



Carmichael Coal Mine and Rail Project Supplementary Environmental Impact Statement

Volume 4, Appendix C5d – North Creek 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
- North Creek 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)

For companies, contact name

Postal address

Suburb			
State		Postcode	
Country			

Contact phone number

Mobile number (non-mandatory requirement)

Fax number (non-mandatory requirement)

Email address (non-mandatory requirement)

@

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.)
- 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.)
- 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)							
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)			
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			
					<input type="checkbox"/> GDA94 <input type="checkbox"/> WGS84 <input type="checkbox"/> other	

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

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

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	
<input type="checkbox"/> 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	
<input type="checkbox"/> 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

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

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)

- 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	<input type="checkbox"/> No	<input type="checkbox"/> Yes
New building work on the premises	<input type="checkbox"/> No	<input type="checkbox"/> Yes
The reuse of existing operational work on the premises	<input type="checkbox"/> No	<input type="checkbox"/> Yes
New operational work on the premises	<input type="checkbox"/> No	<input type="checkbox"/> 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		
<p>A site plan drawn to an appropriate scale (1:100, 1:200 or 1:500 are recommended scales) which shows the following:</p> <ul style="list-style-type: none"> the location and site area of the land to which the application relates (<i>relevant land</i>) 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. 	<input type="checkbox"/> Confirmed	
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.	<input type="checkbox"/> Confirmed	
A statement about the intensity and scale of the proposed use (e.g. number of visitors, number of seats, capacity of storage area etc.).	<input type="checkbox"/> Confirmed	
<p>Information that states:</p> <ul style="list-style-type: none"> 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). 	<input type="checkbox"/> Confirmed <input type="checkbox"/> Not applicable	

A statement addressing the relevant part(s) of the State Development Assessment Provisions (SDAP).	<input type="checkbox"/> Confirmed <input type="checkbox"/> Not applicable	
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.	<input type="checkbox"/> Confirmed <input type="checkbox"/> 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: <ul style="list-style-type: none"> 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. 	<input type="checkbox"/> Confirmed	
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)	<input type="checkbox"/> Confirmed	
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.	<input type="checkbox"/> Confirmed <input type="checkbox"/> 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.	<input type="checkbox"/> Confirmed <input type="checkbox"/> 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.	<input type="checkbox"/> Confirmed <input type="checkbox"/> Not applicable	

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.

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

IDAS form 5—Material change of use assessable
against a planning scheme
Version 3.0—1 July 2013

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 threshold	
Applicable fees	\$
Proposed scale/capacity	
Type of approval sought	<input type="checkbox"/> Development permit and environmental authority (see notes) <input type="checkbox"/> Preliminary approval
Is the proposed ERA a concurrence ERA?	<input type="checkbox"/> No <input type="checkbox"/> 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?	<input type="checkbox"/> No <input type="checkbox"/> 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.	<input type="checkbox"/> Confirmed	
Details of any known acid sulphate soils within or adjoining the premises.	<input type="checkbox"/> Confirmed <input type="checkbox"/> Not applicable	
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.	<input type="checkbox"/> Confirmed	
Details about how the location for the activity on a site protects all environmental values relevant to adjacent sensitive uses.	<input type="checkbox"/> Confirmed	
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.	<input type="checkbox"/> Confirmed	
About the proposed ERA		
Attachment to IDAS form 8—application for an environmental authority (EM941) completed and required information provided.	<input type="checkbox"/> Confirmed	
A statement addressing the relevant part(s) of the State Development Assessment Provisions (SDAP).	<input type="checkbox"/> Confirmed <input type="checkbox"/> Not applicable	

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.

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 (EM1125¹), 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: <ul style="list-style-type: none">(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**.

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

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

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

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
	<input checked="" type="checkbox"/> I am a registered suitable operator. You must provide your suitable operator registration number in the adjacent column. <input type="checkbox"/> I have lodged an application to be registered suitable operator and am waiting for it to be decided <input type="checkbox"/> 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

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

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

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

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

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

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.

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.

7. Biodiversity offsets

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

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

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

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

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.

biodiversity values has been undertaken.

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

☒ No

☐ Don't know/uncertain

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.

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

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.

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

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

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

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.

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.

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

Adani Mining Pty Ltd

North Creek Quarry

Material Change of Use for Extractive Industry and
Environmentally Relevant Activity 16





Adani Mining Pty Ltd

North Creek Quarry

12 July 2013

CDM Smith Australia Pty Ltd
ABN 88 152 082 936
21 McLachlan St
Fortitude Valley
QLD 4006
Tel: +61 7 3828 6900
Fax: +61 7 3828 6999



Table of Contents

Section 1	Introduction	1-1
1.1	Purpose and Scope	1-1
1.2	The Proponent	1-1
1.3	Project Overview	1-1
1.4	Development Approval Process	1-5
1.5	Application Requirements Cross-Reference.....	1-6
Section 2	Development Justification.....	2-1
2.1	Need for Quarry Material	2-1
2.1.1	Quarried Products Uses and Specification	2-2
2.1.2	Transport Costs	2-2
2.2	Alternatives to the Project.....	2-2
2.2.1	Alternatives Considered for Mine and Rail Project.....	2-2
2.2.2	Alternatives Considered for Quarry Project.....	2-3
2.2.3	Alternative Methods of Operation	2-3
Section 3	Project Details.....	3-1
3.1	Site Details	3-1
3.2	Development Description	3-2
3.3	Project Planning and Design	3-3
3.4	Quarry Development Proposal.....	3-4
3.4.1	Initial Construction and Commissioning Phase	3-4
3.4.2	Site Access and Internal Roads.....	3-4
3.4.3	Water Storages, Stormwater and Erosion Control	3-4
3.4.4	Vegetation Clearing and Topsoil Management	3-5
3.4.5	Development of Extraction Cells	3-5
3.4.6	Material Processing	3-2
3.4.7	Product Stockpiling and Despatch.....	3-2
3.4.8	Ancillary Facilities.....	3-3
3.4.9	Machinery and Equipment.....	3-3
3.4.10	Storage of Fuels, Lubricants and Chemicals	3-3
3.4.11	Hours of Operation	3-3
3.4.12	Public Utility and Services.....	3-4
3.4.13	Lighting	3-5
3.4.14	Waste Management.....	3-5
3.4.15	Workforce.....	3-5
3.4.16	Health and Safety and Emergency Response	3-6
3.4.17	Rehabilitation and Landscaping	3-7
Section 4	Environment and Management.....	4-1
4.1	Terrestrial Ecology.....	4-1
4.1.1	Vegetation Communities and Fauna Habitats	4-1
4.1.2	Potential Impacts to Terrestrial Ecology	4-7
4.1.3	Terrestrial Ecology Management.....	4-7
4.2	Aquatic Ecology, Surface Water and Hydrology	4-9
4.2.1	Aquatic Ecology.....	4-9
4.2.2	Surface Water and Hydrology.....	4-9
4.2.3	Potential Impacts.....	4-13
4.2.4	Management of Aquatic Ecology, Surface Water and Hydrology.....	4-13
4.3	Landscape and Visual Amenity.....	4-13
4.3.1	Bushfire Risk Mapping.....	4-14

4.3.2	Visual Amenity Potential Impacts.....	4-14
4.3.3	Management of Landscape and Visual Amenity	4-14
4.4	Soils, Geology and Topography	4-15
4.4.1	Geology and Topography	4-15
4.4.2	Soils.....	4-19
4.4.3	Potential Impacts.....	4-25
4.4.4	Management of Soils, Geology and Topography.....	4-26
4.5	Groundwater.....	4-27
4.5.1	Existing Environment.....	4-27
4.5.2	Potential Impacts.....	4-30
4.5.3	Management Measures	4-31
4.6	Contaminated Land.....	4-32
4.7	Air Quality	4-32
4.7.1	Existing Environment.....	4-32
4.7.2	Project Criteria	4-33
4.7.3	Potential Impacts.....	4-33
4.7.4	Cumulative Impacts.....	4-34
4.7.5	Air Quality Management	4-35
4.8	Noise.....	4-36
4.8.1	Existing Environment.....	4-36
4.8.2	Proposed Criteria and Assessment.....	4-37
4.8.3	Noise Impacts.....	4-39
4.8.4	Cumulative Impacts.....	4-40
4.8.5	Noise Management	4-41
4.9	Traffic, Transport and Site Access.....	4-41
4.9.1	Traffic and Transport requirements.....	4-41
4.9.2	Potential Impacts.....	4-43
4.9.3	Management Measures	4-44
4.10	Cultural Heritage.....	4-44
4.10.1	Indigenous Cultural Heritage Assessment	4-44
4.10.2	Non-Indigenous Cultural Heritage Assessment.....	4-45
4.10.3	Potential Impacts.....	4-46
4.10.4	Management of Cultural Heritage.....	4-46
Section 5	Land Use and Planning	5-1
5.1	State Planning Instruments.....	5-1
5.1.1	State Planning Policies	5-1
5.1.2	Good Quality Agricultural Land Review	5-2
5.1.3	Mackay, Isaac and Whitsunday Regional Plan 2012 and State Planning Regulatory Provisions	5-5
5.2	Local Planning Instruments	5-6
5.2.1	Belyando Shire Planning Scheme 2009	5-6
Section 6	Conclusion.....	6-1
Section 7	Bibliography.....	7-1
Section 8	Acronyms and Abbreviations.....	8-1

List of Figures

Figure 1-1 Quarry project area	1-4
Figure 3-1 Extraction and schematic site layout	3-1
Figure 3-2 Batter treatments	3-8
Figure 3-3 Schematic of quarry bench rehabilitation	3-1
Figure 4-1 Ecological values within and surrounding the site	4-2
Figure 4-2 Conservation significant species locations	4-6
Figure 4-3 Surface water and hydrology	4-12
Figure 4-4 Detailed stratigraphy	4-16
Figure 4-5 Geology and topography	4-17
Figure 4-6 Land Resource Areas	4-21
Figure 4-7 Annual wind rose for local area (source CSIRO 2006)	4-37
Figure 4-8 Predicted noise impact profile - North Creek (VIPAC 2013)	4-40
Figure 4-9 Study area - North Creek Quarry (TTM, 2013)	4-42
Figure 5-1 Good quality agricultural land	5-4

List of Tables

Table 1-1 Development Approvals subject to this application	1-5
Table 1-2 <i>Belyando Shire Planning Scheme 2009</i> requirements cross-reference	1-6
Table 1-3 <i>Sustainable Planning Act 2009</i> requirements cross-reference	1-8
Table 1-4 <i>Environment Protection Act 1994</i> requirements cross-reference	1-9
Table 3-1 Site Details	3-1
Table 3-2 Water Usage	3-5
Table 4-1 Protected Matters Search results for with respective field observations	4-4
Table 4-2 Anticipated extraction volumes	4-19
Table 4-3 Relationship of AMUs to LRAs for North Creek area, Central Highlands	4-20
Table 4-4 Description of Agricultural Management Units regional to the North Creek Quarry	4-22
Table 4-5 Potential constraints of soils from North Creek Quarry area.	4-25
Table 4-6 Groundwater bore details within 10 km of North Creek Quarry	4-28
Table 4-7 Project air quality goals (VIPAC)	4-33
Table 4-8 Modelled quarry dust results at Moray Downs receptor	4-34
Table 4-9 Modelled quarry dust results at Beenboona receptor	4-34
Table 4-10 Cumulative impacts of North Creek and Moray Quarries	4-35
Table 4-11 Summary of noise monitoring results	4-37
Table 4-12 EPP (noise) acoustic quality objectives for dwellings	4-38
Table 4-13 Cumulative $L_{Aeq,adj,1hr}$ noise impacts from all quarries at Moray Downs receptor	4-40
Table 4-14 Estimated daily and peak hour haul vehicle generation (TTM)	4-43
Table 4-15 Queensland Heritage Register search results	4-46
Table 5-1 State Planning Policy Assessment	5-1
Table 5-2 SPP 1/92 Policy Principles	5-2
Table 5-3 Assessment against Desired Environmental Outcomes	5-6
Table 5-4 Alternative solutions	5-7

List of Plates

Plate 1-1: North Creek Quarry site.....	1-2
Plate 1-2: North Creek Quarry extraction area and existing topsoil stockpiles	1-3
Plate 1-3: Existing site access from Bulliwallah Road.....	1-3
Plate 3-1: Proposed plant processing and material stockpiling area	3-1
Plate 4-1: North Creek Quarry site - view north showing previous disturbance and scattered regrowth	4-1
Plate 4-2: North Creek south of the quarry site.....	4-11
Plate 4-3: Existing landscape.....	4-14
Plate 4-4: North Creek Quarry - stockpile of sandstone from recent quarry activities	4-18

Appendices

Appendix A – Adani Environment and Sustainability Policy
Appendix B – Traffic and Transport Impact Assessment
Appendix C – EHP Wildlife Online Search
Appendix D – Conservation Significant Species
Appendix E – Conceptual Erosion and Sediment Control Plan
Appendix F – AMU Summary
Appendix G – EMR/CLR Search
Appendix H – Air Quality Impact Assessment
Appendix I – Noise Impact Assessment

Document History and Status

Revision	Date Issued	Reviewed By	Approved By	Date Approved	Revision Type
A	28/03/2013	Miranda Weston	Miranda Weston		Draft
B	02/04/2013	Miranda Weston	Miranda Weston	02/04/2013	Draft
B	17/04/2013	Dr Ritnesh Syna	Miranda Weston	20/04/2013	Soils and Geology Technical
C	17/04/2013	Rikito Greswell	Tony Smith	19/04/2013	Groundwater Technical
D	26/04/2013	Miranda Weston	Miranda Weston	02/05/2013	Full Technical Review and Incorporation of Client Comments
0	02/05/2013	Dr David Elmoultie	Miranda Weston	06/05/2013	Full Technical Review
1	05/07/2013	Miranda Weston	Miranda Weston	05/07/2013	Address Adani Comments

Distribution of Copies

Version	Date Issued	Quantity	Electronic	Issued To
0	13/06/2013	1	1	Adani for Final Review
1	09/07/2013	1	1	Final
1	12/07/2013	1	1	Final

Printed:	12 July 2013
Last Saved:	12 July 2013 02:31 PM
File Name:	CDM Smith-B12849.01-North Creek Quarry Application REV1 120713
Author:	Tim Kinny
Project Manager:	Miranda Weston
Client:	Adani Mining Pty Ltd
Document Title:	North Creek Quarry Development Application
Document Version:	Final
Project Number:	B12849.01

Executive Summary

CDM Smith Australia (CDM Smith) has been engaged by Adani Mining Pty Ltd (Adani) to obtain a number of approvals to support quarry development. 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, rail, 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 North Creek Quarry, a new road base and embankment material quarry proposed to be located on Lot 2 SP119925, approximately 135 km north of Clermont in Central Queensland. The site is adjacent to the eastern side of Bulliwallah Road, which connects to Moray Carmichael Road in the south and the Gregory Development Road in the north. 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 North Creek Quarry has been utilised for historic quarrying operations (Plate 1-1).

This application seeks a Development Permit for:

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

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 North Creek Quarry has an inferred resource quantity of 1,616,000 cubic metres (m³) [3,232,000 tonnes (t)], however only 603,000 t of material is anticipated to be extracted over an approximate 24 month period. The quarry has a proposed operational footprint of 7.64 hectares (ha) and a depth of approximately 10 metres below ground level (mbgl). At the North Creek Quarry material will be quarried, stockpiled and directly transported to the required location. No crushing or screening operations are proposed. The development will maintain two site access points onto Bulliwallah Road and vehicle transport within the site will be along a dedicated access track through the central portion of the extraction area (Figure 3-1).

The North Creek Quarry is proposed to be developed using a single extraction face that progressively extracts in a north-westerly direction. Processing of the material will occur at the quarry face with an excavator quarrying the material and stockpiling, ready for direct transport. Stockpiling of materials will occur primarily on the quarry floor.

In summary the objectives of this quarry development are:

- Provide short term quarry operation to provide necessary construction material for the Carmichael Coal Mine and Rail Project construction;
- Minimise any potential environmental impacts 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;
- Minimise impacts to local and state roads; and
- Rehabilitate the land post quarry production.

In summary, the North Creek Quarry development will provide essential construction material for the Carmichael Coal Mine and Rail Project and is located strategically close to 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. The location, layout and staging of the proposed development has to a large extent, been determined by consideration of environmental issues and constraints. Particular considerations were the transport and haulage of materials, minimisation of the impact on visual amenity, noise and dust emissions and the nearby waterways (North Creek and the Belyando River).

In particular, 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. Relatively minor clearing is required for the quarry development, however the site is mapped as non-remnant vegetation and an operational works permit is therefore not required.

A 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 North Creek Quarry and associated quarries will not have a significant or assessable pavement impact on the state controlled road network. Access into the site will predominately be via two private access roads to the west which connect to the Bulliwallah Road.

No significant impact upon groundwater is expected from the quarry operations. The quarry is also situated in a position of elevated hydraulic gradient and the lowest level of the quarry will remain above 195 m Australian Height Datum (AHD). There may be some localised impacts to surrounding bores and/or possible recharge, however, monitoring bores may be installed to provide early detection of any potential impact.

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 on site for dust suppression and quarry operations. A Stormwater Management Plan will be developed and implemented prior to operations. The quarry extraction

is also staged with progressive rehabilitation to ensure only a limited and manageable area to minimise exposure to erosion and sediment loss. Clean stormwater will be diverted away from the quarry workings.

Diesel and hydrocarbons will be stored onsite 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. Six test locations were assessed within the North Creek 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 North Creek 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), 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 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 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 North Creek 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 (Figure 1-1). 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 North Creek Quarry, the subject of this report. The proposed North Creek Quarry will be a new embankment material quarry located on Lot 2 SP119925. The site is adjacent to the eastern side of Bulliwallah Road, and will provide a direct supply of road base material for the upgrade and maintenance of local roads.

The lot is within the 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 North Creek Quarry has been utilised for historic quarrying operations.

Total quarry material requirements are approximately 34 million tonnes (MT) for construction of the Carmichael Coal Mine and Rail Project and the associated local council road upgrades. The North Creek Quarry has an inferred resource quantity of 1,616,000 cubic metres (m³) [3,232,000 tonnes (t)], a proposed operational footprint of 7.64 hectares (ha) and a depth of approximately 10 metres below ground level (mbgl). However, only 603,000 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 North Creek Quarry would be primarily used for embankment fill for rail construction.

At the North Creek Quarry rock will be quarried to a range of specifications and transported to the required location. The development will establish two site access points to Bulliwallah Road (Plate 1-3) and vehicle transport within the site will be along a dedicated access track through the central portion of the extraction area.

The North Creek Quarry is proposed to be developed using a single extraction face that progressively extracts in a north-westerly direction (Plate 1-2). Face height of the quarry will be approximately 10 mbgl and processing of the material will occur at the quarry face. In the initial stages of the development material will be stockpiled within the existing disturbed area to the west of the proposed extraction face (Plate 1-1) Once the quarry has expanded, stockpiling of materials will likely also occur primarily on the quarry floor.

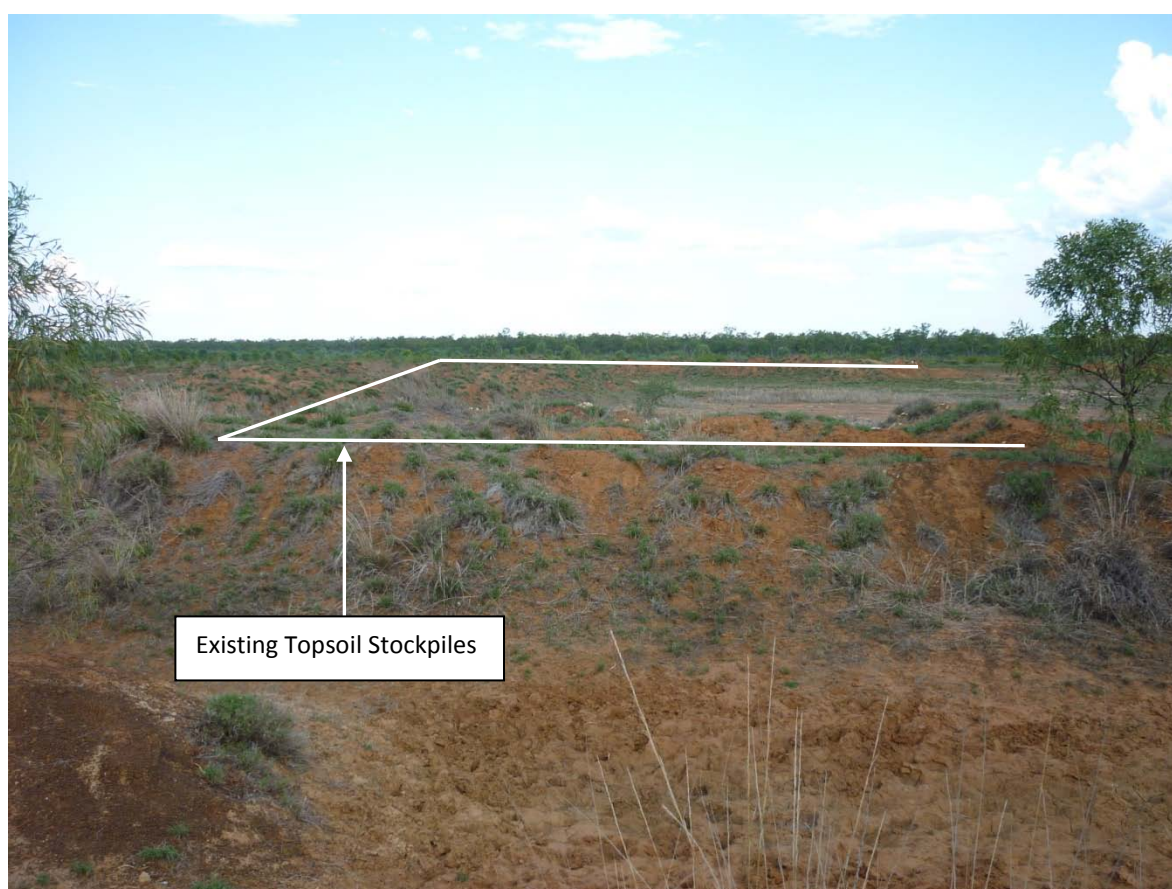


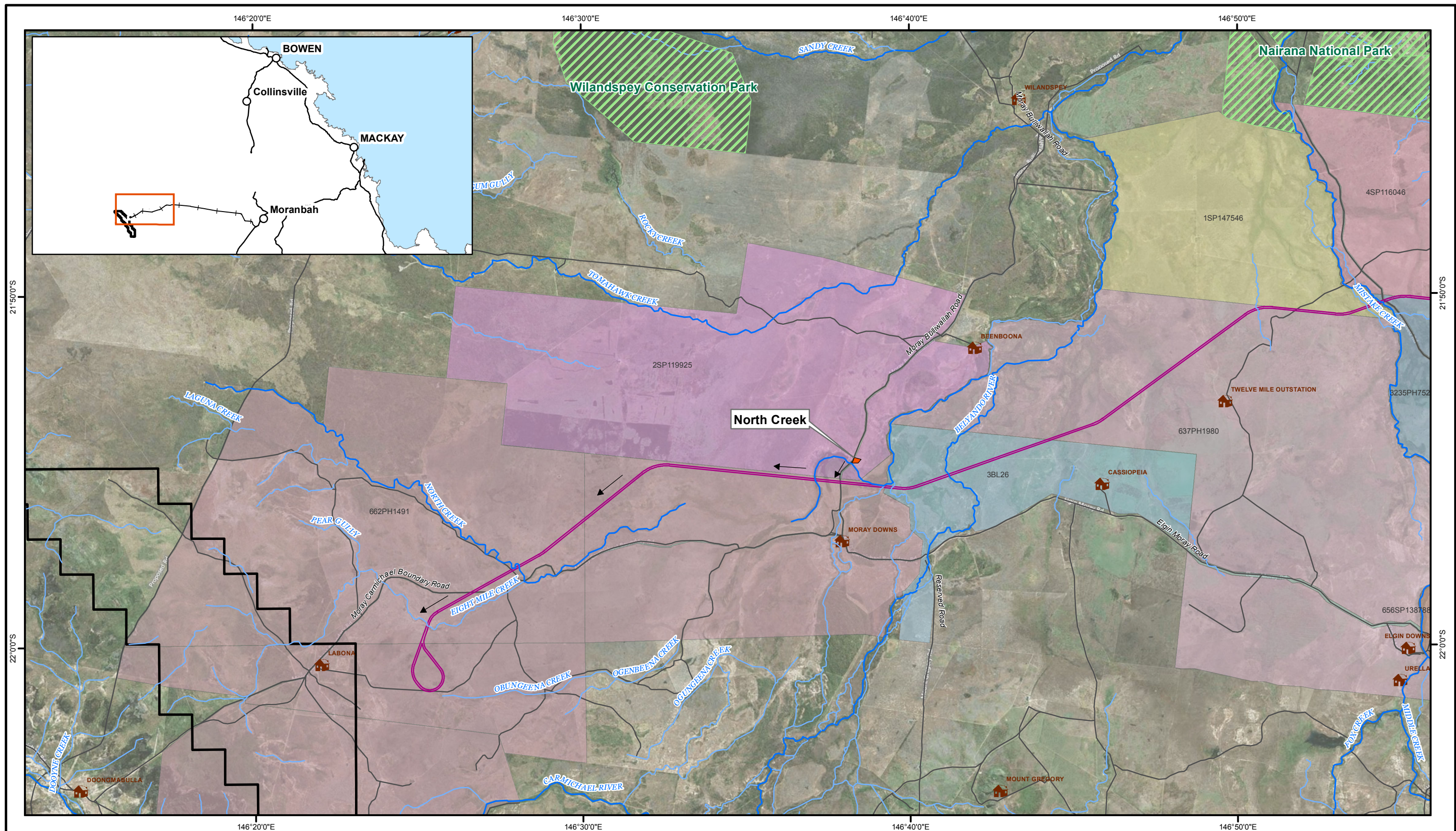
Plate 1-1: North Creek Quarry site



Plate 1-2: North Creek Quarry extraction area and existing topsoil stockpiles



Plate 1-3: Existing site access from Bulliwallah Road



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

Legend

- | | | |
|---|--------------------------------|-----------------------------|
| ○ Town | — Proposed Adani Rail Corridor | — Ergon Electricity Network |
| 🏠 Homestead | — Minor Road | — Major watercourse |
| ⛛ Carmichael Mine - ML 70441 | — Major Road | — Minor watercourse |
| 🌿 National Park | — Railway | ➡ Haulage Route |
| 🟠 North Creek Quarry Investigation Area | | |

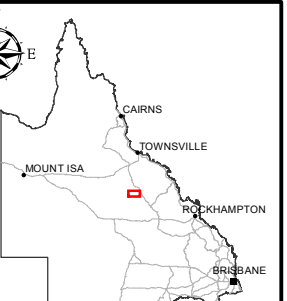
Job: B12849_026-NorthCreek
Date: 8/07/2013

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.

adani **CDM Smith**
cdmsmith.com



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 North Creek Quarry and road upgrades are 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 Environmental Impact Statement (SEIS) 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 Supplementary Environmental Impact Statement (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 North Creek 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) - <i>Sustainable Planning Regulations 2009</i> 4.4.1 - <i>Belyando Shire Planning Scheme 2009</i> Impact Assessable where an industrial use is a 'total use area is over 150m ² in a rural zone'.	Impact Assessable
Environmental Authority for Environmentally Relevant Activity 16 – Extractive and Screening Activities. Threshold 2(c) and 3 (c).	Sch 3, Table 2, Item 1 - <i>Sustainable Planning Regulations 2009</i> <i>Environmental Protection Regulations 2008</i>	Impact Assessable

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.

1.5 Application Requirements Cross-Reference

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

- *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 5-4
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 not 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
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

No.	Criteria to be Addressed	Section of this Document
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”.	Figure 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 4.7.5
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 and Section 3.4.16
2.8 Environmental		
1 (a)	Location of ridgelines and escarpments.	Section 3.4.12.1, Figure 1-1 and Figure 3-1
1 (b)	Location of “watercourses” and “lakes” and the extent of associated riparian buffers.	Figure 1-1 and Figure 3-1
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.	Section 4.1.1 and Figure 4-1
1 (f)	Location of any known sites of indigenous, cultural or natural heritage.	Section 4.10
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.	Assessment manager is local government
(d)	State planning policies.	Section 5.1.1
(e)	Temporary local planning instruments.	Not applicable
(f)	Preliminary approval to which section 242 applies.	Not applicable – No Preliminary Approvals relevant to the Quarry.
(g)	The planning scheme.	Section 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 applicable
(i)	If the assessment manager is an infrastructure provider—an adopted infrastructure charges resolution or the priority infrastructure plan.	Not applicable
(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 applicable
(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 H and Appendix I
(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 applicable
(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 of 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.	A Site Based Management Plan will be developed by the contractor consistent with the CEMP for the project
(k)	Any relevant integrated environmental management system or proposed integrated environmental management system.	Not applicable
(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 operational life of the Carmichael Coal Mine will continue until 2071 with rehabilitation of the Carmichael Coal Mine expected to cease in 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 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 Mine and Rail Project is the supply of suitable local quarry material. The 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 total 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 North Creek site, existing quarries in the area are primarily historic, small and do not contain appropriate infrastructure to immediately utilise. The existing quarries (including North Creek) 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 North Creek 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 North Creek Quarry will provide royalties to the State for the sale of the quarry material, provide local jobs through 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 Rail will require:

- Embankment fill;
- Structural fill;
- Ballast; and
- Main Roads Department (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. 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 distance.

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. North Creek 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 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 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 Environmental Impact Statement (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 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 Project, would likely lead to Adani's demand for coal being met from outside of Australia. The no action option for the Project 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 Project

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 constraints 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. North Creek is an ideal quarry option as it is located immediately north of the Moray Carmichael Road, which is planned to have a significant upgrade. The North Creek 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 proposed 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 North Creek Quarry is proposed to be located on Lot 2 SP119925 with direct access to Bulliwallah Road through two access points. The site is approximately 42 km west of the Gregory Development Road, and approximately 135 km north-west 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 2 SP119925 (Leasehold)	1162 Bulliwallah Road, Clermont	47,600ha	Rural	Quarrying and Cattle breeding / fattening	North Creek 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, however the proposed location of North Creek Quarry is predominately cleared and is subject to intermittent quarry extraction. The topography of the site is generally flat, however slopes slightly south towards North Creek and east towards the Belyando River located approximately 1.5 km away. Site inspections have confirmed that historical quarrying has occurred in the location of the proposed North Creek Quarry (Plate 3-1) and the area is highly disturbed.



Plate 3-1: Proposed plant processing and material stockpiling area

Lot 2 SP119925 does not contain any residential dwellings and the closest known dwellings are approximately 4 km directly south of the proposed North Creek Quarry and are located adjacent to Moray Carmichael Road. These residences will be screened from the quarry operations by vegetation corridors which occur in a general north-south direction (Figure 1-1).

3.2 Development Description

The applicant proposes to initiate formal quarry operations on Lot 4 SP116046, as per Figure 3-1 below. The development proposal includes the construction of all ancillary facilities specifically:

- 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 bulldozer and excavator, one loader, three light plants, one 75 t AB triple truck and a 25,000 L water tank and pumps. Additionally minor ancillary equipment, including service trucks, will be on site when required. Temporary facilities may be erected on site which could include a demountable office, crib room, ablution facilities and a small car park. A small lay down area hardstand, 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 all major servicing will be completed either on site or at Borrow 7 Quarry. Waste materials will be disposed of off site at a licensed facility.

The extraction area for North Creek has been defined as 7.64 ha. Road and embankment material will be extracted from the quarry and transported directly to the required location along the Moray Carmichael Road and the Carmichael Coal 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.

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. Initial 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.

North Creek Quarry was determined to be a preferred location due to proximity to rail corridor. 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; and
- Installation of ancillary services (fuel storage, site office etc).

Site preparation is likely to commence in early 2014.

3.4.2 Site Access and Internal Roads

The proposed North Creek Quarry will maintain two all weather access points. The tracks will directly access Bulliwallah Road which connects to Moray Carmichael Road approximately 2.5 km south of the North Creek Quarry. The traffic and transport arrangements for the North Creek 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 down the centre of the extraction area to transport material off the site. This internal haul road will be relocated as the linear cell extraction is moved onto the second 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 on site and ultimately the site is designed to be self sufficient for water required for all 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 for dust suppression and progressive rehabilitation;
- Clean water will be diverted away from the quarry workings into undisturbed catchment and drainage lines; and
- Erosion and sediment controls will be designed, implemented and maintained in accordance with IECA 2008.

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.

Site runoff collected in the sediment ponds will be reused onsite where possible. The water usage requirements for North Creek 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 (L) Per Day (L/day)	90,000	N/A	N/A	15,000
Total Kilotres Per Month (kl/month) - 3,150				

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 vegetation to south has been preserved. 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 soil remaining in a productive condition 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

North Creek extraction cell preparation will begin with stripping topsoils and stockpiling of the residual soil profile for later 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. North Creek Quarry contains one single rip area of 7.64 ha which will be extracted in a series of cells and internal haul road running from the southern entrance to the northern exit. Site access as illustrated in Figure 3-1.

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. The quarry development plan will guide the development of the quarry and these plans are 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.

Volumes at North Creek Quarry are based on a rippable thickness of ten 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 of rippable resources.

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.

3.4.6 Material Processing

Material on the North Creek Quarry site will not be processed through a screening or crushing process. It is expected that material will be ripped and stockpiled ready for dispatch to laydown areas along the rail construction corridor.

3.4.6.1 Products Produced and Production Rates

The North Creek Quarry will be a short term operation commencing in 2014 and operating until construction of the Carmichael Coal 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 603,000 t of embankment material will be required from this site over this three year period, an average of 22,000 t a month. The highest annual production rate for a year is expected to be during 2015 when up to 319,000 t of material is proposed to be extracted during peak operations. This volume and demand may change and is dependent upon construction schedule and progress of the Carmichael Coal 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, schedules and quality control testing. Some product stockpiles will be maintained at the proposed quarry site in the western area of the site near to the Council road. Stockpiles will provide maximum benefit for noise attenuation from fixed and mobile plant and will screen the operations from the road to minimise any dust or noise impacts to local road users. The road base and fill stockpile will be approximately 3.5 m high whilst the aggregate and ballast stockpile will be approximately 3 m high. Material will predominately be transported off site 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 56 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 rail haul road speed limits of 80 km per hour (km/hr) enforced onsite to minimise dust and ensure safe operation of the site.

3.4.8 Ancillary Facilities

A crib and ablution block will be located off site at the nearby Moray Quarry and the following facilities will be erected on the proposed quarry site to service the quarry workings:

- One spares container 20 ft; and
- One 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 (shared with Moray Quarry site);
- One CAT980H loader;
- One water truck (Mack 8x4 wheeler) (shared with Moray Quarry site);
- Three light plants (ALLIGHT);
- One light vehicles; and
- One 10 Kilo Volt Amperes (kVA) Genset (shared with the Moray Quarry site).

Major machinery and equipment to be deployed permanently on site will include the loaders, excavators, haul trucks and water trucks. Other equipment to be deployed on an 'as needed' basis will potentially include bulldozers. 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 on site. Major servicing will be undertaken by specialist service providers and equipment repair will generally be carried out either on site or at Borrow 7 quarry. Refuelling of mobile plant will be undertaken onsite on a hardstand area.

3.4.10 Storage of Fuels, Lubricants and Chemicals

Fuel storage on site will be in a self banded 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.

All minor fluids and chemicals will be stored at the Moray Quarry which will form the base for the North Creek Quarry operations.

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 be trucked in and stored in a 25,000 L water tank on site for drinking and ablutions operation. On site water for construction and dust suppression will be captured on site from stormwater in retention dams and reused on site where possible.

3.4.12.2 Sewage and Waste Water Management

Waste water will be treated in portable treatment plants comprising modular units with a treatment capacity of less than 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 a 10 EP work force on site will produce a maximum of 500 L per day. The sub-surface irrigation will be physically separated from any work area in a suitable location.

The on site system is not required to have licensing under the *Environmental Protection Act 1994* 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 Australian Standard (AS) 1547.200 - 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 North Creek Quarry will be provided by three industry recognised COMBILITE. The COMBILITE features four 1500W 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 and 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 onsite 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 contractor for recycling. Oils, greases and waste fuels from machinery servicing will be collected and securely stored in a bunded area prior to disposal to a licensed refuse site or recycling agency.

3.4.15 Workforce

There will be approximately 2–4 full time employees onsite 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 North Creek Quarry. Employees will use the rail haul road or Moray Carmichael Road where possible to access the North Creek 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. Local contractors, businesses and utilities will benefit from activities during the quarry operation.

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, comment structures, 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:

- Type of operation;
- Site hazards;
- 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

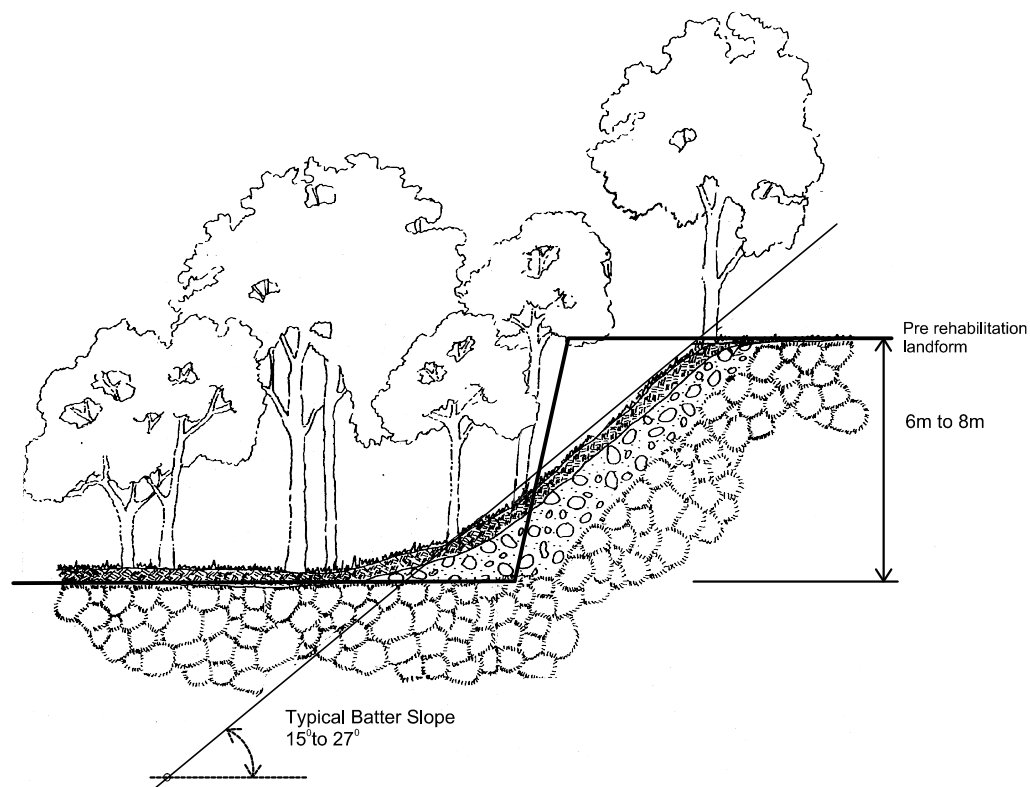
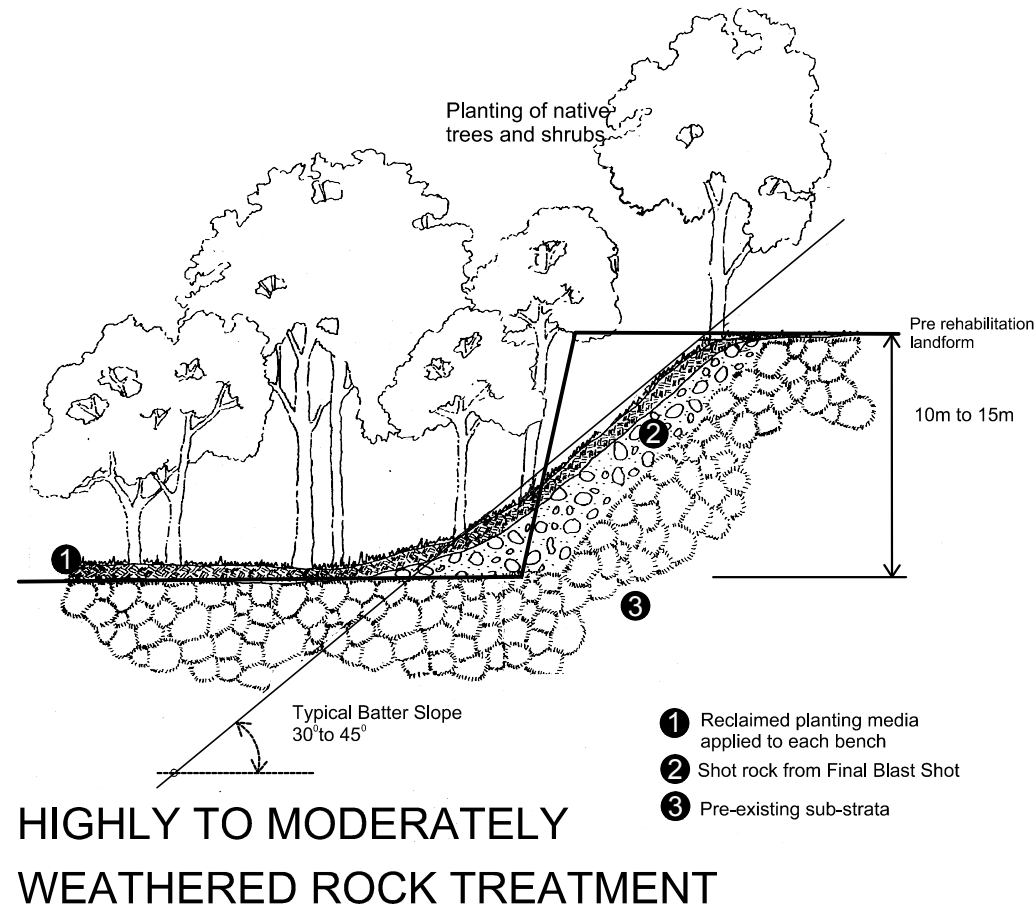
Landscaping of the site is not considered necessary given the rural nature of the location. Visual amenity impacts to the public are likely to be minimal as stockpiling will act to visual screen the operations from the Bulliwallah Road. Due to the short duration of the quarry, planting vegetation as 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. A staged and progressive rehabilitation program has been included in the quarry development plan to ensure the minimum disturbed area is open at any time.

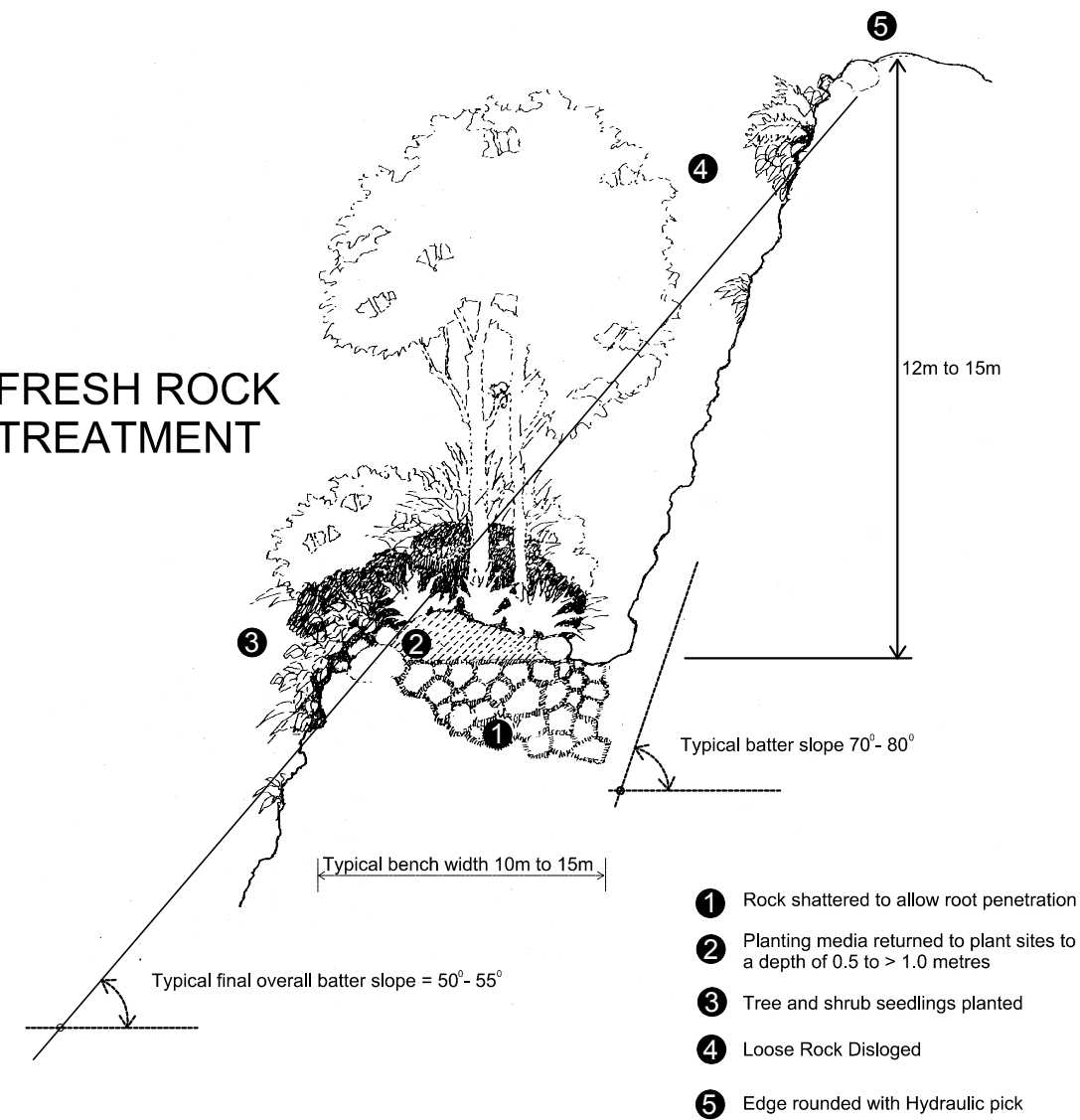
Any remaining open extraction areas will be rehabilitated and better treatments applied to all benches in accordance with Figure 3-2 and Figure 3-3. The following rehabilitation methods will be applied:

- 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 no void left as land will be reprofiled to the gully contour;
- Permanent erosion and sediment controls will be designed to provide long-term stability to the disturbed area;
- Reinstatement of 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.



FRESH ROCK TREATMENT



FILE NAME: F:\Jobs\1603\1603_Wagner_Adeli_Carmichael\000_Generics\Drawings\1603_099_Batter_Treatments.dwg
JOB SUB #
CREATED: 25 June 2013

REV	DESCRIPTION	DATE	BY

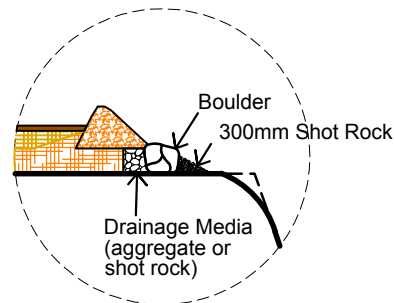
Data Sources:

Photography:	
Topography:	
Cadastral:	
Ecosystem:	
Other:	

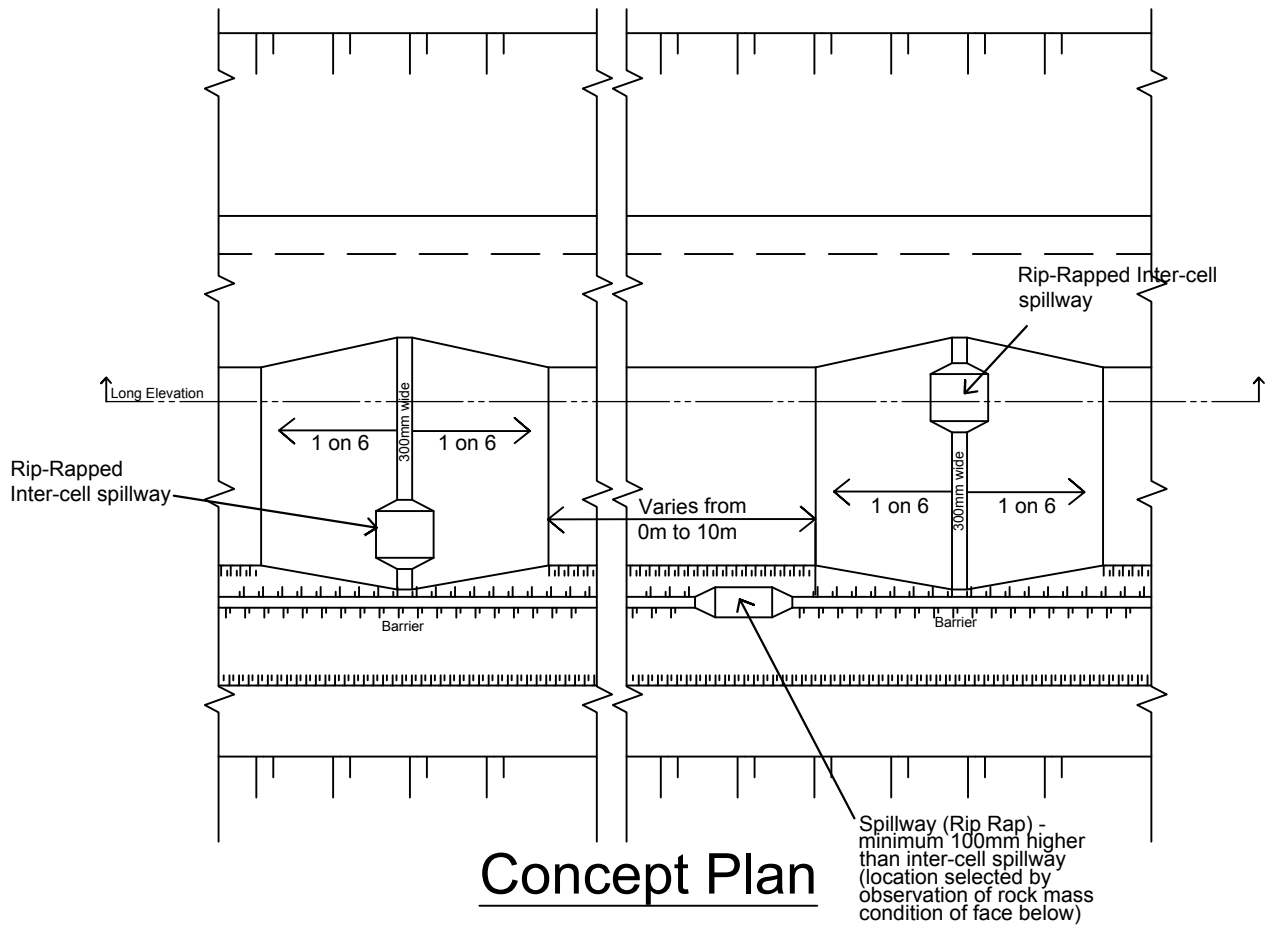
THESE DESIGNS AND PLANS ARE COPYRIGHT AND ARE NOT TO BE USED OR REPRODUCED WHOLLY OR IN PART OR TO BE USED ON ANY PROJECT WITHOUT THE WRITTEN PERMISSION OF GROUNDWORK PLUS. A/N: 80 829 145 908

Legend:

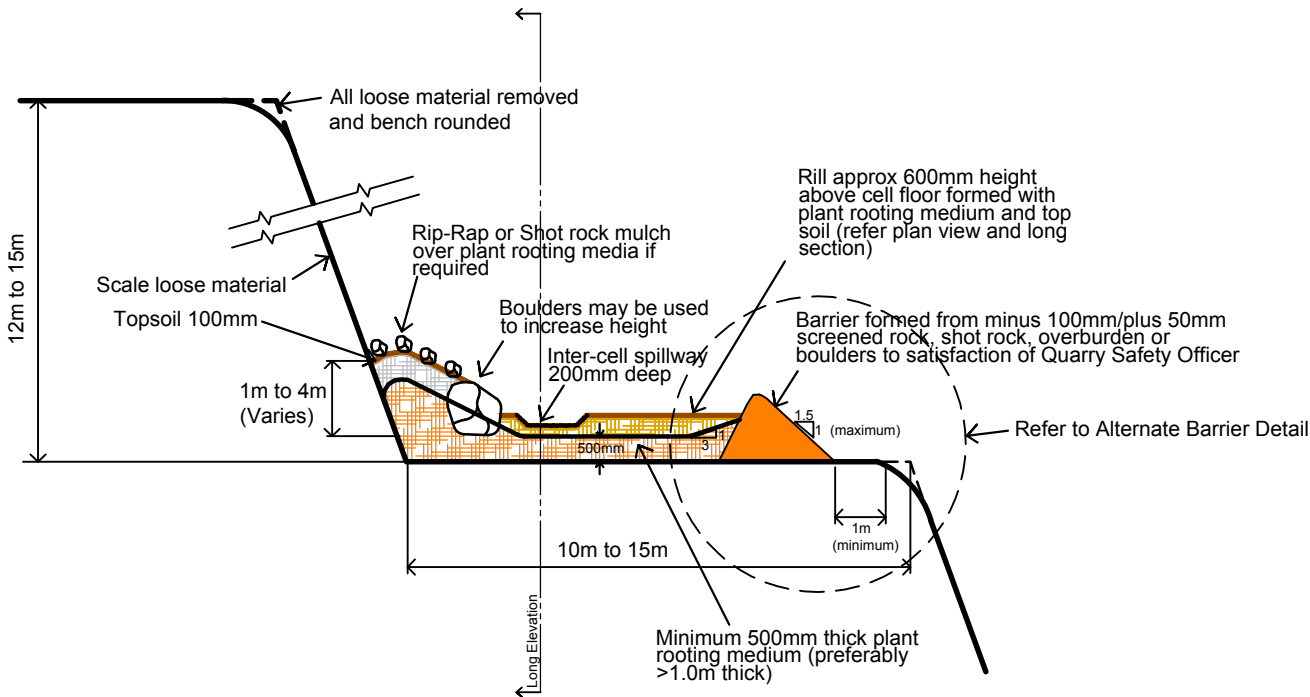
PROJECT:	North Creek Quarry	TITLE:	Figure 3-2 Batter treatments
CLIENT:	Wagner Quarries Pty Ltd	GROUNDWORK plus	DRAWING NUMBER: 1603.099
PH: +61 7 3871 0411	DATE: 25 June 2013	DRAWN:	REVISION:
WWW.GROUNDWORK.COM.AU	PRINTED: 25 June 2013	CHECKED:	DATE: 25 June 2013



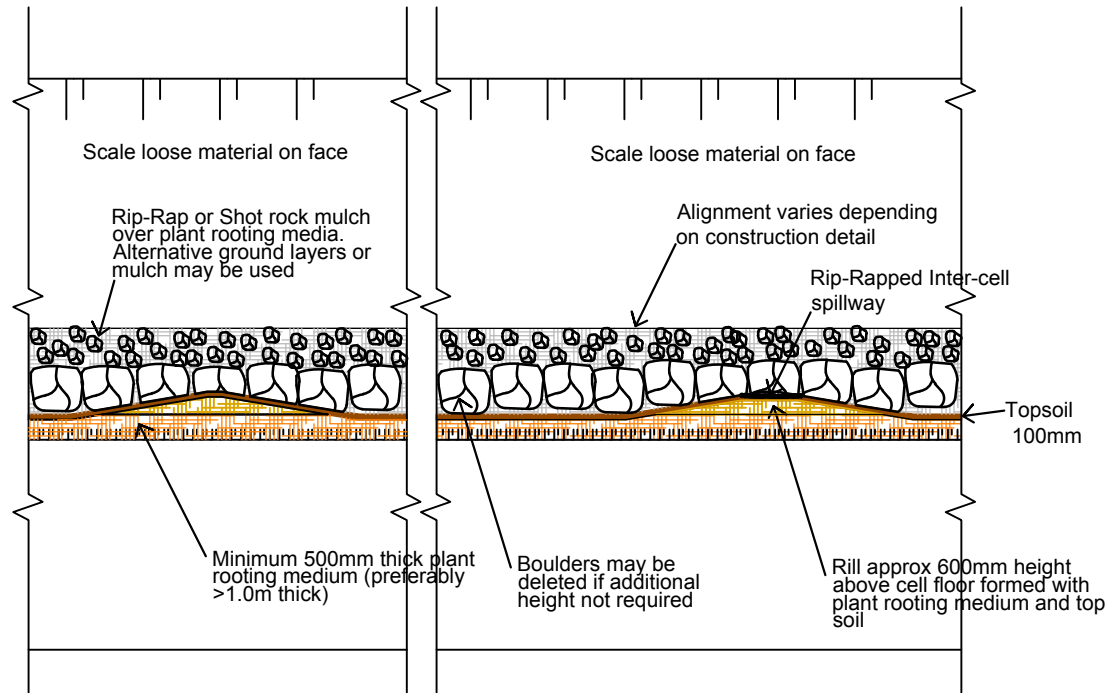
Alternate Barrier Detail



Concept Plan



Concept Cross Elevation



Concept Long Elevation

FILE NAME: F:\Jobs\1603\1603_Wagner_Acacia_Carmichael\000_General\Drawings\1603_100_schematic Bench Rehab.dwg
JOB SHEET #
CREATED: 25 June 2013

REV	DESCRIPTION	DATE	BY

Data Sources:
Photography:
Topography:
Cadastral:
Ecosystem:
Other:

THESE DESIGNS AND PLANS ARE COPYRIGHT AND ARE NOT TO BE USED OR REPRODUCED WHOLLY OR IN PART OR TO BE USED ON ANY PROJECT WITHOUT THE WRITTEN PERMISSION OF GROUNDWORK PLUS. ADM: 80 829 145 906

Legend:

PROJECT: North Creek Quarry	TITLE: Figure 3-3 Schematic of quarry bench rehabilitation
CLIENT: Wagner Quarries Pty Ltd	<div> <div>GROUNDWORK plus</div> <div> SCALE: 1:150 When Printed On A3 DATE: 25 June 2013 PRINTED: 25 June 2013 </div> </div>
	<div> <div>DRAWING NUMBER: 1603.100</div> <div> REVISION: / / DATUM: HORIZONTAL / VERTICAL / ZONE </div> </div>

Section 4 Environment and Management

4.1 Terrestrial Ecology

The North Creek Quarry site occurs within an agricultural area primarily used for cattle grazing. As a result of historic and current grazing and quarry activities, the extent, connectivity and ecological integrity of vegetation communities and the fauna habitat they provide, has been altered significantly from the natural state. The North Creek Quarry area has been cleared in the past and only sparse regrowth trees remain. A minor tributary of the Belyando River lies adjacent to the southern boundary of the proposed quarry area.

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 Regional Ecosystems (RE) (Sattler and Williams 1999). Biodiversity loss is widespread and affects most areas of the region to varying degrees (Dight, 2009).

The vegetation in the wider area is dominated by eucalypt woodland with some patches of *Acacia* forest. The vegetation on the quarry area is largely cleared with scattered regrowth over a dense grass layer dominated by the introduced Buffel Grass (*Cenchrus ciliaris*) (Plate 4-1). As a result there is little habitat suitable for fauna in general available on the site. There is no mapped remnant vegetation on the site or adjacent to the site. The nearest mapped remnant vegetation is approximately 850 m south of the quarry area and will not be impacted by quarry activities (Figure 4-1).



Plate 4-1: North Creek Quarry site - view north showing previous disturbance and scattered regrowth

4.1.1.1 Flora Species

The Commonwealth Government EPBC Protected Matters search results indicate 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 Protected Matters search results indicated *Acacia ramiflora* (listed as Vulnerable) is likely to occur within the area. This species occurs in woodland on sandstone hills (SEWPaC 2013). Sandstone does not occur on the site and there is no suitable habitat for this species.

The Queensland Government EHP Wildlife Online search (**Appendix C**) lists 103 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). The field survey confirmed the presence of the following listed least concern species in low numbers: Ironwood (*Acacia excels*), Current Bush (*Carissa ovate*), Coolabah (*Eucalyptus coolabah*), Emu Bush (*Owenia acidula*) and Dogwood (*Erythroxylum austral*).

4.1.1.2 Weed Species

According to the EPBC Protected Matters search tool, the following four weeds of national significance 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 North Creek survey area: Buffel Grass (*Pennisetum ciliare*) and Rhodes Grass (*Chloris gayana*). Neither of these species is listed under the LP Act or as weeds of national significance.

4.1.1.3 Fauna Species

The desktop assessment of database records indicated the possible 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 database search tool 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 results are provided in Table 4-1, 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 D**.

Table 4-1 Protected Matters Search results for with respective field observations

Species	EBPC Act Status	Potential Habitat	Field observation
Birds			
<i>Erythroriarchis radiatus</i> (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
<i>Geophaps scripta scripta</i> (Squatter Pigeon)	Vulnerable	Occurs in dry woodland. Generally on sandy soils close to water.	Potential - Observed on two occasions in general area. May forage in quarry area.
<i>Peophila cincta cincta</i> (Black-throated Finch - southern)	Endangered	Occurs in grassy open woodlands near water. Prefers areas of intact woodlands.	Unlikely - No suitable habitat.
<i>Rostratula australis</i> (Australian Painted Snipe)	Vulnerable, Migratory	Prefers temporary shallow wetlands. Nests in freshly flooded wetlands with low vegetation.	Unlikely - No suitable habitat.
Mammal			
<i>Phascolarctos cinereus</i> (Koala)	Vulnerable	Occurs in a variety of eucalypt woodlands and open forest.	Unlikely - Habitat cleared.
Reptiles			
<i>Denisonia maculata</i> (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.
<i>Egernia rugosa</i> (Yakka Skink)	Vulnerable	Occurs in a variety of dry sclerophyll woodlands largely in the Brigalow Belt. Constructs burrows in a variety of soil types.	Unlikely - Habitat unsuitable
Migratory Marine Birds			
<i>Apus pacificus</i> (Fork-tailed Swift)	Migratory	Aerial foraging species that occur over a variety of landscapes including highly modified environments.	Potential
<i>Ardea alba</i> (Great Egret)	Migratory	Eastern Great Egret occurs on a variety of wetlands and intertidal habitats.	Unlikely - Observed in general area.
<i>Ardea ibis</i> (Cattle Egret)	Migratory	Cattle Egret prefers damp grassy areas for feeding, particularly pasture.	Potential - Potential to occur in area however quarry site is unsuitable
<i>Gallinago hardwickii</i> (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			
<i>Haliaeetus leucogaster</i> (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 - Habitat unsuitable
<i>Merops ornatus</i> (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. Nest burrows likely to be of this species detected in artificial dirt mounds on quarry site.

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 areas or surrounds during the site inspections:

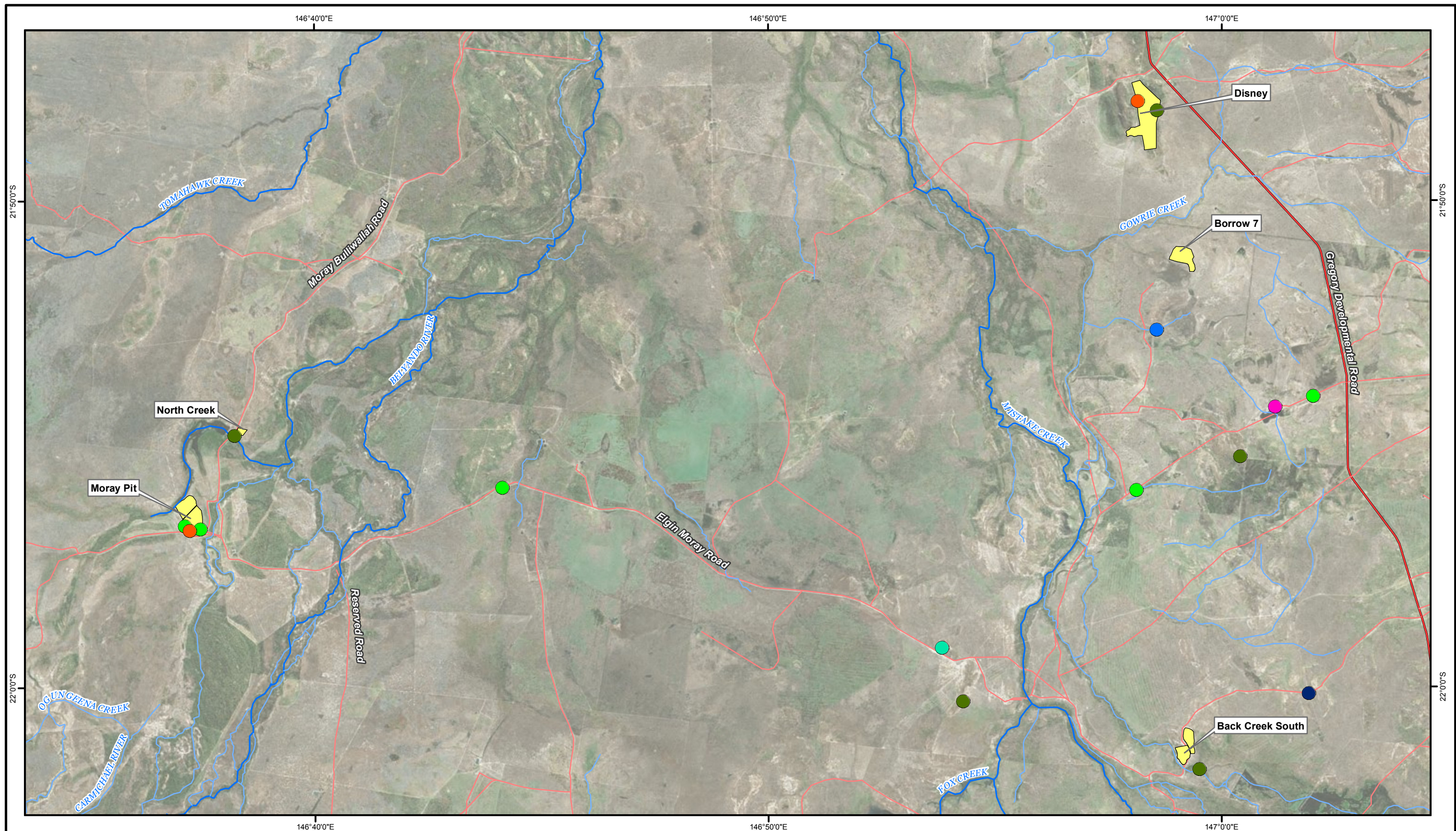
- Cotton Pygmy-goose (*Nettapus coromandelianus*) (NC Act – Near Threatened; EPBC – Migratory) – minimum of 30 individuals observed on large farm dam over 30 km east of the proposed North Creek Quarry;
- Squatter Pigeon (EPBC Act and NC Act – Vulnerable) – three individuals observed approximately 10.3 km east of the proposed North Creek Quarry; and
- Ornamental Snake (EPBC Act – Vulnerable; NC Act – Vulnerable) – recorded over 30 km east of the proposed North Creek Quarry.

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

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

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

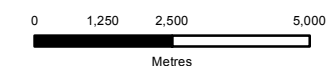
Of the species listed above only potential nesting burrows of Rainbow Bee-eater were detected on the North Creek Quarry site. The remaining species were recorded in the surrounding search area (Figure 4-2).



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

Legend

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



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

adani **CDM Smith**
 cdmsmith.com

4.1.1.5 Protected Areas

Four protected areas are located in the regional area of the proposed North Creek Quarry: Wilandspey Conservation Park; Nairana National Park; Mazeppa National Park; and Epping Forest National Park (Scientific). Nairana National Park lies 26 km north-west of the quarry area. Wilandspey Conservation Park is located approximately 17 km north of the site. Both parks protect extensive tracts of Brigalow woodlands.

Mazeppa National Park is located 70 km south-east of the site and is adjacent to the eastern side of the Gregory Development Road. Epping Forest National Park is located approximately 46 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 (*Lasiornhinus 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 North Creek Quarry may result in the following potential impacts on the terrestrial ecology:

- Temporarily remove existing habitat within the quarry footprint 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

Prior to works occurring, several objectives will be developed in regards to flora and fauna, these will 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.

Despite the lack of clearing required for the North Creek Quarry, pre-clearing surveys will be completed and particularly focus in remaining debris. This will include the following (as a minimum):

- Methods to prevent mortality of native species during pre-construction, construction and operation;
- A commitment that all surveys will be undertaken by suitably qualified persons; and
- Measures to rehabilitate areas that have been disturbed during construction.

This will also ensure:

- 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 daytime 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 Weed Management

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

- Measures for a pre-construction weed audit to 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 off site;
- 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

There are no water bodies within the site. North Creek, a minor tributary of the Belyando River, lies adjacent to the southern boundary of the quarry area. The substrate of the creek line was coarse sand and did not contain any water. It is only likely to flow following heavy rainfall periods. The Belyando River lies approximately 1.5 km east of the quarry area. It is not expected that any drainage line adjacent to, or any habitat on site, would support any aquatic flora or fauna,

The EPBC Protected Matters Search results indicated the potential presence of four Migratory wetland species. No wetland habitat was observed on the site and it is unlikely the site provides any value for these species. The EHP Wildlife Online Search (**Appendix C**) 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). However, the site provides no habitat suitable to the aquatic species, and the closest likely habitat is the Belyando River.

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 mapped wetlands are located close to the quarry area: a lacustrine wetland (farm dam) associated with North Creek direct to the west; and riverine wetland associated with the Belyando River direct to the east.

In accordance with the Burdekin Water Quality Improvement Plan (2009), the site is located within the Belyando Floodplain sub-catchment. Field surveys confirm there was no pooled water on site and no water was observed within the adjacent North Creek (Plate 4-2). 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 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 hill slope 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 shows that the water quality in the Belyando Floodplain sub-catchment contains slightly elevated sediment concentrations and loads during wet season flow events.

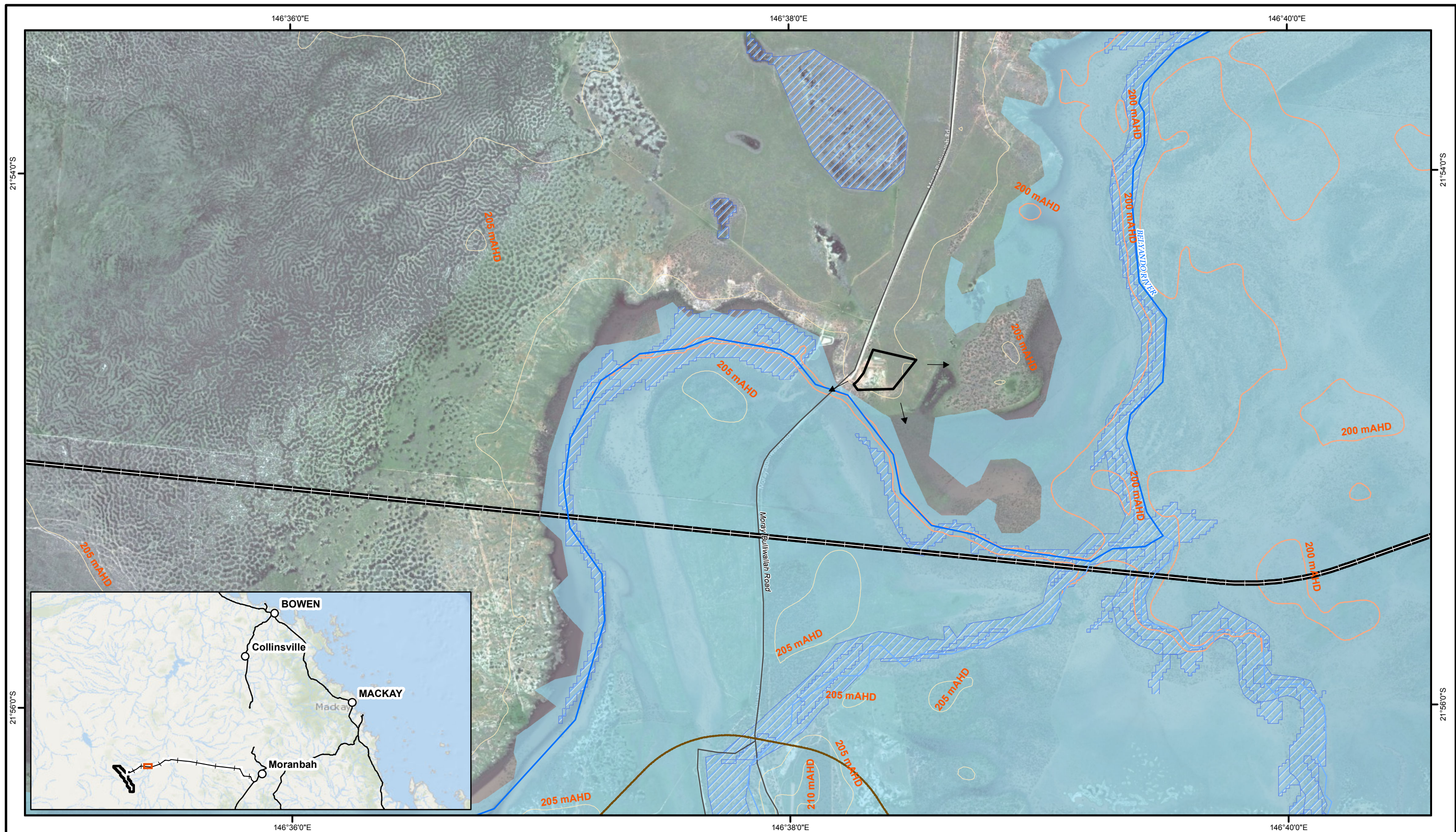


Plate 4-2: North Creek south of the quarry site

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 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.

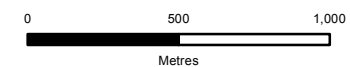
The North Creek Quarry site slopes from an elevation of 207 m AHD at the Bulliwallah Road south towards North Creek at 202 m AHD (Figure 4-3). Surface water runoff will flow down this slope towards the creek; this will be diverted around the site by diversion bunds. Surface water falling within the site will be directed into sediment ponds/water storages for reuse on site. The storages will be located in the northern corner at lowest elevation of the extraction area.



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

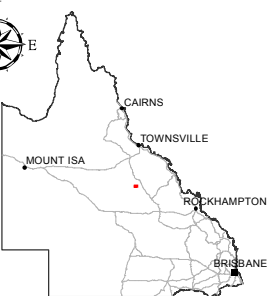
Legend

- | | | | |
|--|------------------------------------|--|---|
| | Carmichael Mine - ML 70441 | | Proposed Moray Road Re-Alignment |
| | North Creek Quarry Extraction Area | | Proposed Adani Rail Corridor |
| | Wetland | | Minor Road |
| | Flood Prone Area (1 in 100 year) | | Major watercourse |
| | | | Minor watercourse |
| | | | Indicative surface water drainage direction |



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; Flood by QLD Reconstruction Authority, 2012, Elevation created from 1sec SRT DEM, Base Layer by Bingmaps, 2011.

adani
CDM Smith
cdmsmith.com



4.2.3 Potential Impacts

The quarry poses no potential impacts to aquatic ecology. 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 storage dams for reuse onsite. 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 (ESCP) in **Appendix E**.

4.2.4 Management of Aquatic Ecology, Surface Water and Hydrology

As mentioned in Section 4.2.1 above, no major watercourses currently exist within the proposed quarry area, however North Creek is located to the south of the site and the Belyando River to the east (1.5 km). 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:

- ESCPs will be implemented prior and during 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.

Stormwater management will include measures to monitor weather forecasts from the BoM 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 property is leasehold and contains direct access to Bulliwallah Road that connects Lot 2 SP119925 to the Moray Carmichael Road (the main access to the surrounding area). The wider landscape consists mainly of remnant sedimentary formations, although granitic intrusions in the form of isolated ranges are also common surrounding the quarry area. Easily eroded cracking clays, with highly dispersive properties due to high sodium content, are common in low-lying areas of the catchment. Previous clearing of vegetation has caused 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 site itself consists of remnant sedimentary soils and rocks and consists of a rise surrounded by lower areas likely formed by run-off associated with the nearby Belyando River. Woody vegetation is very sparse and the area is currently subject to disturbance from cattle grazing and current quarry activities (Plate 4-3).



Plate 4-3: Existing landscape

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 North Creek Quarry site occupies a 'Low' category fire-risk area, although it lies adjacent to 'Medium' category risk areas associated with vegetation along the Belyando River and tributaries. The site has been cleared in the past and is now largely exotic grassland (Buffel Grass) used for cattle grazing.

4.3.2 Visual Amenity Potential Impacts

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

During the night operations there will be impacts from night lighting. With 24 hour operations visual impacts will be predominantly more noticeable at night and will be able to be seen from much greater distances, however is not considered to cause significant impact to any homesteads.

4.3.3 Management of Landscape and Visual Amenity

The proponent commits to ensuring that the placement of plant and equipment minimises its visibility from Bulliwallah Road and the sensitive receptor approximately 4 km to the south of the proposed quarry location.

Management measures to mitigate impacts include:

- Retain appropriate screening and landscape buffers between Bulliwallah Road, public vantage points and surrounding homesteads;

- Minimise clearing between the site and Bulliwallah 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 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. 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 structures 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

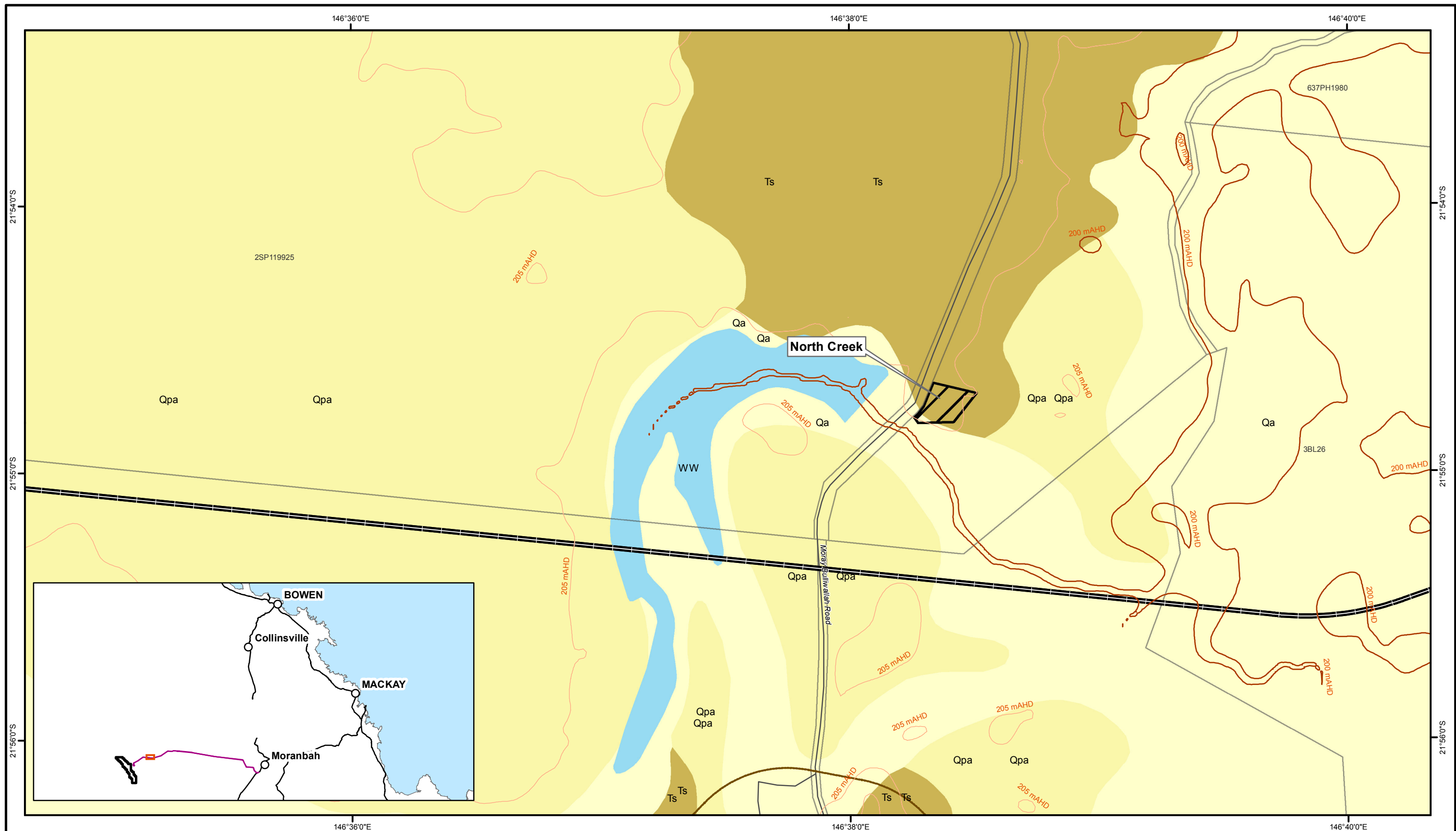
The proposed North Creek Quarry area is located within Late Devonian – Early Carboniferous Drummond Basin, which predominantly comprises of a thick succession of sedimentary and volcano-lithic rocks. The geological profile of the basin is generally comprises sedimentary and volcano-lithic sediments of 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 remains, as they have been masked by Quaternary alluvial deposits. Key geology and structures regional to the North Creek Quarry area is discussed below.

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		Unconformable on all older rocks	Fluvial	
		(Qs)	Superficial	Sand, sandy soil, colluvium			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.
			Bulliwallah Formation (Cib)	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.
			Star of Hope Formation (CIs)	2000	Lapilli tuff, welded tuff, tuffaceous sandstone, minor acid flows; volcanic lithic sandstone; quartz pebbly sandstone and conglomerate.	Plants (White, 1967).	Conformable on Raymond Form.	Fluvial and terrestrial.
			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).
			Mount Hall Formation (CIh)	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		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
			Llanarth Volcanic Member (D/CI)	3200	Dominantly fine tuff. Some thin acid flows and locally at the base volcanic lithic 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.
	PRE-DEVONIAN	Anakie Metamorphics (Pza)		Schist, slate, phyllite, sandstone, shale.	Algae elsewhere (Malone et al., 1965).	Oldest unit in the area.		



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

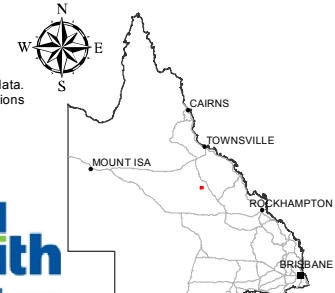
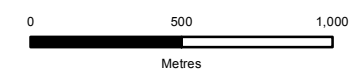
Legend

- Carmichael Mine - ML 70441
- North Creek Quarry Extraction Area
- Property Boundary

- Proposed Adani Rail Corridor
- Minor Road
- Major watercourse
- Minor watercourse

Geology

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



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

adani **CDM Smith**
cdmsmith.com

The North Creek Quarry is located on a topographical low of approximately 200 m AHD, featuring low-lying plains associated with major drainage lines. Consequently, the surficial geology is dominated by alluvial deposits (Figure 4-5). Pleistocene-aged alluvium deposits comprising clay, silt, sand and gravel associated with floodplain alluvium on high terraces are prevalent in areas to the west, east and as pockets to the south. These deposits are overprinted by younger Quaternary-aged alluvium floodplain deposits comprising clay, silt, sand and gravel in areas proximal to drainage lines, the closest one being a meandering tributary of Belyando River, located to the south. Exposures of underlying Tertiary-aged sedimentary deposits comprising clayey sub-labile to quartzose sandstone, sandy claystone, laminated siltstone and minor conglomerate are present on topographical highs (approximately 205 m AHD) to the north and as small lenses to the south on more elevated areas.

Locally, the North Creek Quarry area is located within a meandering tributary of Belyando River and as such is dominated by Quaternary-aged alluvium comprising clay, silt sand and gravels within the low-lying areas present to the south. The majority of the quarry footprint (central and northern portion) area is slightly higher in elevation (~205 m AHD) relative to the southern portion and therefore exposures of Tertiary-aged sedimentary deposits comprising clayey sub-labile to quartzose sandstone, sandy claystone, laminated siltstone and minor conglomerate are present as outcrops.

Current and past quarry activities have removed and stockpiled the bulk of the surface soils and ridge gravels on the site exposing partially lateritised sandstones (Plate 4-4).



Plate 4-4: North Creek Quarry - stockpile of sandstone from recent quarry activities

Rock will be extracted from the 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 California Bearing Ratio (CBR) 15+ standard. The current recoverable volume based on an extraction depth of ten metres, is listed below in Table 4-2. Nevertheless, it is expected that only 603,000 t of this material will be extracted for current infrastructure requirements.

Table 4-2 Anticipated extraction volumes

Density (t/m ³)	Estimated Volume (10 m Extraction Depth)	Tonnes (t)
2.0	1,616,000	3,232,000

4.4.2 Soils

The Geological Survey of Queensland Interactive Resource Tenure Map broadly defines the soils regional to the North Creek 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.

Land use in the Central Queensland area, prior to the recent boom in mining activity has primarily been for agricultural/pastoral purposes, and consequently meaningful information on soils is available from land management studies undertaken for the area. The Queensland Department of Primary Industries (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) (Thwaites and Maher, 1993). LRA are broad landscape units that have 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.

The North Creek Quarry area falls within the Central Highlands (Figure 4-6), which at a regional scale comprises four LRAs. Each LRA, in turn comprises of numerous AMUs. Given that AMUs provide a better description of the productivity potential of the land, AMU's also provide a more rigorous 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.

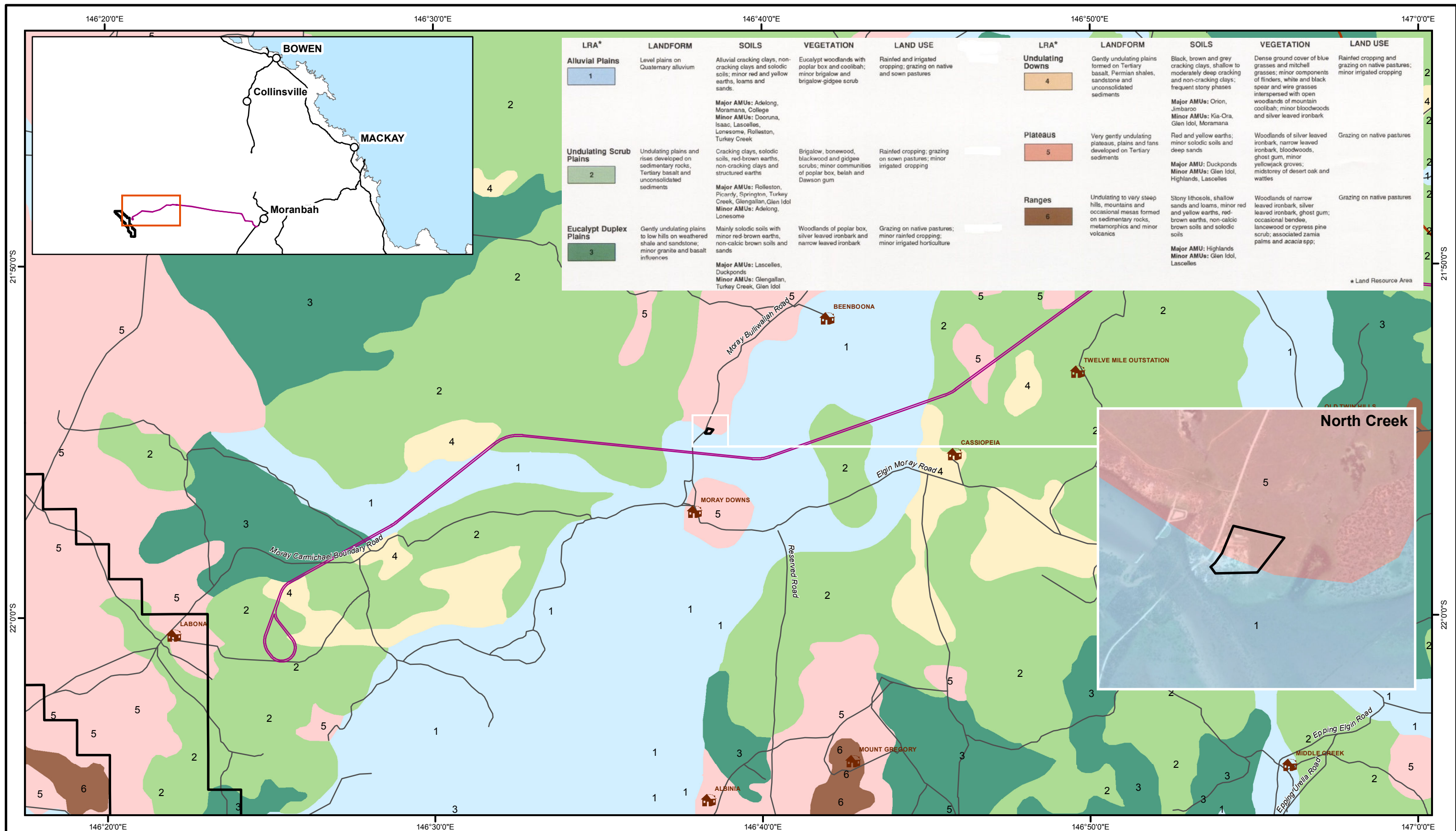
Table 4-3 provides a summary of the common AMUs associated with each LRA for areas regional to the North Creek Quarry. Description of each AMU is provided in Figure 4-6, which shows that the dominant flora type together with surface soils can be used as relatively quick field guide to identify the types of soils present in the area. A description of AMU's regional to the North Creek Quarry.

Table 4-3 Relationship of AMUs to LRAs for North Creek 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 4: Undulating Downs	Orion, Jimbaroo	Kia-Ora, Glen Idol, Moramana
LRA 5: Plateaus	Duckponds	Glen Idol, Highlands, Lascelles

Locally, the North Creek Quarry encompasses an area grouped as LRA 5 and LRA 2. The central to northern portion of the quarry footprint is classed as LRA 5, while the southern portion is grouped as LRA 2 (Figure 4-6). Table 4-4 identifies that numerous AMUs, and hence soil types are present within the area. In addition, it indicates that pockets of different soils are likely to be present that include:

- Uniform clays – non-cracking to heavy cracking with potentially a sandy crust and variable quantity of mulch;
- Duplex soils – hard setting sandy loams;
- Deep uniform sandy soils – loose to firm sand materials; and
- Shallow rocky soils – rock, gravelly or sandy materials.



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

Legend

- Town
- 🏠 Homestead
- ⛛ Carmichael Mine - ML 70441
- North Creek Quarry Extraction Area
- Proposed Adani Rail Corridor
- Railway
- Minor Road
- Major Road
- Major watercourse
- Minor watercourse

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.

adani **CDM Smith**
cdmsmith.com



Table 4-4 Description of Agricultural Management Units regional to the North Creek Quarry

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.	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	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 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 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 4 – Undulating Downs	Uniforms Clays	Orion	Strong, often coarse self-mulching but thin (about 2mm)	Dark reddish to brown heavy clay which is well structured and greater than 45 cm deep to parent rock. Open downs country with scattered ironbark, coolabah and bloodwood. Areas of surface stone occur.
		Jimbaroo		As for ORION AMU, but less than 45 cm to parent rock. Surface stone common
		Kia-ora	Strong, finer and deeper self-mulch (~4-5 mm) than above; often forms a thin, fine sandy crust	Moderately deep black heavy clay downs country. Greater than 45 cm depth and commonly 1.0 to 1.4 m to parent rock. Well structured subsoils.
		Moramana	Medium cracking clay with finer and deeper (2 to 5 mm) self-mulch than the above	Deep reddish brown to grey clay under open coolabah. Well drained. Commonly river deposited material. Shallow gilgai can occur

LRA	General Soil Type	AMU	Soil Surface/Description	Distinguishing Features
	Shallow, uniform non-cracking clay or Duplex soils	Jimbaroo	Firm to hard setting, often stony	Shallow (<45 cm). Texture contrast or uniform clay soils associated with open downs. Commonly reddish brown colour
	Duplex Soils	Glen Idol	Sandy, loam, hard setting	Reddish brown sandy loam to clay loam with ironbark, brigalow or box. Usually no bleach or mottling. Often gravelly surface. Clay subsoils are moderately well drained although quite hard when dry
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 North Creek 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 Duckponds	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 soils	Duckponds	Very low fertility; Excessive regrowth ; Low to medium plant available water capacity (PAWC) (ability of the soil to retain moisture for use by crop or pasture within rooting zone; Sensitive recharge area for groundwater
Shallow rocky soils	Highlands	High infiltration and permeability; Very low PAWC; Restricted effective rooting depth; Medium water erosion hazard

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. If sodic soils are identified onsite, Gypsum may applied to assist in the management of the 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 purpose of managing 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 quarry ESCP and 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 onsite and in a good re-usable condition (GHD, November 2012).

A conceptual ESCP has been prepared by a suitable qualified professional (**Appendix E**) and the additional management measures will be undertaken, as a minimum:

- Site water will be directed into water storage dams for use on site, clean water will be diverted away from the site;
- Measures to limit the area of disturbance and progressively clear areas immediately before construction;
- Minimise the period soils are left exposed during construction;
- Material stockpiles will have silt fences or established bunds installed on the downstream side, and diversion bunds on the upstream side;
- Topsoil stockpiles to be stored for long periods of time (e.g. for longer than one month), will have permanent measures put into place such as grassing; and
- Placement of sediment traps and silt fences to minimise off site impacts.

On site 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;
- 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 North Creek 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 North Creek 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, 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 has not been considered to 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 mapping the following hydrostratigraphic units are delineated beneath and within the vicinity of the North Creek Quarry:

- Unconsolidated Sediments – comprising unconsolidated alluvium, 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 6.5 km of the quarry to the south. These include RN 12030085, located approximately 3.5 km south-west and RN 12030086, 12030087, 12030088 and 12030089 located approximately 6 km south to south-east of the quarry. The borehole logs indicate at least 23 m of alluvium at RN 12030085 and 54.4 m at RN12030089. 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 the depth to the top of Tertiary sediments and Carboniferous bedrock to be 35.6 to 60 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 active water resources investigation bore (12030089) located 6.2 km to the south-east of the site. There are no active water extraction bores within 10 km of the quarry. Table 4-6 outlines all the registered bores within 10 km of the North Creek Quarry.

Table 4-6 Groundwater bore details within 10 km of North Creek Quarry

Registered Number (RN)	Type	Distance from Quarry	Depth (SWL) ⁽¹⁾	Target Aquifer and comments
12030085	Abandoned sub-artesian Monitoring Bore	3.75 km south east	12.22 mbgl	Belyando River Alluvium, Water reported within bore. Aquifer sits 13.5 to 16.9 mbgl.
132303	Abandoned and destroyed	4.8 km south east	-	Bore drilled to 92 m
12030087	Abandoned sub artesian Monitoring Bore, still useable	5.5 km south east	-	Belyando River Alluvium, Dry bore, Aquifer sites 9 to 11.4 mbgl. Bore drilled to 12.5 mbgl.
12030086	Abandoned sub artesian Monitoring Bore, still useable.	5.5 km south east	-	Belyando River Alluvium, Dry bore, Aquifer sites 10.1 to 11.8 mbgl. Bore drilled to 13.9 mbgl.
12030088	Abandoned sub artesian Monitoring Bore, still useable.	5.5 km south east	-	Belyando River Alluvium, Dry bore, Aquifer sites 9.8 to 11.4 mbgl. Bore drilled to 13.9 mbgl.
12030089	Active Water Resources Investigation Bore	6.2 km south east	11.3 mbgl	Belyando River Alluvium, Aquifer sites 11.9 to 12.6 mbgl. Bore drilled to 73.1 mbgl.

(1) Standing Water Level

It should be noted that prior to 1998 there was no requirement for registration of private bores. 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 are available within the quarry area. The nearest registered bore with yield data is RN 90368, located approximately 12 km south-west of the quarry 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, RN30176, with a recorded yield of 11 L/s. This is an abandoned and destroyed water supply bore located approximately 12 km west of the North Creek Quarry and installed within the bedrock.

4.5.1.5 Groundwater Flow Regime

Groundwater depth measurements are available from three bores constructed in the Quaternary alluvium and within 6 km to the south of the North Creek Quarry. Depth to water in the bores ranges from 11.3 mbgl to 15 mbgl. 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 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 North Creek 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 there are no reported spring complexes within the surrounding area. The nearest listed springs are the Doongmabulla Springs, which are listed under the Directory of Important wetlands and located approximately 45 km south-west from the North Creek Quarry.

4.5.1.7 Groundwater Dependant Ecosystem

The National Atlas of Groundwater Dependent Ecosystems (GDE) (BOM, 2013) presents the current knowledge of GDEs across Australia, and shows known GDEs as well as ecosystems that potentially use groundwater. The mapping indicates zones of low potential to support groundwater dependent vegetation within the quarry area, however no GDEs were identified in the North Creek Quarry area through previous field investigations. Areas along North Creek and

the Belyando River to the east have been identified as areas with high potential to support groundwater dependent vegetation (BOM, 2013). Aerial photos show areas of denser vegetation along the Belyando River where high potential for GDEs has been identified.

The Carmichael Coal Mine and Rail EIS 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 base-flow occurs, albeit at reduced rates during dry periods. On this basis, 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 is 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 ($\mu\text{S}/\text{cm}$) with EC of up to 15,500 $\mu\text{S}/\text{cm}$ recorded at RN 12030175, located approximately 19 km south-east of the North Creek Quarry. One EC measurement of 373 $\mu\text{S}/\text{cm}$ is available from the Tertiary sediments at RN 17980, located more than 35 km west of the quarry. No water quality data is available from the alluvium; however, it is expected to vary spatially and temporally due to the influence 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 3.4.3.

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 sourcing from an existing water supply. Any alternative water supply options will be permitted separately and are not discussed herein.

4.5.2 Potential 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. It is understood that the proposed quarry depth is approximately 10 mbgl, which gives quarry base elevations of 193 to 197 m AHD. 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 Management Measures

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;
- Protection and maintenance of integrity of surrounding bores;
- Protecting the quality of existing groundwater resources; and
- Ensuring the development does not impact values associated with GDEs.

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 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 2 SP119925. 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 Disney Homestead to allow the incremental impact of the quarry to be assessed against the existing regional background pollutant concentrations.

The existing levels of particulate matter were monitored at Disney Homestead between 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 the background particulate matter with a diameter of 10 micrometres or less (PM₁₀) concentration to be 10 micrograms per cubic metre (µg/m³), which is the 70th Percentile.

The PM₁₀ 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 Total Suspended Particulates (TSP). The Australian Coal Review states that an average of 40% of TSP was found to consist of particles in the size range of PM₁₀. Particles in the size range of PM_{2.5} were found to comprise only 4% of TSP or equivalently 10% of PM₁₀.

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

- Annual average concentration of TSP of 30 µg/m³;
- 24-hour average concentration of PM₁₀ of 10 µg/m³;
- 24-hour average concentration of PM_{2.5} of 1 µg/m³; and
- Dust deposition of 50 milligrams per square metre per day (mg/m²/day).

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

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 PM₁₀ and PM_{2.5}. The most critical of these is the PM₁₀ criterion as the fraction of PM_{2.5} against PM₁₀ emissions from extraction operations is small (typically less than 10%).

Deposited dust is commonly used as a measure of the potential for dust nuisance, and high levels can reduce the amenity of an area. No formal criteria for dust deposition exist within Queensland, however, EHP has recommended a nuisance guideline of 120 mg/m²/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. The closest noise and/or vibration source to the proposed North Creek Quarry site would be the Bulliwallah Road, adjacent to the site.

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 North Creek Quarry has been prepared identifying potential impacts and is provided in **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 61,391 million tonnes will be extracted. This rate was modelled for the duration of a year 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 receptors to the proposed quarry are Moray Downs Homestead approximately 4 km to the south and Beenboona Homestead 8.8 km to the north-east. The Moray Downs homestead is likely to be screened from the quarry operations by vegetation corridors lining North Creek and an anabranch of the Belyando River lying between the two areas.

The modelled TSP, PM₁₀, PM_{2.5} and dust deposition results for the Moray Downs Homestead and Beenboona Homestead are detailed in Table 4-8 and Table 4-9 respectively.

Table 4-8 Modelled quarry dust results at Moray Downs receptor

Pollutant	Background Levels	Quarry Related Activities	Total	Criteria	Compliance
Dust Deposition (mg/m ² /day)	50	4.14	54.14	120 mg/m ² /day (30 days)	Yes
TSP (µg/m ³)	30	0.62	30.62	90 µg/m ³ (1 year)	Yes
PM10 (µg/m ³)	10	3.55	13.55	50 µg/m ³ (24 hour)	Yes
PM2.5 (µg/m ³)	1	1.71	2.71	25 µg/m ³ (24 hour)	Yes

Table 4-9 Modelled quarry dust results at Beenboona receptor

Pollutant	Background Levels	Quarry Related Activities	Total	Criteria	Compliance
Dust Deposition (mg/m ² /day)	50	0.51	50.51	120 mg/m ² /day (30 days)	Yes
TSP (µg/m ³)	30	0.02	30.02	90 µg/m ³ (1 year)	Yes
PM10 (µg/m ³)	10	0.53	10.53	50 µg/m ³ (24 hour)	Yes
PM2.5 (µg/m ³)	1	0.22	1.22	25 µg/m ³ (24 hour)	Yes

VIPAC's monitoring and modelling of air quality indicates that even in the worst case scenario during peak production the operations will be compliant with required air quality standards. It was noted that the highest contributor to emissions is from pit activities. Emissions from the haul road are predicted to be minimal due to only one truck operating at a time. This assessment is based on the worst case scenario which occurs for one month (September 2014). The following month will be similar although the scheduled extraction rate is slightly less (approximately 60,000 t in October 2014). It can therefore be concluded that the impacts predicted are conservative.

4.7.4 Cumulative Impacts

Activities at Moray Quarry will also be occurring during the operation of North Creek Quarry. Moray Quarry is located 1.3 km north-west of Moray Downs Homestead. Peak production output is scheduled to occur at the same time for both quarries (September 2014). The modelled cumulative impacts of both quarries including background dust levels are detailed in Table 4-10. It can be seen that the predicted cumulative impacts of both quarries (including background dust levels) comply for both Moray Downs and Beenboona sensitive receptors.

Table 4-10 Cumulative impacts of North Creek and Moray Quarries

Pollutant	Cumulative concentrations of North Creek Quarry, Moray Quarry and background dust levels on sensitive receptors		
	Moray Downs	Beenboona	Criteria
Dust Deposition (mg/m ² /day)	86.57	51.3	120 mg/m ² /day (30 days)
TSP (µg/m ³)	56.13	30.05	90 µg/m ³ (1 year)
PM10 (µg/m ³)	42.27	11.46	50 µg/m ³ (24 hour)
PM2.5 (µg/m ³)	23.65	1.77	25 µg/m ³ (24 hour)

4.7.5 Air Quality Management

Air quality and dust management measures will be included and 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 (>2 litres per square metre per hour (L/m²/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 (~4 L/m²/hr) is to be adopted or operations reduced or ceased;
- Restriction of the speed of onsite 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 rapidly 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 is Moray Downs Homestead on Moray Carmichael Road approximately 4 km to the south. This residence is likely to be screened from the quarry operations by vegetation corridors lining North Creek and an anabranch of the Belyando River lying between the two areas (Figure 1-1). 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.

Winds occur predominantly from the north-east during spring and summer, often no greater than 5 metres per second (m/s) (18 km/hr). In autumn and winter, the dominant winds occur from the south-east with the highest wind speed of 8 m/s (28 km/hr) Figure 4-7 shows the annual wind rose for the local area. 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).

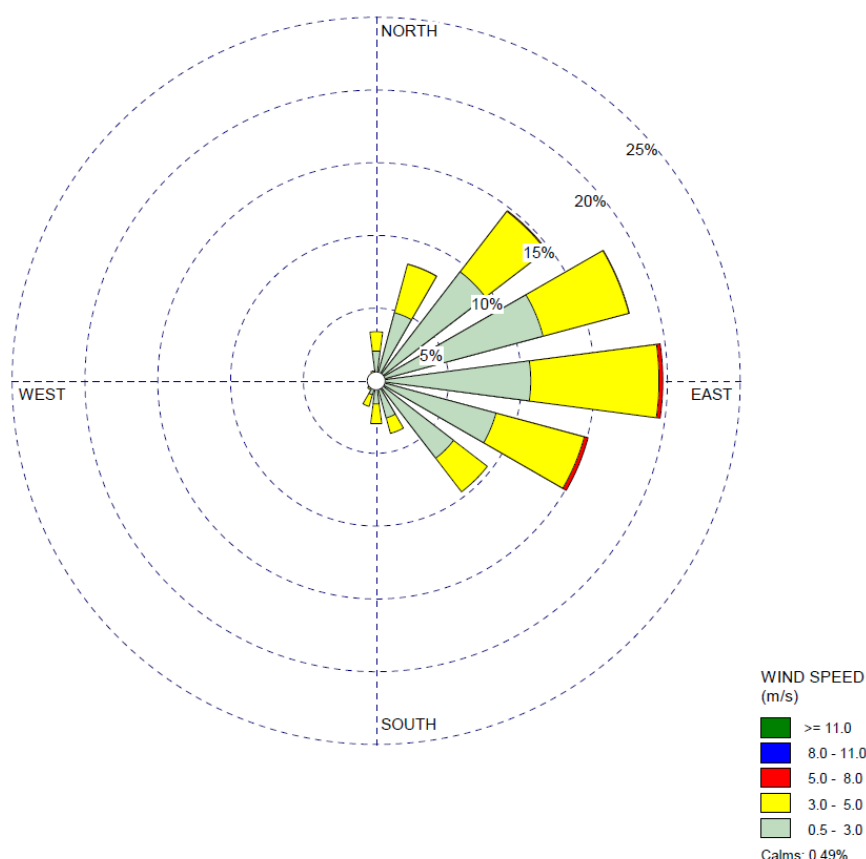


Figure 4-7 Annual wind rose for local area (source CSIRO 2006)

The existing noise environment has been determined through unattended ambient noise monitoring between 27 March and 4 April 2013. The noise monitoring location is identified as Moray Downs Receptor.

Table 4-11 provides the noise monitoring results for all of the days captured at each location. It should be noted that the noise monitoring location is a free-field position near the Moray Downs homestead. The noise monitoring data for individual days is shown in tabulated and graphical form within the full Noise Impact Assessment provided in **Appendix I**.

Table 4-11 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
$L_{Aeq, 1 \text{ Hour}}$ (Max)	53.4	46.5	48.1
L_{A90} (Average)	30.6	36.8	27.0
L_{Amax} (24 hour)	79.0		
L_{A90} Average (22:00–6:00)	27.2		
L_{A10} Average (06:00-00:00)	44.3		

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) outlines these acoustic quality objectives as shown in Table 4-12.

Table 4-12 EPP (noise) acoustic quality objectives for dwellings

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

(1) The A weighted equivalent noise level measured in decibels over a period of 1 hour and adjusted for tonality.

The acoustic quality objective applicable to this quarry 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 on site 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 North Creek Quarry.

The worst-case scenario, or maximum monthly output of 61,391 t extracted and hauled from the site is expected to comply with the external night time noise criteria of 37 dB(A) during stable weather conditions. The highest noise level is predicted to be 22 dB(A) at the Moray Downs receptor for September 2014 when the extraction rate is scheduled to be at 61,391 t. Extraction rates in October 2014 are scheduled to be slightly less (approximately 60,000 t). This represents the peak production which will occur for 9.52% of the quarry life. Approximately 230,000 t will be extracted over the first four months of operation (19% of the overall operating time). The remaining time scheduled production will be less than 41,000 t per month which is considerably less than the modelled noise impact.

The modelling shows the predicted night time noise levels for the combined extraction activities and haulage during the peak production rate month will be 22(dB $L_{Aeq, 1\text{hour}}$) at the Moray Downs Homestead. This is in compliance with the proposed external noise criteria of 37 (dB $L_{Aeq, 1\text{hour}}$). Figure 4-8 shows the noise impact profile for the combined quarry and haulage activities at the North Creek Quarry 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 been achieved at all receptors during peak output in stable conditions. During unstable weather conditions the noise level is predicted to increase up to 30 db(A) at the Moray Downs receptor, which remains in compliance with the proposed noise criteria.

This impact and modelling is based on no noise mitigation measures in place. A number of noise mitigation measures will be installed at the quarry to ensure noise impacts are further reduced.

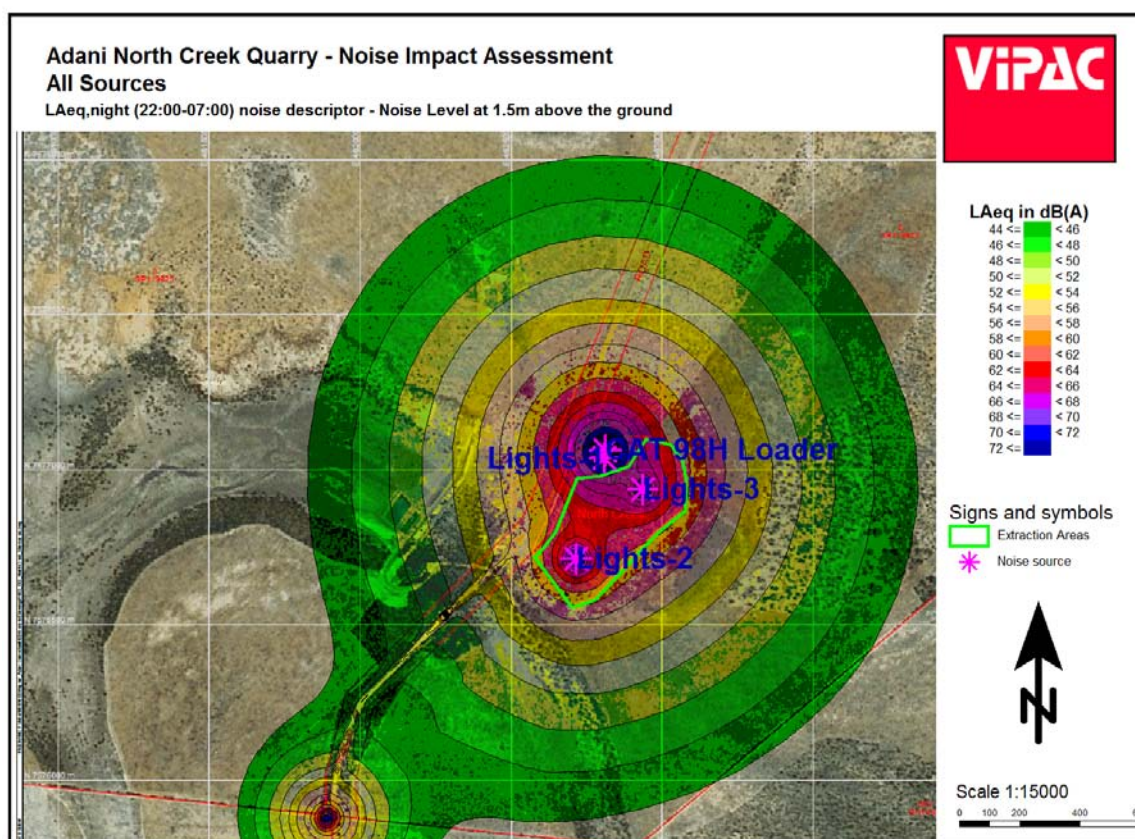


Figure 4-8 Predicted noise impact profile - North Creek (VIPAC 2013)

4.8.4 Cumulative Impacts

Quarrying activities will be occurring at other quarry sites at the same time including Moray, North and Back Creek Quarries. The distances between North Creek and two of the quarries is considerable. However, Moray Quarry is located 2.8 km south of North Creek Quarry and 1.3 km from Moray Downs Homestead. Peak extraction rates from North Creek and Moray Quarries are scheduled to occur during the same period (September 2014). Table 4-13 shows the predicted cumulative noise levels at Moray Downs receptor during both neutral and adverse weather conditions.

Table 4-13 Cumulative $L_{Aeq,adj,1hr}$ noise impacts from all quarries at Moray Downs receptor

Weather conditions	Extraction activities only	Haul roads only	Combined noise levels
Neutral	44	37	45
Adverse	47	40	47

The day-time $L_{Aeq,adj,1hr}$ (indoor) noise criteria (adjusted to 42db(A)) is marginally exceeded by 3db(A) at Moray Downs Homestead during stable weather conditions and night-time noise criteria are exceeded by 8db(A). During adverse weather conditions the day-time noise criteria is exceeded by 5db(A) and night-time noise criteria by 10db(A). The major contributor of noise emissions resulting in the exceedance is Moray Quarry. North Creek noise emissions only contribute 0.03db(A) to the overall noise level. The noise emissions from Moray Quarry are referred to in a separate application. Nevertheless, Moray Downs Homestead has been acquired by the proponent and is likely to be removed or minimally used during the operational period of North Creek and Moray Quarries.

4.8.5 Noise Management

Noise predictions indicate that cumulative noise levels (largely from North Creek and Moray Quarries) may exceed noise criteria at the Moray Downs homestead, however as noted above the homestead is owned by the quarry proponent.

Noise management measures will be included, and 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 that, whilst ensuring 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 only be carried out in the event of a complaint and upon formal request from, the regulatory authority to ensure mitigation measures are effective in maintaining noise below the noise limits.

4.9 Traffic, Transport and Site Access

4.9.1 Traffic and Transport requirements

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

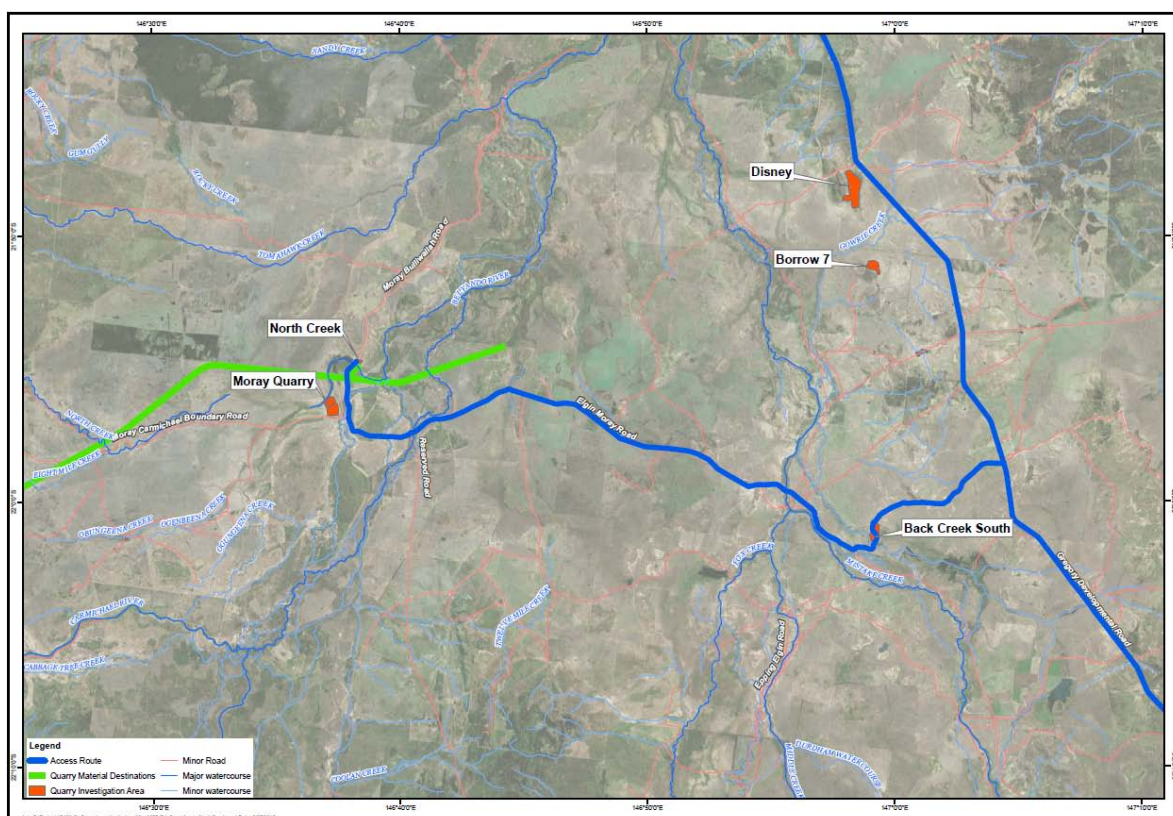


Figure 4-9 Study area - North Creek Quarry (TTM, 2013)

TTM has undertaken a detailed estimate of the likely development traffic generation and distribution, with the site predicted to generate a maximum daily traffic generation 56 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 a 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 North Creek Quarry will be 500,000 t. Haulage will be restricted to the local road network and a private haulage road. Haulage from the North Creek Quarry will not access the any State Controlled Roads (SCR).

TTM has estimated the daily and peak hour haul vehicle generation, and this is shown in Table 4-14.

Table 4-14 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: 957 t	75	13 (120 ESA)	13 (22 ESA)	26 (142 ESA)	6
Peak Month: 2,046 t	75	28 (258 ESA)	28 (47 ESA)	56 (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, these include:

- Ten truck movements 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; and
- Two water deliveries per week from Project water source or from an onsite bore.

This equates to 166 truck movements during the first year of the quarry including the set up. North Creek Quarry traffic is expected to increase traffic on the roads in the study area by no more than 56 vehicles per day (vpd) 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 Doongmabullah Road with an average of 320 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.

4.9.2 Potential Impacts

TTM Consulting was engaged to undertake a Traffic and Transport Impact Assessment for the development of the North Creek Quarry. 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 Department of Transport and Main Roads Guidelines for Assessment of Road Impacts of Development (GARID) has established that North Creek Quarry will not have a significant or assessable pavement impact on the SCR network;
- TTM consider that there will be 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 Moray 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.

4.9.3 Management Measures

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 km and along the rail haul road to 80 km per hour(km/hr) 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 North Creek Quarry access road from Bulliwallah 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 if the access is onto a sealed public road to remove dust and gravel from vehicle tyres.

4.10 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 in EIS completed within the area.

4.10.1 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').

The site is on leasehold land and therefore Native Title is not extinguished. Adani have 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 NRM in November 2011. The CHMP is being amended to include the North Creek Quarry operations.

Indigenous cultural heritage studies undertaken with the Carmichael Coal Mine and Rail EIS have identified indigenous cultural heritage sites located within the region. 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 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. A cultural heritage clearance survey was undertaken by the Jangga People for the initial geotechnical investigations. Six test locations were assessed within the North Creek 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 CHMP a further survey is required prior to obtaining final cultural heritage clearance for the North Creek Quarry site. Adani understands their duty of care to protect and manage Aboriginal cultural heritage values under the ACH Act, and are committed to the management of cultural heritage values in and surrounding the North Creek Quarry site.

4.10.2 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 Great Barrier Reef and the Tree of Knowledge (Barcaldine) are listed as the only Non-Indigenous cultural heritage sites applicable to projects within the immediate area (GHD, November 2012). Neither of these sites is within close proximity to the proposed North Creek 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 4-15 below lists of results from the Queensland Heritage Register search.

Table 4-15 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.

4.10.3 Potential Impacts

This site is predominantly disturbed from previous quarry activity and is unlikely to contain any artefacts and previous surveys have not identified any onsite. However, 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.

4.10.4 Management of Cultural Heritage

As outlined in Section 4.10 - Cultural Heritage, 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 North Creek Quarry development triggers assessment against multiple State and Local legislative instruments and includes two referral agencies for the activities. Section 5 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 North Creek Quarry development

Table 5-1 State Planning Policy Assessment

State Planning Policy	Applicability
Temporary SPP 2/12 – Planning for Prosperity	<p>The SPP applies to development on the Property and gives additional weight in the decision making process to:</p> <ul style="list-style-type: none"> ▪ 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. <p>Part 2 of the SPP states that when making a decision on a development the assessment manager shall give weight to <i>"extractive industry development which can be shown to be complementary to an area's primary intended use"</i> (p.3). Under the <i>Belyando Shire Planning Scheme 2009</i>, 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 the assessment manager.</p>
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 <i>Strategic Cropping Land Act 2011</i> (SCL Act) are 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 trigger proximity to 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 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 <i>Belyando Shire Planning Scheme 2009</i> 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 230 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) are located on Lot 4 SP116046. However, only Class A GQAL is applicable to this development application as a small section in the south of the North Creek Quarry area is mapped (refer to Section 5.1.2 and Figure 5-1 below).

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

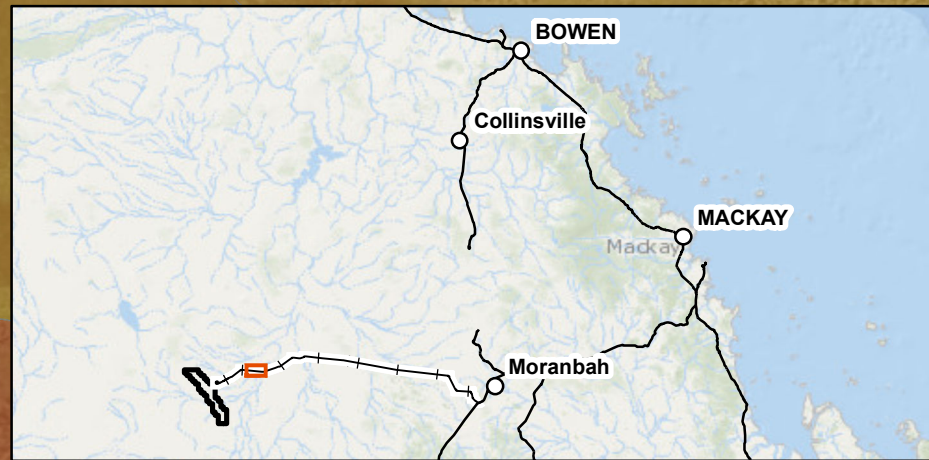
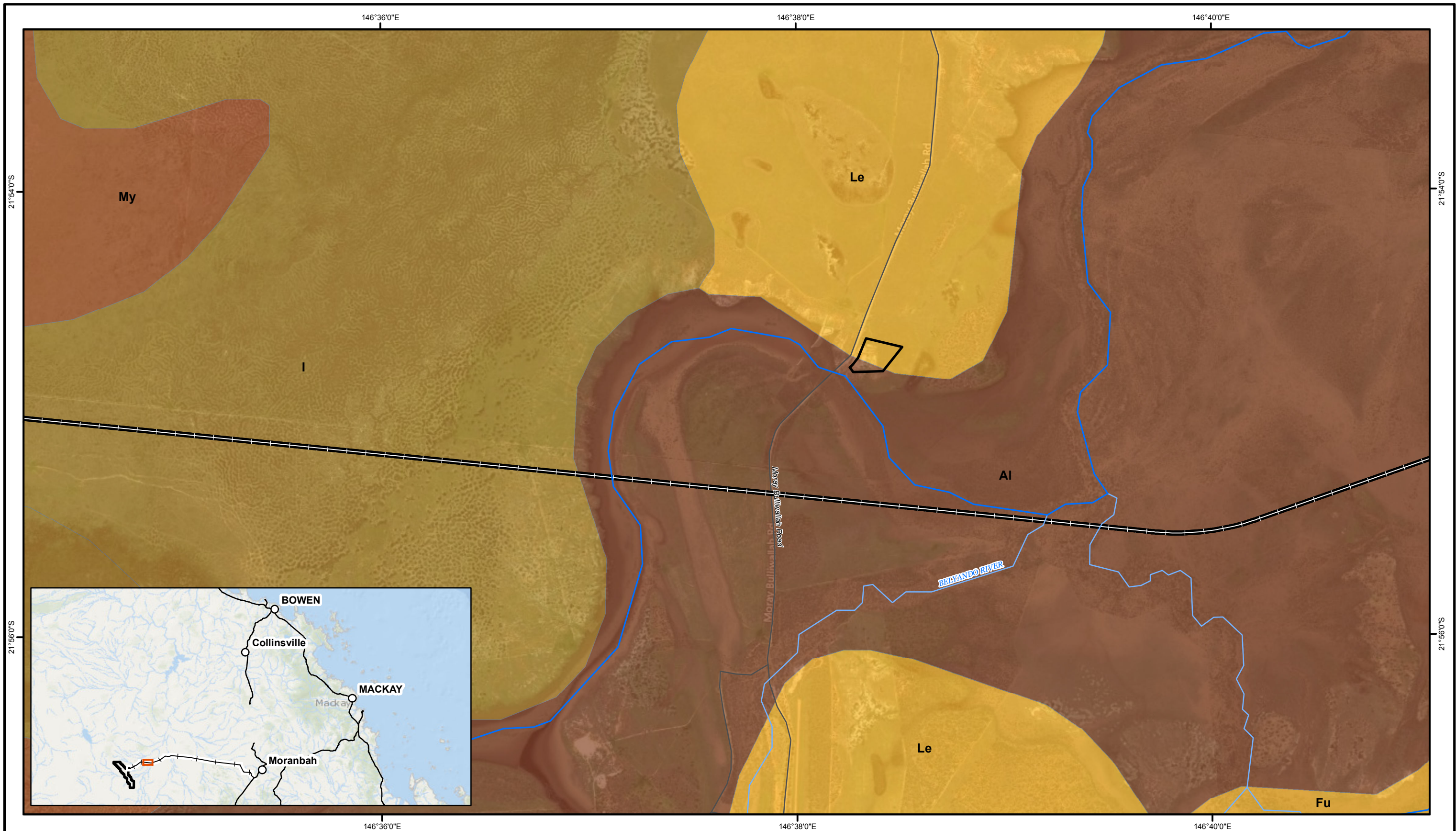
SPP 1/92 was introduced to conserve GQAL and provide guidance to local authorities on how the issue should be addressed when undertaking their planning duties. Local authorities are required to have due regard to the policy. The proposed North Creek Quarry site contains a section of mapped Class A GQAL along its southern section (Figure 5-1). 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 5-2 SPP 1/92 Policy Principles

Policy Principle	Assessment of North Creek 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 North Creek Quarry is considered significantly important for the upgrade and maintenance of infrastructure within the area. As discussed in Section 1.5 – Need for the Project, the site is considered the most suitable due to its proximity to the work site and the limited availability of 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 North Creek Quarry will only affect a small portion of mapped Class A GQAL along the southern section of the site. Therefore, it will not cause alienation of larger sections of GQAL and will not inhibit the existing or future utilisation of the 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.
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.

Policy Principle	Assessment of North Creek Quarry
Due consideration should be given to the protection of good quality agricultural land when applications for rezonings, consent, or subdivision are being determined (Paragraph 4.1).	Consideration has been given to the mapped GQAL on site. 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: <i>"Extractive industries, where they are located and operated so as to ensure no unacceptable detrimental impact on surrounding uses or on the environment"</i> [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 North Creek Quarry is required for the development of local roads and rail infrastructure, and is therefore considered a development with 'overriding need'. In addition, there is minimal impact to GQAL land as it is within a pre disturbed area previously used for quarry activities.



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

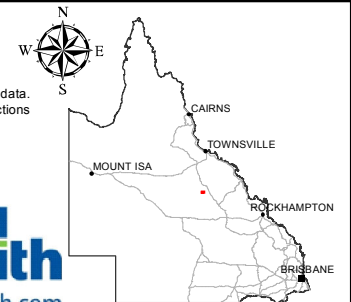
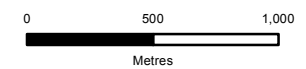
Legend

- Proposed Adani Rail Corridor
- Proposed Elgin Moray Road Re-Alignment
- Proposed Access Road to Elgin Moray Road
- Carmichael Mine - ML 70441

- Minor Road
- Major watercourse
- Minor watercourse

GQAL Class

- A
- B
- C1
- C2
- North Creek Quarry Extraction Area



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.

adani **CDM Smith**
cdmsmith.com

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 with no known flooding impacts or landslide hazard mapping. In addition, the site is mapped as low 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 2–4 permanent on site jobs and potentially more than 10 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 North Creek Quarry.

5.2 Local Planning Instruments

5.2.1 Belyando Shire Planning Scheme 2009

The proposed North Creek 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 5-3).

Table 5-3 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 quarrying and current grazing activities at the North Creek 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 North Creek Quarry development will be utilising a historic quarry area and is necessary of the construction of the local infrastructure. 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 increased 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.

5.2.1.2 Rural Zone Code Assessment

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 5-4.

Table 5-4 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 150 m 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 7.64 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 Bulliwallah 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 North Creek 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 two vegetation corridors 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 North Creek and Moray 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 North Creek 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 two vegetation corridors 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 North Creek and Moray 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 North Creek and Moray 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 on site to supply drinking water and ablution water. On site water for operations and dust suppression to be supplied from onsite erosion and sediment control basins or alternative nearby Project sources.	
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 sewerred 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 sewerred area will have an on site effluent disposal system in accordance with Schedule 1, Division 4: Standards for Sewerage Supply, Section 4.2. The on site 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 <i>Belyando Shire Planning Scheme 2009</i> , 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 7.64 ha Extractive Industry activity would require an excessive number of car spaces. The operator will have a total of 4 permanent personnel on site at any one time and therefore 4 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 Bulliwallah 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 500 m ² 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 North Creek Quarry is proposed to be developed over 7.64 ha of generally disturbed land (grazing and quarry activities), approximately 135 km north of Clermont in Central Queensland. North Creek 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 and existing topsoil stockpiles which will be utilised for North Creek Quarry.

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

Detailed 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 North Creek Quarry site;
- Careful management and noise controls of during the peak production month in unstable weather conditions to ensure 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 North Creek 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 North Creek Quarry development seeks to appropriately utilise quarry resources for the 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 North Creek Quarry will support the economy and employment in the local and wider region and is considered consistent with the principles of ecologically sustainable development.

Section 7 Bibliography

- Australian Government, 2009. *Australian Natural Resources Atlas: Groundwater Management Unit: Unincorporated Area- Bowen*. [Online]
Available at: <http://www.anra.gov.au/topics/water/overview/qld/gmu-unincorporated-area-bowen.html>
[Accessed 04 April 2013].
- Board, B. D. T., 2005. *Burdekin Dry Tropics Natural Resource Management Plan*. Townsville: Burdekin Dry Tropics Community.
- BOM, 2013. *Daily Rainfall - Clermont Post Office*. [Online]
Available at: <http://www.bom.gov.au/jsp/ncc/cdio/weatherData/av>
[Accessed 19 February 2013].
- BOM, 2013. *Groundwater Dependant Ecosystems Atlas*. [Online]
Available at: www.bom.gov.au/water/groundwater/gde/
[Accessed 24 April 2013].
- Cardno, 2012. *Carmichael Coal Mine & Rail Project - Quarry Geotechnical Investigations*, s.l.: s.n.
- Department of Environment and Heritage Protection, 2004. *Planning for Noise Control Guideline*. [Online]
Available at: <http://www.ehp.qld.gov.au/register/p01369aa.pdf>
[Accessed 13 March 2013].
- Department of Environment and Heritage Protection, 2012. *Koala-sensitive Design Guideline: A guide to koala-sensitive design measures for planning and development activities*, Brisbane: Queensland Government.
- Dight, I., 2009. *Burdekin Water Quality Improvement Plan*. Townsville: NQ Dry Tropics.
- Dique DS, P. H. T. J. a. V. D., 2004. Determining the distribution of a regional koala population in south-east Queensland for conservation management. *Wildlife Research*, Volume 31, pp. 109-117.
- DLGP, 2012. *Mackay, Isaac and Whitsunday Regional Plan*, Mackay: Department of Local Government and Planning (DLGP).
- Eds, S. P. a. W. R., 1999. *The Conservation Status of Queensland's Bioregional Ecosystems*. Brisbane: Environmental Protection Agency.
- ESDSC, E. S. D. S. C., 1992. *National Strategy for Ecologically Sustainable Development*, Canberra: Australian Government.
- GHD, 2012. *Carmichael Mine and Rail EIS - Rail Hydrogeology Report*, s.l.: s.n.
- GHD, November 2012. *Carmichael Coal Mine and Rail Project*. s.l.:Adani Mining Pty Ltd.
- NLWRA, 2002. *Australian Catchment: River and Estuary Assessment 2002*. Canberra: National Land and Water Resource Audit.
- NRM, 2002. *Burdekin Basin Draft Water Resource Plan: Water Supply Planning Study Report*. Brisbane: Department of Natural Resources and Mines.

Roth CH, L. G. a. C. D., 2002. *Overview of the Key Natural Resource Management Issue in the Burdekin Catchment, with particular reference to Water Quality and Salinity – Burdekin Catchment Condition Study Phase 1*. Townsville: CSIRO Land and Water.

RPS, 2012. *Galilee Basin Report on Hydrogeological Investigations*. [Online]
Available at: http://www.rlms.com.au/uploaded_docs/Part%203%20Chapter%206%20-%207.pdf
[Accessed 4 April 2013].

Sattler, R. a. W. P., 1999. *The Conservation Status of Queensland's Bioregional Ecosystems*. Brisbane: Environmental Protection Agency.

SEWPaC, 2013. *Acacia ramiflora in Species Profile and Threats Database*. [Online]
Available at: <http://www.environment.gov.au/sprat>
[Accessed 6 March 2013].

VIPAC, 2013. *Disney Quarry Noise Assessment*, s.l.: unpublished.

Section 8 Acronyms and Abbreviations

Acronym/Abbreviation	Description
AAPT	Adani Abbot Point Terminal Pty Ltd
ACH Act	<i>Aboriginal Cultural Heritage Act 2003</i>
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	<i>Environmental Protection Act 1994</i>
EPBC Act	<i>Environment Protection and Biodiversity Conservation Act 1999 (Cth)</i>
EPC	Exploration Permit for Coal
EP Regulation	<i>Environmental Protection Regulation 2008</i>
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	<i>Land Title Act 1994</i>
m	Metre (s)
m ³	Cubic Metres
mbgl	Metres Below Ground Level
MCU	Material Change of Use
MLA	Mine Lease Application
MQSH Act	<i>Mining and Quarry Safety and Health Act 1999</i>
Mtpa	Million Tonnes Per Annum
NC Act	<i>Nature Conservation Act 1992</i>
NNTR	National Native Title Register
NRM	Department of Natural Resources and Mine (Qld)
PMVA	Property Map of Assessable Vegetation
PVMP	Property Vegetation Management Plan
QH Act	<i>Queensland Heritage Act 1992</i>
RE	Regional Ecosystem
RN	Registered Number

Acronym/Abbreviation	Description
SCL	Strategic Cropping Land
SCR	State Controlled Road
SDPWO Act	<i>State Development and Public Works Organisation Act 1971</i>
SP Act	<i>Sustainable Planning Act 2009</i>
SP Regulation	<i>Sustainable Planning Regulation 2009</i>
SPP	State Planning Policy
SWL	Standing Water Level
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	<i>Vegetation Management Act 1999</i>
VPD	Vehicles Per Day
WRP	<i>Water Resource (Burdekin Basin) Plan 2007</i>

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 of 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

**Carmichael Coal Mine Project
North Creek Quarry Proposal
Traffic Engineering Report**

Adani

Reference: 12SCT0107/01NC
24.04.2013

© 2013 - TTM Consulting Pty Ltd

ABN 65 010 868 621

Suite 9, 13 Norval Court

PO Box 949 Maroochydore QLD 4558

T: (07) 5479 2455 F: (07) 5479 3651 E: ttmsc@ttmgroup.com.au

Document Status


Rev No.	Author	Reviewed / Approved		Description	Date
		Name	Signature		
01	G Harris	P Penman RPEQ: 12644		Final	24.04.13

Table of Contents

1.	Background	1
1.1	Introduction	1
1.2	Scope	1
1.3	Methodology	3
1.4	Proposed Development	3
2.	Existing Transport Infrastructure	5
2.1	Introduction	5
2.2	Flooding, Disaster & Relief Review	6
2.3	Public Transport	6
2.4	Road Safety	6
2.5	Road Planning & Scheduled Road Improvements	7
2.6	Development and Mine Planning	7
3.	Access Route Review	9
3.1	Gregory Development Road / Elgin Road Intersection	9
3.2	Elgin Road / Twin Hills Road Intersection	10
3.3	Elgin Road / Moray Carmichael Road / Bulliwallah Road Intersection	11
3.4	Other Intersections	12
3.5	Elgin Road / Moray Carmichael Road / Bulliwallah Road	12
4.	Traffic Volumes	13
4.1	Existing Peak Hour Volumes	13
4.2	Future Year Traffic Growth	13
4.3	Existing ESA's	15
5.	Quarry Operations	16
5.1	Existing (Proposed) Quarry Site Operations	16
5.2	Development Truck ESA Loading	16
5.2.1	Haul Vehicles	16
5.2.2	Service Vehicles	17
5.3	Site Truck Distribution	17
5.4	Site Staff	19

6.	Traffic Impact Assessment	20
6.1	Introduction	20
6.2	Road Corridor Capacity Assessment	20
6.2.1	Assessment Criteria	20
6.2.2	Study Area Operational Performance	21
6.3	Intersection Capacity Assessment	21
6.3.1	Assessment Requirements	21
6.3.2	Intersection Capacity Review	21
6.4	Access Route Intersection Review	22
6.4.1	Gregory Development Road / Elgin Road	23
6.4.2	Other Intersections	24
7.	Pavement Impact Assessment	25
7.1	Introduction	25
7.2	Access Route Pavement Condition Assessment	25
7.2.1	Gregory Development Road	25
7.2.2	IRC Controlled Roads	26
8.	Site Access and Parking Arrangements	27
8.1	Site Access Arrangements	27
8.2	Parking Arrangements and On-site Manoeuvring	27
9.	Traffic Management & Maintenance Plan	28
10.	Developer Contributions	29
10.1.1	DTMR	29
10.1.2	IRC	29
11.	Summary	30
11.1	Existing Traffic Review	30
11.2	Development Traffic Generation and Distribution	30
11.3	Development Traffic Impacts	30
11.4	Developer Contributions	30
11.5	Road Safety School Route, Pedestrian and Cyclist Review	30
11.6	Conclusion	30

Table Index

Table 2.1: Road Hierarchy & Road Characteristics	5
Table 2.2: Crash History – Gregory Developmental Road (2005-2009)	6
Table 4.1: Existing ESAs within Study Area	15
Table 5.1: Estimated Daily & Peak Hour Haul Vehicle Generation	16
Table 5.2: Estimated Number of Service Vehicles For Site Set Up and Operation	17
Table 5.3: Key Service Vehicle Routes	18
Table 6.1: Two Lane Rural Road Capacity – Rolling Terrain Two-Way Flow	20
Table 6.2: Maximum AADT's for Various LOS on Two-Lane Two-Way Rural Roads	21
Table 7.1: Development ESA Impact	25
Table 7.2: Pavement Condition Summary	26

Figure Index

Figure 1.1: Site Location	2
Figure 1.2: Study Area – North Creek Quarry	4
Figure 2.1: Elgin Road / Moray Carmichael Road Upgrade	8
Figure 3.1: Intersection Site Photographs	9
Figure 3.2: Intersection Aerial and Site Photographs	10
Figure 3.3: Intersection Aerial and Site Photographs	11
Figure 4.1: Study Area Peak Hour Traffic 2013	14
Figure 5.1: Study Area Road Sections – North Creek Quarry	19
Figure 6.1: RPDM Chapter 13: Table 13.4	22
Figure 6.2: RPDM Chapter 13: Intersections at Grade: Table 13.5	22
Figure 6.3: Gregory Development / Elgin Road: Warrants for Turn Treatments (2014)	23
Figure 6.4: Gregory Development / Elgin Road: Warrants for Turn Treatments (2024)	23

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. North Creek Quarry is described as Lot 2 on SP119925 ('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.

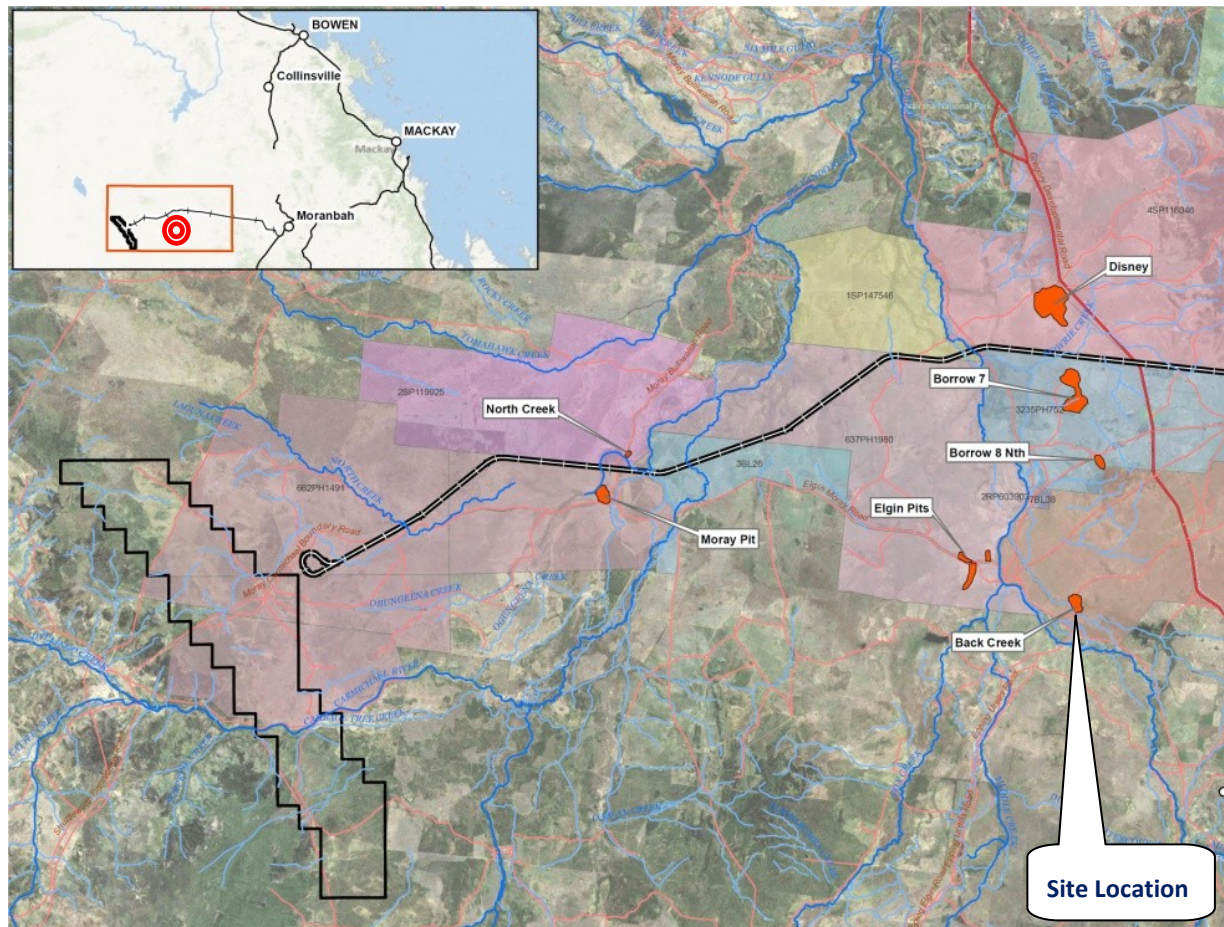


Figure 1.1: Site Location

This report investigates the transport aspects associated with the set up and on-site operations of North Creek and associated 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 North Creek 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 investigated 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](#).

North Creek Quarry will provide embankment fill for the rail line related to the proposed Carmichael Coal Mine.

A review of quarry vehicle generation has identified traffic movements from the Gregory Development Road to North Creek Quarry, and movements from the Quarry to a haul road running adjacent to the proposed rail line. The study area as shown in [Figure 1.2](#) therefore incorporates the Gregory Development Road and the route to the haul road / quarry via Elgin Road and Bulliwallah Road.



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 (Belyando Crossing to Peak Downs Highway)	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 crosses numerous floodplains and floodways, with instances of flooding close to the road 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 be 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 and Rail 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 at the Gregory Development Road / Elgin Road intersection.

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 Moray Carmichael Road / Bulliwallah Road intersection will be reconfigured for this upgrade with Bulliwallah Road forming the minor and northern leg of a standard T intersection.

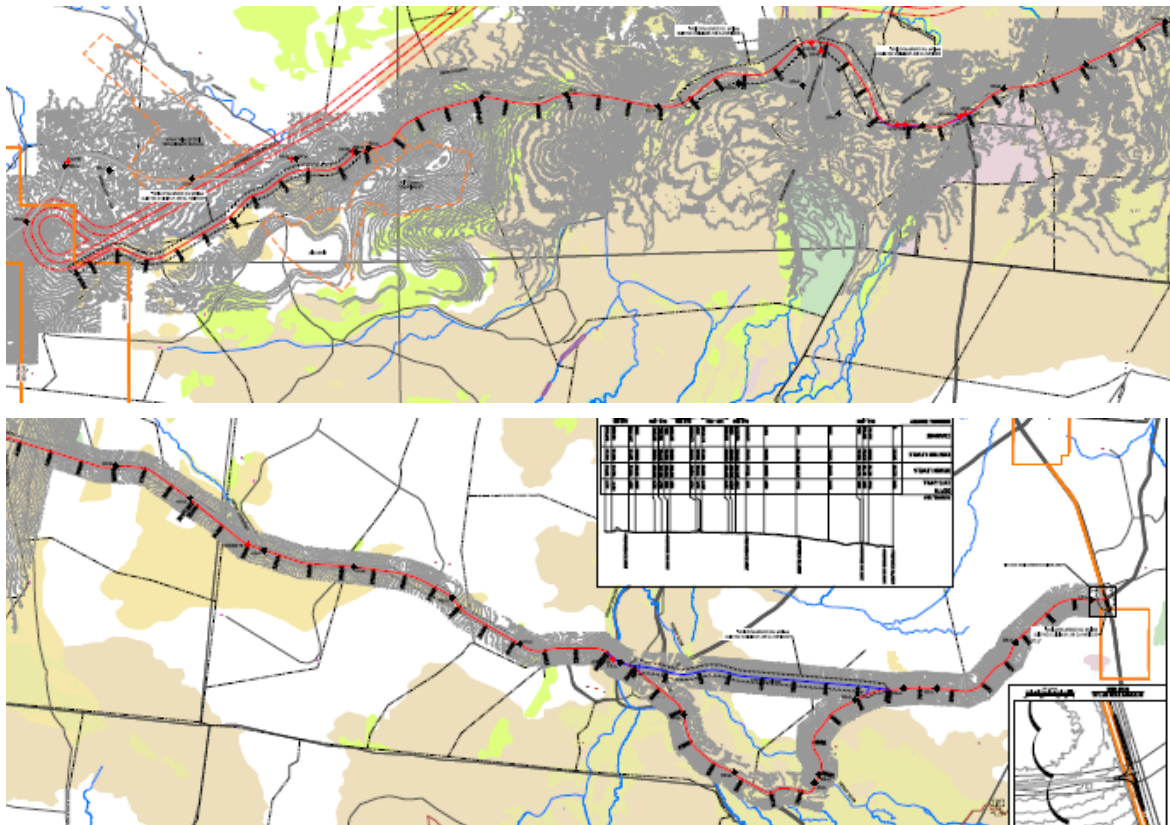


Figure 2.1: Elgin Road / Moray Carmichael Road Upgrade

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 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 Waltham 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.

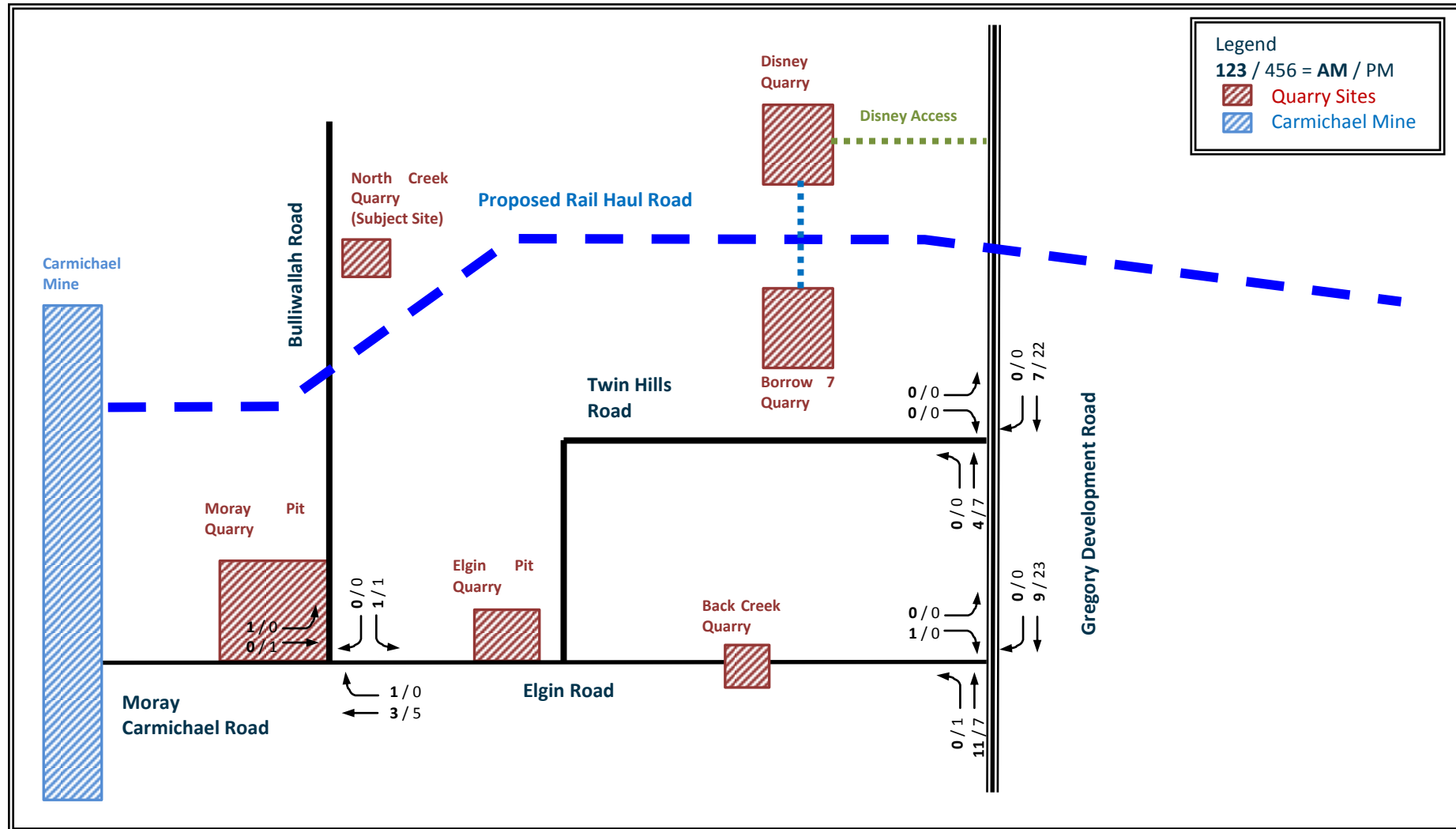


Figure 4.1: Study Area Peak Hour Traffic 2013

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 1 year) at which time quarry operations on site will cease;
- 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 2-4 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 North Creek Quarry will be 500,000t. Haulage will be restricted to the local road network and a private haulage road. Haulage from the North Creek 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: 957t	75	13 (120 ESA)	13 (22 ESA)	26 (142 ESA)	6
Peak Month: 2,046t	75	28 (258 ESA)	28 (47 ESA)	56 (326 ESA)	12

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

- Average Annual ESA: 26 daily two-way trucks = 51,120 ESA; and
- Peak Annual ESA = 72,470 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 3,998L per week needed for North Creek 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	North Creek Deliveries (in + out movements)	North Creek Deliveries (ESA)	North Creek (Annual ESA)	All Quarry Deliveries (in + out movements)	All Quarry Deliveries (ESA)	All Quarry (Annual ESA)
Site Set up	10	30	30	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)	166 trips		550 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 North Creek Quarry, but also all other quarries related to the Carmichael Coal Mine and Rail Project. The defined study area for North Creek 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; and
- Bulliwallah Road from Elgin Road to the North Creek Quarry.

The anticipated truck distributions from the North Creek 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		North Creek Truck Distribution (VPD)	Annual North Creek 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)	550	92% Service Vehicles (6.0)	7,112
Elgin Road (Back Creek to Twin Hills Road)	Section B	100% Service Vehicles (0.5)	550	70% Service Vehicles (4.5)	5,394
Elgin Road (Twin Hills Road to Elgin Pits)	Section C	100% Service Vehicles (0.5)	550	34% Service Vehicles (2.0)	2,670
Elgin Road (Elgin Pits to Bulliwallah Road)	Section D	100% Service Vehicles (0.5)	550	15% Service Vehicles (0.6)	1,130
Moray Carmichael Road (Bulliwallah Road to Moray Pit)	Section E	-	-	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	100% Service Vehicles (0.5)	550	7% Service Vehicles (0.5)	550
Gregory Development Road (Belyando Crossing to Disney)	Section H	38% Service Vehicles (0.1)	208	32% Service Vehicles (1.7)	2,496
Gregory Development Road (Disney to Haul Road)	Section I	38% Service Vehicles (0.1)	208	36% Service Vehicles (2.2)	2,810
Gregory Development Road (Haul Road to Elgin Road)	Section J	38% Service Vehicles (0.1)	208	36% Service Vehicles (2.2)	2,810
Gregory Development Road (Elgin Road to Peak Downs Highway)	Section K	62% Service Vehicles (0.4)	342	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.

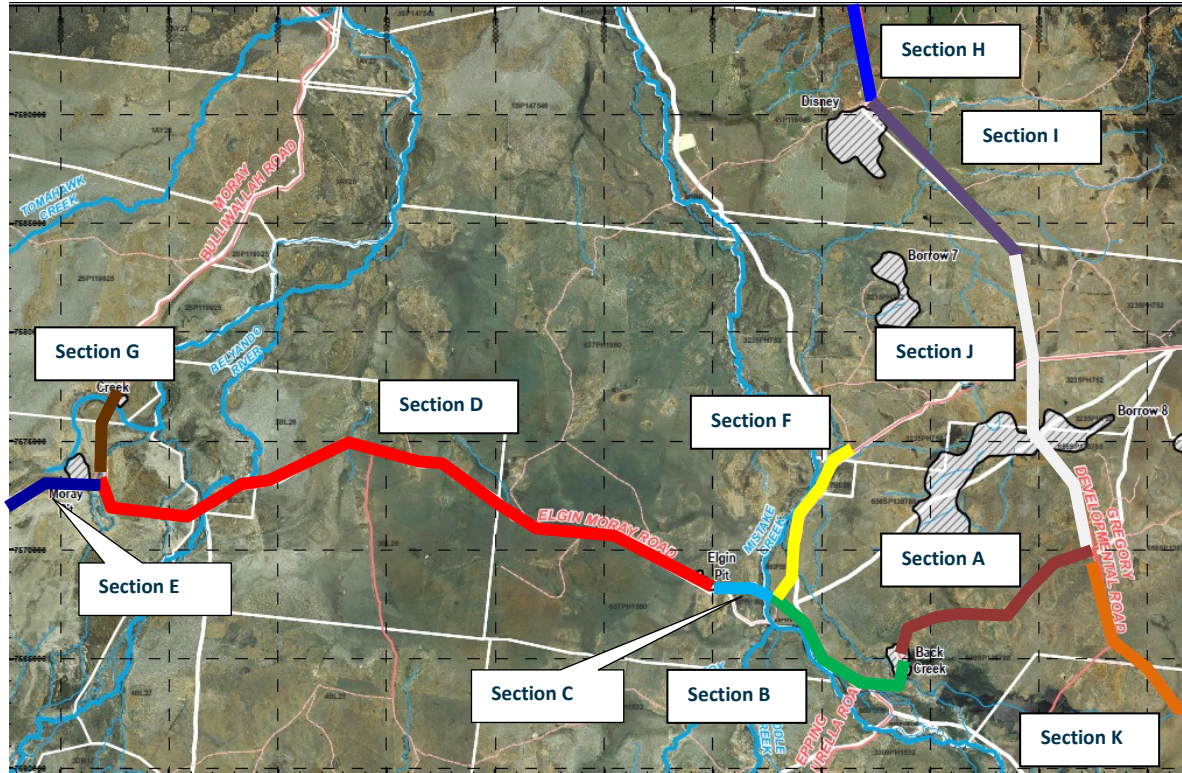


Figure 5.1: Study Area Road Sections – North Creek Quarry

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

Design Hour Volume to AADT Ratio	Level of Service				
	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'.

North Creek Quarry traffic is expected to increase traffic on the roads in the study area by no more than 65vpd 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 320 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)	Deceleration (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.

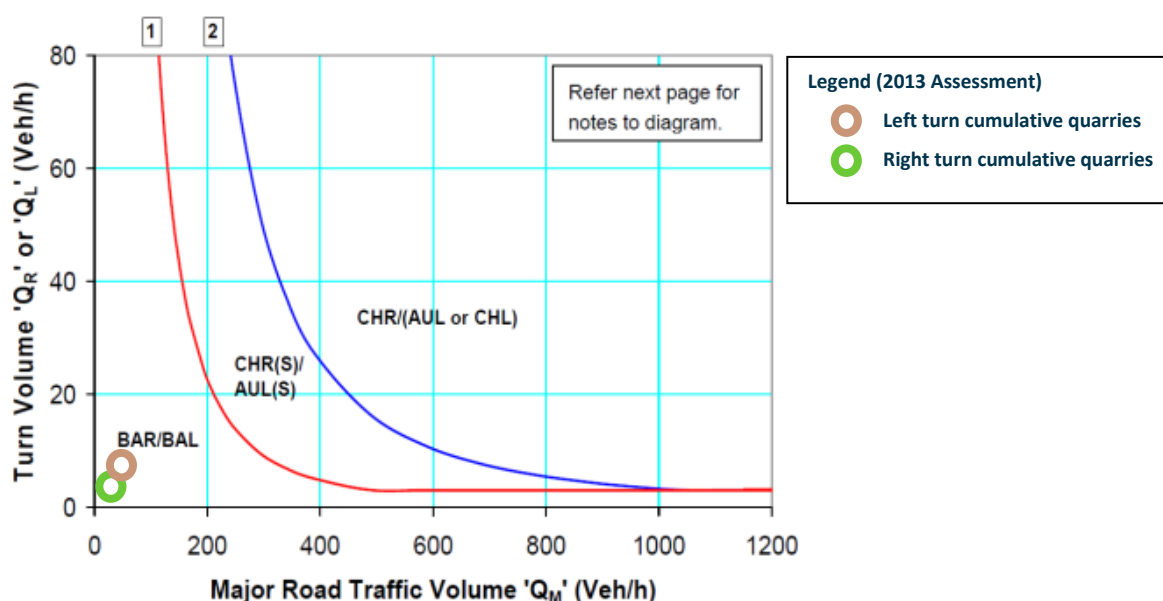


Figure 6.3: Gregory Development / Elgin Road: Warrants for Turn Treatments (2014)

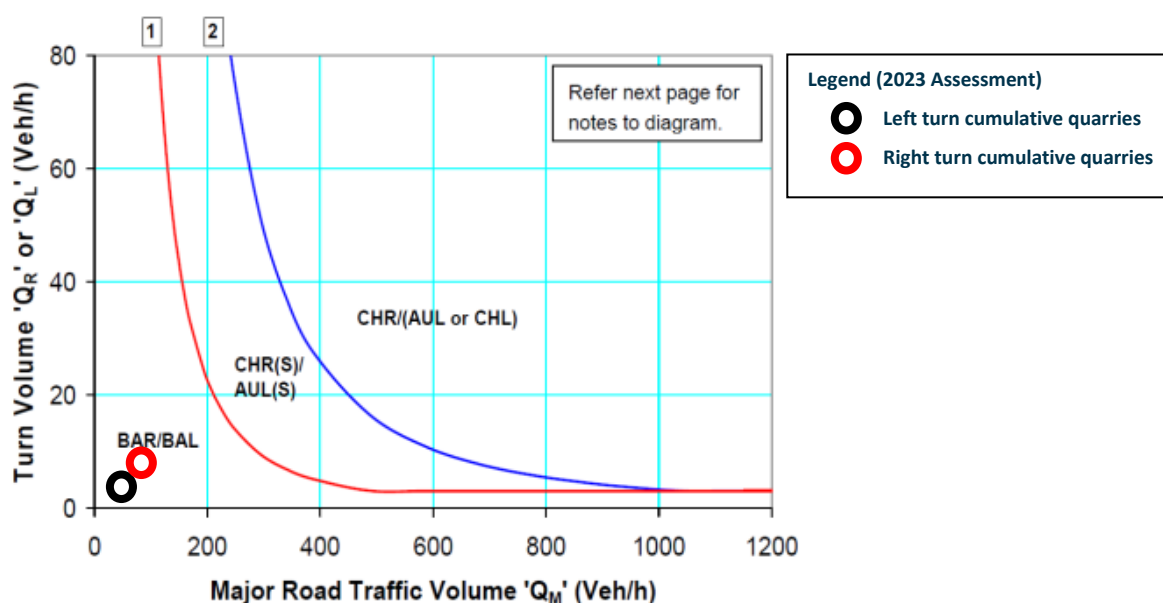


Figure 6.4: Gregory Development / Elgin Road: Warrants for Turn Treatments (2024)

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 North Creek and associated quarries.

6.4.2 Other Intersections

Other intersections along the access route are predicted to carry lower through 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 North Creek 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 North Creek 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)	North Creek ESA	North Creek ESA Impact (2014)	Cumulative Quarry ESA	Cumulative Quarry ESA Impact (2014)
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	342	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 North Creek Quarry from Bulliwallah 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.

It is recommended that the North Creek Quarry access be located at the top of the bank immediately north of North Creek to maximise the available site distance.

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 recommended that on-site 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 North Creek 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, Moray Carmichael Road and Bulliwallah 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 North 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. 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 North Creek Quarry. 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 maximum daily traffic generation 65 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 North Creek Quarry and associated quarries will not have a significant or assessable pavement impact on the state controlled road network.

A minimum of 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 – 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: 21.9132

Longitude: 146.6388

Distance: 15

Email: kinnytp@cdmsmith.com

Date submitted: Wednesday 03 Apr 2013 11:21:43

Date extracted: Wednesday 03 Apr 2013 11:30:06

The number of records retrieved = 168

Disclaimer

As the DSITIA is still in a process of collating and vetting data, it is possible the information given is not complete. The information provided should only be used for the project for which it was requested and it should be appropriately acknowledged as being derived from Wildlife Online when it is used.

The State of Queensland does not invite reliance upon, nor accept responsibility for this information. Persons should satisfy themselves through independent means as to the accuracy and completeness of this information.

No statements, representations or warranties are made about the accuracy or completeness of this information. The State of Queensland disclaims all responsibility for this information and all liability (including without limitation, liability in negligence) for all expenses, losses, damages and costs you may incur as a result of the information being inaccurate or incomplete in any way for any reason.

Kingdom	Class	Family	Scientific Name	Common Name	I	Q	A	Records
animals	amphibians	Bufonidae	<i>Rhinella marina</i>	cane toad	Y			2
animals	amphibians	Hylidae	<i>Cyclorana novaehollandiae</i>	eastern snapping frog		C		2/2
animals	amphibians	Hylidae	<i>Litoria caerulea</i>	common green treefrog		C		1
animals	amphibians	Hylidae	<i>Cyclorana alboguttata</i>	greenstripe frog		C		3/2
animals	amphibians	Limnodynastidae	<i>Limnodynastes tasmaniensis</i>	spotted grassfrog		C		1
animals	amphibians	Limnodynastidae	<i>Platyplectrum ornatum</i>	ornate burrowing frog		C		1
animals	birds	Accipitridae	<i>Haliastur sphenurus</i>	whistling kite		C		1
animals	birds	Accipitridae	<i>Accipiter fasciatus</i>	brown goshawk		C		1
animals	birds	Accipitridae	<i>Elanus axillaris</i>	black-shouldered kite		C		1
animals	birds	Accipitridae	<i>Circus assimilis</i>	spotted harrier		C		1
animals	birds	Accipitridae	<i>Milvus migrans</i>	black kite		C		1
animals	birds	Accipitridae	<i>Aquila audax</i>	wedge-tailed eagle		C		1
animals	birds	Alaudidae	<i>Mirafra javanica</i>	Horsfield's bushlark		C		2
animals	birds	Ardeidae	<i>Egretta novaehollandiae</i>	white-faced heron		C		1
animals	birds	Artamidae	<i>Cracticus tibicen</i>	Australian magpie		C		1
animals	birds	Artamidae	<i>Cracticus nigrogularis</i>	pied butcherbird		C		3
animals	birds	Artamidae	<i>Cracticus torquatus</i>	grey butcherbird		C		1
animals	birds	Artamidae	<i>Artamus cinereus</i>	black-faced woodswallow		C		1
animals	birds	Cacatuidae	<i>Eolophus roseicapillus</i>	galah		C		1
animals	birds	Cacatuidae	<i>Cacatua galerita</i>	sulphur-crested cockatoo		C		1
animals	birds	Cacatuidae	<i>Nymphicus hollandicus</i>	cockatiel		C		1
animals	birds	Campephagidae	<i>Coracina novaehollandiae</i>	black-faced cuckoo-shrike		C		2
animals	birds	Casuariidae	<i>Dromaius novaehollandiae</i>	emu		C		1
animals	birds	Cisticolidae	<i>Cisticola exilis</i>	golden-headed cisticola		C		1
animals	birds	Columbidae	<i>Ocyphaps lophotes</i>	crested pigeon		C		2
animals	birds	Columbidae	<i>Geophaps scripta scripta</i>	squatter pigeon (southern subspecies)		V	V	1
animals	birds	Corcoracidae	<i>Struthidea cinerea</i>	apostlebird		C		1
animals	birds	Corvidae	<i>Corvus orru</i>	Torresian crow		C		2
animals	birds	Cuculidae	<i>Centropus phasianinus</i>	pheasant coucal		C		1
animals	birds	Cuculidae	<i>Cacomantis pallidus</i>	pallid cuckoo		C		1
animals	birds	Estrildidae	<i>Taeniopygia guttata</i>	zebra finch		C		1
animals	birds	Falconidae	<i>Falco cenchroides</i>	nankeen kestrel		C		2
animals	birds	Falconidae	<i>Falco berigora</i>	brown falcon		C		1
animals	birds	Gruidae	<i>Grus rubicunda</i>	brilga		C		1
animals	birds	Maluridae	<i>Malurus melanocephalus</i>	red-backed fairy-wren		C		3
animals	birds	Megaluridae	<i>Cincloramphus mathewsi</i>	rufous songlark		C		1
animals	birds	Meliphagidae	<i>Acanthagenys rufogularis</i>	spiny-cheeked honeyeater		C		1
animals	birds	Meliphagidae	<i>Manorina flavigula</i>	yellow-throated miner		C		1
animals	birds	Monarchidae	<i>Grallina cyanoleuca</i>	magpie-lark		C		2
animals	birds	Motacillidae	<i>Anthus novaeseelandiae</i>	Australasian pipit		C		1
animals	birds	Phasianidae	<i>Coturnix ypsilophora</i>	brown quail		C		1
animals	birds	Psittacidae	<i>Platycercus adscitus</i>	pale-headed rosella		C		1
animals	birds	Rhipiduridae	<i>Rhipidura leucophrys</i>	willie wagtail		C		1
animals	insects	Nymphalidae	<i>Tirumala hamata hamata</i>	blue tiger				1
animals	insects	Nymphalidae	<i>Junonia orithya albicincta</i>	blue argus				1
animals	insects	Nymphalidae	<i>Danaus chrysippus petilia</i>	lesser wanderer				1

Kingdom	Class	Family	Scientific Name	Common Name	I	Q	A	Records
animals	insects	Nymphalidae	<i>Hypolimnys bolina nerina</i>	varied eggfly				1
animals	insects	Nymphalidae	<i>Euploea core corinna</i>	common crow				1
animals	insects	Papilionidae	<i>Papilio aegaeus</i>					1
animals	insects	Pieridae	<i>Catopsilia pyranthe crokeri</i>	white migrant				1
animals	insects	Pieridae	<i>Belenois java teutonia</i>	caper white				1
animals	insects	Pieridae	<i>Eurema hecabe phoebus</i>	large grass-yellow				1
animals	mammals	Bovidae	<i>Bos taurus</i>	European cattle	Y			2
animals	mammals	Canidae	<i>Canis lupus familiaris</i>	dog	Y			1
animals	mammals	Dasyuridae	<i>Sminthopsis macroura</i>	stripe-faced dunnart			C	1
animals	mammals	Macropodidae	<i>Macropus rufus</i>	red kangaroo			C	1
animals	mammals	Macropodidae	<i>Macropus giganteus</i>	eastern grey kangaroo			C	2
animals	mammals	Muridae	<i>Mus musculus</i>	house mouse	Y			1
animals	mammals	Muridae	<i>Pseudomys desertor</i>	desert mouse			C	1
animals	mammals	Phascolarctidae	<i>Phascolarctos cinereus</i>	koala			C V	1
animals	reptiles	Boidae	<i>Aspidites melanocephalus</i>	black-headed python			C	1
animals	reptiles	Pygopodidae	<i>Lialis burtonis</i>	Burton's legless lizard			C	1
animals	reptiles	Scincidae	<i>Cryptoblepharus pannosus</i>	ragged snake-eyed skink			C	1
animals	reptiles	Scincidae	<i>Carlia pectoralis sensu lato</i>				C	2
animals	uncertain	Indeterminate	<i>Indeterminate</i>	Unknown or Code Pending			C	1
plants	higher dicots	Amaranthaceae	<i>Gomphrena</i>				C	1
plants	higher dicots	Amaranthaceae	<i>Ptilotus nobilis subsp. semilanatus</i>				C	1/1
plants	higher dicots	Apocynaceae	<i>Marsdenia viridiflora subsp. viridiflora</i>				C	1/1
plants	higher dicots	Apocynaceae	<i>Secamone elliptica</i>				C	1/1
plants	higher dicots	Apocynaceae	<i>Carissa ovata</i>	currantbush			C	1
plants	higher dicots	Asteraceae	<i>Parthenium hysterophorus</i>	parthenium weed	Y			2/2
plants	higher dicots	Asteraceae	<i>Calotis xanthosioidea</i>				C	1/1
plants	higher dicots	Asteraceae	<i>Xanthium occidentale</i>		Y			1/1
plants	higher dicots	Asteraceae	<i>Sphaeranthus indicus</i>				C	2/2
plants	higher dicots	Asteraceae	<i>Minuria integerrima</i>	smooth minuria			C	1/1
plants	higher dicots	Asteraceae	<i>Pluchea baccharoides</i>	narrow-leaved plains bush			C	1/1
plants	higher dicots	Boraginaceae	<i>Heliotropium geocharis</i>				C	1/1
plants	higher dicots	Boraginaceae	<i>Heliotropium ovalifolium</i>				C	1/1
plants	higher dicots	Boraginaceae	<i>Ehretia membranifolia</i>	weeping koda			C	1/1
plants	higher dicots	Caesalpiniaceae	<i>Senna artemisioides subsp. coriacea</i>				C	1/1
plants	higher dicots	Caesalpiniaceae	<i>Lysiphyllum hookeri</i>	Queensland ebony			C	1
plants	higher dicots	Caesalpiniaceae	<i>Senna circinnata</i>				C	2/2
plants	higher dicots	Caesalpiniaceae	<i>Senna artemisioides subsp. filifolia</i>				C	1/1
plants	higher dicots	Capparaceae	<i>Apophyllum anomalum</i>	broom bush			C	1/1
plants	higher dicots	Casuarinaceae	<i>Casuarina cristata</i>	belah			C	1/1
plants	higher dicots	Chenopodiaceae	<i>Sclerolaena tricuspidis</i>	giant red burr			C	2/2
plants	higher dicots	Chenopodiaceae	<i>Einadia nutans subsp. linifolia</i>				C	1/1
plants	higher dicots	Chenopodiaceae	<i>Atriplex lindleyi subsp. lindleyi</i>				C	1/1
plants	higher dicots	Chenopodiaceae	<i>Chenopodium auricomum</i>				C	1/1
plants	higher dicots	Chenopodiaceae	<i>Sclerolaena bicornis</i>				C	1/1
plants	higher dicots	Chenopodiaceae	<i>Dissocarpus biflorus var. cephalocarpus</i>				C	1/1
plants	higher dicots	Chenopodiaceae	<i>Maireana</i>				C	1

Kingdom	Class	Family	Scientific Name	Common Name	I	Q	A	Records
plants	higher dicots	Combretaceae	<i>Terminalia oblongata</i>			C		1
plants	higher dicots	Convolvulaceae	<i>Polymeria marginata</i>			C		1/1
plants	higher dicots	Convolvulaceae	<i>Ipomoea lonchophylla</i>			C		1/1
plants	higher dicots	Euphorbiaceae	<i>Euphorbia dallachyana</i>			C		1/1
plants	higher dicots	Fabaceae	<i>Crotalaria</i>			C		1
plants	higher dicots	Fabaceae	<i>Glycine falcata</i>			C		1/1
plants	higher dicots	Fabaceae	<i>Desmodium muelleri</i>			C		1/1
plants	higher dicots	Fabaceae	<i>Desmodium campylocaulon</i>			C		2/2
plants	higher dicots	Fabaceae	<i>Indigastrum parviflorum</i>			C		1/1
plants	higher dicots	Gentianaceae	<i>Schenkia australis</i>			C		1/1
plants	higher dicots	Goodeniaceae	<i>Goodenia</i>			C		1/1
plants	higher dicots	Goodeniaceae	<i>Goodenia byrnesii</i>			C		1/1
plants	higher dicots	Goodeniaceae	<i>Goodenia strangfordii</i>			C		1/1
plants	higher dicots	Lamiaceae	<i>Ocimum tenuiflorum</i>			C		1/1
plants	higher dicots	Malvaceae	<i>Sida rohlenae</i> subsp. <i>rohlenae</i>			C		1/1
plants	higher dicots	Malvaceae	<i>Abutilon malvifolium</i>	bastard marshmallow		C		1/1
plants	higher dicots	Malvaceae	<i>Herissantia crispa</i>			C		1/1
plants	higher dicots	Malvaceae	<i>Sida trichopoda</i>			C		1/1
plants	higher dicots	Malvaceae	<i>Sida laevis</i>			C		1/1
plants	higher dicots	Meliaceae	<i>Owenia acidula</i>	emu apple		C		1/1
plants	higher dicots	Mimosaceae	<i>Neptunia gracilis</i> forma <i>gracilis</i>			C		1
plants	higher dicots	Mimosaceae	<i>Archidendropsis basaltica</i>	red lancewood		C		1
plants	higher dicots	Mimosaceae	<i>Acacia argyrodendron</i>			C		1/1
plants	higher dicots	Mimosaceae	<i>Acacia stenophylla</i>	belalie		C		1/1
plants	higher dicots	Molluginaceae	<i>Glinus lotoides</i>	hairy carpet weed		C		2/2
plants	higher dicots	Myoporaceae	<i>Eremophila deserti</i>			C		1
plants	higher dicots	Myoporaceae	<i>Eremophila polyclada</i>	flowering lignum		C		2/1
plants	higher dicots	Myoporaceae	<i>Eremophila mitchellii</i>			C		2/1
plants	higher dicots	Myrtaceae	<i>Eucalyptus coolabah</i>	coolabah		C		1
plants	higher dicots	Myrtaceae	<i>Eucalyptus brownii</i>	Reid River box		C		2/1
plants	higher dicots	Myrtaceae	<i>Corymbia dallachiana</i>			C		1
plants	higher dicots	Myrtaceae	<i>Eucalyptus whitei</i>	White's ironbark		C		1
plants	higher dicots	Myrtaceae	<i>Eucalyptus camaldulensis</i> subsp. <i>acuta</i>			C		1/1
plants	higher dicots	Oleaceae	<i>Notelaea microcarpa</i> var. <i>microcarpa</i>			C		1/1
plants	higher dicots	Oleaceae	<i>Jasminum didymum</i> subsp. <i>racemosum</i>			C		1/1
plants	higher dicots	Pentapetaceae	<i>Melhanianthus ovata</i>			C		1/1
plants	higher dicots	Phyllanthaceae	<i>Phyllanthus virgatus</i>			C		1/1
plants	higher dicots	Polygonaceae	<i>Persicaria attenuata</i>			C		1/1
plants	higher dicots	Polygonaceae	<i>Persicaria lapathifolia</i>	pale knotweed		C		1/1
plants	higher dicots	Portulacaceae	<i>Portulaca oleracea</i>	pigweed	Y			1
plants	higher dicots	Proteaceae	<i>Grevillea parallela</i>			C		1/1
plants	higher dicots	Rubiaceae	<i>Oldenlandia galioides</i>			C		1/1
plants	higher dicots	Rubiaceae	<i>Dentella repens</i>	dentella		C		1/1
plants	higher dicots	Rutaceae	<i>Citrus glauca</i>			C		1/1
plants	higher dicots	Rutaceae	<i>Geijera salicifolia</i>	brush wilga		C		1/1
plants	higher dicots	Rutaceae	<i>Geijera parviflora</i>	wilga		C		2/1

Kingdom	Class	Family	Scientific Name	Common Name	I	Q	A	Records
plants	higher dicots	Santalaceae	<i>Anthobolus leptomerioides</i>			C		1/1
plants	higher dicots	Santalaceae	<i>Exocarpos sparteus</i>	slender cherry		C		1/1
plants	higher dicots	Sapindaceae	<i>Alectryon diversifolius</i>	scrub boonaree		C		1/1
plants	higher dicots	Sparrmanniaceae	<i>Grewia latifolia</i>	dysentery plant		C		1
plants	monocots	Amaryllidaceae	<i>Crinum flaccidum</i>	Murray lily		C		1
plants	monocots	Amaryllidaceae	<i>Calostemma luteum</i>			C		2/1
plants	monocots	Asphodelaceae	<i>Bulbine bulbosa</i>	golden lily		C		1/1
plants	monocots	Cyperaceae	<i>Fimbristylis aestivalis</i>			C		1/1
plants	monocots	Cyperaceae	<i>Cyperus exaltatus</i>	tall flatsedge		C		1/1
plants	monocots	Cyperaceae	<i>Cyperus rotundus</i>	nutgrass	Y			2
plants	monocots	Poaceae	<i>Sporobolus caroli</i>	fairy grass		C		1/1
plants	monocots	Poaceae	<i>Astrebla elymoides</i>	hoop mitchell grass		C		1
plants	monocots	Poaceae	<i>Chrysopogon fallax</i>			C		1
plants	monocots	Poaceae	<i>Panicum larcomianum</i>			C		1/1
plants	monocots	Poaceae	<i>Tragus australianus</i>	small burr grass		C		1
plants	monocots	Poaceae	<i>Dichanthium fecundum</i>	curly bluegrass		C		1/1
plants	monocots	Poaceae	<i>Eragrostis lacunaria</i>	purple lovegrass		C		1
plants	monocots	Poaceae	<i>Eragrostis tenellula</i>	delicate lovegrass		C		1/1
plants	monocots	Poaceae	<i>Tripogon loliiformis</i>	five minute grass		C		1
plants	monocots	Poaceae	<i>Bothriochloa ewartiana</i>	desert bluegrass		C		2
plants	monocots	Poaceae	<i>Dactyloctenium radulans</i>	button grass		C		2
plants	monocots	Poaceae	<i>Eragrostis confertiflora</i>			C		1/1
plants	monocots	Poaceae	<i>Cynodon dactylon</i> var. <i>dactylon</i>		Y			1/1
plants	monocots	Poaceae	<i>Cenchrus ciliaris</i>		Y			1
plants	monocots	Poaceae	<i>Chloris truncata</i>			C		1
plants	monocots	Poaceae	<i>Aristida ingrata</i>			C		1/1
plants	monocots	Poaceae	<i>Enneapogon</i>			C		1
plants	monocots	Poaceae	<i>Aristida</i>			C		1
plants	monocots	Poaceae	<i>Chloris</i>			C		1
plants	monocots	Poaceae	<i>Panicum</i>			C		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 D – Conservation Significant Species

Table 8-1 Predicted conservation significant fauna species and potential to occur on North Creek Quarry site

Scientific name	Common name	EPBC Act ¹	NC Act ²	Preferred habitat	Potential to occur
EVNT fauna species					
<i>Ctenotus capricorni</i>	Capricorn Ctenotus		NT	Occurs in semi-arid sandy areas with Spinifex associated with woodland communities.	Potential to occur on North Creek Quarry as suitable habitat occurs in the area. Single WildNet record only.
<i>Egernia rugosa</i>	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 to occur on North Creek Quarry as suitable habitat (intact woodland with fallen timber) occurs. However, no survey or database records. EPBC online search only.
<i>Antairoserpens warro</i>	Robust Burrowing Snake		NT	Secretive burrowing species. Prefers loose soils in tropical woodlands with tussock grass.	Potential to occur on North Creek Quarry as suitable habitat occurs on site. Two WildNet records.
<i>Denisonia maculata</i>	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. Individual recorded on Borrow 7 but no habitat on North Creek Quarry site. Single WildNet record and EPBC online search.
<i>Furina dunmalli</i>	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.
<i>Nettapus coromandelianus</i>	Cotton Pygmy-goose	M	NT	May occur on a variety of waterbodies but prefers those with abundant floating vegetation which it feeds on.	Occurs in area. At least 30 individuals observed on large farm dam. Will not occur on quarry site. Also WildNet records.
<i>Stictoneeta naevosa</i>	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.
<i>Geophaps scripta scripta</i>	Squatter Pigeon (southern)	V	V	Occurs in dry woodland. Generally on sandy soils close to water.	Occurs in area. Five individuals recorded at two sites. Potential to occur on site however substrate is generally unsuitable (rocky) and no permanent water observed nearby. Also GHD (2012a;b) and WildNet records. EPBC online search

Scientific name	Common name	EPBC Act ¹	NC Act ²	Preferred habitat	Potential to occur
<i>Erythrotriorchis radiatus</i>	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 Project area is predominantly cleared.
<i>Lophoictinia isura</i>	Square-tailed Kite		NT	Occurs in a variety of forested habitats where it forages on birds and eggs.	Potential to occur on North Creek. Species may occur although forested habitat is limited in area. Two WildNet records.
<i>Ephippiorhynchus asiaticus</i>	Black-necked Stork		NT	Large species that occurs on a variety of wetlands. Carnivorous feeding on a variety of vertebrates, crustaceans, molluscs and invertebrates.	Occurs in area. Individual observed on large farm dam. Will not occur on quarry site. Also GHD (2012a) and WildNet records.
<i>Rostratula australis</i>	Australian Painted Snipe	V, M	V	Prefers temporary shallow wetlands. Nests in freshly flooded wetlands with low vegetation.	Will not occur on quarry site. Potential to occur on wetlands in area but no database records. EPBC online search only.
<i>Grantiella picta</i>	Painted Honeyeater		V	Occurs in a variety of forests/woodlands that contain mistletoes. Winter visitor to Queensland.	Potential to occur on North Creek. May sporadically occur wherever there are mistletoes. Single WildNet record.
<i>Poephila cincta cincta</i>	Black-throated Finch (southern)	E	E	Occurs in grassy open woodlands near water. Prefers areas of intact woodlands.	Unlikely. No suitable habitat onsite. Many records in mine area to west by GHD (2012a) and several WildNet records. EPBC online search.
<i>Neochmia ruficauda ruficauda</i>	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.
<i>Phascolarctos cinereus</i>	Koala	V	S	Occurs in a variety of eucalypt woodlands and open forest.	Potential to occur in area where evidence of presence (scratches) observed. Habitat within remaining sites in relatively poor condition or cleared. Also GHD (2012a) and six WildNet database records within 50 km radius of Project area.
<i>Chalinolobus picatus</i>	Little Pied Bat		NT	Occurs in a variety of dry woodland forest types including mallee, eucalypt, <i>Callitris</i> and <i>Casuarina</i> .	Potential to occur in area. Recorded by GHD (2012a;b) and WildNet records.
<i>Lasiornis krefftii</i>	Northern Hairy-nosed Wombat	E	E	Occurs in sandy, grassy woodland.	Unlikely. Species almost entirely restricted to Epping Forest south of Project area. Single Wildnet record.

Scientific name	Common name	EPBC Act ¹	NC Act ²	Preferred habitat	Potential to occur
Migratory species					
<i>Haliaeetus leucogaster</i>	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 Project area or surrounds. No database records. EPBC search only.
<i>Apus pacificus</i> <i>Hirundapus caudacutus</i>	Fork-tailed Swift White-throated Needletail	M	S	Aerial foraging species that occur over a variety of landscapes including highly modified environments.	White-throated Needletail Occurs in area. Both species may seasonally occur over the area.
<i>Ardea modesta</i>	Eastern Great Egret	M	S	Eastern Great Egret occurs on a variety of wetlands and intertidal habitats.	Occurs in area. Several individuals observed on large farm dam. Will not occur on quarry site. Three WildNet records. EPBC online search.
<i>Ardea ibis</i>	Cattle Egret	M	S	Cattle Egret prefers damp grassy areas for feeding, particularly pasture.	Potential to occur in paddocks after heavy rains. Single database record. EPBC online search.
<i>Plegadis falcinellus</i>	Glossy Ibis	M	S	Prefers shallow freshwater habitats. Sometimes occurs in intertidal habitat.	Occurs in area. Several individuals observed on large farm dam. Will not occur on quarry site.
<i>Tringa stagnatilis</i>	Marsh Sandpiper	M	S	May be found in both freshwater and estuarine habitats.	Will not occur on quarry site. Potential to occur on wetlands in area. Single database record.
<i>Gallinago hardwickii</i>	Latham's Snipe	M	S	Occurs in generally low numbers in a variety of permanent or ephemeral wetlands across eastern Australia.	Will not occur on quarry site. Potential to occur on wetlands in area. Single database record. EPBC online search.
<i>Merops ornatus</i>	Rainbow Bee-eater	M	S	Widespread species that may occur in a variety of habitats. Nests in burrows in sandy banks.	Occurs. Recorded onsite. Common in area at time of survey. Also GHD (2012a;b) and database records
<i>Rhipidura rufifrons</i>	Rufous Fantail	M	S	Prefers dense habitats including rainforest, riparian habitats and vine-thicket.	Potential to occur in area. Unlikely to occur on quarry site where habitat is generally poor. Two database records.
<i>Myiagra cyanoleuca</i>	Satin Flycatcher	M	S	Prefers dense habitats. Generally migrates through coastal forests where it may occur in more open habitats.	Potential to occur in area. Unlikely to occur on quarry site where 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 E – Conceptual Erosion and Sediment Control Plan

North Creek 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 North Creek 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.

North Creek Quarry is a new road base and embankment material quarry proposed to be located on Lot 2 SP119925, approximately 135 km north of Clermont in Central Queensland. The site is adjacent to the eastern side of Bulliwallah Road, which connects to Moray Carmichael Road in the south and the Gregory Development Road in the north. 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 North Creek 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 North Creek 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 North Creek 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 North Creek 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.

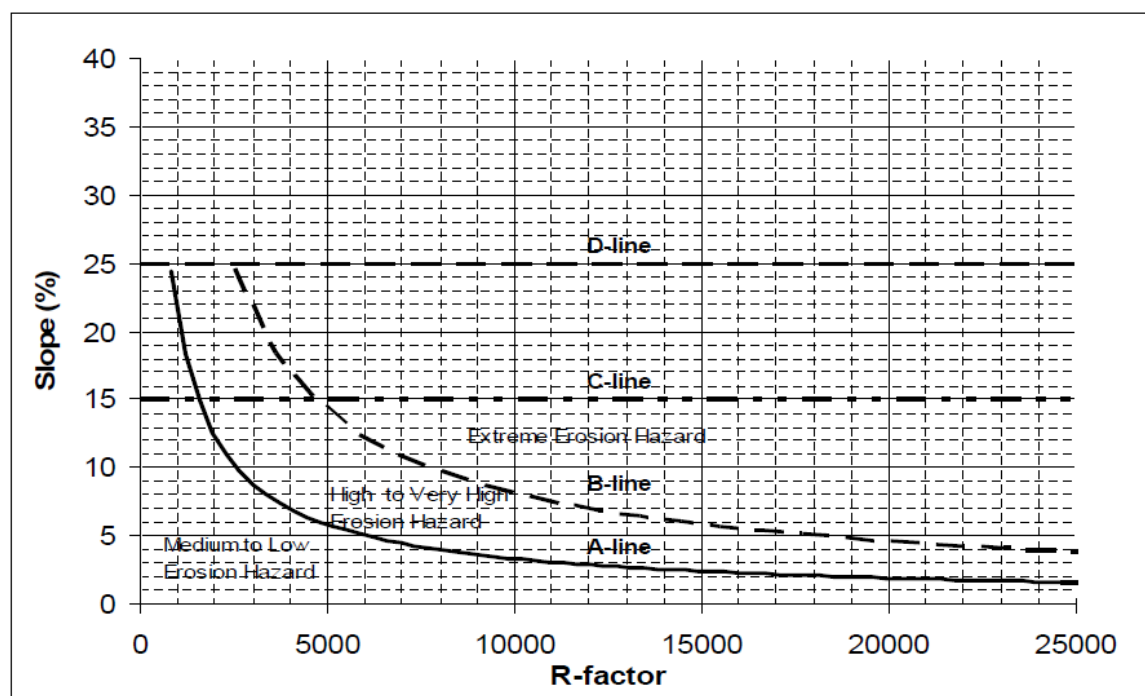


Figure 1 Slope and Rainfall Erosivity Erosion Hazard

1.6.3 Seasonality 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 (m²)

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 North Creek Quarry, and refers to sediment ponds and sediment sumps¹

¹ A sump is a hollow or depression in which liquid collects especially on the floor of a mine or 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	Sump
T – Duration (months)	9
A – Disturbance area (Ha)	76400
S –Slope factor	0.2101
K - Soil erosivity factor	0.066
H Number	9635

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 m² and an estimated soil loss rate that exceeds the equivalent of 150 t/ha/yr (refer to Table 3).

All catchment areas are greater than 2,500m², however the estimated soil loss is less than 150 t/ha/yr indicating that a sediment basin is not required for the North Creek Quarry construction activities. The sump sizing is included based on a 1 in 1 year, 120 hr rain event. The sumps are considered best practice and are not mandatory. The indicative volume of the sump is provided in the Conceptual ESCP drawing attached.

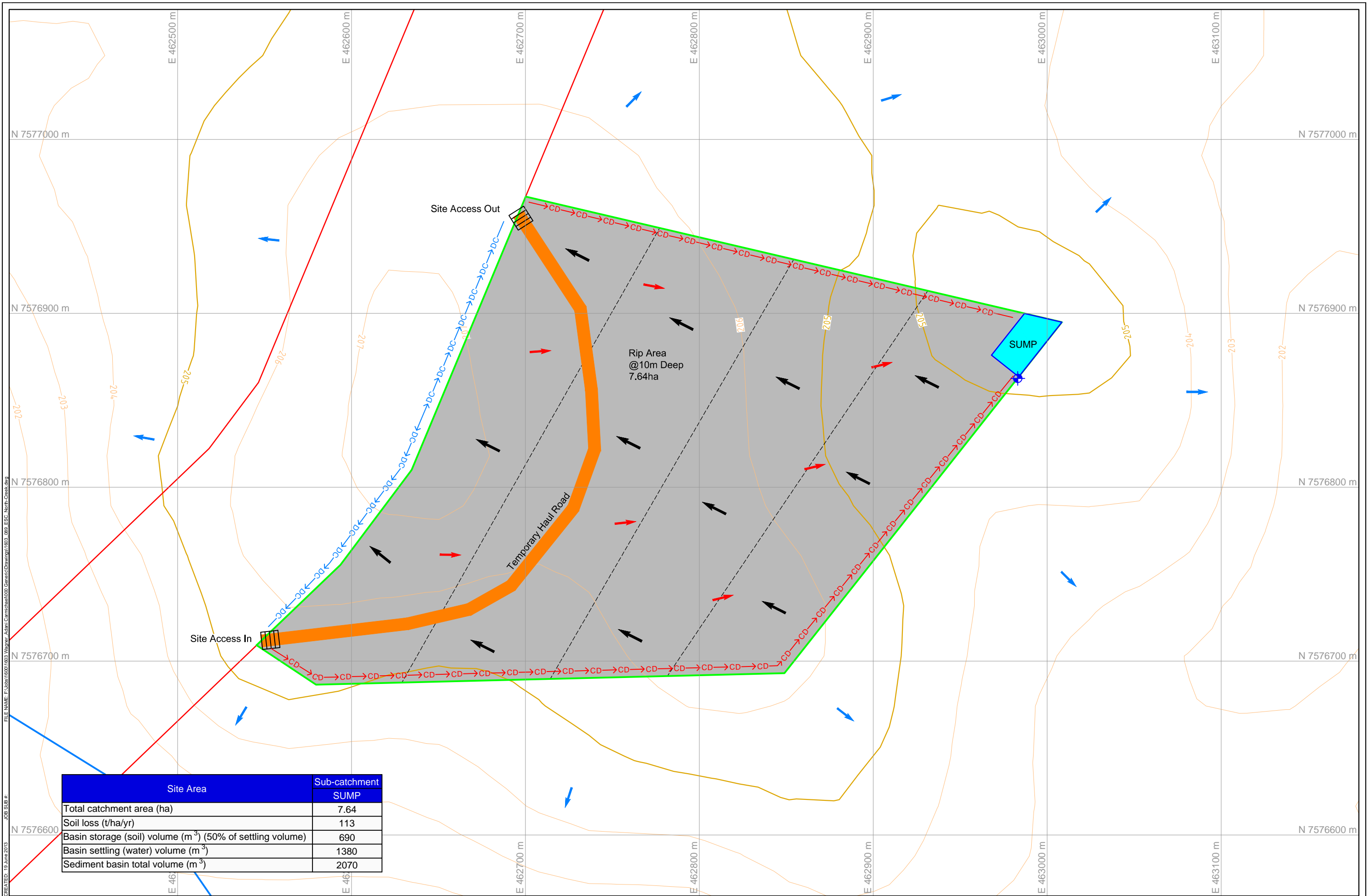
Table 3 RUSLE Calculation

RUSLE Parameters	Sump	Comments
Rainfall erosivity (R-factor)	1804	IECA 2008 Table E1 (Emerald)
Soil erodibility (K-factor)	0.066	IECA 2008 Table E4
Slope length (m)	360	
Slope gradient (%)	2	
Length/gradient (LS-factor)	0.73	IECA 2008 Table F2 or Equation F3
Erosion control practice (P-factor)	1.3	IECA 2008 E11
Ground cover (C-factor)	1	IECA 2008 Table E6
Soil Loss (t/ha/yr)	113	

1.9 Conclusion

The Conceptual ESCP for North Creek Quarry indicates that;

- One sediment basin will be required;
- Adequate space is available for the sediment basin. At this stage of planning the size and location of basin 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.



REV	DESCRIPTION	DATE	BY

Data Sources:
Photography: 1s SRTM 2008 DEM-S © Commonwealth of Australia (Geoscience Australia) 2012
Cadastral:
Ecosystem:
Other:
THESE DESIGNS AND PLANS ARE COPYRIGHT AND ARE NOT TO BE USED OR REPRODUCED WHOLLY OR IN PART OR TO BE USED ON ANY PROJECT WITHOUT THE WRITTEN PERMISSION OF GROUNDWORK PLUS. ADM: 80 829 145 906

Legend:
— Cadastral Boundary
— Ordered Stream
— Isaac Regional Council Quarry Extent
● Discharge Point
← General Direction of Extraction
■ Site Entry / Exit Shakedown Grid
→ Clean Water Flow
→ Dirty Water Flow
→ DC → Clean Water Diversion Channel
→ CD → Dirty Water Catch Drain
■ Basin Location

PROJECT: Carmichael Coal Project
CLIENT: Wagner Quarries Pty Ltd

TITLE: North Creek - Water Management Strategy
Erosion and Sediment Controls Plan
GROUNDWORK plus
PH: +61 7 3871 0411
WWW.GROUNDWORK.COM.AU
SCALE: 1:2,000
0 40
DATE: 20 June 2013
PRINTED: 20 June 2013
DRAWN:
CHECKED:
DRAWING NUMBER: 1603.089
REVISION:
LT DATUM: HORIZONTAL / VERTICAL / ZONE
MGA / AHD / 55

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



Land use suitability

Irrigated (all types) cropping	: <i>all crops and pastures</i>
Dryland cropping	: <i>sorghum, sunflower, mungbeans, wheat, cotton, chickpea, safflower</i>
Forage cropping	: <i>all forage sorghums, oats, dolichos, cowpea</i>
Grazing native pastures	: <i>low productivity of bluegrasses and annuals under scrub; reasonable productivity when cleared</i>
Grazing sown pastures	: <i>highly productive purple pigeon</i>

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

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

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

Land use suitability

Irrigated (all types) cropping	: <i>all crops</i>
Dryland cropping	: <i>all types</i>
Forage cropping (short term)	: <i>all forage sorghums</i>
Grazing native pastures	: <i>reasonably productive bluegrasses and other natives in uncleared state; highly productive when cleared</i>
Grazing sown pastures	: <i>highly productive buffel grass</i>

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

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

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

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

Land use suitability

Irrigated (all types) cropping	: <i>peanuts, horticultural crops and pastures</i>
Forage cropping (short term)	: <i>all forage sorghums</i>
Grazing native pastures	: <i>reasonably productive speargrass, desert bluegrasses, other native grasses in uncleared state; highly productive when cleared</i>
Grazing sown pastures	: <i>reasonable productive buffel grass, stylo</i>

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

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

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

AMU description:

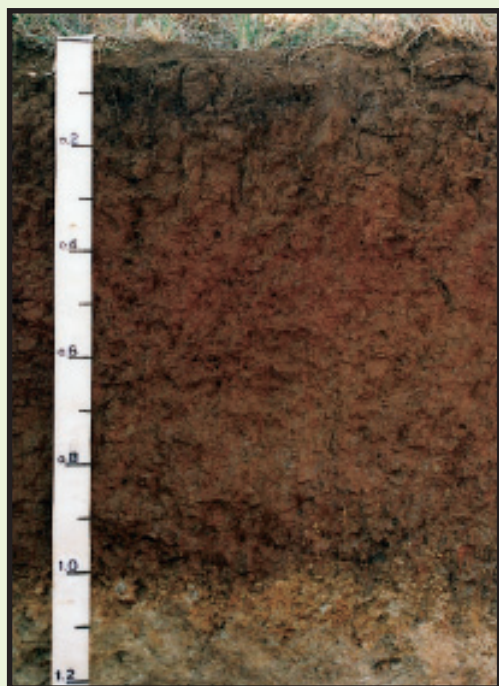
Red to brown duplex soils which are moderately structured and well drained under brigalow scrub

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

Land use suitability

Irrigated (all types) cropping	: <i>all crops and pastures</i>
Dryland farming (small areas only)	: <i>winter crop only, wheat, chickpea, safflower</i>
Forage cropping	: <i>oats</i>
Grazing native pastures	: <i>very low producing wiregrasses and speargrasses in uncleared state; reasonably productive when cleared</i>
Grazing sown pastures	: <i>highly productive buffel grass, rhodes grass, stylo, green panic</i>

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%

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

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

AMU description:

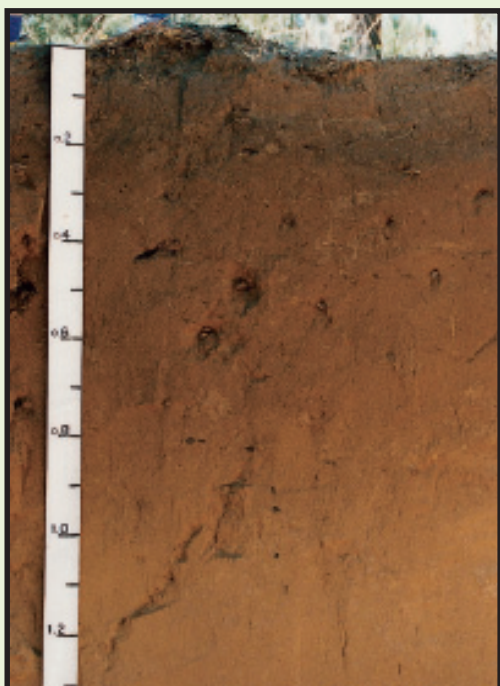
Deep, coarse and medium textured soils associated with alluvial levees and interchannel areas

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

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

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

AMU description:

Shallow cracking and non-cracking clays on undulating open downs formed on basalt

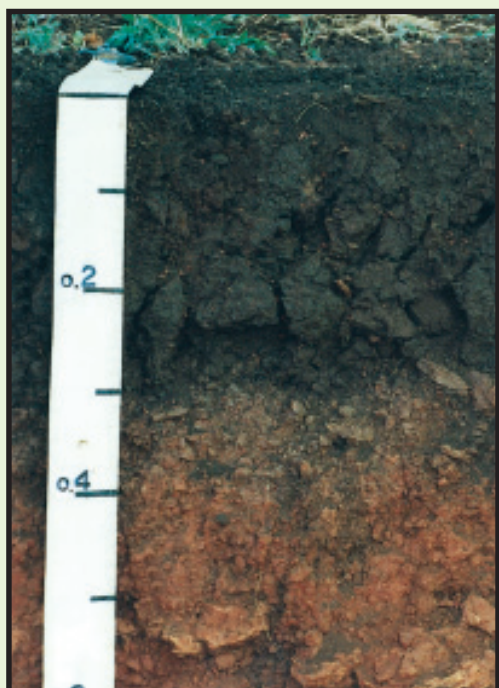
Site description

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

AMU description:

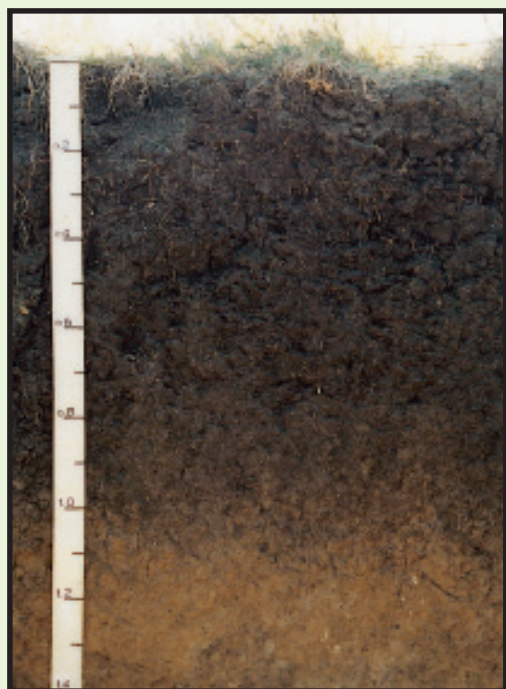
Black cracking clays with a strong fine granular surface mulch on undulating open downs formed on shales

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

Land use suitability

Irrigated (all types) cropping	: <i>all crops and pastures</i>
Dryland cropping	: <i>sorghum, sunflower, chickpea, mungbeans, wheat, safflower, cotton</i>
Forage cropping	: <i>all forage sorghums, oats, dolichos, cowpea</i>
Grazing native pastures	: <i>very highly productive bluegrasses, and other native grasses</i>
Grazing sown pastures	: <i>highly productive buffel grass, rhodes grass, purple pigeon</i>

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

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

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

AMU description:

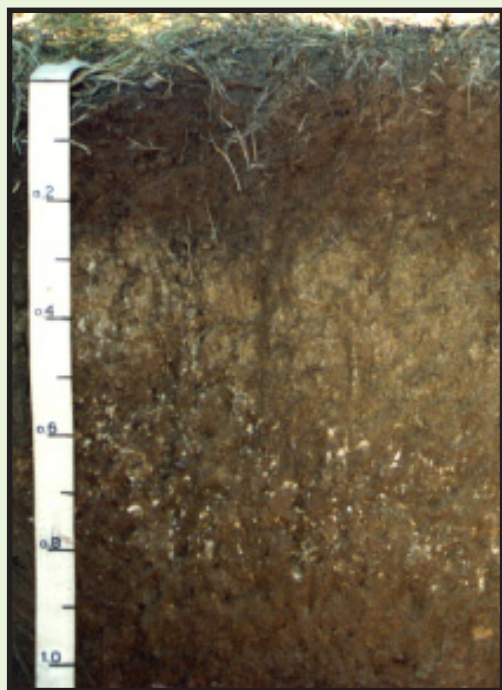
Melonholed grey and brown clays on brigalow scrub plains

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

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

Land use suitability

Irrigated (all types) cropping	: <i>all crops</i>
Dryland cropping	: <i>sorghum, sunflower, wheat, mungbeans, chickpea, safflower, cotton</i>
Forage cropping	: <i>all forage sorghums, oats, dolichos, cowpea</i>
Grazing native pastures	: <i>highly productive bluegrasses and other native grasses uncleared; highly productive when cleared</i>
Grazing sown pastures	: <i>highly productive purple pigeon</i>

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

AMU description:

Deep red, brown to grey uniform clays on broad to narrow, occasionally deeply incised, alluvial plains draining basalt landscapes

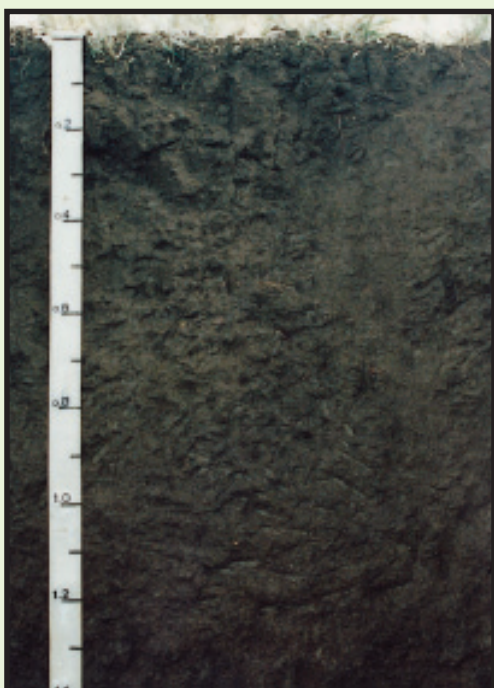
Site description

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

AMU description:

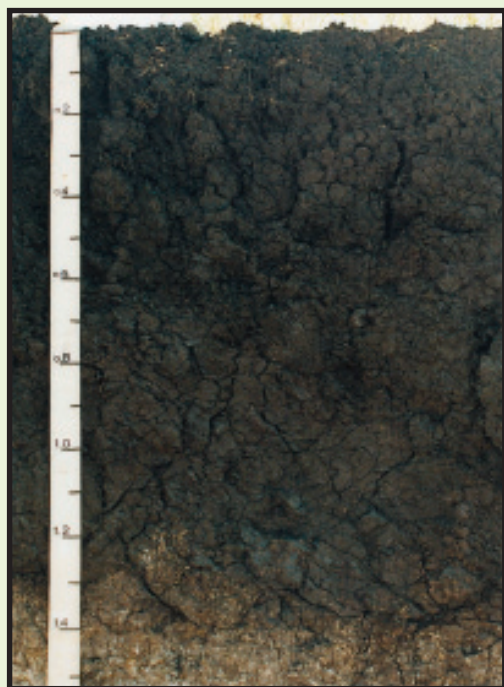
Deep, cracking dark clays on undulating downs on basalt

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

Land use suitability

Irrigated (all types) cropping	: <i>all crops and pastures</i>
Dryland cropping	: <i>sorghum, sunflower, wheat, mungbeans, chickpea, safflower, cotton</i>
Forage cropping	: <i>all forage sorghums, oats, dolichos, cowpea</i>
Grazing native pastures	: <i>very highly productive bluegrasses and other native grasses</i>
Grazing sown pastures	: <i>highly productive purple pigeon</i>

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 establishment

Land use suitability

- Irrigated (all types) cropping** : *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

AMU description:

Deep red, brown to grey cracking clays under brigalow, softwood scrub or gidgee scrub

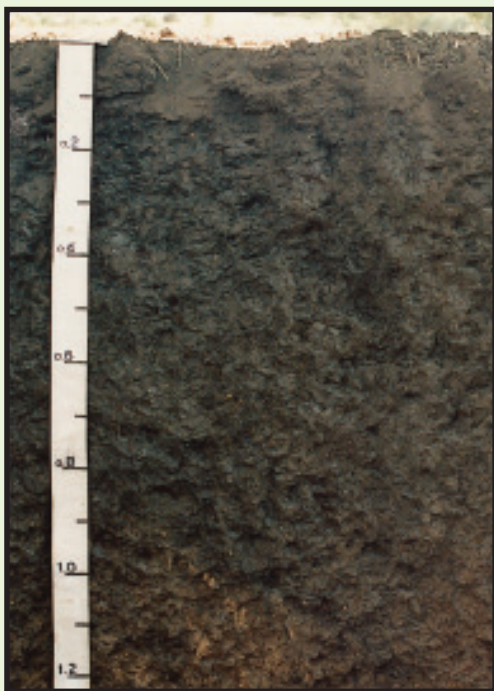
Site description

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

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

Land use suitability

Irrigated (all types) cropping	: <i>all crops and pastures</i>
Dryland cropping (short term)	: <i>sorghum, wheat, chickpea</i>
Forage cropping	: <i>forage sorghums, oats, dolichos, cowpea and millets</i>
Grazing native pastures	: <i>low producing bluegrasses, wire-grasses and other native grasses uncleared; moderately productive when cleared</i>
Grazing sown pastures	: <i>moderately productive buffel grass, rhodes grass and purple pigeon</i>

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

Land use suitability

Irrigated (all types) cropping	: <i>all crops and pastures</i>
Forage cropping	: <i>all forage sorghums, oats, dolichos, cowpea, millets</i>
Grazing native pastures	: <i>very low producing bluegrass and scrub grasses when uncleared; moderately productive when cleared</i>
Grazing sown pastures	: <i>highly productive buffel grass, green panic and rhodes grass</i>

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

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 bottle tree.



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

AMU description:

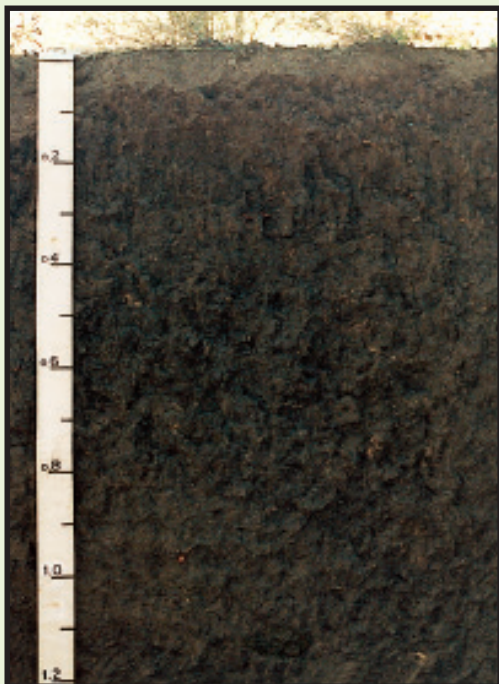
Grey to brown duplex soils with thin sandy surfaces on undulating brigalow scrub country

Site description**Landform**

Midslope positions of undulating landscapes in association with Springton and Picardy AMUs.

Vegetation

Brigalow, belah, Dawson gum and yellow-wood 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

Land use suitability

Irrigated (all types) cropping	: <i>all crops and pastures</i>
Dryland cropping	: <i>sorghum, sunflower, cotton, mungbeans, wheat, chickpea, safflower</i>
Forage cropping	: <i>all sorghum forages, oats, dolichos,</i>
Grazing native pastures	: <i>very low producing bluegrass and other native grasses uncleared; moderately productive when cleared</i>
Grazing sown pastures	: <i>highly productive buffel grass, green panic, rhodes grass and purple pigeon</i>

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: 49050807 EMR Site Id: 27 February 2013
Cheque Number:
Client Reference:

This response relates to a search request received for the site:
Lot: 2 Plan: SP119925
1162 BULLIWALLAH 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 – Air Quality Impact Assessment



Vipac Engineers & Scientists - Brisbane Office

Level 2, 146 Leichhardt Street, Spring Hill QLD 4000

PO Box 436, Toowong QLD 4066

t. +617 3377 0400 | f. +617 3377 0499

e. brisbane@vipac.com.au | www.vipac.com.au

A.B.N. 33 005 453 627 | ISO9001 Certified Quality Management System

CDM Smith Australia Pty Ltd


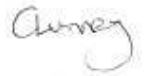
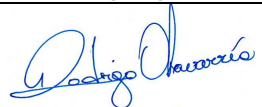
North Creek Quarry Air Quality Assessment



Report No. 70Q-12-0427-TRP-514323-3

8 July 2013

DOCUMENT CONTROL

North Creek Quarry Air Quality Assessment		
REPORT NO: 70Q-12-0427-TRP-514323-3		
PREPARED FOR: CDM Smith Australia Pty Ltd 21 McLachlan Street Fortitude Valley Qld 4006 Australia Contact: Miranda Z. Weston Phone: +61 7 3828 6900 Fax: +61 7 3828 6999	PREPARED BY: Vipac Engineers & Scientists Ltd Level 2, 146 Leichhardt Street Spring Hill, QLD 4000 AUSTRALIA e: brisbane@vipac.com.au t: +61 7 3377 0400 f: +61 7 3377 0499	
AUTHOR:		
	Michelle Clifton	Date: 8 July 2013
	Consulting Scientist	
REVIEWED BY:		
	Chris Lunney	Date: 8 July 2013
	Reviewing Engineer	
ISSUED BY:		
	Rodrigo Olavarria	Date: 8 July 2013
	QA Representative	
REVISION HISTORY:		
Revision No.	Date Issued:	Reason/Comments:
3	8 July 2013	Changed Map
2	8 July 2013	Minor Changes
1	5 July 2013	Minor Changes
0	30 Apr 2013	Initial Issue
DISTRIBUTION:		
Copy No. <u>2</u>	Location	
1	Project	
2	Client (PDF Format)	Uncontrolled Copy

NOTE: This is a controlled document within the document control system. If revised, it must be marked SUPERSEDED and returned to the VIPAC QA Representative.

EXECUTIVE SUMMARY

Vipac Engineers & Scientists Ltd (Vipac) was commissioned to prepare an air quality assessment for the proposed quarry known as North Creek 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, PM₁₀ 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, PM₁₀ 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 North Creek Quarry is one of five (5) proposed quarries as part of the development of the Carmichael Coal Mine and Rail Project. The cumulative impact of the maximum values from the Moray Quarry and North Creek Quarry plus the background concentration levels of TSP, PM₁₀, 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	5
2. PROJECT DESCRIPTION	5
2.1 OVERVIEW	5
2.2 EXTRACTION METHODS	6
2.3 SITE ACTIVITIES.....	7
2.3.1 Equipment	7
2.3.2 Operational Hours.....	7
2.3.3 Transportation	7
2.3.4 Production Schedule	7
3. SITE DESCRIPTION	8
3.1 LOCAL METEOROLOGY.....	8
3.2 SENSITIVE RECEPTORS	8
4. DUST POLLUTION - ACTIVITIES & SIGNIFICANCE	10
4.1 ACTIVITIES.....	10
4.2 SIGNIFICANCE.....	10
4.3 CUMULATIVE IMPACTS.....	10
5. REGULATORY FRAMEWORK & PROJECT CRITERIA	11
5.1 NATIONAL LEGISLATION	11
5.2 STATE LEGISLATION.....	11
5.3 PROJECT CRITERIA	11
6. EXISTING AIR QUALITY	12
7. METHODOLOGY	13
7.1 MODELLING.....	13
7.2 EMISSION RATES	13
8. IMPACT ASSESSMENT.....	14
8.1 CUMULATIVE IMPACTS.....	15
9. MITIGATION	16
10. CONCLUSION.....	17
11. REFERENCES	18
APPENDIX A : MONITORING DATA	19
APPENDIX B : CONTOUR PLOTS	21

1. INTRODUCTION

Vipac Engineers & Scientists Ltd (VIPAC) was commissioned to prepare an air quality assessment for the proposed quarry known as North Creek 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 and Rail Project, a quarry, referred to as North Creek is to be developed to provide embankment fill for the rail corridor. The North Creek Quarry is to be located approximately 42 km west of the Gregory Development Road and at its closest, approximately 900 m north of the proposed rail line, which will service the Carmichael Coal Mine. A location map is shown in Figure 2-1.

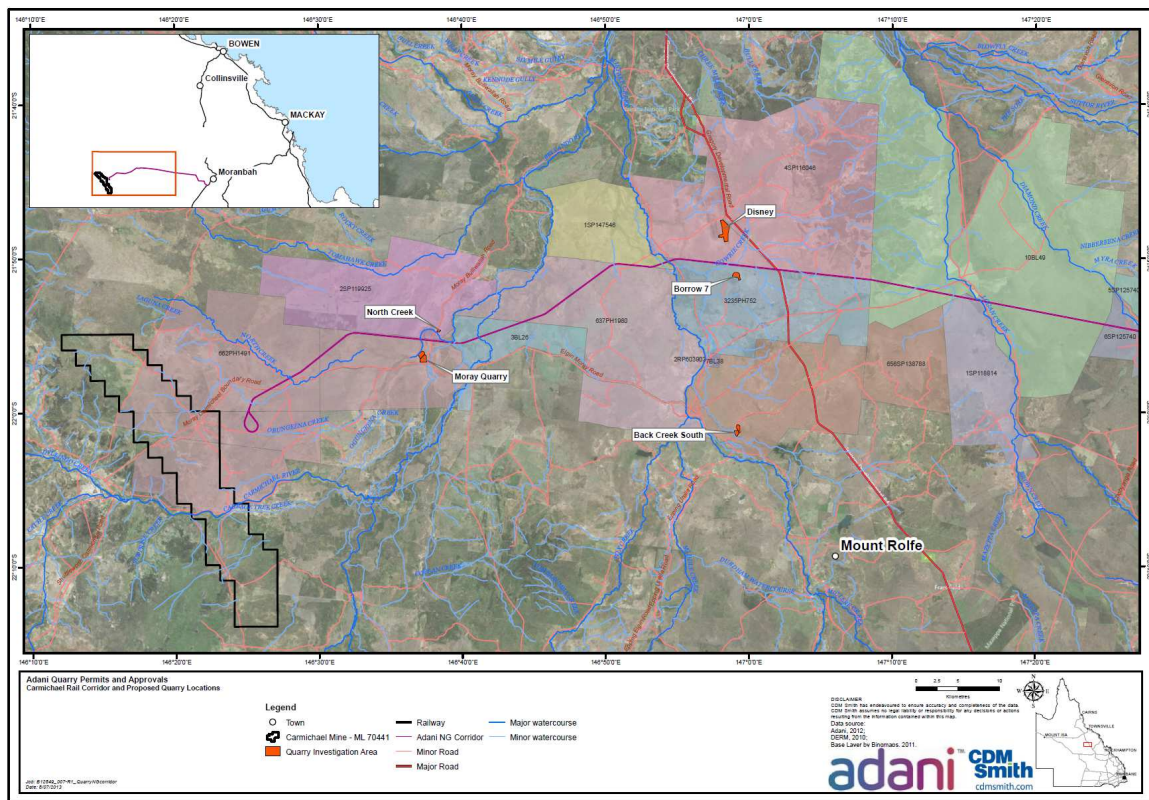


Figure 2-1: Location of Quarries

2.2 EXTRACTION METHODS

The North Creek Quarry is proposed to also be a potential western source of road construction and embankment materials for the rail corridor. The main current constraint at North Creek is the water course to the south of the site, and extraction and ripping has been designed to avoid this area as the material quality exposed in the flat area is comparable to the material exposed in the southern vegetated ridge area. Volumes at North Creek are based on a ripplable thickness of ten metres.

Extraction is to be completed by developing a series of linear rip faces with a small dozer ripping and pushing material to a stockpile which will then be loaded via loader/excavator either straight into a 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 however a new access to the site is also recommended so that the area of vegetation to the south of the site is not further disturbed.

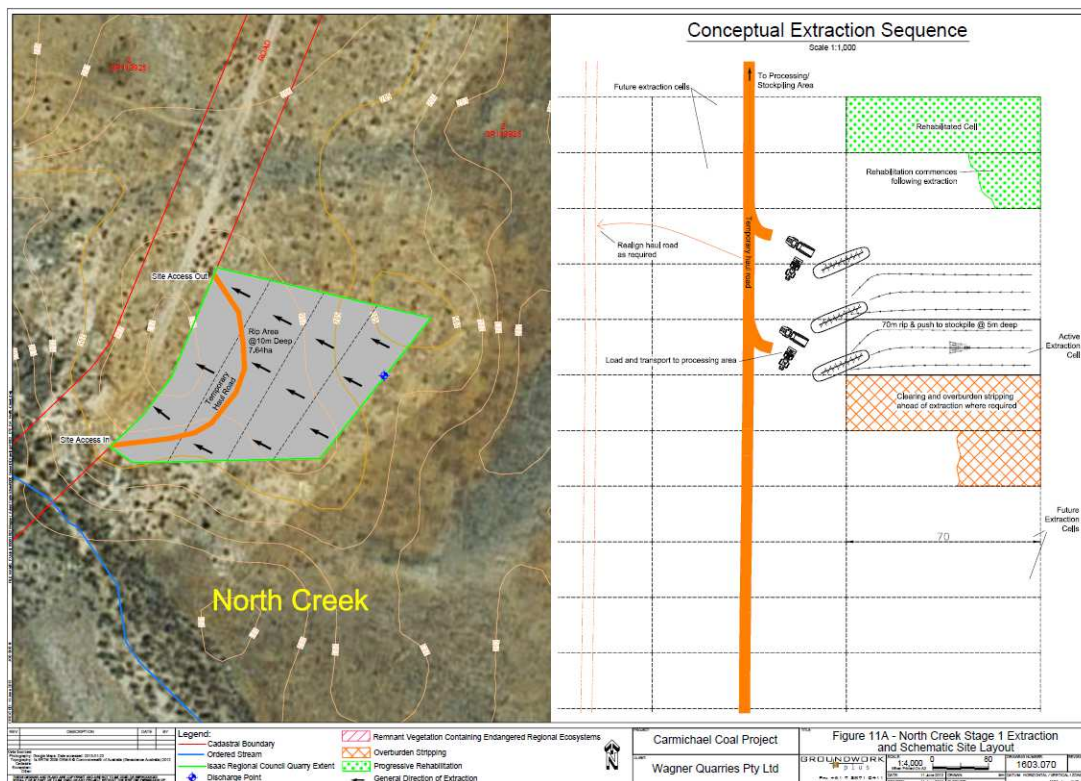


Figure 2-2: Site Layout

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 ACTIVITIES

2.3.1 Equipment

The following equipment will be used at the North Creek Quarry, which is of concern for this assessment is:

- 1x loaders (CAT980H);
- 3x light Plants (ALLIGHT);
- 1x waste Services (Weekly);
- 1x water Tanks & Pumps (25,000litre); and
- 1 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 one (1) truck will haul a maximum 2046 tonnes per day during peak production in September 2014

2.3.4 Production Schedule

The expected output is 603,000 tonnes over a 24-month operational life. The monthly output is shown in Figure 2-3, with the highest output of 61,391 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 North Creek Quarry.

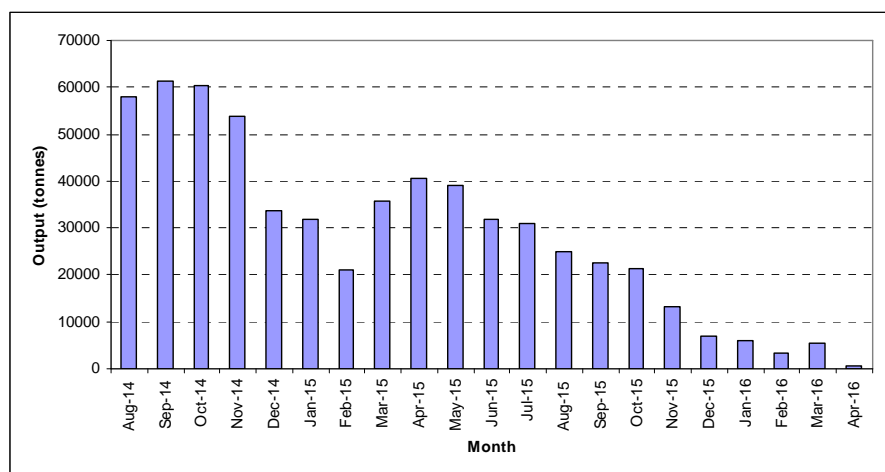


Figure 2-3: Expected Output by Month

3. SITE DESCRIPTION

3.1 LOCAL METEOROLOGY

Local meteorology has been generated for the North Creek 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.

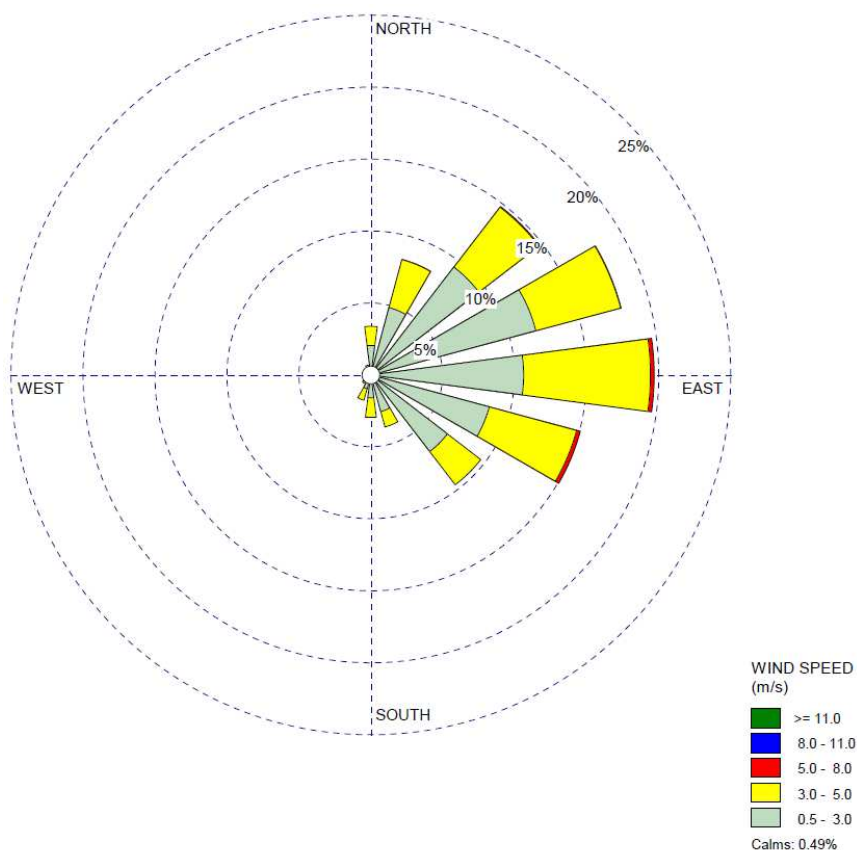


Figure 3-1: Annual Wind Rose (2006)

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 4 km south of the site; and
- Beenboona is located approximately 8.8 km north east of the site.

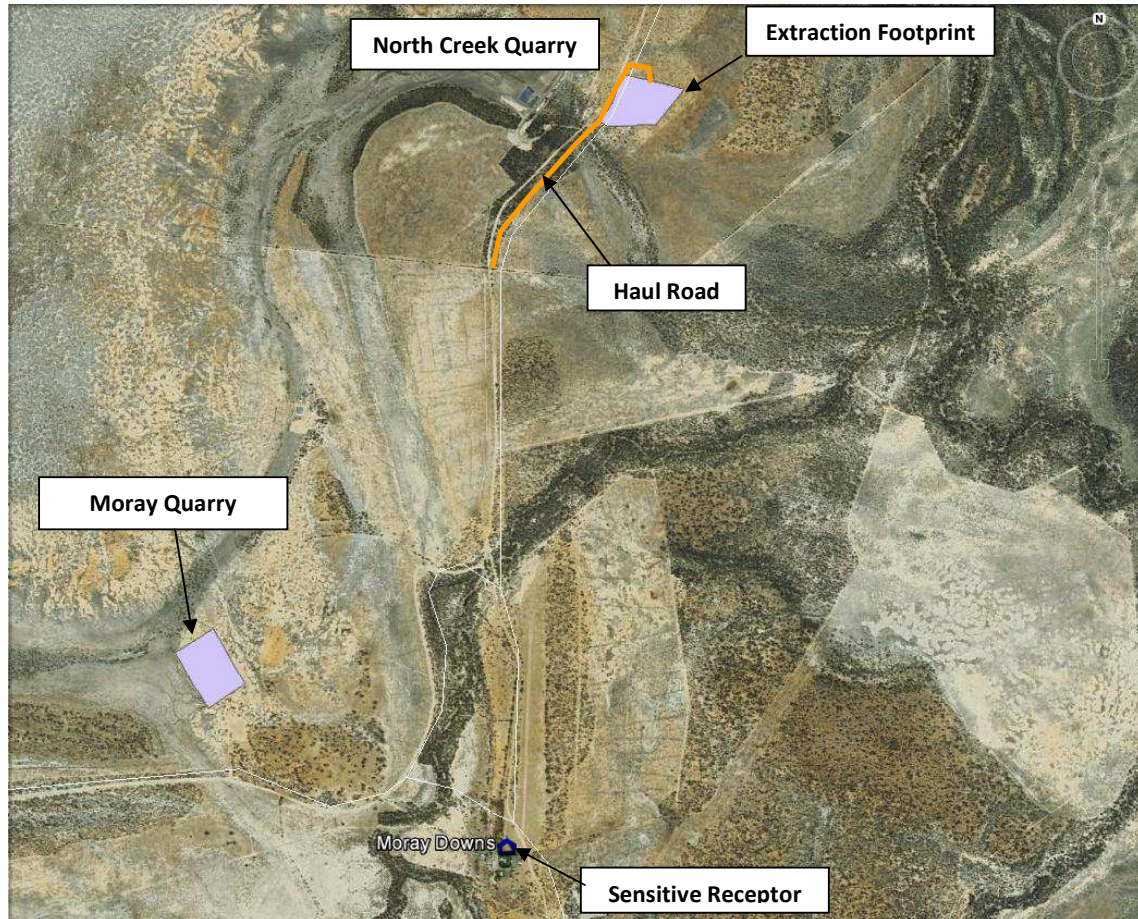


Figure 3-2: Sensitive Receptors Near North Creek Quarry

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 PM_{10}) 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 North Creek Quarry, activities will also be occurring at other quarries (please refer to Figure 2-1), which will use the same haul road. 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 (PM₁₀ 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 (EP Act) 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 EP Act 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 PM₁₀ (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 PM₁₀ criterion as the fraction of PM_{2.5} against PM₁₀ 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/m²/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 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

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 (PM₁₀) 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 the 1st April 2013. North Creek Quarry is approximately 34 km 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 PM₁₀ concentration to be 10 µg/m³, 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 PM₁₀ 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 PM₁₀. Particles in the size range of PM_{2.5} were found to comprise only 4% of TSP or equivalently 10% of PM₁₀.

The following estimates of background levels of dust will be used:

- Annual average concentration of TSP of 30 µg/m³;
- 24-hour average concentration of PM₁₀ of 10 µg/m³;
- 24-hour average concentration of PM_{2.5} of 1 µg/m³; and
- Dust deposition of 50 mg/m²/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 (m²) for representative predictions. Table 7-1 lists the emission rates for the equipment and activities associated with the North Creek Quarry with an output of 61,391 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	0.48	0.13	0.051	Watering – 2 litres/m ² /hour
Loader CAT 980H	3.12	0.83	0.328	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	0.0002	0.0001	0.000025	None Applied
Pit (Wind Erosion)	0.016	0.0083	0.0017	None Applied
Screening	0.007	0.003	0.0008	None Applied
Crushing (Secondary/Tertiary)	0.001	0.0003	0.000075	None Applied

The emission rates for dust and PM₁₀ 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 CAT 980H generates the greatest TSP, PM₁₀ 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, PM₁₀ 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 61,391 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, PM₁₀, 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	Dust Related Activities	Total	Criteria	Compliance
Dust Deposition (mg/m ² /day)	50	4.14	54.14	120 mg/m ² /day (30 days)	✓
TSP (µg/m ³)	30	0.62	30.62	90 µg/m ³ (1-year)	✓
PM ₁₀ (µg/m ³)	10	3.55	13.55	50 µg/m ³ (24-hour)	✓
PM _{2.5} (µg/m ³)	1	1.71	2.71	25 µg/m ³ (24-hour)	✓

Table 8-2: Quarry Dust Results at Beenboona Receptor

Pollutant	Background Levels	Dust Related Activities	Total	Criteria	Compliance
Dust Deposition (mg/m ² /day)	50	0.51	50.51	120 mg/m ² /day (30 days)	✓
TSP (µg/m ³)	30	0.02	30.02	90 µg/m ³ (1-year)	✓
PM ₁₀ (µg/m ³)	10	0.53	10.53	50 µg/m ³ (24-hour)	✓
PM _{2.5} (µg/m ³)	1	0.22	1.22	25 µg/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 minimal with the emissions from the pit activities contributing the greatest emissions during this phase. The emission from the haul road is minimal due to only one truck operating at a time.

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.

The distance between the quarry and the sensitive receptors are significantly 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 North Creek Quarry, activities associated with the Moray Quarry will also be occurring. The assessments for both quarries were based on peak output, with these peak outputs occurring in September 2014 for North Creek Quarry and in September 2014 for 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 (µg/m ³)	56.13	30.05	90 µg/m ³
PM ₁₀ (µg/m ³)	42.27	11.46	50 µg/m ³
PM _{2.5} (µg/m ³)	23.65	1.77	25 µg/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 Moray and North Creek 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 Receptor during the life of the quarry for dust deposition, TSP, PM₁₀ 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.

Vipac understands that Adani is the current owner of Moray Downs Homestead and it is unlikely that the Moray Downs will be occupied at the commencement of activities at the North Creek Quarry. Vipac expects that in the event that the homestead is occupied, Adani will work with the occupants to ensure to minimise air quality impacts from activities at the quarry.

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 ($>2\text{L}/\text{m}^2/\text{h}$) 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 ($\sim 4\text{L}/\text{m}^2/\text{h}$) 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, PM₁₀ 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, PM₁₀ 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, PM₁₀, 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'*.

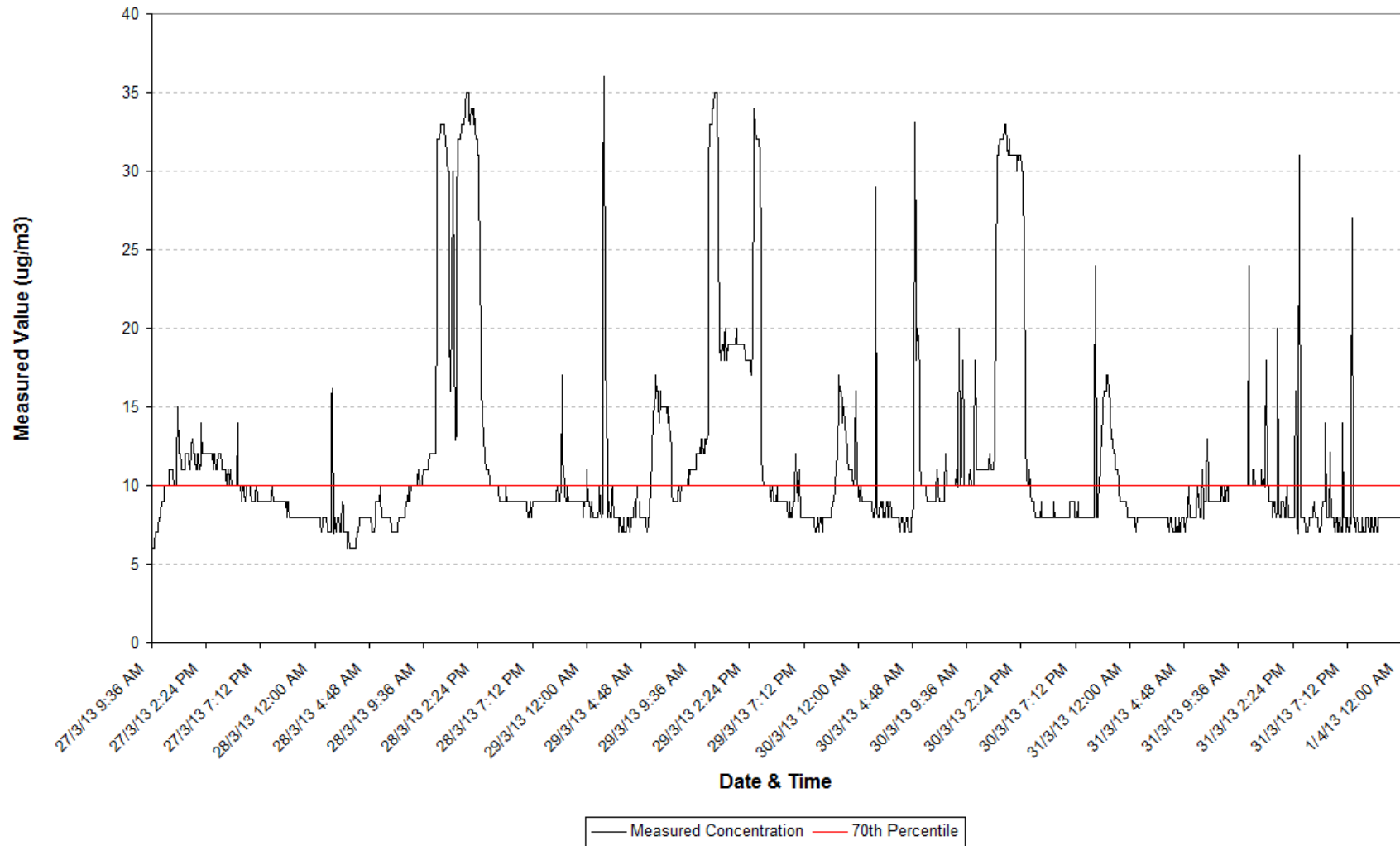
Environment Australia. (1999c). *'NPI Emission Estimation Techniques for Aggregated Emissions from Paved and Unpaved Roads'*. Department of Sustainability, Environment, Water, Population and Communities; Canberra.

Environment Australia 2012, *'NPI Emission Estimation Techniques (EET) Manual for Mining'*. Department of Sustainability, Environment, Water, Population and Communities; Canberra.

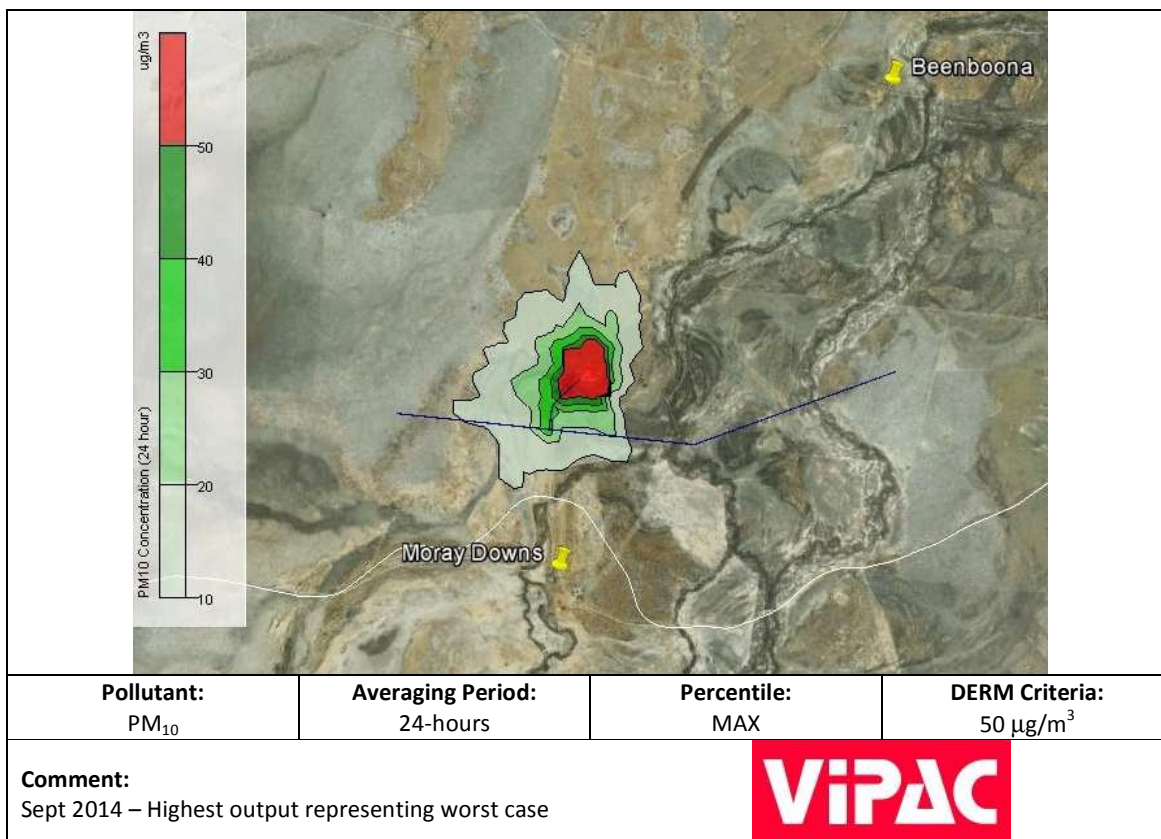
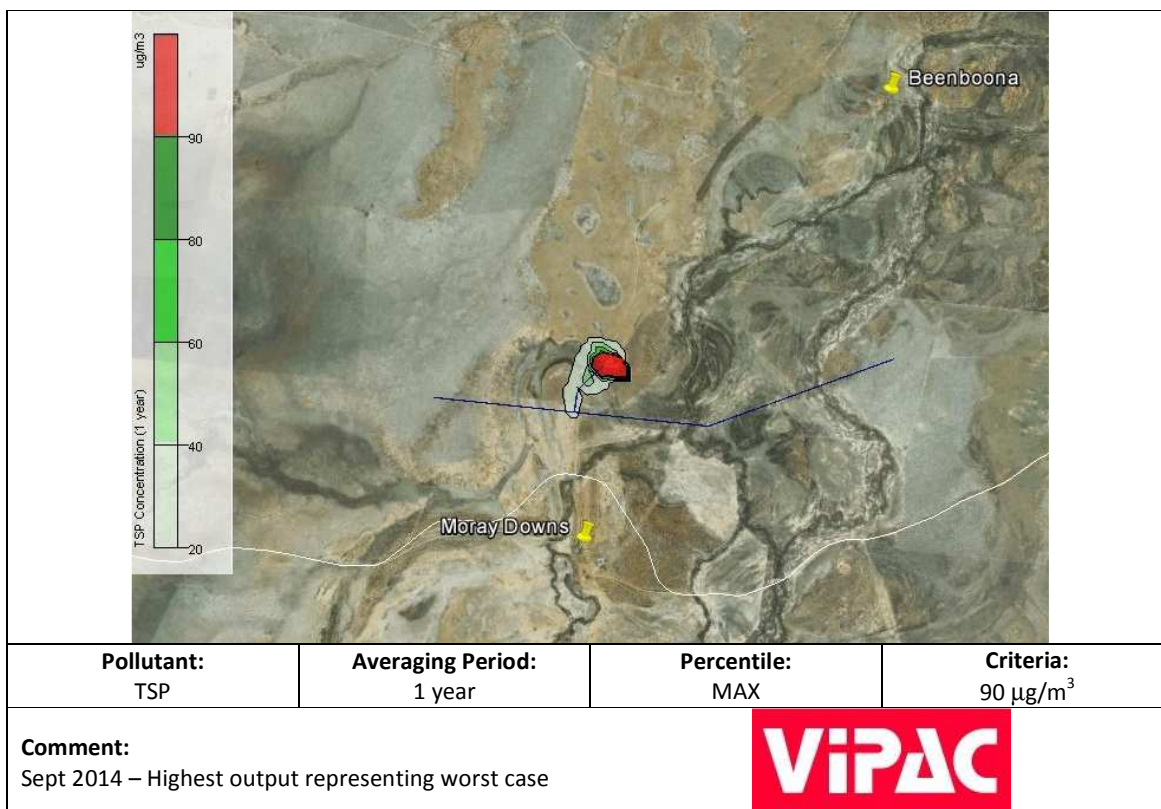
NSW Minerals Council. (2000) *'Particulate Matter & Mining'*. NSW Minerals Council; Sydney.

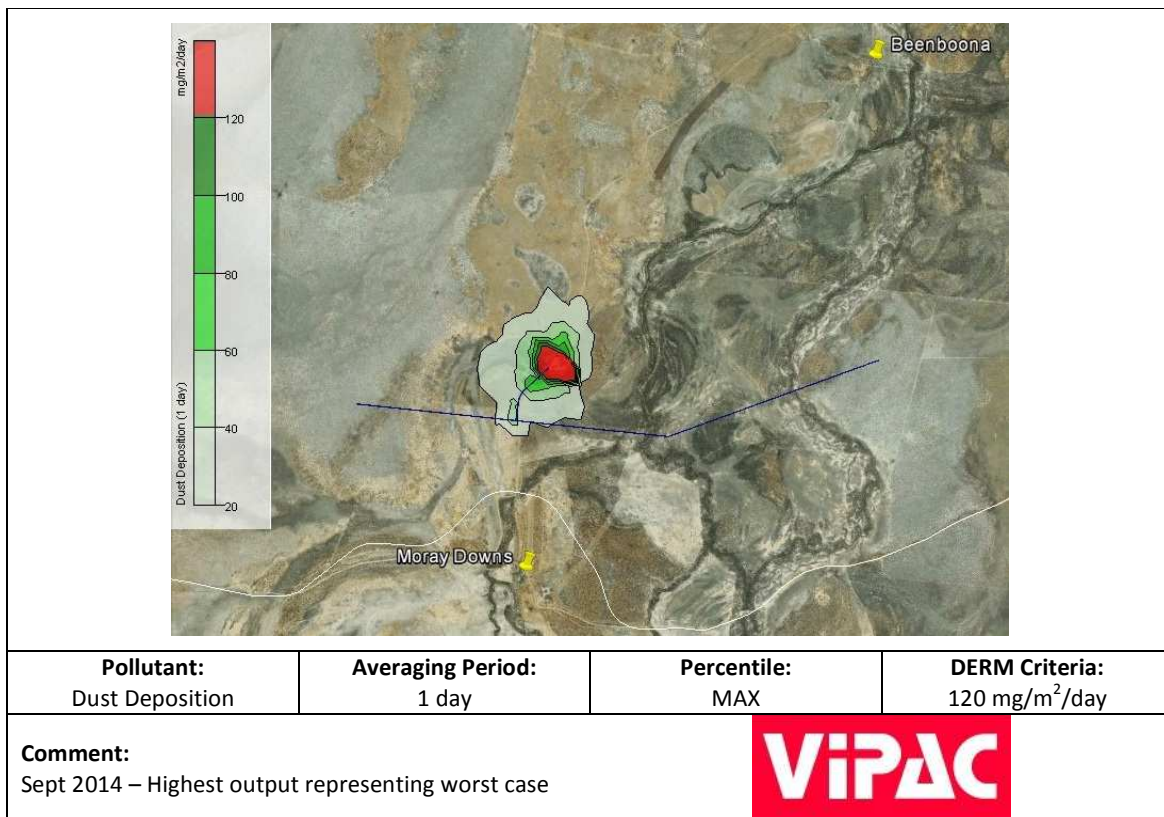
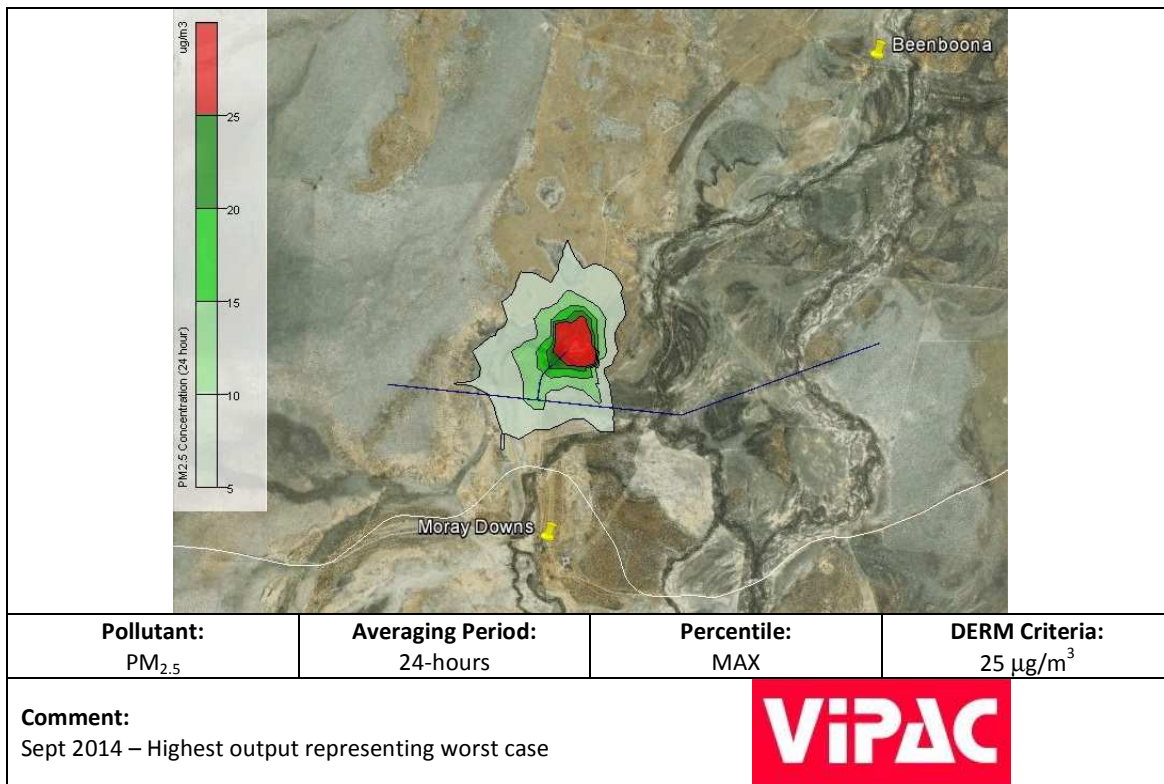
Environmental Protection Agency. (2008). *'Environmental Protection (Air) Policy'* Environmental Protection Agency. SL No. 208. Queensland Government; Brisbane.

APPENDIX A: MONITORING DATA

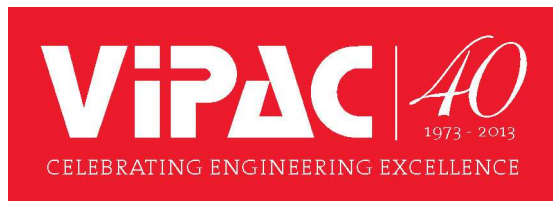


APPENDIX B: CONTOUR PLOTS





Appendix I – Noise Impact Assessment



Vipac Engineers & Scientists - Brisbane Office

Level 2, 146 Leichhardt Street, Spring Hill QLD 4000

PO Box 436, Toowong QLD 4066

t. +617 3377 0400 | f. +617 3377 0499

e. brisbane@vipac.com.au | www.vipac.com.au

A.B.N. 33 005 453 627 | ISO9001 Certified Quality Management System

CDM Smith Australia Pty Ltd

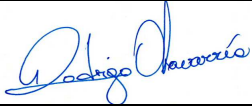


North Creek Quarry Noise Assessment



Report No. 70Q-12-0427-TRP-514324-1

8 Jul 2013

DOCUMENT CONTROL

North Creek Quarry Noise Assessment		
REPORT NO: 70Q-12-0427-TRP-514324-1		
PREPARED FOR: CDM Smith Australia Pty Ltd 21 McLachlan Street Fortitude Valley Qld 4006 Australia Contact: Miranda Z. Weston Phone: +61 7 3828 6900 Fax: +61 7 3828 6999		PREPARED BY: Vipac Engineers & Scientists Ltd Level 2, 146 Leichhardt Street Spring Hill, QLD 4000 AUSTRALIA e: brisbane@vipac.com.au t: +61 7 3377 0400 f: +61 7 3377 0499
AUTHOR:	 Rodrigo Olavarria Project Engineer	Date: 8 Jul 2013
REVIEWED BY:	 Tarmo Saar Reviewing Engineer	Date: 8 Jul 2013
ISSUED BY:	 Daniel Cheetham QA Representative	Date: 8 Jul 2013
REVISION HISTORY:		
Revision No.	Date Issued:	Reason/Comments:
1	8 Jul 2013	Minor Changes
0	30 Apr 2013	Initial Issue
DISTRIBUTION:		
Copy No. <u>2</u>	Location	
1	Project	
2	Client (PDF Format)	Uncontrolled Copy

NOTE: This is a controlled document within the document control system. If revised, it must be marked SUPERSEDED and returned to the VIPAC QA Representative.

EXECUTIVE SUMMARY

Vipac Engineers & Scientists Ltd (Vipac) was commissioned to prepare a noise assessment for the proposed quarry known as North Creek 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 quarry is planned to operate 24 hours a day. As such, the day-time and night-time dwelling (indoors) criteria has been applied.

Noise predictions have been conducted using SoundPLAN noise modelling software. 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 attended and unattended ambient noise monitoring between 27th March and the 4th April 2013. The noise monitoring locations have been identified as Disney Receptor and Old Twin Hills Receptor.

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 61,391 tonnes to be extracted and hauled from the North Creek 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 exceedances of the external day-time and night-time $L_{Aeq,adj,1hr}$ criteria would not be expected for the operation of the North Creek Quarry.

A conservative L_{Amax} noise level was calculated for adverse weather conditions to compare with the outdoor $L_{A1,adj,1hr}$ Acoustic Quality Objective. Under the worst-case adverse noise propagation, the maximum noise levels are expected to comply with the 47 dB(A) $L_{A1,adj,1hr}$ noise criterion at the closest noise sensitive receptor.

A cumulative noise assessment indicated that during neutral weather conditions, when the Back Creek South Quarry, Moray Quarry and North Creek Quarry operate simultaneously, exceedances to the noise criteria up to 3 dB(A) and 8 dB(A) may be expected at the Moray Downs Homestead for the day-time and night-time periods, respectively. Under adverse weather conditions, the noise criteria may be exceeded by up to 10 dB(A) at Moray Downs.

The exceedances for cumulative noise are caused by extraction activities at the Moray Quarry, not by the North Creek Quarry.

Recommendations were provided in this report to mitigate the noise impacts.

Vipac acknowledges that quarry extraction projects by other operators may also be planned in the area in the future. This assessment has only considered the cumulative impacts of proposed quarries operated by Adani. Any future approvals should consider all cumulative impacts.

TABLE OF CONTENTS

1. INTRODUCTION	5
2. PROJECT DESCRIPTION	5
2.1 OVERVIEW	5
2.2 EXTRACTION METHODS	7
2.3 SITE ACTIVITIES	9
2.3.1 Equipment	9
2.3.2 Operational Hours	9
2.3.3 Transportation	9
2.3.4 Site Illumination and Electrical Generation	9
2.3.5 Production Schedule	9
3. SITE DESCRIPTION	10
3.1 LOCAL METEOROLOGY	10
3.2 SENSITIVE RECEPTORS	11
4. REGULATORY FRAMEWORK & PROJECT CRITERIA	12
4.1 CONSTRUCTION AND OPERATION	12
5. METHODOLOGY	13
5.1 NOISE PREDICTION SOFTWARE	13
5.2 METEOROLOGICAL CONDITIONS	13
5.3 MODELLED SOUND POWER LEVELS	13
6. EXISTING ENVIRONMENT	14
6.1 EQUIPMENT	14
6.2 WEATHER CONDITIONS	14
6.3 NOISE MONITORING DATA	14
7. IMPACT ASSESSMENT	15
7.1 NORTH CREEK QUARRY ACTIVITIES	15
7.2 CUMULATIVE IMPACTS	16
7.3 SUMMARY OF RESULTS OF NORTH CREEK QUARRY	18
8. NOISE MITIGATION	19
8.1 NOISE MANAGEMENT	19
8.2 GENERAL NOISE CONTROL MEASURES	19
9. CONCLUSION	20
APPENDIX A : GLOSSARY	21
APPENDIX B : NOISE MONITORING DATA	23
B.1 MORAY DOWNS NOISE MONITORING DATA	24
B.2 TIME HISTORY GRAPH	25
APPENDIX C : NOISE CONTOURS	26

1. INTRODUCTION

Vipac Engineers & Scientists Ltd (Vipac) was commissioned to prepare a noise assessment for the proposed quarry known as North Creek Quarry. The purpose of this report is to evaluate the potential 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 development of the Carmichael Coal Mine and Rail Project, a quarry, referred to as North Creek Quarry is to be developed to provide material for the Moray Carmichael Road upgrade. The North Creek site is proposed to also be a potential western source of road construction and embankment materials for the rail corridor.

The North Creek Quarry is to be located approximately 42 km west of the Gregory Development Road and at its closest, approximately 900 m north of the proposed rail line, which will service the Carmichael Coal Mine. A location map is shown in Figure 2-1.

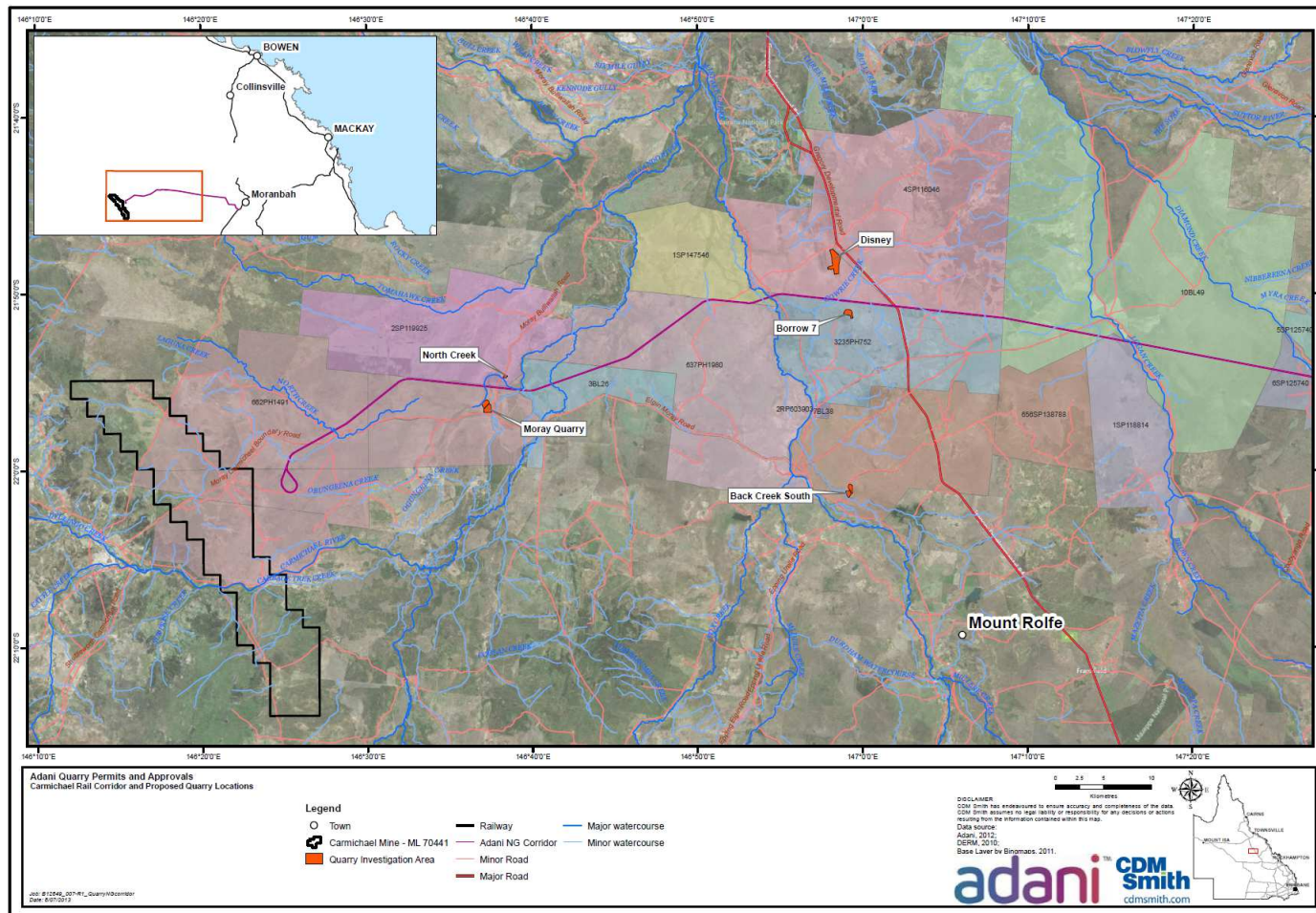


Figure 2-1: Location of Quarries

2.2 EXTRACTION METHODS

Volumes at North Creek Quarry are based on a rippable thickness of ten metres. Extraction is to be completed by developing a series of linear rip faces with a small dozer ripping and pushing material to a stockpile which will then be loaded via loader/excavator either straight into a truck or through a screening plant dependent upon the material quality. The site layout is shown in Figure 2-2. No blasting activities have been specified.

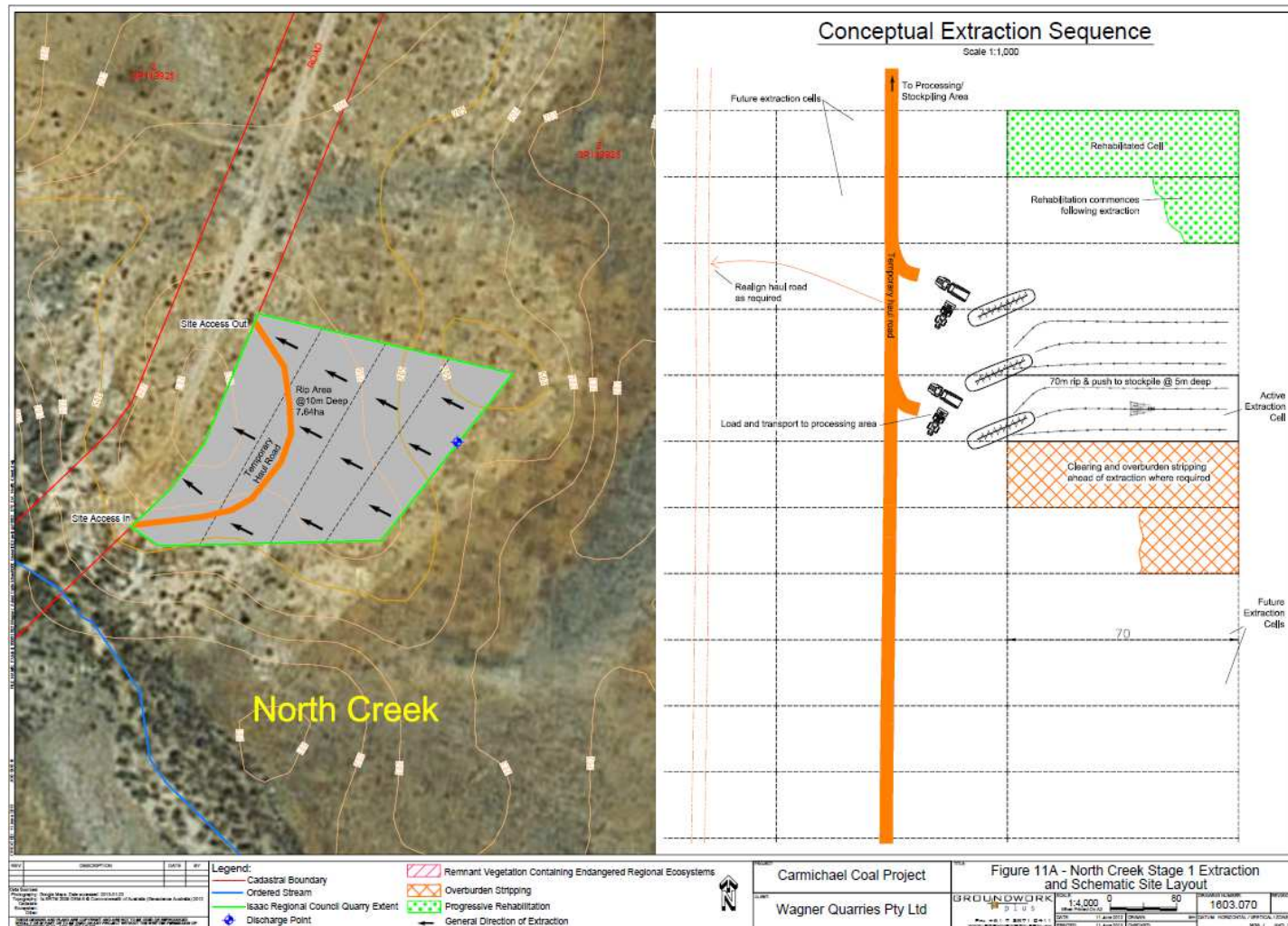


Figure 2-2: North Creek Extraction and Schematic Site Layout

2.3 SITE ACITIVITIES

2.3.1 Equipment

The following equipment will be used at the North Creek Quarry, which is of concern for this assessment:

- 1 x loaders (CAT980H);
- 3 x light Plants (ALLIGHT);
- 1 x waste Services (weekly);
- 1 x water Tanks & Pumps (25,000 litre); and
- 1 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 75 tonne AB triple trucks (road trains) and light vehicles, 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 have a 40 km/h speed limit and one (1) truck is expected to haul a maximum 2,046 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 Site Illumination and Electrical Generation

Three (3) ALLIGHT mobile lighting towers powered by approximately 21 kW generators shall be used to illuminate the site. The lights will run approximately between 5 pm to 7 am. One (1) 10 kVA enclosed genset will be used to power the site facilities. These generators will run 24 hours.

2.3.5 Production Schedule

The expected output is 603,000 tonnes over a 21-month operational life. The monthly output is shown in Figure 2-3, with the highest extraction of 61,391 tonnes per month expected to occur in September 2014.

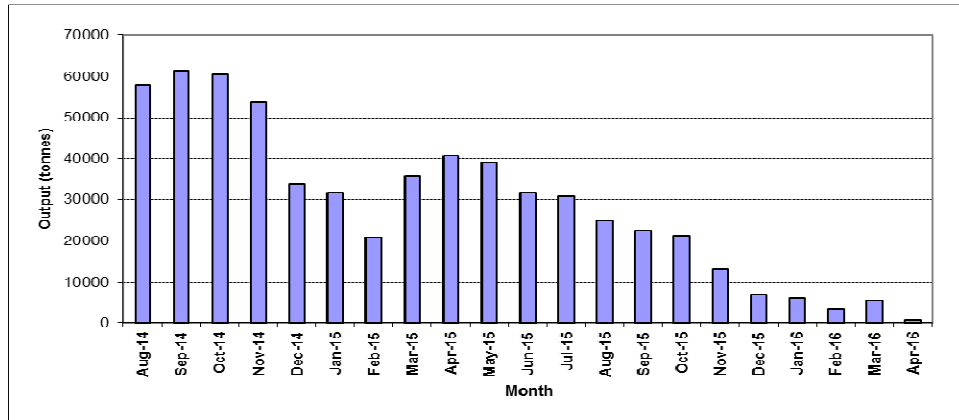


Figure 2-3: Expected Output by Month

3. SITE DESCRIPTION

3.1 LOCAL METEOROLOGY

Local meteorology has been generated for the North Creek 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.

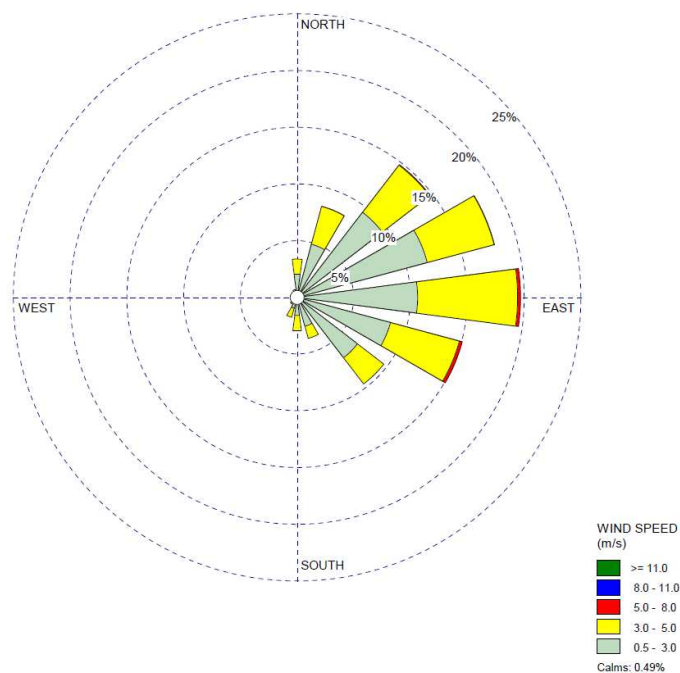


Figure 3-1: Annual Wind Rose (2006)

Local meteorology used in the modelling methodology is discussed in Section 5.2.

3.2 SENSITIVE RECEPTORS

Figure 3-2 shows the location of the closest homestead to the extraction site and Carmichael Road is Moray Downs located approximately 4.2 km south of the quarry and 1.6 km south of the Carmichael Road.

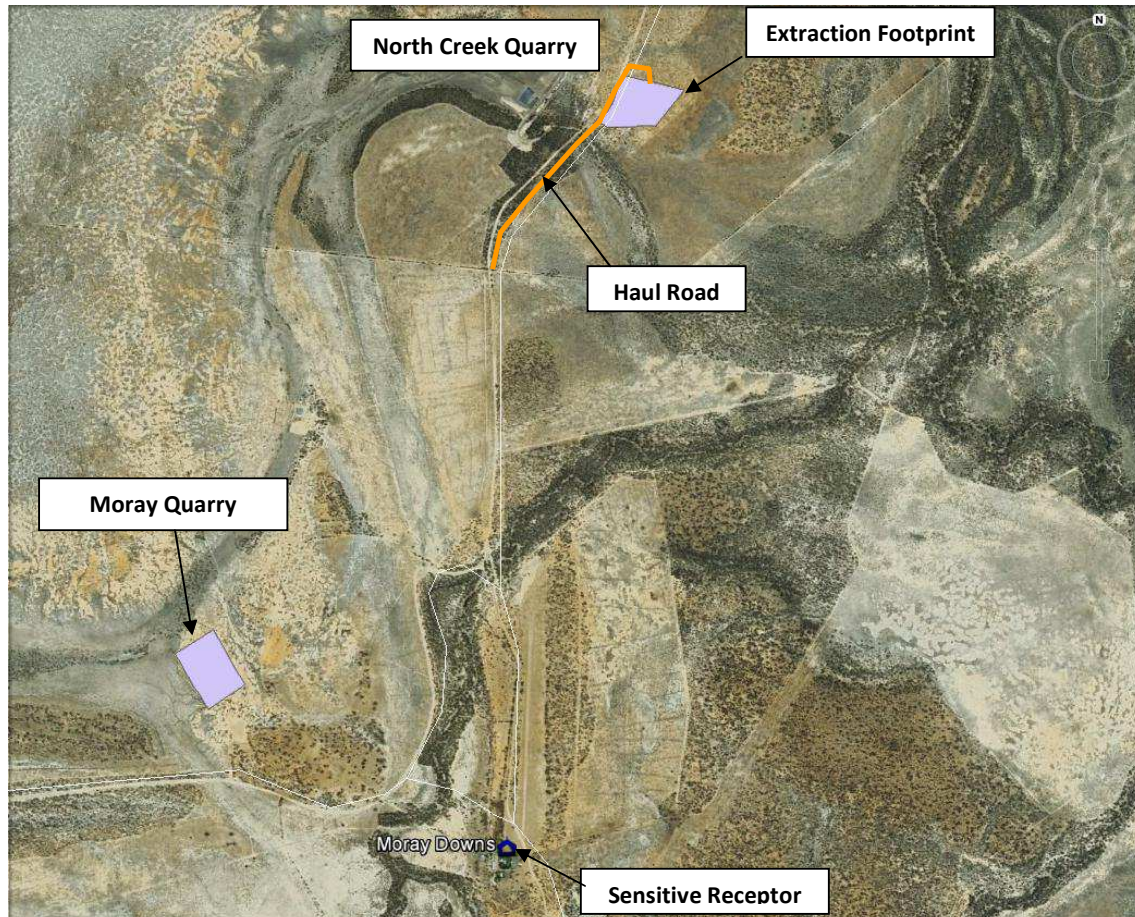


Figure 3-2: Sensitive Receptor Near North Creek Quarry

4. REGULATORY FRAMEWORK & PROJECT CRITERIA

When determining noise level criteria, the Isaac Regional Council refer to the Mackay, Issac 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 (indoors) 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 in the environment requires the definition of the noise sources including associated directivity for each source; SoundPLAN noise modelling software has been used for this analysis.

For this assessment, the CONCAWE prediction methodology has been used to take into consideration the weather conditions at the site. The frequency of 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 980H front end loader	117 / 120
ALLIGHT mobile lighting towers	107
Water tanker	115
75 tonne AB triple trucks (road trains)	112 / 112 (travelling)
	118 (dumping load)

6. EXISTING ENVIRONMENT

The existing noise environment has been determined through unattended ambient noise monitoring between 27th March and the 4th April 2013. The noise monitoring location is identified as Moray Downs Receptor.

6.1 EQUIPMENT

A 01db-Metravib DUO was utilised for the noise monitoring at Moray Downs.

Table 6-1: Noise Measurement Parameters

Measurement Details	DUO – 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

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 6-2.

Table 6-2: 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
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 Pasquill 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. IMPACT ASSESSMENT

The predicted noise levels contained within this Section are based on the maximum output of 61,391 tonnes, which is scheduled to occur in September 2014, as shown in Figure 2-3.

7.1 NORTH CREEK QUARRY ACTIVITIES

Regardless of the quarry output, the majority of noise sources will remain constant throughout the life of the mine. 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	Noise Criteria (outdoors)*		Predicted Noise Levels (dB L _{Aeq, Adj,1hour})			Complies with L _{Aeq,Adj,1hr} Criteria
	Day	Night	Extraction Activities Only	Haul Road Only	Combined Noise Levels	
Beenboona	42	37	12	-	12	YES
Cassiopeia	42	37	6	-	6	YES
Moray Downs	42	37	22	12	22	YES
Mount Gregory	42	37	1	-	1	YES
Twelve Mile Outstation	42	37	3	-	3	YES

- Indicates no contribution from this site at the receptor

* 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 7-1, the predicted noise levels comply with the L_{Aeq,Adj,1hr} noise criteria during neutral weather conditions.

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	Noise Criteria (outdoors)*		Predicted Noise Levels (dB L _{Aeq, Adj,1hour})			Complies with L _{Aeq,Adj,1hr} Criteria
	Day	Night	Extraction Activities Only	Haul Road Only	Combined Noise Levels	
Beenboona	42	37	17	3	17	YES
Cassiopeia	42	37	13	-	13	YES
Moray Downs	42	37	26	15	26	YES
Mount Gregory	42	37	8	-	8	YES
Twelve Mile Outstation	42	37	10	-	10	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 7-2, the predicted noise levels comply with the $L_{Aeq,Adj,1hr}$ noise criteria during adverse weather conditions.

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 Inversion

Sensitive Receptor	$L_{A1,adj,1hr}$ Noise Criteria (outdoors)*		Predicted Noise Levels (dB L_{Amax})		
	Day	Night	$L_{A1,adj,1hr}$ **	Source with Highest Noise Level	Complies with $L_{A1,adj,1hr}$ Criteria
Beenboona	52	47	20	Loader	YES
Cassiopeia	52	47	16	Loader	YES
Elgin Downs	52	47	11	Loader	YES
Geoscience Australia - Disney	52	47	10	Loader	YES
Laurel Hills	52	47	9	Loader	YES
Middle Creek	52	47	10	Loader	YES
Moray Downs	52	47	30	Haul Road	YES
Mount Gregory	52	47	11	Loader	YES
Old Twin Hills	52	47	11	Loader	YES
Twelve Mile Outstation	52	47	13	Loader	YES
Twin Hills	52	47	10	Loader	YES
Urella	52	47	11	Loader	YES

* A facade transmission loss of 7dB(A) taken into consideration to evaluate the outdoors noise level based on indoors 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 comply with the noise criterion.

7.2 CUMULATIVE IMPACTS

During the excavation at the North Creek Quarry, activities associated with the Moray Quarry and Back Creek South Quarry 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; and
- Back Creek South – August 2014.

The distances between the North Creek Quarry and the other quarries are significant, except from Moray Quarry, as shown in Table 7-4.

Table 7-4: Distance Between North Creek Quarry and Other Quarries

Quarry	Distance from North Creek Quarry	Distance from Moray Downs Receptor
Back Creek South	38 km	36 km
Moray	3 km	1 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 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 three 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
			Extraction Activities Only	Haul Road Only	Combined Noise Levels	
	Day	Night				
Beenboona	42	37	18	15	20	YES
Cassiopeia	42	37	17	31	31	YES
Moray Downs	42	37	44	34	45	NO
Mount Gregory	42	37	16	12	17	YES
Twelve Mile Outstation	42	37	17	15	19	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 during neutral weather conditions, at Moray Downs. The highest contributor of noise is the extraction activities at the Moray Downs Quarry and the contribution of the other quarries towards the exceedance is negligible.

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
			Extraction Activities Only	Haul Road Only	Combined Noise Levels	
	Day	Night				
Beenboona	42	37	25	21	26	YES
Cassiopeia	42	37	25	33	34	YES
Moray Downs	42	37	47	36	47	NO
Mount Gregory	42	37	23	18	24	YES
Twelve Mile Outstation	42	37	25	21	26	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 the day-time and night-time $L_{Aeq,Adj,1hr}$ noise criteria during adverse weather conditions, at Moray Downs. The highest contributor of noise is the extraction activities at the Moray Quarry and the contribution of the other quarries towards the exceedance is negligible.

7.3 SUMMARY OF RESULTS OF NORTH CREEK QUARRY

This assessment has reviewed the maximum output of the North Creek Quarry. Based on Vipac's noise predictions, the combined noise levels for extraction activities and haul road movements during maximum output would comply with the outdoors day-time and night-time noise criteria under neutral and 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 8 dB(A), at Moray Downs, under neutral weather conditions. The exceedances are caused by extraction activities at the Moray Quarry, not by the Back Creek South Quarry.

Under adverse weather conditions, the night-time $L_{Aeq,Adj,1hr}$ noise criteria may be exceeded by up to 10 dB(A) at Moray Downs. The exceedance is caused by extraction activities at the Moray Quarry, not by the North Creek Quarry.

The North Creek Quarry has negligible contribution towards the cumulative impacts at Moray Downs, where an exceedance was found.

8. NOISE MITIGATION

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 noise sensitive receptors for the combined operation of the quarries. Vipac understands that Adani is the current owner of Moray Downs and it is unlikely that the Moray Homestead will be occupied at the commencement of activities at the North Creek Quarry. In the event that the homestead is occupied, Vipac expects that Adani will work with the occupiers to ensure to minimise air quality impacts from activities at the quarry.

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 North Creek Quarry activities based on the worst-case scenario of 61,391 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.

Based on Vipac's noise predictions, the combined noise levels for extraction activities and haul road movements during maximum output are expected to comply with the outdoor day-time and night-time noise criterion.

A cumulative noise assessment indicated that during neutral weather conditions, when the Back Creek South Quarry, Moray Quarry and North Creek Quarry operate simultaneously, exceedances to the noise criteria up to 3 dB(A) and 8 dB(A) may be expected at the Moray Downs Homestead for the day-time and night-time periods, respectively. Under adverse weather conditions, the noise criteria may be exceeded by up to 10 dB(A) at Moray Downs.

The exceedances for cumulative noise are caused by extraction activities at the Moray Quarry alone, not by the North Creek Quarry.

Recommendations were provided in this report to mitigate the noise impacts.

Vipac acknowledges that quarry extraction projects by other operators may also be planned in the area in the future. This assessment has only considered the cumulative impacts of proposed quarries operated by Adani. Any future approvals should consider all cumulative impacts.

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.

L₁₀ – level that is equal to or exceeded for 10% of the time interval considered in the absence of the noise under investigation. The L₁₀ 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

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)	47.2	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
LAmx (24hr)	73.9	76.2	77.4	68.4	81.6	73.8	94.3	78.2	82.2
LAeq,Avg(7am to 6pm)	48.7	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)	51.7	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)	36.4	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

B.2 TIME HISTORY GRAPH

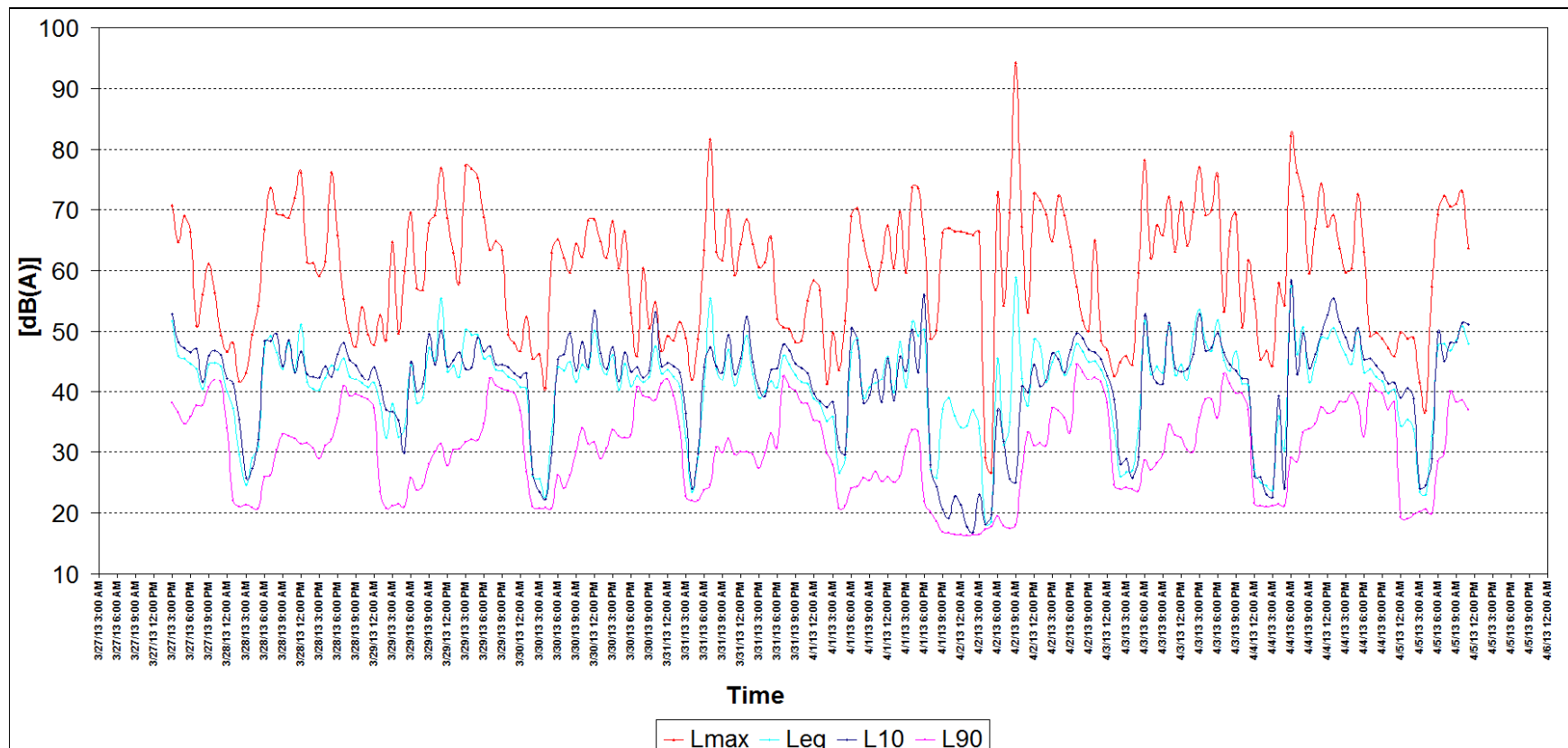


Figure B-1: Moray Downs Noise Monitoring Data

APPENDIX C: NOISE CONTOURS

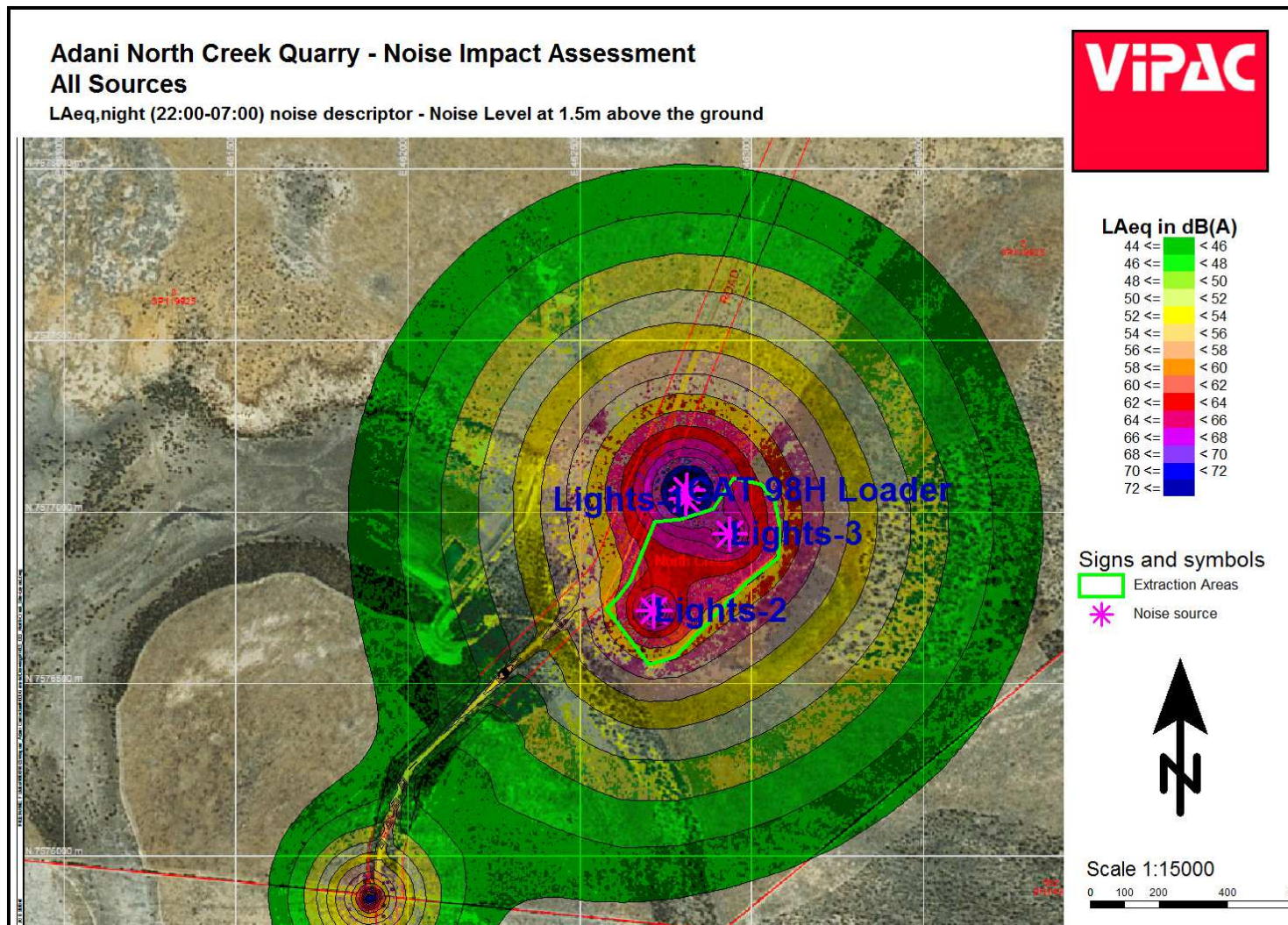


Figure C-1: North Creek – All Quarry Activities

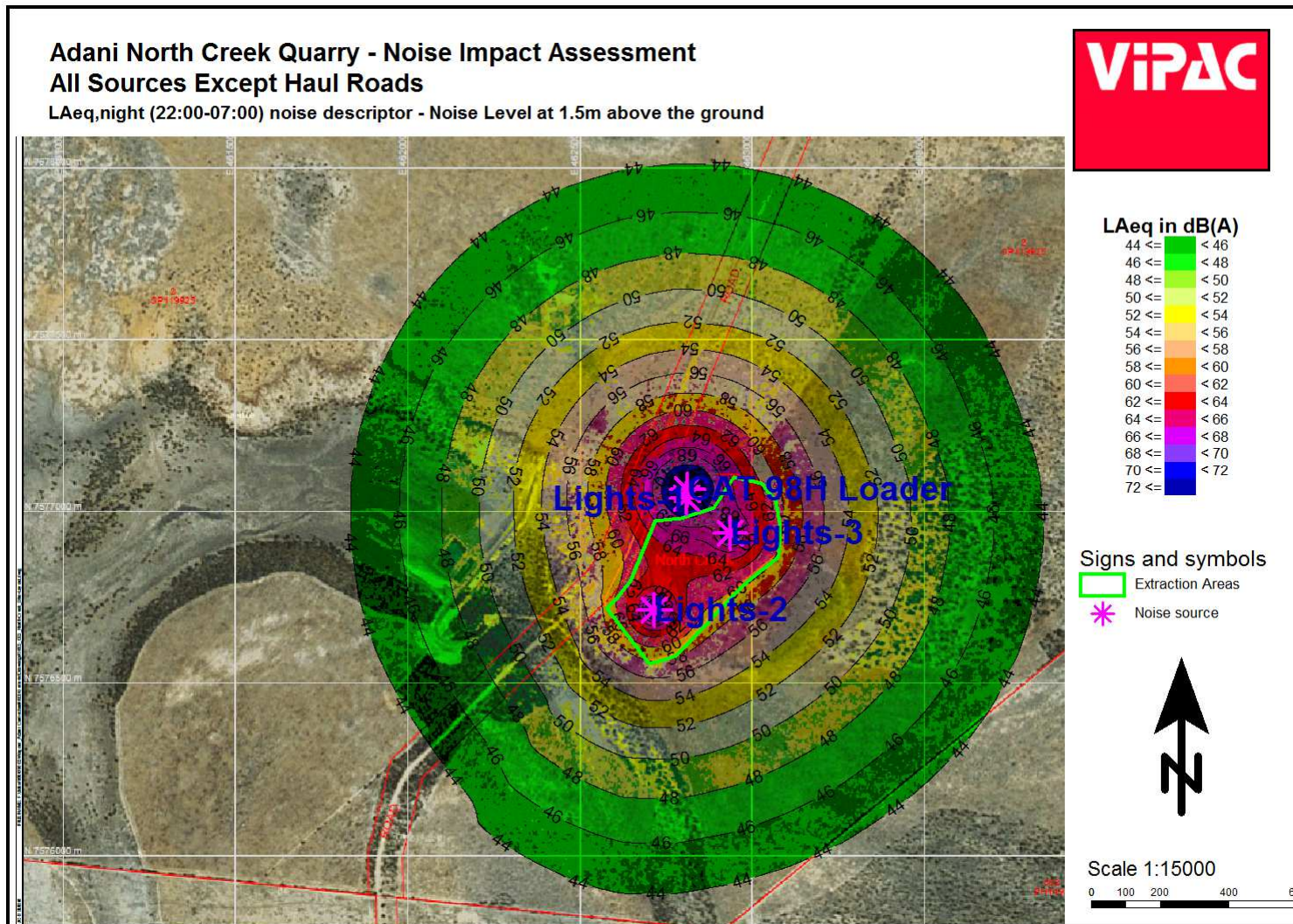


Figure C-2: North Creek - All Activities Except Haul Road

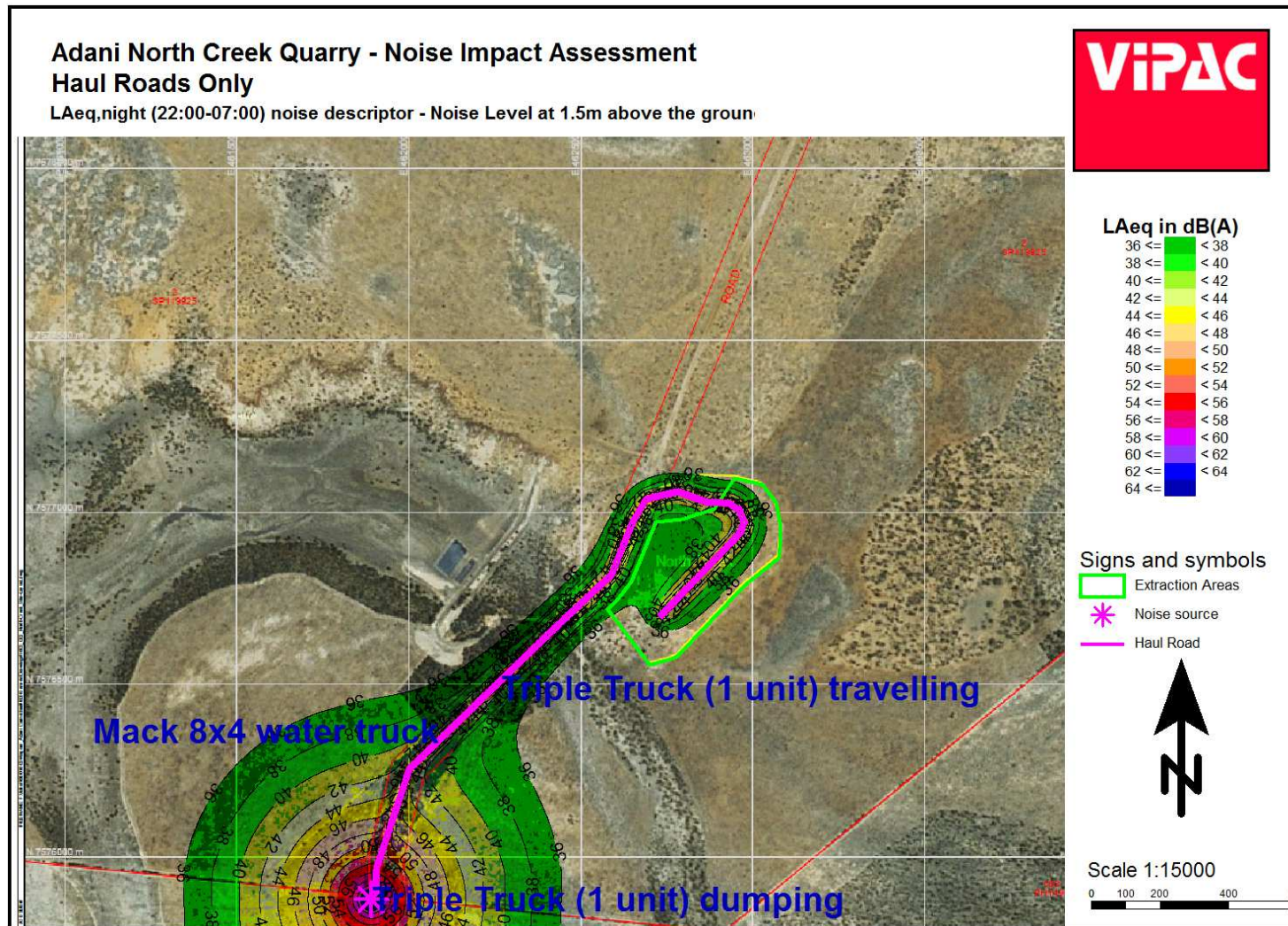


Figure C-3: North Creek - Haul Roads Only