. Further, upon inspection of the dataset, the flood levels represented are in steps of 10 m, starting from 2 m AHD. In the general vicinity of the subject quarry, the flood extent intersects with the 192, 202 and 212 m contours.

The proposed quarry is on topography that varies between 202 m and 212 m AHD. It is important to note that this range is not significantly different to the topographical data error range of 4 m (absolute). The proposed quarry is shown to be covered by the QIFAO flood extent, however, the flood extent at that location on the Belyando River intersects the 202 m AHD contour on the east and west banks. The location of the quarry should in theory be represented as a 'dry island' in the flood extent of both datasets having correct elevations. It can also be shown that there are several other locations in the flood plain that are local high points and should be represented as dry islands. It is understood that due to the interim nature of the QIFAO, that such 'islands' were not delineated and excluded as a matter of course.

Given the characteristics and (intended) coarse nature of the QIFAO flood extent data, it would be unwise and inappropriate to put any reliance on it in an assessment of environment impacts on, or from, the proposed quarry development.

146°36'0"E
146°37'0"E
146°38'0"E
21°56'0"S
21°57'0"S
210 mAHD
205 mAHD
Moray Bullivallah Rd
BHAVANDO RIVER
Moray Bullivallah Road
Moray Carmichael Road
BOWEN
Collinsville
MACKAY
Moranbah
Mackay

Adani Quarry Permits and Approvals
Figure 4-3 Surface water and hydrology

Job: B12849_023-R1_MorayWaterHydro
Date: 13/06/2013

Legend

- Town
- Moray Quarry Access Road
- Proposed Moray Road Re-Alignment
- Carmichael Mine - ML 70441
- Moray Quarry Extraction Area
- Stockpiling and Processing Area
- Flood Prone Area (1 in 100 year)
- Railway
- Proposed Adani Rail Corridor
- Minor Road
- Major Road
- Major watercourse
- Minor watercourse
- Wetland
- Indicative surface water drainage direction

0 250 500
Metres

Data source:
Adani, 2012; DERM, 2010; Flood by QLD Reconstruction Authority, 2012, Elevation created from 1sec SRT DEM, Base Layer by Bingmaps, 2011.

N W E S

CAIRNS
TOWNSVILLE
MOUNT ISA
ROCKHAMPTON
BRISBANE

adani™ CDM Smith cdmsmith.com

4.2.3 Potential Impacts

The quarry has potential for some localised impacts to surface water and hydrology by altering the surface water runoff flows around the quarry workings and into retention dams for reuse on site. The diversion of surface water flows may cause some erosion and sediment movement and possible scouring during large rain events. This will be managed through the installation of erosion and sediment controls outlined in the conceptual erosion and sediment control plan in **Appendix H**.

4.2.4 Aquatic Ecology, Surface Water and Hydrology Management

No major watercourses currently exist within the proposed quarry area, however North Creek is located to the north of the site and the Belyando River to the east. Management measures will be implemented that prevent sediment runoff into these watercourses and maintain the existing environmental conditions.

In order to ensure the appropriate protection of downstream surface waters, the following measures will be in place:

- ESCPs will be implemented for each quarry, prior to the commencement of construction;
- Disturbance areas will be minimised to reduce the volume of disturbed sediment that may potentially effect downstream water bodies;
- Native vegetation clearance will only be undertaken in accordance with relevant permits and approval conditions; and
- Vegetation clearance will consider constraints such as slope and proximity to drainage lines.

Onsite water management will include:

- Details of the water management system, including design criteria, storage capacities, drains and diversion structures; and
- Measures to monitor weather forecasts from the Bureau of Meteorology to plan for potential rainfall events that may hinder construction or operational activities, and management measures to be implemented in the event that a heavy rainfall event is predicted.

4.3 Landscape and Visual Amenity

The landscape consists mainly of remnant sedimentary formations, although granitic intrusions in the form of isolated ranges are also common. Easily eroded cracking clays, with highly dispersive properties due to high sodium content, are also common in the catchment area. Previous clearing of vegetation in the region has caused severe loss of habitat and fragmentation of REs, whilst overgrazing and weed infestations have caused land degradation and reduced soil health in many areas (Roth CH, 2002).

The quarry site generally consists of remnant sedimentary deposits with low lying cleared plains. Vegetation is patchy and irregular and the area has been disturbed by cattle grazing, quarry activities and erosion. The southern portion of the quarry covers a portion of existing remnant vegetation adjacent to Moray Carmichael Road. Infrastructure recorded at the existing quarry site during the field inspection included water and feeding facilities for cattle (see Plate 4-4).

Plate 4-4: Existing water infrastructure onsite

The quarry will be visible to users of the Moray Carmichael Road, however, this will only have temporary impacts as vehicles will be moving along this road. The quarry will be screened from the nearest residents by the Belyando River and associated vegetation which lie between the quarry site and the Moray Downs Homestead. In addition, the topography of the site is as such that the crest of the hill will also shield the quarry workings.

4.3.1 Bushfire Risk Mapping

Bushfire risk mapping has been created for the Isaac region by the Rural Fire Service of Queensland. The most recent mapping (2008) indicates that Moray Quarry site occupies a mixture of 'Low' and 'Medium' category fire-risk areas associated with continuous vegetation located along Belyando River and tributaries. The majority of the site and surrounding area has been cleared in the past and is now largely exotic grassland (Buffel Grass) used for cattle grazing. However, substantial numbers of mature trees remain in the south of the site which remains connected to vegetation directly to the east. The proponent will develop a Fire Risk Management Plan in consultation with Isaac Regional Council and local landowners to minimise any risk of fire as a result of the quarry's activities.

4.3.2 Potential Impacts

During the operation of the quarry over the Carmichael Mine and Rail construction period there is likely to be visual impacts from earth moving and construction vehicles, haulage trucks. Given the short nature of these impacts being limited to the construction period they are not considered significant.

During the night there will be impacts from night lighting for continuous operations for up to three years. With 24 hour operations visual impacts will be predominately more noticeable at night and will be able to be seen from much greater distances. However, no significant impact is considered given the distances to the surrounding homesteads.

4.3.3 Landscape and Visual Amenity Management

The proponent commits to ensuring that the placement of plant and equipment minimises its visibility from the Moray Carmichael Road. Measures to reduce visual impacts include:

- Retain appropriate screening and landscape buffers between public vantage points and surrounding homesteads;
- Minimise clearing between the site and the Moray Carmichael Road;
- Undertake progress rehabilitation to minimise visual impacts of the site; and
- Consultation with potentially affected sensitive receptors.

4.3.3.1 Management of Lighting Impacts

Only essential lighting will be included in the development. Throughout the construction phase, night lighting will be limited to specific construction activities and safety. Lighting will be required for the operation of the quarry over the 24 hour period, lighting will be provided at the site office and amenities area as well as on the working area of the quarry. Main access routes will be identified and illuminated appropriately.

Lighting design will comply with the best available technologies (i.e. Type 6 luminaires) and include light shrouding techniques (i.e. be well shielded, full cut-off and downward directed type fixtures). Luminaires will be mounted low in the vertical plane and use the lowest intensity for the task. Surfaces of structure and ground covering will be designed to minimise reflection.

To ensure lighting management measures are complied with, periodic visual inspections, audits and corrective management of light sources will be undertaken.

4.4 Soils, Geology and Topography

4.4.1 Geology and Topography

The proposed Moray Quarry area is located within Late Devonian – Early Carboniferous Drummond Basin, which predominantly comprises a thick succession of sedimentary and volcano-lithic rocks. The geological profile of the basin generally comprises sedimentary and volcano-lithic sediments of the Drummond Group, divided into numerous formations that range in age from Late Devonian to Early Tertiary.

Present on the western part of the Drummond Basin are sedimentary formations of the overlying Bowen Basin. Overlying these formations are predominantly colluvial and alluvial Tertiary deposits, some of which feature deep weathering profiles resulting in the formation of duricrusts and silcrete deposits. The Tertiary deposits are overlain with predominantly unconsolidated alluvial deposits of Quaternary age. In sporadic locations throughout the Drummond Basin, granitoid intrusions, as well as basal rocks of the Anakie Metamorphic Group are present as outcrops. The presence of these older rocks indicates partial to complete erosion of the overlying strata. A detailed stratigraphy of the Drummond Basin is provided in Figure 4-4.

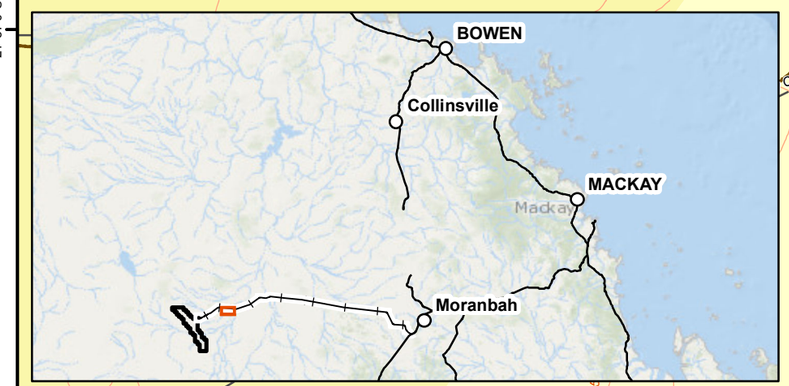
Structurally, the Drummond Basin comprises several anticline and synclines, as well as faults, most of which are responses to orogenic movements (Buchanan Geology Notes). The main folding episode in the Drummond Basin was at the end of the Lower Carboniferous age, as a result of the uplift of Anakie Inlier, which marks the basement of the basin. Other orogenic movements resulting in structural deformation include granitoid intrusions and acid volcanic extrusion (Buchanan Geology notes). In places little evidence of these structures remain, as they have been masked by Quaternary alluvial deposits.

Figure 4-4 Detailed Stratigraphy (Olgers, 1970)

Age		Rock unit and map symbol	Thickness (feet)	Lithology	Palaeontology	Stratigraphic Relationships	Environment of deposition
CAINOZOIC	QUATERNARY	(Qa)	0–50	Silt, sand, gravel, alluvium			Fluvial
		(Qs)	Superficial	Sand, sandy soil, colluvium		Unconformable on all older rocks	Aeolian/fluvial
		(Cz)	Superficial	Soil, sand, gravel			In situ weathering, aeolian and fluvial
		(Czd)	Superficial	Silcrete, ferricrete (duricrust)		Best developed on Tertiary in NE and on Moolayember Form.	Weathering profile
	TERTIARY	(T)	0–30	Poorly sorted argillaceous sandstone, commonly lateritized.		Unconformable on all other rocks	Mainly fluvial with piedmont deposits near the hills and ranges.
MESOZOIC	JURASSIC TO LOWER CRETACEOUS	Ronlow Beds (J/Kr)	200–300	Sandstone, dominantly quartz sandstone. Minor mudstone and siltstone	Silicified wood, plant debris. Microspores and pollens	Disconformable on Moolayember Form. Elsewhere ?disconformable under Walumbilla Form. Probably equivalent of Hutton Sst–Hooray Sdst sequence elsewhere in Eromanga Basin.	Fluviatile deposition in rivers, on floodplains, and local lakes
	MIDDLE TO UPPER TRIASSIC	Moolayember Formation (Rm)	1000±	Dominantly mudstone and siltstone, interbeds of lithic sandstone and quartz sandstone	Poorly preserved plants (White, 1965). Microspores.	Conformable on the Warang Sst. Boundary gradational	Freshwater basin.
	LOWER TRIASSIC	Warang Sandstone (Rlw)	600	Kaolinitic quartz sandstone, minor lenticular ferruginous siltstone. Large scale trough cross-bedding	Unfossiliferous. Spores elsewhere	Disconformable on Rewan Form.; equivalent to Dunda Beds and Clematis Sst. in south. Unconformable on Betts Creek Beds and Unit C-P	Fluvial and aeolian
		Dunda Beds (Rld)	250±	Lithic to quartz sandstone with subordinate thick intervals of mudstone and siltstone	Plant fossils in Galilee Sheet area (White, 1965)	Probably disconformable on Rewan Form.	Fluvial
		Rewan Formation (Rlr)	Subsurface only. 1058 in Exoil Lake Galilee No. 1 Well 12m south of Sheet area	Subsurface only. Lithic sandstone, mudstone, shale, siltstone, minor quartz sandstone in neighbouring areas.	Spores and plant remains elsewhere.	Possibly conformable on Betts Creek Beds subsurface.	Fluvial and possibly deltaic
PALAEOZOIC	UPPER PERMIAN	Betts Creek Beds (Pub)	200+	Interbedded feldspathic lithic sandstone; commonly carbonaceous. Coal recorded in subsurface. Minor conglomerate lenses. Sandstone thin-to thick-bedded, commonly trough cross-stratified.	Mainly poorly preserved plant fragments (White, 1965).	Unconformable on C-P	Mainly fluvial, some swamp deposits
	UPPER CARBONIFEROUS TO LOWER PERMIAN	(C-P)	5000±	One small outcrop of lithic sandstone at White Cliffs. Elsewhere conglomerate, sandstone, siltstone, mudstone, coal.	Indeterminable plant material	Unconformable between Drummond Basin sequence, and Betts Creek Beds and Warang Sst.	Swamp, fluvial, glacial and fluvio-glacial.
	LOWER CARBONIFEROUS	Drummond Group: Natal Formation (Cln)	4000+	Alternating sequence of fine feldspathic quartz sandstone, olive siltstone and mudstone; concretions are common.	Poorly preserved plant material	Conformable on Bulliwallah Form.	Shallow freshwater.
		Drummond Group: Bulliwallah Formation (Clb)	6000	Thin to thick bedded, fine to medium feldspathic quartz sandstone; minor olive mudstone, pebbly feldspathic quartz sandstone and algal limestone.	Poorly preserved plant fossils; algae .	Conformable on Star of Hope Form.	Shallow freshwater.
		Drummond Group: Star of Hope Formation (Cls)	2000	Lapilli tuff, welded tuff, tuffaceous sandstone, minor acid flows; volcanolithic sandstone; quartz pebbly sandstone and conglomerate.	Plants (White, 1967).	Conformable on Raymond Form.	Fluvial and terrestrial.
		Drummond Group: Raymond Formation	3500	Fine to medium quartz sandstone, locally feldspathic; minor interbeds of clayey sandstone and mudstone.	Plants (White, 1967).	Conformable on Mount Hall Form.	Fluvial (mainly flood plain).
		Drummond Group: Mount Hall Formation (Clh)	9000±	Cross-bedded pebbly and conglomeratic quartz sandstone, coarse quartz sandstone. Minor mudstone and lithic sandstone.	Wood fragments	Conformable on Scartwater Form.	Fluvial (mainly point bar).
	UPPER DEVONIAN TO LOWER CARBONIFEROUS	Drummond Group: Scartwater Formation (D/Cw)	4000+	Fine feldspathic sandstone with interbeds of calcarenite, algal limestone, olive mudstone, lithic tuff and tuff.	Plants (White, 1967).	Probably conformable on Llanarth Volcanics and unconformable on Saint Anns Form. and Ukalunda Beds	Fluvial
		Drummond Group: Llanarth Volcanic Member (D/Cl)	3200	Dominantly fine tuff. Some thin acid flows and locally at the base volcanolithic sandstone and conglomerate.	Plants (White, 1967)	Overlapped by Scartwater Form. north of Saint Anns homestead.	Shallow water and terrestrial
		Saint Anns Formation (D/Ca)	2400	Acid and intermediate flows, crystal tuff and lapilli tuff and algal limestone at top. Arkosic, feldspathic and lithic sandstone, conglomerate minor green mudstone and phosphatic sandstone.	Plants (White, 1967); Algae and worm casts.	Unconformable on Ukalunda Beds	Shallow water, possibly partly marine; the upper volcanic part of the unit may be terrestrial.
		Silver Hills Volcanics (D/Cs)	2000+	Rhyolite, breccia, crystal lithic tuff, fine tuff.		Probably unconformable on Anakie Metamorphics.	Probably largely terrestrial.
	MIDDLE DEVONIAN	Ukalunda Beds (Dk)		Lithic and feldspathic sandstone, siltstone, schist, slate, phyllite. Richly fossiliferous limestone in area to the east.	Rich marine fauna elsewhere (Malone et al., 1966).	Unconformable on Anakie Metamorphics.	At least partly marine.
	PRE-DEVONIAN	Anakie Metamorphics (Pza)		Schist, slate, phyllite, sandstone, shale.	Algae elsewhere (Malone et al., 1965).	Oldest unit in the area.	

146°34'0"E
146°36'0"E
146°38'0"E
21°55'0"S
21°56'0"S
21°57'0"S

Qpa
Qa
W
Ts
205 mAHD
210 mAHD
12030085
Moray Sullivallan Road
BELYANDO RIVER
Moray Carmichael Road
Carmichael Boundary Road



Adani Quarry Permits and Approvals
Figure 4-5 Geology and topography

Legend

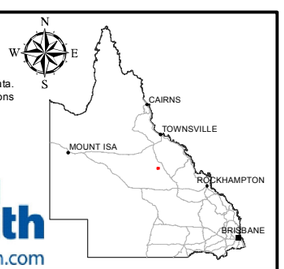
- Groundwater Bore Location
- Carmichael Mine - ML 70441
- Moray Quarry Extraction Area
- Stockpiling and Processing Area
- Moray Quarry Access Road
- Proposed Moray Road Re-Alignment
- Proposed Adani Rail Corridor
- Minor Road
- Major watercourse
- Minor watercourse

Geology

- Water body (unspecified)
- Qa-QLD
- Qpa-QLD
- Ts-QLD

0 500 1,000
Metres

Data source:
Adani, 2012; Geology from DME, 2012; Elevation created from 1sec SRTM DEM; GW bores by GHD, 2011, DERM, 2010.



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Date: 13/06/2013

Regionally, the Moray Quarry area features topographical highs of approximately 205-212 m AHD to the north, south, east and west that is located between low-lying plains (<205 m AHD) associated with major drainage lines. Consequently, the surficial geology is dominated by alluvial deposits within the low-lying areas, predominantly to the south, comprising Quaternary-aged alluvium floodplain deposits consisting of clay, silt, sand and gravel associated with Belyando River. Tertiary-aged sedimentary deposits comprising clayey sub-labile to quartzose sandstone, sandy claystone, laminated siltstone and minor conglomerate are predominant in areas closer to the topographical highs, located as a pocket immediately south the proposed quarry area and areas further east of the quarry area.

Closer to the Moray Quarry area, the local geology comprises Tertiary-aged sedimentary deposits within topographical highs (~205 m AHD) that grade to alluvial deposits associated with floodplains and floodplains of high terraces to the west and east.

As the geology of the Moray Quarry area consists predominantly of sub-labile to quartzose sandstones, potentially large yields of suitable quarry materials are present. Rock will be extracted from the proposed quarry area using a small bulldozer and excavator to retain the engineering integrity of the rock. The rock will be of low to moderate strength and should be capable of producing material of CBR 15+ standard.

4.4.2 Soils

The Geological Survey of Queensland Interactive Resource Tenure Map broadly defines the soils regional to the Moray Quarry area to comprise red massive earths, associated with undulating lands with high gravelly ridges. These soil classifications are primarily based on desktop level interpretation of available geological, aerial and geomorphological information due to a lack of physical mapping at the local scale.

A more recent EIS conducted by GHD (GHD, 2012) provided an assessment of the potential soils likely to be present within the Carmichael Rail corridor. The assessment was based on existing soil and land system information provided by Australian Natural Resource Atlas (ANRA) website (http://www.anra.gov.au/topics/soils/overview/qld/html). The ANRA soil classification is based on two mapping forms:

- Land systems – repeating patterns of soils, vegetation, geology and geomorphology that provide broad statements of dominant soils or vegetation types, land condition and potential land capability; and
- Soils mapping – focuses on predominant soils type or soil association at a smaller scale that provide information on soil types and proportions, land qualities and land suitability. Refer to GHD (2012) report for further information.

A similar type of mapping tool established by Department of Primary Industries (DPI) was used for establishing the soil type/s that is potentially present within the proposed quarry area.

The Central Queensland area, prior to the recent boom in mining activity has historically been primarily worked for agricultural/pastoral purposes, and consequently meaningful information on soils is available from land management studies undertaken for the area. The DPI has undertaken land management studies aimed at identifying and grouping areas with similar physico-geographical and pedological properties directed towards sustainable development. DPI groups areas at a local scale into two divisions according to land management requirements for specific land types; Land Resource Area (LRA) and Agricultural Management Unit (AMU). LRA are broad landscape units that has been mapped and grouped for different soils developed from related

geological units with recurring patterns of topography and vegetation. AMU further separates the LRA units into groups of soil with similar landforms, vegetation and agricultural potential that require similar management requirements. Each LRA can contain multiple AMUs.

This tool was adopted by CDM Smith, as each identified soil unit/s is complemented with a summary sheet that identifies common properties including a generalised lithological profile and photo, limitations and management recommendations for each soil type, group as AMU (**Appendix F**).

The Moray Quarry area falls within the Central Highlands, which at a regional scale (within 5 km) comprises three LRAs. Each LRA, in turn comprises of numerous AMUs. Given that AMUs provide a better description of the productivity potential of the land, it allows a better assessment of the potential impacts that may arise as a result of soil disturbance and further allows the development of appropriate safeguards to return the land to productivity, following disturbance.

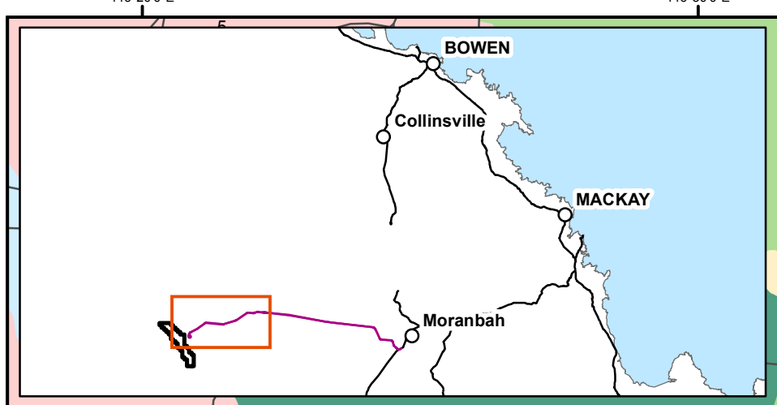
Table 4-3 provides a summary of the common AMUs associated with each LRA for areas regional to the Moray Quarry area. Description of each AMU is provided in Table 4-4, which shows that the dominant flora type together with surface soils can be used as relatively quick field guide to identify the types of soils present in the area.

Table 4-3 Relationship of AMUs to LRAs for Moray Quarry area, Central Highlands.

LRA	AMUs	
	Major Occurrence	Minor Occurrence
LRA 1: Alluvial Plains	Adelong, Moramana, College	Dooruna, Issac, Lascelles, Lonesome, Rolleston, Turkey Creek
LRA 2: Undulating Scrub Plains	Rolleston, Picardy, Springton, Turkey Creek, Glengallan, Glen Idol	Adelog, Lonesome
LRA 5: Plateaus	Duckponds	Glen Idol, Highlands, Lascelles

Locally, the Moray Quarry encompasses an area classed as LRA 1 (Figure 4-6). Table 4-3 identifies that numerous AMUs, and hence soil types are present within the area. Table 4-4 indicates that pockets of different soils exist locally, which is significantly different to the desktop based tenure maps (Figure 4-6). According to Table 4-4, dominant soil types present local to the Moray Quarry area include:

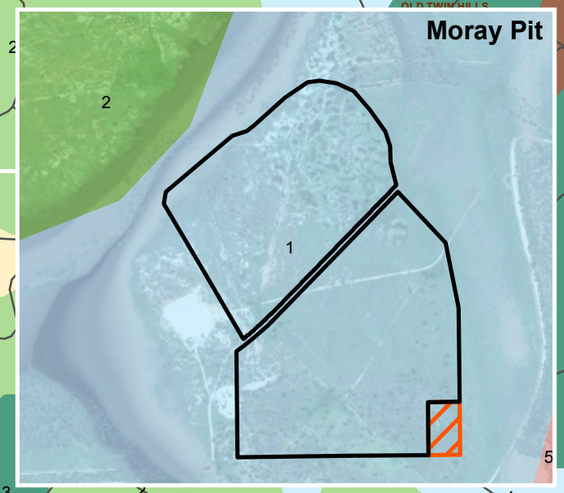
- Uniform clays – non-cracking to heavy cracking with potentially a sandy crust and variable quantity of mulch;
- Duplex soils – hard setting sandy loams; and
- Deep uniform sandy materials – loose to firm and predominant in sand.



LRA*	LANDFORM	SOILS	VEGETATION	LAND USE
Alluvial Plains 1	Level plains on Quaternary alluvium	Alluvial cracking clays, non-cracking clays and solodic soils; minor red and yellow earths, loams and sands. **Major AMUs:** Adelong, Moramana, College **Minor AMUs:** Dooruna, Isaac, Lascelles, Lonesome, Rolleston, Turkey Creek	Eucalypt woodlands with poplar box and coolibah; minor brigalow and brigalow-gidgee scrub	Rainfed and irrigated cropping; grazing on native and sown pastures
Undulating Scrub Plains 2	Undulating plains and rises developed on sedimentary rocks, Tertiary basalt and unconsolidated sediments	Cracking clays, solodic soils, red-brown earths, non-cracking clays and structured earths **Major AMUs:** Rolleston, Picarrdy, Springton, Turkey Creek, Glengallan,Glen Idol **Minor AMUs:** Adelong, Lonesome	Brigalow, bonewood, blackwood and gidgee scrubs; minor communities of poplar box, belah and Dawson gum	Rainfed cropping; grazing on sown pastures; minor irrigated cropping
Eucalypt Duplex Plains 3	Gently undulating plains to low hills on weathered shale and sandstone; minor granite and basalt influences	Mainly solodic soils with minor red-brown earths, non-calcic brown soils and sands **Major AMUs:** Lascelles, Duckponds **Minor AMUs:** Glengallan, Turkey Creek, Glen Idol	Woodlands of poplar box, silver leaved ironbark and narrow leaved ironbark	Grazing on native pastures; minor rainfed cropping; minor irrigated horticulture

LRA*	LANDFORM	SOILS	VEGETATION	LAND USE
Undulating Downs 4	Gently undulating plains formed on Tertiary basalt, Permian shales, sandstone and unconsolidated sediments	Black, brown and grey cracking clays, shallow to moderately deep cracking and non-cracking clays; frequent stony phases **Major AMUs:** Orion, Jimbaroo **Minor AMUs:** Kia-Ora, Glen Idol, Moramana	Dense ground cover of blue grasses and mitchell grasses; minor components of flinders, white and black spear and wire grasses interspersed with open woodlands of mountain coolibah; minor bloodwoods and silver leaved ironbark	Rainfed cropping and grazing on native pastures; minor irrigated cropping
Plateaus 5	Very gently undulating plateaus, plains and fans developed on Tertiary sediments	Red and yellow earths; minor solodic soils and deep sands **Major AMU:** Duckponds **Minor AMUs:** Glen Idol, Highlands, Lascelles	Woodlands of silver leaved ironbark, narrow leaved ironbark, bloodwoods, ghost gum, minor yellowjack groves; midstorey of desert oak and wattles	Grazing on native pastures
Ranges 6	Undulating to very steep hills, mountains and occasional mesas formed on sedimentary rocks, metamorphics and minor volcanics	Stony lithosols, shallow sands and loams, minor red and yellow earths, red-brown earths, non-calcic brown soils and solodic soils **Major AMU:** Highlands **Minor AMUs:** Glen Idol, Lascelles	Woodlands of narrow leaved ironbark, silver leaved ironbark, ghost gum; occasional bendee, lancewood or cypress pine scrub; associated zamia palms and *acacia* spp;	Grazing on native pastures

* Land Resource Area



Adani Quarry Permits and Approvals
Figure 4-6 Land Resource Areas

Legend

- Town
- Homestead
- Carmichael Mine - ML 70441
- Moray Quarry Extraction Area
- Stockpiling and Processing Area
- Proposed Adani Rail Corridor
- Minor Road
- Major Road
- Railway
- Major watercourse
- Minor watercourse

0 2,500 5,000
Metres

Data source:
Adani, 2012;
DERM, 2010;
Base Layer by Bingmaps, 2011.

adani™ CDM Smith cdmsmith.com

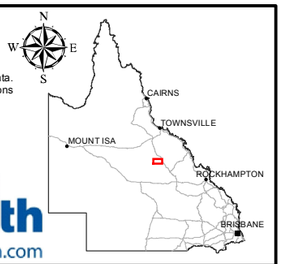


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Table 4-4 Description of Agricultural Management Units regional to the Moray Quarry area

LRA	General Soil Type	AMU	Soil Surface/Description	Distinguishing Features
LRA 1 Alluvial Plains	Uniform Clays	Adelong	Heavy cracking clay with strong but thin (~ 2 mm) mulch; may have thin sandy crust	Dark, uniform and deep (>90 cm) heavy clays on flat to gently undulating floodplains. Dense brigalow, coolabah scrub. Shallow gilgai can also occur
		Moramana	Medium cracking clay with finer and deeper (2-5 mm) mulch than above	Deep reddish brown to grey clay under open coolabah. Well drained. Commonly river deposited material associated with basaltic or shale downs. Shallow gilgai can occur
		College	Cracking and non-cracking grey to brown clay with a sandy crust, a coarse mulch or hard setting surface. Severe surface and/or sub-soil physical limitations indicated by prolonged water logging, regularly water stressed plants, or bare areas. Very coarse surface mulch or crust	Open woodlands of poplar box, brigalow and bauhinia with associated species. May have restricted depth due to gravel layering or high salinity below 50 cm depth. Differs from ROLLESTON AMU in severity of physical restrictions of plant growth.
		Dooruna		Open grassland with isolated, severely stunted brigalow clumps. High salinity below 30 cm and acidic below 50 cm. Restricted occurrence to an area north of Kilcummin
		Rolleston	Deep clays (>90 cm), with typical vegetation of whipstick or moderately stunted brigalow and eucalyptus (mainly Dawson Gum). Subsoils are normally pale coloured and mottled below 60 cm. Drainage is restricted. Surface gravel can occur	Gilgai either absent or less than 40 cm deep
		Lonesome		Gilgai more than 40 cm deep
	Duplex soils	Lascelles	Sandy loam, hard setting	Pale grey to brown, moderately deep (20 to 45 cm to clay) sandy loam surface overlies very hard, coarse and mottled clay subsoils. Very poorly drained, and a bleached soil layer above the clay is common. Open box, ironbark woodlands with associated brigalow, currant bush and others.
		Isaac		Deep sandy loam surface soil (>45 cm to clay)
		Turkey Creek		A thin sandy surface layer (<10 cm) overlying deep, moderately well drained grey or brown clay. Tall brigalow, belah and Dawson Gum are common. Forms a uniform clay with a sandy clay surface following cultivation.
	Deep Uniform sandy soils	Isaac	Loose, coarse sandy to firm	Tall open blue gum, Moreton Bay ash forest with associated species. Deep sandy loams
LRA 2 Undulating Scrub Plains	Uniform clays	Adelong	Heavy cracking clay with a strong but thin (about 2 mm) mulch; may have thin sandy crust	Dark, uniform and deep (more than 90 cm) heavy clays on flat to gently undulating floodplains. Dense brigalow, coolabah scrub. Shallow gilgai can occur

LRA	General Soil Type	AMU	Soil Surface/Description	Distinguishing Features
		Picardy	Cracking and forming a fine, 'soft' mulch	Red, brown to dark grey soils under gidgee, brigalow and softwood scrub. Deep (more than 90 cm), well structured clays often shallow gilgai less than 40 cm deep
		Rolleston	Cracking or non-cracking with sandy crust, coarse mulch or hard setting surface	Grey, brown heavy clays typically under whipstick or slightly stunted brigalow scrub with associated eucalyptus (mainly Dawson Gum) and a range of understorey species. Subsoils are pale coloured and often mottled below 60 cm depth. Drainage is restricted – GILGAI ABSENT OR LESS THAN 40 CM DEEP
		Lonesome		Grey, brown heavy clays typically under whipstick or slightly stunted brigalow scrub with associated eucalyptus (mainly Dawson Gum) and a range of understorey species. Subsoils are pale coloured and often mottled below 60 cm depth. Drainage is restricted – GILGAI MORE THAN 40 CM DEEP
		Springton		Mainly reddish brown to brown often non-cracking and gravelly clay. Distinctive coarse-structured subsoil at 30 cm depth which is indicated by surface waterlogging and reduced water storage capacity (i.e. regularly water stressed plants). Soil depth is greater than 45 cm but often less than 90 cm to rock or gravel. Vegetation commonly brigalow, Dawson Gum, bendee or gidgee scrub
	Duplex Soils	Glengallan	Sandy loam, hard	Pale grey to brown shallow sandy loam surface (<20 cm to clay) overlies very hard, coarse and mottled clay subsoils. Very poorly drained, and a bleached soil layer above the clay is common. Open box, ironbark woodlands with associated brigalow, currant bush and others
		Glenidol		Reddish brown sandy loam to clay loam overlies moderately well drained (i.e. few mottles) clay subsoils. Open ironbark, brigalow or box with associated species
		Turkey Creek		A thin sandy duplex soil under brigalow, Dawson Gum scrub. After cultivation, a sandy clay surface plough layer to 20 cm forms.
LRA 5 – Plateaus	Duplex Soils	Duckponds	Hard setting to firm.	The depth of the sandy loam layer to clay is the distinguishing feature: >45 cm to clay or gravel
		Lascelles		The depth of the sandy loam layer to clay is the distinguishing feature: Between 20 and 45 cm to clay or gravel
		Glen Idol		Reddish brown sandy loam to clay loam overlying moderately well drained (i.e. few mottles) clay subsoils. Open ironbark, brigalow or box with associated species
	Deep uniform sandy soils	Duckponds	Loose to firm	Sandy and uniform >45 cm deep. Tall bloodwood, ironbark, cypress pine and a range of associated species
	Shallow, rocky soils	Highlands	Rocky, gravelly or sandy	Includes the range of shallow, rocky and infertile soils associated with dissected ranges and plateaus

Typical constraints which result from the physical properties of soil types that are potentially present locally to the quarry area are detailed in Table 4-5. A summary of each AMU is provided in **Appendix F**, which details the physical properties of the soils and identifies typical constraints and safeguards for their disturbance.

Table 4-5 Potential constraints of soils from Moray Quarry area.

Soil Type	AMUs	Potential Constraints
Uniform clays	Adelong, Picardy, Rolleston, Lonesome and Springton	Water logging; Medium to high erosion potential; Salinity potential for surface and/or sub-soils
Duplex soils	Glengallan, Glen Idol, Turkey Creek, Lascelles and Duckpond	Hard setting; Medium to extremely high erosion potential; Infertility; Potentially sodic sub-soil; Generally poorly drained with the exception of DUCKPOND and GLEN IDOL AMU which are well drained and exhibit high infiltration and therefore are sensitive to groundwater recharge
Deep uniform sandy materials	Isaac and Duckponds	well drained and exhibit high infiltration and therefore are sensitive to groundwater recharge

4.4.3 Potential Impacts

The potential impacts to the soils, geology and topography include:

- Increased risk of erosion and sediment movement from clearing vegetation, alterations to drainage patterns and stormwater flows, excavation and stockpiling of material and operating during high rain fall events. The impacts from erosion and sediment movement are predicted to be localised and remediated during the rehabilitation process;
- Erosion as a result of sodic soils;
- Sediment movement arising from hard setting, water logged or erosive soils;
- Areas dominated by gravelly and sandy materials are likely to exhibit high infiltration rates and therefore be sensitive to groundwater recharge for potential contaminants (e.g. refuelling, spills and leaks) if a groundwater aquifer within alluvium materials exists;
- Deeper groundwater aquifers, if present, within the sedimentary rocks (Tertiary deposits) may also be at risk if the deeper aquifer is in hydraulic connection with the alluvium aquifer;
- Localised salinity hotspots, as a result of vegetation removal;
- Loss of topsoil that may contribute to soil infertility during rehabilitation; and
- Localised changes to landform as an unavoidable result of the extraction of material.

4.4.4 Management of Soils, Geology and Topography

The objective of management of soils, geology and topography will be to ensure:

- Appropriate soil conservation practices are planned and implemented;
- Creation of stable post-construction landforms; and
- Installation of controls in accordance with the Erosion and Sediment Control Plan (ESCP) and International Erosion Control Association (IECA) guideline requirements.

Loss of topsoil and to a lesser extent subsoil from the construction area is important in terms of rehabilitation success. Topsoil is the most valuable resource in relation to rehabilitation and needs to be retained on site and in a good re-usable condition (GHD, November 2012).

A conceptual ESCP has been prepared by a suitable qualified professional (**Appendix H**) and has included the following, as a minimum:

- Site water will be directed into water storage dams for use on site; off site water will be diverted away from the site to keep water clean;
- Measures to limit the area of disturbance and progressively clear areas immediately before construction;
- Minimises the period soils are left exposed during construction;
- Quarry material stockpiles will have silt fences or established bunds installed on the downstream side, and diversion bunds on the upstream side; and
- Placement of sediment traps and silt fences to minimise off site impacts.

Onsite implementation measures also to be implemented include:

- Processes to maintain a site monitoring program to assess erosion control measures;
- Areas of identified dispersive soils shall be closely monitored to assess the efficacy of the erosion control measures and progressive land rehabilitation works will be undertaken where land is disturbed as use of those areas ceases. Regrading will be undertaken post disturbance to produce slopes that are suitable for the proposed land use;
- Strip and stockpile topsoil for rehabilitation, specifically for areas where low fertility soils exist;
- Addition of gypsum to any sodic subsoils for rehabilitation success;
- Records will be maintained of stripped material to ensure usable soils are retained and logs of stockpiles and kept to reconcile predicted and actual soil volumes; and
- Reprofile the land to match the surroundings and reinstate pre-existing natural drainage flows and pathways.

Fossils

Although no evidence of fossils has been noted in the proposed quarry area, it is acknowledged that sedimentary settings similar to those associated with the quarry site preserve fossiliferous records. If any unique or scientifically important fossil specimens are uncovered, the quarry

operator will consult with the Queensland Museum regarding the find. Work will avoid the find area until advice is received from the Queensland Museum.

4.5 Groundwater

4.5.1 Existing Environment

The proposed Moray Quarry site falls within the Burdekin Basin Catchment, where the *Water Resource (Burdekin Basin) Plan 2007* (WRP) and *Burdekin Basin Resource Operations Plan 2010*, apply. The WRP for the Burdekin Basin Catchment does not have management requirements for groundwater.

4.5.1.1 Bowen Unincorporated Area Groundwater Resource Area

Groundwater management units (GMUs) have been identified for the whole of Australia as part of the Australian Water Resources Assessment 2000 (DSEWPaC, 2009). The assessment forms part of the *2000-2002 National Land and Water Resource Audit*. The Moray Quarry is located within the Unincorporated Area (UA) – Bowen Basin Groundwater Management Units, referred to as the Bowen UA.

The major aquifers within the Bowen UA are Quaternary-aged alluvium, the sand and gravel horizons of the Tertiary-aged sediments and the Tertiary-aged basalts(Australian Government, 2009). The majority of groundwater can be defined as marginal quality; however, supplies of good quality groundwater are common from the alluvial and basalt aquifers. Poorer quality groundwater is typical of the coal bearing strata particularly in the Bowen Basin Stratigraphy. The achievable bore yields are generally below 5 litres per second (L/s) and consequently most groundwater development would be limited to stock and domestic supplies(GHD, 2012).

Aquifers within the Bowen UA are generally utilised for pastoral, irrigation, mining, stock and domestic, and town water. Increased irrigation, developments in the local coal industry and increased mining activity in the gem fields have resulted in recent increases to groundwater demands(Australian Government, 2009). Despite this, the groundwater resources in the Bowen UA are not heavily exploited and the Bowen UA is not considered a major priority and therefore does not require active management in the form of a resource plan (SEWPaC, 2009).

4.5.1.2 Hydrostratigraphic Units

Based on the analysis of existing borehole logs and geological map the following hydrostratigraphic units are delineated beneath and within the vicinity of the Moray Quarry:

- Unconsolidated Sediments –comprising unconsolidated alluvim, colluvium and miscellaneous sediments of Quaternary to Tertiary age. Colluvium is mapped on the slopes and toward the base of the outcropping units and alluvial deposits dominate the low-lying areas along existing creeks and drainage lines; and
- Bedrock – dominated by Tertiary, Carboniferous and Permian sedimentary rocks and a number of outcropping igneous volcanic and metamorphic units. The bedrock is interpreted as a fractured rock aquifer.

The shallow Quaternary alluvium (Qa and Qpa in Figure 4-5) follows the major rivers, creeks and drainage lines, including Belyando River, Carmichael River and North Creek (Figure 4-3). Borehole logs from several registered bores constructed in the Quaternary alluvium are available within the vicinity of the Moray Quarry. These include RN 12030085, located within the quarry area and

RN 12030086, 12030087, 12030088 and 12030089, located approximately 4 to 7 km south-east to east of the quarry. The borehole logs indicate at least 23 m of alluvium at RN 12030085 and 54.4 m at RN 12030089. The latter is located closer to the Belyando River and provides a better indication of the thickness of alluvium.

Depths to the top of Tertiary sediments and bedrock in the broader, Carmichael Coal Mine and Rail Project area presented in GHD (2012) are based on limited borehole data from NRM Groundwater Database. The data indicate depth to the top of Tertiary sediments and Carboniferous bedrock to be 35.6 to 60 meters below ground level (mbgl) and 39 to 96 mbgl respectively.

4.5.1.3 Groundwater Users and Bores

A search of the Queensland NRM Groundwater database (2012) identified six registered bores within a 10 km buffer surrounding the quarry site, of which five are abandoned and one is an unknown water bore located 7 to 8 km south-east of the site. The bore locations are shown in Figure 4-5. Table 4-6 outlines all the registered bores within 10 km of the Moray Quarry site.

Table 4-6 Groundwater Bore Details within 10 km of Quarry site

Registered Number (RN)	Type	Distance from Quarry	Depth to water (SWL)	Target Aquifer and other information
12030085	Abandoned sub-artesian monitoring bore, but still useable.	On site	12.22 mbgl	Belyando River Alluvium.
132303	Abandoned and destroyed	6 km north east	N/a	Drilled in 2003 for water supply but abandoned and destroyed.
12030087	Abandoned sub artesian monitoring bore, but still useable.	4.5 km south east	dry	Drilled in 1975 and constructed in Belyando River Alluvium. Dry.
12030086	Abandoned sub artesian monitoring bore, but still useable.	4.5 km south east	dry	Drilled in 1975 and constructed in Belyando River Alluvium. Dry.
12030088	Abandoned sub artesian monitoring bore.	5 km east	dry	Drilled in 1975 and constructed in Belyando River Alluvium. Dry.
12030089	Existing water resource investigation bore.	7 km east	11.3 mbgl	Drilled in 1975 and constructed in Belyando River Alluvium.

There are also two active water supply bores, RN 17983 and 90368, located 10 km to the west of the quarry, latter of which is screened in the Tertiary sediments with a recorded yield of 3.9L/s.

It should be noted that prior to 1998 there was no requirement for registration of private bores. Therefore, additional water supply bores may exist within the quarry area and the surrounds that have not been identified in this desktop review.

4.5.1.4 Aquifer Properties and Bore Yield

No aquifer properties and bore yield data is available within the quarry area. The nearest registered bore with yield data is RN 90368, with a recorded yield of 3.9 L/s from the Tertiary sediments. The bore yield data from the broader Carmichael Coal Mine and Rail Project area are summarised in GHD (2012) and generally indicate yield of less than 5 L/s, which is typical for the Bowen UA. There is one registered bore, RN 30176, with a recorded yield of 11 L/s. This is an

abandoned and destroyed water supply bore located approximately 10 km west of the Moray Quarry and installed within the bedrock.

4.5.1.5 Groundwater Flow Regime

Bore RN 12030085 is located within the area and has a depth to water reading of 12.2 mbgl (NRM, 2010). This is comparable to depth to water of 11.3 mbgl and 15 mbgl recorded at R 12030085 and RN 90368, located approximately 7 km east and 10 km west of the Moray Quarry, respectively. These data from the Groundwater Database (NRM, 2012) suggest that the alluvium along the Belyando River is saturated to some depth, with depth to water likely to be shallowest below the invert of the river and associated drainage lines.

Episodic rainfall and runoff events, especially those that cause flooding along the creeks, are likely to supply recharge to the water table along the creeks and drainage lines. Therefore, during these wet periods, the creeks function as losing streams and the groundwater system receives recharge. During longer dry periods, transpiration by vegetation and potential evaporation of shallow groundwater along creeks and drainage lines would discharge groundwater back to the atmosphere. Regionally, the water table is likely to follow the regional topography with groundwater flowing away from the quarry area towards the Belyando River and its tributaries. Site specific data will be required to ascertain the groundwater flow direction and elevation of the water table within the quarry area.

As part of the Carmichael Coal Mine and Rail EIS, GHD (2012) bore hydrographs were prepared for registered bores in Project (Rail) Section 2 and Project (Rail) Section 3, located to the north and north-east of the Moray Quarry. The hydrographs indicate that the water levels in the bedrock aquifer (Anakie Metamorphics, the Mt Hall Formation and the Suttor Formation) have remained relatively static and have not responded to seasonal variations in rainfall. This is consistent with the interpretation that most of the rainfall induced recharge is likely to be occurring along the existing creeks and drainage lines via alluvium, with some recharge potentially occurring over parts of the bedrock albeit at reduced rates. Depth to water in the bedrock aquifer is variable and ranges from 27 to 61 mbgl, based on the available groundwater level data within the Carmichael Coal Mine and Rail Project area (GHD, 2012).

4.5.1.6 Groundwater Dependant Springs

According to the Springs of Queensland dataset (EPA, 2005) there are no reported spring complexes within the surrounding area. The nearest springs are the Doongmabulla Springs, which are listed under the Directory of Important wetlands and located approximately 44 km west from the Moray Quarry.

4.5.1.7 Groundwater Dependant Ecosystem

The National Atlas of Groundwater Dependent Ecosystems (GDE) Atlas (BOM, 2013) presents the current knowledge of GDEs across Australia, and shows known GDEs as well as ecosystems that potentially use groundwater. No GDEs have been identified in the quarry area through previous field or desktop investigations; however, the southern portion of the quarry area and Belyando River to the east have been identified as areas with high potential to support groundwater dependent vegetation. Aerial photos show areas of denser vegetation along the Belyando River where high potential for GDEs has been identified.

GHD (2012) indicates that the Belyando River typically sustains flow for several months after rainfall ceases such that in some parts of the river permanent water holes are maintained and some base-flow occurs, albeit at highly reduced rates during dry periods. On the basis of this

evidence, GHD (2012) suggests that vegetation within the riparian zone is likely to be groundwater dependent to some degree, which is also consistent with the GDE Atlas.

4.5.1.8 Groundwater Quality

No groundwater quality data within the quarry area are available. Limited groundwater quality data, primarily electrical conductivity (EC) and pH, from bores located within the broader Carmichael Coal Mine and Rail Project area are presented in GHD (2012). The groundwater EC of bores installed in the bedrock aquifer is generally high, up to 53,100 microsiemens per centimetre (µS/cm) with EC of up to 15,500 µS/cm recorded at RN 12030175, located approximately 19 km east of the Moray Quarry. One EC measurement of 373 µS/cm is available from the Tertiary sediments at RN 17980), located more than 35 km west of the Moray Quarry. No water quality data is available from the alluvium; however, it is expected to vary spatially and temporally due to the influences of recharge and evaporative concentration. The total dissolved solids (TDS) data from bores constructed in the alluvium of the Galilee Basin range from 48 to 4,380 milligrams per litre (mg/L) (RPS, 2012) and reflects fresh to brackish groundwater typically expected in alluvial aquifers.

4.5.1.9 Water Supply for Quarry

Water supply options are currently being investigated. Quantities of water sufficient to satisfy the site operational requirements may be sourced on site from stormwater harvesting and groundwater seepage. The site operational water requirements are outlined in Section 3.4.12.

It is understood that Adani will consider a number of alternative options of water supply should additional water be deemed necessary for the quarry. This may include bore water supply, large water storages and pipeline from an existing water supply. Any alternative water supply options will be permitted separately and are not discussed herein.

4.5.2 Potential Groundwater Impacts

The potential groundwater impacts due to the quarry include:

- Drawdown of the water table due to quarry excavation and associated dewatering activities. The extent of the impact will largely depend on the potential for the base of the quarry to intersect the water table and hydrogeological properties of the aquifer surrounding the quarry. The potential drawdown impacts include the lowering of water table at the location of potentially groundwater dependent vegetation to the south and east of the quarry and along Belyando River and lowering of water levels at registered and unregistered bores. The available depth-to-water data from the Groundwater Database indicates that the water table may occur around 11 to 15 mbgl in the alluvium near creeks. Given the proposed depth of quarry and its proximity to the creeks and Belyando River, the likelihood of intersecting the water table is considered moderate;

- Drawdown of the water table due to pumping from groundwater supply bores. The likelihood of impact is considered low due to the anticipated low bore yield and supplementary water demand. The risk is conservatively assessed as moderate due to the presence of registered bores and current uncertainty about their uses. However, there are no current plans to source water from bores and any impacts will be assessed in the approvals required for a water bore;

- Localised recharge to the water table from quarry operations and associated salinisation and mounding of the water table. This may arise if the water table is not intersected by the quarry and stormwater at the site is not properly managed. The mounding of the water table may

facilitate lateral transport of dissolved salts or contaminants if present within the saturated zone; and

- Localised degradation of groundwater quality due to accidental leaks or spills of chemicals during construction and subsequent lateral migration of contaminants within the saturated zone.

4.5.3 Groundwater Management

A number of potential impacts to groundwater due to proposed works are identified. The main objectives with regards to groundwater include:

- Prevention of the degradation of groundwater quality in the area within and surrounding the development;
- Protecting the quality of existing groundwater resources; and
- Ensuring the development does not impact values associated with groundwater dependent ecosystems.

In order to minimise adverse impacts to groundwater, the following management methods will be undertaken:

- Laydown areas for vehicles and machinery and storage areas for chemicals, oils and fuels will be contained in appropriately designed facilities. Containment and correct storage will prevent spills, leaks, infiltration and surface runoff and hence prevent contaminants from entering aquifers, waterways and the general environment;
- Spill kits will be available to all personnel in the event of a spill or leak;
- Potential contaminants will be stored and handled in a controlled manner to prevent impacts to creeks, rivers, bores or GDEs;
- Visual inspections of any groundwater seepage during extraction activities. If the water table is intersected during construction, the rate of groundwater seepage is likely to be low due to the assumed low permeability of the bedrock. It is assumed that groundwater seepage could be managed by in-pit sump pumping to facilitate dry construction;
- A number of groundwater monitoring bores may be installed and tested prior to construction to assess baseline groundwater conditions including depth to water, groundwater flow direction, indicative aquifer permeability and groundwater quality. This will assist in the planning for construction requirements; i.e., dewatering and bore water supply, and associated impacts (or lack thereof). It is anticipated that the presence or absence of groundwater in geotechnical investigation holes could inform the efforts required for baseline groundwater assessment and subsequent monitoring. Some of the monitoring bores should be placed outside of the perimeter of the quarry, such that they could be monitored during construction if deemed necessary; and
- Prior to blasting a census of all groundwater bores and spring complexes within a 1 km radius will be undertaken. A search of the Queensland Groundwater Database (NRM, 2012) shows no registered bore within the quarry area. Enquires with the local council and liaison with local landholders will inform the presence of any unregistered bores or unidentified springs within 1 km radius that may warrant monitoring during operation.

4.6 Contaminated Land

The site has been used for historical quarrying operations and a range of agricultural activities, particularly cattle breeding and fattening. A search of the Environment Management Register (EMR) and Contaminated Land Register (CLR) indicates that no known notifiable activity has been undertaken on Lot 4 SP116046. The EMR/CLR Search is attached in **Appendix G**. In addition, multiple site inspections have failed to reveal any indication of hazardous materials being stored, or hazardous activities being undertaken, in the area of the proposed development.

4.7 Air Quality

4.7.1 Existing Environment

The quarry is located within a rural regional landscape dominated by agricultural and mining activities. The air quality is generally of a good standard. VIPAC undertook background monitoring of air quality at the Moray and Beenboona Homesteads to allow the incremental impact of the quarry to be assessed against the existing background pollutant concentrations.

The existing levels of particulate matter were monitored at Disney Homestead (in order to measure regional concentrations) between the 27 March and 1 April 2013, using an environmental dust monitor, which records a particulate matter value every five minutes. Analysis of the data determined particulate matter with a diameter of 10 micrometres or less (PM_{10}) concentration to be 18 micrograms per cubic metre (µg/m^3), which is the 70th Percentile.

The PM_{10} concentration has been used to derive appropriate background concentrations for particulate matter with a diameter of 2.5 micrometres or less ($PM_{2.5}$) and TSP. The Australian Coal Review states that an average of 40% of TSP was found to consist of particles in the size range of PM_{10}. Particles in the size range of $PM_{2.5}$ were found to comprise only 4% of TSP or equivalently 10% of PM_{10}.

The following estimates of background levels of dust have been determined:

- Annual average concentration of TSP of 30 µg/m^3;
- 24-hour average concentration of PM_{10} of 10 µg/m^3;
- 24-hour average concentration of $PM_{2.5}$ of 1 µg/m^3; and
- Dust deposition of 50 milligrams per square metre per day (mg/m^2/day).

Full details of the background monitoring are provided within the Air Quality Impact Assessment prepared by VIPAC in **Appendix I**.

4.7.2 Project Criteria

The *Environmental Protection (Air) Policy 2008* (EPP (Air)) prescribes ambient air quality goals relevant to this quarry. Provided are criteria for PM_{10}, $PM_{2.5}$. The most critical of these is the PM_{10} criterion as the fraction of $PM_{2.5}$ against PM_{10} emissions from extraction operations is small (typically less the 10%).

Deposited dust is commonly used as a measure of the potential for dust nuisance; high levels can reduce the amenity of an area. No formal criteria for dust deposition exist within Queensland; however the EHP has recommended a nuisance guideline of 120 mg/m^2/day.

From all of the regulations, the strictest applicable criteria have been selected for this assessment and are presented in Table 4-7

Table 4-7 Quarry air quality goals (VIPAC)

Pollutant	Basis	Criteria	Averaging Time	Exceedances*
TSP	Human Health	90 µg/m^3	1-year	-
PM_{10}	Human Health	50 µg/m^3	24-hour	Five days per year
$PM_{2.5}$	Human Health	25 µg/m^3	24-hour	-
Dust deposition	Amenity	120 mg/m^2/day	30 days	-

* Allowance intended for natural events such as dust storms or bushfires

Particulate emissions from the surrounding environment include contributors from farming activities (i.e. dust from cultivated areas) and smoke from activities associated with burning off.

4.7.3 Potential Impacts

Air quality impacts are likely to include dust emissions and vehicle and equipment emissions at the quarry operational area and along the haulage routes. The activities likely to contribute to the impacts to air quality include:

- Ripping of quarry material;
- Stockpiling;
- Operation of fuel burning equipment onsite through exhaust emissions;
- Loading of quarry material into haulage trucks; and
- Movement of haulage trucks along dirt roads and haul roads.

An Air Quality Impact Assessment report for the Moray Quarry has been prepared and is provided **Attachment H** of this report.

VIPAC undertook modelling and assessment of the potential impact of the quarry operations using the 3-dimensional dispersion wind field model, CALPUFF and The Air Pollution Model (TAPM), which is a 3-dimensional prognostic model developed and verified for air pollution studies by the CSIRO to simulate the impacts from the quarry. The modelling was based on the peak production month of September 2014 when 66,697 million tonne will be extracted. This rate was modelled for one year duration and as such the modelling results show the worst case scenario with minimal controls in place (dust suppression with a water truck). The actual impacts of the quarry are likely to be significantly less than the predictions and modelling of the worst case scenario.

The nearest sensitive receptor to the proposed quarry is Moray Downs Homestead, approximately 900 m from the quarry. This residence is likely to be screened from the quarry operations by riparian vegetation lining the anabranch of the Belyando River that lies between the two areas. In addition, Moray Downs Homestead has been acquired by the proponent and is likely to be removed or minimally used during the operational period of Moray Quarry. A second homestead (Beenboona) is located approximately 12 km from the site.

The TSP, $PM_{10,}$ $PM_{2.5}$ and dust deposition results for the Moray Downs Homestead are detailed in Table 4-8.

Table 4-8 Quarry dust results at Moray Downs Homestead

Pollutant	Background Levels	Quarry Related Activities	Total	Criteria	Compliance
Dust Deposition ($mg/m^2/day$)	50	10.76	60.76	120 $mg/m^2/day$ (30 days)	Yes
TSP ($\mu g/m^3$)	30	1.24	31.24	90 $\mu g/m^3$ (1-year)	Yes
PM_{10} ($\mu g/m^3$)	10	12.08	22.08	50 $\mu g/m^3$ (24-hour)	Yes
$PM_{2.5}$ ($\mu g/m^3$)	1	6.49	7.49	25 $\mu g/m^3$ (24-hour)	Yes

The impacts on the Beenboona receptor during the life of the quarry are minimal with TSP, $PM_{10,}$ $PM_{2.5}$ concentration as dust deposition is only slightly above background levels.

VIPAC's monitoring and modelling of air quality indicates that even in the worst case scenario peak production the operations will be compliant with required air quality standards. It was noted that highest contributor to all pollutants is from haul truck movements.

During the excavation of the Moray Quarry, activities associated with the North Creek Quarry will also be occurring. The assessments for both quarries were based on peak output, with these peak outputs occurring in September 2014.

Table 4-9 Cumulative impacts of the North Creek and Moray Quarries

Pollutant	Cumulative Concentration of the North Creek and Moray Quarries and Existing Background Levels			
	Moray Downs	Beenboona	Criteria	Compliance
Dust Deposition ($mg/m^2/day$)	86.57	51.3	120 $mg/m^2/day$ (30 days)	Yes
TSP ($\mu g/m^3$)	56.13	30.05	90 $\mu g/m^3$ (1-year)	Yes
PM_{10} ($\mu g/m^3$)	42.27	11.46	50 $\mu g/m^3$ (24-hour)	Yes
$PM_{2.5}$ ($\mu g/m^3$)	23.65	1.77	25 $\mu g/m^3$ (24-hour)	Yes

The cumulative impact of the maximum values all comply for every receptor.

4.7.4 Air Quality Management

Air quality and dust management measures should include the following recommended measures (VIPAC 2013):

- Ongoing visual dust inspections;
- Water sprays should be used for excavation activities where necessary;
- Water spraying of stockpiles will be done on a frequent basis in order to keep the raw material moist to suppress fugitive dust release. The frequency of watering will depend on weather conditions;
- Progressive clearing to minimise the area of potential dust generating areas subject to wind erosion;
- Earth moving activities should be avoided or restricted during meteorological conditions that are favourable for dust dispersal;
- As a good management practice, on haul and access roads moderate level watering (>2L/m^2/hr) is to be adopted wherever there is potential for emissions to exceed the criteria limits such as during high winds;
- Where it is apparent moderate watering frequency is not being effective high level watering (~4L/m^2/hr) is to be adopted or operations reduced or ceased;
- Restriction of the speed of traffic to 40 km/hr to minimise wheel generated dust;
- Public sealed roads will be used where the option exists and should be regularly cleaned and swept;
- Ensuring all vehicles are suitably fitted with exhaust systems that minimise gaseous and particulate emissions to meet vehicle design standards;
- Limiting vegetation and soil clearing, so as to minimise the area of exposed soil that may generate dust;
- Compaction of construction site and stabilisation of vegetation to minimise dust lift off as a result of wind erosion;
- Worked areas should be stabilised as soon as possible after earthworks have been completed (e.g. revegetation or mulching);
- General awareness of minimising dust levels and its benefits should be instructed to workforce personnel;
- Complaint management processes that ensure complaints are readily registered and appropriately addressed;
- Where appropriate public consultation processes should be implemented that inform residents of the potential duration and extent of impacts, thereby allowing them to take appropriate actions (such as not hanging out their washing on those days); and
- Haul vehicles will be covered when travelling on public roads or when significant dust is being produced from works on site.

4.8 Noise

4.8.1 Existing Environment

The nearest sensitive receptor to the proposed quarry (Moray Downs Homestead) is a property residence located approximately 900 m from the extraction site and 1.3 km from the Moray Carmichael Road upgrade. This residence is likely to be screened from the quarry operations by riparian vegetation lining the anabranch of the Belyando River that lies between the two areas.

Winds occur predominantly from the north-east during spring and summer, often no greater than 5 m/s (18 km/h). In autumn and winter, the dominant winds occur from the south-east with the highest wind speed of 8 m/s (28 km/h). The cooler, drier air is characteristic of the dominant south-east winds of moderate strength, usually with long calm periods in the winter (VIPAC, 2013).

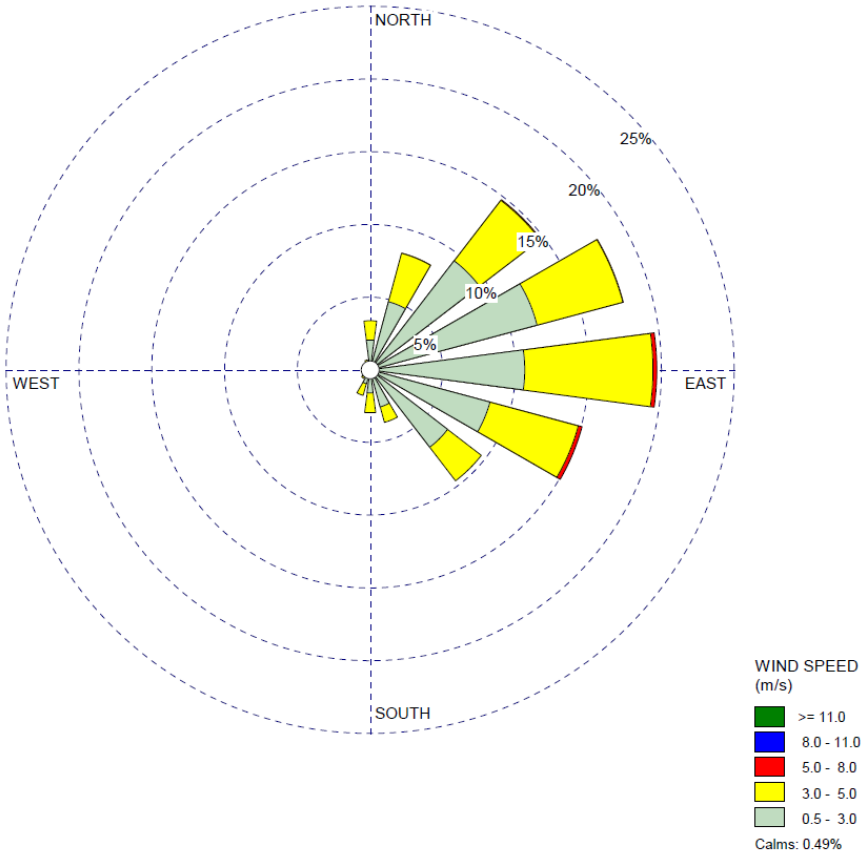


Figure 4-7 Annual Wind Rose (source CSIRO 2006)

The existing noise environment has been determined through unattended ambient noise monitoring between 27 March and 4 April 2013. The noise monitoring was undertaken at Moray Downs Homestead.

Table 4-10 provides the noise monitoring results for all of the days captured at this location. The noise monitoring data for individual days is shown in tabulated and graphical form within the full Noise Impact Assessment provided in **Appendix J**.

Table 4-10 Summary of noise monitoring results

Noise Descriptor	Moray Downs		
	Day (07:00-18:00)	Evening (18:00-22:00)	Night (22:00-07:00)
L_{Aeq} (Average)	47.5	44.4	41.5
$L_{Aeq,\ 1\ Hour}$ (Max)	53.4	46.5	48.1
L_{A90} (Average)	30.6	36.8	27.0
L_{Amax} (24 hour)	79.0		

4.8.2 Proposed Criteria and assessment

The *Environmental Protection (Noise) Policy 2008* (EPP (Noise)) is designed to protect the acoustic environment for health and well-being. Section 8 and Schedule 1 of the EPP (Noise) outline these acoustic quality objectives as shown in Table 4-11.

Table 4-11 EPP (Noise) acoustic quality objectives for dwellings

Sensitive Receptor	Time of Day	Acoustic Quality Objectives (measured at receptor) dB(A)			Environmental Value
		$L_{Aeq,adj,1hr}$	$L_{A10,adj,hr}$	$L_{A1,adj,1hr}$	
Dwelling (outdoors)	Daytime & evening	50	55	65	Health & Wellbeing
Dwelling (indoors)	Daytime & evening	35	40	45	Health & Wellbeing
	Night-time	30	35	40	Sleeping

The time periods referred to in the EPP (Noise) are defined as: Day: 7 am to 6 pm, Evening: 6 pm to 10 pm, Night: 10 pm to 7 am

The acoustic quality objective applicable to this Project is the dwelling (indoors) night time criteria of 30 dB $L_{Aeq,adj,1hr}$. This noise level is an indoor level. In order to predict the external levels, a façade transmission loss of 7 dB has been applied. As such, the adjusted external night time criteria of 37 dB $L_{Aeq,adj,1hr}$ is applied.

The prediction of noise has been predicted using SoundPLAN noise modelling software with the CONCAWE prediction methodology to take into consideration the weather conditions at the site. The significant construction and operational noise sources used for this assessment have been obtained from Vipac's database of noise emissions.

The noise modelling has assessed both the onsite operations and the haulage of material along the site access road.

4.8.3 Noise Impacts

Noise sources are likely to include the following:

- Operation of vehicles and equipment, primarily the dozer and excavator;
- Excavation and stockpiling of material;
- Haulage of quarry material; and
- Reversing alarms on vehicles and equipment.

There will be no blasting activities at the Moray Quarry. The worst-case scenario of 66,697 t extracted and hauled from the site is expected to be maximum of 44 dB(A), which exceeds the external day time criteria of 42 dB(A) and the external night time noise criteria of 37 dB(A) during stable weather conditions.

The combined noise levels for extraction activities and haul road movements during maximum output are expected to exceed outdoor day-time and night-time criteria by 2 dB(A) and 7 dB(A), respectively, under stable weather conditions.

Figure 4-8 shows the noise impact profile for the combined quarry and haulage activities at the Moray site during night time at peak production.

The combined noise levels show that noise levels are driven by the extraction activities, primarily from the dozer and excavator. The results have shown that compliance with the acoustic objectives for the night-time period has not been achieved at all receptors during peak output in stable and adverse conditions, with exceedances of greater than 3dB(A) expected.

This impact and modelling is based on no noise mitigation measures in place. A number of noise mitigations will be installed to ensure noise impacts are reduced and limits not exceeded. In addition, the nearest sensitive receptor (Moray Downs Homestead), has been acquired by the proponent and is likely to be removed or minimally used during the operational period of Moray Quarry and the nearby North Creek Quarry.

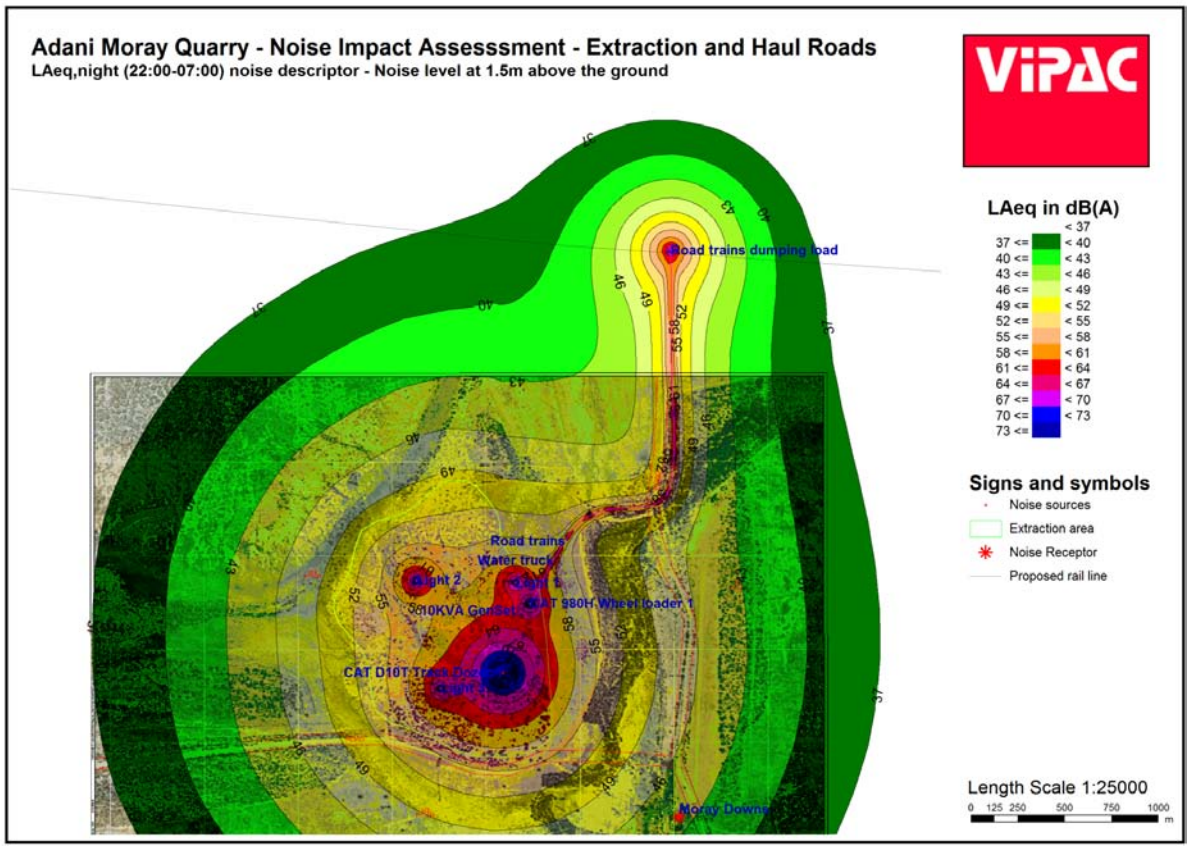


Figure 4-8 Moray Quarry noise impacts for quarrying and haulage

4.8.4 Noise Management

Noise and vibration management measures will include the following:

- Avoiding unnecessary revving of engines and switch off equipment when not required;
- Keeping haul routes well maintained and avoid steep gradients;
- Ensure that all operators of plant and haul trucks do not drive aggressively and horn use is limited;
- Minimise the drop heights of materials;
- Start up plant and vehicles sequentially rather than all together;
- Audible reversing warning systems on mobile plant and vehicles shall be of a type which, whilst ensuring that they give proper warning, has a minimum noise impact on persons outside sites. When reversing, mobile plant and vehicles should travel in a direction away from sensitive receptors whenever possible;
- As far as reasonably practicable, sources of significant noise shall be enclosed. The extent to which this can be done depends on the nature of the machine or process to be enclosed and their ventilation requirements;
- Plant shall always be used in accordance with manufacturers' instructions. Care should be taken to site equipment away from noise sensitive areas. Where possible, loading and unloading should also be carried out away from such areas;
- Machines that might have intermittent use should be shut down between work periods or should be throttled down to a minimum. Machines should not be left running unnecessarily, as this can be noisy and wastes energy;
- Plant from which the noise generated is known to be particularly directional should, wherever practicable, be orientated so that the noise is directed away from noise-sensitive areas; and
- Acoustic covers to engines shall be kept closed when the engines are in use and idling.

Noise monitoring will be carried out in the event of a complaint and upon a formal request of a regulatory authority to ensure mitigation measures are effective in maintaining noise below the noise limits.

4.9 Lighting

The quarry operation will ensure that only essential lighting will be included in the development. Throughout the construction phase, night lighting will be limited to specific construction activities and safety. Lighting on site will be required for the operation of the quarry over the 24 hour period, lighting will be provided at the site office and amenities area as well as on the working area of the quarry.

Lighting design will comply with the best available technologies (i.e. Type 6 luminaires) and include light shrouding techniques (i.e. be well shielded, full cut-off and downward directed type fixtures). Luminaires will be mounted low in the vertical plane and use the lowest intensity for the task. Intense lights or clusters of lights will be avoided where possible.

Main access routes will be identified and illuminated appropriately, and lighting along alternative routes will be at emergency levels only. Long wavelength lights will be minimised wherever possible, where this is not possible, Low-Pressure Sodium (LPS) lights or Light Emitting Diodes (LEDs) should be used. Surfaces of structure and ground covering will be designed to minimise reflection. To ensure lighting management measures are complied with, periodic inspections, audits and corrective management of light sources will be undertaken.

4.10 Traffic, Transport and Site Access

4.10.1 Traffic and Transport requirements

Quarry vehicle generation has identified traffic movements from the Gregory Development Road to Moray Quarry, and movements from the Quarry to a haul road running parallel to the proposed rail line. The study area as shown in Figure 4-9 therefore incorporates the Gregory Development Road and route to the haul road via Elgin Road and Bulliwallah Road.

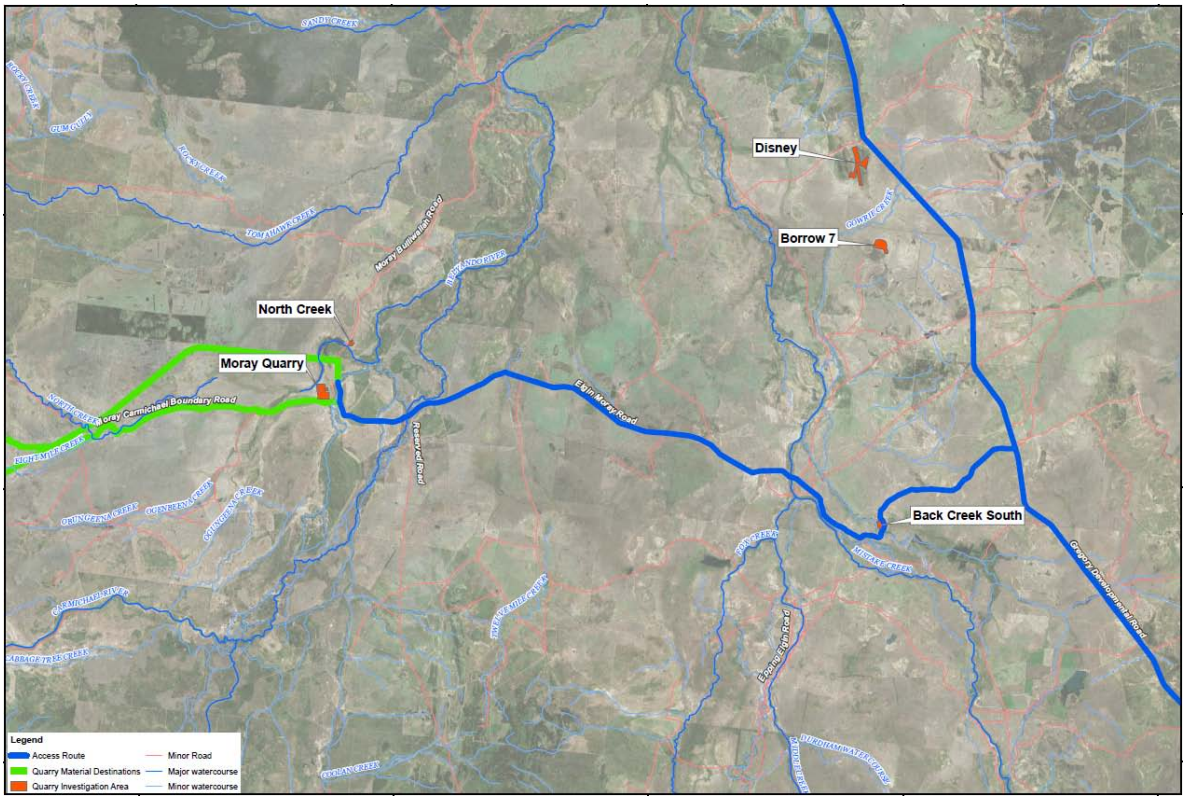


Figure 4-9 Study area - Moray Quarry (TTM, 2013)

TTM has undertaken a detailed estimate of the likely development traffic generation and distribution, with the site predicted to generate a total daily traffic generation 60 vehicles (in / out).

The Council controlled roads do not have a posted speed limit and therefore 80 km per hour has been adopted as the highest speed allowed on these gravel roads. Elgin Road is partially signed as 20 km per hour in the vicinity of Moray Downs Homestead immediately south of the intersection with Bulliwallah Road. Elgin Road and Bulliwallah Road vary in carriageway width from 6 m to 10 m, however are generally around 8 m wide. Twin Hills Road is generally one lane construction, however some sections allow vehicles to pass each other.

All intersections within the study area are 3 arm priority controlled intersections, with the exception of Gregory Development Road / Twin Hills Road / Avon Road intersection which is a four arm staggered intersection. The Elgin Road / Bulliwallah Road / Doongmabullah Road intersection does not appear to have a specific priority route.

Haulage of quarry material will be undertaken by AB triple vehicles with an average payload of 75 t. The highest predicted annual haulage from Moray Quarry will be 500,000 t. Haulage will be restricted to the local road network and a private haulage road. Haulage from the Moray Quarry will not access the SCR.

TTM has estimated the Daily and Peak Hour Haul Vehicle generation, and this is shown in Table 4-12.

Table 4-12 Estimated daily and peak hour haul vehicle generation (TTM)

Tonnage/day	Average tonnes per load	Trucks in (load bearing)	Trucks out (non load bearing)	Total daily truck movements	Peak hour truck movements
Average: 724 t	75	10 (92 ESA)	10 (17 ESA)	20 (109 ESA)	4
Peak Month: 2,223 t	75	30 (276 ESA)	30 (50 ESA)	60 (326 ESA)	12

*ESA = Equivalent Standard Axles

In addition to the haulage of material there will be a number of service vehicles required to set up the site and service the operation of the site, these include:

- It is anticipated that 20 truck movements will be required for set up of the site and delivery and mobilisation of equipment and plant;
- One fuel delivery per week from Townsville to be transported in B-double with a 50,000 L capacity;
- Two water deliveries per week from from bores or the mine.

This equates to 176 truck movements during the first year of the Quarry including the set up of the Quarry.

Moray Quarry traffic is expected to increase traffic on the roads in the study area by no more than 69 Vehicles Per Day (vpd) during peak operations and as such the Level of Service 'A' is expected to be retained on all roads. Cumulative development traffic will be highest on Elgin Road and Doongmabullah Road with an average of 302 vehicles extra per day. As such, Level of Service 'A' is expected to be retained however some sections along this route may experience Level of Service 'B' roadway capacities in peak periods.

4.10.2 Potential Impacts

TTM Consulting was engaged to undertake a Traffic and Transport Impact Assessment for the development of the Moray Quarry, this is provided in **Appendix B**. The scope of the transport assessment included:

- Identification of likely traffic volumes, distribution and composition from the future development;
- Identification of likely traffic impact of development on the public road network;
- Identification of likely pavement impact of development on the public road network;

- Road upgrades to be provided to mitigate the impact of the proposed development on the external road network, if any; and
- Access configuration to provide efficient and safe manoeuvring between the site and the public road network.

A summary of the impacts as assessed in the report are:

- A detailed assessment of the development traffic impacts in accordance with the GARID guidelines has established that Moray Quarry will not have a significant or assessable pavement impact on the state controlled road network;
- TTM consider that there will no school route, pedestrian or cyclist impacts associated with the development proposal. TTM are of the view that there are no traffic planning or engineering reasons why the proposed development should not proceed as planned;
- TTM considers that all intersections within the study area will operate under uninterrupted flow conditions; and
- Impacts to the local road network will be restricted to the Elgin and Moray Carmichael Roads which are subject to a Road Agreement with IRC which includes upgrades by Adani of this road network.

A copy of this Traffic and Transport Impact Assessment undertaken by TTM is provided in **Appendix B** to this report.

4.10.3 Traffic and Transport Management

In order to mitigate the impacts of traffic and transport from the quarry site and within the quarry site the following general measures will be implemented:

- Haulage of quarry material will be restricted to the rail haul road and avoid transport of material on State and local roads;
- Speed limits within the site to 40 kms and along the rail haul road to 80 kms per hour to reduce dust and safety impacts; and
- A Traffic Management and Maintenance Plan will be developed and implemented prior to commencement of the Project.

The management measures that will be implemented for the Moray Quarry access from Moray Carmichael Road include:

- A posted speed limit of 80 km/hr with suitable site distances to approaching vehicles;
- Basic right (BAR) turn treatments and shoulder provisions;
- A 7 m wide carriageway;
- Lane flares at the access to allow haul vehicles to enter and exit simultaneously without conflict; and
- A cattle grid at the property boundary to remove dust and gravel from vehicle tyres.

4.11 Cultural Heritage

The desktop assessment of cultural heritage values for this report includes:

- Identification of indigenous stakeholders through registered cultural heritage bodies, Native Title tenure and Indigenous Land Use Agreements (ILUA);
- Identification of non–aboriginal cultural heritage places and values through evaluation of relevant cultural heritage databases; and
- Identification of heritage sites collected from the Carmichael Coal Mine and Rail EIS (GHD, November 2012).

4.11.1 Indigenous Cultural Heritage Assessment

The principle legislation protecting indigenous cultural heritage in Queensland is the *Aboriginal Cultural Heritage Act 2003* (ACH Act). Under the ACH Act a person who carries out an activity must take all reasonable and practicable measures to ensure the activity does not harm Aboriginal cultural heritage (the 'cultural heritage duty of care').

There is one registered Native Title claim covering the site (QUD6230/98, QC98/10), and an Indigenous Land Use Agreement (ILUA) is currently being prepared between Adani and the Jangga people (Table 4-13). The site is on leasehold land and therefore Native Title is not extinguished, as such the quarry and its associated operations will be addressed within the forthcoming ILUA with Jangga Operations Pty Ltd. No further Native Title determinations were identified from the National Native Title Register (NNTR) for the study area.

Table 4-13 Native Title Claim Details

Name	Tribunal No.	Status	Agreement Details
Jangga People Registered Native Title Claim Area (QUD 6230/98)	QC98/10	In Negotiation	Area Agreement

In addition to the current ILUA negotiations, Adani has established the following agreements with the Jangga People:

- An Early Works Agreement was established in July 2011 for cultural heritage clearances undertaken from July to November 2011; and
- A Cultural Heritage Management Plan (CHMP) for the life of the Project was established and approved by the Chief Executive of ERM in November 2011. The CHMP is being amended to include the Moray Quarry operations.

Indigenous cultural heritage studies of adjacent Carmichael Coal Mine and Rail Project have identified indigenous cultural heritage sites located within the locality of the site. The Carmichael Coal Mine and Rail (2012) literature suggested there is considerable evidence of the close association of discreet archaeological deposits with soaks and gilgai, which are predominate in the area of the proposed quarry.

Cultural heritage finds in the general locality have been dominated by a considerable variety of stone artefacts, with only three scarred trees and two occurrences of grinding grooves being noted. The majority of the scatters were low density; however, several scatters exhibited medium to high artefact densities, indicating that they may represent the locations of camping sites.

Adani understands its duty of care to protect and manage Aboriginal cultural heritage values under the ACH Act, and is committed to the management of cultural heritage values in and surrounding the Moray Quarry site. Adani will manage those values and mitigate project impacts through the CHMP as executed with the Jangga People.

4.11.2 Non-Indigenous Cultural Heritage Assessment

The *Queensland Heritage Act 1992* (QH Act) is the principle legislation protecting non-indigenous cultural heritage in Queensland. The QH Act establishes the Queensland Heritage Council, which administers the Queensland and local heritage registers. Under the QH Act, penalties may apply for damage caused to places or items on the registers.

The Carmichael Coal Mine and Rail EIS (GHD, November 2012) listed the Great Barrier Reef and the Tree of Knowledge (Barcaldine) as the only Non-Indigenous cultural heritage sites applicable to the overall quarry. Neither of these sites are within close proximity to the proposed Moray Quarry and therefore the development will not impact listed Non-Indigenous cultural heritage sites. Nevertheless, un-listed Non-Indigenous cultural heritage sites exist and these can include homesteads, churches, convict paving, agricultural buildings, survey trees, various sheds and huts, windmills, camps, tracks and stock routes. Various registers and data sources were consulted to identify existing sites of significant cultural heritage. Table 4-14 below lists of results from the Queensland Heritage Register search.

Table 4-14 Queensland Heritage Register search results

Title	Registration Type	Street Name	Location
Carmila Cane Lift	State Heritage	49 Hindles Road	Carmila West
Christ Church Anglican Church	State Heritage	Cannon Street	Saint Lawrence
Clermont Cemetery	State Heritage	Cemetery Road	Clermont
Irlam's Ant Bed Building	State Heritage	Clermont-Alpha Road	Oaky Creek
Meatworks and Wharf Site	State Heritage	Settlement Road	Saint Lawrence
Nebo Hotel	State Heritage	2 Reynolds Street	Nebo
Police Station and former Courthouse and Cell Block	State Heritage	Macartney Street	Saint Lawrence
Stone Farm Building	State Heritage	739 Fleurs Lane	Clermont

(GHD, November 2012)

The searches have indicated that there are no known Indigenous or non-Indigenous Cultural Heritage sites on the Property or within the immediate vicinity.

4.11.3 Potential Impacts

A cultural heritage clearance survey was undertaken by the Jangga People for the initial geotechnical investigations. Fifteen test pit locations were assessed within the Moray Quarry borrow pits and the preliminary findings confirmed the site to be clear of Indigenous cultural heritage constraints by the Jangga representatives. In accordance with the current CHMP a further survey is required prior to obtaining final cultural heritage clearance for the Moray Quarry site.

There may be potential impacts to cultural heritage items in the form of displacement (removal from site through cultural heritage survey) or unknown destruction if present items are not identified and removed during the cultural heritage surveys.

4.11.4 Cultural Heritage Management

As outlined in Section 4.11, a CHMP covering the site is being prepared with the Jangga People. The CHMP defines and describes the objectives and practical measures for protecting or enhancing Indigenous cultural heritage environmental values, these include:

- Provisions for review and amendment;
- Commitment to implementing duty of care requirements;
- Commitment to ongoing field assessment of areas to be disturbed; and
- Commitment to adopting a hierarchical policy of avoidance through to management of impact (GHD, November 2012).

The management and mitigation processes set out in the CHMP include:

- Cultural heritage awareness training;
- Continued communication;
- Continued cultural heritage assessment and associated reporting;
- Adani will work with relevant Aboriginal parties to include cultural heritage training into its induction materials for exploration, construction and operation; and
- Representatives from relevant Aboriginal groups will have the opportunity to present cultural heritage awareness training face to face with key project personnel (GHD, November 2012).

No activities will be commenced until a full assessment of the site has been undertaken in line with the CHMP. Aboriginal parties and their relevant archaeologists will produce reports on the outcomes of their surveys, including methodology, nature and extent of Aboriginal cultural heritage observed, significance of artefacts, items or places of conservation or cultural heritage values and their values, likely impacts and recommendations for management (GHD, November 2012).

Based on the recommendations contained in the survey report and ongoing communications, management measures will be implemented and may include avoidance, further assessment, mitigation and or monitoring (GHD, November 2012).

Section 5 Land Use and Planning

The Moray Quarry development triggers assessment against multiple State and local legislative instruments and includes two referral agencies for the activities. This section provides an assessment of the proposed development against the relevant legislative instruments.

5.1 State Planning Instruments

5.1.1 State Planning Policies

A State Planning Policy (SPP) is a statutory instrument developed by the State Government for matters of state interest and is prepared under the SP Act. SPPs may provide detailed codes and standards used in technical aspects of development assessment. Assessment against the 13 current SPPs is given in Table 5-1, only the temporary SPP 2/12 – Planning for Prosperity and SPP 1/92 – Development and the Conservation of Agricultural Land is applicable to the Moray Quarry development.

Table 5-1 State Planning Policy Assessment

State Planning Policy	Applicability
Temporary SPP 2/12 – Planning for Prosperity	The SPP applies to development on the Property and gives additional weight in the decision making process to: ▪ Agricultural uses in an area zoned for agricultural uses; and ▪ Mineral and extractive resource development which is complementary to an area's primary intended use. Part 2 of the SPP states that when making a decision on a development the assessment manager shall give weight to *"extractive industry development which can be shown to be complementary to an area's primary intended use"* (p.3). Under the *Belyando Shire Planning Scheme 2009*, Extractive Industry is listed as an 'appropriate use' within the Rural Zone. Therefore, SPP 2/12 is applicable to the development and shall be considered by IRC when assessing the development.
SPP 1/12 – Protection of Strategic Cropping Land (SCL)	The property does not contain any potential or confirmed SCL. Therefore, SPP 1/12 and the *Strategic Cropping Land Act 2011* (SCL Act) is not applicable to this development application.
SPP 4/11 – Protection Wetlands of High Ecological Significance in Great Barrier Reef Catchments	The SPP is not applicable as no wetland protection areas are located within the Property. The nearest is located approximately 6.3 km to the south of the development.
SPP 5/10 - Air, Noise and Hazardous Materials	The SPP is not applicable as the area is not listed as a management area for the purposes of the policy.
SPP 4/10 – Healthy Waters	The SPP is relevant to stormwater and wastewater management for urban purposes. The proposed development is for Extractive Industry in a Rural zoned area and therefore the SPP is not relevant.
SPP 3/10 – Acceleration of compliance assessment	The SPP is not applicable as reconfiguration of a lot is not proposed as part of the development.
SPP 2/10 – South East Queensland Koala Conservation	The SPP is not applicable as the Site is outside the South East Queensland area defined in the SPP.
SPP 2/07 – Protection of Extractive Resources and Guideline	The SPP is not applicable as no key resource areas are located within, or near, the Site.
SPP 1/07 – Housing and Residential Development	The SPP is not applicable as it is applies only to local governments, and the development is seeking to establish an Extractive Industry.

State Planning Policy	Applicability
SPP 1/03 – Mitigating the Adverse Impacts of Flood, Bushfire and Landslide	As per the introductory note in the *Belyando Shire Planning Scheme 2009* SPP 1/03 the flooding component of SPP 1/03 is the only part applicable to development in the former shire area. This is confirmed in Annex 2 and Annex 3 of the SPP which exempts the Belyando Shire Council area from the fire and landslide provisions. In addition, no natural hazard management areas were identified as affecting the site.
SPP 2/02 – Planning and Managing the Development Involving Acid Sulfate Soils	Acid sulfate soils are not likely to occur at the Site as elevations are greater than 10 m AHD (elevation is approximately 205 m AHD). Therefore, an assessment against the provisions of SPP 1/02 has not been included.
SPP 1/02 - Development in the Vicinity of Certain Airports and Aviation Facilities	SPP 1/02 is not applicable as no aviation facilities are located at or near the Site.
SPP 1/92 – Development and the Conservation of Agricultural Land	All three types of Good Quality Agricultural Land (GQAL) occur on Lot 4 SP116046. The site of the proposed Moray Quarry is classified as Class A GQAL (refer to Section 5.1.2 and Figure 5-1).

The Queensland Government released a new Draft State Planning Policy (draft SPP) on the 22 April for public comment. This Draft SPP is intended to replace the 13 current SPP's into one single SPP.

5.1.2 Good Quality Agricultural Land Review

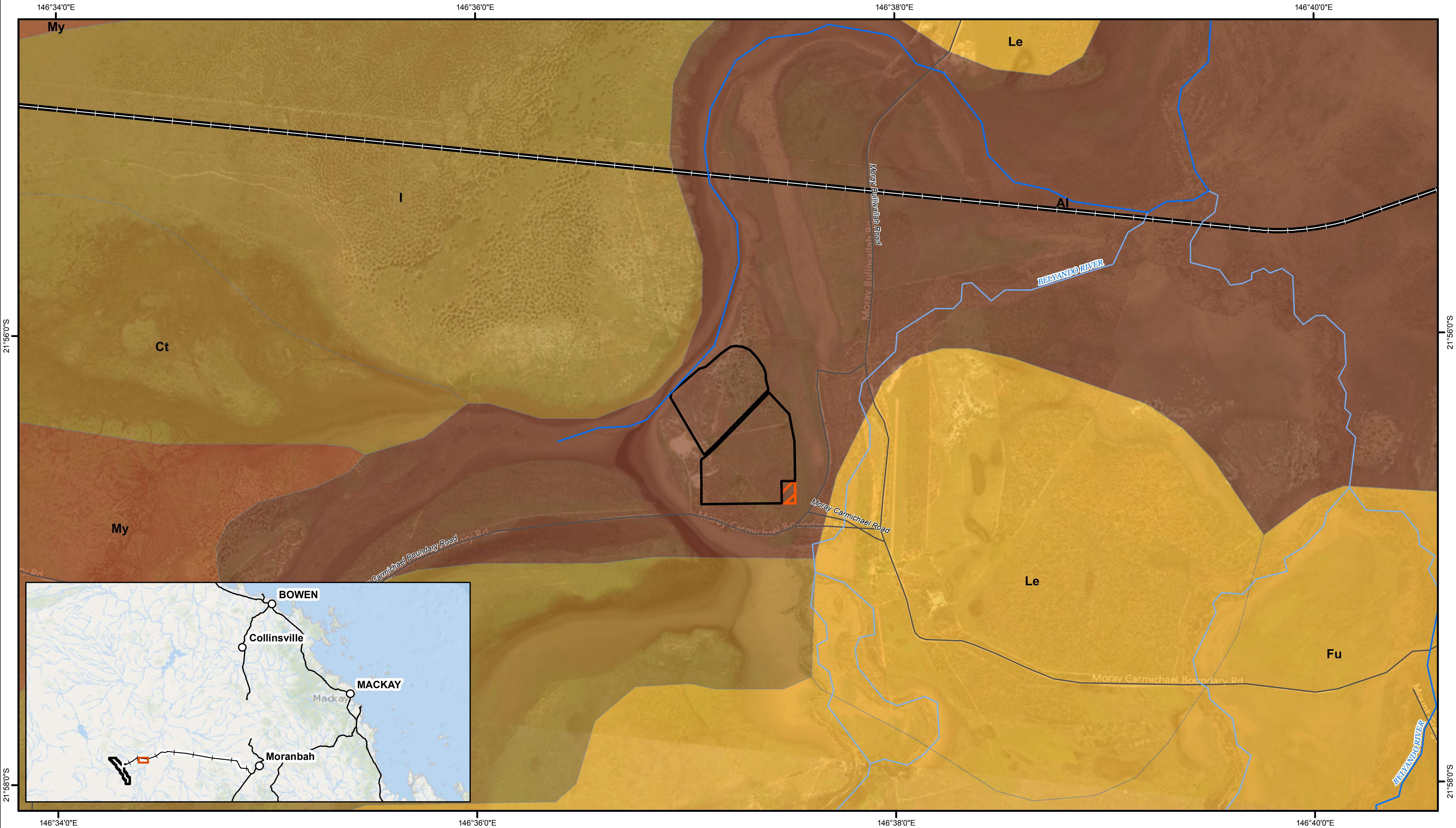
SPP 1/92 was introduced to conserve GQAL and provide guidance to local authorities on how the issue should be addressed when undertaking their planning duties. Local authorities are required to have due regard to the policy. The proposed Moray Quarry site is mapped as Class A GQAL. Therefore a review of the proposed development against the provisions of SPP 1/92 has been undertaken and the policy principles have been discussed in below.

Table 4-2 SPP 1/92 Policy Principles

Policy Principle	Assessment of Moray Quarry
Good quality agricultural land has a special importance and should not be built on unless there is an overriding need for the development in terms of public benefit and no other site is suitable for the particular purpose (Section 3).	The expansion of the Moray Quarry is considered significantly important for the upgrade and maintenance of infrastructure within the area. As discussed in Section 2 – Development Justification, the site is considered the most suitable due to its proximity to the work site and the limited availability if quarry material within the region.
The alienation of some productive agricultural land will inevitably occur as a consequence of development, but the Government will not support such alienation when equally viable alternatives exist, particularly where developments that do not have very specific locational requirements (for example, 'rural residential') are involved (Paragraphs 4.6-4.7).	The Moray Quarry will only affect a small portion of mapped Class A GQAL. Therefore, it will not cause alienation of larger sections of GQAL and will not inhibit the existing or future utilisation of surrounding land for agricultural activities. In addition, the quarry has specific locational requirements which necessitate its development within the area.
When preparing, reviewing or amending planning schemes, local authorities will be expected to include\ provisions for the conservation of good quality agricultural land, regardless of the effect of market fluctuations on its viability (Section 4).	Not applicable to the current assessment of this development application.

Policy Principle	Assessment of Moray Quarry
The preparation of strategic plans should include an evaluation of alternative forms of development, and significant weight should be given to those strategies which minimise the impacts on good quality agricultural land (Paragraph 4.2-4.3).	Not applicable to the current assessment of this development application.
Due consideration should be given to the protection of good quality agricultural land when applications far rezonings, consent, or subdivision are being determined (Paragraph 4.1).	Consideration has been given to the mapped GQAL onsite. However, the site has been subject to historic quarrying activities and is highly disturbed, and therefore it is not considered suitable for agricultural activities.
Where a planning scheme does not 'contain adequate agricultural land conservation provisions, the Government will be guided by the principles set out in this Policy when considering applications for the approval of planning schemes, rezoning and other scheme amendments (Paragraph 4.1).	Not applicable to the current assessment of this development application. However, the assessment manager shall consider the principles of the policy.
The fact that existing farm units and smallholdings are not agriculturally viable does not in itself justify their further subdivision or rezoning for non-agricultural purposes. Subdivision provisions and policies should be devised in a way that encourages amalgamation of titles where this would enhance farm viability (Paragraph 4.5).	Reconfiguration of a lot is not proposed as part of this development application and the existing agricultural activities will maintain viability as the development will not alienate sections of GQAL.
Local Authority planning provisions should aim to minimise instances of incompatible uses locating adjacent to agricultural operations in a manner that inhibits normal farming practice. Where such instances do arise, measures to ameliorate potential conflicts should be devised wherever possible (Paragraph 4.8).	In accordance with the Rural Zone Code of the *Belyando Shire Planning Scheme 2009* the following is an appropriate use: *"Extractive industries, where they are located and operated so as to ensure no unacceptable detrimental impact on surrounding uses or on the environment"* [Section 4.1.2.2 (4) (b)]. Therefore, it is considered that the local planning provisions adequately address incompatible uses within the rural zone.

SPP 1/92 applies to GQAL irrespective of whether farming activities are present. However, SPP 1/92 contains provisions which allow assessing authorities to determine an 'overriding need' for certain developments and these developments may justify the loss of mapped GQAL. SPP 1/92 lists examples of potential developments with 'overriding need' including mining and resources developments, roads, railways, dams and other major infrastructure with siting requirements. The Moray Quarry is required for the development of local roads and rail infrastructure, and is therefore considered a development with 'overriding need'.



Adani Quarry Permits and Approvals
Figure 5-1 Good quality agricultural land and soil mapping

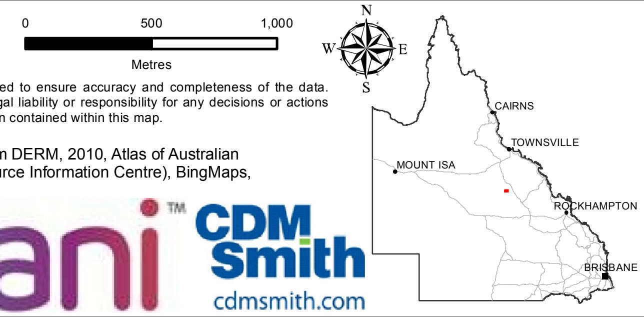
Job: B12849_025-R1_MoraySoilGQAL
Date: 13/06/2013

Legend

- Proposed Adani Rail Corridor
- Proposed Elgin Moray Road Re-Alignment
- Proposed Access Road to Elgin Moray Road
- Carmichael Mine - ML 70441
- Moray Quarry Extraction Area
- Stockpiling and processing area
- Minor Road
- Major watercourse
- Minor watercourse

GQAL Class

- A
- B
- C1
- C2



DISCLAIMER
CDM Smith has endeavoured to ensure accuracy and completeness of the data. CDM Smith assumes no legal liability or responsibility for any decisions or actions resulting from the information contained within this map.

Data source:
Adani, 2012; GQAL from DERM, 2010, Atlas of Australian Soils by National Resource Information Centre), BingMaps, 2011.

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5.1.3 Mackay, Isaac and Whitsunday Regional Plan 2012 and State Planning Regulatory Provisions

The *Mackay, Isaac and Whitsunday Regional Plan 2012* (the Regional Plan) establishes the strategic direction for the region to 2031. As the pre-eminent plan for the region the regional plan takes precedence over all other planning instruments. The Regional Plan implements this strategy through a regional framework, Desired Regional Outcomes (DRO) and contains the Regional Plan State Planning Regulatory Provisions.

The proposed development is considered complementary to the regional framework and the DROs of the Regional Plan for the following reasons:

- The proposed development is located on a site which is considered above the standard flood level of 202 m AHD. In addition, the site is mapped as low to moderate bushfire risk. The proposed development will assist in developing a sustainable regional economy and due to the temporary nature of the development it is not expected that climate change will have an impact;
- It will assist in diversifying the region's economy and provide employment opportunities;
- Quarry material from the proposed development will be used to construct *"infrastructure and services that meet the region's needs to support the economy"* (p.14) and accessibility;
- The development will be located in a currently disturbed area and will limit impacts on the general environment;
- The quarry will facilitate the development of the region's natural resources, particularly the Carmichael Coal Mine and Rail Project which will provide rail access to the secluded Galilee Basin;
- The surrounding ridgelines and points visible from public areas will be protected, therefore retaining the regional landscape; and
- The quarry will provide 8–10 permanent onsite jobs and potentially more than 50 haulage personnel. This complements the vision to develop a strong regional economy.

The proposed development is in the Regional Landscape and Rural Production Area of the Regional Plan. Although urban and residential uses are considered inappropriate in this area, economic diversification is supported, including small-scale industrial development such as the Moray Quarry.

5.2 Local Planning Instruments

5.2.1 Belyando Shire Planning Scheme 2009

The proposed Moray Quarry is defined as 'Extractive Industry' under the *Belyando Shire Planning Scheme 2009* and is located within the Rural Zone. In accordance with Section 4.1.1 – Rural Zone Table of Assessment, an MCU for Extractive Industry is an impact assessable development to be assessed against all applicable codes.

5.2.1.1 Desired Environmental Outcomes

The *Belyando Shire Planning Scheme 2009* contains three Desired Environmental Outcomes (DEO) that set the strategic direction for the Shire. Given the scale and size of the proposal, together with the nature of the matters to be assessed, it is considered prudent to undertake an assessment against the relevant DEOs of the *Belyando Shire Planning Scheme 2009* to demonstrate that the proposal achieves the intent of the planning scheme.

Table 5-2 Assessment against Desired Environmental Outcomes

Desired Environmental Outcome	Assessment
The Natural Environment and Cultural Heritage	Under the DEO the ecological systems, natural environment and significant cultural heritage is to be protected and existing or intended landscape maintained. None of the ecologically significant sites listed in the DEO will be impacted by the development. As a result of historic and current grazing activities at the Moray Quarry site, the extent, connectivity and ecological integrity of vegetation communities and the fauna habitat they provide, have been altered. Nevertheless, the operations and extraction areas have been located to minimise impacts on the environment and management measures have been provided in Section 4. Therefore, it is considered that the proposal is consistent with this DEO.
Economic Development	The DEO states that the viability of the mining industry is to be protected and the economy of the area is to be diversified. In addition, natural resources are to be used suitably. The Moray Quarry development will be utilising a historic quarry area and it necessary of the construction of the Carmichael Coal Mine and Rail Project. Therefore, it is considered that the proposal is consistent with this DEO.
Community Wellbeing	Under the DEO the towns of Moranbah and Clermont are retained as the primary employment centres for the Shire and provide the regions primary services. The towns are to maintain strong, connected and vibrant communities. The rural amenity and productive capacity of other parts of the Shire is to be maintained. The proposed development will increase demand for goods and services from the towns of Moranbah and Clermont, further establishing them as the primary service centres for the region. In addition, the quarry will be located in an unproductive area and the productive capacity of the surrounding agricultural land will be retained. Therefore, it is considered that the proposal is consistent with this DEO.

The proposed Extractive Industry development is consistent with the outcomes for the Rural Zone Code (Section 4.1.2.2) particularly the following:

- *"The Rural 'Zone' retains its viability as an area of primary production and natural resource use, including mining."*
- *"Rural activities" and mining are appropriately located within the Rural "Zone" and are not prejudiced by inappropriate development."*
- *"Is located, designed and operated in a manner that protects and enhances the predominant rural scale, intensity, form and character*"
- *"Does not prejudice or impact adversely on other 'uses', particularly 'sensitive land uses', including those within other zones."*
- *"Has an appropriately designed access to the road network, and traffic generated by the development does not impact adversely on the local road network."*
- *"Does not adversely impact on areas and sites of conservation importance, including cultural and high landscape values."*

In accordance with the Rural Zone Code the following is an appropriate use:

- *"Extractive industries, where they are located and operated so as to ensure no unacceptable detrimental impact on surrounding uses or on the environment"* [Section 4.1.2.2 (4) (b)].

A review of development against the Performance Criteria and Acceptable Solutions for MCU in the Rural Zone has been undertaken. Where the proposed development does not comply with a Performance Criteria and Acceptable Solutions, alternative solutions have been proposed and are listed in Table 5-3.

Table 5-3 Alternative solutions

Performance Criteria	Acceptable Solutions
Amenity	
PC2 Non-"Rural Activities" - Scale Non-"rural activities" are of a scale that is consistent with the amenity and character of the locality and do not prejudice the operation and viability of other "uses" or activities in the Rural "Zone" or other "zones".	**AS2** The "total use area" is less than 150m^2.
Alternative Solution – PC2	
The development is a non-rural activity and is considered consistent with the amenity and character of the locality. The total use area will be approximately 91.2 ha however due to its location the development will not adversely impact the amenity of the surrounding area. Management measures to reduce light spillage, as well as prevent dust and noise impacts on surrounding sensitive receptors and Moray Carmichael Road are outlined in Section 4.	
PC3 Non-"Rural Activities" - Operating Hours Non-"rural activities" are operated so as to ensure that the activities and the operation of equipment occur at appropriate times to protect the amenity of the locality.	**AS3** Non-"rural activities" are operated only between the hours of 7:00am and 6:00pm.

Performance Criteria	Acceptable Solutions
Alternative Solution – PC3	
In order to maintain the projected road construction schedule the Moray Quarry is proposed to operate on a 24 hr basis. The location for the Extractive Industry is remote and the closest sensitive receptor (Moray Downs Homestead) is located approximately 4 km to the south of the proposed quarry pit. The Moray Downs Homestead will be screened from the quarry operations by a vegetation corridor that run in a general north-south direction. In addition, the homestead has been acquired by the proponent and is likely to be removed or minimally used during the operational period of Moray and North Creek Quarries. The activities of the quarry at night will be minimised to essential operations only and management measures will implemented to avoid any potential noise and light impacts.	
PC4 Non-"Rural Activities" - Delivery of Goods The loading and unloading of goods in connection with non- "rural activities" occurs at appropriate times to protect the amenity of the locality.	**AS4.1** Loading and unloading occurs only between the hours of: (a) 7:00am and 6:00pm, Monday to Friday; and (b) 7:00am and 12:00 (noon) on Saturdays. **AS4.2** No loading and unloading occurs on Sundays and public holidays.
Alternative Solution – PC4	
In order to maintain the projected road construction schedule the Moray Quarry is proposed to operate on a 24 hr basis. The location for the Extractive Industry is remote and the closest sensitive receptor (Moray Downs Homestead) is located approximately 4 km to the south of the proposed quarry pit. The Moray Downs Homestead will be screened from the quarry operations by a vegetation corridor that run in a general north-south direction. In addition, the homestead has been acquired by the proponent and is likely to be removed or minimally used during the operational period of Moray and North Creek Quarries. The activities of the quarry at night will be minimised to essential operations only and management measures will implemented to avoid any potential noise and light impacts.	
PC11 Landscaping and External Activity Areas Landscaping and external activity areas are provided on-site to: (a) contribute to a pleasant and functional rural built form; (b) provide positive sun and breeze control; (c) make provision for recreation areas; and (d) contribute to the positive visual qualities of the locality.	No acceptable solution is prescribed.
Alternative Solution – PC11	
The development will be for an operating quarry and no permanent infrastructure is proposed. The site will not be accessible to the general public and landscaping is not considered necessary for the development.	
PC12 Lighting The design of lighting does not prejudice the amenity of the locality through poorly directed lighting, lighting overspill or lighting glare.	**AS12** Direct lighting or lighting does not exceed 8.0 lux at 1.5 metres beyond the boundary of the site.
Alternative Solution – PC12	
Lighting will be directly focused on work fronts, access and amenities areas. Lighting will be provided by industry standard mobile light towers with three 1500 W halide lights with the ability to be directed towards the specific work area to prevent light spill from the boundary. The units are fitted with a fluid containment tray to prevent any environmental spills. In addition, the Moray Downs Homestead (the closest sensitive receptor) has been acquired by the proponent and is likely to be removed or minimally used during the operational period of Moray and North Creek Quarries.	
Infrastructure	
PC14 Water Supply All "premises" have an adequate volume and supply of water for the "use".	**AS14.2** "Premises" are connected to an approved water allocation as provided by the relevant agency. **or** **AS14.3** "Premises" are connected to a rain water tank with a minimum capacity of: (a) 45, 000 litres where not in a reticulated water supply area; (b) 22, 000 litres where in a reticulated water supply area.

Performance Criteria	Acceptable Solutions
Alternative Solution – PC14	
A 25,000 L water tank will be maintained onsite to supply drinking water and ablution water. Onsite water for operations and dust suppression to be supplied by a water storage dam which will have approximate capacity of 45 ML to collect overland flow from the quarry site.	
PC15 Effluent Disposal All "premises" provide for the treatment and disposal of effluent and other waste water to ensure the protection of public health and environmental values.	**AS15.1** "Premises" are connected to Council's reticulated sewerage system. **or** **AS15.2** "Premises" not in a sewered area have an on-site effluent disposal system in accordance with Schedule 1, Division 4: Standards for Sewerage Supply, Section 4.2.
Alternative Solution – PC15	
"Premises" not in a sewered area will have an onsite effluent disposal system in accordance with Schedule 1, Division 4: Standards for Sewerage Supply, Section 4.2.The onsite sewage code NRM and the onsite sewage facilities guidelines for effluent Quality NRM are no longer current documents. The site will comply with the AS1547.300 – Onsite Domestic –Wastewater management.	
PC19 Vehicle Parking and Service Vehicle Provision Vehicle parking and service vehicle provision is adequate for the "use" and ensures safe and functional operation for motorists and pedestrians.	**AS19.1** All "uses" provide vehicle parking in accordance with Schedule 1, Division 2: Standards for Roads, Carparking, Manoeuvring Areas and Access, Section 2.2(1)(a). **AS19.2** Car parking, service vehicle parking and manoeuvring areas are designed and constructed in accordance with Schedule 1, Division 2: Standards for Roads, Carparking, Manoeuvring Areas and Access, Section 2.2(1)(b).
Alternative Solution – PC19	
Under Schedule 1, Section 2.2 (1) (a) of the *Belyando Shire Planning Scheme 2009*, Industry uses (including Extractive Industry) must have 1 car parking space per 100m^2 of total use area. The definition of 'total use area' would likely include all areas of the proposed development used for quarrying. To comply with the code for a 91.2 ha Extractive Industry activity would require an excessive number of car spaces. The operator will have a total of 8-10 permanent personnel on site at any one time and therefore 6 car spaces are proposed. This quantity of spaces will accommodate the workforce and no car parks for public vehicles are required.	
PC20 Roads Adequate all-weather road access is provided between the "premises" and the existing road network.	**AS20** Roads are designed and constructed in accordance with Schedule 1, Division 2: Standards for Roads, Carparking, Manoeuvring Areas and Access, Section 2.1(1).
Alternative Solution – PC20	
Access road from the quarry will be directly onto Moray Carmichael Road and will be designed for all weather access. The access roads will be hard patched gravel with a 9 m width.	
PC30 Excavation or Filling Excavating or filling of land: (a) ensures safety and amenity for the users of the "premises" and nearby land; (b) minimises soil erosion and instability of surrounding areas; and (c) does not degrade the environmental values of receiving waters	**AS30.1** Batters have a maximum slope of 25%, are terraced at every rise of 1.5 metres and each terrace has a minimum depth of 750mm. **AS30.3** The extent of filling or excavation does not exceed 40% of the site area or 500m2 whichever is lesser. **AS30.4** Filling and excavation is not greater than 1 metre in height or depth.
Alternative Solution – PC30	
Not relevant to an extraction area, but is relevant to the development of site access roads. The extraction and filling for the access roads will meet AS30.1 and AS30.4. The access road will be 9 m wide.	

Section 6 Conclusion

The Moray Quarry is proposed to be developed over 91.2 ha of generally disturbed land (grazing and quarry activities), approximately 145 km north of Clermont in Central Queensland. Moray Quarry is cleared, contains a significant amount of exotic species, has no watercourses and is subject to intermittent quarry extraction. The topography of the site is generally flat except for the small sedimentary rock outcrop in the southern section of the site.

Onsite monitoring and surveys were carried out to assess the existing environment, the flora and fauna present, the existing background noise and air quality and the current road conditions and traffic movements.

Desktop analyses by Environmental Scientists and Engineers were undertaken for the flora and fauna, ecology, soils and geology, hydrogeology and traffic and transport. The impact assessment has determined that the activity will be acceptable and no major or high risk impacts are likely. The main issues requiring careful management include:

- Weed control prior to development of the site to address Buffel Grass (*Pennisetum ciliare*) and Rhodes Grass (*Chloris gayana*);
- Appropriate implementation of erosion and sediment controls to ensure the surface water quality and aquatic ecosystems of North Creek and the Belyando River are not adversely impacted;
- Undertaking of a further indigenous cultural heritage survey to obtaining final cultural heritage clearance for the Moray Quarry site;
- Careful management of air and noise controls during the peak production month to ensure air and noise limits are not exceeded; and
- Baseline monitoring of nearby groundwater bore and installation of groundwater bores to ensure there are no unexpected impacts to local groundwater.

The land use and planning assessment has established that the quarry is generally consistent with the requirements of the *Belyando Shire Planning Scheme 2009* and State Planning instruments.

In accordance with Australia's National Strategy for Ecologically Sustainable Development (1992), ecologically sustainable development is defined as *"using, conserving and enhancing the community's resources so that ecological processes, on which life depends, are maintained, and the total quality of life, now and in the future, can be increased"* (ESDSC, 1992). The Moray Quarry is proposed to be developed on a disturbed site and will be located to avoid Threatened Ecological Communities and areas of conservation significance. The Moray Quarry development seeks to appropriately utilise quarry resources for the construction of new infrastructure and upgrading of local roads to service the surrounding region. Comprehensive environmental management controls will be enforced during construction and operation of the quarry and the ecological processes of the surrounding area will be maintained. The Moray Quarry will support the economy and employment in the local and wider region and is considered consistent with the principles of ecologically sustainable development.

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Section 8 Acronyms and Abbreviations

Acronym/Abbreviation	Description
AAPT	Adani Abbot Point Terminal Pty Ltd
ACH Act	*Aboriginal Cultural Heritage Act 2003*
AHD	Australian Height Datum
AMU	Agricultural Management Unit
BOR	Bureau of Meteorology
CBR	California Bearings Ratio
CHMP	Cultural Heritage Management Plan
CLR	Contaminated Land Register
CSIRO	Commonwealth Scientific and Industrial Research Organisation
dB	Decibels
DEO	Desired Environmental Outcome
DPI	Department of Primary Industries (DPI)
DRO	Desired Regional Outcome
DTMR	Department of Transport and Main Roads (Qld)
EC	Electrical Conductivity
EHP	Department of Environment and Heritage Protection (Qld)
EIS	Environmental Impact Statement
EMR	Environment Management Register
EP Act	*Environmental Protection Act 1994*
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999* (Cth)
EPC	Exploration Permit for Coal
EP Regulation	*Environmental Protection Regulation 2008*
EPP	Environmental Protection Policy
ERA	Environmentally Relevant Activity
ERP	Emergency Response Plan
ESCP	Erosion and Sediment Control Plan
GDE	Groundwater Dependant Ecosystem
GMU	Groundwater Management Unit
GQAL	Good Quality Agricultural Land
ha	Hectare
IDAS	Integrated Development Assessment System
ILUA	Indigenous Land Use Agreement
IRC	Isaac Regional Council
km	Kilometre (s)
kVA	Kilo Volt Amperes
LRA	Land Resource Area
LT Act	*Land Title Act 1994*
m	Metre (s)
m^3	Cubic Metres
mbgl	Metres Below Ground Level
MCU	Material Change of Use
MLA	Mine Lease Application
MQSH Act	*Mining and Quarry Safety and Health Act 1999*
Mtpa	Million Tonnes Per Annum
NC Act	*Nature Conservation Act 1992*
NNTR	National Native Title Register
NRM	Department of Natural Resources and Mine (Qld)
PMAV	Property Map of Assessable Vegetation
PVMP	Property Vegetation Management Plan
QH Act	*Queensland Heritage Act 1992*
RE	Regional Ecosystem
RN	Registered Number

Acronym/Abbreviation	Description
SARA	State Assessment and Referral Agency
SCL	Strategic Cropping Land
SCR	State Controlled Road
SDPWO Act	*State Development and Public Works Organisation Act 1971*
SP Act	*Sustainable Planning Act 2009*
SP Regulation	*Sustainable Planning Regulation 2009*
SPP	State Planning Policy
SWL	Standing Water Level
SWMP	Stormwater Management Plan
t	Tonnes
TEC	Threatened Ecological Community
TDS	Total Dissolved Solids
TMR	Department of Transport and Main Roads (Qld)
UA	Unincorporated Area
µS/cm	Microsiemens per centimetre
VM Act	*Vegetation Management Act 1999*
VPD	Vehicles Per Day
WRP	*Water Resource (Burdekin Basin) Plan 2007*

Appendix A - Adani Environment and Sustainability Policy

Adani Mining Pty Ltd

Environment and Sustainability Policy

Adani Mining Pty Ltd is an environmentally responsible company that is committed to protection of the environment and to the sustainable management of its operations and activities.

We will achieve this by:

- Promoting engagement, participation and a culture of innovation;
- Encouraging the efficient use of water and energy, recycling of materials, reduction of waste and prevention of pollution;
- Improving our management if greenhouse emissions and energy efficiency;
- Implementing and maintaining an Environmental Management System in accordance with AS/NZS ISO 14001;
- Meeting or exceeding environmental legislation and other criteria to which we subscribe;
- Completing regularly reviews of our environmental performance and identify and implement opportunities for improvement;
- Motivating and influencing our suppliers and subcontractors with our approach towards responsible environmental practice;
- Promoting initiatives, systems, values and behaviours that drive environmental sustainability;
- Displaying strong leadership in environmental management internally and within the industries we operate; and
- Provide a positive environmentally friendly working environment.

We all have an accountability and responsibility to:

- Immediately report and remediate any damage, spills or loss of containment;
- Follow all environment and sustainability work practices, procedures, instructions and rules;
- Work in a manner which ensures minimal environmental impact;
- Encourage other employees to work in a responsible manner; and
- Participate in training.

Samir Vora
Chief Operating Officer

Date: 24th May 2012

Appendix B - Traffic and Transport Impact Assessment

TRAFFIC · PARKING · ACOUSTICS

Moray Quarry Proposal

Traffic Engineering Report

Adani

Reference: 12SCT0107/01MP

24.04.2013

 Reference No: 12SCT0107/01MP

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1. Background

1.1 Introduction

TTM Consulting has been engaged by Adani undertake a Traffic and Pavement Impact Assessment in support of an Extension of Use application for an existing quarry. Moray Quarry is described as Lot 662 on PH1491 ('the site'), as shown in **Figure 1.1**. It is understood that a Development Application will be lodged with Isaac Regional Council (IRC), with the Department of Transport and Main Roads (DTMR) as a concurrence agency.

1.2 Scope

This report investigates the transport aspects associated with the proposed development. The scope of the transport aspects investigated includes:

- Identification of likely traffic volumes, distribution and composition from the future development;
- Identification of likely traffic impact of development on the public road network;
- Identification of likely pavement impact of development on the public road network;
- Road upgrades to be provided to mitigate the impact of the proposed development on the external road network, if any; and
- Access configuration to provide efficient and safe manoeuvring between the site and the public road network.

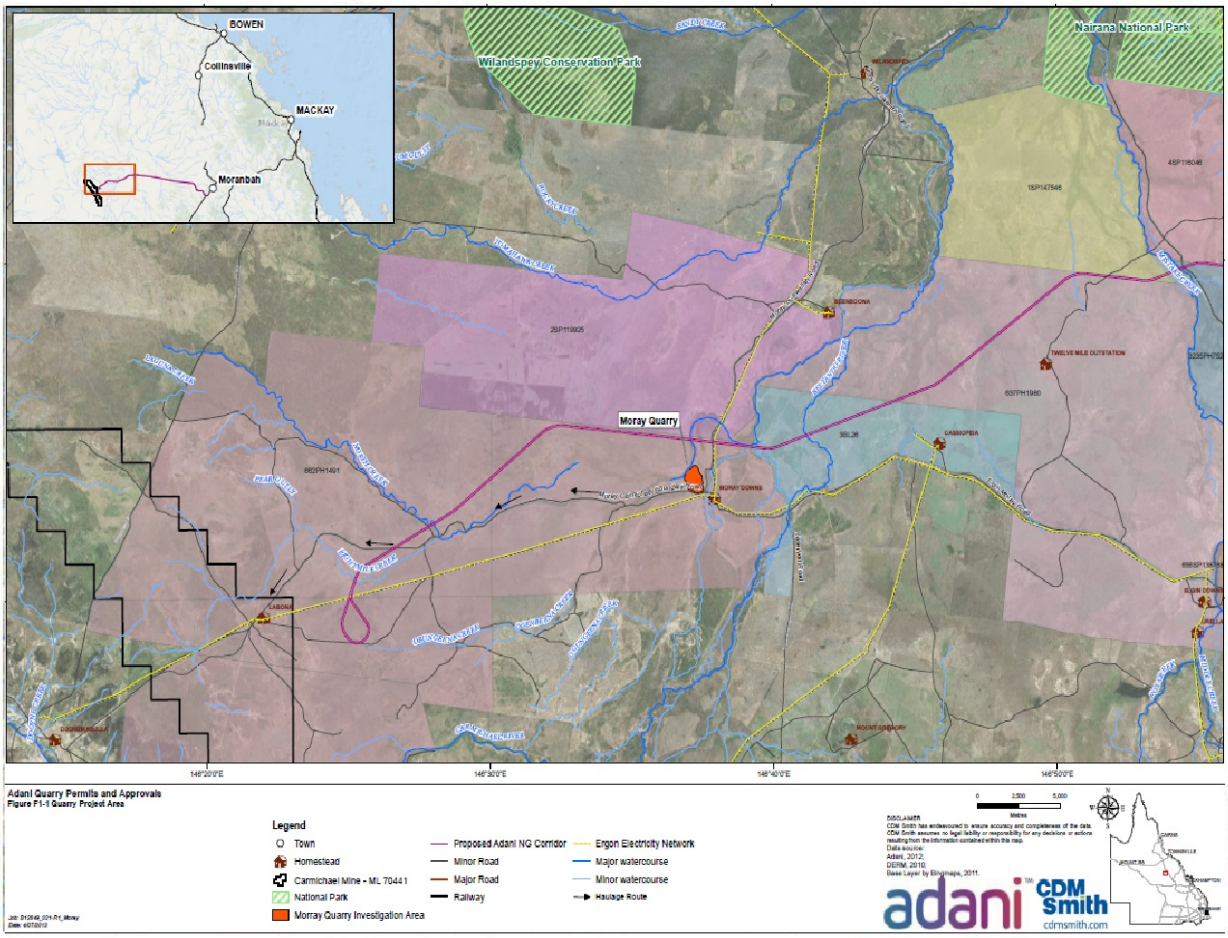


Figure 1.1: Site Location

This report investigates the transport aspects associated with the set up and on-site operations of Moray Pit and quarries only. This report does not include an assessment of the following:

- Fuel requirements for haulage activities. Fuel for haulage activities will utilise a centrally located fuel farm which will be shared with other uses involved with mining and rail operations. This fuel farm will be assessed within the EIS for the Carmichael Coal Mine and Rail Project;
- Construction or use of haul road / rail maintenance road. This will be assessed with specific applications regarding the Carmichael Rail Project, including any interim use of a haulage facility crossing state or local roads;
- Use of Moray Pit and associated quarries for commercial activities not related to the Carmichael Coal Mine and Rail Project. The use of these quarries is primarily for the construction of this project with a cumulative 1Mtpa of material required per year after this period; and
- The ultimate layout of the Gregory Development Road / Elgin Road intersection or alignment of Elgin Road.

To assess the proposed transport arrangements, the development plans have been assessed against the following guidelines and planning documents:

- Belyando Shire Planning Scheme;
- Department of Transport and Main Roads Road Planning and Design Manual; and
- Department of Transport and Main Roads Guidelines for Assessment of Road Impacts of Development (GARID).

1.3 Methodology

TTM have reviewed development traffic movements to obtain a 'Study Area'. Existing and proposed transport infrastructure within this study area was then investigation through desktop study, liaison with road authorities (IRC and DTMR) and a site visit on Tuesday 5th March 2013.

Data obtained from road authorities includes road volume and composition data, accident data, road maintenance and rehabilitation information among other information. The site visit included a basic road condition assessment, intersection movement surveys and a site distance assessment.

The traffic and pavement impacts of the proposed development within the study area were then assessed using principles in GARID.

1.4 Proposed Development

The development proposal is the expansion of existing quarry operations to 500,000 tonnes per annum (tpa). The existing quarry produces an insignificant output which will not be deducted from future operations to provide a robust assessment. Further information on the proposed quarry operations is provided in **Section 5**, with the site layout shown in **Appendix A**.

Moray Quarry will provide embankment fill for a rail line and airport related to the proposed Carmichael Coal Mine.

A review of quarry vehicle generation has identified traffic movements from the Gregory Development Road to Moray Quarry, and movements from the Quarry to a haul road running parallel to the proposed rail line. The study area as shown in **Figure 1.2** therefore incorporates the Gregory Development Road and route to the haul road via Elgin Road and Bulliwallah Road.

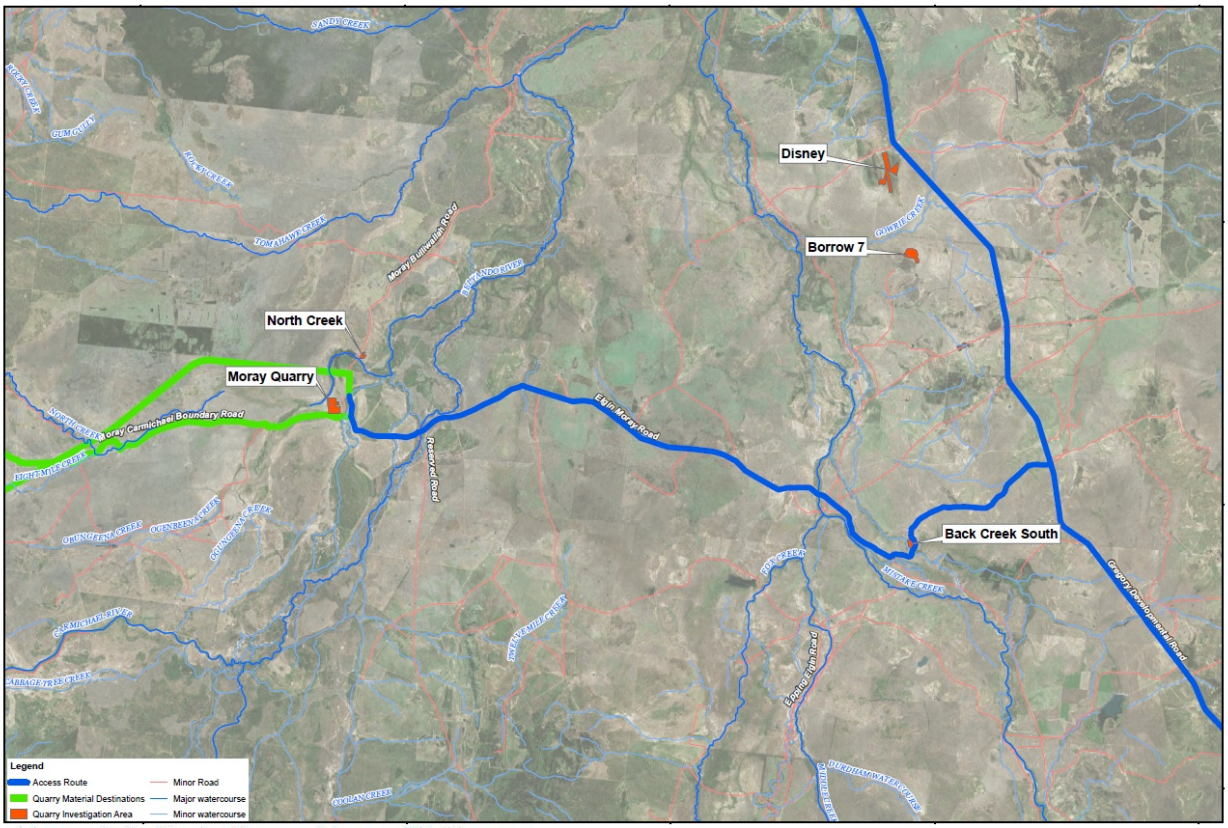


Figure 1.2: Study Area – Moray Pit Quarry

2. Existing Transport Infrastructure

2.1 Introduction

This Chapter provides a review of the existing transport infrastructure adjacent to the proposed development site, with **Table 2.1** providing a summary of the key road characteristics.

Table 2.1: Road Hierarchy & Road Characteristics

Road	Posted Speed Limit	Road Characteristics	AADT (Source)	Road Authority and Status
Elgin Road (Elgin Moray Road)	80kph	Gravel, 8m with 2 Lanes	61 (IRC)	IRC controlled, Local Road
Bulliwallah Road (Moray Bulliwallah Road)	80kph	Gravel, 8m with 2 Lanes	10 (IRC)	IRC controlled, Local Road
Moray Carmichael Road (Moray Carmichael Boundary Road)	80kph	Gravel, 8m with 2 Lanes	56 (IRC)	IRC controlled, Local Road
Twin Hills Road	80kph	Gravel, 4-5m, 1 lane	2 (Survey)	IRC controlled, Local Road
Gregory Developmental Road (Clermont to Belyando Crossing)	110kph	Sealed, 8m with 2 lanes	450 (DTMR)	DTMR controlled, State Strategic Road

The Council controlled roads do not have a posted speed limit and therefore 80kph has been adopted as the highest speed allowed on these gravel roads. Elgin Road is partially signed as 20kph in the vicinity of a homestead immediately south of the intersection with Bulliwallah Road. Elgin Road and Bulliwallah Road vary in carriageway width from 6m to 10m, however are generally around 8m wide. Twin Hills Road is generally one lane construction, however some sections allow vehicles to pass each other.

All intersections within the study area are 3 arm priority controlled intersections, with the exception of Gregory Development Road / Twin Hills Road / Avon Road intersection which is a four arm staggered intersection. The Elgin Road / Bulliwallah Road / Moray Carmichael Road intersection does not appear to have a specific priority route.

Section 3 reviews the access routes and intersections in more detail.

2.2 Flooding, Disaster & Relief Review

The Gregory Development Road and Kilcummin Diamond Downs Road cross numerous floodplains and floodways, with instances of flooding close to the roads at multiple locations for significant periods, which have caused multiple road closures. A 12km section of Gregory Development Road is included as part of the Reconstructing Mackay / Whitsunday – West Package. Works on this package started in April 2012 and are expected to be completed late 2013, however the specific section of Gregory Development Road to be reconstructed is unknown. DTMR identified that during significant rain events they may restrict load limits on this road to protect the pavement.

2.3 Public Transport

School bus routes may utilise roads within the study area, particularly Gregory Development Road. During the site visit however, TTM did not see evidence of school bus routes or stops on these roads. There are no dedicated foot or cycle paths within the study area.

2.4 Road Safety

A review of crash data was undertaken for the section of Gregory Developmental Road between Clermont and Belyando Crossing, approximately 158 km in length. A summary of this data is shown in **Table 2.2** with the data. The crash data reveals:

- A total of 39 accidents over a 5 year period (includes non serious crashes for 3.5 years only);
- 87% were single vehicle crashes, and 13% were multi-vehicle crashes;
- 46% of accidents were single vehicle accidents where the vehicle left the carriageway; and
- Fatigue was recorded as a contributing factor in 31% of the crashes, with driver inattention contributing to 18% of accidents.

Table 2.2: Crash History – Gregory Developmental Road (2005-2009)

Year	Single Vehicle	Multiple Vehicles	Fatal	Total
2007	6	1	1	7
2008	11	1	1	12
2009	9	1	-	10
2010	-	1	-	1
2011	4	-	1	4
2012	4	1	-	5
Total	34	5	3	39

Elgin Road experienced three single vehicle accidents during the above period which resulted in hospitalisations. No other vehicle accidents were recorded within the study area.

2.5 Road Planning & Scheduled Road Improvements

TTM have reviewed the Queensland Transport and Roads Investment Program 2012-13 to 2015-16 for the Mackay / Whitsunday region. It is understood that Gregory Development Road will be rehabilitated from 6km north of the Twin Hills Road intersection for a distance of approximately 71km in a southerly direction. It is further understood signage will installed or replaced at the Gregory Development Road / Bowen Development Road intersection.

Following a review of Council's 2011-2012 budget, it is understood that the following roads were subject to being re-sheeted during this period:

- Twin Hills Road;
- Bulliwallah Road; and
- Avon Road.

2.6 Development and Mine Planning

TTM are also involved in five other quarry applications within the local region as part of development of the Carmichael Coal Mine Project. The cumulative impact of these quarries within the study area will also be reviewed. DTMR have advised that other developments such as other mine projects do not have to be included in the cumulative impact review.

It is understood that Elgin Road and Moray Carmichael Road will be upgraded, realigned and maintained by Adani as part of the Carmichael Coal Mine and Rail Project. This upgrade will also include the provision of turn treatments of the Gregory Development Road / Elgin Road intersection. It is understood that the Elgin Road / Moray Carmichael Road upgrade will take place over a 12 month period from April 2014.

TTM have been advised that discussions relating to contributions with DTMR for the Carmichael Coal Mine and Rail Project are still ongoing and may be influenced by the conclusions in this report.

The ultimate layout of the upgraded Elgin Road is shown in **Figure 2.1**. It is understood that the Doongmadbullah Road / Bulliwallah Road will be reconfigured for this upgrade with Bulliwallah Road forming the minor and northern leg of a standard T intersection.

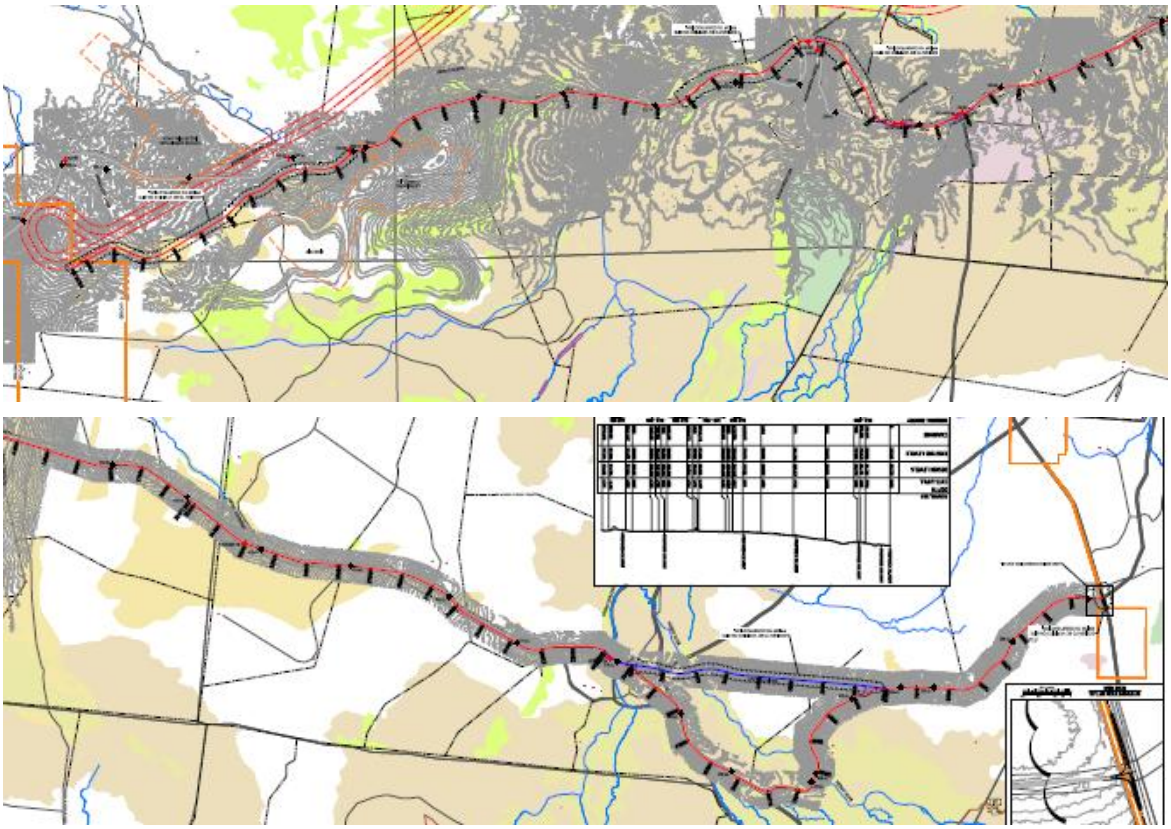


Figure 2.1: Elgin Road Upgrade

3. Access Route Review

3.1 Gregory Development Road / Elgin Road Intersection

The intersection layout is a typical priority 3-arm intersection as shown in **Figure 3.1**, with no turn treatments provided. This intersection has good visibility in both the north and south directions, with the following traffic and geometric attributes:

- A posted speed limit of 110km/hr;
- A 7 metre wide carriageway with 0.5m wide shoulders;
- Minimum 350m site distance in each direction;
- A wide 31 metre entry width to Elgin Road for large turning vehicles;
- Elgin Road is sealed to 25.5m from Gregory Development Road; and
- A cattle grid on Elgin Road, 35m from Gregory Development Road restricts movement at this location to one lane only.

Figure 3.1: Intersection Aerial and Site Photographs

3.2 Elgin Road / Twin Hills Road Intersection

The intersection layout is a typical priority 3-arm intersection as shown in **Figure 3.2**, with no turn treatments provided. This intersection has good visibility in both the east and west directions, with the following traffic and geometric attributes:

- Speed limit not posted;
- Elgin Road has a 7m wide gravel carriageway with grass verges;
- Twin Hills Road has a 5m wide gravel carriageway with grass verges; and
- Minimum 350m site distance in each direction.

Figure 3.2: Intersection Aerial and Site Photographs

3.3 Elgin Road / Moray Carmichael Road / Bulliwallah Road Intersection

The intersection layout is a non-standard 3-arm intersection. No turn treatments are provided at this intersection however the radius from each leg is wide enough to enable two-way traffic flow along each leg. The intersection is large and photographs do not adequately show the intersection geometry. Aerial imaging in this region is also poor and therefore **Figure 3.3** only shows photographs of the intersection to each leg.

This intersection has good visibility in both the north and south directions, with the following traffic and geometric attributes:

- No posted speed limit;
- Elgin Road (southern approach) narrows to 5m wide at a bridge / culvert immediately south of the intersection;
- Moray Carmichael Road (western approach) and Bulliwallah Road (northern approach) are approximately 7m wide from the intersection; and
- Minimum 150m site distance in each direction.

Figure 3.3: Intersection Aerial and Site Photographs

3.4 Other Intersections

There are other intersections along the access route (Elgin Road) with Mt Gregory Road and Walthum Road. These intersections are all gravel with the minor roads including a 3m wide carriageway, and minimum 200m sight distances in each direction.

3.5 Elgin Road / Moray Carmichael Road / Bulliwallah Road

These roads are gravel and generally 8m wide. The road geometry does not include any sharp curves or steep inclines and reasonable sight distance is provided along most of the route. There are a number of cattle grids between property boundaries which restrict the road to one lane. These cattle grids have advanced warning signs. There are also 4 one lane bridges along the route. These bridges also have advanced warning signage with give way controls on the western approach to provide priority.

4. Traffic Volumes

4.1 Existing Peak Hour Volumes

DTMR have provided 2012 Annual Average Daily Traffic (AADT) data for the Gregory Development Road. A summary of this traffic data is provided in **Appendix B**.

TTM conducted 24 hour intersection movement surveys at the following intersections on Tuesday 5th March 2013:

- Gregory Development Road / Elgin Road;
- Gregory Development Road / Twin Hills Road / Avon Road; and
- Elgin Road / Bulliwallah Road / Moray Carmichael Road .

The peak hours were generally found to be 9:15-10:15am and 3:30-4:30pm. The level of truck (i.e. non-car) content on the Gregory Development Road was found to be 29%. The peak hour results of these surveys are shown in **Figure 4.1**.

4.2 Future Year Traffic Growth

It has been agreed with DTMR that a 10% growth is suitable for the 10 year design horizon (till 2024) with a 5% growth rate for further assessment after this year.

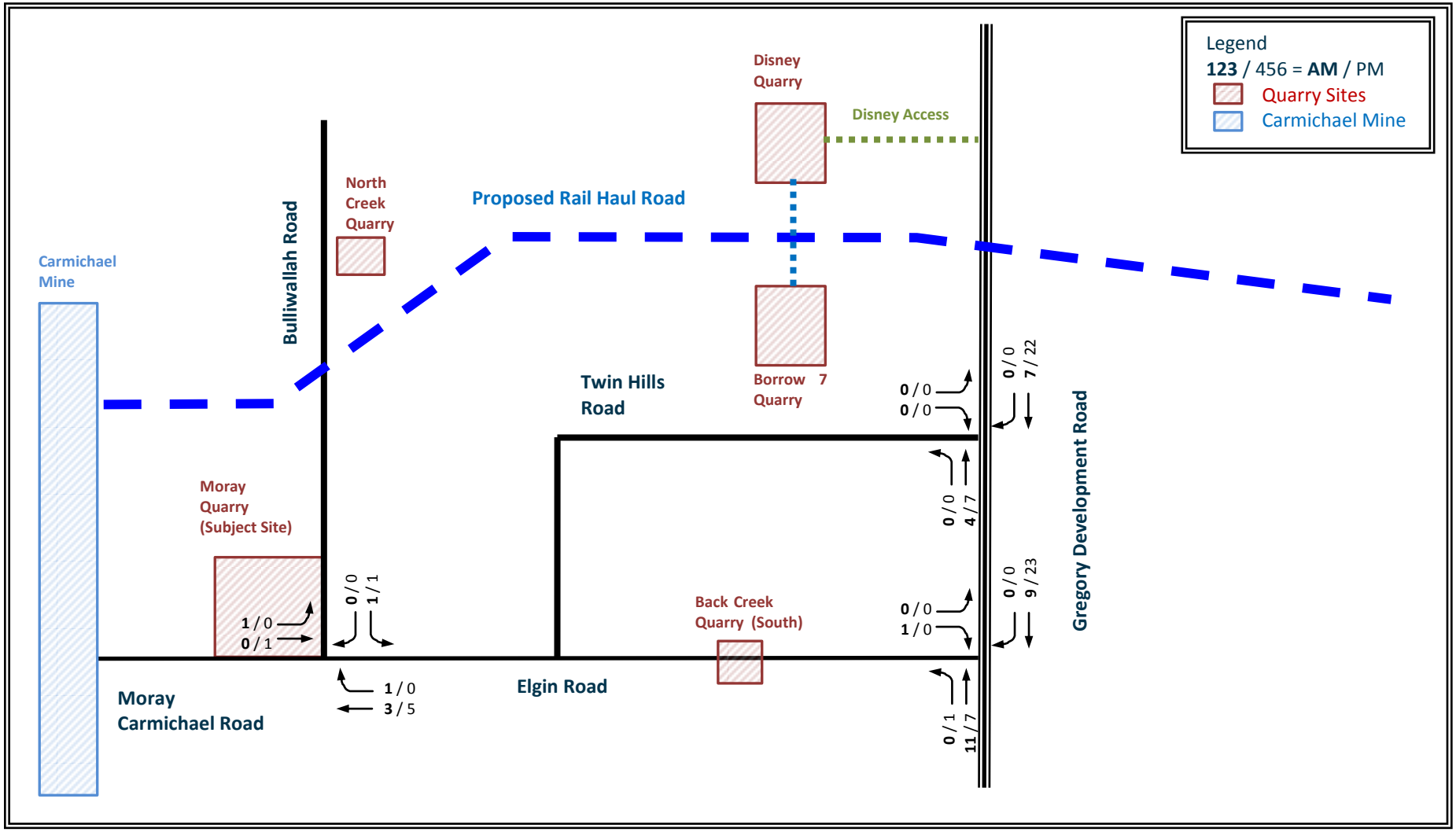


Figure 4.1: Study Area Peak Hour Traffic 2013

4.3 Existing ESA's

Advice from DTMR identifies an ESA value of 3.2 per heavy vehicle for all roads other than the Bruce Highway. This ESA value will be used for all existing heavy vehicles noted within the study area.

Table 4.1 provides the existing levels of ESAs on roads within the study area with the level of ESA's based on existing traffic data noted in **Table 2.1**, with heavy vehicle composition based on DTMR and Council advice.

Table 4.1: Existing ESAs within Study Area

Road	Number of Vehicles per Class	ESA Total	
		Daily	Annual
Gregory Development Road	450vpd with 28.7%HV @ 3.2 ESA / HV	**413**	**150,700**
Elgin Road	61vpd with 35.7% HV @ 3.2 ESA / HV	**69.7**	**25,400**
Moray Carmichael Road	56vpd with 53.5% HV @ 3.2 ESA / HV	**95.9**	**35,000**
Bulliwallah Road	10vpd with 22.4% HV @ 3.2 ESA / HV	**7.2**	**2,620**

5. Quarry Operations

5.1 Existing (Proposed) Quarry Site Operations

The following existing operational parameters have been considered for the traffic and pavement impact assessments:

- The expanded operations are intended for a short term period only (approx 2 years); and will remain operational at a significantly reduced capacity and on an as need basis for maintenance;
- The site will operate 24 hours;
- Typical annual quarry operations are 360 working days per year;
- An AB Triple vehicle with an average payload of 75t will be used;
- Truck movements will be split 50% in and 50% out during peak traffic periods;
- It is predicted that there will be 3-4 staff working on site; and
- The site peak traffic periods are between 07:00 and 08:00 and 16:00 and 17:00.

5.2 Development Truck ESA Loading

5.2.1 Haul Vehicles

It is likely that a typical AB Triple will haul the material from the quarry. The payload will be approximately 75t for each vehicle. TTM have reviewed the "Review of Heavy Vehicle Axle Load Data – Information Paper" (NTC Australia, July 2005). This document provides ESA values for an unloaded A Triple vehicle (1.67 ESA / vehicle) and an equation to derive ESA values for various loads (9.2 ESA / vehicle with a 75t payload).

The highest predicted annual haulage from Moray Quarry will be 500,000t. Haulage will be restricted to the local road network and a private haulage road. Haulage from the Moray Quarry will not access the SCR. The predicted daily level and peak hour number of trucks generated shown in **Table 5.1**.

Table 5.1: Estimated Daily & Peak Hour Haul Vehicle Generation

Tonnage/day	Average tonnes per load	Trucks in (load bearing)	Trucks out (non load bearing)	Total daily truck movements	Peak hour truck movements
Average: 724t	75	10 (92 ESA)	10 (17 ESA)	20 (109 ESA)	4
Peak Month: 2,223t	75	30 (276 ESA)	30 (50 ESA)	60 (326 ESA)	12

Based on the assumptions shown in **Table 5.1** (combination of unloaded and loaded trips) we have calculated the following to establish the daily and equivalent ESA's generated annually:

- Average Annual ESA: 20 daily two-way trucks = 39,240 ESA; and
- Peak Annual ESA = 72,467 ESA (Maximum permissible haulage based on 500,000tpa).

5.2.2 Service Vehicles

TTM have been advised that service vehicles for site set up and operation will be as indicated in **Table 5.2**. Traffic Reports for other quarry applications should be reviewed for detail regarding service vehicle movements for other individual quarries.

Quarry operations may generate some additional minor and infrequent heavy vehicle movements, such as trucks collecting waste from site. These movements are however expected to be low in number and utilise smaller trucks, which would involve small ESA increases. **Table 5.2** includes conservative values for water and maintenance deliveries which should offset the non-inclusion of these other heavy vehicles.

Fuel requirements are based on 11,852L per week needed for Moray Quarry and 257,685L for all quarries collectively. Fuel will be transported in B-doubles with a 50,000L capacity, with a conservative ESA value of 8 per delivery accounting for entry (loaded) and exit (unloaded) movements of each vehicle. It is reiterated that this fuel is for the operation of the quarry / quarries only and does not include haulage activities, which will be serviced via a communal fuel farm and assessed through the EIS for the Carmichael Coal Mine and Rail Project.

Table 5.2: Estimated Number of Service Vehicles For Site Set Up and Operation

Service Vehicles	Moray Deliveries (in + out movements)	Moray Deliveries (ESA)	Moray (Annual ESA)	All Quarry Deliveries (in + out movements)	All Quarry Deliveries (ESA)	All Quarry (Annual ESA)
Site Set up	20	60	60	400	1,200	1,200
Operations: From Townsville	Fuel: 1 per week	Fuel: 4 per week	Fuel: 208	Fuel: 12 per week	Fuel: 48 per week	Fuel: 2,496
Operations: From Mackay	Water: 2 per week Maintenance: Negligible	Water: 6 per week	Water: 312	Water: 12 per week Maintenance: 14 per week Total: 26 per week	Water: 36 per week Maintenance: 42 per week Total: 78 per week	Water: 1,872 Maintenance: 2,184 Total: 4,056
Total (Annual)	**176 trips**		**580 ESA**	**2,376 trips**		**7,752 ESA**

5.3 Site Truck Distribution

TTM have consulted with Adani to determine likely distributions of quarry material. This includes not only the Moray Quarry, but also all other quarries related to the Carmichael Coal Mine and Rail Project. The defined study area for Moray Quarry includes the following road sections:

- Gregory Development Road from Peak Downs Highway to Belyando Crossing:
- Elgin Road;
- Moray Carmichael Road from Elgin Road to the Mine Site;
- Bulliwallah Road from Elgin Road to the Haul Road; and
- Haul Road from Bulliwallah Road to Mine Site.

The anticipated truck distributions from the Moray Quarry and associated quarries within this study area only are shown in **Table 5.3**. Route sections identified in this Table are shown in **Figure 5.1**. Heavy vehicles associated with site set up have been included in the route from the Peak Downs highway to provide a robust assessment (worst case scenario).

Table 5.3: Key Service Vehicle Routes

Haulage Routes		Moray Pit Truck Distribution (VPD)	Annual ESA's	All Quarry Truck Distribution (VPD)	All Quarry Annual ESA's
Key Routes	Study Ref				
Elgin Road (Gregory Development Road to Back Creek)	Section A	100% Service Vehicles (0.5)	**580**	92% Service Vehicles (6.0)	**7,112**
Elgin Road (Back Creek to Twin Hills Road)	Section B	100% Service Vehicles (0.5)	**580**	70% Service Vehicles (4.5)	**5,394**
Elgin Road (Twin Hills Road to Elgin Pits)	Section C	100% Service Vehicles (0.5)	**580**	34% Service Vehicles (2.0)	**2,670**
Elgin Road (Elgin Pits to Bulliwallah Road)	Section D	100% Service Vehicles (0.5)	**580**	15% Service Vehicles (0.6)	**1,130**
Moray Carmichael Road (Bulliwallah Road to Moray Quarry)	Section E	100% Service Vehicles (0.5)	**580**	7% Service Vehicles (0.5)	**580**
Twin Hills Road (Elgin Road to Borrow 7 Access)	Section F	-	**-**	35% Service Vehicles (2.5)	**2,724**
Bulliwallah Road (Elgin Road to North Creek)	Section G	-	**-**	7% Service Vehicles (0.5)	**550**
Gregory Development Road (Belyando Crossing to Disney)	Section H	36% Service Vehicles (0.1)	**208**	32% Service Vehicles (1.7)	**2,496**
Gregory Development Road (Disney to Haul Road)	Section I	36% Service Vehicles (0.1)	**208**	36% Service Vehicles (2.2)	**2,810**
Gregory Development Road (Haul Road to Elgin Road)	Section J	36% Service Vehicles (0.1)	**208**	36% Service Vehicles (2.2)	**2,810**
Gregory Development Road (Elgin Road to Peak Downs Highway)	Section K	64% Service Vehicles (0.4)	**372**	68% Service Vehicles (4.3)	**5,256**

5.4 Site Staff

It is anticipated that the quarry staff will be transferred by bus between the workers accommodation village and quarry site. The transfer route used will generally follow the proposed rail haulage route and then access the local road network towards each quarry site location.

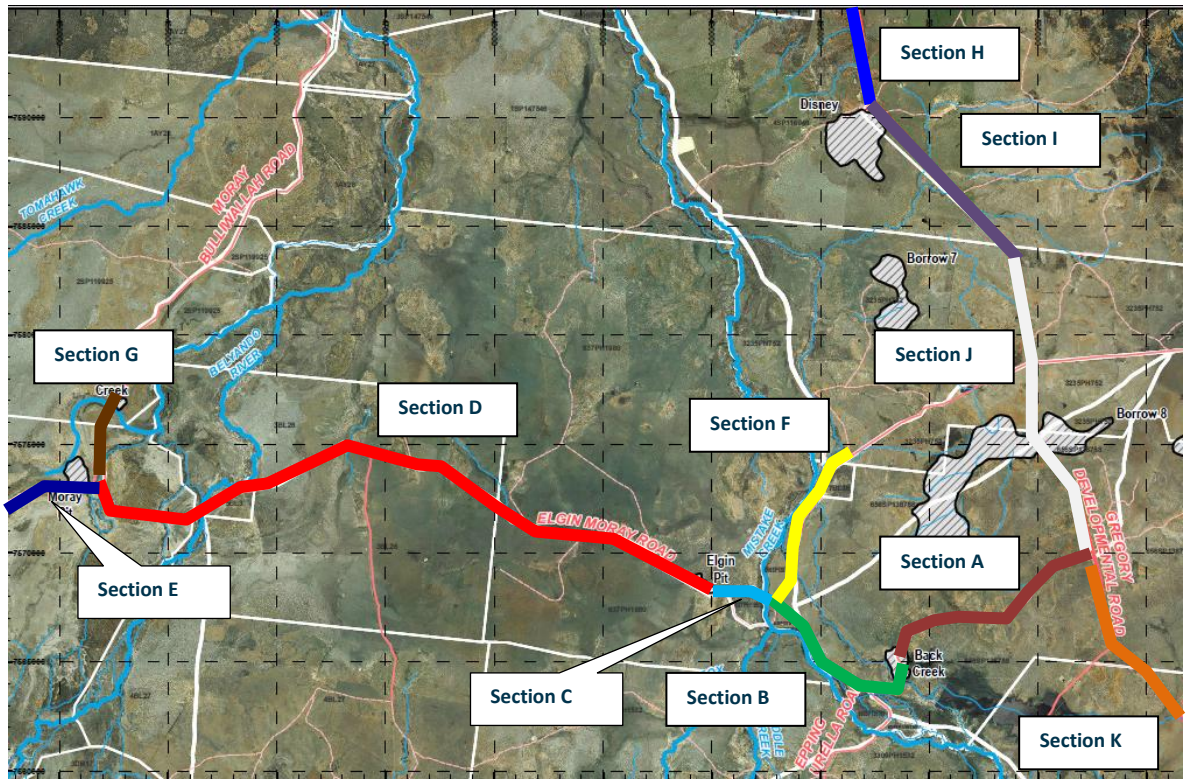


Figure 5.1: Study Area – Moray Quarry

6. Traffic Impact Assessment

6.1 Introduction

This Chapter reviews the traffic operation and capacity performance within the study area.

6.2 Road Corridor Capacity Assessment

6.2.1 Assessment Criteria

The AUSTROADS Guide to Traffic Management indicates that two-lane rural highways have a capacity of 2,800 passenger cars per hour total for both directions of flow, under ideal conditions where there are no restrictive roadway, terrain or traffic conditions.

AUSTROADS defines level of service as a qualitative measure describing operational conditions within a traffic stream. The term Level of Service (LOS) and its characteristics for rural roads is defined in **Table 6.1**.

Table 6.1: Two Lane Rural Road Capacity – Rolling Terrain Two-Way Flow

LOS	Description	Rating
A	Free, unrestrictive flow	Very Good
B	Mostly free flow, few disruptions	Very Good
C	Stable flow	Good
D	Mostly stable flow, some delays	Acceptable
E	Congested flow, delays common	Bad
F	Forced flow	Bad

The volume and composition of traffic on a given road determines the level of interaction between vehicles and is measured as its LOS. LOS decreases with increasing traffic volumes. LOS 'A', LOS B', LOS 'C' in a rural context are satisfactory, with a LOS 'D' satisfactory in some circumstances.

In cases where traffic, terrain or geometric data may not be precisely known, the AUSTROADS Guide provides planning guidance on maximum AADT values that two-lane, two-way rural roads can accommodate under various terrain conditions.

Table 6.2 shows the values for various Levels of Service for a rural road in rolling terrain with varying ratios of design hour volume to AADT.

Table 6.2: Maximum AADT's for Various LOS on Two-Lane Two-Way Rural Roads

	Level of Service				
Design Hour Volume to AADT Ratio	**A**	**B**	**C**	**D**	**E**
0.10	1,100	2,800	5,200	8,000	14,800
0.11	1,000	2,500	4,700	7,200	13,500
0.12	900	2,300	4,400	6,600	12,300
0.13	900	2,100	4,000	6,100	11,400
0.14	800	1,480	3,700	5,700	10,600
0.15	700	1,800	3,500	5,300	9,900

6.2.2 Study Area Operational Performance

The highest volume road within the study area is Gregory Development Road which carries 450vpd. This volume is significantly less than the AADT threshold for a Level of Service 'A'.

Moray Quarry traffic is expected to increase traffic on the roads in the study area by no more than 69vpd vehicles during peak operations and as such the Level of Service 'A' is expected to be retained on all roads.

Cumulative development traffic will be highest on Elgin Road and Moray Carmichael Road with an average of 302 vehicles extra per day. As such, Level of Service 'A' is expected to be retained however some sections along this route may experience Level of Service 'B' roadway capacities in peak periods.

Roads operating at a LOS 'B' should have no significant road capacity issues with the predicted level of development traffic having a negligible impact on overall road corridor performance.

6.3 Intersection Capacity Assessment

6.3.1 Assessment Requirements

In a review of the GARID Guidelines Criteria 3: Traffic Operation Assessment, traffic operation impacts need to be considered for any section of a State Controlled Road (SCR) where the construction or operational traffic generated by the development equals or exceeds 5% of the existing AADT on the road section, intersection movements or turning movements.

6.3.2 Intersection Capacity Review

In a review of existing and future year traffic volumes at all intersections within the study area the highest trafficked road is Gregory Development Road with 31vph in the PM peak. TTM considers that all intersections within the study area will operate under uninterrupted flow conditions, which is based on guidance from the DTMR: Road Planning and Design Manual (RPDM) Chapter 13: Intersections at Grade: 13.5.4 Unsignalised Minor Road Intersections.

Table 13.4 Intersection Capacity - Uninterrupted Flow Conditions, is shown in **Figure 6.1**, with the level of peak hour traffic well below the criteria set in the table. TTM can therefore assume that uninterrupted flow conditions will occur, that the site access and local intersections will operate with nominal delays and queuing and no further capacity assessment is required.

Table 13.4 Intersection Capacity – Uninterrupted Flow Conditions

Major Road Types[1]	Major Road Flow (vph)[2]	Minor Road Flow (vph)[3]
Two-Lane	400	250
	500	200
	650	100
Four-Lane	1000	100
	1500	50
	2000	25

Notes
1. Major road is through road i.e. has priority
2. Major road design volumes include through and turning movements
3. Minor road design volumes include through and turning volumes

Figure 6.1: RPDM Chapter 13: Table 13.4

6.4 Access Route Intersection Review

TTM have reviewed the sight distance of all intersections within the study area in accordance with DTMR requirements as shown in **Figure 6.2**. Assessment of the required turn treatments at all intersections are also included in this review.

Table 13.5 Intersection Sight Distance for Level Pavement

Design Speed (km/h)	Dece-leration (g)(1)	Entering Sight Distance 1.15m to 1.15m (m)(3)	ASD - Approach Sight Distance (1.15m to 0.0m)				SISD - Safe Intersection Sight Distance (1.15m to 1.15m)			
			Absolute Minimum 2.0 secs(5)		Desirable 2.5 secs(5)		Absolute Minimum 2.0 secs(5)		Desirable 2.5 secs(5)	
			m(2)	min R(4)	m(2)	min R(4)	m(2)	min R(4)	m(2)	min R(4)
40	0.56	100	33	500	39	700	66	500	72	600
50	0.52	125	47	1000	54	1300	89	900	96	1000
60	0.48	160	63	1800	71	2200	113	1400	121	1600
70	0.45	220	82	2900	91	3600	140	2200	149	2500
80	0.43	305	103	4600	114	5700	170	3200	181	3600
90	0.41	400	128	7200	140	8600	203	4500	215	5100
100	0.39	500	157	10800	170	12600	240	6300	253	7000
110	0.37	500	190	15700	205	18300	282	8700	297	9600
120	0.35	500	229	22800	245	26100	329	11800	345	13000

Notes:
1. Average deceleration adopted, given in terms of acceleration due to gravity (g).
2. For grade corrections to ASD and SISD, see Table 13.6.
3. Limiting values of ESD based on the assumption that drivers are unlikely to seek gaps greater than 500m.
4. Crest vertical curve radius (m).
5. Reaction times.

Figure 6.2: RPDM Chapter 13: Intersections at Grade: Table 13.5

6.4.1 Gregory Development Road / Elgin Road

As noted in **Section 3.1**, the sight distance in each direction at this intersection exceeds 350m as shown in **Figure 3.1**. This sight distance is higher than the 345m sight distance noted in **Figure 6.2** for a road with a 120kph design speed and is therefore considered suitable.

Figure 6.3 identifies required turn treatments at this intersection based on base and project movement volumes for the Gregory Development Road / Elgin Road intersection on opening day (2014). **Figure 6.4** shows the required turn treatments in 2024. For a conservative assessment, it has been assumed that all daily vehicles will arrive in a single peak hour with double the average daily deliveries during peak periods. Existing movements at this intersection have been increase by 10% pa as noted earlier in this report.

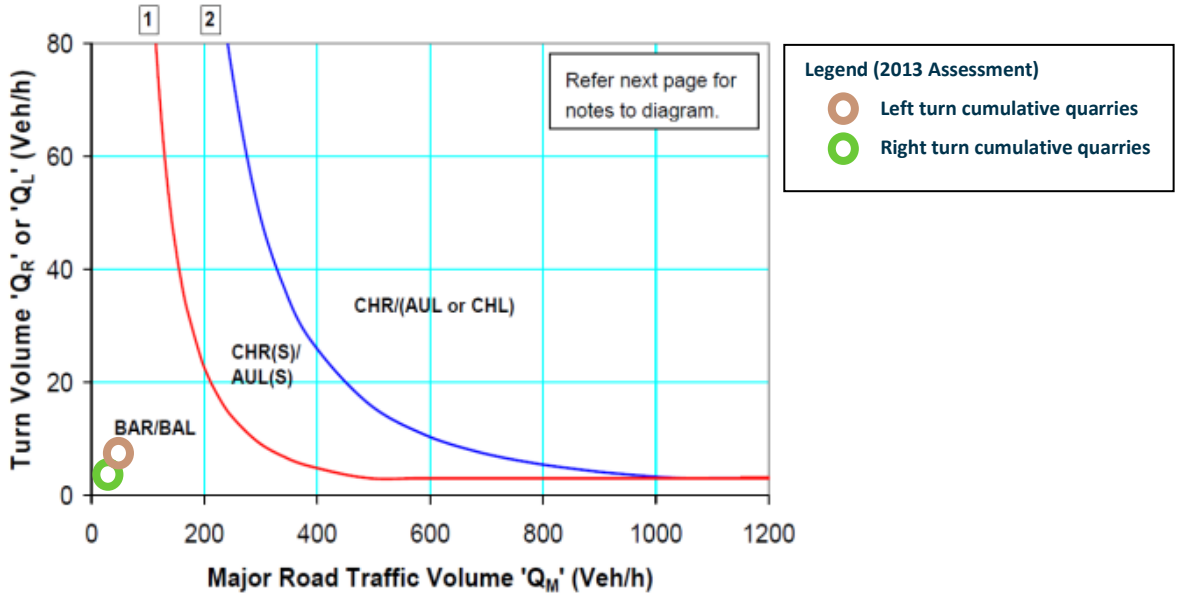


Figure 6.3: Gregory Development / Elgin Road: Warrants for Turn Treatments (2014)

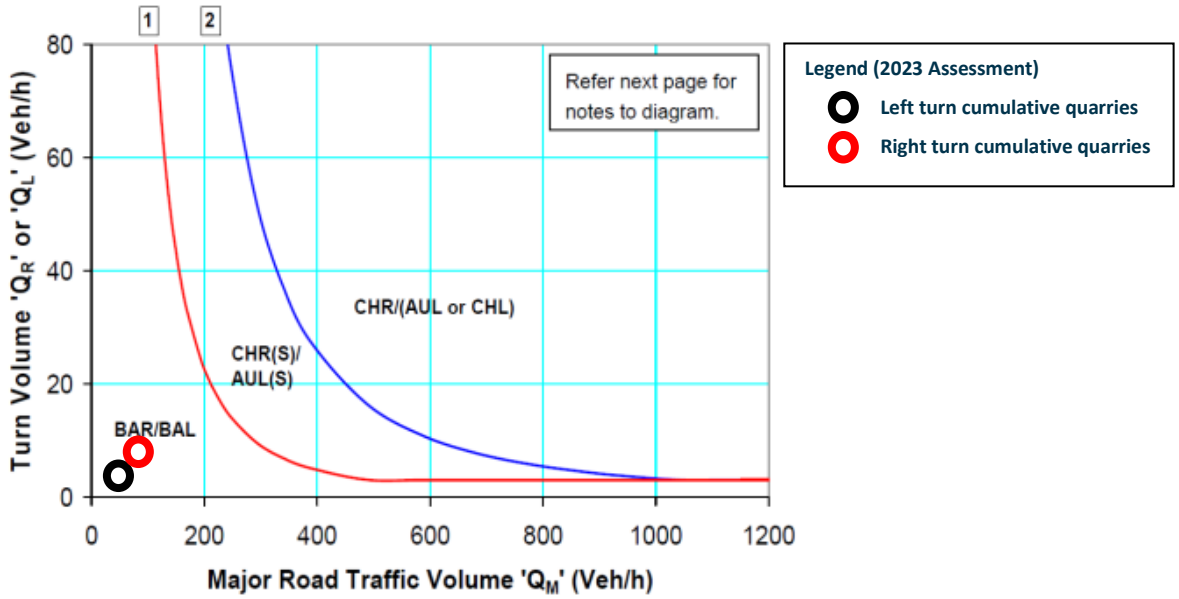


Figure 6.4: Gregory Development / Elgin Road: Warrants for Turn Treatments (2024)

This analysis identifies that basic left (BAL) and basic right (BAR) turn treatment are required at the Gregory Development Road / Elgin Road intersection prior to quarry operations. Higher order intersection treatments may be required based on other development in the area, however, these types of turn treatments only are required for the Moray Quarry and associated quarries.

6.4.2 Other Intersections

Other intersections along the access route are predicted to carry lower through and turn volumes than the Gregory Development Road / Elgin Road intersection. As such, BAL and BAR treatments should be suitable for minor intersections along this route. This should be confirmed when designing the final alignment of Elgin Road / Moray Carmichael Road . Also sight distances at each upgraded intersection should meet Austroads sight distances for the design speed of the road (10kph above the posted speed limit).

7. Pavement Impact Assessment

7.1 Introduction

Department of Transport and Main Roads (DTMR) has produced Guidelines for Assessment of Road Impacts of Developments Proposals, which aids in the assessment of impacts on state controlled roads (SCR).

In general terms, DTMR considers that an impact on a road is insignificant if there is a less than 5% increase in traffic, measured either as annual average daily traffic (AADT) or equivalent standard axles (ESAs). Haulage from Moray Quarry will not utilise the SCR and as such only service vehicles identified in **Table 5.2** and **Table 5.3** will have an impact on the SCR.

Table 7.1 shows the anticipated impact on the Gregory Development Road relating to predicted quarry movements for Moray Quarry and the five other quarries related to the Carmichael Coal Mine and Rail Project.

Table 7.1: Development ESA Impact

Road Segment /Site AADT Survey Location	Existing Annual ESA's (2012)	Moray Pit ESA	Moray Pit ESA Impact (2013)	Cumulative Quarry ESA	Cumulative Quarry ESA Impact (2013)
Section H	150,700	208	0.1%	2,496	1.6%
Section I	150,700	208	0.1%	2,810	1.9%
Section J	150,700	208	0.1%	2,810	1.9%
Section K	150,700	372	0.2%	5,256	3.5%

This assessment is based on 2012 volumes on the Gregory Development Road. As such the impact of quarry operations on the state controlled road network is expected to reduce over time.

7.2 Access Route Pavement Condition Assessment

7.2.1 Gregory Development Road

TTM has sourced the existing pavement condition from two sources. TTM undertook a visual assessment in 5th March 2013. This assessment identified the existing pavement configuration and indicative current surface condition, with a road summary shown in **Table 7.2**.

Table 7.2: Pavement Condition Summary

Road	Section	Length	Width	Condition
Gregory Development Road	Clermont to Belyando Crossing	157.8km	8m	Good surface, with minor rutting / roughness

The Gregory Development Road is a sealed road with a good standard from Clermont through to Belyando Crossing. Sealed shoulders between 0.5-1.0m wide are provided along this length.

7.2.2 IRC Controlled Roads

All Council roads within the study area are gravel with a general width of approximately 8m. Whilst there was some level of potholing, rutting and roughness on the local roads, the access route on the whole was in reasonable to good condition. Road defects were generally located in the vicinity of cattle grids, bridges and near water pooling. A Traffic Management and Maintenance Plan will be implemented as part of the Operational Works, as further noted in **Chapter 8**.

8. Site Access and Parking Arrangements

8.1 Site Access Arrangements

TTM understand that the site access arrangements will be designed in accordance with both Council and AUSTROAD's requirements and submitted as part of the Operation Works Application.

In developing a site access layout into the Moray Quarry from Moray Carmichael Road, TTM recommend the following access layout characteristics:

- A posted speed limit of 80km/hr with suitable site distances to approaching vehicles;
- A 7 metre wide carriageway;
- Lane flares at the access to allow haul vehicles to enter and exit simultaneously without conflict;
- BAR treatments and shoulder provisions; and
- A cattle grid at the property boundary to remove dust and gravel from vehicle tyres.

8.2 Parking Arrangements and On-site Manoeuvring

TTM recommend that formal parking areas are provided for vehicles that are required to wait on-site, including parking areas dedicated for the anticipated peak number of buses, private vehicles and service vehicles on site at any given time. Formal parking areas should also be kept clear of haul vehicle manoeuvring with a preference to segregate haul vehicle routes from other vehicle movements as soon as possible within the property boundary.

It is also recommend that onsite haul vehicle swept paths are reviewed to ensure for adequate internal manoeuvring and clearance zones between any pedestrian, operational and parking requirements.

TTM note that Adani will incorporate the above recommendations into their site plan for Moray Quarry.

9. Traffic Management & Maintenance Plan

TTM recommend for a Traffic Management and Maintenance Plan to be implemented for the duration of quarry haulage activities, which would be in place prior to any on-site activity. This plan will be developed in conjunction with both Council and DTMR and will likely to cover the following areas:

- Interim haulage of quarry material along Elgin Road;
- Interim haulage of quarry material onto the Gregory Development Road;
- Construction of the Gregory Development Road overpass;
- Upgrade of Elgin Road / Moray Carmichael Road ;
- Construction of haul route intersections with local roads (Bulliwallah Road); and
- Maintenance Plan to be developed for designated quarry routes on both Local and State controlled roads.

10. Developer Contributions

10.1.1 DTMR

Table 7.1 indicates that the proposed operations of all quarries, including Back Creek Quarry, will not have a significant impact on the state controlled road network. As such no assessment of contributions is required. Any upgrade of the Gregory Development Road / Elgin Road intersection should be at the cost of Adani. It is understood that the upgrade of this intersection will incorporate higher order turn treatments than included in this report and as such the intersection layout should suitably mitigate traffic impacts from quarry operations.

10.1.2 IRC

It is understood that Adani will be responsible for all costs associated with the upgrade and maintenance of the access route from the Gregory Development Road to Carmichael Coal Mine and Rail Project. This agreement is considered suitable in lieu of direct contributions to Council.

It is anticipated that contributions or a similar agreement would be required for Bulliwallah Road between Moray Carmichael Road and the proposed haul road. This should be discussed with Council if other arrangements have not already been made.

11. Summary

The predicted development traffic has been reviewed, with capacity and pavement assessments undertaken, with the main assessment conclusions as follows:

11.1 Existing Traffic Review

The existing background traffic data has been reviewed, with existing peak hour and ESA values calculated.

11.2 Development Traffic Generation and Distribution

TTM has undertaken a detailed estimate of the likely development traffic generation and distribution, with the site predicted to generate a total daily traffic generation 69 vehicles (in / out).

11.3 Development Traffic Impacts

A detailed assessment of the development traffic impacts in accordance with the GARID guidelines has established that Moray Quarry and associated quarries will not have a significant or assessable pavement impact on the state controlled road network.

A BAR / BAL treatment should be provided at the Gregory Development Road / Elgin Road intersection prior to the commencement of quarry operations.

The proposed operations will have pavement impacts on Elgin Road / Moray Carmichael Road and will require turn treatments.

11.4 Developer Contributions

Adani will fully fund the upgrade of the Gregory Development Road / Elgin Road intersection which is considered suitable to mitigate impacts at this intersection.

Adani will be responsible for the maintenance and upgrade of Elgin Road / Moray Carmichael Road , which is considered suitable to mitigate development impacts along this route. Contributions or agreements regarding the use of Bulliwallah Road between Moray Carmichael Road and the proposed haul road should be considered to mitigate development impacts on this road section.

11.5 Road Safety School Route, Pedestrian and Cyclist Review

TTM consider that there will no school route, pedestrian or cyclist impacts associated with the development proposal.

11.6 Conclusion

From a review of this report, TTM are of the view that there are no traffic planning or engineering reasons why the proposed development should not proceed as planned.

Appendix C - Vegetation Clearing Report

environmental management

saunders havill group

Material Change of Use Concurrence Agency Policy Response

and

Regional Vegetation Management Code Response

Brigalow Belt and New England Tablelands Bioregion

Moray Downs Quarry

Moray Downs, Moray Carmichael Boundary Road, Clermont

6550
08 May 2013
Adani Mining Pty Ltd

adani™

surveying town planning urban design environmental management landscape architecture

Document Control

Title	Moray Downs Quarry - MCU Policy & Regional Vegetation Management Code Response - Brigalow Belt and New England Tablelands Bioregion
Address	Moray Downs, Moray Carmichael Boundary Road, Clermont
Job Number	**6550**
Client	**Adani Mining Pty Ltd**

Document Issue

Issue	Date	Prepared By	Checked By
Draft	26.04.2013	Renee Wallerstein	Dr Andrew Davies
Client Issue	02.05.2013	Dr Andrew Davies	Murray Saunders
Final	08.05.2013	Dr Andrew Davies	Murray Saunders

Disclaimer

This report has been prepared for **Adani Mining Pty Ltd**. **Saunders Havill Group** cannot accept responsibility for any use of or reliance upon the contents of this report by any third party.

Reports and/or Plans by Others

Reports and/or plans by others may be included within this Environmental Management report to support the document.

Table of Contents

Figures

Tables

Plans

I. Introduction

The *Environmental Management Division* of the **Saunders Havill Group** was engaged by **Adani Mining Pty Ltd** to respond to the *2009 MCU Concurrence Agency Policy* for works associated with the Moray Downs Quarry site on Moray Carmichael Boundary Road, Clermont. A Response to the Regional Vegetation Management Code (RVMC) to clear remnant vegetation associated with Extractive Industry that is not in a key resource area is provided with this application. The purpose of the quarry is to provide structural material for the Carmichael Coal Mine and Rail Project.

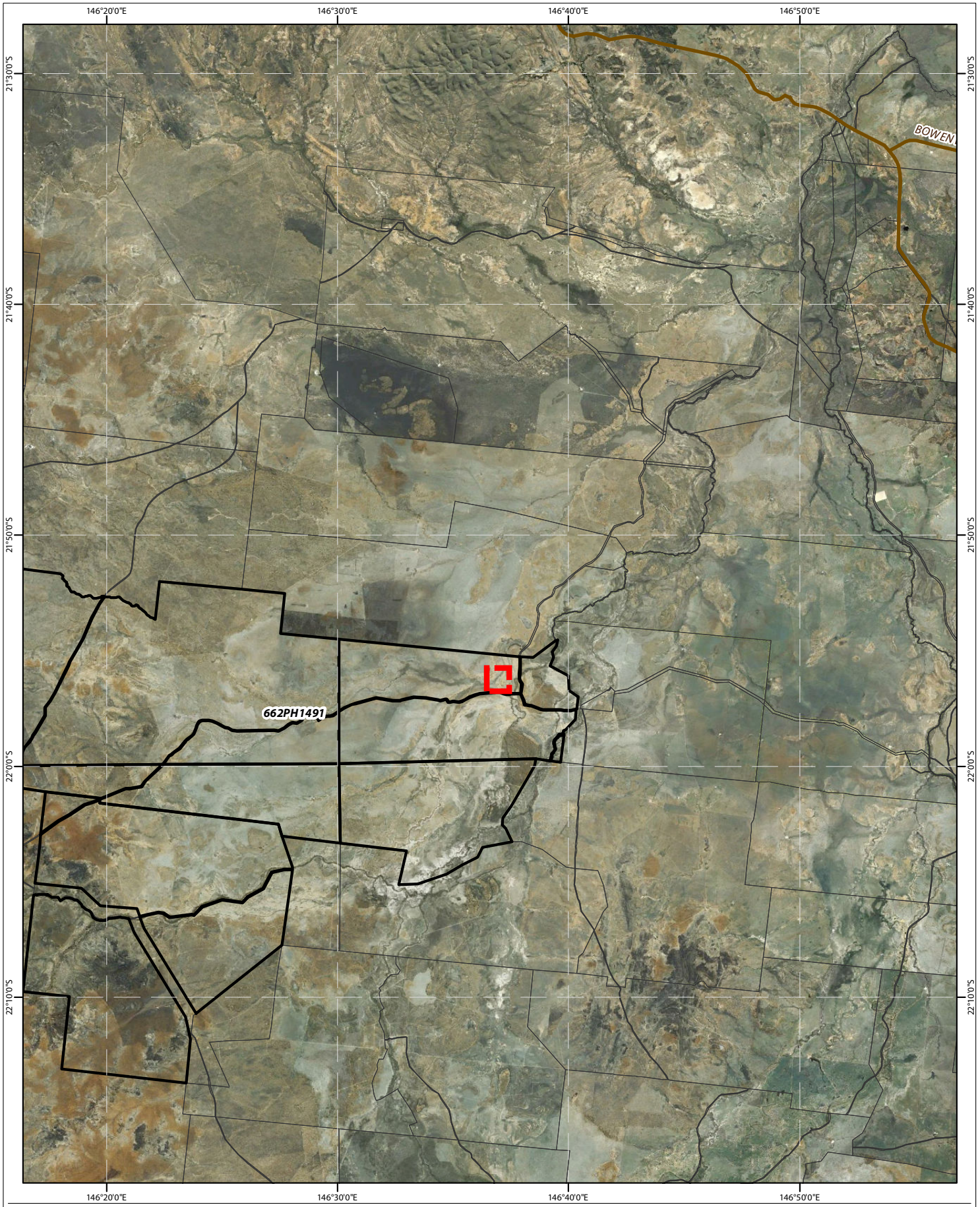
This report addresses Assessment Table F-2 (refer herein to **Table 2**) of the *Concurrence Agency Policy for Material Change of Use (MCU) – version 2, 2009* as the proposed clearing is in Least Concern remnant vegetation. A response to Part Xb of the *Regional Vegetation Management Code for Brigalow Belt and New England Tablelands Bioregion* (refer herein to **Table 3**) is provided. Please see **Appendix A** for the Property Vegetation Management Plan.

The total area of disturbance is approximately 69.52 ha. Contextually, the assessment site is located approximately 120 kilometres North-West of Clermont (Refer to **Figures 1 & 2**). The surrounding land use is rural.

I.I. Key Site Details

Table 1: Property Summary

Address	Moray Downs, Moray Carmichael Boundary Road, Clermont
RPD	Lot 662 on PH1491
Area	69.52 ha (Quarry)
Local Government Area	Isaac Regional Council
Planning Scheme	*Belyando Shire Planning Scheme 2009*
Local Plan Zoning	Rural
Vegetation Management Act 1999 (VMA)	Least Concern RE 11.3.7 / 11.3.10 and non-remnant
Topography	Gentle Undulating Rise
Existing Land Use	Rangelands
Proposed Land Use	Quarry / Extraction
Land Tenure	Leasehold



Legend

- Major Roads
- Lot 662 on PH1491
- Isaac DCDB

Figure 1 *Site Context*

File ref. *6550 E 01 Aerial Site Context A*
Date *1/05/2013*
Project *Carmichael Coal Rail Project*

0 1 2 4 6 8 10 km
Scale (A4): 1:400,000 [GDA 1994 MGA Z55]

N

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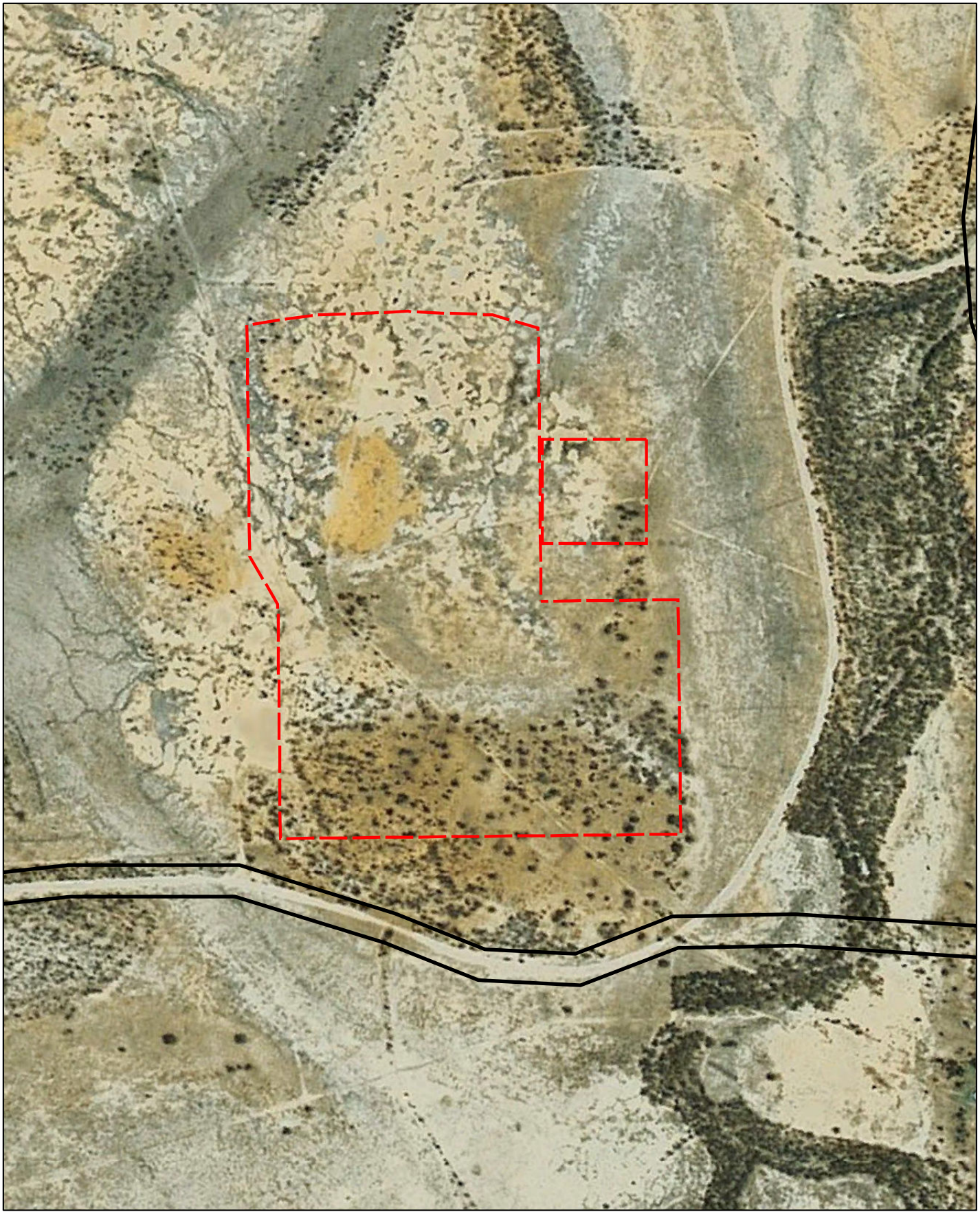
Layer Sources DCDB, Places, Major Roads (DNRM 2012), RE (DEHP 2012), PMAV Changes (SHG 2013)



Legend

- Lot 662 on PH1491
- Isaac DCDB

Figure 2 *Site Aerial*

File ref. *6550 E 02 Site Aerial A*
Date *1/05/2013*
Project *Carmichael Coal Rail Project*

0 50 100 200 300 400 500 *m*

N

Scale (A4): 1:10,000 [GDA 1994 MGA Z55]

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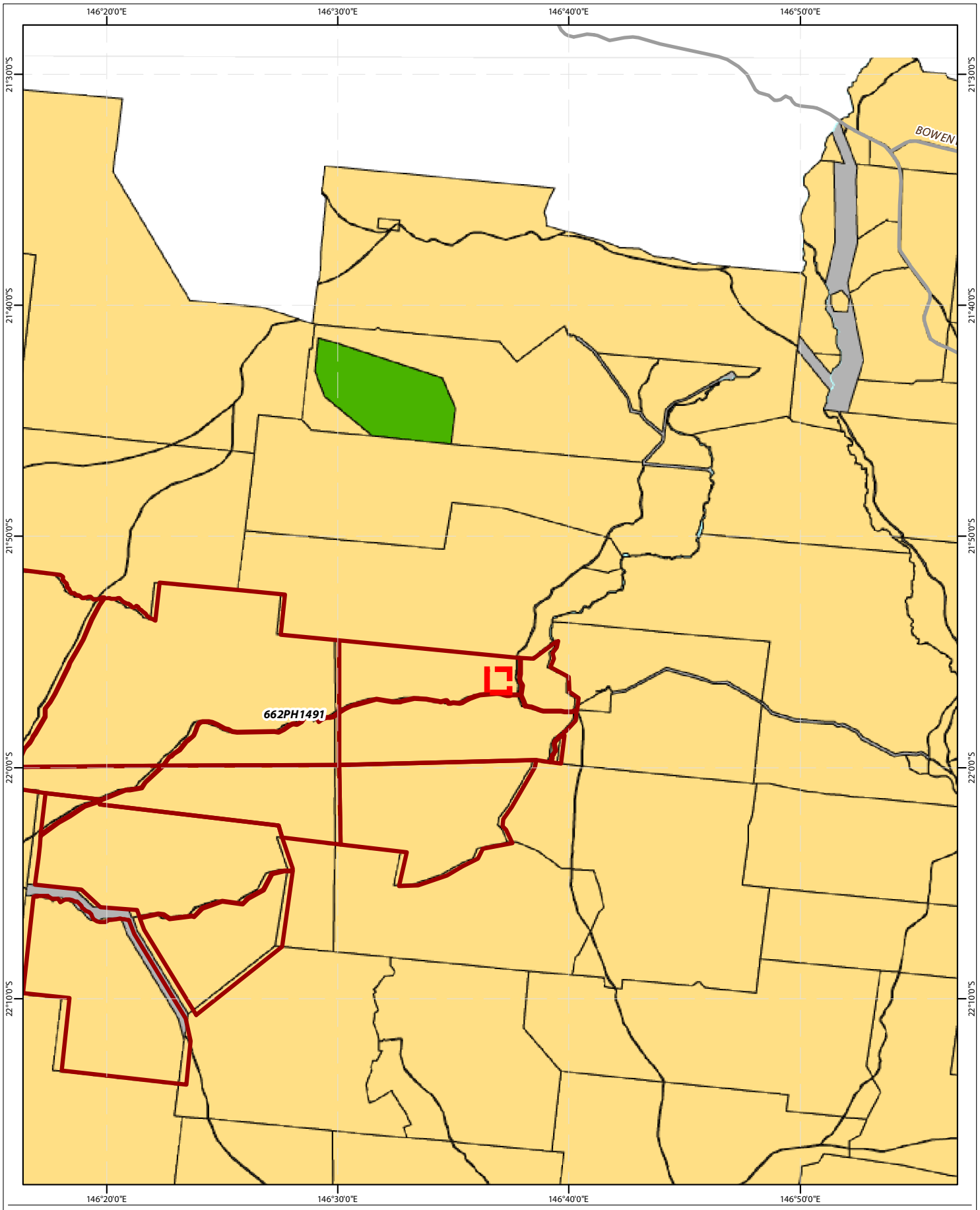
Layer Sources DCDB, Places, Major Roads (DNRM 2012)

1.2. Background

This application covers the proposed Moray Downs Quarry and represents a site currently zoned Rural under the *Belyando Shire Planning Scheme 2009* (see **Figure 3**) where excavation cannot occur without clearing of vegetation protected under the VMA. The location and extent of the required quarry were determined post extensive geotechnical and environmental investigations across a range of potential sites. The Moray Downs Quarry site is currently overlayed with a remnant vegetation polygon by *Regional Ecosystem and Remnant Mapping Version 6.1* (see **Section 2** Flora Assessment).

From *Assessment Table 1* of the *Concurrence Agency Policy for Material Change of Use (MCU) – version 2, 2009*, clearing *as a result of the MCU in an area to which a PMAV category does not apply - vegetation shown on a regional ecosystem or remnant map as remnant vegetation* (1(b)) for *Applications for any other purpose* (e) requires assessment against *Criteria Table F-1 or F-2 of this Policy*. As clearing is proposed in Least Concern vegetation only, a response to Table F-2 (*Clearing as a result of the MCU involves clearing of* least concern *regional ecosystems*) is provided (please see **Section 3** Response to Criteria Table F-2 and **Section 4** Response to the Regional Vegetation Management Code**)**.



Legend:

ZONING

- Commercial
- Industry
- Open Space and Recreatio
- Rural
- Urban

- Road
- Waterway

Figure 3 *Belyando Shire Planning Scheme Zoning Map*

File ref. *6550 E 01 Aerial Site Context A*
Date *1/05/2013*
Project *Carmichael Coal Rail Project*

0 1 2 4 6 8 10 km

Scale (A4): 1:400,000 [GDA 1994 MGA Z55]

N

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Layer Sources *DCDB, Places, Major Roads (DNRM 2012), RE (DEHP 2012), PMAV Changes (SHG 2013)*

2. Flora Assessment

The proposed quarry site is predominantly in cleared land with scattered *Flindersia dissosperma* (Scrub Leopardwood) and *Acacia cambagei* (Stinking Wattle) over a shrub layer of *Atalaya hemiglauca* (Whitewood) and *Carissa ovata* (Currant Bush) and ground layer dominated by *Pennisetum ciliare* (Buffel Grass). Where it extends into the remnant polygon to the South (Least Concern RE 11.3.7 / 11.3.10), mapped vegetation is characterised by *Corymbia clarksoniana* (Long Fruited Bloodwood) with *Eucalyptus brownii* (Reid River Gum) and scattered *Corymbia dallachiana* (Ghost Gum). Please see **Appendix B** for the full species list.

RE 11.3.7- Least Concern

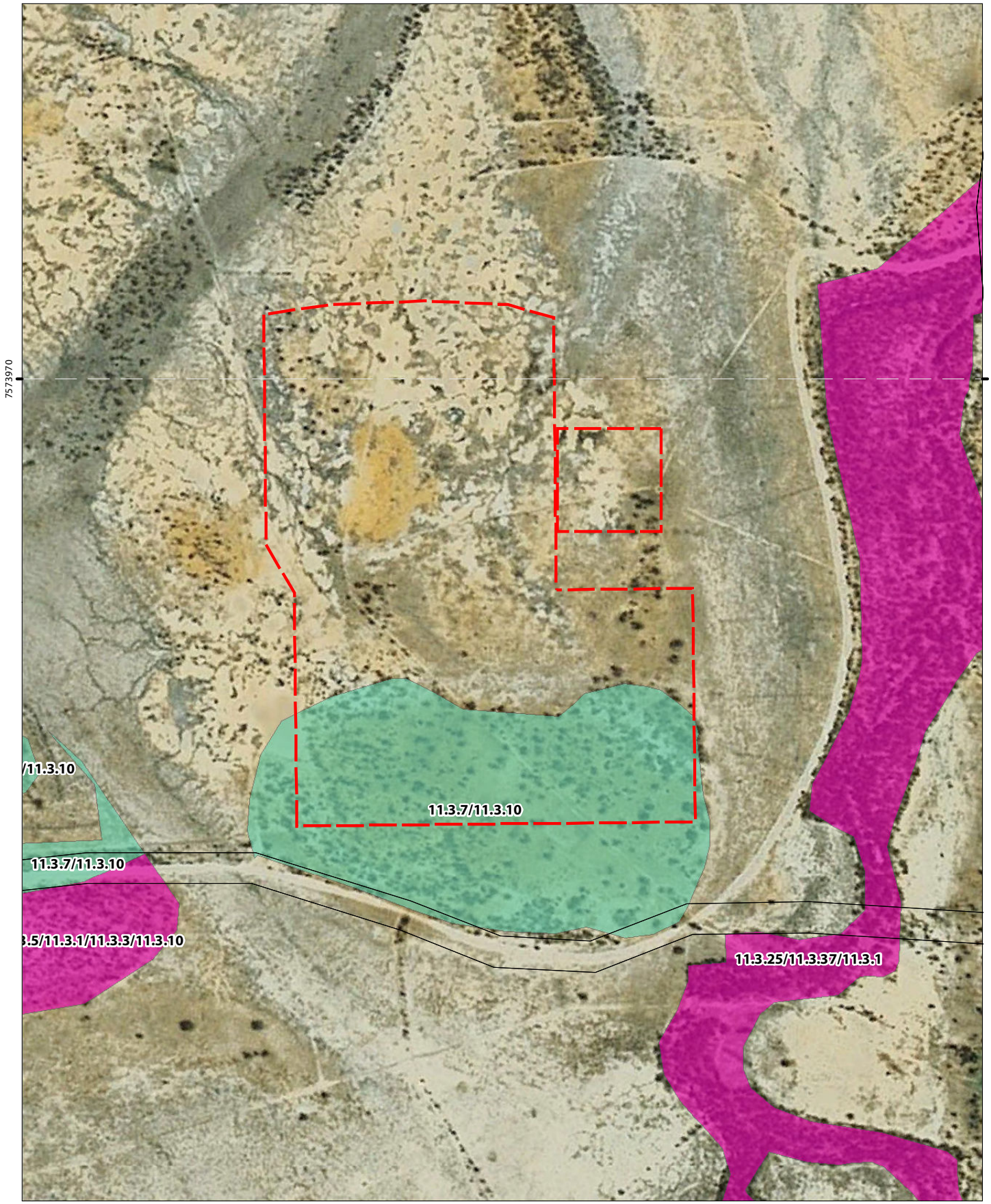
Description	*Corymbia clarksoniana, C. tessellaris and C. dallachiana* tall woodland to open-woodland (12 - 17 m high). There is usually a low open-woodland tree layer (7 - 11 m high) dominated by species such as *Acacia salicina, Lysiphyllum hookeri* or *Grevillea striata*. Occurs on levees and plains formed from Quaternary alluvial deposits. Soils are usually deep uniform sands with minor areas of sandy red earths. (BVG1M: 9e).

RE 11.3.10- Least Concern

Description	*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 on Cainozoic alluvial plains. (BVG1M: 17a) Major vegetation communities include: 11.3.10a: Palustrine wetland (e.g. vegetated swamp). *Eucalyptus brownii* on closed depressions Occurs on closed depressions (BVG1M: 17a). 11.3.10b: Floodplain (other than floodplain wetlands). *Eucalyptus brownii* on floodplains (BVG1M: 17a)

Photo: Moray Downs Quarry Site Vegetation

Least Concern RE 11.3.7 / 11.3.10 is mapped within the southern portion of the quarry footprint by *Regional Ecosystem and Remnant Mapping Version 6.1* (**Figure 4**, next page).



Legend

- Isaac DCDB

Regional Ecosystem v6.1

- Remnant vegetation containing Endangered REs
- Remnant vegetation containing Of Concern REs
- Remnant vegetation that is a Least Concern RE

Figure 4 *Regional Ecosystem v6.1*

File ref. *6550 E 05 RE A*
Date *2/05/2013*
Project *Carmichael Coal Rail Project*

0 50 100 200 300 400 500 *m*

N

Scale (A4): 1:10,000 [GDA 1994 MGA Z55]

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Layer Sources DCDB, Places, Major Roads (DNRM 2012), RE v6.1 (DEHP 2012)

3. Response to Criteria Table F-2.

The following is a response to Criteria Table F-2. Performance requirements for 'clearing as a result of the MCU involves clearing of *least concern* regional ecosystems' as per *Concurrence Agency Policy for Material Change of Use (MCU) – version 2, 2009*

Table 2: Criteria Table F-2

Performance requirement
PR F1 To regulate the clearing of vegetation in a way that ensures the conservation of regional ecosystems, clearing as a result of the MCU only occurs where the applicant has demonstrated that the development has first avoided and minimised the impacts of the development. **Response** Extensive geotechnical and ecological surveys (including vegetation surveys) have been completed along and adjoining the alignment of **Adani's** Carmichael Coal Mine and Rail Project. This included the investigation of a large volume of properties for potential use to supply necessary quarry material for construction requirements of the rail and mine facility. Through constraint analyses and detailed geotechnical review these quarry areas have been refined to the most suited locations relative to where the rail and mine construction works are occurring. Through ground proofing, the Moray Quarry avoids clearing of remnant vegetation and where this is not possible clearing has been limited to Least Concern Communities. Substantially more suitable quarry material is available in areas which would have required clearing of Of Concern and Endangered communities, however, these have been avoided to minimise impacts. **PR F1 is achieved.**
PR F2 Clearing as a result of the MCU assessed under this Table may occur only where the MCU meets: a) Performance Requirements 2 to 10 of the relevant code, Part Xb for an extractive purpose

Response

Please see **Section 4** Response to the Regional Vegetation Management Code, below, which demonstrates how **PR F2 is achieved.**

4. Response to Regional Vegetation Management Code

Table 1: Part Xb: Requirements for clearing for an extractive industry in an area that is not a Key Resource Area

Performance Requirement	Comment
PR Xb.2: Clearing is staged 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 — clearing — a) is staged in line with operational needs that restricts clearing to the current operational area; and b) is limited to the area from which material will be extracted within the term of the permit; and c) cannot occur until all required permits are obtained.	Clearing will be staged in line with operational needs. Refer to **Appendix 1** for detailed plans showing the proposed Quarry works. **PR Xb. 2 is achieved.**

Performance Required	Acceptable Solutions	Comments
PR Xb.3: Wetlands To regulate the clearing of vegetation in a way that prevents the loss of biodiversity and maintains ecological processes — assessable vegetation associated with any natural significant wetland and/or natural wetland is protected to maintain n— a) water quality by filtering sediments, nutrients	**AS Xb.3** Xb.3.1 Clearing does not occur — a) in any natural wetland; and b) within 100 metres from any natural wetland; and	The site does not contain a wetland, nor is it in proximity to a wetland. **PR Xb 3 is achieved.**

Performance Required	Acceptable Solutions	Comments
and other pollutants; and b) aquatic habitat; and c) terrestrial habitat.	c) in any natural significant wetland; and d) within 200 metres from any natural significant wetland.	
PR Xb.4: Watercourses To regulate the clearing of vegetation in a way that does not cause land degradation, prevents the loss of biodiversity and maintains ecological processes — assessable vegetation associated with any watercourse is protected to maintain — a) bank stability by protecting against bank erosion; and b) water quality by filtering sediments, nutrients and other pollutants; and c) aquatic habitat; and d) terrestrial habitat.	**AS Xb.4** Xb.4.1 Clearing does not occur — a) in any watercourse; and b) within the relevant distance stipulated in Table 2, of each high bank of each watercourse.	The site does not contain a watercourse, nor is it in proximity to a watercourse. **PR Xb 4 is achieved.**

Performance Required	Acceptable Solutions	Comments
PR Xb.5: Connectivity To regulate the clearing of vegetation in a way that prevents the loss of biodiversity and maintains ecological processes — areas of mapped remnant vegetation are retained that are — a) of sufficient size and configured in a way to maintain ecosystem functioning; and b) of sufficient size and configured in a way to remain in the landscape in spite of any threatening processes; and c) located on the lot(s) that are the subject of the application to maintain connectivity to mapped remnant vegetation on adjacent properties.	**AS Xb.5** Xb.5.1 Where clearing is less than — a) 10 metres wide in the coastal subregions of the Brigalow Belt Bioregion; or b) 2 hectares in the coastal subregions of the Brigalow Belt Bioregion; or c) 25 metres wide in the non-coastal subregions of the Brigalow Belt and the New England Tableland Bioregion; or d) is less than 5 hectares in the non-coastal subregions of the Brigalow Belt and the New England Tableland Bioregion; clearing does not— i) reduce the width of mapped remnant vegetation to less than 200 metres; and ii) occur where the width of mapped remnant	Vegetation clearing for the quarry will not impact upon ecological processes in the area. The quarry will not impact on connectivity given the limited ecological values within the proposed quarry area. Where clearing will occur in mapped remnant vegetation the area is not considered contiguous. Post Quarry rehabilitation will reinstate remnant communities in clearance locations. **PR Xb 5 is achieved.**

Performance Required	Acceptable Solutions	Comments
	vegetation is less than 200 metres; OR Xb.5.2 Clearing does not — a) reduce areas of contiguous mapped remnant vegetation to less than 10 hectares in the coastal subregions of the Brigalow Belt Bioregion; and b) occur in areas of contiguous mapped remnant vegetation that are less than 10 hectares, in the coastal subregions of the Brigalow Belt Bioregion; and c) reduce areas of contiguous mapped remnant vegetation to less than 50 hectares in the non-coastal subregions of the Brigalow Belt and the New England Tableland Bioregion; and d) occur in areas of contiguous mapped remnant vegetation that are less than 50 hectares, in the non-coastal subregions of the Brigalow Belt	

Performance Required	Acceptable Solutions	Comments
	and the New England Tableland Bioregion; and e) reduce the width of mapped remnant vegetation to less than 200 metres; and f) occur where the width of mapped remnant vegetation is less than 200 metres; and reduce the total extent of mapped remnant vegetation to less than 30%; and h) occur where the total extent of mapped remnant vegetation is less than 30%.	
PR Xb.6: Salinity To regulate the clearing of vegetation in a way that does not cause land degradation and maintains ecological processes — clearing does not contribute to — a) waterlogging; or b) the salinisation of groundwater, surface water or soil.	**AS Xb.6** Xb.6.1 Where clearing is less than — a) 2 hectares; or b) 10 metres wide. OR Xb.6.2	Site investigations found no evidence of salt scalds, seepage or waterlogging in the area. Clearing in the quarrying area is not considered to cause any land degradation and will be managed through the construction, operational and rehabilitation phase via the site Integrated Environmental Management System. **PR Xb 6 is achieved.**

Performance Required	Acceptable Solutions	Comments
	Clearing does not occur— a) in any discharge area; and b) within 200 metres of any discharge area.	
PR Xb.7 Conserving remnant vegetation that are *endangered* regional ecosystems and *of concern* regional ecosystems To regulate the clearing of vegetation in a way that conserves remnant vegetation that are *endangered* regional ecosystems and *of concern* regional ecosystems — maintain the current extent of *endangered* regional ecosystems and *of concern* regional ecosystems.	**AS Xb.7** Xb.7.1 Clearing — a) does not occur in an *endangered* regional ecosystem or an *of concern* regional ecosystem that is listed in Table 4; and b) in an *endangered* regional ecosystem or an *of concern* regional ecosystem that is not listed in Table 4 only occurs where the clearing is less than 10 metres wide or 0.5 hectares.	The site vegetation is classified as *least concern* and does not contain any *endangered* or *of concern* regional ecosystems. **PR Xb 7 is achieved.**
PR Xb.8: Essential habitat To regulate the clearing of vegetation in a way that prevents the loss of biodiversity — maintain the current extent of essential habitat.	**AS Xb.8** Xb.8.1 Clearing does not occur in an area which is shown as essential habitat on the essential habitat map.	The regional ecosystems on site are not mapped as providing essential habitat. **PR Xb 8 is achieved.**

Performance Required	Acceptable Solutions	Comments
PR Xb.9: Conservation status thresholds To regulate the clearing of vegetation in a way that conserves remnant vegetation that are regional ecosystems and prevents the loss of biodiversity — maintain the current extent of regional ecosystems listed in Table 5.	**AS Xb.9** Xb.9.1 Clearing in a regional ecosystem listed in Table 5, does not occur unless the clearing is less than 2 hectares.	The site is mapped as containing regional ecosystems 11.3.7 / 11.3.10, which are not listed in Table 5. **PR Xb 9 is achieved.**
PR Xb.10: Acid sulphate soils To regulate the clearing of vegetation in a way that does not cause land degradation and maintains ecological processes in the coastal subregions of the Brigalow Belt Bioregion, and the Marlborough Plains subregion (11.14) — clearing activities do not result in disturbance of acid sulphate soils or changes to the hydrology of the location that will either- a) aerate horizons containing iron sulphides; or b) mobilise acid and/or metals.	**AS Xb.10** Xb.10.1 In the coastal subregions of the Brigalow Belt Bioregion, and the Marlborough Plains subregion (11.14), clearing in land zone 1, land zone 2 or land zone 3 in areas below 5 metre Australian Height Datum— a) is carried out in accordance with an acid sulphate soils environmental management plan as outlined in the State Planning Policy 2/02 Guideline: Planning and Managing Development involving Acid Sulphate Soils; and b) follows management principles in accordance	Extractive resource activities will occur within Land Zone 3, however are not within a coastal subregion of the Brigalow Belt Bioregion. **PR Xb 10 is achieved.**

Performance Required	Acceptable Solutions	Comments
	with the Soil Management Guidelines in the Queensland Acid Sulphate Soil Technical Manual.	

5. Appendices

Appendix A

Property Vegetation Management Plan

Appendix B

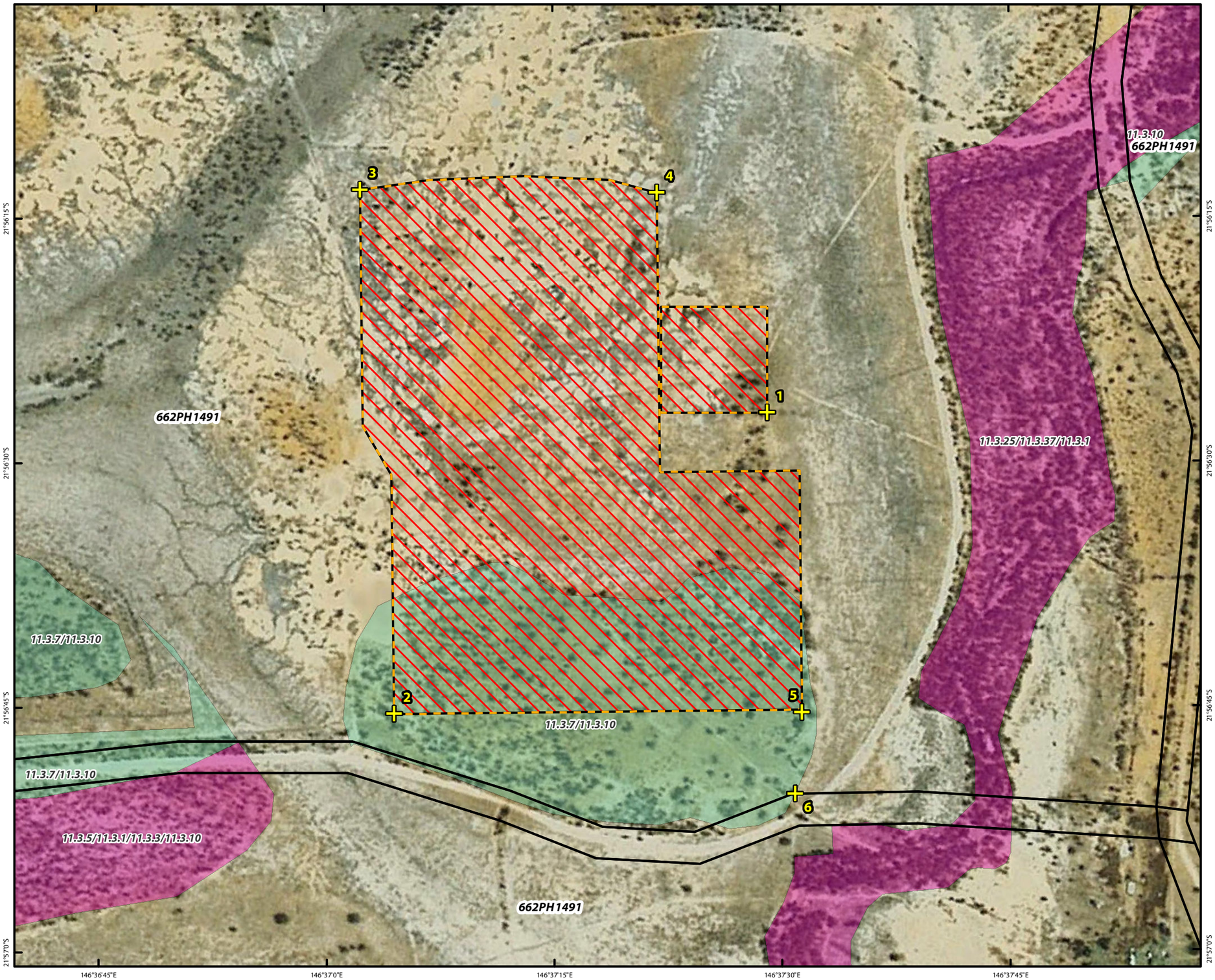
Species List

Appendix A

Property Vegetation Management Plan

146°36'45"E 146°37'0"E 146°37'15"E 146°37'30"E 146°37'45"E

21°56'15"S 21°56'30"S 21°56'45"S 21°57'0"S



PVMP Coordinate Table *(GDA94 MGA z55)*			
Id	**Description**	**Longitude (m)**	**Latitude (m)**
1	Disturbance Area Boundary	461250.877423	7573674.3807
2	Disturbance Area Boundary	460546.929912	7573105.43539
3	Disturbance Area Boundary	460482.766473	7574094.74631
4	Disturbance Area Boundary	461042.862137	7574089.00858
5	Disturbance Area Boundary	461317.128524	7573108.28113
6	Site DCDB	461303.574205	7572955.13363

Legend

- PVMP Coordinates
- DCDB
- Quarry Disturbance Extent
- Area to be Cleared / Disturbed

Regional Ecosystem v6.1

- Remnant vegetation containing Endangered REs
- Remnant vegetation containing Of Concern REs
- Remnant vegetation that is a Least Concern RE

N

0 50 100 200 m

saunders havill group

adani™

APPROVED COMPANY ISO 9001 Quality Management Systems QMS

APPROVED COMPANY ISO 14001 Environmental Management Systems QMS

ISSUES:

Issue	Date	Description	Drawn	Checked
A	9.01.2013	Prelim Draft	TC	RM

Carmichael Coal Rail Project

Moray Quarry - Property Vegetation Management Plan

Date | 8/05/2013
Scale | 1:7,500 @ A3
Data Information:
Universal Transverse Mercator
GDA 1994 MGA Zone 56
Client | Adani Mining Pty Ltd
Project | Carmichael Coal Rail Project
Address/RPD | Isaac Regional Council
Source | DCBD (DNRM, 2012), Aerial (Google, 2012) RE & HVR (EHP, 2013)

Plan 1

Of 1

SHG File
6550 E 03 Moray Quarry A

Appendix B

Species List

Scientific Name	Common Name	Conservation Status (NCA)	EPBCA Status
Acacia cambagei	Gidgee	Least Concern	Not Listed
Astrebla squarrosa	Bull Mitchell	Least Concern	Not Listed
Atalaya hemiglauca	Whitewood	Least Concern	Not Listed
Bothriochloa bladhii	Forest Blue-grass	Least Concern	Not Listed
Carissa ovata	Currant Bush	Least Concern	Not Listed
Chloris gayana	Rhodes Grass	Least Concern	Not Listed
Enneapogon nigricans	Black Heads	Least Concern	Not Listed
Flindersia dissosperma	Scrub Leopardwood	Least Concern	Not Listed
Pennisetum ciliare	Buffel Grass	Not Listed	Not Listed
Corymbia clarksoniana	Clarkson's Bloodwood	Least Concern	Not Listed
Corymbia dallachiana	Ghost Gum	Least Concern	Not Listed
Aristida latifolia	Feathertop Wiregrass	Least Concern	Not Listed
Acacia salicina	Sally Wattle	Least Concern	Not Listed
Eucalyptus brownii	Reid River Box	Least Concern	Not Listed
Lysiphyllum carronii	Red Bauhinia	Least Concern	Not Listed

Appendix D - EHP Wildlife Online Search

Queensland Government

Wildlife Online Extract

Search Criteria: Species List for a Specified Point
Species: All
Type: All
Status: All
Records: All
Date: All
Latitude: 21.9436
Longitude: 146.6221
Distance: 15
Email: kinnytp@cdmsmith.com
Date submitted: Wednesday 03 Apr 2013 11:19:44
Date extracted: Wednesday 03 Apr 2013 11:20:04

The number of records retrieved = 163

Kingdom	Class	Family	Scientific Name	Common Name	I	Q	A	Records
animals	amphibians	Hylidae	*Litoria rothii*	northern laughing treefrog		C		1
animals	amphibians	Hylidae	*Cyclorana novaehollandiae*	eastern snapping frog		C		2/2
animals	amphibians	Hylidae	*Cyclorana alboguttata*	greenstripe frog		C		2/2
animals	birds	Acanthizidae	*Smicrornis brevirostris*	weebill		C		2
animals	birds	Accipitridae	*Haliastur sphenurus*	whistling kite		C		1
animals	birds	Accipitridae	*Accipiter fasciatus*	brown goshawk		C		1
animals	birds	Accipitridae	*Circus assimilis*	spotted harrier		C		1
animals	birds	Accipitridae	*Milvus migrans*	black kite		C		1
animals	birds	Accipitridae	*Aquila audax*	wedge-tailed eagle		C		1
animals	birds	Aegothelidae	*Aegotheles cristatus*	Australian owlet-nightjar		C		1
animals	birds	Alaudidae	*Mirafra javanica*	Horsfield's bushlark		C		1
animals	birds	Ardeidae	*Egretta novaehollandiae*	white-faced heron		C		1
animals	birds	Artamidae	*Artamus cinereus*	black-faced woodswallow		C		1
animals	birds	Artamidae	*Cracticus torquatus*	grey butcherbird		C		2
animals	birds	Artamidae	*Cracticus nigrogularis*	pied butcherbird		C		3
animals	birds	Artamidae	*Cracticus tibicen*	Australian magpie		C		2
animals	birds	Cacatuidae	*Nymphicus hollandicus*	cockatiel		C		1
animals	birds	Cacatuidae	*Cacatua galerita*	sulphur-crested cockatoo		C		1
animals	birds	Cacatuidae	*Eolophus roseicapillus*	galah		C		1
animals	birds	Campephagidae	*Coracina novaehollandiae*	black-faced cuckoo-shrike		C		1
animals	birds	Campephagidae	*Lalage leucomela*	varied triller		C		1
animals	birds	Columbidae	*Geophaps scripta scripta*	squatter pigeon (southern subspecies)		V	V	1
animals	birds	Columbidae	*Ocyphaps lophotes*	crested pigeon		C		3
animals	birds	Corcoracidae	*Struthidea cinerea*	apostlebird		C		1
animals	birds	Corvidae	*Corvus orru*	Torresian crow		C		1
animals	birds	Cuculidae	*Cacomantis pallidus*	pallid cuckoo		C		1
animals	birds	Estrildidae	*Taeniopygia guttata*	zebra finch		C		1
animals	birds	Falconidae	*Falco cenchroides*	nankeen kestrel		C		1
animals	birds	Falconidae	*Falco berigora*	brown falcon		C		1
animals	birds	Gruidae	*Grus rubicunda*	brolga		C		1
animals	birds	Halcyonidae	*Todiramphus pyrrhopygius*	red-backed kingfisher		C		1
animals	birds	Halcyonidae	*Dacelo novaeguineae*	laughing kookaburra		C		1
animals	birds	Maluridae	*Malurus melanocephalus*	red-backed fairy-wren		C		1
animals	birds	Megaluridae	*Cincloramphus mathewsi*	rufous songlark		C		1
animals	birds	Meliphagidae	*Manorina flavigula*	yellow-throated miner		C		3
animals	birds	Meliphagidae	*Gavicalis virescens*	singing honeyeater		C		1
animals	birds	Meliphagidae	*Acanthagenys rufogularis*	spiny-cheeked honeyeater		C		1
animals	birds	Monarchidae	*Grallina cyanoleuca*	magpie-lark		C		1
animals	birds	Monarchidae	*Myiagra inquieta*	restless flycatcher		C		1
animals	birds	Motacillidae	*Anthus novaeseelandiae*	Australasian pipit		C		1
animals	birds	Pachycephalidae	*Pachycephala rufiventris*	rufous whistler		C		2
animals	birds	Pardalotidae	*Pardalotus striatus*	striated pardalote		C		1
animals	birds	Petroicidae	*Microeca fascinans*	jacky winter		C		1
animals	birds	Pomatostomidae	*Pomatostomus temporalis*	grey-crowned babbler		C		1
animals	birds	Psittacidae	*Platycercus adscitus*	pale-headed rosella		C		1
animals	birds	Psittacidae	*Trichoglossus haematodus moluccanus*	rainbow lorikeet		C		1

Kingdom	Class	Family	Scientific Name	Common Name	I	Q	A	Records
animals	birds	Rhipiduridae	*Rhipidura leucophrys*	willie wagtail		C		2
animals	birds	Strigidae	*Ninox boobook*	southern boobook		C		1
animals	insects	Nymphalidae	*Tirumala hamata hamata*	blue tiger				1
animals	insects	Nymphalidae	*Junonia orithya albicincta*	blue argus				1
animals	insects	Nymphalidae	*Danaus chrysippus petilia*	lesser wanderer				1
animals	insects	Nymphalidae	*Hypolimnas bolina nerina*	varied eggfly				1
animals	insects	Nymphalidae	*Euploea core corinna*	common crow				1
animals	insects	Papilionidae	*Papilio aegeus*					1
animals	insects	Pieridae	*Catopsilia pyranthe crokera*	white migrant				1
animals	insects	Pieridae	*Belenois java teutonia*	caper white				1
animals	insects	Pieridae	*Eurema hecabe phoebus*	large grass-yellow				1
animals	mammals	Bovidae	*Bos taurus*	European cattle	Y			2
animals	mammals	Macropodidae	*Macropus giganteus*	eastern grey kangaroo		C		2
animals	mammals	Macropodidae	*Macropus rufus*	red kangaroo		C		1
animals	mammals	Molossidae	*Tadarida australis*	white-striped freetail bat		C		1
animals	mammals	Muridae	*Pseudomys delicatulus*	delicate mouse		C		1
animals	mammals	Muridae	*Mus musculus*	house mouse	Y			1
animals	mammals	Phascolarctidae	*Phascolarctos cinereus*	koala		C	V	1
animals	reptiles	Diplodactylidae	*Lucasium steindachneri*	Steindachner's gecko		C		1
animals	reptiles	Gekkonidae	*Heteronotia binoei*	Bynoe's gecko		C		1
animals	reptiles	Scincidae	*Carlia pectoralis sensu lato*			C		2
animals	reptiles	Scincidae	*Menetia greyii*			C		1
animals	reptiles	Scincidae	*Ctenotus leonhardii*			C		1
animals	reptiles	Scincidae	*Cryptoblepharus pannosus*	ragged snake-eyed skink		C		1
animals	reptiles	Varanidae	*Varanus tristis*	black-tailed monitor		C		1
animals	uncertain	Indeterminate	*Indeterminate*	Unknown or Code Pending		C		1
plants	higher dicots	Amaranthaceae	*Ptilotus nobilis subsp. semilanatus*			C		1/1
plants	higher dicots	Amaranthaceae	*Gomphrena*			C		1
plants	higher dicots	Apocynaceae	*Marsdenia viridiflora subsp. viridiflora*			C		1/1
plants	higher dicots	Apocynaceae	*Secamone elliptica*			C		1/1
plants	higher dicots	Asteraceae	*Minuria integerrima*	smooth minuria		C		1/1
plants	higher dicots	Asteraceae	*Peripleura scabra*			NT		1/1
plants	higher dicots	Asteraceae	*Calotis xanthosioidea*			C		1/1
plants	higher dicots	Asteraceae	*Xanthium occidentale*		Y			1/1
plants	higher dicots	Asteraceae	*Sphaeranthus indicus*			C		2/2
plants	higher dicots	Asteraceae	*Pluchea baccharoides*	narrow-leaved plains bush		C		2/2
plants	higher dicots	Asteraceae	*Parthenium hysterophorus*	parthenium weed	Y			2/2
plants	higher dicots	Boraginaceae	*Heliotropium ovalifolium*			C		1/1
plants	higher dicots	Boraginaceae	*Heliotropium geocharis*			C		1/1
plants	higher dicots	Boraginaceae	*Ehretia membranifolia*	weeping koda		C		1/1
plants	higher dicots	Caesalpiniaceae	*Senna circinnata*			C		2/2
plants	higher dicots	Caesalpiniaceae	*Senna artemisioides subsp. coriacea*			C		1/1
plants	higher dicots	Caesalpiniaceae	*Senna artemisioides subsp. filifolia*			C		1/1
plants	higher dicots	Capparaceae	*Apophyllum anomalum*	broom bush		C		1/1
plants	higher dicots	Caryophyllaceae	*Polycarpaea multicaulis*			C		1/1
plants	higher dicots	Casuarinaceae	*Casuarina cristata*	belah		C		1/1

Kingdom	Class	Family	Scientific Name	Common Name	I	Q	A	Records
plants	higher dicots	Chenopodiaceae	*Maireana*			C		1
plants	higher dicots	Chenopodiaceae	*Sclerolaena bicornis*			C		1/1
plants	higher dicots	Chenopodiaceae	*Chenopodium auricomum*			C		1/1
plants	higher dicots	Chenopodiaceae	*Sclerolaena tricuspis*	giant red burr		C		2/2
plants	higher dicots	Chenopodiaceae	*Einadia nutans subsp. linifolia*			C		1/1
plants	higher dicots	Chenopodiaceae	*Atriplex lindleyi subsp. lindleyi*			C		1/1
plants	higher dicots	Chenopodiaceae	*Dissocarpus biflorus var. cephalocarpus*			C		1/1
plants	higher dicots	Convolvulaceae	*Ipomoea lonchophylla*			C		1/1
plants	higher dicots	Convolvulaceae	*Polymeria marginata*			C		1/1
plants	higher dicots	Euphorbiaceae	*Euphorbia dallachyana*			C		1/1
plants	higher dicots	Fabaceae	*Glycine falcata*			C		1/1
plants	higher dicots	Fabaceae	*Desmodium muelleri*			C		1/1
plants	higher dicots	Fabaceae	*Crotalaria*			C		1
plants	higher dicots	Fabaceae	*Desmodium campylocaulon*			C		2/2
plants	higher dicots	Fabaceae	*Indigastrum parviflorum*			C		1/1
plants	higher dicots	Gentianaceae	*Schenkia australis*			C		1/1
plants	higher dicots	Goodeniaceae	*Goodenia strangfordii*			C		1/1
plants	higher dicots	Goodeniaceae	*Goodenia byrnesii*			C		1/1
plants	higher dicots	Goodeniaceae	*Goodenia*			C		1/1
plants	higher dicots	Lamiaceae	*Ocimum tenuiflorum*			C		1/1
plants	higher dicots	Malvaceae	*Sida rohlenae subsp. rohlenae*			C		1/1
plants	higher dicots	Malvaceae	*Sida laevis*			C		1/1
plants	higher dicots	Malvaceae	*Sida trichopoda*			C		1/1
plants	higher dicots	Malvaceae	*Herissantia crispa*			C		1/1
plants	higher dicots	Malvaceae	*Abutilon malvifolium*	bastard marshmallow		C		1/1
plants	higher dicots	Malvaceae	*Hibiscus krichauffianus*			C		1/1
plants	higher dicots	Meliaceae	*Owenia acidula*	emu apple		C		1/1
plants	higher dicots	Mimosaceae	*Acacia stenophylla*	belalie		C		1/1
plants	higher dicots	Mimosaceae	*Acacia argyrodendron*			C		1/1
plants	higher dicots	Mimosaceae	*Neptunia gracilis forma gracilis*			C		1
plants	higher dicots	Molluginaceae	*Glinus lotoides*	hairy carpet weed		C		2/2
plants	higher dicots	Myoporaceae	*Eremophila mitchellii*			C		1/1
plants	higher dicots	Myoporaceae	*Eremophila polyclada*	flowering lignum		C		2/1
plants	higher dicots	Myrtaceae	*Eucalyptus camaldulensis subsp. acuta*			C		1/1
plants	higher dicots	Myrtaceae	*Eucalyptus brownii*	Reid River box		C		1/1
plants	higher dicots	Myrtaceae	*Eucalyptus coolabah*	coolabah		C		1
plants	higher dicots	Oleaceae	*Jasminum didymum subsp. racemosum*			C		1/1
plants	higher dicots	Oleaceae	*Notelaea microcarpa var. microcarpa*			C		1/1
plants	higher dicots	Pentapetaceae	*Melhania ovata*			C		1/1
plants	higher dicots	Phyllanthaceae	*Phyllanthus virgatus*			C		1/1
plants	higher dicots	Polygonaceae	*Persicaria lapathifolia*	pale knotweed		C		1/1
plants	higher dicots	Polygonaceae	*Persicaria attenuata*			C		1/1
plants	higher dicots	Portulacaceae	*Portulaca oleracea*	pigweed	Y			1
plants	higher dicots	Proteaceae	*Grevillea parallela*			C		1/1
plants	higher dicots	Rubiaceae	*Oldenlandia galioides*			C		1/1
plants	higher dicots	Rubiaceae	*Dentella repens*	dentella		C		1/1

Kingdom	Class	Family	Scientific Name	Common Name	I	Q	A	Records
plants	higher dicots	Rutaceae	*Geijera parviflora*	wilga		C		2/1
plants	higher dicots	Rutaceae	*Geijera salicifolia*	brush wilga		C		1/1
plants	higher dicots	Rutaceae	*Citrus glauca*			C		1/1
plants	higher dicots	Santalaceae	*Exocarpos sparteus*	slender cherry		C		1/1
plants	higher dicots	Santalaceae	*Anthobolus leptomerioides*			C		1/1
plants	higher dicots	Sapindaceae	*Alectryon diversifolius*	scrub boonaree		C		1/1
plants	higher dicots	Verbenaceae	*Verbena macrostachya*			C		1/1
plants	monocots	Amaryllidaceae	*Calostemma luteum*			C		2/1
plants	monocots	Amaryllidaceae	*Crinum flaccidum*	Murray lily		C		1
plants	monocots	Asphodelaceae	*Bulbine bulbosa*	golden lily		C		1/1
plants	monocots	Cyperaceae	*Cyperus rotundus*	nutgrass	Y			1
plants	monocots	Cyperaceae	*Cyperus exaltatus*	tall flatsedge		C		1/1
plants	monocots	Cyperaceae	*Fimbristylis aestivalis*			C		1/1
plants	monocots	Poaceae	*Panicum*			C		1
plants	monocots	Poaceae	*Aristida ingrata*			C		1/1
plants	monocots	Poaceae	*Chloris truncata*			C		1
plants	monocots	Poaceae	*Sporobolus caroli*	fairy grass		C		1/1
plants	monocots	Poaceae	*Astrebla elymoides*	hoop mitchell grass		C		1
plants	monocots	Poaceae	*Triodia pungens*			C		2/2
plants	monocots	Poaceae	*Dichanthium fecundum*	curly bluegrass		C		1/1
plants	monocots	Poaceae	*Eragrostis tenellula*	delicate lovegrass		C		1/1
plants	monocots	Poaceae	*Dactyloctenium radulans*	button grass		C		1
plants	monocots	Poaceae	*Eragrostis confertiflora*			C		1/1
plants	monocots	Poaceae	*Cynodon dactylon var. dactylon*		Y			1/1
plants	monocots	Poaceae	*Panicum larcomianum*			C		1/1

CODES

I - Y indicates that the taxon is introduced to Queensland and has naturalised.

Q - Indicates the Queensland conservation status of each taxon under the *Nature Conservation Act 1992.* The codes are Extinct in the Wild (PE), Endangered (E), Vulnerable (V), Near Threatened (NT), Least Concern (C) or Not Protected ( ).

A - Indicates the Australian conservation status of each taxon under the *Environment Protection and Biodiversity Conservation Act 1999.* The values of EPBC are Conservation Dependent (CD), Critically Endangered (CE), Endangered (E), Extinct (EX), Extinct in the Wild (XW) and Vulnerable (V).

Records – The first number indicates the total number of records of the taxon for the record option selected (i.e. All, Confirmed or Specimens).
This number is output as 99999 if it equals or exceeds this value. The second number located after the / indicates the number of specimen records for the taxon.
This number is output as 999 if it equals or exceeds this value.

Appendix E - Conservation Significant Species

Four categories were used to classify the likelihood of a species being present. Categories were defined as:

1. Known – confirmed during field assessments;
2. Likely – suitable good quality habitat observed during field assessments and desktop records from the area;
3. Potential – possibility of suitable habitat and records of the species occurring within the wider quarry area; and
4. Unlikely – no suitable habitat or not known to occur within the local region.

Table 8-1 Predicted conservation significant fauna species and potential to occur on Moray Quarry site

Scientific name	Common name	EPBC Act[1]	NC Act[2]	Preferred habitat	Potential to occur
EVNT fauna species					
Ctenotus capricorni	Capricorn Ctenotus		NT	Occurs in semi-arid sandy areas with Spinifex associated with woodland communities.	**Unlikely -** No suitable habitat occurs onsite. Single WildNet record only.
Egernia rugosa	Yakka Skink	V	V	Occurs in a variety of dry sclerophyll woodlands largely in the Brigalow Belt. Constructs burrows in a variety of soil types.	**Potential -** Suitable habitat (woodland with fallen timber) occurs. However, no survey or database records. EPBC online search only.
Antairoserpens warro	Robust Burrowing Snake		NT	Secretive burrowing species. Prefers loose soils in tropical woodlands with tussock grass.	**Potential -** Suitable habitat may occur onsite. Two WildNet records.
Denisonia maculata	Ornamental Snake	V	V	Prefers seasonally inundated areas on deep cracking clay soils and adjacent habitat. Feeds exclusively on frogs. Rare to absent where Cane Toads are abundant.	**Unlikely -** No suitable habitat occurs onsite. Single WildNet record and EPBC online search.
Furina dunmalli	Dunmall's Snake	V	V	Rarely encountered. Forests to woodlands, associated with Brigalow scrub.	**Unlikely -** Species at the edge of predicted range in quarry area. Habitat generally highly degraded. No survey or database records. EPBC online search only.
Nettapus coromandelianus	Cotton Pygmy-goose	M	NT	May occur on a variety of waterbodies but prefers those with abundant floating vegetation which it feeds on.	**Known -** At least 30 individuals observed on large farm dam. Will not occur on quarry site**.** Also WildNet records.

Scientific name	Common name	EPBC Act[1]	NC Act[2]	Preferred habitat	Potential to occur
Stictoneeta naevosa	Freckled Duck		NT	Occurs on large well-vegetated swamps.	**Unlikely** - Quarry area not in species normal range. Single WildNet record is likely rare vagrant occurrence.
Geophaps scripta scripta	Squatter Pigeon (southern)	V	V	Occurs in dry woodland. Generally on sandy soils close to water.	**Likely -** Five individuals recorded at two sites. Potential to occur on site. Habitat suitable for foraging. Also GHD (2012a;b) and WildNet records. EPBC online search
Erythrotriorchis radiatus	Red Goshawk	V	V	Prefers areas close to the coast featuring extensive open forest and woodland with a mosaic of vegetation types. Nests in tall emergent trees close to water.	**Unlikely -** No survey or database records. EPBC online search only. Landscape throughout quarry area is predominantly cleared.
Lophoictinia isura	Square-tailed Kite		NT	Occurs in a variety of forested habitats where it forages on birds and eggs.	**Potential -** Species may occur although forested habitat is limited in area. Two WildNet records.
Ephippiorhynchus asiaticus	Black-necked Stork		NT	Large species that occurs on a variety of wetlands. Carnivorous feeding on a variety of vertebrates, crustaceans, mollusks and invertebrates.	**Known -** Individual observed on large farm dam. Will not occur on quarry site. Also GHD (2012a) and WildNet records.
Rostratula australis	Australian Painted Snipe	V, M	V	Prefers temporary shallow wetlands. Nests in freshly flooded wetlands with low vegetation.	**Unlikerly** - May occur on wetlands in area but no database records. EPBC online search only. Will not occur on quarry site.
Grantiella picta	Painted Honeyeater		V	Occurs in a variety of forests/woodlands that contain mistletoes. Winter visitor to Queensland.	**Potential -** May sporadically occur wherever there are mistletoes. Single WildNet record.
Poephila cincta cincta	Black-throated Finch (southern)	E	E	Occurs in grassy open woodlands near water. Prefers areas of intact woodlands.	**Potential -** Suitable foraging habitat in remnant vegetation and permanent water nearby. Many records in mine area to west by GHD (2012a) and several WildNet records. EPBC online search.
Neochmia ruficauda ruficauda	Star Finch (eastern)	E	E	Occurs in grassy flats/woodlands near water.	**Unlikely -** Species present range is much further north. No database records. EPBC online search only.
Phascolarctos cinereus	Koala	V	S	Occurs in a variety of eucalypt woodlands and open forest.	**Potential –** Potential evidence of presence (scratches) observed. Also GHD (2012a) and six WildNet database records within 50 km radius of quarry area.
Chalinolobus picatus	Little Pied Bat		NT	Occurs in a variety of dry woodland forest types including mallee, eucalypt, *Callitris* and *Casuarina.*	**Potential** - May roost onsite where suitable hollows occu**r.** Recorded by GHD (2012a;b) and WildNet records.

Scientific name	Common name	EPBC Act[1]	NC Act[2]	Preferred habitat	Potential to occur
Lasiorhinus krefftii	Northern Hairy-nosed Wombat	E	E	Occurs in sandy, grassy woodland.	**Unlikely -** Species almost entirely restricted to Epping Forest south of quarry area. Single Wildnet record.
Migratory species					
Haliaeetus leucogaster	White-bellied Sea-eagle	M	S	Occurs in coastal areas including beaches, estuaries and lagoons, but may range well inland on larger rivers. Predominantly feeds on fish.	**Unlikely -** No suitable habitat in quarry area or surrounds. No database records. EPBC search only.
Apus pacificus *Hirundapus caudacutus*	Fork-tailed Swift White-throated Needletail	M	S	Aerial foraging species that occur over a variety of landscapes including highly modified environments.	**Potential** - White-throated Needletail occurs in area. Both species may seasonally occur over the area.
Ardea modesta	Eastern Great Egret	M	S	Eastern Great Egret occurs on a variety of wetlands and intertidal habitats.	**Known -** Several individuals observed on large farm dam. Will not occur on quarry site. Three WildNet records. EPBC online search.
Ardea ibis	Cattle Egret	M	S	Cattle Egret prefers damp grassy areas for feeding, particularly pasture.	**Potential** - Potential to occur in paddocks after heavy rains. Single database record. EPBC online search. Will not occur on quarry site.
Plegadis falcinellus	Glossy Ibis	M	S	Prefers shallow freshwater habitats. Sometimes occurs in intertidal habitat.	**Known -** Several individuals observed on large farm dam. Will not occur on quarry site.
Tringa stagnatilis	Marsh Sandpiper	M	S	May be found in both freshwater and estuarine habitats.	**Potential** - Potential to occur on wetlands in area. Single database record. Will not occur on quarry site.
Gallinago hardwickii	Latham's Snipe	M	S	Occurs in generally low numbers in a variety of permanent or ephemeral wetlands across eastern Australia.	**Potential** - Potential to occur on wetlands in area. Single database record. EPBC online search. Will not occur on quarry site.
Merops ornatus	Rainbow Bee-eater	M	S	Widespread species that may occur in a variety of habitats. Nests in burrows in sandy banks.	**Known -** Recorded onsite. Common in area at time of survey. Also GHD (2012a;b) and database records
Rhipidura rufifrons	Rufous Fantail	M	S	Prefers dense habitats including rainforest, riparian habitats and vine-thicket.	**Unlikely -** Habitat is generally poor for this species. Two database records.
Myiagra cyanoleuca	Satin Flycatcher	M	S	Prefers dense habitats. Generally migrates through coastal forests where it may occur in more open habitats.	**Unlikely -** Habitat is generally poor for this species.. Also GHD (2012a) and single database record.

[1] EPBC Act: E = Endangered; V = Vulnerable; M = Migratory.

[2] NC Act: E = Endangered; V = Vulnerable; NT = Near Threatened; S = Special least concern.

Appendix F - AMU Summary

AMU summary sheets 4

Read this in conjunction with a set of the green sheets

The following sheets provide summary information about each AMU, and its associated land use suitability and management. Soil and site descriptions presented here are directly relevant to decisions on land use and management. A set of limitations to land use have been deduced from these descriptions. Recommendations are given for crop suitability, land conservation practices and stocking rates.

AMU information

The sheets provide photographs of the landscape and a representative soil profile for each AMU. These are accompanied by summary information on the representative soil's characteristics and chemical and physical properties.

Site description: summarises the environmental characteristics that relate to the AMU. The landscape photograph shows a typical example of the AMU landscape in as close to its natural state as possible.

Representative soil profile: it must be stressed that this comprises a photograph and description of a *representative* soil within the range of soils of the named AMU. The representative soil is usually the most commonly occurring within the AMU.

The soil description is simplified from the profile descriptions contained in Appendix III of the *Resource Information,* but is detailed enough to identify the soil. Soil colour, structure and types of inclusions are defined in the Glossary.

Distinguishing soil properties: briefly summarises the chemical and physical attributes of the soil which are relevant to land use.

Chemical properties

Statements are made on the natural availability of the three major nutrient elements (nitrogen - N, phosphorus - P and potassium - K) in the top 10 cm of the soil. The availability of micronutrients is also mentioned if they are significant. The general ratings used for the interpretation of soil chemical analyses are given in Table 4.1.

A measure of soil acidity or alkalinity is given as pH for the surface soil. pH7 is neutral, less than 7 is acid and greater than 7 is alkaline. The pH trend with an increase in depth is also given. Further explanation of pH is given in the Glossary.

Salinity and sodicity within the profile are based on the chemical analyses of the soil samples taken for each representative soil. Salinity is based on the electrical conductivity (EC) value and relates to inherent salinity (that is, presence of salts in the profile). Sodicity relates to the exchangeable sodium percentage (ESP) value. The terms are defined in the Glossary.

Physical properties

Statements are made on the following if relevant:

- surface condition - the character of the topsoil in its natural, uncultivated state;
- workability - the ease or otherwise of working the soil with machinery;
- infiltration and permeability - how readily water enters the top soil and moves through the profile;
- effective rooting depth - depth to which most plant feeder roots will penetrate;
- PAWC - Plant Available Water Capacity, or the ability of the soil to retain moisture for use by the crop or pasture within the rooting zone.

- drainage - how freely water moves through and out of, the soil; the drainage categories are defined in the Glossary and are given as:
  - very poorly drained
  - poorly drained
  - imperfectly drained
  - moderately well drained
  - well drained
  - rapidly drained

Table 4.1. *Ratings used for interpretation of soil analyses*

		Ratings				
Soil Test	**Units**					
		Very low	**Low**	**Medium**	**High**	**Very high**
EC	(dS/m)	<0.1 5.	0.15-0.45	0.45-0.90	0.90-2.0	>2.0
Cl	(%)	<0.01	0.01-0.03	0.03-0.06	0.06-0.20	>0.20
P	(mg/kg)	<10	10-20	20-40	40-100	>100
Extr. K	(m.eq%)	<0.1	0.1-0.2	0.2-0.5	0.5-1.0	>1.0
Total N	(%)	<0.05	0.05-0.15	0.15-0.25	0.25-0.50	>0.50
Total P	(%)	<0.005	0.005-0.02	0.02-0.05	0.05-0.10	>0.10
Total K	(%)	<0.1	0.1-0.5	0.5-1.0	1.0-3.0	>3.0
PAWC	(%)	<5	5.1-8.0	8.1-12	12.1-15	>15

Source: Bruce and Rayment, 1982 (chemical analyses) Reid et al, 1979 (physical analyses)
[1] See reference list in Resource Information

Land use information

Land use suitability: suitability for irrigated or dryland cropping and sown pastures is presented; commonly recommended crops and pastures are listed.

Land use limitations: includes aspects important to soil management.

Land conservation: includes statements on water erosion hazard and surface runoff; this information is provided because of the erratic nature of the rainfall, its short duration and high intensity.

Soils are identified as *suitable*, of *limited suitability*, or *unsuitable* for conservation structures, strip cropping and dams. Soil conservation structures are otherwise classed as not applicable *(n.a.)* where soils are not suitable for cropping. This information is for guidance only - local DPI Land Conservation Officers should be consulted for more detailed advice.

Stocking rates: recommendations are given for cattle in Adult Equivalents (AE) which represents a 450 kg live weight, non-lactating bovine, and are guidelines only, as rates will vary depending on such factors as the intensity of management, pasture type, browse availability and seasonal conditions.

Estimated stocking rates are given for native pastures in both cleared and uncleared states, as well as sown legume and grass pastures. These estimates are the best figures that can be provided as general recommendations given current knowledge. Graziers should seek advice concerning stocking in specific areas.

Where a grazing management system is not practised for the given AMU the stocking rate is stated as being not applicable (n.a.).

Management recommendations: lists important recommendations for responsible land management which allow optimal land use with minimum land degradation.

These recommendations are based on the known inherent properties of the soils and the limitations they present to any land use.

AMU summary sheets

1 Adelong

Land use suitability

Irrigated (all types) croppping : *all crops and pastures*
Dryland cropping : *sorghum, sunflower, mungbeans, wheat, cotton, chickpea, safflower*
Forage cropping : *all forage sorghums, oats, dolichos, cowpea*
Grazing native pastures : *low productivity of bluegrasses and annuals under scrub; reasonable productivity when cleared*
Grazing sown pastures : *highly productive purple pigeon*

Land use limitations

- flooding
- brigalow, yellowwood, coolibah regrowth
- waterlogging
- frost

Land conservation

Water erosion hazard : medium
Surface runoff : medium
Contour banks : broad based
Waterways : suitable, grass with African Star grass or purple pigeon, angleton, creeping and native bluegrasses
Strip cropping : suitable
Diversion banks : suitable
Dams : suitable (some sand lenses)

Stocking rates

Uncleared native pasture : 25 to 50 ha / AE
Cleared native pasture : 10 to 12 ha /AE
Sown pasture : 3 to 5 ha / AE

Management recommendations

- When spelling cultivation, sown pastures are needed because native pastures won't regenerate
- Use minimum tillage techniques to retain stubble
- Rotate crops
- Use press-wheels to assist establishment
- Contour banks and waterways necessary on cultivation greater than 0.5% slope

Adelong 1

AMU description:

Self-mulching, dark or grey cracking clay of brigalow / coolabah scrub with yellowwood on alluvial plains

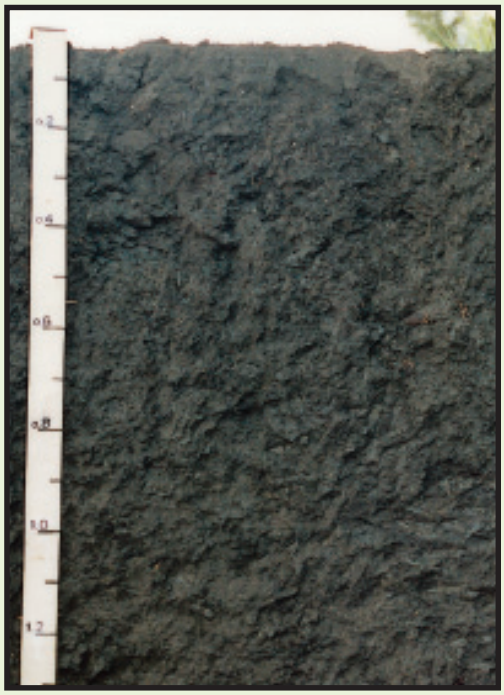
Site description

Landform

Wide, level, alluvial plains of major drainage lines. Low lying clay plains and interchannel areas are prone to flooding. Characterised by low local relief and slopes below 1%.

Vegetation

Extensively cleared for farming. Dense brigalow scrub with coolibah and yellowwood and associated wilga and belah.



Representative soil profile

Depth (m)	Description
0 to 0.05	Brownish grey, heavy clay; self-mulching surface; strong, fine blocky structure; abrupt change to:
0.05 to 0.35	Greyish brown, heavy clay; strong blocky structure; a few carbonate nodules; gradual change to:
0.35 to 1.5	Greyish brown, heavy clay; strong lenticular structure; a few carbonate nodules.

Distinguishing soil properties

Chemical

- N: low to medium K: very high
  P: low to very high
- surface pH 7.5, tending more alkaline with depth
- sodic below 1.2 m
- low salinity below 1.2 m

Physical

- self-mulching to weak crusting surface; heavy clay difficult to work when wet
- effective rooting depth greater than 1.0 m
- high to very high PAWC
- imperfectly drained

2 College

AMU description:

Coarse self-mulching or crusting, grey and brown cracking and non-cracking clays on alluvial plains and levees

Site description

Landform

Elevated levees, terraces and relict alluvial plains often in small, localised occurrences.

Vegetation

Shrubby woodlands of brigalow, poplar box, silver leaved ironbark, sandalwood and Dawson gum.

Representative soil profile

Depth (m)	Description
0 to 0.05	Greyish brown, heavy clay; cracking surface; moderate, coarse blocky structure; abrupt change to:
0.05 to 0.25	Greyish brown, heavy clay; strong, coarse blocky structure; gradual change to:
0.25 to 0.8	Dull brown, heavy clay; strong blocky structure; some soft and nodular carbonate; gradual change to;
0.8 to 1.5	Dull brown, heavy clay; lenticular structure; a few carbonate nodules.

Distinguishing soil properties

Chemical

- N: low to very low P: very low K: medium
- surface pH 7.5, tending acid by 1.0 m depth
- high sodicity below 0.3 m to 0.5 m
- high salinity below 0.4 m

Physical

- either coarse mulching, crusting or hard setting surface; coarse cloddy surface with tillage, poor workability
- restricted infiltration and low permeability
- effective rooting depth 0.2 m to 0.4 m
- low PAWC
- poor drainage
- high dispersion below 0.2 m

College 2

Land use suitability

Irrigated (all types) croppping : *all crops*
Dryland cropping : *all types*
Forage cropping (short term) : *all forage sorghums*
Grazing native pastures : *reasonably productive bluegrasses and other natives in uncleared state; highly productive when cleared*
Grazing sown pastures : *highly productive buffel grass*

Land use limitations

- crusting and sealing surface
- sodic and saline
- narrow moisture range for successful cultivation (poor workability)
- low PAWC
- restricted effective rooting depth
- very low P

Land conservation

Water erosion hazard : low
Surface runoff : medium to high
Contour banks : n.a.
Waterways : n.a.
Strip cropping : n.a.
Diversion banks : suitable
Dams : suitable

Stocking rates

Uncleared native pasture : 15 to 20 ha / AE
Cleared native pasture : 5 to 10 ha /AE
Sown pasture : 5 to 6 ha / AE

Management recommendations

- Largely unsuitable for dryland cropping
- Requires more frequent irrigation than other cracking clay soils
- Use minimum tillage techniques on irrigated land
- Sow pasture seed after clearing when using for grazing

3 Dooruna

Land use suitability

Grazing native pastures **:** *highly productive bluegrasses, bull mitchell and others*

Land use limitations

- low fertility
- salinity
- very coarse surface
- low PAWC
- waterlogging
- frost

Land conservation

Water erosion hazard	**:** low
Surface runoff	**:** medium to high
Contour banks	**:** n.a.
Waterways	**:** n.a.
Strip cropping	**:** n.a.
Diversion banks	**:** suitable
Dams	**:** unsuitable (saline and sodic soil)

Stocking rates

Native pasture : 6 to 7 ha / AE

Management recommendations

- Do not cultivate
- Do not overgraze

Dooruna 3

AMU description:

Coarse cracking grey clays on level plains with tussock grasslands and clumps of stunted brigalow and coolibah

Site description

Landform

Level plains in the north-west.

Vegetation

Tussock grasslands with occasional clumps of stunted brigalow and coolibah.

Representative soil profile

Depth (m)	Description
0 to 0.05	Greyish brown, heavy clay; crusting and cracking surface; very coarse, blocky structure; abrupt change to:
0.05 to 0.3	Greyish brown, heavy clay; strong, coarse blocky structure; gradual change to:
0.3 to 1.3	Greyish brown, heavy clay; strong lenticular structure; some gypsum below 0.8 m; diffuse change to:
1.3 to 1.5	Greyish brown, heavy clay; distinct red and grey mottles.

Distinguishing soil properties

Chemical

- N: very low P: very low K: very low
- low zinc
- surface pH 7.0, acid below 0.5 m
- strongly sodic below 0.3 m
- high salinity below 0.3 m to 0.6 m

Physical

- coarse self-mulching surface; very cloddy if cultivated, poor workability
- restricted infiltration and low permeability
- effective rooting depth 0.3 m to 0.6 m
- low PAWC
- very poor drainage and high dispersion below 0.3 m

4 Duckponds

AMU description: Deep, red and yellow sandy earths and duplex soils with a deep A horizon of plateaus, rises and fans

Site description

Landform
Elevated plateaus, tablelands and rises of relict streams and old land surfaces. Slopes generally between 1% and 4%.

Vegetation
Tall open woodlands comprising bloodwood, silver leaved ironbark, Moreton Bay ash, ghost gum and poplar box with areas of cypress pine, yellowjack and bonewood scrub. Wide range of understorey shrubs including desert oak and various wattles.

Representative soil profile

Depth (m)	Description
0 to 0.25	Dull reddish brown, coarse sandy loam; firm to hard setting surface; massive structure; clear change to:
0.25 to 0.6	Dark reddish brown, coarse sandy clay loam; massive structure; gradual change to:
0.6 to 1.2	Red, coarse sandy clay; diffuse change to:
1.2 to 1.8	Red, coarse sandy clay, rounded quartz gravel common.

Distinguishing soil properties

Chemical

- N: very low P: low
  K: medium to high
- surface pH 5.0, tending alkaline with depth
- non sodic and non saline

Physical

- coarse sandy, firm to hard setting surface; quite abrasive on tillage implements
- effective rooting depth greater than 1.0 m
- very high infiltration and permeability
- low to medium PAWC
- well drained

Duckponds 4

Land use suitability

Irrigated (all types) croppping : *peanuts, horticultural crops and pastures*

Forage cropping (short term) : *all forage sorghums*

Grazing native pastures : *reasonably productive speargrass, desert bluegrasses, other native grasses in uncleared state; highly productive when cleared*

Grazing sown pastures : *reasonable productive buffel grass, stylo*

Land use limitations

- very low fertility
- excessive regrowth
- low to medium PAWC
- sensitive recharge area for groundwater
- weed infestation
- surface sealing

Land conservation

Water erosion hazard : medium to low
Surface runoff : low to medium
Contour banks : narrow based
Waterways : suitable, grass with buffel grass and native grasses
Strip cropping : n.a.
Diversion banks : suitable
Dams : generally suitable

Stocking rates

Uncleared native pasture : 12 to 15 ha / AE
Cleared native pasture : 8 ha /AE
Sown pasture : 8 ha / AE

Management recommendations

- Not suitable for dryland cropping
- P supplementation usually required, particularly if using stylos for production gains
- Do not destroy trees if on groundwater intake area
- Do not clear if shrubby understorey present
- Marginally suitable for improved pasture grasses

5 Glengallan

Land use suitability

Forage cropping (short term)	: *all forage sorghums, oats*
Grazing native pastures	: *low producing bluegrasses, speargrass, wiregrasses and other native grasses in uncleared state; reasonably productive when cleared*
Grazing sown pastures	: *reasonably productive buffel grass, stylo*

Land use limitations

- low fertility
- very low PAWC
- sodic subsoil
- poorly drained
- hard setting surface
- excessive regrowth

Land conservation

Water erosion hazard	: extremely high
Surface runoff	: high
Contour banks	: unsuitable
Waterways	: With buffel grass
Strip cropping	: unsuitable
Diversion banks	: suitable if subsoil not exposed
Dams	: generally suitable

Stocking rates

Uncleared native pasture	: 40 ha / AE
Cleared native pasture	: 10 to 15 ha /AE
Sown pasture	: 7 to 8 ha / AE

Management recommendations

- Cultivate only in short-term to control regrowth
- Do not expose subsoil because of erodibility hazard
- Topsoil dam walls to prevent piping and gully erosion

Glengallan 5

AMU description:

Thin, sandy-surfaced yellow-brown duplex soils; hard setting surface overlies coarse, impervious clay subsoils under brigalow/eucalypt scrub

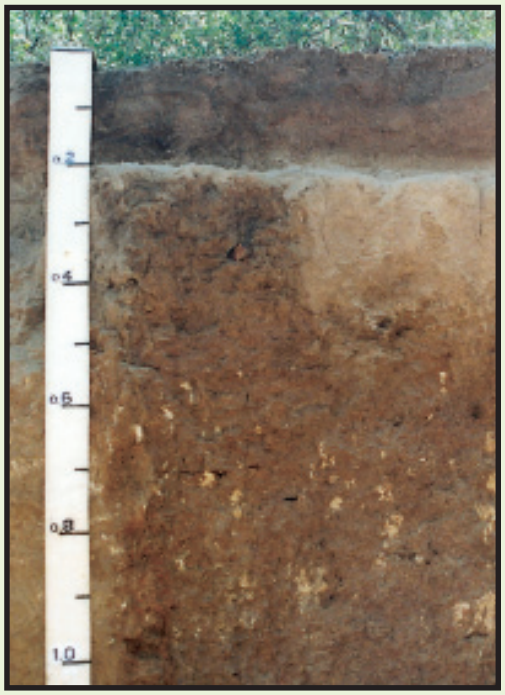
Site description

Landform

Undulating plains of low local relief with most slopes below 1%.

Vegetation

Brigalow scrub with emergent eucalypts (Dawson gum, poplar box, yapunyah) and understorey of currant bush and sandalwood.



Representative soil profile

Depth (m)	Description
0 to 0.18	Dark brown, sandy clay loam; hard setting surface; weak, blocky to massive structure; abrupt change to:
0.18 to 0.2	Sandy clay loam; bleached A2 horizon; massive structure; abrupt change to:
0.2 to 0.5	Brown, sandy medium clay; strong, medium columnar structure; gradual change to:
0.5 to 1.25	Brown, sandy medium clay; strong, coarse prismatic structure; soft carbonate; a few orange mottles; clear change to:
1.25 to 1.5	Greyish red, sandy medium heavy clay.

Distinguishing soil properties

Chemical

- N: very low P: low to medium
  K: medium
- low zinc
- surface pH 6.5, tending alkaline with depth
- strongly sodic below 0.2 m
- low salinity

Physical

- hard setting structureless surface, highly susceptible to plough pan development; poor workability; surface seals and sets hard after rain
- very low infiltration and permeability
- very poor drainage
- effective rooting depth less than 0.2 m
- very low PAWC
- highly dispersive below 0.2 m

6 Glen Idol

AMU description: Red to brown duplex soils which are moderately structured and well drained under brigalow scrub

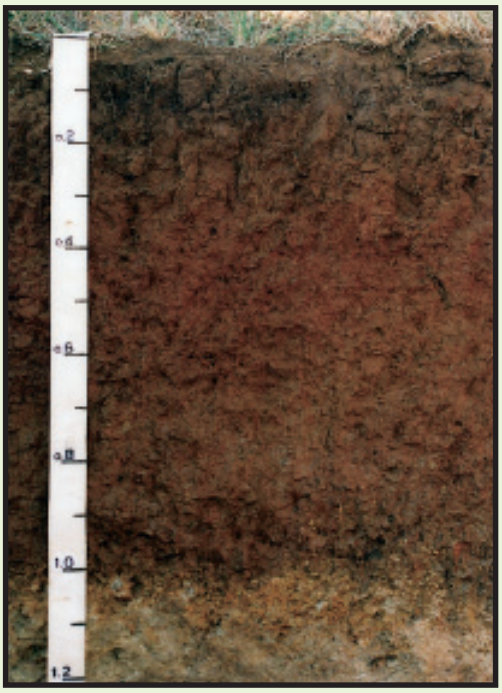
Site description

Landform

Undulating and gently undulating plains of low local relief with slopes generally less than 2% but can be greater than 20%.

Vegetation

A range including brigalow with associated bauhinia, ooline, Dawson gum, yapunyah; silver leaved ironbark, gidgee and bonewood scrub.



Representative soil profile

Depth (m)	Description
0 to 0.3	Dark reddish brown, clay loam; firm surface; weak, fine blocky structure; clear change to:
0.3 to 0.55	Dark reddish brown, medium clay; moderate prismatic structure; gradual change to:
0.55 to 1.0	Dull reddish brown, medium clay; strong prismatic structure; few yellow and grey mottles; clear change to:
1.0 +	Weathered basalt.

Distinguishing soil properties

Chemical

- N: low P: medium
  K: medium
- low zinc
- surface pH 7.0, tending alkaline with depth
- non sodic
- low salinity

Physical

- firm to hard setting surface; seals with rain after tillage
- infiltration and permeability restricted below 0.5 m
- effective rooting depth 0.5 m to 0.8 m
- medium PAWC
- moderate dispersion below 0.5 m

Glen Idol 6

Land use suitability

Irrigated (all types) croppping	:	*all crops and pastures*
Dryland farming (small areas only)	:	*winter crop only, wheat, chickpea, safflower*
Forage cropping	:	*oats*
Grazing native pastures	:	*very low producing wiregrasses and speargrasses in uncleared state; reasonably productive when cleared*
Grazing sown pastures	:	*highly productive buffel grass, rhodes grass, stylo, green panic*

Land use limitations

- low N
- medium PAWC
- hard setting surface
- excessive regrowth

Land conservation

Water erosion hazard	:	medium
Surface runoff	:	medium to high
Contour banks	:	narrow based
Waterways	:	suitable, grass with buffel grass, Katambora rhodes, native grasses
Strip cropping	:	n.a.
Diversion banks	:	suitable
Dams	:	suitable

Stocking rates

Uncleared native pasture	:	40 ha / AE
Cleared native pasture	:	10 to 12 ha /AE
Sown pasture	:	3 to 5 ha / AE

Management recommendations

- Do not overgraze because of susceptibility to wind erosion
- Control regrowth
- Do not clear bonewood scrub and slopes greater than 20%

7 Highlands

Land use suitability

Grazing native pastures : *very low producing black speargrass, bluegrasses and other native grasses*

Land use limitations

- very low PAWC
- restricted effective rooting depth
- shallow soil
- hard setting surface

Land conservation

Water erosion hazard	: medium
Surface runoff	: high
Contour banks	: n.a.
Waterways	: n.a.
Strip cropping	: n.a.
Diversion banks	: suitable
Dams	: unsuitable

Stocking rates

Uncleared native pasture	: 50 ha / AE
Cleared native pasture	: n.a.
Sown pasture	: n.a.

Management recommendations

- Do not develop
- Maintain timber for property use, wildlife abd catchment protection

Highlands 7

AMU description: Shallow, gravelly soils on rugged uplands and dissected ridges

Site description

Landform

Mountains, hills and dissected plateaus.

Vegetation

Eucalypt woodlands or open forest (narrow leaved ironbark, silver leaved ironbark, yapunyah, lemon scented gum) and a range of understorey vegetation including lancewood, bendee, rosewood and other wattles.

Representative soil profile

Depth (m)	Description
0 to 0.35	Reddish brown, sandy clay loam; massive structure; large amount of rock and gravel; diffuse change to:
0.35+	Fresh rock (variable).

Distinguishing soil properties

Chemical

- N: very low P: very low K: very low
- neutral pH trend
- non sodic and non saline

Physical

- firm to hard setting; often very gravelly
- high infiltration and permeability
- very shallow rooting depth less than 0.3 m
- very low PAWC

8 *Isaac*

AMU description:

Deep, coarse and medium textured soils associated with alluvial levees and interchannel areas

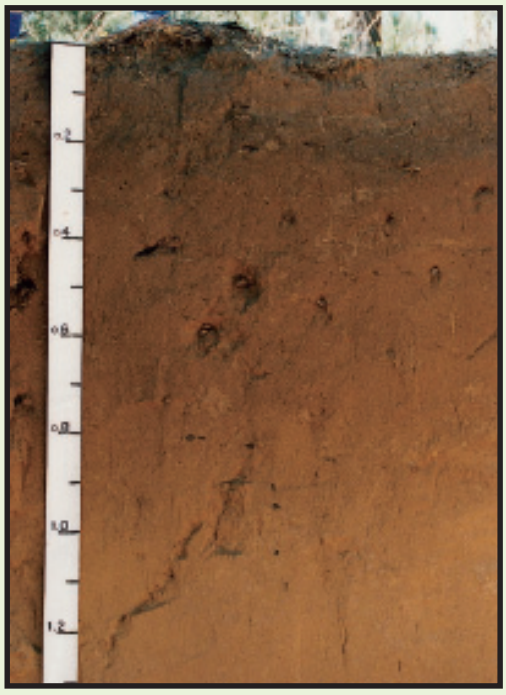
Site description

Landform

Narrow levees and alluvial plains of low relief associated mainly with major streams.

Vegetation

Tall woodlands of blue gum and Moreton Bay ash.



Representative soil profile

Depth (m)	Description
0 to 0.1	Brownish grey, sandy clay loam; firm surface; weak blocky structure; clear change to:
0.1 to 0.6	Brownish black, sandy clay loam; weak blocky structure; gradual change to:
0.6 to 1.45	Brown, sandy loam; clear change to:
1.45+	Brownish grey, sandy light medium clay.

Distinguishing soil properties

Chemical

- N: very low P: high
  K: medium
- neutral pH trend
- non sodic and non saline

Physical

- loose to firm, deep sandy surface
- very high infiltration and permeability
- effective rooting depth greater than 1.0 m
- low to medium PAWC
- well drained

Isaac 8

Land use suitability

Grazing native pastures : *moderately productive native grasses in uncleared state; highly productive when cleared*

Grazing sown pastures : *highly productive green panic, buffel grass and stylo*

Land use limitations

- flooding
- low to medium PAWC
- access because of wetness
- weed invasion
- frost

Land conservation

Water erosion hazard : low
Surface runoff : low
Contour banks : n.a.
Waterways : n.a.
Strip cropping : n.a.
Diversion banks : n.a.
Dams : n.a.

Stocking rates

Uncleared native pasture : 8 to 10 ha / AE
Cleared native pasture : 6 to 8 ha /AE
Sown pasture : 5 to 6 ha / AE

Management recommendations

- Do not develop for cropping
- Add stylos to native pasture
- Stock conservatively to prevent weed invasion, particularly by parthenium
- Observe clearing guidelines with respect to distances from creeks and rivers

9 Jimbaroo

Land use suitability

Grazing native pastures : *highly productive bluegrasses and others in uncleared state; highly productive when cleared*

Grazing sown pastures : *moderately productive purple pigeon*

Land use limitations

- shallow soil depth
- low to medium PAWC

Land conservation

Water erosion hazard	: high
Surface runoff	: medium to high
Contour banks	: n.a.
Waterways	: suitable, grass with African Star grass, purple pigeon, creeping bluegrass or angelton
Strip cropping	: n.a.
Diversion banks	: suitable
Dams	: unsuitable

Stocking rates

Uncleared native pasture	: 7 to 15 ha / AE
Cleared native pasture	: 6 to 10 ha /AE
Sown pasture	: 6 to 10 ha / AE

Management recommendations

- Do not develop

Jimbaroo 9

AMU description:

Shallow cracking and non-cracking clays on undulating open downs formed on basalt

Site description

Landform

Often occurs within Orion or Kia-Ora AMUs on ridgelines and crests of gently undulating open downs.

Vegetation

Open woodlands of mountain coolibah, silver leaved ironbark or bloodwood. Ground cover of bluegrass, mitchell grass, black speargrass and wiregrass.

Representative soil profile

Depth (m)	Description
0 to 0.05	Brownish black, medium heavy clay; strong blocky structure; self-mulching and cracking; abrupt change to:
0.05 to 0.3	Brownish black, medium heavy clay; strong blocky structure; some carbonate concretions; clear change to:
0.3+	Weathered basalt.

Distinguishing soil properties

Chemical

- N: low to medium
  P: low to medium
  K: high
- low copper
- surface pH 7.5, tending slightly more alkaline with depth
- non sodic and non saline

Physical

- self-mulching surface, often stony
- moderate infiltration and permeability
- effective rooting depth less than 0.45 m
- low to medium PAWC

10 *Kia-Ora*

AMU description:

Black cracking clays with a strong fine granular surface mulch on undulating open downs formed on shales

Site description

Landform

Undulating plains in the south-west on generally higher slopes (>1.5%) than Orion AMU.

Vegetation

Bluegrass tussock grasslands.

Representative soil profile

Depth (m)	Description
0 to 0.2	Dark grey brown, medium heavy clay; strong, medium granular structure; self-mulching and cracking surface; abrupt change to:
0.2 to 0.8	Brownish black, heavy clay; strong blocky structure; gradual change to:
0.8 to 1.1	Brownish black, heavy clay; a few carbonate nodules; clear change to:
1.1 to 1.4	Brown, medium heavy clay; large amounts of soft carbonate (lime); abrupt change to:
1.4+	Weathered shale.

Distinguishing soil properties

Chemical

- N: medium P: very high K: high
- low zinc
- surface pH 8.0, tending more alkaline with depth
- non sodic and non saline

Physical

- strong and fine mulching surface, sealing in places with moderate to good workability
- moderate infiltration and permeability
- effective rooting depth 0.45 m to 1.5 m
- high to very high PAWC

Kia-Ora 10

Land use suitability

Irrigated (all types) croppping	:	*all crops and pastures*
Dryland cropping	:	*sorghum, sunflower, chickpea, mungbeans, wheat, safflower, cotton*
Forage cropping	:	*all forage sorghums, oats, dolichos, cowpea*
Grazing native pastures	:	*very highly productive bluegrasses, and other native grasses*
Grazing sown pastures	:	*highly productive buffel grass, rhodes grass, purple pigeon*

Land use limitations

- soil erosion
- surface sealing

Land conservation

Water erosion hazard	:	high
Surface runoff	:	medium to high
Contour banks	:	broad based
Waterways	:	suitable, grass with African Star grass, Indian bluegrass, purple pigeon, buffel grass, Katambora rhodes, creeping bluegrass, angleton and native grasses
Strip cropping	:	suitable
Diversion banks	:	suitable
Dams	:	suitable

Stocking rates

Uncleared native pasture	:	4 to 5 ha / AE
Cleared native pasture	:	n.a
Sown pasture	:	5 ha / AE

Management recommendations

- Contour banks on cultivated land over 0.5%
- Use minimum tillage techniques
- Rotate crops
- Waterways stabilisation requires care
- When spelling cultivation, sown pastures are needed because native pastures won't regenerate

11 Lascelles

Land use suitability

Grazing native pastures : *low to very low producing black speargrass, desert bluegrass and other native grasses uncleared; moderate grass production when cleared*

Grazing sown pastures : *low producing buffel grass and stylo*

Land use limitations

- very low to low PAWC
- low fertility
- sodic subsoil
- very high erodibility of subsoil
- excessive regrowth
- hard setting surface

Land conservation

Water erosion hazard : extremely high
Surface runoff : high
Contour banks : unsuitable
Waterways : suitable if topsoil intact, grass with buffel grass
Strip cropping : n.a.
Diversion banks : unsuitable
Dams : generally suitable

Stocking rates

Uncleared native pasture : 15 to 20 ha / AE
Cleared native pasture : 15 ha / AE
Sown pasture : 12 to 15 ha / AE

Management recommendations

- Do not mechanically clear
- Use chemical treatment to selectively clear areas
- Do not expose sodic soils

Lascelles 11

AMU description:

Hard setting, yellow-brown sandy duplex soils with hard, impervious clay subsoils

Site description

Landform

Undulating plains of low local relief with slopes generally less than 1%.

Vegetation

Woodlands of poplar box, narrow leaved ironbark and silver leaved ironbark, with understorey of sandalwood, currant bush and wattles (occasionally without shrubby understorey).

Representative soil profile

Depth (m)	Description
0 to 0.2	Yellowish brown, sandy loam; hard setting surface; very coarse, massive structure; clear change to:
0.2 to 0.3	Sandy loam; conspicuous bleach; massive structure; abrupt change to:
0.3 to 0.8	Yellowish brown, medium heavy clay; strong, coarse columnar structure; gradual change to:
0.8 to 1.5	Yellowish brown, medium clay; strong blocky structure; carbonate nodules common.

Distinguishing soil properties

Chemical

- N: very low P: very low to medium K: medium
- low to medium copper and zinc
- surface pH 6.5, tending alkaline with depth
- strongly sodic below 0.4 m to 0.6 m
- low salinity below 0.5 m

Physical

- hard setting sandy surface; seals and sets hard with rain following tillage
- initial high infiltration but tends to waterlog once wetting front encounters subsoil clay layer
- effective rooting depth 0.2 m to 0.5 m
- very low to low PAWC
- highly dispersive below 0.4 m to 0.6 m

12 Lonesome

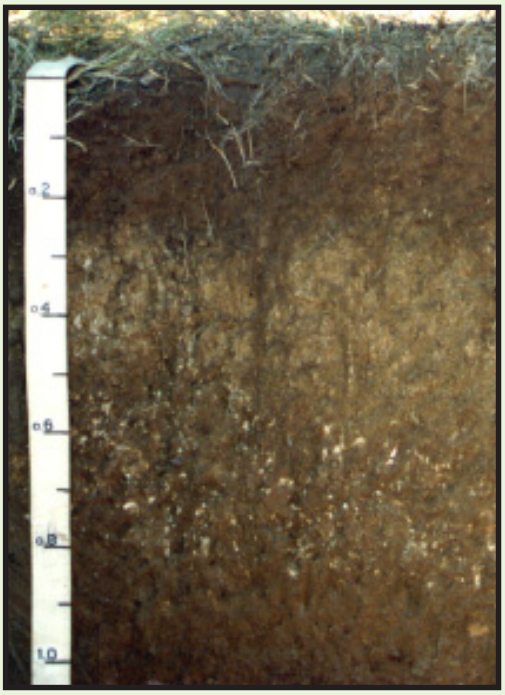
AMU description: Melonholed grey and brown clays on brigalow scrub plains

Site description

Landform
Level or gently undulating plains with melonhole gilgai.

Vegetation

Brigalow scrub which may include yapunyah. Areas of blackwood and gidgee occur to the north of the area.



Representative soil profile

Depth (m)	Description (gilgai mound)
0 to 0.05	Brown, light clay; moderate granular structure; self-mulching and cracking surface; clear change to:
0.05 to 0.3	Brown, medium clay; moderate blocky structure; some soft carbonate; clear change to:
0.3 to 0.85	Yellow-brown, medium heavy clay; moderate prismatic structure; soft carbonate common; gradual change to:
0.85 to 1.5	Brown, heavy clay; strong blocky structure; grey and red mottles common.

Distinguishing soil properties

Chemical

- N: low P: low
  K: medium to high
- low zinc
- surface pH 8.0, tending acidic below 0.2 m
- strongly sodic below 0.2 m (mounds); 0.6 m (depressions)
- salinity below 0.3 m (mounds); 0.6 m (depressions)

Physical

- gilgais over 0.4 m deep; mounds are sandy crusting; depressions are coarse mulching, remaining waterlogged for extended periods
- very low infiltration and permeability
- very poorly drained
- effective rooting depth 0.2 m mounds; 0.6 m depressions
- medium PAWC (depressions); very low PAWC (mounds)
- highly dispersive below 0.2 m mounds; 0.6 m depressions

Lonesome 12

Land use suitability

Grazing native pastures : *very low producing bluegrasses and other native grasses when uncleared; low producing when cleared*

Grazing sown pastures : *moderately productive purple pigeon, buffel grass, rhodes grass and para grass*

Land use limitations

- gilgais
- coarse self-mulching surface
- high salinity and sodicity
- shallow effective rooting depth

Land conservation

Water erosion hazard	**:** low
Surface runoff	**:** low to medium
Contour banks	**:** n.a.
Waterways	**:** n.a.
Strip cropping	**:** n.a.
Diversion banks	**:** suitable
Dams	**:** suitable

Stocking rates

Uncleared native pasture	: 40 to 50 ha / AE
Cleared native pasture	: 15 to 20 ha / AE
Sown pasture	: 6 to 10 ha / AE

Management recommendations

- Develop only for sown pasture
- Gilgais may support para grass

13 Moramana

Land use suitability

Irrigated (all types) croppping : *all crops*
Dryland cropping : *sorghum, sunflower, wheat. mungbeans, chickpea, safflower, cotton*
Forage cropping : *all forage sorghums, oats, dolichos, cowpea*
Grazing native pastures : *highly productive bluegrasses and other native grasses uncleared; highly productive when cleared*
Grazing sown pastures : *highly productive purple pigeon*

Land use limitations

- flooding
- salinity
- frost

Land conservation

Water erosion hazard : medium
Surface runoff : medium
Contour banks : broad based
Waterways : suitable, grass with African Star grass, purple pigeon, Indian bluegrass, creeping bluegrass, angleton or native grasses
Strip cropping : suitable
Diversion banks : suitable
Dams : suitable

Stocking rates

Uncleared native pasture : 12 to 15 ha / AE
Cleared native pasture : 4 to 6 ha /AE
Sown pasture : 3 to 5 ha / AE

Management recommendations

- Do not clear black tea tree
- Use minimum tillage techniques to retain stubble
- Rotate crops
- Use press wheels to assist establishment
- Contour banks and waterways necessary on cultivated slopes over 0.5%
- When spelling cultivation, sown pastures are needed because native pastures won't regenerate

Moramana 13

AMU description:

Deep red, brown to grey uniform clays on broad to narrow, occasionally deeply incised, alluvial plains draining basalt landscapes

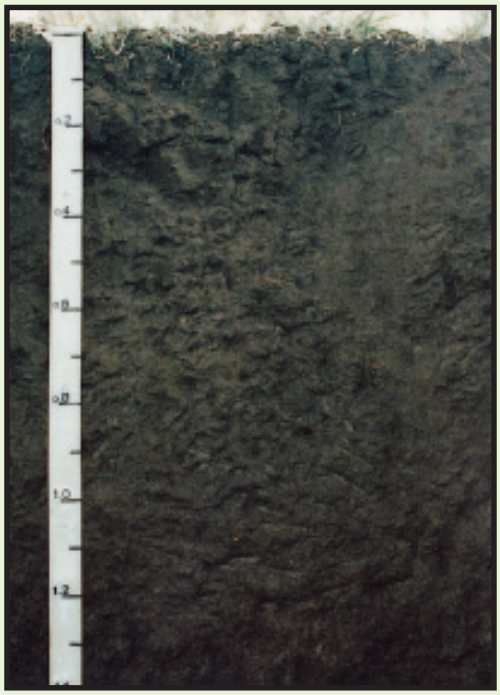
Site description

Landform

Alluvial plains along streams draining the basalt areas.

Vegetation

Tall open woodlands of coolibah with associated black tea tree, brigalow and yellowwood.



Representative soil profile

Depth (m)	Description
0 to 0.2	Grey brown, medium heavy clay; strong, fine granular structure; self-mulching surface; gradual change to:
0.2 to 0.4	Grey brown, medium heavy clay; strong, medium blocky structure; gradual change to:
0.4 to 1.5+	Grey brown, medium heavy clay; strong lenticular structure; a few carbonate nodules.

Distinguishing soil properties

Chemical

- N: low P: very low to low K: medium
- low zinc
- surface pH 7.5, tending more alkaline with depth
- non sodic
- occasional high salinity below 0.5m; otherwise very low salinity apart from seepage areas

Physical

- fine self-mulching surface; good workability
- moderate infiltration and permeability;
- moderately well drained
- effective rooting depth greater than 1.0 m
- high PAWC

14 *Orion*

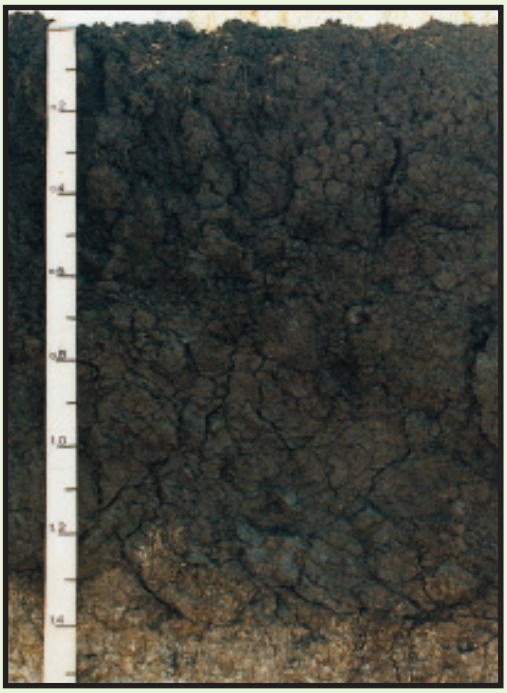
AMU description: Deep, cracking dark clays on undulating downs on basalt

Site description

Landform
Undulating plains and rises on basalt.

Vegetation

Open grasslands of bluegrass, mitchell grass, black speargrass and wiregrass with scattered mountain coolibah, bloodwood, silver leaved ironbark and wattles.



Representative soil profile

Depth (m)	Description
0 to 0.05	Brownish black, medium clay; self mulching and cracking surface; strong blocky structure; clear change to:
0.05 to 0.35	Brownish black, heavy clay; strong blocky structure; gradual change to:
0.35 to 1.3	Brown, heavy clay; strong lenticular structure; a few carbonate nodules; gradual change to:
1.3+	Weathered basalt.

Distinguishing soil properties

Chemical

- N: low P: very low to low
  K: medium to high
- low zinc
- surface pH 7.5, tending more alkaline with depth
- non sodic and non saline

Physical

- strong self-mulching surface; surface stone can occur
- heavy clay difficult to work when wet
- low to moderate infiltration and permeability
- imperfect drainage
- effective rooting depth greater than 0.45 m (governed by depth to parent material)
- high PAWC

Orion 14

Land use suitability

Irrigated (all types) croppping	**:**	*all crops and pastures*
Dryland cropping	**:**	*sorghum, sunflower, wheat. mungbeans, chickpea, safflower, cotton*
Forage cropping	**:**	*all forage sorghums, oats, dolichos, cowpea*
Grazing native pastures	**:**	*very highly productive bluegrasses and other native grasses*
Grazing sown pastures	**:**	*highly productive purple pigeon*

Land use limitations

- soil erosion
- fertility
- coarse and thin surface mulch
- surface sealing
- surface stone
- variability of depth and PAWC

Land conservation

Water erosion hazard	**:**	high
Surface runoff	**:**	medium to high
Contour banks	**:**	broad based
Waterways	**:**	suitable, grass with African Star grass, purple pigeon, Indian bluegrass, creeping bluegrass, and native grasses
Strip cropping	**:**	suitable
Diversion banks	**:**	suitable
Dams	**:**	unsuitable

Stocking rates

Uncleared native pasture	:	4 to 5 ha / AE
Cleared native pasture	:	n.a.
Sown pasture	:	5 ha / AE

Management recommendations

- Contour banks on cultivation over 0.5% slope
- Use minimum tillage techniques
- Rotate crops
- Do not clear black tea tree
- Waterways stabilisation requires care
- Use press wheels to assist crop establishement

15 Picardy

Land use suitability

Irrigated (all types) croppping	: *all crops and pastures*
Dryland cropping	: *sorghum, sunflower, wheat, mungbeans, chickpea, safflower, cotton*
Forage cropping	: *all forage sorghums, oats, dolichos, cowpea*
Grazing native pastures	: *low producing bluegrasses and scrub grasses when uncleared; moderately productive when cleared*
Grazing sown pastures	: *highly productive buffel grass, rhodes grass and purple pigeon*

Land use limitations

- soil erosion
- surface sealing

Land conservation

Water erosion hazard	: high
Surface runoff	: medium to high
Contour banks	: broad based
Waterways	: suitable, grass with African Star grass, buffel grass, purple pigeon, Indian bluegrass, Katambora rhodes, creeping bluegrass, angleton and native grasses
Strip cropping	: suitable
Diversion banks	: suitable
Dams	: suitable

Stocking rates

Uncleared native pasture	: 25 ha / AE
Cleared native pasture	: 13 ha /AE
Sown pasture	: 3 to 4 ha / AE

Management recommendations

- Contour banks on cultivated land over 0.5%
- Use minimum tillage techniques
- Rotate crops

Picardy 15

AMU description:

Deep red, brown to grey cracking clays under brigalow, softwood scrub or gidgee scrub

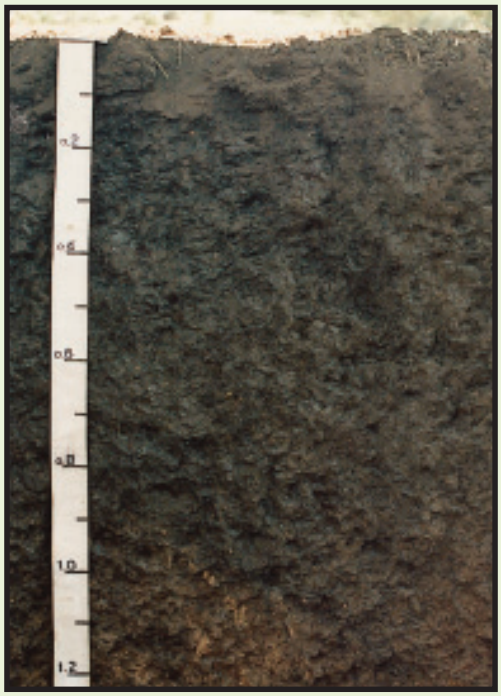
Site description

Landform

Level to undulating plains.

Vegetation

Fairly dense scrub consisting of brigalow, yellowwood and associated softwood species or gidgee; mostly cleared for cultivation.



Representative soil profile

Depth (m)	Description
0 to 0.1	Brown, medium clay; strong, fine granular structure; self-mulching and cracking surface; abrupt change to:
0.1 to 0.35	Brown, medium heavy clay; strong, medium blocky structure; gradual change to:
0.35 to 1.0	Greyish brown, medium heavy clay; strong lenticular structure; a few carbonate nodules; a gradual change to:
1.0 to 1.5+	Yellow-brown, medium heavy clay; soft carbonate common; basalt often encountered before 2 m.

Distinguishing soil properties

Chemical

- N: medium P: medium to high K: medium to high
- low zinc
- surface pH 8.0, tending more alkaline with depth
- possible medium sodicity below 1.2 m
- possible medium salinity below 1.2 m

Physical

- strong granular self-mulching surface; easy workability; occasional tendency to seal following cultivation
- moderate infiltration and permeability
- imperfect drainage below 0.5 m
- effective rooting depth greater than 0.9 m
- high to very high PAWC

16 Rolleston

AMU description:

Deep, cracking grey to brown clays formed from highly weathered sediments under brigalow / eucalypt scrub

Site description

Landform

Level and lower sloping areas of undulating plains. Includes areas of normal gilgai with less than 0.4 m vertical interval.

Vegetation

Commonly brigalow and Dawson gum scrub with areas of gidgee and blackwood to the north.

Representative soil profile

Depth (m)	Description
0 to 0.05	Greyish brown, heavy clay; crusting and cracking surface; moderate, fine granular structure; clear change to:
0.05 to 0.3	Greyish brown, heavy clay; moderate blocky structure; some soft carbonate; gradual change to:
0.3 to 1.2	Dull brown, heavy clay; strong lenticular structure; a few carbonate nodules and manganese veins; gradual change to:
1.2 to 1.5	Dull brown, heavy clay.

Distinguishing soil properties

Chemical

- N: very low to medium
  P: very low to medium
  K: high
- surface pH 8.0, tending acid below 0.6 m
- sodic below 0.5 m
- very low to medium salinity below 0.5 m

Physical

- crusting to coarse mulching; often gilgais less than 0.4 m deep with depressions remaining wet for extended periods
- slow infiltration and permeability
- poorly drained
- effective rooting depth 0.5 m
- medium to high PAWC
- moderately dispersive below 0.5 m

Rolleston 16

Land use suitability

Irrigated (all types) croppping	: *all crops and pastures*
Dryland cropping (short term)	: *sorghum, wheat, chickpea*
Forage cropping	: *forage sorghums, oats, dolichos, cowpea and millets*
Grazing native pastures	: *low producing bluegrasses, wire-grases and other native grasses uncleared; moderately productive when cleared*
Grazing sown pastures	: *moderately productive buffel grass, rhodes grass and purple pigeon*

Land use limitations

- sodic and salinity
- gilgais
- coarse surface mulch
- regrowth

Land conservation

Water erosion hazard	:low to medium
Surface runoff	:low to medium
Contour banks	:broad based
Waterways	:suitable, grass with African Star grass, buffel grass, Katambora rhodes, purple pigeon, Indian bluegrass, creeping bluegrass, angleton and native grasses
Strip cropping	:unsuitable
Diversion banks	:suitable
Dams	:suitable

Stocking rates

Uncleared native pasture	: 25 ha / AE
Cleared native pasture	: 10 to 15 ha / AE
Sown pasture	: 7 to 8 ha / AE

Management recommendations

- Contour banks on cultivated land over 0.5%
- Rotate forage crops
- Use minimum tillage techniques
- Land levelling required insome areas

17 Springton

Land use suitability

Irrigated (all types) croppping : *all crops and pastures*
Forage cropping : *all forage sorghums, oats, dolichos, cowpea, millets*
Grazing native pastures : *very low producing bluegrass and scrub grasses when uncleared; moderately productive when cleared*
Grazing sown pastures : *highly productive buffel grass, green panic and rhodes grass*

Land use limitations

- restricted soil depth
- low to moderate PAWC
- sodic subsoil
- soil erosion
- workability; crusting and sometimes hard setting surface

Land conservation

Water erosion hazard : medium
Surface runoff : medium to high
Contour banks : broad based
Waterways : suitable, grass with African Star grass, buffel grass, Indian bluegrass, Katambora rhodes, creeping bluegrass, angleton and native grasses
Strip cropping : unsuitable
Diversion banks : suitable
Dams : suitable

Stocking rates

Uncleared native pasture : 30 to 40 ha / AE
Cleared native pasture : 10 to 12 ha /AE
Sown pasture : 4 to 5 ha / AE

Management recommendations

- Contour banks on cultivated land over 0.5%
- Use minimum tillage techniques
- Rotate forage crops
- Retain all organic matter to reduce soil structural damage

Springton 17

AMU description:

Red to brown cracking and non-cracking clays usually on upper slopes of undulating scrub country

Site description

Landform

Mid and upper sloping areas of undulating landscapes in association with Turkey Creek AMU.

Vegetation

Woodlands or scrub with a range of species including brigalow, bonewood, wilga, belah, bendee, yellowwood, gidgee, silver leaved ironbark, Dawson gum and bottletree.

Representative soil profile

Depth (m)	Description
0 to 0.2	Dull reddish brown, medium clay; moderate, fine to medium blocky structure; abrupt change to:
0.2 to 0.4	Dull reddish brown, medium heavy clay; coarse blocky structure; a few carbonate nodules; clear change to:
0.4 to 1.4	Reddish brown, medium heavy clay; coarse blocky structure; a few carbonate nodules; clear change to:
1.4+	Weathered basalt.

Distinguishing soil properties

Chemical

- N: low to medium
  P: low to medium K: medium
- low zinc
- surface pH 8.0, tending more alkaline
- strongly sodic below 0.5 m
- low to medium salinity below 0.6 m

Physical

- crusting to hard setting surface; cloddy after cultivation
- slow infiltration and permeability
- poorly drained below 0.5 m
- effective rooting depth 0.4 to 1.0 m (often quite variable)
- low to medium PAWC
- high dispersion below 0.5 m

18 Turkey Creek

AMU description:

Grey to brown duplex soils with thin sandy surfaces on undulating brigalow scrub country

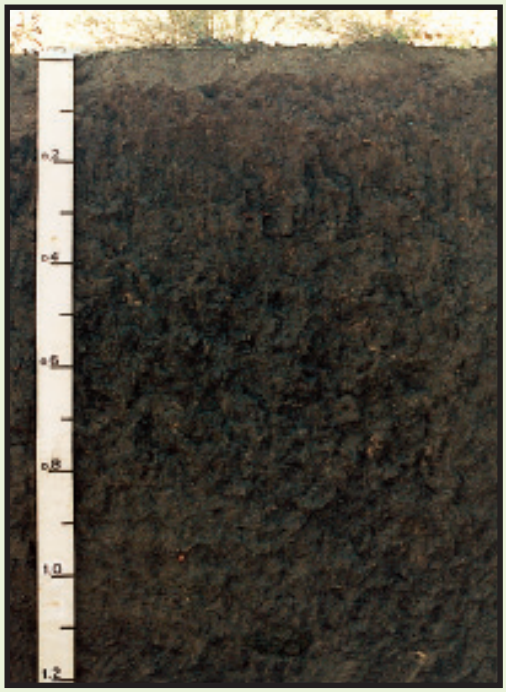
Site description

Landform

Midslope positions of undulating landscapes in association with Springton and Picardy AMUs.

Vegetation

Brigalow, belah, Dawson gum and yellowwood scrub.



Representative soil profile

Depth (m)	Description
0 to 0.05	Brown, sandy clay loam; weak granular structure; clear change to:
0.05 to 0.25	Grey brown, medium clay; strong, medium blocky structure; gradual change to:
0.25 to 1.5+	Grey brown, heavy clay; strong lenticular structure; a few carbonate nodules.

Distinguishing soil properties

Chemical

- N: low to medium K: medium
  P: very low to medium
- low copper and zinc (in virgin state)
- surface pH 8.0, tending more alkaline with depth
- medium sodicity below 0.7 m
- low salinity below 0.7 m

Physical

- hard setting sandy surface becoming a sandy clay following tillage; vulnerable to plough pan formation
- moderate infiltration and permeability
- imperfect drainage
- effective rooting depth 0.6 m to 1.0 m
- medium to high PAWC
- slight tendency for clay dispersion below 0.6 m

Turkey Creek 18

Land use suitability

Irrigated (all types) croppping : *all crops and pastures*
Dryland cropping : *sorghum, sunflower, cotton, mungbeans, wheat, chickpea, safflower*
Forage cropping : *all sorghum forages, oats, dolichos,*
Grazing native pastures : *very low producing bluegrass and other native grasses uncleared; moderately productive when cleared*
Grazing sown pastures : *highly productive buffel grass, green panic, rhodes grass and purple pigeon*

Land use limitations

- rapid nutrient decline
- plough pan development
- weed infestation

Land conservation

Water erosion hazard : high
Surface runoff : medium
Contour banks : broad based
Waterways : suitable, grass with African Star grass, buffel grass, Katambora rhodes, purple pigeon and native grasses
Strip cropping : n.a.
Diversion banks : suitable
Dams : suitable

Stocking rates

Uncleared native pasture : 40 ha / AE
Cleared native pasture : 10 to 15 ha / AE
Sown pasture : 3 to 4 ha / AE

Management recommendations

- Contour banks on cultivated land over 0.5%
- Practice reduced tillage techniques on all cultivation
- Good weed control is vital (particularly parthenium)
- When spelling cultivation, sown pastures are needed because native pastures won't regenerate

Appendix G - EMR / CLR Search

Department of Environment and Heritage Protection (EHP)
ABN 46 640 294 485
400 George St Brisbane, Queensland 4000
GPO Box 2454, Brisbane QLD 4001, AUSTRALIA
www.ehp.qld.gov.au

SEARCH RESPONSE
ENVIRONMENTAL MANAGEMENT REGISTER (EMR)
CONTAMINATED LAND REGISTER (CLR)

Tim Kinny
21 McLachlan Street
Fortitude Valley QLD 4006

Transaction ID: 49050808 EMR Site Id: 27 February 2013
Cheque Number:
Client Reference:

This response relates to a search request received for the site:
Lot: 662 Plan: PH1491
5509 ELGIN Road
CLERMONT

EMR RESULT

The above site is NOT included on the Environmental Management Register.

CLR RESULT

The above site is NOT included on the Contaminated Land Register.

ADDITIONAL ADVICE

From the 1st August 2012, the price of an EMR/CLR search will increase to $41.55 per lot for internet based searches and $48.85 per lot for EMR/CLR searches done by means other than the internet.

If you have any queries in relation to this search please phone 13QGOV (13 74 68)

Registrar
Administering Authority

Appendix H - Conceptual Erosion & Sediment Control Plan

Moray Quarry
Conceptual Erosion and Sediment Control Plan

1.1 Introduction

CDM Smith Australia Pty Ltd (CDM Smith) has been engaged by Adani Mining Pty Ltd (Adani) to prepare the development application and relevant supporting documentation for Moray Quarry. As part of the supporting documentation, a Conceptual Erosion and Sediment Control Plan (ESCP) has been prepared to outline proposed environmental management measures regarding water runoff and erosion prevention.

Moray Quarry is a new road construction and rail embankment material quarry proposed to be located on Lot 662 PH1491 approximately 145 km north of Clermont in Central Queensland. The site is bounded by Bulliwallah Road to the east and Moray Carmichael Road to the south-east. The lot is within the Isaac Regional Council (IRC) area and is zoned Rural under the *Belyando Shire Planning Scheme 2009* and although the property is primarily used for agricultural activities, the site of the proposed Moray Quarry has been utilised for historic quarrying operations.

1.2 Scope

This Conceptual ESCP applies to the four stages of vegetation clearing, overburden stripping and extraction for the quarry, associated with the proposed Carmichael Coal Mine and Rail Project. This Conceptual ESCP has been prepared as an overview to demonstrate possible Erosion and Sediment Control (ESC) Planning options and is not intended as a final design.

1.3 Purpose

The purpose of this Conceptual ESCP is to characterise the risk of erosion during construction and operation of the Moray Quarry, and demonstrate that water management and erosion and sediment control requirements of the quarry can be met within the proposed quarry site. The main objectives of the Conceptual ESCP are to:

- Identify the likely need for the construction of sediment basins;
- Identify that adequate space has been made available for the construction and operation of major sediment traps and essential flow diversion systems;
- Demonstrate to the regulatory authority that there is a feasible means of constructing the project while still protecting key environmental values;
- Identify problem soil areas including dispersive soils, acid sulphate soils, areas of potential mass movement; and
- Identify protected environmental features on the site such as protected vegetation.

This Conceptual ESCP will assist the preparation of the Adani Site Based Management Plan (SBMP) and subsequent detailed construction phase ESCPs. This Conceptual ESCP has been prepared in reference to the Best Practice Erosion and Sediment Control, International Erosion Control Association (Australasia) (IECA, 2008).

1.4 Relevant Legislation

This Conceptual ESCP has been prepared to satisfy environmental management requirements for new developments under the:

- *Environmental Protection Act 1994*; and
- *Belyando Shire Planning Scheme 2009.*

1.5 Hazard and Risk Definitions

- Soil erosion hazard is a prediction of the susceptibility of a parcel of land to erosion, based on the predicted rainfall, soil type and gradient. Wind erosion is considered in dry areas.
- Soil erosion risk is the likelihood of environmental harm occurring due to disturbance activities occurring for the quarry.

Both erosion hazard and erosion risk have been considered in this assessment to determine appropriate controls to be implemented as part of the Moray Quarry construction and operation works.

1.6 Erosion Hazard Assessment

There are a number of different methodologies available to assess erosion hazard within the IECA Guidelines, however no single method considers all of the parameters which may influence the erosion hazard, due to the inherent complexity of erosion hazard assessment. Over the course of the quarry operating life the areas of the site are likely to change in shape, slope and ground cover, and rainfall hazard constantly changes throughout the year. This section discusses the main aspects of erosion hazard.

Slope steepness, slope length, soil type, rainfall erosivity and ground cover type are the main determinants of erosion. To overcome this limitation, site parameters have been assessed by adopting different methodologies from various best practice guidelines including the Sunshine Coast Regional Council (SCRC) Guidelines. This approach allows for the consideration of the site's soil type, slope as well as seasonal changes in rainfall erosivity and wind erosion potential.

1.6.1 Soil Erosion Hazard

Soil erosion hazard for an exposed soil surface is a function of surface roughness, infiltration rate, soil chemistry, and soil particle size. The Geological Survey of Queensland Interactive Resource Tenure Map broadly indicates that pockets of different soils exist locally. The dominant soil types present local to the Moray Quarry area include:

- Uniform clays – non-cracking to heavy cracking with potentially a sandy crust and variable quantity of mulch;
- Duplex soils – hard setting sandy loams; and
- Deep uniform sandy materials – loose to firm and predominant in sand.

In the absence of detailed soil data for the site, particularly exchangeable sodium percentage, Emerson Class Testing and particle size, it has been assumed that the soils are dispersive and highly erodible. This assumption increases predicted erosion rates and, subsequently, increases the size and cost of sediment basins and other erosion and sediment controls. If a soil survey is completed before the Construction ESCP is developed, detailed soil data can be used to refine the design details for sediment controls.

There is an extremely low chance of encountering acid sulphate soils in the quarry area. Acid sulfate soils are rarely encountered away from coastal areas.

Given the relatively low slopes in the area, the risk of mass movement outside the confines of the quarry pit is low. Soil and rock movement within the quarry is a geotechnical consideration and outside the scope of this document.

1.6.2 Slope and Rainfall Erosivity Erosion Hazard

Figure 1, sourced from SCRC (2008), provides a tool to classify the erosion hazard of the site based on slope and rainfall erosivity. Rainfall erosivity is applicable to all climates. The adopted rainfall erosivity (R factor) for the quarry area is 1804 (Emerald – in the absence of comprehensive Clermont data) with a typical slope ranging from <1% to 15% equating to a medium to low erosion hazard for slopes below 12% and a high to very high erosion hazard for slopes above 12%, as defined by the 'A' line.

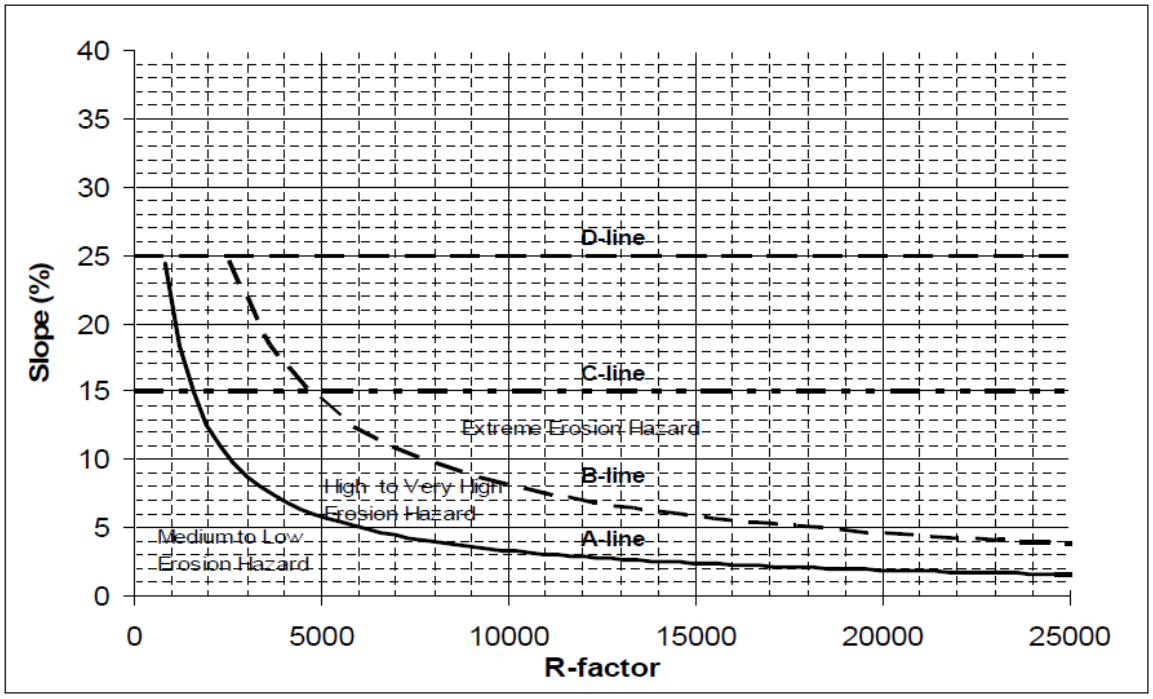


Figure 1 Slope and Rainfall Erosivity Erosion Hazard

1.6.3 Seasonal Erosion Hazard

Table 1, sourced from IECA 2008, illustrates the seasonal change in erosion hazard experienced within the Charters Towers region, based on monthly rainfall erosivity. The Charters Towers data was chosen as it is the closest available in IECA 2008 and provides similar climate and rainfall erosivity. Construction works occurring in the dry season, (April to November) when rainfall is unlikely, have an erosion hazard rating of very low. Construction works occurring in the wet season, (December to March) when rainfall is likely, have an erosion hazard of moderate to high.

Table 1 Erosion Hazard Based on Monthly Rainfall Erosivity

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
High	High	High	Low	V low	V low	V low	V low	V low	V low	Low	Mod

Wind erosion is a key contributor to dust generation, which has the potential to impact on the construction workforce on the quarry, vegetation communities and local sensitive receptors. Areas

of the site that have exposed soil that are susceptible to wind erosion must be covered using a soil binder, mulch or vegetation to achieve 75% cover. Maintaining 75% cover on exposed soils reduces the wind erosion hazard to very low in the dry season and, depending on the technique chosen will also reduce the water erosion hazard.

If construction activities associated with the excavation of the foundations and service trenches is undertaken onsite these will have a moderate wind erosion hazard if conducted in the dry season.

1.6.4 Summary of Erosion Hazard Assessments

Taking into account the various different erosion hazard assessment methods based on soil characteristics, slope, rainfall erosivity and seasonality experienced at the site, the erosion hazard assessment is summarised as follows:

- A low hazard for land disturbance activities which occur within the dry season;
- A moderate to high hazard for land disturbance activities which occur within the wet season;
- A medium to low hazard rating for most areas based on slope, with small isolated areas of high hazard; and
- A moderate wind erosion hazard for construction activities associated with excavation during construction and operation.

Based on the hazard assessment erosion protection required for dry season construction works can be significantly less than if construction occurs during the wet season.

1.7 Erosion Risk

Erosion risk is a function of the likelihood and intensity of expected rainfall, the estimated rate of soil loss and the anticipated period of soil disturbance.

For this assessment the TASK method has been adopted (IECA 2008). The TASK method is a modification of the Revised Universal Soil Loss Equation (RUSLE) and is preferred because it is the simplest and most easily understood method.

TASK considers soil loss rates by calculating the soil erosivity (K Factor), slope factor together with the area of disturbance and the amount of time the area is to be disturbed. The method categorises disturbances as either a low erosion risk (TASK number < 200) or a high erosion risk (TASK Number > 200). The formula for calculating the erosion risk using the TASK method is:

H = TASK
Where:

H= Numerical Value of the TASK number
T = Duration of soil disturbance (months)
A = Total area of soil disturbance (m^2)
S = Slope factor (Table F2 or Equation F3 IECA 2008)
K = Soil erosivity factor (RUSLE K-factor)

The assessment has been undertaken on the extraction footprint proposed to be disturbed during the extraction of the Moray Quarry and refers to sediment ponds and sediment sumps[1].

[1] A sump is a hollow or depression in which liquid collects especially on the floor of a mine of cave (Oxford Dictionary 2013)

Table 2 provides a summary of the TASK parameters adopted to determine the subsequent erosion risk for both catchment areas. Both catchment areas are considered to be classified as high risk.

Table 2 Erosion Risk Assessment

H= TASK	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10	RA11	SPA1
T – Duration (months)	6	6	6	6	6	6	6	6	6	6	6	6
A – Disturbance area (Ha)	9.3	9.9	10.1	10.5	7.8	9.3	7.4	7	5	7	7	2
S –Slope factor	0.141	0.278	0.278	0.141	0.278	0.141	0.278	0.278	0.141	0.412	0.345	0.605
K - Soil erosivity factor	0.066	0.066	0.066	0.066	0.066	0.066	0.066	0.066	0.066	0.066	0.066	0.066
H Number	**5194**	**10908**	**11128**	**5864**	**8594**	**5194**	**8153**	**7712**	**2792**	**11410**	**9574**	**4788**

1.8 Sediment Control Requirements

RUSLE is used as the primary method for determining sediment control standard and sediment basin size (IECA 2008, section 4.5 and section E3).

IECA (2008) recommends the use of Type 1 sediment traps with a catchment area exceeding 2,500 m^2 and an estimated soil loss rate that exceeds the equivalent of 150t/ha/yr (refer to Table 3).

All catchment areas are greater than 2,500m^2, however the estimated soil loss for the is less than 150t/ha/yr, with the exception to the Stockpile and Processing Area (SPA1 – 193t/ha/yr) indicating that one sediment basin is required for the Moray Quarry construction activities. The sediment basin included is based on a 1 in 1 year, 120 hr rain event. The sumps located in the Rip Areas (RA1 to RA11) are considered best practice and are not mandatory. The indicative volume of the basins and the sumps are provided in the Conceptual ESCP drawing attached.

Table 3 RUSLE Calculation

RUSLE Parameters	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10	RA11	SPA1	Comments
Rainfall erosivity (R-factor)	1804	1804	1804	1804	1804	1804	1804	1804	1804	1804	1804	1804	IECA 2008 Table E1 (Emerald)
Soil erodibility (K-factor)	0.066	0.066	0.066	0.066	0.066	0.066	0.066	0.066	0.066	0.066	0.066	0.066	IECA 2008 Table E4
Slope length (m)	80	80	80	80	80	80	80	80	80	80	80	80	
Slope gradient (%)	0.5	1.5	1.5	0.5	1.5	3	1.5	1.5	0.5	2.5	2	4	
Length/gradient (LS-factor)	0.02	0.29	0.29	0.02	0.29	0.63	0.29	0.29	0.02	0.51	0.40	0.89	IECA 2008 Table F2 or Equation F3
Erosion control practice (P-factor)	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	IECA 2008 E11
Ground cover (C-factor)	1	1	1	1	1	1	1	1	1	1	1	1	IECA 2008 Table E6
Soil Loss (t/ha/yr)	**3**	**66**	**66**	**3**	**45**	**98**	**66**	**66**	**3**	**105**	**79**	**193**	

1.9 Conclusion

The Conceptual ESCP for Moray Quarry indicates that;

- Sediment basins will be required;
- Adequate space is available for the sediment basins. At this stage of planning the size and location of basins is indicative, and can be adjusted in the Construction ESCP to suit site requirements when further detail becomes available;
- Based on the information available, all ESC requirements can be adequately managed in the Construction ESCP;
- Problem soils are likely in this area, and the assumptions used in this report reflect a worst case scenario. Acid sulfate soils are unlikely to occur, and mass movement of soil is likely to be contained within the quarry pit; and
- The ESC devices can be accommodated without impacting on protected vegetation or other environmental constraints as identified in Section 4 of the overarching Development Application.

Site Area	Sub-catchment											
	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10	RA11	SPA1
Total catchment area (ha)	9.3	9.9	10.1	10.5	8.2	7.8	7.4	7	5	7	7	2
Soil loss (t/ha/yr)	3	66	66	3	45	98	66	66	3	105	79	193
Basin storage (soil) volume (m^3) (50% of settling volume)	840	894	912	948	741	705	668	632	452	632	632	181
Basin settling (water) volume (m^3)	1680	1788	1824	1896	1481	1409	1336	1264	903	1264	1264	361
Sediment basin total volume (m^3)	2520	2682	2736	2844	2222	2114	2004	1896	1355	1896	1896	542

E 460250 m
E 460500 m
E 460750 m
E 461000 m
E 461250 m
E 461500 m
N 7574500 m
N 7574250 m
N 7574000 m
N 7573750 m
N 7573500 m
N 7573250 m
N 7573000 m

RA1
RA2
RA3
RA4
RA5
RA6
RA7
RA8
RA9
RA10
RA11
SPA1

Rip Area 1
9.25ha approx.
Rip Area 2
9.88ha approx.
Rip Area 3
10.08ha approx.
Rip Area 4
10.47ha approx.
Rip Area 5
8.17ha approx.
Rip Area 6
7.82ha approx.
Rip Area 7
7.37ha approx.
Rip Area 8
7.04ha approx.
Rip Area 9
5.03ha approx.
Rip Area 10
7.04ha approx.
Rip Area 11
7.04ha approx.

Site Access
Site Access
Moray Pit
Stockpiling &
Processing Area
2.01ha approx.
ROAD

Legend:
- Site Boundary
- Cadastral Boundary
- Easement Boundary
- General Direction of Extraction
- Isaac Regional Council Quarry Extent
- Proposed Road Alignment (CDM Smith, 2013)
- Temporary Haul Road
- Site Entry / Exit Shakedown Grid
- Clean Water Flow
- Dirty Water Flow
- DC Clean Water Diversion Channel
- CD Dirty Water Catch Drain
- Basin Location

REV	DESCRIPTION	DATE	BY

Data Sources:
Photography:
Topography: 1s SRTM 2008 DEM-S © Commonwealth of Australia (Geoscience Australia) 2012
Cadastre:
Ecosystem:
Other:

PROJECT: Carmichael Coal Project

CLIENT: Wagner Quarries Pty Ltd

TITLE: Moray - Water Management Strategy
Erosion and Sediment Controls Plan

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JOB SUB #:
CREATED: 24 June 2013

Appendix I - Air Quality Impact Assessment

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CDM Smith Australia Pty Ltd

Moray Quarry
Air Quality Assessment

Report No. 70Q-12-0427-TRP-514362-3
8 July 2013

DOCUMENT CONTROL

Moray Quarry Air Quality Assessment		
REPORT NO: 70Q-12-0427-TRP-514362-3		
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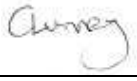
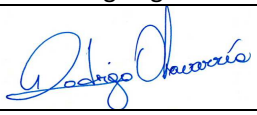
REVIEWED BY:		
	Chris Lunney	Date: 8 July 2013
	Reviewing Engineer	
ISSUED BY:		
	Rodrigo Olavarria	Date: 8 July 2013
	QA Representative	
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2	5 July 2013	Minor Changes
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EXECUTIVE SUMMARY

Vipac Engineers & Scientists Ltd (Vipac) was commissioned to prepare an air quality assessment for the proposed quarry known as Moray Quarry. The purpose of this report is to evaluate the potential impacts of dust generated from various activities and to provide recommendations to mitigate and minimise any potential impacts that might have an effect on the surrounding community.

This assessment has used the worst-case output month, September 2014 and modelled the impacts over a full year to ensure compliance during the life of the quarry.

The emission factors for various quarrying activities were derived from US EPA AP42 and Environment Australia (2012) National Pollutant Inventory (NPI) - *Emissions Estimation Technique (EET) Manual for Mining.*

The modelling has predicted no exceedances of the Queensland Department of Environmental and Heritage (EPP (Air)) objectives at either the Moray or Beenboona receptors. High background levels dominate the dust deposition and TSP rather than emissions from the various quarry activities, whereas the smaller particles, PM_{10} and $PM_{2.5}$ are a direct result of the quarry activities.

The highest contribution for all pollutants is the emissions from the quarry itself, not the haul truck movements. The duration of the maximum output, upon which this assessment is based is only one month therefore, the levels presented are the worst-case for one month.

The modelling results have identified that the criteria was not exceeded at either sensitive receptor during the life of the quarry for dust deposition, TSP, PM_{10} or $PM_{2.5}$ concentrations. Best practice mitigation recommendations to suppress dust dispersal are employed to ensure compliance with the criteria at all times.

The Moray Quarry is one of five (5) proposed Adani quarries as part of the development of the Carmichael Coal Mine and Rail Project. The cumulative impact of the maximum values from the Moray and North Creek Quarries plus the background concentration levels of TSP, PM_{10}, $PM_{2.5}$ and dust deposition all comply for every receptor when production output schedules are taken into account.

To conclude, this assessment has determined that the operation of this site as a quarry will not adversely impact nearby sensitive receptors and is suitable for development.

TABLE OF CONTENTS

1. INTRODUCTION

Vipac Engineers & Scientists Ltd (Vipac) was commissioned to prepare an air quality assessment for the proposed quarry known as Moray Quarry. The purpose of this report is to evaluate the potential impacts of dust generated from various activities and to provide recommendations to mitigate and minimise any potential impacts that might have an effect on the surrounding community.

2. PROJECT DESCRIPTION

2.1 OVERVIEW

To facilitate development of the Carmichael Coal Mine and Rail Project, a quarry, referred to as Moray is to be developed to provide embankment fill for the rail corridor and airport. The Moray Quarry is to be located along Elgin Road / Moray Carmichael Road, approximately 44 km west of the Gregory Development Road and is approximately 2.3 km south of the proposed rail line, which will service the Carmichael Coal Mine. A location map is shown in Figure 2-1.

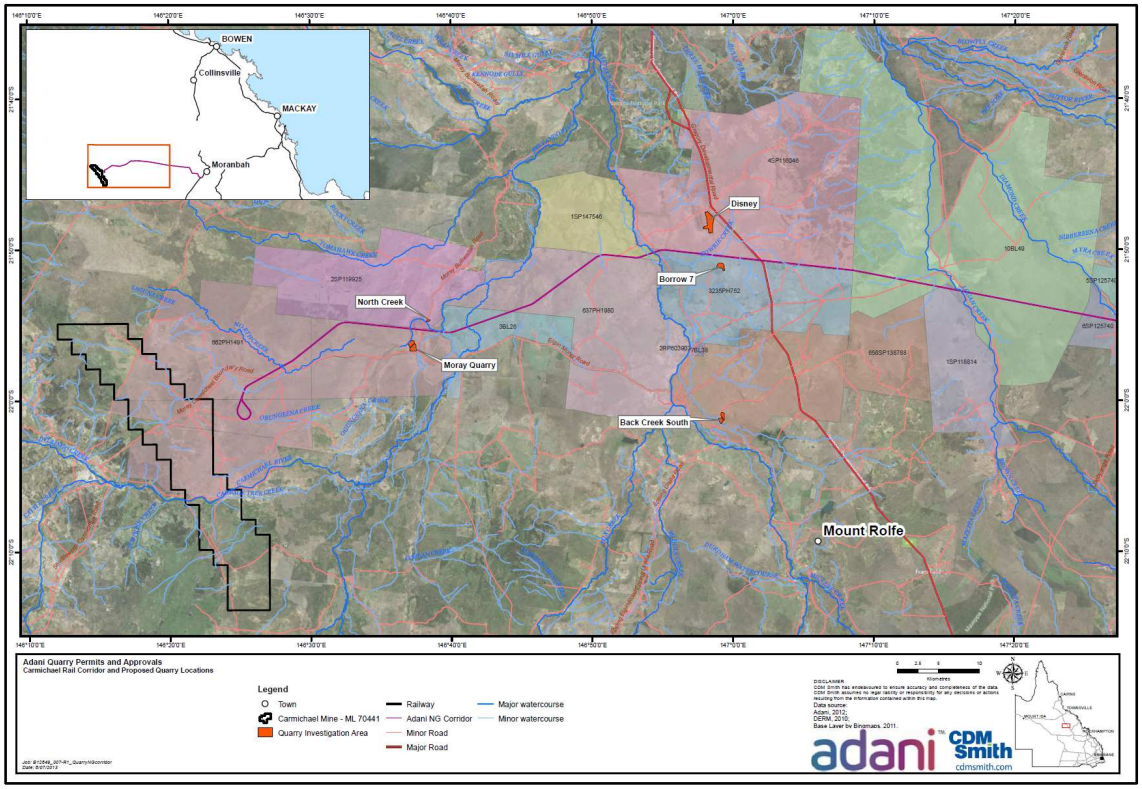

Figure 2-1: Location of Quarries

2.2 EXTRACTION METHODS

Extraction for this Project area is recommended to start by development of a linear rip face with dozer ripping and pushing material to stockpile, which will then be loaded via loader/excavator either straight into truck or through a screening plant dependent upon the material quality.

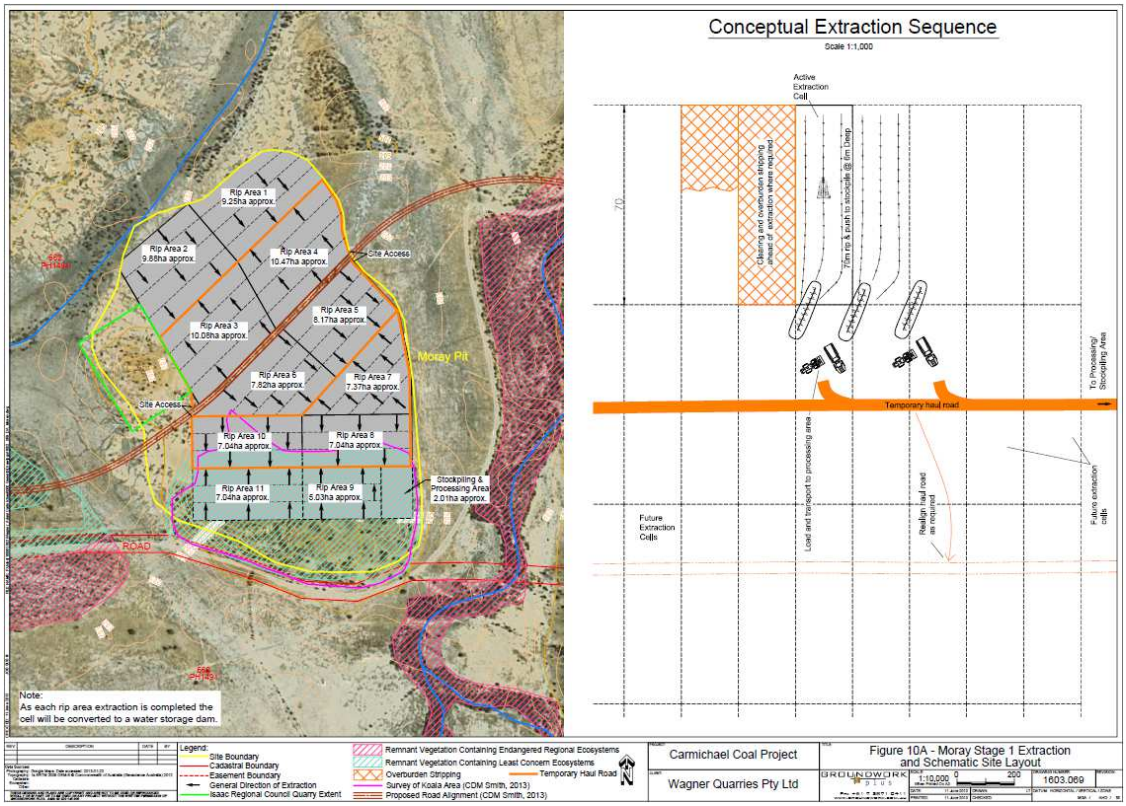

Figure 2-2: Site Layout

The height of the stockpile has been calculated to be seven metres high, based on the 'just in time' principle to accommodate the amount of material quarried during peak production.

2.3 SITE ACITIVITES

2.3.1 Equipment

The following equipment will be used at the Moray Quarry, which is of concern for this assessment is:

- 1 x Bulldozer (D10T);
- 1 x Loader (CAT980H);
- 1 x Water truck (Mack 8x4 Wheeler);
- 3 x ALLIGHT plants;
- 1 x light vehicles (Ford Ranger);
- 1 x 10 kVA Genset; and
- 2 x 75 tonne AB triple trucks (road train).

All the equipment listed above shall be used at the extraction site, with the exception of the triple trucks, which will travel to and from the extraction site.

2.3.2 Operational Hours

The quarry will operate 24 hours 360 days per year and there is a wet weather contingency in the schedule.

2.3.3 Transportation

The haul road will be 40 km/h speed limit and two (2) trucks will haul a maximum 2046 tonnes per day during peak production in September 2014. The number of trucks has been determined from the amount of haulage material, the distance travelled and expected turn-around times of loading/unloading.

2.3.4 Production Schedule

The expected output is 652,000 tonnes over a 30-month operational life. The monthly output is shown in Figure 2-3, with the highest extraction of 66,697 tonnes expected to occur in September 2014. This schedule is subject to change with the construction schedule, delays in approvals or other factors impacting construction, which may extend the operating period of the Moray Quarry.

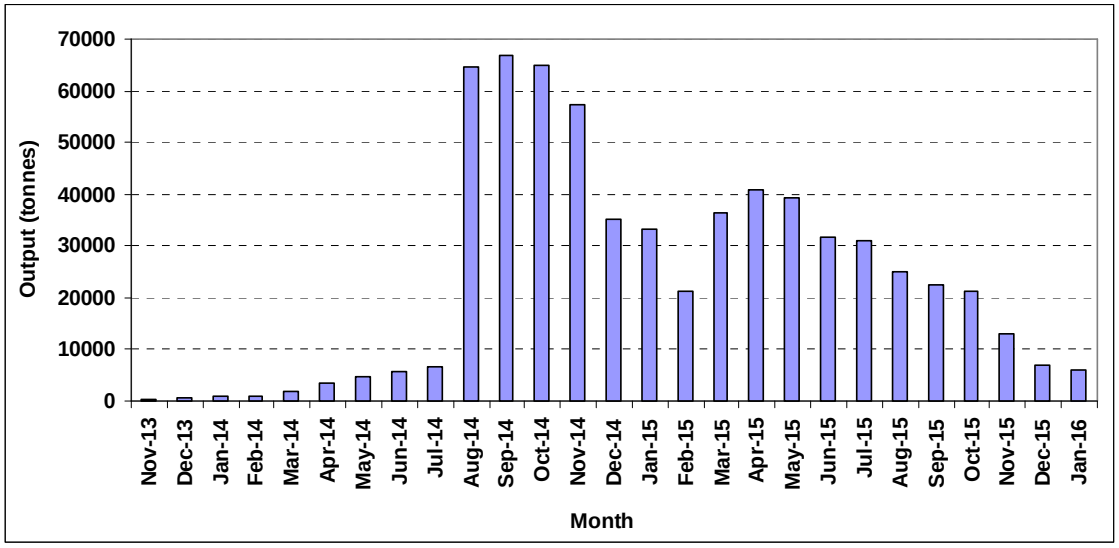

Figure 2-3: Expected Output by Month

3. SITE DESCRIPTION

3.1 LOCAL METEOROLOGY

Local meteorology has been generated for the Disney Quarry using the 2006 database from The Air Pollution Model (TAPM), which is a 3-dimensional prognostic model developed and verified for air pollution studies by the CSIRO. (Figure 3-1).

Winds occur predominantly from the north east during spring and summer, often no greater than 5 m/s (18 km/h). In autumn and winter, the dominant winds occur from the south east with the highest wind speed of 8 m/s (28 km/h). The cooler, drier air is characteristic of the dominant southeast winds of moderate strength, usually with long calm periods in the winter.

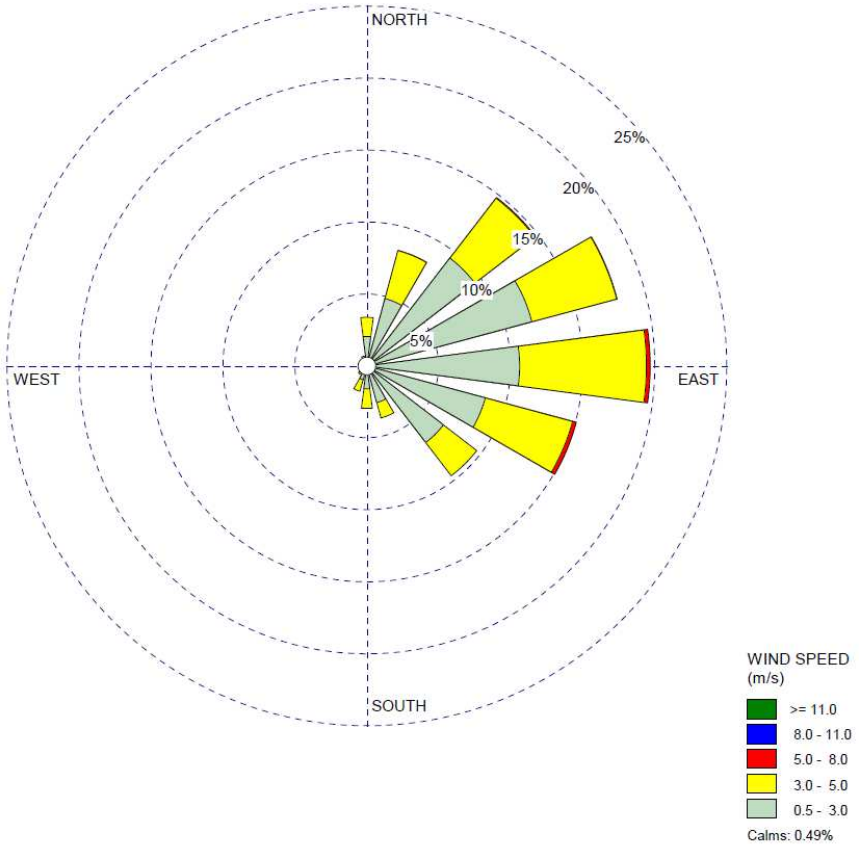

Figure 3-1: Annual Wind Rose (2006)

3.2 SENSITIVE RECEPTORS

Figure 3-2 shows the location of the closest homesteads to the extraction site and Carmichael Road. The homesteads are:

- Moray Downs is located approximately 800 m south east of the site; and
- Beenboona is located approximately 12 km north east of the site.

Figure 3-2: Sensitive Receptors Near Moray Quarry

4. DUST POLLUTION - ACTIVITIES & SIGNIFICANCE

The total suspended particulates (TSPs) consist of coarse and fine particles. In the atmosphere particles range in size from 0.1 to 50 µm; the size of the particles determines how far into the respiratory system the particles penetrate. Particles with an aerodynamic diameter greater than 10 µm are screened out in the upper respiratory tract while particles smaller than 10 µm (PM_{10}) may penetrate into the lower respiratory tract.

4.1 ACTIVITIES

Activities that can generate dust include ripping, stockpiling, blasting, loading and unloading, and haulage. The relevance of each of these activities is influenced by quantity, duration and location, as well as site topography, meteorology and proximity of local receptors.

4.2 SIGNIFICANCE

Larger particles are associated with public nuisance, being particularly noticeable on clean surfaces such as cars, windows and window ledges, or surfaces that are usually expected to remain free of dust. Deposition may impact dust-sensitive locations such as schools, retirement homes, and hospitals and deter the use of amenity areas by local residents.

The potential significance of dust is influenced by the size of particles:

- Large dust particles (greater than 30 µm) make up the greatest proportion of dust and largely deposit within 100 metres of the source;
- Intermediate sized particles (10 to 30 µm) are likely to travel 200 to 500 metres; and
- Smaller dust particles (less than 10 µm, also known as PM10) make up a smaller proportion of the dust and remain airborne for longer, dispersing more widely and depositing more slowly over a wider area, although impacts beyond 1 km are unlikely.

4.3 CUMULATIVE IMPACTS

During the excavation of the Moray Quarry, activities will also be occurring at other Adani quarries (please refer to Figure 2-1). The cumulative impacts are discussed in detail in Section 8.

5. REGULATORY FRAMEWORK & PROJECT CRITERIA

5.1 NATIONAL LEGISLATION

In 1998, the National Environment Protection Council (NEPC) made Australia's first national ambient air quality standards as part of the National Environment Protection Measure for Ambient Air Quality (known as 'Air NEPM'). The Air NEPM sets national standards for the key air pollutants; carbon monoxide, ozone, sulphur dioxide, nitrogen dioxide, lead and particles (PM_{10} and $PM_{2.5}$). The Air NEPM requires the state governments to monitor air quality and to identify potential air quality problems.

5.2 STATE LEGISLATION

The *Environmental Protection Act (1994)* has an extremely broad objective "to achieve ecologically sustainable development in Queensland", however in practice the legislation concentrates primarily on point-source pollution and land contamination. This is partly due to the existence of a range of other legislation that deals with protection of other aspects of the environment.

Subordinate to the *Environmental Protection Act 1994* is the Queensland *Environmental Protection (Air) Policy 2008* (EPP Air). Section 7 of the EPP (Air) states *"The environmental values of the air environment to be enhanced or protected under this policy are the qualities of the air environment that are conducive to suitability for the life, health and wellbeing of humans."*

Ambient air quality goals relevant to this Project are prescribed by the EPP. Provided are criteria for PM_{10} (particulate matter less than 10 microns in diameter), $PM_{2.5}$ (particulate matter less than 2.5 microns in diameter). The most critical of these is the PM_{10} criterion as the fraction of $PM_{2.5}$ against PM_{10} emissions from mining operations is small (typically less than 10%).

Deposited dust is commonly used as a measure of the potential for dust nuisance. If present at high levels deposited dust can reduce the amenity of an area. No formal criteria for dust deposition exist within Queensland, however the Department of Environment and Heritage Protection (EHP) has recommended a nuisance guideline of 120 $mg/m^2/day$.

5.3 PROJECT CRITERIA

From all of the regulations, the strictest applicable criteria have been selected for this assessment and are presented in Table 5-1.

Table 5-1: Project Air Quality Goals

Pollutant	Basis	Criteria	Averaging Time	Exceedences*
TSP	Human Health	90 $\mu g/m^3$	1-year	-
PM_{10}	Human Health	50 $\mu g/m^3$	24-hour	Five days per year
$PM_{2.5}$	Human Health	25 $\mu g/m^3$	24-hour	-
Dust deposition	Amenity	120 $mg/m^2/day$	30 days	-

** Allowance intended for natural events such as dust storms or bushfires*

6. EXISTING AIR QUALITY

In line with common practice, to assess the impact of a quarry the incremental impact is quantified and added to existing background pollutant concentrations. Monitoring was conducted for particulate matter (PM_{10}) for a period of six (6) days and the daily averages derived for comparison to long term monitoring conducted by DERM in similar locations.

The weather observations during the monitoring period were obtained from the Bureau of Meteorology for the Emerald, located on Emerald Airport (station number 035264). During this time no rainfall was recorded as shown below in Table 6-1.

Table 6-1: Weather Observations During Monitoring Period

Date	9:00 AM			3:00 PM			Daily
	Temp (°C)	Direction	Speed (km/h)	Temp (°C)	Direction	Speed (km/h)	Rainfall (mm)
27/3/2013	24.9	ESE	17	30.8	ENE	19	0
28/3/2013	24.9	ESE	17	30.9	E	17	0
29/3/2013	24.2	NNE	11	30.8	ESE	17	0
30/3/2013	25.5	E	7	31.0	NE	15	0
31/3/2013	24.8	N	13	31.3	NNE	15	0
1/4/2013	21.8	ESE	13	26.5	NE	9	0

The existing levels of particulate matter were monitored at Disney Homestead between the 27th March and 1st April 2013. Moray Quarry is approximately 36km south-west of Disney Homestead. This receiver was chosen, in order to measure regional concentrations. The monitoring was carried out using an environmental dust monitor, which records a particulate matter value every five minutes. Analysis of the data determined the background PM_{10} concentration to be 18 $\mu g/m^3$, which is the 70th Percentile, in line with common practice and the Environmental Impact Statement for the Carmichael Coal Mine and Rail Project.

The chart of the monitoring data is shown in Appendix A.

The PM_{10} concentration has been used to derive appropriate background concentrations for $PM_{2.5}$ and TSP. The Australian Coal Review states that an average of 40% of TSP was found to consist of particles in the size range of PM_{10}. Particles in the size range of $PM_{2.5}$ were found to comprise only 4% of TSP or equivalently 10% of PM_{10}.

The following estimates of background levels of dust will be used:

- Annual average concentration of TSP of 30 $\mu g/m^3$;
- 24-hour average concentration of PM_{10} of 10 $\mu g/m^3$;
- 24-hour average concentration of $PM_{2.5}$ of 1 $\mu g/m^3$; and
- Dust deposition of 50 mg/m^2/day.

7. METHODOLOGY

7.1 MODELLING

A 3-dimensional dispersion wind field model, CALPUFF, has been used to simulate the impacts from the quarry. CALPUFF is an advanced non-steady-state meteorological and air quality modelling system developed and distributed by Earth Tech, Inc. The model has been adopted by the U.S. Environmental Protection Agency (U.S. EPA) in its '*Guideline on Air Quality Models*' as the preferred model for assessing near-field applications involving complex meteorological conditions such as calm conditions.

To generate the broad scale meteorological inputs to run CALPUFF, this study has used the model The Air Pollution Model (TAPM), which is a 3-dimensional prognostic model developed and verified for air pollution studies by the CSIRO.

The default TAPM databases for terrain, land use and meteorology were used in the model. The meteorological modelling year was 2006 and four nested grid domains were used with grid spacing of 30 km, 10 km, 3 km and 1 km.

7.2 EMISSION RATES

The emission rates for individual quarrying activities were obtained from Environment Australia (2012)-National Pollutant Inventory (NPI) - *Emissions Estimation Technique (EET) Manual for Mining.* The EET for mining contains emission factors covering a range of mining and extraction activities and the NPI emission factors are derived from the USEPA AP-42. These emission rates were then implemented into the CALPUFF model taking into consideration the phases of the quarry and the emission area (m^2) for representative predictions. Table 7-1 lists the emission rates for the equipment and activities associated with the Moray Quarry with an output of 66,697 tonnes in September 2014.

Table 7-1: Emission Factors for North Creek Activities (g/second)

Source	NPI based Emission Factor (gram/second)			Controls Assumed
	TSP	PM_{10}	$PM_{2.5}$	
Haul Trucks - HR to Rail	2.54	0.65	0.267	Watering – 2 litres/m^2/hour
Loader CAT 980H	3.52	0.93	0.369	None Applied
Railway Deposition	0.28	0.101	0.029	None Applied
Water Truck/Fuel Truck	0.35	0.091	0.037	Watering – 2 litres/m^2/hour
Stockpile	0.0007	0.407	0.0001	None Applied
Light Vehicles	0.269	0.069	0.028	None Applied
Pit (wind erosion)	0.123	0.062	0.013	None Applied
Service Trucks	1.577	0.407	0.16	None Applied
Bulldozer D10T	4.722	1.14	0.49	None Applied
Haul Trucks HR to Airport	0.088	0.023	0.0092	Watering – 2 litres/m^2/hour
Dump trucks CAT 740B	0.309	0.111	0.032	None Applied

The emission rates for dust and PM_{10} from various quarrying activities are listed in Table 7-1. These emission factors are derived from the NPI and shown here in grams per second. It can be seen from the Table that the bulldozer generates the greatest TSP, PM_{10} and $PM_{2.5}$ emissions per second.

The emissions from blasting have not been predicted due to the short nature of the event and the large fragments displaced during the blast, which immediately return to the ground.

8. IMPACT ASSESSMENT

This section details the quantitative assessment of dust deposition, TSP, PM_{10} and $PM_{2.5}$ concentration impacts for each scenario, as described below, of the quarry activities upon Moray Downs and Beenboona Receptors.

Activities associated with the initial construction phase are not expected to be a source of dust or particulate emissions therefore this phase has not been modelled. In order to predict the worst-case scenario the maximum output of 66,697 tonnes in September 2014, which has been modelled over a full year. The chart in Figure 2-3 identifies that for the majority of the quarry's life, the output will be significantly less and thus the impacts will be lower than the predictions in this Section.

The TSP, PM_{10}, $PM_{2.5}$ and dust deposition results for the closest sensitive receptors are detailed in Table 8-1 and the modelling plots are shown in Appendix A.

Table 8-1: Quarry Dust Results at Moray Downs Receptor

Pollutant	Background Levels	Quarry Related Activities	Total	Criteria	Compliance
Dust Deposition ($mg/m^2/day$)	50	10.76	60.76	120 mg/m^2/day (30 days)	✓
TSP ($\mu g/m^3$)	30	1.24	31.24	90 $\mu g/m^3$ (1-year)	✓
PM_{10} ($\mu g/m^3$)	10	12.08	22.08	50 $\mu g/m^3$ (24-hour)	✓
$PM_{2.5}$ ($\mu g/m^3$)	1	6.49	7.49	25 $\mu g/m^3$ (24-hour)	✓

Table 8-2: Quarry Dust Results at Beenboona Receptor

Pollutant	Background Levels	Quarry Related Activities	Total	Criteria	Compliance
Dust Deposition ($mg/m^2/day$)	50	1.3	51.3	120 mg/m^2/day (30 days)	✓
TSP ($\mu g/m^3$)	30	0.05	30.05	90 $\mu g/m^3$ (1-year)	✓
PM_{10} ($\mu g/m^3$)	10	1.46	11.46	50 $\mu g/m^3$ (24-hour)	✓
$PM_{2.5}$ ($\mu g/m^3$)	1	0.77	1.77	25 $\mu g/m^3$ (24-hour)	✓

It can be seen from Table 8-1 that the impacts on the Moray Downs Receptor during the life of the quarry are low and the criteria for all pollutants are achieved. The highest level will be PM_{10}, which will be 12.08 $\mu g/m^3$, when this is added to the background level of PM_{10}, the predicted PM_{10} concentration is less than half of the criterion.

The impacts on the Beenboona Receptor during the life of the quarry are minimal with TSP, PM_{10} and $PM_{2.5}$ concentration as dust deposition only slightly above the background levels, as shown in Table 8-2.

The duration of the maximum output, upon which this assessment is based is only one month therefore, the levels presented in Table 8-1 are the worst-case for one month and it can therefore be concluded that the impacts predicted are conservative.

Traffic movements of the staff vehicles arriving and leaving site were not available at the time of writing this report; however, these emissions will be negligible compared to the haul road emissions. As such, these were not modelled. The ambient air monitoring data suggests that the existing air quality at the Project location is good. This assessment has incorporated conservative background concentrations in the model to incorporate other emission sources.

The Victorian EPA has defined buffer guidelines for a variety of industries as a risk management tool. It is acknowledged that separation distances provide an additional level of protection by allowing more distance and space in which emissions may dissipate without adversely affecting sensitive receptors.

Applying the guidelines assesses the suitability of proposed development locations and the potential impacts of development. These guidelines assume a good standard of dust management is carried out on site. The recommended buffer distances for quarrying material without blasting is 200 m and with blasting is 500 m.

The distance between the quarry and the sensitive receptors are greater than the recommended buffer distances; therefore impacts from the quarry upon the sensitive receptors are not expected.

8.1 CUMULATIVE IMPACTS

During the excavation of the Moray Quarry, activities associated with the North Creek will also be occurring. The assessments for both quarries were based on peak output, with these peak outputs occurring in September 2014 for both North Creek Quarry and Moray Quarry.

Table 8-3: Cumulative Impacts of the North Creek and Moray Quarries

Pollutant	Cumulative Concentration of North Creek Quarry, Moray Quarry and Existing Background Levels		
	Moray Downs	Beenboona	Criteria
Dust Deposition ($mg/m^2/day$)	86.57	51.3	120 $mg/m^2/day$
TSP ($\mu g/m^3$)	56.13	30.05	90 $\mu g/m^3$
PM_{10} ($\mu g/m^3$)	42.27	11.46	50 $\mu g/m^3$
$PM_{2.5}$ ($\mu g/m^3$)	23.65	1.77	25 $\mu g/m^3$

The cumulative impacts take into account the varying output schedules of the various quarries. It can be seen from Table 8-3 that the cumulative impact of the maximum values from the North Creek and Moray Quarries plus the background concentration levels of TSP, $PM_{2.5}$ and dust deposition all comply for every receptor.

9. MITIGATION

The modelling results have identified that the criteria was not exceeded for any Sensitive Receptors during the life of the quarry for dust deposition, TSP, PM_{10} or $PM_{2.5}$ concentration. It is recommended that best practice mitigation to suppress dust dispersal be employed to ensure compliance with the criteria at all times.

Adani is the current owner of Moray Downs. It is unlikely that the Moray Homestead will be occupied at the commencement of activities at the Moray Quarry. In the event that the homestead is occupied, Adani will work with the occupiers to ensure to minimise air quality impacts from activities.

Best practice mitigation measures described in this section will further minimise the potential for health issues and nuisance from an air quality perspective:

- Minimising the extent of clearing which bares earth;
- Water trucks should be summoned based on visual dust inspection;
- As a good management practice, on haul and access roads moderate level watering (>2L/m^2/h) to be adopted wherever there is a potential for emissions to exceed the criteria limits such as during high winds;
- Where it is apparent moderate watering frequency is not being effective high level watering (~4L/m^2/h) is to be adopted or operations reduced or ceased;
- Water sprays should be used for excavation activities where necessary;
- Water spraying of stockpiles should be done on a frequent basis in order to keep the raw material moist to suppress fugitive dust release. The frequency of watering will depend on weather conditions;
- Light and heavy vehicle speed restriction of 40 km/hour should be imposed on unpaved surfaces within the quarry;
- Using sealed roads where the option exists for the purpose of transporting materials;
- Public sealed roads used by the Project should be regularly cleaned and swept;
- Worked areas should be stabilised as soon as possible after earthworks have been completed (example: re-vegetation, paving, mulch);
- General awareness of minimising dust levels and it's benefits should be instructed to workforce personnel;
- Where appropriate public consultation processes should be implemented that inform residents of the potential duration and extent of impacts, thereby allowing them to take appropriate action (such as not hanging out their washing on those days); and
- Complaint management processes that ensure complaints are readily registered and rapidly addressed.

10. CONCLUSION

This report has evaluated the potential impacts of dust generated from various activities and has provided recommendations to mitigate and minimise any potential impacts that might have an effect on the surrounding community.

This assessment has used the worst-case output month, September 2014 and modelled over a full year to ensure compliance during the life of the quarry.

The emission factors for various quarrying activities were derived from US EPA AP42 and Environment Australia (2012) National Pollutant Inventory (NPI) - *Emissions Estimation Technique (EET) Manual for Mining.*

The modelling has predicted no exceedences of the Queensland Department of Environmental and Heritage (EPP (Air)) objectives at either the Moray or Beenboona receptors. High background levels dominate the dust deposition and TSP rather than emissions from the various quarry activities, whereas the smaller particles, PM_{10} and $PM_{2.5}$ are a direct result of the quarry activities.

The highest contribution for all pollutants is the emissions from the quarry itself, not the haul truck movements. The duration of the maximum output, upon which this assessment is based is only one month therefore, the levels presented are the worst-case for one month.

The modelling results have identified that the criteria was not exceeded at either sensitive receptor during the life of the quarry for dust deposition, TSP, PM_{10} or $PM_{2.5}$ concentrations. Best practice mitigation recommendations to suppress dust dispersal are employed to ensure compliance with the criteria at all times.

The cumulative impact of the maximum values from the Moray and North Creek Quarries plus the background concentration levels of TSP, PM_{10}, $PM_{2.5}$ and dust deposition all comply for every receptor when production output schedules are taken into account.

11. REFERENCES

Department of Environment and Resource Management. (2008). '*National Environment Protection Measure for Ambient Air Quality'.*

Environment Australia. (1999c). *'NPI Emission Estimation Techniques for Aggregated Emissions from Paved and Unpaved Roads'.* Department of Sustainability, Environment, Water, Population and Communities; Canberra.

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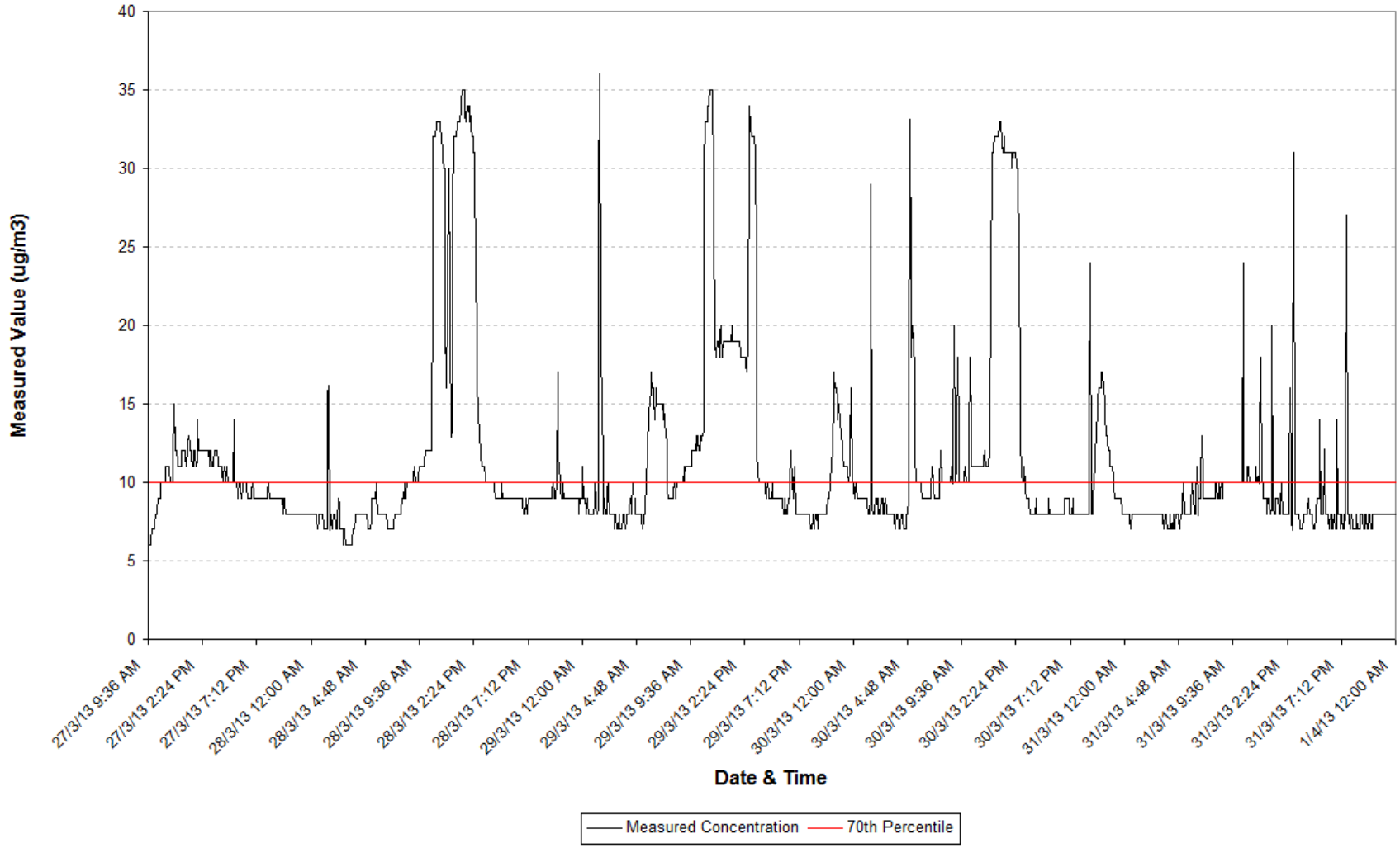
NSW Minerals Council. (2000) '*Particulate Matter & Mining'.* NSW Minerals Council; Sydney.

Environmental Protection Agency. (2008). *'Environmental Protection (Air) Policy'* Environmental Protection Agency. SL No. 208. Queensland Government; Brisbane.

APPENDIX A: MONITORING DATA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25
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10
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28/3/13 9:36 AM
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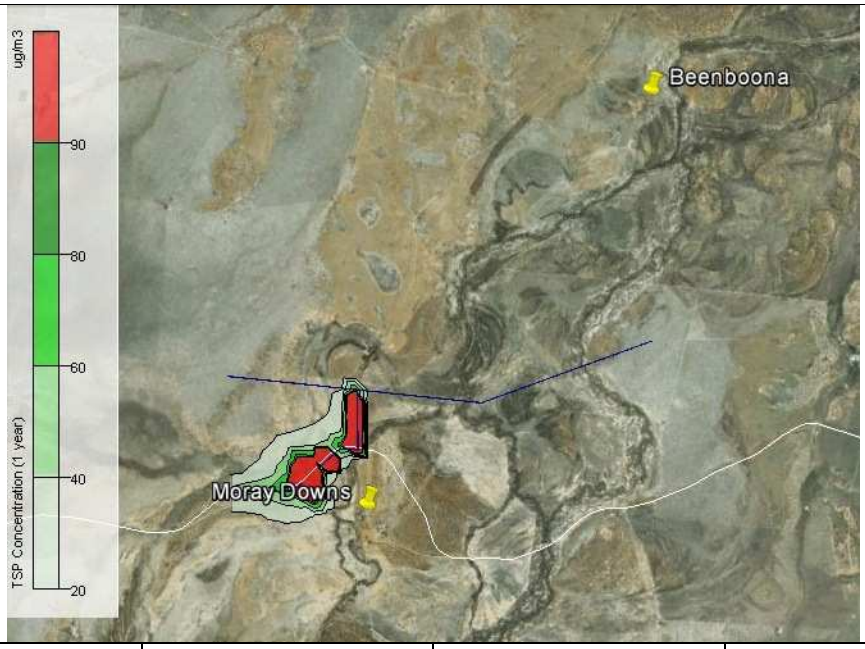
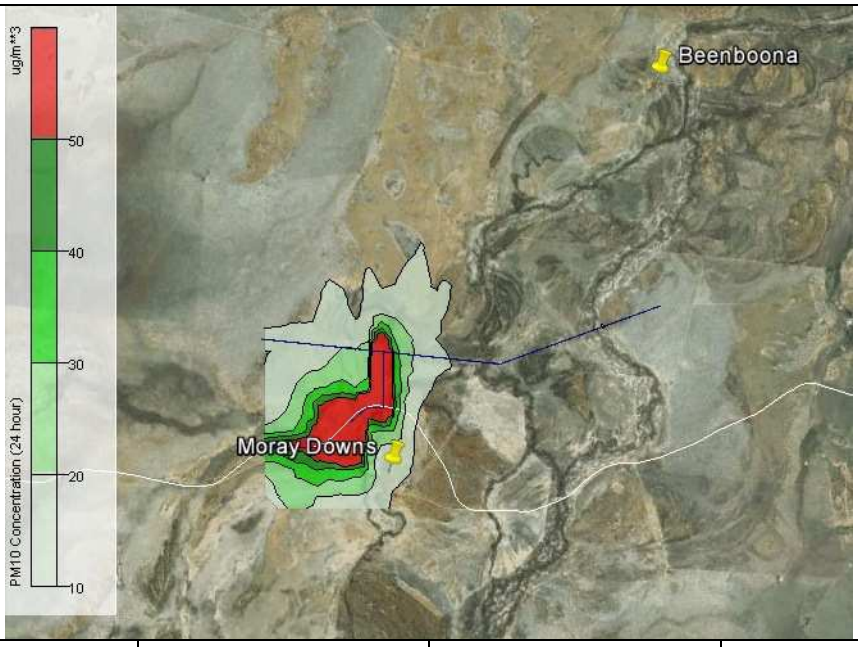
Date & Time
Measured Concentration
70th Percentile

APPENDIX B: CONTOUR PLOTS



Pollutant:	Averaging Period:	Percentile:	Criteria:
TSP	1 year	MAX	90 µg/m^3

Comment:
Sept 2014 – Highest output representing worst case



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PM_{10}	24-hours	MAX	50 µg/m^3

Comment:
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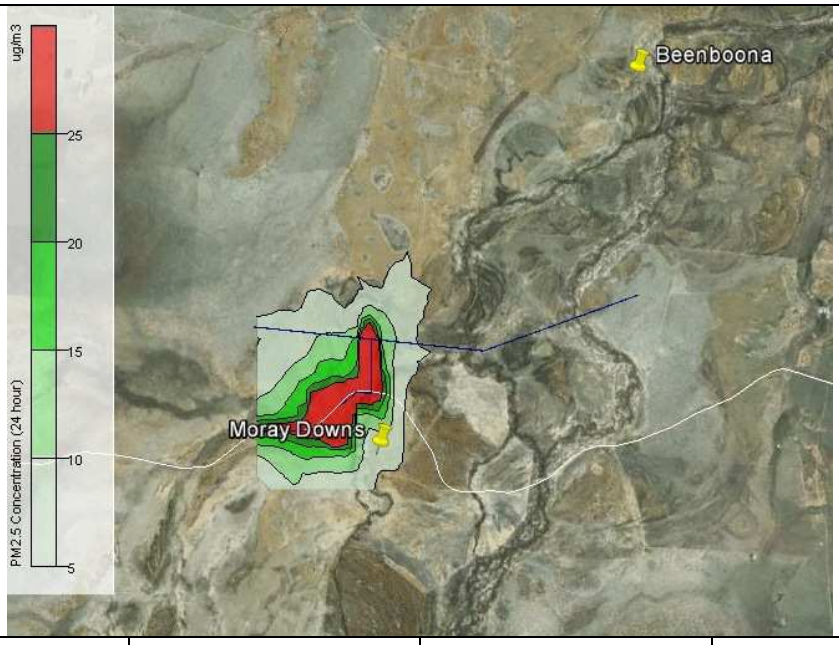
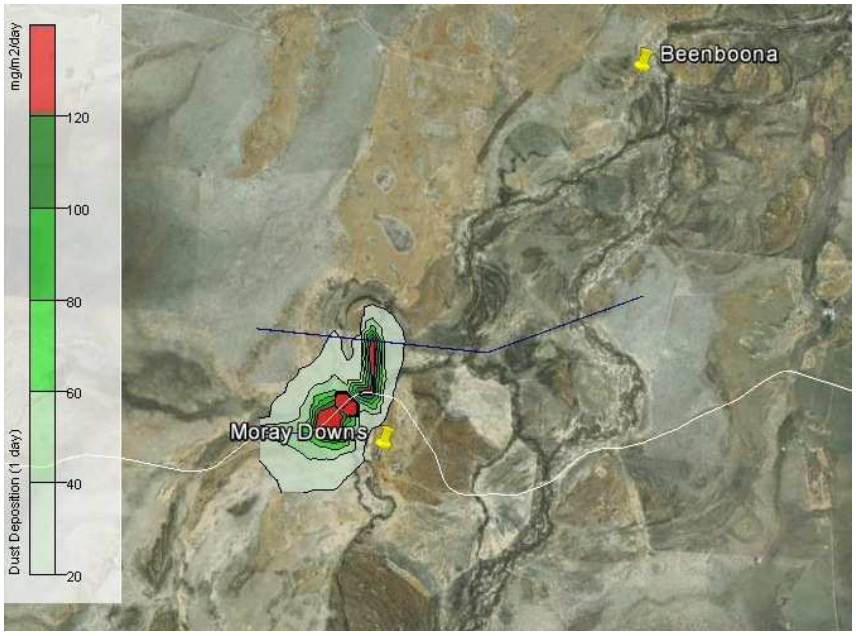


Pollutant:	Averaging Period:	Percentile:	DERM Criteria:
$PM_{2.5}$	24-hours	MAX	25 µg/m^3

Comment:
Sept 2014 – Highest output representing worst case



Pollutant:	Averaging Period:	Percentile:	DERM Criteria:
Dust Deposition	1 day	MAX	120 mg/m^2/day

Comment:
Sept 2014 – Highest output representing worst case

Appendix J - Noise Impact Assessment

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CDM Smith Australia Pty Ltd

Moray Quarry
Noise Assessment

Report No. 70Q-12-0427-TRP-514340-3
8 Jul 2013

DOCUMENT CONTROL

Moray Quarry

Noise Assessment

REPORT NO:
70Q-12-0427-TRP-514340-3

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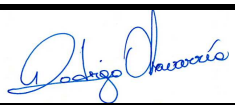
AUTHOR:		
	Rodrigo Olavarria	Date: 8 Jul 2013
	Project Engineer	
REVIEWED BY:		
	Tarmo Saar	Date: 8 Jul 2013
	Reviewing Engineer	
ISSUED BY:		
	Daniel Cheetham	Date: 8 Jul 2013
	QA Representative	

REVISION HISTORY:		
Revision No.	**Date Issued:**	**Reason/Comments:**
3	8 Jul 2013	Changed Map
2	5 Jul 2013	Minor Changes
1	5 Jul 2013	Project Changes
0	30 Apr 2013	Initial Issue

DISTRIBUTION:

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EXECUTIVE SUMMARY

Vipac Engineers & Scientists Ltd (Vipac) was commissioned to prepare a noise assessment for the proposed quarry known as Moray Quarry. The purpose of this report is to evaluate the potential impacts of noise generated from various activities and to provide recommendations to mitigate and minimise any potential impacts that might have an effect on the surrounding community.

The EPP (Noise) Policy 2008 Acoustic Quality Objectives have been applied to this project. The dwelling (indoor) day-time and night-time criteria have been applied. Where the Acoustic Quality Objective is an indoor level, a façade transmission loss of 7 dB(A) has been applied to obtain an outdoor noise criterion.

Noise predictions have been conducted using SoundPLAN noise modelling software. For this assessment, the CONCAWE noise prediction methodology has been used to take into consideration the weather conditions at the site. The significant operational noise sources used for this assessment have been obtained from Vipac's own database of noise emissions based on the type and number of noise generating equipment and plant advised by Adani Mining Pty Ltd.

The existing noise environment has been determined through unattended ambient noise monitoring between 27th March and 4th April 2013. The noise monitoring location has been identified as Moray Downs.

Whilst the quarry extraction output may change significantly, the majority of the activities will remain the same, with the number and frequency of the haul trucks changing to reflect the output rates.

The worst-case scenario of 66,697 tonnes to be extracted and hauled from the Moray site in September 2014 has been assessed. The noise assessment has considered the extraction and hauling activities separately and in combination. Predictions for the combined activities have indicated that the $L_{Aeq,adj,1hr}$ noise criteria would be exceeded during neutral and adverse weather conditions at the Moray Downs homestead. The primary noise contributor at this receptor is excavation activities (i.e. Dozer usage) at the Moray Quarry.

A conservative L_{Amax} noise level was calculated to compare with the outdoor $L_{A1,Adj,1hr}$ Acoustic Quality Objective. The $L_{A1,Adj,1hr}$ noise criteria is expected to be exceeded under neutral and adverse weather conditions.

A cumulative noise assessment has also been conducted to include the operation of the North Creek, Moray and Back Creek South quarries which are to be operated by Adani.

Exceedances of the day-time and night-time $L_{Aeq,Adj,1hr}$ noise criteria were found when the other quarries operate at the same time as the Moray Quarry. The extraction activity at the Moray Quarry is the dominant noise source. Noise emissions from haulage of material from the Back Creek South Quarry were found to contribute to the noise levels at Moray Downs, where noise exceedances of the $L_{Aeq,Adj,1hr}$ noise criteria was found, however, they were not found to cause an exceedance on their own.

Recommendations have been provided in this report to mitigate the noise impacts.

It is important to note that the Moray Quarry is likely to have a negligible noise impact on noise sensitive receptors, other than Moray Downs. Vipac has been advised that it is unlikely that the Moray Downs homestead will be occupied at the commencement of activities at the Moray Quarry. In the event that the homestead is occupied, Vipac expects Adani to work with the occupiers to ensure that noise impacts from Moray Quarry activities are minimised.

Overall, the operational life of the Moray Quarry is two years and any perceived impacts would be temporary in nature.

TABLE OF CONTENTS

1. INTRODUCTION

Vipac Engineers & Scientists Ltd (Vipac) was commissioned to prepare a noise impact assessment for the proposed quarry known as Moray Quarry. The purpose of this report is to evaluate the potential noise impacts from various activities and to provide recommendations to mitigate and minimise any potential impacts that might have an effect on the surrounding community.

2. PROJECT DESCRIPTION

2.1 OVERVIEW

To facilitate the development of the Carmichael Coal Mine and Rail Project, a quarry, referred to as Moray is to be developed as a potential western source of road construction and embankment materials for the rail corridor.

The Moray Quarry is to be located along Elgin Rd / Moray Carmichael Rd, approximately 44 Km west of the Gregory Development Road and is approximately 2.3 km south of the proposed rail line, which will service the Carmichael Coal Mine. A location map is shown in Figure 2-1.

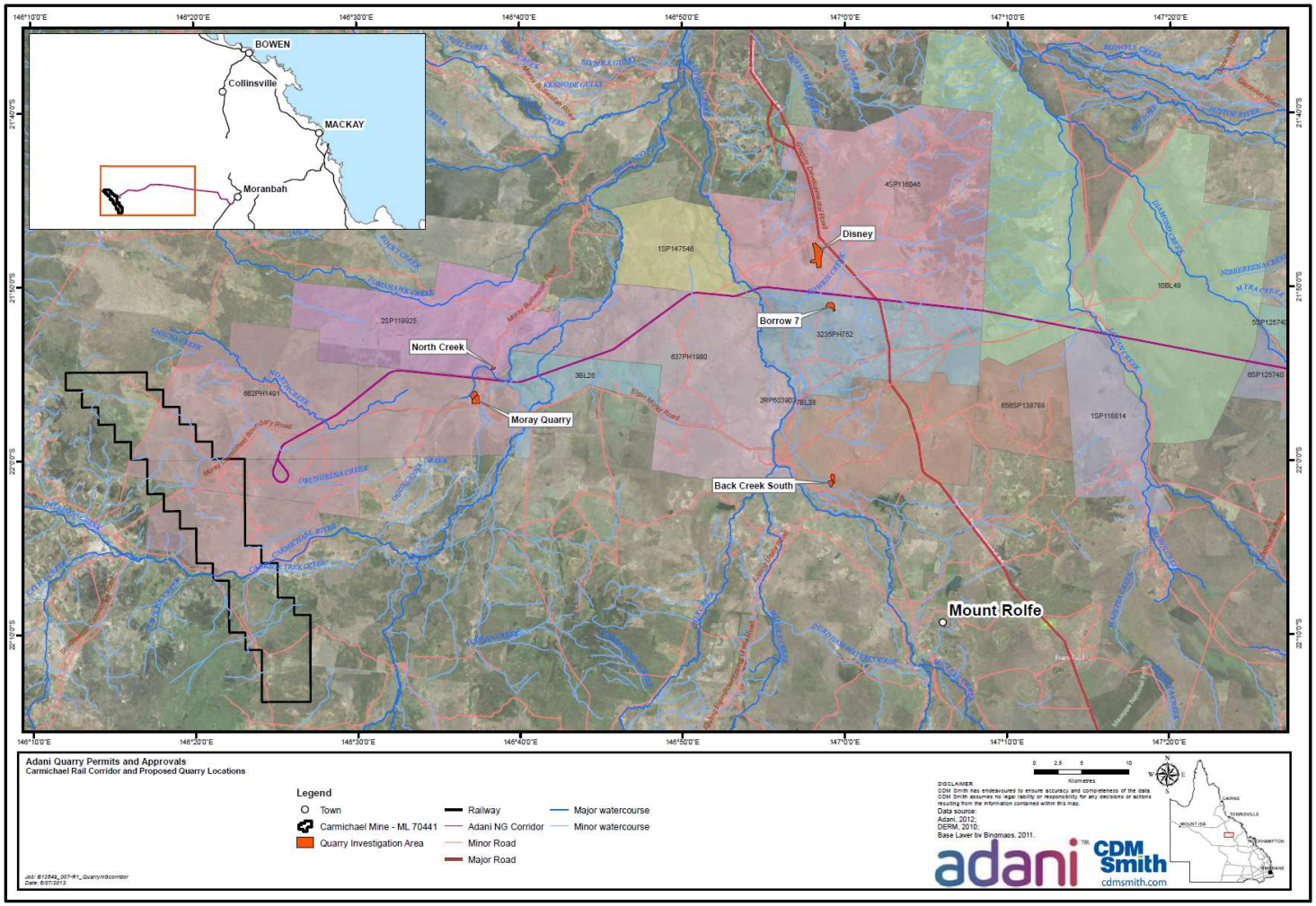

Figure 2-1: Location of Quarries

2.2 EXTRACTION METHODS

Extraction for this project area is recommended to start by development of a linear rip face with dozer ripping and pushing material to stockpile, which then will be loaded via loader to road trains, which will haul the extracted material to the rail line.

An extraction and schematic layout is shown in Figure 2-2.

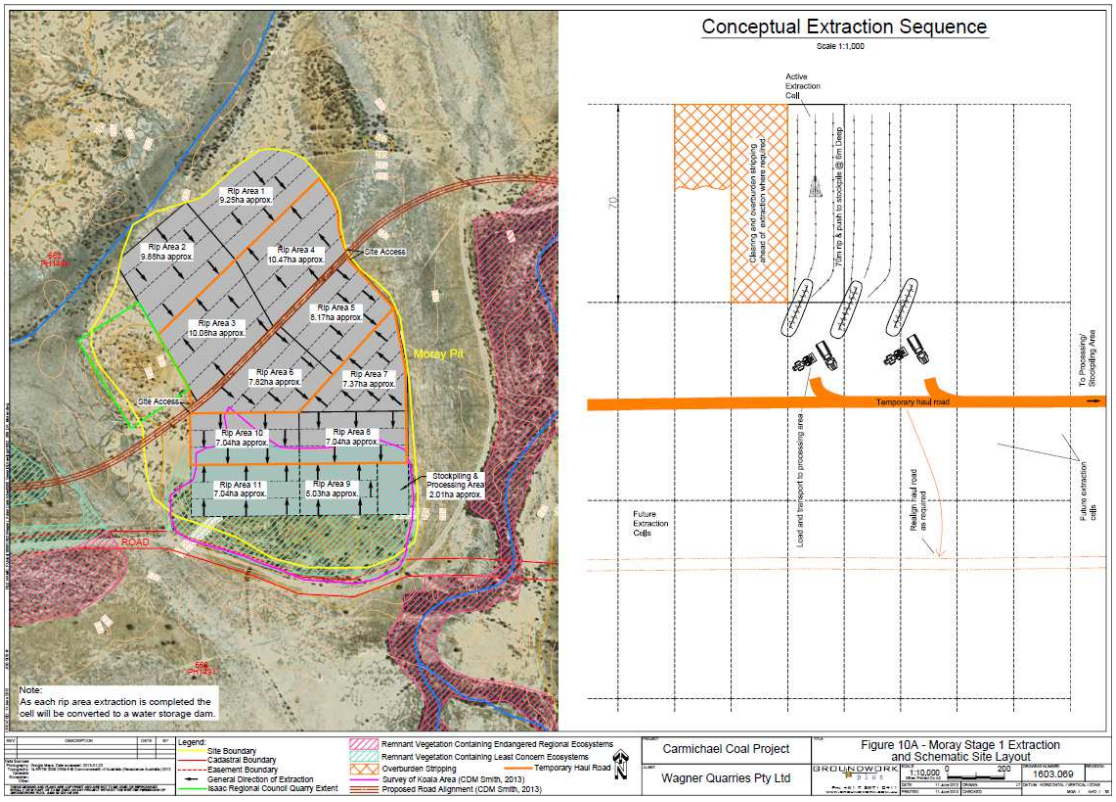

Figure 2-2: Moray Stage 1 Extraction and Schematic Layout

2.3 SITE ACTIVITIES

2.3.1 Equipment

The following equipment will be used at the Moray Quarry, which is of concern for this assessment:

1 x Bulldozer (D10T);

1 x Loader (CAT980H);

1 x Water truck (Mack 8x4 Wheeler);

3 x ALLIGHT plants;

1 x 10 kVA Genset; and

2 x 75 tonne AB triple trucks (road trains).

All the equipment listed above shall be used at the extraction site, with the exception of the 75 tonne AB triple trucks (road trains) and water truck, which will travel to and from the extraction site.

2.3.2 Operational Hours

The quarry will operate 360 days per year and there is a wet weather contingency in the schedule.

2.3.3 Transportation

The Moray Quarry is to be developed as a potential western source of road construction and embankment materials for the rail corridor. Therefore, the extracted material will be hauled to the rail line construction site located north of the Moray Quarry. The haul road will be 40 km/h speed limit and two (2) trucks will haul a maximum 2046 tonnes per day during peak production in September 2014.

The number of trucks has been determined from the amount of haulage material, the distance travelled and expected turn-around times of loading/unloading.

2.3.4 Production Schedule

The expected Moray Quarry output is 652,000 tonnes over a 30-month operational life. The monthly output is shown in Figure 2-3, with the highest extraction of 66,697 tonnes expected to occur in September 2014. This schedule is subject to change with the construction schedule, delays in approvals or other factors impacting construction, which may extend the operating period of the Moray Quarry.

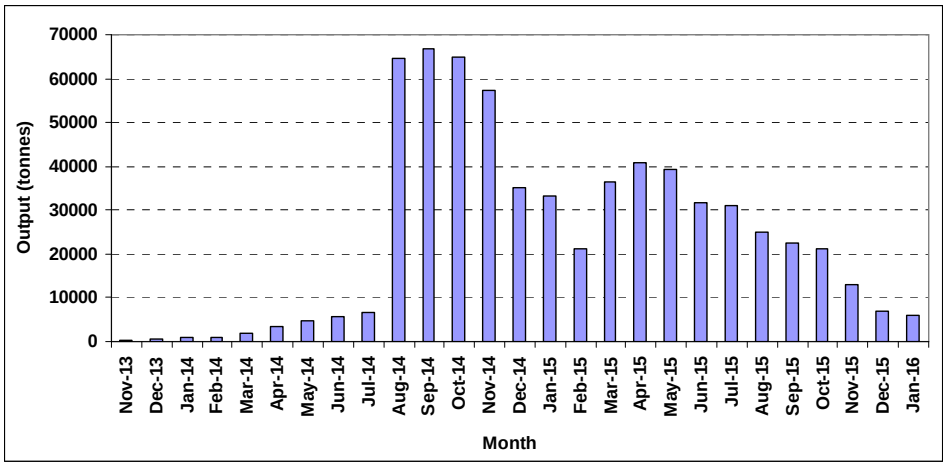

Figure 2-3: Expected Output by Month

3. SITE DESCRIPTION

3.1 LOCAL METEOROLOGY

Local meteorology has been generated for the Moray Quarry using the 2006 database from The Air Pollution Model (TAPM), which is a 3-dimensional prognostic model developed and verified for air pollution studies by the CSIRO. (Figure 3-1).

Winds occur predominantly from the northeast during spring and summer, often no greater than 5 m/s (18 km/h). In autumn and winter, the dominant winds occur from the southeast with the highest wind speed of 8 m/s (28 km/h). The cooler, drier air is characteristic of the dominant southeast winds of moderate strength, usually with long calm periods in the winter.

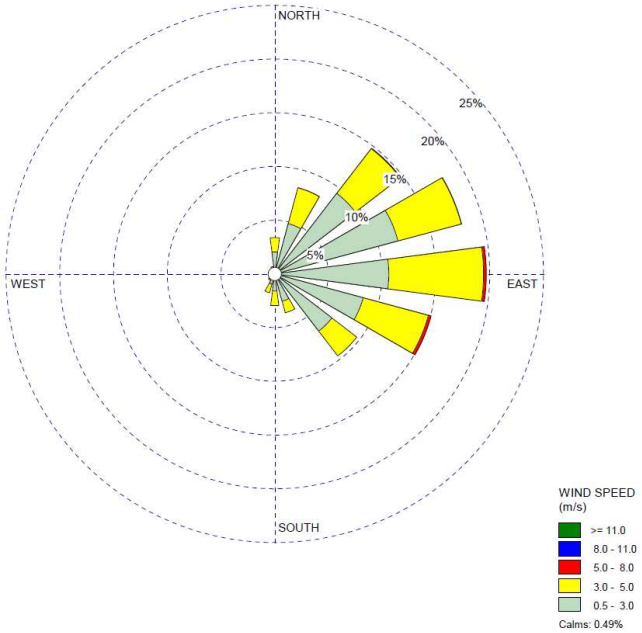

Figure 3-1: Annual Wind Rose (2006)

Local meteorology used in the modelling methodology is discussed in Section 5.2.

3.2 NOISE SENSITIVE RECEPTORS

Figure 3-2 shows the location of the extraction site relative to the homesteads and Carmichael Road. The closest homesteads are:

- Beenboona receptor located approximately 11.2 Km from the site;
- Moray Downs receptor located approximately 900m from the extraction site and 1.3Km from the Moray Carmichael Boundary Road upgrade.

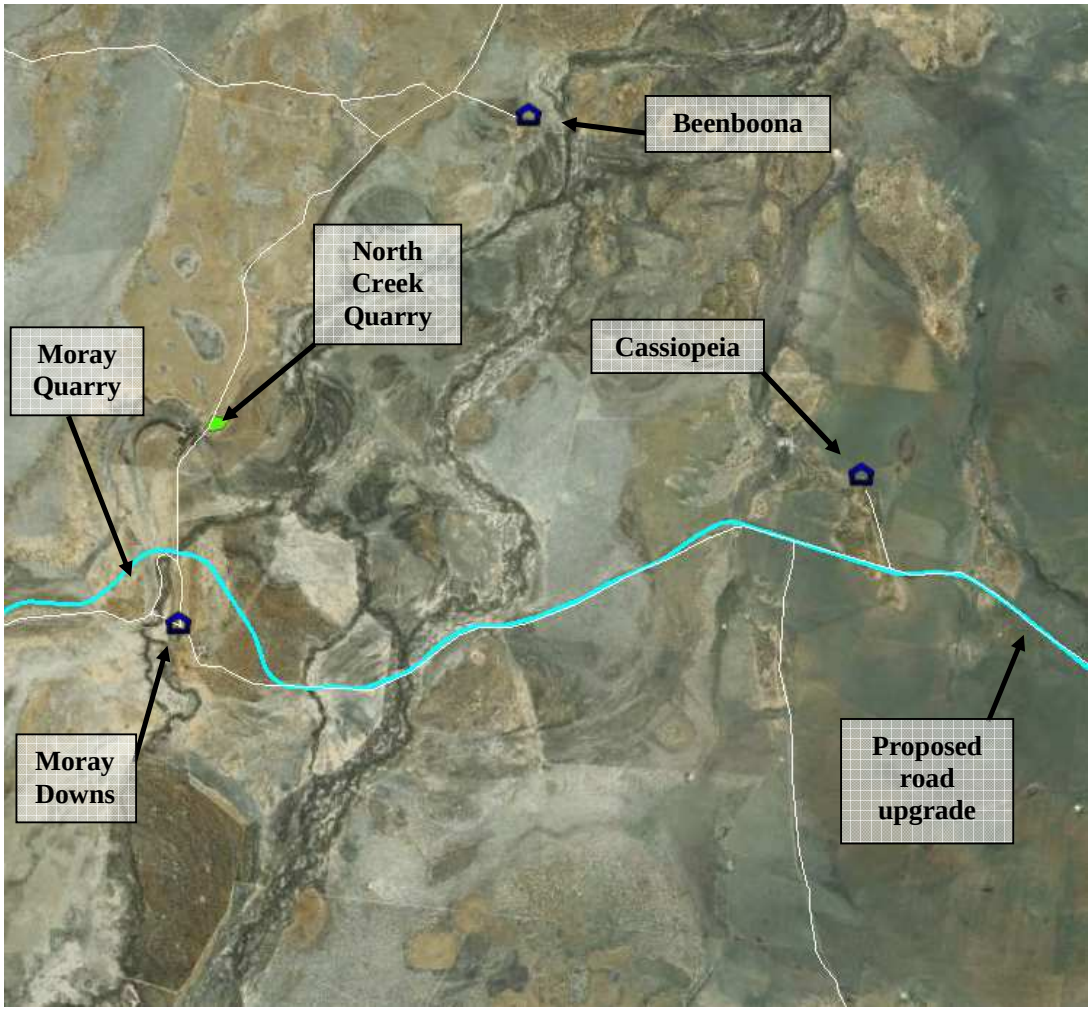

Figure 3-2: Closest Sensitive Receptors to the Site

4. REGULATORY FRAMEWORK & PROJECT CRITERIA

When determining noise level criteria, the Isaac Regional Council refer to the Mackay, Isaac and Whitsunday Regional Plan (2012), which lists the following legislative documents and guidelines:

Environmental Protection Act 1994;

Environmental Protection Regulation 2008;

Environmental Protection (Noise) Policy 2008 (EPP); and

State Planning Policy 5/10: Air, Noise and Hazardous Materials.

4.1 CONSTRUCTION AND OPERATION

The *Environmental Protection (Noise) Policy 2008* (EPP Noise) is designed to protect the acoustic environment for health and well-being. Section 8 and Schedule 1 of the EPP (Noise) outlines these acoustic quality objectives as shown in Table 4-1.

Table 4-1: EPP (Noise) Acoustic Quality Objectives for Dwellings

Sensitive Receptor	Time of Day	Acoustic Quality Objectives (measured at receptor) dB(A)			Environmental Value
		$L_{Aeq,adj,1hr}$	$L_{A10,adj,hr}$	$L_{A1,adj,1hr}$	
Dwelling (outdoor)	Daytime & evening	50	55	65	Health & Wellbeing
Dwelling (indoor)	Daytime & evening	35	40	45	Health & Wellbeing
	Night-time	30	35	40	Sleeping

The time periods referred to in the EPP (2008) are defined as: Day: 7 am to 6 pm, Evening: 6 pm to 10 pm, Night: 10 pm to 7 am

The strictest Acoustic Quality Objectives applicable to this Project are the Dwelling (indoor) values. In order to predict the outdoor levels, a façade transmission loss of 7 dB(A) has been applied. As such, the noise limits applicable to the projects are presented in Table 4-2.

Table 4-2: Noise Criteria Applicable to the Project

Sensitive Receptor	Time of Day	Noise Limit (measured at the receptor) dB(A)			Environmental Value
		$L_{Aeq,adj,1hr}$	$L_{A10,adj,hr}$	$L_{A1,adj,1hr}$	
Dwelling (outdoor)	Daytime & evening	50	55	65	Health & Wellbeing
Dwelling (outdoor noise level to comply with indoor Acoustic Quality Objective)	Daytime & evening	42	47	52	Health & Wellbeing
	Night-time	37	42	47	Sleeping

The $L_{Aeq,Adj,1hr}$ and the $L_{A1,Adj,1hr}$ acoustic parameters described in the Acoustic Quality Objectives are appropriate for considering the noise emissions associated with continuous noise sources and time-varying noise sources respectively.

5. METHODOLOGY

5.1 NOISE PREDICTION SOFTWARE

The prediction of noise will be modelled using SoundPLAN noise modelling software. For this assessment, the CONCAWE prediction methodology has been used to take into consideration the weather conditions at the site. The frequency of temperature inversions has been determined by obtaining the weather conditions at the proposed Project site from The Air Pollution Model (TAPM), which uses detailed meteorological data from the Bureau of Meteorology (BOM), land use and terrain data to produce complex wind fields that account for large and short scale meteorological effects.

5.2 METEOROLOGICAL CONDITIONS

The weather conditions for the site at night-time (18:00-07:00 hours) during the winter months and annual conditions have been analysed. It was determined that the worst-case conditions (Stability Class F) occur for 30% of the time during the year.

The wind roses for each season were analysed and for the whole year and it has been determined that wind speeds do not occur at or below 3 m/s for more than 30% in any season or full year between any source-to-receiver. As a result, wind was not included in the prediction methodology, as it is not considered to be a feature at this site.

5.3 MODELLED SOUND POWER LEVELS

The significant construction and operational noise sources used for this assessment are identified in Table 5-1. The noise sources have been obtained from Vipac's own database of noise emissions.

Table 5-1: Sound Power (L_W) of the Noise Sources used in Noise Modelling

Noise source	Sound Power Level, L_W / L_{Amax} in dB(A)
CAT D10T Bulldozer	121 / 125
CAT 980H front end loader	117
Mack 8x4 wheeler water truck	112
ALLIGHT mobile lighting towers	107
10kVA enclosed genset	87
75 tonne AB triple trucks (road trains)	112 (Travelling)
	118 (dumping load)

6. EXISTING NOISE ENVIRONMENT

The existing noise environment has been determined through unattended ambient noise monitoring between 27th March and 4th April 2013. The noise monitoring locations have been identified as Moray Downs.

6.1 NOISE MEASUREMENT EQUIPMENT

The measurements were carried out using one 01db-Metravib DUO environmental noise loggers at Moray Downs, approximately 1 km south-east of the Moray Downs Quarry.

Table 6-1: Noise Measurement Parameters

Measurement Details	Moray Downs
Weighting	A
Measurement Parameters	60 and 15 minute
Microphone height	1.5 m
Location & Position	-21° 57.057, 146° 37,982
	Free field – mixture of soft and hard ground
Last Date of Lab Calibration	27/6/2012
Site Calibration	94 dB(A) pre/post measurement

6.2 WEATHER CONDITIONS DURING NOISE MEASUREMENTS

The weather observations during the noise measurement period were obtained from the Bureau of Meteorology for the Emerald, located on Emerald Airport (station number 035264). During this time no rainfall was recorded as shown below in Table 6-2.

Table 6-2: Weather Observations During Noise Monitoring Period

Date	9:00 AM			3:00 PM			Daily
	Temp (°C)	Direction	Speed (km/h)	Temp (°C)	Direction	Speed (km/h)	Rainfall (mm)
27/3/2013	24.9	ESE	17	30.8	ENE	19	0
28/3/2013	24.9	ESE	17	30.9	E	17	0
29/3/2013	24.2	NNE	11	30.8	ESE	17	0
30/3/2013	25.5	E	7	31.0	NE	15	0
31/3/2013	24.8	N	13	31.3	NNE	15	0
1/4/2013	21.8	ESE	13	26.5	NE	9	0
2/4/2013	24.6	SE	20	30.0	E	15	0
3/4/2013	24.6	SSE	13	30.5	ENE	11	0
4/4/2013	24.1	ESE	15	30.3	E	11	0

The Pasquil stability classes during monitoring period could not be accurately determined, as cloud cover data is not collected during the night-time period.

6.3 NOISE MONITORING DATA

Table 6-3 provides the noise monitoring results for all of the days captured at each location. It should be noted that all of the monitoring locations are free-field positions. The noise monitoring data for individual days is shown in tabulated and graphical form in Appendix B.

Table 6-3: Summary of Noise Monitoring Results

Noise Descriptor	Moray Downs		
	Day (07:00-18:00)	Evening (18:00-22:00)	Night (22:00-07:00)
L_{Aeq} (Average)	47.5	44.4	41.5
$L_{Aeq,\ 1\ Hour}$ (Max)	53.4	46.5	48.1
L_{A90} (Average)	30.6	36.8	27.0
L_{Amax} (24 hour)	79.0		

7. NOISE IMPACT ASSESSMENT

The predicted noise levels contained within this Section are based on the maximum output of 66,697 tonnes, which is scheduled to occur in September 2014, as shown in Figure 2-3.

7.1 MORAY QUARRY ACTIVITIES

Regardless of the quarry output, the majority of noise sources will remain constant throughout the life of the Moray Quarry. These sources will be around the quarry and generally be operating for 100% of the time. As such, the noise from these activities has been predicted separately to provide a worst-case scenario for the extraction activities.

The predicted noise levels are presented in Table 7-1 for neutral weather conditions. The noise contour maps for night-time noise levels are shown in Appendix C.

Table 7-1: Predicted $L_{Aeq,Adj,1hr}$ Noise Levels – Neutral Weather

Sensitive Receptor	$L_{Aeq,Adj,1hr}$ Noise Criteria (outdoor)*		Predicted Noise Levels (dB $L_{Aeq,Adj,1hr}$) Outdoor			Complies with $L_{Aeq,Adj,1hr}$ Criteria
	Day	Night	Extraction Activities Only	Haul Road Only	Combined Noise Levels	
Beenboona	42	37	14	2	14	YES
Moray Downs	42	37	44	25	44	NO

* *A facade transmission loss of 7 dB(A) taken into consideration to evaluate the outdoor noise level based on indoor Acoustic Quality Objectives.*

Based on the results from Table 7-1, the predicted noise levels marginally exceed the day-time $L_{Aeq,Adj,1hr}$ noise criteria by 2 dB(A) at Moray Downs. The exceedance at night-time is 7 dB(A).

Noise predictions were also conducted for adverse weather. Results are shown in Table 7-2.

Table 7-2: Predicted $L_{Aeq,Adj,1hr}$ Noise Levels – Adverse Weather

Sensitive Receptor	$L_{Aeq,Adj,1hr}$ Noise Criteria (outdoor)*	Predicted Noise Levels (dB $L_{Aeq,1hour}$)			Complies with $L_{Aeq,Adj,1hr}$ Criteria
	Night	Extraction Activities Only	Haul Road Only	Combined Noise Levels	
Beenboona	37	21	8	21	YES
Moray Downs	37	47	27	47	NO

* *A facade transmission loss of 7 dB(A) taken into consideration to evaluate the outdoor noise level based on indoor Acoustic Quality Objectives.*

Based on the results from Table 7-2, the predicted noise levels exceed the night-time $L_{Aeq,Adj,1hr}$ noise criteria by 10 dB(A) at Moray Downs.

Conservative L_{Amax} noise levels were calculated for adverse weather conditions (i.e. temperature inversions) to compare with the $L_{A1,adj,1hr}$ Acoustic Quality Objective outdoor. The results are shown in Table 7-3.

Table 7-3: Predicted L_{Amax} Noise Levels During Temperature Inversions

Sensitive Receptor	$L_{A1,1hr}$ Noise Criteria (outdoor)*	Predicted Noise Levels (dB L_{Amax})		
	Night	$L_{A1,Adj,1hr}$ **	Source with Highest Noise Level	Complies with $L_{A1,Adj,1hr}$ criteria
Beenboona	47	25	Dozer	YES
Moray Downs	47	50	Dozer	NO

* *A facade transmission loss of 7 dB(A) taken into consideration to evaluate the outdoor noise level based on indoor Acoustic Quality Objectives.*

** *Conservative L_{Amax} descriptor used instead of L_{A1} in the assessment.*

Table 7-3 shows that under the worst-case noise propagation, the maximum noise levels are expected to exceed the $L_{A1,Adj,1hr}$ noise criterion.

Noise predictions also indicated that the maximum noise levels would also exceeded under neutral weather conditions, at 48 dB(A) at Moray Downs.

7.2 CUMULATIVE IMPACTS

During the excavation of the Moray Quarry, activities associated with North Creek and Back Creek South will also be occurring at the same time. Moray, North Creek and Back Creek South will have peak production months that are close to each other.

The peak production months for the quarries are as follows:

- Moray Quarry – September 2014;
- North Creek – September 2014;
- Back Creek South – August 2014.

The distances between the Moray and the other quarries are significant, except from North Creek, as shown in Table 7-4.

Table 7-4: Approximate distances to Moray Quarry and Moray Downs homestead

Quarry	Distance from Moray Quarry	Distance from Moray Downs homestead
North Creek	3.7 km	4 km
Back Creek South	38 km	37 km
Borrow 7	38 km	36.5 km
Disney	38 km	38 km

Given the production schedules, the distances between the extraction sites and the distance of noise receptors to haul roads, it is expected that cumulative noise impacts between Moray, North Creek and Back Creek South may occur.

To allow for the possibility that the peak production months of these quarries may coincide, a worst-case calculation was made, which combines the peak production predictions for these quarries. The results are shown in Table 7-5 for neutral weather conditions.

Table 7-5: Cumulative $L_{Aeq,Adj,1hr}$ Noise Impacts (Neutral Weather)

Sensitive Receptor	$L_{Aeq,Adj,1hr}$ Noise Criteria (outdoor)*		Predicted Noise Levels (dB $L_{Aeq,Adj,1hr}$) Outdoor			Complies with $L_{Aeq,Adj,1hr}$ Criteria
	Day	Night	Extraction Activities Only	Haul Road Only	Combined Noise Levels	
Cassiopeia	42	37	17	31	31	YES
Middle Creek	42	37	27	15	27	YES
Moray Downs	42	37	44	34	45	NO
Twin Hills	42	37	25	18	26	YES
Urella	42	37	28	25	29	YES

* *A facade transmission loss of 7 dB(A) taken into consideration to evaluate the outdoor noise level based on indoors Acoustic Quality Objectives.*

Based on the results in Table 7-5, the predicted noise levels exceed the day-time and night-time $L_{Aeq,Adj,1hr}$ noise criteria by 3 dB(A) and 8 dB(A), respectively, during neutral weather conditions, at Moray Downs. The exceedance is caused by the extraction activities at the Moray Downs Quarry. Back Creek South and North Creek have negligible contribution towards the exceedance at Moray Downs.

Table 7-6 shows the results of the cumulative impact assessment for adverse weather conditions.

Table 7-6: Cumulative $L_{Aeq,Adj,1hr}$ Noise Impacts – Adverse Weather

Sensitive Receptor	$L_{Aeq,Adj,1hr}$ Noise Criteria (outdoor)*	Predicted Noise Levels (dB $L_{Aeq,Adj,1hr}$) Outdoor			Complies with $L_{Aeq,Adj,1hr}$ Criteria
	Night	Extraction Activities Only	Haul Road Only	Combined Noise Levels	
Cassiopeia	37	25	33	34	YES
Middle Creek	37	32	21	32	YES
Moray Downs	37	47	36	47	NO
Twin Hills	37	31	23	31	YES
Urella	37	32	28	34	YES

* *A facade transmission loss of 7 dB(A) taken into consideration to evaluate the outdoor noise level based on indoors Acoustic Quality Objectives.*

Based on the results in Table 7-6, the predicted noise levels exceed night-time $L_{Aeq,Adj,1hr}$ noise criteria by 10 dB(A) during neutral weather conditions, at Moray Downs. The exceedance is caused by the extraction activities at the Moray Downs Quarry. Material haulage from Back Creek South has an important contribution towards the noise levels at Moray Downs, however, extraction processes at Moray Downs is dominant.

The noise contribution from the North Creek Quarry is negligible.

7.3 SUMMARY OF RESULTS OF MORAY QUARRY

This assessment has reviewed the maximum output of the Moray Quarry. Based on Vipac's noise predictions, the combined noise levels for extraction activities and haul road movements during maximum output are expected to exceed outdoor day-time and night-time $L_{Aeq,Adj,1hr}$ by 2 dB(A) and 7 dB(A), respectively, under neutral weather conditions.

The $L_{Aeq,Adj,1hr}$ noise criteria may be exceeded at Moray Downs by 10dB(A), during adverse weather conditions.

The $L_{A1,Adj,1hr}$ noise criteria is expected to be exceeded by 3 dB(A) under adverse weather conditions.

A cumulative noise assessment indicated that when the North Creek, Moray and Back Creek South quarries operate simultaneously, the day-time $L_{Aeq,Adj,1hr}$ noise criteria may be exceeded by up to 3 dB(A) and the night-time $L_{Aeq,Adj,1hr}$ noise criteria may be exceeded by up to 7 dB(A), under neutral weather conditions. The exceedances are caused by extraction activities at the Elgin North Quarry and the Moray Quarry.

Under adverse weather conditions, the night-time $L_{Aeq,Adj,1hr}$ noise criteria may be exceeded by up to 10 dB(A). The exceedances are caused by extraction activities at the Moray Quarry.

It is important to note that the Moray Quarry is likely to have a negligible noise impact on noise sensitive receptors, other than Moray Downs. However, the transportation of materials from Back Creek South could have an important noise impact on Moray Downs.

8. NOISE MITIGATIONS

This section outlines the potential mitigation options available to reduce noise at sensitive receptors.

8.1 NOISE MANAGEMENT

Noise predictions indicated that exceedances could be expected at the closest sensitive receptors to the Moray Quarry, due to the operation of the Moray Quarry alone and in combination with other quarries.

Vipac has been advised that it is unlikely that the Moray Downs homestead will be occupied at the commencement of activities at the Moray Quarry. In the event that the homestead is occupied, Vipac expects Adani to work with the occupiers to ensure that noise impacts from Moray Quarry activities are minimised.

Furthermore, a noise management plan, which includes the following items, could be applied to reduce noise impact at Moray Downs:

- Do not operate the Moray Quarry at night. If this is not possible, modify the production schedule so that the peak months of the Moray Quarry occur in summer, to avoid temperature inversions. However, noise exceedances are still expected during the daytime;
- Use a wheeled dozer instead of a tracked dozer;
- Select a dozer that has all the latest noise reduction technologies applied, in other words, “buy new”;
- Modify the production schedule of Moray, North Creek and Back Creek South, so that the peak production months for the quarries are as far apart as possible;
- Re-assess the haul road design, with view to minimizing compression breaking of trucks (apply appropriate signage on the road) and minimizing gradients;
- Reduce the peak monthly outputs;
- Liaise with property owners and explain the temporary nature of the Project, to minimize noise complaints;

- If a noise complaint is received, conduct noise monitoring to determine if the noise criteria is being exceeded and if further noise mitigations can be applied;
- Consider noise mitigation options at noise sensitive receptors, if noise exceedances do occur and are ongoing.

8.2 GENERAL NOISE CONTROL MEASURES

There are many general measures that can reduce noise levels at the source such as:

- Applying a 'buy quiet' policy when selecting quarry equipment;
- Avoiding unnecessary revving of engines and switch off equipment when not required;
- Keeping haul routes well maintained;
- Ensure that all operators of plant and haul trucks do not drive aggressively and horn use is limited;
- Minimise the drop heights of materials;
- Start-up plant and vehicles sequentially rather than all together;
- Audible reversing warning systems on mobile plant and vehicles should be of a type which, whilst ensuring that they give proper warning, have a minimum noise impact on persons outside sites. When reversing, mobile plant and vehicles should travel in a direction away from sensitive receptors whenever possible;
- As far as reasonably practicable, sources of significant noise should be enclosed. The extent to which this can be done depends on the nature of the machine or process to be enclosed and their ventilation requirements;
- Plant should always be used in accordance with manufacturers' instructions. Care should be taken to site equipment away from noise sensitive areas. Where possible, loading and unloading should also be carried out away from such areas;
- Machines such as cranes that might have intermittent use should be shut down between work periods or should be throttled down to a minimum. Machines should not be left running unnecessarily, as this can be noisy and wastes energy;
- Plant from which the noise generated is known to be particularly directional should, wherever practicable, be orientated so that the noise is directed away from noise-sensitive areas; and
- Acoustic covers to engines should be kept closed when the engines are in use and idling.

9. CONCLUSION

Vipac completed noise predictions to determine the potential noise impacts from the Moray Quarry activities based on the worst-case scenario of 66,697 tonnes of material being extracted in September 2014. The noise assessment has considered the extraction and hauling activities separately and in combination.

Given the temporary nature of the operations, we expect that the equipment to be used will be second hand rather than new equipment. It is therefore unknown if any plant will include any noise control options, such as low-noise tyre tread designs for road trains, high performance silencers for machines or sound absorbing panels around the power house of excavators. Without this knowledge, the sound power level of machines and their location in the computer model were chosen conservatively to model a worst-case scenario.

Predictions for the combined activities have indicated that exceedances to the $L_{Aeq,Adj,1hr}$ noise criteria can be expected for the day-time and night-time periods, during the maximum output of the Moray Quarry alone.

A cumulative noise assessment was conducted to include the operation of the North Creek Quarry, Moray Quarry and Back Creek South Quarry.

Exceedances of the day-time and night-time $L_{Aeq,Adj,1hr}$ noise criteria were found when the other quarries operate at the same time as the Moray Quarry. The extraction activities at the Moray Quarry are the dominant noise source. Noise emissions of haulage from the Back Creek South Quarry were found to contribute to the noise levels at Moray Downs, where noise exceedances of the $L_{Aeq,Adj,1hr}$ noise criteria was found, however, they were not found to cause an exceedance on their own.

Recommendations were provided in this report to mitigate the noise impacts.

This report addressed the cumulative noise emissions from the Back Creek South Quarry, Moray Quarry and North Creek Quarry which are to be operated by Adani.

It is important to note that the Moray Quarry is likely to have a negligible noise impact on noise sensitive receptors, other than Moray Downs. Vipac has been advised that it is unlikely that the Moray Downs homestead will be occupied at the commencement of activities at the Moray Quarry. In the event that the homestead is occupied, Vipac expects Adani to work with the occupiers to ensure that noise impacts from Moray Quarry activities are minimised.

Overall, the operational life of the Moray Quarry is two years and any perceived impacts would be temporary in nature.

APPENDIX A: GLOSSARY

Ambient noise – the totally encompassing noise in a given situation at a given time; it is usually composed of noise from many sources, near and far.

Attenuation – a general term used to indicate the reduction of noise or vibration, by whatever method or for whatever reason, and the amount in decibels, by which it is reduced.

A-weighting – a frequency weighting devised to attempt to take into account the fact human response to sound not equally sensitive to all frequencies.

dB(A) – the A-weighted sound pressure level.

Decibel (dB) – the logarithmic-scaled unit used to report the level or magnitude of sound.

Hertz (Hz) - the unit of frequency.

L (Level) – the sound pressure level (SPL); it implies the use of decibels related to the ratio of powers or the power related quantities such as sound intensity or sound pressure.

L_{10} – level that is equal to or exceeded for 10% of the time interval considered in the absence of the noise under investigation. The L_{10} is considered to be representative of road traffic noise. The A-weighted background level is denoted as L_{A10}.

Loudness – the measure of the subjective impression of the magnitude or strength of a sound.

Noise descriptors – A noise descriptor is a measure of noise used to define a specific characteristic of noise, e.g. average energy, variation (maximum and minimum) and annoyance. Noise descriptors are based on measurements of the sound pressure level. Common noise descriptors are provided below:

$L_{Aeq,T}$	Time–average A-weighted sound pressure level
$L_{A90,T}$	Background A-weighted sound pressure level
Max $L_{pA,T}$	A-weighted maximum instantaneous sound pressure level, obtained using time weighting F
Min $L_{pA,T}$	A-weighted minimum instantaneous sound pressure level, obtained using time weighting F
$L_{Amax,T}$	Maximum A-weighted sound pressure level, obtained by arithmetically averaging of the maximum levels of the noise under investigation -
$L_{Amax,adj,T}$	A-weighted sound pressure level, obtained using time-weighting F, and arithmetically averaging the maximum levels of the noise under investigation, during time interval 'T' and adding adjustments for tonality and impulsiveness
$L_{Amin,T}$	Minimum A-weighted sound pressure level, obtained by arithmetic averaging of the minimum levels of the noise under investigation
$L_{Abg,T}$	A-weighted sound pressure level, obtained using time weighting F and arithmetically averaging the lowest levels of the ambient sound pressure level, during time interval T

Noise limit – a maximum or minimum value imposed on a noise index e.g. a legal purpose.

Sound power – the sound energy radiated per unit time by a sound source, measured in watts.

Vibration – oscillating motion of matter about a fixed equilibrium position.

APPENDIX B: NOISE MONITORING DATA

B.1 MORAY DOWNS NOISE MONITORING DATA

Table B-1: Noise Descriptors Measured at Moray Downs

Descriptor	Date								
	27/3/13	28/3/13	29/3/13	30/3/13	31/3/13	1/4/13	2/4/13	3/4/13	4/4/13
LA10, 18hr (6am to 12am)	-	45.1	45.2	46.0	44.9	38.7	41.5	45.8	47.7
LA90, 8hr (10pm to 6am)	28.0	27.9	28.4	32.8	30.7	16.7	30.3	25.6	24.2
LAmax (24hr)	-	76.2	77.4	68.4	81.6	73.8	94.3	78.2	82.2
LAeq,Avg(7am to 6pm)	-	46.2	48.6	45.1	47.5	46.4	49.7	48.0	48.2
LAeq,Avg (6pm to 10pm)	43.6	43.7	44.8	42.0	43.9	44.4	46.3	48.0	42.9
LAeq,Avg (10pm to 7am)	41.6	39.8	39.7	42.1	40.3	38.3	43.9	48.2	40.0
LAeq,Max 1hr (7am to 6pm)	-	51.2	55.4	50.1	55.5	51.5	58.8	53.6	50.7
LAeq,Max 1hr (6pm to 10pm)	44.7	45.6	45.9	42.7	46.0	50.2	48.0	51.8	43.8
LAeq,Max 1hr(10pm to 7am)	47.4	44.6	44.1	47.6	46.6	45.5	51.7	57.5	47.7
LA90,Avg,1hr (7am to 6 pm)	-	30.9	29.3	30.5	29.7	27.5	28.8	32.5	35.9
LA90,Avg , 1hr(6 pm to 10pm)	37.9	38.8	39.6	37.9	38.6	19.4	40.8	39.9	38.4
LA90,Avg, 1hr(10pm to 7am)	27.7	27.6	28.1	31.7	30.0	17.0	30.1	25.9	24.7

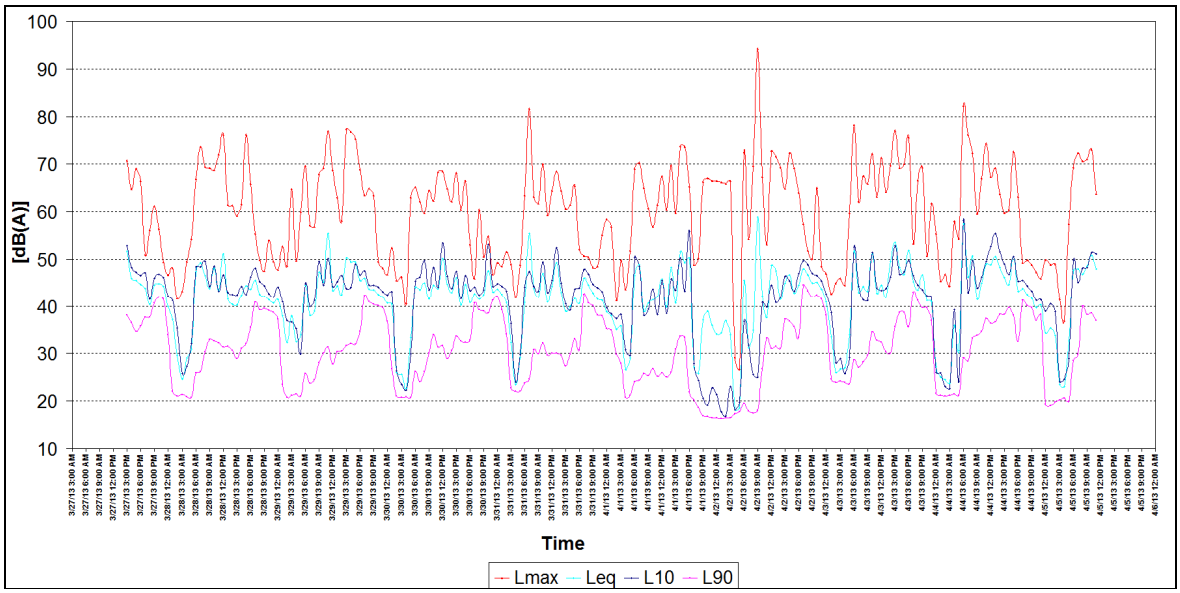

Figure B-1: Moray Downs Noise Monitoring Data

APPENDIX C: NOISE CONTOUR MAPS

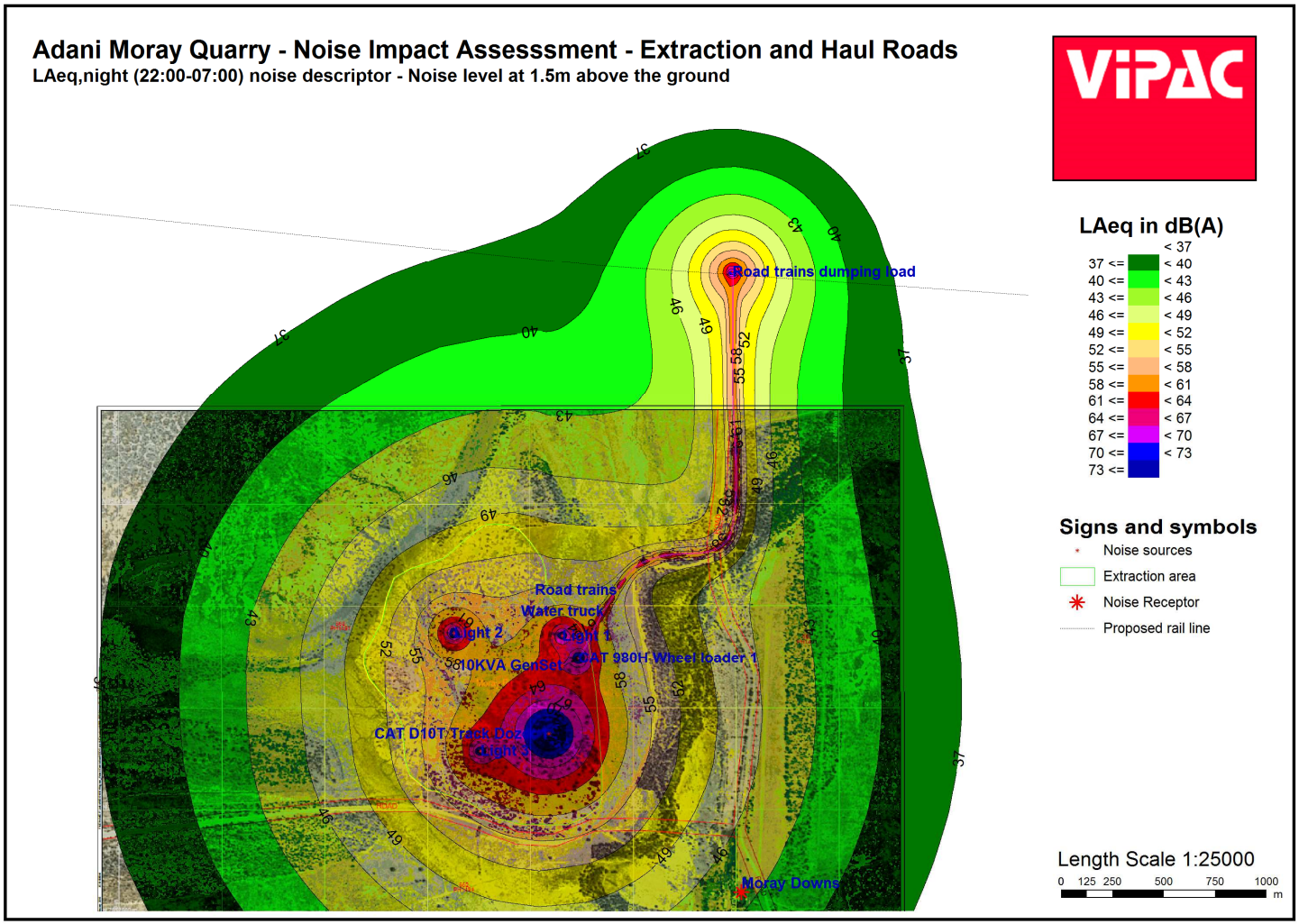

Figure C-1: Moray – All Quarry Activities

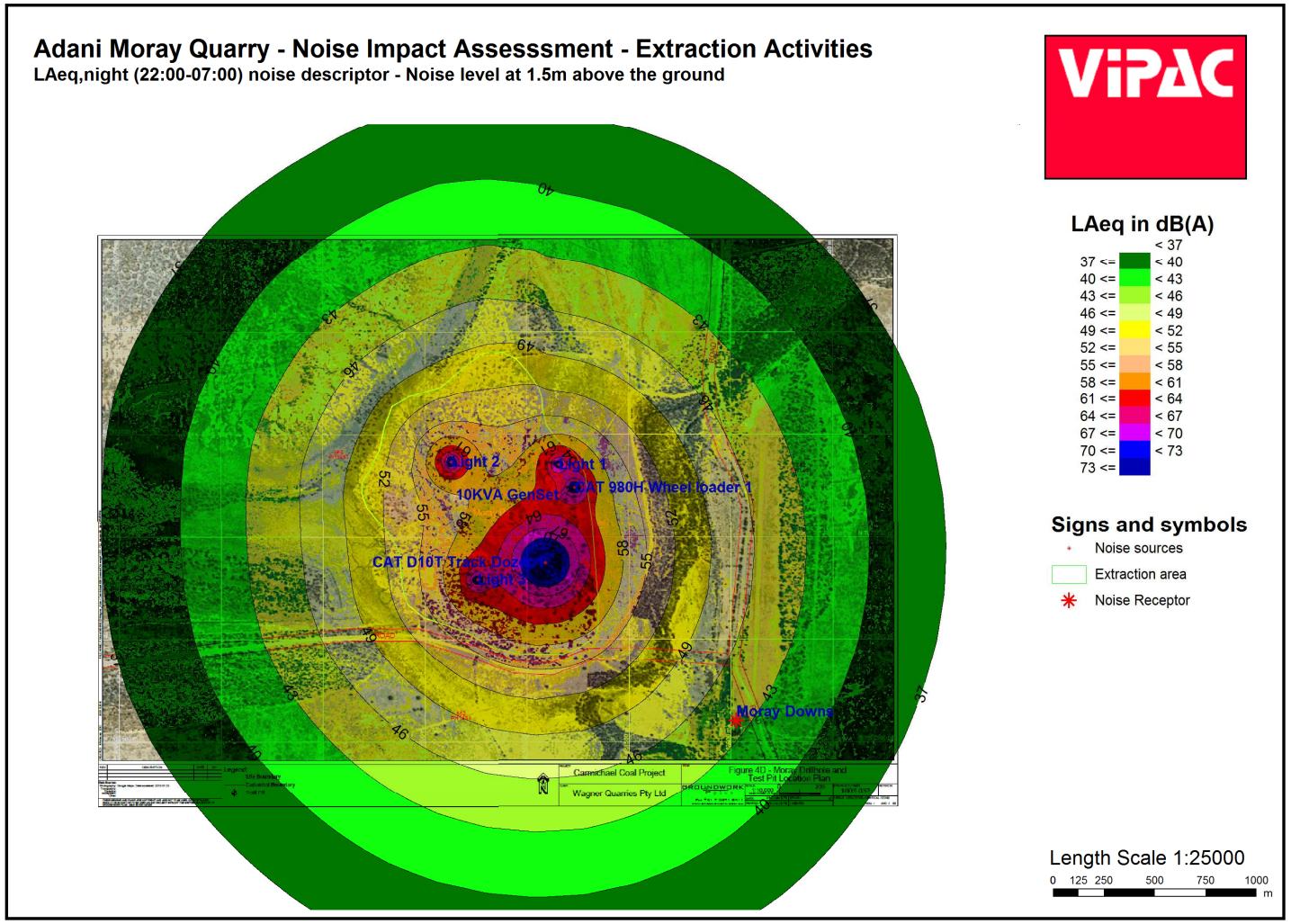

Figure C-2: Moray – All Activities Except Haul Roads

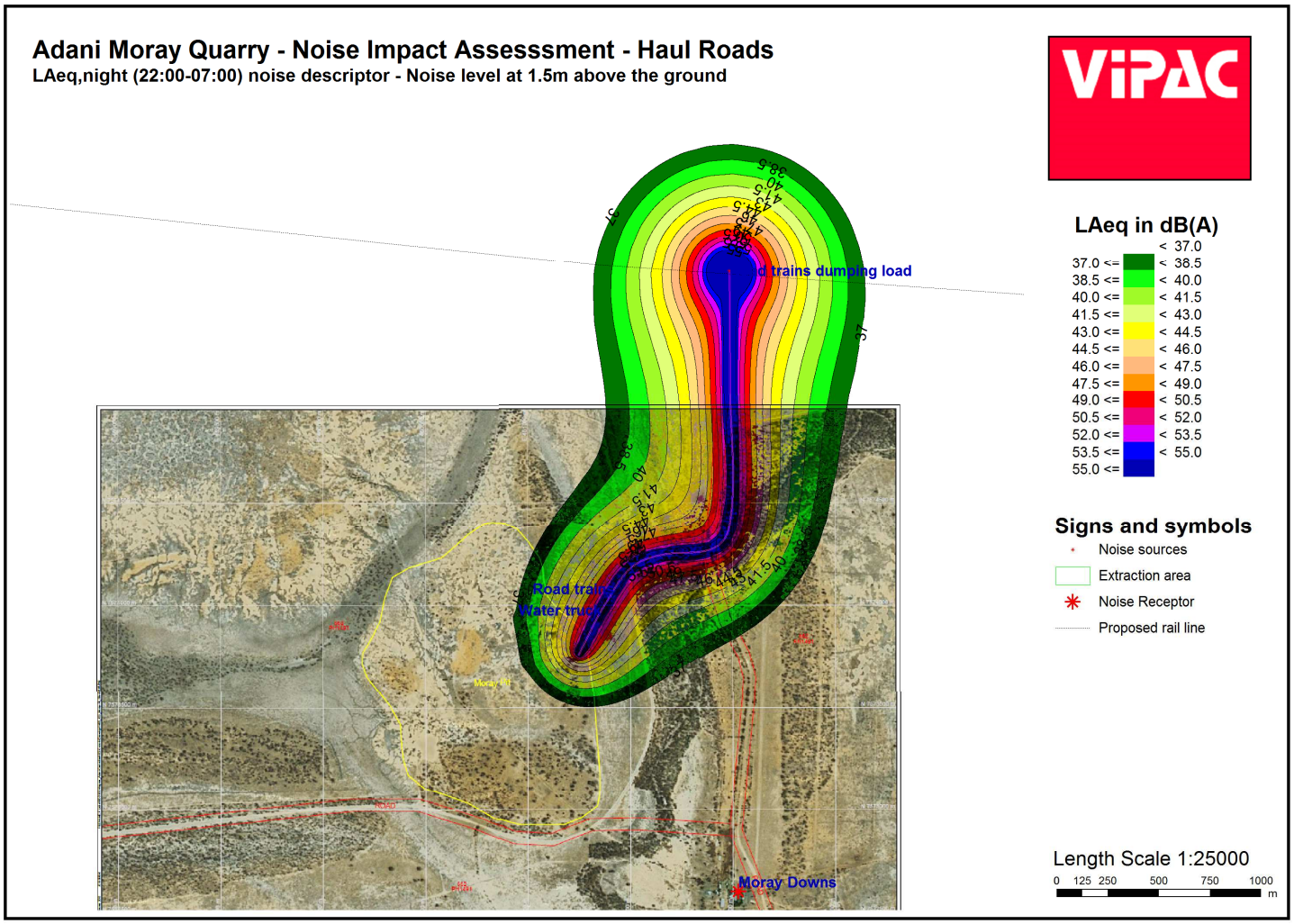

Figure C-3: Moray – Haul Roads Only