CORAKI QUARRY

ENVIRONMENTAL IMPACT STATEMENT

Prepared for:
Quarry Solutions Pty Ltd

Date:
November 2015

Reference:
1837.DA1.005

Document Control

Project/ Report Details

Document Title:	Environmental Impact Statement
Principal Author:	James John Lawler
Client:	Quarry Solutions Pty Ltd
Ref. No.	1837.DA1.005

Document Status

Issue	*Description*	*Date*	*Author*	*Reviewer*
0	Environmental Impact Statement	29/9/2015	James John Lawler	Clayton Hill
1	Environmental Impact Statement	5/11/2015	James John Lawler	Clayton Hill

Distribution Record

Recipient	
Quarry Solutions Pty Ltd	1e
Department of Planning and Environment	1e, 2h, 1cd

Groundwork Plus ABN: 80 829 145 906

Queensland
6 Mayneview Street, Milton Qld 4064
PO Box 1779, Milton BC, Qld 4064
P: +61 7 3871 0411
F: +61 7 3367 3317

South Australia
2/1 First Street, Nuriootpa SA 5355
PO Box 854, Nuriootpa SA 5355
P: +61 8 8562 4158

E: info@groundwork.com.au

Table of Contents

Table of Contents

Table of Contents

Table of Contents

Table of Contents

DIAGRAMS

TABLES

FIGURES

Table of Contents

DRAWINGS

ATTACHMENTS

Executive Summary

Quarry Solutions Pty Ltd (Quarry Solutions) propose to establish the Coraki Quarry (the project), to be located at Seelems Road and Petersons Quarry Road, Coraki, New South Wales. The site is located approximately 2.5 kilometres to the north west of Coraki, on the Far North Coast of New South Wales (NSW).

The project would extract a maximum of 1,000,000 tonnes per annum, primarily for the planned upgrade of the Woolgoolga to Ballina – Pacific Highway upgrade project (Pacific Highway upgrade project) and thereby support and enhance the economic viability of the region. Consent is being sought for a period of 7 years. Accordingly, the project satisfies the criteria for State Significant Development (SSD) pursuant to the *State Environmental Planning Policy (State and Regional Development) 2011* and therefore requires development consent under the *Environmental Planning and Assessment Act 1979* (EP&A Act).

It is understood that the Pacific Highway upgrade project will require in the order of 1,230,000 tonnes of roadbase and 1,400,000 tonnes of aggregate. Resource investigations have confirmed that the site contains in the order of 2,900,000 million tonnes of unweathered high quality basalt suitable to supply a significant proportion of the construction materials requirements for the Pacific Highway upgrade project. As a result, it is anticipated that the project will provide a significant economic benefit to the local area and region by providing a supply of high quality construction materials thereby avoiding the need to exhaust other local quarry reserves required for the long term supply for local projects. The project will also contribute to local employment and training opportunities through direct and indirect employment opportunities, including creation of new project specific positions, in addition to non-direct employment growth for local businesses supplying goods and services to the project. There would also be significant operational efficiency and quality assurance benefits for the Pacific Highway upgrade project if the majority of construction materials were sourced from a single quarry rather than multiple smaller reserves. Material test results confirm that the resource meets the relevant NSW Roads and Maritime Services (RMS) specifications for the quarry products proposed to be produced from the resource.

The project has been designed to avoid impacts to the environmental values of the site where practicable and minimise any remaining potential impacts through appropriate design and management measures. A thorough and comprehensive assessment of existing environmental values and potential environmental impacts have been undertaken enabling preparation of a detailed Environmental Management Plan (EMP) to guide the day to day operation of the project.

Assessment of the project determined that archaeology and historic heritage, traffic, biodiversity, noise and air quality, vibration and surface water were key aspects of the project which could potentially cause environmental impacts. Accordingly, these matters were considered by further detailed specialist assessment reports. The assessments of heritage and biodiversity found that the project would avoid areas of significance and would require only minimal management measures to minimise and mitigate the risk of potential impacts. Whereas, the assessment of noise and air quality, vibration and surface water identified a comprehensive range of management measures should be implemented to minimise and mitigate the risk of potential and cumulative environmental impacts. The assessment of potential traffic impacts determined that the proposed haul route had sufficient capacity to cater to the project and existing background traffic without requiring intersection or road upgrades.

This Environmental Impact Statement (EIS) has been prepared in accordance with the Secretary's Environmental Assessment Requirements (SEARs) issued by the Secretary of the Department of Planning and Environment on 22 May 2015 and revised on 30 July 2015 (refer Attachment 1). The preparation of the EIS has incorporated a process involving, assessment of the environmental values of the site, consultation with government agencies and adjoining land owners and completion of expert technical assessments.

Sufficient assessment of the project has been undertaken through the preparation of the EIS, and as such it is recommended that the project be approved. The project will avoid and minimise potential impacts to a degree that will enable significant economic and operational benefits to be sustainably achieved.

1. Introduction

Groundwork Plus has been commissioned to prepare this EIS on behalf of Quarry Solutions. The EIS has been prepared in relation to the project, to be located at Seelems Road and Petersons Quarry Road, Coraki, New South Wales (refer Figure 1 and Drawing No. 1837.DRG.007R1 Site Location Plan). Extraction is proposed to primarily occur within Lot 401 DP633427 (Lot 401). Stockpiling and processing will occur on Lot 401 as well as the adjacent Petersons Quarry (refer Figure 2 and Drawing No. 1837.027 Conceptual Site Layout Plan). An Environmental Management Plan (EMP) has been prepared for the project (refer Attachment 2).

Due to anticipated demand for construction materials associated with the Pacific Highway upgrade project, Quarry Solutions propose to establish the project to supply materials on a project basis. It is anticipated that the project will extract a maximum of 1,000,000 tonnes per annum. Consent is being sought for a period of 7 years.

The project would provide operational efficiencies and quality assurance benefits for the Pacific Highway upgrade project in comparison to the logistics of sourcing the required construction materials from multiple smaller resources spread throughout the region. The project would provide the additional economic benefit of preserving the other smaller resources for their long term use for local projects.

Although the project incorporates land associated with the existing Petersons Quarry, it is not intended that the project approvals will replace the existing Petersons Quarry development consent or Environment Protection Licence (EPL) as it is required for continued supply of construction materials to the local market (including Richmond Valley Council) on an on-going basis. Accordingly, a separate consent and EPL is sought for the project from those held for the existing Petersons Quarry.

It is important to note that Quarry Solutions has been granted a lease by the Richmond Valley Council to operate the Petersons Quarry. The Petersons Quarry is subject to a consent and EPL of significant age and limited conditions. Accordingly, it is known that the project will be subject to more stringent and comprehensive regulatory requirements and conditions. As a result, to the extent that the Petersons Quarry will continue operation during the life of the project, it will be operated to a standard consistent with the regulatory requirements imposed on the project. This approach will ensure that environmental management and monitoring of the operations of the project will be consistent. In essence, the Petersons Quarry will become part of the day to day operation of the project for the life of the project with the exception that the project will not rely upon the extractive resource within the Petersons Quarry which is to be retained for the future use of the local region and not for supply to the Pacific Highway upgrade project.

Adopting this approach to the regulatory requirements of the project is consistent with the assessment of noise, dust, surface water and traffic impacts undertaken for this EIS which have considered the cumulative impacts of the continuation of the Petersons Quarry for the life of the project.

1.1 The Applicant

The applicant is Quarry Solutions Pty Ltd a subsidiary of SEE Civil Pty Ltd (SEE Civil) an innovative company committed to delivering excellence in all areas of business. Established in 1988, and with over 25 years of experience in civil construction, material processing and quarry operations, it has become a successful Australian owned company. SEE Civil owns and operates its own quarries under Quarry Solutions as well as an extensive range of mobile crushing and screening plant and equipment.

1.2 Purpose and Scope of the Document

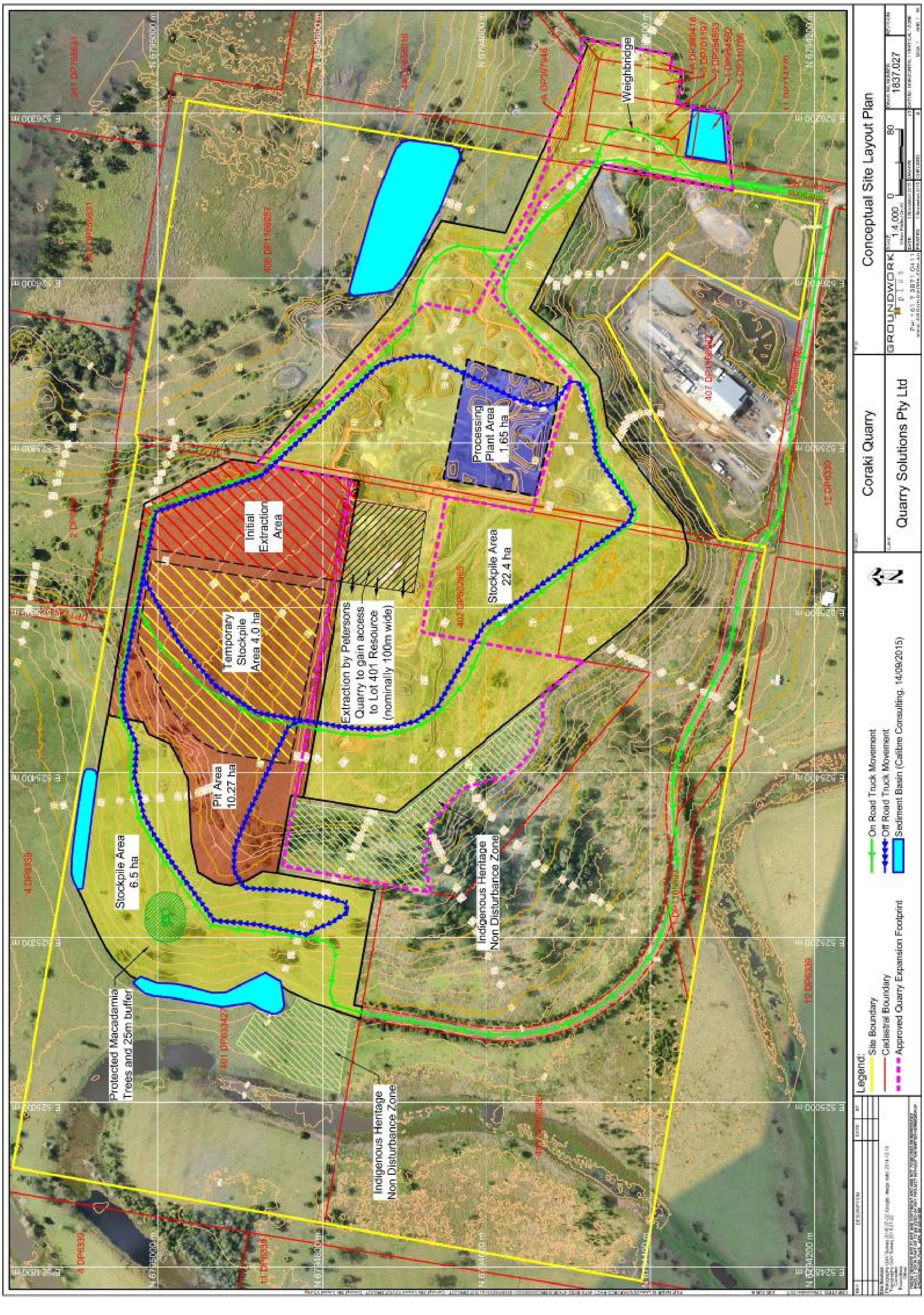
The project is classified as State Significant Development (SSD) under the *State Environmental Planning Policy (State and Regional Development) 2011*. This EIS accompanies the development application for SSD, in accordance with the *Environmental Planning and Assessment Act 1979* (EP&A Act). The EIS has been prepared in accordance with the SEARs issued on 22 May 2015 and revised on 30 July 2015. The NSW State Government is the consent authority, in consultation with the Richmond Valley Council. This EIS addresses the following matters:

- The location and nature of the project
- A review of the environmental impacts associated with the construction, operation, decommissioning and rehabilitation of the project
- Recommendations to control and mitigate potential impacts
- An outline of how the applicant will meet its obligations under relevant legislation and policies
- An outline of the environmental assessment process for the proposal for the consent authority's consideration in providing consent for the proposal.

Under Section 79C of the EP&A Act, the proposal must be evaluated against a range of considerations including environmental planning instruments, the EP&A Regulation, the likely environmental, social and economic impacts of the development, the suitability of the site, and the public interest.

Figure 1 Site Location Plan

Figure 2 Conceptual Site Layout Plan



2. Objectives of the Proposal and Consideration of Alternatives

2.1 Objectives of the Proposal

The objectives of the proposal are to establish the project to realise the full potential of a known extractive resource (hard rock), and establish an ecologically sustainable development which minimises impacts on the natural and built environment through sensitive design and appropriate environmental management practices. The project seeks to extract a maximum of 1,000,000 tonnes per annum, for supply to the Pacific Highway upgrade project and thereby support and enhance the economic viability of the region.

2.2 Need for the Project, Alternatives and Options Considered

Quarried products are used in the building and construction industries and are essential components for providing shelter and infrastructure. The quarry industry is market driven and therefore is focused on price, quality and service. The industry is dominated by a few large, national, vertically integrated companies. However, independent operators such as Quarry Solutions provide market choice and special services and contribute significantly to the vitality and strength of local businesses and industry.

Extractive industries are a significant contributor to the material needs of local and regional communities and to economic activity and development. Extractive resources are site specific, limited in occurrence by geological conditions and are finite. Because they are high-volume, low-cost materials, they need to be located close to the communities that use them as the cost of transport to the end user contributes greatly to the overall cost of the delivered product. Extractive resources underpin all urban and infrastructure development and make a major contribution to the ongoing economic growth of the community through direct and indirect employment opportunities.

Cement Concrete & Aggregates Australia (CCAA), notes in its document, ‘A strong foundation for New South Wales’ future’, (CCAA 2015) that,

- “NSW is Australia’s largest State with a population of 7.5 million people”.
- “As our state grows there will be a need for improved connectivity through enhanced transport options including roads, rails, ports and airports.”
- “Each kilometre of a typical 2 lane asphalt highway requires approximately 14,000 tonnes of crushed rock or about 400 truckloads of material.”
- “An average new house requires 110 tonnes of crushed rock, sand and cement and 54 cubic metres of concrete”.
- “Heavy construction materials are geologically constrained and required in high volumes to build the State’s priority infrastructure. It is the foundation of the building and construction industry, which is vital to the New South Wales economy.”

The NSW RMS identified the construction material requirements for the Pacific Highway upgrade project in the EIS prepared for that project (RMS 2012). Specifically, Section 6.4 of the EIS identified an estimated demand of 1,230,000 tonnes of roadbase and 1,400,000 tonnes of aggregate. The RMS rightly identified that ‘*Quarry outputs are restricted by the licence for the facility*’ and commented that some materials may need to be sourced from further afield if not available in the required volume locally. As such there is a known need for the construction materials that can be supplied by the project.

It is understood that RMS and Pacifico (the delivery partner for the Pacific Highway upgrade project) have not yet confirmed the full detailed materials specifications for the Pacific Highway upgrade project. However, it is anticipated that the specifications will be particularly stringent given the safety improvements being sought and will be similar to existing RMS specifications. Accordingly, it can be expected that not all quarries in the region will have resources which comply with the specifications for the Pacific Highway upgrade project which will further narrow the number of available and viable sources.

2.2.1 *Option 1 – Do nothing*

The ‘do nothing’ option would not satisfy the proposal objectives and would not allow for the establishment of the project. This option would rely upon the availability of suitable quality materials in the necessary volumes from existing quarries in the region introducing project risk associated with consistency of product, operational hours, output capacity and varying haulage routes. This option could result in significant adverse economic impacts to the Pacific Highway upgrade project through delayed delivery of construction materials, or the cost of transporting additional material from outside of the region.

2.2.2 *Option 2 – Alternative proposal*

Increasing the annual extraction limit of the adjoining Petersons Quarry was considered as an alternative to the project. However, this option was considered unfavourable as the Petersons Quarry is required to provide a secure long term supply of construction materials for the Richmond Valley Council and the local community. Accelerated extraction of the Petersons Quarry resource to the Pacific Highway upgrade project would significantly reduce the operating life of the quarry and impact its availability for long term supply to local construction projects including local road projects. It was also noted that the Petersons Quarry is constrained by higher environmental values than those identified for Lot 401.

2.2.3 *Option 3 – Coraki Quarry Project*

The preferred and chosen option is to proceed with the proposed project which includes extraction of a maximum of 1,000,000 tonnes per annum from Lot 401. The site is considered to hold a high quality basalt resource capable of meeting a majority of the construction materials demand for the Pacific Highway upgrade project. Particularly being informed by a resource assessment which indicates that the material should be suitable for use as high quality roadbase, concrete aggregate, sealing aggregate and asphalt aggregate pending appropriate supporting material testing.

2.2.4 *Justification of the preferred option*

Option 3 is the preferred option and is considered to be the most appropriate in terms of balancing commercial viability with environmental impacts and outcomes in accordance with the principles of ecologically sustainable development. Option 3 is considered more favourably given that a sufficient level of scientific certainty can be reached to confirm potential impacts to the limited biodiversity values of the site can largely be avoided and other potential impacts to surrounding land uses can be mitigated through a range of typical management measures commonly employed for quarry operations. Option 3 also addresses inter-generational equity by preservation of the resource within the Petersons Quarry for long term supply to local construction projects including local road projects.

2.2.5 *Design refinements*

An iterative design process has been employed to design the project which has resulted in numerous revisions to the site layout. The following revisions to the site layout have been made in order to first avoid and then minimise potential environmental impacts:

- A buffer of at least 40m will be maintained to the watercourse in the west of the site.
- The operational areas of the quarry will be designed to be outside portions of the site identified as being at risk to flooding.
- A perimeter bund will be installed to the processing and stockpile area to minimise potential noise, dust and visual amenity impacts.
- A buffer of 25m will be provided to the *Macadamia tetraphylla* – Rough-shelled Bush Nut on Lot 401.
- Incorporation of the Petersons Quarry land to enable extraction to proceed from the existing Petersons Quarry pit through the adjoining property boundary into Lot 401 minimising environmental impacts by retaining the existing topographic screening provided by the existing Petersons Quarry pit.
- Incorporation of the Petersons Quarry land for establishment of the processing plant required for the project, minimising noise and amenity impacts as the proposed location is topographically screened within the existing Petersons Quarry pit.

- Incorporation of the Petersons Quarry land for stockpiling achieving stockpiling capacity of up to 1,000,000 tonnes, minimising offsite impacts and providing for improved logistical delivery of materials to the Pacific Highway upgrade project.
- Incorporation of the Petersons Quarry land facilitating a one way on-road and off-road traffic flow system improving operational efficiency and safety for quarry staff and haulage contractors.
- Establishment of Indigenous Heritage Non Disturbance Zones including an area within Lot 401 adjacent to Seelems Creek.

3. The Proposal

3.1 Location and Site Description

3.1.1 Location and site context

The site is located at Seelems Road and Petersons Quarry Road, Coraki NSW 2471, including Lot 401 and land associated with the existing Petersons Quarry. The site is located approximately 2.5 kilometres to the north west of Coraki, on the Far North Coast of New South Wales. Coraki has a population of approximately 2,000 people, situated approximately 720 kilometres north of Sydney and 240 kilometres south of Brisbane.

Land use directly adjacent to the site is rural in nature, predominantly consisting of cattle grazing. The land in the locality has been extensively cleared for grazing purposes. Several farm sheds are scattered on neighbouring properties. Residential development in the vicinity of the site is extremely sparse but includes a number of dwellings to the east on Spring Hill Road, Coraki and also a dwelling to the south on Lagoon Road (refer Figure 3 and Drawing No. 1837.DRG.002R1 Site and Surrounds). The closest residences to the proposed extraction area are located approximately 335 metres to the north, 820 metres to the east and 595 metres to the south (refer Figure 4 and Drawing No. 1837.DRG.037 Nearby Sensitive Receptors) of the proposed extraction area.

Lot 407 on DP1166287, south of the site, is an existing industrial operation. The industrial operation was initially approved by consent in 1997 and includes the manufacture of pre-cast concrete panels and structures for bridges, road construction and other building activities and is now known as the Doolan Deck Factory. It is understood the industrial operation relies upon premixed concrete sourced from the general market and does not rely on quarry materials directly from the existing Petersons Quarry or the project.

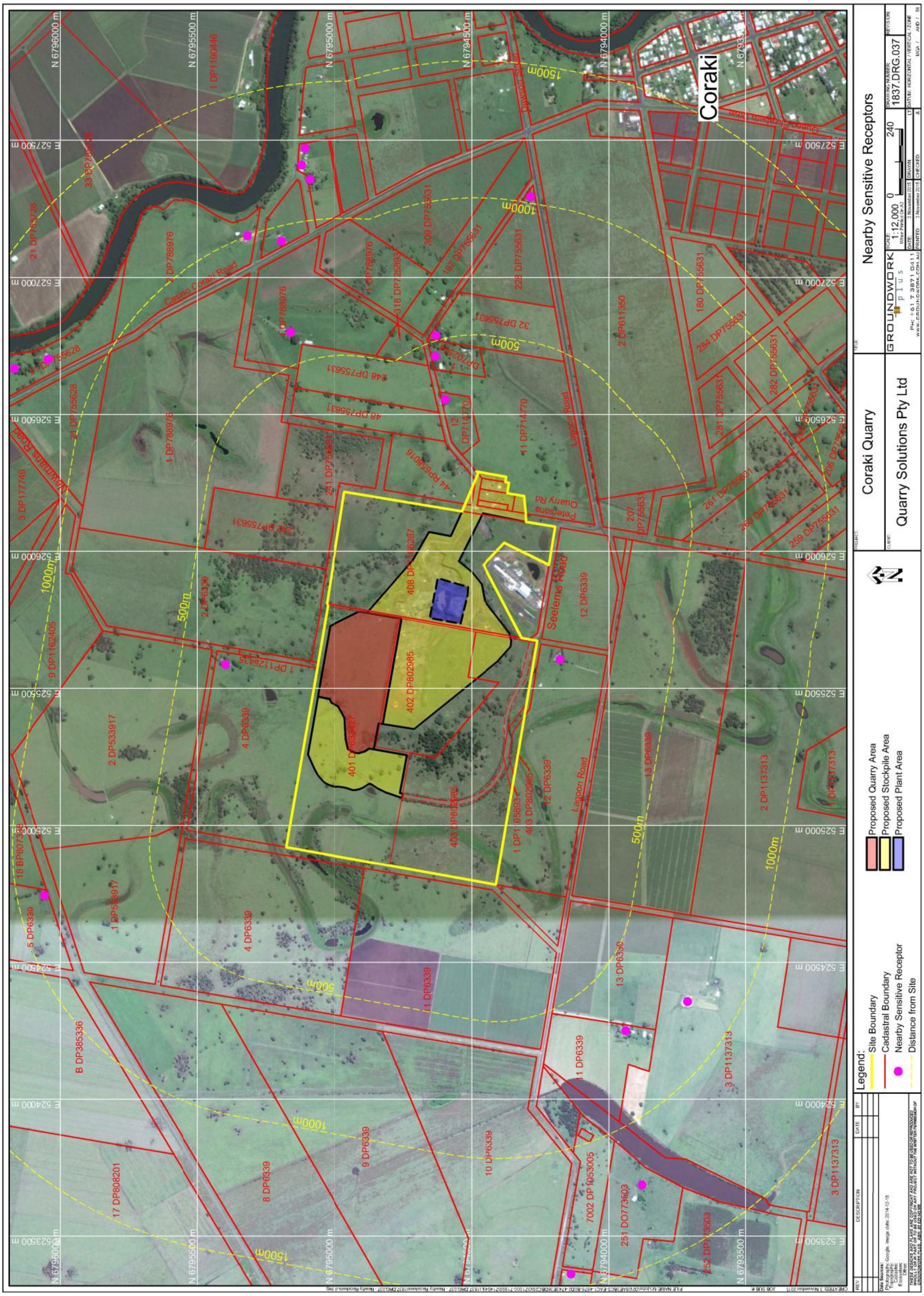
Petersons Quarry, owned by Richmond Valley Council and forming part of the land for the project, has been in operation since 1916 supplying quarry materials for road construction and for private sale. Quarrying operations have been undertaken in response to demand, with operations typically undertaken two or three days of the week. The Petersons Quarry is operated pursuant to Environment Protection Licence (EPL) No. 3397 which has now been transferred from Richmond Valley Council to Quarry Solutions.

3.1.2 Site details

Access:	Access to the project is via Seelems Road and Petersons Quarry Road.
Site:	Lot 401 DP633427, Lot 402 DP802985, Lot 403 DP802985, Lot 408 DP1166287, Lot A DP397946, Lot A DP389418, Lot 3 DP701197, Lot 2 DP954593, Lot 1 DP954592 and Lot 1 DP310756.
Tenure:	Freehold
Registered Proprietor:	· Varoli Pty Ltd (ACN 003728229): Lot 401 DP633427 · Richmond Valley Council: Lot 402 DP802985, Lot 403 DP802985, Lot 408 DP1166287, Lot A DP397946, Lot A DP389418, Lot 3 DP701197, Lot 2 DP954593, Lot 1 DP954592, and Lot 1 DP310756.
Current Land Use:	The site is currently used for cattle grazing and the existing Petersons Quarry.
Local Government Area:	Richmond Valley Council.

Figure 3 Site and Surrounds

Figure 4 Nearby Sensitive Receptors



3.1.3 *Description of existing environment*

Regional Climate:

The site is within the Richmond River Catchment and is centred approximately 2.5km north west of Coraki, and 16km south-south west of Lismore. The region is subject to a humid subtropical climate with mild to warm temperatures all year round and ample rainfall.

There is a Bureau of Meteorology Weather Station located at Union Street, Coraki with rainfall records dating back to 1895 but limited other information. Review of the Union Street records confirms most rain falls between December and April. The driest month is September. The annual mean rainfall is about 1,285 mm.

Temperature data was not available for the Union Street, Coraki weather station. Accordingly, Lismore was adopted as a suitable representative of regional climatic conditions rather than Ballina on the following basis. Lismore is approximately 20km NNW of the site. Ballina is approximately 30km ENE of the site. Mean monthly maximum temperatures are highest in January (about 29.9°C) and lowest in June and July (about 20.7°C). Mean minimum temperatures drop to 6°C in July. A summary of the Regional Climatic Statistics is shown in Table 1 below:

Table 1 – Summary of Regional Climatic Statistics

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Rainfall (mm)													
Mean	146.7	160.9	173.6	128.1	114.7	100.0	76.2	54.8	48.7	71.9	89.8	117.6	1285
Temperature (°C)													
Mean min.	18.8	18.6	16.9	14.1	9.6	8.0	6.0	6.6	9.7	12.7	15.5	17.4	12.8
Mean max.	29.9	29.2	28.1	25.8	23.3	20.7	20.7	22.6	25.8	27.3	28.5	29.3	25.9

Source: Temperature - Bureau of Meteorology 2015, Lismore Airport (Station No. 058214), Rainfall – Bureau of Meteorology 2015, Union St Coraki (Station No. 058015)

Topography, drainage and waterways:

The site occurs entirely within the Clarence Lowlands subregion of the South Eastern Queensland - Clarence Lowlands Bioregion, and includes the Lamington Volcanic Slopes, Grafton-Whiporie Basin and Clarence-Richmond Alluvial Plains Mitchell Landscapes.

The site is comprised of locally elevated land which rises above the adjacent floodplains and wetlands. Spring Hill is located in the western section of Lot 402, with a high point of approximately RL 47 m AHD. Seelems Creek meanders across the western portion of the study area as a series of ox-bow wetlands. The topography of the surrounding area is predominantly low relief, flood prone, alluvial plains.

Plate 1. The existing stock watering dam on Lot 401 looking to the western boundary of Lot 401.

The Richmond River is located approximately 1.7 km to the east. Kennedys Swamp lies to the north and occupies the area north of the 5m contour line within Lot 408. Kennedys Swamp has an approximate catchment area of 200ha and is bounded by the Casino – Coraki Road to the east, Newmans Road to the north and Spring Hill to the south and west. Surface runoff from the eastern slopes of Spring Hill flow east into the existing quarry and are then directed north through a small sediment retention basin into Kennedys Swamp.

Seelems Creek extends across Lot 403 DP 802985 and Lot 401 DP633427. The catchment area of Seelems Creek at this point is estimated to be in excess of 800ha and predominantly comprises agricultural land. Currently, surface runoff from the western slopes of Spring Hill flows into Seelems Creek. Surface water from the southern slopes of Spring Hill flows south by overland flow into a lower section of Seelems Creek. The New South Wales Water Quality and River Flow Objectives (OEH 2015) provides the water quality objectives for Uncontrolled Streams within the Richmond River Catchment. The physico-chemical indicators and numerical criteria (trigger values) for lowland rivers is shown below in Table 2.

Table 2 – Summary of Water Quality Objectives for Lowland Rivers*

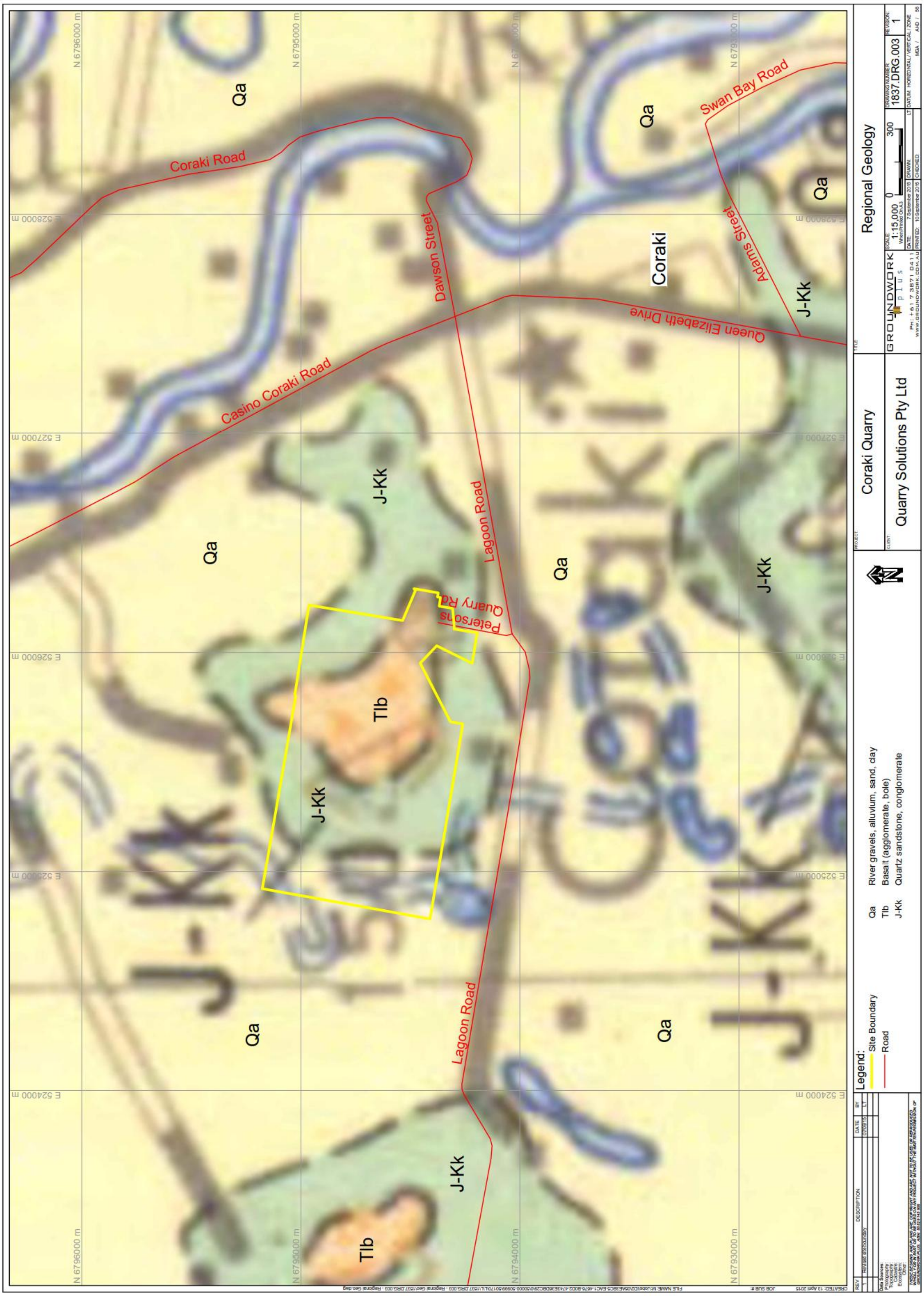
Total Nitrogen (N) (µg/L)	Total P (µg/L)	DO (%sat)		Turbidity (NTU)	pH		Conductivity (µs/cm)
		lower	upper		lower	upper	
350	25	85	110	6-50	6.5	8.5	125-2200

* Note: Physico-chemical indicator and numerical criteria has been based on the protection of aquatic systems water quality objective.

The land within the area traverses several different soil landscapes; including Coraki and McKee. These are residual landscapes, dominated by sites where deep soils have formed from in-situ weathering of parent materials. Landform elements include some summit surfaces, plateaux, terrace plain, peneplains and old ground surfaces (Morand 1994). The Coraki landscape is characterised by low, undulating rises on Kangaroo Creek Sandstone. The relief is 10-30 m and surface slopes are 2-10%. Elevation is generally <30 m and the vegetation has been extensively cleared (Morand 1994). The McKee landscape is characterised by very low to low undulating hills and rises on Lismore Basalts. Relief is 30-50 m with slopes up to 10%. Slopes are simple or waning and drainage depressions are common. This soil landscape has also been extensively cleared.

The broader study area includes the North Casino landscape which is characterised by drainage depressions forming swamps and intermittent swamps associated with the Richmond River Alluvial Plain. The Tweed Heads 1:250,000 Geological series sheet 56-3 indicates the underlying geology of Spring Hill comprises Lismore Basalts of the Tertiary period related to the Lamington Volcanics. A zone of Kangaroo Creek Sandstone of the Jurassic-cretaceous period surrounds the Spring Hill Lismore Basalts with alluvium sands and gravels from the Quaternary period (refer Figure 5 and Drawing No. 1837.DRG.003R1 Regional Geology).

Figure 5 Regional Geology



Geology and Groundwater Hydrology:

Seelems Creek is located in the western portion of the site. The catchment area of Seelems Creek at this point is estimated to be in excess of 800 ha and predominantly comprises agricultural land. Currently surface water runoff is directed into Seelems Creek. It is not known whether these surface water bodies are groundwater recharged, reliant purely on surface water, or a combination of both. Geotechnical investigations were undertaken in 2015. A soil and eluvium profile (overburden) overlies the entirety of area, amongst which sparse basaltic outcrops occur. The soil and eluvium profile generally thickens away from the main ridge line to the north and west. Over the main area of proposed quarrying activity the soil and eluvial profile is generally between 0.2m and 2m thick. The main basalt layer present within the eastern portion of Lot 401 on DP633427 was the focus of the investigations. This basalt is a black, fine grained, sparsely porphyritic, homogenous columnar jointed basalt interpreted to have high rock strength and durability. The basalt resource and flow varies from 12m to 20m in thickness.

Plate 2. View of the Basalt resource within an existing bench at the Petersons Quarry.

Groundwater was not intercepted in any of the bores drilled during the resource investigations despite extending below the depth of the resource to the underlying clay. There are no registered bores currently located within the site boundary. Groundwater in the local area is used for stock watering, irrigation, farm use and general (homestead) water supply. Based on local groundwater information sourced from the Bureau of Meteorology, there are a total of 34 groundwater bores within a 5 km radius search centred on the town of Coraki (approximately 2.5km south east of the Site). A representation of the closest bores to the site is provided below in Table 3.

Table 3 – Summary of Nearby Bores

Bore Reg. No.	Bore Status	Purpose	Lat. Long.	Direction from the site	Bore Depth (m)	Standing Water Levels
GW301592	Unknown	Stock and Domestic	-28.9667597 153.25700778	500m north	29.5m	nr
GW050643	Functional	Unknown	-28.96341102 153.25579271	850m north	6.1m	nr
GW045838	Unknown	Stock and Domestic	-28.97868869 153.27329254	300m east	6.1m	nr

Notes: nr = no records found

Erosion Risk: Erosion risk for the region based on monthly average rainfall depth is shown below in Table 4:

Table 4: Erosion Risk

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
H	H	H	H	H	M	M	M	M	M	H	H

Notes: E = Extreme, H = High, M = Medium, L = Low, VL = Very Low Sourced from Table 4.4.2, p. 4.12 of IECA.

Vegetation: The site area occurs entirely within the Clarence Lowlands subregion of the South Eastern Queensland - Clarence Lowlands Bioregion (DoE 2015). The site includes the following; Mitchell Landscapes, (OEH 2015a), Lamington Volcanic Slopes, Grafton-Whiporie Basin, Clarence-Richmond Alluvial Plains.

The land consists of mainly open grassland with minor patchy scrub at lower elevations towards Seelems Creek to the west of the Site. Native vegetation recorded during the field survey was generally restricted to the western portions of Lot 401 on DP633427 and Lot 403 on DP802985, and along the boundary of Lots 402 and Lot 403 on DP802985.

Plate 3. View from the southern boundary of Lot 401 looking north along the proposed alignment of the internal access road to the western stockpile area, with the existing stock watering dam located to the west of the access road to be converted for surface water management.

The field survey identified four native vegetation types within or in close proximity to the study area, all of which are recognised as Endangered Ecological Communities (EECs), including, NR179: Hoop Pine - Yellow Tulipwood dry rainforest of the North Coast, NR161: Forest Red Gum - Swamp Box of the Clarence Valley lowlands of the North Coast, NR217: Paperbark swamp forest of the coastal lowlands of the North Coast, NR150: Coastal freshwater meadows and forblands of lagoons and wetlands. Other native vegetation recorded onsite occurs as scattered paddock trees, planted amenity screens alongside access tracks, or as minor components within otherwise heavily disturbed and exotic-dominated patches of regrowth. Camphor Laurel and Lantana (Lantana camara) are dominant features of the latter.

Four specimens of a threatened species not returned by the database searches were recorded during the field survey, namely *Macadamia tetraphylla* (Rough-shelled Bush Nut). The specimens occur together within the centre of Lot 401 on DP633427, adjacent to a clump of other scattered, paddock trees and outside of any of the recognised native vegetation zones on the site.

Acid Sulphate Soil: The site is predominately mapped as containing Class 5 (lowest risk of containing acid sulphate soil) (refer Figure 6 and Drawing No. 1837.DRG.021R1 Acid Sulphate Soil Mapping).

Flooding: The site is not within the Flood Planning area in accordance with the NSW Planning Portal Mapping but is mapped as containing flood prone land in accordance with Richmond Valley Council's flood mapping. However, the operational areas of the project are located outside of the flood prone areas of the site (refer Figure 7 and Drawing No. 1837.DRG.011R1 1 in 100 year ARI design Flood).

Figure 6 Acid Sulfate Soil Mapping

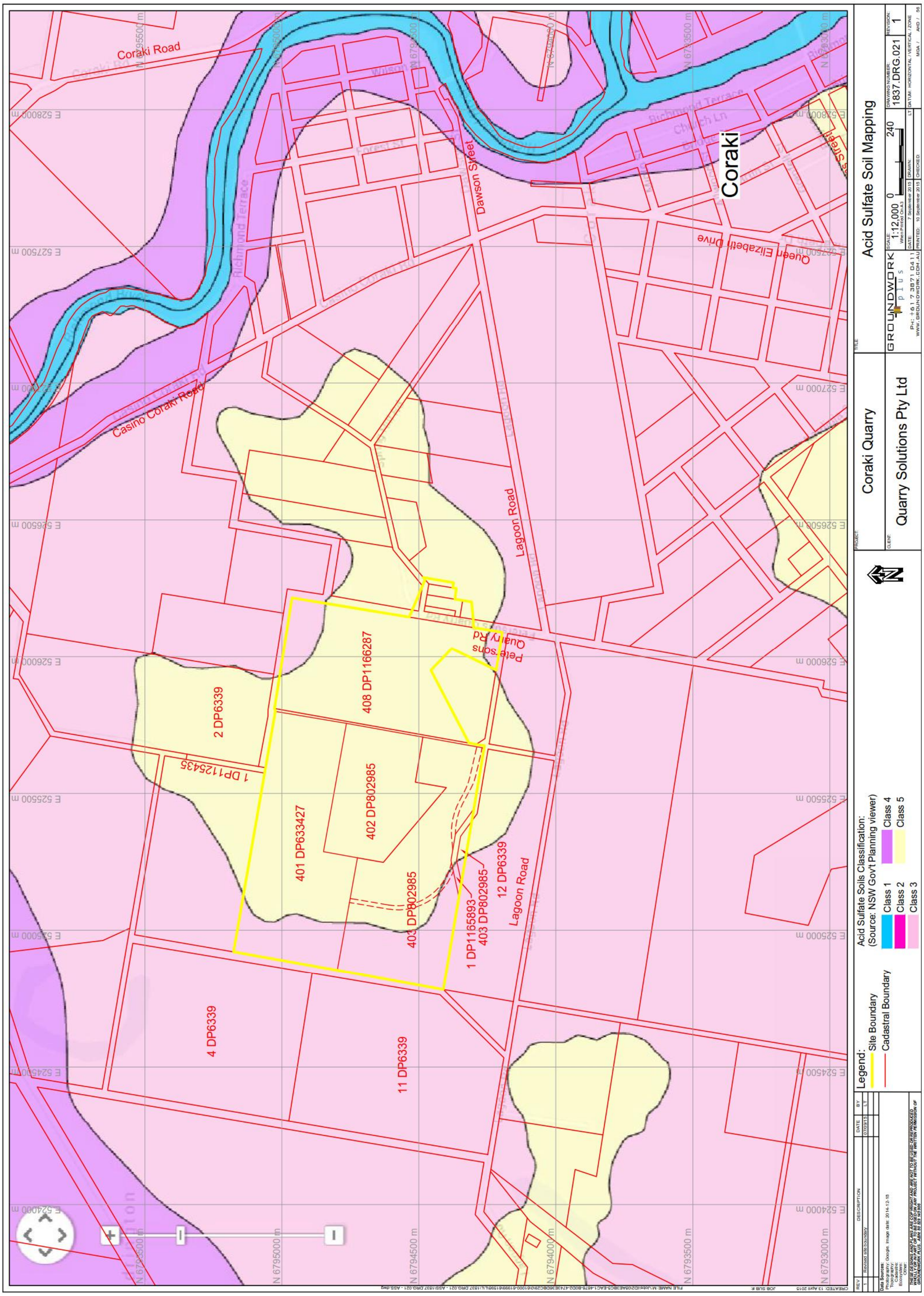
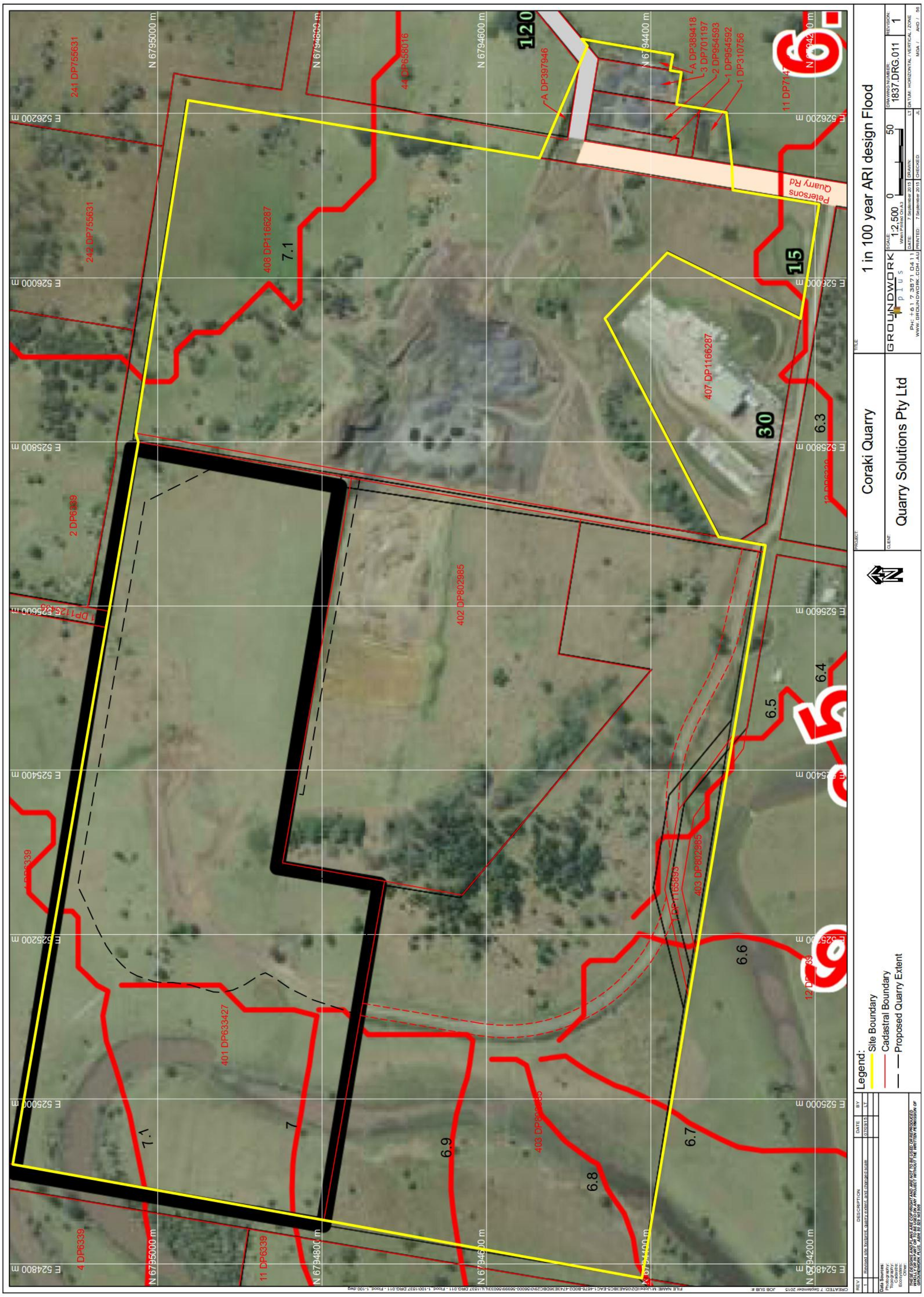


Figure 7 1 in 100 year ARI design Flood



This document is uncontrolled when printed.

Existing Land Use:	The site is currently utilised for cattle grazing and the existing Petersons Quarry.
Adjacent Land Use:	North – Rural area including cattle grazing. East – Rural area including cattle grazing and also semi-rural dwellings on Spring Hill Road. South – Industry (manufacture of pre-cast concrete panels) West – Rural area including cattle grazing.
Nearby Sensitive Receptors:	The nearest sensitive receptors to the extraction area are rural residences, approximately 595m to the south, 820m to the east, 335m to the north and 2.1km to the west (refer to Figure 4 and Drawing No. 1837.DRG.037 Nearby Sensitive Receptors).
Cultural Heritage:	The subject area was found to be highly disturbed by previous agricultural and quarrying land use. No Aboriginal object sites were recorded. Generally, the site has been found to be of low archaeological sensitivity and significance. However, one landform situated in close proximity to Seleems Creek is assessed to be of some greater archaeological potential and significance.
Air Quality:	The ambient air quality for the area is influenced primarily by agricultural activities, and the existing Petersons Quarry.
Noise:	Existing noise levels are considered to be representative of an existing quarry within a rural area and are likely to be attributed to operation of the existing Petersons Quarry, including blasting, extraction, crushing and screening, mobile equipment use and vehicle movements.
Visual Amenity:	It is likely that visual amenity from surrounding land may have line of sight to the stockpiling activities proposed to occur on the elevated levels of the site. However, as the design of the quarry is proposed to retain the receding rim of Spring Hill and extend the existing Petersons Quarry pit into Lot 401 it is anticipated that the extraction area and processing plant area will be well screened from surrounding land.

3.2 Description of the Proposal

3.2.1 Site layout and quarry design

A conceptual site layout is shown in Figure 2 and Drawing No. 1837.027 Conceptual Site Layout Plan. Extraction will primarily occur within Lot 401 as an extension of the existing Petersons Quarry pit. Stockpiling areas will be established on both Lot 401 and the Petersons Quarry land to achieve stockpile capacity for up to 1,000,000 tonnes of materials as requested by the delivery partner for the Pacific Highway upgrade project.

The existing site office, weighbridge and visitor car parking area of the Petersons Quarry will be utilised for the project. A site office and workshop will be established. These will be temporary demountable structures which would be removed at the completion of the project. It is anticipated that a number of shipping containers would be located within proximity to the workshop to provide secure storage for materials and equipment on an as needs basis. Fuel and chemical storage, including a self bunded above-ground fuel tank and oils for minor servicing onsite, would also be located in proximity to the site office and workshop. Any fuel and chemical storage facilities would be self bunded temporary demountable structures and removed from the site at the completion of the project. It is proposed to locate the site office, workshop and any fuel and chemical storage facilities within the existing site office, weighbridge and visitor car parking area of the Petersons Quarry as this area is topographically screened from the surrounding land.

The mobile processing plant for the project will be established within the existing Petersons Quarry pit to take advantage of the topographic screening available to that location which will assist in minimising potential risk of environmental nuisance from noise and dust emissions. The mobile processing plant for the project will also service the needs of the Petersons Quarry for the life of the project.

Plate 4. View of the pit of the existing Petersons Quarry looking west. The mobile processing plant will be located to the far left of view.

Given the time limited, project specific nature of the project the processing plant will consist of mobile crushing and screening plants rather than a permanent fixed plant. The existing stormwater detention basins of the Petersons Quarry will be augmented and sized to cater to the additional disturbance areas resulting from the project, in addition to a new stormwater detention basin on Lot 401. Water collected in the stormwater detention basins will be used to assist in dust management.

Figure 8 and Drawing No. 1837.032 Conceptual Quarry Development Plan Initial Extraction Stage, illustrates how the initial extraction area will be developed from the existing Petersons Quarry pit into Lot 401. The existing Petersons Quarry pit has a floor of approximately RL18m AHD. This will be continued into Lot 401. Internal benches will be developed to enable progressive extraction to occur from east to west within Lot 401. The internal northern face of the extraction area will be a single wall of approximately 20m in height to retain the receding rim of the hill, topographically screening the extraction operations both visually and acoustically from the surrounding land to the north, east and west. Stockpile areas will be established with earthworks required as necessary to establish pads or hardstand areas of suitable slope. Topsoil and overburden will be used to establish perimeter bunds where necessary to assist in visually screening the stockpile areas and also direct stormwater to the stormwater detention basins for treatment. A 25m wide buffer will be established around the *Macadamia tetraphylla* – Rough-shelled Bush Nut on Lot 401 to retain and protect those environmental values in situ.

Figure 9 and Drawing No. 1837.033 Conceptual Quarry Development Plan Final Extraction Stage, illustrates the full extraction of the resource on Lot 401 to a floor of RL18m AHD. Internal benches will adjoin the existing Petersons Quarry to facilitate continued efficient development of that resource for the Richmond Valley Council into the future. The internal northern and eastern face of the extraction area will be retained as a single wall of approximately 20m in height. The internal western face of the extraction area will be approximately 3m in height to transition to the western stockpile area on Lot 401. A ramp between the extraction area and the western stockpile area on Lot 401 will be retained in the final land form to accommodate continued connection for any potential redevelopment of the land.

Cross sections of the quarry design have been prepared to illustrate retention of the topographic features where possible to assist in visual and acoustic screening of the project (refer Figure 10 and Drawing No. 1837.035 Cross Sections A to E).

3.2.2 Production quantities

It is proposed to extract a maximum of 1,000,000 tonnes per annum dependant on project demand and timing. The expected operating life of the quarry is five (5) to seven (7) years subject to the duration of the upgrade works to the Pacific Highway. As the proposed development will involve extracting and processing more than 30,000 tonnes of extractive materials per year, it will require an EPL under the *Protection of the Environment Operations Act 1997* (POEO Act).

Figure 8 Conceptual quarry development plan initial extraction stage

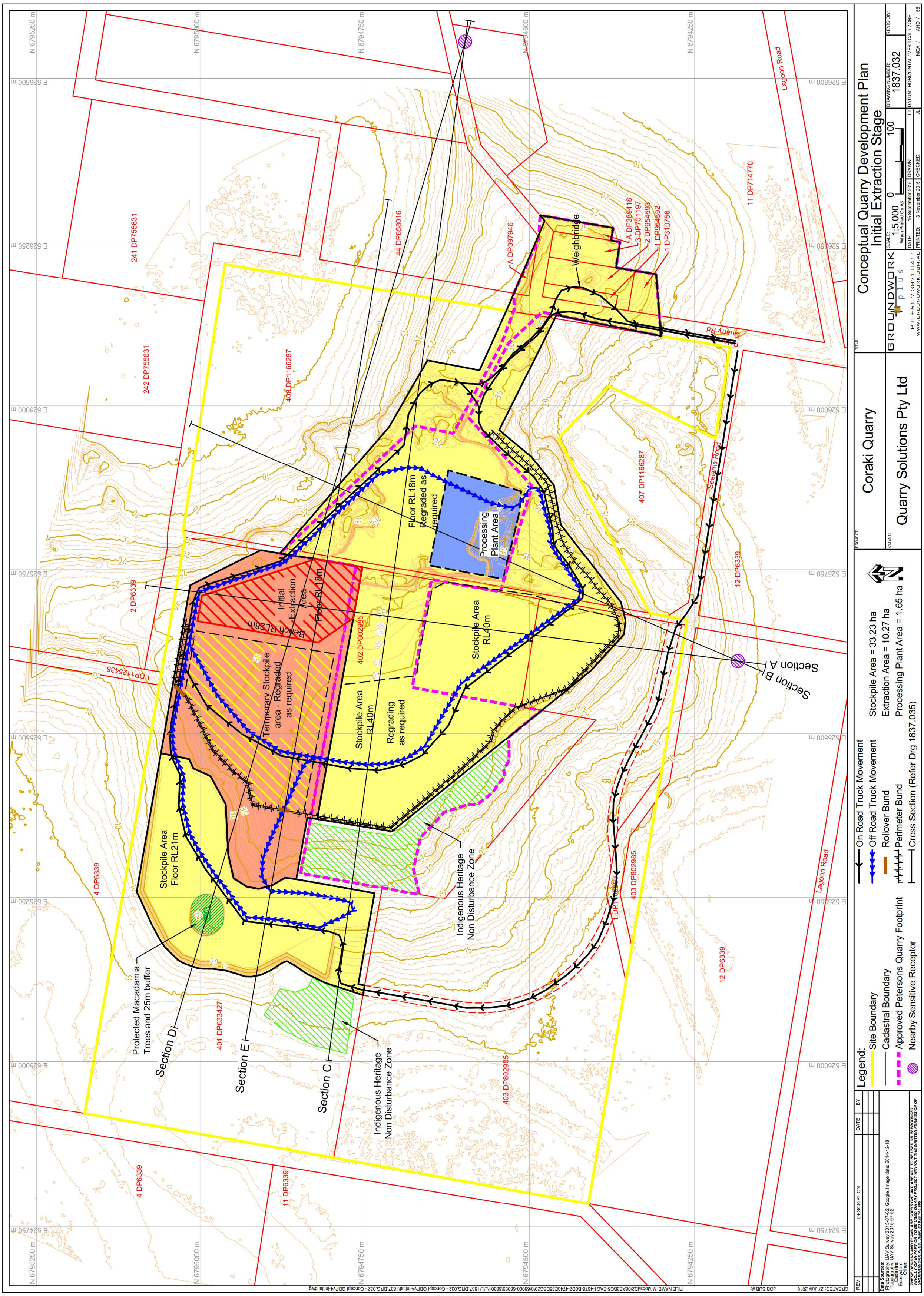
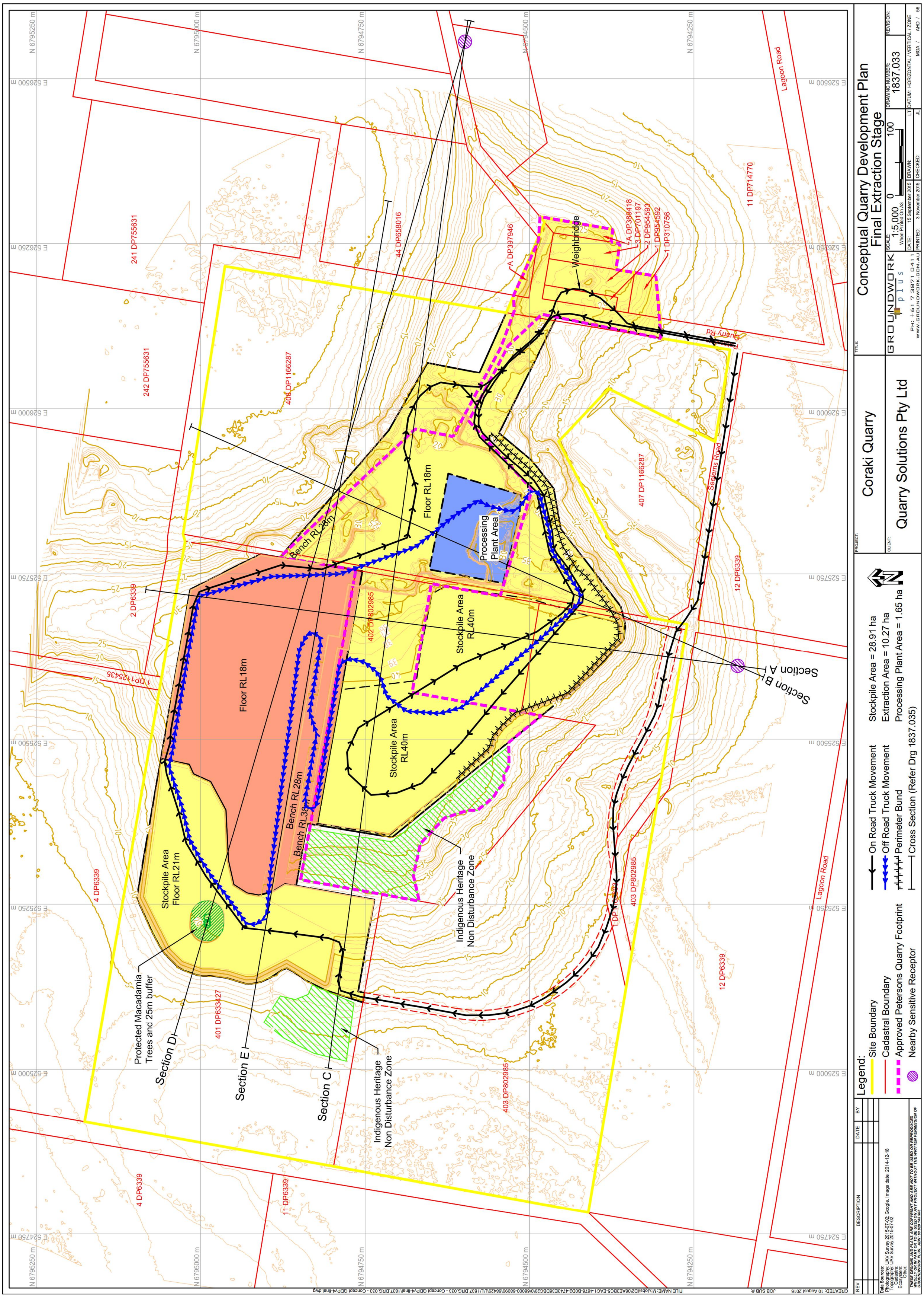
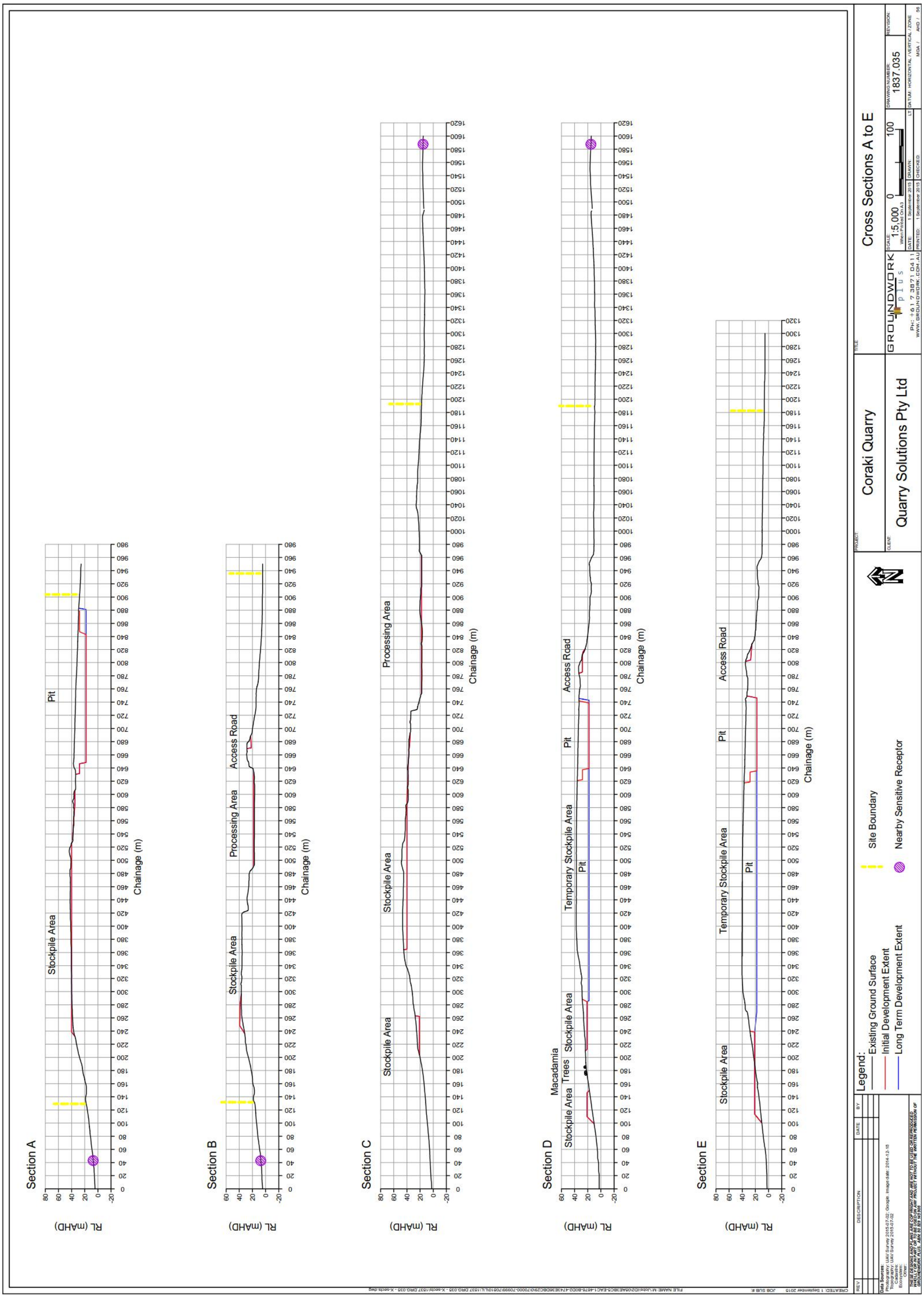


Figure 9 Conceptual quarry development plan final extraction stage



This document is uncontrolled when printed.

Figure 10 Cross sections A to E



3.2.3 *Extraction and resource depth*

The main basalt layer present within the eastern portion of Lot 401 was the focus of the resource investigations and where quarrying activities are proposed. The drilling delineated a large basalt resource between 13 and 42 metres AHD of approximately 3.3 million tonnes indicated resource. The basalt is a black, fine grained, sparsely porphyritic, homogenous columnar jointed basalt interpreted to have high rock strength and durability.

Petrographic examination of this material indicates that the material is predicted to be suitable for use in high quality roadbase, concrete aggregate and asphalt / sealing aggregate pending further source rock and material tests. The observations of the drill chip and core samples from investigations have generally supported the characteristics of this petrographic examination (high strength, low alteration) except in the weathered material which may be highly variable in its rock strength.

Based on the resource investigation the resource profile includes an overburden thickness of 0.2 to 2 metres and a basalt resource thickness of 12 to 20 metres. Based on the clearly delineated rock types encountered during drilling the basalt is revealed to overly an arkose sandstone at true depths. The interface of these two rock types is occupied by smectite clay and extremely weathered basalt facilitated by the hydraulic conductivity of the underlying sandstone.

Plate 5. Characteristic transition from pristine basalt (black) to extremely weathered and smectitic remnant basalt and clay (grey) to an arkose sandstone (orange-brown).

As part of the resource investigations, preliminary material tests were undertaken to assess the strength and durability of the materials intersected. The tests were undertaken on 10mm and 20mm aggregate samples from the Petersons Quarry, processed by a contractor employed by Council using a mobile crushing plant. The crushing plant circuit didn't include a vertical shaft impactor and subsequently material test results are likely to improve with the plant proposed to be used by Quarry Solutions for the project, ensuring deleterious material is liberated from the harder more competent resource.

Critical to the maximisation of the resource for the project will be an understanding of the road pavement design parameters and specifications and opportunities to work with the material quality prevalent at Coraki/Petersons. The results of the material tests are summarised below in Table 5. Based on the observations of the drill chips from the holes drilled into the basalt on Lot 401, it is considered a reasonable assumption that the strength and durability properties of the resource is consistent between the Petersons Quarry and the resource within Lot 401.

Table 5 – Source Material Test Results

Material Test	Test Method	Result
Dry Strength	RMS T215	253kN
Wet Strength	RMS T215	253kN
Wet/Dry Strength Variation	RMS T215	0%
Apparent Particle Density	AS1141.6.1	2.86t/m^3
Particle Density (S.S.D.)	AS1141.6.1	2.78t/m^3
Water Absorption (Coarse Aggregate)	AS1141.6.1	1.5%
Sodium Sulphate Soundness	AS1141.24	0.7%
Micro-Deval Abrasion	ASTM D7428-08	14.2
Los Angeles Value	AS1141.23	15%

Based on the above results an estimate of the resource volume is shown in Table 6 below. This estimate also assumes a 20m buffer to the northern property boundary of Lot 401.

Table 6 – Indicated Resource Estimate – Coraki Quarry Basalt

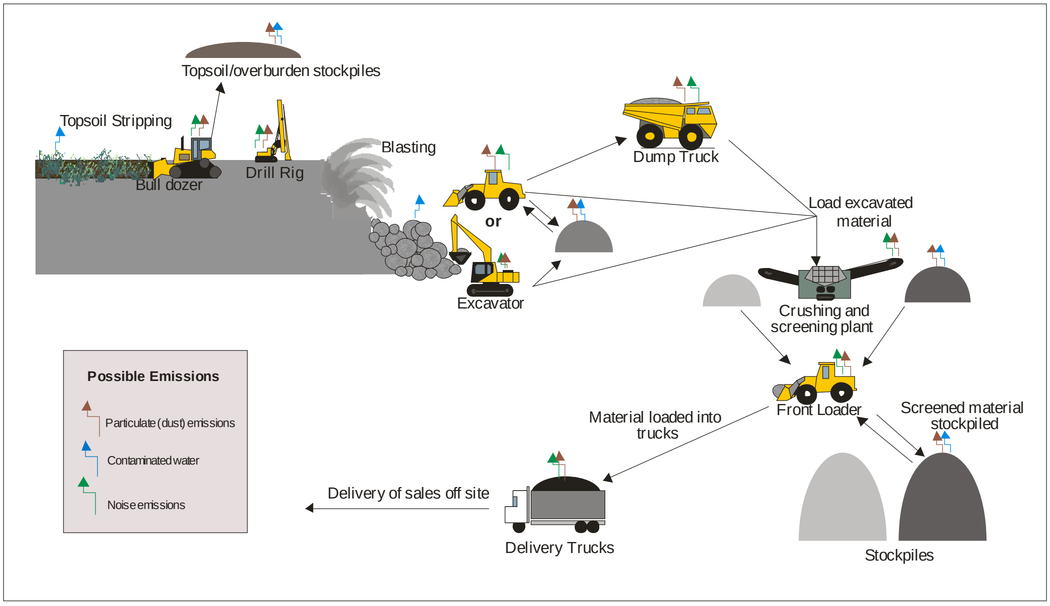
Proposed Coraki Quarry	Estimated m^3 (*in situ*)	Specific Gravity (estimate)	Product Yield tonnes (*in situ*)
Overburden (including residual soils and extremely weathered material)	50,000	1.8 tonnes/m^3	90,000
Transitional basalt material (Distinctly weathered basalt)	130,000	2.1 tonnes/m^3	273,000
Unweathered Basalt (slightly weathered and fresh basalt)	1,050,000	2.78 tonnes/m^3	2,919,000

*Rounded to nearest significant figure

3.2.4 Extraction method

The proposed quarry will use typical quarrying methodologies that involve clearing, topsoil and overburden stripping, drill and blast, extraction, load and haul (internal), processing and stockpiling, and sale, load and dispatch as shown in Diagram 1.

Diagram 1 – Conceptual Site Extraction Operations



Site operations comprise the following basic elements:

- clearing of vegetation and stripping of topsoil and overburden material using mechanical means (i.e. bulldozer or excavator) and stockpiling for incorporation into the site rehabilitation works where required, or use in constructing stormwater control structures (e.g. perimeter bunds)
- drilling and blasting the exposed underlying rock to a manageable size or extraction of less competent or fractured rock using mechanical equipment (e.g. hydraulic excavator or bulldozer with ripper attachment)
- loading won material from the extraction face by front end loader or excavator into off highway trucks for cartage to the crushing and screening plant.
- processing of the won material by the crushing and screening plant
- stockpiling of material in overhead storage bins/silos for either blending to produce roadbase using a pugmill or stockpiled on ground in the stockpile area/hardstand area by either front end load or off highway trucks.
- loading of products into road trucks using either a front end loader or directly from the pugmill for transport off site.

An EMP has been prepared to assist in the management and protection of surrounding environmental values and describes how the operator proposes to manage potential environmental impacts associated with the project (refer Attachment 2).

3.2.5 *Water requirements*

Water will be required where necessary for dust suppression during the construction and operational phases of the proposed quarry. Any water required for use on the site will be sourced from the sediment basin, rainwater tanks installed on the site buildings or imported from a licensed water contractor.

3.2.6 *Equipment*

Vehicles and equipment that will typically be required for the development and operation of the proposed quarry include (but are not limited to), mobile crushing, screening and blending plants, drill rigs, excavators, front end loaders, off highway trucks, water trucks, light vehicles and on-road delivery trucks.

Extractive industry operations require plant and equipment reliant on diesel fuel. The consumption of fuel will be minimised as the processing plant will be connected to the reticulated electricity network. Mobile equipment such as excavators, loaders and other minor plant will require diesel fuel. Accordingly, a specialist emissions assessment is not considered to be warranted in this instance.

3.2.7 *Access and transport*

Access to and from the site is via an existing track through Lot 403 on DP802985 and Lot 1 on DP1165893, via Seelems Road and Petersons Quarry Road which also services the existing Petersons Quarry. The existing access track from Seelems Road would be maintained where necessary. The anticipated haulage route to the Pacific Highway is via Petersons Quarry Road to Lagoon Road to Queen Elizabeth Drive to Coraki Woodburn Road to the Pacific Highway at Woodburn.

3.2.8 *Hours of operation and project duration*

The proposed hours of operation are 6am to 7pm Monday to Saturday, 9am to 3pm Monday to Friday for blasting, and no work on Sundays or public holidays. Operation of the quarry is planned to take place as soon as possible, subject to the appropriate approval being granted and timing of the Pacific Highway upgrade works. The expected operating life of the quarry is five (5) to seven (7) years subject to the duration of the upgrade works to the Pacific Highway.

3.2.9 *Rehabilitation*

Rehabilitation is an essential component of quarry planning and development. Good planning prior to the commencement of quarrying greatly assists in the management of environmental impacts and provides for efficient operations. The program for implementing rehabilitation works for quarries primarily depends on the rate at which terminal benches are reached. As the expected operating life of the quarry is only five (5) to seven (7) years (subject to the duration of the upgrade works to the Pacific Highway), it is anticipated that a majority of rehabilitation works will not be undertaken until the final stage of the project when terminal benches are reached. The site has been historically used for grazing. The final rehabilitated land form shall be compatible with the historical land use (e.g. grazing) in the short term, but facilitating long term redevelopment options, potentially for industrial uses subject to further strategic planning by Richmond Valley Council. Accordingly, the landform shall comprise of gently sloping free draining platforms with any remaining sediment basins converted into a water reservoir for stock watering purposes. Rehabilitation management measures are included in the EMP.

4. Statutory Requirements

4.1 Planning Context

The EP&A Act and associated regulations and environmental planning instruments provide the framework for assessing environmental impacts and determining planning approvals for developments in NSW.

The assessment also considers the requirements of the *Threatened Species Conservation Act 1995* (TSC Act) and the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

4.2 Environmental Planning and Assessment Act 1979 and Environmental Planning and Assessment Regulation 2000

Section 89C(2) of the EP&A Act states the following:

> *(2) A State environmental planning policy may declare any development, or any class or description of development, to be State significant development.*

The project is classified as State Significant Development (SSD) under the *SEPP (State and Regional Development) 2011* (discussed in section 4.3 below) and as such is SSD for the purposes of the EP&A Act. The project will be assessed under Part 4 of the EP&A Act, with the Minister as the consent authority, taking into consideration the matters set out in Section 79C. As such, an EIS is required. This EIS has been prepared in line with Schedule 2 of the EP&A Regulation and addresses the obligations of the consent authority under Section 79C of the EP&A Act.

4.3 State Environmental Planning Policy (State and Regional Development) 2011

Section 8(1) of the *SEPP (State and Regional Development) 2011* designates certain development as SSD, as follows (our emphasis added):

> *(1) Development is declared to be State significant development for the purposes of the Act if:*
> *(a) the development on the land concerned is, by the operation of an environmental planning instrument, not permissible without development consent under Part 4 of the Act, and*
> *(b) the development is specified in Schedule 1 or 2.*

Schedule 1 of the *SEPP (State and Regional Development) 2011* includes extractive industries as being SSD if the following applies (our emphasis added):

> *(1) Development for the purpose of extractive industry that:*
> *(a) extracts more than 500,000 tonnes of extractive materials per year, or*
> *(b) extracts from a total resource (the subject of the development application) of more than 5 million tonnes, or*
> *(c) extracts from an environmentally sensitive area of State significance.*

As such, the project constitutes SSD and is assessed by the Minister as the consent authority under Part 4 of the EP&A Act.

4.4 State Environmental Planning Policy (Mining, Petroleum Production and Extractive Industries) 2007

The relevant aims of the *SEPP (Mining, Petroleum Production and Extractive Industries) 2007* are:

- to provide for the proper management and development of mineral, petroleum and extractive material resources for the purpose of promoting the social and economic welfare of the State, and

- to facilitate the orderly and economic use and development of land containing mineral, petroleum and extractive material resources
- to promote the development of significant mineral resources
- to establish appropriate planning controls to encourage ecologically sustainable development through the environmental assessment, and sustainable management, of development of mineral, petroleum and extractive material resources

Section 12 of this SEPP relates to the compatibility of the proposed extractive industry with other land uses. Pursuant to this section, before determining an application for consent for development for the purposes of mining, petroleum production or extractive industry, the consent authority must:

(a) consider:
  - *(i) the existing uses and approved uses of land in the vicinity of the development, and*
  - *(ii) whether or not the development is likely to have a significant impact on the uses that, in the opinion of the consent authority having regard to land use trends, are likely to be the preferred uses of land in the vicinity of the development, and*
  - *(iii) any ways in which the development may be incompatible with any of those existing, approved or likely preferred uses, and*

(b) evaluate and compare the respective public benefits of the development and the land uses referred to in paragraph (a) (i) and (ii), and

(c) evaluate any measures proposed by the applicant to avoid or minimise any incompatibility, as referred to in paragraph (a) (iii).

The site is ideally situated for the project, being well separated from sensitive receivers and incorporating land associated with the existing Petersons Quarry. The surrounding area is rural in nature and sparsely populated. Apart from urban uses at Coraki, land uses in the vicinity of the site comprise low scale cattle grazing and/or large lot rural residential living.

Coraki is located approximately 2.5 kilometres to the south-east of the site. Given that the project is located on the northern and far side of the existing Petersons Quarry from Coraki, and the natural topography of the land between the project and Coraki provides for physical shielding of the project, it is unlikely that the project will lead to any significant disturbance or impacts to Coraki. However, it is acknowledged that transport of material to the Pacific Highway upgrade project will occur through Coraki.

In accordance with Part 3 of this SEPP, this EIS has also assessed the proposed development for the following:

Significance of resource	Section 3.2.3 and Attachment 9
Compatibility with existing land uses	Section 3.1 and 6.12
Impact on surface water and groundwater resources	Section 7.8, 7.9 and Attachment 8
Impact on threatened species and biodiversity	Section 7.4 and Attachment 5
Impact on air quality/greenhouse gas emissions	Section 7.5, 7.6 and Attachment 66.10
Resource recovery efficiency/re-use, recycling, waste	Section 7.14 and Attachment 2
Transport	Section 7.3 and Attachment 4
Rehabilitation	Section 7.11 and Attachment 2

4.5 State Environmental Planning Policy No. 33 – Hazardous and Offensive Development

The SEPP No. 33 – Hazardous and Offensive Development (SEPP 33) refers to and places obligations on potentially hazardous industry which is defined as any industry which, if the development were to operate without employing any measures (including, for example, isolation from existing or likely future development on other land) to reduce or minimise its impact in the locality or on the existing or likely future development on other land, would pose a significant risk to human health, life or property or to the biophysical environment. This includes a hazardous industry and a hazardous storage establishment.

The project is designed to avoid significant risk to human health, life or property or to the biophysical environment and it is considered that the proposal does not constitute a potentially hazardous industry. However, a review has also considered the criteria outlined in Table 2 of the SEPP 33 guideline in relation to transportation of dangerous goods. It is anticipated that the project will require Class 5.1 (III) ammonium nitrate suspension as an explosive pre-cursor. Deliveries of the product may occur in single bulk delivery above the 2 tonne threshold. However, it should be noted that the same product is currently relied upon for the Petersons Quarry. Nevertheless, the project would therefore be considered a potentially hazardous development with respect to the transport of dangerous goods. This is assessed in Section 7.14.

4.6 State Environmental Planning Policy No. 44 – Koala Habitat Protection

SEPP No. 44 – Koala Habitat Protection (SEPP 44) encourages the conservation and management of natural vegetation areas that provide habitat for Koalas to ensure that permanent free living populations will be maintained over their present range. This policy applies to each of the Local Government Areas (LGAs) listed in Schedule 1 of SEPP 44. The site is located within the Richmond Valley LGA. SEPP 44 lists Richmond River as an applicable LGA. The Richmond River Shire Council was amalgamated with the former Casino Council in 2000 to form the Richmond Valley Council. Therefore this SEPP is applicable to the site.

SEPP 44 restricts granting development consent on land identified as a core koala habitat without preparation of a plan of management. The Biodiversity Assessment Report advises that no evidence of Koala occurrence was found within the study area, and although it is possible this species may also occasionally utilise food trees occurring within the open paddock and fringing the wetlands, these areas are considered to be of less value to the species than the habitats occurring off-site. The proposed development footprint has been positioned to avoid the clearing and fragmentation of the relatively large, well-connected tracts of vegetation and associated habitat within the study area, and avoids all patches of vegetation recognised as native vegetation communities that have greatest value to the majority of known or potentially occurring terrestrial flora and fauna species. Consequently, preparation of a koala plan of management is not required under SEPP 44.

4.7 State Environmental Planning Policy No. 55 – Remediation of Land

SEPP No. 55 – Remediation of Land (SEPP 55) aims to provide for a State-wide planning approach to the remediation of contaminated land and to promote the remediation of contaminated land for the purpose of reducing the risk of harm to human health or the environment. Specifically, this policy aims to ensure that:

- Contamination and remediation are considered in zoning or rezoning proposals and development applications.
- Remediation works are permissible and only require consent where they have the potential for significant environmental impacts (Category 1). In all other cases no consent is required (Category 2).
- Local government authorities are notified before and after remediation takes place.
- Remediation is carried out to appropriate standards.

There are no existing known occurrences of contaminated land within the site and the nature of the project means that contamination is unlikely. Potentially contaminating activities associated with the project include the operation of a workshop and storage of diesel and oils. However, design and management measures are proposed to prevent potential contamination.

4.8 State Environmental Planning Policy North Coast Regional Environmental Plan

The *State Environmental Planning Policy North Coast Regional Environmental Plan* (REP) applies to the LGAs listed in Section 3, which includes the Richmond River LGA. The site is located within the Richmond Valley LGA. The Richmond River Shire Council was amalgamated with the former Casino Council to form the Richmond Valley Council in 2000. However, it is noted that Clause 1.9 (2) of the Richmond Valley Local Environmental Plan (LEP) 2012 directs that the REP does not apply to land administered by the LEP. Therefore the REP is not relevant.

4.9 Protection of the Environment Operations Act 1997

The *Protection of the Environment Operations Act 1997* (POEO Act) sets the framework for environment protection during both the construction and operation of a development or scheduled activity.

Under Schedule 1 of the POEO Act, a licence would be required for:

- Land based extractive activities that involve extraction, processing or storage of more than 30,000 tonnes of extractive materials per year (Section 19).

Therefore, the project is a 'scheduled activity' and requires an EPL under Chapter 3 of the POEO Act. It is noted under Section 89K of the EP&A Act, an authorisation of the following kind cannot be refused if it is necessary for carrying out SSD that is authorised by a development consent under this Division and is to be substantially consistent with the consent:

> *(e) an environment protection licence under Chapter 3 of the Protection of the Environment Operations Act 1997 (for any of the purposes referred to in section 43 of that Act).*

4.10 Protection of the Environment Administration Act 1991

This Act established the Environment Protection Authority (now part of the Office of Environment and Heritage (OEH)). It enables OEH to provide administration for protection of the environment, carry out environmental audits and prepare reports on the state of the environment.

4.11 National Parks and Wildlife Act 1974

The *National Parks and Wildlife Act 1974* (NPW Act) aims to conserve the State's natural and cultural heritage; foster public appreciation, understanding and enjoyment of the State's natural and cultural heritage; and manage any lands reserved for the purposes of conserving and fostering public appreciation and enjoyment of the State's natural and / or cultural heritage. The NPW Act governs the protection and care of native fauna and flora and aboriginal places and objects through NSW. Section 7.4 and Attachment 6 of this EIS assesses the impact of the proposal on native flora and fauna and the requirement for further assessment and referral. Section 7.2 and Attachment 3 of this EIS address the impact of the proposal on indigenous heritage.

4.12 Threatened Species Conservation Act 1995

The *Threatened Species Conservation Act 1995* (TSC Act) aims to conserve and protect certain classes of threatened, endangered and vulnerable species, populations and ecological communities.

Section 5A of the EP&A Act lists a number of factors to be taken into account when deciding if there is the likelihood of a significant impact on threatened species, populations and their habitat or on ecological communities. If there is a chance of an impact, then an Assessment of Significance would be required to determine the significance of the impact. If there is likelihood for a significant impact on threatened species, populations and their habitat or on ecological communities then a Species Impact Assessment is required.

Impacts on threatened species are discussed in Section 7.4 and Attachment 5.

4.13 Native Vegetation Act 2003

The *Native Vegetation Act 2003* (NV Act) regulates the clearing of native vegetation. Clearing is defined as, cutting down, felling, thinning, logging, removing, killing, destroying, poisoning, ringbarking, uprooting or burning native vegetation including native grasses and herbage. Permission to clear native vegetation must be obtained for proposals under Part 4 of the EP&A Act. Impacts on native vegetation are discussed in Section 7.4 and Attachment 5 of this EIS.

4.14 Heritage Act 1977

The NSW *Heritage Act 1977* (Heritage Act) aims to protect and preserve items of non-Aboriginal heritage significance. The Heritage Act provides for the protection of items of local, regional and State heritage significance. It establishes a list of State Heritage Items and outlines processes for approval of development which may impact items of heritage significance. A search of the State Heritage Inventory was undertaken, with no items identified within proximity to the site. The listed items located closest to the site, are located within Coraki approximate 2 kilometres south-east of the site.

4.15 Noxious Weeds Act 1993

The Noxious Weeds Act 1993 (NW Act) aims to prevent the establishment, reduce the risk of spread and minimise the extent of noxious weeds. The NW Act guides the management of declared noxious weeds within Local Government Areas (LGAs). A number of weeds species were recorded on site and are listed in appendix 6 of the Biodiversity Assessment Report (refer Attachment 5).

4.16 Fisheries Management Act 1994

The NSW *Fisheries Management Act 1994* (FM Act) provides for the protection of threatened fish and marine vegetation and is administered by the Department of Primary Industries (DPI). The FM Act aims to protect fishery resources and marine species, and conserve habitats and diversity.

The FM Act works in conjunction with the EP&A Act. If the following activities form part of a proposal, a permit from DPI under the FM Act is required:

- Aquaculture
- Dredging or reclamation
- Harm marine vegetation (mangrove, seagrass, seaweed)
- Obstruct free passage of fish.

The project has maintained buffers to mapped waterways and aquatic habitat areas and is located on a hill and adjacent to the existing Petersons Quarry. Specifically, no dredging is proposed. Surface water will be managed to achieve the relevant water quality objectives and release criteria to the set by the EPA, subject to the outcome of this EIS.

Accordingly, in our assessments and consideration of the project impacts, the following is not anticipated as part of the proposed development:

- Dredging
- Works within a waterway
- Impacts or damage to marine vegetation
- Placement of spoil in waterways
- Activities that block fish passage
- Impacts to fishing and aquaculture.

The proposed development is not subject to the provisions of the FM Act.

4.17 Water Management Act 2000

The Water Management Act 2000 (WM Act) protects rivers and foreshores and water resources in NSW by providing for the sustainable management of water resources.

The WM Act serves to protect ecosystems from excessive extraction of water. Water users are now generally required to obtain a licence (called a Water Access Licence or WAL) to extract surface water. Licences are also required to extract ground water from a bore.

The proposal will use dry extraction methods. Rainwater tanks will collect runoff from site buildings to provide a small amount of water for personal consumption. Water from sediment basins on the site will be used for dust suppression and to irrigate newly revegetated areas but do not require a water access licence as they will be required to achieve compliance with the conditions of the EPL issued for the site.

The WM Act includes provisions to control or permit works within 40 metres of the top of bank. The proposed development does not involve any works within 40 metres of the top of a bank, removing the requirement for a Controlled Activity Approval (refer section above, FM Act).

Geotechnical investigations were undertaken in 2015. Groundwater was not intercepted during the drilling despite extending below the depth of the resource to the underlying clay and sandstone layers. The existing Petersons Quarry pit has a floor at RL18m AHD and groundwater intrusion is not evident. The resource investigations confirmed that the underlying clay and sandstone layers were found approximately 1.9m below the existing floor of the Petersons Quarry. The project proposes to maintain a depth of RL18m AHD for extraction within Lot 401. Accordingly, no impact on groundwater is anticipated and a licence under the NSW Aquifer Interference Policy will not be required.

4.18 Roads Act 1993

The Roads Act 1993 (Roads Act) provides for the classification of roads and for the declaration of the Roads and Maritime Services (Roads and Maritime) and other public authorities as roads authorities for both classified and unclassified roads. It also regulates the carrying out of various activities in, on and over public roads. Richmond Valley Council is the relevant road authority, and Council's approval is required in accordance with Section 138 of the Roads Act 1993. Section 7.3 and Attachment 4 of this EIS addresses potential traffic impacts associated the proposed development.

4.19 Environment Protection and Biodiversity Conservation Act 1999

The *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) protects nationally and internationally important flora, fauna, ecological communities and heritage places, which are defined in the EPBC Act as Matters of National Environmental Significance (MNES). An assessment of MNES was undertaken as part of the Biodiversity Assessment Report (refer Attachment 5). A referral is not required as part of the project.

4.20 Richmond Valley Local Environmental Plan 2012

The proposed development is located in the Richmond Valley LGA. The relevant Local Environmental Plan (LEP) is the *Richmond Valley Local Environmental Plan 2012* (LEP). The site is located on land partly zoned RU1 Primary Production, and partly zoned E2 Environmental Conservation. The proposed development is solely located on land zoned RU1. Within the RU1 land zone, an extractive industry is permissible with consent. The proposed development is consistent with the objectives of the zone RU1, which are:

- *To encourage sustainable primary industry production by maintaining and enhancing the natural resource base.*
- *To encourage diversity in primary industry enterprises and systems appropriate for the area.*
- *To minimise the fragmentation and alienation of resource lands.*
- *To minimise conflict between land uses within this zone and land uses within adjoining zones.*
- *To ensure that development does not unreasonable increase the demand for public services or public facilities.*

The following provisions of the LEP are relevant to a consideration of the application:

Clause 4.3 – Height of buildings
This clause provides direction on maximum building heights and siting of buildings to minimise potential visual impacts. The proposed development will require a demountable relocatable site office, which will be well below the maximum building height of 8.5 metres on the site. The site office will be located in proximity to the existing Petersons Quarry

weighbridge. This area of the site is well screened topographically and has traditionally been the location of the site office and amenities for the Petersons Quarry.

Clause 6.1 – Acid Sulfate Soils

The proposed development is located on land mapped as 'Class 5' on the Acid Sulfate Soils Map. Assessable development includes development on land mapped as 'Class 5', involving works within 500 metres of adjacent Class 1, 2, 3 or 4 land that is below 5m AHD and by which the water table is likely to be lowered below 1m AHD on adjacent Class 1, 2, 3 or 4 land. The proposed development is within 500 metres of land designated as 'Class 3' land, however, works will not occur below 5m AHD and the water table is not likely to be lowered as groundwater is not anticipated to be encountered. The resource investigations, encountered no groundwater in the extraction area. It is anticipated that any groundwater resides within the underlying clay and sandstone layer, and as it is proposed to retain a floor of basalt, no interaction with groundwater is anticipated. In addition, based on discussions with Council, no groundwater has been intercepted by operations at the adjacent Petersons Quarry. As such, the remainder of this clause is not applicable to the proposed development.

Clause 6.6 Terrestrial Biodiversity

This clause applies to land identified as 'biodiversity' on the Terrestrial Biodiversity Map. The Biodiversity Assessment Report (refer Attachment 5) considered the terrestrial biodiversity mapping and confirmed that the proposed development is located outside of the areas containing biodiversity value.

Clause 6.10 Wetlands

The Biodiversity Assessment Report (refer Attachment 5) considered the wetland values. The project will maintain appropriate buffers and surface water will be managed to achieve the relevant water quality objectives and release criteria to be set by the EPA (subject to the outcome of this application).

5. List of Approvals and Licences

In addition to the development consent from the Minister for Planning for SSD, it is anticipated that the following licences and approvals would be required to carry out the project:

- Environment Protection Licence pursuant to the *Protection of the Environment Operations Act 1997*
- Approval under Section 138 of the *Roads Act 1993* for works in a public road if works are required in relation to the sealing of Seelems Road.

6. Consultation

The integrity of the planning and assessment process is reliant on genuine and transparent stakeholder engagement. Quarry Solutions is committed to working with the community and being an active and responsible member of the local community. A project specific stakeholder engagement process has been undertaken as part of the environmental impact assessment process including engagement with relevant authorities, the Richmond Valley Council, local community members, adjoining land owners and residents, local businesses and the Bogal Local Aboriginal Land Council.

6.1 Local Community Engagement

6.1.1 Surrounding landowners

During the preparation of this EIS, Quarry Solutions has actively engaged with surrounding land owners, residents and local businesses through a coordinated effort of letters and telephone calls followed by face to face meetings held in early September 2015. Feedback received during those discussions were recorded by Quarry Solutions staff and was incorporated into the design of the development and proposed management measures. Formal responses from surrounding land owners, residents and local businesses were not received as part of this engagement process. The engagement program was supported by a Community Briefing Paper which communicated key aspects of the project. The primary issue raised by the engagement program included management of the additional truck movements through Coraki. This is addressed in more detail in Section 7.3 and Attachment 4.

6.1.2 Richmond Valley Council

Quarry Solutions proactively engaged with the Richmond Valley Council throughout the preparation of this EIS including a number face to face of meetings with Council officers, Councillors and the Mayor. Formal minutes of these meetings were not taken or issued. The primary issues raised during discussions included preservation of the Petersons Quarry resource for the needs of the local community and potential traffic impacts. Subsequently, (as discussed in Section 3.2) the project has been designed to extract material primarily from Lot 401 and establish working benches to facilitate the efficient development of the Petersons Quarry into the future. A range of management measures have also been identified to assist in minimising potential for traffic impacts, including for example a Driver’s Code of Conduct and GPS monitoring of haulage trucks. It was also identified that the Section 94 Heavy Haulage Contributions Plans 2013 (RVC 2013) notes that an extractive industry use with the proposed annual extraction is required to pay $1.08/tonne for the pavement impact likely to be generated on Council’s roads (refer Section 7.3 and Attachment 4).

6.2 Aboriginal Community Involvement

Consultation with the Aboriginal community has been undertaken in accordance with the guidelines as set out in the NSW OEH’s *Aboriginal cultural heritage consultation requirements for proponents 2010* (DECCW 2010). This consultation process is discussed in detail in the Aboriginal Cultural Heritage Assessment Report (refer Attachment 3). No registrations of interest were made by any Aboriginal Parties other than the Bogal Local Aboriginal Land Council.

6.3 State Authorities

Consultation with relevant State Authorities has been undertaken during the preparation of the EIS to enable relevant issues to be identified and refinements made to the assessment process.

The Department of Planning & Environment (DP&E) were consulted with closely. On 24 April 2015 the request for SEARs for the project was submitted with the preliminary environmental assessment. On 22 May 2015 the DP&E provided the SEARs for the project. On 27 May 2015 the DP&E were consulted via email correspondence and telephone regarding inclusion of the Petersons Quarry land into the project, followed by submission of a revised conceptual site layout plan on 27 July 2015. Having considered the information provided the DP&E issued revised SEARs on 30 July 2015.

The New South Wales Environment Protection Authority (EPA) were contacted via email and telephone on 29 May 2015 to discuss the scope of the EIS and clarify a number of matters including, the intention to minimise diesel emissions by relying upon mains power for the processing plant and thereby not requiring a quantitative assessment of diesel emissions for the project. The EPA responded by email on 22 June 2015 confirming that a quantitative assessment of diesel emissions for the project and providing recommendation for the methodology of the noise and dust impact assessment. The advice of the EPA has been incorporated into the assessment of the potential noise and dust impacts generated by the project as discussed in Section 7.5 and 7.6 and Attachment 6.

The New South Wales Office of Environment and Heritage (OEH) was consulted by email and telephone on 12 June 2015 to clarify the scope of the EIS. OEH responded by letter dated 22 July 2015 that a person accredited in the NSW biobanking scheme would not need to prepare the Biodiversity Assessment Report subject to the protection of the 'Rough-shelled Bush Nut trees'. OEH also provided clarification via email dated 1 July 2015 that a flood impact assessment would not be required and the project could rely upon the Richmond Valley Council flood mapping to identify floor prone areas of the site. The recommendations of OEH have been incorporated into the assessment of biodiversity values in Section 7.4 and Attachment 5.

Dr Julie Dibden undertook direct consultation with OEH in accordance with OEH's Aboriginal cultural heritage consultation requirements for proponents 2010. Consultation included correspondence dated 4 May 2015 sent to, OEH, Bogal Local Aboriginal Land Council, Office of the Registrar Aboriginal Land Rights Act 1983, The National Native Title Tribunal, Native Title Services Corporation Limited and Richmond Valley Council. In addition an advertisement was placed in the local paper (Northern Star) on 6 May 2015. Following advice from OEH further correspondence dated 18 May 2015 was also sent to a list of known Aboriginal Parties for the Richmond Valley Local Government Area that OEH considered likely to have an interest in the project. The Office of the Registrar Aboriginal Land Rights Act 1983 responded (no date) indicating that it did not appear that there were registered Aboriginal owners for the project area. The Native Title Services Corporation Limited responded on 7 May 2015 indicating that they would provide the correspondence to any individuals, groups or organisations that it was aware of asserting traditional interest in the area. The Bogal Local Aboriginal Land Council responded on 11 May 2015 indicating that they required a survey of the area to be undertaken which subsequently occurred. The National Native Title Tribunal responded via email on 7 May 2015 indicating that Native Title has been extinguished for the area in question given the property is freehold. Further details of consultation are provided in Section 7.2 and Attachment 3.

DP&E, EPA and Roads & Maritime Services were consulted by email and telephone in June 2015 by Groundwork Plus, MWA Environment and MRCagney in relation to methodology of the traffic noise assessment and traffic impact assessment including location of monitoring and traffic survey points. The agencies confirmed verbally that potential off site transport impacts are to be assessed in accordance with the NSW Road Noise Policy and other relevant statutory documents. These matters have been assessed in detail in Section 7.3, Attachment 4, 7.5, 7.6 and Attachment 6.

The advice of the NSW Rural Fire Service was considered in relation to potential bushfire hazard and has been addressed in Section 7.14 and Attachment 2 and will be further managed in accordance with the existing Petersons Quarry Pollution Incident Response Management Plan (PIRMP) which will be revised in due course to incorporate the broader project area.

The New South Wales Department Primary Industries (DPI) and New South Wales Trade & Investment (DT&I) and North Coast Local Land Services were consulted by email and telephone on 28 May 2015 to discuss the scope of the EIS and clarify relevant matters including the DPI guideline Agriculture Issues for Extractive Industry (DPI 2012) and comments regarding fisheries protection. It was noted through subsequent email correspondence dated 28 and 29 May 2015 that whilst the site is mapped as containing regionally significant farmland, the site has a topsoil and overburden depth of less than 1m across the identified resource proposed to be extracted and therefore does not meet the criteria for regionally significant farmland. Through that discussion and email correspondence it was also confirmed that the incorrect version of the DT&I comments were attached to the DPI comments that were included in the original SEARs and in fact there were no items of concern regarding Fisheries. This resulted in a revised letter being issued by Kristian Holz, Director Policy, Legislation and Innovation, Department of Primary Industries. As such the Biodiversity Assessment Report was not required to include aquatic surveys. These matters have been addressed in Section 7.12 and 7.4 and Attachment 5.

The New South Wales Office of Water (OoW) was consulted by email and telephone on 28 May 2015 in relation to the project and the scope of the EIS in relation to surface water, water licencing and groundwater impacts. It was discussed that groundwater is unlikely to be intercepted considering the results of the resource assessment and decision to maintain the same depth of extraction as the Petersons Quarry (RL 18m AHD) which had not encountered groundwater. Proposed buffers of 40m to waterways and management measures for surface water were also discussed to clarify the anticipated water demand for the project. The OoW responded by email dated 28 May 2015 confirming that a water licence is unlikely to be required if the project is development consistent with this approved and that the EIS should outline the intended supply of water for the project and re-use of treated surface water for dust suppression. This information has been incorporated within Section 7.8 and Attachment 8.

6.4 Environmental Assessment Requirements

As the proposal is a designated development, SEARs were requested and were provided on 22 May 2015 and revised on 30 July 2015 (refer Attachment 1). Table 7 below provides a summary of assessment requirements from relevant agencies and a cross reference to where they are addressed within this EIS.

Table 7 – Summary of Environmental Assessment Requirements

Issue/ requirement	Addressed
Department of Planning and Environment	
A full description of the development, including: 1. Need 2. Resource description 3. Site layout and extraction plan 4. Extraction and processing activities 5. Infrastructure and facilities 6. Waste management strategy 7. Water management strategy 8. Rehabilitation strategy 9. Likely interactions with nearby quarries.	Refer the following: 1. Refer Section 2.2 2. Refer Section 3.1.3, 3.2.4 and 7.9 3. Refer Drawing No. 1837.027, 032, 033 and 035 4. Refer Section 3.2 5. Refer Section 3.2 6. Refer Section 7.14 7. Refer Section 7.8 8. Refer Section 7.11 9. Refer Section 3 and Drawing No. 1837.027, 032, 033 and 035
A list of relevant approvals.	Refer Section 5
An assessment of likely environmental impacts, including: · Existing environment · Likely impacts · Implementation measures to mitigate or manage likely impacts · Monitoring and reporting measures	Refer Section 7
A consolidated summary of proposed environmental management and monitoring measures	Refer Section 8
Consideration of relevant environmental planning instruments	Refer Section 4
Reasons why the development should be approved, with regard to ESD	Refer Section 7.16
The EIS must address the following specific matters:	
· Land resources	Refer Section 7.12
· Traffic and transport	Refer Section 7.3
· Blasting and vibration	Refer Section 7.7
· Air quality	Refer Section 7.6
· Noise	Refer Section 7.5
· Surface and groundwater	Refer Section 7.8 and 7.9
· Biodiversity	Refer Section 7.4
· Aboriginal and historical heritage	Refer Section 7.2
· Visual	Refer Section 7.10
· Hazards	Refer Section 7.14
· Social and economic	Refer Section 7.13
· Rehabilitation	Refer Section 7.11
· Consultation	Refer Section 6.0

6.5 Public Exhibition and Notification

Section 89(F) of the EP&A Act outlines public participation procedures for SSD, which requires, as soon as practicable after a development application is made for consent to carry out SSD, the Secretary must:

1. *place the application and any accompanying information on public exhibition for a period (of not less than 30 days) prescribed by the regulations (the submission period) commencing on the day after which notice of the application is first published as referred to in paragraph (b), and*
2. *cause notice of the application to be given and published in accordance with the regulations.*

7. Environmental Assessment

7.1 Potential Environmental Impacts

The Preliminary Environmental Assessment for the project identified aspects of the project which could potentially cause environmental impacts and warranted further detailed assessment as part of this EIS. Those aspects are summarised below in Table 8.

Table 8 – Summary of Potential Environmental Impacts

Issue	Potential Impact	Specialist Assessment Required
Archaeology and historic heritage	New areas of disturbance area proposed. The NSW Office of Environment and Heritage (OEH) Aboriginal Heritage Information Management System (AHIMS), identifies one record near the site. Accordingly, an Aboriginal Cultural Heritage Assessment Report (refer Attachment 3) has been prepared. That assessment also addresses non-aboriginal heritage matters.	Yes, refer to Section 7.2
Traffic	Extractive industry operations require haulage of extracted material via the surrounding road network which if not adequately managed may cause physical damage to roads. Accordingly, a Traffic Impact and Pavement Assessment Report (refer Attachment 4) has been prepared	Yes, refer to Section 7.3
Biodiversity	Extractive industry operations often require clearing of vegetation. These activities if not adequately controlled, may cause impacts to areas of biodiversity value. The project has been designed to avoid impacts to areas considered to hold biodiversity value and is primarily located within areas of the site devoid of native vegetation. However, extractive industry operations also involve activities which if not adequately managed may result in impacts to native vegetation from introduction or spread of noxious and environmental weeds. Accordingly, a Biodiversity Assessment Report (refer Attachment 5) has been prepared.	Yes, refer to Section 7.4
Noise & Air Quality	Extractive industry operations have the potential to generate noise and dust emissions that, if inadequately controlled, may cause nuisance to nearby sensitive receptors. Accordingly, a Noise and Dust Assessment (refer Attachment 6) has been prepared.	Yes, refer to Section 7.5 and 7.6
Vibration	Extractive industry operations have the potential to generate vibration impacts which if inadequately managed may impact nearby sensitive receptors. Accordingly a Blast Parameters Evaluation (refer Attachment 7) has been prepared.	Yes, refer to Section 7.7
Surface water	Extractive industry operations have the potential to generate sediment loads which if inadequately managed may impact on surface water quality. Accordingly a Surface Water Management Assessment (refer Attachment 8) has been prepared.	Yes, refer to Section 7.8
Groundwater	The Petersons Quarry has been in operation since 1916. The existing floor of the Petersons Quarry is at RL 18m AHD. No groundwater intrusion is evident within Petersons Quarry. Resource investigations did not encounter groundwater (refer Attachment 9). The proposed Coraki Quarry would establish a pit floor at RL 18m AHD consistent with Petersons Quarry. Accordingly, it is understood that the local groundwater is held within the underlying sandstone and clay and retention of the pit floor will provide suitable separation.	No, refer to Section 7.9
Visual amenity	The project will utilise the existing Petersons Quarry which is topographically screened from surrounding residents to facilitate the initial extraction area for the Coraki Quarry. Stockpiling will occur on the crest of the hill. Earthen bunds are proposed to provide visual and acoustic screening and to assist in stormwater management. Accordingly, the project has been designed to minimise potential visual amenity impacts.	No, refer to Section 7.10
Rehabilitation	Extractive industry operations include activities which disturb the existing soil structure by removing the extractive resource. Rehabilitation of disturbed areas to a safe, stable, non-polluting state is required to return the land to a suitable state for re-commencement of the historic land use (cattle grazing) or new land use (subject to relevant approvals). Accordingly, rehabilitation of the site at the conclusion of the project is addressed in the EMP.	No, refer Section 7.11
Land use, land forms and agricultural suitability	Extractive industry operations include activities which disturb the existing soil structure by removing the extractive resource. Extractive industry operations also involve activities which have the potential to generate dust which if not adequately managed may impact on agricultural activities. The site is located in proximity to rural and agricultural activities. However, the site is not considered to be good quality agricultural land as it has a topsoil and overburden depth of less than 1m. The project will be managed in accordance with the measures outlined in the EMP which will minimise the potential for dust impacts to nearby sensitive receptors.	No, refer to Section 7.12
Socio-economic	The potential socio-economic impacts of the project have been assessed as part of this EIS.	No, refer to Section 7.13
Hazards	The project does not constitute a potentially hazardous industry and hard rock extractive industry operations generate limited amounts of waste. Any fuels and chemicals stored on-site will be stored in accordance with the relevant standards and licence requirements. Disposal of waste will be managed by a licenced waste contractor.	No, refer to Section 7.14
Cumulative impacts	The cumulative impacts of the project have been addressed as part of the specialist assessment supporting the EIS.	No, refer to Section 7.15
Ecologically Sustainable Development (ESD)	The project is to be assessed in relation to the principles of ESD.	No, refer to Section 7.16

7.2 Archaeology and Historic Heritage

Key findings

A process of Aboriginal community consultation and assessment (refer Attachment 3) has been undertaken to identify and record any Aboriginal cultural areas, objects or places and to assess the archaeological potential of the proposal area, and to formulate management recommendations based on the results of community consultation, background research, field survey and significance assessment. The site was found to be highly disturbed by previous agricultural and quarrying land use.

No Aboriginal object sites were recorded. Generally, the site has been found to be of low archaeological sensitivity and significance.

The entire area in which impacts would occur has undergone relatively high levels of prior disturbance associated with land clearance/agriculture and previous quarrying. This previous land use is assessed to have caused reasonably high levels of impact to almost all ground surfaces and hence, to any Aboriginal objects which may once have been present in those areas.

The impacts associated with almost 100 years of quarrying cover an area measuring approximately 17.5 hectares. These impacts include deep quarrying and more shallow disturbances associated within stockpile clearing. All areas however, possess negligible areas of original ground surface. Accordingly, the area encompassed by the existing quarrying works has no potential to host Aboriginal cultural materials.

Impacts in the remainder of the subject area vary. All areas have been cleared of original native vegetation and have been used for agriculture. Ground surfaces are now covered with introduced pasture species including couch and kikuyu. Remnants of farm fences and infrastructure remain. Generally the ground surfaces are uneven indicating prior disturbance. Minor land disturbance has occurred at the western edge of the basalt in Lot 401. Elsewhere, farm dams, water diversion channels and a well formed access road into Lot 401, have caused localised impacts.

There is one known site located on the site of the existing Petersons Quarry which has information restrictions and its nature is not discussed further here. It is, however located within a previously defined Non Disturbance Zone which will be maintained by the project. One additional land form was identified situated in close proximity to Seleems Creek and assessed to be of some greater archaeological potential and significance. This project will respect that land form by including an additional Non Disturbance Zone (refer Figure 2 and Drawing No. 1837.027 Conceptual Site Layout Plan).

The proposed development would entail the removal and disturbance of potential artefact bearing deposit and, accordingly, has the potential to cause fundamental impacts to any Aboriginal areas, places or objects. The proposed works entail ground disturbance and, accordingly, have the potential to cause impacts to any Aboriginal areas, places or objects which may be present within the zones of direct impact. However, no Aboriginal object sites have been recorded in the proposed extraction and stockpiling areas. Accordingly, no harm to Aboriginal objects is proposed. It is noted that the previously identified Non Disturbance Zone in which AHIMS 04-4-0142 is located will be maintained and would not be disturbed as a result of the project.

No Aboriginal objects or cultural values are known to occur in the area of the proposed impacts. Consideration of ecologically sustainable development and cumulative impacts in regard to Aboriginal heritage are not necessary. Avoidance or the mitigation of harm has not been considered as an option in relation to the proposed activities. It is considered that the significance of the Aboriginal objects is not sufficient to warrant the implementation of impact avoidance strategies. No known items of historic heritage significance occur within the proximity of the site and therefore the project is not expected to impact either directly or indirectly on any listed heritage item.

Recommended management strategies include the establishment of the additional Non Disturbance Zone, (which has been incorporated into the design of the project) and the preparation of an Aboriginal Heritage Management Plan (AHMP) by the project archaeologist, in consultation with the NSW OEH and Registered Aboriginal Parties. The management plan would set out procedures relating to the management and mitigation of development impacts, a protocol for the management of unexpected archaeological finds and the conservation of areas outside the extraction footprint, as required.

7.2.1 *Introduction*

The content and format of the report is set out in accordance with the NSW OEH (2011) Guide to investigating, assessing and reporting on Aboriginal cultural heritage in NSW document. The report aims to document:

- The Aboriginal objects and declared Aboriginal places (as relevant) located within the area of the proposed activity;
- The cultural heritage values, including the significance of the Aboriginal objects and declared Aboriginal places that exist across the whole area that will be affected by the proposed activity, and the significance of these values for the Aboriginal people who have a cultural association with the land, as relevant;
- How the requirements for consultation with Aboriginal people have been met (as specified in clause 80C of the NPW Regulation);
- The views of those Aboriginal people regarding the likely impact of the proposed activity on their cultural heritage (if relevant);
- The actual or likely harm posed to the Aboriginal objects or declared Aboriginal places from the proposed activity, with reference to the cultural heritage values identified;
- Any practical measures that may be taken to protect and conserve those Aboriginal objects or declared Aboriginal places (if relevant); and
- Any practical measures that may be taken to avoid or mitigate any actual or likely harm, alternatives to harm, or, if this is not possible, to manage (minimise) harm (if relevant).

The assessment has been managed and undertaken by Julie Dibden (Australian National University: BA with Honours; PhD), NSW Archaeology Pty Ltd and the following section of this EIS is based on her expert advice contained within Attachment 3.

7.2.2 *Description of the area*

Aboriginal people have occupied NSW for more than 42,000 years. Evidence and cultural meanings relating to occupation are present throughout the landscape. A consideration of landscape is particularly valuable in archaeological modelling for the purposes of characterising and predicting the nature of Aboriginal occupation across the land. In Aboriginal society, landscape could be both the embodiment of Ancestral Beings and the basis of a social geography and economic and technological endeavour. The various features and elements of the landscape are/were physical places that are known and understood within the context of social and cultural practice.

Given that the natural resources that Aboriginal people harvested and utilised were not evenly distributed across landscapes, Aboriginal occupation and the archaeological manifestations of that occupation will not be uniform across space. Therefore, the examination of environmental context is valuable for predicting the type and nature of archaeological sites which might be expected to occur. Factors that typically inform the archaeological potential of landscape include the presence or absence of water, animal and plant foods, stone and other resources, the nature of the terrain and the cultural meanings associated with a place.

Additionally, geomorphological and humanly activated processes need to be defined as these will influence the degree to which material evidence may be visible and/or conserved. Land which is heavily grassed and geomorphologically stable will prevent the detection of archaeological material, while places which have suffered disturbance may no longer retain artefacts or stratified deposits. A consideration of such factors is necessary in assessing site significance and formulating mitigation and management recommendations. The following information describes the landscape context of the subject area.

The subject area is on the Wardell 1:25,000 topographic map. For mapping purposes it is in Zone 56. The project would occur in Lot 401 DP633427, Lot 402 DP802985, Lot 403 DP802985, Lot 408 DP1166287, Lot 1 DP954592, Lot

2 DP954593, Lot 3 DP701197, Lot A DP389418, Lot 1 DP310756, Lot A DP397946 in the Parish of West Coraki, County of Richmond.

The subject area occurs entirely within the Clarence Lowlands subregion of the South Eastern Queensland - Clarence Lowlands Bioregion, and includes the Lamington Volcanic Slopes, Grafton-Whiporie Basin and Clarence-Richmond Alluvial Plains Mitchell Landscapes (BAAM Pty Ltd 2015).

The subject area is comprised of locally elevated land which rises above the adjacent floodplains and wetlands. Spring Hill is located in the western section of Lot 402, with a high point of approximately RL 47 m AHD. Seelems Creek meanders across the western portion of the study area as a series of ox-bow wetlands. The topography of the surrounding area is predominantly low relief, flood prone, alluvial plains (Figure 2).

The Richmond River is located approximately 1.7 km to the east. Kennedys Swamp lies to the north and occupies the area north of the 5 m contour line within Lot 408. Kennedys Swamp has an approximate catchment area of 200 ha and is bounded by the Casino – Coraki Road to the east, Newmans Road to the north and Spring Hill to the south and west. Surface runoff from the eastern slopes of Spring Hill flow east into the existing quarry and are then directed north through a small sediment retention basin into Kennedys Swamp.

Seelems Creek extends across Lot 403 DP 802985 and Lot 401 DP633427. The catchment area of Seelems Creek at this point is estimated to be in excess of 800 ha and predominantly comprises agricultural land. Currently, surface runoff from the western slopes of Spring Hill flows into Seelems Creek. Surface water from the southern slopes of Spring Hill flows south by overland flow into a lower section of Seelems Creek.

The land within the study area traverses several different soil landscapes; including Coraki and McKee. These are residual landscapes, dominated by sites where deep soils have formed from in-situ weathering of parent materials. Landform elements include some summit surfaces, plateaux, terrace plain, peneplains and old ground surfaces (Morand 1994).

The Coraki landscape is characterised by low, undulating rises on Kangaroo Creek Sandstone. The relief is 10-30 m and surface slopes are 2-10%. Elevation is generally <30 m and the vegetation has been extensively cleared (Morand 1994). The McKee landscape is characterised by very low to low undulating hills and rises on Lismore Basalts. Relief is 30-50 m with slopes up to 10%. Slopes are simple or waning and drainage depressions are common. This soil landscape has also been extensively cleared.

The broader study area includes the North Casino landscape which is characterised by drainage depressions forming swamps and intermittent swamps associated with the Richmond River Alluvial Plain. The Tweed Heads 1:250,000 Geological series sheet 56-3 indicates the underlying geology of Spring Hill comprises Lismore Basalts of the Tertiary period related to the Lamington Volcanics. A zone of Kangaroo Creek Sandstone of the Jurassic-cretaceous period surrounds the Spring Hill Lismore Basalts with alluvium sands and gravels from the Quaternary period. During the field inspection, pebbles derived from conglomerate associated with the sandstone were observed in isolated exposures on the simple slope.

Excavations undertaken at the existing quarry show shallow topsoils, typically only 200 mm thick, overlying approximately 1.8 m of ‘overburden’ material comprising weathered basalt and soil. Pockets of structured, plastic clays are located throughout the proposed quarry. Basalt, the material extracted from the existing quarry, is located beneath this overburden area.

The unquarried area of Lot 402 currently comprises dense grassland and patches of weeds which have colonised following the removal of cattle. Lot 401 DP633427 is still grazed and grass and weed cover is consistent. Lower areas within Lot 403, to the west and south-west of the proposed quarry include disturbed wetlands associated with Seelems Creek. A mixture of dry rainforest species were planted in 2008 along both sides of the access road (right of carriageway) through Lot 403 to Lot 401 DP 633427 (clearly visible in Figure 2).

Before European colonisation, the native vegetation would have comprised largely dense gallery rainforest stands which are reported to have covered the Richmond River floodplains (Collins 2005). It is noted here that Belshaw (1978) has argued that areas of rainforest may have been uninhabited or inhabited irregularly. Much of this vegetation has been cleared for cattle grazing and agriculture, particularly for the sugar cane plantations. BAAM Pty Ltd (2015) identified four native vegetation types within or in close proximity to the subject area:

- Hoop Pine - Yellow Tulipwood dry rainforest of the North Coast – a component of the Lowland Rainforest in the NSW North Coast and Sydney Basin Bioregions.
- Forest Red Gum - Swamp Box of the Clarence Valley lowlands of the North Coast – a component of the Sub-tropical Coastal Floodplain Forest of the NSW North Coast bioregion.
- Paperbark swamp forest of the coastal lowlands of the North Coast – a component of the Swamp sclerophyll forest on coastal floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions.
- Coastal freshwater meadows and forb lands of lagoons and wetlands – a component of the Freshwater wetlands on coastal floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions.

These four communities occur outside the development footprint. In areas where impacts would occur, the shrubby vegetation is dominated by Camphor Laurel (*Cinnamomum camphora*) and Lantana (*Lantana camara*).

7.2.3 Material evidence of peoples living on the land

A search of the NSW OEH Aboriginal Heritage Information Management System (AHIMS) was conducted on 29th April 2015 (AHIMS client service ID: 170901). The search area measures 240 square kilometres, with a buffer of 50 meters, and is encompassed by the following co-ordinates at Datum GDA, Zone 56 - Eastings: 519000 - 534000, Northings: 6786000 - 6802000. A total of 27 Aboriginal sites are located in the AHIMS search area, some of which are discussed below (Table 1; Figure 3). Note. A number of AHIMS sites including the two discussed below, have information restrictions.

Searches have been conducted of the NSW State Heritage Inventory and the Australian Heritage database. No Aboriginal heritage sites are listed on these as being in the proposed activity area. The AHIMS register only includes sites which have been reported to NSW OEH. Generally, sites are only recorded during targeted surveys undertaken in either development or research contexts. Accordingly, this search cannot be considered to be an actual or exhaustive inventory of Aboriginal objects situated within the local area or indeed within the study area itself.

Two sites on the AHIMS register are located in or close to the subject area and these are discussed below.

- AHIMS 04-4-142 Spring Hill Coraki - located on the western end of Lot 402 DP802985.
- AHIMS 04-4-0121 Twin Pines Birth Place - located south of the property and subject area.

However, in general terms there has been very little archaeology conducted in the immediate local area.

7.2.4 Predictive model of aboriginal site distribution

The assessment adopted a predictive model to assist in the consideration of the type of Aboriginal objects know to occur in the region and the potential for their presence within the subject area to occur.

Stone Artefacts
Stones artefacts are located either on the surface and/or in subsurface contexts. The detection of artefacts depends on ground surface factors and whether or not the potential archaeological bearing soil profile is visible. Prior ground disturbance, vegetation cover and sediment/gravel deposition can act to obscure artefact presence. The raw materials used for artefact manufacture will commonly be silcrete, chert, quartzite, quartz and volcanics. Within the local area, stone artefacts will be widely distributed across the landscape in a virtual continuum, but with significant variations in density in relation to different environmental factors. Artefact density and site complexity will be greater near reliable water and the confluence of resource zones.

Given the environmental context, it is assessed that in the subject area stone artefacts will be present in variable densities ranging from negligible/low to low/moderate density. Higher artefact density is predicted to be present on reasonably flat ground close to Seelems Creek. Elsewhere, artefact density is predicted to be very low.

Grinding Grooves
Grinding grooves are found in rock surfaces and result from the manufacture and maintenance of ground edge tools. Given the absence of large sandstone exposures, grinding groove sites are unlikely to be present.

Burials sites
Burial sites have been recorded within the wider region. This site type is rarely located during field survey and are not predicted to be present in the subject area.

Rock Shelter Sites
Rock shelters sites are unlikely to be present in the study area given the absence of vertical stone outcrops.

Scarred and Carved Trees
Scarred and carved trees result from either domestic or ceremonial bark removal. Carved trees associated with burial grounds and other ceremonial places have been recorded in the wider region. In an Aboriginal land use context this site type would most likely have been situated on flat or low gradient landform units in areas suitable for either habitation and/or ceremonial purposes.

Bark removal by European people through the entire historic period and by natural processes such as fire blistering and branch fall make the identification of scarring from a causal point of view very difficult. Accordingly, given the propensity for trees to bear scarring from natural causes, their positive identification is impossible unless culturally specific variables such as stone hatchet cut marks or incised designs are evident and rigorous criteria with regard to tree species/age/size and specific characteristics with regard to regrowth is adopted.

Nevertheless, the likelihood of trees bearing cultural scarring remaining extant and in situ is low given events such as land clearance and bushfires. Generally scarred trees will only survive if they have been carefully protected (such as the trees associated with Yuranigh's grave at Molong where successive generations of European landholders have actively cared for them).

The subject area is has been cleared previously and this site type is unlikely to be present.
Stone Quarry and Procurement Sites
Sites will only be located where exposures of a stone type suitable for use in artefact manufacture occur. Given the presence of stone outcrops in the proposal area this site type is may be recorded during the study.

Ceremonial Places and Sacred Geography
Burbung and ceremonial sites are places which were used for ritual and ceremonial purposes. Possibly the most significant ceremonial practices were those which were concerned with initiation and other rites of passage such as those associated with death. Sites associated with these ceremonies are burbung grounds and burial sites. Additionally, secret rituals were undertaken by individuals such as clever men. These rituals were commonly undertaken in 'natural' locations such as water holes. Ceremonial grounds are known to exist in the local area.

Contact Sites
These sites are those which contain evidence of Aboriginal occupation during the period of early European occupation. Evidence of this period of 'contact' could potentially be Aboriginal flaked glass, burials with historic grave goods or markers, and debris from 'fringe camps' where Aborigines who were employed by, or traded with the white community, may have lived or camped. The most likely location for contact period occupation sites would be places adjacent to permanent water and located in relative proximity to centres of European occupation such as towns and homesteads. The potential for such sites to be in the proposal area is possible but unlikely.

7.2.5 Field inspection methodology

In accordance with the OEH Code of Practice for Archaeological Investigation of Aboriginal Objects in NSW, the purpose of a field survey is to record the material traces and evidence of Aboriginal land use that are, visible at or on the ground surface, or exposed in section or visible as features (e.g. rock shelters with rock-art), and to identify those areas where it can be inferred that, although not visible, material traces have a high likelihood of being present under the ground surface.

The field inspection entailed a comprehensive pedestrian survey undertaken across the subject area. The survey was aimed at locating Aboriginal objects, areas and places. An assessment was also made of prior land disturbance, survey coverage variables (ground exposure and archaeological visibility) and the potential archaeological sensitivity of the land. The field survey was designed to assess the archaeological sensitivity of all areas where impacts are proposed. The data collected during this field assessment forms the basis for the documentation of survey results outlined in the section below.

7.2.6 Field inspection results

The entire area in which impacts would occur has undergone relatively high levels of prior disturbance associated with land clearance/agriculture and previous quarrying. This previous landuse is assessed to have caused reasonably high levels of impact to almost all ground surfaces and hence, to any Aboriginal objects which may once have been present in those areas.

Impacts in the remainder of the subject area vary. All areas have been cleared of original native vegetation and have been used for agriculture. Ground surfaces are now covered with introduced pasture species including couch and kikuyu. Remnants of farm fences and infrastructure remain. Generally the ground surfaces are uneven indicating prior disturbance. Elsewhere farm dams, water diversion channels and a well formed access road into Lot 401 have caused localised impacts. During the field survey, effective survey coverage (ESC) was variable, but generally low.

A total of area of approximately 44 hectares was assessed during the field work. Ground exposures inspected included areas of bare earth, erosion, animal burrows and vehicle tracks, and measured approximately less than 0.1 hectares in area. Of that ground exposure area, archaeological visibility inspected (the potential artefact bearing soil profile) is estimated to have been approximately 0.1 hectares. Effective Survey Coverage is calculated to have been 0.2% of the proposal area. The ESC encountered during the field survey is considered to be very low. However, areas of ground exposure with reasonable archaeological visibility (the potential artefact bearing soil profile) were frequently encountered. Given the absence of artefacts recorded, it is concluded that artefact density is likely to be extremely patchy in distribution and present in generally very low density.

No Aboriginal stone objects were recorded during the field assessment. However, Survey Unit 4, a very gently inclined simple slope adjacent to the wetland is predicted to contain artefact density in a low/moderate distribution (refer Figure 11 Location of Survey Units). For the purposes of this assessment it is described as an archaeologically sensitive landform.

Figure 11 Location of survey units

7.2.7 Consultation

A formal process of Aboriginal community consultation has been undertaken in accordance with the guidelines as set out in the NSW OEH's Aboriginal cultural heritage consultation requirements for proponents 2010.

In order to identify, notify and register Aboriginal people who may hold cultural knowledge relevant to determining the cultural significant of Aboriginal objects and/or places in the subject area, the following procedure was implemented.

Correspondence dated 4 May 2015 was sent to:

- The NSW OEH;
- Bogal Local Aboriginal Land Council (NLALC);
- Office of the Registrar, Aboriginal Land Rights Act 1983;
- The National Native Title Tribunal;
- Native Title Services Corporation Limited;
- Richmond Council.

In addition, an advertisement has been placed with the local paper (Northern Star) and appeared in the 6 May 2015 edition.

Following advice received from NSW OEH, further correspondence dated 18 May 2015 was sent to a list of known Aboriginal Parties for the Richmond Valley local Government area that OEH considered likely to have an interest in the proposal.

The Office of the Registrar Aboriginal Land Rights Act 1983 responded (no date) indicating that it did not appear that there were registered Aboriginal owners for the project area.

NTSCORP responded on 7 May 2015, indicating that they would provide our correspondence to any individuals, groups or organisations NTSCORP is aware assert traditional interest in the area.

The Bogal Local Aboriginal Land Council responded (11 May 2015) indicating that they required a survey of the area to be undertaken. We have taken this response to assume a registration of interest in the Aboriginal consultation process.

The National Native Title Tribunal responded via email on 7 May 2015 indicating that Native Title has been extinguished for the area in question given the property is freehold.

No Registrations of Interest were made by any Aboriginal Parties other than Bogal Local Aboriginal Land Council.

The Bandjalang Aboriginal Corporation Prescribed Body Corporate RNTBC administers land on behalf of the Bandjalang People. Their native title rights and interests were first recognised in the Bandjalang People #2 native title determinations of 2013. This matter recognises the Bandjalang people as having non-exclusive native title rights and interests over traditional lands on the north coast of New South Wales, at and around Evans Head.

Further enquires were made of ntscorp on 2 June 2015 advising that we had not heard from the Bandjalang Aboriginal Corporation Prescribed Body Corporate. Mr George Toona indicated that further communications would be made with this group. A ntscorp person was to meet with them in person on 4 June 2015 and was to advise on that occasion about the quarry and my attempts to communicate with them. A further email was received from Mr Toona on 11 June 2015 indicating that no comments had been received from the Bandjalang Directors about the quarry.

We discussed this matter further with Ms Rosalie Neve, NSW OEH on 12 June 2015. It was discussed that in regard to the Aboriginal site on Lot 402, an Aboriginal place nomination was in progress but not yet determined. Ms Neve advised that while no response has been received from the Bandjalang Aboriginal Corporation and we may therefore reasonably assume that there are not any issues, we should ensure that the proposal does not undermine and possible future aspirations the Corporation may have in regard to the site. Furthermore, she advised that we ensure an ongoing communications strategy is in place.

In accordance with Section 4.2 and 4.3 of the Aboriginal cultural heritage consultation requirements for proponents 2010 guidelines, information with regard to the project, proposed consultation process and assessment methodology was furnished to the Bogal Local Aboriginal Land Council for input and comment; none received.

Following a modification to the original project description, further letters were sent to the agencies on 7 August 2015 providing notification. Again following advice from OEH, a second batch of letters were sent to a list of Aboriginal groups OEH felt may have an interest in the area. No responses have been received.

7.2.8 The potential for harm from the proposed activity

The assessment considered the nature and extent of the proposed activity and any potential harm to Aboriginal areas, objects and/or places. The project would entail the removal and disturbance of a potential artefact bearing deposit and, accordingly, has the potential to cause fundamental impacts to any Aboriginal areas, places or objects. The proposed works entail ground disturbance and, accordingly, have the potential to cause impacts to any Aboriginal areas, places or objects which may be present within the zones of direct impact.

However, no Aboriginal object sites have been recorded in the proposal area other than Archaeological Sensitive Landform (ASL 1). This area will be subject to active conservation measures within the development context. Accordingly, no harm to Aboriginal objects is proposed. It is note that the previously identified Indigenous Non Disturbance Zone in which AHIMS 04-4-0142 is located will be maintained and would not be disturbed as a result of the proposal.

Ecologically Sustainable Development (ESD) is defined in the *Protection of the Environment Administration Act 1991*. Section 6(2) of that Act states that ESD requires the effective integration of economic and environmental considerations in decision-making processes and that ESD can be achieved through the implementation of:

(a) the precautionary principle,
(b) inter-generational equity,
(c) conservation of biological diversity and ecological integrity,
(d) improved valuation, pricing and incentive mechanisms.

The principles of ecologically sustainable development and the matter of cumulative harm have been considered for this project. Given the low levels of prior, existing and potential future impacts in the local and regional context in which the proposed activity area is situated, the majority of cultural values, including archaeological, which attach to comparable landforms and the broader landscape remain intact across the region.

No Aboriginal objects or cultural values are known to occur in the area of the proposed impacts. Considerations of ecologically sustainable development and cumulative impacts in regard to Aboriginal heritage are not necessary.

Avoidance or the mitigation of harm has not been considered as an option in relation to the proposed activities. It is considered that the significance of the Aboriginal objects is not sufficient to warrant the implementation of impact avoidance strategies. However, it is proposed that Survey Unit 4 be formalised as a Heritage Conservation Zone. A number of management strategies are possible and these are each given consideration below.

7.2.9 Management and mitigation strategies

Further Investigation

The field survey has been focused on recording artefactual material present on visible ground surfaces. Further archaeological investigation would entail subsurface excavation undertaken as test pits for the purposes of identifying the presence of artefact bearing soil deposits and their nature, extent, integrity and significance. Further archaeological investigation in the form of subsurface test excavation can be appropriate in certain situations. These generally arise when a proposed development is expected to involve ground disturbance in areas which are assessed to have potential to contain high density artefactual material and when the Effective Survey Coverage achieved during a survey of a project area is low due to ground cover, vegetation etc.

No areas of the proposal area have been identified which warrant further archaeological investigation in order to formulate appropriate management and mitigation strategies. The archaeological nature of the proposed impact areas are relatively well established. As noted above, we have assessed the impact areas to contain very low or low density distributions of artefacts and identified it to be disturbed.

Finally, it is noted that no Aboriginal objects or survey units with potential conservation value have been identified to have a high probability of being present in the subject area. Accordingly, test excavation conducted under OEH's Code of Practice for Archaeological Investigation of Aboriginal Objects in New South Wales (DECCW 2010: 24) is not necessary.

Conservation

Conservation is a suitable management option in any situation, however, it is not always feasible to achieve. Such a strategy is generally adopted in relation to sites which are assessed to be of high cultural and scientific significance, but can be adopted in relation to any site type. In the case at hand, the development of a heritage conservation strategy within the area encompassed by Survey Unit 4 should be given consideration by the applicant.

Mitigated Impacts

Mitigated impact usually takes the form of partial impacts only (i.e. conservation of part of an Aboriginal site or Survey Unit) and/or salvage in the form of further research and archaeological analysis prior to impacts. Such a management strategy is generally appropriate when Aboriginal objects are assessed to be of moderate or high significance to the scientific and/or Aboriginal community and when avoidance of impacts and hence full conservation is not feasible. Salvage can include the surface collection or subsurface excavation of Aboriginal objects and subsequent research and analysis. In the case at hand, the development of a mitigated impact strategy is not considered to be essential from an archaeological perspective.

Monitoring

Monitoring during construction for the purposes of identifying cultural material that may be uncovered during earth disturbance can be implemented as a management strategy. However, monitoring is a reactive rather than proactive strategy, and as such, is not an ideal management tool in cultural heritage management. Monitoring for artefacts is not a widely accepted method of management because sites of significance can be destroyed as monitoring is taking place and because it can result in lengthy and costly delays to development works if significant cultural material is uncovered. In the case at hand, the development of a monitoring strategy is not considered necessary or appropriate.

7.2.10 Recommendations

The following conclusions and recommendations are made:

1. No Aboriginal objects have been recorded in impact areas and an Aboriginal Heritage Impact Permit is not required in respect of the proposal.
2. Section 7.2.9 of this EIS and Section 7 of the assessment (Attachment 3) sets out possible management and mitigation strategies and these should be given consideration by the proponent and the Registered Aboriginal Party. Their implementation can occur within the framework of the Aboriginal Heritage Management Plan developed for the project.
3. It is recommended that an Aboriginal Heritage Conservation Zone should be set up in the area encompassed by Survey Unit 4.
4. An Aboriginal Heritage Management Plan (AHMP) must be developed by an archaeologist, in consultation with the NSW OEH and the Registered Aboriginal Party. The AHMP must set out the procedures relating to the management and mitigation of development impacts, a protocol for the management of unexpected finds and the conservation of relevant areas outside the extraction area.
5. The AHMP would provide the framework to ensure the conservation of heritage within Survey Unit 4 and the existing Indigenous Heritage Non Disturbance Zone.

7.3 Traffic Impact and Pavement Assessment

Key findings

An assessment of the potential impacts of the project on the local road network has been undertaken (refer Attachment 4) and a summary of the key findings is provided below.

The anticipated haulage route to the Pacific Highway is via Petersons Quarry Road to Lagoon Road to Queen Elizabeth Drive to Coraki Woodburn Road to the Pacific Highway at Woodburn. Richmond Valley Council is the relevant authority for all roads within the haulage route except for the Pacific Highway. Seelems Road is an unsealed road with no posted speed limit sign. Petersons Quarry Road is a sealed one-lane road and is also without a speed limit sign. Lagoon Road is a sealed (undivided) two-lane road with a posted speed limit of 100km/h. Queen Elizabeth Drive is a sealed (undivided) two-lane road with a speed limit of 80km except for the posted school zone. The Coraki Woodburn Road is a sealed (undivided) two-lane road with a posted speed limit of 100km/h.

The trips generated by the proposed development have been estimated by adopting the following project parameters shown in Table 9 below.

Table 9 – Summary of Project Trip Generation

Total (max) haulage	1,000,000 tonnes per year
Working weeks per year	50 weeks
Working days per week	6 days
Working hours per day	13 hours
Average mass of material per vehicle	36 tonnes per vehicle
Average hourly traffic volume (IN)	= (1,000,000 / 50 / 6 / 13 / 36) = 7 vehicle per hour (vph)
Average hourly traffic volume (OUT)	7vph
Peak hour factor	3 (for the purpose of this traffic impact assessment, a peak hour factor of 3 has been adopted which is considered to be a conservative assumption)
Peak hour traffic volume (IN)	21vph
Peak hour traffic volume (OUT)	21vph

As it is anticipated that the project will commence operations in July 2016 for a period of 5 to 7 years. The design horizon year of the proposed development is 2023. The results of the assessment conducted illustrates that all key intersections along the haul route will operate within satisfactory operating conditions beyond the design horizon year with the existing geometries. Therefore no external road network improvements are required in conjunction with the proposed development.

Furthermore the assessment considered the suitability of the unsealed Seelems Road and from a traffic impact and pavement assessment sealing of Seelems Road is not recommended. However, Quarry Solutions have identified there would be benefit to sealing Seelems Road for noise and dust mitigation and therefore intend to progress that matter on a voluntary basis with Richmond Valley Council.

It is also identified that Richmond Valley Council have the authority to levy contributions where the project will, or is likely to, generate additional heavy haulage vehicle movements. The applicable rate to be levied is $1.08/tonne.

Whilst the assessment of traffic impacts associated with the project confirms that no physical upgrades of the local road network are warranted, Quarry Solutions are committed to safe driving practices and have advised that the following traffic management measures will be implemented for the project:

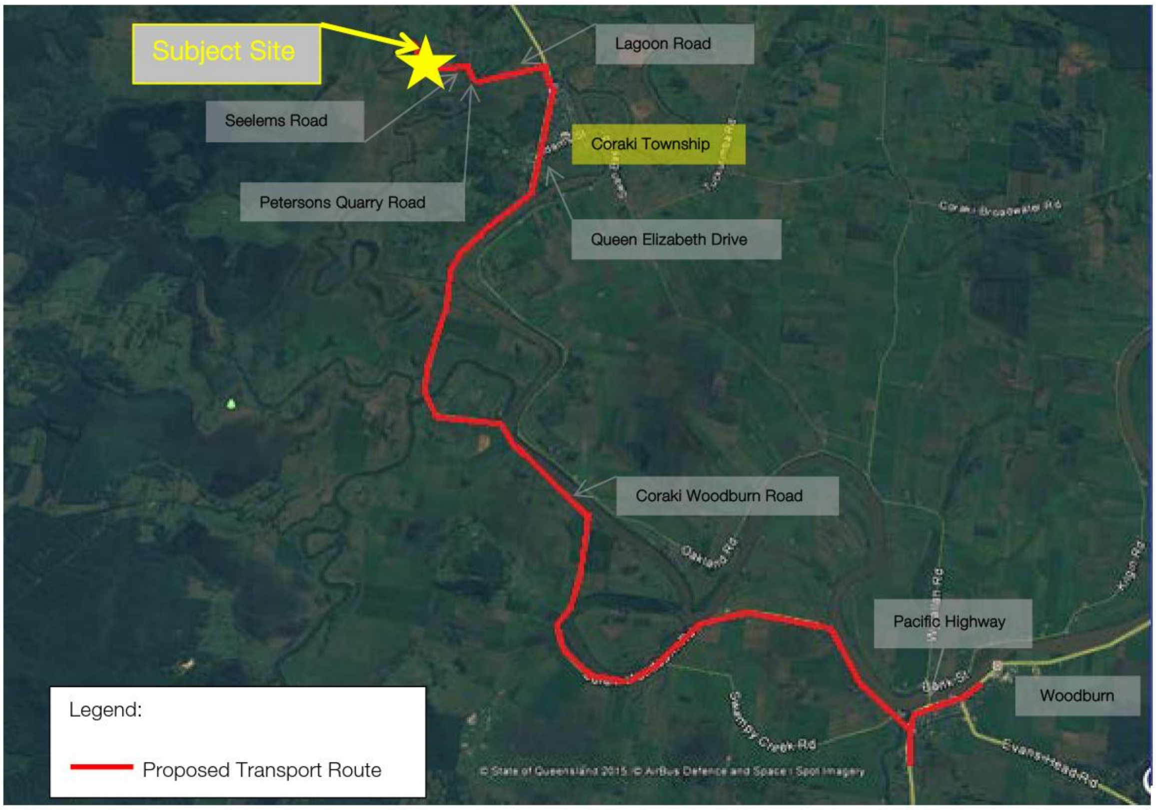
- A Driver's Code of Conduct
- Forward and drive facing cameras as well as GPS monitoring devices on all on road haulage trucks.
- GPS monitoring devices to local school buses (at Quarry Solutions cost) to monitor separation distances between on road haulage trucks and local school buses.

7.3.1 The transport route

The proposed internal transport route, shown on Figure 2 and Drawing 1837.027 Conceptual Site Layout Plan, comprises the haul vehicle drivers entering the site via Seelems Road (the section fronting Lot 407 of DP1166287) and exiting the site via Petersons Quarry Road; the haul vehicles will circulate the site in a clockwise direction (one-way flow). The proposed external transport route from the site to the Pacific Highway, Woodburn is via Petersons Quarry

Road, Lagoon Road, Queen Elizabeth Drive, Coraki Woodburn Road and thence the Pacific Highway. The proposed external transport route is illustrated in Figure 12 The external transport route.

Figure 12 The external transport route



7.3.2 *Existing road network*

The hierarchical classification and characteristics of roads in the vicinity of the subject site are described in Table 10 below.

Table 10 – Existing Local Road Hierarchy

Road	Speed limit	Characteristics	Authority
Seelems Road[1]	-*	Unsealed road	Richmond Valley Council
Petersons Quarry Road	-*	Sealed road	Richmond Valley Council
Lagoon Road	100km/h	Sealed (undivided) two-lane road	Richmond Valley Council
Queen Elizabeth Drive	80km/h**	Sealed (undivided) two-lane road	Richmond Valley Council
Coraki Woodburn Road	100km/h	Sealed (undivided) two-lane road	Richmond Valley Council
Pacific Highway	50km/h***	Sealed (undivided) two-lane road	Roads and Maritime Services

Note:
1Seelems Road is the road section extending to Lot 407 of DP1166287 up to the site boundary, it is approximately 380m long from Petersons Quarry Road
**Speed limit sign is not present.*
***Speed limit varies; the speed limit reduces to 40km/h from 8:00am to 9:00am and from 2:30pm to 4:00pm on school days within the school zone.*
****Speed limit of Pacific Highway near the Coraki Woodburn Road / Pacific Highway intersection.*

The typical cross-section of Seelems Road, Petersons Quarry Road, Lagoon Road, Queen Elizabeth Drive and the Coraki Woodburn Road are shown below.

Plate 6. Seelems Road looking east towards Petersons Quarry Road

Plate 7. Petersons Quarry Road looking north

Plate 8. Lagoon Road looking west

Plate 9. Queen Elizabeth Drive looking north

Plate 10. Queen Elizabeth Drive looking south near school zone

Plate 11. Coraki Woodburn Road looking north-west

7.3.3 Base traffic volumes

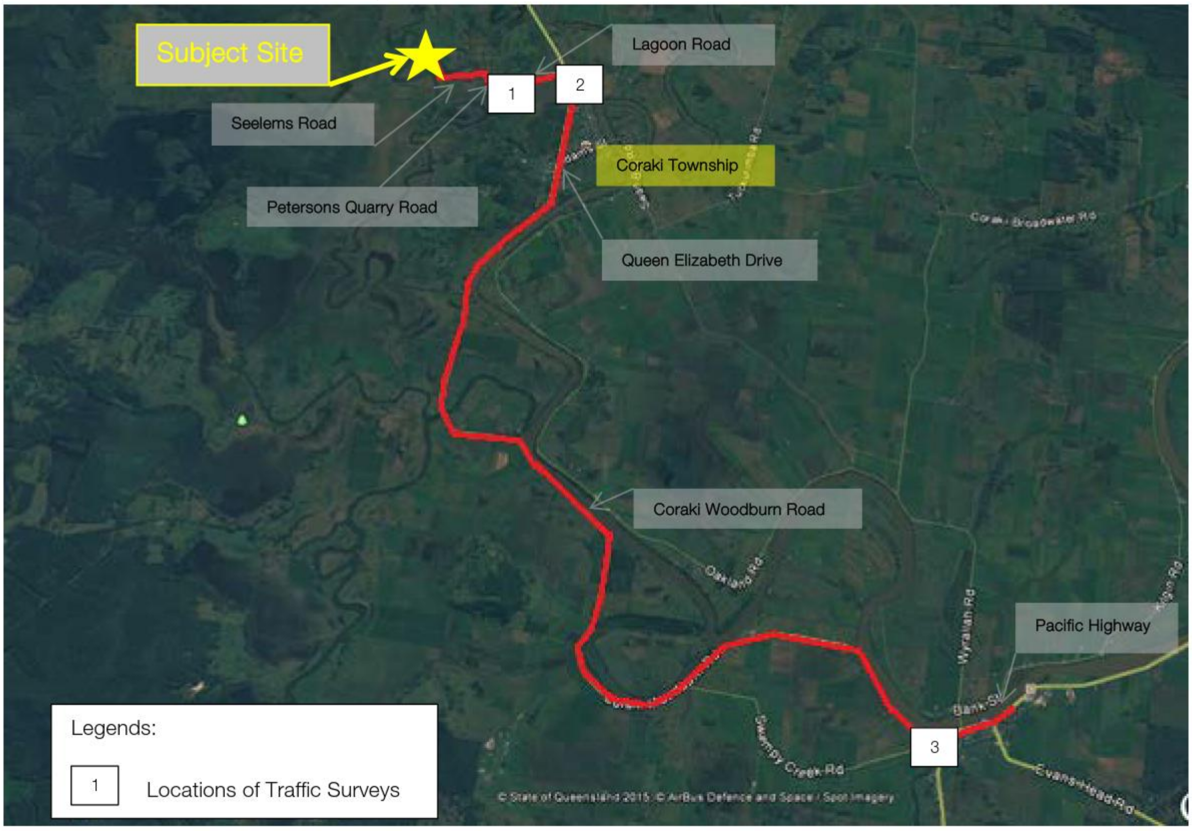
As a part of this study, traffic surveys were commissioned to be undertaken by Austraffic at the following intersections in the vicinity of the site on Thursday 21st May 2015 from 6:30am to 10:30am and from 2:00pm to 6:00pm. The locations of traffic surveys are illustrated in Figure 13 Locations of traffic surveys.

- Intersection 1: Petersons Quarry Road / Lagoon Road;
- Intersection 2: Lagoon Road / Queen Elizabeth Drive; and
- Intersection 3: Coraki Woodburn Road / Pacific Highway.

The detailed results of these traffic surveys are included in Appendix C of Attachment 4.

It is noted that it is the industry accepted traffic engineering practice to undertake the traffic impact assessment for a development of a small to medium scale based on the results of a single day's traffic survey. It is of course understood that there are daily / seasonal variations of traffic volumes at intersections or road corridors, however, the single day traffic survey as utilised in such cases provides suitable information in relation to the general traffic volumes / operational characteristics of intersections and provides a good indication of how the affected intersections would operate with and without the proposed development. In this instance, the survey date was carefully chosen to avoid school holidays and Mondays / Fridays, so that the results of the survey could best represent the average traffic volumes of a normal weekday working day.

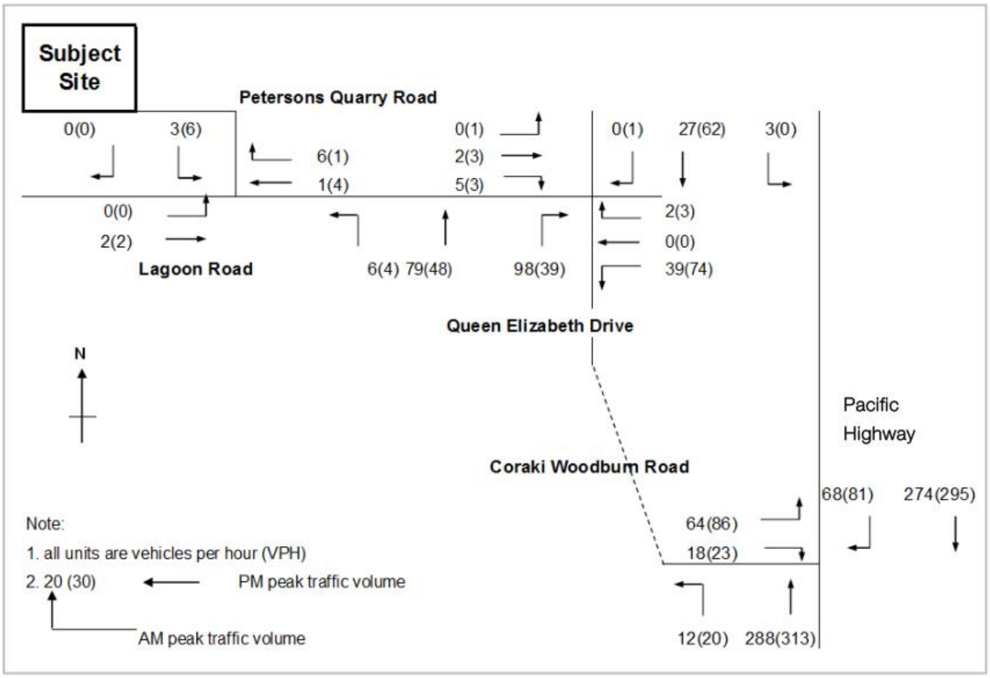
Figure 13 Locations of traffic surveys



The observed AM and PM peak hour periods of traffic at the intersections are summarised in Table 4-1 of Attachment 4. The individual peak hour of traffic volumes of each intersection have been adopted for the analyses outlined in this traffic impact assessment. Accordingly traffic volumes will not match from intersection to intersection, however, it is considered that this approach will ensure the worst-case-scenario has been assessed for each location.

Figure 14 illustrates the 2015 observed traffic volumes during the peak hour periods.

Figure 14 2015 Observed traffic volumes



7.3.4 *Cumulative impact and adjacent developments*

From the point of view of undertaking holistic traffic loading on the road network, it is noted that adjacent to the subject site there is an industrial site and the Petersons Quarry. The survey undertaken on Thursday 21st May 2015 would include the traffic generated by the adjoining industrial site.

After the completion of the traffic survey, MRCagney was advised that the Petersons Quarry only operated on Wednesdays; therefore, the traffic generated by the Petersons Quarry would not have been included in the background traffic survey.

Based on results of intersection performance analysis (SIDRA analysis), included in Section 6 of Attachment 4, it is clear that all affected intersections have ample reserve capacity with and without the proposed development in the design year. All affected intersections would operate satisfactorily even if the total traffic volume generated was to double; therefore, there are no operational concerns with both the Petersons Quarry and the proposed development operating simultaneously.

The pavement impact of a development should be assessed based on the Annual Average Daily Traffic (AADT), not daily traffic volumes of a single survey day, therefore, the AADT (2015) on the adjacent road network already essentially includes the traffic generated by the Petersons Quarry.

Possible pavement contributions associated with the existing Petersons Quarry is a separate issue. As noted in Section 8 of Attachment 4, the pavement impact / contribution of the proposed development is calculated based on Section 94 Heavy Haulage Contributions Plans 2013.

7.3.5 *Based traffic growth*

It is anticipated that the proposed quarry will commence operations in July 2016 for 5 to 7 years. Therefore, the design horizon year of the proposed development would be 2023 (the last operational year of the proposed development).

For the purpose of this assessment, an average growth rate of 3% p.a. (compound) has been adopted to estimate future background traffic volumes. The growth of the traffic volumes on Petersons Quarry Road is assumed to be zero without the proposed development. Calculations of the base traffic volumes are provided in Attachment 4.

Figures 15 and 16 illustrate the 2016 and 2023 base traffic volumes without the proposed development during the peak hour periods that have been used as the basis of the traffic assessment outline herein.

Figure 15 2016 Base traffic volumes without the proposed development

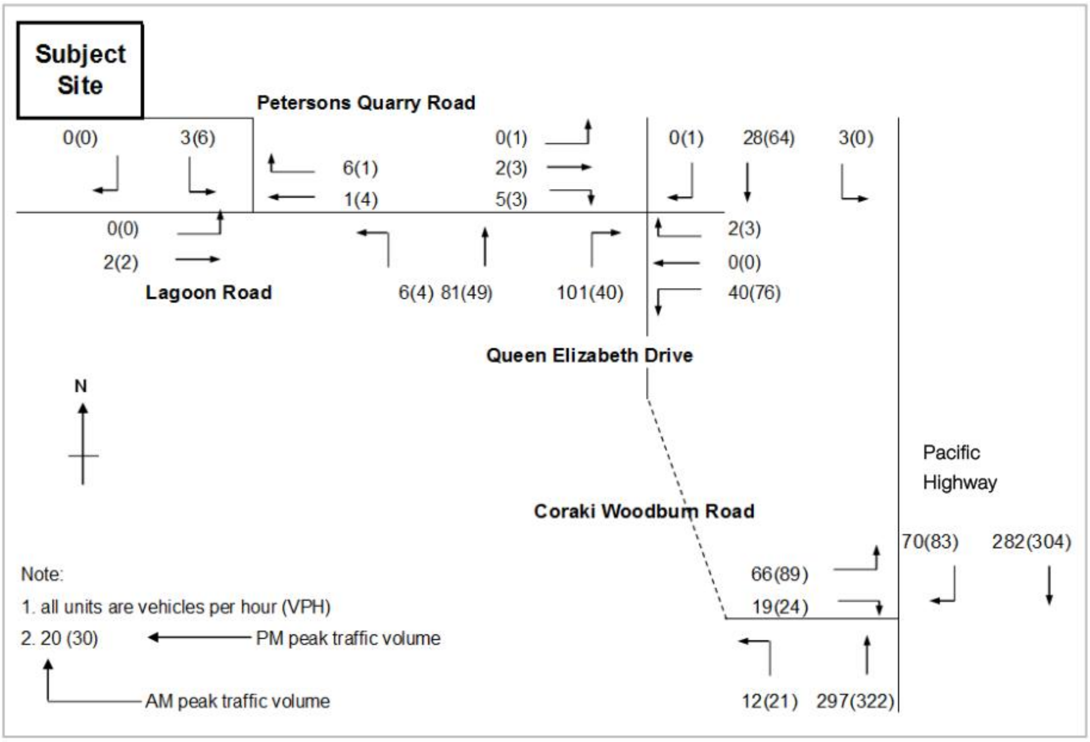
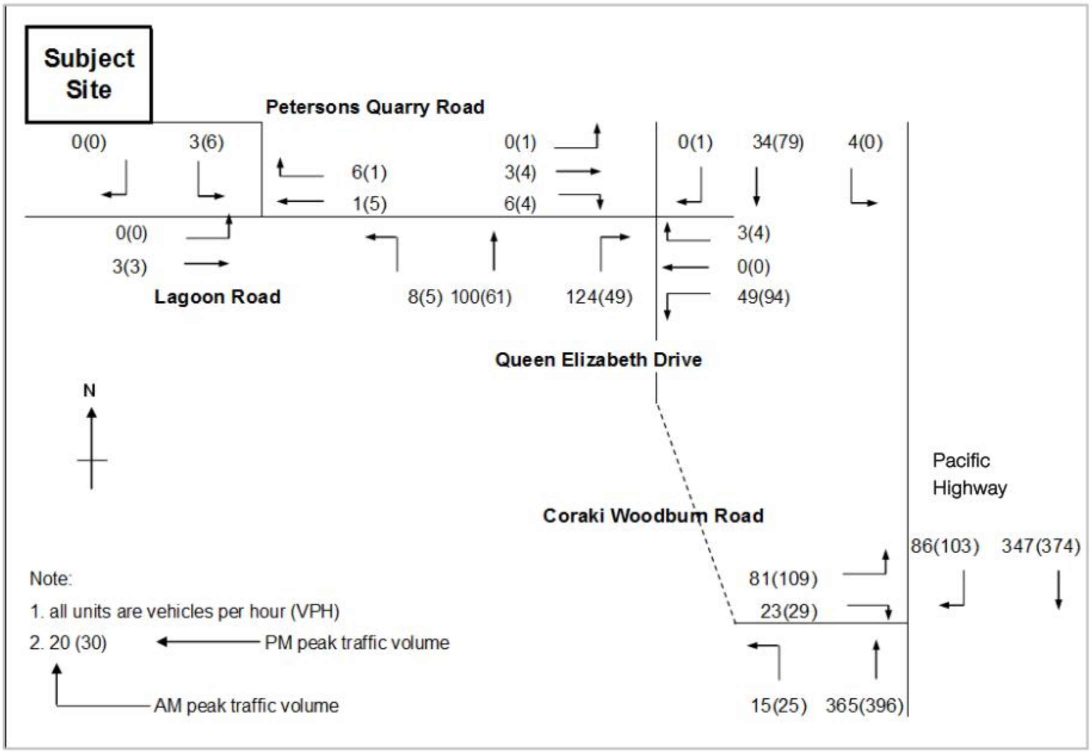


Figure 16 2023 Base traffic volumes without the proposed development



7.3.6 *Traffic volumes generated by the project*

The maximum annual production volume of the project is anticipated to be 1M tonnes per year. It is not possible to forecast the future actual annual peak production volume at this planning stage, therefore, the maximum production threshold (1M tonnes per year) has been adopted to assess the traffic impact of the site on the surrounding road network; this is considered to be a conservative assumption. We have been advised that the proposed operating hours of the loading and hauling activities would be from 6:00am to 7:00pm from Monday to Saturday; there would be no operation on Sundays as well as major public holidays, such as Anzac Day, Good Friday, Easter Monday or Christmas Day.

The trips generated by the project have been estimated by adopting the following project parameters. Whilst a number of these parameters have been based on assumptions, these are considered reasonable and reflective of the likely operations of the proposed development. Therefore, the resultant volume forecasts are considered appropriate for the purposes of this assessment.

Total (max.) haulage*: 1,000,000 tonnes per year;
Working weeks per year: 50 weeks;
Working days per week: 6 days;
Working hours per day: 13 hours;
Average mass of material per vehicle**: 36 tonnes per vehicle;
Average hourly traffic volume (IN): = [1,000,000 / 50 / 6 / 13 / 36] = 7vph; and
Average hourly traffic volume (OUT): 7vph (assumed same as IN traffic volumes).

*MRCagney has been advised that the maximum production threshold would be 1M tonnes per year.
**MRCagney has been advised that 36t payload truck & dog would be used.

It is noted that the project would generate an average hourly traffic volume of 7vph (IN) and 7vph (OUT). However, in order to ensure sufficient infrastructure is proposed to be provided to cater for the ‘worst-case’ peak design scenario, it is conservatively assumed that the proposed development would generate more than the average hourly traffic volumes during the peak hour periods by introducing the concept of peak hour factor.

Peak hour factor***: 3 (for the purpose of this traffic impact assessment, a peak hour factor of 3 has been adopted);
Peak hourly traffic volume (IN): = [1,000,000 / 50 / 6 / 13 / 36 x 3] = 21vph; and
Peak hourly traffic volume (OUT): 21vph (assumed same as IN traffic volumes).

***Peak hour factor is the ratio of the absolute peak operating conditions to the average operating conditions of a peak production year. This represents what is considered to be the ‘worst-case’ peak design scenario and has been used as the basis of this traffic impact assessment.

It is understood that there will be total of 15 on-site staff (on different shifts) working at the project. Whilst the staff may not necessarily arrive / leave the site during the AM and PM road peak hour periods, it is conservatively assumed that approximately one-third of staff would arrive at the site during the AM peak hour period and leave the site during the PM peak hour period; ie. staff of the site would generate 5vph during the AM peak hour period (5vph IN + 0vph OUT) and the PM peak hour period (0vph IN + 5vph OUT). The trips generated by the staff are in addition to the trips generated by the hauling activities.

It is understood that the quarry is proposed to predominately supply materials to the scheduled upgrade works on the Pacific Highway at Woodburn. It is understood that all of the quarried materials will be delivered to the Pacific Highway to the north of the Pacific Highway / Coraki Woodburn Road intersection in the early stage of the Pacific Highway upgrade project; and all of the quarried materials will be delivered to the Pacific Highway to the south of the Pacific Highway / Coraki Woodburn Road intersection in the latter stage of the project. The location of the housing of staff working at the site cannot be known at this stage; however, it is conservatively assumed the staff come from the north during the early stage, and vice versa in the latter stage in this traffic assessment; which are considered as the ‘worst-case’ scenarios.

The peak hourly trips forecast to be generated by the proposed development based on the aforementioned assumptions are illustrated in Figure 17 (the early stage) and Figure 18 (the latter stage).

Figure 17 Trips forecast to be generated by the project (early stages)

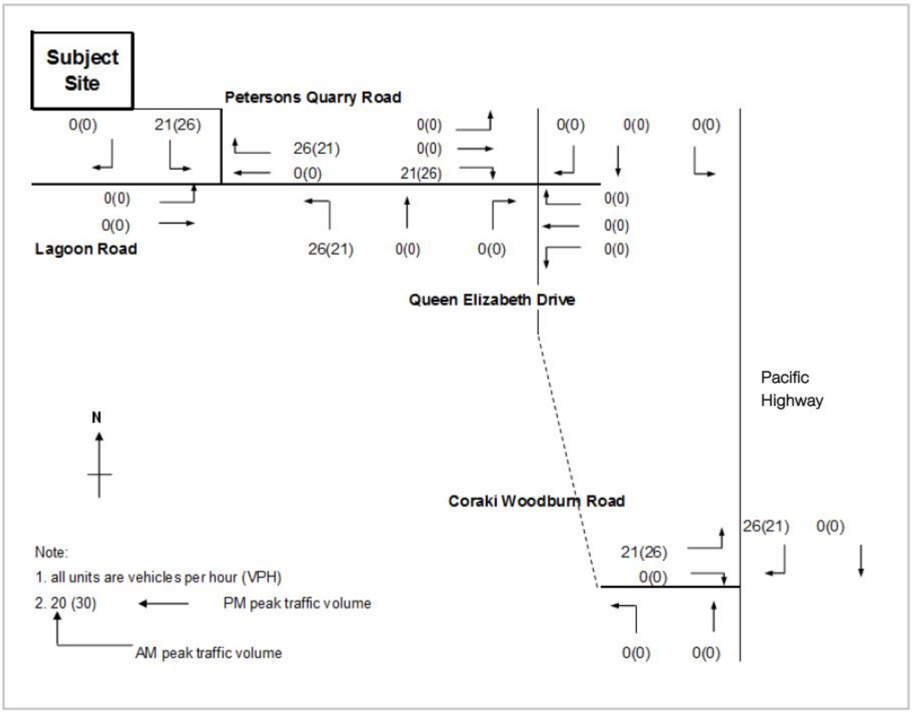
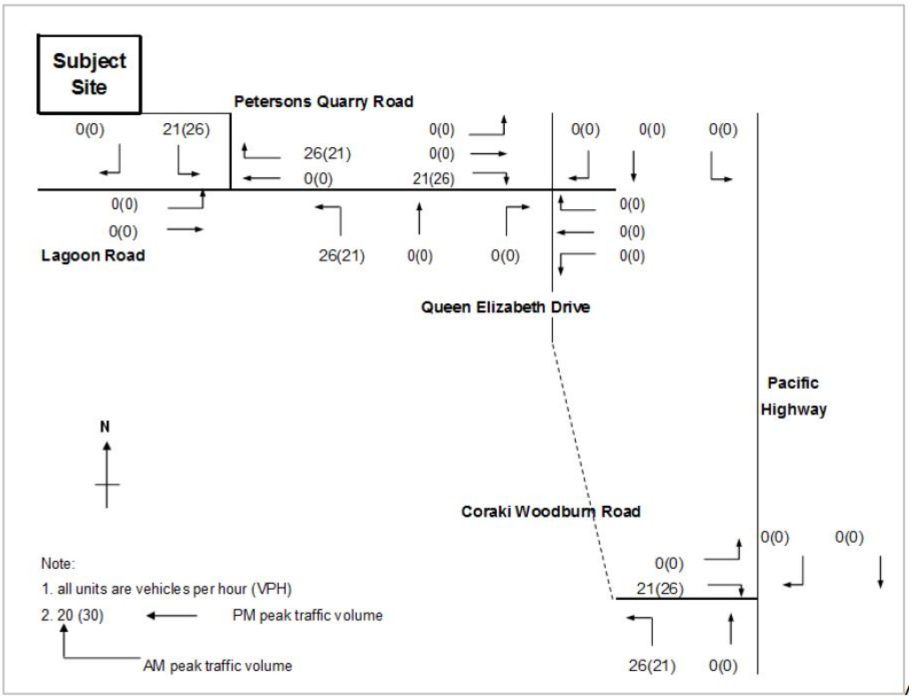


Figure 18 Trips forecast to be generated by the project (later stages)



Adding the forecast development-generated traffic to the base traffic volumes, the 2016 and 2023 design traffic volumes (the early stage) are illustrated in Figures 19 and 20 respectively. Similarly, the 2016 and 2023 design traffic volumes (the latter stage) are illustrated in Figures 21 and 22 respectively.

Figure 19 2016 Design traffic volumes with the project (early stages)

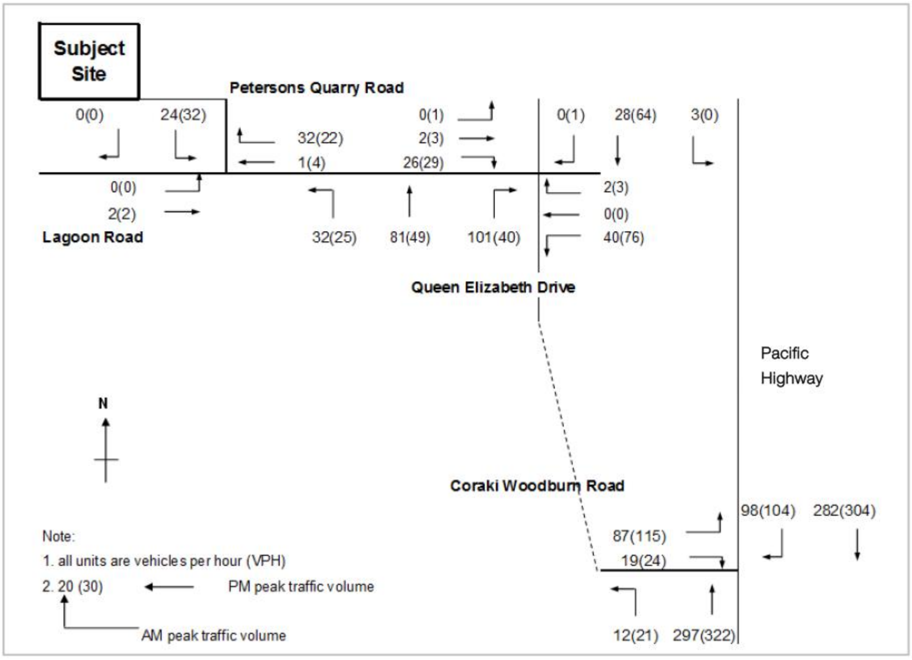


Figure 20 2023 Design traffic volumes with the project (early stages)

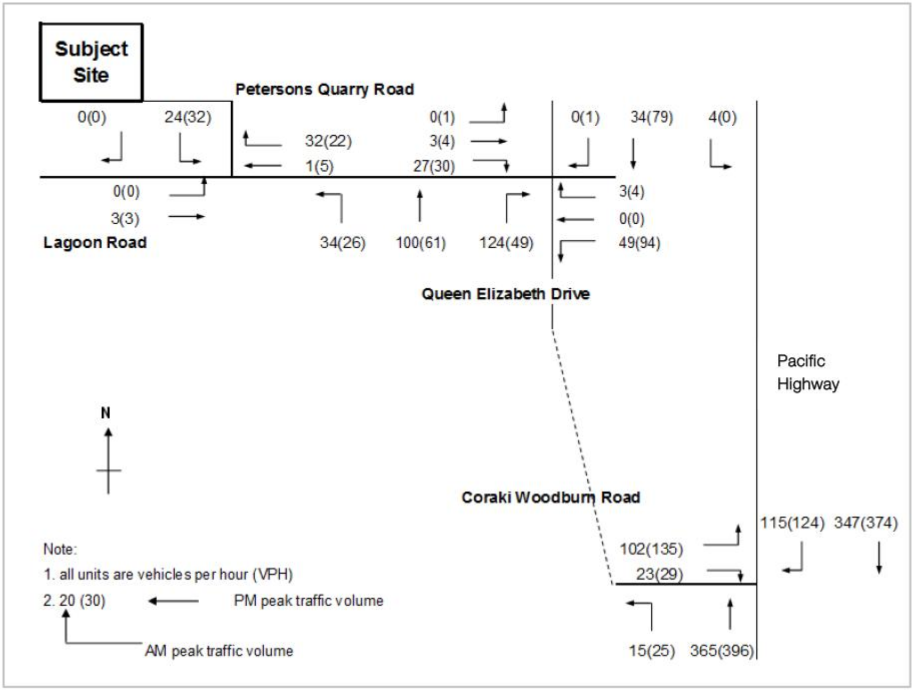


Figure 21 2016 Design traffic volumes with the project (later stages)

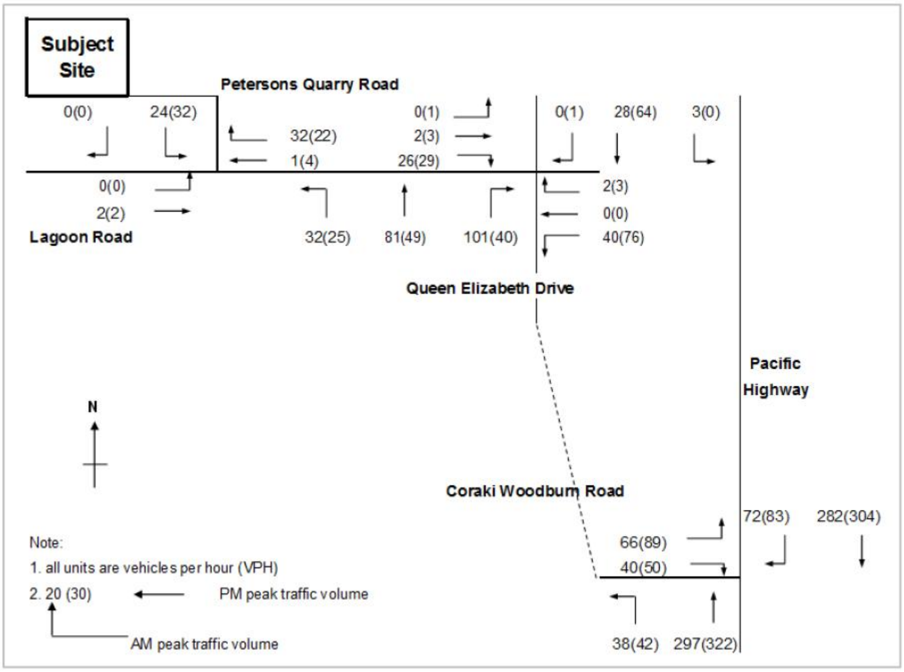
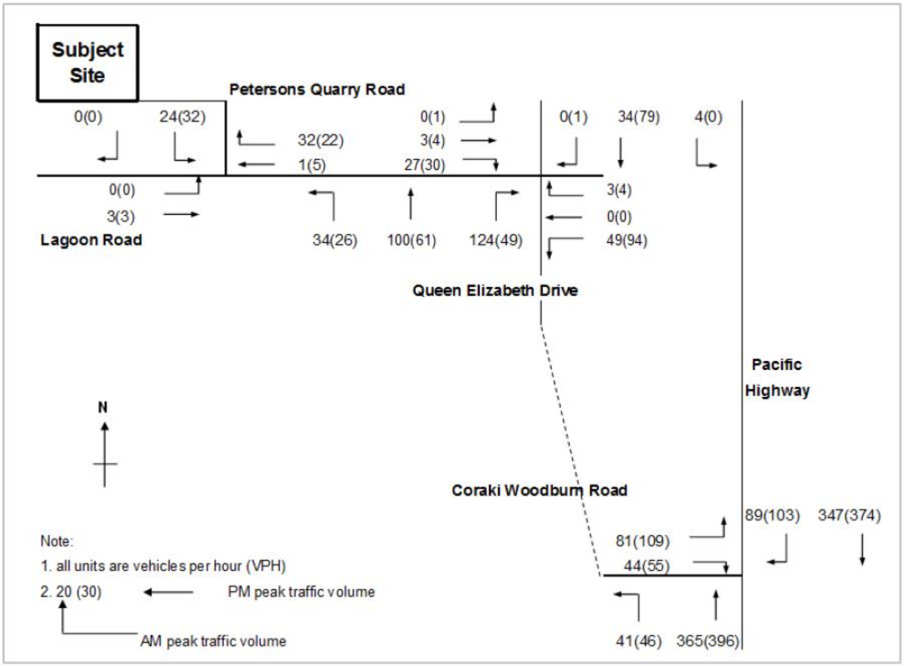


Figure 22 2023 Design traffic volumes with the project (later stages)



7.3.7 Intersection performance

To quantify the impact of the proposed development on the operation of the external road network, future operation of the following key intersections has been assessed in Attachment 4:

- Intersection 1: Petersons Quarry Road / Lagoon Road;
- Intersection 2: Lagoon Road / Queen Elizabeth Drive; and
- Intersection 3: Coraki Woodburn Road / Pacific Highway.

The following is a summary of the findings of the analyses which is provided in greater detail in Attachment 4.

Intersection 1: Petersons Quarry Road / Lagoon Road

The configuration of the Petersons Quarry Road / Lagoon Road intersection modelled in the SIDRA analyses is shown in Figure 6-1 of Attachment 4. The number of vehicles turning right from Petersons Quarry Road onto Lagoon Road during the entire traffic survey period was zero; it is anticipated that the right turn movement from Petersons Quarry Road will continue to be minimal. Therefore, no right turn on Petersons Quarry Road has been modelled in the SIDRA analyses for simplicity; not withstanding this assumption, review of the results of the analysis will clearly reveal that such an assumption is immaterial.

Results of the analyses of the operation of the Petersons Quarry Road / Lagoon Road intersection for the base and design scenarios in 2016 (the opening year of the site) and 2023 (design year - the last operational year of the site) are summarised in Tables 6-1 and 6-2 of Attachment 4 respectively. It is noted that the traffic generation / distribution at this intersection are the same for both the early and latter stages of the Pacific Highway upgrade project. Detailed results are provided within Appendix B of Attachment 4.

The results provided in Tables 6-1 and 6-2 of Attachment 4 indicate that the Petersons Quarry Road / Lagoon Road intersection would continue to operate well within satisfactory operating conditions beyond the design horizon year (2023) with development of the subject proposal.

All development-related trips entering Petersons Quarry Road will turn right from Lagoon Road. It is also noted that the through traffic on Lagoon Road at the Petersons Quarry Road / Lagoon Road intersection will be less than 10vph during the AM and PM peak hour periods in 2023. Therefore, no right turn lane treatment is considered to be necessary at the Petersons Quarry Road / Lagoon Road intersection due to the extremely low through traffic on Lagoon Road.

The intersection is forecast to operate safety and efficiently for the foreseeable future. As alluded to in Section 4 of Attachment 4, clearly this intersection would also accommodate traffic associated with the existing Petersons Quarry.

Intersection 2: Lagoon Road / Queen Elizabeth Drive

The existing configuration of the Lagoon Road / Queen Elizabeth Road intersection modelled in the SIDRA analyses is shown in Figure 6-2 of Attachment 4.

Results of the analyses of the operation of the Lagoon Road / Queen Elizabeth Road intersection for the base and design scenarios in 2016 (the opening year of the site) and 2023 (design year - the last operational year of the site) are summarised in Tables 6-3 and 6-4 of Attachment 4 respectively. It is noted that the traffic generation / distribution at this intersection are the same for both the early and latter stages of the Pacific Highway upgrade project. Detailed results are provided within Appendix B of Attachment 4.

The results provided in Tables 6-3 and 6-4 of Attachment 4 indicate that the Lagoon Road / Queen Elizabeth Drive intersection would continue to operate well within satisfactory operating conditions beyond the design horizon year (2023) with development of the subject proposal. Traffic volumes are sufficiently low so as not to warrant turn lane treatments. As alluded to in Section 4 of Attachment 4, clearly this intersection would also accommodate traffic associated with the existing Petersons Quarry.

Intersection 3: Coraki Woodburn Road / Pacific Highway

The existing Coraki Woodburn Road / Pacific Highway intersection is an old-style right turn Type B geometry, it operates in a similar fashion to an intersection with an auxiliary right turn lane; therefore, for the purpose of this assessment, the Coraki Woodburn Road / Pacific Highway intersection has been modelled as an intersection with an auxiliary right turn lane in the SIDRA analyses as shown in Figure 6-3 of Attachment 4. It is noted that this assumption does not indicate that a modified treatment for the right turn is required; it simply is the adopted modelling approach, which is generally accepted as being appropriate for such a circumstance.

Results of the analyses of the operation of the Coraki Woodburn Road / Pacific Highway intersection for the base and design scenarios in 2016 (the opening year of the site) and 2023 (design year - the last operational year of the site) for the early stage of the Pacific Highway upgrade project are summarised in Tables 6-5 and 6-6 of Attachment 4 respectively. The early stage of the Pacific Highway upgrade project will be completed before 2023, therefore, it is considered to be a conservative assumption to adopt the design year of 2023 for the early stage scenarios.

Results of the analyses of the operation of the Coraki Woodburn Road / Pacific Highway intersection for the base and design scenarios in 2016 and 2023 for the latter stage of the Pacific Highway upgrade project are summarised in Tables 6-7 and 6-8 of Attachment 4 respectively. Detailed results are provided within Appendix B of Attachment 4.

The results provided in Tables 6-5 to 6-8 of Attachment 4 indicate that the Coraki Woodburn Road / Pacific Highway intersection would continue to operate within satisfactory operating conditions beyond the design horizon year (2023) with the proposed development in all scenarios. As alluded to in Section 4 of Attachment 4, clearly this intersection would also accommodate traffic associated with the existing Petersons Quarry.

The identified maximum design queue lengths of the right turn movement from the Pacific Highway (the northern approach of the intersection) and the left turn movement from the Pacific Highway (the southern approach of the intersection) would be typically be just one vehicle during the both AM and PM peak hour periods in 2023; it is considered that the existing old-style Type B treatment for the right turn movement on the northern approach and the existing left turn lane on the southern approach would continue to operate safely and efficiently in the future, particularly being mindful of the proposed lifespan of the project.

7.3.8 Seelems Road

The section of Petersons Quarry Road between Seelems Road and the Petersons Quarry Road / Lagoon Road intersection is sealed.

Seelems Road is the road section extending to Lot 407 of DP1166287 up to the site boundary; it is approximately 380m long from Petersons Quarry Road. It is currently unsealed.

As previously discussed, the haul vehicle drivers will enter the site via Seelems Road (the section fronting Lot 407 of DP1166287) and exit the site via Petersons Quarry Road; the haul vehicles would circulate the site in clockwise direction (one-way flow).

The assessment included in this section of this report has been prepared to determine whether Seelems Road is required to be sealed in conjunction with the project.

Richmond Valley Council's Planning Scheme does not provide clear guideline in relation to how much traffic would trigger the need for provision of a sealed road. Therefore, reference has been made to the document "Upgrading of Unsealed Rural Roads to Sealed Standard" of Rockhampton Regional Council; this is considered to be an appropriate parallel and we have found use of the recommendations therein to be useful. This documents suggests that "*Traffic volumes – An unsealed rural road must be in the range of 150-500 AADT (Annual Average Daily Traffic). A road will not be considered for a minimum standard if there is less than 150 AADT unless there are significant issues shown in assessment score. A road that has an AADT greater than 500 will qualify for a full road design*".

The analysis is mindful that the proposed development will be the primary user of Seelems Road; and the proposed development will only operate until 2023. The identified maximum allowable Annual Average Daily Traffic Volumes (AADT) of 500vpd for an unsealed road has been adopted as an upper threshold for the purpose of this pavement assessment. The analysis also conservatively uses the maximum production rate rather than the average which would normally be considered appropriate in consideration of Annual Average Daily Traffic volumes (AADT).

As noted, the proposed development will be in operation until 2023. Therefore, the design year of the pavement requirement of Seelems Road is 2023.

The future AADT of Seelems Road is calculated as below:
Step 1: Operational years of the proposed development = from Year 2016 to Year 2023;
Step 2: Base daily traffic volumes in 2015* = 80vpd;
Step 3: Growth Rate** = 0%;

Step 4: Base daily traffic volumes in 2023 = 80vpd;
Step 5: Total (max.) haulage*** = 1,000,000 tonnes per year;
Step 6: Working weeks per year = 50 weeks;
Step 7: Working days per week = 6 days;
Step 8: Average mass of material per vehicle**** = 36 tonnes per vehicle;
Step 9: Average daily traffic volume (haulage vehicles – IN trips only) = [1,000,000 / 50 / 6 / 36] = 93vpd ; and
Step 10: 2023 AADT (with the proposed development) = [80 + 93] = 173vpd*****.

*Assumes 2015 daily traffic volumes = ((2015 AM peak hour traffic volume + 2015 PM peak hour traffic volume) x 5) = ((9 + 7) x 5) = 80vpd.
**Assumes the growth rate of traffic volumes of Seelems Road (without the proposed development) is 0% p.a. (compound).
***MRCagney has been advised that the maximum production threshold would be 1M tonnes per year.
****MRCagney has been advised that 36t payload truck & dog would be used.
*****Staff tips are not anticipated to use Seelems Road.

Therefore the results of above calculations (including the conservative assumption of maximum production every year) indicate that the 2023 daily traffic with the project is in order of 173vpd; whilst this traffic stream has a relatively high proportion of heavy vehicles, the fact that it is based on a conservative methodology and is somewhat less than 500vpd leads to the appropriate conclusion that providing a gravelled pavement is appropriate. Sealing of Seelems Road is not recommended to be required to cater for the forecast traffic generated by the project.

7.3.9 Heavy haulage contribution

Section 94 Heavy Haulage Contributions Plans 2013 enables "*Richmond Valley Council to levy developer contributions under section 94 of the Environmental planning and Assessment Act 1979 where the anticipated development will, or is likely to, generate additional heavy haulage vehicle movements, such as from mines and extractive industries*".

The road / traffic impact of the proposal has been assessed based on the maximum production volumes (1,000,000 tonnes per year) to ensure satisfactory operation of road infrastructure components at all times.

However, the pavement impact and the pavement contribution for this proposal should be assessed based on the average production over the operational years of the proposal. It is not considered appropriate to utilise maximum production rates for this calculation as pavement impact is fundamentally based on average daily ESAs and cumulative pavement impacts. The average production rate of the proposed development would be 800,000 tonnes per year from 2016 to 2023. In practical terms, the levy could be applied on the basis of actual tonnages with a reporting protocol put in place.

Section 94 Heavy Haulage Contributions Plans 2013 notes that an extractive industry use with the proposed annual extraction is required to pay $1.08 / tonne for the pavement impact likely to be generated on Council's roads.

7.4 Biodiversity

An assessment of the biodiversity values in and around the proposed development footprint of the project has been undertaken (refer Attachment 5) to inform decision making regarding the avoidance and mitigation of impacts on significant biodiversity values resulting from the project.

Key findings

A preliminary assessment of ecological values on the proposed development site concluded that the area of the proposed development footprint was unlikely to hold any notable value for flora or fauna species of significance and, therefore, the requirements for biodiversity offsets under the BioBanking process was also unlikely. Consequently, the OEH confirmed that the Framework for Biodiversity Assessment would not need to be used to assess the biodiversity values and associated impacts, subject to the results of further investigations. The DPI also confirmed there are no fisheries issues and no aspects of the works trigger the need for any approvals under the NSW *Fisheries Management Act 1994*, provided the nearby wetland was not impacted.

The biodiversity values of the study area were assessed through a desktop review of available information together with a field survey conducted by two ecologists over one day. The survey primarily involved the assessment of all native vegetation, habitats and other landscape features on and adjacent to the proposed site development footprint for informing subsequent mapping and value assessments, and determining the need for any further assessment for threatened species. Given the small size of the site, all vegetation communities, habitats and flora species were able to be assessed and accounted for during the survey.

The study area occurs entirely within the Clarence Lowlands subregion of the South Eastern Queensland - Clarence Lowlands Bioregion, and includes the Lamington Volcanic Slopes, Grafton-Whiporie Basin and Clarence-Richmond Alluvial Plains Mitchell Landscapes.

Seelems Creek meanders across the western portion of the study area as a series of ox-bow wetlands, none of which are recognised as "important" wetlands. Wetlands also occur to the east and north-east of the study area, known locally as Kennedy's Swamp. No state or regionally significant biodiversity links are recognised as occurring within the study area, although vegetation associated with Seelems Creek may act as a local biodiversity link.

Native vegetation recorded during the field survey was restricted to the western and central portions of the study area, as well as to the north-east. The ground-truthed extent was found to match that shown in aerial imagery for the site, which confirms that the proposed development footprint is largely devoid of native vegetation and has been used for grazing livestock and existing quarrying operations.

The field survey identified four native vegetation types within or in close proximity to the study area but outside the proposed development footprint, all of which are recognised as Endangered Ecological Communities (EECs):

- Hoop Pine - Yellow Tulipwood dry rainforest of the North Coast – a component of the "Lowland Rainforest in the NSW North Coast and Sydney Basin bioregions" EEC. Found to be in moderate condition.
- Forest Red Gum - Swamp Box of the Clarence Valley lowlands of the North Coast – a component of the "Sub-tropical Coastal Floodplain Forest of the NSW North Coast bioregion" EEC. Found to be in moderate condition.
- Paperbark swamp forest of the coastal lowlands of the North Coast – a component of the "Swamp sclerophyll forest on coastal floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions" EEC. Found to be in moderate condition.
- Coastal freshwater meadows and forblands of lagoons and wetlands – a component of the "Freshwater wetlands on coastal floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions" EEC. Found to be in good condition.

These native vegetation communities all occur outside of the proposed development footprint. None of the vegetation on the study area is recognised as a Threatened Ecological Community under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

Other native vegetation recorded onsite occurs as scattered paddock trees, planted amenity screens alongside access tracks, or as minor components within otherwise heavily disturbed and exotic-dominated patches of regrowth. Camphor Laurel (*Cinnamomum camphora*) and Lantana (*Lantana camara*) are dominant features of the latter.

Four specimens of *Macadamia tetraphylla* (Rough-shelled Bush Nut) were recorded during the field survey, a species currently listed as Vulnerable under both the NSW *Threatened Species Conservation Act 1995* (TSC Act) and EPBC Act. The specimens occur together, adjacent to a clump of other scattered, paddock trees and outside of any of the recognised native vegetation zones on the study area. These plants are either relicts of a dry rainforest or forested wetland community that once occupied that part of the site, or they have propagated from seeds dispersed from nearby communities. No other threatened flora species were recorded during the field survey, despite targeted searching within all habitat types (including comprehensive searches within the proposed development footprint), and despite the majority of species being detectable throughout the year.

The degraded habitats present within the area of the proposed development footprint provide very limited habitat value for threatened fauna species. A number of threatened fauna species have the potential to occur within the habitats present within the study area, at least as transient visitors during foraging (particularly birds and bats). Black-necked Stork (*Ephippiorhynchus asiaticus*) (Endangered: TSC) and Comb-crested Jacana (*Irediparra gallinacea*) (Vulnerable: TSC Act) are also known to occur on the site from previous records, and the study area continues to provide suitable habitat for these species.

Forest Red Gums (Eucalyptus tereticornis) within the open forest habitat to the north-east of the study area showed scratches consistent with those of Koala (*Phascolarctos cinereus*) (Vulnerable: TSC Act and EPBC Act). No evidence of Koala occurrence was found within the study area, and although it is possible this species may also occasionally utilise food trees occurring within the open paddock and fringing the wetlands, these areas are considered to be of less value to the species than the habitats occurring off-site. The results of the field survey generally support the Richmond Valley Council's Local Environmental Plan mapping of relative biodiversity importance in that the far western and central parts of the study area and areas to the north-east contain native vegetation and associated habitat values for native fauna, including species of conservation significance. The results of the field survey also generally support the Koala Habitat Atlas mapping in that the vegetation in the north-east well outside the proposed extraction and stockpiling areas offers the highest value Koala habitat, with less valuable potential habitat occurring on the fringes of the wetlands (Richmond Valley Council 2015).

The proposed site development footprint (incorporating the Petersons Quarry) has been positioned to avoid the clearing and fragmentation of the relatively large, well-connected tracts of vegetation and associated habitat within the study area, and avoids all patches of vegetation recognised as native vegetation communities that have greatest value to the majority of known or potentially occurring terrestrial flora and fauna species. As a result potential cumulative impacts from the operation of both the Petersons Quarry and the project have been considered in the design of the project. Subsequently, no EECs, wetlands or important habitat for threatened flora and fauna species will be directly impacted. Buffers will be retained between the recognised vegetation communities (and associated EECs and wetlands) and the edge of the proposed site disturbance footprint to further prevent secondary impacts.

In response to the survey results, the original footprint was redesigned to avoid the clearing of four Macadamia tetraphylla specimens, with a 25 m buffer to be established and maintained around the plants. This development design, along with further management actions proposed to avoid and mitigate impacts to these plants, suggests any impacts are highly unlikely to be significant.

Implementation of a number of other mitigation measures is also recommended to reduce impacts on native flora and fauna to levels that will not cause significant or permanent harm. This includes the development and implementation of an Environmental Management Plan that includes components to reduce secondary impacts on terrestrial flora, fauna and ecosystems.

Overall, the project is not expected to result in the direct loss of any significant biodiversity values and, once the proposed mitigation measures are implemented, the remaining impacts of the project on terrestrial ecological values are predicted to be minor or negligible, particularly in the context of existing site conditions and current impacts from previous land clearing, weed invasion and the presence of livestock. Hence offsets to compensate for residual impacts are assessed to be unnecessary, and a referral to the Commonwealth in relation to impacts on species listed under the EPBC Act is not considered necessary at this time.

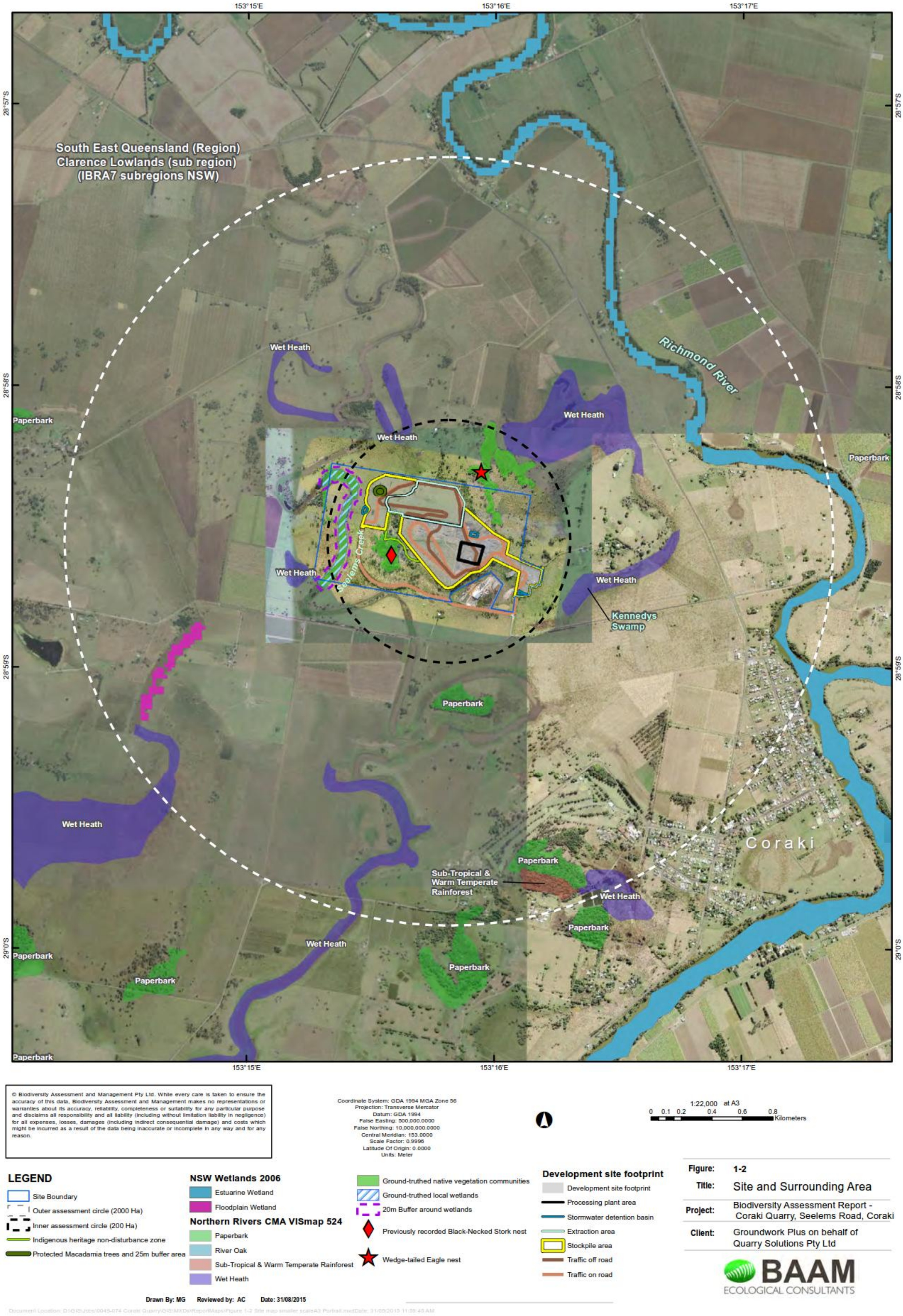
7.4.1 Background

Quarry Solutions Pty Ltd has commissioned the preparation of a development application for an Extractive Industry at Seelems Road (via Petersons Quarry Road), Coraki in New South Wales on land properly described as Lot 401 on DP633427, Lot 402 on DP802985, Lot 403 on DP802985, Lot 408 on DP1166287, Lot A on DP397946, Lot A on DP389418, Lot 3 on DP701197, Lot 2 on DP954593, Lot 1 on DP954592 and Lot 1 on DP310757. A Site Map and Location Map are provided as Figures 23 and 24, respectively.

As the project is considered a State Significant Development, the proponent must prepare an Environmental Impact Statement (EIS) as part of an application under the NSW *Environmental Planning and Assessment Act 1979*. Before preparing an EIS, proponents must also apply to the Secretary of the Department of Planning and Environment for the Secretary's Environmental Assessment Requirements (SEARs), which set out matters to be addressed in the EIS.

Figure 23 Site map showing biodiversity values

Figure 24 Biodiversity values of the surrounding area



Under the NSW Biodiversity Offsets Policy for Major Projects, the SEARs typically require a proponent to apply the Framework for Biodiversity Assessment (FBA) to assess impacts on biodiversity. Stages 1 and 2 of the FBA require the preparation of a Biodiversity Assessment Report (BAR) describing the biodiversity values present on the development site and the impact of the project on these values. A Biodiversity Offset Strategy is then prepared that outlines how the proponent intends to offset the impacts of the project.

The SEARs received for the project identified biodiversity as one of the key issues to be addressed, having regard to the requirements of the NSW Office of Environment and Heritage (OEH) and Primary Industries NSW (DPI) specified in the SEARs. In particular, OEH's requirements included addressing and documenting biodiversity impacts in accordance with the FBA, unless otherwise agreed by OEH.

A preliminary assessment of ecological values on the site, including a brief desktop review and field investigation, was completed by BAAM on 22 April 2015, prior to the release of the SEARs. The primary issues derived from the desktop review were the potential presence of Hairy-joint Grass (*Arthraxon hispidus*), currently listed as Vulnerable under the Commonwealth Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act), within the area of the proposed development footprint, including/particularly within cleared areas, and the Lowland Rainforests of Subtropical Australia Threatened Ecological Community (Critically Endangered – EPBC Act) in association with drainage lines on the study area. The preliminary site investigation revealed neither of these occurs within the area of the proposed development footprint, and the site is largely devoid of native vegetation and had been used for grazing livestock, particularly within the area nominated for the main quarry pit. However, it was considered prudent for quarry designs to establish sufficient buffers to nearby wetlands and native vegetation, pending the results of further investigations.

It was concluded the site of the area of the proposed development footprint was unlikely to hold any notable value for flora or fauna species of significance and, therefore, a requirement for biodiversity offsets under the BioBanking process was also unlikely. Consequently, following a review of the results of the preliminary assessment, correspondence received from OEH confirmed that, due to the degraded state of the site, OEH would not require the FBA to be used to assess the biodiversity values and associated impacts, subject to the results of further investigations (refer Attachment 5, Appendix 2).

Correspondence received from DPI also confirmed that, given the location of the site in the landscape and the fact that no dredging, works within a waterway, impacts or damage to marine vegetation, placement of spoil in waterways, activities that block fish passage or impacts to fishing and aquaculture were anticipated, there are no fisheries issues and no aspects of the works trigger the need for any approvals under the NSW Fisheries Management Act 1994, provided the nearby wetland was not impacted by the proposal (refer Attachment 5, Appendix 2).

The SEARs also state it should be established whether the project requires a separate approval under the EPBC Act, while Richmond Valley Council also identified biodiversity values of local significance requiring assessment as part of the SEARs.

7.4.2 Methodology

The biodiversity values of the study area were assessed through a desktop review of available information together with a field survey conducted by two ecologists over one day.

The desktop review involved an inspection of publicly available databases and mapping, and other information, including:

- The Commonwealth Department of the Environment (DoE) EPBC Online Protected Matters Search Tool (10 km x 10 km search area centred on the site);
- The NSW BioNet Atlas of NSW Wildlife and associated species profiles (10 km x 10 km search area centred in the site);
- Publically available spatial data for the mapping of IBRA Bioregions, Mitchell Landscapes, wetlands and waterways, and native vegetation.
- Richmond Valley Council environmental planning layers and Koala (*Phascolarctos cinereus*) habitat mapping; and

- Aerial photography and background information on the project and the results of previous studies undertaken in support of proposed extensions to the adjacent Peterson's Quarry, as provided by the applicant or otherwise publically available.

The field survey was conducted on 2 July 2015 by Adrian Caneris (Principal Wildlife Expert) and David Fell (Principal Botanist), following a preliminary site investigation undertaken by Dr Lindsay Popple (Senior Ecologist) on 22 April 2015 (Appendix 1). Data from the Bureau of Meteorology indicates conditions were mild (maximum of 240C) with minimal rainfall (2.2mm) during the preliminary site investigation, with moderate rainfall during the preceding month (138mm). Conditions during the survey on 2 July were cool-mild (maximum of 200C) and dry, with limited rainfall during the preceding month (37mm). All survey work was performed in accordance with BAAM's NSW Scientific Licence (SL100704) and Certificate of Accreditation as an Animal Research Establishment.

The survey primarily involved the assessment of all native vegetation, habitats and other landscape features on and adjacent to the proposed site development footprint (subject to access) for informing subsequent mapping and value assessments, and determining the need for any further assessment for threatened species. The field work focused on assessing vegetation and habitats within and directly adjacent to Lot 401 on DP633427, given proposed development within the other Lots included in the application are restricted to previously disturbed areas associated with Petersons Quarry.

The flora survey generally followed the methods outlined in the FBA, and included plot and transect surveys for the assessment of native vegetation. Targeted searches for threatened flora species were also undertaken across the site throughout the survey period. The location of survey locations is shown on Figure 3-1 of Attachment 5.

Given the small size of the site, all vegetation communities, habitats and detectable flora species were able to be assessed and accounted for during the survey. As the time of year for the survey (winter) is outside the most suitable time for detecting many of the threatened fauna species potentially occurring in the vicinity of the site, the fauna survey component focused on the availability and quality of habitats present, combined with active searching for fauna signs (e.g. Koala scratches and scats) and opportunistic species records.

The locations of any significant values were recorded by GPS for subsequent mapping purposes.

While it is acknowledged that the time of year and conditions during which the primary survey was undertaken (i.e. winter, with limited rainfall) may fall outside the ideal time of the year to survey for one or more target species, the likelihood of their occurrence is able to be assessed through integration of the following sources of information:

- Review of the published literature pertaining to the known distributions, habitat requirements and detectability of the species; and
- Onsite habitat assessment results and professional experience.
- The likelihood of occurrence assessment used the following four categories to determine the probability of conservation significant flora and fauna species occurring in the habitats available within the study area:
- Known to occur: the species was detected during field assessment, or is known from past surveys in the study area and is not now considered locally extinct.
- Likely to occur: a medium-high probability the species occurs in or regularly visits the study area because suitable habitat occurs, the study area is within the known distribution of the species, there are past records of the species in the vicinity of the study area, and the species is not considered locally extinct.
- Potential to occur: either: (a) there are no past records of the species in the vicinity of the study area but suitable habitat occurs and there is insufficient information on the distribution of the species (e.g. it is naturally rare and/or difficult to detect) to categorise the species as likely or unlikely to occur; or (b) there are past records of the species in the vicinity of the study area but habitat in the study area is marginal or spatially limited meaning that the species' presence on the study area would be transitory at best.
- Unlikely to occur: a very low probability that the species occurs in the study area because: (a) suitable habitat does not occur; or (b) the study area is outside the known distribution of the species; or (c) the species is considered locally extinct; or (d) there are no records of the species in the local region despite adequate survey effort; or (e) suitable habitat occurs, the study area is within the known distribution of the species and there are past records of the species in the vicinity of the study area but the species has not been observed despite sufficient

spatial and temporal survey effort for detecting the species. Based on the above, where the likelihood of a species' occurrence is inconclusive, the species is typically assessed as having potential to occur and is subsequently considered in the assessment of potential impacts. This includes species for which the time of year the survey is undertaken is generally not suitable for detection.

7.4.3 Existing environment

The study area occurs entirely within the Clarence Lowlands subregion of the South Eastern Queensland - Clarence Lowlands Bioregion. The study area includes the following Mitchell Landscapes:

- Lamington Volcanic Slopes.
- Grafton-Whiporie Basin.
- Clarence-Richmond Alluvial Plains.

Seelems Creek meanders across the western portion of the study area as a series of ox-bow wetlands, none of which are recognised as "important" wetlands. The wetlands in the study area would be considered local wetlands, with an applicable riparian corridor width of 20m. Wetlands known as Kennedy's Swamp occur to the east and north-east of the study area.

Native vegetation recorded during the field survey was generally restricted to the western portions of Lot 401 on DP633427 and Lot 403 on DP802985, and along the boundary of Lots 402 and Lot 403 on DP802985, as well as to the north-east of the study area. Further details on this ground-truthed vegetation are provided in Section 3.2 of Attachment 5.

Native vegetation currently recognised in the broader area includes that described as "wet heath" in patches to the north-west, north-east, east and south-west of the study area, while a patch of "paperbark" is mapped to the south.

No state or regionally significant biodiversity links are recognised as occurring within the study area. Vegetation associated with Seelems Creek may act as a local biodiversity link.

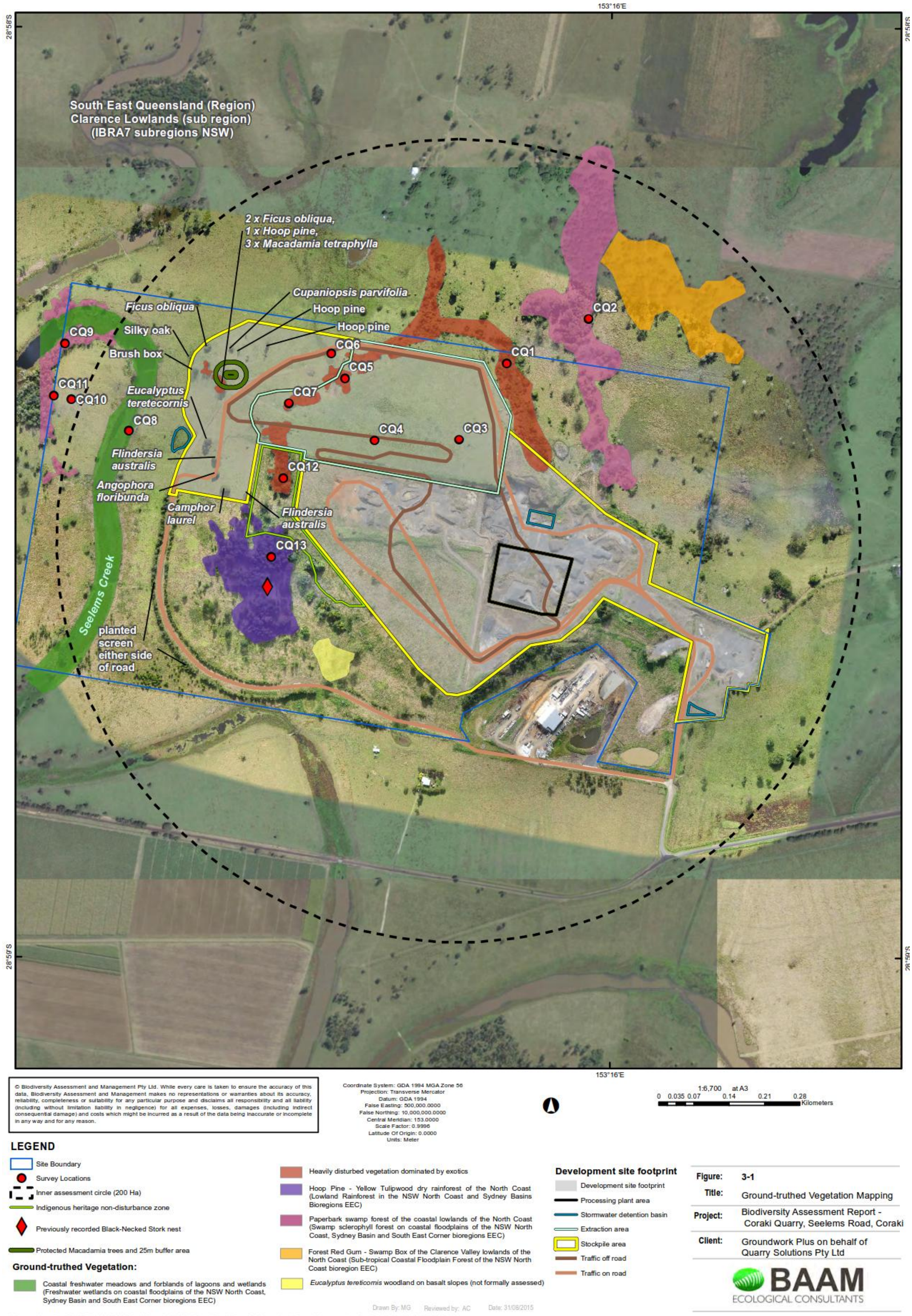
No recognised native vegetation types or associated biodiversity links are proposed to be directly impacted by the project (refer to Section 4.0 of Attachment 5). As such, an assessment of current and future landscape values for the purposes of determining a change in landscape value is not considered necessary.

The field survey identified four native vegetation types within or in close proximity to the study area, all of which are recognised as Endangered Ecological Communities (EECs):

- NR179: Hoop Pine - Yellow Tulipwood dry rainforest of the North Coast – a component of the "Dry Rainforests" vegetation class and "Lowland Rainforest in the NSW North Coast and Sydney Basin Bioregions" EEC (survey site CQ13 on Figure 3-1).
- NR161: Forest Red Gum - Swamp Box of the Clarence Valley lowlands of the North Coast – a component of the "Coastal Valley Grassy Woodlands" vegetation class and "Sub-tropical Coastal Floodplain Forest of the NSW North Coast bioregion" EEC (survey site CQ2).
- NR217: Paperbark swamp forest of the coastal lowlands of the North Coast – a component of the "Coastal Swamp Forests" vegetation class and "Swamp sclerophyll forest on coastal floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions" EEC (survey sites CQ9 and CQ11).
- NR150: Coastal freshwater meadows and forblands of lagoons and wetlands – a component of the "Coastal Freshwater Lagoons" vegetation class and "Freshwater wetlands on coastal floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions" EEC (survey site CQ8).

As shown on Figure 25, these native vegetation communities all occur outside of the proposed development footprint.

Figure 25 Ground truthed vegetation mapping



7.4.4 *Threatened species – flora*

A search of the NSW BioNet Atlas of NSW Wildlife (10 km x 10 km search area centred in the site) returned a total of five flora species listed as threatened under the NSW *Threatened Species Conservation Act 1995* (TSC Act), including three species listed as Endangered and two species listed as Vulnerable (Appendix 5 of Attachment 5). Four of these species are also currently listed as threatened under the EPBC Act (two Endangered, two Vulnerable).

The Commonwealth EPBC Online Protected Matters Search Tool (10 km x 10 km search area centred on the site) returned an additional eight threatened flora species, including three listed as Endangered and five species listed as Vulnerable (Appendix 5 of Attachment 5). All of these species are also currently listed as threatened under the TSC Act (three Endangered, five Vulnerable).

Table 3.1 of Attachment 5 presents an assessment of potential occurrence of threatened flora species from the database searches, based on a review of species profiles and the habitat types present on the study area. Some of these species are assessed as having the potential to occur, including within disturbed habitats on basalt hills and on adjoining properties. However, none were detected despite targeted searching within all habitat types (including comprehensive searches within the proposed development footprint), and despite the majority of species being detectable throughout the year. Hence the potential for significant impacts on these species is considered low. The same applies to Hairy-joint Grass *Arthraxon hispidus*, which may not have been detectable during the 2 July (winter) survey, but was specifically targeted during the 22 April (autumn) survey during appropriate conditions.

Furthermore, the current extent of impacts from grazing and weed invasion throughout the native habitats within the study area is such that some species are considered unlikely to occur regardless of search effort. This includes all remaining target species that may not have been detectable during either survey.

Four specimens of a threatened species not returned by the database searches were recorded during the field survey, namely *Macadamia tetraphylla* (Rough-shelled Bush Nut), currently listed as Vulnerable under both the TSC Act and EPBC Act. The specimens occur together within the centre of Lot 401 on DP633427, adjacent to a clump of other scattered, paddock trees and outside of any of the recognised native vegetation zones on the study area, as shown on Figure 25 above. The geographic coordinates and a description of each specimen are provided in Table 3.2 of Attachment 5. These plants are either relicts of a dry rainforest or forested wetland community that once occupied that part of the site, or they have propagated from seeds dispersed from nearby communities.

7.4.5 *Threatened species – fauna*

A search of the NSW BioNet Atlas of NSW Wildlife (10 km x 10 km search area centred in the site) returned a total of 11 fauna species listed as threatened under the TSC Act, including one species listed as Endangered and 10 species listed as Vulnerable (Appendix 5 of Attachment 5). Two of these species are also currently listed as Vulnerable under the EPBC Act.

The Commonwealth EPBC Online Protected Matters Search Tool (10 km x 10 km search area centred in the site) returned an additional 33 fauna species listed as threatened under the EPBC Act, including 14 species listed as Endangered and 19 species listed as Vulnerable (Appendix 5 of Attachment 5). This includes a number of marine species for which the site and proposed activities should not be viewed as relevant, including 11 species of albatross, two species of giant-petrel, one species of marine fish and five species of marine turtle. These 19 species are not considered further in this report.

Forest Red Gums (*Eucalyptus tereticornis*) within the open forest habitat to the north-east of the study area showed scratches consistent with those of Koala (Vulnerable: TSC Act and EPBC Act). No evidence of Koala occurrence was found within the study area, despite targeted searches. Although it is possible Koalas may occasionally utilise food trees occurring within the open paddock and fringing the wetlands, these areas are of less value to the species than the habitats occurring off-site.

An assessment of Koala habitat in the context of Commonwealth and local statutes is provided in Sections 3.4.2 and 3.5.2 of Attachment 5, respectively.

No other threatened fauna species identified in the database searches were recorded during the field survey, although it is acknowledged that the time of year during which the survey was undertaken (winter) is outside the suitable time for detecting some of these species. Nonetheless, coverage of the site during the survey was such that all potential habitats were able to be assessed in sufficient detail to enable an informed assessment of potential occupancy for all species.

Table 3.3 of Attachment 5 presents the assessment of potential occurrence of threatened fauna species identified in the database searches. This assessment is based on a review of species profiles and the assessment of habitats during the field survey. Several threatened fauna species have the potential to occur within the habitats present within the study area, at least as transient visitors during foraging, particularly birds and bats.

Black-necked Stork (Endangered: TSC) and Comb-crested Jacana (*Irediparra gallinacea*) (Vulnerable: TSC Act) are known to occur on the site from previous records, and the study area continues to provide suitable habitat for these species. In particular, the dry rainforest community on the boundary of Lots 402 and Lot 403 on DP802985 provides known breeding habitat for Black-necked Stork while the wetlands associated with Seelems Creek provide known habitat for both Black-necked Stork and Comb-crested Jacana, as well as potential habitat for a number of other species.

As noted in Section 2.2 of Attachment 5, species known, considered likely or considered to have the potential to occur are subsequently considered in the assessment of potential impacts. This includes species for which the time of year the survey is undertaken is generally not suitable for detection.

Even so, the degraded habitats present within the area of the proposed development footprint provide very limited habitat value for threatened fauna species. Hence the potential for significant impacts on these known, likely or potentially occurring species is considered low, and many species are considered unlikely to occur regardless of search effort. This includes all remaining target species that may not have been detectable during the survey.

A list of all other fauna species recorded during the survey is provided in Appendix 7 of Attachment 5.

7.4.6 Matters of National Environmental Significance

Threatened Ecological Communities

The Commonwealth EPBC Online Protected Matters Search Tool (10 km x 10 km search area centred in the site) identified one threatened ecological community (TEC) that may occur within the study area: ‘Lowland Rainforest of Subtropical Australia’ (Critically Endangered) (Appendix 5 of Attachment 5). The field survey found that one vegetation community potentially corresponding to this TEC occurs within the study area, that being the Hoop Pine - Yellow Tulipwood dry rainforest of the North Coast vegetation type occurring on the boundary of Lots 402 and Lot 403 on DP802985.

As noted in the listing advice for the Lowland Rainforest of Subtropical Australia TEC, the listing focuses on protecting patches of this community that are “most functional, relatively natural…”, “…and in relatively good condition” (TSSC, 2011). Accordingly, condition thresholds have been developed to establish whether a patch of vegetation retains sufficient conservation values to be considered a TEC.

An assessment of vegetation data obtained for the patch of Hoop Pine dominated dry rainforest community recorded during the field survey (Appendix 3 of Attachment 5) against these condition thresholds confirms the community present onsite fails one of the mandatory criteria relating to the high species richness that characterises good examples of the TEC – that is, patches need to contain at least 30 of the native woody species listed in an appendix to the listing advice, whereas the patch present on the study area contains less than 30 of these species.

Accordingly, none of the vegetation on the study area is recognised as a TEC and a referral to the Commonwealth in relation to impacts on TECs is not considered necessary at this time.

Threatened Species

The Commonwealth EPBC Online Protected Matters Search Tool and a search of the NSW BioNet Atlas of NSW Wildlife (10 km x 10 km search area centred in the site) (Appendix 5 of Attachment 5) indicate the potential presence of a number of EPBC Act listed threatened flora and fauna species for the study area.

Flora

None of the threatened flora species returned by the database searches were recorded during the field survey, despite targeted searching within all habitat types (including comprehensive searches within the proposed development footprint), and despite the majority of species being detectable throughout the year. Current impacts from grazing and weed invasion throughout the native habitats within the study area is also such that some of these species are considered unlikely to occur regardless of search effort or detectability. However, four specimens of a threatened species not returned by the database searches were recorded during the field survey: *Macadamia tetraphylla* (Rough-shelled Bush Nut). This species is currently listed as Vulnerable under both the TSC Act and EPBC Act.

The four recorded specimens occur together within the centre of Lot 401 on DP633427, adjacent to a clump of other scattered, paddock trees and outside of any of the recognised native vegetation zones on the study area, as shown on Figure 3-1 of Attachment 5. These specimens are either relicts of a dry rainforest or forested wetland community that once occupied that part of the site, or they have propagated from seeds dispersed from nearby communities.

Recognised threats to *Macadamia tetraphylla* that are currently present on the site include invasion of habitat by weeds and grazing and trampling (of seedlings) by domestic stock. Recognised activities to assist this species focus on the protection and expansion of rainforests and other native habitats.

An assessment of potential impacts on this species is provided in Section 4.0 of Attachment 5.

Fauna

None of the threatened fauna species returned by the database searches were recorded during the field survey, although it is acknowledged that the time of year during which the survey was undertaken (winter) is outside the suitable time for detecting many of these species. Nonetheless, coverage of the site during the survey was such that all potential habitats were able to be assessed in sufficient detail to enable an informed assessment of potential occupancy for all species returned by the database searches.

Table 3.3 of Attachment 5 presents the assessment of potential occurrence of threatened fauna species returned by the database searches, based on a review of species profiles and the assessment of habitats undertaken during the field survey. This excludes a number of marine species for which the site and proposed activities should not be viewed as relevant.

Forest Red Gums within the open forest habitat to the north-east of the site showed scratches consistent with those of Koala (Vulnerable: TSC Act and EPBC Act) and it is possible this species may also occasionally utilise food trees occurring within the open paddock and fringing the wetlands. The assessment of potential occurrence also indicates the study area provides potential habitat for Grey-headed Flying-fox (Vulnerable), Australasian Bittern (Vulnerable) and Painted Snipe (Vulnerable).

Koala

Known Koala habitat occurs in close proximity to the study area in the form of Forest Red Gum woodland, and Koalas may also visit eucalypts occurring as scattered paddock trees and on the wetland fringes. The results of a habitat assessment performed in accordance with the EPBC Act referral guidelines for Koala are summarised in Table 3.4 of Attachment 5. The total habitat score from this assessment is 4; as this total score is <5, the habitats onsite are not considered to represent critical habitat and the referral guidelines indicate a referral to the Commonwealth in relation to impacts on this species is not considered necessary at this time.

Grey-headed Flying-fox

Grey-headed Flying-fox may visit the forested habitats on site in response to seasonal flowering events. However, such foraging habitat is widespread in the local region, and this species travels widely to exploit seasonal flowering trees, so any loss of habitat within the study area will not have an adverse effect on the long-term survival of the species in the locality. Furthermore, no roosting camp occurs in the study area, so the proposed action is unlikely to have an adverse effect on the life cycle of the species. Accordingly, a referral to the Commonwealth in relation to impacts on this species is not considered necessary.

Australasian Bittern and Painted Snipe
It is possible that these species may occasionally utilise the thicker vegetated areas within the wetland habitats on the study area and adjacent properties. However, there are no confirmed records of either species in the vicinity and similar foraging habitat is widespread in the local region. Accordingly, a referral to the Commonwealth in relation to impacts on these species is not considered necessary at this time.

Other Threatened Species
There is also a low potential for Regent Honeyeater, Coxen's Fig-Parrot, Red Goshawk and Swift Parrot to visit the study area during foraging/hunting. However, there are no confirmed records of any of these species in the vicinity and the habitats present within the study area are not particularly valuable for these species, given their degraded condition, small patch size and isolation. Accordingly, a referral to the Commonwealth in relation to impacts on these species is not considered necessary at this time.

7.4.7 Matters of Local Environmental Significance

Richmond Valley Council's Local Environmental Plan (LEP) mapping (RVC 2015a,b) indicates a recognised wetland occurs in the western portion of the study area, consistent with the freshwater wetland community identified during the field survey (refer Figure 1-1 and Section 3.2.1 of Attachment 5). The LEP mapping also identifies the western part of the study area as an important area for biodiversity, which appears to be associated with the wetland.

The LEP mapping identifies important areas for biodiversity in the centre and to the north-east of the study area. These areas were identified as comprising native vegetation communities during the field survey, other than the smallest patch mapped in the centre of the study area that was found to be dominated by exotics (refer Figure 3-1 and Section 3.2 of Attachment 5). These areas are also identified on the LEP mapping as wetlands. No wetland vegetation was recorded within these areas during the field survey, although they could become seasonally inundated, thereby providing potential habitat for frogs and water birds.

The results of the field survey generally support the LEP mapping of relative biodiversity importance in that the far western and central parts of the study area and areas to the north-east contain native vegetation and associated habitat values for native fauna, including species of conservation significance.

Richmond Valley Council's Koala Habitat Atlas mapping indicates Class B and C secondary Koala habitat occurs to the north-east and in the far west of the study area, respectively.

The Richmond Valley Koala Habitat Atlas defines Class B secondary Koala habitat as areas of forest or woodland where primary Koala food tree species comprise less than 30% of the overstorey trees, or together with secondary food tree species comprise at least 30% (but less than 50%) of the overstorey trees, or where secondary food tree species alone comprise at least 30% (but less than 50%) of the overstorey trees (primary Koala food tree species absent). This habitat class is capable of supporting medium to low-density Koala populations. Class C secondary Koala habitat is defined as areas of forest or woodland where Koala habitat is comprised of secondary and supplementary food tree species (primary Koala food tree species absent), where secondary food tree species comprise less than 30% of the overstorey trees. This habitat class is capable of supporting low-density Koala populations.

The results of the field survey generally support the Koala Habitat Atlas mapping in that the vegetation in the north-east offers the highest value Koala habitat, with less valuable potential habitat occurring on the fringes of the wetlands.

It is understood that a Black-necked Stork once nested in a Hoop Pine located within the centre of the dry rainforest community occurring within the centre of the study area (refer Figure 3-1 of Attachment 5). The current field survey found no active nests in any of the trees within this community, nor was any evidence of recent nesting activity found. Therefore Black-necked Stork is unlikely to currently utilise these trees for nesting. However, this vegetation continues to provide potential breeding resources.

7.4.8 *Impact assessment*

During the construction phase, clearing and/or grubbing activities will be required for the establishment of all key infrastructure components outside of the previously disturbed areas associated with Petersons Quarry. Clearing will also occur progressively during quarry operation for the extension of the pit and stockpile areas.

Clearing of vegetation reduces the total amount of habitat and populations of flora and fauna, and has the potential to result in isolation of habitats and populations, changes to remaining vegetation that cause the loss of food, breeding and shelter resources for fauna, and exposure to introduced species that are either competitors or predators.

Removal of vegetation will also result in direct loss of individual plants, including large trees that may provide nesting resources to fauna, and can result in the mortality of fauna present at the time of clearing.

Secondary impacts can affect peripheral vegetation through:

- soil disturbance/exposure and altered water flow patterns, and subsequent erosion and sedimentation, which may expose tree roots, smother vegetation, and potentially alter the physical form, chemical processes and ecological health of downstream aquatic and riparian habitats;
- increased desiccation, light penetration, wind-throw, herbivory, weed invasion, nest predation, and parasitism for adjacent flora and fauna. In particular, introduced weeds can change vegetation community composition and in some cases increase the intensity of fire, leading to further community degradation;
- salinisation of areas downslope, depending on the clearing extent and nature of the associated landform and geology/soils; and
- clearing, earthworks, vehicle movements, wind and blasting within the project area causing increased dust which will potentially impact on nearby vegetation. Excessive dust has been known to reduce photosynthesis rates and inhibit plant growth, and pollutants in dust can impede plant growth.

Clearing can also create barriers to fauna movement through habitat fragmentation, affecting reproductive cycles and facilitating the incursion of pest species and aggressive, native “edge” species deeper into woodlands and open forests.

In addition to clearing and the associated secondary (or indirect) impacts, the construction and operation phases have the potential to result in on-going disturbance to surrounding habitats. Noise, dust and vibration affect habitat adjacent to active areas due to ground disturbance, the operation and movement of machinery traffic along haul roads, exposed stockpiles and blasting.

Noise, including background noise, generated by human activities can potentially affect behaviour and persistence of species and communities by, for example, masking of alarm and mating calls, location and motion of resources, obstructions or potential harms; in short, noise pollution affects the sending and reception of behavioural and social signals in faunal communities.

Another potential impact associated with fauna, particularly reptiles and small mammals, is becoming trapped in any trenches or other excavations that remain open for any period of time. This may lead to mortality either by exposure, starvation, thirst or predation by other species. Open pipes may also attract fauna, particularly micro-bats and reptiles, which may then be injured or killed when the pipes are transported and utilised.

An increase in heavy and light vehicle traffic during both the construction and operation phases could contribute to increased animal/vehicle collisions on local roads. Species particularly susceptible to traffic collisions include larger and slow-moving snakes, monitors and other large lizards, macropods and frogs (during wet periods).

Vehicles also have the potential to introduce and/or spread weed species and plant pathogens in disturbed soil, while general waste and land disturbance has the potential to attract highly competitive and/or predatory exotic fauna species. Increased human presence has the potential to increase the frequency of accidental fires within vegetated areas, adversely affecting habitat structure and therefore habitat value for a range of significant species.

Fuels and chemical spills from storage areas and oils from heavy machinery can enter the environment, affecting habitats where the spill occurs, and potentially causing more widespread impact if contaminants reach waterways.

The operation of the quarry also has the potential to disrupt natural ecological processes within the local area through:

- limiting the natural movement and dispersal of ground-dwelling and flightless fauna (i.e. for breeding and foraging purposes), which are unable to traverse the quarried landscape;
- altering the local surface water environment due to large-scale landform modification, and subsequent potential impacts on downstream terrestrial ecosystems, particularly wetlands and riparian vegetation, and other sensitive vegetation communities and dependent fauna. This includes alterations to base flows, as well as to the frequency and extent of flooding; and
- creating long-term edge effects along the borders of the active area and adjacent habitat.

It is understood the hours of operation will be restricted to 6am to 7pm Monday to Saturday, with no night works proposed. As such, there will be no impacts as a result of artificial lighting, which could otherwise affect behaviour of both nocturnal and diurnal fauna.

7.4.9 Impact management

The overarching principle of relevant State and Commonwealth environmental protection policies in terms of impact management is to avoid impacts as much as possible in the first instance, following which mitigation measures should be used to reduce unavoidable impacts to acceptable/insignificant levels. Where impacts remain at unacceptable/significant levels post-mitigation, only then should compensatory measures (e.g. offsets) be employed as a last resort.

The following sections outline the proposed measures for avoidance, mitigation and compensation to address potential impacts on terrestrial ecological values as a result of the proposed development.

The most effective means of impact avoidance is through appropriate development footprint design. As shown, the proposed site development footprint has been positioned to avoid the clearing and fragmentation of the relatively large, well-connected tracts of vegetation and associated habitat within the study area, and avoids all patches of vegetation recognised as native vegetation communities that have greatest value to the majority of known or potentially occurring terrestrial flora and fauna species. No EECs, wetlands or important habitat for threatened flora and fauna species (as identified during the site survey and recognised on local government mapping) will be directly impacted. Buffers will be retained between the recognised vegetation communities (and associated EECs and wetlands) and the edge of the proposed site disturbance footprint to further prevent secondary impacts.

It is imperative that the positive ecological outcomes of this design are respected through strict controls on the clearing of vegetation, access and storage of site personnel, vehicles, machinery, materials and excavated soil, and other construction and activities throughout the life of the Project. Of particular importance will be the identification and enforcement of no-go areas and regular monitoring of the condition of retained vegetation and habitat for unauthorised clearing and secondary impacts.

Original development plans involved the clearing of patches of isolated vegetation within the centre of Lot 401 on DP633427 area as part of a designated stockpiling area. The field survey undertaken as part of the current assessment recorded four specimens of Macadamia tetraphylla (currently listed as Vulnerable under the TSC Act and EPBC Act) within one of these patches. In response to the survey results, the original footprint was redesigned to avoid the clearing of these specimens. Taking into account site constraints and the necessary size of the stockpiling area to meet operational requirements, the current, revised footprint incorporates the retention of these specimens and a 25m buffer.

Additional management measures to mitigate residual impacts on these plants are discussed in the following section.

7.4.10 *Impact mitigation*

In general, the area proposed to be disturbed for the project is of relatively low habitat value in the context of the surrounding area and particularly in comparison with the adjacent patches of native vegetation. The overall value of the proposed disturbance area (as habitat) has been reduced because of historical clearing and grazing practices, which have significantly reduced areas of cover and facilitated the dominance of exotic vegetation.

Nonetheless, the area within the proposed site development footprint (outside of currently disturbed areas associated with Petersons Quarry) still retains some limited habitat value and provides resources for some terrestrial fauna species. Furthermore, the mosaic of pasture, remnant vegetation and regrowth across the entire site provides resources for species that are adapted to respond to a range of conditions. For example, mobile species adapted to foraging in open areas, but with specific or preferred requirements, will use such areas (e.g. Cattle Egrets). Habitat osaics also increase the resources available to other fauna species. For example, microbats may roost in woodland and forage in open areas, as do larger marsupials (e.g. kangaroos and wallabies). There is also the potential for direct and indirect impacts on adjacent habitats and associated flora and fauna species, without adequate controls. Consequently, implementation of the following mitigation measures is recommended to reduce impacts on native flora and fauna to levels that will not cause significant or permanent harm:

- Restrict disturbance and access to areas absolutely necessary for the construction and the operation of the Project. Clearly cordon off all adjacent vegetation and buffer extents that are not to be disturbed from clearing activities, creating ‘no go zones’ for vehicles, materials, machinery, workers, excavated soil or fallen timber.
- Implement strict controls on construction and operational/maintenance activities that encroach into buffer areas around EECs, wetlands and known populations/habitats of significant species.
- Implement measures to avoid the spill of earth and rock downslope of the quarry footprint into areas of retained vegetation.
- Design and install temporary erosion control measures to avoid impacts on retained vegetation downslope of the quarry footprint.
- Leave ground layer vegetation (grasses and herbs) in situ wherever possible to assist soil stability. Mulching of heavily disturbed areas can assist in reducing soil erosion. Where necessary, temporary interception devices such as hay bales or geotextile fabric fencing can be employed to slow stormwater and intercept sediment.
- Non-millable vegetation can be mulched and used in rehabilitation or soil stabilisation works, provided no weeds are incorporated into the mulch.
- Consider the installation of nest boxes in areas where hollow-bearing trees must be removed and relocate large fallen logs and boulder piles to adjacent habitat to increase sheltering opportunities for displaced animals where it is not feasible to avoid such features during clearing.
- Ensure a fauna spotter/catcher is present during clearing and site preparation works to:
    - Check habitat (vegetation, logs, rock outcrops) for fauna and breeding sites,
    - Check any stored materials, including stockpiled timber, prior to removal,
    - Check temporary excavations for trapped fauna, and
    - Ensure appropriate treatment of injured/orphaned animals through liaison with local Wildlife Carers.
- Establish ‘go slow zones’ (40km/hr) for vehicles and machinery where non-gazetted roads or tracks are located adjacent to patches of native vegetation communities.
- Limit construction and operational work to daylight hours as far as practicable, and any lighting within outdoor areas should comply with relevant Australian Standards and be of low spillage, with no or limited upward spillage.
- Minimise vehicle and machinery access and subsequent soil compaction and weed transfer risk within and adjacent to retained vegetation.
- Undertake regular monitoring of the health and condition of retained vegetation and habitat, and the health of significant plant specimens.
- Undertake regular monitoring of road kills.
- Educate the workforce on the location of significant/sensitive communities and species and potential impacts from unauthorised activities.
- Develop and implement an Environmental Management Plan (EMP) that includes the following components to reduce secondary impacts on terrestrial flora, fauna and ecosystems:
    - Threatened species management,
    - Noise and dust suppression,

- Weed management,
- Management of environmental flows, runoff quality, erosion and sediment,
- Fuel, chemical spill and waste management, and
- Waste management.

Mitigation strategies relevant to the components of the EMP are outlined below in more detail for inclusion in the EMP. Management of erosion and sedimentation, soil and water contamination, environmental flows, noise, dust, vibration and chemical and oil spill management are standard components of Environmental Management Plans and are addressed within other specialist reports for the project.

The EMP will also address rehabilitation of the site post-operation. It is understood such rehabilitation will be limited to that necessary to return the site to a safe, stable, non-polluting state, suitable for reinstatement of previous land use (i.e. rural – cattle grazing).

7.4.11 Threatened species management

Macadamia tetraphylla

As noted, original development plans have been modified to allow the retention of four specimens of *Macadamia tetraphylla* together with a 25m buffer to be established and maintained around the plants. This far exceeds the minimum tree protection zone recommended within AS 4970-2009 “Protection of trees on development sites”, which specifies a buffer radius equivalent to 12 times the stem diameter at breast height to minimise direct impacts to tree canopies and root zones. A larger (25m) buffer is appropriate for this site, given the threatened status of the plants and the scale of the adjacent development and associated, potential impacts from dust and soil compaction.

The locations of the plants and the 25m buffer will be clearly marked to facilitate onsite recognition, and will be recorded in all relevant quarry documentation for future reference. The 25m buffer will also be managed, such that existing weed infestations will be removed from within the buffer area. In-fill planting and edge-seal planting of native species ill also be undertaken to minimise the effect of further weed intrusion. The retention of a 25m buffer enhanced and maintained in this way is expected to improve existing habitat condition such that the plants’ chances of survival are at least equivalent to their chances of survival if the development was not to occur.

Collection and storage of seeds from the existing plants is also recommended as insurance against potential mortality due to quarrying operations.

Regular monitoring of the existing plants and habitat within the surrounding buffer is also recommended, intended at detecting major changes to plant health and habitat conditions for informing adaptive management strategies. The monitoring is also intended to record detectable alterations to hydrology and water quality caused by the proposed stockpile area. It is anticipated that these factors will be managed by installing a physical barrier to minimise build-up of sedimentation, nutrients and weed propagules into the buffer.

A more detailed account of the proposed management actions for this species is provided in Table 4.1 of Attachment 5.

Black-necked Stork

Although previous studies indicate a Black-necked Stork once nested in a Hoop Pine located within the centre of the dry rainforest community occurring in the centre of the study area, targeted searches undertaken as part of the current field survey found no active nests in any of the trees within this community, nor was any evidence of recent nesting activity found. Therefore, Black-necked Stork does not currently utilise these trees for nesting. However, this vegetation continues to provide potential breeding resources, and there is a small possibility this species may utilise this habitat for nesting in the future.

Accordingly, it is recommended a fauna spotter/catcher is engaged to regularly (i.e. fortnightly) inspect the Hoop Pine dry rainforest community for signs of nesting throughout the construction phase of the project where this coincides with the breeding season for Black-necked Stork (May to January, inclusive). If any nesting activity is identified, a species management plan is to be developed and implemented that ensures any impacts to this species are not significant.

Weed Management

The proliferation of weed species in the landscape can have a serious effect on biodiversity values and ecosystem function. Pest plants may be controlled by:

- Limiting the introduction of weeds and weed propagules into the area of interest,
- Rapidly controlling any weeds that become established on the site,
- Regular monitoring of the area of interest, and
- Preparing a control/eradication plan with follow up action when and where needed.

The following actions should be taken during the life of the Project to reduce the possibility of weeds (or their propagules) entering the site:

- Regularly survey disturbance areas and haul/access roads, and identify and remove any new infestations of invasive weeds encountered. Treatment needs to take place in accordance with local and regional Pest Management Plans and State government recommendations.
- Ensure onsite personnel undertake appropriate training in vehicle hygiene and weed awareness and identification.
- Prepare a car park (preferably gravelled) to house all vehicles entering the site offices. The car park would be regularly checked for any weeds and treated.
- Prepare wash down areas and/or utilise Council approved wash down facilities for any machinery or vehicles entering the Project area that have been working outside of the local area.
- Obtain pest free certification for any soil, fill, mulch, etc entering the site.
- Appoint a person responsible for regularly monitoring for potential pest occurrences (and treatment if required) of equipment, vehicles, machinery and materials (including soil, mulch, fill) entering the site.
- Maximise the diversity and cover of native species when revegetating disturbed areas.

7.4.12 Residual impacts

The Project is not expected to result in the direct loss of any significant biodiversity values and, once the proposed mitigation measures are implemented, the remaining impacts of the Project on terrestrial ecological values are predicted to be minor or negligible, particularly in the context of existing site conditions and current impacts from previous land clearing, weed invasion and the presence of livestock. Hence offsets to compensate for residual impacts are not considered necessary.

7.4.13 Summary of MNES

Under the EPBC Act an action would require approval from the Minister if the action has, will have, or is likely to have, a significant impact on a matter of national environmental significance (MNES). MNES relevant to terrestrial ecology have been addressed throughout this report as part of the existing environment and impact assessment process, and it is concluded that there are no such MNES for which proposed measures of avoidance and mitigation are unable to reduce impacts to insignificant levels. In particular:

- Original development plans have been modified to allow the retention of the four specimens of *Macadamia tetraphylla* recorded within the study area, with a 25 m buffer established and maintained around the plants. This development design, along with further management actions proposed to avoid and mitigate impacts to these plants, suggests any impacts are highly unlikely to be significant.
- Although Koala habitat occurs in close proximity to the study area, and Koalas may also occur occasionally within the study area, consideration of the results of a habitat assessment performed in accordance with the EPBC Act referral guidelines for Koala indicates a referral to the Commonwealth in relation to impacts on this species is not necessary at this time.
- A number of listed Migratory species are known or considered likely to utilise the study area for foraging and, potentially, breeding. However, the local region has not been identified as supporting an ecologically significant proportion of habitat for any of these species, which are all common and widely distributed, and are neither known to be declining nor at the limit of their range within the study area.
- The proposed site development footprint has been positioned to avoid the clearing and fragmentation of the relatively large, well-connected tracts of vegetation and associated habitat within the study area, and avoids all

patches of vegetation that have greatest value to the majority of known or potentially occurring terrestrial flora and fauna species. No wetlands or other important habitat for threatened flora and fauna species as identified during the site survey and recognised on local government mapping will be directly impacted. Buffers will also be retained between the recognised vegetation communities (and wetlands) and the edge of the proposed site disturbance footprint, to further prevent secondary impacts.

Overall, the findings of this assessment indicate that, provided the impact mitigation measures outlined in this report are successfully implemented, there are no predicted significant impacts on any species listed as threatened or migratory under the EPBC Act. Accordingly, a referral to the Commonwealth in relation to impacts on species listed under the EPBC Act is not considered necessary at this time.

7.4.14 Summary of MLES

Matters of local ecological significance have been addressed throughout this report as part of the existing environment and impact assessment process, and it is concluded that there are no such matters for which proposed measures of avoidance and mitigation are unable to reduce impacts to insignificant levels. In particular:

- The proposed site development footprint has been positioned such that no wetlands or other important habitat for threatened flora and fauna species as identified during the site survey and recognised on local government mapping will be directly impacted. Buffers will also be retained between the recognised vegetation communities (and wetlands) and the edge of the proposed site disturbance footprint, to further prevent secondary impacts.
- The current field survey found no active nests of Black-necked Stork in any of the trees within this community, nor was any evidence of recent nesting activity found. Therefore Black-necked Stork is unlikely to currently utilise these trees for nesting.

7.5 Noise

MWA Environmental undertook an assessment of potential noise impacts from the project (refer Attachment 6) which is presented below for ease of reference.

7.5.1 Purpose of report

MWA Environmental was commissioned by Quarry Solutions Pty Ltd to undertake a Noise and Dust Assessment for the proposed Coraki Quarry.

The assessment has been conducted as supporting documentation for the Environmental Impact Statement (“EIS”) prepared by Groundwork Plus in accordance with the Secretary’s Environmental Assessment Requirements (“SEARs”) issued by the Secretary of the Department of Planning and Environment on 22 May 2015 and revised on 30 July 2015.

The NSW Environmental Protection Authority advised by email dated 22 June 2015 that no quantitative assessment of diesel emissions associated with the project will be required. As such, the scope of the air quality assessment has been limited to particulate emissions.

7.5.2 Site description

The subject site is located at Seelems Road, Coraki, New South Wales. The site is located approximately 2 kilometres to the north-west of Coraki Village. The subject site comprises the following properties:

Primary Resource Area

- Lot 401 on DP633427

Access Road via Easement

- Lot 403 on DP802985

Existing Petersons Quarry

- Lot 402 DP802985
- Lot 408 DP1166287
- Lot A DP397946
- Lot A DP389418
- Lot 3 DP701197
- Lot 2 DP954593
- Lot 1 DP954592
- Lot 1 DP310756

Access to the Pacific Highway from the quarry is via Seelems Road / Petersons Quarry Road, Lagoon Road, Casino-Coraki Road, Queen Elizabeth Drive and Coarki-Woodburn Road. The haulage route to the Pacific Highway is shown on Figure 26 Quarry Haulage Route and Receptor Locations.

7.5.3 *Surrounding land uses*

Surrounding land uses are shown on the aerial photograph included as Figure 3.

Surrounding land uses generally comprise rural allotments with scattered detached dwellings.

The nearest surrounding residential dwellings relative to the subject site boundaries are described as follows:

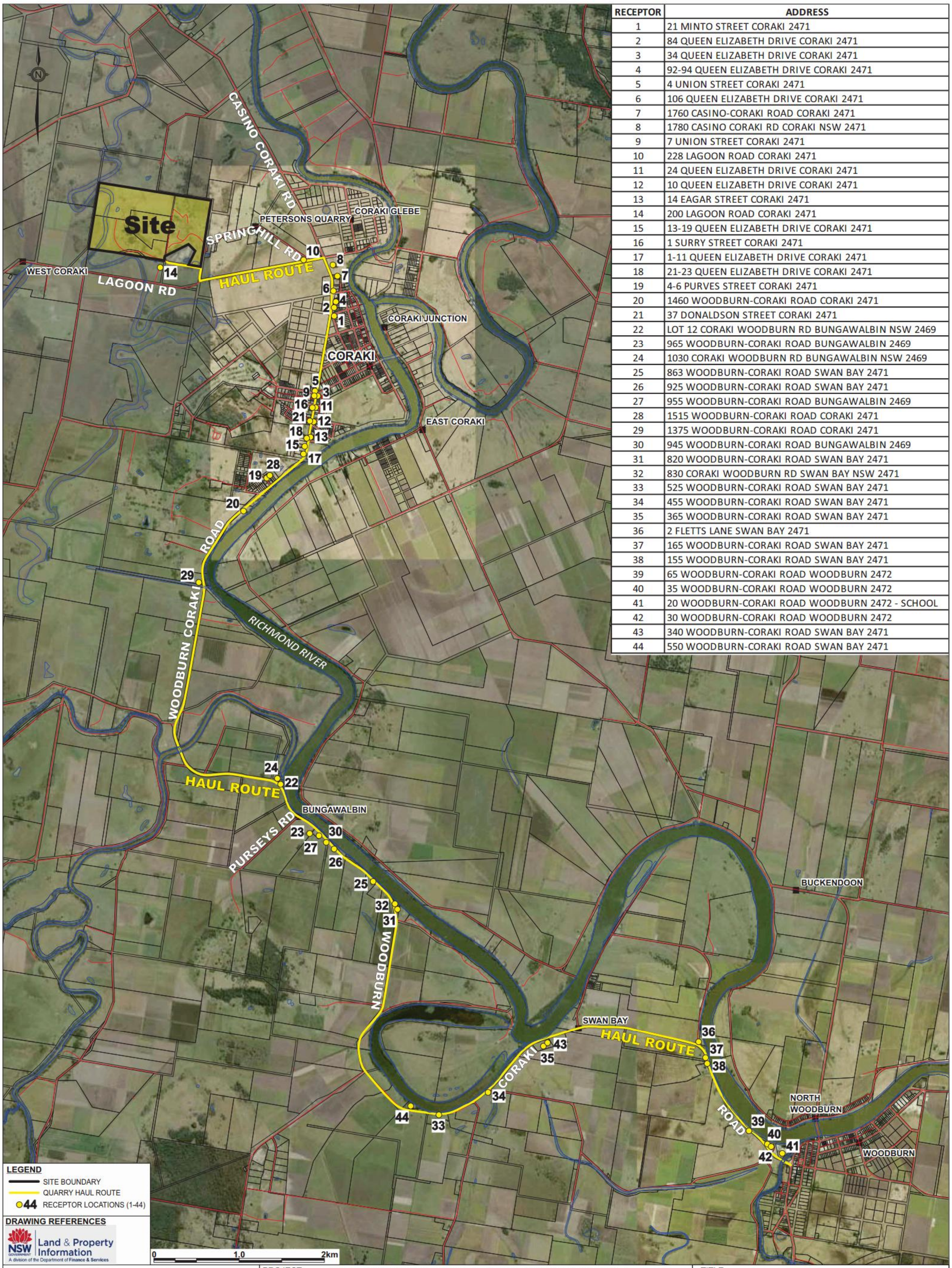
To the North:	Dwelling 310 metres to north, on Newmans Road
To the South:	Dwelling 85 metres to the south of the access road through Lot 403 on DP802985, 600m south of new resource area on Lot 401 on DP633427
To the West:	Dwelling 980 metres to the southwest of the access road through Lot 403 on DP802985
To the East:	Dwelling 285 metres to the east of the existing Petersons Quarry 825 metres east of the new resource area on Lot 401 on DP633427

Only one residential dwelling (to the north on Newmans Road) is located within 500 metres of the proposed new resource area on Lot 401 on DP633427.

Nine (9) residential dwellings surrounding the subject site have been nominated R1 to R9 on Figure 27 Surrounding residences for the purposes of this assessment.

Based upon aerial photography and site inspection, 44 residential dwellings were identified as being located within 100 metres of the haulage route between the quarry access and the Pacific Highway. These residences are shown on Figure 26 for the purposes of this assessment.

Figure 26 Quarry Haulage Route and Receptor Locations



RECEPTOR	ADDRESS
1	21 MINTO STREET CORAKI 2471
2	84 QUEEN ELIZABETH DRIVE CORAKI 2471
3	34 QUEEN ELIZABETH DRIVE CORAKI 2471
4	92-94 QUEEN ELIZABETH DRIVE CORAKI 2471
5	4 UNION STREET CORAKI 2471
6	106 QUEEN ELIZABETH DRIVE CORAKI 2471
7	1760 CASINO-CORAKI ROAD CORAKI 2471
8	1780 CASINO CORAKI RD CORAKI NSW 2471
9	7 UNION STREET CORAKI 2471
10	228 LAGOON ROAD CORAKI 2471
11	24 QUEEN ELIZABETH DRIVE CORAKI 2471
12	10 QUEEN ELIZABETH DRIVE CORAKI 2471
13	14 EAGAR STREET CORAKI 2471
14	200 LAGOON ROAD CORAKI 2471
15	13-19 QUEEN ELIZABETH DRIVE CORAKI 2471
16	1 SURRY STREET CORAKI 2471
17	1-11 QUEEN ELIZABETH DRIVE CORAKI 2471
18	21-23 QUEEN ELIZABETH DRIVE CORAKI 2471
19	4-6 PURVES STREET CORAKI 2471
20	1460 WOODBURN-CORAKI ROAD CORAKI 2471
21	37 DONALDSON STREET CORAKI 2471
22	LOT 12 CORAKI WOODBURN RD BUNGAWALBIN NSW 2469
23	965 WOODBURN-CORAKI ROAD BUNGAWALBIN 2469
24	1030 CORAKI WOODBURN RD BUNGAWALBIN NSW 2469
25	863 WOODBURN-CORAKI ROAD SWAN BAY 2471
26	925 WOODBURN-CORAKI ROAD SWAN BAY 2471
27	955 WOODBURN-CORAKI ROAD BUNGAWALBIN 2469
28	1515 WOODBURN-CORAKI ROAD CORAKI 2471
29	1375 WOODBURN-CORAKI ROAD CORAKI 2471
30	945 WOODBURN-CORAKI ROAD BUNGAWALBIN 2469
31	820 WOODBURN-CORAKI ROAD SWAN BAY 2471
32	830 CORAKI WOODBURN RD SWAN BAY NSW 2471
33	525 WOODBURN-CORAKI ROAD SWAN BAY 2471
34	455 WOODBURN-CORAKI ROAD SWAN BAY 2471
35	365 WOODBURN-CORAKI ROAD SWAN BAY 2471
36	2 FLETTS LANE SWAN BAY 2471
37	165 WOODBURN-CORAKI ROAD SWAN BAY 2471
38	155 WOODBURN-CORAKI ROAD SWAN BAY 2471
39	65 WOODBURN-CORAKI ROAD WOODBURN 2472
40	35 WOODBURN-CORAKI ROAD WOODBURN 2472
41	20 WOODBURN-CORAKI ROAD WOODBURN 2472 - SCHOOL
42	30 WOODBURN-CORAKI ROAD WOODBURN 2472
43	340 WOODBURN-CORAKI ROAD SWAN BAY 2471
44	550 WOODBURN-CORAKI ROAD SWAN BAY 2471

mwa ENVIRONMENTAL
Max Winders & Associates Pty Ltd tas MWA Environmental
Level 15, 241 Adelaide St, Brisbane. GPO BOX 3137, Brisbane Qld 4001
P 07 3002 5500 F 07 3002 5588 E mail@mwaenviro.com.au
W www.mwaenviro.com.au
ABN 94 010 833 084

PROJECT
CORAKI NOISE AND DUST ASSESSMENT
PETERSONS QUARRY EXPANSION
PETERSONS QUARRY ROAD CORAKI NSW

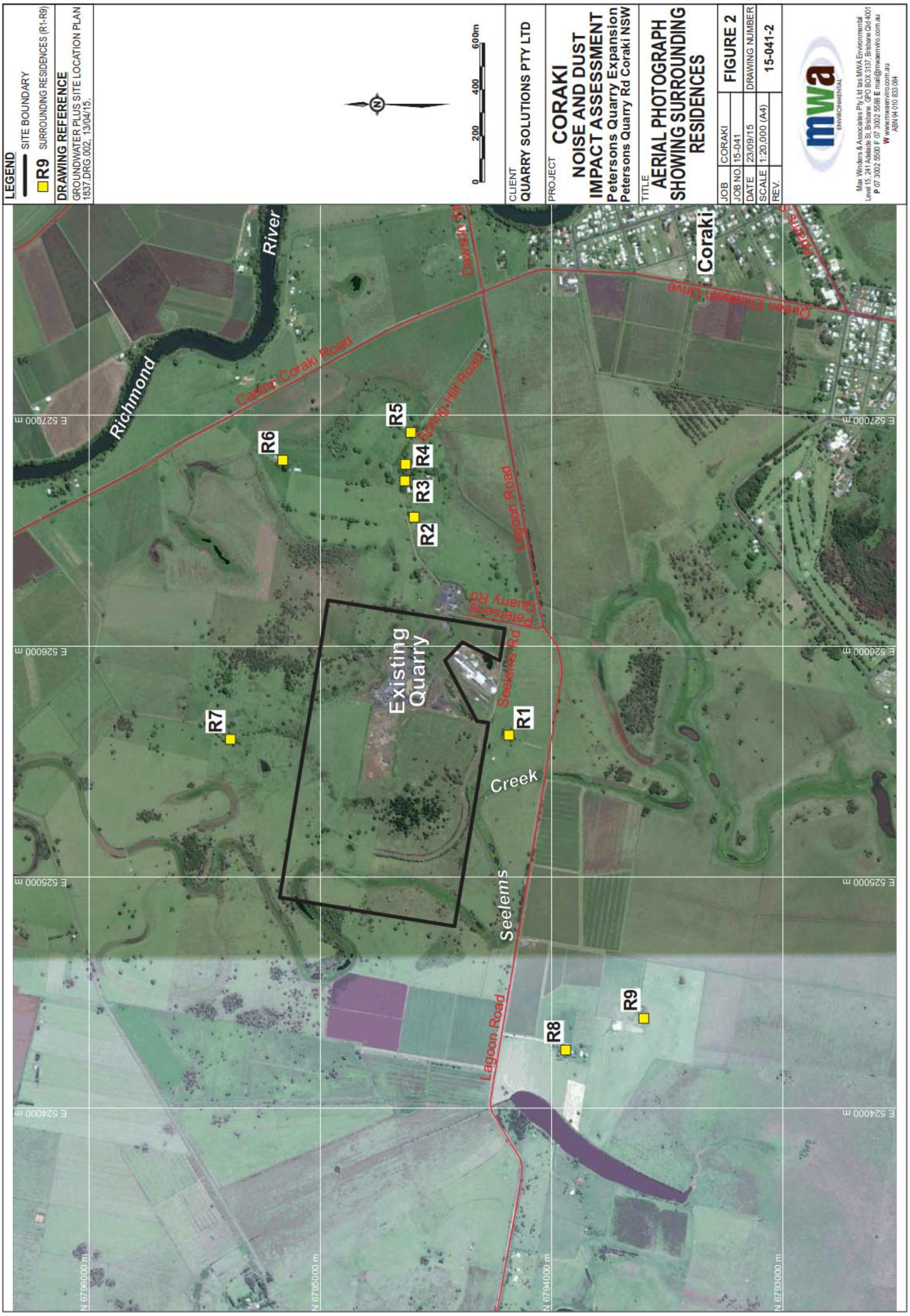
CLIENT
QUARRY SOLUTIONS PTY LTD

DRAWING REFERENCE
NSW GOVERNMENT LAND AND PROPERTY INFORMATION GIS

TITLE
QUARRY HAULAGE ROUTE AND RECEPTOR LOCATIONS

JOB	CORAKI	**FIGURE 3**
JOB NO.	15-041	
DATE	23/09/15	DRAWING NUMBER
SCALE	1:40,000 (A3)	**15-041-3**

Figure 27 Surrounding residences



7.5.4 Proposed development

Key elements of the Description of the Proposal contained in the Environmental Impact Statement by Groundwork Plus are reproduced as follows:

- Extraction will primarily occur within Lot 401 as an extension of the existing Peterson's Quarry pit. Stockpiling areas will be established on both Lot 401 and the Peterson's Quarry land to achieve stockpile capacity for up to 1,000,000 tonnes of materials as requested by the delivery partner for the Pacific Highway upgrade project.
- The existing site office, weighbridge and visitor car parking area of the Peterson's Quarry will be utilised for the project.
- The processing plant for the project will be established within the existing Peterson's Quarry pit to take advantage of the topographic screening available to that location which will assist in minimising potential risk of environmental nuisance from noise and dust emissions. Given the time limited, project specific nature of the project, the processing plant will consist of mobile crushing and screening plants rather than a permanent fixed plant.
- The Conceptual Quarry Development Plan Initial Extraction Stage illustrates how the initial extraction area will be developed from the existing Peterson's Quarry pit into Lot 401. The existing Peterson's Quarry pit has a floor of approximately RL18. This will be continued into Lot 401. Internal benches will be developed to enable progressive extraction to occur from east to west within lot 401. The internal northern face of the extraction area will be a single wall of approximately 20m in height to retain the receding rim of the hill, topographically screening the extraction operations both visually and acoustically from the surrounding land to the north, east and west. Stockpile areas will be established with earth works required as necessary to establish pads of suitable slope. Topsoil and overburden will be used to establish perimeter bunds where necessary to assist in visually screening the stockpile areas and also direct stormwater to the stormwater detention basins for treatment.
- The Conceptual Quarry Development Plan Final Extraction Stage illustrates the full extraction of the resource on Lot 401 to a floor of RL18m. Internal benches will adjoin the existing Peterson's Quarry to facilitate continued efficient development of that resource for the Richmond Valley Council into the future. The internal northern and eastern face of the extraction area will be retained as a single wall of approximately 20m in height. The internal western face of the extraction area will be approximately 3m in height to transition to the western stockpile area on Lot 401. A ramp between the extraction area and the western stockpile area on Lot 401 will be retained in the final land form to accommodate continued connection for any potential redevelopment of the land.

It is proposed to extract a maximum of 1,000,000 tonnes of hard rock material per annum. The expected operating life of the quarry is five (5) to seven (7) years subject to the duration of the upgrade works to the Pacific Motorway. As the proposed development will involve extracting and processing more than 30,000 tonnes of extractive materials per year, it will require an environment protection licence under the Protection of the Environment Operations Act 1997 (POEO Act).

Hours of operation and project duration

The proposed hours of operation are 6am to 7pm Monday to Saturday, 9am to 3pm Monday to Friday for blasting, and no work on Sundays or public holidays. Operation of the quarry is planned to take place as soon as possible, subject to the appropriate approval being granted and timing of the Pacific Motorway upgrade works. The expected operating life of the quarry is five (5) to seven (7) years subject to the duration of the upgrade works to the Pacific Motorway.

Concurrent Operation of Petersen's Quarry

Quarry Solutions has a contract to operate the Petersen's Quarry for Richmond Valley Council for a period extending beyond the expected five (5) to seven (7) year operating life of the Coraki Quarry. The Coraki Quarry will integrate the current extraction area and processing area of the Petersen's Quarry for the life of the project. Any quarry materials required by Richmond Valley Council through the life of the project will be sourced from the existing Petersen's Quarry resource area, crushed in the Coraki Quarry processing plant and stockpiled within the nominated Coraki Quarry stockpile areas.

Given that the extraction, processing, stockpiling and product loading activities will all be undertaken using the same equipment and personnel operating the Coraki Quarry there is no risk of significant cumulative noise and dust emissions.

7.5.5 *Quarry noise assessment*

In order to characterise the existing ambient noise environment at the locality, noise dataloggers were placed adjacent to the nearest residences to the north and east.

The noise datalogger locations are shown on Figure 28 Noise Monitoring Locations.

The noise dataloggers were programmed to provide a statistical noise level analysis based on 15-minute sampling periods continuously over the monitoring period. The recorded noise levels are presented as statistical components, which are described as:

L1:	Noise level exceeded for 1 percent of the measurement period, referred to as the adjusted maximum sound pressure level.
L10:	Noise level exceeded for 10 percent of the measurement period, referred to as the averaged maximum sound pressure level.
L90:	Noise level exceeded for 90 percent of the measurement period. AS1055.1–1997 notes that the L90 is described as the background sound pressure level.
Leq	An "average" measurement, and as per AS1055.1–1997 defined as the value of the sound pressure level of a continuous steady sound state, that within a measurement period, has the same mean square sound pressure as a sound under consideration whose level varies with time.

Table 11 below provides the minimum, maximum and average statistical noise levels recorded by the 'North' Location 1 noise datalogger.

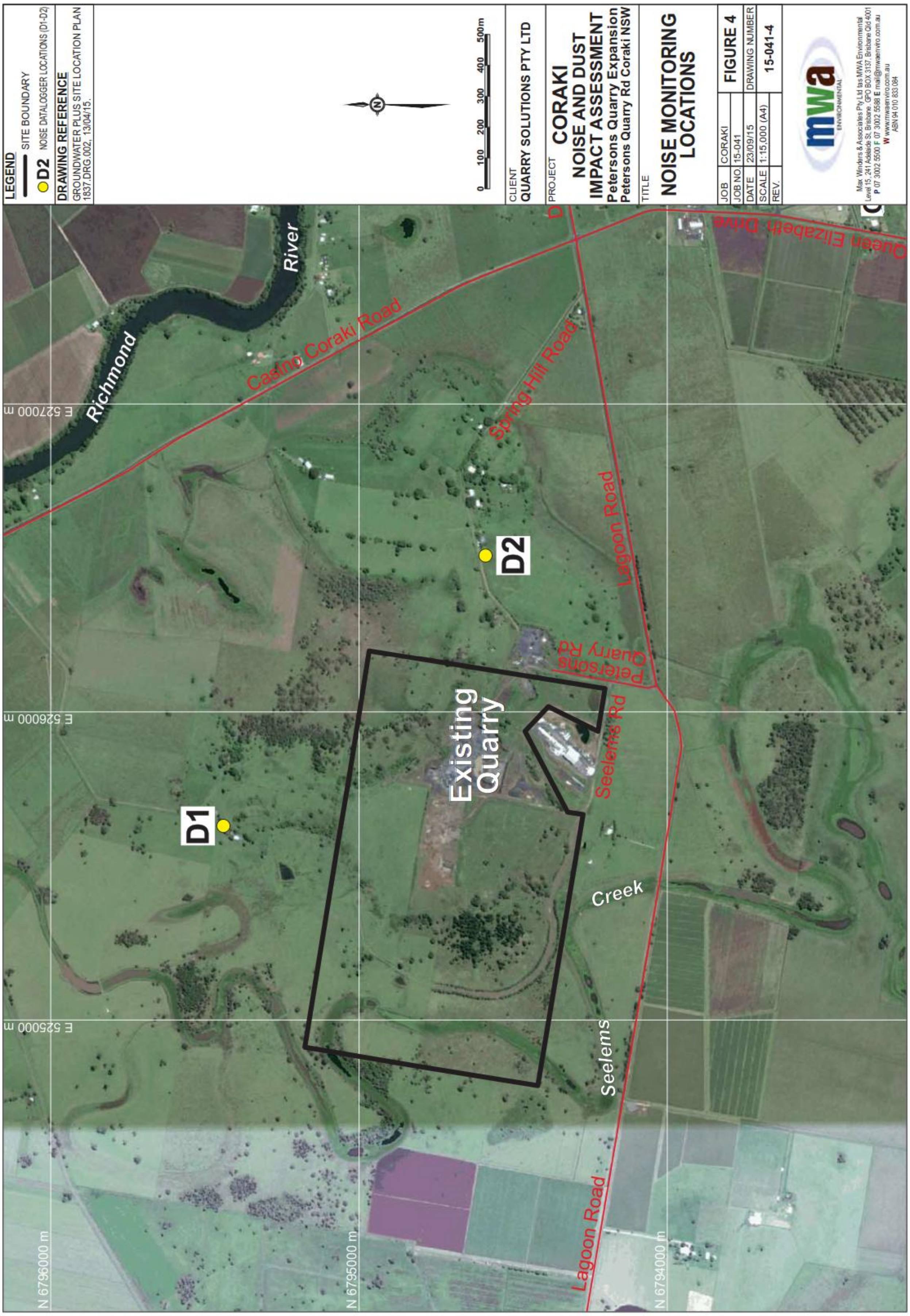
Table 11 Range of Datalogger Recorded Statistical Noise Levels 21 to 27 April 2015 'North' Location 1

Parameter	Period	Recorded Noise Levels – dB(A)		
		Minimum	Maximum	Average
L_1	Daytime (7am-6pm)	33.5	80.0	51.8
	Evening (6pm-10pm)	29.0	58.0	36.5
	Nighttime (10pm-7am)	28.5	76.0	50.3
L_{10}	Daytime (7am-6pm)	30.0	71.5	42.6
	Evening (6pm-10pm)	27.0	36.0	31.1
	Nighttime (10pm-7am)	27.0	64.5	41.9
L_{90}	Daytime (7am-6pm)	28.0	52.5	34.8
	Evening (6pm-10pm)	26.0	34.0	28.2
	Nighttime (10pm-7am)	26.0	56.0	32.8
L_{eq}	Daytime (7am-6pm)	29.0	70.0	43.7
	Evening (6pm-10pm)	26.5	47.5	31.4
	Nighttime (10pm-7am)	26.5	64.0	41.3

MWA Environmental is not aware of the operation of the Petersen's Quarry during the 'North' Location 1 noise datalogging period but notes that:

- There was no apparent operation of the Petersen's Quarry on 21 April 2015;
- There was no apparent operation of the Petersen's Quarry on 27 April 2015;
- More recent information regarding the Petersen's Quarry indicates that extraction and processing activities are occasional only; and
- The pit location where crushing is typically undertaken at the Petersen's Quarry is well topographically shielded from the 'North' Location 1 noise monitoring location.

Figure 28 Noise monitoring locations



On this basis it is expected that Petersen's Quarry operations did not influence the Rating Background Levels measured at 'North' Location 1. Table 12 below provides the minimum, maximum and average statistical noise levels recorded by the 'East' Location 2 noise datalogger.

Table 12 Range of Datalogger Recorded Statistical Noise Levels 12 to 21 August 2015 'East' Location 2

Parameter	Period	Recorded Noise Levels – dB(A)		
		Minimum	Maximum	Average
L_1	Daytime (7am-6pm)	42.6	71.8	53.5
	Evening (6pm-10pm)	30.9	55.9	42.1
	Nighttime (10pm-7am)	27.9	72.0	42.2
L_{10}	Daytime (7am-6pm)	34.4	65.7	44.7
	Evening (6pm-10pm)	28.2	48.2	35.9
	Nighttime (10pm-7am)	26.0	61.5	35.9
L_{90}	Daytime (7am-6pm)	27.8	55.3	33.7
	Evening (6pm-10pm)	25.1	42.2	28.1
	Nighttime (10pm-7am)	24.8	38.9	28.9
L_{eq}	Daytime (7am-6pm)	33.7	62.3	43.6
	Evening (6pm-10pm)	26.6	46.0	33.6
	Nighttime (10pm-7am)	25.6	59.1	34.0

The dataloggers used were an Acoustic Research Laboratories noise datalogger, model EL-215 (Location 1) and an Acoustic Research Laboratories noise datalogger, model EL-316 (Location 2). Each logger was pre-calibrated to 94 dB at 1kHz using a Rion Sound Level Calibrator, model NC-73. At post-calibration, the dataloggers exhibited less than ±0.5 dB deviation.

Quarry Solutions has advised MWA Environmental that the following activities occurred at the Petersen's Quarry during the 'East' Location 2 noise datalogging period:

- No extraction;
- No crushing or screening; and
- Loading and dispatch of between 50 tonnes to 370 tonnes of aggregates/roadbase on 13, 14, 18 & 19 August with no activity on other days – overall low numbers of trucks loaded and dispatched.

On this basis operations at the Petersen's Quarry during the 'East' Location 2 were limited to intermittent loading of trucks and would not have significantly influenced 1 hour average background noise levels or the measured Rating Background Levels. From the noise datalogger measurements, the following Table 13 details the measured Rating Background Levels (RBLs).

Table 13 Measured Rating Background Levels – dB(A)

Noise Monitoring Location	Time Period	RBL dB(A)
'North' Location 1	7am to 6pm	30
	6pm to 10pm	27
	10pm to 7am	28
'East' Location 2	7am to 6pm	30
	6pm to 10pm	26
	10pm to 6am	27

7.5.6 *Relevant noise criteria*

The relevant noise criteria for the assessment of noise impacts from the proposed development are taken from the *NSW Industrial Noise Policy*.

The NSW *Industrial Noise Policy* provides specific policy objectives:

- *to establish noise criteria that would protect the community from excessive intrusive noise and preserve amenity for specific land uses; and*
- *to use the criteria as the basis for deriving project specific noise levels*

The appropriate noise criteria are established by means of a comparison between a 'Rating Background Level ("RBL") plus 5 dB(A)' 'Intrusiveness Criterion' and 'Amenity Criteria' levels, with the lower level being adopted as the basis for deriving project specific noise levels.

From the noise datalogger measurements, the RBLs measured at Noise Datalogger Locations 1 and 2 were 30 dB(A) for the 7am to 6pm period. For the early morning 6am to 7am and early evening 6pm to 7pm periods the minimum RBL of 30 dB(A) has been adopted for assessment of intrusive noise criteria in accordance with the NSW Industrial Noise Policy. This is consistent with the 7am to 6pm RBL.

On this basis, the relevant 'Intrusiveness Criterion' level for assessment of noise from the proposed quarrying activity is L_{Aeq} 35 dB(A) for the proposed operating hours 6am to 7pm.

From Table 2.1 of the *Industrial Noise Policy*, the appropriate 'Amenity Criteria' are as follows for "Residential receiver in a Rural area":

Time of Day	*Recommended L_{Aeq} Noise Level, dB(A)*	
	Acceptable	*Recommended Maximum*
Day (7am to 6pm)	*50*	*55*
Evening (6pm to 10pm)	*45*	*50*
Nighttime (10pm to 7am)	*40*	*45*

As the 'Intrusiveness Criterion' levels are lower than the 'Amenity Criteria' the more stringent 'Intrusiveness Criterion' level of L_{Aeq} 35 dB(A) is applied to the assessment of noise emissions from the proposed quarrying activities.

7.5.7 *Quarry noise modelling methodology*

To enable assessment of noise from the proposed quarrying operations a detailed noise model has been established using the SoundPLAN 7.3 software applying the CONCAWE noise propagation algorithms. The CONCAWE noise propagation method / algorithms were applied to the modelling to allow assessment of noise propagation under specific meteorological conditions e.g. wind directions.

This model is an accepted regulatory model that allows input of site-specific terrain data and source noise data as sound power level spectra.

Modelling has been undertaken based upon the layouts for the 'Initial Pit' and 'Final Pit' operations as per the 3D CAD plans provided by Groundwork Plus.

The source noise data was derived from measurements conducted by MWA Environmental at comparable and representative existing extractive industry facilities. The modelled sound power level data is provided in Attachment 3 of Attachment 6.

As discussed, given that the extraction, processing, stockpiling and product loading activities will all be undertaken using the same equipment and personnel operating the Coraki Quarry there is no risk of significant cumulative noise emissions from the Petersen's Quarry during the life of the project.

7.5.8 Topographic data

The model was established over an area of approximately 4km by 3km centred on the subject land. Digital elevation data for the locality and the subject land, including representations of the 'Initial Pit' and 'Final Pit' landforms was supplied by Groundwork Plus and integrated into the noise model.

7.5.9 Meteorological conditions

Site-specific meteorological conditions have been assessed based upon the meteorological modelling undertaken for the dispersion modelling. Analysis of the relevant meteorological parameters at the site during the operating hours 6am to 7pm for the purposes of noise assessment including stability classes and wind roses is provided in Attachment 4 of Attachment 6.

The analysis demonstrates that:

- Temperature inversion conditions, as Pasquill Gifford F-Class Stability, occur for approximately 6 percent of operating hours in the year; and
- Wind speeds of up to 3 m/s from directions within a 45 degree sector centred on the nearest residences to the north, south and east occur for less than 30 percent of operating hours during any season.

On the basis of the objective meteorological analysis in accordance with the NSW Industrial Noise Policy, temperature inversions and winds of up to 3 m/s from source to the nearest receivers are not assessed to be significant conditions for the purposes of this noise assessment.

7.5.10 Quarry noise modelling

The following noise sources were represented in the model:

Table 14 Noise Sources Used in SoundPLAN 7.3 Modelling

NOISE SOURCE	LOCATION
Primary (Jaw) Crusher	Existing Petersons Quarry Pit
3x Cone Crushers	
Primary Screen	
Secondary Screen	
Tertiary Screen	
Quaternary Screen	
Rock Drill	Lot 401 on DP633427 Resource Area
Rock Pick	
Excavator Loading Shot Rock	
Haul Trucks	Pit to Plant and Plant to Western Stockpiles routes
Loader at Southern Stockpiles	Southern Stockpiles
Loader at Western Stockpiles	Western Stockpiles
Product Trucks	50/50 split Seelems Road Entry and Petersons Quarry Road Entry routes

The above-listed sources are the key noise sources which are expected to operate at the quarry on a regular basis. Other plant items and vehicles may be required to be used at the quarry at times but should not increase overall noise emissions above the level of the above modelled noise sources operating simultaneously. The operating Sound Power Levels ("SWLs") of key processing and mobile equipment have been taken from source noise surveys conducted at comparable and representative existing extractive industry operations. A +5 dB(A) impulse adjustment to the Rock Pick SWL was applied by MWA Environmental to address the noise character of this source.

The modelled SWLs are summarised in Table 15 below.

Table 15: Sound Power Levels - LAeq,T - dB(A)

SOURCE	MODELLED SWL $L_{Aeq,T}$ - dB(A)	SOURCE REPRESENTATION
Primary Crusher	113	Point Source
Screen 1 & Cone Crusher 1	110	Point Source
Cone Crusher 2	109	Point Source
Crusher 3	109	Point Source
Screen 2	107	Point Source
Screen 3	105	Point Source
Screen 4	105	Point Source
Pit to Plant Haul Road (Dump Trucks) 5 loads per hour	75/m	Line Source
Plant to Western Stockpiles (Dump Trucks) 2.5 loads per hour	72/m	Line Source
Loader Loading Truck (1 hour work cycle)	104	Point Source
Loader Loading Truck (1 hour work cycle)	104	Point Source
Excavator Loading Truck[1] (1 hour work cycle)	110	Point Source
Rock Drill[2]	110	Point Source
Rock Pick	118[3]	Point Source
Access Road (7 loads per hour via each entry)	66/m	2x Line Sources

---

[1] Truck tray with impact absorptive lining

[2] Proprietary quietened rock drill

[3] Including +5dBA impulse adjustment

7.5.11 Noise control measures

Based upon an iterative noise modelling process, it has been determined that the following noise control measures are required to comply with the relevant noise limits:

1. The proposed Stockpile Area pads are relatively open and will require earth bunds and/or acoustic barriers to the following locations:
    a. Northern perimeter of the Western Stockpile Area to a minimum height of 6 metres above the RL21m pad level (‘Screen 1’)
    b. Southern perimeter of the Southern Stockpile Area to a minimum height of 4 metres above the RL40m pad level (‘Screen 2’)
    c. Northern perimeter of the Southern Stockpile Area to a minimum height of 4 metres above the RL40m pad level (‘Screen 3’)
2. The northern perimeter of the extraction area will require an earth bund and/or acoustic barrier to a minimum height of 6 metres above the natural ground level at the northern perimeter of the Extraction Area (‘Screen 4’).
3. Wherever practicable materials should be stockpiled at locations that shield noise from internal traffic routes and truck loading areas from the nearest residences i.e.:
    a. Maintain stockpiles along the northern perimeter of the Western Stockpile Area and stock / reclaim from the southern side whenever practicable
    b. Maintain stockpiles along the southern and eastern perimeters of the Southern Stockpile Area and stock / reclaim from the northern and western sides whenever practicable
4. An acoustic barrier and/or earth mound to a minimum height of 4 metres above the access road off Seelems Road shall be constructed (‘Screen 5) for a length of 200 metres from the site entry point.
5. The processing plant shall be operated at the most shielded location available (e.g. at the southeastern corner of the existing Petersons Quarry pit at the RL18m bench) to the extent practicable. If not practicable then appropriate acoustic screening shall be installed to the crushers, screens and any other processing equipment as necessary to comply with the relevant noise limits. Commissioning phase testing is recommended to confirm acceptable siting and/or acoustic treatment of the processing plant.
6. Trays of all dump trucks that handle shot rock[4] and oversize material are to be lined with an appropriate absorptive material.
7. The rock pick should be operated at the most shielded location practically available within the pit to provide acoustic shielding to the north and east.
8. Drilling should be undertaken using a proprietary quietened drill rig e.g. Atlas Copco SmartRig ROC D9C.
9. Extraction sequencing should be designed such that the drill rig is shielded to the north by retained topography of minimum height 5 metres above the drilling pad level and supplemented with earth mounding and/or acoustic barriers as necessary to achieve the overall physical shielding.
10. The internal traffic routes at the northeastern perimeter to be shielded by topographic cut, earth bund and/or acoustic barrier directly to the northeast of the traffic routes to a minimum height of 4 metres above the adjacent traffic route (‘Screen 6). It is noted that the northwestern section of ‘Screen 6’ is not required once the internal traffic route is directed through the extraction area (pit) as the retained topography will achieve the required shielding.
11. All internal roads for road haulage and off-road trucks should be constructed and maintained to avoid excessive noise associated with uneven surfaces and potholes.
12. It is recommended that mobile plant (e.g. front-end loaders, dozers, haul trucks, excavators) be fitted with broadband reversing alarms to mitigate potential nuisance from tonal characteristics of traditional beeper alarms.

---

[4] i.e. pit to plant haulage

The acoustic 'Screen' locations are shown on Figure 28 Acoustic screening. The acoustic 'Screens' may be constructed of any combination of earth bunding, acoustic barrier and/or additional topographic cut to achieve the necessary total height. We note that an acoustic barrier should be constructed as gap-free (less than 1% leakage) and of materials achieving a minimum surface density of 12.5kg/m.

Based upon the modelling and assessment undertaken by MWA Environmental, all of the above noise control measures are necessary to comply with the relevant noise criteria at surrounding sensitive receptors. The relative importance of each measure is difficult to articulate given that the noise reduction achieve by each measure varies for each noise source and for each receptor location. Whilst each measure in isolation may achieve an incremental reduction in overall noise from the quarry at different receptor locations the cumulative effect of all recommended noise mitigation measures has been assessed to be sufficient to comply with the relevant noise criteria at all receptors. Previous experience with hard road quarrying indicates that critical noise sources to mitigate to avoid nuisance are:

- Crushing and screening plant; and
- Heavy mobile equipment operating at exposed locations (e.g. rock drills, dump trucks).

It is understood that the landowner of Lot 401 also owns Lot 4 on DP6339 to the north containing the residence R7. If the applicant is able to reach a commercial arrangement with the landowner such that R7 is not a noise sensitive place for the purposes of the operation of Coraki Quarry then the noise control measured numbered 1a, 3a and 9 are not required. If the applicant is able to reach a commercial arrangement with the landowner of Lot 12 DP6339 to the south, such that R1 is not a noise sensitive place for the purposes of the operation of Coraki Quarry then the noise control measured numbered 1b, 3b and 4 are not required. In addition to the above specific noise control measures, all fixed and mobile plant and equipment operated at the site should be selected and maintained to minimise noise emissions.

7.5.12 Noise modelling results

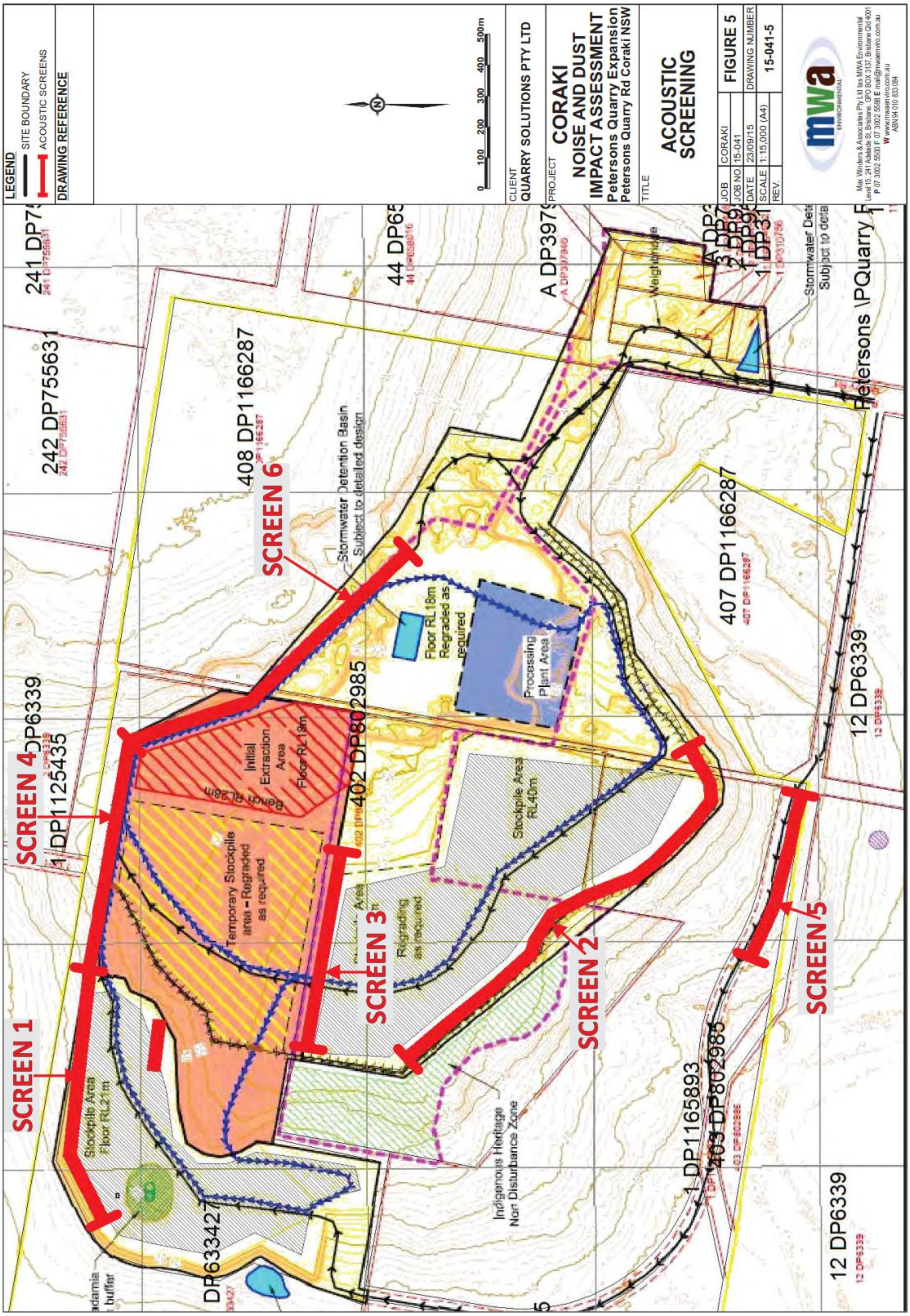
The results of the SoundPLAN 7.3 modelling for the 'Initial Pit' and 'Final Pit' operation scenario are provided in Attachment 5 of Attachment 6 as contours of predicted resultant noise levels on a cadastral base showing the locations of the representative surrounding residences. The predicted resultant noise levels at the representative receptor locations are summarised in Table 6 below.

Table 16 Summary of Model Results for Receptors – dB(A) 'Initial Pit' and 'Final Pit' Scenarios

RECEPTOR	PREDICTED L_{Aeq} NOISE LEVEL - dB(A)		*NOISE CRITERION* L_{Aeq} *- dB(A)*
	INITIAL PIT	FINAL PIT	
R1	35	35	*35*
R2	35	35	*35*
R3	33	34	*35*
R4	28	28	*35*
R5	27	27	*35*
R6	35	35	*35*
R7	35	35	*35*
R8	24	27	*35*
R9	23	24	*35*

The model-predicted quarry noise levels at the industrial facility (concrete panel manufacturer) on Lot 407 on DP1166287 to the southeast range 41 to 47 dB(A) L_{Aeq} with the noise control measures. This is noted to be compliant with the NSW Industrial Noise Policy 'amenity criteria' for 'Industrial Premises' which are an 'Acceptable' level of 70 dB(A) L_{Aeq} and a 'Recommended Maximum' level of 75 dB(A) L_{Aeq}.

Figure 29 Acoustic screening



7.5.13 *Outcomes of quarry noise modelling*

On the basis of the noise assessment conducted, the predictions demonstrate that, subject to the implementation of the noise mitigation measures, the proposed quarrying activities can comply with the relevant noise criteria at surrounding sensitive receptors and the industrial facility on Lot 407 on DP1166287. Detailed consideration should be given to the requirement to shield and/or acoustically treat the processing plant and to the most practical methods of achieving the acoustic shielding required through the use of topographic cut, earth bunds and/or barriers at various locations.

7.5.14 *Monitoring*

The controls nominated for the project will require regular monitoring and review to ensure that performance accords with design criteria and also reflect the dynamic nature and changing needs of the operation. Accordingly, the Quarry Manager will:

- Ensure regular surveillance of the site to qualitatively assess noise generation from plant and machinery.
- Ensure all plant and machinery and vehicles are serviced in accordance with, or more frequently than, manufacturers' specifications.
- Initiate a noise survey when requested by the administering authority, or as otherwise deemed necessary, to investigate a noise complaint.

Methods for measurements and reporting of noise monitoring will comply with the current edition of the NSW Industrial Noise Policy. The measurement and reporting of noise levels will be undertaken by a person or body possessing both the qualifications and the experience appropriate to perform the required measurements.

The Petersons Quarry has been in operation for many years including activities and locations representative of the project. The modelling and assessment conducted as part of this EIS has determined that implementation of a comprehensive range of noise management measures can adequately minimise noise impacts. Accordingly, it is considered real time monitoring is not necessary in this instance. It is proposed that routine monitoring will be undertaken on an annual basis to assess compliance with the relevant conditions of approval and a copy of the annual compliance report made available to the relevant authorities if requested. Monitoring locations will include Lot 12 DP714770, Lot 12 DP6339 and Lot 4 DP6339 subject to the consent of those land owners. A weather station will be installed on site for the life of the project to accurately record the relevant atmospheric conditions. Monitoring will include:

- LAmax, adj, T
- Background noise (Background) as LA 90, adj, T or Labg, T
- Max LpA,T
- The level and frequency of occurrence of any impulsive or tonal noise effects due to extraneous factors such as traffic noise
- Atmospheric conditions including wind speed and direction
- Effects due to extraneous factors such as traffic noise
- Location, date and time of recording.

7.5.15 *Road traffic noise assessment*

The assessment by MWA Environmental also considered road traffic noise at residences within 100m of the proposed haulage route to the Pacific Highway and considered the relevant criteria specified in the NSW Road Noise Policy (Department of Environment, Climate Change and Water NSW, 2011). The relevant noise criteria was determined to be those for, "existing residences affected by additional traffic on existing freeways / arterial / sub-arterial roads generated by land use developments".

Coraki-Woodburn Road, Queen Elizabeth Drive and Casino-Coraki Road are sub-arterial category roads and thus the relevant criteria for the Day period (7am to 10pm) is L_{Aeq}(15 hour) 60dB(A). Whereas for the Night period (10pm to 7am is L_{Aeq}(9 hour) 55dB(A). Seelems Road, Petersons Quarry Road and Lagoon Road are local category roads with the relevant criteria generally being, L_{Aeq}(1 hour) 55dB(A) for the Day period and L_{Aeq}(1 hour) 50dB(A) for the Night period.

Consideration was given to the proximity of the residence at 228 Lagoon Road to the sub-arterial road network and in that instance the sub-arterial assessment criteria was applied. Therefore, only the residence at 200 Lagoon Road, located immediately to the south of the Seelems Road entry to the project was considered to fall within the local road category for the relevant noise criteria assessment of 55dB(A) and 50dB(A) for the Day and Night periods respectively.

For circumstances where the existing 'background' road traffic noise levels are close to, or exceed, the nominated assessment criteria, the NSW Road Noise Policy provides for an assessment of the land use development impacts against a 'Relative Increase' criteria of up to 2dB as a minor impact that is barely perceptible to the average person.

Road traffic noise monitoring was conducted over a 24 hour period (12 to 13 August 2015) at three locations adjacent to the haulage route shown on Figure 30 and correlated with the traffic counts undertaken during the period of 11 to 17 August 2015 for the purpose of model validation and assessment of the background traffic volumes over the assessment period. The traffic noise model was conducted using the SoundPLAN 7.3 software applying the accepted CoRTN traffic noise prediction methodology.

Prevailing meteorological conditions during the monitoring period were generally fine with several brief periods of light rainfall. Wind conditions were calm to light northerly during the mornings of 12 and 13 August 2015 and moderate to strong winds on the afternoon of 12 August 2015. Winds were relatively light during the evening and night period on 12 August 2015. Whilst the period of elevated wind speeds on the afternoon of 12 August 2015 would have affected the measured noise levels the overall impact is considered to be acceptable considering the purpose of the monitoring and proximity of the monitoring locations to the dominant road traffic noise source. The noise monitoring was conducted using Rion NL-21 and Rion NL-42 noise datalogger units which were pre-calibrated to a reference signal of 94 dB at 1kHz. No calibration drift was observed post-measurement.

Site specific topographic information was input to the model for a domain extending from the quarry access to the Pacific Highway based upon NSW Government Land & Property Information 10 metre topographic contours. The road centreline was digitised from review of NSW Globe imagery.

Residential dwellings identified as being within 100 metres of the haulage route were input to the model as discrete receptor. For the section of the haulage route through the township of Coraki, a limited number of dwelling locations were nominated for the purposes of the assessment on the basis that the selected receptors are representative of the dwellings nearest to this section of the haulage route. Other residential dwellings through the Coraki township along Queen Elizabeth Drive are similarly or less exposed to road traffic noise.

Based upon the traffic counts undertaken, average traffic speeds are below the posted speed limits due to the characteristics of the roads. The measured average traffic speeds have been applied to the appropriate road sections for the purposes of the modelling.

The model was setup to represent the design scenario traffic as per Section 3.3 of Attachment 6 for the following assessment periods:

- 15 Hour (7am to 10pm)
- 9 Hour (10pm to 7am)
- AM Peak Hour (7am to 10pm) – relevant to 200 Lagoon Road only
- Night Peak Hour (6am to 7am) - relevant to 200 Lagoon Road only

Residential dwellings within 100 metres of haulage route were represented as discrete receptors in the model. It is noted that the nominated dwelling receptor locations through the Coraki township are representative of dwelling nearest to the roadway along this section of the haulage route. Other residential dwellings through the township of Coraki are similarly or less exposed to road traffic noise compared to the nominated representative receptors.

Figure 30 Road traffic noise monitoring locations

mwa ENVIRONMENTAL

Max Winders & Associates Pty Ltd tas MWA Environmental
Level 15, 241 Adelaide St, Brisbane. GPO BOX 3137, Brisbane Qld 4001
P 07 3002 5500 F 07 3002 5588 E mail@mwaenviro.com.au
W www.mwaenviro.com.au
ABN 94 010 833 084

PROJECT
CORAKI NOISE AND DUST ASSESSMENT
PETERSONS QUARRY EXPANSION
PETERSONS QUARRY ROAD CORAKI NSW

TITLE
ROAD TRAFFIC NOISE MONITORING LOCATIONS

CLIENT
QUARRY SOLUTIONS PTY LTD

DRAWING REFERENCE
NSW GOVERNMENT LAND AND PROPERTY INFORMATION GIS

JOB	CORAKI	**FIGURE 6**
JOB NO.	15-041	
DATE	23/09/15	DRAWING NUMBER
SCALE	1:40,000 (A3)	**15-041-6**

Model predicted LAeq 15 Hour (7am to 10pm) and LAeq 9 Hour (10pm to 7am) noise levels (including façade reflection) at each residential dwelling in proximity to a sub-arterial category road are summarised in Table 17 below.

Table 17 Summary of Model Predicted 15 Hour (7am to 10pm) & 9 Hour (10pm to 7am) Noise Levels

RECEPTOR	MODEL PREDICTION - at façade - dB(A)			
	L_{Aeq} (15 hour) Average		L_{Aeq} (9 hour) Average	
	With Development Overall Level	Increase as a Result of Development	With Development Overall Level	Increase as a Result of Development
R1	54.9	2.1	50.6	0.4
R2	56.6	2.1	52.3	0.5
R3	60.1	1.6	54.8	0.4
R4	54.1	2.2	49.8	0.4
R5	58.9	1.8	54.1	0.4
R6	60.4	1.5	55.1	0.4
R7	52	2.1	47.6	0.4
R8	52.4	2.1	47.7	0.5
R9	59.1	1.7	54.3	0.5
R10	56.2	7.8	47.3	4.8
R11	59.9	1.6	54.7	0.4
R12	58.6	1.9	53.9	0.4
R13	60.3	1.6	55	0.4
R14	Refer Table 13 below			
R15	56.8	2.1	52.4	0.5
R16	59.8	1.6	54.7	0.5
R17	59.1	1.9	54.3	0.4
R18	58.1	1.9	53.8	0.4
R19	49.7	2	45.9	0.5
R20	62.7	1.3	56.7	0.4
R21	59.2	1.7	54.3	0.5
R22	61.6	1.6	55.8	0.6
R23	52.1	2	47.3	0.6
R24	56.2	2	51.2	0.6
R25	63.2	1.5	57.1	0.7
R26	64.2	1.3	57.7	0.6
R27	58.3	2.1	53.5	0.7
R28	49.3	2.1	45.6	0.4
R29	56	1.7	51.3	0.4
R30	59.9	2	54.9	0.6
R31	59	2	54	0.6
R32	61.2	1.7	55.6	0.6
R33	64.6	1.2	58	0.6
R34	61	1.7	55.6	0.7
R35	52.7	2	47.9	0.6
R36	57.8	2	52.9	0.6
R37	62.6	1.5	56.7	0.6
R38	63	1.5	56.9	0.6
R39	61.6	1.7	56	0.6
R40	60.3	1.8	55.1	0.6
R41	52	2.3	47.2	0.7
R42	56.9	2.1	52	0.7
R43	54.8	2.1	50	0.7
R44	56	2.1	51.1	0.6
CRITERION	*60dBA ASSESSMENT CRITERIA*	*2dBA IF ASSESSMENT CRITERIA EXCEEDED*	*55dBA ASSESSMENT CRITERIA*	*2dBA IF ASSESSMENT CRITERIA EXCEEDED*

Model predicted L_{Aeq} 1 Hour (7am to 10pm) and L_{Aeq} 1 Hour (10pm to 7am) noise levels (including façade reflection) at the 200 Lagoon Road dwelling in proximity to a local category road are summarised in Table 13 below.

Table 18 Summary of Model Predicted 1 Hour (7am to 10pm) & 1 Hour (10pm to 7am) Noise Levels

RECEPTOR	MODEL PREDICTION - at façade - dB(A)			
	L_{Aeq} (1 hour) 7am to 10pm		L_{Aeq} (1 hour) Average 10pm to 7am	
	With Development Overall Level	Increase as a Result of Development	With Development Overall Level	Increase as a Result of Development
R14	43.4	3.9	41.1	7.4
CRITERION	*55dBA ASSESSMENT CRITERIA*	*2dBA IF ASSESSMENT CRITERIA EXCEEDED*	*50dBA ASSESSMENT CRITERIA*	*2dBA IF ASSESSMENT CRITERIA EXCEEDED*

7.5.16 Outcomes of the traffic noise modelling

Based upon the road traffic noise modelling conducted it has been determined that:

1. For 14 of the 43 nominated dwellings in proximity to the sub-arterial category haulage roads, compliance is predicted to be achieved with the 60 dB(A) L_{Aeq} (15 hour) (7am to 10pm) assessment criteria specified in the NSW *Road Noise Policy* for "*existing residences affected by additional traffic on existing freeways/arterial/sub-arterial roads generated by land use developments*".
2. For 12 of the 43 nominated dwellings in proximity to the sub-arterial category haulage roads, compliance is predicted to be achieved with the 55 dB(A) L_{Aeq} (9 hour) (10pm to 7am) assessment criteria specified in the NSW *Road Noise Policy* for "*existing residences affected by additional traffic on existing freeways/arterial/sub-arterial roads generated by land use developments*".
3. For the 200 Lagoon Road residence, compliance is predicted to be achieved with the 55 dB(A) L_{Aeq} (1 hour) (7am to 10pm) and 50 dB(A) L_{Aeq} (1 hour) (10pm to 7am) assessment criteria specified in the NSW Road Noise Policy for "*existing residences affected by additional traffic on existing local roads generated by land use developments*".
4. For residences where the cumulative L_{Aeq} (15 hour) (7am to 10pm) noise level post-development is predicted to exceed the 60 dB(A) assessment criteria, the increase as a result of the development does not exceed 2dB(A). This is considered to be a minor change in accordance with the NSW *Road Noise Policy* and impacts are unlikely to warrant mitigation works, particularly considering the purpose and limited operational life of the proposed development.

7.6 Dust

MWA Environmental undertook an assessment of potential dust impacts from the project (refer Attachment 6) which is presented below for ease of reference.

7.6.1 Ambient dust concentrations

Ambient air quality monitoring data was sourced from the NSW Office of Environment and Heritage. Routine ambient particulate monitoring is not undertaken in close proximity to Coraki. The monitoring station selected for representative ambient concentrations is Wyong, located on the central coast. A summary of the ambient particulate data applied to this assessment is provided in Table 19 below.

Table 19 Ambient Particulate Data Applied to Assessment

POLLUTANT	AVERAGING TIME	AMBIENT ($\mu g/m^3$)*	SOURCE
TSP	Annual Average	30.1	Conservative assumption of double Wyong Year 2014 PM_{10} Annual Average
PM_{10}	24 Hour Average	17.2	70th percentile Wyong Year 2014 PM_{10} 24 hour average
	Annual Average	15.1	Wyong Year 2014 PM_{10} Annual Average
$PM_{2.5}$	24 Hour Average	6.2	70th percentile Wyong Year 2014 $PM_{2.5}$ 24 hour average
	Annual Average	5.5	Wyong Year 2014 $PM_{2.5}$ Annual Average
Dust Deposition	Annual Average	40 mg/m^2/day 1.2 g/m^2/month	Assumption based upon typical data

** unless stated otherwise*

In selecting the Wyong monitoring station as the most representative yet conservative basis for assessing ambient particulate concentrations at the Coraki site, consideration was also given to the alternative sites summarised in Table 20 below.

Table 20 Summary of Alternative Ambient Monitoring Sites

Pollutant	PM_{10}					$PM_{2.5}$	
Location	Wyong	Tamworth	Bathurst	Mountain Creek	Springwood	Wyong	Springwood
Distance from Coraki	500km	320km	600km	260km	160km	500km	160km
Site Description	"Central Coast"	"Rural Monitoring Site"	"Rural Monitoring Site"	"South East QLD"	"South East QLD"	"Central Coast"	"South East QLD"
Climatic and Land use Character	Similar coastal climate, larger population centre, more dense transport	More arid climate, larger population centre	More arid climate, larger population centre	Similar coastal climate, larger population centre, more dense transport	Similar coastal climate, major urban area, more dense transport	Similar coastal climate, larger population centre, more dense transport	Similar coastal climate, major urban area, more dense transport
Statistic	Adopted	2010-2014 Period Data				Adopted	2010-2014 Period Data
70th percentile	17.2	16.8	14.5	15.9	14.7	6.2	5.3
Annual Average	15.1	14.7	12.7	14.3	13.4	5.5	4.7

In assessing the above alternative ambient monitoring sites, Wyong was considered the most appropriate dataset based upon, the most consistent climatic conditions to Coraki and the adopted ambient concentrations from the Wyong dataset are higher (more conservative) than the alternative station averages.

7.6.2 *Relevant dust guidelines*

This assessment has also addressed the particulate air quality objectives specified in the *Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales (2005).* The adopted assessment criteria for particulate emissions associated with the proposed quarrying activities are summarised in Table 21 below.

Table 21 Applicable Particulate Objectives

POLLUTANT	AVERAGING PERIOD	GUIDELINE	SOURCE
TSP	Annual Average	90 μg/m^3	NSW Approved Methods
PM_{10}	24 Hour Average (6th highest)	50 μg/m^3	Air NEPM
	Annual Average	30 μg/m^3	NSW Approved Methods
$PM_{2.5}$	24 Hour Average	25 μg/m^3	Air NEPM
	Annual Average	8 μg/m^3	Air NEPM
Dust Deposition	Annual Average (increment)	2 g/m^2/month	NSW Approved Methods
	Annual Average (Total Cumulative)	4 g/m^2/month	NSW Approved Methods

7.6.3 *Dust modelling methodology*

To enable assessment of dust concentrations and deposition rates from the proposed quarrying operations, detailed dispersion modelling has been conducted using the CALMET / CALPUFF modelling system.

The CALMET / CALPUFF modelling system considers 3-dimensional unsteady state meteorology and is suitable for modelling pollutant transport on a regional scale and for complex terrain and coastal zones. The CALMET / CALPUFF modelling system simulates the effects of spatially and time varying meteorology on pollutant transport within the model domain, including chemical transformation and removal. CALPUFF considers emissions as a series of puffs that, if emitted at a sufficient frequency, simulate a continuous emission. This representation of the plume as a series of puffs allows the pollutant transport to vary spatially across the model domain in accordance with the 3-dimensional meteorological field.

A site-specific 3-dimensional prognostic meteorological dataset generated using TAPM was processed using the CALMET program to provide meteorological inputs in a form suitable for the CALPUFF dispersion model. The terrain and land use resolution was refined to a 200 metre grid for the CALMET / CALPUFF modelling to ensure a reasonable representation of the terrain at the locality. CALMET prepares 3-dimensional meteorological data for each hour of the CALPUFF run based upon the 3-dimensional prognostic dataset generated using TAPM.

The CALMET / CALPUFF model was set up to model dispersion within a 10 km x 10 km area surrounding the subject site. The topography of the subject site and surrounding area was sourced from NASA Shuttle Radar Topography Mission (SRTM3) digital elevation data at a resolution of 200 metres. The CALPUFF model was then nested by a factor of four to a finer receptor grid of 50 metres over the modelling domain. The CALPUFF sampling domain was limited to a 3.2 km x 2.4 km area encompassing the nearest sensitive receptor locations.

Emissions estimation and CALPUFF dispersion modelling has been undertaken for the Final Extraction Stage. The assessment of the Final Extraction Stage is deemed the worst-case as this stage has the longest onsite vehicle paths for haulage between pit and plant and from plant to the northern stockpile area. The size of the active pit area and stockpile areas for the Final Extraction Stage is also larger than earlier stages, with these exposed areas subject to wind erosion. The outcome of this is that potential particulate emissions from the quarry are highest during the Final Extraction Stage.

Product trucks are equally distributed between accessing the northern stockpile via Seelems Road and the southern stockpile via Quarry Road. Haulage of material via dump truck and product trucks is a major contribution to total particulate emissions generated from the site.

The assessment has conservatively assumed an extraction and production rate at the proposed maximum limit of 1 million tonnes per annum.

As discussed, given that the extraction, processing, stockpiling and product loading activities will all be undertaken using the same equipment and personnel operating the Coraki Quarry there is no risk of significant cumulative dust emissions from the Petersen's Quarry during the life of the project.

Dust concentrations and deposition rates have been assessed at representative discrete receptors. Gridded receptor modelling has also been undertaken to produce contours of the predicted dust concentrations and deposition rates over the model domain.

The model-predicted dust concentrations and deposition rates due to emissions from the proposed quarrying activities were added to the ambient concentrations presented above to assess the cumulative dust exposure at surrounding receptors.

In order to assess the potential dust deposition from the quarry it was necessary to model a particle size distribution. Whilst the actual particle size distribution of various sources and materials does vary, it is considered reasonable to apply a generalised particle size distribution for the purposes of this modelling. The modelled particle size distribution was derived from the following data included in the USEPA AP42 Chapter 13.2.4 *Aggregate handling and Storage Piles.*

7.6.4 Meteorological data

No site-specific meteorological data was available for this assessment. In the absence of site specific data, following accepted methodology for assessment, the TAPM software was utilised to develop a prognostic meteorological model which generated a year of representative hourly meteorological data for the locality.

TAPM has been used to predict meteorological parameters specific to the area surrounding the subject site including temperature, wind speed, wind direction and stability classification. The model accesses databases of surface characteristics (terrain height, soil and vegetation) and synoptic weather analyses provided by CSIRO to carry out these analyses. TAPM is able to process the output data to produce meteorological data files suitable for input to the CALMET / CALPUFF modelling system i.e. a 3-dimensional grid of hourly varying meteorological parameters over a full year.

The centre coordinates for the model grid were Latitude -28o58'30" and Longitude 153o16'. The following nested model grids were applied to the TAPM modelling:

40 x 30 km grid (total area 1200 km x 1200 km)
40 x 10 km grid (total area 400 km x 400 km)
40 x 3 km grid (total area 120 km x 1204 km)
40 x 1 km grid (total area 40 km x 40 km)

Twenty-five vertical grid levels were modelled. The TAPM model was set up to generate a site-specific meteorological data file for the locality, based upon synoptic analysis data for the representative Year 2010, as provided by CSIRO.

The nearest Bureau of Meteorology (BoM) stations are located at Lismore and Casino. Lismore is located north of Coraki, however review of the area surrounding Lismore indicates elevated terrain to the east and west. No significantly elevated terrain is located surrounding Coraki. Lismore observation data was included as nudging observations in TAPM with a 5 kilometre radius of influence due to the proximity of surrounding terrain. Casino is located further inland than Coraki and is not located in proximity to any elevated terrain. Casino observation data was included as nudging observations in TAPM with a 20 kilometre radius of influence with the station being more representative of the prevailing meteorology of the surrounding region.

The TAPM output was processed using the CALTAPM software to produce a 3-dimensional data file suitable for input to the diagnostic CALMET model as an ‘initial guess field’. The CALMET model further resolved the prognostic meteorology to a finer terrain, land use and soil type resolution of 200 metres over a 10 x 10 km area covering the subject site and surrounding region for the purpose of dispersion modelling.

Analysis of the CALMET derived meteorology for the subject land including a wind rose, wind frequency graph, monthly average temperatures graph and tabulated stability class analysis is contained in Attachment 7 of Attachment 6.

7.6.5 Dust emission sources

The following sources were represented in the CALPUFF Model:

- Haul Routes (unpaved) as a series of area sources;
- Access Roads (unpaved) as a series of area sources;
- Access Roads (paved) as a series of area sources;
- Wind Erosion from stockpiles and unsealed areas as area sources;
- Drilling as an area source;
- Loading Truck at Pit as an area source;
- Main Processing Plant operation as an area source;
- Loading to Stockpiles as an area source; and
- Loading from Stockpiles to trucks as an area source.

Dust emissions from each of these sources have been represented in the CALPUFF model as area sources with appropriate locations, sizes and initial dispersion parameters to represent the releases.

Emissions rates for each of the above sources have been calculated using published emission factors from the following references:

- NPI Emission Estimation Technique Manual for Mining v3.1, Environment Australia (2012);
- USEPA AP42 Chapter 13.2.2 Unpaved Roads (2006);
- USEPA AP42 Chapter 11.19.2 Crushed Stone Processing and Pulverized Mineral Processing (2004); and
- USEPA AP42 Chapter 13.2.4 Aggregate Handling and Storage Piles (2006).

Emission rates have been estimated based upon extraction and production rate at the currently approved limit of 1 million tonnes per annum and distributed for each source based upon the proposed operating hours.

In accordance with the method presented in the NPI Emission Estimation Technique Manual for Mining v3.1, wind erosion emissions have only been represented when wind speed is greater than a 5.4m/s threshold.

A summary of the emission rate estimation techniques, emission factors and emission rates for the quarrying operations are included as Attachment 8 of Attachment 6. Also included in Attachment 8 of Attachment 6 is a summary of the calculated particulate emission rates for each major source group based upon the adopted emission factors and including the control measures recommended below.

The emission estimations and prior experience demonstrate that the key particulate emission sources at a quarry are:

- Vehicles operating on unsealed roadways (product truck routes and pit-to-plant haulage); and
- Crushing and screening plant including conveyor drop points.

The management of particulate emissions from these two key emission sources will be critical and specific recommendations for dust control measures are recommended below.

7.6.6 Dust control measures

It is recommended that the following dust control measures are implemented at the quarry:

- Watering of all haul roads and access roads at a rate of at least 2 litres/m^2/hour at times when dust emissions are visible from vehicle movements;
- Sealing (e.g. asphalt) part of the access road off Seelems Road for a minimum length of 200 metres west from the Seelems Road entry point;
- Enclosure and/or use of effective water sprays to crushers and screens within the permanent processing plant;
- Effective water misting sprays to permanent processing plant at transfer points including load-out points from elevated storage bins if utilised;
- Rock drill to have an appropriate dust extraction system with collector fitted to rig and/or wet drilling via water sprays; and
- Management of dust emissions from stockpiles during high wind speed conditions through appropriate use of sprinklers and/or chemical suppressant products as required.

The above dust control measures have been considered in dust emission estimation calculations presented in this report.

All of the above dust control measures are recommended as appropriate to manage emissions from the proposed quarry but, as noted above, the most critical dust management measures relate to:

- The watering of unsealed roads;
- Sealing of the section of access road adjacent the Seelems Road entry points; and
- Effective water misting sprays to permanent processing plant.

The recommended dust control measures are proven and practical methods of effectively managing particulate emissions from quarrying activities. Subject to compliance with the relevant air quality objectives, there is no requirement for the implementation of more complex, costly and/or operationally challenging methods.

7.6.7 Dust modelling results

Summaries of the model-predicted dust concentrations and deposition rates at the selected representative receptors for the Final Extraction Stage are provided in Table 17 of Attachment 6. Other residential dwellings within the model domain are no more affected than the selected representative receptors.

The results of the gridded receptor modelling for each scenario are presented in Attachment 9 of Attachment 6 as contours of predicted particulate concentrations and deposition rates over an aerial photograph base.

The modelling conducted demonstrates that, with the recommended dust management measures, the proposed quarrying activities can comply with the relevant air quality objectives at all surrounding residences. On this basis, with the implementation of appropriate dust management there will be no requirement to consider reductions in the duration, intensity or nature of activities on the site which would inhibit the ability of the project to achieve the objective of servicing the Pacific highway upgrade project.

The overall contributions of the quarry to the local airshed for the expected 5 to 7 year life of the project are also summarised in Table 17 of Attachment 6. MWA Environmental notes that for the annual average objectives the highest overall development contributions at any receptor range 7% to 16% of the air quality objectives. This is considered to be an acceptable incremental contribution from a development in a rural locality that is not expected to be subject to significant intensification in urban or industrial land uses within the expected 5 to 7 year life of the project.

The maximum predicted 24 hour average PM2.5 concentration at any receptor relates to an increment of 18% of the air quality objective. Again, this is considered to be an acceptable incremental contribution from a development in a rural locality that is not expected to be subject to significant intensification in urban or industrial land uses within the expected 5 to 7 year life of the project.

The maximum predicted 6th highest PM10 24 hour average concentration at any receptor relates to an increment of 59% of the air quality objective. Whilst a significant contribution to the airshed capacity in terms of the peak 24 hour periods, the overall impact is considered to be acceptable considering that:

- In this rural locality it is unlikely that significant cumulative impacts at residential receptors would occur during the same 24 hour periods when specific wind alignments generate peak impacts occur from the quarry at a particular receptor.
- The limited 5 to 7 year expected life of the project dictates that project contributions to the aished capacity will not persist over an extended project life.
- The limited 5 to 7 year expected life of the project reduces the likelihood that any new land uses with the potential to generate significant cumulative impacts will occur during the project life.
- Annual average PM10 contributions remain low at 16% of the air quality objective.

7.6.8 Monitoring

The Environmental Management Plan includes an Air Quality (Dust) Management Plan, prepared to control potential air quality impacts occurring as a result of land disturbance and operations necessary for the project. The performance targets adopted for the project include, that dust and particulate matter are not to exceed the following levels when measured at the boundary of any sensitive receptor:

- dust deposition of 4 g/m2-month (130 mg/m2-day), when monitored in accordance with Australian Standard AS 3580.10.1 Methods for sampling and analysis of ambient air – Determination of particulates – Deposited matter – Gravimetric method; and
- an aerodynamic diameter of less than 10 µm (PM10) suspended in the atmosphere of 50 µg/m3 over a 24 hour averaging time when monitored in accordance with Australian Standard AS 3580.9.6 Methods for sampling and analysis of ambient air – Determination of suspended particulate matter – PM10 high volume sampler with size-selective inlet – Gravimetric method.

The modelling and assessment conducted for this EIS determined that compliance with the performance targets can be achieved, accordingly real time monitoring is not considered necessary in this instance. However, the controls nominated for the project will require regular monitoring and review to ensure that performance accords with design criteria and also reflect the dynamic nature and changing needs of the operation.

Daily visual surveillance will be undertaken by all employees to ensure dust generation on site is controlled appropriately. Dust and particulate monitoring will be undertaken as required in accordance with the relevant conditions of the EPL but at least monthly. Monitoring will be carried out at a place relevant to the potentially affected, nuisance-sensitive place. Monthly dust deposition monitoring will be undertaken at Lot 12 DP714770, Lot 12 DP6339 and Lot 4 DP6339 subject to the consent of those land owners. Monitoring will be undertaken by a suitably qualified person in accordance with:

- Australian Standard AS3580.10.1 of 2003 – Determination of particulate matter – Deposited matter – Gravimetric method (or most recent edition).
- Approved Methods and Guidance for the Modelling and Assessment of Air Pollutants in NSW (EPA, 2001).
- Approved Methods for the Sampling and Analysis of Air Pollutants in NSW (EPA 2001).

A weather station will be installed on site for the life of the project to accurately record the relevant atmospheric conditions. When requested to undertake monitoring, monitoring results are to be provided to the administering authority following completion of the monitoring event. Monitoring shall be carried out at a place(s) relevant to the potentially affected dust sensitive place and must include:

- for a complaint alleging dust nuisance, dust deposition.
- for a complaint alleging adverse health effects caused by dust, the concentration per cubic metre of particulate matter with an aerodynamic diameter of less than 10 micrometre (µm) (PM10) suspended in the atmosphere over a 24hr averaging time.

7.7 Vibration and blast fumes

7.7.1 Vibration management

Vibration from extractive industry operations is generally restricted to blasting activities. Blasting is used to fragment rock and this activity can result in ground vibration and air over pressure which may cause annoyance and alarm to neighbours. Blasting and explosives technology and practices have advanced rapidly in recent years. Application of leading practice technology to operating practice can be particularly effective in maintaining ground vibration and airblast overpressure to within acceptable environmental levels. Ground vibration at quarry sites can be caused by crushing and screening operations, vehicle and mobile machinery movements and drilling and blasting activities. With the exception of blasting, ground vibration from these sources is limited and localised and extremely unlikely to cause annoyance external to the Site. Airblast refers to the sound pressure level or noise level which is generated primarily from the displacement of rock mass during the blasting process. At most quarries the only significant source of airblast overpressure relates to blasting activities.

Quarry Solutions is committed to applying modern blasting technology to the quarry operation. Experienced and licensed organisations will be contracted to provide blasting services on the site including laser surveying of quarry face profile; blasthole design and layout; blasthole deviation measurement; explosives loading and blast initiation planning; priming, loading, stemming and initiation of blast; ground vibration/airblast monitoring; blast fume management and reporting. Various options are available for controlling vibration and air blast from blasting activities.

An assessment of potential vibration impacts has been undertaken (refer Attachment 7) to identify recommended blast parameters to be implemented at the project to control vibration within approved and acceptable levels. The blasting assessment process is conducted using industry standards, industry rules and blasting experience to evaluate multiple blasting scenarios. Each scenario was evaluated to determine if the specific scenario complies with anticipated licence conditions and minimises disturbance to the neighbouring properties. The closest properties were identified and the distance measured from the proposed extraction limit boundary to the closest residential property. A single set of site blast data from the Petersons Quarry was supplied and was used as a guide along with AS2187.2-2006 to determine the potential blast vibration, airblast overpressure and flyrock projection.

The ANZECC guidelines state that in relation to airblast 100% of blasts must be less than 120 dBL and 95% of the blasts must be less than 115 dBL, which reflects the requirements of AS2187.2-2006. Whereas, in relation to ground vibration the maximum level is to be 10mm/s and 95% of blast must be less than 5mm/s. The nearest sensitive receptor to the proposed blasting activities for the project is 140 Newmans Road, Coraki (Lot 4 DP6339) located 335m from the northernmost extraction limit. The assessment identified the following recommendations to ensure blasting for the project complies with the adopted blast criteria:

- Establish permanent blast monitoring locations at the two closest neighbouring properties, which are 140 Newmans Road (Lot 4 DP6339) and 200 Lagoon Road (Lot 12 DP6339), Coraki.
- Start developing a blast vibration equation, specific to the Coraki Quarry. A suitably qualified person should be involved in this process, as using incorrect techniques can add additional cost to blast vibration control;
- Commence blasting using a maximum of a 12 m bench height and 89 mm blast holes to ensure compliance with airblast overpressure and blast vibration. After 3 blasts, the results can be reviewed and evaluated as to whether 102 mm blast holes should be implemented. The airblast overpressure and blast vibration compliance must be maintained;
- Establish the recommended Blast Exclusion Zones (BEZ). If required measure the flyrock projection distances from the first 10 blasts and recalibrate the flyrock equations. This will enable optimisation of the BEZ distance. Due to the use of a conservative value for the constant K in the prediction equations it would be expected that the exclusion distance could be reduced, however this must not be taken for granted;
- All blasts must be face profiled, surveyed and bore tracked to ensure airblast overpressure compliance, combined with the ability to control face burst that can cause flyrock incidents;
- Blast volumes should be maximised to reduce the frequency of disturbances to the neighbouring properties. A target blast volume of 18,750m^3 and 15 tonnes of bulk explosive load is recommended. Shot sizes should be limited to a maximum of 3 rows deep initially, to minimise vibration reinforcement if utilising a non-electric initiation

system. Once actual blast vibration data has been collected and analysed shot sizes may be increased, if the data supports increasing the blast Maximum Instantaneous Charge (MIC) and remaining under 5mm/s;
- Orientate blasts with free faces not directly facing the sensitive receivers, to assist with airblast overpressure control;
- Initiation sequencing for initial blasts, should target no more than a single blast hole MIC of 88kg until the vibration attenuation can be accurately assessed.
- All proposed parameters are for initial blasting at the site. Once actual blast data is available from blasting at the proposed site, then parameters may be optimised using the analysis techniques outlined in this document. Site specific constant (k value) will require calibration for flyrock, blast vibration and airblast overpressure.

The assessment concludes that the project does not introduce any significant risks or impacts to surrounding properties and that blasting at the project is expected to comply with the anticipated licence requirements and ANZECC guidelines subject to the implementation of the above recommendations.

In relation to potential cumulative impacts of blasting for both the Petersons Quarry and the project, as previously discussed, for the duration of the project the Petersons Quarry will adopt the more stringent environmental requirements anticipated to be imposed for the project. The resource assessment prepared for the project determined that the resource is consistent in quality and structure in both the Petersons Quarry and on Lot 401. Accordingly, the same blast parameters and recommendations discussed above can be implemented for the life of the project. To minimise project costs and maximise material delivery efficiencies the drilling and blasting programs at Petersons Quarry and the project will be coordinated and operated as a single project increasing the effectiveness of safety procedures for blasting.

7.7.2 Blast fume management

As discussed above, Quarry Solutions is committed to applying modern blasting technology to the quarry operation including blast fume management and controls. Blast fumes are the gases generated throughout the chemical reaction of initiation of explosives. Some of the gases are toxic and some of the gases are not. Those gases that can be of risk to health are:

- Oxides of Nitrogen (NOX)
- Nitrogen Oxide (NO2)
- Nitric Oxide (NO).

Nitrogen Oxide is the plume seen from a blast, this is generally a red / orange colour, this can also be attributed to over gassing the explosive or having an influx of diesel in the mix of Ammonium Nitrate fuel oil (ANFO) or ANFO/Emulsion products. The main risk to health is that of lung inflammation or (pulmonary oedema) which can take effect several hours after the blasting event. Other health effects may include:

- Dizziness
- Headache
- Eye, nose and throat irritation
- Shortness of breath
- Wheezing or exacerbation of asthma.

The potential for impacts from blast fumes during blasting is considered by the drill and blast contractor in the preparation of the blast management plan prepared for each blast. Potential impacts can be avoided through implementation of typical management measures such as:

- Blast Exclusion Zone – If blasting in conditions that may be expected to produce fume then the Blast Exclusion Zone should account for the potential to produce fume. The Blast Exclusion Zone risk assessment must address the potential to produce fume and have in place a procedure that if unfavourable wind direction, with a higher potential to produce blast fume or dust the blast will only be fired with favourable wind directions; and
- Blasting procedure / Blast Design Procedure – This procedure must address product selection, with reference to hole conditions e.g. wet hole product only used in wet or damp hole, not ANFO. Low density products used in

softer wet ground condition to ensure more favourable detonation of explosives, e.g. 1.0 density in clay overburden, increases sensitivity of the product.

- Inspection delay – It is important that all staff and visitors abide by all blasting safety procedures, which typically include a mandatory delay of five (5) minutes from the time of initiation before anyone is to enter the blast zone to inspect for misfires. This 5 minute period is to be adhered to for non-electric and electronic initiation blasts taking place. Adhering to this procedure will dramatically reduce any risk of persons being affected by blast fumes associated with blasting.

On the basis that Quarry Solutions is committed to applying modern blasting technology and practices under the supervision of suitably qualified drill and blast contractors potential for blast fume impacts are considered to be low and can be managed by well-known and typical practices employed by the industry.

7.7.3 Monitoring

Drilling and blasting on the site will be undertaken in accordance with the relevant conditions of approval once issued. At least one calibrated and approved monitor with geophone and microphone will measure the air over pressure and vibration of each blast that is initiated onsite. Monitoring must be undertaken by a suitably qualified person in accordance with Australia Standard 2187.2 – Explosives Storage, Transport and Use – Part 2 use of Explosives and include:

- peak particle velocity (mm/s)
- air blast overpressure level (dB linear peak)
- location of the blasting within the site
- atmospheric conditions including temperature, relative humidity, wind speed and direction
- affects due to extraneous factors
- location, date and time of measurements.

The vibration monitoring system will consist of a series of individual monitors which will be positioned at specified locations around the quarry and covering the nearest of the potentially sensitive receptors adjacent to the site. Each vibration monitor will have four recording channels. An external geophone (transducer) will monitor ground vibration in three directions (transverse, vertical and longitudinal particle velocities) and report the level in mm/s. An external microphone will measure the level of overpressure, reporting the data in units of dBL. The monitors will be configured with a vibration threshold trigger to record blast events which exceed a minimum value, typically around 0.3mm/s. The recording duration will be set to exceed the duration of the blast.

Monitoring locations for blasting will be identified prior to each blast. In the event that additional monitoring sites are required, these will be confirmed by the Quarry Manager. Blast monitoring will be undertaken in accordance with AS 2187.2 - 2006.

Vibration and air overpressure monitoring will be controlled/completed by the contractor. The contractor will provide the necessary equipment and personnel and/or procedures to deploy, upload and forward the measured blast data through and undertake any necessary subsequent analyses and distribution to Quarry Solutions. Blast data from the contractor will be made available after each blast for analysis, comment and close out. This data will be provided to the relevant authorities upon request and will be kept for a period of five years.

7.8 Surface Water

An assessment of potential surface water impacts and measures required to manage potential impacts from the project has been undertaken (refer Attachment 8).

7.8.1 Site description

Flow from the site discharges into Seelems Creek which has a catchment in excess of 800ha predominately comprising agricultural land. Seelems Creek discharges into the Richmond River approximately 6km downstream from the site. The site consists of mainly open grassland with minor patchy scrub towards to lower elevations on the site.

7.8.2 Target environmental values

The existing Petersons Quarry is operated pursuant to EPL 3397. However, EPL 3397 does not provide specific water quality limits and monitoring requirements due to the age of the approval.

Accordingly, the assessment considered the physio-chemical indicators and numerical criteria (trigger values) for uncontrolled streams within the Richmond Richer Catchment in the setting of the target environmental values that are to be achieved for any water releases from the project, described below in Table 22.

Table 22 Physio-chemical indicators and numerical criteria

Total Nitrogen (N) (mg/L)	Total P (mg/L)	DO (%sat)		Turbidity (NTU)	pH		Conductivity (ms/cm)
		Lower	Upper		Lower	Upper	
350	25	85	110	6-50	6.5	8.5	125-2200

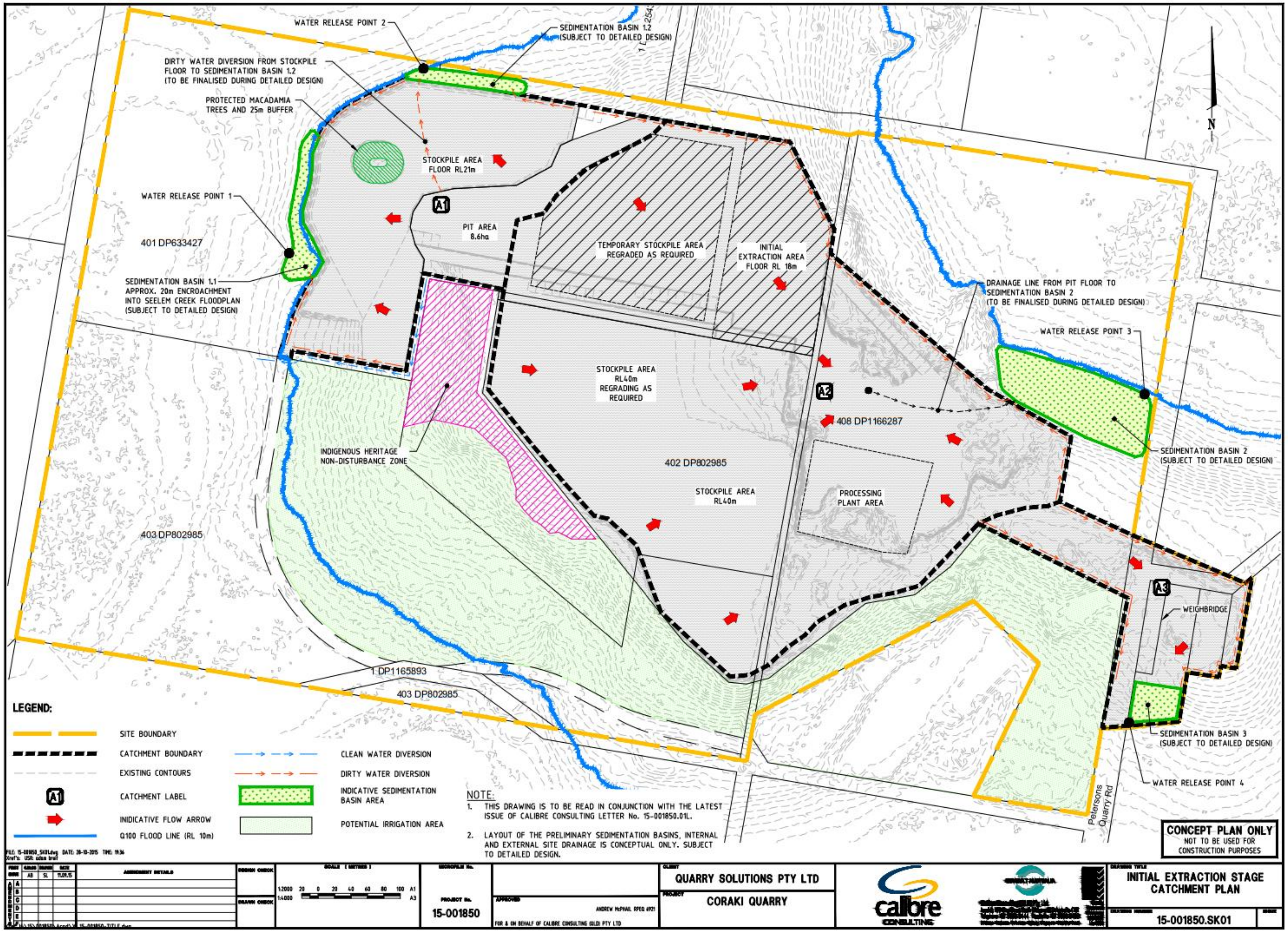
7.8.3 Surface water quality impacts

A surface water management strategy is outlined in Section 2.2 of Attachment 8.

The on-site surface water management strategy involves a system of dirty water collection drains that convey surface water runoff to respective sedimentation basins. A total of 3 sedimentation basins are proposed for the project including the existing Petersons Quarry within the overall surface water management system for the project (as per the conceptual surface water management sketch in Attachment A of Attachment 8) and shown below in Figure 31 thereby addressing potential cumulative impacts of the combined disturbance areas.

The sedimentation basins have been sized in accordance with Managing Urban Stormwater Soils and Construction: Volume 1 (Blue Book) and Volume 2E (Mines & Quarries). The sedimentation basins have been sized to capture the 90 percentile 5 day rainfall event for their respective catchments.

Figure 31 Surface water management plan



NOTE:
1. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH THE LATEST ISSUE OF CALIBRE CONSULTING LETTER No. 15-001850.01L.
2. LAYOUT OF THE PRELIMINARY SEDIMENTATION BASINS, INTERNAL AND EXTERNAL SITE DRAINAGE IS CONCEPTUAL ONLY. SUBJECT TO DETAILED DESIGN.

The sedimentation basins will provide stormwater quality polishing and treatment for the frequent rainfall events for on-site stormwater runoff. The sedimentation basins are expected to discharge during intense or extended rainfall events (further discussed in Section 2.3 of Attachment 8). It is anticipated that any overflows from the sedimentation basins will coincide with flows within the Seelems Creek catchment. Some testing of on-site water was undertaken by Groundworks Plus. The testing was sampled from the existing on-site pond and another area of standing water in the pit. The results of the testing are provided below in Table 23.

Table 23 Physio-chemical indicators from on-site sampling

Location	DO (%sat)	Turbidity (NTU)	pH	Conductivity (ms/cm)
Pit	6.3	75	8.8	490
Pond	6.4	100	7.6	930

The water quality testing undertaken on site indicates that some indicators are in excess of the trigger values in Table. The adopted management strategy includes minimal uncontrolled discharges plus controlled discharges with TSS less than 50mg/L after rainfall events. It is further noted that the sediment basis will be discharged via sheet flow to open grass land prior to entering any nearby water bodies.

7.8.4 Surface water quantity impacts

The sedimentation basins will not need to comply with the harvestable rights dam maximum on the basis that they will be required for treatment of sediment laden water and the EPA under the Environmental Protection License will include a condition which will require treatment of sediment laden water prior to release.

From the water balance analysis in Section 2.3 of Attachment 8, the average yearly overflow and controlled discharges from Sedimentation Basin 2 into the receiving environment during the final extraction stage is approximately 141,590 m3/year. From the contributing catchment to Sedimentation Basin 2 in the existing scenario (a volumetric runoff coefficient of 0.48), the average runoff from the catchment is approximately 180,195 m3/year. With losses (evaporation and on-site reuse), there will be a reduction in stormwater runoff from the site.

The site is located adjacent to Seelems Creek. Seelems creek discharges into the Richmond River approximately 6km downstream of the site, south of the township of Coraki. Refer to Attachment F of Attachment 8 for the waterways adjacent to the site. The quarry and associated infrastructure will be above the 100 year ARI flood level (10m AHD). Sedimentation Basin 1.1 extends approximately 20m into the Seelems Creek floodplain fringe of an extensive floodplain (approximately 1,600 m wide) on the western site boundary. It is anticipated that this may have impacts on flood levels in the immediate vicinity of the basin only. The basin will be designed so that the impact on the floodplain is minimised. As there is no external infrastructure adjacent to, or upstream of Sedimentation Basin 1.1, any minor impact that the basin may have on flood levels is not likely to affect any properties.

With the proposed surface water management strategy, there will be no significant impact on water quality and quantity as a result of the development.

7.8.5 Soil and water management plan

During the construction and operational phase of the quarry development, a large amount of soil has the potential to be eroded and deposited onto nearby lands or downstream receiving environments. To minimise that potential impacts of land disturbances from the development, a Soil and Water Management Plan has been prepared based on Managing Urban Stormwater Soils and Construction: Volume 1 (Blue Book) and Volume 2E (Mines & Quarries).

7.8.6 Sizing of sediment basins

All on-site sedimentation basins have been sized in accordance with the guidelines set out in Managing Urban Stormwater Soils and Construction: Volume 1 (Blue Book) and Volume 2E (Mines & Quarries). In the absence of site specific soil data, information on the likely soil type has been sourced from the Lismore-Ballina Soil Landscape section of the Blue Book (Appendix C – Table C2) for Coraki (Ck). Conservatively, the assessment undertaken in Attachment 8 adopted a soil type for the project as ‘Type F’ (bulk of soil is fine grained with 33% finer than 0.02mm). The total volume of a ‘Type F’ sediment basin is the sum of the following two components:

- A settling zone, within which water is stored allowing the settlement of suspended sediment, and
- A sediment storage zone, where deposited sediment is stored until the basin is cleaned out.

The settling zone volume is determined from the 90th percentile, 5 day rainfall event as per Table 6.1 in the Mines and Quarries book. This is the minimum design requirement for a 'Type F' sedimentation basin for quarries with a disturbance duration greater 3 years.

As outlined in the water balance modelling in Section 2.3 of Attachment 8, the sedimentation basins designed for the 90th percentile, 5 day rainfall event overflow with a higher frequency than that outline in Table 6.2 in Volume 2E of the Mines and Quarries manual. An additional 2 water balance modelling scenarios (Scenarios 3 and 4) were investigated where the design rainfall event was increased to the 95th percentile, 5 day event.

The design rainfall depth has been taken from the closest site rainfall depth chart in the Blue Book (Table 6.3a). The Lismore (058037) 90th percentile, 5 day rainfall depth is 60.2 mm and the 95th percentile, 5 day rainfall depth is 95.3 mm. The volumetric runoff coefficient (Cv) adopted for the site was 0.74. This value is higher than that recommended in Table F3 (Appendix F of the Blue Book) for the expected soil type at Coraki for disturbed sites (upper limit Cv for Coraki of 0.48). The adopted Cv is reflective of the disturbance activity (quarrying) and the type of quarry material which will result in a high runoff potential from the site. Contributing catchment areas to each sedimentation basin are provided in Attachment A of Attachment 8 for both the initial and final extraction stages. The sediment storage zone is taken as either the:

- 50% of the settling zone capacity, or
- Two months soil loss as calculated with the Revised Universal Soil Loss Equation (RUSLE).

It was found that 50% of the settling zone capacity yields a larger storage volume for each sedimentation basin and was therefore adopted for calculating the total sediment storage volume. Clear water diversion bunds are to be located near the western site boundary to divert clean water around the site. This clean water diversion helps to minimise the required onsite sediment basin size. Refer to Attachment B of Attachment 8 for sediment basin volume calculations for individual catchments. The final sedimentation basin volumes are subject to detailed design of the development.

7.8.7 Site water balance

A detailed site water balance was undertaken to assess the overall site surface water management system and to quantify the volume and frequency of discharges from the site. Daily rainfall data was extracted from the Bureau of Meteorology's website for Coraki (Union Street rain gauge – 058015). The station has daily rainfall readings from 1895 to 2015. The mean rainfall for Coraki is 1263 mm/year. Evaporation data was extracted from the nearest pan evaporation gauge at the Alstonville Fruit Research Station (058131), approximately 20km away from the site. Four scenarios were investigated for the site water balance:

- Scenario 1 - Sedimentation basins sized to capture the 90th percentile, 5 day rainfall event (the minimum required rainfall depth specified in Section 2.2.2)
- Scenario 2 - Sedimentation basins sized to capture the 90th percentile, 5 day rainfall event (the minimum required rainfall depth specified in Section 2.2.2) and increasing site water reuse to reduce outflow event frequency and volumes
- Scenario 3 - Sedimentation basins sized to capture the 95th percentile, 5 day rainfall event (above the required rainfall depth specified in Section 2.2.2)
- Scenario 4 - Sedimentation basins sized to capture the 95th percentile, 5 day rainfall event (above the required rainfall depth specified in Section 2.2.2) and increasing site water reuse to reduce outflow event frequency and volumes

Scenario 4 was adopted following analysis. Refer to Attachment E of Attachment 8 for detailed calculations from the site water balance modelling. Each scenario has a dust suppression rate of 2 l/m2/hour. This dust suppression rate was applied to all roads within the site. The quarry is expected to operate 6 days a week for 13 hours per day. Total road length has been delineated for both the initial and final extraction stage. For scenario 2 and 4, an additional external irrigation area was identified. This potential irrigation area is identified in Attachment A. An irrigation rate of 4 l/m2/hour was estimated. It is proposed to operate the external irrigation system for the same duration as the operation of the quarry. The area identified is approximately 18.25 ha. Irrigation water is supplied from Sedimentation Basins 1, 2 and 3.

The water balance includes dosing and discharge of treated water. It is assumed that immediately after a rain event in each scenario, the basins will be dosed (with an appropriate dosing agent). After 4 days of residence time, the basin is lowered (either by gravity or pump) to allow the 90th percentile, 5 day storm volume to remain free in each basin. If a rain event occurs within the 4 day period after dosing, the water will not be released until further dosing is completed following the subsequent rainfall event. Remaining water in the sediment storage zone may be used for on-site dust suppression. As per Table 6.2 in Volume 2E of the Mines and Quarries manual, the indicative average annual sediment basin overflow frequency is 2 to 4 spills per year. For Scenario 4 the average number of overflow events is 2 times per year. This is equivalent to the spill frequency identified within the Managing Urban Stormwater Soils and Construction: Volume 2E (Mines & Quarries). Overflows from the sedimentation basins are, on average, preceded by a 5 day rainfall total of 153.9mm.

7.8.8 Monitoring

The stormwater controls nominated will require regular monitoring and review to ensure that performance accords with design criteria and also reflects the dynamic nature and changing needs of the operation.

Monitoring of surface water or groundwater will be undertaken in accordance with the Approved Methods for the Sampling and Analysis of Water Pollutants in NSW (DECCW, 2004). The Quarry Manager shall carry out monthly surveillance of on site water storages and treatment systems. Inspection of site water storages and treatment systems shall also be carried out by the Quarry Manager immediately prior to anticipated runoff-producing rainfall and as soon as practicable following the event. Monitoring will consist primarily of visual inspection of the site, particularly with regards to erosion control structures during storm events and/or extended periods of heavy rain. Observations of the performance of the various components of the system will be made and ameliorative action taken to rectify underperformance. The Quarry Manager may engage the services of a suitably qualified person to conduct any water quality sampling and review monitoring results required to provide advice in relation to the water quality management if a complaint is received or requested by the administering authority. A summary schedule of the various inspections, performance criteria and responses that shall be performed on-site is shown in Table 2 – Action Plan for the Surveillance and Maintenance of Stormwater Control Devices of Attachment 2 and shown below for ease of reference.

Inspection	Minimum Frequency	Performance Criteria	Response
Inspect drainage lines including catch drains, contour drains and diversions	Quarterly	· erosion in areas adjacent to water conveyancing structures · overtopping of water conveyancing structures (identified by the scouring of the drain batters perpendicular to the direction of flow)	· eroded areas shall be treated appropriately (e.g. rock lined) as soon as practicable · drains to be cleaned of sediments and retreated as necessary to original design specifications · revegetation with grasses in the catchment of the drain may be required to reduce sediment loadings of runoff
Inspect potential sediment storage capacity of grit traps, sediment traps and excavation pit	Quarterly or following major rainfall events	· storage capacity maintained	· sediment to be removed from the structure and reused on site where possible · recycle sediment basin waters to ensure adequate free storage is maintained for the collection and holding of runoff
Waste containers	Quarterly	· waste to be stored in appropriate containers	· Ensure waste materials are stored and disposed of properly
Spill response stations	Quarterly and following use	· equipment to be properly maintained and stocked	· maintain equipment · replace / restock equipment as necessary
Maintenance / refuelling area	Quarterly	· fuel, oil spills · contractor maintenance · fuel storage integrity maintained	· clean up spills and the investigate spill source · maintain contractor maintenance records · investigate and repair potential leaks

7.9 Groundwater

The Petersons Quarry has been in operation since 1916 and has established a pit floor at RL 18m AHD. Resource investigations conducted in 2015 including percussion drilling of 12 holes and diamond core drilling of 5 holes (refer Attachment 9) did not encounter groundwater despite penetrating through the basalt resource into the underlying clay and sandstone layers. There is no evidence of groundwater seepage into the Petersons Quarry pit. There is also no evidence to indicate past quarry operations have encountered groundwater seepage into the Petersons Quarry pit.

It is anticipated that any local groundwater table is contained within the underlying clay and sandstone layers. It is proposed to limit the extraction depth on Lot 401 to retain a floor of basalt separating the project operations from those layers. This is consistent with the approach adopted for the Petersons Quarry which, as discussed above, shows no evidence of groundwater intrusion. Accordingly, it is considered unlikely that the project will encounter or impact upon groundwater individually or on a cumulative basis with Petersons Quarry.

Whilst it is unlikely that the project will encounter or impact upon groundwater, ongoing surface water monitoring in accordance with the anticipated requirements of the EPL for the project will serve to indicate any potential for impact through changes to water quality results. If it is suspected that the project is encountering groundwater based on observation of groundwater inflow or water quality monitoring results a hydrological investigation would be undertaken.

7.10 Visual Amenity

The project is located in a predominately rural setting. The rural landscape has been largely cleared of vegetation. The surrounding rural land utilised primarily for cattle grazing is considered to provide vistas of moderate scenic quality. The Petersons Quarry has been in operation since 1916 and is part of the landscape.

The Petersons Quarry has been developed in a manner which retains the leading edge of Spring Hill to screen the operations of the quarry from the surrounding area to the greatest practicable extent. The project has been designed to extract the resource from Lot 401 in the same manner has adopted by the Petersons Quarry. Spring Hill is limited in elevation and well established mature trees are located on its lower slopes providing a screen to operations being conducted on the upper elevations of the hill. An industrial facility is located immediately to the South of the project and is visible from Lagoon Road and Seelems Road.

The potential impact of the project on the visual amenity of the surrounding land is informed by the assessment of views from 6 representative locations around the project as shown below in Figure 32 Visual assessment and Plate 12 to 17 below. The only change between the initial and final extraction stage is the extent of the pit on Lot 401 which is shielded by the leading edge of the hill. Accordingly, there is no need to consider visual amenity impacts for each stage.

The project is located directly adjacent to and including land associated with the Petersons Quarry. The proposed extraction area for the project has been designed to extend from the existing Petersons Quarry pit to maximise topographical screening as a design measure to mitigate potential noise, dust and visual impacts. Stockpiling will occur in elevated locations on the top of Spring Hill associated with the Petersons Quarry and also the western portion of Lot 401. Elevated areas of Spring Hill are currently used for stockpiling for the existing Petersons Quarry. As such, for the life of the project it will appear as a single operating quarry when viewed from the surrounding landscape with the extraction, stockpiling and processing for the Petersons Quarry and the project occurring in tandem.

As the hours of operation will be restricted to 6am to 7pm Monday to Saturday no extended night works are proposed and therefore lighting impacts outside of operating hours are likely to be limited to the minimum necessary for security lighting. Accordingly, between 10pm and 6am it is anticipated that artificial lighting within the overall site will be directed and shielded to achieve compliance with the parameters for the control of obtrusive light given in Table 2.1 of Australian Standard AS 4282 (1997) Control of Obtrusive Effects of Outdoor Lighting.

Figure 32 Visual assessment

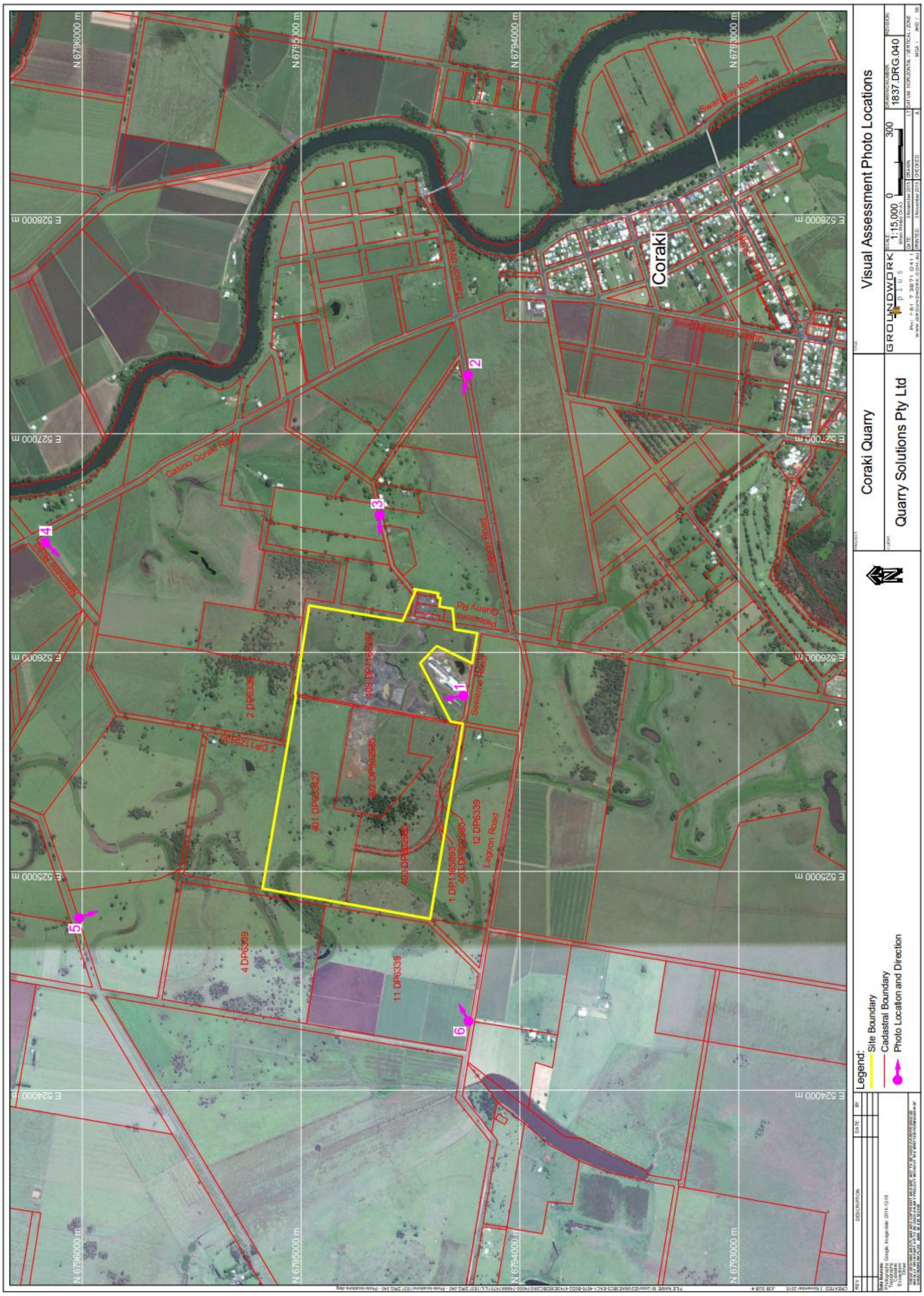


Plate 12 Location 1 Seelems Road

As shown in Plate 12 above, the visual amenity of Seelems Road is impacted by the existing industrial facility. Existing vegetation on the slope of the hill will be retained and provide a screen to the stockpiling area proposed to be establish on the top of the hill. Stockpiling activities will be further screened from view by the proposed earthen noise bunds ('screen 2' described in Attachment 6) to be established along the crest of the hill behind the existing vegetation. Accordingly, only limited views of the project will be afforded from Seelems Road.

Plate 13 Location 2 Lagoon Road (east)

As shown in Plate 13 views of the project are not available from Lagoon Road due to the intervening hill immediately to the east of the where the weighbridge and site office will be located.

Plate 14 Location 3 Spring Hill Road

Plate 14 above is taken from the road reserve of Spring Hill Road and shows the visibility of the existing Petersons Quarry which include a small area of the active pit and also stockpiling occurring on the cleared plateau of the hill. Visibility is partially screened by intervening vegetation which is to be retained. Lot 401 can currently be seen as a cleared grassy plateau of the hill. This area will also be used for stockpiling in the initial stages of the project. However, the proposed earthen noise bunds ('screen 6' described in Attachment 6) will be established on the crest of the hill and screen the areas to be utilised for stockpiling and extraction within Lot 401. Plate 15 below is taken from the road reserve of Newmans Road to the north east of the site. The cleared grassy plateau on Lot 401 can be seen but is partially screened by the existing vegetation on the lower slope of the hill which will not be impacted by the project. Visibility of the project within Lot 401 will be further diminished by the proposed earthen noise bunds ('screen 1', 4 and 6 as described in Attachment 6).

Plate 15 Location 4 Newmans Road

Plate 16 Location 5 Reynolds Road

Plate 16 above is taken from the road reserve of Reynolds Road to the north west of the site. The detached house on Lot 4 DP6339 is visible in the left of the image. The cleared grass slope of the western slope of Lot 401 and the top of the plateau can be seen in Plate 16 which corresponds to the proposed stockpile area located on Lot 401. Views of the proposed stockpile area would be minimised through the proposed earthen noise bund (‘screen 1’ as described in Attachment 6.

Plate 17 Location 6 Lagoon Road (west)

Plate 17 above is taken from the road reserve of Lagoon Road to the west of the site. The existing vegetation on the western slope of Lot 402 DP802985 can be seen. This vegetation is to be retained and will assist in screening the project from the west. The western slope of Lot 401 is visible from this location which corresponds with the western stockpiling area. Whilst this area will be visible it is relatively low in elevation and will only impact on a limited extent of the views from this location. The southern most portion of the proposed stockpiling area on Lot 402 DP802985 will be visible from this location as the density of the existing vegetation is less in that area. However, the proposed earthen noise bund ('screen 2' described in Attachment 6) will minimise the visibility of that area.

Accordingly, based on the above representative locations it is considered that the visual impacts of the project are low due to the design of the extraction area as an extension of the existing Petersons Quarry pit and screening provided by existing vegetation on site and surrounding land which will not be impacted by the project.

It is also noted that the life time of a typical quarry is greater than 30 years and therefore any visual impacts remain in the landscape for an extended period of time. In comparison the project life of only 7 years is short and will see any residual visual amenity impacts resolved in a shorter time period than what would ordinarily be experienced for a typical quarry.

7.11 Rehabilitation

Rehabilitation is an essential component of quarry planning and development. Good planning prior to the commencement of quarrying greatly assists in the management of environmental impacts and provides for efficient operations.

A review of the rehabilitation obligations for the Petersons Quarry was undertaken as part of the preparation of the EIS and it was identified that the consent and EPL outline limited requirements for rehabilitation due to the age of the approvals. It has also be noted that after the life of the project a substantial amount of resource will remain within Petersons Quarry and it is anticipated that it will continue for an extended time period beyond the life of this project. Accordingly, for the purposes of this project, rehabilitation should be considered separately to the future rehabilitation obligations of Petersons Quarry.

A detailed rehabilitation management plan has been prepared as part of the EMP (refer Attachment 2). The rehabilitation management plan has been prepared to guide planning, landforming, revegetation, maintenance and environmental management associated with land disturbed by extraction activities at the site. Extractive industry is a temporary land use. Designing and implementation of rehabilitation works is therefore an important element of an extractive industry. Integration of rehabilitation and extractive operations assists in cost control as well as minimising potential environmental impacts. Potential impacts resulting from extractive industry include:

- Soil erosion
- Pollution of storm water run off
- Sedimentation of waterways
- Increased nutrient loads in waterways
- Introduction of weed species
- Potential clearing of vegetation
- Potential loss of habitat and biodiversity.

The rehabilitation management plan is relevant only to Lot 401, as the existing Petersons Quarry will remain as an operational quarry. It is also noted that the access road on Lot 403 DP 802985 will remain as an access road to Lot 401 and will not require rehabilitation.

The program for implementing rehabilitation works for quarries primarily depends on the rate at which terminal benches are reached. As the expected operating life of the project is only five (5) to seven (7) years (subject to the duration of the upgrade works to the Pacific Highway), rehabilitation works will not be undertaken until terminal benches and floors are reached within Lot 401 and the resource is exhausted. As previously identified the existing Petersons Quarry will continue operation beyond the life of the project. Therefore land associated with the Petersons Quarry shall not be rehabilitated at the completion of the project. Accordingly, rehabilitation will be limited to disturbed areas on Lot 401 only and not include benches and other disturbed areas within Petersons Quarry.

Significant rehabilitation work is not anticipated at the end of the project because the processing plant, weighbridge, site office, workshop and other activities are located outside Lot 401 and within land associated with the existing Petersons Quarry. Therefore actions such as removal of surface infrastructure, workshops and other buildings and services will not be required. It is noted that as the overburden depth is shallow, the project will not result in large overburden dumps. Overburden will be utilised on site for establishment of stormwater controls, stockpile pads and potentially blended with the high quality basalt resource during the crushing and screening process to create saleable product.

Lot 401 has been historically used for grazing. The final rehabilitated land form shall be compatible with the historical land use (e.g. grazing) in the short term, resulting in pasture grasses over large flat floors which will be suitable for long term redevelopment options, potentially for industrial uses, subject to further strategic planning by Richmond Valley Council. Accordingly, it is considered that the final landform should comprise of grassed gently sloping free draining platforms with any remaining sediment basins converted into a water reservoir for stock watering purposes. Rehabilitation management measures are included in the EMP.

This final landform is consistent with the key principles of the *Strategic Framework for Mine Closure* as it:

- Provides a safe, stable and self-sustaining final landform compatible with the intended final land use;
- Reduces the need for long term monitoring and maintenance by achieving a rehabilitation outcome that will be quickly established and completed after the project ceases;
- Achieves a sustainable plant cover which will protect against potential sediment and erosion impacts; and
- Does not prevent the continued operation of the Petersons Quarry.

Preliminary closure and rehabilitation completion criteria for the project should include the following:

- Rehabilitation areas are free of any contamination and hazardous materials, grassed and sediment basins converted into stock watering dams;
- Terminal faces are assessed by a suitably qualified expert as being safe and stable;
- Runoff water quality from the site does not pose a threat to downstream water quality and there is no evidence of erosion from rehabilitation areas; and
- There are no significant weed infestations.

The following performance targets and completion criteria will be adopted:

- Return the site to a safe, stable, non-polluting state, suitable for reinstatement of previous land use (i.e. rural – cattle grazing).
- Maintain the general amenity (visual, air quality, water quality, etc.) of the surrounding area.
- Prevent the degradation of non-operational areas.
- Limit land disturbance to that which is necessary at any one time.
- Identify any land contamination and implement appropriate remediation or management where necessary.
- Ensure progressive rehabilitation is carried out during the progression of quarry activities where practicable and commence progressive rehabilitation as areas become available.
- Select suitable plant species for revegetation.
- Reinstate stable drainage patterns.
- Prevent the introduction or spread of declared weeds and pest species.

Strategies and mitigation measures to achieve the performance targets include the following.

Rehabilitation Staging

The staging of the rehabilitation works will follow the sequence of quarry development as terminal benches are reached. The terminal benches on the southern side of Lot 401 will ultimately be subsumed by the eastwards extension of the Petersons Quarry on Lot 402 DP802985 hence will not require rehabilitation. There will remain a wall, but no benches, on the northern side of Lot 401, hence no benches in this area of the quarry requiring rehabilitation. The western benches of Lot 401 represent the western edge of development which will be achieved at the end of the life of the project. These benches will therefore be rehabilitated at the end of the Project life.

Final Land Use

The following measures shall ensure that the landform created by extraction activities is stable and is connected into the surrounding landscape:

- Using earthmoving equipment to progressively shape and trim the workings to the desired design profiles and flattening the gradients of selective batters to a stable angle of repose on reaching the terminal limits of extraction.
- Rounding or marrying the contours into the natural ground surface.
- Scaling down loose rock.
- Topsoiling and grassing of contours.
- Providing access to the terminal workings to allow maintenance of rehabilitation works.
- Designing landform and drainage to control erosion for the particular hydrological regime.
- Where necessary, planting media should be spread and shaped over selected rock faces and topsoiled to assist in retaining precipitation and controlling sediment movement.

Terminal quarry benches shall be battered to varying slopes depending on the geotechnical properties of the substrate.

Once quarry operations are completed, the extraction floor will be contoured to a gentle grade to establish a free draining platform. The area will be covered in topsoil to a suitable depth and seeded with paddock grass species to return the land to its current use of cattle grazing.

The stock dam to be developed as a sediment dam on the western extremity of the site adjacent to the Indigenous Heritage Non-Disturbance Zone will remain after the cessation of the Project as a stock dam and not require rehabilitation.

Topsoil Management

Topsoil and any overburden / remaining extracted material on site will be used as part of the rehabilitation of the final landform. Topsoil supports and promotes plant growth, soil micro-organisms, organic matter and nutrients. Topsoil is defined as the organic rich, friable layer beneath the natural ground surface. The physical properties of topsoil are important for promoting and supporting plant growth. The following measures should be implemented for topsoil stripping:

- Topsoil should not be stripped when it is too wet or too dry.
- Topsoil when stripped should be used directly for rehabilitation to the maximum practicable extent, or stockpiled and preserved for future use.
- Stockpiling of topsoil should not exceed a height of 2 to 3 m and should be shaped (i.e. batters no greater than 2:1) and revegetated to protect the soil from erosion and weed infestation.
- Stockpiles should be maintained in a free draining condition and long-term soil saturation should be avoided.
- Runoff waters external to the areas to be stripped should be diverted away from the working area.
- Stripping of topsoil should be limited to the minimum area necessary.

The following measures should be implemented for topsoil spreading:

- Whenever possible, stripped topsoil should be directly placed on an area undergoing rehabilitation.
- Areas to be topsoiled should be re-shaped prior to placing topsoil.
- Equipment used to spread topsoil should be scheduled to avoid compaction.
- Before respreading the topsoil, loosen the subsoil to break up any compacted or surface sealing and to enable keying of the two (2) soils.
- On slopes less than 3:1, loosen lightly compacted subsoil with a tined implement ensuring all ripping operations occur along the contour.
- Topsoil is to be removed from stockpiles in a manner that avoids vehicles travelling over the stockpiles.

- Topsoil is to be respread in the reverse sequence to its removal so that the original upper soil layer is returned to the surface to re-establish the entrapped seed content of the soil.
- Ensure all exposed subsoils are covered.
- Topsoil is to be respread over selected batters, contours, bunds and disturbed areas to a minimum thickness of 100 mm.
- After spreading topsoil, ensure the surface is left in a roughened state to assist moisture infiltration and inhibit soil erosion.
- Prior to any planting, cultivate any compacted or crusted topsoil surfaces.
- Soil spreading is to be immediately followed by seeding or planting if applicable.
- Straw or organic mulch may be spread over the soil to minimise potential soil erosion until the area is revegetated.
- If erosion occurs on treated surfaces, the area is to be re-topsoiled and sown with cover grass.

Revegetation

There are a range of methods for establishing vegetation that may include; natural regeneration, hydro-mulching, seed broadcasting, seedling planting and direct seeding. Natural regeneration followed by seed broadcasting shall be the preferred method of establishing vegetation. All methods shall be accompanied by appropriate weed control to prevent rehabilitated areas from being overrun with weed species. The quarry floor and former stockpile areas will be revegetated using suitable pasture species in order to return the area to its current use of cattle grazing.

Weed and Pest Control

Any materials (e.g. earth, soil, mulch and straw) brought onto the site for rehabilitation shall be inspected to ensure the materials are free from weeds and pests. Prior to the establishment of vegetation, a spraying campaign may be required to control weeds to prevent migration of weed species into areas under rehabilitation. Alternative methods for controlling both grass and weeds include manual weeding, slashing, weed matting and mulching. Predation (e.g. grazing animals, birds, kangaroos, hares, and insects) are risks for revegetation. Depending on the situation, specific measures may be required to protect the works from predation such as fencing, barriers, etc.

Monitoring

Once rehabilitation commences, the Quarry Manager shall undertake a monitoring program to review the ongoing success of the rehabilitation treatment. Rehabilitation measures including landform stability, long-term sediment and erosion controls and revegetation of profiled final land surfaces will be visually monitored by the Quarry Manager and, where relevant, assessed by technical experts to determine the effectiveness of measures implemented. The Quarry Manager may engage a suitably qualified consultant to monitor the establishment of vegetation and land stability. The key parameters to be measured as part of the monitoring program will include:

- Erosion
- Groundcover
- Vegetation species (richness of desired species)
- Weed presence.

The Quarry Manager shall conduct regular inspections of any rehabilitated areas to ensure timely maintenance works are carried out as necessary. Maintenance works may include fertilising, watering, repairs to barriers, guards and plant failure replacements, refer to Table 24.

Table 24 Maintenance Schedule for Revegetation Works

Item	Activity	Frequency
Weed Control		
Site Preparation (where necessary)	Application of herbicide and / or slashing	One (1) treatment at least two (2) weeks prior to seeding / planting
Ongoing Weed Management	Application of herbicide	Suggested biannually or as required
Supplementary Weeding	Application of herbicide	As required

Item	Activity	Frequency
Revegetation Management	Monitor performance and conduct any necessary maintenance	· One month after seeding / seedling planting. · Three (3) months after seeding / seeding planting. · Six (6) months after seeding / seedling planting. · 12 months after seeding / seedling planting. OR · Following significant rainfall events (e.g. >25 mm).
	Replace diseased or dead plants	As necessary following maintenance inspections
	Fertilise (if applicable)	Two (2) months after topsoil spreading or seeding
	Apply mulch (if available)	One-off around plantings
Weed Control		
Site Preparation (where necessary)	Application of herbicide and / or slashing	One (1) treatment at least two (2) weeks prior to seeding / planting
Ongoing Weed Management	Application of herbicide	Suggested biannually or as required
Pasture Management		
Grass Height	Slashing	Biannually until established
Grass Vigour	Fertilise	Annually (if necessary)

7.12 Land Use, Land Forms and Agricultural Suitability

7.12.1 Land use

The site is located at Seelems Road and Petersons Quarry Road, Coraki NSW 2471, including Lot 401 and land associated with the existing Petersons Quarry. The site is located approximately 2.5 kilometres to the north-west of Coraki on the Far North Coast of New South Wales (NSW). Coraki has a population of approximately 2,000 people, situated approximately 720 kilometres north of Sydney and 240 kilometres south of Brisbane.

Land use directly adjacent to the site is rural in nature, predominantly consisting of cattle grazing. The land in the locality has been extensively cleared for grazing purposes. Several farm sheds are scattered on neighbouring properties. Residential development in the vicinity of the site is extremely sparse but includes a number of dwellings to the east on Spring Hill Road, Coraki and also a dwelling to the south on Lagoon Road. The closest residences to the proposed extraction area are located approximately 335 metres to the north, 820 metres to the east and 595 metres to the south of the extraction area. Lot 407 on DP1166287, south of the site, is an existing industrial operation.

Petersons Quarry, owned by Richmond Valley Council and forming part of the land for the project, has been in operation since 1916 supplying crushed basalt for road construction and for private sale. Quarrying operations have been undertaken in response to demand, with operations typically undertaken two (2) or three (3) days of the week. The Petersons Quarry is operated pursuant to Environment Protection Licence (EPL) 3397. The Petersons Quarry will continue operation for the duration of the project and after cessation of the project and rehabilitation of Lot 401.

Specialist assessments have considered the potential impacts to nearby sensitive receptors associated with noise, dust, vibration and traffic and have recommended project specific management measures. Accordingly, it is not anticipated that the project would have a significant detrimental impact on the rural activities conducted on surrounding land.

As identified in Section 7.11 the proposed post extraction land use of Lot 401 is the re-establishment of the historical use of cattle grazing. It is considered that this is the most logical post extraction land use given the proximity of Lot 401 to the Petersons Quarry which would continue operation for the foreseeable future. However, it is noted that the proposed quarry design would establish the pit floor at the same elevation as the existing Petersons Quarry floor ensuring that a large flat land form is established which could be easily adapted for industrial land uses subject to further strategic planning and analysis by Richmond Valley Council.

7.12.2 Land form

The site occurs entirely within the Clarence Lowlands subregion of the South Eastern Queensland - Clarence Lowlands Bioregion, and includes the Lamington Volcanic Slopes, Grafton-Whiporie Basin and Clarence-Richmond Alluvial Plains Mitchell Landscapes.

The site is comprised of locally elevated land which rises above the adjacent floodplains and wetlands. Spring Hill is located in the western section of Lot 402, with a high point of approximately RL 47 m AHD. Seelems Creek meanders across the western portion of the study area as a series of ox-bow wetlands. The topography of the surrounding area is predominantly low relief, flood prone, alluvial plains.

The Richmond River is located approximately 1.7 km to the east. Kennedys Swamp lies to the north and occupies the area north of the 5m contour line within Lot 408. Kennedys Swamp has an approximate catchment area of 200ha and is bounded by the Casino – Coraki Road to the east, Newmans Road to the north and Spring Hill to the south and west. Surface runoff from the eastern slopes of Spring Hill flow east into the existing quarry and are then directed north through a small sediment retention basin into Kennedys Swamp.

The topography of the site, which includes the Petersons Quarry has been modified since the commencement of the Petersons Quarry in 1916. The existing Petersons Quarry has resulted in two areas of extraction. Firstly, an early area of extraction within which the site office, weighbridge, staff and visitor carparking areas are located directly off Petersons Quarry Road. Secondly, the primary pit within Lot 408 DP1166287 which is also extending into Lot 402 DP802985.

The project will utilise the land associated with the existing Petersons Quarry to commence initial extraction into Lot 401 from the existing pit on Lot 408. This design takes advantage of the existing topographic buffers established by the Petersons Quarry. The project will proceed at the same depth as the existing Petersons Quarry so that the same pit floor level is established. Accordingly, the project is considered to be a logical progression of the existing extractive industry activities on the site and will result in a post extraction land use suitable for recommencement of the previous rural land use (cattle grazing).

7.12.3 Acid sulfate soils

The site is predominately mapped as containing Class 5 (lowest risk of containing acid sulfate soil (refer Figure 6 and Drawing No. 1837.DRG.021R1 Acid Sulfate Soil Mapping). The proposed extraction area is limited to the portion of the site mapped as Class 5. As previously noted the LEP states that, assessable development includes development on land mapped as ‘Class 5’, involving works within 500 metres of adjacent Class 1, 2, 3 or 4 land that is below 5m AHD and by which the water table is likely to be lowered below 1m AHD on adjacent Class 1, 2, 3 or 4 land. The proposed development is within 500 metres of land designated as ‘Class 3’ land, however, works will not occur below 5m AHD and the water table is not likely to be lowered as groundwater is not anticipated to be encountered. Resource investigations encountered no groundwater in the extraction area. It is anticipated that any groundwater resides within the underlying clay and sandstone layers, and as it is proposed to retain a floor of basalt, no interaction with groundwater is anticipated. In addition, based on discussions with Council, no groundwater has been intercepted by operations at the adjacent Petersons Quarry. As such, potential acid sulfate soils are not anticipated to be encountered by the project.

7.12.4 Northern Rivers Farmland Protection Project

The importance of agricultural land on the NSW North Coast has been recognised by the Northern Rivers Farmland Protection Project under which the portion of site comprising the basalt resource is mapped as ‘Significant Non-Contiguous Regionally Significant Farmland’ whereas the lower lying portions of the site are mapped as ‘Other Rural Land’.

It is understood Regionally Significant Farmland has the following attributes:

1. Slope generally less than 15%.

2. Consists predominantly of any of the following soil types: Chocolate Soils, Euchrozems Krasnozems, Some Grey, Brown and Red Clays, Black Earths, Chernozems, and Prairie Soils. These soils are groups 4 and 5 in Table 8.2 from Murphy et al. (2000). They are soils of high fertility. Group 4 soils have a high level of fertility in their virgin state which is significantly reduced after only a few years of cultivation. Group 5 soils generally only require treatment with chemical fertilisers after several years of cultivation. Physically, Krasnozems are better than most soils but they have some undesirable chemical features. Australian Soil Classification equivalents are Dermosols, Ferrosols and Vertosols. The above soils are generally characterised by well-developed structure, high fertility and good drainage.
3. Soils are generally deeper than 1 metre.
4. Well drained landscape.
5. Rock outcrop less than 10%.
6. Flood free.
7. Not affected by other constraints/hazards either within the soil landscape or originating in adjoining soil landscapes (eg: run-on, mass movement, localised flooding).

It is considered that Spring Hill has been mapped incorrectly on the basis that whilst the site (including Petersons Quarry) has areas of slope of less than 15%, is flood free and well drained, it does not have soils deeper than 1m with significant rock outcropping and would not be suitable for farming. On this basis, it is considered that the project would not have a significant detrimental impact on the supply of regionally significant farm land.

7.13 Socio-economic

As previously outlined, during the preparation of this EIS, Quarry Solutions has actively engaged with surrounding land owners, residents and local businesses through a coordinated effort of letters and telephone calls followed by face to face meetings. Feedback received during those discussions were recorded by Quarry Solutions staff and was incorporated into the design of the development and proposed management measures. The engagement program was supported by a Community Briefing Paper which communicated key aspects of the project. The primary issue raised by the engagement program included management of the additional truck movements through Coraki.

This EIS includes a range of specialist reports to assess the potential impacts of the project, including those likely to impact upon the local community. The design of the project incorporates a range of mitigation and management measures to address those potential impacts and has been informed by the findings of the specialist reports. The findings of this EIS are that the project will not result in significant impacts to the community particularly when consideration is given to the purpose of the project to supply essential construction materials to the Pacific Highway upgrade project and for a limited time of only 7 years.

Quarry Solutions is committed to engaging with the local community and becoming a member of the local community over the long term. Quarry Solutions is an equal opportunity employer and the Coraki Quarry Project will create a number of new employment opportunities within Quarry Solutions for local residents which will be advertised locally and on-line at the Quarry Solutions website. It is important to note that the employment opportunities will include a range of traineeships for school leavers, and Quarry Solutions looks forward to assisting the next generation of quarry men and women to start their careers in the quarry industry. In addition to local employment opportunities, Quarry Solutions will provide opportunities for educational site visits for local schools and other community groups to learn about the role that quarries play in the construction industry and how the materials which are essential for building roads and houses are produced.

Quarry Solutions anticipate the project will bring direct expenditure in the local economy of up to $1,900,000 per annum for the life of the project. Quarry Solutions anticipate this direct expenditure will incorporate between 8 to 10 jobs locally based job opportunities generating up to $800,000 per annum in wages. Indirect employment will be created in the local region to supply support services to the project, such as food, accommodation, repairs and maintenance, and transport. In addition to this the project will require support services and supplies such as food, cleaning, accommodation, equipment hire, fencing, general hardware supplies, plumbing, repairs and maintenance, fuel, stationery, and transport. The value associated with these supply and service supports will vary depending on the stage of the operation, but they will be up to $700,000 per annum.

Quarry Solutions also anticipate temporary hire of equipment may be required from time to time to meet production peaks if maintenance of plant and equipment reduces the capacity of the fleet on site. Crushing and screening equipment, dump trucks and front end loaders, water trucks , excavators, road haulage trucks and general hire equipment may be required and annual spend will be up to $400,000 subject to production demands and breakdowns requiring replacement equipment.

Richmond Valley Council also hold a Section 94 Heavy Haulage Contribution Plan under which a payment of $1.08 per tonne is required to compensate for pavement impacts likely to be generated on the local road network. Based on the maximum extraction rate of 1,000,000 tonnes per annum this would result in an annual contribution of $1,080,000.

Taking into consideration the anticipated direct expenditure in the local economy of $1,900,000 in addition to the annual Section 94 contribution of $1,080,000 the project will contribute up to $2,980,000 annually to the local area. This direct expenditure combined with the overall the socio-economic and road safety improvements of the Pacific Highway upgrade project to which the project will contribute are predicted to result in a net benefit over the life of the project to the community.

7.14 Hazards

SEPP 33 has been considered as the policy applies to developments that are considered potentially offensive which is considered to be any project which requires an EPL from the EPA. A review of the project has been undertaken to consider whether a Preliminary Hazard Analysis (PHA) is required. The review has considered the criteria for hazardous material storage quantities outlined in Table 3 of the SEPP 33 guideline (Department of Planning 2011a). Quarry Solutions have advised that the project will not store more than the threshold amounts and that diesel fuel will not be stored with Class 3 flammable liquids. It is also understood that the site will not have an explosives storage magazine or on-site storage of Class 5.1 ammonium nitrate suspension. Based on this information, the development is not considered potentially hazardous.

The review has also considered the criteria outlined in Table 2 of the SEPP 33 guideline in relation to transportation of dangerous goods. It is anticipated that the project will require Class 5.1 (III) ammonium nitrate suspension as an explosive pre-cursor. Deliveries of the product may occur in single bulk delivery above the 2 tonne threshold. However, it should be noted that the same product is currently relied upon for the Petersons Quarry. Nevertheless, the project would therefore be considered a potentially hazardous development with respect to the transport of dangerous goods. Therefore, the project should be assessed against the requirements of the Hazardous Industry Planning Advisory Paper No 11: Route Selection (HIPAP11) (Department of Planning 2011b). The advisory paper directs that a route assessment should consider the following:

- Examination of the road hierarchy and identification of routes for heavy vehicle transportation;
- Elimination of those routes where there are legal or physical constraints, special/sensitive land uses or where there is inadequate emergency access;
- Rating the potential routes on the basis of environment and land use risk factors, traffic factors and economic factors;
- A comparison of each of the route alternatives on the basis of their rating against each of the factors.

In relation to the above, all dangerous goods for the project and the existing Petersons Quarry rely on the proposed project haul route to and from the Pacific Highway at Woodburn. No other route is used and this will not differ as a result of the project. The traffic impact and pavement assessment for the project has confirmed that the proposed project haul route does not require any road or intersection upgrades. Therefore, a detailed transport safety study is not warranted for the continued transport of dangerous goods to the site.

In relation to bushfire hazard, the Richmond Valley Council Bushfire Prone Land Map 2015 identifies the existing patch of vegetation straddling Lot 402 and 403 DP802985 as Bushfire Vegetation Category 2 with a 30m buffer. That vegetation is to be retained and protected for the duration of the project and contained within a Non Disturbance Zone. The stockpile areas adjacent to the vegetation will provide effective fire breaks and act as Asset Protection Zones to project infrastructure. It is noted that buildings associated with the project will not be located in proximity to that vegetation. It is also noted that the project would not constitute a special fire protection purpose as defined by the *Rural*

Fires Act 1997, and therefore would not trigger the need to obtain a bush fire safety authority. Nevertheless, the management measures outlined in the EMP and availability of plant and equipment such as water trucks will assist in mitigating potential bush fire risk.

The principal wastes likely to be generated by the project may include but are not necessarily limited to:

- Classified liquid and non-liquid wastes (e.g. batteries, oil filters, waste oil, hydrocarbons and containers, oil/water emulsions and tyres)
- Metal and used or faulty parts and equipment
- Food scraps, packaging and consumables (e.g. paper, cardboard)
- Green waste.

These wastes are consistent with those already generated by the Petersons Quarry operations and the project will be serviced by a licensed waste contractor. Management measures in relation to wastes are included within the EMP (refer Attachment 2). Accordingly, it is considered that wastes generated by the project are unlikely to have a significant detrimental impact on the environment.

7.15 Cumulative Impacts

Cumulative impacts, relate to the potential interaction of the project and its potential impacts with other activities and land uses in the local area and those potential impacts.

The project is located adjacent to and including land associated with the existing Petersons Quarry which would continue operation for the life of the project and beyond. The project has been designed and assessed as a continuation of the existing Petersons Quarry such that both activities will occur in tandem but managed as a single project by Quarry Solutions.

The project is also located in proximity to an existing industrial facility (manufacture of precast concrete panels) located immediately south of the site but will have limited interaction with the facility.

The project would result in additional extraction of approximately 10.3ha of land above and beyond that anticipated to occur in association with the existing Petersons Quarry. The site is located on land partly zoned RU1 Primary Production, and partly zoned E2 Environmental Conservation. The proposed development is solely located on land zoned RU1. Within the RU1 land zone, an extractive industry is permissible with consent. Therefore, the project is consistent with the zone and intent of the LEP.

As the land associated with the project incorporates the existing and approved extent of the Petersons Quarry consideration must be given to the existing regulatory requirements of the Petersons Quarry. The Petersons Quarry is subject to a consent and EPL of significant age and limited conditions. Accordingly, it is known that the project will be subject to more stringent and comprehensive regulatory requirements and conditions. As a result, to the extent that the Petersons Quarry will continue operation during the life of the project, it will be operated to a standard consistent with the regulatory requirements imposed on the project. This approach will ensure that environmental management and monitoring of the operations of the project will be consistent. In essence, the Petersons Quarry will become part of the day to day operation of the project for the life of the project with the exception that the project will not rely upon the extractive resource within the Petersons Quarry which is to be retained for the future use of the local region and not for supply to the Pacific Highway upgrade project. Adopting this approach to the regulatory requirements of the project is consistent with the assessment of noise, dust, surface water and traffic impacts which have considered the cumulative impacts of the continuation of the Petersons Quarry for the life of the project.

As discussed in previous section cumulative impacts to biodiversity, cultural heritage and surface water have been considered as the project encompasses the existing and approved extent of the Petersons Quarry. By ensuring that the existing and approved extent of the Petersons Quarry is incorporated within the project area the cumulative impacts of vegetation clearing and land disturbance are known, measurable and manageable. Subsequently, the project has been designed to avoid impacts to those values.

As discussed in Section 7.12, cumulative impacts to the capacity of the surrounding land to be used for agriculture has been considered. Lot 401 is currently used for rural activities (cattle grazing) and the project will for the life of the project interrupt that use. However, the proposed rehabilitation objectives for the project will see Lot 401 returned to a post extraction land form suitable for recommencement of rural activities. It is also noted that Lot 401 is only a small land holding when considered in the context of the broader rural landscape. Accordingly, there is not a significant cumulative impact on the capacity of the nearby land to support viable rural activities.

As discussed in Section 7.10 cumulative impacts to visual amenity of the surrounding land are not significant as the Petersons Quarry is an existing feature of the landscape. Potential impacts have been addressed and minimised through design of the project including retention of native vegetation and establishment of noise attenuation bunds which assists in obscuring views of the existing Petersons Quarry and will also assist in obscuring the views of the project.

As discussed in Section 7.3 the assessment of potential traffic impact associated with the project have taken into consideration background traffic associated with the Petersons Quarry and determined that the proposed haul route is suitable in its current form and does not require any upgrades to cater to the project and continued operation of the Petersons Quarry.

In relation to potential noise, dust and vibration emissions which could occur concurrently, the potential impact for each has been considered and is not expected to have an adverse effect on nearby sensitive receptors compliance with the more stringent requirements of the project will be adopted for the Petersons Quarry. This will ensure that the Petersons Quarry and the project are operated in tandem pursuant to the same environmental controls for the life of the project.

7.16 Principles of Ecologically Sustainable Development

The *Protection of the Environment Administration Act 1991* outlines a number of principles of ecologically sustainable development (ESD). These are presented and discussed below in relation to the project.

7.16.1 The precautionary principle

According to the precautionary principle, if there are threats of serious or irreversible environmental damage, lack of full scientific certainty should not be seen as a reason not to protect the environment. The use of the precautionary principle implies that proposals should be carefully evaluated to identify possible impacts and assess the risk of potential consequences.

A sufficient level of scientific certainty in relation to potential project impacts has been achieved through detailed evaluation of all key issues including specialist assessments for biodiversity, traffic, noise, dust and blasting impacts. Conservative worst case analysis have been adopted where there is uncertainty in data used to inform assessments. The assessment process has been guided by a detailed study of the existing environment which has resulted in the project avoiding impacts to areas of environmental significance. The development of mitigation measures and safeguards to manage impacts aims to reduce the risk of serious and irreversible impacts on the environment. Generally, throughout this assessment, there has been found to be a low level of uncertainty in the data relied upon and the findings of the assessment.

7.16.2 Inter-generational equity

The principle of inter-generational equity requires the present generation to ensure that the health, diversity and productivity of the environment are maintained or enhanced for the benefit of future generations. The project would involve the use of finite resources (for the upgrade of the Pacific Highway), and contribute minimally to climate change. The design of the project avoids areas of environmental significance on the site thereby ensuring they are maintained for the benefit of future generations.

7.16.3 Conservation of biological diversity and ecological integrity

Conservation of biological diversity and ecological integrity are a fundamental consideration of ESD. The impacts of the proposal on local populations of threatened species, threatened communities and their habitats have been assessed in detail in this EIS and Attachment 5. The project avoids impacts to areas of environmental significance on the site thereby conserving the biological diversity of species located on the site.

7.16.4 Appropriate valuation of environmental factors

This principle requires that "*costs to the environment should be factored into the economic costs of a project*". This EIS has examined the environmental consequences of the project and identified mitigation measures where there is potential for adverse impacts to occur. Requirements imposed in terms of implementation of these mitigation measures would increase both the capital and operating costs of the proposal. This signifies that environmental resources have been given appropriate valuation.

8. Summary of Commitments

The SEARs for the project required a summary of all proposed environmental management and monitoring measures for the project. Accordingly, if development consent is granted, Quarry Solutions will commit to the following:

Project life

1. The project approval life will be for 7 (seven) years from the date of development consent, subject to the completion of the Pacific Highway upgrade project and noting that closure and rehabilitation activities may extend beyond the 7 (seven) year operational approval period.

Extraction rate

2. The project shall not extract more than 1,000,000 tonnes per annum from the Coraki Quarry, noting that the Coraki Quarry is separate from and in addition to the existing Petersons Quarry annual extraction volumes.

Hours of operation

3. Quarry operations will be undertaken between 6am and 7pm Monday to Saturday.
4. Blasting activities will be undertaken between 9am and 3pm Monday to Friday.
5. No operations will be undertaken on a Sunday or on public holidays.

Environmental management

6. The project will be undertaken in accordance with the EMP (refer Attachment 2). Prior to the commencement of the project the EMP will be updated to reflect relevant conditions of consent and other relevant authorities.

Aboriginal Heritage Management Plan

7. An Aboriginal Heritage Management Plan is to be prepared. Quarry Solutions will carry out the project in accordance with an Aboriginal Heritage Management Plan.
8. The identified Non Disturbance Zones will be protected in situ for the life of the project.

Traffic management

9. Sealing of Seelems Road and the first 200m of the internal access road within Lot 403 DP802985.
10. Implementing and enforcing compliance with a Driver's Code of Conduct.
11. Installation of forward and driver facing cameras on haulage trucks managed by Quarry Solutions.
12. Installation of GPS monitoring devices on haulage trucks managed by Quarry Solutions.
13. Paying for the installation of GPS monitoring devices on all local school buses where permission is provided.
14. Paying the relevant s94 contributions to the Richmond Valley Council.

Biodiversity

15. The measures outlined in the BAAM Biodiversity Assessment Report (refer Attachment 5) will be implemented including, but limited to the following:
    - Implement a 25m buffer to the *Macadamia tetraphylla* located on Lot 401 and the management and monitoring actions identified in Table 4.1 of the Biodiversity Assessment Report.
    - Engage a fauna spotter to inspect the Hoop Pine dry rainforest community for signs of nesting by the Black-necked Stork during May to January (inclusive). If any nesting activity is identified, a species management plan is to be developed and implemented.
    - Restrict disturbance and access to only those areas absolutely necessary for the construction and the operation of the project. Clearly cordon off all adjacent vegetation and buffer extents that are not to be disturbed by the project, creating 'no go zones' for vehicles, materials, machinery, workers, excavated soil or fallen timber.
    - Implement sediment and erosion control measures, including measures to avoid the spill of earth and rock downslope of the quarry footprint into areas of retained vegetation.
    - Ensure a fauna spotter/catcher is present during clearing and site preparation works.
    - Establish 'go slow zones' (40km/hr) for vehicles and machinery where non-gazetted roads or tracks are located adjacent to patches of native vegetation communities.

- Limit construction and operational work to 6am and 7pm Monday to Saturday, and any lighting within outdoor areas should comply with relevant Australian Standards and be of low spillage, with no or limited upward spillage.
- Minimise vehicle and machinery access and subsequent soil compaction and weed transfer risk within and adjacent to retained vegetation.
- Educate the workforce on the location of significant/sensitive communities and species and potential impacts from unauthorised activities.

Noise

16. The noise mitigation measures specified in Section 2.6.2 of the MWA Noise and Dust Assessment (refer Attachment 6) are to be implemented and maintained for the project, including the following:
    - Acoustic screening by way of cut, earth bunds and/or barriers to various locations;
    - Use of a proprietary quietened rock drill; and
    - Operation of the processing plant at the most shielded location and/or implementation of acoustic treatments as necessary to comply with the relevant noise limits.

Dust

17. The dust control measures specified in Section 4.3.3 of the MWA Noise and Dust Assessment (refer Attachment 6) are to be implemented and maintained for the project, including the following:
    - Watering of all haul roads and access roads at a rate of approximately 2 litres/m^2/hour at times when dust emissions are visible from vehicle movements;
    - Sealing (e.g. asphalt) part of the access road off Seelems Road for a minimum length of 200 metres west from the Seelems Road entry point;
    - Use of effective water sprays on the processing plant;
    - Effective water misting sprays to processing plant at transfer points including load-out points from elevated storage bins if utilised;
    - Rock drill to have an appropriate dust extraction system with collector fitted to rig and/or wet drilling via water sprays; and
    - Management of dust emissions from stockpiles during high wind speed conditions through appropriate use of sprinklers and/or chemical suppressant products as required.

Blasting

18. The following blast management measures will be implemented for the project:
    - Establish permanent blast monitoring locations at the two closest neighbouring properties, which are 140 Newmans Road (Lot 4 DP6339) and 200 Lagoon Road (Lot 12 DP6339), Coraki.
    - Start developing a blast vibration equation, specific to the Coraki Quarry. A suitably qualified person should be involved in this process, as using incorrect techniques can add additional cost to blast vibration control;
    - Commence blasting using a maximum of a 12 m bench height and 89 mm blast holes to ensure compliance with airblast overpressure and blast vibration. After 3 blasts, the results can be reviewed and evaluated as to whether 102 mm blast holes should be implemented. The airblast overpressure and blast vibration compliance must be maintained;
    - Establish the recommended Blast Exclusion Zones (BEZ). If required measure the flyrock projection distances from the first 10 blasts and recalibrate the flyrock equations. This will enable optimisation of the BEZ distance. Due to the use of a conservative value for the constant K in the prediction equations it would be expected that the exclusion distance could be reduced, however this must not be taken for granted;
    - All blasts must be face profiled, surveyed and bore tracked to ensure airblast overpressure compliance, combined with the ability to control face burst that can cause flyrock incidents;
    - Blast volumes should be maximised to reduce the frequency of disturbances to the neighbouring properties. A target blast volume of 18,750m^3 and 15 tonnes of bulk explosive load is recommended. Shot sizes should be limited to a maximum of 3 rows deep initially, to minimise vibration reinforcement if utilising a non-electric initiation system. Once actual blast vibration data has been collected and analysed shot sizes may be increased, if the data supports increasing the blast Maximum Instantaneous Charge (MIC) and remaining under 5mm/s;
    - Orientate blasts with free faces not directly facing the sensitive receivers, to assist with airblast overpressure control;

- Initiation sequencing for initial blasts, should target no more than a single blast hole MIC of 88kg until the vibration attenuation can be accurately assessed.
- All proposed parameters are for initial blasting at the site. Once actual blast data is available from blasting at the proposed site, then parameters may be optimised using the analysis techniques outlined in this document. Site specific constant (k value) will require calibration for flyrock, blast vibration and airblast overpressure.

Water

19. The surface water management system and water balance scenario prepared by Calibre Consulting (refer Attachment 8) will be implemented.
20. The project will be operated in accordance with the conditions of the EPL for the project once it is issued by the EPA.

Greenhouse gases and hazards

21. Quarry Solutions will continue to investigate financially practicable initiatives to reduce energy consumption and greenhouse gas emissions.
22. Dangerous goods will be stored in accordance with dangerous goods storage requirements and relevant Australian Standards.

Rehabilitation

23. Upon terminal benches being reached within Lot 401, the areas of disturbance within Lot 401 will be rehabilitated to a safe, stable and non-polluting state, suitable for the recommencement of the previous land use (cattle grazing).
24. Areas of the Petersons Quarry used by the project will be returned to the land owner in a safe and stable state suitable for the continued operation of the Petersons Quarry.

Community engagement

25. Quarry Solutions will operate a free call telephone number for the Coraki Quarry for the life of the project.
26. Quarry Solutions will engage with the community in relation to employment opportunities and traineeships.
27. Quarry Solutions will provide opportunities for educational site visits by local schools and other community groups to visit the quarry.

9. Conclusion and Justification

The proposal by Quarry Solutions Pty Ltd to establish the Coraki Quarry (the project), at Coraki, New South Wales is to be assessed as a State Significant Development pursuant to the *State Environmental Planning Policy (State and Regional Development) 2011* and therefore requires development consent under the *Environmental Planning and Assessment Act 1979*.

The project would extract a maximum of 1,000,000 tonnes per annum, primarily for the planned upgrade of the Woolgoolga to Ballina – Pacific Highway upgrade project (Pacific Highway upgrade) and thereby support and enhance the economic viability of the region. Consent is being sought for a period of 7 years subject to the progress of the Pacific Highway upgrade project and not including the necessary time for completion of any rehabilitation works.

The project has been designed to avoid impacts to the areas of environmental significance on the site where practicable and minimise any remaining potential impacts through appropriate design and management measures. A thorough and comprehensive assessment of existing environmental values and potential environmental impacts have been undertaken. Environmental aspects considered by this EIS include the following:

- Aboriginal and history heritage
- Traffic impacts
- Biodiversity impacts
- Noise, Dust and Blasting impacts
- Surface water management
- Resource characteristics

These matters were subject to detailed specialist assessments which identified project specific mitigation measures to avoid and minimise potential environmental impacts.

Extractive industries are a significant contributor to the material needs of local and regional communities and to economic activity and development. Extractive resources are site specific, limited in occurrence by geological conditions and are finite. Because they are high-volume, low-cost materials, they need to be located close to the communities that use them as the cost of transport to the end user contributes greatly to the overall cost of the delivered product. Extractive resources underpin all urban and infrastructure development and make a major contribution to the ongoing economic growth of the community through direct and indirect employment opportunities.

The NSW Roads and Maritime Services (RMS) identified the construction material requirements for the Pacific Highway upgrade project in the EIS prepared for that project (RMS 2012). Specifically, Section 6.4 of the EIS identified an estimated demand of 1,230,000 tonnes of road base and 1,400,000 tonnes of aggregate. The RMS rightly identified that '*Quarry outputs are restricted by the licence for the facility*' and commented that some materials may need to be sourced from further afield if not available in the required volume locally. As such, there is a known need for the construction materials that can be supplied by the project. Source material testing indicates that the resource is likely to be suitable for use in high quality road base, concrete aggregate, sealing aggregate and asphalt aggregate in accordance with the stringent specification requirements anticipated for the Pacific Highway upgrade project.

The potential environmental impacts of the project have been identified and measures proposed to manage and mitigate those impacts. Therefore, it is considered unlikely that the project would have a significant detrimental impact on the environmental values of the site. The project would provide economic benefits to the local community through additional employment whilst also providing improved material delivery efficiencies to the Pacific Highway upgrade project which will benefit the wider region. Accordingly, it is considered that the proposal is justified and its impacts acceptable subject to the implementation of the management and mitigation measures identified by this EIS and supporting specialist assessments.

10. Declaration

This Environmental Impact Statement provides a true and fair assessment of the proposed Coraki Quarry Project in relation to its potential effects on the environment. It addresses to the fullest extent possible all matters affecting or likely to affect the environment as a result of the proposal. This statement has been prepared in accordance with Schedule 2 of the *Environmental Planning and Assessment Regulation 2000*.

Environmental Impact Statement prepared by
Name: James John Lawler
Qualifications: BBltENV (Urb&RegPlan), GradDip (UrbDes)
Address: 6 Mayneview Street, Milton, QLD 4064

In respect of the proposed Coraki Quarry Project

Proposal
Applicant name: Quarry Solutions Pty Ltd (Quarry Solutions) ABN 13 133 700 848
Applicant address: 24A Ozone Street, Chinderah, NSW, 2487
Land to be developed: As shown in the Environmental Impact Statement (Drawing 1837.027 Conceptual Site Layout Plan).

Environmental Impact Statement
An Environmental Impact Statement is attached.

Certificate
I certify that I have prepared the contents of this Environmental Impact Statement and to the best of my knowledge:

i. the statement has been prepared in accordance with Schedule 2 of the NSW Environmental Planning and Assessment Regulation 2000;
ii. the statement contains all available information that is relevant to the environmental assessment of the development, activity or infrastructure to which the statement relates; and
iii. that the information contained in the statement is neither false nor misleading.

Name: James John Lawler
Date: 4 November, 2015

11. References

Australian and New Zealand Environment and Conservation Council (ANZECC) (1990), *Technical basis for guidelines to minimise annoyance due to blasting overpressure and ground vibration*.

Bureau of Meteorology (2015), *Summary statistics Lismore Airport AWS* (Station No. 058214), Australian Government, Available: http://www.bom.gov.au/climate/averages/tables/cw_058214.shtml.

Charman, P.E.V. & Murphy, B.W. (2000), *Soils: their properties and management*, 2nd ed. Oxford University Press, Melbourne.

Cement Concrete & Aggregates Australia (CCAA) (2015), *A strong foundation for New South Wales' future,* Available: http://www.ccaa.com.au/imis_prod/documents/Library%20Documents/CCAA%20Policy%20Priorities/NSW_Policy_Infrastructure_LR_16.02.15.pdf

Department of the Environment (DoE) (2015), *Australia's bioregions (IBRA)*: dataset, Available: http://www.environment.gov.au/land/nrs/science/ibra

Department of Environment and Climate Change (2008), *Managing Urban Stormwater: Soils and Construction (Volume 2E: Mines and quarries)*, New South Wales Government, Available: http://www.environment.nsw.gov.au/resources/stormwater/08208soilsconststorm2e.pdf.

Department of Environment and Conservation (2005), *Approved methods for the modelling and assessment of air pollutants in New South Wales*, New South Wales (NSW) Government, Available: http://www.epa.nsw.gov.au/resources/air/ammodelling05361.pdf.

Department of Environment, Climate Change and Water (2011), New South Wales (NSW) Government, *NSW Road Noise Policy*, Available: http://www.epa.nsw.gov.au/resources/noise/2011236nswroadnoisepolicy.pdf.

Department of Planning (2011a), *Hazardous and Offensive Development Application Guidelines; Applying SEPP 33*, New South Wales Government, Available: http://d.planning.nsw.gov.au/Portals/0/Applying%20SEPP%2033%20Final%202011.pdf

Department of Planning (2011b), *Hazardous Industry Planning Advisory Paper No 11: Route Selection*, New South Wales Government, Available: http://www.planning.nsw.gov.au/en/Policy-and-Legislation/~/media/D051490C6EE24BAF99BE2A0795418ACE.ashx

Landcom (2004), *Managing Urban Stormwater: Soils and Construction (Volume 1: Blue Book*), ed. 4, New South Wales Government, Available: http://www.environment.nsw.gov.au/resources/water/BlueBookVol1.pdf.

Morand, D. (1994), *Soil Landscapes of the Murwillumbah – Tweed Heads 1:1000000 Sheet Map*, Department of Land and Water Conservation, Sydney.

Office of Environment and Heritage New South Wales (OEH) (2015), *NSW Water Quality and River Flow Objectives*, Available: http://www.environment.nsw.gov.au/ieo/index.htm.

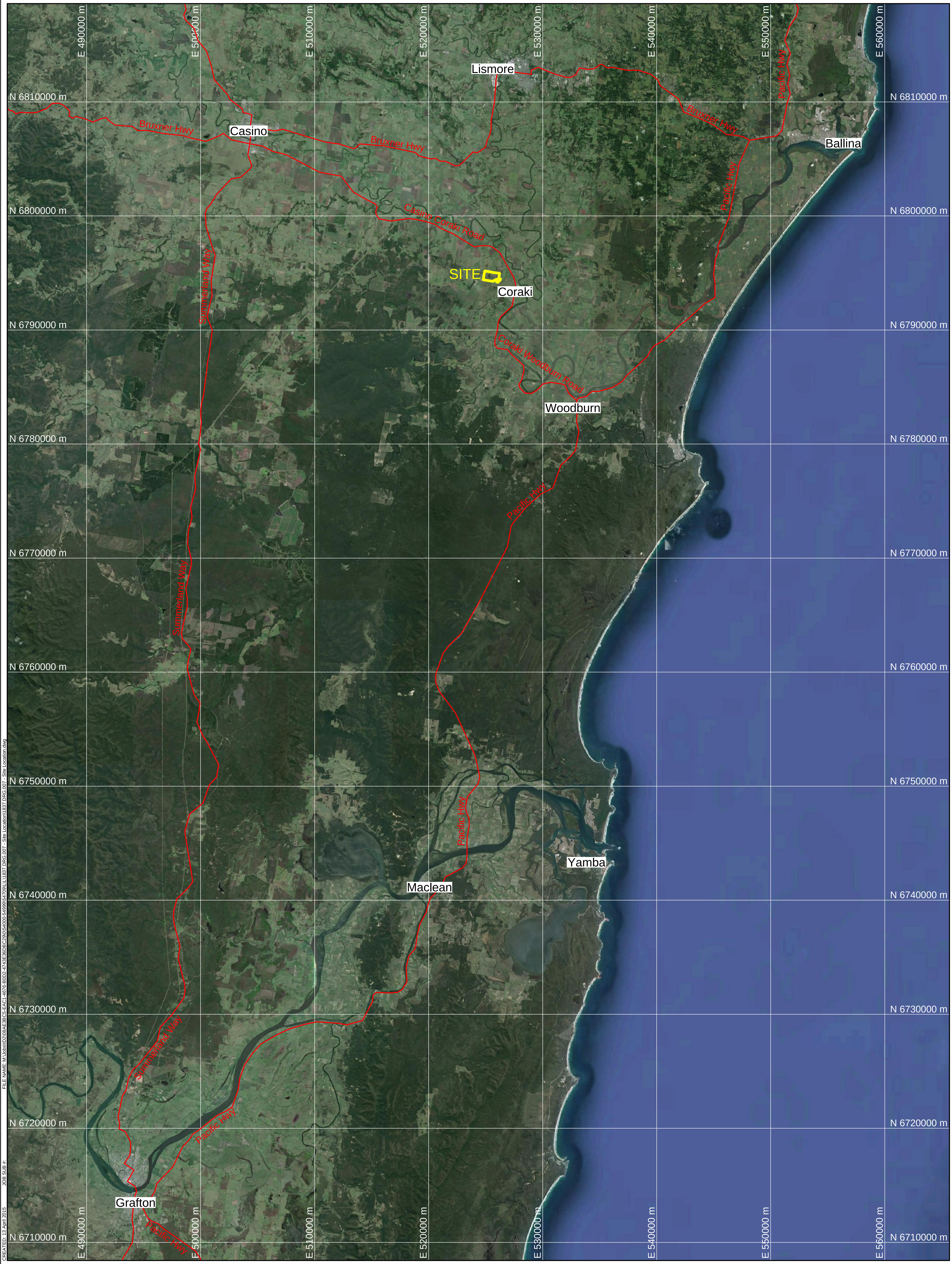
Office of Environment and Heritage New South Wales (OEH) (2015a), *Mitchell Landscapes (version 3)*: dataset. Available: http://mapdata.environment.nsw.gov.au/geonetwork/srv/en/metadata.show?uuid={E8403EB4-C4D5-4AF2-BE49-EF4C31351D1D}.

Richmond Valley Council (RCV) (2013), *Section 94 Heavy Haulage Contributions Plans 2013,* Available: http://www.richmondvalley.nsw.gov.au/content/Document/PlanningAndDevelopment/RVC_S94_Heavy_Haulage_Contributions_Plan_2013.pdf.

Richmond Valley Council (2015), *Richmond Valley Koala Habitat Atlas Derivative Map*, map, Available: http://www.richmondvalley.nsw.gov.au/icms_docs/137671_Richmond_Valley_Koala_Habitat_Atlas_Derivative_Map.pdf

Roads and Maritime Services (RMS) (2012), *Woolgoolga to Ballina Pacific Highway Upgrade Environmental Impact Statement 2012*, Available: http://www.rms.nsw.gov.au/projects/northern-nsw/woolgoolga-to-ballina/project-documents-eis.html.

drawings



CREATED: 13 April 2015

FILE NAME: M:\Jobs\ID2\08AE3BC5-EAC1-4676-B0D2-4743E36DBC29\0\54000-54999\54709\L\L\1837.DRG.007 - Site Location\1837.DRG.007 - Site Location.dwg

JOB SUB #:

REV	DESCRIPTION	DATE	BY
1	Revised site boundary	07/09/15	LT

Data Sources:
Photography: Google. Image date: 2013-04-10
Topography:
Cadastre:
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. ABN: 80 829 145 906

Legend:
🟨 Site Boundary
🟥 Major Road

N

PROJECT:
Coraki Quarry

CLIENT:
Quarry Solutions Pty Ltd

TITLE:
Site Location Plan

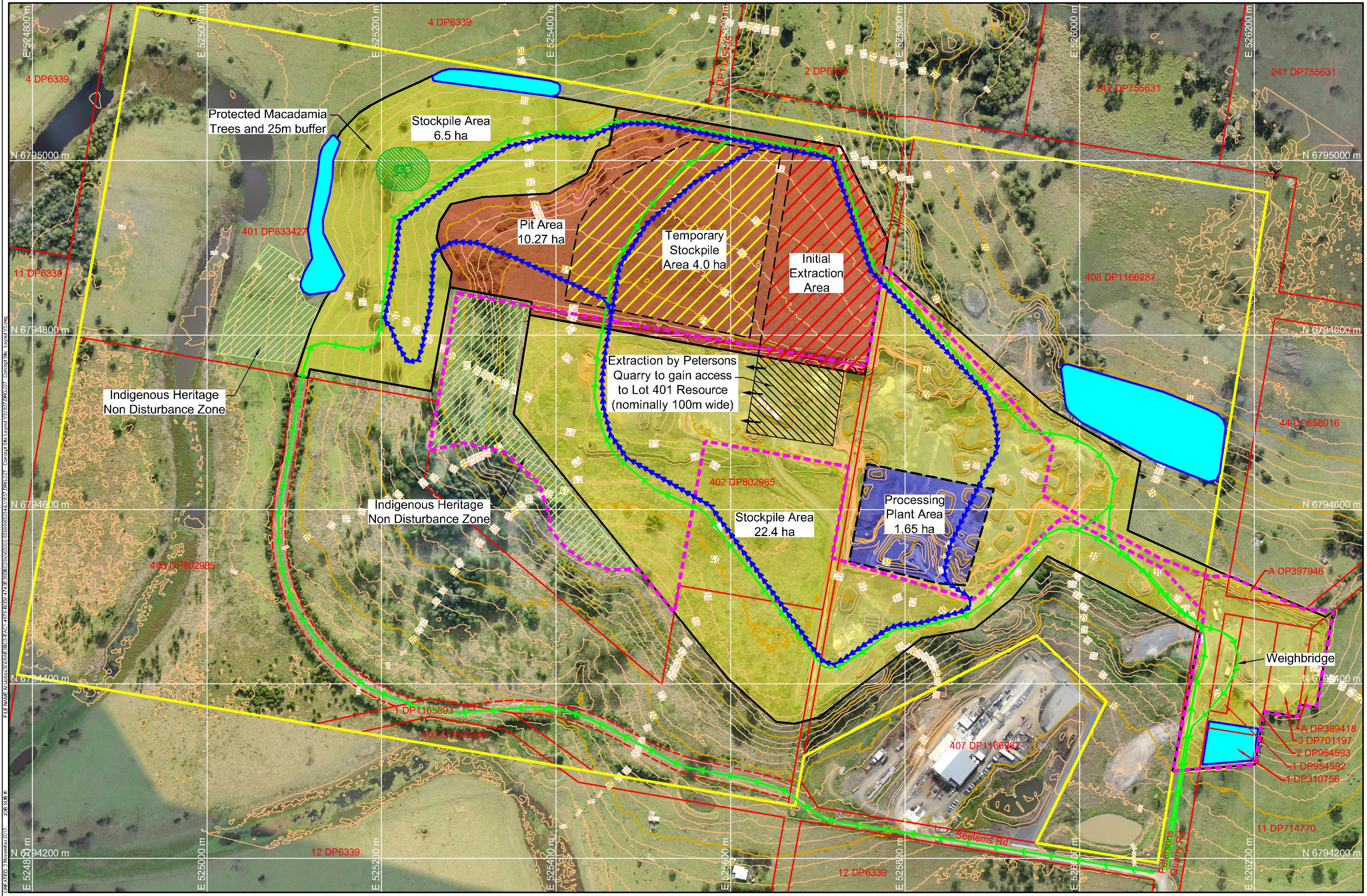
GROUNDWORK plus
PH: +61 7 3871 0411
WWW.GROUNDWORK.COM.AU

SCALE: 1:300,000
When Printed On A3
0 6km

DATE: 7 September 2015
PRINTED: 10 September 2015
DRAWN: LT
CHECKED: JL

DRAWING NUMBER: 1837.DRG.007
REVISION: 1

DATUM: HORIZONTAL / VERTICAL / ZONE
MGA / / 56



REV	DESCRIPTION	DATE	BY

Data Sources:
Photography: UAV Survey 2015-07-02; Google. Image date: 2014-12-18
Topography: UAV Survey 2015-07-02
Cadastre:
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. ABN: 80 829 145 906

Legend:
- Site Boundary
- Cadastral Boundary
- Approved Quarry Expansion Footprint
- On Road Truck Movement
- Off Road Truck Movement
- Sediment Basin (Calibre Consulting, 14/09/2015)

N

PROJECT:
Coraki Quarry

TITLE:
Conceptual Site Layout Plan

CLIENT:
Quarry Solutions Pty Ltd

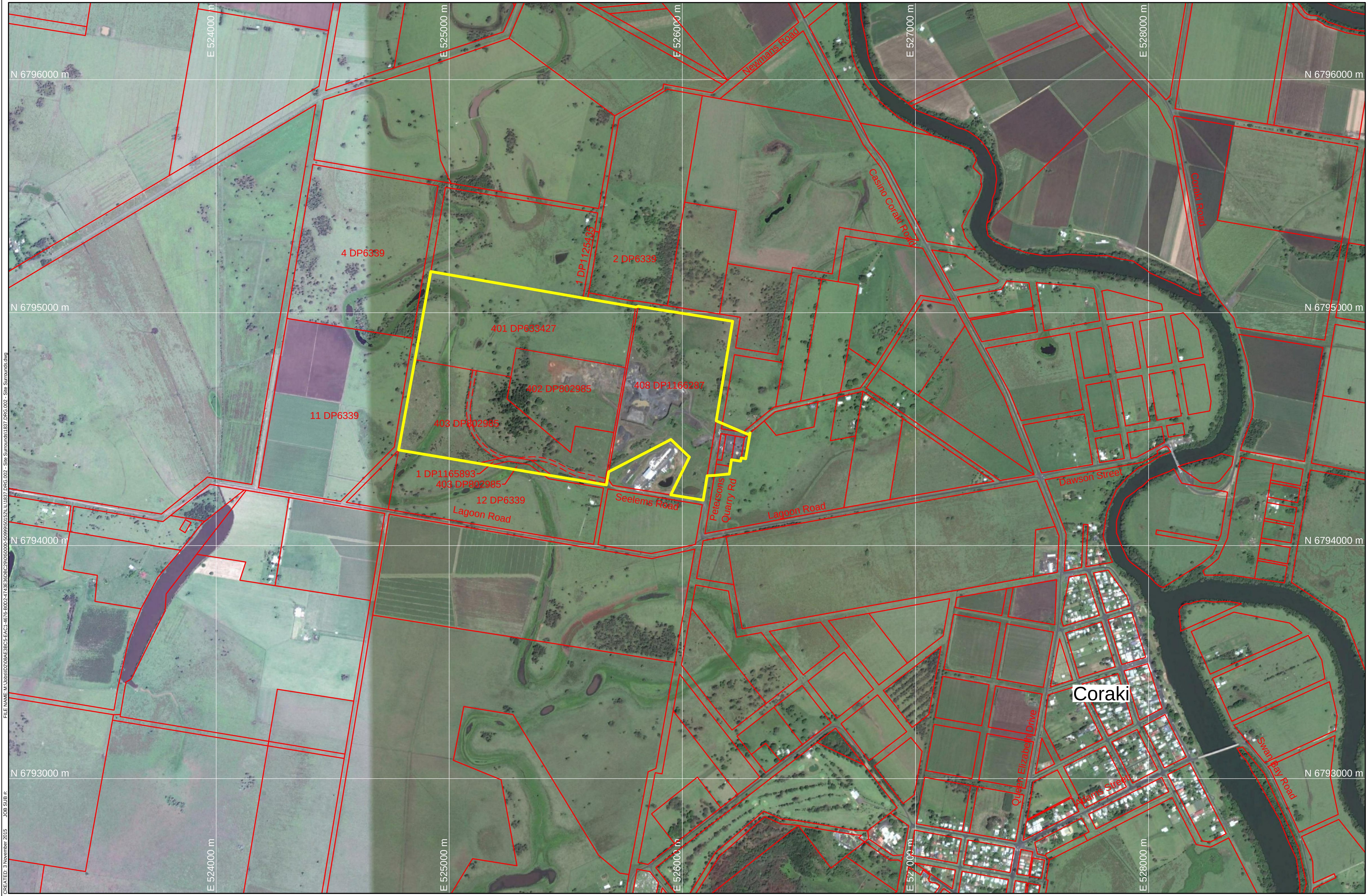
GROUNDWORK plus
PH: +61 7 3871 0411
WWW.GROUNDWORK.COM.AU

SCALE: 1:4,000 When Printed On A3 0 80
DRAWING NUMBER: 1837.027
REVISION:
DATE: 3 November 2015
DRAWN: LT
PRINTED: 3 November 2015
CHECKED: JL
DATUM: HORIZONTAL / VERTICAL / ZONE MGA / AHD / 56

CREATED: 3 November 2015

JOB SUB #:

FILE NAME: M:\Jobs\ID2\08AE3BC5-EAC1-4676-B0D2-4743E36DBC29\0\50000-50999\50152\L\L\1837.DRG.002 - Site Surrounds\1837.DRG.002 - Site Surrounds.dwg



REV	DESCRIPTION	DATE	BY
1	Revised site boundary	07/09/15	LT

Data Sources:
Photography: Google. Image date: 2014-12-18
Topography:
Cadastre:
Ecosystem:
Other:

Legend:
🟨 Site Boundary
🟥 Cadastral Boundary

N

PROJECT:
Coraki Quarry

CLIENT:
Quarry Solutions Pty Ltd

TITLE:
Site and Surrounds

GROUNDWORK plus
PH: +61 7 3871 0411
WWW.GROUNDWORK.COM.AU

SCALE: 1:15,000 When Printed On A3 0 300

DRAWING NUMBER: 1837.DRG.002

REVISION: 1

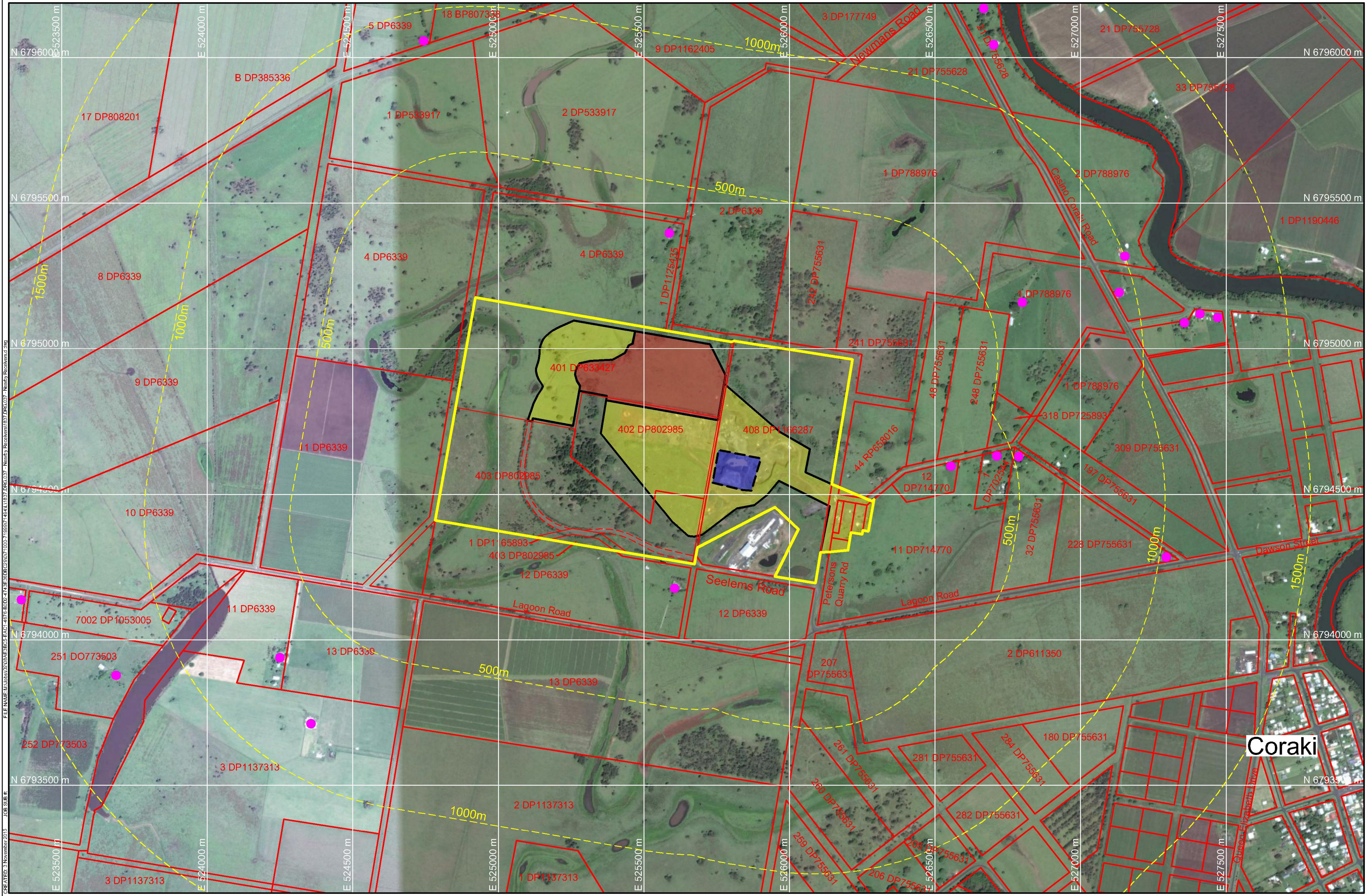
DATE: 3 November 2015

DRAWN: LT

PRINTED: 3 November 2015

CHECKED: JL

DATUM: HORIZONTAL / VERTICAL / ZONE
MGA / AHD / 56



CREATED: 3 November 2015 JOB SUB #:

REV	DESCRIPTION	DATE	BY

Data Sources:
Photography: Google. Image date: 2014-12-18
Topography:
Cadastre:
Ecosystem:
Other:

Legend:
- ━ Site Boundary
- ━ Cadastral Boundary
- ● Nearby Sensitive Receptor
- - - Distance from Site
- 🟥 Proposed Quarry Area
- 🟨 Proposed Stockpile Area
- 🟦 Proposed Plant Area

N

PROJECT: Coraki Quarry

TITLE: Nearby Sensitive Receptors

CLIENT: Quarry Solutions Pty Ltd

GROUNDWORK plus
PH: +61 7 3871 0411
WWW.GROUNDWORK.COM.AU

SCALE: 1:12,000 When Printed On A3 0 240

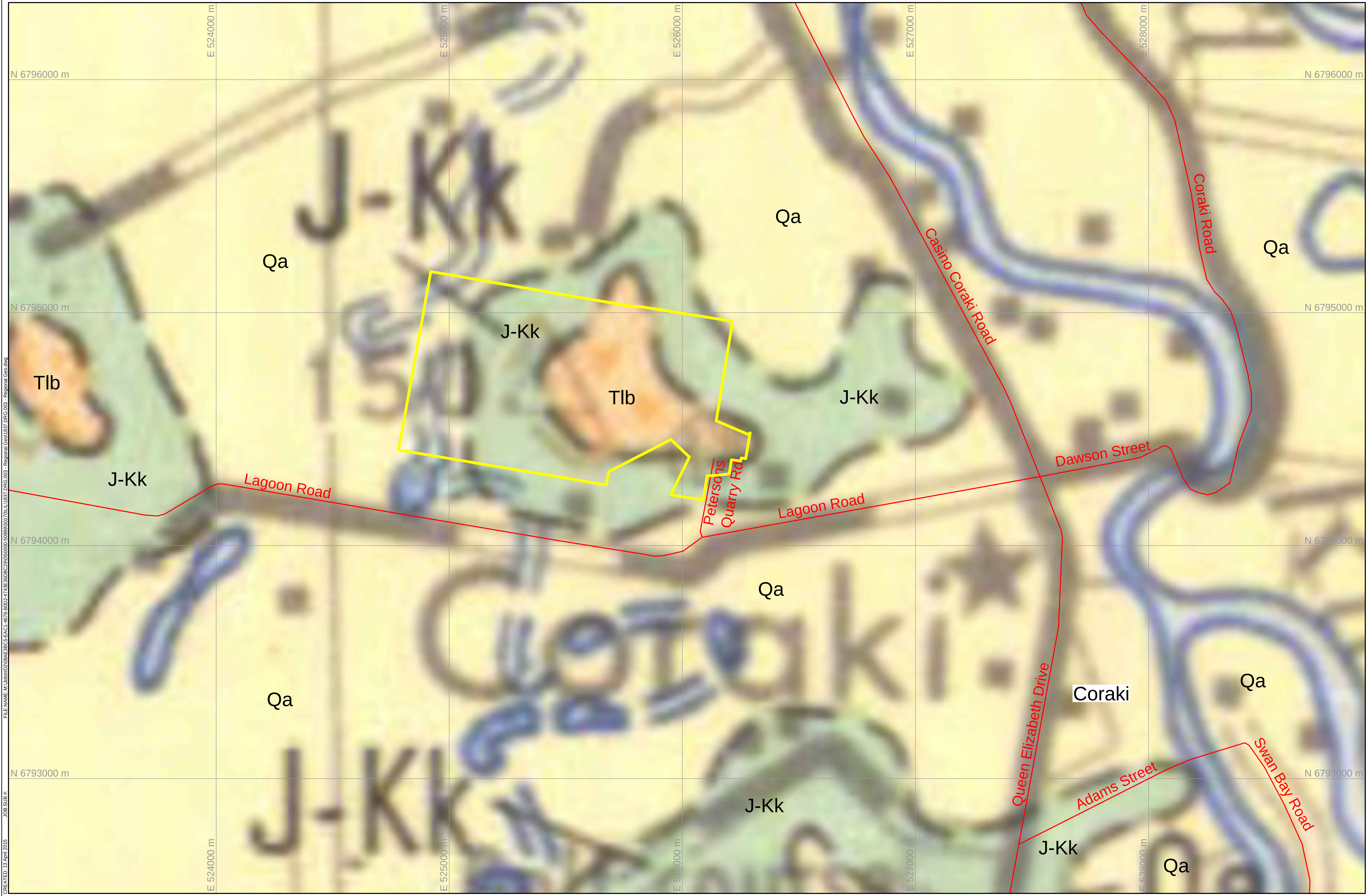
DRAWING NUMBER: 1837.DRG.037

REVISION:

DATE: 3 November 2015 DRAWN: LT

PRINTED: 3 November 2015 CHECKED: JL

DATUM: HORIZONTAL / VERTICAL / ZONE MGA / AHD / 56



CREATED: 13 April 2015 JOB SUB #: FILE NAME: M:\Jobs\ID2\08AE3BC5-EAC1-4676-B0D2-4743E36DBC29\0\50000-50999\50170\L\L\1837.DRG.003 - Regional Geo\1837.DRG.003 - Regional Geo.dwg

REV	DESCRIPTION	DATE	BY
1	Revised site boundary	07/09/15	LT

Data Sources:
Photography:
Topography:
Cadastre:
Ecosystem:
Other:

Legend:

🟨	Site Boundary
🟥	Road

Qa	River gravels, alluvium, sand, clay
Tlb	Basalt (agglomerate, bole)
J-Kk	Quartz sandstone, conglomerate

N

PROJECT: Coraki Quarry

CLIENT: Quarry Solutions Pty Ltd

TITLE: Regional Geology

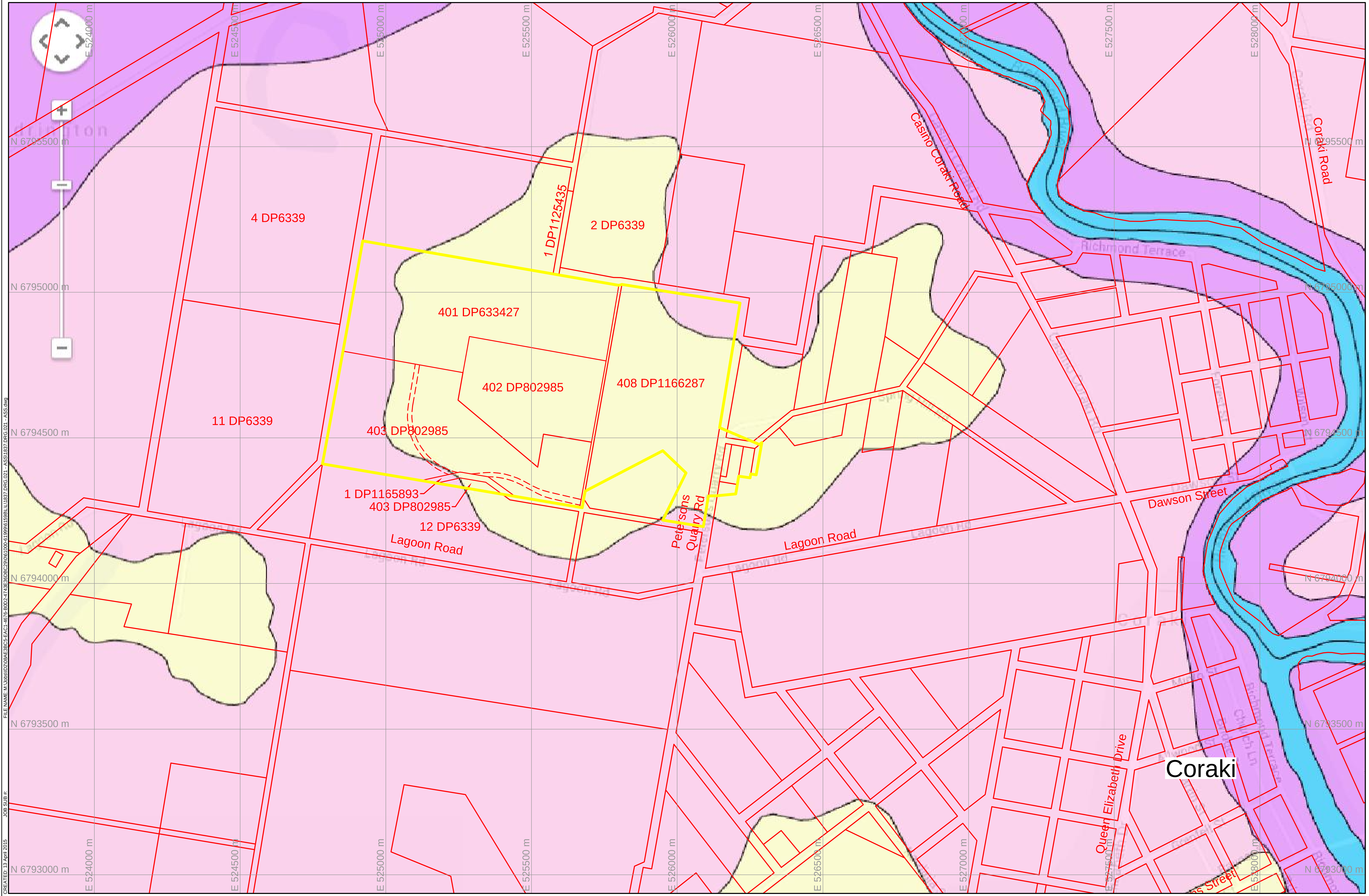
GROUNDWORK plus
PH: +61 7 3871 0411
WWW.GROUNDWORK.COM.AU

SCALE: 1:15,000 When Printed On A3 0 300

DATE: 7 September 2015
PRINTED: 10 September 2015
DRAWN: LT
CHECKED:

DRAWING NUMBER: 1837.DRG.003
REVISION: 1

DATUM: HORIZONTAL / VERTICAL / ZONE
MGA / AHD / 56



CREATED: 13 April 2015

JOB SUB #:

FILE NAME: M:\Jobs\ID2\08AE3BC5-EAC1-4676-B0D2-4743E36DBC29\0\61000-61999\61598\L\L\1837.DRG.021 - ASS\1837.DRG.021 - ASS.dwg

REV	DESCRIPTION	DATE	BY
1	Revised site boundary	07/09/15	LT

Data Sources:
Photography: Google. Image date: 2014-12-18
Topography:
Cadastre:
Ecosystem:
Other:

Legend:
— Site Boundary
— Cadastral Boundary

Acid Sulfate Soils Classification:
(Source: NSW Gov't Planning viewer)

🟦	Class 1	🟪	Class 4
🟥	Class 2	🟨	Class 5
▨	Class 3		

N

PROJECT:
Coraki Quarry

CLIENT:
Quarry Solutions Pty Ltd

TITLE:
Acid Sulfate Soil Mapping

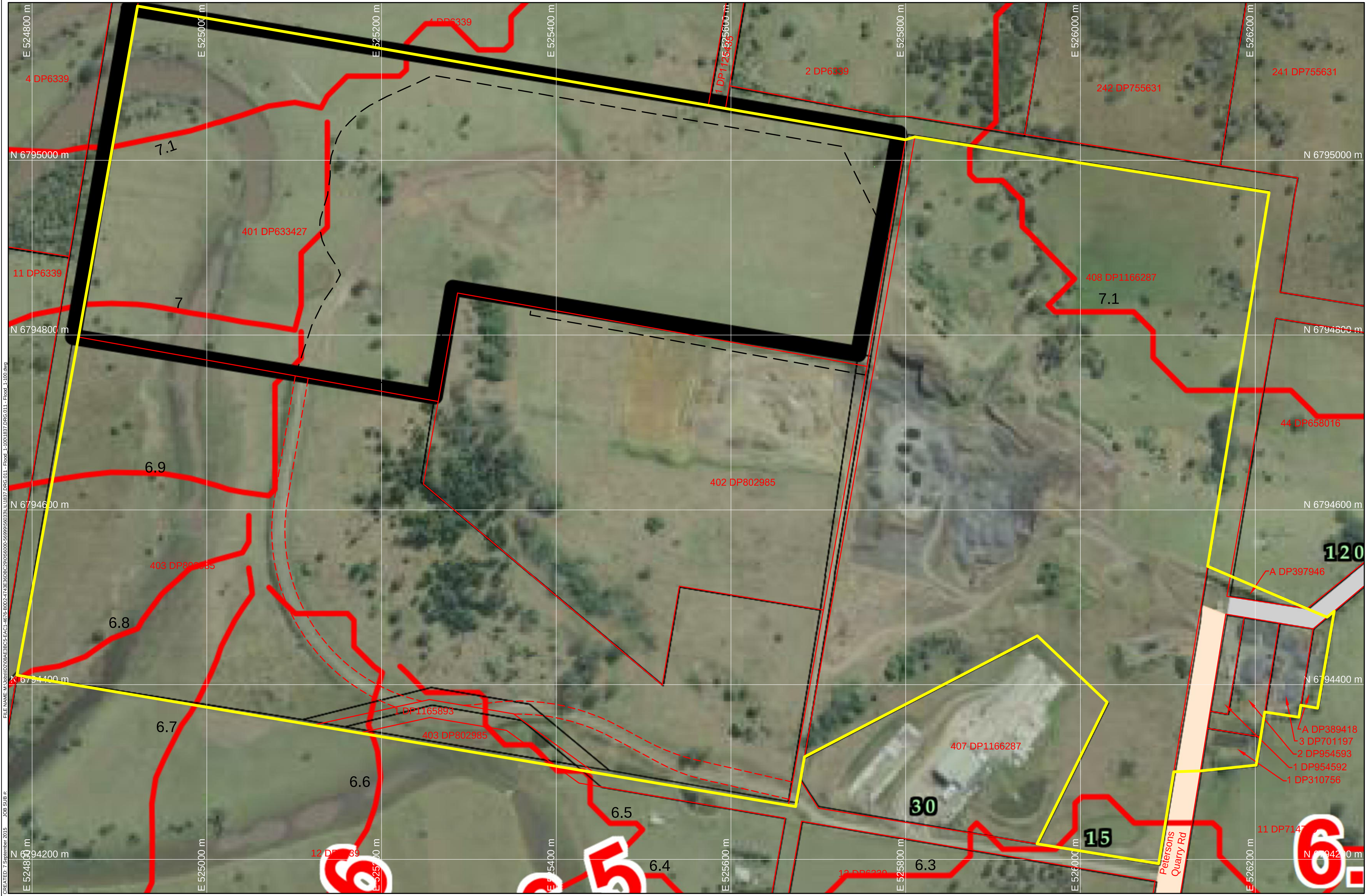
GROUNDWORK plus
PH: +61 7 3871 0411
WWW.GROUNDWORK.COM.AU

SCALE: 1:12,000 When Printed On A3 0 240

DATE: 7 September 2015
PRINTED: 10 September 2015
DRAWN: LT
CHECKED:

DRAWING NUMBER: 1837.DRG.021
REVISION: 1

DATUM: HORIZONTAL / VERTICAL / ZONE
MGA / AHD / 56



FILE NAME: M:\Jobs\ID2\08AE3BC5-EAC1-4676-B0D2-4743E36DBC29\0\56000-56999\56033\L\1837.DRG.011 - Flood_1-100\1837.DRG.011 - Flood_1-100.dwg

JOB SUB #:

CREATED: 7 September 2015

REV	DESCRIPTION	DATE	BY
1	Revised site footprint, quarry extent, and changed scale	07/09/15	LT

Data Sources:
Photography:
Topography:
Cadastre:
Ecosystem:
Other:

Legend:
━ Site Boundary
— Cadastral Boundary
– – Proposed Quarry Extent

N

PROJECT:
Coraki Quarry

CLIENT:
Quarry Solutions Pty Ltd

TITLE:
1 in 100 year ARI design Flood

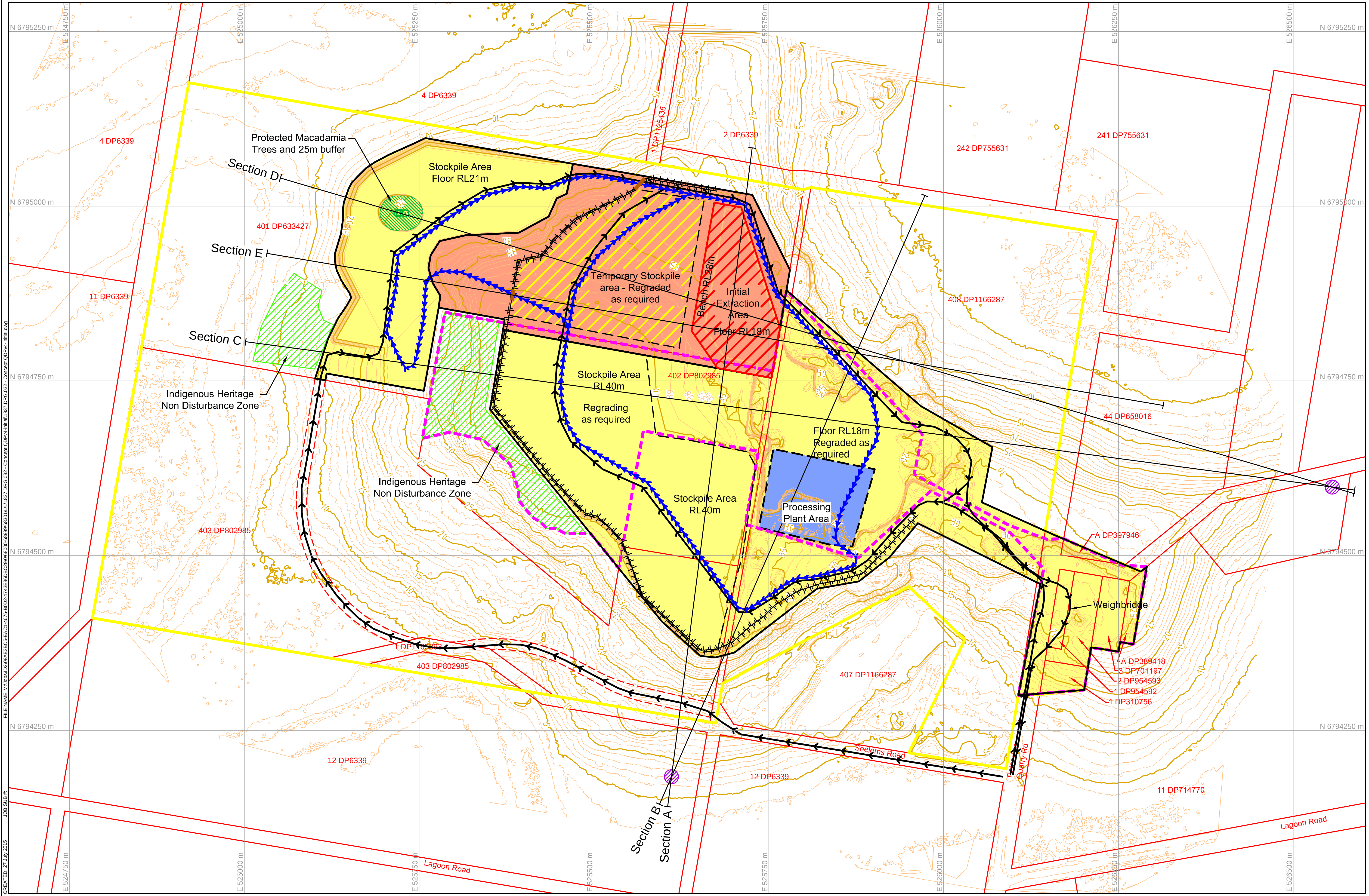
GROUNDWORK plus
PH: +61 7 3871 0411
WWW.GROUNDWORK.COM.AU

SCALE: 1:2,500 When Printed On A3
0 50

DRAWING NUMBER: 1837.DRG.011
REVISION: 1

DATE: 7 September 2015
PRINTED: 7 September 2015
DRAWN: LT
CHECKED: JL

DATUM: HORIZONTAL / VERTICAL / ZONE
MGA / AHD / 56



CREATED: 27 July 2015

JOB SUB #:

FILE NAME: M:\Jobs\ID2\08AE3BC5-EAC1-4676-B0D2-4743E36DBC29\0\68000-68999\68301\L\L\1837.DRG.032 - Concept QDPv4-initial\1837.DRG.032 - Concept QDPv4-initial.dwg

REV	DESCRIPTION	DATE	BY

Data Sources:

Photography: UAV Survey 2015-07-02; Google. Image date: 2014-12-18
Topography: UAV Survey 2015-07-02
Cadastre:
Ecosystem:
Other:

Legend:

- Site Boundary
- Cadastral Boundary
- Approved Petersons Quarry Footprint
- Nearby Sensitive Receptor
- On Road Truck Movement
- Off Road Truck Movement
- Rollover Bund
- Perimeter Bund
- Cross Section (Refer Drg 1837.035)

Stockpile Area = 33.23 ha
Extraction Area = 10.27 ha
Processing Plant Area = 1.65 ha

N

PROJECT:
Coraki Quarry

CLIENT:
Quarry Solutions Pty Ltd

TITLE:
Conceptual Quarry Development Plan Initial Extraction Stage

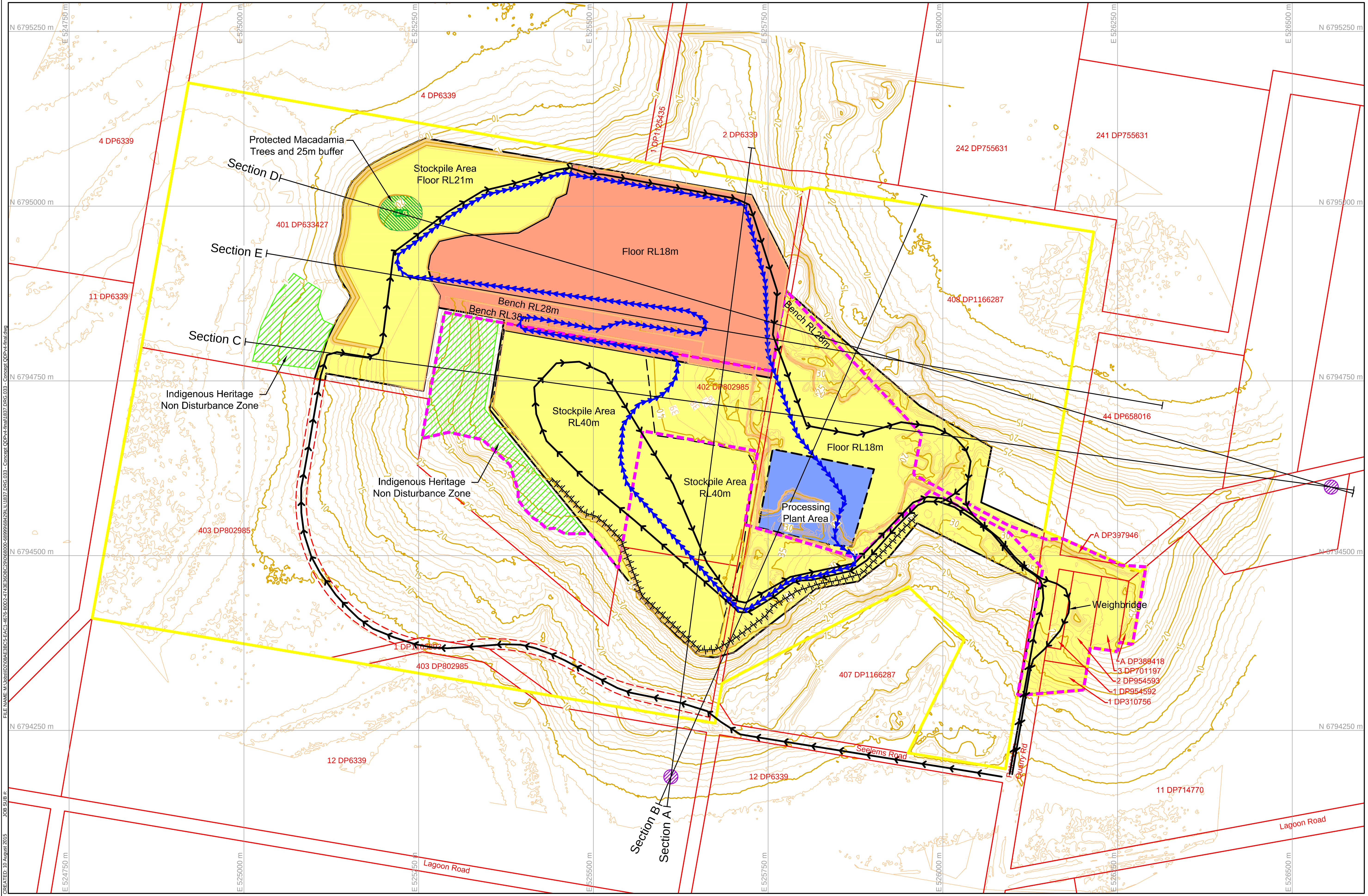
GROUNDWORK plus
PH: +61 7 3871 0411
WWW.GROUNDWORK.COM.AU

SCALE: 1:5,000 When Printed On A3 0 100

DRAWING NUMBER: 1837.032
REVISION:

DATE: 15 September 2015
PRINTED: 3 November 2015
DRAWN: LT
CHECKED: JL

DATUM: HORIZONTAL / VERTICAL / ZONE
MGA / AHD / 56



FILE NAME: M:\Jobs\ID2\08AE3BC5-EAC1-4676-B0D2-4743E36DBC29\0\68000-68999\68429\L\L\1837.DRG.033 - Concept QDPv4-final\1837.DRG.033 - Concept QDPv4-final.dwg

JOB SUB #:

CREATED: 10 August 2015

REV	DESCRIPTION	DATE	BY

Data Sources:
Photography: UAV Survey 2015-07-02; Google. Image date: 2014-12-18
Topography: UAV Survey 2015-07-02
Cadastre:
Ecosystem:
Other:

Legend:

Site Boundary
Cadastral Boundary
Approved Petersons Quarry Footprint
▨ Nearby Sensitive Receptor
On Road Truck Movement
Off Road Truck Movement
Perimeter Bund
Cross Section (Refer Drg 1837.035)

Stockpile Area = 28.91 ha
Extraction Area = 10.27 ha
Processing Plant Area = 1.65 ha

N

PROJECT:
Coraki Quarry

CLIENT:
Quarry Solutions Pty Ltd

TITLE:
Conceptual Quarry Development Plan
Final Extraction Stage

GROUNDWORK plus
PH: +61 7 3871 0411
WWW.GROUNDWORK.COM.AU

SCALE: 1:5,000 When Printed On A3 0 100

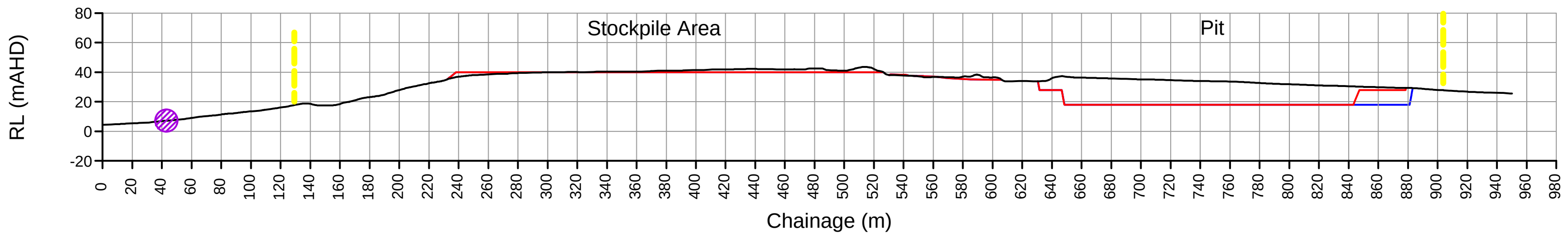
DRAWING NUMBER: 1837.033

REVISION:

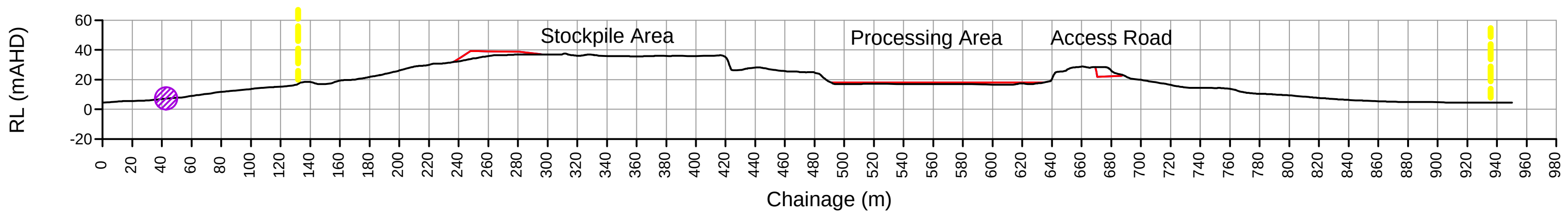
DATE: 15 September 2015
PRINTED: 3 November 2015
DRAWN: LT
CHECKED: JL

DATUM: HORIZONTAL / VERTICAL / ZONE
MGA / AHD / 56

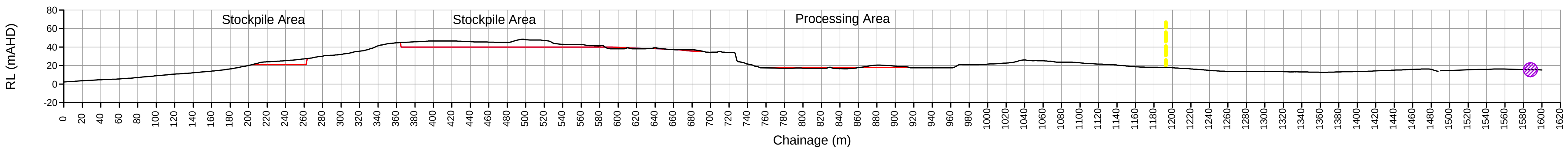
Section A



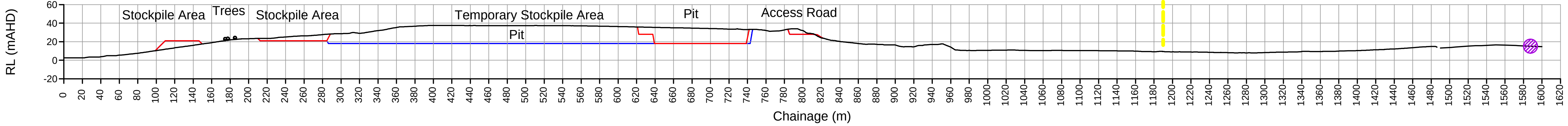
Section B



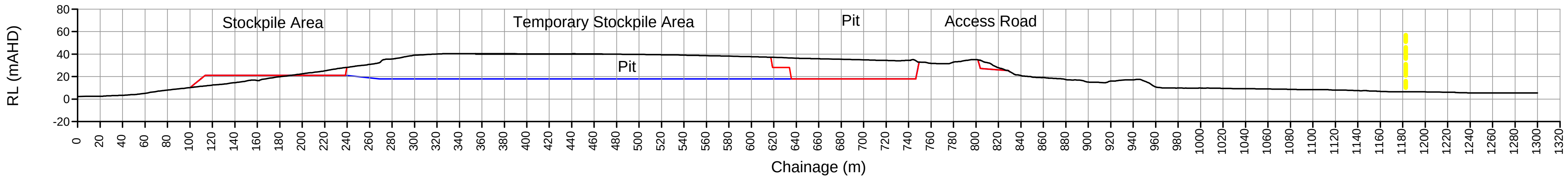
Section C



Section D



Section E



CREATED: 1 September 2015 JOB SUB #: FILE NAME: M:\Jobs\ID2\08AE3BC5-EAC1-4676-B0D2-4743E36DBC29\0\70000-70999\70810\LL\1837.DRG.035 - X-sects\1837.DRG.035 - X-sects.dwg

REV	DESCRIPTION	DATE	BY

Data Sources:
Photography: UAV Survey 2015-07-02; Google. Image date: 2014-12-18
Topography: UAV Survey 2015-07-02
Cadastre:
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. ABN: 80 829 145 906

Legend:
- ― Existing Ground Surface
- ― Initial Development Extent
- ― Long Term Development Extent
- ┆ Site Boundary
- ▨ Nearby Sensitive Receptor

N

PROJECT:
Coraki Quarry

CLIENT:
Quarry Solutions Pty Ltd

TITLE:
Cross Sections A to E

GROUNDWORK plus
PH: +61 7 3871 0411
WWW.GROUNDWORK.COM.AU

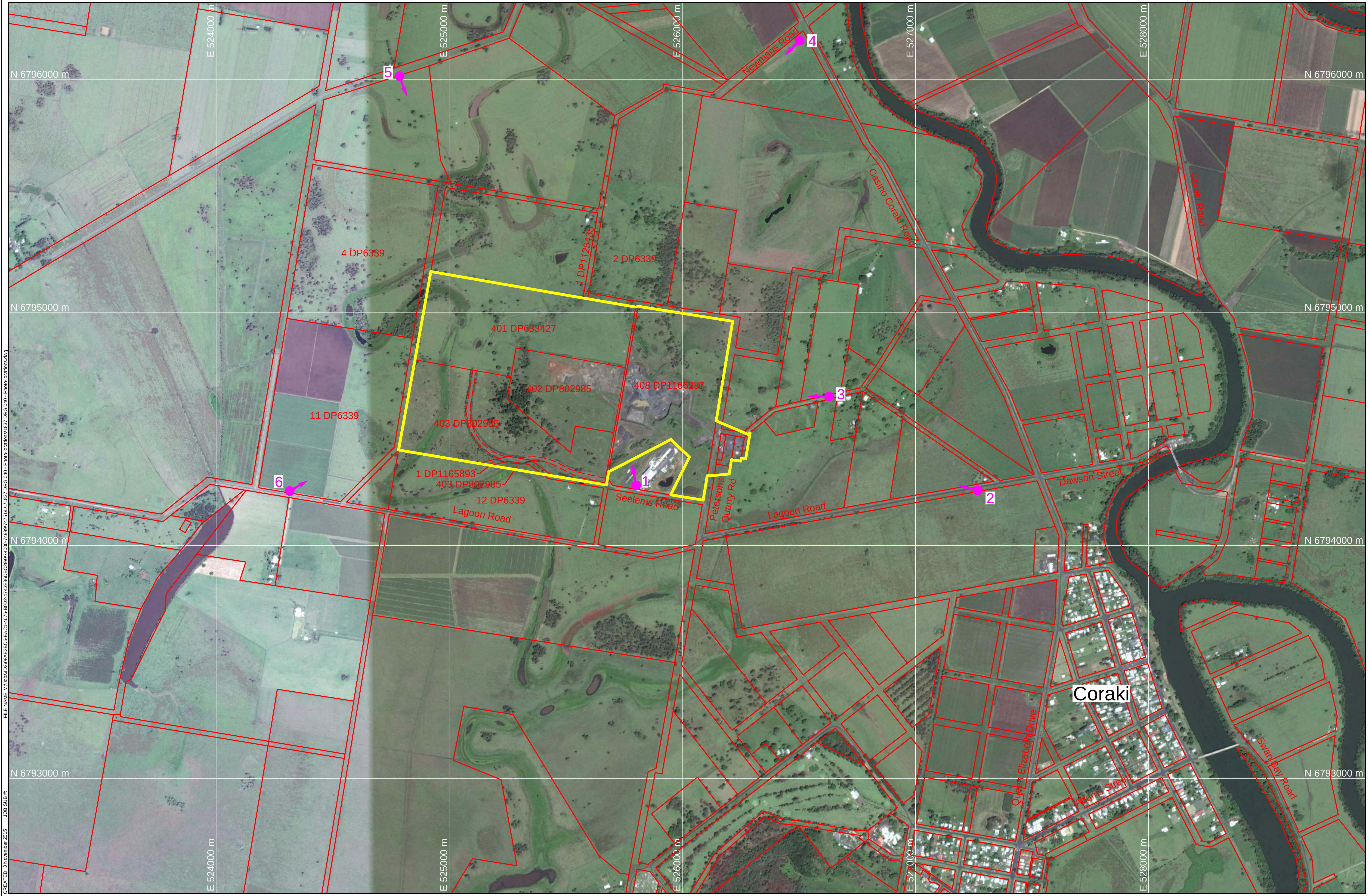
SCALE: 1:5,000 When Printed On A3 0 100

DRAWING NUMBER: 1837.035

REVISION:

DATE: 1 September 2015
PRINTED: 1 September 2015
DRAWN: LT
CHECKED:

DATUM: HORIZONTAL / VERTICAL / ZONE
MGA / AHD / 56



CREATED: 3 November 2015 JOB SUB #: FILE NAME: M:\Jobs\ID2\08AE3BC5-EAC1-4676-B0D2-4743E36DBC29\0\74000-74999\74751\L\L\1837.DRG.040 - Photo-locations\1837.DRG.040 - Photo-locations.dwg

REV	DESCRIPTION	DATE	BY

Data Sources:

Photography: Google. Image date: 2014-12-18
Topography:
Cadastre:
Ecosystem:
Other:

Legend:

🟨	Site Boundary
🟥	Cadastral Boundary
●→	Photo Location and Direction

N

PROJECT:
Coraki Quarry

CLIENT:
Quarry Solutions Pty Ltd

TITLE:
Visual Assessment Photo Locations

GROUNDWORK plus
PH: +61 7 3871 0411
WWW.GROUNDWORK.COM.AU

SCALE: 1:15,000 When Printed On A3 0 300

DRAWING NUMBER: 1837.DRG.040
REVISION:

DATE: 3 November 2015
PRINTED: 3 November 2015
DRAWN: LT
CHECKED: JL
DATUM: HORIZONTAL / VERTICAL / ZONE
MGA / AHD / 56

attachments

Attachment 1

SEARs

NSW GOVERNMENT | Planning & Environment

Resource Assessments
Contact: Swati Sharma
Phone: (02) 9228 6221
Email: swati.sharma@planning.nsw.gov.au

Mr Jim Lawler
Quarry Solutions Pty Ltd
PO Box 6009
Tweed Heads South NSW 2486

Dear Mr Lawler

State Significant Development - Modified Secretary's Requirements
Coraki Quarry Project (SSD 7036)

The Department has modified the Secretary's requirements in response to your emails dated 2, 21, 24 and 27 July 2015. The only changes made to the requirements are in relation to the description and location of the project.

Please note that the Secretary may alter these requirements at any time.

If you have any enquiries about these requirements, please contact Swati Sharma at the details listed above.

Yours sincerely

Howard Reed

Howard Reed 30-7-15
Director
Resource Assessments
as the Secretary's delegate

Secretary's Environmental Assessment Requirements

State Significant Development

Section 78A(8A) of the *Environmental Planning and Assessment Act 1979*

Application Number	SSD 7036
Proposal	The Coraki Quarry Project, which involves: • establishing a new quarry to extract a maximum of 1 million tonnes/year of hard rock material over an operating life of approximately 7 years; • using a portion of the existing Petersons Quarry to establish and operate a processing plant for Coraki Quarry; • using the Petersons Quarry road access to access Coraki Quarry; • transporting material off-site by trucks, primarily to supply upgrade works on the Pacific Highway; and • rehabilitating the site.
Location	Lot 401 DP 633427; Lot 402 DP 802985; Lot 403 DP802985; Lot 408 DP1166287; Lot A DP 397946; Lot A DP 389418; Lot 3 DP 701197; Lot 2 DP 954593; Lot 1 DP 954592; and Lot 1 DP 310757, Seelems Road, Coraki in the Richmond Valley local government area.
Applicant	Quarry Soultions Pty Ltd
Date of Issue	22 May 2015
General Requirements	The Environmental Impact Statement (EIS) for the development must comply with the requirements in Clauses 6 and 7 of Schedule 2 of the *Environmental Planning and Assessment Regulation 2000.* In particular, the EIS must include: • a full description of the development, including: – the need for the development; – the resource to be extracted, including the amount, type and composition, having regard to DRE's and EPA's requirements (see Attachment 2); – the site layout and extraction plan, including cross-sectional plans; – the production process and processing activities, including the in-flow and out-flow of materials and points of discharge to the environment; – surface infrastructure and facilities (including any infrastructure that would be required for the development, but the subject of a separate – approvals process); – a waste (overburden, rejects, tailings, etc.) management strategy, having regard to EPA's requirements (see Attachment 2); – a water management strategy, having regard to EPA's and DPI's requirements (see Attachment 2); – a rehabilitation strategy to apply during, and after completion of, extraction operations, and proposed final use of site; and – the likely interactions between the development and any other existing, approved or proposed extractive industry development in the vicinity of the site (including the adjacent Petersons Quarry); • a list of any approvals that must be obtained before the development may commence; • an assessment of the likely impacts of the development on the environment, focussing on the specific issues identified below, including: – a description of the existing environment likely to be affected by the development, using sufficient baseline data;

	– an assessment of the likely impacts of all stages of the development, including any cumulative impacts, taking into consideration any relevant laws, environmental planning instruments, guidelines, policies, plans and industry codes of practice; – a description of the measures that would be implemented to mitigate and/or offset the likely impacts of the development, and an assessment of: o whether these measures are consistent with industry best practice, and represent the full range of reasonable and feasible mitigation measures that could be implemented; o the likely effectiveness of these measures; and o whether contingency plans would be necessary to manage any residual risks; and – a description of the measures that would be implemented to monitor and report on the environmental performance of the development if it is approved; • a consolidated summary of all the proposed environmental management and monitoring measures, identifying all the commitments in the EIS; • consideration of the development against all relevant environmental planning instruments (including Part 3 of the *State Environmental Planning Policy (Mining, Petroleum Production and Extractive Industries) 2007)*; and • the reasons why the development should be approved having regard to biophysical, economic and social considerations, including the principles of ecologically sustainable development. While not exhaustive, Attachment 1 contains a list of some of the environmental planning instruments, guidelines, policies, and plans that may be relevant to the environmental assessment of this development. In addition to the matters set out in Schedule 1 of the *Environmental Planning and Assessment Regulation 2000*, the development application must be accompanied by a signed report from a suitably qualified expert that includes an accurate estimate of the: • capital investment value (as defined in Clause 3 of the *Environmental Planning and Assessment Regulation 2000*) of the development, including details of all the assumptions and components from which the capital investment value calculation is derived; and • jobs that would be created during each stage of the development.
Key Issues	The EIS must address the following specific matters: • **Land Resources** – including a detailed assessment of: - potential impacts on soils and land capability (including potential erosion and land contamination); - potential impacts on landforms (topography), paying particular attention to the long term geotechnical stability of any new landforms (such as overburden dumps); - potential impacts on areas of regionally significant farmland and associated industries, having regard to the requirements of DPI (see Attachment 2); and - the compatibility of the development with other land uses in the vicinity of the development in accordance with the requirements in Clause 12 of *State Environmental Planning Policy (Mining, Petroleum Production and Extractive Industries) 2007*. • **Traffic & Transport** – including: - accurate predictions of the road traffic generated by the construction and operation of the development, including cumulative traffic levels associated with the adjacent Petersons Quarry, and a description of the types of vehicles likely to be used for transportation of quarry products, the public roads in the Richmond Valley LGA likely to be so used and the times during which those roads would be so used; - a detailed assessment of potential traffic impacts on the capacity, condition, safety and efficiency of the local and State road network (as identified above), having regard to the requirements of the Richmond Valley Council and RMS (see Attachment 2); and - a detailed description of the measures or works (including concept plans)

that would be used and/or implemented to upgrade, maintain and improve the capacity, efficiency and safety of the road network used by the development.

- **Blasting & Vibration** – including:
  - proposed hours, frequency, methods and impacts; and
  - an assessment of the likely blasting impacts of the development on people, buildings, animals, infrastructure and significant natural features having regard to the relevant ANZECC guidelines.
- **Air Quality** – including a quantitative assessment of potential:
  - construction and operational impacts, with a particular focus on dust emissions including $PM_{2.5}$ and PM_{10};
  - dust generation from blasting and processing, as well as diesel emissions and dust generated from the transportation of quarry products;
  - reasonable and feasible mitigation measures to minimise dust and diesel emissions; and
  - monitoring and management measures, in particular, real-time air quality monitoring.
- **Noise** – including a quantitative assessment of potential:
  - construction, operational and off-site transport noise impacts in accordance with the *Interim Construction Noise Guideline*, *NSW Industrial Noise Policy* and the *NSW Road Noise Policy* respectively;
  - reasonable and feasible mitigation measures to minimise noise emissions; and
  - monitoring and management measures, in particular real-time and attended noise monitoring.
- **Water** – including:
  - detailed assessment of potential impacts on the quality and quantity of existing surface and ground water resources, including impacts on the regional water supply, having regard to the requirements of DPI (see Attachment 2);
  - an assessment of Acid Sulfate Soils on the site and outline mitigation and management measures to limit potential impacts on surface water and ground water in the local and regional area;
  - a detailed site water balance and an assessment of any volumetric water licensing requirements, including a description of site water demands, water disposal methods (inclusive of volume and frequency of any water discharges), water supply infrastructure and water storage structures;
  - an assessment of proposed water discharge quantities and quality against receiving water quality and flow objectives;
  - an assessment of the likely flooding impacts of the development;
  - identification of any licensing requirements or other approvals under the *Water Act 1912* and/or *Water Management Act 2000*;
  - demonstration that water for the construction and operation of the development can be obtained from an appropriately authorised and reliable supply in accordance with the operating rules of the *Water Sharing Plan for the Richmond River Unregulated, Regulated and Alluvial Water Sources 2010* (or any other relevant Water Sharing Plan (WSP));
  - a description of the measures proposed to ensure the development can operate in accordance with the requirements of any relevant WSP or water source embargo, having regard to the requirements of DPI (see Attachment 2); and
  - a detailed description of the proposed water management system (including sewage), water monitoring program and other measures to mitigate surface and groundwater impacts.
- **Biodiversity** – including:
  - an assessment of the likely biodiversity impacts, having regard to OEH's and DPI's requirements (see Attachment 2); and
  - an offset strategy (depending on the outcomes of the assessment of biodiversity impacts) to ensure the development maintains and improves the biodiversity values of the region in the medium to long term;
- **Heritage** – including an assessment of the likely Aboriginal and historic heritage (cultural and archaeological) impacts of the development, having regard to OEH's requirements (see Attachment 2);

	• **Visual** – including an assessment of the likely visual impacts of the development on private landowners in the vicinity of the development and key vantage points in the public domain, paying particular attention to the creation of any new landforms (noise bunds, etc.); • **Hazards** – including an assessment of the likely risks to public safety, paying particular attention to potential bushfire risks and the transport, handling and use of any dangerous goods; • **Social & Economic** – including: - an assessment of potential impacts on local and regional communities including impacts on social amenity; - a detailed description of the measures that would be implemented to minimise the adverse social and economic impacts of the development, including any infrastructure improvements, or contributions and/or voluntary planning agreement or similar mechanism; and - a detailed assessment of the costs and benefits of the development as a whole, and whether it would result in a net benefit for the NSW community. • **Rehabilitation** – including the proposed rehabilitation strategy for the site having regard to the key principles in the *Strategic Framework for Mine Closure*, including: - rehabilitation objectives, methodology, monitoring programs, performance standards and proposed completion criteria; - nominated final land use, having regard to any relevant strategic land use planning or resource management plans or policies; and - the potential for integrating this strategy with any other rehabilitation and/or offset strategies in the region.
Consultation	During the preparation of the EIS, you must consult with relevant local, State and Commonwealth Government authorities, service providers, Aboriginal stakeholders, community groups and affected landowners. In particular, you must consult with the: • Office of Environment and Heritage (including the Heritage Branch); • Environment Protection Authority; • Division of Resources and Energy within the Department of Trade and Investment, Regional Infrastructure and Services; • Department of Primary Industries (including the NSW Office of Water, NSW Forestry, Agriculture and Fisheries sections and Crown Lands division); • Roads and Maritime Services; • NSW Rural Fire Service; • North Coast Local Land Services; • Richmond Valley Council; and • community groups. The EIS must: • describe the consultation process used and demonstrate that effective consultation has occurred; • describe the issues raised by public authorities, service providers, community groups and landowners; • identify where the design of the development has been amended in response to issues raised; and • otherwise demonstrate that issues raised have been appropriately addressed in the assessment.

ATTACHMENT 1

Environmental Planning Instruments, Policies, Guidelines & Plans

Air	
	Approved Methods for the Modelling and Assessment of Air Pollutants in NSW (EPA)
	Approved Methods for the Sampling and Analysis of Air Pollutants in NSW (EPA)
	Generic Guidance and Optimum Model Settings for the CALPUFF Modelling System for Inclusion into the 'Approved Methods for the Modelling and Assessments of Air Pollutants in NSW, Australia'
	National Greenhouse Accounts Factors (Commonwealth)
Noise	
	NSW Industrial Noise Policy and associated Application Notes (EPA)
	Interim Construction Noise Guideline (DECC 2009)
	NSW Road Noise Policy (EPA)
Water	
Water Sharing Plans	Water Sharing Plan for the Richmond River Unregulated, Regulated and Alluvial Water Sources 2010
Groundwater	NSW State Groundwater Policy Framework Document (NOW)
	NSW State Groundwater Quality Protection Policy (NOW)
	NSW State Groundwater Quantity Management Policy (NOW)
	NSW Aquifer Interference Policy 2012 (NOW)
	Office of Water Guidelines for Controlled Activities (2012)
	Groundwater Monitoring and Modelling Plans – Information for prospective mining and petroleum exploration activities (NOW)
	Australian Groundwater Modelling Guidelines 2012 (Commonwealth)
	National Water Quality Management Strategy Guidelines for Groundwater Protection in Australia (ARMCANZ/ANZECC)
	Guidelines for the Assessment & Management of Groundwater Contamination (EPA)
Surface Water	NSW Government Water Quality and River Flow Objectives (EPA)
	Using the ANZECC Guideline and Water Quality Objectives in NSW (EPA)
	National Water Quality Management Strategy: Australian Guidelines for Fresh and Marine Water Quality (ANZECC/ARMCANZ)
	National Water Quality Management Strategy: Australian Guidelines for Water Quality Monitoring and Reporting (ANZECC/ARMCANZ)
	National Water Quality Management Strategy: Guidelines for Sewerage Systems – Effluent Management (ARMCANZ/ANZECC)
	NSW Water Conservation Strategy (2000)
	State Water Management Outcomes Plan
	NSW State Rivers and Estuary Policy (1993)
	Approved Methods for the Sampling and Analysis of Water Pollutants in NSW (EPA)
	Managing Urban Stormwater: Soils & Construction (Landcom) and associated Volume 2E: Mines and Quarries (EPA)
	Managing Urban Stormwater: Treatment Techniques (EPA)
	Managing Urban Stormwater: Source Control (EPA)
	Technical Guidelines: Bunding & Spill Management (EPA)
	Environmental Guidelines: Use of Effluent by Irrigation (EPA)
	A Rehabilitation Manual for Australian Streams (LWRRDC and CRCCH)
	NSW Guidelines for Controlled Activities on Waterfront Land (NOW)
Land	
	Soil and Landscape Issues in Environmental Impact Assessment (NOW)
	Agfact AC25: Agricultural Land Classification (NSW Agriculture)

	Agricultural Issues for Extractive Industries (NSW Trade and Investment)
	State Environmental Planning Policy No. 55 – Remediation of Land
	Australian and New Zealand Guidelines for the Assessment and Management of Contaminated Sites (ANZECC)
Traffic	
	Guide to Traffic Generating Development (RMS)
	Road Design Guide (RMS) & relevant Austroads Standards
Biodiversity	
	Framework for Biodiversity Assessment (OEH)
	NSW Biodiversity Offsets Policy for Major Projects (OEH)
	Guidelines for Threatened Species Assessment (DP&E)
	NSW State Groundwater Dependent Ecosystem Policy (NOW)
	Risk Assessment Guidelines for Groundwater Dependent Ecosystems (NOW)
	State Environmental Planning Policy No. 44 – Koala Habitat Protection
Heritage	
	The Burra Charter (The Australia ICOMOS charter for places of cultural significance)
	Draft Guidelines for Aboriginal Cultural Heritage Assessment and Community Consultation (DP&E)
	Aboriginal Cultural Heritage Consultation Requirements for Proponents (OEH)
	NSW Heritage Manual (OEH)
	Statements of Heritage Impact (OEH)
	Richmond Valley Local Environmental Plan 2012 (Heritage)
Public Safety	
	State Environmental Planning Policy No. 33 – Hazardous and Offensive Development
	Hazardous and Offensive Development Application Guidelines – Applying SEPP 33
	Hazardous Industry Planning Advisory Paper No. 6 – Guidelines for Hazard Analysis
Waste	
	Waste Classification Guidelines (EPA)
Rehabilitation	
	Mine Rehabilitation – Leading Practice Sustainable Development Program for the Mining Industry (Commonwealth)
	Mine Closure and Completion – Leading Practice Sustainable Development Program for the Mining Industry (Commonwealth)
	Strategic Framework for Mine Closure (ANZMEC-MCA)
Environmental Planning Instruments - General	
	State Environmental Planning Policy (Mining, Petroleum Production and Extractive Industries) 2007
	State Environmental Planning Policy (State and Regional Development) 2011
	State Environmental Planning Policy (Infrastructure) 2007
	Richmond Valley Local Environmental Plan 2012

ATTACHMENT 2

Agency Correspondence

Attachment 2

EMP

GROUNDWORK plus

CORAKI QUARRY
ENVIRONMENTAL MANAGEMENT PLAN

Prepared for:
Quarry Solutions Pty Ltd

Date:
September 2015

Reference:
1837.610.002

Document Control

Project/ Report Details

Document Title:	Environmental Management Plan
Principal Author:	David Doolan and Rob Preslmaier
Client:	Quarry Solutions Pty Ltd
Ref. No.	1837.610.002

Document Status

Issue	*Description*	*Date*	*Author*	*Reviewer*
0	Environmental Management Plan	29/09/2015	D. Doolan/ R. Preslmaier	C. Hill

Distribution Record

Recipient	
Quarry Solutions	1e
Department of Planning and Environment	1e, 2h, 1CD

Groundwork Plus ABN: 80 829 145 906

Queensland
6 Mayneview Street, Milton Qld 4064
PO Box 1779, Milton BC, Qld 4064
P: +61 7 3871 0411
F: +61 7 3367 3317

South Australia
2/1 First Street, Nuriootpa SA 5355
PO Box 854, Nuriootpa SA 5355
P: +61 8 8562 4158

E: info@groundwork.com.au

Table of Contents

TABLES

DRAWINGS

Site Location Plan	*Drawing No. 1837.DRG.007R1*
Conceptual Site Layout Plan	*Drawing No. 1837.027*
Nearby Sensitive Receptors	*Drawing No. 1837.DRG.037*

ATTACHMENTS

Attachment 1 Incidents and Complaints Procedure

1. Introduction

1.1 Project Overview

Groundwork Plus has been commissioned to prepare this Environmental Management Plan (EMP) on behalf of Quarry Solutions Pty Ltd (Quarry Solutions) as part of the Environmental Impact Statement (EIS) for the Coraki Quarry Project (the Project). The EMP has been prepared in relation to the Project, to be located at Seelems Road and Petersons Quarry Road, Coraki, New South Wales (refer Drawing 1837.DRG.007 – Site Location Plan). Extraction is proposed to primarily occur within Lot 401 DP633427 (Lot 401). Stockpiling and processing will occur on Lot 401 as well as the adjacent existing Petersons Quarry (refer Drawing 1837.027 – Conceptual Site Layout Plan) owned by Richmond Valley Council (RVC).

Due to anticipated demand for construction materials associated with the Pacific Highway upgrade project, Quarry Solutions propose to establish the Project to supply materials on a project basis. It is anticipated that the project will extract a maximum of 1,000,000 tonnes per annum. Consent is being sought for a period of 7 years. As the Project is necessary to support the Pacific Highway upgrade, the proposed development constitutes a State Significant Development (SSD). Although the Project incorporates land associated with the existing Petersons Quarry it is not intended that the Project approvals will replace the existing development consent and Environment Protection Licence (EPL) for the Petersons Quarry as these will still be required to enable the ongoing operation of Petersons Quarry for supply of construction materials to the local market (including RVC) on an on-going basis, after the approval of the Project lapses. Accordingly, a separate consent and EPL is sought for the Project to the existing Petersons Quarry. It is important to note that for the duration of the Project the existing Petersons Quarry will be leased to and fall under the control of Quarry Solutions but remain in the ownership of RVC. This EMP will apply to the integrated operation of both quarries for the duration of the Project.

Project operations are anticipated to comprise of the following basic elements:

- Clearing of vegetation and stripping of topsoil and overburden material via mechanical means (i.e. bulldozer or excavator) and stockpiling for later use as; saleable general fill, utilisation in production of processed material, incorporation into on-site rehabilitation works where required, or use in construction of stormwater controls (e.g. perimeter banks, bunds).
- Drilling and blasting the exposed underlying rock from the developed quarry benches to reduce the material into a manageable size for relocation of the materials to the quarry pit or bench below, ready for transfer to the processing area.
- Transferring raw material from the quarry face or pit floor to the designated crushing and screening plant / stockpile hardstand area using an off highway haul truck(s) loaded by an excavator or front-end loader.
- Crushing and screening the raw material using a crushing and screening processing plant.
- Stockpiling the final products using a front-end loader and / or off-road haul truck within designated stockpiling area(s) before the material is sold and loaded into road trucks for transportation off-site for use.
- Rehabilitating disturbed areas progressively once extraction is completed where practicable.

Quarry products produced on-site may include, but are not limited to: crushed rock, road base and sub base pavement materials, pre-coated aggregates, asphalt and sealing aggregates, concrete aggregates (fine and coarse) and other products such as armour rock, ballast, erosion control rock, processed fill, landscape materials, and drainage media. Blasting will typically occur on an 'as needs' basis and will be dependent upon the market demand and production requirements for the site. At the anticipated maximum rate of production of 1,000,000 tonnes per annum it is expected that there would be two (2) blasts per month. Explosives are not anticipated to be stored on site, but will be transported to the site for immediate use as required by a blasting contractor. Unsealed internal access roads will be utilised to facilitate the movement of personnel, plant, equipment, and light vehicles into and out of the site. Unauthorised vehicle access will be prevented by the use of a wire perimeter fence and clearly displayed signage at the access road entrance. Major plant and equipment to be used on site will include, but not be limited to the processing plant, drill rigs, excavators, front end loaders, off highway trucks, water trucks, light vehicles and on-road delivery trucks. Those plant and equipment will be supported by infrastructure including generators, a weighbridge, site office and workshop.

1.2 Site Details

The site is located at Seelems Road and Petersons Quarry Road, Coraki NSW 2471, including Lot 401 DP633427 and land associated with the existing Petersons Quarry. The site is located approximately 2.5 kilometres to the north-west of Coraki, on the Far North Coast of New South Wales (NSW).

Access:	Access to the project is via Seelems Road and Petersons Quarry Road.
Site:	Lot 401 DP633427, Lot 402 DP802985, Lot 403 DP802985, Lot 408 DP1166287, Lot A DP397946, Lot A DP389418, Lot 3 DP701197, Lot 2 DP954593, Lot 1 DP954592 and Lot 1 DP310756.
Area:	Site Area: 100 ha Project Area: 40.83 ha Extraction Area: 10.27 ha Stockpiling Area: 28.91 ha Processing Area: 1.65 ha
Tenure:	Freehold.
Registered Proprietor:	· Varoli Pty Ltd (ACN 003728229): Lot 401 DP633427. · Richmond Valley Council: Lot 402 DP802985, Lot 403 DP802985, Lot 408 DP1166287, Lot A DP397946, Lot A DP389418, Lot 3 DP701197, Lot 2 DP954593, Lot 1 DP954592, and Lot 1 DP310756.
Current Land Use:	The site is currently used for cattle grazing and the existing Petersons Quarry.
Local Government Area:	Richmond Valley Council.

1.3 Relevant Legislation

A comprehensive assessment of the relevant legislation to which this project is required to comply with is detailed in Section 4.0 – Statutory Requirements of the EIS document. Though broadly speaking, the site and its operations will be largely managed to ensure compliance with the following legislation.

The Protection of the Environment Operations Act 1997 (POEO Act) sets the framework for environment protection during both the construction and operation of a development or scheduled activity. Under Schedule 1 of the Act, a licence would be required for, '*Land based extractive activities that involve extraction, processing or storage of more than 30,000 tonnes of extractive materials per year*' (Section 19). Therefore, the Project is a 'scheduled activity' and requires a licence under Chapter 3 of the POEO Act. It is noted under Section 89K of the *NSW Environmental Planning and Assessment Act 1979*, an authorisation of the following kind cannot be refused if it is necessary for carrying out SSD that is authorised by a development consent and is to be substantially consistent with the consent:

> *(e) an environment protection licence under Chapter 3 of the Protection of the Environment Operations Act 1997 (for any of the purposes referred to in section 43 of that Act).*

The POEO Act makes it an offence to pollute waters, described as a change in the physical, chemical or biological characteristics of the water, without a licence. Quarry operations will be conducted in accordance with the document *Managing Urban Stormwater, Soils and Construction - Volume 2E - Mines and Quarries* (NSW Department of Environment and Climate Change, 2008) to ensure compliance with this Act.

The *Protection of the Environment Administration Act 1991* established the Environment Protection Authority (now part of the Office of Environment and Heritage (OEH)). It enables OEH to provide administration for protection of the environment, carry out environmental audits and prepare reports on the state of the environment.

1.4 Potential Environmental Impacts

The identification of activities and potential impacts is fundamental to designing and implementing procedures and measures proposed in the EMP. Activities associated with carrying out extractive industry have been tabulated against potential environmental impacts to provide a focus for preparing the EMP, refer to Table 1 – Identification of Potential

Environmental Impacts. The location of the nearest sensitive receptors is shown in Drawing 1837.DRG.037 – Nearby Sensitive Receptors.

Table 1 – Identification of Potential Environmental Impacts

ACTIVITY/EQUIPMENT	POTENTIAL IMPACTS											
	Noise	Air Quality	Water Quality	Traffic	Visual Amenity	Social and Economic Factors	Land Contamination	Soils	Groundwater	Stormwater and Soil Erosion	Fauna and Flora	Waste
Activities												
Vegetation Clearing	·	·	·			·		·		·		
Construction	·	·	·	·	·	·		·		·		
Topsoil Stripping	·	·	·					·		·		
Overburden Stripping	·	·	·							·		·
Raw Material Extraction	·		·						·			
Raw Material Stockpiling and Loading	·		·							·		
Raw Material Hauling	·		·	·						·		
Raw Material Unloading	·		·							·		
Washing and Screening	·		·							·		·
Product Stockpiling	·	·	·							·		
Product Handling	·	·	·							·		
Maintenance Activities	·		·				·			·		·
Handling and storage of oils, greases, fuels and chemicals			·				·	·		·		·
Rehabilitation Activities	·	·	·		·	·		·		·		·
Stormwater Management			·							·		
Waste Management			·				·		·			
Extracting water from extraction pit for dust control and wash plant use	·								·			
Equipment												
Front End Loader	·	·	·					·		·		
Excavator	·	·	·					·		·		
Miscellaneous Stationary Motors	·		·							·		
Haul Truck	·	·	·							·		
Product Delivery Trucks	·	·	·	·						·		
Light Vehicles	·	·	·	·						·		
Stormwater Discharge	·		·		·	·				·		

· potential risk if inappropriately managed

An assessment of the Environmental Values has been undertaken and included in the overarching EIS document, and the accompanying specialist technical reports. Assessment of the potential environmental impacts has been provided in the EIS documents.

1.5 Purpose of Environmental Management Plan

This EMP is a management document that links the potential environmental impacts with commitments and measures to safeguard the surrounding environment. It is the principal management tool for guiding environmental management at the site, by providing the framework for environmental management at the operational level to prevent or minimise environmental impacts. The objective of the EMP is to meet anticipated conditions likely to be prescribed in the relevant approval documentation; i.e. the Environment Protection Licence. The structure of the EMP comprises a series of procedures for ease of implementation. The elements of the EMP are based on a standard format (that may be adapted for a particular issue or activity) addressing the, purpose, performance targets, relevant conditions, strategies/mitigation measures and monitoring.

2. Procedures and Policies

2.1 Environmental Policy

Site management is committed to being environmentally responsible and to conduct activities in compliance with environmental legislation, and will strive to achieve a sound practice of environmental management. In the process of implementing this policy, management shall:

- implement work programs to protect the surrounding environment.
- meet the requirements of all laws, acts, regulations and standards relevant to its operations and activities.
- make the most efficient use of natural resources taking due regard of environmental issues and ensuring land maintains long term productivity.
- implement a program to train all employees in general environmental issues and individual workplace environmental responsibilities.
- continually improve environmental practices to reflect changing legislation, new technology and scientific advances, lessons learned from environmental incidents and increasing knowledge and experience of site specific issues.
- allocate necessary resources to ensure the implementation of the environmental policy.

2.2 Implementation and Training

Implementation of the EMP will require:

- commitment by the Owners, Managers and employees of the site.
- access to technical expertise for tasks such as environmental monitoring, modelling or assessment, as needed.

Management shall ensure that sufficient funding is provided to implement the EMP. All employees and sub-contractors will be inducted on the environmental management procedures and practices to be carried out at the quarry and be informed of the environmental management objectives and the specifics of the EMP including protection of buffer areas, impact minimisation measures, operational practices, maintenance measures, reporting measures, and individual responsibilities. They shall also be made aware of penalties if development conditions are breached and reporting requirements for incidents involving environmental harm and safety in accordance with the relevant environmental legislation.

A record of all employee training/inductions will be maintained on site. Each employee shall be responsible for implementing environmental policies within the scope of their duty statement or job description.

The currency of the EMP should be checked regularly (at least every three years) or as a result of significant change(s) to operations, to ensure up-to-date versions are available and to avoid confusion and mistakes.

2.3 Incidents and Complaints Procedure

The objective of the Incidents and Complaints Procedure is to ensure that incidents and complaints are reported, investigated and appropriate action is taken. A summary of the Incidents and Complaints Procedure is provided below in Diagram 1 – Incidents and Complaints Procedure Summary. For further details regarding each element of the procedure refer to Attachment 1 – Incidents and Complaints Procedure.

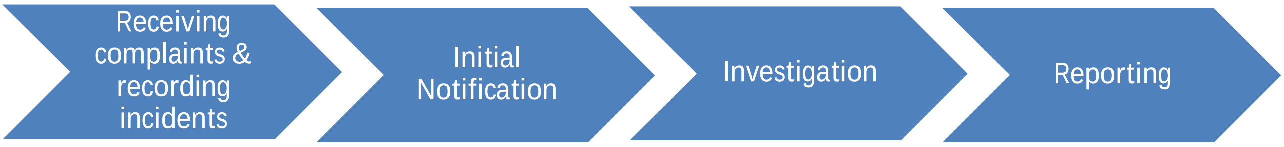


Diagram 1 – Incidents and Complaints Procedure Summary

2.4 Monitoring Requirements

The controls nominated in this EMP will require regular surveillance and review, to ensure that performance aligns with design criteria and also reflects the dynamic nature and changing needs of the operation. The monitoring requirements are contained in each management plan, as outlined in Section 3.0.

All instruments used to measure or monitor parameters required under the relevant conditions of development and operational requirements are to be calibrated, maintained and operated appropriately. All monitoring is to be undertaken by a person or body possessing appropriate experience and qualifications to perform the required measurements.

2.5 Records and Reporting

All environmentally relevant documentation, including policies, procedures, forms, records, and reports required to be kept as per this EMP shall be available at the approved/licensed premises for a period of at least five (5) years and be available for inspection by an authorised person.

If monitoring is required following a complaint or incident, the report shall:

- record the date and time of sampling.
- be endorsed by a person or body possessing appropriate experience and qualifications to perform the required measurements on all records of analysis results.
- record the results of all analyses, measurements and observations and interpretations (if appropriate).
- be made available on request to any authorised person who must be permitted to make copies thereof.

3. Management Plans

3.1 Air Quality (Dust) Management Plan

Purpose	This Air Quality (Dust) Management Plan has been prepared to control potential air quality impacts occurring as a result of land disturbance and operations necessary for the extractive industry operation. Quarry activities have the potential to generate dust that, if inadequately controlled, has the potential to cause nuisance to surrounding sensitive receptors. Activities that may generate dust emissions include: · crushing and screening operations · rock drilling and blasting · wind action on topsoil / overburden and material stockpiles and disturbed areas · topsoil / overburden stripping · extraction and transportation of raw materials (e.g. earthmoving machinery-ground interaction, materials digging, loading / unloading, haul truck and light vehicle movements on unsealed roads, material spillage from haul trucks) · product stockpiling and dispatch (e.g. stockpiles and stockpile pads, product loading, truck tyre-road interaction, material spillage from trucks) · rehabilitation works.
Performance Targets	Dust and particulate matter not exceeding the following levels when measured at the boundary of any sensitive receptor: · dust deposition of 4 g/m^2-month (130 mg/m^2-day), when monitored in accordance with Australian Standard AS 3580.10.1 *Methods for sampling and analysis of ambient air – Determination of particulates – Deposited matter – Gravimetric method*; and · an aerodynamic diameter of less than 10 µm (PM$_{10}$) suspended in the atmosphere of 50 µg/m^3 over a 24 hour averaging time when monitored in accordance with Australian Standard AS 3580.9.6 *Methods for sampling and analysis of ambient air – Determination of suspended particulate matter – PM$_{10}$ high volume sampler with size-selective inlet – Gravimetric method*.
Relevant Conditions	Refer to the EPL once issued.
Strategies/mitigation measures	Strategies/mitigation measures for the management of dust emissions will be implemented in accordance with the relevant conditions of development and may include the following: *Disturbed Areas* · Dampen down cleared areas, extraction working areas, stockpiles and other hardstand areas by water spraying when visual surveillance indicates excessive dust generation and propagation from point or mobile sources. · Limit clearing, topsoil and overburden removal at any one time to that necessary whilst providing for effective production of the resource. · Monitor meteorological conditions to time particular activities with favourable weather conditions. · Restrict vehicle and mobile machinery movements to designated routes and standing areas to the extent practicable.

3.1 Air Quality (Dust) Management Plan

- Maintain buffers between operational areas and the site boundaries where possible, and between operational areas and Indigenous Heritage Non-Disturbance Zone and Protected Macadamia Trees.

Processing Plant

- Dampen down work areas.
- Dampen materials prior to transport.
- Use water sprays at the processing plant.
- Use shielding and/or windbreaks where possible.
- Maintain vehicles and equipment in accordance with the original equipment manufacturers' specifications.

Stockpiles

- Use water sprays or chemical dust suppressant products as required during high wind conditions likely to generate dust releases.
- Stabilise and revegetate topsoil and overburden stockpiles where possible.
- Use dust suppressants and shielding where possible.
- Limit the height and slope of stockpiles.

Trafficable Areas

- Water haul and access roads at a rate of approximately 2 litres/m^2/hr at times when dust emissions are visible from vehicle movements.
- Enforce a maximum speed of 40 km/hr on unsealed haul and internal roads.
- Keep trafficable areas as clean as possible.
- Seal the first 200m of the internal access road from the Seelems Rd entry point.
- Maintain road surfaces in good condition.

Material Transport and Transport Vehicles

- Ensure signage is installed to advise drivers to contain and cover all loads of material prior to leaving the site.
- Ensure loads are appropriately contained and covered prior to leaving the site.
- Dampen down the load prior to transport where necessary and practicable.
- Clear spillages from side rails, tailgates and draw bars of trucks (following loading and tipping).
- Level loads prior to truck exit from the site (e.g. via shaker pad) where possible.
- Securely fix tailgates of all material transport vehicles prior to loading to prevent material.

Screening Equipment

- Install windshields, enclosures and/or barriers where possible.
- Maintain material in moistened state.

Rehabilitation

- Progressively rehabilitate the site as areas become available.
- Minimise windblown dust during any rehabilitation activities.
- Ensure vehicles use established roads and tracks where possible and limit access to any rehabilitated areas.

3.1 Air Quality (Dust) Management Plan

Other

- The rock drill is to have an appropriate dust extraction system with collector fitted to the rig and/or wet drilling system via water sprays.
- Blasting should be limited to periods of favourable weather conditions where possible.
- Employees and contractors are to be made aware of dust management practices.
- Ensure sufficient on site water supply is available for dust suppression.
- Apply good housekeeping practices.

Monitoring

The controls nominated will require regular monitoring and review to ensure that performance accords with design criteria and also reflect the dynamic nature and changing needs of the operation.

Daily visual surveillance will be undertaken by all employees to ensure dust generation on site is controlled appropriately.

Dust and particulate monitoring will be undertaken as required in accordance with the relevant conditions of the EPL. Monitoring will be carried out at a place relevant to the potentially affected, nuisance-sensitive place. Monitoring is to be undertaken by a suitably qualified person in accordance with:

- Australian Standard *AS3580.10.1 of 2003 – Determination of particulate matter – Deposited matter – Gravimetric method* (or most recent edition).
- *Approved Methods and Guidance for the Modelling and Assessment of Air Pollutants in NSW* (EPA, 2001).
- *Approved Methods for the Sampling and Analysis of Air Pollutants in NSW (EPA 2001).*

When requested to undertake monitoring, monitoring results are to be provided to the administering authority following completion of the monitoring event. Monitoring shall be carried out at a place(s) relevant to the potentially affected dust sensitive place and must include:

- for a complaint alleging dust nuisance, dust deposition.
- for a complaint alleging adverse health effects caused by dust, the concentration per cubic metre of particulate matter with an aerodynamic diameter of less than 10 micrometre (µm) (PM_{10}) suspended in the atmosphere over a 24hr averaging time.

3.2 Water Management Plan

Purpose	This Water Management Plan (WMP) has been prepared to control potential environmental impacts occurring as a result of land disturbance, necessary for the extractive industry operation. Extractive industry operations have the potential to impact on surface runoff water quality. These activities include: · Vegetation clearing · Topsoil stripping · Overburden removals · Extraction pit development · Construction and maintenance of internal roads and hardstands · Stockpiling of topsoil, raw feed and product · Spillage during handling of materials · Use and storage of oils, greases, fuels and other chemicals. Additionally a Surface Water Management Plan (SWMP) has been developed by appropriately qualified persons in conjunction with the Surface Water Management Assessment conducted as part of the EIS. The purpose of the SWMP is to define the locations of sediment dams during the initial and final stages of the development. This WMP and the SWMP should be read in conjunction with each other.
Performance Targets	· To ensure contaminants are not directly, or indirectly, released from the site to any waters, or the bed and banks of any waters. · To ensure no environmental nuisance complaints are received. · To ensure the quality of surface water discharged from the site meets the release limits outlined in the EPL.
Relevant Conditions	Refer to EPL once issued.
Strategies/mitigation measures	Strategies/mitigation measures for the management of surface runoff, surface water quality, groundwater quality and erosion and sediment transport from the site will be implemented in accordance with best practice, any relevant conditions of approval and the document *Managing Urban Stormwater, Soils and Construction - Volume 2E - Mines and Quarries* (NSW Department of Environment and Climate Change, 2008). Measures employed may include the following: *General* The stormwater control principles for the development comprise: · Ensure the first disturbance activities at the site are for the installation of stormwater management, erosion and sediment controls to ensure stormwaters are adequately managed. Sedimentation basins as per the SWMP shall be installed prior to extraction works being undertaken. · A general philosophy that any overland flow from disturbed areas is considered to be contaminated with sediment/suspended solids therefore requires treatment prior to release. · Divert clean catchment overland flow around and away from disturbed areas to the extent practicable using a diversion bank and natural contours where practicable.

3.2 Water Management Plan

- Overland flows from the disturbed areas within the quarry area are to be captured in the quarry sump/pit and/or sediment basins for treatment prior to discharging (naturally or pumped) as either concentrated flow into an existing drainage line or as sheet flow over the adjacent grassed buffer areas (excluding the Indigenous Heritage Non-Disturbance Zone and Protected Macadamia Trees area).
- Sediment basins specified in the SWMP are to be designed in accordance with *Managing Urban Stormwater, Soils and Construction – Volume 1 – Blue Book and Volume 2E - Mines and Quarries* (NSW Department of Environment and Climate Change, 2008).
- Manage stormwater by use of preventative procedures such as using a perimeter bund, diversion banks or drains, containment, recycling, treatment and by use of corrective procedures such as maintenance, de-silting and revegetation of disturbed areas.
- Within 120 hours of the most recent significant rainfall event, the required design capacity of the upper settling volume of designed on site sediment basins should be reinstated for the capture and storage of stormwater runoff from the next rainfall event.

Stormwater Contamination Management

Measures to be taken to minimise the potential for contamination of stormwater overland flow from site are as follows:

- Treat access roads and hardstand areas using a base course of gravel where possible.
- Prevent and/or minimise the contact of incidental rainfall and stormwater runoff with wastes or other contaminants.
- Clean up any spillage of wastes, contaminants or other materials as quickly as practicable.
- Direct surface water runoff from disturbed areas to the quarry sump/pit and sediment basins for treatment prior to release off-site.
- Recycle water collected in the quarry sump/pit and sediment basins to the maximum extent practical (e.g. dust suppression, irrigation).
- Undertake any necessary on site maintenance in an area where contaminants cannot be released to any receiving waterways or on site sediment basins.
- Store all hazardous materials, chemicals and wastes generated on site under cover where possible or with appropriate safeguards.
- Undertake progressive rehabilitation of disturbed areas to the extent practicable.
- Dispose of wastes off-site on a regular basis.

Erosion Control Measures

Reasonable and practicable erosion control measures will be implemented on site to limit soil erosion including stabilising and vegetating road embankments and batters, temporary overburden and topsoil stockpiles and diversion banks or perimeter bunds. Measures shall be constructed where applicable in accordance with the SWMP - Attachment D – Erosion and Sediment Control Drawings.

Strategies/mitigation measures for the management of surface runoff, surface water quality, groundwater quality and erosion and sediment transport from the site will be implemented in accordance with best practice and any relevant conditions of approval and may include the following measures:

- Divert clean catchment runoff using a series of suitable banks and/or diversion drains.
- Stabilise permanent bunds via revegetation.
- Minimise land disturbance to the extent practicable.
- Limit exposure time of unprotected batters and slopes.

3.2 Water Management Plan

	· Install stormwater drainage devices as soon as practical and in a logical progression. · Implement a monitoring program to assess the effectiveness of erosion and sediment control methods and devices. · Diversion or catch drain outlets will be treated appropriately unless otherwise stated. · Install silt fences to control sheet runoff and sediment traps to treat concentrated flows if necessary. · Construct internal roads with an appropriate cross fall to direct runoff from the road surface into drains, then to the sediment basins where necessary. · Use flocculation or coagulant agents, such as gypsum, to assist in the settling of suspended solids if required. · Induct and train staff on the prevention and control of erosion. · Monitor the water quality of the stormwater released in accordance with approval requirements. · Design, construct and maintain bunded areas and roofed storage with holding capacities to conform to the appropriate regulatory requirement or the provisions of Australian Standard *AS1940-2004 - The Storage and Handling of Flammable and Combustible Liquids*, or most recent edition.
Monitoring	The stormwater controls nominated will require regular monitoring and review to ensure that performance accords with design criteria and also reflects the dynamic nature and changing needs of the operation. Monitoring of surface water or groundwater will be undertaken in accordance with the *Approved Methods for the Sampling and Analysis of Water Pollutants in NSW* (DECCW, 2004). The Quarry Manager shall carry out monthly surveillance of on site water storages and treatment systems. Inspection of site water storages and treatment systems shall also be carried out by the Quarry Manager immediately prior to anticipated runoff-producing rainfall and as soon as practicable following the event. Monitoring will consist primarily of visual inspection of the site, particularly with regards to erosion control structures during storm events and/or extended periods of heavy rain. Observations of the performance of the various components of the system will be made and ameliorative action taken to rectify underperformance. The Quarry Manager may engage the services of a suitably qualified person to conduct any water quality sampling and review monitoring results required to provide advice in relation to the water quality management if a complaint is received or requested by the administering authority. A summary schedule of the various inspections, performance criteria and responses that shall be performed on-site is shown in Table 2 – Action Plan for the Surveillance and Maintenance of Stormwater Control Devices.

Table 2 – Action Plan for the Surveillance and Maintenance of Stormwater Control Devices

Inspection	Minimum Frequency	Performance Criteria	Response
Inspect drainage lines including catch drains, contour drains and diversions	Quarterly	· erosion in areas adjacent to water conveyancing structures · overtopping of water conveyancing structures (identified by the scouring of the drain batters perpendicular to the direction of flow)	· eroded areas shall be treated appropriately (e.g. rock lined) as soon as practicable · drains to be cleaned of sediments and retreated as necessary to original design specifications · revegetation with grasses in the catchment of the drain may be required to reduce sediment loadings of runoff
Inspect potential sediment storage capacity of grit traps, sediment traps and excavation pit	Quarterly or following major rainfall events	· storage capacity maintained	· sediment to be removed from the structure and reused on site where possible · recycle sediment basin waters to ensure adequate free storage is maintained for the collection and holding of runoff
Waste containers	Quarterly	· waste to be stored in appropriate containers	· Ensure waste materials are stored and disposed of properly
Spill response stations	Quarterly and following use	· equipment to be properly maintained and stocked	· maintain equipment · replace / restock equipment as necessary
Maintenance / refuelling area	Quarterly	· fuel, oil spills · contractor maintenance · fuel storage integrity maintained	· clean up spills and the investigate spill source · maintain contractor maintenance records · investigate and repair potential leaks

3.3 Noise Management Plan

Purpose	Uncontrolled or unmitigated site noise has the potential to be a nuisance at neighbouring residences. Site equipment or activities that have potential to generate significant noise have been identified and include: · Excavators (clearing vegetation, stripping topsoil, raw product handling, rehabilitation) · Drill rigs · Processing plant (processing of raw materials) · Front end loaders (product haulage, loading) · Off highway haul trucks (haulage of raw material to the processing plant) · Water truck (water cartage, dust suppression) · Face loaders (raw product handling) · Road trucks (product delivery) · Light vehicles (employee vehicles, maintenance vehicles, service vehicles) · Maintenance activities · Ancillary plant and equipment (e.g. pumps, welders). Section 3.4 – Blasting Management Plan addresses vibration and overpressure associated with site blasting activities.
Performance Targets	Noise from the site must not cause an environmental nuisance at any nuisance sensitive place or commercial place.
Relevant Conditions	Refer to EPL once issued.
Strategies/mitigation measures	Strategies/mitigation measures for the management of noise emissions from the site will be implemented in accordance with the relevant conditions of development. Generic requirements include the following: · Hours of operation will be restricted to the following: - 6 am to 7 pm Monday to Saturday. · Hours of blasting will be restricted to the following: - 9 am to 3 pm Monday to Friday. · No operations are proposed on Sundays and Public Holidays. · Enclose fixed engines, pumps and compressors where practicable. · Maintain equipment in accordance with the original equipment manufacturer's specifications. · Shut down equipment when not in use. · Reduce vehicle speed to 40 km/hr on internal access roads. · Heavy mobile equipment (e.g. front-end loaders, dozers, haul trucks, excavators) shall be fitted with broadband reversing alarms to mitigate potential nuisance from tonal characteristics of traditional beeper alarms. · Avoid unnecessary operation of plant or revving of mobile or stationary motors and engines. · Fixed and mobile plant and equipment operated at the site should be selected and maintained to minimise noise emissions. Specific quarry layout design requirements recommended by the Noise Assessment are: The proposed Stockpile Area pads will be shielded by earth bunds and/or acoustic barriers at the following locations: a) Northern perimeter of the Western Stockpile Area to a minimum height of 6 metres above the RL21 m pad level.

3.3 Noise Management Plan

b) Southern perimeter of the Southern Stockpile Area to a minimum height of 4 metres above the RL40 m pad level.
c) Northern perimeter of the Southern Stockpile Area to a minimum height of 4 metres above the RL40m pad level.

The northern perimeter of the extraction area will be shielded with an earth bund and/or acoustic barrier to a minimum height of 6 metres above the natural ground level at the northern perimeter of the Extraction Area.

Wherever practicable materials shall be stockpiled at locations that shield noise from internal traffic routes and truck loading areas from the nearest residences. Specific areas to be attended are:

a) Maintain stockpiles along the northern perimeter of the Western Stockpile Area and stock / reclaim from the southern side whenever practicable.
b) Maintain stockpiles along the southern and eastern perimeters of the Southern Stockpile Area and stock / reclaim from the northern and western sides whenever practicable.

An acoustic barrier and/or earth mound to a minimum height of 4 metres above the access road off Seelems Road shall be constructed for a length of 200 metres from the site entry point.

The processing plant shall be operated at the most shielded location available (to the extent practicable). If not practicable then appropriate acoustic screening shall be installed to the crushers, screens and any other processing equipment as necessary to comply with the relevant noise limits.

Commissioning phase noise testing shall be conducted to confirm acceptable siting and/or acoustic treatment of the processing plant.

All raw material haul truck trays are to be lined with an appropriate absorptive material.

The rock pick shall be operated at the most shielded location practically available within the pit to provide acoustic shielding to the north and east.

Drilling should be undertaken using a quietened drill.

Extraction sequencing shall be designed such that the drill rig is shielded to the north by retained topography of minimum height 5 metres above the drilling pad level and supplemented with earth mounding and/or acoustic barriers as necessary to achieve the overall physical shielding.

The internal traffic routes at the north-eastern perimeter will be shielded by topographic cut, earth bund and/or acoustic barrier directly to the northeast of the traffic routes to a minimum height of 4 metres above the adjacent traffic route. Note that the north-western section of this acoustic barrier will not be required once the extraction area is established and traffic directed internally within the pit as the retained topography will achieve the required shielding.

All internal roads for road haulage and off-road trucks shall be constructed and maintained to avoid excessive noise associated with uneven surfaces and potholes.

3.3 Noise Management Plan

Monitoring

The Quarry Manager will:

- Ensure regular surveillance of the site to qualitatively assess noise generation from plant and machinery.
- Ensure all plant and machinery and vehicles are serviced in accordance with, or more frequently than, manufacturers' specifications.
- Initiate a noise survey when requested by the administering authority, or as otherwise deemed necessary, to investigate a noise complaint.

Methods for measurements and reporting of noise monitoring will comply with the current edition of the *NSW Industrial Noise Policy*.

The measurement and reporting of noise levels will be undertaken by a person or body possessing both the qualifications and the experience appropriate to perform the required measurements.

Monitoring must include:

- $L_{Amax, adj, T}$
- Background noise (Background) as $L_{A\ 90, adj, T}$ or $L_{abg, T}$
- Max $L_{pA,T}$
- The level and frequency of occurrence of any impulsive or tonal noise effects due to extraneous factors such as traffic noise
- Atmospheric conditions including wind speed and direction
- Effects due to extraneous factors such as traffic noise
- Location, date and time of recording.

3.4 Blasting Management Plan

Purpose

Blasting will be required to fragment rock to a manageable size that can be transported and fed into the processing plant. Blasting practice has the potential to generate excessive overpressure and vibration impacts that may cause annoyance and discomfort to surrounding neighbours.

Performance Targets

Blasting activities must not exceed the limits for peak particle velocity and air blast overpressure in Table 3 – Blasting Noise Limits when measured at any sensitive place.

Table 3 – Blasting Noise Limits

Blasting criteria	Blasting limits
Airblast overpressure	115dB (Linear) Peak for 95% of blasts initiated and not greater than 120dB (Linear Peak) at any time.
Ground vibration peak particle velocity	5mm/second peak particle velocity for 95% of blasts and not greater than 10mm/second peak particle at any time.

Relevant Conditions

Refer to EPL once issued.

Strategies/mitigation measures

The following control measures may be implemented to assist in mitigating potential noise nuisance from blasting associated with the site activities:

- Unless prior approval is obtained from the EPA blasting is only permitted during the following hours:
  - 9 am to 3 pm Monday to Friday
  - No blasting at any time on Sundays or public holidays.
- Handling, transport and use of explosives shall be carried out in accordance with the requirements of Australian Standard AS2187, and the *Work Health and Safety Act 2011* and associated *Regulation* (also 2011).
- Only suitably experienced and qualified blasting personnel shall be employed or contracted to provide blasting services.
- As per the recommendations of the *Coraki Quarry – Proposed Blast Parameters Evaluation Report v5* (Blast It Global, 7 Sept 2015 blasting will be commenced using a maximum of a 12 m bench height and 89 mm blast holes to ensure compliance with airblast overpressure and blast vibration. After 3 blasts, the results shall be reviewed and evaluated as to whether 102 mm blast holes could be implemented.
- Recommended Blast Exclusion Zones will be established for flyrock protection.
- All blasts shall be face profiled, surveyed and bore tracked to ensure airblast overpressure compliance, combined with the ability to control face burst that can cause flyrock incidents.
- Blast volumes shall be maximised to reduce the frequency of disturbances to the neighbouring properties. A target blast volume of 18,750 m^3 and 15 tonnes of bulk explosive load is recommended. Shot sizes should be limited to a maximum of 3 rows deep initially, to minimise vibration reinforcement if utilising a non-electric initiation system. Once actual blast vibration data has been collected and analysed shot sizes may be increased, if the data supports increasing the blast Maximum Instantaneous Charge (MIC) and remaining under 5mm/s.
- Orientate blasts with free faces not directly facing the sensitive receivers, to assist with airblast overpressure control.
- Initiation sequencing for initial blasts, targeting an MIC of 1 blast hole maximum, until the vibration attenuation can be accurately assessed.
- A blast plan shall be prepared for each blast, containing blast hole layout, initiation sequence, charging, stemming type and height, charge weight and any other design element, required for good blasting practice.

3.4 Blasting Management Plan

	· A blast vibration equation shall be developed specific to the Coraki Quarry. · Blast areas may be dampened down prior to blasting to minimise dispersion of dry and fine materials where practicable, or where it is identified as a source of potential dust nuisance.
Monitoring	Monitoring of blasting activities must be undertaken in accordance with the *NSW Industrial Noise Policy* and the Australian and New Zealand Environmental Council (ANZECC, 1990) *Technical Basis for Guidelines to Minimise Annoyance Due to Blasting Overpressure and Ground Vibration*. Permanent blast monitoring locations will be established at the two closest neighbouring properties. Airblast overpressure and ground vibration monitoring For the purposes of checking compliance with the airblast overpressure conditions and ground vibration conditions and for investigating complaints of noise and vibration annoyance, monitoring must be undertaken and at least the following descriptors, characteristics and conditions determined: 1. maximum instantaneous charge (MIC) in kg 2. location of the blast within the quarry (including which bench level) 3. airblast overpressure level, dB (linear) peak 4. peak particle velocity (mms-1) 5. location, date and time of recording 6. meteorological conditions (including temperature, relative humidity, temperature gradient, cloud cover, wind speed and direction) 7. distance/s from the blast site to noise-affected building/s, structure/s or the boundary of any noise-sensitive place. Where a nuisance complaint regarding airblast overpressure or ground vibration is received, consideration will be given to available monitoring results and locations, and if required or advantageous, a monitor will be installed at an appropriate location in consultations with the administering authority. All monitoring and reporting shall be undertaken by a person or body possessing both the qualifications and the experience appropriate to perform the required measurements.

3.5 Hydrocarbons and Chemical Management Plan

Purpose	The Hydrocarbons and Chemicals Management Plan has been prepared to control the potential for spills or leaks from chemicals and hydrocarbons associated with the extraction activities. Site operations have the potential to contaminate land and water in and surrounding the site by the release of various chemicals used and/or stored on site. These chemicals could include: · distillate (e.g. fuel for stationary and mobile engines) · oils and greases (e.g. lubricants and hydraulic oils for stationary and mobile equipment) · miscellaneous chemicals (e.g. weedicide, paint, solvents).
Performance Targets	The following performance targets are relevant: · No land contamination that would require notification to the RVC. · No serious spills of oils, greases, fuels or other hazardous chemicals (for this purpose, hydrocarbon spill incidents have been classified as follows: minor spill ≤5 L, major spill 5 L to 20 L, and serious spill ≤20 L). · No preventable release of hydrocarbons and chemicals to the environment.
Relevant Conditions	Refer to EPL once issued.
Strategies/mitigation measures	Strategies/mitigation measures for the management of hydrocarbons and chemicals at the site will be implemented in accordance with the relevant conditions of development and may include the following: *General* · Spills are to be cleaned up immediately. · Undertake refuelling and equipment maintenance within designated hardstand or paved areas where practicable. · Maintain all Material Safety Data Sheets (MSDS) and information relating to the storage, use and handling of chemicals at the site office. · Ensure employees are familiar with proper fuelling and spill clean-up procedures. · Induct all new employees on the use of handling of chemicals used on site. · Maintain the site in a neat and tidy condition. · Discourage “topping off” of fuel tanks. · Use drip pans during refuelling and equipment maintenance. *Spill Kits* · Maintain appropriate spill kits at locations known to all employees (e.g. refuelling locations, chemical storage facilities, mobile equipment). · Ensure employees are familiar with proper spill clean-up procedures. *Bunding and Storage* · All chemical storage facilities on site must meet specifications of Australian Standard *AS 1940 - The storage and handling of flammable and combustible liquids*. · Bunding will be constructed of material which is impervious to the material stored and transferred therein.

3.5 Hydrocarbons and Chemical Management Plan

	· Bunds will be kept in good condition (e.g. no cracks, gaps or leaks). · Roofed storage facilities will be provided where practicable. · Stormwater captured within bunding is to be removed as soon as practicable and disposed of as contaminated water. Prior to removal the water is to be free from contaminants. · Empty hydrocarbon and chemical containers are to be stored with closures in place on a concrete hardstand or within a bunded area. · Where vehicle access to the bunded area is required, access must be by way of a rollover bund. · Bunds and/or drains are to be in place to exclude surface waters from washing/degreasing areas.
	Disposal · Hydrocarbon contaminated materials are to be appropriately disposed of at a licensed facility. · If the material is a Classified Liquid Waste, it will be transported and disposed of by a licenced transport contractor. · Oily waste materials, including liquid hydrocarbons, should be segregated from general wastes for disposal off-site by a licensed contractor. · Records are to be kept on disposal of waste for all Classified Waste Materials.
Monitoring	Areas where handling of hydrocarbons and chemicals occur (e.g. refuelling or minor on site servicing) shall be regularly inspected by the Quarry Manager. All employees will be responsible for the safe day-to-day handling, use and temporary storage of chemicals being used on site.

3.6 Waste Management Plan

Purpose	This Waste Management Plan has been prepared to ensure wastes produced on site are appropriately managed. Unmanaged wastes can detract from the amenity of the site and locality and can increase operational costs. The principal wastes that may be generated from the site operations may include, but are not necessarily limited to: · Classified Liquid and Non-Liquid Wastes (e.g. batteries, oil filters, waste oil/hydrocarbons and containers, oil/water emulsions and tyres) · metal and used or faulty parts and equipment · food scraps, packaging and consumables (e.g. paper, cardboard) · green waste. The *Protection of the Environment Operations (Waste) Regulation 2014* is the legislation governing waste management in NSW and the *Environmental Guidelines: Assessment, Classification and Management of Liquid and Non-Liquid Wastes (EPA, 1999*) guide the classification and management of wastes. The waste management hierarchy nominates a preferred order of waste management as follows: *(a) AVOID unnecessary resource consumption;* *(b) REDUCE waste generation and disposal;* *(c) RE-USE waste resources without further manufacturing;* *(d) RECYCLE waste resources to make the same or different products;* *(e) RECOVER waste resources, including the recovery of energy;* *(f) TREAT waste before disposal, including reducing the hazardous nature of waste; and* *(g) DISPOSE of waste only if there is no viable alternative.*
Performance Targets	The following performance targets are relevant: · Apply the waste management hierarchy to the minimisation of waste. · Maintain a record of any disposal of Classified Wastes in accordance with the *Environmental Guidelines: Assessment, Classification and Management of Liquid and Non-Liquid Wastes 1999*. · No unlawful disposal of wastes on or off site.
Relevant Conditions	Refer to EPL once issued.
Strategies/mitigation measures	Strategies/mitigation measures for the management of waste materials at the site will be implemented in accordance with the relevant conditions of the EPL and may include the following: *<u>Waste Avoidance</u>* Waste avoidance relates to preventing the generation of waste or reducing the amount of waste generated. Reasonable and practicable measures for achieving waste avoidance may include, but are not necessarily limited to: · Input substitution (using recyclable materials instead of disposable materials, for example using oil delivered in recyclable steel drums instead of non-recyclable plastic containers). · Increased efficiency in the use of raw materials, energy, water or land (purchasing consumables in bulk (large containers) rather than in small quantities).

3.6 Waste Management Plan

- Improved maintenance and operation of equipment (keep equipment in good working order to reduce wear and overhaul).
- Undertaking an assessment of waste minimisation opportunities from time to time.

Waste Re-use

Waste re-use refers to re-using waste, without first substantially changing its form. Reasonable and practicable measures for reusing waste may include, but are not necessarily limited to:

- Recovering and separating solvents, metals, oil, or components or contaminants and reusing separated solvents for degreasing plant and equipment.
- Applying waste processing fines to land in a way that gives agricultural and ecological benefits (using fine sediments in rehabilitation activities).
- Using overburden for constructing bunds and landforming.
- Reusing silt/sediment on site to the maximum practicable extent.

Waste Recycling

Waste recycling refers to treating waste that is no longer useable in its present form and using it to produce new products. Reasonable and practicable measures may include, but are not necessarily limited to:

- Recovering oils, greases and lubricants for collection by a licensed oil recycling contractor, recovering, separating and recycling packaging (including paper, cardboard, steel and recyclable plastics).
- Recycling used plant and equipment to the maximum practicable extent.
- Finding alternatives to disposal of non-recyclable materials (using conveyor belts for noise attenuation, mudflaps, ute tray liners).
- Providing suitable receptacles and storage areas for collection of materials for recycling.

Energy Recovery from Waste

This refers to recovering and using energy generated from waste. Due to the scale of the operation, energy recovery is not considered viable.

Waste Disposal

This refers to disposing of waste which cannot otherwise be reused, recycled or used for energy recovery. Reasonable and practicable measures may include, but are not necessarily limited to:

- Regulated wastes must be transported and disposed of in accordance with the *Environmental Guidelines: Assessment, Classification and Management of Liquid and Non-Liquid Wastes*.
- Disposal to a licensed waste disposal facility (i.e. landfill or transfer station).

Waste Storage

Waste storage containers or areas to be provided and located at safe and convenient locations at the site. Each container will be identified with the type of wastes which may be disposed of in each container. Each container or area will be designed to prevent the escape of materials.

3.6	Waste Management Plan
	__Classified Waste and Licenced Waste Transport__ Classified waste is commercial or industrial waste, whether or not it has been immobilised or treated and is of a type or contains a constituent of a type listed in *Environmental Guidelines: Assessment, Classification and Management of Liquid and Non-Liquid Wastes 1999*. The *Environmental Guidelines: Assessment, Classification and Management of Liquid and Non-Liquid Wastes* set out the process by which wastes are classified. These will be followed for suspect Classified Wastes. All Classified Wastes will be transported by a licensed commercial transporter.
Monitoring	The Quarry Manager will undertake a monthly visual inspection to ensure the waste management hierarchy is being effectively implemented. All employees and contractors shall be responsible for ensuring wastes are stored and removed from the site on a regular basis (e.g. daily or weekly). The Quarry Manager shall ensure that required waste treatment measures are implemented at the site. The Quarry Manager shall ensure waste receptacles are provided and the waste type identified and that temporary waste storage areas are signed, recycling bins are emptied when full and materials which may cause land contamination are not disposed of on the site. The Quarry Manager shall keep a record of Classified waste generated at the site, treatment and disposal methods, licenced contractors for transporting and disposing of waste and the location of the facility for accepting the waste.

3.7 Fauna and Flora Management Plan

Purpose	This Flora and Fauna Management Plan has been developed to protect fauna and flora within the site. In general, the area proposed to be disturbed for the project is of relatively low ecological value in the context of the surrounding area and particularly in comparison with the adjacent patches of native vegetation. The overall value of the proposed disturbance area (as habitat) has been reduced because of historical clearing and grazing practices, which have significantly reduced areas of cover and facilitated the dominance of exotic vegetation. Nonetheless, the area within the proposed site development footprint (outside of currently disturbed areas associated with Petersons Quarry) still retains some limited habitat of ecological value and provides resources for some terrestrial fauna species. The mosaic of pasture, remnant vegetation and regrowth across the entire site provides resources for species that are adapted to respond to a range of conditions. This Section of the EMP does not address the threatened species (macadamia trees) on the site. Protection of those species is addressed in Section 3.8.
Performance Targets	No damage to fauna and flora within the site.
Relevant Conditions	Refer to Consent and EPL once issued.
Strategies/mitigation measures	Restrict disturbance and access to areas absolutely necessary for the construction and the operation of the Project. Clearly cordon off all adjacent vegetation and buffer extents that are not to be disturbed from clearing activities, creating 'no go zones' for vehicles, materials, machinery, workers, excavated soil or fallen timber. · Implement strict controls on construction and operational/maintenance activities that encroach into buffer areas around wetlands and known populations/habitats of significant species. · Implement measures to avoid the spill of earth and rock downslope of the quarry footprint into areas of retained vegetation. · Design and install temporary erosion control measures to avoid impacts on retained vegetation downslope of the quarry footprint. · Leave ground layer vegetation (grasses and herbs) in situ wherever possible to assist soil stability. Mulching of heavily disturbed areas can assist in reducing soil erosion. Where necessary, temporary interception devices such as hay bales or geotextile fabric fencing can be employed to slow stormwater and intercept sediment. · Non-millable vegetation can be mulched and used in rehabilitation or soil stabilisation works, provided that no weeds are incorporated into the mulch. · Consider the installation of nest boxes in areas where hollow-bearing trees must be removed and relocate large fallen logs and boulder piles to adjacent habitat to increase sheltering opportunities for displaced animals where it is not feasible to avoid such features during clearing.

3.7 Fauna and Flora Management Plan

Strategies/mitigation measures (continued)	· Ensure a fauna spotter/catcher is present during clearing and site preparation works to: - Check habitat (vegetation, logs, rock outcrops) for fauna and breeding sites, - Check any stored materials, including stockpiled timber, prior to removal, - Check temporary excavations for trapped fauna, and - Ensure appropriate treatment of injured/orphaned animals through liaison with local Wildlife Carers. · Establish ‘go slow zones’ (40 km/hr) for vehicles and machinery where non-gazetted roads or tracks are located adjacent to patches of native vegetation communities. · Limit construction and operational work to daylight hours as far as practicable, and any lighting within outdoor areas should comply with relevant Australian Standards and be of low spillage, with no or limited upward spillage. · Minimise vehicle and machinery access and subsequent soil compaction and weed transfer risk within and adjacent to retained vegetation. · Undertake regular monitoring of the health and condition of retained vegetation and habitat, and the health of significant plant specimens. · Undertake regular monitoring of road kills. · Educate the workforce on the location of significant/sensitive communities and species and potential impacts from unauthorised activities.
Monitoring	All employees on site shall carry out general daily visual surveillance for cordoned off areas within the quarry. The Quarry Manager shall: · Conduct a weekly inspections of all areas and access routes on site to ensure that cordoned off areas are maintained in an undisturbed state. Disturbance of cordoned off areas will be reported to senior management and corrective action taken to protect the disturbed area.

3.8 Threatened Species Management Plan

Purpose	This Threatened Species Management Plan has been developed to ensure adequate control measures are implemented to control impacts on those species of Flora and Fauna that have been categorised as 'Threatened'. This management plan has been adapted from that detailed in the Biodiversity Assessment Report prepared by the consultants BAAM as part of the EIS.
Performance Targets	The following performance objectives and targets have been identified for Threatened Species management: · On site establishment of procedures and responsibilities · Backup propagation material is collected for Macadamia tetraphylla · Edge-seal planting of the 25 metre buffer perimeter · The buffer area is delineated and cordoned off to prevent vehicular and pedestrian traffic intrusion. · Macadamia tetraphylla and vegetation monitoring · Removal of major weed infestation within the buffer (see Weed Management Plan)
Relevant conditions	Refer to Consent and EPL once issued.
Strategies/mitigation measures	*Management Actions to avoid and mitigate impacts to Macadamia tetraphylla* A pre-start meeting is to be arranged by the Quarry Manager to clearly define roles and the approach to Macadamia tetraphylla management. Seeds are collected for use as backup propagation source if mortality of existing Macadamia tetraphylla individuals occurs following clearing. The perimeter of the 25 m buffer is to be planted with locally native species to prevent weed intrusion. · Undertake regular monitoring of the health of the retained Macadamia tetraphylla specimens and surrounding vegetation. · Ensure monitoring is conducted by personnel experienced in flora surveying. · Delineate and cordon off the buffer area to prevent vehicular and pedestrian traffic intruding. · Ensure personnel do not disturb (i.e. trample) retained or regenerated vegetation. Any major weed infestation within the 25 metre buffer will be removed appropriately.
Monitoring	The following monitoring schedule has been proposed for each of the above strategies: · The pre-start meeting is to occur prior to commencing works. · Back-up propagation sources is to occur prior to works commencing and every 12 months following clearing. · Edge-seal planting of the 25 metre buffer perimeter is to occur post clearing · Macadamia tetraphylla and vegetation monitoring is to occur after two weeks, six weeks and three months, then on a bi-annual basis for two years following completion of works · Removal of major weed infestation within the buffer is to be undertaken immediately after the clearing and if adaptive management is triggered during monitoring thereafter.

3.9	Weed Management Plan
Purpose	This Weed Management Plan has been developed to ensure adequate control measures are implemented to control the spread and infestations of weeds and declared plant species within the site. Weed impacts that may occur due to the extractive industry operations include: · areas of exposed earth available for weed colonisation including topsoil stockpiles · spread of existing weed infestations due to disturbance and vehicle traffic · unsuccessful or weed-infested revegetated areas. The *Noxious Weeds Act 1993* (The Act was last amended on 1 January 2014) (NW Act) provides for the identification, classification and control of noxious weeds. The NW Act imposes obligations on occupiers of land to control noxious weeds declared for their area.
Performance Targets	Prevent the introduction and spread of noxious weeds on the site.
Relevant Conditions	Refer to EPL once issued.
Strategies/mitigation measures	Specific control measures to be implemented may include, but not necessarily be limited to the following strategies. *General* · Noxious weed infestations are to be controlled as soon as possible to prevent further spread of weeds. · Maintain groundcover for as long as possible by minimising land disturbance at any one time, where practicable. · Annual weed spraying campaigns should be implemented at the site, with additional spraying campaigns (e.g. spot spray, bi-annual sprays, etc.) undertaken if necessary. · Noxious weeds identified on site will be prioritised for weed management according to the class of weeds identified, and the cause of the weed establishment will be determined to prevent or minimise further introduction and spread. · Weed plant materials and seed should be disposed of at a Council refuse station, or buried at an appropriate depth on site, whenever possible. · Employees should be trained appropriately to recognise existing and potential weeds present on site and within the surrounding area to ensure they are not inadvertently brought onto the site via items contaminated by seed (e.g. vehicles, machinery, hand tools, soil, mulch or livestock). · Obtain pest free certification for any soil, fill, mulch, etc. entering the site. · Appoint a person responsible for regularly monitoring for potential pest occurrences (and treatment if required) of equipment, vehicles, machinery and materials (including soil, mulch, fill) entering the site. · If areas containing noxious weeds are encountered, clean all equipment, vehicles and machinery prior to leaving the area. · Species-specific control methods are to be used in accordance with State government guidelines. *Access Roads/Hardstand areas* · All access routes and hard stand areas will be maintained in a weed-free or weed-reduced state, to lessen the spread of weed seed by vehicle movements. · Established roads and tracks should be used wherever possible and noxious weed-infested areas / sites are to be avoided.

3.9 Weed Management Plan

Topsoil Management

- Visual surveys will be undertaken prior to all topsoil stripping operations and, if necessary, control mechanisms will be undertaken to reduce the risk of the contamination of topsoil stockpiles with seed and vegetative weed material.
- Weed control mechanisms may include separate stockpiling, herbicide spraying of stripped soils, or disposal as fill of soil materials infested with weeds.
- Weed control mechanism strategies will be implemented to control weed infestation if required, both before and after use of top-dressing material in the rehabilitation program.
- All topsoil stockpiles will be regularly monitored and managed for weed infestation.

Rehabilitation

- Implement progressive rehabilitation as soon as practical as areas become available.
- Avoid importing topsoil onto the site where possible.
- Prior to the establishment of vegetation:
    - a spraying campaign may be required to prevent migration or establishment of weed species into the area under rehabilitation
    - alternative methods for controlling both grasses and weeds may be used, including manual weeding, burning, slashing, weed matting and mulching, where practicable.

Weed Control Methods

As a guide to assist in planning weed control, a summary of weed control options that may be implemented are presented in Table 4 – General Weed Control Options

Monitoring

All employees on site shall carry out general daily visual surveillance for weeds within the quarry and ensure that vehicles leaving site are free of soil and vegetation.

The Quarry Manager shall:

- Conduct weekly inspections of all access routes on site to ensure they are maintained weed free or in a reduced state to lessen the spread of weed seed by vehicle movements.
- Conduct inspection of any area/s and treat any weed infestations prior to topsoil removal.
- Carry out at least four thorough inspections per year of the quarry to identify:
    - effectiveness of weed control measures implemented and whether an amendment is required
    - new areas where weed control is required
    - infestations of new weed species
    - areas where rehabilitation should be carried out.

Note: The frequency of inspections will vary depending on the identified weed species on-site and what management requirements are necessary for those species.

Table 4 – General Weed Control Options

Infestation Level	Biological	Chemical	Mechanical	Physical
Low (Canopy cover between 1% and 10%)	Not suitable.	Spot-spraying by hand with a registered herbicide.	Not suitable.	Hand grubbing (remove roots and burn plant).
Medium (Canopy cover between 11% and 50%)	Release of biological control agents.	Spot-spraying by hand with a registered herbicide.	Chaining, rolling, raking or back-ploughing, then burning.	Follow up control of seedlings – could include physical removal.
High (Over 50% canopy cover)	Inspect infestation to see if, and what, bio-control agents are already present. If necessary, release biological control agents and monitor their progress.	Aerial spraying with a registered herbicide.	Chaining, rolling or raking. Use fire to kill any regrowth and break seed dormancy.	Follow up control of seedlings – could include physical removal.

3.10 Rehabilitation Management Plan

Purpose	This Rehabilitation Management Plan has been prepared to guide planning, landforming, revegetation, maintenance and environmental management associated with land disturbed by extraction activities at the site. Extractive industry is a temporary land use. Designing and implementation of rehabilitation works is therefore an important element of an extractive industry. Integration of rehabilitation and extractive operations assists in cost control as well as minimising potential environmental impacts. Potential impacts resulting from extractive industry include: · Soil erosion · Pollution of storm water run off · Sedimentation of waterways · Increased nutrient loads in waterways · Introduction of weed species · Potential clearing of vegetation · Potential loss of habitat and biodiversity. This Rehabilitation Management Plan is relevant only to Lot 401, as the existing Petersons Quarry will remain as an operational quarry. The access road on Lot 403 DP 802985 will remain as an access road to Lot 401 and will not require rehabilitation.
Performance Targets	Performance targets nominated for rehabilitation of the site are to: · Return the site to a safe, stable, non-polluting state, suitable for reinstatement of previous land use (i.e. rural – cattle grazing). · Maintain the general amenity (visual, air quality, water quality, etc.) of the surrounding area. · Prevent the degradation of non-operational areas. · Limit land disturbance to that which is necessary at any one time. · Identify any land contamination and implement appropriate remediation or management where necessary. · Ensure progressive rehabilitation is carried out during the progression of quarry activities where practicable and commence progressive rehabilitation as areas become available. · Select suitable plant species for revegetation. · Reinstate stable drainage patterns. · Prevent the introduction or spread of declared weeds and pest species.
Relevant Conditions	Refer to EPL once issued.
Strategies/mitigation measures	Strategies/mitigation measures for the management of rehabilitation activities at the site will be implemented in accordance with the relevant conditions of development and may include the following: *<u>Rehabilitation Staging</u>* The staging of the rehabilitation works will follow the sequence of quarry development as terminal benches are reached. The terminal benches on the southern side of Lot 401 will ultimately be subsumed by the eastwards extension of the Petersons Quarry on Lot 402 DP802985 hence will not require rehabilitation. There will remain a wall, but no benches, on the northern side of Lot 401, hence no benches in this area of the quarry requiring rehabilitation. The western benches of Lot 401 represent the western edge of development

3.10 Rehabilitation Management Plan

which will be achieved at the end of the life of the project. These benches will therefore be rehabilitated at the end of the Project life.

Final Land Use

The following measures shall ensure that the landform created by extraction activities is stable and is connected into the surrounding landscape:

- Using earthmoving equipment to progressively shape and trim the workings to the desired design profiles and flattening the gradients of selective batters to a stable angle of repose on reaching the terminal limits of extraction.
- Rounding or marrying the contours into the natural ground surface.
- Scaling down loose rock.
- Topsoiling and grassing of contours.
- Providing access to the terminal workings to allow maintenance of rehabilitation works.
- Designing landform and drainage to control erosion for the particular hydrological regime.
- Where necessary, planting media should be spread and shaped over selected rock faces and topsoiled to assist in retaining precipitation and controlling sediment movement.

Terminal quarry benches shall be battered to varying slopes depending on the geotechnical properties of the substrate.

Once quarry operations are completed, the extraction floor will be contoured to a gentle grade to establish a free draining platform. The area will be covered in topsoil to a suitable depth and seeded with paddock grass species to return the land to its current use of cattle grazing.

The stock dam to be developed as a sediment dam on the western extremity of the site (see Drawing 1837.027) adjacent to the Indigenous Heritage Non-Disturbance Zone will remain after the cessation of the Project as a stock dam and not require rehabilitation.

Topsoil Management

Topsoil and any overburden / remaining extracted material on site will be used as part of the rehabilitation of the final landform. Topsoil supports and promotes plant growth, soil micro-organisms, organic matter and nutrients. Topsoil is defined as the organic rich, friable layer beneath the natural ground surface. The physical properties of topsoil are important for promoting and supporting plant growth.

The following measures should be implemented for topsoil stripping:

- Topsoil should not be stripped when it is too wet or too dry.
- Topsoil when stripped should be used directly for rehabilitation to the maximum practicable extent, or stockpiled and preserved for future use.
- Stockpiling of topsoil should not exceed a height of 2 to 3 m and should be shaped (i.e. batters no greater than 2:1) and revegetated to protect the soil from erosion and weed infestation.
- Stockpiles should be maintained in a free draining condition and long-term soil saturation should be avoided.

3.10 Rehabilitation Management Plan

- Runoff waters external to the areas to be stripped should be diverted away from the working area.
- Stripping of topsoil should be limited to the minimum area necessary.

The following measures should be implemented for topsoil spreading:

- Whenever possible, stripped topsoil should be directly placed on an area undergoing rehabilitation.
- Areas to be topsoiled should be re-shaped prior to placing topsoil.
- Equipment used to spread topsoil should be scheduled to avoid compaction.
- Before respreading the topsoil, loosen the subsoil to break up any compacted or surface sealing and to enable keying of the two (2) soils.
- On slopes less than 3:1, loosen lightly compacted subsoil with a tined implement ensuring all ripping operations occur along the contour.
- Topsoil is to be removed from stockpiles in a manner that avoids vehicles travelling over the stockpiles.
- Topsoil is to be respread in the reverse sequence to its removal so that the original upper soil layer is returned to the surface to re-establish the entrapped seed content of the soil.
- Ensure all exposed subsoils are covered.
- Topsoil is to be respread over selected batters, contours, bunds and disturbed areas to a minimum thickness of 100 mm.
- After spreading topsoil, ensure the surface is left in a roughened state to assist moisture infiltration and inhibit soil erosion.
- Prior to any planting, cultivate any compacted or crusted topsoil surfaces.
- Soil spreading is to be immediately followed by seeding or planting if applicable.
- Straw or organic mulch may be spread over the soil to minimise potential soil erosion until the area is revegetated.
- If erosion occurs on treated surfaces, the area is to be re-topsoiled and sown with cover grass.

Revegetation

There are a range of methods for establishing vegetation that may include; natural regeneration, hydro-mulching, seed broadcasting, seedling planting and direct seeding. Natural regeneration followed by seed broadcasting shall be the preferred method of establishing vegetation. All methods shall be accompanied by appropriate weed control to prevent rehabilitated areas from being overrun with weed species.

The quarry floor and former stockpile areas will be revegetated using suitable pasture species in order to return the area to its current use of cattle grazing.

Weed and Pest Control

Any materials (e.g. earth, soil, mulch and straw) brought onto the site for rehabilitation shall be inspected to ensure the materials are free from weeds and pests. Prior to the establishment of vegetation, a spraying campaign may be required to control weeds to prevent migration of weed species into areas under rehabilitation. Alternative methods for controlling both grass and weeds include manual weeding, slashing, weed matting and mulching. Predation (e.g. grazing animals, birds, kangaroos, hares, and insects) are risks for revegetation. Depending on the situation, specific measures may be required to protect the works from predation such as fencing, barriers, etc.

3.10 Rehabilitation Management Plan

Buffers

- Site perimeter to be fenced to the extent necessary.
- Work areas to be clearly defined.
- Vehicles limited to defined tracks.

Monitoring

Once rehabilitation commences, the Quarry Manager shall undertake a monitoring program to review the ongoing success of the rehabilitation treatment. Rehabilitation measures including landform stability, long-term sediment and erosion controls and revegetation of profiled final land surfaces will be visually monitored by the Quarry Manager and, where relevant, assessed by technical experts to determine the effectiveness of measures implemented. The Quarry Manager may engage a suitably qualified consultant to monitor the establishment of vegetation and land stability.

The key parameters to be measured as part of the monitoring program will include:

- Erosion
- Groundcover
- Vegetation species (richness of desired species)
- Weed presence.

The Quarry Manager shall conduct regular inspections of any rehabilitated areas to ensure timely maintenance works are carried out as necessary. Maintenance works may include fertilising, watering, repairs to barriers, guards and plant failure replacements, refer to Table 5 – Maintenance Schedule for Revegetation Works.

Table 5 – Maintenance Schedule for Revegetation Works

Item	Activity	Frequency
Weed Control		
Site Preparation (where necessary)	Application of herbicide and / or slashing	One (1) treatment at least two (2) weeks prior to seeding / planting
Ongoing Weed Management	Application of herbicide	Suggested biannually or as required
Supplementary Weeding	Application of herbicide	As required
Revegetation Management	Monitor performance and conduct any necessary maintenance	· One month after seeding / seedling planting. · Three (3) months after seeding / seeding planting. · Six (6) months after seeding / seedling planting. · 12 months after seeding / seedling planting. OR · following significant rainfall events (e.g. >25 mm).
	Replace diseased or dead plants	As necessary following maintenance inspections
	Fertilise (if applicable)	Two (2) months after topsoil spreading or seeding
	Apply mulch (if available)	One-off around plantings
Weed Control		
Site Preparation (where necessary)	Application of herbicide and / or slashing	One (1) treatment at least two (2) weeks prior to seeding / planting
Ongoing Weed Management	Application of herbicide	Suggested biannually or as required
Pasture Management		
Grass Height	Slashing	Biannually until established
Grass Vigour	Fertilise	Annually (if necessary)

3.11 Cultural Heritage Management Plan

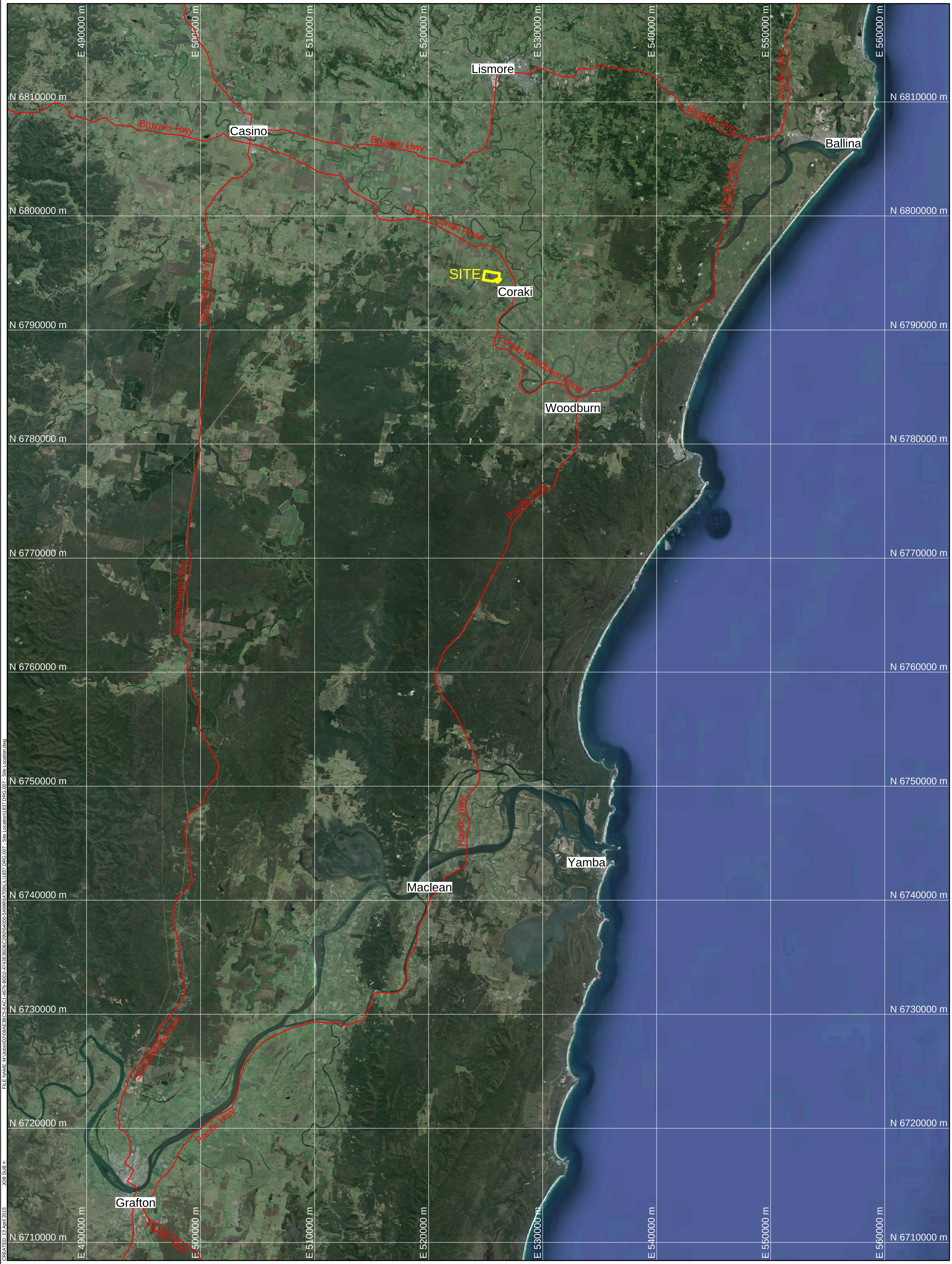
Purpose	Areas of interest of cultural heritage have been identified on the site. A standalone Cultural Heritage Management Plan will be developed by appropriately qualified persons in conjunction with local Aboriginal experts.

3.12 Emergency Response Plan / Pollution Incident Response Management Plan

Purpose	The existing Petersons Quarry Pollution Incident Response Management Plan (PIRMP) will be revised in order to provide coverage to the Project. The fundamental elements of the PIRMP will remain unchanged.

29/09/2015
1837.610.002

drawings



CREATED: 13 April 2015 JOB SUB #: FILE NAME: M:\Jobs\ID2\08AE3BC5-EAC1-4676-B0D2-4743E36DBC29\0\54000-54999\54709\LL\1837.DRG.007 - Site Location\1837.DRG.007 - Site Location.dwg

REV	DESCRIPTION	DATE	BY
1	Revised site boundary	07/09/15	LT

Data Sources:
Photography: Google. Image date: 2013-04-10
Topography:
Cadastre:
Ecosystem:
Other:

Legend:

🟨	Site Boundary
🟥	Major Road

N

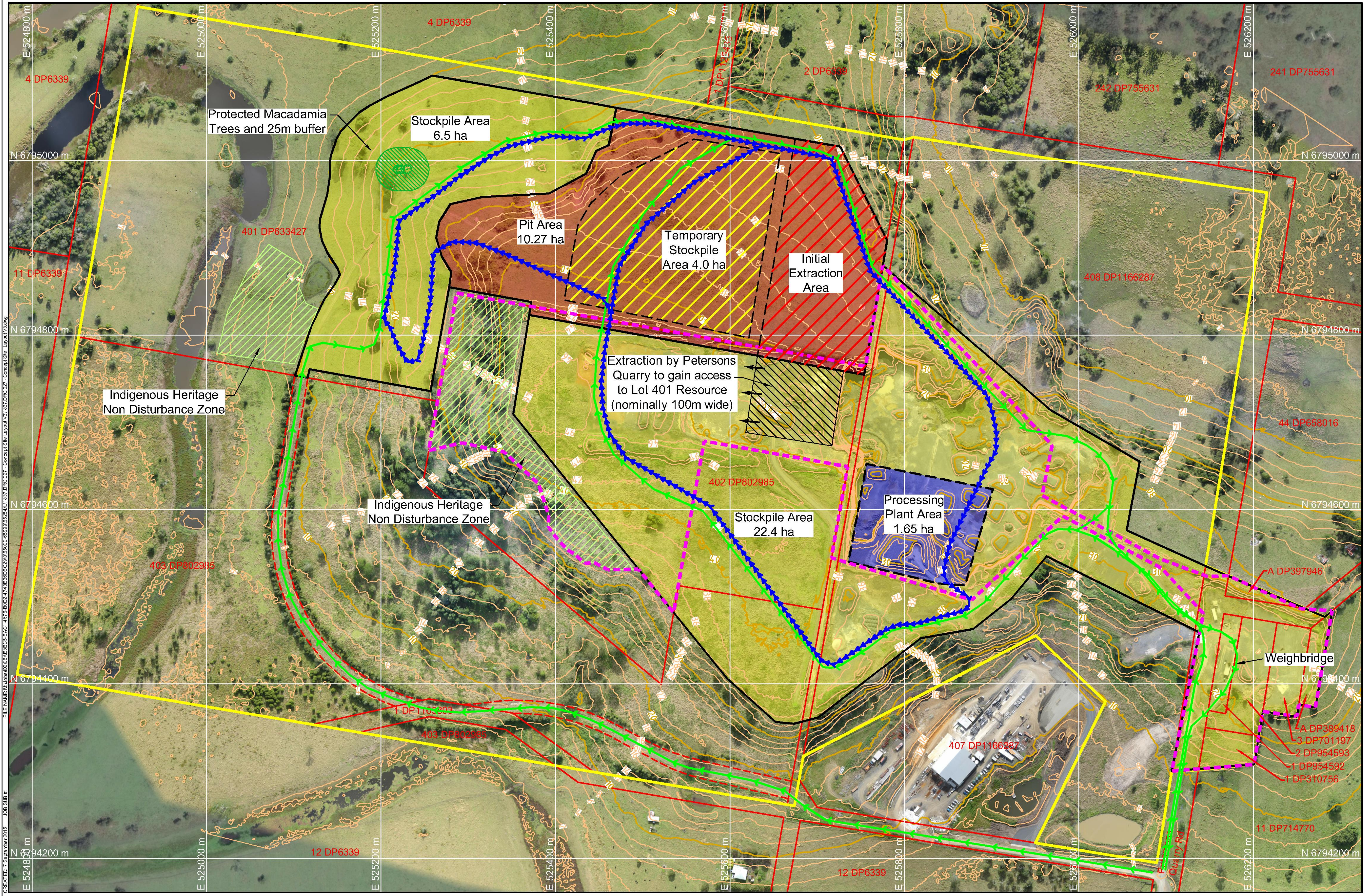
PROJECT:
Coraki Quarry

CLIENT:
Quarry Solutions Pty Ltd

TITLE:
Site Location Plan

GROUNDWORK plus
PH: +61 7 3871 0411
WWW.GROUNDWORK.COM.AU

SCALE: 1:300,000 When Printed On A3	0 – 6km	DRAWING NUMBER: 1837.DRG.007	REVISION: 1
DATE: 7 September 2015	DRAWN: LT	DATUM: HORIZONTAL / VERTICAL / ZONE	
PRINTED: 10 September 2015	CHECKED: JL	MGA / / 56	



REV	DESCRIPTION	DATE	BY

Data Sources:
Photography: UAV Survey 2015-07-02; Google. Image date: 2014-12-18
Topography: UAV Survey 2015-07-02
Cadastre:
Ecosystem:
Other:

Legend:
- 🟨 Site Boundary
- 🟥 Cadastral Boundary
- ▬ ▬ Approved Quarry Expansion Footprint
- ← On Road Truck Movement
- ◀◀◀◀ Off Road Truck Movement

N

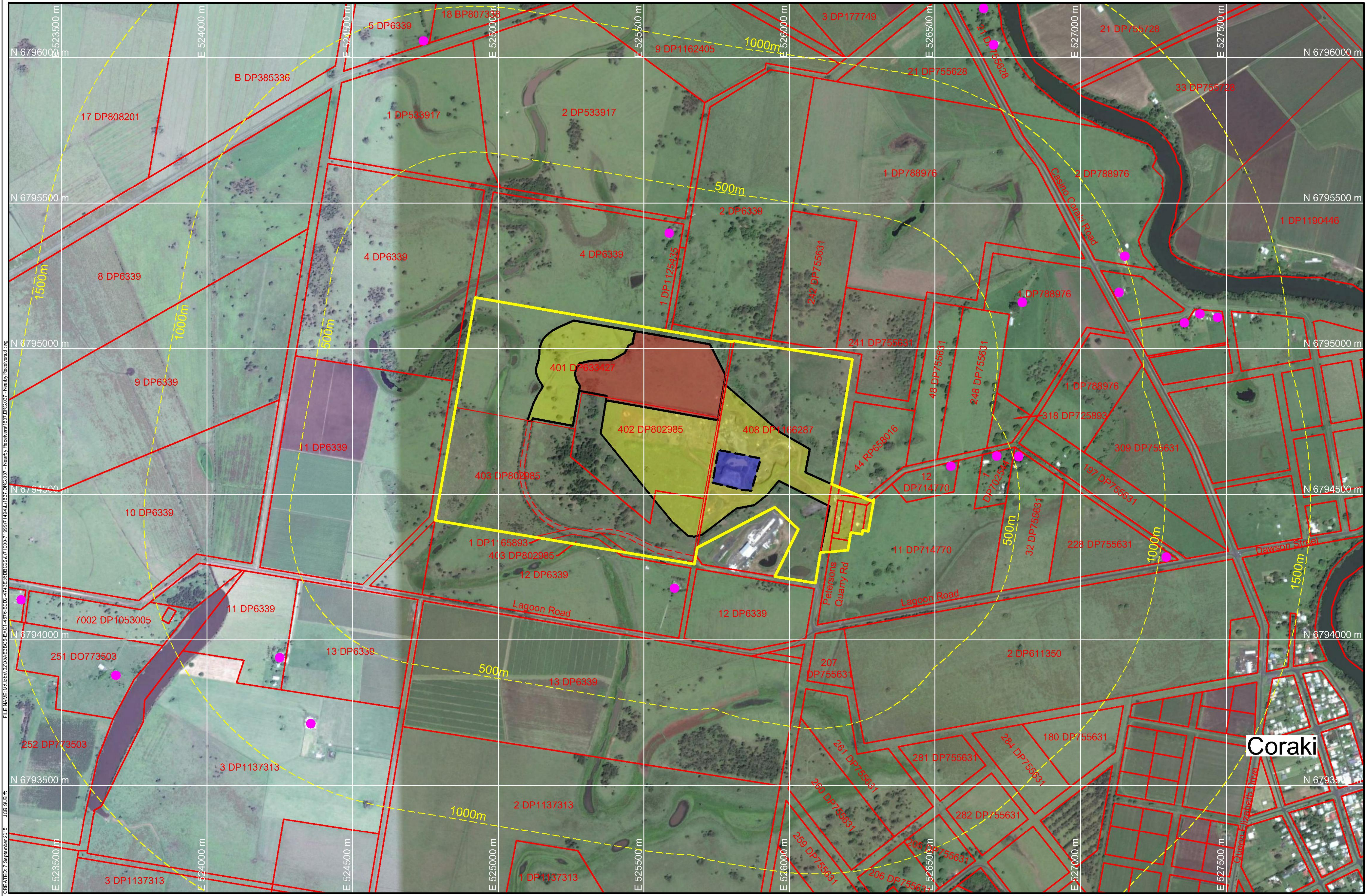
PROJECT: Coraki Quarry

TITLE: Conceptual Site Layout Plan

CLIENT: Quarry Solutions Pty Ltd

GROUNDWORK plus
PH: +61 7 3871 0411
WWW.GROUNDWORK.COM.AU

SCALE: 1:4,000 When Printed On A3 0 80
DRAWING NUMBER: 1837.027
REVISION:
DATE: 7 September 2015
PRINTED: 7 September 2015
DRAWN: LT
CHECKED: JL
DATUM: HORIZONTAL / VERTICAL / ZONE MGA / AHD / 56



CREATED: 7 September 2015 JOB SUB #: FILE NAME: M:\Jobs\D2\08AE3BC5-EAC1-4676-B0D2-4743E36DBC29\0\71000-71999\71494\L\1837.DRG.037 - Nearby Receivers\1837.DRG.037 - Nearby Receivers.dwg

REV	DESCRIPTION	DATE	BY

Data Sources:
Photography: Google. Image date: 2014-12-18
Topography:
Cadastre:
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. ABN: 80 829 145 906

Legend:
- Site Boundary
- Cadastral Boundary
- ● Nearby Sensitive Receptor
- Distance from Site
- 🟥 Proposed Quarry Area
- 🟨 Proposed Stockpile Area
- 🟦 Proposed Plant Area

N

PROJECT:
Coraki Quarry

TITLE:
Nearby Sensitive Receptors

CLIENT:
Quarry Solutions Pty Ltd

GROUNDWORK plus
PH: +61 7 3871 0411
WWW.GROUNDWORK.COM.AU

SCALE: 1:12,000 When Printed On A3 0 240

DRAWING NUMBER: 1837.DRG.037

REVISION:

DATE: 7 September 2015
DRAWN: LT
PRINTED: 7 September 2015
CHECKED: JL

DATUM: HORIZONTAL / VERTICAL / ZONE
MGA / AHD / 56

attachments

Attachment 1

Incidents and Complaints Procedure

Incidents and Complaints Procedure

The objective of the Incidents and Complaints Procedure is to ensure that incidents and complaints are reported, investigated and appropriate action is taken. A summary of the Incidents and Complaints Procedure is provided below in Diagram 1 – Incidents and Complaints Procedure Summary. For further details regarding each element of the procedure refer to Attachment 1 – Incidents and Complaints Procedure.

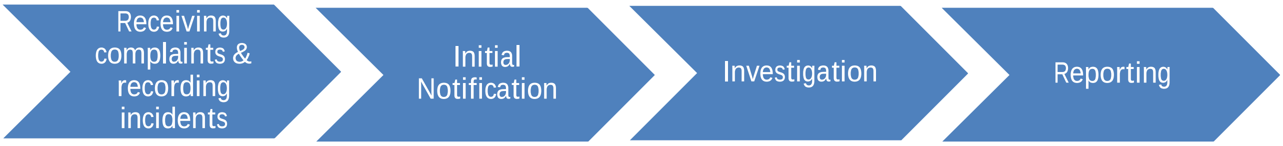


Diagram 1 – Incidents and Complaints Procedure Summary

Receiving Complaints/Recording Incidents

The Quarry Manager will be responsible for ensuring that all employees at the site are familiar with the procedure for incidents and complaint recording. The Quarry Manager will liaise personally with the complainant to discuss the nature of the complaint, identify possible causes and explain actions to prevent further complaints.

All complaints received or any employee involved in an incident having environmental implications or who becomes aware of any situation that develops into an incident, shall be reported to the Quarry Manager or delegate as soon as practicable. Employees are to show respect and understanding to complainants.

The following details shall be recorded at the receipt of an incident or complaint:

- date, time, location and nature of the incident or complaint
- type of communication (telephone, letter, email, personal, etc.)
- name, contact address and contact telephone number of the person reporting the incident or complaint (i.e. note: if the complainant does not wish to be identified then '*not identified*' is to be recorded)
- details of incident or complaint
- response and investigation undertaken as a result of the incident or complaint
- name of person responsible for receiving and/or investigating the complaint
- response and investigation undertaken as a result of the complaint
- action taken as a result of the complaint investigation and signature of responsible person.

Step 1. Notification

When an environmental incident/complaint occurs, the Quarry Manager will notify the administering authority via telephone on 131 555 (Pollution Hotline) or local office as soon as practicable after becoming aware of any release of contaminants not in accordance with the conditions of the approval. A standard form for such notification is attached see below – INITIAL NOTIFICATION FORM.

Step 2. Investigation

All incidents and complaints should be investigated. The investigations should include:

- determining what activities (and equipment) were being carried out or operated at the time of the complaint/incident
- determining whether, at the time of the complaint, normal day to day activities were conducted
- identifying whether equipment or activities on site were the source of complaint (or whether other activities in the locality were the cause of the complaint)
- determining what potential actions may be carried out to resolve complaint and/or minimise the likelihood of further complaint or release of contaminants to the environment.

Appropriate action is to be undertaken as soon as practical, but no longer than two days, to either determine the source of the complaint, and/or minimise further impact in the case of an incident. Corrective action is to be implemented and an assessment conducted to determine what, if any, preventative action can be implemented to prevent a similar incident from occurring again. All incidents and complaints reported shall be filed in a complaint/incident register available on the site.

The incident/complaint form shall be checked by the Quarry Manager two (2) weeks after receipt of complaint to ensure appropriate corrective action has been taken and that the issue has been resolved. If monitoring is undertaken to investigate a complaint the Quarry Manager, or the consultant commissioned to undertake the study/survey, an objective summary of the results of the study/survey shall be provided to the complainant.

Step 3. Reporting

Within 14 days of the incident/emergency, in addition to the information provided in the initial notification form, provide further information to the administering authority as shown in the attached form (see FURTHER NOTIFICATION FORM).

Within fourteen (14) days of the incident/emergency the written advice of the results of any environmental monitoring (not previously supplied) in relation to the incident/emergency shall be supplied to the relevant regulatory authority.

EMERGENCY AND INCIDENT

Environment Protection Authority Initial Notification Form

This form is to be completed when notifying the EPA of any emergency or incident, which has or may cause environmental harm. The EPA is to be contacted by telephone or facsimile (of this form) within 24 hours after becoming aware of the emergency or incident.

Date: ....

Environmental Protection Licence (EPL) Number: ....

Operator's name: ....

Your name: ....

Site location: ....

Name and telephone number of contact person: ....

....

Location of emergency or incident within Site: ....

....

Time of the emergency / incident / event: ....

Time that operators became aware of the emergency / incident / event: ....

The suspected cause of the emergency / incident / event: ....

....

The environmental harm caused, threatened, or suspected to be caused by the emergency / incident / event:

....

....

....

Actions taken to prevent further environmental harm and mitigate any environmental harm caused by the emergency / incident / event:

....

....

....

....

....

....

....

....

....

....

Name: .... Signature: ....

EMERGENCY AND INCIDENT

Environment Protection Authority Further Notification Form

Not more than 14 days following the initial notification of an emergency or incident, the holder of the EPL must provide the following written advice along with the initial notification form.

This record must be kept for a period of five (5) years.

EPL Number ....

Designated contact person: ....

Date of Event: ……/……/…… Time of Event: ……………. am/pm

Proposed action to prevent a recurrence of the emergency / incident / event:

....

....

....

Outcomes of actions taken at the time to prevent or minimise environmental harm and / or environmental nuisance:

....

....

....

Results of any environmental monitoring performed:

....

....

....

Further comments:

....

....

....

....

....

....

....

Name: .... Signature: ....

Attachment 3

Aboriginal Cultural Heritage Assessment Report

New South Wales Archaeology Pty Ltd ACN 106044366

Coraki Quarry,
Seelems Road, Coraki NSW
Aboriginal Cultural Heritage Assessment Report

Date: 30 September 2015
Author: Dr Julie Dibden
Proponent: Quarry Solutions
Local Government Area: Richmond Valley Council

www.nswarchaeology.com.au

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF PLATES

LIST OF TABLES

SUMMARY

This summary presents an overview of the legislative context, proposed development, subject area, *and* study aims, conclusions and recommendations.

The National Parks and Wildlife Act 1974 (NPW Act) is the primary legislation for the protection of some aspects of Aboriginal cultural heritage in NSW. One of the objectives of the NPW Act is:

> *… the conservation of objects, places or features (including biological diversity) of cultural value within the landscape, including but not limited to: (i) places, objects and features of significance to Aboriginal people … (s.2A(1)(b)).*

Part 6 of the NPW Act is administered by the NSW Office of Environment and Heritage (NSW OEH) and provides specific protection for Aboriginal objects and declared Aboriginal places by establishing offences of harm. Harm is defined to mean destroying, defacing or damaging an Aboriginal object or declared Aboriginal place, or moving an object from the land. Anyone proposing to carry out an activity that may harm an Aboriginal object or declared Aboriginal place must investigate, assess and report on harm that may be caused by the activity they propose.

An Aboriginal Heritage Impact Permit (AHIP) may be required if harm to Aboriginal objects and/or declared Aboriginal places is proposed. When this is the case, an Aboriginal Cultural Heritage Assessment Report (ACHAR) is necessary to support the AHIP application.

Quarry Solutions (the proponent) is preparing a development application for a hard rock quarry at Seelems Road, Coraki, New South Wales. The Coraki Quarry would establish a new extraction and stockpiling area on Lot 401 DP633427 whilst utilising the existing Petersons Quarry land to establish the processing plant and additional stockpile area. The project satisfies the criteria for State Significant Development pursuant to the State Environmental Planning Policy (State and Regional Development) 2011 and therefore requires development consent under the Environmental Planning and Assessment Act 1979.

An Environmental Impact Statement (EIS) has been prepared in accordance with the Secretary's Environmental Assessment Requirements (SEARs) issued by the Secretary of the Department of Planning and Environment on 22 May 2015 and revised on 30 July 2015. The SEARs for the proposal include the requirement for an Aboriginal cultural heritage assessment (addressing both cultural and archaeological significance) which must demonstrate effective consultation with Aboriginal communities in determining and assessing impacts, and developing and selecting mitigation options and measures.

This assessment has been conducted in accordance with the NSW Office of Environment and Heritage's (NSW OEH 2011) *Guide to investigating, assessing and reporting on Aboriginal cultural heritage in NSW* and *Code of Practice for Archaeological Investigation of Aboriginal Objects in New South Wales* (NSW DECCW 2010a).

A process of Aboriginal community consultation has been undertaken in accordance with the guidelines as set out in OEH's *Aboriginal cultural heritage consultation requirements for proponents 2010* (NSW DECCW 2010b).

The study has sought to identify and record any Aboriginal cultural areas, objects or places and to assess the archaeological potential of the proposal area, and to formulate management recommendations based on the results of community consultation, background research, field survey and significance assessment.

A search of the NSW OEH Aboriginal Heritage Management Information System (AHIMS) has been conducted (AHIMS Reference: 170901). Some 27 Aboriginal object sites are listed in the search, one of which is in the subject area. AHIMS site #04-4-142 has information restrictions and its nature is not discussed further here. It is located on the site of the existing Petersons Quarry and within a previously defined *Indigenous Heritage Non Disturbance Zone*.

A cultural heritage and archaeological survey for Aboriginal areas, objects and places has been conducted by archaeologists Julie Dibden and Andrew Pearce, NSW Archaeology Pty Ltd and Daryl Knight, Bogal Local Aboriginal Land Council.

The subject area was found to be highly disturbed by previous agricultural and quarrying land use. No Aboriginal object sites were recorded. Generally, the subject area has been found to be of low archaeological sensitivity and significance. However, one landform situated in close proximity to Seleems Creek is assessed to be of some greater archaeological potential and significance. This area is considered to be an archaeologically sensitive landform and for the purposes of this assessment is named *Sensitive Archaeological Landform - SAL 1*.

As a result of the assessment the following conclusions are made:

- No Aboriginal objects have been recorded in impact areas.
- One area classified as a Sensitive Archaeological Landform (SAL 1) has been identified. This area would be excluded from any impacts associated with the development and formally set aside as an Aboriginal Heritage Conservation Zone.
- A previously identified AHIMS site is present on the site of the existing Petersons Quarry and is currently protected in an Indigenous Heritage Non Disturbance Zone. This would be retained and respected for the proposed Coraki Quarry project.
- Management and mitigation measures are discussed in Section 7 and these should be given consideration during the formulation of the Aboriginal Heritage Management Plan (see below).
- An Aboriginal Heritage Management Plan (AHMP) should be developed by the project archaeologist, in consultation with the NSW OEH and Registered Aboriginal Parties. The Cultural Heritage Management Plan would set out procedures relating to the management and mitigation of development impacts, a protocol for the

management of unexpected archaeological finds and the conservation of areas outside the extraction footprint, as required.

Acknowledgments

Archaeological evidence confirms that Aboriginal people have had a long and continuous association with the region for thousands of years. We would in particular like to acknowledge and pay our respects to the traditional owners of the country which is encompassed by the proposal.

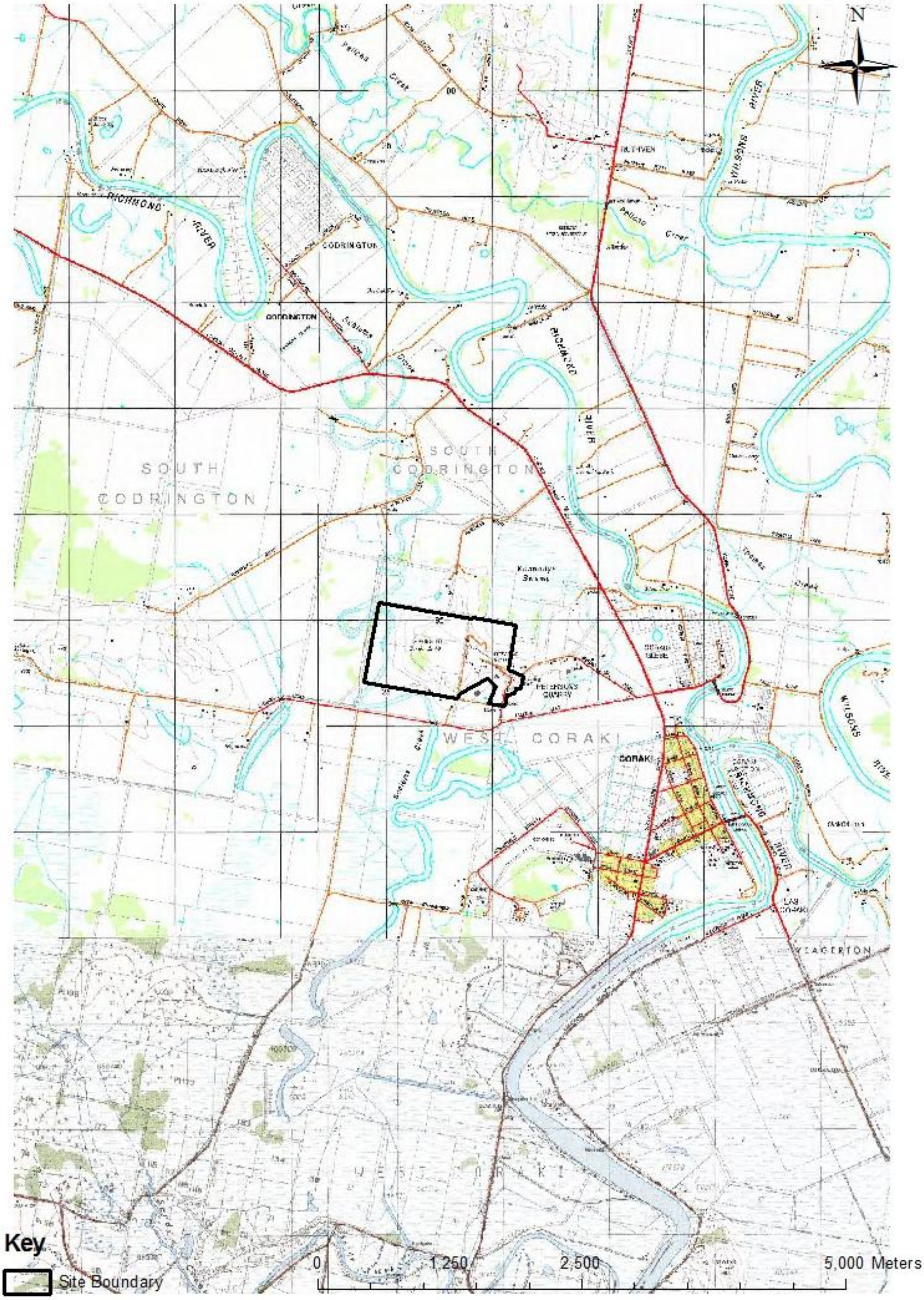


Figure 1 Location of the subject area.

1. INTRODUCTION

This document describes the Aboriginal cultural heritage assessment undertaken in respect of the proposed Coraki Quarry (Figure 1).

Quarry Solutions Pty Ltd propose to establish the Coraki Quarry (the project), to be located at Seelems Road, Coraki. The site is located approximately two kilometres north-west of the township, on the Far North Coast of New South Wales.

The proposal would include land encompassed by the existing Petersons Quarry and Lot 401 DP633427, located immediately to the north. Petersons Quarry is a hard rock basalt quarry owned by Richmond Valley Council (RVC) and has been in operation since 1916, supplying crushed basalt for road construction and private sale.

The Petersons Quarry currently operates in accordance with the conditions of a consent acquired in 1985 and further modified in 2009.

Quarry Solutions has been granted a lease by Richmond Valley Council to operate the Petersons Quarry on behalf of the Council. Petersons Quarry will be used as an integral part of the new Coraki Quarry project operations. Access into the Lot 401 rock resource and extraction would occur from Petersons Quarry. The existing processing area of the Petersons Quarry would be used for the material extracted from Lot 401 and the processed material would be stockpiled on the Petersons Quarry site and Lot 401.

The project would extract approximately 800,000 tonnes of hard rock material annually (and a maximum of 1 Million tonnes per annum), primarily for the planned upgrade of the Woolgoolga to Ballina section of the Pacific Highway.

The project satisfies the criteria for State Significant Development pursuant to the State Environmental Planning Policy (State and Regional Development) 2011 and requires development consent under the Environmental Planning and Assessment Act 1979.

The objective of the cultural heritage assessment is to prepare an Aboriginal Cultural Heritage Assessment Report which would form a component of an Environmental Impact Statement prepared in accordance with the Secretary's Environmental Assessment Requirements.

The content and format of the report is set out in accordance with the NSW OEH (2011) *Guide to investigating, assessing and reporting on Aboriginal cultural heritage in NSW* document. The report aims to document:

- The Aboriginal objects and declared Aboriginal places (as relevant) located within the area of the proposed activity;
- The cultural heritage values, including the significance of the Aboriginal objects and declared Aboriginal places that exist across the whole area that will be affected by the

proposed activity, and the significance of these values for the Aboriginal people who have a cultural association with the land, as relevant;

- How the requirements for consultation with Aboriginal people have been met (as specified in clause 80C of the NPW Regulation);
- The views of those Aboriginal people regarding the likely impact of the proposed activity on their cultural heritage (if relevant);
- The actual or likely harm posed to the Aboriginal objects or declared Aboriginal places from the proposed activity, with reference to the cultural heritage values identified;
- Any practical measures that may be taken to protect and conserve those Aboriginal objects or declared Aboriginal places (if relevant); *and*
- Any practical measures that may be taken to avoid or mitigate any actual or likely harm, alternatives to harm, or, if this is not possible, to manage (minimise) harm (if relevant).

This assessment has been managed and undertaken by Julie Dibden (Australian National University: BA with Honours; PhD), NSW Archaeology Pty Ltd.

2. DESCRIPTION OF THE AREA

In this section, background and relevant contextual information is compiled, analysed and synthesized. The purpose of presenting this material is to gain an initial understanding of the cultural landscape; the following topics are addressed (*cf.* NSW OEH 2011: 5):

- The physical setting or landscape;
- History of peoples living on that land; *and*
- Material evidence of Aboriginal land use.

2.1 The Physical Setting or Landscape

Aboriginal people have occupied NSW for more than 42,000 years (Bowler *et al.* 2003). Evidence and cultural meanings relating to occupation are present throughout the landscape (NSW OEH 2011: iii).

A consideration of landscape is particularly valuable in archaeological modelling for the purposes of characterising and predicting the nature of Aboriginal occupation across the land. In Aboriginal society, landscape could be both the embodiment of Ancestral Beings and the basis of a social geography and economic and technological endeavour. The various features and elements of the landscape are/were physical places that are known and understood within the context of social and cultural practice.

Given that the natural resources that Aboriginal people harvested and utilised were not evenly distributed across landscapes, Aboriginal occupation and the archaeological manifestations of that occupation will not be uniform across space. Therefore, the examination of environmental context is valuable for predicting the type and nature of archaeological sites which might be expected to occur. Factors that typically inform the archaeological potential of landscape include the presence or absence of water, animal and plant foods, stone and other resources, the nature of the terrain and the cultural meanings associated with a place.

Additionally, geomorphological and humanly activated processes need to be defined as these will influence the degree to which material evidence may be visible and/or conserved. Land which is heavily grassed and geomorphologically stable will prevent the detection of archaeological material, while places which have suffered disturbance may no longer retain artefacts or stratified deposits. A consideration of such factors is necessary in assessing site significance and formulating mitigation and management recommendations. The following information describes the landscape context of the subject area.

The subject area is on the Wardell 1:25,000 topographic map. For mapping purposes it is in Zone 56. The project would occur in Lot 401 DP633427, Lot 402 DP802985, Lot 403 DP802985, Lot 408 DP1166287, Lot 1 DP954592, Lot 2 DP954593, Lot 3 DP701197, Lot A DP389418, Lot 1 DP310756, Lot A DP397946 in the Parish of West Coraki, County of Richmond.

The subject area occurs entirely within the Clarence Lowlands subregion of the South Eastern Queensland - Clarence Lowlands Bioregion, and includes the Lamington Volcanic Slopes, Grafton-Whiporie Basin and Clarence-Richmond Alluvial Plains Mitchell Landscapes (BAAM Pty Ltd 2015).

The subject area is comprised of locally elevated land which rises above the adjacent floodplains and wetlands. Spring Hill is located in the western section of Lot 402, with a high point of approximately RL 47 m AHD. Seelems Creek meanders across the western portion of the study area as a series of ox-bow wetlands. The topography of the surrounding area is predominantly low relief, flood prone, alluvial plains (Figure 2).

The Richmond River is located approximately 1.7 kilometers to the east. Kennedys Swamp lies to the north and occupies the area north of the 5 m contour line within Lot 408. Kennedys Swamp has an approximate catchment area of 200 hectares and is bounded by the Casino – Coraki Road to the east, Newmans Road to the north and Spring Hill to the south and west. Surface runoff from the eastern slopes of Spring Hill flow east into the existing quarry and are then directed north through a small sediment retention basin into Kennedys Swamp.

Seelems Creek extends across Lot 403 DP 802985 and Lot 401 DP633427. The catchment area of Seelems Creek at this point is estimated to be in excess of 800 hectares and predominantly comprises agricultural land. Currently, surface runoff from the western slopes of Spring Hill flows into Seelems Creek. Surface water from the southern slopes of Spring Hill flows south by overland flow into a lower section of Seelems Creek.

The land within the study area includes different soil landscapes, including Coraki and McKee. These are residual landscapes, dominated by sites where deep soils have formed from *in-situ* weathering of parent materials. Landform elements include some summit surfaces, plateaux, terrace plain, peneplains and old ground surfaces (Morand 1994).

The Coraki landscape is characterised by low, undulating rises on Kangaroo Creek Sandstone. The relief is 10-30 m and surface slopes are 2-10%. Elevation is generally <30 m and the vegetation has been extensively cleared (Morand 1994). The McKee landscape is characterised by very low to low undulating hills and rises on Lismore Basalts. Relief is 30-50 m with slopes up to 10%. Slopes are simple or waning and drainage depressions are common. This soil landscape has also been extensively cleared.

The broader study area includes the North Casino landscape which is characterised by drainage depressions forming swamps and intermittent swamps associated with the Richmond River Alluvial Plain.

The Tweed Heads 1:250,000 Geological series sheet 56-3 indicates the underlying geology of Spring Hill comprises Lismore Basalts of the Tertiary period related to the Lamington Volcanics. A zone of Kangaroo Creek Sandstone of the Jurassic-cretaceous period surrounds the Spring Hill Lismore Basalts with alluvium sands and gravels from the Quaternary

period. During the field inspection, pebbles derived from conglomerate associated with the sandstone were observed in isolated exposures on the simple slope.
Excavations undertaken at the existing quarry show shallow topsoils, typically only 200 mm thick, overlying approximately 1.8 m of 'overburden' material comprising weathered basalt and soil. Pockets of structured, plastic clays are located throughout the proposed quarry. Basalt, the material extracted from the existing quarry, is located beneath this overburden area.

The unquarried area of Lot 402 currently comprises dense grassland and patches of weeds which have colonised following the removal of cattle. Lot 401 DP633427 is still grazed and grass and weed cover is consistent. Lower areas within Lot 403, to the west and south-west of the proposed quarry, include disturbed wetlands associated with Seelems Creek. A mixture of dry rainforest species were planted in 2008 along both sides of the access road (right of carriageway) through Lot 403 to Lot 401 DP 633427 (clearly visible in Figure 2).

Before European colonisation, the native vegetation would have comprised largely dense gallery rainforest stands which are reported to have covered the Richmond River floodplains (Collins 2005). It is noted here, that Belshaw (1978) has argued that areas of rainforest may have been uninhabited or inhabited irregularly. Much of this vegetation has been cleared for cattle grazing and agriculture, particularly to make way for sugar cane plantations. BAAM Pty Ltd (2015) identified four native vegetation types within or in close proximity to the subject area:

- Hoop Pine - Yellow Tulipwood dry rainforest of the North Coast – a component of the *Lowland Rainforest in the NSW North Coast and Sydney Basin Bioregions*.
- Forest Red Gum - Swamp Box of the Clarence Valley lowlands of the North Coast – a component of the *Sub-tropical Coastal Floodplain Forest of the NSW North Coast bioregion*.
- Paperbark swamp forest of the coastal lowlands of the North Coast – a component of the *Swamp sclerophyll forest on coastal floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions*.
- Coastal freshwater meadows and forb lands of lagoons and wetlands – a component of the *Freshwater wetlands on coastal floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions*.

These four communities occur outside the development footprint. In areas where impacts would occur, the shrubby vegetation is dominated by Camphor Laurel (*Cinnamomum camphora*) and Lantana (*Lantana camara*).

The wetland of Seelems Creek provides potential feeding habitat for wetland birds including the Black-necked Stork. Greenloaning Biostudies (2006) note that a highly modified form of the Freshwater Wetlands on coastal floodplains Endangered Ecological Community (EEC) occurs in association with Seelems Creek. Greenloaning Biostudies (2006) found that the following groups of faunal species occur in the area:

- Macropods – foraging on the dense grasslands and utilising some of the forest remnants and dense grasslands for shelter;

- Fruit bats - feeding on both rainforest fruits and blossoms;
- Microchiropteran bats - foraging over and within the various habitats and some species such as the Long-eared Bat (*Nyctophilus* spp.) potentially roosting in the dense forest of rainforest tree species;
- Forest birds - potentially small numbers of frugivores feeding on rainforest fruiting tree species;
- Grassland birds - such as wrens; and
- Wetland birds – foraging in the Seelems Creek system and potentially nesting in adjoining habitat such as is the case with the Black-necked Stork.

According to Daryl Knight, Bogal Local Aboriginal Land Council (Knight pers. comm 2015), the wetlands also have fish species including catfish, mullet and perch, and aquatic fauna including eels, yabbies and turtles.

Summary

The local area possesses relatively high biodiversity values. Seelems Creek would have been a source of potable water and abundant and varied flora and fauna resources. In an Aboriginal landuse context, the small area of Lot 401 which is situated immediately adjacent to Seelems Creek is likely to have been utilised by Aboriginal people for hunting and gathering and camping. Such activities are likely to have resulted in moderate levels of artefact discard. Away from the creek margins where the development footprint is located, land use would have been less intensive and artefact discard would have been correspondingly low.

Figure 2 Location of the subject area in its environmental context.

2.2 History of Peoples Living on the Land

Aboriginal people have occupied Australia for at least 40,000 years and possibly as long as 60,000 (Mulvaney and Kamminga 1999: 2). By 35,000 years before present (BP), all major environmental zones in Australia, including periglacial environments of Tasmania, were occupied (Mulvaney and Kamminga 1999: 114).

At the time of early occupation, Australia experienced moderate temperatures. However, between 25,000 and 12,000 years BP (the Last Glacial Maximum), dry and either intensely hot or cold temperatures prevailed (Mulvaney and Kamminga 1999: 114). At this time the mean monthly temperatures on land were 6-10ºC lower; in southern Australia coldness, drought and winds acted to change the vegetation structure from forests to grass and shrublands (Mulvaney and Kamminga 1999: 115-116).

During the Last Glacial Maximum at about 24-22,000 years ago, sea levels fell to about 130 metres below present and, accordingly, the continent was correspondingly larger. With the cessation of glacial conditions temperatures rose with a concomitant rise in sea levels. By c. 6,000 BP, sea levels had more or less stabilised to their current position. With the changes in climate during the Holocene, Aboriginal occupants had to deal not only with reduced landmass, but changing hydrological systems and vegetation; forests again inhabited the grass and shrublands of the Late Glacial Maximum. As Mulvaney and Kamminga (1999: 120) have remarked:

> When humans arrived on Sahul's shores and dispersed across the continent, they faced a continual series of environmental challenges that persisted throughout the Pleistocene. The adaptability and endurance in colonising Sahul[1] is one of humankinds' inspiring epics.

As far as possible, an ethnographic and historical review of Aboriginal life in the region will be outlined below. However, our understanding of Aboriginal people in this area and the historical dimension of the colonial encounter has been reconstructed from scant records produced during a context of death and dispossession (Swain 1993: 115); it is sketchy and severely limited. Stanner (1977) has described the colonial and post-colonial past as a 'history of indifference', and this portrays both the substantive situation which prevailed and the general lack of regard for this history. For a considerable period of time after Europeans arrived in Australia, no concerted ethnographic investigations were undertaken to learn about the society and culture of Aboriginal people. As a result, in trying to reconstruct the complex traditional cultures of varying Aboriginal groups, investigators of today are necessarily required to piece together, as best as possible, fragmentary information derived from the incidental annotations of disparate early observers. As elsewhere, this applies also to the Aboriginal peoples who occupied the country that included the subject area. Knowledge and understanding of Aboriginal social life and organisation in south-eastern New South Wales at the time of European occupation is minimal.

---

[1] Sahul is the name given to the single Pleistocene era continent which combined Australia with New Guinea and Tasmania.

Tindale (1974) defined 'tribal' groups and his mapping indicates the local area is within the country of the Bundjalung people. The Bundjalung inhabited the region which extended from the Clarence River to the Logan River in south-east Queensland. Speakers of the Nyangbal language group occupied the region east of Bundjalung along the coastal plain and encompassing Ballina. Tindale's (1974) modelling was based on an uncritical adoption of the Radcliffe-Brown model of social organization in which the band is perceived as the most important structural feature in Aboriginal social organisation. Tindale's tribal boundaries were largely defined according to what he understood to be language groups (Flood 1980: 107) and his work was conceptualized according to a model of band social organisation in which the 'horde' or clan was considered to be the group which possessed political power and proprietary rights to land (Rumsey 1989: 70). The 'tribes' which Tindale determined to have existed were seen as coterminous with language groups with the implication that these groupings were territorial units.

The assumptions inherent in this conflation of language group with tribe are no longer seen to be relevant and, furthermore, the concept of tribe as a territorial group is not regarded as being correct or useful. In Aboriginal society people were multilingual rather than monolingual; therefore conceiving of language groups as bounded social groupings is not appropriate (Rumsey 1989: 74). In the Radcliffe-Brown model, the land/language relationship was seen as indirect: the estate of a tribe was seen as the aggregation of all the clan estates who spoke the same language. This relationship is now viewed to be direct – it is recognised that the importance of land/language relations in Aboriginal society is that particular languages and particular tracts of country were directly linked according to Dreaming activity (Rumsey 1989: 74-75).

While it was previously assumed that tribes or language groups functioned as politically cohesive corporate groups, more recently it has been recognised that linguistic groupings do not structure the Aboriginal social and geographical landscape. Sutton and Rigsby (1979: 722) argue that Tindale's tribal boundaries are not meaningful at either a demographic or political level. In order to overcome Tindale's limited and flowed tribal boundary model, recourse must be made to more contemporary anthropological concepts and understanding.

The ethnohistoric record suggests that the lower Richmond supported one of the densest Aboriginal populations in Australia (Collins 2005). The Aboriginal population appears to have been concentrated along the coast, however, densities of up to one person per 2.5 square kilometres have been proposed for the riverine corridor. Gollan (nd cited in Collins 2005) reported that 200 to 300 Aboriginal people would gather at Woodburn for a tribal gatherings. In the foothills of the coastal ramp, which lacked abundant resources, populations were apparently smaller; approximately one person per five square kilometres (Pierce 1971).

A demographic model to describe possible settlement/movement patterns was developed by (McBryde 1974). She argued that clan groups would range between the sea coast and the foothills of the coastal ranges on a seasonal basis. On ethno-historical evidence, McBryde suggests that some seasonal movement was common and that the basic subsistence economy of hunting, fishing and gathering was neither static, nor completely migratory, but characterised by movement between the coast and the foothills (McBryde 1974). Some historical references refer to seasonal movement on a limited scale including Ainsworth (1922) on the Richmond River, Dawson (1935) and McFarlane (1934) on the Clarence River. Bray (1923) states that the Lismore 'tribe' used to go to Ballina at the mouth of the river. Sullivan (1976: 20) notes that inland groups were allowed to come to the Tweed coast for a time. The archaeological evidence for movement in the coastal river valleys is less conclusive (McBryde 1974: 338). However, the evidence suggests that contact between members of the coastal clans was frequent and may have involved relatively large numbers.

McBryde (1978) has documented the material culture of the North Coast Aboriginal people. McBryde's sources refer to shields (McFarlane 1934; Dawson 1935), single point fire hardened spears, three types of boomerangs (Dawson 1935), clubs, nulla nulla and pademelon sticks (McFarlane 1934), wooden battle axes, stone axes, digging sticks, bark and palm leaf bags, wooden water vessels, possum rugs, cane and shell necklaces and stone knives (Bundock 1898). McBryde considered that the region of the Tweed, Richmond and Clarence Rivers appeared to form a distinct unit. This is particularly so in the case of fishing technology. The multi-pronged fishing spear and the shellfish hook are both absent from this region. Fish were caught in nets or speared in the shallows (McBryde 1978: 187). Spears were single pointed fire hardened weapons (Dawson 1935: 22), of both lighter and heavier varieties (Byrne 1986: 3). Neither the woomera nor the spear throwing stick was used in this region (Dawson 1935: 22). The range of materials is considered wider than observed in central Australian tribes with fewer all-purpose items, few composite tools and a number of specialised ones. This may reflect a more sedentary life style in a rich environment that required fewer, but more specialised, tools (McBryde 1978: 187). The stone tool element in the material culture was small and unspecialised. The archaeological evidence suggests changes to a simpler stone technology took place only centuries before European settlement. The stone tools in use immediately prior to European settlement, 'show little typological sophistication and did not demand highly skilled craftsmanship' (McBryde 1978: 198).

Initiation ceremonies of the north coast reportedly involved the gradual revealing of sacred information and a corresponding growth in social and economic status (Collins 2005). Bundjalung males passed through at least two degrees of initiation before becoming full members and permitted to marry. The major initiation ceremonies were undertaken at bora grounds, one of which is located to the south of Coraki. Women also reportedly had their own initiation grounds and associated rites (Winterbotham 1983).

Radcliffe-Brown (1929) reported that sacred spots known as 'Djurebil' (also more generically called 'increase sites') were located throughout Bundjalung country. These spots were often marked by a natural feature such as a water-hole or a significant rock or group of trees (see also, Section 2.3.2). Initiated people performed rites at each Djurebil within their territory to ensure the maintenance and well-being of the associated species or resource. According to Oakes (1979), Djurebils were 'rogation spots where the sacred being was ceremonially asked to make a certain natural resource more plentiful.

2.3 Material Evidence

A search of the NSW OEH Aboriginal Heritage Information Management System (AHIMS) was conducted on 29th April 2015 (AHIMS client service ID: 170901). The search area measures 240 square kilometres, with a buffer of 50 meters, and is encompassed by the following co-ordinates at Datum GDA, Zone 56 - Eastings: 519000 - 534000, Northings: 6786000 - 6802000. A total of 27 Aboriginal sites are located in the AHIMS search area, some of which are discussed below (Table 1; Figure 3). Note. A number of AHIMS sites including the two discussed below, have information restrictions.

Searches have been conducted of the NSW State Heritage Inventory and the Australian Heritage database. No Aboriginal heritage sites are listed on these as being in the proposed activity area.

The AHIMS register only includes sites which have been reported to NSW OEH. Generally, sites are only recorded during targeted surveys undertaken in either development or research contexts. Accordingly, this search cannot be considered to be an actual or exhaustive inventory of Aboriginal objects situated within the local area or indeed within the study area itself.

The Aboriginal objects on AHIMS for the site search area are listed below in Table 1, and the location of those nearest the subject area are shown in Figure 3. It should be noted that sites recorded in AGD have been to converting to GDA for mapping purposes. Those sites with information restrictions are not shown on Figure 3.

Two sites on the AHIMS register are located in or close to the subject area and these are discussed below.

AHIMS 04-4-142 *Spring Hill Coraki* - located on the western end of Lot 402 DP802985 - It is located within an existing *Indigenous Heritage Non Disturbance Zone* and will not be subject to impacts. This site has had an Aboriginal Place nomination prepared (Ashley Moran OEH pers comm 25/8/15).

AHIMS 04-4-0121 *Twin Pines Birth Place* - located south of the property and subject area.

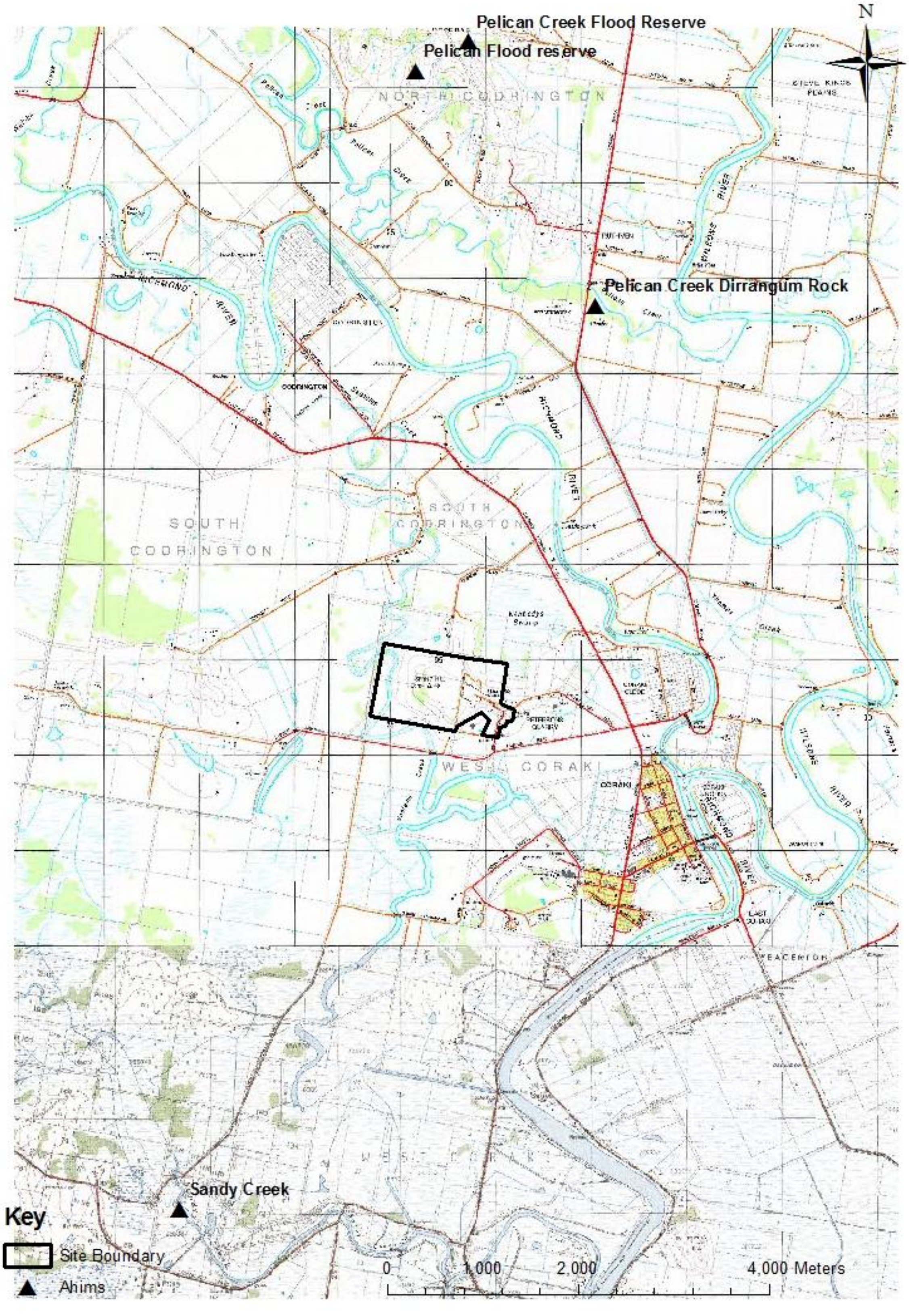


Figure 3 Location of registered Aboriginal sites identified in the search of the NSW OEH AHIMS in respect of proposed activity area (compiled using mapping from ***Topoview Raster*** *2006* NSW Dept. of Lands).

Table 1 AHIMS Site search; asterisk denotes site located on Lot 402.

Site ID	Site name	Datum	Easting	Northing	Site features	Site types
13-1-0062	Sandy Creek	AGD	522690	6789050	Modified Tree (Carved or Scarred) : -	Scarred Tree
04-4-0100	Pelican Creek Flood Reserve	AGD	525720	6801300	Modified Tree (Carved or Scarred) : -, Artefact : -	
13-1-0175	Scar Tree 4Lot 11, DP 773099	GDA	523070	6786358	Modified Tree (Carved or Scarred) : 1	
13-1-0172	Scar Tree 1 Lot 11,DP773099	GDA	523271	6786330	Modified Tree (Carved or Scarred) : -	
13-1-0173	Scar Tree 3 Lot 11,DP 773099	GDA	523247	6786312	Modified Tree (Carved or Scarred) : 1	
13-1-0174	Scar Tree 2 Lot 11, DP 773099	GDA	523266	6786338	Modified Tree (Carved or Scarred) : -	
13-1-0176	Scar Tree 5 Lot 11, DP 773099	GDA	522989	6786402	Modified Tree (Carved or Scarred) : -	
13-1-0177	Scar Tree 6 Lot11, DP 773099	GDA	522957	6786403	Modified Tree (Carved or Scarred) : 1	
13-1-0178	Scar Tree 7 Lot 11, DP 773099	GDA	522170	6786403	Modified Tree (Carved or Scarred) : 1	
04-4-0142*	Restriction applied. Please contact ahims@environment.nsw.gov.au.					
04-4-0126	Tucki Tucki Scarred Trees	AGD	530838	6799157	Modified Tree (Carved or Scarred) : 2	
13-1-0100	Coraki Land Fill 1	AGD	519950	6785800	Artefact : -	Isolated Find
04-4-0024	Tucki Tucki Lismore	AGD	530400	6801300	Ceremonial Ring (Stone or Earth) : -	Bora/Ceremonial
13-1-0012	Restriction applied. Please contact ahims@environment.nsw.gov.au.					
04-4-0091	Pelican Flood reserve	AGD	525160	6800990	Artefact : -, Modified Tree (Carved or Scarred) : -	Open Camp Site,Scarred Tree
04-4-0039	Pelican Creek Dirrangum Rock	AGD	527050	6798530	Aboriginal Ceremony and Dreaming : -	Natural Mythological (Ritual)
13-1-0125	Restriction applied. Please contact ahims@environment.nsw.gov.au.					
13-1-0126	Restriction applied. Please contact ahims@environment.nsw.gov.au.					
13-1-0127	Restriction applied. Please contact ahims@environment.nsw.gov.au.					
04-4-0122	Restriction applied. Please contact					

Site ID	Site name	Datum	Easting	Northing	Site features	Site types
	ahims@environment.nsw.gov.au.					
13-1-0128	Restriction applied. Please contact ahims@environment.nsw.gov.au.					
13-1-0129	Restriction applied. Please contact ahims@environment.nsw.gov.au.					
04-4-0120	Restriction applied. Please contact ahims@environment.nsw.gov.au.					
04-4-0121	Restriction applied. Please contact ahims@environment.nsw.gov.au.					
13-1-0164	Restriction applied. Please contact ahims@environment.nsw.gov.au.					
13-1-0137	Restriction applied. Please contact ahims@environment.nsw.gov.au.					
04-4-0123	Restriction applied. Please contact ahims@environment.nsw.gov.au.					

2.3.1 Previous Archaeological Work

There has been very little archaeology conducted in the immediate local area. The following reviews assessments conducted across the wider region.

The earliest evidence of Aboriginal occupation of northern NSW and southern Queensland dates into the Pleistocene at Wallen Wallen Creek on North Stradbroke Island, where a cultural sequence dating from between 20,560 ± 250 BP and the early Holocene has been excavated. Analysis of faunal material from the site indicates an economy initially based on the hunting of terrestrial animals, which developed to one based on the exploitation of marine species and shellfish. This switch is attributed to changing local ecologies keyed into rising sea levels (Neal and Stock 1986).

The earliest known date for Aboriginal occupation in far northern NSW is between 4,700 BP and 4,200 BP, obtained from the basal strata of a shell midden at Sexton Hill south of Tweed Heads (Appleton 1993).

At East Ballina, a shell midden deposit adjacent to Chickiba Creek was dated and found to have accrued between 1,750 BP and c.100 BP (Bailey 1975). Nearby at Angels Beach, North Ballina, assorted shell material produced a range of dates of between 900 - 1,000 BP and 530 BP. Assessed on a stylistic basis, stone artefacts found in association with the shell were categorised as being produced within the past 2,000 years (Rich 1994).

While shell material deposits at South Ballina and Broadwater was dated to 260 BP and 200 BP respectively (McBryde 1982), an 80 cm deep layer of beach foreshore shell midden at Byron Bay was found to have accrued between 1,000 and 400 BP. The shell material at this site was comprised predominantly of pipi, with minor inclusions of other targeted shell species and, additionally, some fish and animal remains. These midden materials were accompanied by an assemblage of stone artefacts believed to have been derived from raw materials available from a nearby intertidal pebble beds. The artefacts were characterized as being predominantly primary flaking debitage that was indicative of the poor knapping quality of the raw materials used (Collins 1994).

At Wombah in the Clarence area, dating by McBryde (1974) of an estuarine midden located 10 km from the coast indicated an occupation phase ranging between c. 3,260 BP and the period of European contact. The midden was comprised predominantly of oyster shell, with very few examples of animal and fish bone, indicating an economy based almost exclusively around the harvesting of shellfish. Few stone artefacts were represented, and those present consisted mostly of unifacial pebble tools, ground edge axes, utilised flakes, a few small retouched tools and a few bone points. The presence of glass artefacts indicated use of the site into the contact period. Despite the high volume of shell, McBryde (1974) concluded the site represented a number of short and sporadic seasonal visitations to the site, lasting only a few months.

Piper (1991) conducted an archaeological assessment of the northern approaches to the Mororo Bridge, some 25 kms south of the subject area. He recorded three isolated artefacts, a scraper/core, a retouched flake and a flake, on low spurs adjoining the floodplain. The raw materials were described as siliceous stone.

Everick Heritage Consultants (2008) conducted an assessment of the proposed Champions' Sandstone Quarry located to the north of Coraki. The 50 hectare area is on the eastern margins of a southerly projection of low hills that separate the floodplain of the Wilson River to the west and the floodplain of the Tucki Tucki Creek and Tuckean Swamp to the east. The site is comparable to that of the subject area. No Aboriginals objects were found during two field inspections. However, the archaeological potential or otherwise of the area was not discussed and no discussion of the results was made.

OzArk (2011) conducted a heritage assessment in relation to a proposal by Transgrid to construct a 205 km 330kV transmission line between Dumaresq and Lismore. Surveying a corridor 60 m wide from Dumaresq to Casino, and 90 m wide from Casino to Lismore, 50 Aboriginal heritage sites were recorded along with 11 sensitive archaeological landforms. The findings of the survey were that the incidence of recorded sites conformed with the assumption that major Aboriginal sites were to be found within close proximity to water.

The Aboriginal cultural heritage assessments in relation to the Pacific Highway Upgrade (‘PHU’) Woolgoolga to Ballina, have been the most numerous comprehensive archaeological investigations carried out in the broader region, although by necessity conducted along a narrow corridor. While work on this project is at present ongoing, some initial results have already been reported. Preliminary field surveys entailing some 1,865 hectares identified 50 areas of potential archaeological deposit and 54 Aboriginal heritage sites. Forty eight potential archaeological deposits were then excavated, with 30 of these found to contain subsurface Aboriginal deposits (NSW Roads and Maritime Services 2013).

In the Wells Crossing to Iluka Road assessment section, conducted over a total area of some 1,000 hectares five surface finds and a total of 15 PADs were recorded. These were excavated, with nine containing sub-surface Aboriginal cultural deposit (25 artefacts in total). Seven control test pits were excavated and none of these contained artefacts. In addition, the excavation included 422 test pits (0.5 metres x 0.5 metres). Aboriginal objects were retrieved from 17 of these test pits. The conclusion of the works was that the nature of the archaeology discovered within the project corridor did not represent a significant difference from that located in the surrounding region (Brooke *et al.* 2012).

Everick Heritage Consultants (2014) conducted an Aboriginal Cultural Heritage Due Diligence Assessment in relation to the expansion of an existing quarry at Mororo, some 25 kms south of the subject study area. Surveying an area of some 12.5 ha, in conditions of variable archaeological visibility, no Aboriginal objects were identified, and the area was generally assessed to be of low archaeological potential, due in part because of high levels of ground disturbance.

NSW Roads and Maritime Services (2014) commissioned an Aboriginal Cultural Heritage Assessment Report in relation to their proposal to construct an additional new bridge at Grafton, about 70 m downstream of the existing bridge. In addition, to two previously recorded Aboriginal places, an area with two Aboriginal sandstone artefacts near to the river was recorded. These artefacts being sandstone river cobbles with one a modified river cobble most likely used for as a chopping tool and the other a grinding stone.

2.3.2 Predictive Model of Aboriginal Site Distribution

Based on the above review and a consideration of the elevation, geology, hydrology and topography of the study area, the type of Aboriginal objects known to occur in the region and the potential for their presence within the subject area are listed as follows.

Stone Artefacts

Stones artefacts are located either on the surface and/or in subsurface contexts. The detection of artefacts depends on ground surface factors and whether or not the potential archaeological bearing soil profile is visible. Prior ground disturbance, vegetation cover and sediment/gravel deposition can act to obscure artefact presence. The raw materials used for artefact manufacture will commonly be silcrete, chert, quartzite, quartz and volcanics. Within the local area, stone artefacts will be widely distributed across the landscape in a virtual continuum, but with significant variations in density in relation to different environmental factors. Artefact density and site complexity will be greater near reliable water and the confluence of resource zones.

Given the environmental context, it is assessed that in the subject area stone artefacts will be present in variable densities ranging from negligible/very low to low/moderate. Higher artefact density is predicted to be present on reasonably flat ground close to Seelems Creek. Elsewhere, artefact density is predicted to be very low.

Grinding Grooves

Grinding grooves are found in rock surfaces and result from the manufacture and maintenance of ground edge tools. Given the absence of large sandstone exposures, grinding groove sites are unlikely to be present.

Burials sites

Burial sites have been recorded within the wider region. This site type is rarely located during field survey and is not predicted to be present in the subject area.

Rock Shelter Sites

Rock shelters sites are unlikely to be present in the study area given the absence of vertical stone outcrops.

Scarred and Carved Trees

Scarred and carved trees result from either domestic or ceremonial bark removal. Carved trees associated with burial grounds and other ceremonial places have been recorded in the wider region. In an Aboriginal land use context this site type would most likely have been situated on flat or low gradient landform units in areas suitable for either habitation and/or ceremonial purposes.

Bark removal by European people through the entire historic period and by natural processes such as fire blistering and branch fall make the identification of scarring from a causal point of view very difficult. Accordingly, given the propensity for trees to bear scarring from natural causes, their positive identification is impossible unless culturally specific variables such as stone hatchet cut marks or incised designs are evident and rigorous criteria with regard to tree species/age/size and specific characteristics with regard to regrowth is adopted.

Nevertheless, the likelihood of trees bearing cultural scarring remaining extant and in situ is low given events such as land clearance and bushfires. Generally scarred trees will only survive if they have been carefully protected (such as the trees associated with Yuranigh's grave at Molong where successive generations of European landholders have actively cared for them).

The subject area is has been cleared previously and this site type is unlikely to be present.

Stone Quarry and Procurement Sites

A lithic quarry is the location of an exploited stone source (Hiscock & Mitchell 1993:32). Sites will only be located where exposures of a stone type suitable for use in artefact manufacture occur. Given the presence of stone outcrops in the proposal area this site type is may be recorded during the study.

Ceremonial Places and Sacred Geography

Burbung and ceremonial sites are places which were used for ritual and ceremonial purposes. Possibly the most significant ceremonial practices were those which were concerned with initiation and other rites of passage such as those associated with death. Sites associated with these ceremonies are burbung grounds and burial sites. Additionally, secret rituals were undertaken by individuals such as clever men. These rituals were commonly undertaken in 'natural' locations such as water holes. Ceremonial grounds are known to exist in the local area.

In addition to site specific types and locales, Aboriginal people invested the landscape with meaning and significance; this is commonly referred to as a sacred geography. Natural features are those physical places which are intimately associated with spirits or the dwelling/activity places of certain mythical beings (*cf*. Knight 2001; Boot 2002). Boot (2002) refers to the sacred and secular meaning of landscape to Aboriginal people which has '…

legitimated their occupation as the guardians of the places created by their spiritual ancestors'.

Knight's (2001) Masters research conducted in the area of the Weddin Mountains, examined the cultural construction and social practice of inhabiting a sacred landscape. This approach is a departure from a consideration of the land and its resources as being a determinant of behaviour, to one in which land is regarded as a *text;* – within this conception, land and its individual features, are redolent with meanings and significances which are religiously and ritually centred, rather than economically based.

Knight's (*cf.* 2001:1) work was possible in great measure by the historical record which explicitly defines Weddin as a site of ritual significance. However, the research was additionally driven by a theoretical approach to 'cultural landscapes'. Landscape is redefined away from considerations of its material features which provide a backdrop to human activity, towards a view that a landscape *is rather*, a conceptual entity. According to this view, the natural world does not exist outside of its conceptual or cognitive apprehension. The landscape becomes known within a naming process or narrative; thus the landscape is brought into being and understanding – within this process: - '… explanatory parables…' such as legends and mythology are the embodiment of the landscape narrative (Knight 2001: 6).

These narratives are relative to a particular culture, and it is this which makes an archaeological investigation of the cultural landscape such a thorny one. At distance in time and cultural geography, and especially in the absence of specific ethnographic information, how can the archaeologist attempt to investigate and know these narratives? Knight (2001: 11) employed the concept of the landscape as *mentifact,* whereby archaeological interpretation is concerned with the reconstruction of the landscape as a reflection of prehistoric cosmologies. He argued that this can be reconstructed by exploring the systematic relationships between sites and their topographic setting. This is defined as an *inherent* approach as it is concerned with the role of landscape in both everyday and sacred life. This view is concerned with an integration of the sacred and profane rather than their existence as separate categories of social life: - where "Cult activity may have existed as an inextricably 'embedded' component of daily life, where significant locations and ritual aspects of material culture were thoroughly incorporated into secular ranges and uses" (Knight 2001:13). In this regard, Knight (2001: 14) correctly points out that no dichotomy between the material and ideational world existed within Aboriginal life.

Knight (2001: 15) argued that the notion of sacred space is of central concern within an inherent perspective on interpreting cultural landscape. Within human cosmologies, locales within the landscape are constructed as being sacred space; this process of the construction of sacred space has been termed *hierophany* by Eliade (1961 in Knight 2001: 15). However, while Knight (2001: 15) suggests that physical entities such as stones, trees, or topographic features such as mountains, caves and rocky outcrops may be subject to such processes of transformation or construction, in reality, in Aboriginal society any natural feature of less obvious significance can and should be included within this listing. Aboriginal constructions of heirophany can include the most insignificant landscape features and objects of less fixed temporal existence such as animals and plants. While the outside observer readily 'sees' and apprehends mountains and rocky features, more subtle elements of the natural world are easily passed 'unseen'. This point is one which suggests that the personal cultural geography of the archaeologist can severely impact upon the interpretation of the sacred landscape (*cf.* also, Boot 2002: 288). Knight (2001) does acknowledge this to some extent illustrating the issue by referring to the example of "Jump Up Rock" situated north of Weddin. This place is only understood to have been an important landscape feature by recourse to prior knowledge regarding the meaning of the site name; the hill itself is insignificant and therefore not readily apprehended through an outsiders gaze as being of special significance. Knight (2001: 16) refers to the issue of peculiarities of form (e.g. shape, colour, size or texture) and natural distinctiveness (e.g. isolated mountains or rocky features within a plains context) as being an important distinguishing feature of sacred locales. Knight (2001: 16) argues that the construction of sacred space in such a manner is particularly relevant to people for whom the natural domain is the dwelling place of/or the manifestation of their deities. Knight (2001: 16) again draws from Eliade (1964) to suggest that it is at the sacred place that the three fundamental cosmological worlds, the everyday, the upper and underworld may converge; typically the upper world will be associated as a point of 'access' with tall things such as trees while the underworld will be associated with pools and caves. Eliade contends that places where all three worlds can possibly connect, the *axis mundi*, are of a heightened order of sacredness. Hierophanies are therefore natural features which are ascribed sacredness. Additionally, Knight (2001: 17) refers to their ability to provide a landscape based opportunity for people to commune with other worldly deities and associated power because they may constitute spatial access between worlds via ritual.

Guided by these theoretical considerations, Knight (2001: 20) engaged with Bradley's (cited in Knight 2001) model of the 'archaeology of natural places' in order to provide guidance for investigating the cultural landscape. In this view, natural places can be explored archaeologically in order to determine the nature of their role in human cosmologies by attending to four archaeological categories: - Votive offerings, rock art, production sites and monuments. This model was developed within a European context, with its attendant biases of concepts and archaeological categories; clearly not all concepts, some of which are clearly Eurocentric, will be applicable in Australia. Nor will all these data sets be found within the Australian context.

Knight (2001) gives consideration to the types of natural places which might be ascribed sacred significance. These include mountains, woodlands and groves, springs, pools and lagoons, rock outcrops and caves and sinkholes. He argues that Aboriginal cosmology is expressed via the natural landscape and sacred places were those which were directly related to the Dreaming. He says that these sacred sites typically are those which are remarkable or important physiographically such as caves, rocks and so on. Given the potential for natural features to have been important places within an Aboriginal cosmological frame of reference, the survey has sought to identify outstanding natural features present in the study area. A number of special places have been recorded in the immediate local area as a result of cultural mapping conducted for the Native Title claimants (Ashley Moran pers. comm 25/8/15). One of which is located in the western end of Lot 402: AHIMS # 04-4-0122.

Contact Sites

These sites are those which contain evidence of Aboriginal occupation during the period of early European occupation. Evidence of this period of 'contact' could potentially be Aboriginal flaked glass, burials with historic grave goods or markers, and debris from 'fringe camps' where Aborigines who were employed by, or traded with the white community, may have lived or camped. The most likely location for contact period occupation sites would be places adjacent to permanent water and located in relative proximity to centres of European occupation such as towns and homesteads. The potential for such sites to be in the proposal area is possible but unlikely.

2.3.3 Field Inspection – Methodology

In accordance with the OEH *Code of Practice for Archaeological Investigation of Aboriginal Objects in NSW*, the purpose of a field survey is to record the material traces and evidence of Aboriginal land use that are:

- Visible at or on the ground surface, or
- Exposed in section or visible as features (e.g. rock shelters with rock-art),

and to identify those areas where it can be inferred that, although not visible, material traces have a high likelihood of being present under the ground surface (DECCW 2010a: 12).

The methodological approach adopted in this assessment attends particularly to location and relationality as a means of contextualising the material evidence of cultural practice across space. Given the nature of the physiography, different places within the region are likely to have been utilised for different purposes, and also by different categories of people. Landscape is more than a set of 'objective' topographic features. Landscapes are constructed out of cultural and social engagement; they are '... topographies of the social and cultural as much as they are physical contours' (David & Thomas 2008: 35). The conceptual approach to understanding landscape in this assessment is based on a concern with experience, occupation and bodily practice (cf. Thomas 2008: 305). The location of material evidence in different environmental and topographic contexts across the region has the potential to be informative of different activities and social contexts. Landform and environmental elements, as measurable empirical space, will be employed methodologically to explore landuse, occupation and the nature of both recorded and unseen (ie subsurface) material evidence. Given the space encompassed by the study area, this methodology allows for the identification, at a fine level of spatial resolution, of elements representative of the patterns of social life and how these may vary over space.

The approach to recording in the current study has been a 'nonsite' methodology (cf. Dunnell 1993; Shott 1995). The density and nature of the artefact distribution will vary across the landscape in accordance with a number of behavioural factors which resulted in artefact discard. While cultural factors will have informed the nature of land use, and the resultant artefact discard, environmental variables are those which can be utilised archaeologically in order to analyse the variability in artefact density and nature across the landscape. Accordingly, in this study, while the artefact is the elementary unit recorded, Landform Units are utilised as a framework of recording, analysis (cf. Wandsnider and Camilli 1992) and ultimately, the formulation of recommendations. The Landform Units variables recorded are described below.

The field inspection entailed a comprehensive pedestrian survey undertaken across the subject area. The survey was aimed at locating Aboriginal objects, areas and places. An assessment was also made of prior land disturbance, survey coverage variables (ground exposure and archaeological visibility) and the potential archaeological sensitivity of the land.

The field survey was designed to assess the archaeological sensitivity of all areas where impacts are proposed. The data collected during this field assessment forms the basis for the documentation of survey results outlined in the section below. The variables recorded are defined below:

Survey Unit Variables

Landscape variables utilised are conventional categories taken from the *Australian Soil and Land Survey Field Handbook* (McDonald *et al.* 1998).

Survey Coverage Variables

Survey Coverage Variables are a measure of ground surveyed during the study and the type of archaeological visibility present within that surveyed area. Survey coverage variables provide a measure with which to assess the effectiveness of the survey so as to provide an informed basis for the formulation of management strategies.

Specifically, an analysis of survey coverage is necessary in order to determine whether or not the opportunity to observe stone artefacts in or on the ground was achieved during the survey. In the event that it is determined that ground exposures provided a minimal opportunity to record stone artefacts, it may be necessary to rely on the relevant predictive modelling to assess the archaeological nature of an area. In some cases archaeological test excavation may need to be undertaken to determining whether or not stone artefacts are present. Conversely, if ground exposures encountered provided an ideal opportunity to record the presence of stone artefacts, the survey results may be considered to be reliable.

Two variables were used to measure ground surface visibility during the study; the area of ground exposure encountered, and the quality and type of ground visibility (archaeological visibility) within those exposures. The survey coverage variables estimated during the survey are defined as follows:

Ground Exposure (GE) – an estimate of the area of exposures of bare ground; *and*

Archaeology Visibility (AV) – an estimate of the average levels of potential archaeological surface visibility within those exposures of bare ground. Archaeological visibility is generally less than ground exposure as it is dependent on adequate breaching of the bare ground surface which provides a view of the subsurface soil context. Based on subsurface test excavation results conducted in a range of different soil types across New South Wales it is understood that artefacts are primarily situated 10 - 30 cm below the ground; reasonable archaeological visibility therefore requires breaching of the ground surface to at least a depth of 10 cm.

Based on the two visibility variables as defined above, an estimate (Net Effective Exposure – NEE) of the archaeological potential of exposure area within a survey unit has been calculated. The Effective Survey Coverage (ESC) calculation is a percentage estimate of the proportion of the Survey Unit which provided the potential to view archaeological material.

2.3.4 Field Inspection – Results

The entire area in which impacts would occur has undergone relatively high levels of prior disturbance associated with land clearance/agriculture and previous quarrying. This previous landuse is assessed to have caused reasonably high levels of impact to almost all ground surfaces and hence, to any Aboriginal objects which may once have been present in those areas.

The impacts associated with almost 100 years of quarrying cover an area measuring approximately 17.5 hectares (Plates 1-4). These impacts include deep quarrying (Plate 5) and more shallow disturbances associated within stockpile clearing (eg Plate 3). All areas however, possess negligible areas of original ground surface. Accordingly, the area encompassed by the existing quarrying works (Survey Unit 1) has no potential to host Aboriginal cultural materials.

Impacts in the remainder of the subject area vary. All areas have been cleared of original native vegetation and have been used for agriculture. Ground surfaces are now covered with introduced pasture species including couch and kikuyu (Plate 6). Remnants of farm fences and infrastructure remain (Plate 7). Generally the ground surfaces are uneven indicating prior disturbance. Minor quarrying has been undertaken at the west edge of the basalt in Lot 401 (Plate 8). Elsewhere farm dams, water diversion channels and a well formed access road into Lot 401 have caused localised impacts (Plate 9).

During the field survey, effective survey coverage (ESC) was variable, but generally low. Survey coverage is described and summarised in Tables 2 and 3 below. The assessment area and individual Survey Units are shown in Figures 4 and 5 respectively.

Table 2 Survey Unit descriptions and proposed impacts.

Name	Proposed impact	Description
SU1	Quarrying, stockpile, processing plant.	Crest; open aspect; nil original ground surface. Existing quarry area; highly disturbed.
SU2	Lot 401: quarrying; Lot 402: stockpile.	Crest; open aspect; flat; very shallow soil (<20cm). Grassed farm land.
SU3	Stockpile	Simple slope to west; 6-8° gradient. Grassed farm land.
SU4	Nil: Proposed *Aboriginal Archaeological Conservation Zone*	Simple slope to west; 1-2° gradient. Grassed farm land.
SU5	Stockpile	Simple slope to north-west; 6-8° gradient. Grassed farm land.

Table 3 Survey coverage.

Name	Area (sq m)	GE (%)	GE (sq m)	AV (%)	NEE	ESC (%)	Aboriginal site recordings	Predicted artefact density
SU1	174,508	0	0	0	0	-	nil	Negligible
SU2	162,874	<0.5	<814	80	<651	0.4	nil	Very low
SU3	45,962	<0.5	<229	80	<183	0.4	nil	Very low
SU4	11,142	<0.5	<55.7	20	<11	0.09	Sensitive Archaeological Landform - SAL 1	Low/moderate
SU5	42,701	<0.5	<213	80	<170	0.4	nil	Very low
	437,187		<1,311.7		<1,015	0.2		

A total of area of c. 44 hectares was assessed during the field work (Table 3). Ground exposures inspected included areas of bare earth, erosion, animal burrows and vehicle tracks, and measured approximately less than 0.1 hectares in area. Of that ground exposure area, archaeological visibility inspected (the potential artefact bearing soil profile) is estimated to have been c. 0.1 hectares (NEE). Effective Survey Coverage is calculated to have been 0.2% of the proposal area. The ESC encountered during the field survey is considered to be very low. However, areas of ground exposure with reasonable archaeological visibility (the potential artefact bearing soil profile) were frequently encountered. Given the absence of artefacts recorded, it is concluded that artefact density is likely to be extremely patchy in distribution and present in generally very low density.

Site Recordings

No Aboriginal stone objects were recorded during the field assessment. However, Survey Unit 4, a very gently inclined simple slope adjacent to the wetland is predicted to contain artefact density in a low/moderate distribution. For the purposes of this assessment it is described as an sensitive archaeologically landform (Plate 10).

Plate 1 Existing stockpile area at the west end of Petersons Quarry site; looking 90°. This area would be quarried first which would then provide access into Lot 401. Arrow denotes the south east corner of Lot 401.

Plate 2 Existing stockpile area at the west end of Petersons Quarry site; looking 130°. Note, grassed bund wall in middle distance and proposed stockpile area beyond as indicated by arrow.

Plate 3 Existing stockpile area at the west end of Petersons Quarry site; looking 260°. Note, Spring Hill Trig indicated by an arrow.

Plate 4 The weighbridge area at the east end of the existing quarry; looking south-east.

Plate 5 The floor of existing quarry in Lot 403 where the processing plant is proposed.

Plate 6 Pasture on Lot 401; looking west. Note, boundary fence and visual screening bund on existing Petersons quarry.

Plate 7 Remains of farm infrastructure on basalt near east end of Lot 401; looking 250°.

Plate 8 Minor quarrying at northwest edge of basalt on Lot 401; looking 90°.

Plate 9 Formed road providing access into Lot 401; looking north. Note also, farm dam as denoted by arrow.

Plate 10 Sensitive archaeological landform - SAL 1; looking south.

Figure 4 Location of Assessment Area.

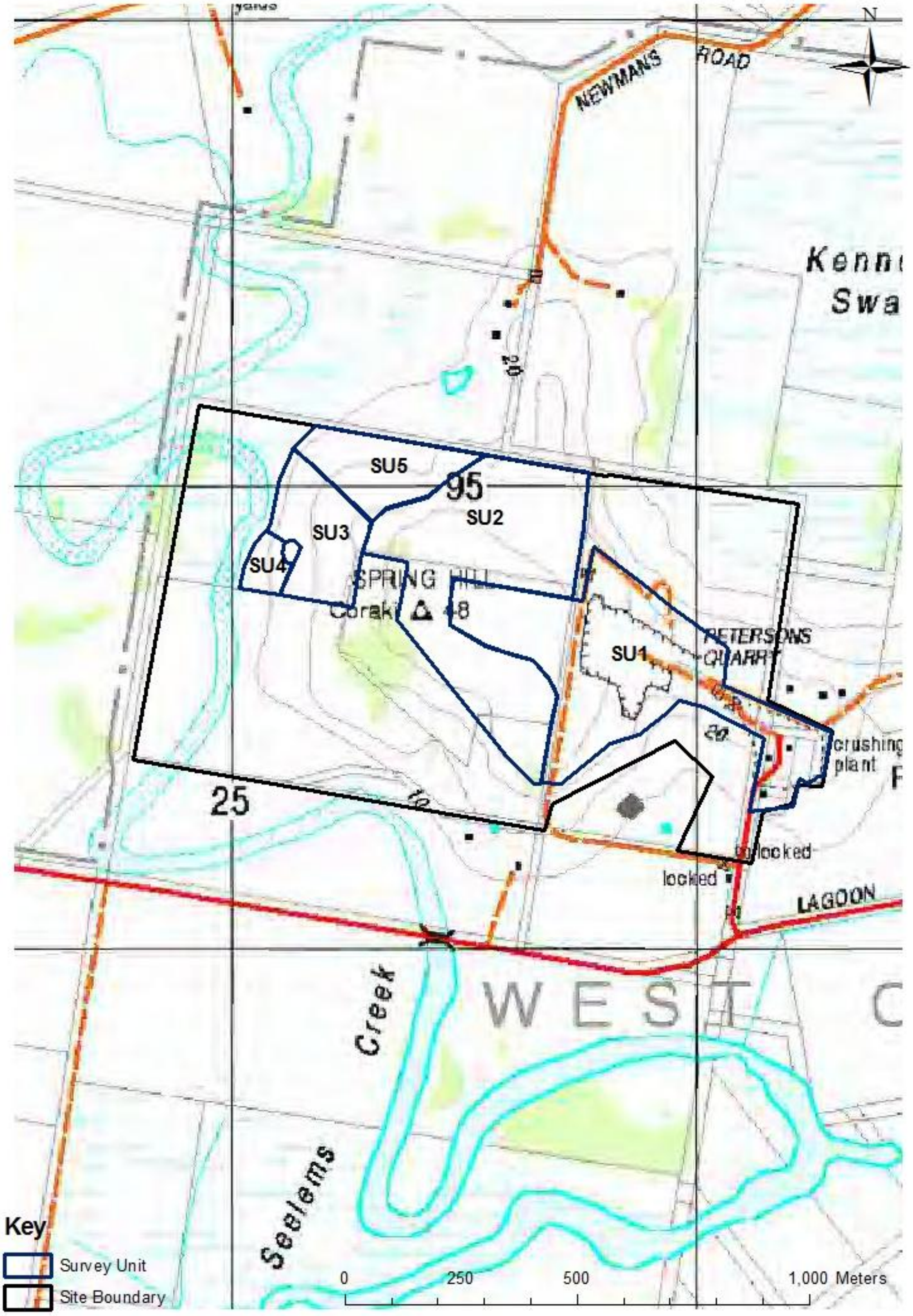


Figure 5 Location of Survey Units.

3. CONSULTATION PROCESS

A formal process of Aboriginal community consultation has been undertaken in accordance with the guidelines as set out in the NSW OEH's *Aboriginal cultural heritage consultation requirements for proponents 2010* (NSW DECCW 2010b).

3.1 Consultation

In order to identify, notify and register Aboriginal people who may hold cultural knowledge relevant to determining the cultural significant of Aboriginal objects and/or places in the subject area, the following procedure was implemented (see Appendix 1).

Correspondence dated 4 May 2015 was sent to:

- The NSW OEH;
- Bogal Local Aboriginal Land Council (BLALC);
- Office of the Registrar, *Aboriginal Land Rights Act 1983*;
- The National Native Title Tribunal;
- Native Title Services Corporation Limited;
- Richmond Council.

In addition, an advertisement has been placed with the local paper (Northern Star) and appeared in the 6 May 2015 edition.

Following advice received from NSW OEH, further correspondence dated 18 May 2015 was sent to a list of known Aboriginal Parties for the Richmond Valley local Government area that OEH considered likely to have an interest in the proposal.

The Office of the Registrar Aboriginal Land Rights Act 1983 responded (no date) indicating that it did not appear that there were registered Aboriginal owners for the project area.

NTSCORP responded on 7 May 2015, indicating that they would provide our correspondence to any individuals, groups or organisations NTSCORP is aware assert traditional interest in the area.

The Bogal Local Aboriginal Land Council responded (11 May 2015) indicating that they required a survey of the area to be undertaken. We have taken this response to assume a registration of interest in the Aboriginal consultation process.

The National Native Title Tribunal responded via email on 7 May 2015 indicating that Native Title has been extinguished for the area in question given the property is freehold.

No Registrations of Interest were made by any Aboriginal Parties other than Bogal Local Aboriginal Land Council.

The Bandjalang Aboriginal Corporation Prescribed Body Corporate RNTBC administers land on behalf of the Bandjalang People. Their native title rights and interests were first recognised in the Bandjalang People #2 native title determinations of 2013. This matter recognises the Bandjalang people as having non-exclusive native title rights and interests over traditional lands on the north coast of New South Wales, at and around Evans Head.

Further enquires were made of ntscorp on 2 June 2015 advising that we had not heard from the Bandjalang Aboriginal Corporation Prescribed Body Corporate. Mr George Toona indicated that further communications would be made with this group. A ntscorp person was to meet with them in person on 4 June 2015 and was to advise on that occasion about the quarry project and my attempts to communicate with them. A further email was received from Mr Toona on 11 June 2015 indicating that no comments had been received from the Bandjalang Directors about the project.

We discussed this matter further with Ms Rosalie Neve, NSW OEH on 12 June 2015. It was discussed that in regard to the Aboriginal site on Lot 402, an Aboriginal place nomination was in progress but not yet determined. Ms Neve advised that while no response has been received from the Bandjalang Aboriginal Corporation and we may therefore reasonably assume that there are not any issues, we should ensure that the proposal does not undermine any possible future aspirations the Corporation may have in regard to the site. Furthermore, she advised that we ensure an ongoing communications strategy is in place.

In accordance with Section 4.2 and 4.3 of the *Aboriginal cultural heritage consultation requirements for proponents 2010* (NSW DECCW 2010b) guidelines, information with regard to the project, proposed consultation process and assessment methodology was furnished to the Bogal Local Aboriginal Land Council for input and comment; none received.

Following a modification to the original project description, further letters were sent to the agencies on 7 August 2015 providing notification. Again following advice from OEH, a second batch of letters were sent to a list of Aboriginal groups OEH felt may have an interest in the area. No responses have been received.

A draft copy of this report has be furnished to Bogal Local Aboriginal Land Council (BLALC) for review (sent 2/9/15). BLALC had previously reported via email (dated 25/8/15) that Darryl Knight had reported a 'clear inspection'.

4. SUMMARY AND ANALYSIS OF BACKGROUND INFORMATION

In previous sections, the results of the background research and survey have been outlined. The purpose of this section of the ACHAR is to summarise and explain the results.

It is noted that no information about Aboriginal places, areas or objects has been received as a result of the formal process of Aboriginal consultation which has been undertaken (as specified in clause 80C of the NPW Regulation – see previous section).

One Aboriginal site is known to be present in the subject area. This site is located within a previously defined ***Indigenous Heritage Non Disturbance Zone*** (see Figure 6). This area will be retained and honoured within the context of the proposed development.

No Aboriginal object sites were recorded during the current assessment. However, a Sensitive Archaeological Landform (SAL 1) has been identified. In an Aboriginal land use context, the majority of the subject area is assessed to have been used for low levels of occupation and that artefact discard would have been correspondingly low. However, Survey Unit 4, a very gently inclined simple slope situated adjacent to Seelems Creek, is predicted to have been subject to a certain level of land use which may have resulted in the accumulated discard of stone artefacts of low/moderate density.

It is probable that land adjacent to larger wetlands located elsewhere in the district would have sustained intensive Aboriginal occupation and may well have functioned as base camp locales. Places such as the subject area where water is less abundant and expansive, are likely to have been used during hunting and gathering forays conducted away from base camps by small groups of people. As such, we predict that the landform encompassed by Survey Unit 4 may contain an artefact occurrence associated with such land use.

In the predictive model outlined in Section 2.3.2, it was suggested that stone quarrying or procurement may have taken place at the basalt outcrop. However, no evidence of such activity was found during the field inspection.

While the Effective Survey Coverage for the surveyed area is calculated to have been relatively low at the time of survey, many areas of reasonable ground exposure possessing reasonable archaeological visibility were distributed throughout the subject area. These exposures enabled a reasonable characterisation of artefact distribution within the proposal area. The survey results are therefore assessed to be a relatively accurate reflection of the artefact density in the proposal area. That is, the absence of Aboriginal object recordings is assessed to be real. Accordingly, based on the relevant predictive model of site distribution for the area, and the results of the field survey, artefact density in the study area is assessed to be very low. The exception is Survey Unit 4 located adjacent to Seelems Creek.

Archaeological test excavation has not been undertaken in respect of the proposal as it could not be justified (*cf.* NSW DECCW 2010a: 24). While Survey Unit 4 situated near to the creek is assessed to be of relatively higher archaeological sensitivity than the majority of the subject area, it is able to be avoided and, accordingly, will be subject to a conservation outcome. While Effective Survey Coverage was generally very low during field survey, given the high levels of previous disturbance and predicted very low density of stone artefact distribution, subsurface test excavation is not warranted. The predictions in regard to the nature of any undetected (subsurface) archaeology is made with relatively high confidence.

It is concluded there are no information gaps which are of a significant magnitude to warrant further consideration.

5. CULTURAL HERITAGE VALUES AND STATEMENT OF SIGNIFICANCE

The information provided in this report and the assessment of significance of Aboriginal objects provides the basis for the proponent to make informed decisions regarding management and mitigation which should be undertaken in respect of proposed impacts.

5.1 Significance Assessment Criteria

The NPWS (1997) defines significance as relating to the meaning of sites: "meaning is to do with the values people put on things, places, sites, land". The following significance assessment criteria is derived from the relevant aspects of ICOMOS Burra Charter and NSW Department of Urban Affairs and Planning's 'State Heritage Inventory Evaluation Criteria and Management Guidelines'.

Aboriginal sites are assessed under the following categories of significance:

- cultural value to contemporary Aboriginal people,
- archaeological value,
- aesthetic value,
- representativeness, and
- educational value.

Aboriginal cultural significance

The Aboriginal community will value a place in accordance with a variety of factors including contemporary associations and beliefs and historical relationships. Most heritage evidence is valued by Aboriginal people given its symbolic embodiment and physical relationship with their ancestral past.

Archaeological value

The assessment of archaeological value involves determining the potential of a place to provide information which is of value in scientific analysis and the resolution of potential archaeological research questions. Relevant research topics may be defined and addressed within the academy, the context of cultural heritage management or Aboriginal communities. Increasingly, research issues are being constructed with reference to the broader landscape rather than focusing specifically on individual site locales. In order to assess scientific value, sites are evaluated in terms of nature of the evidence, whether or not they contain undisturbed artefactual material, occur within a context which enables the testing of certain propositions, are very old or contain significant time depth, contain large artefactual assemblages or material diversity, have unusual characteristics, are of good preservation, or are a part of a larger site complex. Increasingly, a range of site types, including low density artefact distributions, are regarded to be just as important as high density sites for providing research opportunities.

In order to assess the criteria of archaeological significance further, and also to consider the criteria of rarity, consideration can be given to the distribution of stone artefacts across the continent. There are two estimates of the quantity of accumulated stone artefacts in Australia (Wright 1983:118; Kamminga 1991:14; 2002). Wright estimated an average of 500,000 débitage items and 24,000 finished tools per square kilometre, which equates to a total of about 180 billion finished stone tools and four trillion stone débitage items in Australia. Kamminga's estimates, which were determined from a different set of variables, provide a conservative estimate of 200 billion stone tools and 40 million tonnes of flaking débitage (see Kamminga 1991:14; 2002). These two estimates are similar, and suggest that the actual number of stone tools and items of flaking débitage in Australia is in the trillions. The stone artefacts distributed in the proposed activity area cannot, therefore, be considered to be rare.

The vast majority of stone artefacts found in Australia comprise flaking debris (termed débitage) from stone tool making. While it can be reasonably inferred from a range of ethnographic and archaeological evidence that discarded stone artefacts and flaking debris was not valued by the maker, in certain circumstances these objects may to varying degrees have archaeological research potential and/or Aboriginal social value. However, only in very exceptional circumstances is archaeological research potential high for particular open context sites such as those encountered in the subject area (Kamminga, J. pers. comm. June 2009).

Representativeness

Representative value is the degree to which a "class of sites are conserved and whether the particular site being assessed should be conserved in order to ensure that we retain a representative sample of the archaeological record as a whole" (NPWS 1997). Factors defined by NPWS (1997) for assessing sites in terms of representativeness include defining variability, knowing what is already conserved and considering the connectivity of sites.

Educational value

The educational value of cultural heritage is dependent on the potential for interpretation to a general visitor audience, compatible Aboriginal values, a resistant site fabric, and feasible site access and management resources.

Aesthetic value

Aesthetic value relates to aspects of sensory perception. This value is culturally contingent.

5.2 Significance Value of the Aboriginal Object Sites in the Study Area

The majority of the subject area is assessed to be of relatively low archaeological value primarily because of the predicted very low density artefact distribution and the significant extent of previous impacts. It is noted that Aboriginal heritage sites often have high cultural value to the local Aboriginal community given that they provide direct physical and symbolic linkages to their ancestral past and to the landscape. The cultural values of the identified sites may possibly differ to the archaeological significance values.

5.3 Statement of Significance

A total of five Survey Units were defined in the proposal area. No Aboriginal objects were found and significant previous impacts have taken place. Because of the high levels of prior ground disturbance and the predicted low distribution of the artefacts, the value of the materiality in proposed impact area is low. The exception is the Sensitive Archaeological Landform (SAL 1) which is likely to hold a greater level of significance.

6. THE PROPOSED ACTIVITY

In this section, the nature and extent of the proposed activity and any potential harm to Aboriginal areas, objects and/or places is identified.

Petersons Quarry has been operating since 1916, and was formally approved under DA 103/85 in 1985. To date, extraction within the approved Petersons Quarry has generally continued in a westerly direction, starting from the eastern end of the quarry area. The quarry has been upgraded twice, first in the 1950s and then in the late 1970s. In 1985, an EIS was prepared for the continued use and expansion of the quarry and development approval was given (DA 103/85) for quarrying operations within Lot 405 DP 632493 and Lot 402 DP 802985. A further modification was made on 2009. Existing operations at Petersons Quarry are continuing under the terms of that approval.

6.1 Proposed Impacts

Quarry Solutions, the proponent, has been granted a lease by Richmond Valley Council to operate the existing Petersons Quarry on behalf of the Council. Petersons Quarry will be used as an integral part of the new Coraki Quarry project operations. Access into the Lot 401 rock resource and extraction, would occur from Petersons Quarry. The existing processing area of the Petersons Quarry would be used for the material extracted from Lot 401 and the processed material would be stockpiled on the existing Petersons Quarry site and on Lot 401 (Figure 6).

6.2 Type of Harm

The proposed development would entail the removal and disturbance of potential artefact bearing deposit and, accordingly, has the potential to cause fundamental impacts to any Aboriginal areas, places or objects.

6.3 Harm Assessment

The proposed works entail ground disturbance and, accordingly, have the potential to cause impacts to any Aboriginal areas, places or objects which may be present within the zones of direct impact. However, no Aboriginal object sites have been recorded in the proposal area other than Sensitive Archaeological Landform (SAL 1). This area will be subject to active conservation measures within the development context (Figures 6 & 7). Accordingly, no harm to Aboriginal objects is proposed.

It is noted that the previously identified *Indigenous Non Disturbance Zone* in which AHIMS 04-4-0142 is located will be maintained and would not be disturbed as a result of the proposal (Figures 6 & 7).

Figure 6 The proposed impacts. Note, location of Indigenous Heritage Non Disturbance Zones.

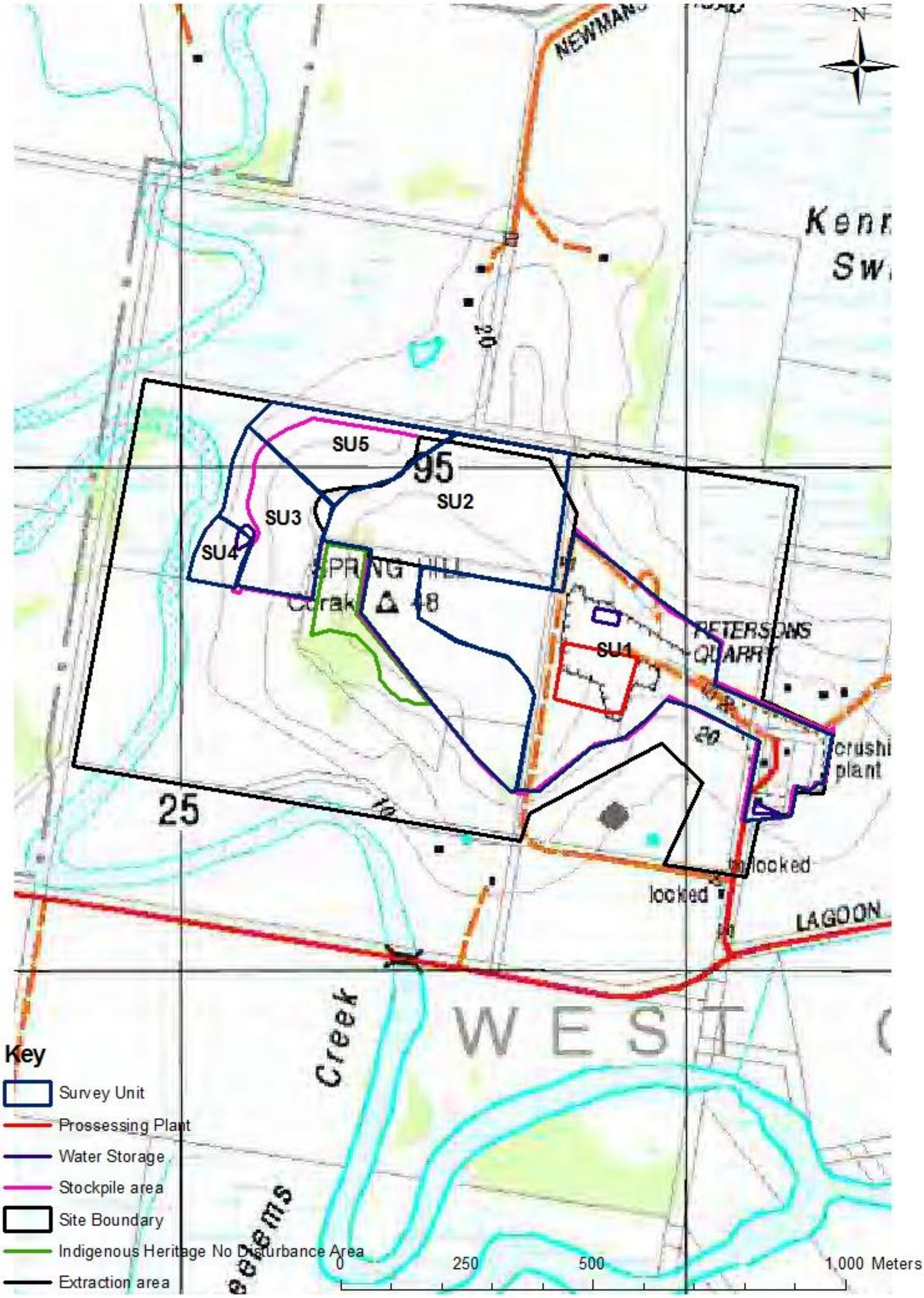


Figure 7 Proposed impacts in relations of Survey Units and Indigenous Heritage Non Disturbance Zones inclusive of Survey Unit 4.

7. AVOIDING AND/OR MINIMISING HARM

Ecologically Sustainable Development (ESD) is defined in the Protection of the Environment Administration Act 1991. Section 6(2) of that Act states that ESD requires the effective integration of economic and environmental considerations in decision-making processes and that ESD can be achieved through the implementation of:

(a) the precautionary principle,

(b) inter-generational equity,

(c) conservation of biological diversity and ecological integrity,

(d) improved valuation, pricing and incentive mechanisms.

The principles of ecologically sustainable development and the matter of cumulative harm have been considered for this project. Given the low levels of prior, existing and potential future impacts in the local and regional context in which the proposed activity area is situated, the majority of cultural values, including archaeological, which attach to comparable landforms and the broader landscape remain intact across the region.

Given that the majority of area in which impacts would occur has sustained very high levels of prior impact, the proposed works would therefore occur in areas which have already received a certain level of impact and harm. Therefore, considerations of ecologically sustainable development and cumulative impacts can be considered largely irrelevant in the matter at hand.

However, no Aboriginal objects or cultural values are known to occur in the area of the proposed impacts (the development footprint). Therefore, considerations of ecologically sustainable development and cumulative impacts in regard to Aboriginal heritage are not necessary.

Avoidance or the mitigation of harm has not been considered as an option in relation to the proposed activities. However, as noted previously, Survey Unit 4 which has been defined as a Sensitive Archaeological Landform will be formalised as a Aboriginal Archaeological Conservation Zone.

A number of management strategies are possible and these are each given consideration below.

7.1 Management and Mitigation Strategies

Further Investigation

The field survey has been focused on recording artefactual material present on visible ground surfaces. Further archaeological investigation would entail subsurface excavation undertaken as test pits for the purposes of identifying the presence of artefact bearing soil deposits and their nature, extent, integrity and significance. Further archaeological investigation in the form of subsurface test excavation can be appropriate in certain situations. These generally arise when a proposed development is expected to involve ground disturbance in areas which are assessed to have potential to contain high density artefactual material and when the Effective Survey Coverage achieved during a survey of a project area is low due to ground cover, vegetation etc.

No areas of the proposal area have been identified to warrant further archaeological investigation in order to formulate appropriate management and mitigation strategies. The archaeological nature of the proposed impact areas are relatively well established. As noted above, we have assessed the impact areas to contain very low or low density distributions of artefacts and identified it to be disturbed.

Finally, it is noted that no Aboriginal objects or survey units with potential conservation value have been identified to have a high probability of being present in the development footprint. Accordingly, test excavation conducted under OEH's *Code of Practice for Archaeological Investigation of Aboriginal Objects in New South Wales* (DECCW 2010: 24) is not necessary.

Conservation

Conservation is a suitable management option in any situation, however, it is not always feasible to achieve. Such a strategy is generally adopted in relation to sites which are assessed to be of high cultural and scientific significance, but can be adopted in relation to any site type.

In the case at hand, the development of a Aboriginal Archaeological Conservation strategy for the area encompassed by Survey Unit 4 has been conducted during the context of this heritage assessment.

Mitigated Impacts

Mitigated impact usually takes the form of partial impacts only (i.e. conservation of part of an Aboriginal site or Survey Unit) and/or salvage in the form of further research and archaeological analysis prior to impacts. Such a management strategy is generally appropriate when Aboriginal objects are assessed to be of moderate or high significance to the scientific and/or Aboriginal community and when avoidance of impacts and hence full conservation is not feasible. Salvage can include the surface collection or subsurface excavation of Aboriginal objects and subsequent research and analysis. In the case at hand, the development of a mitigated impact strategy is not considered to be essential from an archaeological perspective.

However, given the development of a heritage conservation strategy for Survey Unit 4, this serves to mitigate development impacts.

Monitoring

Monitoring during construction for the purposes of identifying cultural material that may be uncovered during earth disturbance can be implemented as a management strategy. However, monitoring is a reactive rather than proactive strategy, and as such, is not an ideal management tool in cultural heritage management. Monitoring for artefacts is not a widely accepted method of management because sites of significance can be destroyed as monitoring is taking place and because it can result in lengthy and costly delays to development works if significant cultural material is uncovered. In the case at hand, the development of a monitoring strategy is not considered necessary or appropriate.

8. STATUTORY INFORMATION

The NPW Act provides statutory protection for all Aboriginal objects and Aboriginal Places.

An 'Aboriginal object' is defined as

> 'any deposit, object or material evidence (not being a handicraft for sale) relating to Aboriginal habitation of the area that comprises New South Wales, being habitation before or concurrent with the occupation of that area by persons of non-Aboriginal extraction, and includes Aboriginal remains'.

An Aboriginal place is an area declared by the Minister to be an Aboriginal place for the purposes of the Act (s84), being a place that in the opinion of the Minister *is or was of special significance with respect to Aboriginal culture*.

Part 6 of the National Parks and Wildlife Act 1974 (NPW Act) provides specific protection for Aboriginal objects and declared Aboriginal places by establishing offences of harm. Harm is defined to mean destroying, defacing, damaging or moving an object from the land. There are a number of defences and exemptions to the offence of harming an Aboriginal object or place. One of the defences is that the harm is carried out under an Aboriginal Heritage Impact Permit (AHIP).

However, under Section 89J of the Environmental Planning and Assessment Act 1979, the following authorisations are not required for State Significant Development that is authorised by a development consent granted after the commencement of this Division (and accordingly the provisions of any Act that prohibit an activity without such an authority do not apply):

> *an Aboriginal heritage impact permit under section 90 of the National Parks and Wildlife Act 1974.*

However, the management and mitigation strategies proposed in this report should form Statement of Commitments for inclusion in any Development Approval documents.

9. RECOMMENDATIONS

The recommendations are made on the basis of:

- A consideration of the relevant legislation (see Section 8 Statutory Information).
- The results of the investigation as documented in this report.
- Consideration of the type and scale of impacts proposed.

The following conclusions and recommendations are made:

1. No Aboriginal objects have been recorded in impact areas.

2. Section 7 of this report sets out possible management and mitigation strategies and these should be given consideration by the proponent and the Registered Aboriginal Party. Their implementation can occur within the framework of the Aboriginal Heritage Management Plan developed for the project.

3. During the conduct of this assessment an Aboriginal Heritage Conservation Zone has been developed for the area encompassed by Survey Unit 4.

4. An Aboriginal Heritage Management Plan (AHMP) must be developed by an archaeologist, in consultation with the NSW OEH and the Registered Aboriginal Party. The AHMP must set out the procedures relating to the management and mitigation of development impacts, a protocol for the management of unexpected finds and the conservation of relevant areas outside the extraction area.

5. The AHMP would provide the framework to ensure the conservation of heritage within Survey Unit 4 and the existing Indigenous Heritage Non Disturbance Zone.

10. REFERENCES

Appleton, M. 1993 An Archaeological investigation of a shell midden at Sextons Hill South of Tweed Heads. Unpublished report for Ian Hill and Associates Pty Ltd.

Ainsworth, J.1922 Reminiscences 1847 – 1922. Beacon Printery, Ballina.

BAAM Pty Ltd 2015 Biodiversity Assessment Report, Coraki Quarry, Coraki, NSW. Prepared for Groundwork Plus on behalf of Quarry Solutions Pty Ltd.

Bailey, G.N. 1975 The role of molluscs in coastal economies: the results of midden analysis in Australia. Journal of Archaeological Science 2:45-62.

Belshaw, J. 1966 The Economic Basis of Aboriginal life in Northern NSW in the 19th Century, BA (Hons) Thesis, Armidale: University of New England.

Belshaw, J. 1978 'Population distribution and the pattern of seasonal movement in northern NSW', in McBryde, I (ed.) *Records of times past: ethnohistorical essays on the culture and ecology of the New England tribes*. Canberra: Australian Institute of Aboriginal Studies.

Boot, P. 2002 Didthul, Gulaga and Wadbilliga: An archaeological study of the Aboriginals of the New South Wales South Coast hinterland. Unpublished PhD thesis, The Australian National University.

Bowler, J.M., Johnston, H., Olley J.M., Prescott J.R., Roberts R.G., Shawcross, W. & Spooner, N.A. 2003 New ages for human occupation and climatic change at Lake Mungo, Australia. Nature Vol. 421, No. 30, pp. 837-840.

Bray, J. 1923 'Bundjalung file' - manuscript. Lismore: Richmond River Historical Society.

Bundock, M. 1898 Notes on the Richmond River Blacks. In R.L. Dawson (ed.) Manuscript Bundock Family Papers (1940). Sydney: Mitchell Library.

Byrne, D 1986 Aboriginal Archaeological Sites in the Shire of Maclean: a Heritage Study. Unpublished report to the Council of the Shire of Maclean.

Collins, J. 1994 Archaeological Assessment and Conservation of Aboriginal Midden Site #4-5-61 at The Pass, Byron Bay, NSW. Unpublished report to Cape Byron Headland Reserve Trust. Byron Bay.

Collins, J. 2005 Upgrading the Pacific Highway Woodburn to Ballina Route Selection Study: Aboriginal Heritage Assessment, Unpublished report to Hyder Consulting.

David, B. & J. Thomas 2008 Landscape Archaeology: Introduction. In David, B. & J. Thomas (eds). *Handbook of Landscape Archaeology*. pp. 27 – 43. Left Coast Press Inc., Walnut Creek.

Dawson, R. 1935 Some recollections and records of the Clarence and Richmond River Aboriginal People. In Aboriginal Words and Names, Sydney: W.C. Penfold and Co.

Dunnell, R. 1993 The Notion Site in J. Rossignol and L. Wandsnider eds *Space, Time and Archaeological Landscapes*. New York: Plenum, pgs 21-41.

Everick Heritage Consultants Pty Ltd 2008 Heritage Assessment of Champions Quarry. Tuckurimba via Lismore NSW.

Everick Heritage Consultants Pty Ltd 2014 Aboriginal Cultural Heritage Due Diligence Assessment. Sly's Quarry LOT 2 DP 1055044 - Mororo, Clarence Valley NSW.

Flood, J. 1980 The Moth Hunters: Aboriginal Prehistory of the Australian Alps. AIAS: Canberra.

Greenloaning Biostudies (2006) Ecological Biodiversity Assessment Report – Petersons Quarry DP 802985 Lots 402 and 403, DP 632493 Lot 405. Prepared for Richmond Valley Council.

Hiscock, P. & Mitchell, S. 1993 *Stone Artefact Quarries and Reduction Sites in Australia: Towards a Type Profile*. AGPS: Canberra.

Kamminga, J. 1992 Aboriginal Settlement and Prehistory of the Snowy Mountains. In Scougall, B. (ed) *Cultural Heritage of the Australian Alps: Proceedings of the symposium held at Jindabyne, New South Wales, 16-18 October 1991, Australian Alps Liaison Committee*. CPN Publications: Canberra pp 101-124.

Kamminga, J., R. Paton and I. McFarlane 1989 *Archaeological Investigations in the Thredbo Valley, Snowy Mountains*. Report to Farada Pty Ltd. Anutech: Canberra.

Kamminga, J. 1991 Report on the Archaeological Collection, National Museum of Australia. Report to the National Museum of Australia, Canberra. April 1991. (3 vols).

Kamminga, Jo. Personal communication Oct 2007.

Knight, Daryl personal communication 14 August 2015.

Knight, T. 2001 Stepping Stones to the Sky Archaeological Perspectives on the Cultural Significance of the Weddin Mountains in Recent Prehistory. Unpublished Master of Arts by Research Thesis. School of Archaeology and Anthropology Australian National University, Canberra.

McBryde, I. 1974 *Aboriginal Prehistory in New England*. Sydney: Sydney University Press.

McBryde, I. 1978 *Records of times past: ethnohistorical essays on the culture and ecology of the New England tribes*. Canberra: Australian Institute of Aboriginal Studies.

McBryde, I. 1982 Coast and Estuary: Archaeological investigations on the north coast of NSW at Wombah and Schnapper Point. Australian Institute of Aboriginal Studies, Canberra.

McDonald, R. Isbell, R, Speight, J. Walker, J. and M. Hopkins 1998 *Australian Soil and Land Survey Field Handbook*. CSIRO Australia.

McFarlane, D. 1934 *The mode of living of the Clarence River tribes*. Richmond River Historical Society, Aboriginal People File, Lismore

Moran, Ashley Personal communication. 25 August 2015.

Morand, D. 1994 Soil Landscapes of the Murwillumbah- Tweed Heads 1:1000000 Sheet Map. Department of Land and Water Conservation. Sydney.

Mulvaney, J. and J. Kamminga 1999 *Prehistory of Australia*. Allen and Unwin: St Leonards.

Neal, R. and E. Stock 1986 Pleistocene occupation in the south-east Queensland coastal region. Nature 323:618-621.

New South Wales Department of Environment, Climate Change and Water 2010a Code of Practice for Archaeological Investigation of Aboriginal Objects in New South Wales 2010.

New South Wales Department of Environment, Climate Change and Water 2010b Aboriginal cultural heritage consultation requirements for proponents 2010.

New South Wales Office of Environment and Heritage 2011 Guide to investigating, assessing and reporting on Aboriginal cultural heritage in NSW.

NSW Roads and Maritime Services 2012 Upgrading the Pacific Highway - Woolgoolga to Ballina Upgrade. Working Paper. Aboriginal Cultural Heritage Assessment - Wells Crossing to Iluka Road Section

NSW Roads and Maritime Services 2013 Woolgoolga to Ballina. Pacific Highway Upgrade. EIS. Main Volume 1B. Chapter 12 - Aboriginal Heritage.

NSW Roads and Maritime Services 2014 Additional Crossing of the Clarence River at Grafton Appendix H – Technical Paper: Aboriginal heritage assessment.

Ozark 2011 Aboriginal and Historic Heritage Assessment Far North NSW (Dumaresq to Lismore 330kV Transmission Line) Project

Pierce, R. 1971 The Effects of Aquatic Foods on the Diet and Economy of the Aborigines of the North Coast at the Time of First Settlement, BA(Hons) Thesis, University of New England.

Piper, A 1991, An Archaeological Investigation and Aboriginal Consultation on Aboriginal Sites at Mororo, NSW. Unpublished report to the Road Traffic Authority.

Rich, E.1994 Archaeological salvage of Angels Beach Estate, North Ballina, NSW. Unpublished report for Ballina - North Creek Aboriginal Sites Management Committee and Ballina Shire Council, Ballina.

Rumsey, A. 1989 Language Groups in Australian Aboriginal Land Claims. *Anthropological Forum*. Vol. VI No 1 pp 69-79.

Shott, M. 1995 Reliability of Archaeological Records on Cultivated Surfaces: A Michigan Case Study. *Journal of Archaeological Field Archaeology*. Vol 22; pgs 475 – 490.

Stanner, W. E. H. 1977 'The History of Indifference Thus Begins'. *Aboriginal History*. Vol. 1; No. 1; pp. 3 – 26.

Sullivan, S 1978 Aboriginal diet and food gathering methods in the Richmond and Tweed River Valleys, as seen in early settler records. In I. McBryde (ed.), *Records of Times Past: ethnohistorical essays on the culture and ecology of the New England tribe*s. Canberra: Australian Institute of Aboriginal Studies.

Sutton, P. & B Rigsby 1979. Linguistic communities and social networks on Cape York Peninsula. In S. Wurm (ed) *Australian Linguistic Studies*. pp 713-732. Canberra: ANU.

Swain, T. 1993 *A Place for Strangers Towards a History of Australian Aboriginal Being*. Cambridge University Press, Cambridge.

Thomas, J. 2008 Archaeology, Landscape, and Dwelling. In David, B. & J. Thomas (eds). *Handbook of Landscape Archaeology*. pp. 27 – 43. Left Coast Press Inc., Walnut Creek.

Tindale, N. 1974 *Aboriginal Tribes of Australia*. ANU Press, Canberra.

Wandsnider, L and E. Camilli 1992 The Character of Surface Archaeological Deposits and Its Influence on Survey Accuracy. *Journal of Field Archaeology*. Vol. 19 pgs 169 - 188.

Winterbotham, L. 1983 The Gaiarbau Story, *Queensland Ethno-history Transcripts* 1, Ed: Langevad, G, 1:1, 21 -111.

Wright, R. 1983 Stone implements. In G. Connah (ed.), *Australian field archaeology: a guide to techniques*. Australian Institute of Aboriginal Studies, Canberra, pp. 110-25.

GLOSSARY

Aboriginal object - A statutory term, meaning: '… any deposit, object or material evidence (not being a handicraft made for sale) relating to the Aboriginal habitation of the area that comprises NSW, being habitation before or concurrent with (or both) the occupation of that area by persons of non-Aboriginal extraction, and includes Aboriginal remains' (s.5 NPW Act).

Declared Aboriginal place - A statutory term, meaning any place declared to be an Aboriginal place (under s.84 of the NPW Act) by the Minister administering the NPW Act, by order published in the NSW Government Gazette, because the Minister is of the opinion that the place is or was of special significance with respect to Aboriginal culture. It may or may not contain Aboriginal objects.

Development area - Area proposed to be impacted as part of a specified activity or development proposal.

Harm - A statutory term meaning '… any act or omission that destroys, defaces, damages an object or place or, in relation to an object – moves the object from the land on which it had been situated' (s.5 NPW Act).

Place - An area of cultural value to Aboriginal people in the area (whether or not it is an Aboriginal place declared under s.84 of the Act).

Proponent - A person proposing an activity that may harm Aboriginal objects or declared Aboriginal places and who may apply for an AHIP under the NPW Act.

Proposed activity - The activity or works being proposed.

Subject area - The area that is the subject of archaeological investigation. Ordinarily this would include the area that is being considered for development approval, inclusive of the proposed development footprint and all associated land parcels. In this instance, the subject area is defined as the area in which proposed impacts would take place.

APPENDIX 1

Example of letter sent to agencies:

New South Wales Archaeology Pty Limited ABN 53106044366

PO Box 2135
Central Tilba NSW 2546
Ph 02 44737947
www.nswarchaeology.com.au

4 May 2015

Aboriginal Heritage
Regional Operations Group
Office of Environment and Heritage
Locked Bag 914
Coffs Harbour NSW 2450

Dear Sir/Madam

Re: Coraki Quarry - Aboriginal Cultural Heritage Assessment

A new hard rock extraction quarry is proposed for Lot 401 DP 633427, Seelems Road, via Petersons Quarry Road, 2.5 kilometres northwest of Coraki. An Aboriginal Heritage Assessment is being prepared. NSW Archaeology Pty Ltd is undertaking consultation with Aboriginal people on behalf of the proponent according to the requirements stipulated in the former NSW DECCW Aboriginal cultural heritage consultation requirements for proponents, 2010. The purpose of Aboriginal community consultation is to assist the proponent in understanding Aboriginal peoples views and concerns about the project, and to understand cultural values present in the area, and to assist the NSW Office of Environment and Heritage (OEH) in a determination of an AHIP application or development determination, if and as required.

We are seeking to identify Aboriginal persons who hold cultural knowledge relevant to this project area and who may wish to register an interest in the process of community consultation. Those who choose to register will have the opportunity to provide culturally appropriate information and to comment on the cultural heritage significance of Aboriginal objects and the area. If you are aware of Aboriginal people or groups who you believe may wish to register an interest in the process of Aboriginal consultation please provide contact details to NSW Archaeology Pty Ltd on behalf of the proponent before the 18 May 2015.

Yours faithfully

Dr Julie Dibden
New South Wales Archaeology Pty Limited

Example of letter sent to potential Aboriginal RAPs:

New South Wales Archaeology Pty Limited ABN 53106044366

PO Box 2135
Central Tilba NSW 2546
Ph 02 44737947
www.nswarchaeology.com.au

18 May 2015

Aaron Talbot & Natalene Mercy
6 Bando St
Gunnedah NSW 2380

Dear Sir/Madam

Re: <u>Coraki Quarry - Aboriginal Cultural Heritage Assessment</u>

A new hard rock extraction quarry is proposed for Lot 401 DP 633427, Seelems Road, via Petersons Quarry Road, 2.5 kilometres northwest of Coraki. An Aboriginal Heritage Assessment is being prepared. NSW Archaeology Pty Ltd is undertaking consultation with Aboriginal people on behalf of the proponent according to the requirements stipulated in the former NSW DECCW Aboriginal cultural heritage consultation requirements for proponents, 2010. The purpose of Aboriginal community consultation is to assist the proponent in understanding Aboriginal peoples views and concerns about the project, and to understand cultural values present in the area, and to assist the NSW Office of Environment and Heritage (OEH) in a determination of an AHIP application or development determination, if and as required.

Aboriginal people with cultural knowledge relevant to determining the significance of Aboriginal objects and/or places in the area are invited to register an interest in the process of community consultation. OEH provided your details to us and indicated that you may have an interest in the area.

If you wish to, please register in writing to: Julie Dibden, NSW Archaeology PL, PO Box 2135 Central Tilba NSW 2546: ph 0427074901, before 1 June 2015. Please note that if you do register an interest, your details will be forwarded to the NSW OEH and the Bogal Local Aboriginal Land Council unless you specify that you do not want your details released.

Yours faithfully

Dr Julie Dibden
New South Wales Archaeology Pty Limited

Example of 2nd letter sent to agencies:

New South Wales Archaeology Pty Limited ABN 53106044366

PO Box 2135
Central Tilba NSW 2546
Ph 02 44737947
www.nswarchaeology.com.au

7 August 2015

Aboriginal Heritage
Regional Operations Group
Office of Environment and Heritage
Locked Bag 914
Coffs Harbour NSW 2450

Dear Sir/Madam

Re: Coraki Quarry - Aboriginal Cultural Heritage Assessment

Further to my original correspondence dated 4 May 2015 in regard to a new hard rock extraction quarry for Lot 401 DP 633427, Seelems Road, via Petersons Quarry Road, a modification to the works is proposed. Quarry Solutions, the proponent, has been granted a lease by Richmond Valley Council to operate the existing Petersons Quarry on behalf of the Council. Petersons Quarry will be used as an integral part of the new Coraki Quarry project operations. Access into the Lot 401 rock resource and extraction, would occur from Petersons Quarry. The existing processing area of the Petersons Quarry would be used for the material extracted from Lot 401 and the processed material would be stockpiled on the existing Petersons Quarry site as well as the proposed stockpiling area on Lot 401.

The existing Petersons Quarry currently operates in accordance with the conditions of a consent acquired in 1985 and further modified in 2009. At that time, an Aboriginal Heritage Non Disturbance zone was proposed to be established on the western boundary of the Petersons Quarry site. This zone would be retained and respected for the proposed Coraki Quarry project.

An Aboriginal Heritage Assessment is currently being prepared and NSW Archaeology Pty Ltd is undertaking consultation with Aboriginal people in accordance with the requirements stipulated in the former NSW DECCW Aboriginal cultural heritage consultation requirements for proponents, 2010. The purpose of Aboriginal community consultation is to assist the proponent in understanding Aboriginal peoples views and concerns about the project, and to understand cultural values present in the area, and to assist the NSW Office of Environment and Heritage (OEH) in a determination of an AHIP application or development determination, if and as required.

In light of the modification as described above, we are seeking to identify Aboriginal persons who hold cultural knowledge relevant to this project area and who may wish to register an interest in the process of community consultation. Those who choose to register will have the opportunity to provide culturally appropriate information and to comment on the cultural heritage significance of Aboriginal objects and the area.

If you are aware of Aboriginal people or groups who you believe may wish to register an interest in the process of Aboriginal consultation please provide contact details to NSW Archaeology Pty Ltd on behalf of the proponent before the 21 August 2015.

Yours faithfully

Dr Julie Dibden
New South Wales Archaeology Pty Limited

Advertisement:

PAGE 24

www.northernstar.com.au

Notices

Public Notices

A new hard-rock extraction quarry is proposed for Coraki located 2.5 kms northwest of the township.

The project site is Lot 401 DP 633427, Seelems Road via Petersons Quarry Road.

An Aboriginal Heritage Assessment is being prepared. Aboriginal people with cultural knowledge relevant to determining the significance of Aboriginal objects and/or places in the area are invited to register an interest in the process of community consultation. The purpose of community consultation with Aboriginal people is to assist the proponent with the preparation of an Aboriginal Cultural Heritage Assessment.

Please register on behalf of the proponent, to NSW Archaeology PL, PO Box 2135 Central Tilba NSW 2546, before 20 May 2015.

Found

Border Collie X Found

Young male, about 6 mths old
Found wandering at
Lagoon Grass
Monday arvo, 4th May
Please telephone
0405 134 363

Jobs

Accounting

Accountant Position

We are seeking a full time Accountant for approx 15 months to cover a maternity leave period.

The Accountant is responsible for weekly reporting, month end close, monthly profit and loss, financial reporting, variance analysis, general ledger and bank reconciliations, monthly BAS preparation, FBT, maintenance of Fixed Asset registers.

Required skills:-

Ability to perform under pressure, meet deadlines, accurate data entry skills, excellent Excel skills, Word, Outlook, knowledge of SAP software an advantage.

Qualifications:- Relevant tertiary degree, CPA desirable, minimum 5 years experience. Salary – negotiable

Please apply by forwarding your application letter and resume by 8 May 2015:
Accountant Position
Macadamia Processing Co Limited
2 Cowlong Road
Alphadale via Lismore 2480
Or email to reception@mpcmacs.com.au

TURSA

Accounting Staff
(Multiple positions)

TURSA is seeking applications from suitably qualified persons with previous accounting experience to be based in our Lismore head office Accounting Unit.

Administrative Assistant—Accounting
Administrative Assistant—Data Entry

Applicants who are highly organised, and display a proven ability to multi-task are encouraged to apply. High volume payroll experience would be highly regarded.

Further information regarding these roles, selection criteria, and application details are available on www.tursa.com.au
Applications Close:
COB Tuesday 5th of May 2015

finda
Visit finda.com.au

Jobs

Banking, Finance & Insurance

PARAPLANNER

A local Boutique life insurance & financial planner is looking for an experienced paraplanner or back office worker.

Salary and hours negotiable for the right applicant.

Experience with Xplan is prefered

Contact:
02 66876082 or 0428607353
Email trish.carterfinancial@bigpond.com

Medical & Healthcare

RSL LifeCare

Care Staff

Night Shifts, Permanent Part-time & Casual Positions

Florence Price Gardens Ballina is a new 120 bed aged care home providing exceptional aged care to the local community. We are seeking qualified care staff for night shifts on a casual and permanent part-time basis.

Essential Criteria:
- Certificate 3 in Aged Care or equivalent
- Experience in residential care; plus skills and experience working within dementia specific areas will be highly regarded
- Current National Criminal History Check

This is an opportunity to work with a quality leading provider in Aged Care Services. You will enjoy benefits, including a thorough orientation and training program and a tremendous sense of self-worth and achievement.

Please send your resume or any enquiries to:
Pamela Robertson – Manager
Email: pamela.robertson@rsllifecare.org.au or
Phone: 02 6681 9016 or 0419 996 679

Applications open to: 15 May 2015

Surgical Specialty Clinic Receptionist

Leading surgical specialty clinic is looking for an enthusiastic and energetic Receptionist to be an integral part of our busy team.

Dental or Medical nursing experience will be required to fulfil this position, as well as, great administration and organisational skills; strong computer knowledge, good listening skills, able to show initiative and communicate effectively within a team.

A great opportunity to extend your skills in a specialist field.

Please email letter of application and resume to manager@maxillofacial.com.au

General Vacancies

LISMORE SHOPPING
square

MARKETING MANAGER

An exciting opportunity exists for a full time Marketing Manager with drive and flair to join our busy retail team.
Responsibilities:
- Manage ongoing execution of the brand program
- Formulate and manage marketing budgets
- Conduct market research to identify new opportunities
- Build strong relationships with retailers, and understand their business
- Manage social media platforms and website
- Merchandising and presentation of centre
- Develop and execute centre events, campaigns, competitions
- Assisting in the day to day running of the Centre

To be considered you will need:
- At least two years of marketing experience is favourable
- Sound computer skills (Microsoft Office Suite)
- A clear and confident communication style
- A strong work ethic and desire to be a team member
- Be a creative thinker
- Previous shopping centre marketing experience favourable.

An attractive package, commensurate with experience will be negotiated. Applications close 15th May 2015
If you would like to be part of our friendly, supportive and professional team, please email your covering letter and confidential CV to enquiries@lismoreshoppingsquare.com

General Vacancies

BUNDABERG SUGAR

Looking for a lifestyle change?

We require two **Shift Supervisors** for our Millaquin and Bingera sites in Bundaberg. These positions offer challenging and rewarding results for candidates who excel in their work as supervisors for sugar factory operations.

Duties will include the maintenance of factory operations to meet rate, lost time, sugar quality, recovery and customer interface requirements as well as the monitoring mill performance.

To apply or for further information contact:
applications@bundysugar.com.au
Or refer to our website
www.bundysugar.com.au
An Equal Opportunity Employer

Experienced
Traffic Controller Supervisors

Required for long-term local work
Starting 1st June.

Must have current red card and ideally first aid certificate.

Please email resumes to
nnswtraffic@workforce.com.au

GOT YOUR EYE ON SOMETHING SPECIAL???

Earn Extra $$$ Delivering Catalogues into Letterboxes
- Enthusiastic and reliable people are needed for immediate start in ALSTONVILLE, LISMORE, GOONELLABAH, LISMORE HEIGHTS, WOLLONGBAR on an independent contracting basis
- Car an advantage

Apply **NOW** at **www.deliver4dollars.com.au** (visit to learn more) or phone 1800 178 119
Please enter Ref No 1614 in application
SALMAT - www.salmat.com.au

Harvey Norman

Harvey Norman is seeking a
Part Time
Debtors Clerk
for the Ballina store.
Previous experience preferred
but not essential.

Please apply:
theresa.mccluskie@au.harveynorman.com

Hospitality, Tourism & Travel

Cook Required

Applicants should hold formal cooking qualifications and have knowledge of a range of cooking techniques and use of ingredients. Good English required as well as the ability to work well with others. This is a full-time position working 38 hours a week. To apply, please apply to cyprustreepty@bigpond.com, Byron Bay 2481,

E: cyprustreepty@bigpond.com

Restaurant Manager wanted

Lennox Head
For busy Asian restaurant in Lennox Head. Diploma of Management and on the job training required.
Salary $ 53900 plus super.
Contact: Ricky 0418 193 138

Apprentice Chef Wanted

South Lismore Bowling Club looking for an Apprentice Chef to join the team.
No qualifications needed
Please call 02 66213510 or send resumes to slbc@onestream.com.au
Applications close Friday 15th May

Head Chef

Cooking, Ordering, Cleaning, teaching. 25 to 30 hours per week, day and night, weekends. Must have experience and good work Ethics. Send your Resume to:
THE CHANNON TAVERN
thechannonbutterfactorytavern@hotmail.com

Attract Experienced Local Sales Staff.

To advertise, call 1300 967 500 or visit finda.com.au

finda
ONE LOCAL TO ANOTHER

Wednesday, May 6, 2015

Northern Star

Proposed project information, consultation process and project methods documents:

PROJECT DESCRIPTION AND PROPOSED CULTURAL HERITAGE ASSESSMENT AND CONSULTATION PROCESS
Coraki Quarry - Aboriginal Cultural Heritage Assessment

PROPOSED PROJECT INFORMATION
NSW Archaeology Pty Ltd has been commissioned by Groundwork Plus on behalf of Quarry Solutions Pty Ltd to conduct a formal process of Aboriginal Consultation in relation to a proposed quarry development as described below.

This document is being provided to Registered Aboriginal Parties (RAPs) for the purposes of providing information in regard to the project and agreeing on outcomes relating to the assessment process.

Groundwork Plus is preparing a development application for an Extractive Industry at Seelems Road (via Petersons Quarry Road), Coraki New South Wales (the Site) on land described as Lot 401 DP633427 (the proposed activity area – see map below). The approximate area of Lot 401 DP633427 is 23.06 hectares. Activities would occur on approximately half of the lot.

It is noted that access to the site is from Seelems Road via Petersons Quarry Road through Lot 403 on DP802985.

The site has an elevation of approximately 4m-41m AHD. Toward the east where the extraction would occur, the area is elevated from the areas to the west and north with elevations between 32m-40m AHD.

The land consists of mainly open grassland with minor patchy scrub at lower elevations towards Seelems Creek. An area of lowland rainforest exists on the adjoining Petersons Quarry to the south of the Site and extending into Lot 403 on DP802985 (where access is proposed).

The map below shows the location of the proposed quarry and access road in relation to an existing quarry.


Google earth
Petersons Quarry Rd
Quarry
Lot 401 DP 633427.
Varoli Pty Ltd
Lot 403
DP 502965
Richmond
Valley
Council.
? 'Right of Way?
Lot 1 DP 1165593
Richmond Valley Council
Lot 12
DP 6339
Susan Elizabeth Ann Bodley

PROPOSED CULTURAL HERITAGE ASSESSMENT AND CONSULTATION PROCESS

The cultural heritage assessment process for this project would be conducted in accordance with the *Aboriginal Cultural Heritage Consultation Requirements for Proponents 2010* (NSW DECCW). The NSW Office of Environment and Heritage - OEH (formally DECCW) manages Aboriginal cultural heritage in NSW in accordance with the National Parks and Wildlife Act 1974. Part 6 of the Act provides specific protection for Aboriginal objects and Aboriginal places by administering offences for harming them without authorisation. When an activity is likely to impact Aboriginal objects or declared Aboriginal Places, approval of the OEH is required, issued in the form of an Aboriginal Heritage Impact Permit (AHIP).

NSW OEH requires effective consultation with Aboriginal people because it recognises that:

- Aboriginal people should have the right to maintain culture, language, knowledge and identity;
- Aboriginal people should have the right to directly participate in matters that may affect their heritage; and
- Aboriginal people are the primary determinants of the cultural significance of their heritage.

The purpose of the NSW OEH Aboriginal Cultural Heritage Consultation Requirements for Proponents document (NSW DECCW 2010) is to facilitate positive Aboriginal cultural heritage outcomes by:

- affording an opportunity for Aboriginal people who hold cultural knowledge relevant to determining the significance of Aboriginal object(s) and/or place(s) in the area of the proposed project to be involved in consultation so that information about cultural significance can be provided to NSW OEH to inform decisions regarding applications for an AHIP; and
- providing Aboriginal people who hold cultural knowledge relevant to determining the significance of Aboriginal object(s) and/or place(s) in the area of the proposed project with the opportunity to participate in decision-making regarding the management of their cultural heritage by providing proponents with information regarding cultural significance and inputting into management options (NSW DECCW 2010).

The ACHCRP requirements outline four main consultation stages to be implemented in the course of consultation undertaken with Aboriginal people (these are outlined below). In summary, the consultation process involves getting the views of, and information from, Aboriginal people and reporting these.

In order to fulfil the consultation requirements, NSW Archaeology Pty Ltd, on behalf of the proponent, proposes to implement the following procedure:

Stage 1 Notification of project proposal and registration of interest.

This stage is already underway, and the aim is to identify, notify and register Aboriginal people who hold cultural knowledge relevant to determining the cultural significance of Aboriginal objects and/or places in the proposal area.

- NSW Archaeology, on behalf of the proponent, has sought to identify the names of Aboriginal people who may hold cultural knowledge relevant to determining the significance of Aboriginal objects and/or places. An advertisement has been placed in the local paper and letters have been written to various agencies.

- As we receive registrations of interest, NSW Archaeology is making a record of the names of each Aboriginal person or group who has registered an interest. Unless it is specified by a registered Aboriginal party that they do not want their names released, the list of names will be provided to OEH and the Local Aboriginal Land Council.

- Where an Aboriginal organization representing Aboriginal people who hold cultural knowledge has registered an interest, a contact person for that organization must be nominated. We rely on that organization to make these arrangements. Where Aboriginal cultural knowledge holders have appointed a representative to act on their behalf, this information must be provided in writing to NSW Archaeology.

Stage 2 Presentation of information about the proposed project

The aim of this stage is to provide Registered Aboriginal Parties with information about the scope of the proposed project and the proposed cultural heritage assessment process.

- The proponent has engaged NSW Archaeology to conduct the consultation process. It is therefore the role of Julie Dibden, NSW Archaeology, to co-ordinate the assessment process. Aboriginal parties are invited to define their role, function and responsibility in this process.
- All Registered Aboriginal Parties are invited to identify, raise and discuss any cultural concerns, perspectives and assessment requirements (if any). In this regard Registered Aboriginal Parties should contact Julie Dibden, and this may be done in writing or by telephone.
- Provision of project information and the proposed cultural heritage process is provided to Registered Aboriginal Parties as per this document and the accompanying *Methodology* document.
- If further information is required in regard to the proposal this will be provided to Registered Aboriginal Parties upon request. If necessary, additional information about the project will be provided; this may entail a project site visit.
- A record will be made that the proposed project information has been submitted. A record of any agreed outcomes and any contentious issues that

may require further discussion to establish mutual resolution (if applicable) will be made and provided to Registered Aboriginal Parties.
- All comments and feedback in regard to the Consultation Process and Project Methodology should be provided to NSW Archaeology within 28 days.

Stage 3 Gathering information about cultural significance
The aim of stage 3 is to facilitate a process whereby Registered Aboriginal Parties can contribute to culturally appropriate information gathering and the project methodology, provide information that will enable the cultural significance of Aboriginal objects and/or place in the proposal area to be determined, and to have input into the development of cultural heritage management options.

- A proposed methodology for the cultural heritage assessment will be provided to Registered Aboriginal Parties for review. Any comments in regard to the methodology should be provided to Julie Dibden, NSW Archaeology, within 28 days. Any protocols that Registered Aboriginal Parties wish to be adopted into the information gathering process and assessment methodology, and any other matters should be provided in writing or may be sought by the consultant.
- As a part of consultation, NSW Archaeology, on behalf of the proponent, seeks cultural information from Registered Aboriginal Parties to identify whether there are any Aboriginal objects or places of cultural value to Aboriginal people in the proposal area and if so, to uncover knowledge about their context in order to reveal their meaning and significance. Registered Aboriginal Parties who wish to contribute to this process should make contact with Julie Dibden (within 28 days) so that appropriate arrangements regarding collecting cultural knowledge can be made.
- If any information obtained is sensitive, appropriate protocols will be developed and implemented for sourcing and holding sensitive information.
- Registered Aboriginal Parties are invited to identify, raise and discuss any cultural concerns, perspectives and assessment requirements by telephone or in writing to Julie Dibden, NSW Archaeology, within 28 days.
- All feedback received from Registered Aboriginal Parties will be documented in the Aboriginal cultural heritage assessment report as appropriate.

Stage 4 Review of Draft Cultural Heritage Assessment Report
The aim of this stage is to prepare and finalise an Aboriginal cultural heritage assessment report with input from Registered Aboriginal Parties.

- A draft report will be compiled.
- The draft report will be provided to Registered Aboriginal Parties for review and comment.
- Any comments in regard to the report should be provided to Julie Dibden, NSW, within 28 days.

- After considering comments the report will be finalised and copies will be provided to registered Aboriginal parties. The final report will include copies of any submissions made and the proponents response to any submissions.

PROPOSED METHODOLOGY FOR THE INDIGENOUS HERITAGE (CULTURAL AND ARCHAEOLOGICAL) ASSESSMENT

Coraki Quarry - Aboriginal Cultural Heritage Assessment
Aboriginal Cultural Heritage Assessment

NSW Archaeology Pty Ltd has been commissioned by Groundwork Plus to conduct a formal process of Aboriginal Consultation in relation to the proposed Coraki Quarry (the proposed activity area – see map below). The proponent is preparing an Aboriginal Cultural Heritage Assessment for the proposed development.

NSW Archaeology Pty Ltd is undertaking consultation with Aboriginal people on behalf of the proponent according to the requirements stipulated in the former NSW DECCW Aboriginal cultural heritage consultation requirements for proponents, 2010**.**

NSW Archaeology Pty Ltd is a consultancy specialising in Indigenous cultural heritage management, and aims to prepare assessments of a high standard to satisfy all stakeholders including the local Aboriginal community and the NSW Office of Environment and Heritage – OEH.

The project will be conducted in accordance with the requirements of the OEH *Guide to investigating, assessing and reporting on Aboriginal cultural heritage in NSW* and the *DECCW 2010 Code of Practice for Archaeological Investigation of Aboriginal Objects in New South Wales*. In addition the study is being undertaken following the requirements for *Aboriginal Cultural Heritage Consultation Requirements for Proponents 2010* (ACHCRP) (NSW DECCW 2010).

In accordance with the process as outlined in *Aboriginal Cultural Heritage Consultation Requirements for Proponents 2010* (ACHCRP) (NSW DECCW 2010), this methodology is being provided to all Aboriginal groups/individuals who have registered an interest in this process of consultation. The purpose of providing registered stakeholders with this methodology is for stakeholders to review and provide feedback to the consultant, including identification of issues/areas of cultural significance that might affect the methodology. Stakeholders are invited to make a written response to this proposed methodology within 28 days.

The methodology which is proposed to be implemented during this project is set out below.

It is proposed that the assessment of cultural heritage values of the project area will entail the following aspects as defined in the OEH *Guide to investigating, assessing and reporting on Aboriginal cultural heritage in NSW*:

Review of background information: Definition and mapping of the physical landscape; reviewing historic values via recourse to written and oral histories and existing heritage data bases; and define the material evidence of Aboriginal land use via review of previous research, development of predictive model and a field inspection and survey (the latter to be documented in a survey report). Any information received from registered Aboriginal parties will be used in this process. Registered Aboriginal parties are invited to inform Julie Dibden in regard to areas, objects and places of cultural value in the proposed activity area.

Initiate ongoing consultation in accordance with the OEH's Aboriginal Cultural Heritage Consultation Requirements for Proponents 2010. Information is sought from registered Aboriginal parties on whether there are any Aboriginal areas, objects or places of cultural value to Aboriginal people in the proposed activity area.

Identify and assess the cultural heritage values: Upon receipt of information that would enable the cultural significance of Aboriginal areas, objects and/or places in the proposed activity area to be determined, the range of social, historical, scientific and aesthetic values present across the study area would be identified, mapped, and assessed as to why they are important. A field survey will be undertaken.

Assess harm of the proposed activity: Identification of the nature of the proposed activity and any potential harm to Aboriginal areas, objects and/or places. This would take into consideration the principles of ecologically sustainable development (ESD) if relevant.

Develop harm avoidance and/or minimisation strategies: Registered stakeholders would be invited to have input into the development of cultural heritage management options. The development of avoidance and/or minimisation strategies if required would commence in the field, and be developed further within an Aboriginal cultural heritage assessment report.

Documentation of Findings: An Aboriginal cultural heritage assessment report would be prepared. The report would be prepared in accordance with the report outline as set out in OEH's *Guide to investigating, assessing and reporting on Aboriginal cultural heritage in NSW*.

A draft copy of the report will be provided to all Aboriginal groups or individuals who register an interest in this project for review and comment.

Upon review of this proposed methodology, registered stakeholders are invited to make submissions relating to the information gathering and assessment methodology, and any matters such as issues/areas of cultural significance that might affect, inform or refine the assessment methodology, to Julie Dibden within 28 days. All feedback received will be documented in the cultural heritage assessment report, which will include copies of submissions received and the proponents response to issues raised.

Attachment 4

Traffic Impact and Pavement Assessment Report

FINAL REPORT

Coraki Quarry
Traffic Impact and Pavement Assessment Report

Quarry Solutions Pty Ltd

Prepared by:

MRCagney Pty Ltd

October 2015

MRCagney

Document Information

Client	Quarry Solutions Pty Ltd
Job Number	5639
Title	Coraki Quarry
Prepared by	MRCagney Pty Ltd MILTON QLD
Date	29/10/2015

Quality Assurance Register

Issue	Description	Prepared by	Reviewed by	Authorised by	Date
a	Draft	MM	BT	BT	06/07/2015
1	Draft Final	MM	BT	BT	29/07/2015
2	Final	MM	BT	BT	11/09/2015
3	Final	MM	BT	BT	29/10/2015

Table of Contents

1. Introduction

MRCagney has been commissioned by Quarry Solutions Pty Ltd to prepare a traffic impact assessment (TIA) and pavement impact assessment (PIA) report to support the development application of the proposed Coraki Quarry to be located to the north of Seelems Road, Coraki.

The likely production schedules of the proposed development are listed below:

- Maximum annual production rate - up to 1M tonnes per year; and
- Average annual production rate - approximately 0.8M tonnes per year over 5 to 7 years.

It is anticipated that the proposed quarry will start operating in July 2016 for 5 to 7 years.

We have been advised that the proposed development constitutes 'State Significant Development' and will be assessed by the NSW State Government in consultation with the Richmond Valley Council. It is understood that the quarry is proposed to predominately supply materials to the scheduled upgrade works of the Pacific Highway at Woodburn.

The traffic impact of the proposal has been assessed based on maximum production rates to ensure satisfactory operation of road infrastructure components at all times during the operational period of the site. In contrast, pavement impacts associated with the proposal are usually assessed based on the average production rates over the operational life as pavement impacts are fundamentally based on cumulative impacts. In this instance, however, the maximum annual production rate of 1M tonnes per annum has been considered as a conservative assumption in consideration of the Seelems Road pavement.

It is of course not possible to forecast the future actual annual maximum and average production volumes at this planning stage, with the actual rates being subject to variables such as operating costs and the specific demands of the upgrade works of the Pacific Highway. Notwithstanding this, the targeted maximum and average operating conditions of the proposed quarry mentioned above have been modelled and assessed herein as they are understood to be appropriate yardsticks in this instance.

In the event actual production rates ultimately are above the targeted maximum and / or average production rates identified, updated traffic and / or pavement assessment could be undertaken.

It is noted that access is proposed from Seelems Road as well as through an adjoining property, which is a quarry site owned by Council and to be also operated by the applicant.

A summary of findings is provided in Section 9 of this report.

2. Existing Conditions

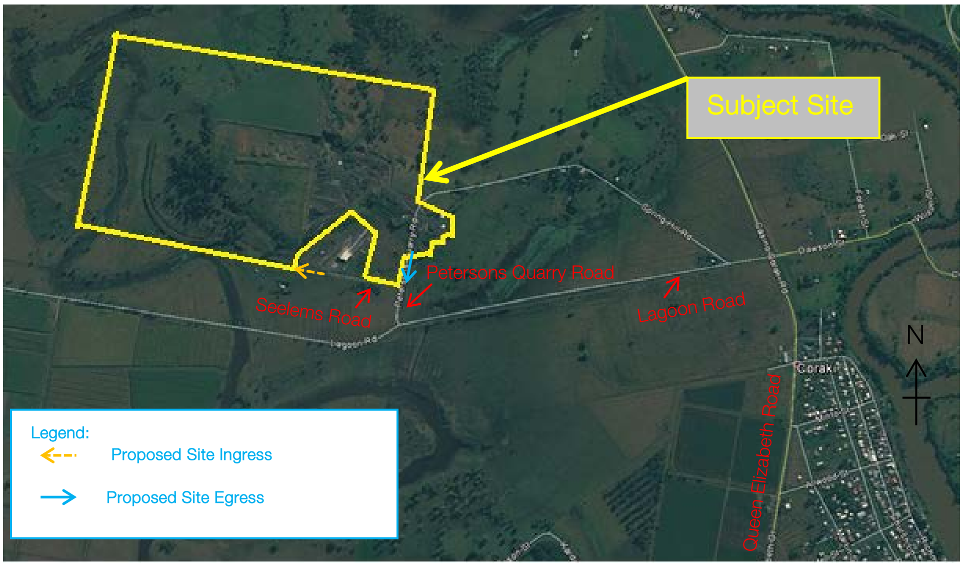
2.1 Subject Site

The subject site is located on Seelems Road, Coraki and is adjacent to the existing Petersons Quarry. The location of the site is illustrated on the Locality Map in Figure 2-1.

The locations of the proposed site ingress and egress are illustrated in Figure 2-1.

The site plan of the proposed development is included in Appendix A of this report.

Figure 2-1 Locality Map



2.2 Existing Road Network

The hierarchical classification and characteristics of roads in the vicinity of the subject site are described in Table 2-1 below.

Table 2-1 Existing Local Road Hierarchy

Road	Speed limit	Characteristics	Authority
Seelems Road[1]	-*	Unsealed road	Richmond Valley Council
Petersons Quarry Road	-*	Sealed road	Richmond Valley Council
Lagoon Road	100km/h	Sealed (undivided) two-lane road	Richmond Valley Council
Queen Elizabeth Drive	80km/h**	Sealed (undivided) two-lane road	Richmond Valley Council
Coraki Woodburn Road	100km/h	Sealed (undivided) two-lane road	Richmond Valley Council
Pacific Highway	50km/h***	Sealed (undivided) two-lane road	Roads and Maritime Services

Note:

[1] Seelems Road is the road section extending to Lot 407 of DP1166287 up to the site boundary, it is approximately 380m long from Petersons Quarry Road

*Speed limit sign is not present.

**Speed limit varies; the speed limit reduces to 40km/h from 8:00am to 9:00am and from 2:30pm to 4:00pm on school days within the school zone.

***Speed limit of Pacific Highway near the Coraki Woodburn Road / Pacific Highway intersection.

The typical cross-section of Seelems Road is displayed in Figure 2-2.

Figure 2-2: Seelems Road looking east towards Petersons Quarry Road

The typical cross-section of Petersons Quarry Road is displayed in Figure 2-3.

Figure 2-3: Petersons Quarry Road looking north

The typical cross-section of Lagoon Road is displayed in Figure 2-4.

Figure 2-4: Lagoon Road looking west

The typical cross-sections of Queen Elizabeth Drive are displayed in Figures 2-5 and 2-6.

Figure 2-5: Queen Elizabeth Drive looking north

Figure 2-6: Queen Elizabeth Drive looking south near school zone

The typical cross-sections of Coraki Woodburn Road are displayed in Figure 2-7.

Figure 2-7: Coraki Woodburn Road looking north-west

3. The Transport Route

It is understood that the quarry is proposed to predominately supply materials to the scheduled upgrade works of the Pacific Highway at Woodburn.

The proposed internal transport route, illustrated in Figure 3-1, comprises the haul vehicle drivers entering the site via Seelems Road (the section fronting Lot 407 of DP1166287) and exiting the site via Petersons Quarry Road; the haul vehicles will circulate the site in a clockwise direction (one-way flow). Accordingly, only unladen haul vehicles would utilise Seelems Road.

We have been advised that staff vehicles are unlikely to utilise Seelems Road as the site office and the staff car parking area will be within the existing Petersons Quarry weighbridge area accessed via Petersons Quarry Road; upon review of the site plan, this appears to be an appropriate assumption.

The proposed external transport route from the site to the Pacific Highway, Woodburn is via Petersons Quarry Road, Lagoon Road, Queen Elizabeth Drive, Coraki Woodburn Road and thence the Pacific Highway. The proposed external transport route is illustrated in Figure 3-2.

Figure 3-1 The Proposed Internal Transport Route within the Site

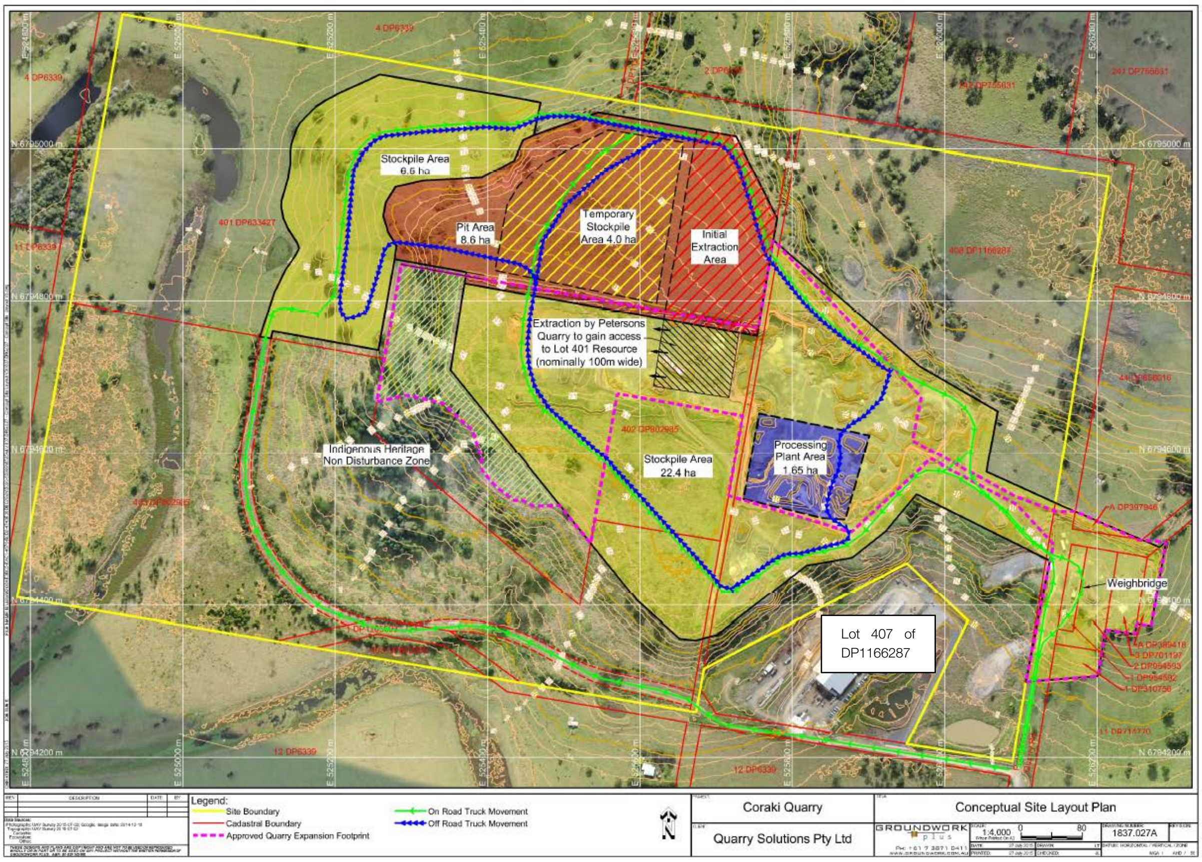
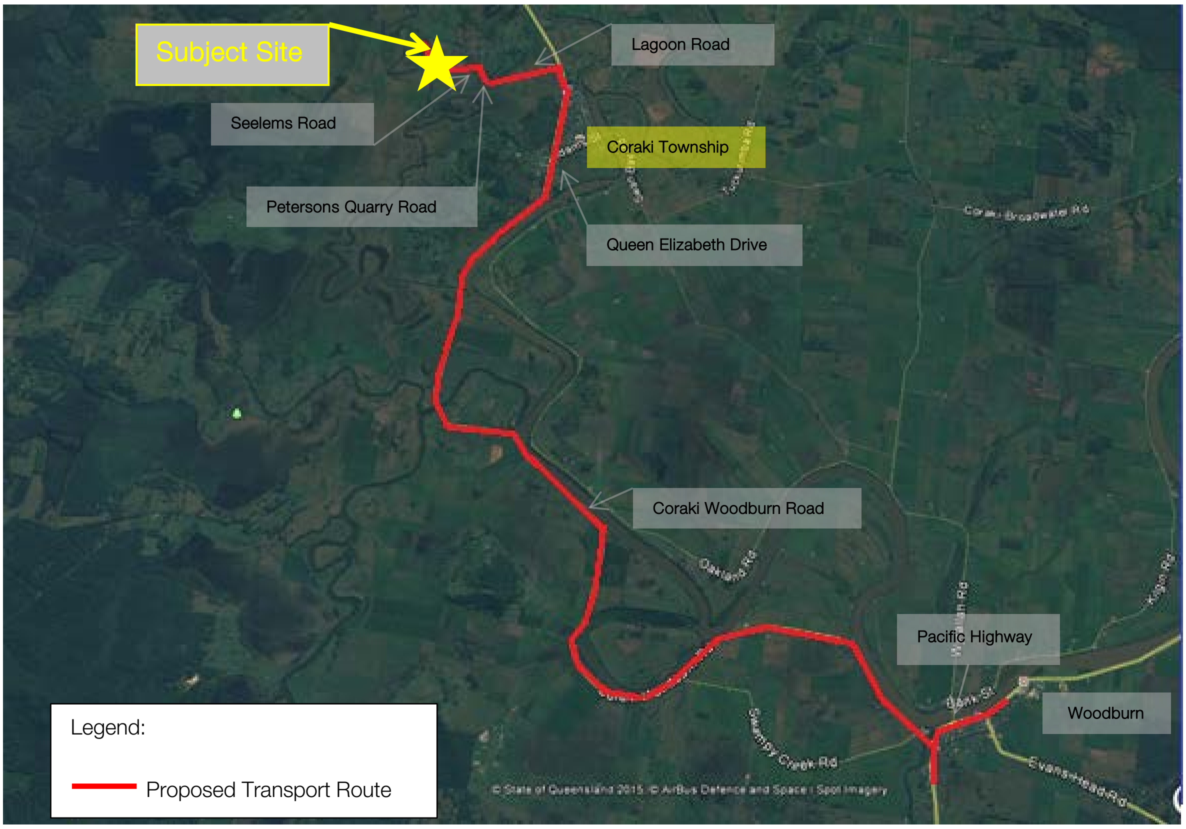


Figure 3-2 The Proposed External Transport Route to / from Pacific Highway, Woodburn Area



4. Base Traffic Volumes

4.1 2015 Traffic Volumes

As a part of this study, traffic surveys were commissioned to be undertaken by Austraffic at the following intersections in the vicinity of the site on Thursday 21st May 2015 from 6:30am to 10:30am and from 2:00pm to 6:00pm. The locations of traffic surveys are illustrated in Figure 4-1.

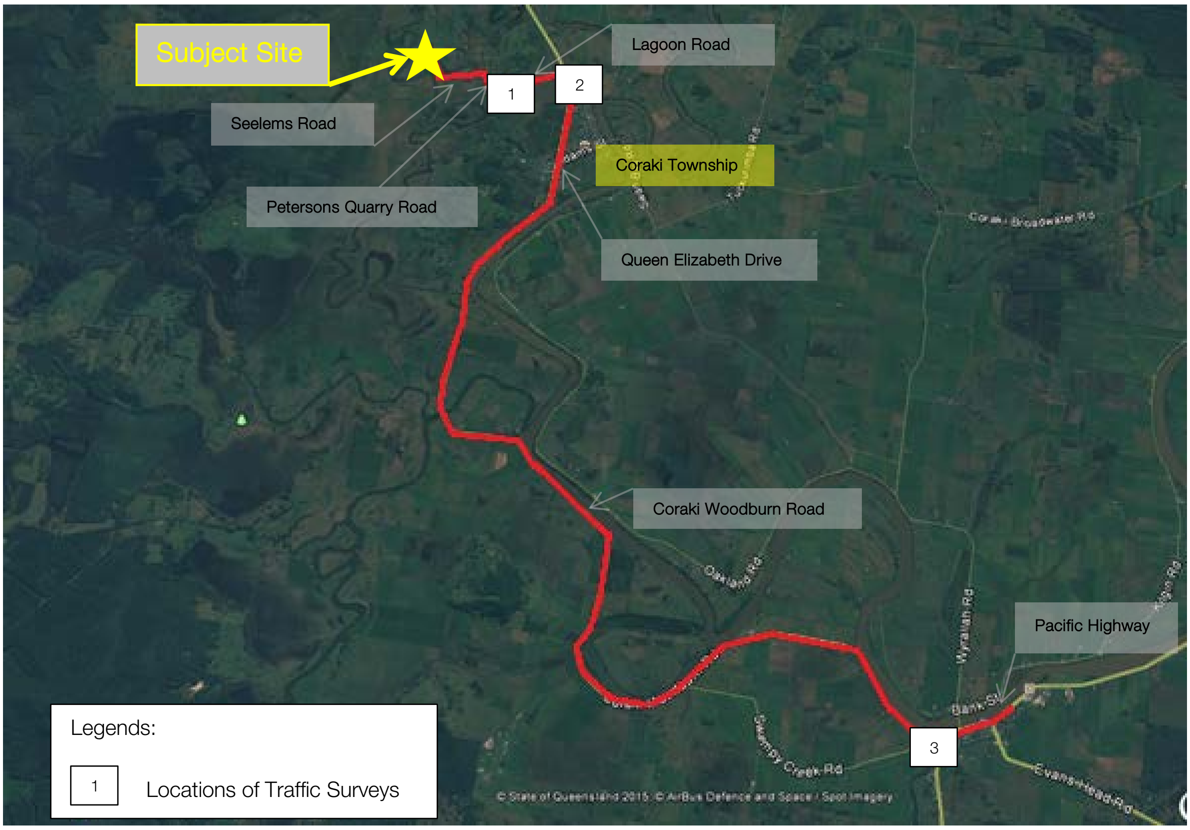
- Intersection 1: Petersons Quarry Road / Lagoon Road;
- Intersection 2: Lagoon Road / Queen Elizabeth Drive; and
- Intersection 3: Coraki Woodburn Road / Pacific Highway.

The detailed results of these traffic surveys are included in Appendix C of this report.

It is noted that it is the industry accepted traffic engineering practice to undertake the traffic impact assessment for a development of a small to medium scale based on the results of a single day's traffic survey. It is of course understood that there are daily / seasonal variations of traffic volumes at intersections or road corridors, however, the single day traffic survey as utilised in such cases provides suitable information in relation to the general traffic volumes / operational characteristics of intersections and provides a good indication of how the affected intersections would operate with and without the proposed development.

In this instance, the survey date was carefully chosen to avoid school holidays and Mondays / Fridays, so that the results of the survey could best represent the average traffic volumes of a normal weekday working day.

Figure 4-1: Locations of Traffic Surveys



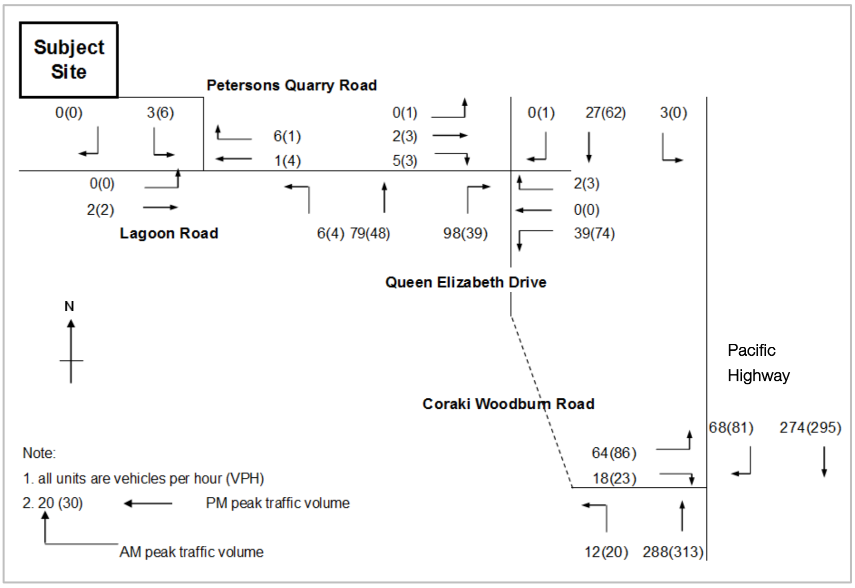
The observed AM and PM peak hour periods of traffic at the intersections are summarised in Table 4-1. The individual peak hour of traffic volumes of each intersection have been adopted for the analyses outlined in this traffic impact assessment. Accordingly traffic volumes will not match from intersection to intersection, however, it is considered that this approach will ensure the worst-case-scenario has been assessed for each location.

Figure 4-2 illustrates the 2015 observed traffic volumes during the peak hour periods.

Table 4-1: 2015 Observed AM and PM Peak Hour Periods

Intersection	AM Peak Hour Period	PM Peak Hour Period
Intersection 1: Petersons Quarry Road / Lagoon Road	9:15am - 10:15am	3:15pm - 4:15pm
Intersection 2: Lagoon Road / Queen Elizabeth Drive	7:30am - 8:30am	3:30pm - 4:30pm
Intersection 3: Coraki Woodburn Road / Pacific Highway	8:45am - 9:45am	3:00pm - 4:00pm

Figure 4-2 2015 Observed Traffic Volumes



4.2 Adjacent Existing Developments

From the point of view of undertaking holistic traffic loading on the road network, it is noted that adjacent to the subject site there is an industrial site and the Petersons Quarry. The survey undertaken on Thursday 21st May 2015 would include the traffic generated by the adjoining industrial site.

After the completion of the traffic survey, MRCagney was advised that the Petersons Quarry only operated on Wednesdays; therefore, the traffic generated by the Petersons Quarry would not have been included in the background traffic survey.

Based on results of intersection performance analysis (SIDRA analysis), included in Section 6 of this report, it is clear that all affected intersections have ample reserve capacity with and without the proposed development in the design year. All affected intersections would operate satisfactorily even if the total traffic volume generated was to double; therefore, there are no operational concerns with both the Petersons Quarry and the proposed development operating simultaneously.

The pavement impact of a development should be assessed based on the Annual Average Daily Traffic (AADT), not daily traffic volumes of a single survey day, therefore, the AADT (2015) on the adjacent road network already essentially includes the traffic generated by the Petersons Quarry.

Possible pavement contributions associated with the existing Petersons Quarry is a separate issue. As noted in Section 8 of this report, the pavement impact / contribution of the proposed development is calculated based on Section 94 Heavy Haulage Contributions Plans 2013 (Ref. 1).

4.3 Base Traffic Growth

It is anticipated that the proposed quarry will commence operations in July 2016 for 5 to 7 years. Therefore, the design horizon year of the proposed development would be 2023 (the last operational year of the proposed development).

Background Traffic Growth

For the purpose of this assessment, an average growth rate of 3% p.a. (compound) has been adopted to estimate future background traffic volumes. The growth of the traffic volumes on Petersons Quarry Road is assumed to be zero without the proposed development.

The 2016 base traffic volumes [Figure 4-3] are calculated as follows:

= 2015 observed traffic volumes [Figure 4-2] x $(1 + 3\%)^1$

The 2023 base traffic volumes [Figure 4-4] are calculated as follows:
= 2015 observed traffic volumes [Figure 4-2] x $(1 + 3\%)^8$

Figures 4-3 and 4-4 illustrate the 2016 and 2023 base traffic volumes without the proposed development during the peak hour periods that have been used as the basis of the traffic assessment outline herein.

---

[1] "Section 94 Heavy Haulage Contributions Plans 2013", Richmond Valley Council, 2013.

Figure 4-3 2016 Base Traffic Volumes without the Proposed Development

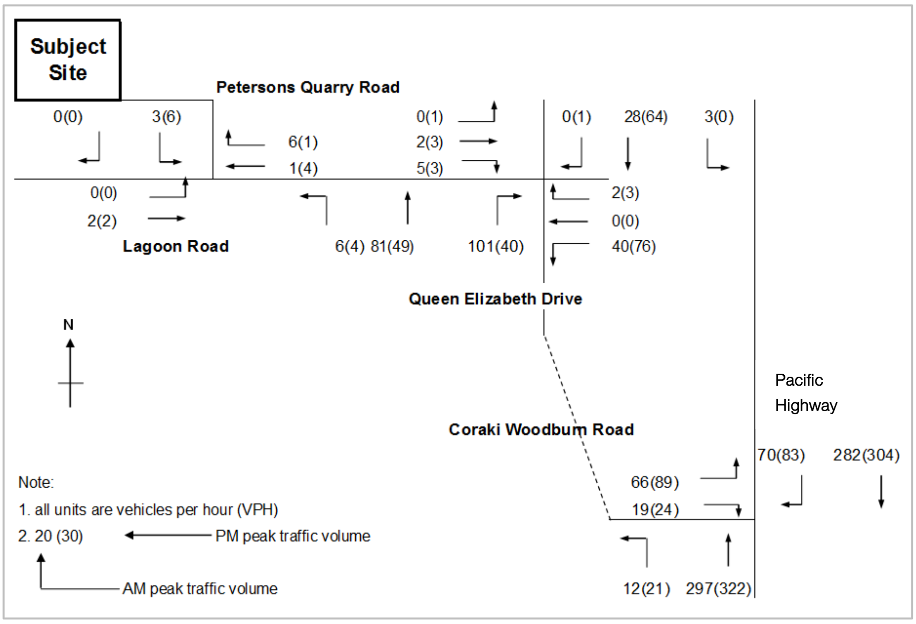
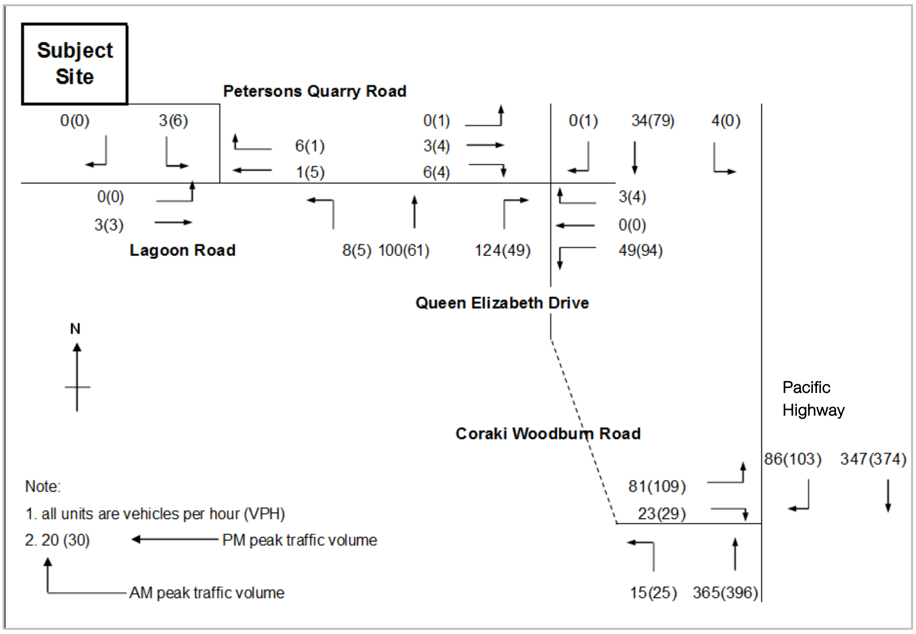


Figure 4-4 2023 Base Traffic Volumes without the Proposed Development



5. Traffic Volumes Generated by the Proposed Quarry

5.1 Trip Generation

The maximum annual production volume of the proposed development is anticipated to be 1M tonnes per year. It is not possible to forecast the future actual annual peak production volume at this planning stage, therefore, the maximum production threshold (1M tonnes per year) has been adopted to assess the traffic impact of the site on the surrounding road network; this is considered to be a conservative assumption. We have been advised that the proposed operating hours of the loading and hauling activities would be from 6:00am to 7:00pm from Monday to Saturday; there would be no operation on Sundays as well as major public holidays, such as Anzac Day, Good Friday, Easter Monday or Christmas Day.

The trips generated by the proposed development have been estimated by adopting the following project parameters. Whilst a number of these parameters have been based on assumptions, these are considered reasonable and reflective of the likely operations of the proposed development. Therefore, the resultant volume forecasts are considered appropriate for the purposes of this assessment.

- Total (max.) haulage*: 1,000,000 tonnes per year;
- Working weeks per year: 50 weeks;
- Working days per week: 6 days;
- Working hours per day: 13 hours;
- Average mass of material per vehicle**: 36 tonnes per vehicle;
- Average hourly traffic volume (IN): = [1,000,000 / 50 / 6 / 13 / 36] = 7vph; and
- Average hourly traffic volume (OUT): 7vph (assumed same as IN traffic volumes).

*MRCagney has been advised that the maximum production threshold would be 1M tonnes per year.
**MRCagney has been advised that 36t payload truck & dog would be used.

It is noted that the proposed development would generate an average hourly traffic volume of 7vph (IN) and 7vph (OUT). However, in order to ensure sufficient infrastructure is proposed to be provided to cater for the 'worst-case' peak design scenario, it is conservatively assumed that the proposed development would generate more than the average hourly traffic volumes during the peak hour periods by introducing the concept of peak hour factor.

- Peak hour factor***: 3 (for the purpose of this traffic impact assessment, a peak hour factor of 3 has been adopted);
- Peak hourly traffic volume (IN): = [1,000,000 / 50 / 6 / 13 / 36 x 3] = 21vph; and
- Peak hourly traffic volume (OUT): 21vph (assumed same as IN traffic volumes).

***Peak hour factor is the ratio of the absolute peak operating conditions to the average operating conditions of a peak production year. This represents what is considered to be the 'worst-case' peak design scenario and has been used as the basis of this traffic impact assessment.

It is understood that there will be total of 15 on-site staff (on different shifts) working at the proposed development.

Whilst the staff may not necessarily arrive / leave the site during the AM and PM road peak hour periods, it is conservatively assumed that approximately one-third of staff would arrive at the site during the AM peak hour period and leave the site during the PM peak hour period; ie. staff of the site would generate 5vph during the AM peak hour period (5vph IN + 0vph OUT) and the PM peak hour period (0vph IN + 5vph OUT). The trips generated by the staff are in addition to the trips generated by the hauling activities.

It is understood that the quarry is proposed to predominately supply materials to the scheduled upgrade works on the Pacific Highway at Woodburn. It is understood that all of the quarried materials will be delivered to the Pacific Highway to the north of the Pacific Highway / Coraki Woodburn Road intersection in the early stage of the Pacific Highway upgrade project; and all of the quarried materials will be delivered to the Pacific Highway to the south of the Pacific Highway / Coraki Woodburn Road intersection in the latter stage of the project. The location of the housing of staff working at the site cannot be known at this stage; however, it is conservatively assumed the staff come from the north during the early stage, and vice versa in the latter stage in this traffic assessment; which are considered as the 'worst-case' scenarios.

The peak hourly trips forecast to be generated by the proposed development based on the aforementioned assumptions are illustrated in Figure 5-1 (the early stage) and Figure 5-2 (the latter stage).

Figure 5-1 Trips Forecast to be Generated by the Site – the Early Stage of the Pacific Highway Upgrade Project

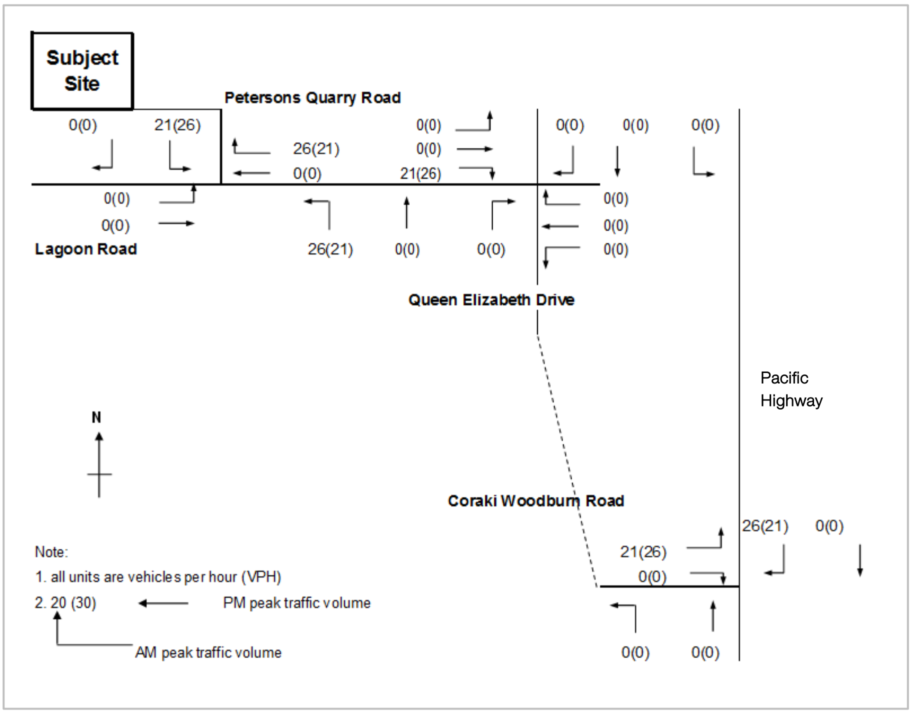
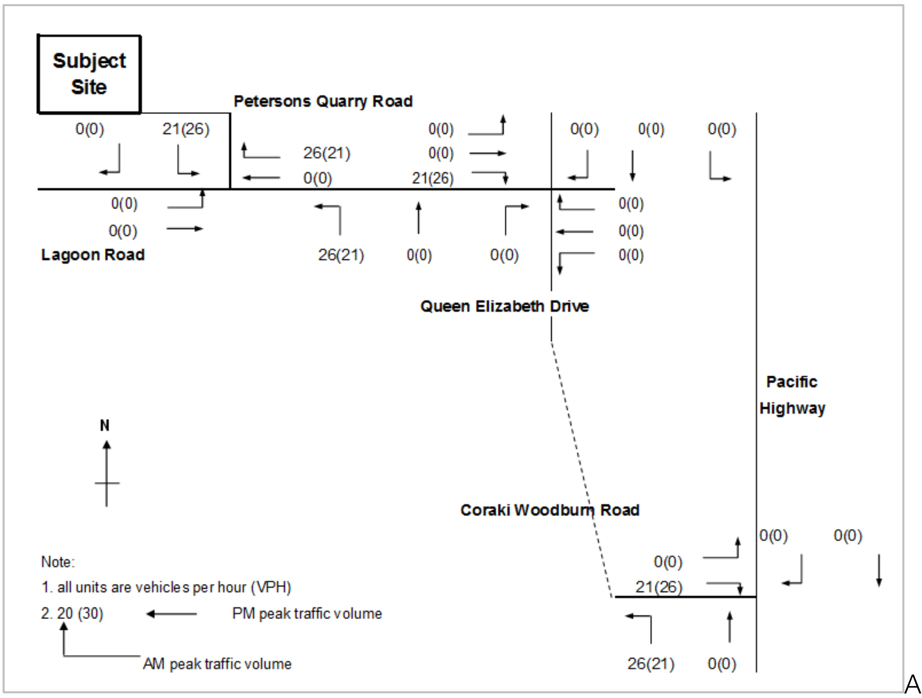


Figure 5-2 Trips Forecast to be Generated by the Site – the Latter Stage of the Pacific Highway Upgrade Project



Adding the forecast

Adding the forecast development-generated traffic to the base traffic volumes, the 2016 and 2023 design traffic volumes (the early stage) are illustrated in Figures 5-3 and 5-4 respectively.

Similarly, the 2016 and 2023 design traffic volumes (the latter stage) are illustrated in Figures 5-5 and 5-6 respectively.

Figure 5-3 2016 Design Traffic Volumes with the Proposed Development – the Early Stage of the Pacific Highway Upgrade Project

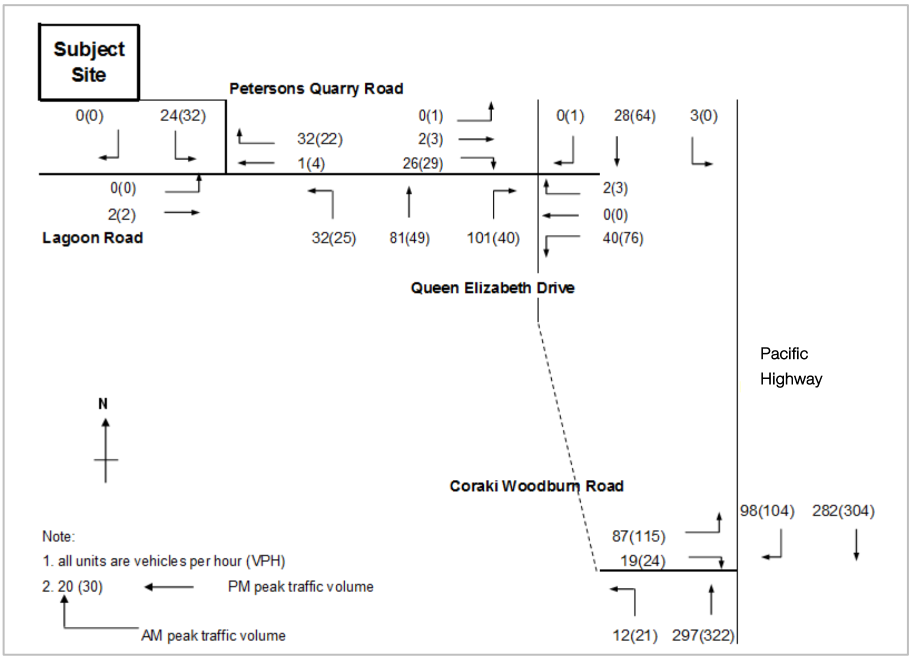


Figure 5-4 2023 Design Traffic Volumes with the Proposed Development – the Early Stage of the Pacific Highway Upgrade Project

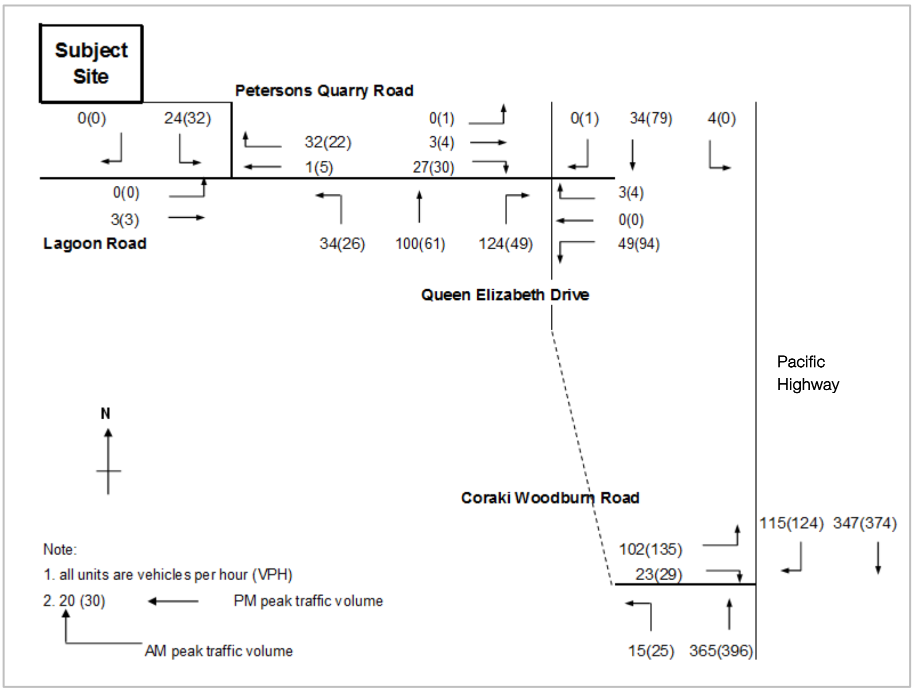


Figure 5-5 2016 Design Traffic Volumes with the Proposed Development – the Latter Stage of the Pacific Highway Upgrade Project

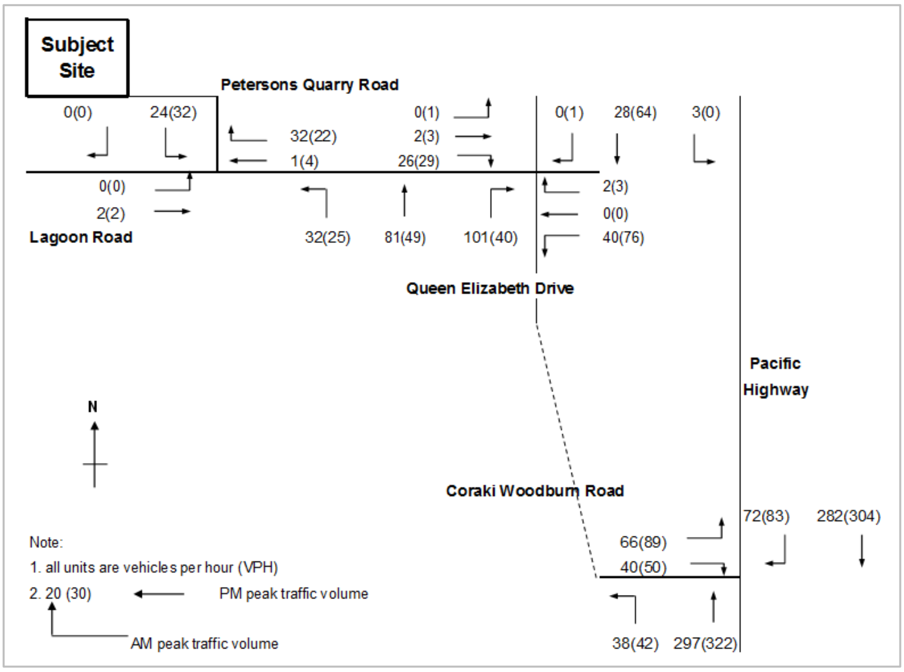
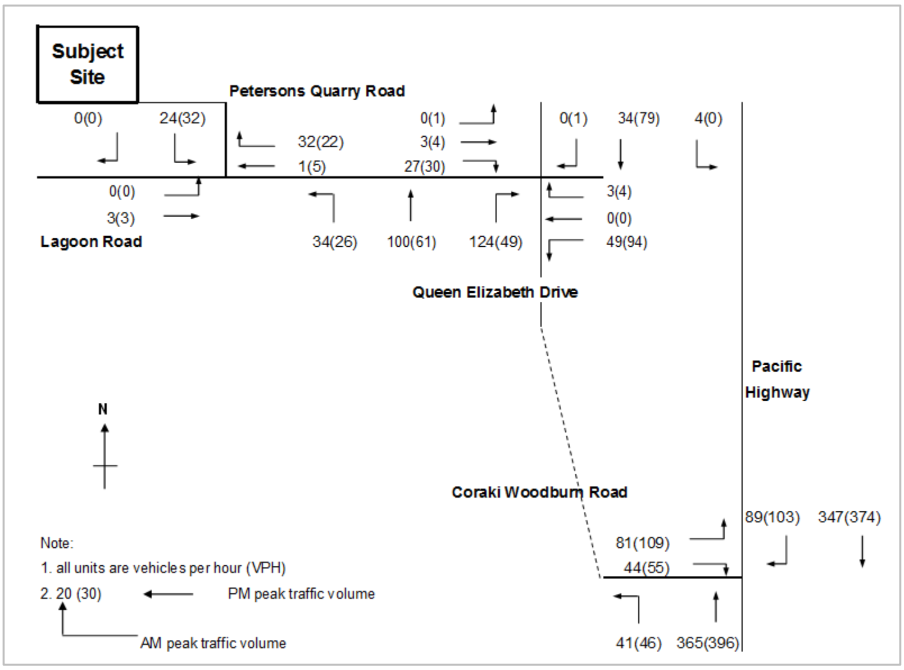


Figure 5-6 2023 Design Traffic Volumes with the Proposed Development – the Latter Stage of the Pacific Highway Upgrade Project



6. Intersection Performance

6.1 Intersection Capacity

To quantify the impact of the proposed development on the operation of the external road network, future operation of the following key intersections has been assessed:

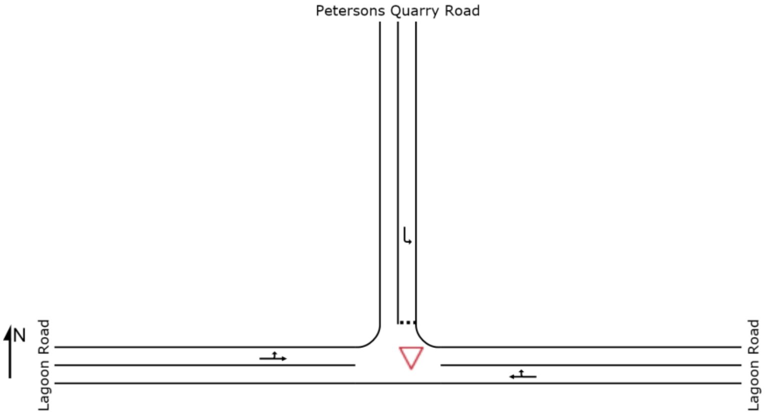
- Intersection 1: Petersons Quarry Road / Lagoon Road;
- Intersection 2: Lagoon Road / Queen Elizabeth Drive; and
- Intersection 3: Coraki Woodburn Road / Pacific Highway.

The following sections of this report summarise the findings of the analyses.

6.1.1 Intersection 1: Petersons Quarry Road / Lagoon Road Intersection

The configuration of the Petersons Quarry Road / Lagoon Road intersection modelled in the SIDRA analyses is shown in Figure 6-1. The number of vehicles turning right from Petersons Quarry Road onto Lagoon Road during the entire traffic survey period was zero; it is anticipated that the right turn movement from Petersons Quarry Road will continue to be minimal. Therefore, no right turn on Petersons Quarry Road has been modelled in the SIDRA analyses for simplicity; not withstanding this assumption, review of the results of the analysis will clearly reveal that such an assumption is immaterial.

Figure 6-1: Modelled Configuration of the Petersons Quarry Road / Lagoon Road Intersection



Results of the analyses of the operation of the Petersons Quarry Road / Lagoon Road intersection for the base and design scenarios in 2016 (the opening year of the site) and 2023 (design year - the last operational year of the site) are summarised in Tables 6-1 and 6-2 respectively. It is noted that the traffic generation / distribution at this intersection are the same for both the early and latter stages of the Pacific Highway upgrade project. Detailed results are provided within Appendix B.

Table 6-1: 2016 Operational Characteristics of the Petersons Quarry Road / Lagoon Road Intersection

Leg	Movement	2016 Base				2016 Design			
		AM		PM		AM		PM	
		Degree of Saturation (v/c)	95% Back of Queue (m	Degree of Saturation (v/c)	95% Back of Queue (m)	Degree of Saturation (v/c)	95% Back of Queue (m)	Degree of Saturation (v/c)	95% Back of Queue (m)
Lagoon Road (East)	T	0.01	0	0.00	0	0.03	1	0.02	1
	R	0.01	0	0.00	0	0.03	1	0.02	1
Petersons Quarry Road (North)	L	0.00	0	0.01	0	0.02	1	0.03	2
Lagoon Road (West)	L	0.00	0	0.00	0	0.00	0	0.00	0
	T	0.00	0	0.00	0	0.00	0	0.00	0

Note: Practical Maximum Degree of Saturation (X_p) for a priority intersection is 0.80.

Table 6-2: 2023 Operational Characteristics of the Petersons Quarry Road / Lagoon Road Intersection

Leg	Movement	2023 Base				2023 Design			
		AM		PM		AM		PM	
		Degree of Saturation (v/c)	95% Back of Queue (m	Degree of Saturation (v/c)	95% Back of Queue (m)	Degree of Saturation (v/c)	95% Back of Queue (m)	Degree of Saturation (v/c)	95% Back of Queue (m)
Lagoon Road (East)	T	0.01	0	0.00	0	0.03	1	0.02	1
	R	0.01	0	0.00	0	0.03	1	0.02	1
Petersons Quarry Road (North)	L	0.00	0	0.01	0	0.02	1	0.03	2
Lagoon Road (West)	L	0.00	0	0.00	0	0.02	0	0.00	0
	T	0.00	0	0.00	0	0.02	0	0.00	0

Note: Practical Maximum Degree of Saturation (X_p) for a priority intersection is 0.80.

The results provided in Tables 6-1 and 6-2 indicate that the Petersons Quarry Road / Lagoon Road intersection would continue to operate well within satisfactory operating conditions beyond the design horizon year (2023) with development of the subject proposal.

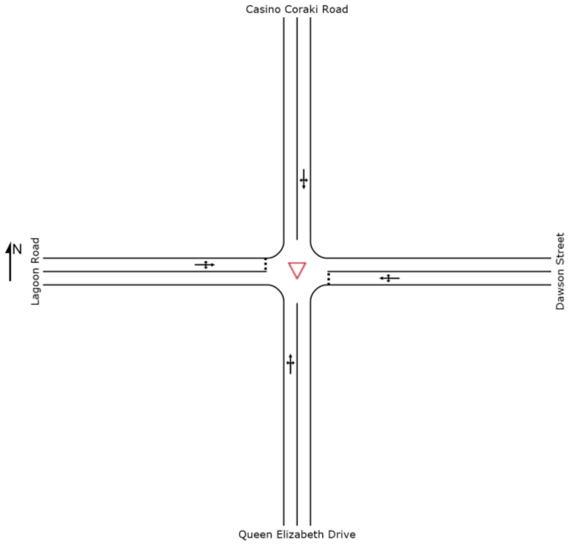
All development-related trips entering Petersons Quarry Road will turn right from Lagoon Road. It is also noted that the through traffic on Lagoon Road at the Petersons Quarry Road / Lagoon Road intersection will be less than 10vph during the AM and PM peak hour periods in 2023. Therefore, no right turn lane treatment is considered to be necessary at the Petersons Quarry Road / Lagoon Road intersection due to the extremely low through traffic on Lagoon Road.

The intersection is forecast to operate safety and efficiently for the foreseeable future. As alluded to in Section 4 of this report, clearly this intersection would also accommodate traffic associated with the existing Petersons Quarry.

6.1.2 Intersection 2: Lagoon Road / Queen Elizabeth Road Intersection

The existing configuration of the Lagoon Road / Queen Elizabeth Road intersection modelled in the SIDRA analyses is shown in Figure 6-2.

Figure 6-2: Modelled Configuration of the Lagoon Road / Queen Elizabeth Road Intersection



Results of the analyses of the operation of the Lagoon Road / Queen Elizabeth Road intersection for the base and design scenarios in 2016 (the opening year of the site) and 2023 (design year - the last operational year of the site) are summarised in Tables 6-3 and 6-4 respectively. It is noted that the traffic generation / distribution at this intersection are the same for both the early and latter stages of the Pacific Highway upgrade project. Detailed results are provided within Appendix B.

Table 6-3: 2016 Operational Characteristics of the Lagoon Road / Queen Elizabeth Road Intersection

Leg	Movement	2016 Base				2016 Design			
		AM		PM		AM		PM	
		Degree of Saturation (v/c)	95% Back of Queue (m)	Degree of Saturation (v/c)	95% Back of Queue (m)	Degree of Saturation (v/c)	95% Back of Queue (m)	Degree of Saturation (v/c)	95% Back of Queue (m)
Queen Elizabeth Drive (South)	L	0.11	4	0.05	2	0.12	4	0.07	2
	T	0.11	4	0.05	2	0.12	4	0.07	2
	R	0.11	4	0.05	2	0.12	4	0.07	2
Dawson Street (East)	L	0.03	1	0.05	2	0.03	1	0.05	2
	T	0.03	1	0.05	2	0.03	1	0.05	2
	R	0.03	1	0.05	2	0.03	1	0.05	2
Casino Coraki Road (North)	L	0.02	0	0.04	0	0.02	0	0.04	0
	T	0.02	0	0.04	0	0.02	0	0.04	0
	R	0.02	0	0.04	0	0.02	0	0.04	0
Lagoon Road (West)	L	0.01	1	0.01	1	0.04	1	0.04	1
	T	0.01	1	0.01	1	0.04	1	0.04	1
	R	0.01	1	0.01	1	0.04	1	0.04	1

Note: Practical Maximum Degree of Saturation (X_p) for a priority intersection is 0.80.

Table 6-4: 2023 Operational Characteristics of the Lagoon Road / Queen Elizabeth Road Intersection

Leg	Movement	2023 Base				2023 Design			
		AM		PM		AM		PM	
		Degree of Saturation (v/c)	95% Back of Queue (m)	Degree of Saturation (v/c)	95% Back of Queue (m)	Degree of Saturation (v/c)	95% Back of Queue (m)	Degree of Saturation (v/c)	95% Back of Queue (m)
Queen Elizabeth Drive (South)	L	0.13	5	0.07	2	0.15	5	0.08	2
	T	0.13	5	0.07	2	0.15	5	0.08	2
	R	0.13	5	0.07	2	0.15	5	0.08	2
Dawson Street (East)	L	0.04	1	0.07	2	0.04	1	0.07	2
	T	0.04	1	0.07	2	0.04	1	0.07	2
	R	0.04	1	0.07	2	0.04	1	0.07	2
Casino Coraki Road (North)	L	0.02	0	0.04	0	0.02	0	0.04	0
	T	0.02	0	0.04	0	0.02	0	0.04	0
	R	0.02	0	0.04	0	0.02	0	0.04	0
Lagoon Road (West)	L	0.01	0	0.03	0	0.05	1	0.04	1
	T	0.01	0	0.03	0	0.05	1	0.04	1
	R	0.01	0	0.03	0	0.05	1	0.04	1

Note: Practical Maximum Degree of Saturation (X_p) for a priority intersection is 0.80.

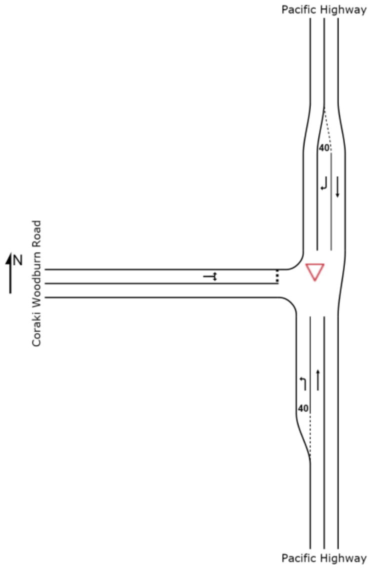
The results provided in Tables 6-3 and 6-4 indicate that the Lagoon Road / Queen Elizabeth Drive intersection would continue to operate well within satisfactory operating conditions beyond the design horizon year (2023) with development of the subject proposal. Traffic volumes are sufficiently low so as not to warrant turn lane treatments.

As alluded to in Section 4 of this report, clearly this intersection would also accommodate traffic associated with the existing Petersons Quarry.

6.1.3 Intersection 3: Coraki Woodburn Road / Pacific Highway Intersection

The existing Coraki Woodburn Road / Pacific Highway intersection is an old-style right turn Type B geometry, it operates in a similar fashion to an intersection with an auxiliary right turn lane; therefore, for the purpose of this assessment, the Coraki Woodburn Road / Pacific Highway intersection has been modelled as an intersection with an auxiliary right turn lane in the SIDRA analyses as shown in Figure 6-3. It is noted that this assumption does not indicate that a modified treatment for the right turn is required; it simply is the adopted modelling approach, which is generally accepted as being appropriate for such a circumstance.

Figure 6-3: Modelled Configuration of the Coraki Woodburn Road / Pacific Highway Intersection



Results of the analyses of the operation of the Coraki Woodburn Road / Pacific Highway intersection for the base and design scenarios in 2016 (the opening year of the site) and 2023 (design year - the last operational year of the site) for the early stage of the Pacific Highway upgrade project are summarised in Tables 6-5 and 6-6 respectively. The early stage of the Pacific Highway upgrade project will be completed before 2023, therefore, it is considered to be a conservative assumption to adopt the design year of 2023 for the early stage scenarios.

Results of the analyses of the operation of the Coraki Woodburn Road / Pacific Highway intersection for the base and design scenarios in 2016 and 2023 for the latter stage of the Pacific Highway upgrade project are summarised in Tables 6-7 and 6-8 respectively. Detailed results are provided within Appendix B.

Table 6-5: 2016 Operational Characteristics of the Coraki Woodburn Road / Pacific Highway Intersection – the Early Stage of the Pacific Highway Upgrade Project

Leg	Movement	2016 Base				2016 Design			
		AM		PM		AM		PM	
		Degree of Saturation (v/c)	95% Back of Queue (m)	Degree of Saturation (v/c)	95% Back of Queue (m)	Degree of Saturation (v/c)	95% Back of Queue (m)	Degree of Saturation (v/c)	95% Back of Queue (m)
Pacific Highway (South)	L	0.01	0	0.01	0	0.07	0	0.01	0
	T	0.17	0	0.18	0	0.17	0	0.18	0
Pacific Highway (North)	T	0.16	0	0.18	0	0.16	0	0.18	0
	R	0.08	2	0.10	3	0.11	4	0.12	4
Coraki Woodburn Road (West)	L	0.14	4	0.19	5	0.16	5	0.22	6
	R	0.14	4	0.19	5	0.16	5	0.22	6

Note: Practical Maximum Degree of Saturation (X_p) for a priority intersection is 0.80.

Table 6-6: 2023 Operational Characteristics of the Coraki Woodburn Road / Pacific Highway Intersection – the Early Stage of the Pacific Highway Upgrade Project

Leg	Movement	2023 Base				2023 Design			
		AM		PM		AM		PM	
		Degree of Saturation (v/c)	95% Back of Queue (m)	Degree of Saturation (v/c)	95% Back of Queue (m)	Degree of Saturation (v/c)	95% Back of Queue (m)	Degree of Saturation (v/c)	95% Back of Queue (m)
Pacific Highway (South)	L	0.01	0	0.01	0	0.01	0	0.01	0
	T	0.21	0	0.22	0	0.21	0	0.22	0
Pacific Highway (North)	T	0.19	0	0.22	0	0.19	0	0.22	0
	R	0.11	3	0.13	4	0.14	5	0.16	5
Coraki Woodburn Road (West)	L	0.20	6	0.29	9	0.23	7	0.32	11
	R	0.20	6	0.29	9	0.23	7	0.32	11

Note: Practical Maximum Degree of Saturation (X_p) for a priority intersection is 0.80.

Table 6-7: 2016 Operational Characteristics of the Coraki Woodburn Road / Pacific Highway Intersection – the Latter Stage of the Pacific Highway Upgrade Project

Leg	Movement	2016 Base				2016 Design			
		AM		PM		AM		PM	
		Degree of Saturation (v/c)	95% Back of Queue (m)	Degree of Saturation (v/c)	95% Back of Queue (m)	Degree of Saturation (v/c)	95% Back of Queue (m)	Degree of Saturation (v/c)	95% Back of Queue (m)
Pacific Highway (South)	L	0.01	0	0.01	0	0.02	0	0.02	0
	T	0.17	0	0.18	0	0.17	0	0.18	0
Pacific Highway (North)	T	0.16	0	0.18	0	0.16	0	0.18	0
	R	0.08	2	0.10	3	0.08	3	0.10	3
Coraki Woodburn Road (West)	L	0.14	4	0.19	5	0.21	6	0.27	9
	R	0.14	4	0.19	5	0.21	6	0.27	9

Note: Practical Maximum Degree of Saturation (X_p) for a priority intersection is 0.80.

Table 6-8: 2023 Operational Characteristics of the Coraki Woodburn Road / Pacific Highway Intersection – the Latter Stage of the Pacific Highway Upgrade Project

Leg	Movement	2023 Base				2023 Design			
		AM		PM		AM		PM	
		Degree of Saturation (v/c)	95% Back of Queue (m)	Degree of Saturation (v/c)	95% Back of Queue (m)	Degree of Saturation (v/c)	95% Back of Queue (m)	Degree of Saturation (v/c)	95% Back of Queue (m)
Pacific Highway (South)	L	0.01	0	0.01	0	0.02	0	0.03	0
	T	0.21	0	0.22	0	0.21	0	0.22	0
Pacific Highway (North)	T	0.19	0	0.22	0	0.19	0	0.22	0
	R	0.11	3	0.13	4	0.11	4	0.13	4
Coraki Woodburn Road (West)	L	0.20	6	0.29	9	0.31	10	0.43	16
	R	0.20	6	0.29	9	0.31	10	0.43	16

Note: Practical Maximum Degree of Saturation (X_p) for a priority intersection is 0.80.

The results provided in Tables 6-5 to 6-8 indicate that the Coraki Woodburn Road / Pacific Highway intersection would continue to operate within satisfactory operating conditions beyond the design horizon year (2023) with the proposed development in all scenarios. As alluded to in Section 4 of this report, clearly this intersection would also accommodate traffic associated with the existing Petersons Quarry.

The identified maximum design queue lengths of the right turn movement from the Pacific Highway (the northern approach of the intersection) and the left turn movement from the Pacific Highway (the southern approach of the intersection) would be typically be just one vehicle during the both AM and PM peak hour periods in 2023; it is considered that the existing old-style Type B treatment for the right turn movement on the northern approach and the existing left turn lane on the southern approach would continue to operate safely and efficiently in the future, particularly being mindful of the proposed lifespan of the proposal.

7. Seelems Road

The section of Petersons Quarry Road between Seelems Road and the Petersons Quarry Road / Lagoon Road intersection is sealed.

Seelems Road is the road section extending to Lot 407 of DP1166287 up to the site boundary; it is approximately 380m long from Petersons Quarry Road. It is currently unsealed.

As previously discussed, the haul vehicle drivers will enter the site via Seelems Road (the section fronting Lot 407 of DP1166287) and exit the site via Petersons Quarry Road; the haul vehicles would circulate the site in clockwise direction (one-way flow).

The assessment included in this section of this report has been prepared to determine whether Seelems Road is required to be sealed in conjunction with the development.

Richmond Valley Council's Planning Scheme does not provide clear guideline in relation to how much traffic would trigger the need for provision of a sealed road. Therefore, reference has been made to the document "Upgrading of Unsealed Rural Roads to Sealed Standard" (Ref.2) of Rockhampton Regional Council; this is considered to be an appropriate parallel and we have found use of the recommendations therein to be useful.

Ref.1 suggests that "*Traffic volumes – An unsealed rural road must be in the range of 150-500 AADT (Annual Average Daily Traffic). A road will not be considered for a minimum standard if there is less than 150 AADT unless there are significant issues shown in assessment score. A road that has an AADT greater than 500 will qualify for a full road design*".

The analysis is mindful that the proposed development will be the primary user of Seelems Road; and the proposed development will only operate until 2023. The identified maximum allowable Annual Average Daily Traffic Volumes (AADT) of 500vpd for an unsealed road has been adopted as an upper threshold for the purpose of this pavement assessment. The analysis also conservatively uses the maximum production rate rather than the average which would normally be considered appropriate in consideration of Annual Average Daily Traffic volumes (AADT).

As noted, the proposed development will be in operation until 2023. Therefore, the design year of the pavement requirement of Seelems Road is 2023.

The future AADT of Seelems Road is calculated as below:

Step 1: Operational years of the proposed development = from Year 2016 to Year 2023;

Step 2: Base daily traffic volumes in 2015* = 80vpd;

Step 3: Growth Rate** = 0%;

Step 4: Base daily traffic volumes in 2023 = 80vpd;

Step 5: Total (max.) haulage*** = 1,000,000 tonnes per year;

Step 6: Working weeks per year = 50 weeks;

Step 7: Working days per week = 6 days;

Step 8: Average mass of material per vehicle**** = 36 tonnes per vehicle;

---

[2] "Upgrading of Unsealed Rural Roads to Sealed Standard Procedure", Rockhampton Regional Council, 5 February 2015.

Step 9: Average daily traffic volume (haulage vehicles – IN trips only) = [1,000,000 / 50 / 6 / 36] = 93vpd ; and

Step 10: 2023 AADT (with the proposed development) = [80 + 93] = 173vpd*****.

*Assumes 2015 daily traffic volumes = ((2015 AM peak hour traffic volume + 2015 PM peak hour traffic volume) x 5) = ((9 + 7) x 5) = 80vpd.

**Assumes the growth rate of traffic volumes of Seelems Road (without the proposed development) is 0% p.a. (compound).

***MRCagney has been advised that the maximum production threshold would be 1M tonnes per year.

****MRCagney has been advised that 36t payload truck & dog would be used.

*****Staff tips are not anticipated to use Seelems Road.

Therefore the results of above calculations (including the conservative assumption of maximum production every year) indicate that the 2023 daily traffic with the proposed development is in order of 173vpd; whilst this traffic stream has a relatively high proportion of heavy vehicles, the fact that it is based on a conservative methodology and is somewhat less than 500vpd leads to the appropriate conclusion that providing a gravelled pavement is appropriate. Sealing of Seelems Road is not recommended to be required to cater for the forecast traffic generated by the proposed development.

8. Council Heavy Haulage Contribution

Section 94 Heavy Haulage Contributions Plans 2013 (Ref.1) enables *"Richmond Valley Council to levy developer contributions under section 94 of the Environmental planning and Assessment Act 1979 where the anticipated development will, or is likely to, generate additional heavy haulage vehicle movements, such as from mines and extractive industries"*.

The road / traffic impact of the proposal has been assessed based on the maximum production volumes (1,000,000 tonnes per year) to ensure satisfactory operation of road infrastructure components at all times. The traffic impact assessment of the proposal has been included in Section 6 of this report.

However, the pavement impact and the pavement contribution for this proposal should be assessed based on the average production over the operational years of the proposal. It is not considered appropriate to utilise maximum production rates for this calculation as pavement impact is fundamentally based on average daily ESAs and cumulative pavement impacts. We have been advised that the average production rate of the proposed development would be 800,000 tonnes per year from 2016 to 2023. In practical terms, the levy could be applied on the basis of actual tonnages with a reporting protocol put in place.

Section 94 Heavy Haulage Contributions Plans 2013 (Ref.1) notes that an extractive industry use with the proposed annual extraction is required to pay $1.08 / tonne for the pavement impact likely to be generated on Council's roads.

9. Summary

MRCagney has been commissioned by Quarry Solutions Pty Ltd to prepare a traffic impact assessment (TIA) and pavement impact assessment (PIA) report to support the development application of the proposed Coraki Quarry to be located to the north of Seelems Road, Coraki.

The likely production schedules of the proposed development are listed below:

- Maximum annual production rate - up to 1M tonnes per year; and
- Average annual production rate – approximately 0.8M tonnes per year over 5 to 7 years.

Site Access

The haul vehicle drivers will enter the site via Seelems Road (the section fronting Lot 407 of DP1166287) and exit the site via Petersons Quarry Road, the haul vehicles will circulate the site in a clockwise direction (one-way flow).

Traffic Impact

It is anticipated that the proposed quarry will commence operations in July 2016 for 5 to 7 years. Therefore, the design horizon year of the proposed development will be 2023 (the last operational year of the proposed development).

The results of SIDRA analyses, included in Section 6 of this report, illustrate that all key intersections (the Petersons Quarry Road / Lagoon Road intersection, the Lagoon Road / Queen Elizabeth Drive intersection and the Coraki Woodburn Road / Pacific Highway intersection) along the haul route would operate within satisfactory operating conditions beyond the design horizon year (2023) of the proposed development with the existing geometries. This conclusion is cognisant of the existing operation of the Petersons Quarry and the adjacent industrial site.

Based on the results of SIDRA analyses of the Coraki Woodburn Road / Pacific Highway intersection, the identified maximum design queue lengths of the right turn movement from the Pacific Highway (the northern approach of the intersection) and the left turn movement from the Pacific Highway (the southern approach of the intersection) would be typically be just one vehicle during the both AM and PM peak hour periods in 2023; it is considered that the existing old-style Type B treatment for the right turn movement on the northern approach and the existing left turn lane on the southern approach would continue to be suitable in the future (in terms of capacity and safety), particularly being mindful of the proposed lifespan of the proposal (the proposed development will cease operation in 2023).

Therefore no external road network improvements are required in conjunction with the proposed development.

Seelems Road

The results of calculations included in Section 7 of this report (including the conservative assumption of maximum production every year) indicate that the 2023 daily traffic with the proposed development is in order of 173vpd; whilst this traffic stream has a relatively high proportion of heavy vehicles, the fact that it is based on a conservative methodology and is somewhat less than 500vpd leads to the appropriate conclusion that providing a gravelled pavement is appropriate. Sealing of Seelems Road is not recommended to be required to cater for the forecast traffic generated by the proposed development.

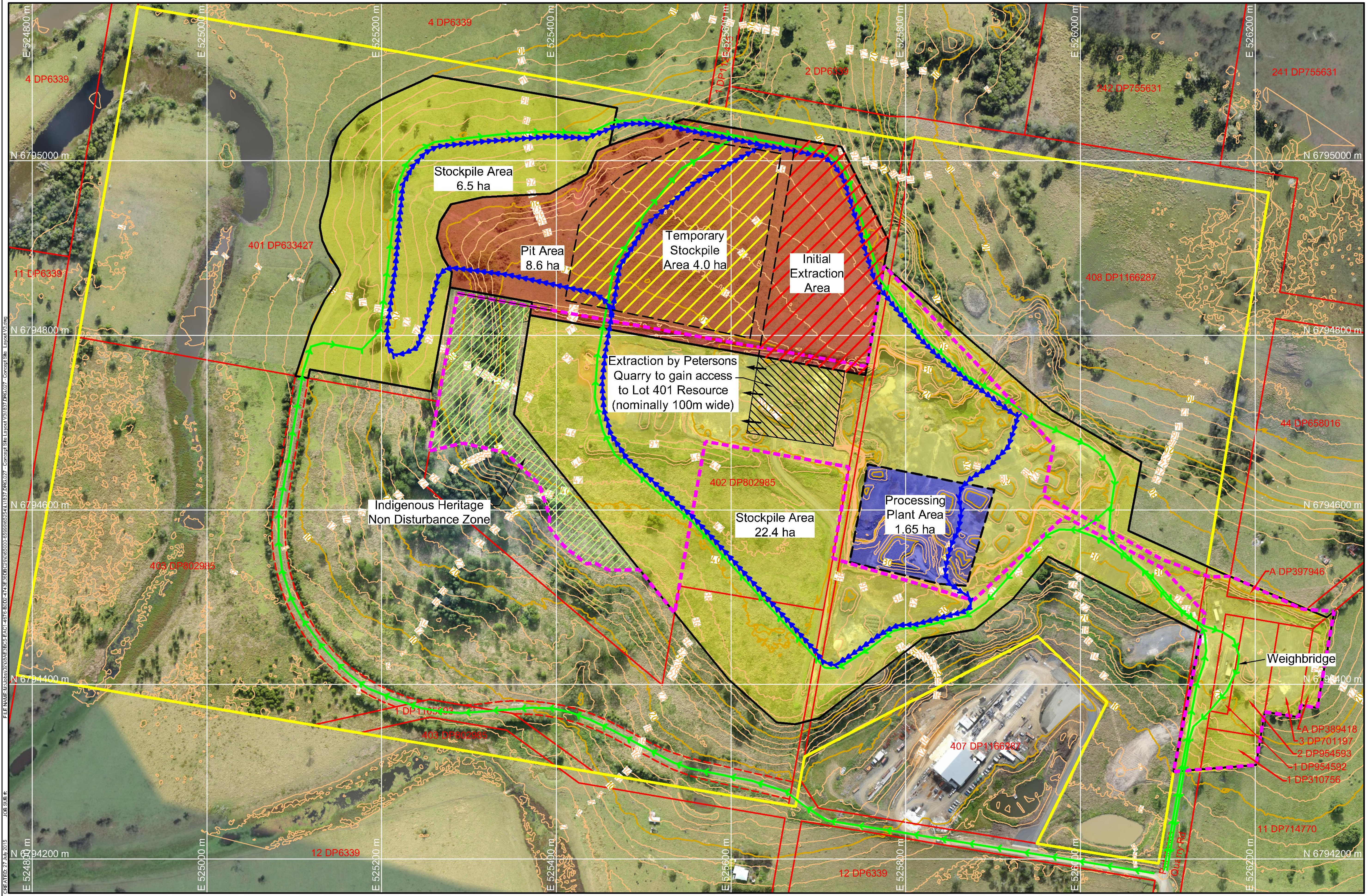
Pavement Requirements

Section 94 Heavy Haulage Contributions Plans 2013 (Ref.2) notes that an extractive industry use with the proposed annual extraction is required to pay $1.08 / tonne for the pavement impact likely to be generated on Council’s roads.

.

Appendix A

Site Plan



REV	DESCRIPTION	DATE	BY

Data Sources:
Photography: UAV Survey 2015-07-02; Google. Image date: 2014-12-18
Topography: UAV Survey 2015-07-02
Cadastre:
Ecosystem:
Other:

Legend:
- 🟨 Site Boundary
- 🟥 Cadastral Boundary
- ▬ ▬ Approved Quarry Expansion Footprint
- ← On Road Truck Movement
- ◀◀◀◀ Off Road Truck Movement

N

PROJECT:
Coraki Quarry

TITLE:
Conceptual Site Layout Plan

CLIENT:
Quarry Solutions Pty Ltd

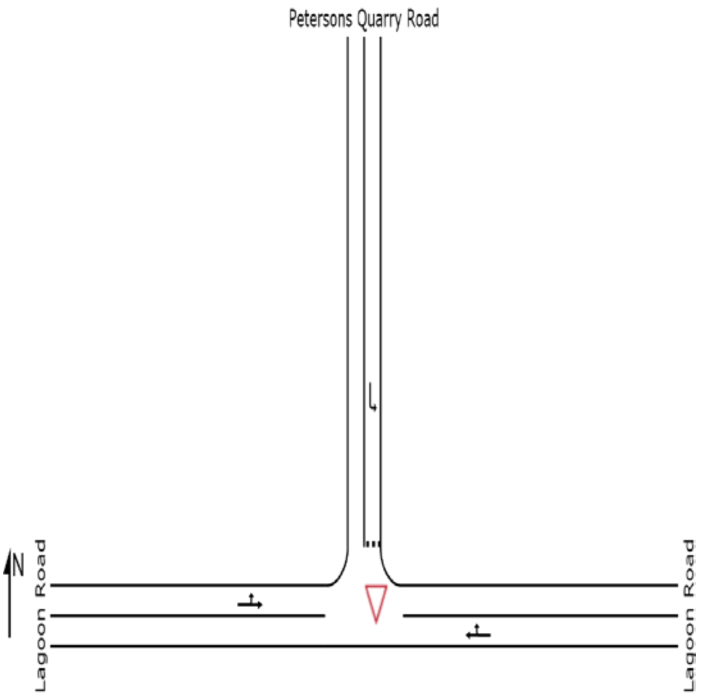
GROUNDWORK plus
PH: +61 7 3871 0411
WWW.GROUNDWORK.COM.AU

SCALE: 1:4,000 When Printed On A3 0 80
DATE: 27 July 2015
PRINTED: 27 July 2015
DRAWN: LT
CHECKED: JL
DRAWING NUMBER: 1837.027A
REVISION:
DATUM: HORIZONTAL / VERTICAL / ZONE
MGA / AHD / 56

Appendix B

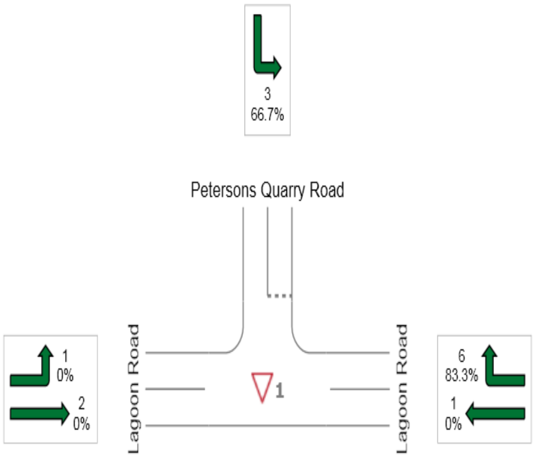
Results of SIDRA Analyses

Intersection 3: Coraki Woodburn Road / Pacific Highway



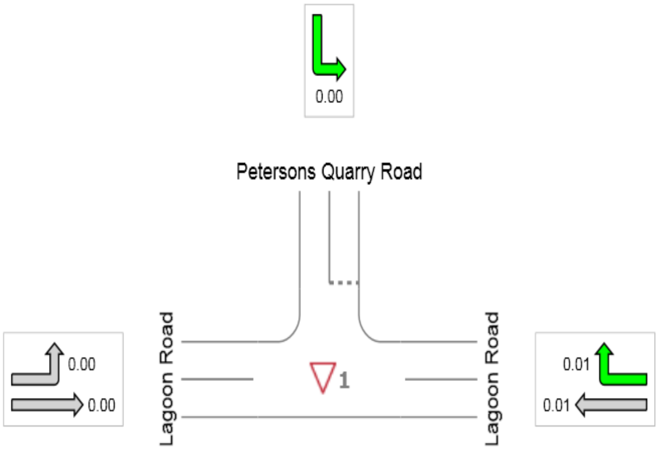
INTERSECTION GEOMETRY

Giveway Intersection



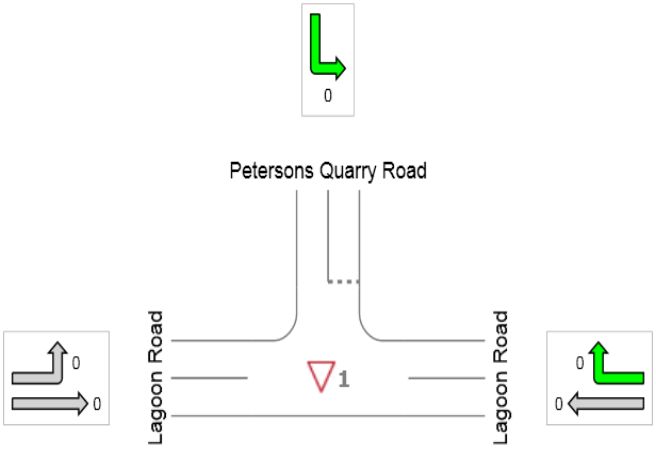
TRAFFIC VOLUMES

All units are vehicles per hour



DEGREE OF SATURATION

Demand Volume / Capacity (v/c) ratio



QUEUES

Largest 95% Back of Queue for any lane used by movement (metres)

MRCagney

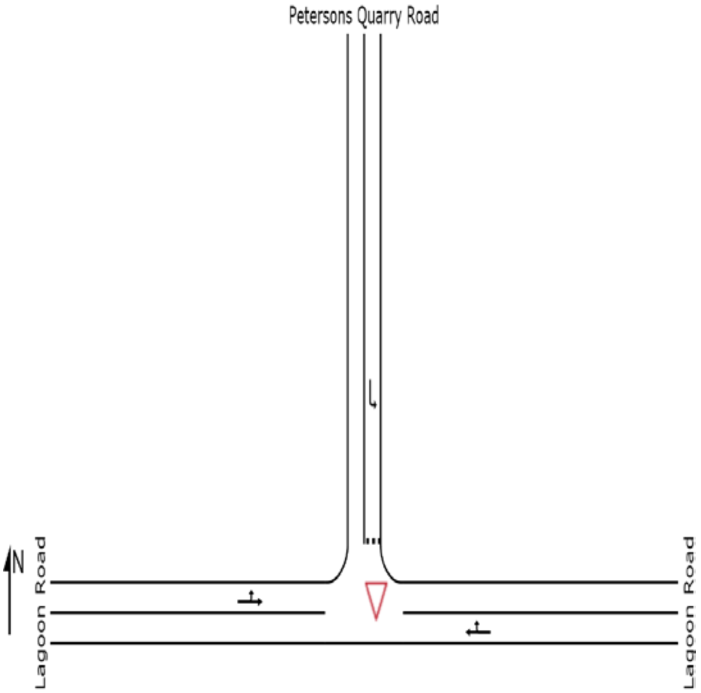
1_PETERSONS QUARRY_LAGOON.SIP6

Produced by SIDRA INTERSECTION 6.1
Copyright © 2000-2015
Akcelik & Associates Pty Ltd

SIDRA INTERSECTION
SIDRA SOLUTIONS

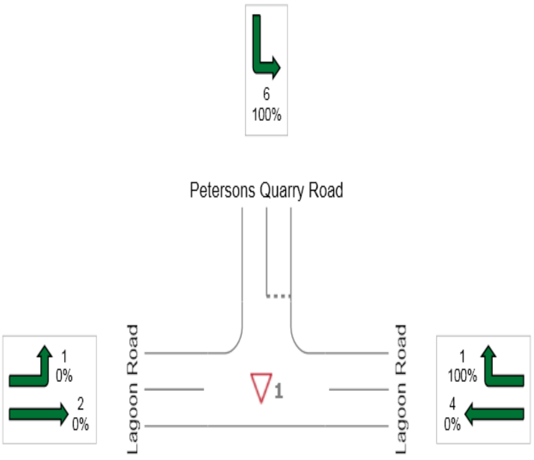
2016 BASE AM PEAK HOUR
PETERSONS QUARRY ROAD / LAGOON ROAD UNSIGNALISED INTERSECTION

FIGURE 1.1



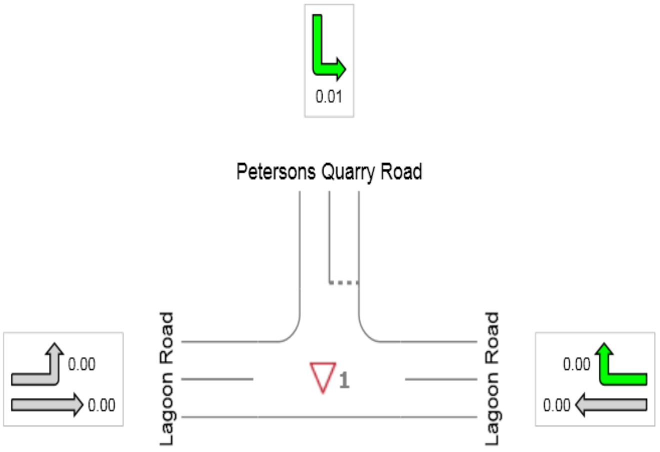
INTERSECTION GEOMETRY

Giveway Intersection



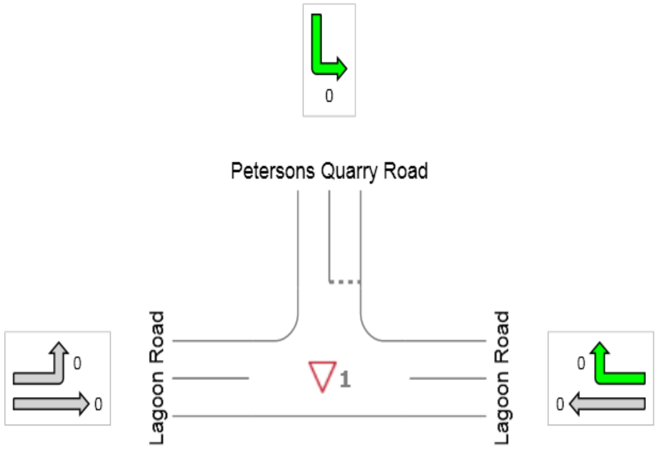
TRAFFIC VOLUMES

All units are vehicles per hour



DEGREE OF SATURATION

Demand Volume / Capacity (v/c) ratio



QUEUES

Largest 95% Back of Queue for any lane used by movement (metres)

MRCagney

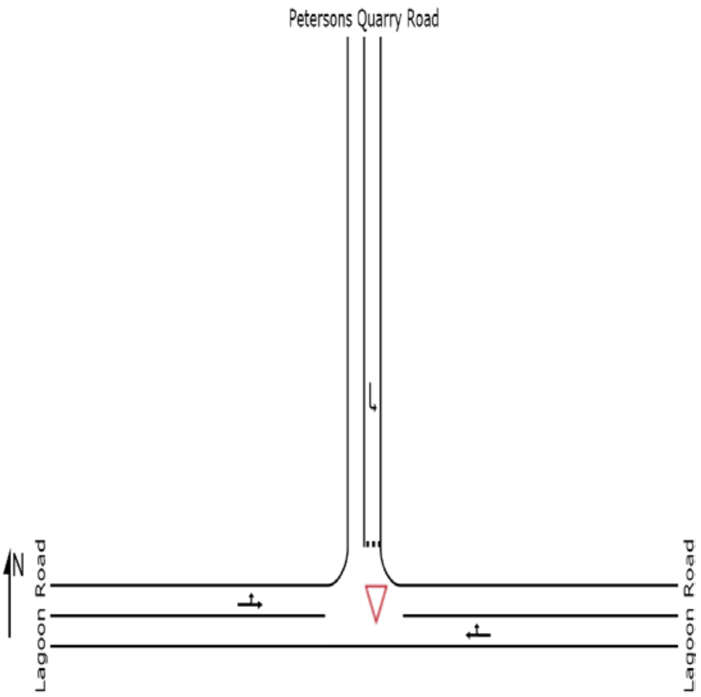
1_PETERSONS QUARRY_LAGOON.SIP6

Produced by SIDRA INTERSECTION 6.1

SIDRA INTERSECTION
SIDRA SOLUTIONS

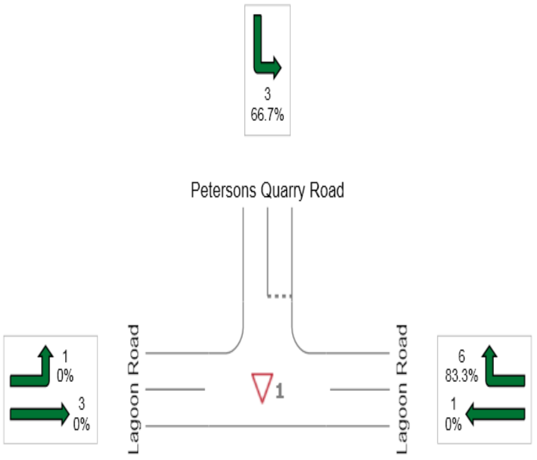
2016 BASE PM PEAK HOUR
PETERSONS QUARRY ROAD / LAGOON ROAD UNSIGNALISED INTERSECTION

FIGURE 1.2



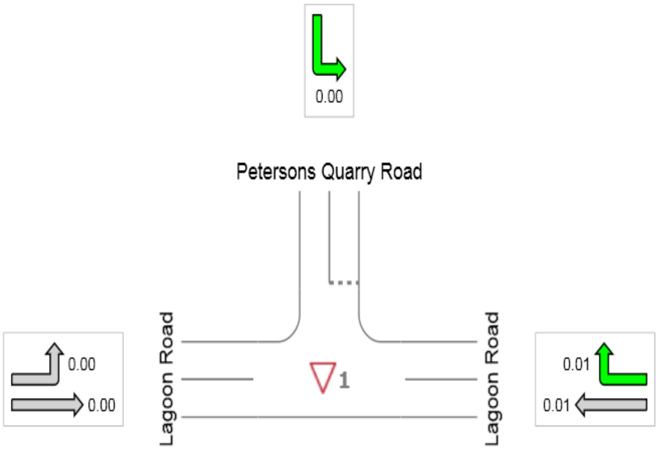
INTERSECTION GEOMETRY

Giveway Intersection



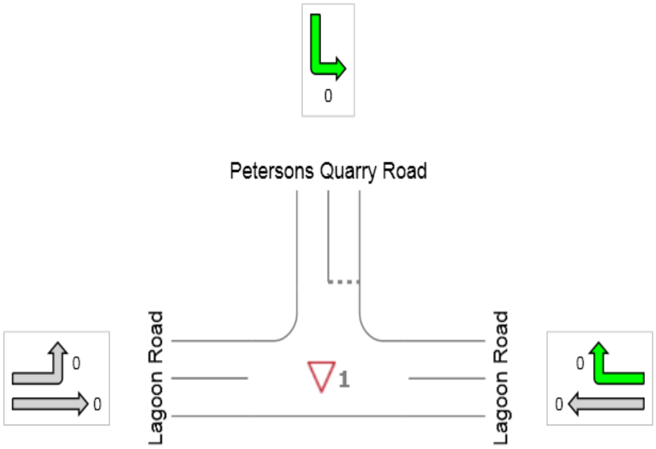
TRAFFIC VOLUMES

All units are vehicles per hour



DEGREE OF SATURATION

Demand Volume / Capacity (v/c) ratio



QUEUES

Largest 95% Back of Queue for any lane used by movement (metres)

MRCagney

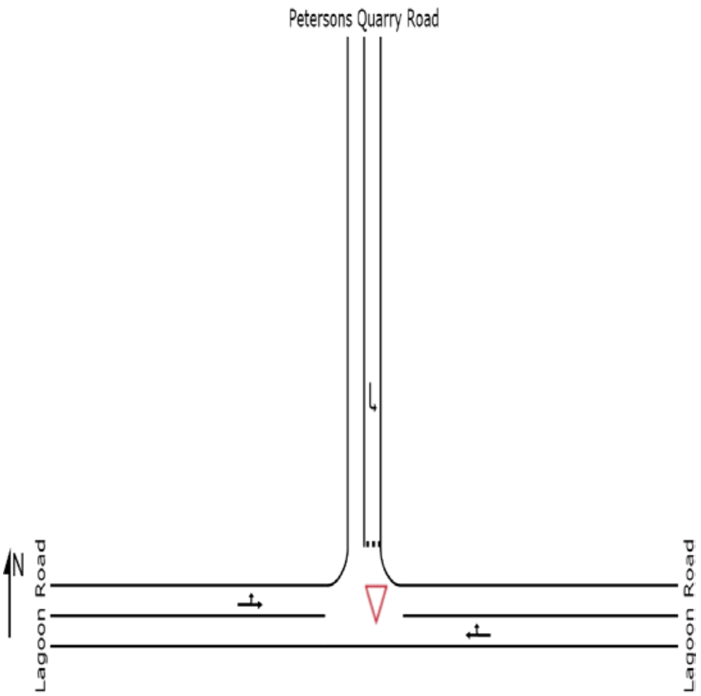
1_PETERSONS QUARRY_LAGOON.SIP6

Produced by SIDRA INTERSECTION 6.1

SIDRA INTERSECTION
SIDRA SOLUTIONS

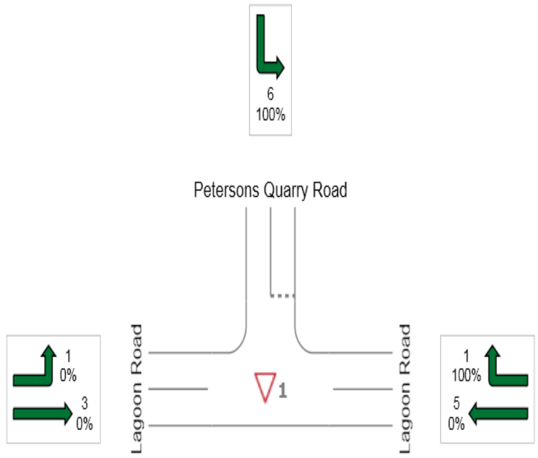
2023 BASE AM PEAK HOUR
PETERSONS QUARRY ROAD / LAGOON ROAD UNSIGNALISED INTERSECTION

FIGURE 1.3



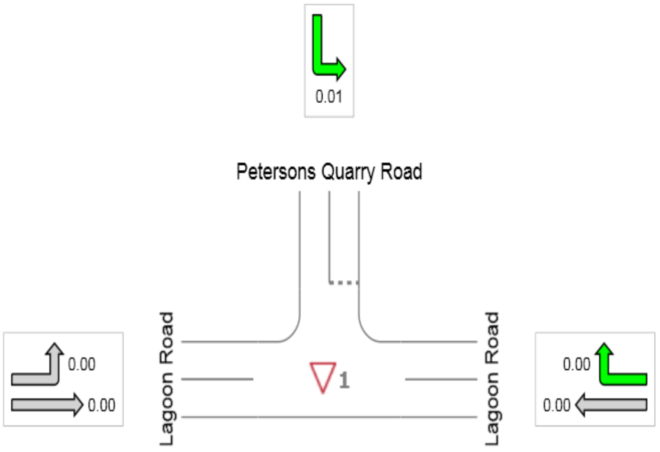
INTERSECTION GEOMETRY

Giveway Intersection



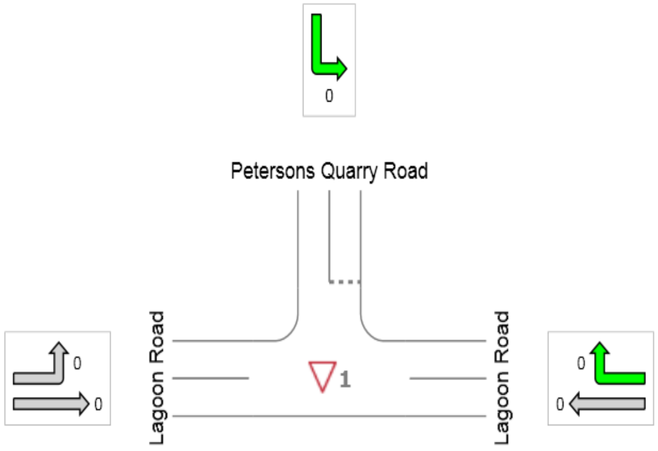
TRAFFIC VOLUMES

All units are vehicles per hour



DEGREE OF SATURATION

Demand Volume / Capacity (v/c) ratio



QUEUES

Largest 95% Back of Queue for any lane used by movement (metres)

MRCagney

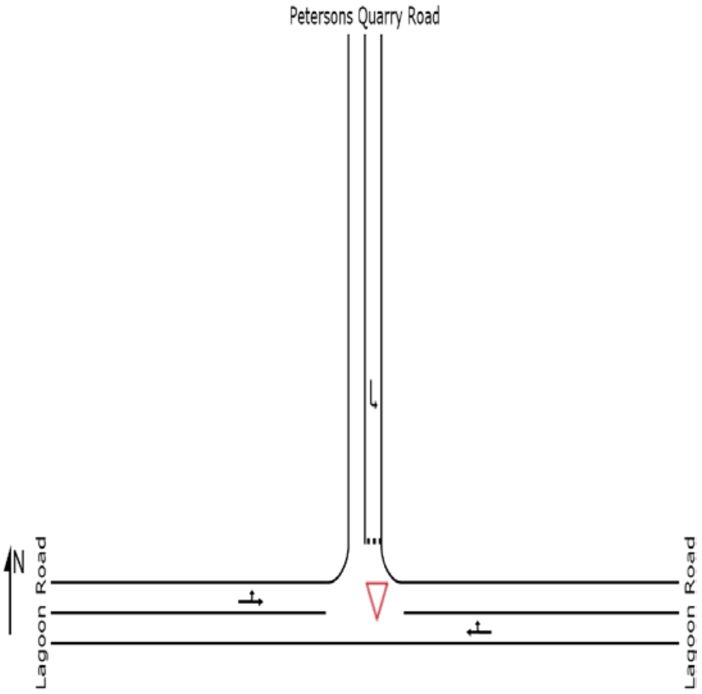
1_PETERSONS QUARRY_LAGOON.SIP6

Produced by SIDRA INTERSECTION 6.1

SIDRA INTERSECTION
SIDRA SOLUTIONS

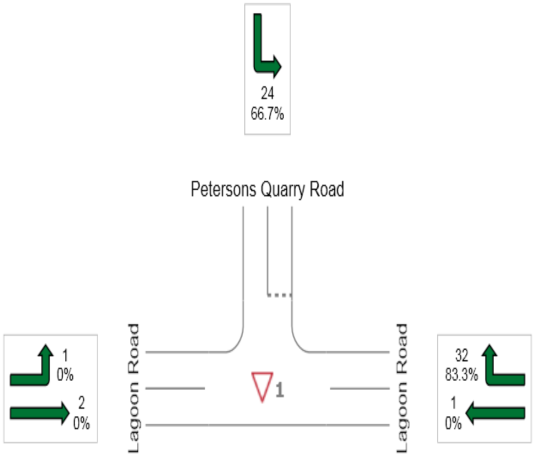
2023 BASE PM PEAK HOUR
PETERSONS QUARRY ROAD / LAGOON ROAD UNSIGNALISED INTERSECTION

FIGURE 1.4



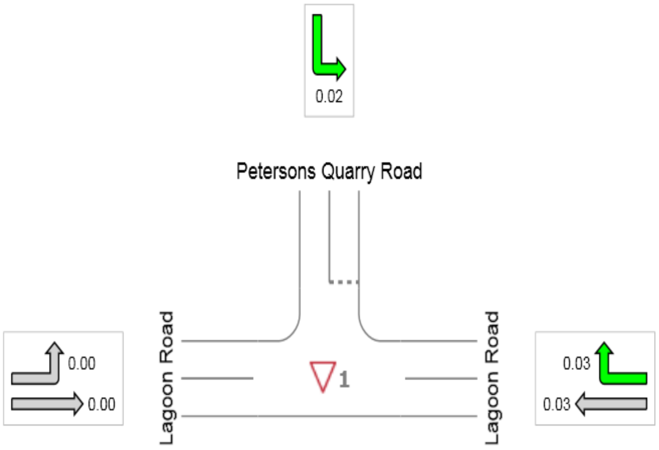
INTERSECTION GEOMETRY

Giveway Intersection



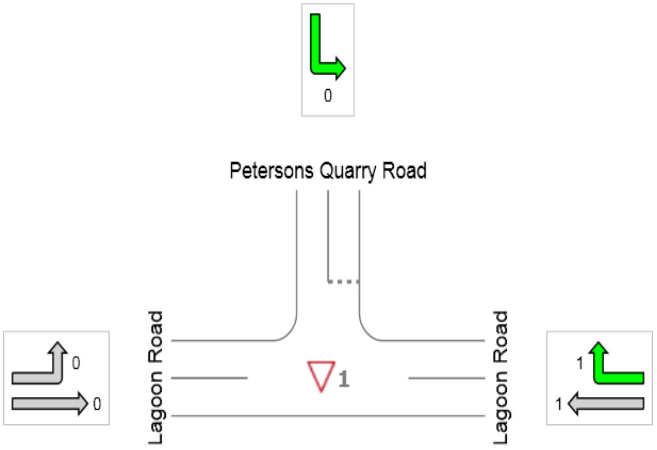
TRAFFIC VOLUMES

All units are vehicles per hour



DEGREE OF SATURATION

Demand Volume / Capacity (v/c) ratio



QUEUES

Largest 95% Back of Queue for any lane used by movement (metres)

MRCagney

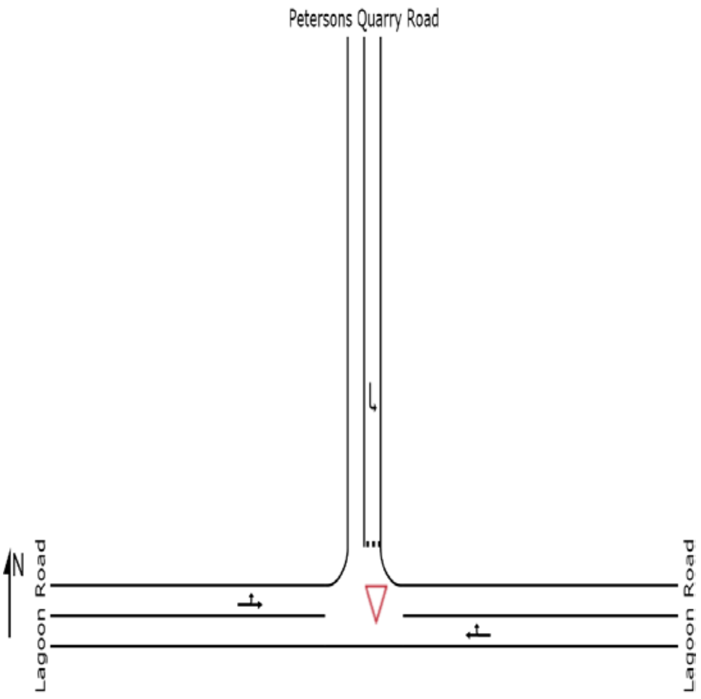
1_PETERSONS QUARRY_LAGOON.SIP6

Produced by SIDRA INTERSECTION 6.1
Copyright © 2000-2015
Akcelik & Associates Pty Ltd

SIDRA INTERSECTION
SIDRA SOLUTIONS

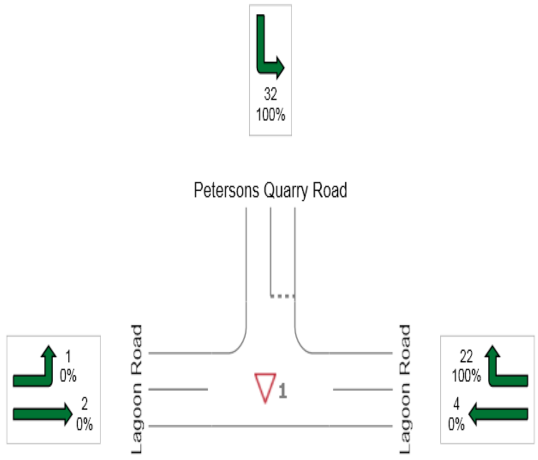
2016 DESIGN AM PEAK HOUR
PETERSONS QUARRY ROAD / LAGOON ROAD UNSIGNALISED INTERSECTION

FIGURE 1.5



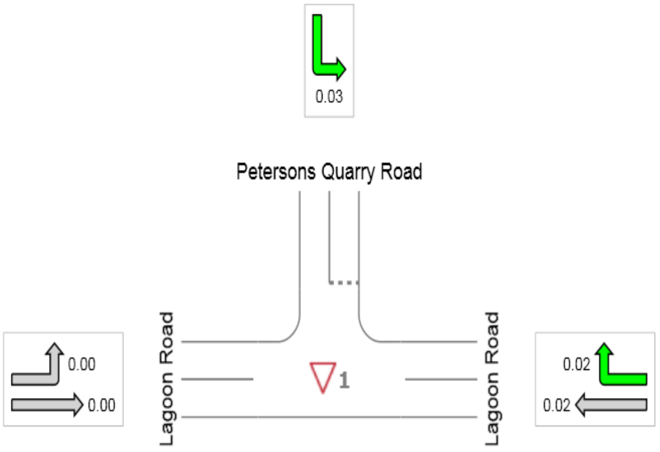
INTERSECTION GEOMETRY

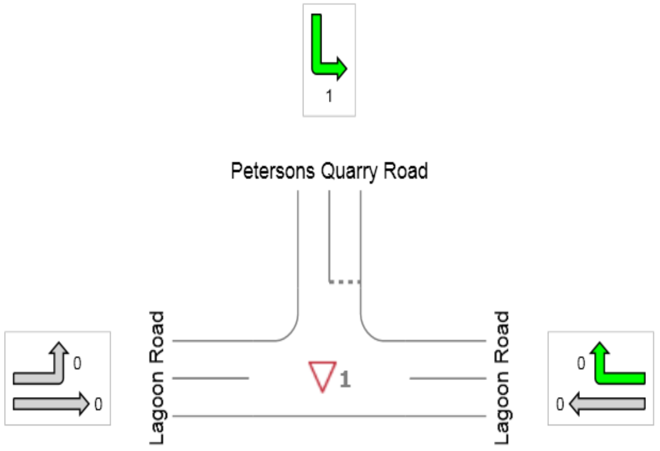
Giveway Intersection



TRAFFIC VOLUMES

All units are vehicles per hour





DEGREE OF SATURATION

Demand Volume / Capacity (v/c) ratio

QUEUES

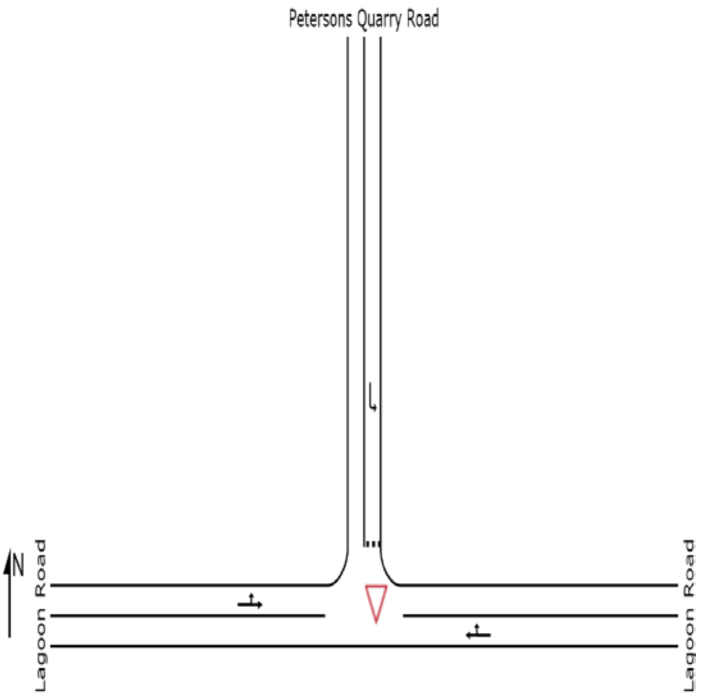
Largest 95% Back of Queue for any lane used by movement (metres)

1_PETERSONS QUARRY_LAGOON.SIP6

Produced by SIDRA INTERSECTION 6.1
Copyright © 2000-2015
Akcelik & Associates Pty Ltd

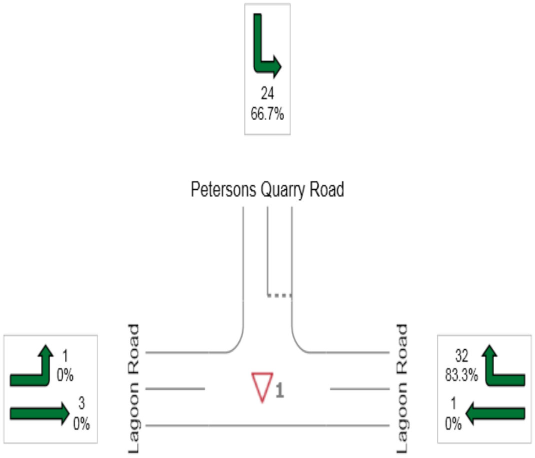
2016 DESIGN PM PEAK HOUR
PETERSONS QUARRY ROAD / LAGOON ROAD UNSIGNALISED INTERSECTION

FIGURE 1.6



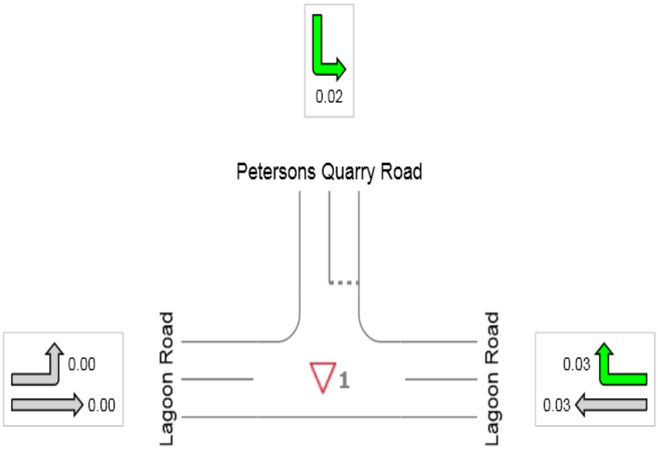
INTERSECTION GEOMETRY

Giveway Intersection



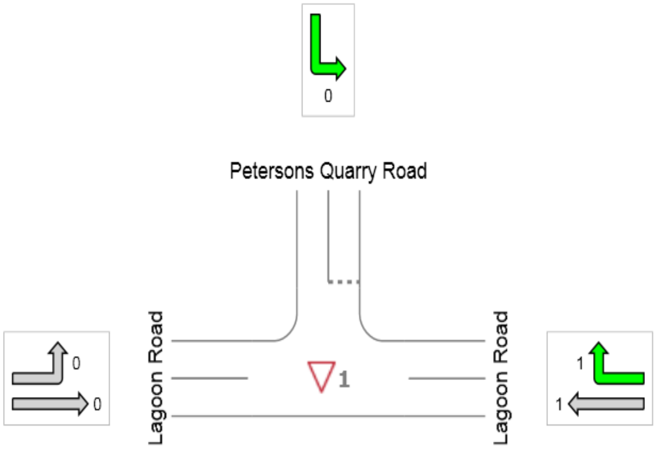
TRAFFIC VOLUMES

All units are vehicles per hour



DEGREE OF SATURATION

Demand Volume / Capacity (v/c) ratio



QUEUES

Largest 95% Back of Queue for any lane used by movement (metres)

MRCagney

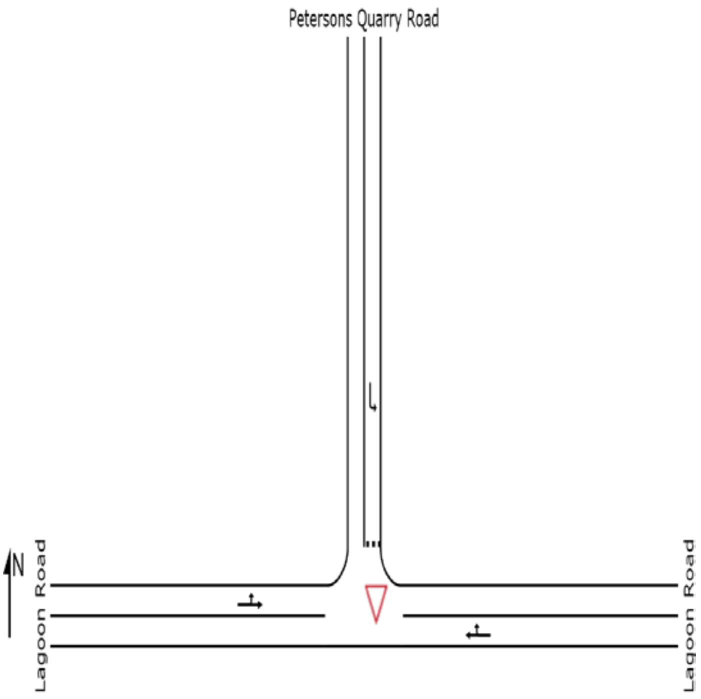
1_PETERSONS QUARRY_LAGOON.SIP6

Produced by SIDRA INTERSECTION 6.1
Copyright © 2000-2015
Akcelik & Associates Pty Ltd

SIDRA INTERSECTION
SIDRA SOLUTIONS

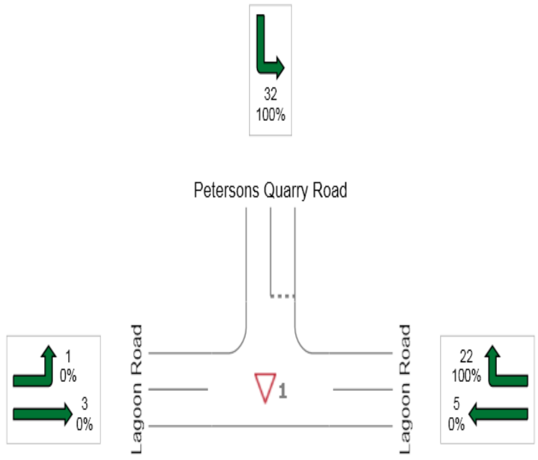
2023 DESIGN AM PEAK HOUR
PETERSONS QUARRY ROAD / LAGOON ROAD UNSIGNALISED INTERSECTION

FIGURE 1.7



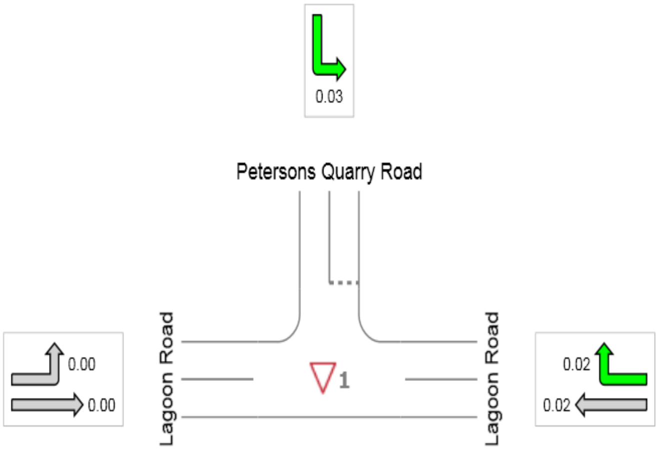
INTERSECTION GEOMETRY

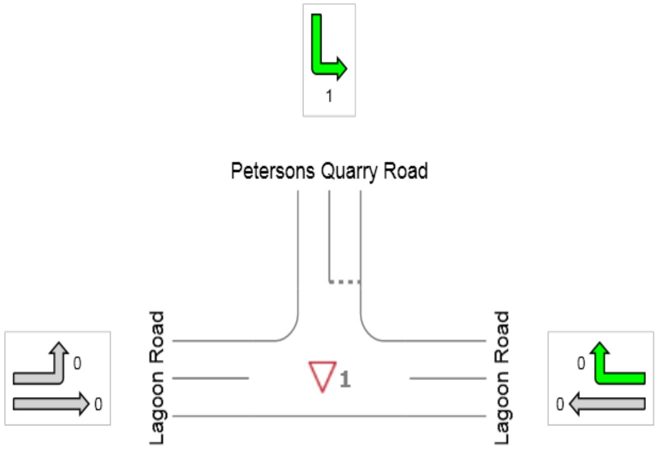
Giveway Intersection



TRAFFIC VOLUMES

All units are vehicles per hour





DEGREE OF SATURATION

Demand Volume / Capacity (v/c) ratio

QUEUES

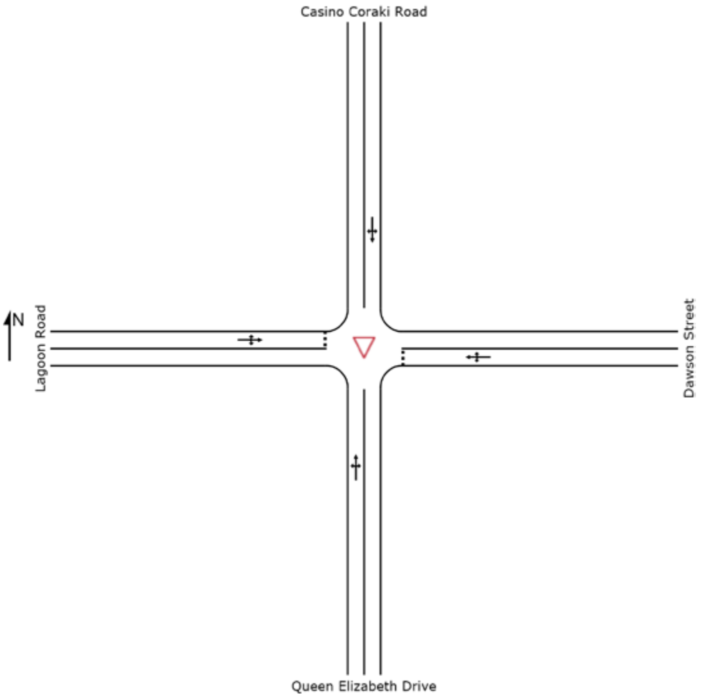
Largest 95% Back of Queue for any lane used by movement (metres)

1_PETERSONS QUARRY_LAGOON.SIP6

Produced by SIDRA INTERSECTION 6.1

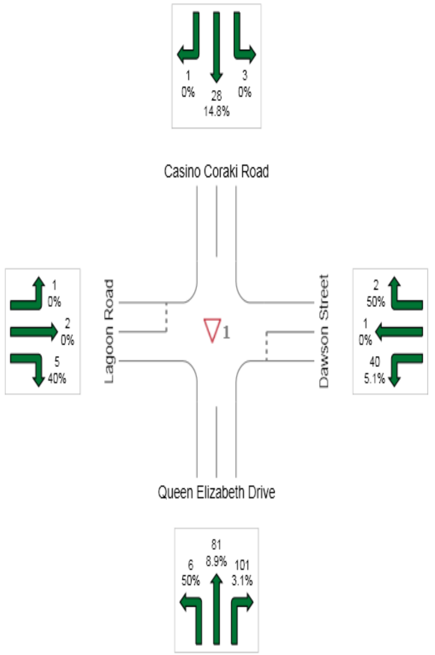
2023 DESIGN PM PEAK HOUR
PETERSONS QUARRY ROAD / LAGOON ROAD UNSIGNALISED INTERSECTION

FIGURE 1.8



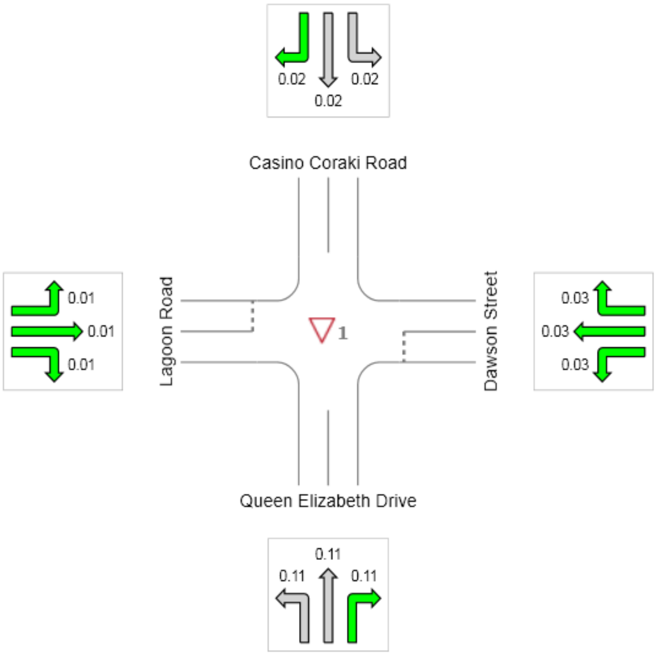
INTERSECTION GEOMETRY

Giveway Intersection



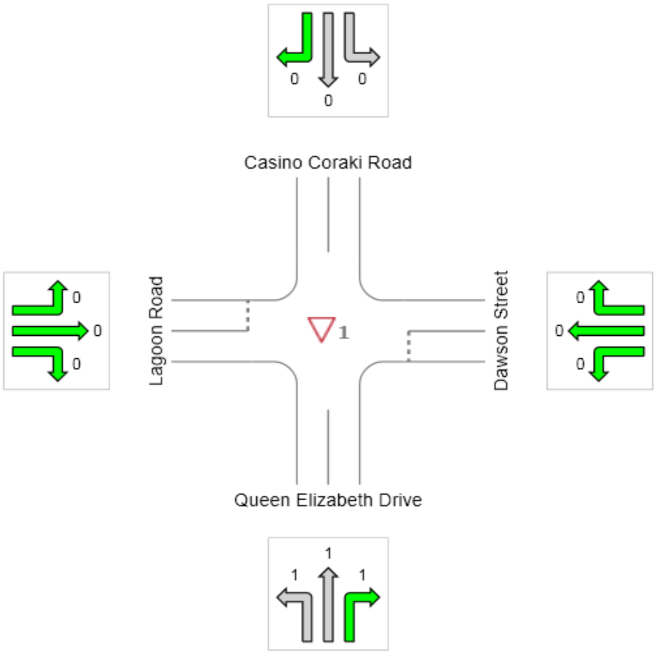
TRAFFIC VOLUMES

All units are vehicles per hour



DEGREE OF SATURATION

Demand Volume / Capacity (v/c) ratio



QUEUES

Largest 95% Back of Queue for any lane used by movement (metres)

MRCagney

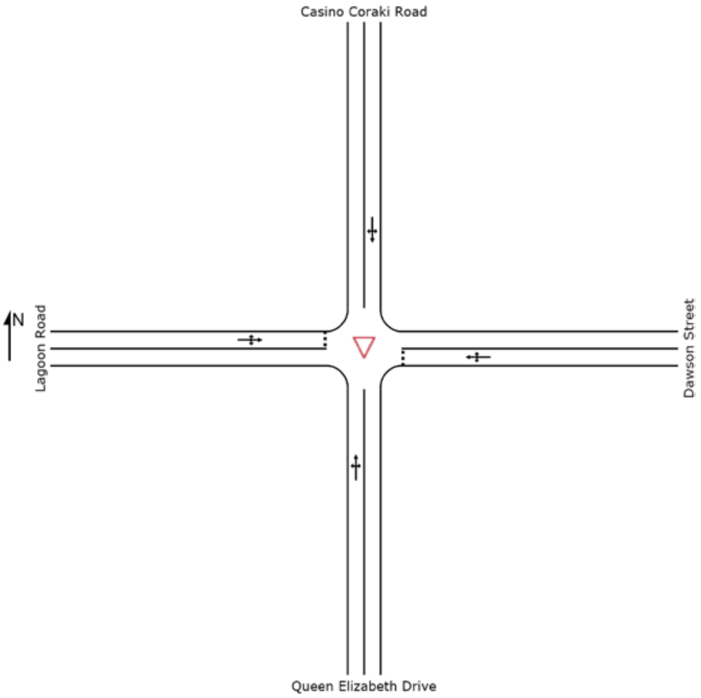
2_LAGOON_QUEEN ELIZABETH.SIP6

Produced by SIDRA INTERSECTION 6.1

SIDRA INTERSECTION
SIDRA SOLUTIONS

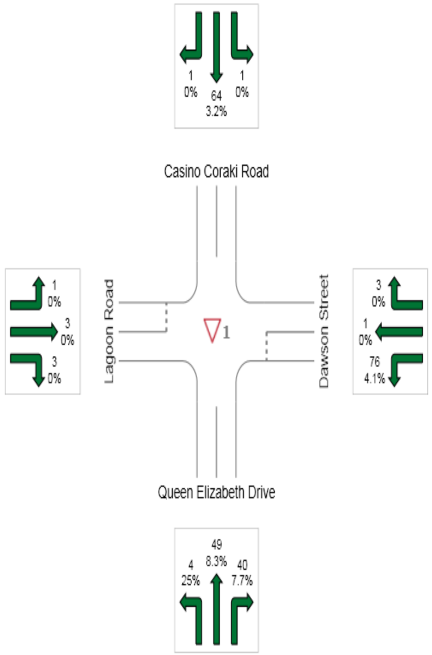
2016 BASE AM PEAK HOUR
LAGOON ROAD / QUEEN ELIZABETH DRIVE UNSIGNALISED INTERSECTION

FIGURE 2.1



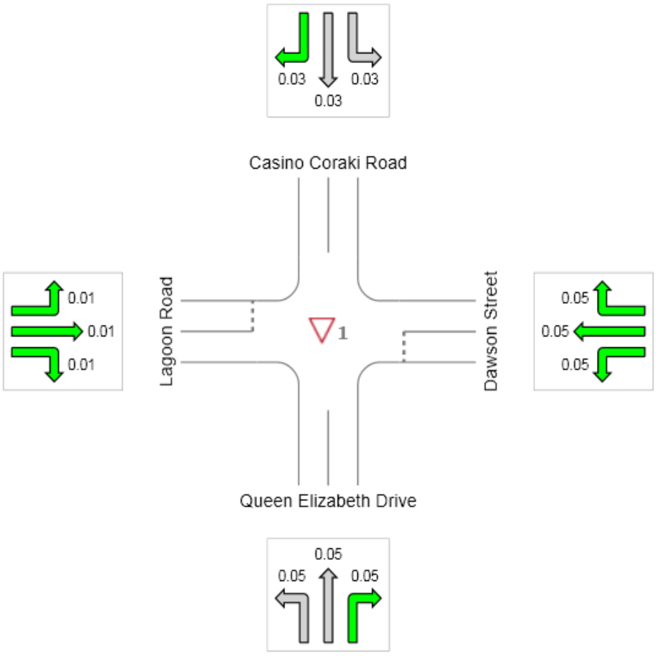
INTERSECTION GEOMETRY

Giveway Intersection



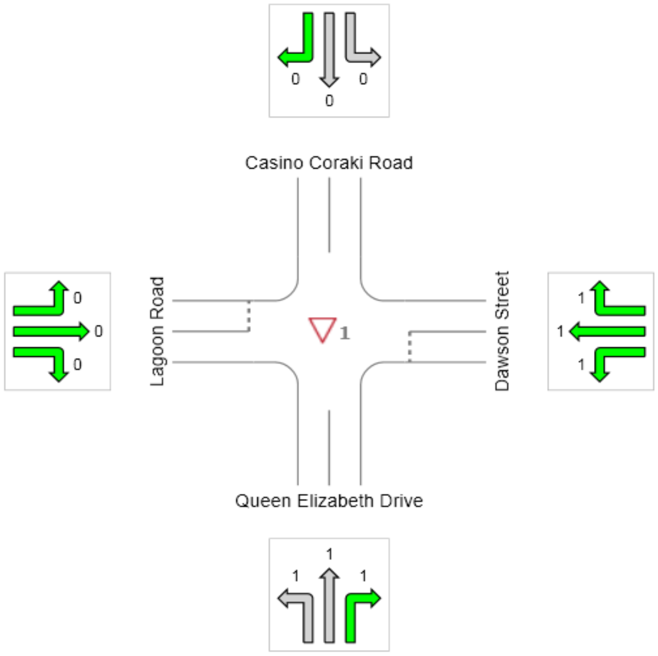
TRAFFIC VOLUMES

All units are vehicles per hour



DEGREE OF SATURATION

Demand Volume / Capacity (v/c) ratio



QUEUES

Largest 95% Back of Queue for any lane used by movement (metres)

MRCagney

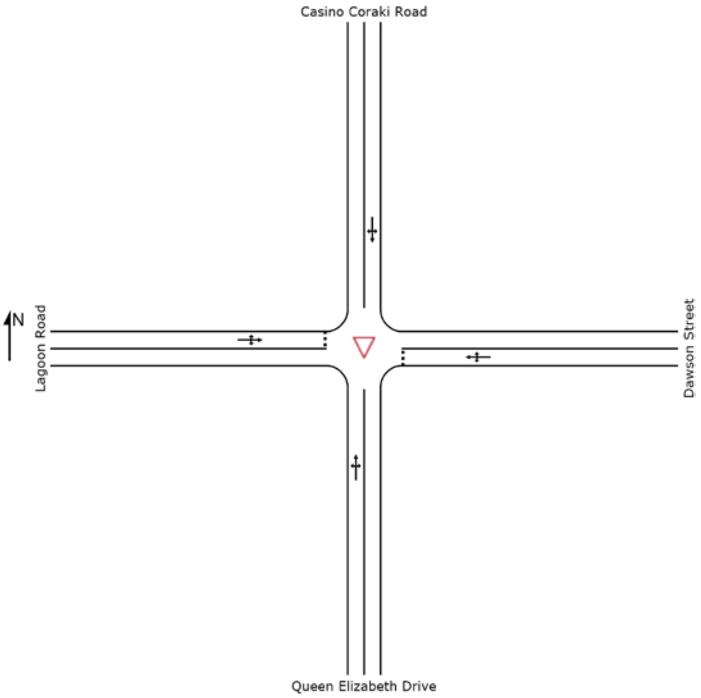
2_LAGOON_QUEEN ELIZABETH.SIP6

Produced by SIDRA INTERSECTION 6.1

SIDRA INTERSECTION
SIDRA SOLUTIONS

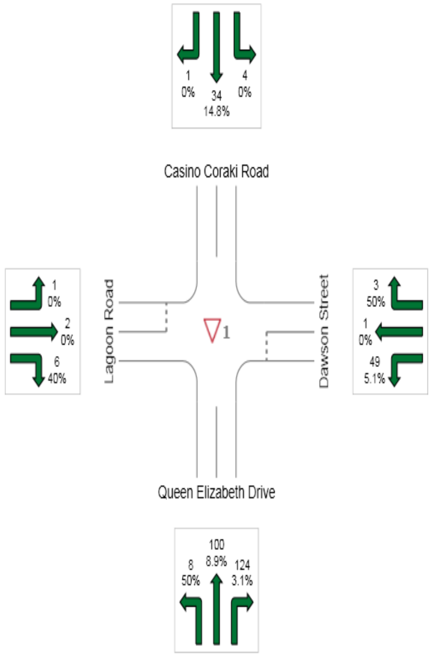
2016 BASE PM PEAK HOUR
LAGOON ROAD / QUEEN ELIZABETH DRIVE UNSIGNALISED INTERSECTION

FIGURE 2.2



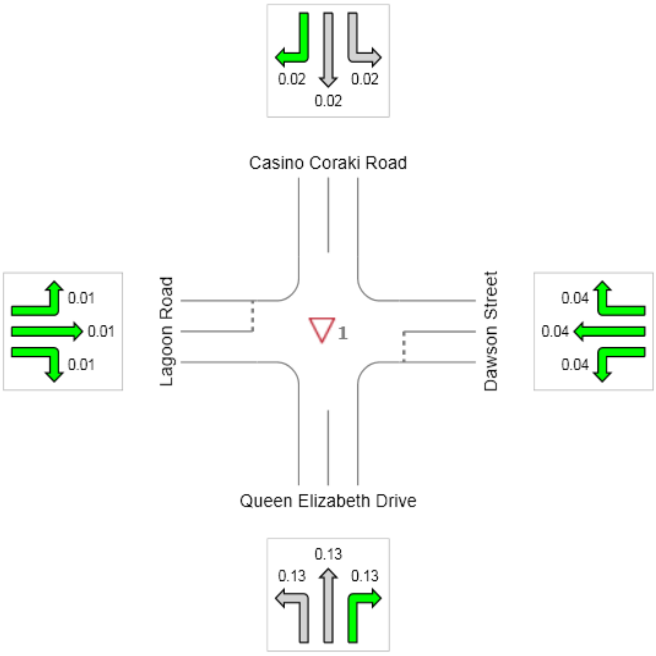
INTERSECTION GEOMETRY

Giveway Intersection



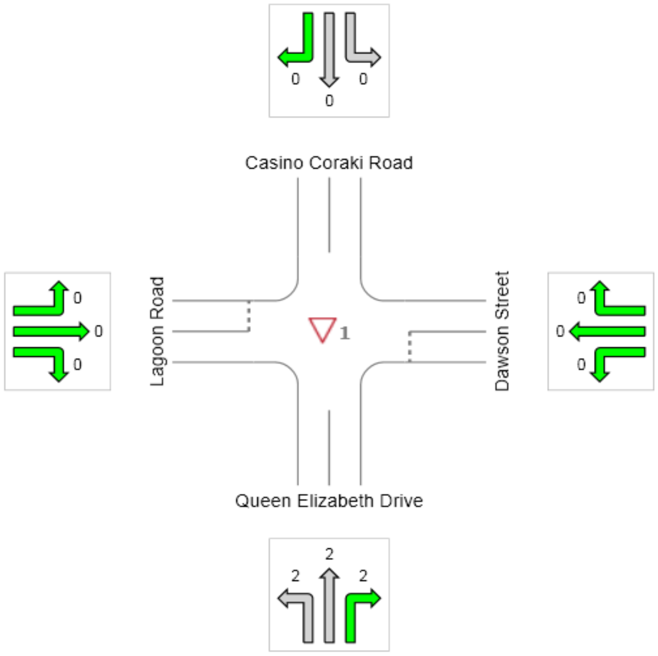
TRAFFIC VOLUMES

All units are vehicles per hour



DEGREE OF SATURATION

Demand Volume / Capacity (v/c) ratio



QUEUES

Largest 95% Back of Queue for any lane used by movement (metres)

MRCagney

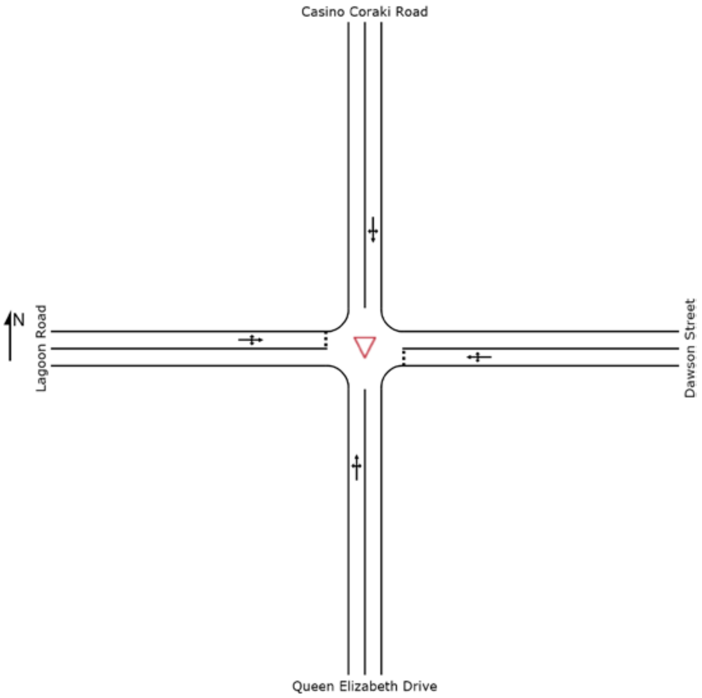
2_LAGOON_QUEEN ELIZABETH.SIP6

Produced by SIDRA INTERSECTION 6.1

SIDRA INTERSECTION
SIDRA SOLUTIONS

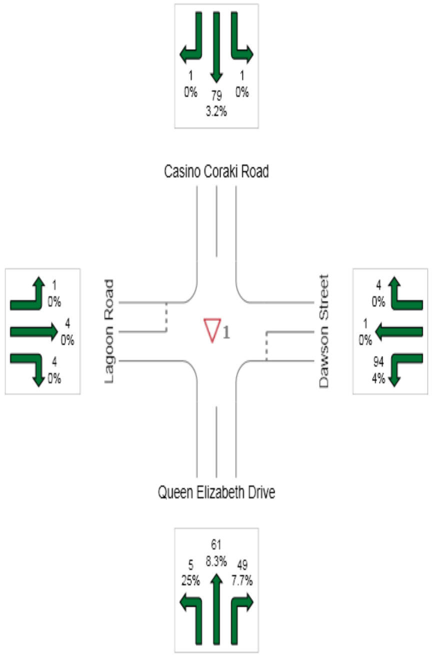
2023 BASE AM PEAK HOUR
LAGOON ROAD / QUEEN ELIZABETH DRIVE UNSIGNALISED INTERSECTION

FIGURE 2.3



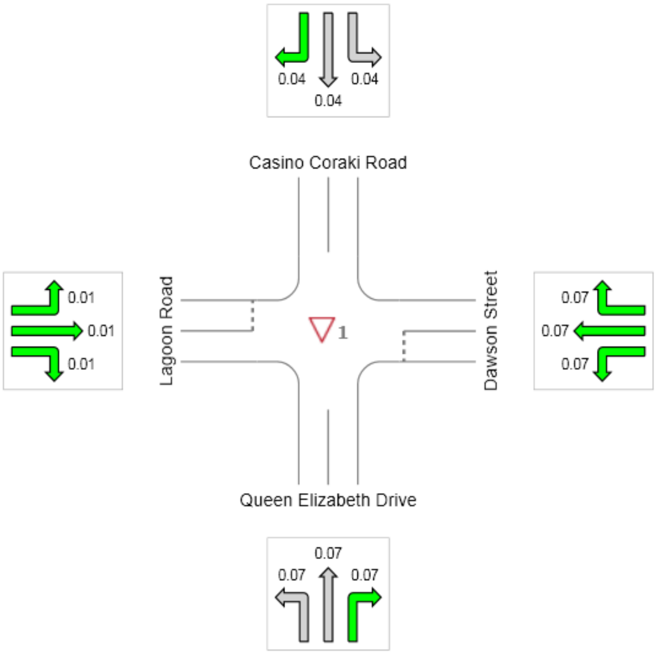
INTERSECTION GEOMETRY

Giveway Intersection



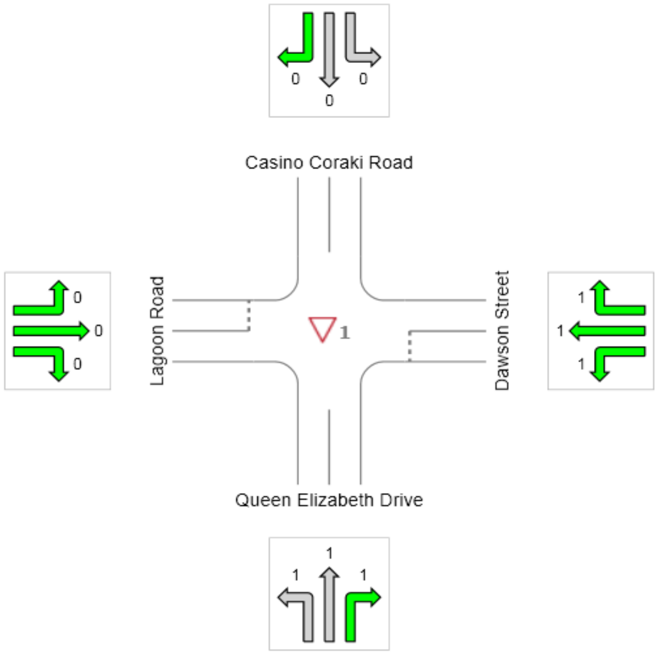
TRAFFIC VOLUMES

All units are vehicles per hour



DEGREE OF SATURATION

Demand Volume / Capacity (v/c) ratio



QUEUES

Largest 95% Back of Queue for any lane used by movement (metres)

MRCagney

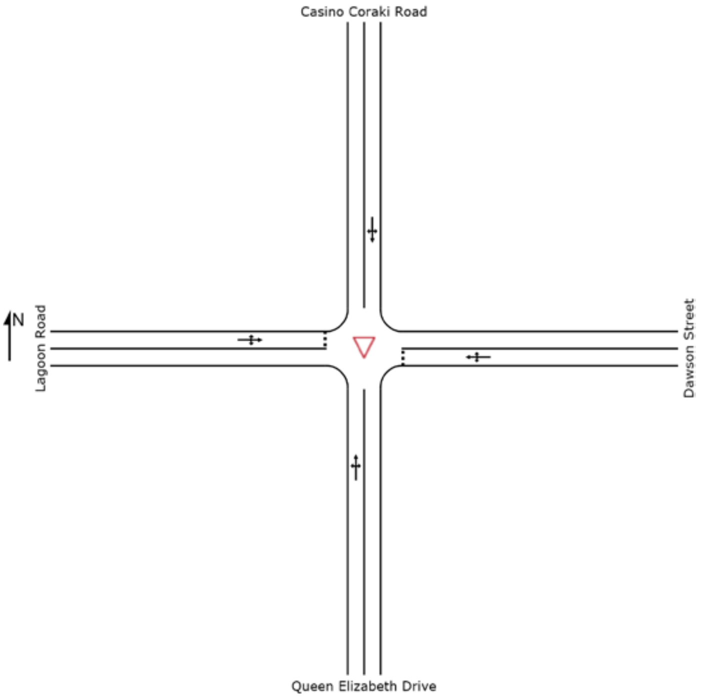
2_LAGOON_QUEEN ELIZABETH.SIP6

Produced by SIDRA INTERSECTION 6.1

SIDRA INTERSECTION
SIDRA SOLUTIONS

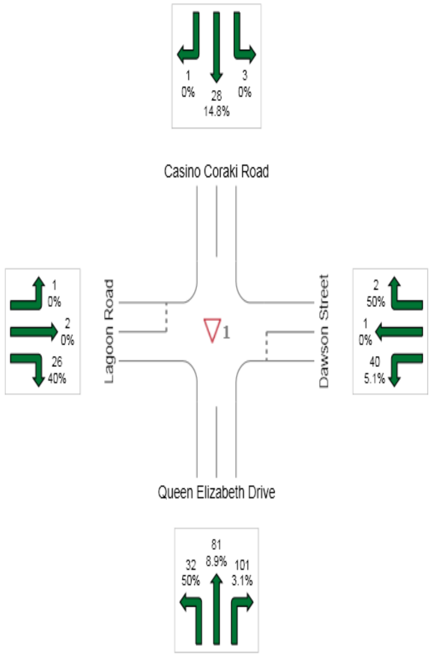
2023 BASE PM PEAK HOUR
LAGOON ROAD / QUEEN ELIZABETH DRIVE UNSIGNALISED INTERSECTION

FIGURE 2.4



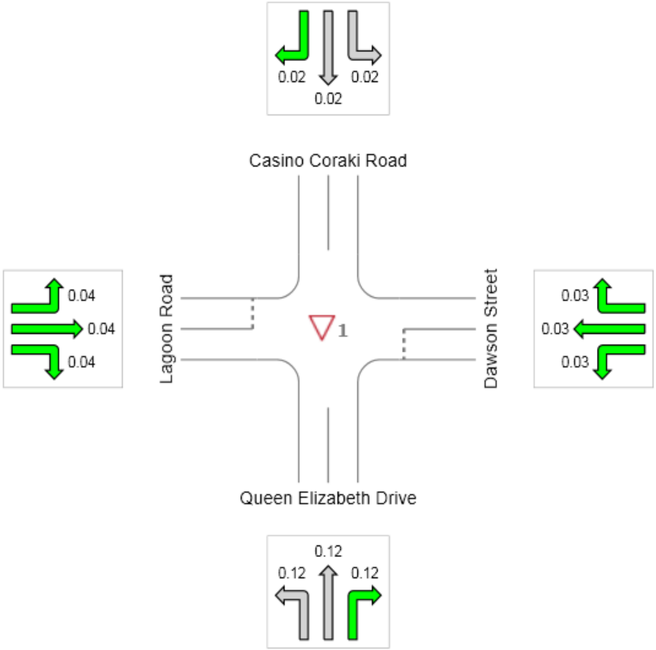
INTERSECTION GEOMETRY

Giveway Intersection



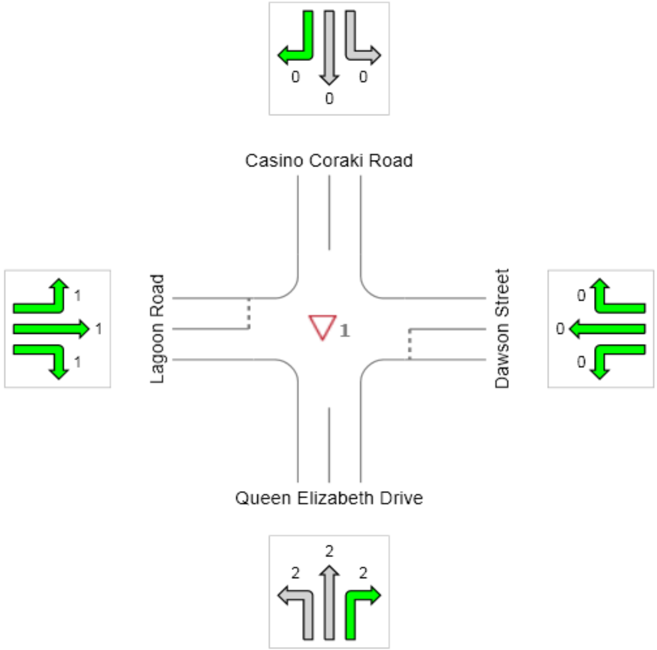
TRAFFIC VOLUMES

All units are vehicles per hour



DEGREE OF SATURATION

Demand Volume / Capacity (v/c) ratio



QUEUES

Largest 95% Back of Queue for any lane used by movement (metres)

MRCagney

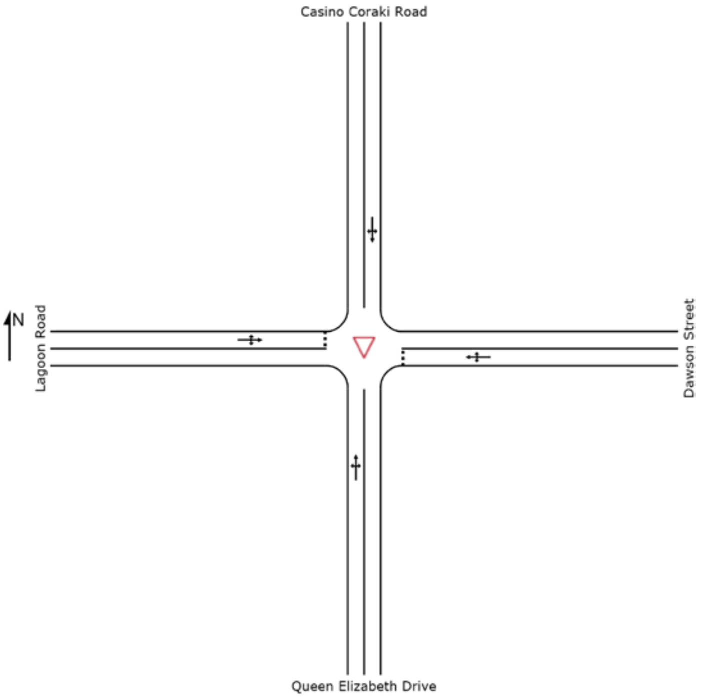
2_LAGOON_QUEEN ELIZABETH.SIP6

Produced by SIDRA INTERSECTION 6.1

SIDRA INTERSECTION
SIDRA SOLUTIONS

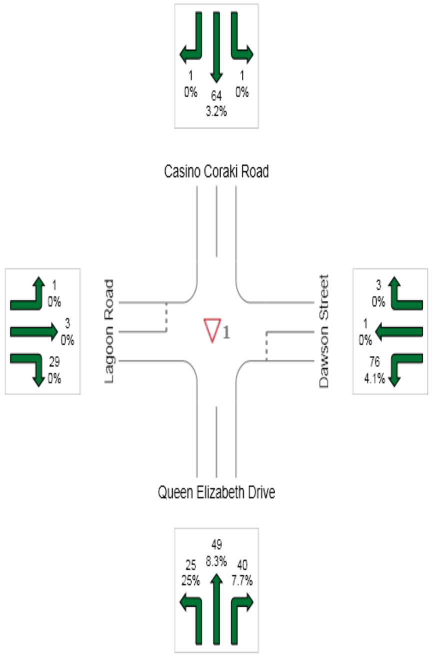
2016 DESIGN AM PEAK HOUR
LAGOON ROAD / QUEEN ELIZABETH DRIVE UNSIGNALISED INTERSECTION

FIGURE 2.5



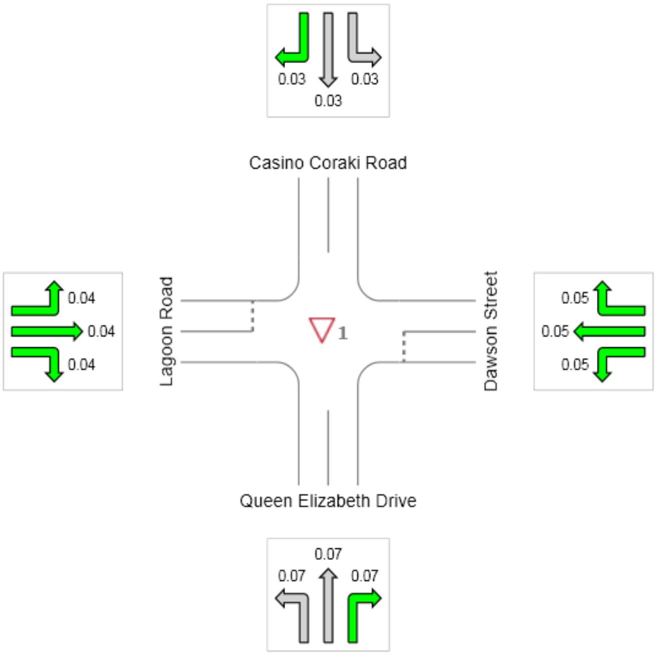
INTERSECTION GEOMETRY

Giveway Intersection



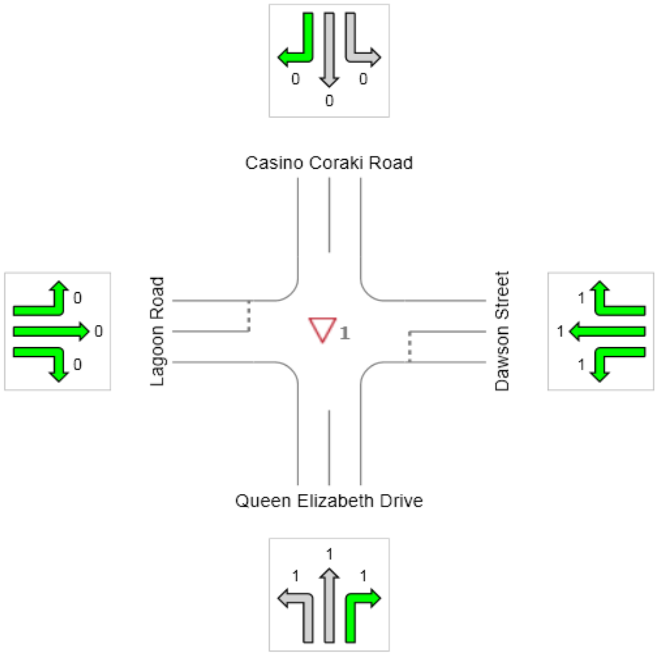
TRAFFIC VOLUMES

All units are vehicles per hour



DEGREE OF SATURATION

Demand Volume / Capacity (v/c) ratio



QUEUES

Largest 95% Back of Queue for any lane used by movement (metres)

MRCagney

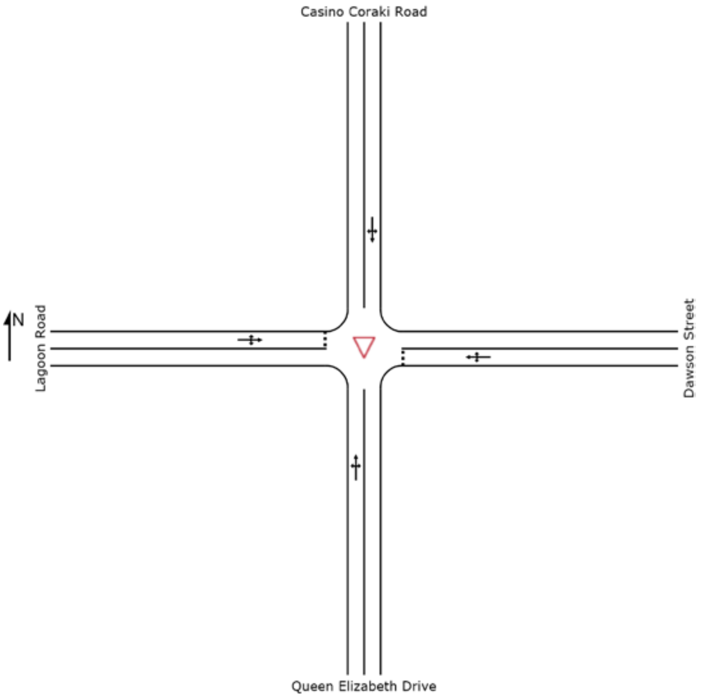
2_LAGOON_QUEEN ELIZABETH.SIP6

Produced by SIDRA INTERSECTION 6.1

SIDRA INTERSECTION
SIDRA SOLUTIONS

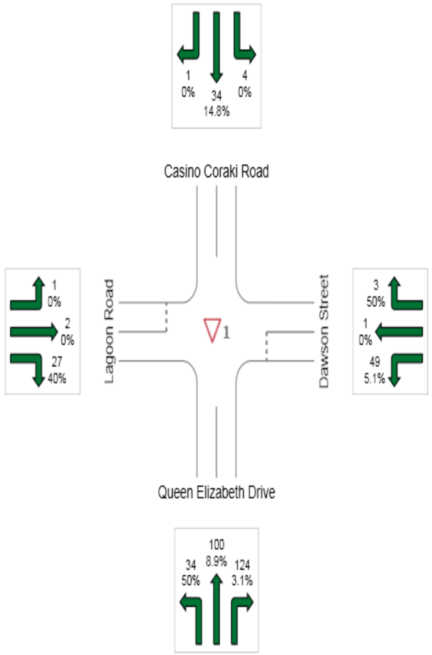
2016 DESIGN PM PEAK HOUR
LAGOON ROAD / QUEEN ELIZABETH DRIVE UNSIGNALISED INTERSECTION

FIGURE 2.6



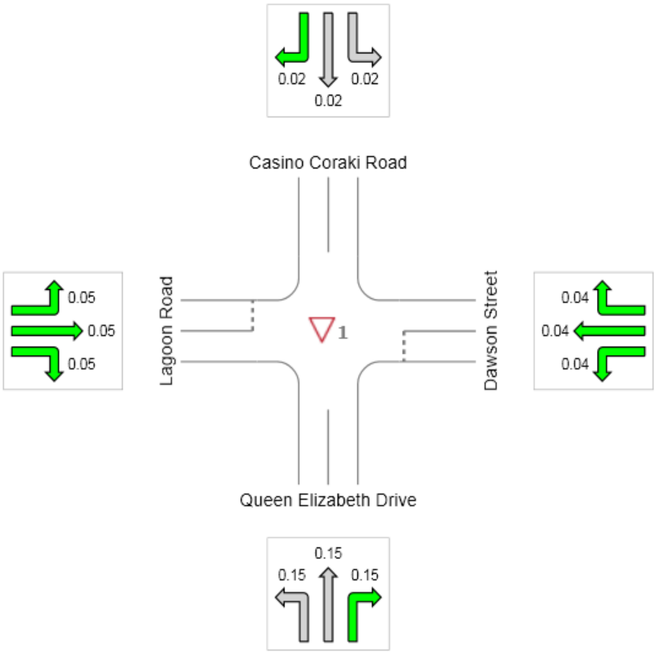
INTERSECTION GEOMETRY

Giveway Intersection



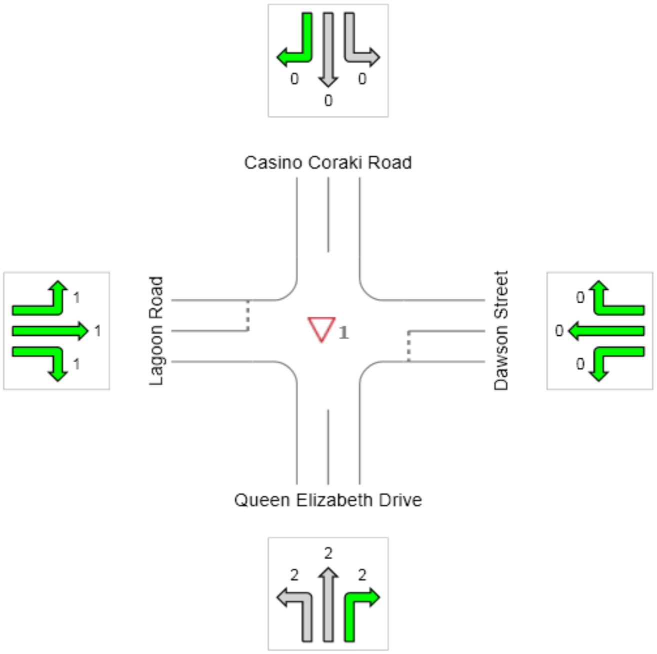
TRAFFIC VOLUMES

All units are vehicles per hour



DEGREE OF SATURATION

Demand Volume / Capacity (v/c) ratio



QUEUES

Largest 95% Back of Queue for any lane used by movement (metres)

MRCagney

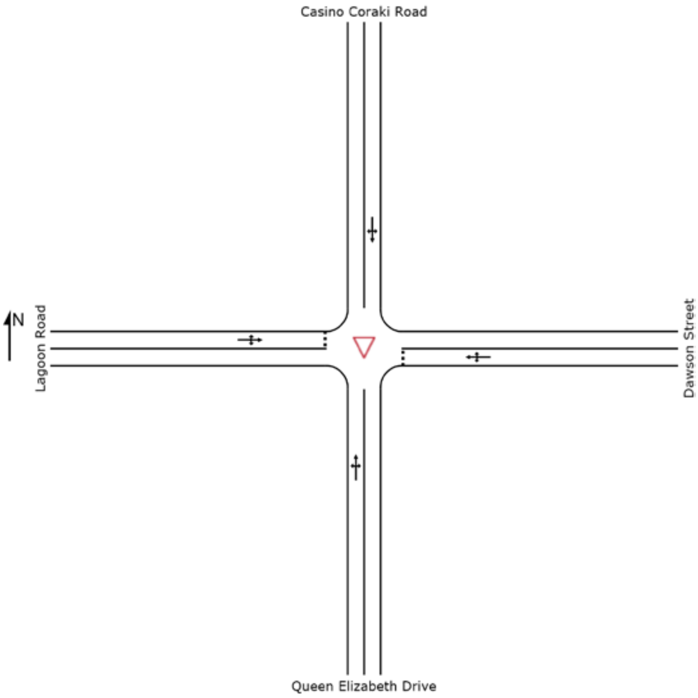
2_LAGOON_QUEEN ELIZABETH.SIP6

Produced by SIDRA INTERSECTION 6.1

SIDRA INTERSECTION
SIDRA SOLUTIONS

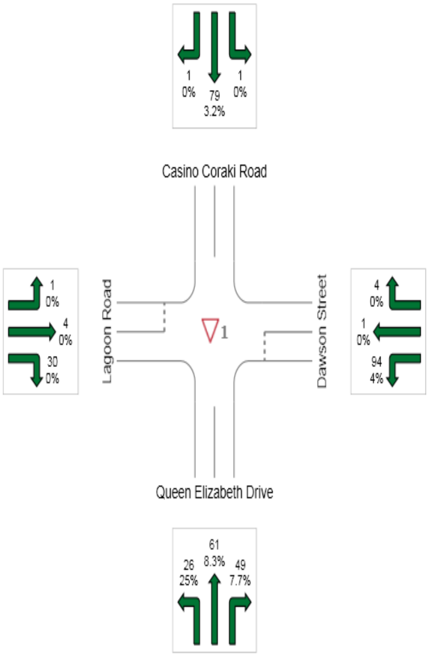
2023 DESIGN AM PEAK HOUR
LAGOON ROAD / QUEEN ELIZABETH DRIVE UNSIGNALISED INTERSECTION

FIGURE 2.7



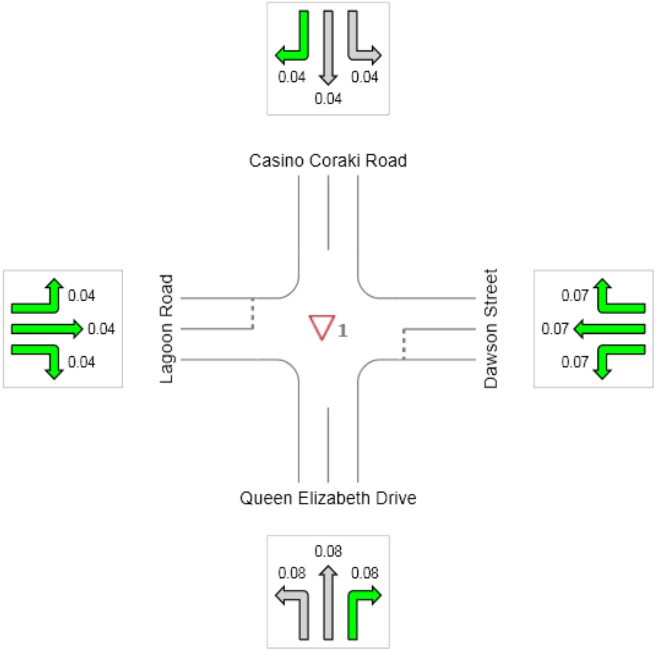
INTERSECTION GEOMETRY

Giveway Intersection



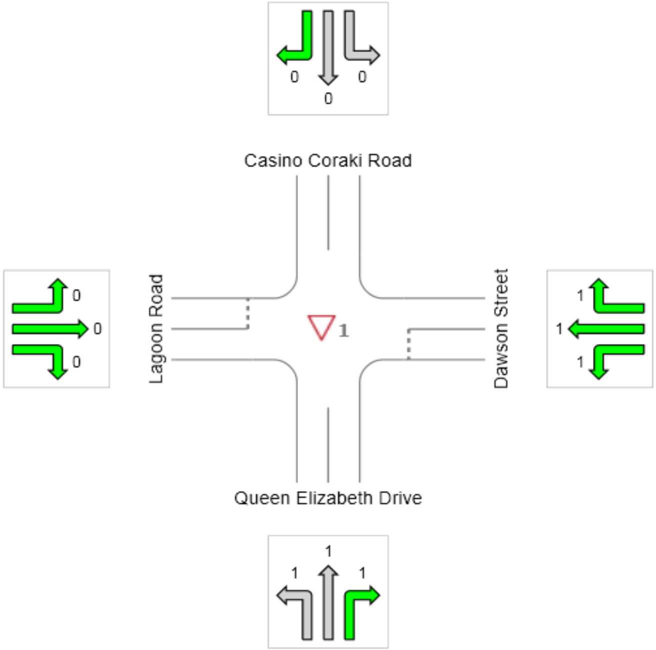
TRAFFIC VOLUMES

All units are vehicles per hour



DEGREE OF SATURATION

Demand Volume / Capacity (v/c) ratio



QUEUES

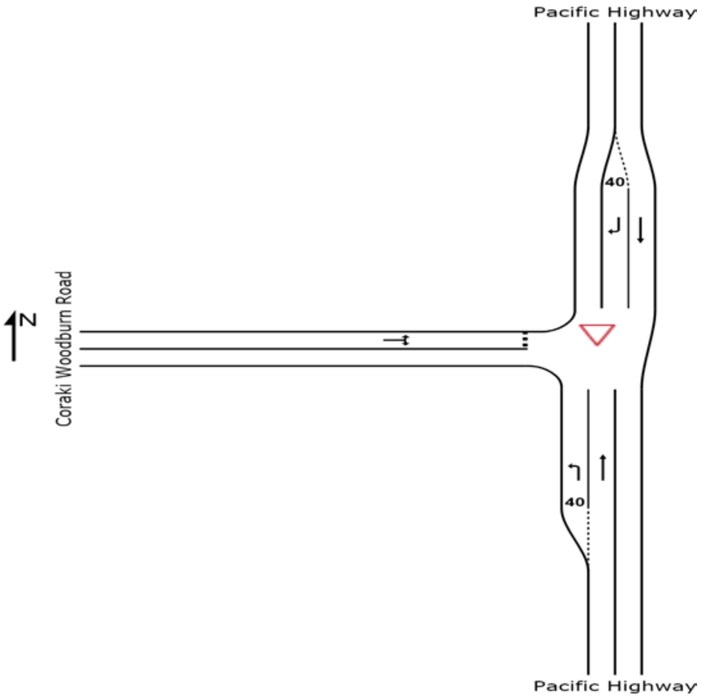
Largest 95% Back of Queue for any lane used by movement (metres)

2_LAGOON_QUEEN ELIZABETH.SIP6

Produced by SIDRA INTERSECTION 6.1

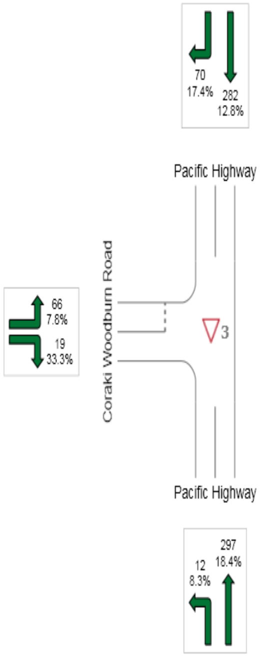
2023 DESIGN PM PEAK HOUR
LAGOON ROAD / QUEEN ELIZABETH DRIVE UNSIGNALISED INTERSECTION

FIGURE 2.8



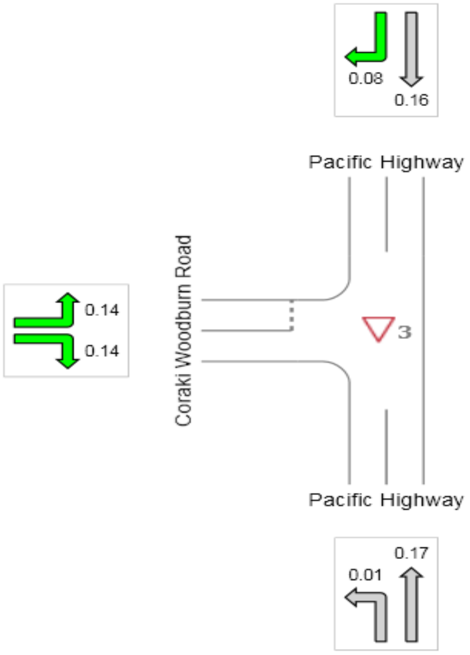
INTERSECTION GEOMETRY

Giveway Intersection



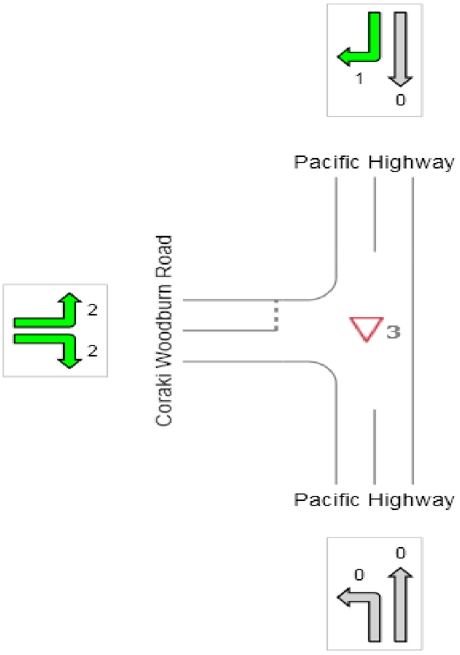
TRAFFIC VOLUMES

All units are vehicles per hour



DEGREE OF SATURATION

Demand Volume / Capacity (v/c) ratio



QUEUES

Largest 95% Back of Queue for any lane used by movement (metres)

MRCagney

3_CORAKI WOODBURN_PACIFIC.SIP6

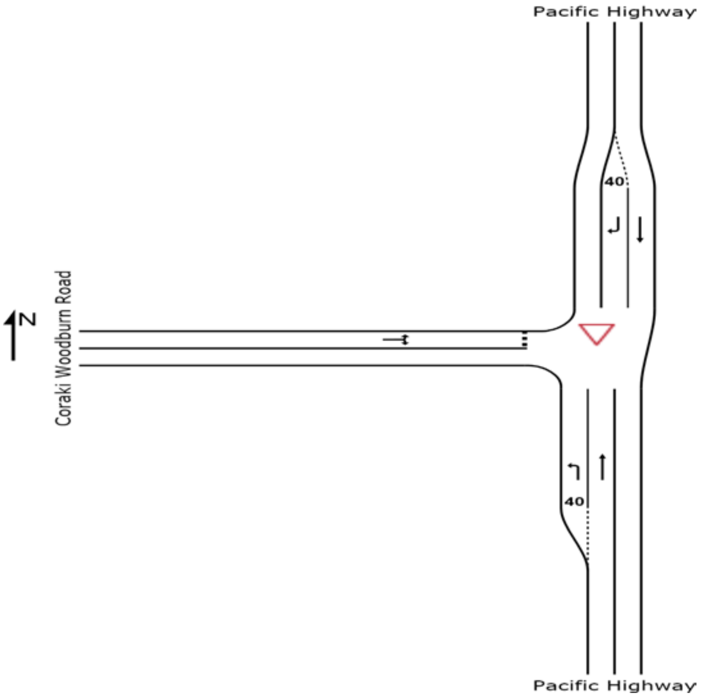
Produced by SIDRA INTERSECTION 6.1

Akcelik & Associates Pty Ltd

SIDRA INTERSECTION
SIDRA SOLUTIONS

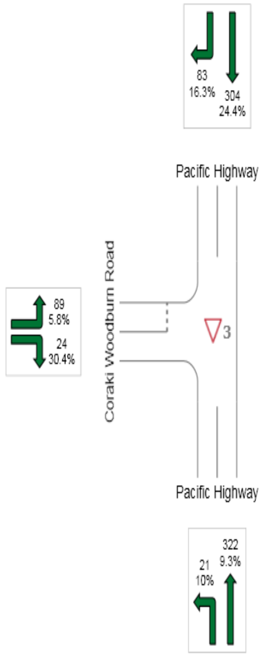
2016 BASE AM PEAK HOUR
CORAKI WOODBURN ROAD / PACIFIC HIGHWAY UNSIGNALISED INTERSECTION

FIGURE 3.1



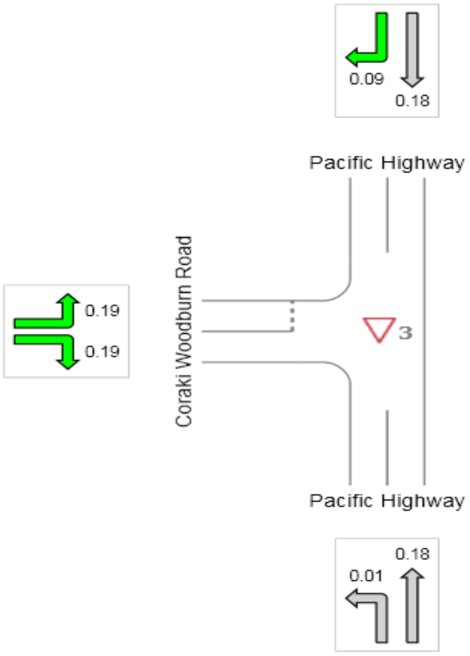
INTERSECTION GEOMETRY

Giveway Intersection



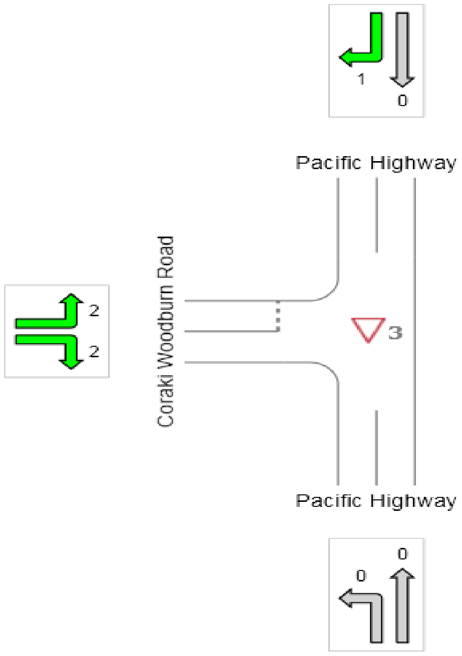
TRAFFIC VOLUMES

All units are vehicles per hour



DEGREE OF SATURATION

Demand Volume / Capacity (v/c) ratio



QUEUES

Largest 95% Back of Queue for any lane used by movement (metres)

MRCagney

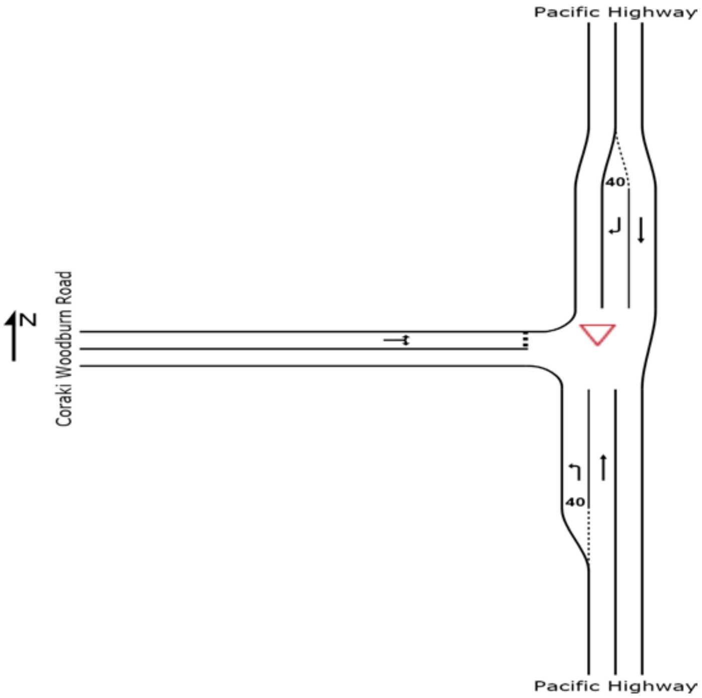
3_CORAKI WOODBURN_PACIFIC.SIP6

Produced by SIDRA INTERSECTION 6.1

SIDRA INTERSECTION
SIDRA SOLUTIONS

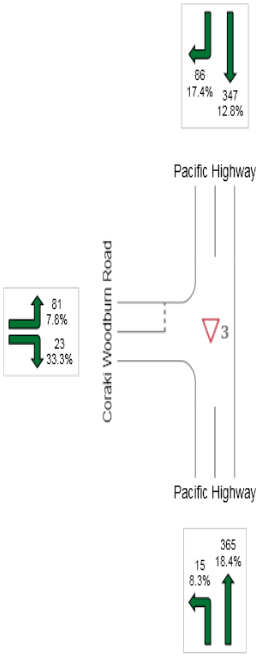
2016 BASE PM PEAK HOUR
CORAKI WOODBURN ROAD / PACIFIC HIGHWAY UNSIGNALISED INTERSECTION

FIGURE 3.2



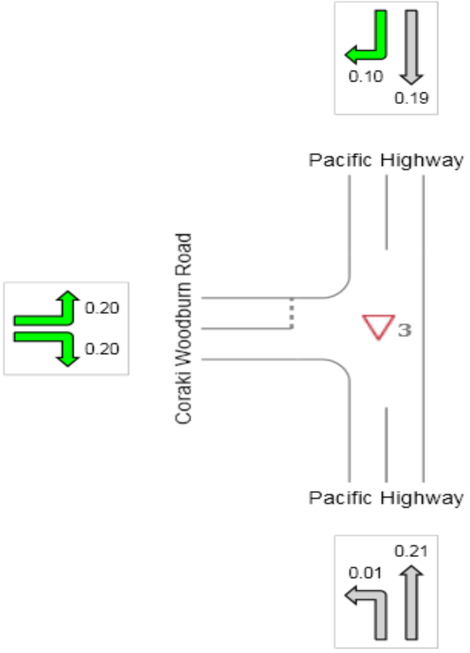
INTERSECTION GEOMETRY

Giveway Intersection



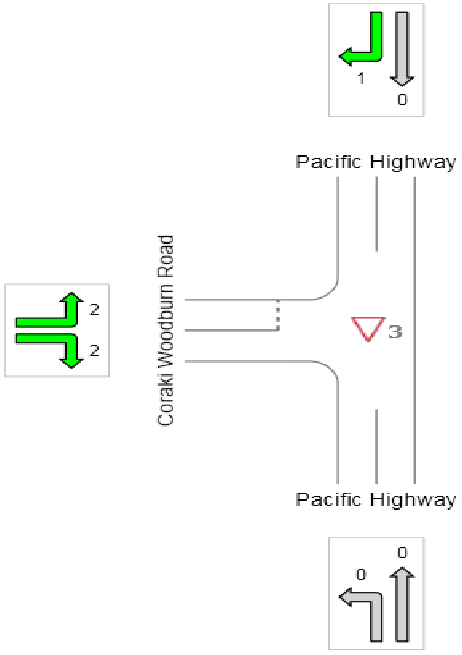
TRAFFIC VOLUMES

All units are vehicles per hour



DEGREE OF SATURATION

Demand Volume / Capacity (v/c) ratio



QUEUES

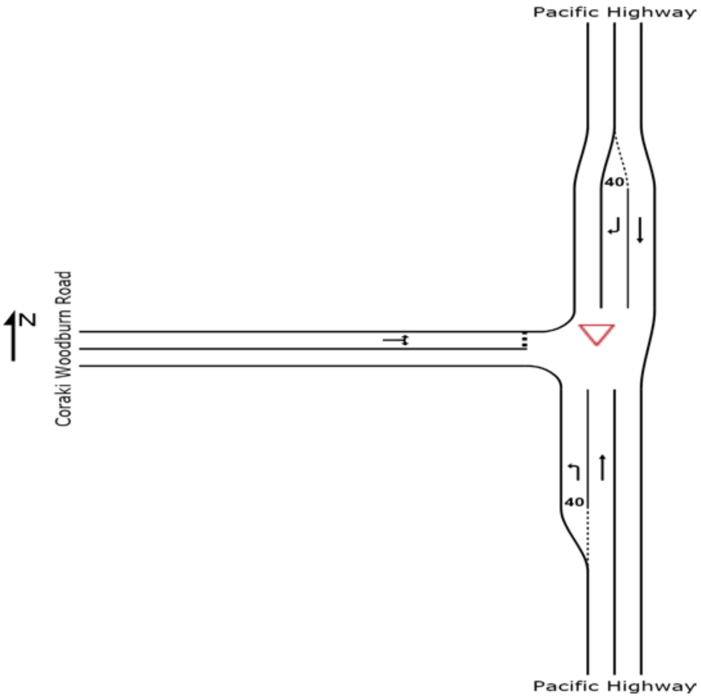
Largest 95% Back of Queue for any lane used by movement (metres)

3_CORAKI WOODBURN_PACIFIC.SIP6

Produced by SIDRA INTERSECTION 6.1

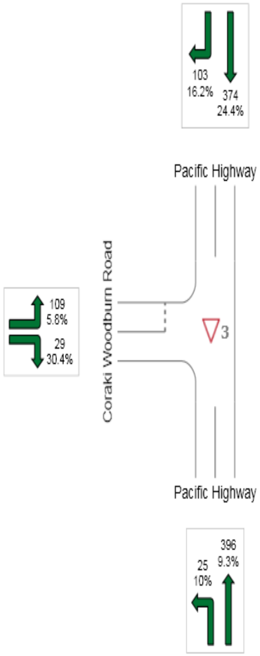
2023 BASE AM PEAK HOUR
CORAKI WOODBURN ROAD / PACIFIC HIGHWAY UNSIGNALISED INTERSECTION

FIGURE 3.3



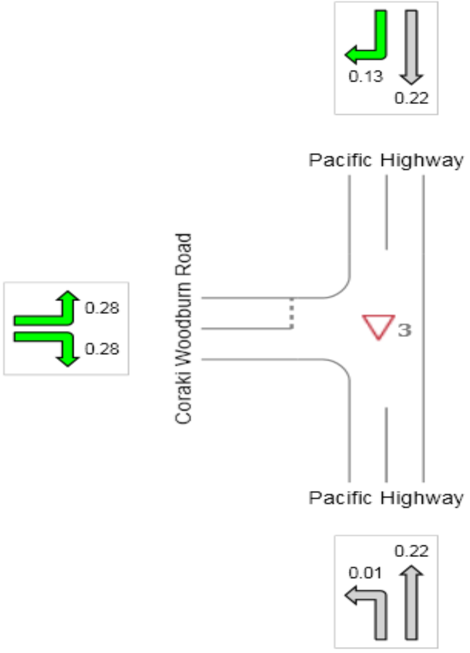
INTERSECTION GEOMETRY

Giveway Intersection



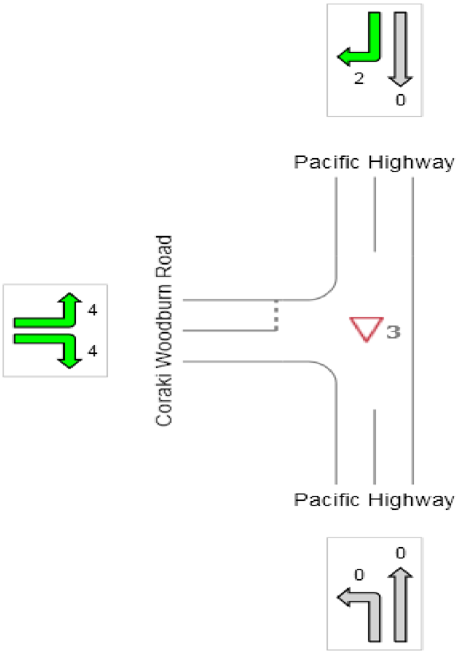
TRAFFIC VOLUMES

All units are vehicles per hour



DEGREE OF SATURATION

Demand Volume / Capacity (v/c) ratio



QUEUES

Largest 95% Back of Queue for any lane used by movement (metres)

MRCagney

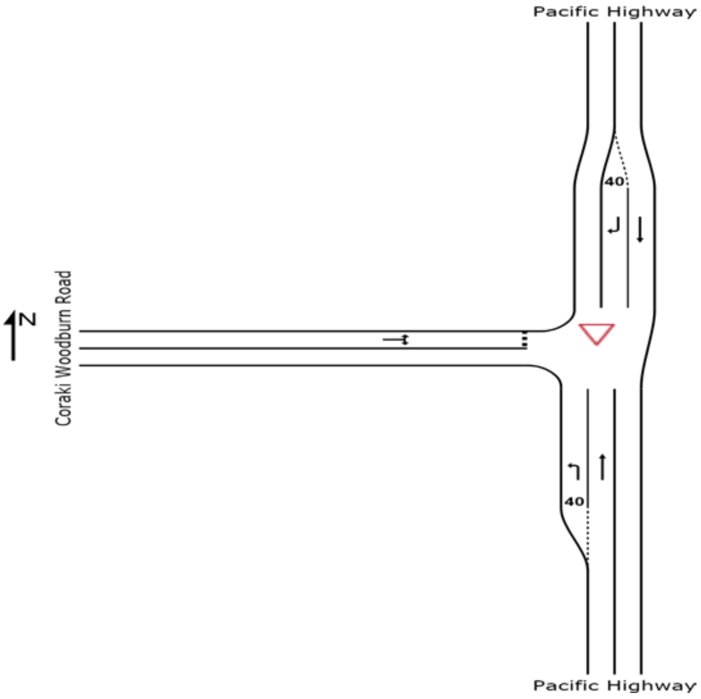
3_CORAKI WOODBURN_PACIFIC.SIP6

Produced by SIDRA INTERSECTION 6.1

SIDRA INTERSECTION
SIDRA SOLUTIONS

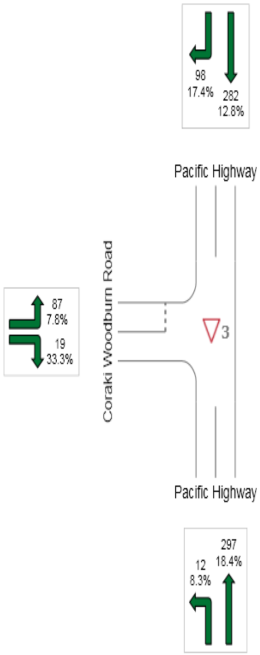
2023 BASE PM PEAK HOUR
CORAKI WOODBURN ROAD / PACIFIC HIGHWAY UNSIGNALISED INTERSECTION

FIGURE 3.4



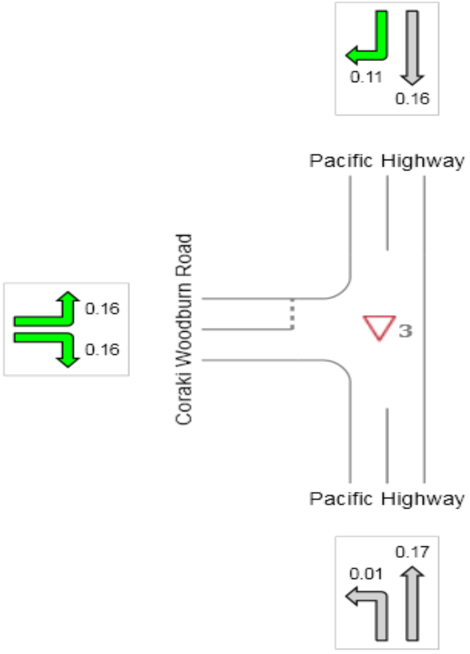
INTERSECTION GEOMETRY

Giveway Intersection



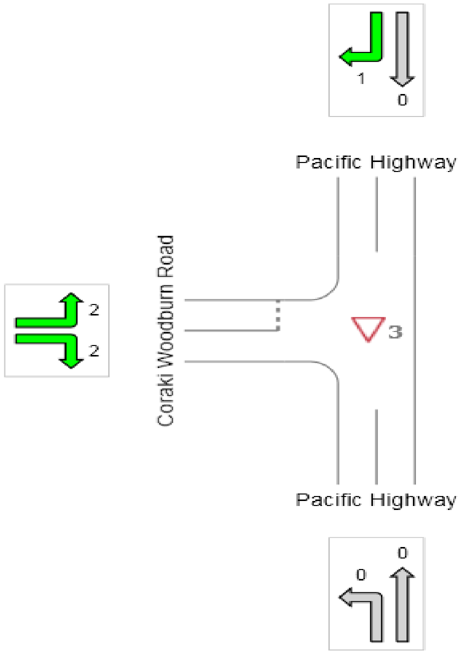
TRAFFIC VOLUMES

All units are vehicles per hour



DEGREE OF SATURATION

Demand Volume / Capacity (v/c) ratio



QUEUES

Largest 95% Back of Queue for any lane used by movement (metres)

MRCagney

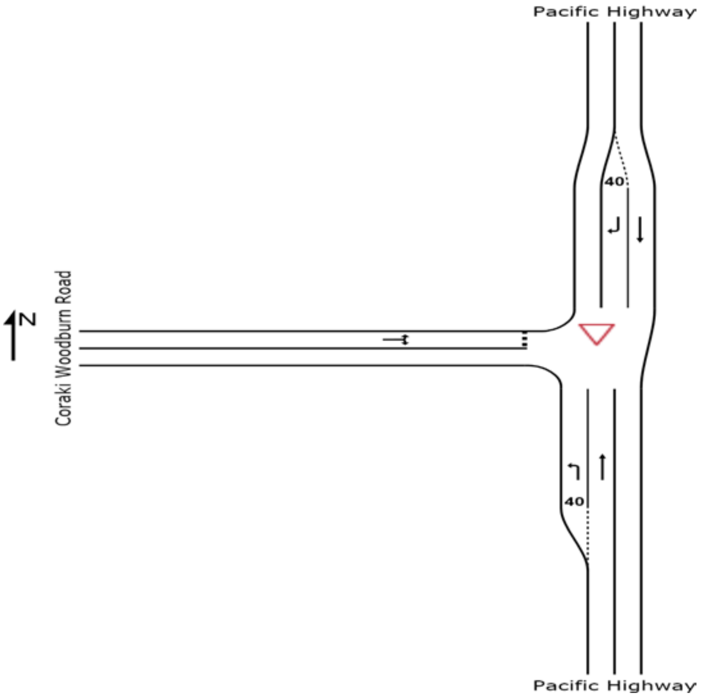
3_CORAKI WOODBURN_PACIFIC.SIP6

Produced by SIDRA INTERSECTION 6.1

SIDRA INTERSECTION
SIDRA SOLUTIONS

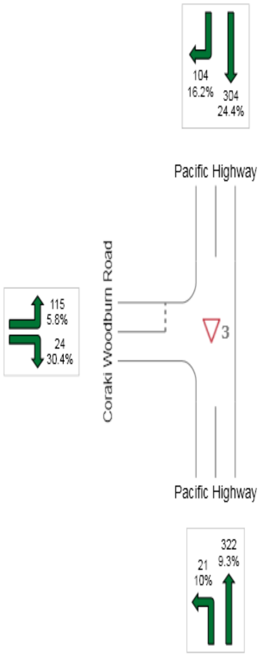
2016 DESIGN AM PEAK HOUR – EARLY STAGE OF THE PACIFIC HIGHWAY UPGRADE PROJECT
CORAKI WOODBURN ROAD / PACIFIC HIGHWAY UNSIGNALISED INTERSECTION

FIGURE 3.5



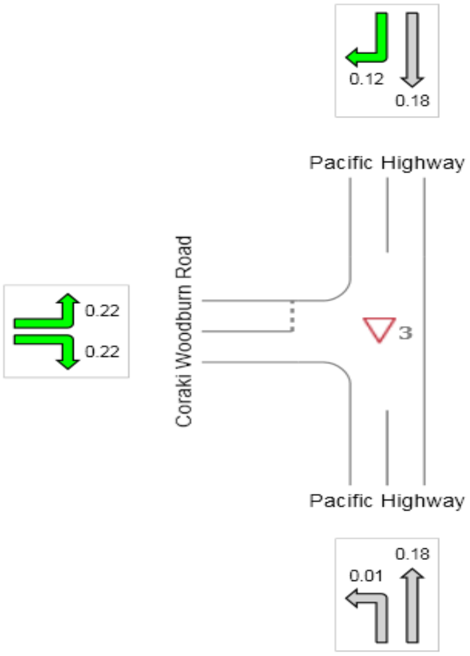
INTERSECTION GEOMETRY

Giveway Intersection



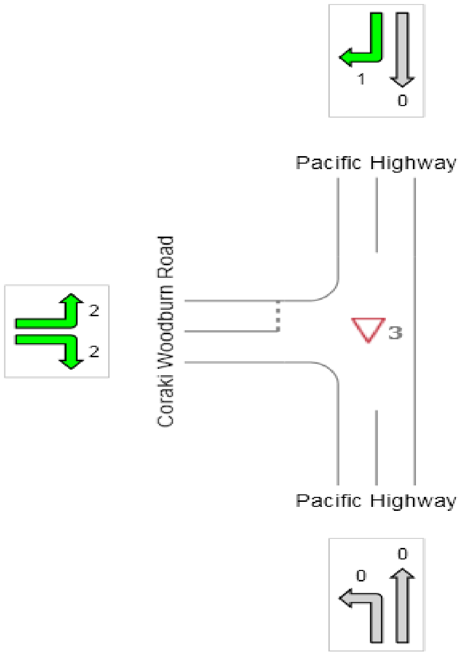
TRAFFIC VOLUMES

All units are vehicles per hour



DEGREE OF SATURATION

Demand Volume / Capacity (v/c) ratio



QUEUES

Largest 95% Back of Queue for any lane used by movement (metres)

MRCagney

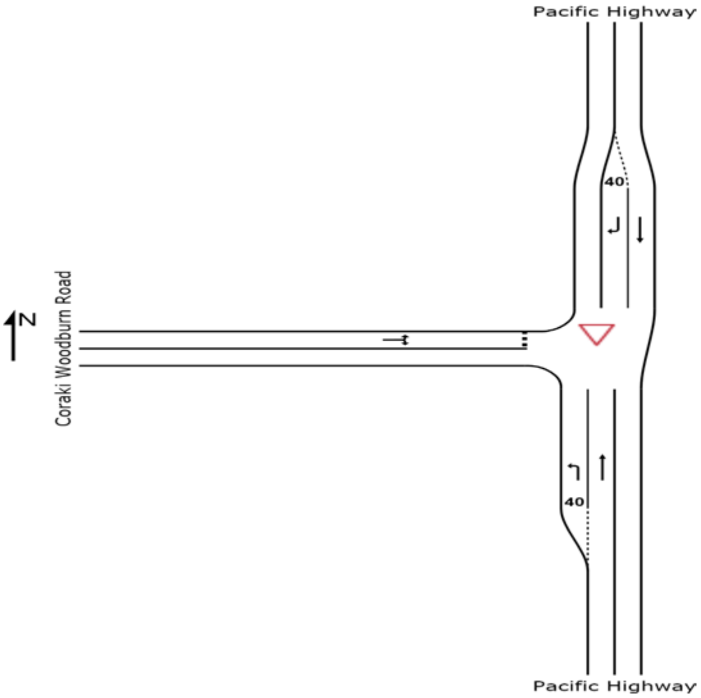
3_CORAKI WOODBURN_PACIFIC.SIP6

Produced by SIDRA INTERSECTION 6.1

SIDRA INTERSECTION
SIDRA SOLUTIONS

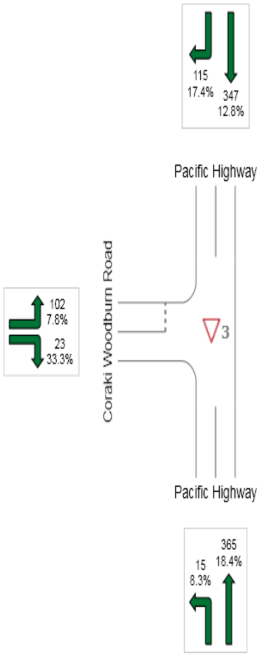
2016 DESIGN PM PEAK HOUR – EARLY STAGE OF THE PACIFIC HIGHWAY UPGRADE PROJECT
CORAKI WOODBURN ROAD / PACIFIC HIGHWAY UNSIGNALISED INTERSECTION

FIGURE 3.6



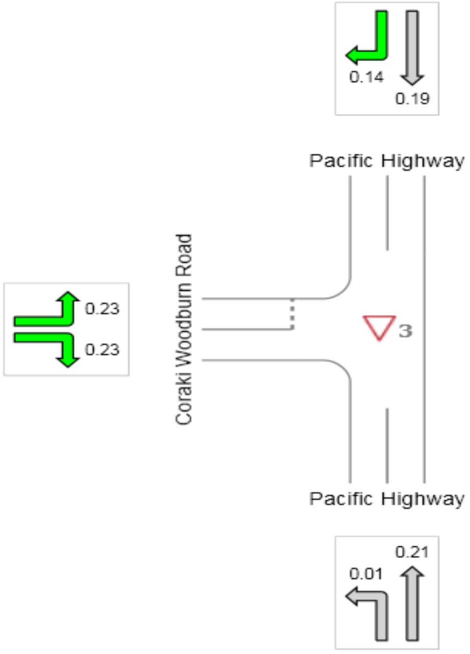
INTERSECTION GEOMETRY

Giveway Intersection



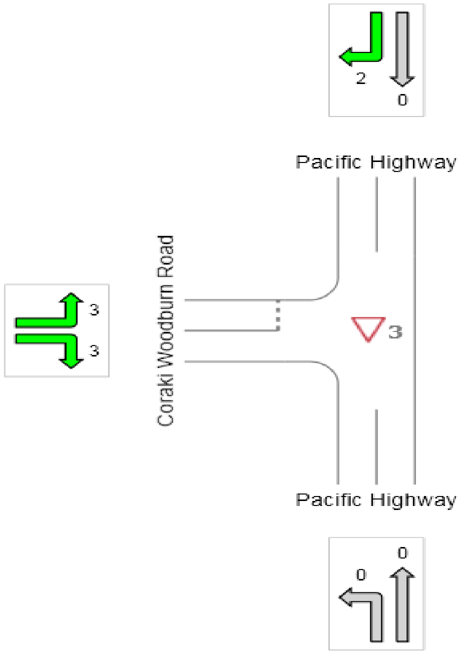
TRAFFIC VOLUMES

All units are vehicles per hour



DEGREE OF SATURATION

Demand Volume / Capacity (v/c) ratio



QUEUES

Largest 95% Back of Queue for any lane used by movement (metres)

MRCagney

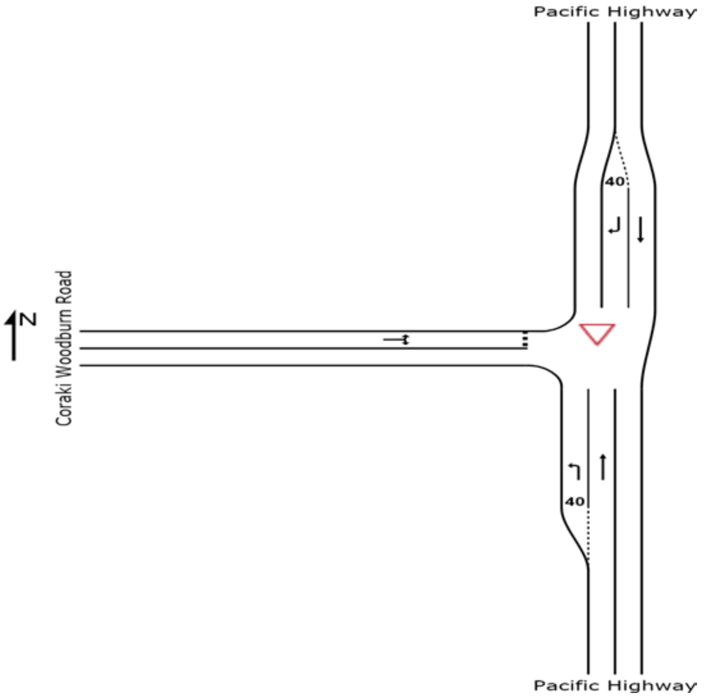
3_CORAKI WOODBURN_PACIFIC.SIP6

Produced by SIDRA INTERSECTION 6.1

SIDRA INTERSECTION
SIDRA SOLUTIONS

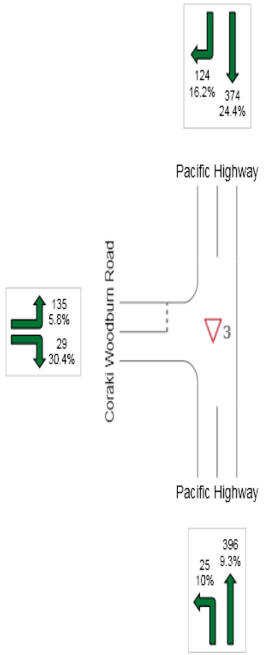
2023 DESIGN AM PEAK HOUR – EARLY STAGE OF THE PACIFIC HIGHWAY UPGRADE PROJECT
CORAKI WOODBURN ROAD / PACIFIC HIGHWAY UNSIGNALISED INTERSECTION

FIGURE 3.7



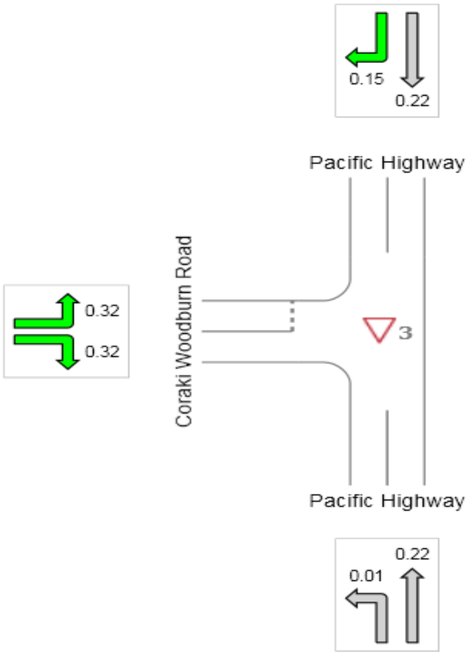
INTERSECTION GEOMETRY

Giveway Intersection



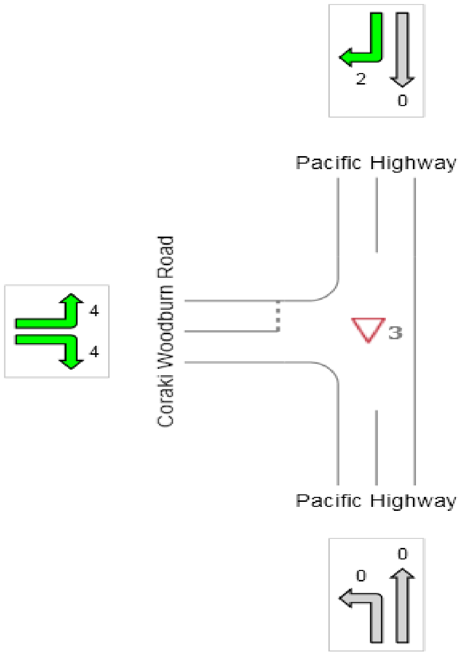
TRAFFIC VOLUMES

All units are vehicles per hour



DEGREE OF SATURATION

Demand Volume / Capacity (v/c) ratio



QUEUES

Largest 95% Back of Queue for any lane used by movement (metres)

MRCagney

3_CORAKI WOODBURN_PACIFIC.SIP6

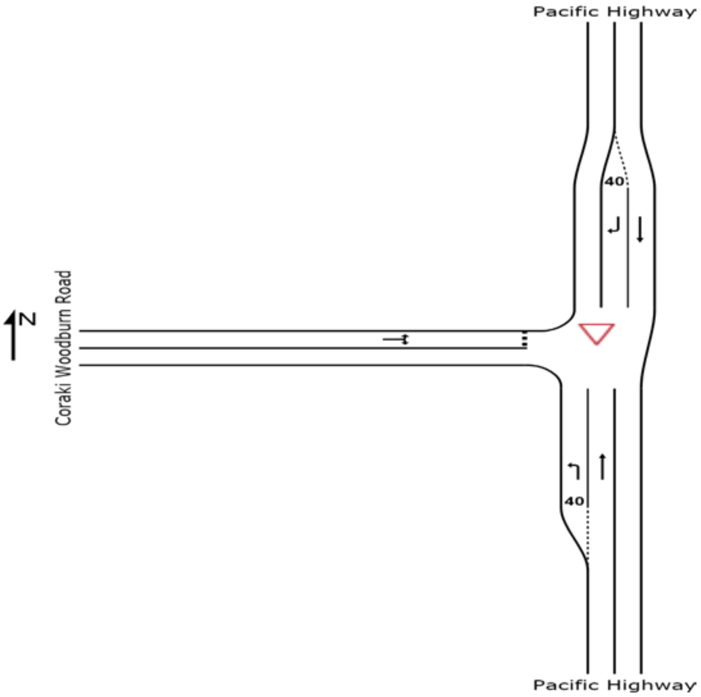
Produced by SIDRA INTERSECTION 6.1
Copyright © 2000-2015
Akcelik & Associates Pty Ltd

SIDRA INTERSECTION

SIDRA SOLUTIONS

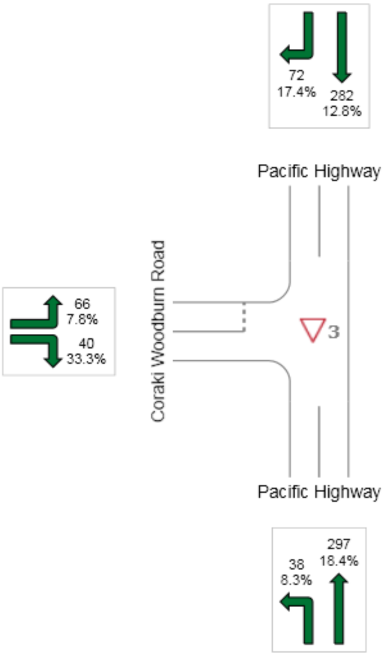
2023 DESIGN PM PEAK HOUR – EARLY STAGE OF THE PACIFIC HIGHWAY UPGRADE PROJECT
CORAKI WOODBURN ROAD / PACIFIC HIGHWAY UNSIGNALISED INTERSECTION

FIGURE 3.8



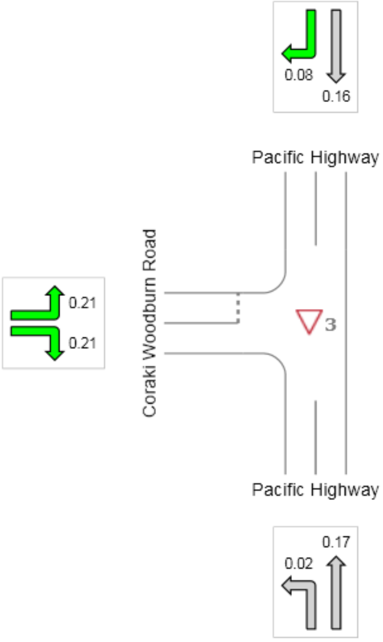
INTERSECTION GEOMETRY

Giveway Intersection



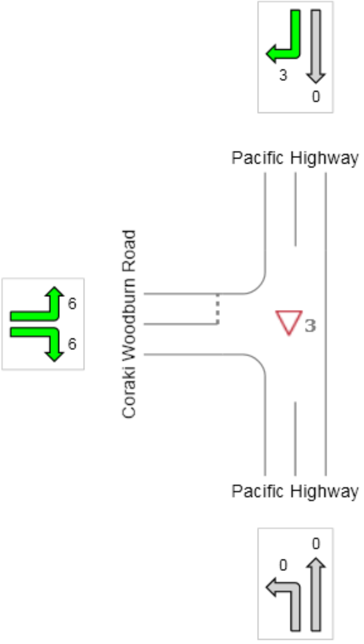
TRAFFIC VOLUMES

All units are vehicles per hour



DEGREE OF SATURATION

Demand Volume / Capacity (v/c) ratio



QUEUES

Largest 95% Back of Queue for any lane used by movement (metres)

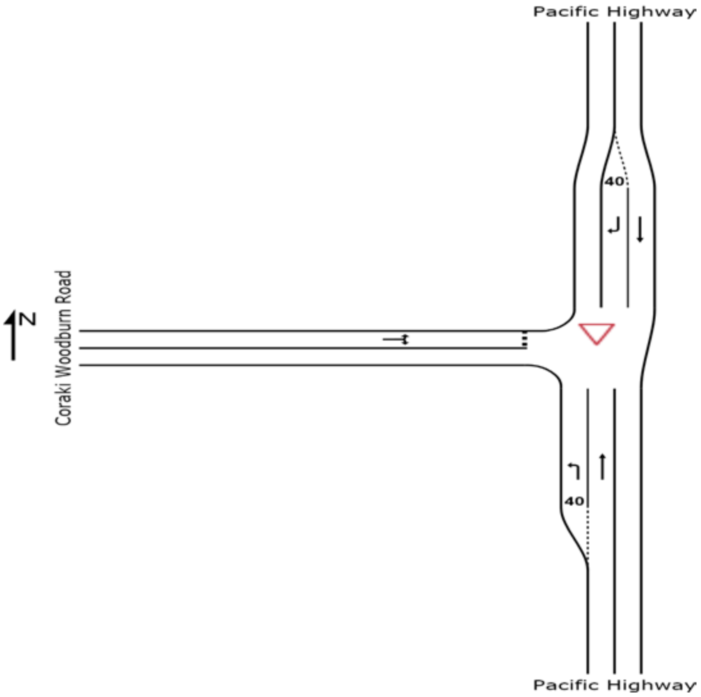
3_CORAKI WOODBURN_PACIFIC.SIP6

Produced by SIDRA INTERSECTION 6.1

Akcelik & Associates Pty Ltd

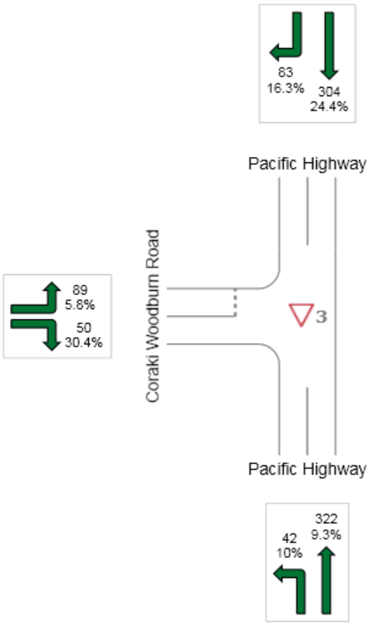
2016 DESIGN AM PEAK HOUR – LATTER STAGE OF THE PACIFIC HIGHWAY UPGRADE PROJECT
CORAKI WOODBURN ROAD / PACIFIC HIGHWAY UNSIGNALISED INTERSECTION

FIGURE 3.9



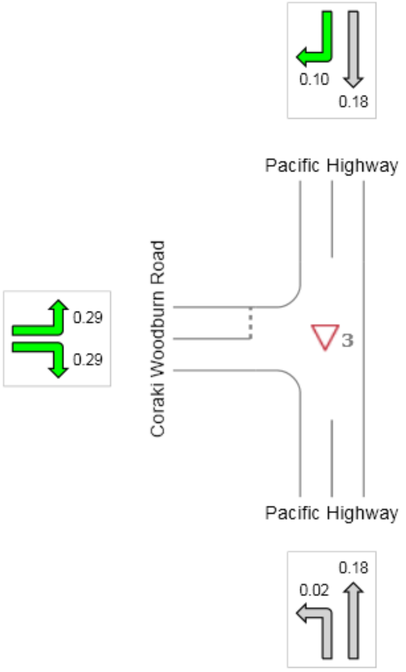
INTERSECTION GEOMETRY

Giveway Intersection



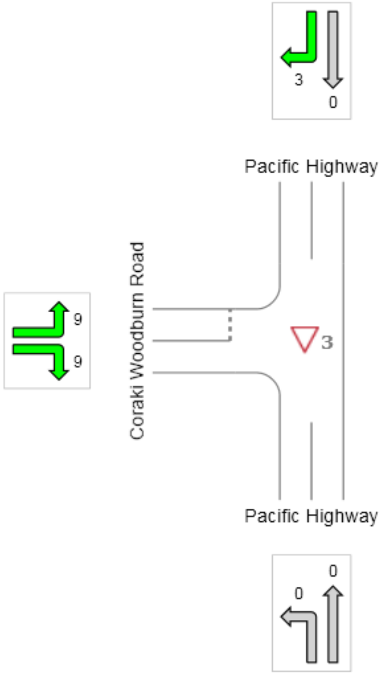
TRAFFIC VOLUMES

All units are vehicles per hour



DEGREE OF SATURATION

Demand Volume / Capacity (v/c) ratio



QUEUES

Largest 95% Back of Queue for any lane used by movement (metres)

MRCagney

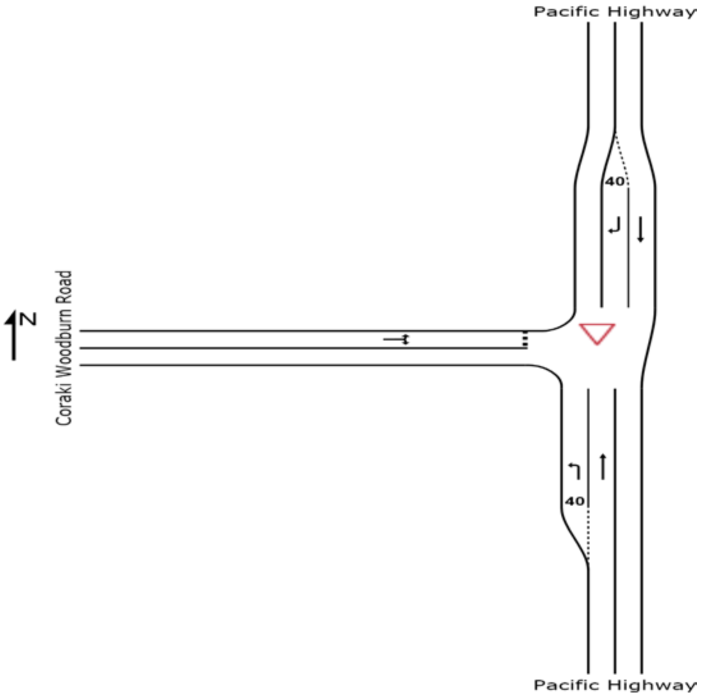
3_CORAKI WOODBURN_PACIFIC.SIP6

Produced by SIDRA INTERSECTION 6.1
Copyright © 2000-2015
Akcelik & Associates Pty Ltd

SIDRA INTERSECTION
SIDRA SOLUTIONS

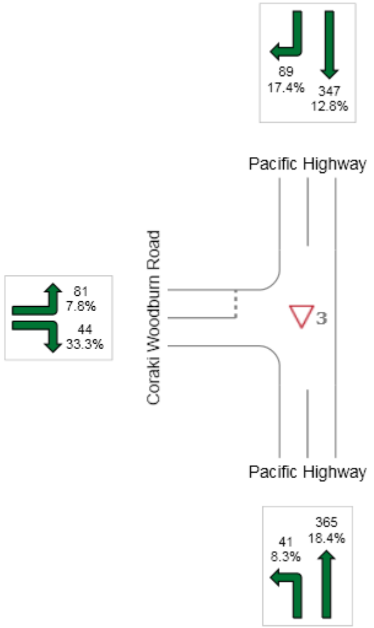
2016 DESIGN PM PEAK HOUR – LATTER STAGE OF THE PACIFIC HIGHWAY UPGRADE PROJECT
CORAKI WOODBURN ROAD / PACIFIC HIGHWAY UNSIGNALISED INTERSECTION

FIGURE 3.10



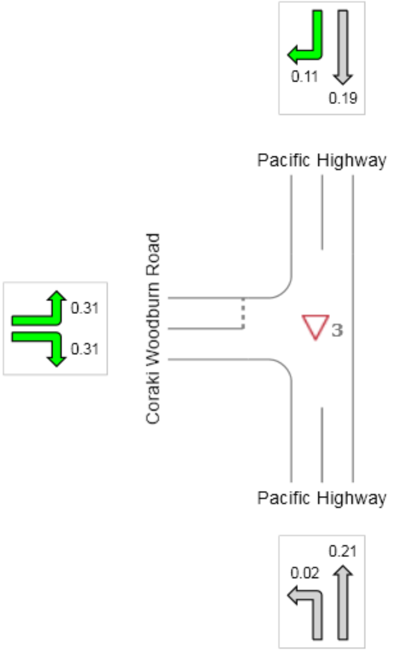
INTERSECTION GEOMETRY

Giveway Intersection



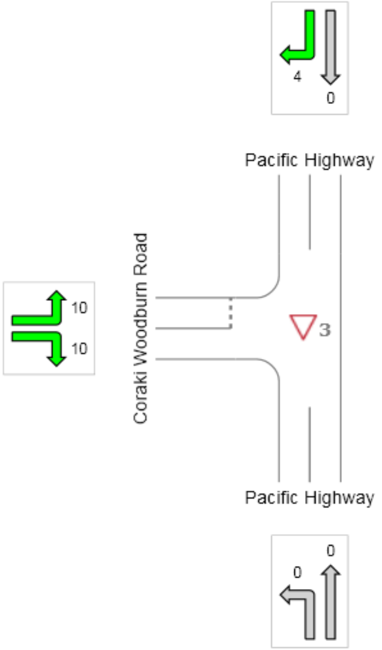
TRAFFIC VOLUMES

All units are vehicles per hour



DEGREE OF SATURATION

Demand Volume / Capacity (v/c) ratio



QUEUES

Largest 95% Back of Queue for any lane used by movement (metres)

MRCagney

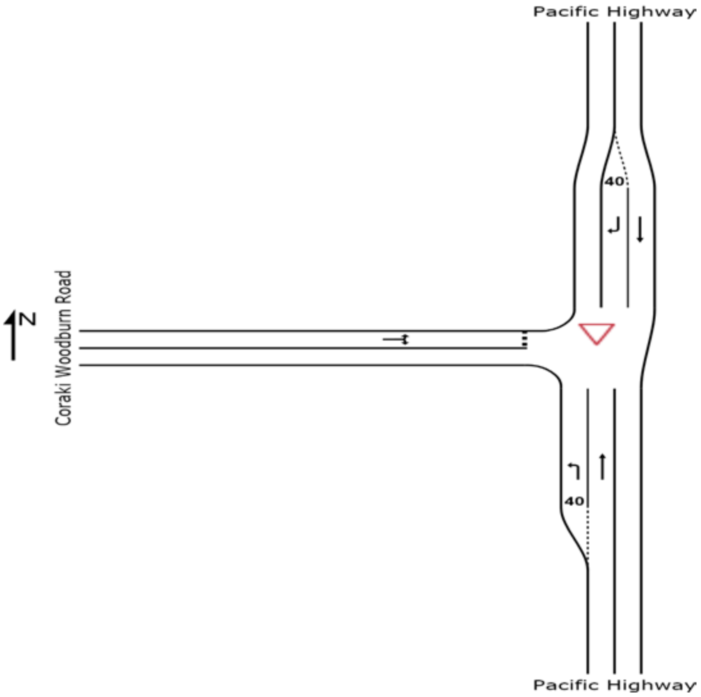
3_CORAKI WOODBURN_PACIFIC.SIP6

Produced by SIDRA INTERSECTION 6.1

SIDRA INTERSECTION
SIDRA SOLUTIONS

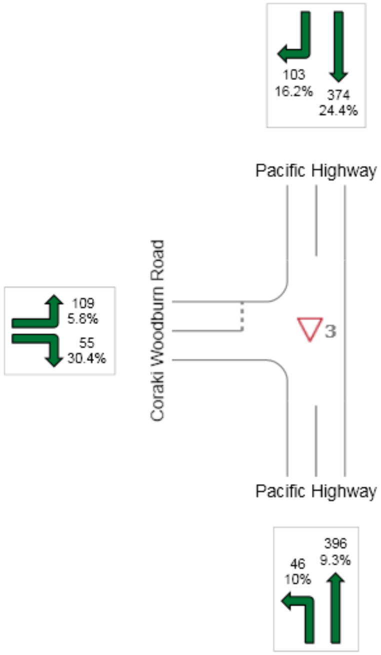
2023 DESIGN AM PEAK HOUR – LATTER STAGE OF THE PACIFIC HIGHWAY UPGRADE PROJECT
CORAKI WOODBURN ROAD / PACIFIC HIGHWAY UNSIGNALISED INTERSECTION

FIGURE 3.11



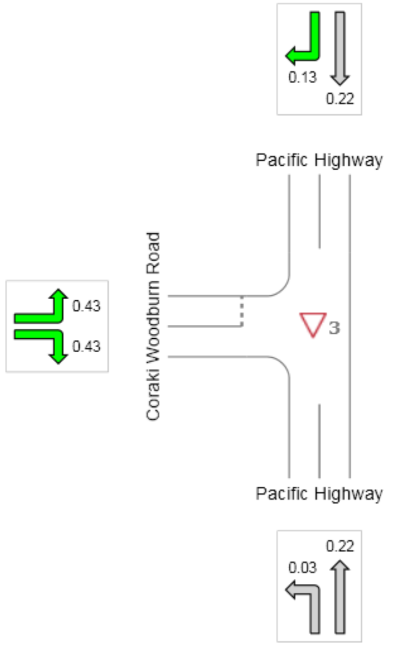
INTERSECTION GEOMETRY

Giveway Intersection



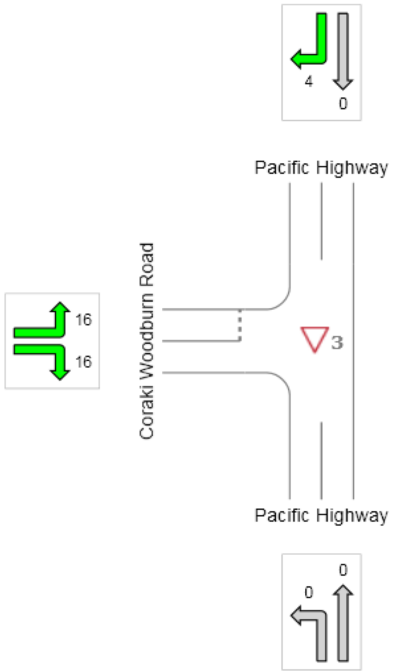
TRAFFIC VOLUMES

All units are vehicles per hour



DEGREE OF SATURATION

Demand Volume / Capacity (v/c) ratio



QUEUES

Largest 95% Back of Queue for any lane used by movement (metres)

3_CORAKI WOODBURN_PACIFIC.SIP6

Produced by SIDRA INTERSECTION 6.1

2023 DESIGN PM PEAK HOUR – LATTER STAGE OF THE PACIFIC HIGHWAY UPGRADE PROJECT
CORAKI WOODBURN ROAD / PACIFIC HIGHWAY UNSIGNALISED INTERSECTION

FIGURE 3.12

Appendix C

Results of Traffic Surveys

AUSTRAFFIC VIDEO INTERSECTION COUNT

Site No.: 1 **Weather:** Showers

Location: Petersons Quarry Road/Lagoon Road, Coraki

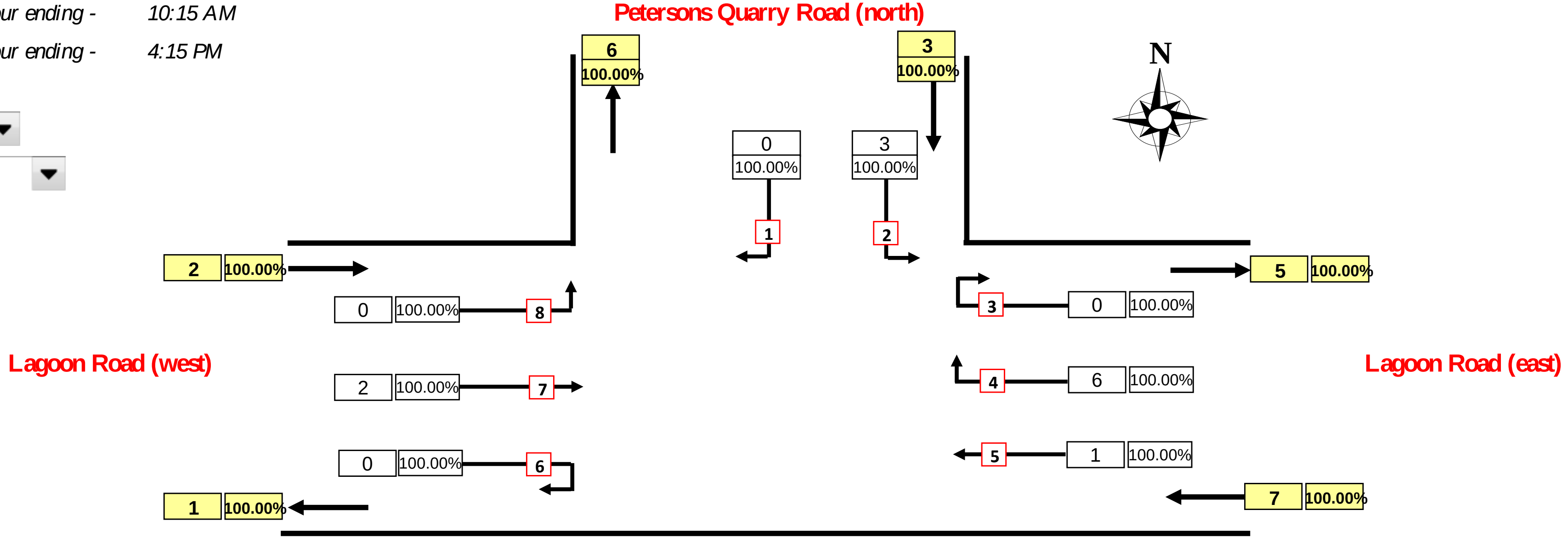
Day/Date: Thursday, 21 May 2015

Summary: AM Peak : *Hour ending - 10:15 AM*

PM Peak : *Hour ending - 4:15 PM*

Hour Ending: 10:15 AM

Classification: Total Vehicles



Note: 3.28% = proportion of selected vehicle classification as a percentage of total vehicles

AUSTRAFFIC VIDEO INTERSECTION COUNT

Site No.: 1 **Weather:** Showers

Location: Petersons Quarry Road/Lagoon Road, Coraki

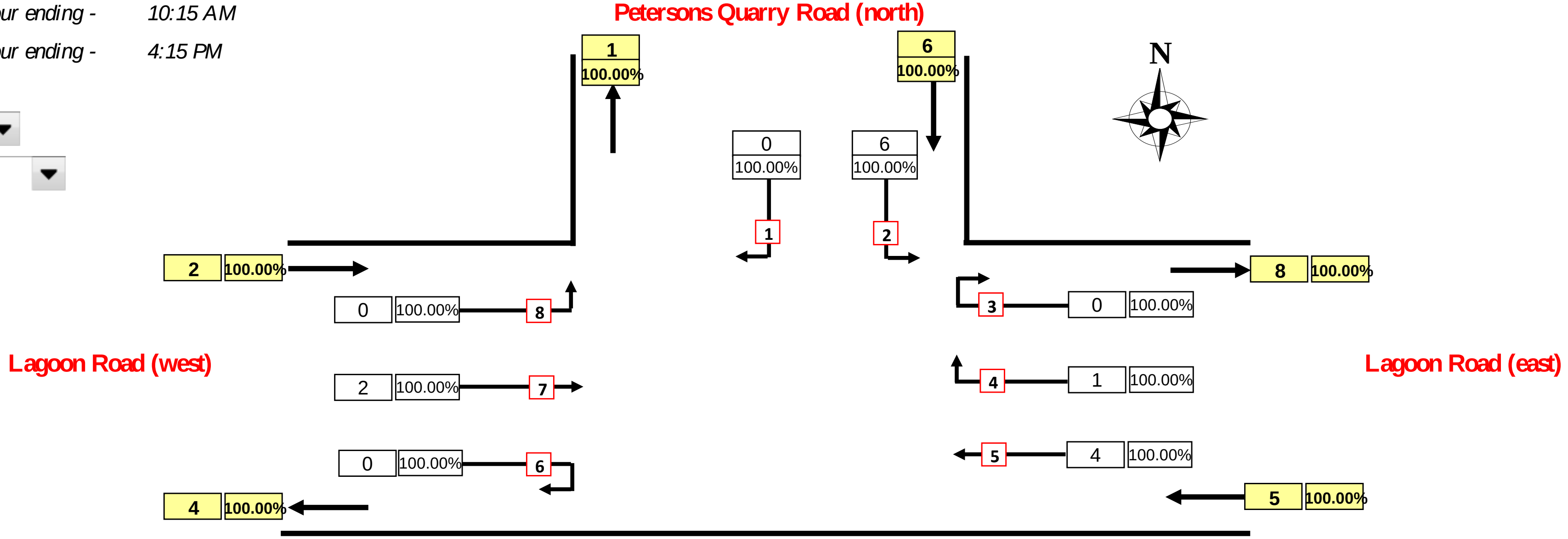
Day/Date: Thursday, 21 May 2015

Summary: AM Peak : *Hour ending - 10:15 AM*

PM Peak : *Hour ending - 4:15 PM*

Hour Ending: 4:15 PM

Classification: Total Vehicles



Note: 3.28% = proportion of selected vehicle classification as a percentage of total vehicles

AUSTRAFFIC VIDEO INTERSECTION COUNT

Site No.: 2 **Weather:** Showers

Location: Logoon Road/Casino-Coraki Road, Coraki

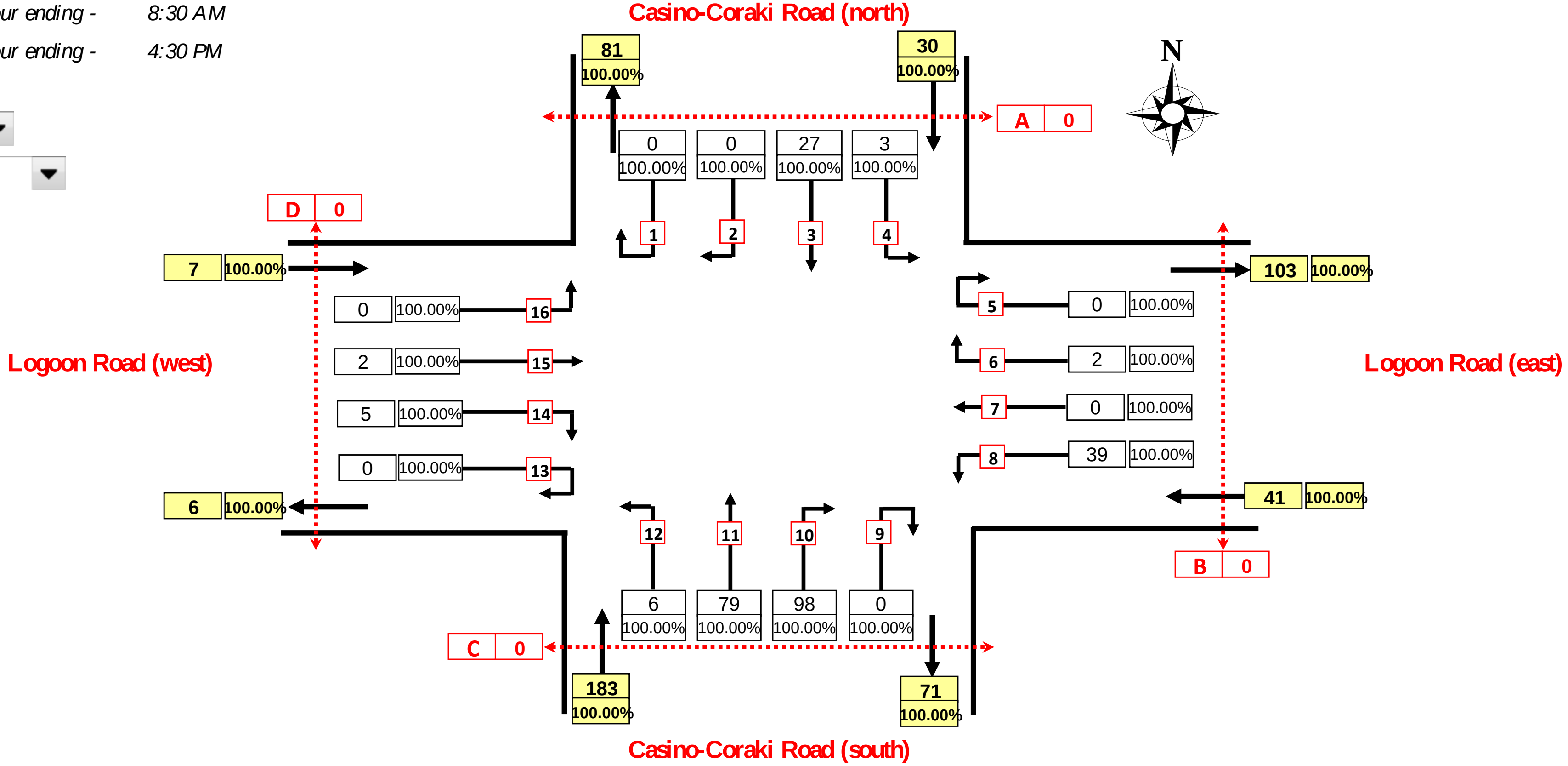
Day/Date: Thursday, 21 May 2015

Summary: AM Peak : *Hour ending - 8:30 AM*

PM Peak : *Hour ending - 4:30 PM*

Hour Ending: 8:30 AM

Classification: Total Vehicles



Note: 3.28% = proportion of selected vehicle classification as a percentage of total vehicles

AUSTRAFFIC VIDEO INTERSECTION COUNT

Site No.: 2 **Weather:** Showers

Location: Logoon Road/Casino-Coraki Road, Coraki

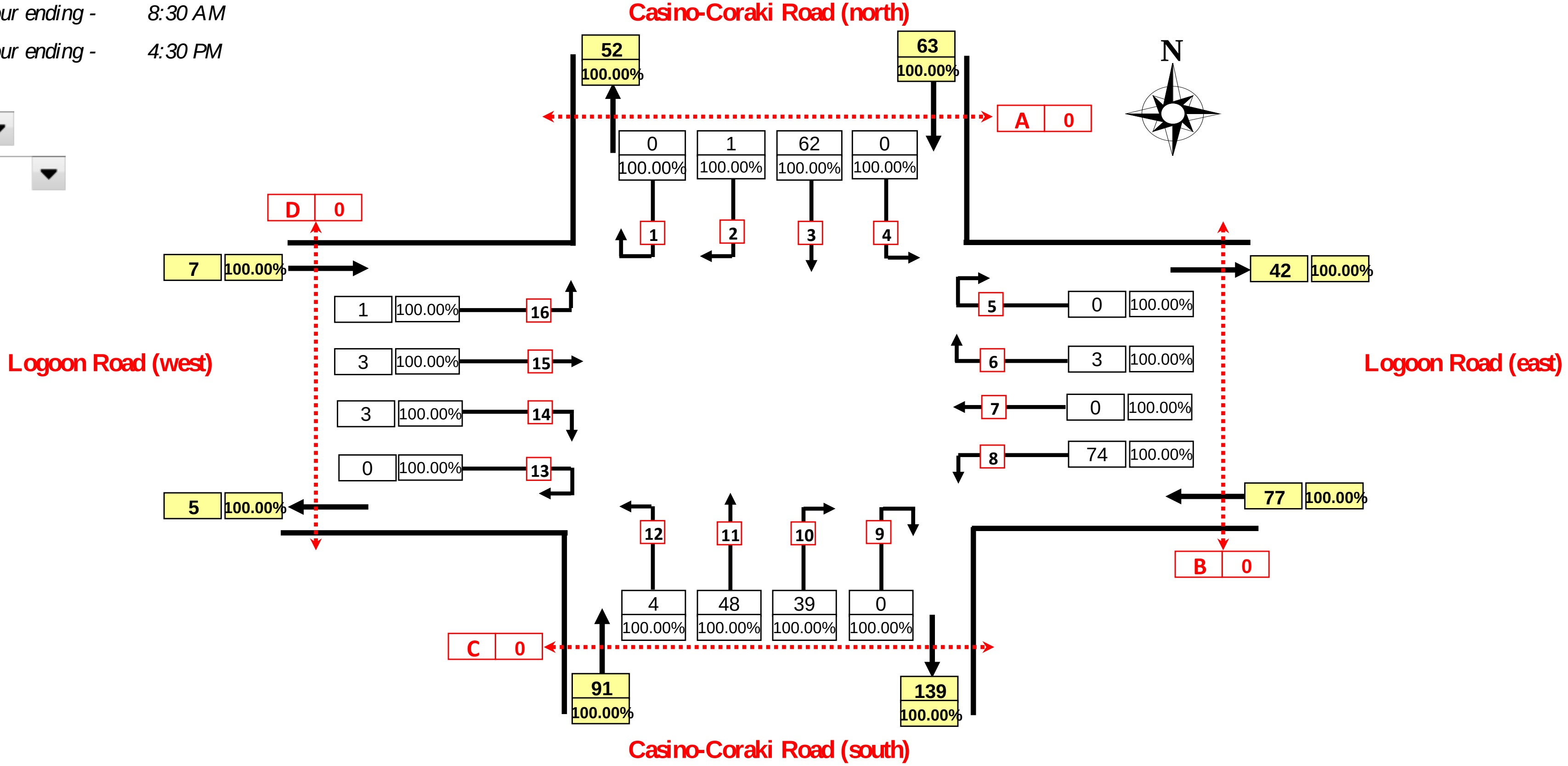
Day/Date: Thursday, 21 May 2015

Summary: AM Peak : *Hour ending - 8:30 AM*

PM Peak : *Hour ending - 4:30 PM*

Hour Ending: 4:30 PM

Classification: Total Vehicles



Note: 3.28% = proportion of selected vehicle classification as a percentage of total vehicles

AUSTRAFFIC VIDEO INTERSECTION COUNT

Site No.: 3 **Weather:** Showers

Location: Coraki Woodburn Road/Pacific Highway, Coraki

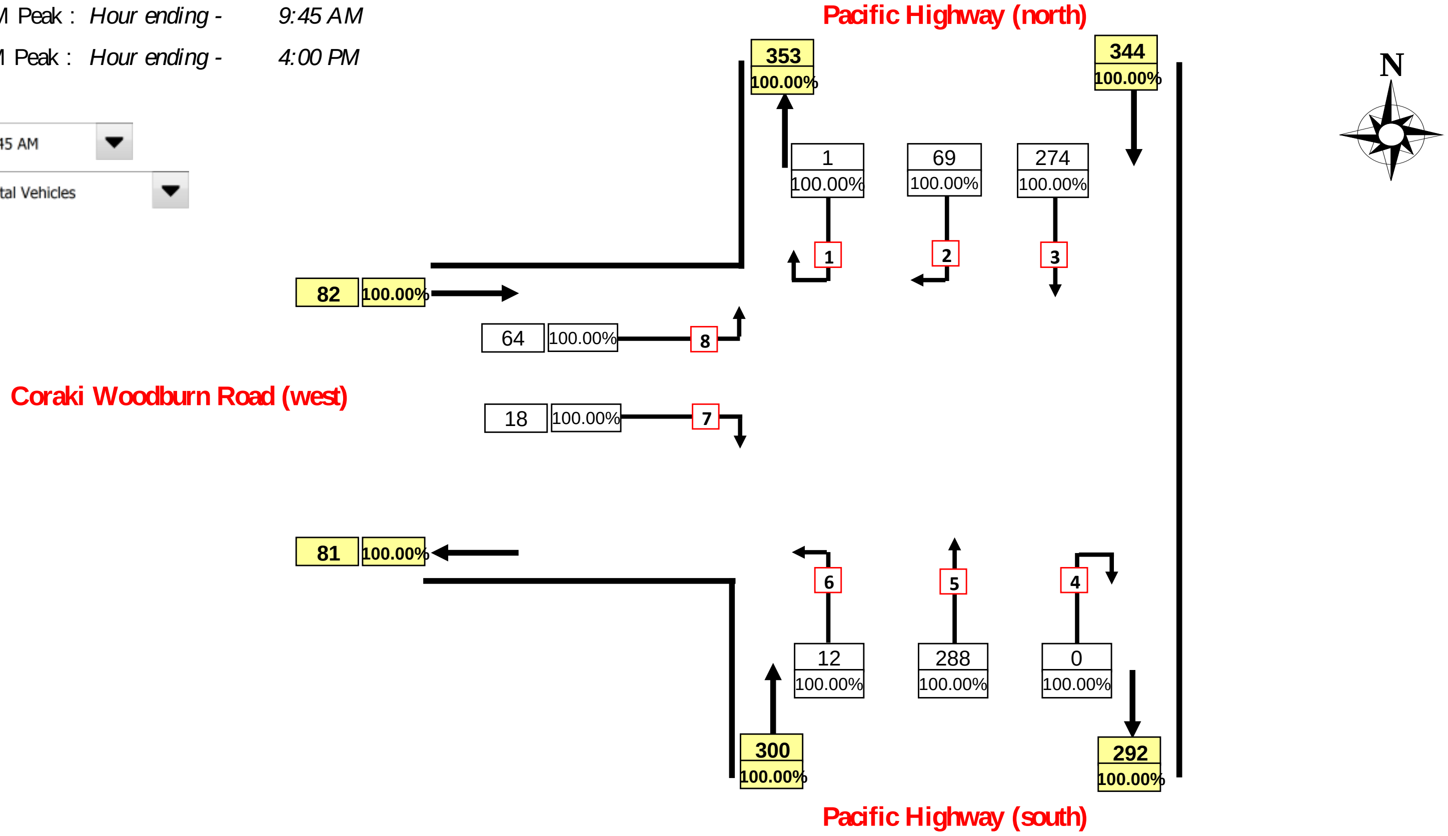
Day/Date: Thursday, 21 May 2015

Summary: AM Peak : *Hour ending - 9:45 AM*

PM Peak : *Hour ending - 4:00 PM*

Hour Ending: 9:45 AM

Classification: Total Vehicles



Note: 3.28% = proportion of selected vehicle classification as a percentage of total vehicles

AUSTRAFFIC VIDEO INTERSECTION COUNT

Site No.: 3 **Weather:** Showers

Location: Coraki Woodburn Road/Pacific Highway, Coraki

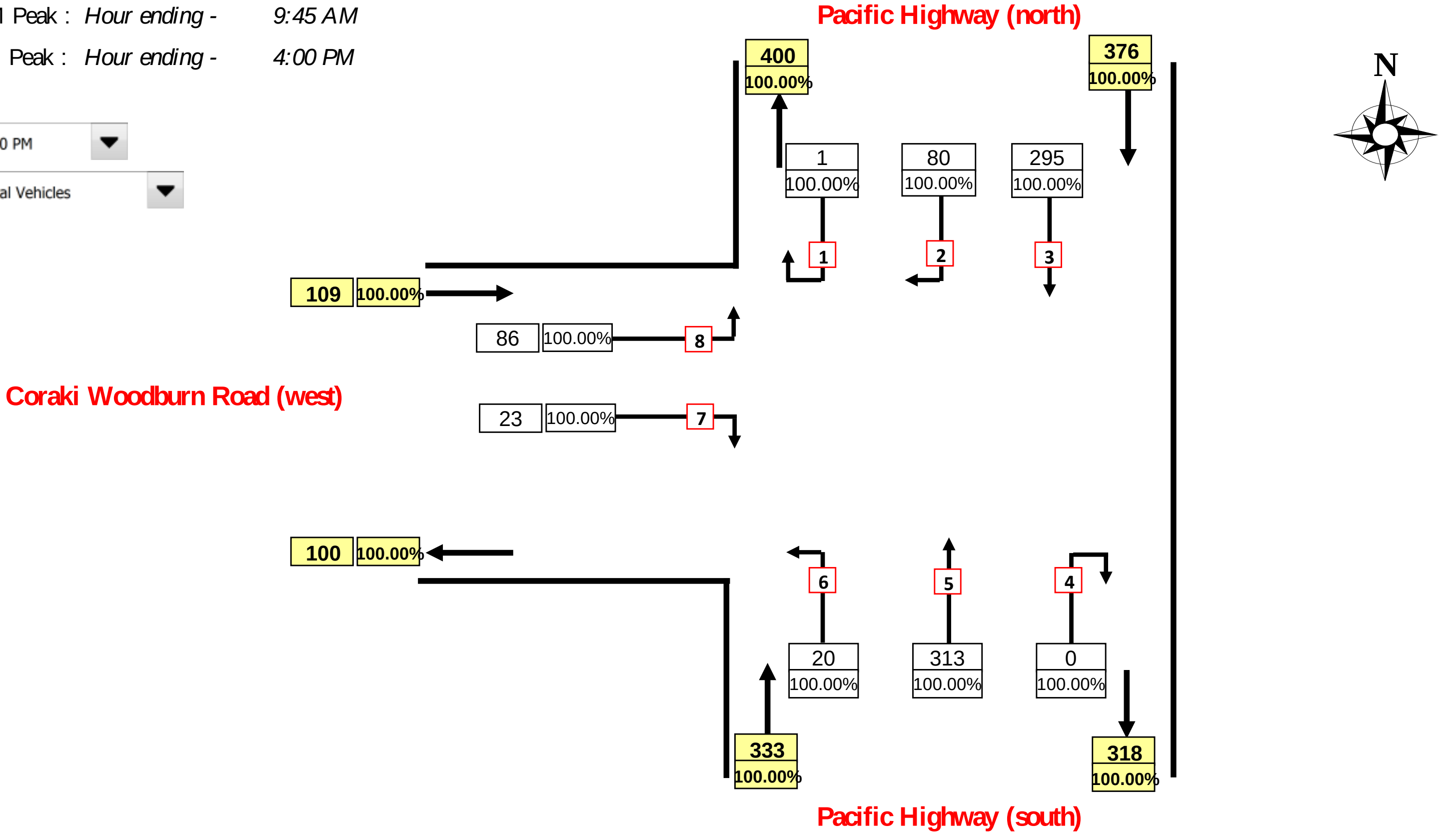
Day/Date: Thursday, 21 May 2015

Summary: AM Peak : *Hour ending - 9:45 AM*

PM Peak : *Hour ending - 4:00 PM*

Hour Ending: 4:00 PM ▼

Classification: Total Vehicles ▼



Note: 3.28% = proportion of selected vehicle classification as a percentage of total vehicles

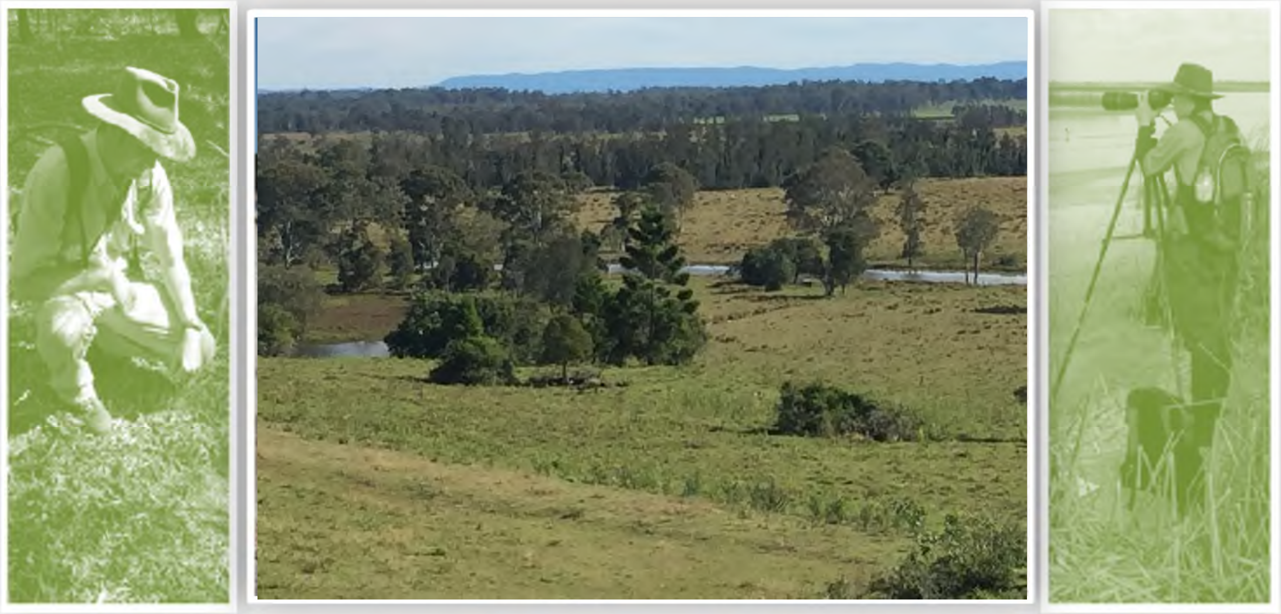
Attachment 5

Biodiversity Assessment Report

BIODIVERSITY ASSESSMENT REPORT

CORAKI QUARRY, CORAKI, NSW

Prepared for
Groundwork Plus on behalf of Quarry Solutions Pty Ltd



Biodiversity Assessment and Management Pty Ltd
PO Box 1376
CLEVELAND 4163
October 2015

BAAM
ECOLOGICAL CONSULTANTS

Specialised ecological knowledge that reduces your risk

Document Control Sheet

File Number: 0049-074

Project Manager/s: Jedd Appleton

Client: Groundwork Plus on behalf of Quarry Solutions Pty Ltd

Project Title: Biodiversity Assessment Report: Coraki Quarry, Seelems Road, Coraki, NSW

Project Author/s: Adrian Caneris, David Fell and Jedd Appleton

Project Summary: Assessment of terrestrial ecological values and potential impacts of a proposed extractive industry at Coraki in northern NSW in accordance with the Framework for Biodiversity Assessment, for informing a development application and EIS for the project.

Draft Preparation History:

Draft No.	Date draft completed	Reviewed by	Issued by
0049-074 Draft A	21/8/15	David Fell and Dr Penn Lloyd	Jedd Appleton

Revision/ Checking History Track:

Version	Date of Issue	Checked by	Issued by
0049-074 Version 0	02/09/15	Jedd Appleton	Jedd Appleton
0049-074 Version 1	30/10/15	Jedd Appleton	Jedd Appleton

Document Distribution:

Destination	Revision							
	1	Date Dispatched	2	Date Dispatched	3	Date Dispatched	4	Date Dispatched
Client Copy 1 - digital	A	21/8/15	0	02/09/15	1	23/10/2015		
Client Copy 1- hard copy								
PDF - server	A	21/8/15	0	02/09/15	1	23/10/2015		
PDF – backup – archived Disk/tape	A	21/8/15	0	02/09/15	1	23/10/2015		
Hard Copy -library								

NOTICE TO USERS OF THIS REPORT

Copyright and reproduction

This report and all indexes, schedules, annexures or appendices are subject to copyright pursuant to the Copyright Act 1968 (Cth). Subject to statutory defences, no party may reproduce, publish, adapt or communicate to the public, in whole or in part, the content of this report without the express written consent of Biodiversity Assessment and Management Pty Ltd.

Purpose of Report

Biodiversity Assessment and Management Pty Ltd has produced this report in its capacity as {consultants} for and on the request of Groundwork Plus on behalf of Quarry Solutions Pty Ltd (the "Client") for the sole purpose of providing a Biodiversity Assessment Report for the proposed Coraki Quarry site (the "Specified Purpose"). This information and any recommendations in this report are particular to the Specified Purpose and are based on facts, matters and circumstances particular to the subject matter of the report and the Specified Purpose at the time of production. This report is not to be used, nor is it suitable, for any purpose other than the Specified Purpose. Biodiversity Assessment and Management Pty Ltd disclaims all liability for any loss and/or damage whatsoever arising either directly or indirectly as a result of any application, use or reliance upon the report for any purpose other than the Specified Purpose.

This report has been produced solely for the benefit of the Client. Biodiversity Assessment and Management Pty Ltd does not accept that a duty of care is owed to any party other than the Client. This report is not to be used by any third party other than as authorised in writing by Biodiversity Assessment and Management Pty Ltd and any such use shall continue to be limited to the Specified Purpose. Further, Biodiversity Assessment and Management Pty Ltd does not make any warranty, express or implied, or assume any legal liability or responsibility for any third party's use in whole or in part of the report or application or use of any other information or process disclosed in this report and to the full extent allowed by law excludes liability in contract, tort or otherwise, for any loss or damage sustained by any person or body corporate arising from or in connection with the supply or use of the whole part of the report through any cause whatsoever.

Biodiversity Assessment and Management Pty Ltd has used information provided to it by the Client and governmental registers, databases, departments and agencies in the preparation of this report. Biodiversity Assessment and Management Pty Ltd does not know, nor does it have any reason to suspect, that the information provided to it was false, inaccurate, incomplete or misleading at the time of its receipt. This report is supplied on the basis that while Biodiversity Assessment and Management Pty Ltd believes all the information in it is deemed reliable at the time of publication, it does not warrant its accuracy or completeness and to the full extent allowed by law excludes liability in contract, tort or otherwise, for any loss or damage sustained by any person or body corporate arising from or in connection with the supply or use of the whole or any part of the information in this report through any cause whatsoever.

Signed on behalf of Date: 30/10/2015

Biodiversity Assessment and Management Pty Ltd

Director

EXECUTIVE SUMMARY

Purpose of the report

This report has been prepared for Groundwork Plus on behalf of Quarry Solutions Pty Ltd to document an assessment of the biodiversity values in and around the proposed development footprint for an Extractive Industry at Seelems Road, Coraki. The purpose of the report is to inform decision making regarding the avoidance and mitigation of impacts on significant biodiversity values resulting from the project.

Study approach

A preliminary assessment of ecological values on the proposed development site concluded that the area of the proposed development footprint was unlikely to hold any notable value for flora or fauna species of significance and, therefore, the requirements for biodiversity offsets under the BioBanking process was also unlikely. Consequently, the NSW Office of Environment and Heritage confirmed that the Framework for Biodiversity Assessment would not need to be used to assess the biodiversity values and associated impacts, subject to the results of further investigations. DPI NSW also confirmed there are no fisheries issues and no aspects of the works trigger the need for any approvals under the NSW *Fisheries Management Act 1994*, provided the nearby wetland was not impacted.

The biodiversity values of the study area were assessed through a desktop review of available information together with a field survey conducted by two ecologists over one day. The survey primarily involved the assessment of all native vegetation, habitats and other landscape features on and adjacent to the proposed site development footprint for informing subsequent mapping and value assessments, and determining the need for any further assessment for threatened species. Given the small size of the site, all vegetation communities, habitats and flora species were able to be assessed and accounted for during the survey.

Landscape features

The study area occurs entirely within the Clarence Lowlands subregion of the South Eastern Queensland - Clarence Lowlands Bioregion, and includes the Lamington Volcanic Slopes, Grafton-Whiporie Basin and Clarence-Richmond Alluvial Plains Mitchell Landscapes.

Seelems Creek meanders across the western portion of the study area as a series of ox-bow wetlands, none of which are recognised as “important” wetlands. Wetlands also occur to the east and north-east of the study area, known locally as Kennedy’s Swamp. No state or regionally significant biodiversity links are recognised as occurring within the study area, although vegetation associated with Seelems Creek may act as a local biodiversity link.

Vegetation communities

Native vegetation recorded during the field survey was restricted to the western and central portions of the study area, as well as to the north-east. The ground-truthed extent was found to match that shown in aerial imagery for the site, which confirms that the proposed development footprint is largely devoid of native vegetation and has been used for grazing livestock and existing quarrying operations.

The field survey identified four native vegetation types within or in close proximity to the study area, all of which are recognised as Endangered Ecological Communities (EECs):

- Hoop Pine - Yellow Tulipwood dry rainforest of the North Coast – a component of the “Lowland Rainforest in the NSW North Coast and Sydney Basin Bioregions” EEC. Found to be in moderate condition.

- Forest Red Gum - Swamp Box of the Clarence Valley lowlands of the North Coast – a component of the “Sub-tropical Coastal Floodplain Forest of the NSW North Coast bioregion” EEC. Found to be in moderate condition.
- Paperbark swamp forest of the coastal lowlands of the North Coast – a component of the “Swamp sclerophyll forest on coastal floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions” EEC. Found to be in moderate condition.
- Coastal freshwater meadows and forblands of lagoons and wetlands – a component of the “Freshwater wetlands on coastal floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions” EEC. Found to be in good condition.

These native vegetation communities all occur outside of the proposed development footprint. None of the vegetation on the study area is recognised as a Threatened Ecological Community under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

Other native vegetation recorded onsite occurs as scattered paddock trees, planted amenity screens alongside access tracks, or as minor components within otherwise heavily disturbed and exotic-dominated patches of regrowth. Camphor Laurel (*Cinnamomum camphora*) and Lantana (*Lantana camara*) are dominant features of the latter.

Threatened species

Four specimens of *Macadamia tetraphylla* (Rough-shelled Bush Nut) were recorded during the field survey, a species currently listed as Vulnerable under both the New South Wales *Threatened Species Conservation Act 1995* (TSC Act) and EPBC Act. The specimens occur together, adjacent to a clump of other scattered, paddock trees and outside of any of the recognised native vegetation zones on the study area. These plants are either relicts of a dry rainforest or forested wetland community that once occupied that part of the site, or they have propagated from seeds dispersed from nearby communities.

No other threatened flora species were recorded during the field survey, despite targeted searching within all habitat types (including comprehensive searches within the proposed development footprint), and despite the majority of species being detectable throughout the year.

Forest Red Gums (*Eucalyptus tereticornis*) within the open forest habitat to the north-east of the study area showed scratches consistent with those of Koala (*Phascolarctos cinereus*) (Vulnerable: TSC Act and EPBC Act). No evidence of Koala occurrence was found within the study area, and although it is possible this species may also occasionally utilise food trees occurring within the open paddock and fringing the wetlands, these areas are considered to be of less value to the species than the habitats occurring off-site.

In addition to Koala, a number of threatened fauna species have the potential to occur within the habitats present within the study area, at least as transient visitors during foraging (particularly birds and bats). Black-necked Stork (*Ephippiorhynchus asiaticus*) (Endangered: TSC) and Comb-crested Jacana (*Irediparra gallinacea*) (Vulnerable: TSC Act) are also known to occur on the site from previous records, and the study area continues to provide suitable habitat for these species.

The degraded habitats present within the area of the proposed development footprint provide very limited habitat value for threatened fauna species.

Matters of local significance

The results of the field survey generally support the Richmond Valley Council’s Local Environmental Plan mapping of relative biodiversity importance in that the far western and central parts of the study area and areas to the north-east contain native vegetation and associated habitat values for native fauna, including species of conservation significance. The results of the field survey also generally support the Koala Habitat Atlas mapping in that the vegetation in the north-east offers the highest value Koala habitat, with less valuable potential habitat occurring on the fringes of the wetlands.

Potential impacts

Clearing and grubbing activities during the construction and operational phases of the development primarily will reduce the overall amount of habitat and populations of flora and fauna, and has the potential to result in isolation of habitats and populations, changes to remaining vegetation that cause the loss of food and shelter resources for fauna, and exposure to introduced species that are either competitors or predators. Removal of vegetation will also result in direct loss of individual plants, including large trees that may provide nesting resources to fauna, and can result in the mortality of fauna present at the time of clearing. Secondary impacts can also affect peripheral vegetation through soil disturbance/exposure and altered water flow patterns, edge effects, and excessive dust.

The construction and operation phases have the potential to result in on-going disturbance to surrounding habitats due to noise, dust and vibration. An increase in heavy and light vehicle traffic could contribute to increased animal/vehicle collisions on local roads, and reptiles and small mammals may become trapped in any trenches or other excavations that remain open for any period of time. Vehicles also have the potential to introduce and/or spread weed species and plant pathogens in disturbed soil, while general waste and land disturbance has the potential to attract highly competitive and/or predatory exotic fauna species. Fuels and chemical spills from storage areas and oils from heavy machinery can enter the environment, affecting habitats where the spill occurs, and potentially causing more widespread impact if contaminants reach waterways.

Impact management

The proposed site development footprint has been positioned to avoid the clearing and fragmentation of the relatively large, well-connected tracts of vegetation and associated habitat within the study area, and avoids all patches of vegetation recognised as native vegetation communities that have greatest value to the majority of known or potentially occurring terrestrial flora and fauna species. No EECs, wetlands or important habitat for threatened flora and fauna species will be directly impacted. Buffers will be retained between the recognised vegetation communities (and associated EECs and wetlands) and the edge of the proposed site disturbance footprint to further prevent secondary impacts.

In response to the survey results, the original footprint was redesigned to avoid the clearing of four *Macadamia tetraphylla* specimens, with a 25 m buffer to be established and maintained around the plants. This development design, along with further management actions proposed to avoid and mitigate impacts to these plants, suggests any impacts are highly unlikely to be significant.

Implementation of a number of other mitigation measures is also recommended to reduce impacts on native flora and fauna to levels that will not cause significant or permanent harm. This includes the development and implementation of an Environmental Management Plan that includes components to reduce secondary impacts on terrestrial flora, fauna and ecosystems.

Overall, the Project is not expected to result in the direct loss of any significant biodiversity values and, once the proposed mitigation measures are implemented, the remaining impacts of the Project on terrestrial ecological values are predicted to be minor or negligible, particularly in the context of existing site conditions and current impacts from previous land clearing, weed invasion and the presence of livestock. Hence offsets to compensate for residual impacts are assessed to be unnecessary, and a referral to the Commonwealth in relation to impacts on species listed under the EPBC Act is not considered necessary at this time.

BIODIVERSITY ASSESSMENT REPORT

CORAKI QUARRY, SEELEMS ROAD, CORAKI, NSW

Table of Contents

Table of Figures

Table of Appendices

Appendix 1: Results of preliminary ecological investigation for Coraki Quarry

Appendix 2: Correspondence from EOH and Primary Industries NSW confirming required level of assessment

Appendix 3: Vegetation survey data

Appendix 4: Vegetation condition (site value) scores

Appendix 5: Database searches

Appendix 6: Flora species list from field survey

Appendix 7: Fauna species list from field survey

Table of Terms and Abbreviations

AKF	Australian Koala Foundation
BAAM	Biodiversity Assessment and Management Pty Ltd
BAR	Biodiversity Assessment Report
DoE	Commonwealth Department of Environment
DPI	New South Wales Department of Primary Industries
EEC	Endangered Ecological Community
EIS	Environmental Impact Statement
EMP	Environmental Management Plan
EPBC Act	Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*
FBA	Framework for Biodiversity Assessment
LEP	Local Environmental Plan
MNES	Matter of National Environmental Significance
NSW	New South Wales
OEH	New South Wales Office of Environment and Heritage
SEARs	Secretary's Environmental Assessment Requirements
TEC	Threatened Ecological Community
TSC Act	New South Wales *Threatened Species Conservation Act 1995*

1.0 INTRODUCTION

1.1 BACKGROUND

Quarry Solutions Pty Ltd has commissioned the preparation of a development application for an Extractive Industry at Seelems Road (via Petersons Quarry Road), Coraki in New South Wales on land properly described as Lot 401 on DP633427, Lot 402 on DP802985, Lot 403 on DP802985, Lot 408 on DP1166287, Lot A on DP397946, Lot A on DP389418, Lot 3 on DP701197, Lot 2 on DP954593, Lot 1 on DP954592 and Lot 1 on DP310757. A Site Map and Location Map are provided as **Figures 1-1 and 1-2**, respectively.

As the project is considered a State Significant Development, the proponent must prepare an Environmental Impact Statement (EIS) as part of an application under the NSW *Environmental Planning and Assessment Act 1979*. Before preparing an EIS, proponents must also apply to the Secretary of the Department of Planning and Environment for the Secretary's Environmental Assessment Requirements (SEARs), which set out matters to be addressed in the EIS.

Under the NSW Biodiversity Offsets Policy for Major Projects, the SEARs typically require a proponent to apply the Framework for Biodiversity Assessment (FBA) to assess impacts on biodiversity. Stages 1 and 2 of the FBA require the preparation of a Biodiversity Assessment Report (BAR) describing the biodiversity values present on the development site and the impact of the project on these values. A Biodiversity Offset Strategy is then prepared that outlines how the proponent intends to offset the impacts of the project.

The SEARs received for the project identified biodiversity as one of the key issues to be addressed, having regard to the requirements of the NSW Office of Environment and Heritage (OEH) and Primary Industries NSW (DPI) specified in the SEARs. In particular, OEH's requirements included addressing and documenting biodiversity impacts in accordance with the FBA, unless otherwise agreed by OEH.

A preliminary assessment of ecological values on the site, including a brief desktop review and field investigation, was completed by BAAM on 22 April 2015, prior to the release of the SEARs (refer **Appendix 1**). The primary issues derived from the desktop review were the potential presence of Hairy-joint Grass (*Arthraxon hispidus*), currently listed as Vulnerable under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act), within the area of the proposed development footprint, including/particularly within cleared areas, and the Lowland Rainforests of Subtropical Australia Threatened Ecological Community (Critically Endangered – EPBC Act) in association with drainage lines on the study area. The preliminary site investigation revealed neither of these occurs within the area of the proposed development footprint, and the site is largely devoid of native vegetation and had been used for grazing livestock, particularly within the area nominated for the main quarry pit. However, it was considered prudent for quarry designs to establish sufficient buffers to nearby wetlands and native vegetation, pending the results of further investigations.

It was concluded the site of the area of the proposed development footprint was unlikely to hold any notable value for flora or fauna species of significance and, therefore, a requirement for biodiversity offsets under the BioBanking process was also unlikely. Consequently, following a review of the results of the preliminary assessment, correspondence received from OEH confirmed that, due to the degraded state of the site, OEH would not require the FBA to be used to assess the biodiversity values and associated impacts, subject to the results of further investigations (**Appendix 2**).

Correspondence received from DPI also confirmed that, given the location of the site in the landscape and the fact that no dredging, works within a waterway, impacts or damage to marine vegetation, placement of spoil in waterways, activities that block fish passage or impacts to fishing and aquaculture were anticipated, there are no fisheries issues and no aspects of the works trigger the need for any approvals under the NSW *Fisheries Management Act 1994*, provided the nearby wetland was not impacted by the proposal (**Appendix 2**).

The SEARs also state it should be established whether the project requires a separate approval under the EPBC Act, while Richmond Valley Council also identified biodiversity values of local significance requiring assessment as part of the SEARs.

Notes:

Data Source: Image from ArcGIS Online Bing Maps data (c) 2010 Microsoft Corporation and its data suppliers. Regional Ecosystems V7 and RE Waterways sourced from QLD Government 2012.

LEGEND

- Site Boundary
- Inner assessment circle (200 Ha)
- 🟩 Ground-truthed native vegetation communities
- 🟥 Other ground-truthed vegetation
- ▨ Ground-truthed local wetlands
- 20m Buffer around wetlands
- Protected Macadamia trees and 25m buffer area
- Indigenous heritage non-disturbance zone
- ♦ Previously recorded Black-Necked Stork nest
- ★ Wedge-tailed Eagle nest
- Mitchell Landscapes v3

Development site footprint

- Development site footprint
- Processing plant area
- Stormwater detention basin
- Traffic on road
- Traffic off road
- Stockpile area
- Extraction area
- Cadastre

0 50 100 200 300 400
Meters

1:8,075 at A3

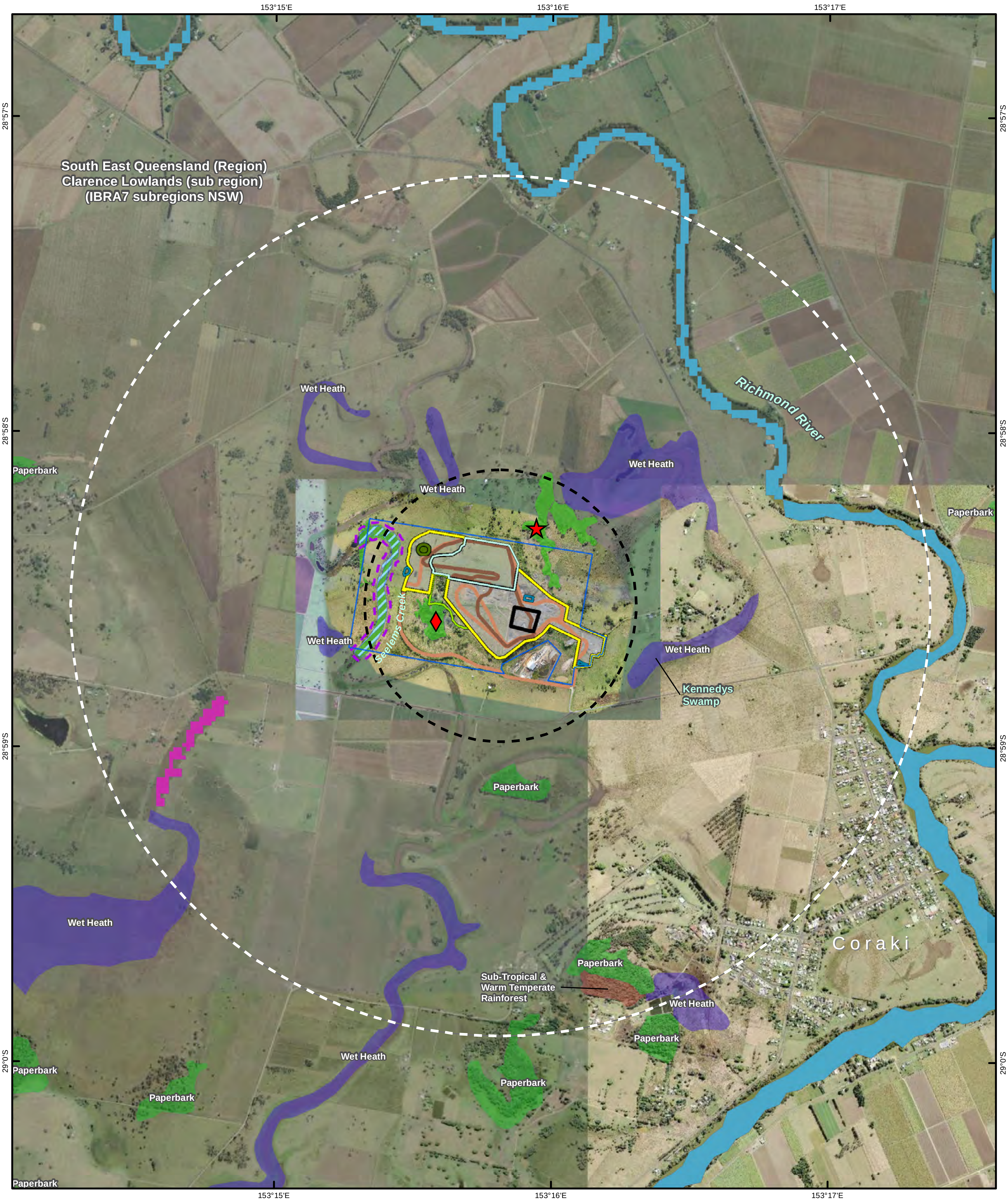
Coordinate System: GDA 1994 MGA Zone 56
Projection: Transverse Mercator
Datum: GDA 1994
False Easting: 500,000.0000
False Northing: 10,000,000.0000
Central Meridian: 153.0000
Scale Factor: 0.9996
Latitude Of Origin: 0.0000
Units: Meter

Drawn By: MG Reviewed by: AC Date: 31/08/2015

Figure:	1.1
Title:	Site Map
Project:	Biodiversity Assessment Report - Coraki Quarry, Seelems Road, Coraki
Client:	Groundwork Plus on behalf of Quarry Solutions Pty Ltd

BAAM
ECOLOGICAL CONSULTANTS

Document Location: D:\GIS\Jobs\0049-074 Coraki Quarry\GIS\MXDs\ReportMaps\Figure 1-1 Site Map.mxdDate: 31/08/2015 12:03:27 PM



Coordinate System: GDA 1994 MGA Zone 56
Projection: Transverse Mercator
Datum: GDA 1994
False Easting: 500,000.0000
False Northing: 10,000,000.0000
Central Meridian: 153.0000
Scale Factor: 0.9996
Latitude Of Origin: 0.0000
Units: Meter

1:22,000 at A3
0 0.1 0.2 0.4 0.6 0.8 Kilometers

LEGEND

- ▭ Site Boundary
- ▭ Outer assessment circle (2000 Ha)
- ▭ Inner assessment circle (200 Ha)
- ▬ Indigenous heritage non-disturbance zone
- ▬ Protected Macadamia trees and 25m buffer area

NSW Wetlands 2006

- 🟦 Estuarine Wetland
- 🟪 Floodplain Wetland

Northern Rivers CMA VISmap 524

- 🟩 Paperbark
- 🟦 River Oak
- 🟥 Sub-Tropical & Warm Temperate Rainforest
- 🟪 Wet Heath

- 🟩 Ground-truthed native vegetation communities
- ▨ Ground-truthed local wetlands
- ▭ 20m Buffer around wetlands
- ◆ Previously recorded Black-Necked Stork nest
- ★ Wedge-tailed Eagle nest

Development site footprint

- ▭ Development site footprint
- ▬ Processing plant area
- ▬ Stormwater detention basin
- ▬ Extraction area
- ▭ Stockpile area
- ▬ Traffic off road
- ▬ Traffic on road

Figure:	**1-2**
Title:	Site and Surrounding Area
Project:	Biodiversity Assessment Report - Coraki Quarry, Seelems Road, Coraki
Client:	Groundwork Plus on behalf of Quarry Solutions Pty Ltd

BAAM
ECOLOGICAL CONSULTANTS

Drawn By: MG Reviewed by: AC Date: 31/08/2015

Document Location: D:\GIS\Jobs\0049-074 Coraki Quarry\GIS\MXDs\ReportMaps\Figure 1-2 Site map smaller scaleA3 Portrait.mxdDate: 31/08/2015 11:59:48 AM

1.2 PURPOSE AND FORMAT OF THIS REPORT

Biodiversity Assessment and Management Pty Ltd (BAAM) has prepared this report for Groundwork Plus on behalf of Quarry Solutions Pty Ltd to document an assessment of the biodiversity values in and around the proposed development footprint (the "study area") to inform decision making regarding the avoidance and mitigation of impacts of the project on significant biodiversity values.

Although OEH has confirmed the FBA does not need to be used to assess the biodiversity values of the study area and impacts of the project (subject to the results of further investigations), this report follows the methods and reporting format outlined in the FBA where possible and appropriate to ensure sufficient information is available to regulating authorities. Accordingly, the following is provided:

- A description of the methodology used for the assessment, including desktop and field-based research.
- A description and mapping of existing biodiversity values present on the site and in the surrounding area, including landscape features, native vegetation and threatened species.
- A description of matters of national environmental significance (MNES) known or predicted to occur on the site.
- A description of biodiversity values recognised under local statutes.
- A discussion of potential impacts to the identified values and recommendations for their avoidance or mitigation, as required.
- Confirmation of whether any further assessment is required to meet the requirements for the EIS.

2.0 METHODOLOGY

The biodiversity values of the study area were assessed through a desktop review of available information together with a field survey conducted by two ecologists over one day.

2.1 DESKTOP REVIEW

The desktop review involved an inspection of publicly available databases and mapping, and other information, including:

- The Commonwealth Department of the Environment (DoE) EPBC Online Protected Matters Search Tool (10 km x 10 km search area centred on the site);
- The NSW BioNet Atlas of NSW Wildlife and associated species profiles (10 km x 10 km search area centred in the site);
- Publically available spatial data for the mapping of IBRA Bioregions, Mitchell Landscapes, wetlands and waterways, and native vegetation.
- Richmond Valley Council environmental planning layers and Koala (*Phascolarctos cinereus*) habitat mapping; and
- Aerial photography and background information on the project and the results of previous studies undertaken in support of proposed extensions to the adjacent Peterson's Quarry, as provided by the Proponent or otherwise publically available.

2.2 FIELD SURVEY

The field survey was conducted on 2 July 2015 by Adrian Caneris (Principal Wildlife Expert) and David Fell (Principal Botanist), following a preliminary site investigation undertaken by Dr Lindsay Popple (Senior Ecologist) on 22 April 2015 (**Appendix 1**). Data from the Bureau of Meteorology indicates conditions were mild (maximum of 24^0C) with minimal rainfall (2.2mm) during the preliminary site investigation, with moderate rainfall during the preceding month (138mm). Conditions during the survey on 2 July were cool-mild (maximum of 20^0C) and dry, with limited rainfall during the preceding month (37mm). All survey work was performed in accordance with BAAM's NSW Scientific Licence (SL100704) and Certificate of Accreditation as an Animal Research Establishment.

The survey primarily involved the assessment of all native vegetation, habitats and other landscape features on and adjacent to the proposed site development footprint (subject to access) for informing subsequent mapping and value assessments, and determining the need for any further assessment for threatened species. The field work focused on assessing vegetation and habitats within and directly adjacent to Lot 401 on DP633427, given proposed development within the other Lots included in the application are restricted to previously disturbed areas associated with Petersons Quarry.

The flora survey generally followed the methods outlined in the FBA, and included plot and transect surveys for the assessment of native vegetation. Targeted searches for threatened flora species were also undertaken across the site throughout the survey period. The location of survey locations is shown on **Figure 3-1**.

Given the small size of the site, all vegetation communities, habitats and detectable flora species were able to be assessed and accounted for during the survey. As the time of year for the survey (winter) is outside the most suitable time for detecting many of the threatened fauna species potentially occurring in the vicinity of the site, the fauna survey component focused on the availability and quality of habitats present, combined with active searching for fauna signs (e.g. Koala scratches and scats) and opportunistic species records.

The locations of any significant values were recorded by GPS for subsequent mapping purposes.

While it is acknowledged that the time of year and conditions during which the primary survey was undertaken (i.e. winter, with limited rainfall) may fall outside the ideal time of the year to survey for one or more target species, the likelihood of their occurrence is able to be assessed through integration of the following sources of information:

- Review of the published literature pertaining to the known distributions, habitat requirements and detectability of the species; and
- Onsite habitat assessment results and professional experience.

The likelihood of occurrence assessment used the following four categories to determine the probability of conservation significant flora and fauna species occurring in the habitats available within the study area:

- **Known to occur**: the species was detected during field assessment, or is known from past surveys in the study area and is not now considered locally extinct.
- **Likely to occur**: a medium-high probability the species occurs in or regularly visits the study area because suitable habitat occurs, the study area is within the known distribution of the species, there are past records of the species in the vicinity of the study area, and the species is not considered locally extinct.
- **Potential to occur**: either: (a) there are no past records of the species in the vicinity of the study area but suitable habitat occurs and there is insufficient information on the distribution of the species (e.g. it is naturally rare and/or difficult to detect) to categorise the species as likely or unlikely to occur; or (b) there are past records of the species in the vicinity of the study area but habitat in the study area is marginal or spatially limited meaning that the species' presence on the study area would be transitory at best.
- **Unlikely to occur**: a very low probability that the species occurs in the study area because: (a) suitable habitat does not occur; or (b) the study area is outside the known distribution of the species; or (c) the species is considered locally extinct; or (d) there are no records of the species in the local region despite adequate survey effort; or (e) suitable habitat occurs, the study area is within the known distribution of the species and there are past records of the species in the vicinity of the study area but the species has not been observed despite sufficient spatial and temporal survey effort for detecting the species.Based on the above, where the likelihood of a species' occurrence is inconclusive, the species is typically assessed as having potential to occur and is subsequently considered in the assessment of potential impacts. This includes species for which the time of year the survey is undertaken is generally not suitable for detection.

2.3 DATA ANALYSIS AND REPORTING

Analysis of data obtained from the desktop review and field survey followed the methods outlined in the FBA, subject to the availability of associated resources. For example, as no member of the study team is currently an accredited BioBanking Assessor, access could not be gained to the BioBanking Credit Calculator for the purposes of the threatened species assessment. Instead, publically available information was used to supplement information gained from the field survey and the existing knowledge of the study team for the purposes of assessing the occurrence of biodiversity values and potential impacts from the project.

3.0 EXISTING ENVIRONMENT

3.1 LANDSCAPE FEATURES

Landscape features of the site and surrounds are shown on **Figures 1-1 and 1-2**. Given the small size of the development site, the assessment has adopted an inner assessment circle of 100 ha and an outer assessment circle of 1,000 ha.

3.1.1 IBRA Bioregion and Subregion

The study area occurs entirely within the Clarence Lowlands subregion of the South Eastern Queensland - Clarence Lowlands Bioregion (DoE 2015).

3.1.2 NSW Landscape Regions

The study area includes the following Mitchell Landscapes, as shown on **Figures 1-1 and 1-2** (OEH 2015a):

- Lamington Volcanic Slopes.
- Grafton-Whiporie Basin.
- Clarence-Richmond Alluvial Plains.

3.1.3 Waterways and Wetlands

Seelems Creek meanders across the western portion of the study area as a series of ox-bow wetlands, none of which are recognised as "important" wetlands. Information provided by Groundwork Plus indicates the nearest SEPP 14 coastal wetland is approximately 9 km to the east of the study area.

The wetlands in the study area would be considered local wetlands, with an applicable riparian corridor width of 20 m (**Figure 1-1**). Wetlands known as Kennedy's Swamp occur to the east and north-east of the study area (**Figure 1-2**) (OEH 2015b).

3.1.4 Native Vegetation Extent

The extent of native vegetation recorded during the field survey is shown on **Figure 1-1**, while the extent of currently mapped native vegetation in the broader region (based on OEH [2015c]) is shown on **Figure 1-2**.

Native vegetation recorded during the field survey was generally restricted to the western portions of Lot 401 on DP633427 and Lot 403 on DP802985, and along the boundary of Lots 402 and Lot 403 on DP802985, as well as to the north-east of the study area (**Figure 1-1)**. Further details on this ground-truthed vegetation are provided in **Section 3.2**.

Native vegetation currently recognised in the broader area includes that described as "wet heath" in patches to the north-west, north-east, east and south-west of the study area, while a patch of "paperbark" is mapped to the south (**Figure 1-2**).

3.1.5 Biodiversity Links

No state or regionally significant biodiversity links are recognised as occurring within the study area.

Vegetation associated with Seelems Creek may act as a local biodiversity link.

3.1.6 Other Landscape Features

Information provided by Groundwork Plus indicates a Black-necked Stork (*Ephippiorhynchus asiaticus*) once nested in a Hoop Pine located within the centre of the vegetation community occurring along the boundary of Lots 402 and Lot 403 on DP802985 (refer **Figure 1-1**). The results of an assessment of this previously identified landscape feature based on the current field survey are discussed in **Section 3.5.3**.

The July 2015 survey recorded an active Wedge-tailed Eagle (*Aquila audax*) nest in the north-eastern part of the site (**Photo 1**, **Figure 1-1**).

3.1.7 Landscape Value

No recognised native vegetation types or associated biodiversity links are proposed to be directly impacted by the project (refer to **Section 4.0**). As such, an assessment of current and future landscape values for the purposes of determining a change in landscape value is not considered necessary.

Photo 1: Wedge-tailed Eagle nest recorded during the July 2015 survey

3.2 NATIVE VEGETATION

Native vegetation types confirmed on the site during the field investigation are shown on **Figure 3-1**, along with areas identified as being dominated by exotic vegetation and/or cleared paddocks. The ground-truthed extent was found to match that shown in aerial imagery for the site, which confirms that the proposed development footprint is largely devoid of native vegetation and has been used for grazing livestock (**Photos 2** and **8-9**) and existing quarrying operations.

Photo 2: General view of proposed development footprint within Lot 1 on DP633427

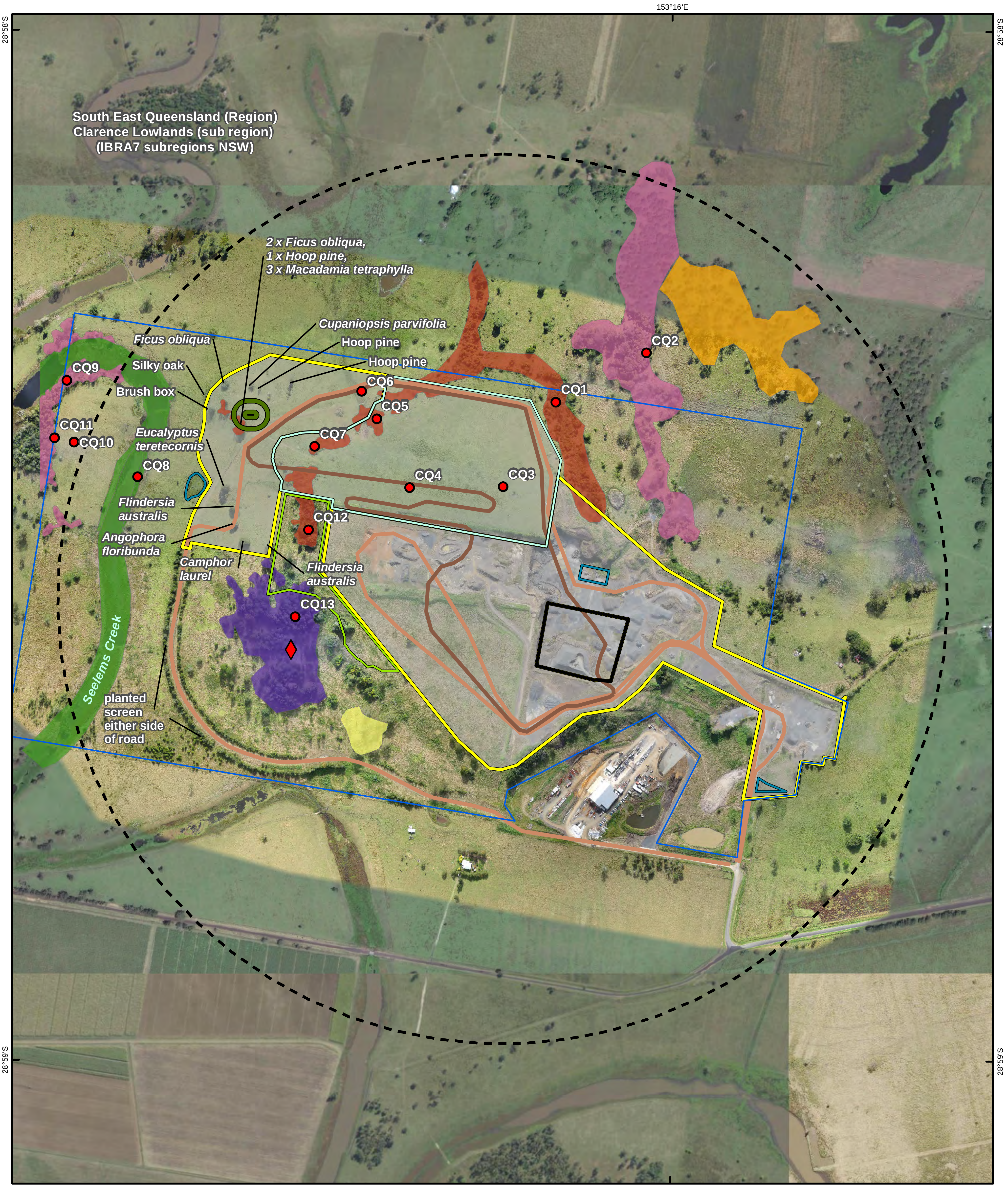
Native vegetation communities recorded during the survey are described in the following sections. Vegetation survey data are provided in **Appendix 3**.

3.2.1 Native Vegetation Types and Ecological Communities

The field survey identified four native vegetation types within or in close proximity to the study area, all of which are recognised as Endangered Ecological Communities (EECs):

- NR179: Hoop Pine - Yellow Tulipwood dry rainforest of the North Coast – a component of the “Dry Rainforests” vegetation class and “Lowland Rainforest in the NSW North Coast and Sydney Basin Bioregions” EEC (survey site CQ13 on **Figure 3-1**).
- NR161: Forest Red Gum - Swamp Box of the Clarence Valley lowlands of the North Coast – a component of the “Coastal Valley Grassy Woodlands” vegetation class and “Sub-tropical Coastal Floodplain Forest of the NSW North Coast bioregion” EEC (survey site CQ2).
- NR217: Paperbark swamp forest of the coastal lowlands of the North Coast – a component of the “Coastal Swamp Forests” vegetation class and “Swamp sclerophyll forest on coastal floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions” EEC (survey sites CQ9 and CQ11).
- NR150: Coastal freshwater meadows and forblands of lagoons and wetlands – a component of the “Coastal Freshwater Lagoons” vegetation class and “Freshwater wetlands on coastal floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions” EEC (survey site CQ8).

As shown on **Figure 3-1**, these native vegetation communities all occur outside of the proposed development footprint.



Coordinate System: GDA 1994 MGA Zone 56
Projection: Transverse Mercator
Datum: GDA 1994
False Easting: 500,000.0000
False Northing: 10,000,000.0000
Central Meridian: 153.0000
Scale Factor: 0.9996
Latitude Of Origin: 0.0000
Units: Meter

1:6,700 at A3
0 0.035 0.07 0.14 0.21 0.28 Kilometers

LEGEND

- ▭ Site Boundary
- ● Survey Locations
- ⬚ Inner assessment circle (200 Ha)
- ━ Indigenous heritage non-disturbance zone
- ◆ Previously recorded Black-Necked Stork nest
- ━ Protected Macadamia trees and 25m buffer area

Ground-truthed Vegetation:

- 🟩 Coastal freshwater meadows and forblands of lagoons and wetlands (Freshwater wetlands on coastal floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions EEC)
- 🟥 Heavily disturbed vegetation dominated by exotics
- 🟪 Hoop Pine - Yellow Tulipwood dry rainforest of the North Coast (Lowland Rainforest in the NSW North Coast and Sydney Basins Bioregions EEC)
- 🟪 Paperbark swamp forest of the coastal lowlands of the North Coast (Swamp sclerophyll forest on coastal floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions EEC)
- 🟧 Forest Red Gum - Swamp Box of the Clarence Valley lowlands of the North Coast (Sub-tropical Coastal Floodplain Forest of the NSW North Coast bioregion EEC)
- 🟨 *Eucalyptus tereticornis* woodland on basalt slopes (not formally assessed)

Development site footprint

- ⬜ Development site footprint
- ━ Processing plant area
- ━ Stormwater detention basin
- ━ Extraction area
- 🟨 Stockpile area
- ━ Traffic off road
- ━ Traffic on road

Figure:	**3-1**
Title:	Ground-truthed Vegetation Mapping
Project:	Biodiversity Assessment Report - Coraki Quarry, Seelems Road, Coraki
Client:	Groundwork Plus on behalf of Quarry Solutions Pty Ltd

BAAM
ECOLOGICAL CONSULTANTS

Drawn By: MG Reviewed by: AC Date: 31/08/2015

Document Location: D:\GIS\Jobs\0049-074 Coraki Quarry\GIS\MXDs\ReportMaps\Figure 3-1 Ground-truthed vegetation mapping v2.mxdDate: 31/08/2015 12:04:09 PM

Photo 3. Lantana dominated regrowth on steep basalt slopes.

Photo 4. Heavy infestation of Climbing Asparagus Fern and Lantana dominating regrowth on steep basalt slopes.

Photo 5. Regrowth shrubland with Camphor Laurel, Climbing Asparagus Fern and Lantana on steep basalt slopes.

Photo 6. Site CQ2. Open forest of Forest Red Gum, *Melaleuca styphelioides,* with *Pentaceras australis, Araucaria cunninghamii, Alphitonia excelsa, Mallotus phillipensis* and *Casuarina glauca.* Alluvial plain and margins on adjoining property. Representative of Sub-tropical Coastal Floodplain Forest of the NSW North Coast bioregion EEC.

Photo 7. View of Site CQ2 from western margin of alluvial plain and basalt foot slope. Swamp foxtail grasslands on margins represent potential habitat of Hairy-joint Grass. Targeted searches did not locate the species.

Photo 8. Site CQ3. Typical exotic dominated grassland of *Cynodon dactylon, Pennisetum clandestina, Senecio madagascarensis, Gomphocarpus physocarpus, Thesium vulgare,* and *Solanum mauritianum.*

Photo 9. Site CQ4. Grazed and disturbed spring seepage zone on basalt slope provides potential habitat for Hairy-joint Grass. Targeted searches did not record the species.

Photo 10. Dense thickets of Mysore Thorn (*Caesalpinea decapatala*).

Photo 11. Site CQ8. Degraded margins of freshwater wetland with *Persicaria strigosa, Leersia hexandra* and *Digitaria didactyla*. Margins provides potential habitat for Hairy-joint Grass, although targeted searches did not record the species. Representative of Freshwater Wetland on Coastal Floodplain EEC*.*

Photo 12. Degraded margins of freshwater wetland with senescent Melaleuca and infestation of Water Hyancinth. Representative of Freshwater Wetland on Coastal Floodplain EEC*.*

Photo 13. Degraded margins of freshwater wetland with scattered *Melaleuca quinquenervia.*

Photo 14. Open forest of Forest Red Gum, *Melaleuca quinquinervia, M. styphelioides, Callistemon salignus, Casuarina glauca* on alluvial floodplain adjoining to the east.

Photo 15. Eastern margin of open forest of Forest Red Gum, *Melaleuca quinquinervia, M. styphelioides, Callistemon salignus, Casuarina glauca* on alluvial floodplain.

Photo 16. Closed regrowth forest of Camphor Laurel* (dominant*),* with *Dysoxylum fraseranum, Mallotus phillipensis, Flindersia australis,* and *Cryptocarya triplinervis* on steep basalt slopes.

Photo 17. Site CQ13. Depauperate dry rainforest of Hoop Pine (*Araucaria cunninghamii*) with Camphor Laurel* on steep basalt slopes. Representative of Swamp sclerophyll forest on coastal floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions EEC.

3.2.2 Native Vegetation Condition

The native wetland community associated with Seelems Creek in the western portion of the study area was found to be heavily disturbed by cattle grazing and infested by Water Hyancinth (*Eichornia crassipes*) (**Photos 11-13**), with drainage impeded by a rocky stock crossing. Patches of the adjoining swamp forest were also found to be heavily disturbed by grazing, with numerous weed species in the mid-lower strata and ground layer.

The Hoop Pine dry rainforest community (**Photo 17**) is infested with exotic species on the margins, with Camphor Laurel (*Cinnamomum camphora*), privets (*Ligustrum* spp.), White Passion Flower (*Passiflora subpeltata*), Coral Berry (*Rivina humilis*) and Climbing Asparagus Fern (*Asparagus africanus*), and is relatively low in native species richness compared to other communities that are representative of the Lowland Rainforest EEC.

The paperbark swamp forest and Forest Red Gum open forest (**Photos 6-7** and **14-15**) to the north-east of the study area are subject to grazing, although retain a high proportion of native species and a number of valuable habitat trees.

Other native vegetation recorded onsite occurs as scattered paddock trees, planted amenity screens alongside access tracks, or as minor components within otherwise heavily disturbed and exotic-dominated patches of regrowth (**Figure 3-1, Appendix 3**). Camphor Laurel and Lantana (*Lantana camara*) are dominant features of the latter (**Photos 3-5** and **16**).

Appendix 4 provides the results of vegetation condition (site value) score calculations for each of the four identified native vegetation types, from applying the site attribute measurements recorded during the field survey (**Appendix 3**) and relevant benchmark data from the Vegetation Benchmarks Database to the site value formula specified in the FBA. The scores indicate that, despite current impacts from grazing and weed invasion, the Hoop Pine dry rainforest, paperbark swamp forest and Forest Red Gum open forest communities are currently in moderate condition (scoring between 50-65), while the wetland community is in relatively good condition (scoring 87.5).

3.3 THREATENED SPECIES

3.3.1 Threatened Flora

A search of the NSW BioNet Atlas of NSW Wildlife (10 km x 10 km search area centred in the site) returned a total of five flora species listed as threatened under the NSW *Threatened Species Conservation Act 1995* (TSC Act), including three species listed as Endangered and two species listed as Vulnerable (**Appendix 5**). Four of these species are also currently listed as threatened under the EPBC Act (two Endangered, two Vulnerable).

The Commonwealth EPBC Online Protected Matters Search Tool (10 km x 10 km search area centred on the site) returned an additional eight threatened flora species, including three listed as Endangered and five species listed as Vulnerable (**Appendix 5**). All of these species are also currently listed as threatened under the TSC Act (three Endangered, five Vulnerable).

Table 3.1 presents an assessment of potential occurrence of threatened flora species from the database searches, based on a review of species profiles and the habitat types present on the study area. Some of these species are assessed as having the potential to occur, including within disturbed habitats on basalt hills and on adjoining properties. However, none were detected despite targeted searching within all habitat types (including comprehensive searches within the proposed development footprint), and despite the majority of species being detectable throughout the year. Hence the potential for significant impacts on these species is considered low. The same applies to Hairy-joint Grass *Arthraxon hispidus*, which may not have been detectable during the 2 July (winter) survey, but was specifically targeted during the 22 April (autumn) survey during appropriate conditions.

Furthermore, the current extent of impacts from grazing and weed invasion throughout the native habitats within the study area is such that some species are considered unlikely to occur regardless of search effort. This includes all remaining target species that may not have been detectable during either survey.

Table 3.1. Potential occurrence within the study area of threatened flora species identified from database searches.

Species	Common Name	EPBC	TSC	Important Habitat Requirements[1]	Potential Occurrence within Habitat Types Present on the Study Area						Concluding Comments based on Field Survey
					Dry Rainforest	Forest Red Gum Open Forest on Floodplain	Melaleuca Swamp Forest	Freshwater Wetland	Disturbed Rainforest Patches	Paddock	
NSW BioNet Atlas records											
Desmodium acanthocladum	Thorny Pea	V	V,P	Rainforest or riparian areas.	Potential	n/a	n/a	n/a	Potential	n/a	Potential to occur, including within the disturbed habitat on basalt hills and on adjoining properties, although not detected despite targeted searching and the species being detectable all year. Information provided by Groundwork Plus indicates the closest known records are approximately 2 km to the east of the study area on the banks of the Richmond River.
Myrsine richmondensis	Ripple-leaf Muttonwood	E	E,P	Subtropical, dry rainforest and swamp forest.	Potential	n/a	Potential	n/a	Potential	n/a	Potential to occur, including within the disturbed habitat on basalt hills and on adjoining properties, although not detected despite targeted searching and the species being detectable all year.
Gossia fragrantissima	Sweet Myrtle	E	E,P	Rainforest or isolated remnants in cleared or regrowth areas.	Potential	n/a	n/a	n/a	Potential	n/a	Potential to occur, including within the disturbed habitat on basalt hills and on adjoining properties, although not detected despite targeted searching and the species being detectable all year.
Melaleuca irbyana	Weeping Paperbark		E,P	Open eucalypt forest on poorly drained soils.	n/a	Potential	n/a	n/a	n/a	n/a	Does not occur. Not detected despite targeted searching and the species being easily detectable all year.
Syzygium hodgkinsoniae	Red Lilly Pilly	V	V,P	Riverine and subtropical rainforest, or remnant and regrowth rainforest.	Potential	n/a	n/a	n/a	Potential	n/a	Potential to occur, although not detected despite targeted searching and the species being detectable all year.
Additional Protected Matters Search Tool results											
Allocasuarina defungens	Dwarf Heath Casuarina	E	E	Dry sclerophyll forests, wetlands and heathlands.	n/a	Potential	Potential	Potential	n/a	n/a	Unlikely to occur. No confirmed records in the vicinity and not detected despite targeted searching and the species being detectable all year.
Arthraxon hispidus	Hairy-joint Grass	V	V	Moist sites on edges of rainforest or in wet eucalypt forest.	Potential	n/a	n/a	n/a	Potential	Potential	Potential to occur. No confirmed records in the vicinity and not detected despite thorough, targeted searching of potential habitat on seepage zones on hillslopes and along wetland margins.
Bulbophyllum globuliforme	Hoop Pine Orchid	V	V	Epiphytic on Hoop Pines, usually on upper trunk and branches.	Potential	n/a	n/a	n/a	n/a	n/a	Unlikely to occur. No confirmed records in the vicinity and not detected despite targeted searching of potential habitat in Hoop Pine dry rainforest.
Clematis fawcettii	Stream Clematis	V	V	Dry or subtropical rainforest or regrowth rainforest.	Potential	n/a	n/a	n/a	Potential	n/a	Unlikely to occur. No confirmed records in the vicinity and not detected despite targeted searching and the species being detectable all year.
Cryptocarya foetida	Stinking Cryptocarya, Stinking Laurel	V	V	Littoral and subtropical rainforests and wet sclerophyll forests.	Potential	n/a	n/a	n/a	n/a	n/a	Potential to occur, although no confirmed records in the vicinity and not detected despite targeted searching and the species being detectable all year.
Ochrosia moorei	Southern Ochrosia	E	E	Riverine and subtropical rainforest.	Potential	n/a	n/a	n/a	n/a	n/a	Unlikely to occur. No confirmed records in the vicinity and not detected despite targeted searching and the species being detectable all year. Degraded nature of rainforest habitats present generally unsuitable.
Phaius australis	Lesser Swamp-orchid	E	E	Swampy grassland or swampy forest including rainforest, eucalypt or paperbark forest, mostly in coastal areas.	Potential	Potential	Potential	n/a	n/a	n/a	Unlikely to occur. No confirmed records in the vicinity and the degraded nature of habitats present being generally unsuitable.
Thesium australe	Austral Toadflax, Toadflax	V	V	Grassland, grassy open forest or woodland on fertile or moderately fertile soils and coastal headlands, often in association with Kangaroo Grass.	n/a	Potential	n/a	n/a	n/a	Potential	Unlikely to occur. No confirmed records in the vicinity and no Kangaroo grass habitat present.

Abbreviations: EPBC = status under the EPBC Act; **TSC** = status under the TSC Act; E = Endangered; P = Protected; V = Vulnerable.

Important habitat requirements sourced from OEH online threatened species profiles (OEH 2015d).

Four specimens of a threatened species not returned by the database searches were recorded during the field survey, namely *Macadamia tetraphylla* (Rough-shelled Bush Nut) (**Photos 18-20**), currently listed as Vulnerable under both the TSC Act and EPBC Act. The specimens occur together within the centre of Lot 401 on DP633427, adjacent to a clump of other scattered, paddock trees (**Photos 21-23**) and outside of any of the recognised native vegetation zones on the study area, as shown on **Figure 3-1**. The geographic coordinates and a description of each specimen are provided in **Table 3.2**. These plants are either relicts of a dry rainforest or forested wetland community that once occupied that part of the site, or they have propagated from seeds dispersed from nearby communities.

Recognised threats to *Macadamia tetraphylla* that are currently present on the site include invasion of habitat by weeds, and grazing and trampling (of seedlings) by domestic stock (OEH 2015d). Recognised activities to assist this species focus on the protection and expansion of rainforests and other native habitats (OEH 2015d).

A list of all other flora species recorded during the survey is provided in **Appendix 6**.

Table 3.2. Location and description of *Macadamia tetraphylla* specimens found on the site

Easting	Northing	Description
525230	6794990	Small tree (5 m) in good condition (**Photo 18**). Single trunk to 1.5m then branched. Coppice shoots below. On upper slope / crest of basalt hillslopes and plateau with 5 degrees slope. Occurs on margin of three large paddock trees (*Ficus obliqua* x 2 and *Araucaria cunninghamii* x1). Degraded habitat with grazed groundcover of Kikuyu (*Pennisetum clandestinum*), Tobacco Bush (*Solanum mauritianum*), Fireweed (*Senecio madagascarensis*), Balloon Cotton Bush (*Gomphocarpus physocarpus*) and Lantana.
525219	6794990	Small tree (1.5 m) in poor condition (**Photo 19**). Single stem with dry rot and damaged by stock. Coppice suckers from rootstock. Habitat as for specimen 1.
525222	6794989	Sapling (1 m) in poor condition (**Photo 20**). Single stem. Occurs within patch of lantana in close proximity to specimens 1, 2 and 4.
525222	6794989	Sapling (0.5 m) in poor condition. Multi stemmed. Occurs within patch of lantana in close proximity to specimens 1, 2 and 3.

3.3.2 Threatened Fauna

A search of the NSW BioNet Atlas of NSW Wildlife (10 km x 10 km search area centred in the site) returned a total of 11 fauna species listed as threatened under the TSC Act, including one species listed as Endangered and 10 species listed as Vulnerable (**Appendix 5**). Two of these species are also currently listed as Vulnerable under the EPBC Act.

The Commonwealth EPBC Online Protected Matters Search Tool (10 km x 10 km search area centred in the site) returned an additional 33 fauna species listed as threatened under the EPBC Act, including 14 species listed as Endangered and 19 species listed as Vulnerable (**Appendix 5**). This includes a number of marine species for which the site and proposed activities should not be viewed as relevant, including 11 species of albatross, two species of giant-petrel, one species of marine fish and five species of marine turtle. These 19 species are not considered further in this report.

Forest Red Gums (*Eucalyptus tereticornis*) within the open forest habitat to the north-east of the study area showed scratches consistent with those of Koala (Vulnerable: TSC Act and EPBC Act) (**Photo 24**) (**Figure 3-1**). No evidence of Koala occurrence was found within the study area, despite targeted searches. Although it is possible Koalas may occasionally utilise food trees occurring within the open paddock and fringing the wetlands, these areas are of less value to the species than the habitats occurring off-site.

Photo 18. *Macadamia tetraphylla* at 525230 6794990.

Photo 19. *Macadamia tetraphylla* at 525219 6794990.

Photo 20. *Macadamia tetraphylla* at 525222 6794989.

Photo 21. Looking east to localtion of Macadamia plants (top left) and depauperate dry rainforest of Hoop Pine (far right)

Photo 22. Degraded habitat of *Macadamia tetraphylla* occurrence.

Photo 23. Cluster of *Ficus obliqua* and Hoop Pine trees. *Macadamia tetraphylla* plants occur in Lantana on the left hand margin.

Photo 24: Tree-trunk scratches consistent with Koala found within the open forest habitat to the north-east of the site.

An assessment of Koala habitat in the context of Commonwealth and local statutes is provided in **Sections 3.4.2 and 3.5.2**, respectively.

No other threatened fauna species identified in the database searches were recorded during the field survey, although it is acknowledged that the time of year during which the survey was undertaken (winter) is outside the suitable time for detecting some of these species. Nonetheless, coverage of the site during the survey was such that all potential habitats were able to be assessed in sufficient detail to enable an informed assessment of potential occupancy for all species.

Table 3.3 presents the assessment of potential occurrence of threatened fauna species identified in the database searches. This assessment is based on a review of species profiles and the assessment of habitats during the field survey. Several threatened fauna species have the potential to occur within the habitats present within the study area, at least as transient visitors during foraging, particularly birds and bats (**Table 3.3**). Information provided by Groundwork Plus indicates Black-necked Stork (Endangered: TSC) and Comb-crested Jacana (*Irediparra gallinacea*) (Vulnerable: TSC Act) are known to occur on the site from previous records, and the study area continues to provide suitable habitat for these species. In particular, the dry rainforest community on the boundary of Lots 402 and Lot 403 on DP802985 provides known breeding habitat for Black-necked Stork while the wetlands associated with Seelems Creek provide known habitat for both Black-necked Stork and Comb-crested Jacana, as well as potential habitat for a number of other species.

As noted in **Section 2.2**, species known, considered likely or considered to have the potential to occur are subsequently considered in the assessment of potential impacts. This includes species for which the time of year the survey is undertaken is generally not suitable for detection.

Even so, the degraded habitats present within the area of the proposed development footprint provide very limited habitat value for threatened fauna species. Hence the potential for significant impacts on these known, likely or potentially occurring species is considered low, and many species are considered unlikely to occur regardless of search effort. This includes all remaining target species that may not have been detectable during the survey.

A list of all other fauna species recorded during the survey is provided in **Appendix 7**.

Table 3.3. Potential occurrence within the study area of threatened fauna species identified in database searches.

Species	Common Name	EPBC	TSC	Important Habitat Requirements[1]	Potential Occurrence within Habitats Present on the Study Area							Comments
					Dry Rainforest	Forest Red Gum Open Forest on Floodplain	Melaleuca Swamp Forest	Freshwater Wetland	Disturbed Rainforest Patches	Scattered Paddock Trees	Grassed Paddock	
NSW BioNet Atlas records												
Anseranas semipalmata	Magpie Goose		V,P	**Foraging:** Open grasslands, pastures, shallow wetlands or crops, vegetated dams, mangroves or flood plains. **Breeding:** Emergent vegetation above water 60-100 cm deep.	n/a	Low potential as foraging habitat.	Low potential as foraging habitat.	Potential foraging habitat.	n/a	Low potential as foraging habitat.	Low potential as foraging habitat.	The freshwater wetlands in the study area provide suitable habitat for this species, while adjacent floodplains could also be used for foraging.
Ephippiorhynchus asiaticus	Black-necked Stork		E,P	**Foraging:** Shallow open freshwater or saline wetlands and watercourses, occasionally mud- and sand-flats, farm dams and drains. **Breeding:** Live or dead tree within or near foraging habitat. Usually isolated, live, paddock trees in NSW, but also in paperbarks and occasionally low shrubs within wetlands.	Former, known breeding habitat.	Potential breeding habitat.	Potential breeding habitat.	Potential foraging habitat.	Potential breeding habitat.	Potential breeding habitat.	n/a	This species was known to utilise the dry rainforest habitat in the study area for breeding in the past, and this habitat continues to provide potential breeding resources. However, no current or recent breeding activity was recorded during the field assessment.
Ixobrychus flavicollis	Black Bittern		V,P	**Foraging and breeding:** Wetland vegetation bordering water bodies or watercourses.	n/a	Low potential.	Low potential.	Potential to occur.	n/a	n/a	n/a	Potential to occur in wetland areas abutted by forested habitats or holding dense grasses. Domestic stock access would reduce any likelihood of the species occurring.
Pandion cristatus	Eastern Osprey		V,P	**Foraging:** Protected open water. **Breeding:** Emergent living or dead trees or artificial towers within 3 km of foraging habitat.	n/a	Low potential as breeding habitat.	n/a	Little to no value as foraging habitat.	n/a	Low potential as breeding habitat.	n/a	The habitats within the study area are of relatively low value for this species.
Irediparra gallinacea	Comb-crested Jacana		V,P	**Foraging and breeding:** Floating aquatic vegetation, or fringing vegetation, of permanent, slow-moving or still freshwater wetlands.	n/a	n/a	n/a	Known to occur.	n/a	n/a	n/a	Information provided by Groundwork Plus indicates this species is known to occur in wetland areas on the study area from previous records.
Turnix maculosus	Red-backed Button-quail		V,P	**Foraging and breeding:** Grassland, grassy understorey, crops or sedgeland.	n/a	Low potential.	n/a	Low potential.	n/a	n/a	Low potential.	The habitats within the study area are of relatively low value for this species. There is potential for the species to utilise the grassed paddocks once suitable cover was established.
Phascolarctos cinereus	Koala	V	V,P	**Foraging and breeding:** Wet and dry sclerophyll forests, woodlands and forested wetlands.	n/a	Known to occur.	Potential to occur.	n/a	n/a	Low potential.	n/a	Characteristic scratches were found within open forest habitat to the north-east of the site during the current survey. Suitable feed trees my also occur on the fringes of the wetlands and as scattered paddock trees.
Pteropus poliocephalus	Grey-headed Flying-fox	V	V,P	**Foraging:** Most vegetation types. **Breeding:** Canopy trees associated with rainforest, or coastal scrub or riparian or estuarine communities and with sufficient forage resources available within 40km.	Low potential as foraging habitat.	Potential foraging habitat.	Potential foraging habitat.	n/a	Low potential as foraging habitat.	Potential foraging habitat.	n/a	This species may visit the forested habitats in response to seasonal flowering events.
Miniopterus australis	Little Bentwing-bat		V,P	**Foraging:** Most vegetation types. **Breeding:** Caves, often limestone.	Potential foraging habitat.	Potential foraging and roosting habitat.	Potential foraging habitat.	n/a	Potential foraging habitat.	Potential foraging and roosting habitat.	n/a	This species forages within most forested habitats, and the study area has the occasional large tree that may provide hollows for roosting.
Myotis macropus	Southern Myotis		V,P	**Foraging:** Waterbodies (including streams, or lakes or reservoirs) and fringing areas of vegetation up to 20m. **Breeding:** Likely to be as per roosting habitat – i.e. close to water in caves, mine shafts, hollow-bearing trees, storm water channels, buildings, under bridges and in dense foliage.	Low potential.	Potential foraging and roosting habitat.	Potential foraging and roosting habitat.	Potential foraging habitat.	Low potential.	Low potential.	n/a	Potential to occur in wetland areas abutted by forested habitats.
Scoteanax rueppellii	Greater Broad-nosed Bat		V,P	**Foraging:** Most forested vegetation types. **Breeding:** Likely to be as per roosting habitat – i.e. tree hollows.	Potential foraging habitat.	Potential foraging and roosting habitat.	Potential foraging habitat.	n/a	Potential foraging habitat.	Potential foraging and roosting habitat.	n/a	This species forages within most forested habitats, and the study area has the occasional large tree that may provide hollows for roosting.
Additional Protected Matters Search Tool results												
Anthochaera phrygia	Regent Honeyeater	E	CE	**Foraging and breeding:** Dry sclerophyll forests, woodlands and forested wetlands.	n/a	Low potential.	Low potential.	n/a	n/a	n/a	n/a	No confirmed records in the vicinity and the habitats within the study area are of relatively low value for this species. There is low potential for the species to visit during localised flowering.

Species	**Common Name**	**EPBC**	**TSC**	**Important Habitat Requirements[1]**	**Potential Occurrence within Habitats Present on the Study Area**							**Comments**
					Dry Rainforest	**Forest Red Gum Open Forest on Floodplain**	**Melaleuca Swamp Forest**	**Freshwater Wetland**	**Disturbed Rainforest Patches**	**Scattered Paddock Trees**	**Grassed Paddock**	
Botaurus poiciloptilus	Australasian Bittern	E	E	**Foraging:** Freshwater or brackish wetlands, tussocky wet paddocks or drains. **Breeding:** Emergent vegetation (e.g. Phragmites, Typha) in freshwater or brackish wetlands.	n/a	n/a	n/a	Potential to occur.	n/a	n/a	n/a	No confirmed records in the vicinity although some potential to occur within the thicker vegetated areas within the wetlands.
Cyclopsitta diophthalma coxeni	Coxen's Fig-Parrot	E	CE	**Foraging:** Figs or other fleshy-fruited trees in rainforest or wet sclerophyll forest or remnants. **Breeding:** Live or dead eucalypts close to rainforest or trees within rainforest close to foraging habitat.	Low potential.	Low potential.	n/a	n/a	Low potential.	Low potential.	n/a	No confirmed records in the vicinity although occasional food trees present.
Dasyornis brachypterus	Eastern Bristlebird	E	E	**Foraging:** Dense native tussock grasses >80% projected groundcover and >40cm tall; with sparse midstory in ecotone of open forest/rainforest or within open forest up to 1 km of rainforest. **Breeding:** Dense native tussock grasses in open grassy patches within open forest with dense native tussock grasses >80% projected groundcover and >40 cm tall, with sparse midstory, in ecotone of open forest/rainforest or within open forest up to 1 km of rainforest.	n/a	n/a	n/a	n/a	n/a	n/a	n/a	No confirmed records in the vicinity and the study area provides no suitable habitat for this species.
Erythrotriorchis radiatus	Red Goshawk	V	CE	**Foraging:** Open woodland and sclerophyll forest, subtropical rainforest, Melaleuca swamp forest, Araucaria vine forests and riparian habitats along or near watercourses or wetlands, preferring a mosaic of vegetation types. **Breeding:** Tall stand of trees within 1km of permanent water, often adjacent to rivers or clearings. Usually one of the tallest trees is selected for the nest location.	Low potential.	Low potential.	Low potential.	n/a	Low potential.	Low potential.	n/a	No confirmed records in the vicinity and the habitats within the study area are of relatively low value for this species. There is low potential for the species to visit and roost during hunting.
Lathamus discolor	Swift Parrot	E	E	**Foraging:** Dry sclerophyll forests, woodlands and forested wetlands. Breeds in Tasmania.	n/a	Low potential.	Low potential.	n/a	n/a	n/a	n/a	No confirmed records in the vicinity and the habitats within the study area are of relatively low value for this species. There is low potential for the species to visit during localised flowering.
Rostratula australis	Australian Painted Snipe	E	E	**Foraging and breeding:** Areas of tussock grass, lignum, reeds, sedges or rushes within 500 m of, and including, shallow wetlands or ephemeral or permanent waterbodies, or inundated grasslands/paddocks.	n/a	n/a	n/a	Potential to occur.	n/a	n/a	n/a	No confirmed records in the vicinity although some potential to occur within the thicker vegetated areas within the wetlands.
Turnix melanogaster	Black-breasted Button-quail	V	CE	**Foraging and breeding:** Predominantly drier low closed forests. In NSW, also wetter subtropical rainforest sometimes in association with moist eucalypt forest or dry rainforest associated with eucalypt forest.	Very low potential.	n/a	n/a	n/a	n/a	n/a	n/a	No confirmed records in the vicinity and the study area provides virtually no suitable habitat for this species.
Phyllodes imperialis smithersi	Pink Underwing Moth	E	E	**Foraging and breeding:** Rainforest where fruiting plants and the food plant *Carronia multisepalea* is present.	n/a	n/a	n/a	n/a	n/a	n/a	n/a	No confirmed records in the vicinity and no suitable habitat present within the study area.
Chalinolobus dwyeri	Large-eared Pied Bat, Large Pied Bat	V	V	**Foraging:** Dry sclerophyll forests and woodlands. **Breeding:** Roof domes in sandstone caves and overhangs (maternity and nursery roosts).	n/a	n/a	n/a	n/a	n/a	n/a	n/a	No confirmed records in the vicinity and no suitable habitat present within the study area.
Dasyurus maculatus maculatus	Spot-tailed Quoll	E	V	**Foraging:** Most forested vegetation types. **Breeding:** Hollow-bearing trees, fallen logs, small caves, rock crevices, boulder piles, rocky-cliff faces or animal burrows.	n/a	n/a	n/a	n/a	n/a	n/a	n/a	No confirmed records in the vicinity and no suitable habitat present within the study area.
Potorous tridactylus tridactylus	Long-nosed Potoroo	V	V	**Foraging and breeding:** Rainforest or vegetation with dense understorey.	n/a	n/a	n/a	n/a	n/a	n/a	n/a	No confirmed records in the vicinity and the study area provides no suitable habitat for this species.
Pseudomys novaehollandiae	New Holland Mouse	V		**Foraging and breeding:** Dry sclerophyll forests, heathlands and forested wetlands.	n/a	n/a	n/a	n/a	n/a	n/a	n/a	No confirmed records in the vicinity and the study area provides no suitable habitat for this species.
Coeranoscincus reticulatus	Three-toed Snake-tooth Skink	V	V	**Foraging:** Earthworms and other soft-bodied invertebrates in loose soil, leaf litter, rotting logs, clumps of fallen epiphytes. **Breeding:** Littoral and subtropical rainforest, wet sclerophyll forest with well-developed rainforest understorey; many rotting logs and well developed leaf litter.	n/a	n/a	n/a	n/a	n/a	n/a	n/a	No confirmed records in the vicinity and the study area provides no suitable habitat for this species.

Abbreviations: EPBC = status under the EPBC Act; **TSC** = status under the TSC Act; CE = Critically Endangered; E = Endangered; P = Protected; V = Vulnerable.

Important habitat requirements sourced from OEH online threatened species profiles (OEH 2015d).

3.4 MATTERS OF NATIONAL ENVIRONMENTAL SIGNIFICANCE

3.4.1 Threatened Ecological Communities

The Commonwealth EPBC Online Protected Matters Search Tool (10 km x 10 km search area centred in the site) identified one threatened ecological community (TEC) that may occur within the study area: 'Lowland Rainforest of Subtropical Australia' (Critically Endangered) (**Appendix 5**). The field survey found that one vegetation community potentially corresponding to this TEC occurs within the study area, that being the Hoop Pine - Yellow Tulipwood dry rainforest of the North Coast vegetation type occurring on the boundary of Lots 402 and Lot 403 on DP802985.

As noted in the listing advice for the Lowland Rainforest of Subtropical Australia TEC, the listing focuses on protecting patches of this community that are "most functional, relatively natural…", "…and in relatively good condition" (TSSC, 2011). Accordingly, condition thresholds have been developed to establish whether a patch of vegetation retains sufficient conservation values to be considered a TEC.

An assessment of vegetation data obtained for the patch of Hoop Pine dominated dry rainforest community recorded during the field survey (**Appendix 3**) against these condition thresholds confirms the community present onsite fails one of the mandatory criteria relating to the high species richness that characterises good examples of the TEC – that is, patches need to contain at least 30 of the native woody species listed in an appendix to the listing advice, whereas the patch present on the study area contains less than 30 of these species.

Accordingly, none of the vegetation on the study area is recognised as a TEC and a referral to the Commonwealth in relation to impacts on TECs is not considered necessary at this time.

3.4.2 Threatened species

The Commonwealth EPBC Online Protected Matters Search Tool and a search of the NSW BioNet Atlas of NSW Wildlife (10 km x 10 km search area centred in the site) (**Appendix 5**) indicate the potential presence of a number of EPBC Act listed threatened flora and fauna species for the study area.

Flora

None of the threatened flora species returned by the database searches were recorded during the field survey, despite targeted searching within all habitat types (including comprehensive searches within the proposed development footprint), and despite the majority of species being detectable throughout the year. Current impacts from grazing and weed invasion throughout the native habitats within the study area is also such that some of these species are considered unlikely to occur regardless of search effort or detectability. However, four specimens of a threatened species not returned by the database searches were recorded during the field survey: *Macadamia tetraphylla* (Rough-shelled Bush Nut). This species is currently listed as Vulnerable under both the TSC Act and EPBC Act.

The four recorded specimens occur together within the centre of Lot 401 on DP633427, adjacent to a clump of other scattered, paddock trees and outside of any of the recognised native vegetation zones on the study area, as shown on **Figure 3-1**. These specimens are either relicts of a dry rainforest or forested wetland community that once occupied that part of the site, or they have propagated from seeds dispersed from nearby communities.

Recognised threats to *Macadamia tetraphylla* that are currently present on the site include invasion of habitat by weeds and grazing and trampling (of seedlings) by domestic stock (OEH 2015d). Recognised activities to assist this species focus on the protection and expansion of rainforests and other native habitats (OEH 2015d).

An assessment of potential impacts on this species is provided in **Section 4.0**.

Fauna

None of the threatened fauna species returned by the database searches were recorded during the field survey, although it is acknowledged that the time of year during which the survey was undertaken (winter) is outside the suitable time for detecting many of these species. Nonetheless, coverage of the site during the survey was such that all potential habitats were able to be assessed in sufficient detail to enable an informed assessment of potential occupancy for all species returned by the database searches.

Table 3.3 presents the assessment of potential occurrence of threatened fauna species returned by the database searches, based on a review of species profiles and the assessment of habitats undertaken during the field survey. This excludes a number of marine species for which the site and proposed activities should not be viewed as relevant (refer **Section 3.3.2**).

Forest Red Gums within the open forest habitat to the north-east of the site showed scratches consistent with those of Koala (Vulnerable: TSC Act and EPBC Act) and it is possible this species may also occasionally utilise food trees occurring within the open paddock and fringing the wetlands. The assessment of potential occurrence also indicates the study area provides potential habitat for Grey-headed Flying-fox (Vulnerable), Australasian Bittern (Vulnerable) and Painted Snipe (Vulnerable).

Koala

Known Koala habitat occurs in close proximity to the study area in the form of Forest Red Gum woodland, and Koalas may also visit eucalypts occurring as scattered paddock trees and on the wetland fringes. The results of a habitat assessment performed in accordance with the EPBC Act referral guidelines for Koala (DoE 2014) are summarised in **Table 3.4**. The total habitat score from this assessment is 4; as this total score is <5, the habitats onsite are not considered to represent critical habitat and the referral guidelines indicate a referral to the Commonwealth in relation to impacts on this species is not considered necessary at this time.

Grey-headed Flying-fox

Grey-headed Flying-fox may visit the forested habitats on site in response to seasonal flowering events. However, such foraging habitat is widespread in the local region, and this species travels widely to exploit seasonal flowering trees, so any loss of habitat within the study area will not have an adverse effect on the long-term survival of the species in the locality. Furthermore, no roosting camp occurs in the study area, so the proposed action is unlikely to have an adverse effect on the life cycle of the species. Accordingly, a referral to the Commonwealth in relation to impacts on this species is not considered necessary.

Australasian Bittern and Painted Snipe

It is possible that these species may occasionally utilise the thicker vegetated areas within the wetland habitats on the study area and adjacent properties. However, there are no confirmed records of either species in the vicinity and similar foraging habitat is widespread in the local region. Accordingly, a referral to the Commonwealth in relation to impacts on these species is not considered necessary at this time.

Other Threatened Species

There is also a low potential for Regent Honeyeater, Coxen's Fig-Parrot, Red Goshawk and Swift Parrot to visit the study area during foraging/hunting. However, there are no confirmed records of any of these species in the vicinity and the habitats present within the study area are not particularly valuable for these species, given their degraded condition, small patch size and isolation. Accordingly, a referral to the Commonwealth in relation to impacts on these species is not considered necessary at this time.

3.4.3 Non-threatened Migratory species

The Commonwealth EPBC Online Protected Matters Search Tool and the search of the NSW BioNet Atlas of NSW Wildlife (**Appendix 5**) indicate the potential for a number of species listed as migratory under the EPBC Act to occur in the study area.

Table 3.5 presents the assessment of potential occurrence of non-threatened migratory species returned by the database searches, based on a review of species profiles and the assessment of habitats undertaken during the field survey. This excludes a number of marine species for which the site and proposed activities should not be viewed as relevant, including species of albatross, giant-petrel, marine fish, marine turtle and marine mammals.

Table 3.4. Koala habitat assessment tool results summary.

Attribute	Score	Coastal area criteria	Score	Assessment details
Koala occurrence	+2 (high)	Evidence of one or more Koalas within the last 2 years	**2**	**Desktop:** • The Atlas of NSW Wildlife database search identified 90 Koala records within a 10 x 10 km search area centred on the study area; • The AKF Koala Map (AKF 2015) did not identify any Koala records within the local area (i.e. nearest record approximately 7 km away, north of Tuckurimba). **On-ground:** Forest Red Gums within the open forest habitat to the north-east of the site showed scratches consistent with those of Koala, and it is possible this species may also occasionally utilise food trees occurring within the open paddock and fringing the wetlands.
	+1 (medium)	Evidence of one or more Koalas within 2 km of the edge of the impact area within the last 5 years		
	0 (low)	None of the above		
Vegetation Composition*	+2 (high)	Has forest or woodland with 2 or more known Koala feed tree species in the canopy, OR 1 feed tree species that alone accounts for >50% of the vegetation in the relevant strata.	**1**	**On-ground:** On-ground surveys revealed the only recognised Koala food tree occurring on and near the site is Forest Red Gum (*Eucalyptus tereticornis*), occurring in swamp forest fringing the wetlands in the western portion of the site, and as the dominant canopy tree in open forest occurring to the north-east of the site.
	+1 (medium)	Has forest or woodland with only 1 known Koala feed tree species in the canopy.		
	0 (low)	None of the above		
Habitat connectivity	+2 (high)	Area is part of a contiguous landscape ≥ 500 ha, a contiguous landscape being an area that encompasses no barriers but is bounded by barriers, where a barrier is a feature (natural or artificial) that is likely to prevent the movement of koalas; natural barriers may include steep mountain ranges (cliffs), unsuitable habitats, major rivers / water bodies or treeless areas more than 2 km wide; artificial barriers may include infrastructure (such as roads, rail, mines, large fences etc.) without effective koala passage measures, or developments that create treeless areas more than 2 km wide.	**0**	Habitat on the study area occurs as small, isolated pockets within a landscape otherwise dominated by open pasture and agricultural land.
	+1 (medium)	Area is part of a contiguous landscape < 500 ha but ≥300 ha.		
	0 (low)	None of the above		
Key existing threats	+2 (high)	Little or no evidence of Koala mortality from vehicle strike or dog attack at present in areas that score 1 or 2 for Koala occurrence. Areas which score 0 for Koala occurrence have no dog or vehicle threat present.	**1**	**Desktop:** No relevant information was located. **On-ground:** The study area incorporates the existing Petersons Quarry and another industrial activity (pre-cast concrete facility), and occurs within a largely rural landscape. There is likely to be some degree of dog and/or vehicle threat present.
	+1 (medium)	Evidence of infrequent or irregular Koala mortality from vehicle strike or dog attack at present in areas that score 1 or 2 for Koala occurrence, OR Areas which score 0 for Koala occurrence and are		

Attribute	Score	Coastal area criteria	Score	Assessment details
		likely to have some degree of dog or vehicle threat present.		
	0 (low)	Evidence of frequent or regular Koala mortality from vehicle strike or dog attack in the study area at present, OR Areas with score 0 for Koala occurrence and have a significant dog or vehicle threat present.		
Recovery value **	+2 (high)	Habitat is likely to be important for achieving the interim recovery objectives for the relevant context, as outlined in Table 1 of the referral guidelines (DoE 2014).	**0**	Habitat in the study area occurs as small, isolated pockets within a landscape otherwise dominated by open pasture and agricultural land, and no evidence of Koala occurrence on the study area has been obtained despite targeted survey of the limited habitat present.
	+1 (medium)	Uncertainty exists as to whether the habitat is important for achieving the interim recovery objectives for the relevant context, as outlined in Table 1 of the referral guidelines (DoE 2014).		
	0 (low)	Habitat is unlikely to be important for achieving the interim recovery objectives for the relevant context, as outlined in Table 1 of the referral guidelines (DoE 2014).		
Total Score			**4**	As this total score is <5, the habitats onsite are not considered to represent critical habitat.

* Koala feed tree species are those listed for the North Coast of NSW by OEH (http://www.environment.nsw.gov.au/animals/koalahabitat.htm#north).

** Interim recovery objectives in coastal areas are to (a) protect and conserve large, connected areas of Koala habitat, particularly large, connected areas that support Koalas that are: genetically diverse/distinct; or free of disease or have a very low incidence of disease; or breeding (i.e. presence of back young or juveniles); and (b) maintain corridors and connective habitat that allow movement of koalas between large areas of habitat.

Table 3.5. Potential occurrence within the study area of non-threatened migratory fauna species obtained from database searches.

Species	Common Name	Potential Occurrence within Habitats Present on the Study Area							Comments
		Dry Rainforest	Forest Red Gum Open Forest	Melaleuca Swamp Forest	Freshwater Wetland	Disturbed Rainforest Patches	Scattered Paddock Trees	Grassed Paddock	
Ardea ibis	Cattle Egret	n/a	Potential habitat.	Some potential.	Known habitat.	n/a	Potential habitat.	Known habitat.	Known to utilise open habitats in the study area for foraging, particularly in association with domestic stock. The swamp forest fringing the wetlands may provide suitable breeding resources, although there is no confirmed nesting on the site.
Plegadis falcinellus	Glossy Ibis	n/a	n/a	Potential habitat.	Potential habitat.	n/a	n/a	Potential habitat.	The wetland habitats in the study area provide suitable foraging resources for this species, along with fringing habitats during high rainfall and flood events.
Haliaeetus leucogaster	White-bellied Sea-Eagle	n/a	Some potential.	Some potential.	Some potential.	n/a	Some potential.	n/a	The wetland habitats in the study area provide potential foraging opportunities, although the narrow pondage areas have low value only. The larger trees on site may also provide suitable breeding resources, although there is no confirmed nesting on the study area.
Calidris melanotos	Pectoral Sandpiper	n/a	n/a	n/a	n/a	n/a	n/a	n/a	No suitable habitat present within the study area.
Apus pacificus	Fork-tailed Swift	n/a	n/a	n/a	n/a	n/a	n/a	n/a	No suitable habitat present within the study area.
Hirundapus caudacutus	White-throated Needletail	n/a	n/a	n/a	n/a	n/a	n/a	n/a	This aerial species may occur over any habitat type but the site has no direct relevance to the species.
Merops ornatus	Rainbow Bee-eater	Little to low value.	Known habitat.	Known habitat.	Known habitat.	Little to low value.	Known habitat.	Known habitat.	Observed foraging throughout the more open habitats on the site during the current survey.
Monarcha melanopsis	Black-faced Monarch	Potential habitat.	Low potential.	Potential habitat.	n/a	Potential habitat.	n/a	n/a	Suitable habitat for this species occurs on site within the denser patches of vegetation.
Monarcha trivirgatus	Spectacled Monarch	Potential habitat.	Low potential.	Potential habitat.	n/a	Potential habitat.	n/a	n/a	Suitable habitat for this species occurs on site within the denser patches of vegetation.
Myiagra cyanoleuca	Satin Flycatcher	Potential habitat.	Low potential.	Potential habitat.	n/a	Potential habitat.	n/a	n/a	Suitable habitat for this species occurs on site within the denser patches of vegetation.
Rhipidura rufifrons	Rufous Fantail	Potential habitat.	Low potential.	Potential habitat.	n/a	Potential habitat.	n/a	n/a	Suitable habitat for this species occurs on site within the denser patches of vegetation.
Ardea alba	Great Egret	n/a	n/a	Low potential.	Known habitat.	n/a	n/a	n/a	Known to utilise wetland habitats in the study area for foraging. The melaleuca swamp forest fringing the wetlands may also provide suitable resources during high rainfall and flood events.
Gallinago hardwickii	Latham's Snipe	n/a	n/a	n/a	Low potential.	n/a	n/a	n/a	Some potential to occur within sections of the wetlands containing dense reeds and grasses, although habitat values are limited.

Cattle Egrets (*Ardea ibis*) were observed foraging around the wetlands and within the open paddock habitats within the study area in association with domestic stock, while a Great Egret (*Ardea alba*) was also observed within the wetlands (**Photo 25**). Rainbow Bee-eaters (*Merops ornatus*) were also regularly observed foraging throughout the more open habitats on the site. The assessment of potential occurrence also indicates the study area provides potential habitat for most of the other non-threatened migratory species returned by the database searches.

Photo 25: Great Egret observed within the wetland.

However, the local region has not been identified as supporting an ecologically significant proportion of habitat for any of the species known or considered to have the potential to occur. Furthermore, these species are all common, widely distributed species that are neither known to be declining nor at the limit of their range within the study area. Therefore any future development of the site is unlikely to have a significant impact on any non-threatened migratory species, particularly as the majority of the study area has previously been cleared, and the majority of potential habitat present will be retained as part of future development plans (refer **Section 4.0**). As such, a referral to the Commonwealth in relation to impacts on these species is not considered necessary at this time.

3.5 MATTERS OF LOCAL ENVIRONMENTAL SIGNIFICANCE

3.5.1 Local Environmental Plan Mapping

Richmond Valley Council's Local Environmental Plan (LEP) mapping (RVC 2015a,b) indicates a recognised wetland occurs in the western portion of the study area, consistent with the freshwater wetland community identified during the field survey (refer **Figure 1-1 and Section 3.2.1**). The LEP mapping also identifies the western part of the study area as an important area for biodiversity, which appears to be associated with the wetland.

The LEP mapping identifies important areas for biodiversity in the centre and to the north-east of the study area. These areas were identified as comprising native vegetation communities during the field survey, other than the smallest patch mapped in the centre of the study area that was found to be dominated by exotics (refer **Figure 3-1 and Section 3.2**). These areas are also identified on the LEP mapping as wetlands. No wetland vegetation was recorded within these areas during the field survey, although they could become seasonally inundated, thereby providing potential habitat for frogs and water birds.

The results of the field survey generally support the LEP mapping of relative biodiversity importance in that the far western and central parts of the study area and areas to the north-east contain native vegetation and associated habitat values for native fauna, including species of conservation significance.

3.5.2 Koala Habitat Mapping

Richmond Valley Council's Koala Habitat Atlas mapping (RVC 2015c) indicates Class B and C secondary Koala habitat occurs to the north-east and in the far west of the study area, respectively.

The Richmond Valley Koala Habitat Atlas (AKF 2008) defines Class B secondary Koala habitat as areas of forest or woodland where primary Koala food tree species comprise less than 30% of the overstorey trees, or together with secondary food tree species comprise at least 30% (but less than 50%) of the overstorey trees, or where secondary food tree species alone comprise at least 30% (but less than 50%) of the overstorey trees (primary Koala food tree species absent). This habitat class is capable of supporting medium to low-density Koala populations.

Class C secondary Koala habitat is defined as areas of forest or woodland where Koala habitat is comprised of secondary and supplementary food tree species (primary Koala food tree species absent), where secondary food tree species comprise less than 30% of the overstorey trees. This habitat class is capable of supporting low-density Koala populations.

The results of the field survey generally support the Koala Habitat Atlas mapping in that the vegetation in the north-east offers the highest value Koala habitat, with less valuable potential habitat occurring on the fringes of the wetlands.

3.5.3 Black-Necked Stork Nesting Tree

Information provided by Groundwork Plus indicates a Black-necked Stork once nested in a Hoop Pine located within the centre of the dry rainforest community occurring within the centre of the study area (refer **Figure 3-1**).

The current field survey found no active nests in any of the trees within this community, nor was any evidence of recent nesting activity found. Therefore Black-necked Stork is unlikely to currently utilise these trees for nesting. However, this vegetation continues to provide potential breeding resources.

4.0 IMPACT ASSESSMENT

4.1 IMPACT MECHANISMS

4.1.1 Clearing

During the construction phase, clearing and/or grubbing activities will be required for the establishment of all key infrastructure components outside of the previously disturbed areas associated with Petersons Quarry. Clearing will also occur progressively during quarry operation for the extension of the pit and stockpile areas.

Clearing of vegetation reduces the total amount of habitat and populations of flora and fauna, and has the potential to result in isolation of habitats and populations, changes to remaining vegetation that cause the loss of food, breeding and shelter resources for fauna, and exposure to introduced species that are either competitors or predators (Bennett *et al*. 2000).

Removal of vegetation will also result in direct loss of individual plants, including large trees that may provide nesting resources to fauna, and can result in the mortality of fauna present at the time of clearing.

Secondary impacts can affect peripheral vegetation through:

- soil disturbance/exposure and altered water flow patterns, and subsequent erosion and sedimentation, which may expose tree roots, smother vegetation, and potentially alter the physical form, chemical processes and ecological health of downstream aquatic and riparian habitats;
- increased desiccation, light penetration, wind-throw, herbivory, weed invasion, nest predation, and parasitism for adjacent flora and fauna (Murcia 1995). In particular, introduced weeds can change vegetation community composition and in some cases increase the intensity of fire, leading to further community degradation;
- salinisation of areas downslope, depending on the clearing extent and nature of the associated landform and geology/soils; and
- clearing, earthworks, vehicle movements, wind and blasting within the project area causing increased dust which will potentially impact on nearby vegetation. Excessive dust has been known to reduce photosynthesis rates and inhibit plant growth (Thompson *et al.* 1984, Sharifi, *et al.* 1997), and pollutants in dust can impede plant growth (Farmer 1993).

Clearing can also create barriers to fauna movement through habitat fragmentation, affecting reproductive cycles and facilitating the incursion of pest species and aggressive, native “edge” species deeper into woodlands and open forests.

4.1.2 Construction and Operational Activities

In addition to clearing and the associated secondary (or indirect) impacts, the construction and operation phases have the potential to result in on-going disturbance to surrounding habitats. Noise, dust and vibration affect habitat adjacent to active areas due to ground disturbance, the operation and movement of machinery traffic along haul roads, exposed stockpiles and blasting.

Noise, including background noise, generated by human activities can potentially affect behaviour and persistence of species and communities by, for example, masking of alarm and mating calls, location and motion of resources, obstructions or potential harms; in short, noise pollution affects the sending and reception of behavioural and social signals in faunal communities (e.g. see Brumm and Slabbekoorn 2005).

Another potential impact associated with fauna, particularly reptiles and small mammals, is becoming trapped in any trenches or other excavations that remain open for any period of time. This may lead to mortality either by exposure, starvation, thirst or predation by other species. Open pipes may also attract fauna, particularly micro-bats and reptiles, which may then be injured or killed when the pipes are transported and utilised.

An increase in heavy and light vehicle traffic during both the construction and operation phases could contribute to increased animal/vehicle collisions on local roads. Species particularly susceptible to traffic collisions include larger and slow-moving snakes, monitors and other large lizards, macropods and frogs (during wet periods).

Vehicles also have the potential to introduce and/or spread weed species and plant pathogens in disturbed soil, while general waste and land disturbance has the potential to attract highly competitive and/or predatory exotic fauna species. Increased human presence has the potential to increase the frequency of accidental fires within vegetated areas, adversely affecting habitat structure and therefore habitat value for a range of significant species.

Fuels and chemical spills from storage areas and oils from heavy machinery can enter the environment, affecting habitats where the spill occurs, and potentially causing more widespread impact if contaminants reach waterways.

The operation of the quarry also has the potential to disrupt natural ecological processes within the local area through:

- limiting the natural movement and dispersal of ground-dwelling and flightless fauna (i.e. for breeding and foraging purposes), which are unable to traverse the quarried landscape;
- altering the local surface water environment[1] due to large-scale landform modification, and subsequent potential impacts on downstream terrestrial ecosystems, particularly wetlands and riparian vegetation, and other sensitive vegetation communities and dependent fauna. This includes alterations to base flows, as well as to the frequency and extent of flooding; and
- creating long-term edge effects along the borders of the active area and adjacent habitat.

It is understood the hours of operation will be restricted to 6am to 7pm Monday to Saturday, with no night works proposed. As such, there will be no impacts as a result of artificial lighting, which could otherwise affect behaviour of both nocturnal and diurnal fauna.

4.2 IMPACT MANAGEMENT

The overarching principle of relevant State and Commonwealth environmental protection policies in terms of impact management is to avoid impacts as much as possible in the first instance, following which mitigation measures should be used to reduce unavoidable impacts to acceptable/insignificant levels. Where impacts remain at unacceptable/significant levels post-mitigation, only then should compensatory measures (e.g. offsets) be employed as a last resort.

The following sections outline the proposed measures for avoidance, mitigation and compensation to address potential impacts on terrestrial ecological values as a result of the proposed development.

4.2.1 Impact Avoidance

The most effective means of impact avoidance is through appropriate development footprint design. As shown on **Figures 1-1 and 3-1**, the proposed site development footprint has been positioned to avoid the clearing and fragmentation of the relatively large, well-connected tracts of vegetation and associated habitat within the study area, and avoids all patches of vegetation recognised as native vegetation communities that have greatest value to the majority of known or potentially occurring terrestrial flora and fauna species. No EECs, wetlands or important habitat for threatened flora and fauna species (as identified during the site survey and recognised on local government mapping) will be directly impacted. Buffers will be retained between the recognised vegetation communities (and associated EECs and wetlands) and the edge of the proposed site disturbance footprint to further prevent secondary impacts.

It is imperative that the positive ecological outcomes of this design are respected through strict controls on the clearing of vegetation, access and storage of site personnel, vehicles, machinery, materials and excavated soil, and other construction and activities throughout the life of the Project. Of particular importance will be the identification and enforcement of no-go areas and regular monitoring of the condition of retained vegetation and habitat for unauthorised clearing and secondary impacts.

---

[1] Information provided by Groundwork Plus indicates the resource is a basalt flow over clay, and that extraction will be restricted to within the resource and will retain a floor separating the quarry from the underlying clay resource. Accordingly, no impacts to groundwater residing within the clay layer are anticipated.

Original development plans involved the clearing of patches of isolated vegetation within the centre of Lot 401 on DP633427 area as part of a designated stockpiling area. The field survey undertaken as part of the current assessment recorded four specimens of *Macadamia tetraphylla* (currently listed as Vulnerable under the TSC Act and EPBC Act) within one of these patches. In response to the survey results, the original footprint was redesigned to avoid the clearing of these specimens. Taking into account site constraints and the necessary size of the stockpiling area to meet operational requirements, the current, revised footprint incorporates the retention of these specimens and a 25 m buffer (**Figures 1-1 and 3-1**).

Additional management measures to mitigate residual impacts on these plants are discussed in the following section.

4.2.2 Impact Mitigation

General Management

In general, the area proposed to be disturbed for the project is of relatively low habitat value in the context of the surrounding area and particularly in comparison with the adjacent patches of native vegetation. The overall value of the proposed disturbance area (as habitat) has been reduced because of historical clearing and grazing practices, which have significantly reduced areas of cover and facilitated the dominance of exotic vegetation.

Nonetheless, the area within the proposed site development footprint (outside of currently disturbed areas associated with Petersons Quarry) still retains some limited habitat value and provides resources for some terrestrial fauna species. Furthermore, the mosaic of pasture, remnant vegetation and regrowth across the entire site provides resources for species that are adapted to respond to a range of conditions. For example, mobile species adapted to foraging in open areas, but with specific or preferred requirements, will use such areas (e.g. Cattle Egrets). Habitat mosaics also increase the resources available to other fauna species (Law and Dickman 1998). For example, microbats may roost in woodland and forage in open areas, as do larger marsupials (e.g. kangaroos and wallabies).

As noted in **Section 4.1**, there is also the potential for direct and indirect impacts on adjacent habitats and associated flora and fauna species, without adequate controls.

Consequently, implementation of the following mitigation measures is recommended to reduce impacts on native flora and fauna to levels that will not cause significant or permanent harm:

- Restrict disturbance and access to areas absolutely necessary for the construction and the operation of the Project. Clearly cordon off all adjacent vegetation and buffer extents that are not to be disturbed from clearing activities, creating ‘no go zones’ for vehicles, materials, machinery, workers, excavated soil or fallen timber.
- Implement strict controls on construction and operational/maintenance activities that encroach into buffer areas around EECs, wetlands and known populations/habitats of significant species.
- Implement measures to avoid the spill of earth and rock downslope of the quarry footprint into areas of retained vegetation.
- Design and install temporary erosion control measures to avoid impacts on retained vegetation downslope of the quarry footprint.
- Leave ground layer vegetation (grasses and herbs) in situ wherever possible to assist soil stability. Mulching of heavily disturbed areas can assist in reducing soil erosion. Where necessary, temporary interception devices such as hay bales or geotextile fabric fencing can be employed to slow stormwater and intercept sediment.
- Non-millable vegetation can be mulched and used in rehabilitation or soil stabilisation works, provided no weeds are incorporated into the mulch.
- Consider the installation of nest boxes in areas where hollow-bearing trees must be removed and relocate large fallen logs and boulder piles to adjacent habitat to increase sheltering opportunities for displaced animals where it is not feasible to avoid such features during clearing.
- Ensure a fauna spotter/catcher is present during clearing and site preparation works to:

  - Check habitat (vegetation, logs, rock outcrops) for fauna and breeding sites,
  - Check any stored materials, including stockpiled timber, prior to removal,
  - Check temporary excavations for trapped fauna, and
  - Ensure appropriate treatment of injured/orphaned animals through liaison with local Wildlife Carers.

- Establish 'go slow zones' (40km/hr) for vehicles and machinery where non-gazetted roads or tracks are located adjacent to patches of native vegetation communities.
- Limit construction and operational work to daylight hours as far as practicable, and any lighting within outdoor areas should comply with relevant Australian Standards and be of low spillage, with no or limited upward spillage.
- Minimise vehicle and machinery access and subsequent soil compaction and weed transfer risk within and adjacent to retained vegetation.
- Undertake regular monitoring of the health and condition of retained vegetation and habitat, and the health of significant plant specimens.
- Undertake regular monitoring of road kills.
- Educate the workforce on the location of significant/sensitive communities and species and potential impacts from unauthorised activities.
- Develop and implement an Environmental Management Plan (EMP) that includes the following components to reduce secondary impacts on terrestrial flora, fauna and ecosystems:
  - Threatened species management,
  - Noise and dust suppression,
  - Weed management,
  - Management of environmental flows, runoff quality, erosion and sediment,
  - Fuel, chemical spill and waste management, and
  - Waste management.

Mitigation strategies relevant to the components of the EMP are outlined below in more detail for inclusion in the EMP. Management of erosion and sedimentation, soil and water contamination, environmental flows, noise, dust, vibration and chemical and oil spill management are standard components of Environmental Management Plans and are addressed within other specialist reports for the Project.

The EMP will also address rehabilitation of the site post-operation. It is understood such rehabilitation will be limited to that necessary to return the site to a safe, stable, non-polluting state, suitable for reinstatement of previous land use (i.e. rural – cattle grazing).

Threatened Species Management

Macadamia tetraphylla

As noted in **Section 4.2.1**, original development plans have been modified to allow the retention of four specimens of *Macadamia tetraphylla* together with a 25 m buffer to be established and maintained around the plants. This far exceeds the minimum tree protection zone recommended within AS 4970-2009 "Protection of trees on development sites", which specifies a buffer radius equivalent to 12 times the stem diameter at breast height to minimise direct impacts to tree canopies and root zones (Standards Australia 2009). A larger (25 m) buffer is appropriate for this site, given the threatened status of the plants and the scale of the adjacent development and associated, potential impacts from dust and soil compaction.

The locations of the plants and the 25 m buffer will be clearly marked to facilitate onsite recognition, and will be recorded in all relevant quarry documentation for future reference. The 25 m buffer will also be managed, such that existing weed infestations will be removed from within the buffer area. In-fill planting and edge-seal planting of native species will also be undertaken to minimise the effect of further weed intrusion. The retention of a 25 metre buffer enhanced and maintained in this way is expected to improve existing habitat condition such that the plants' chances of survival are at least equivalent to their chances of survival if the development was not to occur.

Collection and storage of seeds from the existing plants is also recommended as insurance against potential mortality due to quarrying operations.

Regular monitoring of the existing plants and habitat within the surrounding buffer is also recommended, intended at detecting major changes to plant health and habitat conditions for informing adaptive management strategies. The monitoring is also intended to record detectable alterations to hydrology and water quality caused by the proposed stockpile area. It is anticipated that these factors will be managed by installing a physical barrier to minimise build-up of sedimentation, nutrients and weed propagules into the buffer.

A more detailed account of the proposed management actions for this species is provided in **Table 4.1**.

Black-necked Stork

Although previous studies indicate a Black-necked Stork once nested in a Hoop Pine located within the centre of the dry rainforest community occurring in the centre of the study area (refer **Figure 3-1**), targeted searches undertaken as part of the current field survey found no active nests in any of the trees within this community, nor was any evidence of recent nesting activity found. Therefore, Black-necked Stork does not currently utilise these trees for nesting. However, this vegetation continues to provide potential breeding resources, and there is a small possibility this species may utilise this habitat for nesting in the future.

Accordingly, it is recommended a fauna spotter/catcher is engaged to regularly (i.e. fortnightly) inspect the Hoop Pine dry rainforest community for signs of nesting throughout the construction phase of the project where this coincides with the breeding season for Black-necked Stork (May to January, inclusive). If any nesting activity is identified, a species management plan is to be developed and implemented that ensures any impacts to this species are not significant.

Weed Management

The proliferation of weed species in the landscape can have a serious effect on biodiversity values and ecosystem function. Pest plants may be controlled by:

- Limiting the introduction of weeds and weed propagules into the area of interest,
- Rapidly controlling any weeds that become established on the site,
- Regular monitoring of the area of interest, and
- Preparing a control/eradication plan with follow up action when and where needed.

The following actions should be taken during the life of the Project to reduce the possibility of weeds (or their propagules) entering the site:

- Regularly survey disturbance areas and haul/access roads, and identify and remove any new infestations of invasive weeds encountered. Treatment needs to take place in accordance with local and regional Pest Management Plans and State government recommendations.
- Ensure onsite personnel undertake appropriate training in vehicle hygiene and weed awareness and identification.
- Prepare a car park (preferably gravelled) to house all vehicles entering the site offices. The car park would be regularly checked for any weeds and treated.
- Prepare wash down areas and/or utilise Council approved wash down facilities for any machinery or vehicles entering the Project area that have been working outside of the local area.
- Obtain pest free certification for any soil, fill, mulch, etc entering the site.
- Appoint a person responsible for regularly monitoring for potential pest occurrences (and treatment if required) of equipment, vehicles, machinery and materials (including soil, mulch, fill) entering the site.
- Maximise the diversity and cover of native species when revegetating disturbed areas.

4.2.3 Residual Impacts

The Project is not expected to result in the direct loss of any significant biodiversity values and, once the proposed mitigation measures are implemented, the remaining impacts of the Project on terrestrial ecological values are predicted to be minor or negligible, particularly in the context of existing site conditions and current impacts from previous land clearing, weed invasion and the presence of livestock. Hence offsets to compensate for residual impacts are not considered necessary.

Table 4.1. Management Actions to avoid and mitigate impacts to *Macadamia tetraphylla*

Performance Objective	Implementation Strategy	Performance Indicators	Responsibilities, Reporting	Timing and Frequency
On-site establishment of procedures and responsibilities	A pre-start meeting is to be arranged by the Principal to clearly define roles and the approach to *Macadamia tetraphylla* management.	Pre-start meeting is undertaken and all site workers are informed of their obligations with regard to *Macadamia tetraphylla* protection.	The Principal to liaise with the Project Manager and EO throughout construction and operation	Prior to commencing works.
Backup propagation material is collected for *Macadamia tetraphylla*	Seeds are collected for use as backup propagation source if mortality of existing *Macadamia tetraphylla* individuals occurs following clearing.	Seeds are stored and viable	Nursery / ecology contractor	Prior to commencing works and every 12 months following clearing.
Edge-seal planting of the 25 metre buffer perimeter	The perimeter of the 25 m buffer is planted with locally native species to prevent weed intrusion.	The tubestock seedlings are well established and in healthy condition.	Nursery / ecology contractor	Post Clearing
Macadamia tetraphylla and vegetation monitoring	Undertake regular monitoring of the health of the retained *Macadamia tetraphylla* specimens and surrounding vegetation. Ensure monitoring is conducted by personnel experienced in flora surveying. Ensure onsite personnel do not disturb (i.e. trample) retained or regenerated vegetation.	A monitoring program has been implemented and monitoring is occurring at the specified times. Observer/s are experienced in flora monitoring. Undue trampling of vegetation is not evident.	Ecologist undertakes monitoring and a summary report detailing the results of the monitoring is compiled and presented to the Site Manager	After two weeks, six weeks and three months, then on a bi-annual basis for two years following completion of works
Removal of major weed infestation* within the buffer	Any major weed infestation within the 25 metre buffer will be removed appropriately.	Weeds are controlled** to a manageable state.	Nursery / ecology contractor	Targeted weed removal is to be undertaken immediately after the clearing and if adaptive management is triggered during monitoring thereafter.

* Major weed infestations would include any occurrence of Weeds of National Significance, and/or an infestation of any other recognised environmental weed that could threaten the survival of the retained *Macadamia tetraphylla* specimens or surrounding native vegetation, as determined by routine monitoring.

** Species-specific control methods are to be used in accordance with State government guidelines.

4.3 MATTERS OF NATIONAL ENVIRONMENTAL SIGNIFICANCE

Under the EPBC Act an action would require approval from the Minister if the action has, will have, or is likely to have, a significant impact on a matter of national environmental significance (MNES).

MNES relevant to terrestrial ecology have been addressed throughout this report as part of the existing environment and impact assessment process, and it is concluded that there are no such MNES for which proposed measures of avoidance and mitigation are unable to reduce impacts to insignificant levels. In particular:

- Original development plans have been modified to allow the retention of the four specimens of *Macadamia tetraphylla* recorded within the study area, with a 25 m buffer established and maintained around the plants. This development design, along with further management actions proposed to avoid and mitigate impacts to these plants, suggests any impacts are highly unlikely to be significant.
- Although Koala habitat occurs in close proximity to the study area, and Koalas may also occur occasionally within the study area, consideration of the results of a habitat assessment performed in accordance with the EPBC Act referral guidelines for Koala (DoE 2014) indicates a referral to the Commonwealth in relation to impacts on this species is not necessary at this time.
- A number of listed Migratory species are known or considered likely to utilise the study area for foraging and, potentially, breeding. However, the local region has not been identified as supporting an ecologically significant proportion of habitat for any of these species, which are all common and widely distributed, and are neither known to be declining nor at the limit of their range within the study area.
- The proposed site development footprint has been positioned to avoid the clearing and fragmentation of the relatively large, well-connected tracts of vegetation and associated habitat within the study area, and avoids all patches of vegetation that have greatest value to the majority of known or potentially occurring terrestrial flora and fauna species. No wetlands or other important habitat for threatened flora and fauna species as identified during the site survey and recognised on local government mapping will be directly impacted. Buffers will also be retained between the recognised vegetation communities (and wetlands) and the edge of the proposed site disturbance footprint, to further prevent secondary impacts.

Overall, the findings of this assessment indicate that, provided the impact mitigation measures outlined in this report are successfully implemented, there are no predicted significant impacts on any species listed as threatened or migratory under the EPBC Act. Accordingly, a referral to the Commonwealth in relation to impacts on species listed under the EPBC Act is not considered necessary at this time.

4.4 MATTERS OF LOCAL ENVIRONMENTAL SIGNIFICANCE

Matters of local ecological significance have been addressed throughout this report as part of the existing environment and impact assessment process, and it is concluded that there are no such matters for which proposed measures of avoidance and mitigation are unable to reduce impacts to insignificant levels. In particular:

- The proposed site development footprint has been positioned such that no wetlands or other important habitat for threatened flora and fauna species as identified during the site survey and recognised on local government mapping will be directly impacted. Buffers will also be retained between the recognised vegetation communities (and wetlands) and the edge of the proposed site disturbance footprint, to further prevent secondary impacts.
- The current field survey found no active nests of Black-necked Stork in any of the trees within this community, nor was any evidence of recent nesting activity found. Therefore Black-necked Stork is unlikely to currently utilise these trees for nesting.

5.0 REFERENCES

AKF (2008). Richmond Valley Koala Habitat Atlas. Report prepared for Richmond Valley Council.

AKF (2015). Koala Map. Australian Koala Foundation. https://www.savetheKoala.com/Koala-map

Bennett, A, Kimber, S & Ryan, P (2000). 'Revegetation and wildlife: A guide to enhancing revegetated habitats for wildlife conservation in rural environments.' Environment Australia, Canberra.

Brumm, H and Slabbekoorn, H (2005). 'Acoustic Communication in Noise'. In: Slater P J B, Snowdon, C T, Roper T J, Brockmann H J and Naguib M (Eds). *Advances in the Study of Behavior, Volume 35*. Academic Press, London, United Kingdom: pp. 151-209.

Department of Environment, Climate Change and Water (DECCW) (2006). NSW Wetlands: dataset. NSW Department of Environment, Climate Change and Water, Sydney.

Department of the Environment (DoE) (2014). EPBC Act referral guidelines for the vulnerable Koala (combined populations of Queensland, New South Wales and the Australian Capital Territory). Department of the Environment, Canberra.

Department of the Environment (DoE) (2015). Australia's bioregions (IBRA): dataset. Accessed via http://www.environment.gov.au/land/nrs/science/ibra

Farmer, AM (1993). The effects of dust on vegetation. *Environmental Pollution*, **79**: 63-75.

Law, BS and Dickman, CR (1998). 'The use of habitat mosaics by terrestrial vertebrate fauna: implications for conservation and management.' *Biodiversity and Conservation*, **7**: 323-333.

Longcore, T and Rich, C (2004). 'Ecological light pollution.' *Frontiers in Ecology and the Environment* **2**: 191–198.

Murcia, C (1995). 'Edge effects in fragmented forests: implications for conservation.' *Trends in Ecology & Evolution*, **10**: 58-62.

Office of Environment and Heritage New South Wales (OEH) (2015a). Mitchell Landscapes (version 3): dataset. Accessed via http://mapdata.environment.nsw.gov.au/geonetwork/srv/en/metadata.show?uuid={E8403EB4-C4D5-4AF2-BE49-EF4C31351D1D}

Office of Environment and Heritage New South Wales (OEH) (2015b). NSW Wetlands: dataset. Accessed via http://mapdata.environment.nsw.gov.au/geonetwork/srv/en/metadata.show?uuid={047C7B65-9A12-4AE5-9BB1-2EFED60D34E3}

Office of Environment and Heritage New South Wales (OEH) (2015c). A Vegetation Map for the Northern Rivers Catchment Management Authority to support application of the Biodiversity Forecasting Toolkit VIS_ID 524. Accessed via http://mapdata.environment.nsw.gov.au/geonetwork/srv/en/metadata.show?uuid={FDB0706B-7B33-431F-9931-47F6D98DE123}

Office of Environment and Heritage New South Wales (OEH) (2015d). Threatened Species Profiles Database. http://www.environment.nsw.gov.au/threatenedSpeciesApp/

Richmond Valley Council (RVC) (2015a). Richmond Valley Local Environmental Plan 2012: Terrestrial Biodiversity Map (Sheet BIO_009). http://143.119.201.4/map/6610_COM_BIO_009_080_20120131.pdf?id=b3282737-949c-e500-a8b1-85fad5e142be

Richmond Valley Council (RVC) (2015b). Richmond Valley Local Environmental Plan 2012: Wetlands Map / Riparian Land and Waterways Map (Sheet _CL1_009). http://143.119.201.4/map/6610_COM_CL1_009_080_20120131.pdf?id=c8355a6d-fe2f-e837-c76c-e119e8097acf

Richmond Valley Council (RVC) (2015c). Richmond Valley Koala Habitat Atlas Derivative Map. http://www.richmondvalley.nsw.gov.au/icms_docs/137671_Richmond_Valley_Koala_Habitat_Atlas_Derivative_Map.pdf

Sharifi, MR, Gibson, AC and Rundel, PW (1997). Surface dust impacts on gas exchange in Mojave desert shrubs. *Journal of Applied Ecology*, 34(4):837-846.

Standards Australia (2009). AS 4970-2009 Protection of trees on development sites. Standards Australia, Sydney

Thompson, JR, Mueller, PW, Fluckiger, W, Rutter, AJ. **(1984)**. The effect of dust on photosynthesis and its significance for roadside plants. *Environmental Pollution* (Series A), **34**: 171-190.

Threatened Species Scientific Committee (TSSC) (2011). Commonwealth listing advice on Lowland Rainforest of Subtropical Australia. http://www.environment.gov.au/biodiversity/threatened/communities/pubs/101-listing-advice.pdf (accessed 20/07/15).

APPENDIX 1

Results of preliminary ecological investigation

BAAM
ECOLOGICAL CONSULTANTS

specialised ecological knowledge
that reduces your risk

28/05/2015

Jim Lawler
Team Leader - Planning
Groundwork Plus

Dear Jim,

RE: PRELIMINARY ECOLOGICAL INVESTIGATION – CORAKI QUARRY

BACKGROUND

Quarry Solutions Pty Ltd is seeking to develop an extractive industry operation (quarry) on Lot 401 on DP633427, located on Seelems Road at Coraki in NSW. As part of the preparations for a development application, BAAM were engaged by Ground Plus on behalf of Quarry Solutions Pty Ltd to undertake a preliminary assessment of ecological values on the site, including a brief desktop review and site investigation. In particular, advice was sought on matters of national environmental significance (MNES) that may trigger a referral under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act), as well as any noteworthy State or local matters.

The field investigation was undertaken by Dr Lindsay Popple (Senior Ecologist ay BAAM) on 22 April 2015. Initial onsite observations confirmed the site was largely devoid of native vegetation and had been used for grazing livestock, particularly within the area nominated for the main quarry pit (**Photo 1**).

Photo 1: typical site view

In terms of MNES, the primary issues derived from the desktop review were the potential presence of Hairy-joint Grass *Arthraxon hispidus* (Vulnerable – EPBC Act), including/particularly within cleared areas, and the Lowland Rainforests of Subtropical Australia Threatened Ecological Community (Critically Endangered – EPBC Act) in association with drainage lines on the property. The site investigation revealed that neither of these occurs within the subject area. In particular, targeted searches for *Arthraxon hispidus* revealed no specimens, while the only vegetation that could have represented the Rainforest TEC (based on aerial photography) was found to be dominated by Camphor Laurel and Lantana. No other TECs, threatened plants or important habitat for threatened fauna (listed under the EPBC Act) were found to occur within the subject area. However, it is considered that it would be prudent for quarry designs to establish a sufficient buffer to nearby wetlands (**Photo 2**), which may provide habitat for migratory species (some of which are also threatened).

Photo 2: nearby wetland

It was also noted that vegetation on the neighbouring properties may contain the Rainforest TEC, such that sufficient buffers to neighbouring vegetation should be established.

In terms of other potential constraints, it was confirmed by the client representatives present during the site investigations that they intend to remove a number of native trees, including some large Hoop Pines and Figs (**Photo 3**). These do not occur as part of any remnant vegetation communities on site, and a review of the Richmond Valley Planning documentation (Local Environmental Plan and Development Control Plan) suggests there are no restrictions on the removal of these species on private property. However, it would be advisable to confirm this with Council.

There was also mention of a Black-necked Stork (listed as Endangered in NSW) nesting in one of the Hoop Pines near the site in the recent past. The tree shown to Dr Popple showed no signs of nesting, although this may not have been the correct tree and it is not currently breeding season for this species. It would therefore be advisable to check the requirements with Council, assuming they are aware of the past record.

Photo 3: hoop pine to be removed

Otherwise, we don't believe the subject area holds any notable value for flora or fauna species of significance. The site is also not constrained by Richmond Valley Council's Koala habitat or terrestrial biodiversity mapping, which we consider an accurate representation of the limited values present.

We trust this information is suitable for your purposes. Please do not hesitate to contact us on 3286 7788 if you have any queries.

Yours sincerely

Jedd Appleton
Director / Project Delivery Manager
Biodiversity Assessment and Management Pty Ltd

APPENDIX 2

Correspondence from EOH and Primary Industries NSW confirming required level of assessment

NSW GOVERNMENT
Office of Environment & Heritage

RECEIVED
29 JUN 2015
BY: KB

Your reference SSD15_7036
Our reference: DOC15/215377
Contact Krister Waern (02) 6640 2503

Mr Jim Lawler
Team Leader - Planning
Groundwork Plus
PO Box 1779
Milton QLD 4064

Dear Mr Lawler

Re: OEH Environmental Assessment Requirements – Proposed Coraki Quarry, Richmond Valley local government area (SSD15_7036)

Thank you for your email dated 28 May 2015 seeking clarification from the Office of Environment and Heritage (OEH) in relation to the proposed State Significant Development (SSD) application above, particularly in relation to the use of the Framework for Biodiversity Assessment (FBA).

I understand that your environmental consultant Biodiversity Assessment and Management (BAAM) has advised you that due to the lack of biodiversity on the site, they anticipate that no offsets would be required under the BioBanking process. To support this advice, BAAM has undertaken a preliminary ecological investigation, which you have forwarded to OEH.

The BAAM preliminary ecological report states:

a) The site is largely devoid of native vegetation and has been used for grazing;
b) Targeted searches for Hairy Jointgrass (*Arthraxon hispidus*) revealed no specimens;
c) No threatened ecological communities, threatened plants or important habitat for threatened fauna were found to occur within the subject area, and;
d) The report recommended that sufficient buffers are established between the proposed quarry and the nearby wetland and to vegetation occurring on neighbouring properties.

Due to the degraded state of the subject site, OEH will not require that the FBA be used to assess the biodiversity values of the site and the impacts of the proposal on this occasion. However, the Environmental Impact Statement for the quarry will still need to address biodiversity values of the site in enough detail to ensure OEH can assess the proposal.

Please note, that, contrary to the BAAM preliminary ecological report, if biodiversity values are found on the site or the proposed quarry expansion will have indirect impacts on nearby biodiversity values, the applicant will need to address these biodiversity impacts through the FBA.

If you require any further information or clarification regarding this matter please contact Mr Krister Waern, Senior Operations Officer, on (02) 6640 2503.

Yours sincerely

Dimitri Young 22 June 2015

DIMITRI YOUNG
Senior Team Leader Planning, North East Region
Regional Operations

Locked Bag 914, Coffs Harbour NSW 2450
Federation House Level 7, 24 Moonee Street,
Coffs Harbour NSW 2450
Tel: (02) 6651 5946 Fax: (02) 6651 6187
ABN 30 841 387 271
www.environment.nsw.gov.au

From: Cressida Gilmore <cressida.gilmore@trade.nsw.gov.au>
Sent: Thursday, 28 May 2015 2:36 PM
To: Jim Lawler
Subject: EMI_150528_Cressida Gilmore_SSD 15 7036 Coraki Quarry - clarification of aquatic habitat protection requirements

Hi Jim,
I've looked into this issue. Our response (OUT15/10606) included Attachment B which is a bit of a legacy from when we were all in the same department a few years back and coordinated advice. We have been asked to continue doing this by Fisheries to cover any potential gaps in the correspondence chain following restructures within the Department. When I went and checked the DPI response however - OUT15/11867 (have you seen this?) it says that Fisheries have no issues. So that's some cause for confusion really isn't it! I got in touch with Pat Dwyer who is the Fisheries contact for this proposal and he has responded as per below. Hopefully this clarifies things for you?
Regards,
Cressida

"On behalf of Fisheries NSW I have indicated that there are no fisheries issues. Specifically no aspects of the works trigger the need for any approvals under the Fisheries Management Act. I do note however that the works are on the Richmond floodplain and are just a bit more than 50m from a very near a floodplain lagoon which is within the site boundary but not the works footprint (based on the concept site layout plan which remains attached). I suspect the works will trigger NSW Office of Water approvals. Cognisant of this I am happy for the proponent to be advised that the present proposal does not raise Fisheries issues. Because of the floodplain lagoon on the property it is possible that redesign or modification of the proposal might result in a need to consult Fisheries.
I would be the contact."
PAT

Patrick Dwyer | A/Regional Manager Aquatic Ecosystems (North)|
Aquaculture & Aquatic Environment **|** Primary Industries NSW
T 02 6626 1397 | F 02 6626 1377 | M 0407 264 391 | E patrick.dwyer@dpi.nsw.gov.au
W: www.industry.nsw.gov.au | www.dpi.nsw.gov.au
Postal Address: | 1243 Bruxner Hwy | Wollongbar NSW 2477 |

From: Jim Lawler [mailto:jlawler@groundwork.com.au]
Sent: Thursday, 28 May 2015 11:06 AM
To: cressida.gilmore@trade.nsw.gov.au
Subject: SSD 15 7036 Coraki Quarry - clarification of aquatic habitat protection requirements

Hi Cressida,

Firstly, thanks for your time on the phone earlier today. As discussed I am looking to connect with the relevant officer to clarify the matters raised in Attachment B ‘Primary Industries Division – Aquatic Habitat Protection Requirements’, of the departments letter dated 6 May 2015 (your ref OUT15/10606). I am looking to clarify a number of items all of which are associated with the requirement to conduct a ‘survey of fish species’ and other points such as the comments about ‘dredging and reclamation activities’.

As shown on the attached drawings which were included in the request for the Secretary’s Environmental Assessment Requirements (SEARs), the project area is outside of mapped waterways and aquatic habitat areas, on the top of a hill, adjacent to the existing Peterson Quarry run by the Richmond Valley Council. Specifically, no dredging is proposed. Importantly, it is intended to maintain at least a 40m buffer to the water way on the site, and of course surface water within the quarry area will be managed to achieve the relevant water quality objectives and release criteria that will be set by the EPA.

Accordingly, in our assessments and consideration of the project impacts we **do not** anticipate:

- Dredging
- Works within a water way
- Impacts or damage to marine vegetation
- Placement of spoil in waterways
- Activities that block fish passage
- Impacts to fishing and aquaculture.

I would like to clarify with the relevant officer the matters raised as I believe some of the requirements are not relevant in this instance, such as a fish survey and detailed assessment of the bed morphology and characteristics of the waterway. If you could let me know the best point of contact that would be greatly appreciated.

I note that we have no items of clarification regarding the Attachment A – Resource Assessment matters, as those were entirely anticipated given the nature of the project.

Kind regards,

Jim Lawler
Team Leader - Planning

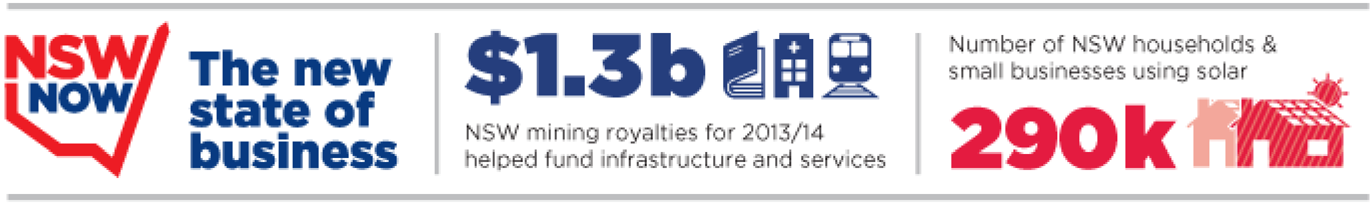
GROUNDWORK plus

GROUNDWORK Plus

Resources, Environment, Planning, Laboratories

6 Mayneview Street, MILTON QLD 4064 AUSTRALIA
(PO Box 1779, MILTON QLD 4064)

Ph: +61 7 3871 0411 Fax: +61 7 3367 3317
www.groundwork.com.au



APPENDIX 3

Vegetation survey data

Site #	Easting	Northing	Landform/ Geology	Vegetation Structure	Structure_Floristics_ Upper (Ht m_% Crown Cover)	Floristics Mid (Ht m_% Crown Cover)	Floristics Lower (Ht m_% Crown Cover)	Floristics Ground (Ht m_% Cover)	Biometric Number	Biometric Type	EEC	Notes
CQ2	525934	6795101	Margin of alluvial floodplain	Open forest.	Upper Ht 12-16m. Crown Cover 70%. _Eucalyptus tereticornis (15%), Melaleuca styphelioides (55%), Pentaceras australe (5%), Araucaria cunninghamii (<5%), Alphitonia excelsa (5%), Mallotus phillipensis (5%), Casuarina glauca (<5%)_	Mid 3-8m, 20%. _Glochidion ferdinandi (10%), Cupaniopsis parviflora (5%), Streblus brunonianus (5%), Alectryon tomentosus (5%), M. styphelioides (5%), Callistemon salignus (5%)_	Lower 1-4m, 10%. _Lantana camara*, Scolopia braunii, Cupaniopsis parviflora, Alectryon tomentosus, Maclura cochinchinensis, Carissa ovata, Flindersia australis, Araucaria cunninghamii, Breynia oblongifolia, Mallotus phillipensis, Alogyne ilicifolia, Callistemon salignus, Ligustrum sinense*, Ligustrum lucidum*_	Ground 0-1m, 90%. _Asparagus lumosus*, Commelina ensifolia, Aeferatum conyzioides*, Juncus usitatus, Doodia aspera, Eustrephus latifolius, Oplismenus aemulus, Plectranthus scutelllaroides, Carex sp., Senecio madagascarensis*_	NR161	Forest Red Gum - Swamp Box of the Clarence Valley lowlands of the North Coast	Sub-tropical Coastal Floodplain Forest of the NSW North Coast bioregion	Located on adjoining property to NE of site. Represents remnant vegetation on alluvial floodplain at margin with basalt footslopes. Grazing. Habitat trees.
CQ3	525677	6794861	Gently sloping basalt hills.	Grassland exotic	0	0	0	Ground 0-0.25m 100%. _Cynodon dactylon*, Pennisetum clandestina*, Senecio madagascarensis*, Gomphocarpus physocarpus*, Thesium vulgare*, Solanum mauritianum*_	NA	NA	NA	Grazed
CQ4	525509	6794859	Gently sloping basalt hills.	Grassland exotic	0	0	0	Ground 0-0.25m 100%. _Cynodon dactylon*, Pennisetum clandestina*, Senecio madagascarensis*, Gomphocarpus physocarpus*, Thesium vulgare*, Solanum mauritianum*_	NA	NA	NA	Grazed
CQ5	525450	6794983	Steep basalt hills	Thicket/ shrubland exotic dominated	Upper 2-6m, 30%. _Cinnamomum camphora*, Hibiscus heterophyllus, Mallotus phillipensis, Maclura cochinchinensis, Ligustrum lucidum*, Ligustrum sinense*, Alectryon tomentosum, Abutilon sp., Wickstroemia indica_	0	0	Ground 0-1m, 60%. _Cymbopogon refractus, Senecio madagascarensis*, Stephania japonica var. discolor, Tagetes minima*, Asparagus plumosus*, Thesium vulgare*_	NA	NA	NA	Heavily disturbed exotic dominated regrowth. Grazed
CQ6	525423	6795032	Steep basalt hills	Sedgeland/ grassland	0	0	0	Ground 0-0.25m, 95%. _Azolla pinnata, Juncus usitatus, Ludwigia peploides subsp. montevidensis, Paspalum sp.*, Senecio madagascarensis*, Cynodon dactylon*, Persicaria sp., Ranunculus inundatus_	NA	NA	NA	Heavily disturbed by cattle and exotic dominated. Micro community occuring as a result of a seepage spring upslope on the basalt hillsope. Not on a floodplain.
CQ7	525339	6794933	Steep basalt hills	Thicket/ shrubland exotic dominated	Upper 2-6m, 90%. _Caesalpinia decapetala*, Lantana camara* and Maclura cochinchinensis*_	0	0	0	NA	NA	NA	Heavily disturbed by cattle and exotic dominated. Grazed on margins.
CQ8	525022	6794879	Alluvial floodplain	Sedgeland/ grassland	Upper 4-6m, <5%. _Melaleuca alternifolia_	0	0	Ground 0-0.25m, 100%. _Carex appressa, Persicaria strigosa, Juncus usitatus, udwigia peploides subsp. montevidensis, Paspalum sp.*, Senecio_	NR105	Coastal freshwater meadows and forblands of lagoons and wetlands	Freshwater wetlands on coastal floodplains of the NSW North Coast,	Heavily disturbed by cattle grazing. Infested by water hyancinth. Drainage of oxbow impedd by rocky stock crossing. Adjoining

Site #	Easting	Northing	Landform/ Geology	Vegetation Structure	Structure_Floristics_ Upper (Ht m_% Crown Cover)	Floristics Mid (Ht m_% Crown Cover)	Floristics Lower (Ht m_% Crown Cover)	Floristics Ground (Ht m_% Cover)	Biometric Number	Biometric Type	EEC	Notes
								madagascarensis, Cynodon dactylon*, Ranunculus inundatus, Eichhornia crassipes*, Setaria sp., Digitaria didactyla, Leersia hexandra.*			Sydney Basin and South East Corner bioregions	open water is 15-20m wide with Azolla and water hyancinth. Persicaria strigosa creeps over edges and forms the dominant cover in places. Native grasses and sedges form 34% of cover with native herbs forming 66%. Linkages to Richmond River.
CQ9	524895	6795052	Alluvial floodplain	Woodland	Upper 10-15m, 13%. *Melaleuca quinquenervia, Casuarina glauca*	Mid 3-8m, 8%. *Maclura cochinchinensis, Acacia excelsa, Cupaniopsis parviflora, Lantana camara*, Asparagus plumosus**	0	Ground 0-0.25m 100%. Cynodon dactylon*, Pennisetum clandestinum*, Senecio madagascarensis*, Gomphocarpus physocarpus*, Thesium vulgare*, Solanum mauritianum*, Lantana camara*, Carex appessa, Dichondra repens, Centella asiatica*, Digitaria didactyla, Conyza sumatrensis*, Asclepias curvassica*, Oxalis cornicualta*, Sigsbeckia orientalis, Sida retusa*, Asparagus plumosus*, Axonopus compressus*, Oplismenus aemulus.	NR217	Paperbark swamp forest of the coastal lowlands of the North Coast	Swamp sclerophyll forest on coastal floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions	Heavily disturbed by cattle grazing. Adjoins degraded areas of freshwater wetland.
CQ10	524908	6794941	Alluvial floodplain	Grassland exotic	0	0	0	Ground 0-0.25m 100%. *Axonopus compressus*, Cynodon dactylon*, Senecio madagascarensis*, Gomphocarpus physocarpus*, Thesium vulgare*.*	NA	NA	NA	Heavily disturbed by cattle and exotic dominated. Grazed paddock.
CQ11	524873	6794949	Alluvial floodplain	Open forest	Upper 10-18m, 60%. *Eucalyptus tereticornis, Melaleuca quinquenervia, M. styphelioides, Callistemon salignus, Casuarina glauca.*	Mid 4-8m, 30%. *Maclura cochinchinensis, Alphitonia excelsa, Cupaniopsis parviflora, Lantana camara*, Asparagus plumosus*, Elaeocarpus obovatus, Streblus brunonianus.*	Lower 1-3m, 30%. *Lantana camara*, Maclura cochinchinensis, Breynia oblongifolia, Parsonsia straminea, Eustrephus latifolius, Alphitonia excelsa, Cupaniopsis parviflora, Asparagus plumosus*, Elaeocarpus obovatus, Streblus brunonianus. Epiphytes of Dendrobium liguliforme.*	Ground 0-0.25m 100%. *Asparagus plumosus*, Carex appressa, Axonopus compressus*, Cynodon dactylon*, Senecio madagascarensis*, Gomphocarpus physocarpus*, Rivina humilis*, Thesium vulgare*, Ipomoea cairica*.*	NR217	Paperbark swamp forest of the coastal lowlands of the North Coast	Swamp sclerophyll forest on coastal floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions	Disturbed by cattle grazing and weed infestation in ground and understorey. Adjoins degraded areas of freshwater wetland.

Site #	Easting	Northing	Landform/ Geology	Vegetation Structure	Structure_Floristics_ Upper (Ht m_% Crown Cover)	Floristics Mid (Ht m_% Crown Cover)	Floristics Lower (Ht m_% Crown Cover)	Floristics Ground (Ht m_% Cover)	Biometric Number	Biometric Type	EEC	Notes
CQ12	525328	6794784	Steep basalt hills	Closed forest (exotic)	Upper 10-15m, 70%. *Cinnamomum camphora* (dominant), Dysoxylum fraseranum, Mallotus phillipensis, Flindersia australis, Cryptocarya triplinervis*	Mid 4-8m, 30%. *Ligustrum lucidum*, Archidendron pruinosum, Mallotus phillipensis, C. triplinervis, Alectryon tomentosum, Breynia oblongifolia, Maclura cochinchinensis, Alphitonia excelsa, Cupaniopsis parviflora, Lantana camara*, Asparagus plumosus*, Elaeocarpus obovatus, Streblus brunonianus,*	Lower 1-4m, 10%. *Ligustrum lucidum*, Mallotus phillipensis, Breynia oblongifolia, Maclura cochinchinensis, Lantana camara*, Asparagus plumosus*.*	Ground 0-0.25m 10%. *Pandora baileyana, Ipomoea cairica*, Rivina humilis*, Stephania japonica var. dicolor, Dioscorea transversa, Passiflora subpetala*, Asparagus plumosus*.*	NA	NA	NA	Heavily disturbed exotic dominated regrowth. Potential to rehabilitate toward dry rainforest type through control of camphor, privet and asparagus fern.
CQ13	525304	6794628	Basalt hills	Closed forest	Upper 15-25m, 80%. *Araucaria cunninghamii (dominant), Cinnamomum camphora**	Mid 8-12m, 20%. *Araucaria cunninghamii (dominant), Cinnamomum camphora*, Alphitonia excelsa, Archidendron pruinosum, Mallotus phillipensis, Jagera psuedorhus, Callistemon salignus (margins).*	Lower 1-5m, 5%. *Maclura cochinchinensis, Mallotus phillipensis, Breynia oblongifolia, Lantana camara*, Asparagus plumosus*, Araucaria cunninghamii, Alphitonia excelsa, C. camphora*, Pandorea baileyana, Pittosporum revolutum, Smilax australis, Eustrephus latifolius, Abutilon sp., Alectryon tomentosum, Archidendron pruinosum, Streblus brunonianus, Alogyne ilicifolius, Cupaniopsis parvifolia, Notelaea longifolia, Ligustrum sinense*, L. lucidum*.*	Ground 0-0.25m <5%. *Rivina humilis*, Stephania japonica var. dicolor, Eustrephus latifolius*	NR179	Hoop Pine - Yellow Tulipwood dry rainforest of the North Coast	Lowland Rainforest in the NSW North Coast and Sydney Basin Bioregions	A simple forest dominated by Araucaria cunninghamii. Weed infested on margins with Camphor laurel, Privets, Passiflora subpeltata, Rivina humilis and Asparagus fern. Potential to rehabilitate toward dry rainforest type through control of camphor, privet and asparagus fern.
CQ14			Basalt hills	Plantings	Upper 4-6m, 50%. *Acacia melanoxylon, Melaleuca alternifolia, Eucalyptus microcorys, Commersonia bartramia, Melia azederach, Acacia disparrima, Casuarina glauca, Banksia integrifolia, Callistemon viminalis, Ficus macrophylla.*	0	0	0	NA	NA	NA	Amenity planting along either side of acces track.

APPENDIX 4

Vegetation condition (site value) scores

NR179: Hoop Pine - Yellow Tulipwood dry rainforest of the North Coast

Site attribute		**Site attribute score**				**Weighting for site attribute score**	**Benchmark Measure**	**Measure for Community Onsite**	**Score**
		0	1	2	3				
a	Native plant species richness	0–10%	>10 – <50% of benchmark	50 – <100% of benchmark	≥ benchmark	25	20	19	2
b	Native overstorey cover	0 – 10% or >200% of benchmark	> 10 – <50% or >150 – 200% of benchmark	50 – <100% or >100 – 150% of benchmark	Within benchmark	10	20-100	80	3
c	Native midstorey cover	0 – 10% or >200% of benchmark	> 10 – <50% or >150 – 200% of benchmark	50 – <100% or >100 – 150% of benchmark	Within benchmark	10	10-60	20	3
d	Native ground cover (grasses)	0 – 10% or >200% of benchmark	> 10 – <50% or >150 – 200% of benchmark	50 – <100% or >100 – 150% of benchmark	Within benchmark	2.5	0-25	0	3
e	Native ground cover (shrubs)	0 – 10% or >200% of benchmark	> 10 – <50% or >150 – 200% of benchmark	50 – <100% or >100 – 150% of benchmark	Within benchmark	2.5	5-25	5	3
f	Native ground cover (other)	0 – 10% or >200% of benchmark	> 10 – <50% or >150 – 200% of benchmark	50 – <100% or >100 – 150% of benchmark	Within benchmark	2.5	5-40	<5	2
g	Exotic plant cover (calculated as percentage of total ground and midstorey cover)	>66%	>33 – 66%	>5 – 33%	0 – 5%	5		>5 – 33%	2
h	Number of trees with hollows	0 (unless benchmark includes zero)	>0 – <50% of benchmark (or if zero included)	50 – <100% of benchmark	≥ benchmark	20	0	0	3
i	Proportion of over-storey species occurring as regeneration	0	>0 – <50%	50 – <100%	100%	12.5		66%	2
j	Total length of fallen logs	0 – 10% of benchmark	>10 – <50% of benchmark	50 – <100% of benchmark	≥ benchmark	10	0.5	0	0

NR161: Forest Red Gum - Swamp Box of the Clarence Valley lowlands of the North Coast

Site attribute		**Site attribute score**				**Weighting for site attribute score**	**Benchmark Measure**	**Measure for Community Onsite**	**Score**
		0	1	2	3				
a	Native plant species richness	0–10%	>10 – <50% of benchmark	50 – <100% of benchmark	≥ benchmark	25	35	25	2
b	Native overstorey cover	0 – 10% or >200% of benchmark	> 10 – <50% or >150 – 200% of benchmark	50 – <100% or >100 – 150% of benchmark	Within benchmark	10	10-35	70	1
c	Native midstorey cover	0 – 10% or >200% of benchmark	> 10 – <50% or >150 – 200% of benchmark	50 – <100% or >100 – 150% of benchmark	Within benchmark	10	5-18	20	2
d	Native ground cover (grasses)	0 – 10% or >200% of benchmark	> 10 – <50% or >150 – 200% of benchmark	50 – <100% or >100 – 150% of benchmark	Within benchmark	2.5	10-60	5	1
e	Native ground cover (shrubs)	0 – 10% or >200% of benchmark	> 10 – <50% or >150 – 200% of benchmark	50 – <100% or >100 – 150% of benchmark	Within benchmark	2.5	0-40	5	3
f	Native ground cover (other)	0 – 10% or >200% of benchmark	> 10 – <50% or >150 – 200% of benchmark	50 – <100% or >100 – 150% of benchmark	Within benchmark	2.5	5-60	90	2
g	Exotic plant cover (calculated as percentage of total ground and midstorey cover)	>66%	>33 – 66%	>5 – 33%	0 – 5%	5		>5 – 33%	2
h	Number of trees with hollows	0 (unless benchmark includes zero)	>0 – <50% of benchmark (or if zero included)	50 – <100% of benchmark	≥ benchmark	20	1	1	3
i	Proportion of over-storey species occurring as regeneration	0	>0 – <50%	50 – <100%	100%	12.5		40%	1
j	Total length of fallen logs	0 – 10% of benchmark	>10 – <50% of benchmark	50 – <100% of benchmark	≥ benchmark	10	5	2	1

NR217: Paperbark swamp forest of the coastal lowlands of the North Coast

Site attribute		**Site attribute score**				**Weighting for site attribute score**	**Benchmark Measure**	**Measure for Community Onsite**	**Score**
		0	1	2	3				
a	Native plant species richness	0–10%	>10 – <50% of benchmark	50 – <100% of benchmark	≥ benchmark	25	6	10	3
b	Native overstorey cover	0 – 10% or >200% of benchmark	> 10 – <50% or >150 – 200% of benchmark	50 – <100% or >100 – 150% of benchmark	Within benchmark	10	10-70	14	3
c	Native midstorey cover	0 – 10% or >200% of benchmark	> 10 – <50% or >150 – 200% of benchmark	50 – <100% or >100 – 150% of benchmark	Within benchmark	10	0-80	11	3
d	Native ground cover (grasses)	0 – 10% or >200% of benchmark	> 10 – <50% or >150 – 200% of benchmark	50 – <100% or >100 – 150% of benchmark	Within benchmark	2.5	0-50	24	3
e	Native ground cover (shrubs)	0 – 10% or >200% of benchmark	> 10 – <50% or >150 – 200% of benchmark	50 – <100% or >100 – 150% of benchmark	Within benchmark	2.5	0-60	0	3
f	Native ground cover (other)	0 – 10% or >200% of benchmark	> 10 – <50% or >150 – 200% of benchmark	50 – <100% or >100 – 150% of benchmark	Within benchmark	2.5	5-60	>5	3
g	Exotic plant cover (calculated as percentage of total ground and midstorey cover)	>66%	>33 – 66%	>5 – 33%	0 – 5%	5		64	1
h	Number of trees with hollows	0 (unless benchmark includes zero)	>0 – <50% of benchmark (or if zero included)	50 – <100% of benchmark	≥ benchmark	20	0.1	0	0
i	Proportion of over-storey species occurring as regeneration	0	>0 – <50%	50 – <100%	100%	12.5		20%	1
j	Total length of fallen logs	0 – 10% of benchmark	>10 – <50% of benchmark	50 – <100% of benchmark	≥ benchmark	10	5	0	0

NR150: Coastal freshwater meadows and forblands of lagoons and wetlands

Site attribute		Site attribute score				Weighting for site attribute score	Benchmark Measure	Measure for Community Onsite	Score
		0	1	2	3				
a	Native plant species richness	0–10%	>10 – <50% of benchmark	50 – <100% of benchmark	≥ benchmark	25	5	9	3
b	Native overstorey cover	0 – 10% or >200% of benchmark	> 10 – <50% or >150 – 200% of benchmark	50 – <100% or >100 – 150% of benchmark	Within benchmark	10	0-5	<5	3
c	Native midstorey cover	0 – 10% or >200% of benchmark	> 10 – <50% or >150 – 200% of benchmark	50 – <100% or >100 – 150% of benchmark	Within benchmark	10	0-5	0	3
d	Native ground cover (grasses)	0 – 10% or >200% of benchmark	> 10 – <50% or >150 – 200% of benchmark	50 – <100% or >100 – 150% of benchmark	Within benchmark	2.5	0-80	34	3
e	Native ground cover (shrubs)	0 – 10% or >200% of benchmark	> 10 – <50% or >150 – 200% of benchmark	50 – <100% or >100 – 150% of benchmark	Within benchmark	2.5	0-10	0	3
f	Native ground cover (other)	0 – 10% or >200% of benchmark	> 10 – <50% or >150 – 200% of benchmark	50 – <100% or >100 – 150% of benchmark	Within benchmark	2.5	2-70	64	3
g	Exotic plant cover (calculated as percentage of total ground and midstorey cover)	>66%	>33 – 66%	>5 – 33%	0 – 5%	5		<5%	3
h	Number of trees with hollows	0 (unless benchmark includes zero)	>0 – <50% of benchmark (or if zero included)	50 – <100% of benchmark	≥ benchmark	20	0	0	3
i	Proportion of over-storey species occurring as regeneration	0	>0 – <50%	50 – <100%	100%	12.5		0	0
j	Total length of fallen logs	0 – 10% of benchmark	>10 – <50% of benchmark	50 – <100% of benchmark	≥ benchmark	10	0	0	3

APPENDIX 5

Database searches

Data from the BioNet Atlas of NSW Wildlife website, which holds records from a number of custodians. The data are only indicative and cannot be considered a comprehensive inventory, and may contain errors and omissions. Species listed under the Sensitive Species Data Policy may have their locations denatured (^ rounded to 0.1Â°; ^^ rounded to 0.01Â°). Copyright the State of NSW through the Office of Environment and Heritage. Search criteria : Public Report of all Valid Records of Entities in selected area [North: -28.92 West: 153.2 East: 153.31 South: -29.02] returned a total of 612 records of 222 species.
Report generated on 3/07/2015 1:50 PM

Kingdom	Class	Family	Species Code	Scientific Name	Exotic	Common Name	NSW status	Comm. status	Records	Info
Animalia	Amphibia	Bufonidae	3269	*Rhinella marina*	*	Cane Toad			8	
Animalia	Reptilia	Typhlopidae	2599	*Ramphotyphlops nigrescens*		Blackish Blind Snake	P		2	
Animalia	Reptilia	Typhlopidae	2603	*Ramphotyphlops proximus*		Proximus Blind Snake	P		1	
Animalia	Reptilia	Boidae	2625	*Morelia spilota*		Carpet & Diamond Pythons	P		1	
Animalia	Aves	Phasianidae	0012	*Excalfactoria chinensis*		King Quail	P		1	
Animalia	Aves	Anseranatidae	0199	*Anseranas semipalmata*		Magpie Goose	V,P		2	ℹ
Animalia	Aves	Anatidae	0211	*Anas gracilis*		Grey Teal	P		2	
Animalia	Aves	Anatidae	0208	*Anas superciliosa*		Pacific Black Duck	P		26	
Animalia	Aves	Columbidae	0028	*Columba leucomela*		White-headed Pigeon	P		1	
Animalia	Aves	Columbidae	0032	*Geopelia humeralis*		Bar-shouldered Dove	P		1	
Animalia	Aves	Columbidae	9931	*Geopelia striata*		Peaceful Dove	P		1	
Animalia	Aves	Anhingidae	8731	*Anhinga novaehollandiae*		Australasian Darter	P		1	
Animalia	Aves	Ciconiidae	0183	*Ephippiorhynchus asiaticus*		Black-necked Stork	E1,P		78	ℹ
Animalia	Aves	Ardeidae	0977	*Ardea ibis*		Cattle Egret	P	C,J	1	
Animalia	Aves	Ardeidae	0186	*Ardea intermedia*		Intermediate Egret	P		2	
Animalia	Aves	Ardeidae	8703	*Ixobrychus dubius*		Australian Little Bittern	P		1	

Animalia	Aves	Ardeidae	0196	*Ixobrychus flavicollis*	Black Bittern	V,P		1	ℹ
Animalia	Aves	Threskiornithidae	0178	*Plegadis falcinellus*	Glossy Ibis	P	C	2	
Animalia	Aves	Threskiornithidae	0180	*Threskiornis spinicollis*	Straw-necked Ibis	P		1	
Animalia	Aves	Accipitridae	0226	*Haliaeetus leucogaster*	White-bellied Sea-Eagle	P	C	1	
Animalia	Aves	Accipitridae	8739	^^*Pandion cristatus*	Eastern Osprey	V,P,3		2	ℹ
Animalia	Aves	Rallidae	0056	*Gallinula tenebrosa*	Dusky Moorhen	P		1	
Animalia	Aves	Charadriidae	0135	*Vanellus tricolor*	Banded Lapwing	P		1	
Animalia	Aves	Jacanidae	0171	*Irediparra gallinacea*	Comb-crested Jacana	V,P		1	ℹ
Animalia	Aves	Scolopacidae	0978	*Calidris melanotos*	Pectoral Sandpiper	P	J,K	1	
Animalia	Aves	Turnicidae	0013	*Turnix maculosus*	Red-backed Button-quail	V,P		1	ℹ
Animalia	Aves	Turnicidae	0019	*Turnix pyrrhothorax*	Red-chested Button-quail	P		1	
Animalia	Aves	Laridae	0110	*Chlidonias hybrida*	Whiskered Tern	P		1	
Animalia	Aves	Cacatuidae	0273	*Eolophus roseicapillus*	Galah	P		1	
Animalia	Aves	Psittacidae	0288	*Platycercus eximius*	Eastern Rosella	P		1	
Animalia	Aves	Psittacidae	0256	*Trichoglossus chlorolepidotus*	Scaly-breasted Lorikeet	P		1	
Animalia	Aves	Psittacidae	9947	*Trichoglossus haematodus*	Rainbow Lorikeet	P		1	
Animalia	Aves	Cuculidae	0337	*Cacomantis pallidus*	Pallid Cuckoo	P		1	
Animalia	Aves	Cuculidae	0347	*Eudynamys orientalis*	Eastern Koel	P		1	
Animalia	Aves	Cuculidae	0348	*Scythrops novaehollandiae*	Channel-billed Cuckoo	P		1	
Animalia	Aves	Alcedinidae	0322	*Dacelo novaeguineae*	Laughing Kookaburra	P		1	
Animalia	Aves	Alcedinidae	0324	*Todiramphus macleayii*	Forest Kingfisher	P		1	
Animalia	Aves	Alcedinidae	0326	*Todiramphus sanctus*	Sacred Kingfisher	P		1	
Animalia	Aves	Coraciidae	0318	*Eurystomus orientalis*	Dollarbird	P		1	
Animalia	Aves	Maluridae	0529	*Malurus cyaneus*	Superb Fairy-wren	P		1	
Animalia	Aves	Acanthizidae	0475	*Acanthiza pusilla*	Brown Thornbill	P		1	

Animalia	Aves	Acanthizidae	0454	*Gerygone mouki*		Brown Gerygone	P	1
Animalia	Aves	Acanthizidae	0488	*Sericornis frontalis*		White-browed Scrubwren	P	1
Animalia	Aves	Meliphagidae	0634	*Manorina melanocephala*		Noisy Miner	P	1
Animalia	Aves	Meliphagidae	0605	*Meliphaga lewinii*		Lewin's Honeyeater	P	2
Animalia	Aves	Meliphagidae	0586	*Myzomela sanguinolenta*		Scarlet Honeyeater	P	1
Animalia	Aves	Meliphagidae	0645	*Philemon corniculatus*		Noisy Friarbird	P	1
Animalia	Aves	Psophodidae	0421	*Psophodes olivaceus*		Eastern Whipbird	P	1
Animalia	Aves	Pachycephalidae	0408	*Colluricincla harmonica*		Grey Shrike-thrush	P	1
Animalia	Aves	Pachycephalidae	0401	*Pachycephala rufiventris*		Rufous Whistler	P	1
Animalia	Aves	Oriolidae	0671	*Oriolus sagittatus*		Olive-backed Oriole	P	1
Animalia	Aves	Oriolidae	0432	*Sphecotheres vieilloti*		Australasian Figbird	P	1
Animalia	Aves	Artamidae	0705	*Cracticus tibicen*		Australian Magpie	P	1
Animalia	Aves	Artamidae	0694	*Strepera graculina*		Pied Currawong	P	1
Animalia	Aves	Rhipiduridae	0361	*Rhipidura albiscapa*		Grey Fantail	P	2
Animalia	Aves	Rhipiduridae	0364	*Rhipidura leucophrys*		Willie Wagtail	P	1
Animalia	Aves	Corvidae	9902	*Corvus orru*		Torresian Crow	P	1
Animalia	Aves	Monarchidae	0373	*Monarcha melanopsis*		Black-faced Monarch	P	1
Animalia	Aves	Monarchidae	0365	*Myiagra rubecula*		Leaden Flycatcher	P	1
Animalia	Aves	Petroicidae	0392	*Eopsaltria australis*		Eastern Yellow Robin	P	2
Animalia	Aves	Hirundinidae	0357	*Hirundo neoxena*		Welcome Swallow	P	1
Animalia	Aves	Sturnidae	0999	*Sturnus vulgaris*	*	Common Starling		1
Animalia	Aves	Nectariniidae	0564	*Dicaeum hirundinaceum*		Mistletoebird	P	1
Animalia	Aves	Estrildidae	0662	*Neochmia temporalis*		Red-browed Finch	P	1
Animalia	Mammalia	Tachyglossidae	1003	*Tachyglossus aculeatus*		Short-beaked Echidna	P	4

Animalia	Mammalia	Phascolarctidae	1162	*Phascolarctos cinereus*		Koala	V,P	V	90	ℹ
Animalia	Mammalia	Vombatidae	1165	*Vombatus ursinus*		Common Wombat	P		1	
Animalia	Mammalia	Phalangeridae	1735	*Trichosurus caninus*		Short-eared Possum	P		1	
Animalia	Mammalia	Phalangeridae	T082	*Trichosurus sp.*		brushtail possum	P		4	
Animalia	Mammalia	Pteropodidae	1280	*Pteropus poliocephalus*		Grey-headed Flying-fox	V,P	V	2	ℹ
Animalia	Mammalia	Molossidae	1938	*Mormopterus ridei*		Eastern Free-tailed Bat			1	
Animalia	Mammalia	Molossidae	T091	*Mormopterus sp.*		mastiff-bat	P		1	
Animalia	Mammalia	Vespertilionidae	1349	*Chalinolobus gouldii*		Gould's Wattled Bat	P		1	
Animalia	Mammalia	Vespertilionidae	1346	*Miniopterus australis*		Little Bentwing-bat	V,P		1	ℹ
Animalia	Mammalia	Vespertilionidae	1357	*Myotis macropus*		Southern Myotis	V,P		3	ℹ
Animalia	Mammalia	Vespertilionidae	1361	*Scoteanax rueppellii*		Greater Broad-nosed Bat	V,P		1	ℹ
Animalia	Mammalia	Vespertilionidae	1022	*Vespadelus darlingtoni*		Large Forest Bat	P		1	
Animalia	Mammalia	Muridae	1395	*Rattus fuscipes*		Bush Rat	P		1	
Animalia	Mammalia	Muridae	1408	*Rattus rattus*	*	Black Rat			1	
Animalia	Mammalia	Canidae	1531	*Canis lupus*	*	Dingo, domestic dog			2	
Animalia	Mammalia	Canidae	1532	*Vulpes vulpes*	*	Fox			12	
Animalia	Mammalia	Felidae	1536	*Felis catus*	*	Cat			1	
Animalia	Mammalia	Bovidae	1518	*Bos taurus*	*	European cattle			1	
Plantae	Flora	Acanthaceae	1010	*Pseuderanthemum variabile*		Pastel Flower			2	
Plantae	Flora	Acanthaceae	7044	*Rostellularia obtusa*					2	
Plantae	Flora	Adiantaceae	8000	*Adiantum hispidulum*		Rough Maidenhair	P		1	

Plantae	Flora	Aizoaceae	7175	*Glinus oppositifolius*				1
Plantae	Flora	Amaranthaceae	7056	*Gomphrena celosioides*	*	Gomphrena Weed		1
Plantae	Flora	Apiaceae	1113	*Eryngium expansum*				2
Plantae	Flora	Apocynaceae	6380	*Carissa ovata*		Currant Bush		1
Plantae	Flora	Apocynaceae	1185	*Parsonsia straminea*		Common Silkpod		4
Plantae	Flora	Arecaceae	1220	*Linospadix monostachyos*		Walking-stick Palm	P	1
Plantae	Flora	Asparagaceae	11785	*Asparagus plumosus*	*	Climbing Asparagus Fern		2
Plantae	Flora	Asteraceae	1255	*Ageratina adenophora*	*	Crofton Weed		1
Plantae	Flora	Asteraceae	1256	*Ageratina riparia*	*	Mistflower		1
Plantae	Flora	Asteraceae	13957	*Centratherum australianum*				1
Plantae	Flora	Asteraceae	12047	*Emilia sonchifolia var. javanica*				1
Plantae	Flora	Asteraceae	1447	*Ethulia conyzoides*	*			1
Plantae	Flora	Asteraceae	7163	*Hemisteptia lyrata*				1
Plantae	Flora	Bignoniaceae	1737	*Macfadyena unguis-cati*	*	Cat's Claw Creeper		1
Plantae	Flora	Capparaceae	1943	*Capparis arborea*		Native Pomegranate		2
Plantae	Flora	Casuarinaceae	2022	*Casuarina glauca*		Swamp Oak		11
Plantae	Flora	Celastraceae	2029	*Elaeodendron australe*				2
Plantae	Flora	Commelinaceae	2209	*Commelina cyanea*		Native Wandering Jew		2
Plantae	Flora	Convolvulaceae	2222	*Dichondra repens*		Kidney Weed		1
Plantae	Flora	Convolvulaceae	2225	*Ipomoea cairica*	*			4
Plantae	Flora	Cyperaceae	2389	*Cyperus procerus*				1

Plantae	Flora	Cyperaceae	2429	*Fimbristylis velata*			1
Plantae	Flora	Cyperaceae	2448	*Isolepis cernua*		Nodding Club-rush	1
Plantae	Flora	Dennstaedtiaceae	7749	*Hypolepis muelleri*		Harsh Ground Fern	3
Plantae	Flora	Dennstaedtiaceae	6403	*Pteridium esculentum*		Bracken	1
Plantae	Flora	Dilleniaceae	2532	*Hibbertia dentata*		Twining Guinea Flower	1
Plantae	Flora	Ebenaceae	2562	*Diospyros australis*		Black Plum	2
Plantae	Flora	Ebenaceae	2566	*Diospyros pentamera*		Myrtle Ebony	1
Plantae	Flora	Elaeocarpaceae	2573	*Elaeocarpus obovatus*		Hard Quandong	2
Plantae	Flora	Elaeocarpaceae	2574	*Elaeocarpus reticulatus*		Blueberry Ash	1
Plantae	Flora	Ericaceae	2649	*Monotoca scoparia*			1
Plantae	Flora	Escalloniaceae	3229	*Quintinia verdonii*		Grey Possumwood	1
Plantae	Flora	Euphorbiaceae	8669	*Alchornea ilicifolia*		Native Holly	2
Plantae	Flora	Euphorbiaceae	2706	*Croton verreauxii*		Green Native Cascarilla	4
Plantae	Flora	Euphorbiaceae	2735	*Mallotus philippensis*		Red Kamala	1
Plantae	Flora	Fabaceae (Caesalpinioideae)	1881	*Caesalpinia subtropica*		Corky Prickly-vine	2
Plantae	Flora	Fabaceae (Caesalpinioideae)	7377	*Senna pendula var. glabrata*	*		1
Plantae	Flora	Fabaceae (Faboideae)	6807	*Austrosteenisia glabristyla*		Giant Blood Vine	2

Plantae	Flora	Fabaceae (Faboideae)	2832	*Derris involuta*					1	
Plantae	Flora	Fabaceae (Faboideae)	2833	*Desmodium acanthocladum*		Thorny Pea	V,P	V	29	ℹ
Plantae	Flora	Fabaceae (Faboideae)	2990	*Pultenaea euchila*					1	
Plantae	Flora	Fabaceae (Faboideae)	11188	*Vigna racemosa*	*				1	
Plantae	Flora	Fabaceae (Faboideae)	10065	*Vigna vexillata var. angustifolia*		Wild Cow Pea			1	
Plantae	Flora	Fabaceae (Mimosoideae)	3824	*Acacia melanoxylon*		Blackwood			1	
Plantae	Flora	Haloragaceae	7456	*Myriophyllum gracile var. lineare*					1	
Plantae	Flora	Haloragaceae	7059	*Myriophyllum striatum*					1	
Plantae	Flora	Juncaceae	3348	*Juncus subsecundus*		Finger Rush			1	
Plantae	Flora	Lamiaceae	3397	*Plectranthus parviflorus*					1	
Plantae	Flora	Lamiaceae	3444	*Salvia plebeia*		Austral Sage			1	
Plantae	Flora	Lauraceae	3471	*Cinnamomum camphora*	*	Camphor Laurel			3	
Plantae	Flora	Lauraceae	3479	*Cryptocarya glaucescens*		Jackwood			1	
Plantae	Flora	Lauraceae	3486	*Cryptocarya triplinervis*		Three-veined Cryptocarya			1	
Plantae	Flora	Lauraceae	9275	*Cryptocarya triplinervis var. triplinervis*					2	
Plantae	Flora	Lauraceae	3495	*Endiandra sieberi*		Hard Corkwood			3	

Plantae	Flora	Lomandraceae	6308	*Lomandra longifolia*		Spiny-headed Mat-rush			1	
Plantae	Flora	Luzuriagaceae	6016	*Geitonoplesium cymosum*		Scrambling Lily			5	
Plantae	Flora	Malvaceae	6129	*Commersonia bartramia*		Brown Kurrajong			1	
Plantae	Flora	Malvaceae	3673	*Sida rhombifolia*	*	Paddy's Lucerne			1	
Plantae	Flora	Moraceae	8841	*Ficus macrophylla subsp. macrophylla*		Moreton Bay Fig			1	
Plantae	Flora	Moraceae	8407	*Ficus superba var. henneana*		Deciduous Fig			1	
Plantae	Flora	Moraceae	3928	*Maclura cochinchinensis*		Cockspur Thorn			7	
Plantae	Flora	Moraceae	3931	*Streblus brunonianus*		Whalebone Tree			6	
Plantae	Flora	Myrsinaceae	3959	*Embelia australiana*					1	
Plantae	Flora	Myrsinaceae	11951	*Myrsine richmondensis*		Ripple-leaf Muttonwood	E1,P	E	1	ℹ
Plantae	Flora	Myrsinaceae	11953	*Myrsine variabilis*					1	
Plantae	Flora	Myrtaceae	4010	*Callistemon pachyphyllus*		Wallum Bottlebrush			3	
Plantae	Flora	Myrtaceae	4015	*Callistemon salignus*		Willow Bottlebrush			2	
Plantae	Flora	Myrtaceae	4019	*Callistemon viminalis*		Weeping Bottlebrush			2	
Plantae	Flora	Myrtaceae	9601	*Corymbia intermedia*		Pink Bloodwood			1	
Plantae	Flora	Myrtaceae	4101	*Eucalyptus grandis*		Flooded Gum			1	
Plantae	Flora	Myrtaceae	4191	*Eucalyptus tereticornis*		Forest Red Gum			9	
Plantae	Flora	Myrtaceae	11397	*Gossia acmenoides*		Scrub Ironwood			2	
Plantae	Flora	Myrtaceae	11398	*Gossia bidwillii*		Python Tree			2	
Plantae	Flora	Myrtaceae	11894	*Gossia fragrantissima*		Sweet Myrtle	E1,P	E	30	ℹ
Plantae	Flora	Myrtaceae	4215	*Leptospermum brachyandrum*					1	

Plantae	Flora	Myrtaceae	4221	*Leptospermum juniperinum*		Prickly Tea-tree			2	
Plantae	Flora	Myrtaceae	4224	*Leptospermum liversidgei*		Olive Tea-tree			1	
Plantae	Flora	Myrtaceae	8199	*Leptospermum polygalifolium subsp. cismontanum*					3	
Plantae	Flora	Myrtaceae	4241	*Leptospermum whitei*					1	
Plantae	Flora	Myrtaceae	4242	*Lophostemon confertus*		Brush Box			1	
Plantae	Flora	Myrtaceae	4243	*Lophostemon suaveolens*		Swamp Mahogany, Swamp Turpentine			2	
Plantae	Flora	Myrtaceae	4245	*Melaleuca alternifolia*					3	
Plantae	Flora	Myrtaceae	6390	*Melaleuca bracteata*		Black Tea-tree			3	
Plantae	Flora	Myrtaceae	4255	*Melaleuca irbyana*		Weeping Paperbark	E1,P		2	ℹ
Plantae	Flora	Myrtaceae	4258	*Melaleuca nodosa*					2	
Plantae	Flora	Myrtaceae	4260	*Melaleuca quinquenervia*		Broad-leaved Paperbark			3	
Plantae	Flora	Myrtaceae	4261	*Melaleuca sieberi*					1	
Plantae	Flora	Myrtaceae	4262	*Melaleuca squamea*		Swamp Honey-myrtle			1	
Plantae	Flora	Myrtaceae	4264	*Melaleuca styphelioides*		Prickly-leaved Tea Tree			3	
Plantae	Flora	Myrtaceae	4266	*Melaleuca thymifolia*		Thyme Honey-myrtle			2	
Plantae	Flora	Myrtaceae	4290	*Syzygium hodgkinsoniae*		Red Lilly Pilly	V,P	V	1	ℹ
Plantae	Flora	Ochnaceae	4306	*Ochna serrulata*	*	Mickey Mouse Plant			2	
Plantae	Flora	Oleaceae	4311	*Jasminum volubile*					3	
Plantae	Flora	Oleaceae	4313	*Ligustrum sinense*	*	Small-leaved Privet			2	
Plantae	Flora	Oleaceae	4318	*Notelaea longifolia*		Large Mock-olive			1	
Plantae	Flora	Onagraceae	7375	*Ludwigia peploides subsp. montevidensis*		Water Primrose			1	

Plantae	Flora	Phyllanthaceae	2695	*Breynia oblongifolia*		Coffee Bush	1
Plantae	Flora	Pittosporaceae	11204	*Pittosporum multiflorum*		Orange Thorn	3
Plantae	Flora	Pittosporaceae	4683	*Pittosporum revolutum*		Rough Fruit Pittosporum	1
Plantae	Flora	Pittosporaceae	4685	*Pittosporum undulatum*		Sweet Pittosporum	1
Plantae	Flora	Poaceae	4831	*Chloris gayana*	*	Rhodes Grass	1
Plantae	Flora	Poaceae	6540	*Cynodon dactylon*		Common Couch	1
Plantae	Flora	Poaceae	4946	*Entolasia marginata*		Bordered Panic	1
Plantae	Flora	Poaceae	5024	*Leersia hexandra*		Swamp Ricegrass	1
Plantae	Flora	Poaceae	7707	*Microlaena stipoides var. stipoides*		Weeping Grass	1
Plantae	Flora	Poaceae	5044	*Oplismenus aemulus*			2
Plantae	Flora	Poaceae	5045	*Oplismenus imbecillis*			3
Plantae	Flora	Poaceae	6395	*Panicum decompositum*		Native Millet	1
Plantae	Flora	Poaceae	9327	*Paspalum ciliatifolium*	*	One-spiked Paspalum	1
Plantae	Flora	Poaceae	5113	*Phragmites australis*		Common Reed	1
Plantae	Flora	Polygonaceae	7568	*Persicaria decipiens*		Slender Knotweed	1
Plantae	Flora	Polygonaceae	5281	*Persicaria hydropiper*		Water Pepper	1
Plantae	Flora	Polygonaceae	8887	*Persicaria praetermissa*			2
Plantae	Flora	Proteaceae	5396	*Grevillea robusta*		Silky Oak	1
Plantae	Flora	Proteaceae	5482	*Stenocarpus sinuatus*		Firewheel Tree	1
Plantae	Flora	Rhamnaceae	7686	*Alphitonia excelsa*		Red Ash	2
Plantae	Flora	Rubiaceae	10868	*Atractocarpus chartaceus*			2
Plantae	Flora	Rubiaceae	11599	*Cyclophyllum longipetalum*		Coast Canthium	1

Plantae	Flora	Rubiaceae	5691	*Hodgkinsonia ovatiflora*			1
Plantae	Flora	Rubiaceae	11942	*Psydrax odorata*		Shiny-leaved Canthium	1
Plantae	Flora	Rutaceae	5722	*Acronychia oblongifolia*		White Aspen	1
Plantae	Flora	Sapindaceae	5878	*Arytera distylis*		Twin-leaved Coogera	1
Plantae	Flora	Sapindaceae	5884	*Cupaniopsis anacardioides*		Tuckeroo	1
Plantae	Flora	Sapindaceae	5886	*Cupaniopsis parvifolia*		Small-leaved Tuckeroo	3
Plantae	Flora	Sapindaceae	5917	*Guioa semiglauca*		Guioa	1
Plantae	Flora	Sapindaceae	12514	*Jagera pseudorhus var. pseudorhus*		Foambark Tree	3
Plantae	Flora	Solanaceae	7043	*Solanum americanum*		Glossy Nightshade	2
Plantae	Flora	Solanaceae	7325	*Solanum capsicoides*	*	Devil's Apple	1
Plantae	Flora	Solanaceae	6080	*Solanum erianthum*	*	Potato Tree	1
Plantae	Flora	Solanaceae	6087	*Solanum laciniatum*		Large-flowered Kangaroo Apple	1
Plantae	Flora	Solanaceae	6090	*Solanum mauritianum*	*	Wild Tobacco Bush	1
Plantae	Flora	Ulmaceae	6218	*Aphananthe philippinensis*		Rough-leaved Elm	4
Plantae	Flora	Urticaceae	6228	*Dendrocnide photinophylla*		Shiny-leaved Stinging Tree	1
Plantae	Flora	Verbenaceae	6248	*Lantana camara*	*	Lantana	3
Plantae	Flora	Violaceae	6272	*Viola hederacea*		Ivy-leaved Violet	2
Plantae	Flora	Viscaceae	6278	*Notothixos incanus*			1

Australian Government
Department of the Environment

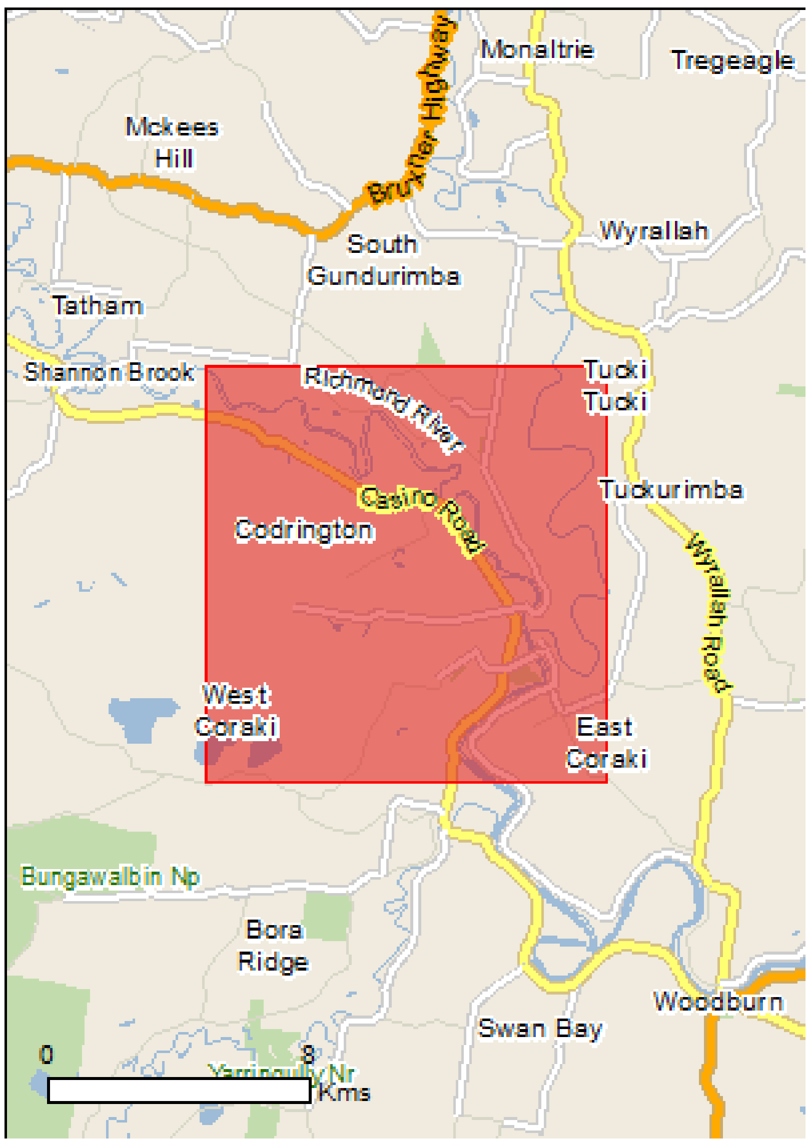
EPBC Act Protected Matters Report

This report provides general guidance on matters of national environmental significance and other matters protected by the EPBC Act in the area you have selected.

Information on the coverage of this report and qualifications on data supporting this report are contained in the caveat at the end of the report.

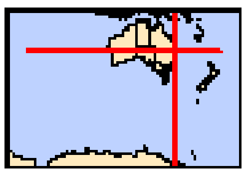
Information is available about Environment Assessments and the EPBC Act including significance guidelines, forms and application process details.

Report created: 03/07/15 15:16:26



This map may contain data which are ©Commonwealth of Australia (Geoscience Australia), ©PSMA 2010

Coordinates
Buffer: 0.0Km



Summary

Matters of National Environmental Significance

This part of the report summarises the matters of national environmental significance that may occur in, or may relate to, the area you nominated. Further information is available in the detail part of the report, which can be accessed by scrolling or following the links below. If you are proposing to undertake an activity that may have a significant impact on one or more matters of national environmental significance then you should consider the Administrative Guidelines on Significance.

World Heritage Properties:	None
National Heritage Places:	None
Wetlands of International Importance:	None
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	None
Listed Threatened Ecological Communities:	1
Listed Threatened Species:	47
Listed Migratory Species:	34

Other Matters Protected by the EPBC Act

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the environment anywhere.

The EPBC Act protects the environment on Commonwealth land, the environment from the actions taken on Commonwealth land, and the environment from actions taken by Commonwealth agencies. As heritage values of a place are part of the 'environment', these aspects of the EPBC Act protect the Commonwealth Heritage values of a Commonwealth Heritage place. Information on the new heritage laws can be found at http://www.environment.gov.au/heritage/index.html

A permit may be required for activities in or on a Commonwealth area that may affect a member of a listed threatened species or ecological community, a member of a listed migratory species, whales and other cetaceans, or a member of a listed marine species.

Commonwealth Land:	1
Commonwealth Heritage Places:	None
Listed Marine Species:	34
Whales and Other Cetaceans:	1
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Commonwealth Reserves Marine:	None

Extra Information

This part of the report provides information that may also be relevant to the area you have nominated.

State and Territory Reserves:	None
Regional Forest Agreements:	1
Invasive Species:	43
Nationally Important Wetlands:	None
Key Ecological Features (Marine)	None

Details

Matters of National Environmental Significance

Listed Threatened Ecological Communities [Resource Information]

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Name	Status	Type of Presence
Lowland Rainforest of Subtropical Australia	Critically Endangered	Community likely to occur within area

Listed Threatened Species [Resource Information]

Name	Status	Type of Presence
Birds		
Anthochaera phrygia Regent Honeyeater [82338]	Endangered	Foraging, feeding or related behaviour likely to occur within area
Botaurus poiciloptilus Australasian Bittern [1001]	Endangered	Species or species habitat known to occur within area
Cyclopsitta diophthalma coxeni Coxen's Fig-Parrot [59714]	Endangered	Species or species habitat may occur within area
Dasyornis brachypterus Eastern Bristlebird [533]	Endangered	Species or species habitat likely to occur within area
Diomedea epomophora epomophora Southern Royal Albatross [25996]	Vulnerable	Species or species habitat may occur within area
Diomedea epomophora sanfordi Northern Royal Albatross [82331]	Endangered	Species or species habitat may occur within area
Diomedea exulans antipodensis Antipodean Albatross [82269]	Vulnerable	Species or species habitat may occur within area
Diomedea exulans exulans Tristan Albatross [82337]	Endangered	Species or species habitat may occur within area
Diomedea exulans gibsoni Gibson's Albatross [82271]	Vulnerable	Species or species habitat may occur within area
Diomedea exulans (sensu lato) Wandering Albatross [1073]	Vulnerable	Species or species habitat may occur within area
Erythrotriorchis radiatus Red Goshawk [942]	Vulnerable	Species or species habitat likely to occur

Name	Status	Type of Presence
		within area
Lathamus discolor Swift Parrot [744]	Endangered	Species or species habitat likely to occur within area
Macronectes giganteus Southern Giant-Petrel [1060]	Endangered	Species or species habitat may occur within area
Macronectes halli Northern Giant-Petrel [1061]	Vulnerable	Species or species habitat may occur within area
Rostratula australis Australian Painted Snipe [77037]	Endangered	Species or species habitat likely to occur within area
Thalassarche cauta cauta Shy Albatross, Tasmanian Shy Albatross [82345]	Vulnerable	Species or species habitat may occur within area
Thalassarche cauta salvini Salvin's Albatross [82343]	Vulnerable	Species or species habitat likely to occur within area
Thalassarche cauta steadi White-capped Albatross [82344]	Vulnerable	Species or species habitat likely to occur within area
Thalassarche eremita Chatham Albatross [64457]	Endangered	Species or species habitat may occur within area
Thalassarche melanophris Black-browed Albatross [66472]	Vulnerable	Species or species habitat may occur within area
Turnix melanogaster Black-breasted Button-quail [923]	Vulnerable	Species or species habitat may occur within area
Fish		
Epinephelus daemelii Black Rockcod, Black Cod, Saddled Rockcod [68449]	Vulnerable	Species or species habitat likely to occur within area
Insects		
Phyllodes imperialis smithersi Pink Underwing Moth [86084]	Endangered	Species or species habitat may occur within area
Mammals		
Chalinolobus dwyeri Large-eared Pied Bat, Large Pied Bat [183]	Vulnerable	Species or species habitat likely to occur within area
Dasyurus maculatus maculatus (SE mainland population) Spot-tailed Quoll, Spotted-tail Quoll, Tiger Quoll (southeastern mainland population) [75184]	Endangered	Species or species habitat known to occur within area
Phascolarctos cinereus (combined populations of Qld, NSW and the ACT) Koala (combined populations of Queensland, New South Wales and the Australian Capital Territory) [85104]	Vulnerable	Species or species habitat known to occur within area
Potorous tridactylus tridactylus Long-nosed Potoroo (SE mainland) [66645]	Vulnerable	Species or species habitat may occur within area
Pseudomys novaehollandiae New Holland Mouse, Pookila [96]	Vulnerable	Species or species habitat likely to occur within area

Name	Status	Type of Presence
Pteropus poliocephalus Grey-headed Flying-fox [186]	Vulnerable	Roosting known to occur within area
Plants		
Allocasuarina defungens Dwarf Heath Casuarina [21924]	Endangered	Species or species habitat may occur within area
Arthraxon hispidus Hairy-joint Grass [9338]	Vulnerable	Species or species habitat may occur within area
Bulbophyllum globuliforme Miniature Moss-orchid, Hoop Pine Orchid [6649]	Vulnerable	Species or species habitat may occur within area
Clematis fawcettii Stream Clematis [4311]	Vulnerable	Species or species habitat likely to occur within area
Cryptocarya foetida Stinking Cryptocarya, Stinking Laurel [11976]	Vulnerable	Species or species habitat likely to occur within area
Desmodium acanthocladum Thorny Pea [17972]	Vulnerable	Species or species habitat likely to occur within area
Gossia fragrantissima Sweet Myrtle, Small-leaved Myrtle [78867]	Endangered	Species or species habitat likely to occur within area
Myrsine richmondensis Purple-leaf Muttonwood, Lismore Muttonwood [83888]	Endangered	Species or species habitat likely to occur within area
Ochrosia moorei Southern Ochrosia [11350]	Endangered	Species or species habitat likely to occur within area
Phaius australis Lesser Swamp-orchid [5872]	Endangered	Species or species habitat likely to occur within area
Syzygium hodgkinsoniae Smooth-bark Rose Apple, Red Lilly Pilly [3539]	Vulnerable	Species or species habitat may occur within area
Thesium australe Austral Toadflax, Toadflax [15202]	Vulnerable	Species or species habitat likely to occur within area
Reptiles		
Caretta caretta Loggerhead Turtle [1763]	Endangered	Congregation or aggregation known to occur within area
Chelonia mydas Green Turtle [1765]	Vulnerable	Species or species habitat known to occur within area
Coeranoscincus reticulatus Three-toed Snake-tooth Skink [59628]	Vulnerable	Species or species habitat may occur within area
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Species or species habitat known to occur within area
Eretmochelys imbricata Hawksbill Turtle [1766]	Vulnerable	Species or species habitat known to occur within area

Name	Status	Type of Presence
Natator depressus Flatback Turtle [59257]	Vulnerable	Species or species habitat may occur within area

Listed Migratory Species [Resource Information]

* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

Name	Threatened	Type of Presence
Migratory Marine Birds		
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Diomedea antipodensis Antipodean Albatross [64458]	Vulnerable*	Species or species habitat may occur within area
Diomedea dabbenena Tristan Albatross [66471]	Endangered*	Species or species habitat may occur within area
Diomedea epomophora (sensu stricto) Southern Royal Albatross [1072]	Vulnerable*	Species or species habitat may occur within area
Diomedea exulans (sensu lato) Wandering Albatross [1073]	Vulnerable	Species or species habitat may occur within area
Diomedea gibsoni Gibson's Albatross [64466]	Vulnerable*	Species or species habitat may occur within area
Diomedea sanfordi Northern Royal Albatross [64456]	Endangered*	Species or species habitat may occur within area
Macronectes giganteus Southern Giant-Petrel [1060]	Endangered	Species or species habitat may occur within area
Macronectes halli Northern Giant-Petrel [1061]	Vulnerable	Species or species habitat may occur within area
Thalassarche cauta (sensu stricto) Shy Albatross, Tasmanian Shy Albatross [64697]	Vulnerable*	Species or species habitat may occur within area
Thalassarche eremita Chatham Albatross [64457]	Endangered	Species or species habitat may occur within area
Thalassarche impavida Campbell Albatross [64459]	Vulnerable*	Species or species habitat may occur within area
Thalassarche melanophris Black-browed Albatross [66472]	Vulnerable	Species or species habitat may occur within area
Thalassarche salvini Salvin's Albatross [64463]	Vulnerable*	Species or species habitat likely to occur within area
Thalassarche steadi White-capped Albatross [64462]	Vulnerable*	Species or species habitat likely to occur within area
Migratory Marine Species		
Caretta caretta Loggerhead Turtle [1763]	Endangered	Congregation or aggregation known to

Name	Threatened	Type of Presence
		occur within area
Chelonia mydas Green Turtle [1765]	Vulnerable	Species or species habitat known to occur within area
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Species or species habitat known to occur within area
Eretmochelys imbricata Hawksbill Turtle [1766]	Vulnerable	Species or species habitat known to occur within area
Manta birostris Giant Manta Ray, Chevron Manta Ray, Pacific Manta Ray, Pelagic Manta Ray, Oceanic Manta Ray [84995]		Species or species habitat may occur within area
Natator depressus Flatback Turtle [59257]	Vulnerable	Species or species habitat may occur within area
Sousa chinensis Indo-Pacific Humpback Dolphin [50]		Species or species habitat likely to occur within area
Migratory Terrestrial Species		
Haliaeetus leucogaster White-bellied Sea-Eagle [943]		Species or species habitat known to occur within area
Hirundapus caudacutus White-throated Needletail [682]		Species or species habitat known to occur within area
Merops ornatus Rainbow Bee-eater [670]		Species or species habitat may occur within area
Monarcha melanopsis Black-faced Monarch [609]		Species or species habitat known to occur within area
Monarcha trivirgatus Spectacled Monarch [610]		Species or species habitat likely to occur within area
Myiagra cyanoleuca Satin Flycatcher [612]		Species or species habitat known to occur within area
Rhipidura rufifrons Rufous Fantail [592]		Species or species habitat known to occur within area
Migratory Wetlands Species		
Ardea alba Great Egret, White Egret [59541]		Breeding known to occur within area
Ardea ibis Cattle Egret [59542]		Breeding likely to occur within area
Gallinago hardwickii Latham's Snipe, Japanese Snipe [863]		Species or species habitat may occur within area
Pandion cristatus Eastern Osprey [82411]		Species or species habitat likely to occur within area
Rostratula benghalensis (sensu lato) Painted Snipe [889]	Endangered*	Species or species habitat likely to occur within area

Other Matters Protected by the EPBC Act

Commonwealth Land [Resource Information]

The Commonwealth area listed below may indicate the presence of Commonwealth land in this vicinity. Due to the unreliability of the data source, all proposals should be checked as to whether it impacts on a Commonwealth area, before making a definitive decision. Contact the State or Territory government land department for further information.

Name
Commonwealth Land - Australian Telecommunications Commission

Listed Marine Species [Resource Information]

* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

Name	Threatened	Type of Presence
Birds		
Anseranas semipalmata Magpie Goose [978]		Species or species habitat may occur within area
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Ardea alba Great Egret, White Egret [59541]		Breeding known to occur within area
Ardea ibis Cattle Egret [59542]		Breeding likely to occur within area
Diomedea antipodensis Antipodean Albatross [64458]	Vulnerable*	Species or species habitat may occur within area
Diomedea dabbenena Tristan Albatross [66471]	Endangered*	Species or species habitat may occur within area
Diomedea epomophora (sensu stricto) Southern Royal Albatross [1072]	Vulnerable*	Species or species habitat may occur within area
Diomedea exulans (sensu lato) Wandering Albatross [1073]	Vulnerable	Species or species habitat may occur within area
Diomedea gibsoni Gibson's Albatross [64466]	Vulnerable*	Species or species habitat may occur within area
Diomedea sanfordi Northern Royal Albatross [64456]	Endangered*	Species or species habitat may occur within area
Gallinago hardwickii Latham's Snipe, Japanese Snipe [863]		Species or species habitat may occur within area
Haliaeetus leucogaster White-bellied Sea-Eagle [943]		Species or species habitat known to occur within area
Hirundapus caudacutus White-throated Needletail [682]		Species or species habitat known to occur within area
Lathamus discolor Swift Parrot [744]	Endangered	Species or species habitat likely to occur within area
Macronectes giganteus Southern Giant-Petrel [1060]	Endangered	Species or species

Name	Threatened	Type of Presence
		habitat may occur within area
Macronectes halli Northern Giant-Petrel [1061]	Vulnerable	Species or species habitat may occur within area
Merops ornatus Rainbow Bee-eater [670]		Species or species habitat may occur within area
Monarcha melanopsis Black-faced Monarch [609]		Species or species habitat known to occur within area
Monarcha trivirgatus Spectacled Monarch [610]		Species or species habitat likely to occur within area
Myiagra cyanoleuca Satin Flycatcher [612]		Species or species habitat known to occur within area
Pandion haliaetus Osprey [952]		Species or species habitat likely to occur within area
Rhipidura rufifrons Rufous Fantail [592]		Species or species habitat known to occur within area
Rostratula benghalensis (sensu lato) Painted Snipe [889]	Endangered*	Species or species habitat likely to occur within area
Thalassarche cauta (sensu stricto) Shy Albatross, Tasmanian Shy Albatross [64697]	Vulnerable*	Species or species habitat may occur within area
Thalassarche eremita Chatham Albatross [64457]	Endangered	Species or species habitat may occur within area
Thalassarche impavida Campbell Albatross [64459]	Vulnerable*	Species or species habitat may occur within area
Thalassarche melanophris Black-browed Albatross [66472]	Vulnerable	Species or species habitat may occur within area
Thalassarche salvini Salvin's Albatross [64463]	Vulnerable*	Species or species habitat likely to occur within area
Thalassarche steadi White-capped Albatross [64462]	Vulnerable*	Species or species habitat likely to occur within area
Reptiles		
Caretta caretta Loggerhead Turtle [1763]	Endangered	Congregation or aggregation known to occur within area
Chelonia mydas Green Turtle [1765]	Vulnerable	Species or species habitat known to occur within area
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Species or species habitat known to occur within area
Eretmochelys imbricata Hawksbill Turtle [1766]	Vulnerable	Species or species

Name	Threatened	Type of Presence
		habitat known to occur within area
Natator depressus Flatback Turtle [59257]	Vulnerable	Species or species habitat may occur within area

Whales and other Cetaceans [Resource Information]

Name	Status	Type of Presence
Mammals		
Sousa chinensis Indo-Pacific Humpback Dolphin [50]		Species or species habitat likely to occur within area

Extra Information

Regional Forest Agreements [Resource Information]

Note that all areas with completed RFAs have been included.

Name	State
North East NSW RFA	New South Wales

Invasive Species [Resource Information]

Weeds reported here are the 20 species of national significance (WoNS), along with other introduced plants that are considered by the States and Territories to pose a particularly significant threat to biodiversity. The following feral animals are reported: Goat, Red Fox, Cat, Rabbit, Pig, Water Buffalo and Cane Toad. Maps from Landscape Health Project, National Land and Water Resouces Audit, 2001.

Name	Status	Type of Presence
Birds		
Acridotheres tristis Common Myna, Indian Myna [387]		Species or species habitat likely to occur within area
Anas platyrhynchos Mallard [974]		Species or species habitat likely to occur within area
Carduelis carduelis European Goldfinch [403]		Species or species habitat likely to occur within area
Columba livia Rock Pigeon, Rock Dove, Domestic Pigeon [803]		Species or species habitat likely to occur within area
Lonchura punctulata Nutmeg Mannikin [399]		Species or species habitat likely to occur within area
Passer domesticus House Sparrow [405]		Species or species habitat likely to occur within area
Pycnonotus jocosus Red-whiskered Bulbul [631]		Species or species habitat likely to occur within area
Streptopelia chinensis Spotted Turtle-Dove [780]		Species or species habitat likely to occur within area

Name	Status	Type of Presence
Sturnus vulgaris Common Starling [389]		Species or species habitat likely to occur within area
Frogs		
Rhinella marina Cane Toad [83218]		Species or species habitat likely to occur within area
Mammals		
Bos taurus Domestic Cattle [16]		Species or species habitat likely to occur within area
Canis lupus familiaris Domestic Dog [82654]		Species or species habitat likely to occur within area
Felis catus Cat, House Cat, Domestic Cat [19]		Species or species habitat likely to occur within area
Lepus capensis Brown Hare [127]		Species or species habitat likely to occur within area
Mus musculus House Mouse [120]		Species or species habitat likely to occur within area
Oryctolagus cuniculus Rabbit, European Rabbit [128]		Species or species habitat likely to occur within area
Rattus norvegicus Brown Rat, Norway Rat [83]		Species or species habitat likely to occur within area
Rattus rattus Black Rat, Ship Rat [84]		Species or species habitat likely to occur within area
Sus scrofa Pig [6]		Species or species habitat likely to occur within area
Vulpes vulpes Red Fox, Fox [18]		Species or species habitat likely to occur within area
Plants		
Alternanthera philoxeroides Alligator Weed [11620]		Species or species habitat likely to occur within area
Anredera cordifolia Madeira Vine, Jalap, Lamb's-tail, Mignonette Vine, Anredera, Gulf Madeiravine, Heartleaf Madeiravine, Potato Vine [2643]		Species or species habitat likely to occur within area
Asparagus aethiopicus Asparagus Fern, Ground Asparagus, Basket Fern, Sprengi's Fern, Bushy Asparagus, Emerald Asparagus [62425]		Species or species habitat likely to occur within area
Asparagus africanus Climbing Asparagus, Climbing Asparagus Fern [66907]		Species or species habitat likely to occur within area
Asparagus plumosus Climbing Asparagus-fern [48993]		Species or species habitat likely to occur within area
Cabomba caroliniana Cabomba, Fanwort, Carolina Watershield, Fish		Species or species

Name	Status	Type of Presence
Grass, Washington Grass, Watershield, Carolina Fanwort, Common Cabomba [5171]		habitat likely to occur within area
Chrysanthemoides monilifera		
Bitou Bush, Boneseed [18983]		Species or species habitat likely to occur within area
Chrysanthemoides monilifera subsp. rotundata		
Bitou Bush [16332]		Species or species habitat likely to occur within area
Dolichandra unguis-cati		
Cat's Claw Vine, Yellow Trumpet Vine, Cat's Claw Creeper, Funnel Creeper [85119]		Species or species habitat likely to occur within area
Eichhornia crassipes		
Water Hyacinth, Water Orchid, Nile Lily [13466]		Species or species habitat likely to occur within area
Genista sp. X Genista monspessulana		
Broom [67538]		Species or species habitat may occur within area
Hymenachne amplexicaulis		
Hymenachne, Olive Hymenachne, Water Stargrass, West Indian Grass, West Indian Marsh Grass [31754]		Species or species habitat likely to occur within area
Lantana camara		
Lantana, Common Lantana, Kamara Lantana, Large-leaf Lantana, Pink Flowered Lantana, Red Flowered Lantana, Red-Flowered Sage, White Sage, Wild Sage [10892]		Species or species habitat likely to occur within area
Opuntia spp.		
Prickly Pears [82753]		Species or species habitat likely to occur within area
Pinus radiata		
Radiata Pine Monterey Pine, Insignis Pine, Wilding Pine [20780]		Species or species habitat may occur within area
Protasparagus densiflorus		
Asparagus Fern, Plume Asparagus [5015]		Species or species habitat likely to occur within area
Protasparagus plumosus		
Climbing Asparagus-fern, Ferny Asparagus [11747]		Species or species habitat likely to occur within area
Rubus fruticosus aggregate		
Blackberry, European Blackberry [68406]		Species or species habitat likely to occur within area
Sagittaria platyphylla		
Delta Arrowhead, Arrowhead, Slender Arrowhead [68483]		Species or species habitat likely to occur within area
Salvinia molesta		
Salvinia, Giant Salvinia, Aquarium Watermoss, Kariba Weed [13665]		Species or species habitat likely to occur within area
Senecio madagascariensis		
Fireweed, Madagascar Ragwort, Madagascar Groundsel [2624]		Species or species habitat likely to occur within area
Solanum elaeagnifolium		
Silver Nightshade, Silver-leaved Nightshade, White Horse Nettle, Silver-leaf Nightshade, Tomato Weed, White Nightshade, Bull-nettle, Prairie-berry, Satansbos, Silver-leaf Bitter-apple, Silverleaf-nettle, Trompillo [12323]		Species or species habitat likely to occur within area
Reptiles		
Hemidactylus frenatus		
Asian House Gecko [1708]		Species or species habitat likely to occur

Name	Status	Type of Presence within area

Caveat

The information presented in this report has been provided by a range of data sources as acknowledged at the end of the report.

This report is designed to assist in identifying the locations of places which may be relevant in determining obligations under the Environment Protection and Biodiversity Conservation Act 1999. It holds mapped locations of World and National Heritage properties, Wetlands of International and National Importance, Commonwealth and State/Territory reserves, listed threatened, migratory and marine species and listed threatened ecological communities. Mapping of Commonwealth land is not complete at this stage. Maps have been collated from a range of sources at various resolutions.

Not all species listed under the EPBC Act have been mapped (see below) and therefore a report is a general guide only. Where available data supports mapping, the type of presence that can be determined from the data is indicated in general terms. People using this information in making a referral may need to consider the qualifications below and may need to seek and consider other information sources.

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

For species where the distributions are well known, maps are digitised from sources such as recovery plans and detailed habitat studies. Where appropriate, core breeding, foraging and roosting areas are indicated under 'type of presence'. For species whose distributions are less well known, point locations are collated from government wildlife authorities, museums, and non-government organisations; bioclimatic distribution models are generated and these validated by experts. In some cases, the distribution maps are based solely on expert knowledge.

Only selected species covered by the following provisions of the EPBC Act have been mapped:

- migratory and
- marine

The following species and ecological communities have not been mapped and do not appear in reports produced from this database:

- threatened species listed as extinct or considered as vagrants
- some species and ecological communities that have only recently been listed
- some terrestrial species that overfly the Commonwealth marine area
- migratory species that are very widespread, vagrant, or only occur in small numbers

The following groups have been mapped, but may not cover the complete distribution of the species:

- non-threatened seabirds which have only been mapped for recorded breeding sites
- seals which have only been mapped for breeding sites near the Australian continent

Such breeding sites may be important for the protection of the Commonwealth Marine environment.

Coordinates

-28.92 153.2,-29.02 153.2,-29.02 153.31,-28.92 153.31,-28.92 153.2

Acknowledgements

This database has been compiled from a range of data sources. The department acknowledges the following custodians who have contributed valuable data and advice:

-Department of Environment, Climate Change and Water, New South Wales
-Department of Sustainability and Environment, Victoria
-Department of Primary Industries, Parks, Water and Environment, Tasmania
-Department of Environment and Natural Resources, South Australia
-Parks and Wildlife Service NT, NT Dept of Natural Resources, Environment and the Arts
-Environmental and Resource Management, Queensland
-Department of Environment and Conservation, Western Australia
-Department of the Environment, Climate Change, Energy and Water
-Birds Australia
-Australian Bird and Bat Banding Scheme
-Australian National Wildlife Collection
-Natural history museums of Australia
-Museum Victoria
-Australian Museum
-SA Museum
-Queensland Museum
-Online Zoological Collections of Australian Museums
-Queensland Herbarium
-National Herbarium of NSW
-Royal Botanic Gardens and National Herbarium of Victoria
-Tasmanian Herbarium
-State Herbarium of South Australia
-Northern Territory Herbarium
-Western Australian Herbarium
-Australian National Herbarium, Atherton and Canberra
-University of New England
-Ocean Biogeographic Information System
-Australian Government, Department of Defence
-State Forests of NSW
-Geoscience Australia
-CSIRO
-Other groups and individuals

The Department is extremely grateful to the many organisations and individuals who provided expert advice and information on numerous draft distributions.

Please feel free to provide feedback via the Contact Us page.

Department of the Environment
GPO Box 787
Canberra ACT 2601 Australia
+61 2 6274 1111

APPENDIX 6

Flora species list from field survey

Abbreviations:
<u>Status</u>: V: Vulnerable; **EPBC Act**: Commonwealth *Environment Protection and Biodiversity Conservation Act* 1999; **TSC Act**: New South Wales *Threatened Species Conservation Act 1995*.

Group	Family	Scientific Name	Common Name	Weeds	Threatened
Angiosperms	Apiaceae	*Centella asiatica*	Gotu Kola	X	
Angiosperms	Apocynaceae	*Carissa ovata*	Conkleberry		
Angiosperms	Apocynaceae	*Parsonsia straminea*	Monkey Rope Vine		
Angiosperms	Araliaceae	*Schefflera actinophylla*	Umbrella Tree	X	
Angiosperms	Araucariaceae	*Araucaria cunninghamii*	Hoop Pine		
Angiosperms	Ascleopiadaceae	*Asclepias curvassica*	Redhead Cotton Bush	X	
Angiosperms	Asclepiadaceae	*Gomphocarpus fruticosus*	Narrow-leaved Cotton Bush	X	
Angiosperms	Asclepiadaceae	*Gomphocarpus physocarpus*	Balloon Cotton Bush	X	
Angiosperms	Asparagaceae	*Asparagus plumosus*	Climbing Asparagus	X	
Angiosperms	Asteraceae	*Ageratina riparia*	Mistflower	X	
Angiosperms	Asteraceae	*Ageratum houstonianum*	Blue Top	X	
Angiosperms	Asteraceae	*Bidens pilosa*	Cobblers Peg	X	
Angiosperms	Asteraceae	*Cirsium vulgare*	Spear Thistle	X	
Angiosperms	Asteraceae	*Conyza sumatrensis*	Fleabane	X	
Angiosperms	Asteraceae	*Eclipta prostrata*			
Angiosperms	Asteraceae	*Senecio madagascarensis**	Fire Weed	X	
Angiosperms	Bignoniaceae	*Pandora baileyana*	Wonga Vine		
Angiosperms	Bignoniaceae	*Pandorea pandorana*	Wonga Vine		
Angiosperms	Caesalpiniaceae	*Caesalpinea decapetala*	Thorny Poinciana	X	
Angiosperms	Caesalpiniaceae	*Senna pendula var. glabrata*	Winter Senna	X	
Angiosperms	Campanulaceae	*Lobelia purpurescens*	Lobelia		
Angiosperms	Capparaceae	*Capparis arborea*	Brush Caperberry		
Angiosperms	Casuarinaceae	*Casuarina glauca*	Swamp Oak		
Angiosperms	Commelinaceae	*Commelina cyanea*	Scurvy Weed		
Angiosperms	Convolvulaceae	*Dichondra repens*	Kidney Weed		
Angiosperms	Cyperaceae	*Carex appressa*	Carex		

Group	Family	Scientific Name	Common Name	Weeds	Threatened
Angiosperms	Cyperaceae	*Cyperus exaltatus*	Tall Flat Sedge		
Angiosperms	Dioscoreaceae	*Dioscorea transversa*	Native Yam		
Angiosperms	Elaeocarpaceae	*Elaeocarpus obovatus*	Hard Quandong		
Angiosperms	Euphorbbiaceae	*Allogyne ilicifolia*	Native Holly		
Angiosperms	Euphorbiaceae	*Breynia oblongifolia*	Breynia		
Angiosperms	Euphorbiaceae	*Drypetes deplanchei*	Yellow Tulip Wood		
Angiosperms	Euphorbiaceae	*Glochidion ferdinandi*	Cheese Tree		
Angiosperms	Euphorbiaceae	*Mallotus philippensis*	Red Kamala		
Angiosperms	Fabaceae	*Austrosteenisia blackii*	Blood Vine		
Angiosperms	Flacourtiaceae	*Scolopia braunii*	Flintwood		
Angiosperms	Juncaceae	*Juncus uncitatus*			
Angiosperms	Lamiaceae	*Plectranthus parviflorus*	Cockspur Flower		
Angiosperms	Lauraceae	*Cinnamomum camphora*	Camphor Laurel	X	
Angiosperms	Lauraceae	*Cryptocarya triplinervis var. pubens*	Thre-veined Laurel		
Angiosperms	Malvaceae	*Abutilon sp.*			
Angiosperms	Malvaceae	*Hibiscus heterophyllus*	Rosella		
Angiosperms	Malvaceae	*Sida acuta*	Spink-headed Sida	X	
Angiosperms	Meliaceae	*Melia azederach*	White Cedar		
Angiosperms	Menispermaceae	*Stephania japonica var. discolor*	Snake Vine		
Angiosperms	Mimosaceae	*Acacia disparrima*	Southern Salwood		
Angiosperms	Mimosaceae	*Acacia melanoxylon*	Blackwood, Sally Wattle		
Angiosperms	Mimosaceae	*Archidendron pruinosum*	Laceflower		
Angiosperms	Moraceae	*Ficus macrophylla*	Moreton Bay Fig		
Angiosperms	Moraceae	*Ficus obliqua*	Small leaved Fig		
Angiosperms	Moraceae	*Maclura cochinchinensis*	Cockspur Thorn		
Angiosperms	Moraceae	*Streblus brunonianus*	Whalebone Tree		
Angiosperms	Moraceae	*Trophis scandens*	Burny Vine		
Angiosperms	Myrtaceae	*Callistemon salignus var. salignus*	Pink-topped Swamp Botlebrush		

Group	Family	Scientific Name	Common Name	Weeds	Threatened
Angiosperms	Myrtaceae	*Callistemon viminalis*	Weeping Bottlebrush		
Angiosperms	Myrtaceae	*Eucalyptus microcorys*	Tallowood		
Angiosperms	Myrtaceae	*Eucalyptus tereticornis*	Forest Red Gum		
Angiosperms	Myrtaceae	*Melaleuca alternifolia*	Tea Tree		
Angiosperms	Myrtaceae	*Melaleuca quinquenervia*	Coastal Paperbark		
Angiosperms	Myrtaceae	*Melaleuca styphelioides*	Prickly Leaved Tea Tree		
Angiosperms	Ochnaceae	*Ochna serrulata*	Mickey Mouse Bush	X	
Angiosperms	Oleaceae	*Ligustrum lucidum*	Broad Leaf Privet	X	
Angiosperms	Oleaceae	*Ligustrum sinense*	Small Leaf Privet	X	
Angiosperms	Oleaceae	*Notelaea longifolia (forma glabra)*	Mock Olive		
Angiosperms	Onagraceae	*Ludwigia octovalvis*	Willow Primrose		
Angiosperms	Onagraceae	*Ludwigia peploides subsp. montevidensis*	Water Primrose		
Angiosperms	Oxalidaceae	*Oxalis corniculata*	Oxalis	X	
Angiosperms	Passifloraceae	*Passiflora edulis*	Edible Passionfruit	X	
Angiosperms	Passifloraceae	*Passiflora suberosa*	Corky Passionfruit	X	
Angiosperms	Passifloraceae	*Passiflora subpeltata*	White Passionfruit	X	
Angiosperms	Phytolaccaceae	*Rivina humilis*	Coral Berry	X	
Angiosperms	Pittosporaceae	*Pittosporum revolutum*	Hairy Pittosporum		
Angiosperms	Pittosporaceae	*Pittosporum undulatum*	Sweet Piitosporum		
Angiosperms	Poaceae	*Andropogon virginicus*	Whisky Grass	X	
Angiosperms	Poaceae	*Axonopus compressus*	Broad leaf Carpet Grass	X	
Angiosperms	Poaceae	*Cymbopogon refractus*	Barb Wire Grass		
Angiosperms	Poaceae	*Cynodon dactylon var. dactylon*	Common Couch		
Angiosperms	Poaceae	*Digitaria ciliaris*	Summer Grass	X	
Angiosperms	Poaceae	*Digitaria didactyla*	Qld Blue Couch		
Angiosperms	Poaceae	*Entolasia stricta*	Wiry Panic		
Angiosperms	Poaceae	*Imperata cylindrica*	Blady Grass		
Angiosperms	Poaceae	*Leersia hexandra*	Swamp Ricegrass		
Angiosperms	Poaceae	*Melinis repens*	Molasses Grass	X	

Group	Family	Scientific Name	Common Name	Weeds	Threatened
Angiosperms	Poaceae	*Oplismenus aemulus*	Wallaby Grass		
Angiosperms	Poaceae	*Paspalum conjugatum*	Paspalum	X	
Angiosperms	Poaceae	*Paspalum dilatatum*	Paspalum	X	
Angiosperms	Poaceae	*Paspalum weinstedii*	Broad Leaf Paspalum	X	
Angiosperms	Poaceae	*Pennisetum clandestinum*	Kikuyu	X	
Angiosperms	Poaceae	*Setaria sphacelata*	Canary Seed Grass	X	
Angiosperms	Polygonaceae	*Persicaria strigosa*	Spotted Knotweed		
Angiosperms	Pontederiaceae	*Eichhornia crassipes*	Water Hyancinth	X	
Angiosperms	Proteaceae	*Banksia integrifolia*	Coastal Banksia		
Angiosperms	Proteaceae	*Macadamia tetraphylla*	Rough-shelled Bush Nut		V (EPBC Act and TSC Act)
Angiosperms	Ranunculaceae	*Ranunculus inundatus*	River Buttercup		
Angiosperms	Rhamnaceae	*Alphitonia excelsa*	Red Ash		
Angiosperms	Rutaceae	*Flindersia australis*	Crows Ash		
Angiosperms	Rutaceae	*Pentaceras australe*	Black Teak		
Angiosperms	Salviniaceae	*Azolla pinnata*	Azolla		
Angiosperms	Sapindaceae	*Alectryon tomentosum*	Hairy Alectryon		
Angiosperms	Sapindaceae	*Cupaniopsis parviflora*	Small-leaved Tuckeroo		
Angiosperms	Sapindaceae	*Guioa semiglauca*	Guioa		
Angiosperms	Sapindaceae	*Jagera pseudorhus*	Foambark		
Angiosperms	Smilacaceae	*Smilax australis*	Sarsaparilla		
Angiosperms	Smilacaceae	*Eustrephus latifolius*	Wombat Berry		
Angiosperms	Solanaceae	*Cestrum parqui*	Green Cestrum	X	
Angiosperms	Solanaceae	*Duboisia myoporoides*	Corkwood		
Angiosperms	Solanaceae	*Solanum mauritianum*	Tobacco Bush	X	
Angiosperms	Solanaceae	*Solanum seaforthianum*	Climbing Solanum		
Angiosperms	Solanaceae	*Solanum torvum*	Devils Fig	X	
Angiosperms	Sterculiaceae	*Commersonia bartramia*	Brown Kurrajong		
Angiosperms	Thymelaeaceae	*Wikstroemia indica*	Tie Bush		

Group	**Family**	**Scientific Name**	**Common Name**	**Weeds**	**Threatened**
Angiosperms	Verbenaceae	*Lantana camara*	Lantana	X	
Angiosperms	Xanthorrhoeaceae	*Lomandra longifolia*	Lomandra		
Ferns & Fern Allies	Aspleniaceae	*Asplenium australasicum*	Birds Nest Fern		
Ferns & Fern Allies	Blechnaceae	*Doodia aspera*	Prickly Rasp Fern		
Ferns & Fern Allies	Dennstaedtiaceae	*Pteridium esculentum*	Bracken Fern		

APPENDIX 7

Fauna species list from field survey

Abbreviations:
Status: V: Vulnerable; **EPBC Act**: Commonwealth *Environment Protection and Biodiversity Conservation Act* 1999; **TSC Act**: New South Wales *Threatened Species Conservation Act 1995*.

Class	Scientific Name	Common Name	Threatened	Exotic	Evidence Only
Frogs	*Crinia signifera*	clicking froglet			
Frogs	*Litoria caerulea*	common green treefrog			
Birds	*Acanthiza pusilla*	brown thornbill			
Birds	*Anas superciliosa*	Pacific black duck			
Birds	*Aquila audax*	wedge-tailed eagle			
Birds	*Ardea ibis*	cattle egret			
Birds	*Ardea modesta*	eastern great egret			
Birds	*Cacatua galerita*	sulphur-crested cockatoo			
Birds	*Centropus phasianinus*	pheasant coucal			
Birds	*Chenonetta jubata*	Australian wood duck			
Birds	*Cisticola exilis*	golden-headed cisticola			
Birds	*Colluricincla harmonica*	grey shrike-thrush			
Birds	*Coracina novaehollandiae*	black-faced cuckoo-shrike			
Birds	*Corvus orru*	Torresian crow			
Birds	*Cracticus nigrogularis*	pied butcherbird			
Birds	*Cracticus tibicen*	Australian magpie			
Birds	*Cracticus torquatus*	grey butcherbird			
Birds	*Cygnus atratus*	black swan			
Birds	*Dicrurus bracteatus*	spangled drongo			
Birds	*Egretta novaehollandiae*	white-faced heron			
Birds	*Eolophus roseicapillus*	galah			
Birds	*Gallinula tenebrosa*	dusky moorhen			
Birds	*Geopelia humeralis*	bar-shouldered dove			
Birds	*Grallina cyanoleuca*	magpie-lark			
Birds	*Haliastur sphenurus*	whistling kite			
Birds	*Lichmera indistincta*	brown honeyeater			

Class	Scientific Name	Common Name	Threatened	Exotic	Evidence Only
Birds	*Macropygia amboinensis*	brown cuckoo-dove			
Birds	*Malurus cyaneus*	superb fairy-wren			
Birds	*Malurus lamberti*	variegated fairy-wren			
Birds	*Malurus melanocephalus*	red-backed fairy-wren			
Birds	*Manorina melanocephala*	noisy miner			
Birds	*Meliphaga lewinii*	Lewin's honeyeater			
Birds	*Melithreptus albogularis*	white-throated honeyeater			
Birds	*Merops ornatus*	rainbow bee-eater			
Birds	*Neochmia temporalis*	red-browed finch			
Birds	*Ocyphaps lophotes*	crested pigeon			
Birds	*Pachycephala rufiventris*	rufous whistler			
Birds	*Phalacrocorax sulcirostris*	little black cormorant			
Birds	*Philemon corniculatus*	noisy friarbird			
Birds	*Platycercus adscitus*	pale-headed rosella			
Birds	*Rhipidura albiscapa*	grey fantail			
Birds	*Rhipidura leucophrys*	willie wagtail			
Birds	*Strepera graculina*	pied currawong			
Birds	*Taeniopygia bichenovii*	double-barred finch			
Birds	*Threskiornis molucca*	Australian white ibis			
Birds	*Trichoglossus chlorolepidotus*	scaly-breasted lorikeet			
Birds	*Trichoglossus haematodus*	rainbow lorikeet			
Birds	*Vanellus miles*	masked lapwing			
Birds	*Zosterops lateralis*	silvereye			
Mammals	*Isoodon macrourus*	northern brown bandicoot			X
Mammals	*Phascolarctos cinereus*	koala	V (EPBC Act and TSC Act)		X
Mammals	*Trichosurus vulpecula*	common brushtail possum			X
Mammals	*Vulpes vulpes*	red fox		X	X

Attachment 6

Noise and Dust Assessment

NOISE AND DUST ASSESSMENT

PROPOSED CORAKI QUARRY

SEELEMS ROAD

CORAKI

Commissioned by:

Quarry Solutions Pty Ltd
c/- Groundwork Plus

Prepared by:

MWA Environmental

4 November 2015

Max Winders & Associates Pty Ltd tas MWA Environmental
Level 15, 241 Adelaide St, Brisbane GPO BOX 3137, Brisbane Qld 4001
P 07 3002 5500 **F** 07 3002 5588 E mail@mwaenviro.com.au
W www.mwaenviro.com.au
ABN 94 010 833 084

DOCUMENT CONTROL SHEET

MWA Environmental
Level 15 241 Adelaide Street
GPO Box 3137 Brisbane 4001

Telephone: 07 3002 5500
Facsimile 07 3002 5588
Email: mail@mwaenviro.com.au

Job Name: Coraki 15-041

Job No: 15-041

Original Date of Issue: 4 November 2015

DOCUMENT DETAILS

Title: Noise and Dust Assessment – Proposed Coraki Quarry – Seelems Road, Coraki

Principal Author: Mr Ben Hyde

Client: Quarry Solutions Pty Ltd
c/- Groundwork Plus

Client Address: 6 Mayneview Street, Milton QLD 4064

Client Contact: Mr Jim Lawler

REVISION/CHECKING HISTORY

Version Number	Date	Issued By		Checked By	
1 Report	23/09/15	BH		PAK	
2 v2 Report	04/11/15	BH		PAK	
3					
4					
5					
6					
7					
8					

DISTRIBUTION RECORD

Destination	Version Number								
	1	2	3	4	5	6	7	8	9
Groundwork Plus (electronic)	1	1							
Quarry Solutions (electronic)	1	1							
File Copy	1	1							
MWA Enviro Library									

CONTENTS TABLE

FIGURES

ATTACHMENTS

1.0 INTRODUCTION

1.1 PURPOSE OF REPORT

MWA Environmental was commissioned by Quarry Solutions Pty Ltd to undertake a Noise and Dust Assessment for the proposed Coraki Quarry.

The assessment has been conducted as supporting documentation for the Environmental Impact Statement ("EIS") prepared by Groundwork Plus in accordance with the Secretary's Environmental Assessment Requirements ("SEARs") issued by the Secretary of the Department of Planning and Environment on 22 May 2015 and revised on 30 July 2015.

The NSW Environmental Protection Authority advised by email dated 22 June 2015 that no quantitative assessment of diesel emissions associated with the project will be required. As such, the scope of the air quality assessment has been limited to particulate emissions.

1.2 SITE DESCRIPTION

The subject site is located at Seelems Road, Coraki, New South Wales. The site is located approximately 2 kilometres to the north-west of Coraki Village.

The site location is shown on **Figure 1**.

The subject site comprises the following properties:

Primary Resource Area

- Lot 401 on DP633427

Access Road via Easement

- Lot 403 on DP802985

Existing Petersons Quarry

- Lot 402 DP802985
- Lot 408 DP1166287
- Lot A DP397946
- Lot A DP389418
- Lot 3 DP701197
- Lot 2 DP954593
- Lot 1 DP954592
- Lot 1 DP310756

An aerial photograph of the subject site and surrounding area is included as **Figure 2**.

Access to the Pacific Highway from the quarry is via Seelems Road / Petersons Quarry Road, Lagoon Road, Casino-Coraki Road, Queen Elizabeth Drive and Coarki-Woodburn Road.

The haulage route to the Pacific Highway is shown on **Figure 3**.

1.3 SURROUNDING LAND USES

Surrounding land uses are shown on the aerial photograph included as **Figure 2**.

Surrounding land uses generally comprise rural allotments with scattered detached dwellings.

The nearest surrounding residential dwellings relative to the subject site boundaries are described as follows:

To the North:	Dwelling 310 metres to north, on Newmans Road
To the South:	Dwelling 85 metres to the south of the access road through Lot 403 on DP802985, 600m south of new resource area on Lot 401 on DP633427
To the West:	Dwelling 980 metres to the southwest of the access road through Lot 403 on DP802985
To the East:	Dwelling 285 metres to the east of the existing Petersons Quarry 825 metres east of the new resource area on Lot 401 on DP633427

Only one residential dwelling (to the north on Newmans Road) is located within 500 metres of the proposed new resource area on Lot 401 on DP633427.

Nine (9) residential dwellings surrounding the subject site have been nominated R1 to R9 on **Figure 2** for the purposes of this assessment.

Based upon aerial photography and site inspection, 44 residential dwellings were identified as being located within 100 metres of the haulage route between the quarry access and the Pacific Highway. These residences are shown on **Figure 3** for the purposes of this assessment.

1.4 PROPOSED DEVELOPMENT

Key elements of the Description of the Proposal contained in the Environmental Impact Statement by Groundwork Plus are reproduced as follows:

Site layout and quarry design

- Extraction will primarily occur within Lot 401 as an extension of the existing Peterson's Quarry pit. Stockpiling areas will be established on both Lot 401 and the Peterson's Quarry land to achieve stockpile capacity for up to 1,000,000 tonnes of materials as requested by the delivery partner for the Pacific Highway upgrade project.

- The existing site office, weighbridge and visitor car parking area of the Peterson’s Quarry will be utilised for the project.
- The processing plant for the project will be established within the existing Peterson’s Quarry pit to take advantage of the topographic screening available to that location which will assist in minimising potential risk of environmental nuisance from noise and dust emissions. Given the time limited, project specific nature of the project, the processing plant will consist of mobile crushing and screening plants rather than a permanent fixed plant.
- Conceptual Quarry Development Plan Initial Extraction Stage (refer **Attachment 1**) illustrates how the initial extraction area will be developed from the existing Peterson’s Quarry pit into Lot 401. The existing Peterson’s Quarry pit has a floor of approximately RL18. This will be continued into Lot 401. Internal benches will be developed to enable progressive extraction to occur from east to west within lot 401. The internal northern face of the extraction area will be a single wall of approximately 20m in height to retain the receding rim of the hill, topographically screening the extraction operations both visually and acoustically from the surrounding land to the north, east and west. Stockpile areas will be established with earth works required as necessary to establish pads of suitable slope. Topsoil and overburden will be used to establish perimeter bunds where necessary to assist in visually screening the stockpile areas and also direct stormwater to the stormwater detention basins for treatment.
- Conceptual Quarry Development Plan Final Extraction Stage (refer **Attachment 1**) illustrates the full extraction of the resource on Lot 401 to a floor of RL18m. Internal benches will adjoin the existing Peterson’s Quarry to facilitate continued efficient development of that resource for the Richmond Valley Council into the future. The internal northern and eastern face of the extraction area will be retained as a single wall of approximately 20m in height. The internal western face of the extraction area will be approximately 3m in height to transition to the western stockpile area on Lot 401. A ramp between the extraction area and the western stockpile area on Lot 401 will be retained in the final land form to accommodate continued connection for any potential redevelopment of the land.

Production quantities

It is proposed to extract a maximum of 1,000,000 tonnes of hard rock material per annum. The expected operating life of the quarry is five (5) to seven (7) years subject to the duration of the upgrade works to the Pacific Motorway. As the proposed development will involve extracting and processing more than 30,000 tonnes of extractive materials per year, it will require an environment protection licence under the *Protection of the Environment Operations Act 1997* (POEO Act).

Hours of operation and project duration

The proposed hours of operation are 6am to 7pm Monday to Saturday, 9am to 3pm Monday to Friday for blasting, and no work on Sundays or public holidays. Operation of the quarry is planned to take place as soon as possible, subject to the appropriate approval being granted and timing of the Pacific Motorway upgrade works. The expected operating life of the quarry is five (5) to seven (7) years subject to the duration of the upgrade works to the Pacific Motorway.

Concurrent Operation of Petersen's Quarry

Quarry Solutions has a contract to operate the Petersen's Quarry for Richmond Valley Council for a period extending beyond the expected five (5) to seven (7) year operating life of the Coraki Quarry. The Coraki Quarry will integrate the current extraction area and processing area of the Petersen's Quarry for the life of the project. Any quarry materials required by Richmond Valley Council through the life of the project will be sourced from the existing Petersen's Quarry resource area, crushed in the Coraki Quarry processing plant and stockpiled within the nominated Coraki Quarry stockpile areas.

Given that the extraction, processing, stockpiling and product loading activities will all be undertaken using the same equipment and personnel operating the Coraki Quarry there is no risk of significant cumulative noise and dust emissions.

2.0 QUARRY NOISE ASSESSMENT

2.1 AMBIENT NOISE MONITORING

In order to characterise the existing ambient noise environment at the locality, noise dataloggers were placed adjacent to the nearest residences to the north and east.

The noise datalogger locations are shown on **Figure 4**.

The noise dataloggers were programmed to provide a statistical noise level analysis based on 15-minute sampling periods continuously over the monitoring period. The recorded noise levels are presented as statistical components, which are described as:

L_1: Noise level exceeded for 1 percent of the measurement period, referred to as the adjusted maximum sound pressure level.

L_{10}: Noise level exceeded for 10 percent of the measurement period, referred to as the averaged maximum sound pressure level.

L_{90}: Noise level exceeded for 90 percent of the measurement period. AS1055.1–1997[1] notes that the L_{90} is described as the background sound pressure level.

L_{eq} An "average" measurement, and as per AS1055.1–1997 defined as the value of the sound pressure level of a continuous steady sound state, that within a measurement period, has the same mean square sound pressure as a sound under consideration whose level varies with time.

Table 1 below provides the minimum, maximum and average statistical noise levels recorded by the 'North' Location 1 noise datalogger.

Table 1: Range of Datalogger Recorded Statistical Noise Levels
21 to 27 April 2015
'North' Location 1

Parameter	Period	Recorded Noise Levels – dB(A)		
		Minimum	Maximum	Average
L_1	Daytime (7am-6pm)	33.5	80.0	51.8
	Evening (6pm-10pm)	29.0	58.0	36.5
	Nighttime (10pm-7am)	28.5	76.0	50.3
L_{10}	Daytime (7am-6pm)	30.0	71.5	42.6
	Evening (6pm-10pm)	27.0	36.0	31.1
	Nighttime (10pm-7am)	27.0	64.5	41.9
L_{90}	Daytime (7am-6pm)	28.0	52.5	34.8
	Evening (6pm-10pm)	26.0	34.0	28.2
	Nighttime (10pm-7am)	26.0	56.0	32.8
L_{eq}	Daytime (7am-6pm)	29.0	70.0	43.7
	Evening (6pm-10pm)	26.5	47.5	31.4
	Nighttime (10pm-7am)	26.5	64.0	41.3

---

[1] Australian Standard *AS 1055.1-1997 Acoustics – Description and measurement of environmental noise, Part 1: General procedures*

MWA Environmental is not aware of the operation of the Petersen's Quarry during the 'North' Location 1 noise datalogging period but notes that:

- There was no apparent operation of the Petersen's Quarry on 21 April 2015;
- There was no apparent operation of the Petersen's Quarry on 27 April 2015;
- More recent information regarding the Petersen's Quarry indicates that extraction and processing activities are occasional only; and
- The pit location where crushing is typically undertaken at the Petersen's Quarry is well topographically shielded from the 'North' Location 1 noise monitoring location.

On this basis it is expected that Petersen's Quarry operations did not influence the Rating Background Levels measured at 'North' Location 1.[2]

Table 2 below provides the minimum, maximum and average statistical noise levels recorded by the 'East' Location 2 noise datalogger.

Table 2: Range of Datalogger Recorded Statistical Noise Levels
12 to 21 August 2015
'East' Location 2

Parameter	Period	Recorded Noise Levels – dB(A)		
		Minimum	Maximum	Average
L_1	Daytime (7am-6pm)	42.6	71.8	53.5
	Evening (6pm-10pm)	30.9	55.9	42.1
	Nighttime (10pm-7am)	27.9	72.0	42.2
L_{10}	Daytime (7am-6pm)	34.4	65.7	44.7
	Evening (6pm-10pm)	28.2	48.2	35.9
	Nighttime (10pm-7am)	26.0	61.5	35.9
L_{90}	Daytime (7am-6pm)	27.8	55.3	33.7
	Evening (6pm-10pm)	25.1	42.2	28.1
	Nighttime (10pm-7am)	24.8	38.9	28.9
L_{eq}	Daytime (7am-6pm)	33.7	62.3	43.6
	Evening (6pm-10pm)	26.6	46.0	33.6
	Nighttime (10pm-7am)	25.6	59.1	34.0

The dataloggers used were an Acoustic Research Laboratories noise datalogger, model EL-215 (Location 1) and an Acoustic Research Laboratories noise datalogger, model EL-316 (Location 2). Each logger was pre-calibrated to 94 dB at 1kHz using a Rion Sound Level Calibrator, model NC-73. At post-calibration, the dataloggers exhibited less than ±0.5 dB deviation.

---

[2] Refer to Section 2.2 which indicates that the adopted Rating Background Levels are the 30 dB(A) minimum as per the NSW Industrial Noise Policy and thus potential influences from extraneous sources are somewhat immaterial

Quarry Solutions has advised MWA Environmental that the following activities occurred at the Petersen's Quarry during the 'East' Location 2 noise datalogging period:

- No extraction;
- No crushing or screening; and
- Loading and dispatch of between 50 tonnes to 370 tonnes of aggregates/roadbase on 13, 14, 18 & 19 August with no activity on other days – overall low numbers of trucks loaded and dispatched.

On this basis operations at the Petersen's Quarry during the 'East' Location 2 were limited to intermittent loading of trucks and would not have significantly influenced 1 hour average background noise levels or the measured Rating Background Levels.[3]

From the noise datalogger measurements, the following **Table 3** details the measured Rating Background Levels (RBLs)[4].

Table 3: Measured Rating Background Levels – dB(A)

Noise Monitoring Location	Time Period	RBL dB(A)
'North' Location 1	7am to 6pm	30
	6pm to 10pm	27
	10pm to 7am	28
'East' Location 2	7am to 6pm	30
	6pm to 10pm	26
	10pm to 6am	27

---

[3] Refer to Section 2.2 which indicates that the adopted Rating Background Levels are the 30 dB(A) minimum as per the NSW Industrial Noise Policy and thus potential influences from extraneous sources are somewhat immaterial

[4] For the early morning 6am to 7am period the lowest 10th percentile L_{90}(1 hour) noise levels have been adopted as an appropriate basis for assessment of intrusive noise criteria.

2.2 RELEVANT NOISE CRITERIA

The relevant noise criteria for the assessment of noise impacts from the proposed development are taken from the *NSW Industrial Noise Policy*.

The NSW *Industrial Noise Policy* provides specific policy objectives:

- *to establish noise criteria that would protect the community from excessive intrusive noise and preserve amenity for specific land uses; and*
- *to use the criteria as the basis for deriving project specific noise levels*

The appropriate noise criteria are established by means of a comparison between a ‘Rating Background Level (“RBL”) plus 5 dB(A)’ ‘Intrusiveness Criterion’ and ‘Amenity Criteria’ levels, with the lower level being adopted as the basis for deriving project specific noise levels.

From the noise datalogger measurements, the RBLs measured at Noise Datalogger Locations 1 and 2 were 30 dB(A) for the 7am to 6pm period. For the early morning 6am to 7am and early evening 6pm to 7pm periods the minimum RBL of 30 dB(A) has been adopted for assessment of intrusive noise criteria in accordance with the NSW Industrial Noise Policy. This is consistent with the 7am to 6pm RBL.

On this basis, the **relevant ‘Intrusiveness Criterion’ level** for assessment of noise from the proposed quarrying activity is **L_{Aeq} 35 dB(A)** for the proposed operating hours 6am to 7pm.

From Table 2.1 of the *Industrial Noise Policy*, the appropriate ‘Amenity Criteria’ are as follows for “Residential receiver in a Rural area”:

Time of Day	*Recommended L_{Aeq} Noise Level, dB(A)*	
	Acceptable	*Recommended Maximum*
Day (7am to 6pm)	*50*	*55*
Evening (6pm to 10pm)	*45*	*50*
Nighttime (10pm to 7am)	*40*	*45*

As the ‘Intrusiveness Criterion’ levels are lower than the ‘Amenity Criteria’ the more stringent ‘Intrusiveness Criterion’ level of **L_{Aeq} 35 dB(A)** is applied to the assessment of noise emissions from the proposed quarrying activities.

2.3 QUARRY NOISE MODELLING METHODOLOGY

To enable assessment of noise from the proposed quarrying operations a detailed noise model has been established using the SoundPLAN 7.3 software applying the CONCAWE noise propagation algorithms. The CONCAWE noise propagation method / algorithms were applied to the modelling to allow assessment of noise propagation under specific meteorological conditions e.g. wind directions.

This model is an accepted regulatory model that allows input of site-specific terrain data and source noise data as sound power level spectra.

Modelling has been undertaken based upon the layouts for the 'Initial Pit' and 'Final Pit' operations as per the 3D CAD plans provided by Groundwork Plus (refer **Attachment 1**).

The model layouts and the source locations for the 'Initial Pit' and 'Final Pit' operations are shown on the drawings included in **Attachment 2**.

The source noise data was derived from measurements conducted by MWA Environmental at comparable and representative existing extractive industry facilities. The modelled sound power level data is provided in **Attachment 3**.

As discussed in **Section 1.4**, given that the extraction, processing, stockpiling and product loading activities will all be undertaken using the same equipment and personnel operating the Coraki Quarry there is no risk of significant cumulative noise emissions from the Petersen's Quarry during the life of the project.

2.4 TOPOGRAPHIC DATA

The model was established over an area of approximately 4km by 3km centred on the subject land. Digital elevation data for the locality and the subject land, including representations of the 'Initial Pit' and 'Final Pit' landforms was supplied by Groundwork Plus and integrated into the noise model.

2.5 METEOROLOGICAL CONDITIONS

Site-specific meteorological conditions have been assessed based upon the meteorological modelling undertaken for the dispersion modelling (refer **Section 4.3.2**).

Analysis of the relevant meteorological parameters at the site during the operating hours 6am to 7pm for the purposes of noise assessment including stability classes and wind roses is provided in **Attachment 4**.

The analysis demonstrates that:

- Temperature inversion conditions, as Pasquill Gifford F-Class Stability, occur for approximately 6 percent of operating hours in the year; and
- Wind speeds of up to 3 m/s from directions within a 45 degree sector centred on the nearest residences to the north, south and east[5] occur for less than 30 percent of operating hours during any season.

On the basis of the objective meteorological analysis in accordance with the *NSW Industrial Noise Policy*, temperature inversions and winds of up to 3 m/s from source to the nearest receivers are not assessed to be significant conditions for the purposes of this noise assessment.

2.6 QUARRY NOISE MODELLING

2.6.1 NOISE SOURCES

The following noise sources were represented in the model:

Table 4: Noise Sources Used in SoundPLAN 7.3 Modelling

NOISE SOURCE	LOCATION
Primary (Jaw) Crusher	Existing Petersons Quarry Pit
3x Cone Crushers	
Primary Screen	
Secondary Screen	
Tertiary Screen	
Quaternary Screen	
Rock Drill	Lot 401 on DP633427 Resource Area
Rock Pick	
Excavator Loading Shot Rock	
Haul Trucks	Pit to Plant and Plant to Western Stockpiles routes
Loader at Southern Stockpiles	Southern Stockpiles
Loader at Western Stockpiles	Western Stockpiles
Product Trucks	50/50 split Seelems Road Entry and Petersons Quarry Road Entry routes

---

[5] Noting that the nearest receptors are directly to the north, south and east of the extraction and processing noise sources

The above-listed sources are the key noise sources which are expected to operate at the quarry on a regular basis. Other plant items and vehicles may be required to be used at the quarry at times but should not increase overall noise emissions above the level of the above modelled noise sources operating simultaneously.

The operating Sound Power Levels ("SWLs") of key processing and mobile equipment have been taken from source noise surveys conducted at comparable and representative existing extractive industry operations.

A +5 dB(A) impulse adjustment to the Rock Pick SWL was applied by MWA Environmental to address the noise character of this source.

The modelled SWLs are summarised in **Table 5** below.

Table 5: **Sound Power Levels - $L_{Aeq,T}$ - dB(A)**

SOURCE	MODELLED SWL $L_{Aeq,T}$ - dB(A)	SOURCE REPRESENTATION
Primary Crusher	113	Point Source
Screen 1 & Cone Crusher 1	110	Point Source
Cone Crusher 2	109	Point Source
Crusher 3	109	Point Source
Screen 2	107	Point Source
Screen 3	105	Point Source
Screen 4	105	Point Source
Pit to Plant Haul Road (Dump Trucks) 5 loads per hour	75/m	Line Source
Plant to Western Stockpiles (Dump Trucks) 2.5 loads per hour	72/m	Line Source
Loader Loading Truck (1 hour work cycle)	104	Point Source
Loader Loading Truck (1 hour work cycle)	104	Point Source
Excavator Loading Truck[6] (1 hour work cycle)	110	Point Source
Rock Drill[7]	110	Point Source
Rock Pick	118[8]	Point Source
Access Road (7 loads per hour via each entry)	66/m	2x Line Sources

---

[6] Truck tray with impact absorptive lining

[7] Proprietary quietened rock drill

[8] Including +5dBA impulse adjustment

2.6.2 NOISE CONTROL MEASURES

Based upon an iterative noise modelling process, it has been determined that the following noise control measures are required to comply with the relevant noise limits:

1. The proposed Stockpile Area pads are relatively open and will require **earth bunds and/or acoustic barriers to the following locations**:
    a. **Northern perimeter of the Western Stockpile Area** to a minimum height of 6 metres above the RL21m pad level ('**Screen 1**')
    b. **Southern perimeter of the Southern Stockpile Area** to a minimum height of 4 metres above the RL40m pad level ('**Screen 2**')
    c. **Northern perimeter of the Southern Stockpile Area** to a minimum height of 4 metres above the RL40m pad level ('**Screen 3**')
2. The **northern perimeter of the extraction area** will require an **earth bund and/or acoustic barrier** to a minimum height of 6 metres above the natural ground level at the northern perimeter of the Extraction Area ('**Screen 4**').
3. Wherever practicable **materials should be stockpiled at locations that shield noise from internal traffic routes and truck loading areas** from the nearest residences i.e.:
    a. Maintain stockpiles along the northern perimeter of the Western Stockpile Area and stock / reclaim from the southern side whenever practicable
    b. Maintain stockpiles along the southern and eastern perimeters of the Southern Stockpile Area and stock / reclaim from the northern and western sides whenever practicable
4. An **acoustic barrier and/or earth mound to a minimum height of 4 metres above the access road off Seelems Road** shall be constructed ('**Screen 5**) for a length of 200 metres from the site entry point.
5. The **processing plant shall be operated at the most shielded location available** (e.g. at the southeastern corner of the existing Petersons Quarry pit at the RL18m bench) to the extent practicable. If not practicable then appropriate acoustic screening shall be installed to the crushers, screens and any other processing equipment as necessary to comply with the relevant noise limits. Commissioning phase testing is recommended to confirm acceptable siting and/or acoustic treatment of the processing plant.
6. **Trays of all dump trucks that handle shot rock**[9] **and oversize material are to be lined** with an appropriate **absorptive material**.
7. The **rock pick should be operated at the most shielded location practically available** within the pit to provide acoustic shielding to the north and east.
8. Drilling should be undertaken using a proprietary **quietened drill rig** e.g. Atlas Copco SmartRig ROC D9C.

---

[9] i.e. pit to plant haulage

9. Extraction sequencing should be designed such that the **drill rig is shielded to the north by retained topography of minimum height 5 metres** above the drilling pad level and **supplemented with earth mounding and/or acoustic barriers as necessary** to achieve the overall physical shielding.
10. The **internal traffic routes at the northeastern perimeter to be shielded by topographic cut, earth bund and/or acoustic barrier** directly to the northeast of the traffic routes to a minimum height of 4 metres above the adjacent traffic route ('**Screen 6**). It is noted that the northwestern section of 'Screen 6' is not required once the internal traffic route is directed through the extraction area (pit) as the retained topography will achieve the required shielding.
11. All **internal roads for road haulage and off-road trucks** should be **constructed and maintained to avoid excessive noise** associated with uneven surfaces and potholes.
12. It is recommended that mobile plant (e.g. front-end loaders, dozers, haul trucks, excavators) be fitted with **broadband reversing alarms** to mitigate potential nuisance from tonal characteristics of traditional beeper alarms.

The acoustic 'Screen' locations are shown on **Figure 5**. The acoustic 'Screens' may be constructed of any combination of earth bunding, acoustic barrier[10] and/or additional topographic cut to achieve the necessary total height.

Based upon the modelling and assessment undertaken by MWA Environmental, all of the above noise control measures are necessary to comply with the relevant noise criteria at surrounding sensitive receptors. The relative importance of each measure is difficult to articulate given that the noise reduction achieve by each measure varies for each noise source and for each receptor location. Whilst each measure in isolation may achieve an incremental reduction in overall noise from the quarry at different receptor locations the cumulative effect of all recommended noise mitigation measures has been assessed to be sufficient to comply with the relevant noise criteria at all receptors. Previous experience with hard road quarrying indicates that critical noise sources to mitigate to avoid nuisance are:

- Crushing and screening plant; and
- Heavy mobile equipment operating at exposed locations (e.g. rock drills, dump trucks).

It is understood that the landowner of Lot 401 also owns Lot 4 on DP6339 to the north containing the residence R7 (refer **Figure 2**). If the applicant is able to reach a commercial arrangement with the landowner such that R7 is not a noise sensitive place for the purposes of the operation of Coraki Quarry then the noise control measured numbered 1a, 3a and 9 are not required.

If the applicant is able to reach a commercial arrangement with the landowner of Lot 12 DP6339 to the south, such that R1 is not a noise sensitive place for the purposes of the operation of Coraki Quarry then the noise control measured numbered 1b, 3b and 4 are not required.

---

[10] An acoustic barrier should be constructed as gap-free (less than 1% leakage) and of materials achieving a minimum surface density of 12.5kg/m^2

In addition to the above specific noise control measures, all fixed and mobile plant and equipment operated at the site should be selected and maintained to minimise noise emissions.

2.6.3 NOISE MODELLING RESULTS

The results of the SoundPLAN 7.3 modelling for the 'Initial Pit' and 'Final Pit' operation scenario are provided in **Attachment 5** as contours of predicted resultant noise levels on a cadastral base showing the locations of the representative surrounding residences (refer **Figure 2**).

The predicted resultant noise levels at the representative receptor locations are summarised in **Table 6** below.

Table 6: Summary of Model Results for Receptors – dB(A)
'Initial Pit' and 'Final Pit' Scenarios

RECEPTOR	PREDICTED L_{Aeq} NOISE LEVEL - dB(A)		*NOISE CRITERION* L_{Aeq} *- dB(A)*
	INITIAL PIT	FINAL PIT	
R1	35	35	*35*
R2	35	35	*35*
R3	33	34	*35*
R4	28	28	*35*
R5	27	27	*35*
R6	35	35	*35*
R7	35	35	*35*
R8	24	27	*35*
R9	23	24	*35*

The model-predicted quarry noise levels at the industrial facility (concrete panel manufacturer) on Lot 407 on DP1166287 to the southeast range 41 to 47 dB(A) L_{Aeq} with the noise control measures recommended in **Section 2.6.2**. This is noted to be compliant with the NSW Industrial Noise Policy 'amenity criteria' for 'Industrial Premises' which are an 'Acceptable' level of 70 dB(A) L_{Aeq} and a 'Recommended Maximum' level of 75 dB(A) L_{Aeq}.

2.6.4 OUTCOMES OF QUARRY NOISE MODELLING

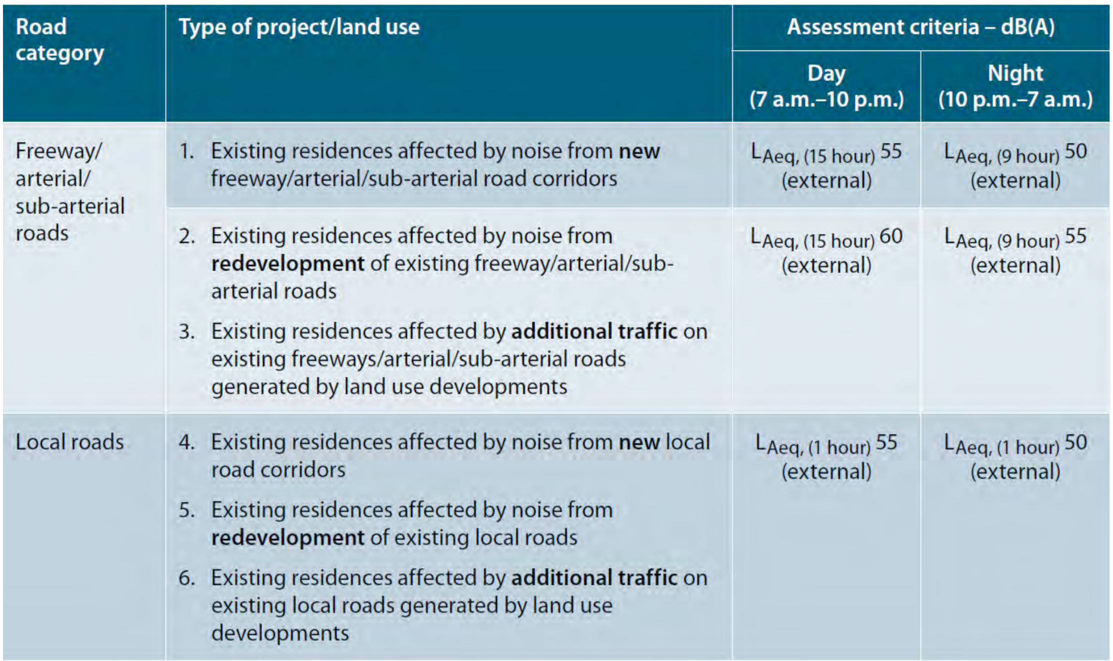
On the basis of the noise assessment conducted, the predictions demonstrate that, subject to the implementation of the noise mitigation measures specified in **Section 2.6.2,** the proposed quarrying activities can comply with the relevant noise criteria at surrounding sensitive receptors and the industrial facility on Lot 407 on DP1166287. Detailed consideration should be given to the requirement to shield and/or acoustically treat the processing plant and to the most practical methods of achieving the acoustic shielding required through the use of topographic cut, earth bunds and/or barriers at various locations.

3.0 ROAD TRAFFIC NOISE ASSESSMENT

3.1 RELEVANT NOISE CRITERIA

The relevant criteria for the assessment of noise associated with the haulage of materials from the proposed development to the Pacific Highway at Woodburn are specified in the *NSW Road Noise Policy* (Department of Environment, Climate Change and Water NSW, 2011).

The *NSW Road Noise Policy* road traffic noise assessment criteria for residential land uses are as follows with the relevant criteria being those for "*existing residences affected by additional traffic on existing freeways/arterial/sub-arterial roads generated by land use developments*":



Road category	Type of project/land use	Assessment criteria – dB(A)	
		Day (7 a.m.–10 p.m.)	Night (10 p.m.–7 a.m.)
Freeway/ arterial/ sub-arterial roads	1. Existing residences affected by noise from **new** freeway/arterial/sub-arterial road corridors	$L_{Aeq,\,(15\ hour)}$ 55 (external)	$L_{Aeq,\,(9\ hour)}$ 50 (external)
	2. Existing residences affected by noise from **redevelopment** of existing freeway/arterial/sub-arterial roads 3. Existing residences affected by **additional traffic** on existing freeways/arterial/sub-arterial roads generated by land use developments	$L_{Aeq,\,(15\ hour)}$ 60 (external)	$L_{Aeq,\,(9\ hour)}$ 55 (external)
Local roads	4. Existing residences affected by noise from **new** local road corridors 5. Existing residences affected by noise from **redevelopment** of existing local roads 6. Existing residences affected by **additional traffic** on existing local roads generated by land use developments	$L_{Aeq,\,(1\ hour)}$ 55 (external)	$L_{Aeq,\,(1\ hour)}$ 50 (external)

Coraki-Woodburn Road, Queen Elizabeth Drive and Casino-Coraki Road are sub-arterial category roads and thus the relevant assessment criteria for residences affected by noise associated with these roadways are:

Day (7am to 10pm): **L_{Aeq} (15 hour) 60 dB(A)**

Night (10pm to 7am): **L_{Aeq} (9 hour) 55 dB(A)**

Seelems Road, Petersons Quarry Road and Lagoon Road are local category roads and thus the relevant assessment criteria are generally:

Day (7am to 10pm): **L_{Aeq} (1 hour) 55 dB(A)**

Night (10pm to 7am): **L_{Aeq} (1 hour) 50 dB(A)**

Given the proximity of the 228 Lagoon Road residence to both a local road and the sub-arterial road network, the sub-arterial category assessment criteria have been applied. The residence at 200 Lagoon Road, to the south of the Seelems Road entry, is the only dwelling assessed as being in proximity to the local road category haulage route.

For circumstances where the existing ‘background’ road traffic noise levels are close to, or exceed, the nominated assessment criteria, the *NSW Road Noise Policy* provides for an assessment of land use development impacts against a ‘Relative Increase’ criteria. The *NSW Road Noise Policy* states:

> *“In assessing feasible and reasonable mitigation measures, an increase of up to 2 dB represents a minor impact that is considered barely perceptible to the average person”*

Fundamentally, the ‘Relative Increase’ criteria acknowledges that if a land use development will result in an exceedance of the relevant road traffic noise assessment criteria but causes an increase of less than 2dB, the overall impact on noise amenity is minor and is unlikely to warrant mitigation works.

MWA Environmental has assessed the road traffic noise levels at residences within 100 metres of the haulage route to the Pacific Highway against the criteria of the NSW *Road Noise Policy*.

3.2 ROAD TRAFFIC NOISE MONITORING

MWA Environmental conducted road traffic noise monitoring over a 24 hour period at three locations adjacent to the haulage route from the site to the Pacific Highway over 12 to 13 August 2015.

The free-field noise monitoring locations were selected as representative of the following distinct route characteristics:

Location 1 - Lagoon Road:	Representative of houses along the local road network adjacent to the site. 26.5m from Lagoon Road 168m from Casino-Coraki Road
Location 2 – Queen Elizabeth Drive:	Representative of residences along the 60km/h zone through Coraki township. 17m from Queen Elizabeth Drive
Location 3 – Coraki-Woodburn Road:	Representative of residences along the main 100km/h sub-arterial network. 17m from Coraki-Woodburn Road

The noise monitoring locations are shown on **Figure 6**.

Prevailing meteorological conditions during the monitoring period were generally fine with several brief periods of light rainfall. Wind conditions were calm to light northerly during the mornings of 12 and 13 August 2015 and moderate to strong winds on the afternoon of 12 August 2015. Winds were relatively light during the evening and night period on 12 August 2015. Whilst the period of elevated wind speeds on the afternoon of 12 August 2015 would have affected the measured noise levels the overall impact is considered to be acceptable considering the purpose of the monitoring and proximity of the monitoring locations to the dominant road traffic noise source.

The noise monitoring was conducted using Rion NL-21 and Rion NL-42 noise datalogger units which were pre-calibrated to a reference signal of 94 dB at 1kHz. No calibration drift was observed post-measurement.

The measured AM Peak L_{Aeq} (1 hour) (7am to 10pm), L_{Aeq} (1 hour) (6am to 7am), L_{Aeq} (15 hour) (7am to 10pm) and L_{Aeq} (9 hour) (10pm to 7am) noise levels for each location are summarised in **Table 7** below.

Table 7: Summary of Measured Road Traffic Noise Levels – dB(A)

DATE	STATISTICAL PERIOD	MEASURED L_{Aeq} NOISE LEVEL - dB(A)		
		LOCATION 1	LOCATION 2	LOCATION 3
12 to 13 August 2015	AM Peak L_{Aeq} (1 hour) (7am to 10pm)	50.6	56.7	58.9
	L_{Aeq} (1 hour) (6am to 7am)	48.5	57.4	58.0
	L_{Aeq} (15 hour) (7am to 10pm)	48.6	56.2	58.0
	L_{Aeq} (9 hour) (10pm to 7am)	40.7	52.6	55.0

Traffic counts were undertaken over the period 11 to 17 August 2015 at three locations adjacent to the noise monitoring locations (refer **Figure 6**) to coincide with the traffic noise monitoring for the purposes of model validation and assessment of the ‘background’ traffic volumes over each assessment period.

The measured traffic volumes, heavy vehicle percentage and average vehicle speeds for the 12 to 13 August 2015 noise monitoring periods are summarised in **Table 8** below.

Table 8: Summary of Traffic Volumes and Parameters 12 to 13 August 2015

DATE	STATISTICAL PERIOD	TRAFFIC VOLUME (vehicles) (HEAVY VEHICLE COMPONENT (%)) [AVERAGE SPEED (km/h)]		
		LOCATION 1	LOCATION 2	LOCATION 3
12 to 13 August 2015	AM Peak 1 hour (7am to 10pm)	19 (31.6%) [66km/h]	156 (15.4%) [59km/h]	118 (15.3%) [93km/h]
	1 hour (6am to 7am)	9 (0%) [62km/h]	112 (8.9%) [62km/h]	82 (12.2%) [94km/h]
	Average 1 hour (7am to 10pm)	10vph (20.3%) [57km/h]	108 (14.9%) [61km/h]	82 (16.1%) [92km/h]
	Average 1 hour (10pm to 7am)	4 (5.9%) [64km/h]	38 (14.6%) [67km/h]	28 (17.5%) [93km/h]

3.3 DESIGN TRAFFIC VOLUMES

The *Coraki Quarry Traffic Impact and Pavement Assessment Report* (MRCagney Pty Ltd, July 2015) has determined that the development will generate an average of 7 heavy vehicles per hour (i.e. loads per hour) which relates to 14 (two-way) vehicle movements per hour along the haulage route during the operating hours 6am to 7pm. This traffic volume have been applied as the design traffic volume for the purposes of this traffic noise assessment with a 100 percent heavy vehicle percentage.

Background traffic[11] was derived from the 11 to 17 August 2015 traffic count data provided by AusTraffic with the volumes assessed for various road sections based upon the most representative count location, as follows:

Location 1: Representative of Lagoon Road from Petersons Quarry Road to Casino-Coraki Road.

Location 2: Representative of Casino-Coraki Road between Lagoon Road and Queen Elizabeth Drive, Queen Elizabeth Drive and Coraki-Woodburn Road between Coraki and Myall Creek Road.

Location 3: Representative of Coraki-Woodburn Road between Myall Creek Road and the Pacific Highway.

---

[11] Background traffic is assessed as the haulage route traffic in the absence of traffic associated with the proposed quarry

The modelled background traffic volumes are summarised in **Table 9** below based upon the average volumes measured over the count period 11 to 17 August 2015, excluding Sunday.

Table 9: Summary of Background Traffic Volumes and Parameters Design Scenario Modelling

STATISTICAL PERIOD	TRAFFIC VOLUME (vehicles) (HEAVY VEHICLE COMPONENT (%)) [AVERAGE SPEED (km/h)]		
	LOCATION 1	LOCATION 2	LOCATION 3
AM Peak 1 hour (7am to 10pm)	20 (39%) [61km/h]	145 (15.8%) [60km/h]	116 (16.6%) [93km/h]
1 hour (6am to 7am)	12 (8.6%) [69km/h]	145 (15.8%) [60km/h]	98 (19.6%) [95km/h]
Average 1 hour (7am to 10pm)	9vph (19.7%) [57km/h]	106 (11.6%) [61km/h]	85 (13.3%) [93km/h]
Average 1 hour (10pm to 7am)	4 (10.4%) [51km/h]	41 (26.6%) [66km/h]	31 (31.6%) [92km/h]

3.4 TRAFFIC NOISE MODELLING

3.4.1 DESCRIPTION OF MODEL

Traffic noise modelling has been conducted using the SoundPLAN 7.3 software applying the accepted CoRTN traffic noise prediction methodology.

Site specific topographic information was input to the model for a domain extending from the quarry access to the Pacific Highway based upon NSW Government Land & Property Information 10 metre topographic contours. The road centreline was digitised from review of NSW Globe imagery.

Residential dwellings identified as being within 100 metres of the haulage route (refer **Figure 3**) were input to the model as discrete receptor. For the section of the haulage route through the township of Coraki, a limited number of dwelling locations were nominated for the purposes of the assessment on the basis that the selected receptors are representative of the dwellings nearest to this section of the haulage route. Other residential dwellings through the Coraki township along Queen Elizabeth Drive are similarly or less exposed to road traffic noise.

Based upon the traffic counts undertaken, average traffic speeds are below the posted speed limits due to the characteristics of the roads. The measured average traffic speeds have been applied to the appropriate road sections for the purposes of the modelling.

3.4.2 MODEL VALIDATION

The model was setup to represent the AM Peak Hour traffic as counted on 12 August 2015. Noise monitoring Locations 1 to 3 (refer **Figure 6**) were represented as discrete receptors in the model. Model predicted AM Peak Hour noise levels at the monitoring location is summarised in **Table 10** below.

Table 10: Summary of Predicted AM Peak Hour Noise Levels - Validation Model for 12 August 2015

Location	Measured		Measured L_{10} - L_{eq} Adjustment	Model-Predicted		Model Error L_{10} 1 hour
	L_{A10} 1 hour	L_{Aeq} 1 hour		L_{10} 1 hour	L_{Aeq} 1 hour	
Location 1 – Lagoon Road	51.5	50.6	*-0.9*	51.5	50.9	*0*
Location 2 – Queen Elizabeth Drive	59.9	56.7	*-3.2*	59.9	56.7	*0*
Location 3 – Coraki-Woodburn Road	60	58.9	*-1.1*	61.9	60.8	*+1.9*

The model was setup to represent the 15 hour (7am to 10pm) traffic as counted on 12 August 2015. Noise monitoring Locations 1 to 3 (refer **Figure 6**) were represented as discrete receptors in the model. Model predicted 15 hour (7am to 10pm) noise levels at each monitoring location are summarised in **Table 11** below.

Table 11: Summary of Predicted 15 hour (7am to 10pm) Noise Levels - Validation Model for 12 August 2015

Location	Measured		Measured L_{10} - L_{eq} Adjustment	Model-Predicted		Model Error L_{10} 15 hour
	L_{A10} 15 hour	L_{Aeq} 15 hour		L_{10} 15 hour	L_{Aeq} 15 hour	
Location 1 – Lagoon Road	50.3	48.6	*-1.7*	47.3	45.6	*-3*
Location 2 – Queen Elizabeth Drive	58.8	56.2	*-2.6*	58.2	55.6	*-0.6*
Location 3 – Coraki-Woodburn Road	59.2	58.0	*-1.2*	60.0	58.8	*+0.8*

Based upon the validation modelling, it is considered that the model is reasonably predicting traffic noise levels along the haulage route. The apparent under prediction of road traffic noise at Location 1 over the 7am to 10pm period is likely due to the greater relative influence of strong winds during the 12 August 2015 afternoon period at this monitoring location which is subject to less dominant road traffic noise as compared to Locations 2 & 3.

The validated model is considered suitable for the purpose of assessing the design scenario road traffic noise levels at residences within 100 metres of the haulage route to the Pacific Highway.

3.4.3 DESIGN SCENARIO PREDICTED NOISE LEVELS

The model was setup to represent the design scenario traffic as per **Section 3.3** above for the following assessment periods:

- 15 Hour (7am to 10pm)
- 9 Hour (10pm to 7am)
- AM Peak Hour (7am to 10pm) – relevant to 200 Lagoon Road only
- Night Peak Hour (6am to 7am) - relevant to 200 Lagoon Road only

Residential dwellings within 100 metres of haulage route (refer **Figure 3**) were represented as discrete receptors in the model. It is noted that the nominated dwelling receptor locations through the Coraki township are representative of dwelling nearest to the roadway along this section of the haulage route. Other residential dwellings through the township of Coraki are similarly or less exposed to road traffic noise compared to the nominated representative receptors.

Model predicted L_{Aeq} 15 Hour (7am to 10pm) and L_{Aeq} 9 Hour (10pm to 7am) noise levels (including façade reflection) at each residential dwelling in proximity to a sub-arterial category road are summarised in **Table 12** below.

Table 12: **Summary of Model Predicted 15 Hour (7am to 10pm) & 9 Hour (10pm to 7am) Noise Levels**

RECEPTOR	MODEL PREDICTION - at façade - dB(A)			
	L_{Aeq} (15 hour) Average		L_{Aeq} (9 hour) Average	
	With Development Overall Level	Increase as a Result of Development	With Development Overall Level	Increase as a Result of Development
R1	54.9	2.1	50.6	0.4
R2	56.6	2.1	52.3	0.5
R3	60.1	1.6	54.8	0.4
R4	54.1	2.2	49.8	0.4
R5	58.9	1.8	54.1	0.4
R6	60.4	1.5	55.1	0.4
R7	52	2.1	47.6	0.4
R8	52.4	2.1	47.7	0.5
R9	59.1	1.7	54.3	0.5
R10	56.2	7.8	47.3	4.8
R11	59.9	1.6	54.7	0.4
R12	58.6	1.9	53.9	0.4
R13	60.3	1.6	55	0.4
R14	Refer **Table 13** below			
R15	56.8	2.1	52.4	0.5
R16	59.8	1.6	54.7	0.5
R17	59.1	1.9	54.3	0.4
R18	58.1	1.9	53.8	0.4
R19	49.7	2	45.9	0.5
R20	62.7	1.3	56.7	0.4
R21	59.2	1.7	54.3	0.5
R22	61.6	1.6	55.8	0.6
R23	52.1	2	47.3	0.6
R24	56.2	2	51.2	0.6
R25	63.2	1.5	57.1	0.7
R26	64.2	1.3	57.7	0.6
R27	58.3	2.1	53.5	0.7
R28	49.3	2.1	45.6	0.4
R29	56	1.7	51.3	0.4
R30	59.9	2	54.9	0.6
R31	59	2	54	0.6
R32	61.2	1.7	55.6	0.6
R33	64.6	1.2	58	0.6
R34	61	1.7	55.6	0.7
R35	52.7	2	47.9	0.6
R36	57.8	2	52.9	0.6
R37	62.6	1.5	56.7	0.6
R38	63	1.5	56.9	0.6
R39	61.6	1.7	56	0.6
R40	60.3	1.8	55.1	0.6
R41	52	2.3	47.2	0.7
R42	56.9	2.1	52	0.7
R43	54.8	2.1	50	0.7
R44	56	2.1	51.1	0.6
CRITERION	***60dBA ASSESSMENT CRITERIA***	***2dBA IF ASSESSMENT CRITERIA EXCEEDED***	***55dBA ASSESSMENT CRITERIA***	***2dBA IF ASSESSMENT CRITERIA EXCEEDED***

Model predicted L_{Aeq} 1 Hour (7am to 10pm) and L_{Aeq} 1 Hour (10pm to 7am) noise levels (including façade reflection) at the 200 Lagoon Road dwelling in proximity to a local category road are summarised in **Table 13** below.

Table 13: Summary of Model Predicted 1 Hour (7am to 10pm) & 1 Hour (10pm to 7am) Noise Levels

RECEPTOR	MODEL PREDICTION - at façade - dB(A)			
	L_{Aeq} (1 hour) 7am to 10pm		L_{Aeq} (1 hour) Average 10pm to 7am	
	With Development Overall Level	Increase as a Result of Development	With Development Overall Level	Increase as a Result of Development
R14	43.4	3.9	41.1	7.4
CRITERION	*55dBA ASSESSMENT CRITERIA*	*2dBA IF ASSESSMENT CRITERIA EXCEEDED*	*50dBA ASSESSMENT CRITERIA*	*2dBA IF ASSESSMENT CRITERIA EXCEEDED*

3.4.4 OUTCOMES OF TRAFFIC NOISE MODELLING

Based upon the road traffic noise modelling conducted it has been determined that:

1. For 14 of the 43 nominated dwellings in proximity to the sub-arterial category haulage roads, compliance is predicted to be achieved with the 60 dB(A) L_{Aeq} (15 hour) (7am to 10pm) assessment criteria specified in the NSW *Road Noise Policy* for "*existing residences affected by additional traffic on existing freeways/arterial/sub-arterial roads generated by land use developments*".
2. For 12 of the 43 nominated dwellings in proximity to the sub-arterial category haulage roads, compliance is predicted to be achieved with the 55 dB(A) L_{Aeq} (9 hour) (10pm to 7am) assessment criteria specified in the NSW *Road Noise Policy* for "*existing residences affected by additional traffic on existing freeways/arterial/sub-arterial roads generated by land use developments*".
3. For the 200 Lagoon Road residence, compliance is predicted to be achieved with the 55 dB(A) L_{Aeq} (1 hour) (7am to 10pm) and 50 dB(A) L_{Aeq} (1 hour) (10pm to 7am) assessment criteria specified in the NSW Road Noise Policy for "*existing residences affected by additional traffic on existing local roads generated by land use developments*".
4. For residences where the cumulative L_{Aeq} (15 hour) (7am to 10pm) noise level post-development is predicted to exceed the 60 dB(A) assessment criteria, the increase as a result of the development does not exceed 2dB(A). This is considered to be a minor change in accordance with the NSW *Road Noise Policy* and impacts are unlikely to warrant mitigation works, particularly considering the purpose and limited operational life of the proposed development.

4.0 QUARRY DUST ASSESSMENT

4.1 AMBIENT DUST CONCENTRATIONS

Ambient air quality monitoring data was sourced from the NSW Office of Environment and Heritage. Routine ambient particulate monitoring is not undertaken in close proximity to Coraki. The monitoring station selected for representative ambient concentrations is Wyong, located on the central coast. A summary of the ambient particulate data applied to this assessment is provided in **Table 14** below.

Table 14: Ambient Particulate Data Applied to Assessment

POLLUTANT	AVERAGING TIME	AMBIENT (µg/m^3)*	SOURCE
TSP	Annual Average	30.1	Conservative assumption of double Wyong Year 2014 PM$_{10}$ Annual Average
PM$_{10}$	24 Hour Average	17.2	70th percentile Wyong Year 2014 PM$_{10}$ 24 hour average
	Annual Average	15.1	Wyong Year 2014 PM$_{10}$ Annual Average
PM$_{2.5}$	24 Hour Average	6.2	70th percentile Wyong Year 2014 PM$_{2.5}$ 24 hour average
	Annual Average	5.5	Wyong Year 2014 PM$_{2.5}$ Annual Average
Dust Deposition	Annual Average	40 mg/m^2/day 1.2 g/m^2/month	Assumption based upon typical data

** unless stated otherwise*

In selecting the Wyong monitoring station as the most representative yet conservative basis for assessing ambient particulate concentrations at the Coraki site, consideration was also given to the alternative sites summarised in **Table 15** below.

Table 15: Summary of Alternative Ambient Monitoring Sites

Pollutant	**PM_{10}**					**$PM_{2.5}$**	
Location	**Wyong**	**Tamworth**	**Bathurst**	**Mountain Creek**	**Springwood**	**Wyong**	**Springwood**
Distance from Coraki	500km	320km	600km	260km	160km	500km	160km
Site Description	"Central Coast"	"Rural Monitoring Site"	"Rural Monitoring Site"	"South East QLD"	"South East QLD"	"Central Coast"	"South East QLD"
Climatic and Land use Character	Similar coastal climate, larger population centre, more dense transport	More arid climate, larger population centre	More arid climate, larger population centre	Similar coastal climate, larger population centre, more dense transport	Similar coastal climate, major urban area, more dense transport	Similar coastal climate, larger population centre, more dense transport	Similar coastal climate, major urban area, more dense transport
Statistic	**Adopted**	**2010-2014 Period Data**				**Adopted**	**2010-2014 Period Data**
70th percentile	**17.2**	16.8	14.5	15.9	14.7	**6.2**	5.3
Annual Average	**15.1**	14.7	12.7	14.3	13.4	**5.5**	4.7

In assessing the above alternative ambient monitoring sites, Wyong was considered the most appropriate dataset based upon:

- the most consistent climatic conditions to Coraki; and
- the adopted ambient concentrations from the Wyong dataset are higher (more conservative) than the alternative station averages.

4.2 RELEVANT DUST GUIDELINES

This assessment has also addressed the particulate air quality objectives specified in the *Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales (2005).*

The adopted assessment criteria for particulate emissions associated with the proposed quarrying activities are summarised in **Table 16** below.

Table 16: Applicable Particulate Objectives

POLLUTANT	AVERAGING PERIOD	GUIDELINE	SOURCE
TSP	Annual Average	90 µg/m^3	NSW Approved Methods
PM$_{10}$	24 Hour Average (6th highest)	50 µg/m^3	Air NEPM
	Annual Average	30 µg/m^3	NSW Approved Methods
PM$_{2.5}$	24 Hour Average	25 µg/m^3	Air NEPM
	Annual Average	8 µg/m^3	Air NEPM
Dust Deposition	Annual Average (increment)	2 g/m^2/month	NSW Approved Methods
	Annual Average (Total Cumulative)	4 g/m^2/month	NSW Approved Methods

4.3 DUST MODELLING

4.3.1 DUST MODELLING METHODOLOGY

To enable assessment of dust concentrations and deposition rates from the proposed quarrying operations, detailed dispersion modelling has been conducted using the CALMET / CALPUFF modelling system.

The CALMET / CALPUFF modelling system considers 3-dimensional unsteady state meteorology and is suitable for modelling pollutant transport on a regional scale and for complex terrain and coastal zones. The CALMET / CALPUFF modelling system simulates the effects of spatially and time varying meteorology on pollutant transport within the model domain, including chemical transformation and removal. CALPUFF considers emissions as a series of puffs that, if emitted at a sufficient frequency, simulate a continuous emission. This representation of the plume as a series of puffs allows the pollutant transport to vary spatially across the model domain in accordance with the 3-dimensional meteorological field.

A site-specific 3-dimensional prognostic meteorological dataset generated using TAPM was processed using the CALMET program to provide meteorological inputs in a form suitable for the CALPUFF dispersion model. The terrain and land use resolution was refined to a 200 metre grid for the CALMET / CALPUFF modelling to ensure a reasonable representation of the terrain at the locality. CALMET prepares 3-dimensional meteorological data for each hour of the CALPUFF run based upon the 3-dimensional prognostic dataset generated using TAPM.

The CALMET / CALPUFF model was set up to model dispersion within a 10 km x 10 km area surrounding the subject site. The topography of the subject site and surrounding area was sourced from NASA Shuttle Radar Topography Mission (SRTM3) digital elevation data at a resolution of 200 metres. The CALPUFF model was then nested by a factor of four to a finer receptor grid of 50 metres over the modelling domain. The CALPUFF sampling domain was limited to a 3.2 km x 2.4 km area encompassing the nearest sensitive receptor locations.

Emissions estimation and CALPUFF dispersion modelling has been undertaken for the Final Extraction Stage. The assessment of the Final Extraction Stage is deemed the worst-case as this stage has the longest onsite vehicle paths for haulage between pit and plant and from plant to the northern stockpile area. The size of the active pit area and stockpile areas for the Final Extraction Stage is also larger than earlier stages, with these exposed areas subject to wind erosion. The outcome of this is that potential particulate emissions from the quarry are highest during the Final Extraction Stage.

Product trucks are equally distributed between accessing the northern stockpile via Seelems Road and the southern stockpile via Quarry Road. Haulage of material via dump truck and product trucks is a major contribution to total particulate emissions generated from the site.

The assessment has conservatively assumed an extraction and production rate at the proposed maximum limit of 1 million tonnes per annum.

As discussed in **Section 1.4**, given that the extraction, processing, stockpiling and product loading activities will all be undertaken using the same equipment and personnel operating the Coraki Quarry there is no risk of significant cumulative dust emissions from the Petersen’s Quarry during the life of the project.

Dust concentrations and deposition rates have been assessed at representative discrete receptors as shown on **Figure 2**. Gridded receptor modelling has also been undertaken to produce contours of the predicted dust concentrations and deposition rates over the model domain.

The model-predicted dust concentrations and deposition rates due to emissions from the proposed quarrying activities were added to the ambient concentrations presented in **Table 14** above to assess the cumulative dust exposure at surrounding receptors.

In order to assess the potential dust deposition from the quarry it was necessary to model a particle size distribution. Whilst the actual particle size distribution of various sources and materials does vary, it is considered reasonable to apply a generalised particle size distribution for the purposes of this modelling. The modelled particle size distribution was derived from the following data included in the USEPA AP42 Chapter 13.2.4 *Aggregate handling and Storage Piles*[12].

---

[12] USEPA (2006) Compilation of Air Pollutant Emission Factors – Volume 1: Stationary Point and Area Sources, AP-42 Chapter 13.2.4 Aggregate Handling and Storage Piles, United States Environmental Protection Agency.

Aerodynamic Particle Size Multiplier (k) For Equation 1				
< 30 µm	< 15 µm	< 10 µm	< 5 µm	< 2.5 µm
0.74	0.48	0.35	0.20	0.053[a]

[a] Multiplier for < 2.5 µm taken from Reference 14.

A detailed summary of the particle size distributions input to the TSP, PM_{10} and $PM_{2.5}$ models is provided as **Attachment 6**.

4.3.2 METEOROLOGICAL DATA

No site-specific meteorological data was available for this assessment. In the absence of site specific data, following accepted methodology for assessment, the TAPM software was utilised to develop a prognostic meteorological model which generated a year of representative hourly meteorological data for the locality.

TAPM has been used to predict meteorological parameters specific to the area surrounding the subject site including temperature, wind speed, wind direction and stability classification. The model accesses databases of surface characteristics (terrain height, soil and vegetation) and synoptic weather analyses provided by CSIRO to carry out these analyses. TAPM is able to process the output data to produce meteorological data files suitable for input to the CALMET / CALPUFF modelling system i.e. a 3-dimensional grid of hourly varying meteorological parameters over a full year.

Technical discussion of the model algorithms, inputs and model validation studies are provided in the Part 1: Technical Paper (Hurley, 2002) and Part 2: Summary of Verification Studies (Hurley *et al*, 2002)[13,14].

The centre coordinates for the model grid were Latitude -28°58’30” and Longitude 153°16’. The following nested model grids were applied to the TAPM modelling:

40 x 30 km grid (total area 1200 km x 1200 km)
40 x 10 km grid (total area 400 km x 400 km)
40 x 3 km grid (total area 120 km x 1204 km)
40 x 1 km grid (total area 40 km x 40 km)

Twenty-five vertical grid levels were modelled.

The TAPM model was set up to generate a site-specific meteorological data file for the locality, based upon synoptic analysis data for the representative Year 2010, as provided by CSIRO.

---

[13] Hurley, P.J. (2002) The Air Pollution Model (TAPM) Version 2: User Manual. Aspendale: CSIRO Atmospheric Research Internal Paper.

[14] Hurley, P.J. (2002) The Air Pollution Model (TAPM) Version 2: Part 1: Technical Description. Aspendale: CSIRO Atmospheric Research Technical Paper.

The nearest Bureau of Meteorology (BoM) stations are located at Lismore and Casino. Lismore is located north of Coraki, however review of the area surrounding Lismore indicates elevated terrain to the east and west. No significantly elevated terrain is located surrounding Coraki. Lismore observation data was included as nudging observations in TAPM with a 5 kilometre radius of influence due to the proximity of surrounding terrain. Casino is located further inland than Coraki and is not located in proximity to any elevated terrain. Casino observation data was included as nudging observations in TAPM with a 20 kilometre radius of influence with the station being more representative of the prevailing meteorology of the surrounding region.

The TAPM output was processed using the CALTAPM software to produce a 3-dimensional data file suitable for input to the diagnostic CALMET model as an 'initial guess field'. The CALMET model further resolved the prognostic meteorology to a finer terrain, land use and soil type resolution of 200 metres over a 10 x 10 km area covering the subject site and surrounding region for the purpose of dispersion modelling.

Analysis of the CALMET derived meteorology for the subject land including a wind rose, wind frequency graph, monthly average temperatures graph and tabulated stability class analysis is contained in **Attachment 7**.

4.3.3 DUST EMISSION SOURCES

The following sources were represented in the CALPUFF Model:

- Haul Routes (unpaved) as a series of area sources;
- Access Roads (unpaved) as a series of area sources;
- Access Roads (paved) as a series of area sources;
- Wind Erosion from stockpiles and unsealed areas as area sources;
- Drilling as an area source;
- Loading Truck at Pit as an area source;
- Main Processing Plant operation as an area source;
- Loading to Stockpiles as an area source; and
- Loading from Stockpiles to trucks as an area source.

Dust emissions from each of these sources have been represented in the CALPUFF model as area sources with appropriate locations, sizes and initial dispersion parameters to represent the releases.

Emissions rates for each of the above sources have been calculated using published emission factors from the following references:

- NPI *Emission Estimation Technique Manual for Mining v3.1*, Environment Australia (2012);
- USEPA AP42 Chapter 13.2.2 *Unpaved Roads* (2006);
- USEPA AP42 Chapter 11.19.2 *Crushed Stone Processing and Pulverized Mineral Processing* (2004); and
- USEPA AP42 Chapter 13.2.4 *Aggregate Handling and Storage Piles* (2006).

Emission rates have been estimated based upon extraction and production rate at the currently approved limit of 1 million tonnes per annum and distributed for each source based upon the proposed operating hours.

In accordance with the method presented in the NPI *Emission Estimation Technique Manual for Mining v3.1*, wind erosion emissions have only been represented when wind speed is greater than a 5.4m/s threshold.

A summary of the emission rate estimation techniques, emission factors and emission rates for the quarrying operations are included as **Attachment 8**.

Also included in **Attachment 8** is a summary of the calculated particulate emission rates for each major source group based upon the adopted emission factors and including the control measures recommended in **Section 4.3.4** below.

The emission estimations and prior experience demonstrate that the key particulate emission sources at a quarry are:

- Vehicles operating on unsealed roadways (product truck routes and pit-to-plant haulage); and
- Crushing and screening plant including conveyor drop points.

The management of particulate emissions from these two key emission sources will be critical and specific recommendations for dust control measures are recommended in **Section 4.3.4** below.

4.3.4 DUST CONTROL MEASURES

It is recommended that the following dust control measures are implemented at the quarry:

- Watering of all haul roads and access roads at a rate of at least 2 litres/m^2/hour at times when dust emissions are visible from vehicle movements;
- Sealing (e.g. asphalt) part of the access road off Seelems Road for a minimum length of 200 metres west from the Seelems Road entry point;
- Enclosure and/or use of effective water sprays to crushers and screens within the permanent processing plant;

- Effective water misting sprays to permanent processing plant at transfer points including load-out points from elevated storage bins if utilised;
- Rock drill to have an appropriate dust extraction system with collector fitted to rig and/or wet drilling via water sprays; and
- Management of dust emissions from stockpiles during high wind speed conditions through appropriate use of sprinklers and/or chemical suppressant products as required.

The above dust control measures have been considered in dust emission estimation calculations presented in this report.

All of the above dust control measures are recommended as appropriate to manage emissions from the proposed quarry but, as noted above, the most critical dust management measures relate to:

- The watering of unsealed roads;
- Sealing of the section of access road adjacent the Seelems Road entry points; and
- Effective water misting sprays to permanent processing plant.

The recommended dust control measures are proven and practical methods of effectively managing particulate emissions from quarrying activities. Subject to compliance with the relevant air quality objectives, there is no requirement for the implementation of more complex, costly and/or operationally challenging methods.

4.3.5 DUST MODELLING RESULTS

Summaries of the model-predicted dust concentrations and deposition rates at the selected representative receptors (refer **Figure 2**) for the Final Extraction Stage are provided in **Table 17** below.

The predicted concentrations at the representative receptors include the ambient concentrations presented in **Table 14** above.

Other residential dwellings within the model domain (refer **Figure 2**) are no more affected than the selected representative receptors.

Table 17: Model-Predicted Particulate Exposure including ambient

RECEPTOR	PM_{10} µg/m³			$PM_{2.5}$ µg/m³		TSP µg/m³	DUST DEPOSITION g/m²/month	
	Highest 24-hour average	6th Highest 24-hour average	Annual Average	Maximum 24-hour average	Annual Average	Annual Average	Annual Average (development contribution)	Annual Average (cumulative)
R1	49.9	46.7	19.9	10.3	6.1	40.2	0.29	1.49
R2	39.5	35.0	18.2	8.8	5.9	36.3	0.16	1.36
R3	42.7	40.1	18.1	9.3	5.8	35.7	0.13	1.33
R4	39.0	35.8	17.6	8.8	5.8	34.7	0.10	1.30
R5	35.7	31.4	17.0	8.3	5.7	33.6	0.08	1.28
R6	43.9	33.0	16.9	9.3	5.7	33.1	0.06	1.26
R7	56.0[15]	43.0	19.1	10.6	6.0	37.0	0.15	1.35
R8	34.5	21.8	15.6	8.4	5.6	30.9	0.02	1.22
R9	28.6	22.0	15.6	7.6	5.6	30.9	0.02	1.22
Included Ambient	17.2	17.2	15.1	6.2	5.5	30.1	(isolation)	1.2
Air Quality Objective	**n/a**	**50**	**30**	**25**	**8**	**90**	**2**	**4**
Compliance?	**n/a**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**
Maximum Development Contribution	**n/a**	**29.5 µg/m³ (59% of objective)**	**4.8 µg/m³ (16% of objective)**	**4.4 µg/m³ (18% of objective)**	**0.6 µg/m³ (8% of objective)**	**10.1 µg/m³ (11% of objective)**	**n/a**	**0.29 µg/m³ (7% of objective)**

---

[15] 38.8 µg/m³ contribution from proposed development to the highest predicted 24-hour average PM_{10}. Total of two (2) 24 hour average periods predicted above 50 µg/m³ including ambient concentrations based upon Wyong data which is likely to be conservative for Coraki.

The results of the gridded receptor modelling for each scenario are presented in **Attachment 9** as contours of predicted particulate concentrations and deposition rates over an aerial photograph base. The plotted concentrations / deposition rates include the ambient concentrations specified in **Table 14**.

The modelling conducted demonstrates that, with the recommended dust management measures (refer **Section 4.3.4**), the proposed quarrying activities can comply with the relevant air quality objectives at all surrounding residences. On this basis, with the implementation of appropriate dust management there will be no requirement to consider reductions in the duration, intensity or nature of activities on the site which would inhibit the ability of the project to achieve the objective of servicing the Pacific highway upgrade project.

The overall contributions of the quarry to the local airshed for the expected 5 to 7 year life of the project are also summarised in **Table 17** above. MWA Environmental notes that for the annual average objectives the highest overall development contributions at any receptor range 7% to 16% of the air quality objectives. This is considered to be an acceptable incremental contribution from a development in a rural locality that is not expected to be subject to significant intensification in urban or industrial land uses within the expected 5 to 7 year life of the project.

The maximum predicted 24 hour average $PM_{2.5}$ concentration at any receptor relates to an increment of 18% of the air quality objective. Again, this is considered to be an acceptable incremental contribution from a development in a rural locality that is not expected to be subject to significant intensification in urban or industrial land uses within the expected 5 to 7 year life of the project.

The maximum predicted 6th highest PM_{10} 24 hour average concentration at any receptor relates to an increment of 59% of the air quality objective. Whilst a significant contribution to the airshed capacity in terms of the peak 24 hour periods, the overall impact is considered to be acceptable considering that:

- In this rural locality it is unlikely that significant cumulative impacts at residential receptors would occur during the same 24 hour periods when specific wind alignments generate peak impacts occur from the quarry at a particular receptor.
- The limited 5 to 7 year expected life of the project dictates that project contributions to the aished capacity will not persist over an extended project life.
- The limited 5 to 7 year expected life of the project reduces the likelihood that any new land uses with the potential to generate significant cumulative impacts will occur during the project life.
- Annual average PM_{10} contributions remain low at 16% of the air quality objective.

5.0 CONCLUSION

MWA Environmental was commissioned by Quarry Solutions Pty Ltd to undertake a Noise and Dust Assessment for the proposed Coraki Quarry. The assessment has been conducted as supporting documentation for the Environmental Impact Statement prepared by Groundwork Plus in accordance with the Secretary's Environmental Assessment Requirements issued by the Secretary of the Department of Planning and Environment on 22 May 2015 and revised on 30 July 2015.

The noise assessment has been based upon detailed noise monitoring and computer noise modelling of the proposed quarrying activities and haulage of materials on between the site and the Pacific Highway. The dust assessment has been based upon detailed meteorological and dust dispersion modelling.

Based upon an iterative noise modelling process, it has been determined that a range of noise control measures (refer **Section 2.6.2**) are required to comply with the relevant noise limits at surrounding sensitive receptors and the industrial facility on Lot 407 on DP1166287, including but not limited to:

- acoustic screening by way of cut, earth bunds and/or barriers to various locations;
- use of a proprietary quietened rock drill; and
- operation of processing plant at the most shielded location and/or implementation of acoustic treatments as necessary to comply with the relevant noise limits.

There may be the potential to reduce the scope of noise mitigation measures if appropriate commercial arrangements are made with the landowners of Lot 4 on DP6339 to the north and/or Lot 12 DP6339 to the south.

The assessment has considered the potential road traffic noise levels at residences within 100 metres of the haulage route between the site and the Pacific Highway at Woodburn.

The assessment has determined that:

- The relevant NSW *Road Noise Policy* assessment criteria for existing residences affected by additional traffic generated by land use developments are predicted to be satisfied with the exception of a number of residences along the sub-arterial road network between Lagoon Road and Woodburn; and
- For residences where the cumulative L_{Aeq} (15 hour) (7am to 10pm) noise level post-development is predicted to exceed the 60 dB(A) assessment criteria, the increase as a result of the development does not exceed 2dB(A). This is considered to be a minor change in accordance with the NSW *Road Noise Policy* and impacts are unlikely to warrant mitigation works, especially considering the purpose and limited operational life of the proposed development.

Detailed computer dust dispersion modelling of the proposed quarrying activities has demonstrated that compliance with the relevant air quality objectives can be achieved at surrounding sensitive receptors with appropriate dust management controls.

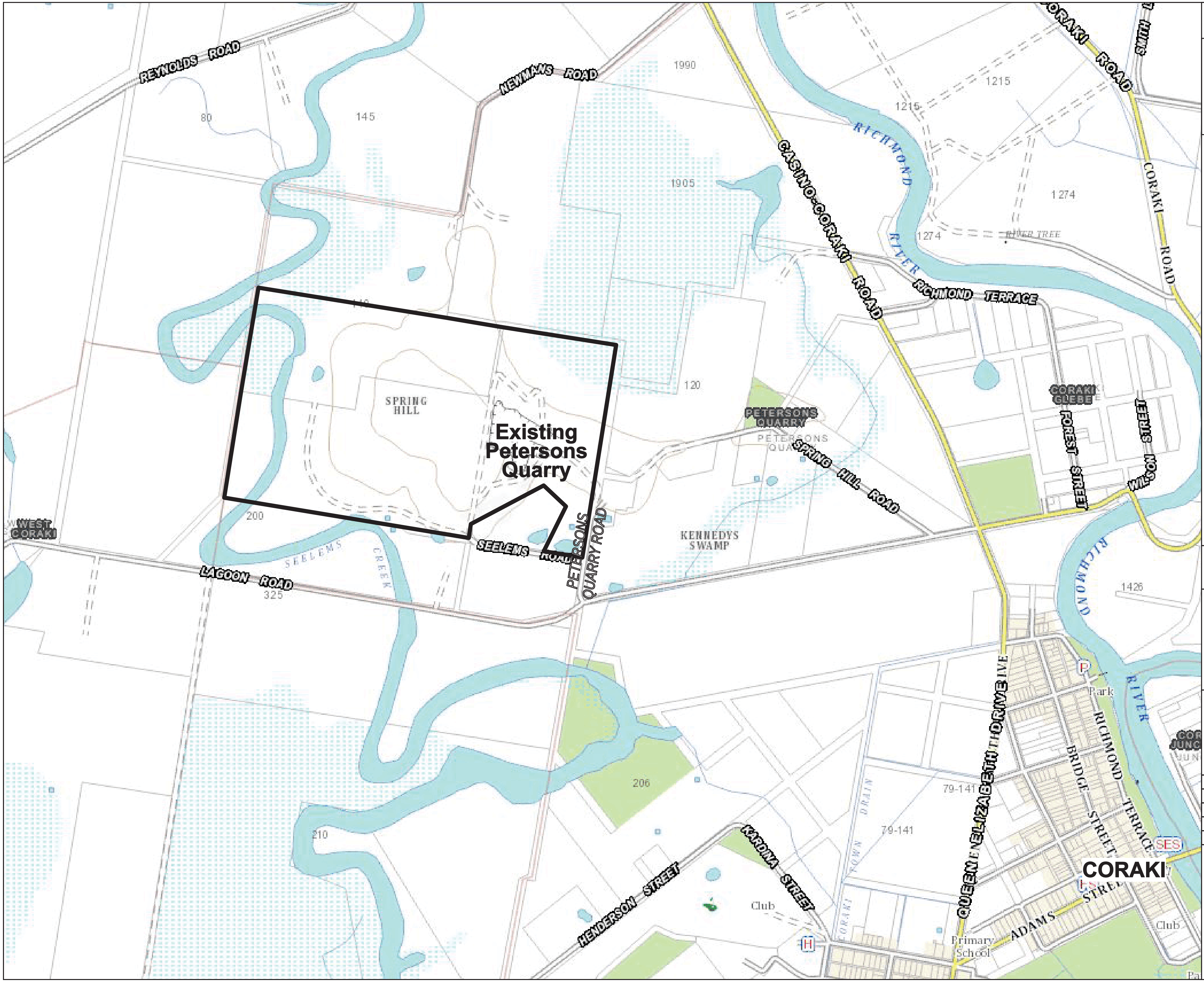
The dust control measures recommended for the quarry to achieve compliance with the regulatory guidelines are:

- Watering of all haul roads and access roads at a rate of at least 2 litres/m^2/hour at times when dust emissions are visible from vehicle movements;
- Sealing (e.g. asphalt) 200 metres of the access road off Seelems Road;
- Enclosure and/or use of effective water sprays to crushers and screens within the permanent processing plant;
- Effective water misting sprays to permanent processing plant at transfer points including load-out points from elevated storage bins if utilised;
- Rock drill to have an appropriate dust extraction system with collector fitted to rig and/or wet drilling via water sprays; and
- Management of dust emissions from stockpiles during high wind speed conditions through appropriate use of sprinklers and/or chemical suppressant products as required.

In summary, the noise and dust impact assessment has concluded that, with appropriate management measures and physical emission controls, the proposed quarrying activities can comply with the relevant noise amenity criteria and air quality objectives at the surrounding sensitive land uses.

MWA Environmental
4 November 2015

FIGURES



LEGEND

SITE BOUNDARY

DRAWING REFERENCE

NSW GOVERNMENT LPI SIX MAPS

NSW GOVERNMENT Land & Property Information
A division of the Department of Finance & Services

CLIENT
QUARRY SOLUTIONS PTY LTD

PROJECT
CORAKI
NOISE AND DUST IMPACT ASSESSMENT
Petersons Quarry Expansion
Petersons Quarry Rd Coraki NSW

TITLE
SITE LOCATION

JOB	CORAKI	**FIGURE 1**
JOB NO.	15-041	
DATE	23/09/15	DRAWING NUMBER
SCALE	1:18,000 (A4)	**15-041-1**
REV.		

mwa ENVIRONMENTAL

Max Winders & Associates Pty Ltd tas MWA Environmental
Level 15, 241 Adelaide St, Brisbane. GPO BOX 3137, Brisbane Qld 4001
P 07 3002 5500 F 07 3002 5588 E mail@mwaenviro.com.au
W www.mwaenviro.com.au
ABN 94 010 833 084

LEGEND

▬ SITE BOUNDARY

🟨 **R9** SURROUNDING RESIDENCES (R1-R9)

DRAWING REFERENCE

GROUNDWATER PLUS SITE LOCATION PLAN
1837.DRG.002, 13/04/15.

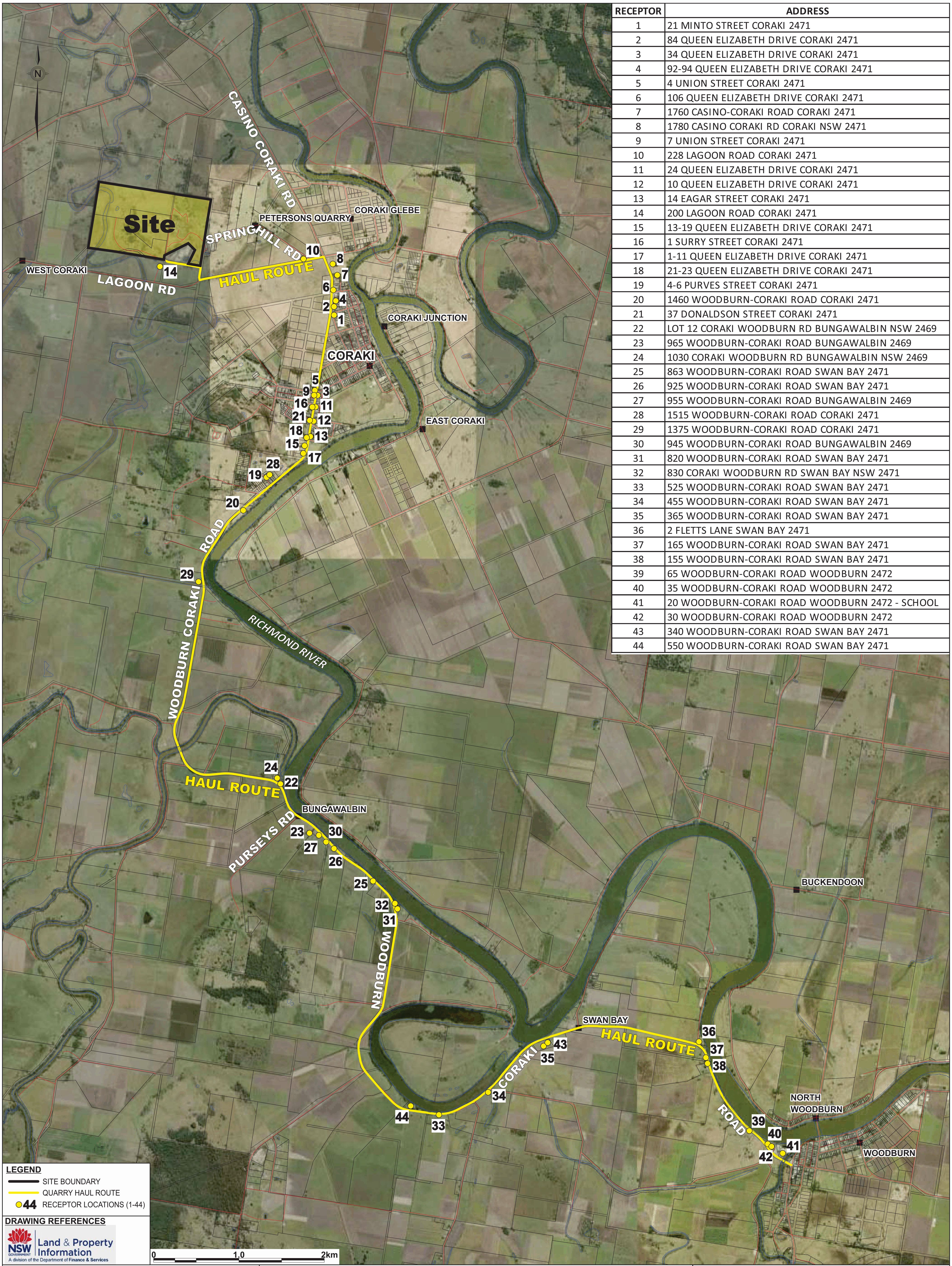
CLIENT
QUARRY SOLUTIONS PTY LTD

PROJECT
CORAKI
NOISE AND DUST
IMPACT ASSESSMENT
Petersons Quarry Expansion
Petersons Quarry Rd Coraki NSW

TITLE
AERIAL PHOTOGRAPH
SHOWING SURROUNDING
RESIDENCES

JOB	CORAKI	**FIGURE 2**
JOB NO.	15-041	
DATE	23/09/15	DRAWING NUMBER
SCALE	1:20,000 (A4)	**15-041-2**
REV.		

Max Winders & Associates Pty Ltd tas MWA Environmental
Level 15, 241 Adelaide St, Brisbane. GPO BOX 3137, Brisbane Qld 4001
P 07 3002 5500 F 07 3002 5588 E mail@mwaenviro.com.au
W www.mwaenviro.com.au
ABN 94 010 833 084



RECEPTOR	ADDRESS
1	21 MINTO STREET CORAKI 2471
2	84 QUEEN ELIZABETH DRIVE CORAKI 2471
3	34 QUEEN ELIZABETH DRIVE CORAKI 2471
4	92-94 QUEEN ELIZABETH DRIVE CORAKI 2471
5	4 UNION STREET CORAKI 2471
6	106 QUEEN ELIZABETH DRIVE CORAKI 2471
7	1760 CASINO-CORAKI ROAD CORAKI 2471
8	1780 CASINO CORAKI RD CORAKI NSW 2471
9	7 UNION STREET CORAKI 2471
10	228 LAGOON ROAD CORAKI 2471
11	24 QUEEN ELIZABETH DRIVE CORAKI 2471
12	10 QUEEN ELIZABETH DRIVE CORAKI 2471
13	14 EAGAR STREET CORAKI 2471
14	200 LAGOON ROAD CORAKI 2471
15	13-19 QUEEN ELIZABETH DRIVE CORAKI 2471
16	1 SURRY STREET CORAKI 2471
17	1-11 QUEEN ELIZABETH DRIVE CORAKI 2471
18	21-23 QUEEN ELIZABETH DRIVE CORAKI 2471
19	4-6 PURVES STREET CORAKI 2471
20	1460 WOODBURN-CORAKI ROAD CORAKI 2471
21	37 DONALDSON STREET CORAKI 2471
22	LOT 12 CORAKI WOODBURN RD BUNGAWALBIN NSW 2469
23	965 WOODBURN-CORAKI ROAD BUNGAWALBIN 2469
24	1030 CORAKI WOODBURN RD BUNGAWALBIN NSW 2469
25	863 WOODBURN-CORAKI ROAD SWAN BAY 2471
26	925 WOODBURN-CORAKI ROAD SWAN BAY 2471
27	955 WOODBURN-CORAKI ROAD BUNGAWALBIN 2469
28	1515 WOODBURN-CORAKI ROAD CORAKI 2471
29	1375 WOODBURN-CORAKI ROAD CORAKI 2471
30	945 WOODBURN-CORAKI ROAD BUNGAWALBIN 2469
31	820 WOODBURN-CORAKI ROAD SWAN BAY 2471
32	830 CORAKI WOODBURN RD SWAN BAY NSW 2471
33	525 WOODBURN-CORAKI ROAD SWAN BAY 2471
34	455 WOODBURN-CORAKI ROAD SWAN BAY 2471
35	365 WOODBURN-CORAKI ROAD SWAN BAY 2471
36	2 FLETTS LANE SWAN BAY 2471
37	165 WOODBURN-CORAKI ROAD SWAN BAY 2471
38	155 WOODBURN-CORAKI ROAD SWAN BAY 2471
39	65 WOODBURN-CORAKI ROAD WOODBURN 2472
40	35 WOODBURN-CORAKI ROAD WOODBURN 2472
41	20 WOODBURN-CORAKI ROAD WOODBURN 2472 - SCHOOL
42	30 WOODBURN-CORAKI ROAD WOODBURN 2472
43	340 WOODBURN-CORAKI ROAD SWAN BAY 2471
44	550 WOODBURN-CORAKI ROAD SWAN BAY 2471

LEGEND

SITE BOUNDARY
QUARRY HAUL ROUTE
● 44 RECEPTOR LOCATIONS (1-44)

DRAWING REFERENCES

NSW GOVERNMENT Land & Property Information
A division of the Department of Finance & Services

mwa ENVIRONMENTAL

Max Winders & Associates Pty Ltd tas MWA Environmental
Level 15, 241 Adelaide St, Brisbane. GPO BOX 3137, Brisbane Qld 4001
P 07 3002 5500 F 07 3002 5588 E mail@mwaenviro.com.au
W www.mwaenviro.com.au
ABN 94 010 833 084

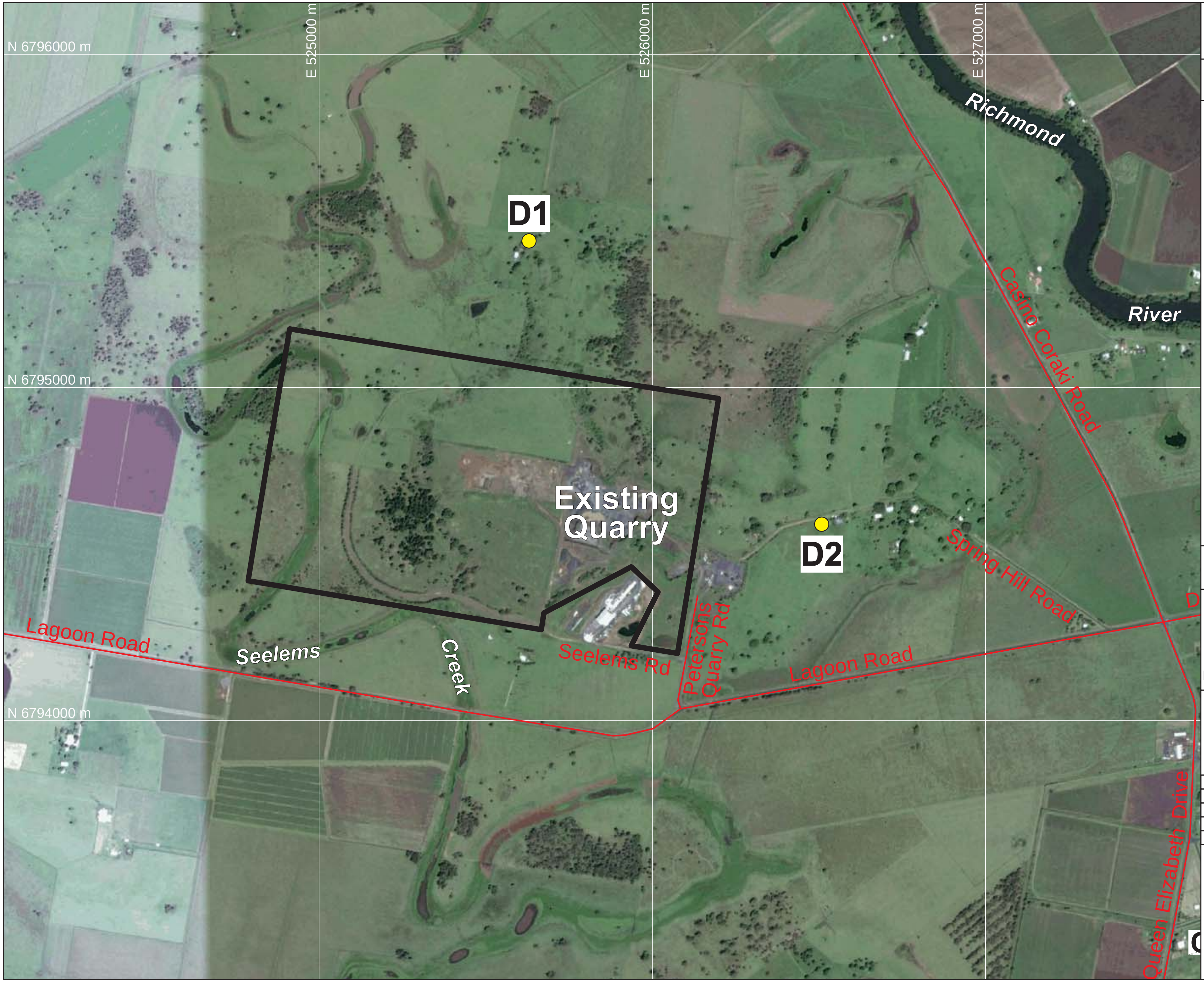
PROJECT
CORAKI NOISE AND DUST ASSESSMENT
PETERSONS QUARRY EXPANSION
PETERSONS QUARRY ROAD CORAKI NSW

TITLE
QUARRY HAULAGE ROUTE AND RECEPTOR LOCATIONS

CLIENT
QUARRY SOLUTIONS PTY LTD

DRAWING REFERENCE
NSW GOVERNMENT LAND AND PROPERTY INFORMATION GIS

JOB	CORAKI	**FIGURE 3**
JOB NO.	15-041	
DATE	23/09/15	DRAWING NUMBER
SCALE	1:40,000 (A3)	**15-041-3**



LEGEND

SITE BOUNDARY

● D2 NOISE DATALOGGER LOCATIONS (D1-D2)

DRAWING REFERENCE

GROUNDWATER PLUS SITE LOCATION PLAN
1837.DRG.002, 13/04/15.

CLIENT
QUARRY SOLUTIONS PTY LTD

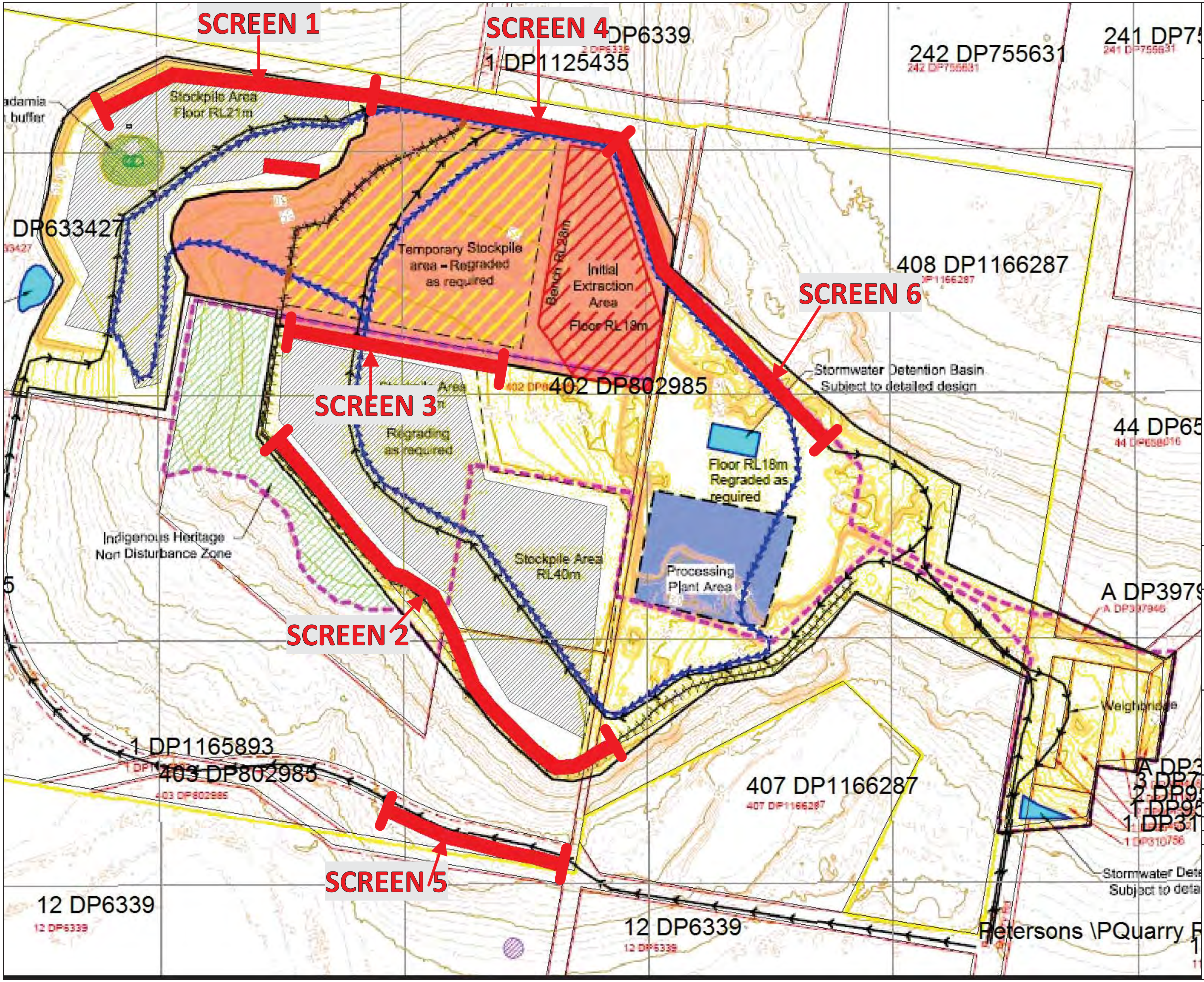
PROJECT
CORAKI
NOISE AND DUST
IMPACT ASSESSMENT
Petersons Quarry Expansion
Petersons Quarry Rd Coraki NSW

TITLE

NOISE MONITORING LOCATIONS

JOB	CORAKI	**FIGURE 4**
JOB NO.	15-041	
DATE	23/09/15	DRAWING NUMBER
SCALE	1:15,000 (A4)	**15-041-4**
REV.		

Max Winders & Associates Pty Ltd tas MWA Environmental
Level 15, 241 Adelaide St, Brisbane. GPO BOX 3137, Brisbane Qld 4001
P 07 3002 5500 F 07 3002 5588 E mail@mwaenviro.com.au
W www.mwaenviro.com.au
ABN 94 010 833 084



LEGEND

▬ SITE BOUNDARY

🟥 ACOUSTIC SCREENS

DRAWING REFERENCE

N

0 100 200 300 400 500m

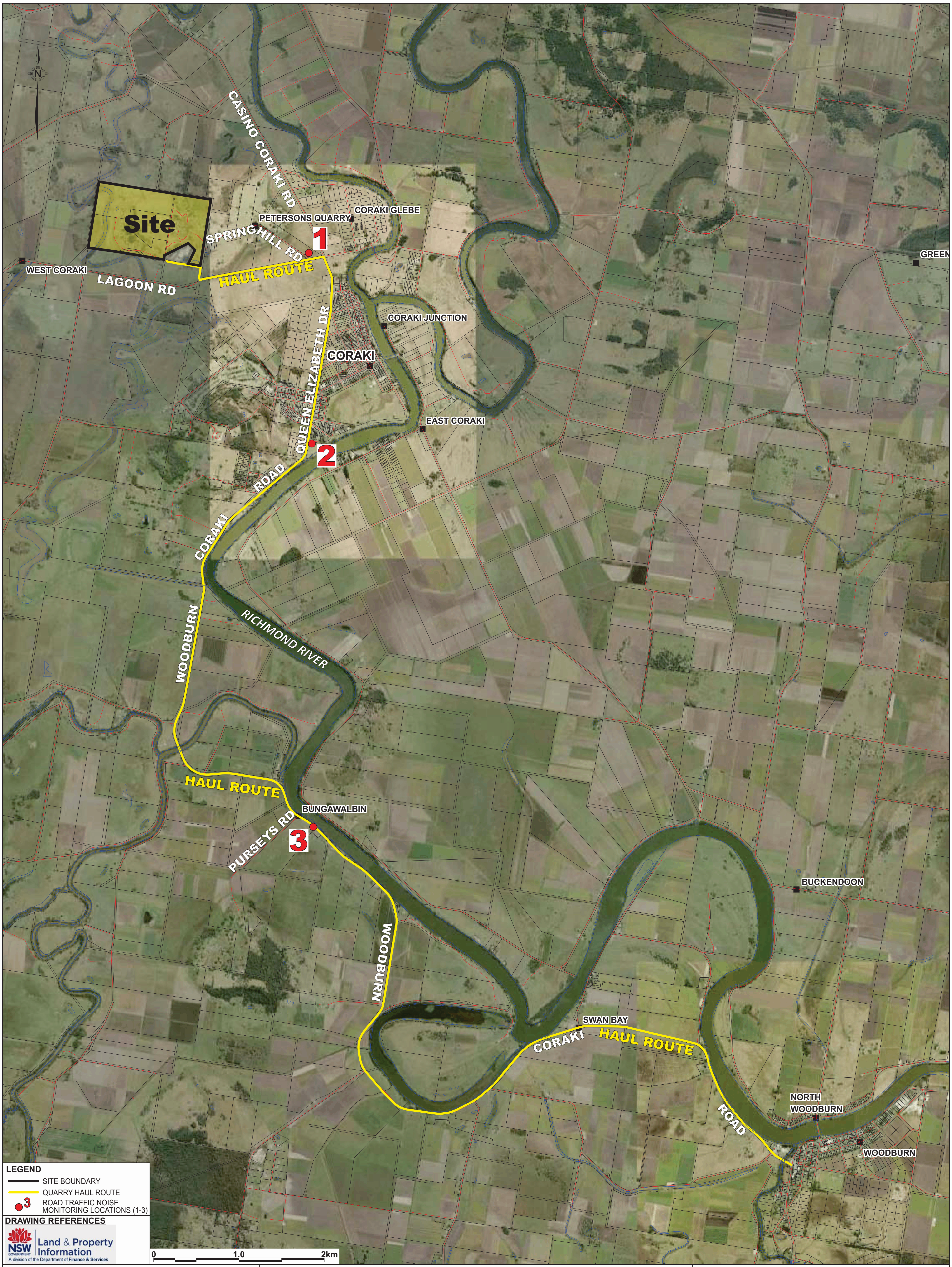
CLIENT
QUARRY SOLUTIONS PTY LTD

PROJECT
CORAKI
NOISE AND DUST IMPACT ASSESSMENT
Petersons Quarry Expansion
Petersons Quarry Rd Coraki NSW

TITLE
ACOUSTIC SCREENING

JOB	CORAKI	FIGURE 5
JOB NO.	15-041	
DATE	23/09/15	DRAWING NUMBER
SCALE	1:15,000 (A4)	15-041-5
REV.		

Max Winders & Associates Pty Ltd tas MWA Environmental
Level 15, 241 Adelaide St, Brisbane. GPO BOX 3137, Brisbane Qld 4001
P 07 3002 5500 F 07 3002 5588 E mail@mwaenviro.com.au
W www.mwaenviro.com.au
ABN 94 010 833 084



mwa ENVIRONMENTAL

Max Winders & Associates Pty Ltd tas MWA Environmental
Level 15, 241 Adelaide St, Brisbane. GPO BOX 3137, Brisbane Qld 4001
P 07 3002 5500 **F** 07 3002 5588 **E** mail@mwaenviro.com.au
W www.mwaenviro.com.au
ABN 94 010 833 084

PROJECT

CORAKI NOISE AND DUST ASSESSMENT
PETERSONS QUARRY EXPANSION
PETERSONS QUARRY ROAD CORAKI NSW

CLIENT
QUARRY SOLUTIONS PTY LTD

DRAWING REFERENCE
NSW GOVERNMENT LAND AND PROPERTY INFORMATION GIS

TITLE

ROAD TRAFFIC NOISE MONITORING LOCATIONS

JOB	CORAKI
JOB NO.	15-041
DATE	23/09/15
SCALE	1:40,000 (A3)

FIGURE 6

DRAWING NUMBER
15-041-6

ATTACHMENT 1

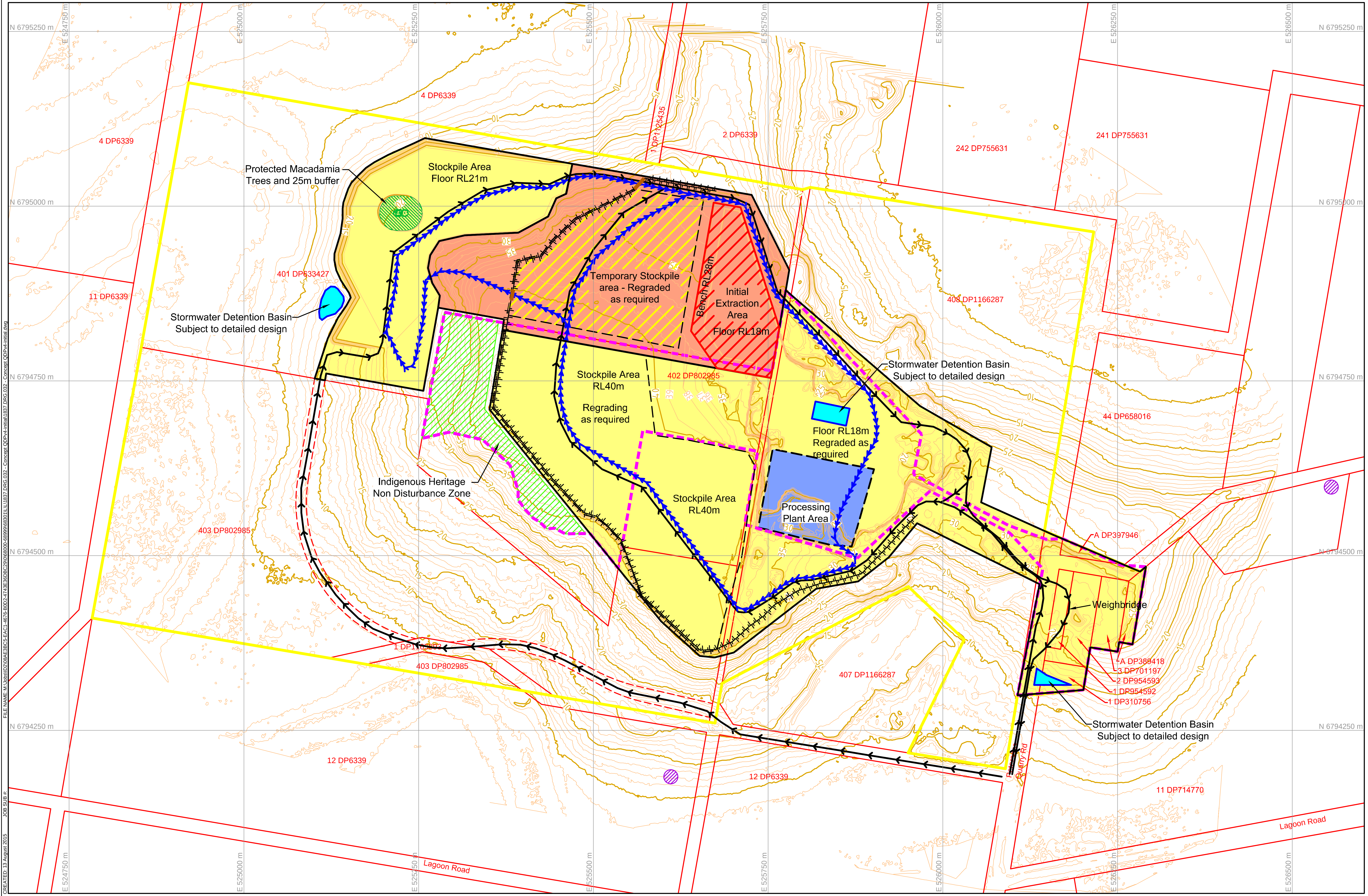
Groundwork Plus Plans

Initial Pit
Final Pit

FILE NAME: M:\Jobs\ID2\08AE3BC5-EAC1-4676-B0D2-4743E36DBC29\0\68000-68999\68301\L\L\1837.DRG.032 - Concept QDPv4-initial\1837.DRG.032 - Concept QDPv4-initial.dwg

JOB SUB #:

CREATED: 13 August 2015



REV	DESCRIPTION	DATE	BY

Data Sources:
Photography: UAV Survey 2015-07-02; Google. Image date: 2014-12-18
Topography: UAV Survey 2015-07-02
Cadastre:
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. ABN: 80 829 145 906

Legend:
- Site Boundary
- Cadastral Boundary
- Approved Petersons Quarry Footprint
- ▨ Nearby Sensitive Receptor
- On Road Truck Movement
- Off Road Truck Movement
- Rollover Bund
- Perimeter Bund

Stockpile Area = 33.23 ha
Extraction Area = 10.27 ha
Processing Plant Area = 1.65 ha

N

PROJECT:
Coraki Quarry

CLIENT:
Quarry Solutions Pty Ltd

TITLE:
Conceptual Quarry Development Plan
Initial Extraction Stage

GROUNDWORK plus
PH: +61 7 3871 0411
WWW.GROUNDWORK.COM.AU

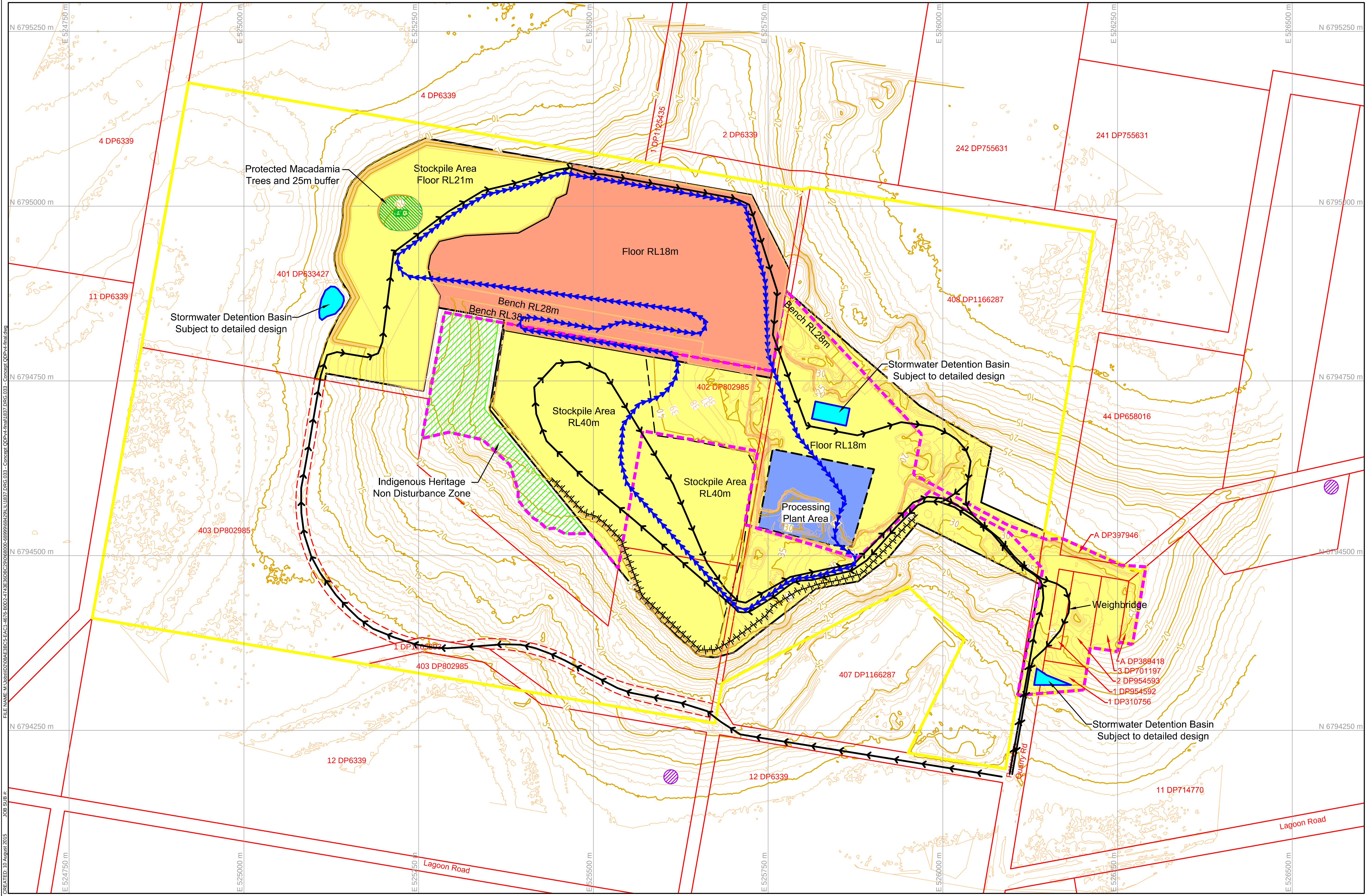
SCALE:	DRAWING NUMBER:	REVISION:
1:5,000 When Printed On A3 (0 – 100)	1837.032	

DATE: 13 August 2015	DRAWN: LT	DATUM: HORIZONTAL / VERTICAL / ZONE
PRINTED: 13 August 2015	CHECKED: JL	MGA / AHD / 56

FILE NAME: M:\Jobs\ID2\08AE3BC5-EAC1-4676-B0D2-4743E36DBC29\0\68000-68999\68429\L\L\1837.DRG.033 - Concept QDPv4-final\1837.DRG.033 - Concept QDPv4-final.dwg

JOB SUB #:

CREATED: 10 August 2015



REV	DESCRIPTION	DATE	BY

Data Sources:
Photography: UAV Survey 2015-07-02; Google. Image date: 2014-12-18
Topography: UAV Survey 2015-07-02
Cadastre:
Ecosystem:
Other:

Legend:

🟨	Site Boundary
🟥	Cadastral Boundary
▬ ▬	Approved Petersons Quarry Footprint
▨	Nearby Sensitive Receptor
←	On Road Truck Movement
◀◀	Off Road Truck Movement
┼┼┼	Perimeter Bund

Stockpile Area = 28.91 ha
Extraction Area = 10.27 ha
Processing Plant Area = 1.65 ha

N

PROJECT:
Coraki Quarry

CLIENT:
Quarry Solutions Pty Ltd

TITLE:
Conceptual Quarry Development Plan
Final Extraction Stage

GROUNDWORK plus
PH: +61 7 3871 0411
WWW.GROUNDWORK.COM.AU

SCALE: 1:5,000 When Printed On A3 0 100

DRAWING NUMBER: 1837.033

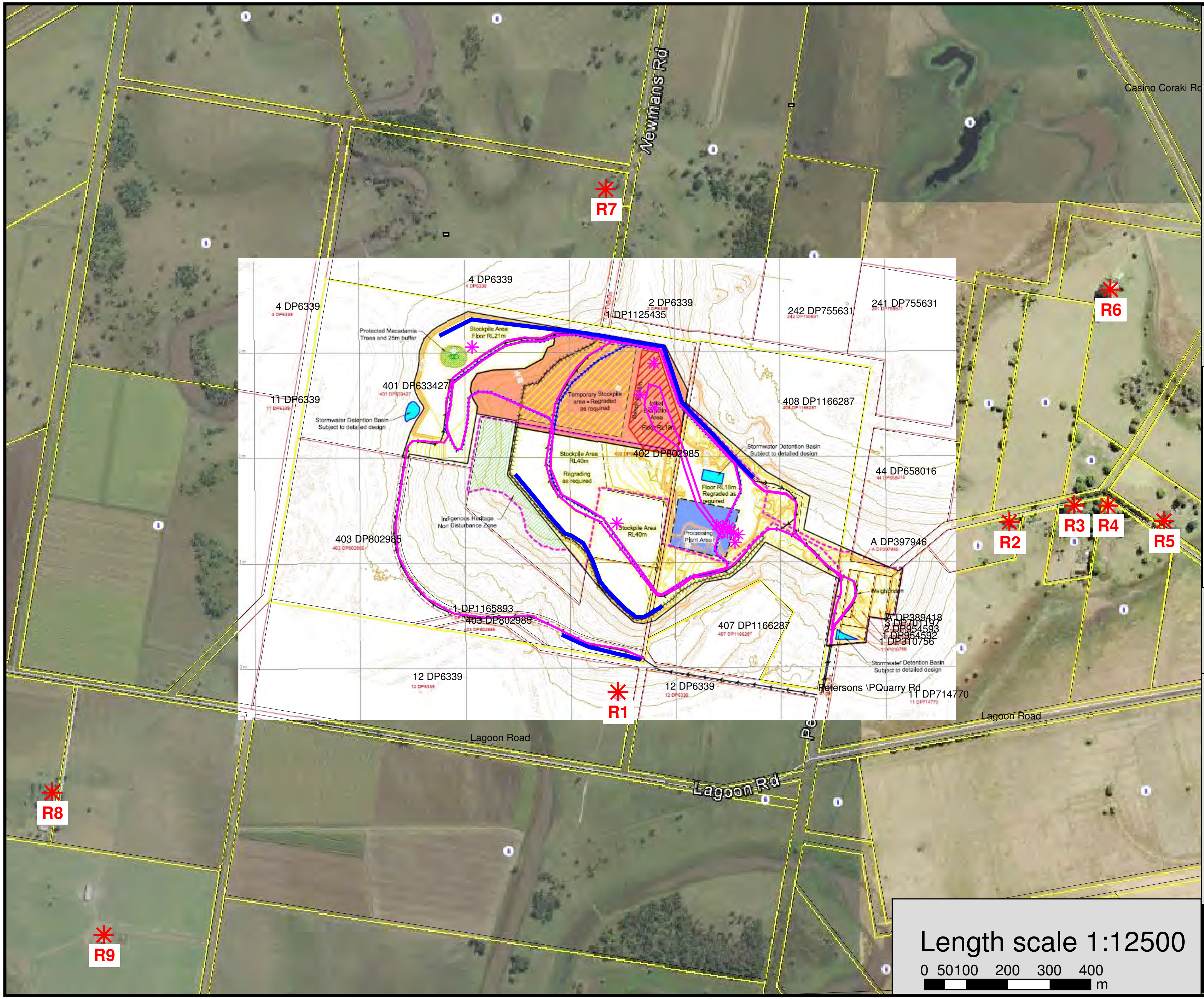
REVISION:

DATE: 13 August 2015
PRINTED: 13 August 2015
DRAWN: LT
CHECKED: JL

DATUM: HORIZONTAL / VERTICAL / ZONE
MGA / AHD / 56

ATTACHMENT 2

SoundPLAN Model Layouts



Legend

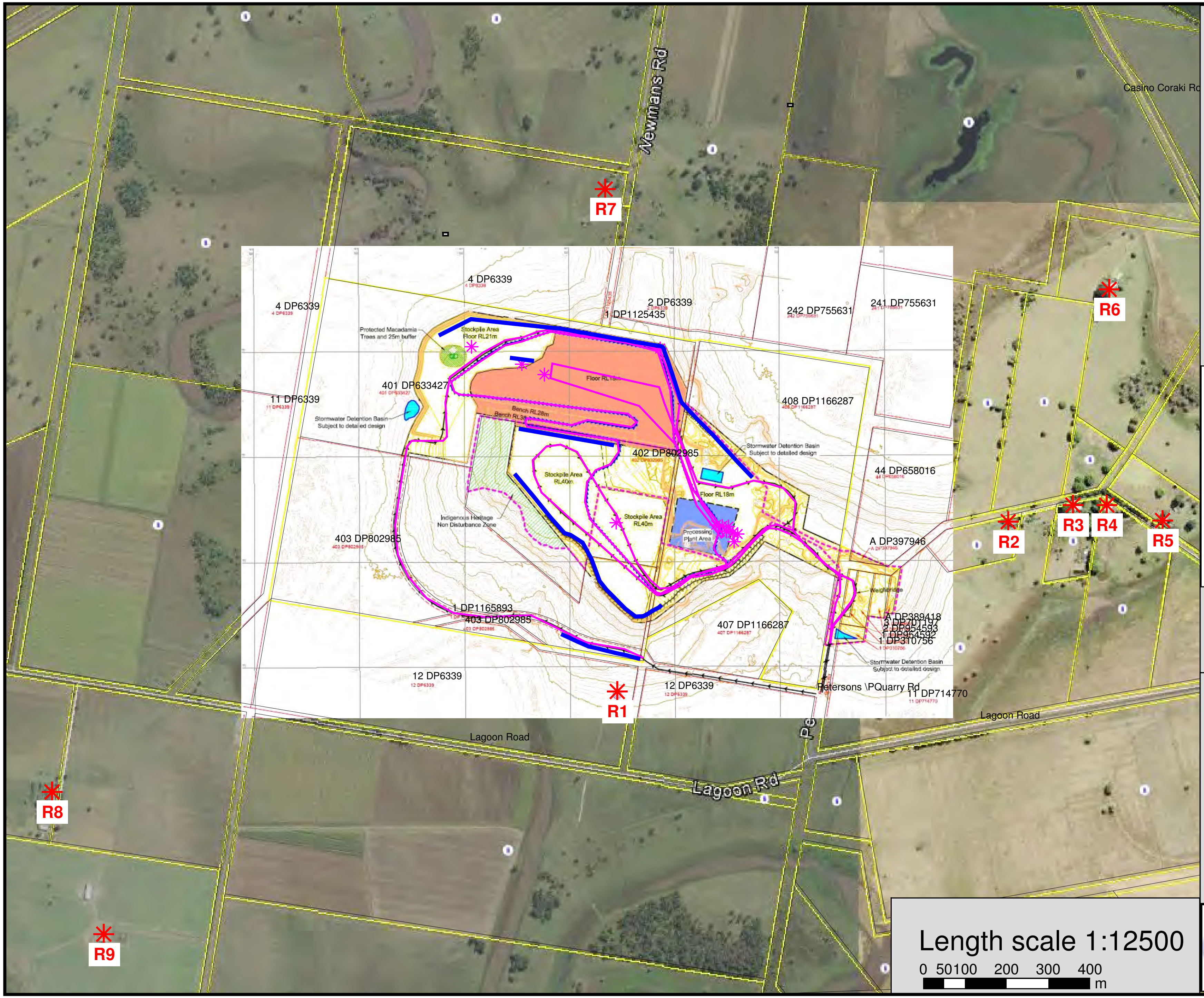
—	Cadastral
✳	Point source
—	Line source
▬	Bund/Barrier/Screening
✳	Point receiver

Coraki 15-041

Initial Pit Scenario

Model Layout

Sept 2015



Legend

— Cadastral

✳ Point source

— Line source

━ Bund/Barrier/Screening

✳ Point receiver

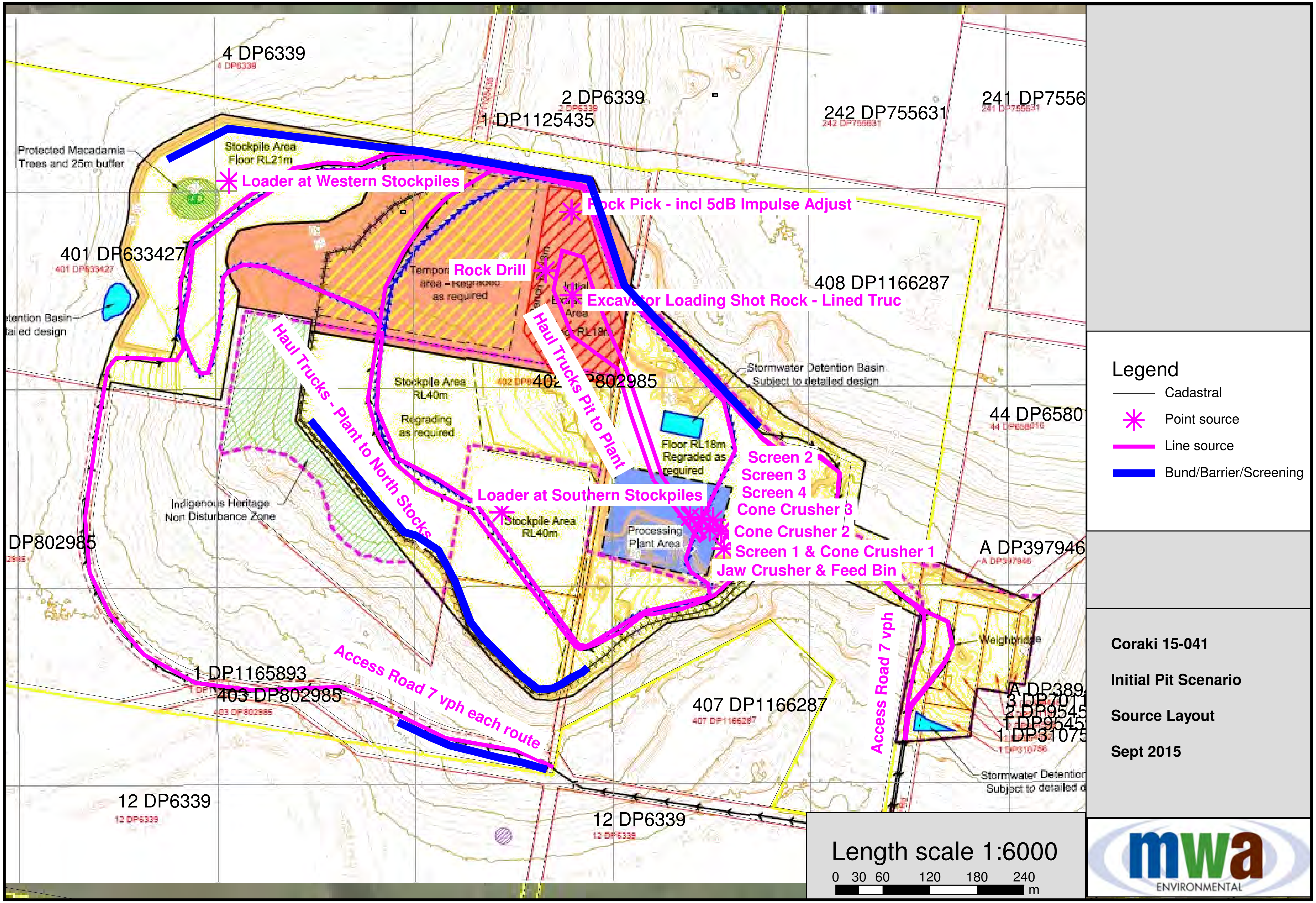
Coraki 15-041

Final Pit Scenario

Model Layout

Sept 2015

mwa ENVIRONMENTAL

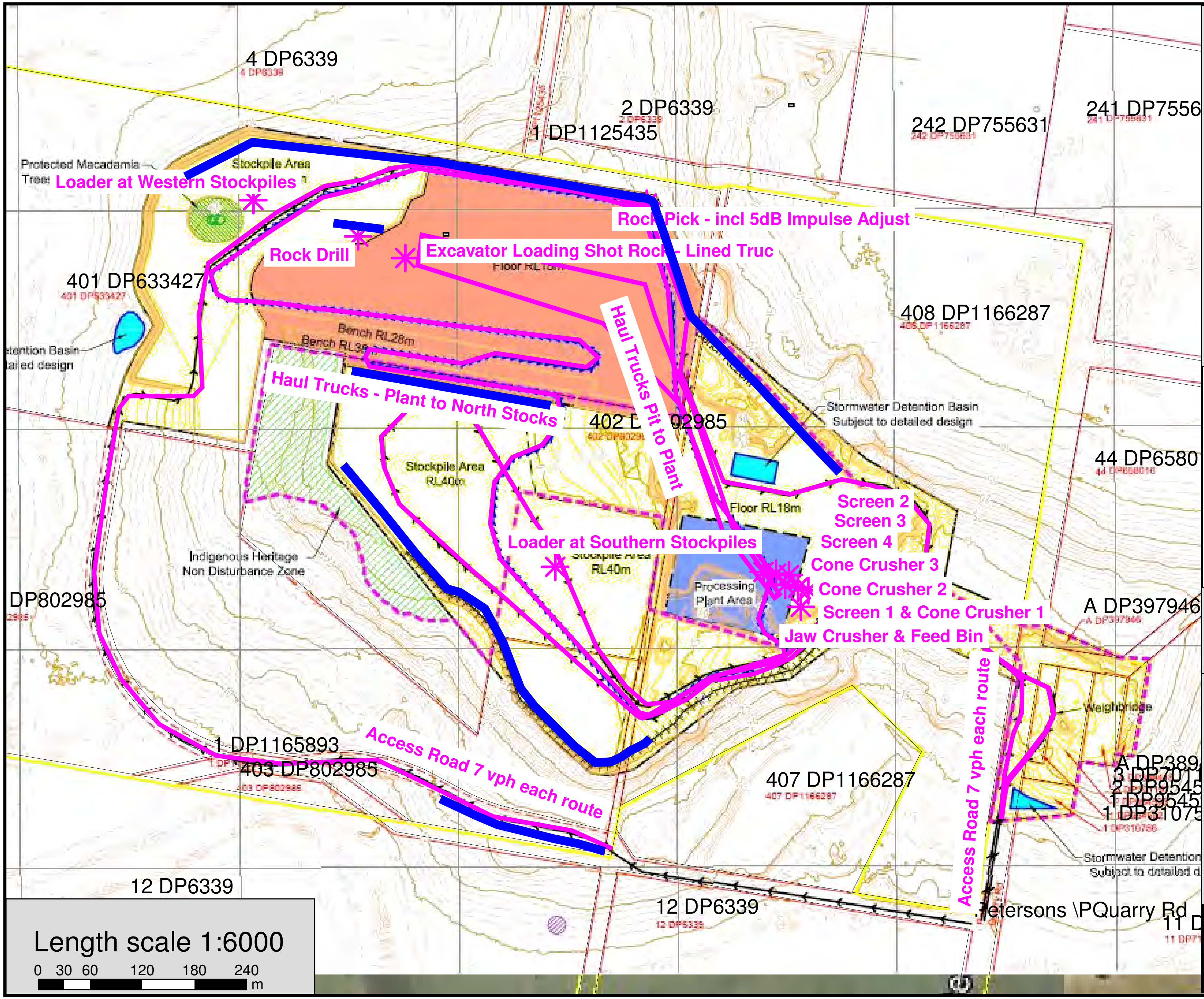


Coraki 15-041

Initial Pit Scenario

Source Layout

Sept 2015



Legend

—	Cadastral
✳	Point source
▬	Line source
▬	Bund/Barrier/Screening

Length scale 1:6000

0 30 60 120 180 240 m

Coraki 15-041

Final Pit Scenario

Source Layout

Sept 2015

mwa ENVIRONMENTAL

ATTACHMENT 3

Modelled Sound Power Levels

No.	Element name	Unit	31.5 Hz	63 Hz	125 Hz	250 Hz	500 Hz	1 kHz	2 kHz	4 kHz	8 kHz	16 kHz	Sum
2	%Access Road 7vph	dB(A)/meter		47.1	51.1	55.1	58.1	61.1	59.1	54.1	49.1		65.5
3	% Loader 15 min Load Cycle	dB(A)/unit		64.1	85.6	91.8	88.5	93.1	92.7	90.6	82.0		104.0
			52.3	77.8	86.6	88.8	94.2	93.2	91.4	86.0	79.0		
			57.9	85.5	92.8	84.9	95.7	92.7	91.1	83.4			
4	% Exc Loading Lined Truck with OS - 15min Work Cycle	dB(A)/unit	58.0	80.7	85.6	93.0	95.0	98.4	100.6	98.0	90.8	73.7	110.2
			75.3	84.6	84.5	91.8	99.2	99.7	99.7	97.9	86.6	70.3	
			72.3	81.3	89.5	92.1	100.3	101.0	99.5	93.8	80.3	60.0	
12	% SWL Jaw Crusher & Feed Bin	dB(A)/unit	66.7	82.9	89.6	95.6	99.8	99.2	99.1	97.9	104.5	73.6	112.7
			74.1	90.7	93.5	97.2	100.7	99.6	98.9	100.6	100.5	63.3	
			77.8	91.3	95.6	97.8	100.5	99.2	98.8	103.6	86.5	58.2	
13	% SWL S1 and CC1	dB(A)/unit	69.4	75.8	87.5	96.1	96.9	98.0	99.3	96.8	87.1	70.9	110.2
			79.5	83.7	89.2	95.1	99.5	100.8	99.9	93.4	82.6	63.9	
			74.9	95.4	95.9	94.1	98.8	100.5	98.2	90.1	77.2	55.4	
14	% SWL S2	dB(A)/unit	77.1	75.4	79.5	92.4	97.5	95.7	94.0	91.5	87.4	75.2	106.7
			87.3	77.9	85.3	93.8	97.2	95.3	93.2	90.4	84.8	68.3	
			77.8	86.5	90.0	95.2	96.6	95.6	92.4	89.1	81.6	56.3	
15	% SWL CC2	dB(A)/unit	74.4	77.2	82.6	91.1	95.3	98.6	96.6	94.2	91.6	77.8	108.6
			84.7	79.2	85.6	92.4	99.8	98.8	96.7	93.4	90.1	67.7	
			75.4	86.3	88.5	92.7	99.2	98.7	95.4	92.7	86.2	58.5	
17	% SWL Mobile Screen	dB(A)/unit	69.6	73.6	77.9	90.9	95.6	90.9	89.9	87.9	80.9	66.8	104.8
			80.0	80.3	80.0	92.8	97.3	97.4	91.4	85.7	76.5	61.6	
			74.3	83.1	83.3	90.9	93.4	94.6	87.9	85.1	71.6	56.0	
19	%Haul Truck (Cat 777C) Driveby Lmax	dB(A)/unit	78.6	91.7	99.2	105.1	106.7	108.5	109.3	103.5	99.7		114.4
28	% Quietened Rock Drill Leq	dB(A)/unit	68.7	95.7	91.7	95.4	101.6	102.9	104.6	100.9	97.8		109.5
29	% Rock Pick LAeq +5dB Impulse	dB(A)/unit	58.9	74.0	96.6	99.3	99.5	106.0	107.7	106.5	99.3	85.6	118.0
			62.7	78.7	94.9	97.6	105.7	108.5	110.1	102.1	96.0	78.8	
			71.1	86.6	99.6	97.0	107.6	108.4	108.2	101.9	91.3	74.4	

ATTACHMENT 4

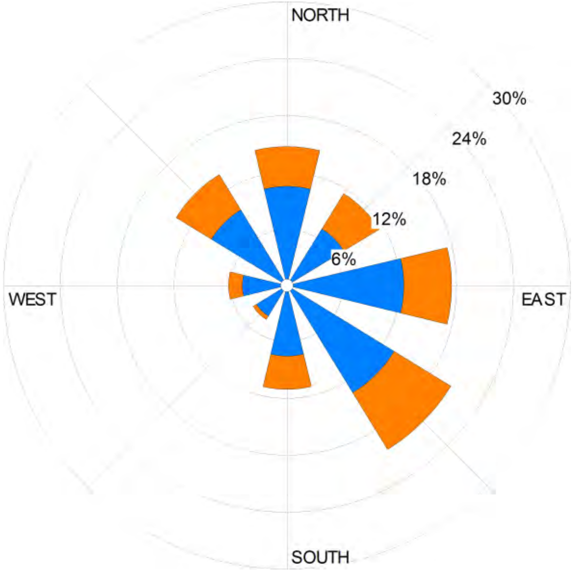
Analysis of Meteorological Conditions for Noise Assessment

Stability Classes for the period 6am to 7pm

Stability Class		Annual		Summer		Autumn		Winter		Spring	
		Counts	**%**	**Counts**	**%**	**Counts**	**%**	**Counts**	**%**	**Counts**	**%**
A	1	106	2%	50	4%	15	1%	3	0.3%	38	3%
B	2	555	12%	171	15%	117	10%	113	9%	154	13%
C	3	810	17%	194	17%	191	16%	243	20%	182	15%
D	4	2920	62%	747	64%	767	64%	666	56%	740	63%
E	5	74	2%	0	0%	14	1%	35	3%	25	2%
F	6	280	6%	8	1%	92	8%	136	11%	44	4%
Sum		4745	100%	1170	100%	1196	100%	1196	100%	1183	100%

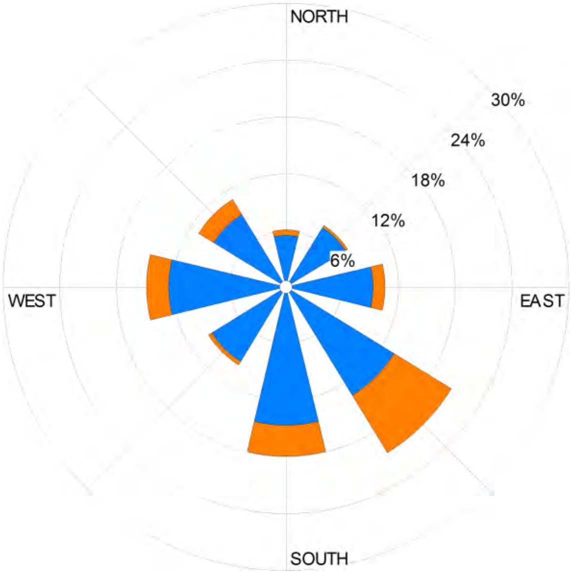
Wind roses for the period 6am to 7pm

Summer



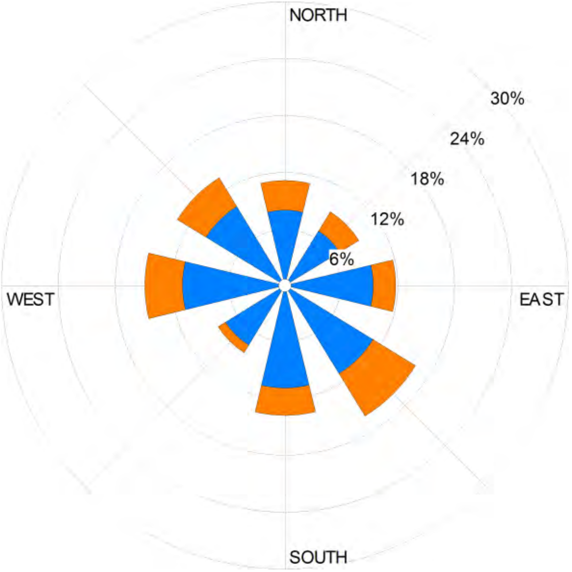
Calms 0.77%

Autumn



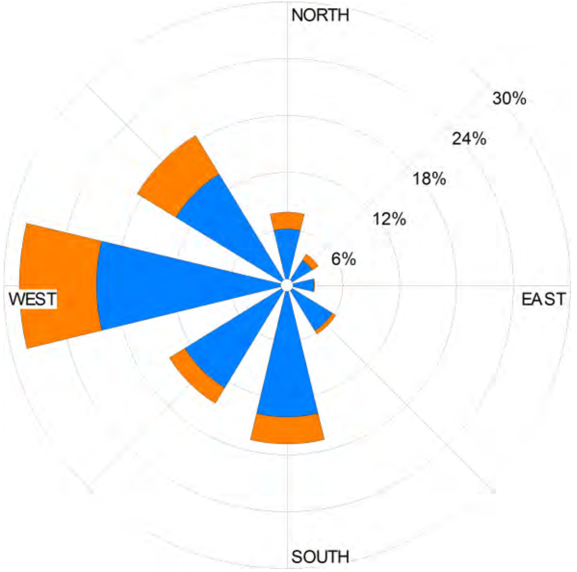
Calms 1.84%

Annual



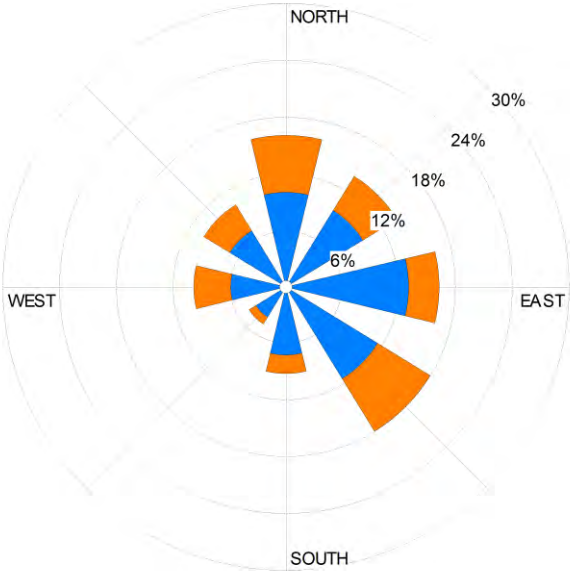
Calms 1.41%

Winter



Calms 0.92%

Spring



Calms 2.11%

Key

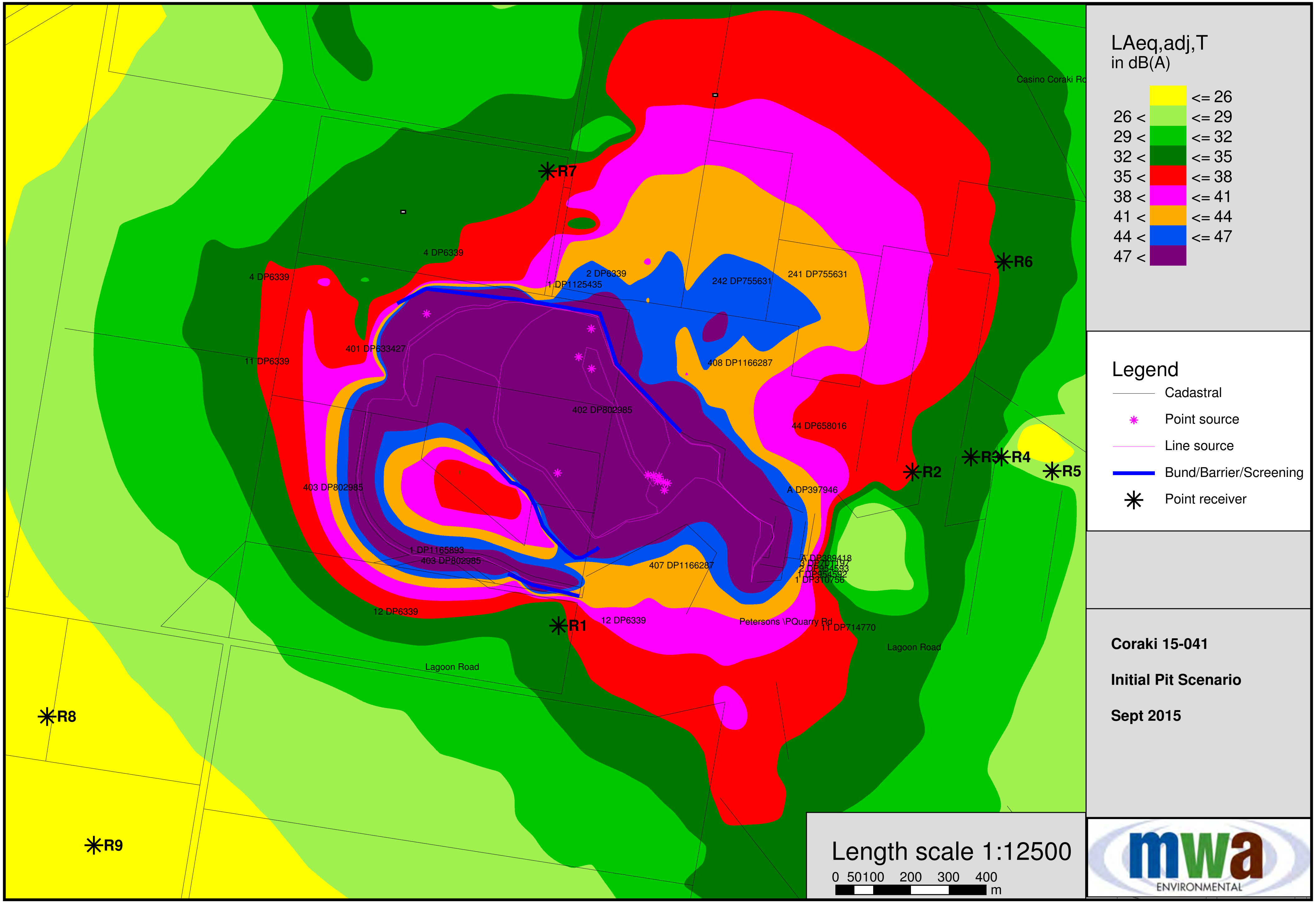
WIND SPEED
(m/s)

🟧 >= 3.00
🟦 0.50 - 3.00

ATTACHMENT 5

Predicted Quarry Noise Levels

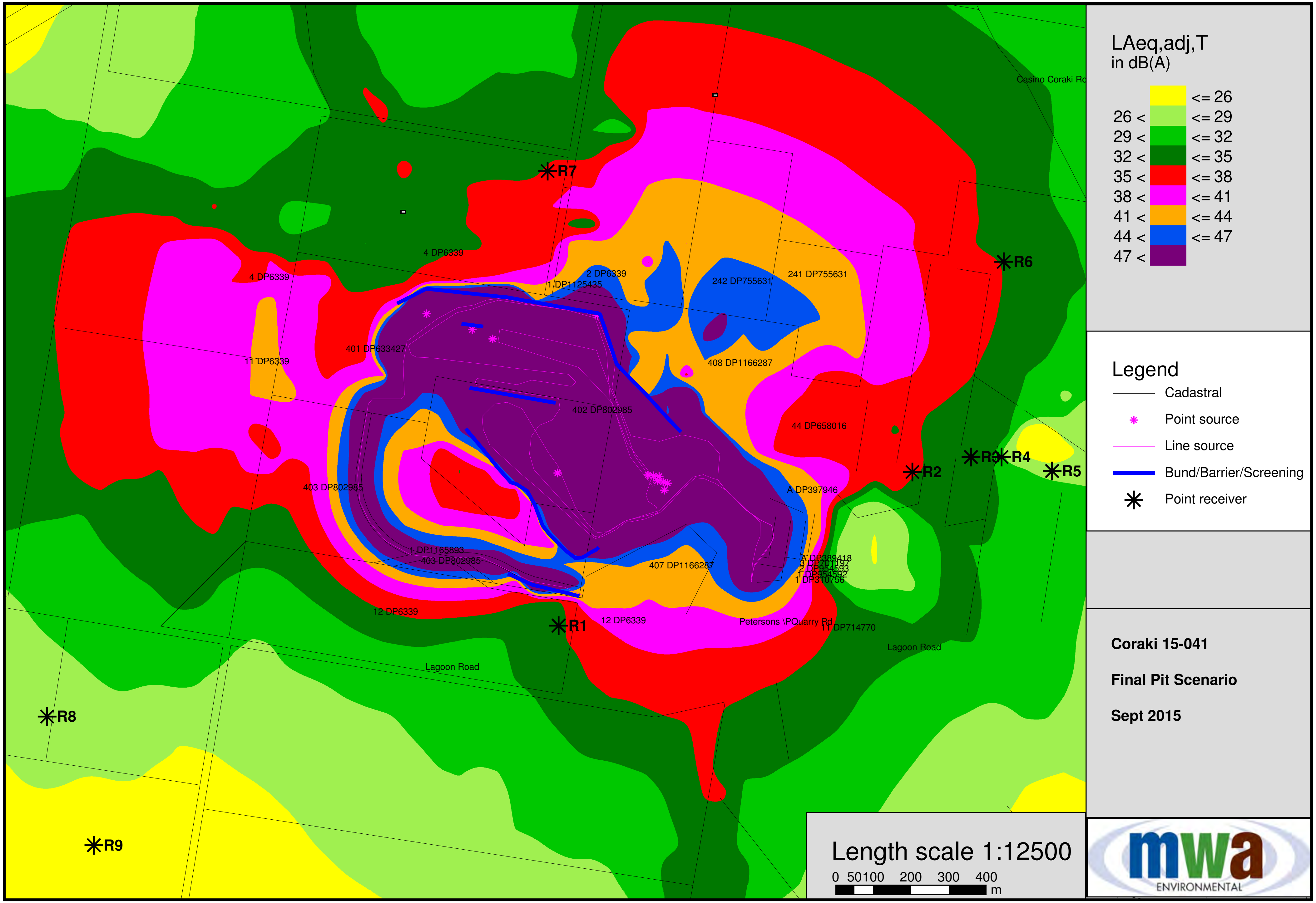
Initial Pit
Final Pit



Coraki 15-041

Initial Pit Scenario

Sept 2015



Coraki 15-041

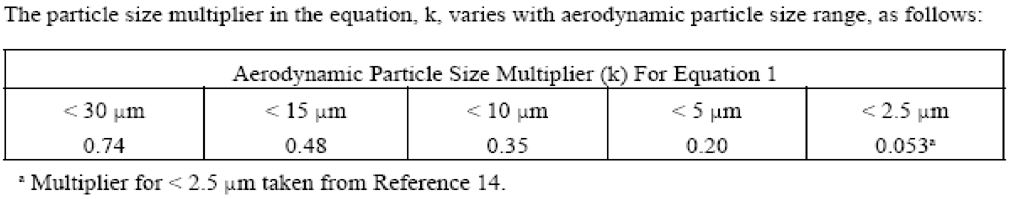
Final Pit Scenario

Sept 2015

ATTACHMENT 6

Modelled Particle Size Distribution

PARTICLE SIZE DISTRIBUTION



The particle size multiplier in the equation, k, varies with aerodynamic particle size range, as follows:

Aerodynamic Particle Size Multiplier (k) For Equation 1				
< 30 μm	< 15 μm	< 10 μm	< 5 μm	< 2.5 μm
0.74	0.48	0.35	0.20	0.053[a]

[a] Multiplier for < 2.5 μm taken from Reference 14.

TSP

FRACTION #	1	2	3	4	5	6
PARTICLE SIZE (MICRONS)	>30	<30	<15	<10	<5	<2.5
ASSUMED MEAN PARTICLE SIZE (MICRONS)	**40**	**22.5**	**12.5**	**7.5**	**3.75**	**1.25**
% OF TOTAL	**0.26**	**0.26**	**0.13**	**0.15**	**0.147**	**0.053**
STANDARD DEVIATION	**0**	**0**	**0**	**0**	**0**	**0**

PM10

FRACTION #	4	5	6
PARTICLE SIZE (MICRONS)	<10	<5	<2.5
ASSUMED MEAN PARTICLE SIZE (MICRONS)	**7.5**	**3.75**	**1.25**
% OF TOTAL	0.15	0.147	0.053
% OF <PM10	**0.428571**	**0.42**	**0.151429**
STANDARD DEVIATION	**0**	**0**	**0**

PM2.5

FRACTION #	6
PARTICLE SIZE (MICRONS)	<2.5
ASSUMED MEAN PARTICLE SIZE (MICRONS)	**1.25**
% OF TOTAL	0.053
% OF <PM2.5	**100**
STANDARD DEVIATION	**0**

ATTACHMENT 7

Analysis of CALMET-Generated Site Meteorological Data

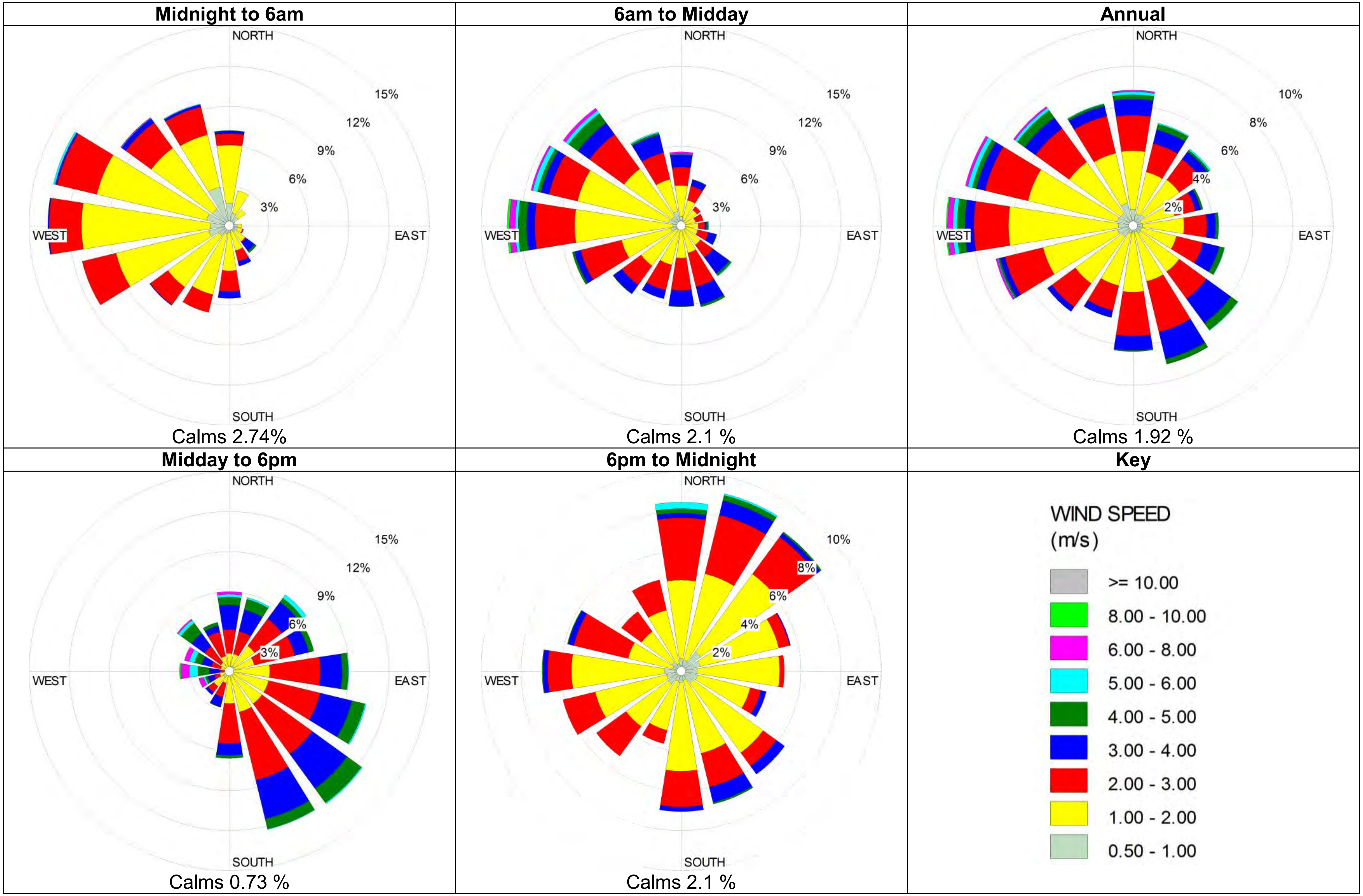


Figure A7.1 Diurnal wind roses for the Site as generated by CALMET

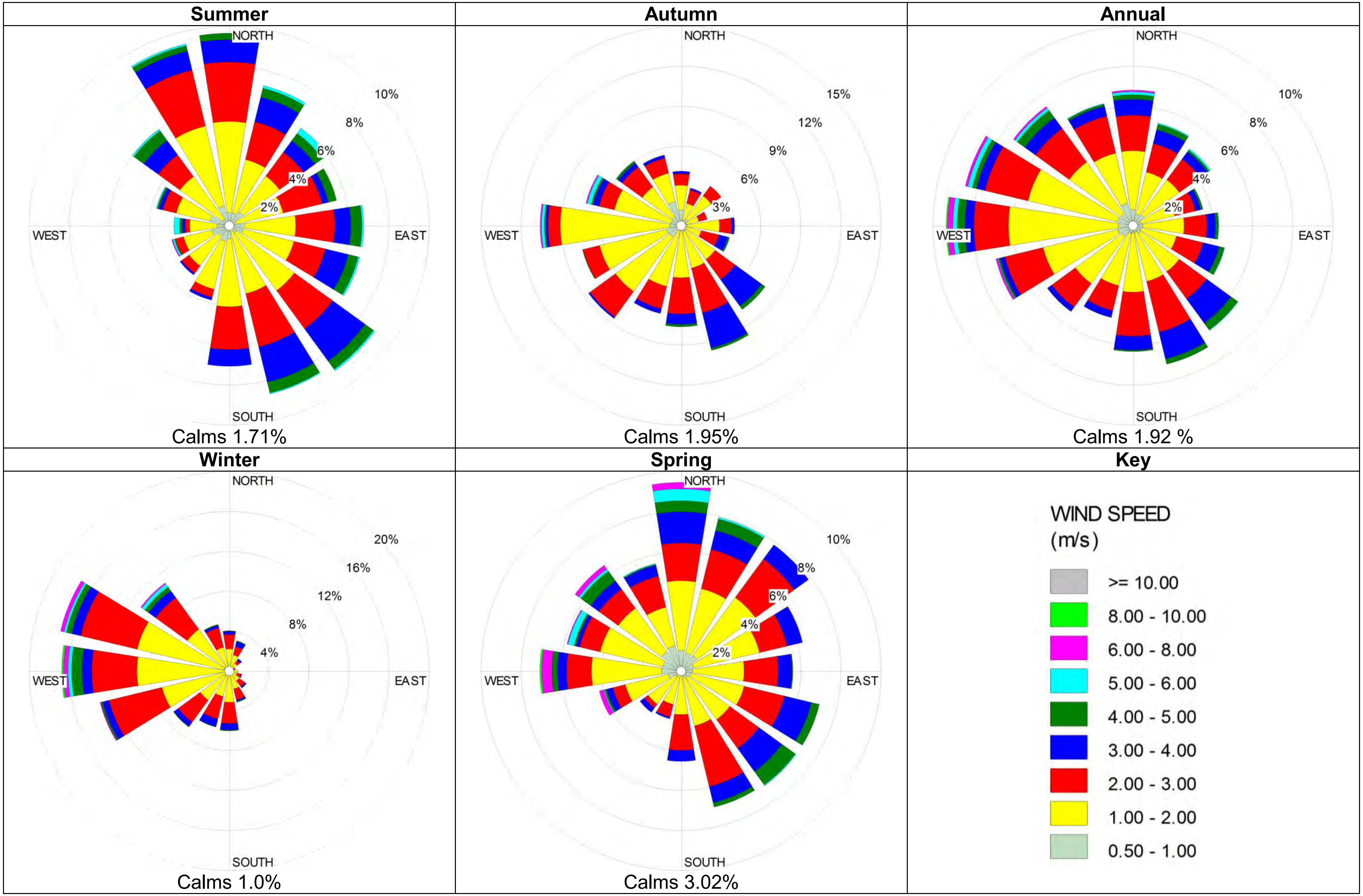


Figure A7.2 Seasonal wind roses for the Site as generated by CALMET

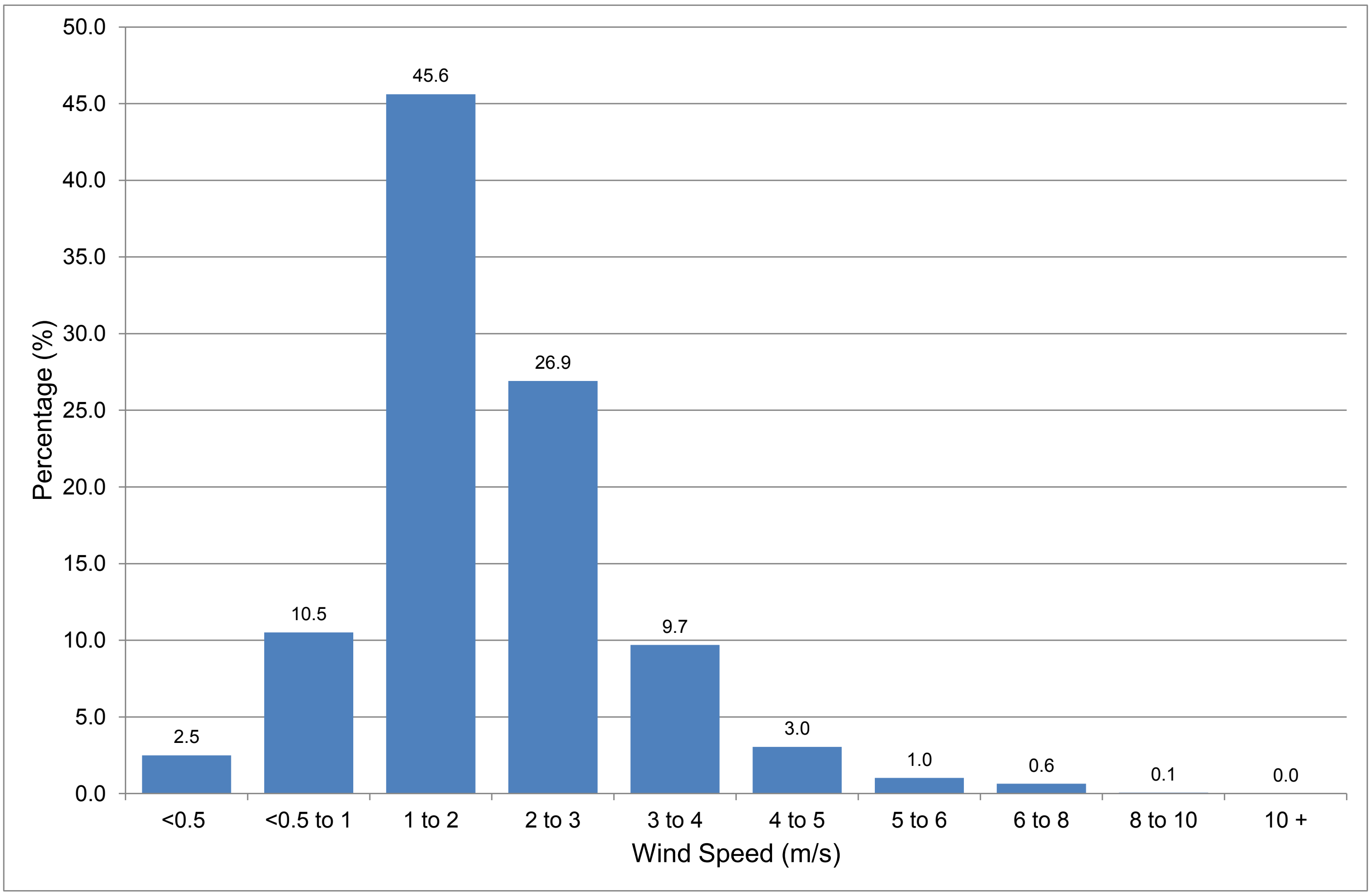


Figure A7.3 Wind frequency graph for the Site as generated by CALMET

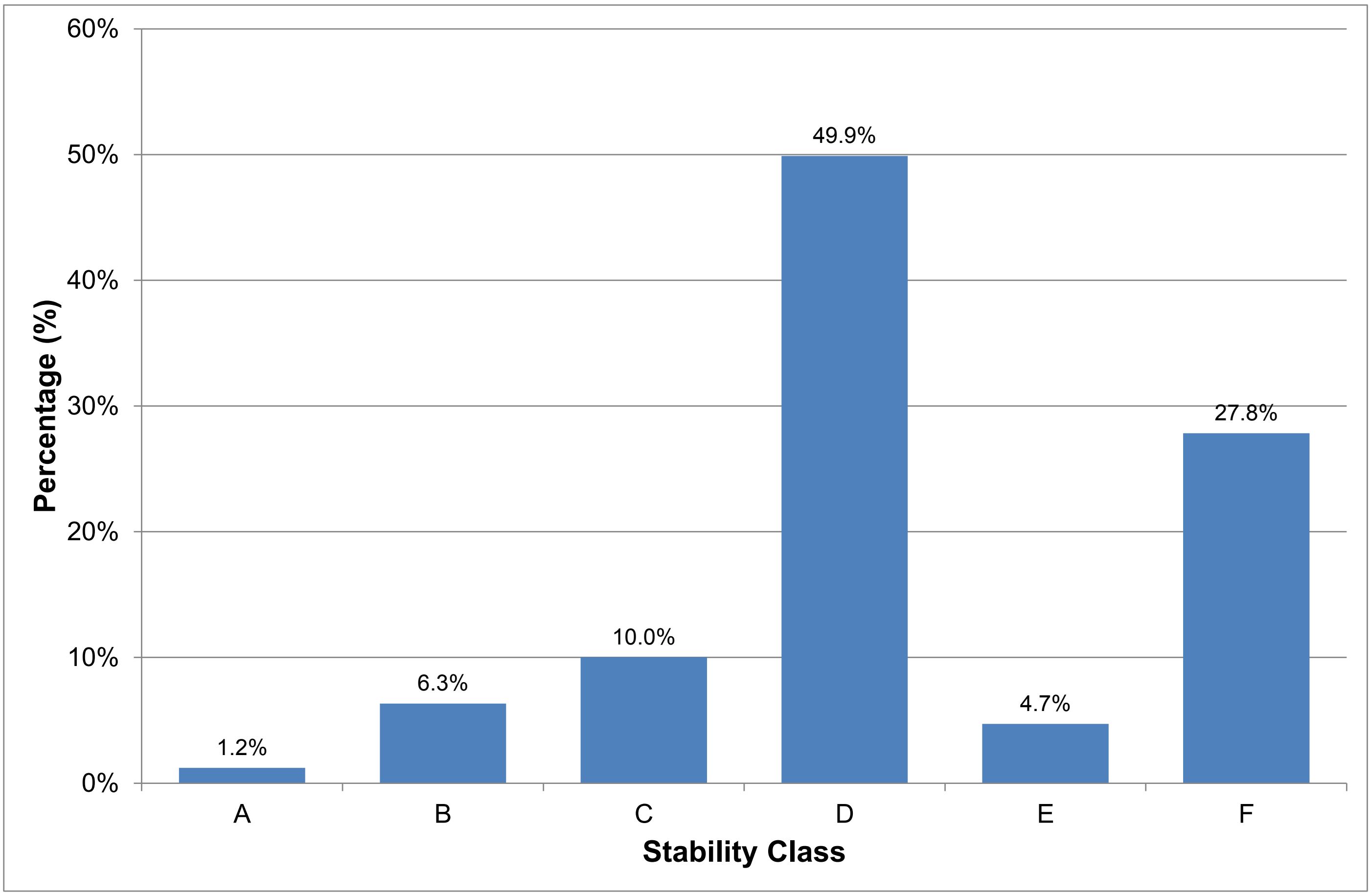


Figure A7.4 Stability Class Histograms for the Site as generated by CALMET

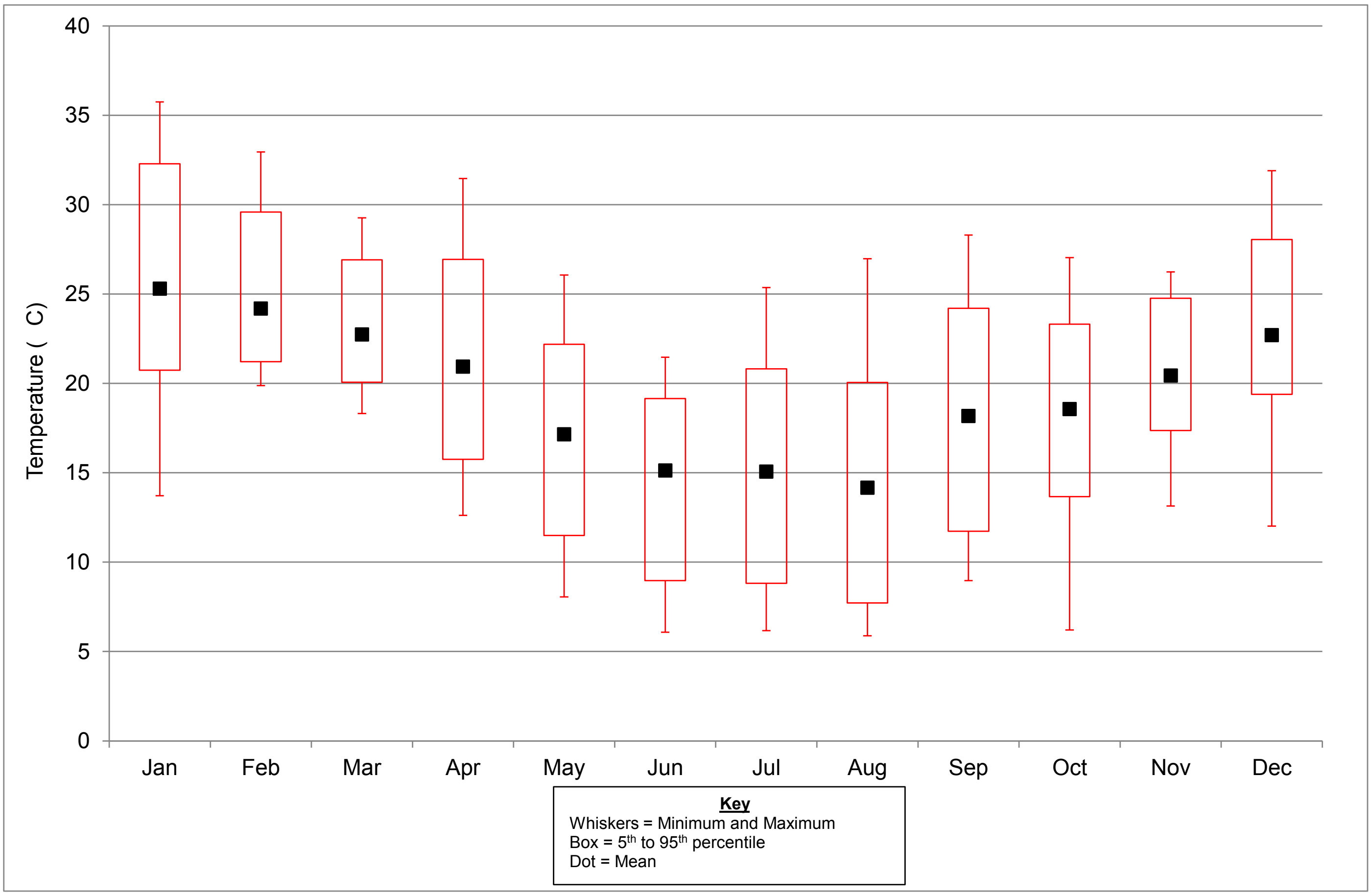


Figure A7.5 Box and Whisker plot of monthly temperature for the Site as generated by CALMET

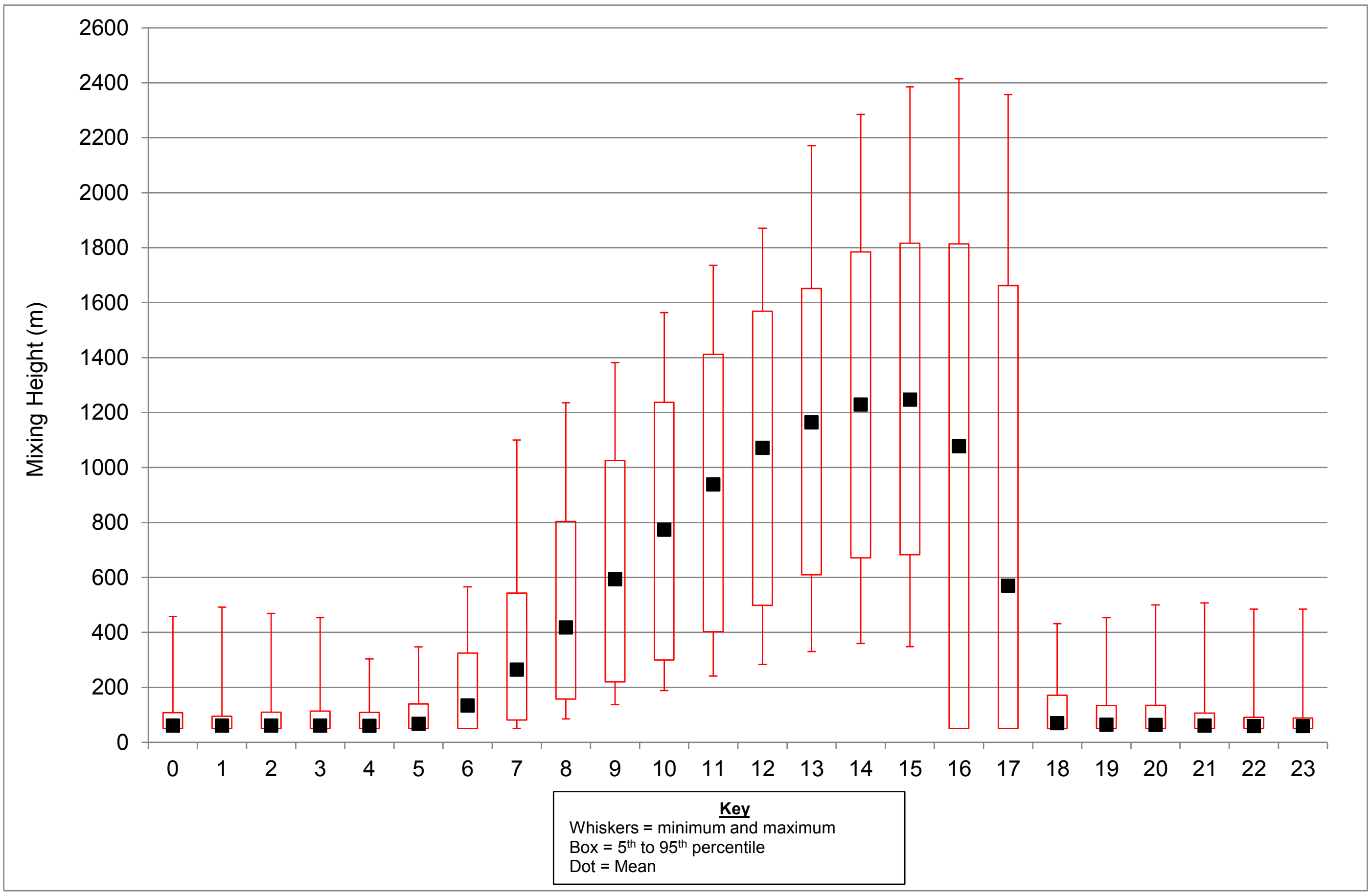


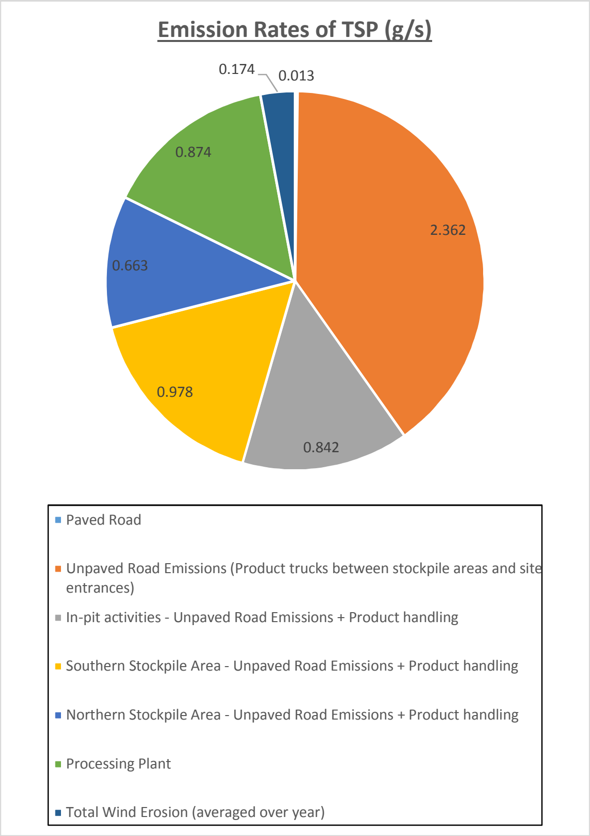
Figure A7.6 Box and Whisker plot of diurnal mixing height for the Site as generated by CALMET

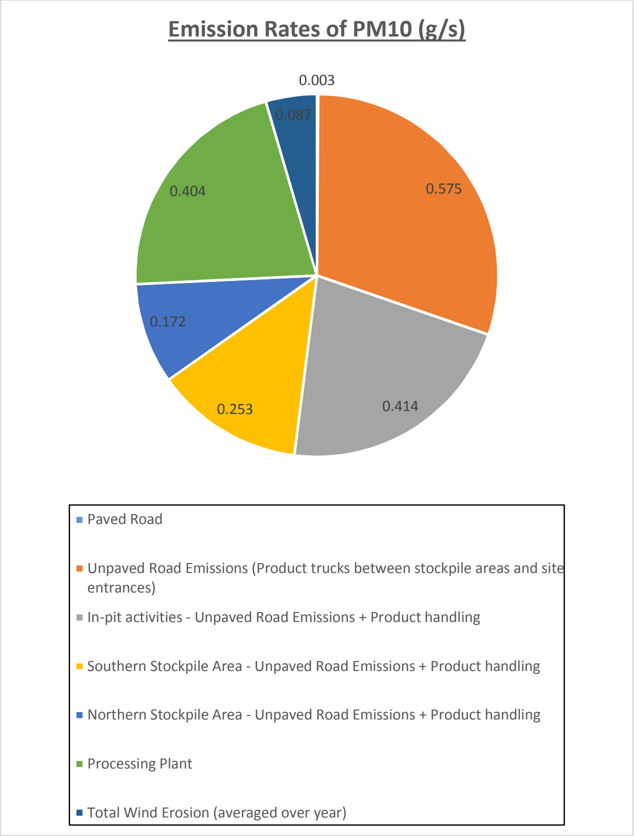
ATTACHMENT 8

Summary of Emission Factors, Control Efficiencies and Assumptions

CORAKI 15-041 - SUMMARY OF PARTICULATE EMISSION RATES - WITH RECOMMENDED CONTROL MEASURES

SOURCE GROUP	EMISSION RATE (g/s)		
	PM2.5	**PM10**	**TSP**
Paved Road	0.001	0.003	0.013
Unpaved Road Emissions (Product trucks between stockpile areas and site entrances)	0.058	0.575	2.362
In-pit activities - Unpaved Road Emissions + Product handling	0.045	0.414	0.842
Southern Stockpile Area - Unpaved Road Emissions + Product handling	0.026	0.253	0.978
Northern Stockpile Area - Unpaved Road Emissions + Product handling	0.018	0.172	0.663
Processing Plant	0.067	0.404	0.874
Total Wind Erosion (averaged over year)	0.013	0.087	0.174
TOTAL	**0.2**	**1.9**	**5.9**





WIND EROSION

- **Exposed Stockpile Areas, Quarry Pit and Processing Plant**

NPI Emission Estimation Technique Manual for Mining (Environment Australia, 2012)

Silt Content (s): 5 % (*USEPA AP42 Chapter 13.2.2 Table 13.2.2-1*)

PAVED ROADS

200 metres of paved road located in proximity to the residence to the south for product trucks accessing the northern stockpile area via the south western access road to the site.

USEPA AP42 Chapter 13.2.1 Paved Roads (2011)

Silt Loading (sL):8.2g/m^2 (*USEPA AP42 Chapter 13.2.1 mean quarrying*)

Control Measures: Level 2 watering (>2 litres/m^2/hour)

UNPAVED ROADS

All unpaved routes for product trucks accessing either the northern or southern stockpile areas

USEPA AP42 Chapter 13.2.2 Unpaved Roads (2006)

Haul Road Silt Content 8.3%: (*USEPA AP42 Chapter 13.2.2 Table 13.2.2-1 Average for quarry haul road*)

Control Measures: Level 2 watering (>2 litres/m^2/hour)

All unpaved routes for dump trucks

USEPA AP42 Chapter 13.2.2 Unpaved Roads (2006)

Haul Road Silt Content 8.3%: (*USEPA AP42 Chapter 13.2.2 Table 13.2.2-1 Average for quarry haul road*)

Control Measures: Level 2 watering (>2 litres/m^2/hour)

IN PIT ACTIVITIES

DRILLING BLAST HOLES (IN PIT)

USEPA AP42 Chapter 11.19.2 Crushed Stone Processing and Pulverized Mineral Processing (2004)

LOADING TRUCKS WITH FRAGMENTED STONE (IN PIT)

USEPA AP42 Chapter 11.19.2 Crushed Stone Processing and Pulverized Mineral Processing (2004)

PROCESSING PLANT

PROCESSING PLANT CONVEYOR TRANSFER POINTS

USEPA AP42 Chapter 11.19.2 Crushed Stone Processing and Pulverized Mineral Processing (2004)

Control Measures: Water Sprays to Conveyor Transfer Points

LOADING TRUCKS WITH CRUSHED PRODUCT (AT STOCKPILES)

USEPA AP42 Chapter 11.19.2 Crushed Stone Processing and Pulverized Mineral Processing (2004)

UNLOADING FRAGMENTED STONE FROM TRUCKS (AT TIP HEAD TO PROCESSING PLANT)

USEPA AP42 Chapter 11.19.2 Crushed Stone Processing and Pulverized Mineral Processing (2004)

Control Measures: Enclosed Primary and Secondary Crusher and Tip Head

Control Efficiency: 70 % (Table 4 NPI Emission Estimation Technique Manual for Mining, Environment Australia 2011)

PROCESSING PLANT PRIMARY CRUSHING

USEPA AP42 Chapter 11.19.2 Crushed Stone Processing and Pulverized Mineral Processing (2004)

Control Measures: Enclosed Primary and Secondary Crusher and Tip Head

PROCESSING PLANT SECONDARY CRUSHING

USEPA AP42 Chapter 11.19.2 Crushed Stone Processing and Pulverized Mineral Processing (2004)

Control Measures: Enclosed Primary and Secondary Crusher and Tip Head

PROCESSING PLANT TERTIARY CRUSHING

USEPA AP42 Chapter 11.19.2 Crushed Stone Processing and Pulverized Mineral Processing (2004)

Control Measures: Water Sprays to Processing Plant.

PROCESSING PLANT QUATERNARY CRUSHING

USEPA AP42 Chapter 11.19.2 Crushed Stone Processing and Pulverized Mineral Processing (2004)

Control Measures: Water Sprays to Processing Plant.

PROCESSING PLANT SCREENING

USEPA AP42 Chapter 11.19.2 Crushed Stone Processing and Pulverized Mineral Processing (2004)

Control Measures: Water Sprays to Processing Plant.

PROCESSING PLANT FINES SCREENING

USEPA AP42 Chapter 11.19.2 Crushed Stone Processing and Pulverized Mineral Processing (2004)

Control Measures: Water Sprays to Processing Plant.

LOADING STOCKPILES WITH CRUSHED PRODUCT

USEPA AP42 Chapter 13.2.4 Aggregate Handling and Storage Piles (2006)

Material moisture content % (M): 0.7 (mean from Table 13.2.4-1)

STOCKPILE AREAS

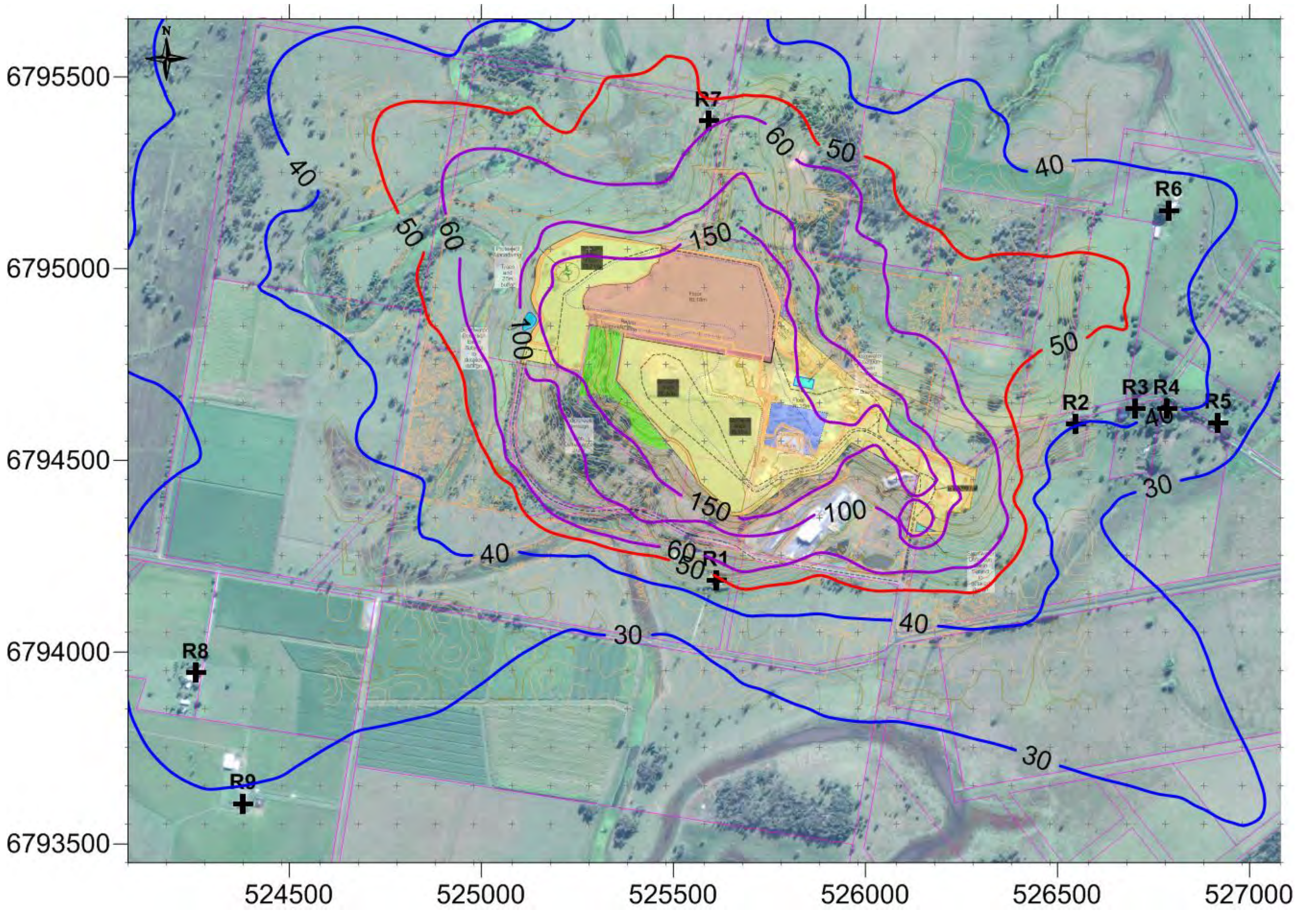
LOADING AND UNLOADING TRUCKS WITH CRUSHED PRODUCT (AT STOCKPILES)

USEPA AP42 Chapter 11.19.2 Crushed Stone Processing and Pulverized Mineral Processing (2004)

ATTACHMENT 9

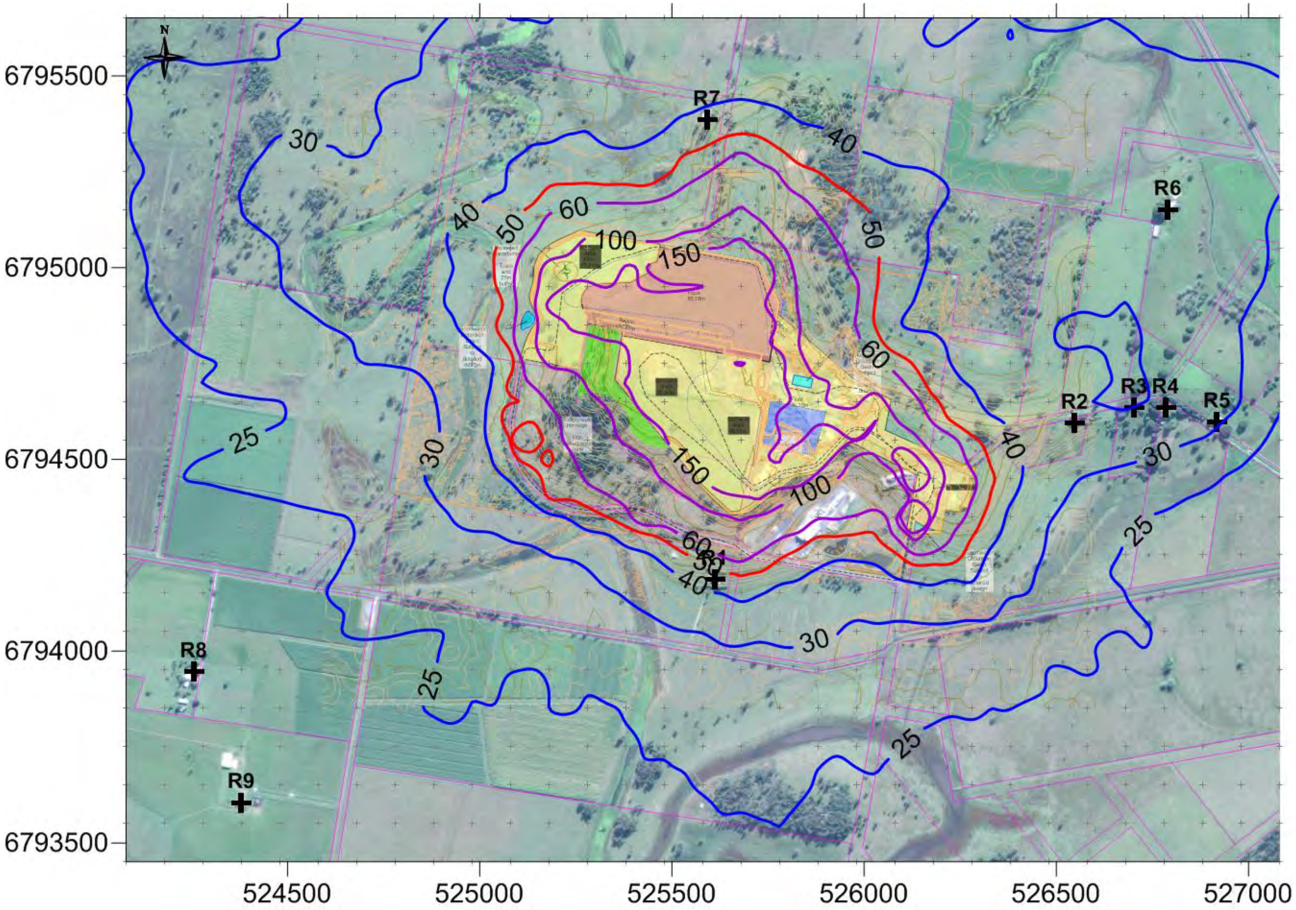
Predicted Particulate Concentrations / Deposition Rates Plots

Final Extraction Stage



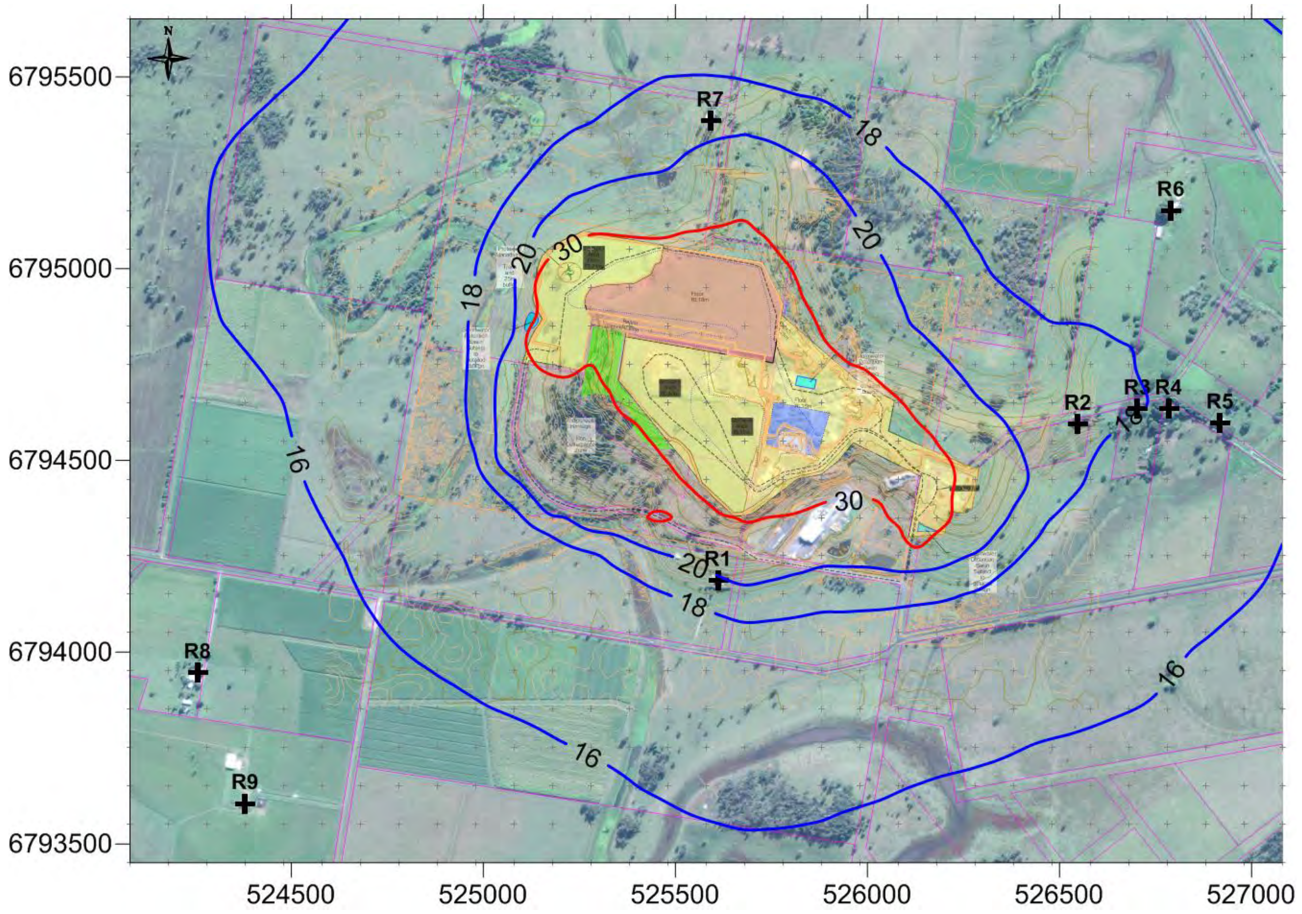
Predicted PM_{10} maximum 24-hour average concentrations

Figure A9.1	Pollutant	Averaging Period	Ambient Concentration	Objective	Date
mwa ENVIRONMENTAL	PM_{10}	24-hour Maximum	17.2 µg/m³	50 µg/m³	2015-09-23



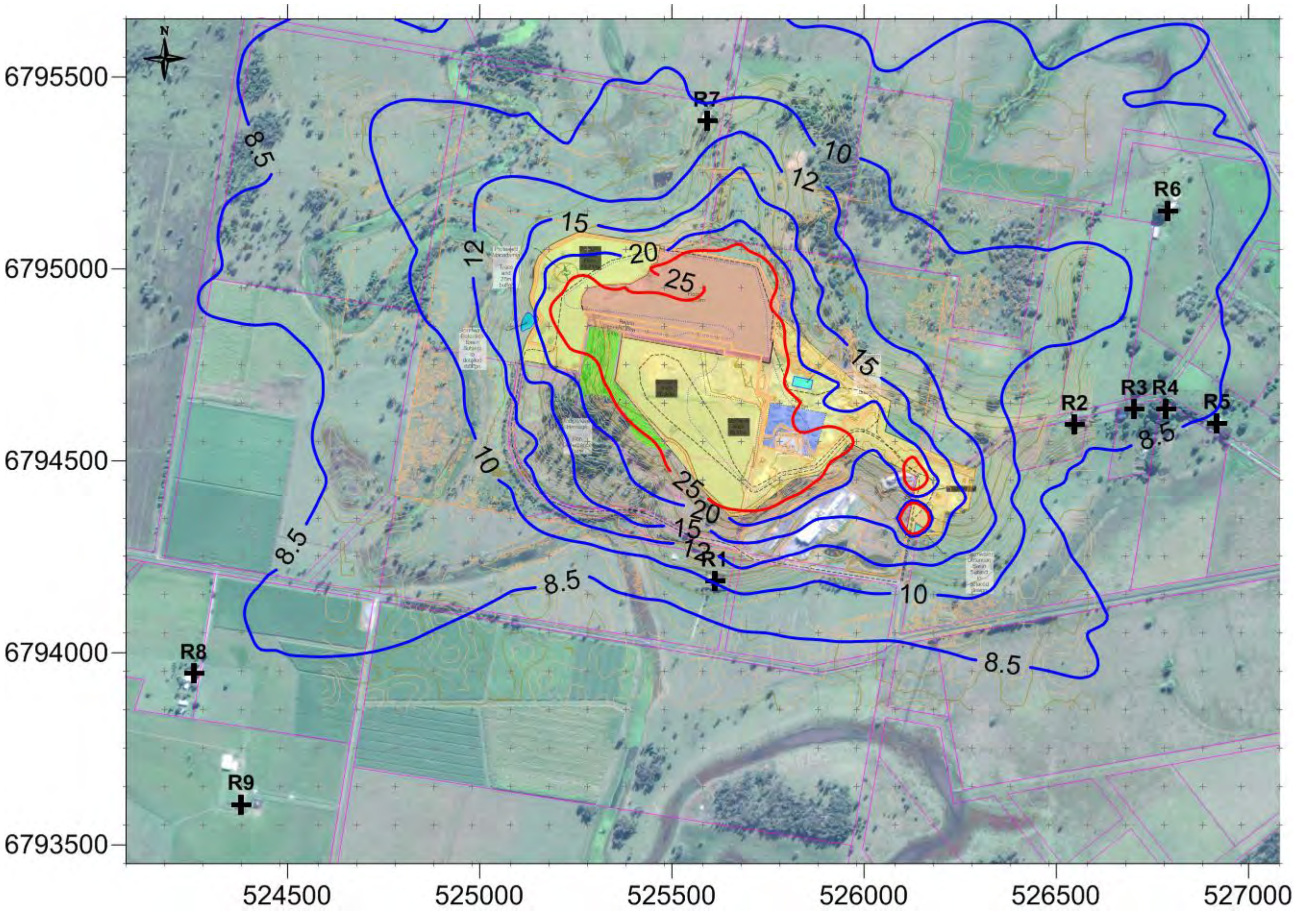
Predicted PM$_{10}$ 6th highest 24-hour average concentrations

Figure A9.2	Pollutant	Averaging Period	Ambient Concentration	Objective	Date
mwa ENVIRONMENTAL	PM$_{10}$	24-hour 6th Highest	17.2 µg/m³	50 µg/m³	2015-09-23



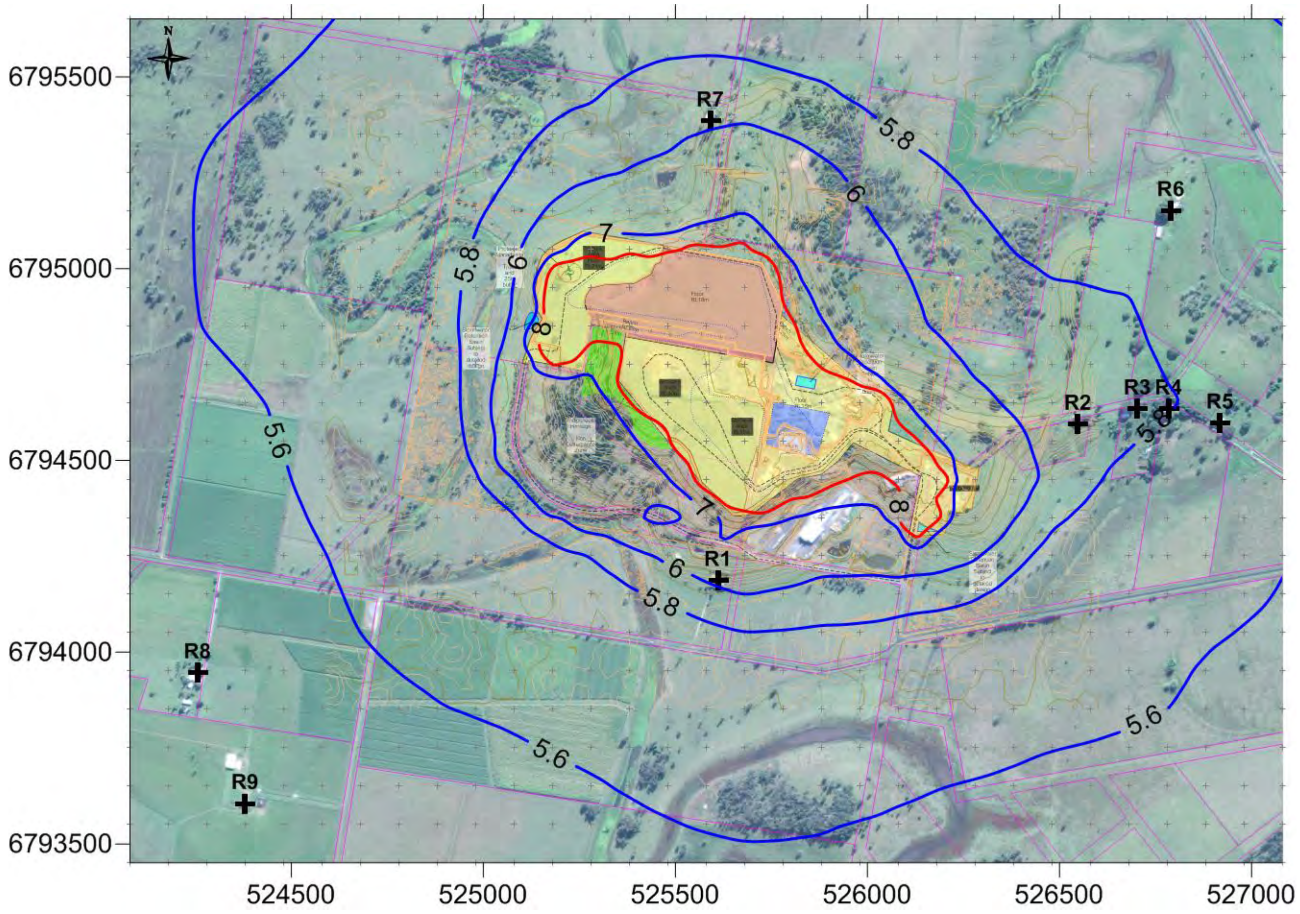
Predicted PM$_{10}$ annual average concentrations

Figure A9.3	Pollutant	Averaging Period	Ambient Concentration	Objective	Date
mwa ENVIRONMENTAL	PM$_{2.5}$	Annual Average	15.1 µg/m^3	30 µg/m^3	2015-09-23



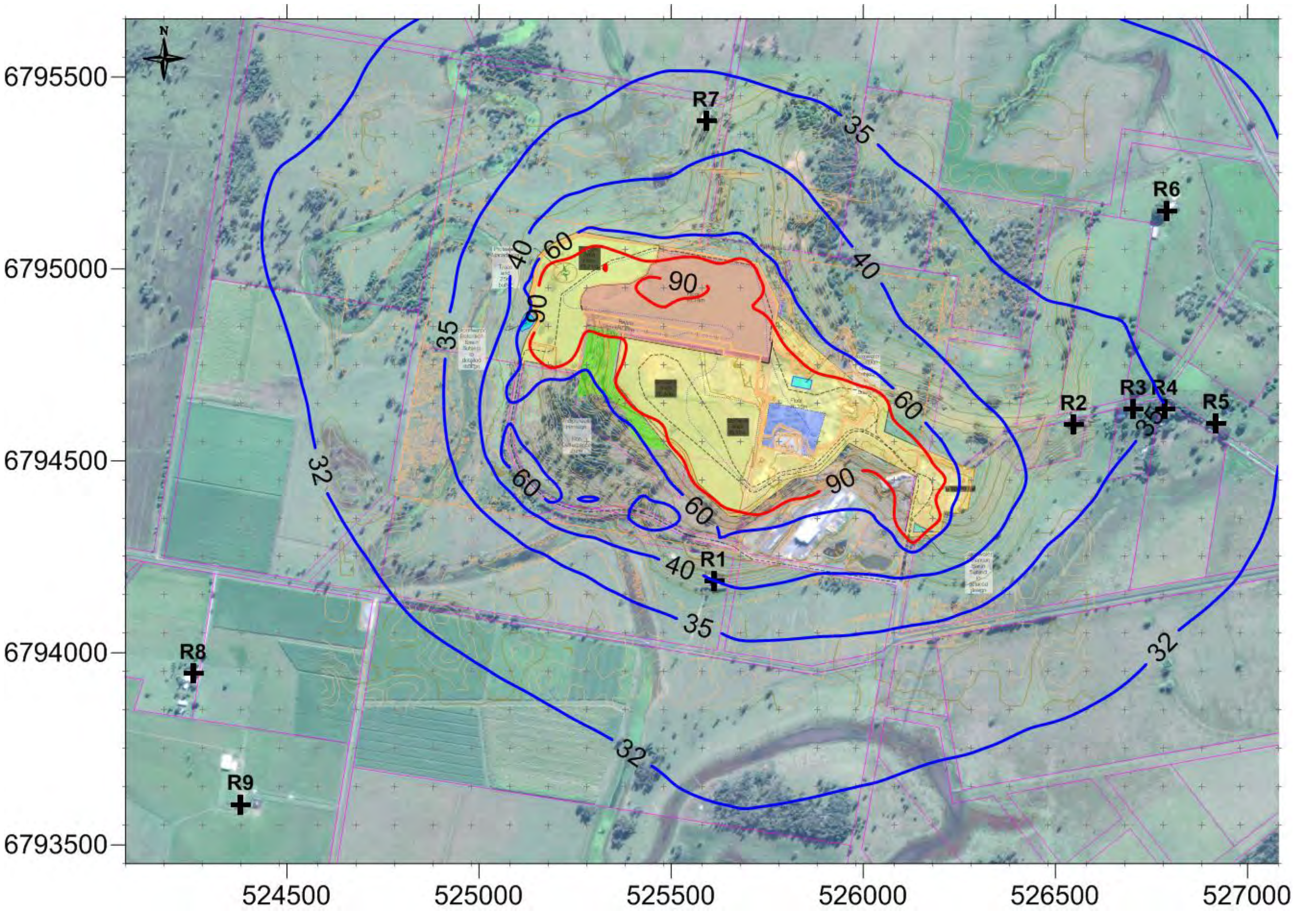
Predicted $PM_{2.5}$ maximum 24-hour average concentrations

Figure A9.4	Pollutant	Averaging Period	Ambient Concentration	Objective	Date
mwa ENVIRONMENTAL	$PM_{2.5}$	24-hour maximum	6.2 µg/m³	25 µg/m³	2015-09-23



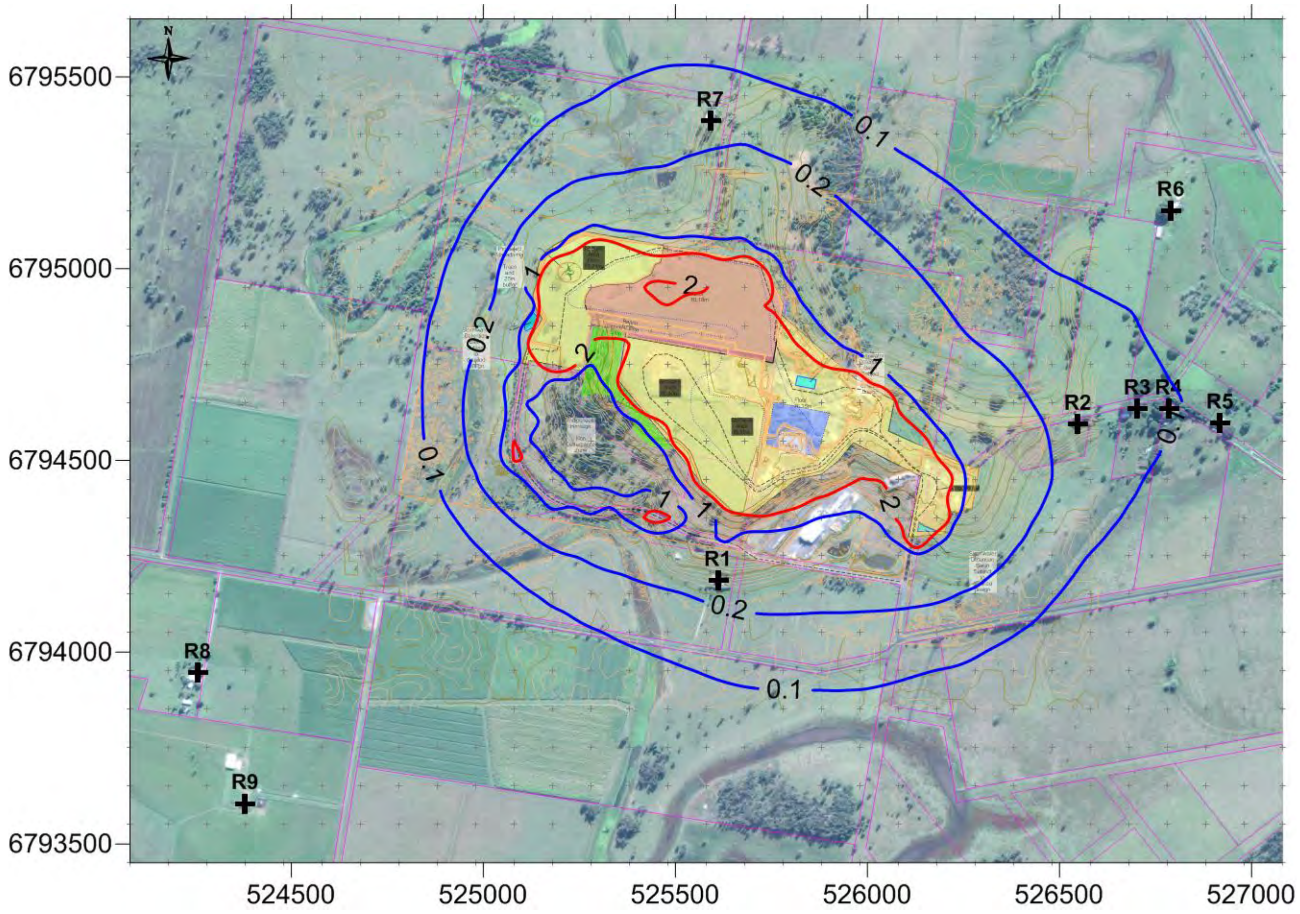
Predicted $PM_{2.5}$ annual average concentrations

Figure A9.5	Pollutant	Averaging Period	Ambient Concentration	Objective	Date
mwa ENVIRONMENTAL	$PM_{2.5}$	Annual Average	$5.5\ \mu g/m^3$	$8\ \mu g/m^3$	2015-09-23



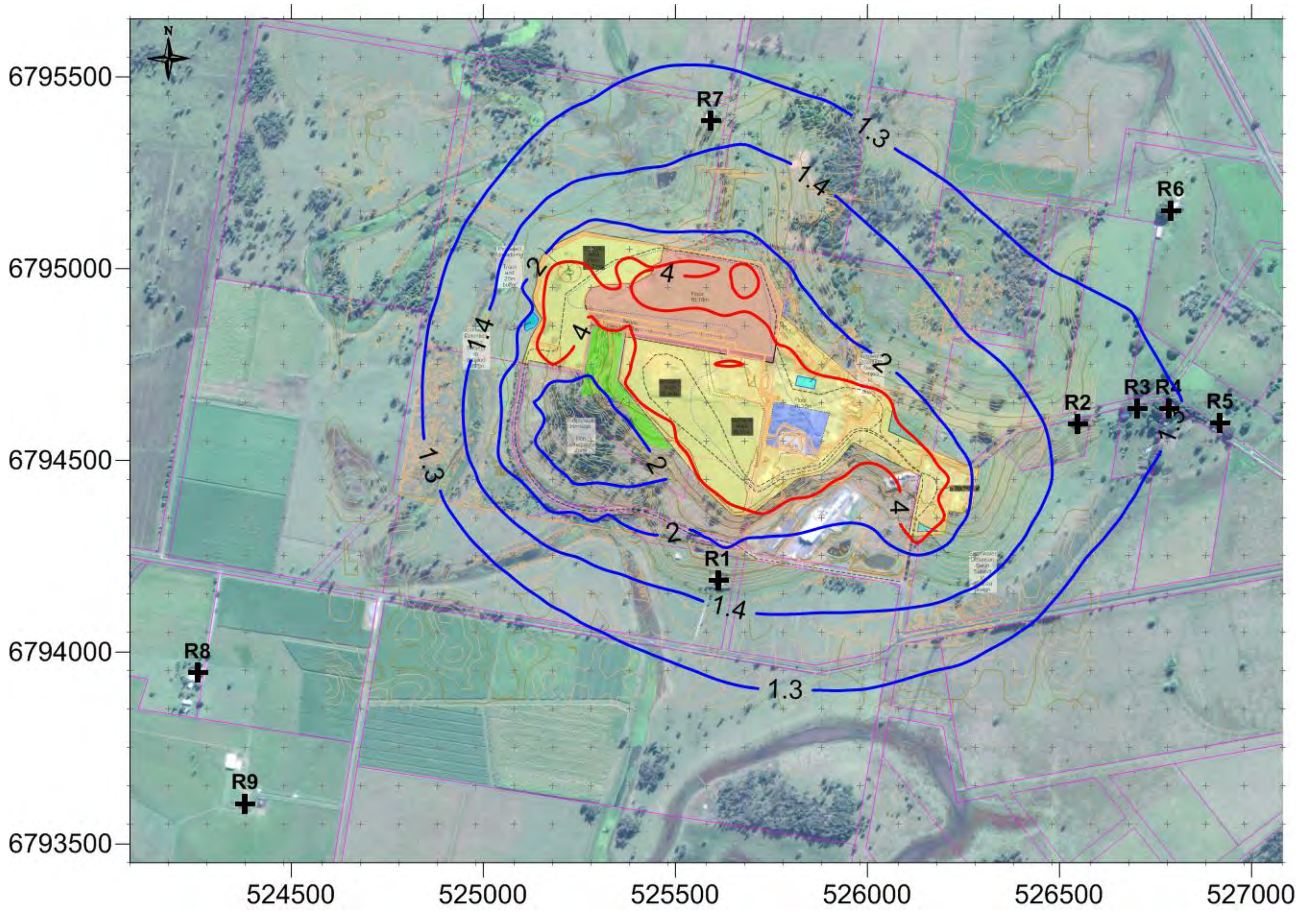
Predicted TSP annual average concentrations

Figure A9.6	Pollutant	Averaging Period	Ambient Concentration	Objective	Date
mwa ENVIRONMENTAL	TSP	Annual Average	30.1 µg/m³	90 µg/m³	2015-09-23



Predicted Annual Average Dust Deposition rates in Isolation

Figure A9.7	Pollutant	Averaging Period	Background Rate	Objective	Date
mwa ENVIRONMENTAL	Dust Deposition	Annual	n/a	2 mg/m^2/month	2015-09-23



Predicted Annual Average Dust Deposition rates (Cumulative)

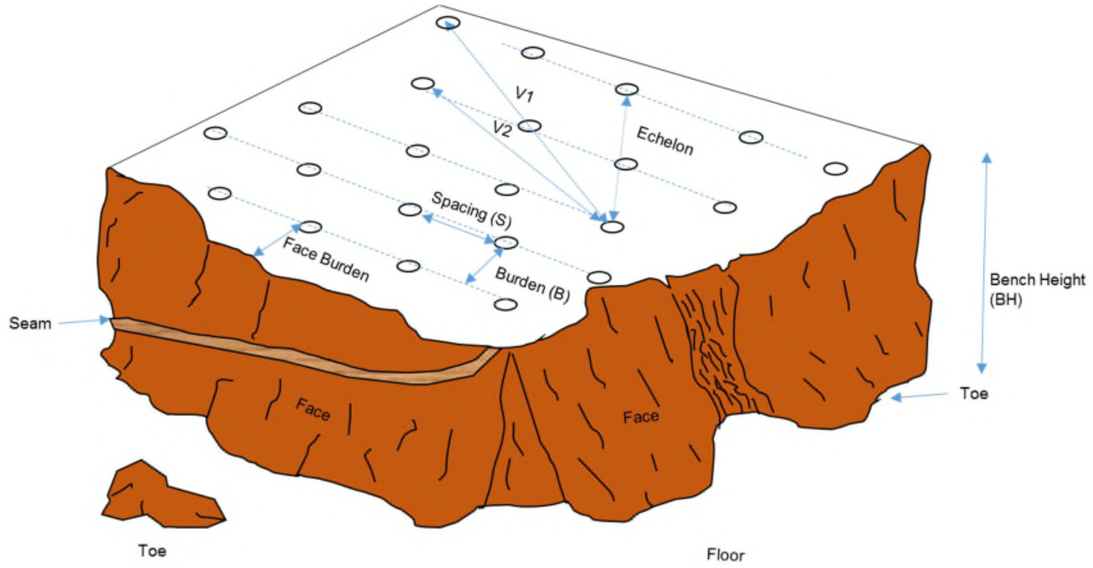
Figure A9.8	Pollutant	Averaging Period	Background Rate	Objective	Date
mwa ENVIRONMENTAL	Dust Deposition	Annual	40 mg/m^2/day / 1.2 g/m^2/month	4 mg/m^2/month	2015-09-23

Attachment 7

Coraki Quarry Proposed Blast Parameters Evaluation

Coraki Quarry

Proposed Blast Parameters Evaluation



10 September 2015

Prepared By:
Drew Martin
Principal Drill & Blast Engineer
Blast It Global Pty Ltd
Email: drew@blastitglobal.com
Ph: **+61 477 339 648**

DOCID: BiG_Groundworkplus_QLD_2.0

Contents

List of Figures

List of Tables

List of Equations

Introduction

As part of an Environmental Impact Statement (EIS) to support the approval of the proposed Coraki Quarry, an assessment of the likely blasting impacts of the development on people, building, animals, infrastructure and significant natural features, must be undertaken. This will ensure that the proposed quarrying practices do not significantly impact on the surrounding neighbours and ensure that the quarry can comply with anticipated licence conditions.

This evaluation report assesses the ability of the proposed drill and blast practices to meet licence conditions. The report evaluates the proposed blast parameters to comply with blast vibration, airblast overpressure and flyrock requirements.

Recommendations are provided outlining best practice drill and blast solutions to meet licence conditions, in line with AS2187.2-2006 and ANZECC guidelines.

Blasting Assessment Process

The blasting assessment process is conducted using industry standards, industry rules and blasting experience to evaluate multiple blasting scenarios. Each scenario was evaluated to determine if the specific scenario complies with licence conditions and minimises disturbance to the neighbouring properties.

The closest properties were identified and the distance measured from the proposed extraction limit boundary to the closest residential property. A single set of site blast data was supplied and was used as a guide along with AS2187.2-2006 to determine the potential blast vibration, airblast overpressure and flyrock projection.

Vibration Assessment

The blast vibration assessment uses the ANZECC guidelines, which are in line with the requirements of AS2187.2-2006 Appendix J. The ANZECC guidelines require blast vibration of less than 5.0 mms^{-1} for 95% of all blasts and no greater than 10.0 mms^{-1} for 100 % of blasts at any sensitive receiver. This refers to measurements at any point within 30 metres of any residential boundary or in or on any other noise sensitive place or commercial property.

Where no suitable site data is available for analysis to determine the expected blast vibration equation, the AS2187.2-2006 Appendix J 50% probability exceedance equation J7.3(1) is widely accepted in the industry as the basis on which to estimate expected blast vibration levels. (Refer to Equation 1 overleaf)

$$V = K\, x \left(\frac{R}{Q^{1/2}}\right)^{-B}$$

Where:

V = ground vibration as a vector peak particle velocity, in millimetres per second
R = distance between charge and point of measurement, in metres
Q = maximum instantaneous charge (effective charge mass per delay), in Kilograms
K_g, B = constants related to site and rock properties for estimation purposes

Equation 1 Blast Vibration VPPV Prediction Equation

The AS2187.2-2006 50% probability exceedance equation uses a K value of 1140 and a B value of 1.6 when no suitable site data is available. K and B constants may be determined in the future following collation of site specific blast data.

Vibration and airblast results from a single blast were supplied and used as an indicator against the AS2187.2-2006 equation.

Airblast Assessment

The two closest residential properties were assessed for expected airblast overpressure using proposed blast parameters and distances to the closest residential dwellings. The ANZECC guidelines state that 100% of blasts must be less than 120 dBL and 95% of the blasts must be less than 115 dBL, which reflects the requirements of AS2187.2-2006.

Airblast estimation equations are generally very inaccurate as the actual airblast result is heavily dependent on factors such as blast confinement, atmospheric conditions and the topography between the blast and sensitive receiver. Equation 2 is an empirical equation developed by the United States Bureau of Mines when conducting blasting research, as documented in the RI 8507 report (Siskind).

$$\text{Airblast (dBL)} = 165 - 24\log_{10}(R/W^{1/3})$$

Where
R = distance to point of concern (m)
W = charge mass per delay (kg)

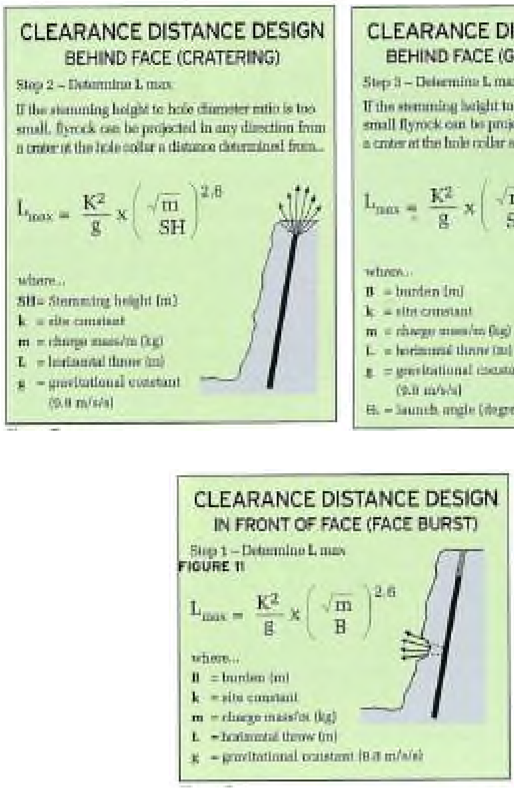
Equation 2 Airblast Estimation Equation

In the author’s experience, this equation delivers a better estimation of actual real world blasting results when compared to the equation documented in AS2187.2-2006 Appendix J section J7.2.

Flyrock Assessment

Australian Standard 2187.2-2006 Appendix E highlights considerations for blast design to minimise the generation of flyrock. AS2187.2-2006 Appendix E (E2.1) - Contributing Factors, outlines the key contributing factors that must be considered when addressing controls to minimise the effects of flyrock and developing a safe and productive Blast Exclusion Zone (BEZ).

Many industry experts have developed site prediction methodologies for determining a safe BEZ to protect quarry personnel, equipment, infrastructure and the general public. The causes of flyrock have been well studied and documented. The three main mechanisms are rifling, cratering and face bursting. The equations show in Figure 1 (Richards & Moore) address the three mechanisms of flyrock generation and will be used to determine the safe blast exclusion distances.



CLEARANCE DISTANCE DESIGN
BEHIND FACE (CRATERING)

Step 2 – Determine L max

If the stemming height to hole diameter ratio is too small, flyrock can be projected in any direction from a crater at the hole collar a distance determined from...

$$L_{max} = \frac{K^2}{g} \times \left(\frac{\sqrt{m}}{SH}\right)^{2.6}$$

where...
SH = Stemming height (m)
k = site constant
m = charge mass/m (kg)
L = horizontal throw (m)
g = gravitational constant (9.8 m/s/s)

CLEARANCE DISTANCE DESIGN
BEHIND FACE (GUN BARRELLING)

Step 3 – Determine L max

If the stemming height to hole diameter ratio is too small flyrock can be projected in any direction from a crater at the hole collar a distance determined from...

$$L_{max} = \frac{K^2}{g} \times \left(\frac{\sqrt{m}}{SH}\right)^{2.6} Sin\,\theta_o$$

where...
B = burden (m)
k = site constant
m = charge mass/m (kg)
L = horizontal throw (m)
g = gravitational constant (9.8 m/s/s)
θ_o = launch angle (degrees)

CLEARANCE DISTANCE DESIGN
IN FRONT OF FACE (FACE BURST)

Step 1 – Determine L max
FIGURE 11

$$L_{max} = \frac{K^2}{g} \times \left(\frac{\sqrt{m}}{B}\right)^{2.6}$$

where...
B = burden (m)
k = site constant
m = charge mass/m (kg)
L = horizontal throw (m)
g = gravitational constant (9.8 m/s/s)

Figure 1 (Richards & Moore) Flyrock Equations

The above equations include a site constant “K”, which requires calibration to site conditions in order to improve the accuracy of the factor of safety calculation, and in some cases, improve productivity by ensuring good energy confinement. This can be achieved by measuring actual blast parameters and recording the maximum fly rock projection distance from each blast on site, thus ensuring specificity to the site’s drill and blast parameters and geology. In this case the absence of any site data dictates that a value of 27 should be used for “K” in order to maximise the factor of safety. Industry standard K values are from 13 in soft rock, to 27 in hard rocks such as granite.

The cratering mechanism can be eliminated by ensuring that the correct stemming length is used in relation to the blast hole diameter. Flyrock caused through a cratering scenario is typically associated with poor blast design. The empirical rule that determines the correct stemming length, as documented in Equation 3, and depicted in **Error! Reference source not found.**

$$SD = D/W^{0.333}$$

Where:

SD = Scaled Depth ($m/\sqrt[3]{kg}$)
W = Charge weight contained in 10 hole diameters (kg)
D = Distance from point of interest (m)

Equation 3: Scaled Depth of Burial equation

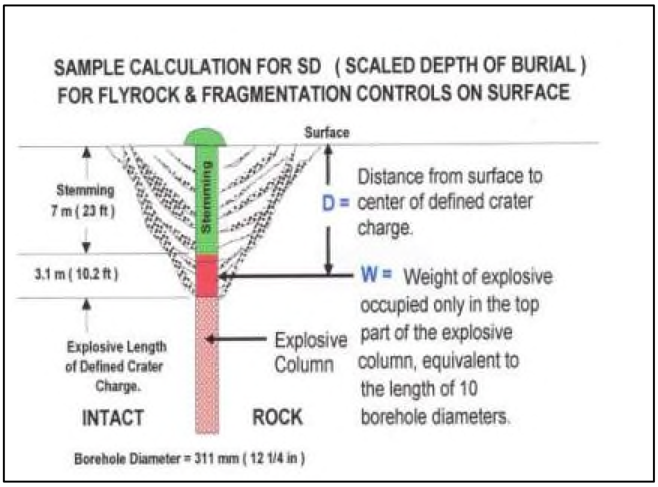


Figure 2 Scale Depth of Burial Dimensions Defined (Chiappetta)

To determine the trajectory of the flyrock, a launch velocity must be calculated using the following equation:

$$V_0 = \sqrt{\frac{L_{\max} g}{Sin 2\theta}}$$

Where:

θ = Flyrock launch angle
L_{max} = maximum flyrock range
V_0 = Launch velocity (ms^{-1})
g = gravitational constant (9.81 ms^{-2})

Equation 4: Launch velocity

The above equations and techniques were used to determine safe blast exclusion zone and maximum theoretical flyrock throw distances.

Proposed Site Blast Parameters

The proposed Coraki Quarry blast parameters are based on typical blast parameters used in other quarries operating in similar rock masses. The blast parameters as listed in Table 1 were evaluated for compliance with airblast overpressure, blast vibration and flyrock requirements, in relation to the extraction boundaries and neighbouring properties. A typical powder factor of 0.7 kgm^{-3} for this type of quarry rock mass was used to determine burden, spacing and subdrill.

Blast Scenario	Hole Dia. (mm)	Bench Height (m)	Burden (m)	Spacing (m)	Stemming (m)	Subdrill (m)	Explosive Density (gcm-3)	MIC* (Kg)
12m_89mm	89	12.0	2.6	3.0	2.3	0.5	1.05	67
6m_89mm	89	6.0	2.3	2.6	2.3	0.5	1.05	28
12m_102mm	102	12.0	3.0	3.4	2.5	0.7	1.05	88
6m_102mm	102	6.0	2.8	3.0	2.5	0.7	1.05	36

*MIC refers to Maximum Instantaneous Charge weight. For the purpose of this evaluation it refers to the total charge weights firing in any 8ms time window from when the first charge fires to when the last charge fires.

Table 1 Site Blast Parameters

The parameters in Table 1, are typical for metropolitan quarrying operations which have nearby residential, commercial or industrial neighbours.

The following explosives systems are assumed:

Bulk explosives:	Emulsion or Watergel, water proof
Bulk explosive density (gcm-3):	1.05
Initiation system:	Non electric
Boosters (g):	150 (89mm) and 400 (102mm)
Down hole delays (ms):	400
Powder factor range (kg/m3):	0.7

Current Site Blast Results

A single set of blast data was supplied from the most recent blast fired at the adjacent council quarry. The blast parameters and results are documented in Table 2. The blast monitoring location was inside the council quarry location, not at a sensitive receiver compliance location. This set of data can be used to evaluate the attenuation of blast vibration and airblast overpressure, although the confidence is low, due to the data be a single data point.

Blast ID	Hole Dia, (mm)	Bench Height (m)	Burden (m)	Subdrill (m)	Stemming (m)	Explosive Density (gcm^{-3})	MIC (kg)	Distance to Monitor (m)	K Value (Constant)	Blast Vibration (mms^{-1})
01	89	16.6	2.9	0.5	2.0	1.2	288	318	743	6.75

Table 2 Actual Blast Results from Adjacent Petersons Quarry (Council Quarry)

For vibration prediction, using Equation 1 with an assumed value for the B constant of 1.6 (an industry average documented in AS2187.2-2006 Appendix J S7.3), the value of the attenuation constant K was back-calculated for the results displayed in Table 2. The resulting value of 734 is below the 50th percentile value of 1140, which is recommended for use in the absence of any other data. This suggests that using a K value of 1140 incorporates some conservatism, an important requirement when conducting an environmental blasting evaluation for a new site.

Proposed Site and Sensitive Receivers

The proposed site is included in Appendix 1, with the proposed extraction areas annotated. Based on the “Initial Extraction Area” there are three sensitive receivers:

- 140 Newmans Road, Coraki (Lot 4 DP6339), residential dwelling, 335 m from the closest extraction limit;

- 200 Lagoon Road, Coraki (Lot 12 DP6339), residential dwelling, 595m from the closest extraction limit;

- 95 Spring Hill Road, Coraki (Lot 12 DP714770), residential dwelling, 820m from the closest extraction limit;

Figure 3 displays the location of the two closest sensitive receivers in relation to the proposed quarry site. As the closest of the three sensitive receiver sites, only the distance to the sensitive receiver at 140 Newman Road, 335 m, will be used for the purpose of evaluating blast vibration and airblast overpressure levels. It is assumed that compliance at this location will result in compliance at all surrounding residential properties.

Figure 3 Coraki Quarry and Sensitive Receiver Locations

Blast Vibration Evaluation

As discussed in the "Current Site Blast Results" section, the blast vibration prediction equation AS2187-2006 Appendix J S7.3 (Equation 1) was applied to the site blast results listed in Table 3 to determine the attenuation constant K value of 743.

As this value is less than the 50th percentile generalised value of 1140, in order to increase the factor of safety based on the limited data available the K value was assumed as 1140 and the B value assumed as the industry average 1.6 for the purposes of determining expected blast vibration in the proposed blasting at the Coraki Quarry.

Blast vibration is calculated assuming a single blast hole firing scenario, which would require the blast to be limited to three rows in depth. If vibration predictions are less than 50% of the 5mms^{-1} value, then the number of blast holes firing in the 8ms time interval can be increased. The results of the vibration prediction equation are shown in Table 3.

Blast Scenario	Distance (m)	Hole Dia, (mm)	No Decks	Bench Height (m)	K	B	MIC (Kg)	PPV (mms-1)	Blast 1 K Value	PPV (mms-1) Using Blast 1 K
12m_89mm	335	89	1	12	1140	1.6	67	3.00	743	1.96
6m_89mm	335	89	1	6	1140	1.6	28	1.49	743	0.97
12m_102mm	335	102	1	12	1140	1.6	88	3.74	743	2.44
6m_102mm	335	102	1	6	1140	1.6	36	1.83	743	1.19

Table 3 Predicted Blast Vibration for Proposed Blast Parameters

Based on these results, the following guidelines are suggested for blasting within the proposed extraction limits to limit blast vibration to less than 5.00 mms^{-1}:

- Commence blasting using a maximum of a 12.0 m bench height;
- Commence blasting using a 102 mm blast hole diameter, with a maximum of 88 kg per delay;
- Commence blasting a minimum of 335 m away from the sensitive receiver, and collect actual measured data to compare against the predicted values. It would be recommended that blasting commences at the greatest distance initially to enable data collection and evaluation of the site blast vibration attenuation characteristics;
- Minimise the number of rows in any pattern - no more than 3 rows if using non electric initiation sequencing. Ensure that no more than a single blast hole MIC, (88 kg) is utilised, for initial blasts;
- Maintain a site vibration equation using actual vibration measured for each blast. This will allow for an accurate estimation of blast vibration prior to firing and blast parameter adjustment to ensure blast vibration compliance.

Using the current blast vibration limit of 5.0 mms^{-1}, blasting can be successfully implemented at the proposed Coraki Quarry initial extraction area using the prescribed blast parameters and initiation systems.

Airblast Overpressure Evaluation

Using Equation 2, the airblast overpressure was calculated for the proposed set of blast parameters, documented in Table 3. This equation does not take into account atmospheric conditions on the day, topography of the landscape between the blast and the sensitive receiver or specialised design techniques used to reduce airblast overpressure. Table 4 displays the results for the airblast overpressure modelling.

Blast Scenario	**Distance (m)**	**Hole Dia, (mm)**	**No Decks**	**Bench Height (m)**	**MIC (Kg)**	**Airblast Overpressure (dBL)**	**Blast 1 Calibration Estimation**
12m_89mm	335	89	1	12	67	119	116
6m_89mm	335	89	1	6	28	116	115
12m_102mm	335	102	1	12	88	120	119
6m_102mm	335	102	1	6	36	117	116

Table 4 Airblast Overpressure Predicted Value

The values displayed in Table 4, in the column labelled “Blast 1 Calibration Estimation”, were calculated using a modified version of Equation 2. The constant has been calibrated using the actual recorded results from Blast 1 at the Petersons Quarry (Council Quarry), the parameters of which are documented in Table 2. The modified equation is shown in Equation 5.

$$Airblast\ (dBL) = 163.8^{\#} - 24\log_{10}(R/W^{1/3})$$

Where
R = distance to point of concern (m)
W = charge mass per delay (kg)
$^{\#}$ = calibrated constant using site data

Equation 5 Calibrated Airblast Estimation Equation

To ensure airblast overpressure control at the proposed Coraki Quarry, a minimum face burden and stemming length must be adhered to. To ensure that the minimum face burdens are not compromised, the blasts should be surveyed and the blast holes bore tracked. Bench heights greater than 6.0 m must be face profiled and bore tracked. Surveying of blasts would also be required to determine accurate distances for developing a site airblast overpressure prediction equation, if required.

Table 5 has suggested minimum face burden dimensions for airblast overpressure control.

Hole Dia. (mm)	Minimum Face Burden (m) ANFO	Minimum Face Burden (m) HANFO (1.1)	Minimum Face Burden (m) Emulsion (1.1)
89	2.4	2.8	2.8
102	2.7	3.2	3.2

Table 5 Suggested Minimum Face Burdens

The suggested minimum face burden parameters are based on the Author’s experience, however it is recommended to consider smaller minimum face burdens specific for site conditions and each blast. The blast bench must be surveyed/laser profiled, modelled and the actual blast holes bore tracked.

Airblast overpressure can also be significantly reduced by decking the face row holes (Martin). The lower the charge weight initiating along the face row, the lower the pressure exerted on the surrounding atmosphere, which reduces the airblast overpressure amplitude. Using non electric initiation, 200ms separation between the top deck and bottom deck has been demonstrated to reduce airblast overpressure by up to 50% or a 3 dBL reduction.

Airblast overpressure is also controlled by using suitable stemming material consisting of screened aggregate, approximately 1/10th of the blast hole diameter in size. The recommended minimum stemming lengths are 2.3m for the 89mm diameter blast holes and 2.5m, for the 102mm diameter blast holes. The suggested stemming lengths should be implemented for the initial blasts at the proposed site and subsequently refined if required.

To reduce the amplitude of the airblast overpressure, blast faces can be orientated in a direction that will reduce the affects. The airblast overpressure behind a well confined blast is much less than the airblast over pressure in front of the blast, measured at the same separation distance.

Using the proposed airblast overpressure limit of 115 dBL, blasting can be successfully implemented at the proposed Coraki Quarry using the prescribed blast parameters and initiation systems and decking the face row. It is suggested that the initial blast incorporates 89mm blast holes on a 12 m bench height scenario to enable evaluation of the actual airblast overpressure generated from blasting at the site.

The blast vibration analysis suggested the use of a 102 mm blast hole diameter on a 12 m bench height. The airblast analysis has determined that a maximum of an 89mm blast hole diameter should be utilised, and therefore the 89 mm blast hole diameter scenario should be used, as the analysis indicates that the quarry blasting activities will be more sensitive to airblast overpressure compliance than blast vibration compliance. A 12m face height, which utilises a decked front row will produce similar airblast overpressure to a 6m bench height.

Flyrock Blast Exclusion Zone

Table 6 lists the blast parameters that have been used to predict the expected blast vibration and airblast overpressure levels in the previous sections of this report, along with the maximum calculated flyrock distances and Scaled Depth of Burial (SDoB). The worst case scenarios were modelled using the equations documented in the “Flyrock Assessment” section of this report. A flyrock constant (K) of 27 was used in all calculations to maximise the factor of safety in the absence of any site data. Where the SDoB is greater than 1.3 the “Maximum Horizontal Distance Crater” value was not used.

Hole Diameter (mm)	**89**	**102**
Bench Height (m)	12	12
Face Burden (m)	2.8	3.2
Burden (m)	2.6	3.0
Spacing (m)	3.0	3.4
Stemming (m)	2.3	2.5
Subdrill (m)	0.5	0.7
Insert Deck Length (m)	0	0
Explosive Density (g/cm3)	1.05	1.05
Charge Weight (kg)	67	88
Max Horizontal Distance Face Burst (m)	76	89
Max Horizontal Distance Cratering (m)	104	119
Max Horizontal Distance Stem Ejection (m)	52	60
SDoB	1.5	1.44

Table 6: Calculated worse case flyrock projection distances

To determine the blast exclusion zone (BEZ), a factor of safety must be applied to the values in Table 6. A minimum factor of safety of 4.0 is recommended for the human clearance distance, which will form the BEZ distance. The BEZ distance is dependent on the blast parameters that are being used. If charge weights, face burdens, explosive types, ground conditions or stemming heights change significantly, the BEZ distance should be adjusted to suit. The factor of safety is only a recommended minimum. It is suggested that a risk assessment be conducted, using experienced blasting and quarrying personnel, prior to assigning a site specific factor of safety.

The author has observed that often when site management do not have a high level of confidence in adherence to blasting plans and procedures, the factor of safety is increased to compensate. An appropriate factor of safety should protect all personnel and property if all procedures and processes are implemented and adhered to.

Due to the large values for the SDoB, the cratering scenario for flyrock can be ignored, except where the stemming zone is broken and preconditioned greater than 500mm in depth. If stemming lengths are reduced, the flyrock model must be re-evaluated to determine the blast exclusion distances.

Figure 4 displays the theoretical blast exclusion zone, if using an 89mm blast hole with the blast parameters documented in Table 6.

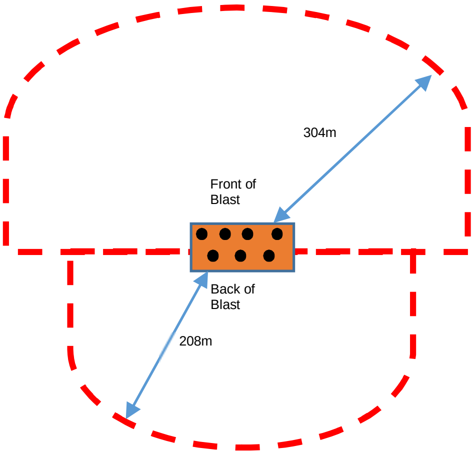


Figure 4 Example of Blast Exclusion Zone for 89mm Dia, On a 12m Bench Height (Free Faced)

Based on the results of the flyrock modelling using the proposed blast parameters, a BEZ with an appropriate factor of safety may be established without affecting neighbouring properties or infrastructure. With actual blast results and measured flyrock distances, the site specific K factor can be established and the BEZ may be able to be reduced.

To reduce the risk of flyrock, developing benches with faces orientated away from infrastructure, neighbouring properties, public infrastructure and open space can significantly reduce the risk associated with flyrock. Quarry Solutions have well establish systems and procedures to calculate, monitor and evaluate blasting plans and procedures to ensure no flyrock events occur.

Blast Volume Sizes and Frequency

The blast volumes for the proposed Coraki quarry will be limited by the maximum capacity of the vehicles transporting the bulk explosives to site. To maximise efficiencies, blasts should be designed to a 15 tonne total explosive load size. Most explosive suppliers can service this load size using a truck and trailer in a single load, or two truck loads of a single bulk explosives vehicle.

The proposed quarry production is 800,000 tonnes per annum, with a maximum of 1,000,000 tonnes. A specific gravity of 2.78 gcm^{-3} was assumed to determine the total volume.

Total Blast Volume (m3) = 1,000,000/2.78 = 359,712 m^3
Total Explosives Required = Volume x Powder factor = 359,712 x 0.7
= 251,799 Kg
Total Number of Blasts = Annual Explosive T/ Explosive load per blast
= 251.80 / 15 = 17 blast per annum

Based on the above calculation and allowances for some smaller blasts due to planning implementation, there would be between 17and 24 blast per annum. This would result in a maximum of two blasts per month.

All blasts must be conducted during daylight hours, between the hours of 9am and 3pm, Monday to Friday.

Recommendations

Based on the evaluation of the proposed blast parameters it is suggested that the following recommendations be implemented to ensure that when quarrying commences in the proposed Coraki Quarry, blasting can be conducted with minimal risk or annoyance to neighbouring properties:

- Establish permanent blast monitoring locations at the two closest neighbouring properties;
- Start developing a blast vibration equation, specific to the Coraki Quarry. A suitably qualified person should be involved in this process, as using incorrect techniques can add additional cost to blast vibration control;
- Commence blasting using a maximum of a 12 m bench height and 89 mm blast holes to ensure compliance with airblast overpressure and blast vibration. After 3 blasts, the results can be reviewed and evaluated as to whether 102 mm blast holes should be implemented. The airblast overpressure and blast vibration compliance must be maintained;
- Establish the recommended Blast Exclusion Zones. If required measure the flyrock projection distances from the first 10 blasts and recalibrate the flyrock equations. This will enable optimisation of the BEZ distance. Due to the use of a conservative value for the constant K in the prediction equations it would be expected that the exclusion distance could be reduced, however this must not be taken for granted;
- All blasts must be face profiled, surveyed and bore tracked to ensure airblast overpressure compliance, combined with the ability to control face burst that can cause flyrock incidents;
- Blast volumes should be maximised to reduce the frequency of disturbances to the neighbouring properties. A target blast volume of 18,750 m^3 and 15 tonnes of bulk explosive load is recommended. Shot sizes should be limited to a maximum of 3 rows deep initially, to minimise vibration reinforcement if utilising a non-electric initiation system. Once actual blast vibration data has been collected and analysed shot sizes may be increased, if the data supports increasing the blast MIC and remaining under 5.00 mms^{-1};
- Orientate blasts with free faces not directly facing the sensitive receivers, to assist with airblast overpressure control;
- Initiation sequencing for initial blasts, should target a MIC of 1 blast hole maximum, until the vibration attenuation can be accurately assessed;
- All proposed parameters are for initial blasting at the site. Once actual blast data is available from blasting at the proposed site, then parameters may be optimised using the analysis techniques outlined in this document. K values will require calibration for flyrock, blast vibration and airblast overpressure.

Based on the assessment of the proposed blast parameters, blasting can be implemented at the proposed Coraki Quarry and comply with the standards outlined in the ANZECC guidelines. There is a very low probability that blast vibration, airblast overpressure or flyrock will affect or impact the neighbouring properties when blasts are designed, implemented and fired using controlled blasting techniques.

Conclusion

This report identified that the proposed blast parameters would enable blasting to occur within 335m of a neighbouring property, with minimal to no disturbance caused to neighbouring properties. According to this study the proposed blasting at the Coraki Quarry does not introduce any significant risk or impacts to the adjacent neighbouring properties. It would be expected that blasting can comply and be conducted safely in the proposed Coraki Quarry site, provided that:

a) The recommendations in this report are followed; and
b) Best practice blasting processes and procedures are implemented and adhered to.

References

Australian and New Zealand Environmental Council, (1990), Technical Basis for Guidelines to Minimise Annoyance Due to Blasting Overpressure and Ground Vibration, www.environment.gov.nsw

Chiappetta F., (2010), Combining Electronic Detonators with Stem Charges and Air Decks, Drill and Blast 2010 Conference, Brisbane Australia

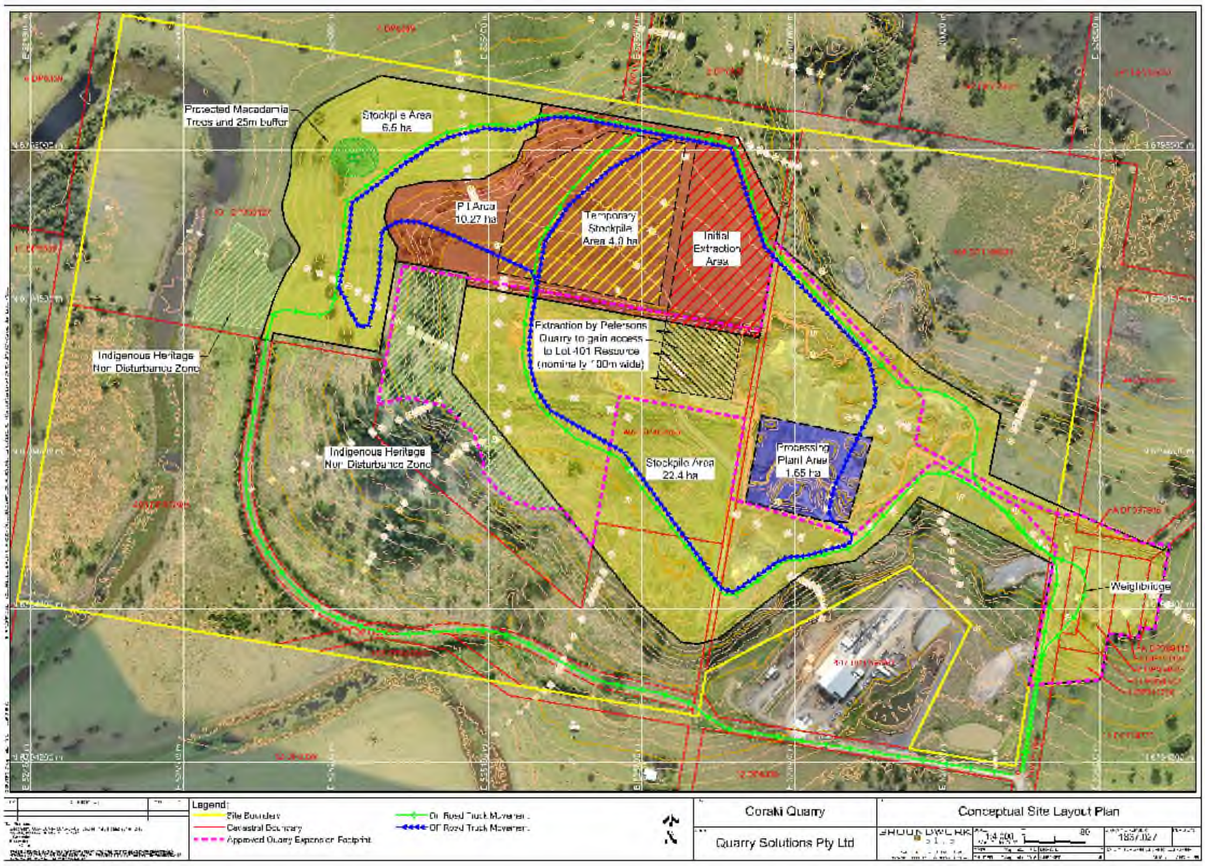
Committee CE-005 (2006), AS 2187.2—2006 Australian Standard™ Explosives—Storage and use Part 2: Use of explosives.

Martin D, (2011), *Quarry Over-Pressure Control - Through Technology and Innovation*, IQA National Conference, Hunter Valley, Australia

Moore A J, and Richards, A B (2002). *Flyrock control – By chance or design*, ISEE Conference, New Orleans.

Siskind.D Stagg.M Kopp J. & Dowding C., (1980), RI 8507 Structure Response and Damage Produced by Ground Vibration from Surface Mine Blasting, United States Department of The Interior, United States of America.

Appendix A Proposed Site Layout - Annotated



Attachment 8

Surface Water Management Assessment

Calibre Consulting (Qld) Pty Ltd
Ground Floor, 545 Queen Street
Brisbane QLD 4000
PO Box 10349 Adelaide Street
Brisbane QLD 4000
T +61 7 3895 3444
ABN 38 109 428 506

Our Ref: 15-001850.02L.AB.ab.docx
Contact: Mr. Andrew McPhail

14 September 2015

Quarry Solutions Pty Ltd
C/- Groundworks Plus
PO Box 1779
Milton QLD 4064

Attention: Jim Lawler

Dear Jim,

Proposed Coraki Quarry
Surface Water Management Assessment

1 GENERAL

The proposed development seeks to establish the Coraki Quarry (within Lot 401 on DP633427, Lots 402 and 403 on DP802985 and Lot 408 on DP1166287). The Site is ideally situated for a quarry, being centrally located within the Site, well separated from sensitive receivers and incorporating the existing Peterson's Quarry.

The development constitutes State Significant Development (SSD). Accordingly, the assessment of the Existing Environmental Values will inform the preparation of an Environmental Impact Statement (EIS) to seek approval for the proposed development.

Surface water investigations and reporting will address the NSW Planning and Environment requirements as per the updated Secretary's Environment Assessment Requirements (SSD 7036 – dated 30 July 2015).

1.1 Site Description

The site is primarily located at the crest of a hill. Flow from the site discharges into Seelems Creek. The contributing catchment area of Seelems Creek to the site is in excess of 800 ha and predominantly comprises agricultural land. Seelems Creek discharges into the Richmond River approximately 6km downstream from the site.

Groundwork Plus have advised that that no groundwater was detected to depths below the depth of the quarry resource. No groundwater inflows have been included in the site water balance assessment.

The site consists of mainly open grassland with minor patchy scrub towards to lower elevations on the site.

1.2 Target Environmental Values

The New South Wales Water Quality and River Flow Objectives (OEH 2015) provides the following physio-chemical indicators and numerical criteria (trigger values) for uncontrolled streams within the Richmond River Catchment:

Table 1: Physio-chemical indicators and numerical criteria

Total Nitrogen (N) (mg/L)	Total P (mg/L)	DO (%sat)		Turbidity (NTU)	pH		Conductivity (ms/cm)
		Lower	Upper		Lower	Upper	
350	25	85	110	6-50	6.5	8.5	125-2200

1.3 Expected Schedule of Works

The following works are expected to be undertaken within Lot 401:

- Access and haul roads
- Erosion control works (temporary and permanent)
- Clean and dirty water diversion banks
- Site clearance
- Topsoil stockpiling
- Quarry extraction and operational stockpiling
- Maintenance program
- Rehabilitation

The following works are expected to be undertaken on the remaining land including the Peterson’s Quarry:

- Dirty water diversion banks
- Quarry extraction and operational stockpiling
- Maintenance program

The development is planned to be undertaken in 2 phases:

- Initial extraction phase
- Final extraction phase

The 2 phases have the same overall site footprint with the only difference being the internal site layout (stockpiles and quarry floor) and haul road arrangement.

2 EIS RESPONSES

2.1 Assessment of potential impacts on the quality and quantity of the existing surface and groundwater resources

2.1.1 Groundwater Impacts

As outlined in Section 1.1, no interaction with any groundwater resource is expected as part of the development.

2.1.2 Surface Water Quality Impacts

A surface water management strategy is outlined in Section 2.2. The on-site surface water management strategy involves a system of dirty water collection drains that convey surface water runoff to respective sedimentation basins. A total of 3 sedimentation basins are proposed for the development (as per the conceptual surface water management sketch in **Attachment A**). The sedimentation basins have been sized in accordance with *Managing Urban Stormwater Soils and Construction: Volume 1 (Blue Book) and Volume 2E (Mines & Quarries)*. The sedimentation basins have been sized to capture the 90 percentile 5 day rainfall event for their respective catchments.

The sedimentation basins will provide stormwater quality polishing and treatment for the frequent rainfall events for on-site stormwater runoff.

The sedimentation basins are expected to discharge during intense or extended rainfall events (further discussed in Section 2.3). It is anticipated that any overflows from the sedimentation basins will coincide with flows within the Seelems Creek catchment.

Some testing of on-site water was undertaken by Groundworks Plus. The testing was sampled from the existing on-site pond and another area of standing water in the pit.

The results of the testing are provided below.

Table 2: Physio-chemical indicators from on-site sampling

Location	DO (%sat)	Turbidity (NTU)	pH	Conductivity (ms/cm)
Pit	6.3	75	8.8	490
Pond	6.4	100	7.6	930

The water quality testing undertaken on site indicates that some indicators are in excess of the trigger values in Table 1.

Our management strategy includes minimal uncontrolled discharges plus controlled discharges with TSS less than 50mg/L after rainfall events.

2.1.3 Surface Water Quantity Impacts

The sedimentation basins will not need to comply with the harvestable rights dam maximum on the basis that they will be required for treatment of sediment laden water and the EPA under the Environmental Protection License will include a condition which will require treatment of sediment laden water prior to release.

From the water balance analysis in Section 2.3, the average yearly overflow and controlled discharges from Sedimentation Basin 2 into the receiving environment during the final extraction stage is approximately 141,590 m^3/year. From the contributing catchment to Sedimentation Basin 2 in the existing scenario (a volumetric runoff coefficient of 0.48), the average runoff from the catchment is approximately 180,195 m^3/year. With losses (evaporation and on-site reuse), there will be a reduction in stormwater runoff from the site.

The site is located adjacent to Seelems Creek. Seelems creek discharges into the Richmond River approximately 6km downstream of the site, south of the township of Coraki. Refer to **Attachment F** for the waterways adjacent to the site.

The quarry and associated infrastructure will be above the 100 year ARI flood level (10m AHD). Sedimentation Basin 1.1 extends approximately 20m into the Seelems Creek floodplain fringe of an extensive floodplain (approximately 1,600 m wide) on the western site boundary. It is anticipated that this may have impacts on flood levels in the immediate vicinity of the basin only. The basin will be designed so that the impact on the floodplain is minimised.

As there is no external infrastructure adjacent to, or upstream of Sedimentation Basin 1.1, any minor impact that the basin may have on flood levels is not likely to affect any properties.

Refer to **Attachment G** for Council's regional flood mapping.

With the proposed surface water management strategy, there will be no significant impact on water quality and quantity as a result of the development.

2.2 Soil & Water Management Plan

During the construction and operational phase of the quarry development, a large amount of soil has the potential to be eroded and deposited onto nearby lands or downstream receiving environments. To minimise that potential impacts of land disturbances from the development, a Soil and Water Management Plan has been prepared based on *Managing Urban Stormwater Soils and Construction: Volume 1 (Blue Book) and Volume 2E (Mines & Quarries).*

2.2.2 Sizing of Sedimentation Basins

All on-site sedimentation basins have been sized in accordance with the guidelines set out in *Managing Urban Stormwater Soils and Construction: Volume 1 (Blue Book) and Volume 2E (Mines & Quarries).*

In the absence of site specific soil data, information on the likely soil type has been sourced from the Lismore-Ballina Soil Landscape section of the Blue Book (Appendix C – Table C2) for Coraki (Ck). Conservatively, we have adopted soil type for the mine as 'Type F' (bulk of soil is fine grained with 33% finer than 0.02mm).

The total volume of a 'Type F' sediment basin is the sum of the following two components:

- A settling zone, within which water is stored allowing the settlement of suspended sediment, and
- A sediment storage zone, where deposited sediment is stored until the basin is cleaned out.

The settling zone volume is determined from the 90th percentile, 5 day rainfall event as per Table 6.1 in the Mines and Quarries book. This is the minimum design requirement for a 'Type F' sedimentation basin for quarries with a disturbance duration greater 3 years.

As outlined in the water balance modelling in Section 2.3, the sedimentation basins designed for the 90th percentile, 5 day rainfall event overflow with a higher frequency than that outline in Table 6.2 in Volume 2E of the Mines and Quarries manual. An additional 2 water balance modelling scenarios (Scenarios 3 and 4) were investigated where the design rainfall event was increased to the 95th percentile, 5 day event.

The design rainfall depth has been taken from the closest site rainfall depth chart in the Blue Book (Table 6.3a). The Lismore (058037) 90th percentile, 5 day rainfall depth is 60.2 mm and the 95th percentile, 5 day rainfall depth is 95.3 mm.

The volumetric runoff coefficient (C_v) adopted for the site was 0.74. This value is higher than that recommended in Table F3 (Appendix F of the Blue Book) for the expected soil type at Coraki for disturbed sites (upper limit Cv for Coraki of 0.48). The adopted C_v is reflective of the disturbance activity (quarrying) and the type of quarry material which will result in a high runoff potential from the site.

Contributing catchment areas to each sedimentation basin are provided in **Attachment A** for both the initial and final extraction stages.

The sediment storage zone is taken as either the:

- 50% of the settling zone capacity, or
- Two months soil loss as calculated with the Revised Universal Soil Loss Equation (RUSLE).

It was found that 50% of the settling zone capacity yields a larger storage volume for each sedimentation basin and was therefore adopted for calculating the total sediment storage volume.

Clear water diversion bunds are to be located near the western site boundary to divert clean water around the site. This clean water diversion helps to minimise the required onsite sediment basin size.

Refer to **Attachment B** for sediment basin volume calculations for individual catchments.

These results are summarised in Table 3 and Table 4.

Table 3: Sedimentation Basin Sizing – 90th percentile, 5 day storm

Catchment Name	Stage	Area (ha)	Required Settling Zone Volume (m^3)	Required Sediment Storage Zone			Required Sedimentation Basin Volume (m^3)
				50% of Settling Zone volume (m^3)	RUSLE Two Month Calculated Soil Loss (m^3)	Adopted Sediment Storage Zone (m^3)	
A1	Initial	8.7	3,855	1,927	480	1,927	5,782
A2	Initial	27.4	12,229	6,114	1,524	6,114	18,343
A3	Initial	3.7	1,640	820	179	820	2,460
B1	Final	6.6	2,905	1,453	364	1,453	4,358
B2	Final	29.6	13,178	6,589	1,642	6,589	19,767
B3	Final	3.7	1,640	820	179	820	2,460

Table 4: Sedimentation Basin Sizing – 95th percentile, 5 day storm

Catchment Name	Stage	Area (ha)	Required Settling Zone Volume (m³)	Required Sediment Storage Zone			Required Sedimentation Basin Volume (m³)
				50% of Settling Zone volume (m³)	RUSLE Two Month Calculated Soil Loss (m³)	Adopted Sediment Storage Zone (m³)	
A1	Initial	8.7	6,102	3,051	480	1,927	9,153
A2	Initial	27.4	19,359	9,679	1,524	6,114	29,038
A3	Initial	3.7	2,596	1,298	179	820	3,894
B1	Final	6.6	4,599	2,299	364	1,453	6,898
B2	Final	29.6	20,862	10,431	1,642	6,589	31,293
B3	Final	3.7	2,596	1,298	179	820	3,894

The change in contributing catchment areas between the initial and final stages result in minor changes in the overall required sedimentation basin volumes. The overall largest required volume for each sedimentation basin between the initial and final extraction stages was adopted as the design basin volume. The practicalities of minor basin reconfigurations through operations was considered more difficult and costly when compared to constructing the largest required basin for each catchment (to cater for initial and final stages) at project initiation.

The adopted sedimentation basin volumes adopted in Table 5 and Table 6 have been calculated based on supporting information in **Attachment C**. These adopted volumes were based off minimum length to width ratios, batter slopes and basin depths.

Table 5: Adopted Sedimentation Basin Volumes 90th percentile, 5 day storm

Basin Name	Required Sedimentation Basin Volume (m³)	Adopted Sedimentation Basin Volume (m³)
Sedimentation Basins 1.1 and 1.2	5,782	5,840
Sedimentation Basin 2	19,767	20,169
Sedimentation Basin 3	2,460	2,592

Table 6: Adopted Sedimentation Basin Volumes 95th percentile, 5 day storm

Basin Name	Required Sedimentation Basin Volume (m³)	Adopted Sedimentation Basin Volume (m³)
Sedimentation Basins 1.1 and 1.2	9,153	9,526
Sedimentation Basin 2	31,293	32,688
Sedimentation Basin 3	3,894	4,308

The required sedimentation basin volume for catchment A1/B1 in Table 3 and Table 4 have been split into 2 basins due to horizontal site constraints. Internal site drainage within these catchments to Sedimentation Basin 1.1 and 1.2 will be confirmed during detailed design.

The adopted volumes will be refined during final detailed design.

The above tables demonstrate that the proposed sedimentation basins have been sized to accommodate the minimum required 90th percentile, 5 day rainfall event volume. The final sedimentation basin volumes are subject to detailed design of the development.

2.2.3 Construction Notes

The following notes should be referenced during the construction and operational phases of the project:

- Construct access roads with erosion control measures in place.

- Install pipe culverts and internal drainage works
- Clear vegetation
- Install the required diversion banks
- Construct sedimentation basins
- Strip topsoil and overburden, stockpile and sow within 14 days with appropriate seed/fertiliser mixture.
- Regularly inspect all sediment control structures for damage, and remove sediment to the overburden stockpiles.
- Carry out ongoing maintenance including resowing/fertilising of areas as required.
- At the completion of the extraction stage, progressively reshape, re-topsoil then revegetate all disturbed areas on Lot 401.

2.2.4 Standard Drawings

The following standard drawings from the Blue Book are applicable to the recommended erosion and sediment controls:

- Stockpiles – SD4-1
- Earth bank (high flows) – SD5-6
- Earth Basin (wet) – SD6-4
- Rock Check Dams – SD5-4
- Culvert outlet protection – SD5-8

These drawings have been included in **Attachment D**.

2.2.5 Hazardous Materials

Any hazardous materials that are kept on site should be stored in an appropriate containment facility and bunded to ensure that in case of a spill, the materials are not released into the downstream receiving environment.

Appropriate spill kits and training should be provided for any hazardous materials kept on site.

2.3 Detailed Site Water Balance

A detailed site water balance was undertaken to assess the overall site surface water management system and to quantify the volume and frequency of discharges from the site

Daily rainfall data was extracted from the Bureau of Meteorology’s website for Coraki (Union Street rain gauge – 058015). The station has daily rainfall readings from 1895 to 2015. The mean rainfall for Coraki is 1263 mm/year.

Evaporation data was extracted from the nearest pan evaporation gauge at the Alstonville Fruit Research Station (058131), approximately 20km away from the site.

Four scenarios were investigated for the site water balance:

- **Scenario 1** - Sedimentation basins sized to capture the 90th percentile, 5 day rainfall event (the minimum required rainfall depth specified in Section 2.2.2)
- **Scenario 2** - Sedimentation basins sized to capture the 90th percentile, 5 day rainfall event (the minimum required rainfall depth specified in Section 2.2.2) and increasing site water reuse to reduce outflow event frequency and volumes
- **Scenario 3** - Sedimentation basins sized to capture the 95th percentile, 5 day rainfall event (above the required rainfall depth specified in Section 2.2.2)
- **Scenario 4** - Sedimentation basins sized to capture the 95th percentile, 5 day rainfall event (above the required rainfall depth specified in Section 2.2.2) and increasing site water reuse to reduce outflow event frequency and volumes

Each scenario has a dust suppression rate of 2 l/m^2/hour was supplied by Groundwork Plus via email (dated 26 August 2015). This dust suppression rate was applied to all roads within the site. The quarry is expected to operate 6 days a week for 13 hours per day. Total road length has been delineated for both the initial and final extraction stage.

For scenario 2 and 4, an additional external irrigation area was identified. This potential irrigation area is identified in **Attachment A**. An irrigation rate of 4 l/m^2/hour was estimated. It is proposed to operate the external irrigation system for the same duration as the operation of the quarry. The area identified is approximately 18.25 ha. Irrigation water is supplied from Sedimentation Basins 1, 2 and 3.

The water balance includes dosing and discharge of treated water. It is assumed that immediately after a rain event in each scenario, the basins will be dosed (with an appropriate dosing agent). After 4 days of residence time, the basin is lowered (either by gravity or pump) to allow the 90th percentile, 5 day storm volume to remain free in each basin. If a rain event occurs within the 4 day period after dosing, the water will not be released until further dosing is completed following the subsequent rainfall event. Remaining water in the sediment storage zone may be used for on-site dust suppression.

As per Table 6.2 in Volume 2E of the Mines and Quarries manual, the indicative average annual sediment basin overflow frequency is 2 to 4 spills per year.

Refer to **Attachment E** for detailed calculations from the site water balance modelling.

It has been assumed that Sedimentation Basins 1.1 and 1.2 behave as a single storage volume for this analysis. A balance pipe or overflow system may be required between Sedimentation Basin 1.1 and 1.2 pending the outcome of the internal drainage layout (to be confirmed during detailed design).

2.3.2 Scenario 1 Site Water Balance

Table 7: Water Balance Results for Scenario 1

Basin Name	Stage	Adopted Sedimentation Basin Volume (m³)	Average Number of Outflow Events Per Year	Average Outflow Volume Per Year (m³/year)
Sedimentation Basin 1.1 and 1.2	Initial	5,840	8	26,182
Sedimentation Basin 1.1 and 1.2	Final	5,840	7	16,043
Sedimentation Basin 2	Initial	20,169	7	76,611
Sedimentation Basin 2	Final	20,169	8	84,842
Sedimentation Basin 3	Initial	2,592	9	11,298
Sedimentation Basin 3	Final	2,592	9	11,298

As shown in Table 7, the detailed site water balance modelling shows that the sedimentation basins overflow regularly throughout an average year.

The average number of overflow events is 8 times per year. This exceeds the spill frequency identified within the *Managing Urban Stormwater Soils and Construction: Volume 2E (Mines & Quarries).*

Overflows from the sedimentation basins are, on average, preceded by a 5 day rainfall total of 92.4mm.

This scenario is not recommended.

2.3.3 Scenario 2 Site Water Balance

Table 8: Water Balance Results for Scenario 2

Basin Name	Stage	Adopted Sedimentation Basin Volume (m^3)	Average Number of Outflow Events Per Year	Average Outflow Volume Per Year (m^3/year)
Sedimentation Basin 1.1 and 1.2	Initial	5,840	4	15,754
Sedimentation Basin 1.1 and 1.2	Final	5,840	3	7,912
Sedimentation Basin 2	Initial	20,169	5	57,994
Sedimentation Basin 2	Final	20,169	5	67,020
Sedimentation Basin 3	Initial	2,592	3	5,772
Sedimentation Basin 3	Final	2,592	3	5,772

As shown in Table 8, the detailed site water balance modelling shows that the sedimentation basins overflow occasionally throughout an average year.

The average number of overflow events is 4 times per year. While the average number of spill events per year meets the frequency identified within the *Managing Urban Stormwater Soils and Construction: Volume 2E (Mines & Quarries)*, Sedimentation Basin 2 exceeds this recommended frequency.

Overflows from the sedimentation basins are, on average, preceded by a 5 day rainfall total of 128.2mm.

2.3.4 Scenario 3 Site Water Balance

Table 9: Water Balance Results for Scenario 3

Basin Name	Stage	Adopted Sedimentation Basin Volume (m^3)	Average Number of Outflow Events Per Year	Average Outflow Volume Per Year (m^3/year)
Sedimentation Basin 1.1 and 1.2	Initial	9,526	5	17,221
Sedimentation Basin 1.1 and 1.2	Final	9,526	4	9,610
Sedimentation Basin 2	Initial	32,688	5	49,340
Sedimentation Basin 2	Final	32,688	5	55,051
Sedimentation Basin 3	Initial	4,308	6	7,543
Sedimentation Basin 3	Final	4,308	6	7,543

As shown in Table 9, the detailed site water balance modelling shows that the sedimentation basins overflow occasionally throughout an average year.

The average number of overflow events is 5 times per year. This exceeds the spill frequency identified within the *Managing Urban Stormwater Soils and Construction: Volume 2E (Mines & Quarries).*

Overflows from the sedimentation basins are, on average, preceded by a 5 day rainfall total of 104.2 mm.

This scenario is not recommended.

2.3.5 Scenario 4 Site Water Balance

Table 10: Water Balance Results for Scenario 4

Basin Name	Stage	Adopted Sedimentation Basin Volume (m³)	Average Number of Outflow Events Per Year	Average Outflow Volume Per Year (m³/year)
Sedimentation Basin 1.1 and 1.2	Initial	9,526	2	8,089
Sedimentation Basin 1.1 and 1.2	Final	9,526	1	3,125
Sedimentation Basin 2	Initial	32,688	3	32,370
Sedimentation Basin 2	Final	32,688	3	38,918
Sedimentation Basin 3	Initial	4,308	2	2,626
Sedimentation Basin 3	Final	4,308	2	2,626

As shown in Table 10, the detailed site water balance modelling shows that the sedimentation basins overflow occasionally throughout an average year.

The average number of overflow events is 2 times per year. This is equivalent to the spill frequency identified within the *Managing Urban Stormwater Soils and Construction: Volume 2E (Mines & Quarries).*

Overflows from the sedimentation basins are, on average, preceded by a 5 day rainfall total of 153.9mm.

This is the recommended water management scenario for the development.

2.4 Surface Water Management System

The conceptual surface water management plan is provided in **Attachment A**. The management strategy includes, but is not limited to:

- Clean water diversion drains
- Dirty water diversion drains
- Sedimentation basins
- Stockpiling and rehabilitation of topsoil and overburden
- On-site reuse of surface water runoff
- Fuel and chemical storage to be contained within bunded facilities
- Dosing and pump out of sediment basins after significant rainfall events

The standard drawings from the Blue Book that are applicable to the project are discussed in Section 2.2.4. The standard drawings have been included in **Attachment D**.

The sedimentation basins have been sized to capture the 95% percentile, 5 day rainfall event.

As discussed in Section 2.1.1, no groundwater interaction is expected as part of the development.

3 CONCLUSION

The outcomes of the stormwater quality management and impacts assessment are summarised below:

- Erosion and sediment control measures will be put in place for management of water quality during construction and operation activities.
- Three sedimentation basins are proposed to treat surface water runoff and for reuse on site.
- Sediment basin calculations demonstrate that there is sufficient volume within each basin to provide the minimum required equivalent 90th percentile, 5 day rainfall event volume, but we have provided the 95th percentile, 5 day rainfall event volume for each sedimentation basin.
- There is no groundwater interaction anticipated.

- With the proposed surface water management strategy, there will be no significant impact on water quality and quantity as a result of the development.
- Detailed water balance modelling demonstrates that with the proposed surface water management system, overflows from the site are within the recommended values in Managing Urban Stormwater Soils and Construction: Volume 2E (Mines & Quarries).

4 RECOMMENDATIONS

Based on the aforementioned outcomes, the following recommendations are made:

- Incorporate the proposed erosion and sediment control strategies for the development.
- Sedimentation basins to be sized based on the 95th percentile, 5 day rainfall event with reuse from dust suppression and an external irrigation scheme (Scenario 4)
- Confirm the sediment basin sizes and locations during the detailed design phase.
- Ongoing water quality testing of water within the Sedimentation basins before and after dosing and discharge.

Detailed design may result in changes to the proposed concept strategies presented in this report, however the design objectives are to be maintained.

For any queries concerning these matters, please contact Mr Adam Broit or the undersigned on (07) 3895 3444.

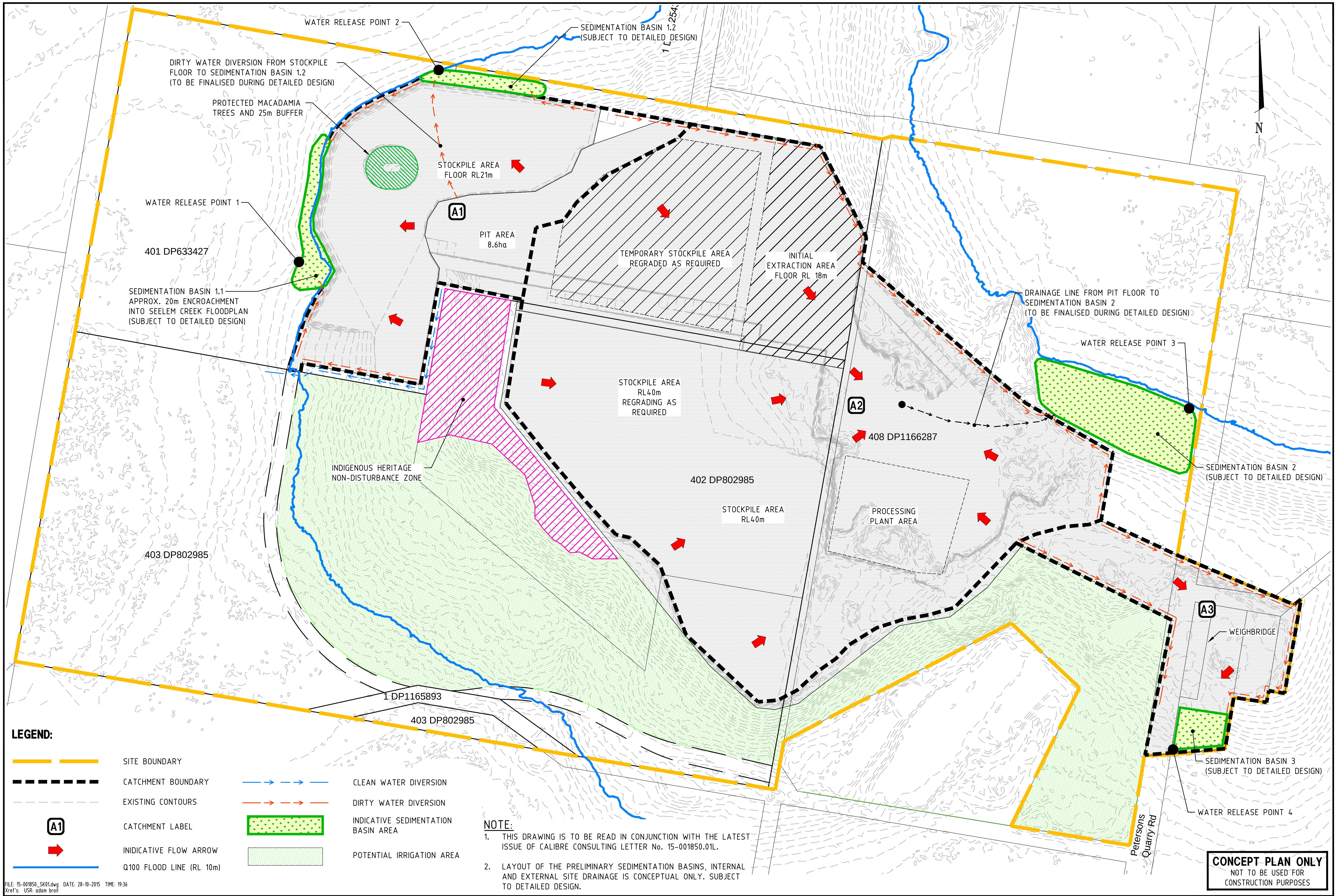
Yours sincerely
Calibre Consulting

Andrew McPhail
Principal Engineer – Water & Environment

ATTACHMENTS
A – Surface Water Management Plan
B – Sedimentation Basin Calculations
C – Sedimentation Basin Volume Calculations
D – Erosion and Sediment Control Drawings
E – Detailed Water Balance Calculations
F – Watercourses
G – Richmond Valley Council Flood Mapping

ATTACHMENT A - SURFACE WATER MANAGEMENT PLAN

Figure 15-001850.SK01	Initial extraction stage catchment plan
Figure 15-001850.SK02	Final extraction stage catchment plan



LEGEND:

▬ ▬	SITE BOUNDARY		
▬ ▬ ▬	CATCHMENT BOUNDARY	→ →	CLEAN WATER DIVERSION
— — —	EXISTING CONTOURS	→ →	DIRTY WATER DIVERSION
A1	CATCHMENT LABEL	🟩	INDICATIVE SEDIMENTATION BASIN AREA
➡	INIDICATIVE FLOW ARROW	▨	POTENTIAL IRRIGATION AREA
—	Q100 FLOOD LINE (RL 10m)		

NOTE:

1. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH THE LATEST ISSUE OF CALIBRE CONSULTING LETTER No. 15-001850.01L.
2. LAYOUT OF THE PRELIMINARY SEDIMENTATION BASINS, INTERNAL AND EXTERNAL SITE DRAINAGE IS CONCEPTUAL ONLY. SUBJECT TO DETAILED DESIGN.

CONCEPT PLAN ONLY
NOT TO BE USED FOR
CONSTRUCTION PURPOSES

FILE: 15-001850_SK01.dwg DATE: 28-10-2015 TIME: 19:36
Xref's: USR: adam broit

	CALCS	DRAWN	DATE	AMENDMENT DETAILS
FIRST ISSUE	AB	SL	11.09.15	
A				
B				
C				
D				
E				
F				

Xref H:\15\001850\Acad\X 15-001850-TITLE.dwg

DESIGN CHECK

DRAWN CHECK

SCALE (METRES)
1:2000 20 0 20 40 60 80 100 A1
1:4000 A3

MICROFILM No.

PROJECT No.
15-001850

APPROVED
ANDREW McPHAIL RPEQ 6921
FOR & ON BEHALF OF CALIBRE CONSULTING (QLD) PTY LTD

CLIENT
QUARRY SOLUTIONS PTY LTD

PROJECT
CORAKI QUARRY

calibre
CONSULTING

CONSULT AUSTRALIA

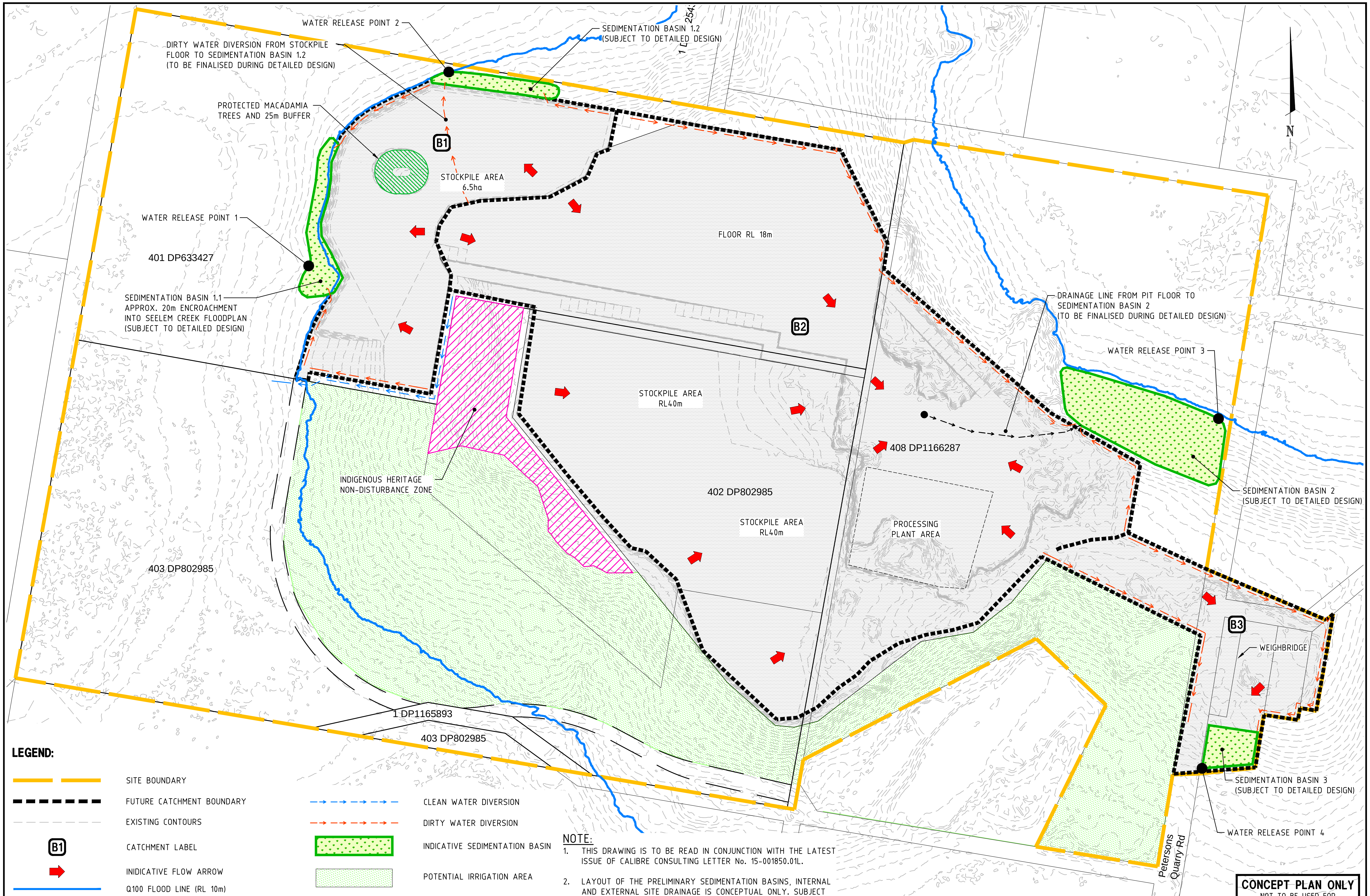
Calibre Consulting (QLD) Pty Ltd
Level 6, 199 Grey Street, South Brisbane QLD Australia 4101
Telephone 07 3895 3444 Facsimile 07 3895 3400
Brisbane Canberra Melbourne Sydney Singapore Sunshine Coast

Quality System
Quality Endorsed Company ISO 9001 Lic 4084

DRAWING TITLE
INITIAL EXTRACTION STAGE CATCHMENT PLAN

DRAWING NUMBER
15-001850.SK01

ISSUE



LEGEND:

▬ ▬	SITE BOUNDARY
■■■■	FUTURE CATCHMENT BOUNDARY
— —	EXISTING CONTOURS
B1	CATCHMENT LABEL
➡	INIDICATIVE FLOW ARROW
▬	Q100 FLOOD LINE (RL 10m)
→ → →	CLEAN WATER DIVERSION
→ → →	DIRTY WATER DIVERSION
🟩	INDICATIVE SEDIMENTATION BASIN
▨	POTENTIAL IRRIGATION AREA

NOTE:

1. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH THE LATEST ISSUE OF CALIBRE CONSULTING LETTER No. 15-001850.01L.
2. LAYOUT OF THE PRELIMINARY SEDIMENTATION BASINS, INTERNAL AND EXTERNAL SITE DRAINAGE IS CONCEPTUAL ONLY. SUBJECT TO DETAILED DESIGN.

CONCEPT PLAN ONLY
NOT TO BE USED FOR
CONSTRUCTION PURPOSES

FILE: 15-001850_SK02.dwg DATE: 14-09-2015 TIME: 10:45
Xref's: USR: adam broif

	CALCS	DRAWN	DATE	AMENDMENT DETAILS
FIRST ISSUE	AB	SL	11.09.15	
AMENDMENTS A				
B				
C				
D				
E				
F				

Xref H:\15\001850\Acad\X 15-001850-TITLE.dwg

DESIGN CHECK

DRAWN CHECK

SCALE (METRES)
1:2000 20 0 20 40 60 80 100 A1
1:4000 A3

MICROFILM No.

PROJECT No.
15-001850

APPROVED
ANDREW McPHAIL RPEQ 6921
FOR & ON BEHALF OF CALIBRE CONSULTING (QLD) PTY LTD

CLIENT
QUARRY SOLUTIONS PTY LTD

PROJECT
CORAKI QUARRY

calibre CONSULTING

CONSULT AUSTRALIA

Calibre Consulting (QLD) Pty Ltd
Level 6, 199 Grey Street, South Brisbane QLD Australia 4101
Telephone 07 3895 3444 Facsimile 07 3895 3400
Brisbane Canberra Melbourne Sydney Singapore Sunshine Coast

Quality System
Quality Endorsed Company ISO 9001 Lic 4084

DRAWING TITLE
INITIAL EXTRACTION STAGE CATCHMENT PLAN

DRAWING NUMBER
15-001850.SK02

ISSUE

ATTACHMENT B - SEDIMENTATION BASIN CALCULATIONS

- *Managing Urban Stormwater Soils and Construction: Volume 1 (Blue Book) and Volume 2E (Mines & Quarries)* Sedimentation Basin calculations
- Sedimentation Basin calculation spreadsheet

All on-site sedimentation basins have been sized in accordance with the guidelines set out in *Managing Urban Stormwater Soils and Construction: Volume 1 (Blue Book) and Volume 2E (Mines & Quarries).*

In the absence of site specific soil data, information on the likely soil type has been sourced from the Lismore-Ballina Soil Landscape section of the Blue Book (Appendix C – Table C2) for Coraki (Ck). Conservatively, we have adopted soil type for the mine as 'Type F' (bulk of soil is fine grained with 33% finer than 0.02mm).

The total volume of a 'Type F' sediment basin is the sum of the following two components:

- A settling zone, within which water is stored allowing the settlement of suspended sediment, and
- A sediment storage zone, where deposited sediment is stored until the basin is cleaned out.

The settling zone volume is determined from the 90th percentile, 5 day rainfall event as per Table 6.1 in the Mines and Quarries book. This is the minimum design requirement for a 'Type F' sedimentation basin for quarries with a disturbance duration greater 3 years.

From the water balance modelling, the sedimentation basins designed for the 90th percentile, 5 day rainfall event overflow with a higher frequency than that outline in Table 6.2 in Volume 2E of the Mines and Quarries manual. An additional 2 water balance modelling scenarios (Scenarios 3 and 4) were investigated where the design rainfall event was increased to the 95th percentile, 5 day event.

The design rainfall depth has been taken from the closest site rainfall depth chart in the Blue Book (Table 6.3a). The Lismore (058037) 90th percentile, 5 day rainfall depth is 60.2 mm and the 95th percentile, 5 day rainfall depth is 95.3 mm.

The volumetric runoff coefficient (C_v) adopted for the site was 0.74. This value is higher than that recommended in Table F3 (Appendix F of the Blue Book) for the expected soil type at Coraki for disturbed sites (upper limit Cv for Coraki of 0.48). The adopted C_v is reflective of the disturbance activity (quarrying) and the type of quarry material which will result in a high runoff potential from the site.

The sediment storage zone is taken as either the:

- 50% of the settling zone capacity, or
- Two months soil loss as calculated with the Revised Universal Soil Loss Equation (RUSLE).

It was found that 50% of the settling zone capacity yields a larger storage volume for each sedimentation basin and was therefore adopted for calculating the total sediment storage volume.

Clear water diversion bunds are to be located near the western site boundary to divert clean water around the site. This clean water diversion helps to minimise the required onsite sediment basin size.

The calculations are summarised in Table B1 and Table B2.

Table B1: Sedimentation Basin Sizing – 90th percentile, 5 day storm

Catchment Name	**Stage**	**Area (ha)**	**Required Settling Zone Volume (m³)**	**Required Sediment Storage Zone**			**Required Sedimentation Basin Volume (m³)**
				50% of Settling Zone volume (m³)	RUSLE Two Month Calculated Soil Loss (m³)	Adopted Sediment Storage Zone (m³)	
A1	Initial	8.7	3,855	1,927	480	1,927	5,782
A2	Initial	27.4	12,229	6,114	1,524	6,114	18,343
A3	Initial	3.7	1,640	820	179	820	2,460
B1	Final	6.6	2,905	1,453	364	1,453	4,358
B2	Final	29.6	13,178	6,589	1,642	6,589	19,767
B3	Final	3.7	1,640	820	179	820	2,460

Table B2: Sedimentation Basin Sizing – 95th percentile, 5 day storm

Catchment Name	**Stage**	**Area (ha)**	**Required Settling Zone Volume (m³)**	**Required Sediment Storage Zone**			**Required Sedimentation Basin Volume (m³)**
				50% of Settling Zone volume (m³)	RUSLE Two Month Calculated Soil Loss (m³)	Adopted Sediment Storage Zone (m³)	
A1	Initial	8.7	6,102	3,051	480	1,927	9,153
A2	Initial	27.4	19,359	9,679	1,524	6,114	29,038
A3	Initial	3.7	2,596	1,298	179	820	3,894
B1	Final	6.6	4,599	2,299	364	1,453	6,898
B2	Final	29.6	20,862	10,431	1,642	6,589	31,293
B3	Final	3.7	2,596	1,298	179	820	3,894

The change in contributing catchment areas between the initial and final stages result in minor changes in the overall required sedimentation basin volumes. The overall largest required volume for each sedimentation basin between the initial and final extraction stages was adopted as the design basin volume. The practicalities of minor basin reconfigurations through operations was considered more difficult and costly when compared to constructing the largest required basin for each catchment (to cater for initial and final stages) at project initiation.

		Settling zone			Low erosion hazard land		High erosion hazard land (Sediment storage based on RUSLE)										Adopted sediment basin volume (m^3)	Basin shape				
Catchment name	Catchment area (ha)	90% - 5 day rainfall*	Cv[#]	Settling volume (m^3)	Sediment storage (m^3)	Total sediment basin volume (m^3)	Slope length (m)	Change in height (m)	Slope	Description	LS factor	S (2yr 6hr rainfall intensity)	R	K**	2 month soil loss volume	Total sediment basin volume (m^3)		L:W ratio	Settling volume depth (m)	Surface area of settling zone (m2)	Minimum length (m)	Minimum width (m)
A1	8.65	60.2	0.74	3855	1927	5782	10	5	50%	Stockpiles	3.33	13.7	4086.6	0.024	480	4335	5782	3	1	3855	108	36
A2	27.45	60.2	0.74	12229	6114	18343	10	5	50%	Stockpiles	3.33	13.7	4086.6	0.024	1524	13753	18343	3				
A3	3.68	60.2	0.74	1640	820	2460	250	16	6%	Typical slope	2.91	13.7	4086.6	0.024	179	1819	2460	3				
B1	6.52	60.2	0.74	2905	1453	4358	10	5	50%	Stockpiles	3.33	13.7	4086.6	0.024	362	3267	4358	3				
B2	29.58	60.2	0.74	13178	6589	19767	10	5	50%	Stockpiles	3.33	13.7	4086.6	0.024	1642	14821	19767	3	1.5	8785	162	54
B3	3.68	60.2	0.74	1640	820	2460	250	16	6%	Typical slope	2.91	13.7	4086.6	0.024	179	1819	2460	3	1	1640	70	23

* taken from Lismore (058037) graph

[#] Appendix F - Table F2 - high runoff potential, for the design rainfall depth

** taken from Appendix C - Coraki soil type for most conservative K factor

		Settling zone			Low erosion hazard land		High erosion hazard land (Sediment storage based on RUSLE)										Adopted sediment basin volume (m^3)	Basin shape				
Catchment name	Catchment area (ha)	95% - 5 day rainfall*	Cv[#]	Settling volume (m^3)	Sediment storage (m^3)	Total sediment basin volume (m^3)	Slope length (m)	Change in height (m)	Slope	Description	LS factor	S (2yr 6hr rainfall intensity)	R	K**	2 month soil loss volume	Total sediment basin volume (m^3)		L:W ratio	Settling volume depth (m)	Surface area of settling zone (m2)	Minimum length (m)	Minimum width (m)
A1	8.65	95.3	0.74	6102	3051	9153	10	5	50%	Stockpiles	3.33	13.7	4086.6	0.024	480	6582	9153	3	1	6102	135	45
A2	27.45	95.3	0.74	19359	9679	29038	10	5	50%	Stockpiles	3.33	13.7	4086.6	0.024	1524	20883	29038	3				
A3	3.68	95.3	0.74	2596	1298	3894	250	16	6%	Typical slope	2.91	13.7	4086.6	0.024	179	2775	3894	3				
B1	6.52	95.3	0.74	4599	2299	6898	10	5	50%	Stockpiles	3.33	13.7	4086.6	0.024	362	4961	6898	3				
B2	29.58	95.3	0.74	20862	10431	31293	10	5	50%	Stockpiles	3.33	13.7	4086.6	0.024	1642	22504	31293	3	1.5	13908	204	68
B3	3.68	95.3	0.74	2596	1298	3894	250	16	6%	Typical slope	2.91	13.7	4086.6	0.024	179	2775	3894	3	1	2596	88	29

* taken from Lismore (058037) graph

[#] Appendix F - Table F2 - high runoff potential, for the design rainfall depth

** taken from Appendix C - Coraki soil type for most conservative K factor

ATTACHMENT C - SEDIMENTATION BASIN VOLUME CALCULATIONS

- Sedimentation Basin Volumes
- Sedimentation Basin calculation spreadsheet

The adopted volumes in Table C1 and C2 were based off minimum length to width ratios, batter slopes and basin depths.

Table C1: Adopted Sedimentation Basin Volumes 90th percentile, 5 day storm

Basin Name	Required Sedimentation Basin Volume (m^3)	Adopted Sedimentation Basin Volume (m^3)
Sedimentation Basin 1.1 and 1.2	5,782	5,840
Sedimentation Basin 2	19,767	20,169
Sedimentation Basin 3	2,460	2,592

Table C2: Adopted Sedimentation Basin Volumes 95th percentile, 5 day storm

Basin Name	Required Sedimentation Basin Volume (m^3)	Adopted Sedimentation Basin Volume (m^3)
Sedimentation Basin 1.1 and 1.2	9,153	9,526
Sedimentation Basin 2	31,293	32,688
Sedimentation Basin 3	3,894	4,308

The adopted volumes will be refined during final detailed design.

The above tables demonstrate that the proposed sedimentation basins have been sized to accommodate the minimum required 90th percentile, 5 day rainfall event volume. The final sedimentation basin volumes are subject to detailed design of the development.

90th percentile, 5 day rainfall

Sedimentation Basin 1 - geometry

Batters		Top length (m)	Top width (m)	L:W	Top surface area (m^2)
1V	4 H	110	36	3.055556	3960
Depth		Bottom length (m)	Bottom width (m)		Bottom surface area (m^2)
	2 m	94.0	20.0		1880
		Volume (m^3)	*Required volume (m^3)*		
		5840.0	*5782*		

Sedimentation Basin 2 - geometry

Batters		Top length (m)	Top width (m)	L:W	Top surface area (m^2)
1V	4 H	165	55	3	9075
depth		Bottom length (m)	Bottom width (m)		Bottom surface area (m^2)
	3 m	141.0	31.0		4371
		Volume (m^3)	*Required volume (m^3)*		
		20169.0	*19767*		

Sedimentation Basin 3 - geometry

Batters		Top length (m)	Top width (m)	L:W	Top surface area (m^2)
1V	4 H	72	24	3	1728
depth		Bottom length (m)	Bottom width (m)		Bottom surface area (m^2)
	3 m	48.00	0.00		0
		Volume (m^3)	*Required volume (m^3)*		
		2592.0	*2460*		

95th percentile, 5 day rainfall

Sedimentation Basin 1 - geometry

Batters		Top length (m)	Top width (m)	L:W	Top surface area (m^2)
1V	4 H	135	45	3	6075
Depth		Bottom length (m)	Bottom width (m)		Bottom surface area (m^2)
	2 m	119.0	29.0		3451
		Volume (m^3)	*Required volume (m^3)*		
		9526.0	*9153*		

Sedimentation Basin 2 - geometry

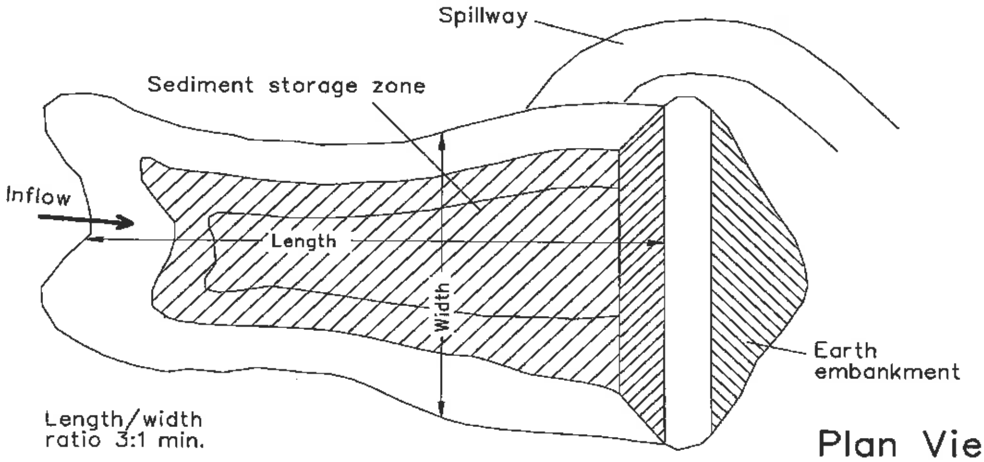
Batters		Top length (m)	Top width (m)	L:W	Top surface area (m^2)
1V	4 H	204	68	3	13872
depth		Bottom length (m)	Bottom width (m)		Bottom surface area (m^2)
	3 m	180.0	44.0		7920
		Volume (m^3)	*Required volume (m^3)*		
		32688.0	*31293*		

Sedimentation Basin 3 - geometry

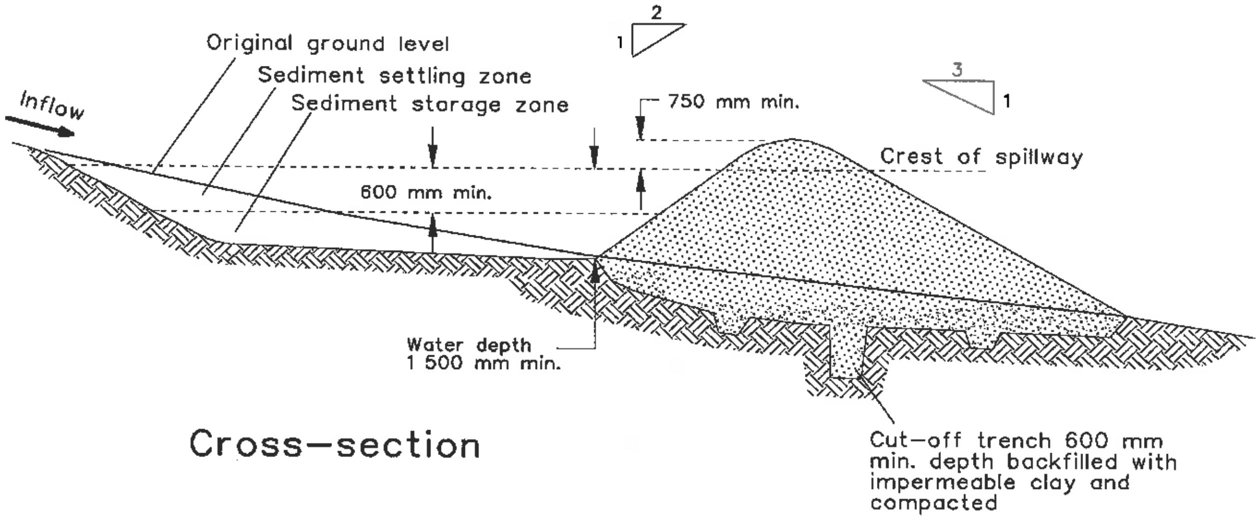
Batters		Top length (m)	Top width (m)	L:W	Top surface area (m^2)
1V	4 H	88	29	3.034483	2552
depth		Bottom length (m)	Bottom width (m)		Bottom surface area (m^2)
	3 m	64.00	5.00		320
		Volume (m^3)	*Required volume (m^3)*		
		4308.0	*3894*		

ATTACHMENT D - EROSION AND SEDIMENT CONTROL DRAWINGS

- *Managing Urban Stormwater Soils and Construction: Volume 1 (Blue Book)* Erosion and Sediment Control standard drawings



Plan View



Cross-section

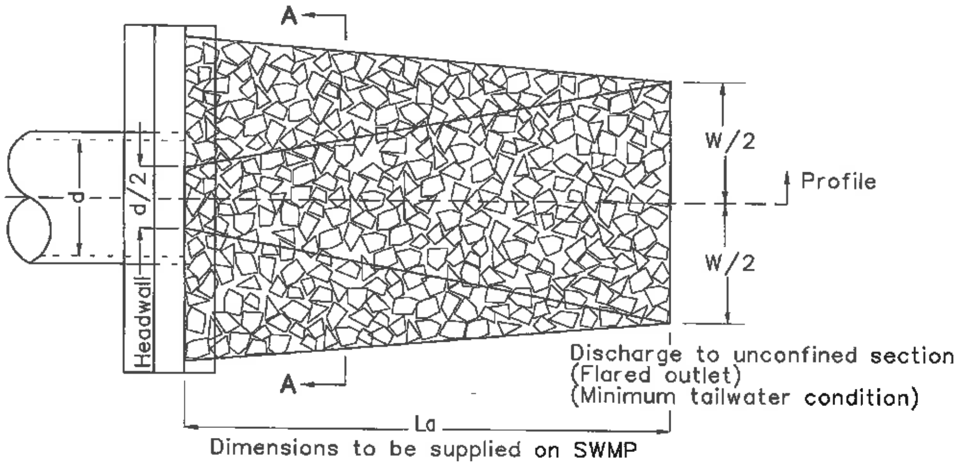
Construction Notes

1. Remove all vegetation and topsoil from under the dam wall and from within the storage area.
2. Construct a cut-off trench 500 mm deep and 1,200 mm wide along the centreline of the embankment extending to a point on the gully wall level with the riser crest.
3. Maintain the trench free of water and recompact the materials with equipment as specified in the SWMP to 95 per cent Standard Proctor Density.
4. Select fill following the SWMP that is free of roots, wood, rock, large stone or foreign material.
5. Prepare the site under the embankment by ripping to at least 100 mm to help bond compacted fill to the existing substrate.
6. Spread the fill in 100 mm to 150 mm layers and compact it at optimum moisture content following the SWMP.
7. Construct the emergency spillway.
8. Rehabilitate the structure following the SWMP.

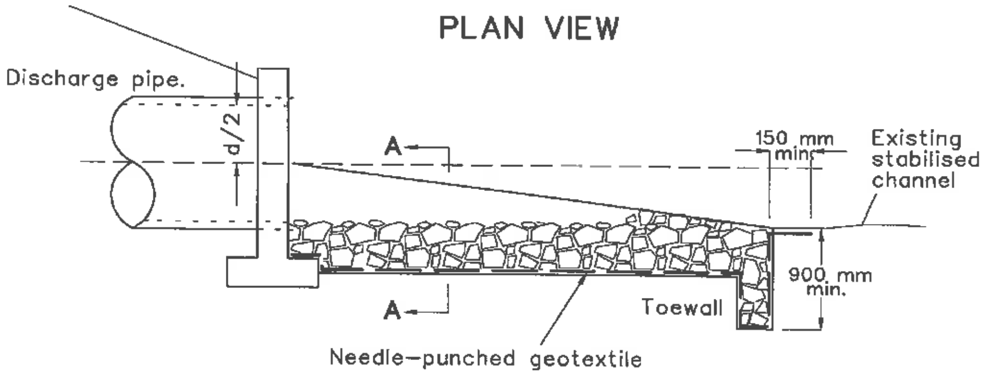
EARTH BASIN - WET

(APPLIES TO 'TYPE D' AND 'TYPE F' SOILS ONLY)

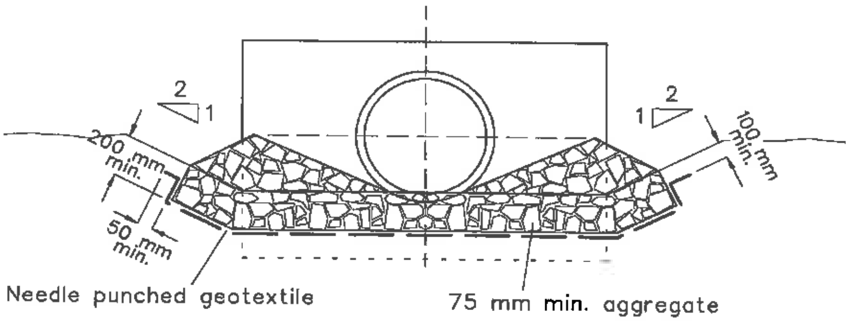
SD 6-4



PLAN VIEW



PLAN VIEW



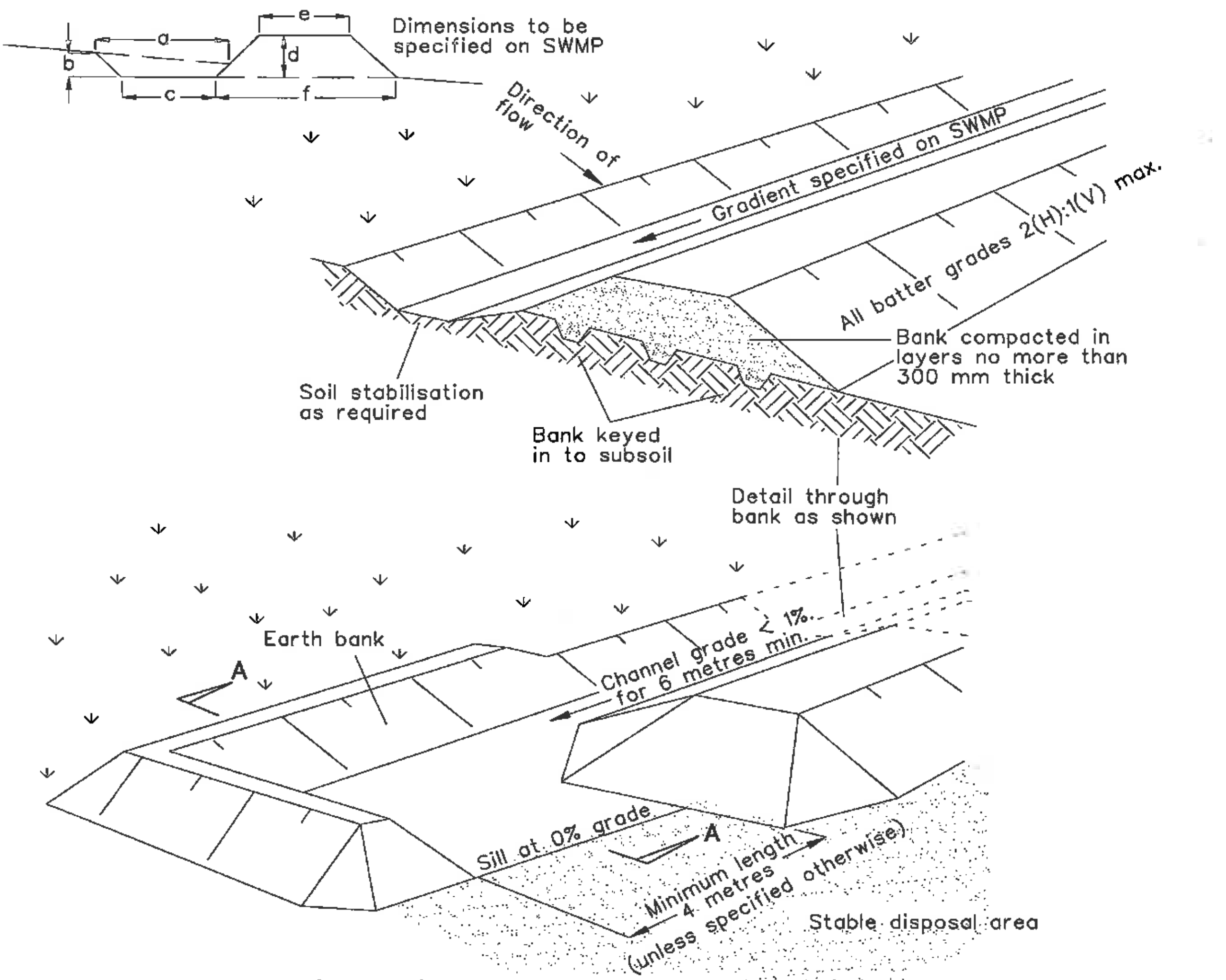
CROSS SECTION AA

Construction Notes

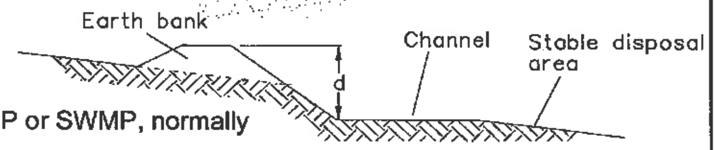
1. Compact the subgrade fill to the density of the surrounding undisturbed material.
2. Prepare a smooth, even foundation for the structure that will ensure that the needle-punched geotextile does not sustain serious damage when covered with rock.
3. Should any minor damage to the geotextile occur, repair it before spreading any aggregate. For repairs, patch one piece of fabric over the damage, making sure that all joints and patches overlap more than 300 mm.
4. Lay rock following the drawing, according to Table 5.2 of Landcom (2004) and with a minimum diameter of 75 mm.
5. Ensure that any concrete or riprap used for the energy dissipater or the outlet protection conforms to the grading limits specified on the SWMP.

ENERGY DISSIPATER

SD 5-8



Level Spreader (or Sill)



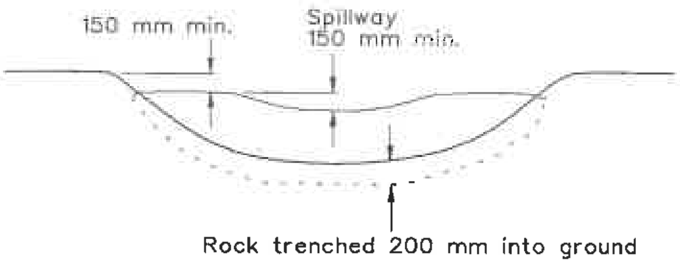
Section AA

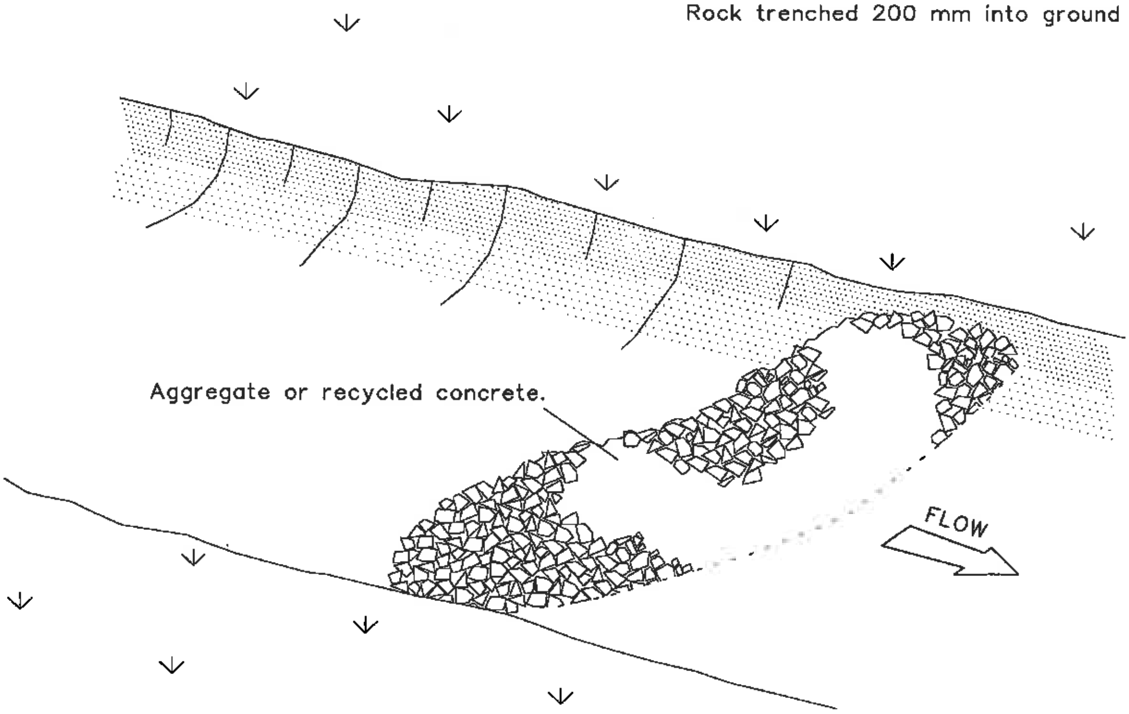
Construction Notes

1. Construct at the gradient specified on the ESCP or SWMP, normally between 1 and 5 percent
2. Avoid removing trees and shrubs if possible - work around them.
3. Ensure the structures are free of projections or other irregularities that could impede water flow.
4. Build the drains with circular, parabolic or trapezoidal cross sections, not V-shaped, at the dimensions shown on the SWMP.
5. Ensure the banks are properly compacted to prevent failure.
6. Complete permanent or temporary stabilisation within 10 days of construction following Table 5.2 in Landcom (2004).
7. Where discharging to erodible lands, ensure they outlet through a properly constructed level spreader.
8. Construct the level spreader at the gradient specified on the ESCP or SWMP, normally less than 1 percent or level.
9. Where possible, ensure they discharge waters onto either stabilised or undisturbed disposal sites within the same subcatchment area from which the water originated. Approval might be required to discharge into other subcatchments.

EARTH BANK (HIGH FLOWS)

SD 5-6





Spacing of check dams along centreline and scour protection below each check dam to be specified on SWMP/ESCP

Construction Notes

1. Check dams can be built with various materials, including rocks, logs, sandbags and straw bales. The maintenance program should ensure their integrity is retained, especially where constructed with straw bales. In the case of bales, this might require their replacement each two to four months.

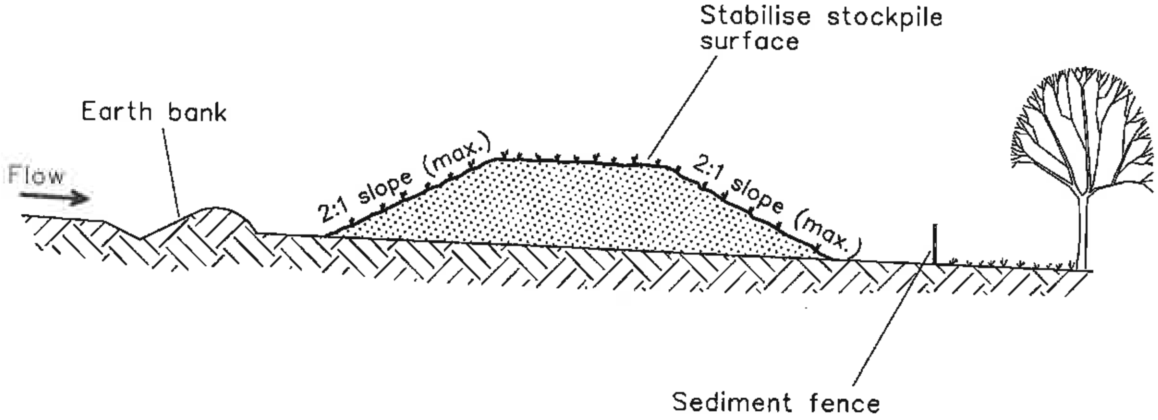
2. Trench the check dam 200 mm into the ground across its whole width. Where rock is used, fill the trenches to at least 100 mm above the ground surface to reduce the risk of undercutting.

3. Normally, their maximum height should not exceed 600 mm above the gully floor. The centre should act as a spillway, being at least 150 mm lower than the outer edges.

4. Space the dams so the toe of the upstream dam is level with the spillway of the next downstream dam.

ROCK CHECK DAM

SD 5-4



Construction Notes

1. Place stockpiles more than 2 (preferably 5) metres from existing vegetation, concentrated water flow, roads and hazard areas.
2. Construct on the contour as low, flat, elongated mounds.
3. Where there is sufficient area, topsoil stockpiles shall be less than 2 metres in height.
4. Where they are to be in place for more than 10 days, stabilise following the approved ESCP or SWMP to reduce the C-factor to less than 0.10.
5. Construct earth banks (Standard Drawing 5-5) on the upslope side to divert water around stockpiles and sediment fences (Standard Drawing 6-8) 1 to 2 metres downslope.

STOCKPILES

SD 4-1

ATTACHMENT E - DETAILED WATER BALANCE CALCULATIONS

- Water balance data
- Water balance calculation spreadsheet

E1 – RAINFALL DATA

Daily rainfall data extracted from the Bureau of Meteorology website for Coraki (Union Street – 058015).

Table E1: Summary rainfall data for Coraki

Item	Rainfall (mm/year)
Mean	1263
Maximum	2324
Minimum	370

The rainfall station has daily rainfall data from 1895 to 2015 (44041 daily observations)

Table E2: Daily rainfall distribution for the Coraki gauge

Percentile	Rainfall (mm/day)
10%	0
50%	0
75%	1.0
90%	10.0
95%	20.3
99%	57.7
99.9%	147.2

E2 – EVAPORATION DATA

Evaporation data was extracted from the nearest pan evaporation gauge at the Alstonville Fruit Research Station (058131), approximately 20km away from the site. The daily evaporation rates are summarised in Table E3.

Table E3: Average daily evaporation for the Alstonville Fruit Research Station

Month	Evaporation (mm/day)
January	5.7
February	5.0
March	4.3
April	3.5
May	2.7
June	2.4
July	2.7
August	3.5
September	4.4
October	5.0
November	5.4
December	5.9

The evaporation rates in Table E3 were applied on the sedimentation basin surface areas to calculate the daily evaporation loss from each basin.

E3 – SEDIMENATION BASIN VOLUMES

Sedimentation basin volumes and surface areas were adopted as per the calculations in **Attachment C.**

E4 – ON-SITE WATER REUSE

A dust suppression rate of 2 L/m^2/hour was supplied by Groundwork Plus via email (dated 26 August 2015). This dust suppression rate was applied to all roads within the site. The quarry is expected to operate 6 days a week for 13 hours per day. Total road length has been delineated for both the initial and final extraction stage.

For each scenario it has been assumed that the dust suppression requirements for roads within each identified catchment have water taken from their respective sedimentation dam (i.e roads in catchment A1 are sprayed with water from Sedimentation Basin 1). Reuse demand for the external roads have been sourced from Sedimentation Dam 2.

For scenarios 2 and 4, an additional external irrigation area was identified. By utilising this additional undisturbed area on the southern portion of the development for irrigation purposes, the average number of outflow events from the sedimentation basins can be greatly reduced. It is proposed to operate the external irrigation system for the same duration as the operation of the quarry. The area identified is approximately 17.16ha. It has been assumed that 50% of this area can be irrigated when required (on non-rain days only). Irrigation water is supplied from Sedimentation Basins 1, 2 and 3.

E5 – CONTROLLED RELEASES FROM THE SEDIMENTATION BASINS

Immediately after a rain event, the basins will be dosed (with an appropriate dosing agent). After 4 days of residence time, the basin is lowered (either by gravity or pump) to allow the design rainfall event volume to remain free in each basin. If a rain event occurs within the 4 day period after dosing, the water will not be released until further dosing is completed following the subsequent rainfall event. Remaining water in the sediment storage zone may be used for on-site dust suppression.

E6 – WATER BALANCE MODEL

A detailed water balance model was generated for each individual sedimentation basin, for each scenario and for both stages of development (initial and final extraction). The water balance model was run within a daily time step spreadsheet. The spreadsheet calculated inflows (rainfall), outflows (evaporation and reuse) and a final volume at the end of each time step. The model used rainfall data from 1900 to 2015, for a total of 42,216 time steps.

The sedimentation basins were assumed to be empty at the start of the simulation.

Due to the large number of spreadsheets and the size of each spreadsheet, the header for scenario 1 (Basin 1 – initial extraction phase only) have been included in this attachment.

For further enquiries, please contact **adam.broit@calibreconsulting.co**

SEDIMENTATION BASIN 1: WATER BALANCE ANALYSIS

Filename:	H:\15\001850\Stormwater\[001850 Coraki Quarry Site Water Balance_150903_revised_discharge.xlsx]Basin 1 initial
Date:	3/09/2015
By:	AB

Configuration						
Start Date	1/01/1900		Pond Bottom Area		1880	m2
Catch Area (ha)	8.6526		Pond Top Area		3960	m2
Area	8.6526		Pond Vol		5840	m3
Cv	0.74		Start Vol	0%	0	m3
Mean Rainfall	1263	mm				
			Pond Bottom RL		0	m AHD
			Pond Top RL (m.AHD)		2	m AHD
			90th percentile, 5 day volume (n		3855	m3
			sed storage volume		1985	m3

Results		
Average WSL	0.54	m AHD
Max WSL	2.00	m AHD
Min WSL	0.00	m AHD
Average outflows	206.746	
Hydraulic Residence Time	8	days

On-site reuse				
	Irrigation	(mm/day)	(mm/day)	(m3/day)
Jan	1	0.026	0.022	195.09
Feb	2	0.026	0.022	195.09
Mar	3	0.026	0.022	195.09
Apr	4	0.026	0.022	195.09
May	5	0.026	0.022	195.09
Jun	6	0.026	0.022	195.09
Jul	7	0.026	0.022	195.09
Aug	8	0.026	0.022	195.09
Sep	9	0.026	0.022	195.09
Oct	10	0.026	0.022	195.09
Nov	11	0.026	0.022	195.09
Dec	12	0.026	0.022	195.09
On-site reuse area	0.8754	ha		

	Surface Area (m2)	Evaporation (m3)	Inflow (m3)	Use (m3)
Mean	2440.056	10.292	203.141	148.137
Minimum	1880.000	4.512	0.000	0.000
Maximum	3960.000	23.364	11691.739	195.089
Sum		360,683	9,344,254	3,796,045

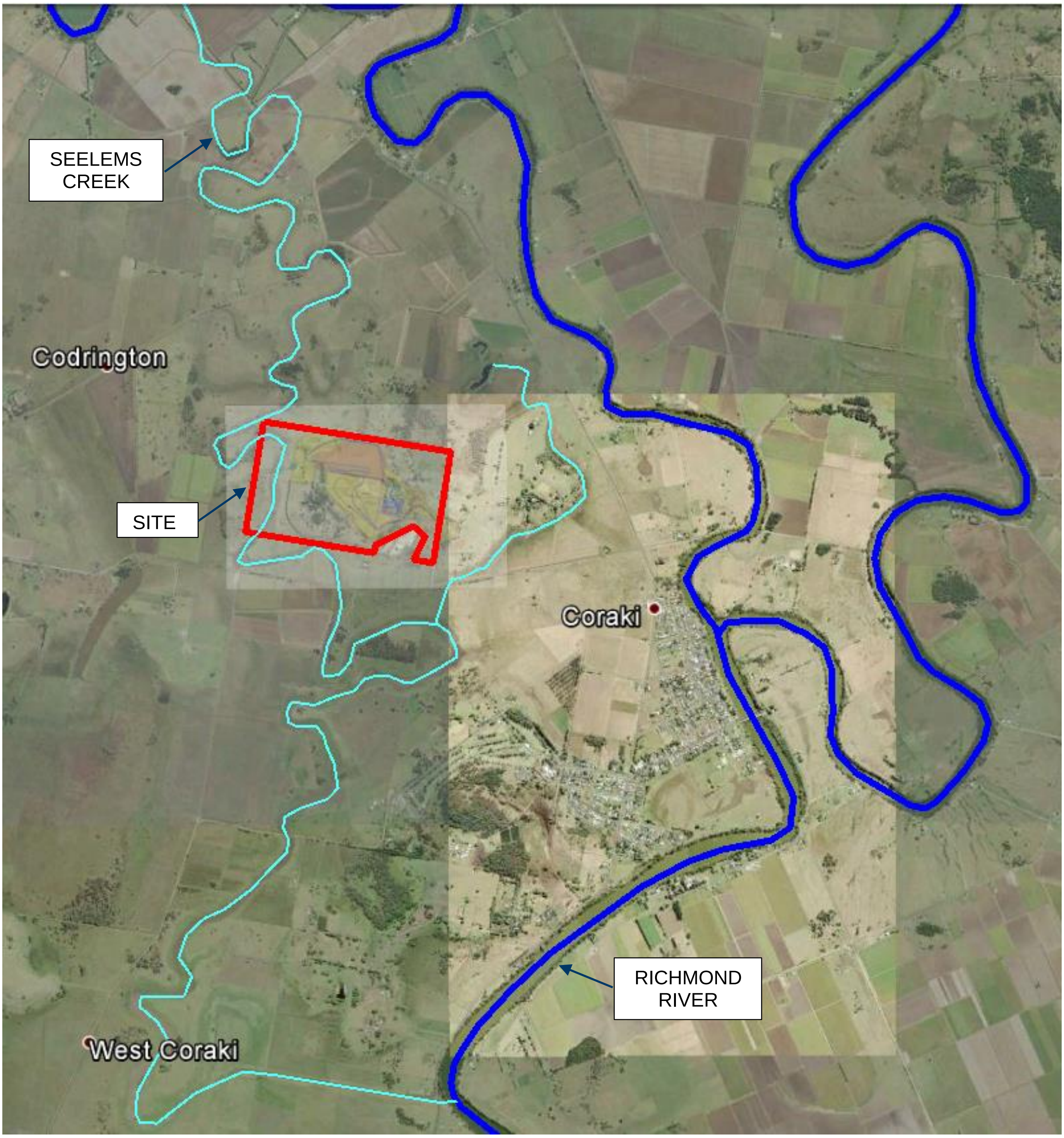
	Overflow (m3)	Finish Vol (m3)	Finish WSL (m.AHD)
Mean	58.609	1572.770	0.539
Minimum	0.000	0.000	0.000
Maximum	11681.047	5840.000	2.000
Sum	3,010,889		
Average/year	26,181.65		

	number of outflow days	number of outflow events
	2433	929
average per year	21.0	8.0

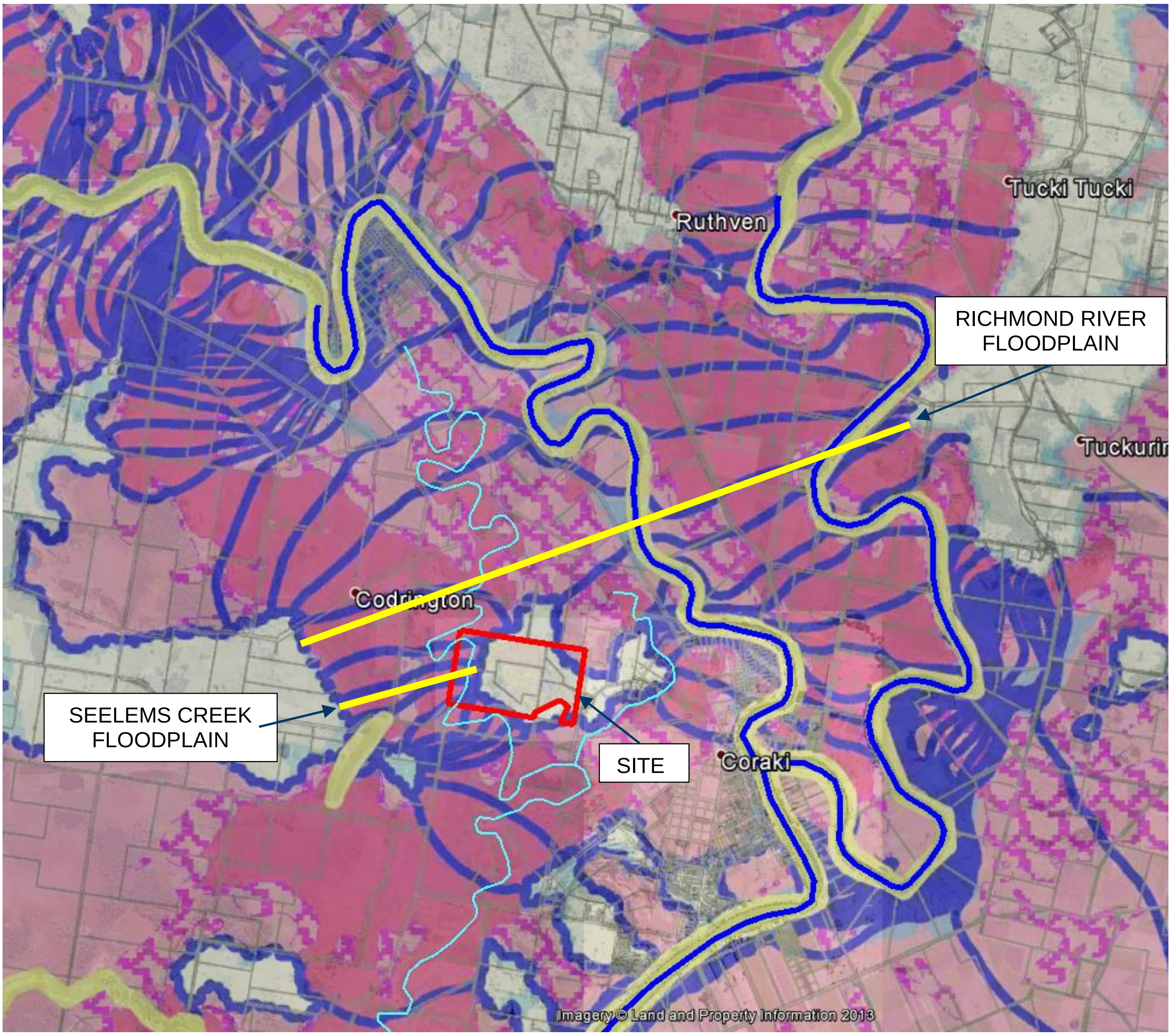
Date	Rain (mm) - original	Rain (mm) - filled	Evaporation (mm)	Start volume (m3)	Non-rain day (1=yes)	Number of consecutive non-rain days	Sedimentation basin controlled discharge	Rain day (1=yes)	number of rain days	Rainfall event length		Surface Area (m2)	Evaporation (m3)	Inflow (m3)	Re-use (m3)	Re-use not met from dam (m3)	Restore 90th percentile, 5 day rainfall volume (controlled discharge)	Overflow (m3)	Finish Vol (m3)	Finish WSL (m.AHD)	Overflow (1=yes)	number of overflow days	no overflow (1=no overflow)	number of no overflow days
1/01/1900	0	0	5.7	0.000	1							1880	10.716	0.000	195.089	195.089		0.000	0.000	0.000			1	
2/01/1900	0	0	5.7	0.000	1	1						1880	10.716	0.000	195.089	195.089		0.000	0.000	0.000			1	2
3/01/1900	0	0	5.7	0.000	1	2						1880	10.716	0.000	195.089	195.089		0.000	0.000	0.000			1	3
4/01/1900	0	0	5.7	0.000	1	3						1880	10.716	0.000	195.089	195.089		0.000	0.000	0.000			1	4
5/01/1900	0	0	5.7	0.000	1	4	dose and pump					1880	10.716	0.000	195.089	195.089		0.000	0.000	0.000			1	5
6/01/1900	0	0	5.7	0.000	1	5						1880	10.716	0.000	195.089	195.089		0.000	0.000	0.000			1	6
7/01/1900	1	1	5.7	0.000				1	1	1		1880	10.716	64.029	0.000	0.000		0.000	53.313	0.000			1	7
8/01/1900	0	0	5.7	53.313	1	1						1899	10.824	0.000	195.089	195.089		0.000	0.000	0.018			1	8
9/01/1900	10.4	10.4	5.7	0.000				1	1			1880	10.716	665.904	0.000	0.000		0.000	655.188	0.000			1	9
10/01/1900	1.3	1.3	5.7	655.188				1	2			2113	12.046	83.238	0.000	0.000		0.000	726.380	0.224			1	10
11/01/1900	28.4	28.4	5.7	726.380				1	3	3		2139	12.191	1818.430	0.000	0.000		0.000	2532.620	0.249			1	11
12/01/1900	0	0	5.7	2532.620	1	1						2782	15.858	0.000	195.089	0.000		0.000	2321.673	0.867			1	12
13/01/1900	0	0	5.7	2321.673	1	2						2707	15.429	0.000	195.089	0.000		0.000	2111.155	0.795			1	13
14/01/1900	1.3	1.3	5.7	2111.155				1	1	1		2632	15.002	83.238	0.000	0.000		0.000	2179.391	0.723			1	14
15/01/1900	0	0	5.7	2179.391	1	1						2656	15.140	0.000	195.089	0.000		0.000	1969.161	0.746			1	15
16/01/1900	0	0	5.7	1969.161	1	2						2581	14.714	0.000	195.089	0.000		0.000	1759.358	0.674			1	16
17/01/1900	0	0	5.7	1759.358	1	3						2507	14.288	0.000	195.089	0.000		0.000	1549.981	0.603			1	17
18/01/1900	0	0	5.7	1549.981	1	4	dose and pump					2432	13.863	0.000	195.089	0.000	1985.000	0.000	1341.030	0.531			1	18
19/01/1900	0	0	5.7	1341.030	1	5						2358	13.438	0.000	195.089	0.000		0.000	1132.502	0.459			1	19
20/01/1900	0	0	5.7	1132.502	1	6						2283	13.015	0.000	195.089	0.000		0.000	924.398	0.388			1	20
21/01/1900	0	0	5.7	924.398	1	7						2209	12.593	0.000	195.089	0.000		0.000	716.716	0.317			1	21
22/01/1900	0	0	5.7	716.716	1	8						2135	12.171	0.000	195.089	0.000		0.000	509.456	0.245			1	22
23/01/1900	0	0	5.7	509.456	1	9						2061	11.750	0.000	195.089	0.000		0.000	302.616	0.174			1	23
24/01/1900	0	0	5.7	302.616	1	10						1988	11.330	0.000	195.089	98.892		0.000	96.197	0.104			1	24
25/01/1900	2	2	5.7	96.197				1	1			1914	10.911	128.058	0.000	0.000		0.000	213.344	0.033			1	25
26/01/1900	5.6	5.6	5.7	213.344				1	2	2		1956	11.149	358.564	0.000	0.000		0.000	560.759	0.073			1	26
27/01/1900	0	0	5.7	560.759	1	1						2080	11.854	0.000	195.089	0.000		0.000	353.815	0.192			1	27
28/01/1900	0	0	5.7	353.815	1	2						2006	11.434	0.000	195.089	47.798		0.000	147.292	0.121			1	28
29/01/1900	0	0	5.7	147.292	1	3						1932	11.015	0.000	195.089	195.089		0.000	0.000	0.050			1	29
30/01/1900	0	0	5.7	0.000	1	4	dose and pump					1880	10.716	0.000	195.089	195.089	1985.000	0.000	0.000	0.000			1	30
31/01/1900	0	0	5.7	0.000	1	5						1880	10.716	0.000	195.089	195.089		0.000	0.000	0.000			1	31
1/02/1900	0	0	5	0.000	1	6						1880	9.400	0.000	195.089	195.089		0.000	0.000	0.000			1	32
2/02/1900	0	0	5	0.000	1	7						1880	9.400	0.000	195.089	195.089		0.000	0.000	0.000			1	33
3/02/1900	3.8	3.8	5	0.000				1	1	1		1880	9.400	243.311	0.000	0.000		0.000	233.911	0.000			1	34
4/02/1900	0	0	5	233.911	1	1						1963	9.817	0.000	195.089	166.084		0.000	29.005	0.080			1	35
5/02/1900	0	0	5	29.005	1	2						1890	9.452	0.000	195.089	195.089		0.000	0.000	0.010			1	36
6/02/1900	0	0	5	0.000	1	3						1880	9.400	0.000	195.089	195.089		0.000	0.000	0.000			1	37
7/02/1900	0	0	5	0.000	1	4	dose and pump					1880	9.400	0.000	195.089	195.089	1985.000	0.000	0.000	0.000			1	38
8/02/1900	0	0	5	0.000	1	5						1880	9.400	0.000	195.089	195.089		0.000	0.000	0.000			1	39
9/02/1900	0	0	5	0.000	1	6						1880	9.400	0.000	195.089	195.089		0.000	0.000	0.000			1	40
10/02/1900	0	0	5	0.000	1	7						1880	9.400	0.000	195.089	195.089		0.000	0.000	0.000			1	41
11/02/1900	0	0	5	0.000	1	8						1880	9.400	0.000	195.089	195.089		0.000	0.000	0.000			1	42
12/02/1900	0	0	5	0.000	1	9						1880	9.400	0.000	195.089	195.089		0.000	0.000	0.000			1	43
13/02/1900	0	0	5	0.000	1	10						1880	9.400	0.000	195.089	195.089		0.000	0.000	0.000			1	44
14/02/1900	64.3	64.3	5	0.000				1	1	1		1880	9.400	4117.080	0.000	0.000		0.000	4107.680	0.000			1	45
15/02/1900	0	0	5	4107.680	1	1						3343	16.715	0.000	195.089	0.000		0.000	3895.876	1.407			1	46
16/02/1900	0	0	5	3895.876	1	2						3268	16.338	0.000	195.089	0.000		0.000	3684.449	1.334			1	47
17/02/1900	8.4	8.4	5	3684.449				1	1			3192	15.961	537.846	0.000	0.000		0.000	4206.333	1.262			1	48
18/02/1900	13.5	13.5	5	4206.333				1	2			3378	16.891	864.395	0.000	0.000		0.000	5053.837	1.441			1	49
19/02/1900	8.1	8.1	5	5053.837				1	3			3680	18.400	518.637	0.000	0.000		0.000	5554.074	1.731			1	50
20/02/1900	5.6	5.6	5	5554.074				1	4	4		3858	19.291	358.564	0.000	0.000		53.347	5840.000	1.902	1	1		
21/02/1900	0	0	5	5840.000	1	1						3960	19.800	0.000	195.089	0.000		0.000	5625.111	2.000			1	1
22/02/1900	0	0	5	5625.111	1	2						3883	19.417	0.000	195.089	0.000		0.000	5410.604	1.926			1	2
23/02/1900	0	0	5	5410.604	1	3						3807	19.035	0.000	195.089	0.000		0.000	5196.480	1.853			1	3
24/02/1900	0	0	5	5196.480	1	4	dose and pump					3731	18.654	0.000	195.089	0.000	1985.000	0.000	1985.000	1.780			1	4
25/02/1900	0	0	5	1985.000	1	5						2587	12.935	0.000	195.089	0.000		0.000	1776.976	0.680			1	5
26/02/1900	0	0	5	1776.976	1	6						2513	12.564	0.000	195.089	0.000		0.000	1569.322	0.609			1	6
27/02/1900	0	0	5	1569.322	1	7						2439	12.195	0.000	195.089	0.000		0.000	1362.038	0.537			1	7
28/02/1900	0	0	5	1362.038	1	8						2365	11.826	0.000	195.089	0.000		0.000	1155.124	0.466			1	8
29/02/1900	#N/A	0	5	1155.124	1	9						2291	11.457	0.000	195.089	0.000		0.000	948.578	0.396			1	9
1/03/1900	0	0	4.3	948.578	1	10						2218	9.537	0.000	195.089	0.000		0.000	743.952	0.325			1	10
2/03/1900	0	0	4.3	743.952	1	11						2145	9.223	0.000	195.089	0.000		0.000	539.639	0.255			1	11
3/03/1900	0	0	4.3	539.639	1	12						2072	8.910	0.000	195.089	0.000		0.000	335.640	0.185			1	12
4/03/1900	0	0	4.3	335.640	1	13						2000	8.598	0.000	195.089	63.137		0.000	131.952	0.115			1	13
5/03/1900	0	0	4.3	131.952	1	14						1927	8.286	0.000	195.089	195.089		0.000	0.000	0.045			1	14
6/03/1900	0	0	4.3	0.000	1	15						1880	8.084	0.000	195.089	195.089		0.000	0.000	0.000			1	15
7/03/1900	6.6	6.6	4.3	0.000				1	1	1		1880	8.084	422.593	0.000	0.000		0.000	414.509	0.000			1	16
8/03/1900	0	0	4.3	414.509	1	1						2028	8.719	0.000	195.089	0.000		0.000	210.701	0.142			1	17
9/03/1900	1.8	1.8	4.3	210.701				1	1	1		1955	8.407	115.253	0.000	0.000		0.000	317.547	0.072			1	18
10/03/1900	0	0	4.3	317.547	1	1						1993	8.570	0.000	195.089	81.202		0.000	113.887	0.109			1	19
11/03/1900	0	0	4.3	113.887	1	2						1921	8.258	0.000	195.089	195.089		0.000	0.000	0.039			1	20
12/03/1900	0	0	4.3	0.000	1	3						1880	8.084	0.000	195.089	195.089		0.000	0.000	0.000			1	21
13/03/1900	0	0	4.3	0.000	1	4	dose and pump					1880	8.084	0.000	195.089	195.089	1985.000	0.000	0.000	0.000			1	22

Reuse					
Initial extraction stage			**Final extraction stage**		
Roads within Catchment A1			**Roads within Catchment B1**		
road length	1459	m	road length	991	m
road width	6	m	road width	6	m
road area	8754	sqm	road area	5946	sqm
application rate	2	L/sqm/hr	application rate	2	L/sqm/hr
daily operational hours	13	hours	daily operational hours	13	hours
Daily application rate	228	m^3	Daily application rate	155	m^3
Roads within Catchment A2			**Roads within Catchment B2**		
Road length	3849	m	Road length	5036	m
road width	6	m	road width	6	m
road area	23094	sqm	road area	30216	sqm
application rate	2	L/sqm/hr	application rate	2	L/sqm/hr
daily operational hours	13	hours	daily operational hours	13	hours
Daily application rate	600	m^3	Daily application rate	786	m^3
Roads within Catchment A3			**Roads within Catchment A3**		
Road length	572	m	Road length	572	m
road width	6	m	road width	6	m
road area	3432	sqm	road area	3432	sqm
application rate	2	L/sqm/hr	application rate	2	L/sqm/hr
daily operational hours	13	hours	daily operational hours	13	hours
Daily application rate	89	m^3	Daily application rate	89	m^3
External haul road			**External haul road**		
External haul road	1467	m	External haul road	1467	m
road width	6	m	road width	6	m
road area	8802	sqm	road area	8802	sqm
application rate	2	L/sqm/hr	application rate	2	L/sqm/hr
daily operational hours	13	hours	daily operational hours	13	hours
Daily application rate	229	m^3	Daily application rate	229	m^3

ATTACHMENT F – WATERCOURSES



ATTACHMENT G – RICHMOND VALLEY COUNCIL FLOOD MAPPING



From Council's flood mapping, approximate floodplain widths have been measured. During flooding events, Seelems Creek acts as an overflow path from the Richmond River floodplain.

The overall width of the Seelems Creek floodplain is 1,600 m at its minimum width (adjacent to the site). The overall width of the greater Richmond River Floodplain upstream of the site is approximately 6,600 m.

Attachment 9

Resource Assessment

REPORT ON INVESTIGATIONS

CORAKI QUARRY

Prepared for:
Quarry Solutions Pty Ltd
Date:
11/09/2015

Reference:
1837.220.001

Document Control

Project/ Report Details

Document Title:	Report on Investigations
Principal Author:	Clayton Hill and Luke Ryan
Client:	Quarry Solutions Pty Ltd
Ref. No.	1837.220.001

Document Status

Issue	*Description*	*Date*	*Author*	*Reviewer*
0	Report on Investigations	13/04/2015	CH	RH
1	Report on Investigations	11/09/2015	CH / LR	RH

Distribution Record

Recipient	
Quarry Solutions Pty Ltd	1E

Groundwork Plus ABN: 80 829 145 906

Queensland
6 Mayneview Street, Milton Qld 4064
PO Box 1779, Milton BC, Qld 4064
P: +61 7 3871 0411
F: +61 7 3367 3317

South Australia
2/1 First Street, Nuriootpa SA 5355
PO Box 854, Nuriootpa SA 5355
P: +61 8 8562 4158

E: info@groundwork.com.au

Table of Contents

DRAWINGS

(Drawing No. 1837.DRG.036)	Drill Summary Plan
(Drawing No. 1837.DRG.002)	Site Location Plan
(Drawing No. 1837.DRG.003)	Regional Geology

ATTACHMENTS

Attachment 1	Percussion Drill Hole Log
Attachment 2	Petrographic Analysis Reports
Attachment 3	Core Drill Hole Log

Executive Summary

Drilling at the proposed Coraki Quarry, north west of the township of Coraki (refer to DRAWING NO. 1837.DRG.036 DRILL SUMMARY PLAN and DRAWING NO. 1837.DRG.002 SITE LOCATION PLAN) has delineated a large basalt resource between 9m and 42m AHD of approximately 3.2 million tonnes of Indicated Resource. The total resource available based on the conceptual pit design is listed below.

TABLE 1 – INDICATED RESOURCES CORAKI QUARRY

Pit Design	Residual Soil** (million tonnes)	Extremely to Distinctly Weathered Volcaniclastics** (million tonnes)	Unweathered Volcaniclastic** (million tonnes)
Total Indicated Resource	0.09	0.27	2.92

* Rounded to the nearest significant figure. **Tonnes factors: Residual Soil 1.8 t/m^2 Extremely to Distinctly Weathered Basalt Agglomerate 2.1 t/m^2 Unweathered Basalt 2.7 t/m$^{2.}$

Key findings of this Resource Investigation are:

- Petrographic analysis confirms that the unweathered rock is of high strength, hardness and durability and will be suitable for use as concrete aggregates, asphalt aggregates, sealing aggregates, high quality road bases, rail ballast, rip rap and unbound pavement material.
- The unweathered hard, durable and strong basalt resource exists over the majority of the investigation area.
- Overburden thickness is not substantial with an average residual soil profile of $\leq$ 0.75m occurring across the site.
- The weathering profile on site is persistent to a depth of around 2m on average across the site, however the distinctly to slightly weathered agglomerate below the residual soil profile will be suitable for use as low to modest quality road base material or non-specification drainage materials.
- Zones of elevated clay interbedded within the resource have been identified but are anticipated to be suitably managed through selective quarrying and blending methods to maximise the total resource.
- Consideration has been given to the design of the extraction pit in relation to visual amenity, noise and water management.
- The lithology of the current and proposed extraction area comprises a consistent succession of superficial residual limonitic soils and basaltic lithosol, highly competent basalt and significantly weathered basalt terminating at depth in sandstone.

Key Action Items

- A set of staged development plans should be completed commensurate with extraction requirements.

1. Introduction

Groundwork Plus was engaged by Quarry Solutions Pty Ltd to undertake a preliminary assessment of a hard rock quarry resource on land described as Lot 401 on DP 633427. Access to the site was obtained through an internal road on Lot 403 on DP802985 via Seelems Road.

The investigations involved:

- Broad spaced percussion drilling, 12 holes for a total of 232m.
- Geological mapping of the proposed quarry area and areas immediately to the north and west of the site.
- Petrographic analysis.
- Preliminary resource calculation.
- Substantiating Diamond Core Drilling and logging consisting of five (5) holes amounting to 103 metres of core.
- Materials Testing.

The Coraki Quarry deposit is located immediately to the north of the existing Richmond Valley Council Petersons Quarry and approximately 2.5 kilometres north-west of the town of Coraki, New South Wales.

The Site is currently being grazed with the land immediately to the south occupied by quarrying activities (Petersons Quarry), Seelems Creek to the west and rural/agricultural land to the north.

2. Site Details

Location: The site is located at Seelems Road, Coraki New South Wales, approximately 2.5 kilometres north west of the township of Coraki, and 16 kilometres south-south west of Lismore. (refer DRAWING NO. 1837.DRG.002 SITE LOCATION PLAN).

Access: Access to the site is through Lot 403 on DP802985, via Seelems Road and Petersons Quarry Road.

Real Property Description: The site comprises Lot 401 on DP633427 and Lot 403 on DP802985.

Area: Approximate area of Lot 401 on DP633427 is 23.06 hectares.

Tenure: Freehold

Registered Proprietor: Varoli Pty Ltd ACN 003728229.

Land Use: The Site is currently utilised for grazing.

Landform: The site has an elevation of approximately 4m-41m AHD. Toward the east where the investigations were focused and where proposed extraction is planned, the area is elevated from the areas to the west and north with elevations between 32m-40m AHD refer DRAWING NO. 1837.DRG.036 DRILL SUMMARY PLAN.

Vegetation: The land consists of mainly open grassland with minor patchy scrub at lower elevations towards Seelems Creek. No vegetation other than grassland and some weeds were encountered in the locations of drilling.

An area of lowland rainforest exists on the adjoining Petersons Quarry to the south of the Site and extending into Lot 403 on DP802985 (access). This vegetation and associated habitat has been previously identified as requiring appropriate mitigation strategies in development of the adjoining quarry and the access road build for Lot 401 on DP633427. Whilst not impacting Lot 401 and the proposed extraction area, any access or changes to access adjoining this area should be carefully considered.

3. Previous Investigations

Whilst it is understood that the immediately adjacent Petersons Quarry has undertaken preliminary drilling investigations in 2008, no further documented studies have been carried out to determine if significant previous geological investigations have occurred in the immediate vicinity of the quarry however it is likely that the only significant published work to be completed, is the data that is provided by the NSW government and relates to broad scaled geological mapping of the area, at a scale of 1:250,000 see DRAWING NO. 1837.DRG.003 REGIONAL GEOLOGY.

4. Work Completed

4.1 Percussion Drilling

A program of 12 percussion drill holes were completed on 25 March 2015 utilising Ron Southon Drilling. The drill hole locations are shown in DRAWING NO. 1837.DRG.036 DRILL SUMMARY PLAN. The drill hole geological logs are contained in ATTACHMENT 1 – PERCUSSION DRILL HOLE LOG and ATTACHMENT 3 – CORE DRILL HOLE LOGS.

The details of the drilling are tabulated below:

Contractor:	Ron Southon Drilling
Drill Rig:	Atlas Copco ECM660
Total Meters Drilled:	232m
Percussion Hole Diameter:	89mm
Drill Hole Inclination:	All holes vertically inclined
Drilling Dates:	25 March 2015

All drill holes were logged with consideration being placed on any factor which could influence quarry development and the properties of the quarried products. Particular consideration was given to the rock strength, degree of weathering and alteration and lithology.

Plate 1 – Atlas Copco ECM660 Percussion Drill Rig

4.2 Diamond Core Drilling

A program of five (5) percussion drill holes were completed from the 5th to the 9th of August 2015 utilising Statewide Drilling. The drill hole locations are shown in DRAWING NO. 1837.DRG.036 DRILL SUMMARY PLAN. The associated diamond core geological logs are contained in ATTACHMENT 3 – CORE DRILL HOLE LOG.

The details of the drilling are tabulated below:

Contractor:	Statewide Drilling
Drill Rig:	Cortech CSD1300G
Total Meters Drilled:	103m
Diamond Core Type:	HQ internal diameter 63.5mm
Drill Hole Inclination:	All holes vertically inclined
Drilling Dates:	5th to 9th of August 2015

Basalt cores were logged on site with consideration placed on the mineralogical and textural features which may influence quarry development and the properties of the quarried products. Particular consideration was given to the rock's lithology, strength, and degree of weathering and alteration.

5. Results of Investigations

5.1 Observations

Outcrops were inspected and, with the drilling data, formed the basis of the broad scale geological map of the site. Observations were made of the soil profile at the dozer cut at the northern side of the site and visual observation of the active extraction areas of the adjoining quarry. Observations relating to the soil and eluvium profile are noted below.

*5.1.1 Soil and Eluvium**

**Eluvium is an accumulation of material that is produced in place by the decomposition or disintegration of rock.*
***Colluvium is a general term for any loose incoherent mass of soil or rock deposited by rain-wash or slow downhill creep.*

A soil and eluvium profile overlies the entirety of area, amongst which sparse basaltic outcrops occur. The soil and eluvium profile generally thickens away from the main ridge line to the north and west. Over the main area of proposed quarrying activity the soil and eluvial profile is generally between 0.2m and 2m thick. Hole 10 (QCP15-10) however identified an isolated area of thicker soil and weathering profile of up to 4m in thickness. The lower quality basaltic material intersected at this location will still however be included within the potential resource calculation due to the isolation and limited volume of this material and its ability to be blended with higher quality material to meet required specifications. This fact has been taken into consideration in the proposed pit outline. It is also suggested that this material may provide a suitable source of material for any planned rehabilitation in the area.

Observations made during the subsequent program of core drilling have supported these findings with the deepest residual soil and weathered basalt lithosol located at QCC15-02 with a profile of 1.4 metres. Across the site the soil profile grades consistently to eluvium which is characterised by the development of weakly lateritised basalt with nodular basalt floats and other weathered material, see (PLATE 2).

Plate 2 – Soil and Eluvium Profile within Dozer Cut Showing Basalt Floats

5.2 Percussion Drilling

5.2.1 Overburden Thickness and Weathering

For the purpose of this investigation, overburden is defined as soil, clay and all highly weathered rock units which overlie moderately to slightly weathered Basalt. This overburden may in part be suitable for use as a general fill product.

Overburden occurs over the main ridge in the area, and ranges generally from 0.2m to 2m in thickness. In the south east of the drilling program area an isolated area of thicker soil and elevated weathering to 4m was encountered. To the north and west of the investigation area, the overburden is thicker $\geq$4m and is controlled by the presence of a creek.

The weathering was described as either HW, MW, SW or Fresh which can be correlated to the Australian Standard AS1726, with the HW, (Highly Weathered), category equalling the RS and XW categories of the standard i.e. residual soils or extremely weathered rock. The MW (Moderately Weathered), category used equates to the DW category of Australian Standard AS1726, and the SW and FR codes used equate exactly with the SW and FR codes used by the Australian Standard AS1726.

5.2.2 Basalt

The main basalt layer present within the eastern portion of Lot 401 on DP633427 was the focus of investigations refer DRAWING NO. 1837.DRG.036 DRILL SUMMARY PLAN and where quarrying activities are proposed. This basalt is a black, fine grained, sparsely porphyritic, homogenous columnar jointed basalt interpreted to have high rock strength and durability.

Plate 3 – Unweathered Basalt Sample

Plate 4 – Hole QCP15-08 Drill Cuttings

Other general observations on the main basalt are:

- The basalt resource and flow varies from 12m to 20m in thickness.
- Rates of penetration in the main basaltic layer were slow whilst rates in the weathered material were moderate to fast. The drilling rate is a qualitative assessment of rock strength and it is a useful indicator of actual rock strength. The drilling indicates that the massive or columnar basalt occurs over a reasonably wide area.
- That due to the compact nature of the basalt that the primary permeability rate will be of the order of 10-10 m/s whilst the secondary porosity of the overall rock mass will be slightly higher given the jointing and fracturing present. Secondary permeability is expected to be in the order of 10-4 m/s.

5.2.3 Clay and Interlayered Basalts

Percussion drilling was focused on determining the extent of the basalt resource however in all occasions was prevented from drilling to the full possible depth of the drill rig (approximately 28m) due to the intersection of a clay layer which underlies the basalt.

At several holes, drilling persevered to determine the depth of the underlying clay layer, however, further depth was not attained due to the plastic nature of the clay with drill cutting return very poor. This clay layer was completely weathered, with low rock strength and is likely to be a constraint on any potential hard rock quarrying. Subsequent core drilling has shown that this clay demarks the limit of the basalt resource with sandstone underlying this.

At several holes (QCP15-01, QCP15-05, QCP15-06, QCP15-09 and QCP15-11), clay intrusions and interbedded clay was encountered with drilling continuing and fresh rock at further depth resulting. Holes QCP15-04 and QCP15-011 also produced high fines encountering clay within the resource matrix (see PLATE 5 and PLATE 6).

Plate 5 – QCP15-04 Clay fines

Plate 6 – QCP15-04 hole cuttings showing clay fines at depth

This clay within the resource should be further assessed as quarrying activities develop. It is noted that due to the large amount of fresh and competent basalt encountered, good operational management will likely be all that is required to manage this.

5.2.4 Alteration and Veining

Little alteration was noted in the unweathered olivine basalt. Secondary minerals smectite and chlorite were noted under microscope along with iddingsite, derived from olivine alteration. Petrographic analysis of the resource confirms however that this alteration will have little effect on the overall rock quality of the basalt.

5.2.5 Hydrology

No groundwater was encountered during the 12 drill holes undertaken onsite as part of the campaign.

5.3 Diamond Core Drilling

5.3.1 Overburden Thickness and Weathering

The core drilling conducted in the proposed extraction area and subsequent to preliminary percussion drilling indicates a relatively minor overburden thickness consisting of limonitic clayey soils with a lithosol substrate containing extremely to distinctly weathered basalt float suspended in eluvium. The depth of this material in the resource profile ranges from 0.9 metres at CCD15-01 to 3.4 metres at CCD15-02 correlating with depths identified during percussion drilling.

5.3.2 Basalt

The target basalt resource of the proposed extraction area represents a mafic magma extrusion overlying a predating sandstone. The rock is consequently homogenous with faint flow lineations expressed by constituent plagioclase laths which compose the rock's ground mass. The distinction between the extremely weathered superficial rock and the markedly pristine underlying basalt is likely due to the vesicular nature of basalt flows at their surface allowing, upon solidification, meteoric fluid fluxes to permeate and preferentially weather the rock. The body of the rock is highly competent with columnar jointing and overlying agglomeritic basalt grading sharply to the superficial lithosols and residual soils observed at the surface. This progression is illustrated exceptionally well in profile by the working faces of the quarries existing operations.

Plate 7 – Photograph of the adjoining quarry’s western face displaying the full profile of the basalt including superficial soils and eluvium, agglomerate basalt and columnar basalt at depth.

5.3.3 Clay and Interlayered Basalts

Aside from the overlying limontic clayey eluvium and smectitic lithosol, clays are also observed in the body of the basalt as matrix locked clay and chloritic material with minor iddingsite shown to be released during crushing. These zones are identified in the core as slightly weathered to distinctly weathered rock zones but are not regarded as significantly deleterious unless liberated by extensive crushing. Clays and chlorite also inhabit linear features in the core samples produced by columnar jointing which is characteristic of this rock type and produces large hexagonal blocks upon extraction.

5.3.4 Hydrology

No groundwater was encountered during the drilling campaign.

5.3.5 Underlying Rock

Based on the clearly delineated rock types encountered during drilling the basalt is revealed to overlie an arkose sandstone at true depths, which increase steadily to the north-east, of 17.4m AHD (CCD15-01), 14.6m AHD (CCD15-02) and 9.6m AHD (CCD15-03). The interface of these two rock types is occupied by smectite clay and extremely weathered basalt facilitated by the hydraulic conductivity of the underlying sandstone.

Plate 8 – Characteristic transition from pristine basalt (black) to extremely weathered and smectitic remnant basalt and clay (grey) to an arkose sandstone (orange-brown). Hole CCD15-01.

5.4 Petrographic Analysis

Petrographic analysis was undertaken on drill cuttings from holes QCP15-04 and QCP15-08 to determine the fresh and competent basalt resource along with the interbedded clay encountered as discussed in Section 5.2. For engineering purposes the basalt is assessed according to ASTM C 295 Standard Guide for *Petrographic Assessment of Aggregates for Concrete* and the *Guideline on Minimising the Risk of Damage to Concrete Structures in Australia, (1996).*

Results of the petrographic analysis undertaken from samples collected from Hole 8 (QCP15-08) are summarised as:

- The supplied rock fragments are identified as aggregate of Basalt derivation, defined as a fine grained Basic Igneous Rock.
- The hand sample is described as a black, finely phaneritic igneous rock with fragments of free clay that range in size from 0.2 and 30.0mm. The drill chips are composed of visible plagioclase, pyroxene, olivine and magnetite crystals and are highly magnetic. Minor sulphides are observed in hand sample as a pyrite phase.
- Petrographic analysis reveals the rock is comprised principally of plagioclase (50%), pyroxene (12%), opaques including magnetite (9%), olivine (5%), sanidine feldspar (5%) and apatite crystals (1%). Interstitial to these crystalline phases ferro-magnesian glass has formed (14%) the devitrification of which has produced secondary smectite clay (2%), chlorite (1%), iddingsite (1%) and trace iron oxide.
- The rock sample is composed primarily of robust primary minerals and volcanic glass (96%) with the balance accounted for by secondary glass derived clay and phyllosilicate phases with iron oxide (4%). Of these 1% is available as weak material coating the chips as fine brown dust with the remained locked within the fabric of competent rock.
- The rock contains nil free silica as quartz species. However, ferro-magnesian volcanic glass comprises a significant proportion of the rock. While evidently silica under-saturated it is prudent given the uncertain chemistry of this glass to regard the sampled rock as having potential for mild alkali-silica reactivity in concrete.
- Accordingly, aggregate represent by this sample is predicted to be suitable for use as Coarse Aggregate in Concrete, Cover Aggregate, Unbound Pavement, and Manufactured Sand. The rock is suitable for Gabion and Revetment and depending upon jointing density in the field source rock may also have utility as Marine Armour Rock.

- For engineering purposes the aggregate may be summarised as:
  - Basalt, a basic igneous rock.
  - Essentially unweathered and non-porous with slight alteration.
  - Composed principally of robust material.
  - Hard, strong and durable.
  - Containing nil free silica but 14% ferro-magnesian volcanic glass.
  - Regarded as prudent to view the source rock as having potential for mild alkali-silica reactivity in concrete.

Results of the petrographic analysis undertaken from samples collected from Hole 4 (QCP15-04) are summarised as:

- The supplied rock fragments are identified as being of Basalt derivation, a finely grained Basic Igneous Rock.
- The sample was taken at a depth of 12.0m and represents a 1.0m zone of increased weathering in the rock's profile. The drill chips are described as a black, finely grained and phaneritic igneous rock. Fragments range from 0.5 to 26.0mm and are composed of visible plagioclase, pyroxene, olivine and magnetite crystals. Minor liberated clays are evident among the samples chips. The grains are highly magnetic and minor sulphides are observed in hand sample.
- Petrographic analysis reveals of the rock is comprised principally of primary phases including plagioclase (43%), pyroxene (12%) and opaques including magnetite (8%). Interstitial to these crystalline phases ferro-magnesian volcanic glass has formed (19%) which has partially devitrified producing secondary smectite clays (3%), iddingsite (2%), chlorite (1%) and iron oxide (1%). The sampled material is non-porous with slight to moderate weathering and weak alteration.
- The rock sample is composed primarily of robust minerals (93%) with the balance accounted for by weak secondary iron oxide and devitrification products including smectite clays, chlorite and iddingsite (7%). Of these 4% are available as weak material which coats the aggregate as a fine clay derived dust.
- The sampled rock contains nil free silica as quartz but volcanic glass comprises a significant proportion of the sample. While this vitric component is evidently silica under-saturated it is regarded as prudent to view the rock as having potential for mild alkali-silica reactivity in concrete due to the unknown chemistry of this glass.
- Crushed rock represented by this sample is predicted to be suitable for use as Coarse Aggregate in Concrete, Cover Aggregate, Unbound Pavement and Manufactured Sand. The rock is suitable for Gabion and Revetment and, depending upon jointing density in the field, source rock may also have utility as Marine Armour Rock.
- For engineering purposes the aggregate may be summarised as:
  - Basalt, a basic igneous rock.
  - Slightly weathered with fines occupied by smectite clays.
  - Composed principally of robust minerals (93%).

- Hard, strong and durable.
- Containing nil free silica.
- Regarded as having potential for mild alkali-silica reactivity in concrete due to abundant volcanic glass.

TABLE 2 – RISK RATING FOR SPECIFIC APPLICATIONS AND SOURCE ROCK QUALITY, represents a risk rating for specific applications and source rock quality of the basalt resource.

TABLE 2 – RISK RATING FOR SPECIFIC APPLICATIONS AND SOURCE ROCK QUALITY

Risk Rating for Application	Low	Mod	High	Comments (Assuming the sample is indicative of overall source rock quality)
Concrete Aggregates	✓			Low secondary mineral count so water demand should be low
Unbound Pavements	✓			Suitable high strength, hard and durable material
Cover Aggregates	✓			Suitable high strength, hard and durable material
Marine Armour	✓			Rock classifies as excellent pursuant to CIRIA guidelines with high density
Manufactured Sand	✓			Low secondary mineral content with low smectite clay levels
Gabion/Revetment	✓			Suitable
Risk Rating Source Rock	**Low**	**Mod**	**High**	
Alkali Silica Reactivity	✓			Perceived low risk due to volcanic glass
Secondary Mineral Impacts	✓			4% of secondary mineral evident component should be monitored although at current volumes is of negligible risk
Durability	✓			Durable
Strength	✓			Very Strong
Hardness	✓			Suitable
Free Silica Content	✓			Nil in this rock
Sulfide content	✓			Minor sulphides visible in hand specimen

*Low risk means a low probability of causing source rock related issues in regard to material performance in any particular applications. Risk is recommended to be considered in conjunction with a sampling frequency protocol for production of any particular product.

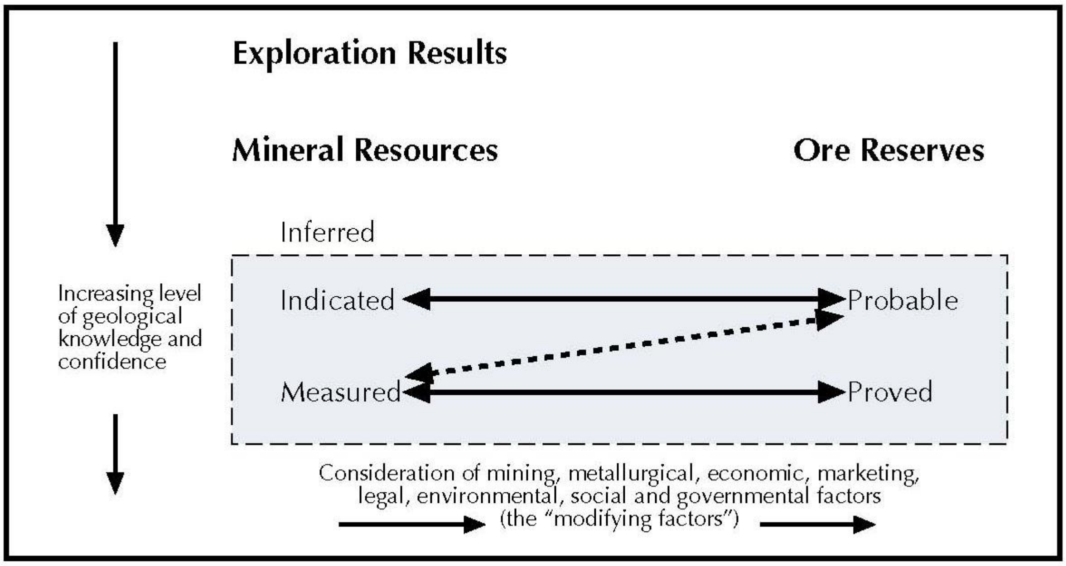
6. Preliminary Resource Estimate

A resource estimation has been completed and could be considered to be classified as an *Indicated Resource* as significantly more data, i.e. drilling and materials testing would be needed to upgrade this resource to a higher degree of confidence.

Following is the classification system as set out in the *JORC 2004* which is the Australasian Code for Reporting of Exploration Results, Mineral Resources and Ore Reserves.

An 'Indicated Mineral Resource' is that part of a Mineral Resource for which tonnage, densities, shape, physical characteristics, grade and mineral content can be estimated with a reasonable level of confidence. It is based on exploration, sampling and testing information gathered through appropriate techniques from locations such as outcrops, trenches, pits, workings and drill holes. The locations are too widely or inappropriately spaced to confirm geological and/or grade continuity but are spaced closely enough for continuity to be assumed.

TABLE 3 – JORC 2004 RESOURCE RESERVE DIAGRAM



To upgrade the resource calculation to a reserve classification has involved the drilling of five (5) HQ diamond core holes were drilled so that strength and durability testing could be completed. These test results are forthcoming. Given, however, that an established quarry is located immediately adjacent to the investigation area and observations of the active faces were able to be undertaken, the additional confidence obtained from increased drilling is likely to support existing knowledge of the resource's testing characteristic. Quarry design, scheduling and economic factors would also need to be considered and it is submitted that for a quarrying resource this is not necessary as the conversion ratio from resource to reserve will be high as the reserve will be more influenced by geological continuity rather than scheduling and, to any practical extent, economic parameters. In essence the resource will most likely approximate the reserve.

A buffer of 20m between the property boundary and the top of the existing quarry workings is assumed for the purposes of volume calculation and may not reflect actual design or approval provided resultant of the EIS prcoess. A pit shell design has been considered in this resource estimation with an overall total slope of pit to be optimised between 50^0 and 55^0. In the weathered material it is likely that stable batter angles will be less than 35^0 whilst in the more competent material they would most likely be greater than 50^0. The resource design was based on 52.5^0. Based on the current data set the maximum interim slope heights may be up to 20m and the basalt could be extracted to slightly above the clay unit which potentially forms the base of the deposit anyway. If these designs hold true then very little material would be excluded from the resource because of pit design issues.

A further amendment to the geological resource is that the specific gravity or bulk density value used for the resource calculation has been revised upwards from 2.6 t/m^3 to 2.78t/m^3. It is suggested that in the basalt the exact value maybe higher than this value as a common bulk density range for basalt is between 2.7 t/m^3 and 3.0t/m^3. If necessary this could be confirmed by additional testwork.

The sandstone which underlies the basalt resource and its clay interface have not been measured as a resource.

As part of this investigation, materials test work will be undertaken to assess the strength and durability of the materials intersected. For the purposes of the above resource calculation it has been assumed that the strength and durability properties of the basalt is consistent with the product currently extracted from the immediately adjoining quarry details of which are included in TABLE 4 – MATERIAL TEST RESULTS below. Based on the observations of the drill chips from the holes drilled into the basalt, this is considered to be a reasonable assumption.

The above resource estimate is based on in-situ volumes. The actual product yield will depend on a number of factors including (but not limited to) clay lenses, weathering seams, batter angles, dilution factors, unsaleable product and losses due to extraction, sales mix and plant configuration.

This estimate also assumes a 20m buffer to the property boundary, and is not constrained by a detailed quarry design at this stage.

TABLE 4 – MATERIAL TEST RESULTS

Material Test	Test Method	Result
Dry Strength	RMS T215	253kN
Wet Strength	RMS T215	253kN
Wet/Dry Strength Variation	RMS T215	0%
Apparent Particle Density	AS1141.6.1	2.86t/m3
Particle Density (S.S.D.)	AS1141.6.1	2.78t/m3

Material Test	Test Method	Result
Water Absorption (Coarse Aggregate)	AS1141.6.1	1.5%
Sodium Sulphate Soundness	AS1141.24	0.7%
Micro-Deval Abrasion	ASTM D7428-08	14.2
Los Angeles Value	AS1141.23	15%

The above results were based on 10mm and 20mm aggregate samples from the Petersons Quarry, processed by a contractor employed by Council using a mobile crushing plant. The crushing plant circuit didn't include a vertical shaft impactor and subsequently material test results are likely to improve with the plant proposed to be used by Quarry Solutions for the project, ensuring deleterious material is liberated from the harder more competent resource. Critical to the maximisation of the resource for the project will be an understanding of the road pavement design parameters and specifications and opportunities to work with the material quality prevalent at Coraki/Petersons.

TABLE 5 – INDICATED RESOURCE ESTIMATE – CORAKI QUARRY BASALT

Proposed Coraki Quarry	Estimated m^3 (*in situ*)	Specific Gravity (estimate)	Product Yield tonnes (*in situ*)
(*In situ* Volumes)			
Overburden (including residual soils and extremely weathered material)	50,000	1.8 tonnes/m^3	90,000
Transitional basalt material (Distinctly weathered basalt)	130,000	2.1 tonnes/m^3	273,000
Unweathered Basalt (slightly weathered and fresh basalt)	1,050,000	2.78 tonnes/m^3	2,919,000

*Rounded to nearest significant figure

7. Conclusions

The geology of the proposed Coraki Quarry site can be summarised as Basalt, defined as a fine grained Basic Igneous Rock.

Limonitic and eluvial soils cover the area with sparse basaltic outcrops breaking through this residual cover. This profile generally thickens slightly to the east of the ridge line. In general, the soil, eluvium and lithosol profile ranges from 0.2m to 2m in thickness with some isolated areas of up to 4m in thickness in the southern portion of the investigation area. Sandstone has been recovered by diamond drill core at a true depth of between 9.6m AHD in the north-east and 18m AHD in the south-west with intermediary drill holes showing the sandstone unit dipping consistently to the north-east.

Petrographic examination of this material indicates that the material should be suitable for use in high quality road base, concrete aggregate, sealing aggregate and asphalt aggregate pending appropriate supporting material testing.

The observations of the drill chip and core samples from investigations have generally supported the characteristics of this petrographic examination (high strength, low alteration) except in the weathered material which may be highly variable in its rock strength.

The high quality basalts are thickest coincident with elevation, and the ridge line in the area, with still significant suitable rock to the north-east due to the sandstone unit’s dip.

The interface of the sandstone and the overlying basalt is occupied by heavily weathered smectite clay and chloritized basalt. As such extraction of the resource will be limited to a depth slightly above this clay unit.

7.1.1 Comments on Quarrying

The main basalt unit is interpreted to be relatively uniform and consistent in its appearance and characteristics and in terms of quarrying it will be a brittle, competent and cohesive body, and generally suitable for bulk extraction. That is, the main basalt unit will be suitable for bulk quarrying and the fresh basalt material is interpreted to contain little poorer quality material and should be relatively uniform and consistent in its distribution.

Requiring management at the proposed Coraki Quarry will be the interbedded clay layer encountered within a number of the drill holes. This layer exists approximately 6m to 10m below natural ground level between percussion drill holes QCP15-04 and QCP15-11, and diamond core drill hole CCD15-01. This zone is anticipated to have reduced rock strength, elevated fines and exhibits moderate to distinct weathering. Consideration should be given to ensuring this material is utilised in conjunction with higher quality and fresh basalt onsite to maximise the resource and extraction.

In the fresh material, batter angles could be designed with a Factor of Safety to be at approximately 1.3. This is based on empirical analysis and experience from pits based in other columnar basalts. The batter angle would need to be shallower than this in the weathered material, most likely less than 35^0, with a batter design of no more than 55^0 being most likely the optimum for a final slope face. If required a fully scheduled and optimised pit could be designed by Groundwork Plus.

It is also strongly recommended that final benches be designed with a minimum width of 12-15m for rehabilitation purposes.

In regards to the proposed pit outline the design is not based on the Lersch-Grossman* algorithm it is merely based on analysing overburden thickness and considering this in relation to the quality of the rock that was intersected below the overburden. Given the drill hole spacing there is significant scope to either decrease or increase the in situ resource as further information becomes available.

*The Lersch-Grossman algorithm is the most commonly used tool for optimising any pit resource against a known set of economic criteria

8. Recommendations

The following recommendations are made;

- That quarry designs are generated using Surpac 3D Modelling Software to maximise the design and optimise extraction and extraction volumes, being cognisant of the environmental constraints likely with such a development e.g. visual amenity, noise, water management etc.
- Consideration may be given to undertaking material tests results from a bulk sample onsite to further determine material strength and durability.

drawings

CREATED: 17 July 2015 JOB SUB #: FILE NAME: M:\Jobs\ID2\08AE3BC5-EAC1-4676-B0D2-4743E36DBC29\0\71000-71999\71404\L\L\1837.DRG.036 - Drilling-summary\1837.DRG.036 - Drilling-summary.dwg

REV	DESCRIPTION	DATE	BY

Data Sources:
Photography: UAV Survey 2015-07-02; Google. Image date: 2014-12-18
Topography: UAV Survey 2015-07-02
Cadastre:
Ecosystem:
Other:

Legend:

🟨	Site Boundary
🟥	Cadastral Boundary
●	Percussion Hole Location
⊕	Diamond Core Hole Location
(20.0m)	Drillhole Depth
1.0	Residual Soil Thickness
1.0	Basalt Thickness
1.0	Clay Thickness
1.0	Sandstone Thickness

N

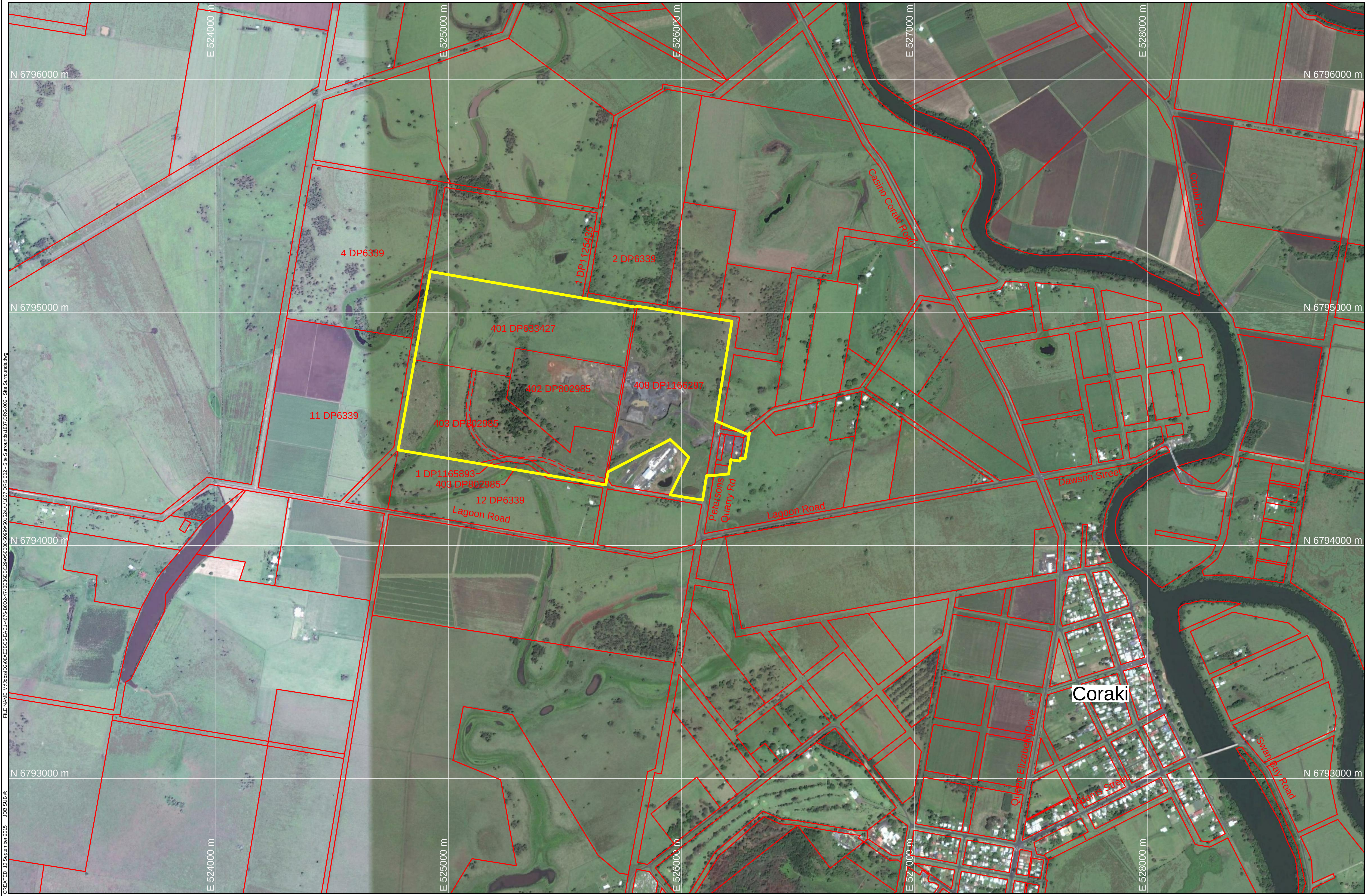
PROJECT:
Coraki Quarry

CLIENT:
Quarry Solutions Pty Ltd

TITLE:
Drill Hole Summary Plan

GROUNDWORK plus
PH: +61 7 3871 0411
WWW.GROUNDWORK.COM.AU

SCALE: 1:4,000 When Printed On A3	0 80	DRAWING NUMBER: 1837.036	REVISION:
DATE: 11 September 2015	DRAWN: LT	DATUM: HORIZONTAL / VERTICAL / ZONE	
PRINTED: 11 September 2015	CHECKED:	MGA / AHD / 56	



FILE NAME: M:\Jobs\ID2\08AE3BC5-EAC1-4676-B0D2-4743E36DBC29\0\50000-50999\50152\L\L\1837.DRG.002 - Site Surrounds\1837.DRG.002 - Site Surrounds.dwg

CREATED: 10 September 2015 JOB SUB #:

REV	DESCRIPTION	DATE	BY
1	Revised site boundary	07/09/15	LT

Data Sources:
Photography: Google. Image date: 2014-12-18
Topography:
Cadastre:
Ecosystem:
Other:

Legend:
🟨 Site Boundary
🟥 Cadastral Boundary

PROJECT:
Coraki Quarry

CLIENT:
Quarry Solutions Pty Ltd

TITLE:
Site and Surrounds

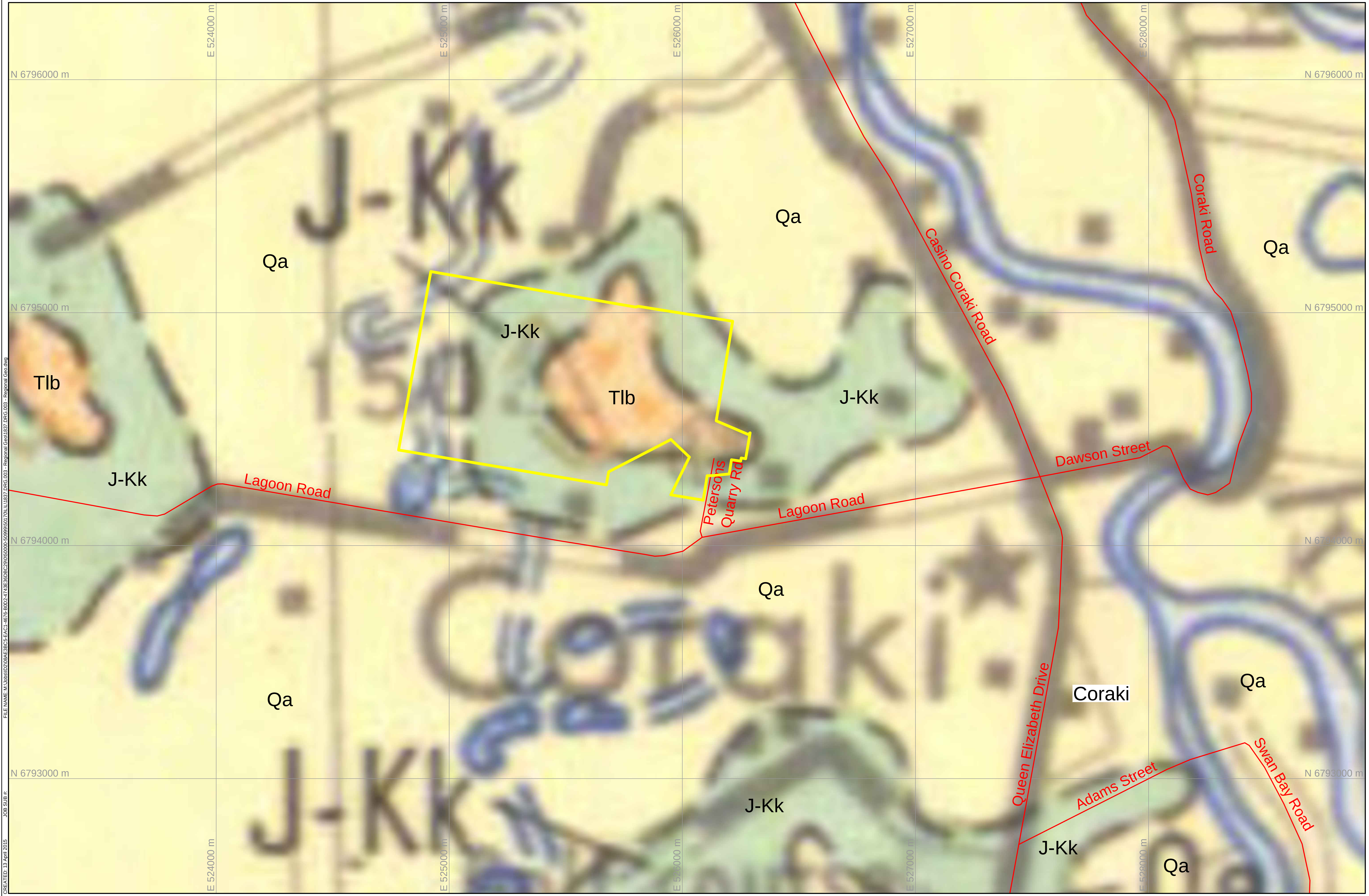
GROUNDWORK plus
PH: +61 7 3871 0411
WWW.GROUNDWORK.COM.AU

SCALE: 1:15,000 When Printed On A3 0 300

DRAWING NUMBER: 1837.DRG.002
REVISION: 1

DATE: 10 September 2015
PRINTED: 10 September 2015
DRAWN: LT
CHECKED: JL

DATUM: HORIZONTAL / VERTICAL / ZONE
MGA / AHD / 56



CREATED: 13 April 2015 JOB SUB #: FILE NAME: M:\Jobs\ID2\08AE3BC5-EAC1-4676-B0D2-4743E36DBC29\0\50000-50999\50170\L\L\1837.DRG.003 - Regional Geo\1837.DRG.003 - Regional Geo.dwg

REV	DESCRIPTION	DATE	BY
1	Revised site boundary	07/09/15	LT

Data Sources:
Photography:
Topography:
Cadastre:
Ecosystem:
Other:

Legend:

🟨	Site Boundary
🟥	Road
Qa	River gravels, alluvium, sand, clay
Tlb	Basalt (agglomerate, bole)
J-Kk	Quartz sandstone, conglomerate

N

PROJECT:
Coraki Quarry

TITLE:
Regional Geology

CLIENT:
Quarry Solutions Pty Ltd

GROUNDWORK plus
PH: +61 7 3871 0411
WWW.GROUNDWORK.COM.AU

SCALE: 1:15,000 When Printed On A3 0 300

DRAWING NUMBER: 1837.DRG.003

REVISION: 1

DATE: 7 September 2015

DRAWN: LT

PRINTED: 10 September 2015

CHECKED:

DATUM: HORIZONTAL / VERTICAL / ZONE MGA / AHD / 56

attachments

Attachment 1

Percussion Drill Hole Log

PERCUSSION DRILL HOLE LOG

Page: 1 of 1

Client:	Quarry Solutions Pty Ltd	Datum (H):	MGA-56	Drill Co:		Location/RP:	
Project:	Coraki Quarry	Datum (V):	AHD	Drill Rig:		Logged By:	
Job No:	1837			Driller:			

Depth (m)	Symbolic Log	Chip Tray Photo	Geological Description Rock Type, Colour, Weathering, Strength, Alteration	Symbolic Log	Chip Tray Photo	Geological Description Rock Type, Colour, Weathering, Strength, Alteration	Symbolic Log	Chip Tray Photo	Geological Description Rock Type, Colour, Weathering, Strength, Alteration

Depth (m): -2, 0, 2, 4, 6, 8, 10, 12, 14, 16, 18, 20, 22, 24, 26

Hole: QCP15-01
Date: 25/03/2015
E = 525425.555
N = 6794957.973
Elev = 34.574

Overburden
Weathering: HW

Weathering: MW
CBR: 20-30
% Fines: 30

Weathering: SW
CBR: 30-40
% Fines: 30-40

Weathering: FR
CBR: 60-80
% Fines: 30-40

CBR: 80
% Fines: 20-30

Weathering: FR
CBR: 80
% Fines: 20-30

CBR: 80
% Fines: 30-40

50% Clay
Weathering: MW
% Fines: 30-40

Weathering: SW
CBR: 60
% Fines: 30

30% Clay
Weathering: MW
% Fines: 30-40

70% Clay
Weathering: HW
% Fines: 30-40

60-70% Clay
Weathering: HW
% Fines: 10

Hole: QCP15-02
Date: 25/03/2015
E = 525457.465
N = 6794937.965
Elev = 37.729

Weathering: SW
CBR: 20-30
% Fines: 20-30

Weathering: FR
CBR: 40-60
% Fines: 20-30

Weathering: FR
CBR: 60
% Fines: 20-30

Weathering: FR
CBR: 60-80
% Fines: 20-30

Weathering: FR
CBR: 80
% Fines: 20

Weathering: FR
CBR: 80
% Fines: 20-30

Weathering: FR
CBR: 80
% Fines: 30

Weathering: FR
CBR: 80
% Fines: 20-30

10% Clay
Weathering: FR
CBR: 60
% Fines: 40

60-70% clay
Weathering: SW-MW
CBR: 20-30
% Fines: 40-50

30% clay
Weathering: SW
CBR: 30-40
% Fines: 20-30

20-30% clay
Weathering: SW
CBR: 30-40
% Fines: 20-30

50% Clay fines
Weathering: SW
CBR: 20
% Fines: 30-40

50% Clay fines
Weathering: SW
CBR: 15-20
% Fines: 40

Hole: QCP15-03
Date: 25/03/2015
E = 525503.947
N = 6794941.521
Elev = 36.079

Weathering: MW
CBR: 15
% Fines: 20-30

Weathering: SW
CBR: 15-20
% Fines: 20-30

Weathering: FR
CBR: 40-50
% Fines: 30-40

Weathering: FR
CBR: 60
% Fines: 30

Weathering: FR
CBR: 60-80
% Fines: 30-40

Weathering: FR
CBR: 80
% Fines: 30

Weathering: FR
CBR: 80
% Fines: 30-40

Weathering: FR
CBR: 80
% Fines: 30

Weathering: FR
CBR: 80
% Fines: 20-30

Weathering: FR
CBR: 80
% Fines: 40

Weathering: FR
CBR: 80
% Fines: 40-50

Weathering: FR
CBR: 80
% Fines: 10

Weathering: FR
CBR: 80
% Fines: 40

5% clay
Weathering: FR
CBR: 80
% Fines: 40

Weathering: FR
CBR: 80
% Fines: 40

Rock Weathering Classification:

RS	Residual Soil	Soil developed on extremely weathered rock
XW	Extremely Weathered	Rock weathered to such anextent it has 'soil' properties
DW	Distinctly Weathered	Rock strength usually changed by weathering
SW	Slightly Weathered	Slightly discoloured but little/no change in strength from fresh
Fr-St	Fresh - Stained Joints	Fresh but with stained joints
Fr	Fresh	No sign of decomposition/staining

Strength of Rock Material:		Point load index (MPa):
EL	Extremely Low	≤ 0.03
VL	Very Low	> 0.03 ≤ 0.1
L	Low	> 0.1 ≤ 0.3
M	Medium	> 0.3 ≤ 1
H	High	> 1 ≤ 3
VH	Very High	> 3 ≤ 10
EH	Extremely High	> 10

Notes:

1. All depths quoted with respect to ground surface measured along axis.
2.
3.
4.

GROUNDWORK plus

PERCUSSION DRILL HOLE LOG

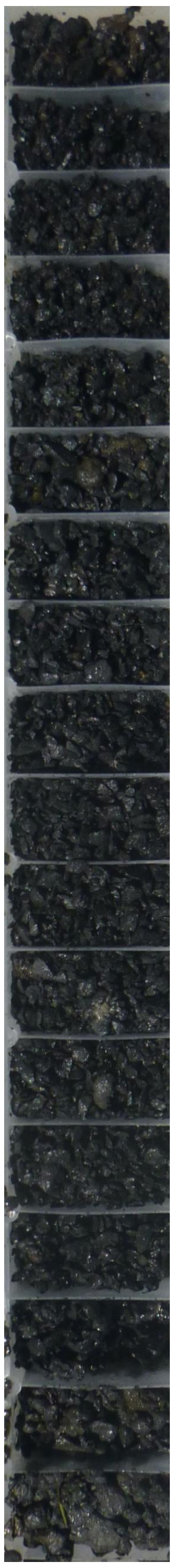
Page: 1 of 1

Client:	Quarry Solutions Pty Ltd	Datum (H):	MGA-56	Drill Co:	Location/RP:
Project:	Coraki Quarry	Datum (V):	AHD	Drill Rig:	Logged By:
Job No:	1837			Driller:	

Depth (m)	Symbolic Log	Chip Tray Photo	Geological Description Rock Type, Colour, Weathering, Strength, Alteration	Symbolic Log	Chip Tray Photo	Geological Description Rock Type, Colour, Weathering, Strength, Alteration	Symbolic Log	Chip Tray Photo	Geological Description Rock Type, Colour, Weathering, Strength, Alteration

Depth (m): -2, 0, 2, 4, 6, 8, 10, 12, 14, 16, 18, 20, 22, 24, 26

Hole: QCP15-04
Date: 25/03/2015
E = 525551.679
N = 6794982.406
Elev = 34.036



20% clay
Weathering: MW
CBR: 10.0-15.0
% Fines: 10

10% clay
Weathering: SW
CBR: 30-40
% Fines: 30

Weathering: HW
CBR: 60
% Fines: 30

Weathering: HW
CBR: 60
% Fines: 40

Weathering: HW
CBR: 60-80
% Fines: 40

High fines moisture stick when compressed
Weathering: HW
CBR: 20-30
% Fines: 50+

High fines moisture stick when compressed
Weathering: HW
CBR: 20-30
% Fines: 50-70

High fines
Weathering: HW
CBR: 20-30
% Fines: 70

40% Clay
Weathering: HW
CBR: 20
% Fines: 70

70-80% clay

Hole: QCP15-05
Date: 25/03/2015
E = 525583.234
N = 6794935.244
Elev = 36.689

OB
Weathering: VW

Weathering: MW
CBR: 5.0-10.0
% Fines: 30

Weathering: SW
CBR: 40-50
% Fines: 40

Weathering: SW
CBR: 60
% Fines: 40

Weathering: FR
CBR: 80
% Fines: 40

5% clay
Weathering: FR
CBR: 60
% Fines: 40

Weathering: FR
CBR: 80
% Fines: 40

Weathering: FR
CBR: 80
% Fines: 50

Weathering: FR
CBR: 80
% Fines: 40

5-10% Clay
Weathering: FR
CBR: 80
% Fines: 30

5-10% Clay
Weathering: FR
CBR: 80
% Fines: 40

Weathering: FR
CBR: 80
% Fines: 40

Weathering: FR
CBR: 80
% Fines: 50

Weathering: FR
CBR: 80
% Fines: 60

Weathering: FR
CBR: 80
% Fines: 50

Hit clay from 20m
Weathering: FR
CBR: 80
% Fines: 70

Hole: QCP15-06
Date: 25/03/2015
E = 525632.036
N = 6794976.247
Elev = 36.37

Weathering: MW
CBR: 10.0-15.0
% Fines: 20

Weathering: SW
CBR: 20-30
% Fines: 30

Weathering: FR
CBR: 60
% Fines: 30

Weathering: FR
CBR: 60-80
% Fines: 40

Weathering: FR
CBR: 80
% Fines: 30

10% clay
Weathering: FR
CBR: 80
% Fines: 30

Weathering: FR
CBR: 80
% Fines: 30

Weathering: FR
CBR: 80
% Fines: 50

Weathering: FR
CBR: 80
% Fines: 40

Weathering: FR
CBR: 80
% Fines: 50

Weathering: FR
CBR: 80
% Fines: 50-60

Weathering: FR
CBR: 80
% Fines: 50

Weathering: FR
CBR: 80
% Fines: 40

Hit clay after 18
Weathering: FR
CBR: 80
% Fines: 30

Rock Weathering Classification:

RS	Residual Soil	Soil developed on extremely weathered rock
XW	Extremely Weathered	Rock weathered to such anextent it has 'soil' properties
DW	Distinctly Weathered	Rock strength usually changed by weathering
SW	Slightly Weathered	Slightly discoloured but little/no change in strength from fresh
Fr-St	Fresh - Stained Joints	Fresh but with stained joints
Fr	Fresh	No sign of decomposition/staining

Strength of Rock Material:		Point load index (MPa):
EL	Extremely Low	≤ 0.03
VL	Very Low	> 0.03 ≤ 0.1
L	Low	> 0.1 ≤ 0.3
M	Medium	> 0.3 ≤ 1
H	High	> 1 ≤ 3
VH	Very High	> 3 ≤ 10
EH	Extremely High	> 10

Notes:

1. All depths quoted with respect to ground surface measured along axis.
2.
3.
4.

GROUNDWORK plus

PERCUSSION DRILL HOLE LOG

Client:	Quarry Solutions Pty Ltd	Datum (H):	MGA-56	Drill Co:		Location/RP:	
Project:	Coraki Quarry	Datum (V):	AHD	Drill Rig:		Logged By:	
Job No:	1837			Driller:			

Depth (m)	Symbolic Log	Chip Tray Photo	Geological Description Rock Type, Colour, Weathering, Strength, Alteration	Symbolic Log	Chip Tray Photo	Geological Description Rock Type, Colour, Weathering, Strength, Alteration	Symbolic Log	Chip Tray Photo	Geological Description Rock Type, Colour, Weathering, Strength, Alteration

Depth (m): -2, 0, 2, 4, 6, 8, 10, 12, 14, 16, 18, 20, 22, 24, 26

Hole: QCP15-07
Date: 25/03/2015
E = 525680.404
N = 6794994.304
Elev = 34.949

Weathering: MW
CBR: 40
% Fines: 30

Weathering: SW
CBR: 40
% Fines: 30

Weathering: FR
CBR: 80
% Fines: 30

Weathering: FR
CBR: 80
% Fines: 40

Weathering: FR
CBR: 80
% Fines: 30

Weathering: FR
CBR: 80
% Fines: 40

Weathering: FR
CBR: 80
% Fines: 30

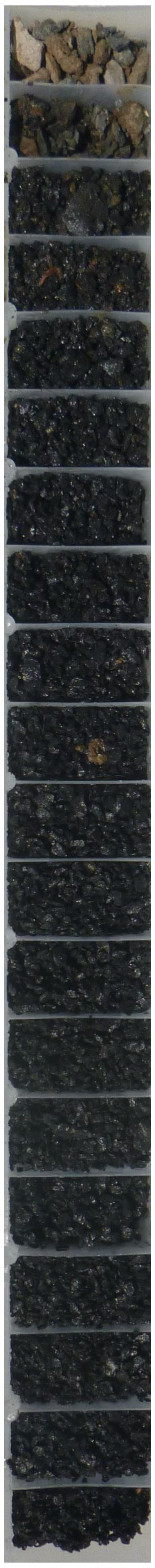
5% clay
Weathering: FR
CBR: 80
% Fines: 30

Weathering: FR
CBR: 80
% Fines: 30

Weathering: FR
CBR: 80
% Fines: 40

Until hit clay
Weathering: FR
CBR: 80
% Fines: 40

Hole: QCP15-08
Date: 25/03/2015
E = 525704.278
N = 6794908.499
Elev = 34.15



Weathering: MW
CBR: 10
% Fines: 10

Weathering: SW-FR
CBR: 30
% Fines: 20

Weathering: FR
CBR: 40-60
% Fines: 20

Weathering: FR
CBR: 60
% Fines: 30

Weathering: FR
CBR: 60-80
% Fines: 30

Weathering: FR
CBR: 80
% Fines: 30

Weathering: FR
CBR: 80
% Fines: 40

Some clay 5%
Weathering: FR
CBR: 80
% Fines: 40

20.5 hit clay
Weathering: FR
CBR: 80
% Fines: 40-50

Hole: QCP15-09
Date: 25/03/2015
E = 525706.706
N = 6794818.201
Elev = 37.285

Weathering: MW
CBR: 40
% Fines: 40

Weathering: SW
CBR: 60
% Fines: 50

Weathering: FR
CBR: 80
% Fines: 40

Weathering: FR
CBR: 80
% Fines: 50

Weathering: FR
CBR: 80
% Fines: 40

5% clay
Weathering: FR
CBR: 80
% Fines: 40

Weathering: FR
CBR: 80
% Fines: 50

Weathering: FR
CBR: 80
% Fines: 40

Weathering: FR
CBR: 80
% Fines: 50

Rock Weathering Classification:

RS	Residual Soil	Soil developed on extremely weathered rock
XW	Extremely Weathered	Rock weathered to such anextent it has 'soil' properties
DW	Distinctly Weathered	Rock strength usually changed by weathering
SW	Slightly Weathered	Slightly discoloured but little/no change in strength from fresh
Fr-St	Fresh - Stained Joints	Fresh but with stained joints
Fr	Fresh	No sign of decomposition/staining

Strength of Rock Material:		Point load index (MPa):
EL	Extremely Low	≤ 0.03
VL	Very Low	> 0.03 ≤ 0.1
L	Low	> 0.1 ≤ 0.3
M	Medium	> 0.3 ≤ 1
H	High	> 1 ≤ 3
VH	Very High	> 3 ≤ 10
EH	Extremely High	> 10

Notes:

1. All depths quoted with respect to ground surface measured along axis.
2.
3.
4.

GROUNDWORK plus

PERCUSSION DRILL HOLE LOG

Page: 1 of 1

Client:	Quarry Solutions Pty Ltd	Datum (H):	MGA-56	Drill Co:		Location/RP:	
Project:	Coraki Quarry	Datum (V):	AHD	Drill Rig:		Logged By:	
Job No:	1837			Driller:			

Depth (m) | Symbolic Log | Chip Tray Photo | Geological Description Rock Type, Colour, Weathering, Strength, Alteration | Symbolic Log | Chip Tray Photo | Geological Description Rock Type, Colour, Weathering, Strength, Alteration | Symbolic Log | Chip Tray Photo | Geological Description Rock Type, Colour, Weathering, Strength, Alteration

-2 0 2 4 6 8 10 12 14 16 18 20 22 24 26

Hole: QCP15-10
Date: 25/03/2015
E = 525617.481
N = 6794824.157
Elev = 39.124

OB Clay
Weathering: HW
% Fines: 10

50% Clay
Weathering: MW
CBR: 10
% Fines: 20

Weathering: MW
CBR: 10
% Fines: 30

10% Clay
Weathering: SW
CBR: 15-20
% Fines: 30-40

5-10% clay
Weathering: SW
CBR: 30
% Fines: 30-40

Weathering: FR
CBR: 30-40
% Fines: 50

Weathering: FR
CBR: 40-60
% Fines: 40-50

Weathering: FR
CBR: 60-80
% Fines: 40-50

Weathering: FR
CBR: 80
% Fines: 40

Weathering: FR
CBR: 80
% Fines: 50

Weathering: FR
CBR: 60-80
% Fines: 50

Weathering: FR
CBR: 60-80
% Fines: 30-40

Weathering: FR
CBR: 60-80
% Fines: 40

Weathering: FR
CBR: 60-80
% Fines: 40-50

Weathering: FR
CBR: 60-80
% Fines: 50

Hole: QCP15-11
Date: 25/03/2015
E = 525517.843
N = 6794837.231
Elev = 39.629

Weathering: MW
CBR: 30
% Fines: 30

Weathering: SW
CBR: 60
% Fines: 30

Weathering: FR
CBR: 80
% Fines: 40

Weathering: FR
CBR: 80
% Fines: 30

Weathering: FR
CBR: 80
% Fines: 40

Weathering: FR
CBR: 80
% Fines: 30

Weathering: FR
CBR: 70
% Fines: 40

Weathering: FR
CBR: 80
% Fines: 50

Weathering: FR
CBR: 70
% Fines: 60

10% Clay
Weathering: FR
% Fines: 60

Weathering: FR
CBR: 80
% Fines: 50

Weathering: MW
CBR: 80
% Fines: 50

40% clay
Weathering: MW
CBR: 40-60
% Fines: 40

20% clay
Weathering: MW
CBR: 40-60
% Fines: 40

10% clay
Weathering: SW
CBR: 60
% Fines: 40

Hit clay
Weathering: FR
CBR: 80
% Fines: 40

Hole: QCP15-12
Date: 25/03/2015
E = 525373.097
N = 6794851.062
Elev = 42.859

20% Clay
Weathering: SW
CBR: 5.0-10.0
% Fines: 20

20% Clay
Weathering: SW
CBR: 10
% Fines: 30

Weathering: FR
CBR: 30-40
% Fines: 30-40

Weathering: FR
CBR: 60
% Fines: 30-40

Weathering: FR
CBR: 60-80
% Fines: 30-40

10% clay
Weathering: FR
CBR: 80
% Fines: 30

Weathering: FR
CBR: 80
% Fines: 30

Weathering: FR
CBR: 80
% Fines: 30-40

Weathering: FR
CBR: 80
% Fines: 40

Clay

Rock Weathering Classification:

RS	Residual Soil	Soil developed on extremely weathered rock
XW	Extremely Weathered	Rock weathered to such anextent it has 'soil' properties
DW	Distinctly Weathered	Rock strength usually changed by weathering
SW	Slightly Weathered	Slightly discoloured but little/no change in strength from fresh
Fr-St	Fresh - Stained Joints	Fresh but with stained joints
Fr	Fresh	No sign of decomposition/staining

Strength of Rock Material:		Point load index (MPa):
EL	Extremely Low	≤ 0.03
VL	Very Low	> 0.03 ≤ 0.1
L	Low	> 0.1 ≤ 0.3
M	Medium	> 0.3 ≤ 1
H	High	> 1 ≤ 3
VH	Very High	> 3 ≤ 10
EH	Extremely High	> 10

Notes:

1. All depths quoted with respect to ground surface measured along axis.
2.
3.
4.

Attachment 2

Petrographic Analysis Reports

GROUNDWORK plus
Resources, Environment, Planning, Laboratories

Petrographic Inspection Report

Title:	Petrographic Report on Percussive Drill Fragments
Prepared for:	Quarry Solutions
Client Ref.	Hole 4
Date Sampled:	25/03/2015
Sample Type.	Basalt Aggregate
Source:	Coraki
Sample ID:	1837-H4
Date of Inspection:	14/04/2015
Report Issued:	17/04/2015
Project/ File Ref.	P2015.0023.001

Contributing Author:

Luke Ryan (BGeo)
Geologist,
Groundwork Plus

Principal Inspector:

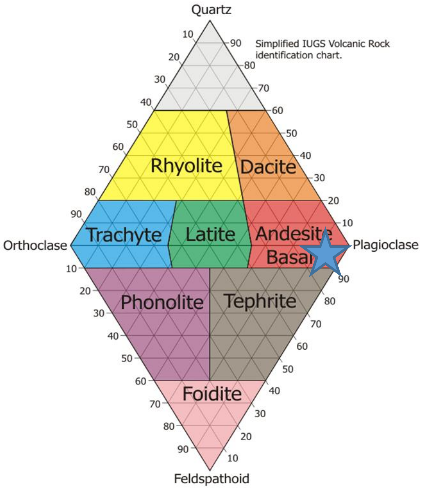
Rod Huntley

Rod Huntley (BSc, M.App.Sc, M.Eng)
Principal Resource Consultant,
Groundwork Plus

Groundwork Plus ABN: 80 829 145 906
6 Mayneview Street, Milton QLD 4064
P: +61 7 3871 0411 F: +61 7 3367 3317
E: info@groundwork.com.au

www.groundwork.com.au

Summary



- The supplied rock fragments are identified as being of **Basalt** derivation, a finely grained **Basic Igneous Rock**.
- The sample was taken at a depth of 12.0m and represents a 1.0m zone of increased weathering in the rock's profile. The drill chips are described as a black, finely grained and phaneritic igneous rock. Fragments range from 0.5 to 26.0mm and are composed of visible plagioclase, pyroxene, olivine and magnetite crystals. Minor liberated clays are evident among the samples chips. The grains are highly magnetic and minor sulphides are observed in hand sample.
- Petrographic analysis reveals of the rock is comprised principally of primary phases including plagioclase (43%), pyroxene (12%) and opaques including magnetite (8%). Interstitial to these crystalline phases ferro-magnesian volcanic glass has formed (19%) which has partially devitrified producing secondary smectite clays (3%), iddingsite (2%), chlorite (1%) and iron oxide (1%). The sampled material is non-porous with slight to moderate weathering and weak alteration.
- The rock sample is composed primarily of robust minerals (93%) with the balance accounted for by weak secondary iron oxide and devitrification products including smectite clays, chlorite and iddingsite (7%). Of these 4% are available as weak material which coats the aggregate as a fine clay derived dust.
- The sampled rock contains nil free silica as quartz but volcanic glass comprises a significant proportion of the sample. While this vitric component is evidently silica under-saturated it is regarded as prudent to view the rock as having potential for mild alkali-silica reactivity in concrete due to the unknown chemistry of this glass.
- Crushed rock represented by this sample is predicted to be suitable for use as Coarse Aggregate in Concrete (MRTS70), Cover Aggregate (MRTS22), Unbound Pavement (MRTS05) and Manufactured Sand. The rock is suitable for Gabion and Revetment and, depending upon jointing density in the field, source rock may also have utility as Marine Armour Rock.
- For engineering purposes the aggregate may be summarised as:
  - Basalt, a basic igneous rock.
  - Slightly weathered with fines occupied by smectite clays.
  - Composed principally of robust minerals (93%).
  - Hard, strong and durable.
  - Containing nil free silica.
  - Regarded as having potential for mild alkali-silica reactivity in concrete due to abundant volcanic glass.

Table 1 – Risk Rating for Specific Applications and Source Rock Quality

Risk Rating for Application	**Low**	**Mod**	**High**	**Comments (Assuming the sample is indicative of overall source rock quality)**
Concrete Aggregates	✓			Low secondary mineral count so water demand should be low
Unbound Pavements	✓			Suitable high strength, hard and durable material
Cover Aggregates	✓			Suitable high strength, hard and durable material
Marine Armour	✓			Rock classifies as excellent pursuant to CIRIA guidelines with high density
Manufactured Sand	✓			Low secondary mineral content with 4% shrink swell fines
Gabion/Revetment	✓			Suitable
Risk Rating Source Rock	**Low**	**Mod**	**High**	
Alkali Silica Reactivity	✓			Some risk given occurrence of ferro-magnesian glass
Secondary Mineral Impacts	✓			Low volumes of secondary mineral evident. These should be monitored although at current volumes are of negligible risk
Durability	✓			Predicted to be durable
Strength	✓			Very Strong
Hardness	✓			Hard
Free Silica Content	✓			Nil
Sulfide content	✓			Minor sulphides visible in hand specimen

*Low risk means a low probability of causing source rock related issues in regard to material performance in any particular applications. Risk is recommended to be considered in conjunction with a sampling frequency protocol for production of any particular product.

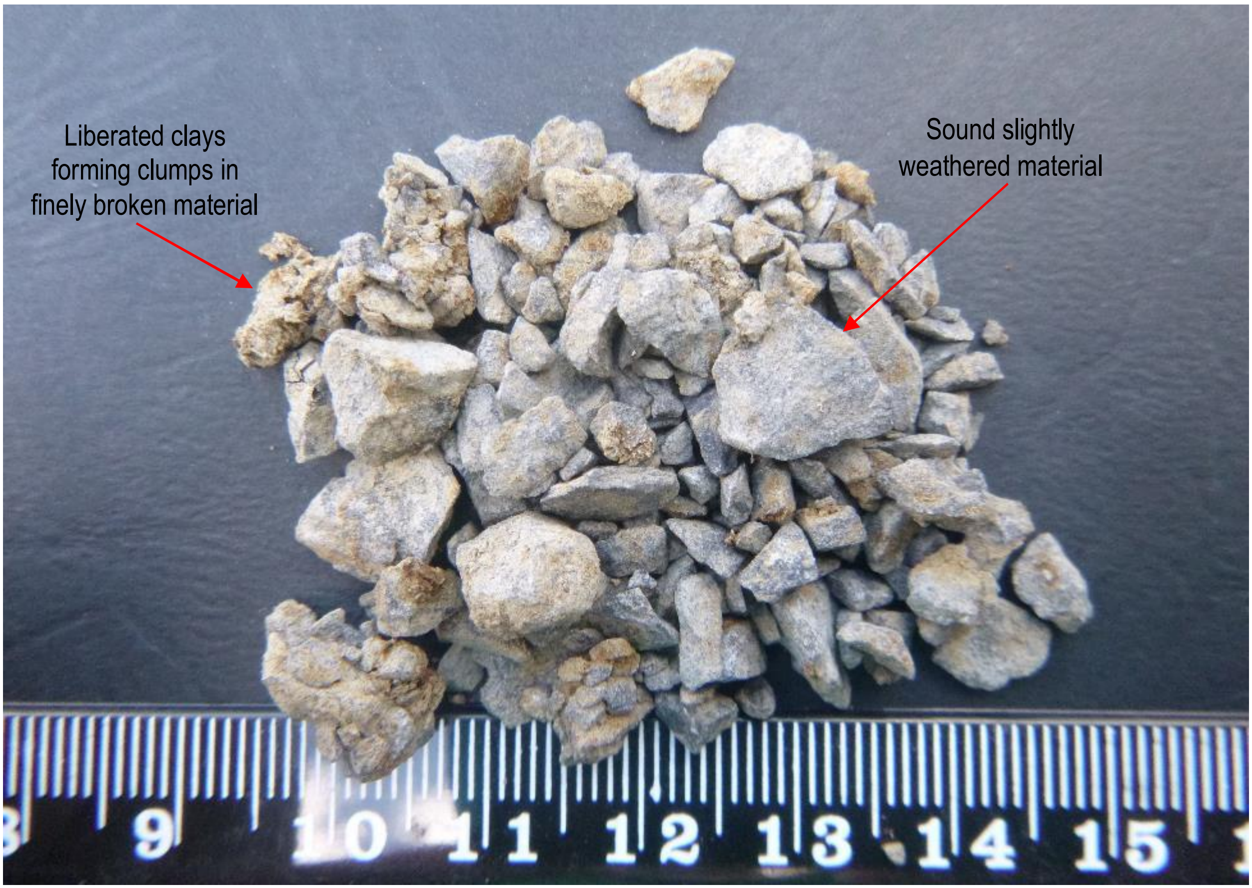


Plate 1. Photograph displaying unwashed slightly to moderately weathered material with sound and clay bound crushed material

Introduction

This report provides the results of a general petrographic assessment of an aggregate sample which was submitted to the Groundwork Plus Petrographic Laboratory. This report describes the method and standards used to assess the sample. The thin section was prepared and analysed by Groundwork Plus Petrographic Services. Communication of subsequent findings are advised by AS 1726-1993 Geotechnical Site Investigations.

Method

The petrographic assessment of the slide was carried out using a Nikon polarising microscope equipped with a digital camera at the Groundwork Plus Petrographic Laboratory. A photograph of the hand specimen and thin section photomicrographs showing grain sizes and any particular aspects of the minerals were included as part of the report (**Plates 1**, **2** and **3**). Modal analysis was conducted on the sample using JMicroVision image analysis software on 200 points (**Table 2 – Modal Analysis of Minerals)**.

The petrology assessment for Alkali Silica Reactivity was based on:

- ASTM C 295 Standard Guide for Petrographic Assessment of Aggregates for Concrete
- AS2758.1 – 1998 Aggregates and rock for engineering purposes part 1: Concrete aggregates (Appendix B)
- AS1141 Standard Guide for the Method for sampling and testing aggregates
- Alkali Aggregate Reaction - Guidelines on Minimising the Risk of Damage to Concrete Structure in Australia - Cement and Concrete Association of Australia and Standards Australia (HB 79-1996)
- The accepted definition of free silica is set out in the Queensland Department of Transport and Main Roads Test Method Q188, and tested pursuant to the Standard Guide for the Method of Sampling and Testing Aggregates AS 1141.

Petrographic Description

Name: Basalt

Lithology: Basic Igneous Rock

Hand Specimen Description

The sample was taken at a depth of 12m and represents a 1m zone of increased weathering in the rock's profile. It is described as a black, finely grained and phaneritic igneous rock. Fragments range from 0.5 to 26.0mm and are composed of visible plagioclase, pyroxene, olivine and magnetite crystals. Grains are highly magnetic and minor sulphides are observed in hand sample.

Plate 2. Microphotograph displaying a basalt fragment which exhibits comprehensive devitrification as bright orange interstitial replacement resulting in smectite clays and minor chlorite. Image shown in cross polarised light.

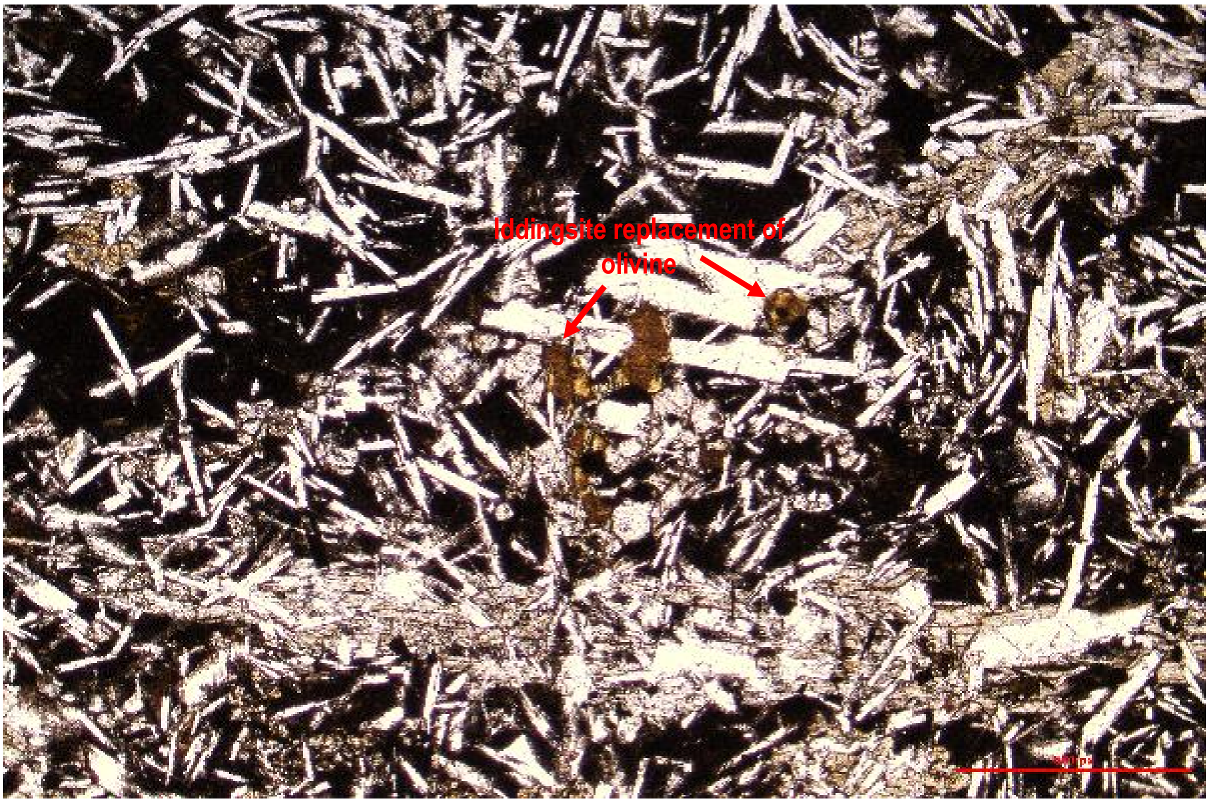


Plate 3. Microphotograph displaying iddingsite replacement of olivine and abundant semi-opaque ferro-magnesian glass with magnetite and minor sulfide opaques. Image shown in plane polarised light.

Thin Section Description

The basalt rock chips provided represent a mafic igneous event composed of mantle derived magma. The source rock is hypidiomorphic, hypocrystalline and sub-ophitic in nature indicating an interruption to the crystallisation sequence. Flow lineation, otherwise common among plagioclase laths in basalts of this kind is consistently absent in this sample. Preferential alignment develops due to the low silica levels and related low viscosity of basalt and is frequently associated with the levels of volcanic glass observed. This basalt can therefore be interpreted as the product of a shallow intrusion forming a sill or dyke complex. This would account for the erratic plagioclase orientation, fecund nucleation and the occurrence of a vitric mesostase component of the basalt. In practical terms this means that gas bubbles trapped in surface eruptions and associated with a high volatile component will be largely absent. The resulting non-porous rock will possess superior resistance to weathering via water ingress and transport and manifest in the field as a consistent albeit confined and fine grained deposit.

Euhedral plagioclase laths are pristine and exhibit random orientation. Subsequent pyroxene formation is confined to available space frequently resulting in poikilitic crystal growth encapsulating predating plagioclase laths. Olivine crystals are observed as 0.1 to 0.5mm euhedral crystals which display iddingsite alteration as characteristic sawtooth alteration patterns associated with iron oxide staining. A vitric mesostasis of ferro-magnesian volcanic glass occupies remaining space. This glass is semi-opaque with extensive perlitic cracks and is the product of magma quenching causing rapid crystal nucleation preventing further crystal growth. Subsequent devitrification has nucleated along these perlitic cracks and produced chlorite and smectite clay due to deuteric alteration. Devitrification and subsequent alteration is not universal and much of the volcanic glass remains pristine. In this case, the rock maintains all of its strength and non-absorptive nature.

Opaques are common in the sampled basalt and are identified in hand specimen as magnetite, which accounts for the significant magnetism of the sample, and a minor pyritic phase. These have not oxidised to cause significant staining and are among the sample's robust phases. A consequence of the sample's randomly orientated crystals is enhanced grain cohesion. This textural feature is well suited to engineering projects such as road pavements and cover aggregates which require even load dispersal among a rock's constituent grains to prevent disaggregation and/or flaky aggregate shape.

Table 2 – Modal Analysis of Minerals

MINERALS	**MODE (per cent)**	**COMMENTS**
Plagioclase	45	Occur as 0.2 to 0.6mm laths
Volcanic Glass	19	Ferro-magnesian mesostasis
Pyroxene	12	Interstitial crystals with sub-ophitic plagioclase
Opaques	8	Magnetite and minor pyrite as observed in hand sample
Sanidine Feldspar	5	As twinned 0.4mm blades
Olivine	4	As 0.1 to 0.5mm euhedral crystals
Apatite	Trace	As 0.1mm rods
SECONDARY MINERALS		
Smectite	3	Alteration product of devitrified volcanic glass
Iddingsite	2	Replacement product of olivine
Chlorite	1	Associated with smectite formation. Predates complete clay replacement
Iron Oxide	1	Minor staining associated with olivine alteration and devitrification reaction
Total	**100**	

Interpretation

Crushed rock represent by this sample is predicted to be suitable for use as Coarse Aggregate in Concrete (MRTS70), Cover Aggregate (MRTS22), Unbound Pavement (MRTS05) and Manufactured Sand. The rock is suitable for Gabion and Revetment and, depending upon jointing density in the field, source rock may also have utility as Marine Armour Rock.

For engineering purposes the aggregate may be summarised as:

- Basalt, a basic igneous rock.
- Slightly weathered with fines occupied by smectite clays.
- Composed principally of robust minerals (93%).
- Hard, strong and durable.
- Containing nil free silica.
- Regarded as having potential for mild alkali-silica reactivity in concrete due to abundant volcanic glass.

Free Silica Content

Nil free silica content.

Enquiries regarding the content of this report should be directed to Groundwork Plus 07 3871 0411

Samples are disposed of after 3 months from the date of report. Thin sections will remain on site indefinitely.

GROUNDWORK
plus
Resources, Environment, Planning, Laboratories

Petrographic Inspection Report

Title:	Petrographic Report on Percussive Drill Fragments
Prepared for:	Quarry Solutions
Client Ref.	Hole 8

Date Sampled:	25/03/2015
Sample Type.	Basalt Aggregate
Source:	Coraki
Sample ID:	1837-H8

Date of Inspection:	14/04/2015
Report Issued:	17/04/2015
Project/ File Ref.	P2015.0023.002

Contributing Author:

Luke Ryan (BGeo)
Geologist,
Groundwork Plus

Principal Inspector:

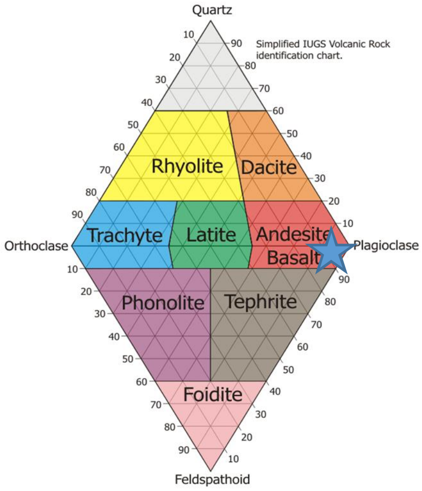
Rod Huntley

Rod Huntley (BSc, M.App.Sc, M.Eng)
Principal Resource Consultant,
Groundwork Plus

Groundwork Plus ABN: 80 829 145 906
6 Mayneview Street, Milton QLD 4064
P: +61 7 3871 0411 F: +61 7 3367 3317
E: info@groundwork.com.au

www.groundwork.com.au

Summary



- The supplied rock fragments are identified as aggregate of **Basalt** derivation, defined as a fine grained **Basic Igneous Rock.**
- The hand sample is described as a black, finely phaneritic igneous rock with fragments of free clay that range in size from 0.2 and 30.0mm. The drill chips are composed of visible plagioclase, pyroxene, olivine and magnetite crystals and are highly magnetic. Minor sulphides are observed in hand sample as a pyrite phase.
- Petrographic analysis reveals the rock is comprised principally of plagioclase (50%), pyroxene (12%), opaques including magnetite (9%), olivine (5%), sanidine feldspar (5%) and apatite crystals (1%). Interstitial to these crystalline phases ferro-magnesian glass has formed (14%) the devitrification of which has produced secondary smectite clay (2%), chlorite (1%), iddingsite (1%) and trace iron oxide.
- The rock sample is composed primarily of robust primary minerals and volcanic glass (96%) with the balance accounted for by secondary glass derived clay and phyllosilicate phases with iron oxide (4%). Of these 1% is available as weak material coating the chips as fine brown dust with the remained locked within the fabric of competent rock.
- The rock contains nil free silica as quartz species. However, ferro-magnesian volcanic glass comprises a significant proportion of the rock. While evidently silica under-saturated it is prudent given the uncertain chemistry of this glass to regard the sampled rock as having potential for mild alkali-silica reactivity in concrete.
- Accordingly, aggregate represent by this sample is predicted to be suitable for use as Coarse Aggregate in Concrete (MRTS70), Cover Aggregate (MRTS22), Unbound Pavement (MRTS05), and Manufactured Sand. The rock is suitable for Gabion and Revetment and depending upon jointing density in the field source rock may also have utility as Marine Armour Rock.
- For engineering purposes the aggregate may be summarised as:
  - Basalt, a basic igneous rock.
  - Essentially unweathered and non-porous with slight alteration.
  - Composed principally of robust material.
  - Hard, strong and durable.
  - Containing nil free silica but 14% ferro-magnesian volcanic glass.
  - Regarded as prudent to view the source rock as having potential for mild alkali-silica reactivity in concrete.

Table 1 – Risk Rating for Specific Applications and Source Rock Quality

Risk Rating for Application	**Low**	**Mod**	**High**	**Comments (Assuming the sample is indicative of overall source rock quality)**
Concrete Aggregates	✓			Low secondary mineral count so water demand should be low
Unbound Pavements	✓			Suitable high strength, hard and durable material
Cover Aggregates	✓			Suitable high strength, hard and durable material
Marine Armour	✓			Rock classifies as excellent pursuant to CIRIA guidelines with high density
Manufactured Sand	✓			Low secondary mineral content with low smectite clay levels
Gabion/Revetment	✓			Suitable
Risk Rating Source Rock	**Low**	**Mod**	**High**	
Alkali Silica Reactivity	✓			Perceived low risk due to volcanic glass
Secondary Mineral Impacts	✓			4% of secondary mineral evident component should be monitored although at current volumes is of negligible risk
Durability	✓			Durable
Strength	✓			Very Strong
Hardness	✓			Suitable
Free Silica Content	✓			Nil in this rock
Sulfide content	✓			Minor sulphides visible in hand specimen

*Low risk means a low probability of causing source rock related issues in regard to material performance in any particular applications. Risk is recommended to be considered in conjunction with a sampling frequency protocol for production of any particular product.

Plate 1. Photograph displaying unweathered basalt composed of fine plagioclase in a mafic groundmass including pyroxene and ferro-magnesian glass. Residual dust is minimal with fractured faces containing little stubborn clay fines.

Introduction

This report provides the results of a general petrographic assessment of a crushed rock sample which was submitted to the Groundwork Plus Petrographic Laboratory. This report describes the method and standards used to assess the sample. The thin section was prepared and analysed by Groundwork Plus Petrographic Services. Communication of subsequent findings are advised by AS 1726-1993 Geotechnical Site Investigations.

Method

The petrographic assessment of the slide was carried out using a Nikon polarising microscope equipped with a digital camera at the Groundwork Plus Petrographic Laboratory. A photograph of the hand specimen and thin section photomicrographs showing grain sizes and any particular aspects of the minerals were included as part of the report (**Plates 1**, **2** and **3**). Modal analysis was conducted on the sample using JMicroVision image analysis software on 200 points (**Table 2 – Modal Analysis of Minerals)**.

The petrology assessment for Alkali Silica Reactivity was based on:

- ASTM C 295 Standard Guide for Petrographic Assessment of Aggregates for Concrete
- AS2758.1 – 1998 Aggregates and rock for engineering purposes part 1: Concrete aggregates (Appendix B)
- AS1141 Standard Guide for the Method for sampling and testing aggregates
- Alkali Aggregate Reaction - Guidelines on Minimising the Risk of Damage to Concrete Structure in Australia - Cement and Concrete Association of Australia and Standards Australia (HB 79-1996)
- The accepted definition of free silica is set out in the Queensland Department of Transport and Main Roads Test Method Q188, and tested pursuant to the Standard Guide for the Method of Sampling and Testing Aggregates AS 1141.

Petrographic Description

Name: Basalt

Lithology: Basic Igneous Rock

Hand Specimen Description

The hand sample is described as black, finely phaneritic igneous rock with fragments clear of clays and ranging in size from 0.2 and 30.0mm. Chips are composed of visible plagioclase, pyroxene, olivine and magnetite crystals and are highly magnetic. Larger fragments often display increased superficial weathering suggesting that while the rock is essentially unweathered at depth jointing or fracturing has permitted meteoric ingress. The density of such jointing planes will determine the proportion of fresh rock versus weathered material. Minor sulphides are observed in hand sample.

Plate 2. Microphotograph displaying representative mineral assemblage of the basalt including abundant plagioclase laths, pyroxene and olivine with opaques and semi-opaque volcanic glass.

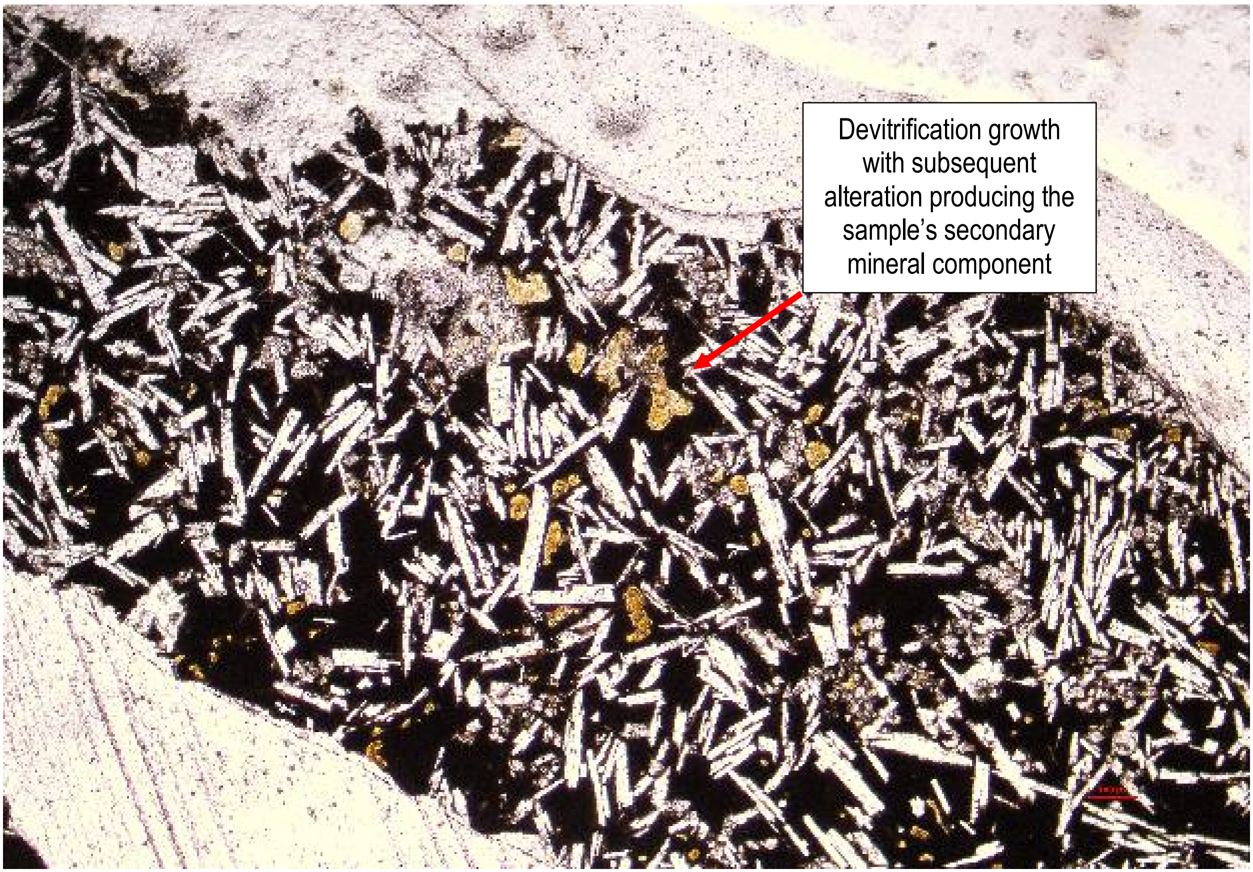


Plate 3. Microphotograph displaying the progression of devitrification of the glass as orange emanating growths through the opaque zones of the sample. These opaque zones are occupied by ferro-magnesian glass, magnetite and minor pyritic phase. Much of the sample's subordinate weak and absorptive component has developed as a consequence of this reaction and the alteration of olivine to iddingsite. Image shown in plane polarised light.

Thin Section Description

Petrographic analysis reveals the rock chips provided are of basaltic derivation with chemical and textural characteristics consistent with the shallow emplacement of mantle derived magma. The source rock is hypidiomorphic, hypocrystalline and sub-ophitic in nature indicating a relatively sudden interruption in the crystallisation sequence sufficient to quench the silica undersatured melt to form ferro-magnesian glass. This textural feature is usually displayed by rock with an abrupt extrusive, genies volcanic history and is therefore associated with flow lineations among plagioclase laths and preserved gas bubbles. These last are, however, absent indicating that atmospheric conditions did not influence the formation of this basalt and that this rock has formed as a shallow intrusive flow with a large cooling surface area amid the host rock.

In practical terms, this has beneficial implications for the basalts utility in engineering projects as the consequently random orientation of the plagioclase crystals provides enhanced grain cohesion in the rock. This feature is well suited to road pavements and cover aggregates and other projects which require even load dispersal among a rock's constituent grains to prevent disaggregation and/or flaky aggregate shape. Further to this, the absence of vesicles (gas bubbles) in the basalt which form due to the abrupt exposure of a magma's volatile component to atmospheric conditions, means that this rock shows increased resistance to weathering by the ingress of meteoric waters. Such ingress is facilitated by the porosity created by these cavities.

Euhedral plagioclase laths are pristine and measure 0.2 to 0.5mm in length. Subsequent pyroxene formation is confined to available space frequently resulting in poikilitic crystal growth encapsulating predating plagioclase laths in long 2 to 3mm crystals. Olivine is observed as 0.1 to 0.5mm euhedral crystals which display iddingsite alteration as characteristic sawtooth alteration patterns associated with iron oxide staining. A vitric mesostasis of ferro-magnesian volcanic glass occupies the remaining interstitial space. This glass is semi-opaque to opaque depending on the iron and magnesium content with extensive perlitic cracks. It has formed due to magma quenching causing rapid crystal nucleation preventing further crystal growth. Subsequent devitrification has nucleated along these perlitic cracks and produced chlorite and smectite clay due to deuteric alteration. Devitrification and subsequent alteration is not universal and much of the volcanic glass remains pristine. In this case, the rock maintains all of its strength and when crushed produces non-absorptive fines.

Opaques are common in the sampled basalt and are identified in hand specimen as magnetite, which accounts for the significant magnetism of the sample, and a minor pyritic phase. These have not oxidised to cause significant staining and are among the sample's robust phases.

Table 2 – Modal Analysis of Minerals

MINERALS	MODE (per cent)	COMMENTS
Plagioclase	50	Occur as 0.2 to 0.6mm laths
Volcanic Glass	14	Ferro-magnesian mesostasis
Pyroxene	12	Interstitial crystals with sub-ophitic plagioclase
Opaques	9	Magnetite and minor pyrite as observed in hand sample
Sanidine Feldspar	5	As twinned 0.4mm blades
Olivine	5	As 0.1 to 0.5mm euhedral crystals
Apatite	1	As 0.1mm rods
SECONDARY MINERALS		
Smectite	2	Alteration product of devitrified volcanic glass
Iddingsite	1	Replacement product of olivine
Chlorite	1	Associated with smectite formation. Predates complete clay replacement
Iron Oxide	Trace	Minor staining associated with olivine alteration and devitrification reaction
Total	**100**	

Interpretation

Accordingly, aggregate represent by this sample is predicted to be suitable for use as Coarse Aggregate in Concrete (MRTS70), Cover Aggregate (MRTS22), Unbound Pavement (MRTS05), and Manufactured Sand. The rock is suitable for Gabion and Revetment and depending upon jointing density in the field source rock may also have utility as Marine Armour Rock.

For engineering purposes the aggregate may be summarised as:

- Basalt, a basic igneous rock.
- Essentially unweathered and non-porous with slight alteration.
- Composed principally of robust material (96%).
- Hard, strong and durable.
- Containing nil free silica but 14% ferro-magnesian volcanic glass.
- Viewed as prudent to regard the source rock as having potential for mild alkali-silica reactivity in concrete.

Silica Content

Nil free silica.

Enquiries regarding the content of this report should be directed to Groundwork Plus 07 3871 0411

Samples are disposed of after 3 months from the date of report. Thin sections will remain on site indefinitely.

Attachment 3

Core Drill Hole Log

GROUNDWORK plus

CORE DRILL HOLE LOG

HOLE NO: QCC15-01
Page: 1 of 2

Client:	Quarry Solutions	Datum (H):	MGA94 Z56	Drill Co:	Statewide Drilling
Project:	Coraki Quarry	Easting:	525443	Drill Rig:	Cortech CSD 1300G
Job No:	1837	Northing:	6794922	Driller:	Trev
Location/RP:		Datum (V):	AHD	Core Dia (mm):	82mm
Start Date:	8/13/2015	Elevation:	37.5	Core Length (m):	21.5
End Date:	8/13/2015	Dip / Azimuth:	-90 / 0	Logged By:	Luke Ryan

Depth (m) Scale 1:100 | Fr-St Fr SW DW XW RS Weathering | Symbolic Log | Strength EL VL L M H VH EH | RQD (%) 0 20 40 60 80 100 | Sample Interval | RMR 0 20 40 60 80 100 | Elevation (m) Scale 1:100

Depth (m): 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21

Geological Description Rock Type, Colour, Grain Size, Texture, Mineral Constituents	Alteration
Red lithosol with basalt float showing significant smectite clay forming limonite infill in abundant fractures. Rock weak and easily broken disagregated. High density jointing with advanced chloritic alteration	Sericitisation and chloritisation
Basalt with low density iron oxide stained fractures. Sericitisation among plagioclase microlites observed lightening rock and producing white dust	Sericitisation
Moderately fractured rock with jointing planes occupied with weathered basalt fragments with smectite clay and iron oxide staining	Sericitisation and chloritisation Sericitisation Sericitisation and chloritisation
Basalt with low density iron oxide stained fractures. Sericitisation among plagioclase microlites observed lightening rock and producing white dust	Sericitisation
Moderately fractured rock with jointing planes occupied with weathered basalt fragments with smectite clay and iron oxide staining	Sericitisation and chloritisation
Basalt with low density iron oxide stained fractures. Sericitisation among plagioclase microlites observed lightening rock and producing white dust	Sericitisation
Moderately fractured rock with jointing planes occupied with weathered basalt fragments with smectite clay and iron oxide staining	
Highly competent dark rock with trace chloritisation and minor iron oxide stained fractures	
Moderate density rock fracturing with elevated chloritisation and and smectite clay occupying 0.5 to 1.0mm fractures	Chloritisation Hydration to clays with remnant chlorite
Smectite clay with remnant extremely weathered basalt	
Clayey medium grained psamite sandstone	Hydration

Elevation (m): 37 36 35 34 33 32 31 30 29 28 27 26 25 24 23 22 21 20 19 18 17

Rock Weathering Classification:

RS	Residual Soil	Soil developed on extremely weathered rock
XW	Extremely Weathered	Rock weathered to such anextent it has 'soil' properties
DW	Distinctly Weathered	Rock strength usually changed by weathering
SW	Slightly Weathered	Slightly discoloured but little/no change in strength from fresh
Fr-St	Fresh - Stained Joints	Fresh but with stained joints
Fr	Fresh	No sign of decomposition/staining

Strength of Rock Material:		Point load index (MPa):
EL	Extremely Low	≤ 0.03
VL	Very Low	> 0.03 ≤ 0.1
L	Low	> 0.1 ≤ 0.3
M	Medium	> 0.3 ≤ 1
H	High	> 1 ≤ 3
VH	Very High	> 3 ≤ 10
EH	Extremely High	> 10

Rock Mass Rating: (after Bienawski)

81-100	Very Good
61-80	Good
41-60	Fair
21-40	Poor
0-20	Very Poor

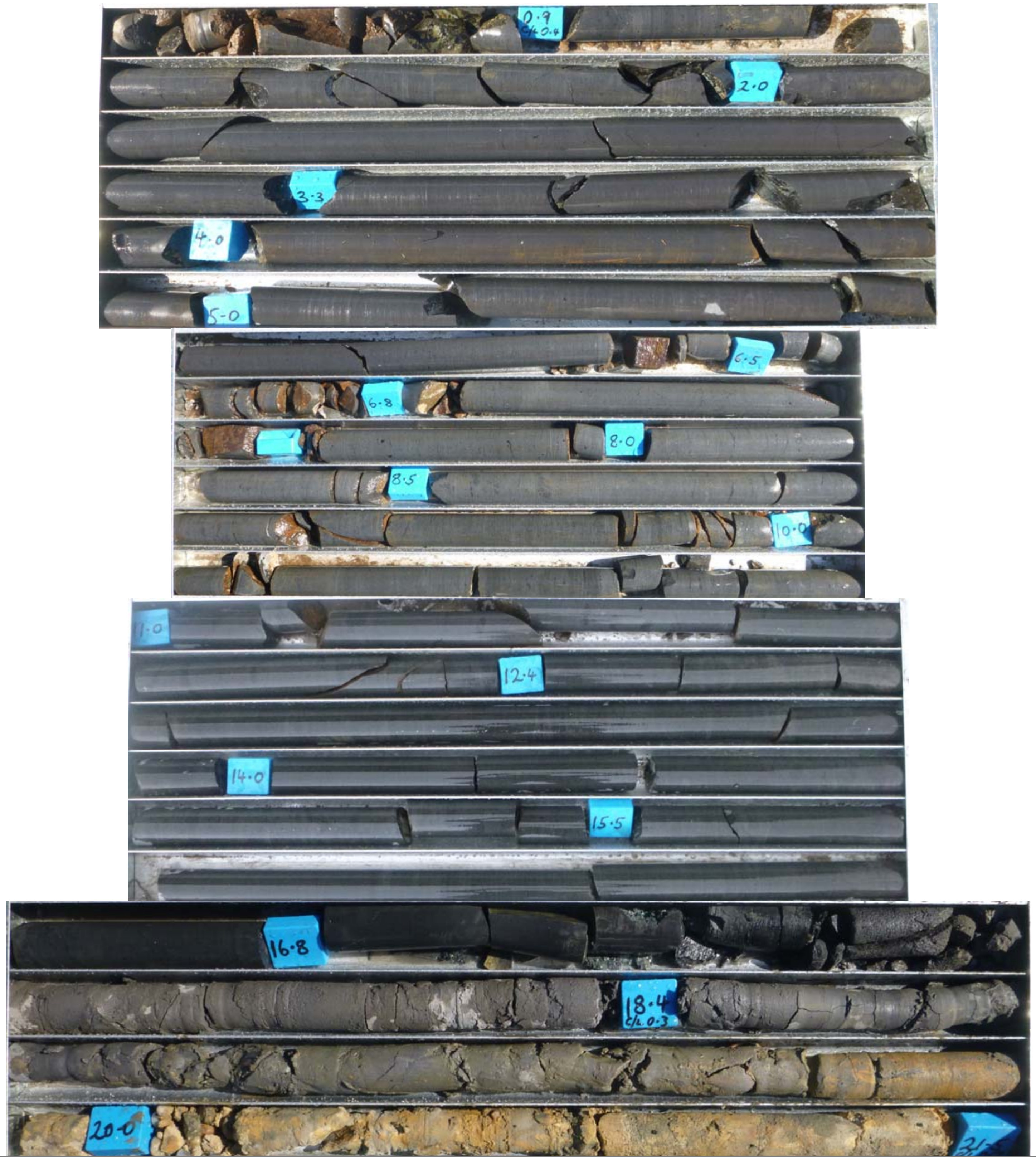
Notes:

1. All depths quoted with respect to ground surface measured along axis.
2. Angles of planar features quoted with respect to hole axis.
3.
4.

GROUNDWORK plus

CORE PHOTOGRAPHS

HOLE NO: QCC15-01
Page: 1 of 2



CORE DRILL HOLE LOG

HOLE NO: QCC15-01

Page: 2 of 2

Client:	Quarry Solutions	Datum (H):	MGA94 Z56	Drill Co:	Statewide Drilling
Project:	Coraki Quarry	Easting:	525443	Drill Rig:	Cortech CSD 1300G
Job No:	1837	Northing:	6794922	Driller:	Trev
Location/RP:		Datum (V):	AHD	Core Dia (mm):	82mm
Start Date:	8/13/2015	Elevation:	37.5	Core Length (m):	21.5
End Date:	8/13/2015	Dip / Azimuth:	-90 / 0	Logged By:	Luke Ryan

Depth (m) Scale 1:100	Weathering Fr-St Fr SW DW XW RS	Symbolic Log	Geological Description Rock Type, Colour, Grain Size, Texture, Mineral Constituents	Strength EL VL L M H VH EH	Alteration	RQD (%) 0 20 40 60 80 100	Sample Interval	RMR 0 20 40 60 80 100	Elevation (m) Scale 1:100
			●						16

EOH 21.5m

CORE PHOTOGRAPHS

HOLE NO: QCC15-01

Page: 2 of 2

Rock Weathering Classification:

RS	Residual Soil	Soil developed on extremely weathered rock
XW	Extremely Weathered	Rock weathered to such anextent it has 'soil' properties
DW	Distinctly Weathered	Rock strength usually changed by weathering
SW	Slightly Weathered	Slightly discoloured but little/no change in strength from fresh
Fr-St	Fresh - Stained Joints	Fresh but with stained joints
Fr	Fresh	No sign of decomposition/staining

Strength of Rock Material:		Point load index (MPa):
EL	Extremely Low	≤ 0.03
VL	Very Low	> 0.03 ≤ 0.1
L	Low	> 0.1 ≤ 0.3
M	Medium	> 0.3 ≤ 1
H	High	> 1 ≤ 3
VH	Very High	> 3 ≤ 10
EH	Extremely High	> 10

Rock Mass Rating: (after Bienawski)

81-100	Very Good
61-80	Good
41-60	Fair
21-40	Poor
0-20	Very Poor

Notes:

1. All depths quoted with respect to ground surface measured along axis.
2. Angles of planar features quoted with respect to hole axis.
3.
4.

CORE DRILL HOLE LOG

HOLE NO: QCC15-02
Page: 1 of 2

Client:	Quarry Solutions	Datum (H):	MGA94 Z56	Drill Co:	Statewide Drilling
Project:	Coraki Quarry	Easting:	525569	Drill Rig:	Cortech CSD 1300G
Job No:	1837	Northing:	6794954	Driller:	Trev
Location/RP:		Datum (V):	AHD	Core Dia (mm):	82mm
Start Date:	8/11/2015	Elevation:	34.517	Core Length (m):	23
End Date:	8/11/2015	Dip / Azimuth:	-90 / 0	Logged By:	Luke Ryan

Depth (m) Scale 1:100	Fr Fr-St SW DW XW RS Weathering	Symbolic Log	Geological Description Rock Type, Colour, Grain Size, Texture, Mineral Constituents	EL VL L M H VH EH Strength	Alteration	RQD (%) 0 20 40 60 80 100	Sample Interval	RMR 0 20 40 60 80 100	Elevation (m) Scale 1:100
0			Clayey loam with limonite and remnant basalt float		Hydration / oxidation				34
1			Significant smectite clay forming limonite infill in abundant fractures. Rock weak and easily broken disagregated. High density jointing with advanced chloritic alteration		Chloritisation				33
4			Basalt with low density iron oxide stained fractures. Sericitisation among plagioclase microlites observed lightening rock and producing white dust		Sericitisation and chloritisiation				30
10			Highly competent dark rock with trace chloritisation and minor iron oxide stained fractures		Sericitisation				24
19			Moderate density rock fracturing with elevated chloritisation and and smectite clay occupying 0.5 to 1.0mm fractures		Chloritisation				15
20			Smectite clay with remnant extremely weathered basalt		Hydration to clays with remnant chlorite				14
21									

Rock Weathering Classification:

RS	Residual Soil	Soil developed on extremely weathered rock
XW	Extremely Weathered	Rock weathered to such anextent it has 'soil' properties
DW	Distinctly Weathered	Rock strength usually changed by weathering
SW	Slightly Weathered	Slightly discoloured but little/no change in strength from fresh
Fr-St	Fresh - Stained Joints	Fresh but with stained joints
Fr	Fresh	No sign of decomposition/staining

Strength of Rock Material:		Point load index (MPa):
EL	Extremely Low	≤ 0.03
VL	Very Low	> 0.03 ≤ 0.1
L	Low	> 0.1 ≤ 0.3
M	Medium	> 0.3 ≤ 1
H	High	> 1 ≤ 3
VH	Very High	> 3 ≤ 10
EH	Extremely High	> 10

Rock Mass Rating: (after Bienawski)

81-100	Very Good
61-80	Good
41-60	Fair
21-40	Poor
0-20	Very Poor

Notes:

1. All depths quoted with respect to ground surface measured along axis.
2. Angles of planar features quoted with respect to hole axis.
3.
4.

CORE PHOTOGRAPHS

HOLE NO: QCC15-02
Page: 1 of 2

CORE DRILL HOLE LOG

HOLE NO: QCC15-02

Page: 2 of 2

Client:	Quarry Solutions	Datum (H):	MGA94 Z56	Drill Co:	Statewide Drilling
Project:	Coraki Quarry	Easting:	525569	Drill Rig:	Cortech CSD 1300G
Job No:	1837	Northing:	6794954	Driller:	Trev
Location/RP:		Datum (V):	AHD	Core Dia (mm):	82mm
Start Date:	8/11/2015	Elevation:	34.517	Core Length (m):	23
End Date:	8/11/2015	Dip / Azimuth:	-90 / 0	Logged By:	Luke Ryan

Depth (m) Scale 1:100	Weathering Fr Fr-St SW DW XW RS	Symbolic Log	Geological Description Rock Type, Colour, Grain Size, Texture, Mineral Constituents	Strength EL VL L M H VH EH	Alteration	RQD (%) 0 20 40 60 80 100	Sample Interval	RMR 0 20 40 60 80 100	Elevation (m) Scale 1:100
22 23			Clayey medium grained psamite sandstone		Hydration				13 12

EOH 23m

Rock Weathering Classification:		
RS	Residual Soil	Soil developed on extremely weathered rock
XW	Extremely Weathered	Rock weathered to such anextent it has 'soil' properties
DW	Distinctly Weathered	Rock strength usually changed by weathering
SW	Slightly Weathered	Slightly discoloured but little/no change in strength from fresh
Fr-St	Fresh - Stained Joints	Fresh but with stained joints
Fr	Fresh	No sign of decomposition/staining

Strength of Rock Material:		Point load index (MPa):
EL	Extremely Low	≤ 0.03
VL	Very Low	> 0.03 ≤ 0.1
L	Low	> 0.1 ≤ 0.3
M	Medium	> 0.3 ≤ 1
H	High	> 1 ≤ 3
VH	Very High	> 3 ≤ 10
EH	Extremely High	> 10

Rock Mass Rating: (after Bienawski)	
81-100	Very Good
61-80	Good
41-60	Fair
21-40	Poor
0-20	Very Poor

Notes:

1. All depths quoted with respect to ground surface measured along axis.
2. Angles of planar features quoted with respect to hole axis.
3.
4.

CORE PHOTOGRAPHS

HOLE NO: QCC15-02

Page: 2 of 2

GROUNDWORK plus

CORE DRILL HOLE LOG

HOLE NO: QCC15-03

Page: 1 of 2

Client:	Quarry Solutions	Datum (H):	MGA94 Z56	Drill Co:	Statewide Drilling
Project:	Coraki Quarry	Easting:	525696	Drill Rig:	Cortech CSD 1300G
Job No:	1837	Northing:	6794975	Driller:	Trev
Location/RP:		Datum (V):	AHD	Core Dia (mm):	82mm
Start Date:	8/12/2015	Elevation:	31.279	Core Length (m):	24.5
End Date:	8/12/2015	Dip / Azimuth:	-90 / 0	Logged By:	Luke Ryan

Depth (m) Scale 1:100 | Fr-St Fr SW DW XW RS Weathering | Symbolic Log | Geological Description Rock Type, Colour, Grain Size, Texture, Mineral Constituents | EL VL L M H VH EH Strength | Alteration | RQD (%) 0 20 40 60 80 100 | Sample Interval | RMR 0 20 40 60 80 100 | Elevation (m) Scale 1:100

Geological Description

- Clayey loam with limonite and large remnant basalt float
- Significant smectite clay forming limonite infill in abundant fractures. Rock weak and easily broken disagregated. High density jointing with advanced chloritic alteration
- Basalt with low density iron oxide stained fractures. Sericitisation among plagioclase microlites observed lightening rock and producing white dust
- Moderately fractured rock with jointing planes occupied with weathered basalt fragments with smectite clay and iron oxide staining
- Highly competent dark rock with trace chloritisation and minor iron oxide stained fractures

Alteration

- Hydration / oxidation
- Sericitisation and chloritisation
- Sericitisation

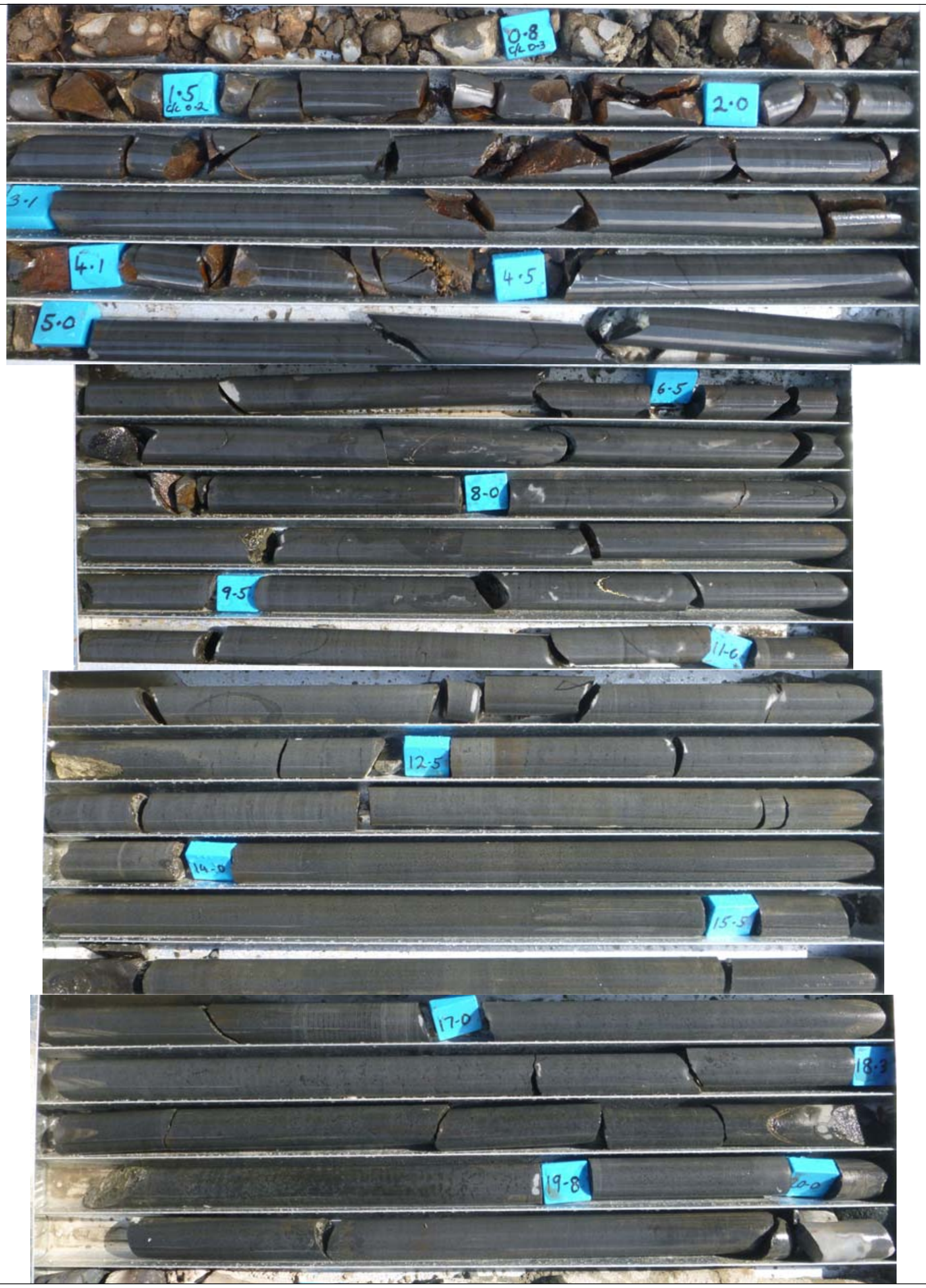
Depth (m)	Elevation (m)
0	31
1	30
2	29
3	28
4	27
5	26
6	25
7	24
8	23
9	22
10	21
11	20
12	19
13	18
14	17
15	16
16	15
17	14
18	13
19	12
20	11
21	10

GROUNDWORK plus

CORE PHOTOGRAPHS

HOLE NO: QCC15-03

Page: 1 of 2



Rock Weathering Classification:

RS	Residual Soil	Soil developed on extremely weathered rock
XW	Extremely Weathered	Rock weathered to such anextent it has 'soil' properties
DW	Distinctly Weathered	Rock strength usually changed by weathering
SW	Slightly Weathered	Slightly discoloured but little/no change in strength from fresh
Fr-St	Fresh - Stained Joints	Fresh but with stained joints
Fr	Fresh	No sign of decomposition/staining

Strength of Rock Material:		Point load index (MPa):
EL	Extremely Low	≤ 0.03
VL	Very Low	> 0.03 ≤ 0.1
L	Low	> 0.1 ≤ 0.3
M	Medium	> 0.3 ≤ 1
H	High	> 1 ≤ 3
VH	Very High	> 3 ≤ 10
EH	Extremely High	> 10

Rock Mass Rating: (after Bienawski)

81-100	Very Good
61-80	Good
41-60	Fair
21-40	Poor
0-20	Very Poor

Notes:

1. All depths quoted with respect to ground surface measured along axis.
2. Angles of planar features quoted with respect to hole axis.
3.
4.

CORE DRILL HOLE LOG

HOLE NO: QCC15-03

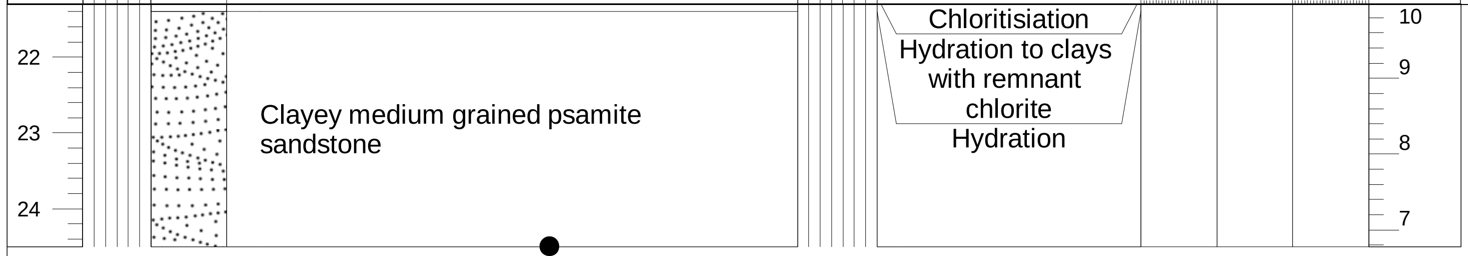
Page: 2 of 2

Client: Quarry Solutions
Project: Coraki Quarry
Job No: 1837
Location/RP:
Start Date: 8/12/2015
End Date: 8/12/2015

Datum (H): MGA94 Z56
Easting: 525696
Northing: 6794975
Datum (V): AHD
Elevation: 31.279
Dip / Azimuth: -90 / 0

Drill Co: Statewide Drilling
Drill Rig: Cortech CSD 1300G
Driller: Trev
Core Dia (mm): 82mm
Core Length (m): 24.5
Logged By: Luke Ryan

Depth (m) Scale 1:100	Weathering Fr-St Fr SW DW XW RS	Symbolic Log	Geological Description Rock Type, Colour, Grain Size, Texture, Mineral Constituents	Strength EL VL L M H VH EH	Alteration	RQD (%) 0 20 40 60 80 100	Sample Interval	RMR 0 20 40 60 80 100	Elevation (m) Scale 1:100
22 23 24			Clayey medium grained psamite sandstone		Chloritisiation Hydration to clays with remnant chlorite Hydration				10 9 8 7



EOH 24.5m

CORE PHOTOGRAPHS

HOLE NO: QCC15-03

Page: 2 of 2

Rock Weathering Classification:

RS	Residual Soil	Soil developed on extremely weathered rock
XW	Extremely Weathered	Rock weathered to such anextent it has 'soil' properties
DW	Distinctly Weathered	Rock strength usually changed by weathering
SW	Slightly Weathered	Slightly discoloured but little/no change in strength from fresh
Fr-St	Fresh - Stained Joints	Fresh but with stained joints
Fr	Fresh	No sign of decomposition/staining

Strength of Rock Material:		Point load index (MPa):
EL	Extremely Low	≤ 0.03
VL	Very Low	> 0.03 ≤ 0.1
L	Low	> 0.1 ≤ 0.3
M	Medium	> 0.3 ≤ 1
H	High	> 1 ≤ 3
VH	Very High	> 3 ≤ 10
EH	Extremely High	> 10

Rock Mass Rating: (after Bienawski)

81-100	Very Good
61-80	Good
41-60	Fair
21-40	Poor
0-20	Very Poor

Notes:

1. All depths quoted with respect to ground surface measured along axis.
2. Angles of planar features quoted with respect to hole axis.
3.
4.

GROUNDWORK plus

CORE DRILL HOLE LOG

HOLE NO: QCC15-04

Page: 1 of 2

Client: Quarry Solutions
Project: Coraki Quarry
Job No: 1837
Location/RP:
Start Date: 8/15/2015
End Date: 8/15/2015

Datum (H): MGA94 Z56
Easting: 525540
Northing: 6794759
Datum (V): AHD
Elevation: 42.302
Dip / Azimuth: -90 / 0

Drill Co: Statewide Drilling
Drill Rig: Cortech CSD 1300G
Driller: Trev
Core Dia (mm): 82mm
Core Length (m): 26
Logged By: Luke Ryan

Depth (m) Scale 1:100	Fr Fr-St SW DW XW RS Weathering	Symbolic Log	Geological Description Rock Type, Colour, Grain Size, Texture, Mineral Constituents	EL VL L M H VH EH Strength	Alteration	RQD (%) 0 20 40 60 80 100	Sample Interval	RMR 0 20 40 60 80 100	Elevation (m) Scale 1:100
0			Clayey loam with limonite and remnant basalt float		Hydration / oxidation				42
1			Moderate density rock fracturing with elevated chloritisation and and smectite clay occupying 0.5 to 1.0mm fractures		Chloritisation and hydration				41
2									40
3									39
4									38
5			Basalt with low density iron oxide stained fractures. Sericitisation among plagioclase microlites observed lightening rock and producing white dust						37
6									36
7									35
8									34
9									33
10									32
11									31
12									30
13					Sericitisation				29
14									28
15									27
16			Highly competent dark rock with trace chloritisation and minor iron oxide stained fractures						26
17									25
18									24
19									23
20									22
21									21

Rock Weathering Classification:

RS	Residual Soil	Soil developed on extremely weathered rock
XW	Extremely Weathered	Rock weathered to such anextent it has 'soil' properties
DW	Distinctly Weathered	Rock strength usually changed by weathering
SW	Slightly Weathered	Slightly discoloured but little/no change in strength from fresh
Fr-St	Fresh - Stained Joints	Fresh but with stained joints
Fr	Fresh	No sign of decomposition/staining

Strength of Rock Material:		Point load index (MPa):
EL	Extremely Low	≤ 0.03
VL	Very Low	> 0.03 ≤ 0.1
L	Low	> 0.1 ≤ 0.3
M	Medium	> 0.3 ≤ 1
H	High	> 1 ≤ 3
VH	Very High	> 3 ≤ 10
EH	Extremely High	> 10

Rock Mass Rating:
(after Bienawski)

81-100	Very Good
61-80	Good
41-60	Fair
21-40	Poor
0-20	Very Poor

Notes:

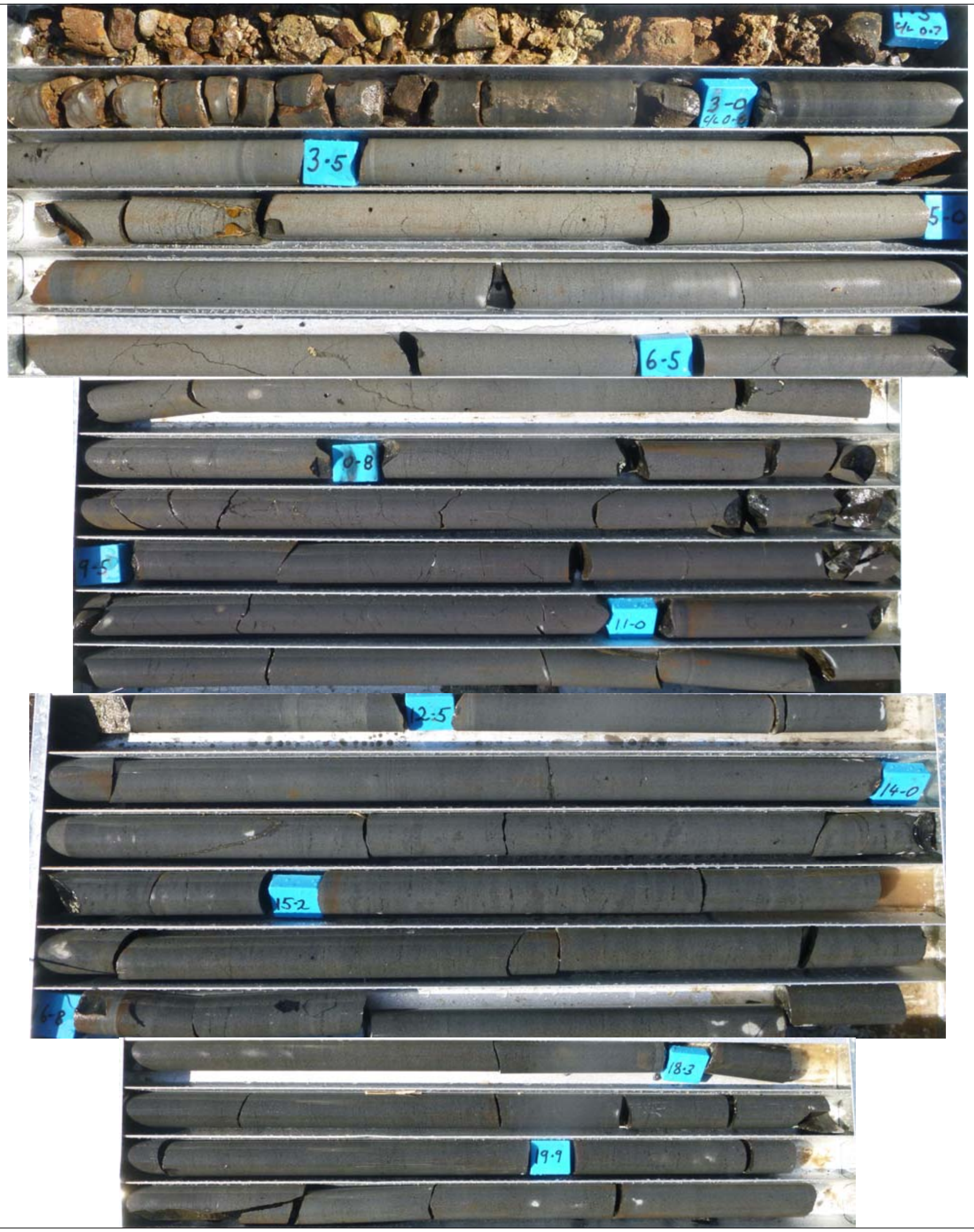
1. All depths quoted with respect to ground surface measured along axis.
2. Angles of planar features quoted with respect to hole axis.
3.
4.

GROUNDWORK plus

CORE PHOTOGRAPHS

HOLE NO: QCC15-04

Page: 1 of 2

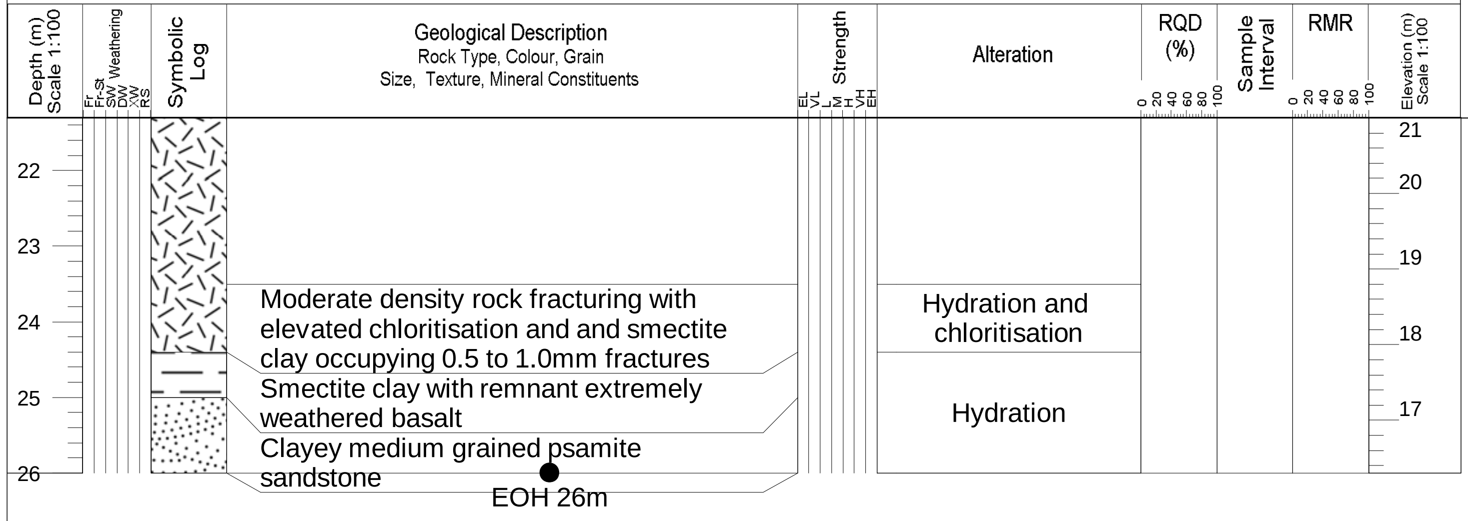


GROUNDWORK plus

CORE DRILL HOLE LOG

HOLE NO: QCC15-04

Client:	Quarry Solutions	Datum (H):	MGA94 Z56	Drill Co:	Statewide Drilling
Project:	Coraki Quarry	Easting:	525540	Drill Rig:	Cortech CSD 1300G
Job No:	1837	Northing:	6794759	Driller:	Trev
Location/RP:		Datum (V):	AHD	Core Dia (mm):	82mm
Start Date:	8/15/2015	Elevation:	42.302	Core Length (m):	26
End Date:	8/15/2015	Dip / Azimuth:	-90 / 0	Logged By:	Luke Ryan



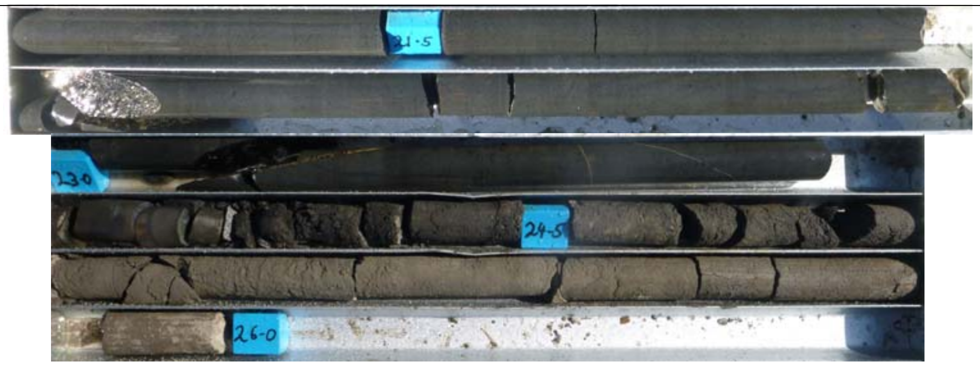
Geological Description Rock Type, Colour, Grain Size, Texture, Mineral Constituents	Alteration
Moderate density rock fracturing with elevated chloritisation and and smectite clay occupying 0.5 to 1.0mm fractures	Hydration and chloritisation
Smectite clay with remnant extremely weathered basalt	Hydration
Clayey medium grained psamite sandstone	

EOH 26m

GROUNDWORK plus

CORE PHOTOGRAPHS

HOLE NO: QCC15-04



Rock Weathering Classification:

RS	Residual Soil	Soil developed on extremely weathered rock
XW	Extremely Weathered	Rock weathered to such anextent it has 'soil' properties
DW	Distinctly Weathered	Rock strength usually changed by weathering
SW	Slightly Weathered	Slightly discoloured but little/no change in strength from fresh
Fr-St	Fresh - Stained Joints	Fresh but with stained joints
Fr	Fresh	No sign of decomposition/staining

Strength of Rock Material:		Point load index (MPa):
EL	Extremely Low	≤ 0.03
VL	Very Low	> 0.03 ≤ 0.1
L	Low	> 0.1 ≤ 0.3
M	Medium	> 0.3 ≤ 1
H	High	> 1 ≤ 3
VH	Very High	> 3 ≤ 10
EH	Extremely High	> 10

Rock Mass Rating: (after Bienawski)

81-100	Very Good
61-80	Good
41-60	Fair
21-40	Poor
0-20	Very Poor

Notes:

1. All depths quoted with respect to ground surface measured along axis.
2. Angles of planar features quoted with respect to hole axis.
3.
4.

GROUNDWORK plus

CORE DRILL HOLE LOG

HOLE NO: QCC15-05

Page: 1 of 1

Client:	Quarry Solutions	Datum (H):	MGA94 Z56	Drill Co:	Statewide Drilling
Project:	Coraki Quarry	Easting:	525811	Drill Rig:	Cortech CSD 1300G
Job No:	1837	Northing:	6794658	Driller:	Trev
Location/RP:		Datum (V):	AHD	Core Dia (mm):	82mm
Start Date:	8/14/2015	Elevation:	17.001	Core Length (m):	8
End Date:	8/14/2015	Dip / Azimuth:	-90 / 0	Logged By:	Luke Ryan

Depth (m) Scale 1:100	Fr Fr-St SW DW XW RS Weathering	Symbolic Log	Geological Description Rock Type, Colour, Grain Size, Texture, Mineral Constituents	EL VL L M H VH EH Strength	Alteration	RQD (%) 0 20 40 60 80 100	Sample Interval	RMR 0 20 40 60 80 100	Elevation (m) Scale 1:100
			Moderate density rock fracturing with elevated chloritisation and and smectite clay occupying 0.5 to 1.0mm fractures		Hydration / oxidation with chloritisation				
			Smectite clay with remnant extremely weathered basalt		Hydration				
			Clayey medium grained psamite sandstone						

Depth (m)	Elevation (m)
0	16.8
1	15.8
2	14.8
3	13.8
4	12.8
5	11.8
6	10.8
7	9.8
8	

EOH 8m

GROUNDWORK plus

CORE PHOTOGRAPHS

HOLE NO: QCC15-05

Page: 1 of 1

Rock Weathering Classification:

RS	Residual Soil	Soil developed on extremely weathered rock
XW	Extremely Weathered	Rock weathered to such anextent it has 'soil' properties
DW	Distinctly Weathered	Rock strength usually changed by weathering
SW	Slightly Weathered	Slightly discoloured but little/no change in strength from fresh
Fr-St	Fresh - Stained Joints	Fresh but with stained joints
Fr	Fresh	No sign of decomposition/staining

Strength of Rock Material:		Point load index (MPa):
EL	Extremely Low	≤ 0.03
VL	Very Low	> 0.03 ≤ 0.1
L	Low	> 0.1 ≤ 0.3
M	Medium	> 0.3 ≤ 1
H	High	> 1 ≤ 3
VH	Very High	> 3 ≤ 10
EH	Extremely High	> 10

Rock Mass Rating: (after Bienawski)

81-100	Very Good
61-80	Good
41-60	Fair
21-40	Poor
0-20	Very Poor

Notes:

1. All depths quoted with respect to ground surface measured along axis.
2. Angles of planar features quoted with respect to hole axis.
3.
4.